



Biological Sound Station Research

2014 Annual Report



ON THE COVER

Biological Sound Station – North Fork Copland Creek
Photograph by Corinne Ross

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Abstract

Beginning in 1992 the wildlife team at Crater Lake National Park began implementing the USFWS northern spotted owl (*Strix occidentalis caurina*) monitoring protocol to determine distribution, abundance, and reproductive success of spotted owls in Crater Lake National Park. As the years have progressed, reductions in budgets 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 currently capable of implementing 1-3 noncompliance surveys at each known owl activity center in any given year versus the 6 surveys recommended in the USFWS monitoring protocol. In an effort to help improve our ability to determine the occupancy of an area by spotted or barred owls the wildlife team began exploring the use of acoustic station to help supplement our spotted owl monitoring efforts.

Based on the results of the 2012-2013 pilot study, we believe using acoustic stations to supplement traditional spotted owl monitoring methods will provide us with a cost effective way to improve our ability to document the presence of spotted owls and barred owls. In the summer of 2014, we began full implementation of our acoustic stations to help improve our spotted owl monitoring abilities. We had 2 primary goals in 2014, the first was to determine if acoustic stations would document spotted owls and barred owls to the same degree as the limited USFWS protocol surveys the wildlife team were conducting; and secondly, to determine if acoustic stations could be used to survey new areas of the Park that have not been surveyed since the early 90s to determine spotted owl or barred owl occupancy.

In the summer of 2014, fourteen sound stations were deployed at six known spotted owl activity centers and one unsurveyed area that contained spotted owl nesting habitat. The following activity centers were monitored: Bear Bluffs, Bybee Creek, Castle Creek, Grayback Ridge, Sand Ridge, and Sun Creek. All of these activity centers overlapped areas where traditional spotted owl field surveys had been completed in previous years. In addition, one area, North Fork of Copeland Creek, was not a known spotted owl activity center but did contain spotted owl nesting habitat. We deployed two sound stations at each site for a period of 4-16 days. A northern spotted owl was recorded at one site, Grayback Ridge, which was also documented using traditional protocol survey methods. Barred owls were documented at 87% of the sites surveyed and were recorded on 53% of the sound stations deployed.

Based on the results of the 2014 effort, we have concluded that acoustic stations can be a valuable tool to help determine spotted owl and barred owl occupancy at known owl activity centers and in new unsurveyed areas of the Park. We plan on continuing this effort in 2015, with the goal of monitoring more known spotted owl activity centers and increasing the number of surveys conducted in unsurveyed areas of the Park to help us better understand the distribution of spotted and barred owls at Crater Lake National Park.

Introduction

Beginning in 1992 the wildlife team at Crater Lake National Park (CRLA or Park) began implementing the USFWS northern spotted owl (*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 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 using acoustic stations to aid in the monitoring effort of northern spotted owls 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 various historical spotted owl territories and to search for new occupied sites. The idea was to use recordings as additional information about spotted owls and barred owls throughout the park, once a spotted owl was recorded, traditional protocol survey would be completed at those sites to determine nesting and reproductive success. The goal was not to replace traditional spotted owl monitoring, but to augment the surveys already being conducted.

Based on the results of the 2012-2013 pilot study, we believe using acoustic stations to supplement traditional spotted owl monitoring methods will provide us with a cost effective way to improve our ability to document the presence of spotted owls and barred owls (Murphy et. al 2013). In the summer of 2014, we began full implementation of utilizing acoustic stations as part of our spotted owl monitoring to help improve our ability to document this species. We had 2 primary goals in 2014, the first was to determine if acoustic stations would document spotted owls and barred owls to the same degree as the limited USFWS protocol surveys the wildlife team conducted; and secondly, to determine if acoustic stations could be used to survey new areas of the Park that have not been surveyed since the early 90s to determine spotted owl or barred owl presence.

As a survey and monitoring method, acoustic stations show potential by providing a cost effective, efficient method to monitor for owls on a twenty four hour continuous recording basis for up to two weeks. The data can be reviewed briefly, and then used to guide current field searches using traditional survey methods should a spotted owl call be recorded. This increases the chance of finding a *Strix* species beyond the number of visits a field crew can typically complete in a short field season. Used in conjunction with the one to three visits generally conducted at a site in a given year, the acoustic stations increases what a crew can learn about species occupancy in an area. As barred owls expand their range into historically spotted owl territory, it has been shown that spotted owls are less likely to vocalize (Crozier 2006), which could alter the efficacy of a traditional survey. Deploying acoustic stations that monitor around the clock may help improve our chances of documented a spotted owl 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 in no way projected to replace the traditional biological surveys of spotted owl habitat. Nor are they deployed with the intent to substitute one or more of the protocol visits developed by the US Fish and Wildlife Service (USFWS 2011). While we believe stations can

be used to conclude presence/absences, nesting status and reproductive success cannot be determined, therefore traditional survey methods are still needed. These stations are intended as supplemental to the traditional surveys.

Methods

The general process for implementing the use of acoustic station to assist in spotted owl monitoring includes: 1) selecting a site, 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

If 2014, the goal was to sample several known spotted owl activity centers using both acoustic stations and traditional protocol surveys to determine spotted owl and barred owl presence. In addition, acoustic stations were used to sample one area that contained spotted owl nesting habitat but that had not been surveyed since the early 90s.

For each area to be sampled, we used a geographic information system (GIS) program called System for the Prediction of Acoustic Detectability (SPreAD or SPreAD-GIS) to model the distribution of sound at each activity center to determine the best locations to place audio recording devices (Figure 1). For known spotted owl activity sites, we used ArcGIS to plot all spotted owl and barred owl locations recorded since 1992. We then used a kernel density estimator with a least squares cross validation and a 95% isopleth to develop polygons that were representative of spotted owl and barred owl use areas at each known site. For each site, table 1 shows the size of the modelled area along with the number of spotted owl and barred owl locations used to create the sample area. To sample the spread of sound in areas that were not historical spotted owl activity centers, we used ArcMap to develop polygons around areas the Park has mapped as spotted owl nesting habitat and then selected the polygon that contained the highest percentage of habitat.

Once we determined the areas to sample, we used the program SPreAD-GIS to model the distribution of sound at each location to determine the best areas to place the acoustic sound stations. As part of the model, we utilized the following inputs:

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

Using these parameters, we modelled how sound would travel over the landscape for each site. We placed 1 point within each polygon 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 polygon that were not

covered by the modeling of the initial station and added an additional station 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.

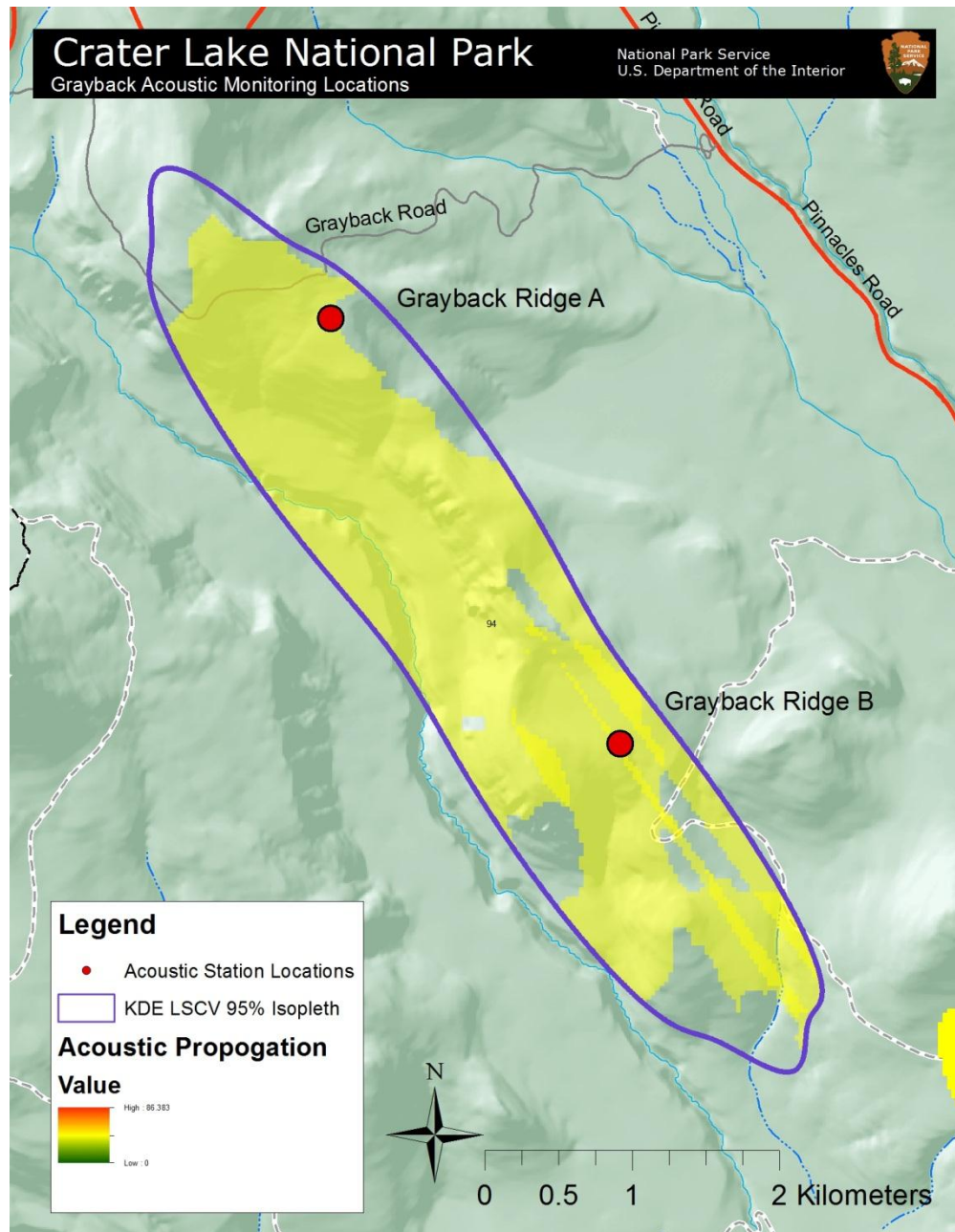


Figure 1. Grayback Ridge known spotted owl activity center with acoustic sampling locations, kernel density estimator polygon, and acoustic propagation.

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 (km2)	# NSO Locations	# Barred Owl Locations
Annie Creek	10.49	9	20
Bear Bluff	0.53	5	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	14	1
Maklaks Crater	2.72	7	9
Sand Ridge	3.87	18	14
Lower Sun Creek	8.20	10	20
Thousand Springs	0.16	4	0

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

- Area should be protected from high winds (e.g. avoid unprotected ridgelines).
- Avoid deploying near large reflective surfaces, such as rock walls.
- Avoid deploying close to constant noise sources such as streams, roads, and nesting birds.
- Prevent equipment / animal conflicts by avoiding game trails and other areas where animals are known to congregate.
- Microphone must be mounted. Small – medium diameter trees are typically used. If not present, alternative mounting options may be explored or a new site should be selected.

Setting up and Removing the Site

Each biological sound station consist 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.



Figure 2. Components of a biological sound station

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 inches above the ground in a way that prevents movement from wind. The 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 otter box on the other end, with extra cord being wrapped around a tree to prevent noise or snagging on passing wildlife (Figure 3)

Once the setup was in place, settings on the Roland recorder were checked to make certain they followed the settings described in the protocol. 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 otter box was sealed, chained to the tree, and covered with woody debris (Figure 3). 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, site 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 otter box and stated their name, location, site ID, date, and time into the microphone to determine if the site was still working. The recorder was turned off and the surveyor recorded the recovery date and time, if the unit was functioning, and any general recovery notes.



Figure 3. Photograph of a sound station deployed at the Lower Sun Creek Site.

File Management, Data Review, and Data Entry

Once back in the office sound files are 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 “Raw Audio Files” and one drive is called “Working Files”. The raw audio files drive is used to store unmanipulated data and acts as a backup, the files on the working files 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 were converted into a text format using a program called AUDIO2NV SPL. Once files are in the text format, SPLAT, a program in AMT is used to create spectrographs of the recordings. Spectrographs are reviewed to determine if any spotted owl or barred owls called at the site. If a spectrograph appears to be an owl, the audio is listened to, and any owl species heard are recorded on the datasheet. Anecdotal observations are noted for other sounds heard while listening for owls and included predatory birds such a great horned owls (*Bubo virginianus*) and goshawks (*Accipiter gentilis*) along with a diversity of other species and sounds (e.g. other owls, coyotes, elk bugle, thunder, trees falling, etc.). Once the sound files are reviewed, the results are entered into an Access database that contains automated summaries that are incorporated into the annual report.

Results

A total of fourteen sound stations were deployed at 7 sites between May 21, 2014 and August 15, 2014. Elevation of the stations ranged from 1451 m to 2000 m. In that time, 5,863 hours of data were recorded. Each station was deployed for an average of 419 hours (264-600), or 17.45 days. However, the actual number of days the acoustic stations sampled averaged 11.14 (0 -16). Spotted owls, barred owls, and/or great horned owls were detected at ten of the stations (table 2). This makes for a detection of an owl species of interest at 71% 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 2014.

Location	Site Name	Days Surveyed	Owls Species Observed
Bear Bluffs	AC-BEBL-A	7*	0
Bear Bluffs	AC-BEBL-B	14	0
Bybee Creek	AC-BYCR-A	15	0
Bybee Creek	AC-BYCR-B	16	Barred and Great Horned Owls
Castle Creek	AC-CACR-A	0**	0
Castle Creek	AC-CACR-B	8*	Barred Owl
Grayback Ridge	AC-GRRI-A	14	Spotted, Barred, and Great Horned Owls
Grayback Ridge	AC-GRRI-B	4*	Barred Owl
North Fork Copeland Creek	AC-NFCC-A	14	Barred Owl and Unknown Strix.
North Fork Copeland Creek	AC-NFCC-B	14	Great Horned Owl
Sand Ridge	AC-SARI-A	14	Barred Owl
Sand Ridge	AC-SARI-B	8**	Unknown Strix
Sun Creek	AC-SUCR-A	14	Barred Owl
Sun Creek	AC-SUCR-B	14	Barred Owl

* reduced number of sample days because sites were unplugged by black bear.

**reason for the reduced number of sample days was undetermined, likely because of old batteries.

The goal was to have each station record for a total of 14 days, however in 5 cases we did not reach the target survey date. In three cases, black bears altered the setup and in so doing unplugged or destroyed the mic wire, in 2 cases the cause of reduced survey time could not be determined but poor battery quality is suspected.

Spotted owls were recorded at one station (AC-GRRI-A) on the Grayback Ridge known spotted owl activity center. Barred owls were documented at 86% (6) of the sites surveyed and were record on 57% (8) of the stations deployed including a pair that was recorded at the one new area of the park that was surveyed. Great horned owls were recorded at three sound stations (21%).

If we compare the diversity of owls observed at each site when using acoustic station versus just implementing the traditional field crew survey methods we can see the benefits of the acoustic stations (table 3). Acoustic stations documented the same species that were observed by the field

crew. Acoustic stations also documented barred owls at 4 sites where field crews did not observe this species. In addition, field crews did not document any great horned owls; however we did record this species at 2 locations using the acoustic stations. Acoustic stations also recorded barred owls and a great horned owl at the one new site (North Fork of Copeland Creek) located in the back country of CRLA, however it was not feasible to survey this site with the field crew.

Table 3. Comparison of owls observed using traditional USFWS protocol methods versus using acoustic stations.

Site	# Traditional Surveys	Owls Observed Traditional Method	# Days Acoustic Survey*	Species Observed Acoustic Method
Bear Bluffs	2 day surveys	None	14	None
Bybee Creek	2 day surveys	None	16	Barred and Great Horned Owls
Castle Creek	3 day surveys	None	8	Barred Owl
Grayback Ridge	2 day surveys	Spotted Owl Pair	14	Spotted, Barred, and Great Horned Owls
Sand Ridge	3 day surveys	Barred Owl	14	Barred Owl
Sun Creek	1 day & 1 night survey	None	14	Barred Owl

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

While reviewing the spectrograph for spotted or barred owls, several incidental species and various unique sound events were documented. Other species that were recorded were: black bears, common poorwill, common raven, coyote, Douglass squirrel, elk, goose, hummingbird, northern pygmy owl, crow, raven, olive-sided flycatcher, pileated woodpecker, red tailed hawk, sharp shinned hawk. A diversity of other song birds were documented but not recorded in the database because of the time constraints associated with identifying all these species. Additional unique sounds recorded included: a tree falling down, rock slide, thunder and rain, and airplanes.

Discussion

Although pilot studies have been done in the past, this was the first year that we attempted to fully implement acoustic stations to assist with monitoring spotted owls at Crater Lake National Park. As with the pilot study, the sound stations have shown effectiveness, although we were not able to use them to inform future surveys as originally intended. Late field crew start dates due to delayed budgets limited the amount of time the wildlife staff had to work on this project. The majority of staff time was spent completing spotted owl compliance surveys using the traditional protocol survey methods. Because of the limited amount of time available to review the data, some of the sound stations data was not analyzed until the later parts of the breeding season which did not give field crews a chance to follow up on “unknown Strix” recordings. If the acoustic stations are to be used as a powerful tool in helping to inform the seasonal survey effort then some changes need to be made to ensure acoustic data is reviewed sooner.

This summer, seven areas were surveyed using the acoustic stations. This is a huge increase over previous years, but there are still many more historic areas and new areas to survey. This year the wildlife staff was able to implement 1-4 surveys using the USFWS spotted owl monitoring protocol at 13 of 16 known spotted owl activity centers. The Red Blanket site was not considered a priority since it burned up in the 2008 Middle Fork fire, the Oasis Butte site was not surveyed because of

logistic issues associated with accessing the site, and the Maklaks Crater site was not surveyed because of a nearby fire. While we did attempt to visit all of the sites at least once, we did not have the staff available to implement the 6 visits required to determine spotted owl occupancy which made using the acoustic stations more valuable in increasing our confidence about the occupancy of spotted owls and barred owls at these sites. However, based on the current equipment available, we were only able to sample 6 of the 16 known spotted owl activity centers. Ideally, 2 sound stations would be placed at each known owl activity center every year. In order to accomplish this in an efficient manner 13 additional sound stations are needed along with field crew time to deploy stations and review data.

In addition to using the acoustic stations to assist in monitoring known owl activity centers, they hold the potential to be of great use in sampling areas of the Park that have not been sampled since the early 90s. This year the acoustic stations were utilized to sample an area of the Park that contained good spotted owl habitat that we called North Fork of Little Copeland Creek. This area of the Park had not been surveyed since the early 90s and no *Strix sp.* had been documented in this area of the park prior to this year. However, this year the two stations placed at this site recorded a barred owl pair. Although barred owls are not the target species, it is important to track the influx of this westward encroaching species. Any more information that can be documented in the dynamics between the *Strix* species can inform future research and policy. This example shows the utility of using acoustic stations to sample beyond the known spotted owl activity centers. Areas such as Crater Creek and Sphagnum Bog have a lot of very good habitat and are in the vicinity of some of the more active known owl activity centers. The area between Red Blanket Canyon and Union Peak has good habitat and since the nest site at Red Blanket Canyon burned up in 2008 those spotted owls might have moved into this area. The Scott Bluffs area is much more of a mosaic of habitat types, but there are sizable patches of good habitat. Sand Creek is close enough to the Sand Ridge spotted owls activity center that owls may be using this area. It is recommended that when feasible acoustic stations are used to survey more of these remote unsurveyed areas.

There are also some practical problems to overcome in the use of acoustic stations. Three of the sound stations deployed were damaged by black bears. It is not completely clear why bears went after these three stations and not the other stations, but it does emphasize the need to keep the stations as clean and as free of smells as possible. It may be that these stations had lingering scents. Some things that can be done to keep scents away is not to snack anywhere near the sound station deployment area, use backpacks that have not carried other equipment such as bait boxes for the red fox camera project that is being implemented alongside the spotted owl monitoring, and possibly even use gloves while handling the microphone and recording unit.

Expanding this project to new areas of the Park and existing known spotted owl activity centers will continue to provide additional information on spotted owls that the wildlife team at CRLA would not otherwise have found including detections of species such as barred owls and great horned owls that otherwise would have gone undetected. Seeing as barred owls pose a threat to spotted owl habitat it had been deemed important by researchers that its spread be documented (Gutiérrez et. al 2006). The incidental detections of barred owls are not superfluous to the management of spotted owls.

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