U.S. Fish & Wildlife Service

Recovery Plan for Four Subspecies of Mazama Pocket Gopher

Photo: Gail Olson, WDFW

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Roy Prairie pocket gopher
(*Thomomys mazama glacialis*)

Olympia pocket gopher
(*Thomomys mazama pugetensis*)

Tenino pocket gopher
(*Thomomys mazama tumuli*)

Yelm pocket gopher
(*Thomomys mazama yelmensis*)

U.S. Fish and Wildlife Service
Portland, Oregon

Approved: HUGH MORRISON Digitally signed by HUGH MORRISON Date: 2022.08.25 14:53:17 -07'00'

Acting Regional Director
U.S. Fish and Wildlife Service

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LITERATURE CITATION SHOULD READ AS FOLLOWS:

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The primary author of this recovery plan is:

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Executive Summary

CURRENT SPECIES STATUS, HABITAT, AND THREATS

Four subspecies of Mazama pocket gopher (Roy Prairie pocket gopher [RPPG], *Thomomys mazama glacialis*; Olympia pocket gopher [OPG], *T. m. pugetensis*; Tenino pocket gopher [TPG], *T. m. tumuli*; and Yelm pocket gopher [YPG], *T. m. yelmensis*) found in Thurston and Pierce Counties, Washington, were listed in 2014 as threatened throughout their ranges under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act) (79 FR 19760; USFWS 2014a, p. 19794). At the same time, a separate rule addressing these four subspecies under section 4(d) of the Act was promulgated when the subspecies were listed (79 FR 19760; U.S. Fish and Wildlife Service (USFWS) 2014a, p. 19790). This 4(d) rule exempts take for certain activities that promote the maintenance of open habitat or restoration of habitat conditions necessary for the conservation of the RPPG, OPG, TPG and YPG and/or promote responsible land uses and conservation efforts. In particular, these include general activities conducted on agricultural and ranching lands, regular maintenance activities at civilian airports, control of noxious weeds and invasive plants, maintenance of roadside rights-of-way, and limited activities on private landowner parcels. We expect the 4(d) rule to continue to promote private lands partnerships critical to the recovery of the four subspecies. Critical habitat was designated for the OPG, TPG, and YPG (79 FR 19712; USFWS 2014b, entire). All four subspecies have a recovery priority number of 6C (USFWS 2016, pp. 72-73), indicating each subspecies has a high degree of threat and a low potential for recovery, and is in conflict with construction or other development projects or other forms of economic activity (48 FR 43098; USFWS 1983, p. 43104).

Threats facing the RPPG, OPG, TPG, and YPG subspecies include fragmentation, degradation, and loss of suitable habitat due to development, military training (RPPG and YPG only), and certain restoration actions, as well as predation by domestic and feral dogs and cats, pest species control (*e.g.*, trapping and poisoning), and small population effects. Many of these threats may result in direct mortality to individuals of these four subspecies. Existing regulatory mechanisms are inadequate to ameliorate these threats. The loss of natural ecosystem maintenance processes means that all four subspecies of Mazama pocket gopher (MPG) are management-reliant (Carroll *et al*. 2015, p. 136; Goble *et al*. 2012, p. 869; Scott *et al*. 2005, p. 386; Scott *et al*. 2010, p, 92), and will require active ongoing management to maintain the prairie habitat characteristics needed for population growth and/or stability.

RECOVERY GOAL AND OBJECTIVES

The goal of the recovery plan is to recover the RPPG, OPG, TPG, and YPG such that they no longer meet the Act's definition of threatened and can be removed from the Federal List of Endangered and Threatened Wildlife (*i.e*., delisted).

To achieve this goal, this recovery plan identifies the following two objectives for the four Thurston/Pierce County subspecies of Mazama pocket gopher:

1) Conserve, restore, and properly manage the quantity, quality, and connectivity (or configuration) of RPPG, OPG, TPG, and YPG habitats to address habitat fragmentation, degradation, or loss and ensure the long-term persistence and viability of each subspecies across its range.

2) Address other known threats to ensure the long-term persistence and viability of each subspecies across its range.

RECOVERY STRATEGIES

Roy Prairie Pocket Gopher

Our recovery strategy for the RPPG is to establish and maintain a minimum of three resilient, self-sustaining local populations[1] distributed across the subspecies' range. Each local population should consist of at least 1,000 individuals, as estimated based on a minimum of 5 years of monitoring over a 10-year period. Each local population should occur on approximately 250 to 500 acres (approximately 100 to 200 hectares (ha)) of suitable habitat on conserved Reserve Cores or functionally connected Reserve Satellites within Reserve Complexes[2] that are managed over the long term. The recovery strategy for the RPPG addresses the threats of habitat fragmentation, degradation, and loss; small and isolated populations; military training; inadequacy of existing regulatory mechanisms; predation; and pest species control. Moreover, it ensures that RPPG local populations can achieve the resiliency, redundancy, and representation needed to recover the subspecies. At the time of recovery, we expect RPPG populations to be self-sustaining and occur on sufficient occupied habitat in protected status that is well-distributed within the subspecies' range.

Olympia Pocket Gopher

Our recovery strategy for the OPG is to establish and maintain a minimum of three resilient, self-sustaining local populations distributed across the subspecies' range. Each local population should consist of at least 1,000 individuals, as estimated based on a minimum of 5 years of monitoring over a 10-year period. Each local population should occur on approximately 250 to 500 acres (approximately 100 to 200 ha) of suitable habitat on conserved Reserve Cores or functionally connected Reserve Satellites within Reserve Complexes that are managed over the long term. The recovery strategy for the OPG addresses the threats of habitat fragmentation, degradation, and loss; small and isolated populations; inadequacy of existing regulatory mechanisms; predation; and pest species control. Moreover, it ensures that OPG populations can achieve the resiliency, redundancy, and representation needed to recover the subspecies. At the time of recovery, we expect OPG populations to be self-sustaining and

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[1] A self-sustaining local population contains a sufficient number of interactive individuals such that it is capable of long-term persistence, maintaining itself without chronic decline, and adaptability over multiple generations. In settings where natural fire cycle processes necessary to maintain early-seral characteristics on the landscape have been lost (*e.g.*, due to presence of structures on the landscape, fire restrictions, and/or fire suppression policies), species such as MPGs become management-reliant, requiring active ongoing management to maintain the prairie habitat characteristics needed for population growth and/or stability. Model results showed that a single, contiguous Reserve with a minimum population of 1,000 individuals would meet our probability of persistence goals (see Appendix B).

[2] Reserve Cores and Reserve Complexes are centered on or substantially overlap areas identified as important to the recovery of these four subspecies of Mazama pocket gopher. Reserve Cores are single, contiguous polygons of medium- to high-quality suitable MPG habitat, managed for MPGs over the long-term. Reserve Complexes are comprised of two or more Reserve Satellites (contiguous polygons of suitable MPG habitat, smaller than Reserve Cores) connected to each other by Protected Matrix (contiguous polygons of lands not solely managed for MPGs). *See Recovery Criteria, Common Criterion 1, for a more detailed description.*

occur on sufficient occupied habitat in protected status that is well distributed within the subspecies' range.

Tenino Pocket Gopher

Our recovery strategy for the TPG is to establish and maintain a minimum of two resilient, self-sustaining local populations distributed across the subspecies' range. Each local population should consist of at least 1,000 individuals, as estimated based on a minimum of 5 years of monitoring over a 10-year period. Each local population should occur on approximately 250 to 500 acres (approximately 100 to 200 ha) of suitable habitat on conserved Reserve Cores or functionally connected Reserve Satellites within Reserve Complexes that are managed over the long term. The recovery strategy for the TPG addresses the threats of habitat fragmentation, degradation, and loss; small and isolated populations; inadequacy of existing regulatory mechanisms; predation; and pest species control. Moreover, it ensures that TPG populations can achieve the resiliency, redundancy, and representation needed to recover the subspecies. At the time of recovery, we expect TPG populations to be self-sustaining and occur on sufficient occupied habitat in protected status that is well distributed within the subspecies' range.

Yelm Pocket Gopher

Our recovery strategy for the YPG is to establish and maintain a minimum of seven resilient, self-sustaining local populations distributed across the subspecies' range in three Recovery Units. The numbers of local populations per Recovery Unit are as follows: a minimum of two local populations in the YPG-North Recovery Unit; a minimum of three local populations in the YPG-East Recovery Unit; and a minimum of three local populations in the YPG-South Recovery Unit. Each local population should consist of at least 1,000 individuals, as estimated based on a minimum of 5 years of monitoring over a 10-year period. Each local population should occur on approximately 250 to 500 acres (approximately 100 to 200 ha) of suitable habitat on conserved Reserve Cores or functionally connected Reserve Satellites within Reserve Complexes that are managed over the long term. The recovery strategy for the YPG addresses the threats of habitat fragmentation, degradation, and loss; small and isolated populations; military training; inadequacy of existing regulatory mechanisms; predation; and pest species control. Moreover, it ensures that YPG populations can achieve the resiliency, redundancy, and representation needed to recover the subspecies. At the time of recovery, we expect YPG populations to be self-sustaining and occur on sufficient occupied habitat in protected status that is well distributed within the subspecies' range.

RECOVERY CRITERIA

Criteria Common to All Four Subspecies of Mazama Pocket Gopher

There are three recovery criteria common to all four subspecies of MPG that form the base recovery strategy for each of the subspecies. The primary components of these criteria, as stated above in the recovery strategies for each subspecies, include the required characteristics of Reserve Cores and Reserve Complexes (Reserve Satellites functionally connected by Protected Matrix); population targets and monitoring requirements for each Reserve; and habitat quality and quantity targets for each. No Reserves are contiguous with each other.

Roy Prairie Pocket Gopher Specific Recovery Criterion
The following is in addition to the Common Criteria. Recovery Criteria for RPPG include a minimum of three Reserves as defined in Common Criterion 1, representing a minimum of three self-sustaining local populations.

Olympia Pocket Gopher Specific Recovery Criterion
The following is in addition to the Common Criteria. Recovery Criteria for OPG include a minimum of three Reserves as defined in Common Criterion 1, representing a minimum of three self-sustaining local populations.

Tenino Pocket Gopher Specific Recovery Criterion
The following is in addition to the Common Criteria. Recovery Criteria for TPG include a minimum of two Reserves as defined in Common Criterion 1, representing a minimum of two self-sustaining local populations.

Yelm Pocket Gopher Specific Recovery Criterion
The following is in addition to the Common Criteria. Recovery Criteria for YPG include a minimum of seven Reserves as defined in Common Criterion 1, representing a minimum of seven self-sustaining local populations. Each of the three Recovery Units for YPG has its own requirements: a minimum of two Reserves in the YPG-North Recovery Unit, a minimum of two Reserves in the YPG-East Recovery Unit, and a minimum of three Reserves in the YPG-South Recovery Unit.

ACTIONS NEEDED

Roy Prairie Pocket Gopher, Olympia Pocket Gopher, Tenino Pocket Gopher, and Yelm Pocket Gopher
Actions were developed for each objective. Primary actions include: protecting, conserving, and enhancing RPPG, OPG, TPG, and YPG habitat; funding and implementing research on limiting factors, developing solutions, and implementing best management practices to minimize impacts; evaluating the need to create new self-sustaining local populations and/or increase the number of individuals within existing local populations; monitoring populations to determine status and trend; and strengthening outreach and cooperation with stakeholders and partner agencies.

TOTAL ESTIMATED COST AND DATE OF RECOVERY

The Recovery Implementation Schedule provides an estimate of the total cost of recovery for each subspecies. Continual and ongoing costs, as well as the estimated total costs are based on the projected timeframe of 40 years to recovery and delisting of each of the subspecies. The total costs below are for implementation of this plan through the year 2062, which is the estimated date of recovery for each subspecies.

Roy Prairie Pocket Gopher
The estimated recovery cost for RPPG is $37,505,000.

Olympia Pocket Gopher
The estimated recovery cost for OPG is $41,628,000.

Tenino Pocket Gopher
The estimated recovery cost for TPG is $33,999,000.

Yelm Pocket Gopher
The estimated recovery cost for YPG is $100,858,000.

The total estimated recovery cost for the four subspecies of Mazama pocket gopher is $213,990,000.

Acronyms and Abbreviations

The following standard abbreviations for scientific or technical acronyms are found in this document:

Act	Endangered Species Act of 1973, as amended
ACUB	Army Compatible Use Buffer Program
CMP	Compensatory Mitigation Program
DoD	Department of Defense
E:I	Edge-to-Interior [Ratio]
ESMC	Endangered Species Management (Plan) Component
FR	Federal Register
HCP	Habitat Conservation Plan
INRMP	Integrated Natural Resources Management Plan
JBLM	Joint Base Lewis-McChord
MOU	Memorandum of Understanding
MPG	Mazama Pocket Gopher
NGO	Non-governmental Organization
OPG	Olympia Pocket Gopher
RIS	Recovery Implementation Strategy
RPA	Reserve Priority Area
RPPG	Roy Prairie Pocket Gopher
RU	Recovery Unit
SBR	Species Biological Report
Service	U.S. Fish and Wildlife Service
SSA	Species Status Assessment
TPG	Tenino Pocket Gopher
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WLA	Wildlife Area (WDFW)
YPG	Yelm Pocket Gopher

Definitions

The populations and habitats of the four federally-listed subspecies of MPG are spatially complex and in this recovery plan we use specific terminology to identify different scales and aspects of this structure. Please also see Figure 1 for a visual schematic of how these elements relate to one another on the landscape.

Recovery Area: A broad-scale geographic area encompassing both suitable and unsuitable habitat, delineating the range within which each subspecies occurs naturally.

Recovery Units: For the Yelm pocket gopher only, the Recovery Area is subdivided into three Recovery Units, which collectively encompass the range of genetic diversity and landscape structure for that subspecies. Recovery Units are areas that are individually necessary for long-term sustainability of the subspecies. Thus, the recovery criteria for Yelm pocket gopher require targets to be met within each of the three Recovery Units in order to preserve the subspecies' range of genetic diversity and landscape adaptation and meet delisting goals.

Resiliency Unit: Resiliency units are groups of potentially interbreeding individuals within a defined area. Within a resiliency unit there are no impermeable barriers to movement of individuals. However, unlike local populations, distances between these groups may be great enough that individuals do not consistently interbreed every year, but do so intermittently over several years. Separate resiliency units were usually delineated on the basis of barriers to movement between groups. Resiliency units collectively represent the current distribution of MPGs within the range of each subspecies. In the SBR, we assessed the current resiliency of these groups within each resiliency unit.

Service Area: The term "Service Area" has been used to identify broad-scale geographic structure for purposes of mitigation and conservation planning. The geographic boundaries of Service Areas are closely aligned with the Recovery Areas for Tenino and Olympia pocket gophers and to the individual Recovery Units for Yelm pocket gopher. This term does not apply to the Recovery Area for Roy Prairie pocket gopher in Pierce County because its conservation has historically developed as a separate process based on different land ownerships and jurisdictions.

Within each Recovery Area, patches of generally suitable MPG habitat occur within broader regions of unsuitable habitat. These patches represent appropriate focus areas for offsets mitigating habitat impacts and partially overlapping subsets of these have been delineated in three contexts that collectively include all of the localities where recovery efforts should be implemented:

- **Reserve Priority Areas (RPAs)**. The planning process identified RPAs as the primary focus areas for habitat protection and mitigation (USFWS *in litt.* 2015, p. 5; USFWS *in litt.* 2017, entire).
- **Proposed critical habitat**. The proposed critical habitat rule (USFWS 2012) delineated geographical areas that included the primary constituent elements of critical habitat for the four subspecies of MPG.

- **Designated critical habitat**. The final critical habitat rule (USFWS 2014b) delineated critical habitat for Yelm, Tenino, and Olympia pocket gophers. Several areas identified in the proposed critical habitat rule were exempted (Department of Defense lands in Pierce County, including all Roy Prairie pocket gopher proposed critical habitat) or excluded (several State and privately owned parcels in Thurston County within the ranges of Tenino and Yelm pocket gophers). Thus, these exempted and excluded lands were not designated as critical habitat in the final rule; however, they remain important for recovery.

To meet the recovery criteria in this recovery plan, **Reserves** with viable populations occupying protected habitat should be established within RPAs, designated MPG critical habitat, or proposed MPG critical habitat that was exempted or excluded. Depending on their spatial configuration, **Reserves** may be:

- **Reserve Core** areas (250 to 500 acres [101 to 202 hectares (ha)] of medium- and high-quality habitat [see Appendix A for definition] in a single block), or
- **Reserve Complex** areas (250 to 500 acres [101 to 202 ha] of medium- and high-quality habitat comprised of multiple **Reserve Satellite** areas functionally connected by Protected Matrix). Each individual Reserve Satellite area must be 10 acres (4 ha) or more.
- This recovery plan, as well as the final WDFW Mazama Pocket Gopher Recovery Plan (Stinson 2020), define **Reserves** with the assumption that they are distinct areas that are not contiguous with one another. Because most existing or potential Reserves are permanently separated from one another by areas of developed or otherwise unsuitable habitat, direct contact or connectivity among Reserves is unlikely.

Protected Matrix need not meet the definition of medium- or high-quality habitat, but should either allow dispersal, connectivity, and recolonization among Reserve Satellites or provide a buffer to adjacent Reserve Core or Reserve Satellite habitat and be protected under compatible long-term management.

The term **population** is generally accepted to mean a group of potentially interbreeding individuals within a defined area. We use the term “population” in two specific contexts in this document:

- When discussing all individuals in a subspecies across its range, we use the term “range-wide population” or “subspecies population.”
- Within each subspecies’ range, there are numerous groups of breeding individuals, which typically interbreed within a single year. We refer to these breeding aggregations, occurring within a Reserve, as “local populations.”

I. Introduction and Overview

A. RECOVERY PLANNING PROCESS

The Service's current approach to recovery planning is termed Recovery Planning and Implementation (RPI) (see USFWS RPI Process). The RPI approach is intended to reduce the time needed to develop and implement recovery plans, increase recovery plan relevancy over a longer timeframe, and add flexibility to recovery plans so they can be adjusted to new information or circumstances. Under RPI, a recovery plan includes the statutorily-required elements under section 4(f) of the Act (objective and measurable recovery criteria, site-specific management actions, and estimates of time and cost), along with a concise introduction and our strategy for how we foresee achieving species recovery. An RPI recovery plan is supported by two supplementary documents: a Species Status Assessment or Species Biological Report that describes the best available scientific information related to the biological needs of the species and assessment of threats; and the Recovery Implementation Strategy, which details the particular near-term activities needed to implement the recovery actions identified in the recovery plan. Under this approach, new information on species biology or details of recovery implementation may be incorporated by updating these supplementary documents without concurrent revision of the entire recovery plan, unless changes to statutorily required elements are necessary.

Thus, this recovery plan document is one piece of a three-part framework:

1. The **Species Status Assessment** (SSA) or **Species Biological Report** (SBR) informs the Recovery Plan; it describes the biology and life history needs of the subspecies, includes analysis of each subspecies' historical and current conditions, and includes discussion of threats and conservation needs of each subspecies. The format of an SSA or SBR is structured around the conservation biology principles of resiliency, redundancy, and representation (Shaffer and Stein 2000, pp. 307-310; Wolf *et al*. 2015, entire). This recovery plan includes summary information on the biology and status of the four Mazama pocket gopher subspecies, with a brief discussion of factors limiting their populations. The SBR written in support of this Recovery Plan (USFWS 2022a) provides a more detailed and comprehensive accounting of these topics. A copy of the current version of the SBR can be found on the Washington Fish and Wildlife Office's Mazama pocket gopher recovery web page, and on our species profile pages for the Roy Prairie, Olympia, Tenino, and Yelm pocket gophers.

2. The **Recovery Plan** contains a concise overview of the recovery strategy for the four MPG subspecies (indicating how their recovered states will achieve redundancy, resiliency, and representation), as well as the statutorily-required elements of recovery criteria, recovery actions, and estimates of the time and cost to achieve the plan's goals.

3. The **Recovery Implementation Strategy** (RIS) is the vehicle for implementing the Recovery Plan. The RIS is a short-term, flexible operational document focused on how, when, and by whom the recovery actions from the Recovery Plan will be implemented. This approach allows us to incorporate new information and adapt to changing circumstances with greater flexibility and efficiency. The RIS is developed

and maintained in cooperation with our conservation partners and focuses on the period of time and scope of activities that work best for us and our partners to achieve recovery goals. The RIS supporting this recovery plan describes specific actions, estimated costs, and implementing parties for recovery of the four MPG subspecies (USFWS 2022b). A copy of the current version of the RIS can be found on the Washington Fish and Wildlife Office's Mazama pocket gopher recovery web page, and on our species profile pages for the Roy Prairie, Olympia, Tenino, and Yelm pocket gophers.

B. SUMMARY OF SUBSPECIES INFORMATION FROM THE SPECIES BIOLOGICAL REPORT

1. Species Biology and Status

Although the species *Thomomys mazama,* or Mazama pocket gopher, includes numerous subspecies that are found in the states of Washington, Oregon, and California, this recovery plan addresses only the four subspecies of MPG that are federally listed as threatened in Thurston and Pierce Counties, Washington. These subspecies are: the Roy Prairie pocket gopher (*Thomomys mazama glacialis*; RPPG), the Olympia pocket gopher (*T. m. pugetensis*; OPG), the Tenino pocket gopher (*T. m. tumuli*; TPG), and the Yelm pocket gopher (*T. m. yelmensis*; YPG). For the purposes of this Recovery Plan, we will refer to these four subspecies collectively as "the four MPG subspecies." The RPPG is endemic to Pierce County, Washington, and the other three subspecies are endemic to Thurston County, Washington.

In 2012, the four MPG subspecies were proposed for listing as threatened with critical habitat under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act) (77 FR 73769, USFWS 2012, entire). The listing of the four MPG subspecies as threatened was finalized in 2014 (79 FR 19760; USFWS 2014a, p. 19794). Critical habitat was also designated for OPG in one location, for TPG in one location, and for YPG in two locations (79 FR 19712; USFWS 2014b, entire). Several areas proposed as critical habitat (USFWS 2012) were exempted under section 4(a)(3)(B)(i) of the Act (RPPG and YPG locations on Department of Defense (DoD) lands at Joint Base Lewis-McChord (JBLM)) or were excluded under section 4(b)(2) of the Act (several locations on State and private lands within the ranges of TPG and YPG), and therefore were not designated as critical habitat in the final rule (USFWS 2014b). Consequently, there is no designated critical habitat for RPPG. However, the proposed critical habitat areas that were exempted or excluded do contain suitable habitat for the RPPG, TPG, and YPG subspecies and are identified in this recovery plan as important sites for recovery of those subspecies.

A rule under section 4(d) of the Act was promulgated when the four MPG subspecies were listed (79 FR 19760; USFWS 2014a, p. 19790). This 4(d) rule exempts take for certain activities that promote the maintenance of open habitat or restoration of habitat conditions necessary for the conservation of the four MPG subspecies and/or promote responsible land uses and conservation efforts. In particular, these include general activities conducted on agricultural and ranching lands, regular maintenance activities at civilian airports, control of noxious weeds and invasive plants, maintenance of roadside rights-of-way, and limited activities on private landowner parcels. The 4(d) rule promotes private lands partnerships critical to the recovery of the four MPG subspecies.

The current recovery priority number for each of the four MPG subspecies is 6C (USFWS 2016, pp. 72-73), indicating each subspecies has a high degree of threat and a low potential for recovery, and is in conflict with construction or other development projects or other forms of economic activity (48 FR 43098; USFWS 1983, p. 43104).

Populations of the four MPG subspecies are concentrated in well-drained, friable (easily crumbled) soils, often associated with glacial outwash. These soils form prairies and grasslands that are desirable for residential and commercial development, as they are flat and well-drained, as well as sources of gravel used for road-building. As such, many of these areas have been lost to conversion due to development. Also, natural and anthropogenic sources of fire that historically maintained the early-successional nature of these prairie and grassland habitats, have been lost due to fire suppression policies. Habitat fragmentation, degradation, and loss therefore continue to be threats for these subspecies. Remaining prairies are mostly small, fragmented, and isolated, although there are a few remaining large prairie areas with varying quality of habitat and varying management. These include 91st Division Prairie (Artillery Impact Area) on JBLM (RPPG subspecies), Olympia Airport (OPG subspecies), Johnson, Weir, and Tenalquot Prairies (YPG subspecies in the YPG-East Recovery Unit), Colvin Ranch on Rock Prairie (YPG subspecies in the YPG-South Recovery Unit), and Scatter Creek Wildlife Area (WLA) (YPG subspecies in the YPG-South Recovery Unit). Because MPGs are dependent on active management to maintain their early-seral, prairie ecosystem characteristics, they are considered to be management reliant (or "conservation reliant") (Carroll *et al*. 2015, p. 136; Goble *et al*. 2012, p. 869; Scott *et al*. 2005, p. 386; Scott *et al*. 2010, p, 92). As such, even when population goals have been achieved, ongoing active management will be required to maintain the prairie habitat characteristics needed for population growth and/or stability.

2. Threats

In the final rule listing the four subspecies of Mazama pocket gopher as threatened (USFWS 2014a, entire), we identified the main threats to each of the four subspecies. They are summarized for each subspecies as: the present or threatened destruction, modification, or curtailment of its habitat or range; predation by cats and dogs; inadequacy of existing regulatory mechanisms; direct mortality and harm from military training impacts (RPPG and YPG only); direct mortality and harm from land uses and management within its habitat; control as a pest species (poisoning and trapping); and small population effects. While all are threats to the subspecies, not all are population-level threats. These threats are discussed in greater detail in the SBR (USFWS 2022).

Loss, Degradation, or Fragmentation of Habitat (Listing Factor A)

Historically, where preferred soils were contiguous and continuous, MPG subspecies populations likely extended across undeveloped expanses of open prairie, but current populations of each of the four subspecies of MPG now either partly or largely occur in small, fragmented patches that are isolated from each other, mainly due to the loss, conversion, and degradation of habitat from residential and commercial development, loss of ecological disturbance processes in grassland habitat (i.e., fire), the spread of invasive plants, and successional changes. Other habitat-related threats include military training impacts to habitat on habitat within the ranges of RPPG and YPG. These are the primary long-term threats to MPG, and are considered to be population-level threats. Non-target effects of restoration activities on the subspecies' habitat, while a threat to individuals, is not considered a population-level threat. Increased predation pressure is also closely linked to habitat degradation and is discussed under Predation (Listing Factor C).

Predation by Cats and Dogs (Listing Factor C)

The four subspecies of MPG occur in rapidly developing areas, and gophers that survive commercial and residential development are vulnerable to predation by domestic and feral cats and dogs. Feral cats are particularly effective predators of small mammals. Predation is a natural part of the MPG's life history; however, the effect of predation may be magnified when there are a small number of gophers at a site. Predation by feral and domestic dogs and cats will likely continue to be a threat to the four subspecies of MPG where they occur in small sites abutting development. This additional predation pressure (above natural levels of predation) is expected to impact numbers of individuals at these small sites. But there are several larger undeveloped areas of occupied gopher soils within each of the ranges of the four subspecies of MPG, and in those areas predation due to feral and domestic dogs and cats is expected to be low. Therefore, predation is not considered to be a population-level threat for any of the four subspecies of MPG.

Direct Mortality and Harm from Military Training Impacts (RPPG and YPG only) (Listing Factor E)

Military training activities cause mortality to RPPGs on thousands of acres in their Recovery Area, and to YPGs on hundreds of acres in the YPG-E Recovery Unit. Large portions of the base's training areas are being managed for maintenance of open grassland/prairie habitat, even as training still occurs in those areas. Overall, we believe direct mortality and harm from military training is a population-level threat to RPPG and YPG due to the areal extent of the training in relation to the range of the species in its Recovery Area (RPPG) or Recovery Unit (YPG-E), and the types of impacts (mortality and harm) that occur as a result. Presence-absence surveys show individual animals continue to persist in these training areas, despite a long history of military training. However, due to a lack of monitoring data that would provide information on population trend over time, uncertainty remains regarding the impact(s) of military training on these populations.

Direct Mortality and Harm from Land Uses and Management (Listing Factor E)

Application of Pesticides and Herbicides

Mazama pocket gophers may be directly impacted by the equipment used to dispense pesticides and herbicides or when there is a significant loss of suitable gopher forage plants at a site. The habitat-related effects of equipment impacts are covered under Factor A. While application of herbicides and pesticides may cause some level of harm to individuals of the four subspecies of MPG, in our 4(d) rule we determined that such activities may create and improve habitat for the subspecies, create or foster conservation partnerships with landowners, and are important elements in the subspecies' conservation and recovery efforts. Application of herbicides and pesticides is a threat to individuals of each of the four subspecies of MPG, but is not a population-level threat.

Prescribed Fire or Wildfire

In our 4(d) rule, we exempted certain agricultural activities on civilian airports and other non-Federal lands, including burning to control noxious weeds and invasive plants. While burning may cause some level of harm to individuals of the four subspecies of MPG, we determined that it may create and improve habitat for the four subspecies, create or foster conservation partnerships with landowners, and is an important element in the subspecies' conservation and recovery efforts. Prescribed fire and wildfire are a threat to individuals of each of the four subspecies of MPG, but do not pose a population-level threat.

Use of Heavy Equipment

Heavy equipment is often used in areas occupied by MPGs during restoration actions or other types of land management actions, such as mowing, planting, haying, fire suppression and control, herbicide and pesticide application, etc. External loads can compress, collapse, and/or destabilize soil profile structure. Heavier equipment tends to rut and compact soils, while more frequently or intensively trafficked areas become more compacted, and/or compacted at greater depth. Fine-grained Nisqually and Spanaway-Nisqually complex soils, as opposed to other preferred soils, are more vulnerable and susceptible to damage from the use of heavy equipment at most times of year, especially when they are wet. Conversely, gravelly soils are more resilient and less susceptible to damage, except when particularly wet or saturated. The potential for direct mortality or harm to MPGs due to the use of heavy equipment depends on local population density, the weather (wet or dry), and the size of the area impacted. If gophers are in their foraging tunnels near the soil surface when soils are damaged, there is a risk of mortality or injury. There is also an energetic cost to the animal when it is required to reconstruct its burrows, especially if the animal is a pregnant or lactating female. Most land managers strive not to damage large areas of soil while using heavy equipment, as doing so would also damage their ability to grow vegetation on those areas. Overall, we anticipate that the use of heavy equipment is a threat to individuals of each of the four subspecies of MPG, but not a population-level threat.

Recreation (Listing Factor E)

Direct impacts from predation by domestic dogs associated with recreational activities does occur (see Predation (Listing Factor C) section above). We anticipate predation by dogs associated with recreational activities is a threat to individuals of each of the four subspecies of MPG but is not a population-level threat.

Control as a Pest Species (Listing Factor E)

Pocket gophers are often considered a pest because they sometimes damage crops and seedling trees, and their mounds can create a nuisance. Because Mazama pocket gophers are State-listed as threatened in Washington, without a permit it is currently illegal under State law to trap or poison them or to trap or poison moles where they overlap MPG-occupied areas. Using traps other than live traps, such as body-gripping traps, also requires a special State trapping permit. However, not all property owners are cognizant of these laws, and differentiating between mole and pocket gopher mounds can be difficult. MPGs that survive commercial and residential development (adjacent to and within MPG habitat) may be subsequently extirpated by trapping or poisoning by humans. Lethal control by trapping or poisoning is most likely a threat to individuals of each of the four subspecies of MPG, where they overlap residential properties, but is not a population-level threat.

Small or Isolated Populations (Listing Factor E)

All four subspecies of MPG occupy areas that are small, fragmented, and physically isolated from one another, and they continue to face threats from further loss or fragmentation of habitat. However, the location, size, and resiliency (discussed in depth in the SBR) of the four subspecies' range-wide populations influence their vulnerability to small population effects at the range-wide population scale. Small population effects are considered to be a population-level threat for OPG and TPG, and a threat to individuals for RPPG and YPG.

3. Resiliency Units and the 3Rs

The SBR describes the current distribution of each of the four subspecies of MPG within their ranges (see Figure 1 and Appendix C of the SBR (USFWS 2022a)). Within each subspecies' Recovery Area or Recovery Unit, we delineated resiliency units, which are groups of potentially interbreeding individuals within a defined area. Within a resiliency unit there are no impermeable barriers to movement of individuals. However, unlike local populations, distances between these groups may be great enough that individuals do not consistently interbreed every year, but do so intermittently over several years. In the SBR we assessed the current resiliency of MPG populations within each resiliency unit. Reserves will ultimately be developed within some or all of the resiliency units for each subspecies.

To have sufficient levels of resiliency, redundancy, and representation, stable or increasing populations of MPG are necessary on functionally connected, good-quality habitat that is well managed. For each subspecies' recovery, a minimum number of well-distributed Reserves are necessary to maintain representation, by protecting the genetic and ecological diversity in each area, and for purposes of redundancy, to guard against losses from catastrophic events such as fire or flood. Reserves should be located on preferred soils, preferably "more preferred" soils[3], within or adjacent to RPAs, designated critical habitat, or proposed critical habitat that was excluded or exempted. Population size within each Reserve should be a minimum of 1,000 individuals.

C. NEW INFORMATION SINCE LISTING

A variety of research and conservation-related actions have occurred since the 2014 listing of the four MPG subspecies. These actions have influenced the recovery strategies for one or more of the four MPG subspecies, and built a foundation of information or agreements that will benefit the subspecies in the future. MPG populations, suitable habitat, and Recovery Areas are spatially complex and interact at multiple scales; for a conceptual schematic illustrating this structure, please refer to Figure 1.

[3] Soils where pocket gophers are most often found (Appendix A in USFWS 2018).

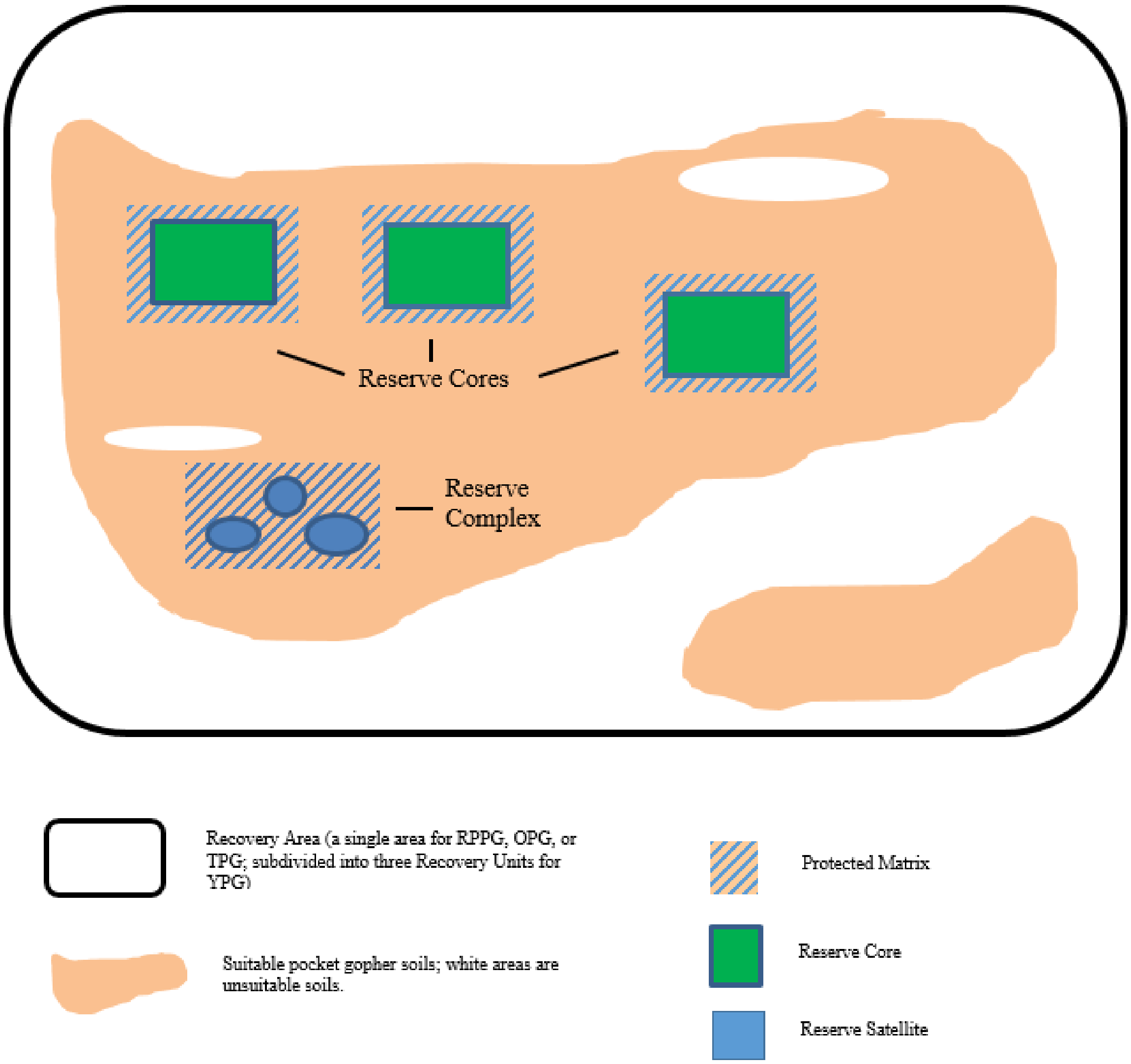

Figure 1. Example schematic of a Recovery Area that includes multiple Reserve Cores and a Reserve Complex.

To guide minimization measures and offset impacts to MPG subspecies or their habitats, whether due to actions covered under section 7 or section 10 of the Act, we delineated a total of five Service Areas for OPG, TPG, and YPG based on specific biological and geographical criteria including subspecies ranges (as currently understood), dispersal barriers, genetics, and population dynamics (USFWS *in litt.* 2015, p. 5; USFWS *in litt.* 2017, entire). Within the Service Areas, smaller areas called Reserve Priority Areas (RPAs) were delineated by the Washington Department of Fish and Wildlife (WDFW) and the Service. RPAs, combined with designated MPG critical habitat and proposed critical habitat that was exempted or excluded, are those places that are most important for and most likely to support conservation and recovery of OPG, TPG, and YPG. The range of the RPPG largely occurs on JBLM and we did not delineate a Service Area or RPAs for RPPG. However, we have delineated a Recovery Area for RPPG (Figure 2).

The RPAs were identified in part to help identify locations where impacts to a subspecies or its habitat may be mitigated or offset within the same Service Area, and thus benefit the conservation and recovery of each of the three Thurston County subspecies. For RPPG, offsets will usually be within medium- to high-quality suitable habitat within its Recovery Area.

The Service Areas were used in delineating the Recovery Areas or Recovery Units (Figure 2) in this recovery plan. The same process used to develop Service Areas for these three subspecies (USFWS *in litt.* 2017) was used to delineate the Recovery Area for RPPG in Pierce County (Figure 2). The RPAs were used to determine placement of Reserves within Recovery Areas and Recovery Units for OPG, TPG, and YPG. Proposed critical habitat areas (DoD lands were exempted from final critical habitat), areas of occupancy, and "more-preferred" soils within the RPPG Recovery Area were used to determine placement of Reserves within the Recovery Area for RPPG.

Several actions have been completed or initiated since the listing to address recovery activities in the Recovery Implementation Strategy (RIS) (USFWS 2022b, entire). These include the permitting of 12 habitat conservation plans (HCPs) in the ranges of OPG and YPG, planning of several other HCPs, provisioning of recovery land acquisition grants in the range of YPG, and initiation of several DoD-related conservation actions.

1. Habitat Conservation Plans

The following HCPs have been completed since 2014 to manage habitat in the OPG and YPG ranges: Kaufman and Meier HCPs in 2016; McLain HCP in 2017; Preserve HCP in 2018; Tveten HCP in 2018 and 2021; Capitol Boulevard Infrastructure Improvements HCP in 2019; DeChaux, M-Gopher, and Puget Sound Energy HCPs in 2020; Tumwater East Distribution Center (Puget West Inc.) HCP in 2021; and the Thurston County HCP in 2022. As of July 2022, the Bush Prairie HCP for OPG habitat near the Olympia airport is under development.

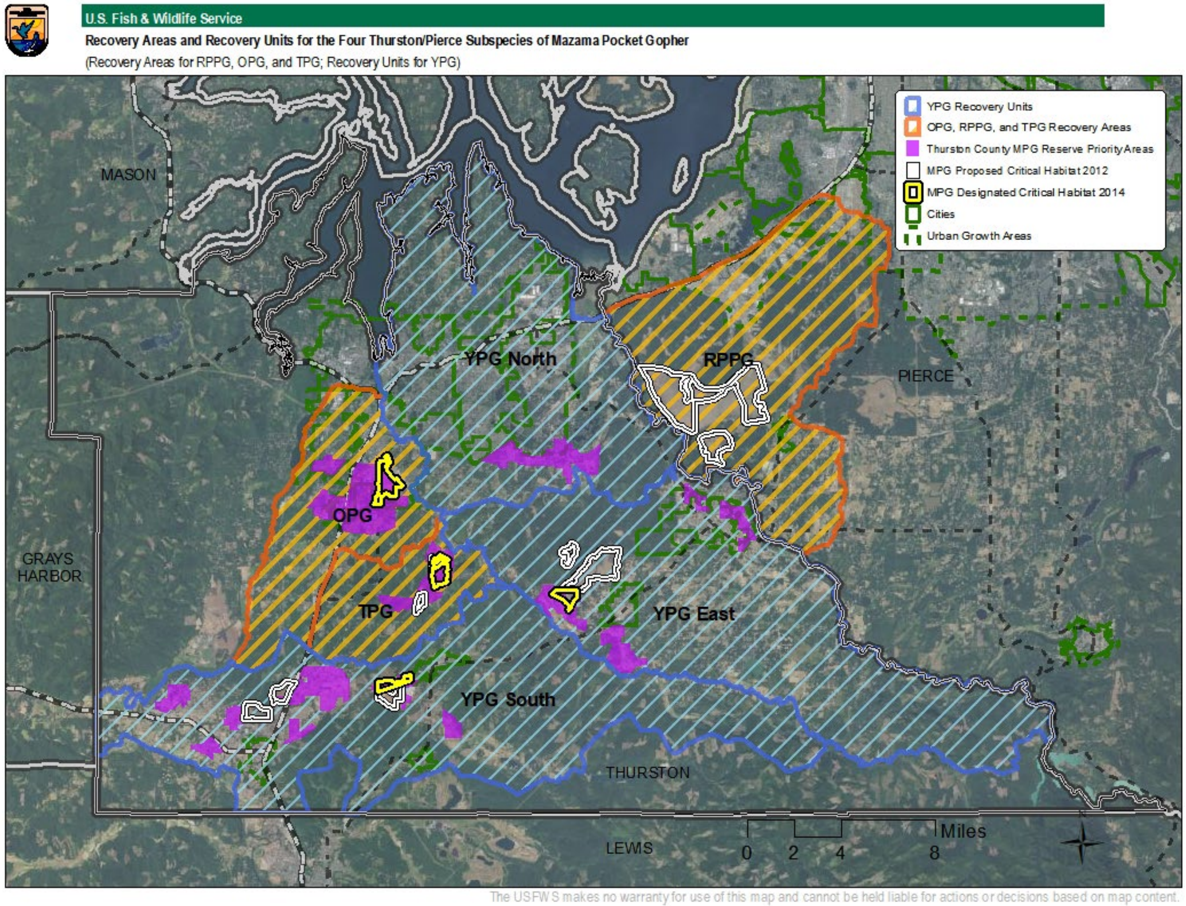

Figure 2. Recovery Areas and Recovery Units for the four MPG subspecies. Within each Recovery Area, recovery will be focused on suitable MPG soils within RPAs, designated critical habitat, and proposed critical habitat that was exempted or excluded, shown here.

2. Recovery Land Acquisition Grants

Section 6 of the Act offers four grant programs through the Cooperative Endangered Species Conservation Fund which provides funding to States and Territories for species and habitat conservation activities on non-Federal lands. Recovery Land Acquisition Grants provide financial assistance to State projects that acquire habitat for the purpose of conserving threatened and endangered species. In Washington State, the Service has awarded Recovery Land Acquisition grants to assist in funding the purchase of a 71-ac (29-ha) conservation easement in the YPG-S Recovery Unit on Frost Prairie, as well as 330 ac (135 ha) of habitat within a larger site on Rock Prairie. Grants have also been awarded by the Service to help fund the initiation of 150 ac (61 ha) of conservation lands or easements in the YPG-S Recovery Unit near the Scatter Creek WLA (WDFW 2019, p. 1).

3. Department of Defense

Coordination between the Department of the Interior and DoD, and/or the Service and JBLM, to promote the conservation of the four subspecies of MPG and other prairie-dependent species has resulted in the development of multiple Memoranda of Understandings (MOUs), section 7 consultations, and policy initiatives. These actions are aimed at increasing military mission flexibility through the conservation (recovery) of MPG and other prairie species' habitats to enhance the Army Compatible Use Buffer (ACUB) Program and south Puget Sound Sentinel Landscapes Program, while the Conservation Policy Initiative supports the initiation of the DoD-and-Service Conservation Pilot Project. The Pilot Project is intended to set defined conservation commitments for several prairie species, including RPPG and YGP, and to provide broad authorization for training flexibility.

4. Research

Multiple research projects have advanced our understanding of MPG genetics, standardized survey methods, methods for assessing site suitability, translocation techniques, dispersal characteristics, and effects of prescribed fire on MPGs. Genetics work conducted by the WDFW (Warheit and Whitcomb 2016, entire) helped guide the development of the recovery strategies for the four MPG subspecies. Results of that work indicated that there are up to eight genetic groupings within Thurston and Pierce Counties (Warheit and Whitcomb 2016, p. 19), and that a high degree of genetic diversity exists across the ranges of the subspecies. The distinct groups are separated by landscape features such as rivers, creeks, or a lack of suitable habitat, resulting in lower gene flow between the groups. These results highlight the importance of protecting the integrity of these groups, as has been reflected in the recovery strategies of the four MPG subspecies in this recovery plan.

II. Recovery

A. RECOVERY STRATEGY

An endangered species is "any species [or subspecies] which is in danger of extinction throughout all or a significant portion of its range," and a threatened species is "any species [or subspecies] which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (Act, Section 3). Consequently, a species will no longer be considered threatened or endangered once the degree of risk to the species has been reduced to the point that it is no longer in danger of extinction (or likely to become so) throughout all or a significant portion of its range, and it is likely to remain at this low degree of risk into the foreseeable future. The fundamental principle of any recovery strategy must therefore be focused on reducing extinction risk and ensuring the persistence of the species. The first step in this process is identifying the possible sources of extinction risk as well as the factors (a.k.a. threats) that influence the long-term viability of a species or subspecies.

The recovery strategies for the four MPG subspecies are based on the following fundamental concepts for reducing the risk of extinction and ensuring, to the extent possible, the persistence of the subspecies into the foreseeable future:

1. Reduce or eliminate the systemic threats to the subspecies identified and described in the final listing rule.

2. Reduce risk from random, chance events (demographic, environmental, and genetic uncertainties) and natural catastrophes by:
   a. Ensuring that subspecies' populations are viable and at or above the minimum population targets; and
   b. Protecting multiple local populations distributed across each subspecies' range.

   We consider a viable range-wide population of MPGs to be one that has sufficient numbers, is self-sustaining, and consists of protected and managed Reserves well distributed across the subspecies' range such that there is a high likelihood of persisting into the foreseeable future despite demographic, genetic, and environmental uncertainties, including random catastrophic events.

3. Provide for long-term survival of each subspecies by:
   a. Protecting and managing habitat sufficient to support the self-sustaining target population sizes.
   This strategy achieves recovery by: (1) managing for large populations with adequate reproduction and recruitment (resiliency); (2) conserving local populations spread across its range (representation); and (3) ensuring the presence of multiple local populations in its range (redundancy). Populations that are represented at multiple sites in this way have a greater chance of being buffered from the negative effects of environmental variation, have a reduced chance of being simultaneously eliminated by a single catastrophic event, and stand a better chance of maintaining historical levels of genetic diversity and gene flow (Soulé and Simberloff 1986, pp.

32-35; Simberloff 1988, pp. 500-502; Fahrig and Merriam 1994, p. 56; Shaffer and Stein 2000, pp. 307-310; Neel and Cummings 2003, pp. 227-228; Wang 2004, p. 341).

b. Restoring and then maintaining habitat to medium- and high-quality condition (see Appendix A for definition) on protected and managed Reserves well distributed across its range; and
c. Monitoring local populations within Reserves to ensure that subspecies populations are self-sustaining.

In addition to establishing protected habitat acreage targets within each Reserve, recovery criteria require that local populations be tracked to document whether subspecies populations are self-sustaining, taking into account expected levels of annual variability, consistent with the overall goal of this recovery plan. Regular local population monitoring (*e.g.*, Olson 2017; Kronland 2017) in each subspecies' Recovery Area (RPPG, OPG, and TPG) or Recovery Units (YPG) must demonstrate that populations are self-sustaining over a minimum 10-year period[4] once local population targets have been met. This will be best accomplished by monitoring individual Reserves.

B. DELINEATION OF RECOVERY UNITS FOR YELM POCKET GOPHER

Establishing Recovery Units (RUs) is an effective tool for species that are divisible into geographically or otherwise identifiable units. Recovery Units are areas that are necessary for long-term sustainability of the species and serve to facilitate species recovery. Recovery goals, and criteria to reach those goals, are set for each RU and when met should be considered indicators that the species could be delisted. To have sufficient levels of resiliency, redundancy, and representation, all RUs are necessary for the recovery of YPG. That is, to recover the YPG, the subspecies should possess healthy, viable local populations within each of the three RUs including: (1) the YPG-North RU; (2) the YPG-East RU; and (3) the YPG-South RU (Figure 2). The purpose of maintaining YPG in each of these areas is to maintain representation by protecting the genetic diversity in each RU. The RUs are also closely aligned with MPG Service Areas. See the *New Information Since Listing* section, above, for more information.

No delineation of RUs was necessary for RPPG, OPG, or TPG due to their smaller ranges, and less complex genetic structures and landscape patterns.

C. RECOVERY GOALS AND OBJECTIVES

The goal of this recovery plan is to recover RPPG, OPG, TPG, and YPG such that they no longer meet the Act's definition of threatened and can be removed from the Federal List of Endangered and Threatened Wildlife (*i.e.*, delisted).

The following recovery objectives are common to each of the four MPG subspecies:

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[4] See discussion of monitoring time-scale below under Common Criterion 2.

- Conserve, restore, and maintain the quantity, quality, and connectivity (or configuration) of RPPG, OPG, TPG, and YPG habitats to address habitat fragmentation, degradation, or loss and ensure the long-term persistence and viability of each subspecies across its range.

- Address other known threats to ensure the long-term persistence and viability of each subspecies across its range.

D. RECOVERY CRITERIA

This recovery plan presents recovery criteria for the four MPG subspecies, including three common criteria that apply collectively to all of the subspecies and individual subspecies-specific criteria. For a conceptual overview of both common criteria and subspecies-specific criteria, see Table 1.

Table 1. Summary of recovery criteria for the four MPG subspecies. See main text for detailed description of each criterion.

Common Recovery Criteria	**(Applicable to all 4 MPG subspecies)**			
Common Criterion 1	Establishment of protected Reserves managed over the long-term for pocket gophers.			
Common Criterion 2	Self-sustaining population of at least 1,000 individuals in each Reserve.			
Common Criterion 3	Approximately 250 to 500 acres (101 to 202 hectares) of medium- or high-quality habitat in each Reserve.			
Subspecies Specific Recovery Criteria	**Roy Prairie Pocket Gopher**	**Olympia Pocket Gopher**	**Tenino Pocket Gopher**	**Yelm Pocket Gopher**
	At least 3 Reserves exist	At least 3 Reserves exist, including at least 1 on each side of I-5	At least 2 Reserves exist, including 1 on Rocky Prairie	YPG-North RU: At least 2 Reserves exist YPG-East RU: At least 2 Reserves exist (1 on Johnson/Weir/ Tenalquot; 1 on Yelm Prairie) YPG-South RU: At least 3 Reserves (1 on each side of I-5; 1 on Frost Prairie)

1. Recovery Criteria Common to Each of the Four Mazama Pocket Gopher Subspecies

To achieve the recovery goal and objectives for each of the four MPG subspecies, demographically viable populations of each subspecies will need to exist within areas of suitable habitat that are protected and managed over the long-term within each subspecies' range, either in large contiguous blocks of medium- to high-quality habitat (Reserve Cores), or in groups of smaller contiguous blocks of medium- to high-quality habitat (Reserve Satellites) functionally connected by Protected Matrix that allows for dispersal (see Figure 1 and specific Criteria, below).

Common Criterion 1: Reserve Establishment

Multiple discrete Reserves (Reserve Cores, Reserve Complexes, or both) are established for each of the four MPG subspecies (see subspecies-specific criteria below for Reserve numbers and distribution; also see Table 1).

Reserve Cores are: (1) centered on, or substantially overlap with, one or more RPAs, designated critical habitat, or proposed critical habitat that was exempted or excluded; (2) protected from further development or conversion; and (3) managed for MPGs over the long term with the goal of maintaining medium- or high-quality habitat (see Appendix A for a description of medium- and high-quality habitat) sufficient to support and maintain a self-sustaining local population of MPGs. As management-reliant species (Carroll et al. 2015, p. 136; Goble et al. 2012, p. 869; Scott et al. 2005, p. 386; Scott et al. 2010, p, 92), MPGs require ongoing active management to maintain the prairie habitat characteristics needed for population growth and/or stability. Non-habitat inclusions (*e.g.*, unsuitable soils, slopes, or cover types; damaged or heavily degraded soils; wetlands, watercourses, or seasonally-inundated areas; impervious or other developed areas) may be present, but such inclusions must not prevent or impair dispersal, reproduction, or other demographic functions of the local population across the suitable and occupied habitat.

Reserve Complexes are: (1) centered on, or substantially overlap with, one or more RPAs, designated MPG critical habitat, and proposed MPG critical habitat that was exempted or excluded; (2) protected from further development or conversion; (3) contain two or more Reserve Satellites which are managed over the long-term for MPGs, with the goal of maintaining medium- or high-quality habitat sufficient to support and maintain a self-sustaining local population of MPGs; and (4) contain Protected Matrix which connects the Reserve Satellites. Fewer, larger Reserve Satellites are preferred over several, smaller Reserve Satellites (see Appendix B for discussion). Protected Matrix is under compatible, long-term management. As with Reserve Cores, non-habitat inclusions (*e.g.*, unsuitable soils, slopes, or cover types; damaged or heavily degraded soils; wetlands, watercourses, or seasonally-inundated areas; impervious or other developed areas) may be present in Reserve Complexes, but such inclusions must not prevent or impair dispersal, reproduction, or other demographic functions of the local population across the suitable and occupied habitat.

Protected Matrix is protected and under demonstrable, compatible long-term management. Protected Matrix serves either or both of the following conservation and recovery functions: (1) Protected Matrix functionally connects Reserve Satellites (*i.e*., within a larger Reserve Complex), allows for dispersal and demographic support between otherwise isolated, small local populations ("genetic rescue"), and may allow for recolonization in the event of local extirpation; and/or (2) Protected Matrix provides a buffer for adjacent Reserve Cores or Reserve Satellites, so as to minimize edge effects. Protected Matrix is not included in the overall occupancy or abundance goal for a given Reserve.

Reserve Cores, Reserve Satellites, and Protected Matrix with lower edge-to-interior (E:I) ratios[5] (Bogaert *et al*. 1999; Imre 2001) are preferred as a means to both minimize edge effects (*e.g*., Winter *et al*. 2000; Henderson 2011) and enable effective and efficient management.

Justification:
This criterion addresses the threats of habitat fragmentation, degradation, or loss; the threat of inadequacy of existing regulatory mechanisms; and the threat of small and isolated populations (79 FR 19760; USFWS 2014a, Factors A, D, and E).

Each Reserve will contribute to representation across a subspecies' range, as each Reserve will support a viable and resilient local population for its particular subspecies for the foreseeable future. Modeling efforts suggest that having a minimum of three Reserves within a subspecies' range would reduce the likelihood of extinction when there is a low-to-moderate probability of a catastrophic event occurring (see Appendix B). Our knowledge of the historical distribution of TPG is more limited compared to other MPG subspecies, but data indicate that TPG has primarily occurred on Rocky Prairie and adjacent MPG soils. The limited historical distribution of this subspecies suggests that a minimum of two Reserves would appropriately represent the range of TPG.

Reserve Complex design configurations can incorporate available compatible land use management around Reserve Satellites. In particular, some agricultural uses (*e.g*., crop production, pasturing, haying, etc.) that incorporate best management practices (*e.g.*, see pp. 19778-9 of USFWS 2014a, as well as the RIS) may be compatible with MPG conservation and recovery.

Modeling has shown that adequately-sized Reserve Complexes can support viable local populations similar to Reserve Cores (see Appendix B). Single Reserve Satellites are not large enough to support and maintain a self-sustaining local population of MPGs;

[5] Edge-to-interior (E:I) ratios are a comparison of the amount of edge (E) of a polygon of habitat, to the amount of interior (I) in that polygon. Lower E:I ratios in a Reserve Core result from minimizing the amount of habitat edge and maximizing the amount of interior habitat. For MPGs, edge impacts are anticipated due to predation (*i.e*., animals entering the polygon from outside), invasive plant encroachment (being carried in by animals or humans, or blown in), compaction of soils due to off-pavement vehicle travel, etc.

two or more Reserve Satellites connected by Protected Matrix are needed to be equivalent to a Reserve Core (see Appendix B).

Collectively, all Reserves will contribute to representation and redundancy across each subspecies' range. Achieving these criteria will significantly improve the conservation trajectory and status of each subspecies to the point of possible delisting under the Act.

Common Criterion 2: Demographic Viability

Each Reserve supports a self-sustaining population with a minimum of 1,000 individuals of the target subspecies. A minimum of 5 years of monitoring utilizing Service-approved protocols across a 10-year period have been conducted and demonstrate the self-sustaining nature of local MPG populations on each Reserve.

Justification:
This criterion addresses the threats of mortality and harm to the four MPG subspecies due to certain restoration actions, other land management actions, predation, pest species control, and impacts of military training, and the threat of small and isolated populations (79 FR 19760; USFWS 2014a, Factors A, C, D, and E).

Model results showed that a single, contiguous Reserve Core with a minimum population of 1,000 individuals would meet our probability of persistence goals. Publicly available population modeling software (Vortex 10; Lacy and Pollak 2018, entire) was used to determine how likely and how quickly populations of varying initial sizes (from 50 to 1,500 individuals) would go extinct, what the yearly growth or death rates would be, how large the populations would or could grow to be (400 to 1,500 individuals), and the size and number of reserves that would be needed. To set up the models, we used a probability of persistence of 98 percent over 50 years, based on information from other similar species (Traill *et al*. 2007, pp. 159-166 (Supplementary Material, Table 1)), focusing on rodents as well as other similar burrowing mammals. For a full summary and description of the modeling effort, see Appendix B.

Mazama pocket gopher local populations often experience fluctuations in abundance. Monitoring must capture and accurately account for these fluctuations. Ten years is generally a sufficient amount of time to achieve this goal and represents an average of 5 to 10 generations (USFWS 2014a, p. 19762). The observed, wide, year-to-year fluctuations in abundance have likely been driven by weather conditions (*e.g.*, cold dry winters, very wet winters, and/or hot dry summers). Such fluctuations may impact gophers directly (*e.g.*, increased tunnel temperature, which may alter thermoregulation capabilities (Gettinger 1975, p. 321; Ross 1980, p. 123-125)), or indirectly (*e.g.*, alterations in local forage vegetation quality or availability, or changes in soil moisture or friability, that influence energetic costs of burrowing) (Vleck 1979, p. 130, 134).

Protected Matrix is not included in the overall occupancy or abundance goal for a given Reserve, and no explicit population goals are required in Protected Matrix. Management for MPGs is not the primary management objective for Protected Matrix.

We expect that each area or parcel(s) of Protected Matrix will serve the function(s) required in Common Criterion 1.

Common Criterion 3: Habitat Area

Each Reserve Core provides approximately 250 to 500 acres (about 100 to 200 ha), or more, of medium- and high-quality habitat (see Appendix A for a description of medium- and high-quality habitat). Each Reserve Complex provides a comparable amount of medium- and high-quality habitat (*i.e.*, approximately 250 to 500 acres (100 to 200 ha), located on functionally connected Reserve Satellites. Each Reserve Satellite contains at least 10 acres (approximately 4 ha) of contiguous medium- or high-quality habitat.

Justification:
This criterion addresses the threat of habitat fragmentation, degradation, or loss and the threat of small and isolated populations (79 FR 19760; USFWS 2014a, Factors A, D, and E).

A minimum of 250 to 500 acres (about 100 to 200 ha) within a Reserve Core, or Reserve Satellites (collectively) within a Reserve Complex, should support a population of approximately 1,000 individuals (see Common Criterion 2)[6].

Based on research conducted by the WDFW on a translocated group of OPGs (reported in CNLM 2016, p. 3), and observations of Botta's pocket gophers (*Thomomys bottae*) by Reichman *et al*. (1982, p. 688), we estimate that approximately 40 percent of the habitat within a Reserve would be occupied at any point in time (see footnote 7).

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[6] Density of gophers on a site is driven in large part by quality of soils and quality of forage vegetation, as well as population demographics. Soils and forage vegetation quality are driven by factors such as season, precipitation, land management activities, and climate. Higher quality soils can, if appropriately managed, support higher quality forage vegetation and therefore higher densities of gophers. Density increases with increasing forage availability (Romañach *et al*. 2005, p. 753). Given an upper and lower limit of density, assumed conservatively to be 5 to 10 gophers per acre (12 to 25 per ha) on medium- to high-quality habitat, and an assumption that Reserves will support an approximate average of 40 percent MPG occupancy, this yields a Reserve size of about 250 to 500 acres (about 100 to 200 ha):

$$MPG\ population \cong \left(n\frac{MPG}{acre}\right) \times\ (40\%\ occupancy)(x\ acres)$$

$$population\ density\ n \cong\ 5\ to\ 10\ \frac{MPG}{acre}$$

$$1{,}000\ MPG\ \cong\ \left(5\frac{MPG}{acre}\right) \times\ (0.4\ )(500\ acres)$$

$$1{,}000\ MPG\ \cong\ \left(10\frac{MPG}{acre}\right) \times\ (0.4\ )(250\ acres)$$

For Reserve Satellite scenarios, we selected 10 acres (approximately 4 ha) as the minimum size for a Reserve Satellite because population modeling results suggest a local population of 50 to 100 gophers in suitable habitat would have an 80 percent probability of persistence over 50 years, assuming no catastrophes. But beyond 50 years, the probability of persistence for small isolated local populations declines rapidly. Therefore, we also recommend striving to connect habitat patches into larger (and thus fewer) Reserve Satellites within a Reserve Complex, rather than numerous smaller Reserve Satellites. This would increase the likelihood of population persistence beyond 50 years for a given Reserve Satellite as well as minimize the complexity of overall reserve management.

In the same way that Protected Matrix is not included in the overall occupancy or abundance goal for a given Reserve, habitat acreage within Protected Matrix is not included in the habitat goal for a given Reserve. Management for MPGs and their habitat is not the primary management objective for Protected Matrix. We expect that each Protected Matrix polygon will serve the functions required in Common Criterion 1. For that reason, suitable habitat acres are only counted on Reserve Cores and Reserve Satellites.

2. Recovery Criteria for the Roy Prairie Pocket Gopher

In addition to the three Common Criteria, above:

RPPG Criterion 1

There are a minimum of three (3) Reserves (as defined and described in Common Criterion 1).

Justification:
See Justification for Common Criterion 1.

3. Recovery Criteria for the Olympia Pocket Gopher

In addition to the three Common Criteria, above:

OPG Criterion 1

There are a minimum of three (3) Reserves (as defined and described in Common Criterion 1), with at least one on each side of Interstate Highway 5 (I-5). The third Reserve may be on either side of I-5.

Justification:
See Justification for Common Criterion 1.

Interstate-5 is a permanent landscape-scale barrier to dispersal between the east and west sides of this subspecies' range that has been in place for decades. Natural dispersal from one side of the freeway to the other likely has not occurred since the mid-1960s, and this is expected to continue into the foreseeable future. Unique genetic differences between local populations on one side versus the other may arise over time. It is likely that local populations on either side of the highway do and will experience independent population dynamics, particularly in response to catastrophic events that may occur on one side of the highway versus the other. Therefore, maintaining representation on both sides of this barrier is essential to recovery of this subspecies.

4. Recovery Criteria for the Tenino Pocket Gopher

In addition to the three Common Criteria, above:

TPG Criterion 1

There are a minimum of two (2) Reserves (as defined and described in Common Criterion 1), with at least one on Rocky Prairie.

Justification:
See Justification for Common Criterion 1.

The distributional extent of this subspecies is much smaller than that of any of the other subspecies. Our knowledge of the historical distribution of this subspecies is limited, but data indicate that the subspecies has primarily occurred on Rocky Prairie and adjacent MPG soils. The limited historical distribution of this subspecies suggests that a minimum of two Reserves would appropriately represent the range of the subspecies.

5. Recovery Criteria for the Yelm Pocket Gopher

In addition to the three Common Criteria, above:

YPG Criterion 1

There are a total minimum of seven (7) Reserves (as defined and described in Common Criterion 1) across the range of the subspecies. Each of the three RUs for YPG has its own requirements under this criterion:

YPG Criterion 1a - YPG-North Recovery Unit:

There are a minimum of two (2) Reserves in the YPG-North RU.

YPG Criterion 1b - YPG-East Recovery Unit:

There are a minimum of two (2) Reserves in the YPG-East RU, with at least one on Johnson/Weir/Tenalquot Prairie and at least one on Yelm Prairie.

YPG Criterion 1c - YPG-South Recovery Unit:

There are a minimum of three (3) Reserves in the YPG-South RU, with at least one on each side of I-5 and one representing Frost Prairie.

Justification:
See Justification for Common Criterion 1.

Due to the genetic complexity of this subspecies (Warheit and Whitcomb 2016, p. 19), each RU requires its own set of Reserves, bringing the total number of Reserves to seven for this subspecies. The necessary number and location of Reserves within each RU were informed by genetics work performed by WDFW (Warheit and Whitcomb 2016, entire). In addition, I-5 is a permanent landscape-scale barrier to dispersal in the

YPG-South Recovery Unit. Natural dispersal from one side of the freeway to the other likely has not occurred for multiple decades, and this dispersal barrier is expected to continue into the foreseeable future. Unique genetic differences between local populations on one side versus the other may arise over time. It is likely that local populations on either side of the highway do and will experience independent population dynamics, particularly in response to catastrophic events that may occur on one side of the highway versus the other. Therefore, maintaining representation on both sides of this barrier is essential to recovery of this subspecies.

III. Recovery Actions

The list of recovery actions below shows the general actions that should be taken to achieve the recovery goals established for each of the four MPG subspecies. Each general action category is assigned a recovery action priority ranking (see below).

Recovery Action Priority Rankings:

- **Priority 1a**: Actions that must be taken to prevent extinction or to prevent the subspecies from declining irreversibly.
- **Priority 1b**: An action that by itself will not prevent extinction, but which is needed to carry out a Priority 1a action.
- **Priority 2**: Actions that must be taken to prevent a significant decline in subspecies population or habitat quality or some other significant negative impact short of extinction.
- **Priority 3**: All other actions necessary to provide for full recovery of the subspecies.

Actions pertain to all four MPG subspecies unless otherwise specified.

A. LIST OF RECOVERY ACTIONS

Specific activities that will accomplish the aims of these recovery actions are indicated in bullets below, and are described in additional detail in the RIS (USFWS 2022b).

1. Protect, conserve, and enhance MPG habitat. (Priority 1a)

    - Identify and prioritize creation and protection of Reserves.
    - Purchase occupied and highly suitable lands in Reserve areas.
    - Implement other short- and long-term strategies to protect Reserves and other important MPG sites from development pressure (*e.g*., mitigation lands, interim permitting strategy, in lieu fee, programmatic HCPs, municipal HCPs).
    - Develop and cooperatively implement programs for the protection and conservation of MPGs, south Puget Sound prairies, oak savanna, and other prairie-dependent species. This can include, but is not limited to, grant funding, habitat acquisition, habitat restoration, regulatory reform programs and policies, management plans, zoning, mitigation, research, and monitoring for each subspecies.
    - Implement conservation programs to avoid, minimize, or offset effects of RPPG and YPG habitat impacts resulting from military training.
    - Monitor implementation of habitat protection activities for MPG conservation (*e.g*., set-asides, mitigation banks).

2. Identify MPG limiting factors and sources of mortality or harm and implement best management practices to minimize impacts. (Priority 1b)

Assessment of ecologically important limiting factors and evaluating the success of management measures that have been implemented is necessary for effective adaptive management. To minimize adverse effects of threats, best management practices should be implemented by all partners.

- Evaluate the effects of vegetation management on MPGs and their habitat.
- Determine if and how translocated individuals of OPG and YPG within the range of TPG are affecting demographic and genetic characteristics and recovery potential of TPG; develop solutions if needed.
- Identify landscape features that influence MPG dispersal and distribution.
- Evaluate impacts of other anthropogenic stressors affecting MPGs (*e.g*., cats, dogs, recreational uses, etc.).
- Evaluate natural factors affecting population health and distribution within and between sites.
- Conduct demographic and genetic studies.
- Revise population viability analysis every 10 years, or when new genetic or demographic information becomes available.
- Implement measures to avoid, minimize, or mitigate impacts to individual RPPGs or YPGs as a result of military training. These include the activities described in the JBLM INRMP and the ESMC for MPGs; and the activities, reasonable and prudent measures, and terms and conditions included in the biological opinion(s) addressing training and related activities at JBLM.
- Develop and implement best management practices to avoid and minimize effects of activities in occupied MPG habitat, including: use of mechanical equipment, particularly heavy equipment operations; implementation and use of restoration tools and techniques (including use of prescribed fire); management of predation by domestic and feral dogs and cats; and minimizing incidental or intentional MPG mortality resulting from control of fossorial animals (such as moles) as pest species (*i.e.*, by poisoning and trapping).

3. To achieve Reserve targets for each subspecies, evaluate the need to either create new local populations or increase the number of individuals in existing local populations within each Recovery Area or Recovery Unit. If needed, create new local populations or increase current (2022) local population sizes through habitat creation and population augmentation. Monitor Reserves/Reserve Complexes as needed to determine status and trend of populations prior to final monitoring requirements in Common Criterion 2. (Priority 2)

   - Evaluate the range-wide need to increase the number of populations.
   - Monitor local populations in individual Reserves as needed to determine status and trend prior to final monitoring requirements in Common Criterion 2.
   - Evaluate the range-wide need to augment existing populations.
   - If needed, evaluate and modify methods of captive breeding, handling, transport, and translocation.
   - If needed, develop and test best practices for habitat expansion.
   - If needed, evaluate sites for suitability and prioritize for habitat expansion.
   - If translocation or habitat expansion is justified, evaluate legal aspects and complete compliance analysis and documentation (permitting, National Environmental Policy Act, etc.)

- If needed and appropriate, establish additional populations within unoccupied areas of the historical range.
- If needed and appropriate, implement and monitor habitat expansion through vegetation manipulation (tree and shrub removal, mowing, restoration, grazing, etc.).

4. Strengthen outreach and cooperation with stakeholders and partner agencies. (Priority 2)

Coordination with landowners, management agencies, and interested members of the public is necessary to effectively implement necessary recovery actions across a broad range of land ownership.

- Facilitate coordination and information sharing.
- Implement outreach and education.

5. Monitor Reserves to determine local population status and trend, sufficient to determine if population goals required in Common Criterion 2 have been met. (Priority 3)

Population survey and monitoring with consistent and repeatable methodology is necessary to assess whether Reserves have met population targets in Common Criterion 2 and to provide baseline information for development of a post-delisting monitoring plan.

- Verify existing comprehensive survey/monitoring scheme (Olson 2017).

Implement survey/monitoring scheme at each Reserve to determine if local population goals required in Common Criteria 2 have been met.

Table 2. Crosswalk relating threats, recovery actions, and recovery criteria.

	Threat	Delisting Criteria	Applicable Recovery Actions
A **Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range**	Habitat loss, degradation, or fragmentation (prairie conversion; vegetation succession; residential and commercial development; military training impacts to habitat; nontarget effects of certain restoration actions)	Common Criterion 1: Reserve Establishment Common Criterion 2: Demographic Viability Common Criterion 3: Habitat Area RPPG Criterion 1 OPG Criterion 1 TPG Criterion 1 YPG Criterion 1	1. Protect, conserve, and enhance MPG habitat 2. Identify limiting factors and sources of mortality or harm for MPGs, and implement best management practices to minimize impacts 4. Strengthen outreach and cooperation with stakeholders and partner agencies
B **Overutilization**	N/A	N/A	N/A
C **Disease or Predation**	Predation by cats and dogs	Common Criterion 2: Demographic Viability	2. Identify limiting factors and sources of mortality or harm for MPGs, and implement best management practices to minimize impacts 4. Strengthen outreach and cooperation with stakeholders and partner agencies
D **Inadequacy of Existing Regulatory Mechanisms**	Need for long-term management commitments to address threats of military training impacts, habitat loss and degradation, and MPG mortality factors	Common Criterion 1: Reserve Establishment RPPG Criterion 1 OPG Criterion 1 TPG Criterion 1 YPG Criterion 1	1. Protect, conserve, and enhance MPG habitat 2. Identify limiting factors and sources of mortality or harm for MPGs, and implement best management practices to minimize impacts 4. Strengthen outreach and cooperation with stakeholders and partner agencies

E **Other Natural or Manmade Factors**	Direct mortality and harm from military training impacts	Common Criterion 1: Reserve Establishment Common Criterion 2: Demographic Viability Common Criterion 3: Habitat Area RPPG Criterion 1 YPG Criterion 1	2. Identify limiting factors and sources of mortality or harm for MPGs, and implement best management practices to minimize impacts 4. Strengthen outreach and cooperation with stakeholders and partner agencies
E **Other Natural or Manmade Factors**	Direct mortality and harm from land use and management within MPG habitat (e.g., certain habitat restoration actions, recreational activities)	Common Criterion 1: Reserve Establishment Common Criterion 2: Demographic Viability Common Criterion 3: Habitat Area RPPG Criterion 1 OPG Criterion 1 TPG Criterion 1 YPG Criterion 1	2. Identify limiting factors and sources of mortality or harm for MPGs, and implement best management practices to minimize impacts 4. Strengthen outreach and cooperation with stakeholders and partner agencies
E **Other Natural or Manmade Factors**	Pest species control (poisoning and trapping)	Common Criterion 1: Reserve Establishment RPPG Criterion 1 OPG Criterion 1 TPG Criterion 1 YPG Criterion 1	2. Identify limiting factors and sources of mortality or harm for MPGs, and implement best management practices to minimize impacts 4. Strengthen outreach and cooperation with stakeholders and partner agencies
E **Other Natural or Manmade Factors**	Small and isolated population effects	Common Criterion 1: Reserve Establishment Common Criterion 2: Demographic Viability Common Criterion 3: Habitat Area RPPG Criterion 1 OPG Criterion 1 TPG Criterion 1 YPG Criterion 1	2. Identify limiting factors and sources of mortality or harm for MPGs, and implement best management practices to minimize impacts 3. If needed, create new local populations or increase local population sizes. Monitor Reserves to determine status and trend prior to final monitoring requirements in Common Criterion 2 5. Monitor Reserves to determine local population status and trend, sufficient to determine if population goals required in Common Criterion 2 have been met

IV. Estimated Time and Cost of Recovery Actions

Attaining the recovery criteria for each of the four MPG subspecies is expected to take approximately 40 years.

The cost estimates in Tables 3-6, below, reflect total estimated costs for specific actions needed to achieve recovery for each of the four MPG subspecies. For a more detailed breakdown of cost estimates and methodology, please see the Recovery Implementation Strategy (USFWS 2022b). Some costs, particularly those associated with land and easement acquisition, are not determinable at this time. In developing the estimate for the cost of land acquisition, we assumed that land would be purchased; however, we may be able to meet the recovery needs of each of the four MPG subspecies through easements or other agreements, in which case, the total cost would be substantially lower.

Table 3. Estimated cost to recover the Roy Prairie pocket gopher

Recovery Action	Estimated Cost	Priority
1. Protect, conserve, and enhance RPPG habitat.	$29,921,000	1a
Land acquisition component of Action 1:	*$5,536,000*	
2. Identify MPG limiting factors and sources of mortality or harm and implement best management practices to minimize impacts.	$1, 015,000	1b
3. To achieve Reserve targets for each subspecies, evaluate the need to either create new local populations or increase the number of individuals in existing local populations in the RPPG Recovery Area (Costs for this TBD). Monitor Reserves as needed to determine status and trend of populations prior to final monitoring requirements in Common Criterion 2.	$3,965,000	2
4. Strengthen outreach and cooperation with stakeholders and partner agencies.	$1,303,000	2
5. Monitor population status, trend, and distribution, sufficient to determine if population goals required in Common Criterion 2 have been met.	$1,301,000	3
Total Estimated Cost	**$37,505,000**	

Table 4. Estimated cost to recover the Olympia pocket gopher

Recovery Action	Estimated Cost	Priority
1. Protect, conserve, and enhance OPG habitat.	$33,954,000	1a
Land acquisition component of Action 1:	*$7,457,000*	
2. Identify MPG limiting factors and sources of mortality or harm and implement best management practices to minimize impacts.	$1, 165,000	1b
3. To achieve Reserve targets for each subspecies, evaluate the need to either create new local populations or increase the number of individuals in existing local populations in the RPPG Recovery Area (Costs for this TBD). Monitor Reserves as needed to determine status and trend of populations prior to final monitoring requirements in Common Criterion 2.	$3,905,000	2
4. Strengthen outreach and cooperation with stakeholders and partner agencies.	$1,303,000	2
5. Monitor population status, trend, and distribution, sufficient to determine if population goals required in Common Criterion 2 have been met.	$1,301,000	3
Total Estimated Cost	**$41,628,000**	

Table 5. Estimated cost to recover the Tenino pocket gopher

Recovery Action	Estimated Cost	Priority
1. Protect, conserve, and enhance TPG habitat.	$28,118,000	1a
Land acquisition component of Action 1:	*$7,285,000*	
2. Identify MPG limiting factors and sources of mortality or harm and implement best management practices to minimize impacts.	$1,165,000	1b
3. To achieve Reserve targets for each subspecies, evaluate the need to either create new local populations or increase the number of individuals in existing local populations in the RPPG Recovery Area (Costs for this TBD). Monitor Reserves as needed to determine status and trend of populations prior to final monitoring requirements in Common Criterion 2.	$2,579,000	2
4. Strengthen outreach and cooperation with stakeholders and partner agencies.	$1,282,000	2
5. Monitor population status, trend, and distribution, sufficient to determine if population goals required in Common Criterion 2 have been met.	$846,000	3
Total Estimated Cost	**$33,999,000**	

Table 6. Estimated cost to recover the Yelm pocket gopher

Recovery Action	Estimated Cost	Priority
1. Protect, conserve, and enhance YPG habitat.	$86,074,000	1a
Land acquisition component of Action 1:	*$21,423,000*	
2. Identify MPG limiting factors and sources of mortality or harm and implement best management practices to minimize impacts.	$1, 165,000	1b
3. To achieve Reserve targets for each subspecies, evaluate the need to either create new local populations or increase the number of individuals in existing local populations in the RPPG Recovery Area (Costs for this TBD). Monitor Reserves as needed to determine status and trend of populations prior to final monitoring requirements in Common Criterion 2.	$9,176,000	2
4. Strengthen outreach and cooperation with stakeholders and partner agencies.	$1,384,000	2
5. Monitor population status, trend, and distribution, sufficient to determine if population goals required in Common Criterion 2 have been met.	$3,059,000	3
Total Estimated Cost	**$100,858,000**	

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APPENDIX A. Mazama Pocket Gopher Habitat Quality

High-quality habitat meets the following minimum requirements: (1) consists of "more-preferred" and/or "less-preferred" soils, with mapped "more-preferred" soils making up greater than or equal to 50 percent by area; (2) native soil profile and structure is unaltered; (3) there is less than 5 percent cover in the form of trees, and less than 10 percent cover in the form of woody shrubs; (4) there is greater than 85 percent herbaceous cover; (5) there is 10 percent or greater native herbaceous cover by area; and (6) there is less than or equal to 5 percent invasive herbaceous plant species cover by area, focusing on those plants which negatively impact MPG habitat[7].

Medium-quality habitat meets the following minimum requirements: (1) consists of "more-preferred" and/or "less-preferred" soils (Appendix A in USFWS 2018), with mapped "more-preferred" soils making up less than 50 percent by area; (2) native soil profile and structure is mostly unaltered, or has been restored; (3) there is less than 5 percent cover in the form of trees (unless native oak savanna, with less than 25 percent cover of oaks [*Quercus garryana*]), and less than 25 percent cover in the form of woody shrubs (other than native oak and kinnikinnick [*Arctostaphylos uva-ursi*]); (4) there is greater than 70 percent herbaceous cover; (5) there is 10 percent or greater native herbaceous cover by area; and (6) there is greater than 5 percent but less than or equal to 10 percent invasive herbaceous plant species cover by area, focusing on those plants which negatively impact MPG foraging or burrowing habitat.

Limiting the cover of invasive trees and woody shrubs and managing for increased herbaceous cover within suitable MPG habitat will improve foraging habitat for MPGs. Managing towards more native vegetative cover will improve overall heterogeneity on each Reserve. At a landscape scale, environmental heterogeneity across locations has been shown to increase the stability of ecosystem functions (Wang and Loreau 2014, p. 898). Ecosystem stability (either an ecosystem's ability to endure perturbations and return to equilibrium, or its ability to resist perturbations altogether), is another term for resilience (Connell and Sousa 1983, p. 790). Invasive species cover of greater than 5 but less than 10 percent is approximately equivalent to a rating of "Fair," while cover of less than 5 percent is approximately equivalent to a rating of "Good" in Rocchio *et al*. (2018, p. 49).

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[7] This includes plants which shade out or outcompete preferred MPG forage plants, or which make above- or below-ground travel difficult for gophers. Examples of common invasive plants found on south Puget Sound prairies are listed in Dunwiddie *et al*. (2006, p. 67 and Appendix A) and Bowcutt and Hamman (2016, p. 38). Note: (a) Not all plants on these two lists meet the above definition (*i.e.*, some are gopher forage plants), and (b) over time, the list of invasive plant species found on south Sound prairies is likely to change. See Appendix C for a list of known MPG forage plants.

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APPENDIX B. Population Modeling for Criteria Development

Citations
The *VORTEX* 10 program should be cited as:

Lacy, R.C. and J.P. Pollak. 2018. Vortex: A Stochastic Simulation of the Extinction Process. Version 10.3.1. Chicago Zoological Society, Brookfield, Illinois, USA.

The *VORTEX* 10 manual should be cited as:

Lacy, R.C., P.S. Miller, and K. Traylor-Holzer. 2018. Vortex Manual. 1 June 2018 update. IUCN SSC Conservation Breeding Specialist Group, and Chicago Zoological Society, Apple Valley, Minnesota, USA. Available On-Line at Vortex 10 Manual; Accessed 3 August 2018.

Methods
Free, publicly available population viability analysis software (*VORTEX* 10; Lacy and Pollak 2018) was used to examine extinction probabilities under model scenarios of variable initial population size, annual reproduction and mortality, carrying capacity, and reserve configuration. Model simulation outputs/outcomes were compared to a defined, generally accepted limit on extinction probability for these taxa: less than 2 percent probability of extinction over 50 years.

"*VORTEX* is an individual-based simulation of deterministic forces as well as demographic, environmental, and genetic stochastic events on wildlife populations. It can model many of the extinction vortices [(forces or scenarios)] that can threaten persistence of small populations. *VORTEX* models population dynamics as discrete, sequential events that occur according to probabilities that are random variables following user-specified distributions. *VORTEX* simulates a population by stepping through a series of events that describe an annual cycle of a typical sexually reproducing, diploid organism: mate selection, reproduction, mortality, increment of age by one year, dispersal among populations, removals, supplementation, and then truncation (if necessary) to the carrying capacity. The simulation of the population is iterated many times to generate the distribution of fates that the population might experience." (link to Vortex 10)

Model simulations included relevant portions of the *VORTEX* 10 "Annual Sequence" (*e.g.*, breeding, mortality, aging), but did not use portions of the sequence regarded as irrelevant to the reserve design and management scenarios under consideration (*e.g.*, harvest, supplementation) (Lacy *et al.* 2018, p. 23).

Simulations were run as individual-based models, not population-based models, allowing for demographic stochasticity. (Lacy *et al.* 2018, p. 21) "Demographic stochasticity is the variation in an observed vital rate due to the sampling variation that is inherent because each individual (an observation) is an independent and random sample from a population with a given mean or probability" (Lacy *et al.* 2018, p. 29).

“Variation across years in the frequencies of births and deaths—both in real populations and in simulated *VORTEX* populations—will have two components: the demographic variation resulting from binomial sampling around the mean for each year, and additional fluctuations due to environmental variability. Catastrophic events…also contribute to the overall observed variation across many years of data, but they are treated separately from standard annual environmental variability” (Lacy *et al.* 2018, p. 30).

“Environmental Variation is the annual fluctuation in probabilities of birth and death arising from random fluctuations in the environment (*e.g.*, weather, abundance of prey or predators, etc.). Annual fluctuations in the probabilities of reproduction and mortality are modeled in *VORTEX* 10 as binomial…distributions” (Lacy *et al.* 2018, p. 29).

Environmental Variation in survival rates was modeled by entering a mean and standard deviation for adult (age 1+) and juvenile (age 0-1) survival. “Environmental Variation in reproduction [was] modeled by…entering a standard deviation for the percent females producing litters of offspring [PBreed, mean and standard deviation]. *VORTEX* determines the percent breeding for a given year by sampling from a binomial distribution with the specified mean and standard deviation” (Lacy *et al.* 2018, p. 45).

“EV correlation between reproduction and survival…Sources of this environmental variation are outside the population; examples include weather, predator and prey population densities, and parasite loads…These factors can affect reproduction and survival independently or simultaneously. If this value is set to 0.0, then EV in reproduction will be independent from EV in mortality. If this value is set to 1.0, then EV in reproduction and EV in survival will be completely synchronized…If this correlation is set to an intermediate value, then EV in reproduction will be partly correlated with EV in survival” (Lacy *et al.* 2018, p. 29). Similarly, where EV correlation between populations is set to an intermediate value, the extrinsic environmental factors that influence annual variation in reproduction and survival will be partly correlated.

Simulations were run for one or more local populations, but not a complex meta-population (*i.e.*, variably interacting group of populations). Meta-population models require the resolution of “added complexities” (Lacy *et al.* 2018, p. 22). It is assumed that most or all of the likely reserve configurations will place these local populations in relatively close proximity, EV correlation between populations was generally set to an intermediate value.

The modeling effort did not resolve an important set of questions relevant to reserve design scenarios that involve groupings of smaller Reserve Satellites surrounded and functionally linked or connected by Protected Matrix (*i.e.*, a Reserve Complex). The modeling effort did not resolve questions about expected variable rates of dispersal and/or exchange across the many forms/configurations that a Reserve Complex could take, nor did it resolve questions about the likely role or function of colonization and recolonization within Reserve Complexes. The basic science to reliably inform the selection of input parameter values specific to these populations of Mazama pocket gopher is incomplete (*e.g.*, spatial and temporal aspects of demography across habitats of variable quality and function). A more robust evaluation of meta-population extinction probabilities was deemed not possible at this time.

Model Development, Refinement, and Application

First Runs/Simulations explored model sensitivity to input values for the following:
Environmental Variation (EV)

EV correlation between reproduction and survival [0.00, 0.25, 0.50, 0.75, 1.00]
EV correlation between populations [0.00, 0.25, 0.50, 0.75, 1.00]

Lifespan (0-7), Broods Per Year (1)
Progeny per Brood/Litter Size (mean 4, standard deviation 1)
Density-Dependent Reproduction (tested and discounted)
Percent Females Breeding (PBreed) (40% to 90%)

Mortality Rate, as a function of age (age 0-1, age 1+)
Annual Adult Survival (20% to 80%)
Annual Juvenile Survival (20% to 80%)

First runs/simulations informed the selection of input values for further model development and refinement. The inputs identified below are within the range of credible values based on review of relevant literature for these and related species. Based on first run simulations in the absence of "catastrophes," the inputs identified below result in intrinsic growth rates (lambda; λ) that approximate 1.0:

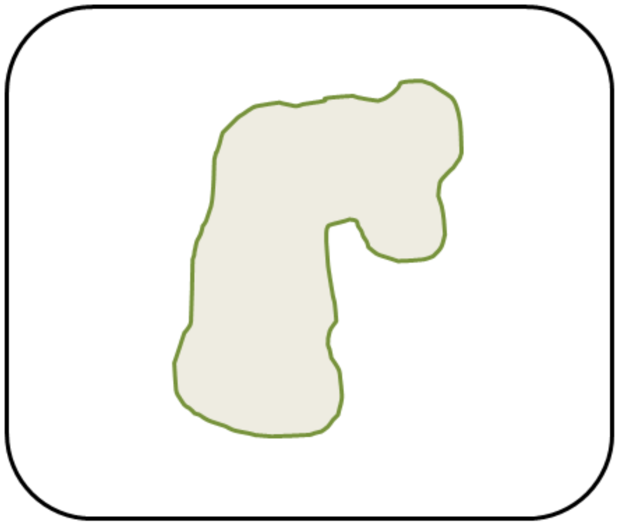
EV correlation between reproduction and survival (0.25)
EV correlation between populations (0.50, 0.75)

Base Value Set 1	Adult Survival (65%, standard deviation 3) Juvenile Survival (30%, standard deviation 5) Percent Females Breeding (PBreed) (65%, standard deviation 5)
Base Value Set 2	Adult Survival (70%, standard deviation 3) Juvenile Survival (25%, standard deviation 5) Percent Females Breeding (PBreed) (70%, standard deviation 5)

Second runs/simulations explored model sensitivity to event scenarios ("catastrophes") that result in substantial annual declines in reproduction, survival, or both. These included:

Events with a year-to-year probability, or annual occurrence rate, of 5% to 20%
Events with variable, moderate severity of impact to reproduction, 0.2 to 0.7
(80% to 30% of normal PBreed retained)
Events with variable, moderate severity of impact to survival, 0.2 to 0.7
(80% to 30% of normal survival retained; all sex and age classes)

Rare events with a year-to-year probability, or annual occurrence rate, of 1% or 2%
Rare events with extreme severity of impact to survival, 0.9
(10% of normal survival retained; all sex and age classes)



Runs/simulations, generating predicted extinction probabilities, were applied to reserve design scenarios involving a **single contiguous Reserve Core**, with a single local population.

Question: How many individuals, what minimum population size, results in acceptable extinction probabilities?

Finding(s): On balance, with consideration for a large number of runs/simulations including medium probability/moderate severity "catastrophes," and low probability/extreme severity "catastrophes," modeling showed that a minimum population size of 1,000 individuals generally and consistently achieved acceptable extinction probabilities.

Application: If a Reserve Core managed for good habitat condition will support <40% pocket gopher occupancy by area[8], and 5 to 10 pocket gophers per acre represents a reasonable, conservative, range of average densities, how many acres of contiguous Reserve Core are necessary to achieve acceptable extinction probabilities? It was determined that a single contiguous Reserve Core should fall in the size range of 250 to 500 acres to ensure acceptable extinction probabilities.

Runs/simulations generating predicted extinction probabilities were applied to reserve design scenarios involving **two or three contiguous Reserve Cores**, each with a single, **isolated**, local population (*i.e.*, no dispersal, translocation, or exchange between Reserve Cores; not a meta-population or "variably interacting group of populations").

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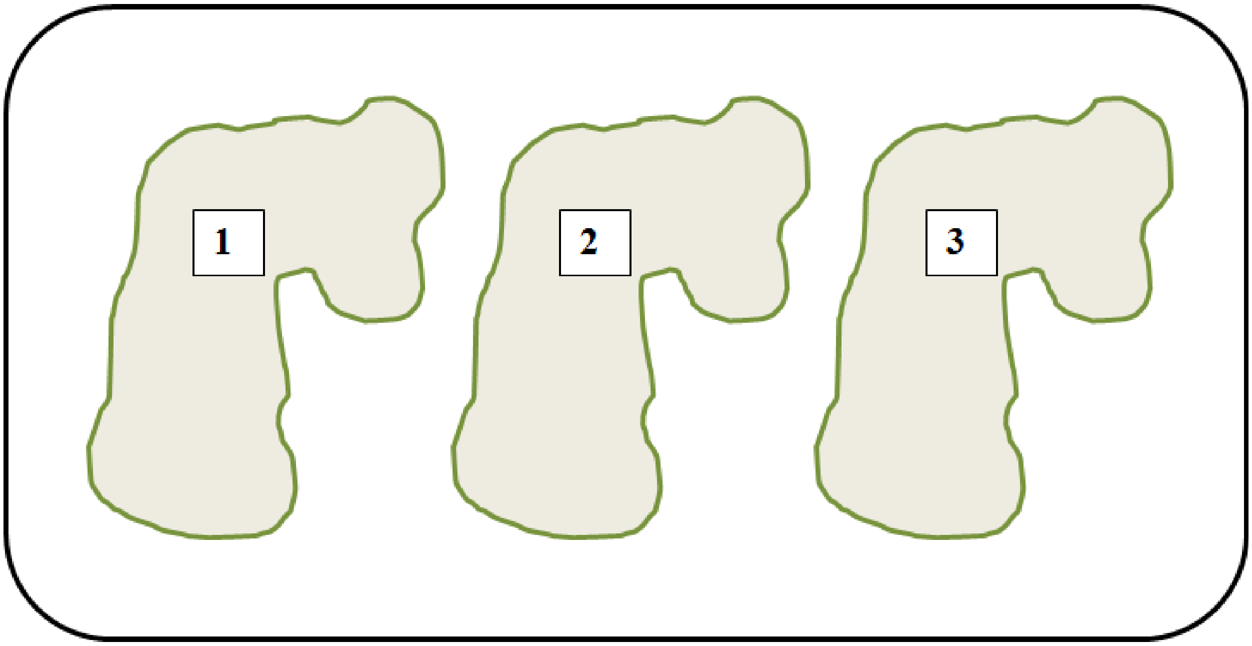
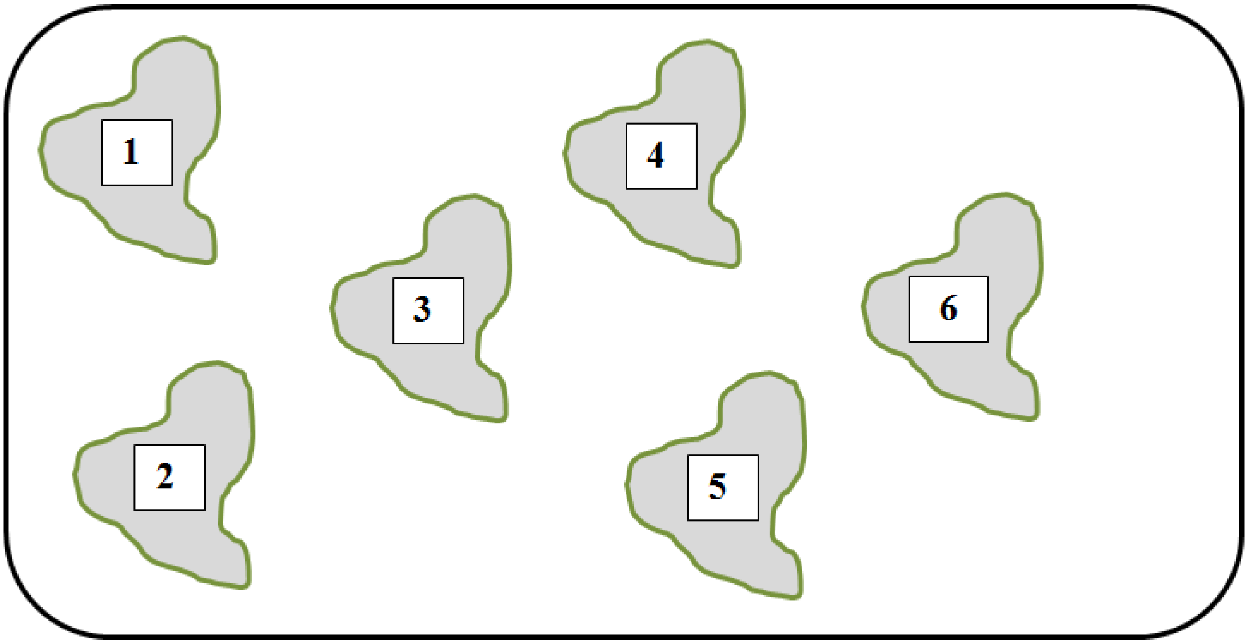
[8] This is an average value in a given year. Gophers are asocial and typically space themselves apart from each other on the landscape, leaving area between their individual burrow systems (Reichman *et al*. 1982, p. 688). Also, local gopher populations as a whole often move around on the landscape (Klaas *et al*. 2000, p. 254; Smallwood 2001, p. 256; Patton *in litt*. 2012) from season to season and year to year, to take advantage of variable availability of forage resources. Based on research (conducted by WDFW on a translocated group of Olympia pocket gophers in Thurston County (reported in CNLM 2016, p. 3) and by Reichman *et al*. (1982, p. 688; *Thomomys bottae* in Arizona), we reasonably estimate that approximately 40 percent of the habitat within a Reserve would be occupied at any point in time.



Question: If the reserve configuration consists of multiple Reserve Cores (1, 2, or 3), meeting the above description, how do the multiple Reserve Cores change modeled extinction probabilities?

Finding(s): Modeling showed that where scenarios include low probability/extreme severity "catastrophes" (year-to-year probability of 1%, 10% of normal survival retained), a third Reserve Core reduces or lowers extinction probabilities by 1.2% to 2.5%. Modeling showed that where scenarios include low probability/extreme severity "catastrophes" (year-to-year probability of 2%, 10% of normal survival retained), a third Reserve Core reduces or lowers extinction probabilities by 8.1% to 11.2%.

Runs/simulations generating predicted extinction probabilities were applied to reserve design scenarios involving **1 to 6 smaller, contiguous Reserve Satellites**, each with a single, **isolated**, local population (*i.e.*, no dispersal, translocation, or exchange between Reserve Satellites; not a meta-population or "variably interacting group of populations").



Question(s): If the reserve configuration consists of 4, 5, or 6 smaller, isolated, Reserve Satellites, each supporting an initial local population of 50 to 500 individuals, (**1**) What is the predicted range of extinction probabilities for the local populations (*i.e.*, for each Reserve Satellite), and (**2**) What is the combined probability that at least one of the local populations will persist for 50 years, for 100 years?

And if the reserve configuration consists of 1, 2, 3, 4, 5, or 6 smaller, isolated, Reserve Satellites, each apportioned an equal share of the combined total initial population (300, 600, 900, or 1,200 individuals), (**3**) What is the combined probability that at least one of the local populations will persist for 50 years, for 100 years?

Finding(s): Where scenarios include low probability/extreme severity "catastrophes" (year-to-year probability of 1% or 2%, 10% of normal survival retained), modeling showed the following:

(**1**) The predicted range of extinction probabilities for the local populations (*i.e.*, for each Reserve Satellite) is 0.205 (20.5%) to 0.879 (87.9%); and (**2a**) The combined probabilities that at least one of the local populations will persist for 50 years range from 0.871 (87.1%; Case = 4 Reserve Satellites, each with an initial local population of 50 individuals; a year-to-year "catastrophe" probability of 2%) to 1.0 (100%; more than Ten Cases); and (**2b**) The combined probabilities that at least one of the local populations will persist for 100 years range from 0.465 (46.5%; Case = 4 Reserve Satellites, each with an initial local population of 50 individuals; a year-to-year "catastrophe" probability of 2%) to 1.0 (100%; Two Cases; Case = 6 Reserve Satellites, each with an initial local population of 400 individuals; a year-to-year "catastrophe" probability of 1%; Case = 6 Reserve Satellites, each with an initial local population of 500 individuals; a year-to-year "catastrophe" probability of 1%).

(**3a**) The combined probabilities that at least one of the local populations will persist for 50 years range from 0.732 (73.2%; Case = 1 Reserve Satellite, with an initial local population of

300 individuals; a year-to-year "catastrophe" probability of 2%) to 1.0 (100%; Six Cases); and (**3b**) The combined probabilities that at least one of the local populations will persist for 100 years range from 0.400 (40.0%; Case = 1 Reserve Satellite, with an initial local population of 300 individuals; a year-to-year "catastrophe" probability of 2%) to 0.997 (99.7%; Case = 6 Reserve Satellites, each with an initial local population of 200 individuals; a year-to-year "catastrophe" probability of 1%).

Application: When the same total number of individuals, the combined total initial population (300, 600, 900, or 1,200 individuals with carrying capacity K = 450, 800, 1200, and 1800, respectively), is apportioned equally across 1, 2, 3, 4, 5, or 6 isolated Reserve Satellites, the combined probabilities of persistence (*i.e.*, probability that at least one of the local populations will persist) are always, under all scenarios, greater for multiple, smaller local populations than for one or two, larger local populations.

These model results were not completely unexpected, but did prompt a set of follow-up comparisons:

> If the reserve configuration consists of 1, 2, 3, 4, 5, or 6 smaller, isolated, Reserve Satellites, each apportioned an equal share of the combined total initial population (300, 600, 900, or 1,200 individuals), (**1**) What is the combined probability that at least one of the local populations will persist for 50 years? (Same Question posed above, Item (3a)); and (**2**) What is the mean population size (*i.e.*, number of individuals; proportion of initial) for local populations still persisting after 50 years?
>
> For combined total initial populations of 300, 600, 900, or 1,200 individuals, these model results and comparisons reveal a consistent pattern of trade-offs between combined persistence probabilities and mean population size (*i.e.*, number of individuals; proportion of initial) persisting after 50 years.

Under all scenarios, combined probabilities of persistence approach 1.00 (100%) when the combined total initial populations (300 or 600 individuals) are apportioned equally across more than 2 Reserve Satellites, or when the combined total initial populations (900 or 1,200 individuals) are apportioned equally across more than 1 Reserve Satellite. **But**, when the combined total initial populations (300 or 600 individuals) are apportioned equally across more than 1 Reserve Satellite, there is a projected steep decline in mean population size (*i.e.*, number of individuals; proportion of initial) for local populations still persisting after 50 years. **And**, when the combined total initial populations (900 or 1,200 individuals) are apportioned equally across more than 1 Reserve Satellite, there is a projected shallower but still steady decline in mean population size (*i.e.*, number of individuals; proportion of initial) for local populations still persisting after 50 years.

These model simulations and comparisons suggest the following: multiple smaller (and isolated) Reserve Satellites do increase combined probabilities of persistence, but those combined probabilities of persistence become negligibly greater (or larger) for reserve configurations that include more than 3 Reserve Satellites; and, for reserve configurations that apportion a combined total initial population across more than 3 smaller (and isolated) Reserve

Satellites, mean population size (*i.e.*, number of individuals; proportion of initial) persisting after 50 years becomes increasingly smaller.

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APPENDIX C. Mazama Pocket Gopher Forage Resources and Diet

Pocket gophers are generalist herbivores. They eat a wide variety of plants, including leafy forbs, succulent roots, shoots, and tubers. All needed water is obtained from their food (Wight 1918, p. 13; Gettinger 1984, pp. 749-750). Pocket gophers aren't known to occur in areas where woody vegetation is dense and no suitable forage is available (Marsh and Steele 1992, p. 210), which includes areas invaded by the native Douglas-fir tree (*Pseudotsuga menziesii*) and the invasive shrub, Scotch broom (*Cytisus scoparius*). The Service considers encroachment by woody vegetation to have substantial negative impacts on suitable MPG habitat and populations occupying such areas. Pocket gophers favor early successional forbs and grasses, as well as native short-statured plant communities.

Pocket gophers are likely less selective about food than are surface-dwelling rodents because, similar to other subterranean rodents, burrowing to locate food is an energetically costly activity (Buffenstein 2000, pp. 64, 68, 69). As with other subterranean rodents (Buffenstein 2000, p. 69), pocket gophers tend to favor highly nutritive foods, such as starchy roots and perennial forbs, but will consume whatever is available.

Maser *et al.* (1981, p. 173) stated that MPGs in Oregon prefer bulbs such as wild onion and wild garlic, but also eat clover, lupines, hairy cat's ear, and grasses. Burton and Black (1978, p. 387) reported that the annual diet of MPGs in Oregon consisted of aboveground parts of forbs and grasses (40 percent and 32 percent, respectively) and 24 percent roots. Feeding preferences appear to change with availability, where they are available, the most succulent plants are most preferred. In summer, when all forbs are most abundant, perennial forbs are preferred over grasses, and grasses are preferred over annual forbs. Most grasses are eaten most frequently during the dormant season (November to May), when forb availability is low or absent. Woody plants are least preferred and a minor component of their annual diet, eaten mostly in winter.

Forbs may provide energy and nutrients that are important or essential for growth and reproduction. Keith *et al.* (1959, p. 139) reported that the experimental removal of forbs from an area occupied by northern pocket gophers in Colorado reduced that population by 87 percent. Pocket gophers given only grasses while in captivity lost weight and died, demonstrating that a grass-only diet would not support a population, and would at most provide a marginal diet (Tietjen *et al.* 1967, p. 641-642).

Studies examining plant materials eaten or cached by pocket gophers, including MPGs, have documented several more or less consistent trends: (1) diets appear to include a high composition of forbs; (2) succulent vegetation is preferred (*e.g.*, forbs, fleshy rooted grasses); (3) seasonal availability is an important determinant of diet and diet composition; (4) when available, forbs are preferred over all other types of vegetation; (5) above-ground parts are taken with greater frequency in spring and summer, while below-ground parts become more important during dormancy and winter; (6) grass shoots, corms, rhizomes, tubers, and roots become more important during dormancy and winter; and (7) grasses provide a marginal diet, unless they bear corms or rhizomes (Philips 1936; Moore and Reid 1951; Ward 1960; Hermann and Thomas 1963; Myers and Vaughan 1964; Teitjen *et al.* 1967; Tryon and Cunningham 1968; Barnes 1973; Turner *et al.* 1973; Ward 1973; Burton 1976; Burton and Black 1978; Gettinger 1984; Cox 1989; Hunt 1992; Witmer *et al.* 1996; Reichman 2007).

Information from these studies has yielded the following list of forbs and grasses that Mazama pocket gophers are known to eat and which occur on Thurston and Pierce County prairies. There may be others, not yet known. These are listed in alphabetic order by scientific name, not order of preference: common yarrow (*Achillea millefolium*), agoseris (*Agoseris* spp.), [non-native] thistle (*Cirsium* spp.), [native and non-native] brome (*Bromus* spp.), camas (*Camassia* spp.), willowherb (*Epilobium* spp.), woolly sunflower (*Eriophyllum lanatum*), [non-native] hairy cat's ear (*Hypochaeris radicata*), [non-native] peavine (*Lathyrus* spp.), lupine (*Lupinus* spp.), slender phlox (*Microsteris gracilis*), Gairdner's yampah (*Perideridia gairdneri*), knotweed (*Polygonum douglasii*), cinquefoil (*Potentilla* spp.), bracken fern (*Pteridium aquilinum*), [non-native] common dandelion (*Taraxacum officinale*), [native and non-native] clover (*Trifolium* spp.), and violet (*Viola* spp.).

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APPENDIX D. Summary of Comments Received on the Draft Recovery Plan

On June 29, 2021, we published a notice in the Federal Register announcing the availability of the draft recovery plan for four subspecies of Mazama pocket gopher (*Thomomys mazama glacialis*, *T. m. pugetensis*, *T. m. tumuli*, and *T. m. yelmensis*) for public review and comment (86 FR 34269). The public comment period was open until August 30, 2021. We received three responses in total: one from a State agency and two from members of the public. We received no comments from Native American Tribes.

One letter contained substantive comments. Comments ranged from minor editorial suggestions to specific recommendations on plan content. We have considered all substantive comments and, to the extent appropriate, we have incorporated the applicable information or suggested changes into the final recovery plan. Below, we provide a summary of substantive comments received with our responses; however, some of the comments we incorporated as changes into the final recovery plan did not warrant an explicit response, and thus are not presented here.

Comment: We recommend that grazing be considered as an additional management practice under Recovery Action #3.

Response: Grazing was added to the list of types of vegetation manipulation that may be implemented under Recovery Action #3 both in this Plan and in the RIS.

Comment: Creating educational materials to be dispersed in residential areas located near gopher habitat could be an effective means of raising public awareness. Perhaps if the public is cognizant of the detrimental effects of domestic and feral cats and dogs on wildlife, unnecessary predation of pocket gophers could potentially be reduced.

Response: Distribution of educational materials is implied in Recovery Action #4 in this Plan, which includes education and outreach. However, we have added wording in the RIS to explicitly include "outreach and educational materials" under Recovery Action #4.

Comment: Due to the usefulness of the information in the Species Biological Report and Recovery Implementation Strategy, these documents should be included as appendices to supplement the rest of the plan.

Response: Both the SBR and the RIS are documents that will be regularly updated, and thus it would not be appropriate to include them as fixed appendices to this Plan. However, in the introduction section of this recovery plan we have added links to the Mazama pocket gopher recovery webpage maintained by our Washington Fish and Wildlife Office, and to the species profile pages for the four MPG subspecies, which will maintain current copies of the SBR and RIS.