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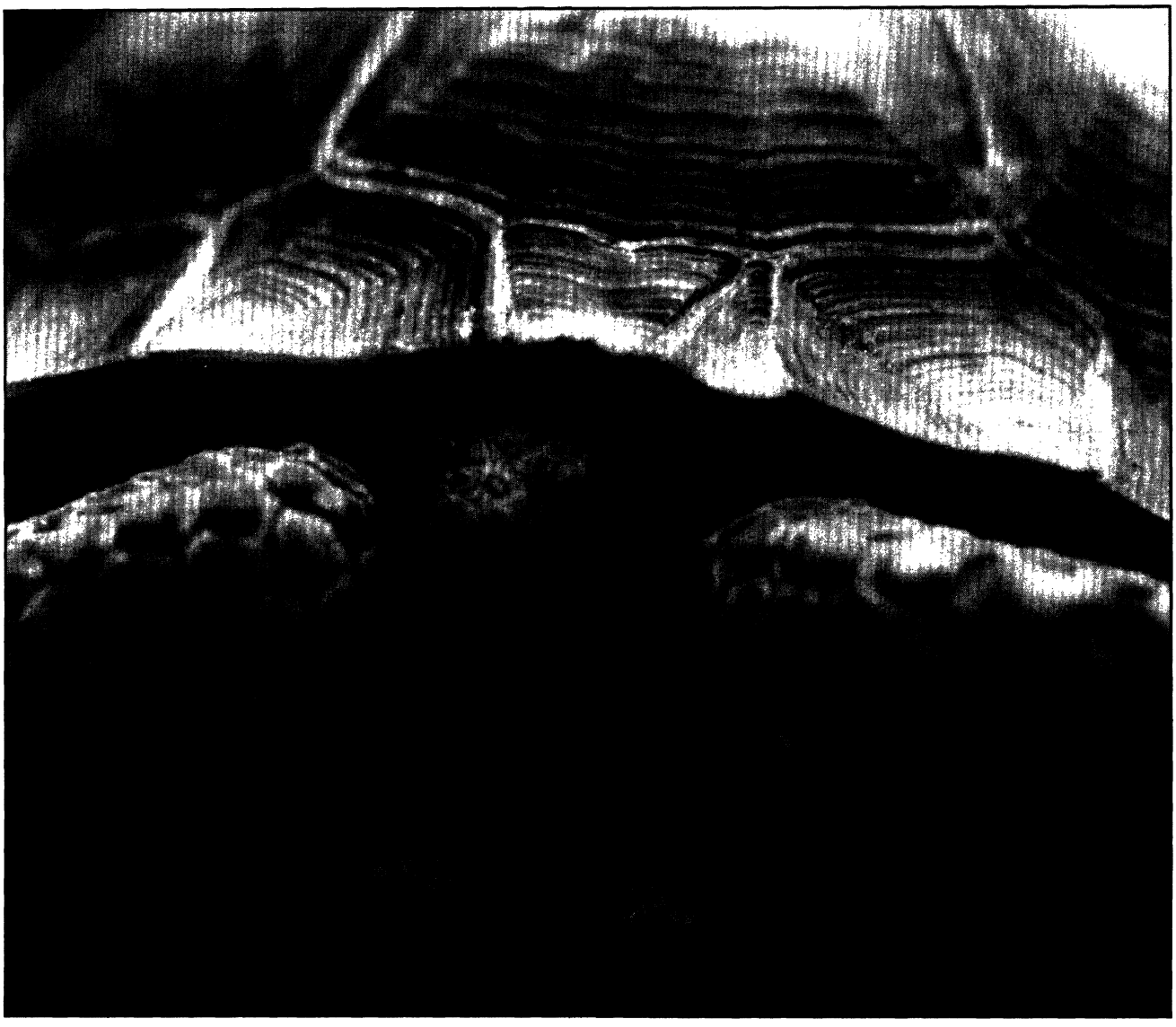

In this Issue:

A Rangewide Conservation and Research Program for the Desert Tortoise in the Desert Southwest

by

Todd C. Esque and John L. Oldemeyer

The desert tortoise (*Gopherus agassizii*), one of four tortoise species inhabiting North America, is the largest terrestrial reptile in the arid southwestern United States (Bury 1982). The range of the desert tortoise includes parts of Utah, Nevada, California, and Arizona in the United States, and extends through Sonora and into Sinaloa in Mexico west of the continental divide. Populations of desert tortoises that inhabit the desert lands north and west of the Colorado River were listed as threatened under the Endangered Species Act (ESA) in April of 1990 (U.S. Fish and Wildlife Service [USFWS] 1990). Critical habitat for the Mojave population of desert tortoises was delineated (USFWS 1994a) and twelve critical habitat units were designated throughout the Colorado and Mojave Deserts. The recovery plan for the Mojave population of the desert tortoise is available to the public through the USFWS (USFWS 1994b). The recovery team for the desert tortoise is chaired by Dr. Peter Brussard, University of Nevada, Reno.

Conservation efforts are being undertaken and research is being conducted on desert tortoises throughout their range in the United States to promote recovery of listed populations and gather baseline data on unlisted populations. Federally funded research focuses primarily on the listed Mojave Desert populations, but a substantial amount of work also is being conducted in the Sonoran Desert of Arizona where the tortoise is not federally listed. Research topics include desert tortoise biology and ecology, causes of population declines, and habitat protection and restoration.

Desert Tortoise Biology and Ecology

Species conservation requires a solid understanding of the target animal's biological and ecological characteristics. Such information enables managers to develop conservation and management strategies and assess the success of those strategies over time. Numerous research studies are currently underway that seek to increase our knowledge of desert tortoise food and habitat needs, reproductive characteristics, juvenile survivorship, and population trends.

Foraging Ecology, Nutritional Needs, and Physiology. Several cooperative research initiatives between government agencies and universities are being conducted on the foraging behavior, nutritional ecology, and physiology of desert tortoises. Tortoises primarily eat annual and herbaceous perennial plant species. In addition to eating native plants, desert tortoises in the Mojave Desert eat a substantial amount of exotic grasses and forbs. Foraging behavior studies indicate that, as a species, desert tortoises are generalists (Esque 1994); in fact, in the Mojave Desert alone, over 120 species of plants were recorded in the diets of tortoises (Jennings 1993, Avery 1994, Esque 1994). However, individual desert tortoises exhibit a high degree of specificity in their selection of forage—plants preferred in one year or at one site may be avoided at other times or places.

Laboratory studies have been conducted to help us understand the nutritional content of desert tortoise food plants relative to foraging patterns observed in field studies. Results of laboratory studies conducted by Dr. C. Richard Tracy at Colorado State University, Dr. Ken Nagey at UCLA, Harold W. Avery, National Biological Survey (NBS) in Riverside, California, and Dr. Olaf Oftedahl at Bureau of Land Management's (BLM) Desert Tortoise Conservation Center near Las Vegas, Nevada, indicate that exotic plants such as Mediterranean grass (*Schismus* spp.) provide less energy, on average, than most other available plant species. However, filaree (*Erodium cicutarium*), another exotic, contains a higher than average proportion of protein in comparison to most exotic plants.

Male desert tortoise (*Gopherus agassizii*) basking in the morning sun. Photo by Todd C. Esque.

Recent research on desert tortoise physiology has provided information on water and mineral balance in tortoises. Contrary to popular belief, desert tortoises cannot meet all their water requirements by eating desert plants. In fact, desert tortoises *must* drink water occasionally in order to rid themselves of excess potassium obtained through their diet (Peterson 1992). Mineral and water balance is a challenge for most desert

herbivores, many of which have adaptations for resolving this metabolic problem. For instance, lizards living in the same environment rid themselves of excess potassium through salt glands.

Reproductive Studies. Reproductive parameters are fundamental to understanding population dynamics. Until recently, most of what we knew about desert tortoise reproduction came from studies conducted at Goffs and Ivanpah Valley, California (Turner et al. 1986, Turner et al. 1984). More reproductive information is now becoming available from the Yucca Mountain study site at the Nevada Test Site (Meuller et al. 1994) and from Joshua Tree National Monument (Karl 1994). In general, reproductive studies have shown that desert tortoises in the Mojave Desert may lay 0-3 clutches per year, with 3-7 eggs per clutch. In addition, recent studies have indicated that the total number of eggs laid by individual tortoises is dependent upon the amount of food available (Henen and Nagy 1994). Studies have also shown that kit foxes (*Vulpes macrotis*), coyotes (*Canis latrans*), and gila monsters (*Heloderma suspectum*) are predators of desert tortoise eggs.

Ecology, Survivorship, and Growth of Neonates. Dr. David Morafka, a researcher at California State University, Dominguez Hills campus, has called neonates "the missing link" in the life history of the desert tortoise. The neonatal stage is perhaps the most difficult stage to study, due in part to the neonates' small size and delicate nature. As a result, very little is known about their behavior or survival requirements. In an effort to better understand "the missing link," Dr. Morafka and his team of student researchers are studying the nesting success, survivorship, ecophysiology, and general ecology of the offspring of wild desert tortoises as part of a long-term research project at Ft. Irwin military base in California. A series of experiments conducted by these researchers has shown that avian predation results in mortalities as high as 80% (Dr. Morafka, pers. comm.). In the absence of avian predation, survivorship in three tortoise cohorts (1990, 1991, and 1992) was approximately 80%. Egg hatching success in these experiments was 94%. This high success rate is attributable in part to the fact that Dr. Morafka and his research team do not tamper with tortoise nests. Studies in which eggs and nests are manipulated have yielded only a 60-70% egg hatching success rate.

Population Trend Analyses. Long-term analysis of trends in population attributes is the key to understanding the population status of long-lived tortoises. The BLM, in cooperation with state wildlife agencies, has collected desert tortoise population data for the past two decades. This long-term data base has been important in the decision-making process for listing the desert tortoise. Drs. Kristin Berry, NBS, and Michael Weinstein, El Morro Institute, are continuing data analysis to find clues to the spread of disease or other mortality factors in desert tortoise populations.

In 1994, studies were initiated to determine the best method of estimating population densities and population trends. These methodological studies were conducted by Edward's Air Force Base, the National Park Service at Joshua Tree National Monument, the Nevada Department of Wildlife, and NBS. Results of these projects are forthcoming.

Threats to Desert Tortoise Populations

Many efforts have been made to determine causes of desert tortoise population declines. Research studies conducted for this purpose have identified the following as major threats to desert tortoise populations in the southwest: disease, raven predation, and habitat fragmentation and alteration through such activities as off-road vehicle use and urbanization. Other issues such as habitat change due to livestock grazing and invasion by exotic plants are being researched to determine their effects on desert tortoise populations. Several of these threats will be discussed in the following sections. Research currently being conducted to better understand the causes of these threats and their impacts on desert tortoise populations

A forum for information exchange on endangered species issues

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Instructions for Authors:
The *Endangered Species UPDATE* welcomes articles related to species protection in a wide range of areas including but not limited to: research and management activities and policy analyses for endangered species, theoretical approaches to species conservation, and habitat protection. Book reviews, editorial comments, and announcements of current events and publications are also welcome.

Readers include a broad range of professionals in both scientific and policy fields. Articles should be written in an easily understandable style for a knowledgeable audience. For further information, contact the editor.

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Cover: Immature Desert Tortoise (*Gopherus agassizii*). Photo by Todd C. Esque.

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also will be discussed.

Upper Respiratory Tract Disease (URTD). URTD is widespread in listed populations of the desert tortoise. This disease, which is often fatal, is spread by contact among individuals. Signs of the disease include a runny nose, swollen eyes, and a dull rather than a rosy pink coloration of the interior of the mouth. Severe cases of URTD include tissue damage around the nares. Disease effects may be exacerbated in nutritionally stressed tortoises (Brown et al. 1992).

Important breakthroughs in URTD were recently made at the Veterinary School of the University of Florida, Gainesville under the direction of Dr. Elliott Jacobson and several of his colleagues, in cooperation with Dr. Kristin Berry. These researchers isolated and identified *Mycoplasma agassizii* as the causative etiologic agent in URTD (Schumacher et al. 1993). Researchers also developed an enzyme-linked immunosorbent assay, or ELISA test, that is useful for the detection of antibodies to URTD. Other researchers have learned that URTD in the federally protected gopher tortoise (*G. polyphemus*) is not caused by *Mycoplasma testudinis*, as was previously thought, but rather by *M. agassizii* (Brown and Brown 1994).

Raven Predation. Ravens are a major predator of juvenile desert tortoises. Raven populations increase when resources that are normally limiting are provided in abundance. Currently, our deserts provide ravens with excess food and water around housing developments, refuse dumps, and sewage treatment facilities. Human-made structures (e.g., power poles and buildings) also provide abundant nest sites.

An experimental program to reduce predation by shooting problem ravens has been initiated in areas of California where raven predation on desert tortoises has been identified as a major threat to tortoise populations (USDI-BLM 1994). In 1994, problem ravens and all other ravens known to forage in the Desert Tortoise Research Natural Area were targeted for shooting. This work is conducted under strict guidelines (USDI-BLM 1994) and is coordinated with several major conservation organizations (e.g., National Audubon Society, Humane Society of the United States, Defenders of Wildlife). Evaluation of the success and effectiveness of this program will be completed by the end of the year.

Highways. Highways and graded roads can directly affect tortoise populations by killing individuals and cause indirect impacts by fragmenting habitats and populations. Nicholson (1978) showed that the influence of highways can extend more than one-half kilometer into the surrounding desert. Marlow and Hoff (1994) similarly reported that in Clark County, Nevada, heavily used highways that intersect desert tortoise habitat can have a measurable effect on tortoise populations up to 4.5 km from the road. Marlow and Hoff also found that desert tortoise mortalities depended on the amount of traffic and the way in which the tortoises moved through their habitat. Recent studies have been designed to determine the effectiveness of tortoise barrier fences to reduce road mortalities (Sazaki and Boarman 1994).

Livestock Grazing. Sheep and cattle have been grazed on desert habitats in the American southwest since the mid-1800s. Almost a century of unregulated use led to degradation of desert rangelands. Eventually, policies were developed to regulate grazing on public lands for the purpose of improving range conditions (USDI 1934). New initiatives such as rangeland reform continue today (USDI-BLM and USDA-Forest Service 1994).

The vegetative components of ecosystems in many parts of the southwest have begun to recover as a result of these grazing policies and initiatives. However, in the case of the desert tortoise, much work remains to be done (General Accounting Office 1991). Livestock grazing reportedly has caused changes in tortoise populations through direct and indirect impacts such as removal of forage plants, trampling of individual tortoises, and habitat disturbances that cause changes in habitat quality (e.g., introduction of exotic plants).

BLM is the primary permitting agency for cattle grazing in desert tortoise habitat. BLM considers classes of livestock, season of use, and potential impacts of grazing on desert tortoises and their habitats through consultations with the USFWS under the Section 7 process outlined in the ESA. The process of permitting livestock grazing in desert tortoise habitat has undergone considerable changes over the past several years due to listing of the tortoise as threatened, identification of critical habitat units, and use of Habitat Conservation Plans to purchase grazing leases. Needless to say, reduction of lands available for grazing permits has caused considerable controversy because of the long history of grazing in the west.

Potential effects of livestock grazing on desert tortoise populations are being studied in a cooperative BLM/NBS research project in southern Nevada and eastern California. This study, coordinated by Phil Medica and John Oldemeyer (both with NBS), is designed to occur in two phases. Phase one will determine a zone of influence of cattle grazing around water holes based on vegetative cover, soil type, and tortoise densities from a point source of disturbance (at stock tanks) to a distance of three miles. Based on results obtained in phase one, BLM and NBS will decide the direction and emphasis of the second phase of the grazing study.

In addition to this cooperative research project, a synthesis of foraging, nutrition, and physiological studies is being used to make a predictive model to determine the level of competition between cattle grazing and the food needs of the desert tortoise. This model has been used by managing agencies to make decisions about cattle grazing.

Desert Tortoise Management and Conservation Initiatives

Several types of desert tortoise management activities have been initiated or are currently being developed. These include the creation of reserves, habitat conservation plans, and coordinated management plans. A common goal of all these activities is the conservation of desert tortoises and their habi-

tats. In general, these activities have been initiated by private entities or local, state, and federal governments. However, they usually are cooperative efforts between broad-based organizations.

Reserves. The Desert Tortoise Research Natural Area (DTRNA) in California is an example of a reserve set aside for desert tortoise conservation. Designated in 1973 by the California BLM in cooperation with a private organization called the Desert Tortoise Preserve Committee, the DTRNA was the first reserve established for desert tortoises. Primary ongoing projects at DTRNA include research and public education. Efforts also are being made to expand the reserve and acquire private inholdings.

Habitat Conservation Plans. Habitat Conservation Plans (HCPs) are an avenue by which private landowners can establish conservation programs to protect the desert tortoise and its habitat. The Habitat Conservation Planning process, established under Section 10a of the ESA, was designed to reduce conflict between those interested in development of private lands and conservation of listed species living on those lands. HCPs allow for a compromise between development interests and regulations mandated in the ESA.

Development of an HCP is the responsibility of those wishing to develop private land. Usually, developers propose "taking" individual endangered species or their habitats in return for a conservation plan benefiting the species as a whole. Mitigative measures in HCP proposals include, but are not limited to setting aside reserves, purchasing land for reserves, funding administrative costs of reserves, and funding research promoting recovery of threatened and endangered species.

Four HCPs exist that were designed primarily to resolve issues related to the desert tortoise and its habitat. Two are local in size: Sunlands and Church Site federal, both located in California (LaRue 1994). The other two are county-wide: Clark County, Nevada and Washington County, Utah. All the plans were in development for more than one year, and only the Church Site federal HCP has been permitted in its entirety. After more than two years of hard work, both county-wide plans are in the final stages of development and are being reviewed by the U.S. Fish and Wildlife Service (USFWS). If adopted, both the Clark County and Washington County HCPs have the potential to help protect important desert tortoise habitat in the northeast Mojave Desert.

Coordinated Management/Conservation Plans. California's West Mojave Coordinated Management Plan encompasses 9.5 million acres, making it one of the largest coordinated management/conservation plans within the range of the desert tortoise (Debi Clark, BLM-CA, pers. comm.). This plan, which targets the desert tortoise, Mojave ground squirrel (*Spermophilus mohavensis*), and several sensitive plant species, is a massive administrative effort requiring cooperation from federal, state, and private entities. Viewed as a template for Eastern and Northern Colorado Desert management plans, this plan will serve as an HCP for private development and a federal Coordinated Management Plan for federal land actions. A public draft of the plan should be available soon.

Desert Tortoise Research Project

Recently, a Desert Tortoise Research Project (DTRP) was formed within the National Biological Survey (NBS), a new research agency for the U.S. Department of Interior. Staff scientists were drawn from BLM offices throughout the range of the desert tortoise in the Mojave and Colorado Desert. The research team consists of Hal Avery, Dr. Kristin Berry, Dr. William Boarman, Lesley DeFalco, Todd Esque, Dr. Jeff Lovich, Phil Medica, and Dr. John Oldemeyer. The office of the team leader, Dr. Oldemeyer, is located at the Midcontinent Ecological Science Center, Ft. Collins, Colorado (formerly the National Ecology Research Center). Field offices are located in St. George, Utah; Las Vegas, Nevada; and Palm Springs and Riverside, California.

The desert tortoise research team has been directed to finish current projects and design and conduct new research on recovery of the desert tortoise. DTRP personnel have been working closely with cooperators in federal, state and local agencies to coordinate and complete research on desert tortoises and their habitats. Current research topics include isolation and description of diseases, physiology, nutrition and foraging ecology, population trends, livestock grazing, raven predation, effects of highways on populations, and habitat restoration.

Future research topics will likely include population demography, reproduction and recruitment, causes of juvenile mortality, impacts of habitat disturbances on populations of tortoises, disease epidemiology, population trends, the function of desert ecosystems, and the relative value of each desert tortoise reserve at an ecosystem level. Work in desert tortoise habitats should also provide valuable information about other sensitive species occurring in desert ecosystems. The emphasis for these research topics will be determined through joint meetings among cooperators.

Conclusion

The desert tortoise is but one of 50 species of tortoises inhabiting tropical and subtropical habitats around the world (Ernst and Barbour 1989). Many of these species have been listed by the International Union for the Conservation of Nature as being in danger of extinction. The monumental efforts being undertaken to understand population declines, set aside reserves of adequate size, and promote recovery of the desert tortoise will have application toward the conservation of other tortoise species and their habitats worldwide.

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Report From the Field

The Bruneau Hot Springsnail Saga

by Patricia Klahr and Stephen Duke

Introduction

In an unprecedented decision, an Idaho district judge removed the Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) from the endangered species list on December 14, 1993. This case was the first in which a federal judge removed a species from the endangered species list. The legal challenge to the listing of this thermal water obligate was brought by the Idaho Farm Bureau and others against the Secretary of Interior (Secretary).

The district court set aside the January 1993 listing of the snail as endangered because of procedural and due process violations. The court ruled that the listing was invalid because the U.S. Fish and Wildlife Service (FWS) violated the Endangered Species Act by failing to take action within eighteen months of the initial proposal to list the species.[1] In the case of the Bruneau hot springsnail, over seven years from the initial proposal passed before the species was listed as endangered. The court also ruled that the FWS failed to provide adequate opportunity for public comment. However, the district court affirmed the scientific basis for the listing, concluding that "the Fish and Wildlife Service articulated a rational connection between the factors identified and the choice made."

Bruneau Hot Springsnail

The Bruneau hot springsnail, first described in 1990, is endemic to Hot Creek and adjacent thermal seeps along an 8 km reach of the Bruneau River in Owyhee County, Idaho. The snail is distinguished by its small size (<2.8 mm shell height) and its squat shell (Hershler 1990). Temperature plays an important role in the distribution of *P. bruneauensis*, who prefer a thermal range between 24° - 35° C and have exhibited growth retardation at cooler temperatures (<24° C) (Mladenka 1992).

The hot springsnail was first collected in the 1950s from the "Indian Bathtub," an historic and culturally significant hot spring located on Bureau of Land Management land in the Hot Creek drainage (Bowler and Olmstead 1991). The Indian Bathtub has shown an abrupt decline in discharge from about 2,400 gallons per minute in 1964 to zero discharge by the summer of 1989 (USGS 1993).

The major threat to the Bruneau hot springsnail is the continuing loss of its thermal spring habitats due to excessive groundwater pumping from the regional geothermal aquifer system. The thermal springs are hydraulically connected with the geothermal aquifer, which has declined more than 30 feet in much of the area, and at least 70 feet in one well (USGS 1993).

The Listing Process

The FWS first proposed listing the Bruneau hot springsnail as endangered on August 21, 1985, citing drastic and continuing reductions in spring flows as the major threat to the species. The ensuing public review process initiated by this proposed rule took place between 1985-1992 and included six separate public comment periods totaling over 200 days. Two public hearings also were held in the area affected by the listing (58 Federal Register 5939). During the course of the comment period, the Idaho Department of Water Resources (IDWR) and other reviewers questioned the FWS's analysis of available scientific information, contending that surveys of available habitat were incomplete and that hydrologic studies linking groundwater usage with spring flows were needed.

Subsequently, the FWS agreed to develop a multi-agency cooperative conservation plan and to conduct additional studies of the springsnail's habitat and the hydrology of the regional geothermal system. The U.S. Congress, at the request of Idaho Senators, appropriated funds for these studies. The studies, conducted by the U.S. Geological Survey, the IDWR, and Idaho State University, began in 1987 and lasted through 1992. Results of these studies revealed additional colonies of springsnails, but also documented that all occupied springsites were hydraulically connected and threatened by groundwater pumping.

The Court Action

In June 1992, two Idaho conservation groups, represented by the Land and Water Fund of the Rockies (LAW Fund), filed a lawsuit in Federal District Court in Boise over the FWS's failure to make a final determination on the listing of the springsnail. Later that year, the same court that ultimately removed the springsnail from the endangered species list approved a settlement in this action. Pursuant to this settlement, the FWS committed to making a final decision on the status of the springsnail. On January 25, 1993, over seven years after the initial listing proposal, the final rule listing the Bruneau hot springsnail as endangered was published.

However, protected status for the Springsnail was short lived. Less than four months after the snail was listed, a lawsuit was filed by the Idaho Farm Bureau asking the court to void the listing due to procedural and due process violations, as well as challenging the scientific and factual basis of the final decision to list. Late in 1993, the court decided in favor of the plaintiffs and held that the statutory deadlines prohibit the Secretary from listing any species more than eighteen months after it is first proposed for listing.

Conclusions

Two options currently exist for restoring the Bruneau Hot Springsnail to the endangered species list: file a relisting petition or file an appeal to the

court's decision. A petition to re-list was filed early in 1994 by the LAW Fund. The FWS is currently processing this petition. The LAW Fund also has filed an appeal of the district court decision that, if successful, would presumably restore the springsnail to the endangered species list. Meanwhile, agricultural-related pumping continues to threaten remaining springsnail habitat.

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[1]An appeal to this decision was filed by the Land and Water Fund of the Rockies in the Ninth Circuit Court of Appeals in May 1994; a decision on this appeal is expected later this year.

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Authors' Note: This paper provides a sample of the many research projects currently being conducted to understand desert tortoise biology. The USDA-Forest Service is publishing a more comprehensive bibliography of desert tortoise research projects (Grover and DeFalco, In Press). A compilation of research results from the Desert Tortoise Conservation Center, Las Vegas, Nevada will be available soon (Spotilla et al. 1994). For the most up-to-date compilation of information on current desert tortoise research and conservation issues, see the abstracts from the 1994 symposium of the Desert Tortoise Council.

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Bulletin Board

Job Announcement

The Center for Plant Conservation (CPC) is seeking a full-time Grant Coordinator for its National Office headquartered at the Missouri Botanical Garden in St. Louis. This position manages existing grants consistent with the mission of the Center for Plant Conservation and requires ability to exercise independent judgement within broad guidelines while interacting directly with funding agencies, contractors, other botanical gardens, administration, budget maintenance, proposal and grant writing, and project direction. Candidate must be able to reinstate and stabilize regional task force meetings in collaboration with the CPC President and lead the implementation of several research and integrated conservation projects on endangered plants. Position duration is one year and is renewable depending upon performance and funding. Position requirements include a Bachelor's degree in plant biology, conservation, or related scientific discipline, Master's degree preferred, or a combination of education and experience/ proficiency with various word processing and spreadsheet software; exceptional verbal and written communication skills; demonstrated leadership abilities and proven creative management skills; three years experience in grant administration with budgetary responsibilities; and an ability to maintain an active travel schedule. Applications will be accepted until the position is filled. However, interested individuals with the specified position qualifications should apply immediately and submit a resume, including salary requirements, to: Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166. CPC is an equal opportunity/ affirmative action employer.

Address Change

The Declining Amphibian Populations Task Force office has moved from its previous address in Corvalis, Oregon, to: Biology Dept., The Open University, Walton Hall, Milton Keyes, MK7 6AA, United Kingdom.

Field Research in Brazil

Instituto Ecologico Cristalino (IEC) is a nonprofit organization seeking to expand research activities at its field station in Mato Grosso State, Brazil. The field station is located in the Meridional Amazon Forest, one of the richest fauna and flora areas in the Amazon. The IEC is seeking institutions that are interested in supporting research in biology, ecology, agroforestry, reforestation, environmental education, and related areas. Contact: Adrianna Gomes Consorte-McCrea, CEA-AF, Instituto Ecologico Cristalino, R. Teodora Baima, 100 11A 01220-03030.

Conservation Biology Meeting

The Ninth Annual Meeting of the Society for Conservation Biology will be held June 7-11, 1995, at Colorado State University in Fort Collins, Colorado. A call for papers and registration information will be mailed in December 1994. For more information contact the meeting organizer: Richard L. Knight, Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins, CO 80523.

Announcements for the Bulletin Board are welcomed. Some items from the Bulletin Board have been provided by Jane Villa-Lobos, Smithsonian Institution.

Endangered Species UPDATE

School of Natural Resources and Environment
The University of Michigan
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