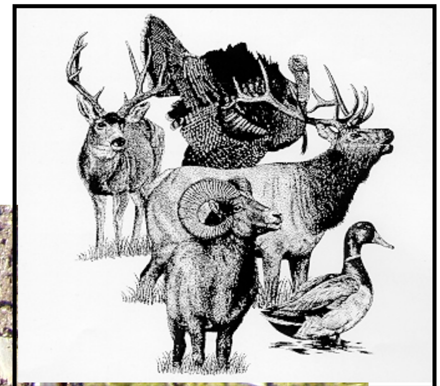
STATE OF WASHINGTON

2017 Game Status and Trend Report



Washington Department of FISH and WILDLIFE

AN OFFICIAL PUBLICATION OF THE STATE OF WASHINGTON

2017 GAME STATUS AND TREND REPORT

July 1, 2016 – June 30, 2017

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

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This Program Receives Federal Aid in Wildlife Restoration, Project W-96-R, Statewide Wildlife Management.

This report should be cited as:

Washington Department of Fish and Wildlife. 2017. 2017 Game status and trend report. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, Washington, USA.

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Blue Mountains Mule Deer Management Zone

MARK VEKASY, Wildlife Biologist
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Introduction

The Blue Mountains Mule Deer Management Zone (MDMZ) is located in southeast Washington and consists of 13 GMUs (145, 149, 154, 157, 162, 163, 166, 169, 172, 175, 178, 181, and 186; Figure 1), with GMU 157 being closed to human entry except by permit.

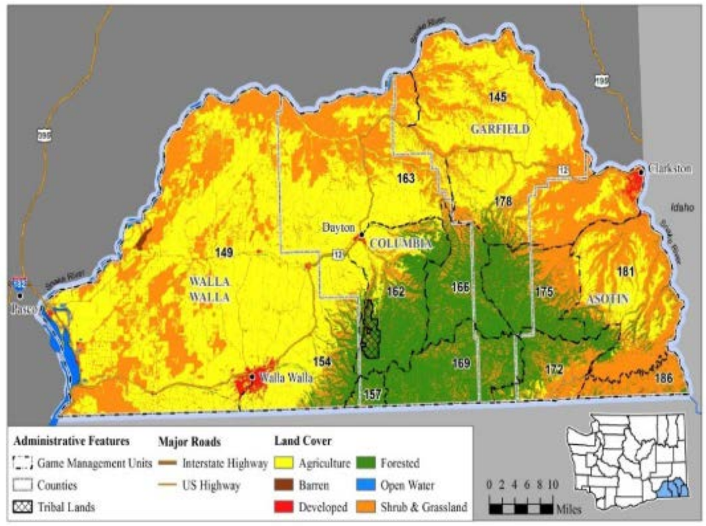

Figure 1. GMUs and generalized land cover types within the Blue Mountains MDMZ.

Management Guidelines and Objectives

The Department's objective within this MDMZ is to maintain a stable population based on abundance and harvest estimates. Additional management objectives include managing for a post-hunt population with a sex ratio of 15-19 bucks:100 does in predominantly agricultural areas and 20-24 bucks:100 does in predominantly public land units.

Population Surveys

Post-hunt aerial surveys conducted between 2012 and 2014 in portions of the Snake River Breaks and the agricultural and grassland ecoregion indicated a population of approximately 20,000 mule deer in the survey area. Individual sightability surveys yielded estimates of 3,353 (90% CI = 2,980-3,726) for most of GMU 181 in 2012, 10,799 (90% CI = 9,986-11,612) for GMU 145 and portions of adjacent units, and 6,052 (90% CI = 5,719-6,385) for approximately half of GMU 149. The mean buck:doe ratio estimate from ground and aerial surveys conducted between 2007 and 2016 was 18.8:100 (ranging from a low estimate of 11.5:100 to a high estimate of 26.6:100, Figure 2).

Post-hunt aerial surveys were not conducted in 2016, but ground composition surveys indicated a buck:doe ratio of 11.5:100 (95% CI: 7.7-15.3, n = 584). While ground and aerial surveys covered ~60% of the zone, where habitat is more open and current survey methods are most effective, mule deer that occur in the higher-elevation forested areas are difficult to monitor and population information is limited to that gleaned from annual harvest estimates.

We plan to conduct post-hunt aerial surveys in December 2017 that will cover the western, northcentral, and northeast portions of the District. We revised subunits and sampling strategy that should produce a statistically robust population estimate for that portion of the District in one year as opposed to multiple years. We plan to repeat surveys for 3-years which will help characterize population abundance and distribution, and also help to refine methods and develop survey methodology for the remaining portions of the District.

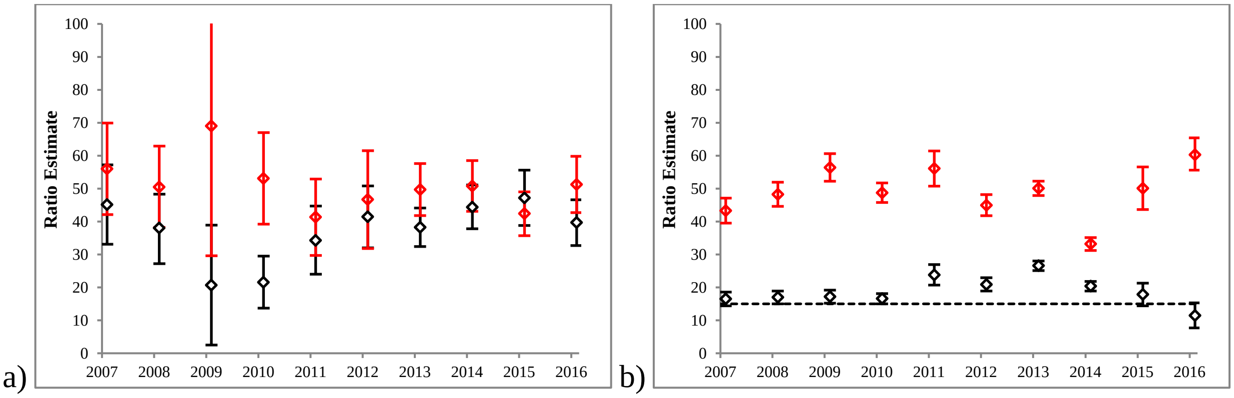

Figure 2. Estimates of buck (black) and fawn (red) ratios per 100 does and post-hunt buck objectives (dashed line) for ground and aerial surveys, (a) pre-hunt and (b) post-hunt in the Blue Mountains MDMZ, 2007–2016.

Hunting Seasons and Recreational Harvest

Recent harvest estimates for 2007-2016 general seasons (Figure 3a) have been relatively stable for 10-years. Improving harvest metrics in some GMUs, particularly 145 and 149, have allowed for increased antlerless permit harvest, but antlerless permit numbers may need to be reduced if the current downward trend continues. Rough indicators of hunter effort (hunter days; Figure 3b) and harvest rate (kills/day; Figure 3b) also indicate stable population conditions. It is important to note that hunter days and kills/day represent all deer hunting in the zone, including white-tailed deer.

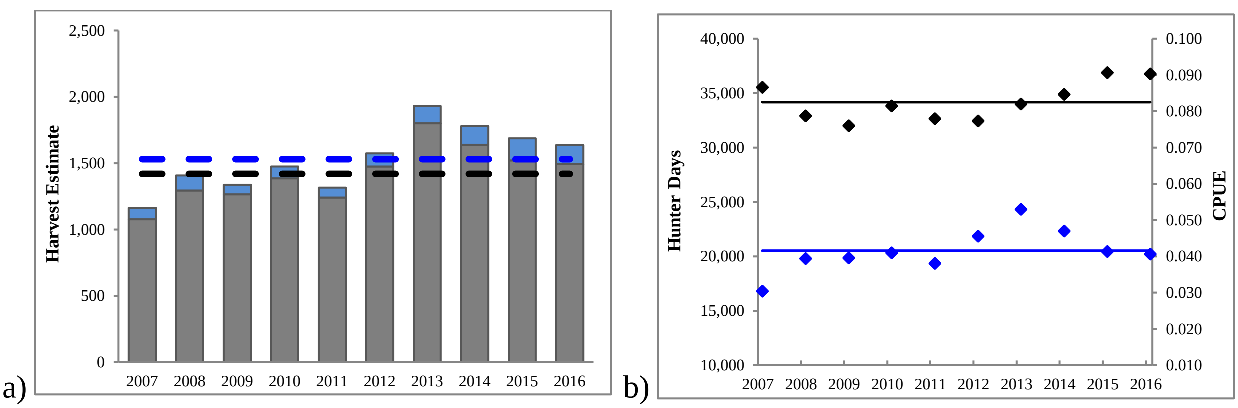

Figure 3. Harvest estimates and 10-yr means (dashed lines) for (a) General BM Zone Harvest (gray) and General + Permit BM Zone Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and harvest/day (blue); b) in the Blue Mountains MDMZ, 2007–2016.

Survival and Mortality

No estimates of pregnancy, fetal, or survival rates are available for mule deer herds in the Blue Mountains MDMZ. In addition to legal hunter harvest, other potential sources of mule deer mortality include predators such as cougars, wolves, golden eagles, and coyotes, collisions with vehicles, and poaching. Other predator species living within this zone include bobcat, black bear, and domestic dogs. While these mortality sources may influence population abundance, particularly in the forested habitats, habitat condition and availability likely have the greatest impact to mule deer populations, particularly here in the Blue Mountains MDMZ where most of the deer population at lower elevation is likely to be summer-range limited.

Habitat

Limited habitat is the major impediment to increasing deer numbers and hunting opportunity within the Blue Mountains MDMZ. The Blue Mountains MDMZ has been altered by landscape changes including conversion to croplands, wildfire suppression and burning, road construction, invasion of noxious weeds, extensive wind power development, and urban-suburban development. Although no single factor has had a direct, large-scale effect on mule deer populations in the Blue Mountains, the cumulative effects of such alterations have likely been detrimental to mule deer habitat over time.

Human-Wildlife Interaction

The agricultural damage prevention program managed by WDFW has changed over the last few years, with responsibilities being shifted from the Enforcement Program to the Wildlife Program. 2014 saw the institution of "damage tags" which must be purchased through the licensing program. Landowners are still entitled to 2 free kill permits, with the requirement of reporting directly to the Conflict Specialist, and are the predominant tags issued in damage situations. Any additional permits are issued as damage permits with the requirement of purchasing a damage tag and reporting through the licensing system. Conflict biologists reported 13 hunters successfully filling kill permits, and only 7 hunters reporting successfully filling a damage tag. Most hunts occurred in GMU 149 and 154 in areas where there would be very little hunting opportunity otherwise, such as in the winery and orchard areas around Walla Walla and Burbank.

Management Concerns

With the mule deer population apparently stable in the Blue Mountains MDMZ, the biggest management concern is habitat alteration and extreme climatic events (i.e., drought and winter conditions). The Conservation Reserve Program (CRP) acres across the zone have probably played the largest role in stabilizing the mule deer population in this agriculture-dominated landscape, but CRP acreages have been declining, and incidental information indicates significant acreages will be removed from the program to be farmed in the next few years. Winter range along the breaks of the Snake and Grande Ronde Rivers is probably secure in the short term, but development of estates with river views on the north side of the river indicates that this range faces threats in the long term. With the majority of mule deer habitat being in private ownership, there is little WDFW can do to protect the long-term security of mule deer in SE Washington.

Management Conclusions

Mule deer populations in the Blue Mountains MDMZ are currently at management objective based on the 10-year mean for post-hunt buck:doe ratio, but the low 2016 post-hunt buck:doe ratio estimate gives reason to closely monitor the population. General season antlerless opportunity is fairly limited, and since population abundance is most sensitive to doe survival, managing antlerless permits is one of the few tools available to influence population changes. Available population survey and harvest data indicate stable to increasing populations where habitat availability and quality allow.

Columbia Plateau Mule Deer Management Zone

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Introduction

The Columbia Plateau MDMZ is located in central-eastern Washington and consists of 21 GMUs (127, 130, 133, 136, 139, 142, 248, 254, 260, 262, 266, 269, 272, 278, 284, 290, 371, 372, 373, 379, and 381; Figure 1).

This MDMZ is dominated by an even mix of uncultivated shrub and grassland, and agriculture. Crops consist of a mixture of dryland and irrigated farming. Dryland crops are predominantly wheat while irrigated crops are much more diverse; including crops commonly foraged upon by mule deer such as orchards, irrigated wheat, and alfalfa.

This MDMZ encompasses about 16,500 square miles and approximately 3,000 (18%) are in state and federal ownership, much of which is open to public hunting.

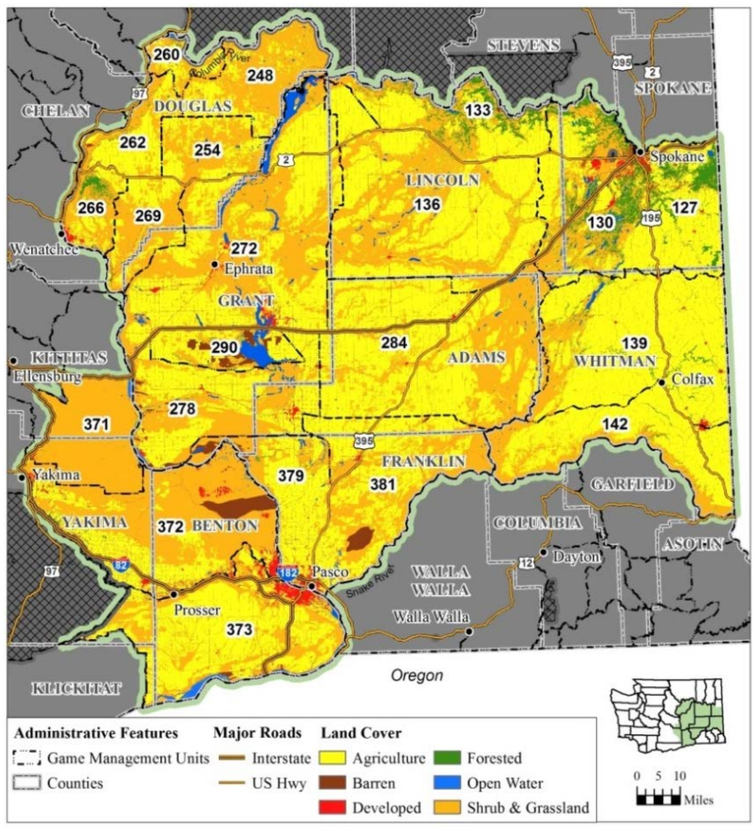

Figure 1. GMUs and generalized land cover types within the Columbia Basin MDMZ.

Management Guidelines and Objectives

The Department's objective within this MDMZ is to maintain a stable population based on abundance surveys and harvest estimates. Additional management objectives include managing for a post-hunt population with a sex ratio of 15 - 19 bucks per 100 does. The exception to this is the Desert Subarea which is managed for a post-hunt population with a sex ratio of 30 bucks per 100 does by limited-entry opportunities.

Population Surveys

Mule deer are present throughout most of the Columbia Plateau MDMZ at varying densities. Highest densities are associated with a relatively equal distribution of escape cover and foraging area, such as where coulees or scablands are surrounded by deep soils suitable for farming. Lowest densities are associated within large monotypic blocks of either agricultural crops or uncultivated ground. While no estimates of mule deer abundance exist for the entire zone, estimates are available for portions of this MDMZ where higher densities occur (Figure 2). These are referred to as 'Subareas' and loosely represent population segments within this MDMZ.

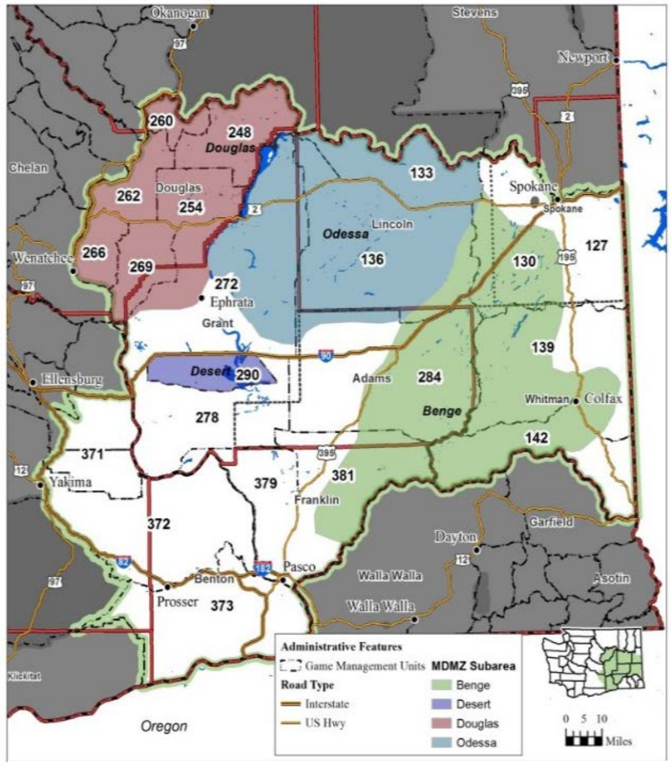

Figure 2. Subareas used for winter population surveys within the Columbia Plateau MDMZ.

Odessa Subarea

Odessa Subarea population estimates from aerial sightability surveys conducted from 2012-2014 resulted in population estimates ranging from 10,980 to 13,582 (Figure 3). Buck to doe ratios, based on ground surveys, have been above management objectives ever year except 2016, but the majority of bucks observed are yearlings (Figure 4). The decline in buck to doe ratios observed in 2016 is likely tied to the low recruitment due to decreased fawn survival in 2015 associated with the drought. Again the post season buck population is highly dependent on yearlings. Fawn to doe ratios, based on ground surveys, have ranged from 57 to 72 fawns per 100 does, but dropped to 43 in 2015, presumably due to extensive drought conditions (Figure 4).

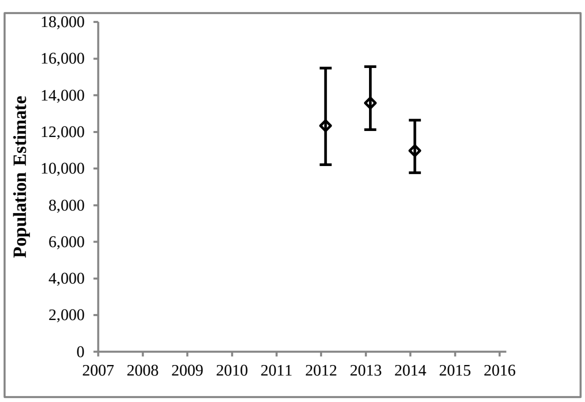

Figure 3. Population estimates with 90% confidence intervals for the Odessa Subarea 2012-14.

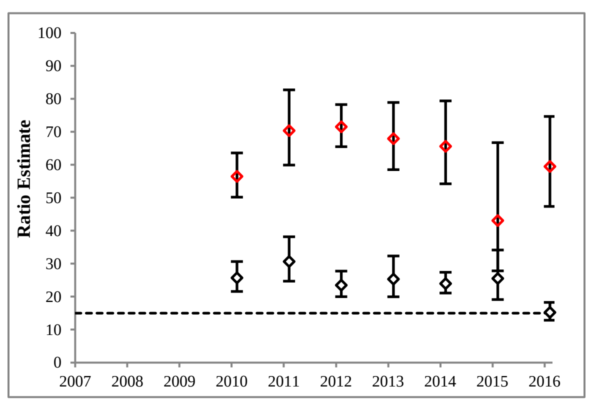

Figure 4. Fawn to doe (red) and buck to doe ratios (black) with 90% confidence intervals from the Odessa Subarea ground counts 2010-16.

Benge Subarea

Benge Subarea population estimates from aerial sightability surveys conducted from 2009-11 and 2015 resulted in population estimates ranging from 11,990 to 13,589 (Figure 5). Buck to doe ratios, based on ground surveys, have been above management objectives ever year except 2016, but similar to the Odessa Subarea the majority of bucks observed are yearlings (Figure 6). The decline in buck to doe ratios observed in 2016 is likely tied to the low recruitment due to decreased fawn survival in 2015 associated with the drought. Again the post season buck population is highly dependent on yearlings. Fawn to doe ratios, based on ground surveys, have remained relatively stable averaging 62 fawns per 100 does, ranging from 56 in 2016 to 69 in 2013 (Figure 6).

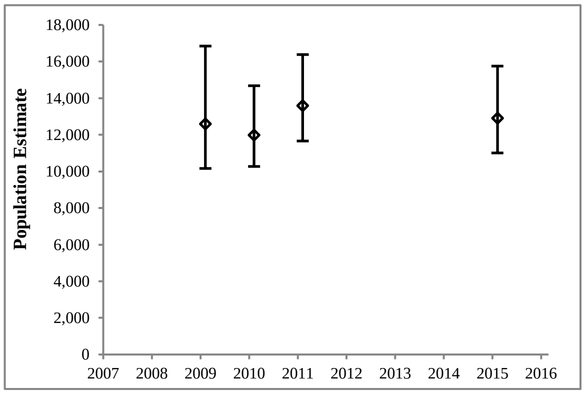

Figure 5. Population estimates and 90% CIs for Benge Subarea in the Columbia Plateau MDMZ, 2009-2011 and 2015.

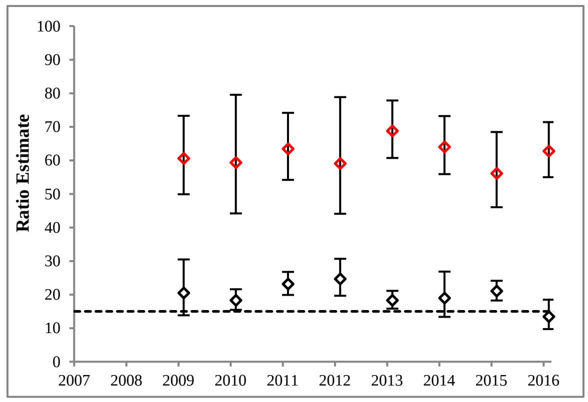

Figure 6. Fawn to doe (red) and buck to doe ratios (black) with 90% CIs for Benge Subarea ground counts in the Columbia Plateau MDMZ, 2009 - 2016.

Desert Subarea (GMU 290)

Desert Subarea (GMU 290) buck to doe ratios have been at or above management objectives since 2006 (Figure 7). Fawn to doe ratios have been low relative to other populations within the zone, ranging from 29 to 58 (Figure 8).

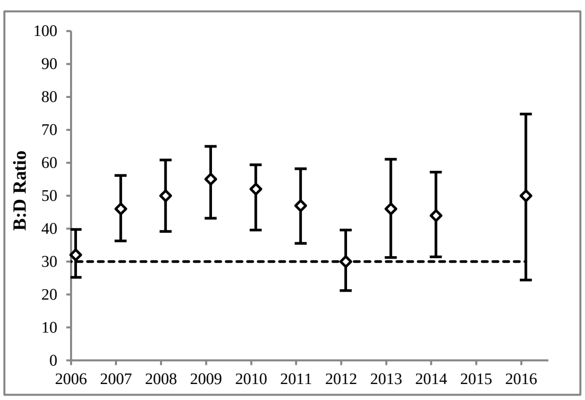

Figure 7. Buck to doe ratios with 90% confidence intervals for the Desert Subarea, 2006-14.

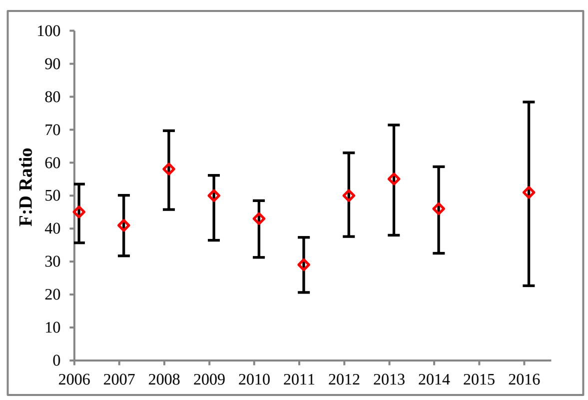

Figure 8. Fawn to doe (red) and buck to doe (black) ratios with 90% confidence intervals for the Desert Subarea, 2006-14.

Douglas Subarea

Douglas Subarea buck to doe ratios have been at or above management objectives since 2008, averaging 22 bucks:100 does (Figure 9a). The open nature of the subarea, along with its high road density, lead to high harvest rates of legal deer, and result in high numbers of juvenile males in buck to doe ratios. In areas where landowners restrict access to large expanses of habitat, numbers of older age-class bucks increase. Fawn to doe ratios have been stable at an average of 60 fawns:100 does over that same period. Ratios are developed from yearly ground surveys along established routes within the subarea. A population estimate derived from a fall aerial sightability survey in the southern portion of the subarea was conducted 2016. The survey resulted in population estimates ranging of 4,992 deer, with 90% confidence intervals of 4,014 and 6,541 (Figure 9b). The objective for 2017 is to refine methodology and expand surveys across the entire Douglas subarea.

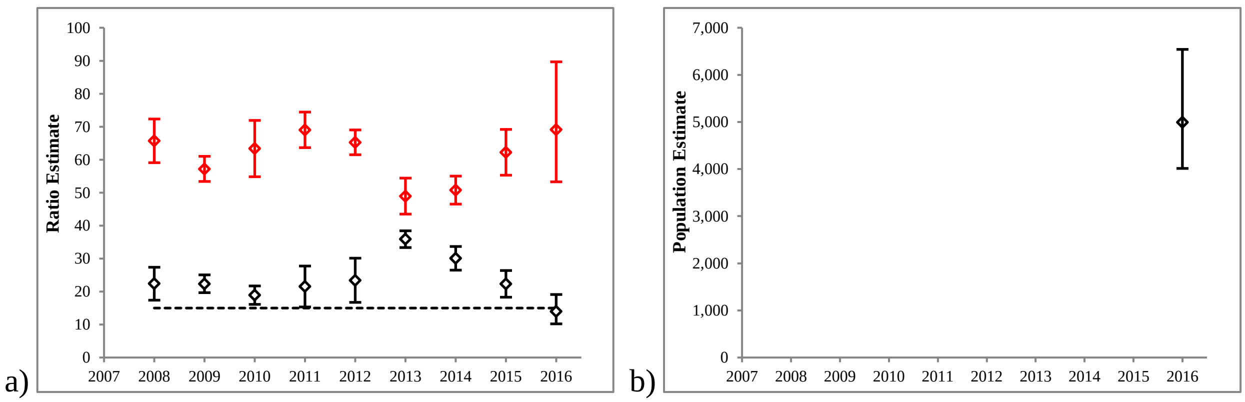

Figure 9. Buck to doe ratios (black) and fawn to does ratios (red) with 90% confidence intervals from the Douglas Subarea ground counts, 2008-2016 (a), population estimate and 90% CIs for Douglas subarea in the Columbia Plateau MDMZ, 2016 (b).

Hunting Seasons and Recreational Harvest

More mule deer are harvested in the Columbia Plateau MDMZ than in any other zone and harvest has been stable to increasing over the past decade with the exception of 2016 (Figure 10a). The decline in 2016 harvest likely was due to poor fawn recruitment in 2015 associated with the 2015 drought. Measures of hunter effort in the zone have generally been stable during the past 10 years (Figure 10b). Estimates of hunter effort (i.e., hunter days; Figure 10b) in this zone are not mule deer specific, but also include days spent hunting white-tailed deer, while kill data is specific to mule deer, therefore kills/day estimates are biased low.

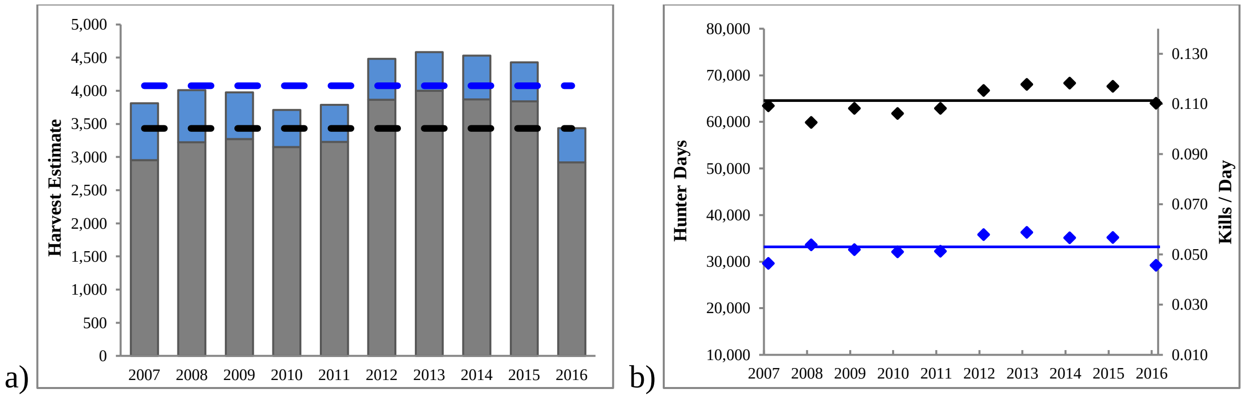

Figure 10. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue) in the Columbia Plateau MDMZ, 2007–2016.

Survival and Mortality

Field studies conducted in the eastern portion of this zone between 2000 and 2008 indicated annual survival ($\hat{s} = 0.92$, 95% CI = 0.91 – 0.93), pregnancy ($\hat{p} = 0.96$, 90% CI = 0.91-1.0), and fetal rates ($\hat{f} = 1.44$, 90% CI = 1.20-1.68) of adult female mule deer were sufficient to maintain stable populations (WDFW 2016). Cause-specific mortality for radio-marked juvenile mule deer (30 marked as neonates, 35 marked at 6 months of age) indicated legal hunting and coyotes were the most frequent sources of mortality ($n = 28$). Juvenile survival rates during the first summer ($\hat{s} = 0.52$) and the first winter (fawns transitioning into the yearling age class; $\hat{s} = 0.90$) are sufficient to maintain stable populations (Johnstone-Yellin et al., 2009, WDFW 2016).

While not observed during recent field studies of marked deer, other sources of mule deer mortality likely include predation, collisions with vehicles, perishing in irrigation canals, and poaching. Predator species living within this zone include cougars, bobcats, black bears, coyotes, golden eagles, and domestic dogs.

Habitat

Loss of important habitat, particularly shrub-steppe, riparian, and wet meadow habitat, is the most important issue facing wildlife managers in the Columbia Plateau MDMZ. Land conversion is the most obvious source of habitat loss, but in this zone, wildfires have become more frequent and more intense in recent years. These fires often result in a rapid invasion of exotic plant species that have little or no nutritional value to mule deer, and restoration of native vegetation requires intensive, long-term effort to be successful. In some areas of the zone, crop fields enrolled in the Conservation Reserve Program (CRP) have partially mitigated the loss of shrub-steppe by providing cover and forage, especially important during fawning season.

Human-Wildlife Interaction

Mule deer in the Columbia Plateau MDMZ are largely migratory and often stage in large numbers on the way to and at the wintering grounds along the Snake River breaks and the Wilson Creek area. These large congregations are cause for concern from wheat farmers, although research suggests depredation by large ungulates does not influence grain yield, provided it occurs before the joint stage, when plants begin to invest in their reproductive phase (Austin and Urness 1995, Dunphy et al., 1982). However, grazing on alfalfa and hay fields does have the potential to reduce forage production (Austin et al., 1998). Currently, seven Deer Areas occur within this zone to address impacts associated with these congregation areas, as well as nuisance damage issues in suburban areas, by providing additional antlerless hunting opportunities (Figure 11). The Wildlife Conflict Section staff at WDFW work with producers to provide technical assistance in both lethal and non-lethal control of deer on agricultural lands including orchards and vineyards with high value crops favored by deer.

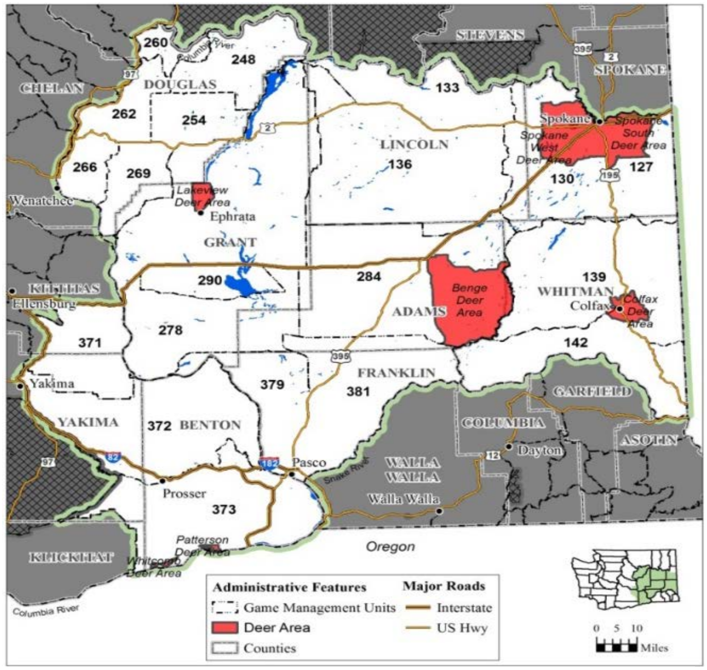

Figure 11. Deer Areas within the Columbia Plateau MDMZ.

Management Concerns

As previously discussed, habitat loss and habitat degradation are management concerns in this area. Though agricultural growth is at a standstill throughout much of this zone, urban sprawl and small ranch development is slowly taking a toll. Impacts from wildfires will vary. Short-term impacts may include reduced habitat suitability, which is particularly damaging during the summer fawning season and/or when precipitation fails to initiate fall green-up and animals are unable to meet nutritional demand of a harsh winter. Long-term benefits of fire on the landscape will vary and depend on fire history and prevalence of invasive vegetation.

Management Conclusions

Mule deer populations in the Columbia Plateau MDMZ are currently at management objectives based on the buck to doe ratio. Demographic and survey data indicate stable populations. Zone-wide harvest has been stable to increasing.

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East Columbia Gorge Mule Deer Management Zone

STEFANIE BERGH, Wildlife Biologist

Introduction

The East Columbia Gorge MDMZ, located in south central Washington, is the smallest of the seven mule deer management zones and consists of two GMUs, 382 and 388 (Figure 1).

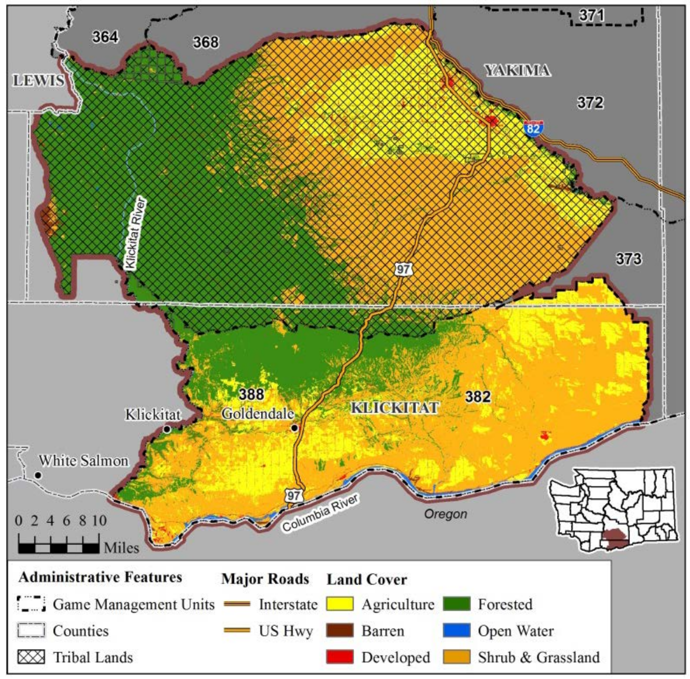

Figure 1. GMUs and generalized land cover types within the East Columbia Gorge MDMZ.

Management Guidelines and Objectives

The Department's objective within this MDMZ is to maintain a stable population based on field surveys and harvest estimates. Additional management objectives include managing for a post-hunt population with a sex ratio of 15 - 19 bucks:100 does.

Population Surveys

Mule deer are present throughout the East Columbia Gorge MDMZ with the highest densities observed during January through March and April on the low elevation winter ranges. Post-hunt aerial surveys in the MDMZ provided a buck:doe ratio for 2016 of 21:100 does (95% CI = 11 – 31, n = 2,259) and is within objective. The post-hunt fawn:doe ratio estimate for 2016 was 58:100 does (95% CI = 49 – 67, n = 2,259).

Hunting Seasons and Recreational Harvest

Harvest estimates indicate a slight decline in harvest (Figure 2a) that likely reflects, in part, lower hunter numbers and related hunter effort (Figure 2b) as well as small population declines within the zone in recent years. Estimates of kills/day have increased slightly over time (Figure 2b).

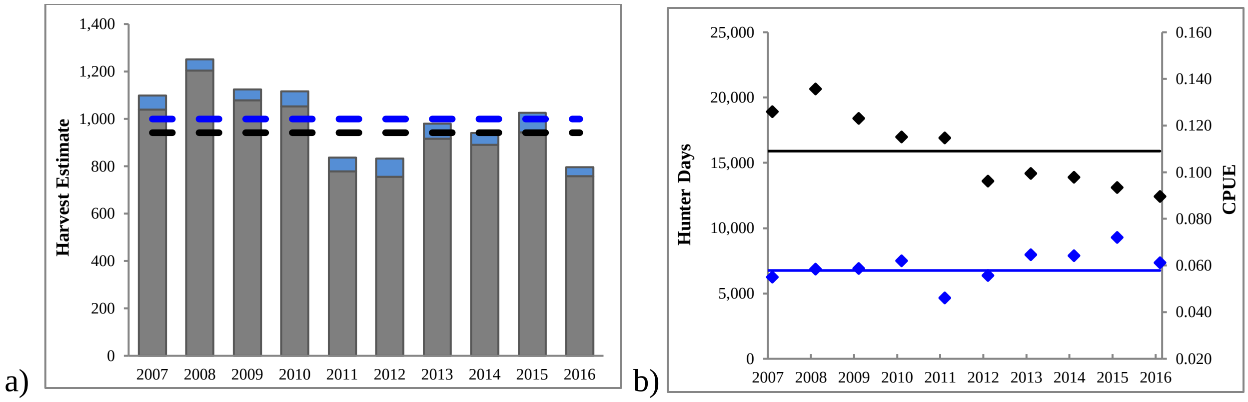

Figure 2. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); in the East Columbia Gorge MDMZ, 2007–2016.

Survival and Mortality

There are no current data on annual survival rates of mule deer in East Columbia Gorge MDMZ. In addition to legal hunting, common mortality sources include disease, predation, and deer-vehicle collisions. Lice infestations and hair loss syndrome have been documented in mule deer (Bernatowicz et al. 2011) and likely contribute to the decline in mule deer numbers. Common predator species include cougar, bobcat, black bear, and coyote. The winter of 2016-17 was very severe with persistent snow down to river level from December through February, making forage unavailable on key wintering habitat. Spring 2017 productivity surveys showed a fawn:adult ratio of 28:100, which is well below the previous 10-year average of 61:100. Annual post-hunt aerial surveys in December 2017 will also shed some light on mortality from the winter of 2016-17.

In the summer of 2017 an outbreak of Adenovirus Hemorrhagic Disease (AHD) was confirmed in the area just east of Goldendale. Reports of deer with signs of AHD came from the Goldendale area in both GMUs 382 and 388. Most of the dead deer reported were fawns, which is common with AHD. Death can occur within three to five days from the time a deer is exposed to the virus, although not all infected deer die. There is no known cure or treatment for the virus. AHD is transmitted by direct contact between deer, making it more likely for the virus to spread in areas with high deer concentrations; so residents were discouraged from providing food and water for deer in that area. This type of AHD is specific to deer and is not uncommon in other states, including Oregon where an outbreak was reported in The Dalles in the spring of 2017. AHD has been common enough in California and other western states that it likely has afflicted Washington deer in the past, but was first confirmed in the state with this summer's outbreak.

Habitat

The East Columbia Gorge MDMZ has experienced extensive alternative energy development and agricultural land conversion in recent years. Electricity generated by wind power currently is one of the fastest growing alternative energy sources in the region with large wind power sites already in operation along the Columbia River. Although wind power is generally considered a "green" energy source, there may well be effects on mule deer and the habitat upon which they depend (Sawyer et al. 2002). More direct effects on the population have occurred in the form of habitat loss from agricultural conversion and associated roadways necessary to access such development, as well as increased mortality from vehicle collisions.

Human-Wildlife Interaction

Agricultural damage to crops such as hay, alfalfa, wheat, berries, and grapes occurs at low levels in the East Columbia Gorge MDMZ. Wildlife Conflict Specialists work closely with producers by developing Damage Prevention Cooperative Agreements (DPCAs), which identify a plan to reduce the amount of damage incurred to agricultural crops using non-lethal and lethal methods. Wildlife Conflict Specialists and landowners use a variety of non-lethal means to discourage deer including: electrified fladry fencing, noisemakers (birdbangers, critter gitters, propane cannons), hazing and herding, scarecrow-like electronic devices, and odor-based repellents such as Plantskyyd. There were five DPCAs related to deer in the East Columbia Gorge MDMZ with no kill or damage permits issued in 2016-2017.

In many circumstances, the Department addresses damage complaints by working with landowners to increase access to their property during hunting seasons so that hunters can help to resolve the damage. The Department also continues to give Youth hunters the opportunity to hunt antlerless deer in GMU 382 during December and January to address chronic damage issues.

Management Concerns

Hairloss syndrome was observed in Klickitat County for the first time in 2000. Hairloss was first documented in GMU 382 in the spring of 2006. Approximately 4% of the deer observed during the April 2017 Klickitat deer surveys had noticeable signs of the syndrome, which is a lower observed prevalence than in the past. Late 1990s declines in harvest, increases in buck mortality rates, and reduced productivity all roughly coincide with the onset of the hairloss syndrome. We will continue to monitor for this disease during spring productivity surveys.

Habitat loss is the greatest concern for mule deer in the East Columbia Gorge MDMZ. Increased development, especially in vineyards and wind power, has the potential to negatively impact this herd. Associated roads and fencing also have an indirect negative impact. Many of the deer in this zone are migratory and winter in the lower elevations, typically preferring habitat with a strong oak (*Quercus garryana*) component (McCorquodale 1996). Increased human activity and habitat conversion in the lower elevation wintering areas can cause these deer to unnecessarily expend energy during the winter months when resources are limited. This could result in lower survival and reproduction rates.

Management Conclusions

Mule deer populations in the East Columbia Gorge MDMZ are currently within the established buck:doe ratio objective, though harvest estimates indicate a slight decline in GMU 382. In response to this decline, managers reduced antlerless harvest permits starting in the 2015 season and also reduced some early season antlered harvest opportunity to support a more stable population. Annual survey efforts will allow managers to continue monitoring the population and determine future management needs.

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East Slope Cascades Mule Deer Management Zone

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Introduction

The East Slope Cascades MDMZ, home to Washington's major migratory mule deer populations, spans three wildlife districts (districts 6, 7, and the northern portion of 8) in north-central Washington and is comprised of 22 GMUs (203, 209, 215, 218, 224, 231, 233, 239, 242, 243, 244, 245, 246, 247, 249, 250, 251, 328, 329, 330, 334, and 335; Figure 1).

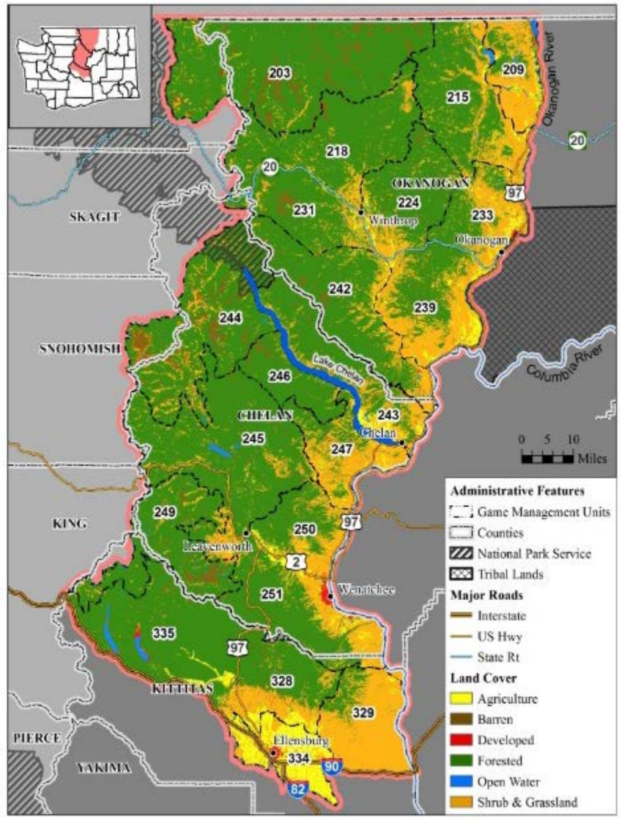

Figure 1. GMUs and generalized land cover types within the East Slope Cascades MDMZ.

Management Guidelines and Objectives

The Department's objective within this MDMZ is to maintain stable populations based on field surveys and harvest estimates and manage for a post-hunt buck:doe ratio objective of 15-19 bucks:100 does in the southern and northern portions, and a minimum of 25 bucks: 100 does in the central portion.

Population Surveys

Mule deer are present throughout the East Slope Cascades MDMZ with the highest densities observed during January through March on the low elevation traditional winter ranges. Recent post-hunt aerial sightability surveys indicate approximately 47,000 mule deer reside within the East Slope Cascades MDMZ (WDFW 2013). In 2016, spring population surveys were conducted in southern portion of the zone (District 8). The estimate was 3,718 deer (90% CI = 3,307-4,494). The southern population was down 40% from 2003 and 10% from the last survey in 2013.

Weather cut short efforts to conduct complete population surveys in the northern portion of the zone in the fall of 2016 and spring of 2017. Data collected were still adequate to develop estimates of ratios. The post-hunt buck:doe ratio (Figure 2a) for the northern portion of the zone (District 6) in 2016 was 20:100 (90% CI = 17-23, n = 1,732). The mean buck:doe ratio estimate from aerial surveys conducted between 2007 and 2016 was 22:100 (ranging from a minimum estimate of 16:100 to a maximum estimate of 34:100).

Poor winter flying conditions in the central portion of the zone (District 7) have limited yearly fall aerial surveys and population estimates. The recent population estimates derived from spring aerial surveys were for 2016, and 2017 were 14,870 deer (90% CI = 12,085-19,679) and 11,061 deer (90% CI = 9,317-13,865), respectively. These estimates are comparable to post-hunt population estimates from 2010 and 2011 (Figure 3a). Deer numbers declined in the central portion of the zone following the 2016-2017 winter.

The post-hunt fawn:doe ratio (an index of productivity) for District 6 (Figure 2a) in 2016 was 71:100 (90% CI = 65-76, *n* = 2465). This is a little below the 10-year average for this metric of 77:100 (ranging from a minimum estimate of 71:100 to a maximum estimate of 82:100). In 2017, ground counts produced a spring fawn:adult ratio (Figure 2b) of 25:100 (90% CI = 22-28, *n* = 2,097). These data yielded a modeled over-winter fawn mortality rate of 61%, which is above the 10-year average of 53%. Conditions during the last two winters were qualitatively harsher than the several years prior and came on the heels of two years of historically large fires that consumed tens of thousands of acres of deer winter range shrub forage.

Within the northern and central portions of the MDMZ, buck ratios have been meeting the management objectives of 15 and 25 bucks:100 does, respectively (Figures 2a & 3b). A combination of rugged topography and limited road access in many GMUs allows for high escapement and results in a higher proportion of older age-class bucks in the population. A larger proportion of older bucks were harvested in 2015, moving the age-class distribution toward younger males; however, escapement of older bucks improved following a more average harvest in 2016. Fawn recruitment varies year to year, although the quality of summer range habitats yield significant production (Figures 2b & 3b).

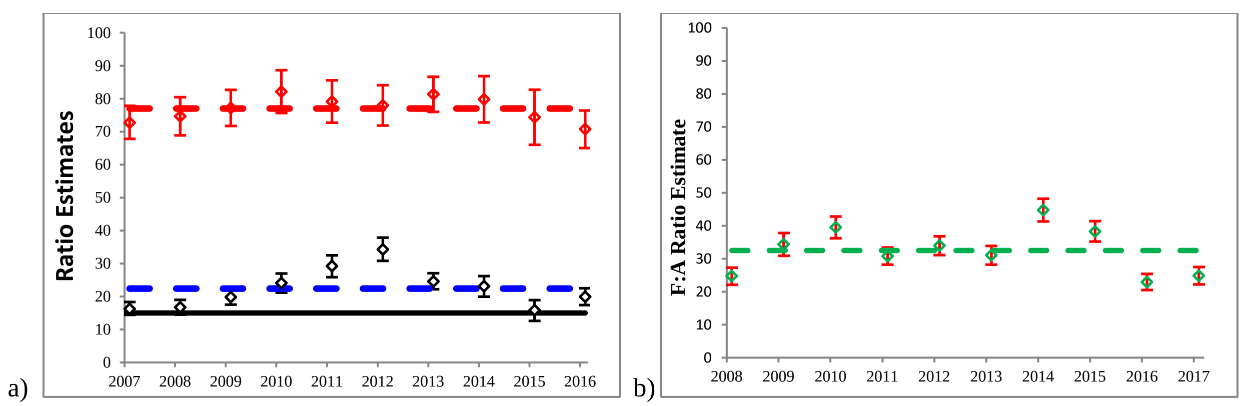

Figure 2. Post-hunt (a) buck:doe ratio estimates (blue) and fawn:doe ratio estimates (red) with 10-year averages (dashed lines), and buck:doe ratio management objective (solid line); and (b) spring fawn:adult ratios (green) with 10-year average (dashed line); for District 6 in the Northern portion of East Slope Cascades MDMZ.

Hunting Seasons and Recreational Harvest

Mule deer harvest in much of the East Slope Cascades MDMZ is greatly influenced by weather conditions during the hunting season and weather conditions during fall and early winter for the past 6 years have been average or below average in severity. The 2016-2017 winter was a departure from that trend with snow depth and duration increased over the preceding average conditions for much of the district. Conservative harvest of antlerless mule deer is generally designed to maintain population stability while still providing some recreational opportunity.

Liberal harvest of antlerless mule deer is used at times to limit herd growth, or reduce deer numbers in damage areas, or for responses to dramatic changes in carrying capacity such as those associated with large wildfires. Harvest estimates from 2006-2015 indicate an increasing trend in recent years (Figure 4a) despite a slow decline in hunter effort, as indicated by decreasing hunter days (Figure 4b). Estimates of kills/day have correspondingly increased in the last two years (Figure 4b).

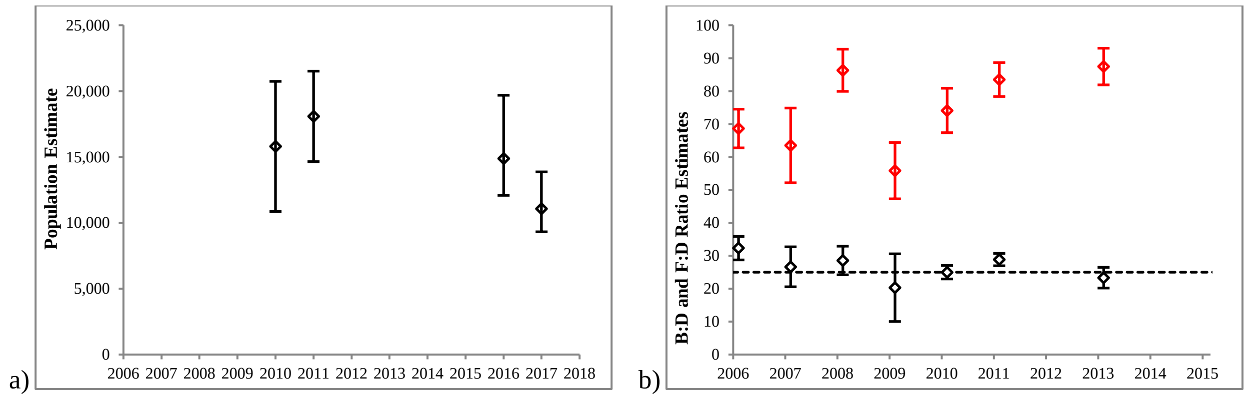

Figure 3. (a) Population estimates with 95% C.I. from the central portion of the East Slope Cascades MDMZ (District 7). Estimates are post-hunt (fall) for 2010 and 2011 and spring for 2016 and 2017, and (b) post-hunt buck:doe ratio estimates (black) and fawn:doe ratio estimates (red), and buck:doe ratio management objective (dashed line).

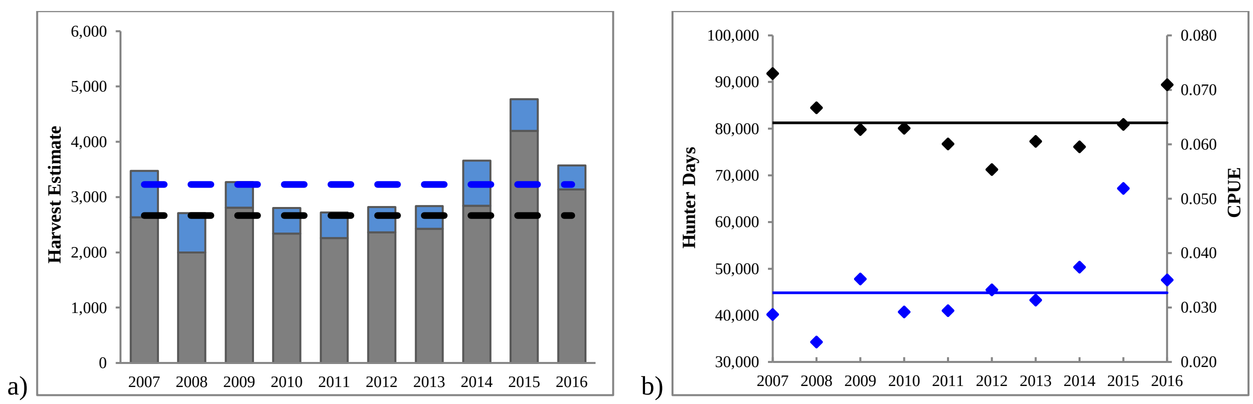

Figure 4. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); in the East Slope Cascades MDMZ, 2007–2016.

Survival and Mortality

Recent pregnancy ($\hat{p} = 0.95$) and fetal rates ($\hat{f} = 1.66$) in East Slope Cascades MDMZ, coupled with a high annual adult doe survival rate ($\hat{s} = 0.92$, $n = 50$) indicate sufficient recruitment to support a stable to increasing population in the zone (WDFW 2016). Early data from a new predator-prey study in the northern portion of the zone support the previous finding of high adult doe survival. Investigations of deaths of radio marked adult female mule deer indicate cougars, poaching, deer-vehicle collisions, and unidentified predators are common sources of mortality, although the high survival rates would suggest these mortality sources are not limiting the adult female segment of the population.

Habitat

The productive, high mountain habitats in this zone make the East Slope Cascades MDMZ extremely important to mule deer. These optimal habitat conditions provide nutritious forage for lactating does and contribute to high fawn survival and recruitment. These habitats are not limited, face little threat of alteration, and are at present self-sustaining. On winter ranges, mule deer move to a small portion of their annual range to find forage and thermal cover.

Habitat related considerations in this zone include continued development and fragmentation of low-elevation habitats, growing use and distribution of off-road vehicles, and increasing disturbance on winter ranges. This is compounded by recent landscape level fires at low elevation and increasing spread of invasive weeds, which result in a reduction of shrub vegetation communities.

Human-Wildlife Interaction

Most deer conflict is restricted to the lower elevation irrigated agriculture lands throughout the Zone. Specific Deer Areas have been established in the northern portion of this Zone with antlerless permit hunt seasons designed to target and reduce deer damage. Permit numbers within each Deer Area fluctuate with the level of reported damage incidents. To date, the program is operating smoothly and appears to be helpful in reducing deer damage complaints.

Damage Prevention Cooperative Agreements (DPCA) and Kill permits are also conservatively issued to reduce deer damage throughout the Zone. In 2016 WDFW Conflict Specialists issued only 19 deer (Mule or White-tailed deer) permits to address deer damage throughout the entire East Slope Cascades Mule Deer Management Zone.

Significant road kill occurs in the northern portion of this zone along State Highways 20 and 153 in the Methow Valley and along a 12.5 mile segment of State Highway 97 in the Okanogan Valley. The Okanogan Trails Mule Deer Foundation Chapter and others are working with the WA Department of Transportation to create underpasses(s) along this segment to reduce road kill and provide safer passage. In the central portion of the zone, State Highways 97 and 97A are the major contributors to deer vehicle collisions.

Research

A large scale predator-prey study with a mule deer component began in the northern portion of the zone beginning in January 2017 when biologists radio-marked 20 mule deer does. Eighteen of the 20 collars are still functioning properly and no mortalities have been documented to date. Researchers hope to have a total of 100 does collared by the end of this coming winter.

Management Concerns

Extensive loss of winter range shrub forage is the primary management concern in the northern three-fourths of the zone. Modest increases in antlerless harvest have been implemented in the most heavily impacted GMUs. The objective of these changes is to stabilize or slightly decrease the local population in the short-term to bring deer numbers in line with the landscape’s reduced carrying capacity, and avoid over-browsing of recovering winter range shrubs. Post-fire conversion winter range communities toward invasive weeds decrease the capability of the landscape to support deer. These affects are most prominent on dry shallow soils on steep aspects; areas where conditions limit restoration success.

Management Conclusions

Mule deer populations in the East Slope Cascades MDMZ are currently above the minimum management objective in the north (15-19 bucks:100 does) and the central portion (25 bucks:100 does), and slightly lower in the south. Survey data indicate stable to increasing population growth overall in the zone.

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Naches Mule Deer Management Zone

JEFFREY A. BERNATOWICZ, Wildlife Biologist

Introduction

The Naches MDMZ is located in central Washington (Figure 1) and includes GMUs 336, 340, 342, 346, 352, 356, 360, 364, and 368.

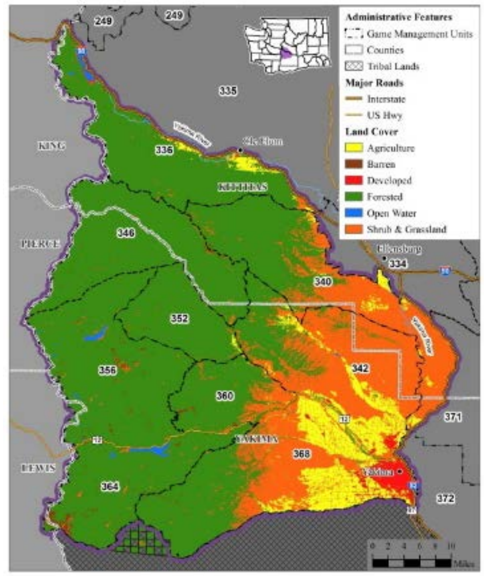

Figure 1. GMUs and generalized land cover types within the Naches MDMZ.

Management Guidelines and Objectives

The Department's objective within this MDMZ is to maintain a stable population based on field surveys and harvest estimates. Additional management objectives include managing for a post-hunt population with a sex ratio of 15 - 19 bucks:100 does.

Population Surveys

Mule deer are present throughout the Naches MDMZ, with the highest densities observed during January through March and April on low elevation traditional winter ranges. Spring aerial surveys have been conducted in the zone since 2003 to estimate abundance. In March 2003, the population was estimated at 7,865 deer (90% CI = 7,114-9,086). Spring aerial population surveys have continued in portions of the zone most years and indicated about a 50% decline by 2007 in those portions of the zone surveyed. In 2013, the abundance estimate for the MDMZ was 4,997 (90% CI = 4,587-5,625), down 36% from the zone-wide 2003 estimate (WDFW 2013). In 2016, 4,311 (90% CI = 3,808-5,155) deer were estimated on spring range. The 2016 estimate was probably biased low because portions of the range were surveyed after deer began migrating back to summer range.

Ground surveys have been conducted periodically since the early 1990's to estimate post-hunt buck:doe ratios for the zone. The post-hunt buck:doe:fawn ratio for the zone in 2014 was 25:100:57 (n=405). In December 2015, the ratio was 16:100:39 (n=169). The ratios within the zone annually are seldom comparable, as ratios vary substantially across the range. December snows often limit ground access for surveys to portions of the range.

Hunting Seasons and Recreational Harvest

State harvest trend for the past 10 years has been variable annually, but relatively stable overall (Figure 2). Neither tribe hunting the Naches MDZ officially reports harvest. The Yakama Nation season for bucks is year-round, with antlerless take allowed September through December. The Muckleshoot Indian Tribe restricts harvest to buck-only during the fall.

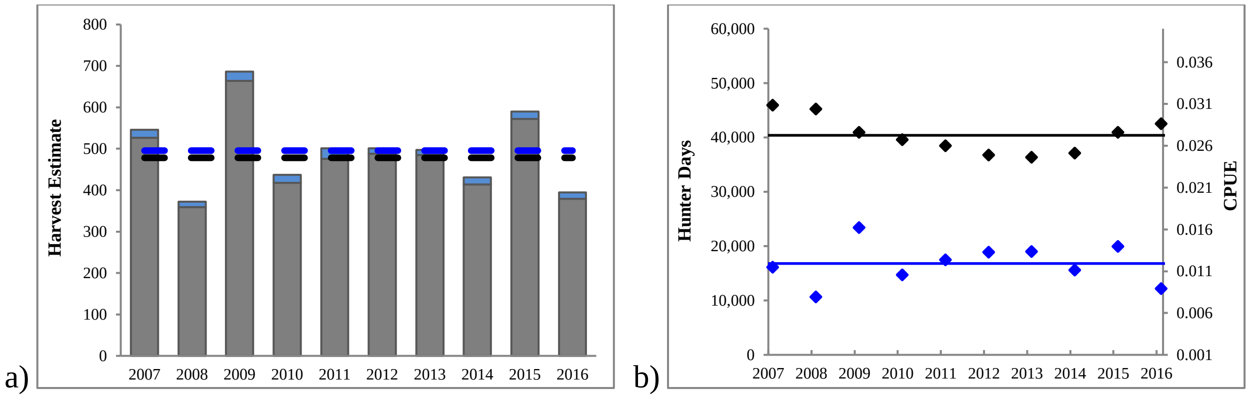

Figure 2. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and b) general season estimates and 10-yr mean for hunter days (black) and harvest/day (blue) in the Naches MDMZ, 2007–2016.

Survival and Mortality

Telemetry studies conducted by the Muckleshoot Indian Tribe (MIT) started in 2013 are ongoing and will provide managers with some zone-specific survival and movement information. A total of 160 adult female mule deer have been radio-marked by the MIT, and 82 mortalities have been documented to date. Estimates of annual survival rates for adult female mule deer were 0.82 (CI = ± 0.07), 0.81 (CI = ± 0.07), and 0.67 (CI = ± 0.08) for the first 3 years of the study, respectively (D. Vales, unpublished data). Survival estimates are based on a biological year running from 05/15 to 05/14. These estimates are consistent with adult female survival documented in other mule deer populations throughout the west (Bleich and Taylor 1998, Unsworth et al. 1999, Bishop et al. 2005, Hurley et al. 2011, Monteith et al. 2014). However, the survival estimates are lower than observed in the Department's research conducted in the Columbia Plateau, East Slope Cascades, and Okanogan Highlands MDMZs (WDFW 2016). Predation by cougars accounted for the highest proportion of the radio-marked deer mortalities in this MDMZ (≈40%). The second and third highest proportions of total mortality were attributed to malnutrition and human-caused mortality at 26% and 16% of total mortalities, respectively.

Since 2004, some deer in this zone were affected by a hair-loss syndrome, a condition caused by an exotic louse. The mule deer population declined in the mid-2000s in this MDMZ and the contributing factors are suspected to have been hair loss syndrome and exacerbating winter mortality (Bernatowicz et al. 2011). Another suspected, but unconfirmed, pathogen may have been adenovirus. The population has not rebounded to recent historic levels noted before 2004.

Habitat

Deer radioed in the northern portion of the winter range disperse through much of the MDMZ, but densities are highest in GMU's 340 and 342. Harvest data match radio-marked deer distribution. There are currently no measures of habitat quality for this deer zone. Fire, post-fire salvage, and thinning/control burns to reduce fuel have probably affected deer habitat in the last decade. In portions of important range in GMU's 340 and 342, fire/human alteration has generally increased browse production. The exception has been in more arid portions of GMU 342 where fires have converted shrub-steppe to grassland. Thinning/burning in GMU 352 appears to have converted many areas to park-like ponderosa pine/grass. The radio-marked deer have not used those areas.

Human-Wildlife Interaction

Deer conflicts with agriculture in the Naches District are typically minimal. In 2016-17, there were 18 damage prevention permits issued, and no harvest recorded. Reporting on the permits is generally poor, but harvest is assumed to be low.

Management Concerns

The largest concern in the Naches MDMZ is that deer density remains below historic levels. Observations/ground surveys indicate a decline in the population sometime between April and December 2005. There wasn't a severe spring/winter weather event, and fall antlerless harvest was 297. In 2004, hair-loss syndrome (HLS), a condition caused by an exotic louse, was noted in the MDMZ. HLS was hypothesized to be a contributing factor, but no confirmatory evidence is available. An all-sex/age die-off in Oregon 2002 was attributed to adenovirus (AHD). The timing and patchy distribution of the population decline in the Naches MDMZ would be consistent with AHD, but no carcasses were recovered and the virus was not confirmed at that time.

The exact cause of the decline probably will never be known. Population recovery seems to be occurring very slowly. Bleich and Taylor (1998) and Robinson et al. (2002) found cougar predation was a limiting factor in some deer populations, but also suggested other factors could be involved. The same may be true in the Naches MDMZ. Cougars are a significant cause of mortality for deer in this zone, but can't be confirmed as the cause of reduced deer density in the Naches MDMZ.

Management Conclusions

Mule deer populations in the Naches MDMZ are low compared to historic levels. The rapid decline was possibly due to parasites/disease. The exact reasons for lack of recovery are unknown, but cougars appear to at least be the dominant proximate cause of adult female deer mortality. During a series of mild winters, the deer population was growing slowly, but declined after a more severe winter in 2015-2016. The buck population is typically within the minimum management objective of 15-19 bucks per 100 does. Survey approaches in this MDMZ are still being refined.

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Northern Rocky Mountains Mule Deer Management Zone

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MIKE ATAMIAN, Wildlife Biologist
CARRIE LOWE, Wildlife Biologist

Introduction

The Northern Rocky Mountains MDMZ is located in northeast Washington and consists of six GMUs (105, 108, 111, 113, 117, and 124; Figure 1).

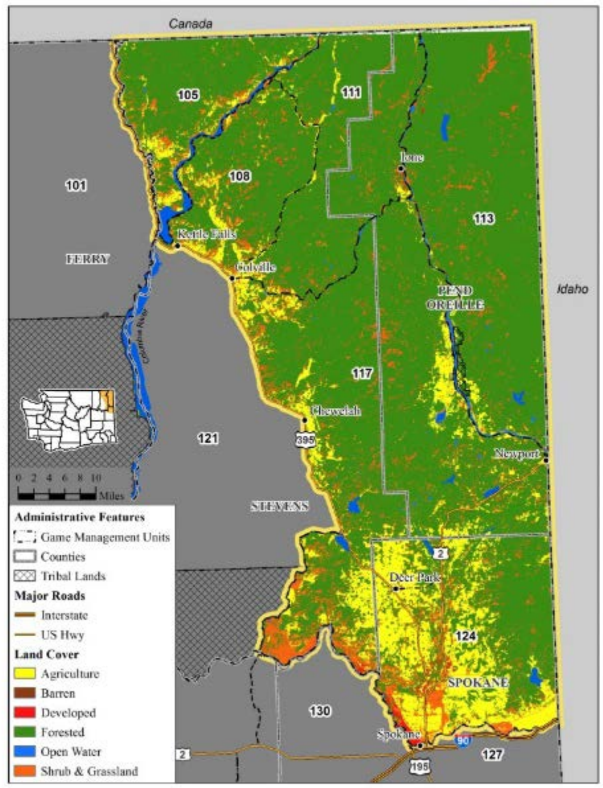

Figure 1. GMUs and generalized land cover types within the Northern Rocky Mountains MDMZ.

Management Guidelines and Objectives

The Department's objective within this MDMZ is to maintain a stable population, based on harvest estimates and other best-available information. Additional management objectives include managing for a post-hunt population with a sex ratio of 15-19 bucks:100 does.

Population Surveys

No estimates of mule deer abundance are available for populations within this zone, but the overall mule deer numbers are low given the limited high quality mule deer habitat in the zone.

Hunting Seasons and Recreational Harvest

Subsequent to 2006 harvest estimates have fluctuated over time (Figure 2a). Estimates of hunter effort (i.e., hunter days; Figure 2b) and harvest rate (i.e., Catch Per Unit Effort {CPUE} or kills/day; Figure 2b) in this zone include days spent hunting white-tailed deer as well, and are consequently skewed with regard to mule deer-specific harvest. Because this zone is predominantly hunted for white-tailed deer, the true number of days spent hunting only mule deer are substantially lower, and harvest rates higher, than indicated.

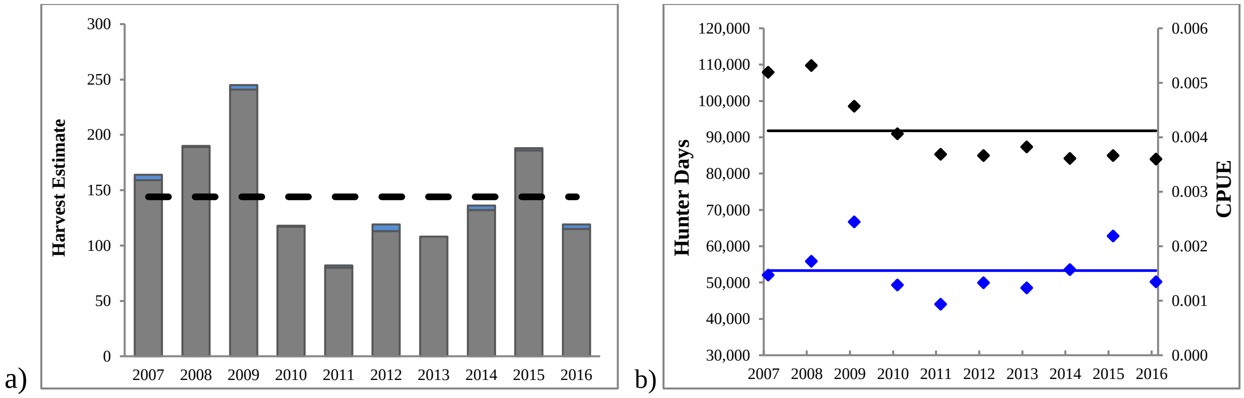

Figure 2. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); in the Northern Rocky Mountains MDMZ, 2006–2016.

Survival and Mortality

No estimates of pregnancy, fetal, or survival rates are available for mule deer herds in the Northern Rocky Mountains MDMZ. Cougars, black bears, grizzly bears, and coyotes occur within this MDMZ, as well as 7 wolf packs as of December 31, 2016 (Washington Department of Fish and Wildlife et. al. 2017). The effects of predation on this population of mule deer are unknown. Mule deer harvest estimates have fluctuated up and down in the past 10 years with an increasing trend over the last 5 years.

Habitat

Habitat within the Northern Rocky Mountains MDMZ is predominantly conifer forest, comprising over 70 % of the total land cover within the zone. Forest types include dry forest at low elevations, mainly composed of ponderosa pine and Douglas-fir, to high elevation forest composed of subalpine fir, western larch, Engelmann spruce, whitebark pine, and lodgepole pine. More mesic sites at any elevation contain western red cedar, western hemlock, and grand fir. Outside the winter season mule deer tend to be found at high elevation ridges and basins, except in GMU 124 where they are found year around along the Spokane River and associated tributaries. Most of these high elevation summer ranges are on public land managed for multiple uses, including wildlife conservation. Lands under private ownership are typically managed for long-term timber production. Hence, there appears to be little threat of habitat conversion for mule deer summer ranges within the Northern Rocky Mountains MDMZ. The one exception to this is in GMU 124 where development along the Spokane River and tributaries is resulting in habitat conversion. Mule deer are apparently adapting to this development and are often reported as nuisance or damage issues in the towns along the river.

Human-Wildlife Interaction

Most mule deer observed within the Northern Rocky Mountains MDMZ are in places where the deer are generally appreciated. Hence, there have been no conflicts reported specific to mule deer, outside of the Spokane area, and all Damage Prevention Cooperative Agreements filed within this zone have been specific to conflicts with white-tailed deer in low elevation farmlands. Within the Spokane area the conflicts with mule deer have typically involved damage to landscaping, and human safety issues, predominantly vehicle deer collisions along Hwy 291 and Northwest Blvd, have also occurred.

Management Concerns

The primary management concerns for mule deer in the Northern Rocky Mountains MDMZ are:

1. Mule deer numbers in this zone appear to be low and restricted in range by suitable mule deer habitat;
2. There is little known about these mule deer including their abundance, population dynamics, habitat selection, and migration habits. Nevertheless, we have a general hunting season on 3-point or better bucks that appears to be sustainable.

Management Conclusions

Mule deer populations in the Northern Rocky Mountains MDMZ are not considered to be at risk based upon hunter harvest metrics. The estimated harvest for 2016 was below the 10-year average, but within the range observed.

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Washington Department of Fish and Wildlife. 2016. Washington State mule deer management plan. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA. 144 p.

Okanogan Highlands Mule Deer Management Zone

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ANNEMARIE PRINCE, Wildlife Biologist

Introduction

The Okanogan Highlands MDMZ is located in north-central Washington and includes GMUs 101, 121, and 204 (Figure 1).

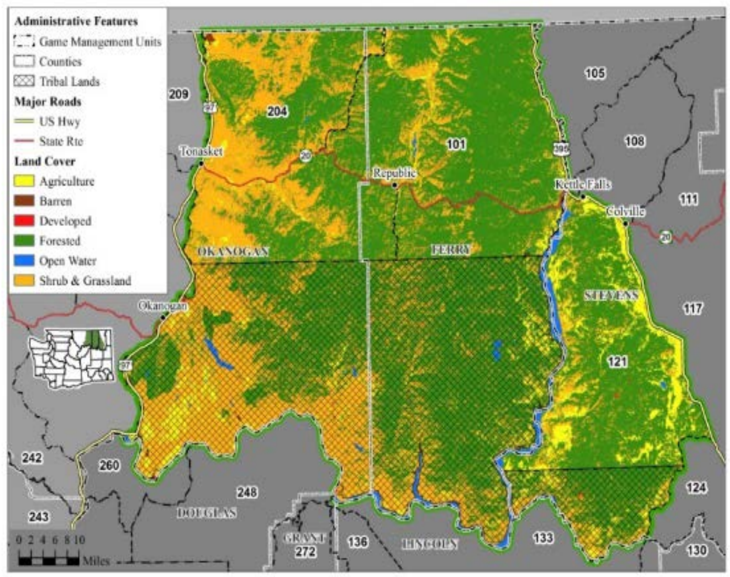

Figure 1. GMUs and generalized land cover types within the Okanogan Highlands MDMZ.

Management Guidelines and Objectives

The Department's objective within this MDMZ is to maintain a stable population based on field surveys and harvest estimates. Additional management objectives include managing for a post-hunt population with a sex ratio of 15 – 19 bucks:100 does.

Population Surveys

Mule deer are present throughout the Okanogan Highlands WDMZ but are more common in the western portion. Pre-hunt ground surveys have been conducted since the early 1980s. Standardized, equal length road-based transects have been used since 2011. These surveys provide a rough index of population trend and buck:doe ratios over time. The estimated pre-hunt buck:doe ratio averaged 27:100 (ranging from a minimum estimate of 15:100 to a maximum estimate of 29:100) between 2011 and 2016. The buck:doe ratio estimate for 2016 was 15:100 (n = 84). Confidence intervals are not calculated due to the small sample sizes. Road-based surveys specific to mule deer fawn to doe ratios have insufficient sample sizes to draw meaningful conclusions about age class ratios.

Hunting Seasons and Recreational Harvest

Harvest trends for the past 10 years have been relatively stable (Figure 2a). Hunter days have declined in recent years due to shortened season length and kills/day have remained stable (Figure 2b).

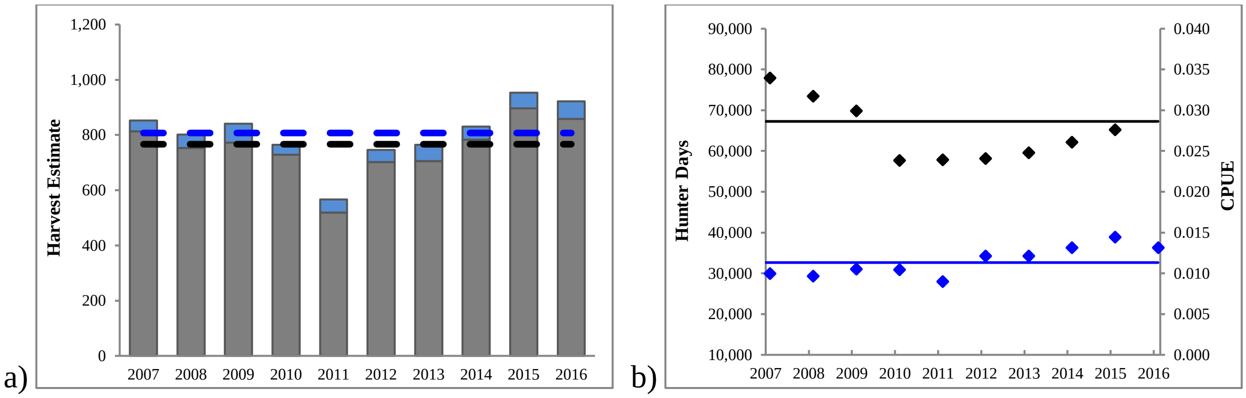

Figure 2. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); in the Okanogan Highlands MDMZ, 2006– 2016.

Survival and Mortality

A study involving adult female mule deer in the zone, conducted between 2000 and 2007, indicated survival ($\hat{s}$ = 0.89, 95% CI = 0.87 – 0.91), pregnancy rates ($\hat{p}$ = 0.93, 90% CI = 0.81 – 1.00), and fetal rates ($\hat{f}$ = 1.44, 90% CI = 1.03 – 1.85) in the Okanogan Highlands MDMZ were sufficient to support stable populations (WDFW 2016). The study also found that cougars and deer-vehicle collisions were the most common sources of mortality (WDFW 2016). As of 2014, the Department has been working in collaboration with the University of Washington to provide updated survival information for this zone over the next few years. Predators in the Okanogan Highlands MDMZ include cougars, black bears, coyotes, golden eagles, and wolves (8 wolf packs, occurring mostly in the eastern portion of the zone, have been documented as of December 31, 2016) (WDFW 2017).

Habitat

Habitat within the Okanogan Highlands MDMZ is predominantly conifer forest, contributing approximately 61% of the total land cover within the zone. Shrub lands combined with upland grass and herbaceous along with agricultural lands make up the next highest level in land cover classes, altogether comprising approximately 33% of the Okanogan Highlands MDMZ area. The Okanogan Highlands MDMZ can also be broken down to about 28% public land and 27% private lands with the remaining 45% comprised of the Colville and Spokane Indian Reservations (WDFW 2016).

Threats to habitat quality within the Okanogan Highlands MDMZ include continued development and fragmentation of low-elevation habitats, increasing use and distribution of off-road vehicles, and increasing prevalence of invasive weeds. In 2015, approximately 272,800 acres were burned by multiple wildfires within the Okanogan Highlands MDMZ. The fires were of varying severities and in some areas mule deer habitat burned very intensely.

Human-Wildlife Interaction

Most deer conflict is restricted to the lower elevation irrigated agriculture lands throughout the Zone. Specific Deer Areas have been established in the western edge of this Zone with antlerless permit hunt seasons designed to target and reduce deer damage. Permit numbers within each Deer Area fluctuate with the level of reported damage incidents. To date, the program is operating smoothly and appears to be helpful in reducing deer damage complaints.

The town of Republic has a resident in-town mule deer population that causes property damage and poses a safety threat. In addition to the Deer Area permits, the town of Republic is generally issued kill permits on a yearly basis, so the local police department can address deer issues.

Damage Prevention Cooperative Agreements (DPCA) and Kill permits are also conservatively issued to reduce deer damage throughout the Zone. In 2016, WDFW Conflict Specialists issued 16 mule deer permits to address deer damage throughout the entire Okanogan Highlands MDMZ.

Research

Currently, three research projects dealing with mule and white-tailed deer are ongoing in various stages of completion within the Okanogan Highlands MDMZ. All are PhD projects from the University of Washington dealing with the effects of wolf re-colonization on deer. The three projects are investigating deer behavior in areas with and without wolves, deer fawn mortality with emphasis on coyotes in areas with and without wolves, and the impacts of recolonizing gray wolves on deer-plant interactions through the use of vegetation enclosures.

Management Concerns

Approximately 28% of the land base comprising the Okanogan Highlands MDMZ is in public ownership. Thus, maximizing hunting opportunities largely depends on securing access to private lands. Besides hunting the other major sources of mortality to deer in this zone include predation by native carnivores and road kills. Periodically, a severe winter will cause major deer loss. The influence of these factors can complicate how best to balance deer hunting opportunity with herd sustainability.

Management Conclusions

Mule deer populations in the Okanogan Highlands MDMZ are considered stable based on harvest data trend.

Literature Cited

Washington Department of Fish and Wildlife. 2016. Washington State mule deer management plan. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA. 144 p.

Washington Department of Fish and Wildlife, Confederated Colville Tribes, Spokane Tribe of Indians, USDA-APHIS Wildlife Services, and U.S. Fish and Wildlife Service. 2017. Washington Gray Wolf Conservation and Management 2016 Annual Report. Washington Department of Fish and Wildlife, Colville, WA, USA.

Blue Mountains White-tailed Deer Management Zone

MARK VEKASY, Wildlife Biologist
PAUL WIK, Wildlife Biologist

Introduction

The Blue Mountains White-tailed Deer Management Zone (WDMZ) is located in southeast Washington and consists of 11 GMUs (154, 157, 162, 163, 166, 169, 172, 175, 178, 181, and 186; Figure 1).

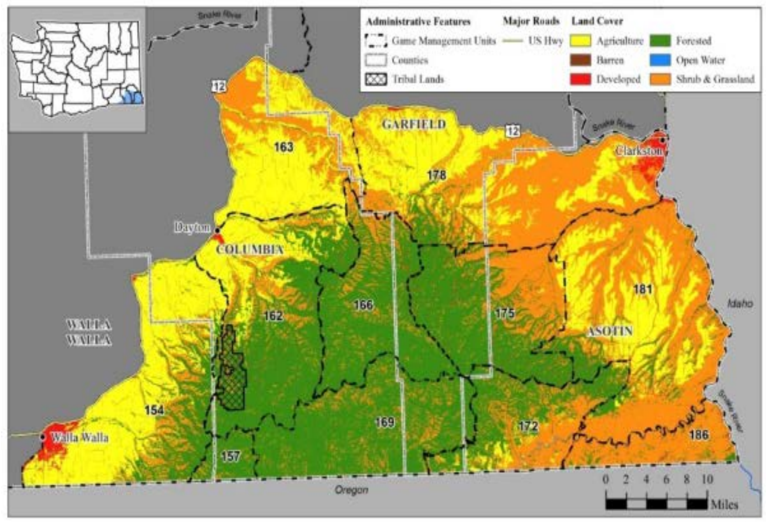

Figure 1. GMUs and generalized land cover types within the Blue Mountains WDMZ.

Management Guidelines and Objectives

The Department's objective within this WDMZ is to maintain a stable population based on available survey data and harvest estimates. Additional management objectives include managing for a post-hunt population with a sex ratio of 15 - 19 bucks:100 does (WDFW 2010).

Population Surveys

White-tailed deer occur throughout the zone but densities are generally greater in the foothills and higher-elevation agricultural areas. Aerial surveys for mule deer are conducted in parts of this zone but are not targeted for monitoring white-tailed deer populations. For background information, we completed our largest survey effort in the Blue Mountains WDMZ in December 2012 in GMU 181, and counted 606 white-tailed deer. Including ground counts throughout the WDMZ, we counted 780 white-tailed deer, with a post-hunt buck:doe ratio of 20 (90% CI = 16.6-24.2) and a fawn:doe ratio of 47 (905 CI = 40.9-53.7). The most recent estimates from 2016 derived from post-hunt ground composition surveys (n = 369) were 22.0 bucks:100 does and 62.5 fawns:100 does.

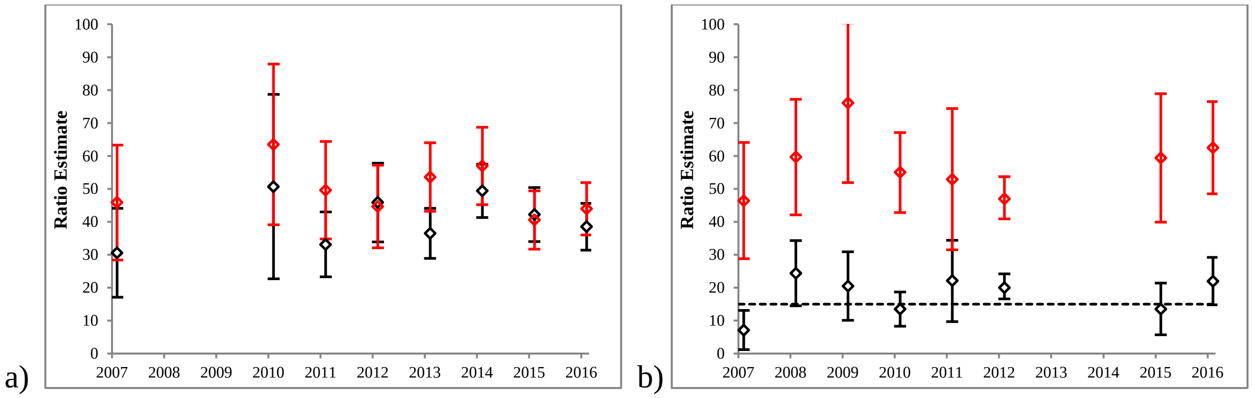

Figure 2. Estimates of buck (black) and fawn (red) ratios per 100 does and post-hunt buck objectives (dashed line) for ground and aerial surveys, (a) pre-hunt and (b) post-hunt in the Blue Mountains MDMZ, 2007–2016. Years where ground counts were below 100 deer have been excluded.

Hunting Seasons and Recreational Harvest

Harvest estimates for the past 10 years (Figure 2a) have been stable, as have the number of hunter days and kills/day (Figure 2b). Hunter days and CPUE are for white-tailed and mule deer combined.

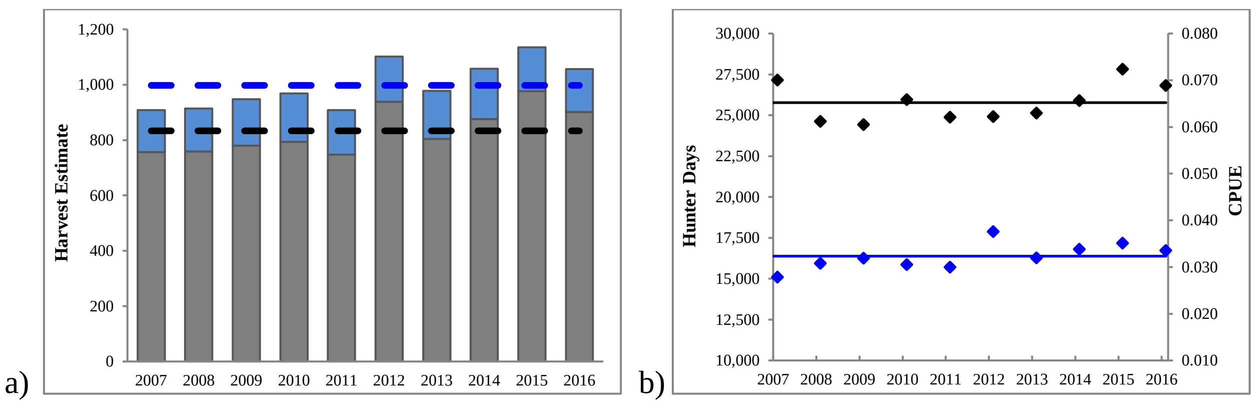

Figure 3. Harvest estimates and 10-yr means (dashed lines) for (a) General BM Zone Harvest (gray) and General + Permit BM Zone Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); in the Blue Mountains WDMZ, 2007–2016.

Survival and Mortality

No estimates of pregnancy, fetal, or survival rates are available for white-tailed deer herds in the Blue Mountains WDMZ. In addition to legal hunter harvest, other potential sources of white-tailed deer mortality include predation, collisions with vehicles, disease (EHD and Bluetongue), and poaching. Predator species living within this zone include cougar, wolves, bobcat, black bear, coyote, golden eagles, and domestic dogs.

Habitat

Similar to mule deer in this area, white-tailed deer populations are generally habitat limited. Habitat limitations include conversion to croplands from CRP, grazing by domestic livestock, wildfire suppression, invasion of noxious weeds, extensive wind power development, and urban-suburban development have been detrimental to available habitat in this zone. Dry conditions that develop during the summer growing season, particularly on the east side of the Blue Mountains, are likely a limiting factor to productivity for white-tailed deer.

Human-Wildlife Interaction

The agricultural damage prevention program managed by WDFW has changed over the last few years, with responsibilities being shifted from the Enforcement Program to the Wildlife Program, with continual adjustments to how permits are issued. 2014 saw the institution of "DPCA" which must be purchased through the licensing program. Landowners are entitled to 2 free kill permits, with the requirement of reporting directly to the Conflict Specialist. Kill Permits make up the majority of damage tags given to landowners. Any additional permits are issued as damage permits with the requirement of purchasing a damage tag and reporting through the licensing system. Most of the harvest has occurred where there would be very little hunting opportunity otherwise, such as in the winery and orchard areas around Walla Walla.

Management Concerns

The biggest management concern for white-tailed deer in the District over the past decade has been the occurrence of epizootic hemorrhagic disease (EHD) or Bluetongue outbreaks. The disease is spread by a biting midge (*Culicoides* spp.), and outbreaks generally occur during drought years when there is limited open water and ample mud for midge breeding habitat, and deer are concentrated near water sources. Our only management option is to gauge the severity of the outbreak, and adjust antlerless permits as necessary. Habitat conversion is an ongoing issue that has mainly resulted in increasing white-tailed deer damage conflicts. Expansion of residential areas and conversion of crop acreage to wineries and orchards has brought deer into conflict with landowners by eating ornamental shrubs, fruit trees, and vines.

Management Conclusions

White-tailed deer populations in the Blue Mountains WDMZ are currently at management objective and harvest data indicate stable to increasing populations where habitat availability and quality allow.

Literature Cited

Washington Department of Fish and Wildlife. 2010. Washington State deer management plan: white-tailed deer. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA. 124 p.

Columbia Basin White-tailed Deer Management Zone

MICHAEL ATAMIAN, Wildlife Biologist
CARRIE LOWE, Wildlife Biologist
SEAN DOUGHERTY, Wildlife Biologist
ELLA ROWAN, Wildlife Biologist
DAVID P. VOLSEN, Wildlife Biologist
DEVON COMSTOCK, Wildlife Biologist
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Introduction

The Columbia Basin White-tailed Deer Management Zone (WDMZ) is located in east-central Washington and consists of 8 GMUs (136, 272, 278, 284, 290, 373, 379, and 381; Figure 1).

Management Guidelines and Objectives

The Department's objective within this WDMZ is to maintain a stable population based on harvest trends. The Columbia Basin is not optimal white-tailed deer habitat and there is no management objective to change the distribution or numbers of the few white-tailed deer that reside there (WDFW 2010).

Population Surveys

GMUs within this zone are primarily managed for mule deer, but white-tailed deer are present at low densities throughout the Columbia Basin WDMZ. No survey work specific to white-tailed deer is being conducted in this WDMZ at this time.

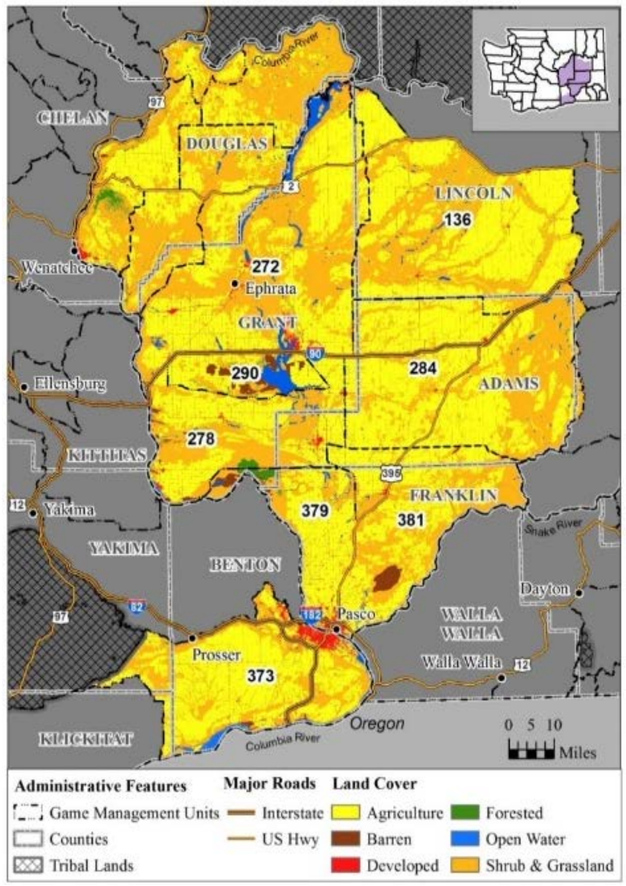


Figure 1. GMUs and generalized land cover types within the Columbia Basin WDMZ.

Hunting Seasons and Recreational Harvest

Harvest estimates have remained low but relatively stable over the past decade (Figure 2a), commensurate with availability of preferred habitat. Measures of hunter effort (hunter days; Figure 2b) and harvest rate (kills/day; Figure 2b) in the zone include days spent hunting all deer (i.e., mule deer) so are less useful as indicators of population trend, but indicate generally stable conditions. The decline in harvest and CPUE in 2015 and 2016 is likely due to the 2015 drought and associated Bluetongue outbreak resulting in reduced white-tailed deer numbers and recruitment.

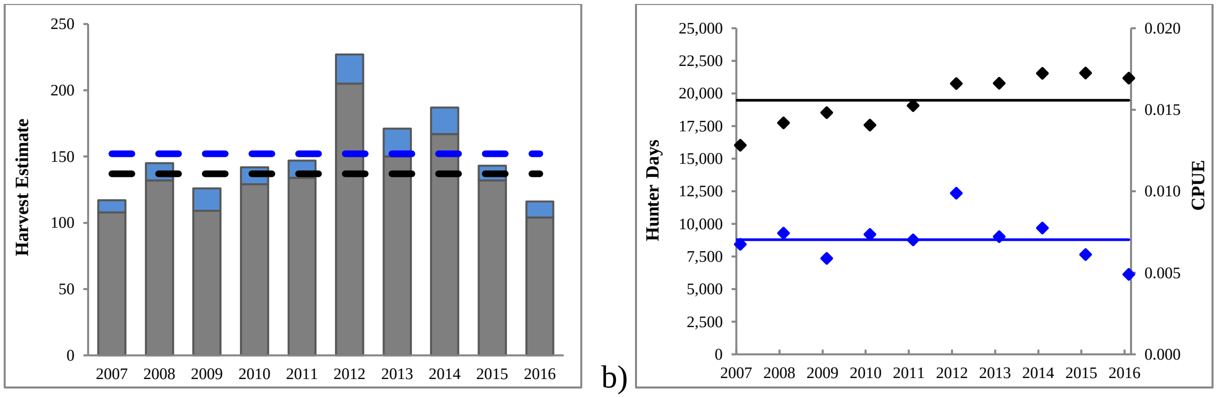
a)


Figure 2. Harvest estimates and 10-yr means (dashed lines) for General State Harvest (gray) and General + Permit State Harvest (blue); a), and general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); b) in the Columbia Basin WDMZ, 2007–2016.

Survival and Mortality

No estimates of pregnancy, fetal, or survival rates are available for white-tailed deer in the Columbia Basin WDMZ. Similar to mule deer, other sources of mortality in this zone likely include collisions with vehicles, drowning in irrigation canals, poaching, and predation. Predator species living within this zone include cougars, bobcats, black bears, gray wolves (transients have been observed but there are no known packs confirmed within this WDMZ at the time of this writing), coyotes, golden eagles, and domestic dogs. Black bears are not common in open shrub-steppe landscapes, but do occur at low levels in some parts of the Columbia Basin. Cougars are comparatively more common.

Habitat

The Columbia Basin zone represents the periphery of white-tailed distribution in central Washington, and habitats present are generally more suitable for mule deer. The overall numbers of white-tailed deer are low in all GMUs within the zone; generally, white-tailed deer are found mostly in the eastern portion of the zone and in association with habitats of very limited extent, such as riparian areas along creeks and streams, CRP grasslands, and non-intensive agricultural tracts. White-tailed deer use in the extensive tracts of shrub-steppe within the zone is not common.

Human-Wildlife Interaction

Given the relatively small number of white-tailed deer in this zone there are no significant white-tailed deer specific issues.

Management Concerns

Drought and loss of riparian habitat are the most important issue facing white-tailed deer in the Columbia Basin WDMZ. Bluetongue (BT) and Epizootic Hemorrhagic Disease (EHD) also occur in this zone and have caused a relatively small number of isolated mortalities every year. The drop in harvest and CPUE in 2015 and 2016 may be related to the 2015 drought and associated BT outbreak, although few mortalities were reported in this WDMZ, those reported were all in GMU 136. The western portion of the WDMZ has had a low level of occurrence of these pathogens.

Management Conclusions

White-tailed deer populations in the Columbia Basin WDMZ are currently within management objective based on harvest data that indicate a stable population.

Literature Cited

Washington Department of Fish and Wildlife. 2010. Washington State deer management plan: white-tailed deer. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA. 124 p.

North Cascade Mountains White-tailed Deer Management Zone

SCOTT FITKIN, Wildlife Biologist
JEFF HEINLEN, Wildlife Biologist

Introduction

The North Cascade Mountains White-tailed Deer Management Zone (WDMZ) is located in north-central Washington and consists of 11 GMUs (209, 215, 218, 224, 231, 233, 239, 242, 243, 247, and 250; Figure 1).

Management Guidelines and Objectives

The Department's objective within this WDMZ is to maintain stable populations based on harvest estimates (WDFW 2010).

Population Surveys

GMUs within the North Cascade Mountains WDMZ are primarily managed for mule deer but white-tailed deer are present at low densities throughout the zone. No formal surveys uniquely designed for white-tailed deer are conducted in this WDMZ.

Hunting Seasons and Recreational Harvest

Harvest estimates for the last 10 years have been low compared with mule deer harvest but relatively stable (Figure 2a). Estimates of hunter effort (which include mule deer hunters as well) have declined slightly in recent years, as indicated by decreasing hunter days, while harvest rates indicate little change (Figure 2b).

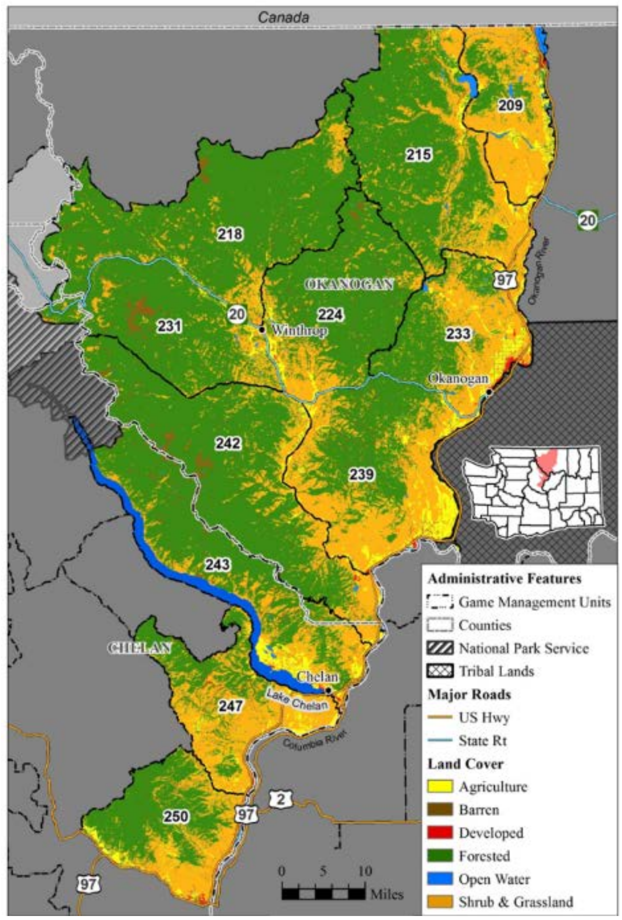


Figure 1. GMUs and generalized land cover types within the North Cascade Mountains WDMZ.

a) b)

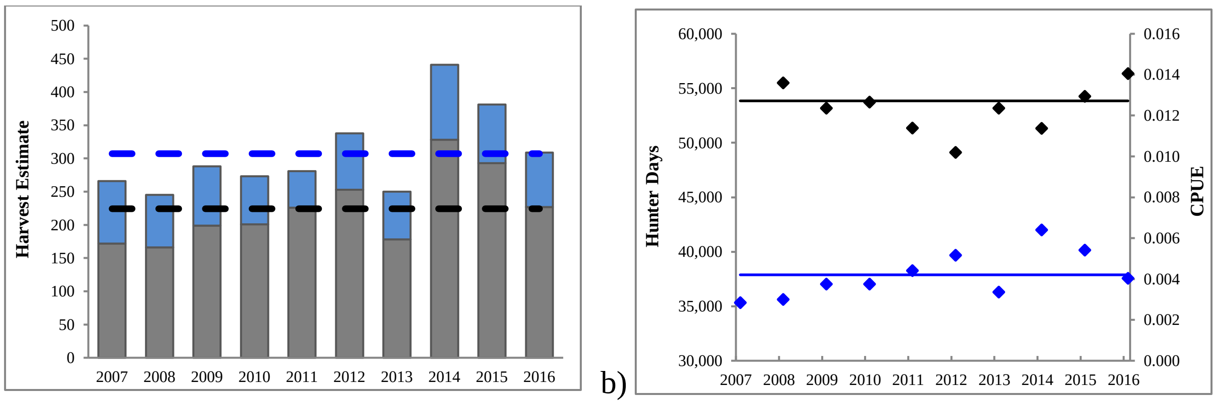


Figure 2. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); in the North Cascade Mountains WDMZ, 2007–2016.

Survival and Mortality

No estimates of pregnancy, fetal, or survival rates are available for white-tailed deer in the North Cascade Mountains WDMZ. Mortality sources in this zone include legal hunting, vehicle collisions, domestic dogs, poaching, and predation. Several predators occur within the North Cascade Mountains WDMZ including coyotes, black bears, cougars, and wolves (2 wolf packs have been documented within the zone as of this writing) but the effects of predation on white-tailed deer in this zone are unknown.

Habitat

Habitat related considerations in this zone include continued development and fragmentation of low-elevation habitats, increasing use and distribution of off-road vehicles, and increasing prevalence of invasive weeds.

Human-Wildlife Interaction

Most deer conflict is restricted to the lower elevation irrigated agriculture lands throughout the Zone. Specific Deer Areas have been established in the northern portion of this Zone with antlerless permit hunt seasons designed to target and reduce deer damage. Permit numbers within each Deer Area fluctuate with the level of reported damage incidents. To date, the program is operating smoothly and appears to be helpful in reducing deer damage complaints.

Damage Prevention Cooperative Agreements (DPCA) and Kill permits are also conservatively issued to reduce deer damage throughout the Zone. In 2016, WDFW Conflict Specialists issued only 8 deer (Mule or White-tailed deer) permits to address deer damage throughout the entire North Cascade Mountains White-tailed Deer Management Zone.

Significant road kill occurs in the northern portion of this zone in the Methow Valley and along a 12.5 mile segment of State Highway 97. The Okanogan Trails Mule Deer Foundation Chapter and others are working with the WA Department of Transportation to create underpasses along Hwy 97 to reduce road kill and provide safer passage.

Management Concerns

Recent extensive loss of winter range shrub forage to wild fires is the primary management concern in the northern three-fourths of the zone. Riparian shrubs are beginning to recover nicely; however, dryland shrub recovery is spotty and proceeding more slowly. Modest temporary increases in antlerless harvest have been implemented in the most heavily impacted GMUs. The objective of these changes is to stabilize or slightly decrease the local population in the short-term to bring deer numbers in line with the landscape's reduced carrying capacity, and avoid over-browsing of recovering winter range shrubs.

Management Conclusions

White-tailed deer populations in the North Cascade Mountains WDMZ are currently at management objective and harvest estimates indicate a stable to slightly growing population.

Literature Cited

Washington Department of Fish and Wildlife. 2010. Washington State deer management plan: white-tailed deer. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA. 124 p.

Okanogan Highlands White-tailed Deer Management Zone

JEFF HEINLEN, Wildlife Biologist
DANA L. BASE, Wildlife Biologist
ANNEMARIE PRINCE, Wildlife Biologist

Introduction

The Okanogan Highlands White-tailed Deer Management Zone is located in north-central Washington and includes GMUs 101 and 204 (Figure 1).

Management Guidelines and Objectives

The Department's objective within this WDMZ is to maintain stable populations based on field surveys and harvest estimates. Additional management objectives include managing for a post-hunt population with a sex ratio of 15-19 bucks:100 does (WDFW 2010).

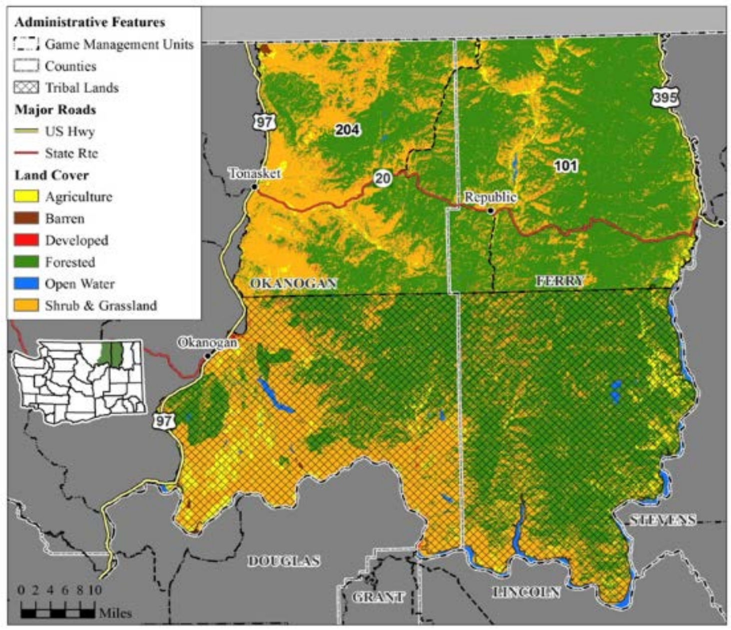


Figure 1. GMUs and generalized land cover types within the Okanogan Highlands WDMZ.

Population Surveys

White-tailed deer are present throughout the Okanogan Highlands WDMZ but are more common in the eastern portion. Because estimates of total white-tailed deer abundance in this zone are not practical, pre-hunt ground surveys have been conducted since the early 1980s and specific routes were established in the early 1990s. Standardized road-based transects of equal length have been used since 2011. These surveys provide a rough index of population trend and buck:doe ratios over time. The estimated pre-hunt buck:doe ratio averaged 30 (range = 24 - 38, *n* = range of 128 - 266 deer classified each year) between 2011 and 2016. The buck:doe ratio estimate for 2016 was 23 :100 (*n* = 135). Confidence intervals are not calculated due to the small sample sizes. Road-based surveys specific to white-tailed deer fawn to doe ratios have insufficient sample sizes to draw meaningful conclusions about age class ratios in this WDMZ.

Hunting Seasons and Recreational Harvest

Harvest estimates have been mostly stable over the last decade (Figure 2a). Number of hunter days reported have been stable and estimates of kills/day increased slightly in recent years. (Figure 2b).

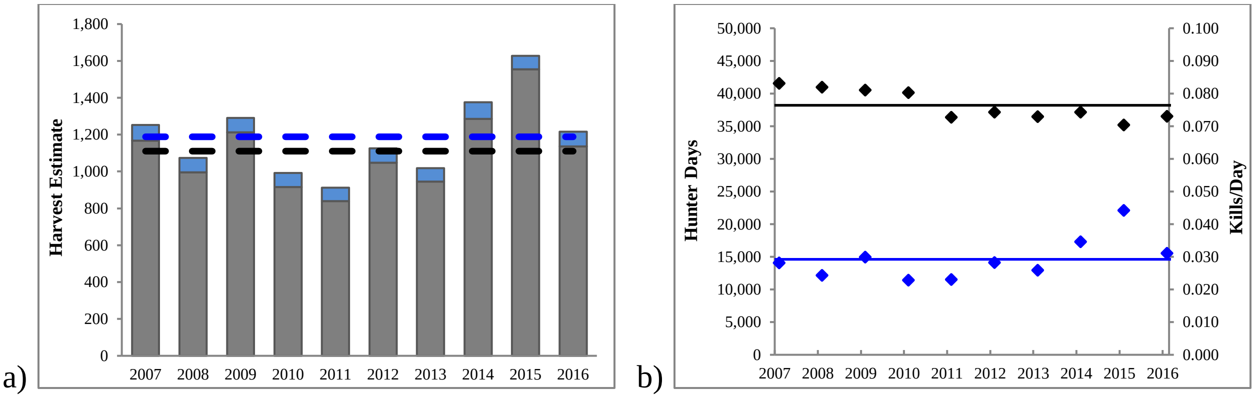


Figure 2. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); b) in the Okanogan Highlands WDMZ, 2007–2016.

Survival and Mortality

No estimates of pregnancy, fetal, or survival rates are available for white-tailed deer in the Okanogan Highlands WDMZ.

In addition to legal hunter harvest, other potential sources of white-tailed deer mortality include disease, poaching, collisions with vehicles, and predation. Predator species living within this zone include cougar, bobcat, black bear, gray wolf (5 packs have been document as of December 31, 2016; WDFW et al. 2017), coyote, golden eagles, and domestic dogs.

Habitat

Habitat within the Okanogan Highlands WDMZ is predominantly conifer forest, contributing approximately 55% of the total land cover within the zone. Shrub land combined with grassland, pasture, and cultivated crops make up the next highest level in land cover classes, altogether comprising approximately 41% of the Okanogan Highlands WDMZ area. These cover classes combined produce the highest densities of white-tailed deer, particularly in the valley bottoms where deer have both forage and cover resources in close proximity. Although cultivated crops alone account for only 0.7% of the aforementioned land cover, their influence on support of the white-tailed deer population cannot be overstated. The Okanogan Highlands WDMZ can also be broken down to about 31% public land and 19% private lands with the remaining 50% comprised of the Colville Indian Reservation (WDFW 2010).

Threats to habitat quality within the Okanogan Highlands WDMZ include continued development and fragmentation of low-elevation habitats, increasing use and distribution of off-road vehicles, and increasing prevalence of invasive weeds. In 2015, approximately 208,800 acres were burned by multiple wildfires within the Okanogan Highlands WDMZ.

Human-Wildlife Interaction

Most deer conflict is restricted to the lower elevation irrigated agriculture lands throughout the Zone. Specific Deer Areas have been established in the western edge of this Zone with antlerless permit hunt seasons designed to target and reduce deer damage. Permit numbers within each Deer

Area fluctuate with the level of reported damage incidents. To date, the program is operating smoothly and appears to be helpful in reducing deer damage complaints.

Damage Prevention Cooperative Agreements (DPCA) and kill permits are also issued to reduce deer damage throughout the Zone. In 2016, WDFW Conflict Specialists issued 36 white-tailed deer permits to address deer damage throughout the entire Okanogan Highlands WDMZ.

Research

Currently, three research projects that address white-tailed and mule deer are ongoing in various stages of completion within the Okanogan Highlands WDMZ. All are PhD projects from the University of Washington dealing with the effects of wolf re-colonization on deer. The three projects are investigating deer behavior in areas with and without wolves, deer fawn mortality with emphasis on coyotes in areas with and without wolves, and the impacts of recolonizing gray wolves on deer as relate to plant interactions through the use of vegetation enclosures.

Management Concerns

As less than half the land base comprising the Okanogan Highlands WDMZ is in public ownership (31%), maximizing hunting opportunities largely depends on securing access to private lands. Closely coupled to this concern is the availability of cultivated crop land cover, particularly cereal grain and alfalfa hay to the deer. Cultivated crops are a major driver to white-tailed deer density and productivity in northeastern Washington and beyond. Besides hunting the other major sources of mortality to deer in this zone include predation by both native carnivores and domestic dogs, and road kills from collision with automobiles. Periodically, but unpredictably, a severe winter will cause major deer loss. Also unpredictable are summer heat and drought that foster conditions for severe outbreaks of hemorrhagic disease. The influence of these diverse factors can greatly complicate how best to balance deer hunting opportunity with herd sustainability.

Management Conclusions

White-tailed deer populations in the Okanogan Highlands WDMZ are currently at management objective and harvest data indicate stable to slowly increasing population growth.

Literature Cited

Washington Department of Fish and Wildlife, Confederated Colville Tribes, Spokane Tribe of Indians, USDA-APHIS Wildlife Services, and U.S. Fish and Wildlife Service. 2017. Washington Gray Wolf Conservation and Management 2016 Annual Report. Washington Department of Fish and Wildlife, Colville, WA, USA.

Washington Department of Fish and Wildlife. 2010. Washington State deer management plan: white-tailed deer. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA. 124 p.

Palouse White-tailed Deer Management Zone

MICHAEL ATAMIAN, Wildlife Biologist
MARK VEKASY, Wildlife Biologist

Introduction

The Palouse White-tailed Deer Management Zone is located in east-central Washington and consists of 7 GMUs in Districts 2 and 3 (127, 130, 133, 139, 142, 145, 149; Figure 1).

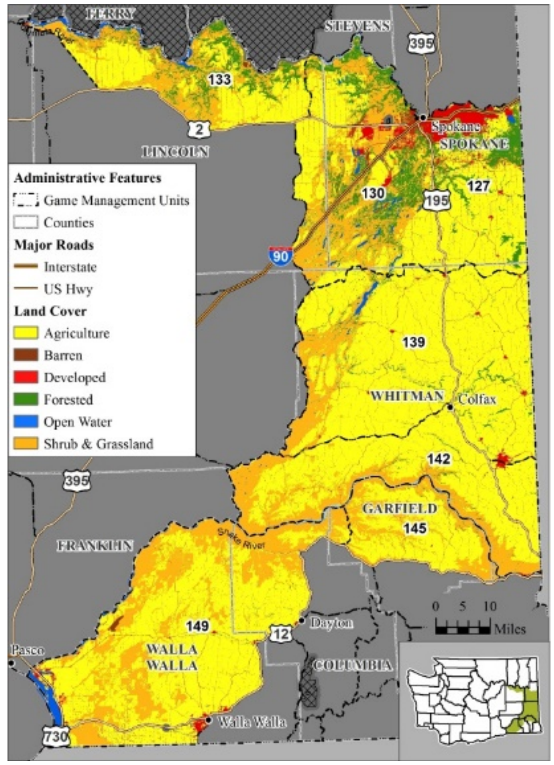


Figure 1. GMUs and generalized land cover types within the Palouse WDMZ.

Management Guidelines and Objectives

The Department's objective within this WDMZ is to maintain a stable population based on available survey data and harvest trends. Additional management objectives include managing for a post-hunt population with a sex ratio of 15 to 19 bucks per 100 does (WDFW 2010).

Population Surveys

White-tailed deer are present at moderate to high densities throughout the Palouse WDMZ. The Palouse WDMZ is split into two areas for management purposes; the North Palouse comprised of those GMUs north of the Snake River (GMUs 127 – 142; District 2) and the South Palouse comprised of those GMUs south of the Snake River (GMUs 145 & 149; District 3).

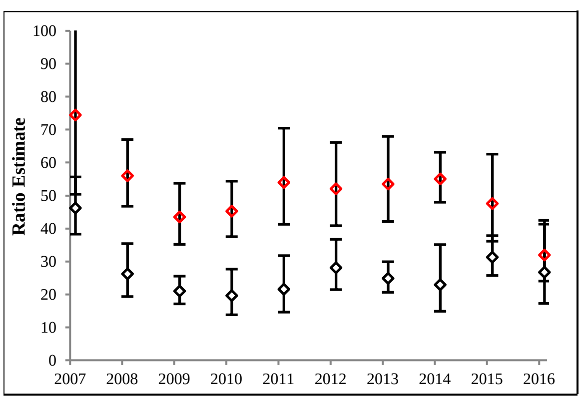


Figure 2. Estimated pre-hunt fawn:doe (◊) and buck:doe (◊) ratios and associated 90% confidence intervals in North Palouse WDMZ (GMUs 127 – 142), 2006–2016.

North Palouse

Pre-hunt ground surveys are conducted throughout the North Palouse. The goal of these surveys is to estimate deer herd composition not population size, therefore routes are altered annually, as needed, to reflect changes in habitat and agricultural crops. Routes are run twice each year; once in August for buck to doe ratios to estimate buck recruitment and once in September for fawn to doe ratios to estimate fawn production. Though the ratio data indicate stable recruitment of bucks, production of fawns has been dropping the past two years, this is likely due to the drought of 2015 and the associated Blue

Tongue outbreak resulting in poor body condition in does which may influence productivity (Figure 2). Post-hunt surveys are not conducted in this WDMZ. Hunting intensifies nocturnal and road-avoidance behavior of bucks, making ground surveys ineffective. Forested cover in the higher white-tailed deer density areas makes aerial surveys ineffective without a sightability correction. Trends in ratio estimates should not be interpreted as population trends; without a population estimate or index and survival estimates we cannot determine if this population is increasing, declining, or stable. WDFW is currently working on developing a survey methodology to deal with these issues.

South Palouse

White-tailed deer are not a management focus in the South Palouse, where they comprise roughly one-quarter of the total deer harvest, most of the management is directed towards mule deer populations, and any population information is incidental to that collected for mule deer. Pre-hunt ground surveys are conducted throughout the 2 GMUs, but sample sizes for white-tailed deer from ground composition surveys are too small and variable to be useful. For a baseline reference, we conducted an aerial survey in December 2013, sampling most of GMU 145 and portions of adjacent GMUs, and obtained a raw count of 2,082 white-tailed deer. We flew surveys following sightability model protocols, but the model was not designed nor validated for white-tailed deer, so we did not calculate a survey area estimate. The post-hunt buck:doe ratio was 24.3 (90% CI = 21.7-27.0), and the fawn:doe ratio was 49.9 (90% CI = 45.8-54.1). In December 2014, we conducted aerial surveys in the northern half of GMU 149 and obtained a raw count of 369 white-tailed deer, with a post-hunt buck:doe ratio of 26.3 (90% CI = 19.8-32.8) and a fawn:doe ratio of 46.9 (90% CI = 37.6-56.3). White-tailed deer numbers are higher in the southern half of the GMU, so the small number counted during aerial surveys is not surprising.

Since those surveys were conducted, we have observed a 50% decline in white-tailed deer harvest in GMU 145, where the effects of drought and hemorrhagic disease were similar to those observed in the North Palouse. As with ratio estimates, trends in harvest estimates should not be construed as population trends, but may serve as a general index in population change. However, many factors are responsible for variation in harvest estimates, including variables that effect hunter effort (species targeted, seasonal and annual weather variables, changes in hunt dates and season length, etc), and changes in permit numbers and type (buck vs. antlerless). GMU 149 was not as severely affected by hemorrhagic disease, and harvest estimates have remained fairly stable there since 2013.

Hunting Seasons and Recreational Harvest

Harvest has remained relatively stable over the past decade (Figure 3a). Estimates of hunter effort for the zone have generally been stable during the past 10 years while estimates of kills/day have fluctuated in response to absolute harvest values (Figure 3b). Estimates of hunter effort (i.e., hunter days; Figure 3b) in this zone are not white-tailed specific but also include days spent hunting mule deer, while kill data is specific to white-tailed deer, therefore kills/day estimates are biased low. The low harvest and decline in CPUE in 2015 & 16 was predominantly due to the 2015 drought and associated blue tongue outbreak resulting in immediate mortalities and poor recruitment the following year. White-tailed deer populations in the Palouse appear to be slowly recovering from these events, aided by a mild 2015/16 winter. The 2016/17 winter was hard on the deer, but does not appear to have had as large an impact on the white-tailed deer population in the Palouse as in the neighboring mountains.

a) b)

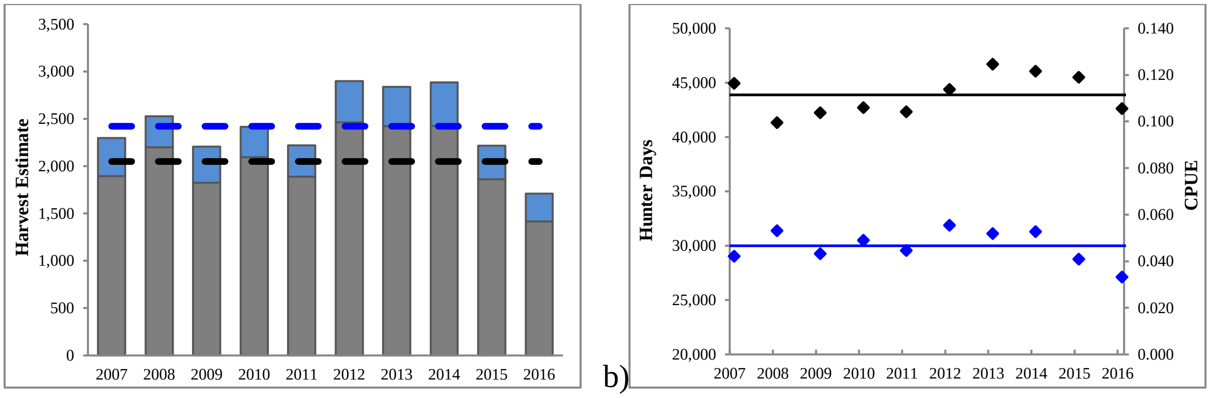


Figure 3. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue);in the Palouse WDMZ, 2007–2016.

Survival and Mortality

No estimates of pregnancy, fetal, or survival rates are available for white-tailed deer in the Palouse WDMZ. Similar to mule deer, sources of mortality in this zone include harvest, collisions with vehicles, poaching, and predation. Predator species living within this zone include cougars, bobcats, black bears, coyotes, golden eagles, and domestic dogs.

Habitat

The Palouse WDMZ includes five broad habitat types: active agricultural fields, Conservation Reserve Program (CRP) fields (primarily grasslands), a native grass/shrub complex (primarily along the breaks of the Snake River), coniferous forest, and riparian. Locations obtained during aerial and ground surveys have shown a relationship between white-tailed deer and riparian corridors, primarily the Palouse, Spokane, Little Spokane, Touchet, Tucannon, and Walla Walla Rivers and some creeks and hollows, such as Rock, Union Flat, Meadow and Deadman Creeks, and Whetstone, Smith, and Kellogg Hollows. We observed fewer white-tailed deer than mule deer along the Snake River breaks and unbroken CRP fields, and more whitetails associated with shrubby draws intermixed with active agricultural fields. Coniferous forest habitat exists primarily in the north of this WDMZ and is intensively used by white-tailed deer, especially when it is associated with agricultural fields. White-tailed deer have also taken advantage of larger acreage (10-20 acre) semi-rural development where forage and cover is present and predation risk (human and non-human) is reduced.

Human-Wildlife Interaction

High numbers of vehicle collisions with white-tailed and mule deer are a problem along State Highways 195, 26 and 2, and Interstate 90 in the North Palouse WDMZ. WDFW is working with the Washington State Department of Transportation to identify hot spots and come up with solutions.

Additionally, crop damage is reported annually in some portions of all GMUs in the North Palouse and is likely to increase as farmers switch to higher value crops like garbanzo beans. Antlerless harvest is the primary tool used to address crop damage; we apply it both at a broad (GMU-wide) scale through general season antlerless opportunity for archery, muzzleloader, youth, senior, disabled, and antlerless only second deer tags (1,325 in 2016), as well as at the individual landowner scale through damage permits (116 issued in 2016).

Deer crop damage complaints in the South Palouse WDMZ, as measured by damage permits issued, account for approximately 44% of the permits issued across District 3, but the majority of complaints are related to mule deer. There are isolated damage issues with white-tailed deer along the boundary of GMU 149 with GMU 154 near Walla Walla, where some orchard, vineyard, and strawberry damage is attributable to whitetails. In response to increasing damage complaints, antlerless permit numbers since 2013 have increased by 200 across both GMUs, with 45 of those permits specifically for white-tailed deer.

Management Concerns

Mass conversion of natural habitats to agriculture occurred in past decades, but represent relatively minor changes today. Gains have been made in deer habitat with enrollment of agricultural acres into the Conservation Reserve Program (CRP). However, with current wheat, lentil, garbanzo bean, and hay prices, several landowners have chosen not to re-enroll in CRP after their contracts expired.

Habitat loss due to development is of concern in GMUs 127 and 130, with the redistribution of Spokane's urban populations outward into rural settings. High-density development (>1house per acre) removes less habitat than low-density development (<1house per 10 acres), but tends to permanently displace deer. While low-density development incorporates more habitat, direct disturbance is less, and more habitat is usable by deer post-construction. However, these deer tend to become damage/nuisance deer. Currently the district promotes high-density clustered development with larger open space areas, with the hope of maintaining larger tracts of habitat that supply some connectivity.

Bluetongue (BT) and Epizootic Hemorrhagic Disease (EHD) occur in this zone and likely cause a small number of isolated mortalities every year. During droughts, these disease events can be more severe and can affect white-tailed deer herds across multiple Management Zones. This occurred in 2015 when white-tailed deer deaths related to BT were reported in the Palouse, Columbia Basin, and Selkirk WDMZs.

Management Conclusions

Based on harvest metrics and limited survey data, white-tailed deer populations in the Palouse WDMZ appear to be meeting management objective.

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Washington Department of Fish and Wildlife. 2010. Washington State deer management plan: white-tailed deer. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA. 124 p.

Selkirk White-tailed Deer Management Zone

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Introduction

The Selkirk WDMZ is located in northeast Washington and consists of 7 Game Management Units (GMUs 105, 108, 111, 113, 117, 121, and 124; Figure 1).

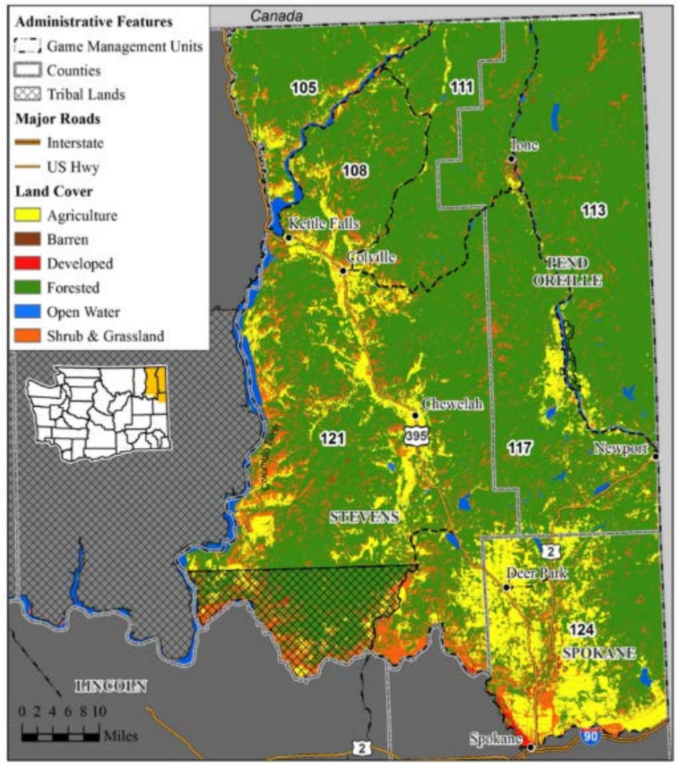

Figure 1. GMUs and generalized land cover types within the Selkirk WDMZ.

Management Guidelines and Objectives

The Department's objective within this WDMZ is to maintain a stable population based on harvest estimates and available survey data. Additional management objectives include managing for a post-hunt population with a sex ratio of 15 to 19 bucks:100 does (WDFW 2010).

GMUs 105 through 121 have similar rural characteristics, climatic traits, land ownership patterns, and cover types; hence management prescriptions and white-tailed deer hunting regulations are uniform throughout these 6 GMUs.

GMU 124, however, is dominated by the metropolitan area of Spokane in the south of the unit and extensive small agricultural properties in the north valleys interspersed with conifer forest in the foothills and mountains. Many of these small, private property owners do not allow hunting, thus functioning as quasi-sanctuaries. This combined with the generally milder winters in GMU 124 results in greater deer abundance than in the northern GMUs. Consequently, hunting regulations are formulated to be more liberal as a mechanism to help keep the white-tailed deer population within local landowner tolerance.

Population Surveys

To date, a reliable estimate of the deer population size for this zone has been unattainable due to forest cover, deer behavior, and staff and funding limitations. As a result indices or surrogates of population size are used for management decisions. Pre-hunt ground surveys have been conducted in GMUs 105 through 121 since the early 1980s. Specific routes were established in the early

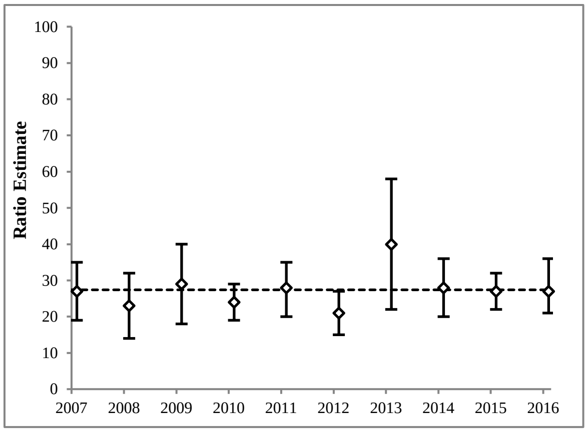

Figure 2. Estimated pre-hunt buck:doe ratios, 90% CIs, and 10-yr average (dotted line) for GMUs 105-121 in the Selkirk WDMZ, 2007-2016.

1990s. The number of routes was increased and the route lengths standardized in 2011. These surveys provide a rough index of population trend and buck:doe ratios over time (Figure 2). The estimated pre-hunt buck:doe ratio averaged 28 bucks:100 does (*n* = range of 451-1522 deer classified each year) from 2007 - 2016. The fawn:doe ratio was 35:100 (90% CI = 22-48, *n* = 585) in 2016.

Pre-hunt ground surveys are also conducted in GMU 124 however the routes are not standardized, because the data are used only to estimate age and sex ratios, not population trend. We are trying to count as many deer as possible in GMU 124 and therefore change the number of and the routes themselves annually to reflect change in habitat and agricultural crops. The fawn:doe ratio was 59:100 (90% CI = 52-67, *n* = 452) in 2016, the same as the previous 10-yr average of 59. The buck:doe ratio was 25 (90% CI = 16-39, *n* = 265) in 2016, similar to the previous 10-yr average of 28.

Hunting Seasons and Recreational Harvest

Estimates of white-tailed deer harvest in this zone indicate a decline between 2008 and 2011, coincident with two consecutive harsh winters in 2008 and 2009 which suppressed fawn recruitment. White-tailed deer populations generally rebound quickly from such temporary weather- and disease-related events, due to their naturally high reproductive potential (McCullough 1987). To support faster recovery WDFW also reduced antlerless harvest opportunity. Harvest and Kills/Day (Figure 3), as well as the standardized ground surveys begun in 2011, indicate populations substantially recovered from the 2 harsh winters.

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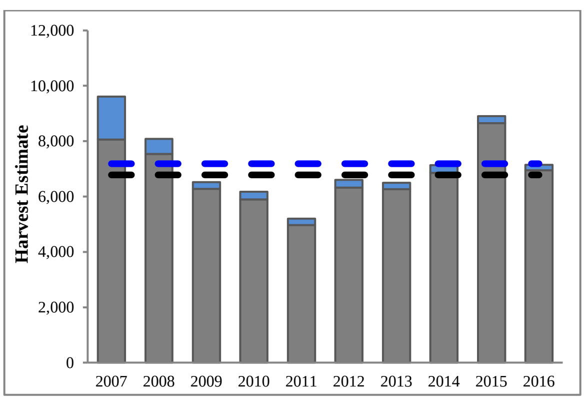


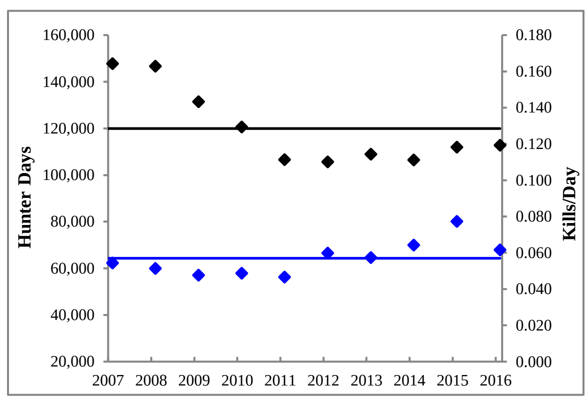
b)


Figure 3. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); in the Selkirk WDMZ, 2007–2016.

Survival and Mortality

Recent research conducted in this zone has provided estimates of annual survival rates for fawns ($\hat{s}$ = 0.56, SD = 0.16) and adult does ($\hat{s}$ = 0.87, SD = 0.05; Henderson 2014). These survival rates indicate recruitment is sufficient to support continued population growth in the Selkirk WDMZ. Mortalities documented during the study were predominantly due to cougars, domestic dogs, and deer-vehicle collisions (Henderson 2014). Other predators in this zone include black bear, grizzly bear, coyote, wolves (9 packs have been documented in this zone as of this writing [WDFW et al. 2017]), and golden eagles.

Regarding recent disease concerns in the zone, white-tailed deer populations throughout the country can be affected, to varying degrees, each fall by different hemorrhagic diseases; most often Epizootic Hemorrhagic Disease (EHD) and Bluetongue Disease. Bluetongue and EHD both naturally occur in this zone and typically cause a relatively small number of mortalities every year. During severe droughts, as happened in fall 2015, these disease events can be more pronounced and affect localized white-tailed deer herds in multiple Management Zones. Because regional weather patterns can substantially affect the scale and locality of an outbreak, incidences are neither predictable nor preventable. Though intense outbreaks, like that experienced in the Selkirk WDMZ in 2015, can be alarming, white-tailed deer appear to be well adapted to survive such ecological challenges due to high reproductive potential (McCullough 1987).

Habitat

Habitat within the Selkirk WDMZ is predominantly conifer forest, contributing approximately 68% of the total land cover within the zone. Shrub land combined with grassland, pasture, and cultivated crops make up the next highest level in land cover classes, altogether comprising nearly 21% of the Selkirk WDMZ area. These cover classes combined produce the highest densities of white-tailed deer, particularly within the farm and forest mosaic where deer have both forage and cover resources in close proximity. Although cultivated crops alone account for only 2.4% of the aforementioned land cover, their influence on support of the white-tailed deer population cannot be overstated. The Selkirk WDMZ can also be broken down to about 37% public land and 57% private lands with the remaining 6% in other categories (WDFW 2010).

Human-Wildlife Interaction

The Selkirk WDMZ is home to the largest populations of white-tailed deer in the state. Areas with large concentrations of agricultural and suburban land uses tend to attract and perpetuate greater densities of white-tailed deer than would normally occur in the wild. This interaction often leads to increased incidence of human-wildlife conflict and increased deer mortality due to vehicle collisions. A study looking at collision rates in Washington indicates that deer-vehicle collisions in this zone are consistently among the highest in the state (Myers et al. 2008). To reduce vehicle collision rates and complaints due to deer damage, the Department has worked with local landowners and county and municipal stakeholders to provide increased antlerless harvest opportunity and reduce deer densities in specific high-risk Deer Areas. A total of 134 white-tailed deer damage prevention permits and 9 kill permits were issued within this zone to landowners dealing with deer damage and enrolled in Damage Prevention Cooperative Agreements in 2016.

Research

Henderson (2014) examined how habitat quality influences migratory strategy of female white-tailed deer within the Selkirk WDMZ. Using GPS-collared female white-tailed deer, an evaluation was accomplished on the influence of deer access to high quality winter habitat based upon the probability of an individual migrating, the differences in seasonal habitat use between and within migratory and resident classes of deer, and the effects of this decision on the survival of female white-tailed deer. Study results found little difference between annual and seasonal rates of deer survival and that the presence of partial migration within this white-tail population may be a response to competition for high quality habitat (Henderson 2014).

Management Concerns

As less than half the land base comprising the Selkirk WDMZ is in public ownership (37%), maximizing hunting opportunities largely depends on securing access to private lands. Closely coupled to this concern is the availability of cultivated crop land cover, particularly cereal grain and alfalfa hay to the deer. Cultivated crops are a major driver to white-tailed deer density and productivity in northeastern Washington and beyond. Besides hunting the other major sources of mortality to deer in this zone include predation by both native carnivores and domestic dogs, and road kills from collision with automobiles on public roadways. Periodically, but unpredictably, a severe winter will cause major deer loss. Also unpredictable are summer heat and drought that foster conditions for severe outbreaks of hemorrhagic disease. The influence of these diverse factors can greatly complicate how best to balance deer hunting opportunity with herd sustainability.

Management Conclusions

White-tailed deer populations in this zone are considered stable on a coarse-scale basis in terms of survey data, recent survival estimates, and harvest metrics.

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Islands Black-Tailed Deer Management Zone

RUTH MILNER, Wildlife Biologist

Introduction

The Islands Black-tailed Deer Management Zone (BDMZ) is located in the Puget Sound in northwest Washington and consists of 11 GMUs (410-417 and 419-422; Figure 1).

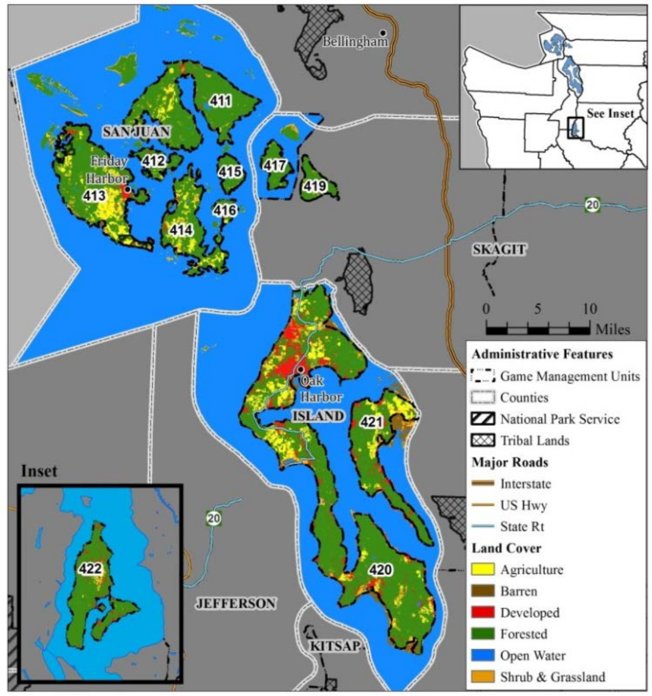

Figure 1. GMUs and generalized land cover types within the Islands BDMZ.

Management Guidelines and Objectives

The Department's objective within this BDMZ is to maintain or reduce the population based on best available knowledge for each island.

Population Surveys

There are no population surveys being conducted in the Islands BDMZ at this time.

Hunting Seasons and Recreational Harvest

Harvest trend over the last decade indicates an increase, (Figure 2a) similar to the number of hunter days and kills/day (Figure 2b).

a) b)

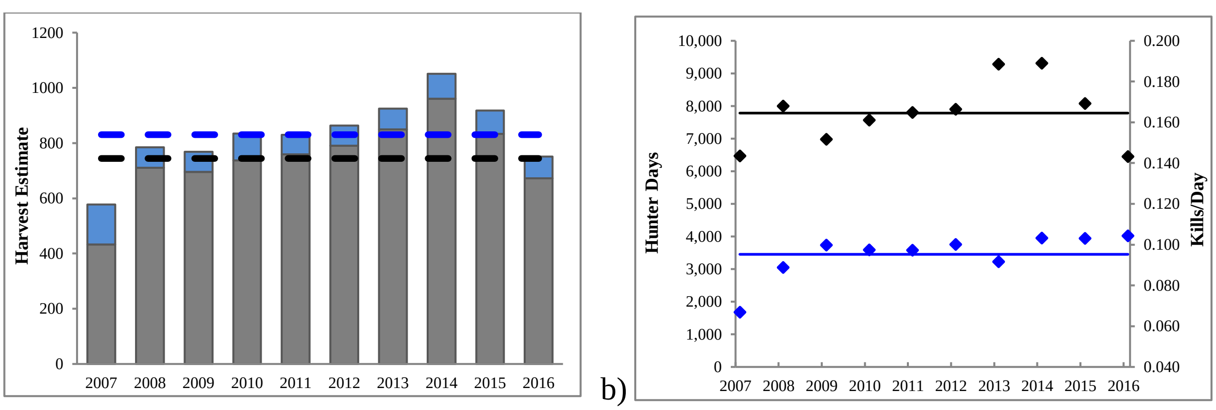

Figure 2. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray) and General + Permit State Harvest (blue); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); in the Islands BDMZ, 2007–2016.

Most of the islands in the BDMZ offer antlerless only second tag special permits as a means to reduce deer densities. However, very little public land where hunting is allowed exists on any island, which limits opportunity for hunters who do not have access to private lands.

Survival and Mortality

No information regarding vital rates is available for black-tailed deer in the Islands BDMZ. In addition to legal hunter harvest, other potential sources of mortality include predation by coyotes on Whidbey, Camano, Guemes and Vashon Islands (the sole large predator in this zone, but absent in the San Juan Archipelago), collisions with vehicles, and poaching.

Habitat

Habitat in the Islands BDMZ generally consists of a mosaic of alder, big-leaf maple or second growth Douglas fir forests intermixed with openings created by small regenerating clear cuts, agricultural fields, hobby farms and horticultural plantings associated with homes and gardens. Although small towns exist on most of the larger islands serviced by the Washington Department of Transportation (WSDOT) ferries, most of the islands retain a highly rural character that provides abundant habitat for black-tailed deer.

Human development affects the amount of habitat available for deer in the island GMUs, particularly on the larger islands where local deer populations are apparently very robust. This may be a response to edge habitats and inadvertent forage enhancements such as gardens and ornamental plantings, which provide abundant food in safe environments where hunting is limited or prohibited.

Human-Wildlife Interaction

Vehicle collisions are common on all the larger islands in this BDMZ. Deer may be encountered any time during the day or night and complaints from residents about deer on roadways are frequent.

Tolerance for high deer populations vary among island residents. Some are anti-hunting and often feed the deer while others favor aggressive reductions in the current populations.

Damage complaints regarding deer depredation on farm crops, ornamental plantings, and conifer seedlings occur throughout the Islands BDMZ. Deer depredation has altered the understory habitat conditions and resulted in reduced diversity of avian species on many islands (Martin et al. 2013). Deer predation has also been identified as a key factor hindering the recovery of the Island Marble Butterfly on San Juan Island, where deer browse flowering plants containing butterfly eggs and larvae (Lambert 2014). Deer also browse the flowers of Golden Paint Brush on Whidbey Island prohibiting the plants from setting seed that is needed for restoration projects.

Management Concerns

In 2013, most of the islands in the BDMZ were split into individual GMUs, in an effort to better understand hunter access and harvest trends on each island where deer occur. Previously, all of the islands were lumped into one or two large GMUs. In spite of outreach efforts to educate hunters of the change, hunters continue to report their harvest using the previously assigned GMU number, thus hindering our ability to assess deer management on an island-by island basis. Although accurate reporting improved in 2016, erroneous GMU reporting remains high, complicating harvest assessments for individual islands.

Management Conclusions

Based on our harvest data, black-tailed deer populations in the Islands BDMZ are currently at or above management objective with an increasing trend.

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Martin, T.G, P Arcese, P.M. Kuhnert, A.J. Gaston and J-L Martin. 2013. Prior information reduces uncertainty about the consequences of deer overabundance on forest birds. Biological Conservation 165:10-17.

North Cascade Mountains Black-Tailed Deer Management Zone

FENNER YARBOROUGH, Wildlife Biologist
MIKE SMITH, Wildlife Biologist

Introduction

The North Cascade Mountains Black-tailed Deer Management Zone (BDMZ) is located in northwest Washington and consists of 11 GMUs (407, 418, 426, 437, 448, 450, 454, 460, 466, 485, and 490; Figure 1).

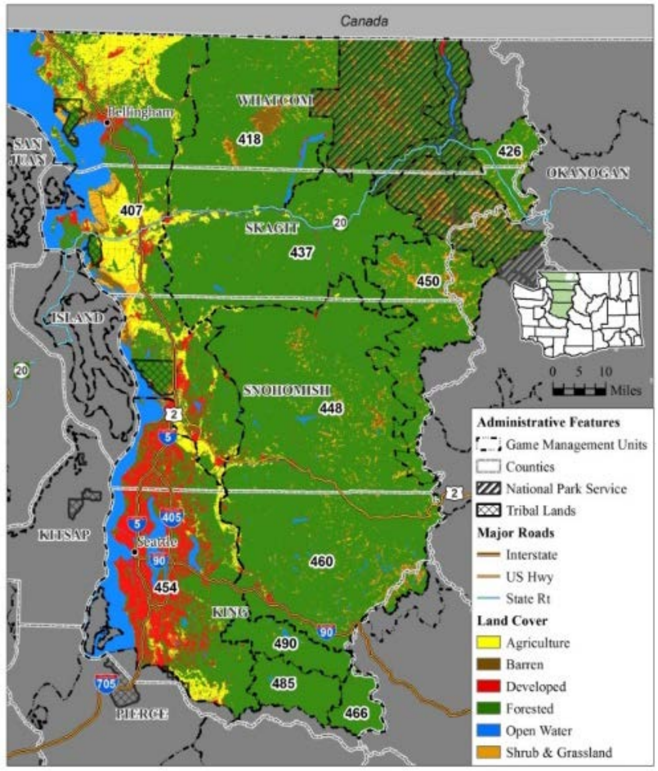

Figure 1. GMUs and generalized land cover types within the North Cascade Mountains BDMZ.

Management Guidelines and Objectives

The Department's objective within this BDMZ is to maintain a stable population, based on harvest estimates and other best available information. Additional management objectives include managing for a post-hunt population with a sex ratio of approximately 15 - 19 bucks:100 does.

Population Surveys

While no estimates of black-tailed deer abundance are available for populations within this zone, local managers believe populations are stable.

Hunting Seasons and Recreational Harvest

Harvest estimates for the past 10 years indicate a slow rise in harvest, commensurate with increases in hunter effort in the zone (Figures 2a and 2b). Overall population stability in the zone is further supported by consistent long-term harvest rates (kills/day; Figure 2b).

a) b)

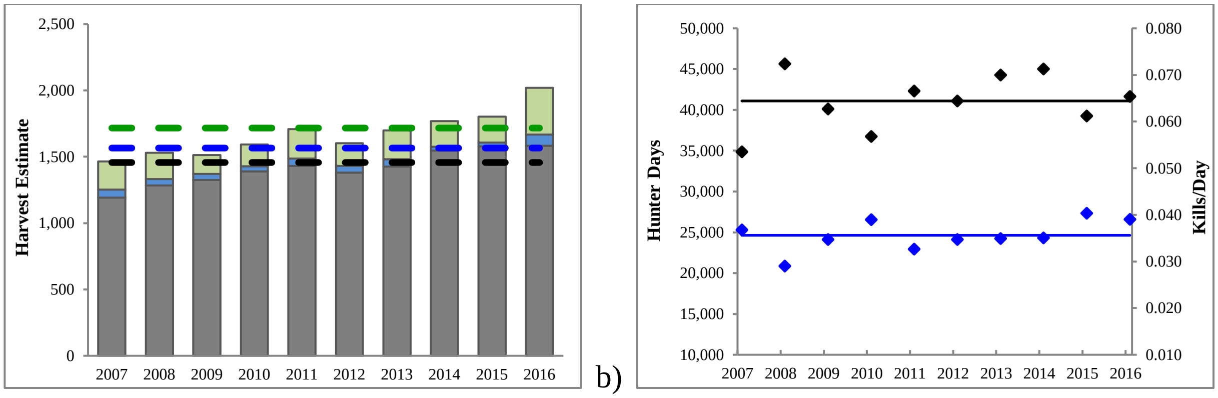

Figure 2. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (gray), General State + Permit State Harvest (blue), and General + Permit + Tribal Harvest (green); and (b) general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); in the North Cascade Mountains BDMZ, 2007–2016.

Survival and Mortality

No estimates of pregnancy or survival rates are available for black-tailed deer herds specific to the North Cascade Mountains BDMZ. However, vital rates of adult does are thought to be sufficient based on harvest trends. In general, estimates of annual survival of black-tailed bucks in Washington State have averaged 50% in forested landscapes with hunting identified as the primary source of mortality (Bender et al. 2004).

Cougars, black bears, bobcats, and coyotes occur within this BDMZ. Although the effects of predation on this population of black-tailed deer are unknown, deer harvest metrics have remained stable.

Habitat

Black-tailed deer habitat has been reduced in western Washington due to human encroachment, a reduction in timber harvest, and the natural progression of aging timber stands.

Road closures continue to increase and may buffer the influences of increased human disturbance throughout deer ranges in Whatcom and Skagit counties. Increased use of herbicides on private timber lands has been observed over the last three to five years. This practice had declined on state and federally owned lands over the last ten years and was considered to be of minimal concern when compared to historical herbicide use levels. It will be necessary to monitor this activity in order to evaluate actual impacts on local deer habitats.

In general, the long-term trend in GMU 454 deer habitat is for a continued decline. This is consistent with the housing and commercial development of habitat currently used by deer. However, deer are taking advantage of 1-10 acre tracts that are cleared for homes. These tracts still provide and may even improve deer forage availability, particularly during winter months, thereby improving overall body condition. This alone can lead to higher productivity and increased survival. Further, because many of these private lands are not open to general public, hunting mortality may be reduced. This can lead to increasing deer densities and may prompt some deer dispersal to surrounding habitats that are accessible to hunters in GMU 454.

The significant majority of GMU 460 is managed for timber production. Annual timber harvests create a mosaic of seral stages that can be beneficial to deer. Openings of 1 to 10 acres exist that provide a good forage base as well as riparian corridors protected by Washington Forest and Fish rules. The forest stands in these corridors provide older age classes that diversify habitat and help intercept snow during harsh winters. This may provide deer access to forage in these sites, serve as travel corridors, and provide added winter shelter. Apparent increases in timber harvesting in the Snoqualmie Forest portion of GMU 460 may provide an increased forage base for deer over time. However, the spraying of herbicides on private industrial timberlands is of concern to ungulate forage and is being examined via internal and external research.

In 2004, King County announced the purchase of development rights on the King County portion of the Snoqualmie Forest (app. 90,000 acres). This will protect a large area of commercial forest as open space and de facto deer habitat. Continued additional research into the relationship between current landscape conditions, herbicide application, deer populations, and habitat quality is needed and a focus. Deer habitat trends in GMU 466 and 485 are dependent on timber management and subsequent seral stage development that determines forage availability. There are several thousand acres of timberlands managed primarily for wood fiber production; with considerations for recreation, fish, and wildlife.

Human-Wildlife Interaction

Deer-related damage to private property has remained a problem throughout the mainland portions of north Region Four. No damage payments were made in this general area in 2016. Twelve damage permits were issued by WDFW Conflict Specialists in Skagit and Whatcom Counties resulting in a harvest of 6 deer. The majority of permits focused on lands engaged in the production of raspberry, strawberry, and blueberries. Four damage permits were issued in King and Snohomish Counties resulting in the harvest of 4 deer. Half of these permits were focused on lands involved in the production of nursery crops and half vegetable crops.

Management Concerns

Safety concerns associated with increased human development, combined with changing attitudes towards hunting have resulted in fewer areas open to hunters in the North Cascades BDMZ. Public hunting sites are limited in many of the North Cascade GMUs. We continue to look for opportunities to partner with private landowners to open more opportunity to hunters.

Management Conclusions

Limited information is available for black-tailed deer populations in the North Cascade Mountains BDMZ but populations are considered stable based upon harvest metrics.

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Olympic Peninsula Black-Tailed Deer Management Zone

BRYAN MURPHIE, Wildlife Biologist

Introduction

The Olympic Peninsula Black-tailed Deer Management Zone (BDMZ) is located in coastal northwestern Washington and consists of 16 Game Management Units (601, 602, 603, 607, 612, 615, 618, 621, 624, 627, 633, 636, 638, 642, 648, and 651; Figure 1).

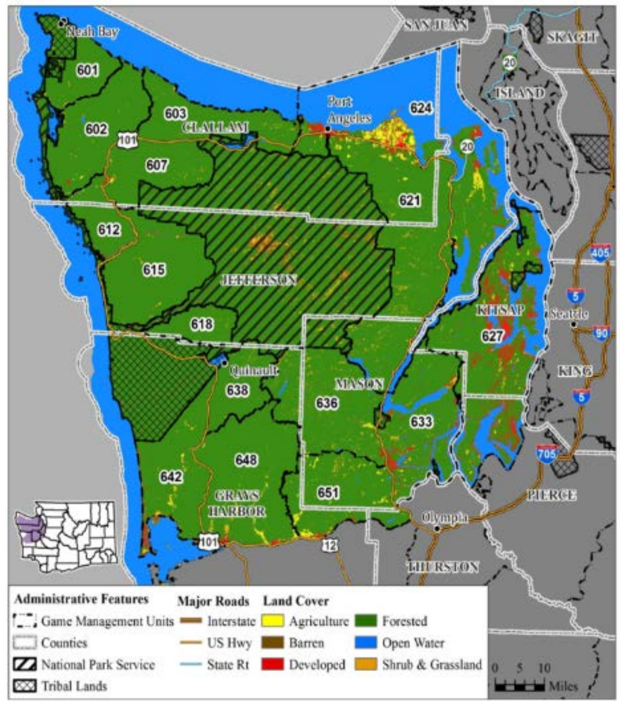

Figure 1. GMUs and generalized land cover types within the Olympic Peninsula BDMZ.

Management Guidelines and Objectives

Black-tailed deer (*Odocoileus hemionus columbianus*) in this BDMZ are managed to maintain productive populations, while providing for multiple uses; including recreational, educational, aesthetic, and a sustainable annual harvest (WDFW 2014). We attempt to achieve these objectives largely through manipulating hunting seasons. Hunting regulations for Olympic BDMZ Game Management Units (GMUs) generally provide liberal buck hunting and a conservative antlerless harvest.

Population Surveys

Monitoring is primarily achieved via mandatory hunter reporting. When funding is available we conduct composition surveys or more targeted projects related to specific GMUs or study areas. Tribal game harvest reports are compiled and published annually by the Northwest Indian Fisheries Commission (for data referred to in this document, see the NWIFC Big Game Harvest Reports for Western Washington Treaty Tribes; 2007-2016/17). Tribal research and monitoring also provides valuable information on black-tailed deer in this BDMZ, through work conducted both independently and in cooperation with WDFW. There were no surveys conducted during this review period.

Hunting Seasons and Recreational Harvest

The 2016 deer hunting season was similar to previous years in the Olympic BDMZ. Most general season hunting opportunity was any buck, while antlerless harvest was limited to certain weapon types and/or by special permit. Deer Area 6020 was open to the harvest of any deer during the general season for all weapon types. Additional hunting opportunity was provided in the Olympic BDMZ during the 2016 season with 540 special permits offered through the Department's special permit system; of these, 317 hunters reported killing 110 deer in 2016.

Estimates from harvest reports indicate a recent increasing trend in harvest and kills/day, while hunter effort has been trending down (Figure 2). On average, Tribal harvest accounts for 10% of the deer harvest in the Olympic BDMZ.

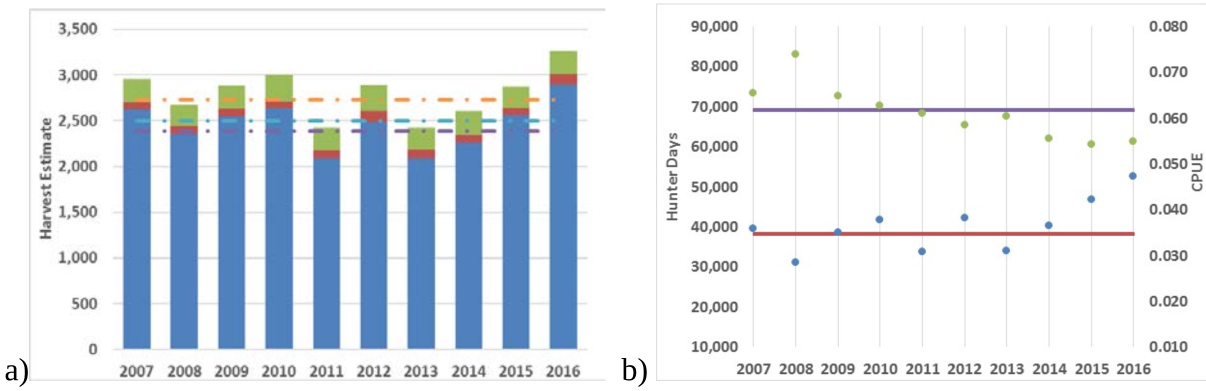

Figure 2. Harvest estimates and 10-yr means (dashed lines) for (a) General State Harvest (purple), General State + Permit State Harvest (blue), and General + Permit + Tribal Harvest (orange); and (b) general season estimates and 10-yr mean for hunter days (purple) and kills/day (red); in the Olympic Peninsula BDMZ, 2007–2016.

Survival and Mortality

Survival and mortality have been studied in some GMUs and inferences can be made from these data in a general sense regarding black-tailed deer in the Olympic BDMZ.

The Makah Tribe estimated adult doe survival rates in the Hoko (GMU 601) ranged from 79-87% and average annual fawn survival to be 33% (95% CI = 24-43) (McCoy et al. 2014). Predation accounted for the majority of all fawn mortality in the Hoko in this study, but fawn survival was strongly influenced by the presence of hair-loss syndrome (HLS). Fawns with HLS had a lower over-winter survival probability than fawns without HLS (57% with HLS versus 80% without HLS) (McCoy et al. 2014). The loss of hair directly affects their ability to maintain body temperature. They are also affected indirectly through an alteration of behavior. Afflicted deer will spend less time feeding and more time scratching or grooming (Murphie 2010). Modeling black-tail population trends assuming both with and without HLS present, indicated that HLS, coupled with predation, was likely limiting the deer population in the Hoko (McCoy et al. 2014). This was the first study to illustrate how HLS may be negatively influencing black-tailed deer populations, particularly in the coastal habitats on the Olympic Peninsula of Washington.

The Department initiated a study of the effects of forest management practices on doe survival and reproduction in 2009. Data from this project has not been analyzed yet, however preliminary observations of monitored deer in the Olympic BDMZ suggests predation was a common cause of mortality among deer during this study. This project is scheduled to end in 2017 with data analysis and reporting to follow.

In 2014, the Elwha Tribe initiated studies of fawn and buck survival and causes of mortality in the Pysht (GMU 603). Their projects are anticipated to last until 2017 (Sager-Fradkin, personal communication).

Habitat

Black-tailed deer in the Olympic BDMZ have access to a wide range of habitat types, from alpine meadows in the Olympic Mountains, to coastal marine estuaries along the outer coast and inland marine waters. Black-tailed deer have a selective foraging strategy preferring to consume the most nutritious plants (Nelson et al. 2008). They consume a variety of browse including woody shrubs, forbs, lichens, and some grasses. Woody shrubs and forbs are typically more abundant in younger, more recently disturbed sites (<20 years old) with less canopy cover than sites in mid to late-seral stages that are created predominately through active logging. Units heavily logged years ago with vast areas of single-aged stands in the mid to late-seral stage of forest succession are the least productive for ungulate forage. Active timber harvest in some GMUs continues to create early seral habitat that include a diverse mix of stand-ages and provides the most benefit to black-tailed deer.

Some common plants present in black-tailed deer diets include, vine maple (*Acer circinatum*), red alder (*Alnus rubra*), cascara (*Rhamnus purshiana*), Himalayan blackberry (*Rubus discolor*), evergreen blackberry (*Rubus laciniatus*), salmonberry (*Rubus spectabilis*), trailing blackberry (*Rubus ursinus*), elderberry (*Sambucus spp.*), red huckleberry (*Vaccinium parvifolium*), fireweed (*Epilobium angustifolium*), willowherb (*Epilobium watsonii*), hairy cat's ear (*Hypocharis radicata*), big deervetch (*Lotus crassifolius*), oxalis (*Oxalis oregana*), and violets (*viola spp.*) (Nelson et al. 2008, Ulapa 2015).

Research

The effects of forest management strategies, particularly the use of herbicides and decreased burning are poorly understood, but may negatively influence ungulate forage and ultimately deer abundance. Two studies were recently initiated to examine these effects, as they relate to black-tailed deer.

In 2009, the Department initiated a study of the effects of forest management practices on black-tailed deer reproduction and population growth. For this study, adult female deer are captured and fitted with GPS collars to determine their habitat use. Their fawns are subsequently captured and monitored for survival. This study is taking place at 8 locales, 4 on private commercial timberlands and 4 on land managed by the Washington Department of Natural Resources. To date, a total of 235 fawns of 212 does have been captured for monitoring. In the Olympic Deer Management Zone, a total of 125 fawns of 80 does have been captured in GMUs 601, 621, 627, 633, and 651 and fitted with GPS and VHF tracking collars for this study. This project is scheduled to end in 2017 with data analysis and reporting to follow.

Ulapa (2015) initiated a project studying how timber management practices influence the availability and quality of forage for black-tailed deer. She found that the use of herbicides reduced the amount and quality of forage available to deer during the first three years following treatment. However, overall forage was still more abundant in these early seral stands than those 14 or more years old. Funding and in-kind contributions were provided by WDFW, the Muckleshoot Tribe, National Council for Air and Steam Improvement, and Weyerhaeuser.

WDFW has initiated a new project with the intent to generate estimates of black-tailed deer abundance or population trends at the GMU level. The field component of this effort began in May 2017 and is expected to last at least 5 years. GPS collars are being deployed on a sample of bucks distributed across western Washington with an objective of maintaining a sample of up to 50 bucks during each year of the 5-year study. Monitoring of these bucks will provide information on buck survival, causes of mortality, and vulnerability to harvest. Additionally, these collars will automatically record a position fix every thirteen hours, providing a fairly detailed account of the area used by these collared bucks.

Human-Wildlife Interaction

In the Olympic BDMZ, most of the deer conflict issues occur in urban areas where natural mortality is considered low. Management actions generally revolve around liberalizing hunting seasons, or adding second deer permits in attempt to increase harvest. These efforts often have limited value due to local shooting ordinances that can reduce deer hunting activity despite liberalized seasons. In response to damage/conflict issues, landowners can work cooperatively with WDFW through Damage Prevention Cooperative Agreements (DPCAs), which are plans designed to proactively prevent, minimize, or correct damage caused by wildlife to crops or livestock and may include both lethal and nonlethal measures.

In response to damage/conflict issues, liberal deer hunting seasons have been established in GMUs 624, 627, and 633. Forty, second-deer permits were available in the portion of GMU 624 designated as Deer Area 6020, but participation and success were quite low; 8 hunters reported harvesting 3 does. General season antlerless hunting is also provided during the general season for all three weapon types in Deer Area 6020. Although general season harvest is not reported at the Deer Area level, the combined general season antlerless harvest in GMU 624 was reported to be 56 in 2016 and the 10-year average is 51. There were 5 DPCAs within the Olympic BDMZ in 2016/17, 22 kill permits were issued, and 7 deer were harvested.

Management Concerns

Our primary objective for black-tailed deer management in this BDMZ is to maintain productive populations, while providing for multiple uses. Currently, WDFW does not use formal estimates or indices of population size to monitor black-tail deer populations. Instead, trends in harvest, hunter success, and catch per unit effort are used as surrogates. Provided harvest and participation are robust, these statistics can provide a reasonable indicator of population trend. However, deer harvest can be influenced by factors other than density. Changes to hunting regulations and a recent trend of timber companies restricting or limiting access to hunt, make it difficult to compare harvest estimates across years. WDFW is currently evaluating new approaches to monitor black-tailed deer populations that are independent of harvest data.

Management Conclusions

Based on harvest data, black-tailed deer populations in the Olympic Peninsula BDMZ are likely within management objectives, with stable populations where habitat allows.

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South Cascade Mountain Black-Tailed Deer Management Zone

NICHOLLE STEPHENS, Wildlife Biologist
ERIC HOLMAN, Wildlife Biologist

Introduction

The South Cascade Mountains Black-tailed Deer Management Zone (BDMZ) is located in the southwest portion of the Cascade Mountains and consists of 22 GMUs (503, 505, 510, 513, 516, 520, 522, 524, 550, 554, 556, 560, 564, 568, 572, 574, 578, 652, 653, 654, 666, and 667; Figure 1).

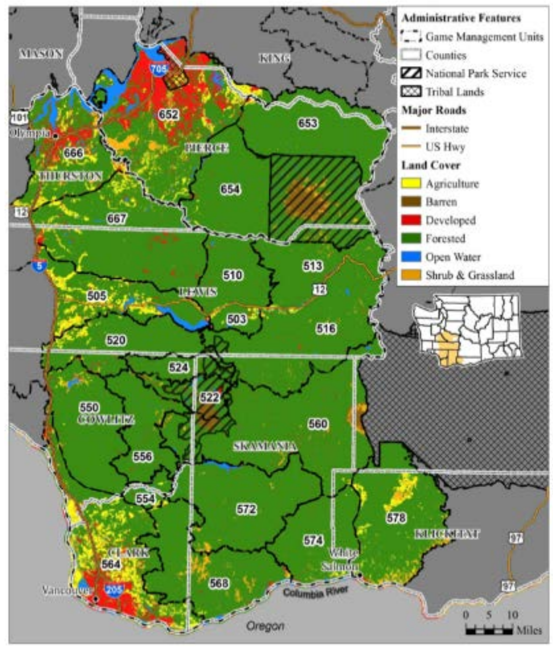

Figure 1. GMUs and generalized land cover types within the South Cascade Mountains BDMZ.

Management Guidelines and Objectives

The Department's objective within this BDMZ is to maintain a stable population based on field surveys and harvest estimates and a post-hunt population with a sex ratio of approximately 15 - 19 bucks:100 does.

Population Surveys

Estimates of black-tailed deer abundance and post-season ratios are not available for all populations within South Cascade Mountains BDMZ, but deer are generally more abundant at lower elevations in the zone. Pre-season buck:doe ratios can provide some indication of harvest intensity from the previous year in instances where post-hunt information is not possible. Based on limited data collected between 2005 and 2009 in GMU 667, in the northeast portion of the zone, the mean pre-hunt buck:doe ratio was 21:100 (90% CI = 16-26, n = 476). Survey data collected during 2014 in GMU 578, in the southeast portion of the zone, indicate a post-season buck:doe ratio of 14:100 (90% CI =7-21, n=172).

Late summer deer productivity surveys were first established in 1995. In 2015, deer observations were conducted throughout the South Cascades from August 15th to September 30th. Personnel from WDFW's Wildlife Management Program along with a variety of volunteers from within WDFW, the U.S. Forest Service, private timber companies, and interested individuals recorded observation data for all deer encountered during field activities or recreational outings. In addition to these incidental deer observations, multiple night deer surveys (spotlighting) were conducted by a combination of Wildlife Management Staff and volunteers. Deer group sizes and composition were determined. All deer were classified as bucks, does, fawns, or unknowns. However, only those groups of deer in which all individuals were classified were included in statistical analysis to help eliminate observer bias.

During the 2015 productivity surveys, a total of 287 deer were classified in the South Cascade Mountains BDMZ, excluding GMUs 652, 653, 654, 666, and 667. The fawn to doe ratio for these surveys was 56:100 (90% CI=44-67, n=287). Fifty-six fawns per 100 does is slightly higher than the historical average of 52:100 for this area. The surveys are conducted after the peak of neo-natal mortality, so these values are closer representatives of recruitment than fecundity.

Hunting Seasons and Recreational Harvest

Hunting seasons in the South Cascade Mountains BDMZ vary by GMU. Most hunting is structured to focus harvest on bucks and hunting is allowed on a general season basis with no antler-restrictions in place. An exception is GMU 578 which is managed with a 3-point or larger antler restriction. In many GMUs archers are allowed to harvest antlerless deer during general seasons. For those hunting with modern firearms, the opportunity to harvest antlerless deer is most commonly restricted to those selected in special permit drawings. Harvest estimates have remained stable over the past 10 years with 2016 seeing the highest harvest since 2007 (Figure 2a). While hunter effort has declined steadily since 2008, the catch-per-unit effort (kills/hunter-day) has increased slightly over the past 10 years (Figure 2b).

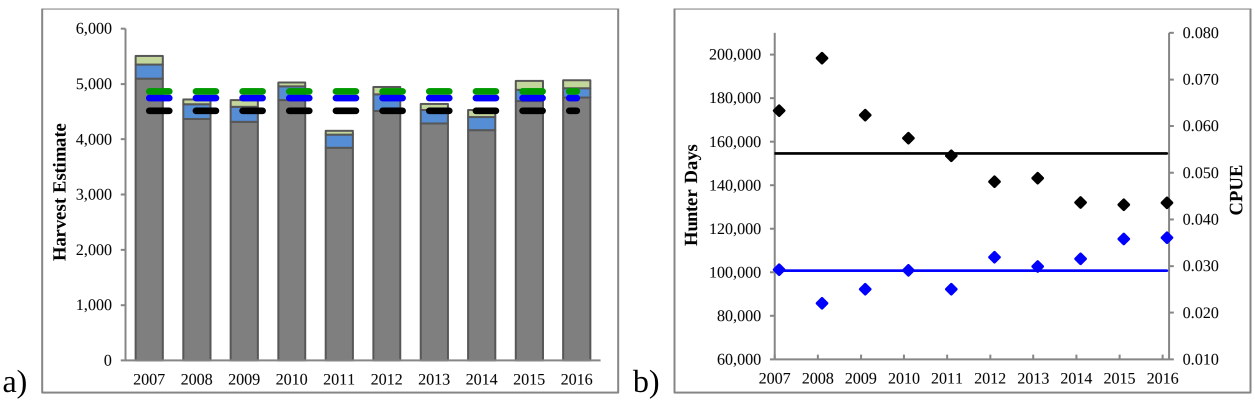

Figure 2. Harvest estimates and 10-yr means (dashed lines) for General State Harvest (gray), General State + Permit State Harvest (blue), and General + Permit + Reported Tribal Harvest (green); a), and general season estimates and 10-yr mean for hunter days (black) and catch-per-unit-effort (blue); b) in the South Cascade Mountains BDMZ, 2007–2016.

Survival and Mortality

Common predator species in the South Cascade Mountains BDMZ include cougar, bobcat, black bear, and coyote. At this time there are no documented gray wolf packs in the herd area (WDFW et al. 2017). Previous estimates of annual survival rates for black-tailed deer bucks in Washington have indicated a mean of 0.50 in forested landscapes, with mortalities primarily due to legal harvest (McCorquodale 1999, Bender et al. 2004). In more urbanized habitat, the annual buck survival rate is closer to 0.86 and mortalities are generally not the result of harvest (Bender et al. 2004). Preliminary estimates of adult doe survival during 2013 in GMU 653, from a study being conducted by the Muckleshoot Tribe in the South Cascade Mountains BDMZ, indicate a mean annual survival rate of 0.85 (D. Vales, personal communication).

Habitat

Habitat in the South Cascade Mountains DBMZ is roughly divided into thirds with U.S. Forest Service managed lands in the east; Industrial and State (DNR) managed forestlands in the middle; and urban, sub-urban, rural and agricultural lands in the western portion of the Zone. Increasing urbanization in the lower elevation portions of the South Cascade Mountains BDMZ has resulted in loss of quality habitat for black-tailed deer. This situation is most acute in the urbanized areas of Pierce, Thurston, and Clark Counties.

The industrial forestlands consist of a mosaic of clearcuts, relatively open young regeneration stands, dense second growth stands of timber, and stream buffers lined with second-growth forest. Industrial timber management practices benefit deer by increasing the quantity of early seral habitats and the subsequent forage base. While beneficial to deer, management practices are not conducted to purposefully increase or improve habitat. Additionally, intensive forest management practices including the planting of dense stands of fast-growing conifer seedlings and the application of herbicides during re-establishment of the timber stand may also be affecting overall productivity due to reduced forage quality and availability. These effects work in tandem by reducing the amount of favorable plants available as forage in the early term and completion of forest canopy closure (typically approximately age 12), far earlier than would occur in a naturally regenerated stand. The magnitude of those effects is influenced by site specific types of post-timber harvest treatments and plant compositions; and the number of years since timber harvest. A commonality among all of these varying factors is that the best quality and most quantity of favorable forage seems to occur approximately 3 to 14 years after timber harvest whether herbicide treatments are applied or not. However the differences between available, favorable forage in that time period for treated and untreated stands can still be substantial. A full treatise on the complexity of these habitat interactions is beyond the scope of this report and we refer the reader to Ulappa (2015) and Geary et al. (2012) for a more comprehensive understanding of this research.

In contrast, very limited timber harvest on federal forests in the last three decades has led to a generally declining trend in habitat quality for deer.

Human-Wildlife Interaction

Deer damage reports occur at low levels in the South Cascade Mountains BDMZ. Wildlife Conflict specialists work closely with producers by developing Damage Prevention Cooperative Agreements (DPCAs) which identify a plan to reduce the amount of damage incurred to agricultural crops using non-lethal and lethal methods. In the South Cascade Mountains BDMZ in 2016-2017 there was only one DPCA in place, however, complaints of damage to home gardens and ornamental plants has been increasing in some parts of the South Cascades BDMZ. Conflict specialists and landowners use a variety of non-lethal means to discourage deer including: temporary electrified fladry fencing, permanent fencing, noisemakers (birdbangers, critter gitters, propane cannons), hazing and herding, scarecrow-like electronic devices, and odor-based repellents such as Plantskyyd. Damage on commercial agriculture production over the past year has occurred in berry fields, Christmas trees plots, and non-commercial gardens.

In many circumstances, the Department addresses damage complaints by working with landowners to increase access to their property during hunting seasons so that hunters can help to resolve the damage. Master Hunters are sometimes deployed to hunt outside of established hunting seasons to directly address damage issues.

Research

From 2009-17 the Department conducted a study of the effects of forest management practices on black-tailed deer ecology. For this study, adult female deer were captured and fitted with GPS collars to determine their space use. Their fawns were subsequently captured and monitored for survival. This study took place at 8 locales; 4 on commercial timberlands and 4 on state land managed by the Washington Department of Natural Resources. A total of 235 fawns of 212 does were captured for monitoring in the entire western Washington study area. In the South Cascades Mountains BDMZ, a total of 88 fawns of 82 does were captured in GMUs 550, 568, and 667 and fitted with GPS or VHF tracking collars for this study.

WDFW initiated a new project in 2017 with the intent to generate estimates of black-tailed deer abundance or population trends at the GMU level. The field component of this effort began in May 2017 and is expected to last at least 5 years. GPS collars are being deployed on a sample of bucks distributed across western Washington with an objective of maintaining a sample of up to 50 bucks during each year of the 5-year study. Monitoring of these bucks will provide information on buck survival, causes of mortality, and vulnerability to harvest. Additionally, these collars will automatically record a position fix every thirteen hours, providing a detailed account of the area used by these collared bucks.

Management Concerns

Habitat Conditions on Federally Managed Lands

Habitat conditions on federally managed lands within the South Cascades Zone are of concern. Large scale fire, timber harvest, disease or other succession re-setting events are largely absent from the federal lands. The resulting landscape is dominated by closed-canopy forest, much of which was harvested from roughly 1950-1990 and subsequently replanted with dense Douglas fir trees. These stands provide little in the way of ungulate forage and lack the diversity and forage resources of either older or younger forests. In recent years, USFS has conducted limited forest thinning and created forest openings to provide more robust forage resources for deer and elk. While beneficial, the scale of these efforts is minimal when compared to the size of the landscape. WDFW should continue to work with USFS to encourage more of this proactive management.

Fee-Only Hunting Access Restrictions

In 2013 and 2014, the largest industrial forestland owner within the South Cascades Zone implemented a fee-only access system for hunting and other recreation on their lands. This system limits the number of individuals allowed access to these lands and has continued in the years that have followed. This has primarily affected GMUs 520, 524, 550, 556, 568 and 667. The ramifications of this limited access to deer hunting opportunity are difficult to quantify as the landowners don’t own entire Game Management Units, some individuals elect to pay the access fee, and some individuals elect to hunt in another area, and some may decide to quit hunting. Up to this point, the total deer harvest has remained similar, on average, in these GMUs before and after the change in recreational access opportunities. The number of people hunting in these

GMUs, however, has decreased by approximately one-third across the six GMUs mentioned above.

Hair Loss Syndrome

"Hair loss syndrome" (HLS) of black-tailed deer was first described in Washington in 1995 and reports came from GMUs 501, 504, 506, 530, in 1996. The condition is caused by a heavy infestation of a Eurasian louse of poorly defined taxonomic status in the genus *Damalinia* (*Cervicola*) sp. The normal hosts of this louse are non-native deer and antelope, which are not seriously affected by the lice.

When black-tailed deer become infested with this foreign louse, they tend to develop a hypersensitivity (severe allergic) reaction to the lice. The reaction causes irritation of the skin and excessive grooming by the deer. Eventually, this excessive grooming leads to loss of the guard hairs, leaving yellow or white patches along the sides. Infestations are heaviest during late winter and early spring and many affected deer, especially fawns, die during this time. The geographical distribution of HLS has steadily expanded since its first appearance and now affects black-tailed deer throughout their range in western Washington.

Over a three-year period, Bender and Hall (2004) reported rates of "hair-slip syndrome" in fawns as 46-74% from 1999-2001. They concluded that HLS was not significant in increasing fawn winter mortality and called for future research to better determine effects HLS has on black-tailed deer populations. Continued study since then has largely determined that HLS in black-tailed deer is generally not additive to winter mortality. However, HLS may increase predation risk due to poor overall body condition. Poor body condition is attributed to a combination of potential factors including poor forage, low birth weight, timing of birth; as well as afflictions including, but not limited to HLS.

Many HLS affected individuals tend to rebound in condition and health if they survive the winter. Ultimately, HLS is very likely only a portion of the regular annual mortality factors acting synergistically in given local populations.

WDFW provides more information regarding hair loss syndrome at our Wildlife Health website: http://wdfw.wa.gov/conservation/health/hair_loss/index.html

In addition to reports of HLS, WDFW annually receives reports of animals with slipper foot, deer warts, and lethargy/unknown illness. While these afflictions can affect the behavior and survival of individual deer, they do not pose a population concern.

Management Conclusions

Black-tailed deer populations in the South Cascade Mountains BDMZ are currently within management objective and harvest data indicates a stable population. In spite of the apparent stability in the population, habitat related concerns such as the lack of early seral forests on the federally managed lands and direct loss of habitat to urbanization remain a concern. Additionally, the progression towards limited, fee-based hunting access programs, and hair loss syndrome complicate deer management in the Zone.

The inability to quantify and monitor the deer population makes arriving at management conclusions or decisions difficult. Development of a method to monitor populations would greatly aid in the sound management of the black-tailed deer resource.

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Willapa Hills Black-Tailed Deer Management Zone

ANTHONY NOVACK, Wildlife Biologist

Introduction

The Willapa Hills Black-tailed Deer Management Zone (BDMZ) is located in the southwest corner of Washington and includes the southern coast of Washington. The total area consists of 12 GMUs (501, 504, 506, 530, 658, 660, 663, 672, 673, 681, 684, and 699 (Figure 1).

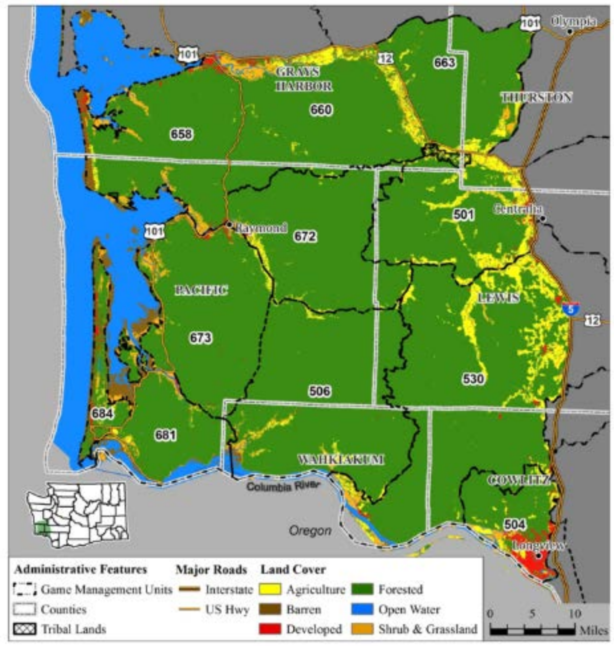

Figure 1. GMUs and generalized land cover types within the Willapa Hills BDMZ.

Management Guidelines and Objectives

The Department's objective within this BDMZ is to maintain stable populations based on field surveys and harvest estimates. Additional management objectives include a post-hunt sex ratio of approximately 15 - 19 bucks:100 does.

Population Surveys

Conventional surveys are not possible due to the dense forest structure in this zone. Populations are currently monitored using harvest data. Tribal game harvest reports are compiled and published annually by the Northwest Indian Fisheries Commission (for data referred to in this document, see the NWIFC Big Game Harvest Reports for Western Washington Treaty Tribes; 2007-2016/17

Hunting Seasons and Recreational Harvest

Estimates from harvest reports for the past decade indicate harvest has been stable (Figure 2a). Hunter effort has declined in recent years (Figure 2b) while kills/day (e.g., Catch per Unit Effort or CPUE) has increased slightly.

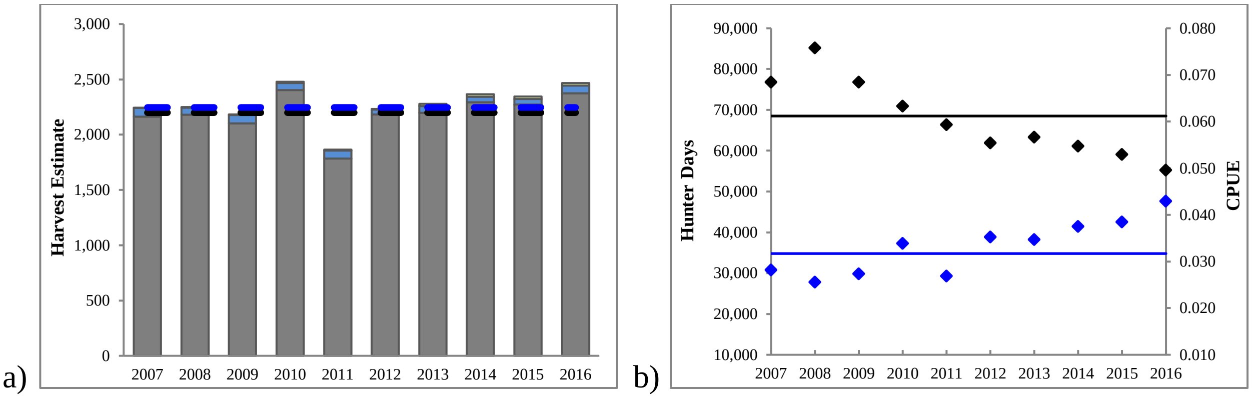

Figure 2. Harvest estimates and 10-yr means (dashed lines) for General State Harvest (gray), General State + Permit State Harvest (blue), and General + Permit + Tribal Harvest (green); a), and general season estimates and 10-yr mean for hunter days (black) and kills/day (blue); b) in the Willapa Hills BDMZ, 2007-2016.

The majority of deer harvested in 2016 were bucks. About 10% of the total harvest (243 out of 2,461 animals) were antlerless deer. Any buck seasons are in effect for all GMUs open during the modern firearm seasons. The majority of GMUs are open for any buck during muzzleloader season with the exception of GMU 684 (any deer) and 699 (no muzzleloader season). The majority of units are open for any deer during archery seasons. GMUs 506, 530, 681 and 699 are limited to any buck during archery seasons. Limited permit opportunities are available for both antlerless deer and bucks throughout the Willapa Hills BDMZ.

Survival and Mortality

No estimates of pregnancy, fetal, or survival rates are available for black-tailed deer in the Willapa Hills BDMZ. Sources of mortality for deer in this BDMZ include hunting, disease, malnutrition, poaching, deer-vehicle collisions, and predation. Common predator species in the Willapa Hills BDMZ include cougar, bobcat, black bear, and coyote. Previous estimates of annual survival rate for black-tailed deer bucks in western Washington revealed a mean survival rate of 0.50 in forested landscapes, with mortalities primarily due to legal harvest (McCorquodale 1999, Bender et al. 2004). Ongoing research will provide some additional data on survival and mortality of female deer and fawns within the BDMZ (see Research section).

Habitat

The majority of forestland in the Willapa BDMZ is managed to maximize revenue from timber production. Both the privately owned industrial forestlands and, a large portion of the publicly owned lands, consist of a mosaic of clearcuts, relatively open young regeneration stands, dense second growth stands of timber, and stream buffers lined with second-growth forest. This mosaic changes on a yearly basis due to ongoing timber cutting operations. Although timber harvest is generally beneficial to deer, timber management practices are not intended to improve deer habitat.

The timber management practices implemented within the Willapa Hills BDMZ is broadly benefiting deer by increasing the quantity of early seral habitats which improves the forage base. Standard forest management practices include; planting dense stands of fast-growing conifer seedlings and, applying herbicides during re-establishment to reduce competitive plant growth. Ulappa (2015) found that herbicide use decreased the amount of understory biomass useable for foraging deer and decreased their daily digestible energy intake, especially in the first 3 years of stand establishment. Despite the widespread use of herbicide, the early seral habitats will still provide more forage and higher daily energy intake for deer than closed canopy stands. Canopy closure for intensely managed forest typically occurs at around 12 years post-planting while more naturally regenerated stands can continue to produce improved levels of forage through the first 30 years. Pre-commercial and commercial thinning of second-growth stands can greatly improve the available deer forage until canopy closure reoccurs.

Human-Wildlife Interaction

Deer conflicts with commercial agricultural activities occur at low levels in the Willapa Hills BDMZ. Wildlife Conflict specialists work closely with producers by developing Damage Prevention Cooperative Agreements (DPCAs) which identify a plan to reduce the amount of damage incurred to agricultural crops using non-lethal and lethal methods. These conflict specialists and landowners use a variety of non-lethal means to discourage deer which may include: electrified fladry fencing, noisemakers, hazing and herding, scarecrow-like electronic devices, and odor-based repellents such as Plantskyyd. The total number of DPCAs in the Region related to deer for 2016-2017 was nineteen with a resulting harvest of 9 deer from 61 permits (Table 1). Deer within this zone primarily cause damage to commercially produced cranberries, wine grapes, blueberries, orchards, and non-commercial garden and ornamental plants.

Table 1. Sum of Deer related Damage Prevention and Control Agreements with resulting deer permits issued and total harvest by GMU in the Willapa Hills BDMZ, 2016-17.

Game Management Unit	DPCA's	Permits Issued	Deer Removed
530	1	1	0
658	8	25	4
672	1	1	0
673	1	1	0
684	8	33	5
Sum	**19**	**61**	**9**

In many circumstances, WDFW addresses damage complaints by working with landowners to increase access to their property during hunting seasons so that hunters can help to resolve the damage. Certified Master Hunters may be deployed to harvest animals outside of the regularly established hunting seasons.

Research

In 2009, WDFW initiated a study of black-tailed deer throughout western Washington to determine black-tailed deer fawn production and survival under a variety of forest management scenarios and conditions. Does were captured in eight different clusters across western Washington with half of those clusters predominately located on private industrial timber land, while the other half were located on Washington Department of Natural Resources (DNR) lands. Black-tailed deer does were captured in late winter or spring and fitted with GPS tracking collars. A vaginal implant transmitter (VIT) was inserted when does were initially captured. During the birthing season, fawns of the collared does were captured and fitted with VHF transmitters to monitor their survival.

A single cluster of does was located within the Willapa Hills BDMZ on state owned lands within Capitol Forest (GMU 663). At the start of 2015, eleven does were being monitored within Capitol Forest. This study ended in 2017.

WDFW initiated a new project in 2017 with the intent to generate estimates of black-tailed deer abundance or population trends at the GMU level. The field component of this effort began in May 2017 and is expected to last at least 5 years. GPS collars are being deployed on a sample of bucks distributed across western Washington with an objective of maintaining a sample of up to 50 bucks during each year of the 5-year study. Monitoring of these bucks will provide information on buck survival, causes of mortality, and vulnerability to harvest. Additionally, these collars will automatically record a position fix every thirteen hours, providing a fairly detailed account of the area used by these collared bucks.

Management Concerns

Hunter Access

WDFW actively works with timber companies to maintain hunting access. The vast majority of lands that provide deer hunting opportunities in the Willapa Hills BDMZ are privately owned industrial timberlands. There is an increasing trend among the timber companies to restrict public access or, require an access permit to hunt or recreate on their lands. Implementation of fee for access programs has reduced hunter participation in the Willapa Hills BDMZ. In some instances, the number of access permits issued is lower than previous hunter participation rates. For other areas, the cost of the permit is considered too much of an added financial burden for hunters. Although the addition of access permits has caused the number of hunters to decline in some GMUs, hunter success has sometimes increased as fewer hunters are afield. Furthermore, access may also be restricted due to the risk of fire which predominately affects early season archery and muzzleloader hunters.

Hair Loss Syndrome

"Hair loss syndrome" (HLS) of black-tailed deer was first described in Washington in 1995 and reports came from GMU's 501, 504, 506, 530, in 1996. The condition is caused by a heavy infestation with a Eurasian louse of poorly defined taxonomic status in the genus *Damalinia* (*Cervicola*) sp. The normal hosts of this louse are non-native deer and antelope, which are not seriously affected by the lice.

When black-tailed deer become infested with this foreign louse, they tend to develop a hypersensitivity (severe allergic) reaction to the lice. The reaction causes irritation of the skin and excessive grooming by the deer. Eventually, this excessive grooming leads to loss of the guard hairs, leaving yellow or white patches along the sides. Infestations are heaviest during late winter and early spring, and many affected deer, especially fawns, die during this time. The geographical distribution of HLS has steadily expanded since its first appearance and now affects black-tailed deer throughout their range in western Washington.

Over a three-year period Bender and Hall (2004) reported rates of "hair-slip syndrome" in fawns as 46-74% from 1999-2001. They concluded that HLS was not significant in increasing fawn winter mortality and called for future research to better determine effects HLS has on black-tailed deer populations. Continued study since then has largely determined that HLS in black-tailed deer is generally not additive to winter mortality. However, HLS may increase predation risk due to poor overall body condition. Poor body condition is attributed to a combination of potential factors including poor forage, low birth weight, timing of birth; as well as afflictions including, but not limited to, HLS.

Many HLS affected individuals tend to rebound in condition and health if they survive the winter Ultimately, HLS is very likely only a portion of the regular annual mortality factors acting synergistically in given local populations.

WDFW provides more information regarding hair loss syndrome at our Wildlife Health website: http://wdfw.wa.gov/conservation/health/hair_loss/index.html

Management Conclusions

Black-tailed deer populations in the Willapa Hills BDMZ appear to be within management objective based on a harvest trend that indicates a stable population. Habitat conditions are expected to support that trend into the near future.

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Elk

Blue Mountains Elk Herd

PAUL WIK, Wildlife Biologist
MARK VEKASY, Wildlife Biologist

Introduction

The Blue Mountains elk herd area is located in southeast Washington and consists of 13 GMUs, including 145 (Mayview), 149 (Prescott), 154 (Blue Creek), 157 (Mill Creek Watershed), 162 (Dayton), 163 (Marengo), 166 (Tucannon), 169 (Wenaha), 172 (Mountain View), 175 (Lick Creek), 178 (Peola), 181 (Couse), and 186 (Grande Ronde) (Figure 1). The landscape is dominated by agricultural land in the prairie and foothill regions, with interspersed grassland areas and brushy draws. The most common habitat in the Blue Mountains is characterized by second growth forests consisting primarily of Ponderosa pine, Douglas fir, grand fir, and subalpine fir. The Blue Mountains have been characterized as a high plateau dissected by deep draws and canyons carved by numerous creeks and rivers.

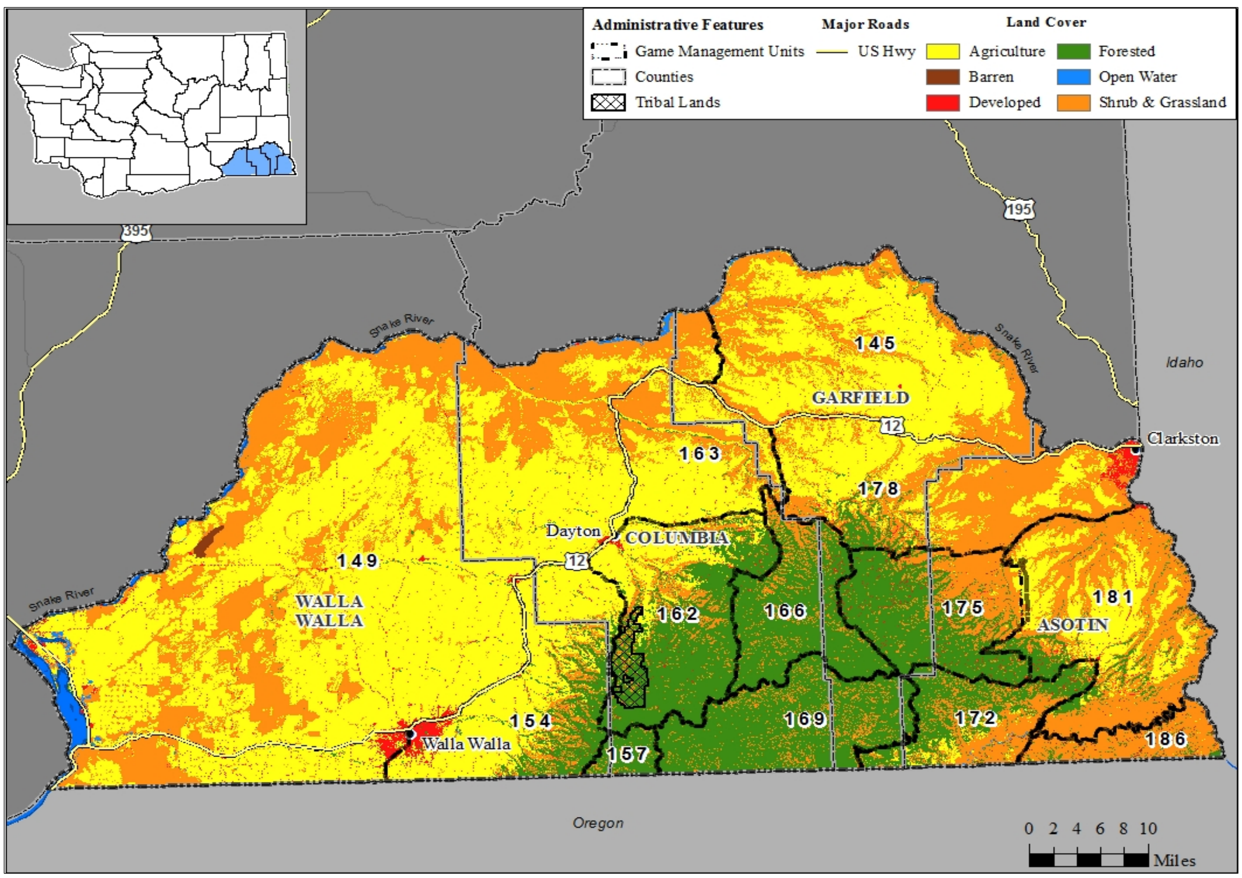

Figure 1. Dominant land use cover types within the 13 game management units that comprise the Blue Mountains elk herd area.

Management Guidelines and Objectives

The Department is currently in the process of updating the Blue Mountains Elk Herd Plan (WDFW 2001), which includes a population objective of maintaining herd size during spring between 4,950 and 6,050 elk. Additional objectives include maintaining a post-hunt population with a bull:cow ratio of 22–28 bulls:100 cows and maintaining an annual survival rate of 0.50 for bulls when bull mortality is monitored (WDFW 2014).

Population Surveys

The Department monitors population status by conducting aerial surveys in the early spring and uses a sightability model developed for elk in Idaho (Unsworth et al. 1999) to generate estimates of elk abundance, age ratios, and sex ratios. In the early spring 2017, the Department estimated total elk abundance to be 4,396 elk (90% CI 4,231–4,561), which is below the management objective of 4,950–6,050 elk. Abundance estimates indicate the Blue Mountains elk herd has been at objective since 2009, but dropped substantially below in 2017 (Figure 2). The estimated bull:cow ratio in spring 2017 was 33 bulls:100 cows, which is above the management objective of 22–28 bulls:100 cows (Figure 3), and the estimated calf:cow ratio in spring 2017 was 18 calves:100 cows. Estimated calf:cow ratios were consistently near 30 calves:100 cows, 2006–2016, and dropped to one of the lowest recorded levels in 2017 (Figure 4).

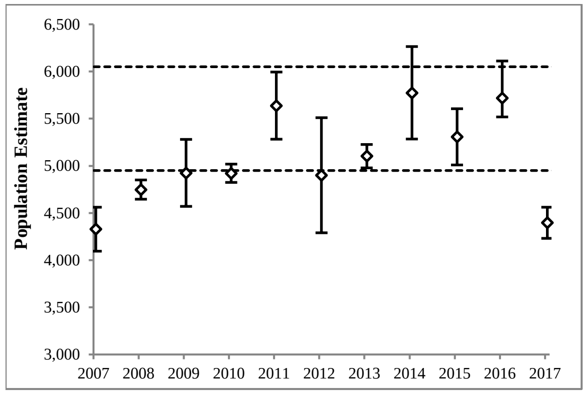

Figure 2. Sightability corrected estimates of total elk abundance with associated 90% confidence intervals in the Blue Mountains elk herd area. 2007–2017. The dashed lines represent management objectives for total elk abundance (4,950–6,050 elk).

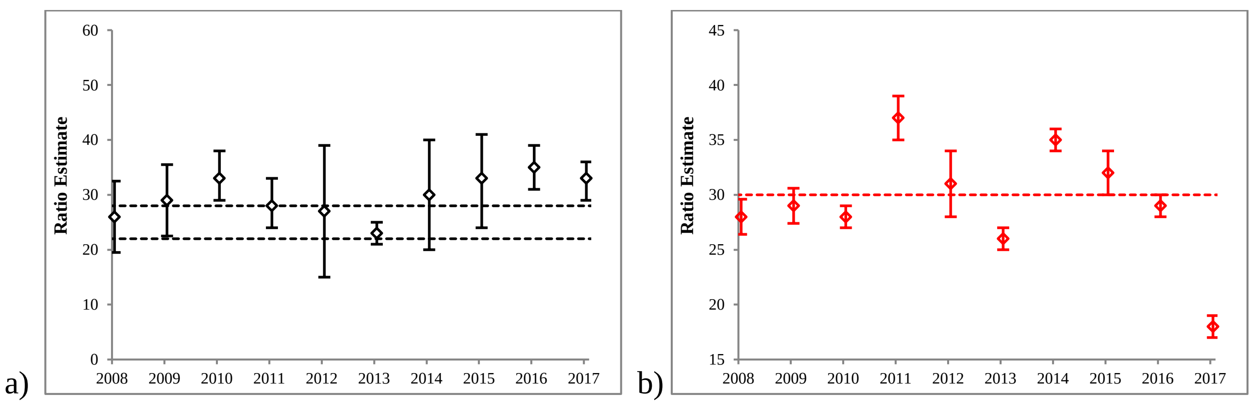

Figure 3. Estimates and associated 95% confidence intervals of (a) post-hunt bull:cow; and (b) cow:calf ratios in the Blue Mountains elk herd area, spring 2008–2017. The dashed lines represent the objective range of 22-28 bulls:100 cows for bull:cow ratios (black); and a calf:cow ratio (red) of ≥ 30 calves:100 cows that should promote herd stability or growth.

Hunting Seasons and Recreational Harvest

The Department restricts general season bull harvest to spikes and offers opportunities to harvest branch-antlered bulls under special permits in all GMUs. The Department generally focuses most opportunities to harvest antlerless elk in areas associated with private land to help alleviate agricultural damage. Estimates of General State Harvest and Total State Harvest have averaged 174 and 373 elk, respectively, 2007–2016, and have been relatively stable 2010–2016 (Figure 5). Estimates of hunter effort during general seasons have also been relatively stable since 2006, while estimates of CPUE have varied, but were similar in most years (Figure 5).

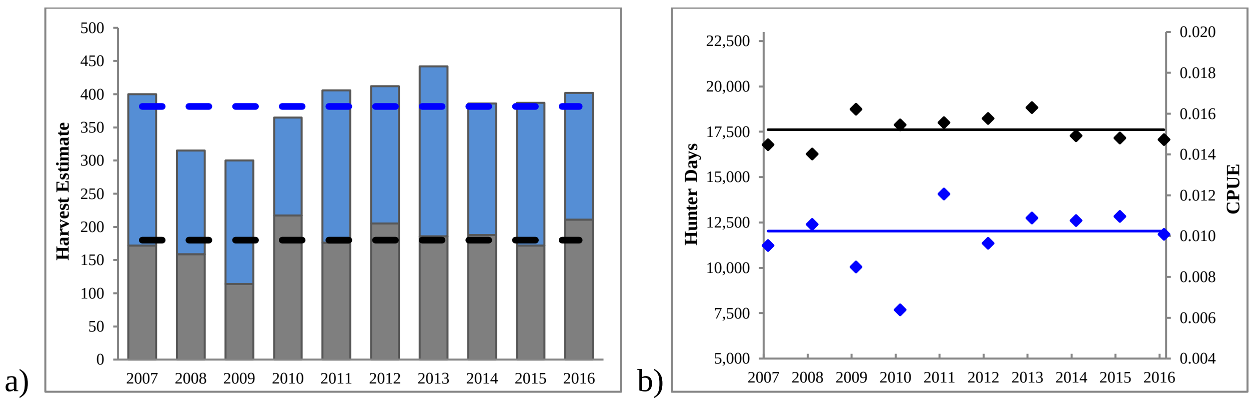

Figure 5. General State Harvest (grey) and Total State Harvest (blue) estimates (a) in the Blue Mountains elk herd area, 2007–2016. The dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates (b) of hunter days (♦) and catch-per-unit-effort (CPUE) (♦), 2007–2016. Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

Survival and Mortality

Common predators of elk in the Blue Mountains area include black bears, cougars, and gray wolves. Black bears and cougars occur throughout the herd area, but black bears are more abundant in forested areas. At the time of this writing, there are 3 confirmed wolf packs within the Blue Mountains elk herd area (WDFW et al. 2017).

Extreme weather events that strongly affect the survival of elk in the Blue Mountains elk herd area are typically rare, but extreme winter weather did occur during the 2016/2017 winter. Calf ratios declinded dramatically as did adult survival. Dead elk were commonly reported or observed during the later portions of the winter in 2017.

There are no ongoing research projects to estimate survival and cause-specific mortality rates for elk in the Blue Mountains elk herd area. The most recent elk survival study occurred 2003–2006 and we (McCorquodale et al 2011) estimated yearling bull survival across the herd area to be 0.41 (95% CI = 0.29–0.53), branch-antlered bull survival to be 0.83 (95% C.I. = 0.76–0.88), and adult cow survival to be 0.80 (95% C.I. = 0.69–0.88). The leading cause of mortality for all sex and age classes monitored was associated with human harvest.

Human-Wildlife Interaction

While actual elk damage claims are low, complaints from farmers are very common and elk damage continues to be a problem in some units and is largely being addressed by issuance of landowner depredation permits. The Lure Crop program is an effective tool used in GMUs 154 and 162. The largest damage issues occur in GMU-154 Blue Creek, GMU-162 Dayton, GMU-178 Peola, and GMU-181 Couse. Damage tags are typically valid from July 1 – March 31, with restrictions on the harvest of antlered elk. Damage issues in GMU-181 have increased in the Cloverland area and are requiring increasingly creative solutions to address. Periodically, high numbers of elk move into the western portion of the unit (Cloverland), with this trend increasing over the past 3 years. Additional effort will be needed to stop this pattern of behavior. During the reporting period, 182 Kill permits and 38 DPCA permits were issued within the Blue Mountains elk herd area. From these, 43 elk were harvested with Kill Permits and 6 with DPCA. This approach to reducing the damage elk cause private landowners is currently accomplishing its goal in a majority of the herd range. This results in more targeted hunts that directly alter elk distribution at the smaller scale.

Research

There is no ongoing elk research being conducted within the Washington portion of the Blue Mountains at this time. The results from the Washington Blue Mountains Elk Vulnerability Study were published in the Journal of Wildlife Management (McCorquodale et al. 2011) and through a department report, which was made available to the public in 2011.

Management Concerns

Road densities in some portions of the Blue Mountains elk herd area are quite high and have the potential to reduce use of important summer range because of human disturbance associated with those roads. The USFS has closed several old roads and reduced overall road densities, but more work is needed to address elk habitat and security needs. In addition, anecdotal evidence suggests elk habitat use in early spring has changed in some portions of the Blue Mountains elk herd area due to disturbance caused by people looking for shed antlers.

Shed antler hunting activity continues to be a concern for elk on the winter range. Shed antler hunting activity in GMUs 154, 162, 166, 169, 172, and 175 can be extremely intense during March and April. Elk use patterns in GMUs 154, 166, 169, 172, and 175 have changed over the last decade due to disturbance caused by shed antler hunting activity. Bull groups are broken and scattered into the upper elevation timber and snow, while cow/calf groups can be redistributed onto agricultural lands. Shed antler hunting and other activities on winter range are putting elk under stress at a critical time of year.

Winter calf ratios declined dramatically during this reporting period, likely attributed to the severe winter for this geographic area (Figure 3). Low calf survival had a negative impact on hunting opportunity through reduced recruitment from the mid-1980s through mid-2000s. Low calf recruitment is thought to be the major factor still preventing Wenaha elk from increasing in numbers.

The Grizzly Complex fire that burned during the summer of 2015 altered tens of thousands of acres in the Washington portion of the Wenaha-Tucannon Wilderness. This burn was predominantly a positive event for the Wilderness, which should improve habitat quality and quantity within it's footprint. The improved habitat will hopefully increase recruitment and attract elk from adjacent private lands in GMU 172.

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Colockum Elk Herd

JEFFERY A. BERNATOWICZ, Wildlife Biologist

Introduction

The Colockum elk herd area is located in central Washington along the eastern foothills of the Cascades and consists of 6 GMUs, which includes 249 (Alpine), 251 (Mission), 328 (Naneum), 329 (Quilomene), 330 (West Bar), 334 (Ellensburg), and 335 (Teanaway) (Figure 1).

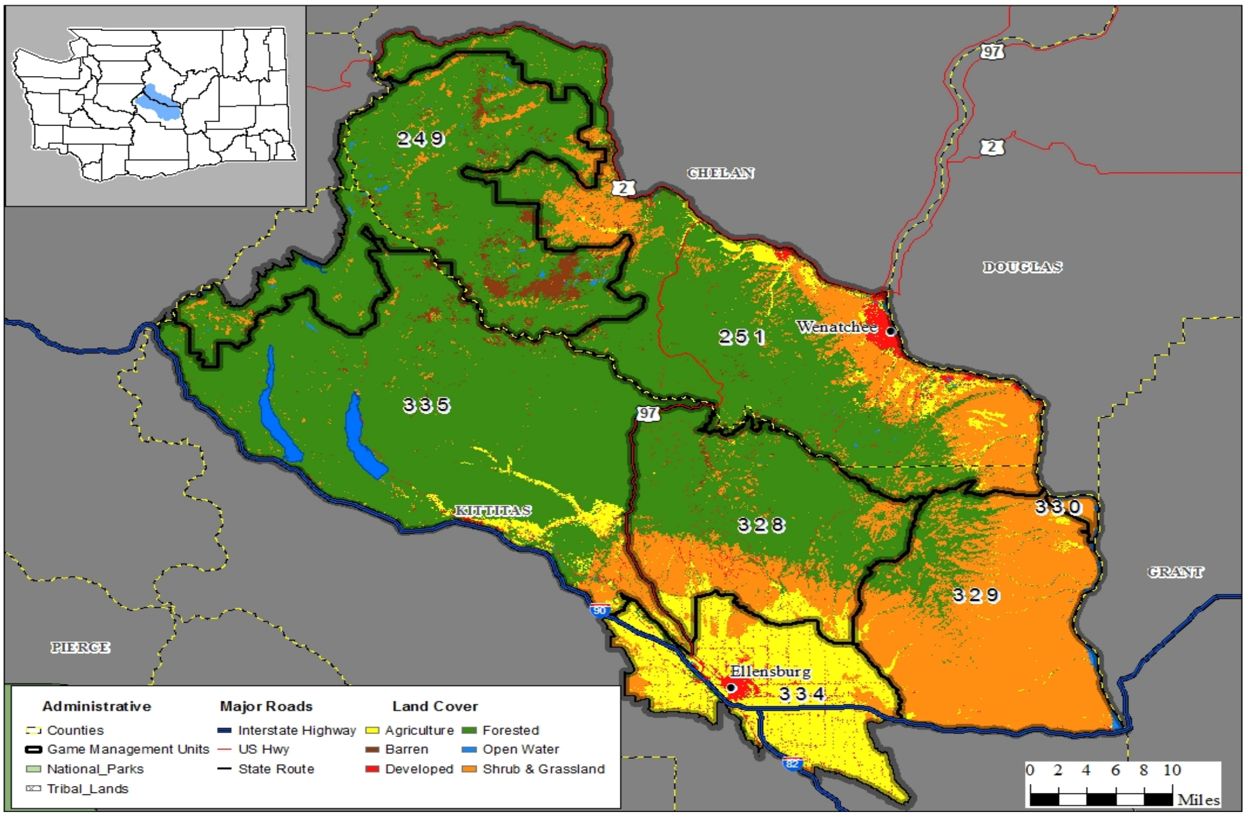


Figure 1. Dominant land use cover types within the 6 game management units that comprise the Colockum elk herd area.

Management Guidelines and Objectives

The Department's current objective is to maintain elk abundance in the surveyed winter range during spring between 4,275 and 4,725 elk (i.e., 4,500 ± 5%) (WDFW 2006). Additional objectives include maintaining a post-hunt population with a bull:cow ratio of 12–20 bulls:100 cows and maintaining an annual survival rate of 0.50 for bulls when bull mortality is monitored (WDFW 2014).

Population Surveys

The Department monitors population status by conducting aerial composition surveys in the spring and uses a sightability model developed for elk in Idaho (Unsworth et al. 1999) to estimate elk abundance, age ratios, and sex ratios in a large historically surveyed area. The Department conducted post-hunt composition surveys in March 2017 and estimated total elk abundance on core winter range to be 4,672 elk (90% CI = 4,654–4,736), which is within the objective. Estimates of total elk abundance steadily increased 2006–2015, but declined 2016 (Figure 2) as a result of increased antlerless hunting and some winter mortaltiy.

The Department estimated post-hunt calf:cow and bull:cow ratios in March 2017 to be 19:100 (95% CI = 19-19) and 13:100 (95% CI =12–14), respectively (Figure 2).

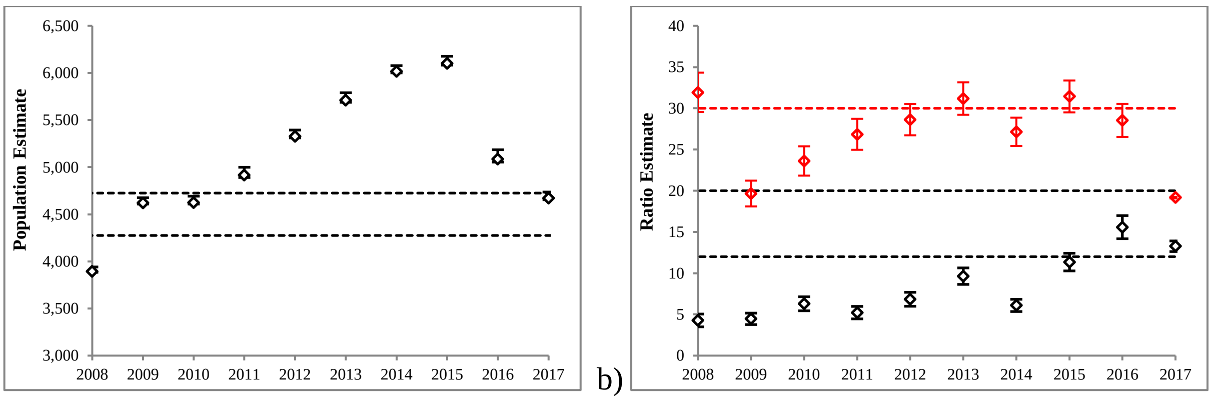
a)


Figure 2. Sightability corrected estimates of total elk abundance with associated 90% confidence intervals in the Colockum elk herd area, 2008–2017 (a). The dashed lines represent management objectives for total elk abundance (4,275–4,725 elk). Also included are estimates of post-hunt calf:cow (◊) and bull:cow ratios (◊), spring 2008–2017 (b). The black dashed lines represent objectives for bull:cow ratios (12–20 bulls:100 cows), whereas the dashed red line represents calf recruitment rates that should promote herd stability or growth (≥ 30 calves:100 cows).

Hunting Seasons and Recreational Harvest

The Department restricts general season bull harvest to true-spikes (1×1 bulls) and offers opportunities to harvest branch-antlered bulls under special permits in all GMUs except 334. In 2012, the Department began to increase opportunities to harvest antlerless elk throughout the herd area to bring the herd down to the management objective. General State Harvest and Total State Harvest have averaged 443 and 634 elk, respectively, 2007–2016. Both estimates steadily declined 2006–2010, while Total State Harvest increased sharply 2011–2015, and General State Harvest increased sharply in 2015 (Figure 3). Both increases are a result of the Department increasing opportunities to harvest antlerless elk. Hunter effort declined in 2010, likely in response to the Department implementing “true-spike” restrictions in 2009, but it increased 2012–2015 as opportunities to harvest antlerless elk were increased (Figure 3).

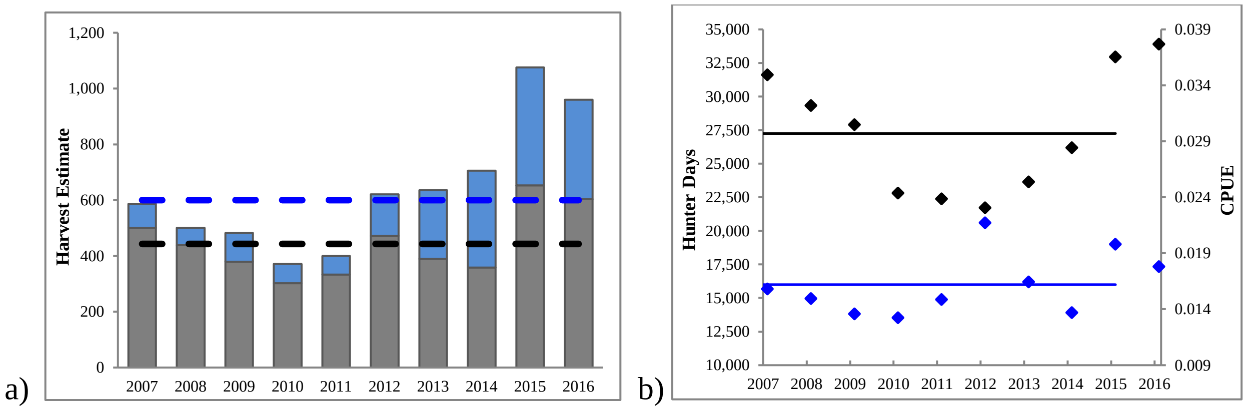


Figure 3. General State Harvest (grey) and Permit State Harvest (blue) estimates (a) in the Colockum elk herd area, 2007–2016. The dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates (b) of hunter days (♦) and catch-per-unit-effort (CPUE) (♦), 2007–2016. Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

Survival and Mortality

Common elk predators that occur within the Colockum elk herd area include black bears, cougars, and gray wolves. Black bears and cougars occur throughout the herd area, but black bears are more abundant in forested habitats. At the time of this writing, there was one confirmed wolf pack within the Colockum elk herd area (WDFW et al. 2017), but not within the core range east of US-97.

The Colockum elk herd, like most elk herds, is typically robust to severe winters. The Department monitored the survival of 105 adult cow elk captured on core winter range 2008–2012 and estimated annual survival rates to be 0.92 (95% CI = 0.87–0.96); 73% of all mortalities were attributed to hunter-harvest (S. McCorquodale, WDFW, unpublished data). The Department is also currently monitoring the survival and movements of mature branch-antlered bulls. We have radio-collared 55 bulls since 2013; preliminarly annual survival rates were about 0.60, and at the time of this writing, 17 mortalities have been documented, 16 of which were attributed to harvest (S. McCorquodale, WDFW, unpublished data). Bracken and Musser (1993) attributed all Colockum elk mortality in an earlier study to humans.

Habitat

Timber harvest in the Colockum elk herd area increased as timber companies logged heavily 5-15 years ago prior to selling their lands. Summer forage quantity and quality likely improved, but security decreased. Recent wildfires may have decreased short-term forage on more than 100,000 acres of winter range by reducing plant diversity. In arid areas, fires often reduce forbs and woody browse.

Human-Wildlife Interaction

The Colockum herd is not fenced off from private lands, and damage is being managed by hunting and hazing. The boundaries of the hunts are adjusted frequently, depending on where damage is occurring. In 2004, the damage season was extended to August 1 – February 28th. In recent years, the general damage season closed in mid-December. Additional problem elk are being managed through hazing, Damage Prevention Cooperative Agreements (DPCA's), and Master Hunter

Permits. The goal is to eliminate/displace elk that have developed a habit of foraging on private agricultural lands. There were >263 damage and kill permits issued within the Colockum herd and an estimated 96 elk harvested on those permits. In the past year, an additional person was put on contract to help haze elk out of fields, mostly outside hunting seasons.

During winter 2015-2016, elk were crossing Interstate-90, presumably in search of suitable forage immediately adjacent to the highway or in the median. The Department of Transportation documented at least 70 elk/vehicle collisons on Interstate-90 adjacent to the Colockum elk herd core winter range. There currently is no barrier to keep elk off the highway or adequate wildlife crossings. The Department responded to this issue in 2016 by hazing elk away from the highway and installing a temporary 3-D fence to keep elk from approaching the highway. However, the effectiveness of these approaches are limited, so the Department will have to work closely with the Department of Transportation to identify longterm solutions if similar events occur in the future. Elk-vehicle conflicts were much lower during winter 2016-17.

Research

The Department is currently collaborating with Central Washington University to increase our understanding of the movement and habitat selection patterns of mature bulls in the Colockum elk herd area. The results of that research should be available by 2018.

Management Concerns

Agricultural damage is frequently a concern for some landowners in the Colockum elk herd area. The herd has been reduced to objective by harvest and winter mortality. There are other factors that cause elk to move into areas where they are in conflict with private landowners. Cultivated lands and irrigated pasture are attractive foraging areas for elk. Human disturbance can be quite high on public lands, especially during late summer, during fall hunting seasons, and in late winter when people begin hunting for shed antlers. Elk are widely distributed during times of the year when human disturbance is low, but they become concentrated in areas associated with the Coffin Game Reserve when human disturbance is high.

Much of the Colockum elk herd area also has a high road density and limited security cover. The high road density and lack of cover historically resulted in high yearling bull mortality. The true-spike regulation has more than doubled yearling recuitment and the overall bull population. In 2016 and 2017, the estimated bull:cow ratio was above objective for the traditional winter range that is surveyed. However, in most years a proportion of the mature bull subpopulaton is difficult to detect or are not located on the surveyed portion of the winter range. New techniques/methods may need to be adopted to better estimate the total bull subpopulation.

Management Conclusions

The Colockum herd is now within the total population objective and has reached bull:cow ratio objectives for the first time since the 12-20 bull per 100 cow objective was set. True-spike general season hunting has reduced yearling bull mortality to the point where branch-antlered bull opportunity can be increased, while maintaining enough adult bulls to keep the herd within the 12-20 objective. Adjustment of the current survey structure is needed to better estimate the full complement of adult bulls in the population.

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Mount Saint Helens Elk Herd

ERIC HOLMAN, Wildlife Biologist

Introduction

The Mount St. Helens elk herd is located in southwest Washington and is comprised of 14 GMUs, which includes 505 (Mossyrock), 520 (Winston), 522 (Loo-Wit), 524 (Margaret), 550 (Coweeman), 554 (Yale), 556 (Toutle), 560 (Lewis River), 564 (Battle Ground), 568 (Washougal), 572 (Siouxon), 574 (Wind River), 578 (West Klickitat), and 388 (Grayback) (Figure 1).

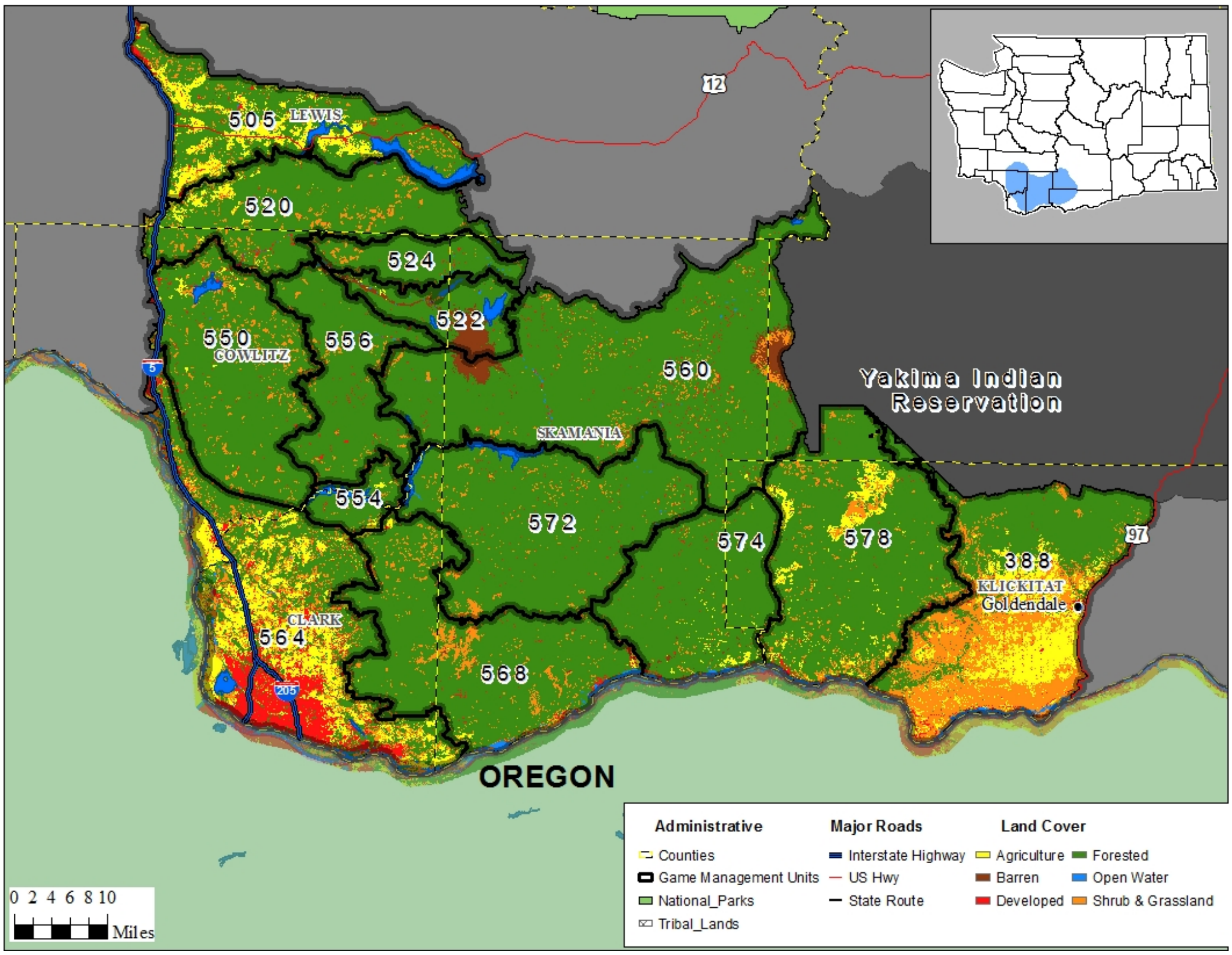

Figure 1. Dominant land use cover types within the 14 game management units that comprise the Mount St. Helens elk herd area.

Management Guidelines and Objectives

In response to the frequency and magnitude of winter mortality events in the 2000s, the Department began liberalizing opportunities to harvest antlerless elk in 2007 with the objective of reducing the Mount St. Helens elk herd by 35% (WDFW 2006). The Department's current objective is to promote population stability as indexed by estimates of total elk abundance in spring. Additional herd objectives include maintaining a post-hunt population with a bull:cow ratio of 12–20 bulls:100 cows and maintaining an annual survival rate of 0.50 for bulls when bull mortality is monitored (WDFW 2014). The Mount St. Helens Elk Herd Management Plan (WDFW 2006) also outlines objectives to continue efforts to monitor and improve winter habitat and wintering elk populations in the Toutle River valley. In addition, plan objectives address minimizing damage conflicts, increasing public appreciation of the elk resource, and using sound science to monitor the herd.

Population Surveys

The Department began monitoring population trend in 2009 by indexing total elk abundance within the core herd area (GMUs 520, 522, 524, 550, 556) using a sightability model developed specifically for the Mount St. Helens elk herd (McCorquodale et al. 2014). In March 2017, the Department estimated total elk abundance within the core herd area to be 1,771 elk (95% CI =1,730–1,882). Estimates of total elk abundance had been relatively stable since the Department reduced opportunities to harvest antlerless elk following the 2012 season (Figure 2). However, after the severe winter of 2016-17 the abundance estimate declined by roughly 33%. In March 2017, the Department estimated post-hunt bull:cow and calf:cow ratios to be 44:100 and 41:100, respectively. Bull:cow ratios have increased since 2010 during the period of purposeful herd reduction and are well above management objective (Figure 3). Calf:cow ratios have ranged from 25-41:100 over the past 6 years (Figure 3).

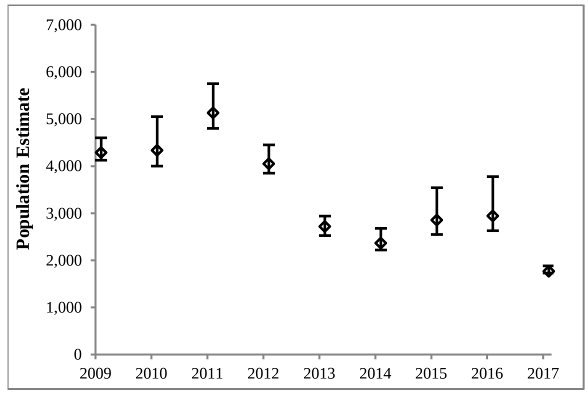

Figure 2. Sightability corrected estimates of total elk abundance with associated 95% confidence intervals in the Mount St. Helens elk herd area (GMUs 520,522, 524, 550, 556), 2009–2017.

Hunting Seasons and Recreational Harvest

The Department limits most general season harvest opportunities in the Mount St. Helens elk herd area to branch-antlered bulls and offers most opportunities to harvest antlerless elk through the special permit system. However, limited opportunities to harvest antlerless elk during general seasons do occur in areas where the Department's objective is to maintain low numbers of elk. During the period of time this review covers, the Department restricted all elk harvest in GMUs 522 and 556 to permit only opportunities. The Department restricted elk harvest in GMU 524 to special permit only from 1983 through 2014, then changed management strategies by allowing general season opportunities for branch-antlered bulls starting in 2015.

Estimates of General State Harvest have averaged 1,289 elk since 2007, and have steadily declined during this 10-year period (Figure 4). Estimates of Total State Harvest have averaged 2,044 elk since 2007, varied widely 2007–2012, and declined precipitously after the Department reduced opportunities to harvest antlerless elk in 2012 (Figure 4). Hunter effort has been steadily declining since 2008, while catch per unit effort (CPUE) declined 2009–2011, but has been more stable in recent years (Figure 4).

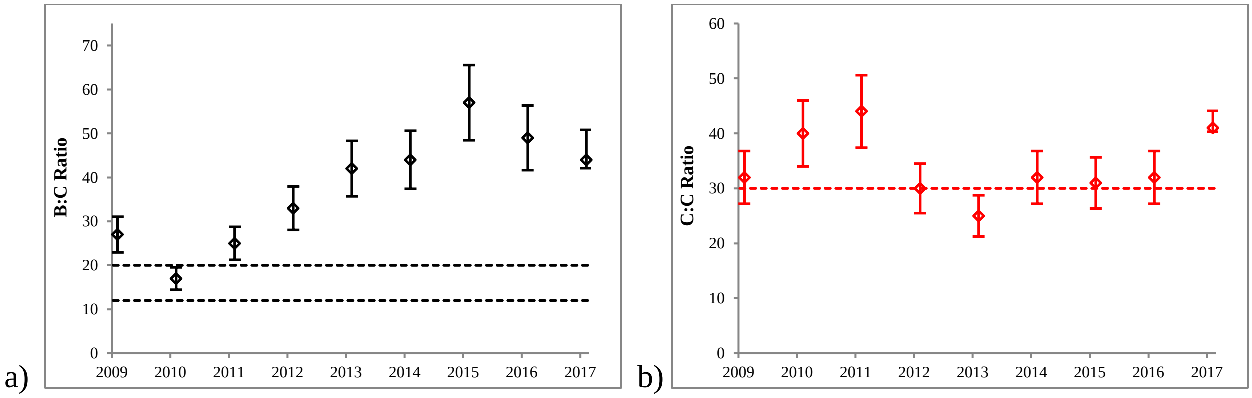

Figure 3. Estimates and associated 95% confidence intervals of post-hunt bull:cow (a) and cow:calf (b) ratios in the Mount St. Helens elk herd area (GMUs 520, 522, 524, 550, 556), spring 2009–2017. The dashed lines represent objectives for bull:cow ratios (12–20 bulls:100 cows) and calf recruitment rates that should promote herd stability or growth (≥ 30 calves:100 cows).

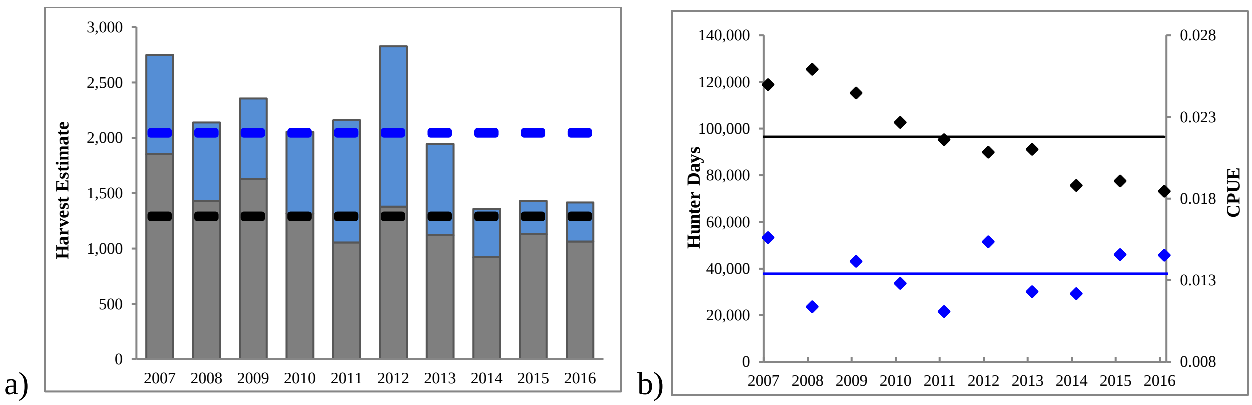

Figure 4. General State Harvest (grey) and Total State Harvest (blue) estimates in the Mount St. Helens elk herd area, 2007–2016 (a). The dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates of hunter days (♦) and catch-per-unit-effort (CPUE) (♦), 2007–2016 (b). Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

Survival and Mortality

Common predators that occur throughout the Mount St. Helens elk herd area include black bears and cougars. At the time of this writing, there are no documented gray wolf packs in the herd area (WDFW et al. 2017).

Some elk in portions of the Mount St. Helens elk herd area are susceptible to increased overwinter mortality events when severe winter and dry summer-fall conditions persist (McCorquodale et al. 2014). Since 1999, the Department has conducted an annual winter elk mortality survey on the Mount St. Helens Wildlife Area and documented the number of elk carcasses detected. Since that time, the number of elk carcasses detected has varied annually and been above the 19-year average on 7 separate occasions, most recently in 2014 (Figure 5).

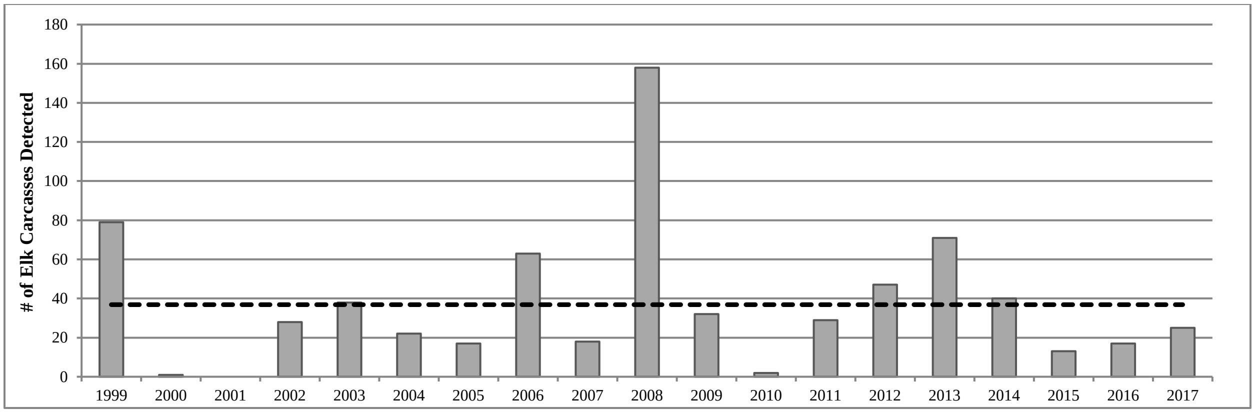

Figure 5. The number of elk carcasses detected during annual winter elk mortality surveys on the Mount St. Helens Wildlife Area, 1999–2017. The dashed line represents the 19-year average.

The Department is currently monitoring the survival and movements of adult cow elk in GMUs 520, 522, 524, 550, and 556. The study of elk in this portion of the Mount St. Helens elk herd area is an effort to determine the effects of treponeme-associated hoof disease (TAHD) on elk survival and reproduction. The project began in February 2015 with the capture of 81 elk. The Department has not analyzed this information to date.

The Department (McCorquodale et al. 2014) monitored the survival of branch-antlered bulls and adult female elk from 2009–2013, but did not attempt to account for elk mortalities by cause beyond distinguishing between hunting-related and natural causes (e.g., predation, disease, winter mortality, etc. combined). Estimated annual survival of adult female elk in GMUs 520, 522, 524, and 556 was 0.85 (95% CI = 0.78–0.91), 2009–2011 and 0.52 (95% CI = 0.38–0.65) in 2012. Estimated annual survival rates of adult female elk in GMU 550, 2009–2011, were 0.64 (95% CI = 0.48–0.78) and 0.52 (95% CI = 0.38–0.65) in 2012. Estimated branch-antlered bull survival was 0.56 (95% CI = 0.43–0.67) across years and GMUs. Most mortality events were associated with harvest-related causes, 2009–2011, while the reduced survival in 2012 was attributed to increased winter-mortality.

Habitat

The majority of the landscape that comprises the Mount St. Helens elk herd area is a roughly even split of private industrial forestlands and U.S. Forest Service (USFS) managed lands. Smaller portions of the herd area are made up of State Department of Natural Resources (DNR) managed forestlands, agricultural areas, urban/suburban lands, small forestland ownerships, etc.

The industrial forestlands consist of a mosaic of clearcuts, relatively open young regeneration stands, dense second growth stands of timber, and stream buffers lined with second-growth forest. Industrial timber management practices benefit elk by increasing the quantity of early seral habitats and the subsequent forage base. While beneficial to elk, management practices are not conducted to purposefully increase or improve elk habitat. Additionally, intensive forest management practices including the planting of dense stands of fast-growing conifer seedlings and the application of herbicides during re-establishment of the timber stand may also be affecting overall productivity due to reduced forage quality and availability. These effects work in tandem by reducing the amount of favorable plants available as forage in the early term and completion of forest canopy closure (typically approximately age 12), far earlier than would occur in a naturally regenerated stand. The magnitude of those effects is influenced by site specific types of post-timber harvest treatments and plant compositions; and the number of years since timber harvest. A commonality among all of these varying factors is that the best quality and most quantity of favorable forage seems to occur approximately 3 to 14 years after timber harvest whether herbicide treatments are applied or not. However the differences between available, favorable forage in that time period for treated and untreated stands can still be substantial. A full treatise on the complexity of these habitat interactions is beyond the scope of this report and we refer the reader to Ulappa (2015) and Geary et al. (2012) for a more comprehensive understanding of this research.

In contrast, very limited timber harvest on federal forests in the last three decades has led to a generally declining trend in quality elk habitat.

The Department continues to take steps to enhance forage quality on the North Fork Toutle River mudflow portion of the Mt. St. Helens Wildlife Area within GMU 522. Forage enhancement efforts have included planting and fertilizing forage plots, mowing pastures, controlling scotch broom and non-native invasive blackberries, planting trees in upland areas and along the banks of the North Fork Toutle River to reduce bank erosion and reestablish tree cover in areas where scotch broom had been removed, and controlling yellow and mouse-ear hawkweed.

In addition, activities on approximately 15,000 acres of mitigation lands managed by Pacificorps include forest canopy removal, fertilization, establishment of forage plots, treatment of invasive plants, maintenance of farmlands and meadows for elk habitat, and creation of meadows and openings within the forested landscape. These enhanced habitats provide high-quality foraging opportunities for elk.

Human-Wildlife Interaction

Conflicts with the production of agricultural crops occur throughout the lower-elevation portions of the Mt. St. Helens Elk Herd area. Elk damage complaints have decreased in recent years, reflecting the reduced elk populaton. A variety of crops are impacted by elk damage, but most of the damage occurs on fields used for hay production.

Wildlife Conflict Specialists work closely with producers by developing Damage Prevention Cooperative Agreements (DPCAs), which identify a plan to reduce the amount of damage incurred to agricultural crops using non-lethal and lethal methods. Non-lethal methods of discouraging elk use are an important component to reducing elk damage and are generally attempted prior to the use of lethal response. Conflict Specialists and landowners use a variety of non-lethal means including: electrified fladry fencing; noisemakers (birdbangers, critter gitters, propane cannons); hazing and herding on foot, with a vehicle or with a dog, scarecrow-like electronic devices; and odor-based repellents such as Plantskyyd.

Lethal methods of deterring elk are also used. These efforts include special late and early season damage hunts within specified elk areas, a region-wide pool of Master Hunters, Youth Hunters and Hunters with Disabilities for immediate response to damage issues, as well as landowner damage permits. Collectively, these hunts are designed to decrease the number of elk causing the damage and/or to haze elk from the area.

In recent years, the most acute situation of elk damage to agricultural crops has been associated with the mid-elevation valleys of Trout Lake and portions of the Glenwood and Gilmer valleys within GMU 578. These valleys are historic winter-range for elk occupying the south Cascade mountains as well as providing year-round habitat. The aggressive use of landowner kill permits and some non-lethal deterrents have failed to reduce this conflict over the course of many years. See Table 1 for a summary of permits issued to to landowers allowing the taking of elk causing agricultural damage in the Mt. St. Helens Elk Herd during 2016-17.

Table 1. Number of Permits to Lethally Remove Elk Causing Damage to Agricultural Crops and Resulting Kills, Mt. St. Helens Elk Herd, 2016-17.

Game Management Unit	Permits Issued	Elk Removed
505	3	1
520	3	1
550	3	3
554	1	0
556	1	1
568	1	1
574	2	2
578	30	27
TOTAL	**44**	**36**

Research

The research associated with TAHD discussed above is scheduled to continue through 2019. It is anticipated that this effort will shed light on the impacts of TAHD on the survival and reproductive fitness of adult female elk. Additional information will include survival rates and reproductive fitness of elk not afflicted with TAHD, habitat use, cause specific mortality among study animals, etc.

Management Concerns

Treponeme-associated hoof disease

TAHD of elk results in abnormal hoof growth, cavitating sole ulcers, and in severe cases, eventual sloughing of the hoof capsule. Elk severely affected by TAHD often have reduced mobility and condition. Consequently, it seems reasonable to assume they would have a reduced probability of survival or reproductive potential. However, it is unknown how TAHD affects the population dynamics of herds where TAHD occurs; this is the focus of ongoing research. The Department is also conducting research to better estimate the distribution and prevalence of TAHD. To learn more about the Department's efforts associated with investigating TAHD, please visit the Department's hoof disease webpage: http://wdfw.wa.gov/conservation/health/hoof_disease/.

Habitat Conditions on Federal Lands

Habitat conditions on federally managed lands within the Mt. St. Helens Elk Herd Area are of concern. Large scale fire, timber harvest, disease, or other succession re-setting events are largely absent from the federal lands. The resulting landscape is dominated by closed-canopy forest, much of which was harvested from roughly 1950-1990 and subsequently replanted with dense Douglas fir trees. These stands provide little in the way of elk forage and lack the diversity and forage resources of either older or younger forests. While some forest thinnings have been completed by the USFS and do provide more robust forage resources, at least temporarily, elk forage and therefore elk populations will continue to be suppressed in GMUs 560, 572, and 574.

Fee-Only Hunting Access Restrictions

In 2014, the largest industrial forestland owner within the Mt. St. Helens Elk Herd area implemented a fee-only access system for hunting and other recreation on their lands. This system limited the number of individuals allowed access to these lands and has continued in the years that have followed. The ramifications of this limited access to elk hunting opportunity are difficult to quantify as the landowners don't own entire Game Management Units, some individuals elect to pay the access fee, some individuals elect to hunt in another area, and some may decide to quit hunting. It is possible that the reduction in participation over the most recent two years illustrated in Figure 4b above reflects this reduction in free, unlimited hunting access within a large portion of the Mt. St. Helens Elk Herd area. Ramifications of reduced hunter access and participation are twofold in as much as it impacts the Department's goals to maximize recreational access to wildlife and likely reduces hunter participation and recruitment, therefore undermining capacity to manage elk and other wildlife.

Management Conclusions

Harvest and survey data indicate the Mount St. Helens elk herd has declined in accordance with the Department's objective of reducing herd size by 35%. The Department began managing for population stability in 2012. Estimates of total elk abundance indicated a stable population during the period spanning 2013–2016.

The winter of 2016/17 was unusually severe. Population surveys conducted in the spring of 2017 indicate a decline of roughly one-third in the surveyed portion of the St. Helens elk herd. However, estimated calf:cow ratios indicate calf recruitment rates are at levels that would promote population growth or stability. In addition, recent estimates of bull survival indicate the Department is achieving its management objective of maintaining annual survival rates of 0.50 for bulls. Opportunites to harvest antlerless elk have been reduced for the 2017 hunting season as a means of moderating the effect of the severe winter.

The effects of the 2016/17 winter, hoof disease, habitat condition on federal lands, and fee-access systems remain concerns for the Mt. St. Helens Elk Herd.

An updated herd plan is needed for the Mt. St. Helens Elk Herd. The existing plan is now more than 10 years old and does not reflect current conditions. Specifically, the plan was written before the presence of hoof disease in southwest Washington elk and prior to the organizational change of wildlife management staff addressing wildlife-human conflicts.

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North Cascade Elk Herd

FENNER YARBOROUGH, Wildlife Biologist

Introduction

The North Cascade elk herd is the smallest of 10 herds formally managed by the Department. The herd area is located in northwest Washington and consists of 5 GMUs, which includes 407 (North Sound), 418 (Nooksack), 437 (Sauk), 448 (Stillaquamish), and 450 (Cascade) (Figure 1).

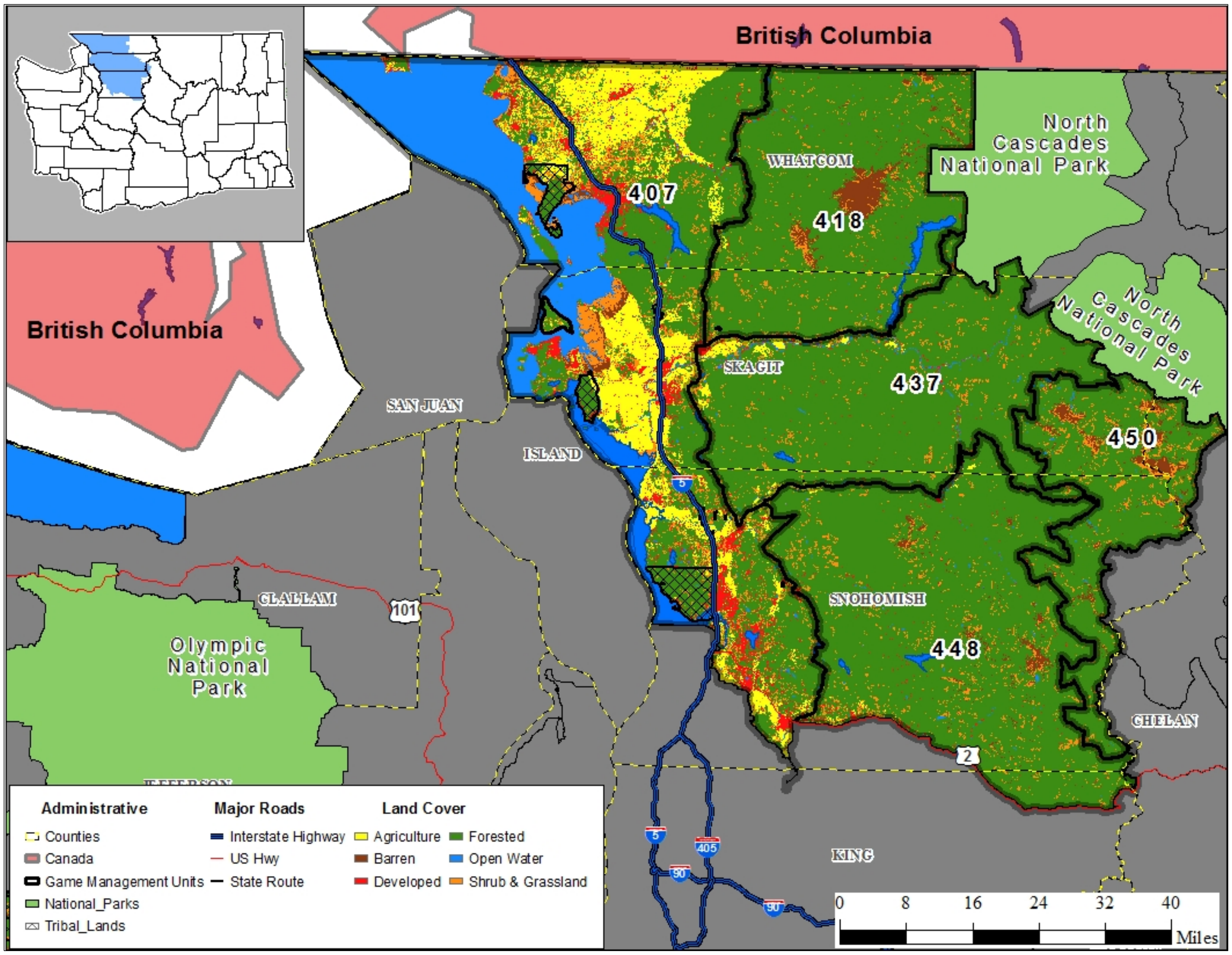

Figure 1. Dominant land use cover types within the 5 game management units that comprise the North Cascade elk herd area.

Management Guidelines and Objectives

The Department is currently updating the North Cascades Elk Herd Plan (WDFW 2002), but at the time of this writing, has not finalized a revised population objective. Current objectives include maintaining a post-hunt population with a bull:cow ratio of 12–20 bulls:100 cows and maintaining an annual survival rate of 0.50 for bulls when bull mortality is monitored (WDFW 2014).

Population Surveys

The Department, in cooperation with the Point Elliot Treaty Tribes, conducts aerial composition surveys during spring and in areas associated with the herd area (GMU 418 and the Skagit River Valley). We derive estimates of total elk abundance and estimates of the bull and cow subpopulations within the survey area using a variant of mark-resight known as the logit-normal mixed effects model (McCorquodale et al. 2011, 2013).

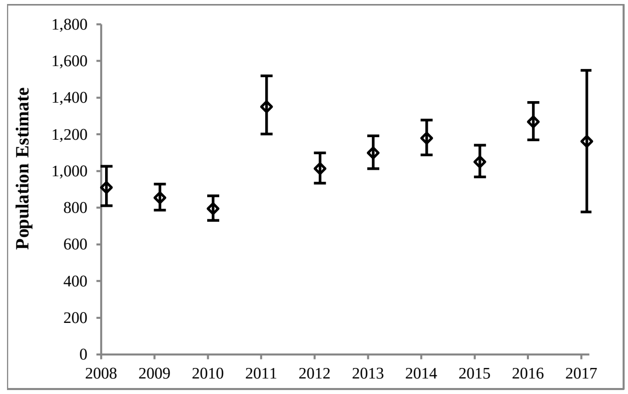

Figure 2. Estimates of total elk abundance using a variant of mark-resight with associated 95% confidence intervals in the North Cascade elk herd area, 2007–2016.

Due to weather issues, biologists were only able to conduct a single aerial survey in spring of 2017 instead of the standard two flights. This resulted in only being able to provide a Lincoln-Petersen estimate. In spring 2017, biologists estimated total elk abundance within the core herd area to be 1,163 (±386) elk. Estimates of bull:cow and calf:cow ratios derived from uncorrected observation data in spring 2017 were 30:100 and 30:100, respectively. Bull:cow ratios remain at levels above the post-hunt management objective of 12–20 bulls:100 cows, while calf:cow ratios have represented good-excellent calf recruitment rates in most years (Figure 3).

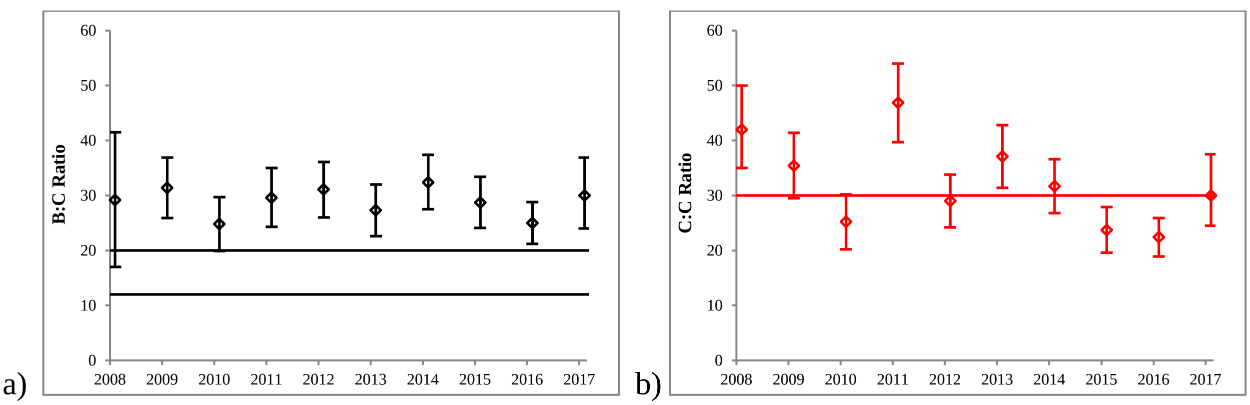

Figure 3. Estimates and associated 95% confidence intervals of (a) post-hunt bull:cow ratios; and (b) calf:cow ratios in the North Cascade elk herd area, spring 2007–2016. The dashed lines represent objectives for bull:cow ratios (12–20 bulls:100 cows) and calf recruitment rates that should promote herd stability or growth (≥ 30 calves:100 cows).

Hunting Seasons and Recreational Harvest

The Department and Point Elliot Treaty Tribes implemented a harvest moratorium throughout most of the herd area 1997–2006 because managers believed the herd had declined to as few as 300 elk. Managers reinstated limited opportunities to harvest bulls in 2007 and allocated those opportunities equally between state and tribal hunters; that approach continues to this day. General season opportunities continue to be limited, but managers have increased permit opportunities as the population has increased. Antlerless harvest is primarily limited to situations involving agricultural damage complaints, but harvest levels have been substantial in some years (e.g., 2013, see below) when abnormal winter conditions concentrated elk in the Skagit River Valley, where conflict with agricultural producers can be high.

Estimates of General State Harvest and Total State Harvest in the North Cascades elk herd area have averaged 26 and 91 elk, respectively, 2007–2016, while estimates of Total Harvest have averaged 123 elk, 2007–2016. Estimates of General State Harvest have remained low as general season harvest opportunities have been limited, while estimates of Total State Harvest and Total Harvest increased sharply 2010–2013 and then decreased precipitously 2014–2015 (Figure 4). The wide variability in harvest estimates 2011–2016 have largely been associated with increased opportunities to harvest antlerless elk to mitigate damage to agricultural crops. We did not generate estimates of hunter effort or CPUE because reported hunting activity was too low to calculate robust estimates of effort.

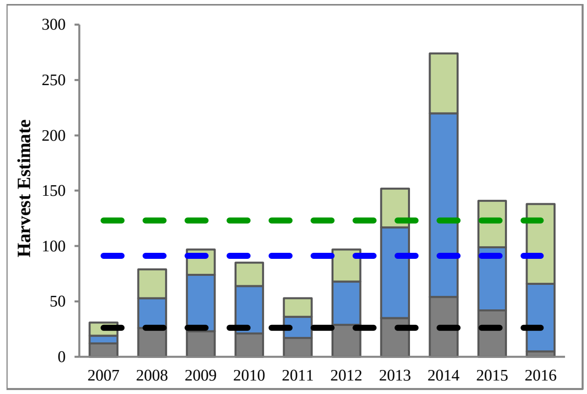

Figure 4. General State Harvest (grey), Total State Harvest (blue), and Total Harvest (green) estimates in the North Cascade elk herd area, 2007–2016. The dashed lines associated with harvest estimates represent the 10-year mean of each estimate.

Survival and Mortality

Common predators of elk that occur throughout the North Cascade elk herd area include black bears and cougars. The Department has documented the presence of gray wolves in the upper Skagit River system near the U.S./Canada border since the early 1990's, but at the time of this writing there were no documented wolf packs within the North Cascades elk herd area (WDFW et al. 2017).

Although biologists have never documented a substantial winter effect on elk survival, it can influence the distribution of this herd. When severe winter conditions persist, elk become concentrated in the Skagit River Valley, where the potential for conflict with agricultural producers is high.

The Department (McCorquodale et al. 2011) monitored the survival of adult female elk and branch-antlered bulls in the North Cascade elk herd area 2005–2011 and estimated annual survival rates to be >0.90 for both sex classes prior to the reinstatement of harvest opportunities in 2007. Following the resumption of opportunities to harvest bulls, we estimated survival of branch-antlered bulls to be 0.68 (95% CI = 0.50–0.82). In addition, of the 270 mortality events we documented during that study, we attributed 77% to harvest-related causes, 14% to elk-vehicle collisions, and only 4% to natural causes (e.g., predation, disease, accidents, etc., combined).

Habitat

Forest management practices on private industrial and state forestlands continue to benefit the North Cascades elk herd by creating a mosaic of habitat types. Specifically, clearcuts and young regenerating stands provide a forage base that is commonly absent in mature forests. Conversely, a large portion of the North Cascades elk herd area is under federal ownership and dominated by mature timber that provides little benefit to elk.

Human-Wildlife Interaction

The damage removal period for deer and elk ran from July 1, 2016 thru March 31, 2017. During that time period, WDFW received 63 elk related complaints with 32 of the complaints on agricultural land. The remainder of complaints came from individuals not engaged in agricultural or livestock production (i.e., trees, gardens, horse owners, etc.)

A total of 41 elk damage permits were issued in 2016-2017 to address Elk Damage in GMU's 407, 418 and 437. The majority of the damage permits were focused in Elk Area 4941 during the state authorized removal period. Of the 41 issued permits, there were 24 elk removed via harvest throughout the three GMU's.

Research

The Department has assisted the Point Elliott Treaty Tribes in using clover traps to capture and collar elk. The Department used VHF and GPS collars to track elk movements and used in population monitoring. In 2016-2017, 6 elk were captured, collared, and released.

Management Concerns

Treponeme-associated hoof disease

The Department confirmed the presence of Treponeme-associated hoof disease (TAHD) in the North Cascade elk herd area in 2016. One confirmed case occurred in the Skagit River Valley, while the other confirmed case occurred near the town of Acme. TAHD of elk results in abnormal hoof growth, cavitating sole ulcers, and in severe cases, eventual sloughing of the hoof capsule. Elk severely affected by TAHD often times have reduced mobility and condition. Consequently, it seems reasonable to assume they would have a reduced probability of survival or reproductive potential. However, it is unknown how TAHD affects the population dynamics of herds where it occurs. The Department is currently investigating the effects of TAHD on elk population dynamics in the Mount St. Helens elk herd area, in addition to, conducting research to better estimate the distribution and prevalence of TAHD. To learn more about the Department's efforts associated with investigating TAHD, please visit the Department's hoof disease webpage: http://wdfw.wa.gov/conservation/health/hoof_disease/

Management Conclusions

Estimates of total elk abundance and calf:cow ratios within the core herd area indicate the North Cascade elk herd has steadily increased since 2007 and that calf recruitment rates have been at levels that would promote population growth or stability in most years. In addition, estimated bull:cow ratios and recent estimates of bull survival indicate the Department is exceeding its objective of maintaining an annual survival rate of 0.50 for bulls. Consequently, in the absence of abnormal weather conditions or exceedingly high harvest rates for adult female elk, the Department expects the North Cascades elk herd to continue to increase.

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North Rainier Elk Herd

MICHELLE TIRHI, Wildlife Biologist
MIKE SMITH, Wildlife Biologist

Introduction

The North Rainier elk herd area is located in west-central Washington and consists of 8 GMUs, which includes 454 (Issaquah), 460 (Snoqualmie), 466 (Stampede), 485 (Green River), 490 (Cedar River), 652 (Puyallup), 653 (White River), and 654 (Mashel) (Figure 1). The primary land use of the North Rainier herd area is forest, with nearly 50% of the total area. These lands occur in the eastern portion of the herd area and dominate the landscape in GMUs 460, 466, 485, 490, 653, and 654. Developed lands make up more than 25% of the herd area. Undeveloped lands, which include designated open space, exceed 10%, but are largely intermingled with developed land. A relatively small amount of agricultural land is found scattered in the eastern parts of GMUs 454 and 652.

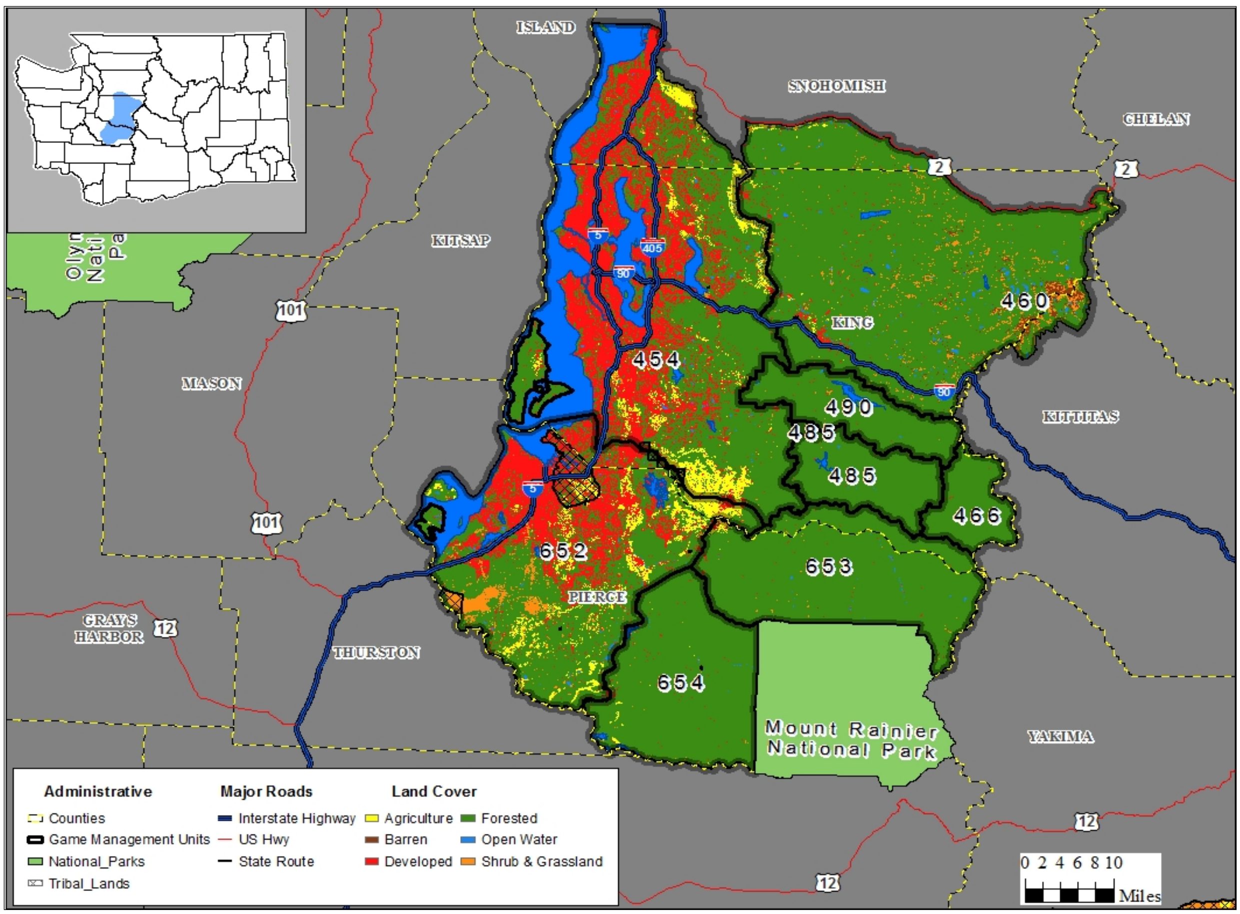


Figure 1. Dominant land use cover types within the 8 game management units that comprise the North Rainier elk herd area.

Management Guidelines and Objectives

The Department is currently updating the North Rainier Elk Herd Plan (WDFW 2002). Population objectives for the updated plan are in development at the time of this writing. Management objectives include maintaining a post-hunt population with a bull:cow ratio of 12–20 bulls:100 cows, maintaining an annual survival rate of 0.50 for bulls when bull mortality is monitored, and managing for a post-hunt 6-point (or better) bull percentage of 2% to 10% of the bull sub-population (WDFW 2014).

Population Surveys

A formalized monitoring program to estimate elk abundance for the entire herd area is currently lacking. However, there are several monitoring efforts that occur within the herd area at smaller scales. The Muckleshoot Indian Tribe (MIT) provides funding for aerial composition surveys in GMU 653 and annually estimates elk abundance using mark-resight, in addition to estimating post-hunt sex and age ratios. Surveys typically only occur in ~65% of the GMU, so estimates of abundance are not reflective of the entire GMU. However, expanded survey efforts occurred in 2012 and 2015, and results indicated the typical survey area included the majority of elk within the GMU (MIT and WDFW unpubl. data). MIT estimated elk abundance in GMU 653 to be 1,257 (95% CI = 945–1,569) elk in spring 2017. Resulting estimates of post-hunt bull:cow and calf:cow ratios were 17:100 (95% CI = 13–21) and 25:100 (95% CI = 19–30), respectively. Estimates of elk abundance steadily increased 2007–2012, but have been stable 2012–2017. Estimates of post-hunt bull:cow ratios have been relatively stable since 2011, while estimates of post-hunt calf:cow ratios have generally been above levels that should promote population growth or stability (Figure 2).

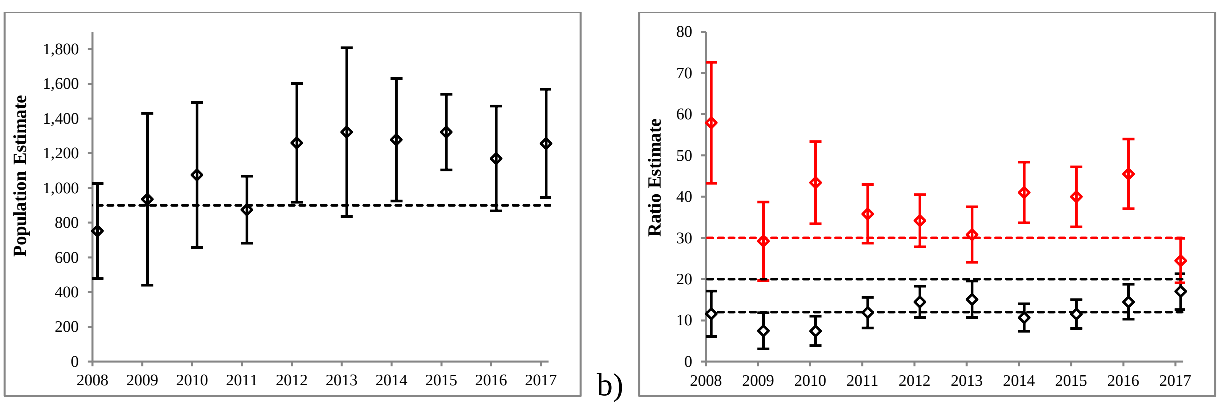
a)


Figure 2. Mark-resight estimates of total elk abundance with associated 95% confidence intervals in GMU 653, 2008–2017 (MIT unpubl. data). (a). The dashed line represents the 2002 management objective for total elk abundance (900 elk) that will increase when the updated North Rainier Elk Herd Plan is adopted. Also included are estimates and associated 95% confidence intervals of post-hunt calf:cow (◊) and bull:cow ratios (◊), spring 2007–2016 (b). The black dashed lines represent objectives for bull:cow ratios (12–20 bulls:100 cows), while the dashed red line represents calf recruitment rates that should promote herd stability or growth (≥ 30 calves:100 cows).

MIT also conducts annual aerial composition surveys and uses mark-resight to estimate elk abundance in GMU 485. They estimated elk abundance to be 655 (95% CI = 506–804) elk in spring 2017. Resulting estimates of post-hunt bull:cow and calf:cow ratios were 18:100

(95% CI = 13–23) and 17:100 (95% CI = 12–22), respectively. Estimates of elk abundance have steadily increased since 2007 (Figure 3). Estimates of post-hunt bull:cow ratios have varied, but have consistently been within objective. Estimates of post-hunt calf:cow ratios have also varied, but have generally been at or above levels that should promote population growth or stability (Figure 4).

Other efforts to monitor elk abundance in the North Rainier elk herd area occur in Elk Areas 4601, 6013, and 6014 and Mount Rainier National Park. The volunteer-based Upper Snoqualmie Valley Elk Management Group (USVEMG) have estimated elk abundance in Elk Area 4601 using ground-based mark-resight surveys since 2010. Estimates of elk abundance indicate elk numbers in Elk Area 4601 have been relatively stable since 2010 (Figure 5). WDFW in partnership with NW Trek and MIT launched a pilot citizen science elk monitoring project in Elk Areas 6013 and 6014 in 2015. A driving route with designated observation points was established and volunteers were trained to conduct monthly dusk or dawn surveys to record elk by sex and age and record observation location. A limited number of volunteers participated in this first year pilot; WDFW intends to work more closely with volunteers in the future and make slight alterations to the project criteria.

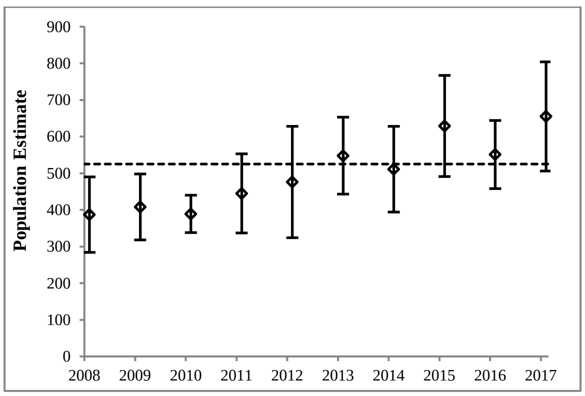


Figure 3. Mark-resight estimates and associated 95% confidence intervals of total elk abundance in GMU 485, 2008–2017 (MIT unpubl. data.). The dashed line represents the 2002 management objective for total elk abundance (525 elk) that will likely change when the updated North Rainier Elk Herd Plan is adopted.

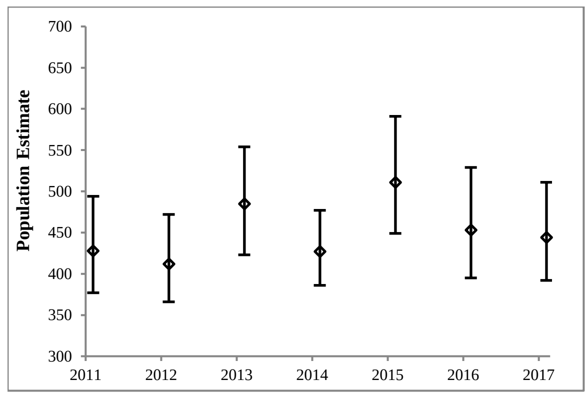


Figure 5. Mark-resight estimates and associated 95% confidence intervals of total elk abundance in in Elk Area 4601, spring 2011–2017.

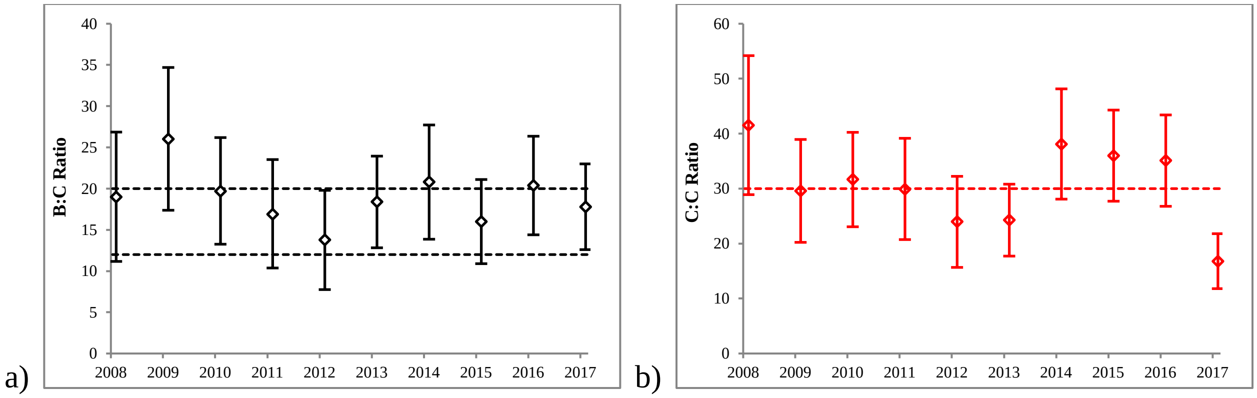


Figure 4. Estimates and associated 95% confidence intervals of post-hunt bull:cow (a) and cow:calf (b) ratios in GMU 485, spring 2008–2017 (MIT unpubl. data). The dashed lines represent objectives for bull:cow ratios (12–20 bulls:100 cows) and calf recruitment rates that should promote herd stability or growth (≥ 30 calves:100 cows).

The Department has also collaborated with MIT, the U.S. Geological Survey, National Park Service, and Puyallup Tribe of Indians to estimate elk abundance in the high alpine meadows of Mount Rainier National Park (MRNP) (Griffen et al. 2015). However, those surveys only include a small portion of the North Rainier elk herd (approximately 400 elk). Based on historical data from collared elk in the 1980s (WDFW unpublished data) about 15% of the elk were resident (i.e., did not migrate) while the remaining 85% migrated to high elevation areas in MRNP. More recently, studies conducted by MIT in 1998 indicated that about half of the White River elk summer outside of MRNP with some being non-migratory and some making short local migrations to nearby ridges.

Hunting Seasons and Recreational Harvest

The Department limits most general season harvest opportunities in the North Rainier elk herd area to branch-antlered bulls and offers most opportunities to harvest antlerless elk through the special permit system. However, limited opportunities to harvest antlerless elk during general seasons do occur during general archery and muzzleloader seasons and in areas where the Department’s objective is to maintain low elk numbers. The Department restricts all elk harvest in GMUs 485 and 653 to special permit only opportunities.

Estimates of General State Harvest and Total State Harvest (e.g., general and permit combined) in the North Rainier elk herd area have averaged 288 and 345 elk, respectively, 2007–2016. Reported tribal harvest averaged 93, while estimates of Total Harvest (e.g., total state and tribal harvest) have averaged 418 elk. All three harvest estimates steadily increased 2007–2013, General State Harvest and Total State Harvest declined slightly 2014-2015 and all three estimates increased again in 2016 (Figure 6). Hunter effort steadily increased, 2007–2016, while CPUE was stable, 2008–2011, increased sharply in 2012, declined for three years and increased sharply again in 2016.

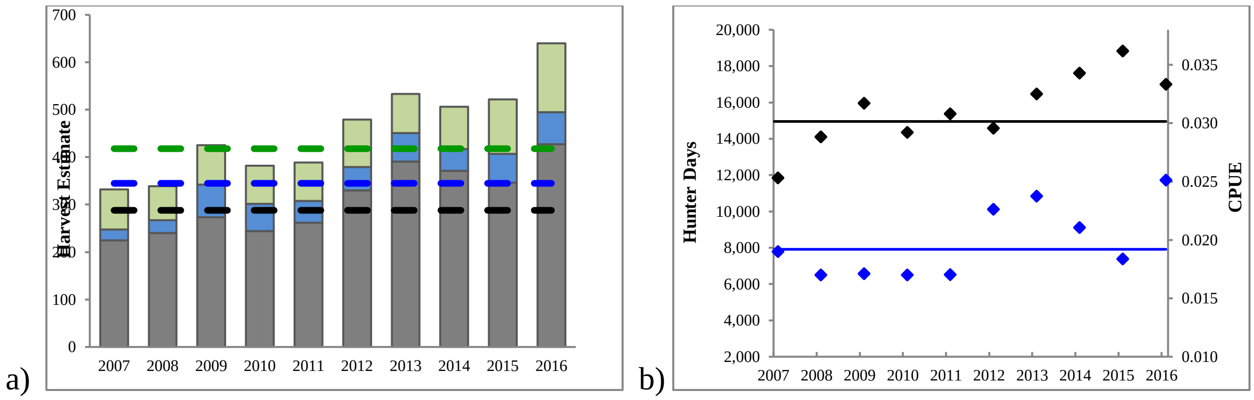


Figure 6. General State Harvest (grey), Total State Harvest (blue), and Total Harvest (green) estimates (a) in the North Rainier elk herd area, 2007–2016. The dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates (b) of hunter days (♦) and the 10-yr mean (black line) and catch-per-unit-effort (CPUE) (♦) and the 10-yr mean (blue line), 2007–2016. Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

Treponeme-associated Hoof Disease (TAHD) in elk

Sporadic reports of lame elk or elk with overgrown or missing hooves have been received in southwest Washington since the mid-1990s. Reports of "hoof disease" have been increasing, and hunters have regularly seen and sometimes harvested elk with this condition. At times, observers have reported many individuals in a group limping and showing signs of hoof disease, which has been noted in males and females and old and very young animals. For more information on Elk Hoof Disease, please visit the WDFW website:
http://wdfw.wa.gov/conservation/health/hoof_disease/.

Currently, it is unlawful to transport the hooves of harvested elk beyond the site where the animal was killed in Game Management Units 407, 418, 437, 454, 501 through 564, 633, 636, and 642 through 699, except when specifically authorized by the Department or when acting as an agent of the Department in the limited capacity of cooperating with research or management actions regarding hoof disease as directed by the Department.

Survival and Mortality

Common predators of elk that occur throughout the North Rainier elk herd area include black bears and cougars. At the time of this writing, there were no documented wolf packs within the herd area (WDFW et al. 2017).

Severe winter conditions are rare in the North Rainier elk herd area and are unlikely to influence the population dynamics of this herd. However, extreme drought conditions that persist through summer and fall have the potential to reduce the availability of high quality forages that elk need to accrue adequate fat stores for winter.

MIT has monitored the survival of adult female elk and calves in GMUs 485, 490, and 653, 1998–present (D. Vales, MIT, unpublished data). During that same period, they estimated annual adult female survival rates that were as low as 0.70–0.75 in some years, but typically ranged between

0.80–0.90. Cougars accounted for 63% and 33% of all adult cow mortalities in GMUs 485 and 653, respectively, prior to MIT implementing a cougar reduction program (see below) and 33% and 25%, respectively, following cougar removals.

Estimates of calf survival were quite variable and ranged from a low of 0.09 in 1999 to a high of 0.82 in 2006. Cougars accounted for 43–88% of all calf mortalities; bears only accounted for 6–11% of calf mortalities. Calf annual mortality rates due to cougar ranged 0.20–0.71. The lowest estimates of cow and calf survival from the MIT research occurred in the late 1990s and early 2000s and indicated cougars were the leading cause of mortality for both adult females and calves.

In response to these findings, MIT implemented a cougar reduction program from 2001 to 2007 to reduce cougar densities in GMUs 485, 466, and 653. Elk survival rates increased during the same time period. In addition to more conservative hunting season structures and ongoing habitat improvement projects during that same time period, this work does suggest that predation was one factor affecting the overall performance of the elk population. In 2016, female and calf survival still occur at levels that should promote population growth and stability (D. Vales, MIT, unpublished data).

Habitat

A large portion of the North Rainier elk herd area consists of lands administered by the USFS. The Huckleberry Land Exchange transferred over 9,000 acres of commercial timberland in the White River drainage to the USFS to be managed mostly as late successional reserve with minimal timber harvest. Restricting timber harvest reduces the amount of forest openings and can, in turn, reduce forage availability to elk and the number of animals a landscape can support. In response, the USFS is creating 400-500 acres of permanent openings to increase forage production for elk and deer in this area under the Greenwater Elk Forage Management Project (USFS 2008). In general, the North Rainier elk herd benefits most from forest management practices on private and state industrial forestlands, where frequent harvesting of mature timber creates a mosaic of early seral habitats that provide an important forage base for this herd.

Elk winter range is a priority habitat under the WDFW Priority Habitats and Species (PHS) Program. PHS is the principal means by which WDFW provides important fish, wildlife, and habitat information to local governments, state and federal agencies, private landowners, consultants, and tribal biologists for land use planning purposes. As such, Pierce County Planning and Land Services has adopted elk winter range as a Habitat of Local Importance within Title 18E.40. (Regulated Fish and Wildlife Species and Habitat Conservation Areas). Land use development permits within mapped elk winter range are regulated by the county under four management goals: 1) minimize human activity that would disturb elk, 2) maximize retention of undisturbed vegetation – particularly forest cover, 3) avoid activities that serve to exclude elk, and 4) protecting private property.

Human-Wildlife Interaction

Elk damage to ornamental shrubs, gardens, crops and pastures is a problem in all of the GMUs to some degree and complaints are received every year. Wildlife Conflict specialists work closely with agricultural producers by developing Damage Prevention Cooperative Agreements (DPCAs) which identify a plan to reduce damage incurred to crops using non-lethal and lethal methods.

Non-lethal methods of discouraging elk use are a very important component to reducing elk damage and are generally attempted prior to the use of lethal measures. WDFW Conflict Specialists and landowners use a variety of non-lethal methods including: electrified fladry fencing, noisemakers (birdbangers, critter gitters, propane cannons), hazing and herding on foot, with a vehicle or with a dog, scarecrow-like electronic devices, and odor-based repellents such as Plantskyyd.

Lethal methods of deterring elk are also used to reduce damage to crops. These efforts include hunts within specified elk areas, pools of Master Hunters, as well as landowner damage permits. See Table 1 for a summary of permits issued to landowners allowing the taking of elk causing agricultural damage in the North Rainier Elk Herd during 2016-17. Collectively, these hunts are designed to decrease the number of elk causing the damage and/or to haze elk from the area.

Table 1. Number of Permits to Lethally Remove Elk Causing Damage to Agricultural Crops and Resulting Kills, North Rainier Elk Herd, 2016-17.

Game Management Unit	DPCA's Issued	Permits Issued	Elk Removed
454	4	1	0
460	1	0	0
466	0	0	0
485	0	0	0
490	0	0	0
652	31	64	31
653	0	1	0
654	4	13	12
TOTAL	**40**	**69**	**43**

In GMU 460, elk damage is a notable problem in some golf courses, Christmas tree farms, nurseries, blueberry farms and other agricultural crops. Vehicle-elk collisions have increased as well. GMU 460 has good elk habitat, primarily on managed forestlands and the potential to support about 450-550 elk without damage concerns. However, damage complaints within the city limits of North Bend and Snoqualmie and vehicle-elk collisions on I-90 have raised concerns. As a result, the Upper Snoqualmie Valley Elk Management Group was formed in 2008. The group is made up of citizens, WDFW wildlife and enforcement personnel, city and county staff. The primary role of the group is to address the problems associated with the herd. Further, Washington Department of Transportation has initiated monitoring and collaborative academic studies to examine vehicle-elk collisions along I-90. Researchers are examining elk use of corridors and movement patterns related to the use of corridors.

Additional elk hunting opportunities aimed at reducing private property damage were initiated in 2014 within Elk Area 4601 and in 2015 in Elk Area 6014. The harvest of antlerless elk was added to general season hunts, aimed at reducing the herd in these localized areas. Regional master hunter permits were also issued in 6014 to further curtail damage.

Elk in GMUs 485, 466 and 653 have largely not been a problem to private property owners with few nuisance complaints received. However, continued monitoring of herd growth and opportunities to track any emigration from these GMUs will be valuable as surrounding communities continue to expand and develop adjacent to core herd use areas.

Research

WDFW is a member of the North Rainier Elk Herd Technical Committee comprised of state, federal, and tribal biologists and researchers who cooparatively manage this elk herd. Members of the Committee collaborated on a Hybrid Double-observer Sightability Model for Aerial Surveys research project from 2008-2014 (Griffen et al. 2013). WDFW is not currently engaged in research in the North Rainier herd planning area and relies heavily on research conducted by MIT.

Management Concerns

Currently, management decisions are based largely on hunter harvest and effort within the herd area. WDFW currently does not have funding or a strategy to fully understand herd size, population demographics, distribution or trends. The work of MIT biologists and others has been helpful in this regard, but a more comprehensive assessment is needed. Elk conflicts with commercial agricultural production and other arenas remains a concern in portions of the herd area. WDFW staff is currently developing an updated herd plan that will identify strategies to address these concerns and the resources needed to implement them.

Management Conclusions

Elk in GMU 454 should continue to be managed with liberal seasons designed to keep damage issues at acceptable levels in developing areas. Isolated sub-herds, generally on the eastern boundary of the GMU should continue to offer hunting and recreational viewing opportunity.

Elk in GMU 460 (outside Elk Area 4601) should continue to be managed for herd growth and expansion. Several small sub-herds occur within and immediately adjacent to the urban boundaries of the cities of North Bend and Snoqualmie (Elk Area 4601). Strong community interest suggests these elk represent a "quality of life" indicator consistent with a rural lifestyle and characterized by open space consisting of greenbelts, local parks, and conservation areas. Encounters of elk and humans along the urban interface present an opportunity for building and expanding public interest in wildlife conservation.

Management goals for the Green River sub-herd in GMU 485 include maintaining the population at a minimum 500 elk, maintaining high bull to cow ratios and ensuring a majority of bulls reach the prime age class (5-10 years). The GMU 485 permit hunt is one of Washington's most popular because of the opportunity to harvest and view quality bulls coupled with high success rates. Cooperative efforts between Tacoma Water, the Muckleshoot Tribe, and WDFW will continue to assess herd composition and population numbers while enhancing habitat in order to achieve population objectives and improve forage conditions in GMU 485.

Elk in GMU 652 and Elk Area 6014 should continue to be managed with liberal seasons and damage prevention permits designed to reduce damage to private property and agricultural crops. Harvest opportunity in Elk Area 6014, which composes a significant portion of GMU 652, was liberalized beginning in 2014-15 season to allow either 3 point minimum bull or antlerless opportunity. Additionally, three separate winter permit hunts were initatied in 6014 each providing 10 permits. Finally, damage harvest permits (master hunters) and landowner kill permits should continue to be used to reduce property damage to acceptable levels.

Management goals for the White River sub-herd in GMUs 653 and 654 should continue to include maintaining a stable to increasing population, maintaining high bull to cow ratios and ensuring a majority of bulls reach the prime age class (5-10 years). The bull-only permit hunt initiated in 2006 in GMU 653 as a population recovery tool has become a very popular hunt due to the higher elevation, rugged terrain, limited hunter entry and large branched bulls available for harvest. Although the herd exceeded 2002 management plan recovery objectives in GMU 653 and this bull only permit hunt may no longer be needed as a recovery tool, the uniqueness and popularity of this hunt may justify maintaining it. Elk in GMU 654 will also be managed to retain high bull:cow ratios and harvest opportunity while reducing elk damage to crops. Elk damage permit hunt opportunity will continue in the expanded Elk Area 6054 which should help control private property damage and provide additional recreational opportunity.

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Olympic Elk Herd

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Introduction

The Olympic Elk Herd area is located on the Olympic Peninsula and consists of 14 GMUs, 601 (Hoko), 602 (Dickey), 603 (Pysht), 607 (Sol Duc), 612 (Goodman), 615 (Clearwater), 618 (Matheny), 621 (Olympic), 624 (Coyle), 636 (Skokomish), 638 (Quinault Ridge), 642 (Copalis), 648 (Wynoochee), and 651 (Satsop) (Figure 1). Much of the land utilized by elk in this area is in public ownership. Federal lands include over 922,000 acres in the Olympic National Park (ONP) consisting of the core of the Olympic Mountains proper, as well as portions of coastal areas along the Pacific coast. Olympic National Forest (ONF) lands adjacent to ONP include an additional 643,000 acres. The State of Washington Department of Natural Resources, manages 368,000 acres of forest lands in the herd area, of which the 168,000 acre Clearwater Block is the largest. Indian Reservation lands encompass over 255,000 acres, the largest being 208,000 acres in the Quinault Indian Nation Reservation. The remainder of the land is in private residential, agriculture, or industrial timber company lands.

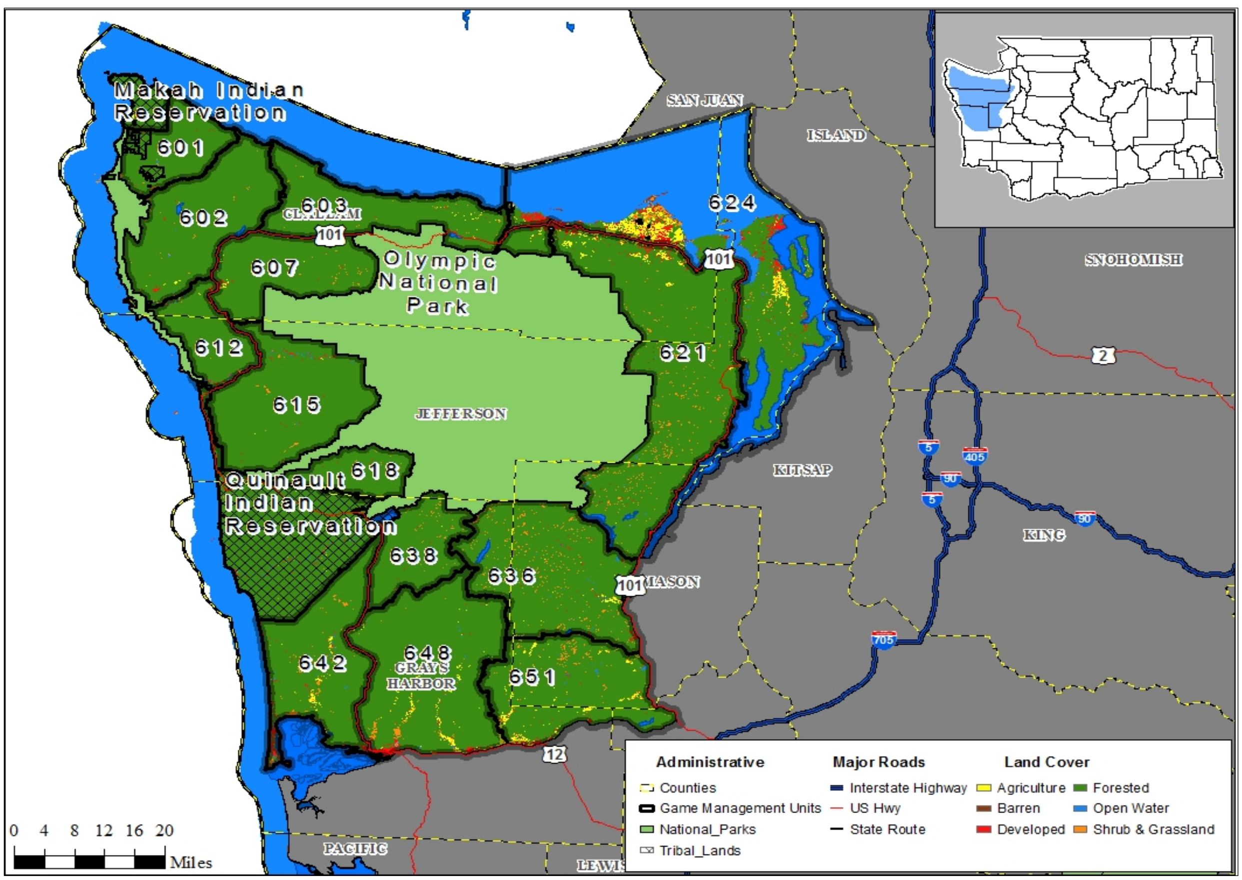

Figure 1. Dominant land use cover types within the 14 game management units that comprise the Olympic Elk Herd area.

Management Guidelines and Objectives

The Olympic Elk Herd Plan identifies a population objective of 11,350 elk outside Olympic National Park (WDFW 2004). However, that objective is likely to change when the plan is updated. The Department has not identified a formalized monitoring strategy to estimate elk abundance or composition throughout the herd area. Consequently, the Department generally manages for stable to increasing elk populations, while providing for multiple uses; including recreational, educational and aesthetic, as well as a sustainable annual harvest. Additional objectives include managing for a pre-season population with 15–35 bulls:100 cows and/or a post-hunt population with 12–20 bulls:100 cows (WDFW 2004) and maintaining an annual survival rate of 0.50 for bulls when bull mortality is monitored (WDFW 2014). We attempt to achieve these objectives largely through manipulating hunting seasons.

Population Surveys

The Department and several Treaty Tribes that have hunting rights on the Olympic Peninsula periodically conduct aerial or ground-based composition surveys in the Olympic Elk Herd area. Formalized estimators (e.g., sightability models, mark-resight, distance sampling, etc.) to correct observed data for detection probabilities that vary among age and sex classes are generally not applied. Even though those data are likely biased and managers must make conservative inferences, it still provides some insight into the current composition of this herd.

Estimates of pre-hunt bull:cow ratios declined over the 2008–2014 time period but have been at the management objective of 15–35 bulls:100 cows during the last three seasons. Estimates of post-hunt bull:cow ratios have been more stable, but the last 3 estimates have been below the management objective of 12–20 bulls:100 cows. Estimates of pre-hunt calf:cow ratios averaged 39:100 cows (range = 31:100 to 46:100), while estimates of post-hunt calf:cow ratios averaged 29:100 cows (range = 24:100 to 34:100) (Figure 2).

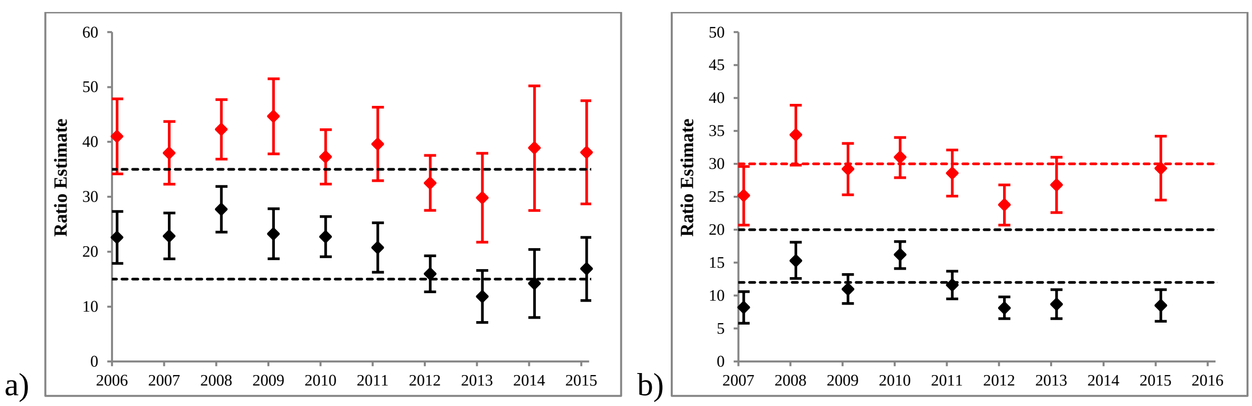

Figure 2. Estimates of pre-hunt (a) bull:cow (black diamond) and calf:cow (red diamond) ratios in the Olympic Elk Herd area, 2006–2016, and post-hunt (b) bull:cow (black diamond) and calf:cow ratios (red diamond), 2007–2015. The black dashed lines represent the objective range for pre-hunt (15–35 bulls:100 cows) and post-hunt (12–20 bulls:100 cows) sex ratios, while the red dashed line represents calf recruitment rates that should promote herd stability or growth (≥ 30 calves:100 cows). Post-hunt ratios from 2014 and 2016 are not included because biologists only conducted surveys in a single GMU during these years.

Hunting Seasons and Recreational Harvest

The legal elk for most general season hunts in the Olympic Elk Herd area are 3-point minimum, branch-antlered bulls. Harvest opportunities for antlerless elk are offered during some general season archery hunts and through a special permit system. Antlerless harvest is usually targeted at areas where the Department's objective is to maintain low elk numbers.

Estimates of General State Harvest and Total State Harvest have averaged 256 and 294 elk, respectively, 2007–2016; while estimates of Total Harvest have averaged 467 elk, 2007–2016. Elk harvest gradually declined, 2010–2013, until increasing in 2015. General season elk harvest declined in 2016 by 18% compared to 2015. Estimates of CPUE have shown a similar trend, while hunter effort has been relatively stable, but also declined in 2016 (Figure 3). The increase in elk harvest recorded in 2015 was in part due to a change in general season hunting regulations that increased the number of GMUs open to an early general season muzzleloader hunt. Total harvest in Figure 3 includes reported Tribal game harvest data which are compiled and published annually by the Northwest Indian Fisheries Commission (for data referred to in this document, see the NWIFC Big Game Harvest Reports for Western Washington Treaty Tribes; 2006-2016/17). On average, Tribal harvest accounts for 40% of the total elk harvest in the Olympic Elk Herd area.

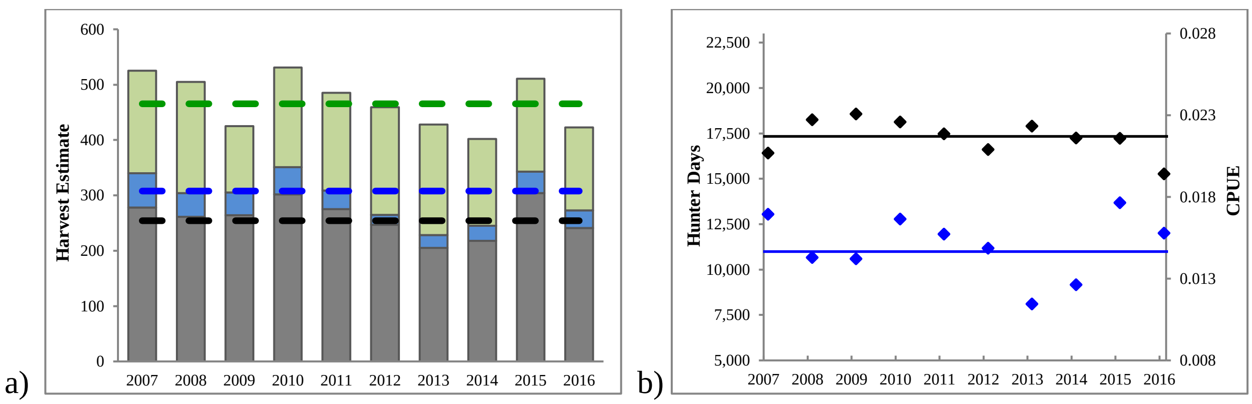

Figure 3. Estimates of (a) General State Harvest (gray), Total State Harvest (blue), and Total Harvest (green) in the Olympic Elk Herd area, 2007–2016. The dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates (b) of hunter days (black) and catch-per-unit-effort (CPUE) (blue), 2007–2016. Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

Survival and Mortality

There have been no comprehensive studies to estimate the survival of elk throughout the Olympic Elk Herd area during a specific time period; however, the Department and several Treaty Tribes have conducted numerous projects in specific GMUs. Cow survival in the Olympic Elk Herd area is generally higher than 80% (Smith et al. 1994; WDFW, unpublished data; R. McCoy, Makah Tribe, unpublished data). Bull survival has been documented to be 23% (Smith et al. 1994) and 29% (R. McCoy, Makah Tribe, unpublished data). Calf survival ranged from 27–40% in one study conducted in GMUs 601 and 602 by the Makah Tribe (R. McCoy, unpublished data).

Causes of mortality among Olympic elk include nutritional stress, predation, legal harvest, poaching, and a variety of other natural and human-related causes (vehicle collision, for example).

Malnutrition and predation are the most common factors associated with the mortality of cows and calves (Smith et al. 1994; WDFW, unpublished data; R. McCoy, Makah Tribe, unpublished data). Hunter harvest is the most common cause of mortality among bulls (Smith et al. 1994; R. McCoy, Makah Tribe, unpublished data). Poaching related mortality accounted for 2.5% among bulls and cows in the Olympic herd in one study (Smith et al. 1994).

Habitat

The Olympic Elk Herd area encompasses a diverse array of habitat types rising in elevation from the coastal and inland marine ecosystems at sea level through a series of forested zones that change with increasing elevation and rainfall. These zones include forests dominated by Sitka spruce (*Picea sitchensis*), then western hemlock (*Tsuga heterophylla*) and Pacific silver fir (*Abies amabilis*) until reaching the subalpine forests dominated by mountain hemlock (Tsuga mertensiana) and subalpine fir (*Abies lasiocarpa*) at higher elevations (Franklin and Dyrness 1973). Douglas fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*) are also common in the Sitka spruce and western hemlock zones, while areas in the subalpine zones often have open parklands and subalpine meadows (Franklin and Dyrness 1973, Henderson et al. 1989).

The western hemlock zone is the most extensive within the Olympic Elk Herd area and, along with areas in the Sitka spruce zone, has probably undergone the most significant alteration through timber harvest and replanting, often with Douglas fir (WDFW 2004). Elk demographics (survival and productivity, for example) are strongly influenced by forest management practices that have created a patchwork of stand types and ages, each with varying degrees of value for elk. Early seral stands, riparian zones, and mature to old growth forests tend be of most value to elk, while those stands 20-30 years after clearcutting have the least value (Lopez-Perez, 2004). Early seral stands are most common on private and state lands currently managed for timber production. Following fairly robust timber harvest in the 1970s and 1980s, recent management of USFS lands within the Olympic Elk Herd area tend to promote the persistence of mid- to late seral forests, which are of less value to elk. However, the USFS is conducting habitat enhancement activities, including thinning and forage seeding, for elk in some areas.

WDFW actively manages 2,034 acres of land in the Olympic Elk Herd area specifically to provide habitat for elk either as mitigation for lost habitat due to dam construction (Wynoochee Mitigation Unit, 1,030 acres of habitat, including pastures planted to provide elk winter forage) or as a means to reduce agricultural crop damage on adjacent private land (Olympic Unit, 963 acres; Anderson Homestead, 41 acres). Private pasture land, planted for other agricultural purposes, can also be an important component of elk habitat in many GMUs, but in many cases, agricultural landowners do not welcome elk on their property.

The effect of weather on elk is mostly related to those conditions that influence the quality and availability of forage. Unusually dry and hot conditions during summer and early fall will reduce the availability of forage during a critical time for elk, as they attempt to recover lost energy stores from the previous winter, prepare for the next winter, and for some, raise a calf. The summers of 2015 and 2016 were likely not favorable to elk, as the Olympic Elk Herd herd area experienced abnormally dry to severe drought-like conditions through much of the summer during both years.

In winter, a period when forage conditions naturally decline, snow accumulation, if substantial and persistent can reduce access to what forage is available and reduce or hinder elk movement. These snow effects usually occur when accumulations are persistent and approach 20 inches or more (Poole and Mowat, 2005). Fortunately, weather conditions over much of the Olympic Elk Herd area tends to be mild and temperate (Washington Climate Center Data) and snow accumulations are most likely to have a more pronounced effect on elk at higher elevations in the Olympic National Park and Olympic Wildnerness Areas of USFS lands. The heavy, wet snow typical of the Olympic Peninsula is subject to repeated thawing and freezing, which can create a thick crust of snow and ice reducing access to forage.

Human-Wildlife Interaction

In the Olympic Elk Herd area, most conflict issues that occur involve elk damage to commercial agricultural crops and pastures. Elk also conflict with activities near the airport in Forks, WA. In response to damage/conflict issues, landowners can work cooperatively with WDFW through Damage Prevention Cooperative Agreements (DPCAs), which are plans designed to proactively prevent, minimize, or correct damage caused by wildlife to crops or livestock and may include both lethal and nonlethal measures. There were 15 DPCAs within the Olympic Elk Herd area in 2016/17 and 22 damage prevention permits and 27 kill permits were issued (Table 1). Additionally, WDFW offered 60 Master Hunter permits for designated areas within Region 6, including those GMUs in the Olympic herd area. Of these, there were 12 Master Hunter harvests in 2016 (Table 1).

Table 1. The number of damage prevention cooperative agreements, damage prevention permits issued and filled, number of kill permits issued and filled, and the number of Master Hunters deployed and their harvest in 2016/17 for Game Management Units (GMU) in the Olympic Elk Herd range.

GMU	DPCAs	Damage Prevention Permit	Damage Prevention Permit Filled	Kill Permits Issued	Kill Permits Filled	Master Hunter Deployed	Master Hunter Harvest
607	1			6	0		
624	2			6	3		
636	3	5	4	2	2	4	4
642	1	3	2	1	1	3	2
648	5	12	5	6	2	4	4
651	5	2	1	6	2	2	2

Management Concerns

The Olympic Elk Herd Plan (WDFW 2004) provided management objectives and guidance for monitoring from 2005-2010, but needs to be updated. A formalized monitoring strategy is under development, as the herd plan is updated. Monitoring during this interim period has been limited to specific GMUs or portions thereof. WDFW has relied primarily on hunting harvest data as the basis for management decisions and the work of others for herd demographics and other information.

Management Conclusions

Elk harvest in the Olympic Elk Herd area declined during 2010 to 2014, increased in 2015, but again dropped below the 10-year average in 2016. The increase in harvest recorded in 2015 occurred during the general season and was in part due to a regulation change adding general season muzzleloader hunting opportunities in several GMUs; general archery season elk harvest was also up in 2015.

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Selkirk Elk Herd

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Introduction

The Selkirk elk herd is located in northeast Washington and includes the Pend Oreille and Spokane sub-herds. The Pend Oreille sub-herd consists of 9 GMUs, including 101 (Sherman), 105 (Kelly Hill), 108 (Douglas), 111 (Aladdin), 113 (Selkirk), 117 (49 Degrees North), 121 (Huckleberry), 124 (Mount Spokane), and 204 (Okanogan East) (Figure 1). The Spokane sub-herd consists of 6 GMUs, including GMUs 127 (Mica Peak), 130 (Cheney), 133 (Roosevelt), 136 (Harrington), 139 (Steptoe), and 142 (Almota) (Figure 1).

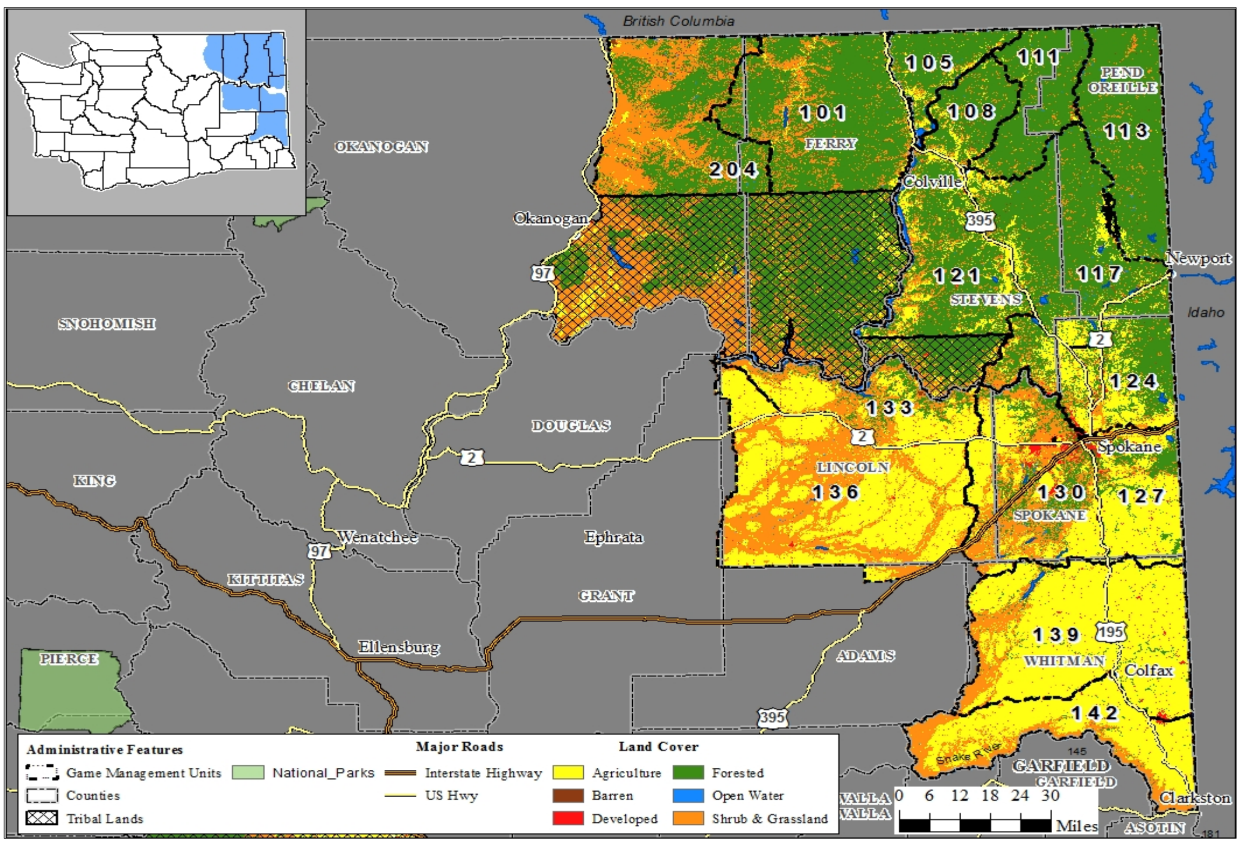

Figure 1. Dominant land use cover types within the 15 game management units that comprise the Selkirk elk herd area.

Management Guidelines and Objectives

The Department's objective is to increase elk abundance in the Pend Oreille sub-herd area to 1,500–2,500 elk and to maintain 1,000–1,500 elk in the Spokane sub-herd area (WDFW 2014a).

Additional objectives include maintaining populations with a pre-hunt bull:cow ratio of 15–35 bulls:100 cows or post-hunt bull:cow ratio of 12–20 bulls:100 cows (WDFW 2014a) and maintaining an annual survival rate of 0.50 for bulls when bull mortality is monitored (WDFW 2014b).

Population Surveys

Habitat and terrain within the Pend Oreille sub-herd area present a sampling environment that is not conducive to conducting typical aerial composition surveys because the dense and largely unbroken forests impede the ability of observers to detect elk. Consequently, the Department does not currently conduct surveys to monitor the Pend Oreille sub-herd.

The Department collaborates with the U.S. Fish and Wildlife Service (USFWS) to conduct pre-hunt aerial composition surveys on the Turnbull National Wildlife Refuge (TNWR), located in the Spokane sub-herd area. However, these surveys only include a small portion of the Spokane sub-herd and are not likely to be representative of the entire sub-herd. The number of elk observed during these surveys since 2006 has ranged 154–460 elk and varies annually. The low count in 2015 is believed to be primarily due to drought moving animals out of the area. However, there has been a concerted effort by WDFW and TNWR, through antlerless hunts on TNWR, to reduce this local population due to elk suppression of aspen regeneration on the refuge and this is likely having an effect as well. Estimated calf:cow ratios have been relatively stable, while estimated bull:cow ratios have consistently been within the management objective of 15–35 bulls:100 cows.

Because the Department has not identified a monitoring strategy to estimate elk abundance in either of the sub-herd areas, we primarily rely on harvest data to make inferences about population trend.

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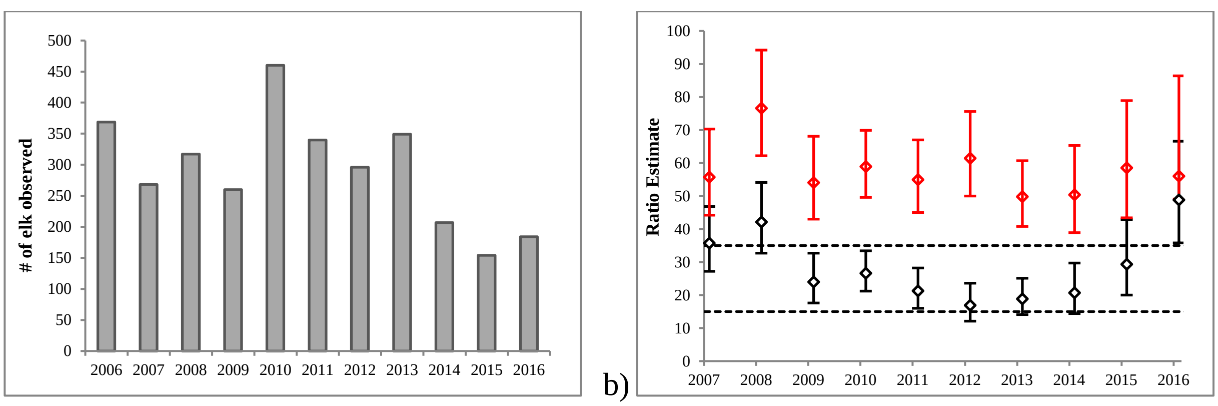


Figure 2. Number of elk (a) observed during aerial composition surveys in autumn on the Turnbull National Wildlife Refuge, 2006–2016. Also included are estimates (b) of pre-hunt, calf:100 cow ratios (◊) and bull:100 cow ratios (◊), autumn 2007–2016. The black dashed lines represent the targeted range for pre-hunting season objectives for bull:cow ratios (15–35 bulls:100 cows).

Hunting Seasons and Recreational Harvest

Most general season harvest opportunities in the Pend-Oreille sub-herd area are for any bull. Most opportunities to harvest antlerless elk are through limited, special permit opportunities. However, opportunities to harvest antlerless elk do occur throughout the sub-herd area during general archery seasons and for all weapon types in GMU 124 where the Department's objective is to maintain elk numbers within landowner tolerance. Estimates of General State Harvest and Total State Harvest (including special permits) have averaged 276 and 304 elk, respectively, 2007–2016, and have been stable 2010–2016 (Figure 3). Hunter effort and CPUE have also been stable since 2009 (Figure 3).

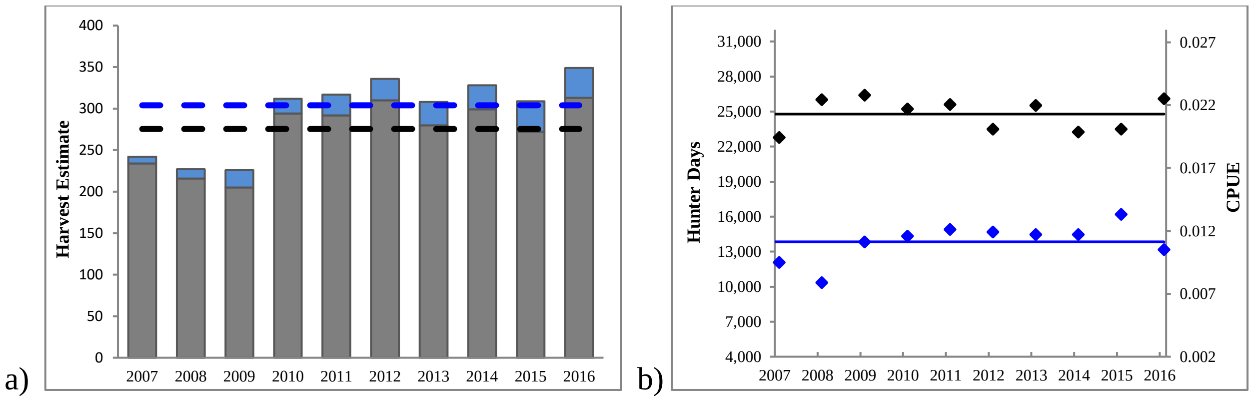
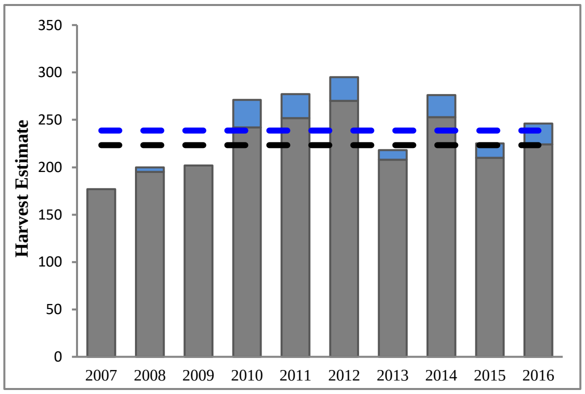


Figure 3. General State Harvest (grey) and Total State Harvest (blue) estimates (a) in the Pend-Oreille sub-herd area, 2007–2016. Dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates (b) of hunter days (♦) and catch-per-unit-effort (CPUE) (♦), 2007–2016. Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

The Department allows the harvest of any elk during all general seasons in the Spokane sub-herd area and collaborates with the USFWS to implement special permit harvest opportunities on TNWR. Estimates of General State Harvest and Total State Harvest in the Spokane sub-herd area averaged 223 and 239 elk, respectively for 2007-2016 (Figure 4a). Both harvest estimates (Figure 4a) and estimates of hunter effort (Figure 4b) vary annually in this sub-herd. Likely much of this variation is a reflection of the access to private lands and the patchy distribution of elk in this area, rather than true variation in the elk population. The slight increase in general harvest after 2009 is likely due to the implementation of the TNWR permit hunts pushing animals off the refuge during the general season.

a) 

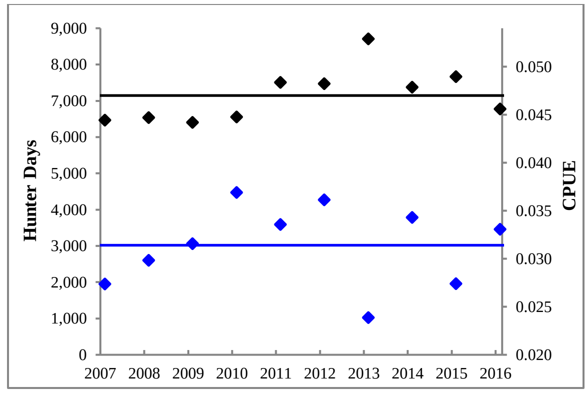
b) 

Figure 4. The estimated (a) General State Harvest (grey) and Total State Harvest (blue) estimates in the Spokane sub-herd area, 2007–2016. The dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates (b) of hunter days (♦) and catch-per-unit-effort (CPUE) (♦), 2007–2016. Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

Survival and Mortality

Common predators that occur throughout the Pend Oreille sub-herd area include black bears, cougars, and gray wolves. The Department documented the first wolf pack in the Pend Oreille sub-herd area in 2009. As of December 31, 2016, the Department had documented 15 wolf packs whose range currently occurs wholly or partially within the Pend Oreille sub-herd area (WDFW et al. 2017).

Black bears and cougars also occur throughout the Spokane sub-herd area. Both habitat conditions and hunter harvest suggest that bear and cougar numbers are likely higher north of the Spokane River in the Pend Oreille sub-herd area than in the Spokane sub-herd area (WDFW 2014a). Most cougar and black bear populations are managed to maintain a stable population. At the time of this writing, there were no documented gray wolf packs in the Spokane sub-herd area (WDFW et al. 2017).

Although the Department has never documented any increased mortality events, severe winter events do occur within the Pend Oreille and Spokane sub-herd areas and likely have the potential to reduce the overwinter survival of elk. In addition, extreme drought conditions that persist through summer and fall have the potential to reduce the availability of high quality forages that elk rely on to accrue adequate fat stores for winter.

Obtaining elk survival estimates and causes of mortality for the Pend-Oreille sub-herd is one goal of the predator-prey project (see research section), but because the project is only in year one of five, there are no estimates currently available. There have been no comprehensive efforts to monitor the survival of elk in the Spokane sub-herd area.

Habitat

Timber harvest is common on state forestlands and even more intensive on private lands. Timber harvest is limited on federal forests. Logging potentially benefits the Pend Oreille sub-herd by increasing the amount of early seral habitats. In addition, the Colville National Forest, with grant money from the Rocky Mountain Elk Foundation (RMEF), has implemented habitat enhancement projects on approximately 58,000 acres to benefit elk. Most of the projects involved prescribed burning to enhance winter forage production, but there were also projects to restore aspen stands and reclaim roadbeds for improved habitat. The RMEF also funded a prescribed burn on 390 acres of elk habitat on the WDFW Chesaw Wildlife Area within the Pend Oreille sub-herd area. Over 350,000 acres within the Pend Oreille sub-herd area were burned by wildfires in the summer of 2015 and approximately 2,500 more acres burned in 2016. These burns will likely benefit elk in the long term, but some areas burned completely and with high intensity, thus it may be years before any benefits to elk are realized.

Conversion of native Palouse Prairie and shrub-steppe habitat in the Spokane sub-herd area to agricultural lands has and continues to reduce the amount of native elk habitat. In addition, the expansion of urban populations associated with the main Spokane metropolitan area continues to result in habitat degradation or loss in GMUs 127 and 130. Consequently, it is likely that social tolerance within agricultural and suburban areas will limit the growth and expansion of the Spokane sub-herd.

Human-Wildlife Interaction

Most elk conflict is restricted to the lower-elevation agriculture lands in the Pend Oreille sub-herd. In 2016, there were 13 damage permits and 33 kill permits issued to landowners experiencing agricultural damage within GMUs 101, 108, 111, 113, 117, and 121 with the bulk of the permits issued in GMUs 117 and 121. Three landowners within GMU 204 reported elk damage in agricultural lands in 2015. Three kill permits resulting in the harvest of two elk were issued in GMU 204 in response to these damage complaints. All damage and kill permits issued were for antlerless elk only. Hunting regulations for GMU 204 were modified in 2016 to allow Early Archery while Late Muzzleloader season was switched to Early Muzzleloader to match the rest of the sub-herd area and to have hunting seasons during the time of year when most damage occurs.

Complaints of agricultural damage caused by the Spokane sub-herd have increased recently; much of the damage has been associated with land that has been converted to legume crops (e.g., garbanzo beans, peas, and lentils). A total of 22 damage permits and 19 kill permits were issued to private landowners for elk in the Spokane sub-herd range. Department staff, Master Hunters, and local sportsman's groups assisted with hazing efforts in some of these areas.

Research

The Predator-Prey Project began in the winter of 2016/17 and seeks to quantify the effects of recolonizing wolf populations on co-occurring ungulate species and another top predator, the cougar. The two primary objectives of this project are to 1) examine the effects of wolf predation on ungulate demography and population growth and 2) investigate the impacts of recolonizing wolves on cougar population dynamics, space use, and foraging behavior. This project consists of two study areas; one in northeast Washington encompassing the majority of Stevens and Pend Oreille counties, where the wolf population is larger and more widely distributed, and the other in Okanogan county in north-central Washington where the wolf population is smaller and portions of suitable habitat remain unoccupied. There is increasing understanding that a multi-species approach to predator-prey studies is relevant to account for the various interactions among apex predators and their prey.

To implement a system-based approach, the Department and University of Washington project personnel are attempting to capture and radio-collar 50 elk and 65 white-tailed deer in NE Washington, 100 mule deer in the Okanogan, and 10 cougars in each study area. The project will also attempt to maintain at least two active GPS collars on wolves in each project study pack. Research efforts were initiated in December 2016 and are slated to continue through 2021. Ungulate capture efforts began in late-January 2017 and the capture crew was able to aerial-dart and collar 34 elk in GMUs 117 and 121. Additional elk will be captured and collared in the winter of 2017/18.

Management Concerns

Federal, state, and private land managers have implemented numerous road closures in recent years that have likely benefited this herd by reducing human disturbance in areas that provide quality elk habitat.

The special permit hunt on TNWR was created to address habitat damage by elk on the Refuge. Elk counts were low during the annual aerial survey in the Turnbull area the past two years. However, reported sightings and increased damage complaints to agricultural crops in the area suggest this was due in part to movement of elk out of the area in response to drought and hunting pressure rather than a true population decline. Future surveys will consider revising the survey area to reflect recent known activities of these elk. The Department will continue to work with TNWR to assess the hunt and if it is accomplishing its objectives.

Management Conclusions

According to harvest estimates and public perception, elk numbers seem to be either stable or slightly increasing within the Pend Oreille sub-herd area. Recent wildfires will likely improve habitat conditions that favor elk.

According to harvest estimates and landowner perceptions elk numbers seem to be increasing within the Spokane sub-herd area. The Department will continue to allow harvest of any elk during the general season for all weapon types in the Spokane sub-herd range, as well as GMU 124 in the Pend Oreille sub-herd range, to help balance these elk populations with landowner tolerance.

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South Rainier Elk Herd

ERIC HOLMAN, Wildlife Biologist

Introduction

The South Rainier elk herd is located in west-central Washington and consists of 5 GMUs including 503 (Randle), 510 (Stormking), 513 (South Rainier), 516 (Packwood), and 667 (Skookumchuck) (Figure 1).

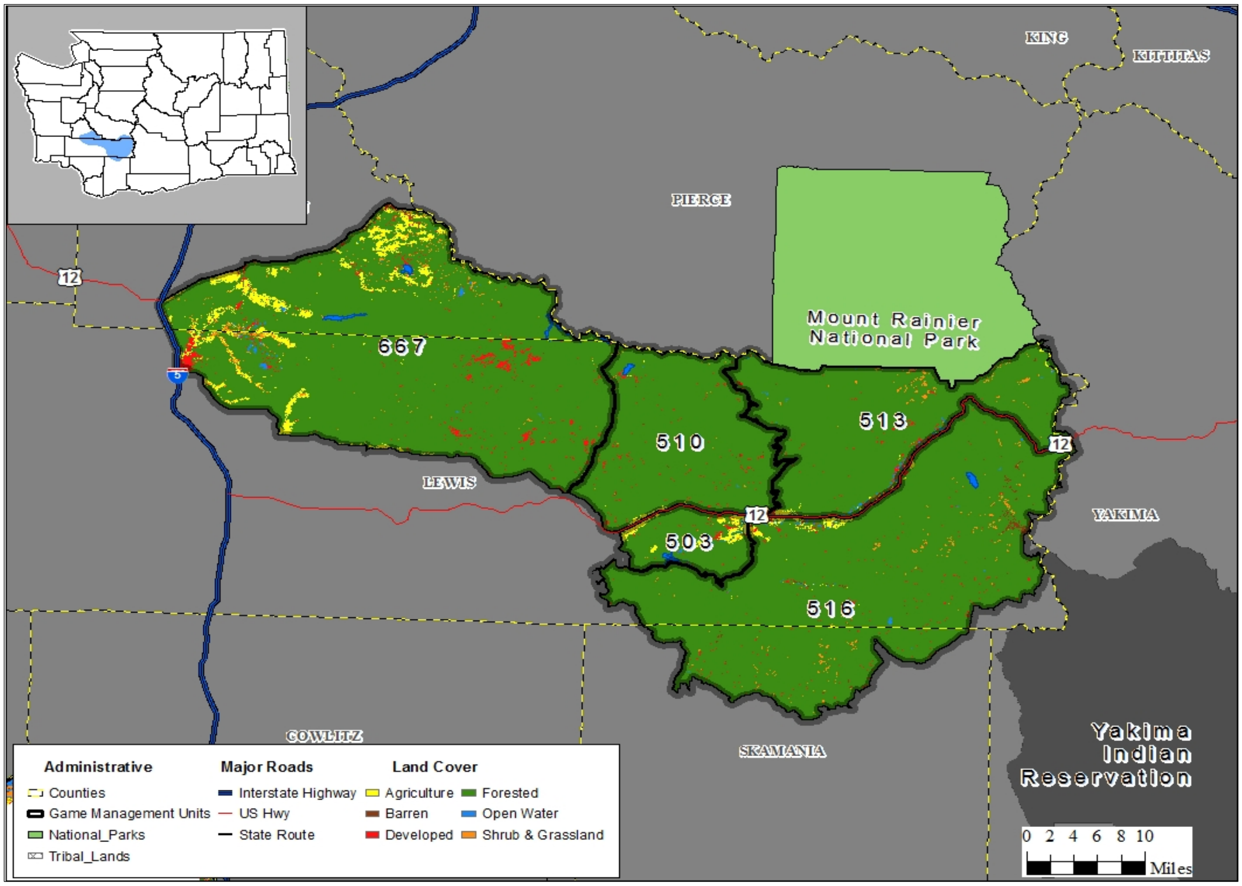

Figure 1. Dominant land use cover types within the 5 game management units that comprise the South Rainier elk herd area.

Management Guidelines and Objectives

The Department identified a management objective of 3,000 elk in the South Rainier Elk Herd Plan (WDFW 2002), however, the plan is overdue for a revision and management objectives may be out of date. In addition, the Department has not identified a formalized monitoring strategy to estimate elk abundance and herd composition in the South Rainier elk herd area. Because the Department has not identified a comprehensive monitoring strategy that is representative of the entire herd, we primarily depend on harvest data to make inferences about population trend.

Population Surveys

The Puyallup Tribe of Indians conducts aerial composition surveys and estimates elk abundance in the upper Cowlitz River basin using a sightability model they developed specific to that area (Gilbert and Moeller 2008). The surveys are conducted in early spring and include portions of GMUs 503, 510, 513, and 516. The results of these surveys are illustrated in Figure 2 (Moeller 2017).

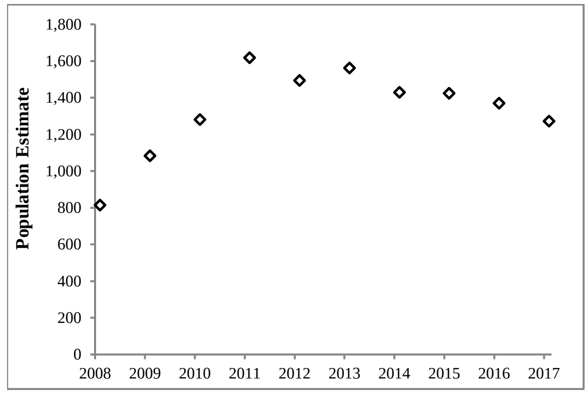

Figure 2. Sightability corrected estimates of total elk abundance in the Cowlitz River Basin, 2008–2017, which includes portions of GMUs 503, 510, 513, and 516. Data are collected and provided by the Puyallup Tribe of Indians.

The Department has also collaborated with the Muckleshoot Indian Tribe, the U.S. Geological Survey, National Park Service, and Puyallup Tribe of Indians to estimate elk abundance in the high alpine meadows of Mount Rainier National Park (MRNP) (Lubow et al. 2015). However, those surveys only include a small portion of the South Rainier elk herd (<550 elk). Additionally, it is unknown what proportion of those elk move outside MRNP, what portion may join either the Yakama or North Rainier Herds, or what portion could be included in the spring survey conducted by the Puyallup Tribe.

The Department has also periodically conducted late winter surveys on the Centralia Mine portion of GMU 667 since 2010. Survey results produce an average bull:cow ratio of 11:100 while the calf:cow ratio averaged 21:100.

Hunting Seasons and Recreational Harvest

The Department limits most general season harvest opportunities in the South Rainier elk herd area to branch-antlered bulls. Opportunities to harvest antlerless elk do occur during some general archery and muzzleloader seasons within GMUs 503 and 667 and by permit in areas where the Department's objective is to maintain low elk numbers. Estimates of annual General State Harvest and Total State Harvest (general and permit harvest combined) have averaged 275 and 323 elk respectively, from 2007–2016 while estimates of Total Harvest (Total State + Tribal) have averaged 386 elk during this time span. All three harvest estimates varied annually 2006–2012, but have been more stable 2013–2016 (Figure 3). Estimates of hunter effort have been stable 2011–2016 (Figure 3). Estimates of hunter success (expressed as catch per unit effort; CPUE) varied annually 2007–2012 but stabilized during 2013–2016 (Figure 3).

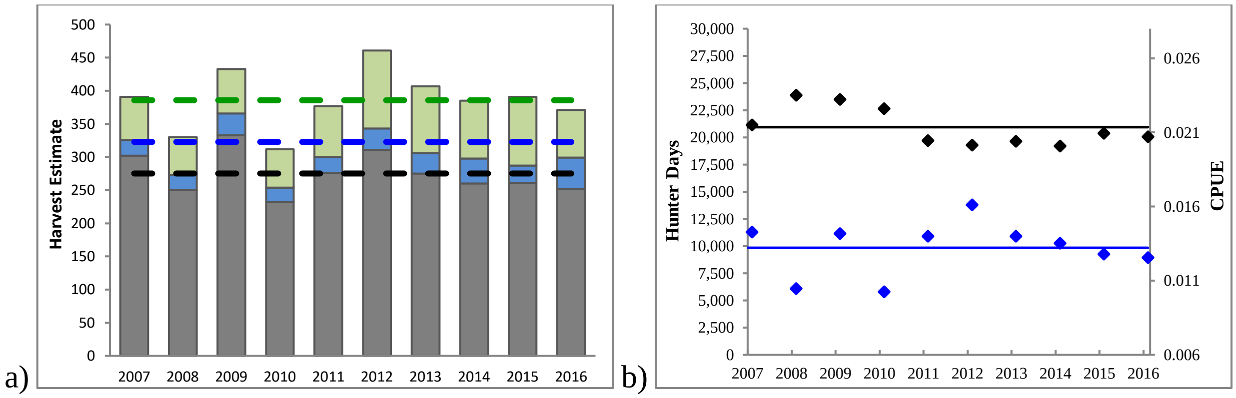

Figure 3. General State Harvest (grey), Total State Harvest (blue), and Total (State + Tribal) Harvest (green) estimates in the South Rainier elk herd area, 2007–2016 (a). The dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates of hunter days (♦) and catch-per-unit-effort (CPUE) (♦), 2007–2016 (b). Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

Survival and Mortality

Common predators of elk that occur throughout the South Rainier elk herd area include black bears and cougars. At the time of this writing, there were no documented wolf packs within the herd area (WDFW et al. 2017).

Severe winter events rarely affect the South Rainier elk herd. However, extreme drought conditions that persist through summer and fall have the potential to reduce the availability of high quality forages that elk rely on to accrue adequate fat stores for winter.

There have been no recent studies to monitor the survival of elk in the South Rainier elk herd area.

Habitat

The majority of the South Rainier elk herd area consists of lands administered by the U.S. Forest Service (USFS). The remainder of the herd area is comprised of private industrial forestland, State Department of Natural Resources (DNR) forestland, national park land, agricultural areas, and suburban/rural residential land use. The herd continues to benefit from the creation of early seral habitats on private industrial forests and DNR forests.

The industrial forestlands consist of a mosaic of clearcuts, relatively open young regeneration stands, dense second growth stands of timber, and stream buffers lined with second-growth forest. Industrial timber management practices benefit elk by increasing the quantity of early seral habitats and the subsequent forage base. While beneficial to elk, management practices are not conducted to purposefully increase or improve elk habitat. Additionally, intensive forest management practices including the planting of dense stands of fast-growing conifer seedlings and the application of herbicides during re-establishment of the timber stand may also be affecting overall productivity due to reduced forage quality and availability. These effects work in tandem by reducing the amount of favorable plants available as forage in the early term and completion of forest canopy closure (typically approximately age 12), far earlier than would occur in a naturally regenerated stand. The magnitude of those effects is influenced by site specific types of post-timber harvest treatments and plant compositions; and the number of years since timber harvest. A commonality among all of these varying factors is that the best quality and most quantity of favorable forage seems to occur approximately 3 to 14 years after timber harvest whether herbicide treatments are applied or not. However the differences between available, favorable forage in that time period for treated and untreated stands can still be substantial. A full treatise on the complexity of these habitat interactions is beyond the scope of this report and we refer the reader to Ulappa (2015) and Geary et al. (2012) for a more comprehensive understanding of this research.

In contrast, very limited timber harvest on federal forests in the last three decades has led to a generally declining trend in habitat quality for elk. Forest thinning projects have partially offset the losses of quality habitat on USFS lands. These projects have been cooperative efforts among the Puyallup Tribe, the Rocky Mountain Elk Foundation, and USFS. Since 2004, 1,366 acres have been enhanced through thinning, weed treatments, and slash piling. Additional thinnings are scheduled for 2017-18 (Moeller, 2017).

A large number of elk in the South Rainier elk herd area concentrate on the valley floor in the Upper Cowlitz River Basin during winter. However, the continued development of this area for agricultural, recreational, and housing purposes continues to result in a loss of critical winter habitat. Currently, elk numbers in the Upper Cowlitz River Basin are higher than some segments of the public would prefer.

Human-Wildlife Interaction

Complaints of damage to agricultural crops occur within the range of the South Rainier Elk Herd. The most severe conflicts are concentrated in the upper Cowlitz River valley and the Hanaford area. In the upper Cowlitz River, a narrow band of low-elevation privately owned land is surrounded by mountainous and forested public and industrial forestland. The upper Cowlitz valley is winter range for elk and their presence is most common in winter and early spring but persists year-round. Elk damage complaints in this area have persisted for many years and are unlikely to be abated given the juxtaposition of attractive food sources and large amount of forestland. A variety of crops are impacted by elk damage but most of the damage is on hay fields.

Wildlife Conflict Specialists work closely with agricultural producers by developing Damage Prevention Cooperative Agreements (DPCAs), which identify a plan to reduce the amount of damage incurred to crops using non-lethal and lethal methods. Non-lethal methods of discouraging elk use are a very important component to reducing elk damage and are generally attempted prior to the use of lethal response. Conflict Specialists and landowners use a variety of non-lethal methods including: electrified fladry fencing; noisemakers (birdbangers, critter gitters, propane cannons); hazing and herding on foot, with a vehicle or with a dog; scarecrow-like electronic devices; and odor-based repellents such as Plantskyyd.

Lethal methods of deterring elk are also used to reduce damage to crops. These efforts include hunts within specified elk areas, pools of Master Hunters, Youth and Hunters with Disabilities for immediate response to damage issues, as well as landowner damage permits. See Table 1 for a summary of permits issued to landowners allowing the taking of elk causing agricultural damage in the South Rainier Elk Herd during 2016-17. Collectively, these hunts are designed to decrease the number of elk causing damage and/or to haze elk from the area.

Table 1. Number of Permits to lethally remove elk causing damage to agricultural crops and resulting number of elk removed, South Rainier Elk Herd, 2016-17.

Game Management Unit	Permits Issued	Elk Removed
503	0	0
513	8	5
516	7	4
667	21	19
Total	**36**	**28**

In addition to conflicts with agriculture, elk in the Upper Cowlitz River Valley are regularly in close proximity to people. This situation is most acute in the town of Packwood where elk are abundant within the city limits, presenting a challenging scenario where many residents very much enjoy the presence of the animals but others do not. A County ordinance does not allow the use of firearms in town so these animals are not hunted, which has created a refuge effect allowing the elk to feed and loaf in town without fear of humans. Because the elk are somewhat habituated to people, direct interaction among elk and people is not uncommon.. Additionally, the elk commonly present a hazard along State Highway 12.

Management Concerns

Treponeme-associated hoof disease

Treponeme-associated hoof disease (TAHD) of elk results in abnormal hoof growth, cavitating sole ulcers, and in severe cases, eventual sloughing of the hoof capsule. Elk severely affected by TAHD often have reduced mobility and condition. Consequently, it seems reasonable to assume they would have a reduced probability of survival or reproductive potential. However, it is unknown how TAHD affects the population dynamics of herds where TAHD occurs; this is the focus of ongoing research. The Department is also conducting research to better estimate the distribution and prevalence of TAHD. To learn more about the Department's efforts associated with investigating TAHD, please visit the Department's hoof disease webpage: http://wdfw.wa.gov/conservation/health/hoof_disease/

Habitat Conditions on Federal Lands

Habitat conditions on federally managed lands within the South Rainier Elk Herd Area are of concern. Large-scale fire, timber harvest, disease, or other succession resetting events are largely absent from the federal lands. The resulting landscape is dominated by closed-canopy forest, much of which was harvested from roughly 1950-1990 and subsequently replanted with dense Douglas fir trees. These stands provide little in the way of elk forage and lack the diversity and forage resources of either older or younger forests. While some forest thinnings have been completed and do provide more robust forage resources at least temporarily, elk forage and likely elk populations will continue to be suppressed in GMUs 513 and 516.

Fee-Only Hunting Access Restrictions

The largest industrial forestland owner within the South Rainier Elk Herd area implemented a fee-only access system for hunting and other recreation on their lands several years ago. This system limited the number of individuals allowed access to these lands and has continued in the years that have followed. The ramifications of this limited access to elk hunting opportunity are difficult to quantify as the landowners don't own entire Game Management Units, some individuals elect to pay the access fee, some individuals elect to hunt in another area, and some may decide to quit hunting. Ramifications of reduced hunter access and participation are twofold in as much as it impacts the Department's goals to maximize recreational access to wildlife and likely reduces hunter participation and recruitment, therefore undermining capacity to manage elk and other wildlife.

Conflict with Agricultural Land Uses in the Upper Cowlitz River Valley

The situation of conflict among agricultural land uses and elk in the Upper Cowlitz River Valley is not likely to conclude in the near term. The close proximity of relatively abundant elk on forestlands surrounding the valley with attractive food resources likely guarantees that these conflicts will continue. Furthermore, large-scale habitat changes such as forest fires or extensive timber harvest on the federal lands, which could generate improved habitat conditions and draw elk away from the valley floor, are unlikely to occur in the near future. However, the forest industry including the USFS have begun to reconsider fuel loading and fire management practices in the face of the megafires of the 21^{st} century (Natl. Acad. Sci., Eng., Med. 2017). Large amounts of funding that would be needed for extensive fencing of agricultural areas is not available and even if funding was available, installation of large-scale fencing would restrict wildlife movement, require maintenance, and be aesthetically unappealing.

Management Conclusions

Harvest data, WDFW winter surveys, spring surveys conducted by the Puyallup Tribe of Indians, and surveys of alpine habitats on the south side of Mt. Rainier National Park all indicate a stable elk population. While none of these methods provides a comprehensive index of the elk population in the South Rainier Herd area, together they do serve as a surrogate means of monitoring the population. Nonetheless, development and implementation of a method to monitor the entirety of the South Rainier Elk Herd including demographic characteristics (i.e., bull and calf to cow ratios) is a management need.

Conflicts with agricultural producers, especially in the Upper Cowlitz River Valley and the Hanaford area are ongoing and will require continuing attention from Wildlife Conflict staff. Additionally, the development of bacterial hoof disease in southwest Washington elk has the potential to impact elk in the South Rainier herd area. The extent of the disease in the South Rainier herd area is not known but the condition is extensive in both the Mt. St. Helens herd area and Willapa Hills herd areas to the south and west. Research on the condition is currently being conducted in the St. Helens Elk herd area and may shed light on management options in the South Rainier herd.

An updated herd plan is needed for the South Rainier herd. The existing plan is now more than 10 years old and does not reflect current conditions. Specifically, the plan was written before the presence of hoof disease in southwest Washington elk and prior to the organizational change of hiring wildlife management staff to specifically address wildlife-human conflicts. Finally, the existing plan prescribes an elk population goal of 3,000 but there is no method currently available to monitor the entire population.

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Willapa Hills Elk Herd

ANTHONY NOVACK, Wildlife Biologist

Introduction

The Willapa Hills elk herd is located in southwest Washington and consists of 12 GMUs (Figure 1), which includes 501 (Lincoln), 504 (Stella), 506 (Willapa Hills), 530 (Ryderwood), 658 (North River), 660 (Minot Peak), 663 (Capitol Peak), 672 (Fall River), 673 (Williams Creek), 681 (Bear River), 684 (Long Beach), and 699 (Long Island). The herd area covers more than 1.7 million acres, of which 22% is in public ownership and 78% is in private ownership. Most of the herd area, is industrial forestland, owned by a variety of private corporations. Small private timber holdings and small farms occur along the major drainages.

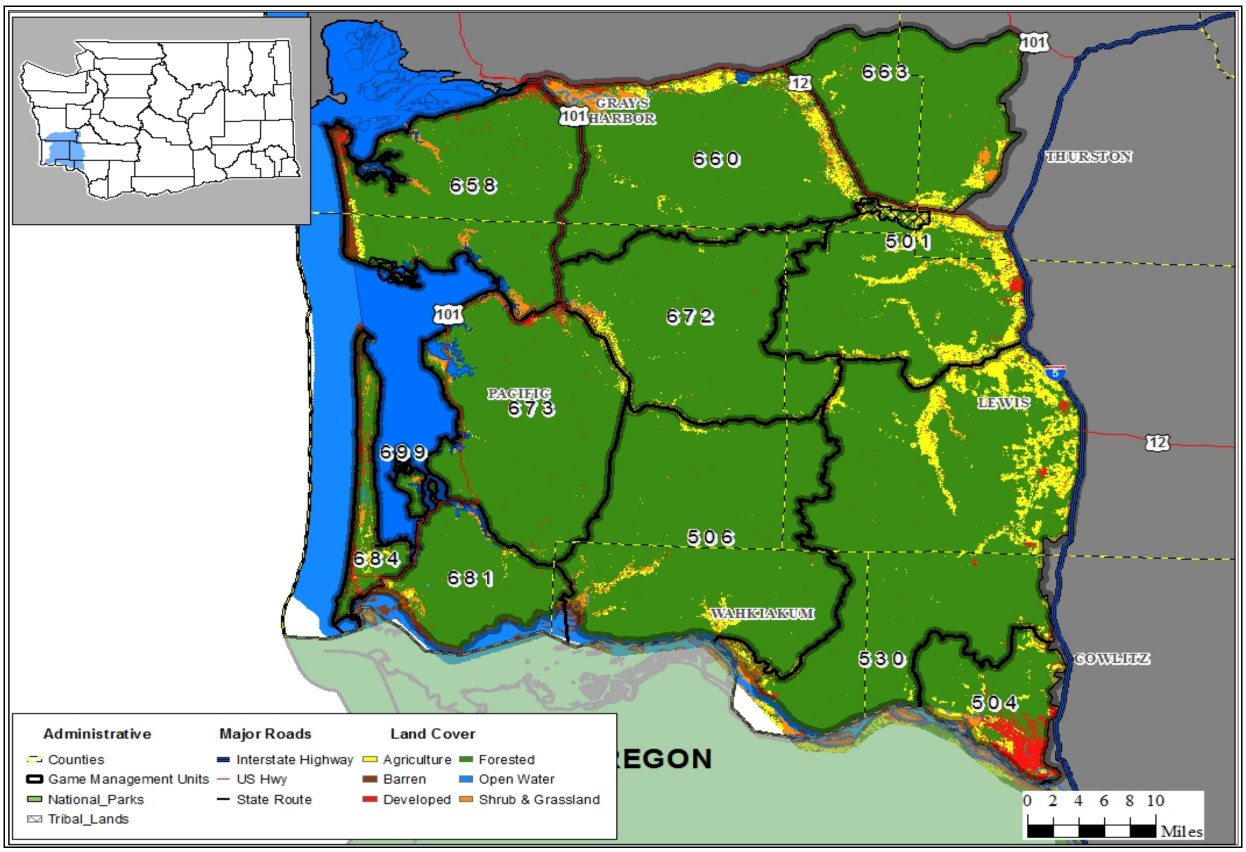

Figure 1. Dominant land use cover types within the 12 game management units that comprise the Willapa Hills elk herd area.

Management Guidelines and Objectives

The Department completed the Willapa Hills Elk Herd Plan in 2014 and identified a population objective of managing this herd for a stable to increasing population (WDFW 2014a). Additional objectives include managing for a pre-hunt population with 15–35 bulls:100 cows or a post-hunt population with 12–20 bulls:100 cows and maintaining an annual survival rate of 0.50 for bulls when bull mortality is monitored (WDFW 2014b).

Population Surveys

Historically, the Department conducted pre-hunt (August-September) or post-hunt (March-April) aerial composition surveys to assess trends in age and sex ratios. However, surveys lacked a formalized sampling design and did not account for biases that are commonly associated with observing elk in densely vegetated habitats (Samuel et al. 1987). Consequently, estimated ratios were not reflective of the entire herd and were likely biased (WDFW 2014a).

In 2014, the Department began efforts to develop a formalized sampling design that will index total elk abundance across the entire herd area using a sightability model developed for elk in the Mount St. Helens elk herd area (McCorquodale et al. 2014). That development continued into 2015. The design includes two survey areas separated by the Willapa River Valley that will be surveyed biannually.

In spring 2016, elk abundance was estimated for the survey area that encompasses the southern portion of the herd area (GMUs 506, 530, 673, and 681). The Department estimated total elk abundance to be 3,666 (95% CI = 3,151–4,512) elk. Resulting estimates of post-hunt bull:cow and calf:cow ratios were 20:100 (95% CI = 12–29) and 43:100 (95% CI = 37–48), respectively.

In spring 2017, elk abundance estimates were developed for the survey area that encompasses the northern portion of the herd area. Sampling efforts for 2017 occurred in GMUs 501, 658, 660, and 672. The Department estimated total elk abundance to be 1,269 (95% CI = 975–1,851) elk. Resulting estimates of post-hunt bull:cow and calf:cow ratios were 18:100 (95% CI = 10–26) and 41:100 (95% CI = 31–51), respectively.

Future reports will display the biannual trends for these separate portions of the Willapa Hills herd area.

Hunting Seasons and Recreational Harvest

The Department limits most general season harvest opportunities in the Willapa Hills elk herd area to branch-antlered bulls and offers most opportunities to harvest antlerless elk through our permit system. Limited opportunities to harvest antlerless elk occur during general archery seasons or in areas where the Department's objective is to maintain low elk numbers. The estimated general season elk harvest by non-tribal hunters averaged 1,154 elk since 2007. The total elk harvest, including special permits, averaged 1,354 elk in the same timeframe. Both general season and total harvest has been generally stable over the ten year timeframe. Hunter effort has declined since 2007, while catch-per-unit-effort (CPUE) steadily increased during that same period (Figure 2).

a) b)

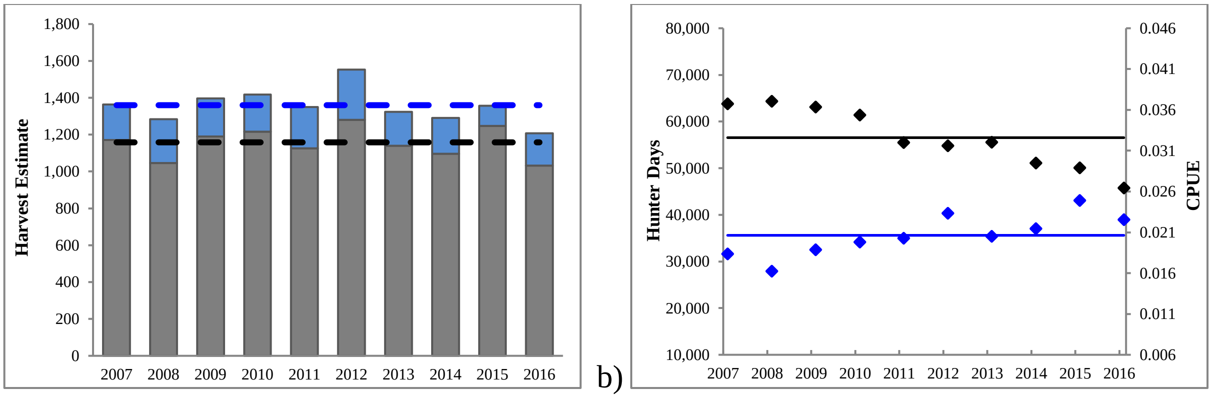

Figure 2. General State Harvest (grey) and Total State Harvest (blue) estimates in the Willapa Hills elk herd area, 2007–2016 (a). The dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates of hunter days (♦) and catch-per-unit-effort (CPUE) (♦), 2007–2016 (b). Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

Survival and Mortality

Common predators that occur throughout the Willapa Hills elk herd area include black bears and cougars. At the time of this writing, there were no documented gray wolf packs in the herd area (WDFW et al., 2017).

Severe winter conditions rarely occur that affect the overwinter survival of elk in the Willapa Hills elk herd area. However, extreme drought conditions that persist through summer and fall have the potential to reduce the availability of high quality forages that elk rely on to accrue adequate fat stores for winter.

The greatest source of mortality for bulls in the Willapa Hills elk herd is likely recreational harvest. There have been no comprehensive studies to estimate the survival of elk in the Willapa Hills elk herd area. However, the Department monitored bull survival for 78 adult bulls in GMU 673, 2005–2009 and estimated annual bull survival to be 0.37 (95% CI = 0.27–0.48), attributing 93% of all mortalities to legal harvest (W. Michaelis, WDFW, unpublished data). Poaching, wounding loss, predation, and malnutrition combined, accounted for <6% of adult bull mortality. Because this study only occurred in GMU 673 and the western third of GMU 506, estimated cause-specific mortality and survival rates may not be representative of the entire Willapa Hills elk herd.

No studies have occurred in the Willapa Hills elk herd area with the specific goal of estimating annual survival rates of cow elk. However, 22 female elk in GMUs 506 and 672 were monitored in 2001 and 2002 as part of a larger study evaluating the relationship between nutritional condition and survival of adult female elk in the Pacific Northwest. During that study Bender et al. (2008) reported a mean annual adult female elk survival rate of 0.92 (95% C.I.= 0.82–1.00).

Habitat

The majority of forestland in the Willapa Hills herd area is managed to maximize revenue from timber production. Both the privately owned industrial forestlands and, a large portion of the publicly owned lands, consist of a mosaic of clearcuts, relatively open young regeneration stands, dense second growth stands of timber and stream buffers lined with second-growth forest. This mosaic changes on a yearly basis due to ongoing timber cutting operations. Forest management practices on private industrial and state forestlands have generally benefited the Willapa Hills elk herd by creating a mosaic of habitats that increases the forage base for this herd.

Industrial timber management practices have also resulted in a high density road system that has increased human access to remote areas. A number of large industrial timber company landowners have begun restricting access to their lands. These restrictions can include land leasing and fee permit requirements which may limit the total number of hunters that access those areas.

Recently, there have been no major changes in the status of elk habitat in the Willapa Hills herd area. At a more localized scale (e.g., GMU) habitat trends are directly related to the proportion of timber stands that are in early seral stages. In recent years, logging has increased in several GMUs, which has resulted in an increase of foraging habitats within those GMUs.

Human-Wildlife Interaction

Elk damage complaints continue to be a substantial management concern in the Willapa Hills elk herd. Chronic damage persists in several GMUs across the entire elk herd area. Management actions in response to elk conflicts generally increase hunting activity at the focal damage zones. These damage zones can cover an entire GMU or, be organized into a special Elk Area. Some focal GMU's include 506 (Willapa Hills), GMU 660 (Chehalis River valley), GMUs 672 (Fall River), 673 (Willapa River valley) and GMU 684 (Long Beach). Within these GMUs, some localized elk areas have been created that target crop depredating elk. These elk areas include 5056 (Grays River Valley) and 6010 (Mallis).

Elk damage occurs on Christmas tree farms, hay and silage fields, cranberries, corn, peas, and commercial seed crops such as carrot, Swiss chard, bok choy, and other agricultural crops. Elk also damage agriculture infrastructure such as fences or irrigation systems. Overall reports of elk conflicts to agriculture for 2015 were similar to past years.

Wildlife Conflict Specialists work closely with producers by developing Damage Prevention Cooperative Agreements (DPCAs). These agreements involve nonlethal measures to prevent elk damage and increase hunter access to modify elk behavior and control group size. Nonlethal measures include herding and hazing by Master Hunters, producers, and WDFW staff, pyrotechnics, and electric fladry fencing. All DPCAs include a public hunting component to increase pressure on groups of elk causing problems. For 2016-17, Wildlife Conflict Specialists managed 34 active DPCAs and worked with many additional landowners without a DPCA. A total of 89 elk permits were issued directly to landowners with a DPCA resulting in 26 animals harvested (Table 1).

Table 1: Sum of elk related Damage Prevention and Control Agreements with associated total of elk permits issued and resulting harvest by GMU in the Willapa Hills elk herd area, 2016-17.

Game Management Unit	DPCAs	Permits Issued	Elk Removed
506	5	11	9
530	1	3	2
658	9	31	6
660	1	4	3
663	2	2	0
672	4	12	4
673	5	11	2
681	1	1	0
684	6	14	0
Total	**34**	**89**	**26**

In addition to the use of DPCAs and the issuance of elk permits to landowners, general season regulations may be liberalized to address elk conflicts within an area. Additionally, special permit seasons can be a tool to address elk conflicts within Elk areas or GMUs. Finally, the Department maintains regional pools of permit hunters that can be deployed to a property incurring agricultural damage. The regional pools of permit hunters are primarily those hunters that have achieved certification as master hunters. Master hunters who draw these permits are deployed directly by WDFW staff to address localized conflicts. Very few elk were harvested within the Willapa Hills elk herd area by this regional pool of permittees.

Research

There is no ongoing elk research being conducted within the Willapa Hills herd area at this time.

Management Concerns

Treponeme-associated hoof disease

Treponeme-associated hoof disease (TAHD) of elk results in abnormal hoof growth, cavitating sole ulcers, and in severe cases, eventual sloughing of the hoof capsule. We find TAHD afflicted elk throughout the majority of the Willapa Hills herd area. Elk severely affected by TAHD often times have reduced mobility and condition. Consequently, they would have a reduced probability of survival or reproductive potential, however, the true effects of TAHD on the population dynamics of herds is unknown. Ongoing research in the Mount St Helens herd area will attempt to identify the specific population level impacts of TAHD on elk.

The Department is also conducting research to better estimate the distribution and prevalence of TAHD. In 2014, a citizen science effort incorporated volunteers to conduct road surveys to locate elk and identify both the number of animals affected and, the geographic distribution of the disease.

To learn more about the Department's efforts associated with investigating TAHD, please visit the Department's hoof disease webpage: http://wdfw.wa.gov/conservation/health/hoof_disease/

Private Land Access

Private timber companies own >70% of the Willapa Hills elk herd land base. Consequently, recreational harvest of the Willapa Hills elk herd has largely been dependent on the willingness of these companies to allow hunters access. If these companies chose to preclude hunter access or charge increased fees, recreational hunting will decline. Since 2011, GMUs that had large quantities of private lands transferred to fee-access programs have seen large declines in hunter participation although overall harvest has remained stable.

Management Conclusions

Harvest data indicate the Willapa Hills elk herd has been relatively stable during the period of 2007–2016 although the 2016 harvest total was the lowest reported for that period of time. Survey data indicate that the Department is meeting its management objective of maintaining populations with a post-hunt bull:cow ratio of 12–20 bulls:100 cows. However, recent monitoring of bull survival rates indicates that in some GMUs, the Department may not be meeting its objective of maintaining an annual survival rate of 0.50 for bulls. Furthermore, the number of mature bulls (5 pt or better) observed during surveys is extremely low. Calf recruitment rates in recent years have been at levels that should promote population stability or growth. While these herd metrics generally indicate a robust and stable elk population; hoof disease, and fee-access systems remain concerns for the Willapa Hills elk herd.

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Yakima Elk Herd

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JASON C. FIDORRA, Wildlife Biologist

Introduction

The Yakima elk herd area is located in central Washington and consists of 11 GMUs, which includes 336 (Taneum), 340 (Manastash), 342 (Umtanum), 346 (Little Naches), 352 (Nile), 356 (Bumping), 360 (Bethel), 364 (Rimrock), 368 (Cowiche), 371 (Alkali), and 372 (Rattlesnake Hills) (Figure 1). The Yakima elk herd also includes the Rattlesnake Hills sub-herd that is located on the Arid Lands Ecology Reserve (ALE) and surrounding lands in GMU 372. The Yakima elk herd is the only herd in the state where the Department maintains a winter feeding program for elk.

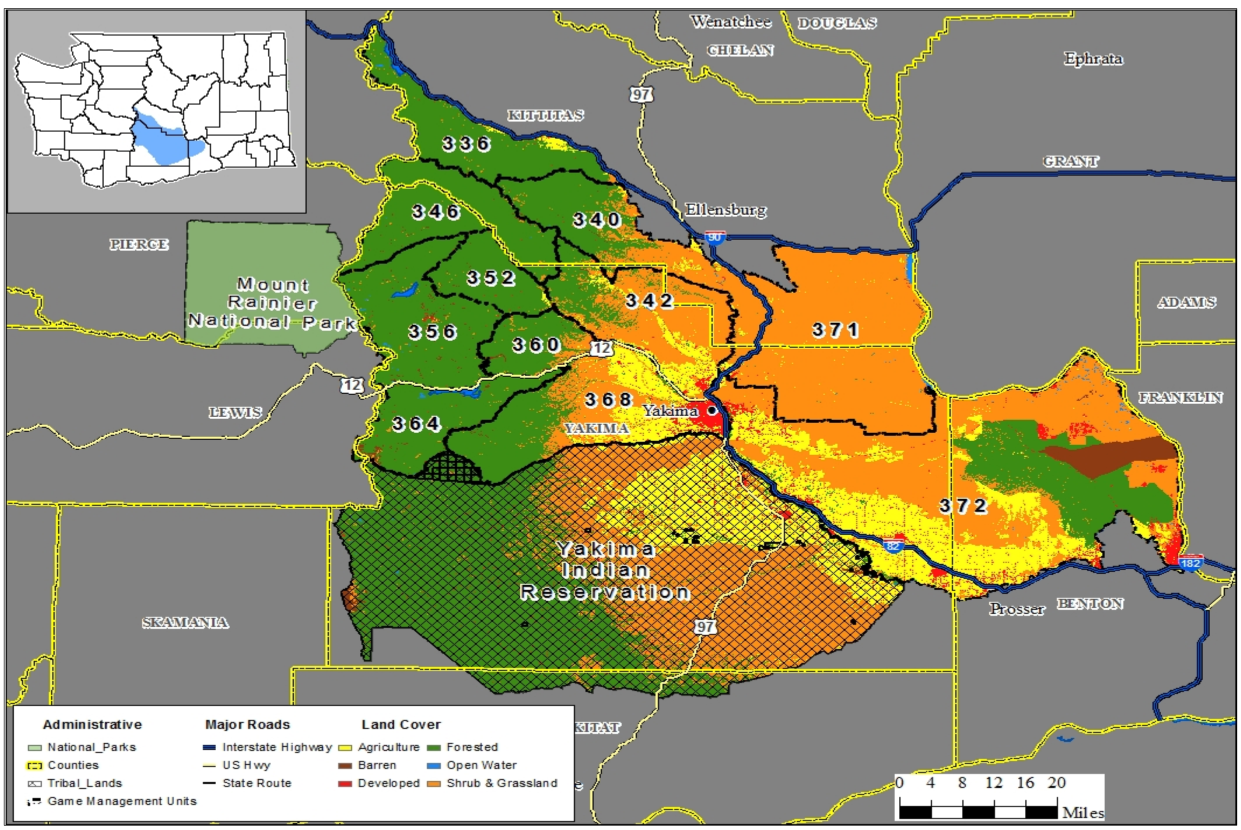


Figure 1. Dominant land use cover types within the 11 game management units that comprise the Yakima elk herd area.

Management Guidelines and Objectives

The Department's current management objective is to manage for a spring population of approximately 9,000–10,000 elk in the greater Yakima elk herd area and <350 elk in the Rattlesnake Hills sub-herd area (WDFW 2002). Additional objectives include managing for a post-hunt sex ratio of 12–20 bulls:100 cows and maintaining an annual survival rate of 0.50 for bulls when bull mortality is monitored (WDFW 2002, WDFW 2014).

Population Surveys

The Department estimates elk abundance in the Yakima herd area in spring by combining ground count data collected at established feed sites with estimates of elk abundance derived from areas adjacent to feed sites. We derive estimates of abundance and ratios in areas adjacent to feed sites by conducting helicopter surveys and using a sightability model developed for elk in Idaho to correct observed data for biases associated with effects of cover and group sizes (Unsworth et al. 1999). However, the Department did not conduct surveys in 2014 or 2015 because winter conditions were mild, and elk did not congregate at feed sites or on traditional low elevation winter ranges. In February 2017, the Department estimated elk abundance within the survey area to be 8,326 (Figure 2). Estimates of post-hunt calf:cow ratios were relatively stable 2007–2016, but fell to a record low of 22 calves per 100 cows in 2017 (Figure 2). The bull:cow ratio has been increasing in recent years. The increase is attributable to winter weather making bulls more visible, as well as decreasing cow numbers.

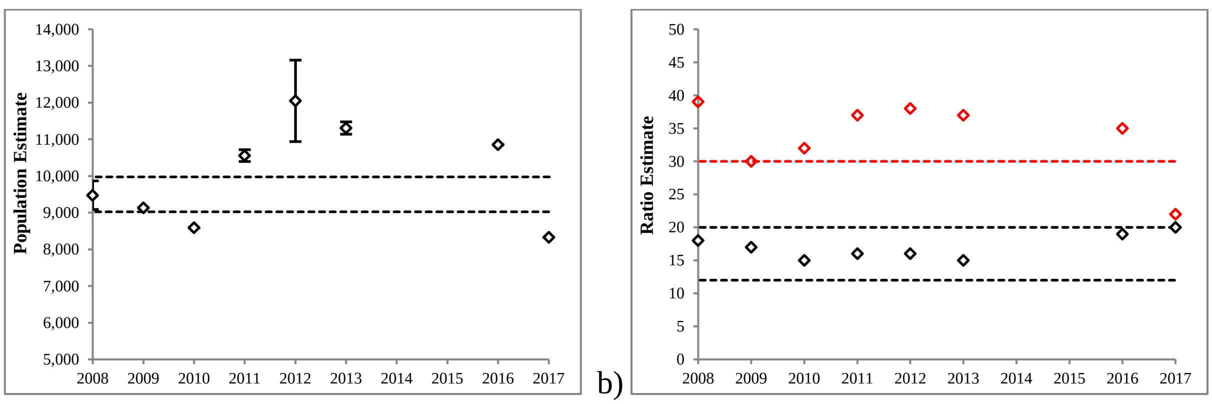
a) 

Figure 2. Sightability corrected estimates of total elk abundance with associated 95% confidence intervals in the Yakima elk herd area, 2008–2017 (a). The dashed lines represent management objectives for total elk abundance (9,025–9,975 elk). Also included are estimates of post-hunt calf:cow (◊) and bull:cow ratios (◊), spring 2008–2017 (b). The black dashed lines represent objectives for bull:cow ratios (12–20 bulls:100 cows), while the dashed red line represents calf recruitment rates that should promote herd stability or growth (≥ 30 calves:100 cows).

The Department collaborates with the U.S. Fish and Wildlife Service (USFWS) to estimate elk abundance in the Rattlesnake Hills sub-herd area using a sightability correction model developed for elk in Idaho (Unsworth et al. 1999). Starting in 2015, winter surveys switched from annual to every-other-year. Thus no survey was completed in 2016. During the last survey in January 2017, elk abundance was estimated to be 1,070 elk, which far exceeds the management objective of 350 elk (Figure 3).

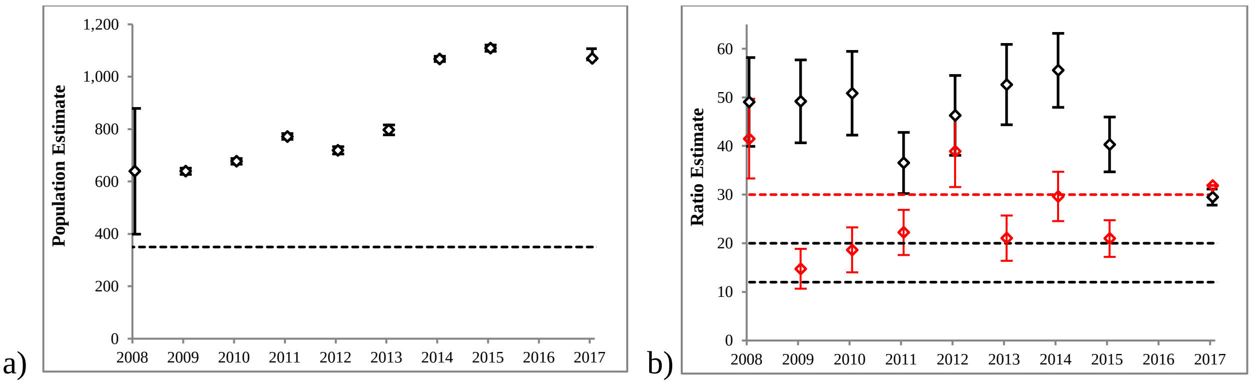


Figure 3. Sightability corrected estimates of total elk abundance with associated 95% confidence intervals in the Rattlesnake Hills sub-herd area, 2008–2017 (a). The dashed line represents the management objective of <350 elk. Also included are estimates of post-hunt calf:cow (◊) and bull:cow ratios (◊), spring 2008–2017 (b). The black dashed lines represent objectives for bull:cow ratios (12–20 bulls:100 cows), while the dashed red line represents calf recruitment rates that should promote herd stability or growth (≥ 30 calves:100 cows).

Hunting Seasons and Recreational Harvest

The Department restricts most general season opportunities to harvest elk to spike bulls and offers opportunities to harvest branch-antlered bulls under special permits in all GMUs. The Department generally focuses most opportunities to harvest antlerless elk in areas associated with private land to help alleviate agricultural damage risks or where surplus antlerless elk exist.

Estimates of General State Harvest and Total State Harvest have averaged 867 and 1,575 elk, respectively, 2007–2016. Both estimates have varied annually (Figure 4).

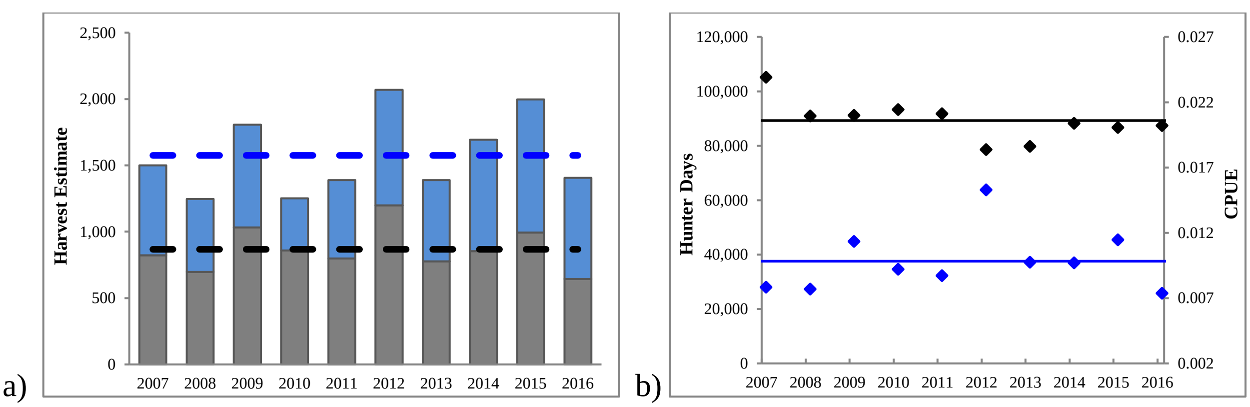


Figure 4. General State Harvest (grey) and Total State Harvest (blue) estimates in the Yakima elk herd area, 2007–2016 (a). The dashed lines associated with harvest estimates represent the 10-year mean of each estimate. Also included are estimates (b) of hunter days (♦) and catch-per-unit-effort (CPUE) (♦), 2007–2016. Estimates of CPUE were generated using estimates of hunter effort and elk harvest during general modern firearm, muzzleloader, and archery seasons combined.

Survival and Mortality

Common predators of elk that occur throughout the Yakima elk herd area include black bears and cougars, but black bears are more abundant in forested habitats. At the time of this writing, there were no documented wolf packs in the herd area (WDFW et al. 2017).

The Yakima elk herd had never been historically prone to winter mortality. This is partially due to up to 70% of the herd being fed in severe winters. That appears to have changed in the last 2 winters. The magnitude of the population decline was documented in 2017. Winter mortality was observed in 2015-16. Drought in the summer of 2015 may have been a factor affecting the amount and the quality of available forage moving into the winter. Some winter mortality was also observed in 2016-17. Substantial antlerless hunting opportunity was also at play in the fall of 2015 and 2016. It is not believed that the 2016-17 mortaltiy was as severe as 2015-16; continued monitoring will be conducted in the 2018 surveys.

The Department (S. McCorquodale, WDFW, unpublished data) monitored the survival of adult female elk and branch-antlered bulls in the Yakima elk herd area, 2003–2006, and estimated bull survival to be 0.63 (95% CI = 0.52–0.73). Estimated cow survival was 0.58 (95% CI = 0.39–0.75) in GMUs 336, 340, 342, and 346 in 2005 and 0.83 (95% CI = 0.73–0.90) during 2003, 2004, and 2006. Estimated cow survival across other portions of the herd area and across all study years was 0.88 (95% CI = 0.84–0.92). WDFW documented causes of mortality for 69 elk during that study and attributed 88% of all mortalities to human causes; one (<2%) mortality was attributed to predation (S. McCorquodale, WDFW, unpublished data).

Habitat

The USFS and Washington Department of Natural Resources (DNR) manage the majority of summer range within the Yakima elk herd area. Habitat quality for elk varies across these ownerships depending on land management and underlying land cover types. A large portion of the herd migrates to wilderness areas, where the only factor impacting habitat is fire. In recent years, the USFS has opted to let some fires burn, which has increased long-term habitat quality. Outside wilderness, the USFS has emphasized reducing the potential for large fires by thinning and underburning. The impact of the thin/burn projects on elk habitat can vary, but should increase forage availability. The main concern is the high road-density in many areas and reduced security cover. Elk may avoid large areas, even if forage quantity/quality increases. WDFW is now “treating” some of their lands with the goal of stands resilent to fire. Large tracts of open forest may result in elk distribution different than currently observed.

Human-Wildlife Interaction

In 2016-17, there were 140 damage/kill permits issued and 27 estimated elk harvested in the core Yakima herd.

The Rattlesnake Hills subherd population remains well above management objectives and crop damage is a constant concern amongst producers near the Arid Lands Ecology reserve that provides refuge for the majority of the subherd year round. There is no Department elk feeding near the Rattlesnake Hills. Conflict section staff work with landowners on preventative control efforts and lethal removal of elk to deter elk from visiting croplands that include wheat, orchards, and vineyards. In 2016-17, 218 damage prevention and 18 kill permits were issued to landowners in the Rattlesnake sub-herd area, resulting in a minimum harvest of 71 elk. In addition to these permits, the use of non-lethal deterrants and public hunting have reduced conflict despite an increasing elk population over the past decade.

Management Concerns

The Yakima elk herd had been at or above objective for much of the last decade and has been very productive. The surplus of elk allowed for significant recreational opportunity, including antlerless harvest. Recreational harvest, drought, and severe winter weather the past 2 winters have contributed to reduced herd size and ultimately hunting opportunity. The herd has historically rebounded quickly after poor recruitment years. It will likely take some time to bring elk numbers back to objective. This may mean reduced antlerless opportunity for the next few years.

There are often questions about the winter feeding program and if there are ways to get elk to move from feedsites to natural winter range. WDFW owns or leases (from DNR) much of the available elk winter range. One of the management issues with elk feeding is human disturbance. Feedsites are closed to all access, but away from feedsites winter range is open to recreation throughout the winter. WDFW lands were originally obtained for elk and deer winter range, but these areas have become very popular for recreation. Elk seek security from human disturbance and would likely concentrate on closed areas even if they were not fed. Closing access to winter range can be controversial. For the foreseeable future, a large portion of the Yakima elk herd will be fed when winter dictates the need.

The trend of managing lands for fire resiliency may lead to more open stands with little security for elk. This is expected to result in a change in elk distribution. When elk do enter high road density areas with minimal cover during hunting seasons, there will be increased harvest. Managing for a specific harvest to meet populations goals could become more difficult.

Management Conclusions

Recent survey data indicate the Department is meeting its management objective of maintaining a population with 12–20 bulls:100 cows in the post-hunt population. The low calf recruitment seen in the 2017 surveys is not expected to continue. Recent survival studies also indicate the Department is meeting its management objective of maintaining annual bull survival at >0.50. The Rattlesnake Hills sub-herd remains well above objective because hunting is not allowed on ALE or the adjacent federal Hanford Site, which limits the Department’s ability to manage this sub-herd.

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Mountain Goat

Mountain Goat Status and Trend Report

STATEWIDE

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Management Guidelines and Objectives

The population monitoring objective for mountain goats is to be able to detect i) substantial declines in population size reliably within a 4-year period, and ii) increases sufficient to justify an increase in harvest opportunity within a 4-year period. The harvest objective is to provide recreational hunting opportunities in individual mountain goat herds that have been documented as large and robust enough to support it, while at the same time goat population size remains stable or increasing. Specific guidelines for managing harvest within sustainable limits are discussed in WDFW (2014). The harvest guidelines are to limit harvest opportunity to 4% or less of the total population (excepting kids) in contiguous areas containing 100 or more mountain goats, and limit harvest of nannies (females) to 30% or less. In a refinement of the "4% , 30%" guidelines, WDFW has begun revising permit limits every 3-years, with reference to whether or not the previous 3-years' harvest of females has exceeded 1.2% of the total estimated local population (excepting kids). Mandatory carcass inspection, instituted in 2015, has increased the accuracy of our knowledge of female harvest, as well as provided valuable information on ages, disease status, and location of harvests.

Population Surveys

With one exception, surveys were conducted using a helicopter and generally occurred between July and late August. (Surveys in the Lake Chelan area have recently been using winter-time boat-based surveys). For most surveys, the total number of goats on an area-wide basis was estimated using a sightability correction model (Rice et al. 2009) developed specifically for use in Washington State. Because the funding level was not sufficient to survey all goat units, priority was given to hunted units.

Hunting Seasons and Recreational Harvest

Mountain goat hunting opportunity in Washington is limited by permit. Permit availability (and therefore hunter opportunity) decreased substantially beginning in the late 1990s (Figure 1), and is currently considerably lower than during the 1980s (which, in turn, was a reduction from the peak years of permit availability during the 1960s and 1970s, Rice and Gay 2010). Twenty-nine (27 general permits, 1 raffle and 1 auction permit) were available in 10 goat management units in 2015. The 2015 mountain goat season provided 47 days of mountain goat hunting (September 15 to October 31; except that archery hunters, auction, and raffle permit hunters' seasons began September 1). Hunters were able to use any legal weapon and harvest any adult goat with horns greater than 4 inches (although hunters were encouraged to select billies (males).

Of the 29 permits available in 2013, 25 were reported used by hunters. These hunters reported harvesting a total of 21 goats. Estimated success (including raffle and auction hunts) of hunters using their permits was thus 84%. Three of the four unsuccessful hunters had permits for the East Olympic Mountain unit; the other had a permit for the Avalanche Gorge area of Mt. Baker.

Given the sensitive nature of mountain goat populations (Rice and Gay 2010) and their generally small sizes (see Population status and trend analysis, below), only goat populations that are surveyed annually, and meet or exceed population guidelines described in WDFW 2008 are considered for recreational hunting.

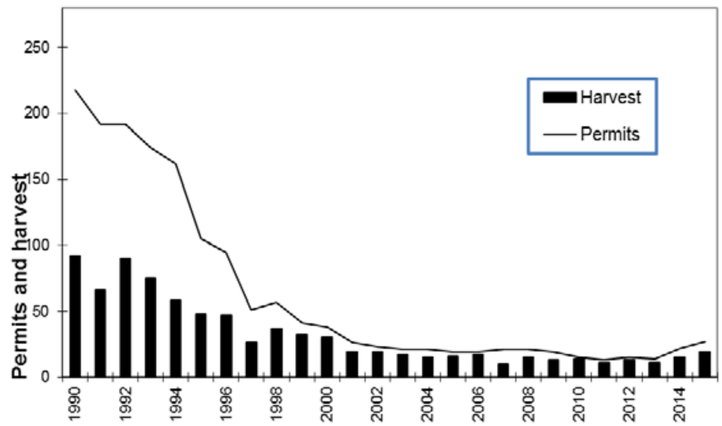

Figure 1. Special permits (line) and mountain goat harvests (vertical bars) in Washington, 1989-2015.

Survival and Mortality

Mountain goat populations have declined in Washington relative to estimated historical levels. Goat populations within the state were considered by Johnson (1983) to have exceeded 10,000 animals (including those within federally-managed areas; within state-managed areas, the guesstimate was 8,555) as recently as 1961 (although documentation for these numbers is weak). Rice (2012) estimated 2,815 (with lower and upper estimates of 2,401 and 3,184 respectively) within Washington during the period 2004-07, of which about 800 were in areas not managed by WDFW. As of 2014, our best estimate is that mountain goats within Washington numbered approximately 3,590 (lower and upper bounds of 2,840 and 3,340). Of these, about 750 live primarily within National Parks. Hunting opportunity has responded accordingly, and current permit levels represent 4% or less of estimated population in herds that are stable or increasing, and which have been surveyed routinely. Despite the overall declining trend in goat numbers and range, a few populations are doing well. Goat populations around Mt. Baker, along the lower Cascade crest, in Goat Rocks, and along the north shore of Lake Chelan appear to be stable, and populations in the Naches Pass and Bumping Units may be increasing. Goat populations south of Darrington in the Boulder River Wilderness have increased to the level where a modest hunting season was initiated in 2015. There are suggestions that goats are recovering southeast of the Boulder River Wilderness, as well as on Glacier Peak. Mountain goats have recently been documented as increasing (from essentially none to approximately 150) in and around Mt. St. Helens.

Habitat

Fire suppression policies and natural forest succession continues to degrade critical mountain goat foraging habitat. Fire suppression allows conifers to invade these natural openings and decreases their foraging value for goats. The degradation and loss of alpine meadows, coupled with increasing recreational human use and disturbance of alpine habitat are likely the two greatest negative impacts to mountain goats. Climate change may pose challenges of an uncertain nature for mountain goat populations in the future.

Management Conclusions

The largest obstacles to effective mountain goat management are i) a consistent funding base to assess the status of goats, ii) difficulty of estimating the size and defining biologically-meaningful boundaries of individual herds, and iii) the existence of large areas of suitable goat habitat where goats are absent. Management activities are now being directed toward a goat translocation project to begin rebuilding goat populations in areas of vacant suitable habitat within the Cascade Mountains.

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Mountain Goat Status and Trend Report: Region 2

Chelan County

DAVID P. VOLSEN, Wildlife Biologist
DEVON COMSTOCK, Wildlife Biologist

Management Guidelines and Objectives

The statewide management goals for mountain goats are to ensure healthy productive populations and native habitats, to provide opportunities for a wide range of non-consumptive uses, and to enhance populations to provide sustained recreational hunting opportunities. Statewide mountain goat strategies recommend that prior to a population being hunted, that it be surveyed to determine its population size and trend, and that the population numbers a minimum 100 goats within the management unit. For stable or increasing goat populations meeting these guidelines, harvest is limited to no more than 4% of the total population (excluding kids), with harvest of females below 1.2% of the estimated population excluding kids (WDFW 2014).

Population Surveys

As part of a hydropower license agreement, the Chelan Public Utility District (PUD) annually completes 12 winter wildlife surveys by boat on Lake Chelan along both north and south shores. For Lake Chelan, the total number of known goats is the result of comparing results from all surveys completed during each winter. This is the only annually collected, long-term data for Chelan County mountain goats (Pope and Cordell-Stine, 2016). However, the varied and rugged terrain as viewed from the lake makes sighting and correctly classifying mountain goat age and sex difficult, and contributes to high variability in the composition data. Kid numbers and ratios might also be biased high due to the large number of unclassified mountain goats recorded in the surveys.

Low snowfalls in recent years have created difficult conditions in which to survey. Without adequate snowfall, goats do not move down to lower elevations where observation increases. Surveys during mild winters, such as 2014-15, return low counts that will bias population estimates downward if not accounted for. As a comparison to ongoing boat-based survey methods, we conducted a helicopter-based aerial survey using sightability correction to estimate goat numbers in a subsection of habitat on the North Shore Lake Chelan. Although this winter's survey was not exhaustive, results showed that large numbers of goats occupying habitat in the survey units were not available for observation from a boat-based survey platform. The aerial sightability survey returned an estimate of 91 goats with a 90% confidence interval of 74 – 108.

Winter counts conducted along driven survey routes in mountain goat areas in other sections of Chelan County returned increasing numbers over time, which suggests that the population is increasing. Additionally, a volunteer led survey effort, using hiking routes, sought to determine presence of goats in portions of the Alpine Lakes Wilderness for which we have no data. Results were promising, finding goats in several areas where their presence and numbers were unknown. This effort has helped document the current mountain goat distribution and will aid in the design of future helicopter based surveys. Priority should be given to acquiring population data using helicopter sightability protocols on goat populations within the East-central Cascades zone as its population, once verified, will likely support harvest opportunities (Table 2).

Hunting Seasons and Recreational Harvest

Until 2001, no goat harvest had occurred in Chelan County in over 20 years. In 2001, 2 permits were authorized for North Lake Chelan, and 2 male goats were harvested (Table 1). Only one permit was issued each year from 2002-2008, with permits again increased to two in 2009. Hunter success has increased recently with nine goats taken in the last three years. Rugged terrain and remote wilderness with restricted access limits hunter success and makes finding adult males difficult. Of the 18 goats harvested since 2001, six have been nannies (33%).

Table 1A: Summary of Mountain Goat Harvest for North Lake Chelan, 2001-2016

Year	Permits	Hunters	Harvest	Male	Female	Success	Goats Seen/Hunter	Days Hunted
2001	2	2	2	2	0	100	24	6
2002	1	1	0	0	0	0	0	20
2003	1	1	0	0	0	0	12	8
2004	1	1	1	1	0	100	3	3
2005	1	1	0	0	0	0	25	15
2006	1	1	0	0	0	0	0	1
2007	1	1	0	0	0	0	27	12
2008	1	1	1	0	1	100	25	8
2009	2	2	2	2	0	100	17	8
2010	2	2	2	2	0	100	35	5
2011	2	2	2	0	2	100	35	9
2012	2	3*	3*	2	1	100	52	7
2013	2	3*	1*	1	0	0	60	0
2014	2	2	2	1	1	100	1	12
2015	2	1	0	0	0	0	0	0
2016	2	2	2	1	1	100	-	14
Table 1B: Summary of Mountain Goat Harvest for South Lake Chelan, 2012-2016								
2012	1	0	0	0	0	0	0	0
2013	1	1	1	1	0	100	20	6
2014	1	1	0	0	0	0	11	0
2015	1	1	1	1	0	100	-	6
2016	1	1	1	1	0	100	-	10

*Includes Raffle/Auction hunter harvest

Table 2. Mountain goat counts in Chelan County, 2000-2016.

Area	North Lake Chelan*	South Lake Chelan*	Stehekin	Chiwawa	North Wenatchee Mtns	East Stevens Pass	Total
2000-01	68	31	6		35		140
2001-02	44	28	2	12		1	87
2002-03	71	39		19		18	147
2003-04	72	56					128
2004-05	118	49					167
2005-06	91	57	4				152
2006-07	75	102					177
2007-08	104	76					180
2008-09	95	66		15	23	20	219
2009-10	81	128		9	69	22	309
2010-11	78	94		8	38	10	228
2011-12	43	116			71	12	242
2012-13	74	103			56		233
2013-14	45	50			78		173
2014-15	76	45			117		238
2015-16	65	50			142		257
2016-17	29	40					69

* Data from Chelan PUD Lake Surveys.

A single permit will continue to be issued for the South Lake Chelan unit. The unit has only been open for hunting since 2012. Hunters have harvested three male goats in the 5 years this unit has been open. Difficult access to areas with goats is the main factor in the low success rate.

Mountain goat populations within the East-central Cascades (Chiwawa, East Stevens Pass, North Wenatchee Mtns, and Stehekin) are not surveyed intensively enough to confidently estimate their population size, and are currently closed to hunting. Surveys conducted since 2008 via driving and hiking routes suggest that goat numbers in the North Wenatchee Mountains Unit are increasing, and warrant formal helicopter sightability surveys to develop a population estimate.

Survival and Mortality

Mountain goat populations in Chelan County remain below historic levels of the 1960s. Observational data suggest that numbers are increasing from historical low numbers of 30 years ago. The Lake Chelan population (which the Chelan PUD has monitored since 1982) appears, roughly, to be stable (Table 3). Kid: adult ratios appear adequate for population growth, averaging 26 kids:100 adults. Boat-based survey observations averaged 93 goats (range: 69-110), with 26 kids:100 adults (range: 21-26) over the last three years. Goat counts for the Lake Chelan population have decreased over the last 4 years, although it is unknown if this is a true population decline or a problem with boat-based visibility, which causes high sighting variability. In the helicopter-based survey, a total of 76 goats were observed, with a sightability-corrected point estimate of 91 (90% CI = 73-109 goats, see Rice et al. 2009). In comparison, the maximum count from boat-based surveys along the north shore was 44 (Pope and Cordell-Stein 2015). These results provide justification for our assumption the population is larger than the boat-based surveys indicate. As well, the substantial variability of counts obtained during repeated boat-based counts reveals their limitations.

Table 3. Mountain goat population composition for Lake Chelan, Chelan County, 2001-2016 (from Chelan PUD Lake Surveys). Data are cumulative high counts from a seasons surveys.

Year	Adults	Kids	Total Count	Kids:100 adults
2001	60	14	74	23
2002	89	21	110	24
2003	103	25	128	24
2004	138	29	167	21
2005	120	29	149	24
2006	129	48	177	37
2007	113	26	139	23
2008	92	24	116	26
2009	133	39	172	29
2010	92	39	131	42
2011	116	33	149	28
2012	111	31	142	28
2013	42	7	49	17
2014	81	20	101	25
2015	84	22	110	26
2016	38	8	69	21
Average	96	26	124	26

Habitat

Fire suppression during the last 50 years has decreased habitat for mountain goats in Chelan County. Most mountain goat habitat is within wilderness areas and is managed by Okanogan-Wenatchee National Forest. Wilderness designation precludes most forms of habitat alteration, with changes in habitat condition occurring from forest fires. Fires are anticipated to reduce habitat initially, but increased forage post-fire will be beneficial to mountain goats. Over the last decade, several major fires in the Lake Chelan Basin (both shores), and North Wenatchee Mountains (Icicle and Tumwater Canyons) have burned substantial mountain goat habitat and range. The subsequent increase in early seral stage vegetation and forage may have contributed to the increase in mountain goat counts during the same time period (both in terms of increased production and visibility). The fires of summer 2015 may provide an additional opportunity to test this hypothesis.

Research

A statewide mountain goat research project was initiated to determine habitat use, seasonal range, population status, methods of survey, and population limiting factors in 2002. There were 3 adult nannies fitted with GPS collars during 2004 in District 7. One was collared on Nason Ridge, and one each on the North and South Lake Chelan Units. In 2005-2006, all goats were found to concentrate their activity in 4-5 mi^2 areas near their capture locations.

Insight was also gained on gene flow and interaction between populations. This was highlighted by two nannies collared on Gamma Ridge on Glacier Peak who traveled 10-12 miles east to the south shore of Lake Chelan. Any potential hunting opportunity offered in South Lake Chelan would have to take into account the potential harvest of goats from Region 4 as well. In addition, in fall 2006, 3 goats collared on Gamma Ridge were found in the Chiwawa region of Chelan County.

Management Conclusions

Mountain goat populations in Chelan County are below historic levels, thus the most of their populations are not hunted. Population trends in areas outside the Lake Chelan area cannot be effectively monitored without additional survey resources. Based on Chelan PUD survey data, average kid production is gradually increasing in both the north and south shore populations. Resources are being directed to formalize helicopter sightability surveys near Lake Chelan to produce a sightability-corrected abundance estimate (Rice et al. 2009) and compare that with boat survey data. Additional emphasis should be placed on new surveys in different section of District 7's mountain goat habitat, particularly those in the East-central Cascades to better understand trends in mountain goat populations and their distribution.

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Mountain Goat Status and Trend Report: Region 2

Methow

SCOTT FITKIN, Wildlife Biologist
JEFF HEINLEN, Wildlife Biologist

Management Guidelines and Objectives

The Methow unit (Goat Unit 2-2) is currently being managed for population growth and increased distribution. We encourage the public to take advantage of watchable wildlife opportunities at the salt lick along the Hart's Pass Road and on Grandview Mountain just northwest of Palmer Lake.

Population Surveys

As resources allow, we conduct annual surveys to determine minimum population size and herd productivity. These data are used to generate hunting permit allocations in accordance with statewide management guidelines. Poor survey conditions and timing produced a small sample size in 2009. Similarly, weather forced the 2013 survey outside of the preferred seasonal window and resulted in the classification of only 26 animals with a ratio of 40 kids per 100 adults. Limited resources precluded surveys in 2014 and 2015. Surveys occurred in 2016 with good conditions and timing; however, only 38 goats were observed (Table 2).

Table 2. Population composition counts from the Methow Unit.

Year	Kids	Yearling	Adults	Minimum Population	Kids:100 Adults
1995	--	--	--	--	--
1996	16	--	41	57	39
1997	20	--	49	69	41
1998	--	--	--	--	44
1999	--	--	--	--	--
2000	11	--	36	47	31
2001	10	--	50	60	20
2002	19	--	61	80	31
2003	8	--	45	53	18
2004	13	17	52	82	*25
2005	18	13	65	96	*28
2006	7	5	31	43	*23
2007	18	5	38	61	*47
2008	--	--	--	--	--
2009	5	--	13	18	*38
2010	--	--	--	--	--
2011	--	--	--	--	--
2012	--	--	--	--	--
2013	6	5	15	26	*40
2014	--	--	--	--	--
2015	--	--	--	--	--
2016	10	2	26	38	*38
2017	--	--	--	--	--

*Starting in 2004 adults and yearlings were classified separately. Prior to 2004 yearlings were classified as adults. Therefore, the ratio K:100 has changed to exclude yearlings starting in 2004.

Hunting Seasons and Recreational Harvest

Over the long-term mountain goat populations have declined significantly in some portions of the North Cascades. Research findings suggest historical hunting levels may have been unsustainably high for goats. As a result, statewide mountain goat management guidelines do not recommend harvest permits until surveys indicate a population size of at least 100 goats in a population management unit. Limited resources caused a gap in survey data over a five year period and resulted in the suspension of harvest in the unit for 3 years (2009-2011) (Table 1). Anecdotal reports during this time suggested a total Methow Unit population of over 100 animals, and possibly some limited range expansion. As a result, a single annual harvest permit was offered in both the 2012 and 2013 seasons. Due to subsequent surveys yielding low numbers of animals, harvest has been suspended since 2014.

Survival and Mortality

This unit had been monitored closely from 2000-2007 with a stable population being observed. Since 2009 surveys suggest a decline in the population size. Continued annual aerial counts in very early summer will be needed to adequately document the status and trend in this population. Incidental observations outside of the traditional hunting unit verify that small numbers of goats are persisting in pockets scattered throughout suitable habitat in the Okanogan District. Little survey work has been done in these areas due to lack of resources. Population size and trend are unknown for these animals.

Table 1. Summary of harvest information for mountain goats in the Methow Unit.

Year	Permits	Hunters	Harvest	Success	Goats seen/hunter
1995	8	8	8	100%	31
1996	8	8	5	63%	8
1997	5	5	4	80%	20
1998	5	5	3	60%	22
1999	5	5	4	80%	32
2000	5	5	5	100%	23
2001	2	2	0	0%	11
2002	2	2	1	50%	26
2003	2	2	2	100%	31
2004	2	2	1	50%	26
2005	2	2	1	50%	48
2006	2	1	1	100%	23
2007	2	1	1	50%	4
2008	2	2	2	100%	38
2009	--	--	--	--	--
2010	--	--	--	--	--
2011	--	--	--	--	--
2012	1	1	1	100%	11
2013	1	1	1	100%	16
2014	--	--	--	--	--

Habitat

Goats in the Okanogan District dealt with an average snow pack during the 2016/2017 winter. Goat habitat is almost entirely within secured areas and habitat availability remains stable. Habitat quality varies noticeably throughout goat range in the Okanogan District due to past wildfires of varying ages. For instance, regenerating burns in the Handcock Ridge area are improving forage conditions in this portion of the Methow Unit. Conversely, the fire in the Mt Gardner area is now over 25 years old and forage conditions may have passed the peak post-fire conditions. Overall, the unit is currently characterized by a mosaic of successional stages. Much of the district's goat habitat is in wilderness areas. As a result, changes in habitat quality will occur primarily through natural, unpredictable events such as wildfires and avalanches, rather than human intervention.

Management Conclusions

Management objectives should continue to focus on population growth and distribution expansion. Resources are needed to allow for a consistent and methodical survey effort annually in late June to better determine population size and trend.

Significant differences in productivity between the north and south portions of the unit may be developing. Limited data from telemetry and survey flights suggests fairly minimal interchange occurs between the two herd segments. In addition, suitable goat habitat adjacent to this unit is sparsely populated and could likely support more animals than exist currently. Efforts to augment the Methow Unit with goats from Washington's Olympic Mountains are planned for the near future. The goal of this augmentation is to boost genetic diversity and improve overall population numbers. Also, the Handcock Ridge band spends significant time west of the Cascade Crest to the northwest of the Methow Unit boundary, and occupied goat range extends beyond the unit boundary to the south. As a result, redrawing and/or splitting the Methow into two units extending across administrative district boundaries should be explored.

Mountain Goat Status and Trend Report: Region 3

Blazed Ridge, Bumping River, Naches Pass

JEFFREY A. BERNATOWICZ, Wildlife Biologist

Management Guidelines and Objectives

The statewide goals for mountain goats are:

1. Preserve, protect, perpetuate, and manage mountain goats and their habitats to ensure healthy, productive populations.
2. Manage mountain goats for a variety of recreational, educational, and aesthetic purposes including hunting, scientific study, cultural and ceremonial uses by Native Americans, wildlife viewing and photography.
3. Enhance mountain goat populations and manage for sustained yield.
4. For populations to be hunted, a minimum of 100 goats older than kids.
5. Harvest should not exceed 4% of a stable population (defined as animals older than kids), with no more than 30% of the harvest being females.

Population Surveys

Tables 1-4 show annual survey results for mountain goat units.

Hunting Seasons and Recreational Harvest

Mountain goat seasons are open only to hunters drawing a special permit. In 2016, there were 6 permits distributed among 2 units (Tables 1-3) in Region 3. Eight goats were known harvested (including 1 Tribal harvest), 5 were reported as billies. All 3 nannies harvested were from Naches Pass.

Survival and Mortality

The status of mountain goat populations is assessed using aerial surveys (Rice et al. 2009) and, as an ancillary data source, interviews with hunters, guides, and other people knowledgeable about local mountain goats.

All goat populations in the Region probably declined from historic levels due to over-harvest. WDFW planning calls for harvests being no more than approximately 4% of the adult (older-than-kid) population. Goats were historically managed with more liberal permit numbers and with harvest rates often over 10%. Since 1996, harvest has been more conservative and populations are increasing in the Bumping River as well as Naches/ Corral Pass. There is no obvious trend in Blazed Ridge. Blazed Ridge is more forested than others and bands of goats may be easily missed. However, observed recruitment in Blazed ridge has been fairly low. The trend for Kachess Ridge is unknown, as no surveys have been conducted since 2005.

Habitat

The majority of goats in the Bumping and Naches Pass areas spend summers in wilderness areas where short- term, habitat is mostly influenced by weather cycles. However, fire suppression has reduced open meadow habitat in wilderness areas. Recent insect outbreaks have killed timber, making these areas prime for a large fire. Recreational use could also be influencing use of available habitat. There is no comprehensive documentation of where these goats winter. Outside the wilderness, timber harvest and road building may impact habitat.

The Blazed Ridge and Kachess Units are mostly outside wilderness areas. Timber harvest continues in both units. The north portion of the Blazed Ridge unit has been particularly heavily logged. The timber cutting has probably improved summer habitat, but may have removed winter cover. Road and trail densities have also increased. There are often roads at the top and bottom of every ridge. Off-road vehicle use and general recreation is heavy in the Blazed Ridge unit.

It is unknown how goats react to roads and human activity, which have increased with Washington's population. Major highways (e.g., I-90) have probably limited movements among herds over time. Smaller highways and developments (e.g., ski areas) could also limit movement and use of some areas. This may limit re-colonization and recovery of some areas and may have long-term implications for genetic diversity.

Management Conclusions

Goat populations in Region 3 have generally been increasing since harvest has been restricted to 4%. Hunters have generally been good at selecting billies, and recruitment in recent years has been good. The last 2 winters have been moderate, but no surveys were flown, so the effects are unknown. The Blazed Ridge Unit is a mystery. Population estimates for Blazed Ridge have varied between 46 and 104 goats the last 5 years. The large swings are larger than would be expected from survey-related sampling variation alone, and may reflect movements in an out of the survey area.

Unit boundaries may not correspond to biological populations. It is likely that gene flow occurs among all goats south of I-90. Hunting units have changed over time. Previously, Blazed Ridge was lumped with Naches Pass. Lines have arbitrarily been drawn in the past, using little knowledge of population structure or movements. In recent years, this led to a conservative harvest. Following decades of overharvest, it was prudent to be conservative. Now that populations are recovering, it may soon be time to revisit objectives for populations and harvest. For units south of I-90, there were an estimated 440 total goats and 306 adults in 2015. A 4% take quota would have allowed 12 permits instead of 6 had the population been viewed at a larger scale. The estimate of 440 goats likely remains biased low. The visibility correction model (Rice et al. 2009) can only adjust for groups of goats seen, and not all groups are seen within a unit on a given survey. Surveys do not cover all habitats. The northwest 1/3 of the Bumping unit is not surveyed, and the unit abuts Mount Rainer National Park. Groups of goats are known to cross the boundary. That said, local overharvest can occur if harvest – particularly of nannies - is concentrated within a small area, even if it numerically sustainable on a larger geographic scale.

North of I-90, the Kachess unit was probably the smallest in the state and has limited habitat. It is unlikely the unit ever had 100 adult goats. A meaningful subdivision of the population would probably stretch between I-90 and Hwy 2. The entire area has never been surveyed, but observations suggest there are well over 100 adult goats between these highways. If surveyed, there may be justification for additional hunting opportunity.

Guideline #5 (4%) may be overly general. Game populations are much more impacted by female harvest than male harvest. Other states use a point system, where harvest of females is accounted for differently than harvest of males. The initiation of mandatory carcass inspection following harvest has allowed WDFW to begin using a point system that accounts for the demographic distinction between harvesting billies and nannies.

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Table 1. Harvest and surveys for Bumping River (Mountain goat Unit 3-7).

Harvest Information				Survey Data (for 2009 and later, figures represent points estimates from sightability-corrected model; Rice et al. 2009)			
Year	Permits	Hunters	Harvest (of which, females in parentheses)	Kids	Older than kids	Total	K:100
2001	2	2	2	14	46	60	30
2002	2	2	2	25	52	77	48
2003	2	2	2	24	59	83	41
2004	2	1	1	16	39	55	41
2005	2	2	2	32	66	98	48
2006	2	2	2	15	39	54	38
2007	2	2	1	9	40	71[a]	22
2008	2	3*	3*	15	53	68	28
2009	2	2	2	17	46	63	27
2010	1	1	1				
2011	1	1	1	28	75	103	37
2012	1	1	1	39	103	142	38
2013	1	1	1 (0)	43	108	151	39
2014	2	2	1 (0)	No	Survey		
2015	3	3	3 (1)	44	101	147[a]	44
2016	3	3	3 (0)	No	Survey		

* Includes auction/raffle

[a] Includes unclassified/yearling

Table 2. Harvest and surveys for Naches/Corral Pass (Mountain goat Unit 3-6 and 4-38).

Harvest Information				Survey Data (for 2009 and later, figures represent points estimates from sightability-corrected model; Rice et al. 2009)			
Year	Permits	Hunters	Harvest (of which, females in parentheses)	Kids	Older than kids	Total	K:100
2001	5	5	4	3	18	21	17
2002	4	3	4	18	41	59	44
2003	3	3	3	18	62	80	29
2004	2	2	1	21	61	82	34
2005	2	2	2	40	55	95	73
2006	2	2	2	18	73	91	25
2007	2	1	1	25	67	107	37
2008	2	3*	3*	37	79	116	47
2009	1	1	1	41	106	147	39
2010	1	1	1	29	74	103	39
2011	1	1	1	37	96	133	38
2012	1	1	1	34	112	147	32
2013	1	1	1 (0)	45	104	169[a]	43
2014	2	2	1 (0)		No	Survey	
2015	3	3	3 (0)	61	125	193[a]	49
2016	3	4*	4 (3)*		No	Survey	

* Includes auction/raffle/tribal

[a] Includes unclassified

Table 3. Harvest and surveys for Blazed Ridge (Mountain goat Unit 3-10).

Harvest Information				Survey Data (for 2009 and later, figures represent points estimates from sightability-corrected model; Rice et al. 2009)			
Year	Permits	Hunters	Harvest (of which, females in parentheses)	Kids	Older than kids	Total	K:100
2001	2	3*	2*	13	40	53	32
2002	1	1	1	15	40	55	37
2003	1	2*	2*	27	66	93	29
2004	2	3*	3*	17	63	80	27
2005	2	2	2				
2006	2	2	2	30[a]	83[a]	113[a]	36
2007	2	1	1	22	56	78	39
2008	2	2	1	22	50	72	44
2009	1	1	0	15	52	67	22
2010	1	1	1				
2011	1	1	1	14	32	46	44
2012	1	1	1	26	78	104	33
2013	1	1	1 (0)	14	53	67	27
2014	1	1	1 (0)	No	Survey		
2015	0	n/a	n/a	19	80	102	24
2016	0	0	0	No	Survey		

* Includes auction/raffle

[a] Probable double count of ~15 animals

Mountain Goat Status and Trend Report: Region 4

Mt. Baker and Boulder River North Areas

FENNER YARBOROUGH, Wildlife Biologist
RUTH MILNER, Wildlife Biologist

Management Guidelines and Objectives

The management objective for mountain goat units in northern Region 4 is to maintain stable populations in all units for public viewing and harvest opportunities. Specific guidelines for managing harvest within sustainable limits are discussed in WDFW's Game Management Plan (2014). The harvest guidelines are to limit harvest to 4% or less of the total estimated population (excluding kids), only allow harvest in goat populations meeting or exceeding 100 total animals, and limit nanny harvest to 30%.

After being closed for many years, the Mt. Baker area was reopened on a limited basis for mountain goat hunting in 2007. As surveys suggested increasing populations (see previous Status and Trend reports), hunting opportunity was gradually increased (Table 1).

Beginning in 2012, mountain goat surveys in the Boulder River Wilderness Area suggested greater abundance than had been seen in the early 2000s. In 2014, mountain goats in this area were documented as having met the requirements set forward in the Game Management Plan (WDFW 2014), and a hunting season was initiated in the Boulder River North Goat Hunt Unit beginning in the 2015 hunting season. A single permit is allocated to State hunters in this unit.

Population Surveys

Population surveys were not conducted by WDFW in the Boulder River Wilderness prior to 2012, due to low population numbers in earlier years and the fact that all units within the Darrington Ranger District of the Mount Baker Snoqualmie National Forest were closed to hunting in 1995. WDFW reinitiated surveys in this area in 2012.

Beginning in 2014, WDFW went to a system of biennial surveys; thus mountain goats were not surveyed by WDFW at Mt. Baker or Boulder River in 2015. In 2016, WDFW surveys in the Mt. Baker area (Figure 1) resulted in an estimated population of 392 goats (95% CI = 372.2-412.2). Within the Boulder River North hunt unit, the total number of goats estimated during the 2016 surveys was of 159 goats (95% CI = 145.7-171.6) (Figure 2).

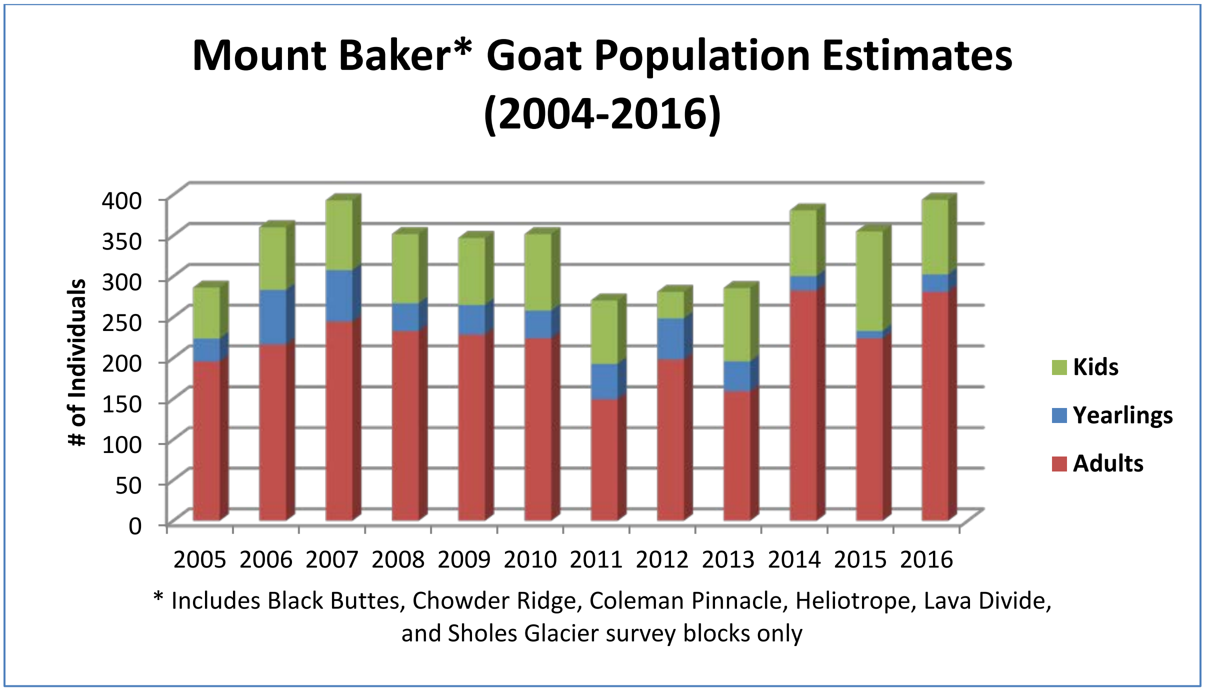

Figure 1. Results from WDFW mountain goat aerial surveys in the Mt. Baker Area from 2005-2016.

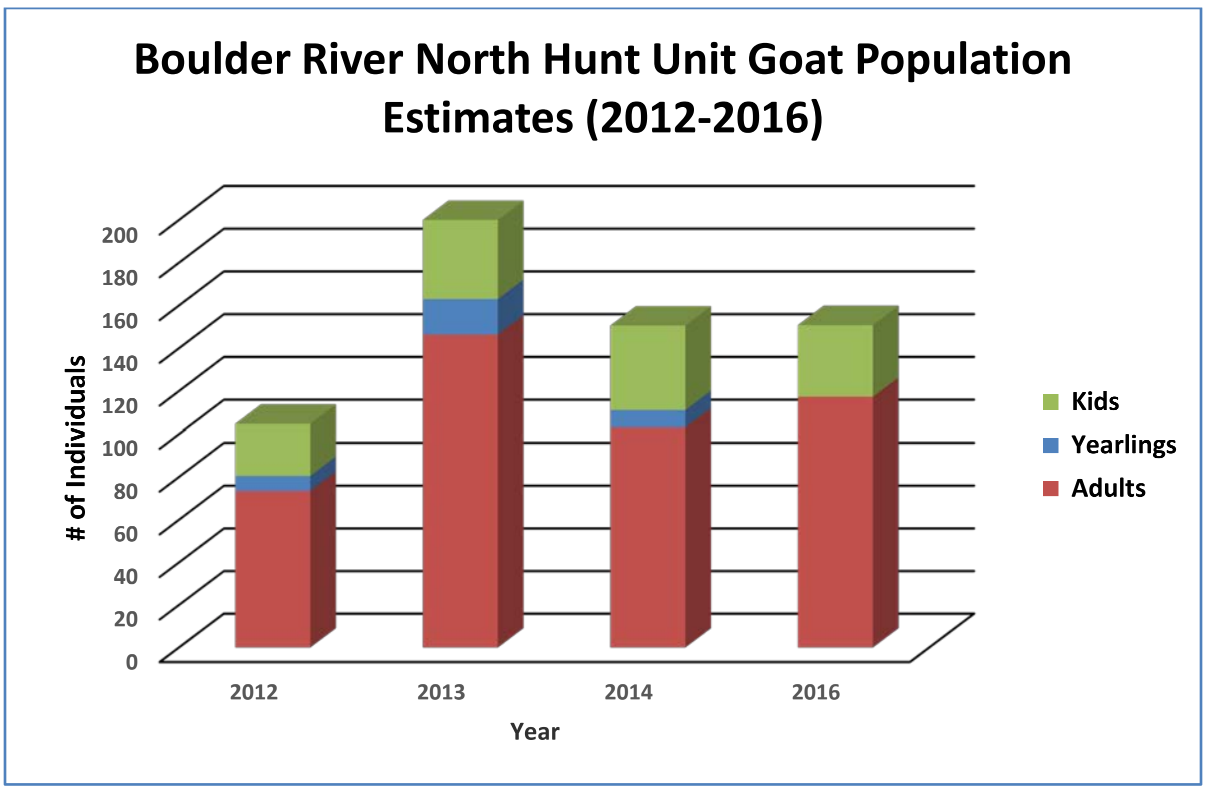

Figure 2. Results from WDFW mountain goat aerial surveys in the Boulder River North Hunt Unit from 2012-2016.

Table 1. Hunting permits, hunters, harvest, hunter success rates, and total days hunted, Mt. Baker mountain goat hunt units, 2009-2016.

Hunt Unit	Year	Permits	Hunters	Harvest	Success (%)	Days hunted
Chowder Ridge	2009	1	1	1	100	2
	2010	1	1	1	100	3
	2011	1	1	1	100	5
	2012	2	2	2	100	N/A
	2013	1	1	1	100	0
	2014	2	2	2	100	5
	2015	1	1	1	100	23
	2016	1	1	9	9	3
Lincoln Peak	2009	1	1	1	100	8
	2010	2	2	2	100	5
	2011	2	2	2	100	19
	2012	1	1	0	0	0
	2013	1	0	0	0	0
	2014	1	1	1	100	4
	2015	2	2	2	100	33
	2016	2	2	1	50	3
Avalanche Gorge	2009	1	1	1	100	1
	2010	1	1	1	100	4
	2011	1	0	0	0	0
	2012	0	-	-	-	-
	2013	2	2	1	50	14
	2014	2	2	2	100	17
	2015	3	5*	3	75	91
	2016	3	3	2	50	15
Dillard Creek	2009	1	0	0	0	-
	2010	1	1	1	100	12
	2011	1	1	1	100	9
	2012	0	-	-	-	-
	2013	0	-	-	-	-
	2014	0	-	-	-	-
	2015	0	-	-	-	-
	2016	0	-	-	-	-

Survival and Mortality

Historically, the majority of historical information regarding goat numbers and distribution has been derived from harvest report cards and questionnaires returned by permitted hunters. Historically, goat management units 4-2, 4-3, 4-4 and 4-5 collectively encompassed the Mt. Baker range in Whatcom and Skagit Counties. Harvest in these units during the period 1969-85 totaled 121 animals with an average harvest of 13 goats per season. For the period 1986-95, harvest totaled 26 animals with a 6 goat per season average. By 1996, all of the Mt. Baker GMUs were closed to hunting due to declines in harvest and goats reported by permit hunters. In 2007, Mount Baker units 4-3 Chowder Ridge and 4-7Avalanche Gorge were reopened with one permit issued per unit. This hunt opportunity has been conservatively managed since then, with the maximum annual allocation of 5 permits in 2010, 2011 and 2014. Current management direction (WDFW 2014) calls for limiting recreational harvest to no greater than 4% of the total estimated harvestable population, excluding kids. A further objective is that 30% or less of the harvest consists of females (nannies). In summer 2014, the harvestable population in the Mt. Baker area (estimated population size excluding kids, and excluding the no-closed Lake Ann survey unit) was estimated at 292.

Within the Boulder River North hunting unit, the population appears stable, with the estimated population (not including kids) exceeding 100 animals in all years post 2012 (Figure 2).

Hunting Seasons and Recreational Harvest

A rebounding mountain goat population in the Mount Baker area has recently facilitated renewed hunting opportunities in this area. In 2016, six permits were issued; three for Avalanche Gorge, two for Lincoln Peak and one for Chowder Ridge.

Reported harvest within the Mt. Baker Area for 2016 was as follows: Avalanche Gorge: 2 billies (one of which was taken by the holder of the statewide auction permit), 1 nanny, Lincoln Peak: 1 nanny, and 0 harvest in Chowder Ridge.

A single permit is available to hunt in the Boulder River North mountain goat hunt area. Since the inception of this hunt in 2015, permittees harvested one billy in each of the 2015 and 2016 hunts.

Habitat

The Mount Baker area mountain goat population has rebounded substantially since the low abundances in the 1980s and 1990s. It is currently unclear whether the increasing trend seen over the past few years can be sustained, or alternatively, if the population is reaching the capacity of the area to maintain goats. Conservative hunting, which was reestablished in 2007, appears to be having negligible effects on population size, age/sex structure, and population trend.

The majority of goats in the Mount Baker area are within the Mount Baker Wilderness area on the Mount Baker-Snoqualmie National Forest and the adjacent North Cascades National Park. Federal land management restrictions are protective of habitat qualities critical for the maintenance of a robust mountain goat population. However, this area has seen an increase of recreational uses including hiking, backcountry skiing, and snowmobiling. Discussions on goat management between WDFW and the Tribes are ongoing and remain a high priority.

The Boulder River North unit lies within the Boulder River Wilderness managed by the Darrington District of the Mount Baker/Snoqualmie National Forest. This area is seeing a population rebound similar to the increases seen on Mount Baker, suggesting that habitat quality in this area of the North Cascades is sufficient for mountain goats.

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Mountain Goat Status and Trend Report: Region 5

Goat Rocks, Smith Creek, Mt. St. Helens

STEFANIE BERGH, Wildlife Biologist

Introduction

Region 5 of the Washington Department of Fish and Wildlife (WDFW) contains multiple areas inhabited by mountain goats. Two mountain goat population management units have been monitored aerially in recent years; Smith Creek (Goat Unit 5-3), and Goat Rocks/Tieton River (Goat Unit 5-4/3-9). The Goat Rocks/Tieton River Unit has historically contained one of the largest goat populations of any goat unit in the state of Washington (Rice 2012). A cooperative ground based survey for mountain goats has been initiated in the Mt. St. Helens National Volcanic Monument. Several other areas within Region 5 support mountain goats including the Mt. Adams and Dark Divide Wilderness and the Tatoosh Mountains. Individual and small groups of mountain goats are reported throughout the southern Cascades region.

Management Guidelines and Objectives

Mountain goat objectives are to manage mountain goats and their habitat to maintain or expand current population levels. In addition, mountain goats are to be managed for recreational, educational, and aesthetic purposes. Recreational management is to be consistent with a stable or increasing population.

Population Surveys

In 2015, the Goat Rocks/Tieton River Unit was surveyed aerially, yielding 310 animals observed (Table 2) and a sightability-corrected population estimate of 325 (Table 3) with a 95% confidence interval of 309 to 341. The Smith Creek Unit was most recently surveyed from the air in 2012, yielding a sightability corrected estimate of 64 goats (95% confidence interval: 48-79; Table 3). All aerial surveys were conducted using the sightability method developed by WDFW (Rice et al. 2009).

Mountain goats were formally surveyed on Mt. St. Helens and the associated Mt. Margaret Backcountry in August of 2014, 2015, and 2016. The ground-based effort involved simultaneous survey and documentation of all goat groups by multiple teams of observers at pre-arranged stations. The 2014 and 2015 surveys of Mt. St. Helens and in the Mt. Margaret backcountry yielded a minimum goat population of 63 and 150, respectively. In 2016, despite fog and low clouds impacting visibility, the survey yielded a minimum goat population of 151. The project was a cooperative effort among WDFW, the U.S. Forest Service, the Cowlitz Tribe of Indians, and volunteers associated with the Mt. St. Helens Institute. Additional surveys are planned for the Mt. St. Helens area in the future as methodology and logistics are refined. A summary of aerial and ground surveys of region 5 mountain goats over the past 10 years indicate a stable population (Figure 1).

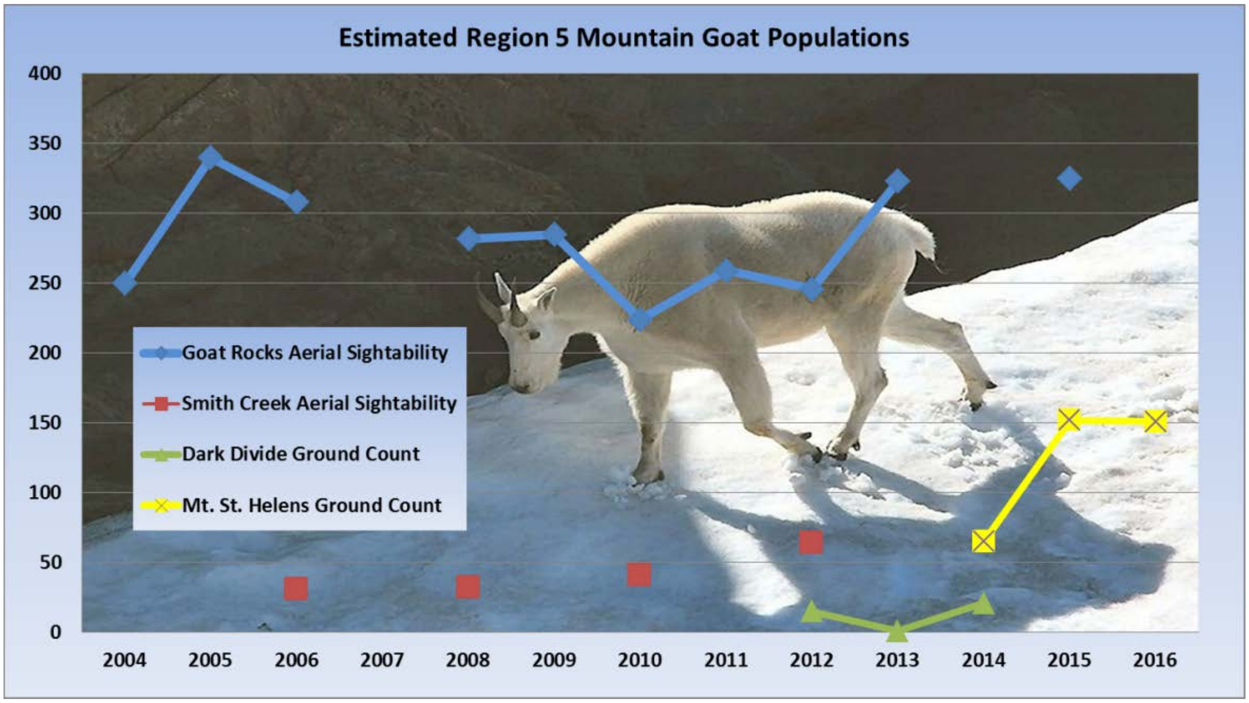

Figure 1. Estimated Region 5 Mountain Goat Populations

No additional mountain goat areas in region 5 were surveyed during 2016. This was due to a lack of funding and because no hunting permits are currently offered for these smaller populations. Unsurveyed areas populated with mountain goats in Region 5 include the Tatoosh Mountains, Dark Divide, and areas between Indian Heaven Wilderness and Mt. Adams. Finally, individual and small groups of mountain goats are commonly observed throughout the southern Cascades in Region 5.

Sightability corrected aerial surveys conducted over the past several years suggest stability in the Goat Rocks and Smith Creek goat populations. Aerial surveys conducted in the mid-2000s by WDFW indicate that mountain goat populations in the Tatoosh unit have declined.

Hunting Seasons and Recreational Harvest

Hunting opportunity for mountain goats in Washington is allowed only to those selected in the Special Permit Drawing. Those fortunate enough to draw a mountain goat tag may hunt only within a specified goat unit. During 2016, hunters were allowed to hunt only with archery equipment from September 1-14 and were allowed to use any legal weapon from September 15 through November 30. The bag limit is one goat of either sex, with horns longer than 4 inches, although hunters are encouraged to refrain from shooting nannies. Tag allocation for each unit is conservative in nature; with dual goals of providing a high-quality hunt for those successful in the permit draw and having little or no effect on the goat population.

Mountain goat studies completed by WDFW have led to a new population guideline to direct harvest management (WDFW 2015). A goat unit must have an estimated population of 100 or more to allow harvest. Furthermore, harvest levels are designed to remove 4% or less of the adult (i.e., older than kid) population (WDFW 2015). Within Region 5, only the Goat Rocks/Tieton River Unit is made up of a population large enough to support hunting under this guideline. Surveys of other areas supporting goats will be conducted periodically. Should populations surpass 100 individuals in these areas, hunts could be considered.

Five tags were offered in the Goat Rocks/Tieton River Goat Unit during 2016. Four of the permit holders reported killing a billy while one reported killing a nanny (Table 1). Information on harvest by Tribal hunters during 2016 indicated the harvest of one male and two female goats from the Goat Rocks population (NWIFC 2016). Neither the auction nor the raffle goat permits were used in the Goat Rocks/Tieton River Unit in 2016.

Table 1. Hunter Survey Summary Goat Rocks 2007-2016

Year	WDFW Permits Issued	WDFW Permit Harvest	Tribal Harvest*	Total Harvest	Total Billies Harvested	Total Nannies Harvested
2016	5	5	3	8	5	3
2015	5	4	1	5	4	1
2014	3	3	1	4	4	0
2013	3	3	1	4	3	1
2012	3	3	1	4	4	0
2011	3	4	0	4	4	0
2010	5	4	2	6	4	2
2009	5	5	0	5	5	0
2008	5	5	0	5	5	0
2007	5	3	0	3	2	1

Note: Harvest exceeded permit numbers in 2011 due to huntng by Auction and Raffle Permit holders.

*As reported by the Northwest Indian Fisheries Commission

Habitat

High elevation openings characteristic of goat habitat are being lost in the Smith Creek Unit due to conifer encroachment. Alpine meadows are critical mountain goat foraging areas. Given the limited extent of suitable goat habitat in the Smith Creek Unit, the loss of habitat represents a threat to the sustained viability of this goat population. Results of the cooperative Cispus Adaptive Management Area (AMA) project indicate that in the four study areas (Stonewall Ridge, South Point Ridge, Smith Ridge, and Castle Butte) a total of 404 acres of alpine meadow were lost in the period spanning 1959- 1990 (Kogut 1996). High alpine meadows are thought to be primarily created through disturbance such as avalanche, disease, wind-throw, and fire (Hemstrom 1979).

Periodic fire is considered to be one of the most important factors in the creation and maintenance of alpine meadow (Olmsted 1979). U.S. Forest Service policy currently dictates the suppression of both man-made and naturally occurring fires. This policy has probably resulted in the losses of alpine meadow documented in the above study. In the years since the completion of this study, the loss of meadow has likely continued. Thus, the need for restoration and preservation of these areas is paramount to continued healthy goat populations. Budgetary, logistical, safety, and other constraints in both the USFS and WDFW make the possibility of a prescribed burn program in the foreseeable future unlikely. However, naturally occurring high-elevation fires have occurred recently in areas associated with Mt. Adams and could occur elsewhere. Another possible avenue to address conifer encroachment is through the use of girdling and snag creation.

Management Concerns

Disease testing on a limited number of samples collected by hunters in 2015 revealed evidence that 1 of 19 mountain goats tested may have been exposed to the bacterium *Mycoplasma ovipneumoniae* (*M. ovi*), which is associated with pneumonia outbreaks in bighorn sheep. This serological sample was collected from a goat harvested in the Goat Rocks. In 2016, 11 goats across the state (4 from the Goat Rocks) were sampled and were negative. In 2016 both volunteers and WDFW staff conducted visual observations of goats in the Goat Rocks. The purpose of these surveys were to 1) observe goats for any signs of respiratory disease, and 2) count goats, including kids, for evidence of any unusually high levels of early mortality that might be evidence of pneumonia infection. During the surveys no mountain goat carcasses were found, nor were goats with signs of lethargy, coughing, head shaking, or other indications of respiratory disease observed. Observations made by WDFW staff observed kid:nanny ratios of approximately 0.38. Pneumonia due to *M. ovi* is believed to be the cause of a decline in at least one mountain goat population in Nevada. The significance of the positive *M. ovi*-antibody test result from a single mountain goat in Washington is not known at this time. Nonetheless, WDFW will continue disease monitoring efforts in the Goat Rocks population via samples collected by hunters and opportunistic sampling, and will continue to collaborate with veterinary researchers at Washington State University to better understand the health of mountain goats in Washington.

Management Conclusions

Mountain goats in Region 5 are valued for both viewing and hunting opportunities. Consequently, harvest quotas are kept at conservative levels to maximize both the consumptive and non-consumptive recreational attributes of these populations. Management direction dictates that two of the traditionally hunted units in Region 5 (Smith Creek and Tatoosh) remain closed until populations increase.

Raffle and auction permit holders sometimes select the Goat Rocks unit as it has one of the highest numbers of goats and has a long history of successful goat hunting. As such, harvest by raffle and auction permit holders must be factored into and considered when setting the permit level for Goat Rocks. A proposed system of multi-year quotas for each sex may address this issue and is prescribed for development in the most recent Game Management Plan (WDFW 2015). The continuation of annual aerial surveys is needed to document trends in population and productivity. In most cases, sightability-adjusted aerial surveys provide the least biased and most efficient method of population estimation, particularly considering the large expanse of area involved. However, the ground-based survey of goats associated with Mt. St. Helens and the Mt. Margaret Backcountry shows promise to become a useful method in those locations. Based upon the results of the cooperative Cispus AMA study, alpine meadow restoration in the Smith Creek Unit is recommended. Fire management in potential goat habitat will also play an important role in the expansion of goat populations outside of the Goat Rocks.

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Table 2: Raw Survey Data from Mountain Goat Flights Region 5 (2005-2015)							
Goat Unit	Year	Adult	Yearling	Kid	Unknown	Total	Kid:Adult
Goat Rocks/Tieton River	2015	224	0	86	0	310	38:100
	2014	No Survey in 2014					
	2013	234	2	72	0	308	30:100
	2012	146	22	33	0	231	23:100
	2011	205	17	31	0	253	15:100
	2010	181	14	36	0	231	20:100
	2009	170	33	73	0	276	43:100
	2008	178	23	60	7	268	34:100
	2007	No Survey in 2007					
	2006	203	14	71	0	290	35:100
	2005	188	47	66	0	303	35:100
Smith Creek							
	2014	No Survey in 2014					
	2013	No Survey in 2013					
	2012	32	4	14	0	50	44:100
	2011	No Survey in 2011					
	2010	28	6	8	0	42	29:100
	2009	No Survey in 2009					
	2008	9	2	4	2	17	44:100
	2007	28	0	6	0	34	21:100
	2006	16	6	5	0	27	31:100
	2005	15	6	11	0	32	73:100

Table 3: Sightability Corrected Mountain Goat Survey Results Region 5 (2005-2015)		
Goat Unit	Year	Population Estimate (90% CI)
Goat Rocks/Tieton River	2015	325 (309-341)
	2013	323 (307-338)
	2012	246 (232-261)
	2011	259 (250-268)
	2010	224 (213-236)
	2009	285 (274-297)
	2008	282 (No CI)
	2006	308 (291-326)
	2005	341 (322-359)
Smith Creek	2012	64 (48-79)
	2010	41 (33-49)
	2008	32 (No CI)

Mountain Goat Status and Trend Report: Region 6

Olympic Mountains

BRYAN MURPHIE, Wildlife Biologist

Introduction

Mountain goats (*Oreamnos americanus*) are not native to the Olympic Mountains. They were introduced from Alberta and Alaska between 1925 and 1929 (Johnson 1983). Introductions occurred on the northern part of the Olympic Peninsula in the vicinity of Lake Crescent near Port Angeles and were conducted primarily by the Klahhane Club, a sportsman's group in Port Angeles at the time (Johnson 1983). The creation of the Olympic National Park (ONP) in 1938 provided complete protection for the introduced mountain goats and the population thrived. The goat population expanded its distribution to areas outside the ONP boundary and by the 1980's the mountain goat population had reached an estimated 1,175 $\pm$ 171 (SE) goats throughout suitable range in the Olympics (Houston et al. 1994). Concerns over the negative effects of non-native mountain goats on endemic plant communities and soils in the ONP prompted an effort to reduce the goat population during the 1980s when 407 goats were relocated to mountain ranges outside the Olympics (Jenkins et al. 2012). An estimated 168 goats were harvested from 1980 until 1997, when the season was closed. No additional removals were conducted and recreational hunting was closed from 1998-2013.

Following a period of relative stability at low numbers for several years, the mountain goat population has increased (Jenkins et al. 2012) and mountain goats currently occupy areas within ONP and on USFS lands along the eastern portion of the Olympic Peninsula. Many of these areas are among the most popular hiking destinations in northwest Washington. As a result, concerns over human-goat conflicts and the negative effects of non-native mountain goats on endemic plant communities have reemerged. WDFW established a mountain goat permit hunt in a designated portion of the eastern Olympic Peninsula wilderness areas in 2014, in part to aid in addressing these concerns.

Management Guidelines and Objectives

Due to the issues described above, the Olympic mountain goat population is not being managed for a sustainable harvest, contrast to populations in the Cascades. Rather, the primary objective for the Olympic Mountain goat permit hunt is to provide a recreational hunting opportunity, while attempting to reduce the potential for conflicts between mountain goats and recreationists within the designated permit area by reducing the number of goats in these areas (WDFW 2015).

Population Surveys

Preliminary estimates from surveys conducted in 2016, were 634 (95% CI = 572-752) goats on the Olympic Peninsula, including ONP and USFS lands and 59 (95% CI = 53-89) goats for those areas surveyed within the designated permit hunt area (K. Jenkins, personal communication). For comparison, Jenkins et al. (2012) estimated that the mountain goat population was 344 $\pm$ 72 in 2011 within the ONP. WDFW conducted surveys within predetermined goat survey blocks in the eastern portion of the Olympics, which included USFS and ONP lands, but not the entirety of goat habitat in the Olympics in 2012 and 2014. Sightability corrected estimates of 66 (90% CI: 51-81) total goats in 2012 and 94 (90% CI: 82-112) total goats in 2014 were generated (Rice 2012; Harris and Rice 2014).

Hunting Seasons and Recreational Harvest

Recreational hunting of mountain goats in Washington State began in 1897 with a bag limit of 2 goats per year and a 3-month season (Johnson 1983). In 1913, the bag limit was reduced to 1 goat then in 1917 hunting was restricted to designated areas in the Cascades until goat hunting in Washington was closed entirely in 1925 (Johnson 1983). Mountain goat hunting by permit in designated hunt units in Washington resumed in 1948. Archery only goat permit hunts were established for three designated permit units in the Olympics in 1980; the Elwha, Quilcene and Hamma Hamma. An estimated 168 goats were harvested from 1980 until 1997, when the season was closed.

Hunting by permit was reopened in 2014 for two designated areas in the eastern Olympics, 6 permits were issued between 3 permit hunts, and 2 hunters were successful in taking nanny goats. In 2016, the two designated permit areas were combined into one large unit (Figure 1) and 6 permits were issued in a split season of 3 permits each. Of the 6 permits issued, 5 hunters reported hunting, and one hunter was successful; taking a nanny from Jefferson Peak.

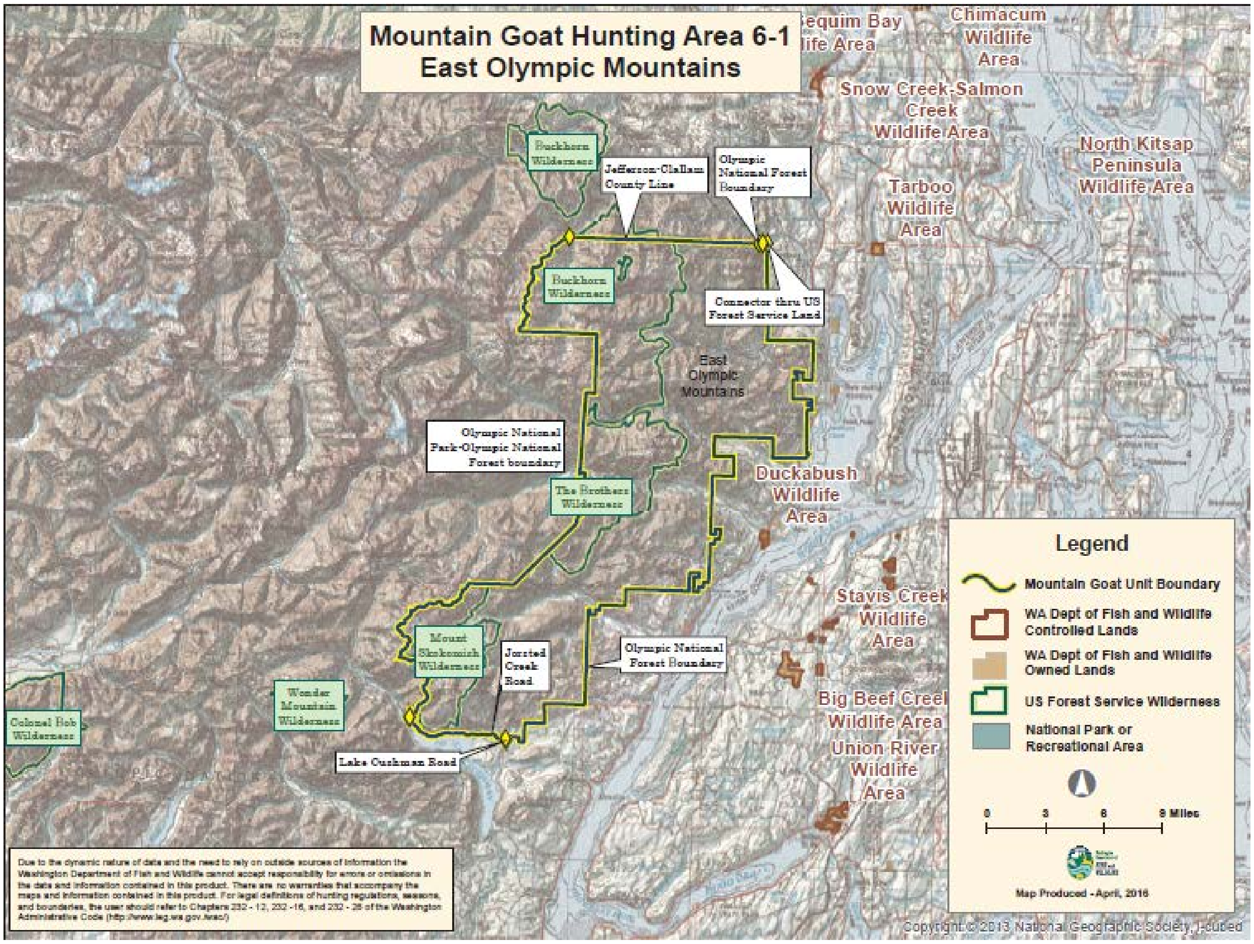

Figure 1. The designated mountain goat hunting area, 6-1, located on the eastern Olympic Peninsula, Washington.

Survival and Mortality

Estimates of survival and causes of mortality are relevant for a specific time, place and population; and these data are not available for mountain goats on the Olympic Peninsula. Generally, causes of mortality include weather, nutritional stress, predation, parasites and disease, natural hazards (for example, avalanches), hunter harvest, and the confounding effects of many of these. Similar to other ungulates, survival is often lower among older adults and young of the year than among prime-aged individuals, and generally higher among females than males.

Habitat

Mountain goats primarily occupy habitats from just below timberline to the highest, rocky peaks in the alpine zone. In the Olympics, mountain goats are generally found at elevations above 1400 m (Jenkins et al. 2011). They select habitats based on availability of forage, landscapes that provide high solar loading, and terrain that is rugged, providing escape from predators (Beus 2010). Mountain goats tend to exhibit strong site-fidelity to seasonal ranges, returning to the same summer and winter ranges year after year (Houston et al. 1994). Transition between seasonal ranges generally occurs in June, to summer range, and October or November, to winter range, but there is considerable individual variability in seasonal migratory behavior (Rice 2008, Jenkins et al. 2011). Summer diets consist primarily of graminoids and forbs, while during the winter they consume more tree and shrub species as part of their diet (Houston et al. 1994).

Human-Wildlife Interaction

Goats that have become accustomed to humans are often drawn to them for providing salt from food and urine. Encounters can range from mildly annoying to life-threatening. These primarily occur along popular hiking routes that traverse areas occupied by mountain goats in the designated Olympic permit hunt area, most notably along the Mount Ellinor and Lena Lake trails. Although numerous accounts of potentially hazardous encounters between humans and mountain goats have been reported, two occurrences in the Olympic Range illustrate the seriousness of the risk these types of encounters pose to humans. In 1999, a hiker on Mount Ellinor reported that he was gored in the leg by an aggressive goat and survived; and in 2010, a hiker at Hurricane Ridge was also gored in the leg, sustaining a fatal injury to his femoral artery (ONP Mountain Goat Action Plan, 2011).

Management Concerns

As a result of an increasing goat population, concerns over human-goat conflicts and the negative effects of this non-native species on endemic plant communities have reemerged. The Department established the goat conflict reduction permit hunt in the eastern Olympics, in part to address these concerns. Ultimately, other management actions will be needed to address these issues.

Management Conclusions

Mountain Goat Populations in the Olympic Mountains have increased in number in recent years. These increases have generated concerns related to goat impacts on native plant communities and dangerous encounters with humans. WDFW will continue to work with Olympic National Park, US Forest Service and other partners to address these concerns. As one measure, the Mountain Goat Conflict Reduction permit hunts in the east Olympic Mountains will be similar to the 2015 season. Six permits will again be available during the 2016 season with permits divided among two hunts: September 5-25 and September 26 – October 6. Archery hunters can begin hunting on September 1, regardless of permit hunt dates.

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Bighorn Sheep

Bighorn Sheep Status and Trend Report

STATEWIDE

RICHARD B. HARRIS, Special Species Section Manager

Management Guidelines and Objectives

In 2014, biologists managing bighorn sheep herds in Washington convened to reconsider herd-specific population objectives that had existed for years, been enshrined in previous Game Management Plans (WDFW 2008), but not recently subjected to updated, rigorous consideration. We referenced updated bighorn herd boundary maps (most created using telemetry data), as well as USFS bighorn habitat model maps. We used pre-disease die-off densities of bighorn sheep in the Blue Mountains as a reference for potential densities, but deviated from this to account for differences in habitat productivity and land-use. Rather than articulate a single objective for each herd, the consensus view was that it made more sense to delineate short-term objectives and long-term potential population sizes (both, expressed in terms of upper and lower bounds). Short-term objectives were considered to coincide with the operational 6-year Game Management Plan (WDFW 2014), and thus used the year 2021 as a target. These objectives were developed in light of most recently-estimated herd sizes, as well as constraints that are unlikely to be overcome before the year 2021 (e.g., presence of persistent pneumonia, long-owner tolerance). Long-term potential herd sizes were envisioned as reflecting the capability of the local habitat to support bighorns, independent of current population sizes, and assuming that existing impediments to population growth might, at some point, be removed. Both short-term objectives and long-term potentials are shown in Table 1. In some cases, short-term objectives coincide with long-term population potentials.

Table 1. Herd-specific short-term objectives and long-term herd potentials, Washington bighorn sheep herds, as developed by district biologists in 2014. Shown are lower and upper bounds. No short-term objective was developed for the currently extirpated Tieton herd; 'nd' = not determined.

Herd	Short-term objective	Long-term potential
Hall Mountain	25-35	nd
Vulcan	70-90	80-110
Lincoln Cliffs	100-120	180-220
Asotin	130-170	240-240
Black Butte	60-100	585-585
Wenaha/Mtn View	130-170	375-375
Tucannon	40-80	160-160
Mt. Hull	80-100	80-100
Sinlahekin	50-80	100-150
Chelan Butte	150-170	150-170
Manson	100-120	200-200
Swakane	130-170	150-180
Cleman Mountain	170-220	170-220
Quilomene	150-170	150-170
Umtanum/Selah Butte	250-300	300-350
Tieton	-	200-250

Harvest objectives for bighorn sheep are to maintain a harvest success that averages >85% over a 3-year period, while at the same time bighorn population size remains stable or increasing.

Strategies and harvest thresholds to obtain these objectives are described in the WDFW's Game Management Plan (2014).

Washington Department of Fish and Wildlife continues cooperative work with the Foundation for North American Wild Sheep, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, U.S. Forest Service, and the Bureau of Land Management on restoration of bighorn sheep within Hells Canyon. Project activities included monitoring lamb production and mortality, sightability surveys, and disease investigations related to spillover of pathogens from domestic to bighorn sheep.

Population Surveys

All bighorn sheep herds in Washington are surveyed annually. In 2016, both ground counts and aerial surveys were used to survey and classify sheep as lambs, ewes, or rams. In some herds, rams were further classified as yearling, less than 3/4 curl, or greater than 3/4 curl; in other herds, rams were classified according to the Class I-IV system. Surveys were conducted at differing times throughout the year, with a general pattern for most regions being to survey total herd composition in winter. Some herds were also surveyed post-lambing in early summer.

Hunting Seasons and Recreational Harvest

Bighorn sheep hunting opportunity in Washington is limited to permit-only hunting. Permit availability, and therefore hunter opportunity, steadily increased in Washington until 2011, but has dropped since that time. (Figure 1). In 2016, 38 special season permits, 1 auction permit, and 4 raffle permit were available (including the potential from multi-species raffles) in 12 different sheep management units. Most 2016 bighorn sheep seasons were September 15 to October 10, (except 4 areas; either October 1-10 or November 3-30). Hunters had the choice of any legal weapon to harvest any bighorn ram (no curl restrictions), as well as ewe (in selected herds). Of the 43 permits available in 2016 (including the auction and raffles), reports were received from 37 hunters, who reported killing 34 sheep (hunter success rate = 92%). Considering only 'any ram' draw permits, a total of 22 were available in 2016, of which 19 were reported harvested from 21 hunters reporting. Two disabled hunters with permits to take juvenile rams from Chelan Butte did not report.

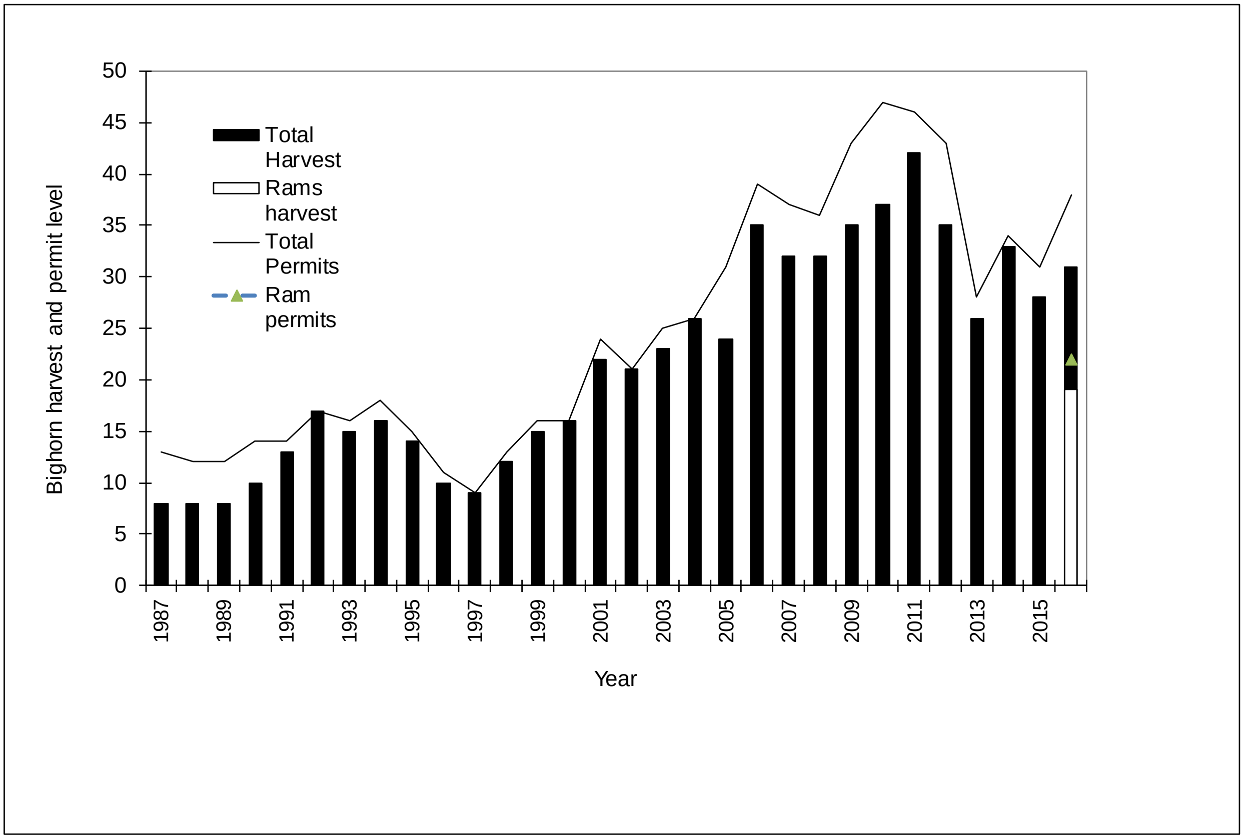

Figure 1. Regular draw permits (line) and harvest (bars) of all bighorn sheep in Washington, 1990-2015 (rams only indicated by triangle).

Survival and Mortality

Survey results indicate bighorn populations are stable in most areas (see regional reports), with some populations having increased since the 1990s, but others declined. Notable exceptions are the Hall Mountain bighorn herd, which has remained small (and is not currently hunted), and some of the Blue Mountain herds, most of which have recently experienced disease outbreaks. Two herds in the Yakima area (Region 3) have also recently experienced pneumonia-related die-offs: Umtanum/Selah in the Yakima Canyon (during winter 2009-10) and the Tieton Herd (in winter/spring 2013). The Cleman Mountain, Chelan Butte, and Swakane herds were evidently had record high numbers in 2015.

Rocky Mountain bighorns in the Blue Mountains continue to struggle as they recover from the 1995 pneumonia outbreak. Lamb mortality has remained high and ewe survival has declined in several herds; however, the total sheep population has remained fairly stable, with a sizable mature ram component.

Mycoplasma ovipneumoniae induced pneumonia continues to plague 4 of the 5 Blue Mountain bighorn populations; Asotin, Black Butte, Wenaha, and Mountain View. The Tucannon herd has not experienced pneumonia caused mortality, but do carry scabies (*Psoroptes ovis*). Bighorn populations in the Blue Mountains have not recovered from the pneumonia die-off as quickly as some herds, possibly from re-infection from domestic sheep and goats that exist within the range of multiple herds. The presence of domestic sheep and goats within and adjacent to bighorn sheep range presents a constant and substantial risk of another major epizootic. WDFW actively works with landowners near bighorn sheep herds to make sure accurate information is available and options to minimize contact are made available. As of 2015, there is some reason for hope that the Asotin Herd may have cleared the bacteria responsible for pneumonia: researchers have been unable to document its presence, and lamb recruitment appears to have returned to normal levels. However, it will require a few more years before we can be confident of this. The Asotin herd has recently lost an excessive number of mature rams to treat-rights hunting.

Other government agencies have encouraged landowners to use domestic goats for weed control. This type of weed control program presents a substantial risk to bighorn sheep populations in southeast Washington. WDFW has recently completed a study of the motivations, knowledge, and attitudes of owners of small domestic sheep or goat flocks in the in the vicinity of bighorn herds in Chelan, Yakima, Kittitas, and Asotin counties. The results of this work will be published in the Wildlife Society Bulletin. Efforts to work with these small flock owners to reduce the risk of disease transmission are ongoing. WDFW has begun working with the Department of Corrections, Washington State University, and local sheep producers to begin a pilot project of raising domestic sheep free of *M. ovipneumoniae.* We hope ultimately to provide for owners of small herds near susceptible bighorn herds a source of sheep free of this particular pathogen, thus reducing the risk to bighorns.

'California' bighorn populations remained stable in most herds (see individual herd reports). In December 2009, an outbreak of pneumonia was discovered at the north end of Umtanum. *M. ovipneumoniae* was documented in the Umtanum/Selah Butte herd. Forty-four sheep are known to have died from December 2009-May 2010. Forty-two were found in the north portion of Umtanum and only 2 at the south end. No natural mortalities were found east of the river in Selah Butte. Recognizing the long-term effects of this disease in bighorn sheep, the Department initiated a culling action of bighorns with clinical signs of pneumonia in the Umtanum herd. Sixty-nine sheep were culled from the herd in an attempt to slow the spread of the disease, increase subsequent lamb recruitment, and better understand the disease distribution. All animals culled from west of the river tested positive for some degree of pneumonia or presence of *M. ovipneumoniae.* East of the river, there did not appear to be significant signs of disease, but *M. ovipneumoniae* could not be ruled out in a few individuals. By August 2010, lamb survival was very low on both sides of the river. Observations of coughing sheep and samples from hunter harvested rams in September confirmed that the disease had spread to Selah Butte. Two of 4 sheep sampled in Umtanum during September were clear of pneumonia, possibly because the disease outbreak was waning. No significant adult mortality has been observed on either side of the river since early 2010, and both lamb and adult survival was high in both 2011 and 2012. While there may have been some double counting of ewes and lambs during aerial surveys in 2012, the herd had, by 2012 recovered to within objectives.

In early 2013, we captured and radio-collared 25 ewes and 5 rams from the Umtanum/Selah Butte herd, to monitor post-recovery lambing and survival. Although initial survival in summer 2013 was high, we documented poor survival in late summer, resulting in poor recruitment herd-wide during 2013, 2015, and 2015. Thus, it appears that the pneumonia has yet to completely clear from the Umtanum/Selah Butte herd. Preliminary results from lambing season 2016 suggest that recruitment remains poor.

In early 2013, the Tieton herd became the latest casualty of pneumonia. We began documenting an unusual number of road-killed animals in late winter 2013. By late March, it was clear that a major die-off had been underway for some weeks, and we surveyed the herd using a helicopter. Where we'd estimated approximately 150 sheep in this population in late 2011 (and as many as 200 or so earlier), we were able to account for only 35 live animals (with almost as many carcasses visible). Veterinary sampling confirmed that all animals had gross lesions consistent with pneumonia, and molecular testing confirmed the presence of *M. ovipneumoniae* in all animals. Because of the virulence of the disease (indicated by the rapid on-set and incidence of mortality), and the proximity to the uninfected Cleman Mountain herd, WDFW decided to remove all remaining animals in the Tieton Herd. As of late mid-September 2013, the combination of agency, USDA Wildlife Services, and independent contractors had removed all but 3 animals, and indications were that these had either died or dispersed far from the Tieton area.

Also in early 2013, the Sinlahekin herd experienced either a dramatic die-off, or an unexpected and unexplained range shift. From an estimated 90-95 animals in 2011 (from a count of 82), we were able to document only 26 animals during repeated counts in 2013. This herd had earlier been documented to have contracted scabies from the mite *Psoroptes ovis*, but large-scale mortality from this mange mite is usually considered rare. In early February 2014, we captured and tested 11 animals from the Sinlahekin herd; none tested positive for active infection or antibodies to *Mycoplasma ovipneumoniae*. These animals were also outfitted with GPS radio-collars, and their status will be monitored. The Sinlahekin herd has evidently begun to bounce back, as recent counts have been closer to the recent peak observed in 2011.

In 2014, WDFW obtained 2 young rams belong to the Lookout herd in Oregon from the Oregon Department of Fish and Wildlife, both of which were placed in the Tucannon Herd, to increase genetic diversity. In January 2016, we moved an additional 7 adult ewes from the Lookout Herd to the Tucannon Herd.

In March 2016, with the cooperation of the U.S. Fish and Wildlife Service and the Kalispel Tribe, WDFW obtained 21 short-yearling bighorn sheep from the National Bison Range (NBR) in western Montana. The NBR herd had grown to record size, and the USFWS was considering euthanizing most of these animals. After confirming that none of the 21 were infected or had been exposed to *M. ovipneumoniae*, we brought 11 animals to the Tucannon Herd, and 10 to the Hall Mountain Herd.

Habitat

Range conditions for bighorn sheep varied from poor to excellent. Recent fires in the vicinity of the Mt. Hull, Tucannon, Swakane, Manson, Umtanum, and Lake Chelan herds have rejuvenated vegetation and reduced conifer encroachment, improving habitat conditions generally for bighorns. Conversely, noxious weed invasion, primarily yellow-star thistle, continued to be a major concern for many bighorn sheep ranges (particularly in the Blue Mountains). Grazing also is a concern in several areas of the Blue Mountains and Yakima River basin.

Management Conclusions

Bighorn sheep management in Washington centers on four main issues at this time: 1) minimizing the probability of new disease outbreaks, 2) helping herds infected with pneumonia-causing bacteria cope with, and ultimately recover from, persistent disease; 3) recovering depleted herds via augmentation; and 4) maintaining, and where possible increasing, habitat quantity and quality. WDFW continues to consider the possibility of establishing new self-sustaining herds in the few remaining areas of unoccupied habitat where land ownership might allow it, but implementation is currently a lower priority than maintaining existing herds.

Disease outbreaks associated with domestic-bighorn interactions is the primary concern for several herds. Disease has decimated or threatens at least 7 bighorn sheep herds at present. For those herds, eliminating the risk of disease transmission between domestic and bighorn sheep is the priority.

Noxious weed control is important for maintaining quality forage habitat for sheep and aggressive programs aimed at eliminating invading species and restoring native grasses are essential. Noxious weed control can be accomplished only in conjunction with better overall range grazing practices. Where the potential exists for conflicts between bighorn sheep and domestic sheep, particularly on federal lands, we should seek cooperative agreements that place a priority on the restoration of native species (i.e., bighorn sheep).

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Bighorn Sheep Status and Trend Report: Region 1

Blue Mountains

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Introduction

Bighorn sheep (*Ovis canadensis*) were first restored in the Blue Mountains on the W.T. Wooten Wildlife Area (Tucannon River) during the early 1960s, and consisted of bighorns transplanted from the Sinlahekin Wildlife Area. Since that re-introduction, four additional herds of bighorn sheep have been established in the Blue Mountains; Asotin Creek, Black Butte, Mountain View (formerly known as the Cottonwood herd), and Wenaha.

The Hells Canyon Initiative (HCI) was established in 1996, with representatives from Washington Department of Fish & Wildlife, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, U.S. Forest Service, Bureau of Land Management, and the Wild Sheep Foundation (formerly known as Foundation for North American Wild Sheep (FNAWS)). HCI coordinates disease research, develops population survey methodology, conducts transplants, coordinates intergovernmental management activities, and implements projects designed to improve bighorn sheep habitat. All five of southeast Washington's bighorn sheep populations are included in the HCI; Black Butte, Mountain View, Wenaha, Tucannon, and Asotin Creek.

Management Guidelines and Objectives

Population objectives for each herd are based on habitat conditions, habitat availability, and minimizing herd expansion into new habitats that may increase the risk of contact and disease transmission with domestic sheep or goats. In 2015, WDFW recognized the utility of differentiating short-term objectives from long-term objectives (http://wdfw.wa.gov/conservation/game/). Short-term objectives take 2014 population sizes as a starting point, account for existing constraints to population growth, and can realistically be achieved within the 6-year planning horizon that WDFW uses (WDFW 2015). Long-term objectives reflect the potential of habitat to support bighorns assuming that constraints such as disease and land-owner tolerance can be resolved. For the Tucannon herd, short-term objectives were identified as being in the range 40-80, whereas the long-term potential was estimated to be approximately 160. For the Mountain View and Wenaha herds combined, short-term objective bounds were 130-170, with the long-term potential estimated at 375. Short-term objectives for the Asotin Creek herd were estimated at 120-130, whereas the potential of the area was estimated to be 240 animals. Short-term objectives for the Black Butte herd were estimated to be 50-60 animals, but the long-term potential, reflecting the past abundance of this herd, was estimated to be 585. For the Blue Mountains herds in aggregate then, the short-term objective would be to have 340-440 animals, but we estimate that ideally the area could ultimately support approximately 1,360 if disease and landowner tolerance issues were resolved.

Population Surveys

Aerial surveys have historically been conducted in February and March using a sightability model developed through the Hells Canyon Initiative. These surveys are conducted to determine population estimates, trend, and herd composition at the low point of the annual population cycle. Radio telemetry locations are obtained frequently throughout the year from the ground and/or aircraft, supplementing the helicopter surveys.

Aerial surveys have not been conducted since 2015 because ground counts have proven adequate for estimating population parameters. Ground counts were obtained for the five herds during March and April of 2017. The minimum population estimate for 2017 (for all herds aggregated) was 342 (164 ewes, 65 lambs, 76 rams, for ratios of 46 (90% CI: 36-57) rams and 40 (90% CI: 30-49) lambs per 100 ewes (Table 1). A population estimate using the sightability correction has not been developed for 2017 at this time, but we estimate that there were approximately 342-370 bighorns in the 5 herds, of which a number inhabit Oregon throughout the year. Lamb recruitment during the 2016-2017 biological year was the highest recorded since the 1996-1997 die-off.

Hunting Seasons and Recreational Harvest

Recreational hunting opportunity was limited to one raffle permit in 2016. Poor recruitment, research removals, past harvest, and tribal harvest limited the available opportunity. One ram was harvested from the Mountain View herd during 2016. Efforts are being made to work with local tribes with treaty rights to limit the current harvest to allow for recovery of the male segment of the population.

Survival and Mortality

Survival analysis has not been completed at this time for the 2016-2017 biological year. The Hells Canyon Restoration Committee will produce an annual report during the fall of 2017 that captures this information.

Habitat

Habitat conditions are moderate to good in most areas. However, the spread of noxious weeds, mostly yellow star-thistle (*Centaurea solstitialis*), thistle (*Cirsium* spp.), and rush skeleton weed (*Chondrilla juncea*) are threatening ranges in the Blue Mountains. Although the School Fire (2005) had immediate negative effects on the Tucannon bighorn sheep population (direct mortality), it appears that the range has recovered. Noxious weeds are not dominating the landscape in the core bighorn range and the grasses and forbs appear to be healthy. During the summer of 2015, the Grizzly Complex wildfire burned a large portion of the Wenaha herd range. It is not yet clear what effect this may have on the habitat within this herd range.

Human-Wildlife Interaction

Bronchopneumonia caused or facilitated by the bacteria *Mycoplasma ovipneumoniae* (*M. ovi*, hereafter) continues to affect 4 of the 5 Blue Mountain bighorn populations in Washington; Asotin, Black Butte, Wenaha, and Mountain View. Bighorn populations in the Hells Canyon area generally (which includes the Washington Blue Mountain herds, but also nearby herds in Oregon and Idaho) have not recovered from bronchopneumonia die-offs as quickly as some herds in other states, possibly because of reinfection from adjacent herds or from domestic sheep and goats that exist within the range of multiple herds. The presence of domestic sheep and goats within and adjacent to bighorn sheep range presents a constant and substantial risk of another major epizootic. WDFW actively works with landowners near bighorn sheep herds to insure accurate disease information is available to stock owners and options to minimize contact between domestics and wild sheep are made available.

Some land-management agencies have encouraged landowners to use domestic goats for weed control. This type of weed control program when used near the range of bighorn sheep presents a substantial risk to bighorn sheep populations in southeast Washington. WDFW staff actively work to explain the risk of using domestic Caprinae species within the ranges of bighorn sheep.

Population Augmentation

No population augmentations occurred during this reporting period.

Research

As part of the Hells Canyon Restoration committee, WDFW is actively participating in research on *M. ovi*-associated pneumonia in bighorn sheep (e.g., Manlove et al. 2014, Cassirer et al. in press). For the past 4 years, WDFW and IDFG researchers have been capturing ewes and lambs in the Asotin, Black Butte, Mountain View, Wenaha, and herds in Oregon and Idaho to determine the bacterial shedding status of animals within those populations. Efforts have been made to remove the chronic shedders of *M. ovi* in the Asotin herd, ideally increasing the survival and recruitment of lambs in the future. Work in the Black Butte and Mountain View herds began in 2015 and will continue through the next few years. Additional information can be found at the 2015 Hells Canyon Initiative Annual Report.

Management Concerns

Disease and harvest amongst the co-managers remain the biggest challenges for bighorn sheep in the Blue Mountains. A long-term solution to pneumonia spreading within and amongst herds of bighorns has eluded researchers and managers for many years. In the Blue Mountains, disease has been proven to be the limiting factor for population growth for more than 20 years. Co-managers will need to continue investing in this problem in order to eliminate future outbreaks and recover from existing exposures.

Within the Washington Blue Mountains, 3 government entities have harvest rights to the bighorn sheep herds (WDFW, Confederated Tribes of the Umatilla Indian Reservation, and Nez Perce Tribe). These 3 entities have started working towards common population goals and harvest regimes to maintain these goals. This will likely be a multi-year process, but coming to an equitable approach for all entities will be the ultimate goal.

Management Conclusions

Four of the five bighorn sheep herds in the Blue Mountains are struggling with *M. ovi* induced bronchopneumonia. The Black Butte, Wenaha, and Mountain View herds still experience periodic pneumonia outbreaks, which result in high lamb mortality and sporadic adult mortalities. It is unclear what path the Asotin herd will take with the recent disease infection and research action that occurred there, although the past 2 years show promise. The Tucannon herd has avoided contracting pneumonia causing bacteria, but suffered a major die-off after being infected with scabies in 1999. This herd has experienced high lamb mortality (not bronchopneumonia related) for the past 3 years. We suspect that predation on this small herd is limiting its recovery, and that it is unlikely to recover without continued management action.

Domestic sheep and goats continue to be a major threat for bighorn sheep in the Blue Mountains. Rural landowners continue to use domestic sheep and goats to control weeds, posing a severe threat to all herds in Hells Canyon. HCI research has shown that a large amount of inter-herd movement occurs (F. Cassirer, IDFG, pers. comm.). Numerous bighorn sheep have been removed, either lethally or transferred to captive research facilities, to minimize the possibility of transmitting diseases. In early 2008, District 3 wildlife management staff authored response guidelines to be implemented when bighorn sheep are located in "high risk" areas, or domestic sheep or goats are located within bighorn range. However, the general practice has been to lethally remove bighorns that move to the lower reaches of Asotin Creek if a captive facility does not have the ability to house the animal.

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			Rams							Population	Ratio (90% CI)	
Year	Lambs	Ewes	C I	C II	C III	CIIIB	C IV	Total	Total	Lambs	Rams
2008	28	125	21	26	24	1	4	76	229	22 (15, 30)	61 (46, 75)
2009	29	131	2	34	23	2	6	67	229	22 (15, 30)	51 (39, 64)
2010	32	136	17	29	33	1	5	85	253	24 (16, 31)	63 (48, 77)
2011	37	129	9	18	37	5	8	77	241	29 (20, 38)	60 (46, 74)
2012	36	113	14	14	29	1	15	73	222	32 (22, 42)	65 (49, 81)
2013	24	114	9	18	37	2	5	71	209	21 (13, 29)	62 (47, 78)
2014	29	131	7	16	28	4	4	59	221	22 (15, 30)	45 (33, 57)
2015	34	113	13	14	21	7	2	57	206	30 (20, 40)	50 (36, 65)
2016	58	129	7	9	20	2	0	79	268	45 (33, 57)	61 (47, 76)
2017	65	164	16	17	16	1	8	76	342	40 (30, 49)	46 (36, 57)

Table 1. Bighorn sheep population trend and herd composition, Blue Mountains, Washington.

			Rams					Ram	Population	Ratio (90% CI)	
Year	Lambs	Ewes	CI	CII	CIII	CIIIB*	CIV	Total	Total	Lambs	Rams
2008	13	40	11	9	6	0	1	27	80	33 (15, 50)	68 (40, 95)
2009	18	48	1	9	6	0	1	17	84	38 (20, 55)	35 (19, 52)
2010	17	46	12	10	12	0	3	37	100	37 (20, 54)	80 (51, 110)
2011	23	40	6	12	16	0	4	38	101	57 (33, 82)	95 (60, 130)
2012	12	26	6	8	10	0	7	31	69	46 (20, 73)	119 (67, 171)
2013	2	22	4	6	15	1	1	27	51	9 (0, 20)	122 (65, 180)
2014	9	29	1	5	16	3	2	27	65	31 (12,50)	93 (52, 134)
2015	13	25	1	1	12	4	0	18	56	52 (23, 81)	72 (30, 114)
2016	16	32	0	3	11	0	0	24	72	53 (26, 80)	80 (44, 116)
2017	15	40	3					19	74	37 (19,56)	47 (26, 69)

Table 2. Asotin herd 10-year survey history.

			Rams					Ram	Population	Ratios (90% CI)	
Year	Lambs	Ewes	CI	CII	CIII	CIIIB	CIV	Total	Total	Lambs	Rams
2008	1	27	2	3	4	0	0	9	37	4 (0, 10)	33 (11, 55)
2009	0	25	1	10	7	2	1	21	47	0 (0,0)	84 (43, 125)
2010	1	19	0	2	2	1	0	5	25	5 (0, 14)	26 (5, 48)
2011	1	25	1	1	5	2	0	9	35	4 (0, 11)	36 (13, 59)
2012	3	24	0	2	4	0	1	7	34	12 (0, 25)	29 (9, 50)
2013	7	26	1	3	5	0	1	10	43	27 (8, 46)	38 (15, 62)
2014	2	25	3	2	0	0	0	5	32	8 (0, 18)	20 (4, 36)
2015	3	11	0	1	2	0	0	3	17	27 (0, 56)	27 (0, 59)
2016	5	10	4	1	1	2	0	8	25	50 (5, 95)	80 (18, 142)
2017	10	14	2	4	3	1	1	11	35	71 (23, 120)	79 (26, 131)

Table 3. Black Butte herd 10-year survey history

			Rams						Population	Ratios (90% CI)	
Year	Lambs	Ewes	CI	CII	CIII	CIIIB	CIV	Total	Total	Lambs	Rams
2008	0	22	2	0	0		0	2	24	0	9 (0, 20)
2009	0	7	0	4	2	0	0	6	13	0	86 (7, 164)
2010	2	18	2	6	6	0	0	14	34	11 (0, 25)	66 (32, 123)
2011	2	21	1	1	3	0	3	8	31	10 (0, 21)	38 (12, 64)
2012	8	16	1	1	5	0	2	9	33	50 (14, 86)	56 (18, 95)
2013	6	23	0	5	3	0	1	9	38	26 (6, 46)	39 (14, 64)
2014	4	26	1	2	3	0	0	6	36	15 (2, 29)	23 (6, 40)
2015	11	30	9	1	2	1	0	13	54	37 (15, 58)	43 (17, 70)
2016	15	28	2	1	4			15	58	54 (25, 82)	54 (25, 82)
2017	14	44	2	5	5		4	15	90	32 (16, 48)	34 (17, 51)

Table 4. Mountain View herd 10-year survey history.

			Rams						Population	Ratios (90% CI)	
Year	Lambs	Ewes	CI	CII	CIII	CIIIB	CIV	Total	Total	Lambs	Rams
2008	3	3	1		1		1	3	9	100 (0, 234)	100 (0, 234)
2009	0	7	0	1	0	0	1	2	9	0	29 (0, 66)
2010	2	5	0	1	2	0	0	3	10	40 (0, 95)	60 (0, 132)
2011	3	6	1	1	1	0	0	3	12	50 (0, 108)	50 (0, 108)
2012	4	12	3	1	1			5	21	33 (2, 65)	42 (5, 78)
2013	3	12	3	1	2	0		6	21	25 (0, 52)	50 (9, 91)
2014	2	12	1	2	3	0	0	6	22	16 (0, 38)	50 (9, 91)
2015	1	10	1	5	2	1	0	9	22	10 (0, 27)	90 (17, 163)
2016	0	17	1	4	4	0	0	9	26	0 (0, 0)	53 (17, 89)
2017	2	13	2	3	3	0	0	8	23	15 (0, 34)	62 (16, 107)

Table 5. Tucannon herd 10-year survey history.

			Rams						Population	Ratios (90% CI)	
Year	Lambs	Ewes	CI	CII	CIII	CIIIB	CIV	Total	Total	Lambs	Rams
2008	11	33	5	14	13	1	2	35	79	33 (14, 52)	106 (64, 148)
2009	11	44	0	10	8	0	3	21	76	25 (11, 39)	48 (27, 69)
2010	8	32	3	8	4	1	1	17	57	25 (9, 41)	53 (27, 79)
2011	8	37	0	3	12	3	1	19	62	22 (8, 35)	51 (28, 75)
2012	9	35	4	2	9	1	5	21	65	26 (10, 42)	60 (33, 87)
2013	6	31	1	3	12	1	2	19	56	19 (5, 34)	61 (32, 91)
2014	12	39	1	5	6	1	2	15	66	31 (14, 47)	38 (19, 58)
2015	6	37	2	6	3	1	2	14	57	16 (4, 28)	38 (17, 58)
2016	22	42						23	87	52 (29, 75)	55 (31, 78)
2017	24	53	7	5	5		3	23	120	45 (27, 64)	43 (26, 61)

Table 6. Wenaha herd 10-year survey history

Bighorn Sheep Status and Trend Report: Region 1

Hall Mountain and Vulcan Mountain

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Introduction

District 1 has two bighorn sheep populations, both resulting from reintroductions. Rocky Mountain bighorn sheep were initially introduced to Hall Mountain in Pend Oreille County, Washington from Alberta, Canada in 1972 (Johnson 1983). The founder herd included 5 rams and 13 ewes. In 1981, 2 additional ewes were translocated to Hall Mountain from Thompson Falls, Montana.

California bighorn sheep were introduced to the Vulcan Mountain area of northern Ferry County, Washington in 1971. Eight bighorn sheep, consisting of 2 rams and 6 ewes, were translocated from the Colockum State Wildlife Area to U.S. Bureau of Land Management land near Little Vulcan Mountain.

Management Guidelines and Objectives

The traditional objective for the Hall Mountain herd was to maintain a population of 40–70 Rocky Mountain bighorn sheep (WDFW 2014). However, population objectives have recently been revised to reflect updated mapping of suitable habitat (http://wdfw.wa.gov/conservation/game/). Short-term early winter herd objectives are between 25 and 35 animals.

The traditional long-term population goal for the Vulcan Mountain bighorn sheep herd is to maintain 80-110 animals on the available range. However, population objectives have recently been revised to reflect updated mapping of suitable habitat (http://wdfw.wa.gov/conservation/game/). Short-term early winter herd objectives are between 70 and 90 animals. Long-term, we estimate that the Vulcan area could support 80 to 110 animals.

Population Surveys

Two aerial surveys of the Hall Mountain herd were conducted during early 2017. A flight funded by the Kalispel Tribe was conducted in April and a flight funded by the Pend Oreille Sportsman's Club was conducted in June. The maximum number of sheep observed during these aerial surveys was 15 (Table 1).

Table 1. Counts of Hall Mountain bighorn sheep, 2001 – 2017. ***Note: The last year of winter feeding was in 2003.***

Year	Lambs	Ewes	Rams	Total Sheep*	Lambs: 100 Ewes: Rams
2001	4	11	8	23	36 : 100 : 73
2002	7	13	4	24	54 : 100 : 31
2003	-	-	-	No Data	No Data
2004	-	-	-	No Data	No Data
2005	7	14	6	27	50: 100: 43
2006	5	7	7	19	71: 100: 100
2007	4	11	7	22	36: 100: 64
2008	9	16	4	29	56: 100:25
2009	5	14	4	23	36: 100: 29
2010	9	11	0	24	82: 100: 0
2011	5	9	1	15	56 : 100 : 11 *
2012	2	6	4	12	33: 100: 67
2013	0	5	3	8	0: 100: 60
2014	3	7	11	21	43:100:157
2015	No surveys conducted				
2016	0	5	8	12	0:100:160**
2017	0	6	9	15	0:100:150

* Total counts some years include unclassified bighorn sheep.
** Ground-based surveys conducted in spring before translocation of NBR sheep.

The Vulcan herd is surveyed with ground-based surveys conducted along an automobile route on county roads as well as from private, primitive roads. During the survey, biologists attempt to classify every detected bighorn sheep, but recognize that the effort likely never results in a complete count, and classification is not possible for animals at extreme distances. In 2016, 2 ground-based surveys were conducted. The highest count recorded count at one time was 41 bighorn sheep observed in June (26 ewes, 11 lambs, 4 rams). However, 13 rams were observed on a November survey, indicating there were at least 50 total sheep within the Vulcan herd (Table 2).

Table 2. Annual population composite counts of the Vulcan Mountain bighorn sheep, 2001 – 2016 .

				--- Rams ---				
Year	**Lambs**	**Ewes**	**Yearling**	**<3/4 curl**	**>3/4 curl**	**Total Rams**	**Total Sheep***	**Lambs:100 Ewes: Rams**
2001	5	8	0	2	2	4	17	63 : 100 : 50
2002	5	8	3	2	4	9	22	63 : 100 : 113
2003	9	17	3	4	3	10	36	53 : 100 : 59
2004	9	20	5	7	5	17	46	45 : 100 : 85
2005	21	32	4	11	7	22	75	66 : 100 : 69
2006	10	24	3	6	4	13	47	42 : 100 : 54
2007	21	39	5	4	6	15	75	54 : 100 : 38
2008	19	42	5	8	5	18	79	45 : 100 : 43
2009	15	43	2	14	7	23	81	35 : 100 : 53
2010	9	24	7	8	4	19	52	38 : 100 : 79
2011**	7	9	-	-	-	15	31	78 : 100 :167
2012**	4	9	1	3	9	13	26	44 : 100 :144
2013	6	15	1	2	7	10	31	40 : 100 : 67
2014	7	19	2	5	1	7	36	37 : 100 : 37
2015	13	19	13	6	7	13	45	68:100:68
2016	11	26	5‡	4	4	13	50	46:100:54

* Total counts some years include unclassified bighorn sheep.
**These counts were conducted by helicopter.
‡ All males.

Hunting Seasons and Recreational Harvest

The Hall Mountain herd is open for the Rocky Mountain special raffle permit hunt, however, there have been no bighorn sheep harvested there since 2010.

Both general public hunters (State) and members of the Colville Confederated Tribes (CCT) hunt bighorn sheep within the Vulcan Mountain Unit. Agency and Tribal biologists annually confer prior to developing their respective permit recommendations. The state permit allocation for 2016 was 1 ram and the permittee was unsuccessful.

Table 3. Summary of State permit numbers and State hunter harvest of bighorn sheep from the Vulcan Mountain Unit, 2005 – 2016.

Year	State	State Hunter Harvest
2005	1	1 ram
2006	1	1 ram
2007	2	2 rams
2008	3	1 ram, 2 ewes
2009	4	1 ram, 3 ewes
2010	4	1 ram, 3 ewes
2011	2	1 ram
2012	1	1 ram
2013	1	None
2014	1	1 ram
2015	1	1 ram
2016	1	None

Survival and Mortality

Predators that occur throughout the Hall Mountain herd area include coyotes, black bears, cougars, and gray wolves. Three mortalities (all females) were documented among 8 GPS-collared sheep introduced from the National Bison Range (See below). One mortality was attributed to a cougar and the other two were classified as unknown; all mortalities occurred during the winter.

Predators that occur throughout the Vulcan herd area include coyotes, black bears, and cougars. During 2016, three mortalities (2 ewes, 1 ram) were documented among 15 radio-collared sheep. All mortalities were attributed to cougars. One of the sheep that died was recently translocated from the Cleman Mountain herd. It wandered off by itself into new habitat soon after translocation and this probably made it more susceptible to predation.

Habitat

Northeastern Washington is densely forested and the Hall Mountain bighorn sheep depend upon the steep terrain, open grasslands, and other scattered sub-alpine openings for forage and predator avoidance. Non-forested escape terrain is limited and fragmented within the range of the Hall Mountain herd including Sullivan Mountain, Crowell Ridge, Gypsy Ridge, and Hall Mountain. Sheep migrating between these and other peaks and ridges have to travel through valley bottoms and dense forest where vulnerability to predators may increase.

The U.S. Forest Service (USFS) owns the vast majority of the land within the range of the Hall Mountain herd. Consequently, there are no immediate threats to habitat quality and quantity. The USFS plans to actively manage portions of the winter range habitat with prescribed burns subject to funding (Suarez 2001). There is no domestic livestock grazing within the national forest area used by the Hall Mountain bighorn sheep.

Several projects to enhance habitat for the Vulcan Mountain Bighorn Sheep have been carried out in recent years. These include broad-range weed control, selective logging, forage plant seeding, water source development, and temporary fencing at Moran Meadow to enhance controlled cattle grazing. Partners accomplishing these projects included several local private landowners, the Wild Sheep Foundation (WSF, formerly Foundation for North America Wild Sheep, FNAWS), the Safari Club International (SCI), the Inland Northwest Wildlife Council (INWC), the USFS, the Bureau of Land Management (BLM), and the WDFW. One large-scale project was the completion of a BLM timber sale within the core sheep range in 2004. This helicopter-logging project was partially designed to improve predator avoidance for bighorn sheep by enhancing sight distances within the most densely forested portions of their range, and to increase forage production (Doloughan 2004). There are no domestic sheep grazing allotments within the Vulcan herd range.

Human-Wildlife Interaction

A winter feeding station was maintained for the Hall Mountain bighorn sheep for many years until it began attracting cougars, posing a risk to humans and an unnatural vulnerability for the sheep. Consequently, winter feeding was discontinued in 2003. More recently, there is concern about bighorn sheep straying beyond their traditional range and increasing the risk of contact with domestic sheep that could harbor *M. ovipneumoniae* (M. ovi.), a bacterium that causes pneumonia in bighorn sheep.

Population Augmentation

In March of 2016, 10 short-yearling (born in spring 2015) bighorn sheep (8 ewes, 2 rams) were translocated from the National Bison Range in Montana to Hall Mountain. All sheep were fitted with GPS radio-collars, tested negative for *Mycoplasma ovipneumoniae* on both nasal swabs and serology, and released at the historic feeding station in the USFS Noisy Creek campground. Unfortunately, two of these translocated ewes moved into residential areas and had to be euthanized because of potential interaction with and transmission of pathogens from domestic sheep and/or goats. There were five sheep still alive and present on Hall Mountain at the time of this writing. Cooperators in this project included the U.S. Fish and Wildlife Service, the Kalispel Tribe, Pend Oreille Sportsman's Club, the Montana Department of Fish, Wildlife, and Parks, the Confederated Salish and Kootenai Tribes, and Global Wildlife Resources.

In January of 2017, 8 sheep were translocated from the Cleman Mountain herd to the Vulcan herd area. All were fitted with GPS radio-collars and released at Vulcan Mountain. As of this writing, 7 of the sheep are still alive and spend the majority of their time on Vulcan Mountain (Figure 1).

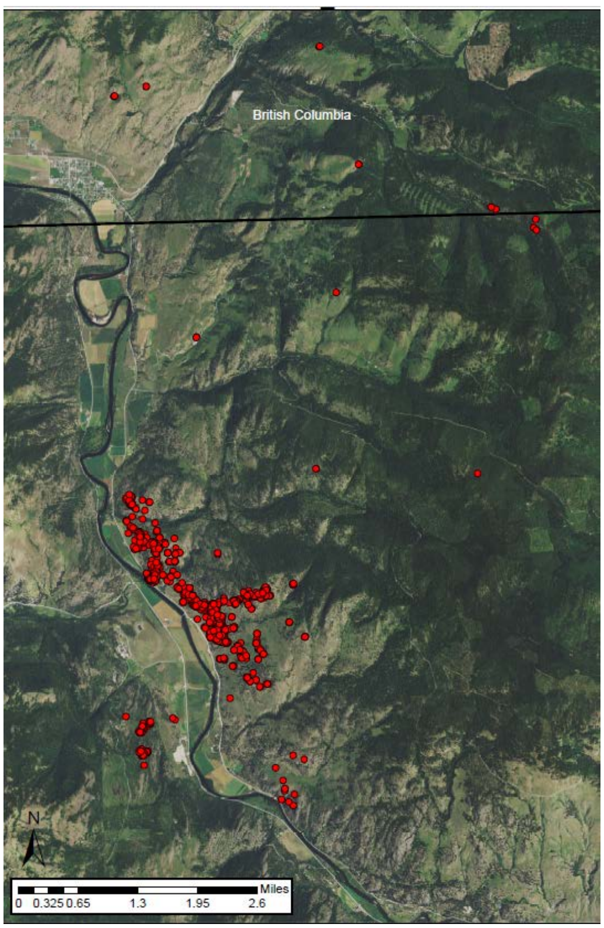

Figure 1a. Map of GPS locations from 8 translocated ewes from the Cleman Mtn. herd, January – October 2017. ***Note: The exploratory movements from recently translocated ewes.***

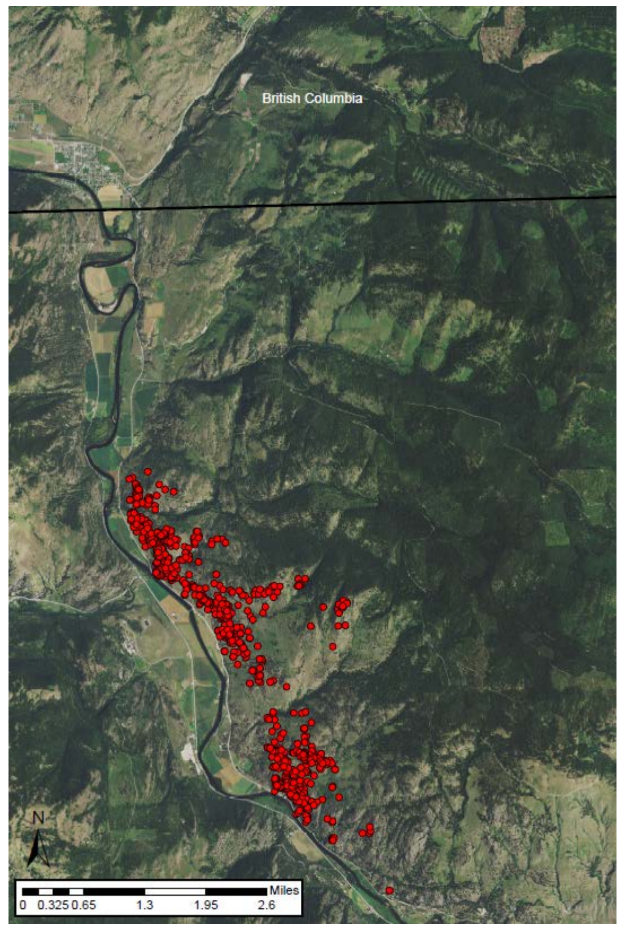

Figure 1b. Map of GPS locations from 6 resident ewes, February 2016 – October 2017.

Research

In 2016, the Kalispel Tribe, WDFW, the US Forest Service, and the Pend Oreille Sportsman's Club began a collaborative research project at Hall Mountain. Objectives of the study are as follows:

1. Estimate ewe and lamb abundance with the assistance of VHF telemetry during multiple helicopter flights.
2. Determine adult and lamb (up to 1 year) survival rates and when possible cause-specific mortality of radio-collared adult sheep.
3. Determine habitat use and movement patterns of Hall Mountain bighorn sheep using GPS locations of radio-collared individuals. Compare GPS locations from radio-collared sheep to the USFS habitat suitability model; determine the proportion of GPS locations that fall within the USFS model. Evaluate bighorn sheep movement and timing of movement between Hall Mountain (US Selkirk Mountains) and the BC Selkirk Mountains.
4. Use DNA collected at bait/capture sites in Washington and BC to understand the genetic relatedness and diversity within the Hall Mountain sheep population. If genetic diversity is low, investigate the possibility of releasing Rocky Mountain bighorns from another herd to increase genetic diversity.
5. Assess general health of Hall Mountain and BC bighorn sheep. Conduct disease testing, pregnancy tests, check for external parasites, and determine body condition (via ultrasound) during captures.

A bait station was established during the winter of 2015 to attract sheep into a corral for capture and subsequent radio-collaring. Unfortunately, no sheep came to the capture site. However, 10 sheep were translocated from the National Bison Range in Montana to Hall Mountain in an effort to address objective four above and to provide a sample of radio-collared sheep for addressing the other objectives. Aerial captures to radiocollar additional sheep will be attempted in the fall/winter of 2017.

In February 2016, WDFW, with assistance from Leading Edge Aviation, captured 7 adult bighorn ewes at Vulcan Mountain. Six of the sheep were fitted with GPS radio-collars and all of the sheep were screened for pathogens and diseases of interest. In addition, 8 radio-collared sheep were added to the Vulcan herd from the Cleman Mountain herd. Radio-collared ewes will be used to locate lambs and assess recruitment into the population. In addition, the collars will aid in finding sheep during any future helicopter surveys.

Management Concerns

Growth of the Hall Mountain bighorn sheep herd appears to be limited and the cause/s of this limitation is undetermined. Current research efforts are underway to help WDFW address this concern. The Hall Mountain bighorn herd is considered a clean herd by WDFW, meaning there are no documented cases of *M. ovipneumoniae*. However, recent collar data indicates this herd may wander farther than previously thought and interactions with domestic sheep and goat herds is a concern.

The Vulcan bighorn sheep population declined dramatically in the late 1990s mainly as a result of complications from exceptionally high internal parasite loads. Domestic goats were known to share part of the Vulcan bighorn sheep range. Evidently the parasite *Muellerius capillaris* using slugs and snails as intermediate hosts was able to jump from domestic goats to the bighorn sheep. Native bighorn sheep, having less natural resistance than domestic goats to *Muellerius capillaris*, likely succumbed to pneumonia that this parasite brings about (Hall 2002). After 2001, the Vulcan herd appeared healthy and began producing lambs annually, suggesting that the overall health of the herd was acceptable. Nevertheless, we know of at least 3 flocks of domestic sheep near the periphery of the Vulcan range, and are concerned about the potential for pathogen transmission from domestic sheep and goats to the Vulcan herd. In addition, in 2014, 3 bighorn sheep that wandered away to the town of Republic from what we suspect was the Vulcan herd were euthanized after they began interacting with domestic sheep and we became concerned that their disease risk was elevated.

Management Conclusions

More intensive monitoring and research will help the Department better understand the dynamics of this herd and determine the future potential of sustaining and/or increasing this herd.

The decline observed in the Vulcan herd since 2009 is of considerable concern, but there is some evidence (survey numbers) that the population has increased during the past few years. The population estimate has nearly doubled since 2012. There are currently 12 radio-collared sheep in the Vulcan herd and in subsequent years, we hope to better understand the limiting factors for this herd by monitoring these animals.

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Bighorn Sheep Status and Trend Report: Region 1

Lincoln Cliffs

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Introduction

Bighorn sheep were reintroduced into the Lincoln Cliffs area in 1990. Sheep distribution was historically centered on the original 1990 release site, a parcel owned by the Bureau of Land Management (BLM), just south of the town of Lincoln. This was an area jointly selected by WDFW and BLM as suitable habitat. The sheep now regularly occupy two main areas throughout the year: the residential community of Lincoln and the cliffs above it, and the cliffs around Whitestone Rock, about 7 miles downriver from Lincoln. Sheep have also been observed frequently using the cliffs above Sterling Valley, the area between Lincoln and Whitestone. Agricultural fields above cliffs and along roads are also used regularly by the sheep. Observations of bighorn sheep have been reported as far east as Porcupine Bay on the Spokane Arm of Lake Roosevelt and to the east side of Banks Lake in Grant County.

Management Guidelines and Objectives

The objective for the Lincoln Cliffs herd is to manage bighorn sheep numbers for a self-sustaining population capable of supporting both consumptive and non-consumptive recreation, while remaining within the local landowners' tolerance. The short-term objective for the Lincoln Cliffs herd is to maintain a population size of 100-120 (http://wdfw.wa.gov/conservation/game/). This is likely the largest feasible herd size here due to increasing landowner concerns and available habitat constraints.

Population Surveys

Aerial surveys have been the preferred method for surveying this herd due to the cliff habitat and lack of road access. Prior to 2002, aerial surveys were inconsistent due to funding and personnel. From 2002-2013, a concerted effort was made to conduct two aerial surveys per year, one in the spring to assess lamb production (Table 1), and one in late fall to assess ram numbers (Table 2). Review of that data showed that the fall flight produced greater ram and ewe counts 90% of the years and greater lamb count 50% of the time. Consequently, it was decided to fly only the fall aerial survey beginning in 2014.

Minimum population estimates are based on the highest count of rams and ewes from all helicopter surveys in a given year (Figure 1). They indicate the Lincoln Cliffs population to be relatively stable through 2010, after which they have shown a positive growth trend (Fig. 1). There was a decline in ewes in 2005 followed by a decline of rams in 2006. The decline in rams also followed three consecutive years of 2 rams being removed, a result of the auction and raffle permit holders selecting the Lincoln herd to hunt. Since 2005, the ewe population has steadily increased. The ram population rebounded immediately after 2006 and had, until 2013, remained fairly stable at around 20 animals. In 2014, 38 rams were observed during aerial surveys, which was the greatest number since regular surveys began in 2002. In particular, the number of younger (¼- and ½-curl) age classes showed a considerable increase. The total number of bighorns observed on the 2016 flight, including lambs, was 107. Only 29 rams were located on this flight.

Herd composition results from the aerial surveys have varied from 39 to 80 rams per 100 ewes over the last 10 years (Table 2). The lamb per 100 ewe ratio has remained relatively stable, although yearly 90% confidence intervals are large (Table 1). The exception was in 2014, when concerns were raised as only 7 lambs were located during the fall aerial survey, all in the Whitestone area. This confirmed what had been reported from public ground observations of the Lincoln group.

Ground counts are conducted whenever possible to supplement the aerial surveys; however, these are often very limited due to terrain and limited access to private property. Ground counts for ewes and lambs have been relatively easy to obtain in the Lincoln group, but less so for the Whitestone group. Ram counts in both areas have proven largely unsuccessful from the ground. Ground counts were conducted regularly during the spring and summer of 2015 and occasionally in 2016 and 2017 to monitor lamb production and survival. Lamb counts have indicated the recruitment failure of the Lincoln sub-herd in 2014 has not recurred. Residents in Lincoln have also been very helpful in reporting counts and other observations of this group.

Hunting Seasons and Recreational Harvest

One ram permit for this herd was offered each year from 1997–2013. In addition to the annual permit, the statewide 2003 and 2005 auction winners and the 2004 raffle winner all selected Lincoln Cliffs to harvest their rams. Until 2014, auction and raffle winners were not allowed to hunt at Lincoln Cliffs because of the regulation that 2 or more general draw permits be available for any unit hosting auction/raffle hunts. In 2014, based on ram numbers and population size general draw ram permits was increased to two, making the herd eligible for auction and raffle hunter, however, neither selected to hunt in this unit in 2014, 2015, or 2016.

Permit hunters have spent an average of 5 days hunting per kill, however days hunted has varied widely from 1 to 14 days. The area is almost entirely composed of private property and days/kill often reflects how much time was spent prior to the hunt gathering permission to access the local properties. Hunter success has remained at 100% for this hunt, which had 2,376 applicants in 2016.

Survival and Mortality

Since 1997, 48 known sheep mortalities (38 rams, 10 ewes) have been documented in this herd: 26 from hunting, 2 from vehicle collisions, 7 from cougar predation, and 13 from unknown causes. The last reported non-hunting mortality occurred in May 2017, when residents witnessed two cougars chase a ewe off a cliff in Sterling Valley.

Habitat

Habitat within the range of the Lincoln Cliffs bighorn sheep is primarily private land. Where intact, it includes sparse ponderosa pine, bunchgrasses, forbs, shrubs, and rock outcrops. The cliffs along the bank of Lake Roosevelt provide escape terrain and lambing areas. The flats above the cliffs are mainly dry land agricultural fields such as wheat and barley. Fields used by the sheep adjacent to roads contain irrigated alfalfa and other crops. Much of the area has been broken into small parcels and developed, and landscaped residential areas are frequented by the sheep.

Human-Wildlife Interaction

Damage complaints related to bighorns in both the Lincoln and Whitestone areas are on the rise. With the growth of this herd, agricultural activities adjacent to escape terrain, and recent drought conditions some local producers are experiencing significant seasonal damage to crops such as winter wheat and alfalfa. WDFW staff and Master Hunters were used periodically in 2014 to haze sheep from fields with little success. Growth in the local human population and associated construction of new housing continue to be a concern in Lincoln. The Lincoln group of sheep spends significant time near residences, so this may become an issue in the future if landowner tolerance changes. At the request of some residents, WDFW is working with the Wild Sheep Foundation to install sheep crossing signs in Lincoln, where roads are driven frequently by visitors and risk of collision is significant.

Population Augmentation

The Lincoln Cliffs population was started with an introduction of 11 'California' bighorns from Northwest Trek in December 1990. Three additional sheep from Vulcan Mountain were released in March 1991 and 5 from Kamloops, British Columbia in 1996. The population showed a steady increase over the following years, and reportedly peaked at around 100 animals in June 1998 (personal communication, J. Hickman). As a result of such growth, the herd was used to augment other populations in the state from 1999–2001. Sixteen ewes and 1 ram lamb were translocated to Lake Chelan, and 11 ewes were captured and released on Cleman Mountain. Aerial and ground surveys in 2002 indicated that population was not recovering from the removal of ewes. As a result, 15 sheep were translocated from Nevada to the Lincoln Cliffs and Whitestone areas in January 2003 (12 ewes, 1 ram, and 2 lambs). There have been no augmentations to this population since 2003.

Research

In February 2015, 10 sheep (8 ewes and 2 rams) were captured and fitted with GPS-enabled radio collars. Animals captured in 2015 were in overall good condition, with moderate to good body fat levels, low parasite loads, and no scabies infestations. With concern over poor lamb recruitment in 2014, all animals were also tested for *Mycoplasma ovipneumoniae (M. ovi)* exposure and active infection. *M. ovi*, a respiratory pathogen that predisposes wild sheep to pneumonia, is associated with domestic sheep or goat contact. An outbreak can cause high lamb mortality and persist in populations for decades. All bighorns captured in 2015 tested negative for *M. ovi*. Radio collars deployed in this capture have aided in location of sheep during lamb monitoring and during aerial surveys. In addition, the GPS data collected from the collars has provided insight into the movements of the ewes and rams in the Lincoln and Whitestone groups. There appears to be little to no interaction between ewes in the Lincoln and Whitestone groups (Figure 2); the one remaining collared ram shows regular movement between the two areas (Figure 2). None of the collared sheep have gone on any large forays out of the known use area.

To date, one mortality has occurred for the 10 sheep that were radio-collared in the February 2015 capture. This ewe was killed by a cougar in September 2015, though later testing indicated she had contracted the bluetongue virus and was in poor condition. One ewe's collar battery failed before the end of May 2015; this collar was an older collar redeployed on this capture. Though the collar GPS and VHF are no longer functioning the ewe was seen during both the 2015 and 2016 survey flights. The one ewe captured but marked only with an ear-tag was seen in the subsequent survey flights. Additionally, one ram collar stopped its GPS transmittal in March 2016; the fate of that ram is unknown, having not been seen or the VHF heard on any subsequent aerial or ground surveys.

Management Concerns

Disease continues to be a concern for bighorn sheep in the Lincoln Cliffs, given the close proximity to rural private lands. The herd is considered "clean," i.e., there have been no documented cases of *M. ovi.* in these sheep. This is important should it ever be considered as a source population to augment failing herds in Washington. In addition, there are over 200 bighorn sheep on the Hellgate Game Reserve, located across Lake Roosevelt within the Colville Reservation boundaries. In 2015 an ear-tagged ewe was observed in Lincoln from the Hellgate population, indicating that movement between the two populations occurs at least occasionally. Thus, a pneumonia outbreak in either could affect both populations.

There are no known large domestic sheep or goat operations in the range of the Lincoln Cliffs bighorns at this time. However, with the current development there is an increased potential for contact with domestic sheep or goats via 4-H and small scale hobby farms. One such flock of domestic goats was identified in the Whitestone area during this reporting period, and the animals were tested for *M. ovi*. Additionally, information regarding the potential of disease interactions between domestic sheep and goats with bighorns was provided to the local 4-H extension for inclusion in the newsletter. Outreach to small farm operations, new residents, and local organizations should continue in order to minimize risk of outbreak. GPS collar data will allow WDFW to better delineate the herd's home range and movements, and thus where to target education and outreach efforts regarding these threats.

Management Conclusions

The Lincoln Cliffs herd is estimated to be at the stated goal of 100-120 animals for this population if lambs are included (http://wdfw.wa.gov/conservation/game/). Given the expansion of this herd to Whitestone Rock, regular use of Sterling Valley, and the addition of GPS marked individuals, available habitat should be reviewed for this herd. Lincoln Cliffs sheep are living primarily on private land, both in the residential area of Lincoln and the agricultural fields above Whitestone. As Lincoln continues to be split into smaller parcels and developed, and the sheep consume agricultural crops, there is an increasing need to explore tools to address damage.

In early 2016, WDFW staff held a public meeting in Lincoln to update residents on current management and listen to concerns and ideas regarding future management of this herd. Outreach to residents and local producers should continue as management decisions are considered. Addition of a limited ewe hunt has been proposed to the public as part of the 2018-2020 hunting season setting process.

Table 1. Lincoln cliffs herd lamb ratios. *2014 – 2016 data are from fall aerial survey, prior to 2014 data are from spring aerial survey.					
Year	**Ewes**	**Lambs**	**Lambs: 100 Ewe**	**Lower 90% CI**	**Upper 90% CI**
2002	8	4	50	0	100
2003	27	13	48	21	75
2004	35	10	29	12	46
2005	21	10	48	18	78
2006	24	8	33	11	55
2007	18	9	50	16	84
2008	34	14	41	19	63
2009	33	11	33	14	52
2010	37	16	43	22	64
2011	34	11	32	14	50
2012	37	12	32	14	50
2013	34	18	53	28	78
2014*	49	7	14	5	23
2015*	39	24	62	36	88
2016*	47	31	66	41	91

Table 2. Lincoln cliffs herd ram ratios from fall aerial surveys.					
Year	**Ewes**	**Rams**	**Rams:100 Ewe**	**Lower 90% CI**	**Upper 90% CI**
2002	18	32	178	92	264
2003	32	18	56	29	83
2004	36	16	44	22	66
2005	21	22	105	52	158
2006	16	9	56	17	95
2007	25	20	80	41	119
2008	30	15	50	24	76
2009	31	18	58	30	86
2010	41	16	39	20	58
2011	42	26	62	37	87
2012	49	21	43	25	61
2013	55	32	58	37	79
2014	49	38	78	50	106
2015	39	29	74	44	104
2016	47	29	62	38	86

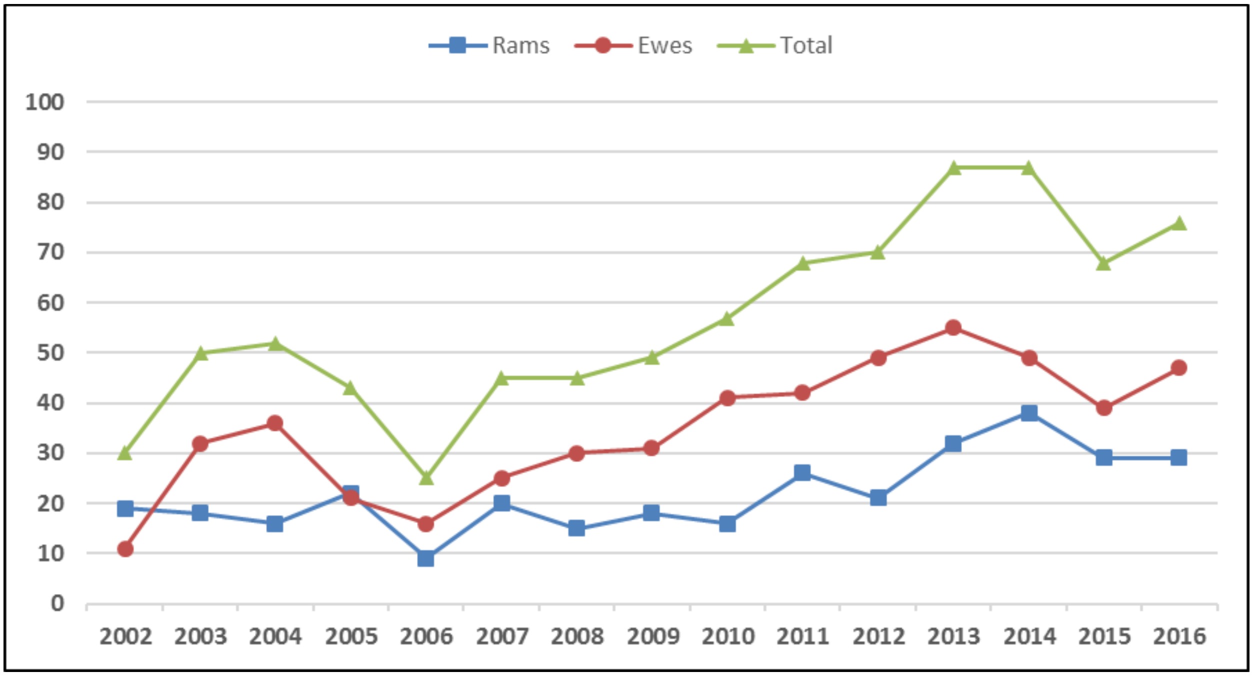

Figure 1. Lincoln Cliffs minimum population estimate by sex for 2002–2016. Shown are the maximum count from all helicopter surveys conducted each year, beginning in 2002, the year regular helicopter surveys were initiated.

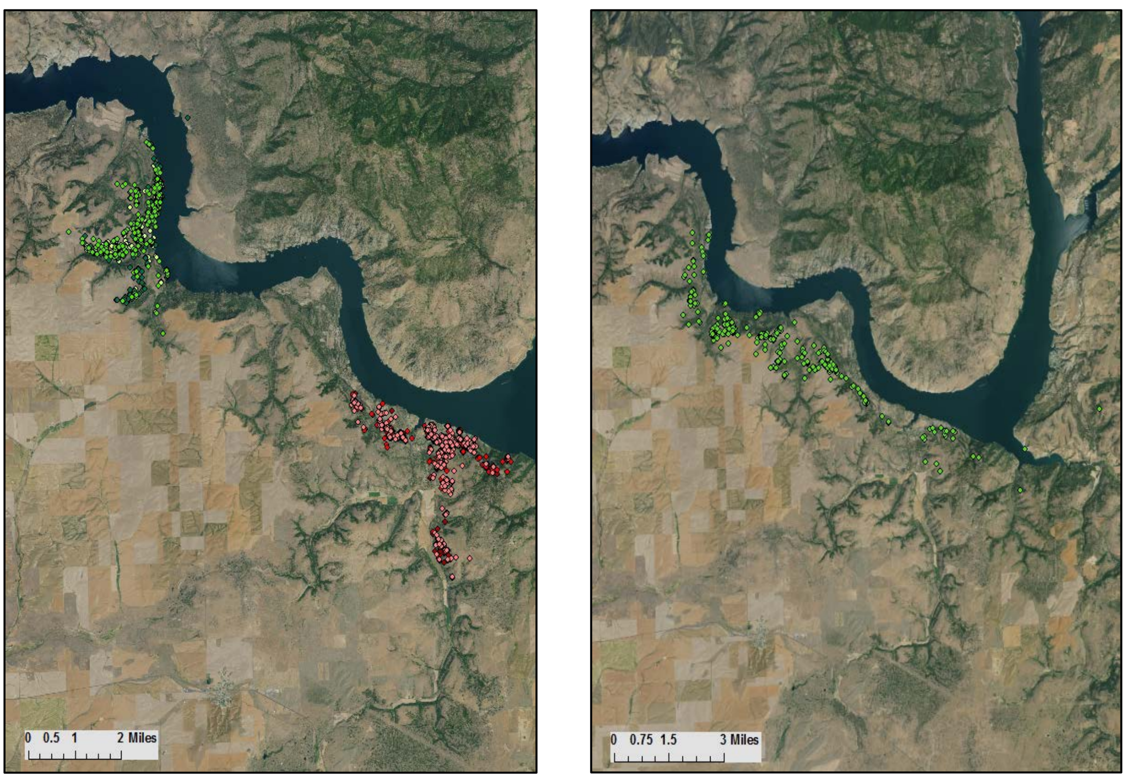

Figure 2. Left-hand panel: Radio locations for 6 Lincoln Cliffs bighorn ewes August 2016–July 2017. Whitestone ewes (3) are in green; Lincoln ewes (3) are in red. Right-hand panel: Radio locations for Whitestone ram August 2016–July 2017 in green.

Bighorn Sheep Status and Trend Report: Region 2

Mt. Hull and Sinlahekin

SCOTT FITKIN, Wildlife Biologist
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Management Guidelines and Objectives

Mt. Hull Herd

The objective for the Mt. Hull herd is to manage bighorn sheep numbers for a self-sustaining population capable of supporting both consumptive and non-consumptive recreation, while remaining within the capability of the limited land base to support it. The short-term objective for the Mt. Hull herd is to maintain a population size of 80-100 (http://wdfw.wa.gov/conservation/game/). This is likely the largest feasible herd size here due to available habitat constraints. Currently, the estimated herd size is above this level at 130-135 animals. The current management focus is to maintain or slightly reduce the current population level while minimizing the risk of disease and agricultural damage. This population supports a conservative, any ram and adult ewe permit harvest to the extent it is compatible with herd demographics.

Table 1. Summary of harvest information for bighorn sheep in the Mt. Hull Unit.

Year	WDFW Permits	WDFW Harvest	CCT[a] Permits	CCT Harvest
1995	1 ram	0	1 ewe	0
1996	1 ram	1 ram	1 ewe	0
1997	1 ram	1 ram	1 ewe	0
1998	1 ram	1 ram	1 ewe	1 ewe
1999	1 ram	1 ram	1 any	1 ram
2000	0	--	1 any	0
2001	0	--	1 any	0
2002	0	--	1 any	0
2003	1 ram	1 ram	1 any	1 ram
2004	1 ram	1 ram	1 any	0
2005	1 ram	1 ram	1 any	0
2006	2 rams	2 rams	2 any	1 ram
2007	2 rams	2 rams	1 any	1 ram
2008	2 rams	2 rams	1 any	1 ram
2009	1 ram 2 ewe	1 ram 1 ewe	1 any 2 ewe	1 ram 1 ewe
2010	1 ram 2 ewe	1 ram 2 ewe	1 any 2 ewe	0 ram 2 ewe
2011	1 ram 2 ewe	1 ram 1 ewe	1 any 2 ewe	1 ram 1 ewe
2012	1 ram 2 ewe	1 ram 2 ewe	1 any 2 ewe	0 ram NR* ewe
2013	2 ram 2 ewe	2 ram 1 ewe	2 any 2 ewe	0 ram 1 ewe
2014	5 ram 2 ewe	5 ram 2 ewe	2 any 2 ewe	2 ram NR* ewe
2015	1 ram 2 ewe	1 ram 1 ewe	4 ram 2 ewe	3 ram 0 ewe
2016	1 ram 2 ewe	0 ram 1 ewe	1 ram 2 ewe	1 ram 0 ewe

[a] CCT=Colville Confederated Tribes
* Not Reported

Sinlahekin Herd

The objective for the Sinlahekin herd is to manage bighorn sheep numbers for a self-sustaining population capable of supporting both consumptive and non-consumptive recreation. The short-term objective for the Sinlahekin herd is to attain a population size of 50-80 (http://wdfw.wa.gov/conservation/game/). Long-term, we estimate that the Sinlahekin sheep habitat could support 100 to 150 animals. The population reached a high in 2011 at an estimated 90-95 animals. In 2012, surveys indicated the population declined by as much as two-thirds, but has been slowly recovering since. Most recent surveys estimate the herd size at of 65-70 animals. The decline occurred in association with the discovery of the ectoparasitic mite *Psoroptes ovis* in the herd, although it is unclear whether there is a causative relationship. The current objective for the Sinlahekin herd is to increase the population size and reestablish harvest permits.

Population Surveys

Population surveys are generally conducted annually to determine composition and trend on both the Mt. Hull and Sinlahekin herds (Tables 2, 3). The surveys are conducted in late fall or early winter and consist of helicopter and/or ground count efforts. An attempt is made to classify all sheep in each herd, and although a complete count is generally not achieved, the majority of animals are typically documented by observers. This result represents a minimum count from which a population estimate is generated.

Mt. Hull Herd

WDFW biologists conducted a ground survey of the Mt. Hull Unit in September 2014 classifying 128 sheep, including 39 rams, 12 of which were ≥ ¾ curl. Observed lamb recruitment was 54 lambs per 100 ewes (Table 2). Multiple survey attempts in 2015 and 2016 failed to produce numbers with acceptable accuracy.

Sinlahekin Herd

WDFW biologists conducted a ground survey of the Sinlahekin Unit in December 2015 classifying 63 sheep, including 11 rams and 11 lambs. This yielded a lamb: ewe ratio of 27:100 (Table 3). Multiple survey attempts in 2016 failed to produce numbers with acceptable accuracy.

Hunting Seasons and Recreational Harvest

Mt. Hull Herd

This herd has supported ram permits since 2003, the number varying with herd size and ram demographics. Beginning in 2009, ewe permits were offered to help achieve herd reduction goals. Permits are split between the Washington Department of Fish and Wildlife (WDFW) and the Colville Confederated Tribe (CCT). Table 1 shows permit levels and harvest success during 1995-2016. During the 2014 hunting season, statewide auction and raffle hunters, as well as the north-central Washington multi-species raffle hunter all took rams from the Mt. Hull herd. For this reason, WDFW permitted harvests was reduced to a single ram in 2015 (although ewe permits remained at 2 animals to reduce the rate of herd increase). In 2016 WDFW permits remained at 1 ram and 2 ewes.

Sinlahekin Herd

In past years, herd demographics supported the issuance of one ram permit annually from 2010 through 2012, and hunters successfully filled all three permits. Since then herd demographics have not met management guidelines for harvest. If herd demographics improve and meet management guidelines opportunities for harvest will again be considered.

Survival and Mortality

Mt. Hull Herd

Observational data suggests that the Mt. Hull herd grew fairly steadily following reintroduction in 1970. Numbers peaked at 80-90 animals around 1990 following several mild winters. The population declined noticeably in the 1990s, particularly following the severe winter of 1992-93. Herd numbers climbed gradually over the next 10 years until the Rocky Hull fire burned a significant portion of the range in 2000. Robust herd growth has prevailed since, likely due to fire's rejuvenating effect on preferred forage plants. The herd reached its highest observed abundance in 2014 at 128 animals. This is above population objectives. The ram cohort fluctuated significantly in the early 2000s in response to fire activity in the US and Canada, but is now quite robust.

In 2001, WDFW augmented the herd with 8 ewes and 3 rams from the Cleman Mountain herd. Additional augmentation occurred in 2003 with 5 animals from John Day, Oregon. Augmentation efforts are primarily designed to maintain genetic diversity. Population growth is achieved largely through natural production. Given the limited range and insular characteristic of the sheep range on Mt. Hull, current herd size is likely near the maximum the landscape can sustainably support.

Table 2. Population composition counts from the Mt Hull area. <3/4 = less than 3/4 curl rams, ≥3/4 = greater than or equal to 3/4 curl rams, and L:100:R is lambs (L) and rams (R) per 100 ewes (100).

Year	Lambs	Ewes	Rams <3/4	Rams ≥3/4	Rams Total	Unknown	Count Total	Population Estimate	L:100:R
1992	0	26	1	7	8	0	34	40-60	0-100-31
1993	0	17	2	7	9	0	26	40-50	0-100-53
1994	5	28	2	8	10	0	53	50-60	18-100-36
1995	11	16	6	11	17	0	44	55	69:100:106
1996	0	5	10	6	16	0	21	40-60	0:100:320
1997	8	25	--	--	8	0	41	55-65	32:100:32
1998	--	--	--	--	--	--	--	--	--
1999	19	24	15	8	23	0	66	70	80:100:96
2000	21	30	9	0	9	0	60	60-65	70:100:30
2001	10	30	15	4	19	0	59	60-70	33:100:63
2002	11	40	6	4	10	0	61	65-70	28:100:25
2003	20	39	9	12	21	0	80	80-90	51:100:54
2004	9	32	7	10	17	0	58	70-90	28:100:53
2005	16	48	16	10	16	0	90	90-100	60:100:33
2006	8	40	25	5	30	0	77	100+	20:100:75
2007	13	54	17	6	23	0	90	100+	24:100:43
2008	18	52	20	13	33	0	103	110-120	35:100:63
2009	17	58	11	10	21	0	96	100+	36:100:29
2010	19	43	6	3	9	0	71	80-100	44:100:21
2011	8	38	13	18	31	0	77	80-100	21:100:82
2012	8	38	26	17	43	0	89	90-100	21:100:113
2013	12	50	17	8	25	3	90	90-100	24:100:50
2014	28	52	27	12	39	9	128	130-135	54:100:75
2015	--	--	--	--	--	--	--	--	--
2016	--	--	--	--	--	--	--	--	--

As herd growth increased, by the mid-2000s the bighorn sheep where coming down in elevation to forage on irrigated agricultural lands and crossing state highway 97 in the process. These behaviors led to an increase in bighorn sheep road kills and agricultural damage complaints which spiked in 2006-2007. To reduce herd size, trapping and relocating animals was accomplished in 2009 and 2011 in cooperation with the Colville Confederated Tribes and helped establish the Hellsgate bighorn sheep herd on the Colville Reservation. In addition to these translocation efforts, ewe-only permits were issued starting in 2009 to help reduce herd size towards management objectives. These permits continue to the present. Changes in private land use during this time also lead to reduced complaints.

The number of road kills and agriculture damage complaints decreased substantially after these herd reduction efforts and private land changes were achieved. Adequate natural forage away from the highway and farmland may also play a role in reduced complaints and road kills. With the population at an all-time high, implementation of more aggressive herd reduction may be necessary to maintain range health and reduce the potential for increases in highway crossings and damage incidents.

Domestic dogs have also been documented chasing bighorn sheep on Mt Hull and, in one case, causing injury to a lamb.

Sinlahekin Herd

Initially, the herd grew rapidly following reintroduction in 1957. High productivity and continued expansion allowed for translocation of sheep to other ranges in Washington. During the 1990s, the population declined, incurring particularly heavy losses during the winter of 1992-93. In 2003, WDFW augmented the Sinlahekin herd with 10 animals from Oregon to improve genetic diversity and bolster production. Herd demographics had improved with survey results showing an increasing population through 2011. This was likely a function of the herd expanding its range into previously unused habitat to the north, genetic mixing through augmentation, and improved survey accuracy. Since 2012, surveys show a dramatic decrease in the population which likely reflects an actual herd reduction rather than an artifact of survey timing. Causes of this decline are currently unknown; however, psoroptic mange may be a factor as discussed below.

In 2010, WDFW and Washington State University initiated a research project to gather data on herd range expansion, seasonal animal movements, and to evaluate the effectiveness of timber harvest and prescribed fire as sheep habitat enhancement tools in the Sinlahekin Wildlife Area. The thesis by Tiffany Baker, entitled “Habitat Selection and Spatial Responses of Bighorn Sheep to Forest Canopy in North-Central Washington” was completed and successfully defended in 2015. Ms. Baker also presented these results at the 20th biennial symposium of the Northern Wild Sheep and Goat Council, in Moscow/Pullman, May 2016. Psoroptic mange was discovered in the Sinlahekin herd during the 2011 capture. The reaction to this parasite in a bighorn herd can vary from no signs at all (a few mites in the ears) to fatal infections. We speculate (but do not know) that psoroptic mange may have contributed to the low observed population size and lamb production since 2012. In 2014, 11 bighorn sheep were captured in the Sinlahekin herd and tested for multiple potential pathogens and parasites. Nothing was found that would explain the reduction in the herd size. However, *Psoroptes* mites continued to persist within the herd. Eight of these sheep were fitted with GPS radio collars to increase survey accuracy. The apparent increase in the Sinlahekin population, based on the count obtained in 2015, was much too dramatic to have been caused by lamb recruitment. More likely, shifts in herd range use during the 2012-2014 period caused the large variation in annual counts. Also possible, although less likely, is that groups of animals emigrated, and then they or other later immigrated, to the Sinlahekin herd. Movements among bighorn herds in the Okanogan Valley and environs are not uncommon (see below). Monitoring of the herd will continue.

Table 3. Population composition counts from the Sinlahekin area. <3/4 = less than 3/4 curl rams, >3/4 = greater than 3/4 curl rams, and L:100:R is lambs (L) and rams (R) per 100 ewes (100).

Year	Lambs	Ewes	Rams <3/4	Rams >3/4	Rams Total	Unknown	Count Total	Population Estimate	L:100:R
1990	--	--	--	--	--	--	--	--	--
1991	--	--	--	--	--	--	--	--	--
1992	6	30	--	--	15	0	41	--	20:100:50
1993	2	17	--	--	4	0	23	--	12:100:24
1994	1	21	--	--	1	0	23	--	5:100:5
1995	9	24	5	6	11	0	44	--	38:100:46
1996	2	20	7	0	7	0	29	30-45	10:100:35
1997	--	--	--	--	--	--	--	25-40	--
1998	--	--	--	--	--	--	--	25-40	--
1999	0	0	0	0	0	0	0	25-40	--
2000	--	--	--	--	--	--	14	20-30	--
2001	6	16	4	0	4	3	29	30-35	38:100:25
2002	8	20	6	0	6	0	34	35-40	40:100:30
2003	--	--	--	--	--	--	--	--	--
2004	--	--	--	--	--	--	--	--	--
2005	2	13	3	2	5	0	20	30-40	15:100:38
2006	3	24	2	3	5	0	32	35-40	12:100:21
2007	2	37	5	7	12	0	51	50-60	15:100:32
2008	7	21	2	3	5	0	33	35-40	33:100:24
2009	15	48	14	9	23	0	86	90-95	31:100:48
2010	15	31	9	5	14	7	67	70-90	48:100:45
2011	4	55	18	5	23	0	82	90-95	7:100:42
2012	2	15	2	0	9	0	26	30-35	13:100:60
2013	4	29	3	2	5	0	38	40-45	14:100:17
2014	7	16	2	2	4	0	27	30-35	44:100:25
2015	11	41	8	3	11	0	63	65-70	27:100:27
2016	--	--	--	--	--	--	--	--	--

Habitat

Mt. Hull Herd

The Mt. Hull range has generally remained in good shape, but this may be changing. The Rocky Hull fire in 2000 appeared to initially reinvigorate natural forage production, and sheep use became more concentrated in the portion of the range that burned. Since then, increased population and noxious weed invasions may have reduced range quality. Cheatgrass has flourished in portions of the burn and other new invasive species, including white-top and Dalmatian toadflax, are present. In the past, programs such as the Forest Service's aggressive weed control effort funded by the Foundation for North American Wild Sheep (now Wild Sheep Foundation), have been helpful.

In 2017, staff of the US Forest Service Tonasket Ranger District initiated an analysis of the Mt Hull herd's habitat conditions within the District's boundaries. Potential management actions being analyzed include conducting prescribed fire, weed control and other efforts to benefit bighorn sheep habitat. On the ground implementation is anticipated to begin in 2019.

Radio collar data indicates that the current landscape supports functional connectivity between the Mt. Hull herd and the bighorn sheep herd at Omak Lake to the south and the Vaseux Lake herd in British Columbia, Canada, to the north. Radio collared sheep from both the Omak Lake and the Vaseux Lake herds have traveled into the Mt Hull herd (2010 and 2016 respectively) and then returned to their original herds. DNA testing of the Omak Lake herd indicated all animals tested but one, are genetically linked to the Sinlahekin herd. The one remaining individual was genetically linked to the Mt. Hull herd. This connectivity may increase genetic mixing but may also increase the chances of disease transmission between these herds.

Sinlahekin Herd

Since the early 2000s, the majority of the Sinlahekin herd has moved north out of its traditional use area on Aeneas Mountain with the exception of a small group that continues to use the area from Aeneas Mountain south to Blue Lake within the Sinlahekin Wildlife Area. Over the years, the amount of available sheep habitat on Aeneas Mountain and in the Sinlahekin Wildlife Area had likely declined due to tree encroachment and forest succession. Management activities have been reversing this trend in recent years.

In 2005, an extensive timber thinning and prescribed fire program to reduce tree encroachment and increase forage conditions began on the Sinlahekin Wildlife Area. To date 2,000 acres within the Sinlahekin Wildlife Area has been treated with prescribed fire. Of that, approximately 1,150 acres were also thinned to reduce conifer stocking levels. The project’s ultimate goal is to thin and/or conduct prescribed fire on 2,700 acres overall. In addition, the 2015 Okanogan Complex fire burned 7,000 acres within the Sinlahekin Wildlife Area. Many of these acres are within the southern end of the Sinlahekin herds range. An aggressive weed control program, in addition to the thinning and burning efforts, should improve habitat conditions for sheep and other ungulates on the Sinlahekin Wildlife Area.

Much of the sheep foraging habitat for the Sinlahekin herd is not under WDFW control. The WADNR and US BLM maintain cattle grazing on their permits in sheep range, and most of the adjacent private land is intensively grazed. These pressures are likely to continue.

Road mortality has been a minor issue in the Sinlahekin herd. Vehicles collisions have killed four mature bighorn rams and one lamb in the last 10 years.

An additional threat to both the Mt. Hull and Sinlahekin herds is the presence of domestic sheep and goats within and adjacent to their range. Wild sheep are often in close proximity to these domestic herds. This interaction may lead to the transfer of disease into these bighorn sheep herds, especially *Mycoplasma ovipneumoniae* and *Mannheimia haemolytica*, two bacterial pathogens that cause bighorn die-offs. WDFW biologists and conflict specialists have been working to encourage holders of small herds of sheep and goats to minimize risk to bighorns.

Management Conclusions

Mt. Hull Herd

Generally, the Mt. Hull herd has thrived in recent years, aided by improved post-fire forage conditions and genetic mixing through augmentation with neighboring herds. Changes in sheep behavior over the last few years suggest that the habitat is being strained by the increase in herd size. This herd is currently exceeding the population management objectives of 55-80 animals. Efforts by WDFW to reduce the Mt. Hull population, changes in land use, and favorable weather over the last few years have helped increase range quality, at least in the short term. These factors have also reduced road mortalities and landowner conflicts. WDFW is continuing to work on improving habitat, reducing the factors associated with vehicle collisions, landowner conflicts, and separation of bighorn sheep from domestic sheep and goats.

Sinlahekin Herd

The herd appears to be recovering from the precipitous decline earlier in the decade either from immigration, improved productivity or a combination of both. Extensive prescribed fire and thinning treatments in association with weed control strategies are producing improved habitat on the Sinlahekin Wildlife Area. Additional habitat improvement projects are in the works. Maintaining separation between bighorn sheep and domestic sheep and goats is a current management priority.

Bighorn Sheep Status and Trend Report: Region 2

Swakane, Chelan Butte, Manson

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Management Guidelines and Objectives

Three herds of 'California' bighorn sheep are found in Chelan County, the products of reintroductions into Swakane Canyon, the north shore of Lake Chelan and Chelan Butte. In addition, bighorn sheep from the Quilomene herd use areas in Chelan County along the Kittitas County border near Tarpiscan Creek, and along Jumpoff Ridge.

Management objectives for the Wenatchee District are: (1) increase the size and range of existing populations; (2) ensure genetic health by augmenting existing populations with bighorns from other areas; (3) minimize risk of disease from domestic sheep grazing allotments on public land, and provide information to the public about the importance of separating wild and domestics sheep; (4) reintroduce bighorn sheep into suitable unoccupied historic habitat within the District; and (5) provide recreational opportunities.

There were an estimated 155-165 bighorn sheep in the Swakane herd as of autumn 2016. The short-term objective for the Swakane herd is to maintain a population size of 130-170 animals (http://wdfw.wa.gov/conservation/game/); long-term, we estimate the habitat could support 150-180 animals. The north shore of Lake Chelan (Manson) population was estimated at 113-130. This is approximately our short-term objective, although we suspect that, long-term, the habitat could support approximately 200 animals. The Chelan Butte herd has expanded from an original release of 35 in 2004, to a current estimate of nearly 200 bighorns. Although habitat analysis (Musser and Dauer 2003) suggests sufficient habitat exists for a population of 195-390 sheep, concerns regarding possible movement of animals out of their core range into areas where they may encounter domestic sheep or goats have led WDFW to propose an objective of 150-170 bighorns (http://wdfw.wa.gov/conservation/game/).

Population Surveys

Prior to 2009, herd population data was collected primarily from incidental reports from WDFW personnel, permit hunters, public sightings, and occasionally aerial and ground surveys during the spring and rut periods (Table 1, 2, 3). In March of 2009, 12 sheep were outfitted with telemetry collars in both the Swakane and Manson herds (18 ewes and 6 rams). VHF collars were placed on 12 ewes and 4 rams, and GPS collars were place on 6 ewes and 2 rams. Collars have improved our ability to locate sheep during ground and aerial surveys, improving survey data, population estimates, and knowledge of home range and habitat use. In 2014, an additional 13 sheep were outfitted with GPS telemetry collars in the Manson herd to continue monitoring efforts. Two ground surveys are conducted on each herd annually; a spring survey to document lamb production and a fall survey focusing on rams during the rut. Minimum population counts are produced from high counts based on sex/age composition. All three herds were surveyed by helicopter in June

2009 to document production and update herd estimates. Additionally, Chelan PUD has been recording bighorn sheep observations during their Lake Chelan big game surveys since 2007.

Hunting Seasons and Recreational Harvest

In 1999, the first ram permit was offered for the Swakane herd, followed by one permit per year from 2000-2008. The only additional Swakane harvest was by the 2002 auction tag winner (Table 4). Currently, the bighorn season in the Swakane runs September 15-October 10. All hunters have been successful at killing a mature ram (≥3/4 curl). No bighorn permit was offered in the Swakane in 2009 due to the high number of vehicle collision mortalities along SR 97A in 2008. Highway mortalities were effectively stopped with the construction of a wildlife fence along SR 97A. A drawing permit for the harvest of one bighorn ram was reinstated for the 2010 hunting season. The ram harvested in 2010 is the new Washington State record and SCI World record California Bighorn Sheep.

Two permits have been offered in the Manson unit since the permit began in 2005. Both auction tag holders and raffle tag holders have regularly harvested rams from the Manson herd. There will be two drawing permits offered for the Manson herd along the north shore of Lake Chelan for 2017.

The Chelan Butte herd was hunted for the first time in 2010, with hunters harvesting mature rams in each year since. Aerial and ground surveys of the area have provided confirmation of an increasing herd. A second drawing permit for the herd was offered in 2016. Additionally, due to the area's easy access and robust population, WDFW is offering 4 additional permits for Hunters with Disabilities (2 juvenile rams and 2 ewes) in 2016. In 2017, hunters with disabilities will again have the opportunity to be drawn for 4 permits, two for bighorn ewes, and two for juvenile rams.

Survival and Mortality

From 1996 to 2000, the Swakane bighorn population increased slowly (Table 1). In 2001, the population was estimated at 51 sheep, representing a 46 percent increase from the 1992-2000 average. The increased count in 2001 resulted after Swakane bands began using the cliffs/breaks along the Columbia River and SR 97A, allowing for better monitoring. The proliferation of residential developments and their associated ornamental plantings along the west shore of the Rocky Reach pool may have enticed bighorns to cross Highway 97A with increasing frequency. For over 30 years, no bighorn mortalities were attributed to vehicle collisions. However, 44 Swakane bighorns have been killed by vehicles on SR 97A (18 rams, 21 ewes, 5 lambs) since 2002. The most recent ground count for the Swakane herd documented a minimum of 156 animals.

In response to these events, multiple agencies and conservation groups including Washington Department of Transportation, State Patrol, WDFW, and the Wenatchee Sportsmen's Association convened a working group to address deer and bighorn sheep vehicle collisions on SR 97A, and developed plans for a wildlife fence to reduce wildlife-vehicle collisions. Phase One of the fence was 4 miles long and extends from mile marker 212 on the north end to mile marker 208 on the south, the section where most collisions have occurred. Construction of this first section was completed 2009. Phase Two, completed in 2010, extended the fence roughly two miles to the south. The remaining 3.3 mile section (Phase Three) was completed in 2011. Vehicle collision mortalities have continued since completion of the fence mainly due to sheep finding vulnerable areas during the rut. Collision rates have dropped significantly, with only 2 vehicle collisions in the previous 12 month period.

Telemetry data from collared sheep has improved our ability to locate sheep and estimate population trends. Focused ground surveys have increased our minimum counts, and in 2015 the best estimate based on multiple surveys was 157 sheep. From 2011 through 2014, Swakane herd counts increased steadily. The current 2016 counts are based on multiple opportunistic aerial and ground based surveys, but we suspect animals were missed. Because these surveys are not exhaustive, their results are being used for ratio comparisons not population estimates.

The Manson herd on Lake Chelan exhibited rapid population growth typical of a founder population in excellent quality, unoccupied habitat. In 2004, June survey data were used to calculate 2002-2004 population trends, indicating a 3-year average annual population growth rate of roughly 38%. This increase seems to have slowed. Locations from recent telemetry data show that several bands have moved westward up lake into steeper, rockier, unoccupied habitat. Compared to the other 2 herds in this District, this herd consistently has lower lamb production. Due to the remote nature of the habitat of this herd, and the difficulty in locating sheep from the water, the population estimate of 101-122 is used from 2009, as a conservative estimate. The 2014 survey retuned an observation of 113 sheep, matching 2009. The collars allowed for a productive aerial survey, where we documented the herd's highest observed count (Table 2). With the addition of new GPS collars we hope to have more accurate counts in the near future. A late spring aerial survey focused on lamb production and recruitment in 2016 and returned a count of only 65 sheep. The low number may have been the result of sheep being distributed differently than was anticipated for the survey. Future efforts will focus on producing a reliable herd estimate.

The Chelan Butte herd has also shown rapid growth and is now expanding their range north of Chelan Butte into Deer Mtn. and Howard Flats. We conducted an aerial survey of this herd to assess production and estimate numbers in 2009. A total of 84 sheep were observed in 2009, and the population was estimated at 84-98. Since 2009, this herd has shown an average 17% increase in the observed minimum count annually to a high of 191 in 2015 (Table 3). The Chelan Butte herd has expanded its range to north of the Chelan River. The majority of our herd counts occur on the main portion of the herd on the wildlife area, so the estimate of 185-200 sheep is thought to be conservative. The current 2016 counts are based on multiple opportunistic aerial and ground based surveys. Because these surveys are not exhaustive, their results are being used for ratio comparisons not population estimates.

We estimate that less than 20 bighorns seasonally use the Colockum and Jumpoff Ridge areas in Chelan County. These sheep are part of the Quilomene herd. A group of 10-15 rams are regularly seen south of Jumpoff Ridge. Residents report a small group of 5-9 ewes and lambs on Jumpoff Ridge and that these animals reside there from spring to fall. If these are in fact resident, these observations suggest the Quilomene sheep have expanded their range.

Habitat

Habitat conditions for Swakane, Manson and Chelan Butte bighorns are excellent, in part due to the high frequency of fires. Fires reduce tree and shrub cover and increase the abundance of grasses and forbs, which in turn benefit bighorns. During summer 2001, the Rex Creek fire on the north shore of Lake Chelan burned over 53,000 acres. However, only a small portion of this burn was known occupied bighorn habitat. During summer 2002, the Deer Point fire on the north shore of Lake Chelan, and down-lake from the Rex Creek fire, burned over 43,000 acres, including most of the occupied bighorn habitat of grass, bitterbrush, mixed shrubs, and ponderosa and lodgepole pine. In October 2002, at least 25 bighorns moved northerly to the Point-No-Point area of the Rex Creek burn, apparently to take advantage of the new forage; they continue to utilize this area. Forage quantity and quality appear to be excellent, following the release of nutrients from both the fires.

The Dinkelman fire in the Swakane area, which burned in 1988, proved beneficial to the Swakane bighorns. In 2010, 20,000 plus acres burned in a low intensity fire in the Swakane. The Chelan Butte herd continues to utilize many of the fallow agriculture fields and adjacent shrub-steppe habitat. There are further opportunities to enhance bighorn, mule deer and other wildlife habitats in Swakane and on Chelan Butte, but these have been limited due to funding constraints.

Several springs were developed or improved for bighorn sheep within the range of the Swakane herd along the breaks of the Columbia River. Prior to fence construction, ewe bands regularly moved to the river to access native riparian and ornamental forage. Completion of the SR 97A fence excluded sheep from a very small amount of habitat, as they have always spent most of their time in habitats west of the highway.

Telemetry data indicate that sheep have not altered their seasonal use habitat patterns use in response to the newly constructed wildlife fence. The fence eliminated the bighorn's use of a narrow band of habitat between SR 97A and the Columbia River. Due to the observed preference of California bighorns for low elevation habitats, those habitats susceptible to human encroachment, there is long-term impact occurring from conversion and development of native habitat. Maintenance of habitat connectivity at low elevations in Chelan County is vital to the long-term health of all 3 herds.

Human-Wildlife Interaction

No official reports of agricultural damage attributed to bighorns were received in 2004-2010; however, reports have been received in recent years from orchardists in the Swakane and Chelan Butte about the presence of bighorns in their orchards. They have expressed concerns of damage to young trees; however, no claims for damage have been filed. Observations indicate that the sheep are feeding mainly on grass within the irrigated orchards, but will feed on orchard trees. New plantings suffer the greatest damage from bighorn when this occurs. In an effort to reduce occurrences of bighorns feeding in orchards, old fences on the Chelan Butte Wildlife Area have been replaced and or upgraded.

Population Augmentation

The Manson herd is likely continuing to grow, and presumably has good genetic diversity due to the variety of founder sources. Chelan Butte was selected as an introduction site for bighorns due to its close proximity to the Manson population. If the recently observed movements of sheep northward from Chelan Butte continue, it is likely that interchange between the Manson herd and sheep on the butte will occur. Anecdotal observations of bighorn sheep accessing habitat in between Swakane and Chelan Butte have also increased in the past two years, suggesting there is some interchange between these herds. During the past few years several females have been observed along the middle reaches of the Entiat River Valley, outside what is considered the core range of the Swakane herd. It is not known if these sheep originated from the Swakane herd, or the Chelan Butte herd. WDFW is building a permanent live trap at Chelan Butte, which will allow personnel to capture, mark, obtain veterinary samples, and potentially move animals to other herds that may need augmentation.

Management Conclusions

The risk of disease transmission from domestic sheep is substantial for both the Swakane and Chelan Butte herds. Domestic sheep were documented 6 times within the core habitat of Swakane bighorns from 2000-2007. Domestic sheep were euthanized by WDFW (with permission from owners) in 2003 and 2007.

Bighorn rams were documented in domestic sheep grazing allotments twice during 2000. WDFW and the Okanogan-Wenatchee National Forest have reduced the risk to bighorns from domestic sheep on Forest Service lands, however, no final solutions have been developed. Bighorns in Swakane are still at risk for disease transmission from domestic animals. In both 2013 and 2014, two to four bighorn ewes were seen multiple times within occupied domestic grazing allotments in the Entiat Valley. Efforts to locate and remove the bighorn sheep were unsuccessful. WDFW continues to work closely with the USFS to minimize encounters between bighorn and domestic sheep.

The Swakane bighorn population is highly accessible for viewing during the winter months. Viewing opportunities, in particular large adult rams, are highly valued by the public. Harvest management should be conservative to maintain this viewing opportunity.

The population objective of 150 sheep for the Manson herd on the north shore of Lake Chelan is conservative, based on the low potential for conflicts, US Forest Service management emphasis for bighorn sheep habitat, and the increase in habitat resulting from wildfires.

This summer two bighorn sheep, one ewe and immature ram, were observed in Douglas County across the Columbia River from the Colockum Wildlife Area. We assume that the sheep crossed the river from the wildlife area, and reports indicate that they resided there for a month or more before they were removed by WDFW staff.

Aerial surveys of sheep groups outfitted with telemetry collars present the best opportunity to monitor the status of Swakane, Chelan Butte and Manson herds. Optimum monitoring would involve helicopter surveys during the rut to monitor rams and total numbers. Routine monitoring of the active collars will be done to keep track of herd movements, range, general habitat use and trends, and contribute additional population data.

Literature Cited

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Table 1. Observed population composition of the Swakane bighorn sheep herd, 1996-2016

Year	Lambs	Ewes	<3/4curl	≥3/4 curl	Total rams	Total sheep	Population estimate	Lambs:100 ewes	Rams:100 ewes
1996	3	19	8	6	16	38	38	16	84
1997	2	4		2	2	8	25	50	50
1998	3	9	7	4	11	23	30	33	122
1999	4	20	5	7	12	36	36	20	60
2000	5	14	1	8	10	29	35	36	71
2001	9	23	6	10	19	51	51	39	83
2002	10	25	9	8	19	54	54	40	76
2003	13	26	5*	8*	20*	59	58	50	77
2004	10	15	6	6	13	38	50-60	67	77
2005	7	27	6	6	13	47	50-60	26	48
2006	11	43	6	7	15	69	70-75	26	35
2007	-	-	-	-	-	-	-	-	-
2008	13	24	4	12	21	58	70-75	54	88
2009	17	34	5	20	30	81	81-90	50	88
2010	17	44	13	13	26	87	87-95	39	59
2011	13	63	14	16	23	107	110-120	22	48
2012	24	58	17	19	40	122	130-140	41	67
2013	27	63	12	29	41	131	130-140	43	65
2014**	27	62	12	11	45	134	130-150	50	74
2015**	38	71	13	15	48	157	150-160	54	68
2016***	6	30	9	13	22	57	130-150	20	73

*12 rams classified from the observed 20. ** High counts from multiple surveys. *** Incomplete count

Table 2. Observed population composition of the Manson bighorn sheep herd, 1999-2016.

Year	Lambs	Ewes	<3/4 curl	≥3/4 curl	Total rams	Total sheep	Lambs: 100 ewes	Rams: 100 ewes	Population estimate
1999	2	10	2		3	15	20	30	15
2000	6	33	6		11	50	18	33	50
2001	12	24	4		12	48	50	50	50
2002	17	36	6		14	67	47	39	70-75
2003	20	54	4	1	5	79	37	9	83-113
2004	16	62	11	5	16	94	26	26	98-129
2005	10	28	12	5	17	59*	36	61	98-129
2006	5	28	1	14	15	79*	18	54	98-129
2007	10	55	9	16	28	93	18	51	98-129
2008	6	31	4	5	16	98*	19	52	98-129
2009	11	59	7	26	43	113	19	73	113-130
2010	11	58	15	17	32	101	19	55	101-122
2011	10	51	6	21	25	86	20	49	101-122
2012	15	52	7	13	22	89	29	42	101-122
2013	18	65	6	11	18	101	28	26	101-122
2014**	23	66	7	11	24	113	35	38	115-130
2015**	25	50	8	9	28	103	50	56	115-130
2016	7	49	7	2	9	65	14	18	115-130

*High count of sheep observed by Chelan PUD during their 12 boat surveys per year.
** Spring 2013 count incomplete. *** High from multiple counts

Table 3. Observed population composition of the Chelan Butte Bighorn sheep herd, 2004-2016.

Year	Lambs	Ewes	<3/4 curl	≥3/4 curl	Total rams	Total sheep	Lambs: 100 ewes	Rams:100 ewes	Population estimate
2004	10	22	3		3	35	45	13	36-47
2005	5	27	1		2	34	19	7	34-53
2006	5	32	3	3	8	45	16	25	45-50
2007	-	-	-	-	-	-	-	-	-
2008	10	32			21	63	31	66	60-70
2009	12	48	3	14	24	84	25	50	84-98
2010	16	50	17	18	35	101	32	70	101-120
2011	19	46	15	13	28	93	41	61	101-120
2012	13	72	10	25	43	128	18	58	130-145
2013	25	97	17	26	41	163	26	42	160-170
2014*	34	97	11	32	52	183	35	54	185-200
2015*	42	91	24	18	58	191	46	64	185-200
2016**	21	34	11	21	32	130	62	94	185-200

* High counts from multiple surveys. ** Incomplete count

Table 4A: Summary of Ram Harvest: Swakane

Year	Permits	Harvest	Comments
2001	1	1	
2002	1	2	*
2003	1	1	
2004	1	1	
2005	1	1	
2006	1	1	
2007	1	1	
2008	1	1	
2009	0	0	**
2010	1	1	
2011	1	1	
2012	1	1	
2013	1	1	
2014	1	1	
2015	1	1	
2016	3	3	*
Total	17	18	

* Includes harvest by Auction tag holder.

** No tag offered due to excessive vehicle mortalities.

Table 4B: Summary of Ram Harvest: Manson

Year	Permits	Harvest	Comments
2005	2	2	
2006	2	2	
2007	2	3	*
2008	2	2	
2009	2	1	
2010	2	4	*
2011	2	4	*
2012	2	3	*
2013	2	3	*
2014	2	2	
2015	2	2	
2016	2	2	
Total	24	30	

* Includes harvest by Auction and/or Raffle tag holders.

Table 4C: Summary of Ram Harvest: Chelan Butte

Year	Permits	Harvest	Comments
2010	1	1	
2011	1	1	
2012	1	1	
2013	1	1	
2014	1	1	
2015	2	5	*
2016	2	5	*
Total	9	15	

* Includes harvest by Auction and/or Raffle tag holders.

Bighorn Sheep Status and Trend Report: Region 3

Quilomene, Cleman Mountain, Umtanum/Selah Butte, and Tieton

JEFFREY BERNATOWICZ, Wildlife Biologist

Management Guidelines and Objectives

The statewide goals for bighorn sheep are:

1. Preserve, protect, perpetuate, and manage bighorn sheep and their habitats to ensure healthy, productive populations.
2. Manage bighorn sheep for a variety of recreational, educational and aesthetic purposes including hunting, scientific study, cultural and ceremonial uses by Native Americans, wildlife viewing and photography.
3. Manage for sustained yield.
4. Numerical goals for each herd are provided in Tables 2-5.

Population Surveys

Quilomene and Umtanum/ Selah Butte had historically been surveyed via helicopter in July. The survey timing was not a good index to actual recruitment or optimal for detecting disease problems. In 2014, surveys were changed to March. Cleman Mountain is surveyed at the feeding station in December/January.

Umtanum and Selah Butte were surveyed from helicopter and the ground numerous times from late 2009 through 2016, due to a disease outbreak and research project. Ground surveys are conducted in August/September to index early lamb recruitment. Final recruitment surveys are flown in February/March. All available information is used to estimate the total population. Survey results are given in Tables 2- 5.

Hunting Seasons and Recreational Harvest

Region 3 supports three populations of ‘California’ Bighorn Sheep: Cleman Mountain, Umtanum/Selah Butte, and Quilomene. The Tieton herd was culled due to a pneumonia outbreak in 2013. Hunting is by permit. The number of permits (WDFW only) and harvest are given in Table 1. The Yakama Nation (YN) issues permits for all herds, and the Muckleshoot Indian Tribe also issues permits for the Cleman Mountain and Umtanum/Selah Butte herds. YN does not report harvest, but their hunters are often encountered by the public/WDFW enforcement. When YN harvest is known, it is included in Table 1.

Survival and Mortality

Bighorn sheep were native to Region 3, but had been eliminated by over hunting and disease by the early 1900s. All existing populations are the result of reintroductions.

The Quilomene reintroduction was the first in the region (early 1960s) and the population was estimated at over 100 animals by the late 1960s. The population then crashed in the early 1970s.

The cause of the decline was unknown, but the population had reportedly died out by 1990. Reintroductions occurred again in 1993. By 1996, 41 bighorns had been released in the area. The Quilomene population quickly grew to over 160 sheep (Table 2). Poor recruitment, observations of coughing sheep, and reports of mortalities indicated a disease outbreak circa 2004-2006. Adult ewe counts had been declining and reached lows in 2014. In 2013, a large, fast moving fire went through the north portion of the herd area. Post-fire, sheep were difficult to find. This was apparently due to a shift in range as numbers rebounded to expected levels in 2015. Lamb recruitment has been fairly low, but the population is at objective. The herd was augmented with 8 ewes, 7 lambs, and 6 rams obtained from the Cleman Mountain herd in January 2017.

The Cleman Mountain population was established in 1967 with the release of 8 animals. The herd remained relatively unchanged for over 20 years. A portion of the population was captured, tested, and treated with antibiotics in 1990. Augmentation included 27 animals during 1989-96. Production increased after 1996, and the population exceeded 150 animals by 2000 (Table 2). Over 165 sheep have been captured and translocated from this herd since 2001. Over 145 were harvested during that period and the population is still above objective. The Cleman Mountain herd continues to produce a large number of lambs, and the herd continues to grow. The Cleman herd is at high risk of contracting bacteria associated with pneumonia outbreaks due to recent disease problems in Tieton, Yakima River Canyon, and nearby domestic sheep grazing allotments. Concerns have led to frequent testing; the most recent testing was in January 2017. No evidence of pneumonia or associated bacteria was detected.

The Cleman herd has been very strong, and it had been difficult keeping the herd at objective. Ewe permits were issued in 2016, and 29 animals were translocated to other herds. Winter 2016-17 was relatively severe for Cleman sheep, with deep crusted snow persisting into March. The bighorns are fed by WDFW during winter, but oddly most adult rams stopped coming to the feed site in early January of 2017. Fifteen adult rams died within 1 mile of the feed site. Most carcasses were decomposed upon investigation, but starvation was initially suspected. A taxidermist cleaning the skulls reported corn in the throat of many of the rams. A well-meaning person may have fed corn to animals, causing corn toxicity (acidosis), which is fairly common in ruminants. The herd has been reduced to objective via harvest, translocation, and winter deaths.

The Umtanum herd was established in 1970 with the release of 8 bighorns west of the Yakima River. Within 15 years, the population grew to an estimated 200 animals, and some sheep crossed the Yakima River. Originally, sheep on the east side of the river were considered a separate herd (Selah Butte). Surveys have shown that animals cross the river in both directions, and it is now considered a single herd. In 2001, 11 sheep were released at the south end of the canyon, near Roza Dam.

Population estimates for Umtanum/Selah Butte varied between 170 and 200 animals until 2002 (Table 4). Dispersal, winter mortality, and the removal of 52 sheep for augmenting other populations probably kept the numbers stable. The increase, after 2002, was largely due to the release of 11 animals and a subsequent increase in lamb production. Harvest was increased during this period to maintain a stable population.

In December 2009, an outbreak of pneumonia was discovered at the north end of Umtanum. Disease loss and culling removed approximately 50% of the Umtanum herd by April 2010. The bacterial pneumonia jumped to the east of the river (Selah Butte) in summer 2010, but no significant adult mortality was noted. By August 2010, low lamb survival was apparent on both sides of the river. Lamb and adult survival was very high in 2011 and 2012. It appeared the herd had recovered and was back at objective. However, testing of 31 animals in February 2013 found *Mycoplasma ovipneumoniae* (*M. ovi*) in one young ram. Adult survival has been high since 2013, but lamb recruitment was low during 2013 through 2017. Samples were collected from sheep on both sides of the river, pneumonia was confirmed, as was the same strain of *M. ovi* that evidently entered the population in 2010. Bernatowicz et al. (2016) provides a full accounting of the experience with pneumonia in the Umtanum/Selah herds (available at http://media.nwsgc.org/proceedings/NWSGC-2016/Bernatowicz_NWSGC20_38-61.pdf). In early fall 2015, there was also an apparent outbreak of blue-tongue virus. Two ram carcasses tested positive, as did one road-killed ewe. Current harvest rates on this herd are probably not sustainable.

The Tieton herd was established with the release of 54 sheep during 1998-2002. Subsequent radio-telemetry indicated relatively low mortality and high lamb recruitment. An aerial survey in 2008 confirmed the population was over objective. Sixty-five animals were removed for translocation since 2009-2012. During the capture, crews confirmed population estimates, and the herd was found to be disease free (last capture March 2012). Harvest removed 49 animals during 2009-2012 in an attempt to keep the population near population objectives. In March 2013, a pneumonia outbreak was confirmed. Mortality appeared to be high, and a decision was made to euthanize the remaining animals to prevent spread to the nearby Cleman Mountain herd. A total of 57 bighorns were euthanized. Pneumonia and *M. ovi* were confirmed in all samples. The strain of *M. ovi* in the Tieton herd was different than that found in the Yakima River Canyon sheep.

Habitat

Forage resources vary annually with moisture. Precipitation had been near or above average 2010-2012, undoubtedly increasing forage production. Drought conditions returned in 2013-2016. A significant portion of the north Quilomene range burned in 2013. The impact of fire is unknown. In forested areas, fires can decrease cover and increase browse. In more arid climates, fires can reduce plant diversity. Moisture was high fall 2016 through spring 2017, increasing total forage for all herbivores.

Population Augmentation

The Quilomene herd received 21 sheep from the Cleman Mountain herd in January 2017. This augmentation was more driven by opportunity than necessity. The Cleman herd has been over objective and are easy to trap at the winter feed site. There was also a desire to learn more about Quilomene sheep via GPS collars.

No habitat enhancement projects have been funded for bighorn sheep in the region. In general, bighorn habitat is difficult to work in and success of any habitat projects would be limited due to shallow soils and arid conditions. Sheep at Cleman Mountain are fed during the winter, mostly to make periodic trapping easier.

The most beneficial projects to bighorn populations would be to reduce/eliminate contact with domestic sheep/goats. In 2006, a large private ranch in Quilomene was purchased by WDFW, and domestic sheep grazing was subsequently eliminated. Similar efforts have secured habitat and reduced risk of domestic/bighorn interactions within the Cleman Mountain herd range.

Management Conclusions

The main threat to bighorn sheep in the region is bacterial pneumonia caused by contact with domestic sheep/goats. The Tieton herd was eliminated and current plans call for holding off on reintroduction until the risk of contact with domestic sheep or goats is substantially reduced. The Yakima River Canyon herd rebounded from the initial die-off, but currently suffers from low lamb recruitment most years.

Disease outbreaks are not unexpected because domestic sheep and/or goats have been documented in close proximity to bighorns in every herd in the Region. Reducing/eliminating risk of contact between bighorns and domestics is essential to the long-term viability and health of bighorns. It may be possible to develop *M. ovi*-free animals in small-sized domestic herds grazed on private lands. This would reduce the risk of pneumonia. For some herds (e.g., Tieton), the larger risk comes from domestic sheep grazing on public (USFS) land.

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Table 1. Summary of bighorn sheep ram harvest in Region 3 since 2000.

Area	Year	Permits	Harvest	Comments
Cleman Mtn.	2001	6	8	Harvest includes raffle and auction hunters
	2002	3	3	
	2003	6	7	Harvest includes raffle hunter
	2004	7	8	Harvest includes auction hunter
	2005	9	5	4 no report
	2006	10	11	Harvest includes raffle hunter
	2007	10	10	Harvest includes raffle hunter, 1 no report
	2008	10	11	Harvest includes raffle, auction, tribal
	2009	6	9	Harvest includes tribal
	2010	6	8	Harvest includes raffle hunter, tribal
	2011	6	13	Harvest includes raffle hunter, tribal
	2012	12	24	Harvest includes raffle hunter, tribal
	2013	10	18	Harvest includes raffle hunter, tribal
	2014	8	11*	Harvest includes raffle hunter, tribal
	2015	6	6*	Harvest includes tribal
	2016	6 Ram,10 Ewe	8 Ram,11 Ewe	Harvest includes tribal
Umtanum/Selah Butte	2001	8	7	
	2002	7	7	
	2003	7	6	
	2004	7	7	
	2005	7	6	1 no report
	2006	10	10	
	2007	10	9	1 no report
	2008	10	14	Harvest includes tribal (2 ewes, 2 rams)
	2009	15	18	Harvest includes auction, tribal
	2010	10	15	Harvest includes raffle hunter, tribal
	2011	8	12	Harvest includes tribal
	2012	5	11	Harvest includes tribal
	2013	5	9	Harvest includes tribal
	2014	6	8*	Harvest includes tribal
	2015	5	8*	Harvest includes raffle hunter, tribal
	2016	4	8*	Harvest includes raffle hunter, tribal
Quilomene	2001	6	5	
	2002	8	9	Harvest includes raffle hunter
	2003	7	6	
	2004	5	5	
	2005	5	5	
	2006	5	4	1 no report
	2007	6	6	
	2008	4	5	Harvest includes tribal
	2009	4	5	Harvest includes tribal
	2010	4	4	
	2011	4	5	Harvest includes auction hunter
	2012	3	4	Harvest includes tribal
	2013	3	4	Harvest includes tribal
	2014	3	3	
	2015	2	2	
	2016	2	2	

Table 2. Quilomene Population Composition

Year	Lambs	Ewes	Total Rams	Adult Rams	Total Count	Estimated Population	Short-term Objective
2002	11	33	24	16	68	165	
2003	23	63	28	18	114	Unknown	
2004	13	99	32	32	144	Unknown	
2005	16	77	24	21	117	Unknown	
2006	14	89	30	22	133	135	
2007	44	75	32	26	151	160	
2008	33	77	14	11	124	160	
2009	27	86	32	23	145	160	
2010	25	57	20	14	102	160	
2011	11	48	15	15	74	150	
2012	41	65	43	37	149	160	
2014	18	34	28	20	83	100	
2015	20	93	47	44	160	160	
2016	17	73	72	54	162	170	150-170
2017	No	Survey					

Table 3. Cleman Mt. Population Composition

Year	Lambs	Ewes	Total Rams	Adult Rams	Total Count	Estimated Population	Short-term Objective
2002	25	91	55	36	171	171	
2003	32	104	66	35	203	203	
2004	17	83	85		185	185	
2005	28	82	67		177	188	
2006	33	93	67	45		193	
2007	20	100	68	50		198	
2008	40	85	64	40		174	
2009	30	98	70	45		198	
2010	35	83	60	48	201	201	
2011	34	83	88	65	205	205	
2012	30	78	59	59	167	180	
2013	45	101	60	50	206	210	
2014						235	
2015	50	129	80	60	259	260	170-220
2016	30	145	40	30	215	215	170-220

Table 4. Umtanum/Selah Butte Population Composition

Year	Lambs	Ewes	Total Rams	Adult Rams	Total Count	Estimated Population	Short-term Objective
2001	42	82	40	31	174	190	
2002	27	97	43	23	167	200	
2003	26	94	52	38	172	220	
2004	33	87	28		148	240	
2005	61	159	69	54	289	290	
2006	27	106	24	21	157	300	
2007	54	120	68	55	242	300	
2008	63	156	60	51	*279	300	
2009	47	149	62	52	257	300	
2010	23	90	63	60	176	210	
2011	33	109	53	50	195	220	
2012	65	155	68	57	*288	270	
2013	42	80	13		135	270	
2014	14	168	85	58	267	270	
2015	13	168	57	49	238	265	
2016	33	144	30	26	233	260	250-300
2017	11	160	46	40	217	240	250-300

* Probable double count of ewes and lambs

Table 5. Tieton Maximum June Population

Year	Lambs	Ewes	Total Rams	Adult Rams	Total Count	Estimated Population	Long-term Potential
2000	11	24	11		46	46	
2001	13	35	19		67	67	
2002	10	30	8	8	48	70	
2003	10	40	20	11	70	80	
2004	19	33	5		57	90	
2005	20	88	4	3	112	110	250
2006	35	55	40	37	130	135	250
2007	23	63	7	0	93	160	250
2008	54	81	32	16	167	200	250
2009						200	250
2010	40	72	89	48		200	250
2012	33	66	24	16	125	150	250
2013	Herd	Eliminated					250

Moose

Moose Status and Trend Report

STATEWIDE

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Introduction

Moose (*Alces alces*) apparently migrated on their own accord into eastern Pend Oreille County, Washington in the 1950s. The first official state documentation of moose in Washington occurred in 1954 (Poelker 1972), although the literature reports a bull moose that was taken by hunting on the Colville Indian Reservation in 1929 (Scheffer and Dalquest 1944). In the decades since, moose have increased both in numbers and distribution and are now common in northeast Washington and can be found in smaller populations in the Okanogan and Blue Mountains; a few scattered individuals have colonized the east slopes of the Cascades. Moose have been documented to wander into many other places throughout the state including the high desert country of the Columbia Basin (WDFW 2015).

Management Guidelines and Objectives

The statewide goals for moose (WDFW 2015) are to:

1. Preserve, protect, perpetuate, and manage moose and their habitats to ensure healthy, productive populations.
2. Manage moose for a variety of recreational, educational, and aesthetic purposes including hunting, scientific study, cultural and ceremonial uses by Native Americans, wildlife viewing, and photography.
3. Manage statewide moose populations for a sustained yield.
4. Manage moose populations with a rigorous, data-based system.

Population Surveys

Surveys were conducted using a helicopter and generally occurred between December and February. These surveys assisted district biologists in crafting permit level recommendations, and generally supported information from hunts indicating a continued positive trend in the moose population in northeastern Washington (Harris et al., 2015).

A more rigorous aerial survey protocol was initiated in winter 2013-15 that is intended to provide a baseline population estimate from which future trends will be assessed. Initial results from surveys conducted in the Colville and Spokane districts are promising, and a manuscript detailing the new estimate of population abundance is currently under peer-review.

Hunting Seasons and Recreational Harvest

Moose hunting opportunities in Washington are by permit only. Most moose hunting seasons were October 1-31, November 1-30, or both months; auction, raffle, and archery hunts began 1 September. Hunters were able to use any legal weapon except in the Parker Lake area, where archery only and muzzle-loader only hunts were authorized. Hunters having successfully taken a moose under an "any moose" permit are prohibited from applying for another "any moose" permit. Permit availability (and therefore hunter opportunity) increased substantially beginning in the late 1990s (Fig. 1), and is currently higher than at any time since moose hunting began in Washington.

In 2015, there were a total of 174 moose permits available (184 including master hunter permits), of which 158 were reported as being used by hunters, resulting in 134 moose reported harvested. Permit types available were "any" moose (107), antlerless only (35), youth antlerless (18), 65-and-over antlerless (4), disabled antlerless (4), hunter instructor incentive antlerless (2), statewide raffle (2), NE multi-species raffle (1), and auction (1). Of the 134 moose reported harvested, 77 were male and 57 were female. For statistics (e.g. number of permits, success rates, etc.) on individual hunt units please see the Hunting Prospects for District 1 and 2 http://wdfw.wa.gov/hunting/prospects/index.html. For information on hunting moose in Washington and the access in individual hunt units please read Moose Hunting in Eastern Washington found here http://wdfw.wa.gov/hunting/goat_sheep_moose/index.html.

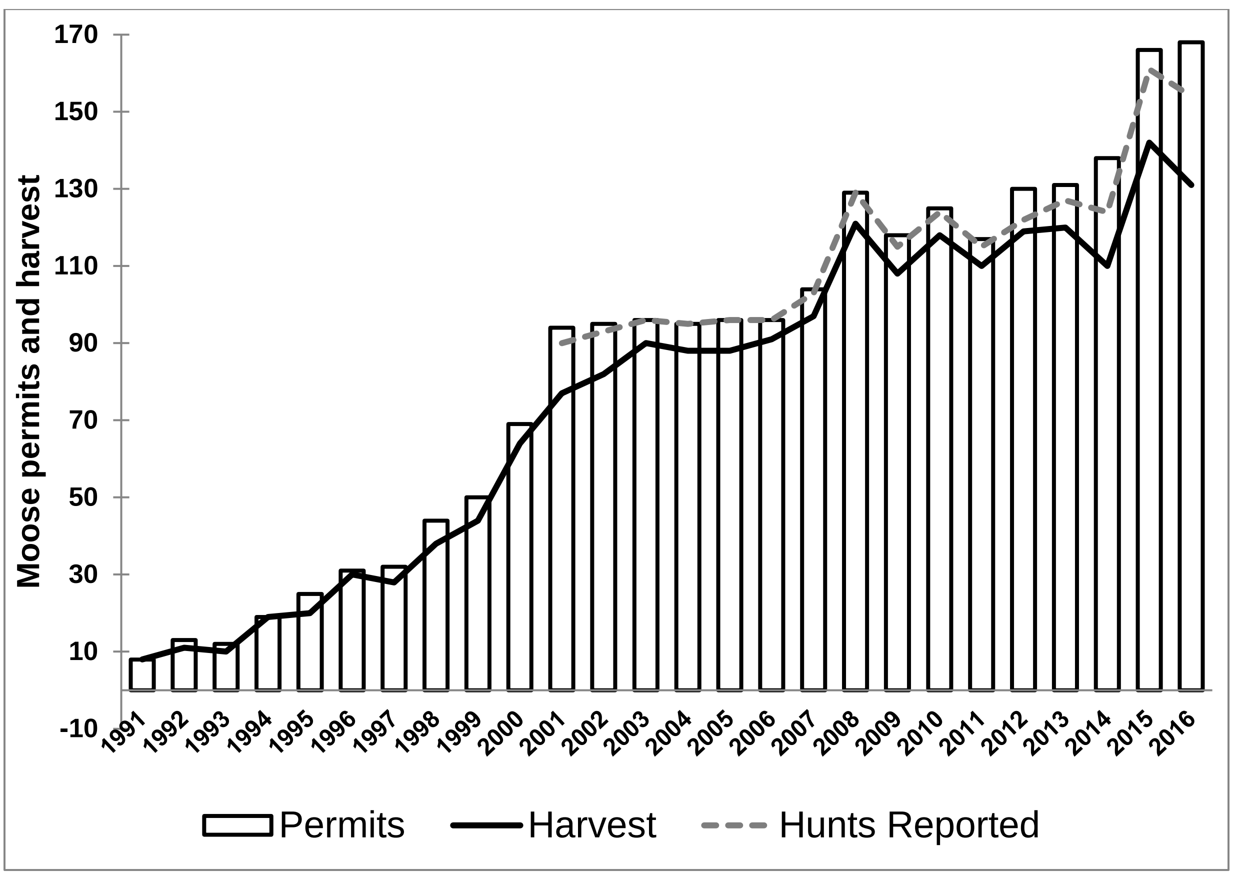

Figure 1. Moose permit numbers (open bars, not including Master Hunter conflict moose permits), hunts reported (dashed line) and harvest reported (solid line) for moose in Washington, 1991-2016.

Habitat

Moose prefer 10-20 year old clear-cuts, burned areas, or thinned stands on mesic sites. Forested cover is important during summer heat and deep winter snow (Costain 1989). As timber harvest has declined on public lands, private industrial timberlands have come to provide a large portion of moose range in Washington. Forest regeneration in these areas tends to produce dense stands of willow, serviceberry, ceanothus, and other shrubs which are preferred browse. However, recently private industrial forests have begun using herbicides to control shrubs to reduce competition for regenerating coniferous trees. Moose can be found at any elevation in Washington, but are most likely found in the 3,000 to 5,000 foot elevation band and are commonly drawn to north slopes or east flowing drainages, which are cool and moist.

Human-Wildlife Interaction

Individual moose can create human safety or nuisance concerns, especially within the metropolitan area of Spokane. The procedure for addressing moose within the urban/suburban area is outlined in the WDFW Dangerous Wildlife Policy. WDFW's Enforcement Program takes the lead on moose incident reports in and near the city. Incidents range from single moose sightings in semi-rural areas resulting in dissemination of literature and discussion on living with wildlife; to moose in dangerous situations requiring immobilization and translocation or euthanization. The number of moose incidents per year has been as high as 87 in 2001, and as low as 16 in 2009.

A Master Hunter moose damage/nuisance hunt was initiated in 2009 and has continued through 2016 in District 2 (GMUs 124-142). This hunt is a limited entry hunt (10 Master Hunters only) and runs from August 1 through March 31. These permits are not activated until damage has occurred and viability for a hunt has been determined by WDFW Enforcement.

Research

With financial and logistic support from WDFW, the University of Montana (UM) has taken the lead in understanding factors controlling demographic parameters of moose in 2 study areas north of Spokane. A total of 74 cow moose were fitted with radio-collars during December 2013, 2014, and 2016. Survival rates of these cohorts are being estimated, as well as cause of death (in most cases). We have not captured or instrumented calves, but are monitoring their survival indirectly by ground-based monitoring of their mothers. UM will continue their lead role on field work through May 2018; we expect a Ph.D. thesis and attendant publications in late 2019.

Management Concerns

Fire suppression, reduced timber harvest, herbicide treatment of broadleaf shrubs that moose browse in regenerating forest, and human development continue to degrade moose foraging habitat. Moose are adapted to colonize forested areas post-disturbance. They can persist at low densities in Washington's forested areas without disturbance, but we expect to see a tempering of population increase unless early seral habitats (e.g., shrub-fields) can be sustained in a mosaic with mature forest (as needed for cover).

Climate change may pose challenges for moose populations in the future, both from the direct energetic effects (moose are adapted to cold climates and become heat stressed, both in summer and winter, when temperatures exceed their thermo-neutral tolerances), and indirect effects (if parasites typically harbored by moose become excessively numerous).

WDFW is also monitoring for the presence and prevalence of the arterial worm *Eleaophora schneideri*, whose typical host is mule deer but has been documented in moose elsewhere in the lower 48 US states. In 2015, *Eleaophora schneideri* was detected in the arteries of 2 out of 41 moose submitted to WDFW for sampling; however neither moose showed any outward signs of infection. Histology performed at the Washington Disease Diagnostic Laboratory at Washington State University detected additional damage to the carotid artery of a number of moose, but whether or not these animals were infected with *E. schneideri* remains unclear. Moose are susceptible to morbidity and mortality from the brain worm *Parelaphostrongylus tenuis*, whose normal host is the white-tailed deer. *P. tenuis* has not yet been documented in or west of the Rocky Mountains.

Management Conclusions

In contrast to many areas along the southern extent of their North American distribution, moose have done well in Washington over the past few decades (WDFW 2015, Base et al. 2006, Nadeau et al. 2017). Hunter demand continues to far exceed supply, thus even if permit levels are increased, moose hunting will be a rare (and generally once-per-lifetime) experience for Washingtonians. Although the new aerial survey protocol is showing promise, tracking moose population trends long-term over large areas will likely always be approximate, and prone to time-lags. Moose may continue to increase outside of their base in Northeastern Washington, and it is possible that, in the future, hunting opportunities can be developed in other parts of the state. We believe we have begun seeing a reduction in the rate of growth, or very possibly a decline, as the moose population reaches the capacity of available forage and as other natural factors (e.g., predators, parasites) respond to their abundance.

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Cougar

Cougar Status and Trend Report

STATEWIDE

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Introduction

Cougars occupy all forested areas as well as some parts of the Columbia basin where vegetation provides adequate cover encompassing approximately 91,000 km^2 throughout Washington (Figure 1). They typically do not occur on the island arhipelago of Puget Sound. For management purposes, the state is divided into fifty population management units (PMUs) (Figure 1).

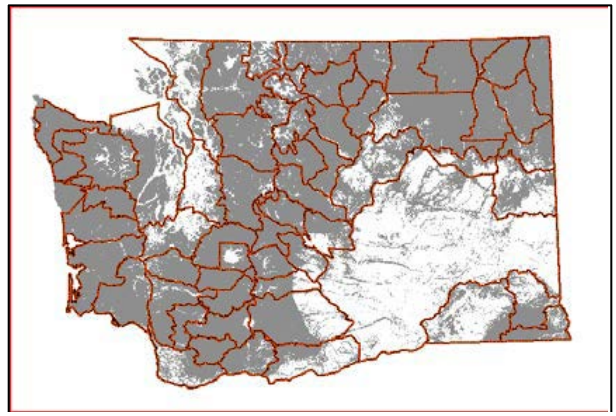

Figure 1. Cougar habitat (gray) and 50 management units in Washington, 2017.

Management Guidelines and Objectives

Since the 2012-13 hunting season, Washington's cougar management program has been founded on cougar behavior and social organization designed to maintain an older cougar age structure, promote population stability, and preserve territoriality (Beausoleil et al. 2013). To achieve these cougar management objectives as outlined in the Department's Game Management Plan (WDFW 2015), the hunt structure is currently administered within 50 population management units (PMUs), each of which is approximately 1,000 km^2 in size. A harvest guideline of 12-16% of the population within each unit allows for an equitable harvest distribution across the jurisdiction. The 12-16% incorporates the margin of error surrounding a documented 14% growth rate (Wielgus et al. 2013) but this sliding scale also allows district biologists throughout Washington to adjust their regional harvest levels accordingly based on total mortality (i.e. non-hunt losses). Several studies in other jurisdictions have validated this growth rate estimate including Robinson et al. (2014) who documented a 12% growth rate in Montana, Logan (2015) demonstrated a slight population decline at a 15.5% harvest rate in Colorado which suggests a growth rate below that level, and Beausoleil et al. (2016) that showed an average harvest rate of 14% (range = 7-21%) over 10 years resulted in a slight population decline in northeast Washington.

Population Surveys

Over the past 15 years rigorous population surveys and analyses have been conducted through long-term cougar research throughout the state. In past status and trend reports, the Department provided adult only (>2 years) population estimates but recently included all independent aged cougars (>18 months), so currently the average density of cougars is 2.1 cougars/100km^2 in Washington. When multiplied by the available habitat the independent-aged statewide population is estimated at 1800-2100 animals. Due to this social behavior, territories of adult males are often arranged on the landscape like pieces of a puzzle, with relatively low overlap. Therefore average densities can be used with a high degree of confidence because territories of male cougars are strongly defended against other males and predictably overlap home ranges of several females. Similar densities from long-term studies have been demonstrated in numerous other jurisdictions throughout western North America (Quigley and Hornocker 2010). Through this behavioral-based territoriality, cougar population size is limited by the amount of available habitat. With a greater understanding of this type of social organization, managers now incorporate and consider the impacts of different levels of cougar harvest on population growth as well as social organization.

Hunting Seasons and Recreational Harvest

Cougar hunting seasons have increased from 60-70 days between 1977 and 1995 to 212-242 days between 1996 and 2017. Currently the season is 242 days. Over the past 10 years Washington's average annual cougar hunter harvest is 163 animals and when incorporating all mortality types averages 200 animals annually (Table 1). Comparing the 5 years of the new hunt structure to the previous structure, average hunter harvest has increased from 145 to 172 annually, an increase of 19%. The Department has collected teeth via mandatory sealing from hunter harvested cougars since 1985, DNA since 2003, and has maintained a cougar harvest reporting hotline since 2004. Under the current harvest guidelines which are applied to all 50 population management units statewide, the Department is able to provide older-aged animals on the landscape, allowing harvest to be more equitable across the entire jurisdiction. Additionally, when closures do occur, the current approach does not impact a large-scale landscape which forces hunters to travel longer distances for quality hunts, therefore the Department is able to provide hunters a better quality hunt and equitably distribute harvest across the entire jurisdiction. In the 5 years of the current structure, an average of 28% of PMU's closed during the season (range = 16-46%) but harvest is expanding as intended.

Table 1. Cougar mortality[a] in Washington by year, sex, and type, 2007-2017.

Year	Hunt Season Male	Hunt Season Female	Hunt Season Sex Unknown	Other[b] Male Mortality	Other[b] Female Mortality	Other[b] Unknown Sex Mortality	Total Mortality
2007-08	81	79	1	16	21	3	201
2008-09	62	94	4	13	10	1	184
2009-10	69	67	2	14	17	0	169
2010-11	82	74	1	11	17	0	185
2011-12	62	54	7	20	9	3	155
2012-13	60	82	5	18	13	1	179
2013-14	78	100	4	28	17	2	229
2014-15	68	88	7	26	13	2	204
2015-16	82	87	3	24	15	2	213
2016-17	110	107	5	33	19	2	276
total	**754**	**832**	**39**	**203**	**151**	**16**	**1995**

[a]Does not include tribal harvest
[b]Other mortality includes unknown mortality type (44%), Depredation (35%), landowner kill (9%) roadkill (6%) and poaching (5%).

Survival and Mortality

Hunting is the highest source of mortality for cougar populations across all study areas in Washington at an average of 48%. In areas of low hunt pressure, natural mortality resulting from intraspecific strife is the leading source of mortality, ranging from 12 to 44% depending on the region of the state. Male survival is typically lower than female, but female survival is the most important factor in determining population growth. Department research projects estimate female survival at an average of 67%, which is dependent on locale.

Habitat

Washington is the smallest of the western states and has the least amount of cougar habitat (91,000km^2) as compared to approximately 30% more habitat in Idaho, 46% more in Oregon, and 60% and more in Montana. Since cougars are generally mediated by forested cougar (Warren et al. 2016) and the majority of cougar habitat in Washington is in federal or State ownership, the core of cougar habitat is relatively secure but is susceptible to wildfire. Since 2007 approximately 10,000 km^2 has been burned in Washington with 50% of that amount occurring since 2015.

Human-Wildlife Interaction

Minimizing human-wildlife conflict is a priority of the Department as outlined in the Game Management Plan (WDFW 2015). Because human population continue to expand in Washington (currently 7.4 million), it is impossible to prevent human-wildlife interactions, so the Department uses a per capita approach for monitoring human-cougar interaction trends. In the past 10 years, complaints have averaged 195 statewide, the lowest of any big game species in the State. Comparing the 5 years of the current management structure to the previous, average complaints has decreased 26% from 224 to 166 annually. Overwhelmingly, the causes of interactions identified by staff include the feeding of deer, which brings cougars closer to human development, and husbandry practices of both livestock and domestic animals. Prevention is the best approach to avoid or minimize potential interactions so information and educational materials are a mandatory component of staff response to a potential conflict.

Population Augmentation

No population augmentation takes place for cougars in Washington.

Research

Significant long-term research of cougar populations has occurred statewide on 8 study areas in Washington resulting in numerous peer-reviewed, published scientific manuscripts. Research topics include abundance and density (Lambert et al. 2006, Beausoleil et al. 2013, Beausoleil et al. 2016), growth rate (Wielgus et al. 2014), using DNA to evaluate gender ID (Beausoleil and Warheit 2015) and genetic structure (Warren et al. 2016), effects of hunting (Robinson et al. 2008, Cooley et al. 2009a, Cooley et al 2009b, Maletzke et al. 2014. Keehner et al. 2015a Keehner et al. 2015b,), prey use (Robinson et al. 2002, Cooley at al. 2008 White et al. 2010, Kertson et al. 2011a), habitat use (Kertson at al. 2011b) and response to human development (Kertson et al. 2013, Maletzke et al. 2017).

Management Concerns

Overall, the management structure implemented in 2012-13 is working as intended. The application of harvest guidelines only after January 1 and the (PMU) closure process continue to present challenges to avoid harvest beyond management objective. On average, 30% of the PMUs close within a given hunt season close (range = 16-44%) and of those, just over half (53%) go beyond the upper end of the harvest guideline (range = 16-88%) (Table 2). About half of the overages occur prior to January 1 (when there is no harvest limit) and the other half after harvest guidelines take effect (but a 72-hour call in takes effect; thus causing a lag time in closure). Percent female harvest may also be a concern as changes in adult female and cub survival are the most influential parameters to population growth (Martorello and Beausoleil 2003). Over the past 10 years, females average 52% of the harvest but it is unknown if that percentage of the harvest rate is at a level where this would be a management concern. Finally, tribal harvest is unknown and not accounted for in harvest guidelines, but is likely an additive source of additional take in the northeast and Olympic peninsula regions of Washington. Accounting for that unknown additional harvest and evaluating its effect is challenging without accurate data records.

Management Conclusions

The current cougar management structure allows the Department to address concerns of various constituencies. For hunters, the management structure provides older aged animals on the landscape thus a better quality hunt, it allows harvest to be equitable across the entire jurisdiction, and when closures do occur, it does not impact a large-scale landscape forcing hunters to travel long distances. For non-consumptive users, the management structure recognizes their values by maintaining population stability, social structure, and ecosystem integrity. For managers, the management structure is science based, defensible, and ensures credibility. Overall the cougar management structure is simple to understand, it's inexpensive to implement, and it satisfies multi-stakeholder interests. The current structure of distributing harvest equitably across the landscape is being demonstrated as harvest clusters are declining and distribution of harvest is increasing. One potential solution to avoiding exceeding harvest guidelines is to revert back to the 24-hour closure Washington used prior 2013. Snow conditions are strongly correlated with cougar harvest; more snow events result in higher hunter success. Being able to respond to hunting conditions would improve the Department's ability to manage harvest as direct hunters to nearby open PMUs during improved conditions. The majority of agencies throughout the west utilize a 24-hour closure when harvest guidelines are met. An additional strategy may be to re-evaluate the early and late season dates. Additionally, improving tribal relations and establishing an agreement to document tribal harvest of cougar would benefit management in the future.

Table 2. Using hunter harvest mortality only, cougar PMU's that closed, by season, and the subsequent harvest rate. Those in gray exceeded management objective of 12-16%

Region	PMU	2012-13	2013-14	2014-15	2015-16	2016-17
1	101			18		15
	105	16	16	32		40
	108, 111	16	16	19	21	29
	113			16		14
	117	18	24	24	20	22
	121	19		20		40
	124, 127, 130	14				20
	145, 166, 175, 178	28	24	28	28	21
	149, 154, 157, 162, 163	27	27		19	36
	169, 172, 181, 186	16	16		16	28
2	204				14	
	209, 215	14			14	12
	218, 231					15
	224					16
	233, 239				16	22
	244, 246, 247					15
	245, 250					16
	249, 251	16				16
3	328, 329, 335	20	19		18	22
	336, 340, 342, 346	18	16		18	15
	352, 256, 360, 364, 368		16		16	23
	382, 388	16	40		16	14
4	466, 485, 490		14			
5	516		14			
	564, 568				16	
	572				14	
	574, 578		16		16	14
6	642, 648, 651	20	14			
	667			28	14	20

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Black Bear

Black Bear Status and Trend Report

STATEWIDE

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Introduction

Black bears (*Ursus americanus*) occupy all forested areas throughout Washington. Only the northern island counties within the Puget Sound archipelago and the shrub-steppe habitat of the Columbia Basin do not support resident black bear populations. For management purposes, the state is divided into 9 black bear management units (BBMUs, Figure 1) consisting of the Olympic Peninsula or Coastal (1), Puget Sound (2), North Cascades (3), South Cascades (4), Okanogan (5), East Cascades (6), Northeast (7), Blue Mountains (8) and Columbia Basin (9) units.

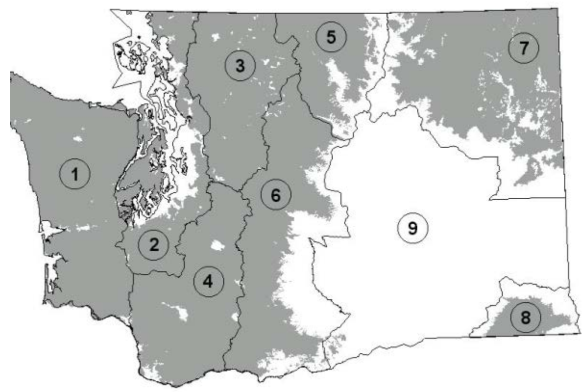

Figure 1. Black bear distribution (in gray) and 9 black bear management units in Washington 2017.

Management Guidelines and Objectives

Black bears are an important game species in Washington and agency objectives include managing for a variety of recreational, educational, and aesthetic purposes (WDFW 2015). Management to preserve, protect, and perpetuate black bears and their habitats to ensure healthy productive populations, while minimizing conflict with people, are goals outlined in WDFW's Game Management Plan (WDFW 2015). Currently, the highest management priority is to acquire a better understanding of bear abundance, density, and growth rate, which will provide a scientifically-based population estimate and an improved foundation for harvest management.

Population Surveys

No formal population estimate for black bears in Washington exists at this time (see Research section below). Like some other agencies, the Department collects hunt statistics and relies on age and sex ratios from hunter harvest to infer population size and trend (Garshelis 1991, Beecham and Rohlman 1994, Folta 2011). There is no mandatory agency inspection for hunter-killed bears but hunters are required to report hunt activity and submit a tooth. The Department developed a mandatory tooth submission process whereby all successful black bear hunters statewide must submit a premolar tooth per WAC 220-415-090 which allows the agency to age harvested animals. Unfortunately, since this rule was established in 1982, submission rates have been low, with the most recent 5-and 10- year averages being 24 and 23%, respectively (Table 1). Age structure of harvested bears is used for population reconstruction and trend indices using sex ratios and median ages.

Table 1. Tooth submission results, by sex, of all known black bear mortalities in Washington, 2007-2016[a].

Year	Total Mortality	# Male Teeth Aged	# Female Teeth Aged	% Male Teeth Aged	% Female Teeth Aged	Total % Teeth Aged
2007	1831	256	120	21	21	21
2008	2384	277	169	18	20	19
2009	1607	216	164	21	30	24
2010	2228	342	211	24	26	25
2011	1817	283	136	N/A	N/A	22
2012	1811	282	183	23	31	26
2013	1378	185	107	20	24	21
2014	1592	231	142	22	26	23
2015	1742	254	168	22	27	23
2016	1621	275	135	25	24	25
	18011	2601	1535	22	25	23

[a]does not include tribal hunting mortality

Hunting Seasons and Recreational Harvest

The Department provides fall hunting opportunity for black bears and an additional special permit spring hunt opportunity for timber damage and density reductions. Hunters have up to 167 days of hunting annually. Over the past 10 years Washington's average annual black bear harvest is the 2nd highest in the western U.S. at 1,801, behind Idaho at 2,234, and followed by California at 1,730, Montana at 1,372, and Oregon at 1,292. Fall hunts occur in all 9 BBMUs and spring hunts take place in 5 BBMUs. The highest percentage of bear harvest in both the spring and fall hunts takes place in the Northeast BBMU and the least from Blue Mountains BBMU (excluding the Columbia Basin BBMU). When viewed by mortality type at a statewide level over the past 10 years, most bear mortality occurs in fall hunting season (85%), followed by timber removals (8%) and spring special permit hunts (4%) (Table 2). Since 1991, the Department has urged hunters not to shoot cubs or a female with cubs but it is not currently prohibited by law. The use of dogs and bait to hunt bears has been prohibited in Washington for over two decades (RCW 77.15.245) but the use of dogs is allowed for special damage permits on commercial timber lands in the spring.

Survival and Mortality

Hunter harvest is the primary source of mortality for radio-collared bears from the 3 research projects (Koehler and Pierce 2005, Beausoleil et al. 2012, WDFW, unpublished information) and nearly all mortality is human related; 77% from hunting, 8% wounding loss, 5% human-conflict, 3% vehicle collisions, 3% poaching, and 2% unknown. Male survival is typically lower than female, but female survival is the most important factor in determining population growth; Department research projects estimate average female survival ranges from 0.56 (Capitol Forest) to 0.95 (Okanogan) with the Copalis, Snoqualmie, and Lake Wenatchee regions falling in between depending on hunting pressure and human access.

Table 2. Black bear mortality, by type and year, in Washington, 2007-2017[a].

Year	Total Fall Hunt	Total Spring Hunt	Total Timber Hunt	Total[b] Other	Total Mortality
2007	1524	61	194	36	1815
2008	2116	69	157	42	2384
2009	1309	78	183	37	1607
2010	1900	62	175	91	2228
2011	1503	61	182	71	1817
2012	1557	75	135	44	1811
2013	1148	85	117	28	1378
2014	1389	85	90	28	1592
2015	1488	94	92	68	1742
2016	1376	124	86	35	1621
	15310	794	1411	480	17995

[a]Does not include tribal harvest

[b]Other includes unknown mortality type (35%), human conflict (33%), and roadkill (32%)

Habitat

The amount of black bear habitat in Washington is estimated at 88,000km^2. Washington is the smallest of the western states and has the least amount of bear habitat as compared to 114,000km^2 in Oregon, 116,000km^2 in Montana, 142,000km^2 in Idaho and 145,000km^2 in California. Approximately 75% of the black bear habitat in Washington is in federal, State, or private industrial timber ownership, so while the core of black bear habitat is relatively secure it is susceptible to wildfire. Since 2007 approximately 10,000km^2 has burned in Washington with 50% of that amount occurring since 2015.

Human-Wildlife Interaction

Human-bear conflict occurs statewide given the distribution of people and bears in Washington and the prevalence of high calorie attractants like garbage, bird feeders, and fruit trees. Over the past 10 years, Washington has averaged 489 documented human-bear interactions annually and average of 462 in the past 5 years (WDFW 2016), a decrease of 6%. The human population in Washington is currently estimated at 7.4 million and most human-bear interactions take place in King County; Washington's most densely human populated area with 2.2 million people. Human-bear conflict activity reflects the variability of environmental conditions and the availability of attractants and is therefore not a good indicator of population status (Spencer et al. 2007). For example, in 2010 human-bear complaints were at an all-time high at 890, the same year Washington experienced a late spring with poor natural forage conditions for black bear, followed by a poor fall huckleberry crop. Managers agree that garbage management and the removal of attractants is the single best way to reduce bear-human interactions.

Population Augmentation

No population augmentation takes place for black bears in Washington.

Research

Black bear management in Washington began in the mid- to late-1960s when basic demographic information was collected and used to establish black bear management guidelines (Poelker and Hartwell 1973). In the 40+ years since, relatively few black bear studies have taken place but most have occurred in the Olympic peninsula region. These include an investigation of population response pre-and post-timber harvest (Lindzey et al. 1986) in the 1970s and survival, habitat use, home range size, and cause specific mortality in three ecoregions (peninsula, Snoqualmie, and Okanogan) in Washington in the mid-1990s (Koehler et al. 2001; Koehler and Pierce 2003; Koehler and Pierce 2005). In the late 1990s, the Department conducted bait station surveys as a population index of bear abundance (Rice et al. 2001) but analysis indicated the technique was an unreliable way to detect a change in population trajectory. This decade, home range size and habitat use were evaluated pre-removal of the Elwha Dam (Sager-Fradkin et al. 2008), and a study of survival and population size took place in Capitol State Forest (Beausoleil et al. 2012). In 2013, the Department launched a research project, in collaboration with Washington State University (WSU), to assess population size and density on both the east and west slopes of the Cascade Mountains using 2 concurrent techniques; capture/collar and DNA collection via barbed-wire hair collection stations. The project includes two wildland study areas, which represent much of the environmental variation and hunting pressure observed in Washington. The first stage of that population estimation effort is currently being analyzed and those data will be available for the next Game Management Plan revision in 2020. Finally, carnivore section staff collaborated on an educational book titled Living with Bears Handbook (Masterson 2016) and published two manuscripts regarding management implications of orphaned and rehabilitated black bears (Beecham et al. 2015, Beecham et al. 2016).

Management Concerns

Collecting teeth is one of the least expensive and time efficient tools managers have available and it facilitates a working relationship with the hunting public. However, the response rate is low and therefore much of the information Washington uses for black bear management, such as median age (Table 3), percent females in the harvest (Table 4), and population reconstruction, is outdated and of limited value. Harvest data can demonstrate both increasing and decreasing population trajectories as each can exhibit the same age structure (Clark 1999) and/or sex ratio (Garshelis 1991) and trends may not be consistent with the true population trajectory (Noyce and Garshelis 1997, Beston and Mace 2012, McLellan et al. 2017). Black bear managers agree that median age is not a reliable technique for management or population estimation. A low median age could be because many of the adults have died or because cub production is high, as both situations can demonstrate a similar age structure. A higher median age may be because hunters are more willing to provide a tooth from older-aged animals and less likely to submit for younger animals, since they already know the age. Generally, median ages can be a reflection of hunting pressure and tend to be lower in areas with greater access (Table 3), but when higher harvest situations are monitored, median age tends to decrease and then remain constant, so it is not sensitive to changes in harvest and likely not useful to managers.

Historically, Washington used population reconstruction (Bender 1997) from tooth submissions and extrapolations of density to habitat availability, but currently does not have science-based field estimates of black bear abundance and density, thus making an estimate of a true harvest rate difficult. Reconstruction does not account for non-harvest mortality and the age structure of harvest may not be representative of the larger population (Williams et al. 2002), and if small changes in harvest rates occur, population estimates can become considerably biased over time (Davis et al. 2007). However, harvest data are important and could be used along with other data collection in a more integrated approach to monitor population trend (Skalski 2012). But while tooth collection for ageing harvest mortalities is critically important, mandatory submission rates in Washington have been low (21%) for decades and needs management and hunter attention to emphasize the importance of this data.

Black bear density is not uniform across the landscape and can vary based on habitat quantity and quality, levels of hunting and non-hunt mortality, and local bear population growth rate. To analyze harvest objectives, the Department uses a BBMU-scale approach or simply looks at harvest on a statewide basis. While areas need to be large enough to be meaningful for modeling and other analyses, there is a tradeoff as it relates to female harvest. The larger the management unit, the less sensitive it is to female harvest rate and percent females in the harvest. Finding that balance of the appropriate scale at which to monitor harvest will continue to be a challenge as most biologists agree that female harvest is more of a management concern. Finally, acquiring and implementing a science-based population estimate and basing harvest objectives on the estimate rather than median ages would improve Department's black bear management program significantly.

Table 3. Median ages of 4,136[a] black bear mortalities, by sex and year, submitted in Washington, 2007-2016

	2007		2008		2009		2010		2011		2012		2013		2014		2015		2016	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
BBMU 1	3.5	4	4	5	3	6	4	6	4	7	4	5	3	7	4	4	4	5	4	5
BBMU 2	3	3.5	2.5	3	3	6	3	6	3	8	3	5	3	6	2.5	2	2	4	2	4
BBMU 3	4	6	4	7	5	6	4	6	4	8	5	6	5	6	4	8	5	9	4	6.5
BBMU 4	3	4	3	3	3	4	3	3	4	5	3	5	3	3	3	5	3	7	4	5.5
BBMU 5	2	2	2	7	5	2	3	6	5	3	6	6	3	2.5	3	3	1	4	3	1
BBMU 6	2	12	3	4	4	6.5	3	4.5	3	5	4	4	4	4	2	7	3	5	4	4
BBMU 7	2	5	3	3	3	4	3	4.5	3	2	5	5	4	4	2	3.5	3	5.5	4	7
BBMU 8	4	6	3	4	5	5	2.5	5.5	4.5	3	3.5	4.5	5.5	3	5	7	3	3.5	2.5	4
BBMU 9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
average	3	5	3	5	3	6	3	5	4	5	4	5	4	5	3	4.5	3	5	4	5

[a]Equates to 23% of the 18,011 total mortalities recorded

Table 4. Percent female black bear mortality, by year and BBMU in Washington, 2007-2016. Gray areas show where management objective was exceeded.

	Percent Female Mortality											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	10-yr Avg	5-yr Avg
BBMU 1	34	36	39	36	N/A	30	32	28	27	29	32	29
BBMU 2	36	39	38	44	N/A	36	42	39	34	43	39	39
BBMU 3	26	40	27	35	N/A	36	32	38	31	42	34	36
BBMU 4	31	33	32	39	N/A	31	31	44	24	37	34	33
BBMU 5	26	24	35	31	N/A	33	27	32	27	32	30	30
BBMU 6	28	34	37	36	N/A	27	30	34	34	35	33	32
BBMU 7	36	33	33	35	N/A	33	31	33	34	32	33	33
BBMU 8	32	33	38	39	N/A	35	29	29	38	37	34	33
BBMU 9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Management Conclusions

Data analysis by Department staff and WSU is currently underway and will provide a much anticipated population estimate for both slopes of the Cascade Mountains by early 2018. Those results, combined with data from previous research projects will allow staff to generate a more precise statewide population estimate. Over the next year, researchers will also establish a protocol for agency staff to monitor black bear populations annually within each District, much like the agency does for deer or elk survey. Finally results of a stable isotope analysis using hair from captured bears will inform management on ways to reduce human-bear interactions. All of these items are high priority needs and objectives outlined in the 2015 Game Management Plan.

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Band-Tailed Pigeon and Mourning Dove

Band-Tailed Pigeon / Mourning Dove Status and Trend Report

STATEWIDE

KYLE A. SPRAGENS, Waterfowl Section Manager

Introduction

Pacific Coast band-tailed pigeons and mourning doves are managed cooperatively with the U.S. Fish and Wildlife Service (USFWS) and western states through the Pacific Flyway Council (PFC). The PFC has developed management plans for these populations, and in 1994 established a population objective for band-tailed pigeons in Washington based on the WDFW call-count survey (PFC 1994). Since that time, PFC has revised the population objective and established closure thresholds based on a new mineral site survey (PFC 2010). Population objectives for mourning doves are being developed as part of the national mourning dove harvest strategy.

Population Surveys

Methods

Band-tailed Pigeon call-count Survey

The WDFW band-tailed pigeon call-count survey was initiated in 1975, and was patterned after the mourning dove survey. A total of 50 routes, 5.7 miles in length comprised the survey, conducted in western Washington below 1,000 ft. elevation. Surveys were completed during a 16-day period beginning the Saturday closest to June 21, as designed by Jeffrey (1989). Data were sent to USGS in Laurel, MD (Bill Kendall) for analysis using route regression programs developed for the mourning dove survey (Sauer *et al.*, 2003). The WDFW call-count survey was discontinued after 2003, but is presented in this report for comparison to the mineral site survey.

Band-tailed Pigeon Mineral Site Survey

In 2001, USGS-BRD (California Science Center) received a grant from USFWS to design a population index survey for use throughout the range of the Pacific Coast population of band-tailed pigeons. USGS conducted mineral site surveys at 8 western Washington locations in 2001-03 (Overton and Casazza 2004). These included two in Region 4 (Oyster Creek - Pigeon Point and Sumas Springs), one in Region 5 (Cedar Creek), and five in Region 6 (Lilliwaup, McAllister Creek, Mud Bay, Potlatch, and Red Salmon Creek). As part of an earlier grant, USGS-BRD evaluated several population survey techniques, and found that an optimally timed mineral site survey offered statistical advantages over other surveys, including the WDFW call-count survey.

A final report on the mineral site survey was completed in 2004, and coastal states adopted the new mineral site survey as the official index for this population. In 2004, WDFW expanded surveys to 15 sites, as specified under protocols developed for the Pacific Flyway (Overton and Casazza 2004). The 15 sites included the 8 locations established in 2001, along with two in Region 4 (Lake Cavenaugh Rd.-Pefley and Warm Beach), four in Region 5 (Altoona, Newaukum River, St. Martin's Hot Springs, and Upper Kalama) and one in Region 6 (Willapa Estuary). Since 2004, the site list has been modified due to access restrictions or other changes in status. Cooperators from WDFW and USFWS completed 15 surveys during the July 10-20, 2015 survey period. In

2016, the Naselle River mineral site was added as operational to the index as it met the minimum criteria of a known naturally occurring mineral site and at least 2 annual counts (Table 2).

<u>Mourning Dove call-count Survey</u>

The mourning dove survey was discontinued by USFWS after the 2013 survey (Seamans and Sanders 2014). WDFW staff in Districts 1, 3, 4, 9, and 17 participated in evaluation of a new point-distance sampling method during 2015, but results are not yet available.

Results

<u>Band-tailed Pigeon call-count Survey</u>

Past call-count survey results are presented in Table 1 and Figure 1.

<u>Band-tailed Pigeon Mineral Site Survey</u>

Mineral site survey raw data summaries are presented in Table 2 and Figure 1. Complete 2017 survey results are available through USFWS (Seamans 2017).

Figure 1 and Table 1 show that based on the call-count survey, the band-tailed pigeon population generally increased from 1975-2003. The route regression method was less precise in determining short-term trends than long-term trends, as evidenced by the large confidence intervals for the two-year trends in Table 1. The large spans of these intervals are caused by low sample size due to changing observers from year to year.

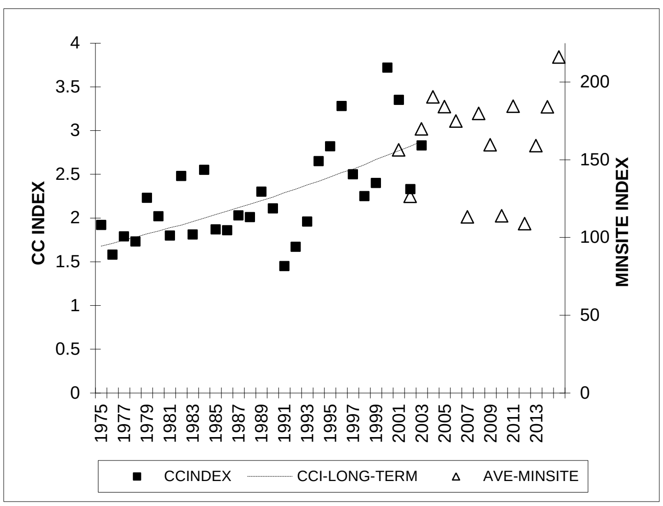

Figure 1. Band-tailed pigeon call-count results and mineral site raw data summaries.

The mineral site survey in 2001-2003 exhibited the same general trend as the call-count survey when the two surveys were run concurrently (Figure 1). This rough correlation can be used in the future to develop population objectives for WA consistent with the PFC management plan (PFC 2010).

Hunting Seasons and Recreational Harvest

The band-tailed pigeon season was closed in Washington from 1991-2001. A limited season was reopened in 2002 and has continued since then, with season dates of September 15-23 and bag/possession limits of 2/4. The mourning dove season was September 1-15 from 1980 through 2007, and September 1-30 since 2008. Bag/possession limits have been 10/20 since 1980.

Methods

Band-tailed Pigeon Harvest Survey

Band-tailed pigeon harvest is estimated annually using mandatory harvest reporting. Written authorization and harvest reports have been required of band-tail hunters in western Washington since the season reopened in 2002. Hunters were required to return a harvest report card by September 30 to avoid a $10 penalty the following year. Reminders were sent out prior to the reporting deadline. Harvest reports returned by the deadline were included in the analysis as the 'first wave' of respondents. A special follow-up survey of non-respondents was conducted via a telephone survey through Washington State University. Responses from this survey were included as the 'second wave' and then the harvest estimates were computed accounting for the non-response bias.

Mourning Dove Harvest Estimation

Mourning dove harvest was estimated as part of the statewide hunter survey conducted by WDFW (WDFW 2016).

Results

Band-tailed Pigeon Harvest

Harvest and hunter activity for the 2002-2016 seasons are summarized in Figures 2-3 and Table 3.

Mourning Dove Harvest

As measured by WDFW (2016) surveys, harvest in 2016 was estimated at 51,552 doves, down 16% from 2015, but 4% below the recent 10-year average (Figure 4). Hunter numbers were estimated at 3,948, down 2% from 2015 and 8% below the recent 10-year average. Number of days hunted was 13,578, down 7% from 2015.

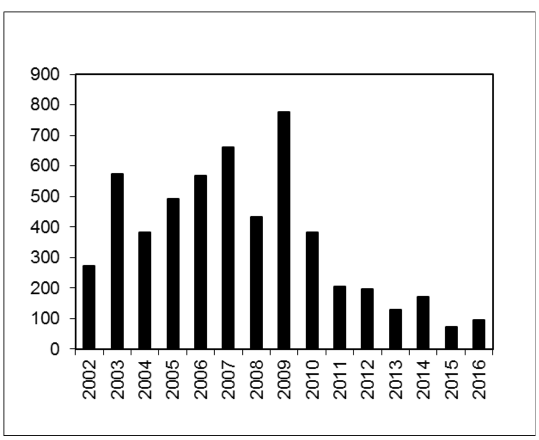

Figure 2. Band-tailed pigeon total harvest.

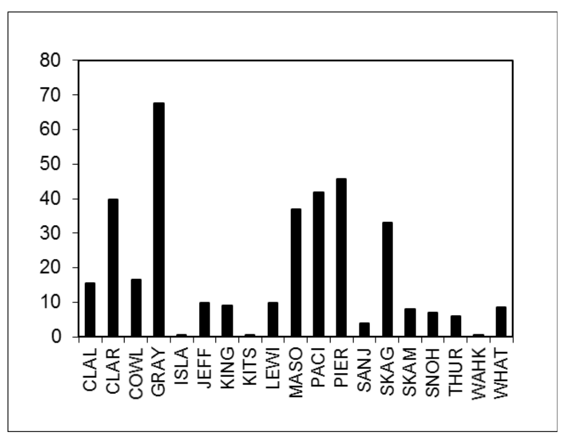

Figure 3. Band-tailed pigeon 2002-2016 average annual harvest by county.

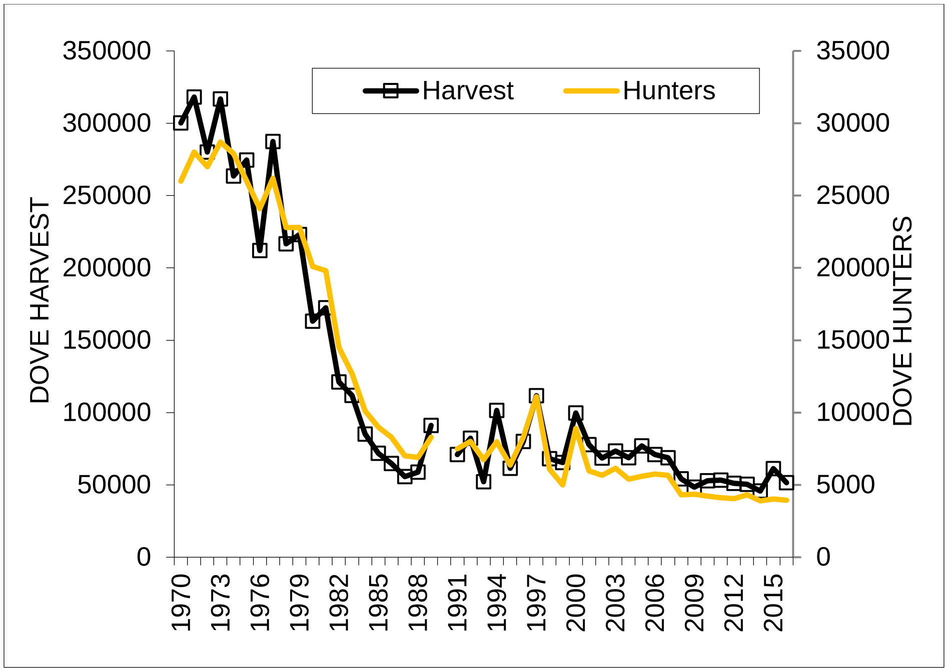

Figure 4. Mourning dove harvest and hunter numbers 1970-2015.

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Table 1. Band-tail call-count survey results - route regression method.

Start Year	End Year	Change	Lower 90% CI	Upper 90% CI	Routes Used	Sig. level
1975	1992	-7.8%	-14.0%	-2.0%	63	p<0.05
1991	1992	10.1%	-50.0%	75.0%	11	n.s.
1975	1993	-6.0%	-11.0%	-1.0%	65	p<0.05
1992	1993	44.0%	-49.0%	152.0%	13	n.s.
1975	1994	-3.4%	-8.2%	1.4%	69	n.s.
1993	1994	71.0%	1.4%	141.0%	24	p<0.05
1975	1995	-2.7%	-9.8%	4.5%	70	n.s.
1994	1995	12.1%	-31.3%	55.3%	12	n.s.
1975	1996	-0.8%	-6.5%	4.9%	59	n.s.
1992	1996	24.3%	10.4%	38.2%	30	p<0.01
1995	1996	36.4%	-35.9%	108.7%	18	n.s.
1975	1997	-0.8%	-6.0%	4.3%	62	n.s
1993	1997	8.9%	0.2%	17.6%	32	p<0.10
1996	1997	-14.3%	-35.4%	6.7%	18	n.s.
1975		-1.5%	-5.5%	2.4%	65	n.s.
1994	1998	2.1%	-8.7%	13.0%	34	n.s.
1997	1998	-11.0%	-45.8%	23.9%	11	n.s.
1975	1999	-0.1%	-4.1%	3.8%	67	n.s.
1995	1999	-3.3%	-11.5%	4.9%	38	n.s.
1998	1999	26.7%	-19.7%	73.1%	14	n.s.
1975	2000	-0.3%	-6.2%	5.5%	70	n.s.
1996	2000	5.9%	-2.3%	14.1%	41	n.s.
1999	2000	21.1%	-12.5%	54.8%	24	n.s.
1975	2001	1.7%	-2.3%	5.7%	70	n.s.
1997	2001	15.8%	8.0%	23.6%	44	p<0.01
2000	2001	1.8%	-16.6%	20.2%	36	n.s.
1975	2002	0.7%	-3.7%	5.0%	71	n.s.
1998	2002	9.4%	2.6%	16.2%	45	P<0.05
2001	2002	0.9%	-27.5%	25.8%	32	n.s.

Table 2: WA band-tailed pigeon mineral site survey raw data

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Altoona				64	0	5	0										
Cedar Cr.	328	215	157	215	185	231	191	312	163	154		142	181	267	207	306	246
L. Cavenaugh - Pefley				108	172	76	71	117	70	89	113	146	156	110	98	149	148
Lilliwaup	60	77	108	199	143	273	141	89	110	123	167	74	210	197	178	251	143
McAllister	82	118	174	124	174	87	25	136	46	134	107	102	77	78	90	105	111
Mud Bay	164	154	222	134	371	294	95	203	130	70	175	87	214	136	297	208	187
Oyster Cr. – Pigeon Pt.	362		455	474	542	293	157	331	314	190	344	121	51	39	14		6
Naselle River															184	115	37
Newaukum				634	167	335	309	219									
Potlatch	135	147	90	297	285	306	168	295	480	129	297	288	333	254	506	406	396
Red Salmon	52	103	121	179	103	64	33	107	41		0	47	5		93		43
Soda Springs												58	112		193	259	246
St. Martins				220	128	191	189	141	210	214	439	180	308	354	435	507	83
Sumas	67	71	31	46		68					78	17	82	74	78		96
U. Kalama				110	225	327	120	350	317	111	368	258	245	187	322	321	243
Totten -Oyster Bay										119	53	101	192	332	486	388	308
Warm Beach				48	58	62	83	36	29	29	72	10	60		33	223	57
Willapa				3	24	10	3	0	5	5		2					

Table 3: WA band-tailed pigeon harvest report summary

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2002-16 AVE.
NUMBER OF PERMITS ISSUED	522	657	766	809	909	894	917	567	632	178	237	244	266	249	253	540
TOTAL DAYS	357	337	209	382	315	364	247	548	362	151	195	85	191	96	112	263
TOTAL HARVEST	273	574	383	492	569	661	434	776	381	205	196	129	172	72	94	361
HARVEST BY COUNTY																
CLAL	37	35	14	25	35	37	5	0	39	0	0	6	0	0	0	16
CLAR	29	45	29	35	60	51	56	94	18	48	29	12	44	19	26	40
COWL	28	54	4	2	3	32	24	39	12	18	15	0	4	9	4	16
GRAY	47	53	104	76	71	145	103	129	83	47	55	26	55	2	18	68
ISLA	0	0	0	0	9	0	0	0	0	0	1	0	0	0	0	1
JEFF	10	16	31	26	14	29	6	4	6	3	0	0	2	0	0	10
KING	4	23	13	6	11	14	9	43	12	0	0	0	0	0	0	9
KITS	0	1	0	0	0	0	0	0	0	1	0	5	0	0	0	0
LEWI	7	13	11	34	5	22	13	19	15	0	1	0	1	1	5	10
MASO	26	38	48	62	63	84	59	126	19	2	2	0	18	1	6	37
PACI	13	21	37	35	73	80	82	136	56	1	47	33	6	6	0	42
PIER	20	82	30	62	85	63	32	85	43	14	34	42	36	28	28	46
SANJ	0	0	12	0	0	0	0	0	0	45	0	0	0	0	0	4
SKAG	33	99	15	97	74	65	31	30	42	3	2	2	3	2	0	33
SKAM	5	16	0	10	16	21	11	27	7	3	3	0	0	0	0	8
SNOH	15	29	3	12	11	3	4	4	10	13	2	0	1	0	0	7
THUR	0	13	8	2	24	10	0	5	13	7	0	0	0	2	6	6
WAHK	0	0	0	0	0	0	0	7	0	0	0	0	0	2	0	1
WHAT	0	34	24	6	14	4	0	28	6	0	5	3	2	0	0	8

Waterfowl

Waterfowl: Breeding Populations and Production Status and Trend Report

STATEWIDE

MATTHEW T. WILSON, Statewide Waterfowl Specialist

Introduction

This report summarizes waterfowl productivity data collected during 2017 in Washington State, including information on breeding waterfowl populations, duck broods, and goose nest surveys. Washington Department of Fish and Wildlife (WDFW), U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service (USFWS), Yakama Indian Nation, Colville Confederated Tribes, Washington Waterfowl Association, and Chelan County Public Utility District contributed data.

Population Surveys

Duck Breeding Population Survey

<u>Methods</u>

Historical surveys to estimate breeding duck populations in eastern Washington were conducted annually within seven strata in eastern Washington: West Okanogan Potholes, Omak-Douglas Potholes, Far East Potholes, Northeast, and Palouse Streams, Columbia Basin Irrigated, and Yakima Valley Irrigated (Fig. 1). Surveys were conducted by ground counts of transects or sections, except helicopter counts were used for the 1/4-sections in the Desert Wildlife Area (Frenchman and Winchester Wasteways) within the Columbia Basin Irrigated strata (Fig. 1). Samples were multiplied by weighting factors to provide an index to the total number of breeding ducks and coots within the defined areas (Tables 1-3). Weighting factors were determined from the proportion of areas within the strata that were sampled. Observations were treated as complete counts within sampling units (transects or quadrats) with no corrections for visibility bias.

Due to concerns about design of past surveys (lack of random sample selection and variance estimates), WDFW began the process of redesigning the eastern Washington waterfowl breeding population survey in 2008, in conjunction with staff from the USFWS Pacific Flyway office formerly in Portland, OR and the USFWS Branch of Population and Habitat Assessment in Laurel, MD. The new design consists of randomly selected ¼ mile helicopter transects to replace the past survey design. The goal of the new survey is to provide breeding population indices (with variance estimates) comparable to surveys conducted in other parts of the Pacific Flyway, for inclusion in the western mallard management protocols adopted by USFWS in 2008. The new and old survey designs were run concurrently for three years (2009-11), and the old design was discontinued after the 2011 survey. The new survey design (including the Irrigated, Potholes, and Northeast Highlands strata) was modified in 2012 to address continued safety and efficiency concerns for the Northeast Highlands stratum (Fig. 2). As a result, transects in this stratum were placed at 10 mile intervals on an east-west orientation across major river valleys.

In addition, minor boundary adjustments were made to other stratum boundaries, including elimination of Saddle Mountain from the Irrigated stratum. Overall, in eastern Washington, observers surveyed approximately 1,688 transect miles over a 6-day period between

May 1-8, 2017.

Beginning in 2010, line-transect surveys, similar to the new eastern Washington survey, were developed and flown for the new western Washington breeding waterfowl population survey (Fig. 3). Observers surveyed approximately 984 transect miles between April 24–April 28, 2017.

The modifications to survey design and areas during the initial years of the aerial survey created difficulties in comparing results across years. To address this issue, survey results from 2009-2012 were reevaluated and standardized by matching strata boundaries to the surveys boundaries used in 2013. Transects and observations from 2009-12 that fell outside 2013 strata boundaries were dropped from analyses. Data from the Highlands in 2010 and 2011 were also excluded from analyses due to different survey methods.

Methods for estimating total number of breeding ducks follow the Standard Operating Procedures of Aerial Waterfowl Breeding Ground Population and Habitat Surveys in North America (USFWS & CWS 1987). Breeding populations are estimated by multiplying the number of pairs, lone drakes, and flocked drakes (<5 male birds) by 2, and grouped birds (mixed or >5 males) by 1. Lone hens are multiplied by 1 for redhead, scaup, ring-necked duck, and ruddy duck only. These diver species are known to be late nesters and males significantly outnumber females.

<u>Results</u>

Total breeding duck counts numbered 168,417 (*SE* 11,855) within three eastern Washington strata (Table 4). Total mallards numbered 68,403 (*SE* 9,157). Gadwall was the second most numerous species on the survey (16,937, *SE* 2,796), followed by Northern shoveler (13,917 *SE* 2,741), American green-winged teal (11,328 *SE* 2,634), and Ruddy duck (8,707 *SE* 3,439, Fig. 4).

The Irrigated stratum comprised 43% of the total duck count in 2017, followed by the Potholes stratum (41%) and the Highlands stratum (16%). Compared to the 2016 survey, 2017 total breeding duck counts increased 110% in eastern Washington (Fig. 5, Table 4).

The revised survey design for western Washington estimated the total breeding duck population at 73,777 (*SE* 6,369). Mallards numbered 34,981 (*SE* 3,406), followed by green-winged teal 10,154 (*SE* 3,749), bufflehead 6,947 (*SE 1,515*), and ring necked duck (4,074 *SE 1,756*); Fig. 6, Table 5). The North Puget Lowlands stratum held the majority of breeding ducks in 2017 (40%), followed by the South Puget Lowlands (34%), Hood Canal (12%), Chehalis River Valley (8%), and Dungeness (6%; Fig. 7, Table 5).

Statewide, the total breeding duck counts increased 99.4% compared to last year and are up 47.8% over the 3-year average. Mallards increased 72.7% (+33% 3-year average), American wigeon increased 28% (+43% 3-year average), and gadwall were up 28% (-2% 3-year average). Wood ducks increased 75% (+27% 3-year average) over last season (Fig. 8). Northern shovelers increased dramatically from 2016 (+525%) and over the long-term (+299%), as well as bufflehead (+330%), Blue-winged teal (+38%), and ruddy ducks (+284%, Fig. 8). Northern pintail were up 704% (+827% long term). These dramatic increases were driven largely by significant snow pack and uncommon water abundance in eastern Washington as well as potential delayed migration for typically more northern breeding species .

Duck Production Survey (Brood Survey)

Methods

The same sampling transects used for historic breeding duck surveys are used for brood surveys in the Potholes, Palouse, and Northeast strata (Fig. 1). These surveys are conducted in late June to early July. All broods observed are recorded by species. The numbers of broods observed are multiplied by the weighting factors for each stratum to provide an index to duck production. Average brood size is very difficult to estimate. Historic surveys in the Irrigated strata were designed to estimate average brood size. As a result the survey effort varied somewhat among years. To provide more consistency, the surveys in the Columbia Basin were redesigned in 1995 by using six sample sites to provide an index to production.

Broods for most species are highly secretive and difficult to observe. The current year's growth of emergent vegetation is more developed than during breeding population surveys in May. Production surveys should be viewed as a rough estimate of production with greater value for long-term trends than for year-to-year changes.

Results

The 2017 duck brood production survey index for the Potholes, Palouse, and Northeast strata declined 30% from 2016, and remains 26% below the long-term for all combined duck species (Fig. 9, Table 6). Brood production increased 9% in the Okanogan strata and 3% in the Northeast, and 8% in the Columbia Basin. The Channeled Scablands decreased 20% and continues falling to 68% below the long term average. The Palouse stratum showed a slight decrease (-10%) compared to 2016, and is now even with the long-term average (Table 7).

Canada Goose Breeding Population Survey

Methods

Canada goose breeding populations are indexed by nest searches conducted within four major geographic areas, mainly along the Snake and Columbia rivers (Table 8). Surveys are conducted annually, biennially, or periodically. Total number of goose nest attempts is used as an index of the goose breeding population, and surveys are focused on areas with high densities of nesting geese. Some areas with relatively recent goose population expansions are not surveyed. Total geese observed during historic and new aerial breeding duck surveys also provide an index to the goose population in those areas not surveyed during nest searches.

Results

The 2017 goose nest index decreased about 3% statewide compared to last year, remaining 23% above the 1974-2016 average. The total eastern Washington index decreased about 3% compared to last year, remaining 25% above the 1974-2016 average (Fig. 10, Table 9). Nest indices remained fairly stable in the upper Columbia (-3%), and decreased slightly in the mid Columbia (-7%) Fig. 11, Fig. 12, Table 9).The lower Columbia was not surveyed due to extremely high water flows limiting access to islands and reducing available nesting area. . Counts were carried over for half of the strata as it was a non-count year or due to access limitations. The lower Columbia section of this stratum is only surveyed every 5 years and was last surveyed in 2012. The other section was only partially surveyed. Therefore, counts from the previous year were used. Four out of 21 surveys were conducted according to the variable survey schedule. Most strata in the state are above their long-term averages (1974-2016) with the exception of the Upper Columbia River stratum, which began a steep decline starting in 2003 (-9%, Fig. 11, Table 9).

The number of geese observed during the breeding duck surveys is presented in Figure 13 and Table 9. This index provides information about the expansion of Canada geese into areas of Washington outside of our traditional goose nest index areas, and in general shows an increasing trend over the complete survey period.

Potential Improvements to Waterfowl Breeding and Production Surveys

- Compare new duck survey results with traditional survey results during concurrent years to project long-term trends.
- Evaluate the duck productivity and goose nest surveys for accuracy, frequency, and completeness of surveys.
- Evaluate ways to combine goose nest surveys and aerial surveys into a more representative goose breeding population index survey.

Literature Cited

U. S. Fish and Wildlife Service and Canadian Wildlife Service. 1987. Standard operating procedures for aerial waterfowl breeding ground population and habitat surveys in North America; revised. Unpublished report.

Figure 1. Historic waterfowl breeding survey areas.

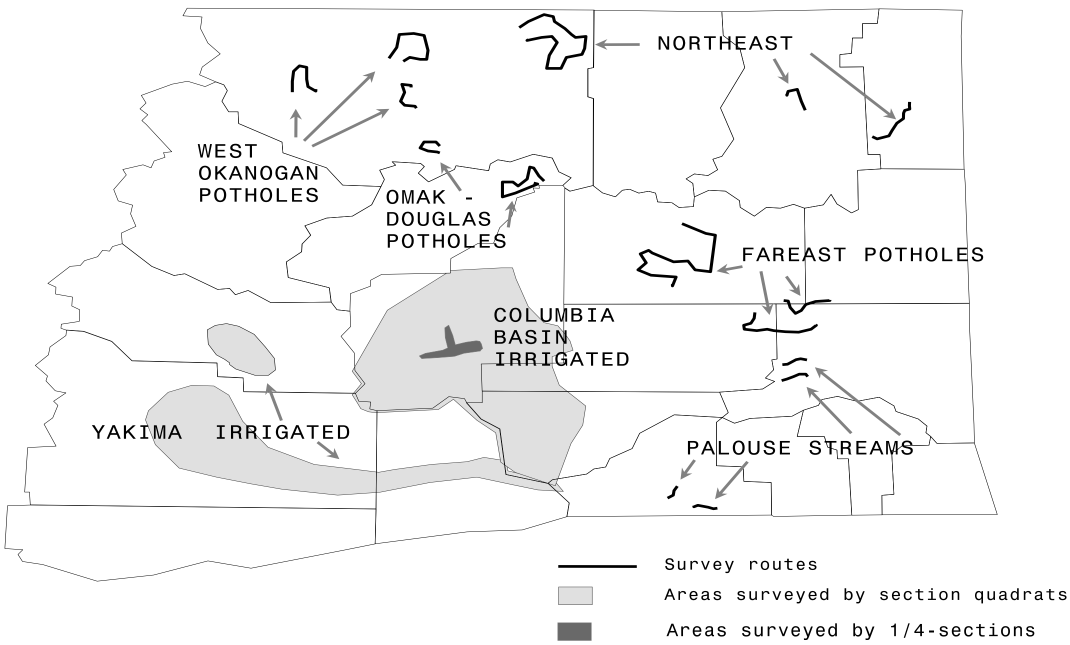

Figure 2. Eastern Washington aerial breeding waterfowl survey transects flown in 2017.

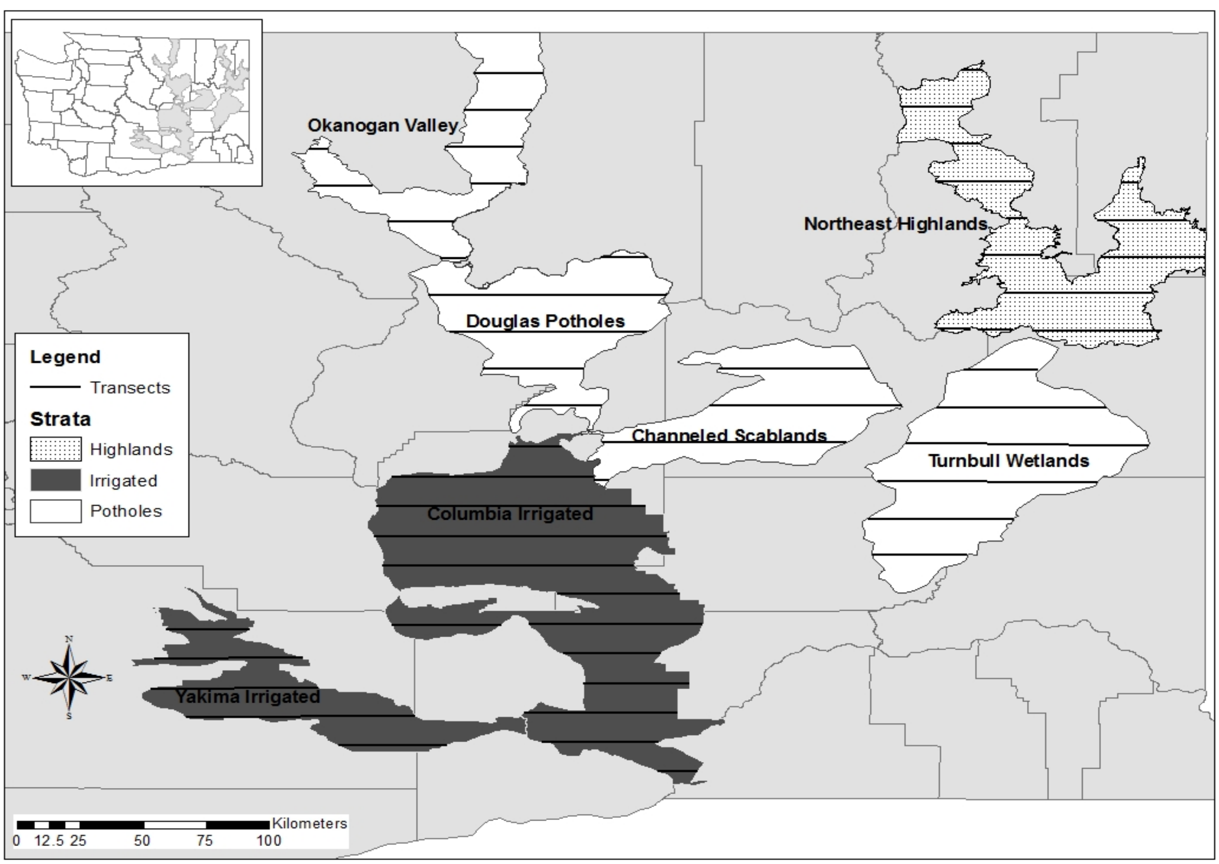

Figure 3. Western Washington aerial breeding waterfowl survey transects flown in 2017.

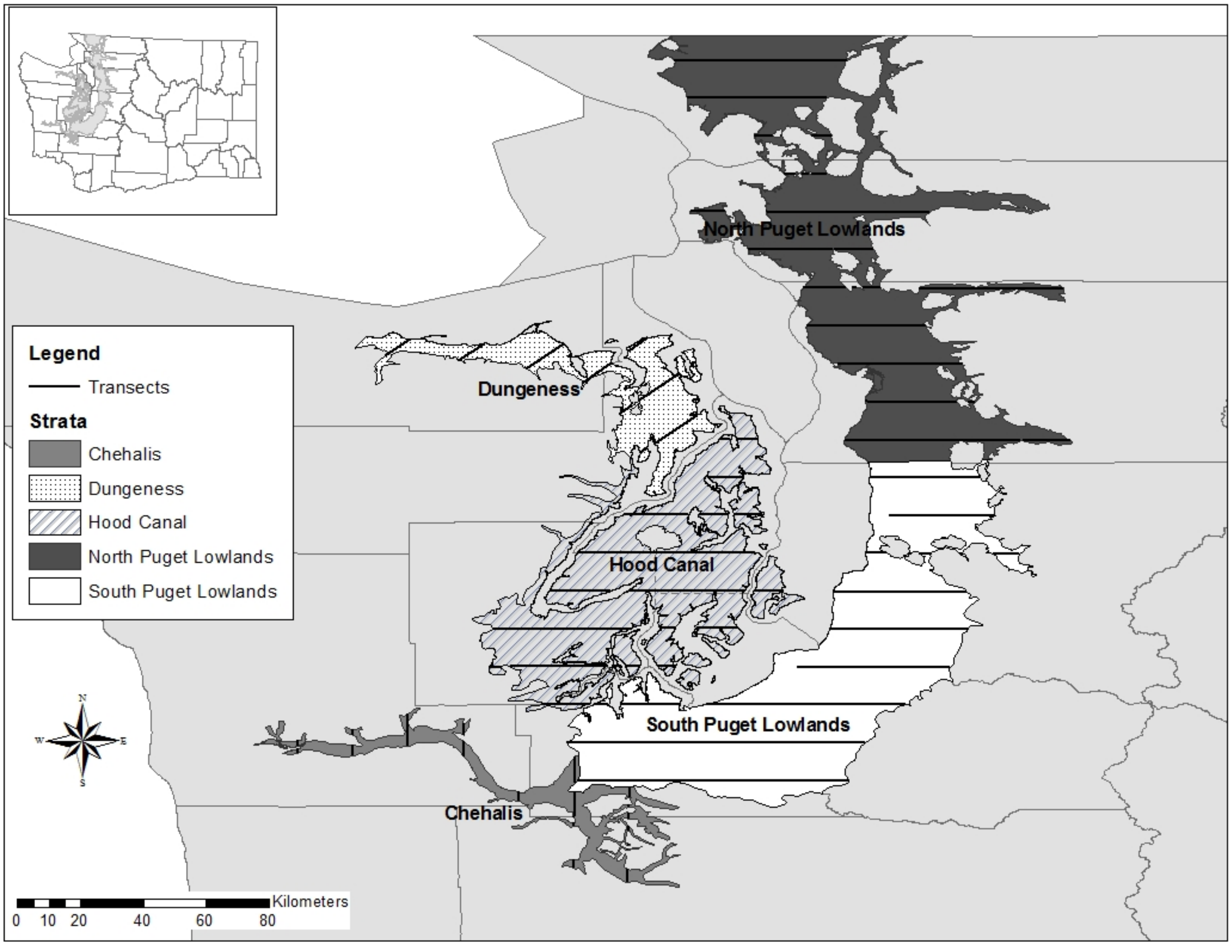

Figure 4. Eastern Washington duck breeding population survey results by species, 2010-17.

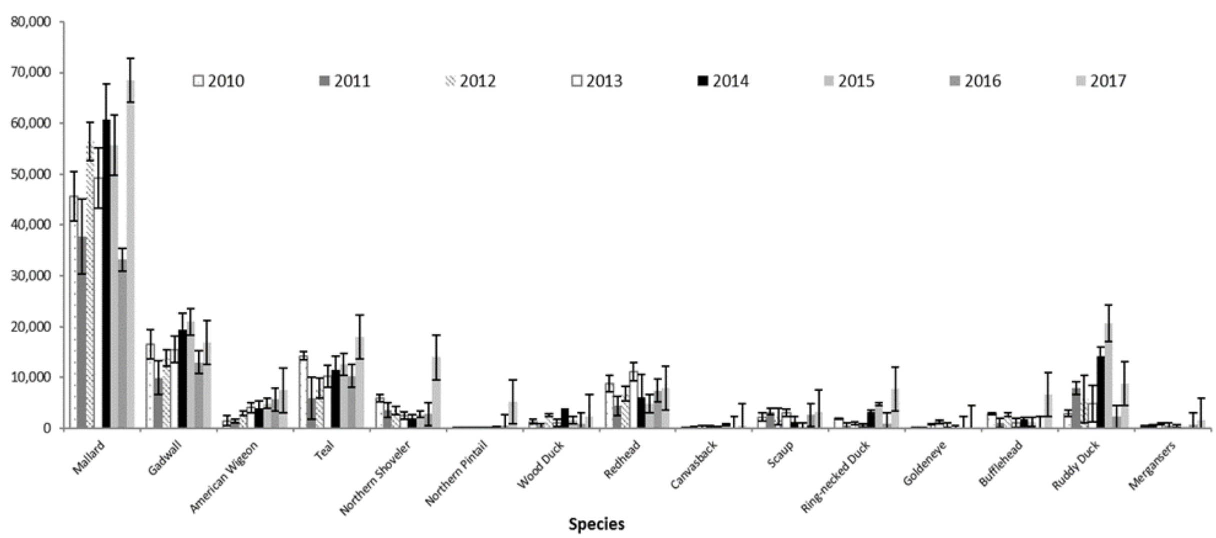

Figure 5. Eastern Washington duck breeding population survey results by species and strata, 2017.

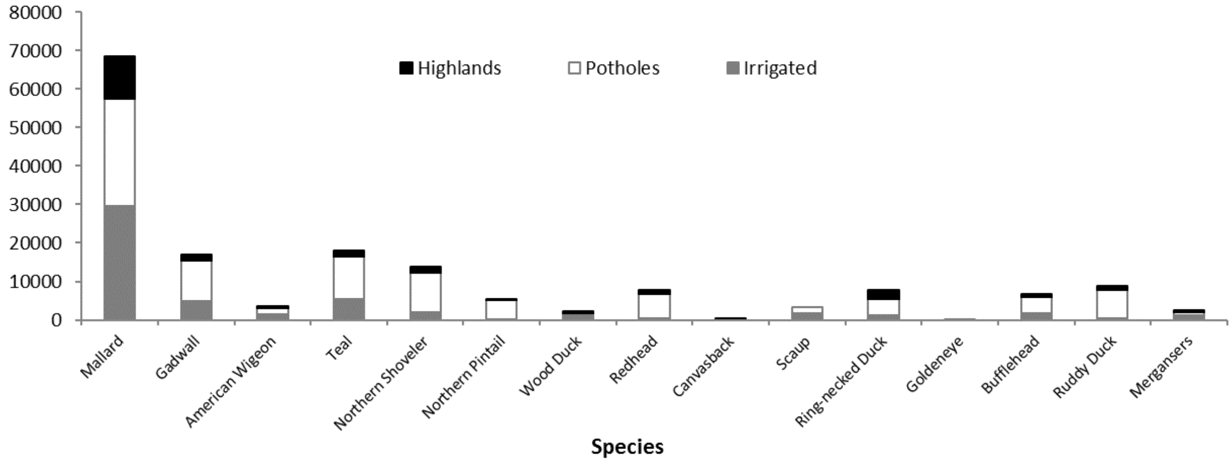

Figure 6. Western Washington duck breeding population survey results by species, 2010-17.

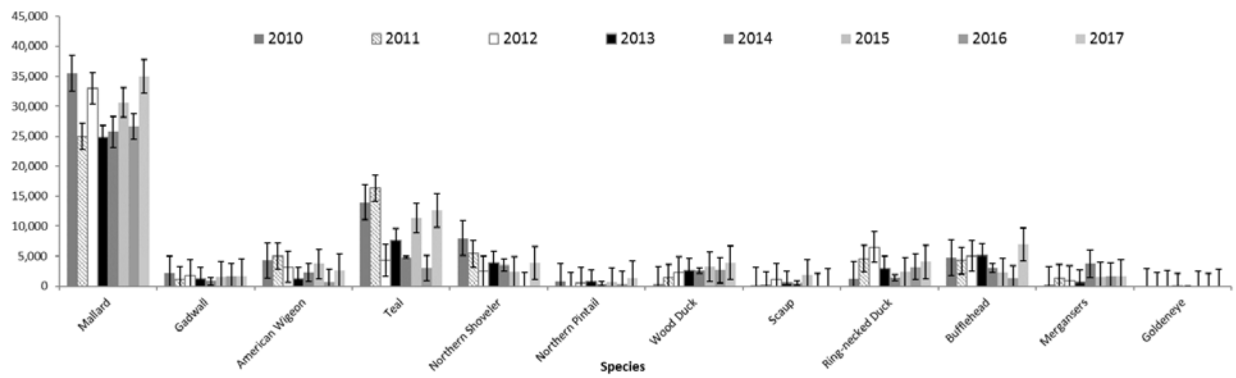

Figure 7. Western Washington duck breeding population survey results by species and strata, 2017.

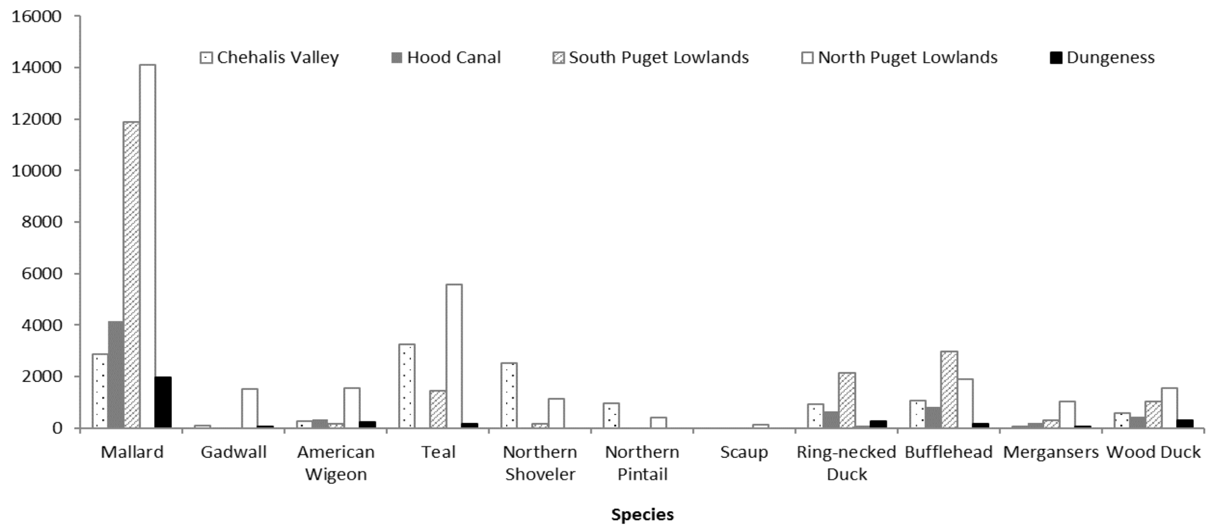

Figure 8. Statewide duck breeding population survey results by species, 2011-17.

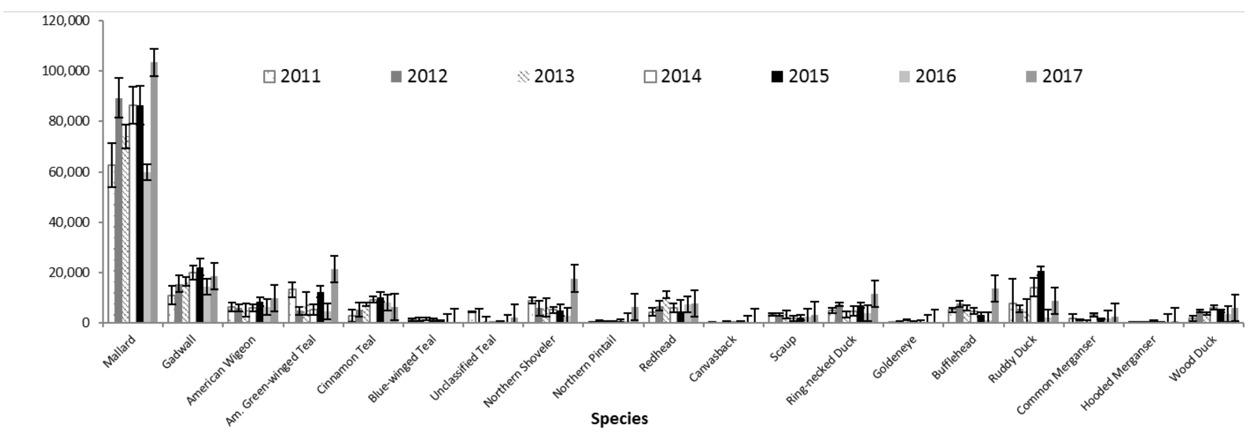

Figure 9. Brood index: Potholes, Palouse, Northeast Strata.

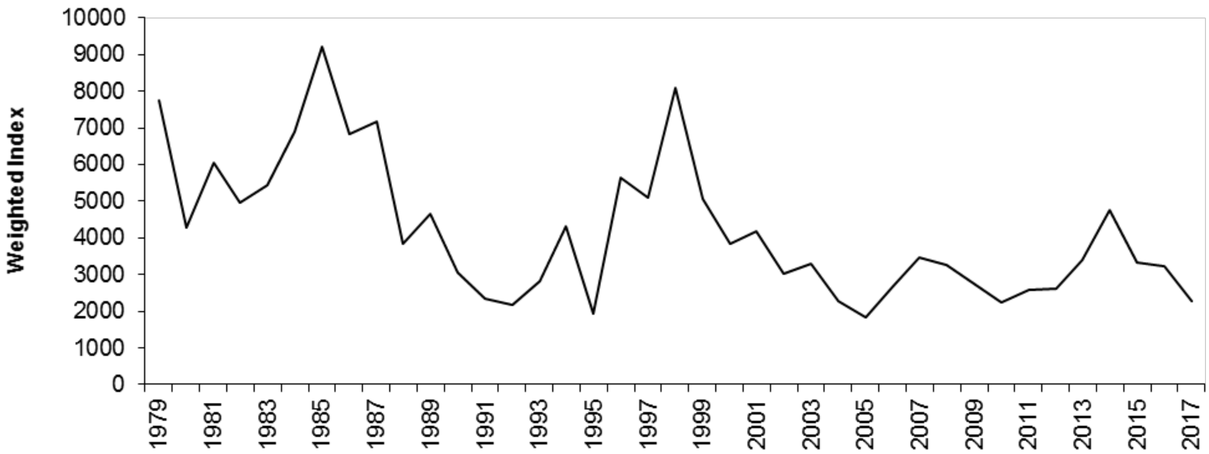

Figure 10. Total Canada goose nests counted in in eastern Washington, 1982-2017.

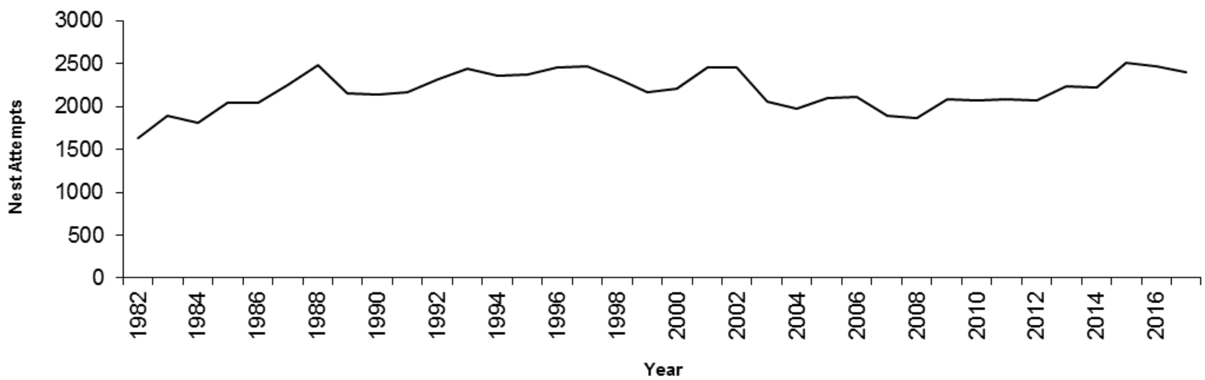

Figure 11. Canada goose nest survey trends in eastern Washington, 1985-2017. UCR = Upper Columbia River; MCR = Middle Columbia River; SR = Snake River; CB= Columbia Basin.

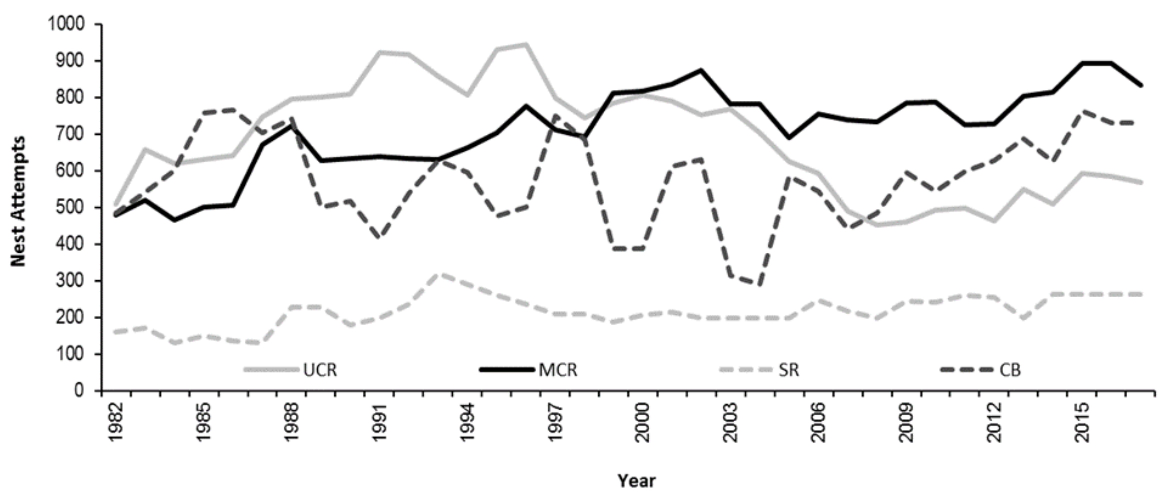

Figure 12. Total Canada goose nests in the lower Columbia River stratum, 1987-2016.

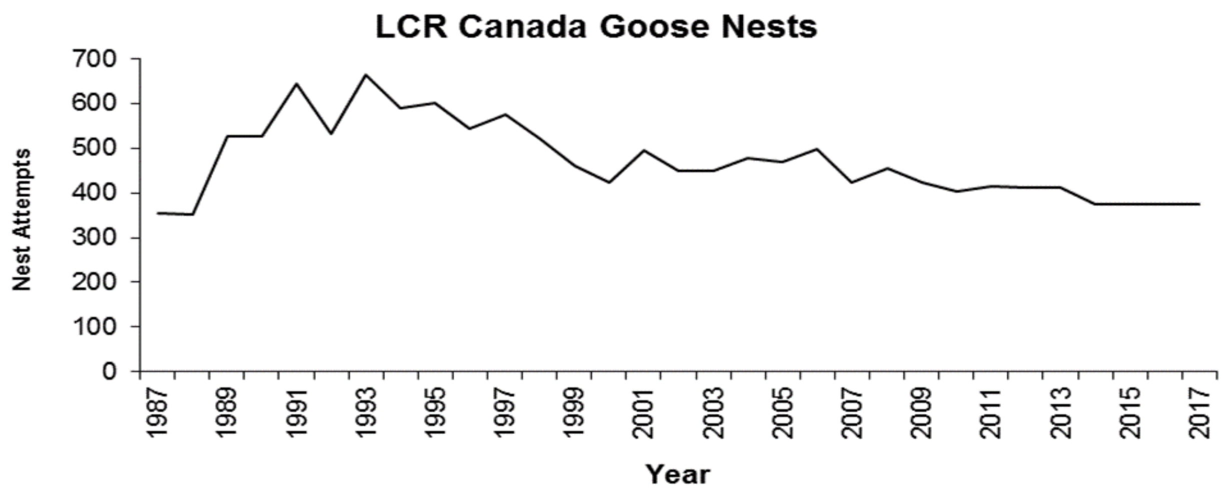

Figure 13. Breeding Canada goose index from breeding duck surveys.

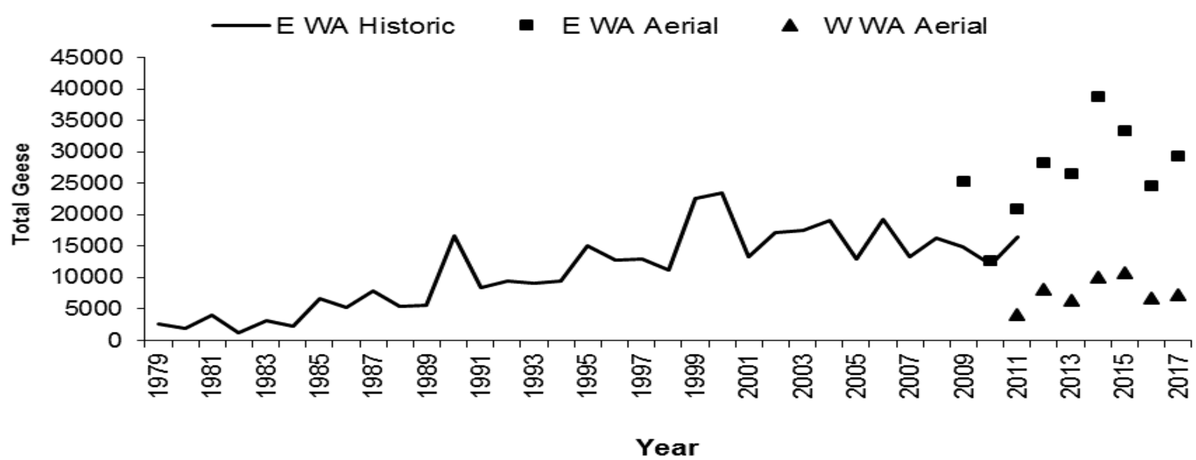

Table 1. Areas and subareas historically surveyed with weighting factors for pond indices, and duck and goose breeding surveys.

Area	Subarea	Survey	Weighting Factor	% of Total Area Sampled
Potholes	West Okanogan		14.06	7.1
		Methow Valley		
		Salmon Creek		
		Sinlahekin		
	Omak Lake		9.83	10.2
	Douglas County		15.26	6.5
	Far East Potholes		18.69	5.3
		Ewan-Revere		
		Sprague-Lamont		
	Lincoln County		47.59	2.1
Highland				
	Northeast		25.53	3.9
		Colville		
		Cusick		
		Molson-Sidley		
	Palouse Streams		32.52	3.1
		Union Flat		
		Palouse River		
		Walla Walla River		
		Touchet River		
Irrigated				
	Columbia Basin – 65 sections		37.25	2.7
	Wasteways[a] – 19 ¼ -sections		10.05	9.9
	Yakima – 35 sections		24.49	3.9

[a] Surveyed by helicopter beginning in 1994

Table 2. Weighted breeding duck population indices by species for eastern Washington historic survey areas (2002-2011).

Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2002-2011 average
Mallard	44676	39843	39958	40794	45485	46053	50647	47977	49160	54940	45953
Gadwall	18527	15353	15185	15665	17995	17165	14065	10277	10277	11735	14624
Am. Wigeon	6501	5028	5442	3439	6012	6240	2618	4283	2844	3248	4566
Am. green-winged teal	2673	1749	1477	2406	4095	4060	1590	1612	1844	1905	2341
Blue +cinnamon teal	13717	11274	14619	12404	9544	11999	11921	9282	8657	6645	11006
Northern shoveler	5968	7794	6293	4477	6581	5409	4898	5555	4199	6249	5742
Northern pintail	395	608	1096	644	1089	723	450	1198	542	2489	923
Wood duck	1863	616	1553	1375	1549	1870	1781	1327	2409	1527	1587
Redhead	11831	8117	8365	4978	8492	8265	7757	7156	6466	6072	7750
Canvasback	1507	919	618	610	1460	756	1132	873	385	765	903
Scaup spp.	9289	12722	4807	5741	9709	6530	4244	5982	2484	3429	6494
Ring-necked duck	1405	3063	850	2525	3640	2732	2995	2521	2381	2136	2425
Goldeneye spp.	4036	4713	3255	3567	2847	2837	3841	3686	3495	3121	3540
Bufflehead	1606	3034	1280	2425	6361	2809	3728	949	2701	6838	3173
Ruddy duck	9023	12175	9624	10150	10464	9538	8262	8378	6400	9306	9332
Merganser spp.	327	757	463	304	121	1279	969	1095	794	1848	796
Total ducks	**133343**	**127764**	**114883**	**111503**	**135442**	**128265**	**120897**	**115663**	**105036**	**122254**	**121505**
American coot	18171	19328	19085	12346	22151	33763	22069	25521	20511	16834	20978
Canada goose	17179	17596	19137	13022	19253	13244	16342	16023	12014	16511	16032

Table 3. Weighted breeding duck population indices by area for eastern Washington historic surveys (1979-2011).

Year	Irrigated	Potholes	Palouse	Northeast	Total
1979	28948	57784	1951	9960	98643
1980	36870	58752	3057	15063	113742
1981	74711	58026	2341	13173	148252
1982	66161	63150	4455	12663	146429
1983	84969	48044	3545	12969	149527
1984	101486	73478	4618	16697	196278
1985	94789	95463	5984	19990	216226
1986	97901	79899	3837	22135	203771
1987	72503	80100	5073	25887	183564
1988	78137	103452	7068	53143	241799
1989	73411	50663	2341	35908	162323
1990	77838	56462	5138	29474	168912
1991	65698	50293	3382	21420	140793
1992	69547	22581	3252	20884	116264
1993	75969	42335	3577	27955	149836
1994	64537	43502	2699	13173	123912
1995	71513	46068	2472	26934	146987
1996	73364	62221	1691	25658	162933
1997	68589	85137	2667	16058	172451
1998	65503	96982	2341	20424	185251
1999	72697	101140	3089	23283	200210
2000	61126	70072	2537	22594	156328
2001	47438	70106	2537	26321	146402
2002	52341	59958	1106	19939	133342
2003	52648	49794	1170	24151	127764
2004	55098	39393	1041	19351	114883
2005	58339	35014	585	17564	111503
2006	72138	46672	1626	15650	135442
2007	63349	42119	2211	20271	128265
2008	62230	38710	1756	17999	120109
2009	50846	44020	1496	19301	115078
2010	55631	30351	1106	17948	105036
2011	71399	36352	1048	13454	122254
1979-2011 ave.	67204	58730	2812	21133	149834

Table 4. Summary of eastern Washington helicopter surveys for breeding waterfowl (2010-2017).

Region	Year	Mallard	Gadwall	American Wigeon	Green-winged Teal	Cinnamon Teal	Blue-winged Teal	Northern Shoveler	Northern Pintail	Redhead	Canvasback	Scaup	Ring-necked Duck	Goldeneye	Bufflehead	Ruddy Duck	Common Merganser	Hooded Merganser	Wood Duck	**TOTAL DUCKS**	American Coot	Canada Goose
Irrigated	2010	27,372	3,129	198	560	4,809	264	3,953	0	1,746	66	1,647	659	0	2,240	231	264	0	1,054	**48,190**	7,016	4,644
	±SE	*5,879*	*698*	*73*	*292*	*2,213*	*127*	*1,417*	*0*	*547*	*52*	*574*	*155*	*0*	*903*	*126*	*116*	*0*	*432*	***6,614***	*2,802*	*1,141*
	2011	20,791	1,749	583	453	648	259	583	0	648	0	1,231	0	0	259	194	259	0	194	**27,916**	1,749	8,452
	±SE	*2,415*	*517*	*169*	*89*	*253*	*117*	*351*	*0*	*433*	*0*	*524*	*0*	*0*	*126*	*89*	*136*	*0*	*159*	***2,621***	*1,015*	*2,270*
	2012	25,192	1,943	96	287	2,229	127	955	64	955	0	1,656	287	605	2,102	573	64	0	510	**37,644**	1,369	7,102
	±SE	*4,275*	*454*	*76*	*188*	*1,113*	*101*	*475*	*53*	*406*	*0*	*679*	*122*	*388*	*860*	*279*	*50*	*0*	*354*	***4,663***	*439*	*1,502*
	2013	17,188	4,520	1,432	191	1,114	859	446	0	509	0	923	223	1,146	573	0	64	0	127	**29,316**	3,342	5,507
	±SE	*2,633*	*1,129*	*600*	*106*	*388*	*303*	*223*	*0*	*154*	*0*	*349*	*175*	*804*	*277*	*0*	*49*	*0*	*106*	***3,128***	*1,139*	*1,672*
	2014	25,815	4,902	1,464	764	3,247	382	637	127	1,114	0	382	127	0	382	0	127	0	446	**39,915**	7,830	7,639
	±SE	*5,350*	*1,707*	*469*	*349*	*1,768*	*254*	*454*	*69*	*420*	*0*	*175*	*59*	*0*	*181*	*0*	*71*	*0*	*171*	***5,963***	*3,075*	*1,696*
	2015	21,581	4,520	1,210	318	1,973	64	318	0	637	32	191	477	0	318	668	159	0	764	**33,231**	3,247	5,570
	±SE	*3,292*	*1,055*	*948*	*139*	*608*	*50*	*104*	*0*	*188*	*26*	*150*	*263*	*0*	*160*	*449*	*136*	*0*	*252*	***3,700***	*1,927*	*1,071*
	2016	15,406	3,024	509	828	2,228	382	796	127	1,305	0	859	191	0	64	32	0	0	382	**26,133**	2,515	3,024
	±SE	*2,145*	*683*	*175*	*333*	*456*	*137*	*529*	*69*	*838*	*0*	*373*	*87*	*0*	*54*	*25*	*0*	*0*	*165*	***2,569***	*1,348*	*1,010*
	2017	29,634	4,966	1,528	3,438	1,910	127	1,942	255	446	0	1,687	1,146	64	1,814	414	64	0	1,082	**50,515**	3,565	5,348
	±SE	*6,820*	*2,016*	*491*	*2,155*	*1,120*	*124*	*993*	*139*	*250*	*0*	*632*	*407*	*67*	*1,176*	*271*	*65*	*0*	*408*	***7,745***	*1,176*	*1,518*
Potholes	2010	18,295	13,422	1,278	2,397	4,634	1,518	1,997	80	7,070	0	559	1,238	80	639	2,676	160	0	240	**56,284**	7,110	7,829
	±SE	*4,436*	*3,261*	*393*	*712*	*1,481*	*636*	*497*	*83*	*1,861*	*0*	*276*	*529*	*86*	*355*	*1,280*	*122*	*0*	*142*	***6,281***	*2,310*	*2,261*
	2011	16,888	8,160	873	1,527	2,356	611	2,967	0	3,753	262	2,007	436	87	785	7,637	262	0	262	**48,874**	7,288	14,139
	±SE	*2,920*	*1,545*	*400*	*643*	*763*	*393*	*788*	*0*	*1,342*	*257*	*1,530*	*217*	*90*	*379*	*4,663*	*192*	*0*	*146*	***6,249***	*1,920*	*4,420*
	2012	20,622	11,054	2,598	454	2,887	1,155	2,145	165	5,486	206	660	454	82	330	5,197	660	0	330	**54,691**	2,887	13,487
	±SE	*3,609*	*2,580*	*978*	*168*	*596*	*412*	*500*	*164*	*1,749*	*167*	*337*	*278*	*81*	*250*	*3,560*	*646*	*0*	*238*	***6,164***	*600*	*3,616*
	2013	21,564	9,854	2,515	495	5,937	536	2,062	0	8,494	247	1,855	165	82	165	3,876	165	82	247	**58,424**	15,709	11,462
	±SE	*5,468*	*3,028*	*1,416*	*265*	*1,852*	*249*	*738*	*0*	*4,292*	*173*	*901*	*170*	*85*	*160*	*1,660*	*161*	*85*	*133*	***8,205***	*7,924*	*3,661*
	2014	24,212	10,952	2,098	0	5,119	755	1,007	0	3,525	0	168	1,091	0	168	11,372	0	84	1,511	**62,061**	13,721	17,246
	±SE	*5,842*	*2,805*	*708*	*0*	*1,696*	*334*	*527*	*0*	*1,267*	*0*	*111*	*634*	*0*	*114*	*9,417*	*0*	*86*	*871*	***11,715***	*7,770*	*5,354*
	2015	24,367	13,895	3,463	1,649	6,350	495	1,484	165	3,876	0	82	3,834	82	330	19,626	0	0	247	**79,946**	7,092	19,337
	±SE	*5,809*	*4,863*	*2,355*	*442*	*1,840*	*334*	*571*	*162*	*1,235*	*0*	*85*	*2,278*	*85*	*263*	*17,031*	*0*	*0*	*169*	***19,075***	*5,642*	*7,525*
	2016	12,940	7,359	4,878	1,612	4,382	0	1,984	331	4,837	0	1,571	207	0	0	1,323	165	0	165	**41,756**	9,343	12,403
	±SE	*1,823*	*1,478*	*2,662*	*690*	*1,068*	*0*	*463*	*193*	*1,654*	*0*	*1,102*	*135*	*0*	*0*	*596*	*120*	*0*	*107*	***4,337***	*3,477*	*3,962*
	2017	27,913	10,308	5,278	7,257	3,628	82	10,390	4,783	6,391	165	1,567	4,370	0	4,041	7,422	742	165	660	**95,160**	13,853	15,049
	±SE	*5,175*	*1,462*	*1,408*	*1,469*	*1,492*	*81*	*2,329*	*1,520*	*1,702*	*162*	*1,268*	*1,027*	*0*	*1,850*	*3,322*	*445*	*115*	*316*	***7,961***	*3,469*	*4,494*

Table 4. Summary of eastern Washington helicopter surveys for breeding waterfowl (2010-2017).

Highlands*	2009*	2,245	1,020	0	0	0	204	204	0	0	204	0	204	0	0	102	0	204	816	**5,204**	2,551	5,919
	±SE	*383*	*294*	*0*	*0*	*0*	*47*	*59*	*0*	*0*	*59*	*0*	*59*	*0*	*0*	*29*	*0*	*71*	*142*	***521***	*736*	*1,136*
	2012	10,582	832	238	79	238	238	396	0	357	0	0	198	159	238	0	79	79	1,704	**15,417**	436	8,719
	±SE	*1,896*	*250*	*112*	*50*	*112*	*157*	*127*	*0*	*149*	*0*	*0*	*122*	*105*	*66*	*0*	*46*	*50*	*621*	***2,042***	*148*	*2,810*
	2013	10,482	1,112	79	516	238	238	0	0	2,184	159	238	119	0	238	913	0	79	715	**17,311**	6,909	9,608
	±SE	*3,617*	*514*	*53*	*176*	*107*	*112*	*0*	*0*	*1,449*	*105*	*146*	*51*	*0*	*146*	*606*	*0*	*49*	*209*	***3,997***	*3,939*	*4,274*
	2014	10,697	3,526	317	0	832	317	238	0	1,426	79	713	2,060	317	1,189	2,853	158	0	1,585	**26,308**	10,539	13,946
	±SE	*2,994*	*1,527*	*160*	*0*	*341*	*210*	*157*	*0*	*785*	*52*	*362*	*560*	*121*	*249*	*1,831*	*61*	*0*	*494*	***4,031***	*6,230*	*4,323*
	2015	9,826	2,536	158	1,109	634	0	951	0	238	713	0	396	79	515	357	158	0	634	**18,304**	1,902	8,439
	±SE	*2,608*	*1,009*	*64*	*394*	*420*	*0*	*574*	*0*	*130*	*472*	*0*	*184*	*55*	*301*	*236*	*110*	*0*	*124*	***2,989***	*701*	*1,795*
	2016	4,884	2,541	318	0	874	0	0	0	1,271	0	159	476	79	0	913	556	0	318	**12,389**	1,112	9,252
	±SE	*1,132*	*868*	*130*	*0*	*263*	*0*	*0*	*0*	*809*	*0*	*78*	*240*	*49*	*0*	*638*	*325*	*0*	*140*	***1,837***	*464*	*3,151*
	2017	10,865	1,664	634	634	792	79	1,585	158	991	317	0	2,219	0	832	872	396	158	555	**22,742**	5,983	8,994
	±SE	*3,251*	*1,271*	*413*	*370*	*637*	*81*	*1,050*	*107*	*751*	*245*	*0*	*1,122*	*0*	*554*	*847*	*280*	*106*	*402*	***4,144***	*5,856*	*3,241*
Total - Eastern Washington	2010*	45,667	16,551	1,476	2,957	9,443	1,781	5,950	80	8,816	66	2,206	1,897	80	2,879	2,907	423	0	1,294	**104,473**	14,126	12,474
	±SE	*7,364*	*3,335*	*400*	*770*	*2,663*	*649*	*1,501*	*83*	*1,940*	*52*	*637*	*551*	*86*	*970*	*1,286*	*168*	*0*	*455*	***6,281***	*3,631*	*2,532*
	2011*	*37,679*	*9,909*	*1,456*	*1,981*	*3,004*	*870*	*3,550*	*0*	*4,401*	*262*	*3,238*	*436*	*87*	*1,045*	*7,831*	*521*	*0*	*456*	***76,790***	*9,036*	*22,591*
	±SE	*3,789*	*1,629*	*435*	*649*	*804*	*410*	*862*	*0*	*1,410*	*257*	*1,618*	*217*	*90*	*400*	*4,664*	*235*	*0*	*216*	***6,249***	*2,172*	*4,969*
	2012	56,396	13,829	2,932	820	5,354	1,520	3,496	229	6,798	206	2,316	938	846	2,670	5,770	803	79	2,544	**107,752**	4,693	29,308
	±SE	*5,908*	*2,632*	*988*	*257*	*1,267*	*453*	*701*	*173*	*1,802*	*167*	*758*	*327*	*410*	*898*	*3,571*	*649*	*50*	*754*	***6,493***	*758*	*4,820*
	2013	49,234	15,486	4,027	1,202	7,289	1,634	2,507	0	11,187	406	3,017	507	1,228	976	4,789	229	162	1,089	**105,051**	25,960	26,577
	±SE	*7,065*	*3,273*	*1,539*	*336*	*1,895*	*408*	*771*	*0*	*4,533*	*202*	*977*	*250*	*808*	*352*	*1,767*	*169*	*98*	*270*	***9,127***	*8,922*	*5,870*
	2014	60,724	19,380	3,879	764	9,198	1,454	1,881	127	6,065	79	1,263	3,279	317	1,738	14,224	286	84	3,541	**128,284**	32,091	38,832
	±SE	*8,469*	*3,621*	*864*	*349*	*2,474*	*469*	*713*	*69*	*1,549*	*52*	*417*	*848*	*121*	*328*	*9,594*	*93*	*86*	*1,016*	***13,750***	*10,423*	*7,088*
	2015	55,774	20,950	4,831	3,077	8,957	558	2,753	165	4,750	745	273	4,708	162	1,163	20,651	318	0	1,645	**131,482**	12,240	33,347
	±SE	*7,168*	*5,077*	*2,540*	*608*	*1,983*	*337*	*816*	*162*	*1,256*	*473*	*173*	*2,301*	*101*	*430*	*17,039*	*175*	*0*	*328*	***19,659***	*6,003*	*7,810*
	2016	33,230	12,924	5,705	2,440	7,484	382	2,780	458	7,413	0	2,589	874	79	64	2,268	721	0	865	**80,278**	12,970	24,678
	±SE	*3,034*	*1,845*	*2,671*	*766*	*1,191*	*137*	*704*	*205*	*2,023*	*0*	*1,166*	*289*	*49*	*54*	*873*	*346*	*0*	*241*	***5,365***	*3,758*	*5,162*
	2017	68,403	16,937	7,439	11,328	6,331	289	13,917	5,196	7,827	482	3,254	7,735	64	6,687	8,707	1,202	323	2,297	**168,417**	23,401	29,390
	±SE	*9,157*	*2,796*	*1,548*	*2,634*	*1,972*	*169*	*2,741*	*1,530*	*1,877*	*294*	*1,417*	*1,574*	*67*	*2,260*	*3,439*	*530*	*156*	*654*	***11,855***	*6,907*	*5,745*

Table 5. Summary of western Washington breeding waterfowl population survey (2010-2017).

Region	Year	Mallard	Gadwall	American Wigeon	Green-winged Teal	Cinnamon Teal	Blue-winged Teal	Unclassified Teal	Northern Shoveler	Northern Pintail	Redhead	Canvasback	Scaup	Ring-necked Duck	Goldeneye	Bufflehead	Ruddy Duck	Common Merganser	Hooded Merganser	Wood Duck	**TOTAL DUCKS**	American Coot	Canada Goose
Chehalis Valley	2010	1,670	0	835	0	0	0	1,035	67	0	0	0	0	200	0	67	0	0	0	0	**3,875**	0	3708
	±SE	*511*	*0*	*777*	*0*	*0*	*0*	*776*	*62*	*0*	*0*	*0*	*0*	*99*	*0*	*50*	*0*	*0*	*0*	*0*	***1,217***	*0*	*3166*
	2011	1,569	58	291	1,104	0	232	494	58	0	0	0	58	1,511	0	349	0	349	0	58	**6,131**	0	174
	±SE	*705*	*59*	*294*	*372*	*0*	*231*	*318*	*59*	*0*	*0*	*0*	*59*	*1,040*	*0*	*170*	*0*	*346*	*0*	*45*	***1,455***	*0*	*148*
	2012	2,156	485	1,967	2,263	0	0	0	701	216	0	0	54	1,455	0	701	0	162	0	189	**10,347**	0	458
	±SE	*1,349*	*470*	*729*	*1,954*	*0*	*0*	*0*	*515*	*209*	*0*	*0*	*52*	*1,349*	*0*	*379*	*0*	*162*	*0*	*148*	***2,952***	*0*	*261*
	2013	1,652	103	0	1,678	52	155	52	155	0	0	0	0	52	0	361	0	0	0	310	**4,569**	129	929
	±SE	*675*	*70*	*0*	*1,304*	*54*	*112*	*42*	*149*	*0*	*0*	*0*	*0*	*50*	*0*	*257*	*0*	*0*	*0*	*92*	***1,509***	*146*	*736*
	2014	2,091	52	1,575	310	0	0	0	568	0	0	0	207	129	0	258	0	258	0	103	**5,550**	0	826
	±SE	*473*	*50*	*1,400*	*182*	*0*	*0*	*0*	*476*	*0*	*0*	*0*	*234*	*98*	*0*	*125*	*0*	*89*	*0*	*65*	***1,593***	*0*	*382*
	2015	2,281	53	610	212	159	0	0	159	0	0	0	796	133	0	159	0	371	0	159	**5,093**	0	875
	±SE	*790*	*51*	*554*	*151*	*153*	*0*	*0*	*105*	*0*	*0*	*0*	*903*	*89*	*0*	*128*	*0*	*239*	*0*	*59*	***1,375***	*0*	*266*
	2016	2,014	258	155	929	0	0	0	0	0	0	0	0	129	0	52	0	310	0	361	**4,208**	0	258
	±SE	*1,015*	*248*	*149*	*893*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*65*	*0*	*42*	*0*	*313*	*0*	*231*	***1,439***	*0*	*154*
	2017	2,866	103	258	3,253	0	0	2,194	2,530	955	0	0	0	929	0	1,058	0	52	0	568	**14,766**	0	181
	±SE	*672*	*107*	*204*	*1,806*	*0*	*0*	*1,562*	*1,710*	*918*	*0*	*0*	*0*	*263*	*0*	*499*	*0*	*52*	*0*	*126*	***3,211***	*0*	*110*
Hood Canal	2010	2,296	0	574	0	0	0	0	287	0	0	0	0	0	0	430	0	0	0	96	**3,683**	0	813
	±SE	*179*	*0*	*349*	*0*	*0*	*0*	*0*	*190*	*0*	*0*	*0*	*0*	*0*	*0*	*250*	*0*	*0*	*0*	*58*	***505***	*0*	*369*
	2011	2,779	0	0	0	0	0	192	0	0	0	0	0	511	0	447	0	0	0	128	**4,057**	0	511
	±SE	*629*	*0*	*0*	*0*	*0*	*0*	*114*	*0*	*0*	*0*	*0*	*0*	*189*	*0*	*171*	*0*	*0*	*0*	*127*	***700***	*0*	*287*
	2012	2,619	0	607	192	0	0	0	0	0	0	0	0	831	0	256	0	0	256	415	**5,175**	0	735
	±SE	*694*	*0*	*564*	*176*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*477*	*0*	*119*	*0*	*0*	*112*	*142*	***1,051***	*0*	*280*
	2013	2,080	63	0	63	0	0	126	0	0	0	0	0	63	0	851	0	126	126	126	**3,624**	0	851
	±SE	*494*	*58*	*0*	*59*	*0*	*0*	*129*	*0*	*0*	*0*	*0*	*0*	*59*	*0*	*435*	*0*	*116*	*116*	*67*	***701***	*0*	*152*
	2014	3,466	0	0	0	0	0	126	63	0	0	0	0	32	63	189	0	0	378	189	**4,380**	0	1008
	±SE	*1,022*	*0*	*0*	*0*	*0*	*0*	*129*	*64*	*0*	*0*	*0*	*0*	*30*	*58*	*120*	*0*	*0*	*153*	*127*	***1,052***	*0*	*423*
	2015	2,822	0	127	127	0	0	0	0	0	0	0	0	190	0	190	0	0	0	761	**4,090**	0	380
	±SE	*576*	*0*	*116*	*116*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*182*	*0*	*126*	*0*	*0*	*0*	*319*	***704***	*0*	*308*
	2016	3,963	0	63	0	0	0	0	0	0	0	0	0	412	0	507	0	0	190	285	**5,422**	63	666
	±SE	*458*	*0*	*65*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*194*	*0*	*261*	*0*	*0*	*121*	*116*	***590***	*61*	*358*
	2017	4,159	0	347	0	0	0	0	0	0	0	0	0	662	0	819	0	63	126	441	**6,617**	0	284
	±SE	*922*	*0*	*354*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*302*	*0*	*427*	*0*	*63*	*141*	*132*	***1,136***	*0*	*198*

Table 5. Summary of western Washington breeding waterfowl population survey (2010-2017).

Dungeness	2010	2,649	0	0	0	0	0	294	1,030	0	0	0	0	0	0	0	0	0	0	0	**3,974**	0	37
	±SE	*378*	*0*	*0*	*0*	*0*	*0*	*169*	*502*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***650***	*0*	*24*
	2011	1,661	181	60	1,963	0	0	0	0	0	0	0	0	453	0	453	0	60	0	0	**4,832**	30	272
	±SE	*527*	*185*	*62*	*1,859*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*318*	*0*	*426*	*0*	*65*	*0*	*0*	***2,014***	*31*	*192*
	2012	2,053	755	0	1,027	0	0	0	60	0	0	0	272	0	0	302	0	0	0	30	**4,499**	0	423
	±SE	*885*	*737*	*0*	*840*	*0*	*0*	*0*	*65*	*0*	*0*	*0*	*252*	*0*	*0*	*99*	*0*	*0*	*0*	*33*	***1,452***	*0*	*300*
	2013	2,971	119	238	1,218	59	0	0	743	0	0	0	505	386	0	713	0	0	0	59	**7,011**	0	861
	±SE	*1,241*	*121*	*162*	*843*	*64*	*0*	*0*	*759*	*0*	*0*	*0*	*471*	*205*	*0*	*292*	*0*	*0*	*0*	*57*	***1,796***	*0*	*893*
	2014	3,162	716	0	1,581	0	0	0	0	60	0	0	0	627	0	1,074	0	0	239	60	**7,518**	0	1581
	±SE	*908*	*611*	*0*	*1,541*	*0*	*0*	*0*	*0*	*61*	*0*	*0*	*0*	*381*	*0*	*527*	*0*	*0*	*230*	*64*	***2,014***	*0*	*1128*
	2015	2,495	119	59	2,228	0	178	30	59	0	0	0	0	89	0	119	0	0	0	89	**5,466**	0	743
	±SE	*665*	*84*	*57*	*2,278*	*0*	*120*	*32*	*64*	*0*	*0*	*0*	*0*	*83*	*0*	*115*	*0*	*0*	*0*	*66*	***2,384***	*0*	*537*
	2016	2,228	475	0	891	178	0	0	0	0	0	0	0	564	0	0	0	0	59	0	**4,397**	0	683
	±SE	*777*	*393*	*0*	*847*	*132*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*269*	*0*	*0*	*0*	*0*	*61*	*0*	***1,252***	*0*	*440*
	2017	1,961	59	238	178	0	0	0	0	0	0	0	0	267	0	178	0	59	0	297	**3,238**	0	208
	±SE	*790*	*64*	*129*	*182*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*176*	*0*	*123*	*0*	*61*	*0*	*109*	***860***	*0*	*116*
South Puget Lowlands	2010	8,691	0	325	0	0	0	372	186	0	0	0	232	511	0	2,974	0	186	0	186	**13,664**	46	1859
	±SE	*1,549*	*0*	*215*	*0*	*0*	*0*	*175*	*148*	*0*	*0*	*0*	*163*	*282*	*0*	*424*	*0*	*131*	*0*	*121*	***1,678***	*40*	*390*
	2011	8,926	509	2,067	1,438	60	120	779	3,175	0	0	0	0	1,048	0	1,917	0	0	120	659	**20,818**	150	1647
	±SE	*1,307*	*538*	*1,635*	*596*	*55*	*76*	*629*	*3,193*	*0*	*0*	*0*	*0*	*380*	*0*	*554*	*0*	*0*	*78*	*466*	***4,037***	*91*	*397*
	2012	15,127	60	449	300	0	0	0	899	60	0	0	120	3,295	0	2,426	0	60	30	539	**23,364**	30	3684
	±SE	*3,569*	*61*	*283*	*218*	*0*	*0*	*0*	*589*	*61*	*0*	*0*	*125*	*1,153*	*0*	*585*	*0*	*56*	*28*	*221*	***3,868***	*28*	*1163*
	2013	10,274	734	499	2,495	0	0	59	2,789	0	0	0	0	2,407	59	2,671	0	59	176	822	**23,043**	29	2436
	±SE	*1,520*	*777*	*528*	*1,365*	*0*	*0*	*62*	*1,977*	*0*	*0*	*0*	*0*	*1,098*	*54*	*624*	*0*	*62*	*93*	*288*	***3,265***	*27*	*880*
	2014	7,359	0	493	0	0	0	92	954	0	0	0	0	431	0	985	0	185	62	1,293	**11,854**	31	3664
	±SE	*932*	*0*	*392*	*0*	*0*	*0*	*95*	*600*	*0*	*0*	*0*	*0*	*227*	*0*	*417*	*0*	*109*	*61*	*182*	***1,291***	*28*	*878*
	2015	9,347	302	60	484	423	0	60	393	0	0	0	1,025	938	0	726	0	181	181	1,119	**15,245**	151	4295
	±SE	*1,680*	*208*	*63*	*374*	*433*	*0*	*64*	*260*	*0*	*0*	*0*	*627*	*307*	*0*	*249*	*0*	*101*	*132*	*315*	***1,986***	*106*	*924*
	2016	9,962	484	363	61	182	0	30	61	0	0	0	0	1,998	0	545	0	121	242	1,029	**15,079**	30	3179
	±SE	*1,271*	*266*	*344*	*57*	*140*	*0*	*33*	*63*	*0*	*0*	*0*	*0*	*789*	*0*	*256*	*0*	*68*	*100*	*336*	***1,627***	*33*	*637*
	2017	11,874	0	182	1,458	0	0	0	182	0	0	0	0	2,156	0	2,976	0	182	121	1,033	**20,165**	61	3189
	±SE	*1,576*	*0*	*128*	*690*	*0*	*0*	*0*	*127*	*0*	*0*	*0*	*0*	*1,700*	*0*	*1,193*	*0*	*169*	*113*	*223*	***2,719***	*56*	*1330*

Table 5. Summary of western Washington breeding waterfowl population survey (2010-2017).

North Puget Lowlands	2010	20,220	2,087	2,534	2,981	0	0	9,290	6,459	795	0	0	0	447	0	1,292	0	99	0	99	**46,303**	99	696
	±SE	*1,760*	*710*	*1,117*	*1,353*	*0*	*0*	*5,424*	*2,446*	*351*	*0*	*0*	*0*	*130*	*0*	*429*	*0*	*66*	*0*	*66*	***6,513***	*46*	*253*
	2011	10,026	375	2,592	6,820	0	239	2,933	2,183	0	0	0	68	1,057	0	1,091	0	784	68	614	**28,850**	0	1364
	±SE	*2,061*	*205*	*1,804*	*4,074*	*0*	*236*	*1,490*	*1,674*	*0*	*0*	*0*	*68*	*600*	*0*	*476*	*0*	*388*	*68*	*215*	***5,479***	*0*	*430*
	2012	11,034	532	199	399	0	66	66	798	266	0	0	665	931	0	1,363	0	332	0	1,130	**17,781**	0	2626
	±SE	*1,515*	*321*	*194*	*250*	*0*	*67*	*68*	*645*	*198*	*0*	*0*	*648*	*478*	*0*	*346*	*0*	*204*	*0*	*439*	***1,991***	*0*	*571*
	2013	7,869	150	449	1,107	60	0	539	180	748	0	0	0	60	60	479	0	209	0	1,316	**13,224**	0	1316
	±SE	*1,692*	*74*	*306*	*695*	*60*	*0*	*478*	*176*	*753*	*0*	*0*	*0*	*42*	*56*	*244*	*0*	*110*	*0*	*463*	***2,137***	*0*	*348*
	2014	9,664	60	180	2,693	120	0	0	1,885	359	0	0	329	180	0	509	0	2,513	120	957	**19,567**	0	3022
	±SE	*1,955*	*59*	*92*	*2,594*	*75*	*0*	*0*	*695*	*312*	*0*	*0*	*266*	*147*	*0*	*283*	*0*	*1,956*	*114*	*344*	***3,908***	*0*	*1238*
	2015	13,673	1,107	2,992	6,403	838	60	120	1,795	598	0	0	120	987	60	1,047	30	778	30	1,137	**31,773**	0	4488
	±SE	*3,393*	*517*	*1,581*	*3,689*	*433*	*56*	*83*	*955*	*504*	*0*	*0*	*113*	*319*	*60*	*524*	*29*	*541*	*29*	*312*	***5,481***	*0*	*1379*
	2016	8,467	419	60	449	299	0	0	0	359	0	0	0	90	0	180	0	658	120	987	**12,087**	0	2005
	±SE	*419*	*268*	*60*	*251*	*310*	*0*	*0*	*0*	*301*	*0*	*0*	*0*	*64*	*0*	*122*	*0*	*494*	*73*	*376*	***2,427***	*0*	*673*
	2017	14,121	1,526	1,556	5,266	60	239	0	1,137	419	0	0	120	60	0	1,915	0	898	120	1,556	**28,991**	180	3411
	±SE	*2,682*	*828*	*1,012*	*3,207*	*61*	*157*	*0*	*842*	*359*	*0*	*0*	*122*	*62*	*0*	*653*	*0*	*469*	*79*	*320*	***4,563***	*130*	*1695*
Total - Western Washington	2010	35,526	2,087	4,268	2,981	0	0	10,992	8,029	795	0	0	232	1,159	0	4,763	0	285	0	381	**71,498**	146	7112
	±SE	*2,436*	*710*	*1,421*	*1,353*	*0*	*0*	*5,485*	*2,510*	*351*	*0*	*0*	*163*	*326*	*0*	*655*	*0*	*146*	*0*	*149*	***6,884***	*61*	*3221*
	2011	24,961	1,124	5,010	11,325	60	591	4,397	5,416	0	0	0	126	4,581	0	4,257	0	1,193	188	1,459	**64,688**	180	3969
	±SE	*2,670*	*607*	*2,454*	*4,533*	*55*	*339*	*1,652*	*3,606*	*0*	*0*	*0*	*90*	*1,312*	*0*	*879*	*0*	*524*	*103*	*530*	***7,279***	*96*	*695*
	2012	32,989	1,832	3,223	4,180	0	66	66	2,457	541	0	0	1,110	6,511	0	5,047	0	554	285	2,303	**61,166**	30	7925
	±SE	*4,256*	*933*	*983*	*2,160*	*0*	*67*	*68*	*1,017*	*294*	*0*	*0*	*708*	*1,899*	*0*	*793*	*0*	*266*	*115*	*533*	***5,555***	*28*	*1384*
	2013	24,845	1,169	1,185	6,561	171	155	775	3,866	748	0	0	505	2,968	119	5,075	0	394	302	2,634	**51,470**	158	6394
	±SE	*2,722*	*795*	*632*	*2,182*	*103*	*112*	*501*	*2,130*	*753*	*0*	*0*	*471*	*1,120*	*78*	*889*	*0*	*171*	*148*	*560*	***4,607***	*149*	*1503*
	2014	25,742	828	2,247	4,584	120	0	92	3,470	419	0	0	536	1,398	63	3,015	0	2,956	798	2,603	**48,869**	210	10101
	±SE	*2,604*	*616*	*1,457*	*3,022*	*75*	*0*	*95*	*1,036*	*318*	*0*	*0*	*354*	*478*	*58*	*750*	*0*	*1,961*	*305*	*419*	***4,964***	*117*	*1975*
	2015	30,618	1,581	3,722	9,454	1,420	238	210	2,407	598	0	0	1,944	2,337	60	2,241	30	1,331	211	3,265	**61,668**	211	10782
	±SE	*3,966*	*566*	*1,678*	*4,356*	*631*	*132*	*109*	*997*	*504*	*0*	*0*	*1,105*	*494*	*60*	*618*	*29*	*599*	*135*	*554*	***6,485***	*123*	*1791*
	2016	26,634	1,637	641	2,330	659	0	30	61	359	0	0	0	3,194	0	1,283	0	1,089	612	2,664	**41,192**	94	6791
	±SE	*2,935*	*599*	*385*	*1,258*	*365*	*0*	*33*	*63*	*301*	*0*	*0*	*0*	*861*	*0*	*388*	*0*	*589*	*183*	*566*	***3,539***	*69*	*1097*
	2017	34,981	1,689	2,580	10,154	60	239	2,194	3,849	1,374	0	0	120	4,074	0	6,947	0	1,254	367	3,894	**73,777**	240	7272
	±SE	*3,406*	*838*	*1,106*	*3,749*	*61*	*157*	*1,562*	*1,910*	*986*	*0*	*0*	*122*	*1,756*	*0*	*1,515*	*0*	*509*	*197*	*444*	***6,369***	*141*	*2169*

Table 6. Weighted duck brood indices by species for the Potholes, Palouse, and Northeast strata, 2004-2017.

																% change from	
Species	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**02-16 Avg**	**2016**	**Average**
Mallard	1260	1284	1221	1200	1786	1419	1416	1035	1042	966	1597	2706	1017	1812	1277	1403	-30%	-9%
Gadwall	299	116	15	107	132	292	87	87	379	274	284	204	383	255	0	194	-100%	-100%
Wigeon	170	95	146	54	54	48	43	10	35	26	26	0	0	26	26	51	0%	-49%
Green-winged teal	158	14	26	118	94	151	183	176	233	272	244	204	179	51	26	142	-49%	-82%
Blue-winged teal	212	92	26	15	0	42	48	0	30	47	101	26	51	26	26	49	0%	-47%
Cinnamon teal	48	24	40	14	103	91	14	138	30	82	0	13	102	0	0	47	0%	-100%
Northern shoveler	238	63	0	29	15	59	44	49	19	19	19	0	25	0	0	39	0%	-100%
Northern pintail	158	20	0	0	0	0	0	0	0	14	0	0	0	0	0	13	0%	-100%
Wood duck	14	42	33	82	107	28	28	42	33	112	141	153	77	255	306	97	20%	216%
Redhead	267	40	0	121	211	252	154	94	184	210	205	383	383	204	0	180	0%	-100%
Canvasback	128	26	15	65	26	90	0	32	0	77	14	51	51	0	0	38	0%	-100%
Scaup	82	0	0	20	14	21	94	17	34	0	26	102	76	26	51	37	96%	36%
Ring-necked duck	26	85	0	108	26	50	14	86	23	14	26	51	77	0	26	41	0%	-36%
Goldeneye	26	266	163	438	444	412	331	275	391	231	138	332	255	204	230	276	13%	-17%
Bufflehead	26	0	26	0	40	14	24	43	14	26	179	0	0	0	0	26	0%	-100%
Scoter	0	0	0	0	0	0	0	0	0	0	26	0	0	0	0	2	0%	-100%
Ruddy duck	167	86	110	201	222	219	183	104	86	218	298	332	492	179	179	205	0%	-13%
Merganser	14	15	0	128	204	77	77	65	56	40	82	102	154	204	128	90	-37%	43%
TOTAL BROODS	3089	3166	1819	4085	3477	3265	2741	2253	2588	2626	3402	4749	3322	3242	2275	3073	-30%	-26%

Table 7. Weighted duck brood indices for E. Washington strata and total unweighted brood counts for the Columbia Basin.

Year	Channeled Scablands	Okanogan	Northeast	Palouse	Total Broods	Columbia Basin
1979	6274	420	868	195	7757	
1980	2598	936	715	33	4281	
1981	4435	1041	485	98	6059	
1982	2296	1131	1123	423	4973	
1983	3349	1080	715	293	5437	
1984	4806	1123	791	195	6915	
1985	6133	1614	1123	325	9196	
1986	4743	965	842	293	6843	
1987	4574	1206	1072	325	7177	
1988	1557	1112	749	434	3851	
1989	2395	1023	894	358	4669	
1990	1099	946	894	130	3068	
1991	246	472	1506	130	2355	
1992	317	434	1021	390	2163	
1993	1232	590	613	390	2825	
1994	2587	672	928	130	4316	
1995	555	504	689	195	1943	160
1996	3922	554	945	228	5649	218
1997	1703	1345	1864	184	5095	179
1998	5193	1837	894	163	8086	279
1999	2816	1362	715	163	5055	170
2000	2898	239	536	163	3836	192
2001	2993	423	715	65	4196	167
2002	2360	139	460	65	3024	137
2003	2011	295	919	65	3291	164
2004	440	905	791	130	2266	147
2005	328	482	945	65	1819	178
2006	450	986	1200	65	2701	No survey
2007	435	984	1864	195	3477	160
2008	945	1413	842	65	3265	61
2009	860	1160	689	33	2741	64
2010	703	854	664	33	2253	51
2011	1155	890	511	33	2588	61
2012	1018	731	842	98	2626	78
2013	1111	1376	817	No Survey	3402	47
2014	759	1633	918	No Survey	3310	76
2015	357	1889	970	26	3242	81
2016	859	787	868	195	2709	13
2017	690	860	895	176	2341	14
LTA	2133	934	895	177	4123	123
2017 vs. 2016	-20%	9%	3%	-10%	-14%	8%
2017 vs. LTA	-68%	-8%	0%	0%	-43%	-89%

Table 8. Goose nest survey areas in Washington.

Survey Area	Year Survey Initiated	Agency Conducting Survey	Frequency of Survey
UPPER COLUMBIA			
Hanford	<1974	WDFW	Biennial
Priest Rapids	<1974	WDFW	Biennial
Wanapum	<1974	WDFW	Periodic
Rocky Reach	1975	Chelan Co. PUD	Annual
Rock Island	<1974	Chelan Co. PUD	Annual
Wells	1980	WDFW	Annual
F.D.R.	1981	WDFW	Periodic
Rufus Woods	1981	Army Corps	Annual
Mouth of Yakima	<1974	WDFW	Biennial
SNAKE RIVER			
Snake River	1975	Army Corps	Annual
Snake River Cliff	1979	Army Corps	Discontinued
MID COLUMBIA			
McNary	<1974	USFWS	Discontinued
John Day	<1974	Umatilla NWR	Biennial
Dalles	<1974	Army Corps	Periodic
Bonneville	1982	Army Corps	Periodic
Tri-Cities	1982	WDFW	Biennial
COLUMBIA BASIN			
Moses Lake	1981	WDFW	Biennial
Potholes Res.	1981	WDFW	Biennial
Lenore, Alkali, Park	1981	WDFW	Periodic
LOWER COLUMBIA			
I-5 to Bonneville	1981	Army Corps	Periodic
I-5 to Puget Island	1981	WDFW	Annual, Biennial starting in 2012

Table 9. Number Canada goose nest counted per region (1974-2017), and total Canada geese observed on duck surveys.

	Canada Goose Nests							Total Geese observed during breeding duck surveys		
Year	Upper Columbia	Snake River	Mid Columbia	Columbia Basin	E WA Total	Lower Columbia	TOTAL	E WA Ground	E WA Aerial	W WA Aerial
1974	279		363		642		642			
1975	297	50	344		691		691			
1976	310	51	345		706		706			
1977	358	51	384		793		793			
1978	329	51	330		710		710			
1979	303	87	292		682		682	2570		
1980	393	112	339		844		844	1925		
1981	500	145	318	249	1212	14	1226	4053		
1982	509	160	480	484	1633	15	1648	1203		
1983	656	171	520	541	1888	15	1903	3225		
1984	618	132	466	601	1817	15	1832	2305		
1985	630	150	500	757	2037	131	2168	6674		
1986	641	136	507	765	2049	73	2122	5225		
1987	745	130	670	702	2247	354	2601	7938		
1988	794	229	723	742	2488	353	2841	5426		
1989	799	227	627	500	2153	527	2680	5605		
1990	808	180	634	518	2140	527	2667	16695		
1991	923	199	637	414	2173	645	2818	8483		
1992	916	236	633	538	2323	531	2854	9483		
1993	858	319	629	628	2434	664	3098	9190		
1994	806	290	662	595	2353	589	2942	9396		
1995	929	261	702	477	2369	600	2969	15017		
1996	944	236	777	501	2458	544	3002	12758		
1997	798	210	711	676	2395	575	2970	13019		
1998	744	210	693	610	2257	522	2779	11199		
1999	783	187	811	315	2096	462	2558	22598		
2000	797	207	816	313	2133	424	2557	23449		
2001	790	214	835	539	2378	496	2874	13307		
2002	751	199	872	629	2451	449	2900	17179		
2003	793	199	782	374	2148	450	2598	17596		
2004	728	199	782	350	2059	478	2537	19137		
2005	626	199	689	584	2098	468	2566	13022		
2006	593	248	753	544	2138	499	2637	19253		
2007	489	217	734	442	1882	422	2304	13244		
2008	451	197	727	485	1860	454	2314	16342		
2009	461	243	749	594	2047	422	2469	14858	25364	
2010	493	241	750	544	2028	403	2431	12014	12782	
2011	499	259	725	599	2082	415	2497	16511	20993	4045
2012	462	255	728	628	2073	412	2485		28347	8231
2013	549	199	803	687	2238	412	2650		26577	6394
2014	508	263	814	624	2209	376	2585		38832	10101
2015	593	263	891	762	2509	376	2885		33347	10782
2016	584	263	891	731	2469	376	2845		24678	6791
2017	**567**	**263**	**833**	**731**	**2394**	**376**	**2770**		**29390**	**7272**
2017 vs. 2016	-3%	0%	-7%	0%	-3%	0%	-3%		19%	7%
Long Term Avg.	624	192	638	557	1916	402	2253		26365	7724
2017 vs. LTA	-9%	37%	31%	31%	25%	-7%	23%		11%	-6%

Waterfowl: Winter Populations and Harvest Status and Trend Report

STATEWIDE

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Introduction

This report summarizes the 2016-17 Washington winter waterfowl surveys, hunting regulations, harvest, and hunter trends. This summary compares current data with data collected over the past 30 years in the state as well as the Pacific Flyway. These data are part of a long-term database archived by the Washington Department of Fish and Wildlife (WDFW) Waterfowl Section. Several of the data sets extend back to the late 1940s.

Population Surveys

Methods

Traditionally the primary assessment to determine status of wintering waterfowl throughout the Pacific Flyway was the January Midwinter Waterfowl Survey (MWS). This was a coordinated, comprehensive survey of the most important waterfowl wintering areas, using a combination of standardized surveys from fixed-winged aircraft and ground observation locations. The MWS combined efforts among several agencies, including WDFW, Oregon Department of Fish and Wildlife (ODFW), California Department of Fish and Wildlife, Yakama Nation, United States Fish and Wildlife Service (USFWS), and Canadian Wildlife Service. WDFW and USFWS refuge staff continue to conduct portions of the MWS in Washington, with particular emphasis related towards brant, snow geese and swans.

WDFW also conducts special winter surveys focused on sea ducks during December and January, as part of the Puget Sound Ecosystem Monitoring Program (PSEMP). Consistent winter aerial surveys of greater Puget Sound began in 1993-94, and have been conducted each subsequent year (except for 2006-07, due to funding limitations). Survey methods have been peer reviewed by a science panel as part of PSEMP. These surveys sample the entire marine shoreline and open water areas using six depth strata. The transects annually cover 7% to 8% of the marine waters in Puget Sound and the Strait of Juan de Fuca, totaling 6,400-7,100 km of transects. Wintering population estimates from these surveys represent minimum estimates as observers are not able to detect all birds present within the transect strip, due to environmental conditions (e.g., glare, waves) and reactions of some species to aircraft (e.g., diving, flight).

Because the MWS does not capture migration peaks or patterns of habitat use throughout the fall/winter, additional fixed-wing and ground surveys take place in key wintering areas from October–March. Specific age structure surveys also take place in the north Puget Sound area for brant, snow geese, and swans, along standard ground observation routes.

Midwinter Waterfowl Survey Results

Beginning in 2016, the USFWS discontinued the Pacific Flyway midwinter index for total waterfowl. Changes in operational priorities for USFWS created the need for states to conduct surveys individually, leaving Washington, California, and Montana as the only Pacific Flyway states to conduct midwinter surveys.

WDFW staff attempted surveys in January 2017, however weather prevented a complete survey in eastern Washington and in portions of western Washington. Yakama Nation personnel completed the Yakima Basin survey in January 2017. In western Washington, 38 individuals including WDFW staff, USFWS refuge staff from Ridgefield NWR, Washington Maritime NWR Complex, Willapa NWR Complex, with the assistance of many volunteers, covered 266 survey sites. The midwinter index for total waterfowl from 2007-2017 is in Table 1.

Ducks

In Washington, the 2017 total wintering waterfowl population was 680,201, down 15% from 2016 levels and 16% below the 10-year average (Fig. 2). The Washington total duck count has represented 13.5% of Pacific Flyway index over the 10-year average from 2005-15 (Fig. 3). The 1991 MWS represents the highest proportion of Washington ducks to total Pacific Flyway (28.6%).

The total number of mallards counted in Washington in 2017 was 194,071, a 15% reduction from the previous year, and 39% below the 10-year average (Table 1). Washington typically holds a high percentage of the Pacific Flyway mallard population with a 10-year average from 2005-15 of 41% (Fig. 4).

Results for special Puget Sound winter surveys through 2016 are presented in Table 2. The current 3-year average for scoters is 55,407, which has declined significantly from the 1994-96 peak average of 107,214. Survey results from 2017 were still be processed at the time of writing.

Canada geese

Canada geese are not well represented in midwinter surveys as they forage in widespread agricultural areas, making them difficult to locate during aerial surveys. Wintering Canada goose numbers began to build in the 1990s, when the MWS first indexed over 400,000 geese.

The number of Canada geese wintering in Washington has been variable over the past 20 years. Canada geese numbered over 90,000 during the winter of 1998-99 and 2000-01. The 2016 total of 24,863 was down 28% from 2015 and 43% below the 10-year average (Table 1, Fig. 5), however portions of eastern Washington were not able to be surveyed.

Snow geese

The northern population of snow geese that over-winter in Skagit, Snohomish, and Island counties of NW Washington and the Fraser River Delta, B.C. nest primarily on Wrangel Island, Russia. Juvenile snow geese comprised 33.4% of the wintering population in the Fraser and Skagit River Deltas in December 2016. MWS snow goose aerial photo counts by WDFW in late December 2016 numbered 103,617. This represents a 27.6% increase over the December 2015 count of

81,195 and 27.6% above the 10-year average (Table 3, Fig. 6). Reports from the Wrangel Island Tundra River colony indicated an increase in juvenile recruitment and survival in 2017.

Brant

The number of brant counted in Washington during the 2016 midwinter survey was 13,409, a 14% increase from 2015, but 22% below the 10-year average (Table 1, Fig. 7). The number of brant counted during the northern Puget Sound midwinter aerial survey on December 30, 2016 was 6,359; an decrease of 12.5% from 2015. The largest concentrations of brant were in Lummi, Padilla, and Samish bays.

Breast color measurements were again taken from brant at Skagit County check stations in 2015-16. Of sampled brant, 68.1% of harvested birds (*n*=91) were gray-bellied (WHA) brant (Mansell 4-8). Since 2006, the WHA harvest composition has ranged from 21% to 79%. Additionally, feather samples were collected from juvenile WHA and black brant to assess breeding origin (arctic versus Yukon-Kuskokwim Delta) using stable isotope analyses; results are being analyzed and will be available for next year's report.

Swans

The 2016 northern Puget Sound (Skagit, Whatcom, Snohomish, King, and Island counties) trumpeter swan MWS totaled 17,644 (Table 3), a 2% increase from the 2015 count of 13,473. Juveniles accounted for 15.0% of the trumpeters observed (Table 3).

The 2016 northern Puget Sound tundra swan midwinter index was 588, down 71% compared to the 2015 index (2,047). Juveniles represented 14.1% of the population (Table 3). These lower counts were likely influenced by sustained cold conditions in the northern Puget Sound region during 2016.

Since 1999, trumpeter swans and, to a lesser degree, tundra swans wintering in northwestern Washington and southwestern British Columbia have experienced high rates of mortality due to ingestion of lead shot pellets. Of the 2,332 carcasses collected from 2000-2011, the majority of deaths were lead-related (66%). An average of 18 lead and 7 steel pellets were recovered per gizzard of lead-exposed swans (n=1,736 gizzards, 43,767 pellets). From 2001-2005, a total of 315 trumpeter and tundra swans were trapped and blood samples collected for lead residue analysis. Trumpeter swans were outfitted with VHF radio transmitters (*n*=243) or satellite transmitters (*n*=6); 61 tundra swans were fitted with neck collars. Locations of radio-tagged swans were used to identify primary forage and roosting areas. Judson Lake, a major roost site on the Washington/British Columbia border, was identified as a potential source of lead shot ingestion. During the winters of 2006-2009, active hazing activities discouraged swans from using the lake, which coincided with an approximate 70% reduction in lead-caused swan mortalities during the first 3 winters (average 67 lead-related mortalities in 2006-09) when compared to the average of 227 lead-related mortalities per year over the previous five years (2001-06). Starting in 2009, hazing at Judson Lake focused on the area of highest lead shot concentration. Bamboo poles and fencing prevented swans from landing in the exclusion area, while allowing them use of about 50% of the lake. The barrier system was successful in excluding swans without an appreciable increase in lead related swan mortality or any swan injuries due to the barrier system.

However, know trumpeter swan mortalities increased to 374 in 2014-15 with 203 (54%) showing signs of lead poisoning. Necropsy results are pending.

Periodic Aerial Survey Results

Aerial waterfowl surveys in northern Puget Sound were accomplished by WDFW. Surveys in the Columbia Basin were conducted cooperatively between WDFW and Yakama Nation biologists (Table 3).

North Puget Sound

The North Puget Sound January 2017 aerial survey totaled 208,475 dabbling ducks. The record high count for this area took place in December 2006 (n=974,180). Waterfowl frequently move between the Fraser River Delta and Boundary Bay, B.C. depending on weather conditions, resulting in high variability in the North Puget Sound survey.

Eastern Washington

MWS results for eastern Washington were incomplete due to weather issues and equipment failures. Results of other periodic surveys in the Columbia and Yakima basins are presented in Table 3.

Long-term monitoring of small Canada geese (Lesser and Taverner's) staging on Stratford (Brooke) Lake and Round Lake has taken place since the early 1970s. These lakes are located near the town of Stratford in central Grant County. Both lakes are on private property and are not hunted. Population trends of Washington's small Canada geese have not been well documented because they forage in widespread agricultural areas and are mixed with other subspecies, making them difficult to survey from the air. October staging surveys were originally aerial counts but switched to ground counts in 2006. Survey results (1976-2015) are presented in Figure 8, with 9,338 counted in 2015. The highest historical count was 80,050 in 1984. This population is of concern due to past high harvest return rates of geese in the Columbia Basin that were banded in Alaska. It is thought the very low counts in 2014 and 2015 are a result of the implementation of a new water feed route through the lakes that has eliminated many of the preferred staging areas for small Canada geese. Surveys were not conducted in 2016 as cold weather had frozen both lakes. It is not known at this time where these populations may have shifted.

Hunting Season Regulations

The 2016-17 waterfowl harvest was regulated under Washington State regulations following federal framework recommendations (Table 4). The federal framework allowed the maximum (107 days) number of days under the Migratory Bird Treaty Act. Washington's season length was 105 days statewide with two additional days for the statewide Youth Hunt on Sept. 17-18. The daily bag-limit was 7 ducks, to include not more than 2 hen mallard, 2 pintail, 3 scaup, 2 canvasback, and 2 redhead statewide; and to include not more than 1 harlequin (season limit), 2 scoter, 2 long-tailed duck, and 2 goldeneye in western Washington (Table 4).

Substantial waterfowl populations in the Pacific Flyway over the last 15 years have allowed for liberal seasons and bag limits (Table 5). The season lengths between 1988-89 and 1993-94 were the most restrictive since 1950. Current regulations are among the most liberal ever offered in

Washington and beginning with the 2014-15 season hunters could retain three times the daily bag in their possession for most waterfowl (Table 5).

WDFW instituted a new license format for the 1999-00 hunting season. A small game license and big game license replaced a general hunting license. For people who hunted a variety of small game species, there was little change in total costs. For people who hunted waterfowl exclusively, the new format resulted in an increase in cost. Before the 2002-03 hunting season, the cost of a migratory bird validation increased from $6.00 to $10.00 (excluding transaction and dealer fees). A 10% surcharge was added to all WDFW licenses in 2009-10 and 2010-11. The validation was replaced with a migratory bird permit in 2011, and the cost was $17.00 in 2015. Beginning in 2011-12, hunters of brant and snow geese in Goose Management Area 1, sea ducks in western Washington, and all geese in SW Washington were required to purchase a special $13.20 migratory bird authorization to obtain harvest record cards for these species (harvest record cards were free prior to this implementation). The federal migratory bird stamp increased to $25.00 in 2015 (Table 5).

Goose hunting regulations are structured to protect declining populations of Canada goose subspecies, increase recreational opportunities on expanding populations of Canada geese, simplify regulations, and address damage/nuisance complaints. The number of goose management areas remained at 5 for 2016-17 (Fig. 9).

Prior to 1984, the goose season length in southwest Washington was 93 days, with bag/possession limits of 3/6. Since that time, the season has evolved to: 1) conserve the dusky Canada goose subspecies, which has declined in numbers since the 1970s; 2) provide control of agricultural damage resulting from higher numbers of other Canada geese in the area; and 3) provide greater recreational opportunity. Significant changes to the SW goose season in 2015-16 began with the closure of dusky Canada goose hunting. Check stations were expensive to operate and it was believed that significant numbers of hunters failed to report to check stations. Other major changes included; more season days and longer hunting hours, elimination of harvest recording, hunting hours extended to 30 minutes after official waterfowl hunting hours to 30 minutes before the end of official waterfowl hunting hours, and the inclusion of Clark and Grays Harbor counties in permit zones 2A and 2B, respectively. Historic season regulations for SW Washington are presented in Table 6. A special late season damage control hunt initiated in 1995-96 was continued in Area 2A and initiated in Area 2B during 2015-16. For 2016-17 Area 2A and 2B were combined into Area 2. The season was open Saturdays, Sundays and Wednesdays during February 11 – March 8, 2017 and open to all hunters possessing the SW goose authorization. State wildlife areas and National Wildlife Refuge lands remained closed during the late season.

Beginning with the 2015-16 season, the Aleutian goose daily bag limit was eliminated, and Aleutians could be hunted as part of the normal Canada goose limit. Previously listed as both a federal and state endangered species, Aleutian Canada goose populations have experienced strong population growth in recent years and have caused crop and pasture depredation complaints in coastal agricultural areas, mainly in Oregon and California. Daily bag limits and possession limits during the September goose season were increased in Area 4 &5 from 3 and 6 to 5 and 10 respectively. Area 2 retained the previous limits for Area 2B, 5 daily and 15 in possession.

Agricultural depredation by snow geese in Skagit County led to the development of the Snow Goose Quality Hunt Program on Fir Island. Presently, thousands of acres were available as Feel Free to Hunt or Register to Hunt. Numerous complaints of public safety concerns due to unethical snow goose hunting led to special restrictions in Skagit County. Hunters were restricted from discharging a firearm within 100 feet of any paved public road for the purpose of hunting snow geese anywhere in Skagit County. Violation of these rules, trespass, exceeding the snow goose bag limit, or shooting across a paved road resulted in invalidation of the hunter's snow goose authorization for 2015-16 and the subsequent season.

The January-only brant season took place in 2017, with 10 hunt days in Pacific County and 8 days in Skagit County (Table 4). The Skagit County brant hunt is dependent on a pre-season count of at least 3,000 brant, allowing a 3 day season, or more than 6,000 brant, allowing an 8 day season. On December 27, 2016, the Skagit County MWS estimated 2,930 brant. The count was conducted again on January 3, 2017 and estimated 3,828 brant (Table 3). An additional photo count was conducted on December 30, 2016 and estimated a minimum of 6,359 brant allowing the full 8-day season in Skagit County to occur on scheduled dates.

Harvest Surveys

<u>Methods</u>

Harvest estimates were based on the Small Game Harvest Questionnaire sent to 10% of the hunting license buyers. Hunters were asked to report the numbers of ducks and geese they harvested by county. The species composition of the waterfowl harvest was derived from a Daily Waterfowl Harvest Report Card Survey. In this survey, cards were sent to over 2,500 waterfowl hunters prior to the start of the season to record the species of the birds they bagged. These data were used to tabulate the species composition of the waterfowl harvest.

Because statewide surveys are not accurate enough to measure harvest of several priority waterfowl species, special surveys have been developed that utilize written hunting authorizations and mandatory reporting. The sea duck (harlequin, scoter and long-tailed duck), brant, and snow goose harvest is estimated annually using a mandatory harvest report card for each species. Written authorization and harvest reports have been required of sea duck hunters in all of western Washington since 2004, brant hunters in all hunt areas since 1990, and snow goose hunters in the primary harvest area (Skagit, Island, Snohomish counties) since 1993. Hunters must return a harvest report card in order to be included in the permit mailing the following year. Starting in 2012-13, hunters failing to turn in their harvest reports were charged a $10 administrative fee to obtain a harvest report card the following year. Harvest reports returned by the deadline are included in the analysis as the 'first wave' of respondents. Reminder notices are sent out to hunters with email addresses available, reminding them to return reports. Responses received after the reporting deadline are included as the 'second wave', and then the harvest estimates are computed accounting for non-response bias. Hunters were required to report harvest by species and county with mandatory harvest report cards by February 15, 2016.

The harvest of dusky Canada was closed beginning with the 2015-16 season in area 2 during October through March (see above) in agreement with ODFW. With removal of check stations, law enforcement checked hunter bags in area 2 in order to determine compliance and were assisted by WDFW personnel specifically trained in determining goose species. WDFW uses standardized criteria for classifying duskys, where a dusky was classified as a dark-breasted Canada goose (Munsell ≤5) with a culmen length of 40-50 mm.

WDFW continued enhanced goose hunter training for people who wish to hunt geese in Goose Management Area 2. The training program was initially developed in 1996, and revised in 1997 in conjunction with ODFW. In this program, hunters study a goose identification workbook and are advised to view a training video. The study materials, including the video, are available from the WDFW website. The workbook is also available through regular mail from WDFW and the video can be purchased from a vendor. Originally, hunters took a 40 question written test at one of eight testing locations and could choose from several testing dates. In 2007-08, WDFW provided the opportunity to take tests online, and by appointment at WDFW offices. Hunters are required to pass the test with a minimum score of 80%. Hunters who fail the test are required to wait 28 days before retesting. The test was updated in 2015 to reflect the dusky Canada goose season closure. If a hunter takes a dusky Canada goose, or does not comply with field check requirements, the authorization will be invalidated and the hunter is not allowed to hunt geese in Goose Management Area 2A and B for the remainder of that waterfowl season.

Waterfowl Harvest Survey Results

The 2016-17 Washington duck harvest of 470,168 was similar to the 2015-16 harvest of 482,866. The duck harvest in Washington declined steadily from over 1,000,000 in the late 1960s, to a low of 242,516 in 1993-94 (Fig. 10). Duck harvest rates in Washington have stabilized over the past 10 years, averaging approximately 445,000 birds annually.

Mallards comprised 47% of Washington's 2016-17 harvest, followed by American wigeon (14%), American green-winged teal (12%), and northern pintail (6%; Table 7). Likely influenced by the below average cold weather, lesser scaup, greater scaup and ring-necked duck combined to account for 11% of total harvest in 2016-17.

The total Canada goose harvest for 2016-17 was 70,532, nearly identical to the 2015-16 harvest of 70,524. A record low harvest of 26,479 occurred in 2004-05; the record high harvest (72,721) occurred in 2006-07. During recent years, the presence of resident large Canada geese has increased in Washington, which has contributed to an overall increasing trend in harvest (Fig. 11). The highest recorded harvest of small Canada geese in Washington was 47,270 in 1979-80. The lowest harvest (8,880) took place in 2003-04. The reasons for the dynamic small goose harvest are uncertain.

Waterfowl harvest is summarized by WDFW administrative regions in Table 8 and Fig. 12. Region 2 has traditionally represented the highest percentage of the state's waterfowl harvest. However, for the 2016-17 season, Region 4 accounted for 27% of the harvest followed by Region 3 (24%) and Region 2 (21%). The proportion of duck harvest was highest in Region 4 (28%), followed by Regions 3 (24%) and 2 (20%). Region 2 accounted for the highest proportion of goose harvest (26%), followed by Region 3 (25%), and Region 4 (20%).

Mandatory Harvest Reporting Results

Restrictive bag limits for most sea ducks were maintained for western Washington in 2016-17. Concerns about low recruitment rates in sea ducks, increasing interest in sea duck hunting, and the unknown impact of reduced sea duck bag limits on compensatory species, particularly Barrow's goldeneyes, led to the measure. The harvest survey indicated a total harvest of 674 scoters, 49 long-tailed ducks, 111 harlequin ducks and 393 goldeneyes (Fig. 13, Table 9). The reported goldeneye harvest included 60% common goldeneye. From 2,157 authorizations, a total of 1,869 days were hunted representing a 0.66 duck per day success rate. Primary harvest areas included Island, Mason, Skagit, Clallam, Pierce, and Whatcom counties.

The 2016-17 pre-season count of brant in Padilla/Samish/Fidalgo Bays was above the threshold of 6,000, allowing the 8 day January brant season in Skagit County. An estimated 538 brant were harvested, a 7% increase of the estimated 505 harvested during the last 8 day season in 2012-13. Brant hunting was allowed in Pacific county and harvest of brant was 46, 35% above the 2015-16 estimate of 34 (Fig. 14, Table 10). From 1,358 authorizations, a total of 548 days were hunted representing a 1.07 brant per day success rate.

The 2016-17 snow goose harvest was estimated at 6,742, increasing nearly 96% from the 2015-16 harvest of 3,446. Snow goose harvest in Washington with high annual variability (Table 11, Fig. 15) depending on several factors including age and production of the Wrangel Island snow goose flock. In addition, the harvest of snow geese in northern Puget Sound is weather dependent, with high wind events leading to greater harvest. This factor, as well as proportion of juveniles, may be of greater importance to harvest than total abundance, because the erratic annual harvest (Fig. 15) does not follow the number of geese counted in Washington during the MWS (Fig.6). These geese have recently expanded their wintering range in northeastern Washington to portions of Snohomish and King Counties.

In the southwest Washington goose season, hunters who passed the identification test in 1996-2016 and did not take a dusky Canada goose in 2013-16 were authorized to hunt in 2016-17. New hunters and those harvesting duskys in 2015-16 were required to take a new test to obtain an authorization. Hunters were not required to record harvest or report to check stations. A combination of uniformed and undercover officers documented hunter compliance through individual field checks throughout the regular and late seasons. Of 351 geese classified during bag checks (table 12), 11 dusky Canada geese were recorded. Figure 16 shows number and species of geese brought to check stations 1969-2015.

Hunter Numbers and Success

The Washington small game hunter survey was used to estimate the number of waterfowl hunters in the state. During the 2016-17 season, an estimated 22,294 hunters participated in the Washington waterfowl season, down about 8% from 2015-16 (Fig. 17). Following a steep decline in 2002, there has been a stable to slightly decreasing number for the last fifteen years, however migratory bird permit sales (Duck Stamp) have been stable since the early 1990s. Prior to that, there was a steady decline in hunters through the 1980s (Fig. 17). The 2004-05 estimate of Washington waterfowl hunters (23,078) was the previous lowest on record.

The estimated average harvest in 2016-17 was just over 21 ducks per hunter. Hunter success, based on ducks harvested per hunter per year, has been on a consistent upward trend since the mid-1990s (Fig. 18). Therefore, it appears the downward trend in duck harvest (Fig. 10) is more related to hunter numbers (Fig. 17) than decreased annual hunter success. Remembering that total duck harvest has remained stable during this same timeframe, the high success rate may indicate that the state has retained many avid and successful waterfowl hunters, but has found a way to retain the sporadic waterfowl hunter.

Members of the hunting public often believe the decline in hunter numbers is a result of the restrictive regulations that began in the mid-1980s (Table 5). This may have contributed to the reduced hunter participation (Fig. 17), but the downward trend in hunter numbers began in the early 1980s when there was a 7 duck daily bag limit, no special restrictions on mallards and pintails, and season lengths were 93 west and 100 east (Table 5). The decline in hunter numbers is likely a result of changes in social views on hunting, lack of recruitment of new hunters or retention of the occasional waterfowler.

The quality of waterfowl hunting opportunities in Washington is good. Decreased hunter numbers result in lower hunter densities in the field and success has remained stable to increasing. In addition, the state is holding a large percentage of the Pacific Flyway's ducks. Urban encroachment in traditional hunting areas will be one of the biggest challenges faced by waterfowl hunters and managers. Regardless, the value of Washington's waterfowl resources remains high and provides quality hunting recreation for the state's hunting population.

WDFW has recognized a decline of quality hunting opportunities found on public hunting areas. In response, WDFW has developed initiatives to address public hunting opportunities on public and private lands. In 2016-17 there were 6 regulated access areas (RAA) on WDFW lands, including Winchester Ponds, Frenchman Ponds, and North Potholes in Region 2, and Bailie Youth Ranch, Mesa Lake, and Windmill Ranch in Region 3. WDFW also continued the Fir Island Snow Goose Quality Hunt in Region 4 and maintained and expanded a private lands access program for waterfowl hunting in Regions 2, 3, and 4. Some of these programs featured limited access designed to reduce hunter crowding and/or limit waterfowl disturbance (Fig. 19).

Recommendations

- Monitor and evaluate success of quality hunt areas and snow goose quality hunt.
- Provide more visual information related to species identification.
- Evaluate methods to derive better harvest totals for geese in SW Washington.
- Provide summary of mallard and Canada goose band returns.

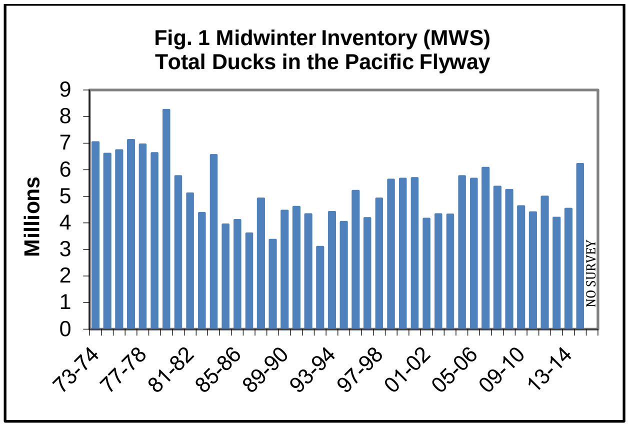


Fig. 1 Midwinter Inventory (MWS) Total Ducks in the Pacific Flyway

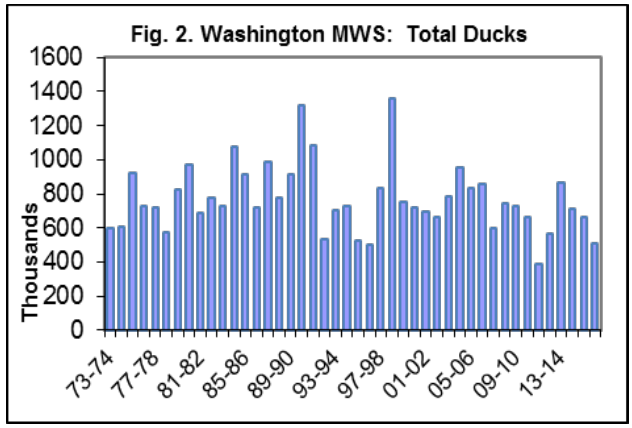


Fig. 2. Washington MWS: Total Ducks

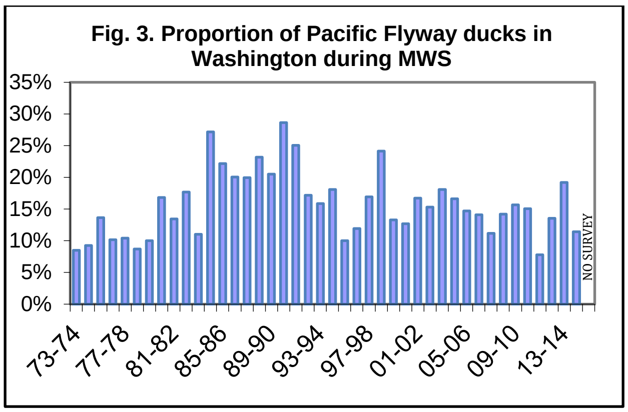


Fig. 3. Proportion of Pacific Flyway ducks in Washington during MWS

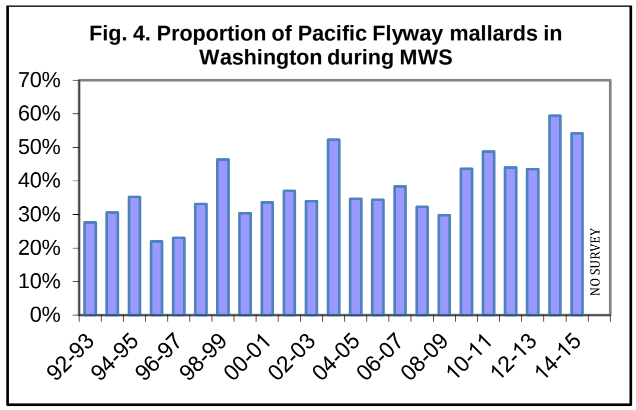


Fig. 4. Proportion of Pacific Flyway mallards in Washington during MWS

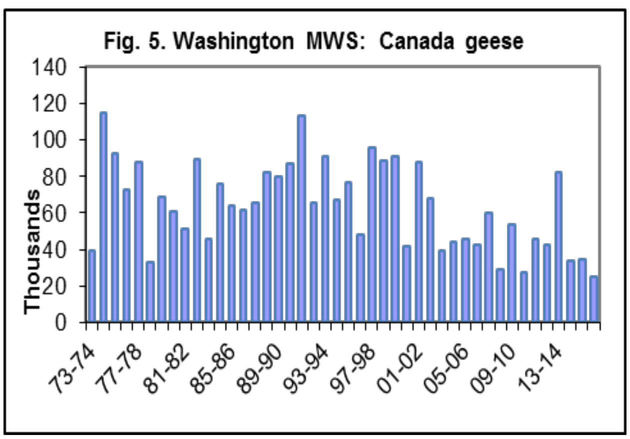


Fig. 5. Washington MWS: Canada geese

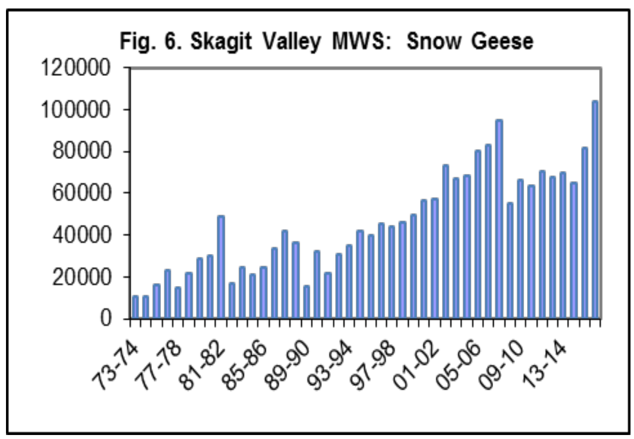


Fig. 6. Skagit Valley MWS: Snow Geese

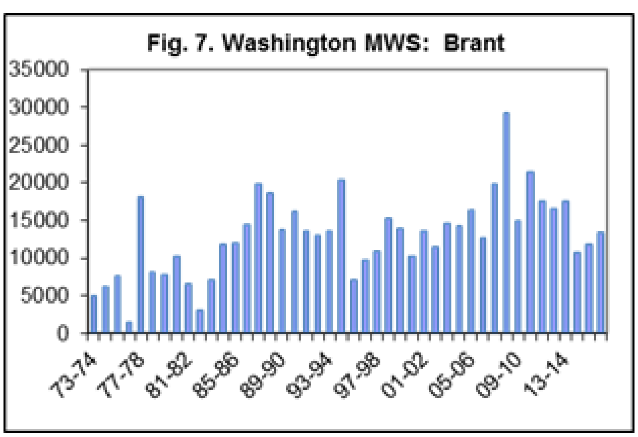


Fig. 7. Washington MWS: Brant

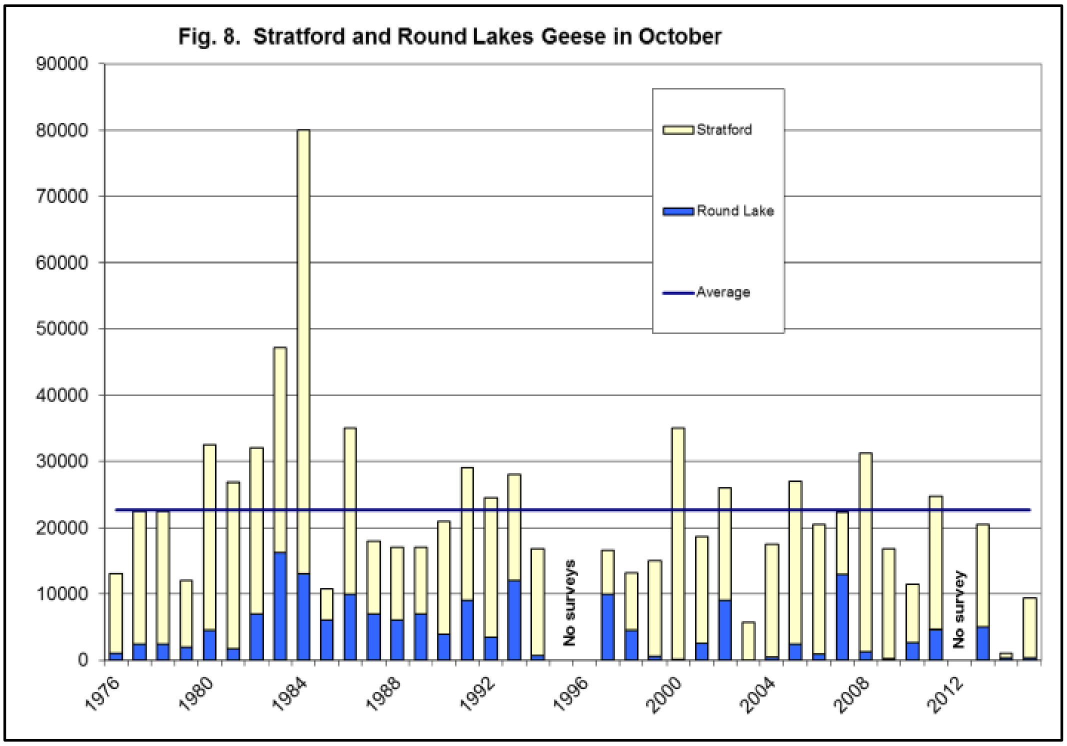


Figure 9. Washington Goose Management Areas.

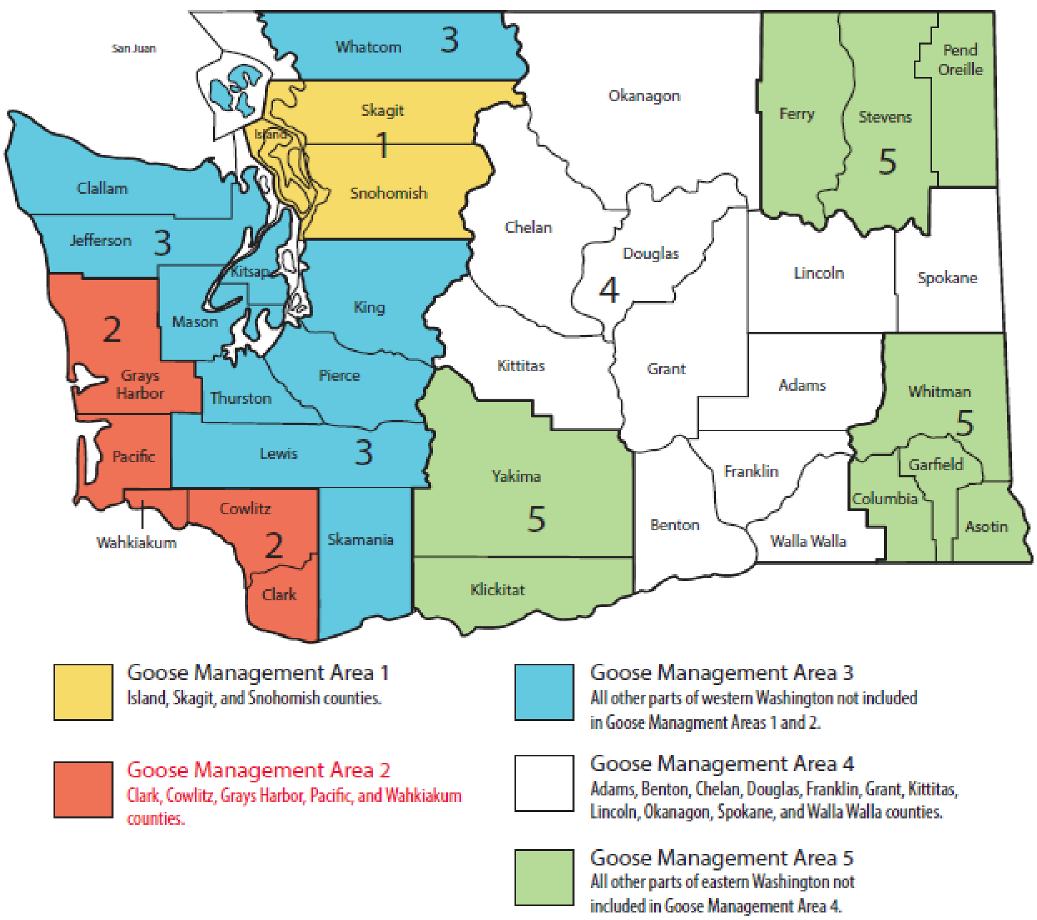


Figure 10. Total harvest of ducks in Washington (1962 – 2017).

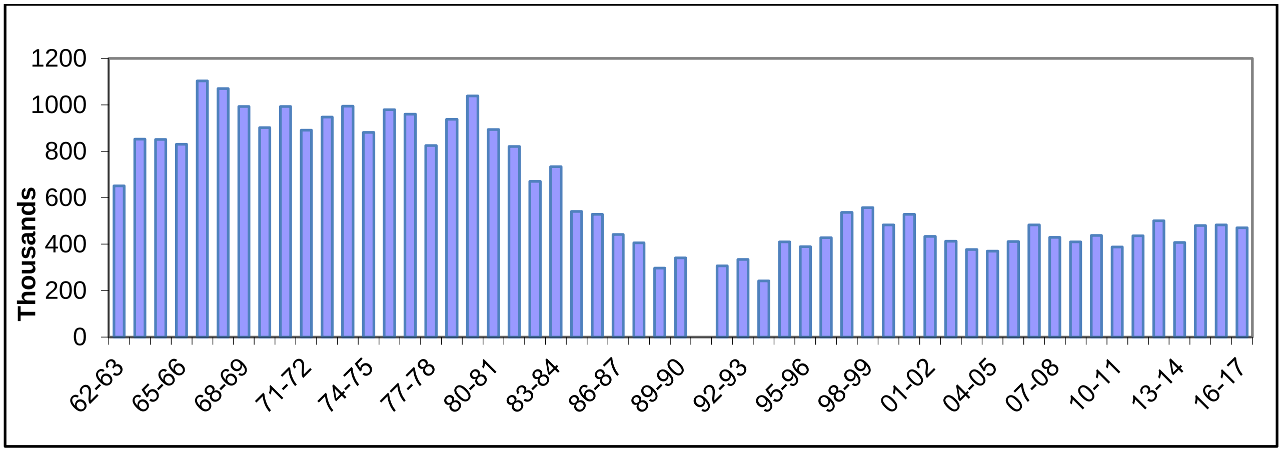
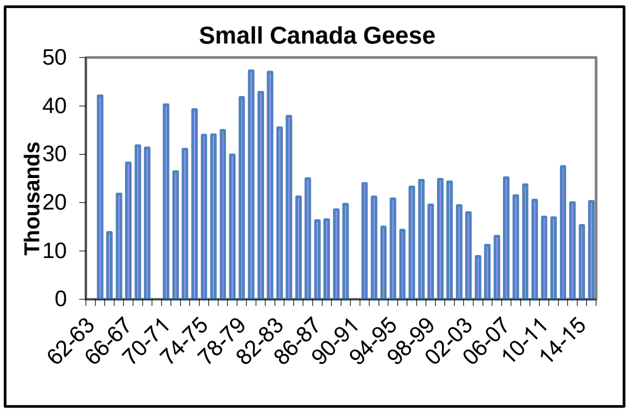
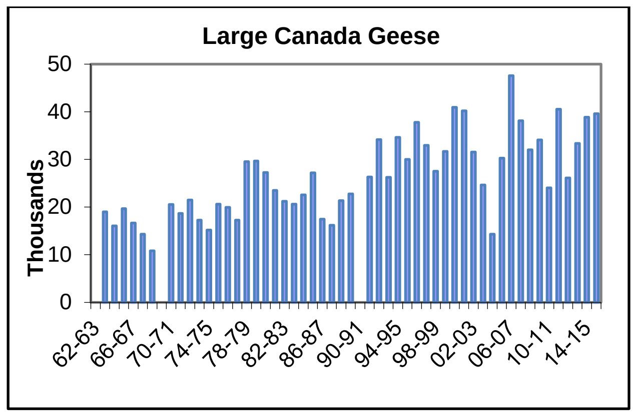
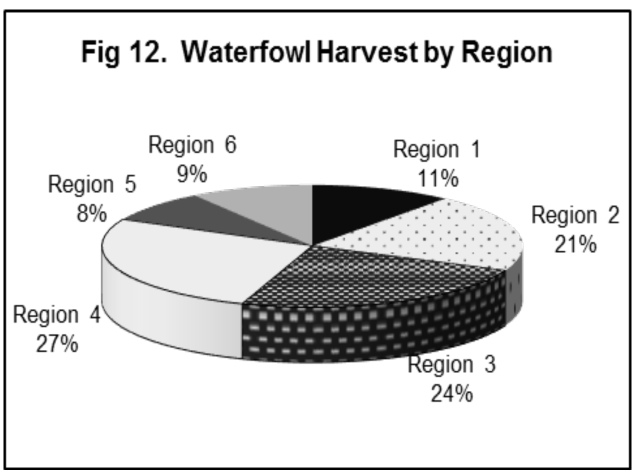
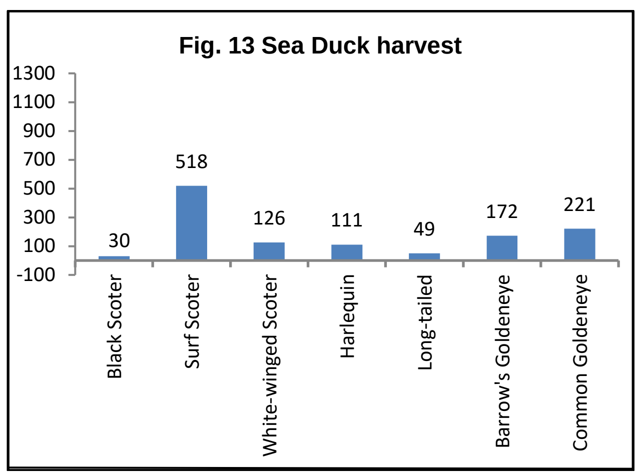


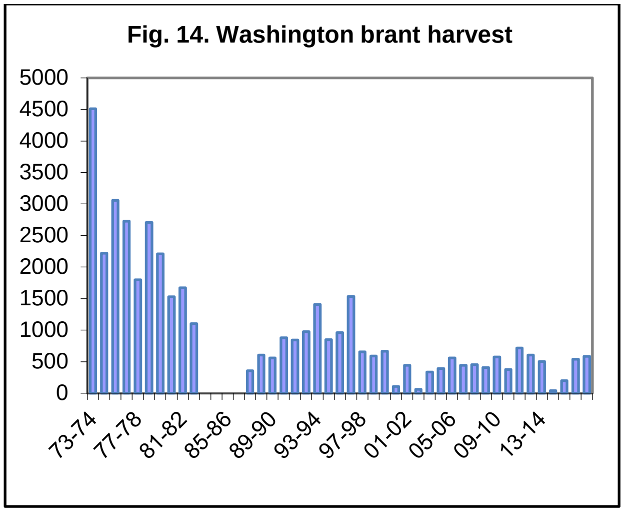
Figure 11. Small and Large Canada goose harvested in Washington (1962-2015).











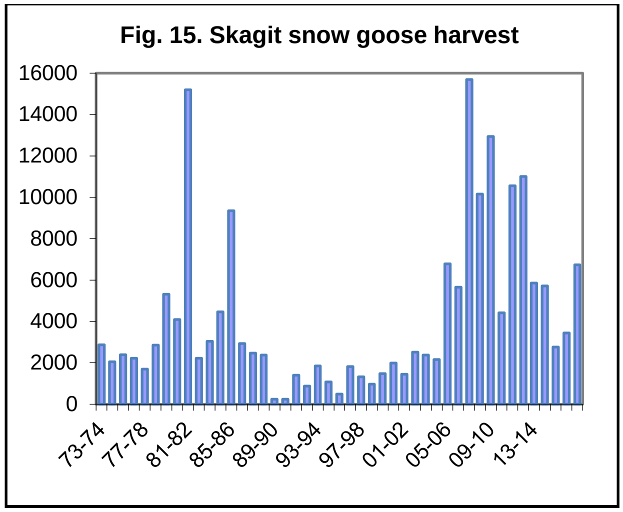
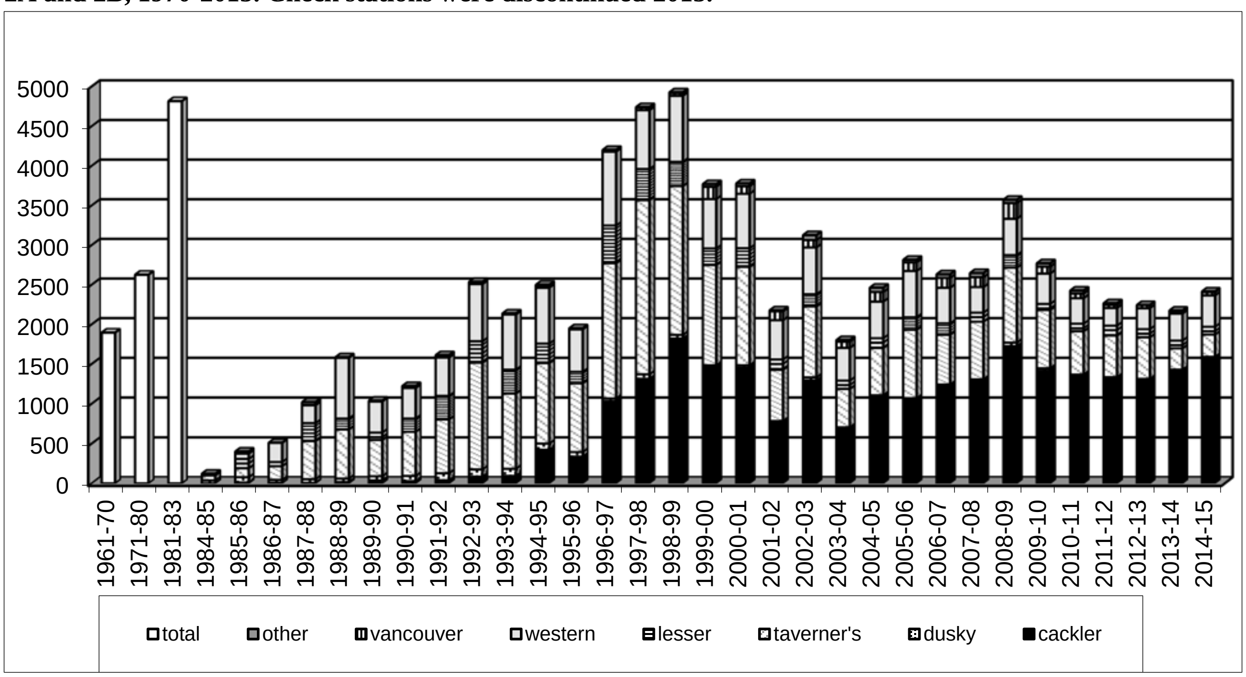
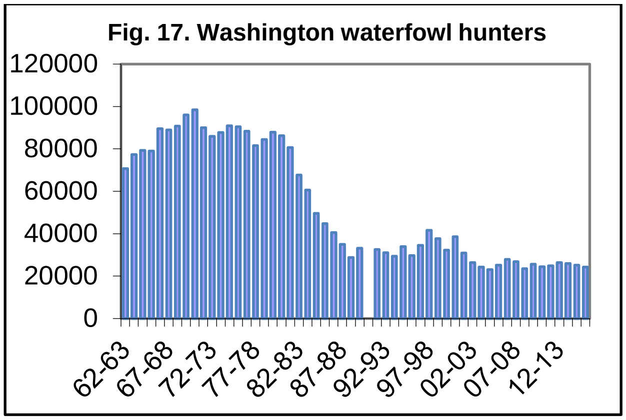


Figure 16. Southwest Washington goose harvest as determined at check stations, Goose Management Areas 2A and 2B, 1970-2015. Check stations were discontinued 2015.





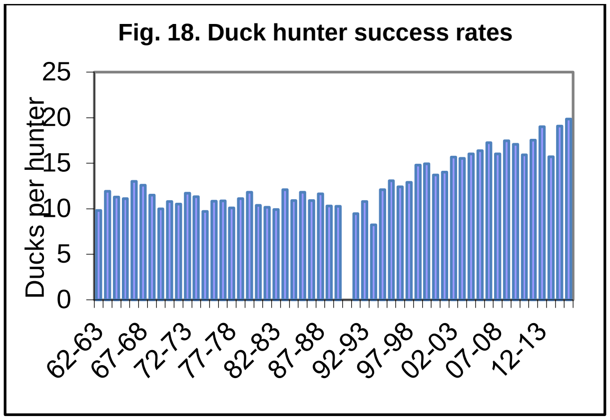


Figure 19. The regulated access program promotes quality hunting opportunities by reducing hunting pressure.

Waterfowl Status and Trend Report 2017

Table 1. Washington Department of Fish and Wildlife Midwinter Waterfowl Survey (MWS) – January 2017.

Species	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	17 vs 16	17 vs. 10yr	07-16avg.
Mallard	494597	313871	254655	405604	349790	282601	254057	529671	381428	227894	194071	-15%	-39%	319364.2
Gadwall	5314	5854	5324	6877	4149	3790	4236	2209	2845	3148	2498	-21%	-39%	4093.0
Wigeon	90734	89614	207236	126059	106149	101072	102264	112831	123440	132633	115949	-13%	-5%	121724.7
Green-winged Teal	30947	15506	15175	11554	18795	16225	8559	14196	22277	36805	12728	-65%	-26%	17182.0
B.W. & Cinn. Teal	272	2	12	20	335	9	3	4	4	19	2	-89%	-95%	41.0
Shoveler	8763	2210	2671	2474	919	5419	2793	3872	2121	3110	3807	22%	30%	2939.6
Pintail	113949	45848	117235	40787	71083	73635	66024	71339	109825	100585	73239	-27%	-5%	76960.0
Wood Duck	99	378	309	1406	501	380	150	9796	220	149	340	128%	-75%	1362.9
Redhead	3645	2443	4668	3550	4015	2501	3226	1132	761	1731	1377	-20%	-46%	2540.4
Canvasback	1501	3790	3239	3789	3148	2157	1528	462	1489	3437	719	-79%	-70%	2375.8
Scaup	29711	35052	40306	43003	31118	49304	52394	41984	42610	67746	59098	-13%	28%	46261.5
Ringneck	12642	16568	19740	8763	5192	5415	3937	5327	8552	12625	19682	56%	86%	10580.1
Goldeneye	13973	15106	15976	14578	14457	11599	13570	10700	10507	13813	8260	-40%	-36%	12856.6
Bufflehead	17511	21230	25510	21609	19451	24019	19830	29131	23964	22594	15261	-32%	-31%	22259.9
Ruddy Duck	2179	3096	1508	1428	1180	2026	1744	2353	2626	4755	1695	-64%	-24%	2241.1
Eider	0	0	0	0	0	0	0	0	0	0	0	0%	0%	0.0
Scoter	15307	16742	12585	10445	11944	13432	13677	13287	14799	14320	922	-94%	-92%	12215.3
Long-tailed Duck	804	504	547	439	663	652	722	867	872	690	95	-86%	-84%	605.1
Harlequin	733	902	670	839	692	1067	918	961	1019	1101	78	-93%	-91%	824.7
Merganser	7443	6377	6523	7894	8775	8302	8262	8771	8834	10239	6303	-38%	-21%	8028.0
Unidentified Ducks	4731	2515	9981	13440	5507	0	2765	9180	2846	5959	885	-85%	-83%	5307.8
Snow Goose*	75141	82583	55016	66176	38976	49699	56973	50354	52023	71714	103617	44%	65%	62713.1
White-fronted Goose	82	42	119	22	113	36	47	24	41	48	35	-27%	-34%	52.7
Canada Goose	42759	60131	28629	53259	26999	45641	42686	82347	33564	34445	24863	-28%	-43%	43256.4
Brant	12712	19775	29243	14895	21457	17502	16454	17485	10706	11811	13409	14%	-22%	17273.7
Tundra Swan**	3548	3570	3380	3211	2544	2247	1652	1171	1767	3654	2108	-42%	-17%	2530.4
Trumpeter Swan**	9104	7747	9852	9457	9984	7603	11043	11623	14225	14201	18334	29%	61%	11406.9
Unknown Swan**	842	292	1100	540	221	1775	2381	3609	2929	1823	826	-55%	-47%	1549.6
Total Waterfowl	**999043**	**771748**	**871209**	**872118**	**758157**	**728108**	**691895**	**1034686**	**876294**	**801049**	**680201**	**-15%**	**-16%**	**808546.5**
Coot	72265	69305	101951	84543	54017	48978	51996	43827	69030	146899	122302	-16%	-45%	79982
B.C. Snow Geese	8007	12276	2495	7788	24285	22265	10225	19633	17309	11954		92%	81%	10837

Table 2. Puget Sound long-term winter survey estimates for sea ducks.

	Scoters					Goldeneye				Bufflehead				Harlequin Duck				Long-tailed Duck				Merganser			
Years	POP	SE	% Change from 2015	% Change from LTA	% Change from 1994-96	POP	SE	% Change from 2015	% Change from LTA	POP	SE	% Change from 2015	% Change from LTA	POP	SE	% Change from 2015	% Change from LTA	POP	SE	% Change from 2015	% Change from LTA	POP	SE	% Change from 2015	% Change from LTA
1994-1996	107,214	5,192	0%	52%	0%	42,872	1,802	0%	50%	62,010	3,429	0%	20%	3,588	310	0%	12%	8,543	882	0%	51%	16,378	1,104	0%	14%
1995-1997	107,625	4,064	0%	52%	0%	39,272	1,903	-8%	37%	65,881	3,352	6%	27%	3,794	320	6%	18%	10,235	1,005	20%	80%	16,804	1,091	3%	17%
1996-1998	93,185	3,567	-13%	32%	-13%	29,250	1,618	-26%	2%	51,913	2,771	-21%	0%	3,867	344	2%	21%	6,836	654	-33%	20%	12,594	585	-25%	-12%
1997-1999	91,080	3,810	-2%	29%	-15%	27,532	1,517	-6%	-4%	46,654	1,434	-10%	-10%	3,535	295	-9%	10%	6,210	555	-9%	9%	11,405	752	-9%	-21%
1998-2000	85,999	3,476	-6%	22%	-20%	26,294	1,195	-4%	-8%	42,322	1,263	-9%	-18%	3,556	331	1%	11%	4,754	232	-23%	-16%	10,424	678	-9%	-27%
1999-2001	84,250	3,241	-2%	19%	-21%	28,959	1,414	10%	1%	48,362	1,617	14%	-6%	3,425	324	-4%	7%	5,995	664	26%	6%	13,594	768	30%	-5%
2000-2002	77,003	2,697	-9%	9%	-28%	28,787	1,446	-1%	1%	45,784	1,585	-5%	-11%	3,349	334	-2%	4%	5,660	658	-6%	0%	13,231	575	-3%	-8%
2001-2003	66,580	2,371	-14%	-6%	-38%	30,125	1,325	5%	5%	54,778	1,720	20%	6%	3,040	266	-9%	-5%	6,345	674	12%	12%	15,379	666	16%	7%
2002-2004	63,613	2,343	-4%	-10%	-41%	29,233	1,322	-3%	2%	53,142	1,454	-3%	3%	3,226	247	6%	1%	4,547	376	-28%	-20%	13,417	576	-13%	-7%
2003-2005	63,000	2,223	-1%	-11%	-41%	28,668	1,203	-2%	0%	55,862	1,394	5%	8%	3,236	221	0%	1%	5,080	384	12%	-10%	14,544	557	8%	1%
2004-2006	67,165	2,497	7%	-5%	-37%	26,314	1,124	-8%	-8%	49,896	1,269	-11%	-4%	3,232	224	0%	1%	4,753	378	-6%	-16%	13,436	518	-8%	-6%
2005-2008	66,790	2,664	-1%	-6%	-38%	25,254	1,070	-4%	-12%	49,353	1,274	-1%	-5%	3,113	192	-4%	-3%	5,028	336	6%	-11%	13,342	561	-1%	-7%
2006-2009	60,548	2,558	-9%	-14%	-44%	25,087	1,188	-1%	-12%	47,910	1,233	-3%	-7%	2,916	186	-6%	-9%	4,491	341	-11%	-21%	12,598	559	-6%	-12%
2008-2010	52,264	2,251	-14%	-26%	-51%	24,853	1,295	-1%	-13%	47,883	1,251	0%	-7%	2,840	174	-3%	-11%	4,542	361	1%	-20%	13,571	643	8%	-6%
2009-2011	44,894	1,523	-14%	-36%	-58%	23,224	1,238	-7%	-19%	44,687	1,170	-7%	-14%	2,341	138	-18%	-27%	4,596	347	1%	-19%	13,446	604	-1%	-6%
2010-2012	46,118	1,405	3%	-35%	-57%	22,266	1,117	-4%	-22%	48,863	1,307	9%	-6%	2,649	145	13%	-17%	4,706	325	2%	-17%	14,380	643	7%	0%
2011-2013	50,075	1,515	9%	-29%	-53%	22,706	1,112	2%	-21%	48,033	1,229	-2%	-7%	2,691	154	2%	-16%	4,795	289	2%	-15%	14,823	858	3%	3%
2012-2014	53,248	2,387	6%	-25%	-50%	24,741	1,311	9%	-13%	56,693	1,452	18%	10%	3,044	180	13%	-5%	5,177	305	8%	-9%	18,176	1,021	23%	27%
2013-2015	54,239	2,664	2%	-23%	-49%	25,604	1,181	3%	-10%	56,805	1,596	0%	10%	3,058	188	0%	-5%	5,275	301	2%	-7%	17,878	1,027	-2%	24%
2014-2016	55,407	2,729	2%	-22%	-48%	25,813	1,211	1%	-10%	56,142	1,680	-1%	9%	3,264	193	7%	2%	5,240	303	-1%	-8%	16,830	829	-6%	17%

Table 3. 2016-17 waterfowl surveys conducted in the Columbia Basin; waterfowl surveys, snow goose photo counts, aerial brant surveys, age-ratio counts conducted in North Puget Sound.

North Columbia Basin	Oct.	Nov.	Dec.	Jan. 12,19
Mallards				27,953
Total Ducks				70,867
Total Geese	No	No	No	2,369
Total Swans	Survey	Survey	Survey	7
Total Coots				34,339
SURVEY TOTAL				135,535

South Columbia Basin	Oct.	Nov. 23	Dec.	Jan. 12,19
Mallards				65,223
Total Ducks				143,882
Total Geese	No	No	No	17,372
Total Swans	Survey	Survey	Survey	30
Total Coots				72,971
SURVEY TOTAL				299,478

Yakima Basin	Oct.	Nov.	Dec.	Feb. 13
Mallards				6,377
Total Ducks				20,915
Total Geese	No	No	No	160
Total Swans	Survey	Survey	Survey	97
Total Coots				0
SURVEY TOTAL				26,845

Northern Puget Sound	Oct. 10	Nov. 17	Dec. 13	Jan. 12
Mallards	31,010	58,003	88,008	85,037
Northern pintail	23,590	48,195	75,865	58,900
American wigeon	15,765	59,570	66,116	55,269
Green-winged teal	10,255	24,554	9,287	9,269
TOTAL DABBLERS	80,620	190,322	239,276	208,475

Snow Goose Counts	Date	Skagit/ Snohomish/ Island Co.	Survey Type	% Young	
	11/28/16	108,765	Aerial – Photo Count	32.8%	
	12/21/16	103,617	Aerial – Photo Count	33.4%	
	1/20/17	99,063	Aerial – Photo Count	25.2%	

Brant Aerial Surveys	Date	Skagit/ Whatcom Co.	Survey Type		
	12/27/16	2930	Aerial – Visual		
	1/3/17	3,828	Aerial – Visual		
	12/30/16	6,359	Aerial – Photo Count		

Swan Age Ratios - North Puget Sound MWS

Species	Sample size	Juveniles	% Young	
Trumpeter Swan	17,644	2,659	15.1%	
Tundra Swan	588	83	14.1%	

Table 4. 2016-17 Washington migratory bird season regulations.

Species	Area	Season Dates (inclusive)/Restrictions	Daily Bag Limit	Possession Limit
Duck	Statewide	Sept. 17-18 (Youth Hunting Only[a])	7[b]	14[b]
		Oct. 15-19 & Oct. 22 - Jan. 29, except scaup season closed Oct. 15- Nov. 4	7[b]	21[b]
Coot	Statewide	Sept. 17-18 (Youth Hunting Only[a])	25	50
		Oct. 15-19 & Oct. 22 - Jan. 29	25	75
Snipe	Statewide	Oct. 15-19 & Oct. 22 - Jan. 29	8	24
Canada Goose Early Seasons	Goose Mgmt Areas 1 & 3	Sept. 10-15	5[c]	15[c]
	Goose Mgmt Area 2	Sept. 3-11	5[c]	15[c]
	Goose Mgmt Areas 4 & 5	Sept. 10-11	5[c,d]	10[c,d]
	Statewide	Sept. 17-18 (Youth Hunting Only[a])	4[c]	8[c]
Goose (except Brant)	Goose Mgmt Area 1	Snow, Ross', Blue, White-fronted Goose : Oct. 15 - Jan. 29[e]	4	12
		Other geese: Oct. 15-27 & Nov. 5 - Jan. 29		
	Goose Mgmt Area 2 Dusky Canada Goose season is closed in Area 2 during October – March.	All areas **except** Ridgefield National Wildlife Refuge: Saturdays, Sundays, & Wednesdays only Oct. 15-23; Nov. 26 - Jan. 22; and Feb. 11 – Mar. 8[f]. During Feb. 11 – Mar. 8, National Wildlife Refuges and WDFW Areas are closed to goose hunting in this management area.	4[g]	12[g]
		Ridgefield National Wildlife Refuge:Tuesdays, Thursdays, & Saturdays only Oct. 15 – 22 and Nov. 26 – Jan. 21[f]	4[g]	12[g]
	Goose Mgmt Area 3	Oct. 15 - 27 & Nov. 5 - Jan. 29	4	12
	Goose Mgmt Area 4	Saturdays, Sundays, & Wednesdays only: Oct. 15 – Jan. 22; Nov. 11, 24, 25; Dec. 26, 27, 29, 30; Jan. 16; ; & every day Jan. 23-29	4	12
	Goose Mgmt Area 5	Oct. 15-17 & every day Oct. 22 - Jan. 29	4	12
Brant	Skagit County	Jan. 7, 8, 11, 14, 15, 18, 21, and 22 **Note:** If Skagit County pre-season brant population is 3,000 – 6,000 (determined by midwinter waterfowl survey), this season will be open only on the following dates: Jan. 7, 11, and 14. If the Skagit County pre-season brant population is below 3,000 (as determined by the midwinter waterfowl survey), this season will be canceled.	2	6
	Pacific County	Jan. 7, 8, 10, 12, 14, 15, 17, 19, 21, and 22	2	6

a. Special youth hunting season open to hunters under 16 years of age (must be accompanied by an adult at least 18 years old who is not hunting).
b. Daily bag limit: 7 ducks, to include not more than 2 hen mallard, 2 pintail, 3 scaup , 2 canvasback, and 2 redhead statewide; and to include not more than 1 harlequin, 2 scoter, 2 long-tailed duck, & 2 goldeneye in western Washington. Possession limit (Youth Hunting Weekend):14 ducks, to include not more than 4 hen mallard, 4 pintail, 6 scaup, 4 canvasback, and 4 redhead statewide; and to include not more than 1 harlequin, 4 scoter, 4 long-tailed duck, and 4 goldeneye in western Washington. Possession limit (regular Season): 21 ducks, to include not more than 6 hen mallard, 6 pintail, 6 canvasback, and 6 redhead statewide; and to include not more than 1 harlequin, 6 scoter, 6 long-tailed duck, and 6 goldeneye in western Washington. Season limit: 1 harlequin in western Washington.
c. Daily bag and possession limits: to include Canada geese only
d. Daily bag and possession limits in Pacific County are 15/45 during the September Canada goose season.
e. Skagit County Special Restrictions: While hunting snow geese, if a hunter is convicted of 1) trespass, 2) shooting from across or along the maintained part of any public highway, 3) discharging a firearm for the purpose of hunting waterfowl within 100 feet of any paved public road on Fir Island or discharging a firearm for the purpose of hunting snow geese within 100 feet of any paved public road in other areas of Skagit County, or 4) exceeding the daily bag limit for snow geese, written authorization will be invalidated for the remainder of the current snow goose season and an authorization will not be issued for the subsequent snow goose season.
f. In Goose Management Area 2, legal hunting hours for geese are 30 minutes after the start of the official waterfowl hunting hours to 30 minutes before the end of the official waterfowl hunting hours.
g. Daily bag limit: 4 geese, except for dusky Canada Geese. Possession limit: 12 geese, except for dusky Canada geese. Dusky Canada goose season closed. A dusky Canada goose is defined as a dark breasted (Munsell 10 YR, 5 or less) Canada goose with a culmen (bill) length of 40-50 mm.

Table 5. Significant historical changes in duck hunting regulations.

	Season		Bag Limit		Special Limits		Stamp Fees		Hunting	Steel shot
Year(s)	East	West	East	West	Mallard	Pintail	State	Federal	License	Regulation
73-74	100	93	6	5	-	2 extra	-	$5.00	$6.50	-
74-75	100	93	6	5	-	-	-	5.00	6.50	-
75-76	100	93	7	7	-	-	-	5.00	6.50	-
76-77	100	93	7	7	-	-	-	5.00	7.50	-
77-79	100	93	7	7	-	-	-	5.00	7.50	3 zones[1]
79-80	100	93	7	7	-	-	-	7.50	7.50	" "
80-82	100	93	7	7	-	-	-	7.50	7.50	1 zone[2]
82-84	100	93	7	7	-	-	-	7.50	10.50	" "
84-85	100	93	7	7	-	4	-	7.50	10.50	" "
85-86	84	79	5	5	5 (1 ♀)	5 (1♀)	-	7.50	12.00	" "
86-87	86	79	5	5	4 (1 ♀)	4 (1♀)	5.00	7.50	12.00	Large zones[3]
87-88	86	79	5	5	4 (1 ♀)	4 (1♀)	5.00	12.00	12.00	" "
88-91	66	59	4	4	3 (1 ♀)	1	5.00	12.00	12.00	" "
91-94	66	59	4	4	3 (1 ♀)	1	6.00	15.00	15.00	Steel statewide
94-95	76	69	4	4	3 (1 ♀)	1	6.00	15.00	15.00	" "
95-96	100	93	6	6	6 (1♀)	2	6.00	15.00	15.00	Bismuth-tin added
96-97	100	93	7	7	7 (1 ♀)	2	6.00	15.00	15.00	" "
97-98	106[5]	106[5]	7	7	7 (2 ♀)	3	6.00	15.00	15.00	Tungsten-iron added
98-99	106[5]	106[5]	7	7	7 (2 ♀)	1	6.00	15.00	15.00	Tungsten-polymer added
99-00	106[5]	106[5]	7	7	7 (2 ♀)	1	6.00	15.00	30.00[4]	Tungsten-matrix added
00-01	105[6]	105[6]	7	7	7 (2 ♀)	1	6.00	15.00	30.00	" "
01-02	105[6]	105[6]	7	7	7 (2 ♀)	1	6.00	15.00	30.00	Tungsten-nickel-iron added
02-03	105[6]	105[6]	7	7	7 (2 ♀)	1[7]	10.00	15.00	30.00	TINT[8] added
03-04	105[6]	105[6]	7	7	7 (2 ♀)	1[9]	10.00	15.00	30.00	" "
04-05	105[6]	105[6]	7	7	7 (2 ♀)	1[10]	10.00	15.00	30.00	Tungsten-bronze, and tungsten-Tin-bismuth added
05-06	105[6]	105[6]	7	7	7 (2 ♀)	1	10.00	15.00	30.00	" "

06-07	105[6]	105[6]	7	7	7 (2 ♀)	1	10.00	15.00	30.00	Tungsten-iron-copper-nickel, Tungsten-tin-iron added
07-08	105[6]	105[6]	7	7	7 (2 ♀)	1	10.00	15.00	30.00	Tungsten-tin-iron-nickel added
08-09	105[6]	105[6]	7	7	7 (2 ♀)	1	10.00	15.00	30.00	
09-10	105[6]	105[6]	7	7	7 (2 ♀)	2	11.00	15.00	36.00	
10-11	105[6]	105[6]	7	7	7 (2 ♀)	2	11.00	15.00	36.00	
11-12	105[6]	105[6]	7	7	7 (2 ♀)	2	15.00	15.00	38.00	
12-13	105[6]	105[6]	7	7	7 (2 ♀)	2	17.00	15.00	40.50	
13-14	105[6,a]	105[6,a]	7	7	7 (2 ♀)	2	17.00	15.00	40.50	
14-15	105[6,b]	105[6,b]	7	7	7 (2 ♀)	2	17.00	15.00	40.50	
15-17	105[6,c]	105[6,c]	7	7	7 (2 ♀)	2	17.00	25.00	40.50	Copper-clad iron added

[1]Non-toxic shot zones were established at Barney Lake, Skagit Bay, and the Columbia River flood plain.
[2]Only Barney Lake was retained as a non-toxic shot zone.
[3]Steel shot in progressively larger zones from 86-87 through 91-92 when steel shot was required statewide.
[4]New small game license format.
[5]Youth hunt one additional day
[6] Youth hunt two additional days
[7]pintail season limited to 62 days (Sept. 21-22; Oct.5-11; Oct 26-Dec. 17)
[8]tungsten-iron-nickel-tin shot
[9] pintail season limited to 62 days (Sept. 20-21; Oct. 11-15, Dec. 2-Jan. 25)
[10]pintail season limited to 62 days (Sept. 18-19; Oct. 16-20; Dec. 7-Jan. 30)
[a] scaup (lesser and greater) season limited to 86 days (Nov. 2-Jan. 26)
[b]scaup (lesser and greater) season limited to 86 days (Nov. 1-Jan. 25)
[c]scaup (lesser and greater) season limited to 86 days (Nov. 7-Jan. 31)

Table 6. History of southwest Washington Canada goose season regulations.

Year	Season	ID Class	Quota	Scheduled Dates (# days)	Closure (# Days Hunted / Sched.)
2002-03	Regular	New	80	2A: Nov. 27-Jan. 26 (25-27) 2B: Nov. 9-Dec. 29 (23)	2A: RF (9/25)*, Others (27/27) 2B: No (23/23)
	Late	New	5	Feb. 1-Mar. 9 (17) – 2A* only	No (17/17)
2003-04	Regular	New	80	2A: Dec. 9-Jan. 24 (19) 2B: Nov. 15-Jan. 4 (15)	2A: RF (9/19)*, Others (19/19) 2B: No (15/15)
	Late	New	5	Jan. 31- Mar. 10 (12) – 2A* only	No (12/12)
2004-05	Regular	New	80	2A: Nov. 27-Jan. 22 (15, RF 25) 2B: Oct. 16-Jan. 15 (14)	2A: No (15/15, RF 25/25) 2B: No (14/14)
	Late	New	5	Feb. 5 - Mar. 9 (10) – 2A* only	No (10/10)
2005-06	Regular	New	80	*2A: Nov. 12-27, Dec. 7-Jan. 29 (30, RF 25)* 2B: Oct. 15-Jan. 14 (27)	2A: No (30/30, RF 25/25) 2B: No (27/27)
	Late	New	5	Feb. 5 - Mar. 9 (10) – 2A* only	No (10/10)
2006-07	Regular	New	80	*2A: Nov. 11-26, Dec. 6-Jan. 28 (32, RF 25)* P: Oct. 15-Jan. 14 (27)	2A: No (32/32, RF 25/25) P: No (27/27)
	Late	New	5	Feb. 3 - Mar. 7 (10) – 2A* only	No (10/10)
2007-08	Regular	New	80	*2A: Nov. 10-25, Dec. 5-Jan. 27 (32, RF 25)* P: Oct. 13-Jan. 12 (27)	2A: No (32/32, RF 25/25) P: No (27/27)
	Late	New	5	Feb. 2 - Mar. 5 (10) – 2A* only	No (10/10)
2008-09	Regular	New	80	2A: Nov. 8-23, Dec. 3-Jan. 25 (32, RF 26) P: Oct. 11–Jan. 10 (27)	2A: No (32/32, RF 26/26) P: No (27/27)
	Late	New	5	Feb. 7 – Mar. 7 (9)	No (9/9)
2009-10	Regular	New	40	2A: Nov. 14-20, Dec. 9-Jan. 31 (31, RF 28) P: Oct. 17–Jan. 16 (27)	2A: No (31/31, RF 28/28) P: No (27/27)
	Late	New	5	Feb. 6 – Mar. 10 (10)	No (10/10)
2010-11	Regular	New	40	2A: Nov. 13-28, Dec. 8-Jan.30 (30, RF 27) P: Oct. 16–Jan 15 (26)	2A: Yes (30/30, RF 5/27) P: No (26/26)
	Late	New	5	2A: Feb. 5 – Mar. 9 (10)	No (10/10)
2011-12	Regular	New	40	2A: Nov. 12-27, Dec. 7-Jan.29 (30, RF 29) P: Oct. 15–26 and Nov. 5-Jan 21 (26)	2A: Yes (30/30, RF 16/29) P: No (26/26)
	Late	New	5	2A: Feb. 4 – Mar. 7 (10)	No (10/10)
2012-2013	Regular	New	40	2A: Nov. 10-25, Dec. 5-Jan. 27 (30, RF 28) P: Oct. 13-24, Nov. 3-Jan. 19 (27)	2A: No (30/30, RF 28/28) P: No (27/27)
	Late	New	5	2A: Feb. 2-Mar. 6 (10)	No (10/10)
2013-2014	Regular	New	40	2A: Nov. 9 – Dec. 1, Dec. 11-Jan. 26 (30, RF 29) P: Oct. 12-23, Nov. 2-Jan. 26 (31)	2A: No (30/30, RF 28/28) P: No (28/28)
	Late	New	5	2A: Feb. 1-Mar. 5 (10)	No (10/10)

2014-2015	Regular	New	80	2A: Nov. 8 – 30 & Dec. 10 – Jan. 25 (32, RF 28) P: Oct. 11-25, Nov. 1-Jan. 17 (30)	2A: No (32/32, RF 28/28) P: No (30/30)
	Late	New	5	2A: Feb. 4-Mar. 8 (10)	No (10/10)
2015-2016	Regular	New	N/A**	2A: Nov. 14 – Dec 6; Dec. 16- Jan. 31 (32, RF 30) 2B: Oct. 17 – 25; Nov. 14 – Jan. 10 (32)	2A: No (32/32, RF 30/30) 2B: No (32/32)
	Late	New	N/A**	2A and 2B: Feb. 10 – Mar. 9*** (13/13)	2A/2B: No (13/13)
2016-2017	Regular	New	N/A**	2: Oct. 15 – 23; Nov. 26 – Jan. 22 (31, RF 32)	2: No (31/31, RF 32/32)
	Late	New	N/A**	2: Feb. 11 – Mar. 8*** (12/12)	2: No (12/12)
* 2A=Clark, Cowlitz, Wahkiakum; 2B=Grays Harbor, Pacific; C=Clark Private; CC=Clark-Cowlitz Private Lands; CSC=Clark/S. Cowlitz Private Lands; P=Pacific; WNC=Wahkiakum/N. Cowlitz; PW=Pacific-Wahkiakum; PWNC=Pacific/Wahkiakum/N. Cowlitz; RF=Ridgefield; SC=S. Cowlitz; **Dusky harvest closed; ***public lands closed					

Table 7. Waterfowl harvest by species in Washington (2016-17)[1].

Species	Harvested	Composition (%)
Mallard	196,142	47
Northern pintail	26,652	6
American wigeon	60,175	14
Green-winged teal	51,847	12
Total ducks	470,168	
September Canada Goose	6,758	9
Regular Season Canada Goose	70,532	89
Late Season Canada Goose	1,420	2
Total waterfowl	556,204	

[1]The total number of ducks and geese harvested is estimated from the more extensive Small Game Harvest Questionnaire. Composition is estimated from wingbee data derived from Pacific Flyway databook.

Table 8. Waterfowl harvest by region (2016-17).

Region	Ducks Harvested	% of State Total Ducks Harvested	Geese Harvested	% of State Total Geese Harvested
Region 1	47,951	10%	10,966	16%
Region 2	93,725	20%	18,029	26%
Region 3	111,426	24%	17,453	25%
Region 4	130,144	28%	14,129	20%
Region 5	40,174	9%	5,456	8%
Region 6	46,748	10%	4,499	6%

Table 9. Estimated number of sea ducks harvested in 2016-17[1].

Species	Harvest
Scoters	674
Black Scoter	30
Surf Scoter	518
White-winged Scoter	126
Harlequin	111
Long-tailed	49
Barrow’s Goldeneye	172
Common Goldeneye	221
TOTAL	1227

[1] These figures are based on analysis of mandatory report returns, corrected for non-response bias.

Table 10. Brant harvest report summary[1].

YEAR	MONTH	PERMITS ISSUED	SUCCESSFUL HUNTERS	HUNTER DAYS	SEASON DAYS	SKAGIT CO. HARVEST	WHATCOM CO. HARVEST	PACIFIC CO. HARVEST	TOTAL HARVEST
1990	DEC	490	338	763	11	808	0	73	881
1991	DEC	654	330	647	11	790	3	52	845
1992	DEC	747	319	709	11	950	9	18	977
1993	DEC	1194	496	765	11	1347	7	53	1407
1994	DEC	1069	287	484	9	825	0	23	848
1995	DEC	1207	343	552	11	918	0	44	962
1996	DEC	1445	254	549	11	1493	0	41	1534
1997	JAN	1331	197	326	5	597	0	59	656
1998	JAN	1348	243	350	5	570	0	18	588
1999	JAN	1336	218	386	9	581	0	86	667
2000	JAN	1295	39	59	5*	0	0	108	108
2001	NOV				5	56	0	20	76
2001	JAN				5	347	0	17	364
2001	ALL	1436	187	277	10	403	0	37	440
2002	NOV				5	18	0	9	27
2002	JAN				5*	0	0	33	33
2002	ALL	1387	27	277	10	18	0	42	60
2003	NOV				5	22	0	13	35
2003	JAN				5	235	0	64	299
2003	ALL	1187	152	200	10	257	0	77	334
2004	NOV				5	36	0	11	47
2004	JAN				5	308	0	34	342
2004	ALL	1612	126	209	10	344	0	45	389
2005	JAN	1707	220	336	5	504	0	53	557
2006	JAN	1793	199	272	7	367	0	74	441
2007	JAN	1795	166	243	7	341	0	112	453
2008	JAN	2116	191	262	7S/10P	328	0	81	409
2009	JAN	1681	232	510	8S/10P	545	0	31	576
2010	JAN	1030	200	387	8S/10P	253	0	125	378
2011	JAN	1232	214	502	8S/10P	638	0	80	718
2012	JAN	1362	254	604	8S/10P	541	0	63	604
2013	JAN	1364	192	651	8S/10P	479	0	26	505
2014	JAN	1352	14	76	10P	0	0	40	40
2015	JAN	1366	193	236	3S/10P	165	0	34	199
2016	JAN	1358		548	8S/10P	538	0	46	584

[1] Figures are based on mandatory report returns, corrected for non-response bias. [2] Days hunted estimate from 1990-2008 included successful hunters only.

Table 11. Snow goose harvest report summary.

YEAR	PERMITS ISSUED	SUCCESSFUL HUNTERS	DAYS HUNTED*	ISLAND CO. HARVEST**	SKAGIT CO. HARVEST**	SNOHOMISH CO. HARVEST**	TOTAL HARVEST**
1993	2298	572	1096	58	677	1124	1859
1994	2588	433	664	60	496	522	1078
1995	2313	221	373	57	99	331	487
1996	2363	427	996	39	381	1400	1820
1997	2795	424	812	38	545	749	1332
1998	3086	341	585	29	678	262	969
1999	3061	445	777	71	815	598	1484
2000	3076	460	1039	18	1058	919	1995
2001	3144	407	953	4	753	696	1453
2002	3196	442	1217	18	1419	1084	2522
2003	3013	530	1155	20	1465	889	2374
2004	3333	474	1075	37	1267	893	2160
2005	3546	895	2665	50	4588	2154	6792
2006	4068	1061	2566	7	3780	1876	5663
2007	4859	1662	5528	53	11462	4175	15690
2008	5583	1253	2912	117	6295	3743	10155
2009	4015	1370	9840	8	9979	2959	12946
2010	4830	770	5078	0	3388	1032	4420
2011	2776	1113	6011	0	6924	4079	11003
2012	2811	966	4359	0	3903	1956	6859
2013	2884	861	4013	126	4016	1579	5721
2014	3010	1110	4499	6	2069	683	2758
2015	3005	1099	4704	6	2373	1067	3446
2016	3240		6680				6742

*days hunted 1993-08 include successful hunters only **harvest estimate does not include wounding loss

Table 12. Southwest Washington Canada goose harvest summary.

Season	Period	Aleutian	Cackler	Dusky	Lesser	Taverner	Vancouver	Western	Other	Total CAGO	Snow	Whitefront	Total
1961-70	10 Year Ave.									1894			
1971-80	10 Year Ave.									2624			
1981-83	10 Year Ave.									4814			
1984-85	Season Total		0	37	0	63	0	20	0	120			
1985-86	Season Total		11	66	116	113	0	67	25	398			
1986-87	Season Total		8	36	51	172	0	241	0	508			
1987-88	Season Total		7	45	225	478	4	224	35	1018			
1988-89	Season Total		17	43	136	617	0	763	7	1583			
1989-90	Season Total		37	52	92	455	9	391	0	1036			
1990-91	Season Total		28	65	165	555	20	383	3	1219			
1991-92	Season Total		39	88	295	675	14	483	15	1609			
1992-93	Season Total		84	91	270	1340	25	722	2	2534			
1993-94	Season Total		93	90	299	944	8	697	4	2135			
1994-95	Season Total		422	77	246	1011	31	704	6	2497			
1995-96	Regular Season		321	57	134	787	12	515	1	1827			
	Late Season		13	2	10	75	0	21	0	121			
	Season Total		334	59	144	862	12	536	1	1948			
1996-97	Regular Season		1001	32	327	1678	9	808	2	3857			
	Late Season		29	3	148	27	9	124	1	341			
	Season Total		1030	35	475	1705	18	932	3	4198			
1997-98	Regular Season		1158	56	376	2042	31	672	5	4340			
	Late Season		153	2	16	155	2	70	0	398			
	Season Total		1311	58	392	2197	33	742	5	4738			
1998-99	Regular Season		1588	44	292	1736	28	724	9	4421			
	Late Season		232	2	14	141	6	109	0	504			
	Season Total		1820	46	306	1877	34	833	9	4925			
1999-00	Regular Season		1255	24	205	1150	140	540	32	3346			
	Late Season		200	3	4	115	15	83	1	421			
	Season Total		1455	27	209	1265	155	623	33	3767			
2000-01	Regular Season		1310	30	130	1236	82	583	34	3405			
	Late Season		140	2	105	6	13	104	1	371			
	Season Total		1450	32	235	1242	95	687	35	3776			
2001-02	Regular Season		664	22	130	601	87	430	11	1945			
	Late Season		94	1	0	43	25	66	0	229			
	Season Total		758	23	130	644	112	496	11	2174			
2002-03	Regular Season		1183	37	152	836	88	551	60	2907			
	Late Season		108	1	1	60	5	40	1	216			
	Season Total		1291	38	153	896	93	591	61	3123			
2003-04	Regular Season		598	24	102	470	73	372	19	1658			
	Late Season		76	4	2	13	5	41	0	141			
	Season Total		674	28	104	483	78	413	19	1799			
2004-05	Regular Season		989	25	123	576	105	424	49	2291			

	Late Season		90	0	0	21	17	37	4	169			
	Season Total		1079	25	123	597	122	461	53	2460			
2005-06	Regular Season		948	30	155	823	106	558	28	2648			
	Late Season		89	1	2	40	2	26	4	164			
	Season Total		1037	31	157	863	108	584	32	2812			
2006-07	Regular Season	8	1085	26	141	580	110	410	44	2404			
	Late Season		127	1	2	48	14	40	1	233			
	Season Total	8	1212	27	143	628	124	450	45	2637			
2007-08	Regular Season	2	1160	21	108	684	113	292	49	2429			
	Late Season		122	1	5	45	12	31	2	218			
	Season Total	2	1282	22	113	729	125	323	51	2647			
2008-09	Regular Season	4	1636	43	154	887	195	406	41	3366	88	27	3481
	Late Season		87	2	4	59	3	52	0	207			207
	Season Total	4	1723	45	158	946	198	458	41	3573	88	27	3688
2009-10	Regular Season	13	1301	28	73	706	75	358	41	2595	8	19	2622
	Late Season		111	4	3	30	12	25	1	186			186
	Season Total	13	1412	32	76	736	87	383	42	2781	8	19	2808
2010-11	Regular Season	4	1245	17	94	525	57	297	37	2276	26	65	2367
	Late Season	1	100	3		22	2	25		153			153
	Season Total	5	1345	20	94	547	59	322	37	2429	26	65	2520
2011-12	Regular Season	1	1150	25	121	505	35	180	21	2038	16	60	2114
	Late Season		154	3	4	20	3	43		227			227
	Season Total	1	1304	28	125	525	38	223	21	2265	16	60	2341
2012-13	Regular Season	16	1168	17	101	503	25	231	1	2062	33	64	2159
	Late Season		125		1	23	13	33		195	2		197
	Season Total	16	1293	17	102	526	38	264	1	2257	35	64	2356
2013-14	Regular Season	4	1247	18	96	257	17	287	8	1934	35	17	1990
	Late Season		160	2	1	12	12	54		241	1	3	245
	Season Total	4	1407	20	97	269	29	341	8	2175	40	20	2235
2014-15	Regular Season	16	1424	42	137	431	20	249	14	2333	7	37	2377
	Late Season		155	3	1	14	3	43		219	3		222
	Season Total	16	1579	45	138	445	23	292	14	2552	10	37	2599
2015-16[a]	Regular Season[b]	0	397	14	13	75	14	67	37	604	5	1	610
	Late Season[b]	0	154	5	5	29	6	26	15	235	2	1	238
	Season total[c]	0	551	19	18	104	20	93	52	839	7	2	844
2016-17[a]	**Regular Season[b]**	**7**	**71**	**4**	**4**	**36**	**0**	**40**	**0**	**152**	**0**	**0**	**152**
	Late Season[b]	**10**	**93**	**5**	**4**	**35**	**0**	**51**	**0**	**199**	**0**	**0**	**199**
	Season total[c]	**17**	**164**	**9**	**8**	**61**	**0**	**91**	**0**	**351**	**0**	**0**	**351**

Note: Mandatory check stations initiated in 1984-85 season, prior estimates from USFWS harvest survey.
[a]Check stations discontinued in 2015.
[b]Numbers derived from % of species identified during bag checks and calculated for regular and late season.
[c]Total includes only measured birds from bag checks

Wild Turkey

Wild Turkey Status and Trend Report

STATEWIDE

ANIS AOUDE, Game Division Manager

Management Guidelines and Objectives

Wild Turkeys were first successfully introduced in Washington in 1960. Population augmentation in the 1980s and 1990s expanded their distribution (Figure 1) and increased hunting and wildlife viewing opportunities (Washington Department of Fish and Wildlife, 2005).

Few translocation activities have occurred in recent years. WDFW management plans identify trapping and translocation as a potential response to damage and nuisance complaints, but those actions are not a significant part of turkey management.

In January 2006, the Department adopted a statewide turkey management plan as a supplement to the Game Management Plan in response to increasing populations and issues related to turkey management. Population management strategies are included in the plan and will be included and updated in future management plans.

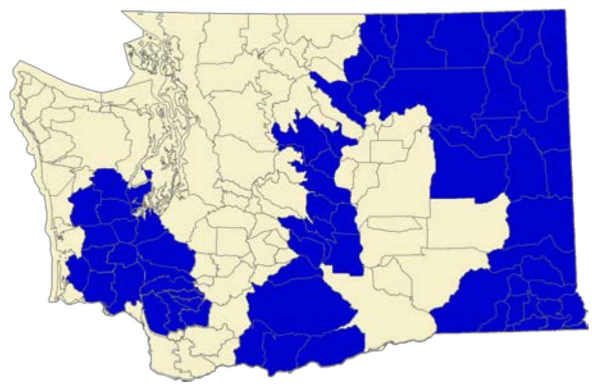


Figure 1: Primary current distribution of wild turkeys in Washington based on Game Management Units.

Hunting Seasons and Recreational Harvest

Hunter effort and hunter harvest of wild turkeys are estimated based on the analysis of mandatory hunter reports. Hunters report on all turkey tags, including tags they did not go hunt. Successful hunters are required to submit a harvest report with date, location, sex, and age of harvested birds. This mandatory reporting system has allowed for better estimates of harvest and hunter participation than those estimates made prior to the reporting requirement.

Hunting seasons for wild turkeys have varied from a 2-day, fall season in 1965 to the current 47-day spring season with additional fall hunting opportunities that vary by GMU.

Beginning in 2004, GMUs 105-124 had a weeklong general early fall season instead of permit-based hunting. In 2005, this was extended to 2 weeks, and in 2006, GMU 101 was included. In 2008, the early fall seasons in GMUs 105-124 were changed to "beardless turkeys only" with the intent to decrease the fall season male harvest. This strategy was successful as male turkey harvest decreased from approximately 55% to less than 20% in the target area.

In 2006, a late fall permit hunt (November 20-December 15) in NE Washington was added for GMUs 101-124. This permit hunt was changed to a general season hunt in 2009 because hunting pressure did not meet management goals for that population. GMUs have since been added where the late fall general season includes almost all 100 series GMUs. A late fall permit hunt was added for GMUs in Okanogan County (218-231 and 242) in 2008, and in 2012 a permit hunt was added in GMU 335 in Kittitas County. All late fall seasons are either sex.

In 2009, the early fall general season was extended to Mica Peak (GMU 127), Roosevelt (GMU 133), and Blue Mountains GMUs (GMUs 145, 149-16, and 172-186). Klickitat County (GMUs 382, 388, 568-578) remains permit only hunting.

Turkey hunting is open to shotgun, archery, and crossbow hunting during the spring and fall seasons. Dogs, baiting, electronic decoys, and electronic calls are not legal in Washington. Non-electronic decoys are permitted. In 2006, the Fish and Wildlife Commission adopted a regulation permitting falconers to hunt turkeys during the fall and winter.

Current regulations are considered relatively conservative. Spring season timing results in harvest of gobblers after peak breeding. The season ends before most nests hatch, so disturbance is minimized. Records show that prior to turkey augmentation activity in the late 1980s, turkey hunter numbers fell to a low of 428 (1987) and turkey harvest averaged 65 birds per year (1983-1987).

GMUs have been grouped to define turkey populations into Population Management Units (PMUs). Washington State is divided into 7 PMUs: Northeast (P10), Southeast (P15), North Central (P20), South Central (P30), Klickitat (P35), Northwest (P40), and Southwest (P50) (Table 1). Changes in harvest, as an indicator of population status, have been tracked at the PMU level. Although harvest years 2011 through 2013 are consistent, differences have occurred in how PMU estimates were calculated in the past, which cause slight differences when comparisons are made to prior years or ten year averages.

Table 1: Game Management Units included in each Population Management Unit.

PMU	GMUs Included
P10	101-136
P15	139-186
P20	All 200 GMUs
P30	All 300 GMUs EXCEPT GMU 382 & 388
P35	GMUs 382, 388, 578, 574, 572, 568
P40	All 400 GMUs PLUS GMUs 601-627
P50	All 500 GMUs EXCEPT 568-578 PLUS GMUs 633-699

The 2016, spring turkey harvest was slightly above the 2015 harvest in all PMUs except P40 and P50. In 2016, an estimated 9,565 individuals hunted turkeys during the spring general season, taking an estimated 4,980 birds. There were 3,086 hunters that pursued turkeys during the 2016 fall general seasons in PMU 10, 15 and 40 with a harvest of 1,778 birds. This represents a 9% increase in harvest and a 24% decrease in hunter participation from the 2015 season.

Harvest estimates show that turkey numbers in P10 are increasing. The growth of the population in parts of P10 have generated an increase in depredation on agricultural land and nuisance conflicts with humans. Liberal fall general seasons are in place here to help address these issues.

Based on harvest trends (Table 2; Figure 2), the Blue Mountains population (P15) has expanded substantially over the past 15 years but may be stablizing.

Even though harvest trends in PMU 20 and 30 indicate some stability, local hunters continue to report concern over decreasing populations. Harvest in PMU 20 and 30 increased substantially in 2010 but has returned to previous levels (Table 2). Additional fall hunting opportunity will continue to be available on a limited permit only basis.

PMU	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
P10	3,445	3,571	3,660	2,677	2,845	2,861	3,695	2,512	2,400	2,461	3,097	3,421
P15	480	730	605	578	761	731	866	642	533	500	531	590
P20	215	220	258	232	228	412	231	203	188	181	260	270
P30	182	169	221	172	245	418	234	162	143	137	157	208
P35	345	362	487	370	447	889	473	514	474	436	475	461
P40	10	8	9	3	5	13	8	5	5	1	3	2
P50	53	77	62	50	65	68	41	30	25	25	38	28
Total	**4,730**	**5,137**	**5,302**	**4,082**	**4,596**	**5,392**	**5,548**	**4,068**	**3,768**	**3,741**	**4,561**	**4,980**

Table 2: Estimated spring turkey harvest in each turkey Population Management Unit (PMU) 2005-2016.

With the exception of 2010, when harvest was unusually high, turkey harvest in P35 has been steady over the past six years (Table 2; Figure 2). The population is believed to be stable and provides the majority of the hunting opportunity in southwest Washington.

Determining population trends for the wild turkey population in P50 is difficult. Sightings of wild turkey continue to be reported in locations away from the original release sites. In addition, turkeys continue to be harvested throughout the season. Harvest in southwest Washington has been on a downward trend (Table 2; Figure 2). This suggests wild turkeys have been reproducing at low levels but are likely maintaining a viable population. Declines in harvest in this area may be due in part to more restrictive access policies recently put in place by private landowners.

Population Surveys

Between 2004 and 2015, the Colville District carried out an annual winter survey of wild turkeys in northeastern Washington (PMU 10). The primary objective of these surveys are to initiate the development of an annual harvest-independent population index for wild turkeys as called for in the agency Game Management Plan. The pilot project tested methodology developed between 2006-2010, and relied on volunteers to help collect data. The greatest corollary benefit was that district biologists were able to gain valuable experience and knowledge of local turkey range, movements, habitat availability, and usage. The survey protocol was modified in 2011 to standardized route lengths, increased the number of routes, and reduced the number of times each transect was run to only one time. No quantifiable population estimate can be calculated from these surveys, but they do provide antidotal information about the current sex ratios and can also provide biologists with some understanding of the number of mature males that would be available for harvest.

District 7 utilizes winter counts to track turkey numbers in Chelan County. Counts are taken at 33 sites in 5 GMUs, using three replicate surveys to obtain a minimum count and sex ratio. Surveys have been conducted since 2008 and counts roughly track harvest in the District. A total of 629 turkeys were observed (153 adult males), roughly a 8% increase in total numbers over counts from winter of 2014-2015. The numbers of adult males recorded varies year to year based on movements of groups and their composition. This past year the number of adult males in the counts increase 91% over last year. It is unlikely the numbers of birds actually increased by that margin, more plausible is that counts from last year under represented adult males in 2014-15.

Habitat

Most of the turkey range in Region 1 is in close proximity to agricultural lands that provide abundant food in the form of waste grain, as well as some berries and fruits during winter months. The Blue Mountains and surrounding areas have provided exceptional habitat for the Rio Grande turkey subspecies. While Stevens, Pend Oreille, Ferry, and northern Spokane counties contain excellent habitat for the Merriam's subspecies.

Ponderosa pine nuts are probably the most important winter food source for turkeys in eastern Washington. In Chelan, Kittitas, and Okanogan counties, the density and distribution of ponderosa pines is much less than in Ferry and Stevens counties where the largest turkey population can be found.

In general, occupied turkey habitat in Okanogan County is less productive than some other areas of the state, due to a lack of extensive mast or berry crops. Much of the habitat is intensively grazed, and turkeys may have to compete with livestock for certain plant foods. In addition, the lack of grain farming in the area may also limit population expansion.

Most of P30 is probably marginal turkey habitat. The forested zone is on the edge of higher elevations and receives significant snowfall. Deep snows in 1992-93 and 1996-97 may have impacted turkey survival in the region. Mild winters and supplemental feeding is the most likely reason recent transplants have been successful.

Winter conditions in Klickitat County (P35) can impact the resident turkey population. Severe weather in 1996 impacted turkey harvest in 1997 and 1998. Mild winters since 1996 have allowed the turkey population to increase and hunting has improved to current levels.

Although we do not specifically monitor habitat conditions related to turkeys in P50, conditions should continue to be adequate. There have been no major changes in habitat management or weather conditions that would have changed turkey survival.

Population Augmentation

There were no new releases of turkeys in any PMU across the state and none are planned in the future. Turkeys are present in most of the areas that would be considered suitable habitat. Concerns related to human/wildlife conflict have precluded introductions in the past. Per management guidelines, turkeys can be trapped and relocated to reduce human conflicts.

Habitat enhancement priorities are identified in the 2015-2021 Game Management Plan. Of special interest are habitat improvements that increase habitat values for a variety of wildlife species in addition to turkeys. The Klickitat Oak Habitat Initiative began in May 2009 focusing on improving oak stand health and understory habitat on the Klickitat Wildlife Area and surrounding lands in Klickitat County. Other efforts have focused in northeast Washington to provide enhanced food resources through weed control, agricultural manipulation, and forest improvements. WDFW works closely with the National Wild Turkey Federation (NWTF) on efforts to promote and fund habitat enhancement work.

Management Conclusions

Harvest in 2016 seems to indicate that the turkey populations are stable to slightly increasing depending on the location. As turkeys were introduced, they have expanded their range and population. Turkey populations across the state appear to be relatively stable with the largest concentrations in Region 1. Spring hunter success rate has averaged between 25-35% since 2002. Management decisions will seek to maintain high hunter success rates in the spring, while also addressing human conflict issues.

Habitat enhancement activities for wild turkeys will continue to focus on winter food enhancements by increasing available grain, clovers, fruiting shrubs, and mast producing trees. In the past, the Klickitat Oak Habitat Initiative has been the major area of focus efforts in northeast Washington. WDFW will continue to partner with NWTF to improve winter habitat for turkeys.

Spokane County has seen an increase of turkeys despite the suburban nature of the area. Turkey nuisance complaints are being received from areas within P10, as well as a few reports from north-central and western Washington. Additional hunting opportunities have been created in the Spokane County area to help address these nuisance complaints. WDFW will be seeking ways to focus hunter effort in areas with private lands experiencing damage.

The turkey population along the eastern Cascade range may have reached the long-term carrying capacity of the habitat. The population will likely fluctuate with adverse and favorable weather conditions. Conflicts with turkeys had been escalating in the Methow and Okanogan watersheds of Okanogan County. Expansion of turkeys in the Methow area has been exacerbated by illegal releases of domestic turkeys. These birds end up as problem animals, particularly in winter when little natural forage is available. A fall permit season has been created for the Methow watershed to help manage conflicts with turkeys.

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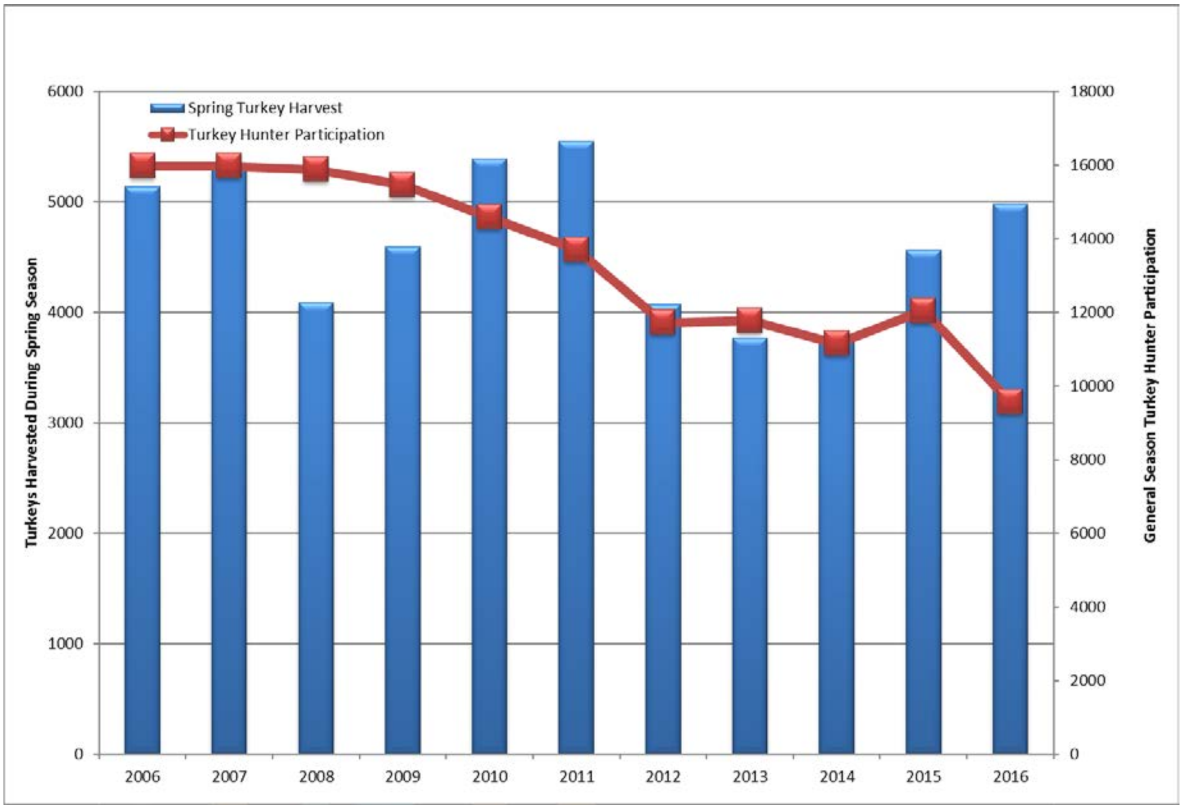

Figure 2: Estimated statewide spring turkey harvest and hunter participation 2005-2016.

Pheasant

Pheasant Status and Trend Report

STATEWIDE

ANIS AOUDE, Game Divison Manager

Population Guidelines and Objectives

Management objectives for upland birds, including pheasant, are outlined in the Washington Department of Fish and Wildlife's (WDFW) Game Management Plan (WDFW 2015). Goals are to bolster pheasant numbers through habitat enchancement to ensure healthy, productive populations for recreation. A specific strategy to enhance Washington pheasant populations is described in the National Wild Pheasant Conservation Plan (Midwest Pheasant Study Group 2013) which focuses on maximizing the values of permanent herbaceous cover to enhance brood success.

In March of 2003, WDFW held a workshop that collected information to help identify key management strategies that would strengthen and support increasing naturally occurring pheasant populations in Washington. Experts in the field of pheasant management discussed research findings and management strategies that may help address population declines in areas where pheasant populations have been historically high. The most significant recommendation from the workshop is to focus efforts in select areas that woud prioritize habitat enhancements that address limiting factors for pheasant populations. A complete 2003 Pheasant Workshop meeting summary can be found at: http://wdfw.wa.gov/publications/pub.php?id=00414

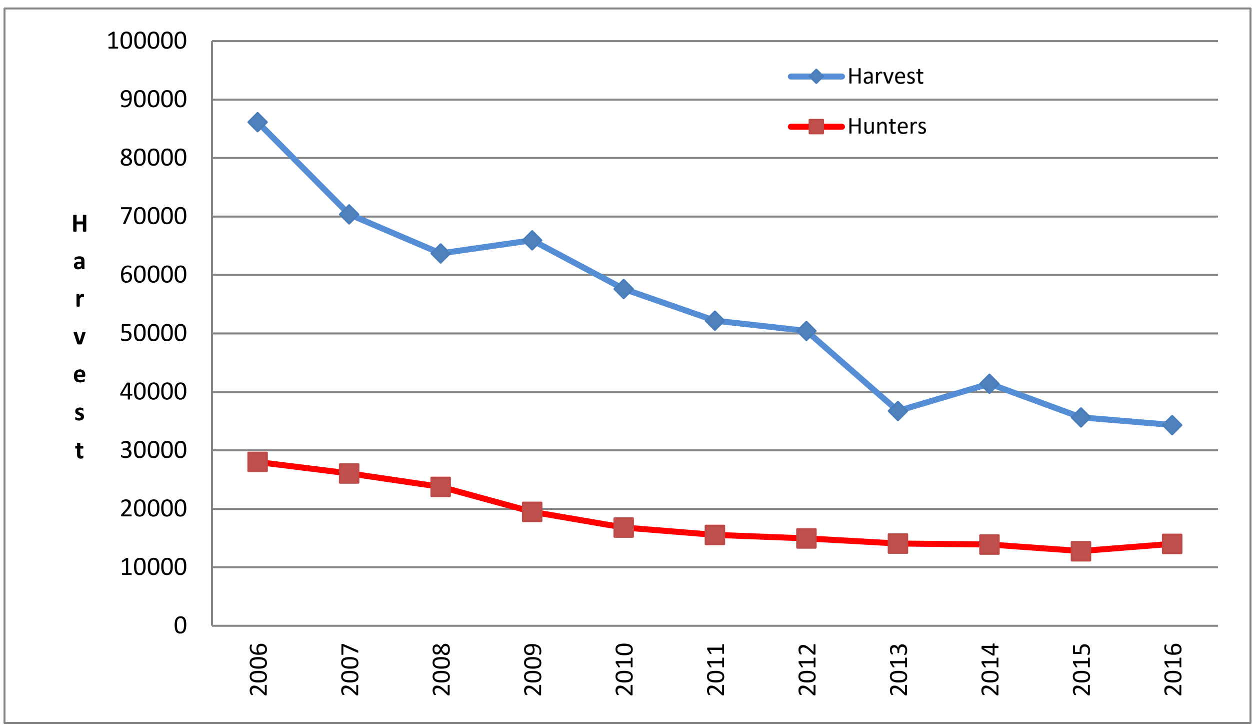

Figure 1 : Estimated annual pheasant harvest and annual hunter participation in Easterm Washington 2006-2016.

Hunting Seasons and Recreational Harvest

Pheasant harvest has varied widely over the past 50 years. Statewide harvest was at its highest during the mid-to-late 1960s with another peak in the late 1970s when over 500,000 pheasants were harvested. Since that time, pheasant harvest has steadily declined. Using harvest as an index of population status, pheasant populations in Washington appear to be much lower than they were in the 1960s and 1970s. Surveys (crowing count and brood index) conducted between 1982 and 1998 supported evidence in the decrease in pheasant numbers in eastern Washington (Rice 2003).

Harvest estimates between 2006 to 2013 indicate a steady decline in pheasant harvest, however, hunter participation is becoming relatively stable between 12,000 and 15,000 hunters per year since 2010 (Figure 1). Not indicated in the current figure but important to note is that in 2001 WDFW changed the small game survey protocols. The 2001 protocol calls for a sample of 25,000 small game hunters to increase the precision of harvest and participation estimates.

Nearly all wild pheasant (i.e., not pen-raised) populations occur in eastern Washington, estimates of harvest and hunter participation for this report include the following counties: Adams, Asotin, Benton, Chelan, Columbia, Douglas, Ferry, Franklin, Garfield, Grant, Kittitas, Klickitat, Lincoln, Okanogan, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman, and Yakima. Due to previous methods of calculation, figures presented for statewide, and basinwide hunter numbers in years prior to 2009 are likely higher than the actual participation at the time. Harvest estimates are assumed to be accurate.

A primary pheasant management zone was established in Washington where populations have been historically high. Within this primary zone, WDFW has delineated a southeast Washington pheasant focus area that includes portions of Columbia, Garfield, Walla Walla, and Whitman counties to focus pheasant management efforts where adequate rainfall (i.e., 14-inches and over) is most conducive to supporting desirable plant communities (Figure 2).

Since 1997, rooster pheasants have been released at in the fall as part of the state funded Eastern Washington Pheasant Enhancement Program (EWPEP). Harvest estimates have included both released and wild birds and therefore the harvest of wild pheasants would be lower than depicted in Figure 1.

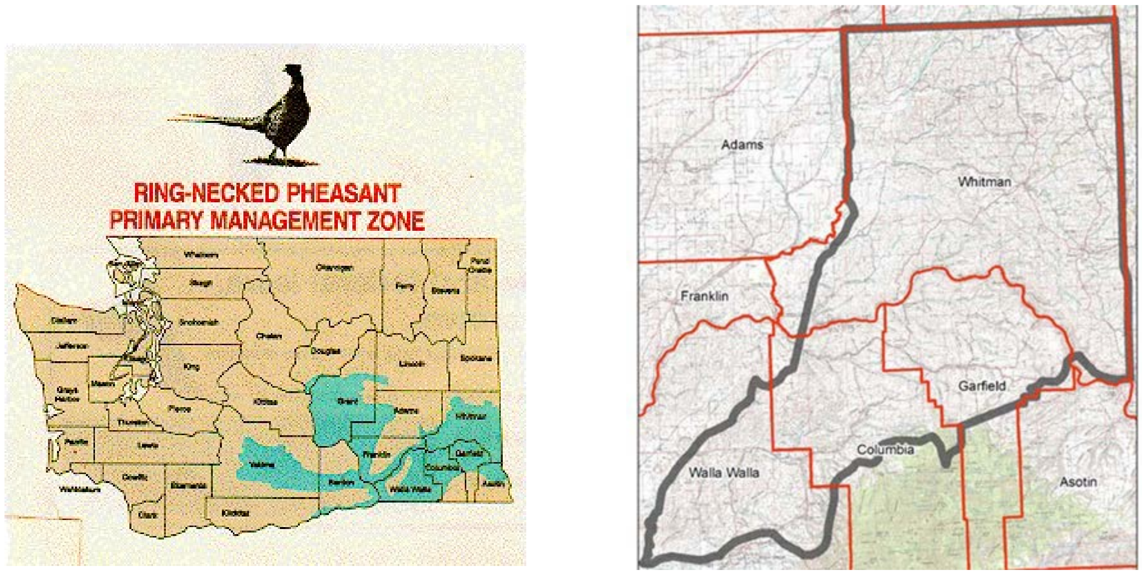

Figure 2: Washington State ringed neck pheasant primary management zone (left) and the southeast Washington Pheasant Focus Area (right).

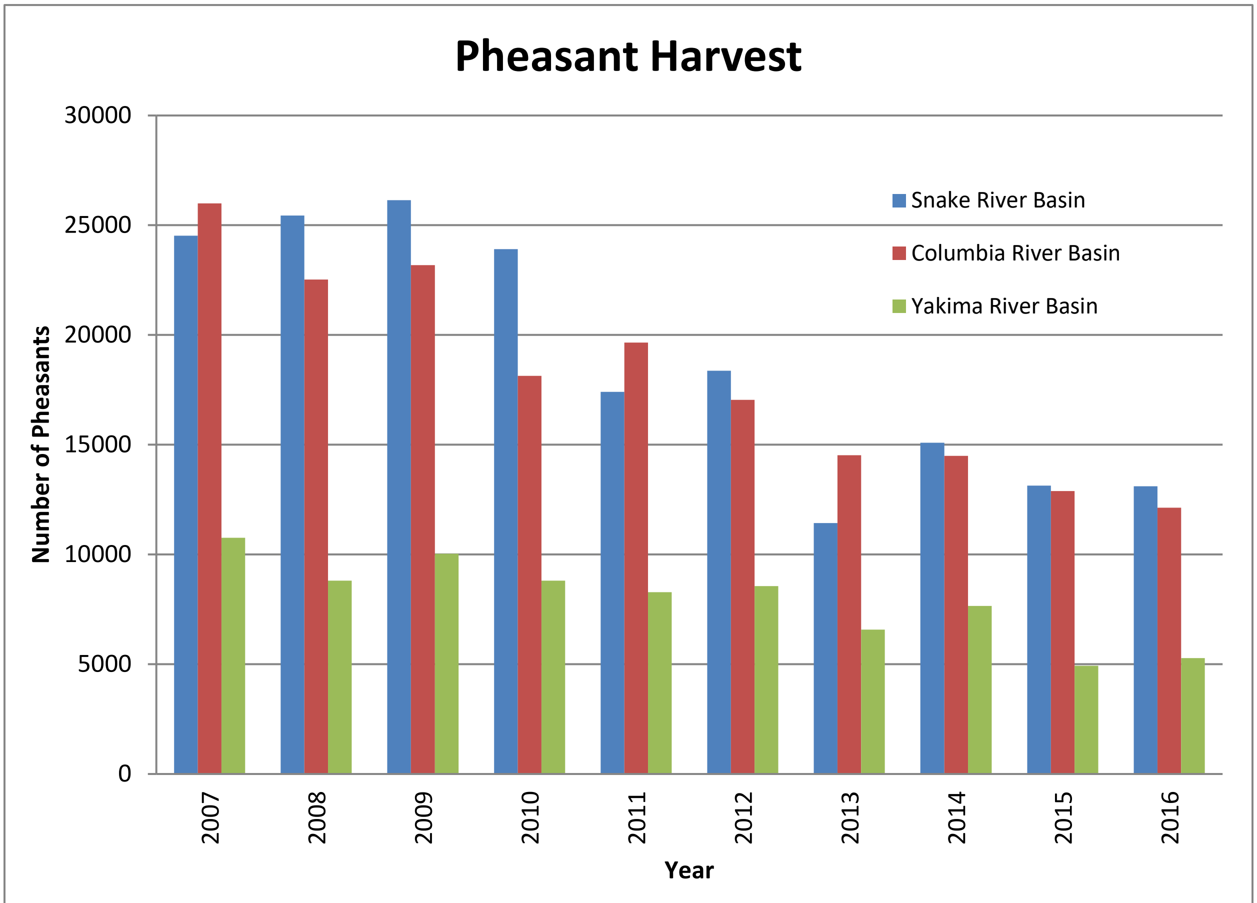

Figure 3. Estimated annual pheasant harvest for eastern Washington river basins between 2007-2016.

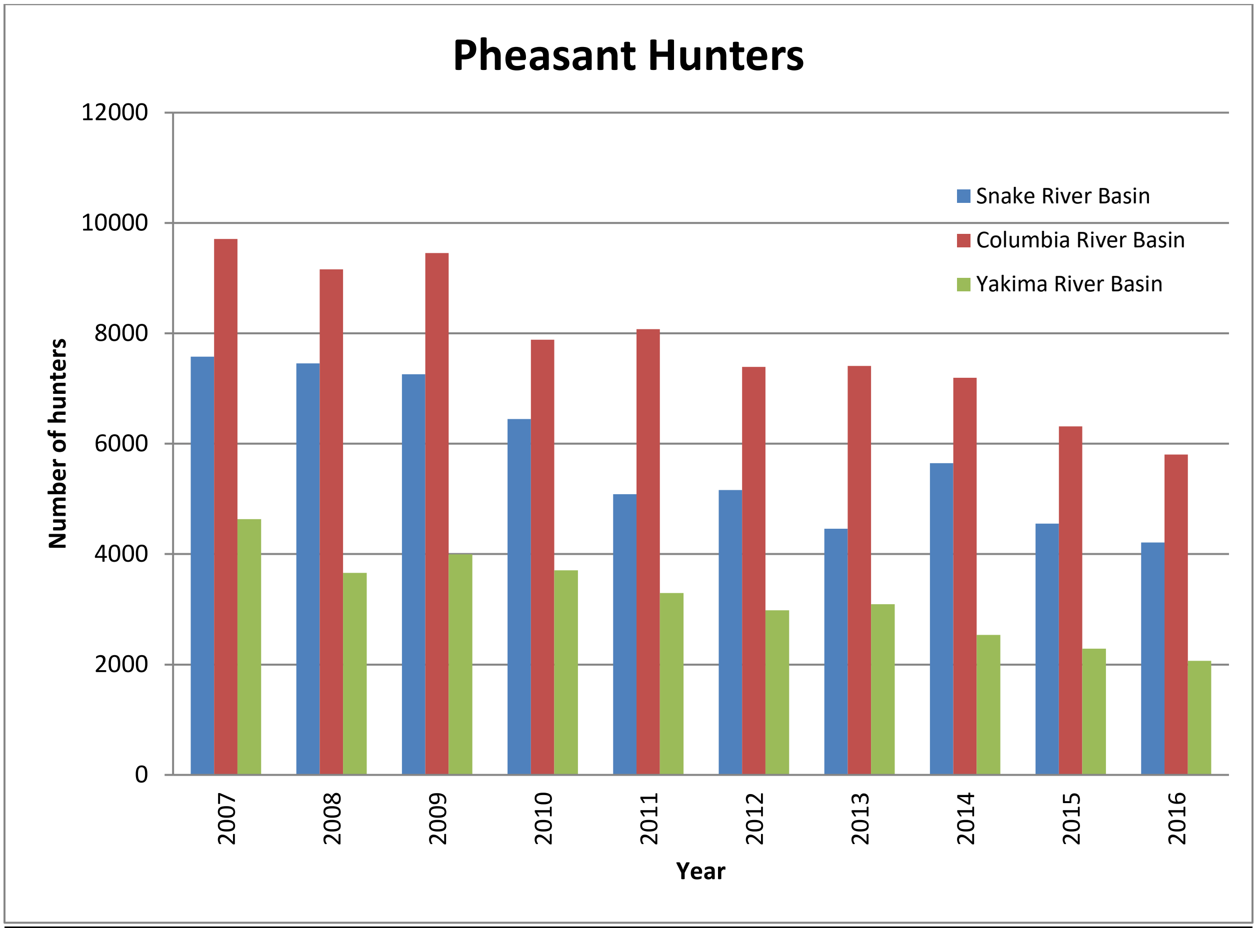

Figure 4. Estimated annual pheasant hunters for eastern Washington river basins between 2006-2015.

In 2009, the EWPEP was audited at the request of the legislature. The findings confirmed the department was fulfilling its legislative mandated strategy of releasing pheasants. Auditors concluded that pheasant populations continued to decline primarily due to loss of habitat and releasing pen-raised pheasants was not effectively sustaining or improving pheasant populations in eastern Washington. In 2009, the legislature rescinded the requirement for the program to use 80 percent of EWPEP funding for purchasing domestically reared pheasants for wild release. Since that time, WDFW has been reducing the number of birds purchased for release to eventually reach a point where the majority of the funds are devoted to habitat enhancement projects on public and private lands. Over the past few years, WDFW has been reducing the number of released pheasants in eastern Washington. In 2016, WDFW released 9,100 pheasants in eastern Washington and are planning to release 9,100 in the fall of 2017. Funding that is allocated to habitat enhancements will help address objectives identified in the 2016-2021 Game Management Plan (WDFW 2015); to increase the amount of quality pheasant habitat in the pheasant focus area.

Harvest estimates for the Columbia, Snake River, and Yakima Basins have been used to track trends within the primary pheasant management zone. The number of pheasants harvested each year reflects decreasing trends in overall populations from 2006 to 2016 (Figure 3), similar to the statewide harvest trend (Figure 1).

For this report, the "Yakima River Basin" consists of Yakima and Benton counties, the "Snake River Basin" is made up of Asotin, Garfield, Columbia, Walla Walla, and Whitman counties, and the "Columbia River Basin" includes Lincoln, Adams, Grant, Douglas, and Franklin counties.

All three pheasant focus areas had a similar harvest to the previous year in 2016. The 2016 estimated harvest in the Columbia River Basin was 12,130 pheasants, which is a 6% decrease from 2015 harvest of 12,892 and a 33% decrease from the ten yearaverage. In 2016 the Yakima River Basin saw an estimated 7% increase in harvest from the 2015 harvest. The Snake River Basin had a similar harvest in 2016 when compared to 2015.

Hunter numbers have have been steadily declining since 1984 (Figure 1). A commonly held upland game philosophy is that hunters will participate in relation to the abundance of the targeted species. In the case of pheasant hunting in Washington, variations in harvest closely mirror hunter participation (Figure 1). Pheasant population declines are apparent, it is not fully understood whether other factors such as limitations on hunting access, economic changes, or other factors might be playing a role in declining participation. Over the past five years, eastern Washington pheasant hunters spent an average of 5.4 days afield and averaged 2.8 birds per hunter at a harvest rate of 0.4 birds per day.

Habitat

Permanent cover is critical to pheasant production, particularly where the stands consist of a diverse mix grasses and broadleaf, flowering plants (forbs). Diverse vegetation can produce more suitable nesting and brood rearing habitat (Midwest Pheasant Study Group, 2013). Most of eastern Washington pheasant habitat is heavily influenced by agriculture, and as a result, CRP is the driving force behind all contiguous pheasant habitat. Conversion of CRP to annual crops creates a net loss of pheasant nesting and brood rearing habitat. In an effort to reduce these losses, WDFW continues to work with the Farm Service Agency (FSA) and the Natural Resource Conservation Service (NRCS) to develop criteria for the State Acres for Wildlife Enhancement (SAFE). SAFE is a CRP program for private landowners to develop, restore, and enhance native wildlife habitat in priority areas. Several WDFW private lands biologist staff in eastern Washington have completed the NRCS Planning Certification which has provided better access and easier integration with our conservation partners. Private lands biologists provide technical assistance to landowners concerning the installation and enhancement of wildlife habitat. Private lands staff also assist with planting of high-diversity mixes of grasses and forbs, shrub cover plots, and food plots across eastern Washington that benefit upland birds and other wildlife.

WDFW has received grants through NRCS's Voluntary Public Access and Habitat Improvement Program. Portions of these grants were directed at improving pheasant habitat and hunting access within the pheasant focus area.

In the Columbia River basin, WDFW has been leveraging federal funding through the Environmental Quality Incentive Program (EQIP) to increase habitat quality in the largely irrigated landscape where habitat is often scattered and generally of poor quality. The focus involves planting unfarmed irrigation circle corners with grasses, forbs, and/or shrubs. These efforts provide high quality habitat, in areas that are otherwise devoid of any habitat.
The cause of the decline in pheasant populations in Washington is not fully understood, but there

are likely linked to several factors. Research in many parts of the United States indicate that loss of habitat is the primary factor for declining pheasant populations (Labisky 1976, Warner et al. 1984). Of particular importance is the loss of nesting and brood rearing habitat, winter cover and escape cover to elude predators (Warner 1979).

Farming practices continue to evolve. Some of the changes in farm practices have had negative impacts on pheasants. During the 1970s, genetically modified wheat began to be farmed due to the high yield capabilities and its dwarf stubble stalk. Herbicide application to wheat stubble and reduced stubble height are considered to be a primary cause of pheasant population decline on the central High Plains (Rodgers 2002). This may also play a role in Washington's declining pheasant populations. In some areas of eastern Washington, wheat stubble may be the only cover available to pheasants at certain times of the year. The shorter stubble height increases a pheasant's visibility to predators. Wheat stubble and the associated waste grain, an important food source for farmland pheasants, are commonly tilled under and re-cropped in higher rainfall or in the irrigated areas of Washington further reducing resources available to pheasants.

Upland game bird fall population densities, and related harvest, also depend on spring weather conditions. Spring rains are needed to provide early plant growth for nesting cover while consistent warm early summer rains create insect rich environments for pheasant chicks. Early spring drought conditions, even with normal temperatures, may decrease insect availability. A large portion of pheasant chick diet's consist of calorically dense, high protein insects (Savory, C. J. 1989). Lower temperatures in experiments impacted pheasant chicks more than pheasant eggs in any stage of incubation (MacMullan, R. A. and L. L. Eberhardt 1953). When Washington experiences cold, wet springs there is a strong likelihood of poor pheasant production. However, the past two years, 2014 and 2015, the weather conditions have been ideal for nesting and brood rearing.

In addition to the factors previously discussed, pesticide use and urban sprawl are also believed to be strong contributors to declines in pheasant populations. Pesticide use in early spring reduces the early germinating plants that are important food resources at that time of the year (De Snoo, G. R. and J. De Leeuw 1996). Some insecticides, organophosphates for example, can have a direct effect on individual pheasants by sickening them and/or by killing them (Blus, L. J. and C. J. Henny 1997). Herbicide use reduces the overall plant diversity, which is a crucial component of high quality pheasant habitat. Across all agricultural states, pesticides are used on an increasingly broader scale, and have negatively impacted pheasant habitat quality throughout the introduced range. Additionally, houses now occupy many of the areas where pheasants were abundant. This trend is especially apparent within the Columbia Basin and southwest Washington.

Population Surveys

Upland bird surveys in Washington were discontinued in the late 1990s due to limited time and funding for district biologists. When survey data is routinely collected, it is possible to combine that information with available state and national land use databases to link wildlife population changes to land use (Nusser et al., 2004).

Two different pheasant surveys were established in the pheasant focus area with nine survey routes in 2010. The spring pheasant crowing survey has been conducted twice each spring for the past five years between April 15 and May 25 to develop a spring male pheasant breeding population index and track land use changes over time. The raw data from the spring of 2015 suggests that the population is about the same as in past years, which is important given that the 2014 hunting season was especially productive within the Snake River Basin. As these surveys continue into the future, trends may become more evident and more precise predictions could be made. For now, the spring pheasant crowing surveys are expected to continue in the pheasant focus area and may be extended throughout the primary management zone as staff time allows.

Research

WDFW and Washington State University conducted research to determine the effects of different habitat types on the abundance of insects available to pheasant broods. Insect availability is believed to be a primary limiting factor for pheasant populations in the area (Savory, C. J. 1989). However, the study found that insect availability was not limiting in any of the habitat types sampled. The study sought to determine and quantify the insect diversity within existing CRP stands, in CRP stands with nonnative forbs and in CRP stands with native forbs. The study determined that insect abundance was greater in CRP fields with a forb component, but there was no significant statistical difference between the native and nonnative forb plantings (Quinn 2015).

An additional component of the study was added in 2013 that involved placing human imprinted pheasant chicks in these various stand types to forage on insects and then evaluating their diet while on site. Fifty four pheasant chicks survived the imprinting process then the four to nine day old pheasant chicks were used to perform foraging trials within each treatment on four farms to measure diet composition, travel rates, and mass change while foraging. The diets of the pheasant chicks did not differ between plots with an average of 2% arthropods, and the remainder consisting of seed, soil, and foliage. The pheasant chicks did travel twice as far while foraging in the in existing CRP stand than in fields with forb plantings, which reflects the results discussed previously (Koepke 2014 and Quinn 2015).

Management Conclusions

Reductions in hunter participation and harvest are indicators of a declining population of pheasants in eastern Washington. Diligent monitoring is needed in combination with increased efforts to improve habitat to sustain viable pheasant populations in eastern Washington. Long term figures indicate that pheasant populations have declined dramatically since the 1980s and have continued to remain at relatively low levels. Causes for the decline are not clearly understood, but habitat loss and land use changes are likely the primary cause. Suitable habitats are becoming increasingly fragmented and isolated or have been severely degraded. In order to address this situation, the following action items have been developed to guide WDFW's efforts to improve habitats for more productive pheasant populations:

1. Support for an Upland Game Bird Specialist within the southeast Washington pheasant focus area.
2. Use of Geographic Information System (GIS) technology to evaluate existing and potential pheasant habitat areas within the pheasant focus area.
3. Continued partnerships with Pheasants Forever and Quail Forever.
4. Utilize a variety of funding sources to place habitat technicians in the pheasant focus area to provide habitat implementation assistance to farmers.

5. Ensure biologists and technicians have full knowledge of all state and federal habitat programs available to assist farmers in improving pheasant habitats.
6. Utilize mid-contract management for existing CRP contracts to improve habitat conditions.
7. Create and restore nesting cover and brood-rearing habitat.
8. Release rooster pheasants only as put-and-take enhancement of hunting opportunity, not as a population management tool.
9. Work closely with FSA to promote development of habitat for pheasants and other upland wildlife. This is critical as large numbers of CRP contracts expire.
10. Continue efforts with Washington State University and the Pacific Northwest Direct Seed Association to retain stubble height.

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Chukar and Gray Partridge

Chukar and Gray Partridge Status and Trend Report

STATEWIDE

ANIS AOUDE, Game Division Manager

Management Guidelines and Objectives

Management goals and objectives for chukar partridge (*Alectoris chukar*) and gray partridge (*Perdix perdix*) are outlined in the Game Management Plan (WDFW 2014). Harvest management is designed to provide maximum recreation opportunity without negatively impacting populations. In the Spring of 2016, the formation of an ad hoc partridge committee formed inspiring collaboration between western states to write a partridge plan that will be presented at the Western Association of Fish and Wildlife conference in January of 2017.

Hunting Seasons and Recreational Harvest

Hunting season for chukar and gray partridge has varied in length over the years by regions. In the early 1960s and 1970s, Region 1 had a split early and late season while the rest of eastern Washington was regulated with one general season. In 1997, the implementation of one standardized season was set to start October 1 and end the second Sunday in January. The season was changed again in 2003 starting on the first Saturday of October extending to mid-January. Currently, daily bag limits are 6 chukar and 6 gray partridge with 18 of each in possession during the general season.

In 2016, chukar harvest was 9,960 birds. This is a 22% decrease from 2015 which is 11% below the 10-year average harvest of 11,242 (Figure 1). Gray partridge harvest was increasing from 2008-2012, but the 2013 harvest dropped approximately 59% from the previous year. The 2013 decline in harvest may be attributed to poor spring weather which also affected the chukar harvest and the decrease in hunter participation. Harvest for gray partridge in 2016 was 3,420 which was a 34% decrease from 2015. Chukar hunter numbers have steadily declined over the last decade, but we did see a 17% increase in hunter participation in 2015 from 2014 followed by a 33% decline in 2016 with an estimated 2,342 hunters participating. Gray partridge hunter participation also declined with an estimated 1,337 hunters participating in 2016. In 2016, the most productive counties for chukar harvest were Asotin (1,522), Chelan (2,418), Yakima (1,465), Douglas (924), and Okanogan (1,087) counties.

Chukar hunting was a major recreational pursuit in southeastern Washington during the 1970s when harvest averaged more than 66,000 birds in Region 1 alone. Since the 1970s, hunter participation and harvest has steadily decline up to 2013 where we have seen the hunter participation declined and harvest begin to stabilize.

Estimated chukar harvest for the past ten years in Regions 1, 2, and 3 is illustrated in Figure 2. Estimated chukar hunter participation numbers in Region 1 and 3 were similar to 2015 data. Regions 2 saw a decrease in chukar participation numbers. Harvest in 2016 decreased substantially for Region 2 from 7,724 birds harvested in 2015 to 4,933 birds harvested in 2016 (decrease of 36%). However, Region 1 and 3 saw no real change in harvest.

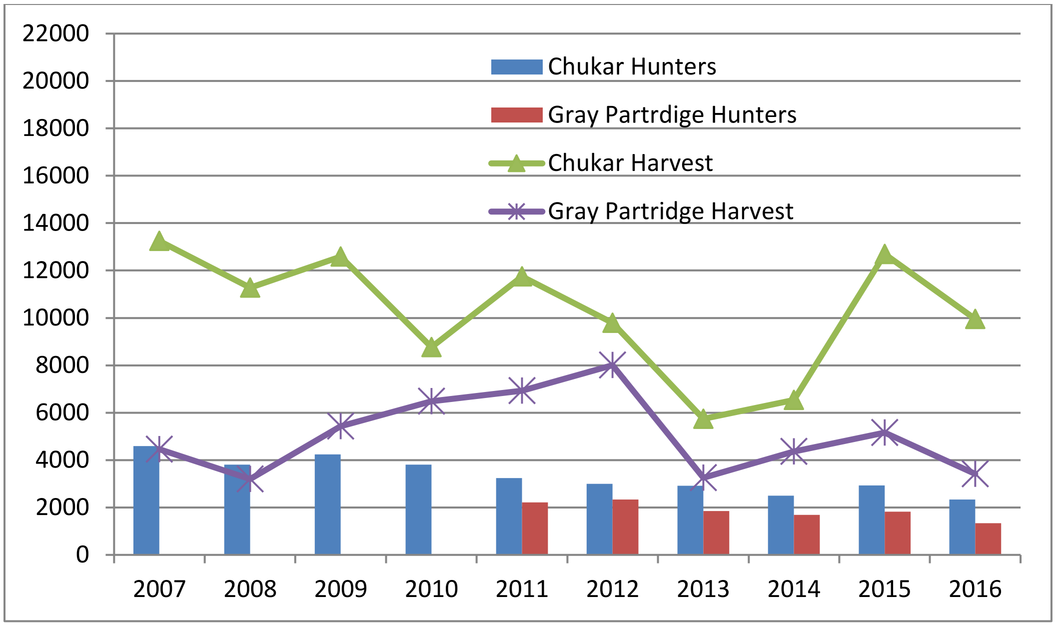

Figure 1. Estimated chukar and gray partridge hunters, chukar and gray partridge harvest statewide for the period 2006 – 2015.

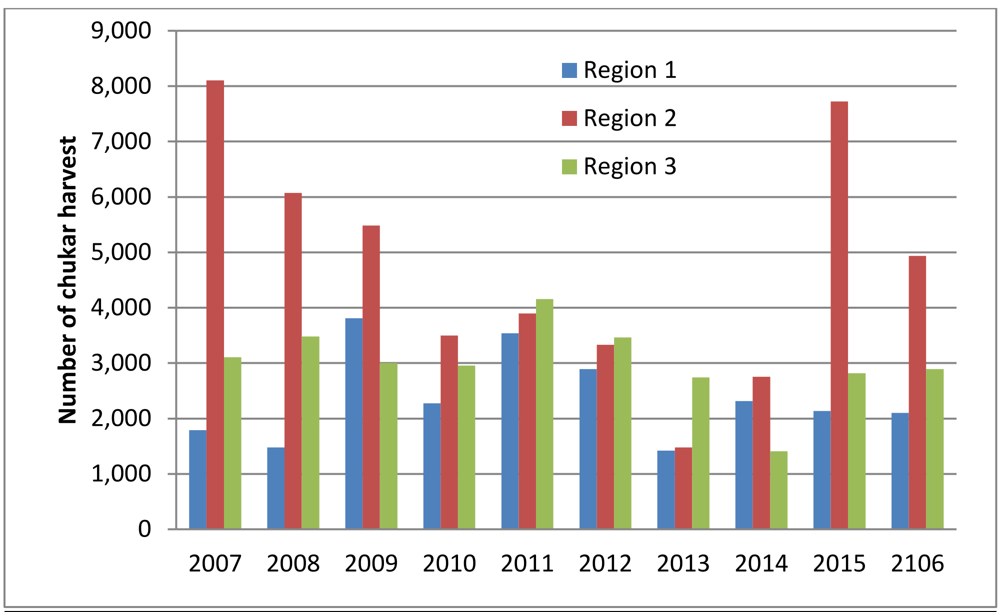

Figure 2. Estimated chukar harvest for Regions 1, 2 and 3 for the period 2006 –2015.

Population Surveys

Chukar populations were surveyed by helicopter from 1987 to 1997, when aerial surveys were terminated due to budget constraints. Depending on time and weather conditions volunteers in Region 2 drive three routes (Colockum-Tarpiscan, Swakane-Nahahum, and Chelan Butte) in early August to count chukar and other game birds. Each route is approximately 20 miles long, and replicated three times. However, in recent years conditions have not been conducive to conducting these surveys. In other regions, field personnel note the abundance of broods during regular field operations and other surveys. Currently, no formal surveys are conducted.

Population Surveys absent field survey information, harvest and hunter effort have been used as an index to population trends. These data are estimated through post-season hunter surveys. Harvest trends suggest that both chukar and gray partridge populations are below long-term averages. Factors that should be considered when looking at this trend is the decline of hunter participation and subsequently harvest as well as climatic weather events. The change in survey method in 2011 needs to also be considered when looking at long-term averages and trends.

Breeding Bird Survey (BBS) information (Sauer et al., 2014) for Washington suggests a stable or steadily increasing population of chukar for the last few years but data credibility is at a moderate level for this species due to low sample size. The BBS data for Gray Partridge illustrate a long-term decline with the same moderate level of confidence.

For chukar and Gray Partridge populations to thrive they are dependent upon recruitment, over-winter survival and spring insect productivity. Persistent snow cover during the winters of 1992-93 and 1996-97 may have influenced the dramatic declines recorded in areas of the state. Populations rebounded rapidly following these rough years with seemingly favorable nesting and brood rearing conditions. Spring drought conditions during 2010-2015 have likely had negative impacts on populations.

Habitat

Chukar habitat is comprised of arid areas with steep slopes, deep valleys, and rocky outcrops. This habitat type can be found where topography, combined with shallow soils, has prevented extensive agriculture and/or development. Cheatgrass is a staple of the chukar diet during spring and fall, and the availability of cheatgrass can have a significant impact on their populations.

In Region 1, some of the best chukar habitat has been overtaken by yellow star-thistle (Centaurea solstitialis). Thousands of acres of habitat along the breaks of the Snake River south of Clarkston are now covered with yellow star-thistle, and likely hinders population recovery. The problem of star-thistle is now so wide spread that several counties have halted control programs leaving it up to the private landowners to control. Although certainly a negative impact, yellow star-thistle is likely not the ultimate cause of the regional population decline.

Chukar habitat is relatively stable in Region 2 because of the precipitous nature of the terrain. However, development is increasing (especially in the Wenatchee Valley), which could impact chukar populations in the future.

In Region 3, WDFW and Department of Defense (DOD) manage the majority of chukar habitat. Both WDFW and DOD are working to increase the chukar numbers on their respective properties. One effort taken by the DOD was to discontinue cattle grazing in 1995 to reduce impacts on wildlife and increase vegetation biomass. Despite collaborative efforts, a substantial portion of both WDFW and DOD property have burned in recent years, which has greatly reduced shrub cover available to resident chukars. Biologists report that chukars in these areas tended to utilize shrub cover more during the winter and breeding season, so losing this habitat type to fires likely reduces the overall habitat quality.

Gray partridge habitat can be found along the "margins" where agricultural fields and native shrub-steppe habitat meet. Their diet consists of cultivated grains, weed seeds such a cheat grass, and clover. Due to "clean" farming conditions their habitat is decreasing. Farm Bill and state habitat programs should be investigated and applied to areas where gray partridge and other upland birds would benefit the most.

Management Conclusions

Based on harvest estimates the decline in both chukar and gray partridge populations is due to many factors including diminishing habitat quality, hunter participation, and climatic events. For example, the invasion of yellow star-thistle has taken over thousands of acres of quality habitat in southeastern Washington reducing available food resources for chukars. Habitat quality in some portions of the state may have actually improved over time with the abundance of wildfires that influenced the spread of annual grasses. However, the concurrent loss of shrub habitat due to fires may be detrimental. Hunter participation for both species has been declining steadily but seems to have stabilized over the past three years. Lastly, chukar and gray partridge populations can also be expected to fluctuate annually in response to weather variability. It is certain that chukar and gray partridge populations in Washington have experienced long-term declines. However, the recent decline in harvest rates, which have continued to be used as the primary population indicator merit further investigation to determine whether they represent a reliable picture of population status or are influenced more heavily by other independent factors.

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Quail

Quail Status and Trend Report

STATEWIDE

ANIS AOUDE, Game Division Manager

Management Guidelines and Objectives

The objectives for quail in Washington are to maintain healthy sustainable populations in all suitable habitats within the state and maximize recreational opportunities consistent with population management objectives outlined in the Game Management Plan (WDFW 2014). In the case of mountain quail (*Oreortyx pictus*) the primary objective is to recover populations in the Blue Mountains and potentially other parts of eastern Washington where significant declines have occurred.

Hunting Seasons and Recreational Harvest

General hunting season for California quail and northern bobwhite (Colinus virginianus) in eastern Washington generally occurs from the beginning of October to mid-January. A special youth only hunting weekend occurs in mid-September. The general season is a mixed bag limit of 10 per day with a possession limit of 30. The general season for California quail, bobwhite quail, and mountain quail (Oreortyx pictus) in western Washington runs from late September through November. Bag limits are the same as eastern Washington, except mountain quail have a daily bag limit of two and a possession limit of four. Mountain quail hunting is closed throughout eastern Washington.

Quail harvest has been on a downward trend following a peak harvest of 190,062 in 2003 (Figure 1). The estimated statewide harvest in 2016 was 69,782 which represents a 13% decrease from the 2015 harvest. Eastern Washington accounts for approximately 98% of the statewide total harvest.

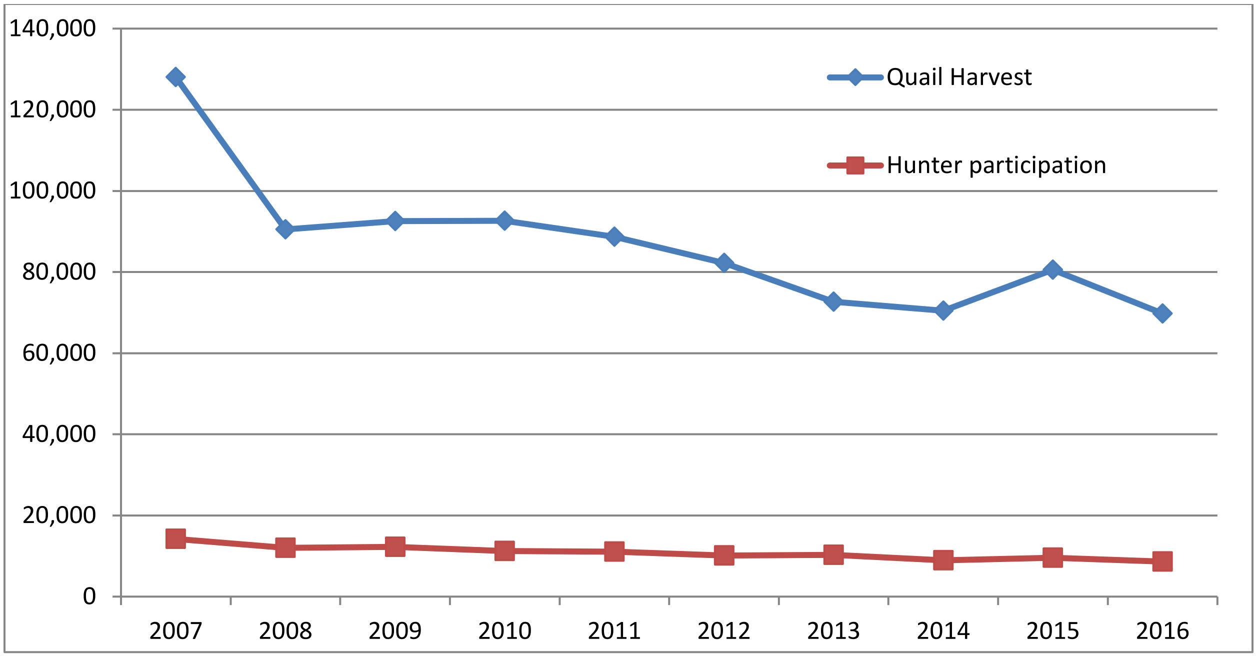

Figure 1. Quail harvest and hunter participation 2007-2016.

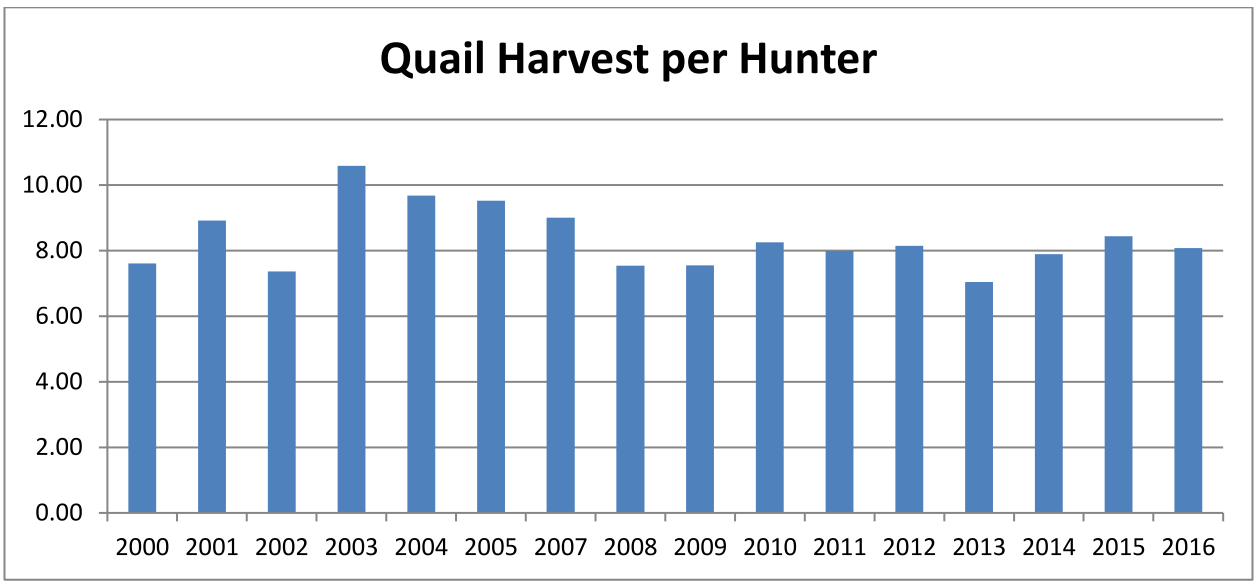

Figure 2. Quail harvest per hunter 2000-2016.

Population Surveys

All population and production surveys were discontinued in 1999 due to limited time and funding for district biologists. The post-hunting season questionnaire is now used to estimate harvest and currently provides the best index of population status.

Based on harvest, it appears that quail populations in Washington are currently much lower than they were in the late 1970s and early 1980s. This decline is most likely related to “clean” farming practices introduced in the early 1980s that has encouraged the removal of shrubby cover along fence lines and draws. In the last 5 years, the US Geological Survey breeding bird survey information for Washington has suggested an increasing trend for California quail populations (Sauer et al. 2014). Another indicator of population is harvest per hunter, but this rate has dropped from an all-time high in 2003 (11 per hunter). Harvest per hunter remained fairly stable from 2008 to 2012 at 8 birds per hunter, but dropped to 7.05 in 2013 reflecting poor spring conditions. In 2016, harvest rebounded slightly to 8.08 birds per hunter (Figure 2).

Given the right environmental conditions quail can be very productive, which may have been the factor that played into the 2013 peak harvest. In 2016, the winter was mild and spring came early bringing lots of insects which will help brood production and potentially increase harvest for 2016.

Five calling survey routes specifically designed to detect the presence of mountain quail were re-established in the Asotin Creek drainage in the spring of 2009. Mountain quail were either heard or observed on 2 of the 5 survey routes that year. The University of Idaho had originally established the routes with WDFW in 2005 using the protocol from “Validation of a Mountain Quail Survey Technique” (Heekin and Reese 1995). These surveys have not been conducted over the past few years.

Habitat

As with other agriculturally associated wildlife, the quantity and quality of quail habitat has been declining for decades. Breeding habitat (including nesting and brood rearing habitat), wintering habitat, and habitat that can provide escape cover are important for sustaining quail populations. Land development and “clean farming” practices have dramatically reduced and fragmented suitable habitat for all upland game birds.

A study looking at the food habits of quail was conducted in southeastern Washington. The study analyzed 157 California quail crops from March – September. The results showed that male and female quail were selective in their feeding habits, preferring leafy green plants in the spring and then transitioning to insects and seeds in the summer (Anthony 1970). The timing of herbicide use in agriculture often corresponds to the “spring green-up” and flushes of undesirable weeds which can reduce the abundance of those early season leafy greens that quail rely on which subsequently impacts quail populations.

The Conservation Reserve Program (CRP) has been a tremendous benefit to Washington upland bird species. The program provides financial incentives to producers to establish perennial vegetation. However, dense vegetation, litter accumulation, and decreased species diversity of older CRP fields, most likely limits the habitat value for some species (Rodgers 1999). Recently, CRP programs have been encouraging landowners to diversify their CRP lands through State Acres for Wildlife Enhancement (SAFE), Environmental Quality Incentives Program (EQIP) and simply requiring more diverse plantings to be reenrolled in the general CRP program. Flowering plants are very beneficial to upland birds because of the insects they attract. The insects in turn serve as an important food resource for newly hatched chicks allowing for greater brood rearing success. Continuation of these programs is considered to be vital to enhance upland bird habitat in eastern Washington.

The highest California quail densities are typically associated with brushy riparian areas and shrub-steppe habitat near riparian areas; however quail have adapted well to urban neighborhoods. Residents enjoy watching quail and often feed them throughout the winter months. Urban quail populations with high survival may act as population reservoirs by providing brood stock to adjacent non-urban populations.

Population Augmentation

Occasionally, private lands biologists and wildlife area staff will trap California quail from urban populations to augment populations that appear to be reduced or to enhance recreational opportunity. No trapping and relocation efforts were conducted this past year.

A three-year project to enhance mountain quail populations in southeast Washington was implemented in March 2005. Mountain quail were trapped in southwest Oregon for release in Idaho and Washington. Washington released 73 birds in March 2005 and 89 in March 2006 in the Asotin Creek watershed. Monitoring of the released birds was accomplished by fitting 50 of the birds with necklace-style radio collars each year. Of the 50 marked birds in 2005, 34% survived to 6 months post release. In 2005, 8 nests had 100% nest success. Average clutch size was 9.25, with average hatch date of July 2. Six of the eight successfully nesting birds had chicks present at 28 days post-hatch, the other 2 failed to have successful flush counts. In March 2006, 89 birds were released with 49 being fitted with necklace-style radio transmitters. By August 2006, 82% of the radio-marked birds had died. Five of the 8 birds attempting to nest during 2006 successfully hatched their nests. Male mountain quail incubated sixty percent of the nests over the 2 years, with 47% of all successful nests raising chicks to 28 days of age. (Stephenson 2008). Unfortunately, birds captured from southwestern Oregon during the winter of 2006/2007 all died in a holding facility in south-central Washington.

In 2012, the mountain quail augmentation effort was reinitiated which included the construction of a new holding facility and the release of 94 birds from western Oregon. However, the survival of the birds from this release was not monitored as closely as with the earlier releases. In 2013, 49 mountain quail trapped in western Oregon were released in the Asotin Creek drainage. 25 of these birds were marked with necklace type transmitters for monitoring. As with previous releases, the initial mortality was high with only eight collared birds alive at the end of June. Two of which were tending nests but neither were successful.

Surveys on the small, dispersed populations of mountain quail are not cost effective, as such the augmentation effort in terms of reestablishing a viable population is very difficult to assess. Prior to any further releases, a full evaluation of the reintroduction effort will need to take place.

Management Conclusions

Washington quail are a major upland game bird species and of significant interest to wildlife viewers. Habitat improvements, including the various Farm Bill programs are vital to WDFW's ongoing efforts to enhance upland game bird populations across the state.

A full evaluation of the mountain quail augmentation project in southeastern Washington is needed to determine whether the methods are helping to reestablish a viable population or whether changes to the current strategy are needed. A first step in this evaluation should be a search for similar evaluations in the neighboring states of Oregon and Idaho where similar augmentation has been occurring. If a review of those efforts is inconclusive, field surveys may be necessary in Washington to examine the current status of mountain quail in the reintroduction area. Habitat enhancements may be needed in conjunction with future releases or as a next step in the recovery effort.

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Grouse

Forest Grouse Status and Trend Report

STATEWIDE

ANIS AOUDE, Game Division Manager

Management Guidelines and Objectives

Forest grouse in Washington include dusky grouse (*Dendragapus obscures)*, sooty grouse (*Dendragapus fuliginosus)*, ruffed grouse (*Bonasa umbellus*), and spruce grouse (*Falcipennis Canadensis*). These four species occur throughout forested lands in Washington. Dusky and sooty grouse were once collectively classified as Blue Grouse. Forest grouse management objectives are:

1. Preserve, protect, perpetuate, and manage forest grouse and their habitats to ensure healthy, productive populations.
2. Manage for a variety of recreational, educational and aesthetic purposes including hunting, scientific study, wildlife viewing, cultural and ceremonial uses by tribes, and photography.
3. Manage statewide populations for sustained harvest.

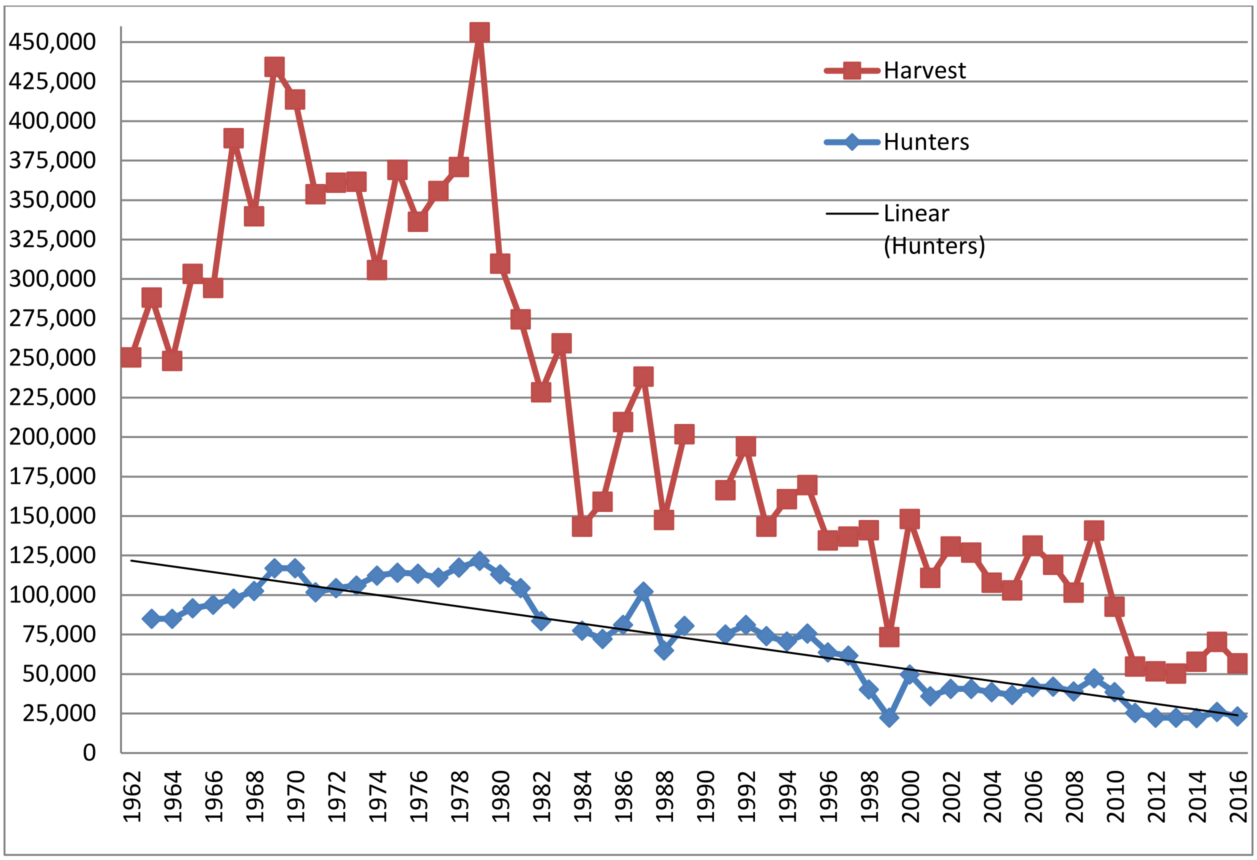

Figure 1: Long-term trend in grouse harvest and hunter numbers, 1963-2016.

Hunting Seasons and Recreational Harvest

A statewide harvest estimate (determined by using mailed hunter questionnaire) is the indicator used for monitoring long-term population trends. Developing estimates of forest grouse hunter numbers and harvest is challenging because of WDFW licensing structure that allows harvest with a big game license or a small game license. Forest grouse harvest survey methods were modified in 1998 and 1999 due to; 1) difficulty in separating effort among the grouse species, 2) inaccuracy in species identification by hunters, and 3) changes in hunting license structure that impacted hunter sample stratification. Comparison of forest grouse harvest information before and after the change in survey methods should be done with caution.

The current September 1st to December 31st hunting season structure has been in place since 1987. A daily bag limit of three of any of the three species was in place from 1952 to 2009 when the bag limit was raised to four. The decision to increase the bag limit was made to increase opportunity not because there was an increase in grouse populations. Hunters had been taking approximately 0.4 grouse per day hunted for the past 50 years. Based on this average, management determined that increasing the bag limit would not impact overall populations. Interestingly, the harvest per day has been approximately 0.3 birds per day since the bag limit was increased. Beginning in 2015, the bag limits were changed again to address hunter concern regarding reduced numbers of grouse being seen by hunters. The regulation at this time is a daily limit of four forest grouse but only three of any one species.

Estimated hunter numbers and harvest have declined from the historic highs of the 1970s and dropped sharply from 2009-2011 but have since leveled off over the past six years (Figure 1). In 2016, the statewide harvest of 56,852 birds was down 19% from the 2015 harvest. The current 10-year statewide harvest average is 79,647 birds, this puts 2016 29% below the 10-year average. Harvest estimates continue to be closely tied to hunter participation. There was a slight increase in hunter participation for 2015, but the average participation rate has remained relatively stable for the past 5 years (Figure 1). Increased restrictions in motorized travel and new fee permit access programs within industrial timberlands may influence hunter participation and contribute to the downward trend.

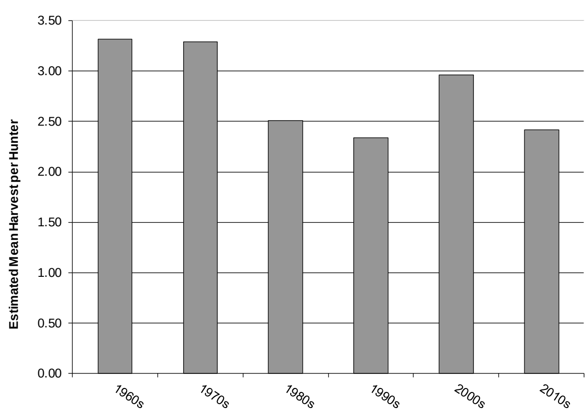

Figure 2: Estimated grouse harvested per hunter in Washington 1963-2016.

Although, grouse hunter and harvest estimates have varied substantially over time; annual estimates of harvest per hunter (an indicator of hunter success) have not declined as steadily. Estimates of hunter success since 2000 have been higher than, or similar to, the 1980s and 1990s (Figure 2).

In 2016, estimated harvest decreased in all regions.

The cause of the long-term and recent harvest declines are not well understood, but reductions in hunter participation are likely a contributor. Loss or changes in forest habitat and vehicular or other access restrictions may also be affecting populations and harvest opportunities.

Region 1 typically has the highest number of both forest grouse hunters and birds harvested in the state. In general, Okanogan and Stevens counties produced the highest numbers of grouse in eastern Washington. West of the Cascades in Region 6 Clallam and Grays Harbor Counties are typically the top producers.

Population Surveys

Currently, statewide population surveys for forest grouse are not conducted; however, some surveys have been conducted in north-central Washington and northeastern Washington over the past 10 years by the upland bird scientist. Forest grouse wings were collected in the same locations each year by placing barrels out for hunters to voluntarily deposit one wing from each grouse harvested. The collected wings are then classified by species, sex, and age. In 2014, the wing collection effort ended in north-central Washington due to limited time and resources. We initiated a pilot grouse wing collection effort in eastern Washington the fall of 2016. Results of this study being analyzed.

Historic statewide wing collection efforts from 1993-95 provided several pieces of important information, including that more than 70% of forest grouse harvest occurs in September and early October, before modern firearm deer seasons. Therefore, current seasons that extend through December probably have very little impact on grouse populations. In addition, there is a tendency for hunters to misidentify grouse species, which has resulted in forest grouse species being combined for current harvest estimation purposes.

Based on long-term harvest trends, it appears that forest grouse populations may be declining. However, it is difficult to draw concrete conclusions due to the fact that harvest estimating methods have changed, hunter participation has declined, hunting access has been more restricted, and there could be other factors that influence harvest independently from population size. The fact that harvest per hunter has not varied much over time (Figure 2) may indicate that the number of grouse available to hunters has not changed as dramatically as the total harvest suggests. Since hunters are not able to consistently identify the species of forest grouse harvested, evaluating population trends for individual species is not possible at this time.

Annual production is greatly influenced by weather conditions during the peak of hatching (late May-early June). Wet and windy weather reduces chick survival due to exposure as well as reducing insect populations at the time when young grouse need a high protein diet. Weather patterns in the spring are often a good predictor of fall harvest and population.

Habitat

Forest management and wildfire are the most significant factors statewide influencing habitat condition and habitat loses for forest grouse populations. Historically, timber harvest activities have been considered beneficial for most species of forest grouse. Recent changes to silviculture techniques such as using herbicide to control broadleaf species which are considered important food resources for grouse may play a significant role in the degree to which commercial forests provide benefits.

Future benefits from timber harvest will depend on the manner in which regenerating forests are managed. Regeneration techniques that include extensive broad leaf tree and shrub control, reduced stocking rates and cover density, and replanting with tree species that provide fewer habitat benefits can negatively impact grouse populations.

In eastern Washington, recent timber market changes have resulted in some timber stands becoming more valuable than they were ten or twenty years ago. Specifically, lodgepole pine forests have increased in value, so there is increased interest in harvesting the timber. In addition, mature lodgepole pine forests have increasingly become infested by pine beetles, killing the trees. Forest managers want to harvest those trees before they decay or burn in wildfires. Whether changes such as these will significantly affect forest grouse are difficult to determine.

Wildfires are an important factor influencing grouse habitat in eastern Washington. Several large fires have occurred in forested areas of Region 2 since the late-1980s. These areas are currently in early successional shrub communities, which should be beneficial to grouse for several years to come but this may be offset by loss of mature forest stands important to winter survival.

There is significant potential to reduce spruce grouse habitat if regeneration techniques are intensive. From a habitat standpoint the better lodgepole and spruce/fir sites may be converted to more merchantable species of trees, and harvested stands may end up at much lower stocking rates than are currently present. Both of these outcomes could reduce the quality of the habitat for spruce grouse.

Supplementation of forest grouse populations is generally considered unnecessary in Washington State. No large-scale efforts have been made to enhance habitat for forest grouse. However, WDFW Habitat Program staff frequently responds to Forest Practice Applications with recommendations to mitigate forest management impacts on wildlife. These recommendations commonly include the following: leaving large down logs in timber harvest areas as drumming logs for ruffed grouse; retaining large, “wolf-tree” Douglas-fir trees on ridge tops for blue grouse winter foraging and roosting, and seeding skid roads and log landings with clover and other grouse forage plants.

Management Conclusions

Many factors may be influencing forest grouse harvest which historically has been used as the primary population status indicator. While harvest has declined, hunter success rates have been reasonably consistent which might suggest that grouse availability to hunters has not changed as significantly as total harvest suggests. The effect of spring weather on chick production and survival is a well-known factor influencing variation in populations; the wide range of variation between regions is vast. Changes in access for hunting may also play a role, as this can be attributed to variation within the sample of hunters surveyed from one year to the next, or it could be recent wildfires forced hunters to new locations.

In past years, the finest level of harvest tracking was at the regional level which is not adequate to identify what factors might be influencing harvest. Currently, we are monitoring data at the county level in hopes of identifying some key factors that are influencing forest grouse populations. Exploring a variety of survey based population monitoring techniques may be necessary as well as studying the effect of hunter harvest and changing silvicultural practices.

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Private Lands Access

Private Lands Access Status and Trend Report

STATEWIDE

CIERA E. STRICKLAND, *Interim* Private Lands Program Manager

Introduction

The Department's Private Lands Access Program promotes cooperation with landowners across the state to provide public access to private property while emphasizing hunting and other outdoor recreational activities. The program's goal is to encourage landowners to provide public access while addressing the costs that landowners incur when allowing the public on their property. A variety of incentives are available to landowners depending upon the property location, habitat(s), and current management of the property. These incentives can include monetary payments, land improvements or Farm Bill technical assistance. Our Private Lands Biologists help the landowners through this process by serving as the program specialists for the Private Lands and the Farm Bill program. Current program funding is primarily provided by Voluntary Public Access and Habitat Incentive Program (VPA-HIP), grants from the Natural Resources Conservation Service (NRCS) and Pittman-Robertson Wildlife and Sport Fish Restoration funds. The success of the program relies on partnerships with private landowners, sportsman's groups and volunteers.

Management Guidelines and Objectives

During this reporting period, the Department had active formal hunting access agreements with 527 landowners encompassing more than 1.3 million acres of private land in Washington (Tables 1 and 2). The majority of landowners have a formal agreement with the Department; however, some industrial timber managers and/or large land parcel owners often work closely with field staff to facilitate public access for hunters without formal agreements. Properties that do not have a formal agreement are not included in Table 1.

The Private Lands Access Program operates and promotes the following five components of hunting access agreements:

- *Feel Free to Hunt* – This includes private lands where the Department has a management agreement with the landowner or organization to provide public access for hunting with minimal restrictions. This type of agreement provides the most open and unrestricted type of access for the public. Many Feel Free to Hunt properties house a wide variety of small game and big game species and provide ample hunting opportunity. Currently, there are 171 properties, with a total of 468,147 acres enrolled in Feel Free to Hunt agreements across the state (Table 2).

- *Register to Hunt* – This includes private lands where the Department has a management agreement with the landowner or organization to regulate hunting access by on-site registration. Hunters are required to sign in using a registration slip found near the designated parking area. parking is usually limited for these properties, to limit the number of hunters. This program is normally used for large circle-irrigation and corporate farms. Currently, there are 14 properties, with a total of 17,219 acres enrolled in Register to

Hunt across the state (Table 2).

- *Hunt by Reservation* **–** This component of the private lands program launched in 2013. It is attractive to many landowners and organizations because it allows access to specific reservation and hunter information via a landowner portal. The Hunt by Reservation program is managed through an online registration system where hunters create an account in order to reserve available properties. The Hunt by Reservation program allows landowners to manage hunting on their lands, without direct contact with hunters. Currently, there are 89 properties, with a total of 102,286 acres enrolled in Hunt by Reservation contracts across the state (Table 2).

- *Hunt by Written Permission* **–** This includes private lands where a landowner or organization voluntarily open their land to public hunting on a contact-for-permission basis. Hunt by Written Permission requires the hunter to make contact with the Landowner, usually by phone, and meet in person to obtain written permission to hunt that property. Written permission is validated by the possession of a written slip, provided to the hunter by the landowner. The Department provides these slips to the landowner at the beginning of the hunting season and we collect them at the end of the hunting season. The Hunt by Written Permission program allows for the greatest flexibility for landowners and is our most widely used access program. Currently, there are 246 properties, with a total of 610,387 acres enrolled in Hunt by Written Permission contracts across the state (Table 2).

- *Landowner Hunting Permit (LHP)* **–** This includes private lands where WDFW negotiates public hunting access to unique and/or high quality hunting opportunities. Landowners are allowed to work with the Department to set customized hunting season opportunities on their property. These opportunities are also advertised annually in the Big Game Hunting Regulations. Currently, there are 7 properties, with a total of 133,630 acres enrolled in Landowner Hunting Permit contracts across the state (Table 2).

Beginning in 2016, the department began an evaluation to assess the overall functionality of the current system that houses private lands property data. We determined that the current platform is no longer able to meet the requirements for the program. In August of 2017, We made plans to migrate the current system and the corresponding program data into a new and improved system. This migration will take the better part of a year, and is intended to be up and running for public use by August 2018.

Population Surveys

In 2016, we proposed using hunter surveys to gather baseline data for the Reservation System. Unfortunately, due to system issues, we were unable to complete a pre-hunt survey prior to the beginning of the 2017 hunt season. We will conduct Post-hunt surveys and analyze the data. Survey response information provides valuable information on user experience, property information and desired system improvements. Survey responses are monitored by program staff and help guide management decisions and communication efforts with landowners.

The post survey consisted of 20 questions and is only available for individuals who reserved and completed a reservation hunt through the Reservation System. This survey is linked to the individual's account and is administered via email.

	FY 2017		Change from 2016		% Change	
Region	**Cooperators**	**Acres**	**Cooperators**	**Acres**	**Cooperators**	**Acres**
1	282	563773	5	13,169	1.81%	2.39%
2	124	356509	-9	-28,621	-6.77%	-7.43%
3	48	175,663	-11	-11,726	-18.64%	-6.26%
4	51	164,302	-3	-17,438	-5.56%	-9.60%
5	14	69,804	0	496	0.00%	0.72%
6	8	1,618	-2	162	-20.00%	11.13%
State Total	**527**	**1,331,669**	**-20**	**-43,958**	**-3.66%**	**-3.20%**

Table 1: FY17 Cooperators, Acreage, and Change from 2016.

Regional Information and Trends

Program objectives and priorities vary by region. The priorities are dependent on available habitat, species emphasis, and hunter access needs. The number of landowner contracts and acres under contract are summarized by region in Table 1, along with changes since the last reporting period. However, these figures do not represent the full scope of access opportunity. Many properties do not fall into the realm of formal agreements, therefore; those properties are not included in Table 1.

With reductions in the Conservation Reserve Program (CRP) and in the economic value of certain crops, some landowners have chosen to return to farming land that was previously CRP ground. Landowners often prefer not to have hunters in areas where crops are being grown.

Region 1

There were 282 cooperators and 563,773 acres enrolled in access agreements in Region 1. Region 1 is one of our most diverse regions due to the latitudinal range of the region. This diversity encompasses many different landscapes which provide unique hunting opportunities throughout the region. Region 1 continues to be a popular area for both upland bird hunting and big game hunting and possesses the largest acreage within the program.

Region 2

There were 124 cooperators and 356,509 acres enrolled in access agreements in Region 2. One of the region's most popular programs is for waterfowl and upland bird hunters. The program offers landowners monetary incentives to allow access on croplands where corn stubble is left to provide food resources throughout the winter months for waterfowl. All of the corn stubble sites are managed through the Reservation System, but based upon certain availability criteria, can also operate as Register to Hunt sites. For more information, see http://wdfw.wa.gov/hunting/cbcs/.

Region 3

There were 48 cooperators and 175,663 acres enrolled in the access agreements in Region 3. A large portion of the acres available in Region 3 are signed up through the Feel Free to Hunt program, primarily for deer and elk hunting. Within Kittitas county, just over 10,000 acres are available through the Hunt by Reservation program on the Puget Sound Energy Wild Horse Wind Facility. The region also enrolls croplands in the corn stubble retention program as described under Region 2.

Region 4

There were 51 cooperators and 164,302 acres enrolled in access agreements in Region 4. Efforts in this region are largely focused on waterfowl and pheasant hunting access. Staff also works with landowners to improve access for deer, elk and bear hunting. In Fall of 2016, the Department extending recreational opportunities by signing agreements with landowners for wildlife viewing. Currently, there are 3 sites within the Region. The majority of contracts with large acreage parcels are with timber companies to facilitate deer, elk, and spring bear hunting access. Some of the waterfowl sites in Region 4 are in the Hunt by Reservation Program and are typically managed to provide quality experiences. These private land contracts in the northern part of the region also help landowners address crop damage problems posed by large numbers of snow geese migrating through the area.

Region 5

There were 14 cooperators and 69,804 acres enrolled in access agreements in Region 5. The program in Region 5 has primarily focused on Klickitat County where the majority of the roughly 70,000 acres have been enrolled in the Feel Free to Hunt sub-program providing deer and turkey hunting opportunities. Other agreements within this region also provide upland bird hunting opportunities. More focus will be directed at securing additional acreage for deer and turkey hunting through the VPA-HIP grant in the upcoming years.

Region 6

There were 8 cooperators and 1,618 acres enrolled in access agreements in Region 6. Opportunities include waterfowl hunting in Grays Harbor and Mason counties and pheasant hunting on private lands in Kitsap County. As in Region 4, a great deal of the effort in Region 6 was devoted to working with large industrial timber companies that are not enrolled in formal contracts. The relationships built between the Private Lands Biologists and private landowners and industrial timber companies have facilitated public access and assisted the landowners with managing public recreation. Work in this area relies heavily on directing volunteer efforts to monitor use, discourage abuse of private lands, conduct cleanup of illegal dump sites, and maintain signage and gates. Much of the private industrial timberland acreage in Region 6 has landowner fee access requirements or is being privately leased. A few of these permit programs have limited hunter numbers. This trend is a growing concern for hunters who are finding it increasingly difficult to locate places to hunt, or they are not willing or able to pay fees for access.

The Department's Private Lands Access Program continues to be a valuable asset to the hunting public and to the landowners that choose to participate. Urban development and changing land uses have continued to reduce the amount of land available to hunters. The implementation of fee permits or exclusive lease access policies by industrial timberland owners is fast becoming a norm in western Washington. As a result of the fee permits, the Department has continued to engage communication efforts with those large landowners. Most of the fee based permit programs that have been implemented are of relatively high cost and have limited the ability of some hunters to acquire those permits. Presently, The Department does not have the resources to match the income potential of these programs. In some instances, the Department has been successful at encouraging landowners to increase the number of low-cost permits to allow additional hunters to access those properties. Hunters who are unwilling or unable to obtain permits are still forced to look elsewhere for hunting access, which will increase pressure on other private and public lands.

The Department is determined to increase public access and hunter opportunity. As situations and opportunities arise, the Department will continue to pursue funding sources and/or no cost agreements to improve the recreational access for the public.

Literature Cited

Washington Department of Fish and Wildlife, 2014. 2015-2021 Game Management Plan. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, Washington, US.

Table 2: Access Agreements and Acreage by County

	Feel Free to Hunt		Hunt by Reservation		Register to Hunt		Hunt by Written Permission		Landowner Hunt Permit		County Totals	
County	**Cooperators**	**Acres**	**Cooperators**	**Acres**	**Cooperators**	**Acres**	**Cooperators**	**Acres**	**Cooperators**	**Acres**	**Cooperators**	**Acres**
Adams	9	11,390					45	108,813			54	120,203
Asotin	6	7,220	21	21,608	2	4,218	16	19,647	2	13,809	47	66,502
Benton	10	30,484	1	871	2	8,320	1	12,150			14	51,825
Chelan												
Clallam							1	353			1	353
Clark							1	20			1	20
Columbia	14	25,593					12	22,151			26	47,744
Cowlitz	1	390									1	390
Douglas	6	9,008					28	80,512			34	89,520
Ferry							6	2,615			6	2,615
Franklin	14	21,087					7	12,175			21	33,262
Garfield	8	8,012	3	1,420	2	3,674	8	15,379			21	28,485
Grant	8	11,442	2	17,374			24	73,227	1	41,870	35	143,913
Grays Harbor	1	290	3	573							4	863
Island	4	1577									4	1,577
Jefferson			1	118							1	118
King	1	288									1	288
Kittitas			2	10,080							2	10,080
Klickitat	6	66,040	3	1,185			3	1,790			12	69,015
Kitsap												
Lewis	1	219									1	219
Lincoln	8	7,885					33	46,340			41	54,225
Mason												
Okanogan												
Pacific							1	65			1	65
Pend Oreille	1	7757	1	238			1	120			3	8,115
Skagit	12	1,197	4	115	2	213	3	157,094			21	158,619
Snohomish	5	860	3	358			1	10			9	1,228
Spokane	2	127,130	1	370			3	3,204			6	130,704
Stevens	1	62,225	3	1,626			16	11,132			20	74,983
Wahkiakum					2	259	1	120			3	379
Walla Walla	31	54,625	3	10,692			17	25,958	1	7,280	52	98,555
Whatcom	10	1,303	4	1,072	2	215					16	2,590
Whitman	6	4,409	34	34,586	2	320	15	14,532			57	53,847
Yakima	6	7,716					3	2,980	3	70,671	12	81,367
Totals	**171**	**468,147**	**89**	**102,286**	**14**	**17,219**	**246**	**610,387**	**7**	**133,630**	**527**	**1,331,669**

Wildlife Conflict Management & Prevention

Wildlife Conflict Management & Prevention Status and Trend Report

STATEWIDE

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Introduction

In 2012, the Washington Department of Fish and Wildlife (WDFW) renewed its focus on human-wildlife conflict management. This report is intended to illustrate efforts to meet the Game Management Plan objectives (WDFW 2014) while creating a historical account of human-wildlife conflict management actions. WDFW has implemented programs that provide opportunities for improved knowledge to develop specific strategies and tools for mitigating human-wildlife conflict in Washington for long-term sustainability of wildlife resources.

The convergence of human population expansion, nature-based tourism, and escalating interest in outdoor recreational opportunities in Washington are likely to result in increasing human-wildlife conflicts. Maintaining a healthy ecosystem for humans and wildlife will require innovative approaches that minimize these negative interactions. These approaches must include science based decision making that incorporate public opinion for social context. WDFW is committed to informing and assisting the public to employ proactive measures and providing quick, effective response once interactions and property damage occur (Conover 2001).

WDFW conducted an opinion survey that identified 29% of the Washington public as having experienced negative situations or problems associated with wildlife (Duda et al. 2014). Deer and raccoons were the most commonly named species causing problems (35% and 25%, respectively), followed by bear (14%), geese (13%), and coyotes (10%; Duda et al. 2014).

WDFW has not always conducted formal assessments of human-wildlife conflict complaints. Current trends indicate that human-wildlife conflict resolution in Washington is a management necessity and traditional recreational harvest is not always effective in resolving negative interactions.

Management Guidelines and Objectives

In December 2014, WDFW published the Game Management Plan (WDFW 2014) which outlined three goals and 10 human-wildlife conflict management objectives with strategies designed to create an integrated system of management actions, data collection, and information sharing.

The goals for human-wildlife conflict management in Washington are to:

1. Improve our understanding and ability to predict human-wildlife conflict issues;
2. Enhance proactive measures to prevent human-wildlife conflict and improve agency response to interaction events; and

3. Minimize, mitigate, and manage conflict events to maintain human tolerance and perpetuate healthy and productive wildlife populations.

Management Actions

WDFW management actions are designed to minimize negative human-wildlife interaction and assist landowners with prevention, mitigation, and, when necessary, compensation for property damage or loss (as provided by law). An effective strategy for managing human-wildlife conflict is to allow staff a degree of flexibility to test and implement new techniques while improving existing mitigation tools. WDFW staff assesses each scenario and use their professional judgment to determine the best course of action for interaction resolution.

In addition to accounting for human-wildlife conflict issues when setting recreational harvest seasons and limits, WDFW will employ other tools when traditional recreational harvest cannot resolve the issue. WDFW has used hunters to assist with deer, elk, and turkey damage issues and hound handlers, trappers, and hunters to assist with bear and cougar depredation events. In each case, there are criteria that must be met and restrictions that direct the final disposition of the animal harvested.

WDFW continues to use a three-category system to respond to human-wildlife conflict issues: 1) self-help, 2) public safety, and 3) non-public safety but requiring assistance. Self-help involves referring a customer to the WDFW web site to obtain an answer to a wildlife-related nuisance problem, directing the customer to a list of certified Wildlife Control Operators available for hire, or directing the customer to contact the United States Department of Agriculture Wildlife Services for help in solving a conflict situation. Often the self-help tools are used to assist with damage situations involving small game, furbearers, and unclassified species (e.g., raccoons, beavers, coyotes, etc.). The WDFW Law Enforcement Program is responsible for interactions affecting public safety that involve bear, cougar, moose, and wolves. Non-public safety wildlife issues, including depredations involving deer, elk, turkey, black bear timber damage, and wolves, are generally resolved through the WDFW Wildlife Program.

Deer, Elk, and Turkey damage prevention and kill permits

Depending upon the circumstances, landowners may enter into a Damage Prevention Cooperative Agreement with WDFW to use non-lethal mitigation tools for damage caused by deer, elk, and turkey. If these mitigation tools are ineffective, a Wildlife Conflict Specialist may issue a damage prevention permit (DPP) or a kill permit (KP) to a landowner that allows for the removal of one or more offending animals through the use of licensed hunters or agency kill authority. During the 2016 damage season (April 2016–March 2017), a total of 2,350 permits were issued to remove offending deer, elk, and turkey (Table 1).

Table 1. Total damage prevention (DPP) and kill permits (KP) issued by Washington Department of Fish and Wildlife Region for deer, elk, and turkey, April 2016–March 2017.

Permit	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Total
DPP Deer	459	34	38	15	–	29	575
KP Deer	179	11	14	11	1	43	259
DPP Elk	76	15	442	2	45	121	701
KP Elk	248	10	92	40	39	76	505
DPP Turkey	25	8	–	–	–	–	33
KP Turkey	269	2	–	6	–	–	277
Total	**1,256**	**80**	**586**	**74**	**85**	**269**	**2,350**

Licensed hunters with a DPP must purchase a Damage Tag to participate in a deer or elk damage resolution hunt and can retain the deer or elk. Hunters purchased 1,060 deer and elk Damage Tags during the 2016 damage season; of those Damage Tag holders who reported, 114 deer and elk were harvested for an estimated success rate of 11% statewide (Table 2).

Table 2. Total reported harvest by hunters with deer and elk Damage Tags for each Washington Department of Fish and Wildlife Region, April 2016–March 2017.

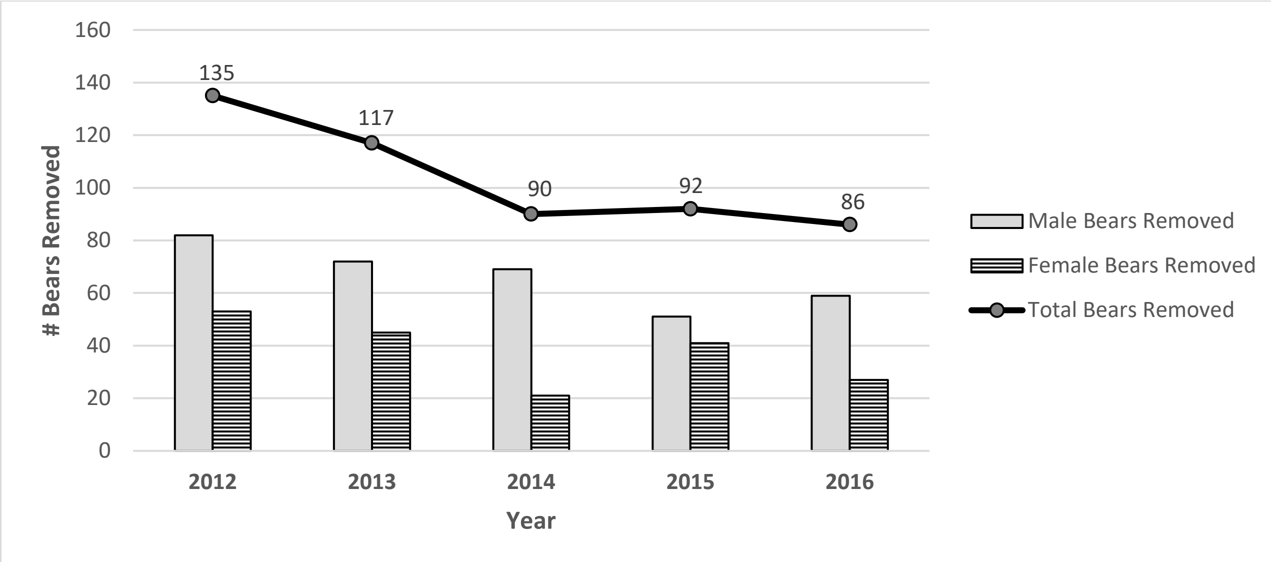
Damage Tag Type	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Grand Total
Deer	61	2	2	0	0	0	65
Elk	4	0	27	0	1	17	49
Grand Total	**65**	**2**	**29**	**0**	**1**	**17**	**114**

Black Bear Timber Damage

Black bears emerge from winter dens when food sources are relatively scarce and may strip bark off certain species of trees to access the carbohydrate-rich cambium. Bark stripping or "peeling" may hinder the growth of the tree or kill it, causing the potential for financial loss to commercial timber growers. The damage period occurs from approximately April through June and ends once other food sources, such as berries, become more abundant.

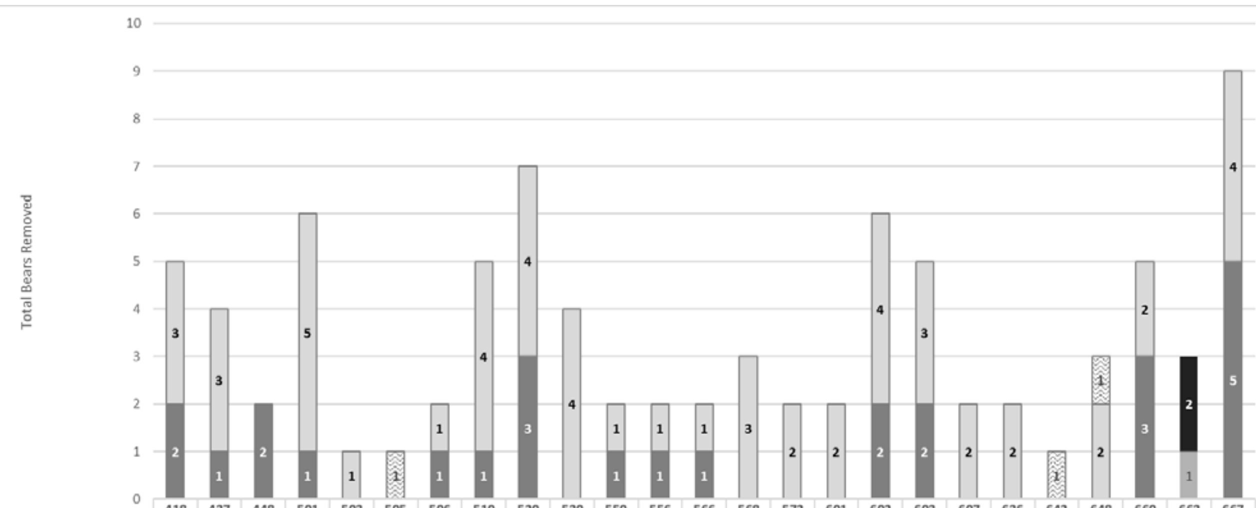
Commercial forest landowners and managers experiencing timber damage caused by black bears may request a black bear timber damage depredation permit. This permit request requires evidence of damage from the landowner/manager, typically in the form of a date-stamped photograph, and must specify the damage location, requested removal method, and who will participate on the permit. The number of depredation permits issued (123 permits in 2012 and 86 permits in 2016) and the number of bears removed (Table 3) varied from 2012–2016 but have generally declined.

Table 3. Number of male and female black bears removed annually during the bear timber damage period, 2012–2016.



A total of 86 bears were removed during the 2016 timber damage period, including 59 males (69%) and 27 females (31%). Age data was acquired for tooth samples from 84 of the 86 harvested bears. Male (n = 59) and female (n = 25) bears had a mean age of 5 years. Most males (59%) and females (56%) were less than 5 years old. Bears were removed using a variety of methods, including hound hunting, trapping with snares, and Master Hunters (Table 4).

Table 4. Number of bears removed during the black bear timber damage period by Game Management Unit (GMU), sex, and removal method, April–June 2016. MH = Master Hunter



	418	437	448	501	503	505	506	510	520	530	550	556	566	568	572	601	602	603	607	636	642	648	660	663	667
Males By Snare						1															1	1			
Males by MH																								2	
Males By Hound	3	3		5	1		1	4	4	4	1	1	1	3	2	2	4	3	2	2		2	2		4
Females By MH																								1	
Females by Hound	2	1	2	1			1	1	3		1	1	1				2	2					3		5

The black bear harvest total for 2016, including the total recreational harvest, the spring permit hunt, and bear timber damage removals, was 1,621 bears statewide. Females represented 35% of the total statewide harvest. Black bear timber damage removals represented 5% of the total statewide harvest.

Carnivore (black bear, cougar, and wolf) depredation on livestock

Accounts of managing and response to livestock losses and injury caused by black bears and cougars are described under those sections. Please see the Wildlife Damage Claims section below for detail regarding compensation claims during fiscal year 2017.

Cost-share and Prevention measures for livestock losses

WDFW offers cost-sharing with livestock producers for deploying conflict prevention measures. Producers that sign a Livestock Damage Prevention Cooperative Agreement (DPCA-L) may receive cost-share funds to assist them with installing and using non-lethal conflict prevention tools. The DPCA-Ls identify non-lethal measures that a producer can use to minimize livestock loss to wolves. The agreements can last up to one year. They may be signed at any time during a fiscal year and end at the close of the fiscal year. Potential prevention measures that may be included in a DPCA-L include: fencing bone yards, surrounding carcasses with fladry, removing carcasses, providing deterrence tools (screamers, range riders, guard dogs, radio-activated guard boxes, fladry, predator fencing, electric fencing, bio fencing), and protecting livestock rearing areas. The most common measures deployed by producers under DPCA-Ls are range riding and sanitation. Cost-share amounts can vary depending on the livestock operation, location of the livestock herd in relation to wolves, proactive measures selected, and duration. During fiscal year 2017 (July 1, 2016 – June 30, 2017), there were 60 DPCA-Ls written with livestock producers statewide.

In addition to DPCA-Ls, WDFW also contracted Range Riders to assist ranchers in effort to minimize livestock losses caused by wolves. Range riders were skilled at assessing potential wolf presence within the vicinity of livestock and provided a consistent human presence with livestock while on grazing allotments. Range rider duties included, but were not limited to: monitoring the health and behavior of a herd; seeking out any signs of wolf or other carnivore activity in the area; implementing tools and techniques that minimize predation risk; deploying non-lethal hazing techniques; trying more intensive livestock management, or any number of other techniques or combination of techniques; and frequent communication with the livestock producer and WDFW staff regarding planned livestock movements and grazing plans. During fiscal year 2017, WDFW had 9 range rider contracts which utilized up to 13 different riders throughout the year.

Wildlife Damage Claims

<u>Agriculture</u>

Commercial agriculture producers who meet the definition of "eligible farmer" (Revised Code of Washington 82.08.855), have cooperated with WDFW prior to claim initiation, and experience crop damage from deer and elk may be eligible for compensation from the state. Funds for compensation are appropriated through legislation. The payment of a claim is conditional on meeting specific criteria [Washington Administrative Code (WAC) 220-440-140 and 220-440-150] and the availability of specific funding for this purpose; Reimbursement for damage claims is not guaranteed. The total compensation paid for deer and elk crop damage claims in fiscal year 2017 (July 1, 2016 – June 30, 2017) was $93,270.96 (with an additional $14,143.66 in assessment fees).

Livestock

Additionally, commercial livestock producers who experience livestock loss caused by bear, cougar, or wolf may be eligible for compensation under WAC 220-440-170. Similar to the deer and elk claims, payment is conditional upon meeting specific criteria and the availability of specific funding for this purpose; Reimbursement for damage claims is not guaranteed. The total compensation paid for direct livestock losses (i.e., losses determined by WDFW to be confirmed or probable) caused by wolves in fiscal year 2017 was $5,106.60 with an additional $300 in assessment fees. The total compensation paid for direct livestock losses caused by cougars in fiscal year 2017 was $3,858.75 with an additional $360 in assessment fees.

In the latter part of fiscal year 2016, the WDFW established an independent, five-member Livestock Review Board (LRB) to evaluate claims and make recommendations to WDFW for indirect livestock losses due to harassment by wolves, including greater than normal losses, reduced weight gains, and reduced pregnancy rates in livestock. The LRB consists of two livestock producers, two members from the environmental community, and a rangeland scientist. The department carefully evaluates and considers the recommendation from the LRB when considering settlement of an indirect livestock loss claim.

Wildlife Control Operators

Wildlife Control Operators (WCO) are private individuals who are certified by WDFW to assist landowners in the prevention or control of wildlife-related damage and charge a fee. A WCO is allowed to harass, control, and/or trap various small game, furbearer species, unclassified wildlife, and predatory birds. WCOs are not certified to handle nuisance issues involving deer, elk, cougar, bear, moose, wolf, bighorn sheep, mountain goats, turkeys, or protected or endangered wildlife.

The WCO program is administered through the Human-Wildlife Conflict Section at the WDFW office in Olympia. Classes for WCO certification are held a total of four times per year, alternating between the Olympia and Spokane WDFW offices. Once a person meets all the requirements for becoming a WCO (WAC 220-440-100) and completes and passes WCO training, they are presented with a certificate valid for three years that allows the individual to handle specific nuisance wildlife issues year-round and state-wide. Fifty people completed training and were certified as WCOs in 2016 compared to 84 people in 2015. Beginning March 2016, a revision to WAC 220-440-100 went into effect and stipulates that a prospective WCO must demonstrate two years of trapping or wildlife damage management experience before they can take the WCO class and apply for WCO certification. Methods of documenting experience include, but are not limited to, possessing a trapper's license for two years, providing a letter of recommendation from a currently certified WCO or trapper, providing evidence of being employed in the wildlife abatement field for two years, providing a written statement verifying they are currently working with a certified WCO, or other method as identified by the department. The more stringent requirements under the revised rule explain the reduction in certifications between 2015 and 2016. Currently, there are 324 people in Washington State with valid WCO certificates.

Special Trapping Permits

Property owners who are experiencing wildlife-related damage to their property are allowed to mitigate the problem by capturing and/or removing the species responsible, with exceptions. In some cases, when nonlethal measures have been deemed ineffective, a property owner may apply for a special trapping permit (STP), valid for 30 days, authorizing the use of one or more body-gripping traps. Body-gripping traps that may be authorized under a STP include a Conibear-type trap in water, a padded-jaw leg-hold trap, and a non-strangling foot snare.

During 2016, 663 STPs were issued statewide which allowed for removal of certain wildlife causing damage to public or private property. The 2016 value is an increase from the 580 permits issued in 2015. The most common authorization requested was for trapping mountain beaver within industrial timberlands.

In 2016, requests for STPs and corresponding wildlife removals were variable by month, but the highest numbers generally occurred fall through spring. Special Trapping Permit requests and the number of animals removed using STPs were highest in western Washington counties.

Table 4. Total number of individual animals reported trapped for the six most common wildlife species removed using Special Trapping Permits in 2016.

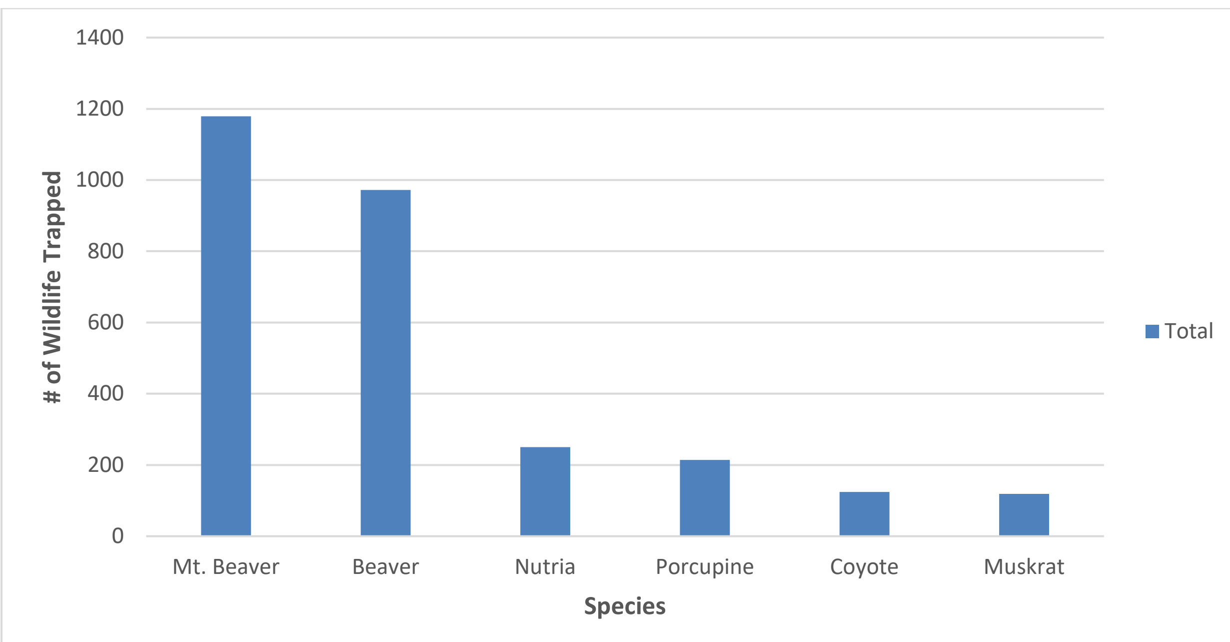


Table 5. Total number of wild animals reported trapped with Special Trapping Permits (STP) and the total STPs in each month, 2016. The number of wildlife reported trapped in each month is based on reporting for 30-day permits that ended within a given month.

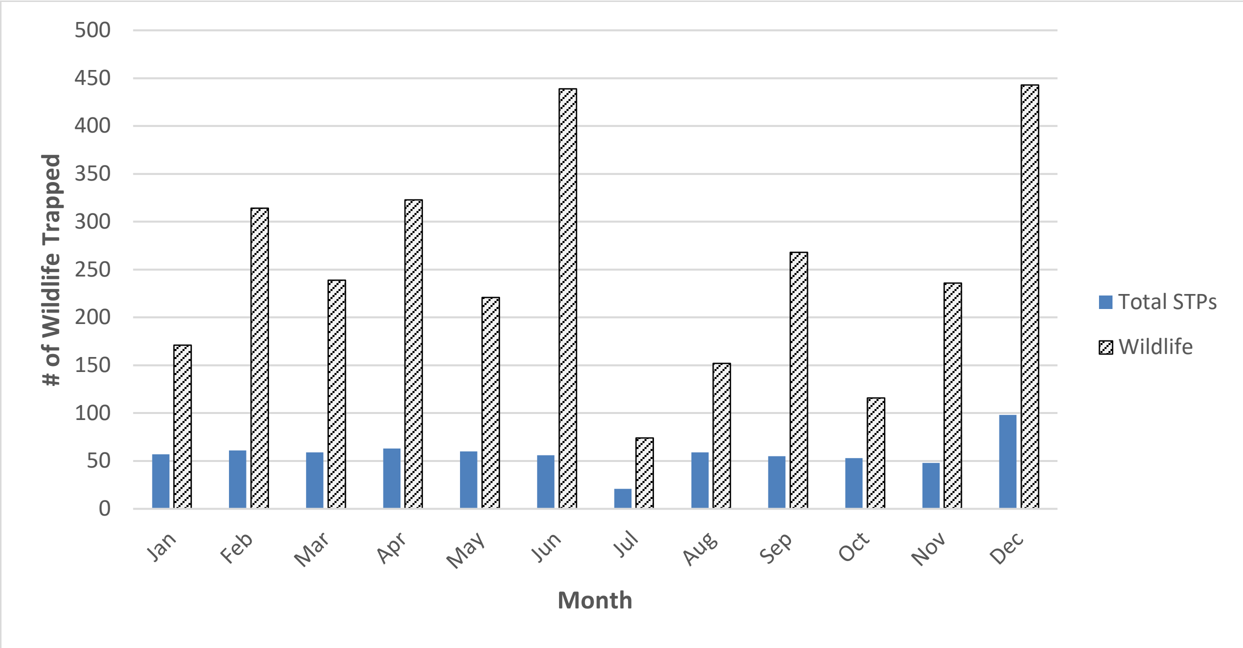
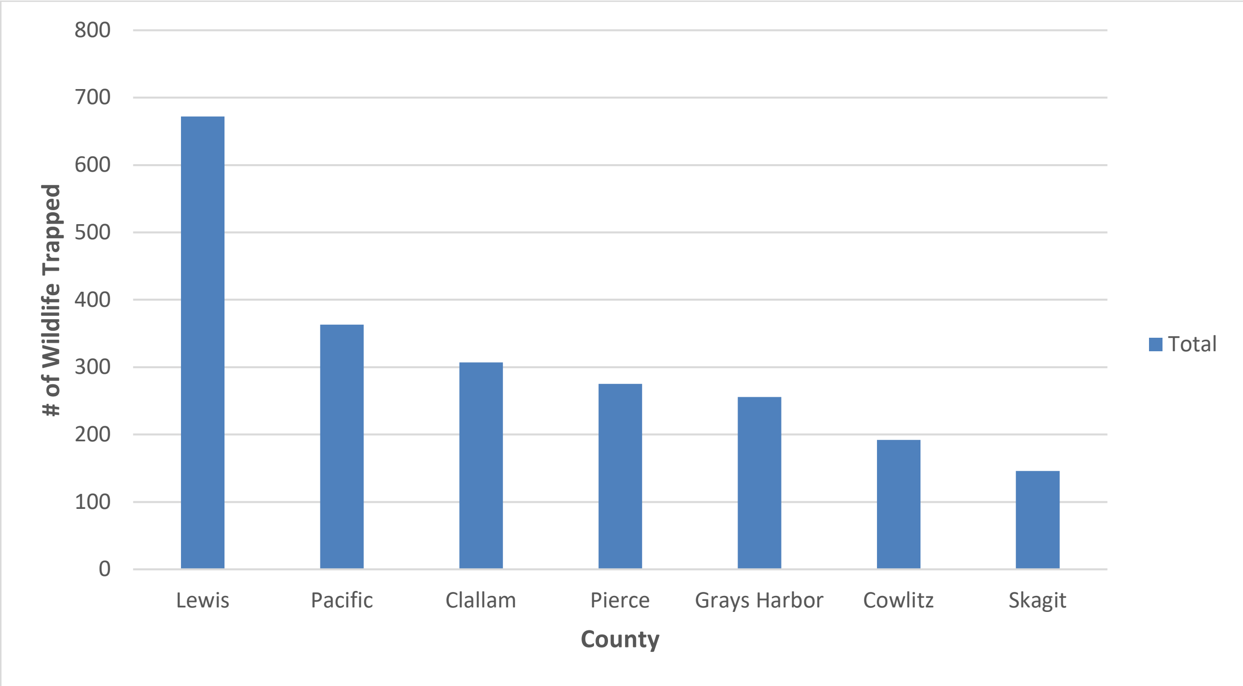


Table 6. The total number of wildlife species reported trapped in the seven counties with the highest reported wildlife removals using Special Trapping Permits in 2016.



Management Conclusions

Minimizing the potential for human-wildlife conflict requires the use of a variety of adaptable tools and techniques to ensure sustainable wildlife populations without negatively impacting our natural resources or the livelihoods of Washington residents. Food resources, such as agriculture crops, livestock, or unnatural attractants in the vicinity of residences, are the motivating mechanism for potential human-wildlife conflict. During 2015, WDFW improved data collection methods, increased response to conflict issues, deployed new methods and techniques for managing conflict, and increased information sharing for mitigating negative encounters. The remaining challenges for effective human-wildlife conflict management include: 1) improving rules that address the primary conflict issues, 2) developing policies and procedures that facilitate a smooth process by which actions can be deployed, and 3) furthering appropriate data collection to direct management activities. An additional challenge and objective for the upcoming years is improving outreach and information sharing through the use of multimedia approaches (e.g., print, audio, and visual platforms).

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