



## **Burrowing Owl Monitoring Objectives Protocol and Data Structures for DoD AKN Program**

Version 1.0

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### **Overview and Purpose**

This document was developed for the Department of Defense (DoD) Avian Knowledge Network (AKN) Program in an effort to compile survey methodology and data structure into one document to provide recommendations for standard protocols for surveying Burrowing Owls on DoD installations. Burrowing Owl is one of 15 bird species that occur on DoD installations that has been identified as a Mission-Sensitive Species (MSS) by DoD. MSS have the highest potential to impact the military mission should they become Federally listed. The MSS list is designed to aid in prioritization of monitoring and management on DoD installations to help reverse declines, prepare installations for potential listing of species, identify potential mission impacts, and provide management and monitoring recommendations based on the best available science.

To support using the best available science to aid in planning and prioritization of monitoring and management of MSS on DoD installations, one of the goals of DoD AKN Mission-Sensitive Species Initiative includes recommending standardized monitoring protocols for future monitoring, including providing support for data entry and management in the AKN. This document was developed by a focus group of subject matter experts from within and outside of DoD to assist biologists in applying standard monitoring protocols for Burrowing Owl monitoring at DoD installations.

### **Scope and Limitations**

This document is intended to provide guidance on Burrowing Owl survey methodologies to address the monitoring objectives outlined in Table 1. Additional monitoring protocols, such as nest monitoring, banding, or demography studies, are outside the scope of this document.

While we recommend following the data structures outlined in "[Field Methods and Avian Knowledge Network Data Structure](#)", we understand that occasionally biologists may have objectives beyond those outlined here, and for that reason may want to collect additional data not included in these sampling protocol definitions. It is important to recognize that the standard sampling protocol definitions outlined in this document represent the minimum standard for baseline surveys. The goal of providing these standards are 1) to provide recommended data structures and field methods to biologists that are designing a monitoring program for Burrowing Owls, and 2) to provide data standards that will allow for comparison of Burrowing Owl monitoring data across geographical space and time. Biologists wishing to collect data beyond the standards outlined in this document are encouraged to follow these data structures at a minimum to contribute to this effort, but have the flexibility to collect additional data as needed to meet their monitoring or analytical objectives.

### **Acknowledgments**

This document summarizes focus group meetings from August 2023 – May 2024 that included members of the DoD AKN Program team (Caitlyn Gillespie (Klamath Bird Observatory), John Alexander (Klamath



Bird Observatory, and Elizabeth Neipert (US Army Engineer Research and Development Center) and members of a DoD Burrowing Owl focus group (David H Johnson (Global Owl Project), Russ Lawrence (Hill AFB and Utah Test and Training Range), Colin Leingang (JBLM Yakima Training Center), and Kevin Warner (Idaho Army National Guard)).

### **How to use this guide**

**1) Determine your monitoring objectives**

Burrowing Owl survey methodology should be chosen based on your monitoring objectives. A series of suggested questions and related monitoring objectives, along with suggested sampling type, are available in Table 1.

**2) Identify a sampling design that meets your objectives**

Sampling design considerations (such as time of day, time of year, and sampling locations) should be established to meet your monitoring objectives. A series of suggested sampling design considerations are outlined in Table 2.

**3) Determine which sampling protocol meets your objectives**

Once you have identified your objectives and sampling design, chose a sampling protocol that meets your needs (Table 3). We have outlined field methods and data structures for Point Counts (Table 4), Area Searches (Table 5) (including field methods for surveying prairie dog towns), and Burrow Checks (Table 6).

**4) Set up your AKN project for your Burrowing Owl data**

To set up your AKN project to manage your Burrowing Owl data, follow the steps below. If you need assistance, please refer to the DoD AKN User Guide (<https://www.dodakn.org/resources/dod-akn-user-guide/>), or sign up for DoD AKN office hours (<https://www.dodakn.org/get-training/#office-hours/>).

Step 1: Add the appropriate Sampling Protocol Definition to your project

Step 2: Create sampling units

Step 3: Make sure researcher names have been added to the project

Step 4: Enter data directly in Biologist (recommended), or upload your data using the Bulk Uploader tool.



## Determine Monitoring Objectives

**Table 1. Monitoring Objectives and Data Needs.** Installation biologists may be interested in Burrowing Owl monitoring for a number of reasons. As sampling design, burrowing owl field data collection protocols, and data needs should be determined by monitoring objectives, we suggest identifying the questions and monitoring objectives most relevant to the installation prior to designing and implementing a Burrowing Owl monitoring program.

Questions	Monitoring Objectives	Data Needs	Suggested Sampling Protocol Type
Are BUOW present?	Determine general inventory and status	Surveys in the appropriate locations, sampling windows, and survey effort to establish occupancy at a landscape scale (see Table 2)	Point Count or Area Search
	Issues related to ground disturbance activities and mitigation	Study design, sampling effort, and data collection required to establish occupancy at a project level scale. See “Local Scale Monitoring” below.	Area Search with follow-up Burrow check
When and where are BUOW present?	Seasonal and spatially explicit occupancy	Surveys in the appropriate locations, sampling windows, and survey effort. See Table 2.	Point Count or Area Search with a follow-up Burrow check
What is the abundance of BUOW on my installation (and/or surrounding areas)?	Determine conservation opportunities, identify habitat quality for other wildlife, and prioritize conservation actions	Surveys that determine number of pairs (plus number of young, depending on time of year) and burrow status. Full survey effort (3 visits/season) is critical.	Point Count or Area Search with a follow-up Burrow check.
What is the trend of BUOW on my installation (and/or surrounding areas)? How does this differ from regional trends?	Determine if BUOW trends are influenced by weather, prey availability, mission activities, etc. Determining if local BUOW trends are similar to broader trends.	Annual variation in abundance, requires robust annual monitoring within the area of interest. May be of interest for specific installations with large populations, or could be a collaborative effort among installations and/or surrounding land management agencies.	Point Count or Area Search with a follow-up Burrow check, repeated for several years.



*Local Scale Monitoring:*

Complete surveys at project scales no less than 14 days prior to initiating ground disturbance activity (CA Department of Fish and Game 2012). If Burrowing Owls are present on a project site, refer to guidelines to minimize negative impacts to burrowing owls, nest burrows and burrowing owl habitat such as those published by the California Department of Fish and Game (2012), the California Burrowing Owl Consortium (1993), New Mexico Department of Game and Fish (2007), or Colorado Parks and Wildlife (2021).

According to the California Burrowing Owl Consortium (1993) there are three definitions of negative impacts:

- Disturbance or harassment within 50 m of occupied burrows.
- Destruction of burrows and burrow entrances. Burrows include structures such as culverts, concrete slabs and debris piles that provide shelter to burrowing owls.
- Destruction and/or degradation of foraging habitat adjacent to occupied burrows.

Sampling Design Considerations

**Table 2. Considerations for determining a Burrowing Owl monitoring sampling design**

Sampling Design Elements	Description	Notes
Where should surveys take place?	Specifics about site selection and pre-assessment may depend on your location (elevation, slope, soil, etc)	Surveys should take place in suitable Burrowing Owl habitat, see Appendix 1.
What dates are best for monitoring BUOW where I am?	Specifics about sampling windows for BUOW depend on geography and elevation	See Appendix 2 for example study start and end dates.
What time of day should I conduct BUOW monitoring?	Surveys should be conducted between first light (typically ½ hour before sunrise) until 11:00am and between 5:00pm until dark.	Survey conditions (e.g. excessive heat) may also change the appropriate time of day for sampling (ending earlier in the morning or starting later in the evening).
How often should I monitor BUOW within a year?	3 visits, at least 1 week apart during peak breeding season	
How far apart should I place survey locations, such as point count points?	Depends on monitoring objectives	If monitoring goals include finding all owls within an area, space monitoring points within 0.25 miles of each other. For larger landscape studies and to avoid accidental double counts



Sampling Design Elements	Description	Notes
		of individual owls, space points 0.5 miles apart
How many survey locations do I need?	Depends on monitoring objectives and size of monitoring area	
How often do we need to revisit to maintain occupancy information?	Depends on monitoring objectives	Objectives may help determine the timing of surveys. Early breeding season visits will likely only observe males, as females are on eggs. Mid-breeding season visits could observe both the male and female in a pair. Late breeding season visits are necessary to observe male, female and young.
What equipment do I need?	Playback recording and equipment	Use a recording that will most likely provoke a response. A recording of a young territorial male is available for download on the DoD AKN portal.



## Field Methods and Avian Knowledge Network Data Structure

**Table 3. Data Collection Method Comparison**

	<b>A</b>	<b>C</b>	<b>B</b>	<b>D</b>
Protocol Type	Point Counts	Area Search	Area Search at a Prairie Dog Colony	Burrow check (survey follow-up)
Scale	Landscape or Project/Local	Landscape or Project/Local	Project/Local	Project/Local
Sampling Effort	3 visits	3 visits during	3 visits	1 visit per season if not part of any other nest monitoring
Audio Playback?	Yes	No	No	No
Season*	Breeding	Breeding	Breeding	Breeding
Useful to establish and/or monitor breeding?	Unlikely without a follow-up burrow check	Sometimes	Sometimes	Sometimes
Used to locate and or identify status of burrows?	No, unless paired with follow-up burrow check	Yes, but burrow check needed to determine status	No, unless paired with follow-up burrow check	Yes

\* This guide is designed to provide advice for biologists interested in breeding season monitoring.

### **A. Point Counts**

Point count surveys should be done during times of the day when owls are most active (Table 2). Do not conduct surveys during excessive rain, dense fog, or when wind speed is >20 mi/hr (12km/hr).

*Point Count Route Placement and Site Selection:* Point counts routes may follow roads in suitable burrowing owl habitat (Appendix 1). Place point count points along routes spaced at least 0.25 miles apart (Garcia et al. 2008), but up to 0.5 miles apart to avoid accidentally counting individuals across more than one point (Conway and Simon 2003).

### *Conducting the Survey*

At each point, the observer pulls off the road, exits the vehicle, and performs a 6-minute survey. During the first 3 minutes, play a recording of a 3-minute call-broadcast sequence (call of a territorial young male). After 3 minutes, during a 3-minute passive period, the observer should visually scan the landscape in all directions. Observers should record any owl that is seen or heard. For each observation, record the count, age, distance bin, and whether or not the owl was observed at a burrow (Table 4). Each observed individual is recorded once during the point count. A description of the behavior of burrowing owls during the surveys, including feeding, resting, courtship, alarm, territorial defense, and those indicative of parents or juveniles can be recorded in the notes if out of the ordinary. If burrowing



owls are observed, a follow up effort should be made at least once per season to locate and describe the burrow (see “Follow up Burrow Check”, Table 6).

Table 4. Point Count AKN Data Structure

**Protocol Type: Point Count**

**Protocol Name: [BUOW 6 1TB 4DB Age Burrow](#)**

**Sampling Unit: Point Count Point**

Field	Domain Values	Required?	Notes
Date	Calendar date in format acceptable by AKN	Yes	
Observer	Researcher name in AKN	Yes	
Start Time	Military time	Yes	
Survey Length	6 minutes	Yes	3 minutes call-broadcast sequence followed by 3 minutes of passive observation. No need to record during in which part of the 6 minute survey owls were detected
Species	BUOW	Yes	
Count	Number of individuals observed	Yes	
Age	Adult Juvenile Unknown	Yes	
Time Bins	one 6-minute bin		
Detection Cues	NR (Not Recorded)	Not Recorded	
Distance	(Binned) <100m 100-200m 200-300m >300m	Yes	
At Burrow?	Yes No Unknown	Yes	
Notes	String	No	



## **B. Area Search**

Area Search surveys should be done during times of the day when owls are most active (Table 2). Do not conduct surveys during excessive rain or when wind speed is >20 mi/hr (12km/hr).

*Area Search Plot Placement and Site Selection:* Area search plots should be created in suitable Burrowing owl habitat (Appendix 1) and the size of the plot should be an area that can be easily surveyed on foot in a standard 20-minute time period on most days. Plot size may vary to account for differences in terrain, vegetation density, and ground surface visibility. Define the boundary of the plot and record sampling effort on any given day by recording tracks. If necessary, a transect-like setup with multiple observers can be used for these surveys. If possible, minimize variation in surveyors and survey time to keep observations consistent over time. Make sure all observers have adequate training on Burrowing Owl identification and survey methods.

*Conducting the Survey:* During a 20-minute search, scan the entire visible area for burrowing owls using binoculars. Observers should record any owl that is seen or heard. For each observation, record the count, age, and whether or not the owl was observed at a burrow (Table 4). A description of the behavior of burrowing owls during the surveys, including feeding, resting, courtship, alarm, territorial defense, and those indicative of parents or juveniles can be recorded in the notes if out of the ordinary. If burrowing owls are observed, a follow up effort should be made at least once per season to locate and describe the burrow (see “Follow up Burrow Check”, Table 6). Minimize disturbance near occupied burrows and take care not to “flush” burrowing owls, especially if predators are present (CA Department of Fish and Game 2012). Burrowing owls may flush if approached by pedestrians within 50 m (Conway and Simon 2003). Map the approximate territory boundaries and foraging areas if known. An example data sheet is available in Appendix 3.

### **Modification of Area Search Protocol for Prairie Dog Colonies**

Area searches at prairie dog towns can be conducted from one or more points that provide unobstructed views of the prairie dog town. For small prairie dog towns that can be adequately viewed in their entirety from a single location, only one survey point may be necessary. The survey point(s) should be selected to provide unobstructed views (with binoculars if necessary) of the entire prairie dog town (burrow mounds and open areas between) and all nearby structures that may provide perches (e.g., fences, utility poles, etc.). (Colorado Parks and Wildlife 2021).





Table 5. Area Search AKN Data Structure

**Protocol Type: Area Search**

**Protocol Name: [AS BUOW Age Burrow](#)**

**Sampling Unit: Area Search Plot (Polygon or Center Point)\***

Field	Domain Values	Required?	Notes
Date	Calendar date in format acceptable by AKN	Yes	
Researcher	Researcher name in AKN	Yes	
Start Time	24-hour (military) time	Yes	
End Time	24-hour (military) time	Yes	
Species	BUOW	Yes	
Count	Number of individuals observed	Yes	
Age	Adult Juvenile Unknown	Yes	
At Burrow?	Yes No Unknown	Yes	
Notes	String	No	

\* While it is best practice to record the boundary of the area search plot each visit, the AKN does not currently allow for recording changes in the boundary of the area search plot as part of the sampling event. These data can be stored in a geodatabase outside of the AKN and uploaded as a zip file to the AKN data catalogue periodically. If the area search plot does not vary over time, it can be uploaded to the AKN as a sampling unit.

### **C. Follow up Burrow Visit**

A follow up Burrow Visit survey can be done during the same Sampling Event as a Point Count or Area Search. It can also be an independent Sampling Event at the Point Count Point or Area Search Plot. In the AKN, Burrow Visit surveys are recorded using a Site Condition protocol type. The Site Condition protocol "[BUOW BurrowCheck](#)" is used in the AKN to record the location and status of any associated Burrowing Owl burrows that are observed as part of a Burrowing Owl point count or area search survey.

Field Methods:

*Site Selection:* Burrow checks accompany either point counts or area searches. Following either a point count or area search survey, a burrow check form can be filled out to verify the location and status of any burrows located during or after the survey.

For each burrow, recording the coordinates (WGS84 Latitude/Longitude), and optionally give the burrow an ID for tracking if part of a larger burrow monitoring study. Identify whether or not the observer has confirmed whether this is a nest burrow (see "confirming nest burrow" below, and record whether any of the following activity signs are observed:



- **Decoration:** Note the presence of any recent Burrow decorations. Make sure decorations are current (prominent and not off to the side). Decorations usually indicate a nest burrow.
- **Feathers:** Note the presence of any Burrowing Owl feathers on or near the burrow entrance.
- **Eggshells:** May indicate recent hatching or predation event
- **Prey Remains:** Note the presence of recent prey items at or near the burrow
- **Young:** Note the presence of any young seen or heard at the burrow
- **Whitewash or Pellets:** Note the presence of any white-wash or pellets on or near the burrow entrance

*Confirming a Nest Burrow:* Nest burrows generally have dung lining the entrance of the burrow, with prey remains and collected materials outside the entrance. Nest burrows may have whitewash and regurgitated pellets visible, or they may be visible at a more prominent perch location nearby. Also, note that if owls flush from the nest burrow, they may return to the general area, but often will not return to the specific nest burrow when an observer is present. Example photos of nest burrows are available at: <https://cpw.state.co.us/conservation/Pages/CONEnergy-Land.aspx> (Colorado Parks and Wildlife 2021).

Table 6. Burrow Check AKN Data Structure

**Protocol Type:** Site Condition

**Protocol Name:** [BUOW BurrowCheck](#)

**Sampling Unit:** Parent Unit (Can be associated with a point count point or an area search plot)

Field	Domain Values	Required?	Notes
Date	Calendar date in format acceptable by AKN	Yes	
Time	24-hour (military) time	Yes	
Researcher	Researcher name in AKN	Yes	
Nest Burrow Confirmed?	Yes No Unknown	Yes	
Burrow ID	String	No	This is helpful if part of a larger monitoring study where burrows are given unique IDs that are tracked over time.
Latitude	Latitude Coordinates of Burrow	Yes	
Longitude	Longitude Coordinates of Burrow	Yes	
Activity Signs: Decoration	Yes No	Yes	



Field	Domain Values	Required?	Notes
Activity Signs: Feathers	Yes No	Yes	
Activity Signs: Eggshells	Yes No	Yes	
Activity Signs: Prey Remains	Yes No	Yes	
Activity Signs: Young	Yes No	Yes	
Activity Signs: White wash or pellets	Yes No	Yes	
Notes	String	No	

### Appendix 1. Burrowing Owl Habitat Guidelines

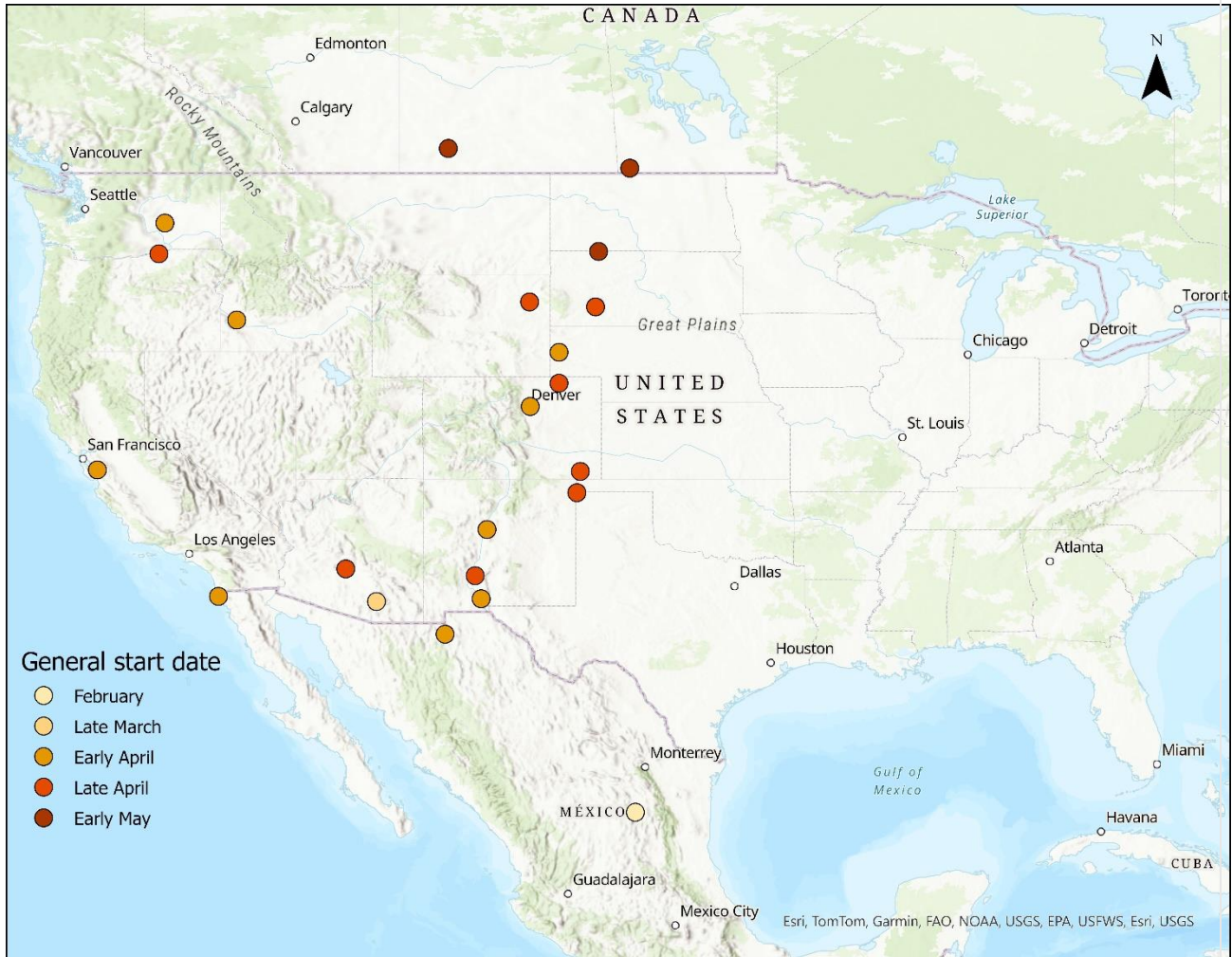
Assess Potential Burrowing Owl Habitat (Adapted from California Burrowing Owl Consortium 1993):

Burrowing Owl habitat can be found in annual and perennial grasslands, deserts, and scrublands characterized by low-growing vegetation (Zarn 1974). Suitable owl habitat may also include trees and shrubs if the canopy covers less than 30 percent of the ground surface. Burrows are the essential component of burrowing owl habitat: both natural and artificial burrows provide protection, shelter, and nests for burrowing owls (Henny and Blus 1981). Burrowing owls typically use burrows made by fossorial mammals, such as ground squirrels or badgers, but also may use man-made structures, such as cement culverts; cement, asphalt, or wood debris piles; or openings beneath cement or asphalt pavement.



Appendix 2. Sampling phenology table by region

Survey timing should correspond with local peak breeding phenology for Burrowing Owls, with three visits spaced at least 1 week apart during the breeding season. Approximate survey start times from example Burrowing Owl studies are displayed on the map below as a guideline; however, local breeding phenology may vary.



Alberta, Canada. Saskatchewan, Canada	(Haug and Oliphant 1987)
Phoenix, Arizona	(Doublet et al. 2023)
Davis-Monthan Air Force Base	(Conway and Ellis 2004)
San Jose, California	(Barclay et al. 2011)
San Diego, California	(Wisinski et al. 2012)
Janos, Chihuahua, Mexico	(Porro et al. 2020)
Pawnee National Grassland, Colorado	(Porro et al. 2020)
Comanche National Grassland, Colorado	(Porro et al. 2020)



Rocky Mountain Arsenal NWR, Denver, Colorado	(Lutz and Plumpton, D.L. 1997)
Morley Nelson Snake River Birds of Prey Conservation Area, Idaho	(Belthoff 2003)
Manitoba (southwestern)	(Froese 2016)
Western Nebraska panhandle	(Porro et al. 2020)
Armendaris Ranch, New Mexico	(Porro et al. 2020)
Las Cruces, New Mexico	(Porro et al. 2020)
Kirtland Air Force Base, New Mexico	(Porro et al. 2020)
Kiowa-Rita Blanca National Grassland, New Mexico/Texas	(Porro et al. 2020)
Hermiston, Oregon	Johnson 2018
Grand River National Grassland, South Dakota	(Porro et al. 2020)
Buffalo Gap National Grassland, South Dakota	(Porro et al. 2020)
Washington (southeastern)	(Conway et al. 2006)
Wyoming	(Conway et al. 2002)
northeastern Mexico	(Ruiz Ayma et al. 2016)





## Area Search Data Form

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Study Area

Site Code

Month Day Year

Visit  Start Time

End Time

Observer

Species	Count	Age	At Burrow?	Notes
B U O W	2	A	Y	
B U O W	3	J	Y	
B U O W	1	A	N	
B U O W	1	U	U	

Study Area

Site Code

Month Day Year

Visit  Start Time

End Time

Observer

Species	Count	Age	At Burrow?	Notes

**Code Lists**  
**Age:** A (Adult), J (Juvenile), U (Unknown)  
**At Burrow:** Y (Yes), N (No), U (Unknown)







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