STATE OF WASHINGTON Mazama Pocket Gopher Recovery Plan and Periodic Status Review

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Washington Department of FISH AND WILDLIFE Wildlife Program

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 220-610-110, 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.

The Mazama pocket gopher (*Thomomys mazama*) was listed as threatened by Washington Department of Fish and Wildlife in March 2006. The four subspecies found in Thurston and Pierce counties were listed as threatened under the federal Endangered Species Act in 2014. This is the Washington State Recovery Plan and periodic status review for the Mazama Pocket Gopher. This is an update of the 2013 draft recovery plan that was not finalized while genetic analysis was completed, population modeling was done, and our understanding of recovery needs progressed. It updates information on the current distribution and abundance of the species in Washington and describes factors affecting populations and habitat, and prescribes strategies to recover the species, such as protecting populations and habitat and research and monitoring needed to aid in recovery actions. It also identifies population objectives for populations needed for reclassification of the species.

As part of the State's listing and recovery procedures, the update of the draft recovery plan and status review was available for 90-day public comment period. Responses to public comments on both the 2019 and 2013 drafts are included in Appendix E and F. Comments received were considered in preparation of the final recovery plan. The Department presented a summary of the recovery plan and periodic status review to the Fish and Wildlife Commission at the July 31, 2020 meeting, and the Commission voted to maintain the species status of Threatened on 21 August.

For additional information about Mazama Pocket Gophers or other state-listed species, check our website, or contact us at wildthing@dfw.wa.gov, or by mail to:

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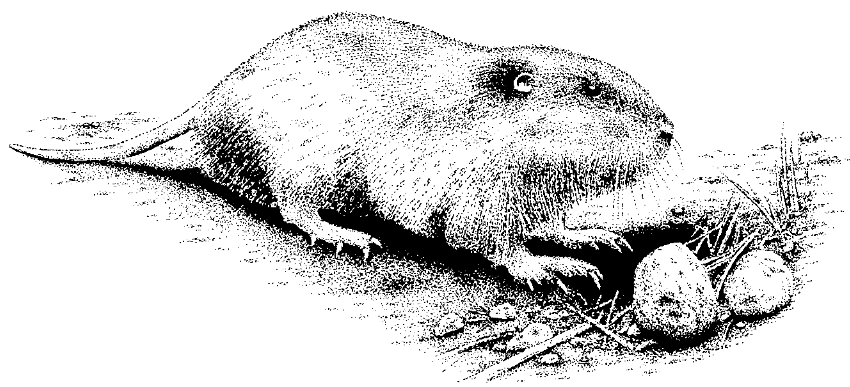

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ACKNOWLEDGEMENTS

The draft recovery plan was improved by comments from Jim Patton, Jim Kenagy, and Gail Olson during peer review. Hannah Anderson, Todd Zuchowski, Kelly McAllister, Tammy Schmidt, Harriet Allen, Gary Wiles, Eric Gardner, Greg Schirato, Bruce Thompson, Scott Pearson, Michelle Tirhi, Jeff Skriletz, Nate Pamplin, Theresa Nation, Karen Reagan, Kim Flotlin, Penny Becker, Kevin White, and Jeff Azzerad also provided comments. John Fleckenstein commented on the draft and provided observations from Olympic National Park. Development of the plan benefitted through discussions with Gail Olson, Jim Patton, Jim Kenagy, Karen Reagan, Kim Flotlin, and Ryan McReynolds. Gretchen Blatz provided plot survey data. Gary Shugart provided data from some specimen labels and access to specimens at Slater Museum, University of Puget Sound for photography. Cover page illustration was rendered by Darrell Pruett.

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, serving as prey for many predators, and providing burrows that are used by a wide variety of other species. Mazama Pocket Gophers were formerly more widespread on south Puget Sound prairies, but their distribution has diminished due to habitat loss and degradation. Protecting or restoring prairie sites for gophers will also help conserve other prairie associated species. The species was state-listed as threatened by the Washington Fish and Wildlife Commission in 2006.

This document is the state recovery plan and first periodic status review for the Mazama Pocket Gopher; it is intended to provide a status update and guide conservation and recovery efforts. It identifies a recovery goal, specifies population targets for reclassification, and outlines recovery strategies and tasks. It also provides an update on the species' status since the 2005 status report and the 2013 draft recovery plan, based on recent research and monitoring information relevant to Mazama Pocket Gophers in Washington.

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 2014, the USFWS added four of these subspecies (*T. m. pugetensis, tumuli, yelmensis*, and *glacialis*) to the federal list of Threatened species and designated critical habitat. The USFWS also promulgated a special 4(d) rule that exempts 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 (USFWS 2014a,b).

The Mazama Pocket Gopher is primarily found in areas with well-drained glacial outwash soils and herbaceous vegetation, many of which were historically prairies and savannahs. The species also occasionally inhabits areas with loamy sand or gravelly soils when the tree cover is removed and herbaceous vegetation is established. WDFW conducted extensive Mazama Pocket Gopher surveys in 2012 that included nearly 1,000 survey plots in Thurston, Mason, Pierce, Lewis, Grays Harbor, Wahkiakum, and Clark counties. Between 2014 and 2017, the U. S. Fish and Wildlife Service surveyed over 1,200 sites in response to development permit applications to Thurston County or cities. The results of the surveys generally confirmed previous descriptions of the distribution of Mazama Pocket Gophers in Washington and refined our understanding of gopher occupancy in various soil types.

Much of the historical gopher habitat of south Puget Sound with appropriate soils and vegetation has been degraded by Scotch Broom (*Cytisus scoparius*), fragmented, or converted to impervious surfaces. Habitat loss to forest 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 7.5 million to 9.2 million 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 representative populations of all the distinct genetic groups of the Mazama Pocket Gophers within the current Washington range. Seven areas that have substantial portions of the remaining habitat and contain populations of Mazama Pocket Gophers in Thurston, Pierce, and Mason counties are identified for recovery emphasis.

Conservation of the populations in 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. Some portions of the range that are densely developed but still host small numbers of gophers in scattered remnants of open habitat (e.g. road margins, etc.), were not identified for recovery emphasis because the potential for long-term persistence is assumed to be low.

Recommendation and recovery objectives. The Mazama Pocket Gopher should remain listed as threatened, but should be considered for downlisting to Sensitive status when the following objectives have been met:

1) Two reserves or reserve complexes are established in each of the Bush Prairie, Mound-Frost Prairie, and 91st Division Prairie recovery areas, and one reserve each in Rocky Prairie, Tenalquot-Yelm Prairie, Chambers Prairie, and Scotts Prairie recovery areas; and

2) Each of the reserves/reserve complexes in at least five of seven reserve areas, supports a population of ≥1,000 Mazama Pocket Gophers.

Conservation activities will focus on protecting and maintaining habitat, and maintaining or restoring habitat connectivity in reserve complexes. Much of the occupied gopher habitat in the south Puget Sound region 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.

Recovery objectives may be revised if the best available science indicates changes are needed. The species' population and listing status will be reviewed every five years as recovery progresses.

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 or degraded. Today, six Mazama Pocket Gopher subspecies remain in Washington, while two subspecies, *T. m. louiei* and *T. m. tacomensis*, are believed to be extinct.

This document is a draft periodic status review and state recovery plan for the Mazama Pocket Gopher. A recovery plan is prepared for state endangered and threatened species (WAC 220-610-110, Appendix A). The first part of this plan is a background section that reviews the biology of the pocket gopher, the current status of populations and habitat in Washington, and the 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 recovery objectives and tasks may be revised as new information becomes available from ongoing and future research, monitoring, and genetic analyses.

Figure 1. Mazama Pocket Gopher (*photo by Rod Gilbert*).

LEGAL STATUS

State. The Mazama Pocket Gopher is listed as a state Threatened species (WAC 220-200-100). It was listed by the Washington Fish and Wildlife Commission in 2006, following a state status review (Stinson 2005). 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, Pierce, and Mason counties and several incorporated cities. 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.

Federal. After evaluating the status of the eight subspecies in Washington (Table 1), the USFWS listed the four subspecies of Mazama Pocket Gopher found in Thurston and Pierce counties (*T. m. pugetensis, tumuli, yelmensis*, and *glacialis*) as threatened under the Endangered Species Act, and designated critical habitat (USFWS 2014a, b). The listing also removed four subspecies (*T. m. couchi, melanops, louiei,* and *tacomensis*) from the list of federal Candidate species.

Concurrent with the listing rule, USFWS also promulgated a special rule under 4(d) of the ESA. Under this special rule, take of these subspecies incidental to certain 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 include existing maintenance activities at airports and farms, livestock grazing, agricultural activities, and certain activities on single-family residential properties (USFWS 2014a).

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 *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 2013). It has not been officially recognized as a form of *T. mazama*, so is not listed at the state or federal level.

Table 1. Federal and state legal status and locations of eight subspecies of Mazama Pocket Gopher, and the Brush Prairie Pocket Gopher (*T. talpoides douglasii*) in western Washington.

Subspecies	**Federal status**	**State status**	**Range (counties)**
T. m. yelmensis (Yelm Pocket Gopher)	Threatened	Threatened	Thurston
T. m. glacialis (Roy Prairie Pocket Gopher)	Threatened	Threatened	Pierce
T. m. pugetensis (Olympia Pocket Gopher)	Threatened	Threatened	Thurston
T. m. tumuli (Tenino Pocket Gopher)	Threatened	Threatened	Thurston
T. m. tacomensis (Tacoma Pocket Gopher)[a]	none	Threatened[a]	Pierce
T. m. couchi (Shelton Pocket Gopher)	none	Threatened	Mason
T. m. melanops (Olympic Pocket Gopher)	none	Threatened	Clallam
T. m. louiei (Cathlamet Pocket Gopher)[a]	none	Threatened[a]	Wahkiakum
T. talpoides douglasii (Brush Prairie Pocket Gopher)[b]	none	none[b]	Clark

[a]These subspecies appear to be extinct.
[b]No certain gopher records in Clark County since 1997; status of this population is uncertain.

DESCRIPTION

Mazama Pocket Gophers (also called ‘Western’ Pocket Gopher) 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 (e.g. pocket gophers) and Heteromyidae (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 (*see* Fig. 15). Moles generally push soil up from vertical shafts creating circular dome-shaped or volcano-like mounds. Pocket

Figure 2. Mazama Pocket Gopher (left) showing characteristic incisors, front claws, and cheek pouches. In contrast, the Coast Mole (*Scapanus orarius)* (right) has side-oriented front claws and a pointed snout.

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.

TAXONOMY AND DISTRIBUTION

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 variability in color and morphology in pocket gophers, including *T. mazama* (Appendix B), 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* exhibited more melanism than the other Washington forms, and contains the only black specimens from Washington.

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

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 15 subspecies into *T. mazama*: 8 of which occured in Washington (*melanops, yelmensis, tacomensis, couchi, glacialis, pugetensis, tumuli*, and *louiei*); and 7 in Oregon and California, (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. 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, but she determined that the subspecies *T. m. glacialis*, *pugetensis*, and *yelmensis* exhibited no differences in this gene and believed that combining these taxa may better reflect an evolutionary unit.

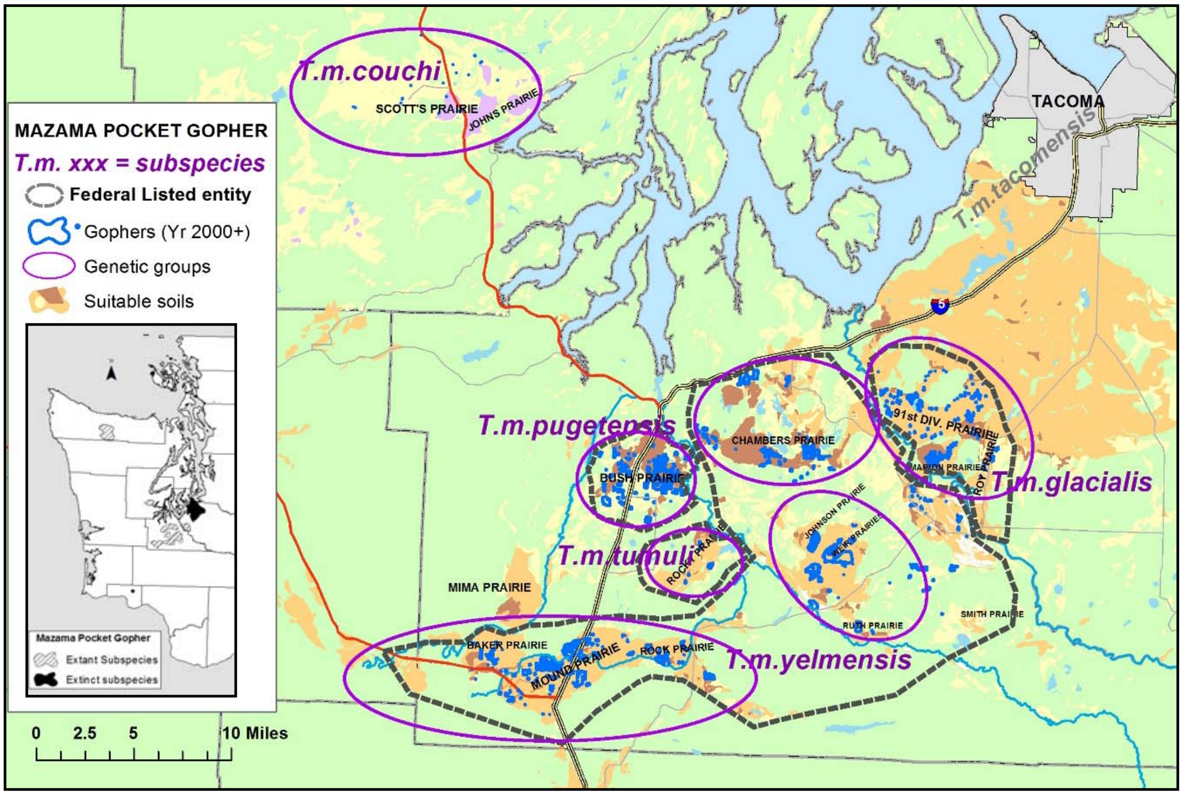

Figure 4. Distribution of 5 extant described subspecies of *T. mazama* in the south Puget Sound region (4 federally listed), one extinct subspecies (*T.m. tacomensis*), and seven differentiated genetic groups (Dalquest and Scheffer 1944, Warheit and Whitcomb 2016) (Inset: range of *T. mazama* in Washington).

More recently, however, WDFW completed a genomic analysis of nuclear DNA from 207 gophers collected in Thurston, Pierce, and Mason counties during 2013-2015 to help guide recovery planning (Warheit and Whitcomb 2016). This study concluded that, contrary to the mitochondrial analysis by Steinberg (1995, 1999), the genetic differentiation of Mazama Pocket Gophers in the south Puget Sound region is generally consistent with the existing subspecific taxonomy (Table 1; Verts and Carraway 2000, USFWS 2014a), but the existing described subspecies do not fully account for all the genetic differentiation that exists among these pocket gophers. The study revealed seven to nine genetic groupings (Fig. 4); in addition to the five named subspecies in the area (*couchi, pugetensis, tumuli, yelmensis, glacialis*), gophers from both Chambers and Tenalquot prairies were differentiated from all others. Gophers from two other locations also appeared to be differentiated, but sample sizes for these sites, Frost Prairie (n = 5) and Yelm Prairie (n = 2) were very small. Genetic groupings were generally separated by rivers, creeks, or by a lack of habitat corridors (Warheit and Whitcomb 2016). Additional collections, karyotyping to determine chromosome number, and analyses would likely be needed, however, before any evaluation to revise subspecific taxonomy would be warranted.

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 (*T. talpoides*) and Botta's Pocket Gopher (*T. bottae*), 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, pers. obs.), 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. Maser et al. (1981:173) observed Mazama Pocket Gophers foraging above ground in the evening on the surface close to their burrows. 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*.

Pocket gophers often 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 were 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 they 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).

There have only been a few observations of burrow construction. 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).

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). Activity is reduced in summer when the soil becomes hot and dry (Chase et al. 1982, Cox and Hunt 1992). Kuck (1969 *in* Bonar 1995) reported that several gophers (*T. talpoides*) monitored by radioactive wire implants remained inactive for long periods of time, including an adult male that was inactive for 13 days.

Mound-building activity of Mazama Pocket Gophers in western Washington also appears to be highly seasonal; as noted for *T. bottae* in California (Cox and Hunt 1992, Romanach et al. 2005a), increased activity is often noted after the first significant fall rains (D. Stinson, pers. obs.; K. McAllister, pers. comm.). Wight (1918) reported that Mazama Pocket Gophers in Oregon tunneled 4.8 times faster in soft, moist soil than in hard-baked soil. Romanach et al. (2005a) reported that *T. bottae* increased burrowing within 2 days of watering, indicating that the change in soil moisture enabled burrow maintenance; subsequent plant growth supported the continued higher level of gopher activity for >3 months, even after the soil dried out. 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. *T. bottae* did not expand their burrow systems when the soil was saturated, but the digging of surface-access tunnels was more directly related to accessing seasonally available foods than to soil moisture (Cox and Hunt 1992).

The amount of surface sign, however, may not provide a consistent indicator of activity in all seasons (Bonar 1995). Cox and Hunt (1992) noted that the appearance of fresh mounds is related primarily to digging main tunnels by *T. bottae* when too much soil is produced to redistribute underground. When short surface-access tunnels were excavated, the soil was more often deposited in unused tunnels or chambers, and surface mounds were not produced.

Pocket gophers are not known to hibernate, apparently remaining active in winter. 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).

Diet and Foraging

Pocket gophers are herbivores that excavate tunnels to feed on roots and above-ground plant parts. They cut plants near burrow openings and sometimes pull entire plants underground (Maser et al. 1981, Busch et al. 2000). 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).

Information available for plant species eaten or cached by Mazama Pocket Gophers in Washington and Oregon is shown in Table 2. 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. Dalquest (1948) included a photo of a food cache that was 2 liters in volume, composed mostly of quackgrass (*Agropyron repens*).

Table 2. 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[c]	*Cytisus scoparius*	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, may be emergency food only, or perhaps are essentially trash dumps (e.g. Scotch broom).

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 forbs were most abundant, perennial forbs were preferred over grasses, and grasses were preferred over annual forbs. Most grasses, especially Mountain Brome (*Bromus carinatus*), were eaten most frequently during the dormant season (November to May), but 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 when herbaceous plants are not available.

Forbs may provide nutrients important for gopher growth and reproduction. Hunt (1992) noted the similarity of gopher diets throughout the western United States when seasons are designated by plant growth stage. *Thomomys* spp. breed with the emergence of green-succulent vegetation, and whenever succulent forbs and grasses are available, they dominate diets, and roots, corms, woody plants, and persistent dry grasses supplement dormant-season diets (Hunt 1992). Rezsutek and Cameron (2011) reported that breeding females maintained the percentage of dicots in their diet, even when dicots were experimentally reduced; dicots generally contain higher concentrations of protein, soluable carbohydrates, Na, Mg, and Ca, and they speculated that females likely compensated by altering burrow structure and foraging to compensate. 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). Romanach et al. (2005b) showed that burrow system length and area of two *Geomys* species decreased with increasing vegetation biomass. 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. 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 (1,166 ft^2; range 73–143 m^2, 788–1,544 ft^2) and 97 m^2 for 4 females (1,048 ft^2; range 47–151 m^2, 508–1,631). 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. Gettinger (1984) reported a mean maximum burrow system area of 106.5 ± 32.2 m^2 (1,150 ± 348 ft^2) for *T. bottae*, but gophers spent 90% of their time in a portion (45%) of the maximum burrow system.

Pocket gophers tend to cluster or clump together to maintain contact with congeners for breeding. The persistent presence of neighbors may limit a gopher's ability to expand a territory in response to reduced food availability. 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 and Remmenga (1961) noted that the size and shape of territories are more consistent at high densities of *T. talpoides*; at low densities they tend to cluster and size and shape are more variable. In lower quality habitat, aggregations of gopher territories may shift around over time, presumably due to a depletion of preferred food resources (Klaas et al. 2000, J. Patton, pers. comm.).

Gopher territory size varies with food abundance to some extent (Keith et al. 1959, Marsh and Steele 1992, Resutek and Cameron 1998), but the energetic cost of burrowing and defending a burrow likely limits how much pocket gophers can increase territory size. Romanach et al. (2005b) 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; total burrow length decreased and the area of a polygon drawn around the burrow system decreased with increasing vegetative productivity. 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. Reichman et al. (1982) reported that burrow length, perimeter, and home range size were all greater, and burrow systems were more linear, for reproductive male *T. bottae* than for females, but that 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.

Movements, dispersal, and gene flow in pocket gophers. 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). Andersen and MacMahon (1981) also found that most adult *T. talpoides* only made small shifts (10–15 m) in their home range over the course of a year. Gophers seem to prefer underground to surface movement, though this may entail conflict with the occupant; 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.

Dispersal is the permanent movement of organisms from one place to another. Dispersal may be the result of an innate drive (Chase et al. 1982), or young may be driven out by the mother (Williams and Cameron 1984). 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. 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.

Most dispersing gophers are weaned young, seeking space for a new burrow system or for an abandoned one to occupy. Some subadults settle in or near the natal burrow system for a time, but others disperse further. 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. 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 area for a burrow system. 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. Andersen and MacMahon (1981) found that a few young *T. talpoides* made long distance (>100 m) movements. 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). But movements were typically not very far— 63% of gophers caught as juveniles and recaptured as adults had 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).

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 young gophers 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). 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 also no difference in the frequency of dispersal of males vs. females, but they did not report data on distances moved.

Dispersal and movements in T. mazama. Olson (2015) conducted a study of Mazama Pocket Gopher dispersal on Joint Base Lewis-McChord (JBLM) at Lower Weir Prairie. Five juvenile *T. mazama* for which parentage could be assigned using DNA, exhibited movements of 69, 88, 130, 227 and 250 m ($\bar{x}$ = 153 m) from their natal burrow (Olson 2015). Telemetry indicated the female with an initial movement of 250 m, subsequently moved 160 m, for a net distance of 300 m from the parental burrow. For 29 radio-collared juveniles, the longest single-day movement was 37 m, but trapping data detected a movement of 367 m by an adult female in a single day (Olson 2015).

The types and amount of unsuitable habitats that would create barriers to dispersal for Mazama Pocket Gophers are unknown. In the south Puget prairie landscape, inhospitable forest and soils likely inhibited dispersal of gophers, and the Nisqually, Deschutes, and Black rivers apparently have long inhibited contact between gopher populations, as suggested by genetic differences (Warheit and Whitcomb 2016). Although pocket gophers are able to swim (Criddle 1930 observed a *T. talpoides* swim 90 m across a river; *see also* Kennerly 1963, Best and Hart 1976, Hickman 1977a), it is unknown how often they do so.

More recently, highways and developed areas with much impervious surface may effectively isolate populations, but in forested locations, road right of ways may provide corridors of habitat between larger patches of habitat for gophers, as suggested by observations in Mason County (G. Schirato, pers. comm., J. Skriletz, pers. comm.). Huey (1941) provides an account of a highway facilitating movement of gophers through a desert environment. Olson (2015) noted that trapping, telemetry, and parentage assignment data suggested that even gravel and dirt roads at the study site were at least a partial barrier to movements. At Weir Prairie, only one animal was captured on both sides of a dirt road, and none were captured on both sides of the gravel road; animals that had burrows next to the roads were frequently detected moving along their edges. Radio-telemetry tracking never recorded locations on both sides of either these roads nor across the paved and dirt roads surrounding the study area. However, parentage assignment indicated that either one juvenile or its' parent must have crossed both a gravel road and a dirt road at some point prior to capture (Olson 2015). Dispersal patterns can vary within species (Stevens et al. 2010), and be influenced by landscape configuration and population dynamics (Andreassen and Ims 2001, Matthysen 2005), so it may not be appropriate to extrapolate results from Olson (2015) to smaller sites or other populations. The Lower Weir Prairie study site was fairly large and the habitat appeared fairly uniform. There appeared to be considerable turnover of individuals between the two years of this study, so vacant burrows may have been readily available, eliminating the necessity for longer dispersal movements.

Reproduction

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).

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). However, Reichman et al. (1982) reported that *T. bottae* seemed to be monogamous within a season; they 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.

T. H. Scheffer noted embryos from 18 March to 15 June in female Mazama Pocket Gophers (n = 312) near Olympia (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 and hairless at birth and had a mean weight of 3.6 g. By day 17, pups ate solid food (Chase et. al 1982). Pups grow rapidly, gaining about 2 g/day for the first 40 days, are believed to be weaned around 35–40 days, and most attain adult weights of 90–100 g by 4–5 months of age (Andersen 1978). *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).

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 1.2 females:1 male, to 2.2 females:1 male (Ingles 1952).

Longevity and sources of mortality. Many pocket gophers live a year or more. In 2014, 3 Mazama Pocket Gophers were live-trapped that had been released at West Rocky Prairie Wildlife Area in 2009, making them at least 5 years old; 7 were at least 4 years old (Olson 2016). Based on zonation lines in mandibles, Livezey and Verts (1979) reported that none of 127 Mazama Pocket Gophers were ≥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, cited in* Busch et al. 2000).

Predation. It is widely assumed that the 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, Smoluk 2011). 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*), and Barn Owl (*Tyto alba*) (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 (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; they are not believed to be reservoirs for any human diseases (Verts and Carraway 1999, 2000, Jones and Baxter 2004).

***Traps and poison*.** Where gophers are perceived to be a problem, trapping and poisoning by humans may occasionally affect their numbers. 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 special permit. Link (2004) discusses non-lethal methods of controlling gopher damage to plantings (https://wdfw.wa.gov/species-habitats/living/species-facts/pocket-gophers).

***Population dynamics*.** Indicators of gopher numbers increase dramatically in the summer after the dispersal of young of the year, and suggest populations 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. Extreme weather may influence pocket gopher populations more than any other factor. 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 force gophers to the surface, exposing them to predators likely resulting in fluctuations in populations and occupancy of flood-prone sites.

Weather likely is an important mortality factor for *T. m. melanops* in the Olympics. Andersen and MacMahon (1981) believed that severe weather was the most important mortality factor for *T. talpoides* in their subalpine study area because it affected 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). 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. Platt et al. (2016) review the literature on the impact of soil-disturbing vertebrates, including pocket gophers, on the physical and chemical properties of soils.

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 dispersal of spores of hypogeous fungi. Pocket gophers may facilitate plant growth by dispersing the spores of myccorhizal 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. *T. talpoides* played a role in establishment of vegetation in the blast zone of Mount St. Helens by transporting fungal spores from nearby refugia as well as exhuming buried soil containing fungal spores and plant seeds (Allen and MacMahon 1988).

Pocket gopher effects on plant diversity and succession. In some prairie ecosystems, the soil moving activities of pocket gophers have been found to be important in maintaining plant species richness and diversity (Martinsen et al. 1990, Klaas et al. 2000), increasing the abundance of forbs (Jones et al. 2008). 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. Native species that benefitted from gopher activity included Common Yarrow (*Achillea millefolium*) 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. Additional study suggested that plant burial and reduced infiltration on gopher mounds may accelerate soil carbon accumulation, aid plant growth at mound edges, and increase hetergeneity of soils and vegetation (Yurkewycz et al. 2014). 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 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 (*Anaxyrus boreas*) 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 (2011) 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) suggested that the species may be a "keystone species" because of the habitat value of gopher burrows to amphibians, reptiles, and other groups. 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.

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, WDFW 2013). In addition to conserved prairies, occupied sites include grassy fields at airports, pastures, fields, Christmas tree farms, and occasionally clearcuts (Stinson 2005, WDFW 2013). 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, Common Dandelions (*Taraxicum officianale*), False Dandelions, and Common 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 2011). Olson (2011) reported that low densities of Scotch Broom 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. Gopher occupancy may also show a negative effect of higher levels of cover by rhizomatous grasses (Kronland et al. 2018).

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 grasslands. 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, occupying the clearcut for several years, as grasses and forbs increase, until the growing trees shade out the herbaceous layer. *T. m. melanops* is found in open parkland and subalpine meadows in the Olympic Mountains (Johnson and Cassidy 1997, Fleckenstein 2013).

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).

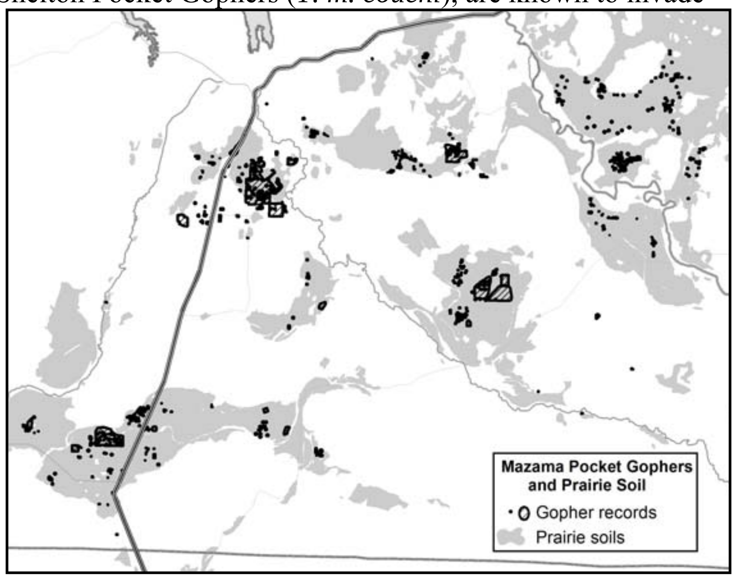

Figure 5. Prairie soils and occurrences of Mazama Pocket Gophers in Thurston and Pierce counties. Many areas of prairie soils no longer support gophers because they are densely developed or have succeeded to forest.

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, though nutrient quality may affect gopher abundance. Soil characteristics that affect gophers include depth and texture, particularly rock and clay content, which affect burrowing efficiency, permeability that can result in periodic flooding of burrows, depth, water-holding capacity, and fertility that affect growth of food plants (Davis et al. 1938, Ingles 1949, Howard and Childs 1959, Miller 1964, Cameron et al. 1988, Baker et al. 2003, Marcy et al. 2013). Wilson and Kilgore (1978) noted that soil porosity has a strong effect on the rate of gas exchange between a mammal and the atmosphere, so in a closed burrow system, saturated soils may handicap gopher respiration. 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); clay content >30% generally excludes pocket gophers (Marcy et al. 2013). These soil characteristics affect the food energy available relative to tunneling effort (Vleck 1979, 1981). Marcy et al. (2013) indicate that soil properties affect pocket gopher distributions because low precipitation and high temperatures can cause clay soils to harden within days; species adapted for tooth-digging (e.g. *T. bottae*) are less affected by the clay content, but claw diggers, like *T. mazama,* are restricted to low-clay soils.

The distribution and abundance of Mazama Pocket Gophers in the south Puget Sound region generally correlate with soil types that historically supported prairie vegetation (Fig. 5). Mazama Pocket Gophers are not found on all historical prairies and they apparently do not require prairie soils, because they also occur in non-prairie soils where woody cover has been removed, though these occurrences are generally close to historical prairies. The historical association with prairie soils was probably related to their avoidance of areas with closed tree canopies and woody root systems, rather than the limitations of other well-drained soils. They may be able to occupy any site that has suitable soil and herbaceous vegetation, and does not have significant tree and shrub cover.

Soils and Mazama Pocket Gophers in Thurston and Pierce counties. Consistent with other gopher species (Baker et al. 2003), soil texture and drainage are factors affecting suitability for Mazama Pocket Gophers. Mazama Pocket Gophers in the south Puget Sound region are found primarily in soils with textures characterized as loamy sands or sandy and gravelly loams; fewer have been found in silt and they have not been found in clay (Fig. 6). Based on gopher sign and trapping data, certain loamy sand soils seem to have the highest abundance of gopher occurrence in Thurston and Pierce counties (McAllister and Schmidt 2005, Olson 2011, USFWS 2018).

Although the amount of sign may be affected by differences in the need for burrow maintenance between sites of different soils, limited trapping data generally confirm the apparent positive relationship between the number of mounds and number of gophers (Olson 2011), and suggest that sandy soils seem to support more gophers. Olson (2011) reported a positive association with sandy loam soil types in the south Puget Sound landscape; this may reflect the productivity of these soils (Pringle 1990:164). The probability of gopher occurrence at a site was 1/3 lower in gravelly loams vs. sandy loam (Olson 2011). Occupancy probability was lower in coarse gravel during spring, and was positively related to the percent of substrate that was soil fines in fall (Olson 2011). Rock content of soil seems to be an important factor. 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 in Pierce and Thurston counties (Steinberg and Heller 1997). Four of 5 sites with gophers had soil that was ≤10% medium rocks by weight. However, Wolf Haven, which was correctly predicted to be 'gopher-free' based on the rocky soil, currently supports gophers that were released there.

While surveying parcels in Thurston County for gopher sign in response to land use applications during 2015–2017, the U.S. Fish and Wildlife Service compiled data on the soils present (USFWS 2018). The number of gopher detections compared to the area of soil type available was used to categorize soils into 'more preferred' and 'less preferred' soils (Table 3).

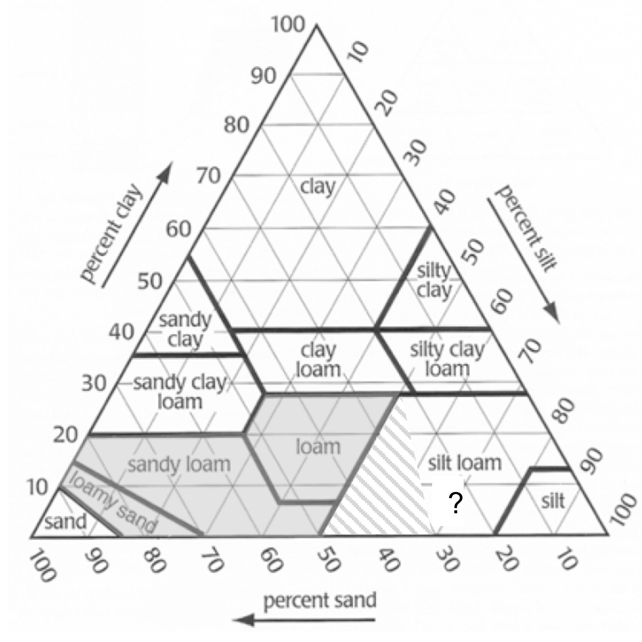

Figure 6. Standard USDA soil texture triangle, with shading to indicate apparent suitability for *T. mazama*; most detections in south Puget Sound region have been in loamy sands or sandy loams (shaded), with fewer in silt (diagonal lines) and none in clay.

Most of the largest historical prairies have gravelly soils (e.g. Spanaway or Spanaway-Nisqually complex unit); these gravelly soils often support gophers, but apparently at lower density than the more preferred sandy loams or loamy sands. Non-prairie loamy sand, and gravelly soil types that gophers occur in include Indianola loamy sand, Cagey loamy sand, and Everett very gravelly sandy loams; these may not have been used by gophers historically due to forest cover. These gopher occurrences are typically adjacent or near prairie soil types (Fig. 7). Mazama Pocket Gophers also occasionally occur in soils that generally have 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 may be forced to retreat during the wet season. This may be true of the small number of pocket gopher occurrences in some locations in Spana, Cagey, McKenna,Yelm fine sandy loam, and Norma soils. In these areas, gopher presence may be affected by topographic position, with gophers absent in depressions, but present on higher ground less often affected by the seasonally high water table. Pastures and agricultural land that have had underground drainage structures installed (drain tiles) may confound these association of gophers with these poorly draining soils.

Table 3. More preferred and less preferred soils relative to area of soil type available and frequency of gopher occurrence (from USFWS 2018).

Thurston County Soils with Confirmed Gopher Occupancy[1]	**Total Thurston MPG Soils Acres[2]**	**Percent Pervious MPG Soils Used (r_i)**	**Manly's Alpha - MPG Soil Preference Index[3]**
Nisqually loamy fine sand, 0–3% slopes	9,308	14.5%	0.200
Spanaway-Nisqually complex, 2–10 % slopes	6,959	18.5%	0.168
Nisqually loamy fine sand, 3–15% slopes	3,711	7.3%	0.152
Cagey loamy sand	5,344	8.1%	0.111
Spanaway gravelly sandy loam, 0–3% slopes	27,975	30.4%	0.082
Indianola loamy sand, 0–3% slopes	5,628	4.8%	0.067
Spanaway gravelly sandy loam, 3–15% slopes	4,596	3.9%	0.054
Norma silt loam	6,805	2.6%	0.024
Spana gravelly loam	1,364	0.4%	0.024
Spanaway stony sandy loam, 3–15% slopes	1,093	0.3%	0.021
Everett very gravelly sandy loam, 0–3% slopes	10,772	2.9%	0.018
McKenna gravelly silt loam, 0–5% slopes	3,361	0.7%	0.013
Spanaway stony sandy loam, 0–3% slopes	1,926	0.3%	0.012
Yelm fine sandy loam, 0–3% slopes	7,342	0.9%	0.011
Yelm fine sandy loam, 3–15% slopes	4,388	0.4%	0.009
Indianola loamy sand, 3–15% slopes	4,839	0.6%	0.009
Alderwood gravelly sandy loam, 0–3% slopes	3,010	0.3%	0.008
Everett very gravelly sandy loam, 3–15% slopes	17,916	1.8%	0.007
Norma fine sandy loam	2,341	0.2%	0.006
Alderwood gravelly sandy loam, 3–15% slopes	16,106	1.0%	0.004
Kapowsin silt loam, 3–15% slopes	5,151	0.1%	0.001
Total	149,935		

[1]Soil types in which Mazama Pocket Gopher (MPG) are known to occur within Thurston County, Washington, east of the Black River.

[2]Total acres of each soil type within Thurston County, Washington, east of the Black River; some acres are covered with impervious surfaces, so are not available to gopher.

[3]Manly's Alpha Index: if this index value is >0.0476, then the soil type is more preferred by gophers ( ). This is a measure of soil use by MPGs compared to soil availability in the County, east of the Black River, and assumes all soils are equally accessible by MPGs.

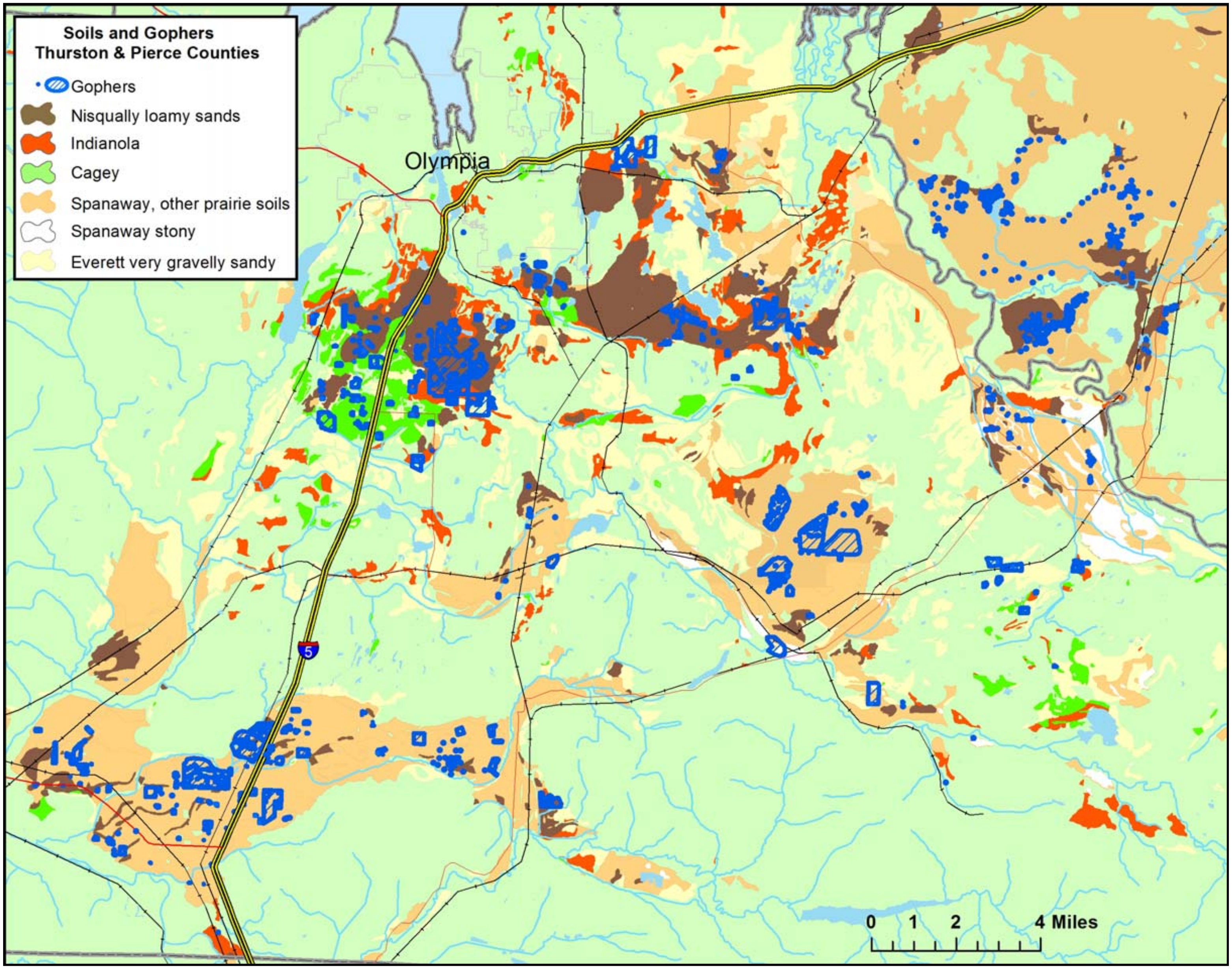

Figure 7. Mazama Pocket Gopher occurrences through 2017, and important prairie soils and other sandy loam soil types in Thurston and Pierce counties, Washington (Blue hatched and dots indicate gopher point and polygon data; soil data from USDA, NRCS).

Mason County soils and gophers. The most extensive area with relatively contiguous grassland occupied by 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, which is fairly widespread in southern Mason County (Fig. 8). Confirmed gopher occurrences provide few data about suitability of soil types and predictions should be viewed as hypotheses. 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%. Based on known gopher occurrences and soil characteristics described in soil surveys, soil types were graded by hypothesized suitability for gophers in Mason County (*see* Appendix C, D) (Ness 1960).

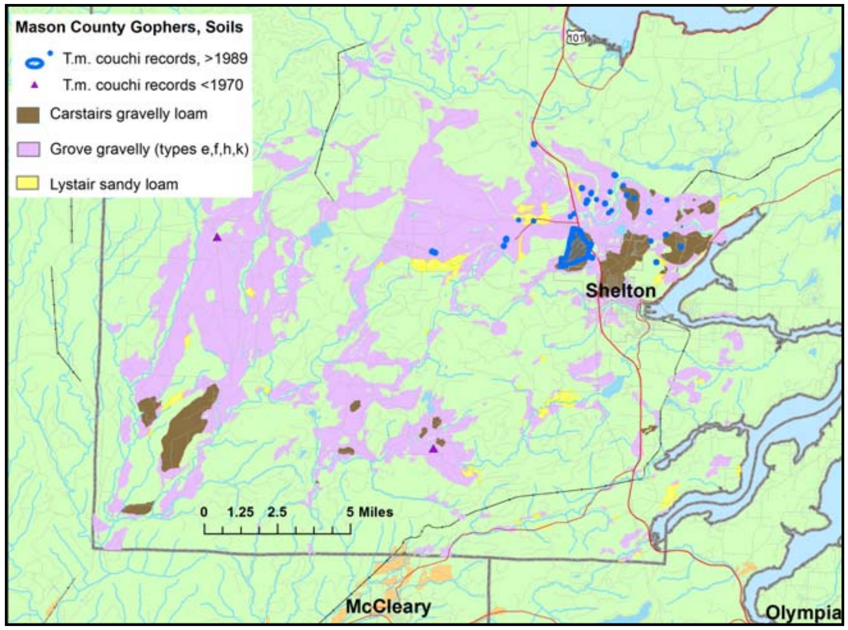

Figure 8. Soil types (USDA, NRCS data) and pocket gopher occurrences (WDFW point and polygon data) in Mason County,

Clallam County gophers and soils. 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 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, pers. comm.). Rocks were a small percentage, but the ground on several sites contained a large percentage of tree roots.

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 D). Only recently has there been quantitative data on abundance for a few occupied sites, along with a more complete picture of their distribution. Populations in Washington have restricted distributions and several historical localities are no longer occupied. 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 Chambers Prairie and Tenalquot Prairie populations) 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. Members of the U. S. Pacific Railroad Expedition reported that gophers were "very abundant on the gravelly prairies near Nisqually" (Suckley and Gibbs 1860:126), but were "closely confined to these prairies or their borders" (Cooper 1860:19). 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 possibly as far east as Puyallup. The populations were not contiguous, but included several somewhat isolated populations that exhibited their own local variations in size and fur color that later recieved the subspecies designations currently used. The loamy sand soil areas in Lacey and Olympia that are now densely developed likely supported large gopher populations.

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, or in Yelm. These museum specimens, as well as later collections from the 1940s–1970s, are listed in Appendix D. 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. An 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%) (Hall et al. 1995, *not seen, in* Crawford and Hall 1997).

The 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, the cessation of Native American maintenance fires 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 shrub, 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 Road 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 D). 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 and more 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 what they thought were gophers (Ramsey and Slipp 1974). Richard Taylor, WDFW, did not detect any gopher sign in several visits to the Wapato Hill site in the 1990s (WDFW files, 1998), and Steinberg (1996a) found no trace of gophers at some historical locations in Tacoma and vicinity. The last potential record of this subspecies was the Wapato Hill report in 1974 (Ramsay and Slipp 1974).

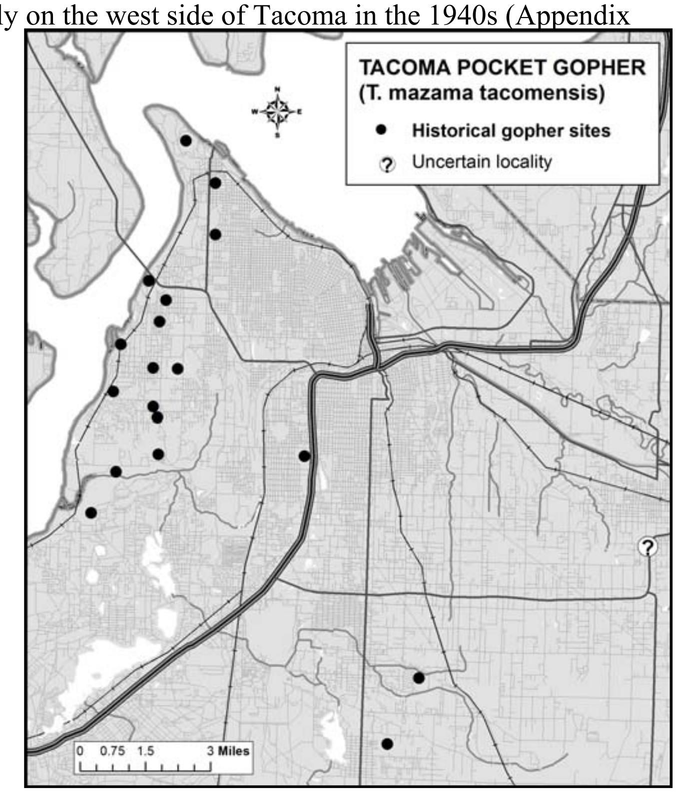

Figure 9. Historical locations in and near Tacoma where *T. m. tacomensis* were found.

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 at one time, 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 D). 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.

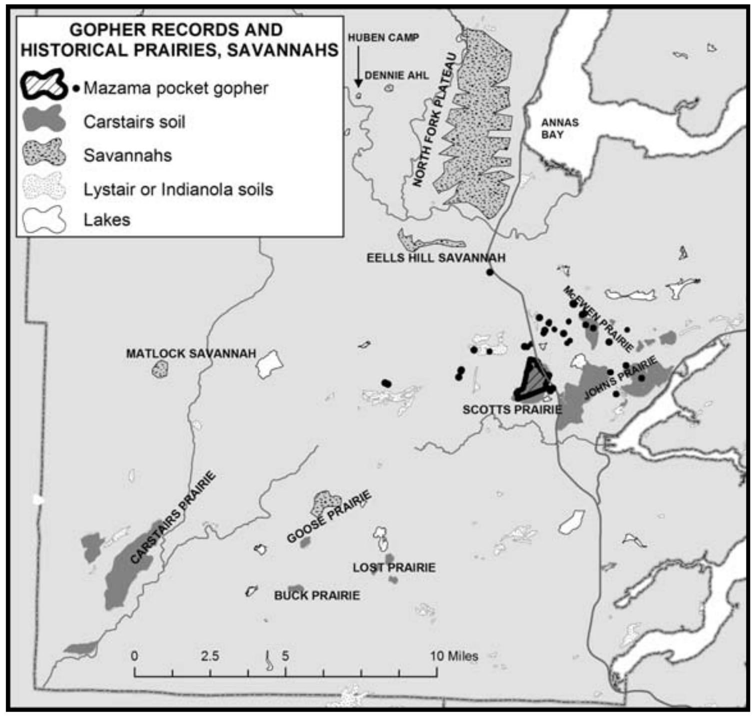

Figure 10. Historical prairies and bear grass savannahs, and gopher records in Mason County. Eells Hill Savannah extended further south but mapping was not completed (savannahs drawn from Peter and Shebitz 2006).

Peter and Shebitz (2006) describe evidence for the historical existence of several bear grass savannahs in Mason County, 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 Eells 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.

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 D), 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 the vicinity in 1986, or 2012, and an old burn where they were once found had regenerated to forest (WDFW unpubl. data); this population may now be extinct.

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).

Mazama Pocket Gophers have been a WDFW priority species and 'species of local importance' in Thurston, Pierce, and Mason counties since the 1990s, and development projects expected to impact them were required by the jurisdictions to survey project sites. Since the 2006 state-listing, Thurston County and cities began requiring surveys before granting development permits in all non-forested 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 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 currently occupied by gophers. Nearly all of the occupied sites were on historical prairies and near previously known sites.

In 2012, WDFW conducted extensive 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 at historical sites in Wahkiakum and Clark counties (WDFW 2013). The surveys included plots in several habitat categories that varied by vegetation cover and soil characteristics. Historical sites were also revisited in Clallam County by DNR Heritage Program Zoologist, John Fleckenstein (Fleckenstein 2013). More recently, USFWS personnel surveyed sites in response to landowner requests and building permit applications in Thurston County; during 2014–2017, they checked ~1,239 sites for gopher presence (USFWS 2016, 2017a, 2018, WSDM 2018). With rare exceptions, the results overwhelmingly confirmed previous descriptions of their distribution of in Washington (Stinson 2005; Fig. 11).

Gopher population estimation. The area and quality of suitable habitat influence the number of gophers on a site, with an upper limit determined by territoriality and energetics. Based on a small number of sites, numbers have ranged from <1- 19 gophers/ac of suitable habitat. However, a single population estimate for an area is of limited utility because gopher numbers fluctuate year-to-year due to environmental conditions, with occasional 'boom or bust' years. Numbers detected 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 estimates. Detectability also varies seasonally with digging activity, complicating surveys and estimation. 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 (Olson 2011). Gophers may also appear to be 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.

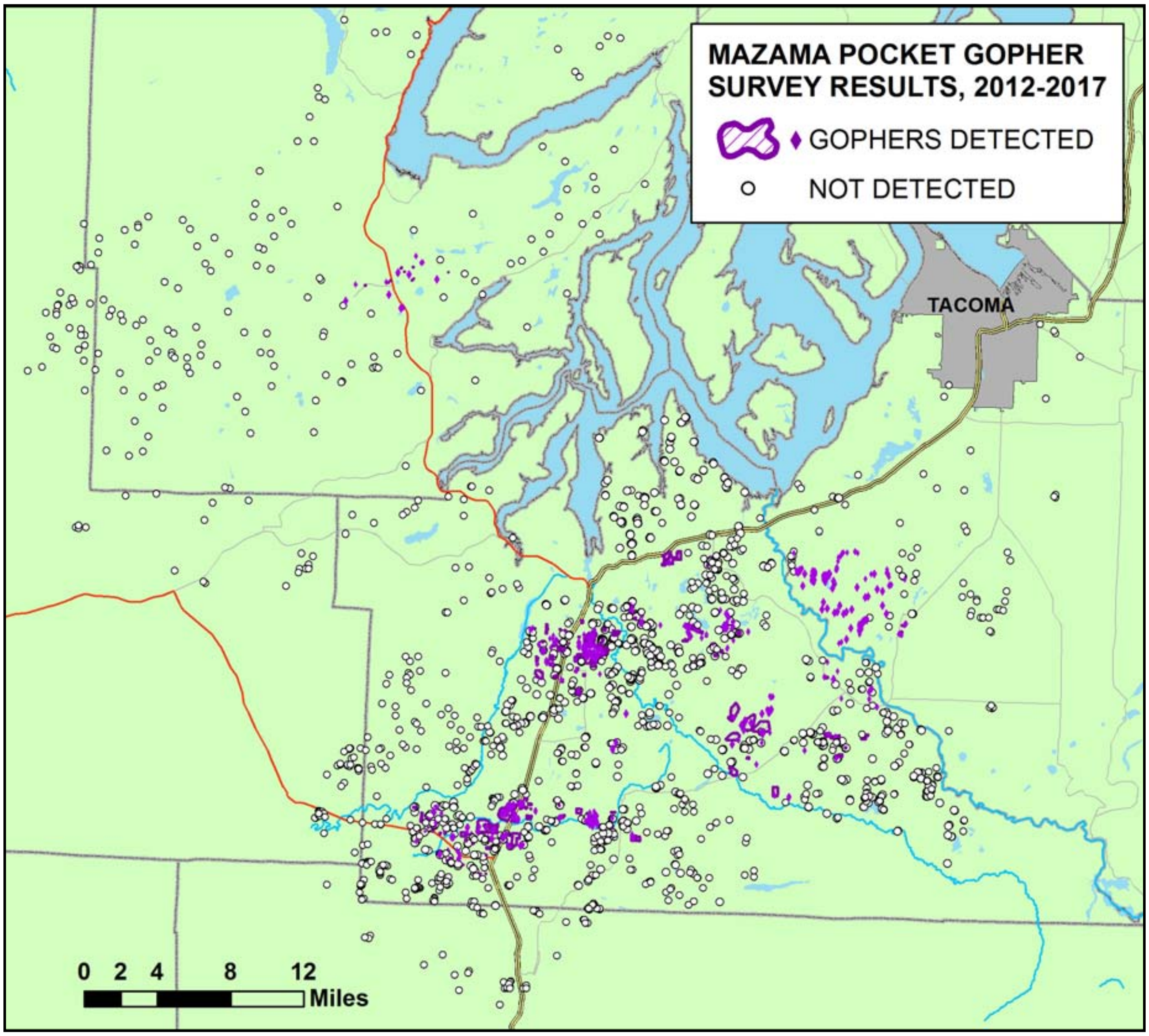

Figure 11. Plots sampled, with and with no gopher detections, including extensive surveys by WDFW in 2012 (WDFW 2013) and sites surveyed by USFWS in Thurston County, 2014-2018 (negative data not included for all years).

Estimates of gopher populations have typically been based on indices such as active burrows or mounds (Olson 2011), 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 abundance or to estimate local populations (Reid et al. 1966, Engeman et al. 1993). Smallwood and Erickson (1995) noted that a problem with the open-hole test is that burrows opened >2 times within a few months were often abandoned. They 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 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 (Smallwood and Erickson 1995).

Although there are numerous 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.

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 pine forest in Oregon, but 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). G. Olson (unpubl. data) captured 200 Mazama Pocket Gophers from roughly 22 acres at the Olympia Airport, although not all the gophers present were captured and others may have entered the plot after residents were removed. This suggested a density of ~9 gophers/ac in the 22 ac area; however, the plot location was not necessarily representative of the entire airport area, but was selected because of the apparent higher density of gopher mounds. Live-trapping on about 70 ac of more gravelly soil at Weir Prairie, compared to the loamy sand at the airport, indicated a density of about ~2 gophers/ac. Both numbers should be considered 'rough' estimates.

More recently, Olson (2017a) developed more efficient standardized survey methods that could be used to determine site occupancy, population abundance estimation, and trend monitoring. She described protocols for mound detection surveys, based on either transects or plots, that are practical to apply as standardized methods, but recommended the transect surveys based on their relative efficiency and the potential for directly estimating abundance using a newly developed analytical approach (Olson 2017a). Using this method, the population at several sites ranged from 75 (95% CI = 19–209) gophers on 150 ac of Lower Weir Prairie on JBLM, to 5,327 (95% CI = 2,765–7,560) on 314 ac of the north unit of Scatter Creek Wildlife Area. The densest population was on 32 ac at Wolf Haven with almost 19 gophers/ac.

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 remnants of historical prairies exist in Pierce, Thurston, and Mason counties (Figs. 12, 13). This includes five of the described subspecies, and two or more unnamed distinct genetic units; the 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, vegetation, and land use history. The largest populations probably include 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. We describe the population areas below, including acreage of the loamy sand soils (Nisqually and Indianola in Thurston and Pierce counties; Carstairs in Mason County), based on the county soil survey, because these soils seem to support higher numbers of gophers. Dunn and Treadwell (2017) investigated the current suitability of land parcels in the range of Mazama Pocket Gopher to provide information about conservation potential. They reported that out of nearly 400 total land parcels examined, 69 met requirements for a high suitability rating for gophers, 127 met requirements for being potentially suitable, and 201 parcels were categorized as having low suitability.

Thurston County

Bush Prairie and Tumwater. Tumwater and the historical Bush Prairie area may support the largest population of Mazama Pocket Gophers in Washington. The gophers in this area, described as *T. m. pugetensis*, are found in vacant lots, yards, and pastures on both sides of Interstate 5, including on several hundred acres of maintained grassland at the Olympia Airport, where they are relatively unmolested by humans or domestic animals. In 2005, McAllister and Schmidt (2005) marked and counted active mounds that were $\geq$10 m from the next nearest marked mound based on a hypothetical territory size.

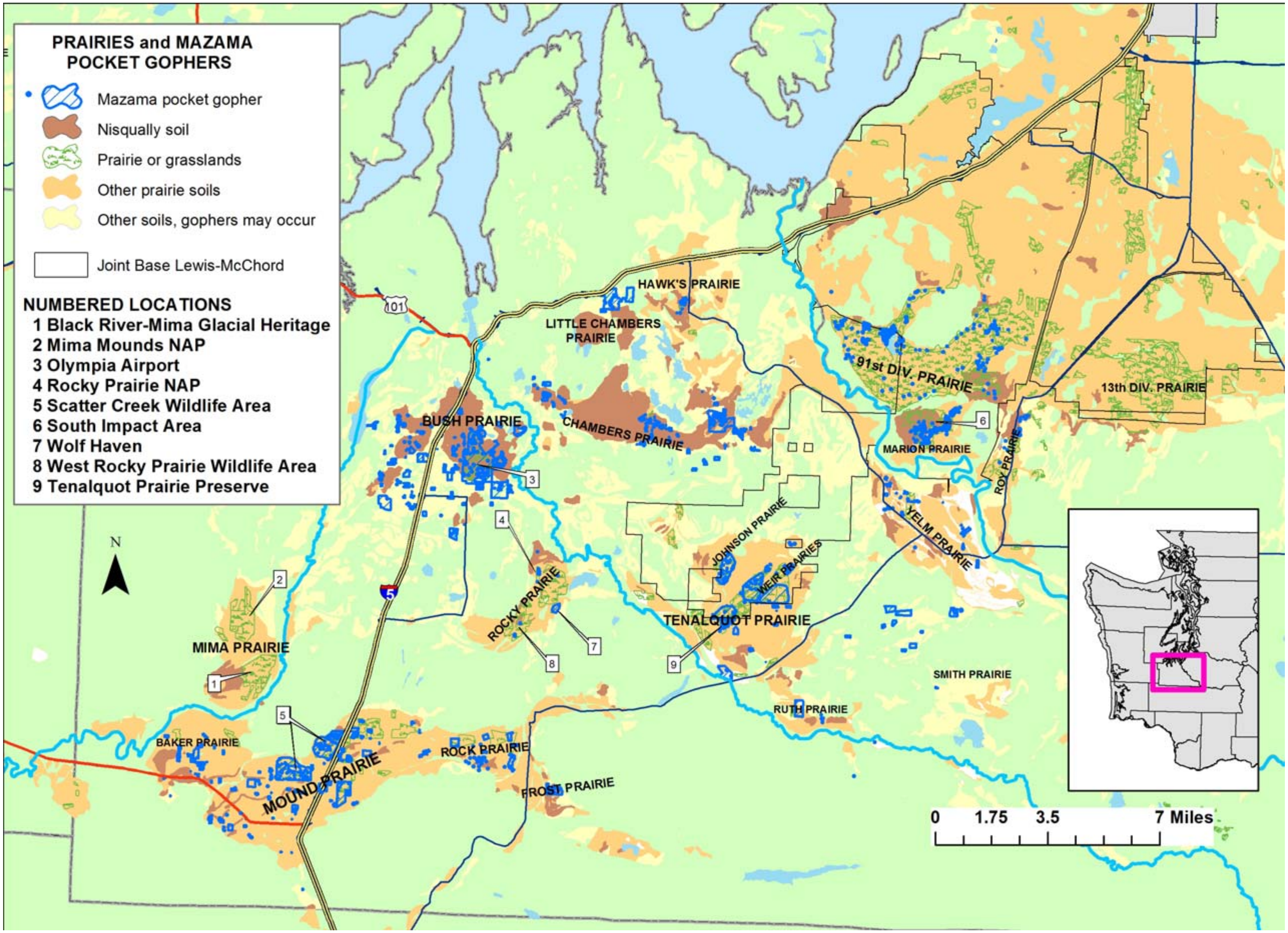

Figure 12. Prairie soils, named historical prairies, named locations mentioned in the text, and known Mazama Pocket Gopher records in Thurston and Pierce counties (does not include historical *T. m. tacomensis* records); prairie/grassland data from Chappell et al. (2003).

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 did not appear as abundant or widespread in subsequent 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 two 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. 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. The gophers present on Chambers, Little Chambers, and Hawks prairies appear to be a relatively distinct genetic group (Warheit and Whitcomb 2016), and these areas were not clearly included in the described subspecies distribution (Dalquest and Scheffer 1944, Hall 1981); a few museum specimens from the area were labeled *T. m. pugetensis*, while others were labeled *T. m. yelmensis.* They are separated from the type locality of *T. m. pugetensis* on Bush Prairie by the Deschutes River, so the area was included in the *T. m. yelmensis* ESA listing. Most of the area has residential development of various densities. 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 several large polygons of Nisqually soil (562 ac, 367 ac, 344 ac), and Indianola soil (200 ac, 176 ac), most of these areas are heavily developed, with dense residential neighborhoods, roads, and businesses. Some of the remaining larger parcels contain wetlands and are unsuitable for gopher persistence. Small pockets of habitat with 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. Rocky Prairie, about 2,200 ac south of East Olympia and north of Tenino, includes the type locality of *T. m. tumuli* (Figs. 4, 12). The population status of *T. m. tumuli* appears to be tenuous, as only small numbers of gophers have been detected in the area; small numbers of gophers are occasionally detected on the Rocky Prairie Natural Area Preserve (NAP), and six were live-trapped there for genetic samples in 2013 (Warheit and Whitcomb 2016).

The Rocky Prairie area includes WDFW's West Rocky Prairie Wildlife Area (WLA) that has 270 ac of mounded and terraced prairie. Schonberg and Randolph (2006) conducted a vegetation survey and described this site as fairly degraded, but with many native forbs present. A 745 ac area of mostly Spanaway-Nisqually complex soils adjacent to West Rocky Prairie WLA is owned by the Port of Tacoma; WDFW is currently attempting to purchase part or all of it. East of West Rocky Prairie WLA is 38 ac of native mounded prairie at Wolf Haven International.

Gopher populations were established at the Wolf Haven site during 2005–2008 (Linders 2008), and at West Rocky WLA during 2009–2011, by moving gophers from other sites. Based on fall 2015 surveys, the population at Wolf Haven was estimated at 600 (95% CI = 297–1,023), and at West Rocky Prairie was 347 (95% CI=148–922; Olson 2017b). No gopher populations were known to be present at either site prior to these translocations. These projects moved gophers from the Olympia Airport and two Tumwater sites, both sites in prairie areas containing the type locality of *T. m. pugetensis*, and established populations near the type locality of *T. m. tumuli* (Dalquest and Scheffer 1944). This was not a concern at the time because Steinberg (1999) suggested, based on mitochondrial genetics, that all the subspecies in Thurston County should probably be combined. However, the recent genetic analysis using more advanced techniques by Warheit and Whitcomb (2016) indicated that the described subspecies were indeed distinct and revealed the existence of 2 or more additional genetic groups (see Taxonomy, p. 3-5). Therefore, any future translocations will maintain separation of recognized subspecies and distinct genetic units, unless, with agreement with USFWS that a 'genetic rescue' augmentation requires gophers of another genetic group to salvage a relictual group from extinction through hybridization, or the subspecific taxonomy is revised.

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; a gopher carcass was found on the site in 1980, but no gophers have been detected there in recent years (K. McAllister, pers. comm. 2005; Skillings Connelly Inc. 2012).

Mound Prairie. Dalquest and Scheffer (1944) described the range of the Yelm Pocket Gopher (*T. m. yelmensis*) as "Mound Prairie, Rochester Prairie, and Vail Prairie" (labeled Baker, Mound, and Ruth prairies in Fig 12). Mound Prairie, near Grand Mound, is bisected by Interstate 5 (Fig.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, but with 80 mapped acres of Nisqually soil on the north unit and 8 ac in the south unit. 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.

East of Mound Prairie is Rock Prairie, an area of >1,200 ac of private lands located southwest of Tenino (Fig. 12). The area still supports Mazama Pocket Gophers, including 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, and the Center for Natural Lands Management now manages Mazama Meadows (121 ac) which may function as a mitigation bank for future development impacts in the area, and the Violet Prairie-Scatter Creek Preserve (65 ac). Some of the remaining private lands have not been surveyed for gophers, and some of the extant grassland mapped by Chappell et al. (2003) had been affected by gravel extraction or other earthmoving. East of Rock Prairie is Frost Prairie, a mix of farms and low and moderate density residential developments, etc., with scattered reports of gopher occupancy but with an increasing amount of higher density development. WDFW recently acquired a conservation easement on ~70 ac of agricultural land known to host gophers.

Tenalquot Prairie. Genetic samples from gophers collected on Tenalquot Prairie sites were identified as a distinct genetic group by Warheit and Whitcomb (2016). This area includes Weir Prairie (Upper, Lower, and South Weir), and Johnson Prairie which are in the Rainier Training Area of JBLM and designated Priority Habitat Areas for the Mazama Pocket Gopher (Fig. 12). Priority Habitat Areas are areas on Joint Base Lewis-McChord that were proposed by the USFWS as critical habitat for the Mazama Pocket Gopher, but were exempted due to the approval and implementation of the Integrated Natural Resources Managament Plan (INRMP) and embedded Endangered Species Management Component (ESMC). 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, but has been known to incur heavy recreational use, even where restricted or prohibited, and in the past, the rules for recreation often went unenforced (e.g., staying on roads, keeping dogs off site or on-leash, etc.). 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. Lower Weir has Spanaway soil, and the prairie vegetation was mostly in poor or fair condition before more recent management (Altman 2003). In the past, recreational and military training activities negatively affected the Weir prairie complex, despite prohibitions; the updated INRMP, ESMC and Programatic Biological Opinion (PBO; USFWS 2017c) emphasize increased informational outreach and enforcement of restrictions on recreation and training activities conducted there (JBLM Environmental Division, Public Works 2017).

The Weir Prairie Complex consists of Upper Weir Prairie (547 ac), Lower Weir Prairie (440 ac), and South Weir (163 ac), and is protected from the most destructive forms of military training, such as off-road vehicle maneuvers and digging. Land Condition Monitoring data provide an indication of the condition of prairie vegetation on Upper Weir (45% poor, 14% fair, and 41% good), Lower Weir (70% poor, 16% fair, 14% good), and South Weir (78% poor, 16% fair, 6% good) (JBLM-FWP 2013).

Johnson Prairie is about 194 ac of native and semi-native grassland and was considered one of the highest quality Puget prairies, but Land Condition data indicate the vegetation condition is 73% poor, 16% fair, and 11% good (JBLM-FWP 2013). It supports a substantial population of Mazama Pocket Gophers (Steinberg 1995, WDFW data), prairie plants and butterflies, and Western Toads (Remsburg 2000, Altman 2003). Activities include recreation, foot maneuvers, parachute drops, helicopter drops, and military field exercises. 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 also includes the Tenalquot Prairie Preserve, a private 125 ac preserve south of South Weir owned by CNLM. WDFW has a conservation easement on the property. It is currently being restored to high quality prairie by CNLM. Gophers are present in low numbers in the Spanaway soils of the area. This area also includes. CNLM also manages a former ranch, Deschutes River Preserve (140 ac) south of the Weir prairies.

Yelm Prairie. Although the subspecies on Mound Prairie was named '*yelmensis*', Dalquest was unable to find gophers on Yelm Prairie in the 1940s. Gophers are now present in modest numbers scattered in pastures and roadsides, which genetically may resemble those on Tenalquot or Chambers Prairie (Warheit and Whitcomb 2016); *T. m. glacialis* is geographically closer, but across the Nisqually River. They are scattered in pastures and open land with prairie soil types, but a substantial portions of the historical prairie has Spanaway stoney soil which may be marginal habitat. Large parts of the area are subdivided and no public conservation lands are present. Washington Dept of Transportation is developing a bi-pass for SR510 on some lands occupied by gophers, for which they purchased 33 ac on Mound Prairie as mitigation.

Pierce County

91st Division and Marion prairies. *T. m. glacialis* is found in Pierce County (Fig. 4,12) in an area that is primarily comprised of JBLM training areas and impact 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, or effects of fires and training activity. JBLM has recently conducted extensive surveys within the impact areas and have found numerous aggregations of gophers scattered across the landscape indicating a healthy and resilient population, despite the impacts of artillery and wildfires. Most of the soil is rocky and may not be optimal habitat, but gophers were detected in nearly all the sample plots surveyed in accessible areas in 2012 (WDFW data).

Ongoing activities have produced a mix of prairie conditions from high quality to seriously degraded. The eastern and northwestern portions of the Artillery Impact Area (AIA) have heavily used ranges. Historic off-road vehicle maneuver training had caused extensive vegetation damage, but many areas of the AIA also contain some of the highest quality prairie sites. 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 annual vernalgrass (*Anthoxanthum aristatum*) (Tveten and Fonda 1999). A portion of the area has a high percent cover of bare ground or rocks (Tveten 1997). The majority of the AIA is now designated Priority Habitat for the Mazama Pocket Gopher, Streaked Horned Lark and Taylor's Checkerspot butterfly and is prohibited from off-road vehicle maneuvers. Military training exercises require JBLM Fish & Wildlife review to assess and minimize disturbance to ESA species populations and habitat.

The South Impact Area and Training Area 18 Marion Drop Zone (Marion Prairie) areas include 186 ac of grassland in a training area (Marion Prairie) north of Yelm 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 mound surveys conducted at both South Impact Area and Marion Prairie sites have detected significant numbers of mounds (Steinberg 1995, JBLM 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 (ENSR 1993). 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.

Training uses of Marion Prairie have been reduced since being designated Priority Habitat for the Mazama Pocket Gopher. Use of the area requires JBLM Fish & Wildlife review. The South Impact Area ranges supports large and small rifle munitions and are heavily occupied by gophers. These ranges are not subject to excavation, but are mowed regularly for target visibility.

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. All populations originally assigned to *T. m. tacomensis* appear to be extinct; there are no confirmed records since 1962 (Appendix D). In 2012, 24 sites with historical records were visited by WDFW personnel; of these, 18 did not appear to have significant habitat (e.g., parking lot, densely developed commercial and residential); 6 sites had some potential habitat at, or in the immediate vicinity (e.g. parks); access was denied at one of these sites, the remaining 5 were surveyed, but no gopher sign was detected (T. Schmidt, pers. comm.). 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.

Mason County

Scotts, Johns, and McEwen Prairies, Mason County. Sanderson Field (Shelton Airport), 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. The Department of Natural Resources Natural Heritage Program mapped 242 ac of "airport grassland" at the airport (Fig. 13), 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 historical Johns, McEwen, and Lost Prairies, and Skokomish bear grass savannahs.

Dalquest and Scheffer (1944) characterized the topsoil 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.

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. 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.

Farrell and Archer (1996) estimated 990 gophers at the Shelton airport, from delineated gopher territories based on "mound systems"; they then applied a correction factor based on the open-hole responses within 48 hours of being opened; the 'open-hole method' may underestimate the number of occupied territories (Smallwood and Erickson 1995), but most of the counts were done in late summer (Farrell and Archer 1996), when numbers would be 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.).

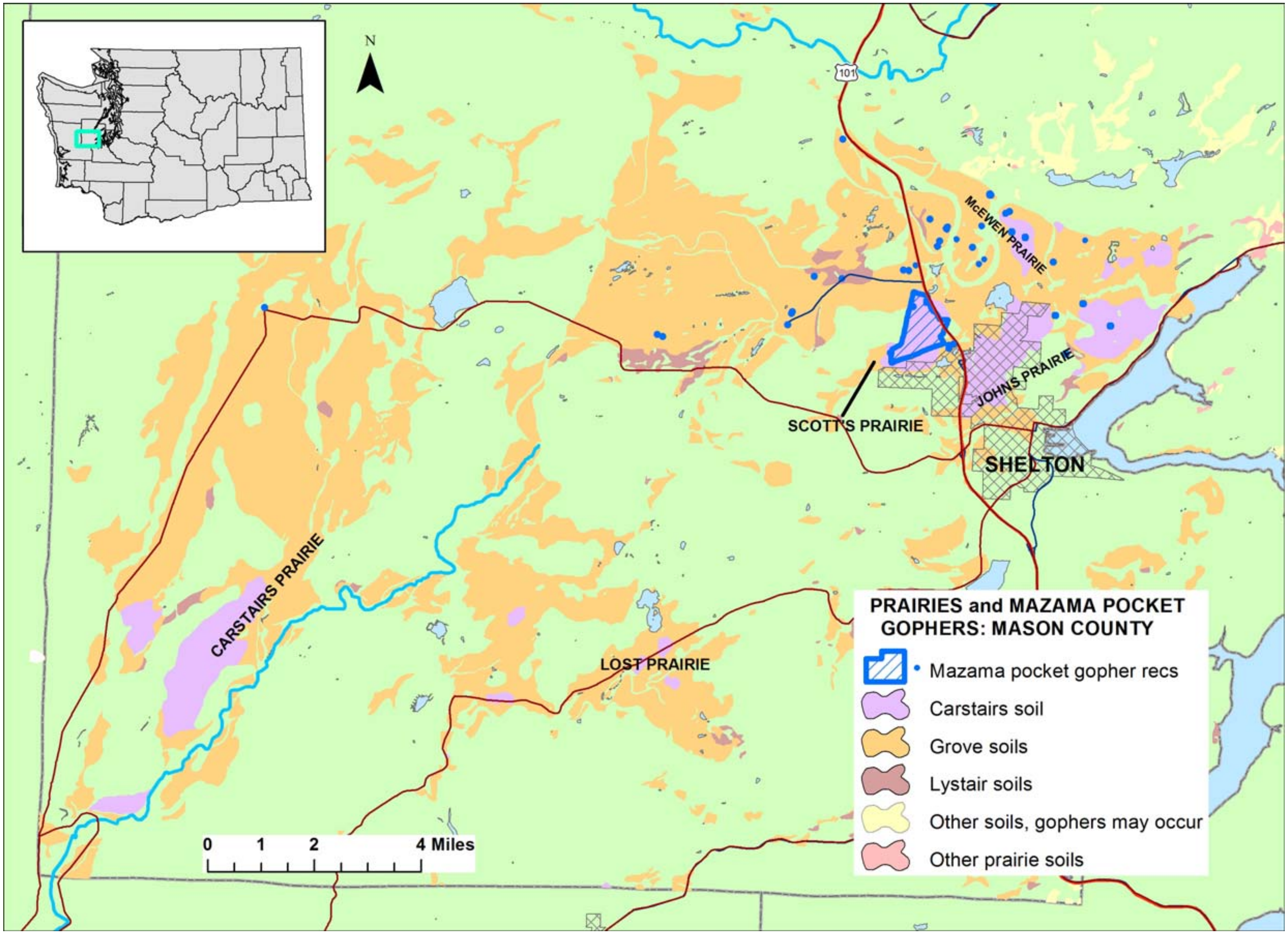

Figure 13. Prairie soils, named historical prairies, and known Mazama Pocket Gopher records (blue points and polygons) in Mason County (*T. m. couchi*); prairie/grassland data from Chappell et al. (2003).

Reconnaissance in 2011 detected possible gopher sign close to several historical sites, and open habitats in the southeastern part of the county and was followed-up by live-trapping. Gopher presence was confirmed at 5 sites, including in the McEwen Prairie area, but they may or may not still be present on Johns Prairie. Extensive surveys in 2012 detected gophers in 12 of 20 plots, but only within a few miles of the airport (Fig. 13). 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 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.).

Clallam County

All known occurrences of *T. m. melanops* are on alpine meadows in Olympic National Park (Fig. 14; Steinberg 1999, Fleckenstein 2013, C. Welch, pers. comm.). Gophers are present at Boulder Lake, Appleton Pass, Happy Lake Ridge, Aurora Peak, and Sourdough Mountain (Appendix D). All records have been from west of the Elwah River (Fleckenstein 2013). No complete inventory has been done, and Fleckenstein (2013) identified several locations that need to be surveyed. It is uncertain how many gopher subpopulations exist 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 surveys did not detect them in potential habitat at many sites in areas adjacent to known current and historical sites, and at three historical localities where Murray Johnson also did not detect gophers in 1951 and 1976 (M. Johnson, *notes on file*; Steinberg 1996b, C. Welch, pers. comm., Fleckenstein 2013). Recent records are within an area of 14,820 ac (6,000 ha), but with probably <2,470 ac (1,000 ha) of suitable habitat (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.). Of 21 occupied patches surveyed by Fleckenstein (2013), only 4 were larger than 2.5 ac in size. Patches were separated by 50 to several hundred meters of forest, and some patches appeared to support only a single gopher burrow system.

All known and probable locations for the gopher were in forest openings (Fleckenstein 2013). Ecological systems at these sites are mapped as North Pacific Maritime Mesic Subalpine Parkland, North Pacific Mountain Hemlock Forest, and North Pacific Mesic Western Hemlock-Silver Fir Forest (Rocchio and Crawford 2015). At a finer scale within these units, all gopher sign was in either grass/forb meadows or areas of largely bare soil at the edges of unstable slopes. Gopher castings and mounds were frequently clumped around patches of lupine, probably Arctic lupine (*Lupinus arcticus*). (Fleckenstein 2013). Forest encroachment seems to be affecting habitat, and no gopher sign was observed in forest or meadows heavily invaded by shrubs and trees (Fleckenstein 2013).

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.

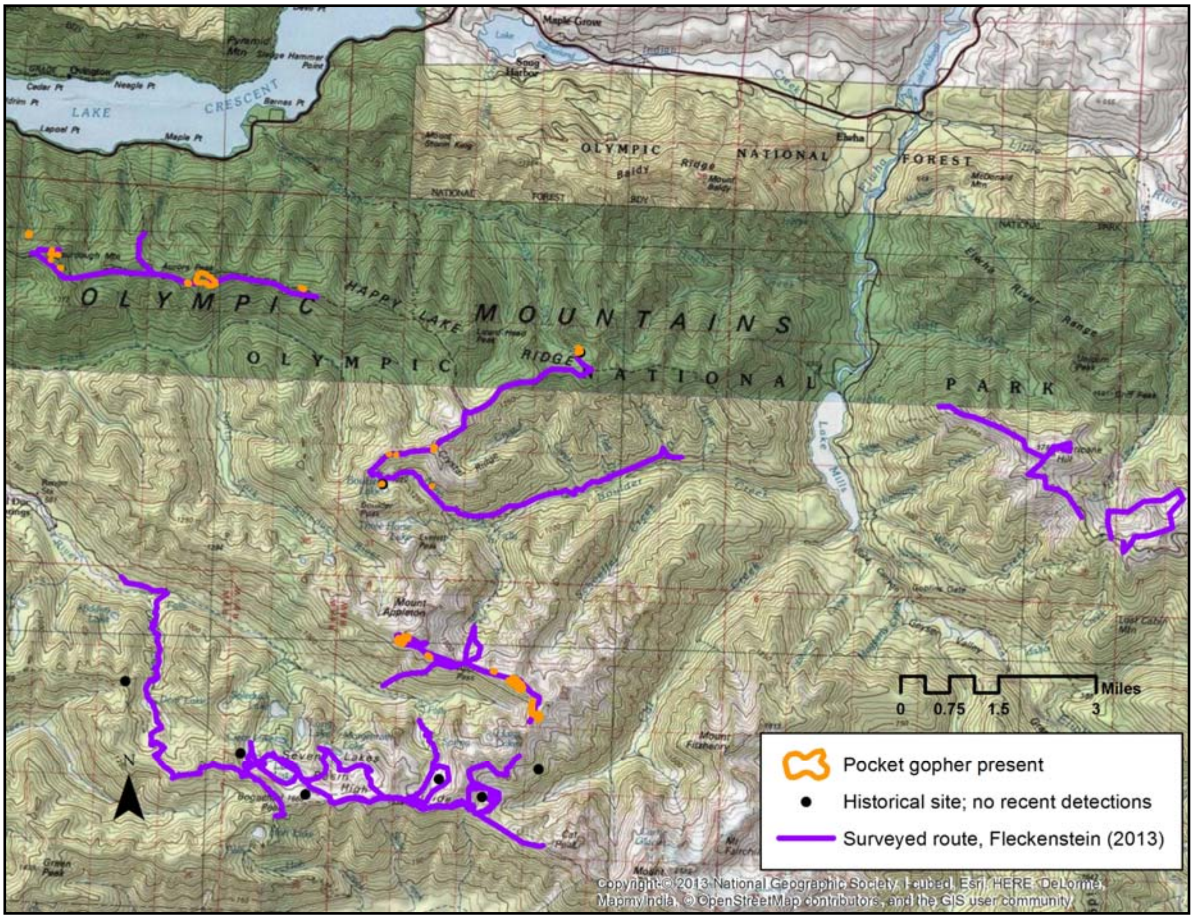

Figure 14. Recent surveys (Fleckenstein 2013) and *T.m.melanops* detections (Steinberg 1996b, C. Welch, pers. comm., Fleckenstein 2013), and approximate location of historical records, Olympic National Park (dark green shading is an artifact of combining two topographic maps).

MANAGEMENT ACTIVITIES

Habitat Protection and Conservation Planning

Dunn and Treadwell (2017) reported the results of a collaborative effort with members of the South Puget Sound Sentinel Landscape work group to analyze and review potential habitat for the conservation of Mazama Pocket Gophers in Pierce and Thurston counties. Using criteria from mitigation guidance about known occupancy by Mazama Pocket Gophers, location of Reserve Priority Areas (RPAs), parcel size, slope, soil type, and service area boundary (USFWS 2015), they conducted a GIS analysis to highlight potential habitat parcels. The effort produced maps and tables showing potential suitable gopher habitat that can be used in gopher conservation, prairie conservation, landscape scale planning, and budgeting needs.

Sites occupied by gophers in Mason County would be designated Fish and Wildlife Habitat Conservation Areas covered by the county critical area ordinance; development activities that require a permit from the county must delineate the occupied area and provide a Habitat Management Plan to avoid, minimize, and mitigate impacts of the proposed actions.

Habitat Conservation Plans. Landowners may receive a permit to take federally listed species incidental to otherwise legal activities, provided they have developed an approved habitat conservation plan (HCP) under Section 10 of the Endangered Species Act. The HCP goals are to avoid and minimize incidental take of the covered species and to mitigate the effects of unavoidable take, primarily by creating conserved habitat areas. HCPs include an assessment of the likely impacts on the species from the proposed action, the steps that the permit holder will take to avoid, minimize, and mitigate the impacts, and the funding available to carry out the steps. HCPs may benefit not only landowners but also species by securing and managing important habitat and by addressing economic development with a focus on species conservation. 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.

The City of Tumwater and Port of Olympia entered into an agreement to jointly develop a Habitat Conservation Plan (HCP) for Bush Prairie to address activities that affect listed and candidate prairie species and their supporting habitats. The proposed term for the Prairie HCP and permit is ~30 years. Thurston County has also been developing an HCP for activities conducted under the authority of Thurston County that would provide a county-wide permitting approach for Thurston County, and facilitate a more efficent local process. If these HCPs are approved by the USFWS, landowners who are issued a building/development permit from the city or county would be 'covered' by the assurances as long as they comply with the conditions of the permit. Although HCP development and approval can be a lengthy and expensive process, several private landowners or developers are developing or have completed HCPs for their land in order to proceed with development projects, and at least one other city and utility have applied for financial assistance for development of an HCP.

JBLM Endangered Species Management Component for the Mazama Pocket Gopher. The objective of the Mazama Pocket Gopher ESMC (Endangered Species Management Component) of the INRMP is to develop management prescriptions and actions that maintain and protect populations and Priority Habitat, support the continued survival of this species on JBLM, and provide for no net loss in the capability of the installation lands to support the military missions (JBLM Environmental Division, Public Works 2017). The INRMP identified 6,345 ac of Priority Habitat of Mazama Pocket Gopher. The primary conservation goals for the Mazama Pocket Gopher on JBLM include: 1) protection of gopher populations; 2) protection and enhancement of habitat areas for gophers; 3) development of a long-term gopher survival strategy; and 4) continue Army Compatible Use Buffer (ACUB) and other regional recovery efforts for the pocket gopher.

The plan states that JBLM will manage occupied and Priority Habitat areas appropriately. There are no plans to expand these protected areas outside of the habitat designated in this ESMC due to the potential impact to the training mission requirements (JBLM-ED- PW 2017). JBLM Fish & Wildlife will continue to manage unprotected occupied and potential habitat for the Mazama Pocket Gopher to contribute to population expansion. The JBLM Army Compatible Use Buffer (ACUB) Program has benefitted gopher recovery through a combination of off-installation efforts including prairie land acquisitions, funding of research, and restoration of degraded prairie habitats. JBLM also participates in other monitoring, surveys, and research projects.

ACUB. JBLM's ACUB Program was started in 2006 to relieve restrictions on training associated with species with potential to be listed under the Endangered Species Act by supporting the conservation of these species on lands off of the installation. To reduce the potential for additional restrictions, the Army undertook proactive conservation actions, both on and off JBLM, under the ACUB Program. Conservation actions funded by ACUB between 2006-2016 included land acquisition, habitat restoration, planning, species monitoring, and research. Although the Mazama Pocket Gopher ESMC refers repeatedly to actions to be done through ACUB, the program has been paused since 2016 while JBLM negotiates a debit/credit system with the USFWS.

Mazama Pocket Gopher working group and conservation action plan. CNLM facilitated Mazama Pocket Gopher workshops in 2006 and 2009, and annual working group meetings most years since, with funding from USFWS, U.S. Dept of the Defense, and other sources. This included the development and annual update of a 'conservation action plan', 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. The meetings convene biologists, planners, and land managers involved in Mazama Pocket Gopher conservation, protection, research, and recovery, and are useful in exchanging information and identifying conservation needs, problems and solutions.

Sentinel Landscapes. The U.S. Departments of Agriculture, Defense, and the Interior established the Sentinel Landscapes Partnership to better serve areas of the United States where working and natural lands converge with national defense facilities. The federal ESA listings have brought restrictions on military training and JBLM hosts some of the largest populations of gophers and other listed Puget prairie species. To help shift some of this burden and promote recovery at the regional level, JBLM was designated as a pilot Sentinel Landscape in July 2013, the first such designated landscape in the nation. The Sentinel Landscape is a diverse partnership working to preserve, restore, and manage critical prairie habitat. Goals of the partnership are to protect annual use of training areas, work with landowners to develop and implement pastureland conservation plans, and protect the diminishing south Puget Sound prairie habitat and promote the recovery of species, including the Mazama Pocket Gopher. Partner organizations include state and local agencies, land trusts, universities, and CNLM. The partners support the JBLM Sentinel Landscape with ongoing technical assistance, identifying lands for agricultural easements with U.S. Department of Agriculture's Natural Resources Conservation Service's (NRCS) Agriculture Conservation Easement Program or acquisition through ACUB and the Department of Defense's Readiness and Environmental Protection Integration Program, prairie habitat restoration. Together, they hope to ensure the viability of JBLM's mission, imperiled species, and working agricultural land in the South Puget Sound, using perpetual land management support and stewardship demonstration projects.

The JBLM Sentinel Landscape designation has encouraged landowners on private lands to work with the NRCS to develop pastureland conservation plans and apply improved conservation practices. The protection of these working lands helps to restore native prairies and species. Multiple properties with remnant prairie, including state- and county-owned lands and private lands purchased in-fee from willing sellers, are being managed as conservation preserves where native prairie is restored and the ESA-listed species are conserved or reintroduced.

Voluntary Stewardship Program. The Voluntary Stewarship program (VSP) is a voluntary state incentive based program for protecting critical areas, including gopher habitat, while maintaining economically viable agriculture (www.scc.wa.gov/vsp). VSP is an initiative under Washington's Growth Management Act that began in 2011, and Thurston County's work plan was approved in 2017 (https://www.co.thurston.wa.us/planning/vsp/voluntary-stewardship-documents.html). The program encourages farm owners to develop stewardship plans that balance critical areas (e.g. habitat) protection with their farming activities; funding is available for practices that protect habitat values. VSP does not "limit the authority of a state agency, local government, or landowner to carry out its obligations under any other federal, state, or local law" (RCW 36.70A.702).

Habitat acquisition. Acquisition efforts require willing sellers and available funding; some recent land acquisitions for conservation support Mazama Pocket Gopher populations. WDFW acquired 270 ac of private prairie/grassland in 2006 with federal and state grants, which now is part of the West Rocky Prairie Wildlife Area. TNC and WDFW acquired an easement on 127 ac adjacent to Weir Prairie now called Tenalquot Prairie Preserve, and managed by CNLM; more recently CNLM, with ACUB funding, acquired the 140 ac Deschutes River Preserve near the town of Rainier, and the 65 ac Violet Prairie-Scatter Creek Preserve, east of I-5 on Mound Prairie. CNLM also acquired the 138 ac Mazama Meadows on Mound Prairie, with funding from Thurston County. In 2019, WDFW used a federal grant to acquire a 72 ac conservation easement on Wilridge Estates on Mound Prairie that allows continued hay production.

Conservation banks. Conservation banks are likely to be established to conserve Mazama Pocket Gophers and other Puget prairie species. Conservation banks are lands that are permanently protected and managed as mitigation for the loss elsewhere of listed and other at-risk species and their habitat. Conservation banking is a freemarket enterprise based on supply and demand of mitigation credits. Credits are supplied by landowners who enter into a Conservation Bank Agreement with the USFWS agreeing to protect and manage their lands for one or more species. Landowners who need to mitigate for adverse impacts to the species may purchase conservation bank credits to meet their mitigation requirements. Conservation banking benefits species by reducing the piecemeal approach to mitigation that often results in many small, isolated and unsustainable preserves that lose their habitat functions and values over time. Mazama Meadows on Mound Prairie east of I-5 owned by CNLM will likely serve as a conservation bank, and others are likely to become established.

Habitat Management and Restoration

Habitat management and restoration for Mazama Pocket Gophers initially 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. Scotch Broom mowing or removal on Scatter Creek WLA has benefitted Mazama Pocket Gophers there, and ongoing prairie restoration activities on several sites re-establishes the food, cover, and seasonal dynamics to which the gophers adapted. 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, WDFW, the Center for Urban Horticulture at University of Washington, the Institute for Applied Ecology, and the Washington Department of Natural Resources. The south Puget Sound program of CNLM has been working with JBLM on prairie habitat enhancement and invasive species control under a cooperative agreement since 1992 (CNLM; the south Puget Sound office of CNLM was formerly part of The Nature Conservancy of Washington) for the 7,400 ac of prairie and oak woodland (J. Lynch, pers. comm.).

The prairie management strategy for JBLM includes the goals of maintaining viable populations of prairie associated species appropriate for each prairie, providing an adaptive management strategy for the listed species, and maintaining ecological processes and disturbances that maintain prairie function, such as fossorial excavation and fire (JBLM-DPW-ED 2017).

Enhancement of priority Mazama Pocket Gopher habitat on JBLM will focus primarily on prescribed fire, Scotch Broom and Douglas-fir control, and invasive species control, especially in areas where gophers are already known to occur (JBLM-ED-PW 2017). Control of broom, fir and other woody species (native and non-native) will mostly be achieved through prescribed fire and to a lesser extent, mowing and girdling. Control of invasive weeds also involves selective use of herbicide. Disturbed areas within suitable habitat are planted/seeded with native prairie species. Prairie restoration efforts for other species improves general prairie quality and benefit the pocket gopher by providing a diverse flora upon which it can forage (JBLM-DPW-ED 2017).

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 and replanting with natives, 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 (Davenport 1997). WDFW also has removed Douglas-fir on portions of West Rocky Prairie WLA. WDFW has been conducting habitat restoration with funds from the Washington Wildlife and Recreation Program and Competitive State Wildlife Grants programs.

Puget Sound Ecological Fire Program. Fire is an important disturbance, used by Native Americans to maintain prairie habitat during the past several thousands of years, and prairie plant and animal species have adaptations and dependency on fire. Without fire, the degradation and loss of prairie habitat and associated species continues. Prescribed fire has again become an important tool for restoring and maintaining prairie habitats, and an interagency fire program has faciliated an increase in the lands treated. Prior to 2008, only one to two burns were done annually, but since the multi-agency Puget Sound Ecological Fire Program was organized, efforts have scaled up in operational capacity, regularly completing 70–90 burns/year in the region (PSEFP 2019). In 2019, the program was able to complete 116 burns on 11 properties, totaling 2,511 acres (PSEFP 2019).

Research

Since the work of Dalquest and Scheffer (1944), Gardner (1950), and Johnson and Benson (1960), the Mazama Pocket Gopher had received limited research attention in Washington until recently. Some research on the species was conducted in Oregon 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). In Washington, Witmer et al. (1996) collected data on biology and habitat use of Mazama Pocket Gophers 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.

Genetics. Steinberg (1995, 1999) re-examined five of the eight *T. mazama* subspecies in Washington using differences in the mitochondrial gene, cytochrome-b. 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 (G.J. Kenagy, pers. comm.). More recently, WDFW completed a genomic analysis of nuclear DNA (Warheit and Whitcomb 2016; see *Taxonomy and distribution*).

Survey methodology for the Mazama Pocket Gopher. 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 confirm 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.

Olson (2011) investigated the relationship between pocket gopher mounds and abundance at two Thurston County sites, the Olympia Airport and Wolf Haven International. Olson (2011) also modeled site occupancy, within-site use, and detection probabilities of Mazama Pocket Gophers in Thurston and Pierce Counties. Olson (2017a) developed standardized transect and plot-based survey methods for determining site occupancy, population estimation, and trend monitoring.

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 a population 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 2016). 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. In 2014, the population was estimated at 558 (249–866, 95% CI; Olson 2016).

Dispersal. A study of pocket gopher dispersal was initiated by WDFW in 2010 on Weir Prairie (Olson 2015). The project was designed to investigate key aspects of their population dynamics necessary to assess current status, estimate risk of extinction, and inform measures taken to reduce this risk. Dispersal is a key component of spatial population dynamics for both genetic and demographic reasons, yet dispersal characteristics of Mazama Pocket Gophers were largely unknown. Results are discussed in this document under the heading *Dispersal and movements in T. mazama*.

Effects of prescribed burns on gophers. Prescribed fire is a key restoration tool because it can kill exotic shrubs, eliminates thatch, mosses and lichen and can be deployed relatively efficiently over large areas. Mazama Pocket Gophers should eventually benefit from the habitat improvements provided by prescribed fires, but the short term impact of prescribed burns on pocket gophers was largely unknown. Two recent studies investigated the effects of prescribed burns on Mazama Pocket Gophers. Olson (2017b) investigated the short-term effects of prescribed burns on gophers using radio telemetry. The late season (21 September) burn left more residual vegetation than is typical and there was no statistical difference in survival rates between treatment and control plots. Causes of a few mortalities suggested that lack of cover resulted in greater exposure of gophers to predation. Hill et al. (2017) looked at the relationship between fire intensity and severity and gopher occupancy on JBLM's Rainier Training Area. They observed a short-term impact after a burn in 2015, a drought year, but gopher occupied area appeared to returned to the pre-burn level the following spring. Reduction of gopher-occupied area was less pronounced after burns in 2016, a more typical year (Hill et al. 2017, Kronland et al. 2018). Additional research is needed to evaluate short term and longer-term effects of prescribed burning programs on Mazama Pocket Gophers.

Effects of grazing treatments. In 2018, a collaborative three year research project began that will study the potential for rare species conservation on grazed prairie in south Puget Sound, with funding from a Sustainable Agriculture Research and Extension grant (Bramwell 2019). The project is a collaboration between the WSU Thurston County Extension Agriculture Program, CNLM, WSU Vancouver, Thurston County Community Planning, and three ranches in Puget Sound. The objectives include developing a regional network of on-farm experimental demonstration sites to evaluate effects of Conservation Grazing Practices on prairie habitat. Among hypotheses that will be evauated is that occupancy of by Mazama pocket gopher, is not significantly different between grazed and ungrazed prairie sites (Bramwell 2019).

Information and Education

Various information products have been produced in recent years, including fact sheets, FAQs, web pages (USFWS, WDFW, and conservation organizations), and a handy card (Fig. 15) that attempts to remove some mystery in identifying gophers vs. moles, though it is often not easy from mounds (the species also has its own Wikipedia entry).

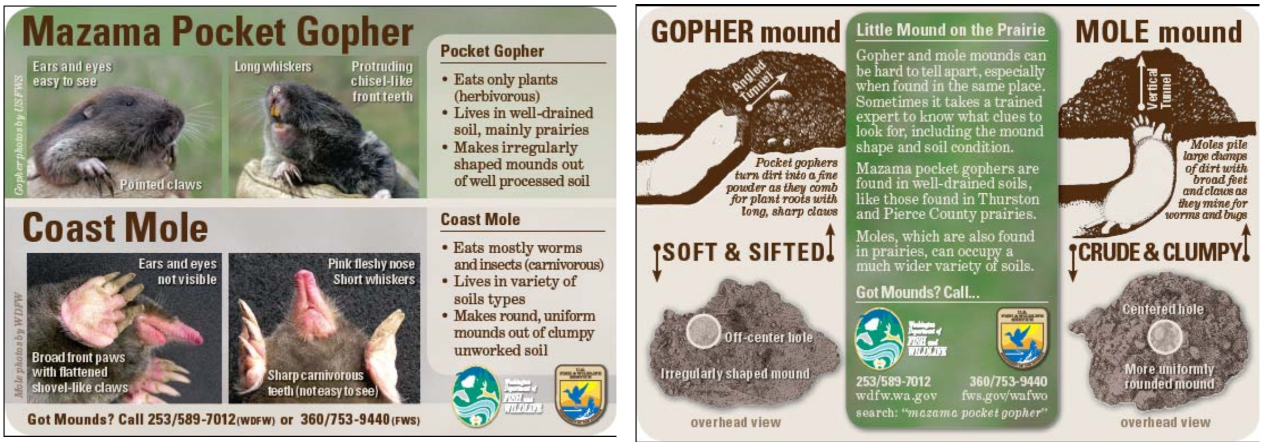

Figure 15. Identification card helpful for identifying moles vs. gophers.

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 best management practices to reduce impacts on prairies, while remaining compatible with other land uses, such as pastures, farming, gardens, and lawns, and provides information about restoration tools specific to Pacific Northwest prairies, and incentive programs available to private landowners to implement prairie restoration.

FACTORS AFFECTING MAZAMA POCKET GOPHERS

Adequacy of Existing Regulatory Mechanisms

Federal protection. The USFWS listed four subspecies in Thurston and Pierce counties (*T. m. pugetensis*, *tumuli*, *yelmensis*, *glacialis*) as threatened under the federal Endangered Species Act, effective 9 May 2014, and designated critical habitat (USFWS 2014a,b). They also promulgated a special rule pursuant to section 4(d). The listing prohibits take, and the 4(d) rule exempts certain activities on specified types of land from the 'take' prohibition. 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 consultation with the Service.

4(d) Rule. Under the special rule, take of these subspecies caused by certain activities would be exempt from prohibitions identified in section 9 of the Act. These exempt activities include airport management actions on civilian airports; certain common practices by agricultural operations on state, county, private, or tribal lands; certain ongoing single-family residential noncommercial activities; noxious weed and invasive plant control conducted on non-federal lands; and certain vegetation management actions and fencing of roadside rights-of-way on highways and roads by federal, state, county, private, or tribal entities. Activities on federal lands or with any federal agency involvement will still need to be addressed through consultation under section 7 of the Act (USFWS 2014a:19790).

Critical habitat. Critical Habitat designation affects federal actions on specified lands by triggering consultation with the USFWS under Section 7 of the ESA when a federal action may affect a listed species. Critical Habitat for three listed subspecies was designated at four locations in Thurston County and totals 1,607 ac (USFWS 2014b). An additional 7,625 ac met the legal definition of Critical Habitat, but was not included; 6,345 ac on JBLM were exempted because there is an approved Integrated Natural Resources Management Plan and associated Endangered Species Management Components, and 1,280 ac of state or private lands covered by other conservation plans that provided adequate management or protection were also excluded (e.g. Habitat Conservation Plans, Wildlife Area Plans).

JBLM. After Section 7 consultation by the U. S. Army and Air Force, USFWS produced a programmatic biological opinion (PBO) for the training, recreation, and other activities on JBLM (USFWS 2017c). It includes mandatory terms and conditions intended to minimize the impact of incidental take and foreseeable adverse effects to the Mazama Pocket Gopher, and requires annual reports to the USFWS. The measures described are non-discretionary and must be undertaken by JBLM to avoid 'take' in violation of Section 9 of the ESA. The PBO states that the action, as proposed, will not appreciably reduce the likelihood of survival and recovery and not likely to jeopardize the continued existence of the Mazama Pocket Gopher subspecies present on JBLM (USFWS 2017c).

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 (WAC 220-200-100 and RCW 77.15.130). Their habitat receives protection through county or municipal critical area ordinances. Critical area ordinances that address wildlife species of conservation concern 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 activity is proposed where gophers are likely to be present (e.g. suitable soil types) the developer must have a survey conducted to determine if gophers are present (https://www.co.thurston.wa.us/permitting/gopher-reviews/index.html). Since the 2014 federal listing, if gophers are present, applicants in Thurston County, and Pierce County (near the town of Roy) must contact the USFWS; if the project may have unavoidable impacts to gopher they would need an approved Habitat Conservation Plan (see HCPs above). If or when the Tumwater/Port of Olympia and Thurston County HCPs are approved, the process should be speeded up and projects may proceed after contributing to a mitigation bank that would be working on gopher conservation and recovery.

If gophers were detected in a survey for a Mason County (state-listed species not federally listed) project, the applicant needs to assess the impact to gophers, and submit a Habitat Management Plan to the county. The county (or city) would 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 (HMPs) were developed for gophers for over 60 sites in Thurston County during 2004-2014. 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. One set-aside in Pierce County has been maintained since the early 1990s and still supports gophers. HMPs typically require perpetual management to prevent broom invasion, and most Thurston

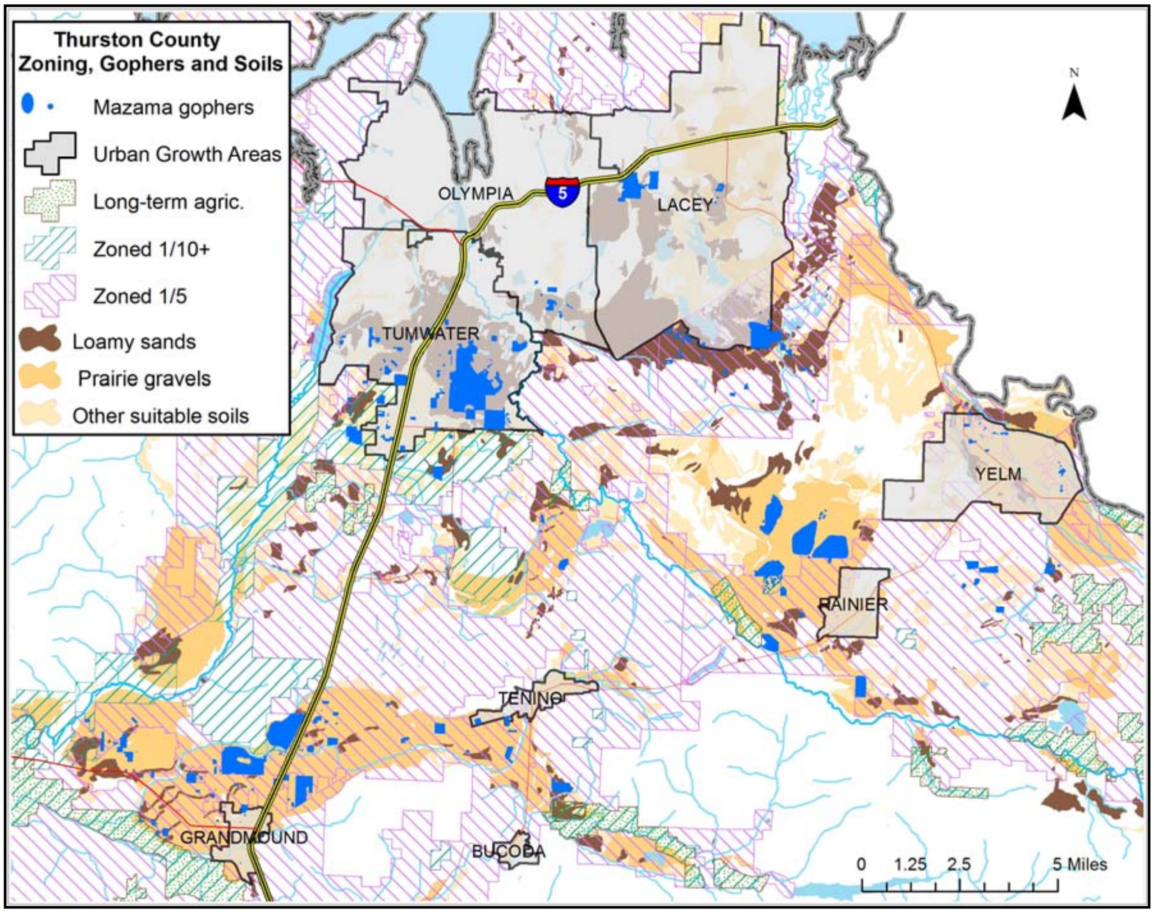

Figure 16. Thurston County zoning, Urban Growth Areas, gopher occurrences and selected soils.

County set-asides were being maintained based on recent site visits (M. Tirhi, pers. comm.). The sites are generally small and can become defacto off-leash dog areas, but if maintained in suitable condition, they may provide stepping stone patches; in combination with other 'satellites', they may contribute to the establishment of functional reserves complexes.

Most of the areas of optimal (hypothesized) loamy sand soils (Nisqually, Indianola), including the Olympia Airport, are within the Urban Growth Areas (UGA) of Tumwater, Olympia, and Lacey (Fig. 16). Under the state's Growth Management Act, county and city Comprehensive Plans designate urban growth areas that "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 ac or 1 unit/10 ac, which may be compatible with gopher occupancy. Off-site mitigation may be preferable for smaller populations in most urban growth areas, when options such as a mitigation bank are available.

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 predicted to increase from an estimated 7.5 million in 2019 to 9.2 million by 2040 (Office of Financial Management 2018; https://www.ofm.wa.gov/sites/default/files/public/dataresearch/pop/stfc/stfc_2018.pdf) 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 55,000 residential units (Sustainable Thurston 2013). 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, factors that increase mortality and inhibit breeding and dispersal may speed their extinction. These factors probably include habitat loss, degradation, and fragmentation, trapping and poisoning by homeowners, and predation by dogs and cats. Kronland et al. (2018) reported a possible negative association between gopher abundance or occupancy and rhizomatous (turf-forming) grasses, that suggests that maintaining prairie habitat quality may be beneficial to gophers.

Most occupied habitat on public lands is affected by non-conservation uses including military training and recreation. The potential effects on gophers of many of these activities are largely unknown, but recreational off-roading can quickly kill all vegetation in an area. Non-military all-terrain vehicles (including dirt bikes and four-wheelers) are strictly prohibited on JBLM except in a designated Off-Road Vehicle Park in Training Area 4.

Implications of habitat loss for populations. Pocket gophers are vulnerable to local extinctions because of the small size of many local breeding populations (Steinberg 1999). 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 groups, 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 and invasion. 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 are intolerant of overhead cover, and many areas have succeeded to forest or have been planted or degraded to turf-forming grasses and exotic annuals. For example, invasion of alpine meadows by trees within the range of *T. m. melanops* may pose a

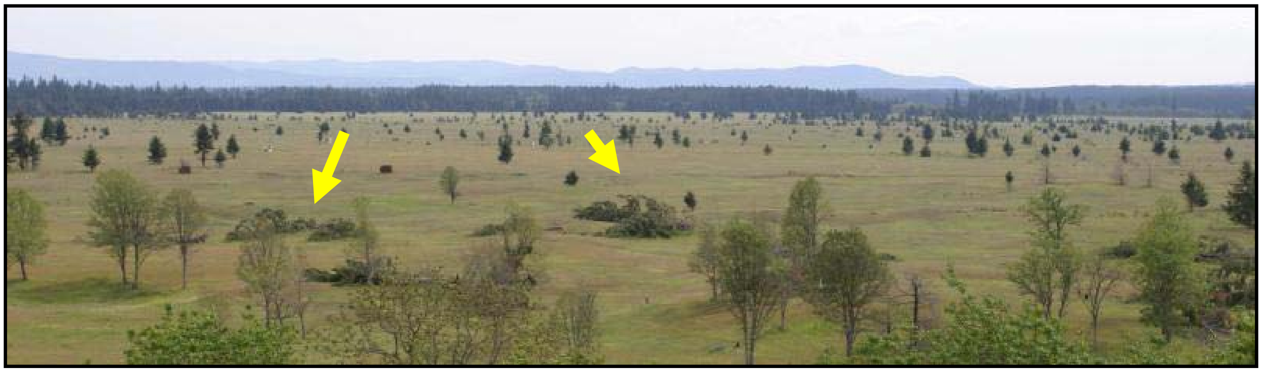

Figure 17. Ongoing removal of Douglas-fir that have invaded Fort Lewis prairie (*Photo by Rod Gilbert*).

significant threat by reducing the area of suitable habitat and isolating habitat patches. 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 affects 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 plant species.

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 2011). 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.

The fire regime established and perpetuated by Native Americans maintained the south Puget Sound prairies for the past 4,000 years or more. The cessation of maintenance burning allowed succession by both native and exotic flora; without vegetation management, the prairies would probably slowly disappear. The invasion by fire-sensitive species allows an unusual build-up of fuels that can lead to very hot fires that harm normally fire-tolerant native species (Tveten 1997). The cessation of burning allows Douglas-fir to invade and overwhelm grassland habitat (Fig. 17). 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, JBLM, 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 JBLM, Mima Mounds and Rocky Prairie NAPs, Thurston County's Glacial Heritage Preserve, Scatter Creek and West Rocky WLAs.

Where Mazama Pocket Gophers are found in 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.

Gravel mining. Some Mazama Pocket Gopher habitat is located on deep 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. It is uncertain if restoration of gravel extraction sites to suitable condition for gophers is economically feasible.

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 an irritant 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. For small and isolated populations, mortalities from persecution added to other hazards may eventually lead to extirpation, and may have been a contributing factor in the apparent extinction of *T. m. tacomensis*.

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), and other small vertebrates including 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. On JBLM, various activities with dogs is considered the most important threat to Mazama Pocket Gopher from civilian recreational users (JBLM ED-PW 2017). Some of these activities include walking dogs, training of hunting dogs, or pheasant hunting. Dogs have been observed digging for Mazama Pocket Gophers and catching and killing them. On JBLM, dogs are required to be leashed at all times in priority and occupied Mazama Pocket Gopher habitat, and are not allowed to dig in occupied habitat. Dog owners caught out of compliance with these rules are prohibited from accessing JBLM indefinitely.

Livestock grazing. Studies in California indicate that pocket gopher density tends to decrease in heavily grazed pastures (Eviner and Chapin 2003), and Steinberg (1996a) did not detect gophers at several locations where they had previously existed on pastures near Tenino, Littlerock, and Vail. There is a 3-year study underway in Thurston County to investigate the relationship between livestock grazing and

Mazama Pocket Gopher occurrence (Bramwell 2019; see *Effect of grazing treatments* in *Research*). Light grazing can benefit perennial forbs which gophers prefer by reducing grass height (M. Chaney, pers. comm.), and gophers have persisted in pastures of well-managed ranches in Thurston County.

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 should aircraft overshoot or land short of the runway. This management benefits gophers by maintaining the grassland and keeping out woody vegetation and fencing 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), which would require Section 7 consultatuion with USFWS. 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 Plan projects significant future land developed for general aviation (~114 ac), aviation related/compatible industry (~245 ac), and additional area for parallel taxiways (Barnard Dunkelberg & Co. 2011). However, the Port of Olympia and City of Tumwater are currently working on an HCP that will be submitted for approval by USFWS, and mitigation for impacts to occupied gopher habitat would be required by an HCP and 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 a 75 ac area of Port property where Scotch Broom and other woody vegetation would be controlled to replace gopher habitat lost to development. The Port of Shelton Comprehensive Plan was revised in 2014 (http://www.portofshelton.com/downloads.html).

Military training and land management on Joint Base Lewis-McChord

The presence of Fort Lewis (now part of JBLM) has generally been positive for Mazama Pocket Gophers by maintaining habitat that supports substantial populations. However, the number of Army personnel stationed at JBLM has increased in recent years, and the increase in training needs may increase impacts on grasslands and pocket gophers. JBLM's ESMC for the species outlines plans for minimizing negative impacts on gophers and their habitat (JBLM ED-PW 2017). All projects that will negatively impact gophers or remove or degrade Mazama Pocket Gopher habitat are subjects of Section 7 consultation with the USFWS and review by JBLM Fish and Wildlife. Anticipated impacts and the measures required to avoid and minimize incidental take are described in the PBO that addresses the activities planned on JBLM through 2020 (USFWS 2017c).

Activities that have the potential to impact gophers include but are not limited to: activities that cause major soil disturbance and compaction, construction, digging/trenching, graveling, wildfires, bombardment, use of live ammunition, off-road maneuvers, use of herbicides or pesticides, mowing, prescribed fire, and civilian recreation with domestic animals (JBLM ED-PW 2017). It is not known what degree of soil compaction occurs from vehicles, but repeated or extensive vehicle maneuvers may crush burrow systems and result in compacted soils that prevent gophers from burrowing and accessing food. Digging activity removes vegetation and creates disturbed sites that are susceptible to colonization by exotic weeds, and presumably disturbs gophers. 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). Some soil contamination from vehicles, explosives, metals, and other chemicals likely occurs.

Fires help reduce invasion by Douglas-fir and Scotch Broom, but portions of the Artillery Impact Area that burn too frequently, have a cover of mostly exotic annual grasses (Tveten and Fonda 1999); although grasses provid an important winter food for gophers, forbs are consistently preferred, and reduction of forbs reduces pocket gopher populations (Keith et al. 1959, Tietjen et al. 1967). Changes that decrease the cover of perennial forbs and result in more annuals would likely have a negative effect on gophers. Areas damaged by military training are repaired by JBLM's 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).

Mazama Pocket Gophers exist primarily on prairies at JBLM where vehicular traffic is currently restricted to established roads. The training most damaging to vegetation has been concentrated on the same areas, so some less-used prairies have been maintained in good condition. Off-road vehicle traffic, digging, and other soil disturbing activities, are prohibited by JBLM regulation on Upper Weir (TA-21), Lower Weir (TA-21), Johnson prairie (TA-22) and South Weir (TA-23), although these areas occasionally receive off-road use by both military and civilian vehicles even though signs are posted which forbid it. The most likely impacts to the populations in these prairies will come from civilian recreation and domestic animals. Most of the AIA (91st Div. Prairie) is also protected from off-road vehicle traffic by default because of safety issues with unexploded ordnance.

JBLM intends to explore ways to reduce training pressures on occupied and priority gopher habitat by creating additional open training lands in TA 13, 14, and 23. These areas will be maintained as open grassland habitat suitable for off road military training (JBLM ED-PW 2017).

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 will 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 climate change may affect the alpine meadow habitat of the Olympic Pocket Gopher which is otherwise secure from threats of habitat loss. Considerable tree encroachment has been evident during the 20th century, changing treeline dynamics and and further isolating and fragmenting the patches of meadow habitat (Woodward et al. 1995, J. Fleckenstein, pers. comm.). There were periods of increased tree establishment in subalpine meadows during the last century, with significant establishment of subalpine fir in the dryer northeastern areas of the Olympics during a wetter period from 1956 –1985, and establishment of Mountain Hemlock in the wetter southwestern parts during a drier period from 1921–1945 (Woodward et al. 1995). 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). But drier summers may also result in an increase in area of dry meadow habitat used by gophers, and increased drought fequency or severity may result in increased fire frequency, potentially offsetting the threat of conifer encroachment (Halofsky et al. 2011).

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).

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 small. The only immediate potential human-related impacts may be from trampling damage and erosion and the potential for long-term negative effects is unclear. Johnson (1977) reported apparent extinctions during the 20th century. Significant changes to the Olympic alpine ecosystem that may affect gophers include the introduction of Mountain Goats that affected vegetation (Houston et al. 1994, Olympic National Park 2018), 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). 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), may have negatively affected 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). The removal of most of the Mountain Goats from Olympic National Park that began in 2018 (Olympic National Park 2018) may be beneficial for the pocket gophers.

RECOMMENDATION

Eight distinct genetic groups of the Mazama Pocket Gopher are found in parts of Thurston, Pierce, Mason, and Clallam counties in western Washington. Their populations have gone through a long history of habitat loss and extinctions, including the *T. m. tacomensis* and *T. m. louiei* subspecies. Due to their resticted distributions, these populations face various levels of threat from loss of habitat to development and other uses, and habitat invasion by forest or exotic Scotch Broom. Although their listing status has increased management attention, most populations are not known to have increased significantly and threats to their habitat remain.

We recommend that the species remain classified as a Threatened species in Washington. When the objectives for down-listing outlined in the following section are met, their status will be re-evaluated and described in a periodic status review with a recommendation about their classification at that time.

RECOVERY

Preface

The Mazama Pocket Gopher is state-listed as Threatened in Washington. The population objectives for recovery, described below, were set with the currently available information and may require future revision. 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 genetic groups in 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 support large subpopulation(s) when conditions are good, while providing some habitat complexity that helps ensure portions of sites will remain suitable during extremes of environmental variation. This suggests it is prudent to secure and restore habitat as needed to recover and maintain more than one population for each distinct genetic group or evolutionary unit, where possible.

Seven areas that contain significant numbers of Mazama Pocket Gophers in Thurston, Pierce, and Mason counties are identified for recovery emphasis (Fig. 18). Conservation of the populations in these seven areas (five in Thurston County, one in Pierce County, and one in Mason County) would preserve representative populations across their range in the south Puget Sound region. Conserving populations in Mason County and in both Thurston and Pierce counties is important because geographically separated populations represent some degree of genetic difference and perhaps adaptation to local conditions. Reserves will also help conserve other listed and unlisted prairie species, and the presence of gophers will maintain some ecological processes. They also include populations of each of the five described subspecies in the region (*pugetensis, tumuli, yelmensis, glacialis,* and *couchi*), and with the exception of *couchi*, these subspecies are now listed as Threatened under the federal Endangered Species Act.

Mazama Pocket Gophers in Clallam County (*T. m. melanops*) are not included in recovery objectives. They are found entirely within Olympic National Park, and there are no immediate threats to the population or habitat; however, they should be monitored periodically (Task 1.2) to assess the need for recovery and the potential need to address tree encroachment, coyote predation, and recreation.

RECOVERY GOAL

The goal of the recovery plan is to secure and maintain self-sustaining representative populations of all the distinct genetic groups of the Mazama Pocket Gophers within the current Washington range.

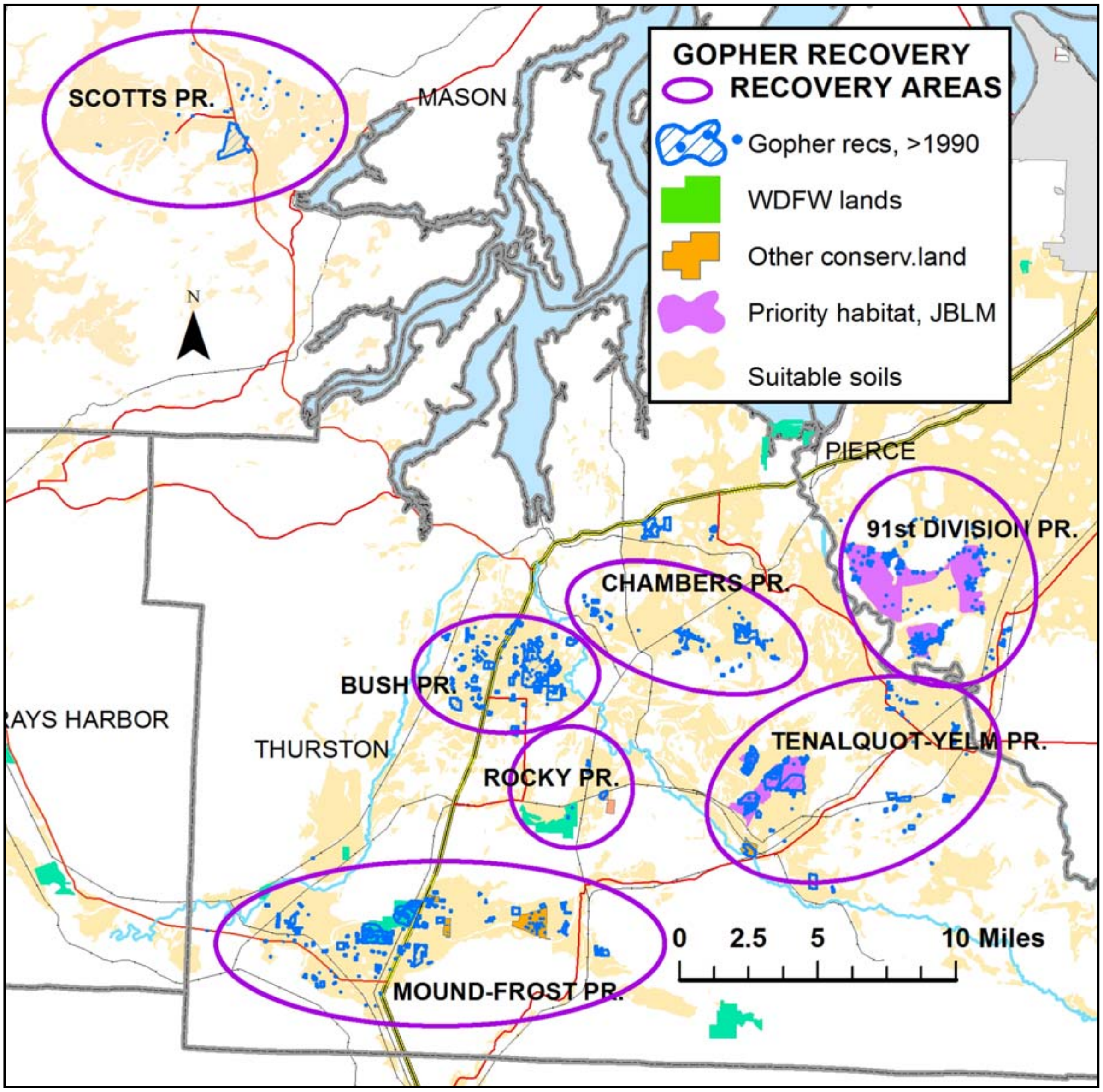

Figure 18. Mazama Pocket Gopher Records (2000-2017), conservation lands, and MPG Recovery Areas in the south Puget Sound region of Washington.

Definitions

Recovery Areas: 7 geographic areas encompassing the described subspecies and major genetic groups of Mazama Pocket Gophers (MPG) (Fig. 18).

Reserves and Reserve Complexes: A large contiguous patch ('Reserve Core'), or aggregation ('Reserve Complex') of 2 or more patches ('satellites'), of protected MPG habitat (Fig. 19). Reserves are located in Reserve Priority Areas (USFWS 2017b), designated critical habitat (USFWS 2014b), public or private conservation lands (e.g. WDFW Wildlife Areas, WDNR Natural Area Preserves, JBLM Priority Habitat, or Center for Natural Lands Management prairie preserves), with demonstrated commitment to perpetual management for MPG persistence. A Reserve Core is not contiguous with another Core. Development rights are retired by easement or deed.

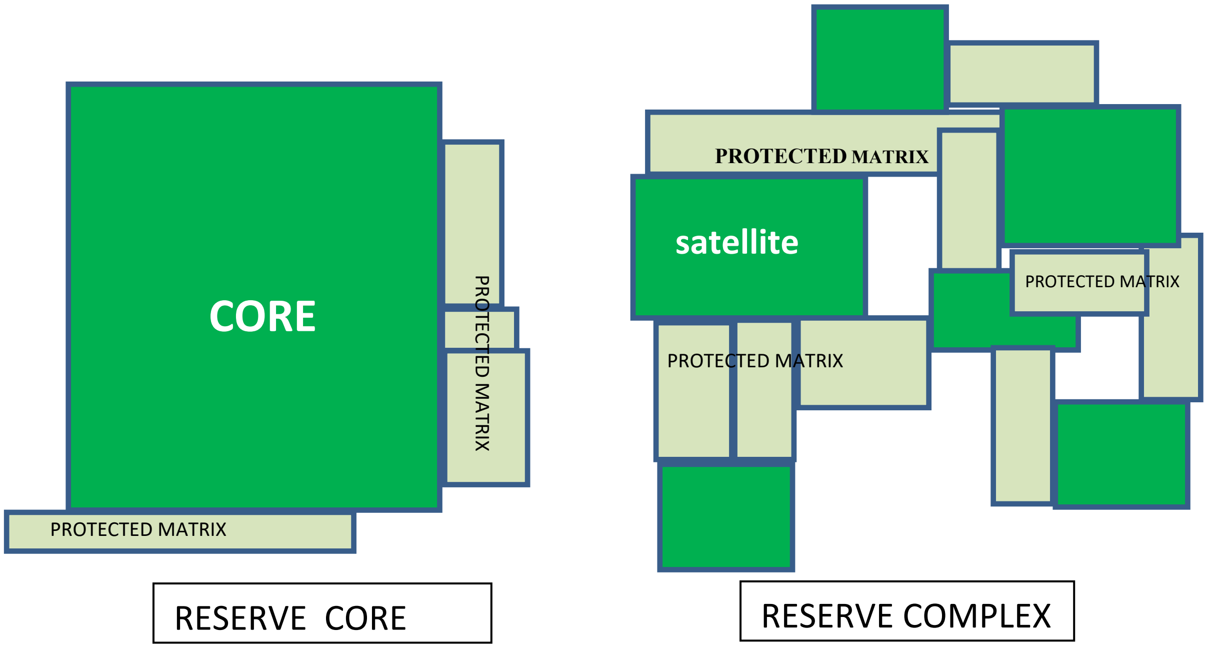

Figure 19. Schematic of Reserve types with a single core or multiple satellites connected by protected matrix (dark green = core or satellites; light green = protected matrix.

- **Reserve Complexes** are a network of two or more **Satellites** that are well connected by **Protected Matrix**.

- **Satellites**: A contiguous patch of protected MPG habitat (≥10 acres) equivalent in quality to a Reserve, but not large enough to independently support gopher persistence for >50 years. Satellites need to be connected by Protected Matrix to other Satellite(s) in a Reserve Complex to function effectively. Set-asides established under Habitat Management Plans prior to the federal ESA listing, or in Mason County, may be <10 acres, but would be considered Protected Matrix, unless intensively managed for MPG.

- **Reserve Cores and Reserve Complexes** contain enough suitable habitat (≥250 ac of Core or Satellites) with 'more preferred soil' (Table 3; USFWS 2018) to support ≥1,000 MPG (the population size likely [~98% probability] to persist for ≥50 years). Area needed is likely 250–500 acres of Core or Satellites depending on soils, habitat quality, and management.

Reserve Cores and Satellites are free of internal barriers that would prevent or substantially impair internal dispersal movements (but may include some non-habitat inclusions; Protected Matrix and non-habitat inclusions of measurable size will not count towards suitable habitat acres needed). Reserve Cores and Satellites with low edge-to-interior (E:I) ratios are considered higher quality because a smaller E:I ratio allows for greater likelihood of interactions between pocket gophers during the breeding season and facilitate dispersal and gene flow within populations.

Protected Matrix: public lands not dedicated to conservation (e.g. airports, city parks) or private rural residential or low intensity agriculture lands that are protected by conservation easements and management is compatible with gopher dispersal and some amount of occupancy and reproduction. Protected Matrix with a low edge-to-interior (E:I) ratio is considered higher function and more desirable because Protected Matrix has the essential role of providing connectivity between Satellites of a Reserve Complex. It may also be used to buffer Reserves from threats in adjacent developed areas (e.g. busy roads, dogs, cats, etc.). It is not included in the needed habitat acreage because it does not have management dedicated to MPG conservation.

RECOVERY OBJECTIVES

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

1) Two reserves or reserve complexes are established in each of the Bush Prairie, Mound-Frost Prairie, and 91st Division Prairie recovery areas, and one reserve each in Rocky Prairie, Tenalquot-Yelm Prairie, Chambers Prairie, and Scotts Prairie recovery areas;

2) Each of the reserves/reserve complexes in at least five of seven recovery areas, supports a population of ≥1,000 Mazama Pocket Gophers.

The Mazama Pocket Gopher will be considered for delisting when the following objectives have been met:

1) Three reserves or reserve complexes are established in the Bush Prairie and Mound-Frost Prairie (with >1 on each side of I-5), and three reserves in the 91st Division Prairie recovery areas, and two Reserves each in Rocky Prairie, Tenalquot-Yelm Prairie, Chambers Prairie, and Scotts Prairie recovery areas;

2). Each reserve and reserve complex in the seven recovery areas supports a population of ≥1,000 Mazama Pocket Gophers for a >20 year period.

Rationale

No estimates of the size of a minimum viable population have been reported for a pocket gopher species, but recent reviews suggest for most species a population of a few thousand or more is desirable for long-term persistence (Lynch and Lande 1998, Allendorf and Ryman 2002, Frankham et al. 2002, Reed et al. 2003, Traill et al. 2007, 2010). In the south Puget Sound region, only a few subpopulations, such as Olympia Airport and Scatter Creek Wildlife Area, and perhaps 91st Division Prairie appear to approach this size (1,000s). Many local subpopulations seem to be small or have scattered clumps of gophers, which may be the more typical situation.

The study of *T. mazama* in Thurston County by Warheit and Whitcomb (2016), and studies of *T. bottae* in California (Patton and Smith 1990, Steinberg and Patton 2000), indicate that pocket gophers, and probably subterranean rodents in general, differ from many species in that they maintain genetic diversity through populations consisting of multiple loosely connected subpopulations, rather than within a large well connected population. Furthermore, genetic diversity *within* subpopulations is low, but high *among* subpopulations, so that population diversity, and genetic diversity across the range of the species, is high. This pattern is likely normal for pocket gophers, and low subpopulation genetic diversity may not affect their probability of persistence as much as expected and observed in other species. Demographic factors that could result in local extirpation are of more immediate concern than genetic diversity in maintaining pocket gopher populations, particularly where small populations become isolated.

In order to meet the recovery objectives, it will be necessary to protect populations in the seven areas identified (Fig. 16), by establishing habitat *reserves*. The discontinuous nature of the habitat and gopher distribution suggest that some *reserves* may need to consist of multiple protected '*satellite*' sites and dispersal habitat between them (*protected matrix*) to facilitate dispersal, recolonization of vacant patches, and demographic recharge of subpopulations. These actions would help provide the representation and resilience suggested by Tear et al. (2005).

Size and number of populations: modeling. We used a population modeling approach to estimate the size of reserves needed to maintain a gopher population large enough to satisfy a defined, acceptable limit on extinction probability: less than 2% probability of extinction over 40 generations (50 years). We used the population viability analysis software, *VORTEX* 10 (Lacy and Pollak 2018) to estimate extinction probability under multiple model scenarios with varying initial population size, annual reproduction and mortality, carrying capacity, and reserve configuration. We modeled populations using expected values for demographic parameters from research on Mazama Pocket Gophers, or from the literature on similar species, and included the possibility of rare catastrophic events that would result in a 90% reduction in the population, such as wildfire or extreme drought. The result of these simulations was that a minimum population size of ~1,000 individuals generally and consistently met our extinction probability limit.

To estimate the size of reserves needed to support at least 1,000 pocket gophers, we assumed that gopher densities are around 5 and 10/ac in moderate and high quality habitats respectively, based on limited data collected from study areas in Thurston County. We also assumed an average of ~ 40% of the habitat in reserve areas would be occupied at any particular time because gophers seem to shift their area of use, perhaps as resources are depleted and recover (Smallwood 2001). Under these assumptions, a single contiguous *reserve core* would need to be 250–500 acres in size, depending on habitat quality to ensure acceptable persistence probabilities.

Establishing a single reserve appeared to be sufficient for long-term population persistence, but not when we included rare catastrophes (e.g. severe drought, fires, etc.). Modeling suggested that establishing two or three *reserves* increased the likelihood of persistence when catastrophes were considered, which would also provide the redundancy suggested by Tear et al. (2005). Therefore, recovery objectives call for at least two *reserves* for each genetic group, with three *reserves* for the largest prairie areas and where they are divided by Interstate 5.

We identified a minimum size of 10 ac for *satellites* because to assemble a reserve complex of ≥250 ac of satellites, smaller satellites add to the complexity and number of easement and management agreements required. Existing smaller set-asides established during county or city permitting could be included, but too many small satellites could add an inordinate amount of complexity, needed work, and fragmentation to the *reserve complex*. A 10 ac parcel, assuming 40% occupancy and good habitat, could potentially support ~40–60 gophers, a number that might be expected to persist while management agreements for protected matrix and connections to additional sateliites are being negotiated.

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. Fortunately, several areas with potential to serve as *reserves* or *satellites* already exist, though they may need improvements in habitat quality to provide and maintain high quality habitat. Incentive programs and partnerships with private landowners will be needed to establish and maintain functional patches of gopher habitat in rural residential and agricultural areas as *protected matrix* to connect the *satellites* of *reserve complexes*.

Needed research. Many aspects of the biology and conservation of Mazama Pocket Gophers remain poorly known, and recovery efforts are more likely to attain objectives with an improved understanding of genetics, population dynamics, movements, habitat needs and management, and limiting factors. Funding should be sought and partnerships between WDFW, universities, and other entities, fostered to conduct the needed research on this species in Washington.

RECOVERY STRATEGIES AND TASKS

(Note: Terms in italics are defined above.)

1. 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 first priority for recovering the species.

1.1 Determine the habitat needs of pocket gophers and the effects of low levels 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; this would help inform requirements for maintaining connectivity on matrix lands.

1.1.1 <u>Investigate effect of habitat characteristics on pocket gopher productivity</u>.

Improved information is needed on the effects of vegetation structure and composition, soil types, and habitat patch size, shape, and connectivity on the occurrence, productivity, and persistence of Mazama Pocket Gophers.

1.1.2 <u>Investigate dispersal in Mazama Pocket Gopher populations, including distance and frequency, and characterize habitat corridors and barriers to gene flow between populations</u>.

Investigate dispersal through demographic and/or genetic methods. Olson (2015) reported some data on dispersal, but additional data would be helpful, such as understanding of what constitutes a barrier to dispersal to help delineate populations. This may also help characterize effective connectivity and inform conditions for management of reserves and protected matrix.

1.1.3 <u>Investigate pocket gopher occurrence and persistence in residential areas, pastures, and agricultural lands to assess tolerance for residential development and agricultural activity</u>.

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

1.1.4 Investigate the habitat requirements of pocket gophers occurring in commercial timberlands and along roadsides, and potential for habitat management to facilitate dispersal and persistence.

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. Develop best management practices for *T. m. couchi* populations in commercial timberland that are compatible with forestry objectives.

1.1.5 Investigate other aspects of the biology of pocket gophers related to habitat needs.

Increased knowledge of diet, home range, activity patterns, spatio-temporal patterns of occupancy, and other life history features is needed for habitat management, predicting site potential, evaluating survey data and techniques, and conservation planning.

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

Although gophers can subsist on non-native species, the long-term stability of gopher populations in non-native vegetation is uncertain. The native prairie vegetation has proven drought tolerant in the past, and has sustained gophers and populations of other species (e.g. butterflies, Streaked Horned Larks, Oregon Vesper Sparrow, etc.) of conservation concern. Striving to enhance native vegetation has the added benefit of providing for these species in addition to gophers. If summer droughts become more severe, then incorporating additional, perhaps non-native species may be needed.

1.2.1 Improve methods of controlling weeds and restoring native vegetation that is beneficial to gophers and other prairie species.

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

1.2.2 Refine understanding of the effect of prescribed burning practices on pocket gophers and their effectiveness to improve habitat for pocket gophers.

The responses of pocket gopher populations to prescribed burns should be further assessed and monitored. Prescribed burns are often used to maintain grasslands by controlling conifer and Scotch Broom invasion. Olson (2017b) and Hill et al. (2017) described short term responses of gopher numbers to prescribed burns, but additional data may be needed.

1.2.3 Develop and refine native plant lists for pocket gopher habitat enhancement projects.

Use information from field trials or observations to help inform habitat improvement projects.

1.3 Update information about soil suitability for pocket gophers.

Soil characteristics are important in determining the distribution and abundance of pocket gophers and determinng the value of potential recovery sites. Uncertainties still exist regarding the suitability of some soil types for gophers, especially in Mason County. USFWS (2018) reported a list of ‘preferred’ soils (*see* Table 3), based on detections during surveys in Thurston County; this list should continue to be updated as more data become available in the future. If/when NRCS (Natural Resource Conservation Service) revises soil classification, update recovery documents with new information.

1.3.1 Update information about soil suitability for pocket gophers in Thurston and Pierce counties.

1.3.2 Improve information about soil suitability for pocket gophers in Mason County.

1.3.3 Improve information about soil suitability for pocket gophers in Clallam County.

1.3.4 Update recovery documents with new soil information or classifications.

1.4 Protect and manage Mazama Pocket Gopher habitat on public lands.

1.4.1 Include gopher conservation and management of habitat in management plans for WDFW.

Incorporate habitat management actions beneficial to pocket gophers in management plans for Scatter Creek and West Rocky Prairie wildlife areas, (e.g. Scotch Broom control, Douglas-fir removal from prairie soil areas, etc.), and any acquired WDFW lands within the range of Mazama Pocket Gophers, and update as needed.

1.4.2 Exchange technical information with Joint Base Lewis-McChord, the ports of Olympia and Shelton, WDNR, counties, and other public entities to protect and manage pocket gopher habitat on public lands.

Public entities manage public lands that are important for pocket gopher recovery. Share technical information with these entities to protect, restore, and manage gopher habitat on their lands through various actions, such as reviewing management plans, conducting restoration projects, using appropriate mowing regimes, and implementing mitigation for loss of habitat.

1.4.3 Maintain, enhance, or restore pocket gopher habitat on sites with potential to serve as *reserves*, and *satellites*.

Maintenance of grassland requires control of Scotch Broom and other invasive vegetation. Habitat enhancement and restoration methods to control invasive vegetation such as mowing, 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 reserves, satellites, and the protected matrix, particularly areas that allow expansion of existing subpopulations, areas currently occupied, sites that may benefit from improving plant diversity, and potential areas selected for reintroduction projects, if that is determined an appropriate strategy.

1.4.4 Seek long-term commitments that protect pocket gopher habitat on public lands.

Assist managers of other public lands to establish, where appropriate, conservation easements, cooperative agreements, habitat conservation plans, mitigation banking mechanisms, and other long-term measures for protecting, restoring, and managing gopher habitat on lands they administer.

1.5 Protect pocket gopher habitat on private lands to maintain or increase connectivity among gopher populations through conservation easements, mitigation banks, cooperative agreements, or acquisitions.

The long-term viability of some populations will depend on the connectivity among two or more *satellite* sites. Strategies to develop and increase connectivity in the matrix should be employed to facilitate dispersal movement potential, which will support demographic stability. Mechanisms to preserve habitat with conservation value include conservation easements, management agreements, mitigation banks, and land acquisitions from willing landowners. Priorities are occupied areas important to supporting populations in the areas identified for recovery (Fig. 18), and connectivity between subpopulations within *reserves* and between *satellites*. While the emphasis for recovery is on public lands wherever possible, it is recognized that private lands also play an important role in preserving connectivity and maintaining important populations. Work with counties, cities, non-governmental organizations, and the USFWS to protect habitat on private lands that are important for connectivity or with populations of gophers with potential for long-term persistence. For populations in high density urban growth areas with lower prospects for persistence, off-site mitigation, such as mitigation banks will be important.

1.5.1 Identify and acquire important habitat from willing sellers for *reserve cores* and *satellites* if, and where, this provides the best option for protecting or restoring essential habitat for gophers.

1.5.2 Identify locations where conservation easements on private lands would be most valuable to establish *protected matrix* of habitat between *satellites*.

Gophers seem able to persist in at least low densities on rural residential and low intensity agricultural lands with appropriate soil and herbaceous vegetation, and that are largely free of woody cover. Therefore, easements that secure development rights, but allow landowners to continue all or most current uses may be attractive to some landowners and be effective at providing needed connectivity. Easements for pasture land may be eligible for funding under the Agricultural Conservation Easement Program (ACEP) in the federal Farm Bill that protects farms and grasslands while maintaining areas as grazing lands. Work with local non-governmental organizations when appropriate.

Identify likely or potential corridors among sites based on gopher records, aerial photographs, vegetation, and soils data. Sites for potential easements should be evaluated by site visits, surveys and/or data from research to confirm their potential and determine if any enhancements are necessary.

1.5.3 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 and Habitat Management Plans in Mason County. Provide technical assistance to Thurston County, Pierce County, cities, Port of Olympia, and any other entities that may develop similar plans. Where subspecies are federally listed (Thurston and Pierce counties), the USFWS has the permitting authority and may grant approval of Habitat Conservation Plans (HCPs) to jurisdictions and landowners.

1.5.4 Establish habitat mitigation banks for pocket gophers.

WDFW should provide information to partners in discussions to establish habitat mitigation banks for Mazama Pocket Gophers in Washington.

1.5.5 Develop standards for conservation easements for private residential and agricultural lands that would protect gopher habitat values for *protected matrix*.

1.5.6 As opportunities arise, assist with enhancement or restoration of pocket gopher habitat on *protected matrix* and other matrix lands with potential for improving connectivity.

Conduct activities such as mowing, tree and shrub removal, planting and/or maintenance of vegetation that helps facilitate dispersal and movement of gophers between and among populations. WDFW should work with partners to develop best management practices for managing matrix lands.

1.5.7 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 suitable soil areas.

1.5.8 Assist private landowners with enrollment in incentive programs to maintain suitable habitat conditions (Voluntary Stewardship Program, Sentinel Lands, ACEP, Environmental Quality Incentives Program [EQIP]).

1.5.9 Provide information about potential property tax reduction for pocket gopher habitat under county Open Space Tax programs and conservation easements available for establishing protected matrix.

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

2. Monitor Mazama Pocket Gopher populations.

Monitoring of populations is needed to determine if reserves are supporting the needed populations and to determine when recovery objectives are achieved. Knowledge of population trends are key components of conserving Mazama Pocket Gophers in Washington.

2.1 Refine methods for estimating population sizes and monitoring pocket gopher population trends.

Monitoring populations of pocket gophers will require development of a sampling scheme and protocol for determining occupancy and population trends. Survey methods have been developed

(Olson 2017a) and validation is nearly complete with implementation expected later this year.

2.1.1 Refine/test methods for estimating the size of pocket gopher populations.

2.1.2 Identify sites and develop sampling scheme for monitoring trends in pocket gopher populations.

2.2 Conduct and/or coordinate surveys and monitoring of populations, data collection and maintenance.

2.2.1 Establish a standard protocol for monitoring population sizes and trends in the identified *reserves/reserve complexes*.

2.2.2 Conduct surveys for monitoring as needed to help other entities with conservation and permitting processes.

With the assistance of cooperating agencies, monitor pocket gopher populations. Use standardized methods for population monitoring from those described by Olson (2017a) or refinements thereof identified by additional research. This will require regular surveys at selected sites.

2.2.3 Coordinate survey and monitoring efforts with Joint Base Lewis-McChord, USFWS, consultants, National Park Service, and other cooperators, as needed.

2.2.4 Clarify the distribution and relative abundance of Mazama Pocket Gophers as needed.

Refined information about gopher distribution may be needed for evaluating potential *satellites* and *protected matrix*.

2.3 Maintain and periodically analyze survey data.

2.3.1 Maintain a database of Mazama Pocket Gopher survey efforts and detections.

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, results from all areas surveyed should be reported and entered into the database.

2.3.2 Periodically summarize and analyze data from surveys to estimate size and trend of Mazama Pocket Gopher populations within *reserves* and other areas, and population trends in *recovery areas*.

3. Protect Mazama Pocket Gophers from human-related mortality.

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

3.1 Investigate survival, recruitment, relative importance of sources of mortality, and dynamics of pocket gopher populations.

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

3.2 Minimize illegal control of pocket gophers.

The species is protected from unlawful taking under RCW 77.15.130. Public outreach (Task 7.1) is an important tool in preventing illegal control of gophers, but law enforcement should also be applied where and when necessary.

3.3 Minimize other human-related sources of gopher mortality.

If information indicates other human-related factors are causing significant mortality, minimize the effects on gopher populations. For example, extensive controlled burns may affect survival in local populations, and dogs and cats occasionally kill gophers.

3.3.1. Change management practices as needed to reduce incidental mortality on public lands.

3.3.2. Enforce leash regulations and remove any feral cats on occupied public lands.

3.3.3. Include information on prohibited actions and means of reducing conflicts with pocket gophers in public outreach materials/actions (see also Task 7.1).

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 conducted since 2005 and have been successful, but initial mortality rates of translocated individuals were high, 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 or genetic groups.

4.1 Conduct additional research to clarify status and boundaries of genetic groups.

The genetic study conducted by WDFW helped clarify the diversity in Thurston and Pierce counties (Warheit and Whitcomb 2016), but additional work is needed to clarify the status of some populations (e.g. Yelm, and those south of Yelm and east of Tenalquot Praire), and boundaries of these groups. Karyotyping to determine chromosome numbers may be needed to ensure reproductive compatibility of different genetic groups.

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

Large but unoccupied sites that are isolated from source populations may exist or be created in the future that would be suitable for supporting gopher populations.

4.3 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.

4.4 Conduct pocket gopher translocations, if needed.

4.4.1 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. If needed, conduct any SEPA or NEPA evaluations for the translocation.

4.4.2 Conduct translocation of gophers.

4.4.3 Monitor the post-release survival and productivity of translocated and resident pocket gophers and evaluate need for additional releases and 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. Review and revise recovery and conservation planning documents for Mazama Pocket Gophers in Washington.

5.1 Prepare periodic status reviews every ~5 years, or as stipulated in WAC 220-610-110.

Evaluate population status and recovery and summarize in periodic status reviews with recommendations to maintain or revise the species listing classification.

5.2 Revise recovery objectives, strategies, and tasks for pocket gophers, if necessary.

Use new information from gopher research, inventories, monitoring, and soil survey revisions, 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.

6. Coordinate and cooperate with public agencies, landowners, and non-governmental groups to help achieve conservation objectives for Mazama Pocket Gophers in Washington.

6.1 Provide information and data to USFWS to assist with federal actions targeting the species.

Data sharing is important for gopher-related activities by the USFWS, such as review of Habitat

Conservation Plans, conservation banks, Safe Harbor Agreements, and federal recovery planning documments.

6.2 Provide information, recommendations, and data to counties, cities, agencies, and landowners.

Provide information, technical review, and recommendations to public planning and regulatory agencies for administering permit programs and to land managers to facilitate habitat management. WDFW should review and provide recommendations on draft HCPs, development proposals and planning documents created by or submitted to regulatory agencies to ensure protection of gopher habitat.

6.3 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.

6.3.1 <u>Secure grants to conduct research and other recovery activities</u>.

6.3.2 <u>Secure funding for habitat-related recovery activities, including habitat management, land acquisition, purchase of development rights, and exploring incentive programs</u>.

6.4 Participate in an interagency working group and participate in recovery planning and update action plans for pocket gophers.

Mazama Pocket Gopher working group meetings have developed and updated a prioritized list of conservation activities and facilitated information exchange among participants. WDFW should also participate in Mazama Pocket Gopher recovery action planning and provide technical information for federal recovery planning.

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

A program of outreach is desirable to provide information to the public about the Mazama Pocket Gopher and to address gopher-related conflicts that some landowners have experienced from damage to garden or landscape plants, or while attempting to develop their property. The overall goal of the program would be to gain greater public support for pocket gopher recovery and prairie conservation.

7.1 Develop and disseminate outreach and education materials relating to pocket gophers to the public.

7.1.1 <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.

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

Outreach and education resources should address species identification and biology, the ecological role of gophers and burrows, 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 has useful guidance. WDFW and USFWS should use their website platforms to provide gopher information to the public. For example, the gopher/mole postcard (Fig. 15).

7.2 Develop and periodically update WDFW's Priority Habitats and Species (PHS) documents for Mazama Pocket Gophers and western Washington prairie habitat.

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

WDFW developed a set of management recommendations on ways to avoid, minimize, and mitigate impacts to pocket gophers and their habitat (WDFW 2011; http://wdfw.wa.gov/publications/01175/wdfw01175.pdf), but since the federal listing these may only be applicable to Mason County. The recommendations are intended to inform government permit reviewers, permit applicants, consultants, and landowners working on projects with potential impacts to Mazama Pocket Gophers of mitigation recommendations. These do not provide the detailed habitat management guidance typical of PHS management recommendations. New information from research and other sources should be incorporated into recommendations as it becomes available.

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

WDFW has standard PHS management recommendations for priority species and habitats. A set of these recommendations will 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 4). 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 to determine and monitor the status of populations and prevent the extinction of a 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 4. 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]
2	1.1 Determine the habitat needs of pocket gophers and effects of development and forestry on persistence.	10	DFW, FWS, UN	tbd	-
2	1.2 Improve methods of restoring and maintaining pocket gopher habitat, including planting and prescribed burns.	10	CNLM, DFW, JBLM	tbd	-
3	1.3 Update information about soil suitability for pocket gophers from surveys, etc.	tbd	DFW	0.5	50%
1	1.4 Protect and manage pocket gopher habitat on public lands.	ongoing	DFW, FWS, JBLM, WDNR	25	30%
1	1.5 Protect pocket gopher habitat on private lands to maintain connectivity through conservation easements, mitigation banks, cooperative agreements, or acquisitions.	15	DFW, FWS, CC, NRCS,	tbd	
1	2.1 Refine methods for estimating populations and monitoring pocket gopher population trends.	1	DFW, FWS, JBLM	100	tbd
2	2.2 Coordinate surveys and monitoring of populations, data collection, and maintenance.	12	DFW, FWS, JBLM	tbd	-
2	2.3 Maintain and periodically analyze survey data.	30	DFW, FWS, JBLM	tbd	50%
2	3.1 Investigate the life history and population dynamics of Mazama Pocket Gophers.	10	DFW, FWS, UN	tbd	-
3	3.2 Minimize illegal control of pocket gophers, if needed.	ongoing	DFW, FWS, PL, UN	5	tbd
3	3.3 Minimize human-related sources of mortality.	tbd	DFW, FWS, PL	tbd	-
1	4.1 Conduct additional research to clarify status and boundaries of genetic groups	5	DFW,FWS, USGS	80	5%
3	4.2 Identify and prioritize suitable unoccupied sites for translocations, if needed for recovery.	2	DFW, FWS	1	50%
3	4.3 Evaluate and modify protocols used for translocation.	1	DFW, FWS	2	75%
3	4.4 Conduct pocket gopher translocations, if needed.	3; as needed	DFW, FWS	30	5%
3	5.1 Prepare periodic status review.	0.2,	DFW, CON	5	90%

Priority	Recovery Task	Duration in years	Potential Cooperators[a]	Est. Annual Cost ($1000's)	DFWShare%[b]
		periodic			
3	5.2 Revise recovery objectives and strategies for pocket gophers, if necessary.	1	DFW, FWS	5	75%
2	6.1 Provide data to USFWS to assist with federal actions targeting the species.	ongoing	DFW, FWS	1	90%
2	6.2 Provide information to counties, cities, agencies, and landowners.	ongoing	DFW, FWS	1	70%
1	6.3 Secure funding for recovery activities.	ongoing	DFW, FWS, JBLM	tbd	-
3	6.4 Participate in an interagency working group and participate in a recovery planning.	ongoing	DFW, FWS, JBLM, CC	10	20%
3	7.1 Develop and disseminate education and outreach materials relating to pocket gophers.	5	DFW, FWS, CNLM	25	25%
3	7.2 Develop and periodically update 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.

Immediate High Priority Actions. Six of the strategies and tasks described previously stand out as immediate high priorities for advancing recovery efforts in Washington. They are described in the Strategies and Tasks section, but repeated here for emphasis should the need arise to direct limited funding and staff time toward particular activities in the short term.

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

2.1 Refine methods for estimating population sizes and monitoring pocket gopher population trends.

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

4.1 Conduct additional research to clarify status and boundaries of genetic groups.

3.1 Investigate the life history and population dynamics of Mazama Pocket Gophers in Washington.

6.3 Secure funding for recovery activities.

REFERENCES CITED

The references cited in the Periodic *Status Review and Recovery Plan for the Mazama Pocket Gopher* are categorized for their level of peer review pursuant to section 34.05.271 RCW, which is the codification of Substitute House Bill 2661 that passed the Washington Legislature in 2014. A key to the review categories under section 34.05.271 RCW is provided in Table A. References were categorized by the author.

Table A. Key to 34.05.271 RCW Categories:

34.05.271(1)(c) RCW	Category Code
(i) Independent peer review: review is overseen by an independent third party.	i
(ii) Internal peer review: review by staff internal to the department of fish and wildlife.	ii
(iii) External peer review: review by persons that are external to and selected by the department of fish and wildlife.	iii
(iv) Open review: documented open public review process that is not limited to invited organizations or individuals.	iv
(v) Legal and policy document: documents related to the legal framework for the significant agency action including but not limited to: (A) federal and state statutes; (B) court and hearings board decisions; (C) federal and state administrative rules and regulations; and (D) policy and regulatory documents adopted by local governments.	v
(vi) Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under the processes described in (c)(i), (ii), (iii), and (iv) of this subsection.	vi
(vii) Records of the best professional judgment of department of fish and wildlife employees or other individuals.	vii
(viii) Other: Sources of information that do not fit into one of the categories identified in this subsection (1)(c).	viii

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Appendix A. Washington Administrative Code.

WAC 220-610-110 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.

The agency determines that a species population may be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

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.

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.

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:

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

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.

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:

Historic, current, and future species population trends.

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

Historic and current habitat trends.

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

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.

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.

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.

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:

Target population objectives.

Criteria for reclassification.

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.

Public education needs.

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.

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.

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.

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.

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.

CLASSIFICATION PROCEDURES REVIEW

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:

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.

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

AUTHORITY

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 220-610-0140, 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 220-200-100, 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 described 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. 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. glacialis	M	20	225	72	30	128	Light yellowish brown
	F	17	220	71	30	116	
T. m. tacomensis[e]	M	13	224	71	31	127	Reddish tan
	F	15	196	57	29	104	
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[ab] of certain soils of Mason County for Mazama Pocket Gophers based on gopher presence and abundance.

	Grade[b]	Soil Type	Survey units[c,d]	Veg.[e]	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
	D	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.

[a]The suitability ranks were hypothesized (by the author) based on apparent 'preference' of pocket gopher species reported in the literature, and frequency of occupancy by *T. mazama* (Olson 2011, WDFW 2013), all which are consistent with the relative abundance of gopher sign in sandy soils compared to very rocky gravels, silts, clays, and soils with seasonal flooding or high water table (see discussion in *Effects of Soil Characteristics on Distribution and Abundance of Pocket Gophers*)

[b]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 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.

[c]"Survey units" are soil types in the county soil surveys (Ness 1960). 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.

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

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

Appendix D. Washington localities, year, and collector of Mazama Pocket Gopher specimens collected from 1825–2006, in major research collections.

Subspecies or genetic group[a]/ Collection locality	County[b]	Year	Collector	Tally[c]	Institution[d]
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
[Chambers Prairie genetic group]					
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	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 or genetic group[a]/ Collection locality	County[b]	Year	Collector	Tally[c]	Institution[d]
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
[Tenalquot Prairie genetic group]					
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
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
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 or genetic group[a]/ Collection locality		County[b]	Year	Collector	Tally[c]	Institution[d]
	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 Cemetary	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
	Olympic National Park	C	1974	Johnson, ML	1	PSM

Subspecies or genetic group[a]/ Collection locality		County[b]	Year	Collector	Tally[c]	Institution[d]
	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]Distinction of genetic group from named subspecies based on Warheit and Whitcomb (2016).
[b]County abbreviations: T = Thurston; P = Pierce; M = Mason; C = Clallam; W = Wahkiakum; Ck = Clark.
[c]Tally is the number of specimens collected at location and year.
[d]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.

APPENDIX E. RESPONSES TO WRITTEN PUBLIC COMMENTS RECEIVED ON THE 2013 DRAFT RECOVERY PLAN.

Responses are the text in italics that follows each comment; page numbers refer to the 2013 Draft Mazama Pocket Gopher Recovery Plan, unless otherwise noted. These are comments received for the 2013 draft; comments on the December 2019 draft are in Appendix F.

Section	Comment and response
General comments	I applaud your proposal to save the gopher. Hopefully, the plan will not get watered down to placate the development community.
	Thanks, the plan is intended to outline the actions needed.
	Once again the DFW is willing to spend millions on an issue that will only have far reaching effects on the eastside in the end. Just try to list a gopher as endangered on the westside and take away land and rights from those who live on that side of the state and they will find a way to redirect their land loss to the eastside and tie up our land for the varmints.
	The Mazama Pocket Gopher only occurs on the "westside" (western Washington), and the listing and recovery actions have no effect on eastern Washington.
Introduction	**p. 1 and elsewhere: "The apparent extinction of …*T.m. tacomensis*… suggests that high density suburban development is incompatible with persistence of pocket gopher populations."** The conclusion that long-term gopher habitat and suburban development are incompatible may well be true, but it should be qualified that the suburban development impacting gopher habitat near Tacoma took place prior to the state's adoption of the Growth Management Act in 1990, which requires local jurisdictions to designate and protect critical areas. WDFW cannot know whether gopher populations would have persisted if suburban development in these areas of Pierce County had included designation and protection of gopher habitat consistent with current WDFW Management Recommendations for the species, as would be the case for new development in similar Thurston County suburban environments today.
	Agreed, had the Growth Management Act been passed and the protection of critical areas begun early in the 20th Century, T. m. tacomensis *might have peristed. It is also uncertain if state and local regulations would be sufficient to secure the species without the federal listing.*
Taxonomy and Distribution	Mapping of prairie and other suitable soils (does not match mapping of soils listing associated with Mazama Pocket Gopher found in the proposed federal listing rule (Fed. Reg. Vol. 77, No. 238, at 73774) (12/11/2012).
	The soil types listing in the proposed rule included soils in the location that gophers were found in Wahkiakum County (e.g. Murnen), and USFWS was very comprehensive, and apparently included all soils with a single gopher record. WDFW has been more conservative about including soils in our 'suitable gopher soils' list. USFWS recorded soil type during surveys, 2014-2017, and reported the information included here in Table 3, which has helped clarify soils likely to be occupied by gophers.
	Genetic research should be completed **on an expedited basis** to determine whether Steinberg's 1996 genetic findings confirm that *T. m. tumuli* and *T m. tacomensis* may be

	subsumed into a redefined *T m. yelmensis* as described in the Draft. Expedited action is needed because subspecies taxonomy change would have significant impact on the federal listing process and also impact state recovery plan objectives found in the Draft.
	Warheit and Whitcomb (2016) used newer genomic tools (see Taxonomy and distribution) for analysis; contrary to earlier work and our expectations, this confirmed the existence of several unique genetic groups in the species' Washington range. Any future work intended to inform subspecific taxonomy could result in an increase, rather than a decrease in the number of named subspecies. Therefore, taxonomic revision would not necessarily result in a revision of recovery objectives, or any major revision of regulatory protections.
Natural History	Recovery planning and management could be greatly enhanced with more complete information on the dietary preferences and requirements of Mazama Pocket Gophers in Washington. As footnoted in Table 2, items found in food caches may not be preferred foods or even consumed at all. In particular, it seems important to know whether Scot's broom is routinely consumed by gophers and provides gophers with important nutrients, or not. This has management implications for how to manage Scot's broom where gophers occur.
	It would be helpful to identify additional native prairie forbs that would be best to include in prairie habitat enhancement. Gophers are not particularly fussy, and many native perennial forbs would probably be eaten but some are probably more nutritious than others. Scotch Broom produces high concentrations of alkaloids, primarily sparteine which has been shown to provide defenses against herbivores, and Scotch Broom is slightly toxic and unpalatable to most livestock. It isn't certain that gophers ever eat Scotch Broom, but given that they only resort to woody species in winter, broom is a non-native invasive, and gophers do not seem to prevent sites from being dominated by broom and rendered unsuitable. Our advice would be to remove broom at every opportunity.
Home Range, Movements and Dispersal	**p. 13.. "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."** With respect to published studies regarding the impact of roads and impervious surfaces on pocket gophers, the USFWS' decision not to list the Wyoming pocket gopher under the ESA (Fed. Reg. Vol. 75, No. 72, at 19599 (4/15/2010) included the following relevant citations and analysis on the subject: "Roads may increase direct mortality from vehicles, but this source of mortality is not always significant to populations …Roads also may improve habitat for pocket gophers in some ways by providing looser soil and increasing vegetation in rights-of-way from precipitation run-off. … The effects of roads on Wyoming pocket gopher populations are not known; however, we have limited anecdotal observations of individual gopher occupancy near roads. In 2009, one Wyoming pocket gopher specimen was captured 7 m (23 ft) from a graded dirt road, and Northern Pocket Gophers were captured as close as 2 m (6.5 ft) to a graded dirt road ... Small mammals may avoid roads due to noise and other factors, but roads may also provide additional habitat or movement corridors ... Northern Pocket Gophers have been observed digging tunnels underneath a right-of-way road (Richens 1966, p. 532)."
	Though Mazama Pocket Gophers have been known to use road right-of-ways for dispersal, especially in otherwise forested locations, the overall effect of paved roads,

	particularly large busy ones, are undoubtedly negative. In Wyoming, road edges may concentrate moisture in an otherwise dry environment; moisture for plant growth is not limited here most of the year. Paved roads eliminate habitat and busy roads pose a hazard if/when a gopher was attempting to disperse across it, and it is unlikely a gopher would cross by tunnelling underneath the compacted prism of a major paved road. Radio telemtery data indicate that even unpaved roads seem to affect gopher dispersal and habitat connectivity (Olson 2015).
Habitat Requirements	pp. 19-22, 39. In general, this section should be updated to reflect results/findings of the WDFW *Mazama Pocket Gopher Distribution and Habitat Survey* (2012) in addition to cited references to Olson (2011). Further, recommend consideration of the limitations of Olson (2011) with respect to reliable predictive occupancy findings for the Mazama Pocket Gopher in light of data gaps, as noted in MacKenzie (2012), *Review of Olson (2011), Mazama Pocket Gopher Occupancy Modeling* (copy provided to WDFW).
	We have updated the section with reference to the 2012 surveys. MacKenzie (2012) notes that the occupancy models of Olson (2011a) cannot be applied more widely in western Washington because forested areas and developed areas were not sampled. Sampling in forest would have provided a lot of negative data, as determined by the 2012 surveys, and surveying developed areas would have required permission from many landowners which would require a great deal of time and expense. The overall relationships between gopher presence and soils, Scotch Broom cover, season, etc., identified by Olson (2011a) are consistent with previous work and observations, the extensive 2012 surveys, and subsequent data. MacKenzie (2012) also noted some details of methods that were not included in the report.
P. 19.	It is striking that WDFW has not identified Thurston County subspecies in [forest] clear-cut areas given the tendency of other pocket gopher species, including varieties of Mazama, to inhabit clear-cut areas and the extensive history of state and federal forest land management gopher eradication programs. Strongly recommend that WDFW continue examination of Capitol Forest clear-cuts where qualified private consultants have identified gopher mounding activity.
	No pocket gophers were found in the Capitol Forest or other Department of Natural Resources forest or clear cut lands. We detected pocket gophers in only 7 of 421 forest and clear cut plots (238 clearcut, 183 open canopy), regardless of ownership (WDFW 2013). These locations were sparsely distributed, and all were near areas of known pocket gopher presence on sites with more open land cover. This may indicate one difference between the subspecies in Thurston County and those elsewhere (Mason County and western Oregon); given the extensive historical prairies, those in Thurston and Pierce counties may be less inclined to inhabit forests, while those elsewhere adapted to their use out of necessity.
Population and Habitat Status	Discussion of past range and distribution, as well as current range and distribution, omits BPA transmission corridor and tribal lands in Thurston and Pierce Counties and adjacent to JBLM. These areas include large areas of contiguous potential habitat should be included/considered in future survey efforts.
	You may be referring to the Nisqually Reservation; the area has potentially suitable soil (Spanaway), but is largely forested, and has been for a long time. Transmission line corridors have potential, but they are often overgrown with Scotch Broom and other woody vegetation. More of these should be surveyed, but they probably would not add substantially to the occupied or suitable habitat.

P. 27	**"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)."** This statement should be revised to clarify the extent of confirmation of earlier Stinson work, i.e., through reference the significant Krippner (2011) update to Stinson's Table 2.3. In addition, the Draft states that the 2012 distribution survey did not include significant amounts of "forested areas or areas of poorly drained soils," where presumably access was challenging. Surveys of these additional areas may well still yield differences in Mazama Pocket Gopher distribution from Stinson's earlier findings. Reliance on earlier findings should be qualified accordingly with respect to the continued absence of comprehensive survey information.
	Krippner (2011) 'updated' Table 2.3 in Stinson (2005), with recent data from WDFW and consultant surveys. However, for several of the sites listed in Krippner (2011), the locations are not an accurate reflection of historical sites; some recent records are 2-3 miles from the historical site, yet there is an implication that gophers are not extinct at the historical site searched by Steinberg in 1995. Stinson (2005) used the historical sites that "may be extinct" listed as a suggestion of the trend for gophers; it was not assumed there were no other gophers in unsurveyed sites in the vicinity. In 2012, WDFW surveyed >1,000 sites, but did not survey where we did not gain permission. Gophers are not found in poorly drained soils because their burrows would flood, and we have not found them in Thurston County forest, other than clearcuts near historical prairie areas (WDFW 2013). The 2012 survey overwhelmingly confirmed the distribution based on accumulated data described in Stinson (2005). USFWS surveys from 2014-2017, have added some occupied sites, particularly southwest of Yelm, but did not produce major changes in the map of occupied areas.
	WDFW simply must come up with a reliable and defensible methodology to identify and estimate occupied gopher habitat in order to have an effective regulatory scheme that can be implemented in conjunction with the Recovery Plan.
	The methods to identify and estimate occupied habitat are established and reasonably reliable, and methods to estimate populations have been developed (Olson 2017a), and will be used to evaluate success of recovery activities.
p. 35	This section should clarify and explain the scope and extent of unsurveyed habitat dismissed as no longer "suitable."
	We revised this section. Some of the historical sites are densely developed commercial or residential areas with little native vegetation, and dominated by buildings and asphalt. These areas were not surveyed. Dr. Murray Johnson and his students last documented gophers in the Tacoma area in 1962, though they may have persisted into the 1970s.
Management Activities p. 40	This section should be updated to reflect HCPs in development with USFWS for private properties as well as acquisitions of conservation properties and easements completed since the Draft was released.
	We have updated this section.
Factors Affecting: Adequacy of Existing	This section should be expanded to include limitations on private property that will result from enforcement under Section 9 of the ESA if the proposed listing becomes final.

Regulatory Mechanisms (p. 41)	
	The federal listing as threatened became effective 9 May 2014. Currently, when a permit application is submitted for a site potentially suitable for gophers, a survey is required, and if they are present, any unavaoidable impacts to gophers would require an individual HCP; whether any mitigation would be on-site or off-site, etc., may depend on the project location, and other details. If the Thurston County and Tumwater (Bush Prairie) HCPs are approved, the process will likely be more streamlined.
P. 41 (and p. 48: Military Training)	This section should include discussion of habitat protections afforded to gopher populations on JBLM through implementation of Department of Defense-mandated ESMP (Endangered Species Management Plan).
	We discuss JBLM's ESMC under Conservation Planning on pages 38-39 in this updated draft.
	DNRs Webster Forest Nursery, located south of Tumwater, is within one of the seven recovery areas. While the majority of this Nursery area is managed very intensively as an agricultural operation, there is a pocket gopher population located on a small portion of the parcel that is less intensively managed; under our management practices, the gopher population has persisted and we believe our operations are compatible with a sustained population on this portion of the holding. While the Recovery Plan is not site-specific at this point in time, we suggest that the normal agricultural practices continue as they have at this Forest Nursery, to provide seedlings needed for statewide reforestation and restoration work.
	The Special Rule (as allowed under Section 4(d) of the Endangered Species Act) published with the federal listing allows 'incidental take' that may occur during existing agricultural activities; such activities "will not be a violation of section 9 of the Act" (USFWS 2014: 19795). WDFW will defer to this special rule in regards to existing agricultural activities.
p.43	**Positive impact of low density development to create openings in forest matrix in Mason County.** This premise should be extended to the extensive low density zoned areas of Thurston County.
	Most of the rural residential areas with gophers in Thurston are in historical prairie areas; low density development (rural zoning with 5-10 ac lots) may have low impact, but it would generally not be positive, except in cases where forest or dense Scotch Broom cover is removed, soils are appropriate, and a source population of gophers is nearby that can colonize/recolonize the site.
p.46 Predation by cats and dogs	This section should include discussion on the use of fencing to discourage dogs from entering protected habitat areas in order to mitigate risk and reduce predation. I note that there appears to be no scientific study specifically addressing dog predation of the pocket gopher.
	Generally, dogs kept on a leash are not a problem, and dogs are not usually allowed to roam freely. Cats are more often allowed to roam freely, and are more difficult to fence out. Some outreach and education will be needed, and where a problem persists, removal of cats on conservation lands may be necessary.
p. 46:	Conclusions based on lack of gophers on rural residential areas near Tenino, Littlerock,

Livestock grazing	and Vail; Krippner (2011) identified gopher populations in Tenino, Littlerock, and Vail locations where Stinson (2005) had deemed them extinct. *See* Table 2.3 (Historical Locations Where Mazama Pocket Gopher Populations may be Extinct from Stinson) (2005).
	The conclusions about grazing were based on Eviner and Chapin (2003), who noted that in California grassland, "areas with heavy grazing had little gopher activity"; Hunter (1991) and Stromberg and Griffin (1996) made similar observations. We also know that forbs may be important in their nutrition, so where heavy grazing reduces forbs and compacts soil, gophers would be negatively affected; Northern Pocket Gophers maintained only on grasses in captivity lost weight and died (Teitjen et al. 1967). However, light to moderate grazing or mowing can have a positive effect on gopher numbers (Phillips 1936). *Stinson (2005) listed several sites as "may" be extinct, where Steinberg (1996a) did not find gophers where they had previously been reported in pastures. If there are now gophers in these same pastures, either Steinberg (1996a) failed to detect them, or gophers had re-colonized the sites; gopher numbers are dynamic, and gopher aggregations can shift around year to year. However, as noted above some of the sites listed by Krippner (2011) are 2-3 miles from the historical sites; we have been unable to confirm any gophers near Littlerock.*
Recovery	The WDNR Meridian Seed Orchard, located on Chambers Prairie in Lacey, is not included within the seven recovery areas delineated by WDFW. However, under our management practices, the gopher population has persisted at this location for decades, and we believe that our operations are compatible with a sustained gopher population on this site. We agree with the reasoning behind the decision to not include this site within the seven key recovery areas.
	We agree that agricultural activities of low-moderate intensity, are often compatible with gophers persisting in field margins, etc. However, results of Warheit and Whitcomb (2016) identified a different genetic group on Chambers Prairie, so we included the area in a recovery area in this draft.
p. 52	WAC 220-610-110 Sec. 11.1.1, requires WDFW to include "target population objectives" as part of the recovery plan for the species. The Draft Recovery Plan for the Mazama Pocket Gopher attempts to meet this regulatory requirement by defining an objective to "maintain a stable or increasing population trend for a 10-year period in each of seven Mazama Pocket Gopher population areas" (page vi). I question whether this general objective for populations satisfies the plain regulatory requirement in WAC 220-610-110 to set a target population objective. Even if this general objective is legally sufficient, it appears impossible to measure success in the absence of a population estimate for each relevant gopher population area, including Thurston County. This section should be revised to include a specific, if qualified, population estimate for each of these areas for use as a baseline. It seems likely that for certain subspecies that a reasonable target may already have been met without need for continued recovery, measurement, and associated regulation of the species.
	Methods to estimate populations have recently been developed (Olson 2017a), and will be used to evaluate success of recovery activities. In this updated draft, we identified a target of ≥1,000 gophers in each reserve, with 2 or 3 reserves needed for each genetic group for delisting, depending on the landscape and feasibility.
P. 53: 1.1.1	This task must be done immediately. Estimates for this purpose should include data or

Estimate size of key subpopulations;	approximations to account for as-yet unsurveyed areas of Thurston County and not just Mason and Clallam Counties.
	As noted above, the methods to identify and estimate occupied habitat are established and will be used to monitor recovery.
P 55. 2.2.3, 2.3.1, 8.3 Review of development proposals and technical assistance to local governments	WDFW should revise current PHS Management Recommendations to create a systemic review process that ensures consistency and timeliness of project review across regulated jurisdictions, focusing efforts on the key population areas identified in the recovery plan.
	Thurston County has been working with USFWS on an HCP that will, if completed, include a regulatory process that may obviate the need for this. We will revise the PHS Management Recommendations, when needed, but creating a "systemic review process across jurisdictions" would be beyond the normal scope of the PHS documents, or WDFW authority for federally-listed species.
P. 55	On p. 55 the Draft plan states: "For populations in high density urban growth areas with lower prospects for persistence, off-site mitigation, such as a mitigation bank, should be pursued." This implies that depending upon circumstances on-site impacts may be preferred, as long as adequate off-site mitigation is provided. Currently, WDFW's management guidelines strongly emphasize the protection of on-site habitat, regardless of location and potential for persistence of the population. The current management guidelines should be updated as soon as possible to fully support the objectives of the recovery plan and to provide more opportunities for creative conservation of the species.
	Agreed. Off-site mitigation must be used carefully, because an occupied site is being lost in exchange for benefits to gophers elsewhere, such as funds to protect or enhance habitat, etc. A proliferation of small scattered off-site mitigation efforts probably is not productive, unless they provide connectivity for reserve satellites. With the federal ESA listings, mitigation proposed in HCPs would need approval of USFWS.
p. 58 Tanslocation	The updated status report should devote more discussion to the success of WDFW translocation efforts given the potential effectiveness of this method to mitigate impacts of development on gopher habitat. WDFW should prioritize developing an effective translocation method between urban and rural population target areas as a priority within the Recovery Plan. In addition, WDFW should consider including use of on-site translocation of gophers into habitat protection areas in conjunction with development.
	Translocation is neither easy, nor cheap, and generally involves high mortality of translocated individuals (unless perhaps moved to an enclosure). Translocation may be used to populate a large reserve, but not done routinely to move gophers 'out of the way' of development; there may be reasons related to habitat quality that determine which parts of a site are occupied, and there would be no conservation value to moving them to marginal locations.
P 56 (2.4)	As a hunting & fishing club and part of our bylaws protecting & preserving animals & fish habitat – we would agree the Mazama Pocket Gopher needs protection. We agree that private landowner sector agreements would be one of the best approaches to help stave further hindrance to the problem and suits towards better success.

	We agree that conservation easements with private landowners will likely be very important and useful for conserving the species.
P 56 (2.4)	Acquire as much land in permanent protection as possible.
	We hope as much land, or easements with adequate protections, as is necessary to ensure the conservation of the species will be acquired by WDFW or conservation organizations.

APPENDIX F. RESPONSES TO WRITTEN PUBLIC COMMENTS RECEIVED ON THE DRAFT RECOVERY PLAN.

Responses are the text in italics that follows each comment; page numbers refer to the December 2019 Draft Mazama Pocket Gopher Recovery Plan. Comments received for the 2013 draft are in Appendix E.

Section	Comment and response
General comments	The gopher shouldn't be listed because it has its own problems with predators, and will continue to decline no matter how much we intervene; let nature take its' course.
	Actually, the outlook for Mazama Pocket Gophers is quite good if adequate reserves are established; their habitat requirements are fairly simple, and the only apparent threats are human-related. They are also a 'keystone' species that affect many other species, and protecting their habitat benefits many other prairie species.
	Please keep the species listed as threatened and do what you can to save the species.
	Thanks. If this plan is implemented, the species should do fine .
	De-list this rodent because it carries fleas that carry bubonic plague and other diseases; it is a pest that can only harm people and livestock, and does not play a significant role in local ecology.
	We are not aware of any record of a pocket gopher carrying flea hosts of bubonic plague, or any other human disease, and since gophers spend most of their time underground, the likelihood of encountering a flea from a gopher are exceedingly small. Gophers do in fact play an important role in grassland ecology; as described in Ecological Relationships and Functions*, some researchers refer to gophers as 'ecosystem engineers' that affect soils, plants, invertebrates, and wildlife species. To ignore the status of gophers is to ignore prairie ecosystems and perhaps doom other species to extinction.*
	These rodents endanger humans and animals with their huge mounds of dirt, and leaving holes that cause broken ankles.
	We are not aware of any recent cases of injuries to humans or livestock resulting from gopher holes. Your reference to "huge mounds of dirt" suggests confusion with mole mounds which are often larger and more conspicuous.
	I thought this was a joke, and wonder if it is a ploy to extract grants from state or federal governments or make work for someone.
	Conserving what remains of the Puget prairies, and the species found there is a challenge, and we understand a gopher may not be particularly charismatic. However, conserving wildlife on remnants of habitat against the continuous expansion of residential and commercial development is often what we do.
	I vote not to list the gopher as threatened; do not waste money on recovering this species, there are more important issues.
	We understand that gophers are not as charasmatic as, say Bald Eagles, but recovery of gophers is an important part of preserving the Puget prairie ecosystems; and the federal ESA listing also can't be ignored.

	WDFW has gotten out of control with these listings.
	WDFW has only listed three species in the last 10 years, during which time we also de-listed four species. There were also a few up or down listing (e.g. from threatened up to endangered or endangered down to threatened) changes during that time. There are likely many more species deserving of listing, but we do not have sufficient data to make that case, and we do not have the staff to evaluate many obscure species only found in Washington or the region.
Population and Habitat Status	I asked federal Fish & Wildlife officials who are involved specifically in the Mazama Pocket Gophers (MPGs): 1) How many MPGs live in Thurston County? 2) What constitutes a sustainable population? They said, "We don't know". Any reasonable person would conclude that the MPG issue is no longer, nor has it ever been about conserving a sustainable population of said creatures. The real issue is clouded in jargon to obscure the real agenda. Would DFW be willing to share with us what the true agenda is?
	Arriving at a reasonble estimate of the total population of gophers is exceedingly complex, can be expensive, and knowing a number at a point in time may not be the most valuable data point to have. As described under Pocket Gopher Surveys and Population Estimation*, WDFW conducted extensive surveys during 2012 involving many staff and sampling over 780 plots, just to better describe their distribution. The listing of the species was not about a number, but about ongoing loss and fragmentation of habitat and the ultimate result for populations. We recently conducted some population modeling (see discussion under* Rationale *under the* Recovery Objectives) *that suggested a local populations of >1,000 gophers would likely perisist for 50 years; it also suggested peristence was more likely for >1 such population, and that would be needed for the 5 listed subspecies, and unique genetic groups in the three county area. There is no hidden agenda, just a complicated world.*
Recovery	Do what you can as long as it doesn't interfere with the day to day use of public or private lands. If that can't be achieved then collect their DNA and freeze it, let nature run it's course if they don't survive, clone them at the appropriate time.
	Gopher habitat protection will have minimal effects on uses of public open-space, but will inevitably affect some uses of some private lands. If we are to keep native wildlife species around, protecting some of their habitat from development is needed. Freezing their DNA for some future date is not a realistic solution; the sample would retain only a meager part of their genetic diversity, and it puts off our responsibilities on a future generation, with the expectation that they would restore the needed habitat, etc., etc. This also ignores the effect on many other prairie dependent species.
	An obvious course of action is to acquire the remainder of West Rocky Prairie from the Port of Tacoma, instead of letting them convert it to a big industrial cargo center.
	There have been discussions about acquiring the property; no agreement had been reached at the time of this writing.
	I suggest you have some public service announcements about why rodents are good and what makes a healthy ecosystem.
	Education and outreach by WDFW and partner organizations about our gophers, prairie,

	and the associated plants and animals is a good idea (as mentioned in recovery stategy 7).

WASHINGTON STATE, PERIODIC STATUS REVIEWS, STATUS REPORTS, RECOVERY PLANS, AND CONSERVATION PLANS

Periodic Status Reviews

2019 Tufted Puffin
2019 Oregon Silverspot
2018 Grizzly Bear
2018 Sea Otter
2018 Pygmy Rabbit
2017 Fisher
2017 Blue, Fin, Sei, North Pacific Right, and Sperm Whales
2017 Woodland Caribou
2017 Sandhill Crane
2017 Western Pond Turtle
2017 Green and Loggerhead Sea Turtles
2017 Leatherback Sea Turtle
2016 American White Pelican
2016 Canada Lynx
2016 Marbled Murrelet
2016 Peregrine Falcon
2016 Bald Eagle
2016 Taylor’s Checkerspot
2016 Columbian White-tailed Deer
2016 Streaked Horned Lark
2016 Killer Whale
2016 Western Gray Squirrel
2016 Northern Spotted Owl
2016 Greater Sage-grouse
2016 Snowy Plover
2015 Steller Sea Lion

Conservation Plans

2013 Bats

Status Reports

2019 Pinto Abalone
2017 Yellow-billed Cuckoo
2015 Tufted Puffin
2007 Bald Eagle
2005 Mazama Pocket Gopher, Streaked Horned Lark, and Taylor’s Checkerspot
2005 Aleutian Canada Goose
1999 Northern Leopard Frog
1999 Mardon Skipper
1999 Olympic Mudminnow
1998 Margined Sculpin
1998 Pygmy Whitefish
1997 Aleutian Canada Goose
1997 Gray Whale
1997 Olive Ridley Sea Turtle
1997 Oregon Spotted Frog

Recovery Plans

2019 Tufted Puffin
2012 Columbian Sharp-tailed Grouse
2011 Gray Wolf
2011 Pygmy Rabbit: Addendum
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

Status reports and plans are available on the WDFW website at:
http://wdfw.wa.gov/publications/search.php