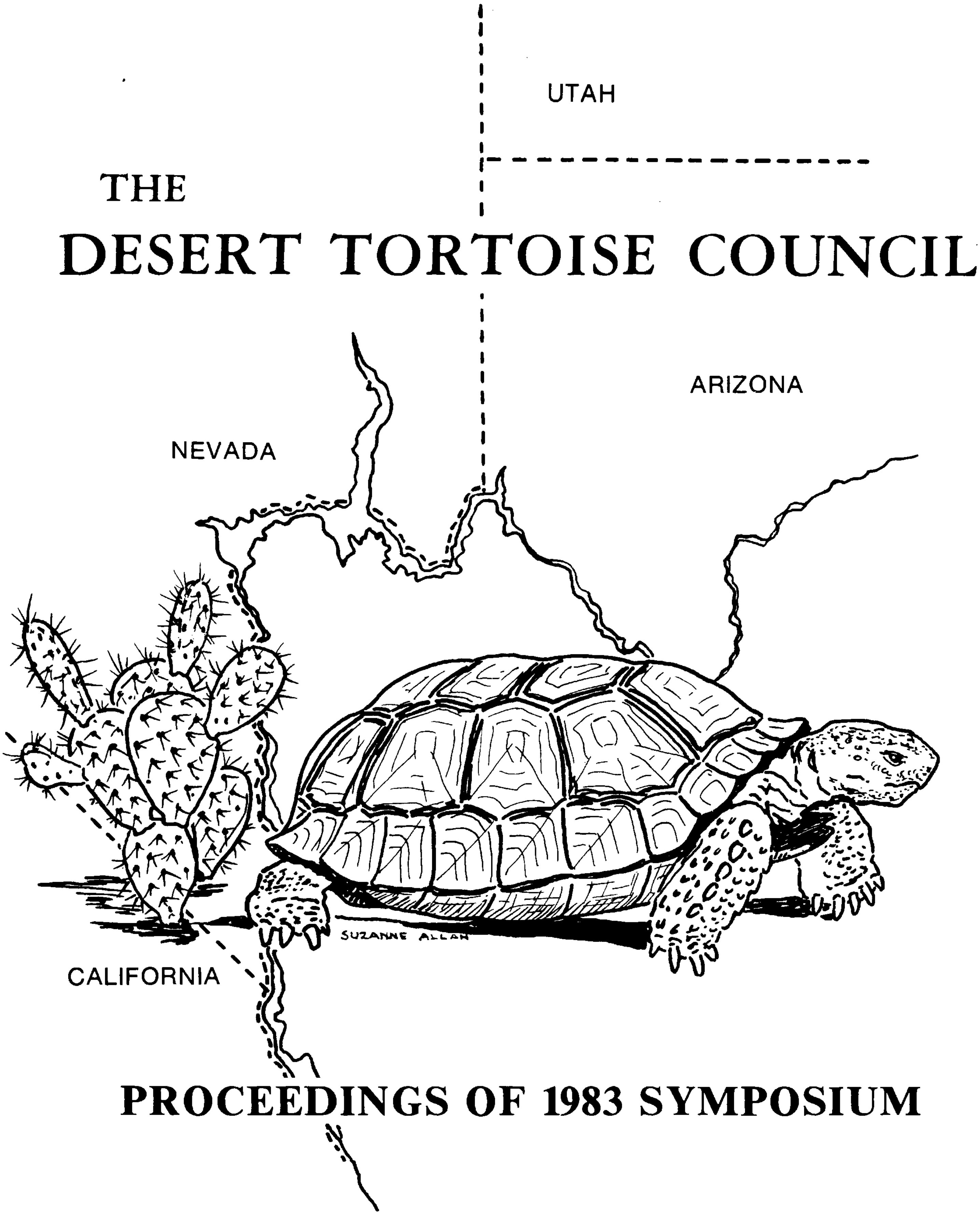
THE DESERT TORTOISE COUNCIL



PROCEEDINGS OF 1983 SYMPOSIUM

DESERT TORTOISE COUNCIL

PROCEEDINGS OF 1983 SYMPOSIUM

A compilation of reports and papers presented
at the eight annual symposium of the
Desert Tortoise Council, 26-28 March 1983,
in Lake Havasu City, Arizona

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These proceedings record the papers presented at the annual symposium of the Desert Tortoise Council. The Council, however, does not necessarily endorse the conclusions reached in the papers, nor can it attest to the validity or accuracy of the data.

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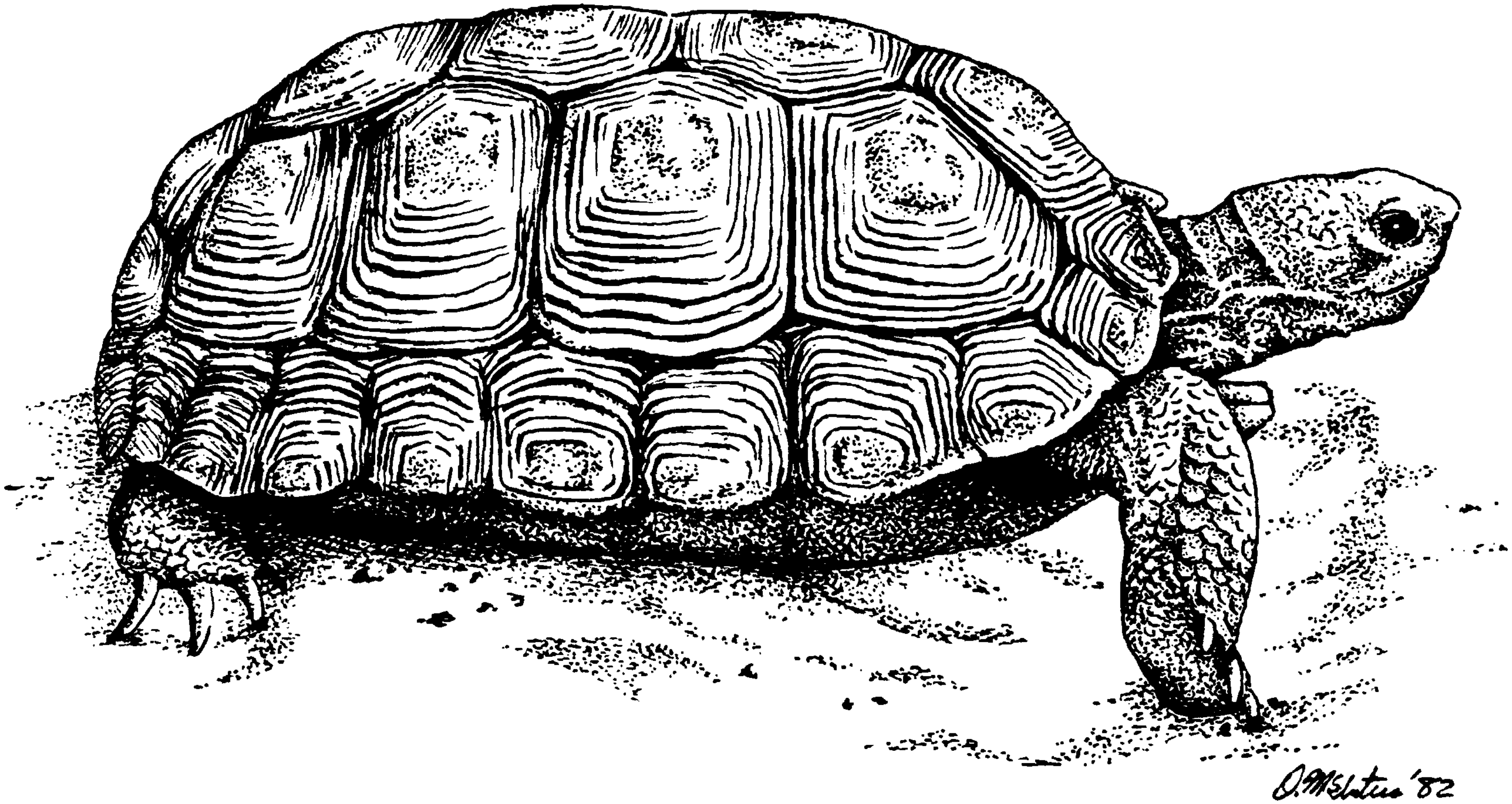

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DESERT TORTOISE COUNCIL

Executive Committee

In 1974, members of the Prohibited and Protected Fishes, Amphibians and Reptiles Committee of the Colorado River Wildlife Council created an interim Four States' Recovery Team to lend a helping hand to the desert tortoise, *Gopherus agassizi*. Interest and concern for the tortoise soon outgrew the scope of the Team; subsequently, on 21 April 1975, its members formally originated the Desert Tortoise Council.

The Council continues to advance toward its goal of assuring the maintenance of viable populations of the desert tortoise throughout the tortoise's range in California, Arizona, Nevada, and Utah. To this end, the Council has effectively combined efforts of state and federal agencies, academic institutions, museums, zoos, turtle and tortoise clubs, and concerned citizens.

Each year, starting in 1976, the Council has held an annual symposium within the Southwest. Each of the symposium proceedings has been published, and more than 200 copies have been mailed gratuitously to select libraries throughout the United States. The reports and scientific papers contained in these publications are a testimonial to the Council's success in carrying out its intended functions, as well as a reminder that much remains to be done.

The goal of the Desert Tortoise Council is to assure the continued survival of viable populations of the desert tortoise, *Gopherus agassizi*, throughout its existing range.

The objectives of the Council are:

1. To serve in a professional advisory manner, where appropriate, on matters involving management, conservation and protection of desert tortoises.
2. To support such measures as shall work to insure the continued survival of desert tortoises and the maintenance of their habitat in a natural state.
3. To stimulate and encourage studies on the status and on all phases of life history, biology, physiology, management and protection of desert tortoises, including studies of native and exotic species that may affect desert tortoise populations.
4. To provide a clearinghouse of information among all agencies, organizations and individuals engaged in work on desert tortoises.
5. To disseminate current information by publishing proceedings of meetings and other papers as deemed useful.
6. To maintain an active public information and conservation education program.
7. To commend outstanding action and dedication by individuals and organizations fostering the objectives of the Council.

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MAJOR ACTIVITIES OF THE DESERT TORTOISE COUNCIL IN 1982

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Since the last symposium, the Desert Tortoise Council has been very active. Major accomplishments of the past year include:

1) The Council formally requested that the California Department of Fish and Game propose to the State Fish and Game Commission that the desert tortoise in California be listed as "rare." No action has been taken to date by the Department.

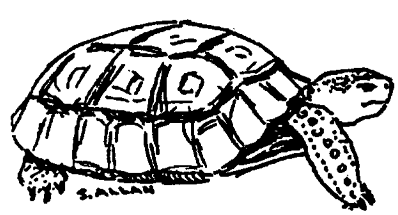
2) The Council received a contract from the U.S. Navy to study tortoise densities in the Chocolate Mountains Aerial Gunnery Range in Imperial County, California. No previous work has been done in this area, which is adjacent to Chuckwalla Bench that has high densities of tortoises. Determining tortoise densities in the Chocolate Mountains should fill in a gap in our knowledge of tortoise distribution.

3) The Council, in the person of Betty Burge, has worked long and hard with agencies in Nevada to protect desert tortoises and their habitat. Activities such as grazing, oil and gas exploration, and off-road vehicle use are having serious impacts on tortoises in Nevada. We need to work closely with various agencies to minimize habitat degradation and effects on tortoises.

4) The Council continued to provide input on the U.S. Bureau of Land Management's Desert Plan and other activities in California. The Council believes that amendments to the Desert Plan have eroded what protection was afforded to the desert tortoise in the original Plan.

5) Action was initiated to change the status of the Council to a non-profit corporation. This requires the establishment of a Board of Directors and other minor changes in the Council's structure and bylaws, but will have no significant effect on how it operates.

6) In order for the Council to function more efficiently, its committees were restructured.



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Excerpts from the Minutes of the 1983 Annual Business Meeting

1) Changes were made in the bylaws so the Council could function as a non-profit corporation.

2) An ad hoc committee was appointed to look into the feasibility and advantages of an affiliation with the Gopher Tortoise Council.

3) Desert Tortoise Council objectives for 1983 were identified:

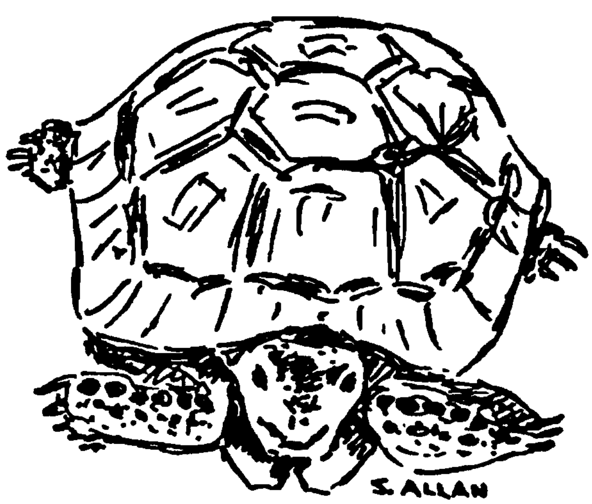
   a) Begin developing recommendations and guidelines for the management of desert tortoise populations for state and federal agencies.

   b) Work closely with the four states where the desert tortoise occurs: in California, work with the Desert Tortoise Preserve Committee and the California Desert Plan; in Utah, continue to provide input for the Desert Tortoise Recovery Plan; in Arizona, work with the Arizona Game and Fish Department; in Nevada, work with the BLM and lend support to Betty Burge.

   c) Continue to reorganize committees to make them more functional and effective, and encourage more involvement in committees by all members.

   d) Promote the publication of the "Status Report of the Desert Tortoise in the United States" in the open literature.

4) No resolutions were presented for consideration at this business meeting.



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1983 FIELD TRIP TO TWO TORTOISE STUDY SITES SOUTHEAST OF YUCCA, ARIZONA

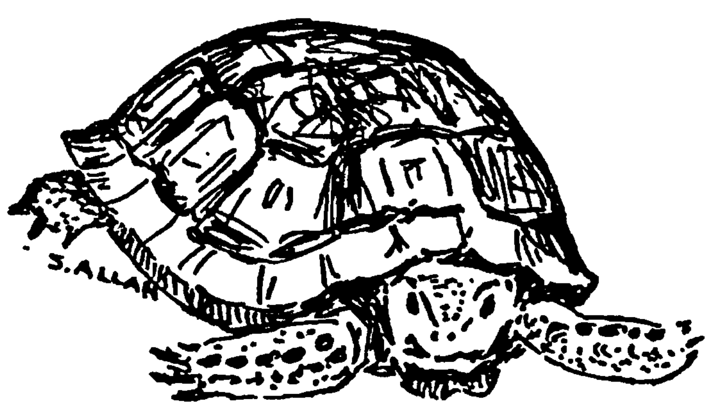
More than 30 attendees of the 1983 Desert Tortoise Council Annual Meeting and Symposium visited two tortoise study sites along Alamo Hill Road, southeast of Yucca, Arizona. Both Betty Burge and Paul Schneider provided insight into the uniqueness of each site — the biological abundance and diversity of the rock outcrops not realized in the adjacent desert environs. Mark Dimmitt, from the Arizona-Sonora Desert Museum, described more than 100 plant species which occur in the area.

Sightings of desert tortoises were the highlights of the field trip. A total of at least 10 were found at the two locations. At Paul Schneider's study site, he observed two adults courting. Russell Beck found two small (70 mm) tortoises at the same site. At the other end of the rocky ridgeline, Diane Mortimer found three tortoises — a 48-mm hatchling, a juvenile, and a slightly larger one digging a burrow under a shrub. Three more tortoises were located by Joan Keenan. Two adult shell remains were observed at Betty Burge's transect site, and Lorie Sheppard and Shellie Freid found two very fresh scats along the base of the hillside.

In addition, Mark Dimmitt and Ken Dodd found a chuckwalla along a boulder-strewn hillside. Sandy Walchuck, Terry Johnson, and Barry Spicer watched a western diamondback rattlesnake consume a cottontail. This was just one of three rattlesnakes encountered on the trip; one measured 52 inches in length.

This especially successful field trip was the product of the overwhelming enthusiasm of all who stayed the extra day to participate.

— *George Pat Sheppard*



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1983 ANNUAL AWARD: CALIFORNIA TURTLE AND TORTOISE CLUB

In my first year as Chairman of the Awards Committee, I find that it is not an easy job. As members of the Committee reviewed the long list of qualified candidates, we were both encouraged and somewhat frustrated — encouraged that so many have done so much (with this kind of dedication we can't lose), and frustrated in making a selection from so many. In some ways, the Committee's job is now easier; it has a list of prospective winners and anticipates more will be added each year.

The Desert Tortoise Council's Annual Award for 1983 goes to the California Turtle and Tortoise Club, often referred to as CTTC. Since the Council's formal organization in 1976, the CTTC has consistently supported its activities and shares several objectives in common, mainly, educating the public regarding the desert tortoise and helping to establish the Desert Tortoise Natural Area. Three CTTC members have served as Council officers and/or Editor of the Council's publications, and numerous members have lent other support, even furnishing refreshments at the annual symposia when asked to do so.

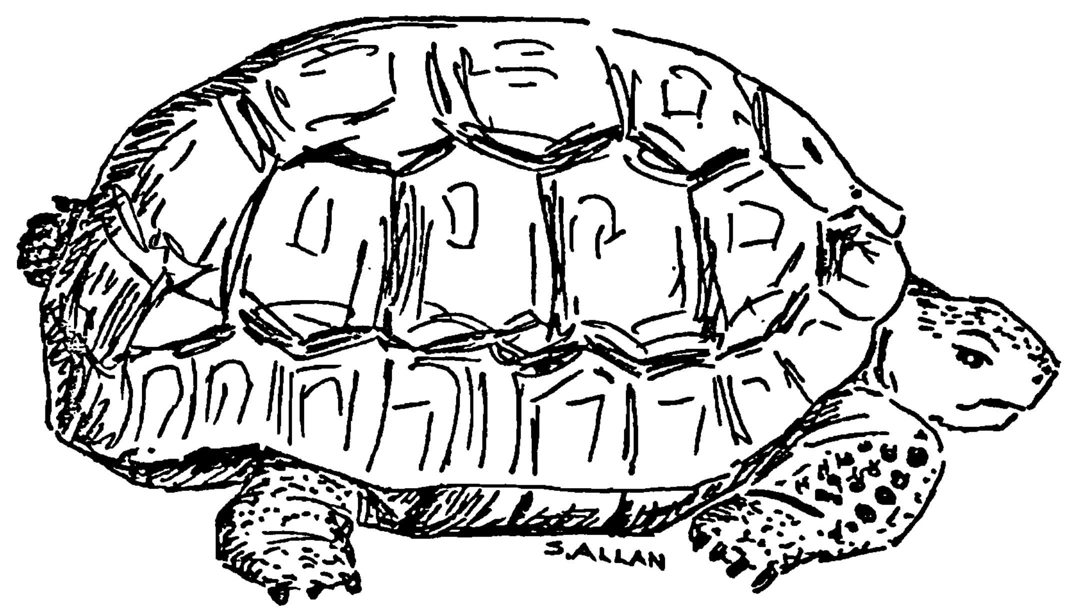
But even before the organization of the Council, members of the CTTC assisted the California Department of Fish and Game with its tortoise program. In 1974, when Frank Hoover and I took over the Department's program for handling unwanted captive tortoises, we needed help not only in finding homes for these tortoises but also for those that were diseased or injured. The CTTC came to the rescue. The CTTC's Adoption Program was established that year and is still going strong. It has not only relieved Frank and me and the Department of Fish and Game of problems related to handling these animals but has also helped existing tortoise populations by offering the would-be tortoise owner an alternative to illegal collection of wild tortoises. The CTTC continues to assist the Department, as well as the public, with the care of sick and injured tortoises, as well. It also promotes the preservation of wild tortoise populations and the proper care of captives by educating the public through the publication of its monthly newsletter, *The Tortuga Gazette*, by each chapter's annual show, and by the distribution of care sheets.

In addition, California Turtle and Tortoise Club members provided considerable time and effort to the California Department of Fish and Game's experimental captive tortoise rehabilitation program. They assisted in construction of facilities at both the Quarter-way House and the Halfway House for selection and rehabilitation of captive tortoises in preparation for return to the wild. Members also helped the Department by sending letters of support to the State Fish and Game Commission for the Department's proposed regulations to provide long-needed protection for California's native amphibians and reptiles. A record number of letters to the Commission resulted in the approval and subsequent passing of these regulations.

Since 1974, the CTTC has been assisting the Desert Tortoise Preserve Committee in the creation and completion of the Desert Tortoise Natural Area (DTNA) not only by publicizing its program but by raising monies. Several chapters of the Club have made annual contributions to the DTNA; the Westchester and Foothill chapters have donated an average of $500.00 a year from their annual show proceeds. In 1982, the Foothill Chapter also donated $1,000.00 specifically for an interpretive sign at the DTNA, the Orange County Chapter donated $500.00 for land purchase, the CTTC Show Committee donated $400.00 for the Legal Defense Fund, and the newly formed Valley Chapter made a sizeable donation. In addition, over the years individual members of various chapters have also donated generously to the Desert Tortoise Preserve Committee.

And so, I am pleased to present the Desert Tortoise Council's 1983 Annual Award to the California Turtle and Tortoise Club in recognition of the CTTC's continuous, enthusiastic support of the Council's activities, as well as for its efforts on behalf of the captive desert tortoise.

—James A. St. Amant



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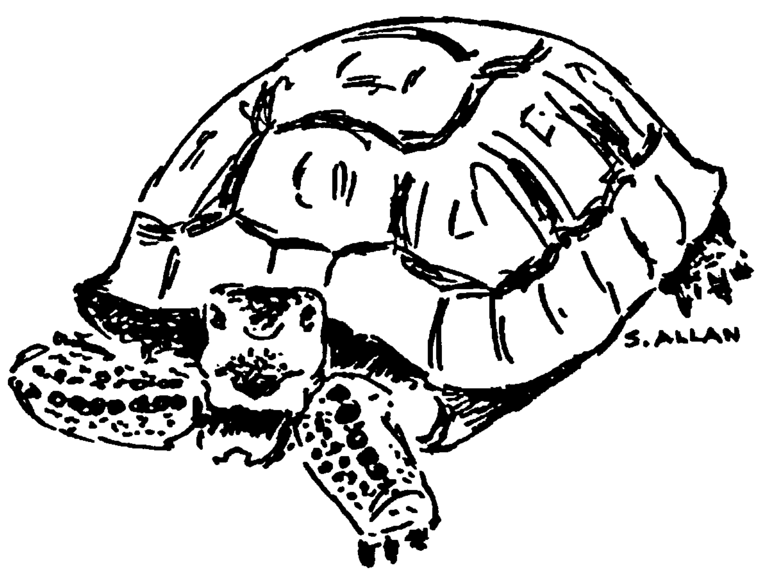

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DESERT TORTOISE 1983 STATUS REPORT FOR THE ARIZONA STRIP AND PHOENIX DISTRICTS, BUREAU OF LAND MANAGEMENT

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1. Inventory was completed this past December of over 250 mi^2 of tortoise habitat, with 1.5-mi transects in each section; survey determined only four isolated groups of tortoises, all north of Virgin Mountain, which may have numbers over 50/mi^2. All other areas north of the Colorado River are below this level.

2. The Virgin River-Pakoon Basin Habitat Management Plan will be written and signed this year. It will identify the desert tortoise as a priority species. Some management efforts to improve habitat conditions for tortoises include establishing seven enclosures, averaging 25 acres in size, in the Pakoon Basin to monitor the recovery of recently burned vegetation in tortoise habitat. The exclosures will encompass equal amounts of burned and unburned vegetation.

   Additionally, special management considerations will be proposed for the 4- or 5-mi^2 areas in the Shivwits Resource Area which may hold tortoise densities of more than 50/mi^2, including:

   a. No livestock waters will be placed within 2 mi of the periphery of higher density sites. Salt and mineral blocks will be placed on waters to avoid creating additional sacrifice areas.

   b. Any projects, mineral exploration, land sales, or other land actions affecting the integrity of tortoise habitat will require clearance by the wildlife biologist.

   c. Livestock operators will be encouraged to go on a system using a rest-rotation method instead of year-round grazing.

3. The Arizona Strip District recognizes the unique opportunity for continued monitoring of the two Beaver Dam Slope study sites in Arizona. Baseline data were published in the Proceedings of the 1981 proceedings of the Council (Sheppard 1981). The District will continue to monitor these sites with field surveys, transects, and forage biomass studies. The monitoring effort is now being developed and will be completed by the end of April.

4. The Arizona Strip District submitted comments to the Director of the Arizona Game and Fish Department on the proposed relaxation of reptile regulations. The major recommendation was to increase protection of this reptile by eliminating any collection of tortoises north of the Colorado River. The Arizona Strip District also proposed maintaining the existing regulations on Gila monsters and the listing as Group III within the state for tortoises. Gila monsters were recommended to be returned to the list.

5. The Arizona Strip District recently has been involved with an exchange of more than 2,000 acres of desert tortoise habitat which would put an area near Littlefield, Arizona, into private ownership for community expansion, agricultural use, and other commercial endeavors. Tortoises will be impacted over the entire 2,000 acres, as well as the periphery outside the exchange. Other impacts could include collection, vehicle traffic, adverse effects from irrigation runoff, and fence construction. These animals should be moved before surface disturbance begins. A location in the Pakoon Basin that is similar in habitat has been proposed for relocation. It is not known when this exchange will take place, but relocation of tortoises will be coordinated through the Arizona Game and Fish Department, with assistance from the Bureau of Land Management and other interested groups.

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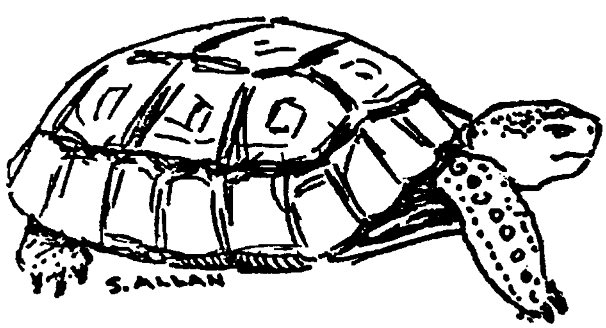

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A GRAZING SYSTEM IN THE MOHAVE DESERT

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Abstract.—Grazing systems have and are being proposed to remedy poor range conditions in many ecosystems in the west. The Arizona Strip District of the Bureau of Land Management placed a three-pasture deferred rotation system on the Beaver Dam Slope allotment in 1970 to replace season-long (winter-spring), continuous grazing. In 1980, vegetation trend and utilization studies indicated that cool (Indian ricegrass) and warm (big galleta) season perennial grasses were in a downward trend, and browse species (burro bush and winterfat) were in an upward trend. Average utilization of all species was light — 30-35%. However, during 1972 and 1976-77, two dry years, utilization was heavy — 60-80%.

In the Mohave Desert, burro bush (*Ambrosia dumosa*), creosote bush (*Larrea tridentata*), and Joshua trees (*Yucca brevifolia*) are the characteristic vegetation. Plants valuable for livestock forage occur in this desert, e.g., Indian ricegrass (*Oryzopsis hymenoides*), big galleta (*Hilaria rigida*), winterfat (*Ceratoides lanata*), Mormon tea (*Ephedra* spp.), ratany (*Krameria* spp.), mallow (*Spaeralcea* spp.), buckwheats (*Eriogonum* spp.), and numerous annuals, especially after wet winters. This forage has attracted sheep and cattle ranchers for winter grazing since the 1800s. After the wet autumns and winters, the lush annual growth can "slick up" cows like good grass country on the Great Plains.

However, in dry years the cattle and sheep grazed only the perennial grasses and shrubs. This, in time, left grazing lands in the Mohave with considerably fewer perennial grasses and shrubs, particularly those desired most by livestock. The dry years became leaner.

The Bureau of Land Management (BLM) has large portions of the Mohave Desert under its administration. The Arizona Strip District (north of the Grand Canyon) administers a portion of the Mohave Desert at its northeastern edge. This part of the Mohave receives an average of 157.5 mm (1968-80) of precipitation (Precipitation Data, Shivwits Resource Area, Arizona Strip District, BLM). It can range from 75 mm in dry years to 350 mm in wet years. Temperatures can exceed 49^{o}C in summer and below freezing in winter. With such fluctuation in temperatures and erratic rainfall, the arid Mohave Desert provides real challenges to range managers who want to improve range conditions.

In 1969, the BLM implemented a three-pasture deferred rotation grazing system on the Beaver Dam Slope allotment, which occurs in the extreme northwestern part of Arizona. There are six key areas on the allotment with trend and utilization data from 1970 to 1980. The key warm-season grass, big galleta, occurred in five of the six key areas in 1970. By 1980, ground cover of big galleta had decreased in two key areas, remained the same in one key area, had disappeared in one area, and had an upward trend in one area. Cool-season grasses — Indian ricegrass (*Oryzopsis hymenoides*) and squirreltail (*Sitanion hystrix*) — also occurred in five of the six areas in 1970. By 1980, three of the key areas lost their cool-season grasses. The other two key areas experienced a slight downward trend or maintained their cool-season grasses (Trend Study files, Arizona Strip District, BLM).

Browse species, winterfat and burro bush, are doing well. Winterfat, a trace in 1970, increased in one key area by 1980, and continues in an upward trend. Winterfat occurred in one key area in 1970. Burro bush occurred in four of the six key areas in 1970 and has a strong upward trend (Trend Study files, Arizona Strip District, BLM).

Utilization of cool-season grasses between 1970 and 1980 showed light use — an average of 33% (range: 10% [slight] to 64% [heavy]). Utilization of warm-season grasses averaged 32% (range: 10 to 60%). Utilization of browse averaged about 35% (range: 10 to 80%) (Utilization Study files, Arizona Strip District, BLM). Utilization by livestock was heavy (60 - 80%, on an average) during dry periods in 1972 and the fall of 1976 through 1977.

The grazing system on the Beaver Dam Slope allotment is a three-pasture deferred system with use from December to June. Two pastures receive a year's rest every other year. One pasture is used in December, January, and February every year and gets nine-months' rest between use periods. The system has been broken occasionally, usually because of a lack of water or feed. The cattle usually went to whichever pasture had the most feed or water, or were pulled off the allotment. This resulted in one pasture occasionally receiving two-years' rest. No difference was noted in the trend of this one pasture from the other pastures. The grazing system has been followed in most years between 1970 and 1980.

With the Mohave Desert's climatic conditions and what can be drawn from the above data, it appears that the three-pasture deferred grazing system has had little chance to improve range conditions. Average utilization of the perennial forage was in general light — around 30 to 35%. The high utilization (above 50%) that occurred in some of the 10 years harmed the desert grasses even when followed with rest from grazing. There is little a manager can do to bring perennial grass back from occasional years of heavy utilization in arid regions. Browse seems to tolerate the heavier utilization.

In planning and placing grazing systems on the Mohave Desert areas, other land use considerations, e.g., endangered species, would have to weigh heavily with the goal of improving range conditions. The three-pasture deferred grazing system appears to have little or no effect in improving range conditions in the Mohave Desert. Managers should look to good management through seasons of use and holding utilization levels within safe limits — below 50% — on all years. The number of animals grazed must be as flexible as the variable precipitation. Grazing systems cost too much and fail to give a significant economic or ecological return on the Mohave Desert.

Proc. Desert Tortoise Council 1983 Symp., pp. 16-18

STATE REPORT - NEVADA

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Abstract.—This spring the Piute Valley permanent study plot in Clark County, Nevada, will be intensely studied. Data gathered at the plot will be valuable in illustrating the trend of the population during the last four years. The Department of Wildlife is also seeking funds to contract a study of the faunal component of the Mojave Desert biome within the state. It is anticipated that some desert tortoise distributional data will emerge from this project.

A number of projects undertaken by the nongame program of the Nevada Department of Wildlife (NDOW) centered upon research and management of the desert tortoise in the state.

Biologists from the Las Vegas District of the Bureau of Land Management (BLM) and NDOW began a project to delineate the desert tortoise's range and relative densities within Nevada. This project involved the compilation of all transect data recorded within the state and application of those data to a mylar overlay of a 1:250,000 scale Army Map Service (AMS) topographic base map. Each transect was represented as a dot on the overlay in the correct township, range, and section. Each dot was color-coded to represent the total adjusted sign (TAS) value that was determined from the transect. From these, boundary lines were drawn to delineate relative tortoise densities. These delineated relative densities are represented in Figure 1. Working copies of the map and overlay are kept in the offices of both the BLM and NDOW. These maps will be referred to and population densities of desert tortoises will be considered when land-use decisions are to be made. We thank Betty Burge for the use of her maps during the completion of this project.

Paul Schneider was contracted to study the population of desert tortoises at the Piute Valley permanent study plot in Clark County. This study plot was established by the Bureau of Land Management in 1979. Schneider will conduct a sixty manday survey of this plot. Data collected will be compared to the data collected in 1979 in order to assess the population trend of the tortoises in this area. Upon completion of the contract, Schneider Cove area east of Piute Valley.

The development of a species management plan is being discussed and a working plan may be written and in effect within a year's time. The plan would create management guidelines for the species within Nevada. From the plan, the department can offer input to land managing agencies with regard to land-use decisions. The management plan should be flexible in context and subject to revision as additional data become available.

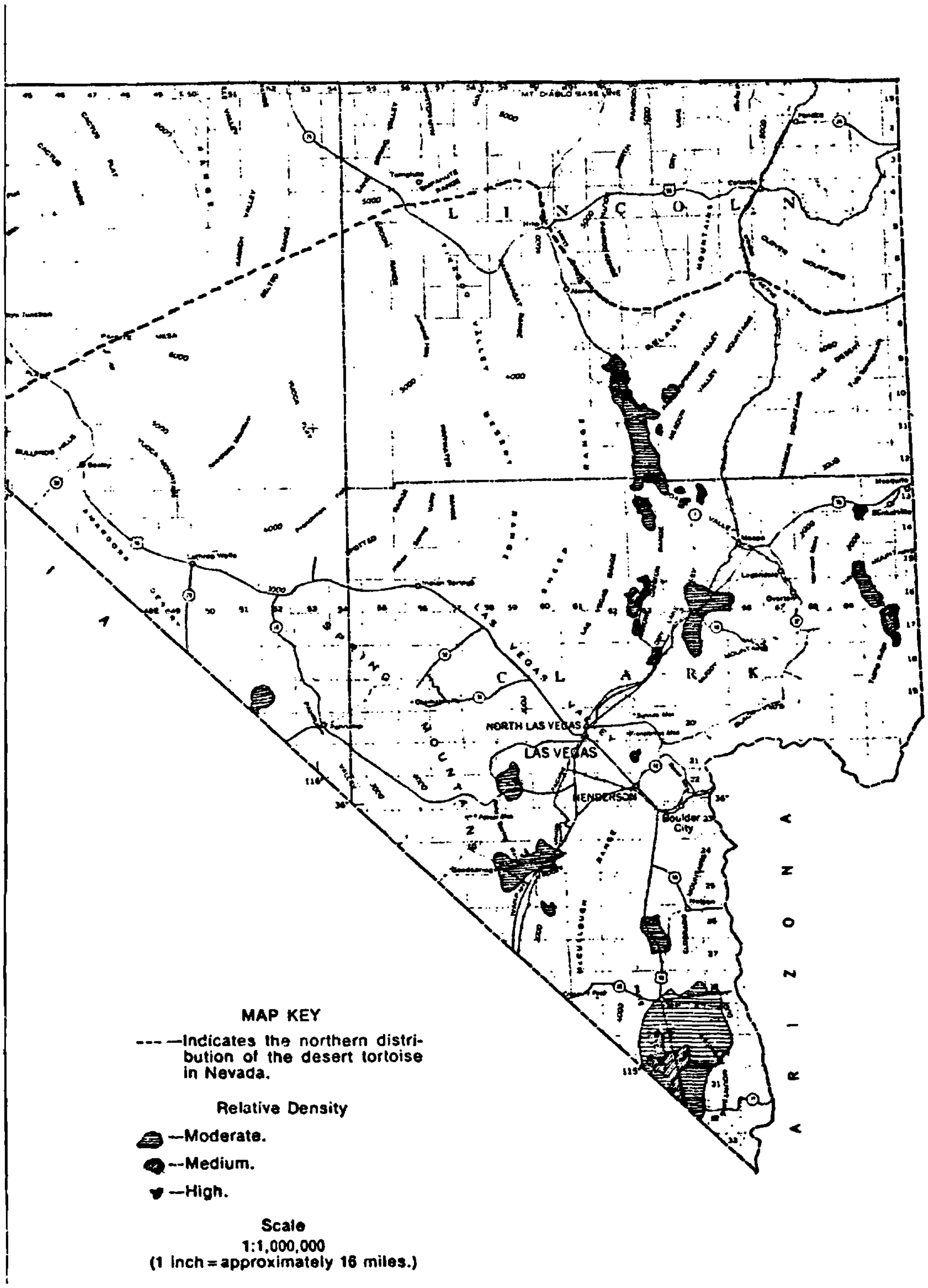

FIG. 1. — Distribution and relative densities of known tortoise populations in Nevada.

With the completion of the species management plan, a memorandum of understanding (MOU) could be arranged with the U.S. Fish and Wildlife Service and the Bureau of Land Management to provide for sound management practices. As a result of the MOU, the department will be solicited for input regarding all land management decisions that may affect the desert tortoise species and its habitat.

The Director has requested $7,500 from the state legislature for the purpose of conducting desert tortoise research and to support programs within the department.

On the legislative front, Nevada Revised Statute 501.379 may be amended to further protect all wildlife species. It will state that the sale, trade, or barter of any wildlife species or parts thereof is prohibited, thus protecting nongame species from commercial exploitation. It also prohibits persons possessing captive tortoises from selling them, thus removing the incentive for financial gain.

Upon suggestions from the TORT-Group of Nevada, a number of changes shall be made in the way department personnel handle tortoises turned in by citizens. Among those changes is a revamping of the temporary holding pens. The TORT-Group has been most helpful in seeing that those tortoises confined to captivity in urban Las Vegas are assured of receiving conscientious care from those who possess them.

A number of days will be spent in the fall of 1983 conducting transects in areas of southern Nevada which have not been checked previously, yet have characteristics of potentially good habitat. Data gathered from the completion of these transects will further our knowledge of the relative densities of tortoise populations within the state.

A study to determine the animal species composition in relation to specific habitat types within the Mojave Desert ecosystem is being planned. Although the scope of the project is fairly broad, involving all animal species, it is expected that some tortoise distributional data will be derived from it. This study will also be funded by monies requested from the state general fund.

In conclusion, the Department of Wildlife is beginning to achieve its goals of understanding the populations of the desert tortoise, identifying adverse land-use impacts affecting the integrity of the populations and managing the species and its habitat accordingly. As a priority species in the nongame program, the desert tortoise will be afforded ample attention. It is the goal of the Department of Wildlife to prevent the desert tortoise population within Nevada from declining to a threatened or endangered status.

Proc. Desert Tortoise Council 1983 Symp., pp. 19-26

SURVEY FOR DESERT TORTOISE ON THE POSSIBLE SITE OF A HIGH-LEVEL NUCLEAR WASTE REPOSITORY, NEVADA TEST SITE

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Abstract.—A survey was conducted between 29 March and 28 May 1982 to determine the distribution and density of desert tortoise (*Gopherus agassizii*) in the vicinity of Yucca Mountain on the Nevada Test Site, an area under study as a potential high-level nuclear waste repository. Desert tortoise sign, including sign in predator scats and on *Neotoma lepida* middens, was recorded along 129 straight-line transects. Transects were generally spaced 200 yards apart and were 1 to 3 mi long. In a total of 197.5 mi of transects completed in the 27.5-mi^2 project area, 208 sign, comprised mainly of scats and remains, were observed; only one live tortoise was found. Sign was observed at elevations between 3,200 and 5,240 ft in vegetation ranging from *Larrea* associations on flats to mixed transition and *Coleogyne* associations on slopes. Due to the relatively low estimated population density observed, and the mitigation activities conducted by the U.S. Department of Energy, no significant impacts to the species are anticipated from the proposed project.

The National Waste Terminal Storage Program is a national search for suitable sites to isolate commercial spent nuclear fuel or high-level radioactive waste. The Nevada Nuclear Waste Storage Investigation (NNWSI) managed by the U.S. Department of Energy (DOE), Nevada Operations Office, was initiated to study the suitability of a portion of Yucca Mountain on the DOE's Nevada Test Site (NTS) as a possible location for such a repository.

The Department of Energy contracted with EG&G Energy Measurements, Inc., to provide information about the flora and fauna of the site. A comprehensive literature survey was conducted to evaluate the status and completeness of the existing biological information for the previously undisturbed area (Collins et al. 1981, 1982). Site specific studies, consisting of preliminary field surveys begun in 1981, confirmed the presence of the desert tortoise (*Gopherus agassizii*) within the project area (Medica et al. 1981). Studies in 1982 were designed to determine the overall distribution and abundance of the tortoise within the area likely to be affected by NNWSI activities.

The Yucca Mountain area of the Nevada Test Site is situated close to the northern range limit of the desert tortoise (Pope 1939, Linsdale 1940). Prior to the 1982 surveys, the desert tortoise was reported from only nine locations on the NTS (Tanner and Jorgensen 1963). A fenced population in Rock Valley, located about 25 mi southeast of the project area, was investigated to determine yearly growth and to develop a method of estimating ages of tortoises under 200 mm in plastron length (Medica et al. 1975). However, the distribution and population densities of tortoise in the remainder of the southwestern portion of the NTS were virtually unknown.

METHODS

The project area covered a 27.5-mi^2 parcel located on Yucca Mountain in the southwestern portion of the Nevada Test Site and adjacent portions of the U.S. Air Force's Nellis Bombing Range and the Bureau of Land Management (BLM) lands in eastern Crater Flat, Nye County, Nevada (Fig. 1).

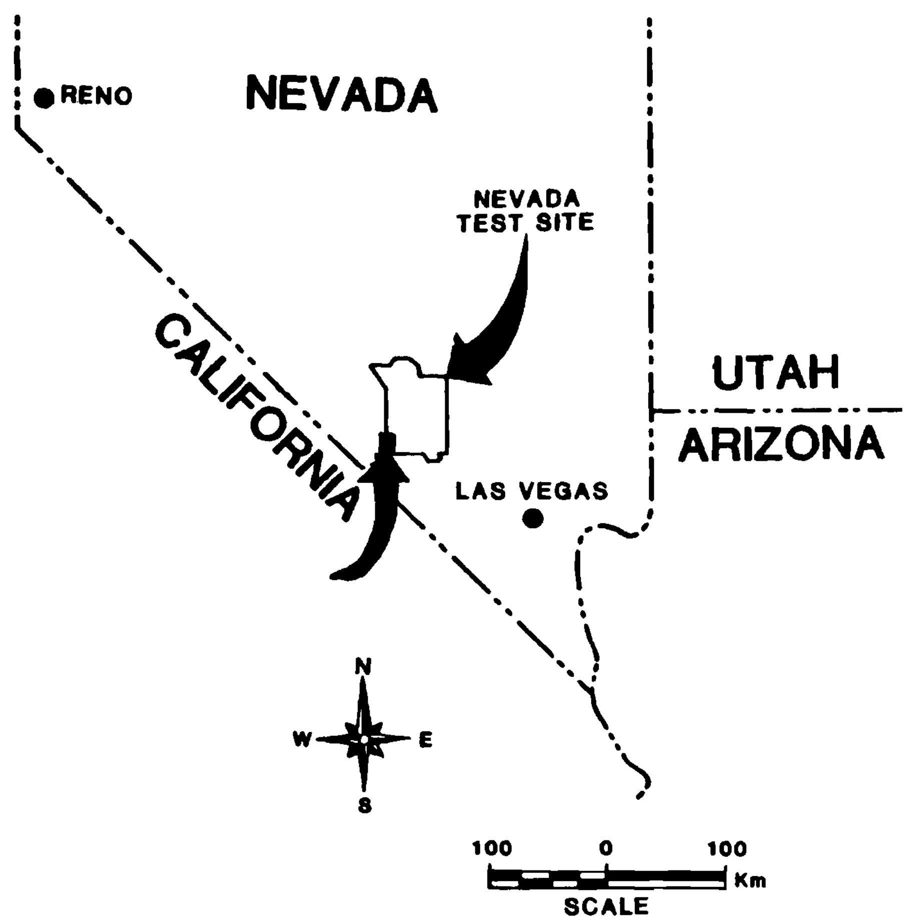

FIG. 1.—Location of the Nevada Nuclear Waste Storage Investigations project area, Nevada Test Site, Nye County, Nevada.

Transect surveys were conducted to gather data on the presence and relative abundance of desert tortoise and associated wildlife. Straight-line transects with effective widths of 10 yards were walked over about half the area at 200-yard intervals for a density of 8/mi. Ridge surveys, which varied in effective width and route were used to sample the rugged terrain which covered the other half of the project area. Transect length was determined by size of the area to be investigated, but it was generally between 1 and 2.5 mi.

Data gathered during surveys included: (1) date, time, and weather conditions; (2) presence of tortoise and their sign; (3) the number of predator

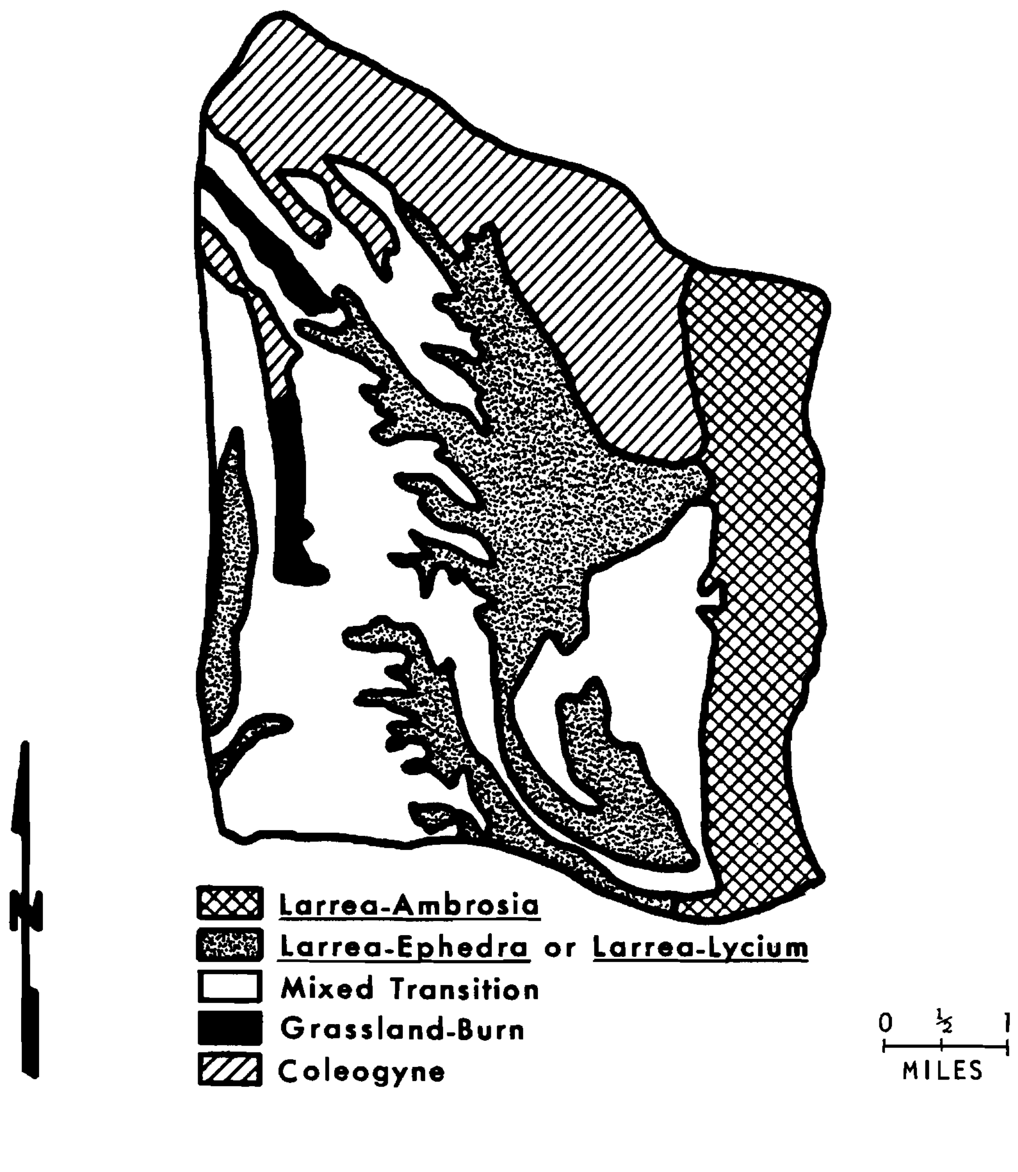

FIG. 2.—Distribution of the major vegetation association groups on Yucca Mountain, Nye County, Nevada, 1983 (*from* O'Farrell and Collins *in press*).

TABLE 1. — Number of tortoise sign observed over 195.7 transect miles on Yucca Mountain.

Sign types	Number observed
Tortoise	1
Burrows	69
Scats	97
Remains	44
Eggshell Fragments	1
Total	212

scats and pellets (coyote and raptor) examined for tortoise remains; and (4) the number of pack rat middens examined for tortoise sign (Burge 1979, 1980). All tortoise coversites (Burge 1978) encountered were prominently flagged with surveyor's tape.

For purposes of analysis, multiple sign found within a 1-square-yard area were adjusted in tallies and defined as one sign. Fragments of skeletal remains were counted as one sign if the pieces were found within 1 to 3 yards.

RESULTS AND DISCUSSION

Between 29 March and 28 May 1982, a total of 129 transects covering 195.7 linear miles were surveyed for the presence of desert tortoise. Surveys were conducted at elevations ranging from 3,200 to 4,900 ft in each of the major vegetation associations (Fig. 2). The dominant vegetation associations included *Larrea-Ambrosia*, *Larrea-Ephedra*, *Larrea-Lycium*, *Coleogyne*, and a series of "mixed transition" associations.

A total of 212 sign (Table 1) were observed during systematic surveys for an average of 1.1 sign observed per mile, or 1.6 sign per 1.5 mi. Sign recorded included a live adult female tortoise that was observed basking on a burrow apron; burrows; scats, which ranged in condition from old and decomposing to recent, and in size from small to large; skeletal remains of adult and juvenile size classes that were of various ages; and eggshell fragments.

Using indices developed by Berry and Nicholson (1979) for estimating absolute densities from sample transect data, an average of 1.6 sign per standard transect indicates densities of less than 20 tortoises/mi^2. Compared with results of surveys conducted for the BLM in other parts of Nevada, Arizona, and California, the density on Yucca Mountain is very low (Berry and Nicholson

1979; Burge 1980; Karl 1980, 1981). Berry and Nicholson (1979) observed at least 10 sign/1.5-mi transect in areas with known tortoise densities of over 200/mi^2.

At the beginning of the study, surveys for desert tortoise were limited to elevations below 4,000 ft and to slopes of less than 20^o because desert tortoise had not been widely reported to occur in steeper or higher terrain. However, as tortoise sign was increasingly found above 4,000 ft and on steep slopes on Yucca Mountain, surveys were extended to include these areas.

Tortoise sign was recorded from throughout the range of topography and elevations present. Burrows and fresh scat were observed on top of Yucca Mountain at 4,900 ft, as well as on several other high, steep, rocky ridges. Additionally, a burrow was discovered 5 mi north of the project area at an elevation of 5,240 ft; several old scats found in the burrow confirmed its use by tortoise.

Over 3.5 times more tortoise sign was observed on sloping terrain than was observed on level terrain, even though the number of transect miles walked in each terrain type was approximately equal. In general, rock outcrops contained the most sign and had the highest coversite potential of all the habitats investigated. Those outcrops in contact with soil rather than rock seemed to be preferred.

Survey results from Arizona indicated a similar preference for slope and rock outcrop habitats (Burge 1980). Surveys and reports from elsewhere in Nevada also indicate the presence of tortoise at higher than expected slope angles and elevations (Karl 1981).

Lower than average numbers of sign (0.2/mi vs 1.1/mi) were observed where well-developed desert pavements supporting nearly pure stands of *Coleogyne* vegetation covered large areas. *Coleogyne* vegetation was observed to be unusually depauperate in winter annuals, which are the primary food source of desert tortoise (Burge and Bradley 1976). This may account for the low tortoise densities observed.

Survey results suggested that the densities of tortoise on Yucca Mountain varied between locations and that their distribution was not random. Tortoise sign was clumped in habitats such as rock outcrops, and tortoise densities were almost certainly higher there than in habitats, such as low bajadas, where virtually no sign was observed. However, clumped sign may have actually been an artifact of the low numbers of tortoise present rather than an expression of habitat preference. A single tortoise can construct or use enough burrows, and deposit enough scats over the course of several years to give the appearance of the presence of more than one individual.

Habitat throughout the study area was similar to tortoise habitat reported by other investigators (Burge 1977, Karl 1980). Soil surfaces were generally friable, and the presence of burrows dug by burrowing owls, kit foxes, badgers, and desert rodents indicated that construction of tortoise burrows was not precluded. Winter annuals, many of which were known food sources for tortoise (Burge and Bradley 1976), were well represented in all vegetation types except *Coleogyne*. Low tortoise densities in the study area were probably more attributable to the adverse regional climatic factors present at the northern edge of the species natural range than to availability of food or shelter.

During the course of site characterization activities and the possible construction of a repository, individual tortoises may be disturbed, displaced, even destroyed, and some potential habitat will be severely damaged. However, the amount of land that will be disturbed, even if a repository is built at the site, will be less than 6% of the project area or about 1,000 acres. Furthermore, because the majority of construction will occur in level terrain at low elevations, little impact is anticipated to the rock-outcrop habitat the tortoise seems to prefer at this site.

The Department of Energy initiated procedures to mitigate disturbances to tortoises. First, they have required that trained biologists conduct preconstruction surveys before any soils or plant associations are disturbed by NNWSI characterization or construction activities. The purpose of the surveys is to determine whether proposed activities pose a potential threat to tortoises, their burrows, or habitat. If potential conflicts are discovered, efforts are made to mitigate them by altering the project design, or by finding an alternate location. As a last resort, tortoises will be removed from sites prior to construction and relocated in nearby, suitable habitat.

The DOE has also funded studies to evaluate the suitability of techniques having potential for restoring disturbed desert habitats (Mitchell *in press*). If effective, cost-efficient reclamation techniques are found, they will be incorporated into the project plan to mitigate the effects of characterization studies, construction activities, and, ultimately, for decommissioning the facilities if they are built.

Because of the very low densities of desert tortoise found in the project area, the relatively small area to be disturbed, and the efforts made to mitigate impacts, only a small number of tortoises will be affected by activities associated with the repository project.

ACKNOWLEDGMENTS

We wish to acknowledge the significant contribution made by Betty Burge, one of the few desert tortoise experts in the Southwest. Betty helped establish the tortoise survey protocols, instructed the field personnel and shared her knowledge of the species with them so they could perform more effectively, participated in all the transect surveys, and assisted with the synthesis and interpretation of the data.

Brenda G. Evans and Thomas Kato of EG&G also participated in tortoise surveys during the first week of the field program.

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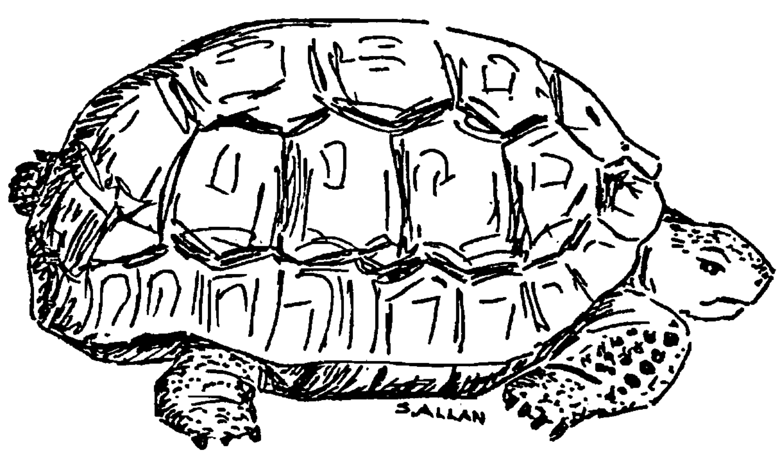

Proc. Desert Tortoise Council 1983 Symp., pp. 27-38

IMPACT OF FRONTIER 500 OFF-ROAD VEHICLE RACE ON DESERT TORTOISE HABITAT

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Abstract.—Prior to the Frontier 500 off-road vehicle (ORV) race, portions of the route within approximately 50 ft of each side of the center of the road were surveyed. Discrete ORV tracks considered to be months to years old were counted separately from tracks considered to be a few days to a few weeks old. The habitat, race course, and ORV tracks were photographed before and after the race. Tortoise burrows were located and flagged to facilitate locating them after the race to note their condition. After the race, the same areas were surveyed, and fresh tracks counted. Of the discrete tracks, the number of recent ones (combining those counted before the race with those counted after the race) exceeded the number of old tracks by 103%. There were 3½ times more fresh tracks from race-day traffic than from pre-race traffic. Hundreds of fresh overlapping tracks and 38% of the discrete tracks extended beyond the allowable course width of 100 ft. Numerous illegal shortcuts were made. Crushed and uprooted shrubs exceeded 390/mi for each side of the road. Observations made during the race included passing in a no-passing zone and destructive and hazardous behavior by spectators.

Several areas in Clark County, Nevada, have been identified where densities of desert tortoise (*Gopherus agassizii*) may be high enough to make long-term survival possible under proper habitat management. These areas have been referred to as "crucial desert tortoise habitat" (Berry *pers. comm.*, U.S. Dept. of Interior 1981). In Nevada, the Bureau of Land Management (BLM) had designated the desert tortoise as a "sensitive" species, and it has been given "protected" status by the state's Department of Wildlife.

A new off-road vehicle (ORV) race — the Frontier 500 — was proposed for initial running in mid-October 1982. The race route traversed 454 mi of which about 12 mi was through crucial desert tortoise habitat. The Frontier 500 was open to 400 entrants; portions of the route, including the 12-mi stretch, had been used by smaller groups of racers for unpermitted and permitted races. Because few tortoises are active in mid-October in this area, direct mortality was not expected to be great; however, studies have shown that habitat degradation from ORV impact is substantial (Adams et al. 1982, Bury et al. 1977, Keefe and Berry 1973, Stebbins 1974, Webb and Wilshire 1978, Wilshire and Nakata 1976, Wilshire et al. 1978) and may have a significant effect upon tortoise populations.

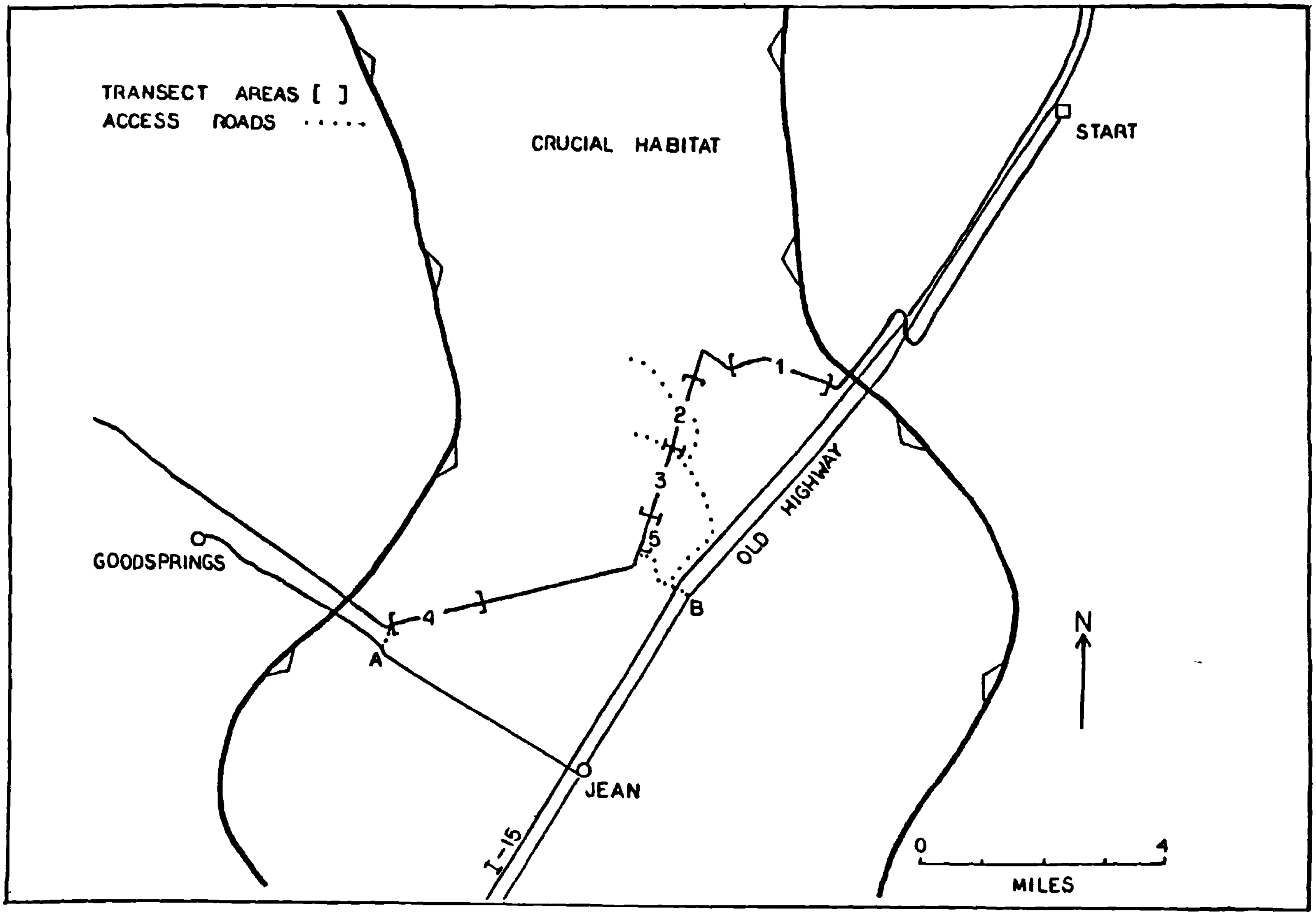

FIG 1.—Frontier 500 race route through crucial desert tortoise habitat.

DESCRIPTION OF THE STUDY AREA

The course was on a bajada at about 3,300 ft elevation. In three places, the course crossed the foot of the southernmost extension of the Bird Spring Mountains. The vegetation was typical Mohave Desert scrub; dominant shrubs were creosote bush (*Larrea tridentata*), burro bush (*Ambrosia dumosa*), and Mohave yucca (*Yucca schidigera*). Black lichen formed a crust over much of the soil which was silty with sparse pebble cover on most areas and well-developed desert pavement on others.

Through the crucial desert tortoise habitat, the course centered on a two-track road (Fig. 1) which, except for the easternmost 2.5 mi, was a powerline service road. Approximately 2 mi of the north-south portion of the service road was over rolling terrain. By design, the road between the poles through the hilly area was constructed around the hills and was, therefore, indirect between the poles. In at least six places, previous racers had made shortcuts over the tops of the hills. The shortcuts were 30 to 60 ft wide and extended as far as 200 ft from the road before joining it again. The areas between the shortcuts and the road were crossed with discrete vehicle tracks and swaths of overlapping tracks. On two of the hills, the shortcut areas supported only sparse shrub cover that appeared to have been stripped. Russian thistle (*Salsola iberica*) had established there. Some gullying was evident on the old trails.

The initial examination of the course was made during the official pre-run period which began three weeks prior to the race. During this period, racers may run the course and become familiar with it. Up to the time of the race, no barricades had been placed across the approach end of the forks where the shortcuts were being used, and no markers had been placed to indicate which fork was the course proper. No pit or spectator areas were designated for the 12-mi stretch of the route. Several foothills next to the course would offer good vantage points from which to view the race; however, parking space was very limited.

METHODS

On 13, 14, and 15 October, I surveyed the vehicle tracks on both sides of the road of the proposed course in five areas (Fig. 1), walking parallel to the road between the road edge and the outer margin of the allowable course width — approximately 45 ft to each side. I counted discrete tracks; those that were continuous for a half mile or more were noted separately. Tracks that appeared to be a few days or a few weeks old were recorded as "recent." Those estimated to be months or years old were recorded as "old." Tracks that extended beyond the allowable course width were noted. Where an indeterminate number overlapped, the swath width was measured.

Within the 45-ft transect width, I flagged tortoise burrows for relocation and comparison after the race. I photographed typical habitat, representative disturbances, road shoulders, and area that could be compared after the race. As each pre-running vehicle passed, I recorded it by type.

TABLE 1. — Pre- and post-race observations on Transects 1 through 5.

	Transect No.										
	1		2		3		4		5		Totals
Dates	13th	17th	14th	19th	14th	19th	15th	20th	15th	20th	
Transect length (miles walked)	3		2.4		2.4		3		0.7		11.5
Discrete tracks											
Pre-race											
Old	120		60		58		37		24		299
Recent	24		7		23		8		7		69
Post-race											
Recent (fresh)		76		62		48		42		11	239
Short coursing		4		20		12					36
Discrete tracks beyond course		24		21		15		25		5	90
Widened stretches of road		1		3		1					5
Existing shortcuts used				3 of 3		1 of 1					4
Tortoise burrows noted	13		7		4		1		1		26
Pre-running vehicles	33		32		15		9		9		98
Time period (PDT)	(6:30-12:15)		(6:30-10:30)		(10:30-12:35)		(6:25-10:25)		(11:00-12:30)		

On the day of the race, 16 October, I parked at access road "B" and walked up the slope next to the road to observe and photograph the racers and spectators. An associate observed the race from the slope on the north side of the course at "A."

On 17, 18, and 20 October, I retraced the five transects, counted new tracks, photographed disturbed soil and vegetation, and checked flagged burrows. For the first three miles, I counted the number of freshly crushed and uprooted shrubs.

RESULTS

The recent tracks and associated impacts shown in Table 1 represent the combined effects of pre-runners, 370 racers on race day, and spectators. All recent sign was included as race-related because of the short time period represented by the sampling.

Types of maneuvers that contributed to old and recent disturbances included circling in place, turning out, passing, backing up, parking, continuous paralleling of the road for a half mile or more, hill climbing, short coursing (short cutting), road widening, and leaving or joining the course from across open desert. The number of recent, race-related tracks showed a 103% increase over the number of old tracks. The number of previously uncounted (fresh) tracks found after the race was 3½ times greater than the number of recent tracks counted before the race.

Each of the four existing shortcuts over the hills was heavily used. New tracks paralleled the shortcuts on the side away from the road, and new tracks crossed the areas between the shortcuts and the road. Elsewhere, there were 36 discrete tracks by short-cutting vehicles; some diverged 160 ft from the road. Where the course joins the powerline road, there is a right-angle turn (Fig. 1) where at least eight vehicles had cut the corner. Some tracks left the road 500 ft before the turn.

Road widening resulted from silt avoidance. After a few racers passed over the fine soil in several areas, the soil became churned and unstable to at least 6 inches deep. The racers that followed moved progressively outward from the road edge in order to gain firmer ground. As a result, stretches of road were widened 50 to 90 ft on a side. Thirty-eight percent of the discrete tracks and hundreds of overlapping tracks extended beyond the allowable course width of 100 ft.

Gouged depressions five to seven inches deep and several inches to many yards long resulted from various maneuvers and occurred on flat land as well as on slopes. The low traction in the typically loose soil increased the destruction from this type of disturbance when turns and fast starts were attempted on slopes. Gouging and skidding uprooted shrubs and removed the soil from the bases of others. With few exceptions, damaged shrubs were evident in every recent off-road track. On Transect 1, I counted 1170 crushed and uprooted shrubs.

None of the 26 flagged tortoise burrows found was damaged; however, race tracks did pass within one to two feet of several. None of the burrows was occupied. The only active tortoise I saw was on an access road, 15 October. About halfway along Tracnsect 2, the road crosses an outcrop that is at least 150 ft long. I explored some of the cavities in the outcrop and found tortoise scats in the opening of one cavity. Year-round use of such cavities by tortoises is expected (Burge 1978). ORV tracks passed over the soil and rocks adjacent to the cavity.

Most of the tracks that paralleled the road for a half mile or more probably were not part of racers' passing maneuvers. I counted ten of these, four of which continued beyond the end of the transects on both sides of the road. Some of these tracks indicated that the driver was going in the opposite direction to the racers. These tracks were probably from spectators — "vicarious racers." They travelled fast enough to leave numerous gouges and skid marks. Their paths extended from within 10 ft of the road to more than 150 ft. A 4-wheeled vehicle (non-racer) moved along both sides of the road of Transect 1 for a total of 2.75 mi. The tracks were closer than 50 ft from the road for most of the distance but veered sharply from the road to more than 150 ft in several places.

Race-related litter (e.g., discarded race vehicle parts) lay next to the road in five places. Two spectators uprooted a cactus and later discarded it. I replanted the cactus the next day but the litter remained for 3½ months until, after several written notifications failed to get results, I pointed it out to a BLM staff member. Where spectators drove and parked along the road edge, I found that several boulders had been removed from their depressions and apparently taken away. In the area along the course near access "A" and "B," spectators drove their vehicles on the course or within the allowable course width during the race. Some parked within a few feet of the course; others drove directly up adjacent, steep slopes. Some spectators parked beyond the allowable course width but stood at the road edge to watch the race. A small, partly denuded turnout on the south side of the course where access road "A" joins it was enlarged to about 2 acres by spectators' vehicle traffic. Hundreds of shrubs were flattened. According to my associate, many spectators arrived here with their ORVs in tow. During the race, spectators drove the ORVs around the area, on adjacent desert, and on the course. There was no effective course monitor observed at "A" or "B." This was also the area of a no-passing zone. My associate observed passing and a near collision between a spectator-driven vehicle and a racer. The potential hazards at this zone include a transformer and a culvert in a depression. Danger was indicated to the drivers by a small cardboard sign with a red arrow on it. The sign was attached to a stake at the road edge. I found this stake on the ground after the race.

DISCUSSION

On 27 January 1983, at the post-race review meeting hosted by the BLM, Las Vegas, BLM's report on the race was made available. Part of its evaluation was based upon impact measured at twenty-nine 50 x 150 m plots that extended to both sides of the road at various places along the 454 mi. One of the plots (No. 1) was in the crucial tortoise habitat at mile 20 of the course. The Natural Resource Consultants' analysis of aerial photos of the plots read: "No impact whatsoever is evident on this site"; however, this plot was located in the no-passing zone and did not represent the surface type typical of the first 20 mi of the race — loose, silty with sparse pebble cover. Attrition of racers was heavy but the first 20 mi of a course would be expected to receive impact from most, if not all, entrants, and passing several vehicles at one time would be a common maneuver. The most typical soil surfaces and the most vulnerable should be included in an array of test plots.

The BLM designed a grading system to evaluate impact. Segments of the course were rated as receiving high, medium, or low impact based upon the following:

High: Course widening and churning, common, i.e., substantial vehicular surface disruption greater than 50 ft wide including the original track. Churning usually more than 1 ft deep in the main track. Some undisturbed areas may remain between tracks.

Medium: Track widening and some churning common; widening less than 50 ft wide, churning can be 1 ft deep in places but usually is less than 6 inches in the main tracks.

Low: No course widening; little track widening, churning, and vegetative off-road impacts.

From the BLM's analysis (U.S. Dept. of Interior 1982*a*, 1982*b*), 70 mi (15.4%) of the 454 mi showed high or medium impact; however, this was determined from "the intensely affected segments of the course where most of the high and medium impacts occurred"; for example, stretches with road widening to 400 ft. I was informed by BLM staff that the progressive road and course widening, encroachment of Russian thistle, and gullying I observed did not warrant remedial consideration. In fact, that 12-mi stretch was not examined.

To look only at areas of high impact after a single race is a very limited approach. Scattered, "low" level degradation in "small" increments that occur at a rate faster that the rate of habitat restoration result in net habitat loss. Cumulative effects have already become evident along the 12-mi stretch where medium impact occurred.

At the above meeting, a recommendation was made and supported by many present that the course be moved to avoid stretches that were unsuitable for racing. This could become a destructive pattern considering that the observed impacts judged high and medium were predictable. Better use of pre-race analysis is indicated.

Various safeguards are anticipated by the BLM, and these become part of the race permit application. Stipulations may be added for any given event. In the case of the permit to the High Desert Racing Association for the running of the Frontier 500, there were 54 stipulations. Those listed below are among the most pertinent to this report:

18 e. The permittee will be responsible for keeping contestants on the designated route/course.

18 d. The permittee will be responsible for the supervision of all participants, spectators, and other persons associated with the event.

18 j. The permittee will do everything possible to ensure that event participants and spectators do not collect or harass wildlife or plants.

At present, there is no charge for habitat damage and no directive for restoration of habitat degraded where race-related impacts have extended beyond designated areas and allowable course width.

18 p. Stakes, flagging materials, litter . . . and other event-related materials will be removed from the course within 15 days after the event.

18 v. Because of the presence of other resource values proximate to the road, the permittee will take action to ensure that "no passing" occurs in the zones shwon on the attached map.

Racers caught short cutting and passing in no-passing zones are disqualified. This is a standard rule within the promoters' regulations. No attempt at enforcement was observed at the potential short-cutting places or in the no-passing zone within the 12-mi stretch.

18 v. (Stipulation) describes the amount of cash surety bond that was held by the BLM — $32,000.

18 af. Non-compliance with any permit stipulation will be grounds for denial of any future High Desert Racing Assoc. application.

To my knowledge, none of the bond was withheld because of impacts from racers, unrecovered litter, and lack of spectator control. The permittee was not required to restore any road conditions, and there seemed to be no question that the race would be run again in 1983.

After the post-race meeting, I submitted comments and recommendations to Mr. Kemp Conn, BLM District Manager, Las Vegas. The following was included:

> The Frontier 500 is to be an annual event; therefore, BLM staff and race promoters should be thinking in terms of course maintenance and in some stretches, remedial treatment and road-bed preparation such as those that have been developed through work shops and described in the Motorcycle Industry Council, Inc.'s *Planner* (1982). Soils that will not lend themselves to the degree of stabilization necessary should be avoided; however, where the effects of racers have already created impacts, above described roads should be considered for stabilization. This should be done before the decision is made to move the route and should be considered whether or not the existing unstable stretches are used for racing in the future

because they are now trails and therefore will attract off-road vehicle users.

Where roads through unstable soils can be stabilized, the soil will remain vulnerable to progressive widening; therefore, these stretches should be designated and signed as "no passing" zones prior to the pre-run period. The existing shortcuts over the hilltops along the service road should be permanently barricaded. Continued use of these shortcuts fosters erosion and destruction of stretches of habitat more than 200 ft wide.

The expense of remedial treatment of roadbeds and their preparation in advance of races would be borne by ORV organizations and promoters that hold races on the particular route.

The Desert Tortoise

Agreement should be reached among representatives of the BLM, the Nevada Department of Wildlife, and biologists who are particularly informed about this species' needs and the effect of impacts relative to those needs as to which areas should be managed as crucial tortoise habitat in Nevada. The Desert Tortoise Council has recommended that no vehicle-oriented play be allowed in these areas.

The proposed month for the next Frontier 500 is September 1983. Any race held from March through September will be when tortoises are active. The chances for direct injury to tortoises will be greater during those months. In addition, during late summer and early fall, tortoises that have spent most of the year away from their winter dens (e.g., cavities in outcrops) will be using them with increasing frequency prior to hibernating in them. These tortoises will be additional to those using the dens year-round. Where outcrops with cavities are used by tortoises, the outcrops should be avoided by at least a mile by all ORV events.

Spectator Control

Impact is predictable where spectators are not controlled. It behooves the BLM to see that promoters' efforts include adequate pre-race announcements via mass media that will reach potential spectators from both local and appropriate out-of-state communities. Announcements might include (1) maps and lists of authorized pit and spectator areas, (2) access limitations deemed necessary to prevent habitat damage beyond the allowable course width and beyond pit and spectator areas, and (3) access limitation imposed to help prevent unnecessary habitat damage and hazards to racers and others within the allowable course width, and in pit and spectator areas. Include announcements of capacities of specific parking locations; that vehicles will be turned away when these area are filled. Spectators should plan to share rides, not expect to park on undesignated areas. Explain that previously used unauthorized parking areas will not be available for parking. Although this may include public land, for THIS event it may be necessary to enforce the recommendation about keeping to roads, trails, and designated parking areas because of the magnitude of the event. BLM staff's best estimate of spectator number was 25,000. Spectators who plan to observe the race by driving their off-road vehicles on public land in the vicinity of the course during the race should be discouraged IN ADVANCE of the race.

Crowd-control monitors and course monitors, supplied by the permittee, should be stationed at both authorized spectator access and parking areas and at unauthorized spectator areas that can be predicted as likely places for spectators to use, such as those along the 12-mi stretch. The monitors should be easily identifiable by bright-colored vests or similar garb.

The BLM should expect to receive from permittees the logistical details of HOW the permittee plans to ensure the protection of the resources. Such plans should be submitted in sufficient time that changes and additions deemed necessary by the BLM can be planned or implemented by the permittee in time to be effective.

Monetary Compensation for Degradation or Loss of Natural Resources

At present there is no charge to the permittee for degrading the natural habitat. Restoration attempts are usually only partially effective, if at all, and impacts are cumulative. Impact scars may not heal after tens of years of nonuse. The answer lies in prevention but, for contributing to the almost one-way situation, those who degrade habitat should bear the responsibility in some positive way.

The BLM should develop a schedule of fines to be paid by the permittee for the following:

1) Habitat damage beyond the allowable course width and beyond designated pit and spectator areas (e.g., a rate per mile of track or per area unit of degradation where applicable).

2) Injury, removal, disturbance, or death of protected, threatened, or endangered plants and animals. Archeological and historical entities and possibly other irreplaceable resources should be included here.

3) Late or incomplete compliance with permit stipulations. The fine should accrue until the stipulation is met.

Items 1 and 2 imply the need for the BLM to develop adequate and efficient pre- and post-race sampling methods especially for areas with relatively high vulnerability to race-related impacts and to quantify the impacts for use with a schedule of fines; however, imposing additional stipulations and fines will be meaningless unless BLM staff follow through.

ACKNOWLEDGMENT

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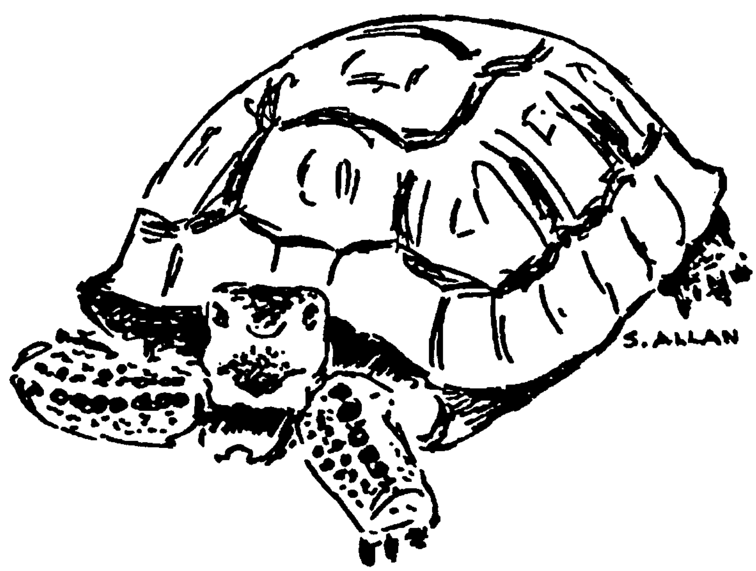

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TORT-GROUP REPORT - NEVADA

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The Organization for the Protection of Nevada's Resident Tortoise (TORT-Group) is located in Las Vegas, Nevada. The handiwork of Betty Burge and Dr. Norma Engberg, this nonprofit society was organized in 1981 to (1) aid in the care and placement of urbanized desert tortoises (*Gopherus agassizii*) that had escaped the confines of backyards, and (2) promote the restriction of off-road vehicle (ORV) activities in the deserts of southern Nevada.

Our organization now has many goals and objectives (Burge 1982), but its foremost goal is to protect the natural habitat of the desert tortoise. The American people, intent on a better life for themselves, are destroying many of the animals that are native to this particular area. SO IT IS WITH THE TORTOISE. As a thirty-two-year resident of Las Vegas, I remember seeing tortoises along the roadway almost everywhere I went. Now, as I drive Nevada's roadways, I never see a desert tortoise. Where have they gone? They have died by the hundreds because we have overgrazed their habitat; we have allowed the ORVs to run races through their prime habitat; we have built homes in their home — the valley.

In the last 100 years, 50 species of animals have become extinct because of man's intrusion into their home areas. I can remember back to 1937 when the ocean between Los Angeles Harbor and Catalina Island was filled with the Pacific sardine. The commercial fisherman and his nets took care of them. They are now thought to be extinct in that area.

The TORT-Group works very closely with the Humane Society, the Animal Shelter, the Nevada Department of Fish and Game, and the Bureau of Land Management. All of these organizations are very interested in the preservation of the desert tortoise. The TORT-Group has 105 dues-paying members. It is our intention to get as many Nevada residents involved in the fight to save the desert tortoise as possible.

May we be successful before it is too late!

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Proc. Desert Tortoise Council 1983 Symp., pp. 40-41

STATE REPORT - UTAH

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The Beaver Dam Slope population of the desert tortoise (*Gopherus agassizii*) is located in the southwest corner of the state. This area is approximately 70 mi^2 in size. The vegetative aspect is Joshua tree—creosote bush type with a variety of annual and perennial forbs and grasses.

The listing of the Beaver Dam Slope population of the desert tortoise as a threatened species was finalized in the 20 August 1980 *Federal Register*; included with the listing was a designation of 35 mi^2 of critical habitat.

Multiple use management will continue in the designated critical habitat with some restrictions. The critical habitat area will continue to be open for oil and gas exploration with the following special stipulations:

1) There would be no surface occupancy within the "Woodbury Desert Study Area" (3,040 acres).

2) Drilling would not be permitted in areas containing sensitive flora and fauna. Prior to issuing permits to drill, the Bureau of Land Management (BLM) would determine if sensitive flora and fauna are present.

3) No surface disturbing activity would be permitted during the months of April through September while the tortoises are active.

4) No surface disturbing activities would be permitted within 500 feet of any desert tortoise winter dens.

5) All mud pits or ponds used in drilling activities would be fenced with chicken wire to prevent tortoises from falling in.

The off-road vehicle (ORV) designations for Washington County were finalized in the 25 September 1980 *Federal Register*. Vehicular travel in the desert tortoise critical habitat area is designated as limited to existing roads and trails.

Presently, the BLM is working with the livestock operators to implement Allotment Management Plans (AMP) in the critical habitat area. The Castle Cliffs AMP will include areas east of Highway 91; the Beaver Dam Slope AMP will include those areas west of Highway 91. Both of these deferred grazing systems are presently under review by the Fish and Wildlife Service. Once this preliminary review has been completed, draft copies will be made available to the public for review. Finalization of these two plans with decisions for closure of the Woodbury Desert Study Area exclosure and grazing reduction should be completed by May 1983.

Managers in Utah are pleased with the results of the latest study on the desert tortoise. The data indicate that tortoise reproduction is occuring, and that in the younger individuals a healthier sex ratio exists (Minden and Metzger 1981). With the present and proposed management being implemented, we are confident that the needs of the desert tortoise in Utah can be met.

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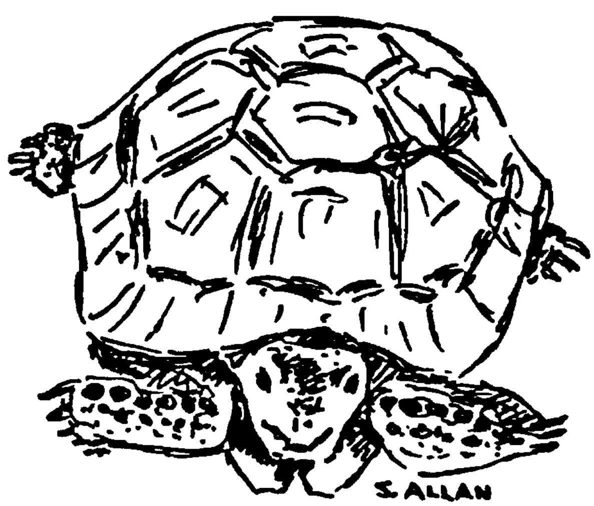

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STATE REPORT - CALIFORNIA

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During 1982, Department of Fish and Game activities regarding the desert tortoise included issuing captive tortoise permits, reviewing research proposals, and providing funding for the Naturalist position at the Desert Tortoise Natural Area (DTNA).

During the period from January 1982 through mid-March 1983, 1812 captive tortoise permits were issued by the Department. The grand total of permits issued now stands at 20,182.

The Department turned over 15 tortoises to turtle and tortoise clubs for adoption in 1982. Roy Lewis of T.E.A.M. reported adopting out 310 desert tortoises and 342 turtles of various species during 1982.

The Department's Interagency Agreement with California State University, Fresno was renewed in July 1982 to continue funding a naturalist at the DTNA. The funds are provided by the Department's Native Species Enhancement Program, also known as the Decal Program. Funds for this program are provided by public donations. Curt Uptain replaced Tom Campbell as the DTNA Naturalist in July 1981. Curt spends an average 8 day/month on or near the DTNA. From August 1982 to February 1983, he spent 180 hours observing people, and 234 hours inspecting and repairing (when possible) fence.

I feel that the DTNA Naturalist Program has been a worthwhile endeavor. However, I also feel that the program should be reviewed periodically to determine if changes in the program are needed. The program should be reviewed jointly by the Department, the Desert Tortoise Council (DTC), the Bureau of Land Management, and the Desert Tortoise Preserve Committee.

We are trying something new this year with research permits. In the past the Department has issued Scientific Collecting Permits for all types of tortoise research, whether they be long-term or short-term studies. Starting this year, we will issue Memoranda of Understanding (MOU) for long-term research projects instead of Scientific Collecting Permits. The MOU's will give us tighter reign on field activities and will provide a better reporting process. All proposals, as in the past, will be reviewed by the DTC Research Advisory Committee. Also, the Bureau of Land Management has requested that no studies be conducted on its permanent tortoise trend plots without prior written permission from its District Manager.

We are in the process of negotiating a MOU with Dr. Frederick Turner regarding the study he will be discussing later today.

In December 1982, we received a request from the DTC Research Advisory

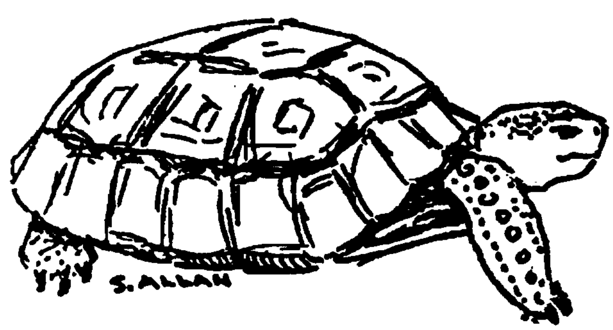
Committee to propose the desert tortoise for Rare classification. The request and supporting information is being reviewed by the Department. If the request is supported by the Department, the proposal will probably go to the Fish and Game Commission in July to be adopted or rejected by the Commission at its October hearing in Los Angeles.

The last subject I would like to cover is the general reptile regulations. We have made a few changes in the bag limits by raising the limits on a few common species. One important item actually relates to commerical use. The regulations now state that it is unlawful to display native reptiles in any place of business where pets or other animals are sold. This closes an important loophole regarding pet shops in particular.

Regarding the commercial use of native reptiles, it is now legal to sell captive-bred albino gopher snakes and common kingsnakes, and there is no possession limit on albinos of either species. Commercial use of wild-caught native species is prohibited except for sale to scientific and educational institutions by biological supply houses under Department permit. Currently, only three supply houses have permits.

A proposed regulation to allow limited, noncommercial captive breeding of native reptiles and amphibians, under a permit system, has been submitted to the Fish and Game Commission for adoption at its 29 April 1983 meeting in Sacramento.

The new regulations regarding reptiles and amphibians were not printed with the sport fishing regulations this year. These regulations will be printed separately and should be available soon.



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STATE REPORT - CALIFORNIA

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The Bureau of Land Management (BLM) report is divided into five parts: (1) a summary of studies on tortoises during 1982 on permanent study sites, (2) a summary of fieldwork undertaken on the two cattle and tortoise study plots in Ivanpah Valley, (3) analysis of tortoise data in 1982 and early 1983, (4) preparations for a new study on the effects of sheep grazing on desert tortoise populations and habitat, and (5) studies planned for 1983 and 1984.

A SUMMARY OF TORTOISE STUDIES DURING 1982 ON PERMANENT STUDY SITES

Between 1977 and 1982, the BLM established or supported census work on 25 study sites in the California deserts. We undertook 30-day and 60-day censuses in spring, as well as a few 20-day fall censuses. Since 1979, we have used only the 60-day spring census technique to monitor permanent study plots (*see* Berry 1979 for a discussion of the technique). In 1982, four permanent plots — the Desert Tortoise Natural Area (Sec. 11), Kramer, Chemehuevi Wash, and Chuckwalla Bench — were censused. One plot, the Desert Tortoise Natural Area, has been studied intermittently since 1973. Two plots, Chemehuevi Wash and Chuckwalla Bench, were established in 1977 and were resurveyed in 1979. The Kramer plot was first surveyed in 1980. Tom Campbell, Lori Nicholson and Ken Humphreys, Paul Schneider, and Peter Woodman were the contractors for data collection. They did not prepare reports summarizing the fieldwork but coded the data for computer input and analysis. We expect to analyze the 1982 data sets in 1983 or 1984 and to compare the 1982 data on population attributes with data obtained in earlier studies. We expect to use the data on growth and mortality in separate studies.

FIELDWORK ON THE TWO CATTLE-DESERT TORTOISE PLOTS IN IVANPAH VALLEY

In 1980 and 1981, the BLM supported a study on the potential effects of cattle grazing on the desert tortoise in Ivanpah Valley (Turner, Medica, and Lyons 1981; Medica, Lyons, and Turner 1982). This two-year study provided baseline information for two plots — the grazed plot and the ungrazed plot — on: (1) attributes of tortoise populations, (2) timing of egg laying, (3) size and number of clutches, (4) movements of tortoises, and (5) production of annual and perennial vegetation. The ungrazed plot was fenced in 1980. Unfortunately, funds were not available in 1982 to continue the project. Instead, the BLM contracted with Philip Medica and Craig Lyons to remove the radio-transmitters from the tortoises on the study plots. Medica and Lyons (1982) captured 75 of the 84 animals with transmitters and removed the equipment. Nine of the transmittered tortoises are still at large in Ivanpah Valley. Two the nine animals have nonfunctional transmitters. Medica has offered to return to the plots as a volunteer in spring of 1983 and to attempt to locate the nine remaining animals.

Biologists in the BLM hope that funds will be available to monitor the grazed and ungrazed plots in the next three to five years (1986 to 1988). By then, the ungrazed plot will have experienced no cattle grazing for five to seven years. Some differences in population attributes of tortoises on the ungrazed and grazed plots may be apparent.

ANALYSIS OF TORTOISE DATA IN 1982 AND EARLY 1983

During the last three years, I and others have analyzed data gathered between 1971 and 1981 on tortoise plots in California. In 1982 and early 1983, Peter Woodman and I prepared three papers on: (1) rates of decomposition of tortoise carcasses at two sites in the Mojave Desert; (2) mortality rates of adults at several permanent study sites in California, Nevada, Arizona, and Utah; and (3) a description of shell-wear patterns in desert tortoises and a preliminary investigation of the use of shell wear in determining adult age groups. Woodman has donated time through the BLM's Volunteer Program to assist with these papers. My time has been contributed also.

PREPARATIONS FOR THE BLM'S NEW STUDY ON THE EFFECTS OF SHEEP GRAZING ON DESERT TORTOISES

The California Desert District of the BLM has recognized for several years that research is needed on the effects of sheep grazing on desert tortoise populations and habitat (Berry 1978, U.S. Dept. of Interior 1980). Cattle grazing and its effects on tortoises have received some attention with the Ivanpah Valley study (Turner, Medica, and Lyons 1981; Medica, Lyons, and Turner 1982). However, funds have not been available to establish a long-term sheep grazing and desert tortoise study. During 1982, BLM personnel made some initial preparations for such a study. Wildlife biologists, range conservationists, and botanists met on several occasions in the office and field to discuss the objectives, locations for study plots, and the minimum size of study plots. The location of study plots was a major problem. Much of the land where sheep and tortoises co-occur is in a checkerboard pattern of alternating sections (square miles) of public and private lands. A site was selected in the western Mojave Desert, northeast of Kramer Junction. An exclosure will be contructed during 1983. The BLM budget also included funds for a 60-day study of tortoise and vegetation inside and adjacent to the exclosure. Unfortunately, it was not possible to advertise and award a contract in time for the spring field season.

STUDIES PLANNED FOR 1983 AND 1984

The BLM plans to work with Dr. Turner of the University of California at Los Angeles (UCLA) and Southern California Edison on projects of mutual interest during 1983 and 1984. Agreements between the BLM, Southern California Edison, and UCLA are in the process of being finalized now. I, as the BLM's representative, will be working with Dr. Turner on a population model for tortoises in the eastern Mojave Desert. I and Dr. Turner also will be undertaking such projects as: (1) a multiple regression analyses of the relationships between tortoise distribution and abundance, environmental attributes, and land uses; (2) two studies on growth; (3) an analysis of the behavior and spatial distribution of small tortoises; and (4) summaries of the known causes of death of tortoises on California study sites.

At this time, we do not know what funds will be available for censusing tortoises on permanent study sites. Bureau biologists hope to obtain funds to continue the monitoring of permanent study sites.

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THE DISTRIBUTION AND ABUNDANCE OF THE DESERT TORTOISE (*GOPHERUS AGASSIZII*) ON THE CHOCOLATE MOUNTAINS AERIAL GUNNERY RANGE

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Abstract.—During 1981, 113 strip-transects were walked on and adjacent to the Chocolate Mountains Aerial Gunnery Range (CMAGR) to determine distribution and relative abundance of the desert tortoise (*Gopherus agassizii*). All but 60 mi^2 on the northern part of the 605 mi^2 gunnery range were included in the survey. Approximately 300 mi^2 or 55% of the area supported tortoise densities estimated at 0 to 25/mi^2. Another 217 mi^2 or 39.7% had estimated densities of 25-50/mi^2. Tortoise populations with densities estimated at 50-100 and 100-250/mi^2 occupied 26 and 3 mi^2, respectively, or 5% of the gunnery range. The populations with $\geq$50 tortoises/mi^2 were found only on the eastern portion of the CMAGR at elevations of 1,150 to 2,050 ft in habitats classified as Sandy Soils, Desert Pavement Mixed with Washes, and Rolling Hills.

Signs of past and current human activities were ubiquitous on the strip-transects, e.g., vehicle tracks and shell casings. Roads, mines and mining pits, and bladed airstrips, were also present. Scats of feral burros were found on 21% of the transects.

The 246 mi^2 of tortoise habitat with densities estimated at $\geq$25 tortoises/mi^2 represent a significant block of habitat on federal land in the Sonoran Desert of the United States and are deserving of protection.

In late 1981, the U.S. Navy contracted with the Desert Tortoise Council to survey the Chocolate Mountains Aerial Gunnery Range (CMAGR) for the desert tortoise, *Gopherus agassizii*, and other rare and endangered reptiles and amphibians. The CMAGR lies in southeastern California, east of the Salton Sea and Salton Sink (Fig. 1), and provides habitat for a number of reptiles. The desert tortoise was considered to be of particular importance to the survey, because it is (1) fully-protected by the state of California under special legislation, which was first enacted in 1939 (Sections 5000-5002, and 5061 of the California Fish and Game Code); (2) listed as a "sensitive species" by the U.S. Bureau of Land Management (U.S. Dept. of Interior, Bureau of Land Management 1980); (3) listed as a threatened species in Utah (Dodd 1980); and (4) under "status review" for a potential listing as threatened and endangered elsewhere within the geographic rance (U.S. Fish and Wildlife Service 1982). The desert tortoise also was proposed for state-listing as a "rare" species in 1982.

Chocolate Mountains Aerial Gunnery Range

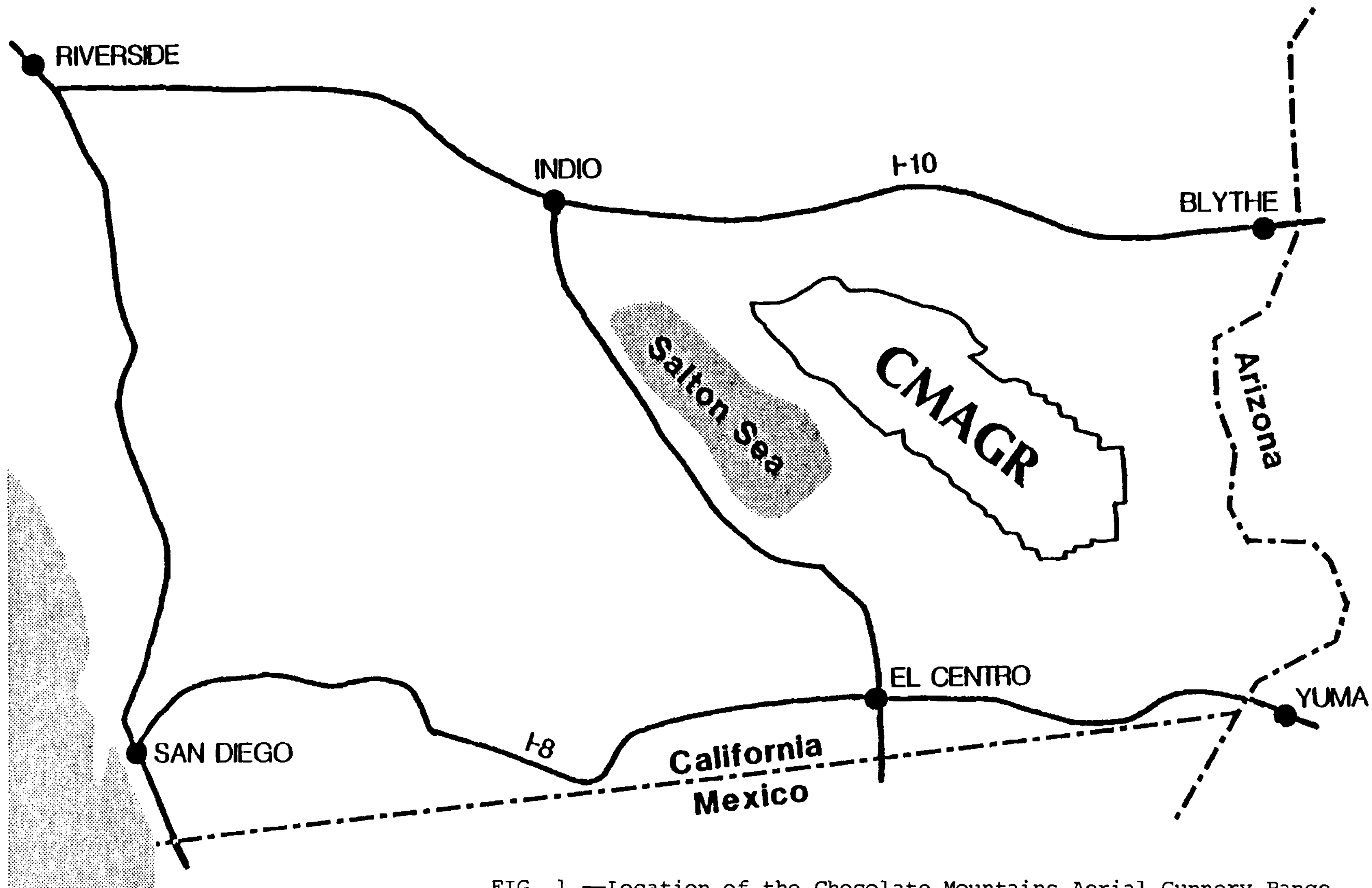

FIG. 1.—Location of the Chocolate Mountains Aerial Gunnery Range in southeastern California.

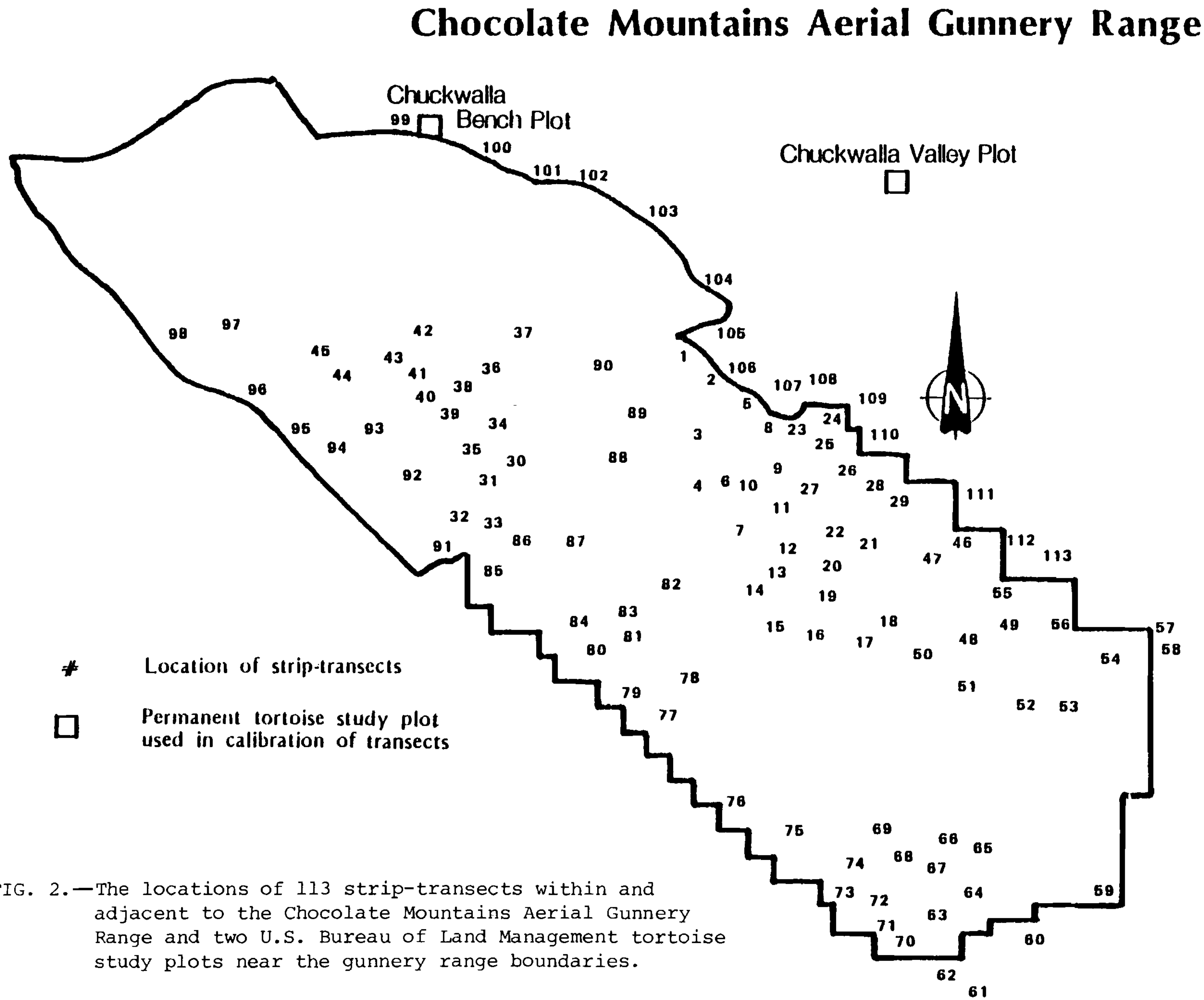

FIG. 2.—The locations of 113 strip-transects within and adjacent to the Chocolate Mountains Aerial Gunnery Range and two U.S. Bureau of Land Management tortoise study plots near the gunnery range boundaries.

This paper deals with tortoise populations and habitat on the CMAGR. More specifically, it covers: the results of a literature survey and interviews on tortoise distribution and abundance on and near the CMAGR; the findings of a field survey of tortoise distribution and abundance; and a brief analysis of ongoing human uses and their potential effects on tortoise populations and habitat.

METHODS

The CMAGR is a military range which is closed to the public. It was accessible for fieldwork by special permit for some hours on some weekends and on one or more 10- to 14-day blocks of time during the year. An area of approximately 60 mi^2 on the northern part of the gunnery range was excluded from the survey by the U.S. Navy because of the presence of live ordnance. The lack of access affected our approach to studying the existing distribution and abundance of the tortoise.

A literature search was undertaken between 1977 and 1982 as part of an overall analysis of the status of the desert tortoise in California and elsewhere in the United States (Berry *in press-1*). Two bibliographies were used for source materials (Douglass 1975, 1977; Hohman, Ohmart, and Schwartzmann 1980), and numerous published and unpublished documents were examined. People who had lived or are living in the desert were interviewed (Berry *in press-2*). We drew upon these materials for the study of the desert tortoise on the Chocolate Mountains Aerial Gunnery Range.

Our approach for determining current distribution and abundance for tortoises was to use a strip-transect technique (Berry and Nicholson 1979, *in press-1*). The strip-transect method involves recording numbers of tortoise sign (burrows, scats, live tortoises, shells, tracks, courtship rings, and drinking sites) on a transect 1.5 mi long and 10 yd wide. Ninety-three transects were walked within the boundaries of the CMAGR, and 20 were walked immediately outside between October and December of 1982 by three field workers experienced with the method (Fig. 2).

Each field worker also walked additional transects on a nearby tortoise study plot, Chuckwalla Valley II, where mark and recapture data were available and densities were known (Fig. 2 and Berry *in press-3*). Sign counts from this plot, where densities were established, could be compared with sign counts from the CMAGR. The Chuckwalla Valley II plot, established by the U.S. Bureau of Land Management (BLM) in 1980, lies several miles east of the CMAGR at the north base of the Little Chuckwalla Mountains (Berry *in press-1*). Soils, terrain, and vegetation at this site were similar to those encountered on the CMAGR.

The numbers of tortoise sign found on each strip-transect were converted to a "corrected" sign value (Berry and Nicholson 1979, *in press-1*). The correction involved an adjustment to the total sign value so that two or more sign obviously associated with a single tortoise were counted as a single sign, rather than two or more sign. For example, if a live tortoise (1 sign) was discovered in a burrow (1 sign) with 3 scats (3 sign), the total of 5 sign recorded at one location on the transect was corrected to a single sign.

A second adjustment was made in sign counts. Carcasses or shell-skeletal material were eliminated from the total sign counts. This was done because the shell-skeletal remains have been removed from the Chuckwalla Valley II

TABLE 1.—Sign counts from strip-transects and estimated tortoise densities on the Chuckwalla Valley II plot.

Field worker	Corrected sign counts	No. of first captures of live tortoises/mi^2 [a]
Betty L. Burge	17	92
" "	10	116
" "	8	92
" "	11	92
" "	3	52
" "	2	36
A. Peter Woodman	9	144
" "	11	92
" "	13	116
" "	9	52
" "	6	52
" "	4	36
L. L. Nicholson	4	36
" "	5	36
" "	9	52
" "	13	144
" "	15	144
" "	10	92

[a] The direct counts of live tortoises within the 0.25 mi^2 area in which the transect was run were multipled by 4 to give the equivalent number of tortoises/mi^2.

study site which was used for calibration of densities.

Sign counts from the 18 transects walked on the Chuckwalla Valley II plot were compared with estimated densities of tortoises for the portion of the plot where the transect was walked (Table 1). The figures for estimated densities shown in Table 1 were derived by analyzing the data collected for the Chuckwalla Valley II plot in 1980 during a 60-day spring census (Berry *in press-3*). Distribution of tortoises on the plot was not homogeneous and densities were markedly greater in some areas than in others. Therefore, the number of first captures[1/] of live tortoises on the corresponding 0.25 mi^2 where the transect was made was used as the density estimate. The tortoise counts for 0.25 mi^2 were multipled by 4 to achieve a 1-mi^2 equivalence for the tortoise density estimate.

When density estimates of tortoises from the 18 correlation transects were regressed on sign counts for the Chuckwalla Valley II plot, the resulting regression equation was:

$$D = 7.09\ CS + 19.33 \qquad (1)$$

where D = densities of tortoises/mi^2 and CS = corrected sign. The correlation coefficient, r, was 0.76.

The numbers of corrected sign found on the 113 transects on and near the CMAGR ranged from 0 to 13. Using Equation (1), the range of densities was estimated at 0-112 tortoises/mi^2. Sign counts were divided into four classes, where 0-1 sign was estimated to represent relative densities of 0-25 tortoises /mi^2, 2-4 sign were equivalent to 25-50 tortoises/mi^2, 5 to 11 sign were equivalent to 50-100 tortoises/mi^2, and 12 to 22 sign were equivalent to 100-250 tortoises/mi^2. A map of relative densities of tortoises was prepared using these sign counts and estimated densities.

Data were recorded for each transect on type of terrain, soils, and vegetation for an analysis of tortoise habitat "preferences." Transparencies (35-mm, color) were taken of many transects for this analysis. Several habitat types were identified and delineated on a map of the CMAGR. The classification was based on superficial physical and biological features of the environment, each of which is of potential importance to tortoises: degree of slope or steepness of terrain; relief; obstacles in the form of pebbles, cobbles, and boulders; hardness of soil; cover of vegetation; and diversity of vegetation.

Data also were collected for each strip-transect on human and other uses which might affect tortoise distribution and abundance: signs of feral burro (*Equus asinus*), tracks of vehicles (old and recent), roads, presence of ordnance, and other human impacts. Although not required as part of the con-

1/ The term "capture" refers to an observation of a live tortoise during a mark-recapture study, not capture and removal of tortoises from the wild.

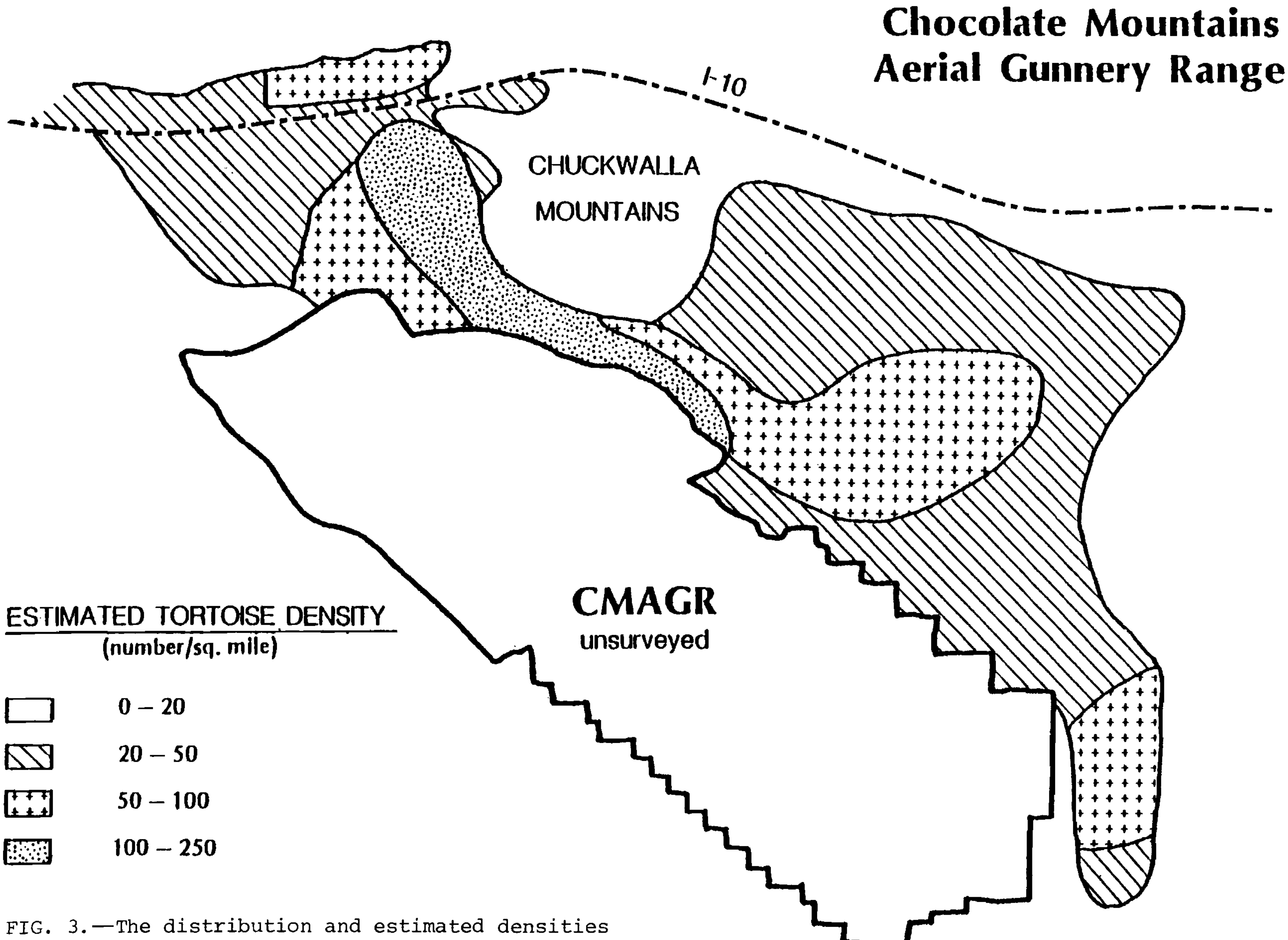

FIG. 3.—The distribution and estimated densities of the desert tortoise outside the Chocolate Mountains Aerial Gunnery Range (*from* Berry and Nicholson 1979, *in press-1*).

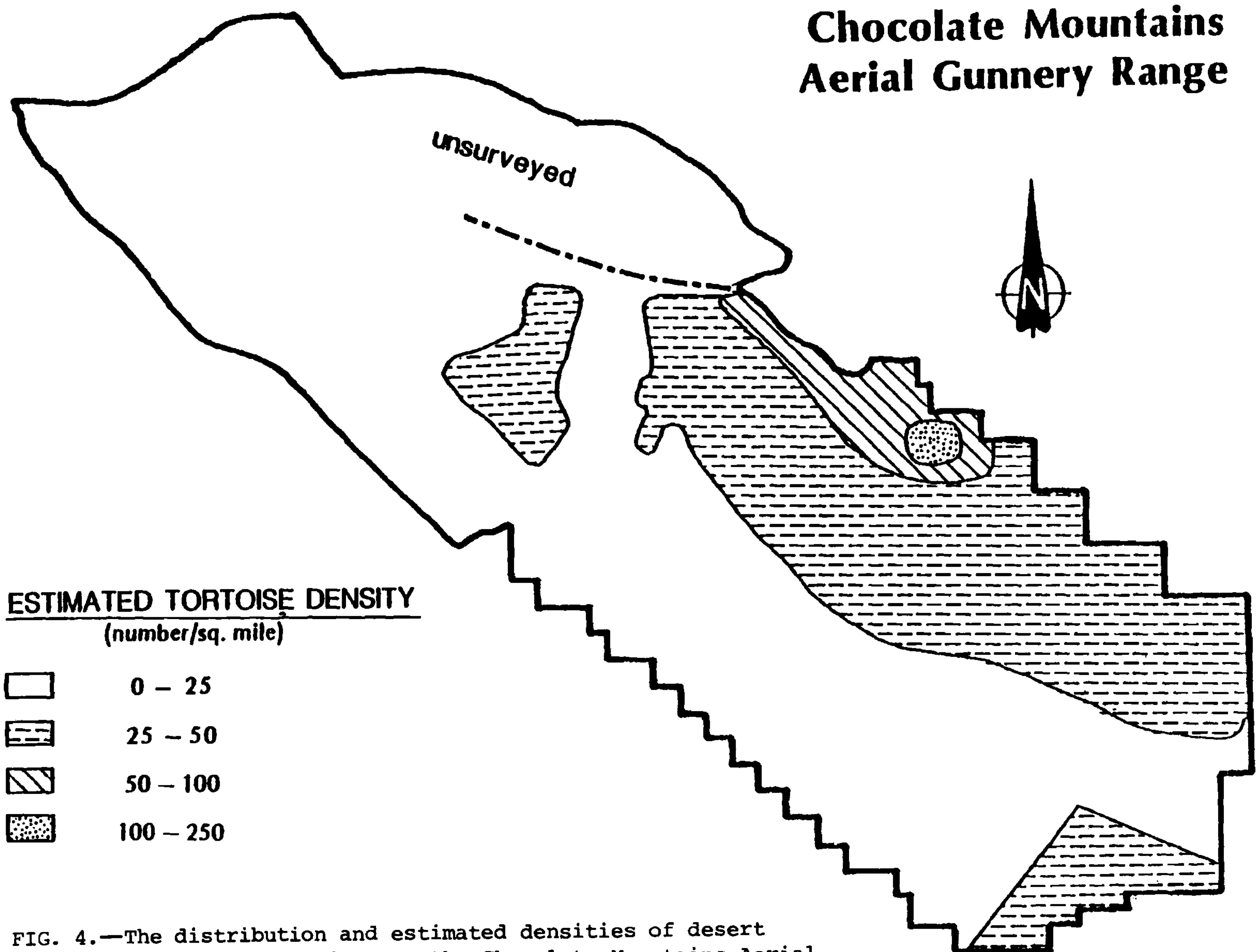

FIG. 4.—The distribution and estimated densities of desert tortoise populations on the Chocolate Mountains Aerial Gunnery Range in 1982.

tract, notes were made on presence of burro mule deer (*Odocoileus hemionus eremicus*) tracks and pellet groups and desert bighorn sheep (*Ovis canadensis nelsoni*) pellet groups. Our field workers could not distinguish pellet groups of these two ungulates so all pellet groups were referred to burro mule deer.

RESULTS

Literature surveys and Other Information Sources

A survey of the literature and search for potentially knowledgeable people who might have information on the distribution and abundance of the desert tortoise on the CMAGR produced little information. Most data were from areas adjacent to or several miles from the boundaries of the gunnery range. Three references in the literature are of marginal interest. Scott (1938) reported that the railroad flag stop, Tortuga, was named because of the presence of numerous tortoises. Tortuga lies a few miles south of the CMAGR. This area did not have tortoises in the 1970s (Berry and Nicholson 1979, *in press-1*). Ragsdale (1939), in writing of tortoises in the Chuckwalla Valley and near Desert Center in the 1930s, implied that the species was common. Chuckwalla Valley and Desert Center are north and northeast of the CMAGR. Jaeger (1955) reminisced about travels on the Chuckwalla Bench and encounters with tortoises there. The Chuckwalla Bench is north and adjacent to the CMAGR.

More recently, Berry and Nicholson (1979, *in press-1*) undertook an analysis of the distribution and abundance of the desert tortoise in California in the late 1970s, using a strip-transect technique and population data from study sites. They reported a major tortoise population with densities estimated at 20 to 250 tortoises/mi^2 in the southern Colorado Desert, in Chuckwalla Valley, the Chuckwalla Bench, and Milpitas Wash regions. These areas are adjacent to the CMAGR in the north and east (Fig. 3). A permanent study plot was established on the Chuckwalla Bench in 1977 as part of this effort, and data were collected on population attributes. This plot lies on the northern boundary of the CMAGR. The CMAGR was not surveyed during this effort.

The Distribution and Relative Abundance of Tortoises on the CMAGR in 1982

The CMAGR covers about 605 mi^2, of which approximately 546 mi^2 were surveyed with 93 strip-transects, a density of 1 transect/5.9 mi^2. Most transects had low corrected sign counts. This information is reflected in the map of distribution and relative abundance of tortoises shown in Fig. 4. The density class of 0-25 tortoises/mi^2 covers the largest area, 300 mi^2 or 55%. The 36 strip-transects in this area had a mean sign count of 0.08 (range = 0-1). The next density class, 25-50 tortoises/mi^2, covered an estimated 217 mi^2, or 39.7% of the gunnery range. The 45 transects in this class had a mean sign count of 1.9 (range = 0-4). Thus about 95% of the surveyed portions of the CMAGR had low densities estimated at 0-50/mi^2.

Tortoise populations with densities estimated at $\geqslant$50/mi^2 are entirely on the eastern side of the mountains and encompass about 29 mi^2 or 5% of the surveyed area. Most of this area was in the 50-100/mi^2 density class. The ten transects walked here had a mean corrected sign of 4.9 (range = 1-8). Approximately 3 mi^2 were delineated as having 100-250 tortoises/mi^2. This estimate is based on two adjacent transects (nos. 26 and 28), which had corrected sign counts of 11 and 13. Using Equation (1), the corrected sign count of 11 and 13 are equivalent to estimated densities of 97 and 112 tortoises/mi^2, respectively. The mean of the two falls within the 100-250/mi^2 density class.

Only one (no. 99) of the 20 transects walked along or outside the CMAGR borders had high sign counts. In most cases, the counts were consistent with the information obtained inside the CMAGR. The strip-transect data from the CMAGR were compared with the distribution and abundance map prepared by Berry and Nicholson (1979, *in press-1*), part of which is shown in Fig. 3. The map shows density classes of 20-50, 50-100, and 100-250 tortoises/mi^2 contacting the CMAGR. These class delineations were based on 36 strip-transects with an average density of 1 transect/18 mi^2. The transect density for the Berry and Nicholson (1979, *in press-1*) map was much lower than the transect density for this study.

The Berry and Nicholson (1979, *in press-1*) map shows two density classes, 50-100 and 100-250 tortoises/mi^2 abutting the northern end of the CMAGR. Although the northern parts of the gunnery range were off-limits to the field survey team, six transects (nos. 99-105) were made adjacent to the northern boundary. Sign counts ranged from 0 to 12, with the high sign count occurring on a single transect (no. 99). With the exception of the single transect with 12 sign, the other transects had markedly lower sign with a mean of 4.0 (range 2-5). This sign level indicates a density class of 20-50 tortoises/mi^2, rather than the 100-250 tortoises/mi^2 found by Berry and Nicholson (1979, *in press-1*). Using the new transect data from the CMAGR study, we suggest that the northern part of the gunnery range and the area immediately outside it probably have small areas with high tortoise densities separated by more extensive areas with low tortoise densities.

The Berry and Nicholson (1979, *in press-1*) map indicates that densities of tortoises to the east of the CMAGR are 20-50/mi^2. We walked 11 transects (nos. 57, 58, 105-113) in this area. The data from this report indicate densities of 25-50 tortoises/mi^2 except in an area of a few square miles, where sign counts from two transects (nos. 109 and 110) show a density of 50-100 tortoises/mi^2. These two transects are adjacent to transects (26 and 28) belonging to a similar sign class within the CMAGR (*compare* Figs. 3 and 4).

The Relationship of Habitat Types to Tortoise Abundance

The CMAGR lies in the southern Colorado or Sonoran Desert of California and ranges in elevation from a low of sea level on the west side next to the Salton Sea, to a high of 2,967 ft in the northern part of the Chocolate Mountains. On the east side of the gunnery range, elevations range from 2,000 ft in the north to 1,000 ft in the south.

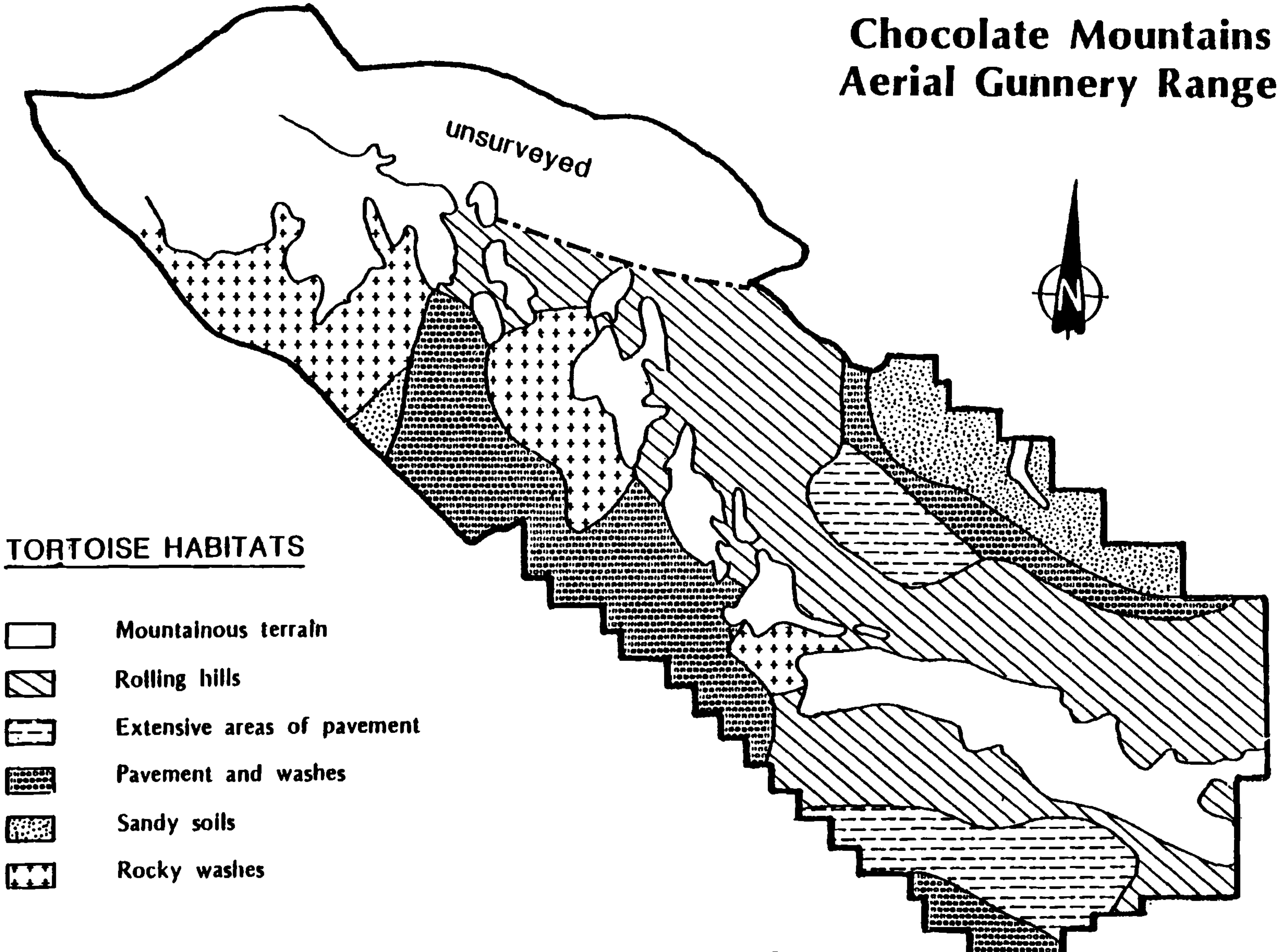

FIG. 5.—The distribution of six habitat types on the Chocolate Mountains Aerial Gunnery Range in southeastern California.

Six habitat types were identified from transect notes and 35-mm slides: (1) mountainous terrain, (2) rolling hills, (3) extensive areas of desert pavement, (4) desert pavement mixed with washes, (5) sandy soils, and (6) rocky washes. The six habitats are described below (Fig. 5).

Mountainous Terrain.—This habitat type is found primarily in the Chocolate Mountains and is typified by steep slopes, canyons, and generally rugged terrain. The soil surface is littered with pebbles, cobbles, and boulders. Vegetation is generally sparse, except in washes, which are dominated by ironwood trees (*Olneya tesota*).

Rolling Hills.—This term is used to describe low, rolling foothills with some ravines. At decreasing elevations, the foothills gradually become deeply dissected fans with washes. Hills are covered with pebbles and cobbles, and are sparsely vegetated. Washes have sandy soils and contain creosote bush (*Larrea tridentata*), burrobush (*Ambrosia dumosa*), galleta grass (*Hilaria rigida*), and ironwood trees.

Extensive Areas of Desert Pavement.—Extensive stretches of desert pavement are covered with pebbles and cobbles and are almost devoid of vegetation. The few washes present are sandy, and contain the same species noted above for Rolling Hills.

Desert Pavement Mixed with Washes.—When this habitat type is compared with Extensive Areas of Desert Pavement, the desert pavement occupies much smaller areas and is broken by frequent, sandy washes. Cover of perennial vegetation is higher also. Broad, sandy washes dominated by ironwood trees are present too.

Sandy Soils.—These are areas of low relief with sandy to pebbly soils. The vegetation is creosote-burrobush. Sandy washes are present also, and these are dominated by ironwood trees.

Rocky Washes.—This term is used to describe dissected alluvial fans with frequent stream washing. The substrate is littered with pebbles, cobbles, and boulders. Perennial shrubs and trees are distributed evenly throughout, with ironwood trees dominating much of the landscape.

Desert tortoise populations with densities $\geq 50/\text{mi}^2$ were found primarily in the Sandy Soils, with small areas of Desert Pavement Mixed with Washes and Rolling Hills. Tortoise burrows were found most often in caliche deposits of washes and hillsides of the Rolling Hills habitat. Elevations ranged from 1,150 to 2,050 ft.

Human Uses

Evidence of human use is omnipresent in the form of: roads; 2-, 3-, and 4-wheel vehicle tracks; mining; ordnance; and bladed airstrips. Vehicle tracks, either old or recent, were ubiquitous, although more tracks/transect (≥ 30) were observed on the east-central and southern portions of the

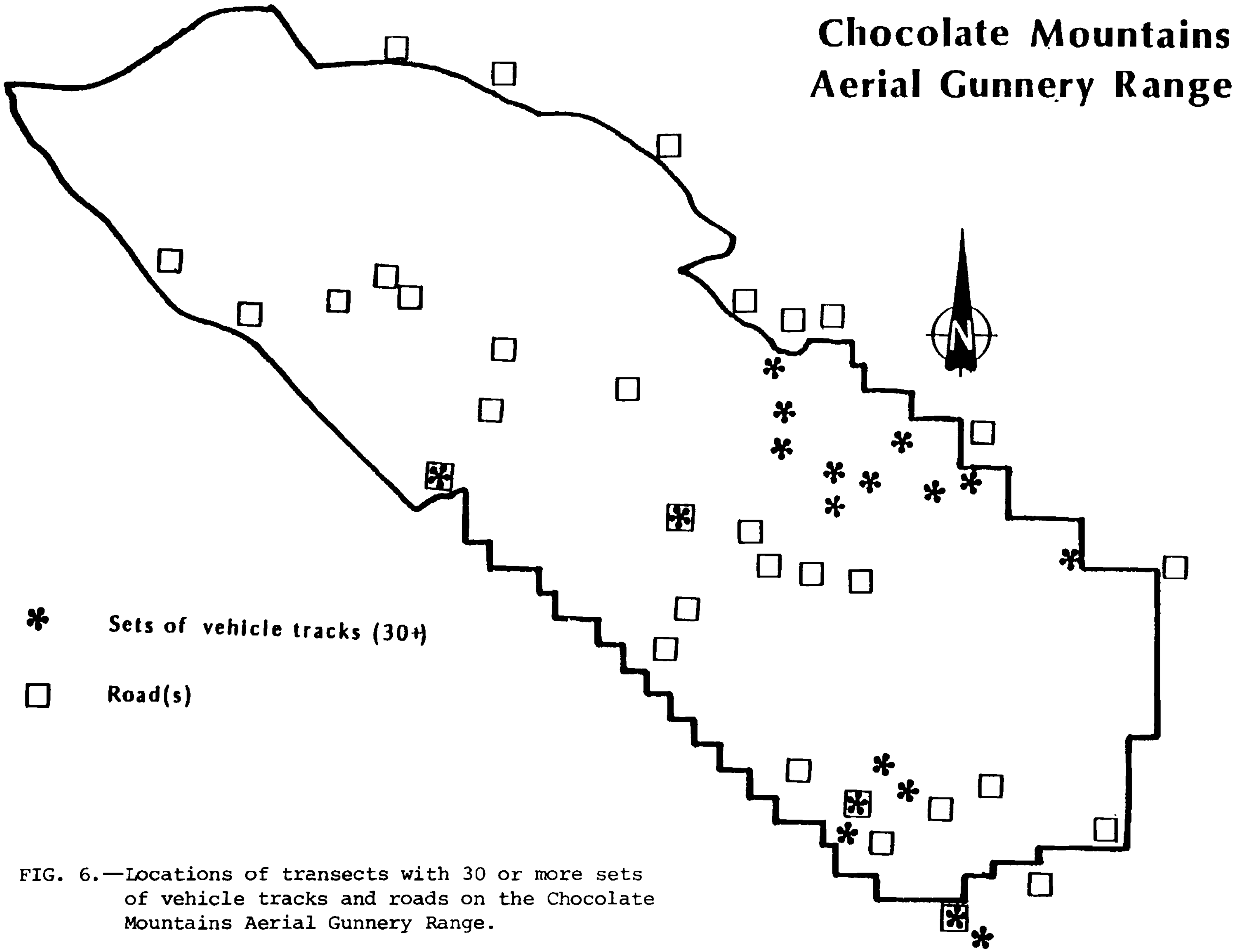

FIG. 6.—Locations of transects with 30 or more sets of vehicle tracks and roads on the Chocolate Mountains Aerial Gunnery Range.

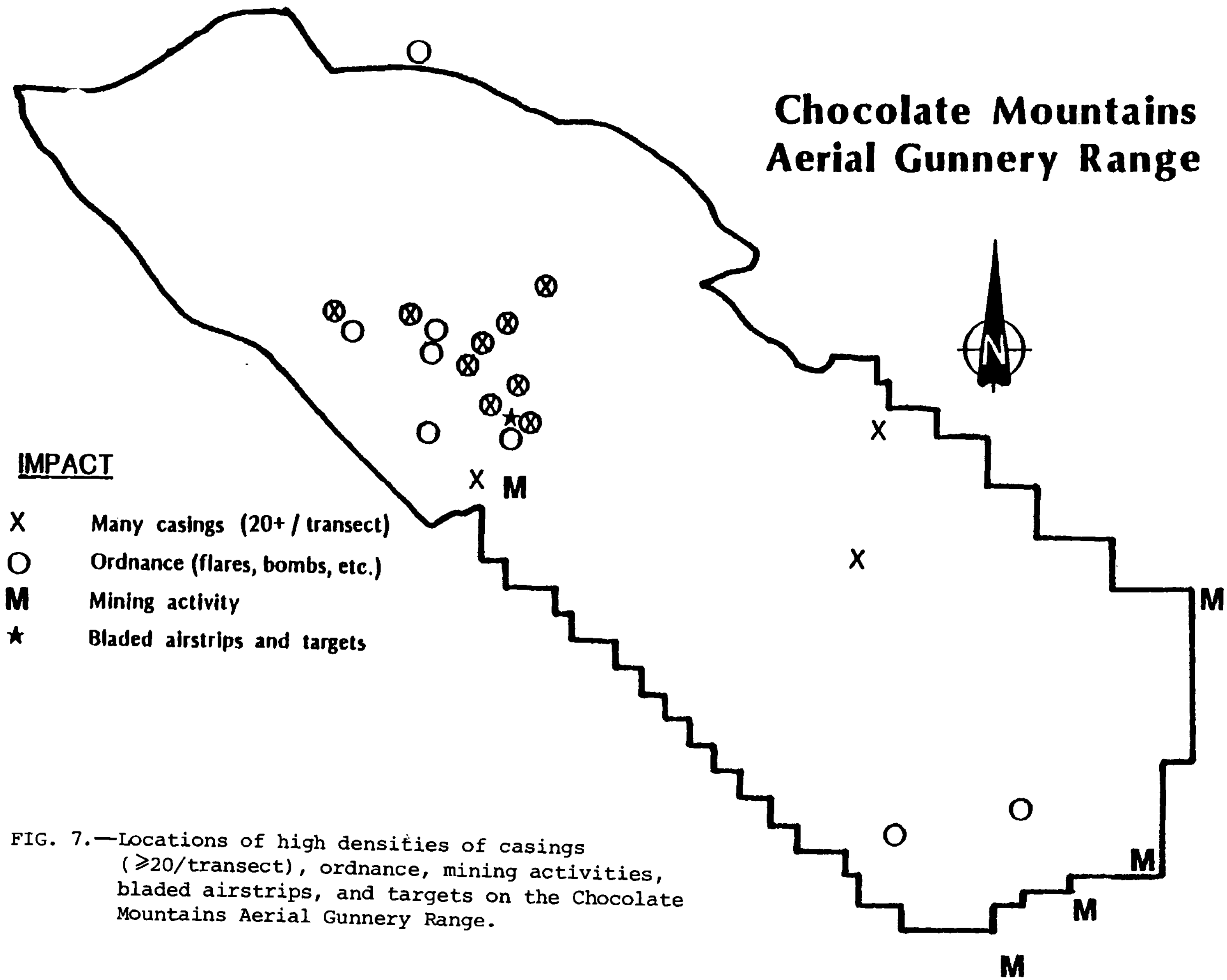

FIG. 7.—Locations of high densities of casings ($\geqslant$20/transect), ordnance, mining activities, bladed airstrips, and targets on the Chocolate Mountains Aerial Gunnery Range.

gunnery range than elsewhere (Fig. 6). Roads are frequent also. They were found on 22 of the 93 transects within CMAGR boundaries. Some vehicle tracks are probably from tanks and may have been made during General Patton's military maneuvers in 1943-1944 (Berry and Nicholson 1979, *in press-2*). Other tracks appear to have been made very recently, and by civilians. Several armed individuals were observed during the course of the project. For example, within a four-day period, several civilians were observed. One male was seen in a 4-wheel convertible on the Salvation Pass Road. He had several guns, water, and an icebox in the car and said that he drove the route often. On another occasion, two men in an open jeep drove on the road and up and down washes in the vicinity of transect 22. The passenger had a gun. Near transect 22 was an abandoned van, which apparently had been used for shelter and as an elaborate campsite. The final example is a teenaged male, who was driving a jeep alone on the gas-line road. Shotgun shells indicate that shooting/hunting occurs.

Artifacts associated with military activities are present — ordnance (bombs, flares, etc.) and 30- and 50-caliber shell casings and clips. Casings and/or clips were found on 105 of the 113 transects but were in higher frequencies ($\geqslant$20/transect) on the northwest portion of the gunnery range than elsewhere (Fig. 7). Targets and a bladed airstrip were found here also.

Feral furros frequent the CMAGR. Scat groups were found on 24 of the 113 transects. Burro sign was present throughout the central part of the gunnery range but was absent from the southern part (Fig. 8).

Other Resources

Data also were collected on the abundance of Munz cholla and the presence of burro mule deer tracks and burro mule deer and bighorn sheep pellet groups. Munz chollas were common to abundant on the northeastern to north-central portions of the CMAGR and uncommon to rare in the central part (Fig. 8). This rare plant was not observed elsewhere. Tracks of burro mule deer and pellet groups of either burro mule deer or desert bighorn sheep were present throughout much of the area (Fig. 8).

DISCUSSION

Distribution and Abundance of the Desert Tortoise on the CMAGR

The distribution and abundance map prepared for the CMAGR is similar to the map prepared by Berry and Nicholson (1979, *in press-1*) for the regions outside the gunnery range. Naturally, questions arise about the reliability of the strip-transect technique and maps. These problems have been explored by Turner et al. (1982) and by Berry and Nicholson (*in press-1*). At this time, the most reliable density estimates for tortoises are made at permanent study plots using mark-and-recapture methods (Turner and Berry *in press*). The density maps developed from strip-transects are dependent on the accuracy

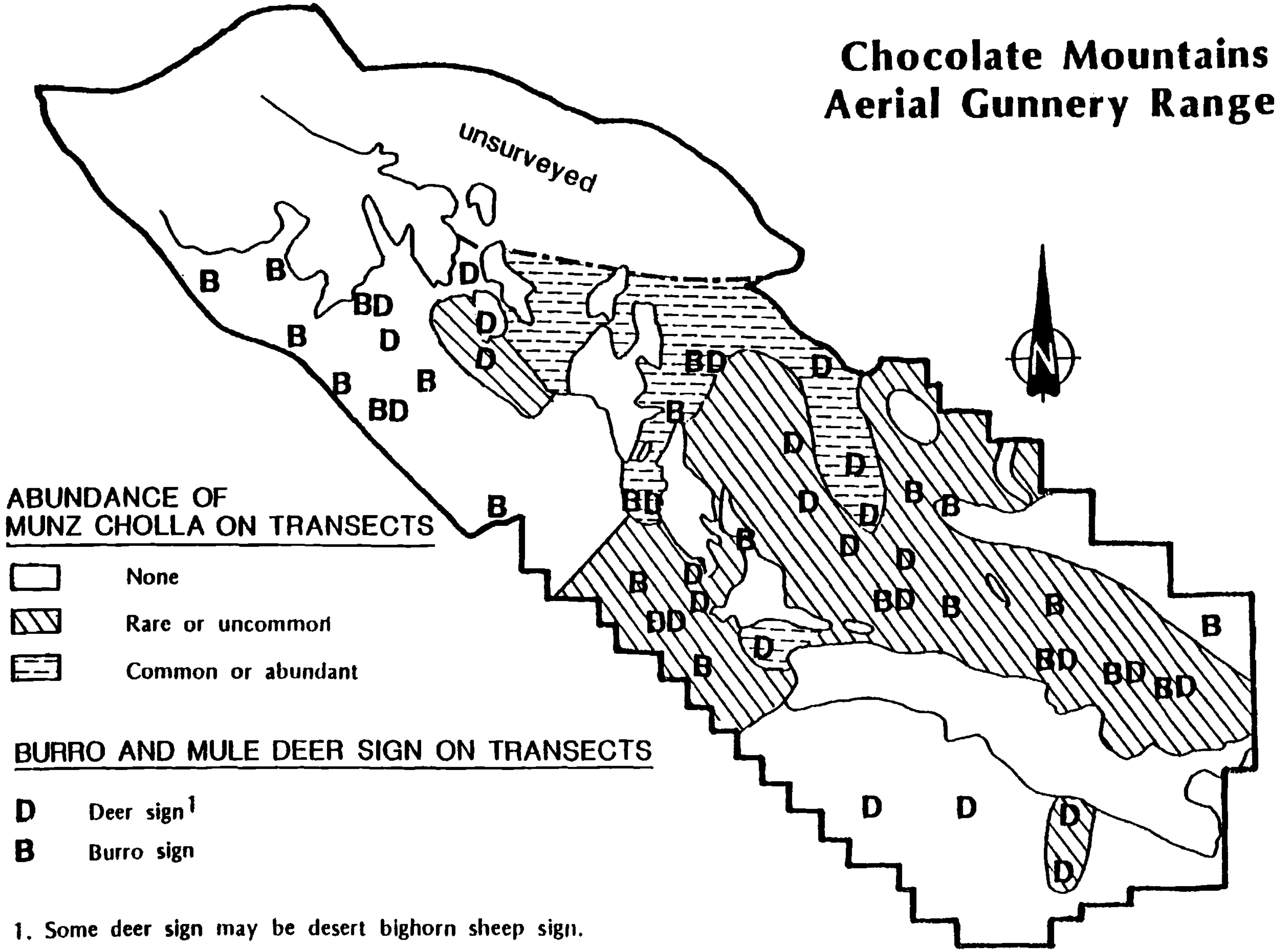

FIG. 8.—The distribution and abundance of Munz cholla on transects and the presence of feral burro and mule deer (desert bighorn sheep) sign on transects walked within the Chocolate Mountains Aerial Gunnery Range.

of census data from the permanent study plots used for the correlation transects. Berry and Nicholson (*in press-1*) have pointed out that the permanent plots such as Chuckwalla Valley II were selected because of their high densities and may not be representative of large areas of habitat nearby. Therefore, the density maps developed from the strip-transects (Figs. 3 and 4) should be used for general information on possible tortoise densities. More specific numbers can be obtained by site-specific mark-and-recapture studies.

Maps of tortoise distribution and density in the Sonoran Desert and CMAGR may be less reliable than those for the Mojave Desert because of the diversity of habitats in the former desert. In the Sonoran Desert, numerous types occur and interdigitate — rocky washes, sandy washes, desert pavement, rolling hills, and mountainous terrain, etc. Because of the heterogeneous nature of the area, tortoise distribution and abundance probably vary considerably within short distances. Populations are probably highly patchy. Maps prepared on a small scale from relatively few transects (e.g., the Berry and Nicholson [*in press-1*] map) are likely to be less accurate than those drawn on a larger scale and derived from a higher density of transects (e.g., Fig. 4, this report).

The Importance of Tortoise Habitat on the CMAGR

The 29 mi^2 of habitat with densities estimated at $\geqslant$50 tortoises/mi^2 within the CMAGR may represent a significant portion of high density habitat on federal land in the Sonoran Desert system in the Southwest. In California, moderate to high density tortoise populations in the Sonoran Desert are found to the north and east of the CMAGR. Berry and Nicholson (1979, *in press-1*) and the BLM (U.S. Dept. of Interior, Bureau of Land Management 1980) call this general area the Chuckwalla Bench Crucial Habitat and Wildlife Habitat Management Area for tortoises. The areas with the highest densities of tortoises have been included in the BLM's Chuckwalla Bench Area of Critical Environmental Concern (U.S. Dept. of Interior, Bureau of Land Management 1983). Virtually all of this tortoise habitat is in a checkerboard land pattern, with alternating sections (mi^2) in private ownership. The Chuckwalla Bench Area of Critical Environmental Concern may have over 200 parcels of private land.

In the Sonoran Desert of Arizona, fewer than a dozen areas with moderate to high density tortoise habitat (50-250 tortoises/mi^2) have been identified (summarized in Berry *in press-1*). Each such area appears to cover only a few square miles, has relatively low numbers of tortoises in the total population ($\geqslant$300), and is island-like in nature. All of these areas are subjected to more than one human use and are considered vulnerable.

Human Impacts

The CMAGR is a live weapons aerial gunnery and bombing range. All areas of the range are extremely dangerous due to unexploded munitions on the ground and actual bombing from the air. Unauthorized entry into the CMAGR is prohibited by federal statute, and state and federal authorities do arrest and prosecute trespassers. However, because of the vast expanse and easy access by ORVs, outsiders do intrude the area. The numerous vehicle tracks indicate that ground use is frequent by civilians.

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DESERT TORTOISE PRESERVE COMMITTEE REPORT

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The primary concern of the Desert Tortoise Preserve Committee is the desert tortoise population and habitat on the Desert Tortoise Natural Area (DTNA). This wildlife preserve includes much of the prime habitat of the Fremont-Stoddard desert tortoise population. The Fremont-Stoddard population was identified during the Bureau of Land Management's Desert Plan process as one of the four remaining major tortoise populations in California (Berry and Nicholson 1979; U.S. Dept. of Interior 1980).

The following is a brief chronology of the programs toward the establishment and protection of the DTNA:

1) In 1972, a proposal for a 10-square-mile preserve was submitted to the Bureau of Land Management (BLM), which has jurisdiction over this public land.

2) By 1976, the proposal had been enlarged several times to include over 38 square miles, 16 of which were in private ownership.

3) In 1977 and 1978, a stock fence was built around most of the DTNA perimeter to prevent sheep and vehicle access but still allow free passage of wildlife.

4) In 1980, the public lands of the DTNA were withdrawn from mineral entry; the interpretive center and nature trails were completed; and the DTNA was officially dedicated.

5) As of 1981, almost five of the 16 sections of private land had been acquired by the BLM and The Nature Conservancy.

Maintenance and Patrol of the DTNA.—Although the maintenance and patrol of the DTNA is the responsibility of the BLM, the Bureau is doing little to patrol, repair the fence, replace interpretive supplies, and maintain the nature trails. Further, the Bureau wants the Committee to take a major role in maintaining and supplying the interpretive center. The Committee believes that this is not the best use of its time and efforts. Curt Uptain, the naturalist funded by the California Department of Fish and Game (DFG), spends eight day/month in the vicinity of and on the Natural Area and will do so until June of 1983. His efforts are the extent of what is presently being done to patrol and maintain the DTNA facilities. The DFG may wish to consider the importance of his efforts when it decides whether to continue the naturalist position.

Private Land Acquisition.—In 1980, the Bureau requested that the Committee contribute funds to equalize the value of a group land exchange in Section 31, inside the southwestern boundary of the DTNA, for the more valuable Section 8, south of the DTNA. The Committee agreed to contribute $12,000 to make the exchange possible. In 1982, the BLM abandoned the exchange due to several problems, including agreement among owners. There is the possibility that The Nature Conservancy can purchase Section 31 in addition to other private parcels in the DTNA and then do a single exchange with the Bureau. Negotiations between the Conservancy and the Bureau center around the Conservancy picking up the land at small parcel prices and the Bureau insisting the exchange be based on much lower large parcel values.

Legal Action.—After careful consideration and exhaustion of all administrative avenues, the Committee found it necessary to file suit against the State Lands Commission. The suit, filed 24 March 1981, charges that the Commission failed to adopt measures to protect the Natural Area from urban development when it made a decision in 1980 to relinquish State surface entry rights in the Second Community of California City (Forgey 1982). The first court hearing was on 21 January 1983 in Kern County Superior Court. The Committee filed two discovery motions which would allow inquiry into the reasons and activities surrounding the Commission's decision. The motions are critical; the pending ruling will affect the Committee's ability to proceed with the litigation.

Oil and Gas Leasing.—This situation is an example of the types of problems that frequently surface in protecting the Natural Area and of the difficulties in working with resource agencies. Recently there has been increased interest in oil and gas leasing in the Mojave Desert. In mid-1981, the Committee heard rumors of applications for leases on the DTNA and requested that the Bureau inform it of such applications. Finally, at the 6 December 1981 meeting of the Committee, the Bureau reported that:

1) four applications were on file that involved the DTNA;

2) the existing withdrawal from mineral entry did not include oil and gas; and

3) the Desert District would reject the leases, but the BLM State Director had the final decision.

The Committee immediately expressed great concern and asked to be kept informed. Apparently, in January 1982, a lease was awarded that included areas in the northeastern part of the DTNA, in addition to lands outside the DTNA. The Committee was not informed. In May 1982, the Bureau apparently cancelled the portions of the lease that included land within the DTNA. Also unknown to the Committee, in July 1982 the leasee filed an appeal with the Department of Interior Board of Appeals on the cancellation.

Meanwhile, the Committee was still hearing rumors of leases being approved in the DTNA. The Committee's attorney continued to make inquiries to the Area, District, and State Office levels of the BLM, and received noncommittal responses. At a meeting with the Committee on 2 September 1982, BLM District Manager Gerald Hillier admitted that a lease including land inside the DTNA was "accidentally" awarded. Committee Attorney Joy Lane's immediate inquiries into the particulars of the lease were not answered by the BLM State Office until 23 September. Lane was told the location of the lease and that the leasee had appealed the BLM's cancellation of the lease. On 23 February 1983, the Board of Land Appeals refused the Committee's request to intervene in the appeal and reinstated the cancelled portion of the lease. The reasons for the decision included improper BLM procedures in cancellation and the fact the Bureau still had control over surface entry in the DTNA with the DTNA Habitat Management Plan providing the guidelines. There is really no guarantee that the Bureau will continue to prohibit surface entry. In addition, the decision set an ominous precedent of management by mistake.

Conclusion.—The Committee and its supporters should be proud of the hard-fought successes toward a protected Desert Tortoise Natural Area. Without continuous public concern and pressure, the Bureau might drop the project entirely. The challenges toward establishing and maintaining the DTNA often seem overwhelming. Yet, given the consequences in terms of tortoise survival and considering the past investments in time, money, and effort, we have no choice but to continue, and even intensify, our efforts.

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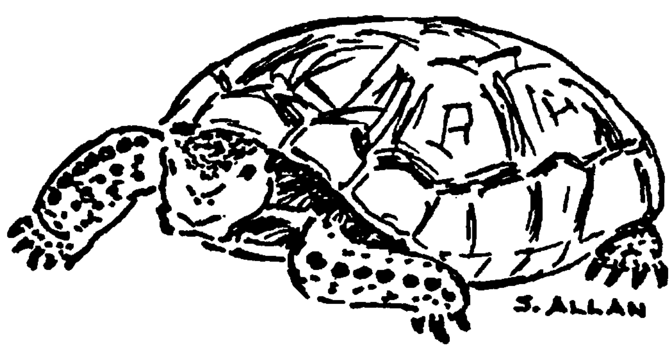

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EFFECTS OF PARKER 400 OFF-ROAD RACE ON DESERT TORTOISE HABITAT IN CHEMEHUEVI VALLEY, CALIFORNIA

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Abstract.—The Parker 400 is a combined motorcycle and four-wheel vehicle race that has been held annually along the same general course since 1972. Two study sites were selected 118 kilometers after the start of the California loop. Site A was a "pit area" and Site B was along 3.2 km of the course. Strip transects were established at each site to assess vehicle track disturbance. We found that the race vehicles were generally spaced so there was very little passing and that they generally stayed on the designated course. However, approximately 225 spectator vehicles and pit crews parked 1 km from the designated area. Many spectators illegally drove two-, three-, and four-wheel vehicles cross-country. Line-transects in Site A showed increases in post-race vehicle tracks from 13.5 to 49.4%. All of these tracks were from cross-country travel by spectators. No tortoise sign was found in the designated spectator viewing area. Fourteen burrows were found at Site B; none were damaged during the race.

Off-road vehicle (ORV) use in the California desert has been described as a legitimate use of public lands within a multiple-use framework (U.S. Dept. of Interior 1980). However, because of the habitat degradation ORVs cause, their use should be considered consumptive (Davidson and Fox 1974, Luckenbach 1975, Badaracco 1976, Celantano 1978). Quantitative documentation of ORV impacts on wildlife have been provided by Berry (1973), Busack and Bury (1974), and Bury et al. (1977). Impacts to vegetation have been shown by Gibson (1973), Berry (1973), Stebbins (1974), Davidson and Fox (1974), Bury et al. (1977), and Rowlands (1980).

The Parker 400 is a competitive off-road racing event that has been sanctioned by the Bureau of Land Management (BLM) and held annually since 1972. Studies by the BLM are underway on wildlife and vegetation trend plots that were established in 1977, after the cumulative effects of seven races (U.S. Dept. of Interior 1981*a*). No baseline data exist of habitat condition along the race course prior to the first race.

The race course passes through one of 27 BLM desert tortoise (*Gopherus agassizii*) trend study plots. This plot was established and surveyed in 1977 to help determine the status of the tortoise in the California desert. It was resurveyed in 1979. The plot is located approximately 32 km south of Needles, California, where the course crosses Highway 95. In order to utilize the 1977 and 1979 data as a baseline for comparison, we chose this site for further study.

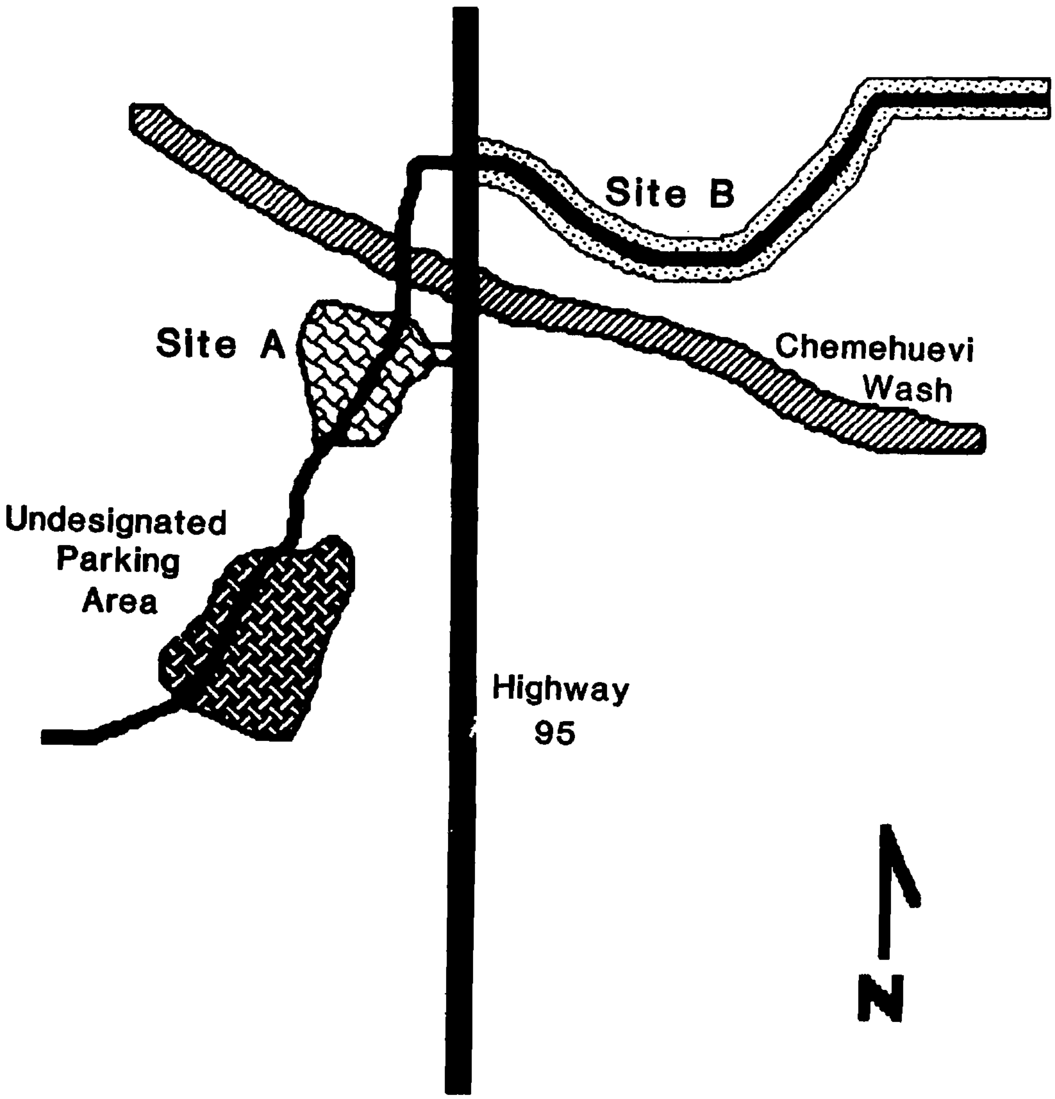

FIG. 1.—Map showing locations of two study sites and nondesignated parking area along the Parker 400 race course, California.

The purpose of this study was to determine the effects, if any, of a competitive event on tortoise populations and habitat, and to determine the effectiveness of habitat protection mitigation measures set forth in the environmental assessment report for the race (U.S. Dept. of Interior 1981*a*).

RACE DESCRIPTION

The Parker 400 is a combined motorcycle and four-wheel vehicle race that has been held along the same general course since its inception (U.S. Dept. of Interior 1981*a*). The first three events (February 1972, 1973; November 1973) were sponsored by the National Off-Road Racing Association, and the last seven events (February 1974, 1975, 1976, 1977; October 1978; February 1979, 1980) have been sponsored by the Short Course Off-Road Enterprise (SCORE).

The 320-km course is made up of two loops — a 169-km loop in California and a 151-km loop in Arizona. The total length of the race is 471 km because the Arizona loop is run twice. The California loop crosses 65 km of BLM land, 3.5 km of state land, and 0.4 km of private land (U.S. Dept. of Interior 1981*a*).

The race is a timed event in which the entrant with the lowest elapsed time wins. The start is staggered with a 30-sec. interval separating each entrant. In the 1981 race, there were 408 entrants — 84 motorcycles and 324 four-wheel vehicles (U.S. Dept. of Interior 1981*b*). Each race vehicle is supported by a pit crew which carries extra gas, spare tires, and spare parts. To prevent "short-coursing" (i.e., not following the designed race course), each entrant must pass six checkpoints. At each checkpoint, the driver must stop to allow race officials to drop a numbered tag into a can on the race vehicle.

Entrants are allowed to inspect or prerun the course, at less-than-race speeds, for 21 days prior to the race. This allows entrants to familiarize themselves with the course and to select pit stops.

All race vehicles must stay within a 20-m corridor (10 m on either side of the course centerline). In areas of greater environmental sensitivity, all vehicles must stay within a 15-m wide corridor (7.5 m on either side of the course centerline), even when passing.

Entry fees have been $250 for motocycles and stock Volkswagen sedans and $375 for all other four-wheel vehicles. In 1981, there were 108 motorcycles and stock Volkswagens (U.S. Dept. of Interior 1981*b*) which paid $27,000 in entry fees, and 300 other four-wheel vehicles which paid $122,500, a grand total of $139,500 in entry fees.

The BLM received a $3,000 bond, posted by SCORE, to insure that the mitigation measures would be followed and that post-race clean-up measures would be completed satisfactorily.

METHODS

Two study sites were selected; both were at the north crossing of Highway

95, near Chemehuevi Wash, in San Bernardino County, California (Fig. 1). Site A was on the west side of the highway and was a designated spectator viewing area (U.S. Dept. of Interior 1981*a*). Site B was located on the east side of Highway 95 and followed the race course from the highway to checkpoint 4, a distance of 3.2 km. The Chemehuevi Wash tortoise trend plot was bisected by Site B.

Both sites were visited before and after the 1981 race (6 and 8 February 1981, respectively) and were monitored on race day, 7 February 1981.

At Site A, four 100-m and two 50-m transects were established around an existing "pit area." The pit area consisted of a 1.5-ha area through which the race course passed. Three of the 100-m transects were 20 m from the perimeter of the denuded area, and one was at the edge. The two 50-m transects were established 200 m from the perimeter of the pit area. The area from the 50-m-transects to the pit area was systematically searched for tortoises and tortoise burrows.

At Site B, six 100-m and nine 50-m line-intercept transects were established. All transects were perpendicular to the course, with the course centerline bisecting the transect. A 20-m corridor (10 m on each side of the course centerline) was searched for tortoises and tortoise burrows.

On the transects, all vehicle tracks were measured and, if possible, counted and identified as to type (i.e., motorcycle, all-terrain cycle [ATC], or four-wheel). Shrubs were measured on all transects and estimates were made of the amount of damage for those which were run over by ORVs. Also at Site B, the race course was measured to determine the amount of course widening.

Crowd control measures, race corridor observations, and sanitary facilities were noted to determine SCORE's compliance with mitigation measures requiring that the course is properly flagged; that all vehicles stay within the designated corridor; that portable toilets are provided; that rare and endangered plants or animals near the course are protected; that the permittee man all checkpoints, spectator viewing areas, and traffic control points; that all race vehicles remain on the designated course; that (to protect desert tortoises) disabled vehicles are not retrieved in the area from Chemehuevi Wash to Turtle Mountain Road until the checkpoint in the area officially closes; and that the BLM provide personnel to observe the effectiveness of the mitigation measures.

RESULTS

Site A

One group camped at the pit area the night before the race, but no one camped there the night after the race. Thus, all vehicle tracks were probably made by people watching the race. Many spectators brought their own two- and three-wheel vehicles to drive, and most of this driving was illegally done off

TABLE 1. — Disturbance by vehicle tracks on six transects at Site A, in the pit area along the Parker 400 race course, 7 February 1981.[a]

		Pre-race[b]			Post-race				
Transect No.	Transect length (m)	Amount of disturbance (%)	2-wheel and ATC tracks (N)	4-wheel vehicle tracks (N)	Amount of disturbance (%)	2-wheel and ATC tracks (N)	4-wheel vehicle tracks (N)	Shrubs damaged (N)	Increase in amount of post-race disturbance (%)
1	100	0	0	0	28.6	9	17+	0	28.6
2	100	3.9	1	6	17.1	8	11	0	13.2
3	100	0.15	1	0	37.6	7	29	4	37.4
4	100	8.1	0	6	57.5	14	48+	0	49.4
5	50	0	0	0	28.4	9	unknown	0	28.4
6	50	0	0	0	22.2	unknown	unknown	0	22.2

[a] The amount of disturbance is the percent of the length of the transect covered by tracks.

[b] All pre-race tracks probably were made within a one-week period, starting two weeks before the race and ending one week before the race.

roads. All six transects showed post-race increases in vehicle tracks; increases ranged from 13 to 49% (Table 1). For example, within a 12-h period, 49.4 m (49%) of one 100-m transect were disturbed by tire tracks. The two transects that were 200 m from the pit area showed increases from no pre-race tracks to over 20% tracked after the race.

Over 75% of three creosote bushes (*Larrea tridentata*) were destroyed on transect 3, at the perimeter of the pit area. These were the only shrubs damaged on race day that were on transects. Many others, outside of the transects, were also damaged. No tortoises or tortoise burrows were found at Site A.

The existing pit area (Site A) was not the only area used for parking by spectators and pit crews. Approximately 0.8 km of the race course was lined by 300 to 400 vehicles. The north end of this parking area was Study Site A, and the southern end was on an area of desert pavement interspersed with small brushy washes. This latter area was completely covered with fresh tracks after the race. Unfortunately, we did not know this area would be so heavily used and cannot show quantitatively the extent of the damage.

The 25 to 30 pit crews at the southern end of the spectator viewing area were parked outside of the restricted corridor. This was despite a mitigation measure requiring that "the permittee will assure that all race and support vehicles remain on the approved course" (U.S. Dept. of Interior 1981*a*). All entrants with pit crews parked outside of the approved corridor should have been disqualified, but the rules as stipulated in the 1981 Environmental Assessment Report (EAR) were not enforced.

One racer was observed to pass his pit stop, turn around, and return on a path 26 m from the course centerline. In turning, he damaged from 40 to 50% of six creosote bushes; about 20% each of four burro bushes (*Ambrosia dumosa*); and 60, 80, and 90% of three other burro bushes. This entrant also should have been disqualified but was not.

The only evidences of spectator control measures were four "No Parking" and one "Parking" sign. These signs were generally followed by spectators, but there were many exceptions. For example, eight cars were parked in Chemehuevi Wash, which was signed as a "No Parking" area. Cars were also parked along Highway 95, which had two "No Parking" signs. The California Department of Transportation, in a 26 March 1979 letter to SCORE, stated that "No Parking" signs should be posted for 255 m on either side of the highway crossing, at intervals of 50 m on each side of the highway. This means that a minimum of 12 signs should have been present.

No sanitation facilities or trash receptacles were found. One mitigation measure stated, "Portable toilets will be provided by permittee in numbers and locations as specified by the BLM" (U.S. Dept. of Interior 1981*a*). The north crossing of Highway 95 is not specified; however, in an 8 December 1978 memorandum from Bruce Ottenfeld (Acting District Manager for Riverside District) to the Yuma District Manager for the BLM stated that both trash receptacles and restroom facilities were inadequate at the north crossing of Highway 95. He recommended that eight Jiffy-Johns and several trash containers be placed

TABLE 2. — Disturbance by vehicle tracks on 15 transects established at Site B, along the Parker 400 race course, 7 February 1981.[a]

Transect No.	Transect length (m)	Pre-race[b] Amount of disturbance (%)	Pre-race[b] 2-wheel and ATC tracks (N)	Pre-race[b] 4-wheel vehicle tracks (N)	Post-race Amount of disturbance (%)	Post-race 2-wheel and ATC tracks (N)	Post-race 4-wheel vehicle tracks (N)	Post-race Shrubs damaged (N)	Increase in amount of post-race disturbance (%)
1	100	26.7	10	11	26.7	10	11	1	0
2	100	6.9	7	3	6.9	7	3	3	0
3	100	0.6	0	5	4.7	unknown	unknown	1	4.1
4	100	0.1	1	0	0.1	1	0	0	0
5	100	0	0	0	0.1	1	0	0	0.1
6	100	0.5	0	1	0.7	1	1	0	0.2
7	50	0	0	0	5.8	0	2+	0	5.8
8	50	5.8	3	3	6.8	3	5	2	1.0
9	50	4.1	unknown	unknown	5.3	unknown	unknown	2	1.2
10	50	1.4	0	1	1.4	0	1	0	0
11	50	1.0	1	1	1.0	1	1	0	0
12	50	1.1	1	1	1.1	1	1	0	0
13	50	0.2	1	0	0.2	1	0	0	0
14	50	1.2	0	1	1.9	2	1	0	0.7
15	50	0.4	1	0	1.4	1	1	0	1.0

[a] The amount of disturbance is the percent of the length of the transect covered by tracks.

[b] All pre-race tracks probably were made within a one-week period, starting two weeks before the race and ending one week before the race.

TABLE 3.—Amount of expansion in race course of the 1981 Parker 400.

Transect No.	Width of course prior to race (m)	Width of course after race (m)	Increase in width (m)	Increase (%)
1	4.5	4.5	0	0
2	3.5	5.4	+1.9	15
3	3.5	9.6	+6.1	174
4	2.0	3.8	+1.8	90
5	4.3	5.6	+1.3	30
6	3.6	4.4	+0.8	22

there, but the Yuma Office did not require them. After the race, we picked up over 3.5 kg of aluminum cans (approximately 300 cans) and saw much paper litter.

Another mitigation measure stated, "BLM will provide personnel to observe the effectiveness of mitigation measures, to provide supplemental visitor control and to report violators" (U.S. Dept. of Interior 1981*a*). Three of us were in the pit area from 0900 to 1330 h when concentrations of spectators were heaviest. No BLM employees were observed during that time."

Site B

These transects indicated little vehicular activity outside the race course corridor (Table 2). Five of the 15 transects showed an increase greater than 2% in vehicle tracks. The course was widened in five of the six transects in which the course width was measured (Table 3). Transect 3 was at a split in the course that was inadequately flagged; consequently, some racers, instead of turning right along the course, mistakenly drove straight onto another road for a short distance before returning to the race course. The other four transects with course widening were at bends in the course, and widening was mostly caused by dirt being thrown onto the outside edge of the turn.

Two instances of passing were observed in the transects, in both cases the vehicles remained within the allotted corridor. Tracks of two other passing vehicles were observed. Both sets of tracks were outside of the race corridor. They were 16 m from the course centerline. Both vehicles took the easiest route around another vehicle and returned to the course quite quickly.

Fourteen tortoise burrows were located in Site B. One was within 1.5 m of the race course on the outside corner of a turn. No burrows were damaged during race activities.

One mitigation measure required: "To protect desert tortoises, disabled vehicles will not be retrieved from Chemehuevi Wash to Turtle Mountain Road until checkpoint 4 officially closes. Recovery vehicles must stay on the courses" (U.S. Dept. of Interior 1981*a*). One disabled race vehicle was seen traveling up Chemehuevi Wash toward Highway 95. Obviously, since he was out of the race, there was no incentive for him to obey the rules.

DISCUSSION

By the time the racers reached the study sites, they were well spread out and the need for passing was minimized. The race course was the quickest path and racers mostly stayed on the course. The major problems were in the spectator and pit area. The off-road driving and parking by spectators and the lack of compliance with the corridor restrictions by the pit crews were the greatest causes of habitat degradation at the north crossing of Highway 95.

The BLM (U.S. Dept. of Interior 1981*a*), in response to a question about the 1980 race stated:

> Observations from the northern crossing of Highway 95 to Chemehuevi Wash showed very little unauthorized ORV use, particularly in sensitive resource areas. BLM monitors in this area and camping spectators were reported to be well-mannered. The course was used for ingress and egress and no cross-country travel was noted.

These data show that this was not the case in 1981.

In their 1981 post-race report, the BLM (U.S. Dept. of Interior 1981*b*) reported that there were 294 vehicles at the north crossing of Highway 95 at 1200 h on race day and that "spectators spread out along the desert pavement area west and adjacent to the spectator area." This means that the 200 to 250 spectator vehicles and pit crews parked on the desert pavement area were not in a designated spectator viewing area. No mention was made in the report about the amount of cross-country travel by spectator's ORVs even though it was noted that in the California start/finish area: "Again, access appeared to have been made over existing roads and washes; cross-country travel was not evident." The BLM should report on spectator access and parking and visitor use of ORVs at all designated viewing areas.

RECOMMENDATIONS

Measures need to be taken to ensure the full implementation of mitigation measures designed to protect habitat at the north crossing of Highway 95. Following are some suggestions for improving compliance with existing mitigation measures:

1) The parking areas should be properly designated by the BLM and the edges cordoned off using ropes and wooden barricades.

2) Parking and pit crews should be restricted to the existing denuded area (Site A).

3) SCORE should make it very clear to spectators that ALL vehicles must be kept on existing roads; this includes all vehicles in official pit and spectator viewing areas, unofficial viewing areas, and start/ finish areas.

4) These rules should be enforced by either SCORE officials or BLM Rangers.

5) Violators should be cited, not just warned.

For the 1981 race, SCORE posted a $3,000 insurance bond with the BLM to insure that post-race cleanup would be completed to the BLM's satisfaction. This bond should be increased and not returned if SCORE does not control spectator and pit crew parking and ORV use. It should be made economically undesirable for SCORE to allow this type of abuse.

Sanitary facilities and trash receptacles should be required at the north crossing of Highway 95. SCORE personnel should be required to clean up the trash that is left by spectators on the day after the race, before it is blown away by the wind.

ACKNOWLEDGMENTS

I wish to thank Karen Bohuski, Tom Campbell, Lori Nicholson-Humphreys, and Tim Shields for help with the fieldwork. Kristin Berry, Mary Trotter, Lori Nicholson-Humphreys, Bev Kohfield, and Tom Campbell made numerous improvements on this paper. Holly Riggs typed the manuscript. The Desert Tortoise Council supported the project.

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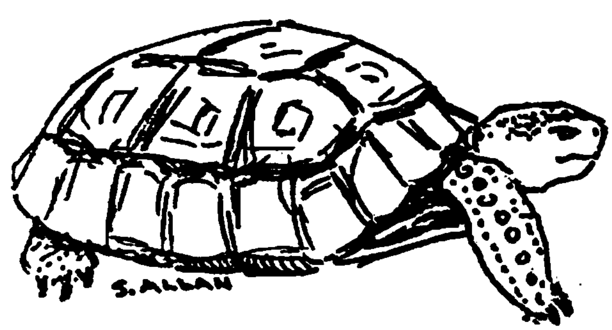

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SOME NATURAL HISTORY OBSERVATIONS OF DESERT TORTOISES AND OTHER SPECIES ON AND NEAR THE DESERT TORTOISE NATURAL AREA, KERN COUNTY, CALIFORNIA

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Abstract.—Between November 1980 and June 1981, 136 carcasses of small desert tortoises (*Gopherus agassizii*) were collected along the fenced periphery of the Desert Tortoise Natural Area in eastern Kern County, California. These tortoises ranged in size from 36 to 103 mm in carapace length and were probably killed by the Common Raven (*Corvus corax*). Most carcasses were found at wooden fence posts. Significantly more carcasses were found along the northwestern part of the fence than elsewhere ($p < 0.001$). Significantly more tortoise burrows were found along the northwestern part of the fence also, compared with numbers of burrows at two other study sites on the fence periphery. A list of miscellaneous sightings of vertebrate species is included.

While employed as a naturalist at the Desert Tortoise Natural Area (DTNA) in 1980 and 1981 (Campbell 1981, 1982), I collected some miscellaneous natural history observations on the desert tortoise (*Gopherus agassizii*) and other species on and near the DTNA. These observations include: (1) data on numbers and distributions of shell-skeletal remains, (2) known and possible causes of death of the dead tortoises, (3) censuses of tortoise burrows inside the DTNA at three locations, and (4) a vertebrate species list.

METHODS

One hundred three days were spent in the field between November 1980 and June 1981 as part of the California Department of Fish and Game's naturalist program for the DTNA (Campbell 1982). Most of the time was spent studying other subjects (Campbell 1981, 1982). The data presented here were collected during these same eight months as time and opportunity permitted.

Tortoise Shell-skeletal Remains

As part of my duties as a naturalist, I patrolled the fenced perimeter of the DTNA at least once/month on a dirt bike and on foot. The fence, which has both wooden and metal posts, covers 49.1 kilometers [= 30.5 mi] and has two breaks of 2.41 km [= 1.5 mi] on the western boundary (Fig. 1). The fence has metal posts spaced at intervals of about 4.6 m [= 15 ft]. Every 183 m [= 600 ft] the fence is buttressed by two wooden posts which are 2.4 m [= 8 ft] apart.

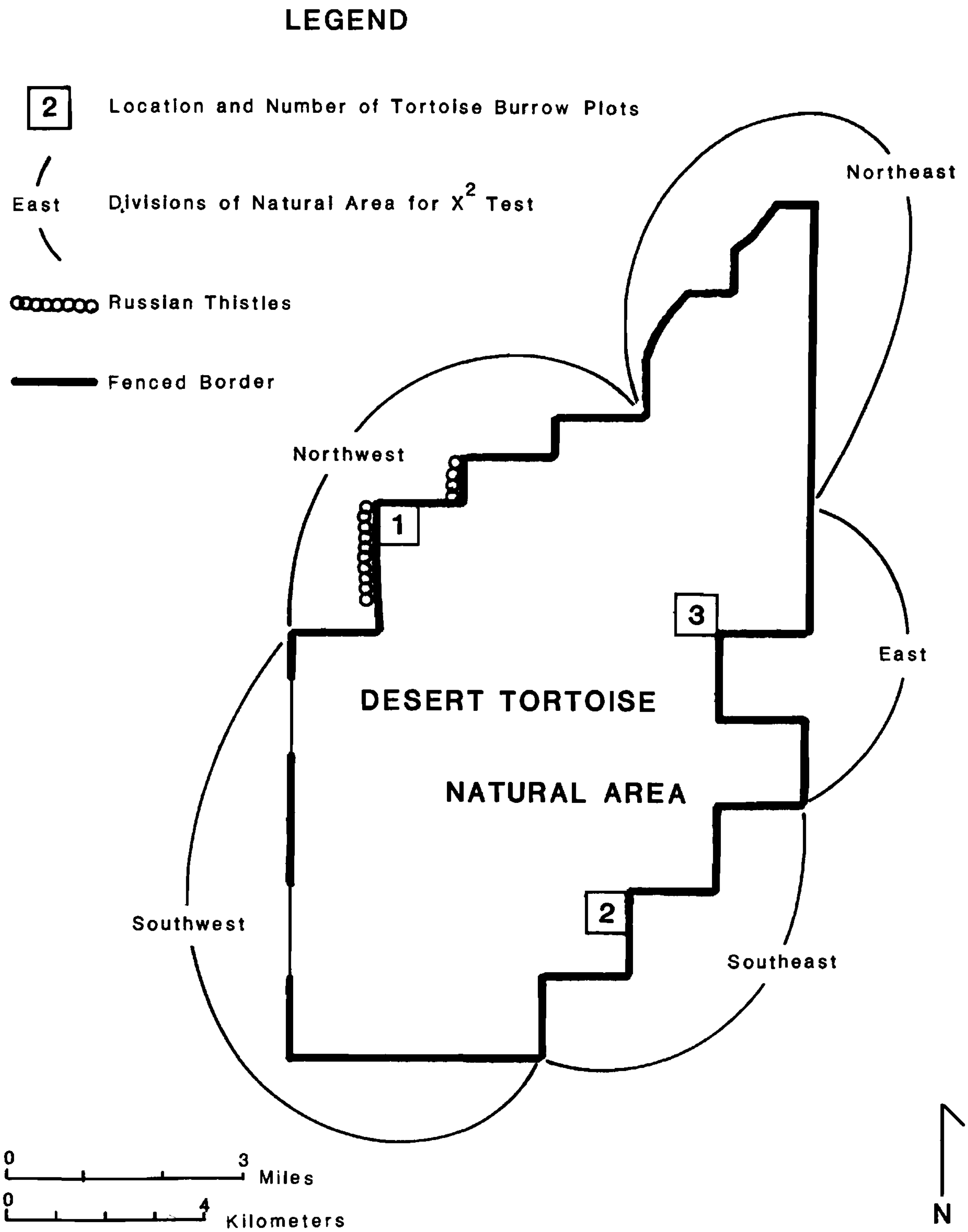

FIG. 1. — Locations for the fence, burrow study plots, and other features of interest on and near the Desert Tortoise Natural Area, Kern County, California.

During the first two months of the study, I noticed that concentrations of small tortoise shells were present around the wooden fence posts. At this time, I began to collect the shells, focusing efforts on the wooden posts. The collections were made opportunistically on a dirt bike by driving from one wooden post to the next. The area around each post was searched on foot. Over the eight-month study period, the entire fenced perimeter, with the exception of approximately 0.8 km [= 0.5 mi] in the rugged terrain of the northeastern part of the DTNA, was covered at least once. Some areas were checked more than once. While all visible shells were collected, it is unlikely that I saw them all. On the western border near the agricultural fields, large dried Russian thistles (*Salsola* sp.) were piled against the fence (Fig. 1). A three-pronged rake was used to pull thistles away from some posts. Some shells were hidden by the thistles or were tangled in them. The thistles also harbored Mojave rattlesnakes (*Crotalus scutulatus*), inhibiting careful examination of these areas. Data on each carcass were recorded on shell cards provided by K. H. Berry (Berry and Nicholson 1979). Tortoises were divided into size-age classes using Berry (1980).

A chi-square test was used to determine whether tortoise carcasses were evenly distributed along the fence. The fenced boundary of the DTNA was divided into five equal areas of 9.8 linear km [= 6.1 mi] each: (1) southwest, (2) northwest, (3) northeast, (4) east, and (5) southeast (Fig. 1). These divisions roughly coincide with both habitat types (vegetation and topography) and land uses adjacent to the fence (*see* Campbell 1982 for figure on land uses). The southwest portion contains creosote bush (*Larrea tridentata*), burrobush (*Ambrosia dumosa*), and goldenhead (*Acamptopappus sphaerocephalus*), and is cut by washes with saltbush (*Atriplex* sp.). Human uses include shooting, some vehicle traffic, and sheep grazing. The northwest portion has a creosote—saltbush community in rolling hills. It lies near the agricultural development at Cantil and the dying mesquite dune thickets. The northeast division is primarily in creosote bush scrub or alkali sink plant communities, the first type in the rugged, mountainous terrain and the second type near the edges of Koehn Dry Lake. The northeast division has intensive off-road vehicle use. The east portion is in creosote bush scrub in gently sloping terrain. Vehicle use and sheep grazing are frequent outside the fence. The southeast portion has vegetation similar to the east and southwest, but has intensive heavy human use from vehicles, general recreation, vandalism, shooting, and grazing.

Censuses of Burrows

While collecting tortoise shell-skeletal remains, I noticed that numbers of carcasses appeared to be much higher on the northwestern perimeter of the fence than elsewhere. Since tortoise burrows are usually identified easily (Berry 1974, 1975; Burge 1977), I decided to conduct censuses of burrows to determine if a relationship existed between the numbers of shells of small tortoises along the fence and numbers of burrows (and thus overall tortoise densities) adjacent to the fence. For the purposes of this study, I used Burge's (1977, 1978) definition of cover sites. The term "burrow" refers to dens, burrows, and pallets. Burge's nonburrow cover sites were not included in my definition.

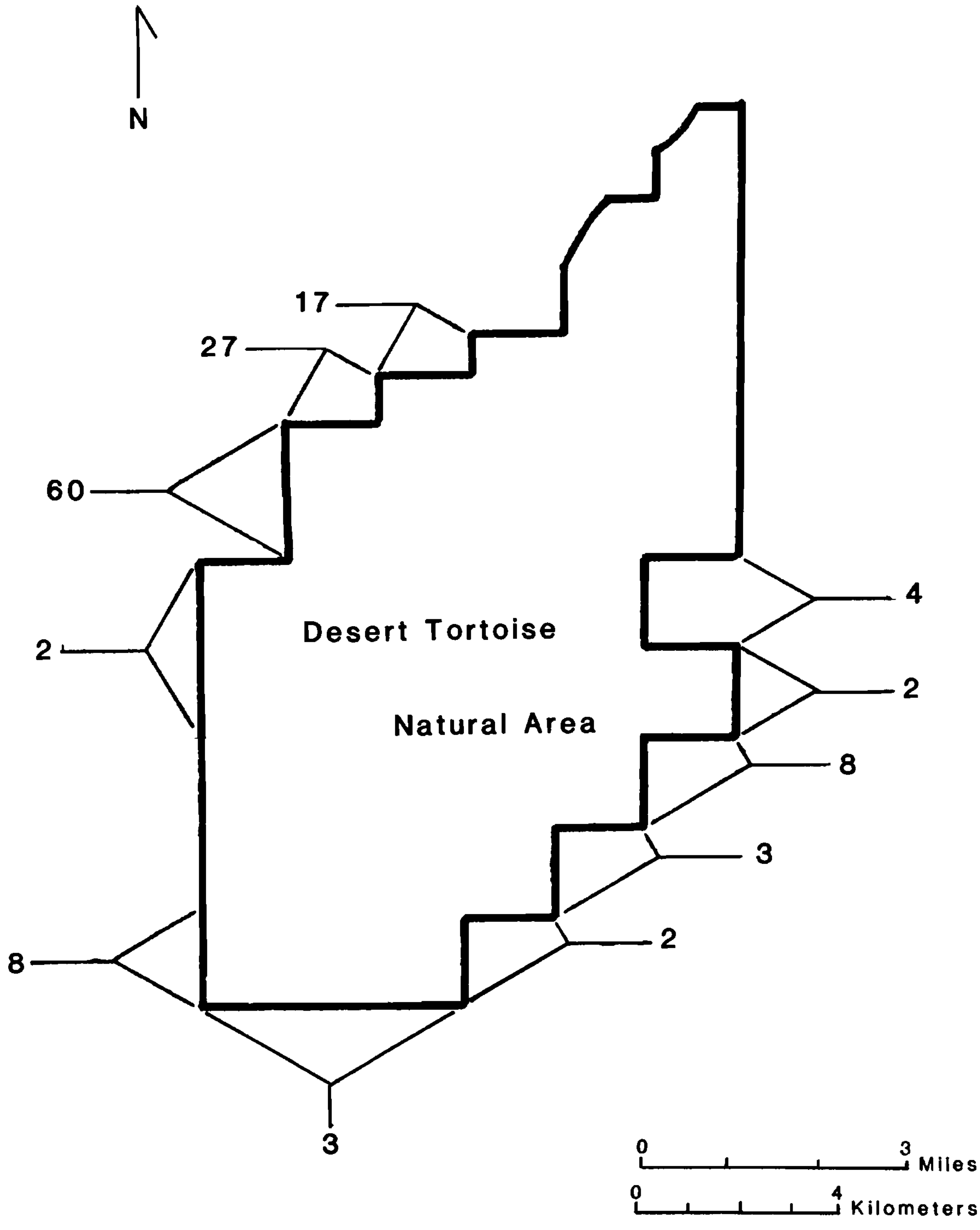

FIG. 2.—Numbers and locations of small tortoise carcasses around the perimeter of the Desert Tortoise Natural Area, Kern County, California.

Surveys of tortoise burrows were conducted on three plots inside the DTNA (Fig. 1). The first plot, located in SW¼ Sec. 5, T. 31S, R. 38E, supported saltbush on the lower slope along the fence. A nearly monotypic stand of creosote bush occurred at mid-elevations with creosote and burro bushes on the upper slopes. Soils were fine-grained, loose, sandy loams. The second plot was part of the U.S. Bureau of Land Management's (BLM) permanent study plot at the interpretive center (NE¼ Sec. 34, T. 31S, R. 38E). It supported a mixed creosote bush—burro bush vegetation and had coarse-grained sandy loam soils. The third plot also was a BLM permanent study plot in SE¼ Sec. 11, T. 31S, R. 38E. Its vegetation and soils were similar to those on plot 2. Twenty-five transects, each 100 m X 1 m, were established randomly on each plot between 16 June and 24 June. Data on the number of burrows, as well as their width, condition, and location, were recorded.

Burrow condition was classified as: (1) active, (2) inactive but usable, and (3) inactive but not usable. A usable burrow was defined as one into which a tortoise might walk or crawl to seek a retreat. It was not caved in or otherwise damaged to the point where a tortoise could not enter. Burrow locations were classified as: (1) in the open, (2) under all or part of the shrub canopy, and (3) at the base of a shrub. Chi-square tests were used to determine whether (1) burrow numbers were significantly different on the three plots, (2) numbers of active burrows were significantly different from numbers of inactive and unusable burrows on the three plots, and (3) significant differences existed in the categories of burrow locations for the three plots.

Vertebrate Species List

A list of vertebrates observed each field day was compiled and was compared with the list prepared by Berry (1978).

RESULTS

Shell-skeletal Remains

One hundred forty carcasses were collected along the fence. Of this total, four were vehicular kills or were shot (Campbell 1982). The remaining 136 were found primarily at wooden fence posts. They ranged in size from 36 to 103 mm in carapace length (CL). Of the 136, 88 or 64.7% were Juvenile 1 ($<$60 mm CL), 47 or 34.6% were juvenile 2 (60-100 mm CL), and 1 or 0.7% was an immature 1 (101-139 mm CL) tortoise. These tortoises probably were killed, eaten, and/or collected by a bird. The Common Raven (*Corvus corax*) was the most likely suspect. The wooden posts appeared to have been used as a perch or site to kill the tortoises. Some shells were pecked open. As many as 14 shells were found at one post.

The carcasses were not uniformly distributed along the fenced periphery of the DTNA (Fig. 2). Significantly more were found along the northwest fence portion near the agricultural fields than elsewhere ($X^2_{df=4} = 248.1$, $p < 0.001$;

TABLE 1.—Chi-square test for uniformity of distribution of small tortoise carcasses at the perimeter fence of the Desert Tortoise Natural Area, Kern County, California.

Divisions of Natural Area fence		No. of tortoise carcasses		X^2
		Observed	Expected	
Northwest		104	27.2	216.7
Northeast		0	27.2	0
East		6	27.2	16.5
Southeast		13	27.2	7.4
Southwest		13	27.2	7.4
	Totals	136	136.0	248.1

see Table 1). None were found along the northeastern portion, which is generally rocky and mountainous or is in the alkali sink plant community bordering Koehn Dry Lake.

Censuses of Burrows

A chi-square analysis of the number of burrows found on each of the three study plots revealed significant differences ($X^2_{df=2} = 8.86$, $p < 0.025$). Plots 1 and 3 contributed to the X^2 value. Plot 1, adjacent to the area with the high numbers of dead tortoises along the fence, had more burrows than the other two plots, and plot 3 had fewer. No significant differences were found between numbers of active burrows and inactive or unusuable burrows on the three plots ($X^2_{df=2} = 3.50$). There were no significant differences between the three plots in the three categories of burrow locations ($X^2_{df=4} = 5.52$).

Vertebrate Species List

No new species were added to the existing reptile lists for the DTNA (Berry 1978). Sixteen new species of birds were observed: Snowy Egret (*Egretta thula*), Blue-winged Teal (*Anas discors*), Black-shouldered Kite (*Elanus caeruleus*), Cooper's Hawk (*Accipiter cooperii*), Whimbrel (*Numenius phaeopus*), Common Barn Owl (*Tyto alba*), Great Horned Owl (*Bubo virginianus*),

TABLE 2.—Vertebrate species observed on and near the Desert Tortoise Natural Area from November 1980 through June 1981.

REPTILES	
Desert Tortoise	*Gopherus agassizii*
Chuckwalla	*Sauromalus obesus*
Zebra-tail Lizard	*Callisaurus draconoides*
Leopard Lizard	*Gambelia wislizenii*
Desert Spiny Lizard	*Sceloporus magister*
Side-blotched Lizard	*Uta stansburiana*
Desert Horned Lizard	*Phrynosoma platyrhinos*
Western Whiptail Lizard	*Cnemidophorus tigris*
Red Racer	*Masticophis flagellum*
Gopher Snake	*Pituophis melanoleucus*
Long-nosed Snake	*Rhinocheilus lecontei*
Sidewinder	*Crotalus cerastes*
Mojave Rattlesnake	*Crotalus scutulatus*
BIRDS	
Snowy Egret	*Egretta thula*
Blue-winged Teal	*Anas discors*
Turkey Vulture	*Cathartes aura*
Black-shouldered Kite	*Elanus caeruleus*
Cooper's Hawk	*Accipiter cooperii*
Red-tailed Hawk	*Buteo jamaicensis*
Rough-legged Hawk	*Buteo lagopus*
Ferruginous Hawk	*Buteo regalis*
Golden Eagle	*Aquila chrysaetos*
Northern Harrier	*Circus cyaneus*
Prairie Falcon	*Falco mexicanus*
American Kestrel	*Falco sparverius*
Gambel's Quail ?	*Callipepla gambelii*
Whimbrel	*Numenius phaeopus*
Mourning Dove	*Zenaida macroura*
Greater Roadrunner	*Geococcyx californianus*
Common Barn-Owl	*Tyto alba*
Great Horned Owl	*Bubo virginianus*
Burrowing Owl	*Athene cunicularia*
Long-eared Owl	*Asio otus*
Common Poorwill	*Phalaenoptilus nuttallii*
Lesser Nighthawk	*Chordeiles acutipennis*
Vaux's Swift	*Chaetura vauxi*
White-throated Swift	*Aeronautes saxatalis*
BIRDS (continued)	
Western Kingbird	*Tyrannus verticalis*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Say's Phoebe	*Sayornis saya*
Horned Lark	*Eremophila alpestris*
Violet-green Swallow	*Tachycineta thalassina*
Common Raven	*Corvus corax*
Rock Wren	*Salpinctes obsoletus*
Northern Mockingbird	*Mimus polyglottos*
LeConte's Thrasher	*Toxostoma lecontei*
Hermit Thrush	*Catharus guttatus*
Loggerhead Shrike	*Lanius ludovicianus*
European Starling	*Sturnus vulgaris*
Yellow-rumped Warbler	*Dendroica coronata*
Townsend's Warbler	*Dendroica townsendi*
Western Meadowlark	*Sturnella neglecta*
Brewer's Blackbird	*Euphagus cyanocephalus*
House Finch	*Carpodacus mexicanus*
Northern Oriole	*Icterus galbula*
Western Tanager	*Piranga ludoviciana*
Lesser Goldfinch	*Carduelis psaltria*
Black-throated Sparrow	*Amphispiza bilineata*
Dark-eyed Junco	*Junco hyemalis*
White-crowned Sparrow	*Zonotrichia leucophrys*
Song Sparrow	*Melospiza melodia*
MAMMALS	
Antelope Ground Squirrel	*Ammospermophilus leucurus*
Audubon Cottontail	*Sylvilagus auduboni*
Badger	*Taxidea taxus*
Black-tailed Jackrabbit	*Lepus californicus*
Botta Pocket Gopher	*Thomomys bottae*
Coyote	*Canis latrans*
Deer Mouse	*Peromyscus* sp.
Desert Kit Fox	*Vulpes macrotis*
Desert Woodrat	*Neotoma lepida*
Grey Fox	*Urocyon cinereoargenteus*
Little Pocket Mouse	*Perognathus longimembris*
Merriam Kangaroo Rat	*Dipodomys merriami*
Southern Grasshopper Mouse	*Onychomys torridus*
Western Pipistrelle	*Pipistrellus hesperus*

Long-eared Owl (*Asio otus*), Vaux's Swift (*Chaetura vauxi*), White-throated Swift (*Aeronautes saxatalis*), European Starling (*Sturnus vulgaris*), Brewer's Blackbird (*Euphagus cyanocephalus*), Dark-eyed Junco (*Junco hyemalis*), and Song Sparrow (*Melospiza melodia*). The presence of the western pipistrelle (*Pipistrellus hesperus*) was confirmed also. (*See* Table 2).

DISCUSSION

Ravens appear to be killing small desert tortoises. The highest numbers of carcasses were found along the fence in the northwestern part of the Natural Area. One possible reason for the high numbers here is that numbers of small tortoises are higher inside or outside the fence. The significantly higher burrow counts for tortoises on the study plot on the same area, compared with similar counts in the eastern and southwestern parts of the Natural Area, support this hypothesis. If higher numbers of adults are present, more adult females could be producing more young individuals.

Another possible explanation is that Ravens are in higher numbers or search the fenced perimeter more frequently and intensively in the northwestern sector than elsewhere. The northwestern sector is closer than the other sectors to the agricultural fields, telephone and power poles, human habitation, large trees (*Tamarix aphylla*, *Populus fremontii*), and paved roads with carrion — all of which might be more attractive to Ravens than open desert.

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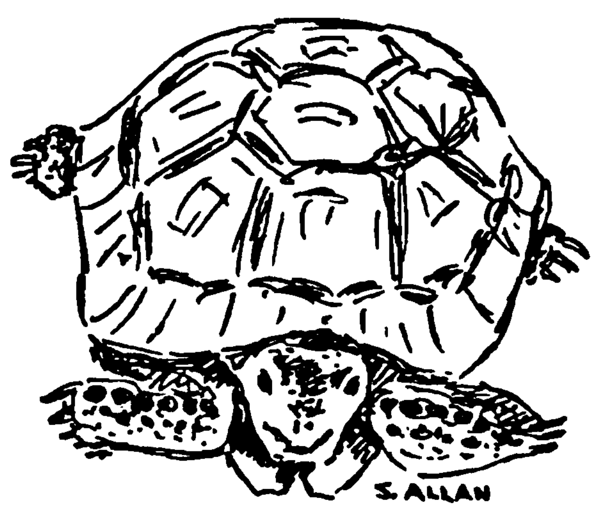

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PUBLIC PARTICIPATION AND THE BUREAU OF LAND MANAGEMENT'S GRAZING PROGRAM: MYTH AND REALITY

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Thank you for inviting me as a representative of the Natural Resources Defense Council, Inc. (NRDC) to address the Desert Tortoise Council on the issue of public participation in the Bureau of Land Management's (BLM's) grazing program. NRDC is a nonprofit, environmental organization with a longstanding commitment to improving the BLM's management of the public lands. Our successful 1974 lawsuit, *NRDC* v. *Morton*, forced the BLM for the first time to analyze the environmental effects caused by livestock grazing in specific areas throughout the western states and to propose specific solutions to existing problems. The environmental impact statement (EIS) process initiated as a result of the litigation constitutes one of the basic vehicles for public participation in BLM grazing decisions. Today, I will describe the framework for public participation in the BLM's grazing EIS and land use planning processes, and will emphasize the importance of using these opportunities for participation to protect environmental and wildlife values, in spite of the difficulties and frustrations that such efforts necessarily entail.

I. The Importance of Public Participation

When the BLM refers to the importance of "public" participation in rangeland management, more often than not the agency is referring to livestock permittees and others who benefit economically from their use of the public lands. This does not mean, however, that there are no opportunities for groups like the NRDC and the Desert Tortoise Council, state and local officials, and private individuals concerned about environmental values to participate in rangeland management. There are a number of avenues, both formal and informal, through which the non-ranching public can significantly affect BLM decision-making on behalf of environmental, wildlife, and other values. While the process is often difficult, time consuming, and extremely frustrating, our experience demonstrates that participating in the BLM's planning process is often the only way to ensure that environmental values, including the interests of the desert tortoise, are not ignored.

Public participation in BLM planning is important in order to ensure that the agency is aware of a full range of viewpoints. In an agency like the BLM where most management decisions are reached at the local level, personal contacts and informal meetings with BLM staff are often the best way to have an impact on decision-making. Most of the people directly affected by BLM grazing decisions are private ranchers with an economic stake in continuing to graze livestock on the public lands. Because of their economic interests, ranchers are in frequent contact with BLM staff. Thus, unless someone makes the effort to contact BLM staff on behalf of environmental values, the BLM will be lobbied exclusively by the livestock industry, and BLM decisions will in all likelihood be tilted in favor of livestock grazing. Vigorous participation by advocates of the desert tortoise and other non-livestock values may result in better, more environmentally sensitive decisions.

Even where BLM decisions are not substantively improved as a result of public participation, such participation plays an important role in the political process. As a legal matter, it is essential to argue a position before the agency prior to going to the courts to assert that the agency has failed to do its job correctly. When necessary, groups like the NRDC are willing to litigate in order to protect environmental values. However, the courts will defer to the agency's expertise unless the agency has ignored public comments or failed to make a reasonable decision in light of all information available to it. Thus, in order for litigation to be successful, it is essential that groups like the Desert Tortoise Council and others with an interest in improving BLM management make the strongest possible factual case before the agency.

The BLM's range management and planning decisions should be an important focus for those concerned about the desert tortoise. Much of the desert tortoise's habitat is under the BLM's jurisdiction. The BLM's planning and grazing EIS processes are designed, in theory, to generate information relevant to a decision and to allow all viewpoints to be heard, so that the agency can establish policies, objectives, and constraints for "multiple use" land management. Land use plans, in principle, are comprehensive documents that guide future management decisions. Thus, participation at this stage of BLM decision-making is critical.

Lack of information about the desert tortoise can be as threatening to the tortoise as BLM unwillingness to take necessary protective or mitigation measures. Without detailed scientific information about the desert tortoise, knowledge of competing uses that threaten its habitat and population viability, and awareness of the public's concern for the desert tortoise, the BLM may simply be unable, as well as unwilling, to make sound multiple use decisions. For this reason, those concerned about the tortoise should use the BLM planning process to provide such information and to make their concerns known.

Excessive and inadequately controlled livestock grazing can have serious adverse effects on the desert tortoise, including the following: (1) competition for limited forage, especially during the spring when the female desert tortoise requires essential nutrients; (2) damage and destruction of desert tortoise burrows and small tortoises by livestock; and (3) damage and destruction of perennial shrubs used by desert tortoises for shelter (Berry 1978). In addition, other activities on BLM lands, such as off-road vehicle use, mineral exploration, and the sale of the lands, can cause extreme destruction of desert tortoise habitat.

The BLM's land use planning and grazing EIS processes are the means through which competing uses of the public lands are reconciled and the adverse effects of livestock grazing and other economic uses of the lands analyzed. The decisions reached through these processes include the amount and conditions of livestock grazing, the allocation of forage between livestock and other wildlife, including the desert tortoise, and the permissible and impermissible uses of specific areas of the public lands. In the absence of environmentally sound planning, the likely result will be a domination of the public lands by the economic users such as livestock ranchers and well-organized recreational concerns, such as ORV groups, and the continued deterioration of the public lands for all other uses.

II. The Regulatory Framework for Public Participation

Before the 1970s, the BLM's public land management was largely ad hoc and heavily biased in favor of the livestock industry. No specific procedures existed to ensure BLM consideration of factors other than maximizing livestock grazing. While it was clear that serious resource deterioration had occurred as a result of overgrazing and other improper grazing practices, very little site-specific inventory information was available to document this harm. The Bureau lacked the kinds of detailed information about numbers of wildlife and critical wildlife habitat that are necessary to take actions to protect and preserve these interests. As a result, land use plans, to the extent they existed at all, were based on inadequate data and failed to impose meaningful constraints on livestock grazing activities.

Congress has since taken several steps to ensure that the BLM considers environmental factors and allows the public to play a meaningful role in the BLM's decision-making processes. Two principal laws are applicable to BLM planning. First, in 1969, Congress passed the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq.*, requiring the BLM and other federal agencies to analyze the environmental impacts of major federal actions having a significant effect on the environment. Second, in 1976, Congress passed the Federal Land Policy and Management Act (FLPMA), 43 U.S.C. § 1701 *et seq.*, requiring the BLM to engage in comprehensive land use planning and to allow the public to play a role in the planning process. (Copies of these provisions of the United States Code may be obtained through your Congressman or at the library.)

A. The National Environmental Policy Act

Congress passed NEPA in order to inject environmental considerations into the decision-making process of all federal agencies. NEPA requires preparation of an EIS for major federal actions, whether a discrete project like power plant construction or a major program like oil leasing or grazing. The EIS must analyze the proposed action and alternative ways of achieving the action's objectives, and compare the environmental costs and benefits of the proposed action and the alternatives. The EIS must also consider the possibility of "no action," i.e., abandoning the project entirely. NEPA is designed to ensure that environmental factors — including wilderness, wildlife, recreation, and public health — are thoroughly considered before decisions having a significant environmental impact are made. In furtherance of this purpose, NEPA provides the public with formal opportunities to contribute to decision-making, and ensures that the public has the information necessary to make an independent assessment of the project. Overall, NEPA was intended to prevent stubborn environmental problems and the interests of the public from being largely ignored.

The BLM's implementation of NEPA was slow to develop. While the authorization of livestock grazing on some 175 million acres of public land was causing serious environmental harm, the agency had completed no comprehensive assessment of the environmental impacts of such grazing on specific areas. In response to pressure from NRDC and other groups, the BLM in 1973 prepared a single EIS that purported to analyze the impacts of the entire grazing program. Believing that this EIS was too broad and generalized to meet NEPA's purposes, NRDC and several other environmental groups filed a lawzuit in 1973 to force the BLM to prepare site-specific grazing EISs. *NRDC* v. *Morton*, 388 F. Supp. 829 (D.D.C. 1974).

The NRDC lawsuit was filed to achieve a number of specific goals. First, reports by the Council on Environmental Quality and other agencies demonstrated that the resources of the public lands had been seriously abused because of improper livestock grazing; half of the lands were shown to be in unacceptable condition, and suffered from accelerated soil erosion, destruction of wildlife habitat, and other serious environmental problems. It was argued that compliance with NEPA would, at a minimum, generate specific information to document these effects. Second, NRDC believed that site-specific EISs would help the BLM to improve resource conditions and to allow it to make necessary changes in management of livestock. The goal was not to eliminate livestock grazing entirely, but rather to improve livestock management and eliminate it in selected areas in order to avoid adverse effects to wildlife and other environmental resources. Finally, the NRDC lawsuit was an attempt to change attitudes within the BLM — to force the agency to recognize that the public lands were valuable for more uses than just livestock grazing and mining.

As a result of the NRDC lawsuit, the BLM was ordered in 1974 to prepare approximately 144 site-specific EISs analyzing the adverse impacts of grazing. The court's opinion emphasized that serious deterioration of the public lands had been caused by overgrazing, and ordered the BLM to analyze in the EISs how much grazing should take place, where it should take place, and under what conditions. The court also ordered the BLM to analyze alternative grazing levels and practices to achieve various resource objectives. Finally, the court stressed NEPA's objective of ensuring effective public participation in agency decision-making, and noted that in the absence of site-specific EISs, there were no effective opportunities for such participation. Thus, as interpreted by the court, NEPA promised to provide an effective means for the non-livestock public to have a meaningful impact on BLM range decisions.

B. The Federal Land Policy and Management Act

While NEPA was enacted with the purpose to inject environmental considerations into all federal agency decision-making processes, the Federal Land Policy and Management Act (FLPMA) was directed specifically to the BLM. FLPMA was enacted in 1976 in order to change "business as usual" at the BLM, and to promote uses of the public lands other than livestock grazing and mineral development. FLPMA requires the BLM to make range decisions pursuant to comprehensive land use planning, taking into account a diversity of public land values. 43 U.S.C. § 1712. These plans must comply with the principles of multiple use and sustained yield, and must ensure that unnecessary environmental degradation does not take place. *Id.* §§ 1712(c)(1), 1732(b). Congress explicitly cited the BLM's duty to consider wildlife, soils, vegetation, and recreational and scenic values in the land use planning process. *Id.* § 1701(a)(8).

FLPMA contained several specific directives mandating public participation in the BLM's decision-making process. The BLM was required to develop, maintain, and revise land use plans incorporating public involvement in both the preparation and implementation of the plans. 43 U.S.C. §§ 1712(f), 1739(e). State and local governments were also given an explicit role in this process. The public was allowed not only to comment on BLM proposals, but also to propose appropriate BLM actions. Thus, FLPMA reinforced the public participation directives of NEPA, and created an independent substantive requirement that the BLM protect and improve resource conditions.

The BLM's response to FLPMA, like its response to NEPA, was quite slow to develop. Although the Act was passed in 1976, regulations to establish land use planning and public participation were not enacted until 1979. 43 C.F.R. Part 1600 (1980). These regulations spelled out a significant public role in BLM planning and also provided a comprehensive framework for the development of land use plans. The regulations were designed to ensure that environmental considerations are provided for in management decisions and to tailor such decisions to specific problems. In addition, the regulations required the BLM to prepare an environmental impact statement analyzing the effects of implementating the land use plan. Thus, the regulations integrated the EIS and planning processes by requiring the BLM to consider various potential land use plans and to analyze the environmental consequences of implementing each of the alternatives. This process created a framework in which the BLM could formulate environmentally sensitive land use plans to govern livestock grazing and all other uses of the public lands.

C. Opportunities for Public Participation

The regulatory process for BLM planning established under FLPMA and NEPA provides a number of formal means for participating in BLM decision-making. The public should become involved as early as possible by getting on the BLM's mailing list for the areas that particularly interest them. (Appendix A contains a list of addresses of BLM district offices within the range of the desert tortoise.) For many state and federal agencies this happens automatically. Once a person is on the mailing list, he or she will receive notice of an opportunity to participate in five formal stages of BLM decision-making:

1) Scoping — the identification of issues for consideration in the land use planning process. For example, issues might include the conflict between desert tortoises and livestock, the conflict between off-road vehicle use and the desert tortoise, and special management actions, such as designation of areas of critical environmental concern, needed to protect tortoise habitat.

2) Commenting on planning criteria — these criteria are statements of principle for resolving conflicts between potentially competing resource uses. For example, one criterion might be to resolve conflicts between livestock and desert tortoises by reducing or eliminating grazing in identified critical desert tortoise habitat.

3) Commenting on the draft environmental impact statement and draft land use plan — these EISs and plans are often complex and difficult to follow. However, it is absolutely necessary to read and consider the documents. A person should look for the presence or absence of specific proposals and alternatives that would address the problems that he is concerned about. The draft EIS and plan should contain specific proposals and actions, not just motherhood statements like "improve desert tortoise habitat." The preferred alternative should resolve the resource issues in a satisfactory way.

4) Protesting the plan — after a final plan is chosen, the public has a right to make a formal protest of any decisions (or failures to make decisions) that they consider objectionable. Such provisions will not be put into effect until the protest is resolved.

5) Comments on plan amendments — the public may comment on any proposed amendments to the plan that are made in the future. In effect, the amendment process is similar to the process used to create the original land use plan.

In addition to these formal means for public participation, there are a number of informal means that should be used to have an impact on BLM decision-making. While BLM policies are formulated in Washington, D.C., they are implemented by district and area managers and other BLM staff located throughout the western states. To be effective, a person should get to know the local BLM staff on a personal basis and make sure that his concerns are communicated as frequently and professionally as possible. Informal presentations, tours of critical wildlife habitat, and other opportunities for dialogue should be followed. Otherwise, the BLM will hear only from the livestock industry, and its decisions will tilt predictably in its direction.

III. Public Participation and the BLM: Myth and Reality

NEPA and FLPMA established a sound framework for public participation in BLM planning. Under the Carter administration, the BLM moved perceptibly toward improved management of the public lands. A number of grazing EISs were prepared with substantial public involvement, including specific proposals to modify existing grazing practices in order to promote environmental values. The EIS process forced the BLM to collect specific data on resources, wildlife, and wildlife habitats; these data were presented in the EIS and provided an essential informational base for future public land management. The EIS process also succeeded in generating increased public enthusiasm and interest in BLM management, and in forcing the agency to consider interests other than those of the livestock industry.

Under the Reagan administration, however, this progress has been thwarted and actions have been taken to return control of range management to the livestock industry. The Director of the BLM, Robert Burford, is a former BLM permittee on the public lands. Interior Secretary Watt represented livestock interests in legal challenges to the Bureau's past efforts to improve rangelands. Under Reagan, the environmental and wildlife community has been largely ignored during BLM decision-making processes. Essentially, Watt and Burford seek to return to the situation before the 1970s when the ranchers in effect ran the BLM.

The Reagan administration has taken a number of actions to circumvent the planning and public participation processes required by Congress. In 1981, the BLM proposed amendments to its land use planning regulations. 46 Fed. Reg. 57448 (Nov. 23, 1981). The revisions were purportedly designed to eliminate "burdensome, outdated and unneeded provisions." However, the effect of the revisions would be to slash opportunities for public participation, and to limit the public's role to reacting to rather than formulating policy. The public would still be able to appeal decisions, but would have a far reduced opportunity to have input into the formulation of those decisions. NRDC and many other groups filed detailed comments objecting to the regulations, and at this time they have not been finalized. While the old 1979 regulations are still officially in force, many of the proposed changes have informally been implemented.

Another major move by the Burford BLM has been to modify the composition of the multiple use advisory boards. These boards are designed to represent a broad spectrum of interests and to ensure that the BLM hears from all sides of an issue in making decisions affecting the public lands. In a blatantly political move, the Reagan administration has purged most of the Democrats from the multiple use boards.

The BLM has also made a number of environmentally destructive changes in its grazing policies and regulations. One policy would allow the BLM to delay any changes in current management until after three to five years of monitoring data have been obtained. While monitoring data are useful to review the implementation of decisions, they are not necessary to demonstrate that adjustments in grazing use may be needed to prevent conflicts with the desert tortoise or to improve range conditions. In effect, the BLM will delay any changes in existing livestock grazing indefinitely, even if current practices are clearly causing rangeland deterioration. This is a policy of doing nothing to protect the public lands, in violation of FLPMA's requirements.

The BLM also has watered down the grazing EISs so that they no longer include information necessary to formulate and implement changes in management practices. While the EISs demonstrate that resource conditions desperately need improvement, the EISs lack the specific data necessary to implement proposals to remedy these problems. The sole alternative is to take no action, which is the intent of the Burford BLM.

In spite of these politically motivated changes, it is critical not to abandon the public lands. While the Burford BLM is trying to push the non-ranching public out of the grazing decision-making process, we must demonstrate to the agency that there are still people who care about the land and its resources and are willing to fight to ensure environmentally sound decisions. In addition, there are many BLM professionals who are concerned about wildlife and environmental values and who are striving to make responsible decisions in spite of changes in policy. Effective public participation will provide much needed support to these professionals. Participation by state and federal agencies in BLM decision-making is particularly critical, since they are given more credence under the current administration than environmentalists, who are by definition labeled "extremists."

NRDC stands ready to coordinate and organize public participation in BLM range decision-making. Though limited resources preclude us from commenting on all grazing EISs and land use plans, we are monitoring the situation and are determined to keep the process meaningful. NRDC is also determined to prevent livestock interests from destroying the public lands, and we look forward to working with groups such as the Desert Tortoise Council, state and federal employees, and other interested individuals who share our concern for the public lands.

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APPENDIX A.—Bureau of Land Management (BLM) District Offices within desert tortoise habitat.

ARIZONA:

Phoenix District Office
Marlyn Jones, District Manager
2015 West Deer Valley Road
Phoenix, AZ 85027

Safford District Office
Lester K. Rosenkrance, District Manager
425 E. 4th Street
Safford, AZ 85546

Yuma District Office
J. Darwin Snell, District Manager
P.O. Box 5680
Yuma, AZ 85364

Arizona Strip District Office
G. William Lamb
196 East Tabernacle
St. George, UT 84770

CALIFORNIA:

California Desert District Office
Gerald Hillier, District Manager
1695 Spruce Street
Riverside, CA 92507

NEVADA:

Las Vegas District Office
Kemp Conn, District Manager
P.O. Box 26569
Las Vegas, NV 89126

UTAH:

Cedar City District Office
Morgan S. Jensen, District Manager
P.O. Box 724
Cedar City, UT 84720

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GRAZING AND ECONOMICS IN THE ARID WEST

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When the color pictures beamed back from the surface of Mars were printed in *Time* magazine, a Texas rancher was quoted as saying that the red, lifeless plains of Mars looked like his own grazing lands. In jest, the rancher had said far more than he realized. For much of the nation's western lands, a similar comment could also have been made. A living land is at the base of everything we call good on this overburdened earth. Clothed with vegetation, whether of Sonoran Desert or rain forest, the land evolved with its characteristic wildlife over a time span incomprehensible to man.

In the desert that surrounds Tucson, all native plants and animals have adapted beautifully to the exacting requirements of a land that is bewildering in its rapid changes from hot to cold, from aridity to torrential downpour. In this boom-and-bust ecosystem, the desert plants and animals mirror in their genes the heredity of their successful ancestors: roots that go deep for permanent water, shallow roots that can use the brief shower, leaves that are shed due to heat (not cold), and seeds that will not sprout unless a chemical growth inhibitor is washed away. The list of adaptations is long, the strategy for survival wondrous.

Yet this land is easily harmed. The seeming armor of spines and scales and claws is actually very vulnerable. Plants that appear to have so much empty soil between them are competing for water, and their roots face the seemingly empty spaces beneath the sun-baked earth, the competition brutal and unending.

Any thoughtful observer will soon realize there are no empty niches in this living land. Any plant or animal that is introduced takes the space that is needed by another already there. When that animal is a 1,000-pound herbivore that gives birth to a calf, the consequences for the other living things are obvious. The cow, a domestic beast, is under the care of man. The rancher will "develop" surface water for his cattle and will feed them when their desert pasture is denuded due to what he calls "drought." By insulating his cattle from the self-protective mechanisms of the desert, he has short-circuited the whole ecosystem. The native herbivores during these times of natural stress either wait it out or die; when the resurgence comes with the rains, their reproductive capacity allows them to recover. The native plants have similar abilities.

After the coming of the cattlemen, however, recovery of the desert from natural drought was much more difficult. When grasses are eaten down for too long, the root systems shrink. There are not enough green blades to photosynthesize the energy from the sun. Plants, after all, must grow for their own sake first; they become what the cattlemen call "forage." As the roots decrease in volume, their ability to hold the soil in place also suffers. The summer rains strike the exposed thin soil. Instead of soaking into the thick mat of interlaced roots, the water runs unimpeded over the ground, and an arroyo is born. As an earthmover, the cow has no peer in the arid West.

Any suggestion of permanent cattle removal from the Southwest causes understandably strong reactions from the ranching communities. The chief objective, always and forever, will be a sentence containing the phrase "food and fiber." The western rancher would have us believe that without grazing 99% of the state land, or 92% of the lands administered by the Bureau of Land Management (BLM), there would be a beef shortage. The facts say otherwise. So that the rancher can ranch, the BLM has constructed (mostly at public expense), fences, cattleguards, wells, windmills, storage tanks, watering troughs, and spring developments. The federal government also kills wildlife that eats an occasional sheep or cow, offers low cost drought or flood relief loans, weed eradication, and much more. Despite these expenditures, totaling nearly $12 million more than receipts from grazing fees, BLM land produced less than 3% of the nation's beef. In the four most arid southwestern states (Arizona, Utah, Nevada, and New Mexico), BLM cattle production totaled less than 0.7% of U.S. beef production (U.S. Department of Interior 1978).

The real consumer impact of such subsidies lies in the fact that they tend to cause less production elsewhere in the U.S. (Handwers 1980). Because the lands not subsidized are far more productive (Iowa, Nebraska, Missouri, etc.), their underutilization due to market advantages enjoyed by a tiny minority of western ranchers is devastating for the consumer. The original subsidy, intended to boost production, has the opposite effect, and the consumer pays twice. Even with today's unfair economic advantage, the states of Nebraska, Kansas, Missouri, Oklahoma, Texas, and Iowa EACH produce more cattle than all BLM lands combined in the eight mountain states (Montana, Idaho, Colorado, Wyoming, Arizona, New Mexico, Utah, and Nevada).

The irony is that the amount of beef in question is so small that it would not even be missed in the marketplace. If all cattle were removed from BLM land in the four states inhabitated by the desert tortoise, the nation would still produce about 99.99% of its beef. Indeed, such land is incapable of supporting the few ranchers now leasing it.

Finally, it must be remembered that even the above low level of production occurred on overgrazed land. In fact, the BLM currently estimates that 81% of its public land in the 10 Western states is in fair to poor condition. Therefore, even the tiny amount of beef now being produced is at the expense of the land, and therefore is being subsidized by all of us. A subsidy consisting only of money is of no permanent consequence. When that subsidy consists of the destruction of one of most basic resources, the land, the situation can only be seen as irrational, even insane.

Overgrazing is not just a problem of the past. It continues today, and it hurts all of us, whether we live in the paved-over desert of the city or out in what remains of the Sonoran or Mohave ecosystems. When one lives in a land where the water out of the faucet has not felt the sun in thousands of years, the source of that water must be appreciated. The very act of drinking Tucson's fossil water should carry with it an awareness that the past makes possible the present. The future that is yet to come cannot be left solely in the hands of the ranchers and the land management agencies. The public that finds beauty and pleasure in living things other than cattle must make its presence felt.

There are ranchers who are true stewards of the land, but they seem either a distinct minority or a very silent majority. Seldom will a stockman acknowledge that overgrazing is a problem today. He will blame drought, burros, off-road vehicles, hunters and/or environmentalists for his problems, but almost never overgrazing. In my opinion, continued cattle overuse of the arid Southwest is inevitable. There simply is not enough plant cover to support enough cattle to make a living unless the desert becomes a cattle monoculture. The profit motive will not allow the rancher to adjust cattle numbers to a level low enough that erosion is arrested, plants recover, and the wildlife comes back. Indeed, there is growing evidence that in much of the Southwest, any grazing is overgrazing.

The power of the rancher who holds a federal grazing lease is greatly increased by banks and other lending institutions. Because such leases are granted for 10 years, are almost never cancelled, and are priced far below grazing rates on private property, such lands have acquired a high market value, against which the rancher may borrow for operating capital.[1/] Because the rancher may own only 40 to 160 acres of "his" 10,000-acre ranch, most of the value of the ranch is usually found in the federal lands under lease. When sold, the ranch goes with the grazing leases completely transferable.

In such a system, grazing reform is nearly impossible. If the BLM attempts to reduce the number of cattle grazed on public land of a given ranch, the bank immediately lowers the ranch's loan value, and the sale price goes down. Today's average rancher is in his late 50s, and the eventual sale of the ranch is the path to retirement. Anything that lowers its value is therefore strenuously opposed.

The southwestern rancher paid the BLM an average of only 12.7 cents per acre per year for grazing in 1978 (last year available). When the cattle were sold, however, the same acre earned for the rancher an income of $3.42. Of course, this profit is in addition to the aforementioned construction work, low cost loans, weed eradication, etc. In return for this high level of public subsidy, we often hear about the importance of maintaining the lifestyle of the rancher, that it is socially acceptable to subsidize such a rugged, independent way of life (Broly 1980). Most of the federal subsidy, however, does not go to the small family rancher. Three percent of the ranchers control 38% of the public land. Only 19% of the Animal Unit Months (AUMs) go to the 72% of the ranchers at the small end of the scale.

Wagner (1978) calculated that wildlife in presettlement times consumed

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1/ Market Values of Federal Grazing Permits in New Mexico, N.M.S.U. Coop Ext Service, Range Imp. Task Force, Report #2.

about 80 million AUMs in the 17 western states, a level that still maintained a climax vegetation. Today, cattle in the 17 western states consume about 282 million AUMs (including all land). Though domestic sheep have declined drastically in the west, the cow that has replaced them eats five times as much food, and today's cattle are 25% larger than those at the turn of the century. At this time, Wagner says that ". . . private lands may be experiencing some of the heaviest pressures they have received in the history of the west."

Public lands, as we all know, are lands nobody wanted in the early days (Sheridan 1981). The land that became private land was the chosen land, land with water, grass, and timber. Today, an average of 67.9% of the non-federal rangelands are in fair to poor condition. Even Montana, with the best record, has 46% of its land in fair to poor condition. I bring this up only to show the absurdity of the frequently heard comment that no rancher would abuse the land from which he makes his living. It's a frightening thing to realize that private lands, which started at a much higher productive level, are in nearly the same condition as the federal lands.

The deserts around Tucson and Phoenix look good now, nice and green with ephemerals. It reminds me of a comment made by naturalist Denzel Ferguson of the Malheur National Wildlife Refuge in Oregon. "That's what people always say when they see green. It's well intended, I know, but it's as if people visiting San Francisco saw a bunch of wharf rats and complimented you on your wildlife. That stuff you're admiring is cheatgrass. It's an annual. A month from now it'll have lost all it's nutrition and make the best fire in the world. It's an invader species. It wasn't even here before the white man came, and if the range were in good condition, you wouldn't see it now" (Broly 1980).

The desert tortoise, while always a part of the desert scene where I live, was not a topic of wildlife that I thought much about until recently. I was concerned more about grizzly bears, wolves, and mountain lions. During my studies about them, I began to learn about the rancher, and the large responsibility of the rancher for their destruction. Perhaps it was necessary, perhaps not. However, not even the most paranoid, fed-hating rancher can accuse the desert tortoise of slaughtering his cows or sheep. Nevertheless, the tortoise seems perilously close to sharing the near-extinction of the wolf and the grizzly. In my opinion, the rancher is again largely responsible.

No matter how one looks at it, the public loses under current grazing policies on BLM land. Most contemporary writing about grazing has focused on the overgrazing aspect, and the resulting impacts on the land's capacity to serve as a renewable resource for all of society's demands. This is as it should be, but emphasis on ecological issues is not enough. The variables involved in determining causes for vegetation change, increased erosion, or decreased wildlife are endless, and leave the advocate for true multiple use of public lands vulnerable to equally endless challenges from the ranching community. Such challenges are at present preventing implementation of new grazing management programs on much of the public land administered by the BLM. In fact, public funds are even involved in the litigation process itself, with many range academics at the taxpayer-supported western land-grant colleges their influence on behalf of the livestock industry.

Given such obstacles to reasoned progress toward a more healthy land base for the West, it is time to scrutinize the economics of public grazing lands, and their true position in the marketplace. The use of economics alone in the overgrazing controversy can bring to the battle a much-needed perspective that is divorced from ecological conclusions that may take decades to verify. It is probably not necessary that the rancher give up all grazing on the public lands of the West. My personal goal would be a ranching industry that has political power equal to its economic contribution to the country. If that condition is ever achieved, the privileged position of the rancher will be no more, and the public lands will become truly public.

The next time you hear a southwestern rancher claim that he feeds the world, or see a Marlboro® ad, remember this quote from Broly (1980): "A Mississippi black in overalls isn't as photogenic as a cowboy with his pony, but he's sure as hell a lot more efficient at raising beef."

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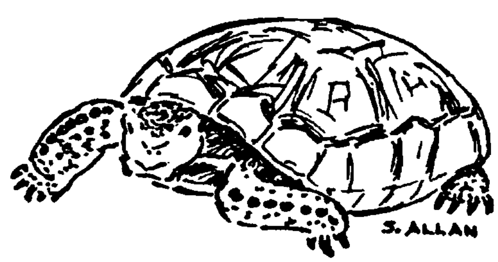

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COMPARATIVE STRATEGIES FOR PRESERVATION OF THE GOPHER TORTOISE (*GOPHERUS POLYPHEMUS*)

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Prior to the surveys of Auffenberg and Franz (1982), the range of the gopher tortoise (*Gopherus polyphemus*) was known only from species accounts in books such as Pope (1939), Carr (1952), and Ernst and Barbour (1972). The extent of current gopher tortoise populations was outlined by Auffenberg and Franz (1979). This range includes dry, upland sandy habitats within the Upper Coastal Plain physiographic province of six states: South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana.

As Mount (1982) noted, attempts to control human predation of gopher tortoises date to the early 1900s when a few Florida counties established hunting seasons and minimum size limits. Taylor (1981, 1982) has offered excellent treatments of the problems inherent in trying to regulate human predation on gopher tortoises. The most recent review of state legislation concerning the gopher tortoise was presented by Franz (1981). Little has changed since Franz's review, and his paper is here briefly reviewed and updated.

<u>South Carolina</u>.—The gopher tortoise has had legal protection since 1975 and is listed as a South Carolina endangered species. J. Sorrow (state report in Franz and Bryant 1982) noted that "the status of the gopher tortoise has changed very little in the past few years" and that "the population is still relatively small and local . . ."

<u>Georgia</u>.—A state act outlaws the taking or possession of any nongame species of wildlife unless listed as an exception. An original act outlawing the disruption of "dens, holes, or homes of any wildlife . . ." was changed in 1979 to concern only "game animals." As Franz (1981) noted, since the gopher tortoise is not considered a game animal in Georgia, this was an adverse change which coincided with attempts to obtain greater protection for the tortoise within the state. H. Wahlquist (state report in Franz and Bryant 1982) noted that the status of the tortoise in Georgia remains unchanged. The Gopher Tortoise Council's 1981 submittal to Georgia that recommended increased protection was unsuccessful.

<u>Florida</u>.—J. Diemer (state report in Franz and Bryant 1982) noted the following: the gopher tortoise "is currently listed as a species of special concern

in Florida." (Franz [1981] noted that an original recommendation to list the gopher tortoise as a threatened species was accepted but later rescinded.) Current regulations set a tortoise hunting season from July 1st to March 31st inclusive with a daily possession limit of five tortoises per day per hunter. A ban on the sale or exportation of gopher tortoises exists.

Alabama.—In 1981 the gopher tortoise was designated as a game animal but without an open season during which it may be lawfully hunted, caught, captured, or killed.

Mississippi.—J. Burris (state report in Franz and Bryant 1982) noted that the gopher tortoise was listed as a threatened species in 1981. This makes it illegal to capture, possess, or sell gopher tortoises in the state.

Louisiana.—The gopher tortoise is not protected in Louisiana. All attempts by the Gopher Tortoise Council to involve Louisiana Fish and Game Commission personnel in conservation efforts have been futile.

DISCUSSION

Five of the six states with gopher tortoise populations have enacted state legislation which has the potential to regulate human predation of gopher tortoises. Only Louisiana fails to consider the gopher tortoise an animal worthy of conservation. Should Louisiana become concerned in the future, such interest would likely be academic. Jennings and Fritts (1983) and Lohoefener (state report to the Gopher Tortoise Council 1983) have presented evidence that the gopher tortoise in Louisiana is probably no longer reproducing in the wild. The last known colony disappeared after the area was intensively clearcut and site prepared. Unless other colonies exist, no colonial situation exists in Louisiana.

J. Sorrow (state representative of South Carolina, *pers. comm.*) has reported that The Nature Conservancy is in the final stages of concluding negotiations with Georgia-Pacific for the transfer of about 900 acres of land. The major holding of gopher tortoises in South Carolina occurs on this tract. This acquisition and the subsequent habitat management for tortoises may affectively preserve the tortoise in South Carolina.

No data exist on the effectiveness of Georgia's regulations. Landers and Garner (1981) listed man as the most important predator of gopher tortoises in Georgia. Prosecution of tortoise hunters in Georgia has not been documented (H. Wahlquist, *pers. comm.*).

Taylor (1981, 1982) presented evidence that most tortoise hunters in Florida probably ignore or are unaware of Florida's regulations which establish hunting seasons and bag limits. Therefore, even though Florida permits a liberal hunting season and bag limit, human predation on tortoises is still largely unregulated.

Alabama arrested and penalized one person for illegal harvest of gopher

TABLE 1.—Ten-year (1970-1980) human population change in the six states' counties that are known to have populations of gopher tortoises.

	Number of counties	1980 Maximum	1980 Minimum	1980 Mean	1970 Mean	Mean Change	Mean % Change
Alabama	16	364379	10586	45898	45937	2661	+ 06
Florida	50	728409	4035	112692	72476	40216	+ 55
Georgia	69	202226	2297	21502	18954	2548	+ 13
Louisiana	3	110554	44207	78486	51333	27153	+ 53
Mississippi	13	157665	9716	44255	34700	9555	+ 28
South Georgia	2	18159	14504	16331	15200	1131	+ 07

tortoises (D. Speake, state report in Franz and Bryant 1982). Speake also quoted the Alabama Director of Conservation as having said "the gopher tortoise has a very high priority with the division [of Conservation]."

There has been no enforcement of Mississippi's regulations that offer protection for the tortoise. Lohoefener (1982) showed human predation to be a major factor in extirpation of the tortoise from the DeSoto National Forest. To date, both human predators and humans charged with the protection of the tortoise have been ignorant of laws protecting the tortoise. Only since 1983 has a list of state threatened and endangered species been appended to a flier explaining hunting and fishing regulations.

Legislation limiting human predation and enforcement of that legislation is essential to the ultimate survival of the gopher tortoise in the southeastern United States. However, at present there is no real evidence to suggest that any of the protection strategies have decreased human predation. Kelley (1980) and Jackson (1981) addressed some of the problems state agencies may have in enforcing nongame legislation. Attempted curtailment of human predation is only one aspect of the many human-caused factors detrimental to gopher tortoise populations.

The human population in the southeastern United States, especially in the range of the gopher tortoise, is growing at a phenomenal rate (Table 1). This growth results in increased feral dog predation on tortoises (Landers and Garner 1981), increased tortoise deaths because of vehicular traffic, and loss of tortoise habitat to agriculturization and urbanization. For the foreseeable future, nothing will be accomplished in limiting these impacts.

Perhaps the most important factor contributing to the demise of gopher tortoise populations is silviculture practices that promote increased wood production at the expense of gopher tortoise habitat (Auffenberg and Franz 1982, Landers and Buckner 1981, Landers and Garner 1981, Landers and Speake 1980, Landers et al. 1980, Lohoefener 1982, Lohoefener and Lohmeier 1981, McRae et al. 1980). Even through, as Lohoefener (1981) pointed out, considerable state and federal land holdings exist within the gopher tortoise's range, no management plans exist for managing forests in a manner conducive to tortoise survival even though management practices for optimizing the selective cutting of longleaf pine (*Pinus palustris*) may also be one of the best schemes for tortoise survival.

SUMMARY

To sumarize, attempts by five of the six tortoise-inhabitated states to regulate human predation have not produced any discernable results. No progress, with the possible exception of the Conecuh National Forest in Alabama, has been made in preserving gopher tortoise habitats. The human population of the southeastern United States is increasing rapidly and pressures for conversion of tortoise habitat to land suitable for more intensive human land use practices are increasing. The future for wild populations of gopher tortoises is bleak and despite recent attempts to gain public awareness, survival of the gopher tortoise has not been enhanced.

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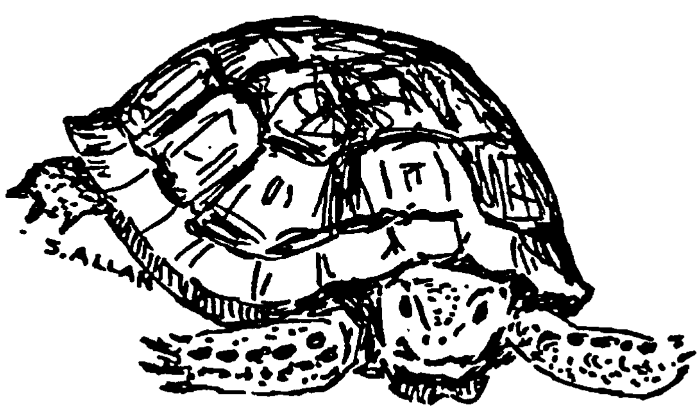

Proc. Desert Tortoise Council 1983 Symp., pp. 108-114

FURTHER OBSERVATIONS OF BOLSON TORTOISES (*GOPHERUS FLAVOMARGINATUS*) AT THE APPLETON-WHITTELL RESEARCH RANCH

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Abstract.—In this update on the bolson tortoise (*Gopherus flavomarginatus*) population at the Appleton-Whittell Research Ranch, the adult enclosures and the difference in behavior at two locations are detailed, the ranges of tortoise weight according to age group are given, and forage preferences of young and old are discussed. Adult courting and mating behavior, two observations of egg laying, incidences of dirt ingestion, and a temporary burrow exchange between a male and a female during the summer of 1982 also are described.

The bolson tortoise (*Gopherus flavomarginatus*) population at the Appleton-Whittell Research Ranch, which now numbers 26 animals, is made up of the same 10 adults as last year (Lindquist and Appleton 1982), plus a total of 16 subadults, juveniles, and hatchlings.

THE ADULT TORTOISES

Enclosures

The adult tortoises are established in four enclosures which range in size from approximately half an acre to three acres. Five live in the two pens just below my house (Appleton 1979), and five in the other two pens which are approximately a third of a mile to the west. Two pens house male and female pairs and two contain two females and one male in each enclosure, a total of six females and four males. The tortoises have established individual burrows, with ramps extending downward from the dirt apron to the burrow mouth at a declination of 23° to 28°; belowground, all but one of the burrows curve to the right. The enclosures provide native forage on which the tortoises are solely dependent; drinking water is available at all times.

Behavior

Five weeks of observation in July and early August 1982 yielded a marked difference in activity patterns between the two locations. Less basking, foraging, copulation, and egg laying was observed in the west pens, which are considerably larger, have heavier soil conditions and less shade, but with greater diversity of forage. There is probably more ingress of wildlife there than in the east pens, which are located close to the house.

My own informal observations, made over a period of years, reflect a marked increase in male foraging, copulation, and fence pacing activity during August and September over recorded observations made five days a week in 1981 and 1982 during late May to mid-August.

Both males and females bite at, and occasionally ingest, dirt. In the Council's 1978 proceedings (Appleton 1978), I described a scat which contained 13 small stones weighing a total of 24.1 g (the largest, weighing 9.2 g, was 3.1 cm long), plus a woody stem and several undigested oak leaves. The scat was found near the burrow of tortoise Larry, 11 months after he arrived from Mexico in 1976. He did not emerge from hibernation until 13 April 1977, although other tortoises were up basking and moving from February on. Examination of many scats during subsequent years has not revealed similar contents.

Each summer, after the monsoons have begun, adult tortoises bring up a quantity of dried fecal matter from their burrows, which is spread over the individual ramps and aprons exterior to the burrow entrance (Appleton 1978). This "house cleaning" behavior occurs briefly and is not continuous throughout the monsoon season.

THE YOUNG TORTOISES

Twenty-four tortoises have hatched at the Research Ranch since 1979, 17 incubation (for method, *see* Appleton 1980) and seven field hatched. Length of incubation has varied from 85 to 96 days. Currently, 16 young bolson tortoises are maintained there, four field established and 12 in hibernation in the house. Incubated hatchlings and young have been encouraged to hibernate indoors from November through March at temperatures between 13° and 17°C, and are checked frequently and roused to drink about every five weeks.

Of the field-hatched tortoises, one two-year-old, kept under care with incubated young, died in hibernation the winter of 1981-1982. Five hatchlings established themselves in self-dug burrows in 1980 and 1981 but could not be found in the spring and summer of 1982; they are assumed to have been preyed upon.

The 1980 hatchling, discovered in one east pen in the summer of 1981, had survived his first winter successfully in a well-constructed burrow with a tiny opening and inconspicuous apron which gave no indication of its down curving, 17-inch length, sloped to the right and ending at a depth of 7½ inches below the ground surface. Two 1980 hatchlings escaped from a feeding enclosure; their fate is unknown.

One hatchling, discovered in the largest west pen on 7 July 1981, was brought to the house for observation. He consistently paced the southwest side of three different enclosures as if attempting to escape in the direction of the west pen, a third of a mile distant. Beginning 15 July, he was again placed in the west pen, observed during the day, and returned to the house at night. During the first day, he grazed, walked, and rested. On 16 July, after foraging and testing under a shrub, he began to dig. For 1¼ hours, he alternately dug for five minutes and rested for five. At 7:30 a.m. on 17 July, he was again placed where he had dug the day before. He rested until 9:00 a.m., and then foraged northwest until he was returned to the house. On 18 July, he grazed and then dug at a fresh location for two hours. At 9:00 a.m. on 19 July, he selected a third site under a dead bush, dug until 11:15 a.m., and then rested until 2:45 p.m. when he grazed for five minutes before returning to the dig for shelter during a thunderstorm; he remained there for the night. On 20 July, he came out to bask from 9:56 a.m. to 10:21 a.m., foraged and returned at 10:45 to bask by the incomplete burrow. On 22 July, he had deepened the burrow enough to provide an overhang and sufficient depth for adequate shelter and concealment.

WEIGHT VARIATIONS ACCORDING TO AGE GROUP

All of the bolson tortoises at the Research Ranch are weighed annually. Weight variations according to age group in the summer of 1982 are shown in Table 1. The two three-year-olds exhibit a more mature appearance in toughness of shell, size and strength of forelimbs, and heaviness of head than do the yearlings and the single two-year-old.

TABLE 1. — The ranges of bolson tortoise weight according to age group at the Appleton-Whittell Research Ranch in the summer of 1982.

Age group	Weight range
At hatching	1 oz - 1 1/3 oz
Yearlings	2 oz - 2 2/3 oz
Two years	3 1/2 oz
Three years	5 3/4 oz - 7 oz
Adult males	12 lbs 5 3/4 oz - 22 lbs 7 1/2 oz
Adult females	15 lbs 5 1/4 oz - 27 lbs 6 1/4 oz

FOOD PREFERENCES

Adult bolson tortoises feed mainly on indigenous grass clumps, such as *Erigrostis intermedia* and *Bouteloua* sp. Feeding patterns follow a "move, crop, move" behavior, during which some stands of grass are left untouched while others are cropped and recropped. Possibly the fresh growth stimulated by this pruning is more palatable, or of greater food value. The plants preferred by young tortoises, although abundant, are only occasionally utilized by adults.

Forbs, rather than grasses, sustain the young and the hatchlings. Perennial grass clumps may be difficult for them to crop, as the base structures are

TABLE 2. — The phosphorus and protein percentages in plants frequently utilized by bolson tortoises at the Appleton-Whittell Research Ranch.

Plants frequently utilized	Phosphorus %	Protein %
By young tortoises:		
Dichondra	0.450	28.19
Evolvulus arizonicus, flowers and buds	0.346	18.97
Evolvulus arizonicus, stems and leaves	0.162	13.92
Portulaca, stems and leaves	0.194	13.07
Sida, stems and leaves	0.236	18.86
Panicum (annual)	0.229	14.81
By adult tortoises:		
Erigrostis intermedia	Not analyzed	12.00
Bouteloua gracilis (blue grama), early	" "	9.80
Bouteloua gracilis (blue grama), mature	" "	6.70
Bouteloua curtipendula (side-oats grama)	" "	7.90
Food value comparisons:		
Good quality alfalfa hay	Not analyzed	15.60
Clover	" "	16 - 17

higher off the ground and the stems are tougher. By placing the young in movable enclosures, located where a diversity of summer forb growth emerges, the following preferences have been noted: *Evolvulus arizonicus* flowers earliest, and the blue flowers are eagerly sought during its growing season, which lasts through October. A prostrate, white variety of *E. arizonicus* is infrequently eaten. From mid-August on, late summer maturing *Sida* sp. and *Portulaca* sp. top the list of favorites. In 1981, K. Lindquist occasionally observed hatchlings foraging on *Erigeron* sp., *Dychoriste decubens*, and *Applopappus nuttalii*. The backup staple for young tortoises is *Dichondra*. A deciduous species is native to the ranch and a commercial evergreen form, available from plant nurseries, is kept growing in hot frames during the winter months.

Although little is known about an animal's ability to select for high nourishment content, laboratory analyses at the University of Arizona show a high phosphorus and a high protein percentage in plants preferred by young tortoises (Table 2).

SEXUAL ACTIVITY

Mating between Larry and Gertie, the most sexually active pair, commenced last summer on 7 July and was further observed on 15, 25, 27, 28, and 30 July. They also mated on 4, 5, 8, 9, 13, 14, and 16 August, after which time the five-day-a-week observations ended. However, almost daily activity continued through August to mid-September. Jane and Potent have been seen copulating as late as mid-October.

During Larry's first encounter with Gertie, in the summor of 1977, he snapped at her head and forelimbs before mounting, but this behavior is no longer evident among mating pairs who are now familiar with each other. Although females have been seen bobbing at a male's burrow, the usual initiation of courtship is male head-bobbing on the female's burrow apron. When she begins to emerge, he will back off a bit as if not to crowd her. Eventually she ascends the ramp and turns to face downward, with her body on an angle, which seems to facilitate union when he mounts. He then rocks back and forth, shifting his weight from one hind leg to another. When positioned, he partially retracts his head several times, then fully retracts it at intervals of 15 seconds or less, sometimes up to 23 times, opening and closing his mouth either silently or with rasping grunts. Often the female will slide down the steep ramp, displacing the male, who sometimes lands upside down. After righting himself, he resumes the bobbing, backing, and mounting process.

EGG LAYING

Egg laying, although occasionally observed in the morning, is more frequent in afternoon hours. Females often lay eggs on the burrow apron, which may be more "workable" than the very compact soil throughout the enclosures, but are also observed to select other sites (Lindquist and Appleton 1982). They will sometimes abandon a dig, leaving the partially excavated hole open.

In 1981, Gertie laid four clutches. She laid the first on 23 April on her burrow apron; that nest was preyed upon by a raccoon, but one egg was saved and incubated. On 8 June, Gertie laid again in tall grass approximately 40 ft northwest of her burrow (Lindquist and Appleton 1982); the nest was excavated by the observer and one broken egg removed, one undamaged and two slightly dented eggs left in the nest and protected by wire netting, and three eggs removed to the incubator. On 6 July, Gertie laid eggs on Larry's burrow apron (Lindquist and Appleton 1982); this nest was left complete and covered with wire. On 11 July, she dug a fourth nest northwest of Larry's burrow (Lindquist and Appleton 1982); this nest was left unprotected but was not disturbed by predators; unfortunately, none of the eggs left in the nests hatched.

At 4:30 p.m. on 17 June 1982, I watched Jane proceed north from her burrow, then west along the fence, scraping her carapace against it as she moved. She stopped and commenced to dig with her rear feet, pivoting from one to the other as the hole deepened, and tilting her body in order to reach down and flip dirt back with alternate legs. I heard only two eggs drop. She rested a few minutes, then pivoted and tilted again, alternately reaching deep with her hind legs as if adjusting or firming dirt around the eggs. Then, with one back leg at a time, she pulled the excavated dirt at the rear rim of the nest forward with a semi-encircling motion. After each addition, she carefully firmed the dirt around the eggs with her rear feet. As the hole filled, her pivoting plastron also smoothed and packed the dirt. At 7:15 p.m., she flipped back dirt and dried grass over the filled area with her front feet, then left without turning, moving slowly in a direct route back to her burrow. I removed the two eggs, breaking one but successfully incubating the other.

At approximately 5:00 p.m. on 21 June 1982, Gertie commenced to dig a nest in tall grass 15 ft south of her burrow. She continued to dig, bracing herself with one hind leg outside the deepening hole and scraping with the other, tilting her body to reach bottom as the hole deepened. Even as darkness fell, she continued, working steadily until 8:00 p.m., when her pace slowed, and at 8:20 p.m., in total darkness, she was heard to stop. At 8:50 p.m., she began to move again, the sounds indicating that she was filling in the nest. At 9:25 p.m., there were sounds of movement over grass, and, at 9:33 p.m., she descended into her burrow. The nest was well camouflaged by smooth dirt and flipped grass. On excavation by the observers, no eggs were discovered. This was the first observation of nesting behavior where the hole, approximately 3 in. wide, 4 in. long, and 4 to 5 in. deep, was carefully filled, in spite of the absence of eggs.

BURROW EXCHANGES

The bolson tortoise seems to prefer single occupancy of its burrow, although instances of switching have been observed (Lindquist and Appleton 1982). In 1979, after establishment in one west pen, female 07 took over the burrow of 01, a smaller male, during the first year of occupancy. Spry, the dominant, although smaller, male in one east pen, attempted to displace Potent, the larger male in that pen, and was seen to bob him up from his burrow and to mount him on several occasions; however, he did not succeed in preempting the burrow until Potent was relocated in a west pen in 1979.

From 1977 to 1982, Gertie, the largest and most active female, made repeated attempts to enter Larry's burrow during the summer months, but was unsuccessful. Larry was considerably smaller, and, since burrow dimensions tend to conform to the sizes and shapes of their occupants, particularly when they turn sideways to block the opening, Gertie was unable to enter and dislodge him. Each summer, she visited regularly, possibly to initiate mating activity. Meanwhile, Larry increased in size and weight and, in late May 1982, his burrow entrance had become big enough to accommodate her. She then enlarged the tunnel and took up residence there for approximately three months, while Larry adopted her former home. He would visit her daily, sometimes sheltering in the tunnel if she was away but leaving it quickly when she returned from foraging. Most mating activity over these months took place at his former burrow, but, as the late summer rains dampened and muddied it, Gertie returned in September to her deeper, more weatherproof, original home, and Larry reclaimed his burrow for the winter months.

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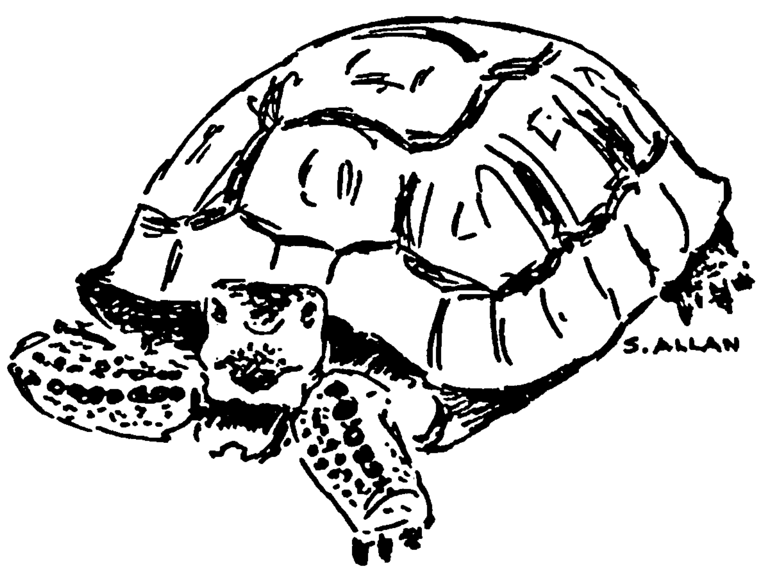

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UPDATE OF THE HOME RANGE AND HABITAT USE STUDY OF THE DESERT TORTOISE, *GOPHERUS AGASSIZI*, IN THE PICHACO MOUNTAINS, ARIZONA

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This report provides an update on the two-year study of the desert tortoise in the Pichaco Mountains in Pinal County, Arizona. I initiated the study for the Bureau of Reclamation in spring, 1982.

The Bureau of Reclamation is constructing the Central Arizona Project (CAP) to bring water from Lake Havasu to Phoenix and, eventually, to Tucson. The final segment of the canal, known as the Tucson Aqueduct, will pass through the Pichaco Mountains where desert tortoises have been reported. Concerns were raised by a number of persons, organizations, and agencies regarding direct and indirect impacts from canal construction and operation. These concerns included crushing of tortoises and burrows from heavy equipment, loss of habitat, severance of movement patterns, and drowning losses. The ultimate goal of this study is to recommend ways to mitigate these impacts to the desert tortoise.

To date, 45 tortoises have been marked with representatives from each of five size classes: >214 mm, 171-214 mm, 101-170 mm, 61-100 mm, and <61 mm. Tortoises were marked with notches in marginal scutes (Burge 1977) and numbers epoxied to the fourth vertebral scute. Very small tortoises were marked only with a permanent felt marker to avoid injury to their unossified carapaces. Eight shell measurements were taken on all tortoises and characteristic markings and scars were noted. The sex ratio was 1:1 among adults and subadults (19 females, 17 males).

Parameters studied for habitat use include diet, den size, climate, slope, aspect, and elevation. Statistical analyses will be conducted after all data have been collected and will be presented in my final report. Preliminary results of the fecal analysis indicate the most abundant food items were forbs during spring (March-May) and shrubs during autumn (September-November). The first year's data showed no significant seasonal trends for cacti, grasses, and trees in tortoise diets.

Sixteen adult tortoises (>214 mm) were equipped with radio transmitters. The transmitters were epoxied to the rear of the carapace on males and to the front of the carapace on females to avoid interference with mating. The final coat of epoxy was tinted to camouflage the transmitter from predators. Fourteen of the transmitters are still functional. One tortoise bearing a radio transmitter was apparently attacked by a predator. The tortoise was found with extensive chewing of the gulars and several toothmarks in the plastron and carapace, but appeared to be healthy. The radio transmitter was missing and was not recovered.

Tortoises are located once a week during warm months and twice monthly during brumation. Locations are plotted on topographic maps with the aid of aerial photos. Mean home range for females was 7.0 ha (range 1.7 to 34.0 ha); males 5.5 ha (range 0.4 to 9.5 ha).

During this first year, tortoises remained in the palo verde—mixed cacti habitat. The majority of summer dens were in caliche in the sides of washes. Other refuges included pallets beneath shrubs, crevices under rocks, and a few burrows dug into soil. Brumation generally occurred at higher elevations and steeper slopes than did summer activity.

Based on telemetry data, the CAP will sever movement patterns of, and present a drowning hazard to, one major concentration of tortoises and will pass within 800 m of another concentration.

Mitigation measures on this aqueduct of the CAP will include crossing structures for movement across the canal and a 2.7 m high wildlife deterrent fence to avoid animal drownings. This fence will extend for approximately 18 km on both sides of the canal. Where necessary, a tortoise-barrier fence will be attached to the bottom of the wildlife deterrent fence that will be 0.5 m high with a 0.5 m apron extending outward, flush with the ground to prevent drowning (Fusari 1981). Placement of crossings and barrier fence for tortoises will be determined when the study is completed.

Fieldwork for this project will be completed in December 1983. Data analyses and the final report will be completed in August 1984. Recommendations for mitigation will then be submitted to the Construction Division of Reclamation for inclusion in final design specifications. Following completion of this study, other portions of the CAP aqueduct will be searched for tortoise and tortoise sign to identify other areas in need of similar mitigation measures.

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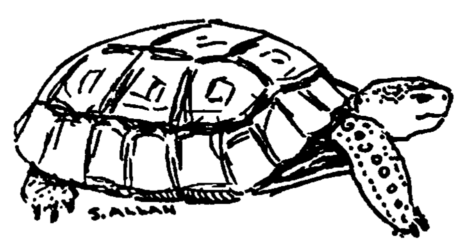

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ECTOPARASITES OF THE DESERT TORTOISE, *GOPHERUS AGASSIZII*, WITH EMPHASIS ON THE SOFT TICKS OF THE GENUS *ORNITHODOROS* (ACARI: ARGASIDAE)

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Abstract.—Although several organisms have been reported as parasitizing the desert tortoise, *Gopherus agassizii*, the only known major ectoparasites are soft ticks of the genus *Ornithodoros*. In contrast to the one-hour engorgement period typically observed on avian and mammalian hosts, these ticks often appear to remain for an extended period on or between the posterior scutes of tortoises. To learn more about the tortoise-tick interactions, a study was initiated with the following goals: (1) to determine how the ticks locate and recognize the tortoise host; (2) to ascertain the time required for the ticks to complete feeding; (3) to discover why the ticks remain on, or depart from, the reptilian host; (4) to ascertain the importance of *Gopherus agassizii* as a host; and (5) to test the ticks for any possible pathogens which might afflict the desert tortoise, man, or other vertebrates.

Although many papers have recorded parasites on the desert tortoise, little is known regarding their interactions. The normal ectoparasites are soft ticks of the genus *Ornithodoros* which are regularly encountered with the tortoise. Facultative or accidental parasites includes molds and other arthropods that are rarely associated with this host. A brief review will illustrate the reported interactions and summarize the available literature.

Woodbury and Hardy (1948:192-3) reported three examples of tortoises, in their humid winter dens, developing mold or fungi on the shell. Two of these occurred as secondary infections in the wounds of recent brandings, while the third infestation was located on the plastron. This suggests to the author that the fungi may have derived its nutrition from external material, such as decaying feces, rather than the tortoise. Poorman (1970) reported that several young tortoises developed a "mildew" when allowed to voluntarily soak in a water dish. Several days without water alleviated the condition, leading the reader to conclude that the fungus was not tolerant to the dry conditions normally experienced by tortoises.

Miles (1953) alluded to "red ants" attacking the soft neck skin of captive tortoises, causing fatalities in young animals. However, this must be considered a case of predation, not parasitism.

Myiasis is a condition caused by dipteran maggots devouring vertebrate tissue. When observed in North American chelonians, "bot-fly" larvae have occasionally been reported as the infesting organism (Packard 1882, McMorris 1969, Neck 1977, Coombs 1977:87). However, whenever the parasites were identified (Wheeler 1890, Kepner 1912, Knipling 1937, Peters 1948, Rainey 1953, Dodge 1955), they were *Cistudinomyia* (previously *Sarcophaga*) *cistudinis*, a flesh fly of the family Sarcophagidae, not one of the bot flies of the families Gasterophilidae, Cuterebridae, or Oestridae. The screwworm-like larvae of several sarcophagid genera cause traumatic or cutaneous myiasis by penetrating pre-existing scars, sores, abrasions, and the wounds left by tick bites, as well as burrowing through the integument (Knipling 1937). Of the three reports relating to *G. agassizii*, two (Woodbury 1952, Byrnes 1969) cited unidentified maggot infestations in open wounds or exposed yolk sacs of captives, while Coombs (1977:87) recorded that "the larvae of a bott [sic] fly was noted under the skin of the neck of a tortoise in July, 1976," but failed to collect and positively identify the larvae.

A chigger is the larval stage of a trombiculid mite and is a common parasite on a variety of vertebrates, including man. Its small size and tendency to attach in confined folds on the host may be responsible for the paucity of chelonian records. Goff and Judd (1981) found numerous specimens of the trombiculid species *Eutrombicula alfreddugesi* in the axillary and inguinal regions of one Texas tortoise, *Gopherus berlandieri*, although 178 tortoises were examined in the study. This pest chigger is abundant in the southern United States, and also was reported from *Gopherus polyphemus* by Wharton and Fuller (1952). Coombs (1974:19, 1977:87) stated that a trombicula mite was noted on a desert tortoise, but did not collect and identify it.

The most frequently reported ectoparasites are soft ticks (Grant 1936; Harbinson 1937; Woodbury and Hardy 1948:192-3; Edmunds 1951; Coffey 1954; Ryckman and Kohls 1962; Kohls et al. 1965; Murphy 1973; Coombs 1974:19, 1977:82, 87; Burge 1978:99-100; Barrow 1979:126). When identified, these acarines were stated to be *Ornithodoros parkeri* or *O. turicata* of the family Argasidae. In analyzing the published reports, it became evident that most authors were actually repeating a few early records. Based on the misspelling of "*Ornithodorus*" [sic] and lack of documented verification by authorities, it would appear that the reports of Murphy (1973) and Coombs (1974:19, 1977:82) are based on the work of Harbinson (1937). Similarly, reports of Edmunds (1951), Coffey (1954), and Kohls et al. (1965) are based on ticks collected in the study by Woodbury and Hardy (1948:192-3). Other citations (Grant 1936, Burge 1978:99-100, Burrow 1979:126) did not include a specific identification. In essence, only Harbinson (1937), Woodbury and Hardy (1948:192-3), and Ryckman and Kohls (1962) are original publications specifying tick identification and locality of collection.

Harbinson (1937) followed the style of Brumpt (1936), using the incorrect *Ornithodorus turicata* spelling, but Brumpt did not include *O. parkeri* described by Cooley in 1936. Harbinson was probably unaware of *O. parkeri*, which is similar to *O. turicata*, but the specimens were apparently lost (Ryckman and Kohls 1962), preventing verification. The acarines were taken from captive tortoises and the actual sources of the ticks and tortoises are unknown.

Woodbury and Hardy (1948:192,3) also referred to the "Adobe tick, *Ornithodorus turicata*" citing Harbinson (1937) and a determination by Albert Grundmann. Since the incorrect spelling was again used, the identifier may not have compared the specimens from Utah to *O. parkeri*. This explanation appears even more parsimonious considering Edmunds' (1951) report citing a new record of *O. parkeri* on *G. agassizii* alongside a literature record for *O. turicata* on desert tortoises, both collected by Woodbury in 1939. Finally, Coffey (1954) mentioned only *O. parkeri* while citing Woodbury and Hardy (1948) who actually reported only *Ornithodorus turicata*.

The report by Ryckman and Kohls (1962) of *O. turicata* on *G. agassizii* at Hi Vista (east of Lancaster), California, appears to be accurate but is based on captive tortoises with the original source of ticks and tortoises unknown.

Davis (1952) alluded to certain California soft ticks which were originally misidentified morphologically as *O. turicata*. However, they were unable to routinely transmit the spirochetes specific to that tick, but did transmit the pathogen found in *O. parkeri*. Therefore, he concluded that "the ticks from Alameda and Kern counties are *O. parkeri* and not *O. turicata*, contrary to previous reports . . ."

In addition to summarizing the available literature on tortoise ectoparasites, this paper also outlines the objectives of a study to help clarify the host-parasite relationship between these desert inhabiting species.

OBJECTIVES OF THE STUDY

I. How a Suitable Host Is Found and Recognized by the Tick

Acarine searching behavior is induced by many diverse stimuli indicative of a potential host. In soft ticks, these inducers may include changes or gradients in expired carbon dioxide, radiant heat, movements, vibrations, sounds, light intensity, odors, and chemical exudates. The question remains as to which of these are used by soft ticks in finding tortoises.

Carbon dioxide, when released in high concentrations through the sublimation of dry ice, attracted *O. coriaceus* (Hokama and Howarth 1977) and *O. parkeri* (Miles 1968). In *O. concanensis* this was not observed when host level concentrations were used (Webb 1979). Since tortoises obviously release carbon dioxide, attempts to attract and capture these ticks will be made using dry ice baited traps as described by Miles (1968).

Webb (1979) found that *O. concanensis* will, when within a few centimeters, orientate toward and attempt to feed on a source of radiant heat. The desert tortoise retreats underground at body temperatures of 37 to 38°C (Brattstrom and Collins 1972), and dissipates the accumulated heat across its presumably vulnerable neck and legs (McGinnis and Voight 1971). Since 37°C approximates the body temperature of burrow-inhabiting mammals, birds, and thermoregulating tortoises, all would present similar thermal targets, capable of stimulating host-locating behavior. Initial tests will utilize tortoises at various temperatures and other heat sources.

Detection of movements and vibrations, generated by fast-moving hosts, seems of major importance for certain hard ticks but has not been demonstrated for soft ticks which are often intimately associated with burrow inhabitants.

Webb et al. (1977) demonstrated that *O. concanensis* utilized auditory stimuli in locating cliff-nesting swallows, but, considering the limited number of vocalizations and other sounds made by tortoises, auditory activation would seem of no importance.

It might be expected that a burrow-dwelling tick would have a limited degree of photoreception, yet avoiding strong light and the concommitent heat could be of great survival value in a desert dweller. Webb (1979) noted that *O. concanensis*, when confronted by a water-bath cooled light, exhibited strong negative phototaxis, yet unfed soft ticks have frequently been found on the tortoise carapace in full daylight. Light reaction experiments should indicate the degree of phototaxis in unfed and engorged ticks.

Another type of chemoreception is associated with the assembly pheromone known from several Old World soft ticks. Leahy et al. (1975) found that unfed and recently fed soft ticks were attracted to paper saturated in a solution washed from other argasids. The attraction was greatest when the source was recently fed females, indicating possible functions in locating both a meal and a mate. By applying the pheromone to the carapace, it may be possible to determine its relationship to the clumped distribution of ticks on the tortoise.

II. Determination of Tick Feeding Period

Soft ticks usually feed very rapidly, requiring as few as 12 minutes (Davis 1941) to engorge on laboratory nestling mice, thus minimizing the time spent in the partially engorged condition. Since ticks are capillary feeders, it would seem likely that feeding time on the low blood pressure system of tortoises would be longer than on the high pressure system of endotherms. This hypothesis will be tested on mice and tortoises under controlled conditions, with the observation of blood imbibing being used to determine the initiation of feeding. Any ticks observed feeding in the field will be rated as to degree of engorgement and time to detachment.

III. Interaction of Tick and Tortoise

Soft ticks usually inhabit the nest material and adjacent crevices within the burrow of their endothermic host. When hungry, they move onto the host, engorge, then detach and retreat to the original microhabitats. When associated with the desert tortoise, they are often found on the rear of the carapace, and are sometimes covered with dried mud or dust. Although some ticks have been found feeding in the seams between the tortoise scutes, most appeared to be unengorged and not feeding, suggesting a possible phoretic association. Further field and laboratory studies should clarify these preliminary observations.

IV. Importance of *Gopherus agassizii* as Host

Soft ticks are rarely found on their endothermic hosts and few surveys have been published on burrow-inhabiting acarines in the desert. Data from the Pacific Northwest and the Midwest, indicate that *O. parkeri* and *O. turicata* parasitize a wide variety of hosts (rattlesnakes to man), but most collections are from the burrows of sciurids and the Burrowing Owl (*Athene cunicularia*). The nestlings of these endotherms are probably primary food sources, since they are readily available and unable to adequately groom, while the desert tortoise may represent either an additional primary host or a less extensively utilized secondary host.

It is unusual to observe more than 20 ticks on a wild tortoise, but captives, which may be unable to escape the increasing parasite populations, often develop heavy infestations (>100 ticks), which are reported as being greatest during hot, dry summers (Turner et al. 1980). However, even the soft tick populations seen on or found in the burrows of wild tortoises, represents populations which could disperse to the other hosts, especially those with which the burrow is commensally shared. Dry ice censusing of burrows belonging to potential and actual hosts should provide population estimates that can be used in determining relative parasite loads.

V. Ticks as Disease Vectors

The worldwide tick genus *Ornithodoros* contains a number of species which are the vectors of organisms pathogenic to man and other vertebrates. In the United States, *O. parkeri* and *O. turicata* have been incriminated in the transmission of relapsing fever to humans, although it is presently unknown within the distribution of the desert tortoise. Fortunately, this disease responds favorably to antibiotics when recognized and treated promptly by physicians. Ticks will be tested for the presence of organisms pathogenic to man by examination of stained hemolymph (blood) smears. Blood parasites are presently unknown in wild desert tortoises (Rosskopf 1982), and little is known about chelonian diseases or their modes of transmission.

INTRODUCTION TO THE TICKS FOUND ON TORTOISES IN THE UNITED STATES

Ticks (Superfamily Ixodoidea) are commonly divided into two families, the Ixodidae or hard ticks, and the Argasidae or soft ticks. The former are commonly found with mouthparts embedded in a recently infested host and are distinguished by their prognathous morphology, rigid dorsal scutum, and extended feeding period (days to weeks). *Amblyomma tuberculatum* is found in the southeastern United States on the gopher tortoise, *Gopherus polyphemus* (Hubbard 1896, Carpenter et al. 1946, Cooney and Hays 1972), giving rise to its common name, "The Gopher Tortoise Tick." It is a representative hard tick, having a 4-stage life cycle consisting of egg, 6-legged larvae, 8-legged nymph, and 8-legged adult. The cycle is completed with the female producing a single clutch of several thousand eggs (9,353 eggs were reported by Cooney and Hayes 1972).

The argasids share share a similar life history, although the nymphal stage consists of 2 to 8 individual feed/grow/molt cycles (Harwood and James 1979). After the final nymphal molt, mating takes place and the female either lays eggs without feeding (autogenically)(Feldman-Muhsam 1973), or delays reproduction until after feeding. Additional blood meals result in progressively smaller clutches so that each female may produce a total of several hundred eggs. Members of this family usually have the capitulum (mouthparts) located ventrally and lack a scutum. All four recognized genera and about one-sixth of the 150 described soft tick species are found in North America, usually inhabiting caves, burrows, and cliff faces, which may be subjected to periodic desiccation. Most argasids can undergo a starvation induced torpor that, in adult females, may last seven years (Frances 1938). The torpor is quickly ended when a potential source of vertebrate blood is detected. Hyperparasitism occurs when the source of vertebrate blood is an engorged or engorging "host-tick" whose integument is pierced by the unfed tick, which then ingests part of the meal (Davis 1941). When they separate, each molts to a slightly larger size, which is correlated to the amount of digested blood.

Ornithodoros parkeri and the closely related *O. turicata*, are in the subgenus *Pavlovskyella* (Kohls et al. 1965), and although appearing to overlap in host preference and ecological niche, are separated on the basis of integumental mammilation, idosomal, and hypostomal length (Cooley and Kohls 1944:57-76). *O. turicata* appears to be the more southern species ranging from Mexico northward into California, Kansas, and Florida. In Florida, it is found parasitizing the gopher tortoise, *G. polyphemus* (Carpenter et al. 1946). *O. parkeri* is reported from Canada southward into California and the southern parts of Nevada and Utah (Cooley and Kohls 1944:57-76). The supposed overlap in distribution, in the southwest and especially in California, may be the result of misidentifications; this was concluded by Davis (1952) in reclassifying the *O. turicata* records from the central valley of California as *O. parkeri*. In conclusion, based on the observations available to the author, *O. parkeri* seems to be the only species of soft tick on free-living desert tortoises in California. The proposed study should provide sufficient material to resolve the question of identification and distribution of the soft ticks found associated with the desert tortoise.

CONCLUSIONS

Of the five different organisms reported as ectoparasites on the desert tortoise, *Gopherus agassizii*, only the soft tick genus *Ornithodoros* has been verified on the host under natural conditions. Although little is known regarding their association, the frequent observations of non-feeding ticks on the tortoises suggest a different, and possibly unique, association between this tick and its hosts. Several aspects of a study designed to elucidate this association are discussed, followed by a brief description of the life history and distribution of the closely related soft ticks *O. parkeri* and *O. turicata*.

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ABDOMINAL SURGERY IN TURTLES AND TORTOISES

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Abstract.—Occasionally, abdominal surgery is required in turtles and tortoises. Indications and methods for the necessary procedures are discussed.

When surgically entering the abdomen (coelomic cavity) of a turtle or tortoise, the most common indications are

1) removal of cystic calculi in California desert tortoises;
2) correction of egg binding, involving abnormally large or misshapen eggs;
3) retrieval of ingested foreign bodies, such as glass, metal, rocks, gravel, and fishhooks (Rosskopf et al. 1981);
4) repair or correction of traumatic injuries caused by gunshot wounds and automobile encounters, among others (Rosskopf and Woerpel 1982);
5) exploratory celiotomy; and
6) peritonitis cleanup, including infection and egg yolk (Rosskopf and Woerpel 1982*a*).

ANESTHESIA

The drug of choice for chelonian anesthesia is ketamine hydrochloride (Ketalar®—Parke-Davis). The drug is mixed 10:1 (10 parts ketamine to 1 part acetylpromazine [Acepromazine—Ayerst]); and is given at doses of 20 to 40 mg/kg. Shell weight is not subtracted when using this dosage. The anesthetic is given intramuscularly into the axillary area (Rosskopf 1980). After 20 to 30 minutes, a surgical plane of relaxation is usually achieved. Additional doses of 10 mg/kg can be given at 20- to 30-minute intervals, if necessary.

When surgical relaxation is inadequate, a prolonged surgical procedure is anticipated, or the animal is a poor surgical risk, the turtle or tortoise may be intubated and placed on a halothane or isoflurane machine. A 1% mixture is used, but the tortoise requires frequent positive pressure bagging. Positive pressure bagging with pure oxygen hastens the recovery of a turtle or tortoise severely depressed by ketamine.

The authors recommend a presurgical workup of the patient, which should

TABLE 1.—Hemogram of a desert tortoise before and after removal of cystic calculus.

	Postoperative[a]	Eight days postoperative	Eighteen days postoperative	Normal values[b]
WBC (mm^3)	4000	5000	6000	3000-8000
Neutrophils (%)	0	0	3	
Heterophils (%)	40	58[c]	39	35-60
Lymphocytes (%)	20	10	29	25-50
Monocytes (%)	0	0	8	0-4
Eosinophils (%)	5	4	0	0-4
Basophils (%)	33[c]	28	21	2-15
PCV (%)	38	42		23-37
Total protein (g/dl)	4.3	3.0		2.2-5.0
SAST (IU/L)	66	152[d]		10-100
Uric acid (mg/dl)	3.7	4.5		2.2-9.2
BUN (mg/dl)	2	5		1-30

[a]September 26, 1981.
[b]*See* Rosskopf 1982.
[c]Reflects inflammation.
[d]Reflects tissue damage.

include thorough physical and hematologic and blood chemistry examinations (Table 1)(Rosskopf 1981, 1982; Rosskopf and Woerpel 1982*a*). The latter should indicate hepatic and renal status as well as predict the degree of risk the intended surgical procedure represents to the patient. In addition, establishment of a presurgical antibiotic level and proper hydration of the turtle or tortoise prior to surgery are important considerations.

METHODOLOGY

The patient is carefully prepped while in dorsal recumbency. The authors prefer to place the turtle or tortoise in a metal backrest to assure stability. The feet are carefully tied for the same reason.

The surgical preparation consists of successive povidone-iodine scrubs (Betadine®—Purdue Frederick) of the entire plastron, followed by isopropyl alcohol and providone-iodine-solution washes.

A portable, circular power saw is used to make a hinged-flap incision through the plastron (Frye 1973). Many brands are available and effective. Isopropyl alcohol is used periodically to cool the blade, which can easily overheat. Goggles should be worn to protect the surgeon's eyes from shell chips and dust. To prevent the operator from inhaling the material, a mask should also be worn. The incision is made wide enough to perform the procedure adequately. If a cystic calculus is to be removed, care must be taken to first measure the size of the stone with the aid of a radiograph.

It is important to note that in certain species of turtles and tortoises, namely sea turtles and snapping turtles, it is possible to enter the coelomic cavity without cutting through the shell due to the small plastron size in these species. This technique has been described by Isenbugel and Barandum (1981). An incision in these animals is made between the caudal border of the plastron and the cranial border of the femur. However, this technique cannot be used in most species.

Once the bone has been incised and the area draped, a periosteal elevator is carefully used to pry the flap of shell and bone away from the peritoneal wall. A scalpel blade is employed gently to free the abdominal musculature from the flap of bone. The flap of bone is freed on three sides of the square incision, leaving musculature attachments and blood supply intact the fourth side. The hinged flap is then opened like a door, thus exposing the thin peritoneal wall.

The peritoneum is incised on the midline, exposing the abdominal viscera. With certain exceptions, the specific procedures performed after this incision are similar to those performed on mammals and birds. The primary difference is that exteriorizing most of the viscera is impossible in turtles due to the extensive connective tissue and ligamentous attachments within the shell (Ashley 1970). The exceptions are the bladder and oviduct, which can easily be stretched or manipulated through the incision. Extreme care must be taken not to tear these organs on the sharp shell edges. Surgeons must also be careful not to tear their gloves.

A cystotomy is performed in standard fashion (Archibald 1970). The authors prefer 3-0 synthetic absorbable material (Dexon®—Haver-Lockhart) to suture the bladder. If urine leakage occurs during a cystotomy, the coelomic cavity is flushed with providone-iodine solution and warm physiologic saline.

A hysterotomy is performed by incising the midline of each oviduct, which actually consists of a combined oviduct and uterus (Ashley 1970). The shell-covered eggs are gently manipulated through the incision. The oviducts are sutured with 3-0 synthetic absorbable suture material. Care must be taken not to drop an egg (or a bladder calculus) because serious internal damage may occur to a developing ovum, resulting in leakage of egg yolk into the body cavity and subsequent peritonitis (Rosskopf and Woerpel 1982*a*).

Enterotomies may be performed to remove foreign bodies. As with mammalian laparotomies, it is advisable to flush the body cavity following such procedures with liberal amounts of warmed physiologic saline and povidone-iodine solution.

Surgeons will note that during abdominal surgery, the turtle or tortoise's heartbeat will be observable through the pericardial sac. Although the slow rate is disconcerting at first, it is a normal occurrence during surgery. Under ketamine, a chelonian's respiratory activity is almost imperceptible.

After the surgical procedure is completed, the peritoneum is sutured carefully with 3-0 synthetic absorbable suture. The hinged flap of bone is then gently replaced in its natural position.

Final closure is completed using any of several commerical boat or auto resins with fiberglass patching material. A catalyst added to the resin when the substance is mixed facilitates hardening. Three or four layers of fiberglass patching material are used in this process. During the patching procedure, care should be taken to prevent resin from seeping into the coelomic cavity. The surgeon should experiment with the resin before using it, to obtain a feel for its hardening time and characteristics. Absorbable gelatin sponges (Gelfoam®—Upjohn) or other absorbable surgical packing may be used along the incision prior to applying the acrylic. The use of antibacterial creams, such as 1% silver sulfadiazine (Silvadene®—Marion Laboratories) or nitrofurazone, may be useful barriers to possible acrylic leakage if the seal is not tight.

Once the acrylic is applied, the tortoise is suspended in a coathanger apparatus to allow drying. This technique is advantageous because it allows the resin to dry without allowing the plastron to come into contact with an adhesive surface. Furthermore, it enables the tortoise to breathe more easily during recovery; it is extremely difficult for a tortoise to expand its lungs while on its back due to the weight of the abdominal organs (Ashley 1970). The acrylic resin usually hardens and dries within 30 to 60 minutes. Drainage may occur through the edges of the patch, but will stop as granulation tissue develops along the incision line.

Aftercare involves keeping the turtle or tortoise warm; judicious use of fluids and antibiotics is also advised (Rosskopf 1980). The authors routinely use intracoelomic saline solution (10 to 20 cc/0.45 kg) daily for the first five days or longer depending on the indication for performing the surgery. Ampicillin (15 mg/kg daily) and gentamicin (10 mg/kg daily for water turtles, and every other day for land tortoises and turtles) are given for 10 days postoperatively. Turtles and tortoises are prevented from hibernating for six months after surgery. Water turtles are not allowed to swim for seven days postoperatively since it is essential that a perfect seal occurs between resin and shell. Force-feeding with commercial food supplements (Nutrical®—Evsco) or other similar feeding supplements may be necessary until normal alimentation resumes. Hematologic workups (Rosskopf 1981, 1982; Rosskopf and Woerpel 1982*b*) and periodic physical examinations (Rosskopf 1980) are used to monitor the turtle or tortoise's postoperative condition. The acrylic patch may be left in place indefinitely in adult animals, but in young animals it should be removed carefully by sanding, routing, or peeling six months to one year later to avoid growth deformities.

CONCLUSION

Abdominal surgery in a turtle or tortoise can be a positive and successful procedure if established medical principles are followed. Veterinarians and animal health technicians that approach such surgery when indicated will be rewarded with a provocative and challenging case.

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A NOTE ON THE LONGEVITY OF A CAPTIVE DESERT TORTOISE (*GOPHERUS AGASSIZI*)

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Hogle Zoological Gardens has served as a depository for desert tortoises (*Gopherus agassizi*) for many years. Following Utah's classification of the desert tortoise as a protected species in 1977, a rush of private captive specimens was turned in to the zoo. According to their owners, a few of the tortoises had been captive for 20, 30, and even 43 years. In addition, a dramatic increase in confiscated specimens were received from the Utah Division of Wildlife Resources. During the past 12 years, these animals have served as a primary source for a captive release project on Utah's Beaver Dam Slope in Washington County. This note reports on a very interesting captive desert tortoise which first came to my attention three years ago. The following account was obtained by interviewing the tortoise owner, Mrs. Gerri Mayhew, Salt Lake City, Utah, and examining old newspaper accounts and old photos of this tortoise.

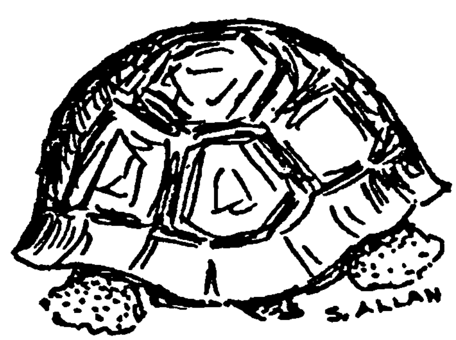
The desert tortoise, a female christened "Bozo," was given to Mrs. Mayhew's family in 1923 by vacationing friends who picked up the tortoise "between California and Utah." Mrs. Mayhew is very sure and precise of the year, as the occasion coincided with other special events which made it easy to remember. Bozo was maintained outdoors in the yard each summer, feeding on dandelion greens, grass and various fruits. The tortoise was "hibernated" in the cool basement each winter. In the mid-1930s, Bozo crawled into the open bottom draft door of the coal furnace and spent several hours there with hot coals falling on her. This resulted in extreme damage across the mid-dorsal region of her carapace and left a large unsightly dent in her carapace. The dent made Bozo easily identifiable and is illustrated in an old photo from the late 1930s and in a newspaper photo (Tribune-Telegraph, Salt Lake City) in 1947.

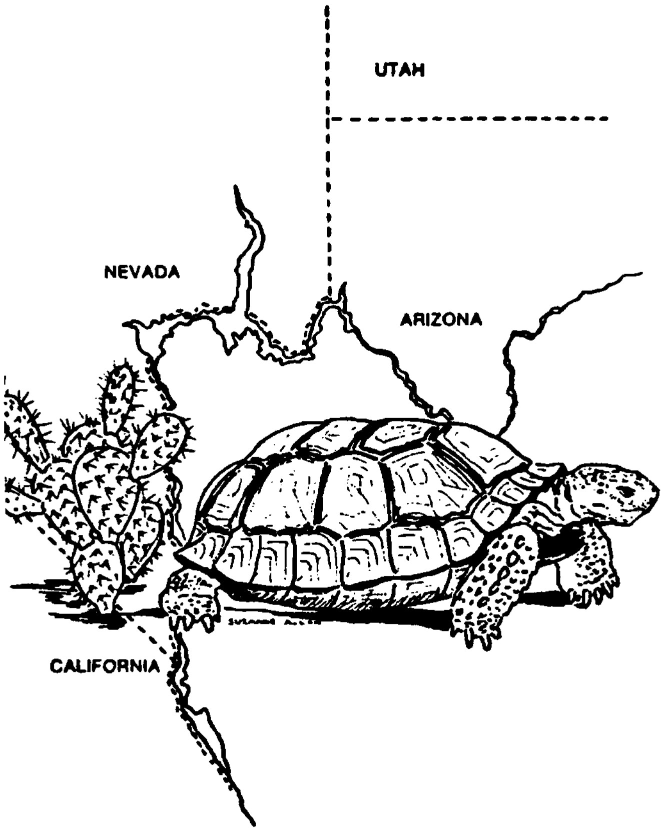
From 1932 to 1945, Bozo laid six eggs each year every spring and then went from 1946 until 1981 without laying any. In 1981, she laid one egg, and laid five eggs in the spring of 1982. When I asked Mrs. Mayhew if the tortoise could have buried eggs during the period from 1946 to 1981 and thus went undiscovered, she stated that the lawn was such that diggings would have been easily noticed.

Bozo was captured as an adult. Mrs. Mayhew says that the tortoise has grown very little since 1923. Photos of the tortoise taken during the 1930s also indicate that little growth has occurred since that time.

During the spring and summer of 1982, which were unusually wet seasons in the Salt Lake Valley, Bozo developed respiratory problems, became very weak, lethargic, and anorexic. Oral cultures revealed multiple organisms including *Pseudomonas*, *Arizona*, and two unidentified gram negative rods. The tortoise did not respond to extensive therapy over a three-week period and was euthanized 2 August 1982 because of her suffering. She is catalogued in the Utah University Herpetology Museum, Salt Lake City, Utah. Mid-carapace length (straight line) is 297 mm.

Although this type of information lacks scientific background and is not subject to authentication, it is important. Mrs. Mayhew is positive of the 1923 acquisition date, the tortoise's size at that time, and that two or more tortoises are not involved. I consider Mrs. Mayhew intelligent, honest, and sincere in her knowledge concerning Bozo's history. While listening to her story, examining the old photos and newspaper accounts, and holding in my hands the eggs of this ancient tortoise, I became intrigued with several thoughts. My first thought involved the obvious trauma expressed by Mrs. Mayhew in losing Bozo, her lifelong companion: I wondered if any other human had cared for any animal for 59 years! Second, like some of the other reptiles, the reproductive capabilities of the female desert tortoise seems ageless. And, finally, that if the information concerning this tortoise's size in 1923 is correct, Bozo may have been 80-plus years in age when she died and was possibly a centenarian.





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