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Hanford Site Burrowing Owl Monitoring Report for Calendar Year 2015



Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

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Hanford Site Burrowing Owl Monitoring Report for Calendar Year 2015

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1.0 Introduction

The U.S. Department of Energy, Richland Operations Office (DOE-RL) conducts ecological monitoring on the Hanford Site to collect and track data needed to ensure compliance with environmental laws, regulations, and policies governing DOE activities. Ecological monitoring data provide baseline information about the plants, animals, and habitat under DOE-RL stewardship at Hanford required for decision-making under the *National Environmental Policy Act* (NEPA) and *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA). The *Hanford Site Comprehensive Land Use Plan* (CLUP, [DOE/EIS-0222-F](#)) which is the Environmental Impact Statement for Hanford Site activities, helps ensure that DOE-RL, its contractors, and other entities conducting activities on the Hanford Site are in compliance with NEPA.

The Hanford Site Biological Resources Management Plan (BRMP, [DOE/RL 96-32](#)) is identified by the CLUP as the primary implementation control for managing and protecting natural resources on the Hanford Site. According to the CLUP;

“the BRMP provides a mechanism for ensuring compliance with laws protecting biological resources; provides a framework for ensuring that appropriate biological resource goals, objectives, and tools are in place to make DOE an effective steward of the Hanford biological resources; and implements an ecosystem management approach for biological resources on the Site. The BRMP provides a comprehensive direction that specifies DOE biological resource policies, goals, and objectives.”

DOE-RL places priority on monitoring those plant and animal species or habitats with specific regulatory protections or requirements; or that are rare and/or declining (federal or state listed endangered, threatened, or sensitive species); or of significant interest to federal, state, or tribal governments or the public. The BRMP ranks wildlife species and habitats (Levels 0-5), providing a graded approach to monitoring biological resources based on the level of concern for each resource. Burrowing Owls (*Athene cunicularia*) are ranked as Level 3 resources. According to BRMP, Level 3 resources require a “Moderate” level of status monitoring.

The Burrowing Owl is classified as a Washington Department of Fish and Wildlife (WDFW) Candidate Species. Burrowing Owls are protected under the *Migratory Bird Treaty Act*; this status provides protection to eggs, nests and birds. Conway and Pardieck ([2006](#)) suggested that the population decline of Burrowing Owls in Washington may be due to reduced numbers of ground squirrels (*Urocitellus spp.*), yellow-bellied marmots (*Marmota flaviventris*), and badgers (*Taxidea taxus*) that create burrows used by the owls. Loss of habitat to development has also negatively affected the species. Most individuals that nest on the Hanford Site migrate south for the winter and return in the spring ([Conway et al. 2002](#)). Because the owls migrate to and nest on the Hanford Site and the Hanford Reach National Monument, the status of Burrowing Owl populations and the locations of burrows are of concern locally to DOE-RL and the U.S. Fish and Wildlife Service (USFWS).

Monitoring Burrowing Owl populations provides essential information to help manage and protect the species and assess impacts from Hanford Site projects. The 2015 monitoring of Burrowing Owls was performed to meet the expectations of the BRMP and the Memorandum of Understanding between DOE and USFWS *Regarding the Implementation of [Executive Order 13186](#), “Responsibilities of Federal Agencies to Protect Migratory Birds”* ([USDOE and USFWS 2013](#)). The monitoring effort will provide data on the distribution and status of Burrowing Owls on the Hanford Site.

The objectives of the 2015 Burrowing Owl monitoring effort were to:

- 1) Perform maintenance on 55 existing Artificial Burrow Systems (ABS) on DOE-RL managed lands of the Hanford Site prior to the 2015 nesting season.
- 2) Survey historical burrow locations on DOE-RL managed lands of the Hanford Site and determine active burrows.
- 3) Assist the USFWS in the trapping and banding of Burrowing Owls at the ABS located at the Hazardous Material Management and Emergency Response (HAMMER) Training and Education Center in the southern portion of the Hanford Site.

2.0 Methods

Public Safety and Resource Protection (PSRP) staff began monitoring the Burrowing Owl population on DOE-RL managed lands of the Hanford Site in 2012 ([Wilde \(a\)](#)) and continued in 2013 ([Wilde \(b\)](#)) and 2015. Methods used in 2015 were similar to those employed in 2013 and included maintaining the existing ABS, determining the status of previously known burrows and surveying for any new burrows, and supporting the long term USFWS banding effort.

2.1 ABS System Maintenance and Status

ABS have been installed by various Hanford contractors as mitigation for environmental impacts from site development and restoration projects (DOE/EA-1412, PNNL 2005 and PNNL 2007). Mitigation action plans require a five year period of monitoring and maintenance of the ABS after installation. The timeline for monitoring and maintenance for most ABS now installed on DOE-RL managed lands of the Hanford Site have expired, with the exception of 10 Washington Closure Hanford LLC (WCH) installed burrows near Army Loop Road which are still maintained by WCH (WCH-631). Regular maintenance of the burrows increases the likelihood of use and ensures that past mitigation efforts continue to provide benefit. Natural burrows tend to decline or collapse over time (Bradbury and Newsome 2010) and cannot be efficiently maintained by staff to extend the life of the burrow. All ABS were maintained regardless of historical activity levels. Burrow entrances were cleared of obstructions and heavy vegetation impeding the burrow function. A heavy bristled brush on a pole was pushed down the entrance opening to remove obstructions including spider webs, vegetation, soil, and other debris. Soil was moved around the burrow entrances recreating original mounds above and around the pipe entrance. The entrance of the burrows

were shaped to replicate a fresh soil push often present at natural mammal burrows. Maintenance was performed prior to the spring arrival of migrating owls to the Hanford Site.

2.2 Status of Known Historical Sites and Surveys for New Burrow Sites

Active burrows from 2013 ([Wilde \(b\)](#)) were visited during the 2015 nesting season. In addition, 65 Hanford Site ABS, regardless of 2013 status, were surveyed to determine if the burrow was actively being used by Burrowing Owls. Field members visually scanned the area as they approached burrow locations, looking for signs of occupation. If an owl was flushed from a burrow, surveyors noted where it landed. These locations were also examined to determine if additional active burrows were present in the vicinity. Field team members determined if a burrow was active by looking for owls in, entering or exiting the burrow, owls present in the immediate vicinity, visual or auditory confirmation of young in the burrow, or the presence of castings, feces, feathers, or footprints at the opening of the burrow and a lack of vegetation growth at the entrance to the burrow (Figure 1). When historically active sites were located, brief scans of the surrounding area for additional burrows were conducted within a few hundred meters of each area. All newly discovered burrows were documented with a GPS and added to the current list of Hanford Site burrows.

When a cluster of burrows that were active in 2013 were void of activity, call broadcast surveys were performed in the area to confirm vacancy. Additional call broadcast surveys were used to verify the results of visual surveys and rule out any false negative results. Previously recorded Burrowing Owl calls were broadcast for 30 seconds followed by 30 seconds of silence. This sequence was repeated followed by 30 seconds of a Burrowing Owl alarm call. Observers then documented any owls that were heard or seen in response to the audio recordings.



Figure 1. Active Burrowing Owl Nest Burrow in a Pipe with Survey Identifiers Such as Feathers, Castings and Footprints

2.3 Burrowing Owl Capture and Banding at the Hazardous Material Management and Emergency Response (HAMMER) Training and Education Center Site

PSRP staff assisted the USFWS in capturing Burrowing Owls at the ABS at the HAMMER Emergency Vehicle Operations Course (EVOC). USFWS was attempting to retrieve tracking devices placed on owls in previous years. From 2009 to 2011, researchers from the USFWS and The Global Owl Project fitted 93 owls from Saskatchewan, Oregon and Washington with ultra-lightweight geolocators. The geolocators can detect sunrise and sunset times, which can be used to determine latitude and longitude. The latitude and longitude data can be used to determine the winter distribution of each individual owl ([Fortin 2013](#)). In order to retrieve the data, however, the owls must be recaptured and the geocator removed. A field survey was performed on the ABS prior to trapping to identify active burrows being used by owls. Field team members placed traps at active burrows or burrows within a cluster that were believed active. Double entry swing door traps were used that allowed capture of an owl returning the burrow as well as any owls, including hatch year birds, exiting the burrow. The traps were placed to appear as an extension of the burrow entrance as seen in Figure 2. In some instances, previously recorded Burrowing Owl calls were broadcast through speakers placed in some traps to attract owls into the trap. Field team members checked the traps once per hour for Burrowing Owls. Team members retrieved owls from the traps, determined the sex and age (hatch year or greater than hatch year) of each owl, then weighed and banded each owl with an identification band before release.



Figure 2. Example of the Traps Used in Front of ABS Openings for Owl Collection and Banding

3.0 Results

For the purpose of this report, the term “burrow” is used to identify either a natural or artificial subterranean nest or cavity structure. A natural burrow could be a hole excavated by a fossorial mammal (mammalian origin) or a man-made object such as a pipe or culvert that was discovered and occupied by owls (anthropogenic origin). An ABS is a structure that was installed specifically for the purpose of attracting Burrowing Owls. All active burrows are captured in the appendix of this document.

3.1 ABS Maintenance and Status

There are 65 ABS on DOE-RL managed lands of the Hanford Site, 10 of which are maintained by WCH. Field team members performed maintenance on 52 of the remaining 55 ABS in February 2015, 30 ABS located at the HAMMER EVOC and 22 burrows along Army Loop Road. Three burrows located at HAMMER EVOC (HAMMER_PNNL_7, HAMMER_PNNL_10 and HAMMER_PNNL_12) were not maintained due to the presence of owls on associated perches. Burrows were maintained and prepped for the upcoming nesting season. All ABS at the HAMMER EVOC course appeared to be habitable following inspection and maintenance.

During 2015, field team members performed maintenance on all 22 Interim Disposal Facility (IDF) mitigation burrows installed parallel to Army Loop Road (Figure 3). Maintenance was performed on the IDF burrows in the same manner as the HAMMER burrows. Despite continual maintenance, not all IDF burrows were habitable. The area where the IDF burrows were installed has sandy soil. Weather conditions and northern pocket gopher (*Thomomys talpoides*) activity in the area had filled many of the burrow entrances and/or chambers. In 2015, five burrows were plugged and deemed unusable (IDF_PNNL_4, IDF_PNNL_6, IDF_PNNL_11, IDF_PNNL_19 and IDF_PNNL_22). Three of these five burrows had been previously deemed unusable in 2013, and the other two changed status from usable in 2013 to unusable in 2015 (IDF_PNNL_4 and IDF_PNNL_19). Three burrows that had been deemed unusable in 2013 changed status to potentially usable after 2015 maintenance. The WCH ABS on Army Loop Road were not maintained by PSRP staff because WCH continues to maintain these burrows (WCH-631).

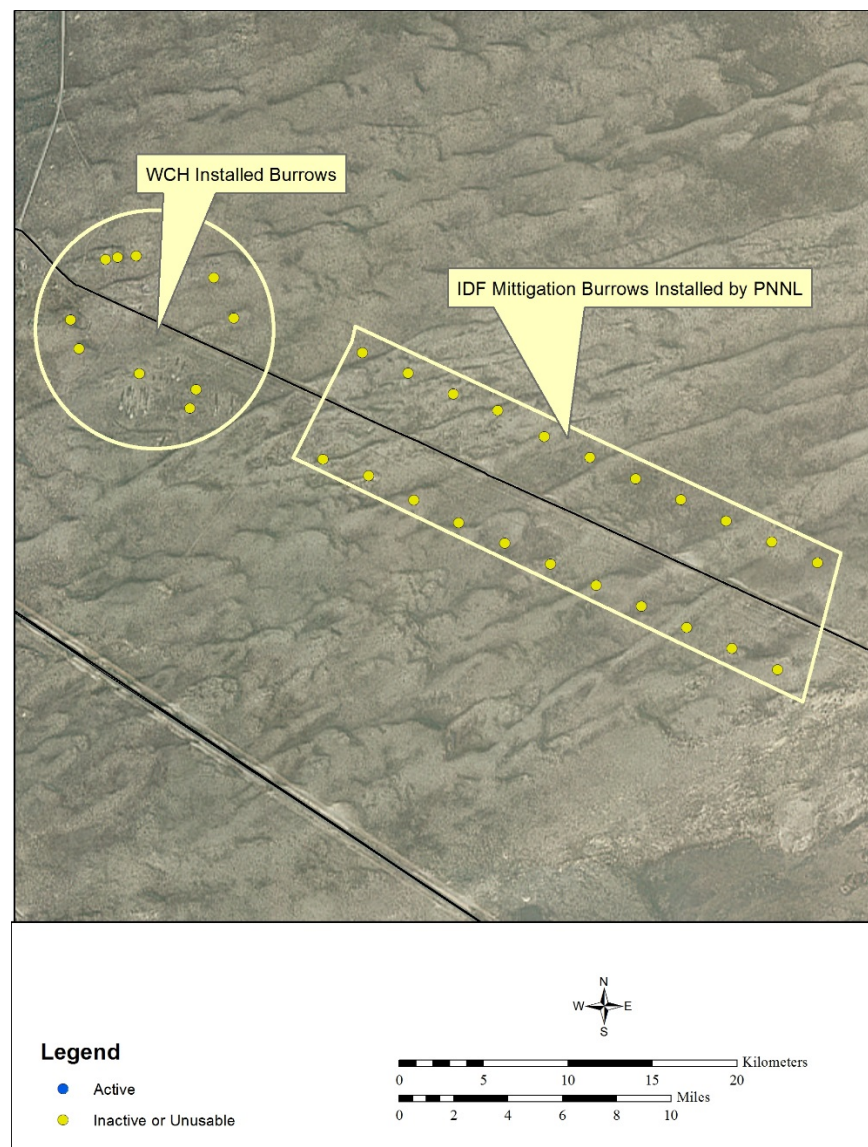


Figure 3. Artificial Burrows Installed Along the Army Loop Road of the Hanford Site

Monitoring staff surveyed all ABS during the first week of May 2015 to document owl activity and determine current status of the burrows using methods described in Section 2.2. If an owl was seen on approach towards a burrow, it was documented as active, as were nearby burrows within the cluster. Further monitoring disturbance was avoided to minimize impacts to potential nesting pairs during the nesting season. Following these methods, 12 burrows at HAMMER were categorized as active (Figure 4). The number of active burrows at HAMMER has decreased since 2012 (16) and 2013 (21) ([Wilde \(a\)](#)). There were no active (0 of 32) ABS on Army Loop Road, including PNNL and WCH installed ABS in 2015. Status of the burrows remain unchanged from previous years.

30 ABS located at the HAMMER EVOC were inspected and maintained, and 18 were considered inactive. 9 of these ABS remained inactive from 2013 to 2015, and 12 of the ABS changed from active in 2013 to inactive in 2015. 2 burrows that had been considered inactive in 2013 changed status to active in 2015 (Figure 4).

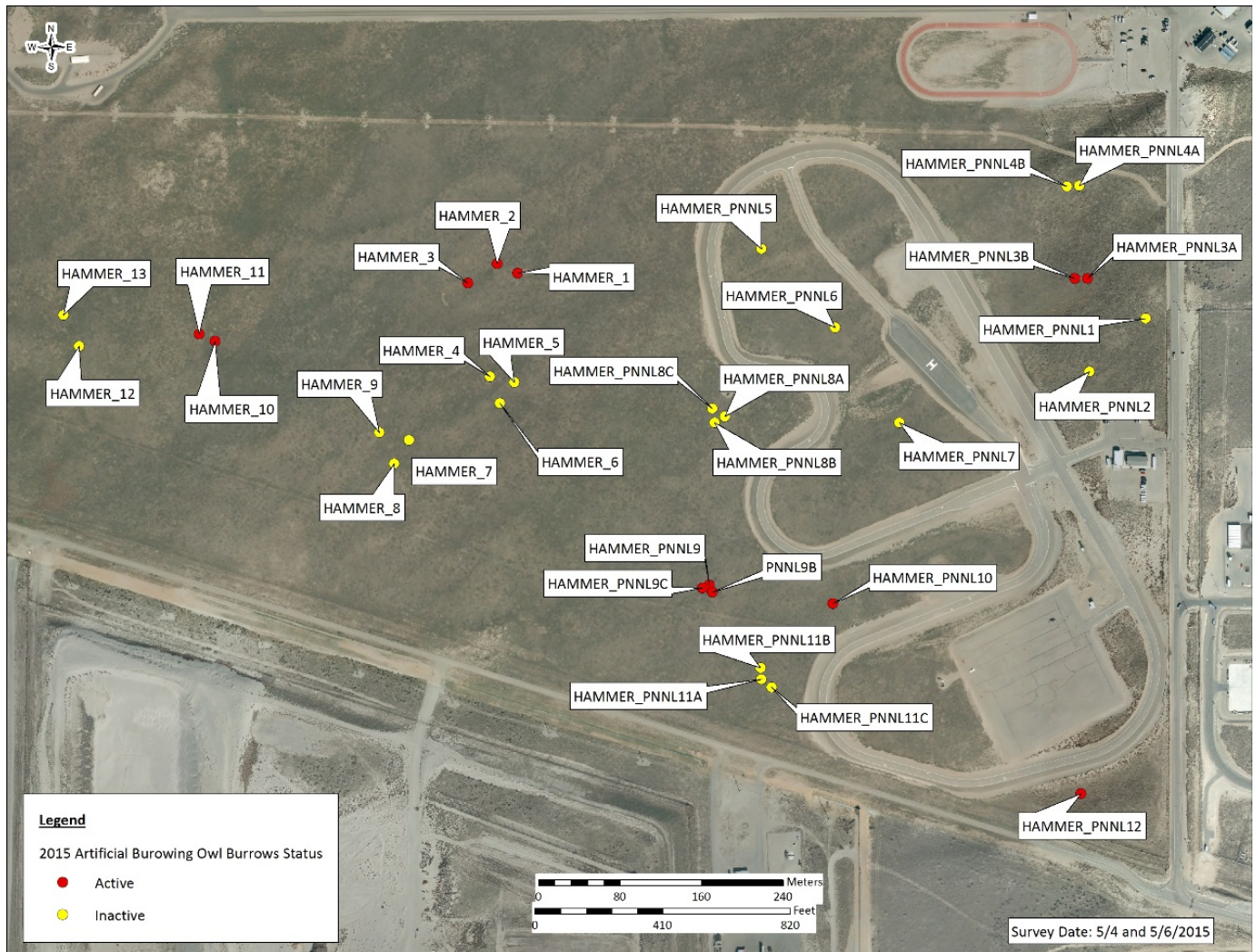


Figure 4. HAMMER ABS Survey Results

3.2 Status of Historical Active Burrows and Surveys for New Burrows

In 2015 there were six active natural burrows known on DOE-RL managed lands of the Hanford Site (Figure 5). 3 of these burrows were of mammalian origins and 3 were of anthropogenic origins. Each active site from 2013 was visited by a field team member in May 2015 to determine if the burrow remained active (Appendix). The burrow was documented as active if an owl or signs of activity were observed. Brief scans of the surrounding area were conducted at each location for additional burrows. One new anthropogenic burrow (ORCH-8) was discovered during the 2015 field survey, and one new mammalian burrow (DUNES_1) was discovered during field surveys for a separate project. Both locations had GPS coordinates taken and were added to the Hanford Site burrow list.

Of the 29 natural burrows listed as active in 2013, 4 of the burrows remained active in 2015 (ORCH-7, ORCH-1A, HolocekHS1, and HolocekHS4). 2 additional active natural burrows were discovered in 2015 (ORCH-8 and DUNES_1). Several locations of historical natural burrows have continued to show a decline

in burrow activity from previous survey periods (2010, 2012 and 2013) to 2015. The burrow clusters along state Highway 240 had 14 active burrows in 2010, which decreased to 3 active burrows in 2013. All 3 of these burrows (H240-1B, H240-10 and H240-11) were marked as inactive in 2015. The Army Loop Road had one active natural burrow (Army-3) in 2013 which was listed as inactive in 2015, likely a result of the burrow entrance having collapsed. The 400 Area had 3 active natural burrows (FFTF-1, FFTF-1A and FFTF-1B) in 2013 that were listed as unusable in 2015; all 3 burrows had collapsed or been dug out by fossorial mammals. None of the 14 active natural burrows in the 100D-100H area (OLDF-2B, OLDF-2A, OLDF-2, OLDF-3, OLDF-3A, OLDF-4, OLDF-5, OLDF-6, OLDF-7, OLDF-8, OLDF-9, OLDF-10, OLDF-11 and OLDF-12) remained active from 2013 to 2015. One of the burrows (OLDF-5) had cheatgrass (*Bromus tectorum*) covering the entrance and the remaining 13 burrows were clear but had no signs of recent activity. The orchard burrows had 5 active burrows (ORCH-6, ORCH-7, ORCH-1A, ORCH-3A and ORCH-3) in 2013 and 2 of those burrows (ORCH-7 and ORCH-1A) remained active in 2015. A new anthropogenic burrow (ORCH-8) with one owl was discovered amongst the Orchard Burrows during the 2015 survey period. The Holocek Homestead burrow cluster had 2 (HolocekHS1 and HolocekHS4) of the 5 active 2013 burrows remaining active in 2015. HolocekHS3 had collapsed becoming unusable. HolocekHS2 and HolocekHS5 had cheatgrass covering the entrances.

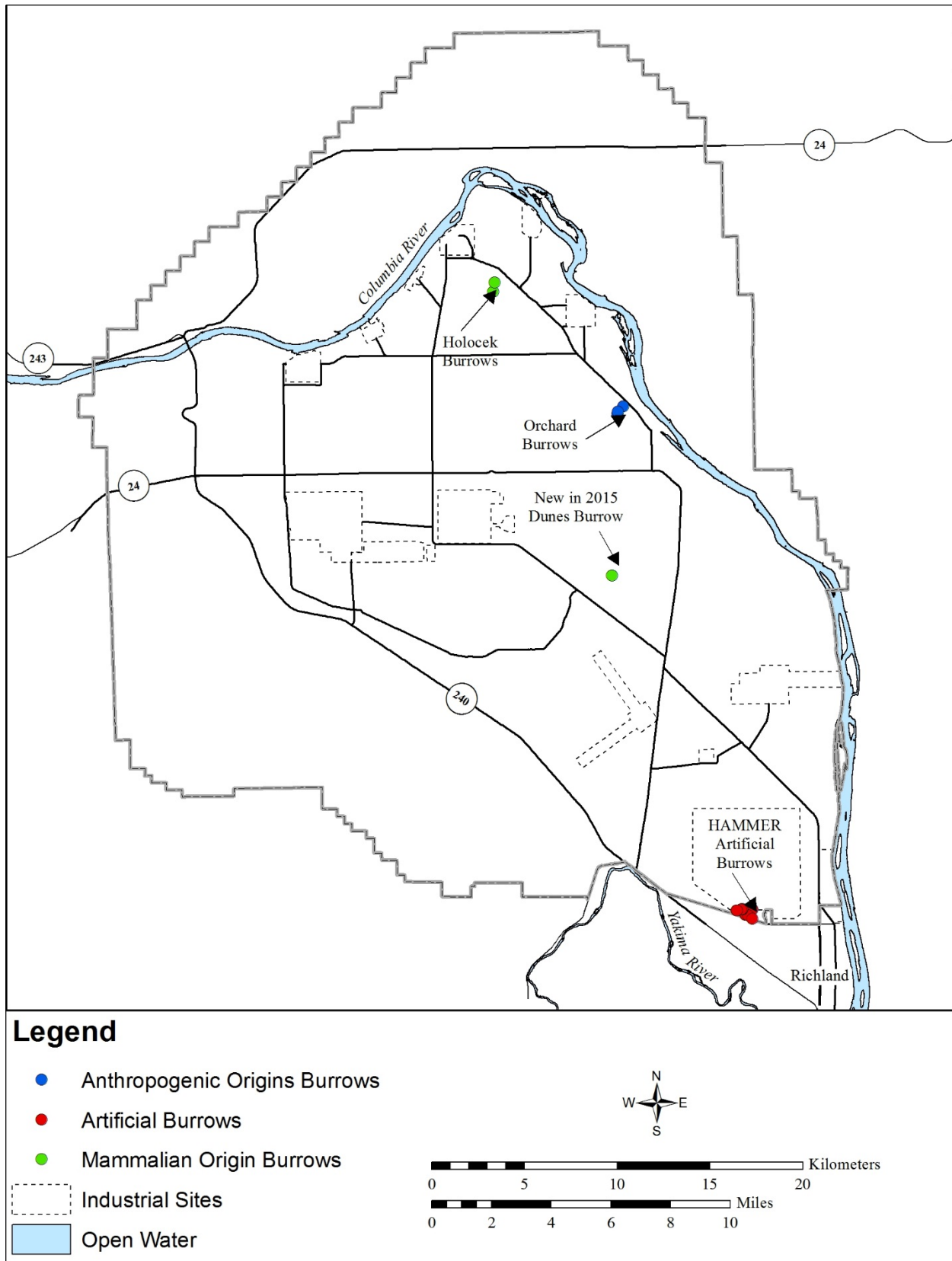


Figure 5. Active Burrowing Owl Burrows on the Hanford Site in 2015

3.3 Burrowing Owl Capture and Banding at the HAMMER Site

PSRP Assisted USFWS in trapping owls at the HAMMER EVOC to recover geolocators used in their owl migration study ([Fortin 2013](#)).

A total of 12 owls were captured and banded from 5 burrows (Figure 6), but no geolocators were recovered. Collections included 4 owls found to be hatch-year birds, the other 8 were after hatch year. The 8 after hatch year owls consisted of 3 males and 5 females. 2 of the captured owls were previously banded, 1 female banded as an adult in 2014 and 1 male banded as a juvenile in 2014 (Table 1). All captured owls were banded, left leg for hatch-year and right leg for after-hatch year, and released with USFWS band numbers (Figure 7).

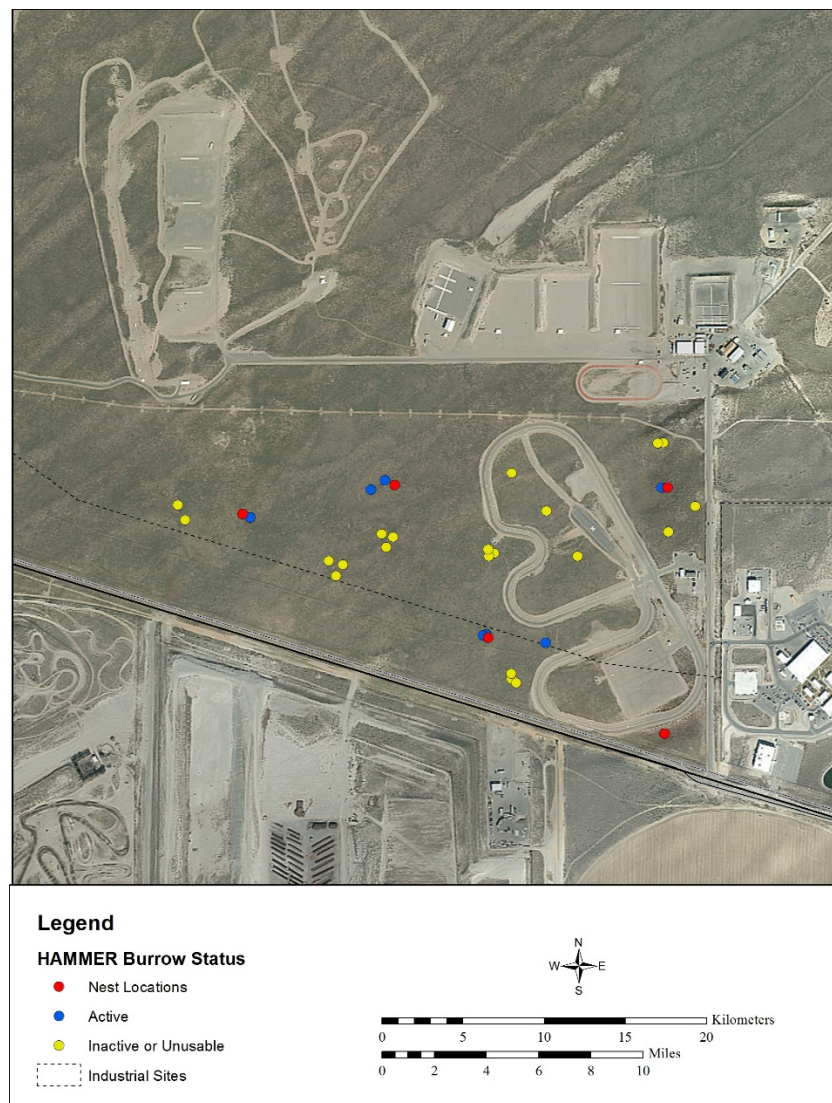


Figure 6. Burrow Status based on USFWS Banding at the HAMMER Facility

Table 1. U.S. Fish and Wildlife Service Burrowing Owl Trapping and Banding at the HAMMER

USFWS Band #	Burrow ID	N=New band R=Recapture	Age*	Sex**
804-11392	HAMMER_1	N	AHY	F
844-65136	HAMMER_1	N	HY	J
1004-02599	HAMMER_10	R	AHY	F
1004-02599	HAMMER_11	R	AHY	F
804-11394	HAMMER_PNNL_10	N	AHY	M
1004-12647	HAMMER_PNNL_12	R	AHY	M
804-11393	HAMMER_PNNL_12	N	AHY	F
844-65133	HAMMER_PNNL_12	N	HY	J
844-65134	HAMMER_PNNL_12	N	HY	J
804-11395	HAMMER_PNNL_3B	N	AHY	F
804-11396	HAMMER_PNNL_3B	N	AHY	M
804-11397	HAMMER_PNNL_9A	N	AHY	F
844-65135	HAMMER_PNNL_9B	N	HY	J

* HT= Hatch Year birds, AHY= After Hatch Year Birds, hatched in any previous year

** F=Female, M=Male, J=Juvenile



Figure 7. Banded Burrowing Owl Following Trapping, Banding and Release

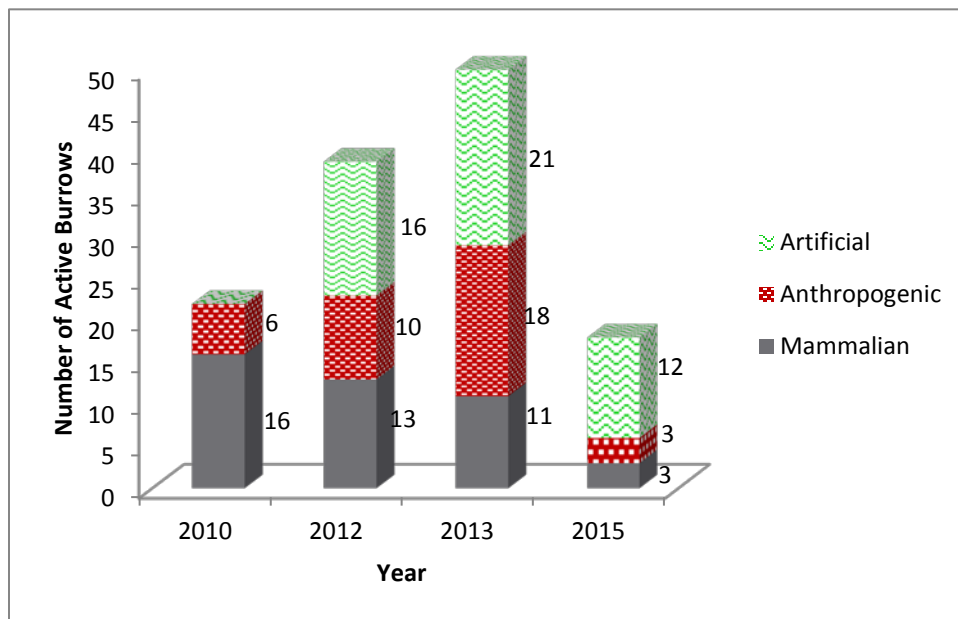


Figure 8. Number of Active Burrows per Year by Burrow Origin Type

4.0 Discussion

Two of the main objectives during the 2015 monitoring effort were to survey historical active burrows, provide status and locate any new burrows in addition to maintaining the ABS on the Hanford Site. Natural burrows of mammalian origin have a limited life expectancy in the wild (Bradbury and Newsome 2010). Therefore, monitoring existing historical burrows without actively searching for newer burrows may seem to suggest that the Hanford Site Burrowing Owl population is declining, which is not necessarily correct. A total of 6 natural burrows and 12 ABS were documented as active in 2015 (Figure 8), for a total of 18 active burrows (Appendix), a decrease from the 50 observed in 2013. ABS activity was down from 21 burrows in 2013 to 12 in 2015, a reduction of use by approximately 43 percent. Of the 15 natural burrows that were active in 2013, only 4 remained active in 2015. Two new active burrows were discovered in 2015, 1 of anthropogenic origin and 1 of mammalian origin. The 6 natural burrows active in 2015 is the lowest number documented in the past 5 years and represents a loss of approximately 73 percent in activity over the next lowest count.

The rapid loss of natural burrows is an alarming change from the previous 3 survey years. Research shows that Burrowing Owls tend to select nest burrows from an area with a high density of burrows, often close to roads, surrounded by bare ground or short grass ([Haug et al. 1993](#)). The Hanford Site has many mammalian digs that superficially appear to meet these preferences. Owls on the Hanford Site appear to historically prefer structures such as clay pipes or abandoned irrigation piping over burrows from mammal

digs. Anthropogenic burrows may require less work for the owls to prepare and maintain as a burrow. This affords the owl more time and energy for hunting, breeding, and rearing young.

While the landscape around the natural burrow clusters remains unchanged, there continues to be a loss of both anthropogenic and mammalian burrows. Weather, mammal use, and general wear over time cause mammalian burrows to have a finite lifespan. This could help explain the decrease in use by Burrowing Owls. Anthropogenic burrows do not face these same stressors, and it remains unclear why anthropogenic burrow use has declined. The major loss of activity noted during the 2015 survey is the loss of what has been called the “old fields” burrows, located in the northeast portion of the Hanford Site near the 100D and 100H Areas. This cluster has been listed as active in each of the previous surveys and was the largest natural cluster on the site. The owls in this location used old irrigation piping that runs throughout the historical agricultural fields. No significant changes to the condition of these pipes were noted during the 2015 surveys. Without further research on the burrows themselves or the owls occupying the burrows, only speculation can be made to the cause of the decline.

The ABS on Hanford Site at the HAMMER complex continue to see steady usage. The USFWS estimated a total of 5 owl nests at the complex based on capture and banding performed during 2015 (Figure 5). The number of nests stayed similar to previously surveyed years, the number of burrows used decreased slightly. The success of this mitigation action suggests that additional onsite mitigation would be successful in preserving the remaining owl population on central Hanford. Relatively close geographically, the Umatilla Army Depot has made large efforts to install ABS when it was believed the breeding population of Burrowing Owls was down to 4 pairs. The efforts of the Global Owl Project and the Army with use of ABS on that site have brought the population back to estimates of over 50 breeding pairs (communications with David Johnson of the Global Owl Project).

It is the recommendation of this review that this resource should be monitored again in 2017 (biennial) with the focus returning to all potential habitat areas in which active burrows have been documented since 2010 and habitat areas similar to the historical sites. These efforts can be used to evaluate if family units have vacated active areas relocating to previously occupied areas. The study of active colonies should consider documenting colony characteristics. Determining production from nest burrows and possible young mortality before fledging may provide explanation for population declines.

Due to the continuous development and removal of infrastructure, natural disturbances, site cleanup activities, and other land use alterations, the landscape of the Hanford Site is continually changing. With a continued loss of mammalian origin burrows and an accompanying loss of anthropogenic burrows, installation of ABS in active colony locations should be evaluated. Since the installation of the HAMMER complex burrows, updated designs and techniques have been developed for installation of Burrowing Owl burrows ([Johnson et. al 2010](#)). The new designs will not only provide adequate burrow locations for the existing populations to increase in number but provide a monitoring opportunity and easier maintenance for greater longevity. Additional ABS installed on Hanford should provide meaningful contributions to slowing the rate of population decline and provide a direct link to conservation and recovery of the species on Hanford.

5.0 References

- Bradbury, J.R., Newsome, H.L. 2010. *Patterns of burrow use by Burrowing Owls (*Athene cunicularia*) at the Mid-Columbia River National Wildlife Refuge Complex*. Visual Aide, Washington State Chapter of The Wildlife Society meeting, February 16-19-2010.
- Conway, C. J., V. Garcia, M. D. Smith, and L. A. Ellis. 2002. *Population Ecology and Habitat Use of Burrowing Owl in Eastern Washington: 2002 Annual Report*. USGS Arizona Cooperative Fish and Wildlife Research Unit, Tucson, Arizona. 50 pp. Online at: <http://wdfw.wa.gov/wildwatch/owlcam/bo-2002ap.pdf>
- Conway, C. J., and K. L. Pardieck. 2006. *Population trajectory of Burrowing Owls (*Athene cunicularia*) in eastern Washington*. Northwest Science 80:292–297. Online at: <http://pubs.er.usgs.gov/publication/5224739>
- DOE/A-1412, Environmental Assessment, 2002, *Expansion of the Bolpentest Hazardous Materials Management and Emergency Response Training and Education Center*, Hanford Site, Richland, Washington
- DOE/EIS-0222-F, 1999, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, U.S. Department of Energy, Washington, D.C. Online at: <http://energy.gov/nepa/downloads/eis-0222-final-environmental-impact-statement-0>.
- DOE/RL-96-32, DOE (U.S. Department of Energy). 2013. *Hanford Site Biological Resources Management Plan. Rev. 1*. U.S. Department of Energy, Richland, WA, Richland, Washington. Online at: <http://www.hanford.gov/files.cfm/doe-rl-96-32-01.pdf>
- Fortin, Amanda. 2013. “Wintering Habits of Burrowing Owls Come as a Surprise” U.S. Fish & Wildlife Service, Fish & Wildlife News. Spring 2013:3. Online at: http://www.fws.gov/home/fwn/pdf/news-spring-13_web.pdf.
- Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing Owl (*Speotyto cunicularia*). In: *The Birds of North America*, No. 61 (A. Poole, and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C. Online at: <http://bna.birds.cornell.edu/bna/species/061>.
- Johnson, D.H, M.A. Gillis, J.L. Rebholz, J.L. Lincer and J.R. Belthoff, 2010, *Users Guide to Installation of Artificial Burrows for Burrowing Owls*, Global Owl and Wildlife Research Institute Online at: <http://wdfw.wa.gov/publications/01199/wdfw01199.pdf>
- PNNL, 2005, Alexander A.K., Sackschewsky M.R., Duberstein C.A., *Use of Artificial Burrows by Burrowing Owls (*Athene cunicularia*) at HAMMER Facility on the U.S. Department of Energy Hanford Site*, Pacific Northwest National Lab, Richland, Washington
- PNNL, 2007, Alexander A.K., Sackschewsky M.R., Duberstein C.A., *Integrated Disposal Facility Sagebrush Habitat Mitigation Project: FY2007 Compensation Area Monitoring Report*, Pacific Northwest National Lab, Richland, Washington

USDOE – U.S. Department of Energy and USFWS – U.S. Fish and Wildlife Service. 2013. *Memorandum of Understanding between the United States Department of Energy and the United States Fish and Wildlife Service: Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds."* September 12.

Online at: <http://energy.gov/sites/prod/files/2013/10/f3/Final%20DOE-FWS%20Migratory%20Bird%20MOU.pdf>.

WCH-631 Rev. 0, 2015, *2015 River Corridor Closure Contractor Revegetation and Mitigation Monitoring Report*, D. L. Phipps, D. C. Shaw, and J.G. Lucas, Washington Closure Hanford, Richland, Washington.

Online at: <http://dmp01.wch-rcc.com/ucm/groups/ias/@docctl/@public/documents/wch/2208084.pdf>.

Wilde(a) J.W., C.T. Lindsey and J.J. Nugent, HNF-54294, 2013, *Burrowing Owl Monitoring Report for Calendar Year 2012*, , Prepared by Mission Support Alliance for the U.S. Department of Energy, Richland, Washington. Online at:

<http://www.hanford.gov/files.cfm/hnf-54294 - rev 00 cleared public.pdf>.

Wilde(b) J.W., C.T. Lindsey, J.J. Nugent and M.S. Filan, HNF-56531, 2013, *Burrowing Owl Monitoring Report for Calendar Year 2013*, Rev. 0, Prepared by Mission Support Alliance for the U.S. Department of Energy, Richland, Washington. Online at:

<http://www.hanford.gov/files.cfm/HNF-56531 - Rev 00.pdf>.

APPENDIX

Historical Status of Burrowing Owl Burrows Active in 2015

Historical Status of Burrowing Owl Burrows Active in 2015

Site Name	Construction	2010	2012	2013	2015
DUNES_1	MAMMAL	n/a	n/a	n/a	Active
HAMMER_1	Artificial	n/a	Active	Inactive	Active
HAMMER_10	Artificial	n/a	Inactive	Active	Active
HAMMER_11	Artificial	n/a	Active	Active	Active
HAMMER_2	Artificial	n/a	Active	Inactive	Active
HAMMER_3	Artificial	n/a	n/a	Inactive	Active
HAMMER_PNNL10	Artificial	n/a	Inactive	Active	Active
HAMMER_PNNL12	Artificial	n/a	Inactive	Active	Active
HAMMER_PNNL3A	Artificial	n/a	Active	Active	Active
HAMMER_PNNL3B	Artificial	n/a	Active	Active	Active
HAMMER_PNNL9	Artificial	n/a	Inactive	Active	Active
HAMMER_PNNL9B	Artificial	n/a	Active	Active	Active
HAMMER_PNNL9C	Artificial	n/a	Active	Active	Active
HolocekHS1	MAMMAL	n/a	Active	Active	Active
ORCH-1A	ANTHROPOGENIC	unk	Active	Active	Active
ORCH-7	ANTHROPOGENIC	n/a	n/a	2013	Active
ORCH-8	ANTHROPOGENIC	n/a	n/a	n/a	Active
HolocekHS4	MAMMAL	n/a	n/a	n/a	Active