Winter Ridge release

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Introduction

Mountain quail (*Oreortyx pictus*) populations have declined in the 20th century throughout the entirety of their historical range, but particularly in the eastern portions found in western Idaho, northwestern Nevada and eastern Oregon. Habitat loss due to fire suppression, overgrazing and water impoundment projects is thought to be responsible for much of the population decline (Brennan 1991, 1994).

In 1996 Oregon Department of Fish and Wildlife began to investigate the current and historical distributions of mountain quail in eastern Oregon. Mountain quail sightings were mapped to further understand their current distribution. From 1997 to 2000 Oregon State University, PhD candidate Michael Pope studied mountain quail in Hells Canyon and in the southwestern cascade and coast ranges. The purpose of his research was to determine life-history characteristics in stable populations (SW Oregon Cascade and Coast Ranges) vs apparently declining populations (northeast Oregon’s Hells Canyon). Pope also documented the translocation of mountain quail taken from the southwestern cascades and coast range and released and monitored in Hells Canyon. Pope’s research gave insight into reproductive characteristics, movements, survival and habitat use which laid the foundation for the ongoing restoration plan for mountain quail.

The Oregon Department of Fish and Wildlife, Oregon State University-Game Bird Department, and U.S. Forest Service initiated the Mountain Quail Translocation Project in 2001. The goal was to re-establish dwindling mountain quail populations throughout eastern Oregon. Loss of habitat due to fire suppression, overgrazing, and water impoundment projects have led to a drastic reduction of mountain quail populations during the last century (Brennan 1991, 1994). This was the 15th year of a cooperative effort to reintroduce mountain quail to their historic range in central and eastern Oregon. Wide ranging changes in habitat in the western Great Basin region have greatly reduced or extirpated populations of mountain quail in their historic range (Gutierrez and Delehanty 1999). Luckily healthy populations exist in Oregon’s western cascade and coast Ranges. Post translocation monitoring of radio marked mountain quail yields valuable information including survival, movements, habitat use and reproductive success that aide in future translocation site selection and development of monitoring protocols (Pope et al. 2003). Since 2001 mountain quail have been translocated to Murders Creek Coordinated Resource Area (2001-2003), Deschutes National Forest (2003-2005), Malheur National Forest (2004, 2005), Steens Mountain (2005-2007), Trout Creek Mountains (2008-2010), Gearhart Mountain (2011-2013) and Winter Ridge (2014). Since 1980 and prior to the Winter Ridge translocation, there had only been 22 documented sightings of mountain quail in Lake County (Fig. 1). This is the second of three years for translocating and monitoring mountain quail at Winter Ridge.
Mountain Quail Natural History

Mountain quail are secretive birds and the sexes are monomorphic in both size and plumage. Within their known range, mountain quail are commonly found in shrub-dominated communities, mixed conifer-shrub habitat (resulting from logging operations or fire) and riparian habitats (Johnsgard 1973, Gutierrez and Delehanty 1999, Pope 2002). A behavior unique to mountain quail is a seasonal migration to breeding areas at higher elevations (Pope 2002). Pair bonds form in late March to April and pairs are usually on breeding ranges by early May (Johnsgard 1973, Pope 2002).

Mountain quail are monogamous and employ a reproductive strategy where both sexes incubate clutches (Pope and Crawford 2001). The female will lay 7 to 15 eggs in two separate
nests usually within 200m of each other and both adults will incubate clutches independently. Male mountain quail are equally as capable as females in incubating and rearing broods. In Oregon, from 2001-2010, 45.3% of the nests were incubated by males and males generally incubated larger clutches and were more successful than females (Budeau and Hiller 2012). Broods are raised independently until the pair reunites at around 10 days’ post hatch (Pope 2002). Nests are often cups lined with surrounding vegetation such as pine needles, feathers and are well concealed. Mountain quail exhibit high nest fidelity and don’t readily abandon clutches. Nests are typically incubated 24 to 30 days and hatch precocial young.

In general quail exhibit low rates of survival with predation being the most common factor of mortality, although they are susceptible to exposure to cold weather and drought (Gutierrez and Delehanty 1999).

**Study Area**

Winter Ridge is an escarpment located in the Fremont National Forest (FNF) in Lake County, OR and is 42.5 km long with an elevation range of 1340 to 2366 meters. Average annual precipitation is 31.9 cm of rain and 46.7 cm of snow (1957-2013 avg.). Average minimum and maximum temperatures are 2.1° C and 17.0° C, respectively (range 30.5° C in July to - 31.0° C in December). The main vegetation association on Winter Ridge is dry ponderosa pine (*Pinus ponderosa*)/fescue (*Festuca sp.*). Lodgepole pine (*Pinus contorta*) occurs at the higher elevations and in areas of colder micro climates. Lower elevations have primarily been converted to agriculture but native vegetation is big sagebrush (*Artemisia tridentata*) communities.

Two release sites were chosen for the first year of a planned three-year mountain quail translocation project. Bennett Flat sits at an elevation of 1649 m and Harvey Flat located 1.9 km to the SE sits at an elevation of 1932 m. Both sites burned in the Winter Fire of 2002 resulting in favorable habitat conditions for mountain quail. Ponderosa pine is the dominant overstory species at both sites. Dominant shrub cover consists of snowbrush (*Ceanothus velutinus*) followed by greenleaf manzanita (*Arctostaphylos patula*). Other common shrubs present are serviceberry (*Amelanchier arborea*), snowberry (*Symphoricarpos albus*), wax currant (*Ribes cerium*), bitter cherry (*Prunus emarginata*), mountain mahogany (*Cercocarpus ledifolius*), rabbitbrush (*Ericameria sp.*), bitterbrush (*Purshia sp.*), and sagebrush (*Artemisia sp.*). Common grasses and ground cover include Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), western needlegrass (*Achnatherum occidentale*), sandberg bluegrass (*Poa secunda*) and bottlebrush squirreltail (*Elymus elymoides*) as well as numerous species of forbs.
Methods

Mountain quail were trapped in the southern Cascade and Coast Ranges between November 2014 and February 2015 using treadle-style traps baited with grain. One hundred sixty-eight mountain quail were marked with aluminum leg bands. Fifty of the 168 were also outfitted with necklace-style VHF radio transmitters manufactured by American Wildlife Enterprises. Age class was determined by plumage (Leopold 1966). Gender was determined for the 50 radio marked birds using DNA from a small sample of blood and analyzed by DDC Veterinary, Fairfield OH, USA. All quail were housed at a holding facility in Roseburg, OR until transport and release on March 20, 2015.

During the 2015 monitoring season four aerial telemetry flights were completed to locate quail when technicians were unable to find them from the ground. Attempts were made to locate individual radio-marked quail from the ground every 7-10 days.

When quail were located the following data were recorded: location (recorded in NAD 83 datum and UTM’s), dominant over and understory plant species, distance from nearest road and water, slope, aspect and elevation. Other information included date, time, associated birds and general observations. When nests were located, birds were flushed and the number of eggs recorded. The type of vegetation concealing the nest cup and the type of nest materials used were also recorded. Nests were monitored weekly from a short distance until hatching or they were depredated. Hatch success for nesting attempts was determined by counting egg shells and membranes. Nests were considered successful if at least one egg hatched. When broods were located an attempt was made to count chicks. Broods were not intentionally flushed from cover until they were old enough to fly. When mortalities were located an attempt was made to determine the cause of death. Mortalities were attributed to avian predators, mammalian predators, or unknown.

Table 1. Mountain quail released on Winter Ridge, Lake County, OR in March 2015

<table>
<thead>
<tr>
<th>Release date</th>
<th>Release total</th>
<th># Radio collars</th>
<th>Male/female collared</th>
<th>HY/AHY* collared</th>
<th># Banded only</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/20/2015</td>
<td>168</td>
<td>50</td>
<td>34/16</td>
<td>28/22</td>
<td>118</td>
</tr>
</tbody>
</table>

*HY=Hatch Year(Juvenile), AHY=After Hatch Year(Adult)
**Results**

Fifty radio-marked quail (Table 2) were monitored for 159 days, during the time period of March 20 until August 26, 2015. Forty-nine of the mountain quail were included in the analysis. Mountain quail band # 3631 was excluded from the analysis due to the length of time she was lost during the monitoring period. She was located June 18 during an aerial telemetry flight with the transmitter broadcasting a mortality signal. Efforts to locate #3631 on the ground post flight were unsuccessful and an exact mortality date, location and cause could not be determined. Mountain quail were randomly radio-collared. By chance males likely represented a larger proportion of collared birds (Table 2) than occurred in the general translocated population. A study of wild-captured quail in southwestern Oregon suggested sex ratios may be slightly female-biased (Pope and Crawford 2001)

<table>
<thead>
<tr>
<th></th>
<th>Harvey Flat Release Site</th>
<th>Bennet Flat Release Site</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>HY Male</td>
<td>16</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>AHY Male</td>
<td>10</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>HY Female</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>AHY Female</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
</tbody>
</table>

**Survival**

Twelve of the forty-nine (24.5%) quail survived until the end of the monitoring period, August 26, 2015. Ten of the thirty-two (30%) Harvey Flat release site quail and two of the eighteen (11%) Bennet Flat release site quail survived until the final day of monitoring. The sex ratio of surviving male and female quail was 5:1. The HY to AHY year ratio was represented as 1:1 for the 12 surviving quail.
Table 3. Survival Timeline of 49 radio-marked quail translocated March 2015 to Winter Ridge, Lake County Oregon.

<table>
<thead>
<tr>
<th>Date</th>
<th>March 27</th>
<th>April 10 (Nesting Grounds)</th>
<th>May 01 (First Day Incubation)</th>
<th>June 02 (First Nest Hatched)</th>
<th>June 29 (Final Nest Hatched)</th>
<th>July 21 (Final day Monitored)</th>
<th>August 26 (Final day Monitored)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days Post Release</td>
<td>7</td>
<td>21</td>
<td>42</td>
<td>74</td>
<td>101</td>
<td>123</td>
<td>159</td>
</tr>
<tr>
<td># Alive</td>
<td>44</td>
<td>35</td>
<td>23</td>
<td>20</td>
<td>18</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>% Survival</td>
<td>89.8</td>
<td>71.4</td>
<td>46.9</td>
<td>40.8</td>
<td>36.7</td>
<td>32.6</td>
<td>24.5</td>
</tr>
</tbody>
</table>

The cause of mortality was placed into three categories; avian, mammalian and unknown. Fifteen mortalities were avian, eight were mammalian and 14 mortalities were unknown. Of the unknown causes one died over the first weekend following translocation. This quail was found whole in an open area and likely died of either stress or exposure due to the snow and cold following the release. The quail could have also sustained a minor injury during the translocation that led to its death. For another quail a likely contributing factor was its leg getting caught in necklace of the transmitter. It had likely been deceased for several days, but had not been scavenged upon. Mortalities were attributed to raptors when radios were found beneath perches with droppings and collars showed no signs of teeth marks or physical damage. Mammalian predation included radios that were chewed or severely damaged, or radios that were located in thick brush with no perches nearby. There was also the likelihood of scavenging by mammals after the quail was killed by a raptor which complicated positive determination. Predators observed in the study area include Great Horned owls (*Bubo virginianus*), Red-tailed hawks (*Buteo jamaicensis*), Cooper’s hawks (*Accipiter cooperii*), Peregrine falcons (*Falco peregrinus*), Northern goshawks (*Accipiter gentilis*), Skunks (*Mephitidae*), Bobcats (*Lynx rufus*), Mustelids and Coyotes (*Canis latrans*).

**Movement**

Pope (2002) found that mountain quail typically pair and travel to breeding areas by May 1st. As of May 1, 2015 twenty-three radio-marked quail were still being monitored. The following movement calculations are based on observations of those twenty-three individuals.

The Bennet Flat release site had movements in three different cardinal directions. The most prominent direction was southeast (91° - 180°) with six quail. This was followed by a
northwestern (271°-360°) movement of three quail. The final cardinal direction of southwest (181°-270°) consisted of a single quail.

The Harvey Flat release site had movements in all cardinal directions. The predominant direction of dispersal included six quail traveling southeast. The dispersal to the southwest was a close second with five quail. There were a total of two quail that dispersed in a northwestern direction and only one of the quail traveled to breeding grounds to the northeast.

Table 4. Movement from release site to breeding areas for mountain quail released on Winter Ridge, Lake Co., OR March 2015.

<table>
<thead>
<tr>
<th></th>
<th>Mean change in elevation from release to breeding area. (m)</th>
<th>Mean elevation at breeding area. (m)</th>
<th>Mean distance from release site to breeding area. (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bennet Flat Release Site</td>
<td>217.8 ± 137.24 (range -125 to +529)</td>
<td>1866.8 ± 137.4 (range 1524 – 2178)</td>
<td>6.23 ± 2.63 (range 0.17 – 13.74)</td>
</tr>
<tr>
<td>Harvey Flat Release Site</td>
<td>-83.86 ± 135.35 (range -360 to +235)</td>
<td>1848.14 ± 135.35 (range 1572 – 2167)</td>
<td>7.38 ± 5.99 (range 1.13 – 28.98)</td>
</tr>
<tr>
<td>Both sites combined</td>
<td>41.83 ± 233.23 (range -360 to +529)</td>
<td>1855.92 ± 189.66 (range 1524 – 2178)</td>
<td>6.23 ± 6.40 (range 0.17 – 28.98)</td>
</tr>
</tbody>
</table>

Reproductive and Nest Site Characteristics

Most nest initiation dates were not determined as the nest was not located until the quail had already began incubation. Three nests were found before incubation had begun ranging from April 29 to May 26. Nests being incubated were found on dates ranging from June 2 to June 19. Hatch dates for monitored nests were June 29 to July 24. The latter date represents a nest where the fate could not be determined because the egg fragments had been scavenged from the nesting site. It was excluded from nest success analysis.

Nine of 12 nests (75%) were successful. HY quail initiated seven of 13 nests (54%) and AHY quail initiated six of 13 nests (46%). Males initiated seven of 13 nests (54%) and Females initiated six of 13 nests (46%). Clutch size analysis does not include one nest with seven eggs (bird #3618) because the nest and quail were likely predated before incubation and possibly completion of clutch. Mean clutch size was 10.25 ± 0.93 (range 8-12). Mean minimum hatch size for successful nests was 7.86 ± 1.17 (range 4-10).
Table 5. Nest data for radio-collared Mountain quail released at Harvey Flat (HF) and Bennet Flat (BF) on Winter Ridge, Lake County, OR 2015. (n= 13)

<table>
<thead>
<tr>
<th>Band #</th>
<th>Gender</th>
<th>Release Site</th>
<th>Date Located</th>
<th>Date Hatched</th>
<th>Clutch Size</th>
<th>Hatch Size</th>
<th>Fate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3681</td>
<td>Male</td>
<td>HF</td>
<td>06/02/2015</td>
<td>06/29/2015</td>
<td>12</td>
<td>5</td>
<td>S</td>
</tr>
<tr>
<td>3653</td>
<td>Male</td>
<td>HF</td>
<td>06/05/2015</td>
<td>07/04/2015</td>
<td>12</td>
<td>4</td>
<td>S</td>
</tr>
<tr>
<td>3571</td>
<td>Male</td>
<td>HF</td>
<td>06/05/2015</td>
<td>07/08/2015</td>
<td>8</td>
<td>8</td>
<td>S</td>
</tr>
<tr>
<td>3657</td>
<td>Male</td>
<td>HF</td>
<td>06/11/2015</td>
<td>07/07/2015</td>
<td>12</td>
<td>9</td>
<td>S</td>
</tr>
<tr>
<td>3624</td>
<td>Female</td>
<td>BF</td>
<td>06/11/2015</td>
<td>N/A</td>
<td>10</td>
<td>0</td>
<td>D</td>
</tr>
<tr>
<td>3591</td>
<td>Female</td>
<td>HF</td>
<td>06/12/2015</td>
<td>07/06/2015</td>
<td>11</td>
<td>10</td>
<td>S</td>
</tr>
<tr>
<td>3640</td>
<td>Female</td>
<td>HF</td>
<td>06/12/2015</td>
<td>07/07/2015</td>
<td>9</td>
<td>3</td>
<td>S</td>
</tr>
<tr>
<td>3551</td>
<td>Female</td>
<td>BF</td>
<td>06/15/2015</td>
<td>07/13/2015</td>
<td>9</td>
<td>9</td>
<td>S</td>
</tr>
<tr>
<td>3613</td>
<td>Male</td>
<td>BF</td>
<td>06/15/2015</td>
<td>07/21/2015</td>
<td>9</td>
<td>unk</td>
<td>unk</td>
</tr>
<tr>
<td>3532</td>
<td>Female</td>
<td>HF</td>
<td>06/19/2015</td>
<td>07/24/2015</td>
<td>9</td>
<td>unk</td>
<td>unk</td>
</tr>
<tr>
<td>3556</td>
<td>Male</td>
<td>BF</td>
<td>06/19/2015</td>
<td>07/08/2015</td>
<td>10</td>
<td>9</td>
<td>S</td>
</tr>
<tr>
<td>3618</td>
<td>Female</td>
<td>BF</td>
<td>05/18/2015</td>
<td>N/A</td>
<td>unk</td>
<td>0</td>
<td>D</td>
</tr>
<tr>
<td>3340</td>
<td>Male</td>
<td>HF</td>
<td>04/29/2015</td>
<td>N/A</td>
<td>12</td>
<td>0</td>
<td>D</td>
</tr>
</tbody>
</table>

S = Successful ≥ 1 chick hatched, D=Depredated, N/A = Not Available

Nest sites were located at highly variable distances from the release sites. Distances ranged from 0.52 km to 29.54 km. The Bennet Flat release site (n=5) had quail initiate nests a mean distance of 3.91 ± 1.5 km ranging from 0.52 km to 9.31 km. Elevation at nest sites ranged from 1711 m to 2175 m with a mean change in elevation of 308.4 ± 100.44 m from the release site. Distance from the nearest road to nesting sites ranged from 109.73 m to 11170.74 m. Distance to the nearest source of water ranged from 49.68 m to 508.41 m. The Harvey Flat release site (n=8) had quail initiate nests a mean distance of 7.97 ± 5.67 km ranging from 1.36 km to 29.54 km. Elevation at nest sites ranged from 1596 m to 2158 m with a mean change in elevation of -10.38 ± 131.84 m from the release site. Distance from the nearest road to nesting sites ranged from 124.36 m to 1047.60 m. Distance to the nearest source of water ranged from 73.76 m to 1111.61 m.
**Individual Nesting Site Descriptions**

The first nest was found on April 29 after finding bird #3340 (Adult Male) at this location on multiple monitoring days, 1.62 km from the Harvey Flat release site. At the time of the location it was only a nest cup and no eggs were present. Nest materials were primarily ponderosa Pine needles with some grass and feathers mixed in. The nest was placed against and partially under a large downed ponderosa. Dense lodgepole pine slash and sagebrush concealed its location. The overstory consisted of ponderosa pine and lodgepole pine and the understory was sagebrush, currant and sparse grass and forbs. There was also a high level of slash surrounding the nest site. Following locations of bird #3340 included checking this nest to monitor its progress. Five eggs were found in the nest on May 19. This was followed by eight eggs May 27 and 12 eggs as of June 3. Bird #3340 was found predated upon by a mammal 79.55 m to the NE of the nesting site on June 12. It was never confirmed if he or his partner were incubating this nest. The final live location on June 3 resulted in only flushing #3340 and his partner could have been incubating a second nest at this time. The nest was never found by predators during the monitoring period. After the mortality of #3340 no other quail were found close to or at this nesting site.

Bird #3618 (Juvenile Female) was located at a nesting site 0.52 km from the Bennet Flat release site. Nest initiation was discovered on May 18 as she was flushed off the nesting site with her partner. Nest materials consisted of ponderosa pine needles and feathers. It was a unique nest as it was covered with ponderosa pine needles above the eggs and had a short tunnel made from needles to access the nest. The nest was backed up against a rock face with sparse manzanita shrubs around it. The overstory was ponderosa pine with an understory of manzanita, snowbrush, willow, slash and sparse grass and forbs. One egg was present on May 22, six eggs were found June 2, and seven eggs on June 11. The nest appeared to be disturbed by an avian predator. The eggs were being taken individually and brought away from the nesting site to feed. The quail was found predated by an avian predator 494 m southeast of the nesting site. She was predated before nest incubation began.
Bird #3551 (Juvenile Female) was located at a nesting site 2.37 km from the Bennet Flat release site. Nest initiation was discovered on May 26 with one egg in the nest. June 2 the nest location could not be pinpointed for an egg count and June 15 the nest was being incubated with nine eggs. The nest was backed up to a large rock with fully needled ponderosa pine branches overhead and partially covered by a snowbrush shrub. The overstory was ponderosa pine and the understory included snowbrush, slash, sapling ponderosa, manzanita, willow and a sparse grass and forb component. The nest was found with all nine eggs successfully hatched on July 13 and the bird was alive with her brood. July 20 she was discovered predated upon on by a mammal 121 m southeast of the nesting site. The fate of her brood is unknown as no chicks were found around the mortality site.

Bird #3681 (Juvenile Male) was located 1.36 km from the Harvey Flat release site. The nest was discovered on June 2 with the male incubating 12 eggs. The nest cup consisted of grass and feathers and was backed up to a clump of bunch grass within a snowbrush shrub. There was no direct overstory at the nesting site. Surrounding habitat was elderberry, snowbrush, minor slash and a moderate grass and forb component. The nest was found successful on June 29 with a minimum hatch size of five. Prior to incubation he was found with two other quail multiple times when egg laying would have begun. He also was found with two adults post hatch. An exact brood count could not be conducted due to limited flight of the young and the potential mixing of broods with other adults. After this location bird # 3681 was only found with an occasional adult partner. He was alone the final location in late August and also found alone October 12 during a radio collar replacement.

Bird #3653 (Adult Male) was located at a nesting site 19.85 km from the Harvey Flat release site. The nest was discovered on June 5 with the male incubating 12 eggs. The nest cup consisted of ponderosa pine needles and feathers. The nest was placed under a smaller rotting piece of slash and had rabbitbrush and a variety of bunchgrass and forb species blocking any direct view of the nest. The surrounding area had very sparse and short vegetation. There was no direct overstory, but ponderosa pine and white fir trees were within 20 yards of the nesting site. There were also larger patches of snowberry further out from the nesting site. The nest was found successful on July 4 with a minimum hatch size of four. The other egg caps/membranes were missing and could have been scavenged before the hatched nest was examined. July 8 he was with a minimum of nine chicks and observed multiple times with a brood size greater than the determined hatch size of four. The final location on August 24 for bird #3653, he was flushed in a patch of willows with a minimum brood size of four. This location was 362 m northwest from the original nesting site.
Bird # 3571 (Juvenile Male) was located at a nesting site 5.59 km from the Harvey Flat release site. The nest was discovered on June 5 with the male incubating eight eggs. The nest cup consisted of pine needles, grass and feathers. It was located under a downed lodgepole pine with other slash and grass clumps blocking the view. The nest was very well hidden and proved difficult to obtain an egg count, even knowing the exact location of the nest. The nesting site had lodgepole and ponderosa pine in the area, but no direct overstory. The understory consisted of slash, sapling lodgepole, bitterbrush and a sparse grass and forb component. The nest was found successful on July 8 with a hatch size of eight. During post hatch locations it proved difficult to obtain an accurate brood size count. He kept the brood in a riparian area with dense areas of willow growth and flushing attempts only obtained partial counts. The final live location on August 11 for bird #3571, he was flushed in a patch of willows with a minimum of three chicks. This location was 275 m northwest from the original nesting site. He was later discovered predated upon by a mammal August 25 and the fate of the brood is unknown.

Bird # 3657 (Juvenile Male) was located at a nesting site 1.36 km from the Harvey Flat release site. The nest was discovered on June 11 with the male incubating 12 eggs. The nest cup consisted of ponderosa pine needles and feathers. The nest was backed up against a medium sized downed ponderosa pine with manzanita shrubs covering the view from above. There was no direct overstory at the nesting site, but ponderosa pines of varying ages were close. The understory consisted of manzanita, snowbrush, slash, ponderosa pine saplings, bitter cherry and sparse grass and forbs. The nest was found successful July 7 with a minimum hatch size of nine. Two of the eggs remained unhatched and one egg was missing. When located post hatch, he was found with a brood size of nine. The following locations he was found alone or with a partner until the final location August 25, when he was observed with five other quail. These quail were not believed to be a part of his brood, but other adults forming a covey. The final location was 3.29 km northwest of the original nesting site.
Bird # 3624 (Adult Female) was located at a nesting site 2.76 km from the Bennet Flat release site. The nest was discovered on June 11 with the female incubating a clutch of 10 eggs. The nest cup consisted of ponderosa pine needles and feathers. The nest was set under a rock overhang with smaller rocks and boulders in the surrounding area. The nest was rather exposed as compared to nesting sites of other quail. There was no direct overstory and the surrounding understory consisted of sagebrush, bitterbrush, boulders and a sparse grass and forb component. The predated nest was found June 29 with no eggs or shell fragments remaining at the nest site. She was never observed with a brood or partner during the remainder of the monitoring period. August 11 she was found dead, but the cause of death could not be determined. The final location was approximately 1.0 km from the original nesting site.

Bird #3591 (Adult Female) was located at a nesting site 1.62 km from the Harvey Flat release site. The nest was discovered on June 12 with the female incubating a clutch of 11 eggs. The nest cup consisted of ponderosa pine needles and feathers. It was backed up against a pole sized ponderosa pine and built in a small sagebrush shrub surrounding by forbs. A ponderosa pine overstory and an understory consisting of sagebrush, snowberry, various forbs and sparse grass were present at the nesting site. The nest was found successful July 6 with a hatch size of 10 and one of the eggs unhatched. Locations post hatch revealed a brood size of nine on July 25. The final location was taken on August 13 and she was with a minimum of five chicks at this time. Monitoring after this location proved difficult as the battery for her transmitter was dying. This caused an intermittent signal making an exact location not feasible to obtain. The final location obtained was 388 m northwest of the original nesting site.

Bird #3640 (Adult Female) was located at a nesting site 29.54 km from the Harvey Flat release site. The nest was discovered on June 12 with the female incubating a clutch of 9 eggs. The nest cup consisted of ponderosa pine needles and feathers. The nest was placed in a smaller dense bitterbrush shrub and surrounded by snowbrush, manzanita and bitterbrush. There was no direct overstory, but a ponderosa pine overstory was close to the nesting site. The understory consisted of snowbrush, manzanita, bitterbrush, mountain mahogany and a sparse grass and forb component. The nest was found successful on July 7 with an unknown hatch size. The nest had already been scavenged and only shell fragments remained. She was located and flushed on July 20 with a minimum of three chicks. There was vocal confirmation of more chicks than the three chicks visually confirmed. An exact count could not be determined between visual and vocal confirmations. The final location was taken on August 24, but a visual was not obtained. The quail and her potential brood were in thick snowbrush
habitat and decided to run instead of flush. The final location obtained was 1.47 km southeast of the nesting site.

Bird #3613 (Juvenile Male) was located at a nesting site 9.31 km from the Bennet Flat release site. The nest was discovered on June 15 with the male incubating a clutch of nine eggs. The nest material consisted of mixed pine needles and feathers. The nest was under a piece of pine bark and tucked into a large cluster of currant and backed up against a standing dead lodgepole. The overstory included dead and alive lodgepole pines. The understory had a large component of slash, sapling ponderosa pine, currant and a variety of bunch grasses and forbs. The nest was found successful on July 21 with a minimum hatch size of four. He was never observed with a brood during the remainder of the monitoring period, but occasionally was with his partner. They were very vocal when together indicating a potential brood accompanying them. This area had very heavy deadfall and was tough to verify brood data due to the pairs propensity to run vs. flushing. The final location was taken August 26 and he was flushed alone 66 m southwest of the nesting site.

Bird #3532 (Adult Female) was located at a nesting site 2.79 km from the Harvey Flat release site. The nest was discovered on June 19 with the female incubating a clutch of nine eggs. The nest material consisted of ponderosa pine needles and feathers. The nest was against a sagebrush shrub and under a larger snowbrush shrub. There was no direct overstory, but ponderosa pine up the steep slope from the nesting site. The understory was very diverse and thick at the nesting site. Understory species included snowbrush, manzanita, multiple currant species, sagebrush, boulders, sapling ponderosa pine, slash, various grass and forbs and sapling aspen patches close by. The nest was found scavenged on July 24, but was not thought to have been predated before hatching. One day later bird #3532 was observed with a minimum of one chick. She was in a boulder field tucked under a crevice and at that time her fate was unknown, but one chick flushed downhill from her location. The following locations she was found alive, but alone. The fate of the brood is unknown and she was found dead from an unknown cause. The final location was 426 m southwest of the nesting site.
Bird # 3556 (Juvenile Male) was located at a nesting site 4.60 km from the Bennet Flat release site. The nest was discovered on June 19 with the male incubating a clutch of 10 eggs. The nest material was composed of ponderosa pine needles and feathers. The nest was tucked into a sagebrush shrub with snowberry and forbs around the nest as well. There was a very thick ponderosa pine needle duff layer as well. The overstory was ponderosa pine and the understory consisted of sagebrush, snowberry and sparse grass and forbs. It was in close proximity of an aspen overstory and dense grass and forb pockets. The nest was found successful on July 8 with a hatch size of nine and one egg remained whole in the nest. The final location was July 22 as an accidental death. Bird # 3556 was discovered intact with its foot stuck in the neck loop of the transmitter. His broods fate is unknown and was not located in close proximity to the adult. The final location was 87 m southwest of the nesting site.

Table 6. Nest site characteristics for eight mountain quail nesting attempts recorded on Winter Ridge, Lake County, OR in 2015.

<table>
<thead>
<tr>
<th>Distance from release site (km)</th>
<th>Mean elevation of nests (m)</th>
<th>Mean change in elevation from release site (m)</th>
<th>Mean distance to nearest road (m)</th>
<th>Mean distance to nearest water(m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.41 ± 5.64 (range .052-29.54)</td>
<td>1935.39 ± 139.06 (range 1596-2175)</td>
<td>112 ± 173.88 (range -336 -+526)</td>
<td>772.67 ± 592.25 (range 109.73-3603.32)</td>
<td>457.04 ± 243.87 (range 49.68-1111.61)</td>
</tr>
</tbody>
</table>

**Discussion**

Winter Ridge was selected as a release site due to the abundance of early successional habitat post fire. In 2002 the Toolbox Complex fire burned over 120,000 acres of the Fremont National Forest along Winter Ridge and westward between Silver Lake and Paisley Oregon. Mountain quail have been shown to favor early successional, shrub dominated habitat and move higher or lower in elevation depending on existing snow cover (Pope 2002). Large areas that burned in 2002 are presently dominated by early successional mixed shrub habitat suitable for mountain quail. Southern portion of Winter Ridge has abundant water in the form of springs, perennial
and intermittent streams as well as several low elevation benches and flats which should provide snow free winter habitat. Mild winters in 2013-14 and 2014-2015 allowed access to Bennet and Harvey flats in March to release translocated quail. A more severe winter would require a later release date or to change the release sites to a lower elevation. These options could impact the survival, movements and relationships of the translocated quail.

Mountain quail were trapped at multiple locations before being transported to the holding facility in Roseburg, OR. They were kept temporarily in two enclosures, which would each represent a release site upon the translocation to Winter Ridge. Time spent at the holding facility provided the opportunity for pair bonds to be formed between quail. It was essential to release each group to a common release site in order to maintain relationships and bonds formed as they were released into unfamiliar territory. Mountain quail typically form pair bonds in early spring and retain that relationship through brood rearing. Mountain quail habitat provides a shorter window for the breeding season and they typically maintain monogamy, rarely re-nesting if the first attempt is unsuccessful (Budeau and Hiller 2012).

During the monitoring period I had several radio-collared mountain quail pair after the translocation. Due to mortality some pair bonds were disrupted before incubation began; one sequence of events was very intriguing. Juvenile female band #3551 and juvenile male band #3557 from the Bennet Flat release site formed a pair bond and traveled southwest towards the Harvey Flat release site to establish their nesting site. Adult male band # 3654 from the Harvey Flat release site was paired with a non-radio-collared quail approximately 0.8 km west of #3551 and #3557. As of May 18 the Bennet Flat pair was still together, likely beginning nest initiation and adult male #3654 was alone at this time. On May 26, juvenile male #3557 was found predated and the juvenile female was found with #3654 at a nesting site with one egg present. The Harvey Flat male remained close to the female quail as she incubated her clutch, but was never found on a nest of his own. June 22 the adult male began to move away from the nesting female and was found alone through the remainder of the monitoring season. It appeared that a temporary pair bond was formed between a Bennet Flat female and a Harvey Flat male. There are numerous scenarios that could explain this unique relationship, but suggests the importance of forming early pair bonds to develop a mutual commitment through brood rearing which is typical behavior for pairs.

**Survival**

Average survival of translocated mountain quail during the first 5 to 6 months following release in the years 2005-2014 was approximately 27.5% (ODFW unpublished data), which is comparable to the 24.5% survival during the 2015 monitoring season. Survival was slightly lower than the 27.2% observed during 2014 monitoring season in the same area of Winter Ridge. Mortality rates remained high through forty-two days post release in 2015. In 2014 the
high mortality rate of approximately one mortality per day lasted through the first twenty-one
days with 54.5% survival. The 2014 mortality rate substantially dropped to one mortality per six
days over the next 17 days. In 2015 the mortality rate of approximately four mortalities per six
days lasted through the first twenty-one days with 71% survival. The mortality rate remained
high at four mortalities per seven days over the next 21 days. Survival increased by May 01
when the quail reached their breeding grounds. Survival to May 01, was 47.7% in 2014 and
46.9% in 2015.

The weather in 2015 during the month of April could have impacted survival between the
twenty-one and forty-two-day period. There was a high level of precipitation during this period
of monitoring. Heavy precipitation in spring and summer is thought to limit the ability of quail
to hear and detect predators leading to higher direct mortality (Hilton, et al. 1999). High
mortality rates directly after the release of translocated mountain quail has been observed in
several past translocation events associated with this project. This peak mortality rate typically
occurs from the release date in March through the month of April. Mortality is highest while
quail are becoming familiar with new surroundings, displaying for mates and traveling to
breeding areas. Increased movement and mating displays make quail more vulnerable to
predation (Nelson 2007). When pairs reach breeding areas, movement is reduced particularly
during incubation (June through early July). From the time the first nest was found incubating
until the final nest was hatched only four mortalities occurred. Harvey Flat release site had
three times the survival percentage as Bennet Flat release site (30% vs. 11% survival). Bennet
Flat has a breeding population of California Quail (*Callipepla californica*), which was confirmed
through productive nests, visual and vocal confirmation. Competition and localized predator
familiarity with quail and their presence in Bennet Flat could have impacted the survival of
mountain quail at the Bennet Flat release site.

**Movement**

Distance traveled from the release sites ranged from 0.17 to 29.98 km and averaged 6.23 ± 6.40
km. Pope found that mountain quail in southwestern Oregon often made movements between
winter and breeding ranges exceeding 26 km. This ability to migrate long distances was
displayed by the translocated quail and shows their ability to seek out desirable habitat and
adapt to changing conditions. These long movements are not necessarily in response to poor
quality habitat at the release sites, because movements may be purely a behavioral response to
seasonal cues (Pope 2002).

Eighteen quail moved in a southern direction and only six quail moved north to reach their
breeding grounds, which is a 6:1 ratio in favor of southern migration. One explanation for
primarily southern movements could be explained by a larger number of riparian corridors for
quail to follow to the south. Riparian corridors provide concealment from potential predators
and typically a reliable food and water source. Mountain quail that were paired and establishing nesting sites only traveled short distances during the breeding season. Several quail either lost their partner or never formed a pair bond and traveled more often and greater distances. Two of those quail were successful in finding a partner, but a nest was never found at their chosen breeding grounds. In August movements became more frequent again as the quail began to form coveys. It became more common to find groups of adult birds by the middle of August and appeared as if the quail were beginning their search for desirable wintering grounds. Monitoring into the fall may provide insight on the success of the translocation and breeding season by observing covey sizes. Prior research has shown an average covey size of nine, but can range from three to twenty mountain quail. Estimating covey size in Bennet Flat may be difficult due to the California quail population. Mountain quail and California quail have been known to covey together during the winter (Winter 2002).

**Nest Success**

Nest success averaged 75% for the ODFW translocation projects conducted 2005-2014. Nest success for 2015 was exactly average at 75%, but brood survival appeared lower than average post hatch. Many of the nest sites had ample water when the quail reached their breeding grounds, but were void of reliable water in close proximity by early July. This was caused by drought like conditions from late May through August on Winter Ridge. The sparse water likely had a direct and indirect effect on brood survival. The broods had to travel a greater distance to acquire the necessary water, which may have made them more susceptible to predation.

Nest success was substantially different for female and male mountain quail. Males successfully hatched 86% of their clutches, but females only successfully hatched 50% of their clutches. This has been a common occurrence in prior studies on nest success for mountain quail. The lower nest success is likely attributed to female quail going into incubation poorer physical condition due to energetic demands of producing simultaneous clutches. Female quail must produce and lay eggs for both nests, requiring a greater intake of nutrients during incubation. This could lead to the female leaving the nest more often and for greater periods of time to recover from the egg production. The nest would be exposed to predators and inclement weather more often and thus decreasing nest success.

Two uncollared mountain quail were also observed with broods in early July within the study area. The first observation included three adults and a minimum of five chicks crossing a minimum maintenance road in Bennet Flat. At least one of the adults was not banded and the others were not determined to be banded or un-banded. This suggests that a mountain quail from a successful brood in 2014 also successfully hatched a clutch in 2015. It is a very encouraging sign that quail from the previous translocation efforts survived the winter and are producing their own broods. The second observation was one adult and a minimum of four
Conclusion

The second season of translocation efforts was comparable in many ways with the 2014 season at Winter Ridge. Survival and nest success were similar for the two years. Habitat conditions also remained favorable. Weather conditions during the monitoring period were less than favorable with a wet spring and extremely dry summer, but the mild winter between translocations boded well for survival. Un-banded quail, which are offspring of previous releases were observed throughout the monitoring period and one even had a brood. These observations suggest self-sustaining populations of mountain quail are possible on Winter Ridge. In October of 2015, a radio-collared juvenile male mountain quail band # 3681 was recaptured using the technique of night spotlighting after tracking with telemetry gear. This quail had its collar replaced with a lightly used transmitter from a mortality early in the monitoring season. This may give some insight to where mountain quail on Winter Ridge travel during the winter. Next year’s monitoring season and future public observations will provide additional insight to the success of mountain quail translocations on Winter Ridge. A large covey of mountain quail (approximately twenty) were observed northeast of the Bennet Flat release site on private land in a wet meadow area late fall of 2014 (personal communication Doug Fairclo). The three years of monitoring will help provide information to guide management decisions and maintain a sustainable population of mountain quail in the Winter Ridge region.

Acknowledgements

I want to thank everyone that helped out during the 2015 monitoring season. The combined effort was instrumental in making it a successful translocation and monitoring season. I would like to thank Craig Foster, Dave Budeau and Kelly Walton for providing me the opportunity to work on the project. It was great to have the chance to discuss the project and various techniques used in more detail. I was also provided the opportunity to help out on various surveys. Mary Jo Hendrick was kind enough to give me a tour of Winter Ridge and provide introductions to USFS workers and private land owners. Scott Jennings piloted the telemetry flights and always kept the flights entertaining. I also would like to thanks Marty St. Louis for all the help along the way and allowing me to stay on site at SLWA. Morning coffee discussing the previous day’s work and going over maps of Winter Ridge was incredibly helpful. He also provided me the opportunity to work on the wildlife area and gain experience while taking a break from chasing quail. The whole Summer Lake Wildlife Area crew (Marty St. Louis, Jared Sisemore, Patrick Hayden and Matt Journey) also made sure I made it back each day and always
made sure to get my tentative plans for the day. It was nice to have that safety net when working alone on Winter Ridge.
Maps

Map 1. Final observed locations for radio-collared Mountain Quail released on Winter Ridge, Lake County, OR, August 2015.

Legend
- Orange diamond = Harvey Flat release site
- Yellow diamond = Bennet Flat release site
- Orange triangle = Harvey Flat nesting site
- Yellow triangle = Bennet Flat nesting site
- Blue circle = Mountain Quail brood movements
Literature Cited


