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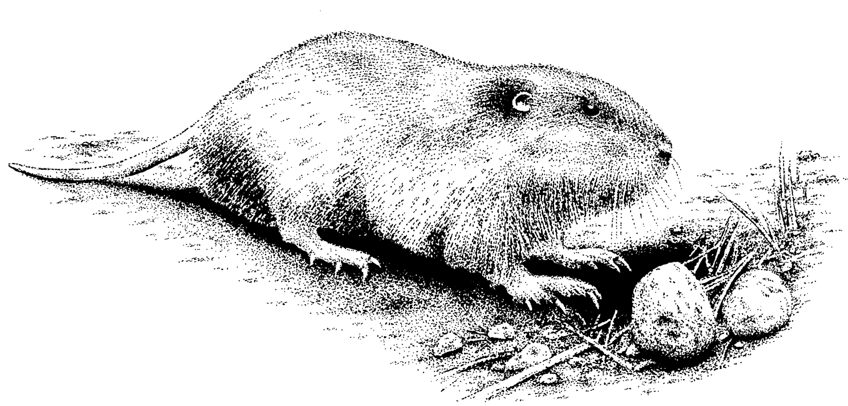
Mazama Pocket Gopher Status Update and Recovery Plan



Derek W. Stinson

Washington Department of Fish and Wildlife
Wildlife Program
600 Capitol Way N
Olympia, Washington

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In 1990, the Washington Wildlife Commission adopted procedures for listing and de-listing species as endangered, threatened, or sensitive and for writing recovery and management plans for listed species (WAC 232-12-297, Appendix A). The procedures, developed by a group of citizens, interest groups, and state and federal agencies, require preparation of recovery plans for species listed as threatened or endangered.

Recovery, as defined by the U.S. Fish and Wildlife Service, is the process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured.

This is the Draft Washington State Status Update and Recovery Plan for the Mazama Pocket Gopher. It summarizes what is known of the historical and current distribution and abundance of the Mazama pocket gopher in Washington and describes factors affecting known populations and its habitat. It prescribes strategies to recover the species, such as protecting populations and existing habitat, evaluating and restoring habitat, and initiating research and cooperative programs. Target population objectives and other criteria for down-listing to state Sensitive are identified.

As part of the State's listing and recovery procedures, the draft recovery plan is available for a 90-day public comment period. Please submit written comments on this report by 19 April 2013 via e-mail to: TandEpubliccom@dfw.wa.gov, or by mail to:

Endangered Species Section
Washington Department of Fish and Wildlife
600 Capitol Way North
Olympia, WA 98501-1091

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ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

The Mazama pocket gopher (*Thomomys mazama*), a small fossorial rodent, is a regional endemic found only in western Washington, western Oregon and northern California. Pocket gophers play an important role in ecological communities by altering soil structure and chemistry, affecting plant occurrences, and serving as prey for many predators, and their burrows provide a retreat for a wide variety of other species. Mazama pocket gophers were formerly more widespread on south Puget Sound prairies, but their distribution has diminished as suitable habitat has been lost to development or degraded by Scotch broom and succession to forest. The species was state-listed as threatened in 2006 by the Washington Fish and Wildlife Commission.

In 2001, the U.S. Fish and Wildlife Service (USFWS) designated eight subspecies of the Mazama pocket gopher in Washington as candidates for listing under the federal Endangered Species Act. In 2012, the USFWS proposed adding four of these subspecies (*T. m. pugetensis, tumuli, yelmensis*, and *glacialis)* to the federal list of Threatened species and designating critical habitat. The proposal also included a 4(d) rule that would exempt some activities from the Act's Section 9 take prohibitions, including some existing maintenance activities at airports and farms, livestock grazing, some agricultural activities, and certain activities on single-family residential properties. The proposal is being evaluated and a final rule is scheduled to be published in late 2013.

The Mazama pocket gopher is primarily found on well-drained glacial outwash soils with grassland or herbaceous vegetation. Many of these areas historically supported prairies and savannahs. In addition to historical prairies areas, they occasionally inhabit areas with sandy loam or gravelly soils when the tree cover is removed and herbaceous vegetation is established. Higher numbers of gophers have been found on loamy sand soil types than on the more widespread gravelly soils, some of which may contain too much rock to be suitable. Most of the areas of loamy sand soils in Thurston County are within the city limits or Urban Growth Areas of Olympia, Tumwater and Lacey, and much is already densely developed. In southeastern Mason County, pocket gophers are found on grassland in former prairie areas near Shelton, and they also occur in forest openings, roadsides, and in the ephemeral herbaceous vegetation in recent clearcuts. WDFW conducted extensive Mazama pocket gopher surveys in 2012. These included nearly 950 survey sites in Thurston, Mason, and Pierce counties, and small portions of Lewis, Grays Harbor, Wahkiakum, and Clark counties. The results of the surveys confirmed previous descriptions of the distribution of Mazama pocket gophers in Washington.

Much of the historical gopher habitat of south Puget Sound with appropriate soils and vegetation has been degraded, fragmented, or converted to impervious surfaces. Habitat loss to succession, agriculture and development has eliminated most of the prairie vegetation. Although significant areas remain in grassland, pasture or turf, trends in the human population suggest that available habitat and the quality of habitat will continue to decline without careful management of conflicting uses. The human population in Washington is expected to increase from the current 6.8 million to 7.7 million by 2020, and to 11 million by the mid-21st century. Prairie habitat continues to be lost, particularly to residential development, and Thurston County is projected to have 170,000 additional people and need an additional 50,000 detached single-family housing units, and >25,000 multi-family units by 2040. As the habitat patches become smaller, fewer, and farther apart, the likelihood of each patch continuing to support pocket gophers declines.

Recovery

The goal of the recovery plan is to secure and maintain self-sustaining populations of Mazama pocket gophers within their current Washington range. Seven areas that have substantial existing habitat and contain significant numbers of Mazama pocket gophers in Thurston, Pierce, and Mason counties are identified for recovery emphasis. Populations in three occupied or formerly occupied areas are not included in recovery objectives for the following reasons: Mazama pocket gophers in Wahkiakum County (*T. m. louiei)* and a portion of Pierce County (*T. m. tacomensi)* appear to be extinct; and Mazama pocket gophers in Clallam County (T. *m. melanop)* are found entirely within Olympic National Park. Because they are within the park, there are no certain threats to the Clallam County population or habitat; however, there may be a need to address tree encroachment in occupied areas.

Conservation of the populations in the seven areas (five in Thurston County, one in Pierce County, and one in Mason County) would preserve representative local populations and subspecies across their range in the south Puget Sound region. Some portions of the range that still host small numbers of gophers were not identified for recovery emphasis because of low potential for long-term persistence. These areas are densely developed or host only small numbers of gophers.

Recovery Objectives

The Mazama pocket gopher will be considered for downlisting to Sensitive status when the following objectives have been met:

- **Objective 1.** Maintain a stable or increasing population trend for a 10-year period in each of seven Mazama pocket gopher population areas (five in Thurston County, one in Pierce County, and one in Mason County); and

- **Objective 2.** Conservation agreements, regulations, or other mechanisms are in place that effectively and sustainably protect and provide the habitat extent, connectivity, and condition necessary to meet Objective 1.

Conservation activities will focus on protecting and maintaining habitat, monitoring population trends, maintaining or restoring habitat connectivity between local subpopulations, and conducting research to describe dispersal, demography, population dynamics, and determining what factors limit populations. Population trends will be monitored over time by sampling site occupancy and other indices. Much of the occupied gopher habitat in the Puget Sound is in public ownership, but some has uses that can conflict with the needs of gophers and a number of sites are on private lands. Recovery will involve partnerships with landowners, federal, state, and local agencies, and private conservation organizations. Incentive programs and partnerships are recommended to facilitate the maintenance of functional pocket gopher habitat in rural residential and agricultural areas with the help of private landowners.

Once the recovery objectives are met, an updated status report will be prepared with a recommendation to downlist the species to state Sensitive. After the species is downlisted to Sensitive, a management plan will be prepared.

INTRODUCTION

The Mazama pocket gopher (*Thomomys mazama*), also known as the Western pocket gopher, is a small fossorial rodent found only in western Washington, western Oregon and northern California (Verts and Carraway 2000). The species is more widespread in Oregon (Verts and Carraway 1998) and the Olympic Mountains of Washington are the northern limit of its range. The gopher was formerly more widespread on south Puget Sound prairies, but its distribution has been diminished as suitable habitat has been lost to development or degraded by Scotch broom (*Cytisus scoparius*) and succession to forest. The apparent extinction of a subspecies, *T. m. tacomensis*, once found in Tacoma, suggests that high density suburban development is incompatible with persistence of pocket gopher populations. The Washington Department of Fish and Wildlife (WDFW) added four subspecies of Mazama pocket gopher to the state Candidate list in 1991 (*T. m. glacialis*, *T.m. tumuli*, *T.m. couchi*, and *T.m. louiei*). In 1997, the entire species was added as a state candidate, including all of the Washington subspecies of Mazama pocket gopher. In 2006, following a state status review (Stinson 2005), the Mazama pocket gopher was listed by the Washington Fish and Wildlife Commission as a state Threatened species (WAC 232-12-011, Appendix A). The U.S. Fish and Wildlife Service (USFWS) recently proposed adding the four extant Mazama pocket gopher subspecies in Thurston and Pierce counties to the list of Threatened species under the federal Endangered Species Act (USFWS 2012), and they are expected to publish a final rule in late 2013.

Per WAC 232-12-297 (Appendix A), a recovery plan is prepared for state endangered and threatened species. The first part of the plan is a background section that reviews the biology of the pocket gopher, the current status of populations and habitat in Washington, and factors affecting populations. The second part identifies recovery objectives, explains the rationale behind them, and outlines recovery strategies and tasks needed to attain the objectives. The plan and status information may be updated as new information becomes available from ongoing and future research, monitoring, and genetic analyses.

LEGAL STATUS

State. The Mazama pocket gopher is listed as a state Threatened species (WAC 232.12.297, Appendix A). As a state Threatened species, unlawful taking of Mazama pocket gophers is a misdemeanor under RCW 77.15.130.

Counties and cities. The Mazama pocket gopher is a "species of local importance" in the critical area ordinances of Thurston and Pierce counties and several incorporated cities. The Shelton pocket gopher (*T. m. couchi*) is a species of local importance in the critical area ordinance of Mason County. This means that actions that require a permit from a county or city and that may adversely affect the species, such as land clearing or development, require an assessment of the potential impacts, including surveys of the site, and avoiding, minimizing, or mitigating those impacts. WDFW provides data on known occupied Mazama pocket gopher sites as well as historic sites to counties and cities as they conduct local land use planning and permitting. The WDFW Priority Habitats and Species (PHS) database contains GIS location data for these species, which is updated on a regular basis, and is regularly available and used by local jurisdictions. The local jurisdictions then use this data to execute their requirement under state law (the Growth Management Act, or GMA) to use best available science to identify and protect habitat conservation areas for these priority species. PHS data and recommendations are recognized as best available science.

Federal. The 8 subspecies of Mazama pocket gopher in Washington are Candidates for listing under the federal Endangered Species Act (USFWS 2007). These include:

- *T. m. yelmensis* (Yelm pocket gopher)
- *T. m. glacialis* (Roy Prairie pocket gopher)
- *T. m. pugetensis* (Olympia pocket gopher)
- *T. m. tacomensis* (Tacoma pocket gopher)
- *T. m. tumuli* (Tenino pocket gopher)
- *T. m. couchi (*Shelton pocket gopher)
- *T. m. melanops* (Olympic pocket gopher)
- *T. m. louiei* (Cathlamet pocket gopher)

The USFWS evaluated the status of the eight subspecies and issued a proposed rule in December 2012 (USFWS 2012) to add four subspecies (*T. m. pugetensis, tumuli, yelmensis*, and *glacialis*) as threatened under the Endangered Species Act, designate critical habitat, and remove four subspecies (*T.m. couchi, melanops, louiei,* and *tacomensis*) from the list of Candidate species. If a genetic study currently underway confirms previous work that suggested that some of these subspecies should be combined, then the listing proposal may be revised.

The proposal also includes a 4(d) rule. Under the proposed special rule, take of these subspecies caused by restoration and/or maintenance-type activities by airports on State, county, private, or Tribal lands and ongoing single-family residential noncommercial activities would be exempt from section 9 of the Act. Exempt activities would include existing maintenance activities at airports and farms, livestock grazing, agricultural activities, and certain activities on single-family residential properties. The final listing rule is expected in the fall of 2013.

The Brush Prairie pocket gopher (*T. talpoides douglasii*) of Clark County was included in the list of federal Candidates in 2007 based on unpublished data that suggested it be considered a *T. mazama*, but nothing has been published to change the taxonomy. In evaluating the subspecies, USFWS cited the lack of clear evidence to support the conclusion that *T. t. douglasii* should be included in *T. mazama*; they concluded that adding it as a Candidate in 2007 was an error, and did not evaluate it further (USFWS 2012).

Figure 1. Mazama pocket gopher (*photo by Rod Gilbert*).

DESCRIPTION

Mazama pocket gophers are small (body ≅ 5.5 in) fossorial rodents with short-necked stocky bodies, narrow hips, and short legs (Figure 1, Appendix B). They transport food in cheek pouches which open on the sides of their mouth and can be turned inside out like pants pockets; this trait is a characteristic of the families Geomyidae and Heteromyidae. Among North American mammals, they share this characteristic with pocket mice (*Perognathus* spp.) and kangaroo rats (*Dipodomys* spp.) (Baker et al. 2003). Pocket gophers, like all rodents, have prominent chisel-like incisors that are rootless and grow continuously (Figure 2; Chase et al. 1982). They have small ears and eyes. Their front feet are equipped with strong claws and their digits and palms are bordered with a fringe of stiff bristles (Verts and Carraway 1998). Their tails are short (≅ 2.5 in) and nearly naked. *T. mazama* is a small pocket gopher, similar in size to the northern pocket gopher (*T. talpoides*), the species commonly found in eastern Washington. Mazama pocket gopher males average 10 – 20% heavier and 5% longer than females (Appendix B).

Pocket gophers are often confused with moles (family Talpidae). Moles are insectivores and lack the prominent gnawing teeth exhibited by rodents such as pocket gophers (Figure 2). Moles also have a pointed snout and front claws that differ substantially from those of pocket gophers. Since both moles and pocket gophers seldom appear above-ground, most people only see the evidence of their digging. The soil mounds of pocket gophers are easily confused with those of moles, but can often be distinguished from mole mounds by their shape, texture, and burrow characteristics. Moles generally push soil up from vertical shafts creating circular dome-shaped or volcano-like mounds. Pocket gophers, however, push soil out from inclined lateral tunnels typically creating fan-shaped mounds or irregular clumps. Mole mounds also lack the earthen plug present in gopher holes, and can be distinguished by the size of dirt particles comprising the mound (the 'broad hands' of moles dislodge large chunks of earth, which get pushed up to form the mound; the 'scratch-digging' of gopher claws accumulates piles of earth with small particle sizes, which then get ejected from the burrow opening). Where snow accumulates in winter, pocket gophers are active under the snow and will fill snow tunnels with discarded soil, which are seen as sinuous ropes of earth on the surface of the ground when the snow melts in spring.

Figure 2. Mazama pocket gopher (left) showing characteristic incisors, front claws, and cheek pouches. In contrast, Townsend's mole (*Scapanus townsendi)* (right) has side-oriented front claws and a pointed snout.

TAXONOMY AND DISTRIBUTION

Figure 3. Museum specimens (left to right) of: *T. m. louiei, T. m. melanops, T. m. couchi,* and *T. m. yelmensis.*

The Mazama pocket gopher is a member of the Geomyidae, a family of New World subterranean rodents that is closely related to the Heteromyidae (pocket mice, kangaroo mice, kangaroo rats) (Verts and Carraway 1998). The genus *Thomomys* was generally accepted in 1857; the genus name *Thomomys* is derived from the Greek words *thomos* ("heap") and *mys* ("mouse") (Maser et al. 1981). The species is named after Mount Mazama, the volcano that exploded about 6,000 years ago producing Crater Lake, Oregon, the type locality for the species (Hall 1981, Robbins and Wolf 1994).

Thomomys is one of the most genetically and morphologically variable genera of mammals (Thaeler 1980, Hall 1981, Hadly 1997, Patton 2005). The great variability in color and morphology (Appendix B)

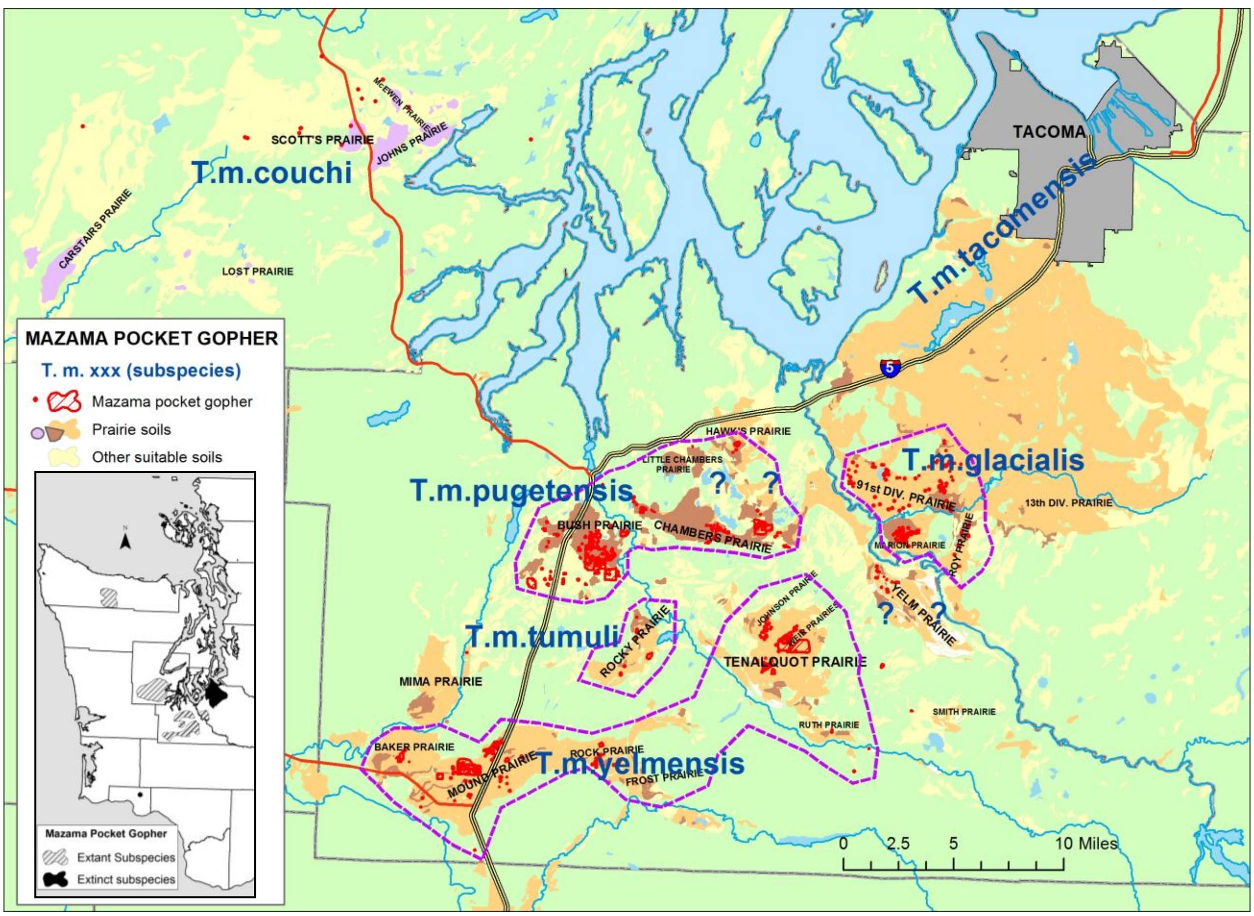

Figure 4. Distribution of six subspecies of *T. mazama* in the south Puget Sound region (Dalquest and Scheffer 1944, Hall 1981); ? denotes uncertainty as these areas were not included in any subspecies description; (Inset: range of 6 extant and 2 extinct subspecies) .

in pocket gophers has resulted in a complex and confusing taxonomy, with about 35 species and 300 described subspecies (Baker et al. 2003). Johnson and Benson (1960) noted that *T. mazama* skins are generally red brown, compared to the yellow brown and gray/brown shades of *T. talpoides*, and the dark patches behind the ears are more obvious in *T. mazama* (Figs. 1, 3). The subspecies *T. m. louiei* exhibits more melanism than the other Washington forms, and contains the only black specimens from Washington.

Thomomys mazama was historically subdivided into 15 subspecies, 8 of which were in Washington (Hall 1981). The western Washington populations now recognized as *T. mazama* were treated as *T. douglasii* after Baily (1915) revised the genus. Goldman (1939) included the western Washington subspecies in *T. talpoides*, as did Dalquest and Scheffer (1944).

Johnson and Benson (1960) suggested that all western Washington forms belonged in *T. mazama*, and not *T. talpoides,* with the exception of a population in Clark County (*T. t. douglasii*). They found that the most reliable morphological character for differentiating *T. mazama* forms from *T. talpoides*, even in juveniles, was the size of the baculum. The bacula of adult *mazama* measure 20-31 mm and those of *talpoides* measure 10-17 mm (Johnson 1982). The resulting taxonomic revision placed the described subspecies *melanops, yelmensis, tacomensis, couchi, glacialis, pugetensis, tumuli*, and *louiei* of Washington, as well as 7 subspecies from Oregon and California, into *T. mazama* (Hall 1981).

Research in recent decades indicates that fur coloration, and skull characteristics that are related to body size (the basis for many subspecific designations), are now considered highly variable traits in pocket gophers that can be affected by soil depth and friability, altitude, and nutritional quality of available vegetation (Patton and Brylski 1987, Smith and Patton 1988, Hadly 1997). Body weight in pocket gophers can be increased as much as 90% by changes in nutrition (Patton and Brylski 1987). These characteristics generally have minor value in determining taxonomic status (Steinberg and Heller 1997, Baker et al. 2003). Verts and Carraway (2000) suggested that *T. mazama* is polyphyletic (originating from >1 ancestral lineage). The prehistoric distribution and origins of the various subspecies are rather poorly understood, and differences in chromosome number (40 – 58) among the subspecies, particularly in Oregon (Thaeler 1980), suggest that further research may result in taxonomic revisions, including perhaps a split of the taxa into 2 or more species (C. Welch, pers. comm.).

Steinberg (1995, 1999) re-examined five of the eight *T. mazama* subspecies in Washington using differences in the mitochondrial gene, cytochrome-b. She determined that the subspecies *T. m. glacialis*, *pugetensis*, and *yelmensis* exhibited no differences in this gene and believed that combining them would better reflect an evolutionary unit. Additional analysis using mitochondrial DNA added support for this suggestion (Welch and Kenagy, in prep.). Steinberg (1996a) was unable to find extant populations of *T. m. tumuli*, *T. m. tacomensis*, or *T. m. louiei* and did not evaluate their genetics. Given their close proximity, and apparent connectivity of historical prairie in those areas, *T. m. tumuli* and *T. m. tacomensis* may also be subsumed into a redefined *T. m. yelmensis*, which is the oldest name (1899) and by the rules of nomenclature would become the valid name. If this taxonomic arrangement of combining these five forms were to be accepted in the future, it would leave four subspecies in Washington: *T. m. yelmensis*, *T. m. couchi*, *T. m. melanops*, and *T. m. louiei*. For purposes of this plan, the subspecies designations currently officially recognized are used (Verts and Carraway 2000; Table 1).

Table 1. General locations of eight subspecies of Mazama pocket gopher in western Washington.

Subspecies	Locations	County
T. m. melanops	Olympic National Park, alpine meadows	Clallam
T. m. couchi	Shelton vicinity, and part of southern Mason County	Mason
T. m. tacomensis[a]	Tacoma and Steilacoom vicinity, possibly SE to Puyallup	Pierce
T. m. glacialis	Roy Prairie, and Ft. Lewis training areas	Pierce
T. m. pugetensis	S of Olympia, Tumwater, Lacey (?)	Thurston
T. m. tumuli	Rocky Prairie, N of Tenino	Thurston
T. m. yelmensis	Grand Mound Prairie, Rochester Prairie, Vail Prairie	Thurston
T. m. louiei[a]	2 mi NE of Skamokawa Pass	Wahkiakum

[a]These subspecies or populations appear to be extinct.

NATURAL HISTORY

Behavior, Burrowing and Burrows

General behaviors and activity. Pocket gophers are adapted to a largely subterranean life and spend most of their time in their burrow systems. The behavior and burrowing activities of Mazama pocket gophers are likely very similar to the northern pocket gopher and Botta's (*T. bottae*) pocket gophers, which have received more research attention. Using radio telemetry, Andersen and MacMahon (1981) found that *T. talpoides* in a subalpine study area were active about 50% of each 24-hour day. Using radioactive tagged *T. bottae*, Gettinger (1984) reported that active time totaled 8.7 hours/day, or 36% of each day, with the remainder spent inactive in their nest chamber. Gopher activity occurred throughout the 24-hour day, with a peak in late afternoon to early evening, and the lowest activity was during 00:00-04:00.

Although largely subterranean, pocket gophers are occasionally captured in pitfall traps (Verts and Carraway 1998; D. Stinson, personal observ.), and their frequent occurrence in the diets of raptors (Douglas 1969, Maser et al. 1981, Chase et al. 1982, Richardson et al. 2001), suggest they are active above ground more than moles. Marsh and Steele (1992) state that gophers rarely venture more than 12-18 inches from their foraging burrows and retreat immediately if disturbed. Gettinger (1984) observed *T. bottae* feeding on the surface only 11 times during a 4-month telemetry study; all were during daylight and none exceeded 2 minutes. Scheffer (1931) and Vaughan (1974) noted that surface activity of pocket gophers occurs mostly at night; although Maser et al. (1981) reported that Mazama pocket gophers are occasionally seen foraging abroad on warm overcast days.

Gophers are believed to be generally solitary and to exclude other gophers from their burrows except when breeding and when females have litters. Territories of *T. talpoides* are re-established by September and remain mutually exclusive until the following spring (Chase et al. 1982). Maser et al. (1981) describe pocket gophers as "pugnacious," probably referring to their territorial behavior in excluding other gophers from burrows. Some authors suggest the possibility of social behavior. Witmer et al (1996) reported that at least 5 of 32 burrow systems during February-April contained an adult pair of Mazama pocket gophers. Lacey (2000) suggests that some reports of plural occupancy may be based on movement of neighbors into 'empty' burrows rather than active burrow sharing. However, Reichman et al. (1982) observed four nests with connections between male and female *T. bottae*; some nests contained young and an apparently well-worn tunnel from the male's burrow system. Using radio-telemetry, Bandoli (1987) recorded only three instances of plural burrow occupancy of 10-20 minute duration by *T. bottae*.

It is not known if pocket gophers vocalize much in the wild. Aside from occasional murmurs or squeaks in captivity, *T. bottae* is generally silent (Howard and Childs 1959). Individuals do, however, seem to signal each other by clicking their teeth together. Gophers squeal with anger when annoyed, and squeak when in pain (Chase et al. 1982).

Pocket gophers retreat to deeper nests when something approaches above ground, suggesting that they have a high sensitivity to low-frequency sounds and seismic vibrations (Reichman and Smith 1990, Francescoli 2000). Although they have reduced pinnae and small eyes, and spend most of their time in dark burrows, their vision and hearing are reasonably good (Francescoli 2000). *T. talpoides* is able to discern predator odors, suggesting gophers have a sensitive sense of smell.

Pocket gophers (*T. bottae*, *Geomys bursarius*, and *Pappogeomys castanops*) generally ignore amphibians, lizards, and beetles encountered in burrows (Hickman 1977b); in one case a tiger salamander (*Ambystoma tigrinum*) was picked up and moved out of the way of excavation. Gophers generally respond to snakes by erecting a soil barricade. Other mammals introduced into gopher burrows in a lab situation are herded to the surface or into a blind tunnel and walled off (Hickman 1977b).

Burrows and burrowing. Members of the family Geomyidae (pocket gophers) are the only truly subterranean rodents in North America. Like other subterranean rodents on other continents (mole-rats, mole-voles, bamboo rats, zokors, etc.), they exhibit many adaptations to burrowing and life underground (Lacey et al. 2000). For example, they have adapted to maintaining activity in a sealed burrow environment that is often low in oxygen and high in carbon dioxide (Reichman and Smith 1990), and are in a perpetual state of vitamin D deficiency due to their lack of exposure to sunshine (Buffenstein 2000).

The environment in a burrow is more moderate than above ground, offering protection from weather as well as from most predators. Unlike other rodents, pocket gophers maintain a sealed burrow system, plugging the entrances with a few inches to a foot of soil (Dalquest 1948). At a depth of 30 cm, almost all daily temperature fluctuations disappear, and a plugged burrow quickly reaches 100% humidity, which can be an advantage in dry environments (Reichman and Smith 1990). The potential for seasonal flooding, and the buildup of parasites are disadvantages to living in burrows. A gopher's burrow system is its home range and territory, and burrows seem to be valuable resources. Burrow systems that become vacant are quickly occupied by gophers from adjacent burrows or dispersing subadults (Witmer et al. 1996, Verts and Carraway 1998, Engeman and Campbell 1999). Reichman et al. (1982) indicated that when a *T. bottae* was removed, its burrow was taken over by another gopher within hours or minutes, suggesting the gophers were aware of the presence and perhaps the position of their neighbors.

The extensive burrow systems of pocket gophers have shallow tunnels with laterals for foraging at the surface, and deeper tunnels with chambers for nests, food caches and deposition of fecal pellets. Mazama pocket gopher tunnels are 3.8–4.4 cm in diameter, and the shallow ones are 10–25 cm below the surface (Witmer et al. 1996, Verts and Carraway 1998). Witmer et al. (1996) reported that deeper tunnels averaging 141 cm in depth (range 119–150 cm) are also dug. Nest chambers are about 25 cm in diameter and are lined with dry grass. Scheffer (1931) noted that the nests of four burrow systems were found at depths of 66, 75, 86 and 91 cm, and Witmer et al. (1996) found nests at an average depth of 88.5 cm (range 48–150 cm, n = 12). Five chambers used for food caches were about 23 cm in diameter at an average depth of 52.8 cm (range 36–72 cm), and were often located 30-60 cm from a nest (Witmer et al. 1996).

Pocket gophers have narrow hips, short limbs, and loosely attached skin that facilitate movements in tunnels, including turning around (Stein 2000). They are able to run backwards almost as fast as forward (Maser et al. 1981). When digging, gophers loosen soil with their claws, and their teeth when necessary, and occasionally push the dirt backwards under their body dog-like with their rear paws (Sterner 2000). While digging, they periodically turn around within the diameter of their own body and push the soil to the surface or into an unused burrow with their front feet and head (Chase et al. 1982). Sterner (2000) reported that captive *T. talpoides* scooped loosened soil against their breast with their forepaws and then pushed it out of the way. Soil is pushed out in one direction, creating the fan-shaped mounds typical of gophers, or under snow cover it is packed into tunnels in the snow. Old nest material, rejected food, and fecal material all remain in the burrow system among unused chambers or abandoned and plugged burrows (Chase et al 1982). Cox and Hunt (1992) reported that mounds are deposited on the surface by *T. bottae* primarily when gophers are expanding the main tunnel and the quantity of soil is more than can be stored in unused tunnels. When short surface-access tunnels were excavated, the soil was more often deposited in unused tunnels or chambers, and surface mounds were not produced.

There have been a few observations of burrow construction over time. One *T. talpoides* dug 146 m of tunnel in 5 months, though the ground was frozen for two of those months (Richens 1966). The gopher created 0–14 mounds per day for a total of 161 mounds. Another was able to construct 152 cm of tunnel per minute through snow (Marshall 1941). Andersen and MacMahon (1981) reported that *T. talpoides* seems to burrow at a relatively constant speed in a given soil type. Under field conditions gophers burrowed at an average speed of 1.5 cm/min (range 0.8–2.5), but stopped completely when the soil was frozen or saturated (Andersen and MacMahon 1981).

Burrow system size is determined in part by energy needs and the energy costs of burrowing and maintaining the system (Vleck 1981). This energy balance is affected by soil type and fertility and food plants available. Burrows that are disturbed are usually rapidly repaired, or the branch sealed off, suggesting that burrows are patrolled. There may be a theoretical maximum useful burrow system size, above which the added size is outweighed by the cost of 'patrolling' or defending it (Kennerly 1964). There may also be a minimum burrow system size determined by food requirements and perhaps the rate of gas diffusion and the respiratory needs of the gopher (Wilson and Kilgore 1978). Wilson and Kilgore (1978) noted that soil porosity has a strong effect on the rate of gas exchange between a mammal and the atmosphere.

Seasonal activity. *Thomomys* pocket gophers adjust their annual cycle of activity to the seasonal changes of weather, soil and plant growth (Cox and Hunt 1992). Pocket gophers remain active in winter and do not hibernate. Where the ground becomes frozen and covered with snow, gophers tunnel through the snow; snow tunnels allow gophers to feed on above-ground vegetation covered by snow without danger of predation (Chase et al. 1982). Mound building by Mazama pocket gophers in Washington appears to be highly seasonal; increased activity is often noted after the first significant fall rains (D. Stinson, pers. obs.; K. McAllister, pers. comm.). Cox and Hunt (1992) reported that burrowing activity of *T. bottae* increased with early winter rains in southern California because it created soil conditions favorable to digging and growth of herbaceous plants and was associated with increased reproductive activity. Gophers did not expand their burrow systems when the soil was saturated.

Wight (1918) reported that Mazama pocket gophers in Oregon tunneled 4.8 times faster in soft, moist soil than in hard-baked soil. Miller (1948, 1957) reported that production of surface mounds by *T. bottae* at two locations in California was highest when soil moisture was 9 –19% suggesting this moisture level provided the easiest digging conditions. Cox and Hunt (1992) noted that the digging of surface-access tunnels was not correlated with soil moisture, but was related to accessing seasonally available foods. Seasonal increases in mound building by *T. bottae* in Arizona seemed to be related to availability of preferred foods and movements of males seeking mates (Bandoli 1981). Precipitation was not a major factor influencing burrowing activity, but the study area did not have a dramatic seasonal difference in precipitation, as occurs in western Washington. Activity is reduced in summer when the soil becomes hot and dry (Chase et al. 1982, Cox and Hunt 1992). Gettinger (1984) reported no period of prolonged inactivity of *T. bottae* during June – September in southern California. Kuck (1969 *in* Bonar 1995) reported that several gophers (*T. talpoides*) remained inactive for long periods of time, including an adult male that was inactive for 13 days.

Diet and Foraging

Pocket gophers are herbivores that excavate tunnels to feed on roots and above-ground plant parts. They also sometimes pull entire plants underground (Busch et al. 2000), or cut plants near burrow openings (Maser et al. 1981). Like other subterranean rodents, pocket gophers tend to be less selective about food than surface-dwelling rodents because burrowing to locate food is energetically costly (Buffenstein 2000). In all subterranean rodents studied, digestion is more efficient than in surface-dwelling rodents (>70% vs. 50-60%; Buffenstein 2000). Subterranean rodents tend to favor high quality foods, such as starchy roots and perennial forbs, but will consume whatever is available (Buffenstein 2000). Maser et al. (1981:173) observed Mazama pocket gophers foraging above ground in the evening on the surface close to their burrows, and wrote:

> "Gophers quickly cut off vegetation, cram as much as possible into their cheek pouches, and disappear underground. They frequently reappear in a short time to continue gathering food. The food that is carried into a burrow is undoubtedly deposited in a storage chamber.…I have not seen one of these gophers take time to eat while it is exposed on the ground."

Information available for plant species eaten or cached by Mazama pocket gophers in Washington and Oregon is shown in Table 3. Witmer et al. (1996) examined Mazama pocket gopher food cache chambers in a fallow field and a Christmas tree farm in western Washington; he found that they usually contained a single type of root, often thistles. Scotch broom, a woody exotic, is probably not a preferred food since gophers seem to be absent where Scotch broom is abundant (Steinberg 1996a, Olson 2011a) and gophers only feed on woody vegetation when herbaceous plants are not available. Dalquest (1948) contains a photo of a food cache that was 2 liters in volume, composed mostly of quackgrass (*Agropyron repens*).

Table 3. Plant species eaten or cached by Mazama pocket gophers.

Common name	Plant species	Plant part[a]	Data type[b]	State	Source
Annual agoseris	*Agoseris heterophylla*	A	S	OR	Burton and Black (1978)
Quackgrass	*Agropyron repens*	R	C	WA	Dalquest (1948)
Wild onions, garlic	*Allium* spp.	R		OR	Maser et al. (1981)
Greenleaf manzanita	*Arctostaphylos patula*	A	O	OR	Burton and Black (1978)
Brome species	*Bromus* spp.	A	S	OR	Burton and Black (1978)
Common camas	*Camassia quamash*	R	C	WA	Scheffer (1995), G. Olson (pers. obs.)
Snowbrush	*Ceanothus velutinus*	A	O	OR	Burton and Black (1978)
Small-flowered blue-eyed Mary	*Collinsia parviflora*	A	S	OR	Burton and Black (1978)
Bull thistle	*Cirsium vulgare*	A	S	OR	Burton and Black (1978)
Thistles	*Cirsium spp.*		C	WA	Witmer et al. (1996)
Scotch broom	*Cytisus scoparius*[c]	R	C	WA	Witmer et al. (1996)
Tall annual willowherb	*Epilobium brachycarpum*	A	S	OR	Burton and Black (1978)
Rabbitbush	*Ericameria bloomeri*	A?	S	OR	Burton and Black (1978)
Woolly eriophyllum	*Eriophyllum lanatum*	A	S	OR	Burton and Black (1978)
Spreading groundsmoke	*Gayophytum diffusum*	A	S	OR	Burton and Black (1978)
Hairy cat's ear	*Hypochaeris radicata*	A, R	C, O	WA, OR	Scheffer (1995) Maser et al. (1981)
Lupines	*Lupinus* spp.	A		OR	Maser et al. (1981)
Velvet lupine	*Lupinus leucophyllus*	A	S	OR	Burton and Black (1978)
Pink microsteris	*Microsteris gracilis*	A	S	OR	Burton and Black (1978)
Dwarf purple monkeyflower	*Mimulus nanus*	A	S	OR	Burton and Black (1978)
Miner's lettuce	*Montia perfoliata*	A	S	OR	Burton and Black (1978)
Leafy nama	*Nama densum*	A	S	OR	Burton and Black (1978)
Gairdner's yampa	*Perideridia gairdneri*	R	C	WA	Scheffer (1995)
Ponderosa pine	*Pinus ponderosa*	A?	S	OR	Burton and Black (1978)
Douglas' knotweed	*Polygonum douglassii*	A	S	OR	Burton and Black (1978)
Bracken fern	*Pteridium aquilinum*	R	C	WA	Scheffer (1995)
Clover spp.	*Trifolium* spp.	A	O	OR	Maser et al. (1981)
Western needlegrass	*Stipa occidentalis*	A	S	OR	Burton and Black (1978)
Common mullein	*Verbascum thapsus*	A	S	OR	Burton and Black (1978)
Goosefoot violet	*Viola purpureum*	A	S	OR	Burton and Black (1978)
Wax currant	*Ribes cereum*	A	O	OR	Burton and Black (1978)

[a]A = above ground parts; R= roots or belowground parts.
[b]C = cache; O = observed eating; S = stomach or cheek pouch contents.
[c]Some caches, particularly of woody species (e.g. Scotch broom), may be emergency food only, or perhaps are essentially trash dumps.

Maser et al. (1981) stated that Mazama pocket gophers were particularly fond of bulbs, such as wild onion and wild garlic, and also ate clover, lupines, hairy cat's ear, and grasses. In a ponderosa pine/ bitterbrush /needlegrass community in Oregon, Burton and Black (1978) reported that the annual diet consisted of aboveground parts of forbs and grasses (40% and 32%, respectively) and 24% roots. Feeding preferences seemed to change with availability, but the most succulent plants available were the most preferred. In July, when all forbs were most abundant, perennial forbs were preferred over grasses, and grasses were preferred over annual forbs. Agoseris, pink microsteris, and blue-eyed Mary were eaten in March and May; Douglas' knotweed, leafy nama, spreading groundsmoke, and tall annual willow-weed were frequently eaten in July and September. Bull thistle, velvet lupine, and goosefoot violets were frequently eaten in summer, while lupines and common mulleins were eaten in winter. Most grasses, especially mountain brome (*Bromus carinatus*), were eaten most frequently during the dormant season (November to May). Western needlegrass was heavily used during the growing season and early winter (Burton and Black 1978). Woody plants were least preferred and were a minor component (4%) of the annual diet, eaten mostly in winter.

The availability of forbs may provide nutrients important for gopher growth and reproduction. Experimental removal of forbs reduced northern pocket gopher populations by 87% (Keith et al. 1959), and reduced the proportion of reproductive female Attwater's pocket gopher (*Geomys attwateri*) and the average length of residency of both sexes (Rezsutek and Cameron 1998). Burton and Black (1978) indicated that management practices that stimulate the production of succulent forbs and grasses are likely to improve habitat. Gophers maintained only on grasses in captivity lost weight and died; those maintained on forbs gained weight (Teitjen et al. 1967).

Home Range, Movements, and Dispersal

Home range size. Pocket gopher territory (i.e. burrow systems) sizes vary widely with habitat quality and reproductive status. Using radio-telemetry, Witmer et al. (1996) estimated that the late winter-early spring home range of Mazama pocket gophers on a fallow field averaged 108 m^2 for 4 males (range 73–143 m^2; 1,166 ft^2, 788–1,544 ft^2) and 97 m^2 for 4 females (range 47–151 m^2; 1,048 ft^2, 508–1,631). Andersen and MacMahon (1981) found that most adult *T. talpoides* only made small shifts (10–15 m) in their home range over the course of a year. One system of foraging tunnels of *T. mazama* in Oregon occupied an area of 22.3 m^2 (241 ft^2, Walker 1949). Ingles (1965) indicated that burrow systems of mountain pocket gophers (*T. monticola*) ranged from 22 m^2 (238 ft^2) for young animals to 222 m^2 (2,398 ft^2) for older animals; burrow systems of females were 8.4-187 m^2 (91–2,020 ft^2, n = 13), and those of males were 7.4-133.6 m^2 (80–1,443 ft^2, n = 6). Gettinger (1984) reported a mean maximum burrow system area of 106.5 ± 32.2 m^2 (1,150 ± 348 ft^2) for *T. bottae*. However, gophers spent 90% of their time in a portion (48 m^2, 578 ft^2or 45%) of the maximum burrow system.

Burrow length, perimeter, and home range size were all greater, and burrow systems were more linear, for reproductive male *T. bottae* than for females and nonreproductive males (Reichman et al. 1982). However, the spacing between and within burrow systems did not vary by sex, reproductive condition, or study site; burrow systems consisted of basic building units with equal branch lengths and equal distances between branch points.

Gopher density. Both the area and quality of suitable habitat influence gopher densities on a site, with an upper limit determined by territoriality. Density also varies seasonally with reproduction and dispersal of young. Although there are numerous density estimates for other pocket gopher species, including the closely related *T. talpoides* (Smallwood and Morrison 1999), there are few data on density of the Mazama pocket gopher. G. Olson (unpubl. data) captured 200 Mazama pocket gophers from 22.3 acres at the Olympia Airport, although not all the gophers present were captured. This suggested a minimum mean density of 9 gophers/ac in the 22 ac plot; live-trapping on 70 ac of gravelly soil at Weir Prairie indicated a density of about 2 gophers/ac.

Gopher densities are also affected by food resources (Keith et al. 1959 Black and Hooven 1977, Resutek and Cameron 1998); how much territory size varies with food abundance is not clear. Romanach et al. (2005) examined the effect of vegetative productivity on the length and geometry of the foraging tunnels of three species of gopher. Burrow system length was inversely related to plant biomass. Generally with increasing vegetative productivity, total burrow length decreased and the area of a polygon drawn around the burrow system decreased. However, this pattern was statistically weak ($r^2 = 0.49$, $P = 0.12$) and was not consistent for the three species studied; the results may have been confounded by differences in clay content of soils.

The energetic cost of burrowing likely limits how much pocket gophers can increase territory size. Reichman and Seabloom (2002) reported that balancing foraging efficiency and territoriality resulted in the spacing between adjacent burrow systems being highly uniform, creating a buffer zone between systems that exists regardless of site productivity. Hansen & Remmenga (1961, *in* Teitjen et al. 1967) noted that the size and shape of territories are more consistent at high densities; at low densities they tend to cluster and size and shape are more variable. The persistent presence of neighbors may limit a gopher's ability to expand a territory in response to reduced food availability. Pocket gophers tend to cluster or clump together to maintain contact with congeners for breeding. In lower quality habitat, these clumps of gophers move around over time, presumably due to a depletion of preferred food resources, so density varies greatly across the landscape and at any particular site through time (J. Patton, pers. comm.).

Patton and Smith (1990) reported that in better habitats, *T. bottae* populations exhibited greater sexual dimorphism and the sex ratio was skewed toward females. This would, in turn, affect mean territory size because females had smaller territories. The difference in territory size between sexes and the sex ratio would affect maximum density. Lidicker and Patton (1987) indicated that in *T. bottae*, the sex ratio is about 1:1 at low density, but skews increasingly to females with increased density.

Movements and dispersal. Dispersal is the permanent movement of organisms from one place to another. The ability of pocket gophers to disperse significant distances, and the frequency that it occurs, affects whether subpopulations are connected by immigration and supported demographically and whether vacant habitat patches are recolonized. Most dispersing gophers are weaned young, seeking space for a new burrow system or to occupy an abandoned one. Dispersal of sexually maturing individuals may be the result of an innate drive (Chase et al. 1982), but Williams and Cameron (1984) suggested that they are driven out by the mother. Vaughan (1963) noted that dispersal of young from assumed natal burrows seemed to be in all directions and only as far as necessary to find a suitable site. Andersen and MacMahon (1981) found that a few immature *T. talpoides* made long distance (>100 m) movements.

Some subadults settle in or near the natal burrow system for a time, but others disperse to establish their own burrow system or assume ownership of one left vacant. Scheffer (1931) noted that excavation of burrows seemed to show that some young dispersed by plugging off a portion of the parental burrow system and expanding lateral tunnels. In a study of *T. bottae*, dispersal was sufficiently common that vacant habitats within a few hundred meters were rapidly colonized (Daly and Patton 1990). In the study, 63% of gophers caught as juveniles and recaptured as adults were recruited within 40 m of their presumed natal territory; 20% had moved 40-100 m, 11% moved 100-200 m, and 6% moved 200-300 m (Daly and Patton 1990). The maximum distance is not known because in this and similar studies, individuals that disappear may have died, or moved beyond the limit of trapping.

Young pocket gophers often disperse above ground (Chase et al. 1982). Vaughan (1963) reported that gophers dispersed from introduction sites by burrowing in the soil or the snow, but that young usually dispersed above ground from parental burrows. Daly and Patton (1990) also reported that pitfall trapping demonstrated that much of the dispersal in *T. bottae* occurred above ground and most dispersal movements occurred in the spring and summer before they reached sexual maturity. Female *T. bottae* tended to disperse soon after they were weaned, while young males dispersed later in the spring and at a larger body size (Daly and Patton 1990). Similar observations were reported for *T. bottae* by Howard and Childs (1959), and for Attwater's pocket gopher (Williams and Cameron 1984) and yellow-cheeked pocket gopher (*Cratogeomys castanops*, Smolen et al.1980); dispersers generally were young, and dispersal peaked near the end of the reproductive season. Male *T. bottae* and *C. castanops* seemed to disperse further from their parental home range than females, as is typical in small rodents (Williams and Baker 1976; *in* Baker et al. 2003). Williams and Cameron (1984) did not detect a significant relationship between percent young dispersers and density of adult, young, or total resident population of Attwater's pocket gopher: there was no difference in the frequency of dispersal of males vs. females, but they did not gather data on distances moved.

Adult pocket gophers are generally sedentary. Once pocket gophers have established a territory, they generally remain there, although they will shift their home range in response to seasonally wet soils. For example, of 400 adult *T. bottae* live-trapped by Daly and Patton (1990), only 5 males and 2 females changed territories; 6 gophers moved 40-100 m, and 1 moved 300 m. The mean distance between captures of *T. talpoides* in Colorado was 28 m for subadult males, 18 m for subadult females, and 11 m for adults; the maximum movements in 24 hours were 18.3 m for adult females, and 64 m for adult males (Hansen 1962). Vaughan (1963) released *T. talpoides* and *T. bottae* into fields where resident gophers had been removed. In the year between release and capture, the average movement by *T. talpoides* (239 m; range 15–790 m, n = 13) was much greater than for *T. bottae* (60 m; range 0 – 274 m, n = 18). Another 37 *T. talpoides* were trapped nine days after release; the mean distance moved was 21 m and 51% were recaptured in the same burrow system into which they had been introduced (Vaughan 1963). In homing experiments, 9 released *T. bottae* returned to their territory through existing tunnel systems in the territories of other gophers (Howard and Childs 1959). One female returned from a distance of 200 m using existing burrows.

For most studied animals, the gene flow resulting from dispersal is important for maintaining genetically diverse populations. However, in pocket gophers the existence of small populations that remain genetically different and low in genetic diversity seems to be normal. Daly and Patton (1990) reported that over a seven-year period, genetic exchange occurred between populations of *T. bottae* in adjacent California fields through recruitment of immigrants into established populations and vacant habitat, but the amount of gene flow did not reduce the genetic differences between them. In the short-term, dispersal between small subpopulations of pocket gophers may be more important for demographic support (preventing local extinction and allowing recolonization of vacant patches) than maintaining genetic diversity.

It is not known what sizes and types of inhospitable habitat create barriers to dispersal for Mazama pocket gophers. In the south Puget prairie landscape, the Nisqually, Deschutes, and Black rivers may have inhibited contact between gopher populations. Although pocket gophers are able to swim (Kennerly 1963, Best and Hart 1976, Hickman 1977a), it is unknown how often they do so while dispersing. Criddle (1930) observed a *T. talpoides* swim 90 m across a river. More recently, highways and associated developed areas may effectively isolate populations, but there are no published studies on the effects of roads and impervious surfaces on pocket gophers.

Reproduction

Reichman et al. (1982) reported that *T. bottae* seemed to be monogamous within a season, but often changed mates between seasons. He found four instances of males and females sharing a common deep nest between their burrow systems and the males did not share a nest with any other neighboring female. Pocket gophers are generally thought to be polygynous based on at least two cases of males siring litters from >1 female, and sex ratios that favor females by as much as 4 to 1 (Daly and Patton 1986, 1990, Steinberg 1996a). One male *T. bottae* inseminated five females (Patton and Feder 1981).

Mazama pocket gophers attain sexual maturity by the breeding season after their birth, when approaching 1 year of age (Scheffer 1931, 1938; Verts and Carraway 2000), which is relatively late for rodents (Busch et al. 2000). In *T. bottae*, many females bred in their first year, particularly in irrigated alfalfa, but none did in drier native habitats (Daly and Patton 1986, Patton and Brylski 1987).

T. H. Scheffer recorded the breeding condition of 313 male and 312 female Mazama pocket gophers near Olympia and noted embryos from 18 March to 15 June (Scheffer 1931, 1938). A female collected in Oregon by Walker (1949) on 21 March was not reproductively active, but one collected 10 April was in breeding condition, and another contained embryos on 3 July. Scheffer (1938) reported that the mean litter size for 53 females was 5.0, based on embryo counts (n = 46), and placental scars (n = 27). Based on embryos or scars in 5 females, Witmer et al. (1996) noted litter sizes of 2, 4, 4, 5 and 7. Scheffer (1938) saw no evidence that gophers in Washington have more than one litter of pups per year. Scheffer (1931) suggested that the gestation period may be about 28 days, but it is more likely that it is similar to the 18 days observed in captive *T. talpoides* (Andersen 1978).

Growth and development. The growth of juvenile Mazama pocket gophers has not been described, but probably mirrors that of the similar-sized *T. talpoides* reported by Andersen (1978). In four litters of 5, pups were blind at birth and had a mean weight of 3.6 g. They were hairless and the eyes were visible as dark spots under the skin. By day 17, pups ate solid food and moved about the cage actively. At day 26, the eyes and ears were open. At day 39, their cheek pouches were used to carry food (Chase et. al 1982). Pocket gophers are believed to be weaned around 35-40 days. *T. talpoides* may disperse from natal burrows at about 2 months; in captivity, fighting among siblings increased at about that time to the point where they had to be separated (Andersen 1978). Pups grow rapidly, gaining about 2 g/day for the first 40 days, and most attain adult weights of 90-100 g by 4-5 months of age (Andersen 1978).

Pocket Gopher Demography and Population Dynamics

Although pocket gophers are short-lived rodents, their life history is somewhat more ‘K-selected’ (later maturity, longer life, fewer and smaller litters, etc.) than most small surface-dwelling rodents (Busch et al. 2000).

Sex ratio. Adult sex ratio varies considerably, with both even and female-biased populations reported. Witmer et al. (1996) reported that the sex ratio of *T. mazama* collected near Lacey (n = 19) and Olympia (n = 38) was even, or nearly so. In spring 2012, live-trapping of Mazama pocket gophers at West Rocky Prairie Wildlife Area indicated an even sex ratio of adults (G. Olson, pers. comm.). Howard and Childs (1959) reported that the sex ratio of *T. bottae* varied year to year from 1:1 to 4 females:1 male. At low density, the adult sex ratio seems to be even, but becomes skewed toward females with increasing density (Lidicker and Patton 1987). Daly and Patton (1990) reported that sex ratio was 1.7:1 in yearlings and 3.7:1 for older *T. bottae*, and was skewed in all 3 years of their study. The greater skew for adults may result from longer life expectancy for females (Daly and Patton 1990), likely reflecting the risks of greater dispersal distances and agonistic encounters between males (Busch et al. 2000, Baker et al. 2003). The sex ratio of adult *T. monticola* in populations on subalpine meadows in California ranged from 1.2f: 1m to 2.2f:1m (Ingles 1952).

Longevity and sources of mortality. Many pocket gophers live a year or more. Based on zonation lines in mandibles, Livezey and Verts (1979) reported that none of 127 Mazama pocket gophers were $\geq$3 years old and only 6 (4.7%) were ≥2 years old. The mean life span of 330 *T. bottae* in a 5-year study was about 13.6 months for males and 18.3 months for females (Howard and Childs 1959). The oldest female was at least 4 years, 9 months, and the oldest male was 3 years old. Daly and Patton (1990) reported that of tagged adult *T. bottae*, only 19% of males survived to the following year, compared to 31% for females.

Mortality in *T. bottae* was thought to be common during dispersal from the natal burrow (Howard and Childs 1959); male survival seemed to be density dependent, with higher numbers of males disappearing before reaching 1 year old during a population high. As many as 85% of young born failed to survive to breed (Patton 1990 *not seen, in* Busch et al. 2000).

Predation. It is widely assumed that subterranean life history is an adaptation to avoid predators (Busch et al. 2000, Cameron 2000). Predation does not seem to affect established gopher populations as much as habitat quality, food availability, and weather extremes (Anderson and MacMahon 1981, Baker et al. 2003). Most predation occurs when subterranean rodents are surface feeding, pushing soil out of burrows, or dispersing (Baker et al. 2003). *Thomomys spp* that spend more time on the surface are regularly preyed on, particularly by hawks and owls (Busch et al. 2000).

Long-tailed weasels (*Mustela frenata*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), spotted owls (*Strix occidentalis*) and house cats are known to prey on Mazama pocket gophers (Scheffer 1931, 1932, Nussbaum and Maser 1975, Toweill and Anthony 1988a,b, Forsman et al. 2001). Other predators probably include red-tailed hawks (*Buteo jamaicensis*) (Witmer et al. 1996), great horned owls (*Bubo virginanus*), and dogs (Scheffer 1932, Maser et al. 1981, Chase et al. 1982). Gopher snakes (*Pituophus catenifer*) prey on pocket gophers, but they are now probably extinct in western Washington (Leonard and Hallock 1997, Altman et al. 2001). Forsman et al. (2001) indicated that *T. mazama* occurred, although rarely, in the diet of spotted owls in the Olympic Mountains. Other known predators of pocket gophers that may prey on *T. mazama* include: red fox (*Vulpes vulpes*), skunks (*Mephitis mephitis* and *Spilogale gracilis*), northern goshawk (*Accipiter gentilis*), kestrel (*Falco sparverius*), barn owl (*Tyto alba*), and long-eared owl (*Asio otus*) (Maser et al. 1981, Chase et al. 1982). Avian predators may be the most successful at catching gophers; in a Colorado study, gophers accounted for 7.4% of the diet of red-tailed hawks and 71.4% of the diet of barn owls (*Tyto alba*) (Douglas 1969).

Parasites. Two species of flea and several species of chewing lice have been identified from Mazama pocket gophers (Walker 1949, Whitaker et al. 1985, Hellenthal and Price 1989). Parasites have not been reported to cause mortalities in *T. mazama*, but Andersen and MacMahon (1981) reported botfly larvae (*Cuterebra* sp.) and helminthes parasites contributed to mortalities in a subalpine *T. talpoides* population. Based on occurrences in other pocket gopher species (*T. talpoides* and *T. bottae)*, Mazama pocket gophers probably are also hosts for Coccidia, tapeworms, and nematodes; but they are not believed to be reservoirs for human diseases (Verts and Carraway 1999, 2000, Jones and Baxter 2004).

***Traps and poison*.** Where they are perceived to be a problem, trapping and poisoning by humans may occasionally affect gophers. Pocket gophers can be a pest in agricultural fields and sometimes affect survival of conifer seedlings (Barnes et al. 1970, Marsh and Steele 1992). As a Threatened species, Mazama pocket gophers are protected wildlife in Washington, so trapping or poisoning is prohibited without a permit. Link (2004) discusses non-lethal methods of controlling gopher damage to plantings (http://wdfw.wa.gov/wlm/living/gophers.htm).

***Population dynamics*.** Gopher populations can increase dramatically in the summer after the dispersal of young of the year, and may increase to 3–4 times the spring adult population. In addition to this annual influx of young-of-the-year, gopher populations also fluctuate year-to-year due to environmental conditions. Pocket gopher populations are reported to undergo occasional extreme fluctuations (Howard 1961, Chase et al. 1982) and are characterized by local extinction and recolonization (Baker et al. 2003); in poorer habitat, local aggregations of gophers may move around perhaps with depletion of the best food plants. Territoriality and extreme weather may influence pocket gopher populations more than any other factors. Extreme winters are known to nearly wipe out the young of the year and produce dramatic population declines (Hansen 1962, Turner et al. 1973 *in* Chase et al. 1982). Flooding of burrows can expose many gophers to predators on the surface and likely results in fluctuations in populations and occupancy of flood-prone sites. Andersen and MacMahon (1981) believed that severe weather was the most important mortality factor in their subalpine study area because it restricted burrowing and therefore the acquisition of food, caused mortality from hypothermia, and increased susceptibility to parasites. They hypothesized that local population numbers varied year-to-year below the point at which population density is limited by territorial behavior.

Ecological Relationships and Functions

Pocket gophers have an impact on ecological communities by altering soil structure and chemistry, and plant occurrences (Hobbs and Mooney 1991, Reichman and Seabloom 2002, Canals et al. 2003). Mielke (1977) reviewed the influence of gophers and other fossorial rodents on soil and plant growth, and suggested that the activities of fossorial rodents may provide an explanation for the genesis of North American prairie soils. Reichman and Seabloom (2002) referred to pocket gophers as “subterranean ecosystem engineers.”

Pocket gopher effects on soils. Pocket gopher burrowing activities may turn 3–7 tons of soil per acre every year, mixing organic matter with the subsoil and speeding soil-forming processes (MacMahon 1999). The soil backfilled by gophers into old burrows also is less compacted than the surrounding matrix (Reichman and Seabloom 2002). Laycock and Richardson (1975) reported the effects of *T. talpoides* on vegetation and soil of subalpine grassland that was protected from livestock grazing for 31 years. They found that where gophers were present in an exclosure, noncapillary porosity, organic matter, total nitrogen, and total phosphorous were higher and bulk density was lower than where gophers were absent. These changes may have resulted from the burial of organic material by mounds, the decay of unused food caches, and the distribution of gopher excrement in the burrow system (Laycock and Richardson 1975). Zinnel and Tester (1992) reported that urine, feces, and decomposing uneaten food apparently resulted in higher total nitrogen in the 21–40 cm and 51–60 cm depth zones of the soil profile as well as higher root biomass in the 11–30 cm zone at nest sites compared to control sites. Canals et al. (2003) demonstrated that gopher disturbances affected the amount and type of nitrogen available to plants in California annual grassland. Clark et al. (2005) reported that the role of rodents in the nitrogen cycle was similar in magnitude to that of large herbivores.

Effects of below-ground herbivory by pocket gophers. Cantor and Whitham (1989) reported that in northern Arizona mountain meadows, the effects of belowground herbivory by pocket gophers were much more dramatic than aboveground herbivory by ungulates. Root herbivory by *T. bottae* apparently prevented aspen (*Populus tremuloides*) from colonizing the deep soils of mountain meadows (Cantor and Whitham 1989); aspen was largely restricted to areas of rock outcrop where the rock and thin soil were unsuitable to gophers. Andersen and MacMahon (1981) estimated that *T. talpoides* consumed 30% of the annual primary productivity represented in below-ground biomass of forbs in a subalpine meadow.

Pocket gopher effects on above-ground plant growth. Dalquest (1948) noted that pocket gophers were pestiferous in newly planted alfalfa, but once established, alfalfa seemed to benefit from gopher activity.

He based this on an apparent correlation between alfalfa growth and gopher activity and abundance, and similar observations of farmers who forbade him from collecting gopher specimens from their established alfalfa fields. Tilman (1983) confirmed a significant positive correlation between above-ground plant biomass and gopher activities in abandoned fields in Minnesota. Murphy et al. (2004) also noted that *Plantago* spp. growing on soil tilled by *T. bottae* were larger than those off of gopher mounds. Fertilized old-field plots from which gophers were excluded showed lower and more variable plant biomass than similar plots available to gophers (Huntly and Inouye 1988). Gopher activity also resulted in a net increase of 5.5% in primary productivity on shortgrass prairie (Grant et al. 1980). However, Reichman and Smith (1985) investigated the effect of pocket gophers on vegetation and reported that gophers seemed to reduce plant biomass above their burrow systems by one-third. They did not think that gophers increased plant growth, but rather that gophers choose the most productive portions of a field. *T. bottae* reduced alfalfa production by about 30% within three years of invading fields in California, and reduced production further in subsequent years (J. Patton, pers. comm.).

Pocket gopher effects on plant diversity and succession. In some prairie ecosystems, pocket gophers have been found to be important in maintaining plant species richness and diversity (Martinsen et al. 1990). The soil moving activities of gophers seem to increase the abundance of forbs (Jones et al. 2008), including many species that they eat.

Soil disturbance created by Mazama pocket gophers' mound-building may increase plant diversity on south Puget Sound prairies. Hartway and Steinberg (1997), who compared plant species occurrence on and away from pocket gopher mounds, found plant diversity three times higher on mounds than off, and a higher diversity of native species (forbs and grasses combined). However, mounds also had much higher diversity of non-native forbs because in many plant communities, soil disturbance creates microsites favorable to colonization by early successional/pioneer species, many of which are weedy exotics. The frequency of occurrence of 12 of 35 species analyzed was significantly different on mounds versus off mounds. Native species that benefitted from gopher activity included yarrow and white-topped aster (*Aster curtus*), a sensitive species in Washington (WNHP 1997). The pattern was different for each prairie site depending on the surrounding plant community; prairie sites with many exotic species had fewer native species on mounds, apparently because the exotic species effectively exclude the native ones (Steinberg 1996a).

Mazama pocket gophers may have accelerated the establishment of prairie vegetation on the glacial outwash and subsequently slowed the invasion of the prairies by trees. Andersen and MacMahon (1985) reported that the mound building activities of *T. talpoides* in areas buried by volcanic tephra by the 1980 eruption of Mt. St. Helens led to changes in local plant community composition and dynamics. Gophers increased the nutrient content of surface soils and increased the rate of succession. Gophers redistribute soil nutrients and create bare ground, resulting in a more patchy distribution and greater average availability of light and soil nitrogen (Huntly and Inouye 1988). A long-term increase in surface nutrients may also occur in other communities where surface nutrients are exhausted by plant growth or leaching (Huntly and Inouye 1988).

Pocket gopher dispersal of spores of hypogeous fungi. Pocket gophers, along with other small mammals, disperse spores of myccorhyzal fungi by feeding on truffles and false truffles and disseminating the viable spores in their droppings (Taylor et al. 2009). These fungi form a symbiotic relationship with plant roots and many plants depend on them for uptake of non-mobile mineral nutrients (Maser et al. 1978). Maser et al. (1978) reported that Mazama pocket gophers from grassy openings in ponderosa pine forest in central Oregon had eaten both above- and below-ground fungi.

Pocket gopher effects on other animals. Pocket gophers also affect many other animal species. Where abundant, they contribute substantially to the prey base of predators. Pocket gophers also improve habitat for a variety of species that use pocket gopher burrow systems as retreats (Hickman 1977b). Using radio telemetry, J. Lynch (pers. comm.) discovered that western toads use Mazama pocket gopher burrows as refuges in summer, sometimes for weeks. The burrow systems of pocket gophers may similarly provide retreats for salamanders, frogs, lizards, snakes, small mammals, and invertebrates. Inactive or abandoned burrows are probably most used because active burrows are normally plugged by the gopher (G. Witmer, pers. comm.). Steinberg (1996a) noted that Mazama pocket gophers seemed to be absent where moles were abundant, but Olson (2011a) detected no relationship between occupancy or plot use of moles and gophers.

Vaughan (1961) reported that 15 of 22 (68%) of the terrestrial vertebrates known from a study site in eastern Colorado regularly inhabited the occupied or abandoned burrows of pocket gophers. He suggested that the availability of gopher burrows affected the local distribution of tiger salamanders and some reptiles. Connior et al. (2008) observed five species of amphibian or reptile in the burrows or mounds of the Ozark pocket gopher (*Geomys bursarius ozarkensis*), but recorded 46 species or subspecies of amphibians, reptiles, and small mammals in the same habitat. They suspected that most of these species used gopher burrows in some way and suggested that the species may be a "keystone species."

Ingles (1965) noted that certain species of arthropods were known only from the nests of pocket gophers. In subalpine areas that receive deep snow, gopher burrows may be an important winter refuge for arthropods. Burrows of *T. monticola* hosted at least 9 species of beetle, 4 species of fly, 3 species of mite, a springtail and a pseudoscorpion (Ingles 1952). Creation of mounds by pocket gophers may affect the distribution of voles (*Microtus* spp.). In tallgrass prairie, voles sometimes used the break in the grass canopy created by gopher mounds as runways (Klaas et al. 1998). Murphy et al. (2004) reported that *T. bottae* benefitted butterfly larvae that fed on *Plantago* spp. because the plants growing on gopher mounds were larger and exhibited delayed senescence.

Vaughan (1974) reported that the soil deposited by *T. talpoides* in Colorado subalpine habitat provided areas for pioneer plant species which were important foods of voles (*Microtus montanus*), deer mice (*Peromyscus maniculatus*), and chipmunks (*Eutamias minimus*). Violets, favored by gopher activity, produced an abundant late summer seed crop that attracted large flocks of migrant mourning doves (*Zenaida macroura*) and dark-eyed juncos (*Junco hyemalis*). Vaughan (1974) concluded that the pocket gopher was the dominant mammal of the study area in terms of its effect on the plant and animal community.

Pocket gophers and Mima mounds. The origins of Mima mounds have long been debated. Dalquest and Scheffer (1942) first hypothesized that the activity of pocket gophers was responsible for the creation of Mima mounds. Gophers push material toward the center of the Mima mound as they dig outward in their territory which is located in the same place year after year (Cox and Allen 1987, Cox and Hunt 1990). Other hypotheses include various geologic and geofluvial processes (Washburn 1988, Berg 1989). Mima mounds co-occur with burrowing rodents in North America, South America, and Africa; Reichman and Seabloom (2002) consider the burrowing mammal hypothesis for the formation of Mima mounds to be the simplest explanation. The gopher hypothesis has been accepted by many ecologists, but the evidence has been insufficient for it, or any other hypothesis, to be more widely accepted. Dalquest (unpubl. field notes, 1940-1941) noted that gophers were absent from some mounded prairies, but were found only on the Mima mounds at other sites.

HABITAT REQUIREMENTS

Mazama Pocket Gopher Association with Prairies and Grassland Vegetation

Mazama pocket gophers in Washington live primarily in open meadows, pastures, prairies and grassland habitats where there are porous, well-drained soils (Dalquest and Scheffer 1944, Dalquest 1948 Johnson and Cassidy 1997). Sites occupied by Mazama pocket gophers in Washington include grassy fields at airports, pastures, fields, Christmas tree farms, and occasionally clearcuts (Stinson 2005). They do not require high quality prairie and can live in a wide range of grasslands, particularly if they include a significant component of forbs, such as clover, lupines, dandelions (*Taraxicum officianale*), false dandelions, and camas. In the south Puget Sound region, pocket gopher populations are predominantly found in areas with prairie soils that retain some prairie vegetation (Fig. 5). The species rarely occurs where grassland has been taken over by dense Scotch broom or where the soil is very rocky (Steinberg 1996a, Olson 2011a). Olson (2011a) reported that low levels of Scotch broom density and shorter vegetation were generally associated with higher occupancy probabilities. Within occupied sites, plot use was higher when broom density was low, fall vegetation was taller and the soil was of a sandy-loam type.

Dalquest (1948) stated that Mazama pocket gophers in Washington occur primarily on grasslands of the glacial outwash plain. Some subspecies of Mazama pocket gopher occur in habitats other than prairies. Dalquest and Scheffer (1944) reported that *T. m. tacomensis* was the only subspecies that occurred on cultivated land away from the outwash prairies. *T. m. louiei*, and subspecies in Oregon, also occur in woodland, particularly in ponderosa pine communities, but they are absent from dense forest (Hooven 1971, Verts and Carraway 1998). Shelton pocket gophers (*T. m. couchi*), are known to invade recent clearcuts if a source population of gophers is nearby. Gophers become common in the clearcut for a few years, as grasses and forbs increase, until the growing trees shade out the herbaceous layer (G. Schirato, pers. comm.). *T. m. melanops* is found in open parkland and subalpine meadows in the Olympic Mountains (Johnson and Cassidy 1997).

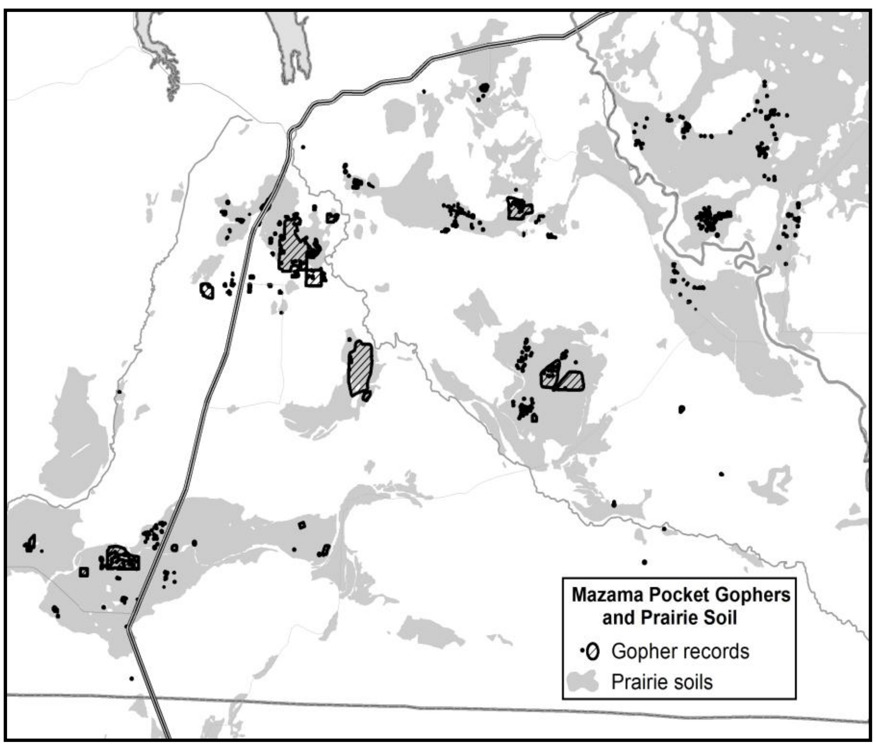

Figure 5. Prairie soils and occurrences of Mazama pocket gophers in Thurston and Pierce counties. Many areas of prairie soils no longer support gophers because they are densely developed or have succeeded to forest.

Mazama pocket gophers were not reported in oak woodland in Washington (Wilson and Carey 2001), but they may have been found in oak savannah historically, particularly where adjacent to open prairie. Oak savannah, with widely scattered Oregon white oak (*Quercus garryana*) and a ground cover of prairie vegetation, was once the most abundant oak community type in the south Puget landscape, but is now nearly gone (Chappell and Crawford 1997).

Effects of Soil Characteristics on Distribution and Abundance of Pocket Gophers

Soil characteristics appear to be more important for pocket gopher distribution than vegetation, as long as edible herbaceous plants are present. Soil characteristics that affect gophers include depth and texture, particularly rock and clay content, which affect burrowing ability, permeability that can result in periodic flooding of burrows, and water-holding capacity and fertility that affect growth of plant foods (Davis et al. 1938, Ingles 1949, Howard and Childs 1959, Miller 1964, Cameron et al. 1988). In general, pocket gophers prefer light-textured, porous, well-drained soils, and do not occur in peat or heavy clay soils (Chase et al. 1982); they also tend to favor areas with deeper soils which provide more plant food (Baker et al. 2003). These soil characteristics affect the food energy available relative to tunneling effort (Vleck 1979, 1981).

The distribution and abundance of Mazama pocket gophers in the south Puget Sound region appear to be correlated with prairie soil types; although they are not found on all remnant prairie sites and they apparently do not require prairie soils. They may be able to occupy any site without significant tree cover and with well-drained sandy loam, loamy sand, or gravelly soil, if not too rocky and the site supports herbaceous vegetation. The historical association with prairie soils was probably related to their avoidance of areas with closed tree canopies, rather than the limitations of other well-drained soils.

In Thurston and Pierce counties, gophers are present primarily in Nisqually, Indianola, Spanaway, and Spanawy-Nisqually Complex soil types (Fig. 6; see Pringle 1990, and Zulauf 1979, for soil type descriptions). Nisqually and Indianola loamy sands seem to be the most suitable soils, based on the abundance of gophers present in these soils. Cagey soils are also sandy, but can have a seasonally high water table. Most of the historical prairies have Spanaway and Spanaway-Nisqually complex soils, which often support gophers, but apparently at lower density than sandy loams or loamy sands based on limited data.

There are some local populations in non-prairie loamy sand, and gravelly soil types (e.g. Indianola loamy sand, Cagey, Grove, Everett) that may not have been used by gophers historically due to forest cover. These occurrences are often adjacent to Nisqually soils. The area with the highest numbers of gophers in Mason County has Carstairs gravelly loam, which is a prairie soil. Several gopher occurrences in Mason County are in gravelly forest soils, including Grove gravelly sandy loam and Shelton gravelly loam, which are widespread in southern Mason County (Fig. 7). The confirmed distribution of gophers provides few data about suitability of soil types and predictions about suitability of soil units with only a few gopher occurrences should be viewed as a hypothesis. Shelton and Alerwood soil types developed on glacial moraines, and Grove, Carstairs, Everett, Indianola, and Lystairs soils originated in glacial outwash plains and eskers (Ness 1960). All of these soils are loose gravel or sand and appear to be suitable for gophers, except perhaps the rockiest types (e.g. Grove cobbly and Grove stony sandy loams; cobbles make up 20-50% of the surface and subsoil of the cobbly soils), and where slopes exceed 15%.

The Olympic pocket gopher of Clallam County has been found in the deepest soils available in the alpine meadows where soils are generally thin (J. Fleckenstein, pers. comm.). No soil survey is available for the *T. m. melanops* sites in Olympia National Park in Clallam County and very little information is available. In occupied habitat, soils seemed to be sandy loam to silty loam and were 20+cm deep (J. Fleckenstein,

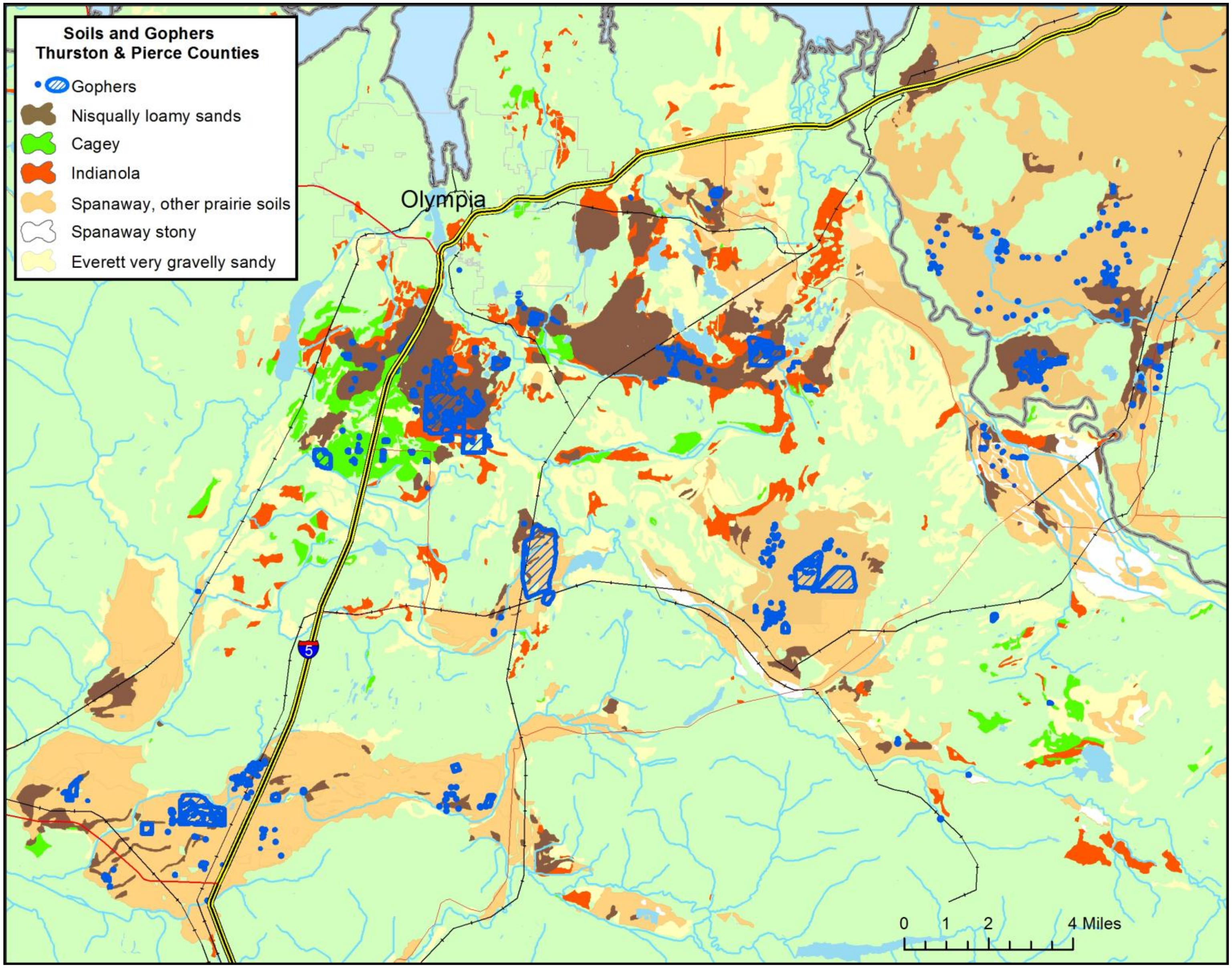

Figure 6. Mazama pocket gopher occurrences and important prairie soils and other sandy loam soil types in Thurston and Pierce counties, Washington (soil data from USDA, NRCS).

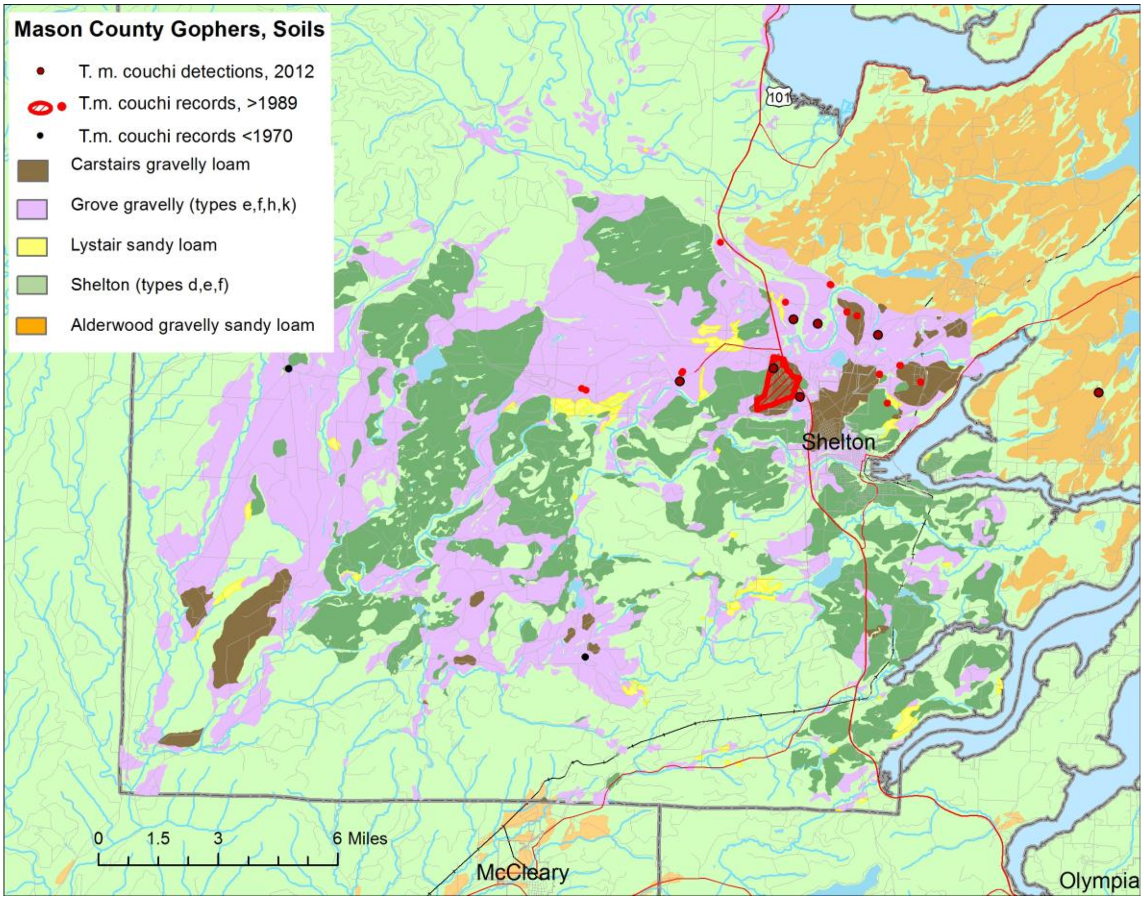

Figure 7. Soil types (USDA, NRCS data) and pocket gopher occurrences (WDFW data) in Mason County, Washington.

pers. comm.). Rocks were a small percentage. The ground on several sites contained a large percentage of tree roots.

Soil type. Mazama pocket gophers in the south Puget Sound region are found primarily in soils with textures characterized as loamy sands or sandy loams and have not been found in clay (Fig. 8). The prolonged rainy season may affect the suitability of silt soils in western Washington. Olson (2011a) reported a positive association with sandy loam soil types in the south Puget Sound landscape. The probability of gopher occurrence at a site was 1/3 lower in gravelly loams vs. sandy loam. Occupancy probability was lower in coarse gravel during spring, and was positively related to the percent of substrate that was soil fines in fall. Within occupied sites, plot use was higher when the soil was of a sandy-loam type (Olson 2011a). This is consistent with general observations that loamy sand soil types (e.g. Nisqually, Indianola, Cagey) seem to have the highest abundance and frequency of occurrence (McAllister and Schmidt 2005, WDFW data), and is consistent with other gopher species (Baker et al. 2003). The frequency of occurrence and apparent abundance of *T. mazama* in loamy sand soils of Thurston and Pierce counties suggest that soil texture and drainage are key characteristics determining suitability.

Rock content of soil also seems to be an important factor affecting gopher occurrence. The proportion of soil by weight made up of medium rocks (1 - 2") correctly predicted the presence or absence of pocket gophers for 8 of 9 sampled sites (Steinberg and Heller 1997). Four of five sites with gophers had soil that was ≤10% medium rocks by weight.

Based on known gopher occurrences and soil characteristics described in soil surveys, soil types were graded by hypothesized suitability for gophers in Thurston and Pierce and Mason counties (Appendix C, D) (Ness 1960, Zulauf 1979, Pringle 1990).

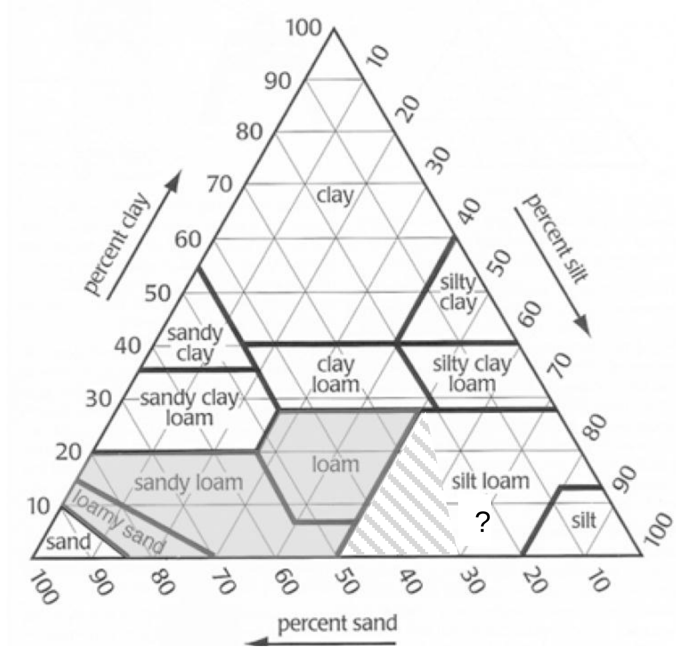

Figure 8. Standard USDA soil texture triangle, with shading to indicate apparent suitability for *T. mazama*; most detections in south Puget Sound region have been in loamy sands or sandy loams (shaded), with fewer in silt (cross-hatch) and none in clay.

Water table. Mazama pocket gophers also occasionally occur at sites with a seasonally high water table, or that experience occasional flooding. Occurrences in these sites may be short-lived colonizations by dispersing subadult gophers from nearby populations on well-drained soils to locations from which they retreat during the wet season. This may be true of the small number of pocket gopher occurrences in Spana, Cagey, Yelm fine sandy loam, and McKenna and Norma soils. In these areas, gopher presence may be determined by topographic position, with gophers absent in depressions, but present on higher ground where the seasonally high water table does not rise as close to the soil surface. Pastures and agricultural land with these poorly draining soils that have had underground drainage structures installed (drain tiles) may also confound these associations.

POPULATION AND HABITAT STATUS

Most of what is known about the past and present status of Mazama pocket gopher populations is limited to distributional information. There are few historical data on population sizes in Washington, other than incidental comments about local populations recorded during scientific collecting (Appendix E). Only recently has there been quantitative data on abundance for a few occupied sites. Populations in Washington have restricted distributions and several have gone extinct. Many remaining populations may be increasingly isolated as prairie habitats are invaded by forest or converted to suburban development.

Past Status of Habitat and Populations

Thurston and Pierce counties. Gopher populations in Thurston (*T. m. pugetensis*, *T. m. tumuli*, and *T. m. yelmensis*) and Pierce counties (*T. m. glacialis* and *T. m. tacomensis*), were more widespread when south Puget prairies and savannahs were more extensive and less fragmented. George Suckley, of the U. S. Pacific Railroad Expedition, reported that gophers were "very abundant on the gravelly prairies near Nisqually" (Suckley and Cooper 1860:126). Gopher populations in Thurston and Pierce counties occurred at suitable sites from the prairies in southwestern Thurston County, northeast to Point Defiance in Tacoma, and as far east as Puyallup. The loamy sand soil areas in Lacey and Olympia that are now densely developed likely supported large gopher populations. The populations were not contiguous, but included several somewhat isolated populations that exhibited their own local variations in size and fur color.

Walter Dalquest, then a graduate student at University of Washington, and Victor Scheffer, with the U.S. Biological Survey attempted to collect a series of 50 gophers from each of 8 different prairie areas from 1939-1942, and they used these specimens for their 1944 monograph on the variation in pocket gophers in Washington. They were unable to capture 50 at some sites; after catching 34 near Vail, Dalquest (unpublished field notes) wrote "I think I have most of the gophers on this prairie." Dalquest did not find any gophers in 1941 at Mima Prairie 1-2 mi southwest of Littlerock. These museum specimens, as well as later collection records from the 1940s–1970s, are listed in Appendix E. Additional information includes the recollections of Mike Thorniley, retired animal damage control agent with Washington Department of Game, who trapped gophers in response to damage complaints at several locations during the 1960–1970s. These included Tenino, along Scatter Creek east of Tenino, Bucoda, the south side of Deep Lake near Millersylvania State Park, just northeast of Offutt Lake, and east of Chain Hill (M. Thorniley, corresp. on file).

More than 90% of the historic prairie and savanna has been converted to agriculture or lost to urban development or the encroachment of coniferous forest (Dunwiddie et al. 2006). The south Puget Sound prairies are the largest remaining remnants of a zone of prairies, oak savanna and woodlands that once stretched from the Willamette Valley in Oregon north to southwestern British Columbia. A recent inventory of prairie sites indicated that of the original 150,000 ac with prairie soils in the southern Puget Sound area, only about 12,500 ac (8%) remain that have >25% native vegetation (Crawford and Hall 1997). Generally, large patches of prairie habitat have become smaller and many smaller patches disappeared. The most frequent causes of prairie loss were urban development (33%), conversion or invasion by forest (32%), and conversion to agriculture (30%) (Crawford and Hall 1997).

The glacial outwash prairies and savannahs were maintained by Native American burning during the last 4,000 years (Leopold and Boyd 1999, Peter and Shebitz 2006, Storm and Shebitz 2006). However, fire suppression allowed the prairies to be invaded by Douglas-fir beginning as early as 1850. No extensive area of prairie remains as it was prior to 1840 (del Moral and Deardorff 1976, Clampitt 1993). Large portions of the original prairies were overgrown with forest by 1960 (Lang 1961). Combined with grazing by up to 13,000 head of stock, disturbance for agriculture, military activity, and successive waves of introduced Eurasian plants, all prairie sites have been altered to some degree. Most native grasslands are degraded by exotic grasses and forbs, or have been invaded by shrubs, especially Scotch broom, Nootka rose (*Rosa nutkana*) and common snowberry (*Symphoricarpos albus*) (Chappell et al. 2001). Scotch broom, an invasive exotic, was introduced prior to 1900 at Steilacoom, apparently as an ornamental (Lang 1961). The relatively infertile and droughty soils of south Puget Sound prairies prevented the complete conversion to agriculture as occurred on the prairies further south, and the establishment of Fort Lewis in 1917 precluded residential development that would otherwise have occurred.

Tacoma area. The Tacoma pocket gopher (*T. m. tacomensis*) was first collected at Fort Steilacoom in the 1850s by George Suckley and C.B.R. Kennerly, but was originally described by Taylor (1919) from a specimen collected by G. Cantwell in 1918. It was found in Tacoma from Point Defiance, south to Steilacoom and perhaps as far east as Puyallup (Fig. 9). T.H. Scheffer caught gophers on Brookdale Rd southeast of Parkland around 1920, and John Finley reported catching gophers as far east as South

Meridian in Puyallup (V. Scheffer, unpubl. notes). Between 1854 and 1962, at least 205 gophers were collected at 20 mappable localities, primarily on the west side of Tacoma in the 1940s (Appendix E). Gophers were apparently becoming harder to find, however, because Murray L. Johnson, who was Curator of Mammals at the Slater Museum, University of Puget Sound in Tacoma from 1948-1983, collected only 5 in 1950, and 2 of the last 3 specimens in 1961-1962. Many of the original collection sites succumbed to suburban development, and one site became an extensive gravel mining operation that recently became Chambers Bay Golf Course. Johnson (notes on file) indicated in 1980 that he had been unable to find any *T. m. tacomensis* for 10 years, although residents adjacent to Wapato Hill in Tacoma indicated in 1974 that their cats had recently killed gophers (Ramsey and Slipp 1974). Dick Taylor, WDFW, did not detect any gopher sign in several visits to the Wapato Hill site in the 1990s (WDFW files, 1998). Steinberg (1996a) and WDFW (T. Schmidt, pers. comm. 2011) personnel found no trace of gophers at the historical locations and at potential sites in Tacoma and vicinity. All populations originally assigned to *T. m. tacomensis* may now be extinct. Their likely extinction may have resulted primarily from the loss and fragmentation of habitat by development and perhaps higher mortalities due to roads, poisoning, trapping, and pets in the suburban environment. The last potential record of this subspecies was the Wapato Hill report in 1974 (Ramsay and Slipp 1974).

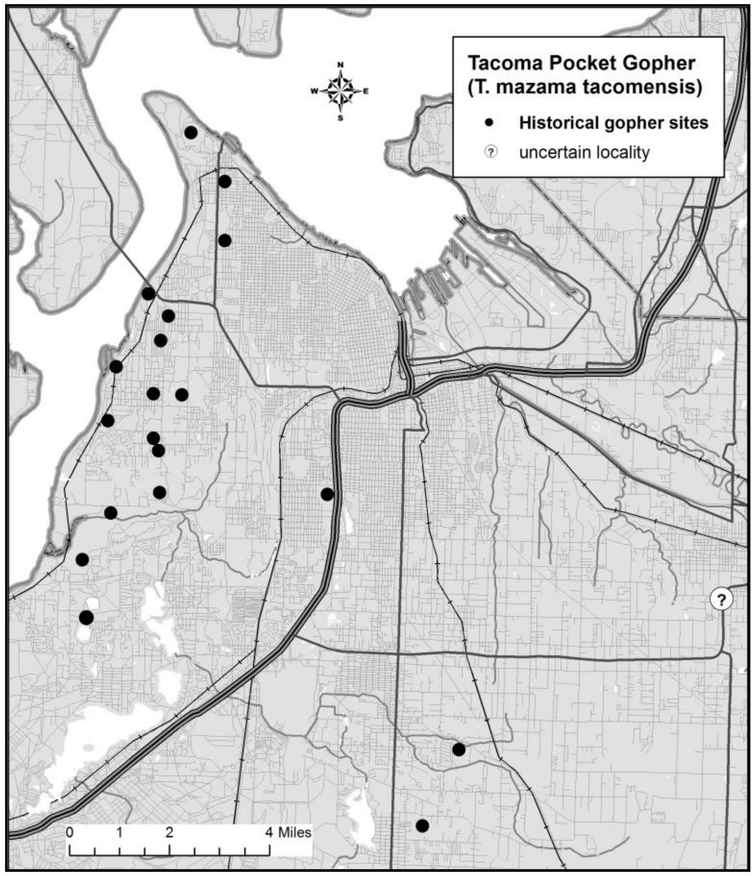

Figure 9. Historical locations in and near Tacoma where *T. m. tacomensis* were found.

Clallam County. The Olympic pocket gopher (*T. m. melanops*) was first collected at the head of the Soleduck River by Vernon Bailey in 1897. Gophers were also collected in the 1920s and 1950s at several other subalpine sites in Olympic National Park, including south of Lake Crescent on Happy Lake Ridge and in meadows between Appleton Peak and Cat Peak (Johnson 1977, Scheffer 1995). Taylor and Cantwell did not find gophers at the heads of the Elwha, Quinault, or Dosewallips rivers in 1921 (Scheffer 1995). Johnson (1977) indicated that gophers were no longer present at the heads of Canyon and Cat creeks or along the High Divide at Bogachiel Peak in 1951 or 1976, but they were found at Appleton Pass, Happy Lake Ridge and Aurora Peak. Johnson (1977) speculated that fire suppression, avalanches, landslides, or weather cycles may have played a role in the local extinctions.

Wahkiakum County. Gardner (1950) described *T. m. louiei* from 9 specimens collected in forest openings northeast of Cathlamet, Wahkiakum County in 1949. M. Johnson collected 11 more in 1956 (Appendix E), when they were found within a 2.25 mi^2 area, but none could be found in 1977 (M.

Johnson, notes). There was no sign of gophers in 1986 and an old burn where they were once found had regenerated to forest (WDFW unpubl. data).

Mason County. There was no information about the distribution or abundance of Shelton pocket gophers (*T. m. couchi*) in Mason County until they were collected on Scotts Prairie, 4 mi north of Shelton by Leo Couch in June 1922, and then described by Goldman (1939). Later, Dalquest and Scheffer (1944:314) caught 7 female gophers on Lost Lake Prairie, southwest of Shelton, which was, "seemingly the entire population." Dalquest did not find any gophers in 1941 at Buck Prairie or Mooney Prairie, north of McCleary. In 1949, Scheffer (1995:56) wrote that the subspecies was, "living only on the prairies near Shelton," and noted gopher activity "beside the highway 1 mi south of Scotts Prairie and on a hill 2 mi north of Shelton (possibly Johns Prairie). He also commented, "the total population of *couchi* gophers is small because of the limited area of the habitat." In reference to their distribution, he stated:

> "Although we have made diligent search and inquiry over a period of many years, we have found no evidence of gophers on the lowland prairies of the peninsula elsewhere than at the southeast corner."

Although Dalquest (1948) stated gophers were known only from Scotts and Lost Lake prairies, they may have been more widespread historically, as prairies and savannahs were more extensive in Mason County in the 19th century before native American maintenance fires ceased (Chappell et al. 2001, Peter and Shebitz 2006). Conner Museum at Washington State University has a single specimen collected by H. Helm at Matlock in 1962 (Appendix E). The historical Carstairs Prairie has a large polygon of Carstairs soil, but nearly all this area is now forested and little open grassland exists in this area. Carstairs Prairie may have supported gophers in the past.

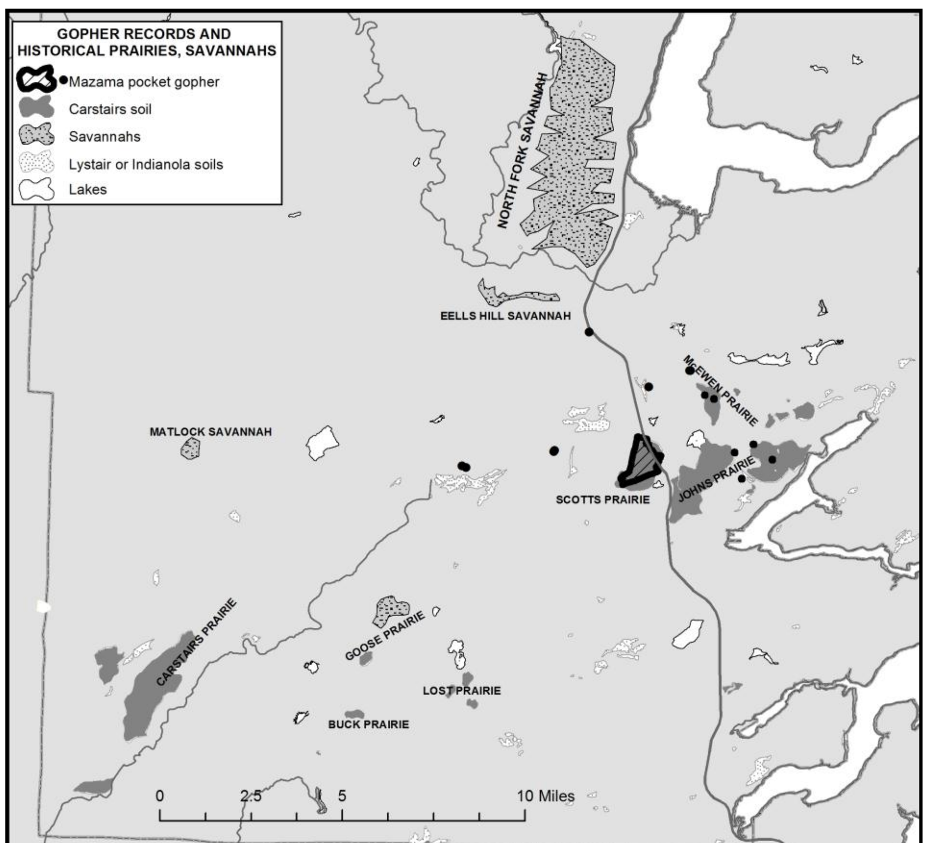

Figure 10. Historical prairies and bear grass savannahs, and gopher records in Mason County. Eells Hill Savannah extended further south but mapping was not completed (savannahs drawn from Peter and Shebitz 2006).

Peter and Shebitz (2006) describe evidence for the historical existence of several savannahs in Mason County, Skokomish bear grass savannahs, that were maintained by the Skokomish Tribe, for at least several hundred years. These sites were burned at regular intervals in part to encourage bear grass (*Xerophyllum tenax*), an important resource for basketry. The largest of these sites, the North Fork Plateau was 3,000 ha (7,410 ac) in area west of Annas Bay of Hood Canal (Fig. 10). Additional savannahs were maintained at Eels Hill, Goose Prairie, Hubin Camp, Dennie Ahl, and Matlock. All of these sites had gravelly soil and are now largely forested, but may have historically been suitable for gophers.

Pocket Gopher Surveys and Population Estimation

Most past information about *T. mazama* populations involved simple indications of presence/absence, sometimes accompanied with notes about relative abundance. Steinberg (1995, 1996a) conducted fairly extensive surveys in 1994-1997 of locations where pocket gophers had been recorded and all sites with intact or restorable prairie, based on a prairie map provided by the WDNR Heritage Program. She visited type localities listed in Hall (1981), locations recorded on gopher specimen tags in museum collections, and locations in the unpublished field notes of Victor Scheffer and Walter Dalquest (Steinberg 1995, 1996a). Additional data includes records on file at WDFW, Joint Base Lewis-McChord (Schmidt 2006, JBLM data), and recent surveys by consultants, as well as ENSR (1993, 1994), and Farrell and Archer (1995).

Since the 2006 state-listing of Mazama pocket gophers, Thurston County and cities began requiring surveys before granting development permits in areas with potentially suitable soils. These surveys delineate the occupied area on a specific project site based on the distribution of characteristic dirt mounds and tailings during season-appropriate visits; they generally do not survey the surrounding lands or make any attempt to evaluate the extent of an entire subpopulation or to determine the number of individuals. From June 2004 – October 2012, WDFW personnel and consultants surveyed 112 project sites in Thurston County. Of these, 61 had gophers present, 47 did not have gophers, and 4 sites could not be determined at the time of survey. The project sites totaled 2,400 ac, but of the area with soil types thought suitable for gophers, only a small percentage (~137 ac) were occupied by gophers. Nearly all of the occupied sites were on historical prairies and near previously known sites. Areas not surveyed are usually forested or have poorly drained soils unsuitable for gopher persistence. The results of the increased survey efforts by consultants and WDFW since 2006 suggest that gophers are found in scattered locations in vacant lots in Tumwater and Lacey as well as in rural and low density residential areas with suitable soil and vegetation.

In 2012, WDFW conducted extensive Mazama pocket gopher surveys with 784 plots in Thurston, Mason, Pierce, and parts of Lewis and Grays Harbor counties, and ~150 supplemental site visits in these counties as well as Wahkiakum and Clark counties. Historical sites were also revisited in Clallam County. These surveys added one new location in Mason County, but the results overwhelmingly confirmed previous descriptions of the distribution of Mazama pocket gophers in Washington as summarized in Stinson (2005) (Fig. 11). The surveys included plots in several habitat categories that varied by vegetation cover and soil characteristics. A full report on the results is expected to be finalized in early 2013.

A single population estimate for an area is of limited utility because gopher numbers fluctuate year-to-year due to environmental conditions. Numbers also increase in the summer after the dispersal of young of the year to perhaps 2–4 times the spring adult population, so the timing of surveys affects population

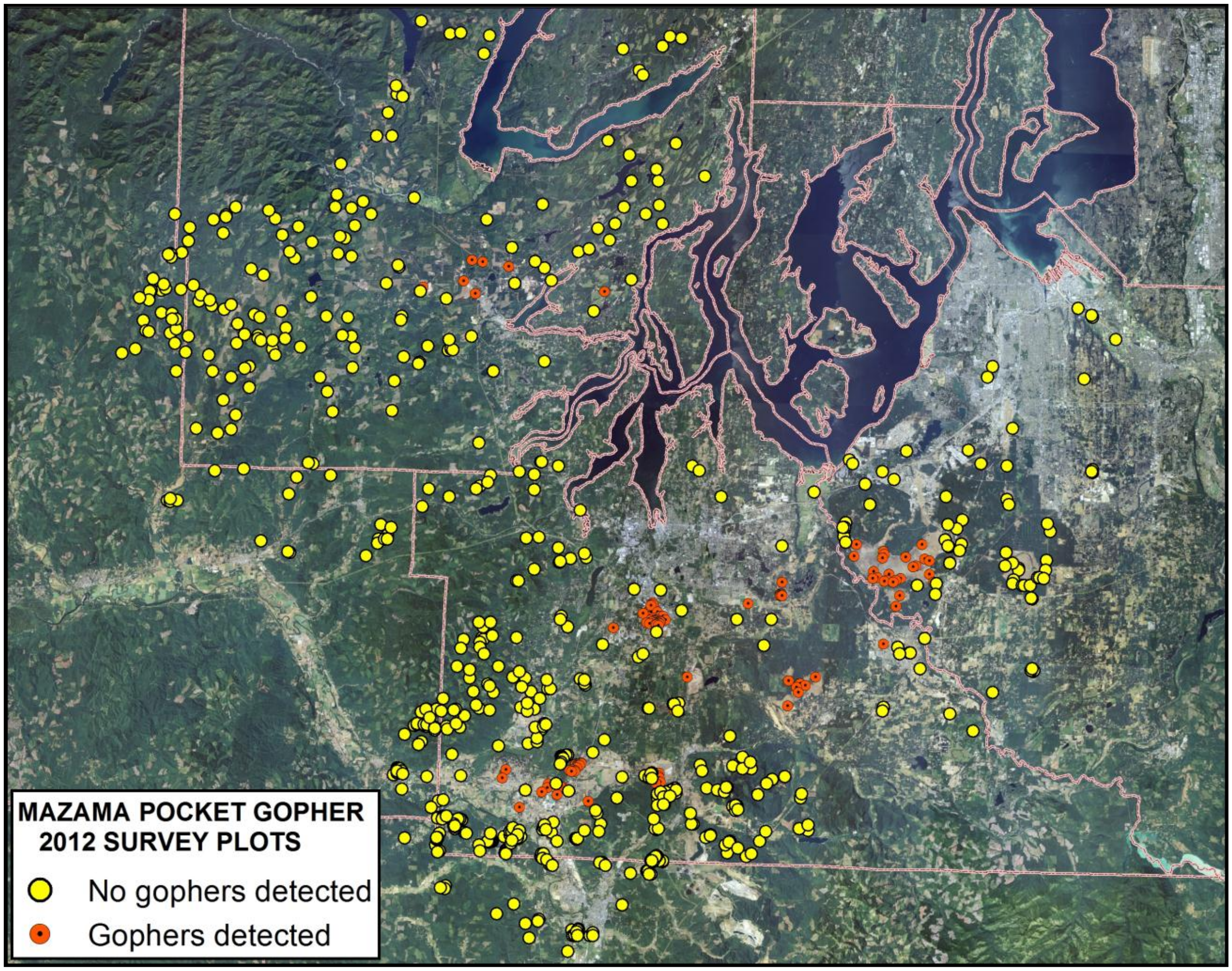

Figure 11. Plots sampled for Mazama pocket gophers in the south Puget Sound region, 2012.

estimates. Olson (2011a) found that detection probabilities were strongly influenced by time of year. Surveys conducted in September and October had 6 times greater detectability than those conducted in March through May, and about 2 times greater detectability than those conducted in November.

Estimates of gopher populations have typically been based on indices such as active burrows or mounds, or removal trapping within a plot and extrapolation to the rest of the occupied area. The number of mounds and plugs, or mound systems and the plugging by gophers in response to opening a burrow has often been used elsewhere as an index to pocket gopher abundance or to estimate local populations. Reid et al. (1966) devised and tested a method using new mounds and sign in 1-ac plots with which they could estimate the early fall population of *T. talpoides* within 10%, but the number of plots required was very high (55) when gopher density was low. Testing of the method involved lethal trapping of all the gophers in the plots, which is not desirable for a species of conservation concern. The mathematical relationship between gopher sign and population size is likely to be different for *T. mazama* and vary with season, soil type, and possibly how long a site has been occupied.

Engeman et al. (1993) compared the results of the use of plot occupancy based on mounds or sign vs. the open-hole method on *T. talpoides* in Idaho. They reported that the open-hole method was more sensitive, because of a lack of activity in the plots. However, their study was conducted in August when gopher activity is likely to be very low. Engeman et al. (1993) leveled all mounds at the start of the test period, which Smallwood and Erickson (1995) believed would bias results. Smallwood and Erickson (1995) developed an index using fresh mounds or sign that was able to account for 95% of the population, and was more accurate and efficient than the open-hole method. They also reviewed other studies, including Reid et al. (1966), and concluded that gopher density could be estimated with high precision using the plot occupancy method, and with fair precision using the fresh mound/sign count method. The number of fresh mounds or sign attributed to each gopher apparently varies little with changes in gopher density (Smallwood and Erickson 1995). They also noted that a problem with the open-hole test is that burrows opened >2 times within a few months were often abandoned. Engeman et al. (1999) refined the open-hole method to determine the proportion of burrow systems that were occupied (vs. abandoned) for *T. mazama* in clearcut ponderosa pine forest in Oregon. They did not evaluate the method for estimating the local population. Variations of these methods (mapping sign and extrapolating from mean territory size reported in the literature) have been used in attempts to estimate local subpopulations in Washington by ENSR (1993, 1994), Farrell and Archer (1996), and McAllister and Schmidt (2005). Ingles (1952) reported that measurement or identity of burrow systems of *T. monticola* based on surface evidence was inaccurate where gophers were close together and that live-trapping was required.

Olson (2011a) pointed out that none of the studies that compared mound numbers to abundance determined whether the relationships were reliable beyond the scope of their study. Olson (2011a) investigated the relationship between mounds and *T. mazama* individuals at the Olympia Airport and Wolf Haven International. Replicate 25 x 25 m plots were surveyed at each study site in spring and fall 2008. All pocket gopher mounds located in each plot were mapped and plots were subsequently live-trapped to determine their association with individual gophers. Overall, there was a positive relationship between the number of mounds and number of gophers, but the airport had about 3 times more mounds per gopher than did Wolf Haven International in both seasons. The airport has loamy sand soil and mowing may cause cave-ins that require more frequent burrow maintenance. Both sites had about the same number of mounds per gopher across seasons within sites, but this may vary year-to-year with precipitation or other factors. Olson (2011a) reviewed the general utility of mound surveys as an index to pocket gopher abundance (including results from her study and those from other published studies) and concluded that establishing a site-specific relationship between the two metrics is necessary. This is likely practical only on the most important sites for which the effort required to simultaneously estimate abundance and conduct mound counts is worthwhile. Otherwise, mound surveys should be restricted to use in establishing pocket gopher presence and describing occupied area (Olson 2011a).

There have been a few attempts to estimate or determine density of Mazama pocket gophers in Washington. Witmer et al. (1996) estimated the early spring density on a site near the Olympia Airport at 24.3 gophers/ac, but it was based on a single 1.5 ac plot. They also reported a minimum density estimate in the early spring of 4 gophers/ac on the DNR Meridian Seed Orchard in Lacey, a site that has Nisqually loamy fine sand. During late summer and early fall of 2009, 200 *T. mazama* were captured from 22.3 ac in Nisqually loamy fine sand at the Olympia Airport. Because not all gophers in the plot were captured, it was estimated that somewhat more than 9 gophers/ac were present in the capture plot (G. Olson, unpublished data). The result could not be extrapolated to the entire airport grassland, however, because gophers are not evenly distributed at the airport and the capture plot was in an area of high gopher activity. About 2 gophers/ac were captured and marked in a 70 ac plot in gravelly soils at Lower Weir Prairie in 2010 and 2011 (G. Olson, pers.comm.).

Present Status of Populations and Habitats

Mazama pocket gophers in the southern Puget Sound region primarily occur in about ten or more general areas where historical and remnant prairies existed in Pierce, Thurston and Mason counties (Fig. 12). This includes five of the described subspecies, and a population in Clallam County accounts for a 6th subspecies. The south Puget Sound concentrations of gopher occurrences and prairie soil types are separated by distance or rivers, and the gopher aggregations within them may be connected by occasional dispersal. The gopher population sizes in these areas vary widely apparently depending on soils and vegetation present. The largest populations of Mazama pocket gopher in Thurston, Pierce, and Mason counties are probably those at the Olympia and Shelton Airports, Scatter Creek Wildlife Area, and Joint Base Lewis McChord. What is known about the status of gopher populations and habitat in these areas is summarized below and listed in Appendix F.

Thurston County

Bush Prairie & Tumwater population. Tumwater and the historical Bush Prairie area appear to support the largest population of Mazama pocket gophers in Washington at the Olympia Airport and surroundings. The gophers in this area, described as *T. m. pugetensis*, are scattered over several hundred acres of maintained grassland at the airport, where they are relatively unmolested by humans or domestic animals. Gophers are also found in vacant lots, yards, pastures, and school grounds in nearby locations on both sides of Interstate 5.

In 2005, McAllister and Schmidt (2005) marked and counted active mounds that were $\geq$10 m from the nearest marked mound based on a hypothetical territory size. From this they derived a crude population estimate of 6,040 for the airport. No trapping was done to determine how closely this approximated the number of actual gophers. The estimate was made in the late summer and early fall near the annual peak in numbers (McAllister and Schmidt 2005) and seems to have been done in a year when the population was particularly high; mounds have not appeared as abundant or widespread in more recent years (G. Olson, pers. comm.).

The grounds of Olympia Airport and adjacent areas provide the most extensive grassland with Nisqually soil in south Puget Sound. The area has ~3,500 ac of Nisqually loamy fine sand, one of 2 extensive areas of this soil in Thurston County, although most of this is no longer grassland. Gophers are also found in Indianola or Cagey loamy sands, or gravelly Everett soil types in this area. Other open land in the area includes a few pastures and agricultural fields. Outside the airport, large portions of the area have been converted to residential or commercial development or have tree cover. Chappell et al. (2003) describe the airport grassland cover type as "…herbaceous vegetation located on and adjacent to airport runways and on soil survey map units that supported pre-settlement grasslands. These short-stature grasslands are regularly mowed and in some cases have remnant native grassland plant species." The airport continues to provide habitat because safety considerations and FAA regulations require that vegetation around runways be kept short. Easterly and Salstrom (2004) indicated that the presence of Dutch rush (*Equisetum hyemale*) suggested that some locations were at least seasonally wet. This may mean that these areas are sub-optimal either because burrows flood seasonally or wet soil inhibits digging and gas exchange; alternatively, they may contribute to an extended season of green vegetation for gophers. Outside the airport fence, much of the grass is mowed turfgrass with low forb diversity that may not be good gopher habitat.

Chambers Prairie population. The appropriate subspecies designation for gophers present on Chambers,

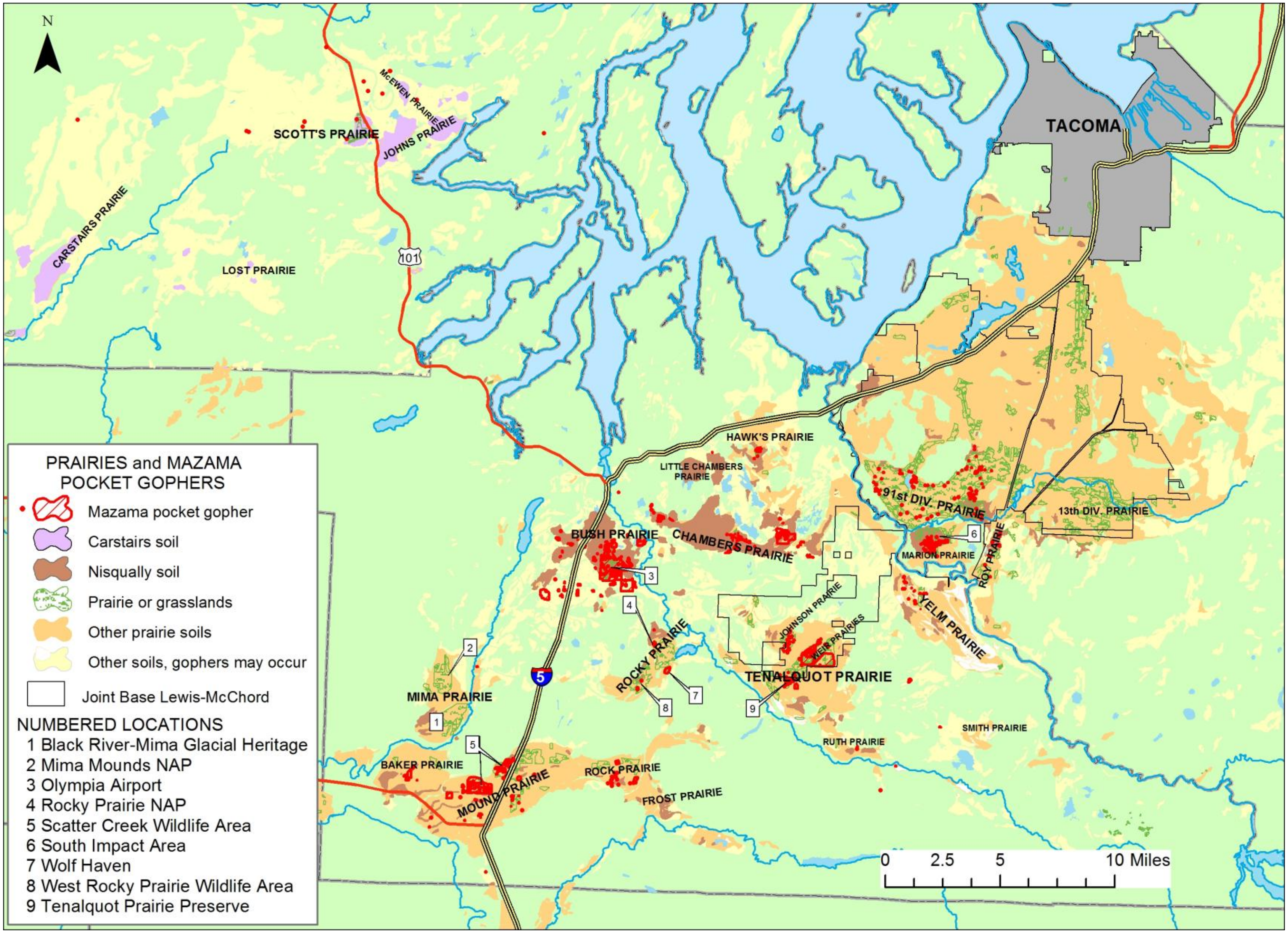

Figure 12. Prairie soils, named historical prairies, and known locations of Mazama pocket gopher records in Thurston and Pierce counties (does not include historical *T. m. tacomensis* records), and Mason County (*T. m. couchi*); prairie/grassland data from Chappell et al. (2003).

Little Chambers, and Hawks prairies is somewhat uncertain. These areas were not clearly included in the described subspecies distribution (Dalquest and Scheffer 1944, Hall 1981); a few specimens from the area are labeled *T. m. pugetensis*, while others are labeled *T. m. yelmensis*. *T. m. pugetensis* may be correct, although they are separated from the type locality on Bush Prairie by the Deschutes River. Chambers Prairie, which extends from about Ward Lake to Lake St. Clair, is the largest area of Nisqually soil type (3,700 ac; Fig. 12), and probably historically supported a very extensive gopher population. Most of the area has residential development of various densities (Fig. 13). Chambers Prairie has gophers scattered in vacant lots, roadsides, and rural and agricultural sites, but no large extensive populations like the airport are known to be present. The northwestern half of the area is within the urban growth areas of Olympia and Lacey and much is densely developed. Gophers appear to be gone from dense older neighborhoods, perhaps with the exception of occasional dispersers from larger patches of habitat. The southeastern half of the area also has turf, Christmas tree and berry farms, and pastures.

Little Chambers Prairie and Hawks Prairie. Although this area contains three polygons of Nisqually soil (562 ac, 367 ac, 344 ac), and one of Indianaola soil (200 ac), most of these areas are heavily developed, with dense residential neighborhoods, roads, and businesses (Fig. 13). Some of the larger parcels contain wetlands and are unsuitable for gopher persistence. Small pockets of habitat with

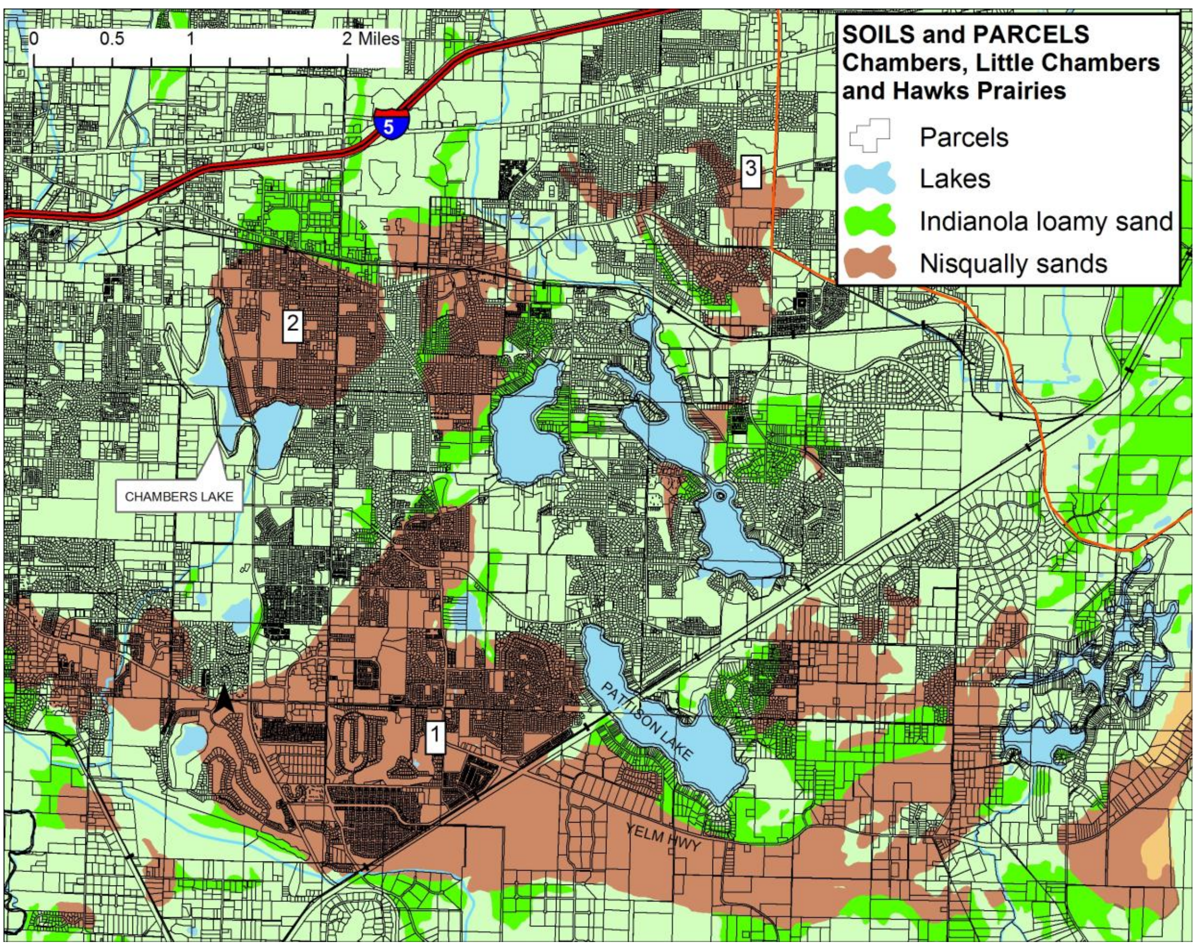

Figure 13. Parcels and Nisqually and Indianola soils on historical Chambers (1), Little Chambers (2), and Hawks prairies (3) in Lacey and Olympia, Thurston County.

gophers exist on some less developed or undeveloped lands, but these subpopulations appear to be small and isolated, and would not be expected to persist in the long-term.

Rocky Prairie population. Rocky Prairie, about 2,200 ac south of East Olympia and north of Tenino, was the type locality of *T. m. tumuli* (Figs. 4, 12). Within this area, WDFW's West Rocky Prairie Wildlife Area (WLA) includes 270 ac of mounded and terraced prairie. No gopher populations were known to be present at West Rocky WLA until a translocation project established a gopher population during 2009-2011 using gophers captured at the Olympia Airport (Olson 2011b). Schonberg and Randolph (2006) conducted a vegetation survey and described this site as fairly degraded, but with many native forbs present. A 750 ac area adjacent to West Rocky Prairie WLA is privately owned by a sand and gravel company and is currently mined for gravel.

East of West Rocky Prairie WLA, a small Mazama pocket gopher population was established on 38 ac of native mounded prairie at Wolf Haven International during 2005- 2008 (Linders 2008). North of Wolf Haven International is a large area (~600 ac) of mounded prairie on private lands with Spanaway-Nisqually complex soil that was once a ranch and supported a significant population of gophers in the early 1990s; the current status of gophers at this site is unknown. West of this property, small numbers of gophers are occasionally detected at the Rocky Prairie Natural Area Preserve (NAP). The translocation projects moved gophers from the Olympia Airport and two Tumwater sites, both within the range of *T. m. pugetensis*, and established populations in the range of *T. m. tumuli*. The population status of *T. m. tumuli* may have been tenuous, as Steinberg (1996) was unable to find any, and only very small numbers of gophers have been detected in the area since then. Any future translocations will maintain separation of subspecies, but genetic analysis may indicate taxonomic distinction between some subspecies is not warranted.

Mound Prairie (west of I-5) population. The range of the Yelm pocket gopher (*T. m. yelmensis*) was described as "Mound Prairie, Rochester Prairie, and Vail Prairie (Dalquest and Scheffer 1944). Mound Prairie, near Grand Mound, is bisected by Interstate 5 (Figs.12). West of I-5, the north and south units of Scatter Creek WLA, totaling 1,140 ac support significant numbers of gophers which appear to have increased in recent years (G. Olson, K. McAllister, pers. comm.). After 2004, when Scotch broom control became more widespread and intensive, gophers spread throughout the northern two-thirds of the north unit, where they hadn't previously been observed (D. Hays, pers. comm.). Scatter Creek WLA contains about 600 ac of prairie, and is mostly Spanaway-Nisqually complex soils. The north unit has about 80 ac of Nisqually soil and the south unit has about 8 ac. Most of the land west of I-5 near Scatter Creek WLA is subdivided into 5 ac parcels, with some high density areas, including the Grand Mound Urban Growth Area.

Mound/Rock Prairies (east of I-5) population. Rock Prairie, an area of >1,200 ac of private lands, is located southwest of Tenino (Fig. 12). The area still supports Mazama pocket gophers on two large ranches (Steinberg 1996a, K. McAllister, pers. comm.), and one ranch has a Grassland Reserve Program easement with management guidelines that will protect prairie vegetation and maintain conditions suitable for gophers. Open grassland still exists on the large parcels. Some of the remaining private lands have not been surveyed for gophers. Some of the extant grassland indicated in the Chappell et al. (2003) data has been affected by gravel extraction or earthmoving in recent years. The remainder of Mound Prairie is a mix of low and moderate density residential developments, farms, gravel mines, etc., with scattered reports of gopher occupancy but with an increasing amount of higher density development.

Tenalquot Prairie population. This area includes Weir Prairie (Upper, Lower, and South Weir), and

Johnson Prairie, which are in the Rainier Training Area of JBLM, and Tenalquot Prairie Preserve (Fig. 12). The Rainier Training Area has received less military training activity than other prairie sites due to its distance from the main part of the base. The prairie sites on JBLM have substantial populations of gophers and contain some of the best examples of native Puget Sound fescue prairie. Most of the area is Spanaway soil types. This area also includes private lands south of the Rainier Training Area.

A WDFW research team trapped, marked, and released gophers on Lower Weir Prairie during May through July in 2010 and 2011. They caught 139 adult gophers in a 70 ac study plot in 2010 and 130 individuals (adults+ juveniles) in 2011, for a density of ~2 adult gophers/ac in both years (G. Olson, unpubl. data). Lower Weir has Spanaway soil, and the prairie vegetation is mostly in poor or fair condition (Altman 2003). The Weir prairies are frequently used for hunting, horseback riding, and off-road driving.

The Weir Prairie Research Natural Area consists of Upper Weir Prairie (547 ac) and Lower Weir Prairie (440 ac), and is protected from the most destructive forms of military training, such as off-road vehicle maneuvers and digging. A large portion of the vegetation on Upper Weir (55%) is in good or fair condition; 30% of Lower Weir and 22% of South Weir are in good to fair condition (Altman 2003). Unauthorized training with tracked vehicles on South Weir (141 ac) in 1996 resulted in extensive damage to the vegetation there.

Johnson Prairie is about 194 ac of native and semi-native grassland and is one of the highest quality Puget prairies. It supports a substantial population of Mazama pocket gophers (Steinberg 1995, WDFW data), as well as a high diversity of plants, butterflies, Oregon vesper sparrows, and western toads (Remsburg 2000, Altman 2003). Past activities have primarily been foot maneuvers, parachuting, and limited vehicle use (Remsburg 2000). No tracked or wheeled vehicle use is allowed off established roads because the site is designated a Secondary Research Natural Area. Civilian recreational impacts are an increasing concern because unauthorized off-road vehicle use has increased in recent years. It is also frequently used for hunting and horseback riding. Two nearby areas of Nisqually soil (49, 43 ac) on JBLM lands west of Johnson Prairie have a forest cover of Douglas-fir.

Tenalquot Prairie Preserve is a 125 ac preserve south of South Weir owned by The Nature Conservancy. WDFW has a conservation easement on the property. It is currently being restored to high quality prairie by the Center for Natural Lands Management. Gophers are present in low numbers in the Spanaway soils of the area.

Pierce County

91st Division and Marion Prairie population. *T. m. glacialis* is found in Pierce County (Fig. 4,12) in an area that is primarily comprised of JBLM training areas, but also includes private lands on the historical Roy Prairie south of the town of Roy. The 91st Division Prairie (about 6,960 ac), on JBLM northwest of Roy, is the largest remaining prairie in the South Puget Sound area. The gopher distribution on 91st Division Prairie appears to be very patchy most years, possibly reflecting pockets of better soil (e.g. Nisqually loamy sand) within an otherwise gravelly Spanaway soil matrix. Surveys by ENSR (1994) found scattered aggregations of gophers. Most of the soil is rocky and may not be optimal habitat, but gophers were detected in nearly all the sample plots surveyed on the area in 2012 (WDFW data).

Ongoing activities have produced a mix of prairie conditions from high quality to seriously degraded. The eastern and western ends have heavily used ranges where the vegetation has been damaged by vehicles and exercises, but the periphery of the impact zone also contains some high quality prairie sites (Altman 2003). In a 2,500-3,000 ac core of the impact area, soil disturbance by explosive ordnance and nearly annual wildfires have maintained grassland; the native bunchgrass has largely been replaced in some areas by introduced forbs and annual grasses, particularly sweet vernalgrass (*Anthoxanthum odoratum*) (Tveten and Fonda 1999). A portion of the area has a high percent cover of bare ground or rocks (Tveten 1997). The northeastern part of the 91st Division Prairie is a training area, which has 875 ac of grassland. It has a significant number of gophers, but is heavily used for a variety of training (Altman 2003).

The South Impact Area and Marion Prairie areas include 186 ac of grassland in a training area north of Yelm (Marion Prairie) and about 486 ac of grassland in the JBLM South Impact Area north of Fort Lewis Rd. Based on soils, Crawford et al. (1995) estimated that the combined area once had about 956 ac of prairie. Both the South Impact Area and Marion Prairie have Nisqually soil, and surveys have found significant numbers of gophers (Steinberg 1995, Ft. Lewis and WDFW data). Based on the density of burrow systems in sample plots, ENSR (1993) estimated 4.28 gophers/ac, but it is not clear how they delineated burrow systems. They estimated 462 gophers on Training Area 18 and 3,060 gophers on all of Fort Lewis (ENSR 1993). However, Steinberg (1996a) cautioned that the estimate may have been grossly inflated because it was based on extrapolation from Marion Prairie, which has Nisqually soil and was where she detected the highest numbers of gophers. ENSR (1994) reported a revised estimate for Marion Prairie of 233 gophers, or 2.15/ac, based on a re-analysis of the same data.

Marion Prairie is heavily used for training and is subject to excavations for artillery fire bases. The South Impact Area has rifle ranges, but is not subject to excavation (J. Lynch, pers. comm.). The Army has developed training infrastructure (Range 92) on an area in the South Impact Area that supports gophers (Ft. Lewis Directorate of Public Works 2010, Chapter 2, p. 16 and Fig. 2-6).

Roy Prairie, south of Roy, was the type locality of *T. m. glacialis* and the area still supports gophers. All of them are on private lands, and although part of the area is Nisqually soil, it has been affected by development, gravel mining, and invasion by woody vegetation. Two gravel quarries were opened in the 1990s on prairie habitat where gophers were known to be present south of Roy; several acres were set aside for gophers as a condition of the permits.

Tacoma area

Mazama pocket gophers do not appear to be present at 21 historically occupied sites in and near Tacoma (Appendix E), and there are no confirmed records since 1962. The populations historically considered *T. m. tacomensis* appear to be extinct. All known sites were visited by WDFW personnel in 2011; most sites no longer contained any suitable habitat.

Mason County

Scotts, Johns, and McEwen Prairies, Mason County. The Shelton Airport (Sanderson Field), on historical Scotts prairie is the center of abundance for *T. m. couchi*, the Shelton pocket gopher. Most recent gopher records are within about 5 miles of Scotts Prairie. Scotts Prairie is a grassland site where the Department of Natural Resources Natural Heritage Program mapped 242 ac of “airport grassland” at the Shelton airport (Sanderson Field) (Fig. 12), which is most of what remains of perhaps 2,603 ac of historical grassland in the Shelton area (Chappell et al. 2001, 2003). Mason County also includes Johns, McEwen, and Lost Prairies, and Skokomish bear grass savannahs.

Attempting to estimate the population at the Shelton airport, Farrell and Archer (1996) delineated gopher territories based on "mound systems" and then applied a correction factor based on the percent of systems with an open-hole response within 48 hours of being opened (76.6%). This produced an estimate of 990 gophers, but it is unknown how closely their perceived mound systems corresponded to actual burrow systems. The open-hole method may underestimate the number of occupied territories (Smallwood and Erickson 1995), and most of the counts were done in late summer (Farrell and Archer 1996), when numbers are highest. Using similar methods, Farrell and Archer (1996) reported a density of 17.9 mound systems/ac from 2 plots on a regenerating clearcut on McEwen Prairie Rd. Gophers were not detected on the site in 1992 shortly after it was clearcut (G. Schirato, pers. comm.), but a population of possibly up to several hundred was present in 1995. The gophers may have reached the site from a road right-of-way that contained a few mounds and was the only adjacent open habitat (G. Schirato, pers. comm.).

Dalquest and Scheffer (1944) characterized the soil on Scotts Prairie as shallow (9") and rocky, and the vegetation as scant; despite these conditions the airport appears to support a fairly large population of gophers. The Port of Shelton has plans to develop some of this area (GeoEngineers, Inc. 2003). Soils at the county fairgrounds south of the airport appear to be even rockier, and may be marginal for pocket gophers (R. Taylor, notes on file).

Most undeveloped areas of Johns Prairie have grown into forest. The main part is an industrial complex with no vegetation, and with some surrounding areas of grass overgrown with Scotch broom. The northern part of Shelton was built on Carstairs (prairie) soil. McEwen Prairie is mostly forested, but gophers are still present in roadsides and openings and a 20 ac site of restored prairie on Green Diamond lands.

In 2005, Shelton pocket gophers were believed to be restricted to about 240 ac at the Scotts Prairie/Shelton airport and a few nearby sites (Stinson 2005). Steinberg (1996a) found no trace of the gopher population at the Lost Lake Prairie site reported by Dalquest and Scheffer (1944); and none in Shelton Valley, Buck Prairie, Bulb Farm Rd, or in the fields or roadsides around Satsop, Elma, and Cedarville. Gophers also seemed to be extinct at historical sites on McEwen and Johns prairies in the 1990s (G. Schirato, pers. comm.). Farrell and Archer (1996) saw no sign of gophers "in the forested areas to the north and west of Sanderson Field" (Shelton airport).

Pocket gophers may currently be at least slightly more widespread in Mason County than was reported by Stinson (2005). A preliminary reconnaissance in 2011 detected possible gopher sign close to several historical sites, including historical beargrass savannahs, clearcuts, powerlines, roadsides, and other open habitat. Live-trapping in October 2011 confirmed the presence of gophers at 5 of these sites, but sign was not detected during visits at most of the other sites. Gophers were detected in the McEwen Prairie area, but may or may not still be present on Johns Prairie. Extensive surveys in 2012 detected gophers only within a few miles of the airport, with the exception of a new location east of Oakland Bay (Fig. 11). Gophers were not detected in many other areas, including areas with historical records (e.g. Matlock, Lost Prairie vicinity, etc.). The surveys confirmed that their range appears to be limited to a portion of southeastern Mason County. Gophers have managed to persist in Mason County in openings in commercial timberland, including roadsides, powerlines, and a shifting network of clearcuts, in addition to the grassland at and near the airport. A recent clearcut on private lands 2–3 miles northwest of the airport was apparently rapidly invaded by gophers, perhaps from a road right-of-way (J. Skriletz, pers. comm.). Gophers may sometimes appear to be extraordinarily abundant at newly invaded sites, but this may in part be an artifact of the pulse of digging activity required to establish territories, while less digging may occur at long-occupied sites. *T. m. couchi* may exist largely as a network or thinly distributed 'meta-population' in a matrix of surrounding timberland, with a core population at the airport.

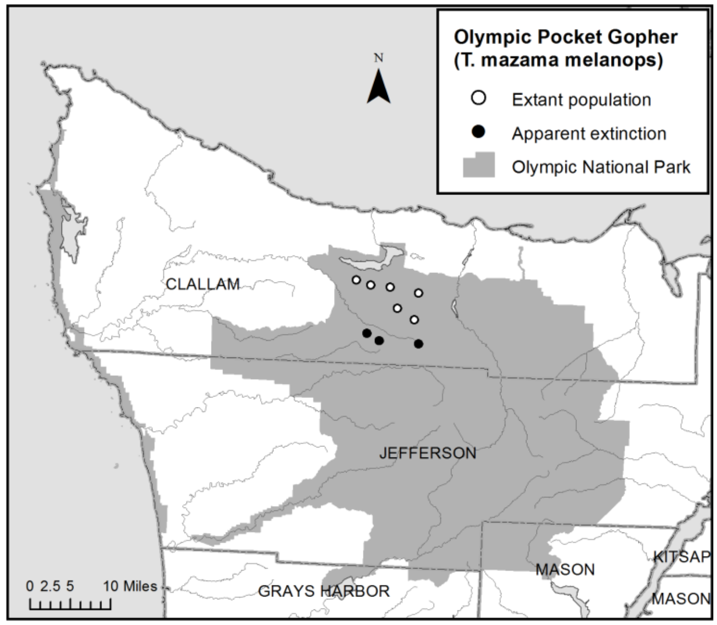

Figure 14. Approximate location of sites currently and formerly occupied by *T.m.melanops* in Olympic National Park.

Clallam County

All known occurrences of *T. m. melanops* are on alpine meadows in Olympic National Park (Fig 14; Steinberg 1999, Welch and Kenagy, in prep.). Gophers are present at Boulder Lake, Appleton Pass, Happy Lake Ridge, Aurora Peak, and Sourdough Mountain (Appendix E, F). No complete inventory has been done, so it is uncertain how many gopher subpopulations are present in the park or how many acres are inhabited. The available habitat is limited and highly fragmented by topography and forest vegetation, and only portions of it are occupied by gophers. Recent known records are within an area of 14,820 ac (6,000 ha), but with probably < 2,470 ac (1,000 ha) of suitable habitat within this area (J. Fleckenstein, pers. comm.). Gopher sign and patches of suitable habitat of < 2.5 – 50 ac were distributed along Happy Lake Ridge in 2012 (J. Fleckenstein pers. comm.). Patches were separated by 50 to several hundred meters of forest, and some patches appeared to support only a single gopher burrow system. Gophers were absent from three historical sites in the park (Johnson 1977, C. Welch, pers. comm., J. Fleckenstein, pers. comm.). Forest encroachment may be affecting habitat. The only immediate potential human-related impacts may be from trampling damage and erosion. The potential for long-term negative effects of human-related factors is unclear. These factors include the introduction of mountain goats that affect vegetation (Houston et al. 1994), the eradication of wolves and subsequent increase in coyotes (Scheffer 1995), fire suppression, and the possible increase in tree invasion of meadows with the reduced snowpacks expected due to climate change (Laroque et al. 2000, Zald et al. 2012).

Wahkiakum County

Pocket gophers were not detected in Wahkiakum County during searches in 1977 (M. Johnson, notes), 1986, (R. Taylor, pers.comm.), 1995 (Steinberg 1995), and 2012 (WDFW data). Gophers have not been detected in Wahkiakum County since the 1950s and the population (subspecies *T. m. louiei*) appears to be extinct.

MANAGEMENT ACTIVITIES

Habitat Management and Restoration

Habitat management and restoration for Mazama pocket gophers primarily involves removal of woody species, such as Scotch broom and trees, from sites with suitable soils and vegetation that is currently or could be occupied by gophers. While little habitat management or restoration has occurred specifically to benefit Mazama pocket gophers, ongoing prairie restoration activities for other species may benefit pocket gophers. Several agencies and organizations have been involved in conducting and improving methods of prairie maintenance and restoration, including the U.S. Army/JBLM, the Center for Natural Lands Management (CNLM; the south Puget Sound office of CNLM was formerly part of The Nature Conservancy of Washington), WDFW, the Center for Urban Horticulture at University of Washington, the Institute for Applied Ecology, and the Washington Department of Natural Resources.

The Prairie Management Plan for Fort Lewis (Altman 2003) included the goal of maintaining viable populations of special status prairie flora and fauna, which includes Mazama pocket gophers. Strategies to accomplish these goals include the commercial or pre-commercial harvest of Douglas-fir from prairie and oak woodland and the burning, mowing, and cutting of Scotch broom. The U.S. Army/Department of Defense has had a prescribed burning program for 7,400 ac of prairie and oak woodland on Fort Lewis since the early 1980s. Portions of the area are subjected to spring, or sometimes fall, burns on a 3-5 year rotation (Tveten 1997, Tveten and Fonda 1999). Burns to remove Scotch broom are done on about 1,500 –3,000 ac annually, with primary focus on the larger grasslands. In addition, Scotch broom is mowed on about 1,000 ac annually. The management objective for grassland sites that receive intense and repeated training is to maintain vegetative cover.

The CNLM has been working with Fort Lewis on prairie habitat enhancement and invasive species control under a cooperative agreement since 1992 (J. Lynch, pers. comm.). CNLM has been assisting with Scotch broom control and conducting research and management experiments on restoration methods (Dunn 1998). The early focus of these projects has been control of Scotch broom, but with the eventual goal of restoring the historical appearance and habitat function. CNLM is also involved in habitat restoration with Thurston County on Black River-Mima Prairie Glacial Heritage Preserve (Grosboll and Kelley 1999).

Habitat restoration to support prairie butterflies may benefit pocket gophers at Tenalquot Prairie, West Rocky and Scatter Creek Wildlife Areas, Rocky Prairie NAP, and Wolf Haven International (Dunn and Fimbel 2011). WDFW restoration work on Scatter Creek WLA has been focused on Scotch broom control, but other actions have included selective removal of Douglas-fir and management experiments with herbicides, fire, and soil nitrogen reduction. Washington Department of Natural Resources removed Douglas-fir and planted native prairie species on Rocky Prairie NAP with a grant from the U.S. Fish and Wildlife Service (Davenport 1997). WDFW also removed Douglas-fir on portions of West Rocky Prairie WLA.

Chaney (pers. comm., 2006) reported on a Grassland Reserve Program (GRP) plan for a private working ranch occupied by gophers on Rock Prairie. The GRP is a voluntary Farm Bill program intended to maintain grazing lands while protecting grassland habitat; it can involve rental payments or permanent easements. The USDA Natural Resources Conservation Service (NRCS) has negotiated several GRP easements in Thurston County, including a 500 ac easement on Rock Prairie. The easements allow NRCS to develop management guidelines that allow livestock grazing while protecting the native prairie vegetation.

Research

Until recently the Mazama pocket gopher had received limited research attention in Washington. Since the taxonomic work of Dalquest and Scheffer (1944), Gardner (1950), and Johnson and Benson (1960), some research on the species focused on control efforts to reduce winter damage to conifer seedlings (Barnes et al. 1970, Hooven 1971, Teipner et al. 1983, Marsh and Steele 1992). Witmer et al. (1996) collected data on biology and habitat use of Mazama pocket gophers in Washington during field trials of population control methods.

Steinberg (1999) conducted studies of the evolution and systematics of Mazama pocket gophers in Washington. She also studied the influence of soil rockiness on gopher distribution (Steinberg and Heller 1997) and the influence of soil disturbance by gophers on the abundance and distribution of native and introduced plants on prairie sites (Hartway and Steinberg 1997). Steinberg (1995) identified factors that need further investigation, including: taxonomy; status and distribution of all remaining populations; dispersal; the impact of soil compaction by military vehicles and training; the influence of Scotch broom; and the influence of gophers on the biodiversity of the native prairie ecosystem. Corey Welch and Dr. G. J. Kenagy of University of Washington investigated the historical biogeography of Mazama pocket gopher populations in Washington using analysis of mitochondrial DNA.

Schmidt (2004) developed and tested the use of various devices to capture hair from gophers as a means to confirm their presence at a site without live-trapping. She found that hair could be used to detect gopher presence, but that gophers often responded to the device by blocking off the tunnel so that the frequency of obtaining hair was very low.

Occupancy modeling for the Mazama pocket gopher. Olson (2011a) modeled site occupancy, within-site use, and detection probabilities of Mazama pocket gophers in Thurston and Pierce Counties. The objectives of the occupancy study were to: 1) identify important habitat factors affecting site occupancy; 2) develop a habitat-based model that could be used to evaluate sites based on site occupancy probabilities; and 3) identify and model factors affecting detectability and within-site use by pocket gophers. Data on pocket gopher presence (using mounds as indicators of presence) and several habitat variables were collected in fall 2008.

Use of mound surveys to index pocket gopher abundance. Olson (2011a) investigated the relationship between pocket gopher mounds and abundance at two Thurston County sites, the Olympia Airport and Wolf Haven International. Methods included mark-recapture of live-trapped gophers at the sites. Specific objectives were to: 1) compare total number of mounds, mounds per gopher, and area associated with mounds and gophers between study areas, among plots within study areas, and between seasons; and 2) determine whether an index based on number of mounds and/or mound area could be used to approximate numbers of pocket gophers. The field work was conducted in 2008; the results were reported in Olson (2011a).

Translocation. Translocation of gophers was the subject of a pilot study in 2005-2008, with the objective of developing methods of establishing a population where gophers were not present. A total of 193 gophers were captured from sites slated for development and released on mounded prairie at Wolf Haven

International in Thurston County (Linders 2008). Techniques for capture, tagging, and release of gophers were improved, and subpopulation was established on the release site. A second, more formal research project was initiated in 2009 to investigate the feasibility of translocation, evaluate methods, estimate survival rates, and establish a population of gophers at West Rocky Prairie WLA (Olson 2011b). In 2009, 210 gophers were captured at Olympia Airport and released at West Rocky Prairie. Another 200 gophers were released in 2010, and 150 in 2011. All the gophers were PIT tagged and some were radio-collared to enable monitoring of movements and survival. Monitoring will continue in 2013.

Dispersal. A study of pocket gopher dispersal was initiated by WDFW in 2010 on Weir Prairie. The goal of the study is to provide information on dispersal characteristics that can be used, along with genetic analyses and a spatial model, to determine the degree of connectivity between current subpopulations, to evaluate long-term viability and to predict the effects of both additional habitat fragmentation and enhancements. The study is designed to determine patterns of gopher dispersal, identify dispersal barriers and corridors, and determine fates of dispersers. In 2010, 184 individuals were captured and marked with PIT tags, and 16 juveniles were radio-collared. In 2011, 160 individuals were captured, and 29 radio collars deployed; at least 1 movement of >100 m was detected. A revised genetic component of the study is ongoing.

Conservation Planning

Thurston County Habitat Conservation Plan. Thurston County is developing a Habitat Conservation Plan (HCP) for activities conducted in Thurston County that affect listed and candidate prairie species and their supporting habitats. An HCP approved by the U. S. Fish and Wildlife Service (USFWS) would provide federal Endangered Species Act assurances through issuance of an Incidental Take Permit for activities conducted under the authority of Thurston County. The plan will support the creation of a conservation bank of the best remaining habitats and restoration sites. It will identify the tools necessary for long-term preservation of the network of habitats needed for survival of Mazama pocket gophers and 10 other species and identify sources of funds for long-term implementation. The HCP will contribute to the conservation and recovery of gophers by reducing direct impacts, mitigating impacts through restoration of suitable sites, and protecting a network of properties with habitat sufficient to sustain populations.

WDFW Lands HCP. WDFW is also working with USFWS in developing an HCP for WDFW lands. WDFW lands occupied by Mazama pocket gophers that will be covered include Scatter Creek and West Rocky Prairie Wildlife Areas. Conservation measures will address management that have the potential to affect gophers. This HCP may be completed in 2013.

Conservation action plan. USFWS provided funding to The Nature Conservancy to facilitate the development of a 'conservation action plan' for the Mazama pocket gopher in 2009. The plan is compiled by an interagency technical group and is revised annually. The plan is a task outline that identifies and prioritizes recovery actions that should be done within 3-5 years, and is useful for prioritizing actions for funding.

JBLM endangered species management plan for the Mazama pocket gopher. The purpose of this plan is to: "prescribe measures for the protection of the species, maintain suitable habitat, follow Army guidelines, ensure continued Army training, and comply with state and federal regulations" (Environmental Natural Resources Branch 2006). The primary conservation goals are to protect existing populations, maintain habitat, ensure long-term gopher survival possibly through translocations, and to cooperate with regional recovery efforts. This plan was being updated in 2012 (J. Lynch, pers. comm.).

Prairie species Habitat Suitability Index Analysis. USFWS and University of Washington developed a Habitat Suitability Model (HSI) for the Mazama pocket gopher. The model will be used to evaluate habitat condition and potential suitability of sites for long-term conservation planning. The final report was undergoing peer review in fall 2012.

Prairie landscape patch dynamics model. In 2008–2009, USFWS convened a panel of experts on south Puget Sound prairie species and biologists with expertise in ecological modeling and mathematics. The intent was to inform efforts to identify, acquire, restore, and maintain an assemblage of prairie reserves that would allow the three federal candidate species (Mazama pocket gopher, Taylor's checkerspot, and Streaked horned-lark) to persist (Golovin et al. 2011). Analysis and the final report is in preparation.

***Habitat acquisition*.** Some recent habitat acquisitions have potential to support Mazama pocket gopher populations. WDFW acquired 270 ac of private prairie/grassland in 2006, which now is part of the West Rocky Prairie Wildlife Area. TNC and WDFW acquired 127 ac adjacent to Weir Prairie now called Tenalquot Prairie Preserve. WDFW used grants to purchase a conservation easement and TNC holds the title to the land, now managed for conservation by CNML. Acquisition efforts require willing sellers and available funding.

Mazama pocket gopher workshops and working group. CNLM facilitated Mazama pocket gopher workshops in 2006 and 2009 and working group meetings in 2009, 2010, 2011, and 2012, with funding from USFWS and the U.S. Dept of the Defense. The meetings convened biologists, planners, and land managers involved in Mazama pocket gopher conservation, protection, research, and recovery. The workshops are useful in exchanging information and identifying conservation needs and problems.

Information and Education

Prairie Landowner Guide for Western Washington. A prairie landowner guide (Noland and Carver 2011) was developed with funding from TNC, Natural Resources Conservation Service, USFWS, Thurston County Conservation District, San Juan County Land Bank, WDNR, and ESA (consultants). It suggests ways prairie landowners can practice land management that will reduce impacts on prairies, while remaining compatible with other land uses, such as pastures, farming, gardens, and lawns. The handbook explains the current best management practices to reduce impacts on prairie lands, information about restoration tools specific to Pacific Northwest prairies, and details on incentive programs available to private landowners to implement prairie restoration.

FACTORS AFFECTING CONTINUED EXISTENCE

Adequacy of Existing Regulatory Mechanisms

***State, county, and city protections*.** The Mazama pocket gopher is protected from 'take' as a threatened species, a category of 'protected wildlife' in state law (RCW 77.15.130). Their habitat receives protection through county or municipal critical area ordinances. Critical area ordinances require environmental review and habitat management plans for development proposals that affect state-listed species. Washington's Growth Management Act requires counties to develop critical area ordinances that address development impacts to important wildlife habitats. The specifics and implementation of critical area ordinances vary somewhat by county. The Mazama pocket gopher is recognized as a species of local importance in the critical area ordinances of Pierce, Thurston, and Mason counties. This generally means that when development activities are proposed where gophers are likely to be present, the developer must determine if gophers are present, assess the impact to gophers, and submit a Habitat Assessment Report (Pierce) or Habitat Management Plan (Thurston, Mason). Counties consult with WDFW, and the permit issued may impose conditions on the development to avoid, minimize and mitigate impacts to the gopher population. Habitat Management Plans have been developed for gophers for 61 sites in Thurston County (2004-October 2012). Most of these are small set-asides (<10 ac) that protect the gophers and some habitat at the site, and preserve some connectivity in the area and the permit conditions require maintaining the vegetation in a suitable condition. However, sometimes the sites are small and permit applicants are unable to effectively address the issue of connectivity of occupied gopher habitat. Off-site mitigation may be preferable for smaller populations in most urban growth areas, when options such as a mitigation bank are available. USFWS and CNLM have recently begun discussions regarding developing a prairie habitat credit/debit system that could be applied to in-lieu fee programs and conservation banks. The credit/debit system would potentially be used by Thurston County to establish a conservation bank as part of a prairie habitat conservation plan.

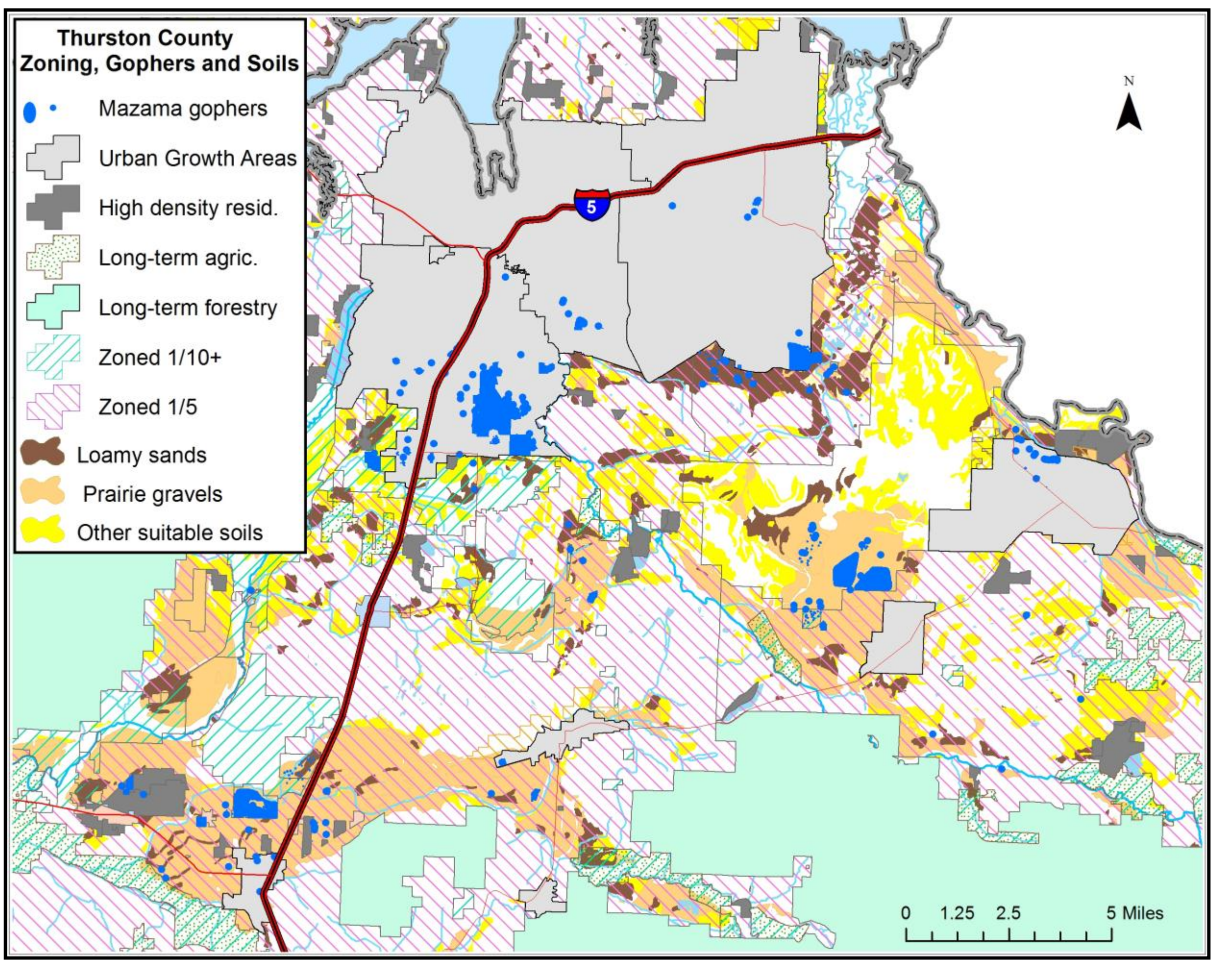

Figure 15. Thurston County zoning, Urban Growth Areas, gopher occurrences and selected soils.

Most of the areas of optimal loamy sand soils (Nisqually, Indianola), including the Olympia Airport, are within the Urban Growth Areas (UGA) of Tumwater, Olympia, and Lacey (Fig. 15). Under the state's Growth Management Act, county and city Comprehensive Plans designate urban growth areas; these "shall include areas and densities sufficient to permit the urban growth that is projected…for the succeeding twenty-year period." These are areas "within which urban growth shall be encouraged" (RCW36.70A.110). However, critical areas within UGAs are still protected (WAC 365-196-485 [3c, 4c]). The Growth Management Act also requires counties to develop and periodically update a comprehensive plan that identifies areas with rural zoning. Outside of UGAs and designated LAMIRDS (Limited Area More Intensive Rural Development) areas, rural zoned areas have a density of 1 unit/ 5 or 10 ac. Gopher records suggest these rural residential areas are often suitable for gophers, but that urban and high density suburban areas may be unsuited to gopher persistence (Fig. 15).

***Federal protection*.** Recently, the USFWS proposed to list the four subspecies in Thurston and Pierce counties (*T. m. pugetensis, tumuli, yelmensis, glacialis*) as Threatened under the federal Endangered Species Act (USFWS 2012). This status increases the protection from federal actions and on federal lands. Section 7(a) of the federal Endangered Species Act requires federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is designated. Section 7(a)(4) of the Act requires federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. Federal agency actions that may require a conference or consultation include collecting or handling the species, and actions that may negatively affect the species through removal, conversion, or degradation of habitat, or granting a permit or funding that would result in another entity conducting similar activities (USFWS 2012). The species is not otherwise protected under federal law. If a species is listed subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service (USFWS 2012).

It is U. S. Army policy to consider candidate species when making decisions that affect them, to avoid taking actions that may cause them to be listed, and to take affirmative actions that can preclude the need to list them (J. Foster, pers. comm.). A final listing decision by the USFWS is expected in fall 2013.

Impacts of Habitat Loss, Fragmentation, Degradation, and Succession

In the south Puget Sound area, much Mazama pocket gopher habitat has been lost to development and succession to forest; some of what remains continues to be degraded by the invasion by Scotch broom and other non-native plants. Trends in the human population suggest that the amount and quality of habitat for Mazama pocket gophers would continue to decline without protection and careful management of conflicting uses. The human population in Washington is expected to increase from an estimated 6.8 million in 2012 to 8.8 million by 2040 (http://www.ofm.wa.gov/pop/april1/). Grassland habitat continues to be lost, particularly to residential development and Thurston County is projected to have 170,000 additional people and need an additional 50,000 detached single-family housing units, and >25,000 multi-family units by 2040 (Sustainable Thurston 2011:A11). As the habitat patches become smaller, fewer, and farther apart, the likelihood of each patch continuing to support grassland-dependent species declines. These trends may negatively affect gophers, but the state regulations discourage the expansion of UGAs into critical areas (WAC 365-196-485 [4b]). High density residential development apparently led to the extinction of *T. m. tacomensis* in Pierce County, and possibly *T. talpoides douglasii* in Clark County. If low density development (~ 1 dwelling/10 ac) created additional openings in the forest matrix in Mason County that were more stable than clearcuts, it is possible that it might benefit gophers.

The persistence of Mazama pocket gophers on roadsides, vacant lots, and lightly grazed pastures suggests that they are relatively resilient, and may be able to persist in rural and low density developed areas. However, extinctions in Tacoma suggest that life for gophers in high density residential and commercial areas is difficult and recruitment and re-colonization is inadequate to maintain local populations in the few remaining patches of habitat. Pocket gophers apparently survived on grasslands within the matrix of suburbs south of Tacoma for some years, but eventually went extinct. When gopher subpopulations become small and isolated, these factors that increase mortality and inhibit breeding and dispersal may speed their extinction. These factors probably include habitat loss, degradation, and fragmentation, trapping by homeowners, and predation by dogs and cats.

Most occupied habitat on public lands is affected by non-conservation uses including military training and recreation, but the potential effects on gophers are largely unknown.

Implications of habitat loss for populations. Pocket gophers are vulnerable to local extinctions because of the small size of local breeding populations (Steinberg 1999). Daly and Patton (1990) noted that the skewed sex ratios and high variance in male reproductive success in *T. bottae* results in low effective size of local populations and relatively large genetic differences between local subpopulations. They observed consistent genetic differences between local subpopulations despite documenting gene flow during seven generations.

Pocket gophers probably persisted historically by continually re-colonizing habitat after local extinctions, but the loss of habitat patches and increases in impervious surfaces and hazards such as busy roads may inhibit the re-colonization that historically occurred. Where additional habitat exists within a few hundred meters, some dispersal and resulting gene flow probably occurs between local subpopulations, and vacant habitat is rapidly colonized. Daly and Patton (1990) also observed reproductive females at low density in small pockets of grassland removed from larger populations. They speculated that these small, perhaps ephemeral subpopulations, may contribute to gene flow. However, as habitat patches become smaller, fewer, and further apart, the likelihood of each patch continuing to support pocket gophers declines.

Succession. Factors that increase woody cover and decrease the abundance of perennial forbs negatively affect gopher occurrence and abundance. Although gophers do not require native prairie vegetation, they do require herbaceous vegetation, and many areas have succeeded to forest or have been planted or degraded to turf-forming grasses and exotic annuals. Dennehy et al. (2011) listed an abundance of invasive exotic plants that degrade prairies in the south Puget Sound region including 17 species of trees, shrubs and vines. Invasion by woody species eventually adversely affect pocket gophers. The potential effects of alien herbaceous species on pocket gophers depend on whether they are palatable to pocket gophers and what effect they have on other palatable species.

The fire regime established and perpetuated by Native Americans maintained the south Puget Sound prairies for the past 4,000 years or more. Fire suppression allows succession by both native and exotic flora; without vegetation management, many of the native prairies would probably slowly disappear. Fire suppression allows fire-sensitive species to invade and allows an unusual build-up of fuels that can lead to very hot fires that harm normally fire-tolerant native species (Tveten 1997).

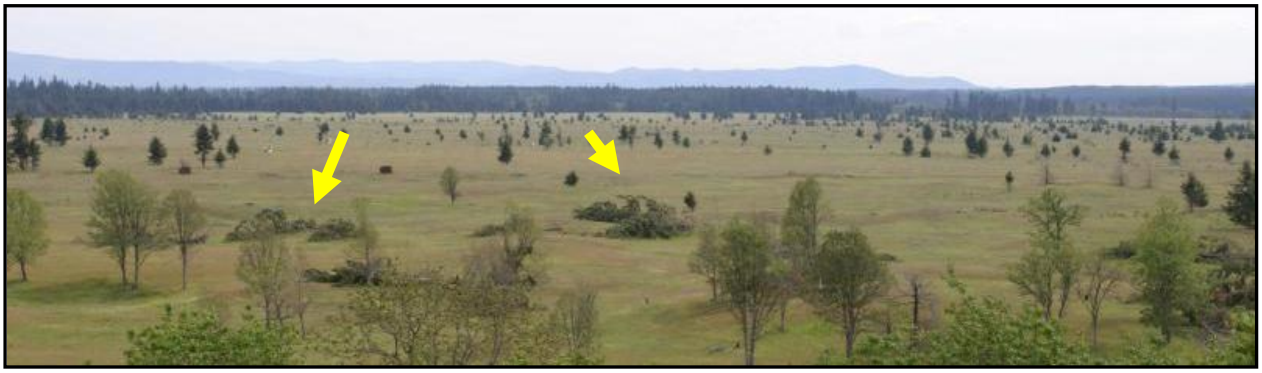

Figure 16. Ongoing removal of Douglas-fir that have invaded Fort Lewis prairie (*Photo by Rod Gilbert*).

Fire suppression allows Douglas-fir to invade and overwhelm grassland habitat (Fig. 16). Disturbances in prairies such as vehicle traffic may also accelerate colonization by Douglas-fir by enhancing seed germination through increased mineral soil contact. From the mid-1960s until 1994, Fort Lewis had an active program to encourage a Douglas-fir monoculture (Perdue 1997); there are now about 16,300 ac of forest on areas that were formerly prairie (Foster and Shaff 2003). In recent years, the Fort, along with other partners, has been conducting Douglas-fir control on prairie areas. Sites where some Douglas-fir has been removed include Johnson Prairie and Weir Prairie RNA on Fort Lewis, Mima Mounds and Rocky Prairie NAP, Thurston County's Glacial Heritage Preserve, Scatter Creek and West Rocky WLAs.

Scotch broom is the most visible invasive species that can cover prairies relatively rapidly. Scotch broom negatively affects the probability of gopher site occupancy and plot use, especially as broom density approaches 10% (Olson 2011a). Scotch broom is killed through burning, hand pulling, or herbicide, but control requires an ongoing program because the plants produce an abundance of seeds that remain viable in the soil for several decades. A 4-inch layer of soil and litter beneath a single broom plant can contain >2,000 seeds (Swift 1996). Fire often stimulates germination of broom seeds in the soil, so a second burn or herbicide is needed to kill the abundant seedlings. Regular mowing can prevent additional Scotch broom seed production. Portions of the Artillery Impact Area on JBLM are now broom free, indicating that frequent burning can prevent broom establishment. Non-native insects have also been introduced in the area for the biological control of Scotch broom, including a seed weevil (*Apion fuscirostre*), a shoot tip moth (*Agonopterix nervosa*), and a twig mining moth (*Leucoptera spartifoliella*). They are slow acting, however, and are not expected to produce quick and dramatic results (Dunn 1998). Although these insect agents have not stopped the spread of Scotch broom, they stress the plants and reduce seed production. Research is ongoing to identify other biological control agents for Scotch broom.

Where Mazama pocket gophers are found on openings in a matrix of commercial timberland, persistence in regenerating stands is presumably affected by the speed at which the planted trees grow and shade out herbaceous vegetation. In private timberlands, this 'green-up' period is prescribed by state Forest Practice rules (WAC 222-34-110); in western Washington the stand is normally replanted within 3 years. Although forest practices only provide a short period when harvest units are suitable for gophers, forestry does provide habitat where none previously existed. According to Bonar (1995), pocket gopher damage to planted forest in the western states did not become economically important until even-age management on extensive areas provided habitat that resulted in greater numbers and spread of gophers. If timberland management played a similar role in Mason County, it might explain the lack of historical gopher records from forest lands until the 1990s.

Invasion of alpine meadows within the range of *T. m. melanops* may pose a significant threat by reducing the area of suitable habitat and isolating habitat patches.

Gravel mining. Some Mazama pocket gopher habitat is located on glacial outwash gravels. Some of these glacial gravel deposits are very deep and valuable for use in construction and road-building and gravel extraction has affected several sites once occupied by gophers. This includes a historical site in Tacoma, two sites south of Roy in Pierce County, and historical Rock and Rocky prairies in Thurston County. Gravel extraction sites could eventually be restored to suitable condition for gophers once gravel removal operations have ceased if an adequate layer of well-drained friable subsoil and topsoil are restored.

Trapping and poisoning. Pocket gophers can damage young trees and, like moles, their diggings can be considered a nuisance by landowners. They can also be a problem in vegetable gardens, and at Christmas tree, berry, and vegetable farms. Mazama pocket gophers are currently legally protected from killing without a permit. However, poison and traps marketed for control of gophers are readily available. The frequency that they are trapped or poisoned deliberately, or by devices intended for moles, is unknown. Mortality from human persecution may not exceed rates typically due to predators, and they probably recover if habitat remains suitable. In small and isolated populations, however, mortalities from persecution added to other hazards may eventually lead to extirpation.

Predation by cats and dogs. The last record of the Tacoma pocket gopher may be animals that were killed by pet cats and identified as gophers by homeowners (Ramsey and Slipp 1974). Pet cats have been known to kill Mazama pocket gophers (WDFW files), but there are no data on the frequency or effects on populations. Cats prey on other pocket gopher species (Meckstroth et al. 2007), as well as numerous other small vertebrates including several rare or endangered small mammals (USFWS 1997, 1998a, 1998b, Winter 2004). Domestic cats are the most abundant carnivore in North America, are the dominant predator in many highly fragmented habitats, and can reach densities exponentially higher than all native carnivores combined (Dauphine and Cooper 2011). The American Veterinary Medicine Association, American Society of Mammalogists, The Wildlife Society, and American Bird Conservancy all strongly encourage owners of domestic cats in urban and suburban areas to keep them indoors. Despite this, many pet owners allow cats to roam, not realizing that cats frequently kill wildlife (even when well fed) and can spread disease to wildlife. Dogs also kill pocket gophers (D. Stinson, pers. obs.), and are able to dig out gophers occasionally, but they are less likely to be free-roaming in residential areas.

Livestock grazing. Studies in California indicate that pocket gopher density tends to decrease in heavily grazed pastures (Eviner and Chapin 2003). There have been no studies of the relationship between livestock grazing and Mazama pocket gopher occurrence in Washington. They have persisted in pastures of well-managed ranches in Thurston County, but smaller, heavily grazed pastures are probably marginal habitat. Steinberg (1996) did not find gophers at several locations where populations had previously existed on pastures in rural residential areas near Tenino, Littlerock, and Vail (Stinson 2005).

Airport Management and Development

Pocket gophers occur in grasslands surrounding airport runways and adjoining lands at Olympia and Shelton. Airport safety considerations require that the vegetation be mowed to maintain visibility, eliminate cover for large animals that might pose a hazard for aircraft, and provide a safety margin

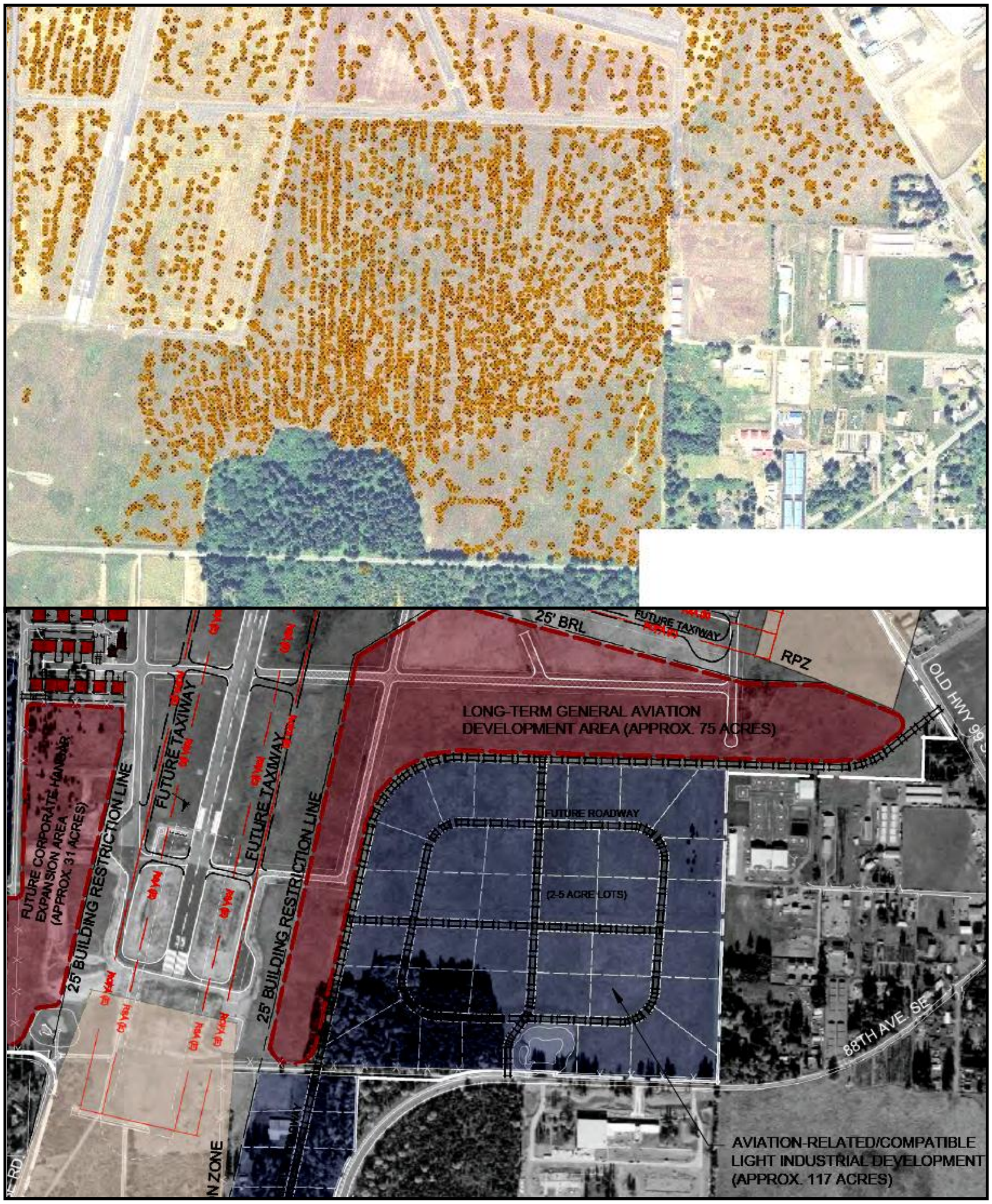

Figure 17. Southeastern portion of Olympia Regional Airport showing gopher mound detections in 2005, top (McAllister and Schmidt 2005), and anticipated development, bottom (Barnard Dunkelberg & Co 2011)

should aircraft overshoot or land short of the runway. This management benefits gophers by maintaining the grassland and keeping out woody vegetation and may benefit from fencing if it limits access by coyotes or other predators. However, if abundant gophers attract too many raptors, aircraft safety might require measures to reduce the gopher population (Witmer and Fantinato 2003). Development of aviation facilities and the surrounding port lands at the Olympia and Shelton airports poses a potential of habitat loss for what may be the largest populations of *T.m. pugetensis* and *T. m. couchi*, respectively.

The Olympia Airport designated 8.6 ac as a Mazama pocket gopher habitat conservation area in an interlocal agreement with WDFW as part of the Airport Five Year Development Plan. The Port of Olympia is currently updating its master plan, and completion was targeted for December 2012. The Plan projects significant future land developed for general aviation (~114 ac), aviation related/compatible industry (~245 ac), and additional area for parallel taxiways (Fig. 17; Barnard Dunkelberg & Co. 2011). Mitigation for impacts to occupied gopher habitat would be required by the Tumwater critical area ordinance.

The Port of Shelton had a habitat management plan prepared for the Shelton pocket gopher population on Sanderson Field to comply with Mason County regulations. The habitat plan was prepared in response to revisions in the Comprehensive Plan which identified several portions of the property for development (GeoEngineers Inc. 2003). The plan identifies an area of Port property where Scotch broom and other woody vegetation would be controlled to replace gopher habitat lost to development.

Military Training

The presence of Fort Lewis (now part of JBLM) has prevented the loss of habitat to agriculture and residential development for some of the largest remaining Mazama pocket gopher populations. The number of Army personnel stationed at JBLM has increased in recent years and additional increases are planned (Ft. Lewis Directorate of Public Works 2010). The increase in training needs may increase impacts on grasslands and pocket gophers. The training most damaging to vegetation has been concentrated on the same areas, so some less-used prairies have been maintained in good condition. Since gophers do not require native vegetation, the effect of degraded vegetation on gopher populations is uncertain, but may result in more annuals. Changes that decrease the cover of perennial forbs would likely have a negative effect on gophers.

Mazama pocket gophers exist primarily on prairies at JBLM where vehicular traffic is currently restricted to established roads, but there are no specific restrictions on training to protect gophers (J. Foster, pers. comm.). Steinberg (1995) speculated that military training may negatively affect some gopher populations by compacting the soil. Vegetative cover declined by 36% after intensive, unauthorized tracked vehicle training occurred on Lower Weir Prairie, which is supposed to be off-limits to vehicle use (ENSR 2000). Areas damaged by military training are repaired by the Land Rehabilitation and Maintenance program. Without restoration, native grasses tend to become replaced by invasive species such as colonial bentgrass and Scotch broom (ENSR 2000:21). Digging activity removes vegetation and creates disturbed sites that are susceptible to colonization by exotic weeds (ENSR 2000), and presumably disturbs gophers. Some soil contamination from vehicles, explosives, metals, and other chemicals likely occurs.

Fires, whether as part of habitat restoration activities or a side-effect of training during the summer, help reduce invasion by Douglas fir and Scotch broom and have maintained some of the highest quality prairie sites on JBLM. However, smaller portions of the Artillery Impact Area burn too frequently, have a cover of mostly exotic annual grasses (Tveten and Fonda 1999); annual grasses are typically the least preferred herbaceous foods of pocket gophers.

Climate Change

The future impacts of climate change on Mazama pocket gophers and their habitats in Washington are uncertain. In general, the stresses and instability associated with climate change are predicted to have greater impact on small isolated populations. Recent models generally predict a modest increase in precipitation in the winter and a modest decrease in summer in western Washington (Littel et al. 2009, Mote and Salathe 2009). Projected higher temperatures are predicted to decrease summer soil moisture up to 25% (Bachelet et al 2011). Many prairie plant species are adapted to summer drought, so reduced summer soil moisture and an increase in wildfire frequency may help keep Douglas-fir and other woody species out of grassland habitats (Bachelet et al 2011). However, increased CO_2 in the atmosphere may affect plant growth and chemical and nutrient composition and affect wildlife in ways that are not yet understood.

It is not clear how or if climate change may affect the habitat of the Olympic pocket gopher, which is restricted to alpine meadows, but forest seems to be encroaching and further isolating the patches of meadow habitat (J. Fleckenstein, pers.comm.). Climate change induced effects on fire frequency or forest succession in subalpine meadows may be affecting *T. m. melanops*, which is otherwise secure from threats of habitat loss. The fire return intervals in the Elwha Valley have been 85 to 230 years (Wendel and Zabowski 2010). Fire and windstorms may clear enough forest to allow isolated meadows to be reconnected periodically, but climate change may affect fire intervals and tree growth. Tree invasion will probably increase if there is a large reduction in snow depth and seasonal persistence (Laroque et al. 2000, Zald et al. 2012).

Blois et al. (2010) reported fossil remains from a cave in northern California deposited during the warming trend at the end of the Pleistocene-Holocene transition. During the period from 11,000 to 7,500 years ago, *Thomomys mazama* declined and disappeared, while *Thomomys bottae* remains increased. *T. mazama* has a more northerly distribution, and apparently their range tracked cooler climates (Blois et al. 2010). Hadly (1997) examined skeletal remains of pocket gophers (*T. talpoides tenellus*) from a cave in Yellowstone National Park, which provided information about the species response to 3,200 years of climate changes. When the environment was relatively wet, pocket gophers were abundant and tended to be larger. During a prolonged period of warm, dry climate, pocket gophers were rare and significantly smaller (Hadly 1997). Although gopher abundance and size changed, the isolated population persisted over several thousand years of climate change without extinction (Hadly et al. 1998).

Climate change may present an opportunity for maintenance funding through payments for carbon sequestration; prairies are more effective at sequestering carbon than forests because of the great biomass of roots (Montgomery 2007) and the nitrogen-poor soils inhibit complete decomposition. Compared to forests, there is no danger of massive carbon release during wildfires or logging because most of the carbon is underground (Bachelet et al. 2011).

Altered Ecological Communities

Olympic pocket gophers (*T. m. melanops*) are only known from Olympic National Park. Their high elevation habitat is limited and their populations are probably small. Johnson (1977) reported apparent extinctions during the 20th century. There have been at least two significant changes to the Olympic alpine animal community that may affect gophers. The eradication of wolves allowed the invasion of the high country by coyotes (Scheffer 1995). Coyotes, which were historically rare on the Olympic Peninsula before the extirpation of wolves and logging, may be responsible for a decline in Olympic marmots (Griffin et al. 2008). Coyotes may also be negatively affecting these small populations of pocket gophers. The introduction of mountain goats in the 1920s (Jenkins et al. 2012), might negatively affect gopher populations through competition for food. Mountain goats have a varied plant diet and can dramatically affect vegetation in localized areas (Vaughan 1975, Houston et al. 1994).

RECOVERY

Preface

The Mazama pocket gopher is state-listed as Threatened in Washington. The population objectives for recovery to a point where they can be re-classified are described below. Tear et al. (2005) suggested a standard for setting conservation objectives was to incorporate the three 'R's: representation, redundancy, and resilience. Redundancy suggests conserving more than one population, and representation would involve conserving all subspecies and all major portions of their range. Resilience indicates conserving populations that have a greater ability to rebound from episodic low points due to extremes of seasonal weather, disease, etc. In practice, this may require conserving sites that are large enough to harbor large subpopulation(s) when conditions are good, while providing some habitat complexity that helps ensure suitable sites during extremes of environmental variation. This suggests it is prudent to secure and restore habitat as needed to recover and maintain multiple populations for each distinct evolutionary unit (subspecies or clade), where possible.

For these reasons, conserving populations in Mason County and in both Thurston and Pierce counties are included because more geographically separated populations likely represent some degree of genetic difference, and populations may have been isolated by the Nisqually and Deschutes rivers. Seven areas that have substantial existing habitat and contain significant numbers of Mazama pocket gophers in Thurston, Pierce, and Mason counties are identified for recovery emphasis (Fig 18). Populations in three occupied or formerly occupied areas are not included in recovery objectives for the following reasons: Mazama pocket gophers in Wahkiakum County (*T. m. louiei)* and a portion of Pierce County (*T. m. tacomensi)* appear to be extinct; and Mazama pocket gophers in Clallam County (T. *m. melanop)* are found entirely within Olympic National Park. Because they are within the park, there are no certain threats to the Clallam County population or habitat; however, there may be a need to address tree encroachment in occupied areas.

Conservation of the populations in the seven areas (five in Thurston County, one in Pierce County, and one in Mason County) would preserve representative local populations across their range in the south Puget Sound region. They also include populations of each of the five described subspecies in the region (*pugetensis, tumuli, yelmensis, glacialis,* and *couchi*), four of which are proposed for federal listing. A genetic study underway may confirm previous work which suggested that these five subspecies could be reduced to two, but regardless of the outcome, these seven populations are locally adapted and important for species recovery.

Some portions of the range that host small numbers of gophers were not identified for recovery emphasis and monitoring because of low potential for long-term persistence. These include densely developed areas (e.g. Little Chambers, Hawks, and Chambers prairies) and/or areas that do not seem to host substantial populations (e.g. Yelm Prairie, Smith Prairie).

RECOVERY GOAL

The goal of the recovery plan is to secure and maintain self-sustaining populations of Mazama pocket gophers within the current Washington range.

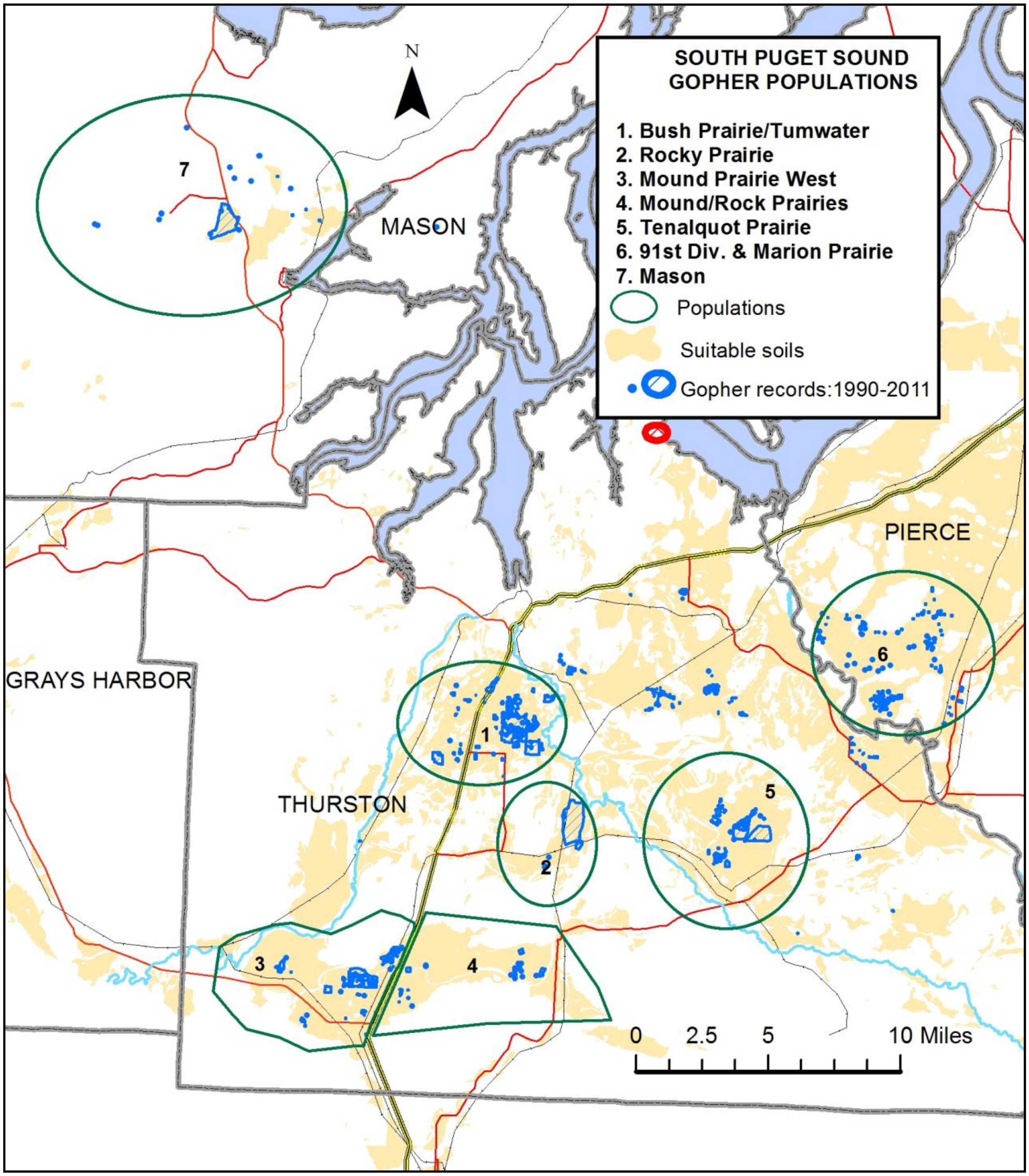

Figure 18. Seven populations of Mazama pocket gophers that will be the focus of recovery actions and monitoring.

RECOVERY OBJECTIVES

The Mazama pocket gopher will be considered for downlisting to Sensitive status when the following objectives have been met:

- **Objective 1.** Maintain a stable or increasing population trend for a 10 year period in each of seven Mazama pocket gopher populations (five in Thurston County, one in Pierce County, and one in Mason County), and

- **Objective 2.** Conservation agreements, regulations, or other mechanisms are in place that effectively and sustainably protect and provide the habitat extent, connectivity, and condition necessary to meet Objective 1.

Rationale

No estimates of the size of a minimum viable population have been reported for a pocket gopher species, but recent reviews suggest a population of a few thousand or more is desirable for long-term persistence of species (Lynch and Lande 1998, Allendorf and Ryman 2002, Frankham et al. 2002, Reed et al. 2003, Traill et al. 2010). In the South Puget Sound, only a few local subpopulations, such as Olympia and Shelton airports, and perhaps 91st Division appear to approach this size (1,000s). Many local subpopulations seem to be small, and some areas with gravel soils have scattered clumps of gophers, which may be the more typical situation.

Demographic concerns may be more important than genetic diversity in maintaining pocket gopher populations. Several studies of *T. bottae* in California indicate that pocket gophers, and probably subterranean rodents in general, differ from many species in having genetic diversity among many small local subpopulations, rather than within populations (Steinberg and Patton 2000). That is, most local populations are small (<100) and have low genetic diversity, but there is great variety between local subpopulations, so that the genetic diversity of the species exists across the range of the species, but not within local subpopulations. This pattern is likely normal for pocket gophers, and low genetic diversity may not affect the probability of persistence for a local population as much as expected and observed in other species.

In order to meet the recovery objectives, it will be necessary to protect most significant subpopulations of the seven populations identified, by protecting core habitat and potential connections for dispersal between them. The nature of the habitat and discontinuous distribution of gophers suggest that some, if not most, populations may exist as a network of small aggregations, with vacancy and recolonization a frequent occurrence. Protecting habitat for dispersal will facilitate recolonization of vacant patches and demographic recharge of subpopulations. These actions would help provide the representation, redundancy, and resilience suggested by Tear et al. (2005).

Populations may be monitored with various methods, including estimation of the size of certain key subpopulations, and changes in occupancy and habitat suitability. Population trends (stable, increasing or decreasing) can be assessed by comparing the year-to-year ratio in occupancy probabilities (MacKenzie et al. 2006). Trend will be determined by a running average of population growth.

Occupied gopher habitat in the Puget Sound is under many public and private ownerships, thus recovery will require partnerships with landowners, federal, state, and local agencies, and private conservation organizations. Incentive programs and partnerships with private landowners may prove helpful in maintaining functional patches of gopher habitat in rural residential and agricultural areas.

Once the recovery objectives are met, an updated status report will be prepared with a recommendation to down-list the species to state Sensitive. After the species is down-listed to Sensitive, a management plan will be prepared.

RECOVERY STRATEGIES AND TASKS

1. Monitor Mazama pocket gopher populations.

Improved knowledge of population trends and distribution are key components of conserving Mazama pocket gophers in Washington. Monitoring of populations is needed to determine seasonal and annual variation in populations, to detect population changes over time, and to determine when recovery objectives are achieved.

1.1 Monitor the status and trend of pocket gopher populations in the seven populations identified for recovery.

Populations identified for recovery (Figure 18) will need to be monitored. This includes populations of all the extant subspecies described for Thurston, Pierce and Mason counties.

1.1.1 <u>Estimate size of key subpopulations of Mazama pocket gophers.</u>

1.1.2 <u>Conduct sampling for occupancy to monitor population trend in the identified recovery emphasis areas.</u>

With the assistance of cooperating agencies, monitor pocket gopher population trends. Use standardized methods for population monitoring after they are developed through research (Task 5.2). Sampling may require regular surveys at selected sites, so many plots will be on public lands with easy access, while trends outside these areas may be assessed with other indices.

1.1.3 <u>Periodically analyze population trends from occupancy data</u>.

1.2 Determine the distribution and relative abundance of pocket gophers (*T. m. couchi)* in Mason County.

1.2.2 <u>Complete opportunistic surveys in potentially suitable habitat in Mason County and adjacent counties, as needed.</u>

Opportunistic surveys should be conducted at sites with potentially suitable habitat or possible detections to identify additional pocket gopher populations and to help clarify gopher habitat associations. In any areas outside the known historic range, confirmation of gopher presence should be done through live-trapping, as needed, to clearly delineate their distribution.

1.3 Determine the distribution and relative abundance of pocket gophers (*T. m. melanops*) in Clallam County.

Limited population information is available for Olympic pocket gophers and a comprehensive inventory and population assessment is desirable. Populations are currently known from only six locations. Surveys should be done in cooperation with the Olympic National Park at all historical locations and at other potentially suitable sites in the park and surrounding areas.

1.4 Coordinate surveys and monitoring of populations, data collection, and maintenance.

1.4.1 <u>Coordinate survey and monitoring efforts with Joint Base Lewis-McChord, USFWS, consultants, National Park Service, and other cooperators, as needed.</u>

1.4.2 <u>Maintain a database of Mazama pocket gopher survey efforts and detections.</u>

Compile survey results from agencies, consultants, and landowners. The Wildlife Survey Data Management (WSDM) section at WDFW, Olympia, maintains a statewide database of survey information on Mazama pocket gophers. WDFW should work with cooperators to facilitate data exchange from pocket gopher surveys. To be fully effective, positive and negative results from all areas surveyed should be reported.

1.4.3 <u>Conduct periodic training of consultants and agency personnel in gopher detection techniques to mmaintain quality and consistency of data.</u>

2. Protect and enhance habitat for Mazama pocket gophers.

Mazama pocket gophers in Washington are primarily threatened by habitat loss and degradation, which makes habitat protection and restoration the greatest priority for recovering the species.

2.1 Update information about soil suitability for pocket gophers.

Soil characteristics are important in determining the distribution and abundance of pocket gophers. Uncertainties still exist regarding the suitability of some soil types for gophers, especially in Mason County. Soil lists should continue to be updated as more data become available in the future.

2.2 Protect pocket gopher habitat on public lands.

2.2.1 <u>Include gopher conservation in Habitat Conservation Plan for WDFW lands, and update the management plans for wildlife areas to include management of habitat for pocket gophers.</u>

Habitat management actions beneficial to pocket gophers in management plans for Scatter Creek and West Rocky wildlife areas should be updated.

2.2.2 As opportunities arise, work with Joint Base Lewis-McChord, the ports of Olympia and Shelton, WDNR, and other public entities to protect and manage pocket gopher habitat on public lands.

Public entities mange public lands that are important for pocket gopher recovery. Efforts should be made to work with these entities to protect, restore, and manage gopher habitat on their lands through various actions, such as preparing management plans, conducting restoration projects, using appropriate mowing regimes, and implementing mitigation for loss of habitat.

2.2.3 Provide technical review and recommendations on development proposals and planning documents from the USFWS, ports of Olympia and Shelton, Joint Base Lewis-McChord, WDNR, and other public entities to protect pocket gopher habitat on public lands.

WDFW should continue to review and provide recommendations on draft development proposals and planning documents prepared by these entities to ensure protection of gopher habitat.

2.2.4 Seek long-term commitments that protect pocket gopher habitat on public lands, where appropriate to achieve Recovery Objective 2.

Assistance should be provided to these entities to establish, where appropriate, conservation easements, cooperative agreements, habitat conservation plans, mitigation banking, and other long-term measures for protecting, restoring, and managing gopher habitat on lands they administer.

2.3 Provide data and technical advice to regulatory agencies to facilitate protection of pocket gopher habitat on private lands and to maintain connectivity among gopher populations.

While the emphasis for recovery is on public lands, it is recognized that private lands also play an important role in preserving connectivity, dispersal habitat and maintaining important populations. Work with counties and cities (and the USFWS if Mazama pocket gophers are federally listed) to protect occupied habitat for pocket gophers on private lands. Populations with potential for long-term persistence should be protected, if possible. For populations in high density urban growth areas with lower prospects for persistence, off-site mitigation, such as a mitigation bank, should be pursued. Review habitat management plans and other documents and provide recommendations to landowners and regulatory agencies. These efforts will have the added benefit of helping to preserve connectivity among gopher populations, which is often dependent on maintaining gopher presence on private lands.

2.3.1 Provide technical assistance to cities and counties to minimize the effects of development on pocket gopher habitat on private lands.

Review and comment on proposed revisions of critical area and clearing and grading ordinances. Review and comment on Habitat Management Plans to improve consistency. Provide technical assistance to Thurston County (currently developing a habitat conservation plan (HCP) for prairie species), Pierce and Mason counties, cities, and any other entities that may develop similar plans.

2.3.2 Provide technical information to USFWS and any public or private entities involved in the establishment of a habitat mitigation bank for pocket gophers.

Participate in discussions and provide information to the USFWS and other partners in discussions to explore the potential to develop one or more habitat mitigation banks for Mazama pocket gophers in Washington.

2.4 Protect essential pocket gopher habitat on private lands through conservation easements, cooperative agreements, or acquisitions.

Various mechanisms exist to preserve habitat on private lands with conservation value. These include conservation easements, management agreements, and land acquisitions from willing landowners. For Mazama pocket gophers in Washington, priorities for conservation easements, management agreements, or land acquisitions are: (1) occupied areas important to supporting the seven populations of pocket gophers identified for recovery; (2) areas that provide connectivity between subpopulations within recovery populations; (3) areas at risk of an alternate land use (e.g., development) that would substantially impair recovery for gophers. Many of these locations will facilitate recovery of gophers and benefit other listed species as well.

2.4.1 Negotiate conservation easements or purchase of development rights agreements to protect pocket gopher habitat on private lands.

Conservation easements have been used successfully to protect and manage blocks of habitat for many species of concern, and are likely to be effective for Mazama pocket gophers as well. Easements for pasture land may be eligible for funding under the Grassland Reserve Program or Farm and Ranchland Protection Program, programs in the federal Farm Bill that protects farms and grasslands while maintaining areas as grazing lands. Work with local non-governmental organizations when appropriate.

2.4.2 Where appropriate, negotiate management agreements or easements with private forest owners to maintain habitat for *T. m. couchi* in Mason County.

Management practices on commercial timberlands may be compatible with conserving habitat for *T. m. couchi* by providing a shifting mosaic of regenerating clearcuts and a network of roadsides. As more is learned about the habitat needs of this subspecies, management agreements with private forest owners may be a useful tool for retaining specific amounts of habitat in clearcuts.

2.4.3 Consider acquisitions of important habitat from willing sellers if they provide the best option for protecting or restoring essential habitat for gophers.

Identify important parcels of pocket gopher habitat on private lands that may be at risk and where there may be willing sellers.

2.5 Increase connectivity between subpopulations in populations identified for recovery.

The long-term viability of some populations will depend on the connectivity among two or more smaller sites with gophers. Strategies to develop and increase corridors should be employed to facilitate dispersal movements, which will support demographic stability and genetic diversity. Specific actions will depend upon the situation of each site relative to other sites in the population, but may include active or passive methods.

2.5.1 <u>Identify potential and actual corridors between sites.</u>

Conduct a GIS analyses to identify likely or potential corridors among sites based on aerial photographs, vegetation, and soils data. Existing corridors will be verified by site visits surveys and/or genetic data. Such corridors will also be evaluated to determine if further enhancements are necessary. Candidates for potential corridors will be targeted for management activities to create new corridors among sites.

2.5.2 <u>Conduct active management to enhance or develop corridors</u>.

When feasible, conduct activities such as tree and shrub removal, planting and/or maintenance of vegetation that helps facilitate dispersal and movement of gophers between and among populations, soil enhancements or disturbance (such as light disking), and fencing or other means of minimizing predation on dispersers using corridors. WDFW will work with landowners, especially JBLM and WDOT, to determine the most efficient and effective means of managing corridors on their lands.

2.6 Maintain and enhance pocket gopher habitat.

Habitat enhancement and restoration methods such as prescribed burning, reseeding, use of herbicides, and mechanical removal of trees and shrubs should be applied when needed to lands with conservation value for gophers. Priorities for habitat management are (1) areas currently occupied by pocket gophers, (2) areas allowing the expansion of existing gopher populations, (3) areas serving as potential corridors between populations, and (4) areas selected for reintroduction projects.

Although Mazama pocket gophers do not require native prairie vegetation, a native mix of plants may be more stable and drought tolerant and also provide improved habitat for other species of concern that rely on prairies (e.g. butterflies, streaked horned larks, Oregon vesper sparrows). Habitat management should use mixtures of locally adapted varieties of native grasses and forbs to avoid potential negative effects on other species.

2.6.1 <u>Maintain, enhance, or restore pocket gopher habitat on conservation lands.</u>

Maintenance of grassland requires control of Scotch broom and other invasive vegetation. Priority areas for these activities include WDFW wildlife areas (i.e. Scatter Creek, West Rocky Prairie wildlife areas), WDNR lands (e.g. Rocky Prairie Natural Area Preserve), TNC lands (i.e. Tenalquot Prairie Preserve), and lands protected through conservation easements or cooperative agreements.

2.6.2 <u>As opportunities arise, assist with enhancement or restoration of pocket gopher habitat on non-conservation lands</u>.

Non- conservation lands include airport lands owned by the ports of Olympia and Shelton, military lands at Joint Base Lewis-McChord, other government lands (i.e., those owned by cities, counties, school districts, state, federal; see Appendix F), and private lands.

3. Protect Mazama pocket gophers from human-related mortality, if needed.

Mazama pocket gophers may experience some level of human-related mortality (e.g., illegal control, predation by non-native species), but the extent of this problem is poorly known. Information from research (Task 5.3) and other sources will be useful in determining the type and amount of human-related mortality occurring in pocket gopher populations.

3.1 Minimize illegal control of pocket gophers, if needed.

The presence of pocket gophers has prevented some private landowners from fully developing their property and may have encouraged some illegal control of gophers through trapping or poisoning. The species is protected from unlawful taking under RCW 77.15.130. Public outreach (Task 8.1) is an important tool in preventing illegal control of gophers, but law enforcement should also be applied where and when necessary.

3.2 Minimize other human-related sources of gopher mortality, if needed.

If information indicates other human-related factors are causing significant mortality, minimize the effects on important subpopulation. For example, extensive controlled burns may affect survival, and dogs and cats occasionally kill gophers. Changes in management or public outreach (Task 8.1) may useful in addressing a problem.

4. Translocate Mazama pocket gophers, if needed to help achieve recovery objectives.

Translocations of Mazama pocket gophers may be necessary in the future to establish populations in new locations with suitable habitat and favorable management approaches. Two translocations have been attempted since 2005 and appear to have been successful. Mortality rates of translocated individuals were significant, requiring releases of significant numbers of gophers repeated over multiple years to establish a population. Any additional translocations should use appropriate source populations that maintain recognized subspecies. Genetic analysis may inform what options for moving gophers are appropriate.

4.1 Identify and prioritize suitable unoccupied sites for translocations, if needed for recovery.

Unoccupied sites that are isolated from source populations may exist or be created in the future that would be suitable for supporting gopher populations, such as a mitigation bank.

4.2 Evaluate and modify protocols used for the capture, transport, and release of pocket gophers during translocations.

Past translocations have contributed substantial information on methods to be used in future projects.

4.3 Conduct pocket gopher translocations, if needed.

4.3.1 Develop plans for specific translocations.

Once a translocation site is identified, a translocation plan should be developed with cooperators. Plans should include information on methods, timing, numbers and sources of gophers, and post-release monitoring techniques. Consideration would be given to determining the appropriate source population for animals. If needed, conduct any SEPA or NEPA evaluations for the translocation.

4.3.2 Conduct translocations of gophers.

Implement established protocols for the capture, transport, and release of pocket gophers.

4.3.3 Monitor the post-release survival and productivity of translocated and resident pocket gophers and evaluate success of the project.

Monitor translocated individuals to assess survival and determine whether additional translocations, habitat improvements, release locations, or improved translocation methods are necessary.

5. Conduct research necessary for Mazama pocket gopher conservation.

Many aspects of the biology and conservation of Mazama pocket gophers remain poorly known. WDFW, universities, and other entities should initiate research on important topics involving this species in Washington. Funding should be sought and partnerships initiated to carry out this work. Research having significant WDFW funding or involvement will be reviewed under WDFW's Scientific Review Protocol.

5.1 Determine if any changes in subspecies designations are appropriate for Mazama pocket gopher populations in Washington.

Genetic analyses of subspecific diversity may provide information for evaluating whether changes in subspecies designations are appropriate. A range-wide genetic study currently being conducted by the U.S. Geological Service, USFWS, and WDFW may help clarify the appropriate subspecific taxonomy. Any changes in designations would need to be recognized by the American Society of Mammalogists and the International Commission on Zoological Nomenclature.

5.2 Develop methods for estimating populations and monitoring pocket gopher population trends.

Monitoring populations of pocket gophers will require development of a sampling scheme and protocol for occupancy determinations.

5.2.1 <u>Develop methods for estimating key pocket gopher subpopulations.</u>

5.2.2 <u>Identify methods and develop sampling scheme for monitoring trends in pocket gopher populations.</u>

Occupancy sampling may be used for monitoring trends, but other methods may be considered.

5.2.3 <u>Identify sites for monitoring pocket gopher population trends.</u>

5.3 Investigate the life history and population dynamics of Mazama pocket gophers.

Improved understanding of the life history and population dynamics of Mazama pocket gophers would be beneficial in many ways, including for assessment of conservation risks and for conservation planning.

5.3.1 <u>Investigate survival, recruitment, relative importance of sources of mortality, and dynamics of pocket gopher populations.</u>

Investigate the demography of gopher populations. Determine whether human-related sources of mortality are significant relative to other sources, including starvation, disease, and native predators.

5.3.2 <u>Investigate the distance and frequency of dispersal and characterize barriers to gene flow between populations.</u>

Investigate dispersal through demographic and genetic methods. Determine what constitutes a barrier to dispersal to help delineate populations and identify populations that are isolated.

5.3.3 <u>Investigate other aspects of the biology of pocket gophers.</u>

Increased knowledge of diet, home range, activity patterns, behavior, and other life history features is desirable.

5.4 Determine the habitat needs of pocket gophers and effects of development and forestry on population persistence.

This research can be done in part by comparing pocket gopher occupancy, productivity, and persistence among different study sites and over time.

5.4.1 Investigate effect of habitat characteristics on pocket gopher productivity.

Improved information is needed on the effects of vegetation structure and composition and soil types on the occurrence and productivity of Mazama pocket gophers.

5.4.2 Investigate the habitat requirements of pocket gophers occurring in commercial timberlands and along roadsides.

T. m. couchi occupies clearcuts and roadsides, but little is known about its vegetation and soil preferences in these habitats. Better information is needed on the habitat requirements of populations living in these types of sites.

5.4.3 If feasible, investigate pocket gopher occurrence and persistence in residential areas, pastures, and agricultural lands to assess tolerance for human development.

Information would be helpful on the responses of pocket gopher populations to different densities of rural housing (e.g. one residence/10 ac, one residence/5 ac, cluster development, and higher densities) and to various types of agricultural land uses and population persistence in these different situations.

5.5 Improve methods of restoring and maintaining pocket gopher habitat, including planting and prescribed burns.

5.5.1 Develop native plant lists for pocket gopher habitat enhancement projects.

Use information from dietary research to help inform habitat improvement projects.

5.5.2 Improve methods of restoring native vegetation and controlling weeds.

Document seed mixes, plant varieties, and methods of controlling weeds, and exchange information among managers to improve success and efficiency of habitat improvement projects.

5.5.3 Evaluate the effectiveness of prescribed burns to improve habitat for pocket gopher.

The responses of pocket gopher populations to prescribed burns should be assessed and monitored. Prescribed burns can be used to maintain grasslands by controlling conifer and Scotch broom invasion.

5.5.4 Investigate the potential for habitat management for *T. m. couchi* in commercial timberland to facilitate dispersal and persistence.

Develop management practices for *T. m. couchi* populations in commercial timberland that will not negatively affect forestry objectives.

6. Review and revise recovery and conservation planning documents for Mazama pocket gophers in Washington.

6.1 Update the WDFW status report for pocket gophers, as needed.

WDFW's status report for Mazama pocket gophers (Stinson 2005) was written in 2005, using taxonomy and population data as they were understood at that time. If significant changes in subspecies designations or population status occur in the future, it may be desirable to prepare a new status review to assist with conservation planning and ongoing management of the species in Washington.

6.2 Revise recovery objectives and strategies for pocket gophers, as needed.

Use new information from research, inventories, and monitoring to periodically update and revise the WDFW pocket gopher recovery plan. The recovery objectives may need to be revised in the future, as new information becomes available. A genetics study initiated in 2012 may provide information about populations or taxonomy that will suggest needed revisions of the recovery objectives and strategies.

7. Coordinate and cooperate with public agencies, landowners, and non-governmental groups to help achieve conservation objectives for Mazama pocket gophers in Washington.

7.1 Provide data to USFWS to assist with federal actions targeting the species.

Sharing information will assist the USFWS with its analysis of an ESA-listing proposal for Mazama pocket gophers, which was released in December 2012 and is scheduled to be finalized in fall 2013. Data sharing would also be important to other future gopher-related activities by the USFWS, such as preparation of Habitat Conservation Plans or proposals to establish critical habitat.

7.2 Secure funding for recovery activities.

The many recovery actions described in this plan will require ongoing funding from federal, state, and private sources. Funding opportunities can be expanded through the formation of partnerships.

7.2.1 Secure grants to conduct research and other recovery activities.

7.2.2 Secure funding for habitat-related recovery activities, including habitat management, land acquisition, purchase of development rights, and exploring incentive programs.

Establishment of mitigation banks is one recommended tool for obtaining funding for acquiring and restoring habitat for Mazama pocket gophers.

7.3 Participate in an interagency working group and participate in a recovery team, if convened to plan recovery actions.

WDFW and The Nature Conservancy co-organized a Mazama pocket gopher workshop in 2006, which has been followed by annual working group meetings since 2009. The working group has included WDFW, USFWS, Center for Natural Lands Management, Joint Base Lewis-McChord, county planners, consultants, and others. Together, these forums have resulted in the creation of a prioritized list of conservation activities and facilitated information exchange among participants. Continuation of the working group and annual meeting is desirable. WDFW should participate in a Mazama pocket gopher recovery team under the guidance of the USFWS to assist with recovery planning, if Washington subspecies are federally listed under the ESA.

7.4 Encourage protection of pocket gopher habitat on private lands by facilitating incentives.

7.4.1 <u>Provide information about potential property tax reduction for pocket gopher habitat under county Open Space Tax programs.</u>

As a species covered by critical area ordinances, occupied habitat, particularly that has a Habitat Management Plan, would qualify for high priority resource points, and may be eligible for open space classification under the Open Space Tax Program.

8. Develop and implement a public outreach and education program.

A program of this type is desirable to provide information to the public about the Mazama pocket gopher and to address gopher-related conflicts that some landowners have experienced while attempting to develop their property. The overall goal of the program would be to gain greater public support for pocket gopher recovery.

8.1 Develop an outreach and education strategy relating to pocket gophers.

8.1.1 <u>Develop and disseminate informational materials on various gopher-related topics.</u>

Outreach and education resources should address species identification and biology, conservation concerns including habitat loss and degradation, management of conflicts (e.g. non-lethal protection of gardens and landscape plantings), opportunities for habitat enhancement, and other recovery actions. Materials should be designed for target audiences, such as landowners, elected officials, and school-aged children in communities with pocket gophers. Some of the materials could also be developed in support of ongoing prairie conservation efforts in southern Puget Sound. A *Prairie Landowner Guide for Western Washington* (Noland and Carver 2011) has been developed that is useful guidance.

8.1.2 <u>Identify partners to assist with outreach and education activities.</u>

This may include county and city governments, non-governmental groups, land management agencies, staff at Joint Base Lewis-McChord, and others.

8.2 Provide gopher information to landowners, land managers, and other members of the public.

Work with partners and the media to distribute informational materials on gophers and give presentations to the public. WDFW should establish a website providing gopher information to the public.

8.3 Develop and periodically update WDFW's Priority Habitats and Species (PHS) documents for Mazama pocket gophers and western Washington prairie habitat.

8.3.1 Periodically update the protection and mitigation recommendations on the WDFW web site.

WDFW has developed a set of management recommendations on ways to avoid, minimize, and mitigate impacts to pocket gophers and their habitat (WDFW 2011). The recommendations are intended to inform government permit reviewers, permit applicants, consultants, and landowners working on projects with potential impacts to Mazama pocket gophers. They are available on the WDFW web site (http://wdfw.wa.gov/publications/01175/wdfw01175.pdf). New information from research and other sources should be incorporated into these recommendations as it becomes available.

8.3.2 Develop and periodically update PHS management recommendations for western Washington prairie habitat.

WDFW has standard PHS management recommendations for priority species and habitats. These recommendations provide a set of "best management practices" for a species for use by local governments, state and federal agencies, landowners, and consultants in land use planning. A set of these recommendations should be developed for western Washington prairie habitats and updated over time as new information from research and other sources becomes available.

IMPLEMENTATION SCHEDULE

Identified below are the agencies, WDFW involvement, task priorities, and estimates of annual expenditures needed for pocket gopher recovery (Table 3). Cost estimates do not mean that funds have been designated or are necessarily available to complete the recovery tasks. **Implementation of recovery strategies is contingent upon availability of sufficient funds to undertake recovery tasks.**

The following conventions are used:
Priority 1: Actions needed to prevent the extinction of the species or its subspecies in Washington.
Priority 2: Actions to prevent a significant decline in population size or habitat quality, or some other significant negative impact short of extirpation.
Priority 3: All other actions necessary to meet recovery objectives.

Table 3. Implementation schedule and preliminary cost estimates for implementation of recovery tasks.

Priority	Recovery Task	Duration in years	Potential Cooperators[a]	Est. Annual Cost ($1000's)	DFWShare %[b]
1	1.1 Monitor the status and trend of gopher populations in seven areas identified.	12	DFW, FWS, JBLM	tbd	-
1	1.2 Determine the distribution and relative abundance of pocket gophers (*T. m. couchi*) in Mason County.	12	DFW, FWS, AP, GD	tbd	-
1	1.3 Determine the distribution and relative abundance of pocket gophers (*T. m. melanops*) in Clallam County.	3	NPS,WNH, FWS	15	15%
2	1.4 Coordinate surveys and monitoring of populations, data collection, and maintenance.	12	DFW, FWS, JBLM	tbd	-
3	2.1 Update information about soil suitability for pocket gophers.	1, as needed	DFW	0.5	99%
1	2.2 Protect pocket gopher habitat on public lands.	ongoing	DFW, FWS, JBLM, WDNR	5	30%
2	2.3 Provide data and technical advice to regulatory agencies to facilitate protection of pocket gopher habitat to maintain connectivity.	ongoing	DFW, FWS, CC,	10	75%
2	2.4 Protect essential pocket gopher habitat on private lands through conservation easements, cooperative agreements, or acquisitions.	10	DFW, FWS, CC, NRCS,	tbd	-
2	2.5 Increase connectivity between gopher subpopulations	10	DFW, JBLM, FWS, CC, PL	tbd	-
2	2.6 Maintain and enhance pocket gopher habitat.	10	DFW, JBLM, CNLM, FWS	tbd	-
3	3.1 Minimize illegal control of pocket gophers, if needed.	3	DFW, FWS, PL, UN	40	tbd
3	3.2 Minimize human-related sources of mortality, if needed.	tbd	DFW, FWS, PL	tbd	-
3	4.1 Identify and prioritize suitable unoccupied sites for translocations, if needed.	2	DFW, FWS	1	50%
3	4.2 Evaluate and modify protocols used for translocation.	1	DFW, FWS	2	75%
3	4.3 Conduct translocations, if needed.	3; as needed	DFW, FWS	30	5%

Priority	Recovery Task	Duration in years	Potential Cooperators[a]	Est. Annual Cost ($1000's)	DFWShare %[b]
3	5.1 Determine if changes in subspecies designations are appropriate for Mazama pocket gopher populations.	1	DFW,FWS, USGS	20	5%
1	5.2 Develop methods for estimating populations and monitoring pocket gopher population trends.	1	DFW, FWS, JBLM	100	tbd
2	5.3 Investigate the life history and population dynamics of Mazama pocket gophers in Washington.	10	DFW, FWS, UN	tbd	-
3	5.4 Determine the habitat needs of pocket gophers and effects of development and forestry on persistence.	10	DFW, FWS, UN	tbd	-
3	5.5 Improve methods of restoring and maintaining pocket gopher habitat, including planting and prescribed burns.	10	CNLM, DFW, JBLM	tbd	-
3	6.1 Update the WDFW status report for pocket gophers, as needed.	1.5	DFW, CON	30	90%
3	6.2 Revise recovery objectives and strategies for pocket gophers, as needed.	1	DFW, FWS	5	75%
2	7.1 Provide data to USFWS to assist with federal actions targeting the species.	ongoing	DFW, FWS	1	90%
1	7.2 Secure funding for recovery activities.	ongoing	DFW, FWS, JBLM	tbd	-
3	7.3 Participate in an interagency working group and participate in a recovery team, if convened.	ongoing	DFW, FWS, JBLM, CC	10	20%
2	7.4 Encourage protection of pocket gopher habitat on private lands by facilitating incentives.	5	DFW, CC	tbd	-
3	8.1 Develop an education and outreach strategy relating to pocket gophers.	5	DFW, FWS, CNLM	25	25%
3	8.2 Provide gopher information to landowners, land managers, and other members of the public.	5	DFW, CNLM, WG	2	25%
3	8.3 Develop and periodically update WDFW's Priority Habitats and Species (PHS) management recommendations for Mazama pocket gopher.	2; as needed	DFW, WG, FWS	tbd	-

[a]Acronyms for cooperators:; AP = Olympia and Shelton airports; CC = counties, cities; CNLM= The Center for Natural Lands Management; CON = Consultants; DFW= Washington Department of Fish and Wildlife; FWS = USDI Fish and Wildlife Service; GD = Green Diamond; JBLM = Joint Base Lewis-McChord; PL = Private landowners;. USGS = Leetown Science Center, U.S. Geological Survey, UN=university researchers; WDNR = Washington Department of Natural Resources; WG = pocket gopher working group; WNH = Washington Natural Heritage Program.

[b] Anticipated DFW share of cost (%) if funds are available.

[c]Cost estimate to be determined.

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PERSONAL COMMUNICATIONS

Marty Chaney, Pasture Specialist
USDA Natural Resource Conservation Service
Olympia, Washington

John Fleckenstein, Zoologist
Natural Heritage Program
Washington Department of Natural Resources
Olympia, Washington

Jeff Foster, Ecologist
Environmental and Natural Resources Division
Joint Base Lewis-McChord

Dave Hays, Fish and Wildlife Biologist
Washington Department of Fish and Wildlife
Olympia, Washington

Eric Holman, Assistant District Wildlife Biologist
Washington Department of Fish and Wildlife
Vancouver, Washington

G. J. Kenagy, Professor Emeritus
Burke Museum and Department of Biology
University of Washington
Seattle, Washington

Linda Krippner
Krippner Consulting, LLC
Seattle, Washington

Jim Lynch, Fish and Wildlife Biologist
Environmental and Natural Resources Division
Joint Base Lewis-McChord

Kelly McAllister (former Thurston County District Wildlife Biologist, WDFW)
Washington Department of Transportation

Gail Olson, Research Scientist
Washington Department of Fish and Wildlife
Olympia, Washington

James, L. Patton
Curator and Professor Emeritus
Museum of Vertebrate Zoology
University of California
Berkeley, California

Scott Pearson, Research Scientist
Washington Department of Fish and Wildlife
Olympia, Washington

Karen Reagan, Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
Lacey, Washington

Greg Schirato, Deputy Assistant Director
Wildlife Program
Washington Department of Fish and Wildlife
Olympia, Washington

Tammy Schmidt, Assistant District Wildlife Biologist
Washington Department of Fish and Wildlife
Lakewood, Washington

Jeff Skriletz, District Wildlife Biologist
Washington Department of Fish and Wildlife
Shelton, Washington

Richard Taylor, Fish and Wildlife Biologist (retired)
Washington Department of Fish and Wildlife
Olympia, Washington

Corey Welch, PhD candidate
Department of Biology
University of Washington
Seattle, Washington

Gary Witmer, Biologist
U.S. Department of Agriculture/APHIS
National Wildlife Research Center
Fort Collins, Colorado

Appendix A. Washington Administrative Code.

WAC 232-12-297 Endangered, threatened, and sensitive wildlife species classification.

PURPOSE

1.1 The purpose of this rule is to identify and classify native wildlife species that have need of protection and/or management to ensure their survival as free-ranging populations in Washington and to define the process by which listing, management, recovery, and delisting of a species can be achieved. These rules are established to ensure that consistent procedures and criteria are followed when classifying wildlife as endangered, or the protected wildlife subcategories threatened or sensitive.

DEFINITIONS

For purposes of this rule, the following definitions apply:

2.1 "Classify" and all derivatives means to list or delist wildlife species to or from endangered, or to or from the protected wildlife subcategories threatened or sensitive.

2.2 "List" and all derivatives means to change the classification status of a wildlife species to endangered, threatened, or sensitive.

2.3 "Delist" and its derivatives means to change the classification of endangered, threatened, or sensitive species to a classification other than endangered, threatened, or sensitive.

2.4 "Endangered" means any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

2.5 "Threatened" means any wildlife species native to the state of Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.

2.6 "Sensitive" means any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats.

2.7 "Species" means any group of animals classified as a species or subspecies as commonly accepted by the scientific community.

2.8 "Native" means any wildlife species naturally occurring in Washington for purposes of breeding, resting, or foraging, excluding introduced species not found historically in this state.

2.9 "Significant portion of its range" means that portion of a species' range likely to be essential to the long-term survival of the population in Washington.

LISTING CRITERIA

3.1 The commission shall list a wildlife species as endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available, except as noted in section 3.4.

3.2 If a species is listed as endangered or threatened under the federal Endangered Species Act, the agency will recommend to the commission that it be listed as endangered or threatened as specified in section 9.1. If listed, the agency will proceed with development of a recovery plan pursuant to section 11.1.

3.3 Species may be listed as endangered, threatened, or sensitive only when populations are in danger of failing, declining, or are vulnerable, due to factors including but not restricted to limited numbers, disease, predation, exploitation, or habitat loss or change, pursuant to section 7.1.

3.4 Where a species of the class Insecta, based on substantial evidence, is determined to present an unreasonable risk to public health, the commission may make the determination that the species need not be listed as endangered, threatened, or sensitive.

DELISTING CRITERIA

4.1 The commission shall delist a wildlife species from endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available.

4.2 A species may be delisted from endangered, threatened, or sensitive only when populations are no longer in danger of failing, declining, are no longer vulnerable, pursuant to section 3.3, or meet recovery plan goals, and when it no longer meets the definitions in sections 2.4, 2.5, or 2.6.

INITIATION OF LISTING PROCESS

5.1 Any one of the following events may initiate the listing process.

- 5.1.1 The agency determines that a species population may be in danger of failing, declining, or vulnerable, pursuant to section 3.3.
- 5.1.2 A petition is received at the agency from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the classification process.
- 5.1.3 An emergency, as defined by the Administrative Procedure Act, chapter 34.05 RCW. The listing of any species previously classified under emergency rule shall be governed by the provisions of this section.
- 5.1.4 The commission requests the agency review a species of concern.

5.2 Upon initiation of the listing process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the classification process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

INITIATION OF DELISTING PROCESS

6.1 Any one of the following events may initiate the delisting process:

6.1.1 The agency determines that a species population may no longer be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

6.1.2 The agency receives a petition from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may no longer be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the delisting process.

6.1.3 The commission requests the agency review a species of concern.

6.2 Upon initiation of the delisting process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the delisting process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

SPECIES STATUS REVIEW AND AGENCY RECOMMENDATIONS

7.1 Except in an emergency under 5.1.3 above, prior to making a classification recommendation to the commission, the agency shall prepare a preliminary species status report. The report will include a review of information relevant to the species' status in Washington and address factors affecting its status, including those given under section 3.3. The status report shall be reviewed by the public and scientific community. The status report will include, but not be limited to an analysis of:

7.1.1 Historic, current, and future species population trends.

7.1.2 Natural history, including ecological relationships (e.g. food habits, home range, habitat selection patterns).

7.1.3 Historic and current habitat trends.

7.1.4 Population demographics (e.g. survival and mortality rates, reproductive success) and their relationship to long term sustainability.

7.1.5 Historic and current species management activities.

7.2 Except in an emergency under 5.1.3 above, the agency shall prepare recommendations for species classification, based upon scientific data contained in the status report. Documents shall be prepared to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act (SEPA).

7.3 For the purpose of delisting, the status report will include a review of recovery plan goals.

PUBLIC REVIEW

8.1 Except in an emergency under 5.1.3 above, prior to making a recommendation to the commission, the agency shall provide an opportunity for interested parties to submit new scientific data relevant to the status report, classification recommendation, and any SEPA findings.

8.1.1 The agency shall allow at least 90 days for public comment.

FINAL RECOMMENDATIONS AND COMMISSION ACTION

9.1 After the close of the public comment period, the agency shall complete a final status report and classification recommendation. SEPA documents will be prepared, as necessary, for the final agency recommendation for classification. The classification recommendation will be presented to the commission for action. The final species status report, agency classification recommendation, and SEPA documents will be made available to the public at least 30 days prior to the commission meeting.

9.2 Notice of the proposed commission action will be published at least 30 days prior to the commission meeting.

PERIODIC SPECIES STATUS REVIEW

10.1 The agency shall conduct a review of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing. This review shall include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification.

10.1.1 The agency shall notify any parties who have expressed their interest to the department of the periodic status review. This notice shall occur at least one year prior to end of the five year period required by section 10.1.

10.2 The status of all delisted species shall be reviewed at least once, five years following the date of delisting.

10.3 The department shall evaluate the necessity of changing the classification of the species being reviewed. The agency shall report its findings to the commission at a commission meeting. The agency shall notify the public of its findings at least 30 days prior to presenting the findings to the commission.

10.3.1 If the agency determines that new information suggests that classification of a species should be changed from its present state, the agency shall initiate classification procedures provided for in these rules starting with section 5.1.

10.3.2 If the agency determines that conditions have not changed significantly and that the classification of the species should remain unchanged, the agency shall recommend to the commission that the species being reviewed shall retain its present classification status.

10.4 Nothing in these rules shall be construed to automatically delist a species without formal commission action.

RECOVERY AND MANAGEMENT OF LISTED SPECIES

11.1 The agency shall write a recovery plan for species listed as endangered or threatened. The agency will write a management plan for species listed as sensitive. Recovery and management plans shall address the listing criteria described in sections 3.1 and 3.3, and shall include, but are not limited to:

11.1.1 Target population objectives.

11.1.2 Criteria for reclassification.

11.1.3 An implementation plan for reaching population objectives which will promote cooperative management and be sensitive to landowner needs and property rights. The plan will specify resources needed from and impacts to the department, other agencies (including federal, state, and local), tribes, landowners, and other interest groups. The plan shall consider various approaches to meeting recovery objectives including, but not limited to regulation, mitigation, acquisition, incentive, and compensation mechanisms.

11.1.4 Public education needs.

11.1.5 A species monitoring plan, which requires periodic review to allow the incorporation of new information into the status report.

11.2 Preparation of recovery and management plans will be initiated by the agency within one year after the date of listing.

11.2.1 Recovery and management plans for species listed prior to 1990 or during the five years following the adoption of these rules shall be completed within 5 years after the date of listing or adoption of these rules, whichever comes later. Development of recovery plans for endangered species will receive higher priority than threatened or sensitive species.

11.2.2 Recovery and management plans for species listed after five years following the adoption of these rules shall be completed within three years after the date of listing.

11.2.3 The agency will publish a notice in the Washington Register and notify any parties who have expressed interest to the department interested parties of the initiation of recovery plan development.

11.2.4 If the deadlines defined in sections 11.2.1 and 11.2.2 are not met the department shall notify the public and report the reasons for missing the deadline and the strategy for completing the plan at a commission meeting. The intent of this section is to recognize current department personnel resources are limiting and that development of recovery plans for some of the species may require significant involvement by interests outside of the department, and therefore take longer to complete.

11.3 The agency shall provide an opportunity for interested public to comment on the recovery plan and any SEPA documents.

<u>CLASSIFICATION PROCEDURES REVIEW</u>

12.1 The agency and an ad hoc public group with members representing a broad spectrum of interests, shall meet as needed to accomplish the following:

12.1.1 Monitor the progress of the development of recovery and management plans and status reviews, highlight problems, and make recommendations to the department and other interested parties to improve the effectiveness of these processes.

12.1.2 Review these classification procedures six years after the adoption of these rules and report its findings to the commission.

<u>AUTHORITY</u>

13.1 The commission has the authority to classify wildlife as endangered under RCW 77.12.020. Species classified as endangered are listed under WAC <u>232-12-014</u>, as amended.

13.2 Threatened and sensitive species shall be classified as subcategories of protected wildlife. The commission has the authority to classify wildlife as protected under RCW 77.12.020. Species classified as protected are listed under WAC <u>232-12-011</u>, as amended.

[Statutory Authority: RCW 77.12.047, 77.12.655, 77.12.020. 02-02-062 (Order 01-283), § 232-12-297, filed 12/28/01, effective 1/28/02. Statutory Authority: RCW 77.12.040. 98-05-041 (Order 98-17), § 232-12-297, filed 2/11/98, effective 3/14/98. Statutory Authority: RCW 77.12.020. 90-11-066 (Order 442), § 232-12-297, filed 5/15/90, effective 6/15/90.]

Appendix B. Measurements and dorsal fur color[a] of eight subspecies of Mazama pocket gophers from Washington.

Subspecies	Sex	N[b]	Total length mean in mm (range, if reported)	Tail length mean in mm (range, if reported)	Hind foot length mean in mm (range, if reported)	Weight (g)	Typical dorsal fur color[a] (Verts and Carraway 2000)
T. m. melanops	-	5[c]	212 (210–216)	71 (67–74)	28 (26–29)	-	Reddish brown
	M	7[d]	209(202-210)	61 (51-66)	28 (26-29)	104	
	F	11[d]	197 (183-213)	58 (46-70)	28 (26-29)	88.7	
T. m. couchi	M	4[c]	210 (197-210)	52 (51-54)	28 (26-30)		Reddish tan
	M	13	196	55	27	87	
	F	9	191	53	27	79	
T. m. tacomensis[e]	M	13	224	71	31	127	Reddish tan
	F	15	196	57	29	104	
T. m. glacialis	M	20	225	72	30	128	Light yellowish brown
	F	17	220	71	30	116	
T. m. pugetensis	M	14	223	62	30	123	Blackish brown
	F	19	205	59	29	96	
T. m. tumuli	M	11	225	60	31	140	Blackish brown
	F	14	216	64	30	118	
T. m. yelmensis	M	21	213 (200–235)	64 (50–70)	29 (28–33)	121	Light brown
	F	21	202	61	28	101	
T. m. louiei[ef]	M	1	249	82	31	-	Black, some dark brown individuals
	F	4	226	71	30	-	

[a] Measurements and fur color may not be reliably used to distinguish between subspecies.
[b] All data from Dalquest (1948), unless otherwise indicated.
[c] Booth (1947).
[d] University of Washington, Burke Museum.
[e] These subspecies, or populations are believed to be extinct.
[f] Gardner (1950)

Appendix C. Hypothesized suitability[a] of certain soils of Thurston, and Pierce counties for Mazama Pocket Gophers based on presence and abundance.

	Grade[a]	Soil Type	Survey units[b,c]	Veg.[d]	Notes , gopher occurrence
Thurston County					
	A	Nisqually loamy fine sand, 0–3, 3–15%	73, 74	P	Gophers often abundant when present
	B	Indianola loamy sand, 0–3%, 3–15%	46, 47	F	Gophers can be abundant
	C	Spanaway gravelly sandy loam, 0–3%, 3–15%	110, 111	P	Gophers often occur at moderate density
	C	Spanaway-Nisqually Complex, 2–10%	114	P	Gophers often occur at low-moderate density
	C	Cagey loamy sand	20	F	Gophers can be abundant, but seasonal high water table affects distribution and persistence (subsurface drain tiles may have improved suitability at some sites)
	C	Everett very gravelly sandy loam, 0–3%, 3–15%	32, 33	F	Many gopher records, low density;
	D	Yelm fine sandy loam, 0–3%, 3–15%	126, 127	F	3–4 occurrences; seasonally high water table affected by topography
	D	Spana gravelly loam	109	P	seasonally high water table; 1 gopher occurrence
	D	Norma fine sandy loam	75	F	seasonally high water table affected by topography
	D	Norma silt loam	76	F	seasonally high water table affected by topography; 1–2 gopher occurrences
	E	McKenna gravelly silt loam, 0–5%	65	F	seasonally high water table; a few gopher occurrences
	E	Alderwood gravelly sandy loam, 0-3%	1	F	several occurrences; can have seasonal high water table, other characteristics suggesting poor suitability
	E	Spanaway stony sandy loam, 0–3%, 3–15%	112, 113	P	2 gopher records; contains 15–35% stones >10”
Pierce County					
	A	Nisqually loamy sands	25A	P	Gophers can be abundant
	B	Indianola loamy sand, 0–6%, 6–15%	18B,C	F	Gophers can be abundant in Thurston
	C	Spanaway gravelly sandy loam	41A	P	Gophers often occur at low-moderate density
	D	Spana loam	40A	P	seasonally high water table affected by topography; 1 gopher occurrence
	D	Everett gravelly sandy loam, 0-6%, 6-15%	13B, C	F	Based on scattered occurrences in Thurston County

[a]Suitability grades:

A, B) Sandy loam or loamy sand soils that support, or would be expected to support, significant gopher populations;
C) Gravelly, or complex soils that support low to moderate populations, or sandy soils with variable seasonal high water table
D) Gravelly, silt loam, or sandy soils with variable seasonal high water table; small number of gopher occurrences;
E) Soils with characteristics suggesting poor suitability (e.g. seasonally high water table, high rock content, or extreme infertility and droughtiness); few or no gopher occurrences.

[b] “Survey units” are soil types in the county soil surveys. County soil survey maps are predictions based on sampling; boundaries between soil units can be inaccurate at any particular site, and soil units often have inclusions of other soil units within them. Therefore, predictions about suitability of soil units with only a few gopher occurrences should be viewed as a hypothesis. County soil surveys for Thurston (Pringle 1990), Pierce (Zulauf 1979), and Ft. Lewis data.

[c]Few to no gophers have been found on significant slopes, so soil types with >15% slope have not been included.

[d]Native vegetation typical of soil type: P = prairie; F = Conifer forest.

Appendix D. Hypothesized suitability[a] of certain soils of Mason County for Mazama Pocket Gophers based on gopher presence and abundance.

	Grade[a]	Soil Type	Survey units[b,c]	Veg.[d]	Notes , gopher occurrence
	A	Carstairs gravelly loam, 0–5%	Ca	P	Known to support substantial numbers of gophers
	B	Indianola loamy sand, 0–3%, 3–15%	Ia, I b, Id, Ie	F	no confirmed records; not widespread
	B?	Lystair sandy loams, 0–5%, 5–15%	Ld, Le	F	1 occupied site
	C?	Lystair loamy sand, 0–5%, 5–15%	Lb, Lc	F	No definite records; very droughty and infertile
	C	Grove gravelly sandy loam	Gh, Gk	F	Several occurrences
	C?	Grove gravelly loam	Ge, Gf	F	Several occurrences?
	D?	Shelton gravelly sandy loam, 0–5%, 5–15%	Se, Sf	F	Cemented substratum
	D?	Shelton gravelly loam, 5–15%	Sd	F	Cemented substratum
	E	Everett gravelly sandy loam, 0-5%, 5-15% , Everett gravelly loamy sand, 0-5%	Eh, Eg, Ed, Ee	DW	Cemented substratum; no confirmed records
	E	Alderwood gravelly sandy loam, 0-3%	Aa, Ab	F	Cemented substratum; may have seasonal high water table, other characteristics suggesting poor suitability; one record, needs confirmation

[a]Suitability grades:
A, B) Sandy soils that support, or would be expected to support, significant populations;
C) Gravelly soils that support low to moderate populations.
D) Gravelly or very droughty infertile sandy soils that may be able to support low to moderate gopher populations;
E) Soils with few or no gopher occurrences and have characteristics suggesting poor suitability (e.g. seasonally high water table, high rock content, or extreme infertility and droughtiness).
? = greater uncertainty of ranks due to limited data.

[b]"Survey units" are soil types in the county soil surveys. County soil survey maps are predictions based on sampling; boundaries between soil units can be inaccurate at any particular site, and soil units often have inclusions of other soil units within them. Therefore, predictions about suitability of soil units with only a few gopher occurrences should be viewed as a hypothesis. County soil surveys for Mason County (Ness 1960).

[c]Few to no gopher have been found on significant slopes, so soil types with >15% slope have not been included.

[d]Native vegetation typical of soil type (does not indicate current land cover): P = prairie; DW = dry woodland, including madrone, manzanita; F = Conifer forest.

Appendix E. Washington localities, year, collector of Mazama pocket gopher specimens collected from 1825– 2006, in major research collections.

Subspecies/ Collection locality	County[a]	Year	Collector	Tally[b]	Institution[c]
T.m pugetensis					
Olympia	T	1922	Cantwell,GG	1	ROM
Olympia	T	1922	Couch, LK, Cantwell, GG	1	NMNH
Olympia	T	1923	Coll. unknown	2	NMNH
Olympia	T	1927	Couch, LK	1	NMNH
Tumwater	T	1923	Couch, LK, Cantwell, GG	1	NMNH
Olympia Airport	T	1954	Johnson, ML	2	PSM
Olympia Airport, 0.6 mi S of Entrance, T17N R02W S11	T	1966	Taylor, RH	5	PSM
N end of Olympia Airport ;	T	1975	Moore ,TJ	3	UWBM
Tumwater; N end of Olympia Airport; T 17N, R 2W, Sec 11	T	1993	Steinberg, EK	8	UWBM
Bush Prairie, 3 mi S Olympia	T	1940	Dalquest, WW	23	MVZ
Bush Prairie, 3 mi S Olympia	T	1940	Scheffer, VB	26	NMNH
Bush Prairie, 3 mi S Olympia	T	1940	Dalquest, WW	2	KU
Olympia, 4 mi S	T	1918	Cantwell, GG	6	NMNH
Olympia, 4 mi South	T	1922	Couch, LK	1	NMNH
Olympia, 4 mi S	T	1940	Dalquest, WW	1	NMNH
Olympia, 6 mi S	T	1930	Couch, LK	2	NMNH
Olympia, Couch garden	T	1930	Couch, LK	1	NMNH
Olympia, Chambers Lake	T	1927	Couch, LK	1	NMNH
Masonic Cemetery (Tumwater, E of Deschutes River)	T	1953	Couch, LK	2	PSM
Jctn of Spurgeon Crk Rd and Yelm Hwy[d]	T	1966	Taylor, RH	3	PSM
Lacey, 0.6 mi NE[d]	T	1967	Taylor, RH	4	PSM
Lacy, 5 mi SE[d]	T	1954	Johnson, ML	1	PSM
Meridian DNR Tree Farm; T 17N, R 1W, Sec 43[d]	T	1993	Steinberg, EK	13	UWBM
T. m. tumuli					
Rocky Prairie, 5 mi N Tenino	T	1941–42	Dalquest, WW	3	MVZ
Tenino, 5 mi N	T	1941–42	Dalquest, WW	32	NMNH
Tenino, 5 mi N of	T	1942	Dalquest, WW	1	KU
T. m. yelmensis					
Tenino	T	1891	Streator, CP	3	NMNH
Tenino, Yelm Prairie[e]	T	1918	Cantwell, GG	2	UCLA
Tenino	T	1924	Couch, LK	1	NMNH
Tenino	T	1938	Dalquest, WW	12	MVZ
Tenino	T	1939	Dalquest, WW	2	KU
Tenino	T	1939	Dalquest, WW	4	UWBM
Tenino, 2 mi SW	T	1941	Scheffer, VB	20	NMNH
Grand Mound, near railroad	T	1954	Johnson, ML	3	PSM
Mound Prairie, near Tenino	T	1938–39	Dalquest, WW	8	MVZ
Mound Prairie, 1 mi S Tenino	T	1941	Dalquest, WW	11	MVZ
Mound Prairie, 2 mi SW Tenino	T	1941	Dalquest, WW	11	MVZ
Rainier	T	1941	Cheney, PW, Anderson, OI	4	PSM
Rochester	T	1918	Cantwell, GG	5	NMNH
Rochester, 3 Mi E	T	1929	Couch, LK	2	NMNH
Rochester Prairie, 2 mi N Rochester	T	1941	Dalquest, WW	2	MVZ
Rochester Prairie, 2 mi N Rochester	T	1942	Dalquest, WW	1	MVZ
Rochester, 2 mi N	T	1941–42	Dalquest, WW	43	NMNH
Rochester, 2.5 mi SE	T	1954	Johnson, ML	1	PSM

Subspecies/ Collection locality	County[a]	Year	Collector	Tally[b]	Institution[c]
Rochester, 2.6 mi SE;	T	1976	Moore, TJ	3	UWBM
Rochester, 3 mi NE	T	1954	Johnson, ML	1	PSM
Rock Prairie; Colvin Property: N of residence; T 16N, R 2W, Sec 38	T	1997	Steinberg EK	6	UWBM
Scatter Creek Wildlife Area; S parcel; T 16N, R 3W, Sec 36 S1/2	T	1997	Steinberg EK	4	UWBM
Lewis Co. line, 0.3 mi N on Old Hwy 99	T	1962	Dix, RE	1	PSM
Dix Farm, N Fords Prairie, nr county line	T	1965	Johnson, ML	2	PSM
Vail, 1 mi S	T	1941	Dalquest, WW	3	NMNH
Vail, 1 mi W	T	1941	Dalquest, WW	28	NMNH
Vaile Prairie, 1 mi W Vail	T	1941	Dalquest, WW	3	MVZ
Vail, 1 mi E	T	1966	Taylor, RH	3	PSM
Johnson Prairie; T 17N, R 1E, Sec 30 SW1/4	T	1997	Steinberg, EK	11	UWBM
Weir Prairie East; T 17N, R 1E, Sec 32 NE1/4	T	1997	Steinberg , EK	2	UWBM
T. m. glacialis					
2 mi S Roy, [Roy Prairie]	P	1941	Dalquest, WW	6	MVZ
Roy-Prairie, 0.5 mi S	P	1954	Johnson, ML	4	PSM
Roy; W Hwy 507, Bastian DLC	P	1988	Johnson, M.L	9	UWBM
Morrow Ranch, 2 mi S Roy	P	1956	Benson, SB	3	MVZ
Roy	P	1914–16	Scheffer, TH	31	NMNH
Roy	P	1962	Johnson, ML	4	PSM
Roy, 0.6 mi S, T17N R02E S38	P	1966	Taylor, RH	12	PSM
Roy, 1 mi S	P	1941	Dalquest, WW	12	NMNH
Roy, 2 mi S	P	1941	Dalquest, WW	31	NMNH
Roy, 2 mi S	P	1941	Dalquest, WW	1	KU
Roy; T 17N, R 2E, Sec 3	P	1975	Thaeler & Moore	8	UWBM
Roy; T 17N, R 2E, Sec 3 NW1/4 of NW1/4	P	1993	Steinberg, EK	2	UWBM
Marion Prairie, Fort Lewis; T 17N, R 1E, Sec 1	P	1992	Strauch, BR	7	UWBM
Marion Prairie, Fort Lewis; T 17N, R 2E, Sec 7	P	1993	Steinberg, EK	9	UWBM
T. m. couchi					
Shelton	M	1922	Couch, LK, Cantwell, GG	1	NMNH
Shelton	M	1924	Couch, LK	5	NMNH
Shelton	M	1929	Couch, LK	3	NMNH
Shelton	M	1940	Dalquest, WW	2	UWBM
Shelton, N of	M	1952	Couch, LK	2	PSM
Shelton, NNE of	M	1953	Couch, LK	4	PSM
Scott's Prairie, 4 mi N Shelton	M	1922	Couch, LK	1	NMNH
Scott's Prairie, 4 mi N Shelton	M	1938–41	Dalquest, WW	18	MVZ
Scott's Prairie, 4 mi N Shelton	M	1938	Dalquest, WW	2	KU
Scott's Prairie, 4 mi N Shelton	M	1940–41	Scheffer, VB	18	NMNH
Shelton; N side of Shelton Airport	M	1976	Moore ,TJ	5	UWBM
Shelton; Shelton Airport; T 20N, R 4W, Sec 11 SW 1/4	M	1993	Steinberg, EK	4	UWBM
2 mi N Shelton HWY 101, Shelton Airport	M	1993	DeWalt, TS	4	LSUMZ
Shelton; Sanderson Field	M	1997	Farrel, K	4	UWBM
Shelton Airport; T 20N, R 4W, Sec 11 SW1/4	M	1997	Steinberg, EK	8	UWBM
Lost Lake Prairie	M	1941	Dalquest, WW	7	MVZ
Matlock	M	1962	Helm, H	1	CMZ
T. m. tacomensis					
Steilacoom	P	1854–56	Suckley, G	4	NMNH
Steilacoom	P	1857-61	Kennerly, CB	2	NMNH
Steilacoom	P	1903	Hollister, N	2	NMNH
Fort Steilacoom	P		Coll. unknown	1	NMNH

Subspecies/ Collection locality	County[a]	Year	Collector	Tally[b]	Institution[c]
Spanaway	P	1914	Scheffer, TH	6	NMNH
Tacoma, 6 mi S	P	1918	Cantwell, GG	8	NMNH
5 mi SW Tacoma	P	1940–41	Dalquest, WW	12	MVZ
Chambers Cr, above, opposite new Tacoma Cemetery	P	1941	Cheney, PW	10	PSM
Tacoma, 5 mi SW	P	1940	Dalquest, WW	2	KU
Tacoma, 5 mi SW;	P	1940	Booth, ES	1	UWBM
Tacoma, 5 mi SW;	P	1940	Dalquest, WW	1	UWBM
Tacoma	P	1940	Scheffer, VB	9	NMNH
Tacoma, 0.5 mi E Of The Narrows	P	1940	Scheffer, VB	5	NMNH
Tacoma, 1 mi S Of Day Island Bridge	P	1940	Scheffer, VB	3	NMNH
Day Island Road, near Sunset Drive	P	1941	Anderson, OI, Cheney, PW	1	PSM
Tacoma, Point Defiance Park, 1 mi S	P	1940–41	Cheney, PW	2	PSM
Tacoma, University Place	P	1941	Scheffer, VB	3	NMNH
Tacoma, 5 mi SW	P	1941	Dalquest, WW	6	NMNH
Tacoma, Lower Chambers Creek	P	1946	Cheney, PW	1	PSM
Tacoma	P	1946–47	Johnson, ML & Cheney, PW	115	PSM
Fircrest	P	1947	Johnson, ML & Cheney, PW	2	PSM
Tacoma	P	1947	unknown	1	UMMZ
Tacoma	P	1949	Goodge, W	1	UWBM
Tacoma	P	1950	Johnson, ML	5	PSM
Chambers Creek	P	1961–62	Johnson, ML	2	PSM
Lake Louise, Tacoma	P	1962	Edwards, O	1	CMZ
T. m. melanops					
Olympic Mountains, Soleduc River	C	1897	Bailey, V	4	NMNH
Soleduck River, Head; Timberline, Olympic Mtns.	C	1897	Bailey, V	1	NMNH
Happy Lake	C	1898	Elliot, DG	5	FMNH
Happy Lake Ridge	C	1921	Taylor, WP	1	NMNH
Happy Lake Ridge	C	1974	Johnson, ML, Johnson, S & Johnson, L	2	UWBM
Happy Lake Ridge	C	2004	Welch, CK	1	UWBM
Happy Lake Ridge Trail	C	2005	Welch, CK	6	UWBM
Canyon Cr. Divide, 5000 ft.	C	1921	Shaw, WT	1	CMZ
Canyon Creek Divide, Bogachiel River, 4500 ft	C	1921	Shaw, WT	2	CMZ
Cat Creek, 4500 ft	C	1921	Shaw, WT	2	CMZ
Cat Creek, Head Waters	C	1921	Cantwell, GG	3	NMNH
Cat Creek, Head Waters	C	1921	Cantwell, GG, Shaw, WT	1	NMNH
Bogachiel Peak	C	1931	Boles and Hibben	4	CMNH
Oyster Lake	C	1953	Johnson, ML	2	PSM
Oyster Lake	C	1953	Johnson, ML & Cheney, PW	3	PSM
Appleton Pass	C	2005	Welch, CK	5	UWBM
Aurora Peak	C	2005	Welch, CK	4	UWBM
Aurora Ridge	C	1976	Johnson, ML	1	PSM
Aurora Ridge	C	1976	Moore, Johnson, & Jeffries	2	UWBM
Boulder Lake	C	1898	Elliot, DG	4	FMNH
Boulder Lake	C	1975	Moore, TJ	4	UWBM
Boulder Lake	C	1975	Johnson, ML	1	UWBM
Boulder Lake	C	2005	Welch, CK	7	UWBM

Subspecies/ Collection locality		County[a]	Year	Collector	Tally[b]	Institution[c]
	Olympic National Park	C	1974	Johnson, ML	1	PSM
	Sourdough Mtn.	C	2006	Welch, CK	3	UWBM
T. m. louiei						
	Cathlamet, 12 mi NNE, Crown-Zellerbach's Cathlamet Tree Farm	W	1949	Moore, HW	9	NMNH
	Cathlamet, N, T10N, R5W, S8,9	W	1956	Johnson, ML	11	PSM

[a]County abbreviations: T = Thurston; P = Pierce; M = Mason; C = Clallam; W = Wahkiakum; Ck = Clark.

[b]Tally is the number of specimens collected at location and year.

[c]Museum abbreviations (in alphabetical order): BM = British Museum; CMNH = Cleveland Museum of Natural History; CMZ = Charles R. Conner Museum of Zoology, Washington State University, Pullman; FMNH = Field Museum of Natural History, Chicago; KU = Natural History Museum, University of Kansas, Lawrence; LSUMZ = Louisiana State University Museum of Natural Science; MVZ = Museum of Vertebrate Zoology, University of California, Berkeley; NMNH = National Museum of Natural History, Smithsonian Institution, Washington, DC; PSM = Slater Museum of Natural History, University of Puget Sound, Tacoma; ROM = Royal Ontario Museum; UCLA = University of California Los Angeles, Dickey Collection; UMMZ = University of Michigan Museum of Zoology; UWBM = Burke Museum of Natural History and Culture, University of Washington, Seattle;

[d]These localities are outside the range of any of the original described subspecies.

[e]Dalquest and Scheffer (1944) interpreted this location as Tenino, and indicated that they had not found gopher on Yelm Prairie.

Appendix. F. Summary of population status, site ownership, habitat, and site management for populations of Mazama pocket gophers in five counties in Washington.

County/Population[a]/Sites	Size (ac)[b]	Ownership	Gopher status, numbers, and distribution[c]	Habitat	Site management
Thurston County					
1. Bush Prairie/Tumwater (*T. m. pugetensis*)					
• Olympia Airport	484	Port of Olympia	A; largest known population (low 1000s?) of *T. m. 'yelmensis'*	Non-native grassland; Nisqually soil	Mowed; airport & light industry; mostly in Tumwater UGA
• Airport vicinity, S to Salmon Creek	-	Private	A; significant numbers scattered throughout area	Fragmented, non-native grassland; mostly Indianola and Cagey soils	Residential, commercial, light industrial
• W of Interstate 5; misc. sites from Kirsop Rd and Littlerock Rd, SW to Salmon Cr	-	Private, Tumwater School Dist.	P; gophers thinly scattered on open habitats	Non-native grassland; Nisqually and Cagey soils	Residential, commercial, agriculture
• Webster Tree Nursery	300	WDNR	P; occasional gophers	Non-native grassland; Cagey soil	Mowed; native plant seed and plug production
2. Rocky Prairie (*T.m. tumuli*)					
• Rocky Prairie Natural Area Preserve	35	WDNR	P/U; occasionally reported present	Native prairie	Conservation
• Along Old Hwy 99, S to Offutt Lake Rd	-	Private	P/U; significant numbers on mounded prairie in about 1990, little current data	Non-native pasture, mounded grassland	Rural residential, pasture
• Wolf Haven International	38	Private	P; small reintroduced population	Mounded prairie	Conservation
• West Rocky Prairie Wildlife Area	270	WDFW	P; reintroduced population	Native and non-native mounded prairie	Wildlife management area
• West Rocky Prairie	-	Private	U; unknown		Proposed gravel mine
3. Mound Prairie West (*T.m yelmensis*)					
• Scatter Creek Wildlife Area	559	WDFW	C; substantial numbers on both N and S units;	Degraded prairie	Wildlife management area; Scotch broom control, recreational uses
• Mound Prairie west of Interstate 5, S to Prather Rd and Hwy 99	-	Private	P; scattered in pastures, open habitats	Pasture, mowed lawns, and vacant lots, some overgrown with Scotch broom	Residential, pasture; mostly zoned 1 residence/5 ac
• Baker Prairie	-	Private	P; scattered in pastures, open habitats	Pasture, mowed lawns, and vacant lots, some overgrown	Rural residential, pasture; significant portion zoned for

County/Population[a]/Sites	Size (ac)[b]	Ownership	Gopher status, numbers, and distribution[c]	Habitat	Site management
				with Scotch broom	higher density
4. Mound/Rock Prairies (*T.m yelmensis*)					
• Mound Prairie east of Interstate 5	-	Private	P; scattered in pastures, open habitats	Pasture, mowed lawns, and vacant lots, some overgrown with Scotch broom	Residential, pasture; mostly zoned 1 residence/5 ac, with some high density developments
• Rock Prairie, SW Tenino	-	Private	P; scattered in pastures, open habitats	Pasture, mounded prairie	Private ranches, rural residential, gravel mine
• Frost Prairie, 1 mi S Tenino	-	Private	U; no recent records	Agricultural fields, pastures; about 250 ac of Nisqually soil	Rural residential, pasture; zoned 1 residence/5 ac
5. Tenalquot Prairie (*T.m yelmensis*)					
• Weir Prairie (TA 21, 23) (Upper, Lower, and South Weir Prairies)	1,193	U.S. Dept. of Defense	C; significant numbers present	Grassland; percent native vegetation varies from moderate to high	Military training area
• Johnson Prairie (TA 22)	221	U.S. Dept. of Defense	C; significant numbers present	Grassland; percent native vegetation varies from moderate to high	Military training area
• Tenalquot Prairie Preserve	94	The Nature Conservancy	P; small numbers present	Prairie	Conservation; habitat restoration underway
• Miscellaneous private	-	Private	P; distribution poorly known	Grazed pasture	Cattle ranch, pasture, rural residential zoned 1 residence/5 ac; part is in Rainier UGA
• Ruth Prairie	-	Private	P; a few records	-	Rural residential, zoned 1 residence/ 5 ac
Miscellaneous Sites, Thurston County					
Chambers Prairie[d]					
• Ward Lake to College St	-	Private	P; scattered aggregations	Vacant lots, roadsides, turfgrass	Mostly, high density residential
• E of Smith Lake to Pattison Lake, S to railroad tracks	-	Private	X?; no records	Nisqually soil	High density residential
• Open habitats along Yelm Hwy from Rainier Rd to Lake St. Clair and Johnson Rd	-	Private	P; scattered aggregations	Open habitats; large area of Nisqually soil	Zoned 1 residence/5 ac
• Meridian Tree Farm	100	WDNR	C/P; small population (22 trapped in 1997)	Non-native grass, widely spaced rows of conifers; Nisqually soil	Mowed; conifer seed production
Little Chambers and Hawks Prairies[d]					

County/Population[a]/Sites	Size (ac) [b]	Ownership	Gopher status, numbers, and distribution[c]	Habitat	Site management
• St. Martin's University	-	Private	P; small numbers in 2006	Vacant land near athletic fields	
• Chambers Lake	-	Private	X; no recent records	Forest/residential (exact location not known)	(exact location not known)
• Mushroom Corner (Steilacoom Rd, S to Union Mill Rd SE)	26+	City of Lacey (26 ac) Private	P; scattered on grassland	Non-native grasses, Scotch broom, tall grass	Planned expansion of regional athletic center; residential, church grounds
Smith Prairie	-	Private	P; small numbers (WDFW 2006)	Mowed turfgrass	Rural residential (1/5 zoning); agriculture; airstrip
Yelm Prairie (along SR 510 from N of Yelm to 2-3 mi S of Yelm)[e]	-	Private	P; modest numbers scattered in N portion, no records in S portion	Open habitats; very stony soils on S portion	Semi-rural and suburban residential, pasture
Pierce County[f]					
6. 91[st] Division & Marion Prairies (*T. m. glacialis*)					
• Artillery Impact Area	6,960	U.S. Dept. of Defense	P; scattered, discontinuous population with higher numbers on Nisqually soil	Grassland; percent native vegetation varies with location; mostly Spanaway soil, but SE part has Nisqually soil	Military training area receiving moderate to high use
• Training Area 6 (Ranges 74, 76)	875	U.S. Dept. of Defense	P; scattered	Grassland; percent native vegetation varies with location; mostly Spanaway soil	Military training area receiving moderate to high use
• Training Area 18	208	U.S. Dept. of Defense	A; present in significant numbers	Nisqually soil	Military training area
• South Impact Area (Ranges 88, 89, 90, 91, 92, 93)	410	U.S. Dept. of Defense	A; present in significant numbers	Grassland; percent native vegetation varies from moderate to high; Nisqually soil	Military training area
• Roy Prairie, Roy, 0.5-2 mi S of Roy	-	Private	C; widely scattered in open habitats	Non-native grassland	Gravel mine, pasture, residential development
Mason County (*T. m. couchi*)					
7. Mason					
• Scotts Prairie (Shelton Airport	272	Port of Shelton	A; largest known population of *T. m. couchi*	Non-native grassland	Mowed; airport, light industry
• Washington Corrections Center, Shelton	300	WA Dept. of Corrections	P; small numbers present	Non-native grassland	Mowed; prison grounds
• W of airport near Dayton-Airport Rd, Eells Hill Rd	-	Private, public	P; significant numbers in	recent clearcuts, roadsides, rail line	Landfill, timberland, race track, Christmas tree farms
• McEwen, N Scotts Prairies	-	Private	P; a few on both sides Brockdale Rd	Roadsides, clearcuts	Commercial, timberland

County/Population[a]/Sites	Size (ac)[b]	Ownership	Gopher status, numbers, and distribution[c]	Habitat	Site management
			in 1992; along McEwen Prairie Rd (S32) (Farrell and Archer 1996); live-trapped off Brockdale Rd, N of Johns Creek (WDFW 2011)		
• Johns Prairie	-	Private	X?; a few mounds in Scotch broom (WDFW data, 1992; Steinberg 1996a); none observed in recent years (G. Schirato, 2004)	Degraded; Scotch broom, weeds	Industrial park
• California Rd, 1.5 mi NW of Brockdale	-	Private	P; live-trapped (WDFW 2011)	'Conversion cut'	Commercial timberland/rural residential
• 1.6 mi N of airport, E of U.S. 101	-	Private	P; live-trapped (WDFW 2011)	power line right-of-way	Brush control
• 1.1 mi W of Dayton	-	Private	P; live-trapped (WDFW 2011)	railroad right-of-way	Brush control
Miscellaneous Sites, Mason County					
• Lost Prairie	-	Private	P?; (Dalquest, field notes; Dalquest & Scheffer 1944); none found by Steinberg (1996a);	Agriculture	Agriculture, rural residential
• Matlock	-	Private	U; collected in 1962;	Clearcut	Commercial timberland
Clallam County (*T. m. melanops*)					
• Aurora Ridge, Aurora Peak	-	Olympic National Park	P; recorded by M. Johnson (1977), C. Welch (UWBM2005), J. Fleckenstein, (pers. comm. 2012)	Subalpine meadows	Conservation, recreation; subject to foot traffic
• Vicinity of Boulder Lake	-	Olympic National Park	P; recorded by Svihla and Svihla (1933), Steinberg (1995, 1996b), C. Welch (pers.comm. 2005)	Subalpine meadows	Conservation, recreation; subject to foot traffic
• Happy Lake, Happy Lake Ridge	-	Olympic National Park	P; recorded by Scheffer (1949, 1995), M. Johnson (1974), Steinberg (1995,1996b), C. Welch (2004, 2005); J. Fleckenstein, (pers. comm. 2012)	Subalpine meadows	Conservation, recreation; subject to foot traffic
• Oyster Lake, Appleton Pass	-	Olympic National Park	P; recorded in 1950s, 1970s (Johnson 1977); gopher activity on plateaus along ridge E of Oyster Lake; Steinberg (1996b), C. Welch (pers.comm. 2005), J. Fleckenstein (pers. comm. 2012)	Subalpine meadows	Conservation, recreation; subject to foot traffic
• Sourdough Mountain	-	Olympic National Park	P; recorded by C. Welch (UWBM2006)	Subalpine meadows	Conservation, recreation; subject to foot traffic

County/Population[a]/Sites	Size (ac) [b]	Ownership	Gopher status, numbers, and distribution[c]	Habitat	Site management
• Cat Creek at 4500 ft elev, High Divide	-	Olympic National Park	X?; none found 1951, 1976 (Johnson 1977)	Subalpine meadows	Conservation, recreation; subject to foot traffic
• "Head of Soleduck River" at timberline (M. Johnson interpreted this as Soleduck Park), Bogachiel Peak	-	Olympic National Park	X?; none found 1951, 1976 (Johnson 1977)	Subalpine meadows	Conservation, recreation; subject to foot traffic
• Canyon Creek divide at head of Bogacheil River (probably E of Deer Lake)	-	Olympic National Park	X?; none found 1951, 1976 (Johnson 1977)	Subalpine meadows	Conservation, recreation; subject to foot traffic
Wahkiakum County (*T. m. louiei*)					
• Huckleberry Ridge, Cathlamet Tree Farm		Private	X? None detected in 1977, 1986, 1995, 2012	Forest, and regenerating clearcuts	Commercial timberland

[a] Population number refers to the seven populations identified for recovery (Fig. 18).
[b] Size = area of grassland in acres.
[c] Recent status: A = abundant; C = common; P = present; U = unknown; X = presumed extinct. More small populations probably exist, particularly on unsurveyed private lands in Thurston and Mason counties.
[d] The subspecific designation for populations in and south of Lacey is uncertain; some museum specimens are labeled *pugetensis*, some *yelmensis*.
[e] The subspecific designation for populations on Yelm Prairie is uncertain; Dalquest and Scheffer (1944) stated that "as far as could be ascertained, no gophers exist there".
[f]For historical *T. m. tacomensis* localities, see Appendix E.

Washington State Status Reports and Recovery Plans

Status Reports

2007	Bald Eagle	√
2005	Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot	√
2005	Aleutian Canada Goose	√
2004	Killer Whale	√
2002	Peregrine Falcon	√
2000	Common Loon	√
1999	Northern Leopard Frog	√
1999	Olympic Mudminnow	√
1999	Mardon Skipper	√
1999	Lynx Update	
1998	Fisher	√
1998	Margined Sculpin	√
1998	Pygmy Whitefish	√
1998	Sharp-tailed Grouse	√
1998	Sage-grouse	√
1997	Aleutian Canada Goose	√
1997	Gray Whale	√
1997	Olive Ridley Sea Turtle	√
1997	Oregon Spotted Frog	√
1993	Larch Mountain Salamander	
1993	Lynx	
1993	Marbled Murrelet	
1993	Oregon Silverspot Butterfly	
1993	Pygmy Rabbit	
1993	Steller Sea Lion	
1993	Western Gray Squirrel	
1993	Western Pond Turtle	

Recovery Plans

2012	Sharp-tailed Grouse	√
2011	Wolf	√
2007	Western Gray Squirrel	√
2006	Fisher	√
2004	Sea Otter	√
2004	Greater Sage-Grouse	√
2003	Pygmy Rabbit: Addendum	√
2002	Sandhill Crane	√
2001	Pygmy Rabbit: Addendum	√
2001	Lynx	√
1999	Western Pond Turtle	√
1996	Ferruginous Hawk	√
1995	Pygmy Rabbit	√
1995	Upland Sandpiper	
1995	Snowy Plover	

√ These reports are available in pdf format on the Department of Fish and Wildlife's web site: http://wdfw.wa.gov/wlm/diversty/soc/concern.htm.
To request a printed copy of reports, send an e-mail to wildthing@dfw.wa.gov or call 360-902-2515.