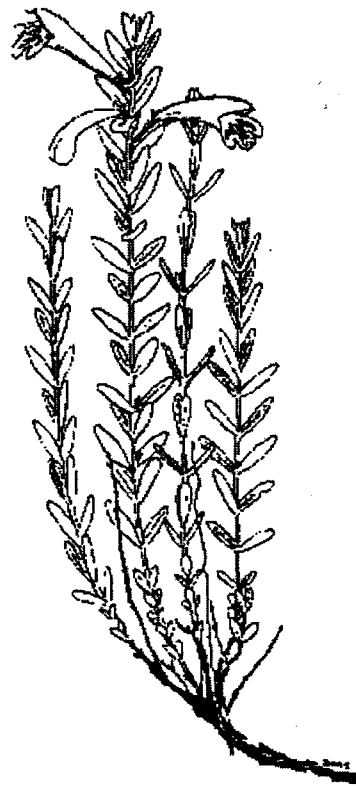


U.S. Fish & Wildlife Service

Todsen's Pennyroyal
(Hedeoma todsenii)
Revised Recovery Plan

U.S. Fish and Wildlife Service
New Mexico Ecological Services
Field Office



August 2001

TODSEN'S PENNYROYAL
(Hedeoma todsenii)
REVISED RECOVERY PLAN

Original Approved: March 22, 1985

Prepared by

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for

**Region 2
U.S. Fish and Wildlife Service
Albuquerque, New Mexico**

Approved:
Acting



Regional Director, U.S. Fish and Wildlife Service

Date:

January 31, 2001

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Literature citations should read as follows:

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In addition, we would like to acknowledge the field assistance of the following individuals of the Department of Biology, New Mexico State University: Cheryl Craddock, Laura Huenneke, Justin VanZee, and Sarah Wood.

EXECUTIVE SUMMARY

Current Status: Todsens pennyroyal is listed as endangered. It is known from 18 sites in the San Andres and Sacramento mountains of south-central New Mexico.

Habitat Requirements and Limiting Factors: Todsens pennyroyal grows in gypseous-limestone soils on north-facing slopes in piñon-juniper woodland. There are no imminent threats to this species from present land management activities. Low number of populations, low sexual reproduction, low genetic diversity, poor dispersal, fire, insect predation, and disease are potential natural threats.

Recovery Objective: Interim goal is downlisting, with a final objective of delisting.

Recovery Criteria: Downlisting to threatened can occur when management plans have been developed and implemented that ensure the continued protection of all extant sites and the responsible land management agencies verify through monitoring that protective management is successful. Delisting can occur when research identifies solutions to the natural threats and these solutions are implemented to ensure that protected populations can sustain themselves indefinitely.

Major Actions Needed:

1. Ensure continuing compliance with laws and regulations.
2. Develop and implement management plans that protect existing populations from potential threats. Verify management success through monitoring.
3. Continue and expand current research to increase understanding of population structure, reproductive biology, and long-term population trends.
4. Search for additional populations.

Estimated Total Cost of Recovery (\$000's):

<u>Year</u>	<u>Need 1</u>	<u>Need 2</u>	<u>Need 3</u>	<u>Need 4</u>	<u>Total</u>
2001	17.0	58.9	120.0	20.0	215.9
2002	17.0	50.6	105.0	20.0	192.6
2003	17.0	44.6	108.0	20.0	189.6
2004	17.0	24.6	87.0	0.0	128.6
2005	17.0	24.6	87.0	0.0	128.6
2006	17.0	24.6	46.0	0.0	87.6
2007	17.0	24.6	11.0	0.0	52.6
2008	17.0	24.6	0.0	0.0	41.6
2009	17.0	24.6	0.0	0.0	41.6
2010	<u>17.0</u>	<u>24.6</u>	<u>0.0</u>	<u>0.0</u>	<u>41.6</u>
Recovery Cost	170.0	326.3	564.0	60.0	1120.3

Date of Recovery: Downlisting to threatened could occur as early as 2006; delisting could occur as early as 2011.

TABLE OF CONTENTS

	Page
DISCLAIMER	iii
ACKNOWLEDGMENTS	iv
EXECUTIVE SUMMARY	v
PART I – INTRODUCTION	1
Brief Overview	1
Taxonomy	2
Morphology	3
Distribution and Abundance	4
Habitat	8
Population and Reproductive Biology	9
Land Ownership	12
Impacts and Threats	13
Conservation Measures	15
PART II – RECOVERY	21
Objectives and Criteria	21
Outline of Recovery Actions	22
Literature Cited	31
PART III – IMPLEMENTATION SCHEDULE	33
APPENDIX	37

PART I – INTRODUCTION

Brief Overview

Todsens pennyroyal (*Hedeoma todsenii* Irving) was given endangered status and critical habitat was designated under the Endangered Species Act of 1973 (Act), as amended, on January 19, 1981 (U.S. Fish and Wildlife Service 1981).

Todsens pennyroyal was known from two sites in the San Andres Mountains when designated as endangered in 1981.

The two parcels of critical habitat, each a square kilometer in size, are on the White Sands Missile Range. Todsens pennyroyal was designated as endangered because of its extremely restricted range and small population size. At the time, it was known from only two places in the San Andres Mountains of southern New Mexico. Both sites were on the White Sands Missile Range, in Sierra County (U.S. Fish and Wildlife Service 1981). A recovery plan for Todsens Pennyroyal was approved in 1985 (U.S. Fish and Wildlife Service 1985). The State of New Mexico lists Todsens pennyroyal as endangered (Sivinski and Lightfoot 1995). Todsens pennyroyal has a recovery priority of 8. This priority indicates Todsens pennyroyal is a full species with a moderate degree of threat and a high recovery potential.

In 1988, Mike Howard of BLM found a new population leading to the discovery of 15 sites in the Sacramento Mountains.

On August 17, 1988, Bureau of Land Management (BLM) wildlife biologist Mike Howard found a population of Todsens pennyroyal at Domingo Peak in Otero County. This population is on the western slope of the Sacramento Mountains, across the Tularosa Basin about 75 kilometers (45 miles) east of the San Andres Mountains populations. During 1990, 1991, and 1993, 15 sites were found in the Sacramento Mountains,

all near Domingo or Mountain Lion peaks. A third San Andres Mountains site was found on September 16, 1990.

There have been 16 new Todsens pennyroyal sites found since the completion of the original Todsens Pennyroyal Recovery Plan (U.S. Fish and Wildlife Service 1985). Also, several reproductive biology and ecology studies have provided some new insights about the species. This new information needs to be incorporated into the recovery program.

The U.S. Forest Service - Lincoln National Forest and the BLM - Las Cruces Field Office manage the Todsens pennyroyal sites in the Sacramento Mountains; the U.S. Department of Defense manages the sites in the San Andres Mountains. There appear to be no immediate threats to Todsens pennyroyal sites from the present activities of the land managing agencies. Soil erosion, illegal grazing, minerals exploration, changes in land use or management, and military activities are potential future threats. Wildfire, low sexual reproduction, limited dispersal ability, and limited suitable habitat are some of the natural threats to the species. If present management remains unchanged, natural threats now appear to far exceed human activities as a potential cause of Todsens pennyroyals possible extinction.

Taxonomy

Todsens pennyroyal was discovered in 1978 and named in 1979.

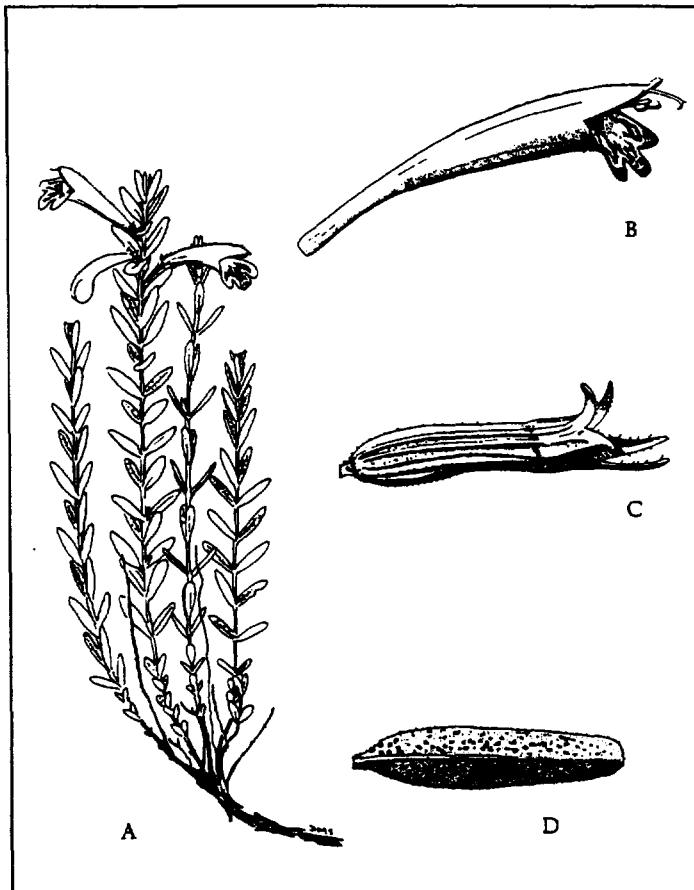
Dr. Thomas Todsens discovered the first Todsens pennyroyal population on August 18, 1978. Dr. Todsens and Dr. Robert Irving found a second population in the San Andres Mountains later in 1978. Todsens pennyroyal was described as a new species in 1979; Dr. Todsens collected the type specimen, "2 miles south of Hardin Ranch, 2000 m" (collection #SA 1-78). The holotype is deposited at the New York Botanical Garden Herbarium;

isotypes are deposited in herbaria at New Mexico State University, the University of Texas, and the U.S. National Herbarium (Irving 1979).

Todsens pennyroyal is a member of the mint family (Lamiaceae). Within its genus, it is placed in the subgenus *Ciliatum*, a group of morphologically distinct, restricted endemics of southern New Mexico, western Texas, and Nuevo Leon, Mexico (Irving 1979).

Morphology

Todsens pennyroyal is a perennial rhizomatous herb 10 - 20 centimeters (cm) (4 - 8 inches (in)) tall and somewhat woody at the base (Figure 1). The rhizomes are



slender and unbranched. The leaves are opposite, 0.8 - 1.5 cm (0.3 - 0.6 in) long, 0.25 - 0.5 cm (0.1 - 0.2 in) wide, lance-shaped, margins smooth, tip rounded to acute, and the lower surface glandular-dotted. The flowers occur singly in the axils of the upper stem leaves. The calyx is 1.3 cm (0.5 in) long and two-lipped; the five calyx teeth are lance-shaped. The corolla is of five united petals, two-lipped, 3.6 cm (1.4 in) long, and orange-red to yellow. Yellow-flowered plants are less common, but have been seen at several places in

Figure 1. Todsens pennyroyal. A. general habit; B. corolla; C. calyx; D. leaf.

the Sacramento Mountains. The corollas of the San Andres Mountains plants are slightly longer than those of the Sacramento Mountains plants (New Mexico Forestry and Resources Conservation Division [NMFRCD] 1991). There are two stamens. The fruits are of four nutlets; usually one or two develop to maturity, but all four may reach maturity (NMFRCD 1992; Huenneke 1993). The oblong-lanceolate leaves and long, bright red-orange corolla easily distinguish Todsens pennyroyal from other members of the genus (Irving 1979).

Distribution and Abundance

Todsens pennyroyal is known from the San Andres and Sacramento mountain ranges of southern New Mexico. There are 3 San Andres Mountains sites, all on White Sands Missile Range, Sierra County, New Mexico (Figure 2). These sites are at elevations of 1,900 - 2,075 meters (m) (6,250 - 6,800 feet (ft)). There are 15 Sacramento Mountains sites in Otero County, New Mexico. There are 8 sites near Domingo Peak (Figure 3) and 7 near Mountain Lion Peak (Figure 4). The Sacramento Mountains sites are at elevations of 1,875 - 2,250 m (6,200 - 7,400 ft). All sites occur where there are loose gypseous-limestone soils. There are often thousands of Todsens pennyroyal stems at a site; however, the number of genetically distinct individuals is unknown because of the highly rhizomatous nature of the plants. The sites may not all be separate populations in a biological sense.

The extent of the Yeso and related gypsum deposits suggests more populations are possible.

The extent of the Yeso and related gypsum deposits in the Tularosa Basin suggests more populations are possible. Suitable habitats may exist elsewhere in the San Andres Mountains, on the western slope of the Sacramento Mountains, or to the north in the Oscura Mountains and on Chupadera Mesa.

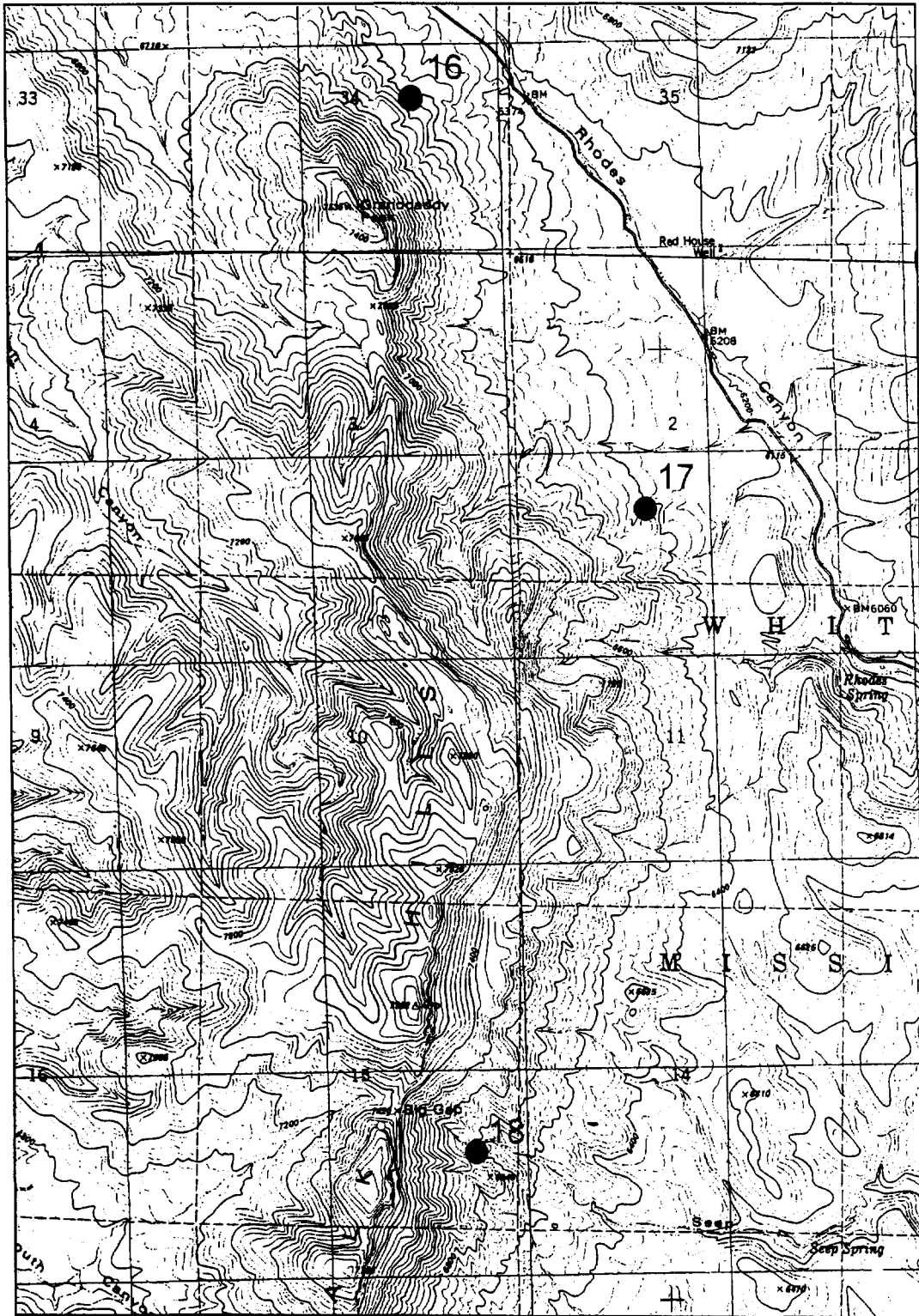


Figure 2. White Sands Missile Range Todsen's pennyroyal sites. The USGS topographic quadrangle is Hardscrabble Mountains, NM; 7.5 min series. Site numbers correspond to numbers in Table 1.

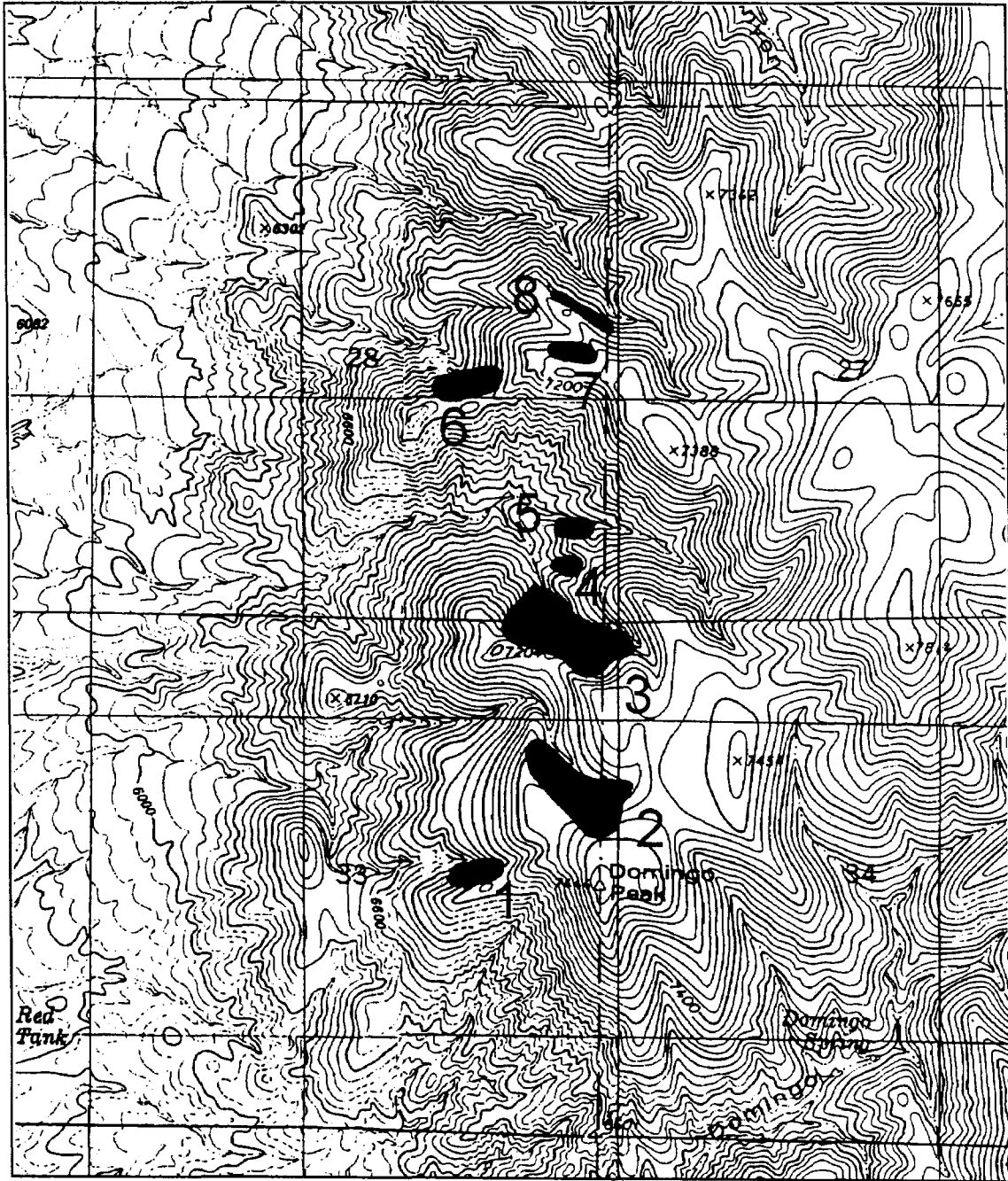


Figure 3. Domingo Peak Todsens pennyroyal sites. The USGS topographic quadrangles are Domingo Peak, NM and Sabinata Flat, NM; 7.5 min series. Site numbers correspond to numbers in Table 1.

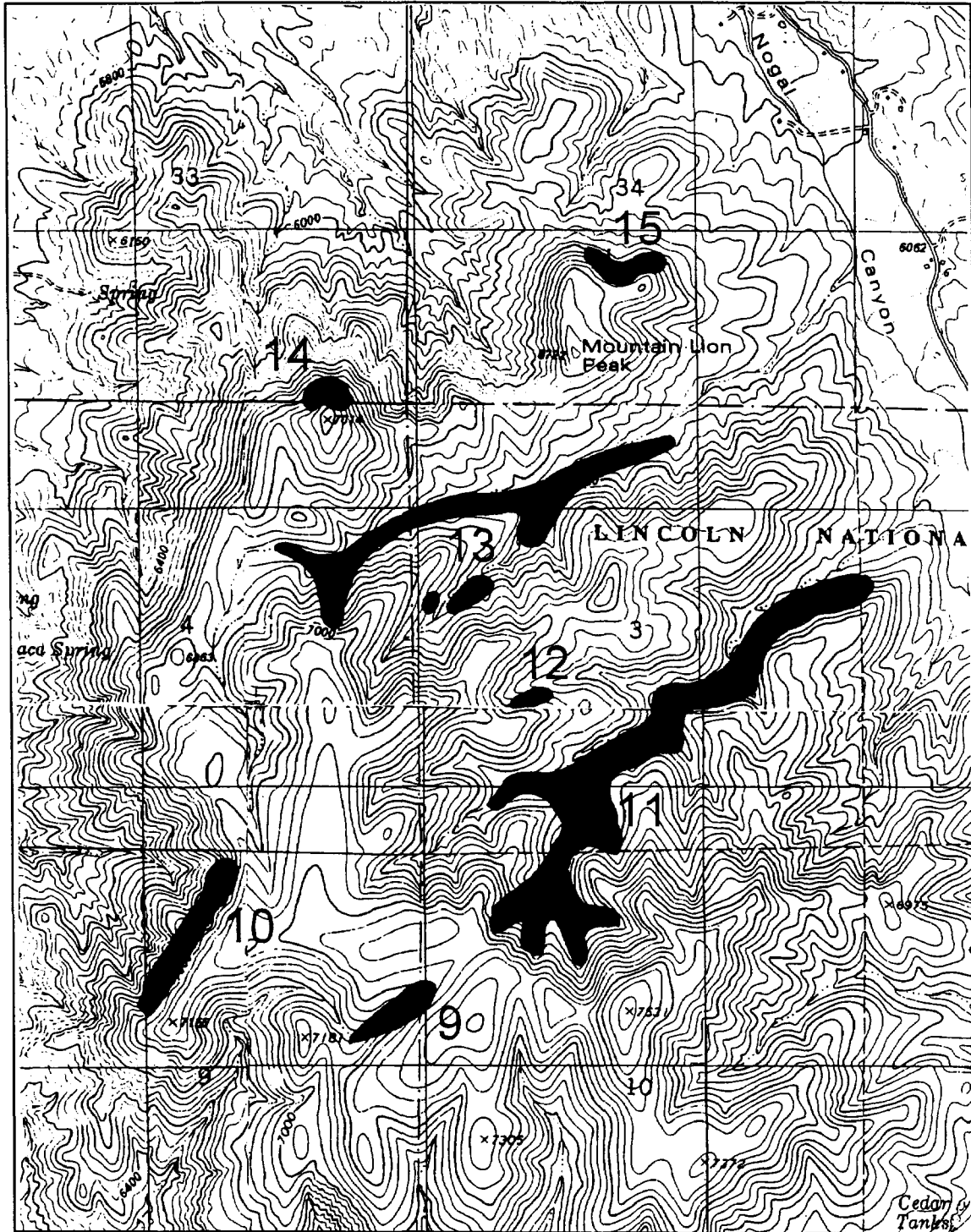


Figure 4. Mountain Lion Peak Todsen's pennyroyal sites. The USGS topographic quadrangles are Cat Mountain, NM; Mescalero, NM; Sabinata Flat, NM; and Domingo Peak, NM; 7.5 min series. Site numbers correspond to numbers in Table 1.

Habitat

Todsens pennyroyal occurs in the Great Basin Conifer Woodland community where piñon pine (*Pinus edulis*) and one seed juniper (*Juniperus monosperma*) are the dominant species (Brown and Lowe 1980). Besides piñon and juniper, other common associates with Todsens pennyroyal include mountain mahogany (*Cercocarpus montanus*), yellowleaf silktassel (*Garrya flavescens*), wavyleaf oak (*Quercus undulata*), white ragweed (*Hymenopappus radiatus*), snakeweed (*Gutierrezia* sp.), and muhly grass (*Muhlenbergia* sp.). Todsens pennyroyal does not appear to associate consistently with any particular species. It grows (and flowers) in the shade of piñon pines and junipers, and in woodland openings with thin grasses (mostly *Muhlenbergia* sp.). At some sites, it is absent from thickets of wavyleaf oak; at other sites, flowering plants are under wavyleaf oak and other shrubs (The Nature Conservancy, New Mexico Field Office 1990; Sarah Wood, pers. comm. 1993).

Todsens pennyroyal is restricted to loose, gypseous-limestone substrates associated with or positioned immediately below the Permian Yeso Formation (NMFRCD 1991). Most plants are on steep (20 - 70 degree), north-facing slopes, with a surface of scree or gravelly cobble; however, some plants at Mountain Lion Peak are on small, nearly level terraces along intermittent streams. The substrates have a thin layer of conifer litter over a mixture of limestone and finer materials. In general, these gypsum-derived soils appear to retain more moisture than other soils in similar situations (NMFRCD 1992). Although natural populations of Todsens pennyroyal are restricted to gypseous substrates, this is not a requirement under cultivation; however, good drainage is essential (Joyce Maschinski, Arboretum at Flagstaff, Flagstaff, Arizona, pers. comm. 1993).

Plants grow in loose gypseous-limestone soils on north-facing slopes.

At Tularosa, the nearest recording station for climatic data, the average annual precipitation is 35.5 cm (14 in) per year, and the frost-free season averages 190 days (National Oceanic and Atmospheric Administration 1991). Tularosa, however, is about 520 - 885 m (1,700 - 2,900 ft) lower in elevation than the Todsens pennyroyal sites, which probably receive more precipitation and have a slightly shorter growing season.

Todsens pennyroyal could have been more common in the Tularosa Basin more than 10,000 years ago when the region was cooler and areas of suitable habitat were perhaps more closely situated (NMFRCD 1992). It may now be a relict species, surviving where aspect and soils create a cooler moister microclimate. Ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*), which are characteristic of higher elevations, occur near Todsens pennyroyal sites in the Sacramento Mountains. This helps support the relict hypothesis, but these trees seldom occur precisely with Todsens pennyroyal (NMFRCD 1992; Laura Huenneke, New Mexico State University, Las Cruces, pers. comm. 1993; Sarah Wood, New Mexico State University, Las Cruces, pers. comm. 1992).

Todsens pennyroyal may be a relict species surviving where aspect and soils create cooler moister sites.

Population and Reproductive Biology

When Todsens pennyroyal was given endangered status in 1981, it had been recognized as a species for only 3 years and relatively little was known about its population and reproductive biology. Research done since then has improved our understanding of the species. The discovery of new sites, more accessible to researchers, helped make some of the work possible.

Plants grow from a system of interconnected rhizomes.

Todsens pennyroyal populations have hundreds to thousands of separate clumps of plants, each clump with 1 - 20 stems. Slender unbranched rhizomes interconnect many of these clumps. Potentially, an entire population could be one genetic individual interconnected through this rhizome system (NMFRCD 1991). Dr. Laura Huenneke (1993) tried to detect genetic differences within and between populations using starch gel electrophoresis of isozymes. If differences were detected within a population, it would suggest the population is composed of several genetically distinct individuals; if no differences were detected, the population might be composed of one genetic individual or of several closely related clones. Results of the isozyme study were inconclusive; there were too many secondary compounds for the protein extraction to work well. The study was not repeated, so no information is yet available about genetic diversity within and between Todsens pennyroyal populations (Laura Huenneke, pers. comm. 1997).

Field observations show low sexual reproduction in Todsens pennyroyal, with less than 20 percent of clumps flowering per season (NMFRCD 1992). Seed set is also low; the percentage of flowers setting seed averaged 24.8 percent (NMFRCD 1992) and 27 percent (Ulaszek 1993) in Sacramento

Mountains populations. Additionally, even fertile flowers rarely produce their full potential of four nutlets. Field observations of seed set per fertile flower have been 1.6 nutlets/flower (Irving 1979), 1.8 nutlets/flower (NMFRCD 1991), 2.3 nutlets/flower (NMFRCD 1992), and 2.3 nutlets/flower (Ulaszek 1993). Seed viability also appears low. In one study, 1 of 20 seeds germinated (U.S. Fish and Wildlife Service 1985), and in another study 8 of 24 embryos stained with tetrazolium chloride were viable (Robert Sivinski, NMFRCD, Santa Fe, pers. comm. 1993). However, Todsens pennyroyal may prove to have strict germination requirements, and a drier than average growing season may have caused the low viability in the staining study (Robert Sivinski, pers. comm., 1993).

Flowering, seed set, and seed viability are all low.

Todsens pennyroyal flowers from June to September. Most flowers are produced from late August to early September, concurrent with the period of highest rainfall. Its orange-red tubular flowers appear specialized for hummingbird pollination; however, hummingbirds rarely visit Todsens pennyroyal and no other pollinators have been seen (NMFRCD 1992; Laura Huenneke, pers. comm. 1993; Ulaszek 1993). There are few other flowers attractive to hummingbirds near Todsens pennyroyal populations and this may account for hummingbird absence (NMFRCD 1992). Pollinator absence may help explain the low seed set because, unlike several other species of pennyroyal, this species has no mechanism for self-pollination (Irving 1979; Huenneke 1993). But, in one field experiment, only 7 of 29 hand-pollinated flowers set seed (Huenneke 1993), so factors other than pollinator absence also appear to contribute to the low seed set.

The nutlets of Todsens pennyroyal appear to be dispersed as a unit with the calyx. The surface of the nutlets becomes mucilaginous when moistened, which may cause the nutlets to adhere to soil and rocks and prevent surface runoff from removing them from suitable habitat (U.S. Fish and Wildlife Service 1985; NMFRCD 1992). This characteristic does not appear to be a dispersal mechanism for moving nutlets long distances to other suitable habitat. Irving observed that calyces and nutlets remain near the parent plants (U.S. Fish and Wildlife Service 1985).

Genetic factors could be playing a role in the low seed production of Todsens pennyroyal. Inbreeding and genetic drift in small isolated populations can lead to an accumulation of deleterious genes causing inbreeding depression. Huenneke (1993) did controlled pollinations to determine if self-incompatibility or inbreeding are factors limiting seed set. Although the sample sizes were small, self-pollination, pollination between flowers in a patch, and pollination between patches of a population all resulted in some seed production. Therefore, self-incompatibility or inbreeding alone are probably not the causes of low seed production.

If Todsens pennyroyal is a relict species surviving in marginal habitats, then physical conditions or competition could be reducing sexual reproduction. Perennial species often have low sexual reproduction when under stress. However, there have been no apparent population declines at any locality and soil analysis shows Todsens pennyroyal grows in soils with good nutrient availability and better water-holding capacity than adjacent sites (NMFRCD 1991).

If a population is lost, recolonization is unlikely due to low seed production and poor dispersal.

Todsens pennyroyal is a narrow endemic whose present distribution probably reflects both its past distribution in the Tularosa Basin and the current distribution of suitable habitat. Sexual reproduction occurs at a relatively low rate; the amount of recruitment from sexual reproduction is unknown. Most reproduction is asexual through underground rhizomes. In this way, a population can potentially occupy all suitable habitat at a specific locality. These large populations, sometimes consisting of thousands of stems, are probably able to survive droughts, flash floods, or other natural disasters. However, if a population is eradicated, the species is unlikely to recolonize that locality because of low seed production and poor seed dispersal. A gradual extirpation of populations, without recolonization, could explain the absence of this species from areas of apparently suitable habitat in the Tularosa Basin (Robert Sivinski, pers. comm. 1993).

Land Ownership

The U.S. Department of Defense manages the Todsens pennyroyal populations in the San Andres Mountains. The BLM - Las Cruces Field Office and the U.S. Forest Service - Lincoln National Forest manage the populations in the Sacramento Mountains (Table 1).

All populations are on public lands under the management of DOD, BLM, or USFS.

Table 1. Land management of Todsens pennyroyal sites. Site numbers correspond to numbers in Figures 1-3. (Summarized from NMFRCD 1991)

Site Num	Location	Land Manager	Year Found	Comments
1	T14S, R11E, Sec 33, NE 1/4	BLM	1990	
2	T14S, R11E, Sec 33, NE 1/4 and Sec 34 NW 1/4	BLM/USFS	1988	Initial discovery site in Sacramento Mts
3	T14S, R11E, Sec 28, SE 1/4, Sec 33, NE 1/4, and Sec 34, NW 1/4	BLM/USFS	1990	
4	T14S, R11E, Sec 28, SE 1/4	BLM	1990	
5	T14S, R11E, Sec 28, SE 1/4	BLM	1990	
6	T14S, R11E, Sec 28, N 1/2 of SE 1/4	BLM	1990	
7	T14S, R11E, Sec 28, SE 1/4 of NE 1/4	BLM	1993	
8	T14S, R11E, Sec 28, SE 1/4 of NE 1/4	BLM/USFS	1991	
9	T14S, R11E, Sec 9, NE 1/4 and Sec 10 NW 1/4	BLM/USFS	1990	
10	T14S, R11E, Sec 9, center of N 1/2	BLM	1990	
11	T14S, R11E, Sec 3, NE 1/4 and S 1/2, and Sec 10, NW 1/4	USFS	1990	
12	T14S, R11E, Sec 3, SW 1/4	USFS	1990	
13	T14S, R11E, Sec 4, NE 1/4 and Sec 3, NW 1/4	USFS/BLM	1990	Disjunct sites in S fork of canyon are likely continuous with main population
14	T13S, R11E, Sec 33, SE 1/4	BLM	1990	
15	T13S, R11E, Sec 34, S 1/2	BLM	1990	
16	T12S, R2E, Sec 34, SE 1/4	DOD	1978	Type locality
17	T13S, R2E, Sec 2, SW 1/4	DOD	1978	Not relocated since initial discovery
18	T13S, R2E, Sec 15, SE 1/4	DOD	1990	

¹DOD = Department of Defense, BLM = Bureau of Land Management, USFS = U.S. Forest Service

Impacts and Threats

Natural threats currently appear greater than threats from human activities.

The relatively remote or inaccessible locations of Todsens pennyroyal populations afford the species some protection. Yet, because of the fragile nature of the habitat and the small size of some populations, accidental disturbance or changes in land use could destroy them.

Present military activities are directed away from Todsens pennyroyal sites. However, expanded military activities during national defense emergencies, or new military peacetime missions could create pressures to use parts of the Missile Range where there is presently little activity.

Habitat damage from illegal livestock grazing is a potential threat to individual populations. All known Todsens pennyroyal sites on White Sands Missile Range and Lincoln National Forest are closed to grazing. However, grazing was reported at the San Andres sites in 1982 (U.S. Fish and Wildlife Service 1985) and cattle from private land have gained access to the Sacramento Mountains sites in the past (Ulaszek 1993). Todsens pennyroyal sites on BLM land are in active grazing allotments (Mike Howard, BLM, Las Cruces, New Mexico, pers. comm. 1993). Livestock do not appear to graze Todsens pennyroyal, but could trample plants and increase soil erosion in fragile Todsens pennyroyal habitats.

If planning were inadequate or if private entities failed to secure proper agency authorizations, then minerals exploration, oil and gas exploration, communications lines, or communications towers could all potentially impact Todsens pennyroyal sites.

In any instance where land ownership or land management responsibilities change, negative impacts to Todsens pennyroyal sites could occur if adequate provisions for continued protection are not made.

Natural threats that might impact Todsens pennyroyal include deer, rabbit, elk, and rodent browsing, insect herbivory, and drought. Unidentified insect larvae have been found feeding on nutlets; 12 percent of the calyces examined at one of the Sacramento Mountains populations either contained larvae or showed evidence of herbivory (Ulaszek 1993). The impact of this insect on recruitment from seed is unknown.

There is no information on how fire affects Todsens pennyroyal. With its extensive underground rhizome system, stands of Todsens pennyroyal would be expected to resprout after fire removed the aboveground stems. Fires could decrease competition for light, water, and nutrients, resulting in greater vigor. Conversely, removing surface vegetation and exposing the substrate could increase erosion and reduce soil moisture. Without specific studies, it is impossible to make accurate predictions about the response of Todsens pennyroyal to fire.

Low genetic diversity could be a threat. Species reduced to a few small isolated populations, as is the case for Todsens pennyroyal, often lose genetic diversity and thus the ability to adapt to changing habitat conditions, predators, or pathogens. It is possible inbreeding or genetic drift in these small populations are partly responsible for the low rate of sexual reproduction in Todsens pennyroyal.

Conservation Measures

Taking and Trade Prohibitions. The Endangered Species Act prohibits maliciously damaging, destroying, or removing and reducing to possession any endangered or threatened plants from areas of Federal jurisdiction. For all other areas, the Act prohibits removing, cutting, digging up, damaging, or destroying endangered plants in knowing violation of any State law or regulation, including State criminal trespass law. For any endangered or threatened plants, the Act and the Lacey Act also prohibit their sale, offer for sale, import, export, or commercial transport in interstate or foreign commerce. The Act provides for permits for otherwise prohibited activities that contribute to the conservation of endangered or threatened species.

Todsens pennyroyal is a New Mexico State endangered plant species listed in NMNRD Rule 85-3 of the State Endangered Plant Species Act (9-10-10 NMSA). This law prohibits taking, possessing, transporting and exporting, selling or offering

for sale any listed plant species. Listed plants can only be collected under State permit for scientific studies and impact mitigation.

A U.S. Forest Service permit is required to collect plants from the Lincoln National Forest. These permits are issued for the collection or study of threatened or endangered species after the U.S. Fish and Wildlife Service issues its permit. The Forest Service permit authorizes only those activities the Fish and Wildlife Service has already approved.

Section 7 Requirements. Section 7 of the Act requires Federal agencies to ensure their actions will not jeopardize the continued existence of endangered or threatened species, or destroy or adversely modify any designated critical habitat areas (Figure 5). Consultation with the U.S. Fish and Wildlife Service may be informal (requests for lists of species, or discussion of effects of a proposed action) or formal (when a Federal agency determines an action may adversely affect a listed species or destroy or adversely modify critical habitat).

Under Section 7(a)(1) of the Act, all Federal agencies are directed to "...utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species...." That is, the Act not only directs agencies to prevent further declines in species through the avoidance of adverse impacts, but also directs them to undertake proactive programs to move species toward recovery.

White Sands Missile Range Conservation Planning and Management. Currently, the Todsens pennyroyal sites are closed to all activities. There is no specific signing or other notice indicating the sensitivity of the area; however, the sites are on all planning databases, and the species' presence is taken into account in all activities. Searches for new Todsens pennyroyal sites are required prior to any projects in potential habitat for the species. White Sands Missile Range personnel have also

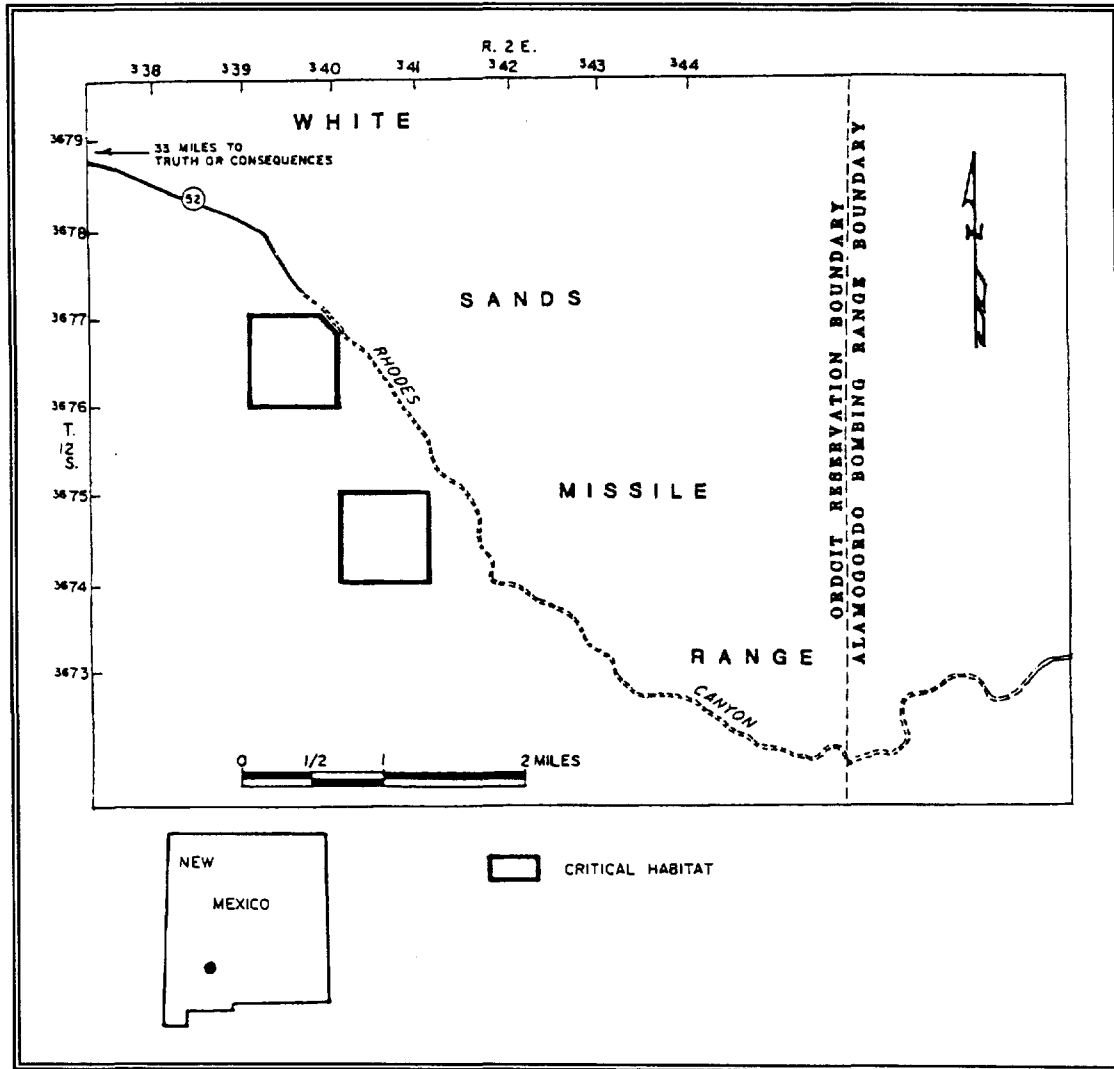


Figure 5. Todsen's pennyroyal critical habitat areas.

investigated potential habitat for Todsen's pennyroyal (David Anderson, White Sands Missile Range, pers. comm. 1998).

Lincoln National Forest Conservation Planning and Management. Todsen's pennyroyal occupies land classified in the Lincoln National Forest Land Management Plan as unsuitable and non-appropriate for both timber management and fuelwood production. Therefore, there will be no authorized logging or fuelwood harvest on the Forest in the vicinity of the Sacramento Mountains Todsen's pennyroyal sites. Todsen's pennyroyal occurs where the grazing allotment has been withdrawn for

many years, so there are no permitted livestock in the occupied habitat on the Forest. Hunting is the only activity near the populations. A Biological Assessment of the effects to Todsens pennyroyal from all programs authorized under the Forest Land Management Plan was completed in May, 1996. The assessment found no adverse effects to Todsens pennyroyal from programs authorized under the plan and the U.S. Fish and Wildlife Service concurred with this finding.

There is additional potential Todsens pennyroyal habitat on the Forest. All potential habitat on the Sacramento Ranger District was surveyed and no more plants were found. Recently identified potential habitat on the Smokey Bear Ranger District was surveyed in 1998 and no plants were found. This work completed surveys of potential habitat on the Forest as it is currently understood (Jose Martinez, Lincoln National Forest, Alamogordo, New Mexico, *in litt.* 1997).

Bureau of Land Management Conservation Planning and Management. Todsens pennyroyal habitat on BLM-lands has been recommended for designation as an Area of Critical Environmental Concern (ACEC). BLM will address this recommendation during a future planning effort. Designation as an ACEC recognizes special resource values, but provides no automatic protection for them. Appropriate protective measures may be added through the BLM planning process. The BLM localities are in an active grazing allotment, but BLM personnel believe the Todsens pennyroyal populations are unlikely to be grazed because of the steep slopes (Mike Howard, pers. comm. 1993).

Research. Faculty of New Mexico State University have done studies of pollination biology and population structure of Todsens pennyroyal. Personnel of the NMFRCD monitored several populations to assess reproductive output and population vigor. Cultivated populations of Todsens pennyroyal were used to determine the species' growing requirements and to do experimental cross-pollination between genets descended from the San Andres and Sacramento mountains populations (Joyce Maschinski, pers. comm. 1993). Continuation of this

work is needed to understand long term population trends and the genetic structure of populations.

PART II – RECOVERY

Objectives and Criteria

The objective of recovery is to protect and manage Todsens pennyroyal so it will sustain itself indefinitely in its natural habitat. There are 18 known Todsens pennyroyal sites; the discovery of 16 sites since 1988 has greatly improved the species' recovery prospects. However, Todsens pennyroyal is still a very rare species with an extremely limited distribution. Its specialized habitat requirements appear to be met in only a few places. Its low rate of sexual reproduction and limited dispersal mean any populations lost are unlikely to reestablish on their own. The first step in recovery will be to ensure no human activities are degrading or destroying existing Todsens pennyroyal populations or habitat. This is largely already being done through the existing policies and procedures of the three land management agencies. It will be possible to reclassify Todsens pennyroyal from its present endangered status to one of threatened when the following actions are accomplished.

**To downlist to threatened –
Implement management
plans to ensure protection
of occupied habitat and
monitor populations to
verify management success.**

1. Plans are developed and implemented to permanently protect occupied Todsens pennyroyal habitat from human degradation or destruction.
2. The responsible land management agencies verify through monitoring that protective management is successful.

Research has shown low sexual reproduction for Todsens pennyroyal, but the causes are yet to be identified. Until this is done, it will be impossible to know if

recovery is beyond management capability. To remove Todsens pennyroyal from the list of endangered and threatened species, it will be necessary to demonstrate the species can sustain itself indefinitely at present or higher population levels. This will require research to identify what factors are presently limiting the species and

To delist – Ensure through research, management, and monitoring that protected populations can sustain themselves indefinitely.

the implementation of management measures to correct any factors within management capability. It will be possible to remove Todsens pennyroyal from the endangered species list when the following actions are accomplished.

1. Research identifies the factors responsible for the low sexual reproduction and restricted distribution of Todsens pennyroyal.
2. Measures are taken to correct any factors within management control.
3. Monitoring and further research demonstrate Todsens pennyroyal can sustain itself indefinitely at present or higher population levels.

Outline of Recovery Actions

The following is an outline of the recovery actions needed to attain the objectives of this plan. Recovery actions are listed in a step-down form with broad categories of recovery actions stepped-down to specific tasks. Tasks listed here also appear in the Implementation Schedule (Part III of this plan), in which costs and scheduling are estimated and lead responsibilities for specific tasks are identified.

- 1 Remove any threats to existing Todsens pennyroyal populations. Protection of Todsens pennyroyal will require enforcement of existing laws, prevention of

habitat disturbance, control of land use impacts through implementation of management plans, and monitoring to verify management effectiveness.

- 1.1 Ensure continuing compliance with applicable Federal and State laws and regulations. All applicable existing laws need continuing compliance. These laws include the Endangered Species Act, the New Mexico Endangered Plant Species Act, the Lacey Act, the National Forest Management Act, and the National Environmental Policy Act.

Section 7 of the Endangered Species Act requires all Federal agencies to consult with the U.S. Fish and Wildlife Service to ensure their actions do not jeopardize the continued existence of any threatened or endangered species or adversely modify any areas designated as critical habitat. The Federal agency has the responsibility to determine if a proposed project or action may affect a threatened or endangered species. Federal agencies often undertake informal consultations with the U.S. Fish and Wildlife Service to help determine a project's potential impacts and to plan ways to reduce or eliminate them. If a "may adversely affect" determination is made, the Federal agency must request formal section 7 consultation.

Under Section 7(a)(1) of the Act, all Federal agencies are directed to "...utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species...." That is, the Act not only directs agencies to prevent further declines in species through the avoidance of adverse impacts, but also directs agencies to undertake proactive programs to move species toward recovery. For Todsens pennyroyal, these proactive programs include the research identified in Task 2 of this plan. Accomplishing these tasks may identify corrective actions for factors that presently limit the distribution, numbers, and reproductive capacity of the species.

- 1.2 Develop and implement management plans to prevent detrimental land use impacts to known Todsens pennyroyal populations. The responsible agencies need to review existing land management plans to see if they contain adequate direction for the management of Todsens pennyroyal. If existing plans are insufficient, new plans or supplements to existing plans need to be written. Plans should require protection of occupied habitats from disturbances like minerals exploration, oil and gas exploration and development, recreation, overgrazing, wood cutting, and military activities. Protections, for example, may include minerals withdrawals, grazing controls, designation of special management areas, timber management prescriptions, and fire management plans. Over the long term, management should be based on information about this species' ecology and biology.

- 1.3 Continue to protect populations from adverse disturbances. White Sands Missile Range, Lincoln National Forest, and Bureau of Land Management take Todsens pennyroyal into account in all planning and decision-making activities. Military activities on White Sands Missile Range are directed away from the Todsens pennyroyal populations and no grazing is permitted in that portion of the Range. The Lincoln National Forest has no logging or grazing for the Sacramento Mountains localities. Hunting and other non-motorized dispersed recreation are the only activities that occur near the populations in the Sacramento Mountains. Finally, there must be provisions to continue protection and management of Todsens pennyroyal sites should management responsibilities change.

- 1.4 Ensure that all personnel dealing with Todsens pennyroyal habitat are aware of the species' presence and the habitat's sensitivity to disturbance. Currently, all appropriate personnel for the BLM, Lincoln National Forest, and White Sands Missile Range are aware of the presence of this species. Known population localities have been entered into planning databases for

all three agencies. Ensure databases are kept current and new personnel know their responsibilities for Todsens pennyroyal.

- 1.5 Remove any stray livestock from Todsens pennyroyal sites. There has been past evidence of livestock at both population centers. Although cattle do not appear to trample or graze Todsens pennyroyal, their activities may increase erosion or change habitat structure. At the Lincoln National Forest sites, the adjacent private property was sold in the early 1990s and the livestock sometimes found on Forest lands were removed. The current private landowner maintains horses within fenced pastures. The BLM Todsens pennyroyal sites are within three grazing allotments, but BLM personnel believe the sites are unlikely to be grazed because of the steep slopes. Regular monitoring is needed to ensure fences are in place and livestock are excluded from Todsens pennyroyal sites.
- 1.6 Assess erosion at Todsens pennyroyal sites and take corrective action if needed. Soils at Todsens pennyroyal sites are highly erodible so natural soil losses are expected. However, at some sites past grazing practices may have produced excessive erosion that continues despite improved management. In particular, rapid downward and horizontal erosion has been reported to threaten parts of the Todsens pennyroyal populations south of Mountain Lion Peak. The effects of erosion here and elsewhere need to be evaluated and erosion control structures put in place if needed.
- 1.7 Establish long-term population monitoring. Monitoring plots were established at several Sacramento Mountains sites, but have not been read recently. The San Andres Mountains population was monitored in the mid-1980s when it was the only extant population known, but this monitoring was discontinued when new populations were discovered in the Sacramento Mountains. Land management agencies need to establish a schedule to monitor the populations under their jurisdiction. Soils where Todsens

pennyroyal occur are sometimes steep and fragile. When the San Andres Mountains population was being monitored, procedures were modified because of concerns for investigator impacts to the habitat. Monitoring must be planned and undertaken carefully to prevent adverse impacts. Monitoring must be a regular ongoing activity of the land management agencies before downlisting or delisting can be considered.

2 Study populations and natural habitat. Past studies have revealed much about the biology of Todsens pennyroyal. Further investigations are needed, however, to determine if extant populations are self-sustaining, and to develop sound management practices for the species. The land management agencies may be able to use their research divisions for some studies and contract with independent researchers for others.

2.1 Study population and reproductive biology of Todsens pennyroyal. Past monitoring and investigations have contributed to our knowledge of the biology of Todsens pennyroyal; however, more studies are needed to learn about the genetic structure of populations and important aspects of life history.

2.1.1 Study genetic structure within and between populations. Some relevant studies were done, but were inconclusive. Studies of all populations are needed to determine genetic relationships within and between populations. These studies could show whether populations are a single clone or are aggregations of genetically distinct individuals. Once genetic diversity is known, population vigor can be studied to learn how it correlates with genetic variability.

2.1.2 Study reproductive biology: Pollination, mating system, seed development, and seed dispersal. Some aspects of reproductive biology have been studied, but the results need to be verified and

expanded with more complete studies. More information is needed about reproductive biology and its relationship to the genetic structure of populations.

2.2 Study the ecological requirements of Todsens pennyroyal. Surveys done in the last 10 years have improved our knowledge of Todsens pennyroyal's distribution and habitat preferences. Further studies will give a better understanding of ecological requirements and may identify specific management prescriptions for maintaining or expanding populations.

2.2.1 Study germination requirements. Determining germination requirements may help explain present population distributions and identify potential rates of population recruitment under varying conditions. Understanding germination requirements would also help in propagation projects if genetic mixing of populations is shown to be needed to increase natural seed production.

2.2.2 Monitor under different environmental conditions or experimentally manipulate cultivated plants to determine growth requirements. Plant stress may be causing the low sexual reproduction in Todsens pennyroyal. Specific investigations could address how factors like competition, sunlight, and soil moisture affect vegetative vigor, flowering, and seed set. Multiple factor experiments, which are extremely hard to analyze, may be needed because multiple factors are always interacting under natural conditions. The results of these experiments could identify ways to manipulate the habitat to increase sexual reproduction.

2.2.3 Determine the distribution of the geologic formations and soils types that match the known Todsens pennyroyal sites. Knowing the distribution of the geologic formations and soil types that match

known Todsens pennyroyal sites will help in searches for new populations and will provide information on potential habitat for future reintroductions (should these prove necessary).

2.2.4 Study the effects of fire on Todsens pennyroyal. Do small plot burn experiments in Todsens pennyroyal habitat to determine how fire at different times and intensities affects the species.

2.3 Use the results of monitoring and research studies to determine if populations can sustain themselves and to make further management decisions for Todsens pennyroyal. The results of the above investigations should be used to determine what size, reproductive characteristics, and dispersal characteristics are needed to have a reasonable assurance that a population can sustain itself indefinitely. If populations are found not to be self-sustainable, then specific management measures can be developed to prevent decline and stabilize them.

3 Use information from previous studies to identify potential habitat and search these areas for Todsens pennyroyal. The discovery of new populations has reduced the vulnerability of the species. The discovery of any more populations will further decrease the chance that Todsens pennyroyal will become more endangered.

3.1 Search for more populations. There is more potential habitat for Todsens Pennyroyal on White Sands Missile Range, Lincoln National Forest, Mescalero Apache Reservation, BLM-lands, and on private lands in the Tularosa Basin. In 1998, the Lincoln National Forest completed searches of all potential habitat on the Forest. All agencies need to do comprehensive searches of potential habitat.

- 3.2 Protect any new populations and use the criteria developed above to determine if the populations can sustain themselves. Any new populations need the same management planning and protection as those already known. Determine if new populations can sustain themselves and apply any needed management measures.
- 4 Establish a working group to help coordination and communication between the various agencies, organizations, and interested citizens playing a role in recovery of Todsens pennyroyal. Recovery will go more smoothly if everyone communicates about recovery activities. Public support will be enhanced if elected officials, county public land users groups, conservation groups, and other interested citizens are included.

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PART III – IMPLEMENTATION SCHEDULE

The following Implementation Schedule outlines actions and costs for the Todsens pennyroyal recovery program. It is a guide for meeting the objectives discussed in Part II of this plan. The schedule indicates task priorities, task numbers, task descriptions, duration of tasks, responsible agencies, and estimated costs. These actions, when accomplished, should recover Todsens pennyroyal and protect its habitat. It should be noted that the estimated monetary needs for all parties involved in recovery are identified for the first 3 years only, and therefore do not reflect total recovery costs. An estimate of total costs to reach the downlisting and delisting objectives for this species is provided in the EXECUTIVE SUMMARY, page iv. Costs are estimated to assist in planning and do not obligate any involved agency to expend the estimated funds.

Task Priorities

- Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
- Priority 2 - An action that must be taken to prevent a serious decline in species population/ habitat quality, or some other significant negative impacts short of extinction.
- Priority 3 - All other actions necessary to meet the recovery objectives.

Abbreviations Used

- FWS - Fish and Wildlife Service
- ES - Ecological Services Field Office
- LE - Law Enforcement, FWS
- FS - Forest Service, Lincoln National Forest
- BLM - Bureau of Land Management
- WSMR - White Sands Missile Range
- NM - State of New Mexico

TODSEN'S PENNYROYAL RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES (\$000)			COMMENTS
				FWS		Other	YEAR 1	YEAR 2	YEAR 3	
				Region	Program					
1	1.1	Ensure continuing compliance with laws and regulations	Ongoing	2	ES LE		2.0	2.0	2.0	
							1.0	1.0	1.0	
						FS	5.0	5.0	5.0	
						BLM	3.0	3.0	3.0	
						WSMR NM	1.0 5.0	1.0 5.0	1.0 5.0	
1	1.2	Develop and implement management plans to prevent detrimental land use impacts	Ongoing			FS	5.0	3.0	3.0	
						BLM	5.0	3.0	3.0	
						WSMR	5.0	3.0	3.0	
1	1.3	Protect populations from disturbance	Ongoing			FS	2.0	2.0	2.0	
						BLM	2.0	2.0	2.0	
						WSMR	2.0	2.0	2.0	
1	2.1.2	Study all aspects of reproductive biology	6	2	ES		20.0	20.0	20.0	
						FS	5.0	5.0	5.0	
						BLM	5.0	5.0	5.0	
						WSMR	5.0	5.0	5.0	
1	1.7	Initiate long-term monitoring	Ongoing			FS	4.0	2.0	2.0	
						BLM	4.0	2.0	2.0	
						WSMR	2.0	1.0	1.0	
1	2.1.1	Study genetic structure of all populations	3	2	ES		7.5	5.0	5.0	
						FS	7.5	5.0	5.0	
						BLM	7.5	5.0	5.0	
						WSMR	5.0	2.5	2.5	

TODSEN'S PENNYROYAL RECOVERY PLAN IMPLEMENTATION SCHEDULE (continued)

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES (\$000)			COMMENTS
				FWS		Other	YEAR 1	YEAR 2	YEAR 3	
				Region	Program					
1	2.2.1	Study germination requirements	2	2	ES	FS BLM WSMR	2.0 0.5 0.5	2.0 0.5 0.5		
1	2.2.2	Determine growth requirements	5	2	ES	FS BLM WSMR	10.0 7.0 7.0 5.0	10.0 7.0 7.0 5.0	10.0 7.0 7.0 5.0	
1	3.2	Protect new populations	Ongoing			FS BLM WSMR		1.0 1.0 1.0	1.0 1.0 1.0	Contingent on discovery of more populations
2	1.4	Ensure appropriate personnel are aware of Todsen's pennyroyal	Ongoing			FS BLM WSMR	0.2 0.2 0.2	0.1 0.1 0.1	0.1 0.1 0.1	
2	1.5	Remove any trespass livestock	2			FS BLM WSMR	2.0 2.0 2.0	2.0 2.0 2.0		
2	1.6	Assess erosion and take corrective action if needed	3			FS BLM	10.0 10.0	10.0 10.0	10.0 10.0	
2	2.2.3	Study geology and soils	3	2	ES	FS BLM WSMR	3.0 1.0 3.0 2.0	2.0 1.0 2.0 1.0	1.0 1.0 1.0 0.5	

TODSEN'S PENNYROYAL RECOVERY PLAN IMPLEMENTATION SCHEDULE (concluded)

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES (\$000)			COMMENTS
				FWS		Other	YEAR 1	YEAR 2	YEAR 3	
				Region	Program					
2	2.2.4	Study fire effects	5	2	ES	FS BLM WSMR	7.0 3.0 3.0	5.0 3.0 3.0	3.0 3.0 3.0	
2	2.3	Use research results to determine if populations can sustain themselves	5	2	ES	BLM FS WSMR			5.0 2.0 2.0 2.0	
3	3.1	Search for more populations	3	2	ES	FS BLM WSMR NM	4.0 4.0 4.0 4.0	4.0 4.0 4.0 4.0	4.0 4.0 4.0 4.0	
3	4	Establish a working group for agency and public coordination	Ongoing	2	ES	FS BLM WSMR NM	0.5 0.2 0.2 0.2 0.2	0.5 0.2 0.2 0.2 0.2	0.5 0.2 0.2 0.2 0.2	
		Totals					215.9	192.6	189.6	

APPENDIX

Reviewers

On October 14, 1994, the U.S. Fish and Wildlife Service announced in the *Federal Register* (59 FR 52187) that review copies of the Draft Todsens Pennyroyal Revised Recovery Plan were available and that comments were being accepted until December 14, 1994. There were 10 requests for the draft plan; none of the requestors provided comments.

In addition, the Fish and Wildlife Service requested comments on the draft plan from the following agencies, groups, and individuals. Those providing comments are marked with an asterisk.

Field Supervisor, Las Cruces Field Office, Bureau of Land Management *
State Director, New Mexico Bureau of Land Management *
Regional Forester, Southwestern Region, U.S. Forest Service *
Forest Supervisor, Lincoln National Forest *
Commander, White Sands Missile Range
Secretary, New Mexico State Energy, Minerals and Natural Resources Department
Director, New Mexico State Land Office
New Mexico Native Plant Society *
New Mexico Natural Heritage Program
New Mexico Nature Conservancy
Dr. Laura Huenneke, New Mexico State University
Dr. Tim Lowrey, University of New Mexico
Dr. Richard Spellenberg, New Mexico State University
Dr. Thomas Todsens *
Mr. Paul Knight, Marron and Associates

Due to the extended time between the original request for comments and the publication of the final revised plan, the draft was returned to the three agencies responsible for management of Todsens pennyroyal populations to let them provide updates to the plan and make additional comments. On September 17, 1997, the draft plan was sent to the following agencies for review. All three agencies provided comments that have been incorporated into the plan.

Field Supervisor, Las Cruces Field Office, Bureau of Land Management
Forest Supervisor, Lincoln National Forest
Commander, White Sands Missile Range

A second request for public review and comment on the Draft Todsens Pennyroyal Revised Recovery Plan was published in the *Federal Register* on November 13, 1998 (63 FR 63487). One comment letter was received in response to this announcement.