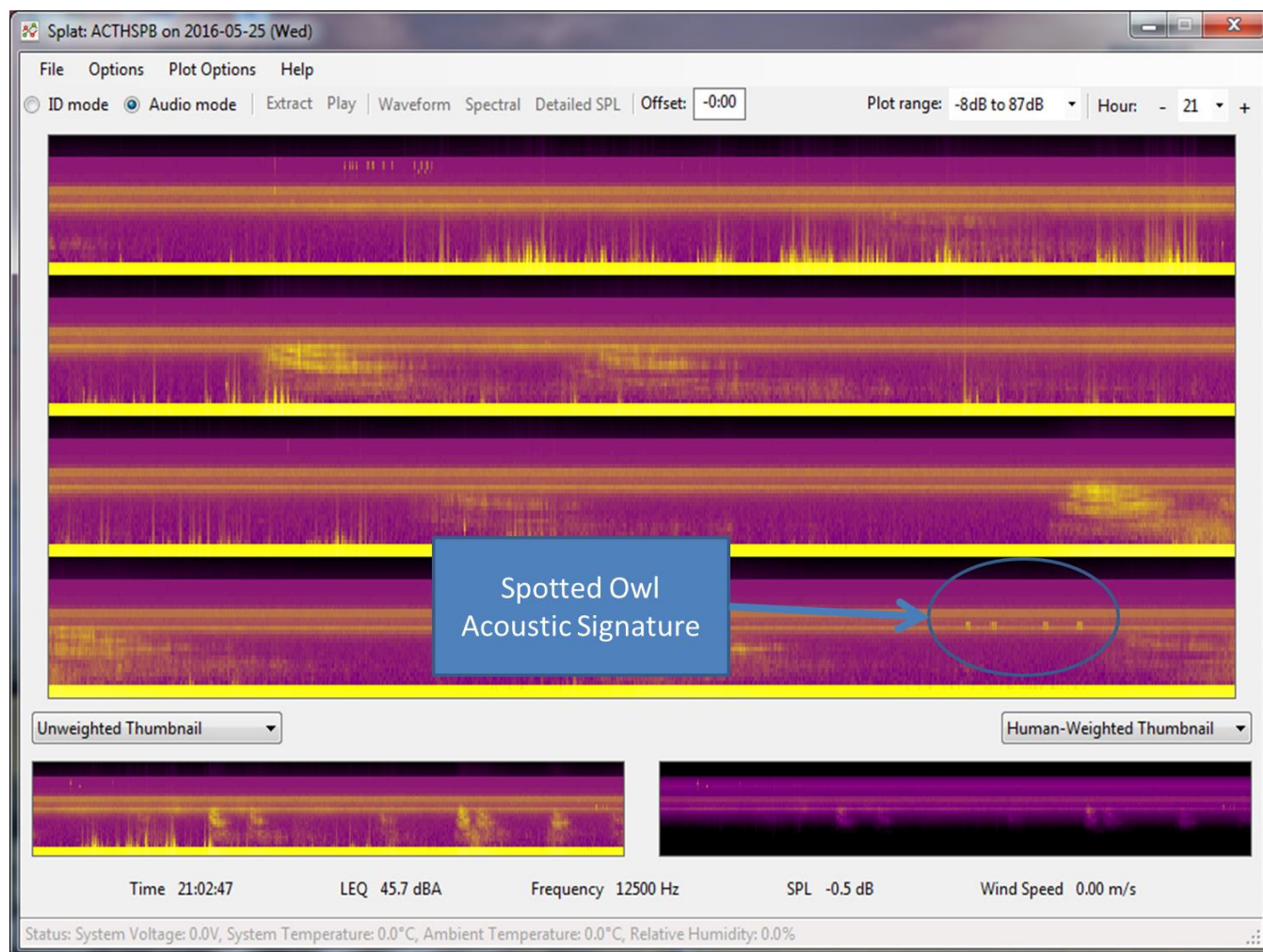




Crater Lake National Park Biological Sound Station Research

2016 Annual Report



ON THE COVER

Spotted owl acoustic signature from the Thousand Springs location

Photograph by Sean Mohren, Terrestrial Ecologist, Crater Lake National Park

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2016 Annual Report

Sean R. Mohren

National Park Service
PO Box 7
Crater Lake, OR 97604

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Abstract

Beginning in 1992 the wildlife team at Crater Lake National Park started implementing the US Fish and Wildlife Service northern spotted owl monitoring protocol to determine distribution, abundance, and reproductive success of northern spotted owls in Crater Lake National Park. As the years progressed, reductions in budgets, shifting priorities and increased awareness of safety has reduced our ability to implement this monitoring protocol, in its entirety, at the Park. In general, the wildlife staff is presently capable of implementing 1-3 noncompliance surveys at each known owl activity center in any given year versus the 6 surveys recommended in the US Fish and Wildlife Service spotted owl monitoring protocol. In addition, there is currently no staff time available to survey areas of the park that contains high quality habitat but is not currently listed as a known owl activity center. In an effort to help improve our ability to determine the occupancy and distribution of northern spotted owl and barred owl, an owl that directly competes with northern spotted owls for habitat and resources, the wildlife team began exploring the use of acoustic stations to help supplement our survey efforts.

Based on the results of our 2012-2016 sampling efforts, we believe using acoustic stations to supplement traditional northern spotted owl monitoring methods provides us with a cost effective way to improve our ability to document the presence of northern spotted owls and barred owls at Crater Lake National Park. The 2016 survey effort represents our third year of full implementation and the details of this effort are described in this report. The primary goals for 2016 were to document northern spotted owls and barred owls at 1) known northern spotted owl activity centers and 2) areas of the Park that contain high quality spotted owl habitat.

In the summer of 2016, 29 sound stations were deployed at 7 known northern spotted owl activity centers and 8 locations that were determined to have suitable northern spotted owl nesting habitat. In general we deployed 2 sound stations at each site for an average of 14.42 days. A northern spotted owl was recorded at only one acoustic station at the Thousand Springs site. Field crews implementing a limited number of surveys following the US Fish and Wildlife Service northern spotted owl survey protocol recorded northern spotted owls at Thousand Springs, Bear Bluff, and Grayback Ridge sites in 2016. The acoustic station at Bear Bluff recorded an unknown *Strix* species, but no definite northern spotted owl. No acoustic station was placed at Grayback this year due to a late snowpack that limited access. Barred owls were documented at 10 sites (48%) using acoustic stations. Of those 10 sites, 7 overlapped with locations where traditional field crew northern spotted owl surveys were conducted. Surveyors recorded barred owls at two of these sites.

From the data gathered using the acoustic stations in 2016, as well as in previous years, it is clear that their implementation is a beneficial asset in monitoring for northern spotted owls and barred owls. Not only have they helped complement the US Fish and Wildlife Service standard surveys, they have also provided us a new tool to survey for northern spotted owls and barred owls in many new locations within the Park.

Introduction

Beginning in 1992 the wildlife team at Crater Lake National Park (CRLA or Park) began implementing the US Fish and Wildlife Service (USFWS) northern spotted owl (NSO) (*Strix occidentalis caurina*) monitoring protocol to determine distribution, abundance, and reproductive success of this species at CRLA (USFWS 2011). As the years have progressed, reductions in budgets, shifts in priorities, and increased awareness of safety has reduced our ability to implement this monitoring protocol in its entirety at the Park. Starting in 2012, the wildlife team at CRLA began a pilot study using acoustic stations to aid in the monitoring effort of NSOs and barred owls (*Strix varia*). This was done experimentally to see if using acoustic stations would help a relatively small wildlife team more comprehensively monitor historical NSO territories and to search for new occupied sites. The idea was to use recording stations to document presence information about NSOs and barred owls throughout the park. Once a NSO was recorded, traditional protocol surveys could be completed at those sites to determine nesting locations and reproductive success.

Utilizing acoustic stations to supplement traditional NSO monitoring methods provides us with an efficient and cost effective way to improve our ability to document the presence and distribution of NSOs and barred owls (Whyte et al. 2015, Ross and Mohren 2014, Murphy et. al 2013). In the summer of 2016, we continued utilizing acoustic stations as part of our NSO monitoring efforts to help improve our ability to document this species. We had 2 primary goals in 2016; the first was to continue to demonstrate that acoustic stations could document NSOs and barred owls to the same degree as the limited number of USFWS protocol surveys the wildlife team conducted; and, secondly, to continue to use acoustic stations to survey new areas of the Park that have not been surveyed since the early 90s to determine NSO or barred owl presence and ultimately distribution. In addition to these main goals, we also wanted to begin tracking the presence and eventually determine the distribution of other Strigidae species.

As a survey method, acoustic stations have shown to be successful by providing a cost effective, efficient method to survey owls. Sounds stations record on a 24-hour continuous basis and can be left in the field for up to a month if necessary. The data can be reviewed quickly and then used to guide field surveys following the USFWS spotted owl survey methods should a NSO call be recorded. This increases the chance of finding a *Strix* species given the limited number of visits a field crew can typically complete in a short field season. Used in conjunction with the field surveys, the acoustic stations increase what the wildlife team can learn about owl occupancy in the Park. As barred owls expand their range into historically NSO territory, it has been shown that NSOs are less likely to vocalize (Crozier 2006), which could alter the efficacy of a traditional survey. Deploying acoustic stations that survey around the clock for extended periods of time may help improve our chances of documenting a NSO that has reduced its calling time. In addition, acoustic stations may be deployed where it would be impractical to undergo a traditional survey, such as in more remote areas of the Park or areas that are not safe to survey at night.

The acoustic sound systems are not projected to replace the traditional biological surveys of NSO habitat. Nor are they deployed with the intent to substitute one or more of the protocol visits

developed by the USFWS (USFWS 2011). While we believe stations can be used as a reliable survey method to conclude presence/absence, nesting status and reproductive success cannot be accurately determined by acoustic stations. Therefore, traditional survey methods are still needed for compliance surveys and to determine the reproductive status of an owl species.

Methods

The general process for implementing acoustic stations includes: 1) selecting a survey area and station locations, 2) setting up the station, 3) retrieving the station, 4) file management, 5) sound file review, and 6) data entry. Each of these sections is discussed briefly below and complete details can be found in the CRLA Acoustic Monitoring Protocol (Murphy and Mohren 2013).

Site Selection

To determine a general area to survey at known NSO activity sites we used ArcGIS to plot all NSO and barred owl locations recorded between 1992 and 2014. We then used a kernel density estimator with a least squares cross validation and a 95% isopleth to develop polygons that were representative of NSO and barred owl use areas. For each site, table 1 shows the size of the modelled area along with the number of NSO and barred owl locations used to create the sample area. To select areas to sample that are not considered NSO activity centers, we used ArcMap to develop polygons around areas of habitat that the Park currently has mapped as NSO nesting habitat and then selected polygons that contained the highest percentage of nesting habitat.

Once we determined the areas to sample, we used a geographic information system (GIS) program called System for the Prediction of Acoustic Detectability (SPreAD or SPreAD-GIS) to model how sound will disperse over the landscape at each area to be surveyed (Figure 1). As part of the model, we utilized the following inputs:

- 10 meter DEM
- National Land Cover (NLCD) vegetation data
- PRISM Minimum June Temperature Data
- Park Humidity Data

Using these parameters, we modelled how sound would travel over the landscape for each site. We placed 1 point within each polygon we wanted to survey located in an area that we thought would be the best location for sound collection based on topography and accessibility. We then ran the SPreAD program and modeled sound based on this point. Once complete, we examined the areas of the survey polygon that were not covered by the modeling of the initial station and added additional stations to cover the remaining area. We then reran the model using both stations to determine total acoustic spread within the owl use area with the ultimate goal of having at least 80% of the polygon cover. Once complete, this provided us with a general location to place two sound recording devices at each site.

Table 1. Polygon size and number of spotted owl and barred owl locations used to determine where to place acoustic stations at each site.

Site	Area (km ²)	# NSO Locations	# Barred Owl Locations
Annie Creek	10.49	9	20
Bear Bluff	0.53	6	2
Boundary Springs	0.05	12	0
Bybee Creek	4.65	10	10
Castle Creek	11.69	12	17
Little Copeland Creek	1.22	13	2
Crater Creek	3.98	21	8
Crater Peak	1.99	5	0
Crescent Ridge	2.15	4	11
Grayback Ridge	8.81	15	2
Maklaks Crater	2.72	7	9
Sand Ridge	3.87	18	14
Lower Sun Creek	8.20	10	20
Thousand Springs	0.16	5	0

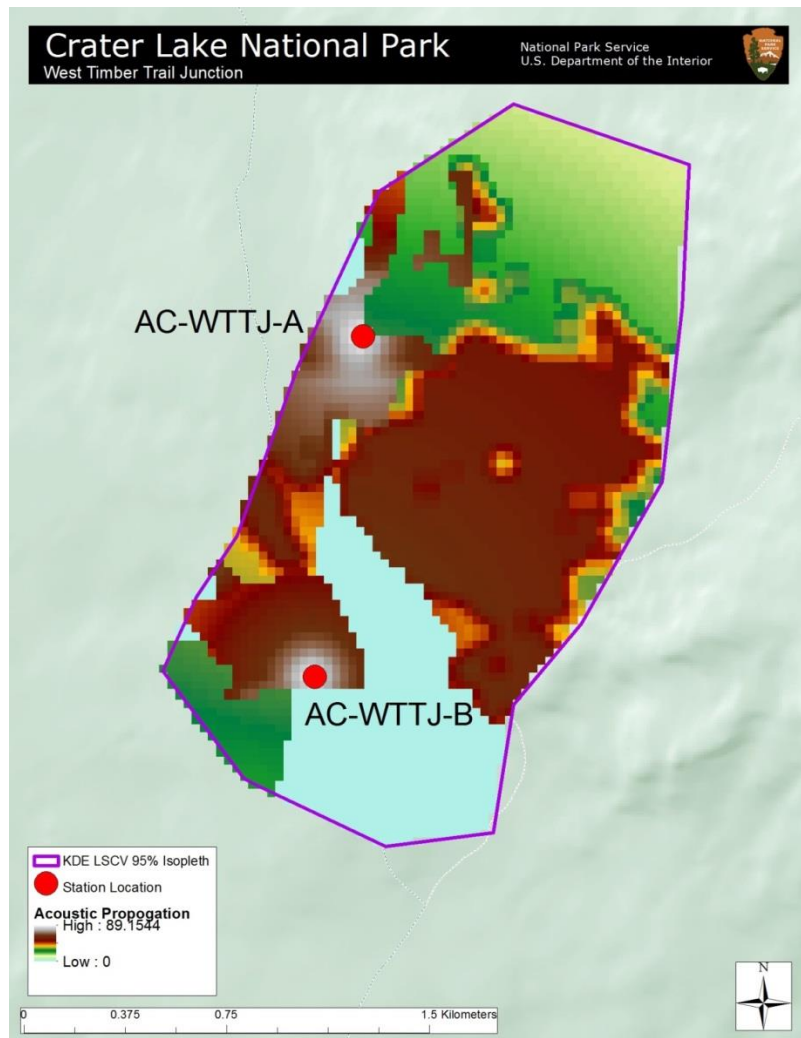


Figure 1. West Timber Trail Junction sample area with acoustic sampling locations, kernel density estimator polygon, and acoustic propagation.

Once the general location of the sound station was selected, it was up to the field crew to determine an appropriate microsite location to setup the recording device. Some things considered when placing the stations included:

- Avoiding areas with high winds (e.g. avoid unprotected ridgelines).
- Avoiding deploying near large reflective surfaces, such as rock walls.
- Shunning areas close to constant noise sources such as streams, roads, nesting birds, and squirrel caches.
- Preventing equipment / animal conflicts by avoiding game trails and other areas where non-target animals were likely to congregate.
- Selecting areas where microphones could be effectively mounted.

Setting up and Removing the Sites

Each biological sound station consists of a Roland R-05 MP3 recorder, Olympus ME51S microphone, 2 Urbanti 100mm funnels, a 40Ah 3.2V LiFePO4 battery, and a modified Pelican case (Figure 2). The wildlife team, as much as possible, standardizes our equipment to make certain results are comparable from site-to-site and year-to-year.

Microphones were incased in a PVC tube which then attaches to two funnels. This structure was securely lashed to a tree using parachute cord at approximately 60-70 inches above the ground in a way that prevents movement from wind. The selected tree was large enough so that it would not move with wind, but small enough that the microphones extend beyond the trunk. An audio cord was attached to the microphone on one end and to the Pelican case on the other end, with extra cord being wrapped around the tree to prevent noise or snagging on passing wildlife (Figure 3).



Figure 2. Components of a biological sound station



Figure 3. Photograph of a sound station deployed at Bybee Creek

Once the setup was in place, settings on the Roland recorder were checked to make certain they followed the settings described in the CRLA Acoustic Survey Protocol (Murphy and Mohren 2013). Once the settings were checked, the station was activated and the device was checked to make sure it was working by having the surveyor record their name, site location, date, and time into the device. Once complete, the Pelican case was sealed, chained to the tree, and covered with woody debris (Figure 4). The surveyor completed the datasheet which included: site ID, general location, date set, time set, surveyor, UTM coordinates, GPS accuracy, elevation, habitat, ground porosity, potential noise, sound station assigned number, microphone orientation, and any general deployment notes. In addition, photographs were taken of the setup and of the habitat in each cardinal direction.

In general, sound stations are deployed for a two week period. Upon arriving at the microphone, the surveyor opened the Pelican case and stated their name, location, site ID, date, and time into the microphone to determine if the site is still working. The recorder was then turned off and the surveyor documented the recovery date and time, if the unit was functioning, and any general recovery notes on the datasheet.



Figure 4. Photograph of a sound station deployed at the Lower Sun Creek Site. The Pelican box is covered with woody debris to prevent being tampered with by wildlife.

File Management, Data Review, and Data Entry

Once back in the office sound files were transferred from the Roland R-05 recorder to a supplemental storage device. Sound files are very large and therefore not stored on the NPS server. Instead they are stored on 2 external hard drives. One drive is called “Acoustic Raw Data” and one drive is called “Acoustic Working”. The raw audio drive is used to store unmanipulated data and acts as a backup, the files on the “Acoustic Working” hard drive are used to analyze the sound data.

Once transferred to the “working” hard drive a toolbox called “Acoustic Monitoring Toolbox” (AMT) developed by the NPS sounds program is used to rename and convert the MP3 files into a useable format. Within the toolbox, a program called “Audio Renamer” is used to rename the MP3 files to include the site ID and sample year. After renaming the MP3 files, they are converted into a text format using a program called AUDIO2NVSPL. Once files are in the text format, SPLAT, a program in AMT, is used to create and review spectrographs of the recordings. Spectrographs are reviewed to determine if any NSOs or barred owls called at the site (Figure 5). If a spectrograph appears to be an owl, the audio is listened to, and any owl species recorded are documented on the datasheet. In addition to owl species, predatory birds such as goshawks (*Accipiter gentilis*) are documented since they may have an effect on the distribution of spotted or barred owls. Along with the raptor calls, a plethora of other species and sounds (e.g. other owls, coyotes, elk bugle, thunder, trees falling, etc.) are periodically documented. Once the sound files are reviewed, the results are entered into a Microsoft Access database that contains automated summaries that are incorporated into this annual report.

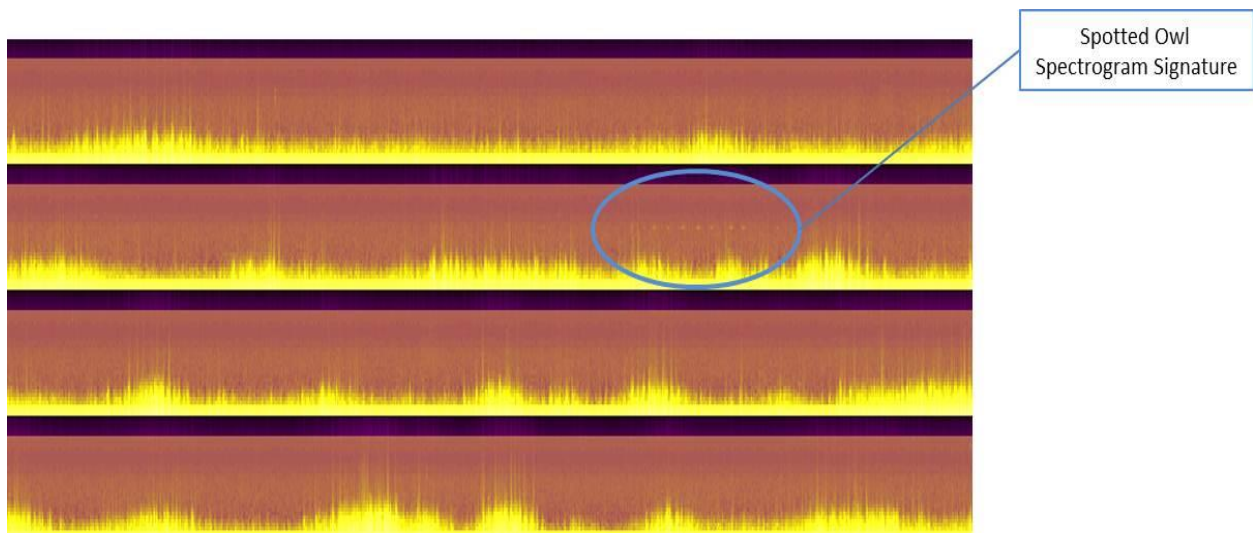


Figure 5. Northern spotted owl spectrogram in the SPLAT tool of the NPS AMT Toolbox.

Results

Results from the 2016 field season

A total of 29 sound stations were deployed at 7 known owl activity centers and 8 areas containing spotted owl nesting habitat between May 24, 2016 and July 27, 2016. We used 2 stations at each site with one exception; only one station was deployed at the Little Copeland Creek site because of the small size of the sample area. We collected 10,064 hours of data with an average of 14.46 days surveyed per station (range 0-27 days). We documented spotted owls at one site during the 2016 field season. Barred owls were recorded on 14 stations at 10 sites in 2016 (Table 2). This makes for a detection of an owl species of interest at 66.6% of the sites surveyed and 51.72% of the deployed stations.

Table 2. Number of days deployed and species observed at sound stations used to sample at Crater Lake National Park in 2016

Site	Location	Days Surveyed	Owl Species	Other Predators
Bear Bluff	AC-BEBL-A-16	18	None	
	AC-BEBL-B-16	18	Northern Pygmy Owl, Northern Spotted Owl	
Bybee Creek	AC-BYCR-A-16	16	Barred Owl	
	AC-BYCR-B-16	0	None	
Castle Creek	AC-CACR-A-16	0	None	
	AC-CACR-B-16	14	Barred Owl, Northern Pygmy Owl	
Crescent Ridge	AC-CRRI-A-16	15	Barred Owl	
	AC-CRRI-B-16	15	Barred Owl, Great Horned Owl	
East Boundary Springs	AC-EABS-A-16	15	None	
	AC-EABS-B-16	15	Flammulated Owl	
Little Copeland Creek	AC-COCR-A-16	18	Barred Owl, Great Horned Owl	Northern Goshawk
North Red Blanket	AC-NORB-A-16	15	Great Horned Owl	
	AC-NORB-B-16	11	Great Horned Owl	
South Boundary	AC-SOBO-A-16	14	Barred Owl	
	AC-SOBO-B-16	14	Barred Owl	
South Fork Bybee	AC-SOFB-A-16	2	None	
	AC-SOFB-B-16	15	Flammulated Owl	
Sun Creek	AC-SUCR-A-16	22	None	
	AC-SUCR-B-16	20	Barred Owl	
Thousand Springs	AC-THSP-A-16	19	Barred Owl, Great Horned Owl	Northern Goshawk
	AC-THSP-B-16	19	Flammulated Owl, Northern Pygmy Owl, Northern Spotted Owl	Northern Goshawk
Trapper Creek	AC-WETC-A-16	18	Barred Owl	
	AC-WETC-B-16	9	Barred Owl, Flammulated Owl, Northern Pygmy Owl	
Union Creek Spring	AC-UNCS-A-16	16	None	
	AC-UNCS-B-16	16	Flammulated Owl	
West Timber Trail Junction	AC-WTTJ-A-16	27	Flammulated Owl,	
	AC-WTTJ-B-16	18	Barred Owl, Flammulated Owl	
Whitehorse Bluffs	AC-WHBL-A-16	13	Barred Owl	
	AC-WHBL-B-16	8	Barred Owl, Flammulated Owl	

The goal was to have each station record for a total of 14 days, however in 7 sampling locations at 6 sites we did not reach the target survey date. Of these 7 cases, 3 sites were destroyed by bears (South Fork Bybee A, Whitehorse Bluff B, and West Trapper Creek B), 2 had old batteries that died (Castle Creek A and Whitehorse Bluff A), and 2 were caused by a mechanical error (Bybee Creek B and North Red Blanket B).

In addition to spotted and barred owl recordings, predatory species such as Northern goshawks and great horned owls were documented on 6 stations (20.69%) at 4 sites (26.67%). Goshawks were documented at the Little Copeland Creek and Thousand Springs sites and great horned owls were documented at: Crescent Ridge, Little Copeland Creek, North Red Blanket, and the Thousand Springs sites (Table 2).

We surveyed 7 sites using both acoustic and the USFWS traditional survey methods. If we compare the diversity of owls observed at each site when using acoustic station versus the traditional field crew survey methods we can see the benefits of the acoustic stations (Table 3). Spotted owls were documented using both the acoustic and field crew survey methods at Thousand Springs. Field crews documented NSOs at the Bear Bluff site, however using the acoustic method we could only determine there was either a spotted owl or barred owl species present. The type of call recorded would not provide us with the opportunity to differentiate between the two species. Barred owls were found by the field crews at 2 sites, while acoustic stations recorded barred owls at 5 sites. In addition, field crews documented one great horned and no pygmy or flammulated owls but we did record these species at multiple sites using the acoustic stations (Table 3).

Table 3. Comparison of owl species of interest observed using traditional USFWS protocol methods versus using acoustic stations.

Overlapping Locations	# Traditional Surveys	Owl Species Observed with Traditional method	# Days Acoustic Surveyed*	Owl Species Observed with Acoustic Methods
Bear Bluff	3	Spotted Owl	18	Northern Pygmy Owl
Bybee Creek	3	Barred Owl, Great Horned Owl	6	Barred Owl
Castle Creek	3	None	14	None
Little Copeland Creek	4	None	18	Barred Owl, Northern Pygmy Owl
Crescent Ridge	2	None	15	Barred Owl, Great Horned Owl
Sun Creek	2	Barred Owl	22	Barred Owl
Thousand Springs	3	Spotted Owl	19	Barred Owl, Great Horned Owl, Flammulated Owl, Northern Pygmy, Northern Spotted Owl

*number of days at least one sound station was in operation

Results from the project to date

Beginning in 2012 the wildlife team at Crater Lake National Park began a 2 year (2012-2013) pilot study to determine the feasibility of utilizing acoustic stations to help supplement field crew surveys. It was determined that acoustic sampling has the potential to be an efficient and effective method to determine NSO and barred owl presence along with the presence of multiple other owl species. Based on the results of the pilot study, full implementation of the project began in 2014. Table 4 provides a breakdown of the number of sites, station, and sampling effort that has been accomplished to date.

Table 4. Number of hours sampled each year along with the average number of hours sampled at each station

Project Status	Year	# of Sites Sampled	# Stations Sampled	Total # Hours Sampled	Average # Days Sampled Per Station
Pilot	2012	5	5	2001	16.67
Pilot	2013	4	6	2187	15.19
Full Implementation	2014	7	14	5863	17.45
Full Implementation	2015	16	32	11,293	14.70
Full Implementation	2016	15	29	10,064	14.46

Since 2014, we have simultaneously sampled 20 sites utilizing both the acoustic survey method and surveys conducted by field crews implementing a limited number of surveys following the USFWS spotted owl survey protocol. Of these 20 sites sampled, we have documented spotted owls at 6 sites and barred owls at 13 sites. When comparing acoustic survey techniques versus traditional field crew surveys we were able to document spotted owls equally. However, using the acoustic surveys we were able to document a significantly larger number of barred owls and great horned owls (Table 5, Figure 6).

Table 5. A comparison of the results of sites surveyed using both acoustic sampling techniques and field surveys following the USFWS spotted owl monitoring protocol.

Site	Year	USFWS Survey Protocol					CRLA Acoustic Protocol				
		# Days Surveyed*	# Spotted Owls	# Barred Owls	# Great Horned Owls	# Goshawks	# Days Surveyed	# Spotted Owls	# Barred Owls	# Great Horned Owls	# Goshawks
Bear Bluffs	2014	2	0	0	0	0	14	0	0	0	0
Bybee Creek	2014	2	0	0	0	0	16	0	1	1	0
Castle Creek	2014	2	0	0	0	0	8	0	1	0	0
Grayback Ridge	2014	2	1	0	0	0	14	1	1	1	0
Sand Ridge	2014	3	0	1	0	0	14	0	1	0	0
Sun Creek	2014	2	0	0	0	0	14	0	1	0	0
Between Copeland and Little Copeland Creek	2015	3	0	0	0	0	16	0	1	0	0
Bear Bluff	2015	3	1	0	0	0	20	1	0	0	0
Bybee Creek	2015	3	0	0	0	0	5	0	1	0	0
Crater Peak	2015	3	0	0	0	0	13	0	0	1	0
Grayback Ridge	2015	1	1	0	0	0	20	1	1	0	0
Sun Creek	2015	2	0	1	0	0	23	0	0	0	0
Thousand Springs	2015	4	1	0	0	0	16	1	0	0	0
Bear Bluff	2016	3	1	0	0	0	18	0	0	0	0
Bybee Creek	2016	3	0	1	1	0	6	0	1	0	0
Castle Creek	2016	3	0	0	0	0	14	0	0	0	0
Little Copeland Creek	2016	4	0	0	0	0	18	0	1	0	1
Crescent Ridge	2016	2	0	0	0	0	15	0	1	1	0
Sun Creek	2016	2	0	1	0	0	22	0	1	0	0
Thousand Springs	2016	3	1	0	0	0	19	1	1	1	1
Total		52	6	4	1	0	305	5	13	5	2

* It should be noted that a majority of these surveys were done during the daytime for safety reason.

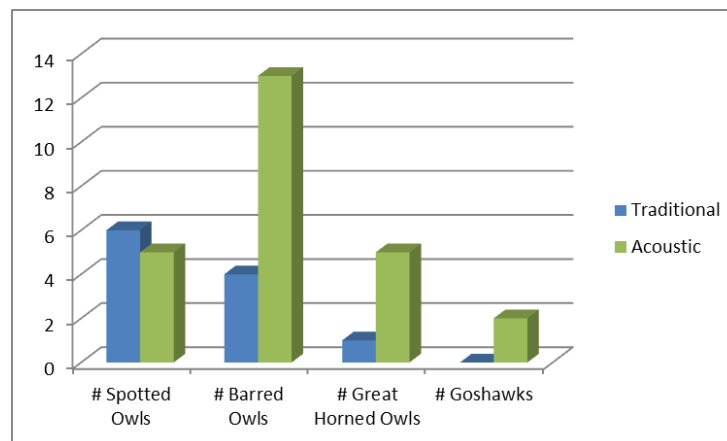


Figure 6. Number of species observed between 2014 and 2016 using USFWS spotted owl protocol surveys versus CRLA acoustic protocol surveys.

Discussion

This year the Thousands Springs known spotted owl activity center was a perfect example of how the wildlife team at Crater Lake National Park plans on utilizing these acoustic units. On our first visit to the site, the field crew sampled the site following the USFWS spotted owl monitoring protocol. At the same time as conducting the survey, they setup the 2 acoustic monitoring stations for this site. During the first visit, the crew did not find any spotted or barred owls. This site occurs on both NPS and USFS lands and each agency samples the portion of the site they are managing. Shortly after the first visit, we were contacted by the USFS and informed that they had found a pair but they did not successfully nest. In the past, spotted owls would nest on either the NPS or USFS portion of the site; we had not documented multiple pairs using this site at the same time. Upon hearing that the nest had failed, we determined there was no reason to continue our field surveys at this site (due to other higher priority sites) and retrieved our acoustic stations after waiting the 14 day sampling period. Upon reviewing the acoustic data we documented a pair of spotted owls and so the crew returned to continue their survey efforts. The crew found another nest and determined it was not successful after multiple follow-up visits. Had we not been utilizing the acoustic stations, we would not have determined that there were actually two nesting attempts (or two different pair of owls) at this site.

The Bear Bluff site is another example on how using the acoustic stations can be beneficial. Upon reviewing the acoustic data from the Bear Bluff site we were able to determine there was a *Strix* species occupying the site, but were unable to determine which species (barred or spotted owl) was there based on only recording a one note hooting call. Generally, when this occurs we would send the crew into the site to try and determine which species was occupying the site. In this case however, the crew had returned to survey the site before we had a chance to review the data and they documented a male spotted owl at the site so there was no need to return to confirm the acoustic recording.

Both of these examples demonstrate how the acoustic stations can be an effective supplement to the traditional survey methodology; however, their main utility is to determine presence and absence. Surveys utilizing the USFWS spotted owl protocol are still necessary to determine nesting locations and reproductive status. Similar to wildlife programs at other Parks and agencies, funding to implement NSO surveys is limited at Crater Lake National Park and is often focused on compliance work to ensure disturbance activities are not having a negative effect on spotted owls. Acoustic stations continue to be an effective and cost efficient method to help better understand the distribution of spotted owls and their competitors throughout the entire park.

As part of this study we have been able to demonstrate that our acoustic survey protocol is just as effective at documenting spotted owls as the limited number of surveys being conducted by the field crew. However, what is unclear is how sampling using the acoustic survey protocol compares to sampling using the complete USFWS protocol which includes 6 visits (including day and night surveys) spaced approximately 1 week apart. The wildlife team at Crater Lake National Park has secured a limited amount of funding to help answer this question in 2019. We will look for some additional funding to help expand this effort beyond the Park boundary into the surrounding USFS

lands where northern spotted owls are likely more abundant and can be sampled earlier in the season due to better weather and accessibility.

We continue to look for ways to make improvements on our sampling methods and equipment. Sometime in 2017 we are expecting a new vegetation map which is being developed by the Klamath Inventory and Monitoring Network. It is our hope that we can use this more detailed map along with some LiDAR data to help better define spotted owl habitat which will help focus some of our sampling efforts.

The fragility of the microphones when being carried into a site is still one of our biggest concerns when implementing this project. Once deployed the microphones seem to hold up fine to the elements, however we have had a few break while carrying them into the site. In the winter of 2017 we will continue to try and improve on this design to make the microphones more secure for transport. In addition, we will experiment with spraying the units with “scent killer” spray to see if we can reduce the number of units being attacked by black bears.

While relatively quick (~2-4 hours for 2 weeks of data), reviewing acoustic data in an efficient manner to make sure we can respond to recorded spotted owl and unknown strix calls can be time prohibitive. We plan on examining acoustic analysis software such as Kaleidoscope to determine the efficacy of using this type of software to search our data for owl calls. Spotted and barred owls have a limited repertoire of calls compared to many songbirds and so this type of processing could be effective in identifying NSO and barred owl vocalizations. In addition to spotted and barred owls, this method might work well for the other owl species at CRLA since they all have stereotypical calls.

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