STATE OF WASHINGTON **Progress Report December 2023**

Recovery of Greater Sage-Grouse in Washington: Progress Report

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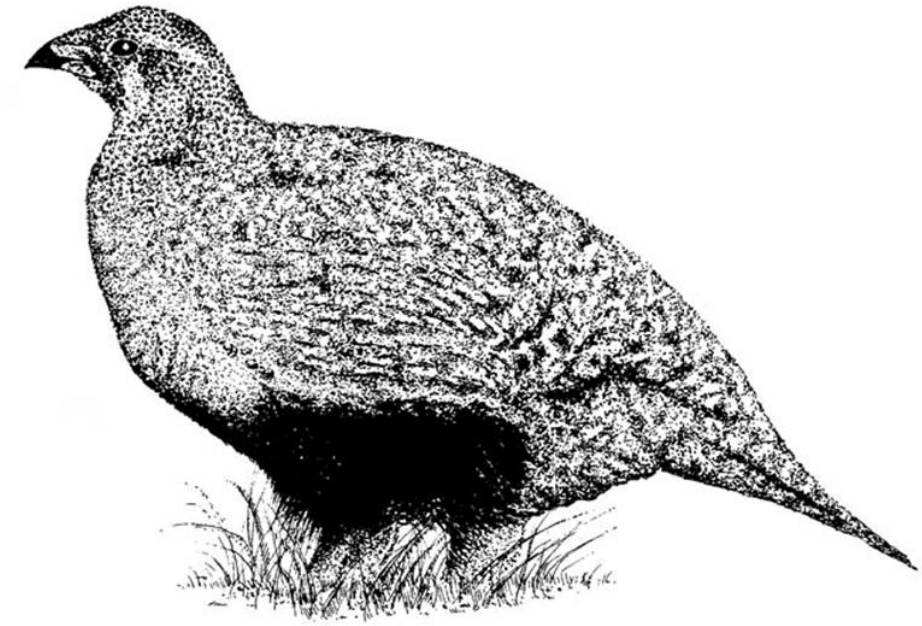
ABSTRACT

Declining populations and distribution of greater sage-grouse (*Centrocercus urophasianus*) in Washington have resulted in serious concerns for their long-term conservation status. The state-listed endangered species had an overall estimated population of 429 in 2023, associated with 22 leks. The birds were distributed between 3 populations including 390 birds with 18 leks in Moses Coulee, 36 birds with 3 leks in the Joint Base Lewis-McChord-Yakima Training Center (JBLM YTC), and 3 birds with 1 lek in Crab Creek. A fourth population, the Yakama Nation (YN), appears to be extirpated following a reintroduction effort, however there has been some unconfirmed reports of sage-grouse south of the YN. The overall population decreased 21% between 2022 and 2023 and 45% since 2020. Between 2004 and 2016 the Washington Department of Fish and Wildlife (WDFW), JBLM YTC, YN, and others collaborated to translocate 507 sage-grouse from other states (Nevada, Oregon, Idaho, and Wyoming) to the Crab Creek, JBLM YTC, & YN populations. Grouse habitat was dramatically impacted by wildfire in 2020 with all three of the remaining populations affected. We examined the impact of wildfires using attendance at leks outside and inside wildfire perimeters, before (spring 2020) and after (spring 2023). Outside of the fire perimeters, attendance at 12 leks declined 28% from an average of 11.8 males (SE = 2.4) in 2020 to 8.5 males (SE = 2.1) in 2023. Inside fire perimeters, attendance at 10 leks declined 63% from an average of 16.5 males (SE = 3.6) in 2020 to 6.1 males (SE = 1.7) in 2023.

On the cover: Photo of CRP habitat in winter and a male sage-grouse in a wheat field by Michael A. Schroeder. *Page 1 and back cover:* Illustrations by Darrell Pruett.

RECOVERY OF GREATER SAGE-GROUSE IN WASHINGTON: PROGRESS REPORT



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INTRODUCTION

Greater sage-grouse have declined dramatically in both distribution and population size in Washington (Schroeder et al. 2000, 2004). The current range for endemic sage-grouse is about 8% of the historic range, occurring in two relatively isolated areas; one primarily on the Joint Base Lewis-McChord-Yakima Training Center (JBLM YTC) in south-central Washington and the other centered in the Moses Coulee area of Douglas County in north-central Washington (Schroeder et al. 2000, Fig. 1). These observed declines in populations and distribution in Washington were accompanied by observations of loss of genetic heterogeneity in northern Washington (Oyler-McCance et al. 2005). There is a small population of sage-grouse in the Crab Creek area in Lincoln County, however, this population is not endemic but was re-established using birds translocated from southern Oregon. Additionally, there are unconfirmed reports of sage-grouse south of the Yakama Nations (YN), where a reintroduction was attempted but appears to have failed.

Historic and recent declines of greater sage-grouse in Washington are linked to conversion, degradation, and fragmentation of native habitat for production of crops, livestock, and energy (WDFW 1995, Hays et al. 1998, Stinson et al. 2004, Shirk et al. 2015). In the Moses Coulee population in north-central Washington (Fig. 1), sage-grouse occupy a 3,500 km^2 mosaic of

mostly private lands used for dryland farming (i.e., wheat), lands enrolled in the federal Conservation Reserve Program (CRP, including State Acres for Wildlife Enhancement [SAFE]), or lands with high-quality shrubsteppe (Schroeder and Vander Haegen 2011). In contrast, the JBLM YTC population in south-central Washington was believed to occupy about 1,150 km^2 >20 years ago (Schroeder et al. 2000), but the current area of occupancy may be as low as 474 km^2 (456 km^2 on JBLM YTC and 18 km^2 on adjacent private land). The JBLM YTC is one of the largest shrubsteppe sites remaining in the state, due largely to its complex topography, isolated nature, and history of low intensity livestock grazing. Grazing by livestock was completely eliminated in 1995 with the exception of several 30-day spring season sheep travel-through events having occurred up through the mid-2000's. These travel-through events were eliminated due to conflicts with military training schedule and other natural resource concerns. Military training and fires pose the greatest threat to habitat security. Cross-country maneuvers with military vehicles decrease habitat quality through sagebrush mortality (Cadwell et al. 1996, Stephan et al. 1996) and disturbance to understory communities (Cadwell et al. 2001). Training activities also ignite wildfires that pose a significant threat to the existing habitat both on and adjacent to the installation. In recent years, larger landscape-scale fires, a higher frequency of natural-caused wildfires (i.e., lightning), and fires originating from adjacent interstate highways (e.g., I-82, I-90) have impacted the installation's remaining unburned areas of suitable habitat to a greater degree than in previous years. When combined with military training related fires, the result is that approximately 59% of the installation has burned at least once in the last 33 years with many of those areas also being subjected to repeated fires over the same period of time. Although fires have impacted the Moses Coulee and Crab Creek areas in the past, the dramatic fire events of 2020 make the historical fires pale in comparison. This local trend of increased fire frequency, larger landscape fires, and an increase in the wildland fire season is consistent across the range of sage-grouse.

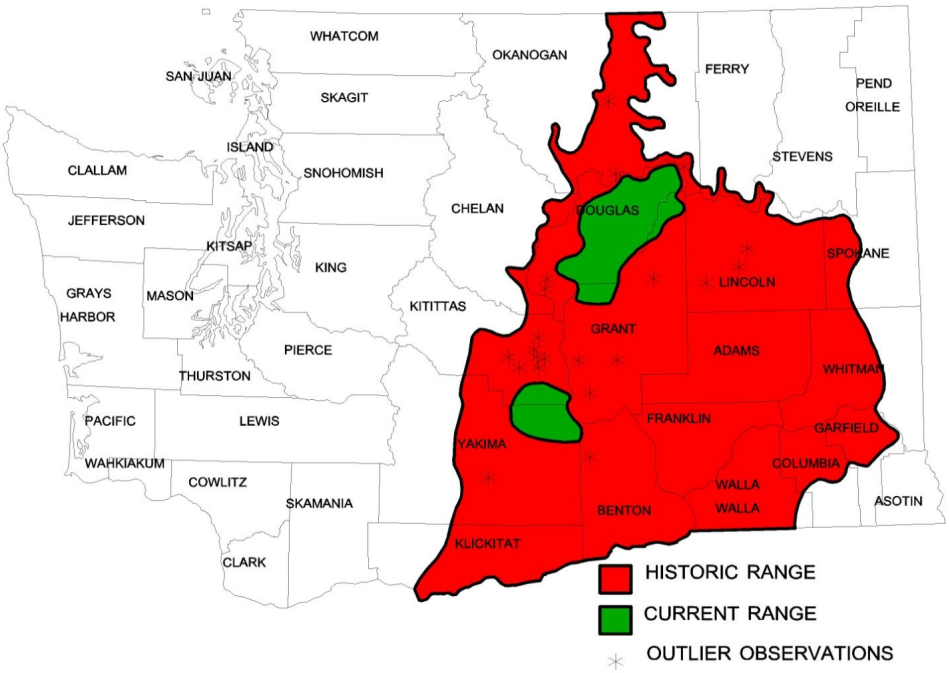

Fig. 1. Estimated historic and current range of greater sage-grouse in Washington prior to translocation efforts (Schroeder et al. 2000). Only endemic populations are shown.

Long-term declines in distribution and abundance of greater sage-grouse in Washington are the primary reasons why the Washington Department of Fish and Wildlife (WDFW) listed the greater sage-grouse as "threatened" within the state in 1998 (Hays et al.) and then as "endangered" in 2020. These population declines (Schroeder et al. 2000, Connelly et al. 2004, Garton 2011), their isolated nature, and their previous status as a subspecies (*C. u. phaios*) were used by the U.S. Fish and Wildlife Service in 2001 to determine that greater sage-grouse in Washington and northern Oregon represented a distinct population segment and that the population segment warranted a federal listing as threatened. Both the "warranted" and "distinct population segment" decisions were reversed in 2015 (U.S. Fish and Wildlife Service). Although greater sage-grouse in Washington State are no longer federally listed as a candidate species, the areas occupied by the two endemic populations (Moses Coulee and JBLM YTC), the one remaining translocated Crab Creek population, and the formerly occupied Yakama Nation population were federally recognized as "Priority Areas for Conservation" (U.S. Fish and Wildlife Service 2013b).

A greater sage-grouse recovery plan was published in 2004 for Washington, which stated as its primary goal "to establish a viable population of sage-grouse in a substantial portion of the species' historic range in Washington" (Stinson et al. 2004). The recovery plan established numerous management units (Fig. 2) to aid in the identification and implementation of management and recovery actions (Stinson et al. 2004). Although greater sage-grouse have been observed in all management units, only four units have active leks; Mansfield Plateau, Moses Coulee, Crab Creek, and Yakima Training Center.

The management units were not designed to limit management and recovery activities, but to focus activities. Even so, enhancement of existing populations was identified as the highest priority (Stinson et al. 2004, Stinson and Schroeder 2014). The recovery plan listed the following strategies, all of which have been applied and/or attempted in at least a portion of the greater sage-grouse range in Washington (Stinson et al. 2004:57). The purpose of this report is to address some of the key activities, particularly inventory and monitoring (item 1 below), translocations (item 3 below), and research (item 9 below).

1) Inventory and monitor the greater sage-grouse populations in Washington.
2) Protect sage-grouse populations.
3) Enhance existing populations and re-establish additional populations with translocations.
4) Protect sage-grouse habitat on public lands.
5) Work with landowners to protect the most important sage-grouse habitat on private land.
6) Facilitate and promote the use of incentives, such as Farm Bill conservation programs, to benefit sage-grouse.
7) Facilitate management of agricultural and rangelands that are compatible with the conservation of sage-grouse (working lands).
8) Restore degraded and burned sage-grouse habitat within sage-grouse management units.

9) Conduct research necessary to conserve sage-grouse populations.

10) Cooperate and coordinate with other agencies and landowners in the conservation, protection, and restoration of sage-grouse in Washington.

11) Develop public information materials and educational programs for landowners, schools, community organizations, and conservation groups as needed.

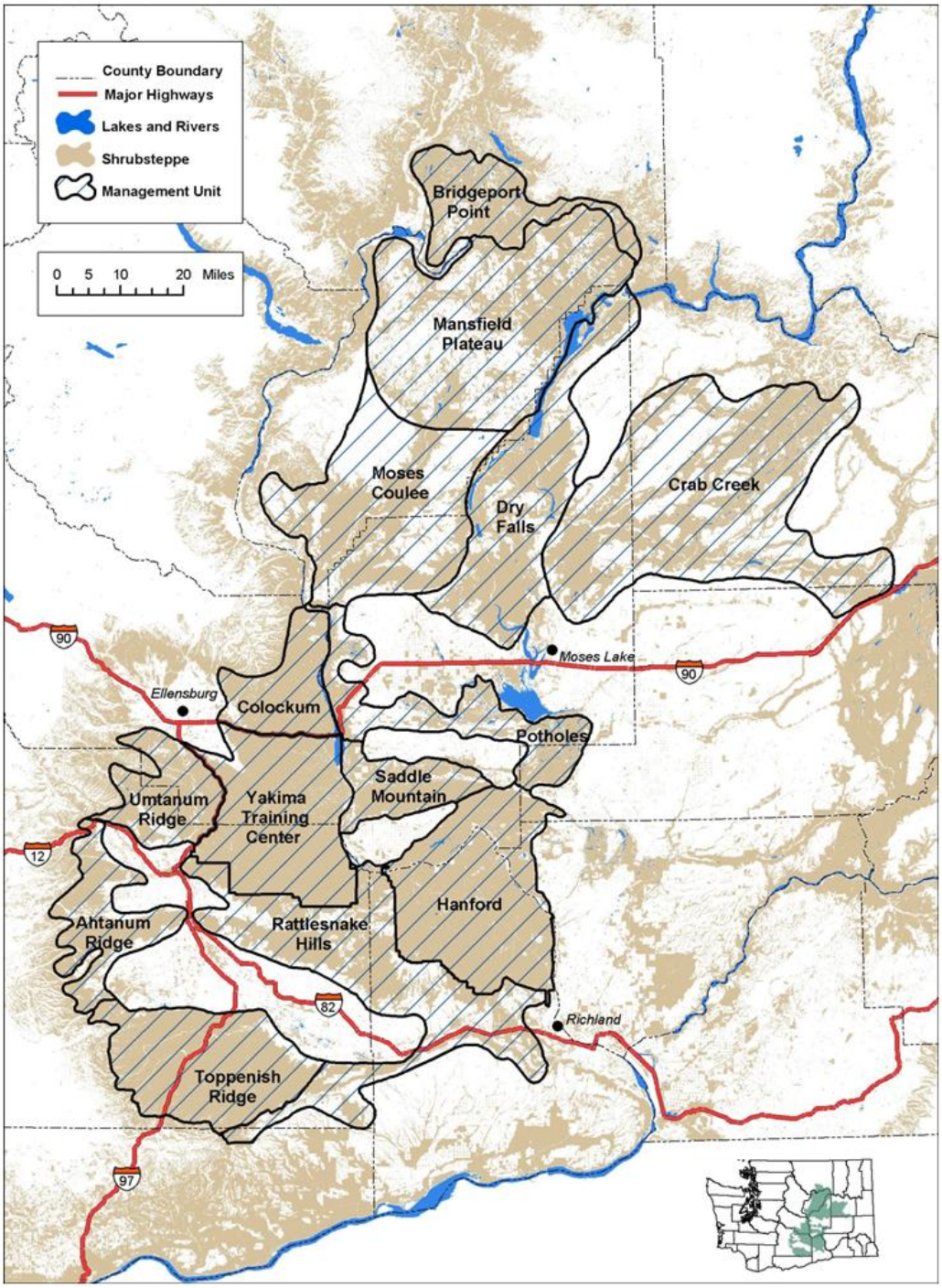

Fig. 2. Greater sage-grouse management units in relation to shrubsteppe cover types in Washington.

METHODS

Leks can be defined as traditional locations where males perform their breeding displays. Because males will sometimes display at satellite or temporary locations, and because lek locations can be altered slightly from one year to the next, lek locations ≤ 3 km from one another were grouped into lek complexes. In contrast, lek complexes were typically separated from the next nearest lek complex by ≥ 6 km. Lek complexes were surveyed annually to obtain information on sage-grouse populations and annual rates of change (Schroeder et al. 2000). The survey protocol included multiple (≥ 3) visits to all known complexes and searches for new and/or previously unknown complexes.

Numbers of males attending lek complexes were analyzed using the greatest number of males observed on a single day for each complex for each year. This technique is well established for greater sage-grouse (Connelly et al. 2000, 2003, 2004), but it may have biases that result in males being undercounted and the sex ratio of males to females being inadequately estimated (Jenni and Hartzler 1978, Emmons and Braun 1984, Walsh 2002, Walsh et al. 2004). Despite these potential biases, lek counts provide an assessment of a population's long-term trend (Connelly et al. 2004). The population size was estimated using a sex ratio of 1.6 females per 1.0 males (Stinson et al. 2004).

Translocations were conducted with consideration of 1) suitability of release sites; 2) genetics and morphology of source populations; 3) capture and translocation methodologies; and 4) monitoring and evaluation of results (IUCN/SSC 2013). Translocations consisted of two types (Griffith et al. 1989): 1) augmentation of existing population at YTC and 2) introduction of grouse to Crab Creek and YN areas where sage-grouse had been extirpated. In the case of augmentations, translocations were used to address demographic or genetic short-comings in the population (e.g. low genetic diversity of sage-grouse in Washington, Oyler-McCance et al. 2005). In the case of introductions, historical presence of greater sage-grouse and suitability of habitat quantity, quality, and configuration were considered (Schroeder et al. 2000).

Sage-grouse were captured during the spring breeding period (late March/early April) or in late summer/early autumn (e.g., October). Birds were captured with the aid of night lighting (Giesen et al. 1982, Wakkinen et al. 1992) when attending leks or in brood areas; spring releases were more successful than other periods (Reese and Connelly 1997). All birds destined for translocation received a health certificate from a veterinarian accredited within the donor state. A list of diseases to screen for was determined in coordination with WA State Department of Agriculture each year and typically included salmonella and avian influenza. West Nile Virus (WNV) was not a concern for spring translocations since the vector of WNV, *Culex* mosquitoes, are not active in early spring. For the single fall translocation we eliminated for consideration any areas that had an outbreak of WNV within 10 days of the translocation, because birds infected with WNV either die or clear WNV and develop antibodies within 10 days (K. Mansfield, WDFW Veterinarian, pers. comm.).

Recently (2022) however, WNV surveillance conducted at JBLM YTC documented a positive WNV detection in a different species of mosquito (i.e., *Aedes vexans*) which based on their life history may pose an extended season disease threat to sage-grouse and other avian species.

Unlike *Culex* species that require surface water in which to lay their eggs, *Aedes vexans* lay their eggs in soil that is seasonally inundated with water (Strickman 1980). *Aedes vexans* eggs can desiccate and last up to 3 years in the soil, waiting for the next precipitation event to hatch (James &Harwood 1969). Since 2009, JLBM YTC has seen an increase in *Aedes vexans* and a decrease in *Culex* species in their WNV surveillance samples and it is thought to be related to climate induced changes to surface water availability on the installation. This may explain why mosquito samples collected on JBLM YTC are exhibiting their highest percentages of *Aedes vexans* in the spring and late September after having received a small (0.5 inch) amount of precipitation. As the Columbia Basin landscape is altered by climate change and the availability of surface water decreases, continued changes in the composition and seasonal abundance of local mosquito communities are likely and could extend the season length that sage-grouse may be exposed to WNV vectors.

Sex and age were determined for all captured birds (Beck et al. 1975, Braun and Schroeder 2015). Blood and feather samples were both obtained for genetic analysis. All birds were banded with a unique numbered metal band. Birds were transported by car in individual boxes that were small enough to contain the birds' wing movement to reduce accidental injury. The bottom of each box was lined with a material to reduce contact between feces and the birds' feet. The birds were released as soon as possible, typically within 24 hours but sometimes as much as 36 hours of capture. In the Crab Creek area, they usually were released at first light on an active lek with the aid of a settling box that permitted the simultaneous remote release of multiple birds following a quiet acclimation period of at least 15 minutes. On JBLM YTC birds generally were released directly from the transportation boxes. Translocated birds (VHF and GPS transmitters) and leks on the release areas were monitored following translocation as recommended (Toepfer et al. 1990, IUCN/SSC 2013, Connelly and Reese 1997).

RESULTS AND DISCUSSION

Overall

The total population estimate for sage-grouse in Washington was 429 in 2023 (Fig. 3). This was a 21% decrease from 2022. The birds were distributed between 3 populations including 390 birds with 18 leks in Moses Coulee, 36 birds with 3 leks in the JBLM YTC, and 3 birds with 1 lek in Crab Creek. Birds were observed on 22 of 62 leks documented in the last 65 years (35% of known leks active). The total number of leks does not include leks documented prior to the mid-1950s, leks that appeared to be temporary, or miscellaneous single males. The long-term declines observed in Washington are similar to those observed in other sage grouse populations in the range periphery of California, Utah, Colorado, North Dakota, South Dakota, Alberta, and Saskatchewan (Connelly and Braun 1997, Connelly et al. 2004, Garton et al. 2011).

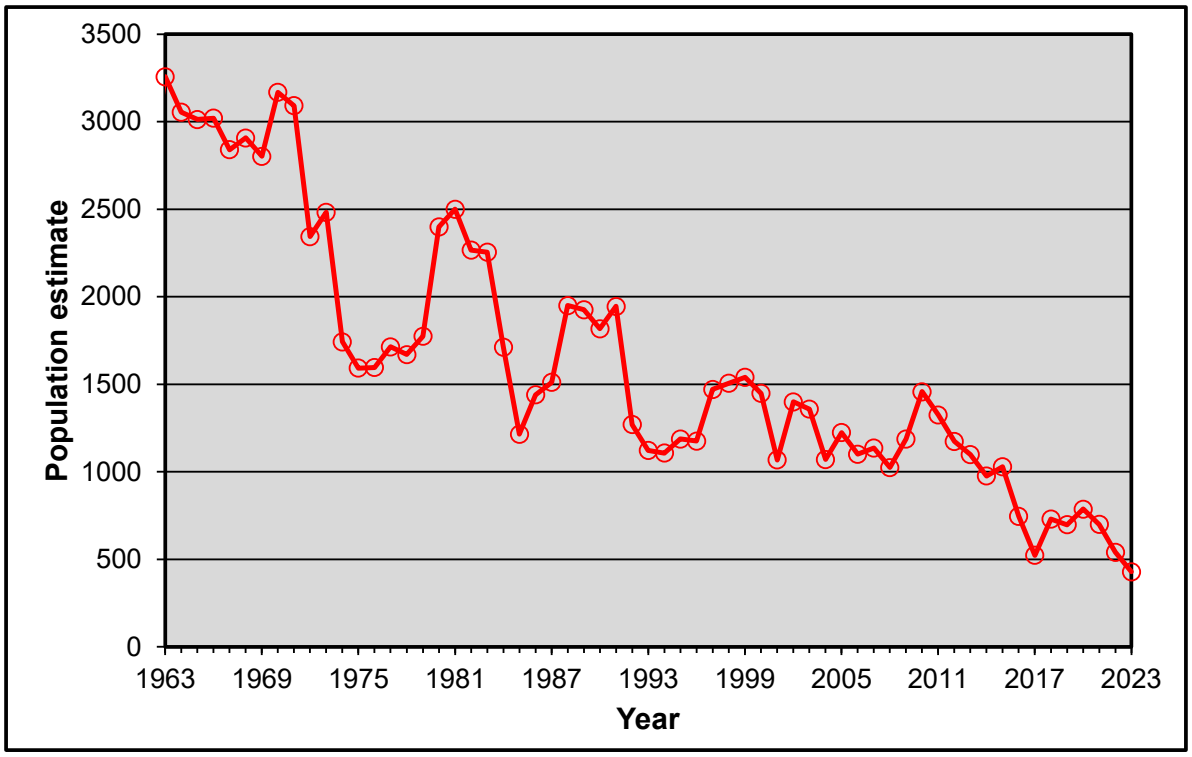

Fig. 3. Population trend for greater sage-grouse in Washington State.

Between 2004 and 2020, a total of 507 sage-grouse were translocated to Washington from four states (Nevada, Oregon, Idaho, and Wyoming) and three yearling males were translocated within Washington (Appendix A). The total does not count six birds that died during processing or transit. Most of the birds (n=373) were translocated from Oregon, with Crab Creek receiving the majority (n=280). In addition to the translocation to Washington noted above, of potential interest is a translocation of sage-grouse from Oregon to British Columbia of 57 mostly juvenile sage-grouse (not counting 6 birds that died during transit or release) on 21 August 1958 (Campbell and Ryder 2010). The birds were released about 6 km north of Okanogan County, Washington. Based on movements of the birds translocated to Washington between 2004 and 2016, it is possible that some of the birds translocated to British Columbia in the late 1950s ended up in Washington.

Wildfires, particularly those in 2020, appeared to be the most significant issue for greater sage-grouse in Washington in the last few years (Fig. 4). The largest wildfire in Washington State history (Cold Springs Canyon/Pearl Hill fire) impacted about 164,000 ha total, including 89,000 ha in the Moses Coulee population. The Whitney fire (~50,000ha) impacted the Crab Creek population and the Taylor Pond fire impacted the JBLM YTC population. The Evans Canyon fire had significant impacts on the Umtanum Ridge sage-grouse management area which is currently unoccupied by sage-grouse. The wildfires of 2020 had a larger impact on greater sage-grouse habitat in Washington State than any other wildfires in recorded history, though the full impacts of the fires on habitat and populations remain to be fully quantified. Outside of the fire perimeters, attendance at 12 leks declined 28% from an average of 11.8 males (SE = 2.4) in 2020 to 8.5 males (SE = 2.1) in 2023 (Fig. 5). Inside fire perimeters, attendance at 10 leks declined 63% from an average of 16.5 males (SE = 3.6) in 2020 to 6.1 males (SE = 1.7) in 2023 (Fig. 5).

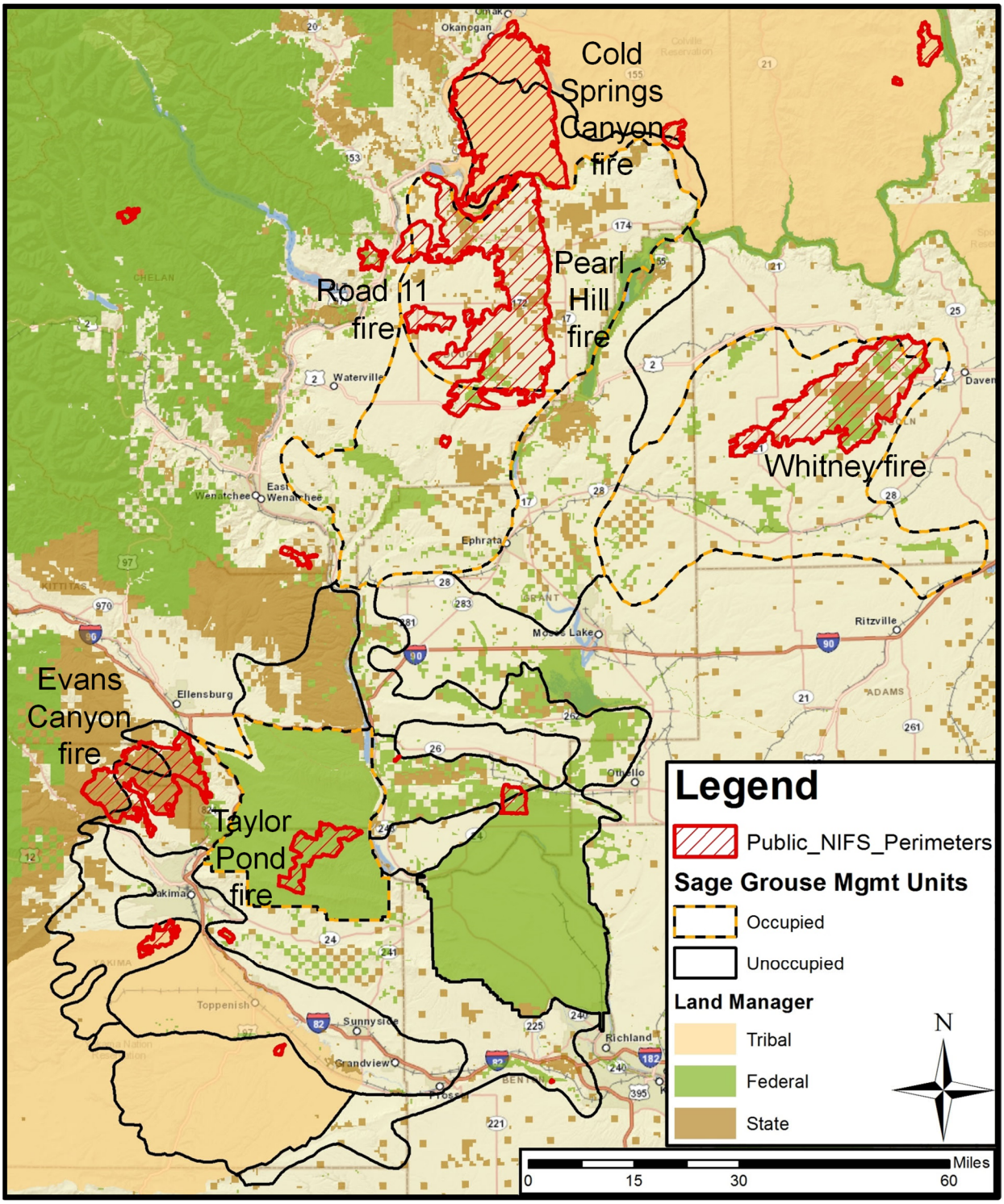

Fig. 4. Wildfire perimeters in 2020 in relation to the greater sage-grouse management units in Washington State.

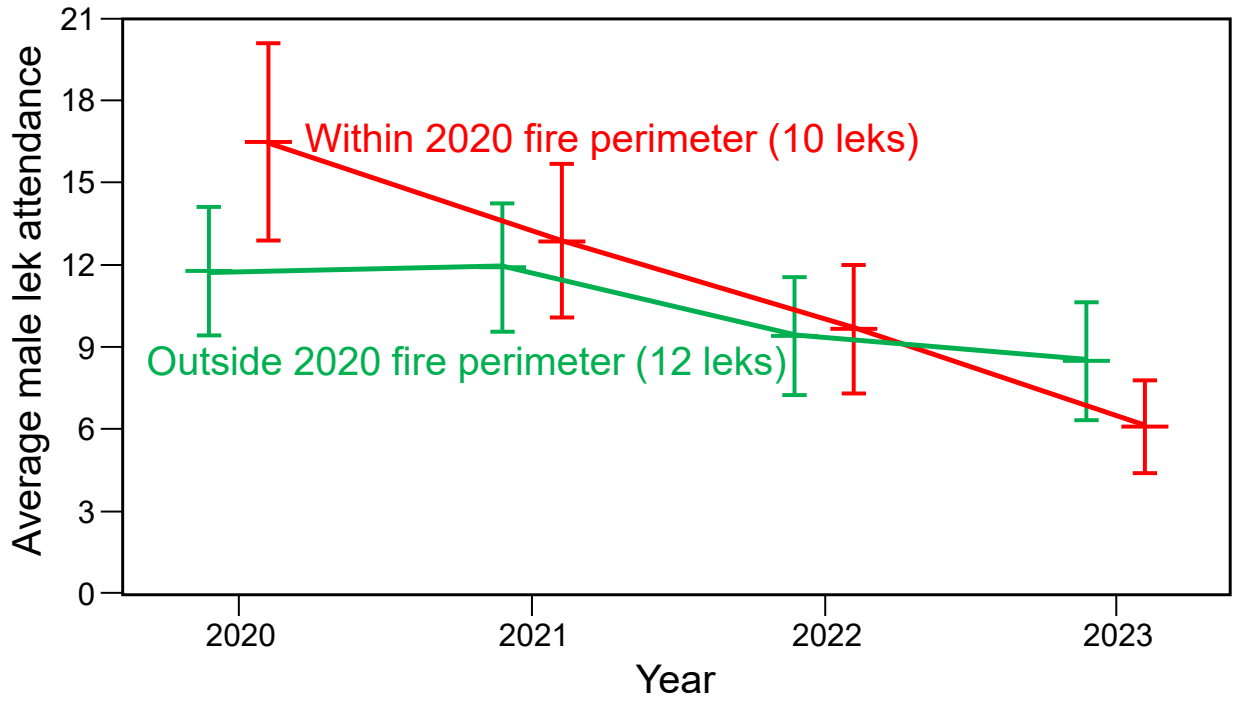

Fig. 5. Average lek attendance (vertical bars represent SEs) inside and outside the 2020 wildfire perimeters in Washington State.

Moses Coulee

The largest population of greater sage-grouse in Washington is in the Moses Coulee area (Moses Coulee and Mansfield Plateau management units combined; Fig. 2). The majority of the Moses Coulee population occupies private land, therefore, most management efforts have focused on private land programs designed to encourage practices that benefit sage-grouse. Chief among these are federal conservation programs such as the CRP and SAFE which support nesting sage-grouse (Schroeder and Vander Haegen 2011, Shirk et al. 2017). Additional efforts include the Sage Grouse Initiative which is focused on sustainable ranching and the Foster Creek Conservation District which produced a Habitat Conservation Plan (FCCD 2015).

Lek surveys in 2023 showed that 18 of 33 historical leks were active with an estimated population of 390 birds in the Moses Coulee population (Fig. 6). The Moses Coulee population decreased 11% between 2020 and 2021, 22% between 2021 and 2022, and 22% between 2022 and 2023 (46% decline over the 3-year interval). The majority of that decrease was associated with the 2020 wildfires. Nine of 17 active leks were directly impacted (within fire perimeters) by the Road 11 and Pearl Hill wildfires. Other leks were also indirectly impacted (within 2 km of fire perimeters) by wildfires in 2020, 2021, or 2022. The recent three years of declines follow 3 years of increases between 2017 and 2020 and 6 of 7 years of decreases between 2010 and 2017.

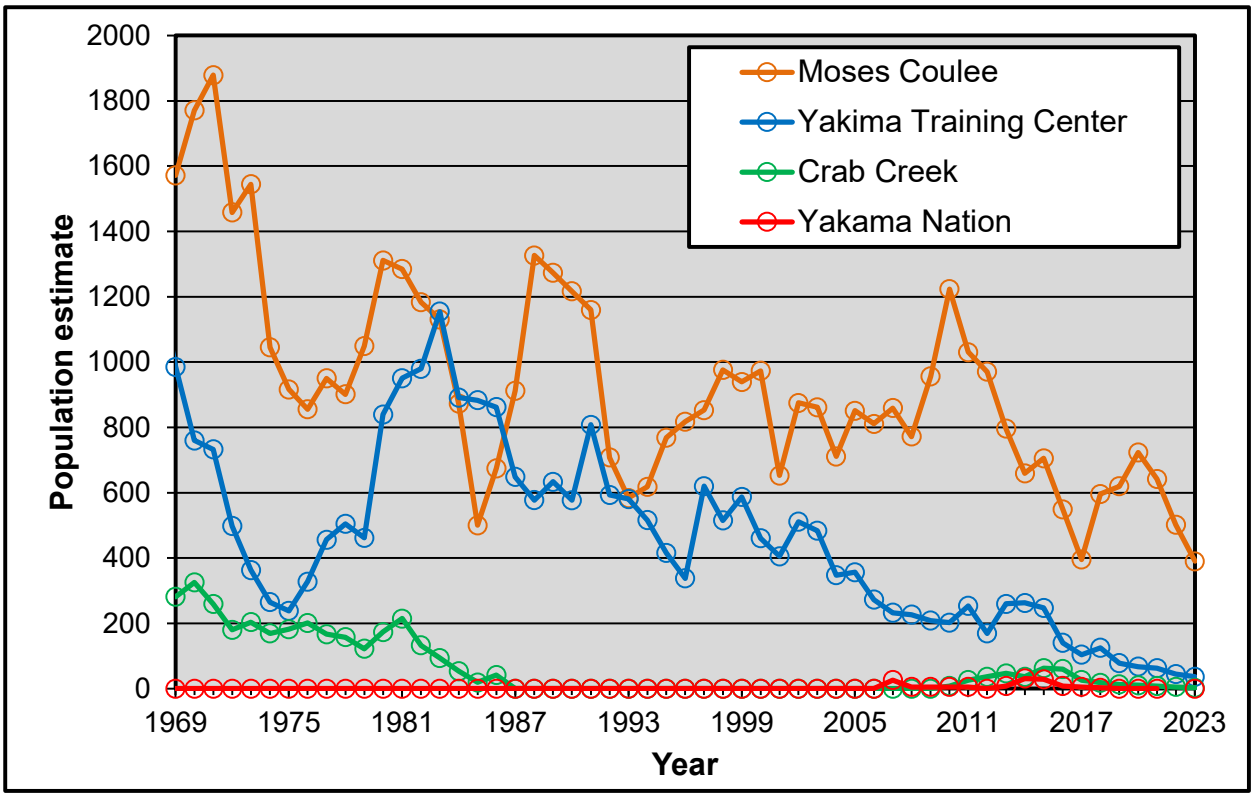

Fig. 6. Population trends for greater sage-grouse in 4 populations in Washington State.

A plausible explanation for the decline between 2010 and 2017 was the dramatic alteration in the abundance of CRP. In 2010 a large number of CRP contracts ended resulting in a conversion of CRP to wheat, CRP to a different type of CRP (e.g., SAFE), and wheat to CRP. Even though at the end of the transition period, there was roughly the same acreage enrolled in conservation programs, there was a lag effect associated with the time it takes for a field of newly planted vegetation to reach maturity (Schroeder and Vander Haegen 2011). Many of these planted fields now outwardly appear to be suitable for sage-grouse despite the impacts of the wildfires in 2020.

No translocations have been conducted to the Moses Coulee population though at least 3 males and 4 females moved into the population from the translocations in Crab Creek. Two of the females died in eastern portions of Moses Coulee, apparently after colliding with large transmission lines. The other two females remained in the Douglas population near known leks until their transmitter batteries failed. All three males returned to Crab Creek; two spent approximately a week in Douglas and appeared to have visited known leks prior to returning.

JBLM YTC

The endemic population of greater sage-grouse on the JBLM YTC (Fig. 1) primarily occupies native habitat on public land. Lek surveys in 2023 showed that the population declined 18% from 2022 (Fig. 6) to an estimated population of 36 in 2022. This was the fifth straight annual decline, resulting in a 71% decline since 2018. Only 3 of 20 historical leks are currently active. The current population is the lowest ever recorded for the installation in more than 50 years of surveys. The long-term decline of the JBLM YTC population is likely due to habitat loss,

degradation, and fragmentation as a result of the military's land-use activities and wildland fires either natural (i.e., lightning) or those originating from either military training activities or adjacent interstate highways. Other factors such as inbreeding depression, predation, and disease may contribute to local declines and management activities addressing such threats have been implemented (e.g., population augmentation; raven control; WNV surveillance/larvicide treatments). It is clear that the population on the JBLM YTC is at immediate risk of extirpation.

Within JBLM YTC, the U.S. Army has designated areas of protection for the species. These Sage-grouse Protection Areas (SGPA's) contain both temporal and spatial restrictions on military training and other land-uses and encompass 31,809 ha, or approximately 25% of the installation. Because wildland fire often results from military training activities, JBLM YTC implements an aggressive fire prevention and suppression program (YTC 2002) which was significantly modified in 2011 and again in 2020 to reduce the frequency of wildfire occurrence and potential for fires escaping designated fire containment areas. Despite these efforts, JBLM YTC continues to be impacted by fires resulting from its training activities, lightning strikes, and human-caused fires originating on adjacent private lands and interstate highways. In 2020, the lightning-caused Taylor Pond fire burned approximately 7,100 ha of which, 2,481 ha were within the sage-grouse population range and 40 ha were within a habitat core area. This fire burned approximately 304 ha of high-quality sage-grouse habitat, while the remaining burned area consisted predominately of native bunchgrasses with early successional shrubs (e.g., rabbitbrush). The nearby Range 10Z lek currently supports 43% of the observed males. A revision of the installation's Integrated Wildland Fire Management Plan (IWFMP) was completed in December of 2020 and was reviewed annually through 2023 in an effort to adaptively manage the ever-present threat and impact of wildland fires on the installation. The installation continues to implement a Wildland Fire Operational Planning Team responsible for making updates to the IWFMP and other wildland fire policies/procedures, assessing fire risk and pre-suppression posture, planning of annual prescribed fire, and conducting after-action reviews of fires.

In order to restore areas impacted by military maneuvers and wildfires, the Army seeds sagebrush, bunchgrasses, and forbs, and plants tens of thousands of bare root seedlings of Wyoming big sagebrush on hundreds of hectares each year (YTC 2002). Within the last decade, JBLM YTC completed sagebrush seeding/planting on approximately 25,000 ha of previously burned areas. Most recently, between 2018 and 2020, 822,523 sagebrush seedlings were planted across 532 ha at an average density of 252 plants/ha. The average survival was 47% for nine sites 1-2 years post-restoration. In addition, 5,059 ha were seeded across eight sites. In 2022 the installation constructed a small greenhouse for the purpose of growing additional plant materials for restoration activities, to include forb species important to sage-grouse that are not commercially available elsewhere.

Military range observation towers no longer required have been removed in key sage-grouse areas to reduce the number of perches and nesting platforms for raptors and common ravens (*Corvus corax*) and since 2015, raven populations have been monitored in most years and their nests are annually removed from other anthropogenic structures located on the installation. Since 2021, the installation implemented raven control measures annually within the SGPA in collaboration with APHIS Wildlife Services. As previously mentioned, JBLM YTC conducts

WNV surveillance annually and has deployed larvicide treatments at a small number of sites to control mosquito populations. Fences within 2 km of leks and those in high use areas on JBLM YTC have been marked or removed. Additionally, several land acquisitions/conservation easements occurring off the installation and additional perch/fence removal projects and implementation of perch deterrent on and/or adjacent to JBLM YTC were agreed upon as mitigation measures associated with the recent Vantage to Pomona 230KV Transmission Line Project and are currently in various stages of implementation. Along with the management responses to military activities, the JBLM YTC also discontinued grazing by livestock in 1995 (Stinson et al. 2004), completed a comprehensive sage-grouse predator assessment and plan in 2018, funded a sage-grouse habitat evaluation on the Yakama Nation completed in 2004, and recently participated on the National Raven Core Team which developed a management strategy to address conflicts associated with ravens in the United States to include impacts to sage-grouse populations. JBLM YTC continues to be an active participant in the Washington State Sage-grouse Working Group and Technical Team. Since 2021, JBLM YTC has participated on various advisory and technical teams affiliated with the Washington Shrub-steppe Restoration and Resiliency Initiative which aims to further conserve shrub-steppe habitat and associated species within the state.

Two population augmentation efforts have been attempted to address genetic issues associated with the JBLM YTC population (e.g., lack of heterogeneity and small population size). A total of 99 sage-grouse have been translocated from Nevada (43), Oregon (38), and Idaho (18) to the installation. The total includes 93 females and 6 males (Appendix A) that were introduced during two separate efforts (2004–2006 and 2014–2016). Subsequent monitoring indicates that translocated females have nested successfully on JBLM YTC during both projects with chicks being observed alive at 50–60 days post-hatch during the initial effort (2004–2006). Although chicks may have been recruited into the autumn population during the first augmentation effort, there is no genetic evidence based on a post-augmentation genetic analyses conducted in 2011 (Small et al. 2011) to conclude that translocated birds from the first release (2004–2006) successfully recruited young into JBLM YTC's breeding population. As such, a second augmentation effort (2014–2016) was implemented and further genetic analyses are underway to evaluate the success of this effort.

Seventy-seven resident sage-grouse (24 males, 53 females) were captured during 2012–2017 to investigate the spatial distribution (i.e. population-level home range and core-use areas) and demographic effects across JBLM YTC. This research was primarily implemented to validate the degree to which recently expanded Sage-Grouse Protection Areas identified as mitigation in the Grow the Army EIS (U.S. Army 2011) were being utilized by sage-grouse. A comprehensive report is being written that will incorporate results of this study pertaining to sage-grouse distribution, core-use areas (annually and seasonally), and population vital rates (i.e. annual survival and nest survival rates). This report will inform the revision of the installation's Sage-grouse Management Plan, a sub-plan of the installation's Integrated Natural Resource Management Plan. Further, Kyle Ebenhoch (Washington State University graduate student) completed his master's research (Ebenhoch 2017) that compared population vital rates of resident and translocated sage-grouse on JBLM YTC from 18 years of radio-tracking data. He concluded that newly translocated sage-grouse had larger daily movements (0.64 km/day) and smaller home ranges (88.18 km2) than residents and previously translocated birds. Annual

survival and nest survival was the same for translocated and resident birds, and nest initiation rates were the same after the first year (Ebenoch et al. 2019).

Crab Creek

The WDFW purchased 7,720 ha in Lincoln County (most of the Crab Creek area is in Lincoln County) in the early 1990s, which became the Swanson Lakes Wildlife Area (SLWA). An additional 518 ha of land owned by the Washington Department of Natural Resources was leased. The acquisition was funded by the Bonneville Power Administration to compensate for habitat lost during the construction and operation of hydroelectric projects in the Columbia Basin (Northwest Power Planning Council 2000). WDFW actively manages habitat at Swanson Lakes for the benefit of prairie grouse (including both sharp-tailed grouse [*Tympanuchus phasianellus*] and greater sage-grouse). From 1992–2007 the Bureau of Land Management (BLM) acquired 29,642 ha in the Crab Creek Management Unit. BLM Twin Lakes and Telford Recreation Areas are immediately adjacent to SLWA, while other parcels (Lakeview Ranch, Rocky Ford, Govan, and Wilson Creek) provide nearby shrubsteppe and riparian habitat. Management of the BLM areas has focused on supporting wildlife habitat, seasonal livestock grazing, and wildlife-based recreational opportunities.

There is a greater proportion of shrubsteppe in the Crab Creek area than there is within the perimeter of the Moses Coulee population of greater sage-grouse in Douglas County. When the revised patterns of land ownership are considered (following acquisitions by the WDFW and BLM), along with the relatively large blocks of suitable and/or improving habitats (Table 1), it is clear that the management potential for sage-grouse in the Crab Creek Management Unit has improved dramatically since the birds were extirpated in the mid-1980s. Some of the specific activities include:

- Restoration of ~1,250 ha of old agricultural fields to shrubsteppe habitat on WDFW and BLM lands since 1995. There are 40 additional ha scheduled to be restored in 2023 contingent on funding.
- Cessation of grazing on ~8,000 ha (SLWA) to provide adequate hiding and nest concealment cover.
- Removal of 24 km of fence and marking of 200 km of necessary fencing.

The historic presence of sage-grouse in the Crab Creek area has been well-established (Yocum 1956), as well as their extirpation (Fig. 1, Schroeder et al. 2000). Six leks were documented in the Crab Creek area for the 1954–1986 period; they were last known to be active in 1955 (Gloyd Seeps), 1974 (Trunk Corner), 1978 (Marlin), 1978 (Odessa), 1984 (Cannawai Creek), and 1986 (Creston Butte). Translocations to reestablish this population were initiated in 2008 and continued through 2015; an additional translocation of 3 males from the Moses Coulee population was conducted in 2020 (Appendix A). A lek was established in a new location in 2010 that continues to be active. The high count of males at this lek declined every year from 2016 through 2023 (23, 10, 7, 5, 4, 3, 2, and 1 respectively; Fig. 6). These counts do not include random sightings such as: 1) single male observed displaying once near Coffeepot Butte in 2018 and 2) 11 males seen flying in 2019 on the Twin Lakes Area within a mile of the lek, but never observed displaying. The 2022 total population was estimated to be 5. Although the population

declines suggest continued augmentations are needed to ensure long-term persistence of the population, the devastation of the 2020 Whitney wildfire (Fig. 4) have made augmentation plans moot because it encompassed almost all of the Swanson Lakes Wildlife Area and adjacent BLM properties and burned most of the essential sagebrush.

Table 1. Estimated landcover in relation to land ownership within the Crab Creek Management Unit (Schroeder et al. 2000).

Ownership	Proportion of area dominated by each habitat (%)				Total area (km^2)
	Shrubsteppe	Cropland	CRP	Other	
WDFW - Swanson Lakes	81	10	6	3	77
DNR	76	21	2	1	142
BLM	92	05	1	2	295
Other government land	91	07	0	1	23
Private land	47	40	12	1	2,739
Total for management unit	52	36	11	1	3,276

During 2008–2020, 283 sage-grouse were released on and adjacent to the Swanson Lakes Wildlife Area (Appendix A). The first translocation in 2008 had multiple purposes. First, it was hoped the translocated birds would 'search' for other sage-grouse and high-quality habitats near the release site. Providing some additional certainty about the current lack of sage-grouse in the area, there had been random sightings of birds since 1986. Second, the released birds would help identify areas of suitable seasonal habitat, which would therefore enable refinement and prioritization of management actions. Third, the released males would have the opportunity to develop a small lek that could provide a focal point for subsequent releases. Fourth, the released birds would provide an opportunity to identify risk factors for the area, which may have been overlooked.

All grouse in 2008 were captured with the aid of night lights on the Hart Mountain National Antelope Refuge, Oregon and released on or adjacent to the SLWA. An autumn translocation was conducted in 2008, but mortality was so high that autumn efforts were discontinued thereafter. In 2009, grouse were captured north of Plush, Oregon. The release site was moved about 3 km west onto BLM Twin Lakes Rec Area where the previous radio-marked birds were spending most of their time and where a lek eventually formed. In 2010 and 2011 grouse were captured in two locations in Oregon, north of McDermitt, Nevada and southwest of Vale, Oregon. In 2012, grouse were captured on Hart Mountain National Antelope Refuge and on Steens Mountain, Oregon. In 2013, grouse were captured north and west of Plush, Oregon. In 2014, grouse were captured north and west of Plush and around Beatys Butte, Oregon. In 2015 birds were captured north and west of Plush and south of Beatys Butte, Oregon. In 2020 3 males were captured in the Moses Coulee population and released near the lek in the Crab Creek area with the hope that they would increase or at least maintain the number of displaying males as an aid to future translocations.

Starting with the Autumn 2008 release, birds were placed in a settling box for about 15 minutes and the box opened remotely to allow the birds to exit calmly on their own and minimize the chances of panic flushes that could ultimately result in longer movements away from the release area. Since the release site was moved to the proximity of the newly formed lek, males have been observed walking out of the settling boxes and immediately joining other displaying males.

The re-introduction area supported a small and vulnerable sage-grouse population persisting in an environment fragmented by agriculture and has a high density of anthropogenic features such as roads, distribution lines, ranch buildings, and fencing (Stonehouse 2013, BLM 2014, Stonehouse et al. 2015). Fragmented agricultural landscapes can support abundant rodents, pigeons and European starlings, that in-turn attract and sustain predators that then opportunistically prey on grouse (Dunn 1977, Rich 1986, Reynolds and Tapper 1996, Moulton et al. 2006). Losses to predation are sustainable in large populations but have a more significant impact on small populations. Under these conditions various authors have suggested that predator reductions may be warranted in the short term to buffer grouse populations from elevated levels of predation (Connelly et al. 2000, Hagen et al. 2011, U.S. Fish and Wildlife Service 2013a).

Of the 148 confirmed mortalities of translocated birds, 74 were assigned to predation and 47 of these were assigned to raptors. In the study area, the most common raptor capable of killing adult sage-grouse is the great horned owl, which was specifically assigned as the predator in 12 mortalities. We began great horned owl control in 2009 following the extremely high mortality event observed during the 2008 autumn translocations in which 23 of 24 birds died within three months of release. Ten mortalities were assigned to raptors and six of these specifically to great horned owls. Eight great horned owls were relocated after this incident.

Removal of nest predators has been shown to temporarily improve nest success, juvenile survival, and population size in ground nesting birds, including grouse (Lawrence 1982, Kauhala et al. 2000, Coates and Delehanty 2004, Baines et al. 2008, Holt et al. 2008). In a similar sage-grouse augmentation program in Strawberry Valley, Utah, predator control resulted in a 24% increase in spring-summer survival and a 2.6-fold increase in chick-to-hen ratios (Baxter et al. 2008). Smith et al. (2010) conducted a meta-analysis of predator removal studies with data from 83 studies for 128 bird species. Predator removal had a significant positive effect on hatching success (+77%), fledging success (+79%), and breeding population size (+71%) compared to control areas. They concluded that predator removal is an effective conservation strategy for enhancing bird populations but the effect is temporary.

Mammalian predators have been the suspected predator in 59% of our known predated nests. Coyotes (*Canis latrans*) are the primary mammalian predator in this area, with badgers a distant second, and few fox, raccoon, weasel, and skunk observations. Master Hunters have been funneled to the project area to hunt coyotes since 2009 but with little success. Given low success of hunters and multiple observations of coyotes taking adult sage-grouse at the lek and on nests, we increased predator control activities in the project area in 2014, by contracting with APHIS to implement focused coyote abatement and common raven removal (permitted by the U.S. Fish and Wildlife Service). Coyote removals were typically done aerially in either a helicopter or super cub, but some ground removals has also been conducted. Ravens were included in the

contract because 20% of nest failures in the project were attributed to ravens, and spring surveys of ravens showed that densities exceeded 0.40 ravens per km^2, the density above which ravens impact sage-grouse nest survival (Coates et al. 2020). Sites with known raven nesting activity in close proximity to grouse leks were chosen to be baited with chicken eggs treated with DRC-1339, an avicide specific to black-pigmented birds. Additionally, to increase probability that only ravens were affected, elevated stations at each site were selected or built to exclude mammals. Raven nest removal and some ground shooting has also been conducted. In total since 2015 we have removed 347 coyotes, 37 great horned owl, and 155 ravens (Table 2).

Table 2. Summary of lethal removals of predators of sage grouse nests and adults by year in support of the Crab Creek reintroduction effort.

Year	Coyote	Great Horned Owl	Common raven
2014	39	1	20 (DRC-1339 bait)
2015	43	12	3
2016	58	6	1
2017	0	1	1
2018	28	12	20 (DRC-1339 bait)
2019	6	0	0
2020	61	1	9 (DRC-1339 bait)
2021	47	4	27 (DRC-1339 bait)
2022	24	0	40 (DRC-1339 bait)
2023	41	0	34 (DRC-1339 bait)
Total	347	37	155

In conjunction with lethal control work has been ongoing to reduce anthropomorphic nesting and perch subsidies for ravens and other aerial predator, this work includes:

- From 2011–2019, we removed 7.6 miles of utility lines (126 utility poles) from core grouse habitat on BLM and WDFW lands.
    - In 2011, 1.1 miles of unused power distribution line (16 poles) was removed from Grant Rd and 1.4 miles (18 poles) leading to the Rock Ranch BLM facility was removed.
    - In 2013, 1.7 miles (26 poles) that had burned in the Apache Pass wildfire were removed from BLM land west of Reiber Rd and replaced with a solar pump to provide livestock water.
    - In 2019, a cooperative project with Inland Power and Light to bury utilities along Schoolhouse Rd and Hatten Rd resulted in the removal of 2.0 miles (50 poles) of telephone line and 1.4 miles (16 poles) of power distribution line around Swanson Lakes and the pasture one BLM ground.
- In 2018 and 2019, we installed sixty-eight (68) Power Line Sentry, Raptor Guard™ perch deterrents and spiked pole caps on 4.3 miles of local transmission line along Seven Springs Dairy Rd. The work was supported by previous research on the effectiveness of various deterrent designs by Dwyer and Doloughan (2014). Monitoring of the sixty-eight deterrents conducted by Whitworth University in 2019 found that perching was reduced

but not eliminated, and deterrents reduced perching particularly well for buteos and ravens, but not as well on great horned owls (Casady et al. 2020, unpublished report).

- Approximately 20 miles of unnecessary fencing and associated fence posts, often used as predator perches, were removed.
- Two unstable barns containing raven and great horned owl nests were demolished by the BLM in 2013, and two other abandoned barns on BLM and WDFW lands in use by ravens and horned owls were destroyed in the 2020 Whitney Rd wildfire.
- An old windmill situated in grouse nesting habitat and used by ravens and raptors was removed by the BLM in 2018.
- Seven to 10 old combines and other junk metal cleared cultural review and were slated for removal in 2017 but low metal prices discouraged salvage by private entities. Instead, staff removed what they could and then crushed and laid down the combines in a lower location, thus reducing value as perching and nesting substrate.
- Roads accessing core areas of WDFW land are closed to minimize disturbance and avoid route and trash proliferation.
- Refuse at the Swanson Lakes headquarters is securely covered in dumpsters that prevent ravens from accessing any food that might subsidize their population.
- All public land (WDFW and BLM) access sites are routinely monitored and kept free of litter and trash.

Yakama Nation

The population of sage-grouse on the Yakama Nation was extirpated before the mid-1960s (Schroeder et al. 2000). A sage-grouse habitat assessment funded by JBLM YTC was conducted on a portion of the Yakama Reservation in 2004. A lek formed in 2013 on private land adjacent to the Yakama Nation following translocation efforts (Appendix A). A single male was observed on this lek in 2018, however this male appeared to be absent in 2019 and was not rediscovered in 2020 (Fig. 5). Based on the lack of males at the only known lek, this translocation appears to have failed. However, there are unconfirmed reports of sage-grouse on private lands to the south of the YN.

PLANS AND PROPOSAL FOR 2024

Work will continue in the three remaining populations in 2024. In addition to the specific inventory, monitoring, and research projects described in this report, conservation activities will include habitat conservation planning, fire recovery, infrastructure consideration, habitat management on public lands, management of generalist predators (common ravens and coyotes), and work with private landowners to protect and develop wildlife habitat on their lands using all options available to them, including federal conservation programs. Some of these efforts have been incorporated into the Washington Shrub-Steppe Restoration and Resiliency Initiative (WSRRI), which is a collaborative effort dedicated to conserving the state's shrubsteppe wildlife and habitat in the face of increasing threats from wildfire, climate change and other stressors.

Although there were plans to resume translocation activities to the Crab Creek management unit, the extensiveness of the 2020 wildfires indicates that further translocations would not be prudent. Effort will instead be focused on post-fire habitat restoration and research to determine the impacts of the fires on the population. Substantial effort will be given to assess the YTC population and determine next best strategies for this population.

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Appendix A. Number of greater sage-grouse translocated to Washington, 2004–2020. When information is available, the translocated birds are differentiated by age (A = adult in spring or yearling or older in autumn, Y/J = yearling in spring or juvenile in autumn).

Target population	Translocation date	Source populations																	
		Nevada				Oregon				Idaho				Washington	Wyoming	Total			
		Male		Female		Male		Female		Male		Female		Male	Male	Male		Female	
		A	Y/J	A	Y/J	A	Y/J	A	Y/J	A	Y/J	A	Y/J	Y	Adult	A	Y/J	A	Y/J
YTC	Spring 2004	0	0	10	15	0	0	0	0	0	0	0	0	0	0	0	0	10	15
	Spring 2005	0	0	0	0	4	1	9	8	0	0	0	0	0	0	4	1	9	8
	Autumn 2006	0	0	0	0	0	1	2	13	0	0	0	0	0	0	0	1	2	13
	Spring 2014	0	0	0	0	0	0	0	0	0	0	2	8	0	0	0	0	2	8
	Spring 2015	0	0	0	0	0	0	0	0	0	0	3	5	0	0	0	0	3	5
	Autumn 2016	0	0	12	6	0	0	0	0	0	0	0	0	0	0	0	0	12	6
Yakama Nation	Spring 2005	0	0	0	0	19		12		0	0	0	0	0	0	19		12	
	Spring 2006	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5		0	
	Autumn 2006	0	0	0	0	5		4		0	0	0	0	0	0	5		4	
	Spring 2007	0	0	0	0	11		4		0	0	0	0	0	0	11		4	
	Spring 2013	19		11		0	0	0	0	0	0	0	0	0	0	19		11	
	Spring 2014	26		12		0	0	0	0	0	0	0	0	0	0	26		12	
Crab Creek	Spring 2008	0	0	0	0	7	3	6	1	0	0	0	0	0	0	7	3	6	1
	Autumn 2008	0	0	0	0	0	7	6	11	0	0	0	0	0	0	0	7	6	11
	Spring 2009	0	0	0	0	12	3	7	6	0	0	0	0	0	0	12	3	7	6
	Spring 2010	9	3	3	9	9	2	1	2	0	0	0	0	0	0	18	5	4	11
	Spring 2011	0	0	0	0	15	5	11	6	0	0	0	0	0	0	15	5	11	6
	Spring 2012	0	0	0	0	20	0	10	8	0	0	0	0	0	0	20	0	10	8
	Spring 2013	0	0	0	0	8	2	6	4	0	0	0	0	0	0	8	2	6	4
	Spring 2014	0	0	0	0	16	4	10	8	0	0	0	0	0	0	16	4	10	8
	Spring 2015	0	0	0	0	13	7	9	11	0	0	0	0	0	0	13	7	9	11
	Spring 2020	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0
Total		57		78		176		185		0		18		3	5	239		271