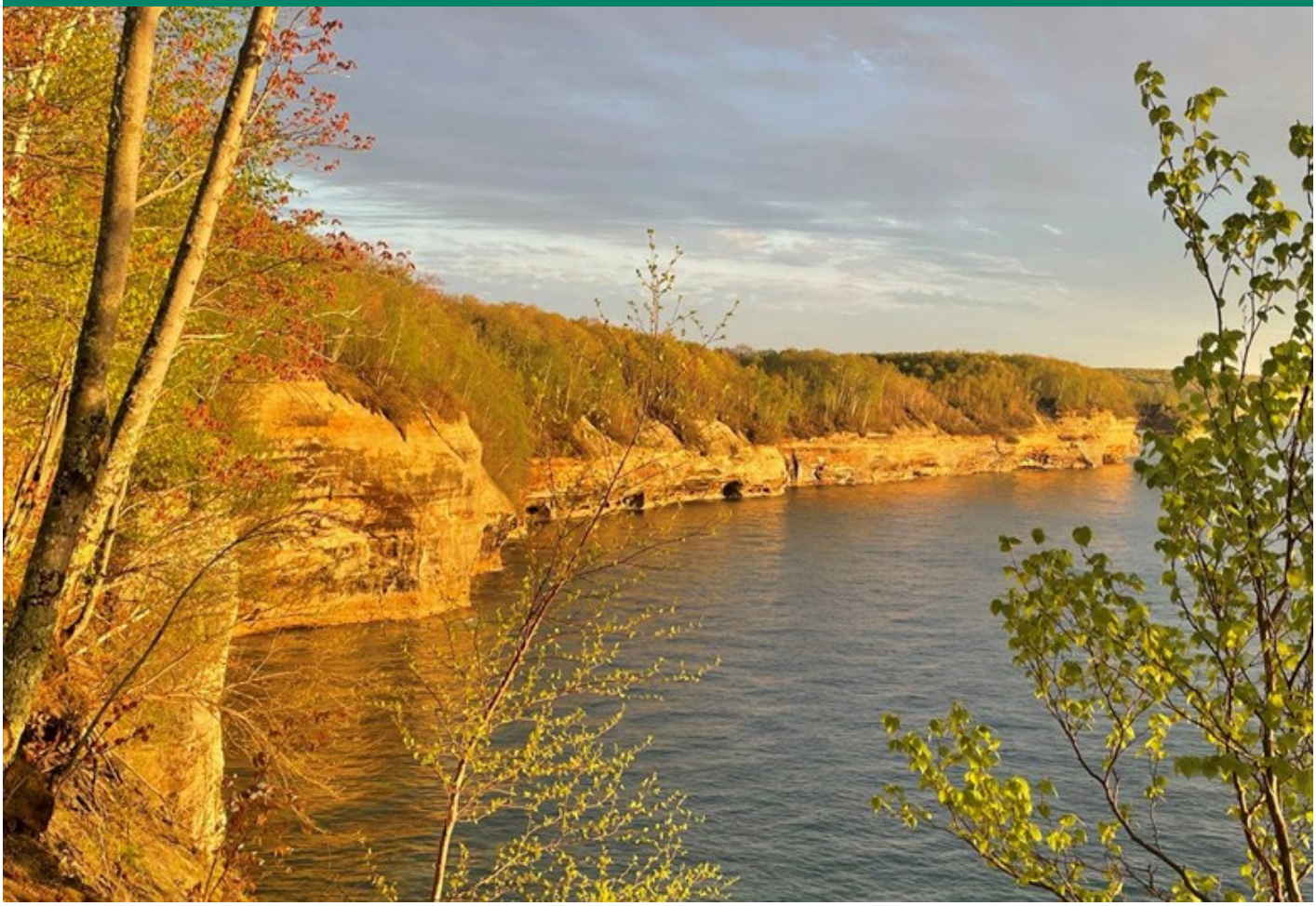
Barred Owls & Beech Bark Disease at Pictured Rocks National Lakeshore



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Cover: Barred owl survey stations located along the North Country Trail on Lake Superior, Pictured Rocks National Lakeshore. Photo by Ashley Cole-Wick.

Introduction

The spread of beech bark disease (BBD) in Pictured Rocks National Lakeshore (PRNL) has resulted in the loss of mature beech (*Fagus grandifolia*) and altered forest structure. Barred Owls (*Strix varia*) prefer large tracts of mature forest, usually mixed deciduous-coniferous cover types (Mazur and James 2021). The loss of large cavity bearing trees from BBD and resulting changes in forest structure of northern hardwood forests has the potential to negatively impact Barred Owl populations.

Information on Barred Owl population status within PRNL is lacking, hindering the ability of National Park Service (NPS) staff to plan and implement forest management actions that promote healthy owl populations. In 2022 we designed and implemented a survey to address the following two objectives: 1) evaluate the current Barred Owl population status within PRNL; and 2) gather baseline Barred Owl data to facilitate long-term population monitoring. Here, we provide the NPS with information about the status of Barred Owl within the PRNL, as well as sample framework and methodology that may be used in future surveys.

Methods

Study Area

Pictured Rocks National Lakeshore (PRNL) is located along Lake Superior between the towns of Munising and Grand Marais, Michigan. Comprised of sandstone cliffs, beaches, waterfalls, sand dunes, inland lakes, and forests, this 73,236-acre park is owned and managed by the National Park Service (NPS). The PRNL, the first National Lakeshore in the United States, preserves more than 67.5 km of lakeshore and is divided into two zones, the Lakeshore Zone and the Inland Buffer Zone (Hop et al. 2010). The Lakeshore Zone is over 12,000 ha and is owned and managed solely by the NPS. In contrast, the Inland Buffer Zone is just under 16,000 ha, and 5% falls under NPS ownership. The remaining 95% falls under a combination of state and private ownership (Hop et al. 2010).

In 2005, the NPS Vegetation Inventory Program was implemented for the PRNL, and a comprehensive vegetation map was generated for the park (Hop et al. 2010). Over 95% of the PRNL's vegetation landscape is characterized as forest, with deciduous hardwood forests dominating uplands (Hop et al. 2010). Sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*) predominate, with American beech interspersed throughout. Although deciduous hardwood forests constitute most of the landscape, coniferous species such as eastern hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*) integrate into hardwood forests, occasionally becoming dominant (Hop et al. 2010). Results from the NPS Vegetation Inventory Program provided the spatial data source for mapping out potential Barred Owl habitat. These data provided a geospatial framework for designing owl surveys in 2022, by establishing survey stations in natural communities known to be used by owls.

Surveys

We demarcated potential Barred Owl habitat using cover type spatial data developed by the NPS Vegetation Inventory Program (Hop et al. 2010). Past research found that Barred Owls in Michigan's Upper Peninsula use old-growth hemlock, maple, and hemlock-maple forests, with an average home range size of 282 ha (Elody and Sloan 1985). To reduce the hazards associated with nocturnal sampling, stations were placed along existing trails and roads. We used a geographic information system (ESRI 2022) to systematically generate survey stations along roads and trails located within potential Barred

Owl habitat (Figure 1), separated by at least 1.6 km to minimize the potential of detecting individual owls at multiple stations (Takas et al. 2001).

We conducted surveys in the early spring when Barred Owls are most vocal. Surveys were conducted at night (0.5 hr after sunset – 0.5 hr before sunrise) under suitable weather conditions (winds < 20 km/h, little or no precipitation). Our goal was to survey each station twice, once in April and a second time in May. However, early spring snowfall made it difficult to access many stations in April, despite delaying surveys until late in the month (Figure 2). We designed the survey to facilitate the estimation of population parameters, such as occupancy (MacKenzie et al. 2002) and density/abundance (Buckland et al. 2001).

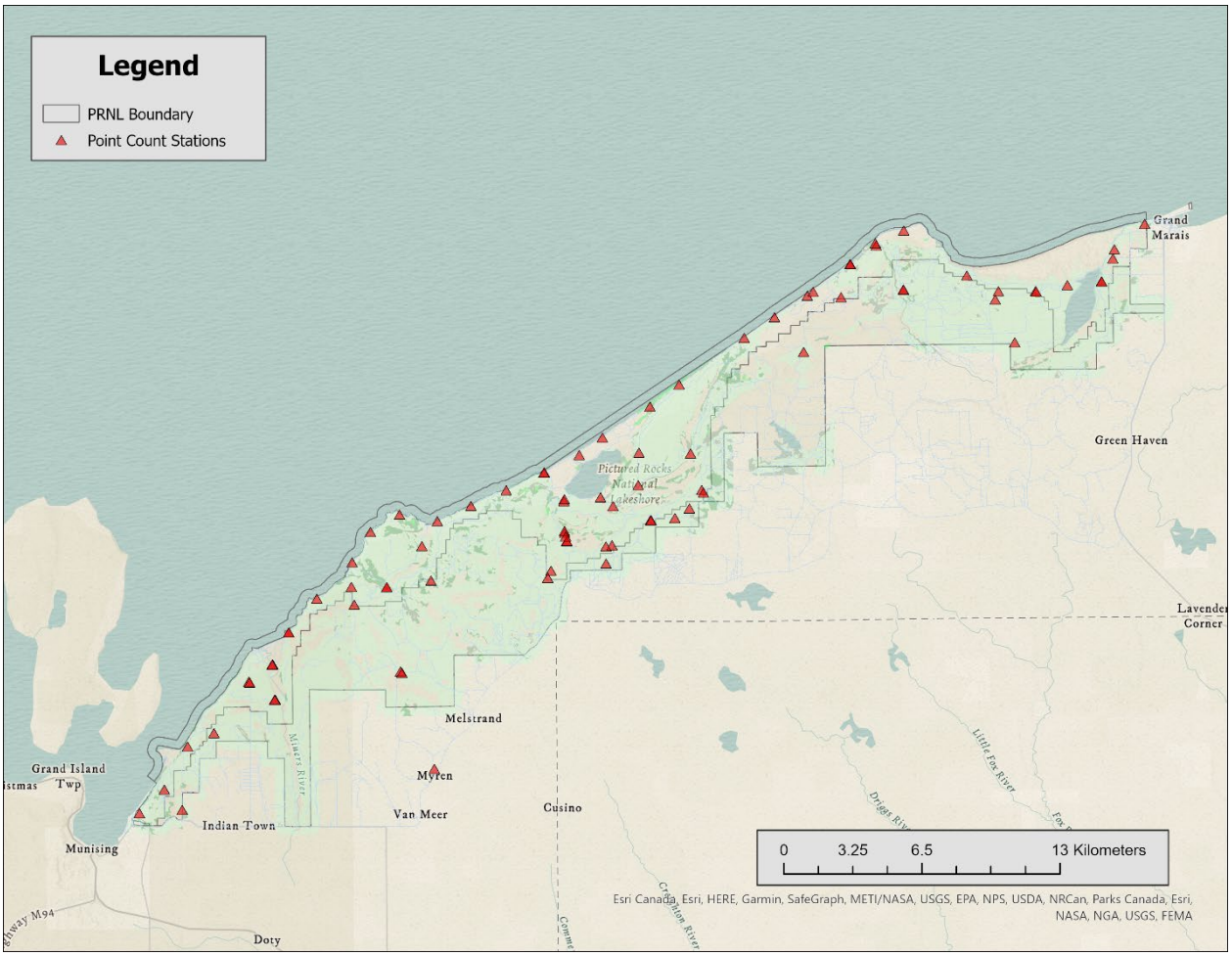

Figure 1. Owl survey stations are at least 1.6 km from each other and located along trails and roads at Pictured Rocks National Lakeshore, Michigan. Overlapping points represent those visited multiple times, at slightly different locations due to accessibility.

Survey methods followed those outlined in *Guidelines for Nocturnal Owl Monitoring in North America* (Takats et al. 2001). Because environmental conditions can affect owl call rates and the ability of surveyors to detect owls (Fuller and Mosher 1987), we recorded the temperature, wind speed, precipitation level and type, snow cover and depth, moon phase and visibility, percent cloud cover, and noise level at the beginning of each survey. We also noted the presence of any obvious disturbance, such as BBD, although this was not always possible due to low visibility during nocturnal surveys.

Electronic broadcasts of conspecific calls were used to elicit responses from Barred Owls. Additionally, we broadcasted Long-eared Owl (*Asio otus*) and Great Horned Owl (*Bubo virginianus*) calls. Surveys at each station consisted of a passive 2-minute listening period, followed by a 2-minute broadcast period for each species, and ended with a second 2-minute passive listening period for a total of 10 minutes. All calls were broadcast from an electronic game caller (FOXPRO NX4).

Figure 2. Nocturnal surveys progressed slowly in April with icy slopes and snowy roads. Photo by Ashley Cole-Wick.

For each owl observation, we recorded the species, number of individuals, sex (if discernable), time period(s) in which the detection occurred (e.g., 1-2 minutes), and estimated location. The approximate location of each owl was estimated by recording the direction and distance at which the owl was first detected. Distance estimates were assigned to 1 of 6 binned categories (from <0.1 km to >1.0 km). Although the survey focused on Barred Owls, we also recorded other nocturnal avian observations.

To assess Barred Owl nesting activity within PRNL, forests in the vicinity of Barred Owl detections were searched for nests during daylight hours. Although typically cavity nesters, Barred Owls will also nest in abandoned stick nests (Mazur and James 2021). A variety of cavity types are used, including open cavities at the tops of snags and broken branches (Postupalsky et al. 1997). We searched for suitable nesting trees with large cavities and stick nests by scanning forests with binoculars and a spotting scope and walking through suitable habitat. Suitable trees with cavities were inspected for signs of nesting activity by checking for the presence of pellets, droppings, and feathers beneath cavities and adjacent perches.

Results

In 2022 we completed 76 surveys (Appendix A), with half as many surveys completed in April than in May due to limited accessibility due to snowpack (Table 1, Figure 3). We detected 20 owls, with Barred Owls constituting 90% of all owls observed (Table 1). Across both survey periods, we detected an average of 0.26 owls per survey (Table 1). Between survey periods, the average number of owls per point was slightly greater during the late-April period (Table 1).

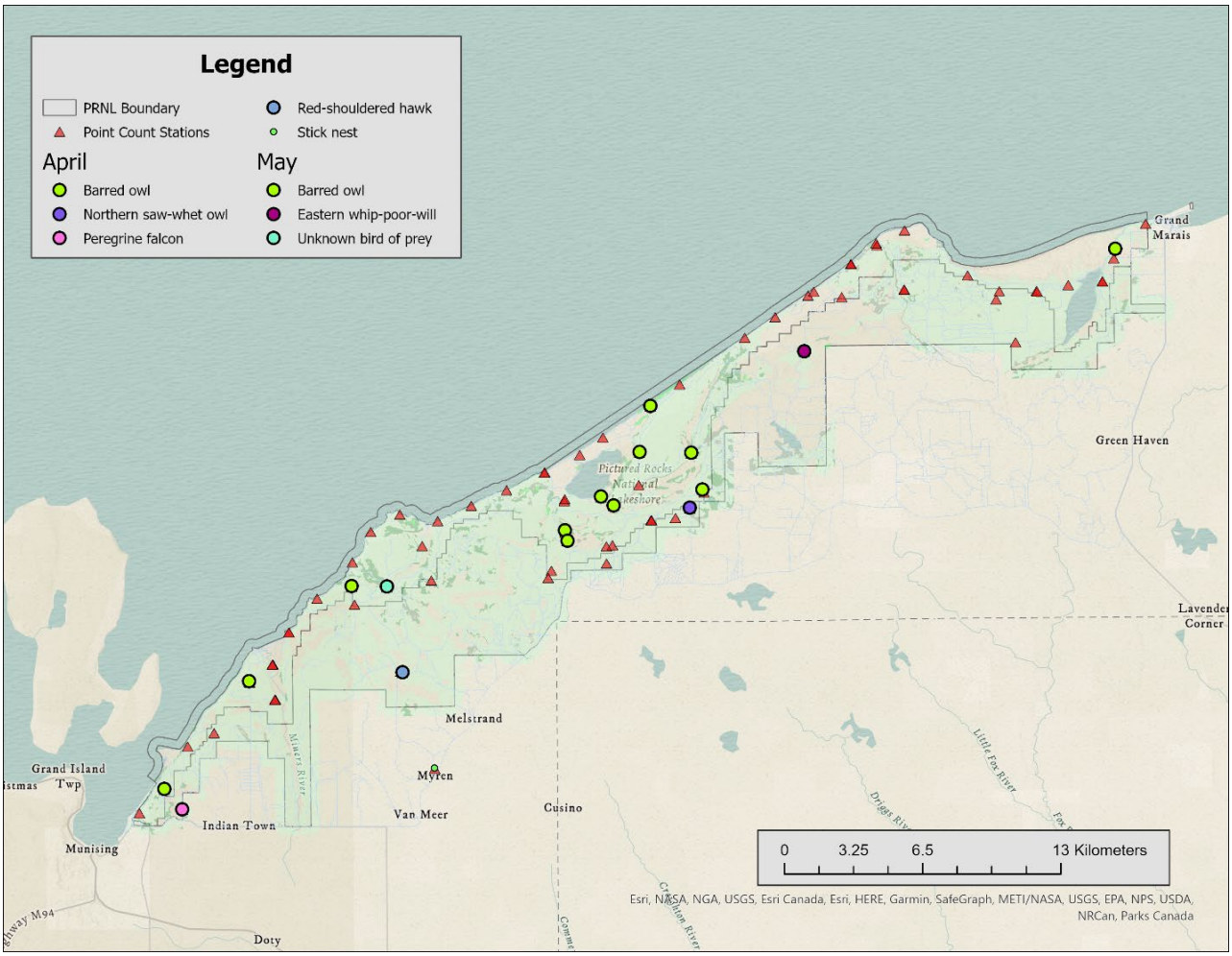

Figure 3. Owl detections by month and by species at Pictured Rocks National Lakeshore, Michigan.

Table 1. Owl detections by survey period with mean number of owls detected per point.

Survey Period	Number of Points Surveyed	Number of Owls Detected	Mean
April[1]	25	7	0.28
May[2]	51	13	0.25
Total	**76**	**20**	**0.26**

[1]Surveys conducted between 4/19-4/25/2022
[2]Surveys conducted between 5/17-5/23/2022

We observed two species, Barred Owl and Northern Saw-whet Owl (*Aegolius acadicus*), along with one large nocturnal bird of prey that was unable to be identified (Table 2). Owls were observed at 14 locations within PRNL (Figure 3), and six of these observations consisted of pairs of owls. Three owl observations were detected while quietly traveling between stations, usually on foot, rather than at stations (listed as "Incidental" in Table 2). For Barred Owls, we detected at least one individual at 21.8% of survey locations and detected an average of 0.24 birds per point.

Table 2. Location information for each owl detected during 2022 surveys within Pictured Rocks National Lakeshore.

Species	# Owls	Date	Station ID	Latitude	Longitude	Bearing	Estimated Distance (km)
Northern Saw-whet Owl	1	4/20	PR27	46.55343	-86.282438	N	0.75 - 1.00
Barred Owl	2	4/20	PR28	46.561187	-86.274780	---	< 0.10
Barred Owl	2	4/19	Incidental	46.539866	-86.357753	N	0.25 - 0.50
Barred Owl	2	4/22	PR02	46.435891	-86.605799	N/NE	0.75 - 1.00
Barred Owl	2	5/17	Incidental	46.576688	-86.281424	---	< 0.10
Barred Owl	1	5/18	PR39	46.596709	-86.306139	SE	> 1.00
Unknown˜	1	5/19	PR15	46.521137	-86.468628	NW	< 0.10
Barred Owl	1	5/19	PR18	46.544272	-86.359306	---	< 0.10
Barred Owl	2	5/20	PR55	46.661179	-86.019472	S/SE	0.25 - 0.50
Barred Owl	1	5/21	PR08	46.521304	-86.490352	E	> 1.00
Barred Owl	1	5/21	PR06	46.481055	-86.553110	NW	0.50 - 0.75
Barred Owl	1	5/22	Incidental	46.558431	-86.336998	SW	0.10 - 0.25
Barred Owl	1	5/22	PR24	46.577247	-86.313137	SW	0.50 - 0.75
Barred Owl	2	5/22	PR22	46.554663	-86.329317	---	< 0.10

--- = Data regarding direction (bearing) of individuals was not recorded in instances where individuals were first detected above the callback speaker/survey location.
~ = Wing noises (flapping) of a large bird of prey were heard in the canopy above the survey station. The bird did not vocalize, and surveyors were unable to make a visual identification.

Incidental Rare Species Sightings

In addition to owls, we recorded occurrence information on all rare avian species encountered while we were traveling between survey locations. While walking, snowshoeing, or driving to survey stations, we looked for evidence of birds of prey, primarily stick nests and potential cavity nests. We also continually listened for vocalizations from owls and other avian species. In addition to two owl species, we also recorded three rare avian species (Figure 2, Table 3).

Table 3. Incidental observations of species with special status documented while conducting owl surveys within Pictured Rocks National Lakeshore.

Date	Species	Status[1]	Latitude	Longitude
4/19/2022	Peregrine Falcon	E	46.427245	-86.594903
4/25/2022	Red-shouldered Hawk	T	46.484725	-86.459602
5/22/2022	Eastern Whip-poor-will	SC	46.619219	-86.211334
Status [1]: SC = Special Concern; T = Threatened; E = Endangered				

Peregrine Falcon (*Falco peregrinus*)

While driving on County Highway 672 to evaluate road conditions on our survey route for later that evening, a Peregrine Falcon was spotted flying above our vehicle on April 19. The individual was identified as a Peregrine Falcon based on its size, wing shape, tail length and flight pattern. This species is currently listed as Endangered in Michigan (Table 3). We added this observation to an existing Element Occurrence in Michigan Natural Features Inventory's (MNFI) Natural Heritage Database.

Red-shouldered Hawk (*Buteo lineatus*)

On the evening of April 21 at approximately 9:20 PM we spotted a large stick nest after dropping one survey team at a location on Chapel Road to hike into owl survey stations. After stopping and exiting the vehicle to inspect this stick nest, we observed a Red-shouldered Hawk flying above us. The nest had evidence of new construction and was decorated with the raptor circling us and the nest, repeatedly calling. This occurrence has been entered into MNFI's Natural Heritage Database. This hawk is currently listed as Threatened in Michigan (Table 3), where they are associated with mature forests in or adjacent to wetlands. This species was recommended for down-listing to Special Concern in Michigan in 2022; however, if the legislature approves this change, MNFI will continue to track this declining raptor species to monitor its status.

Eastern Whip-poor-will (*Antrostomus vociferus*)

After completing surveys during the early morning of May 22, two Eastern Whip-poor-wills were heard while driving along county road H-58. The birds were heard calling from the roadside for approximately 10 minutes. The occupied habitat was best characterized as a hardwood-conifer swamp containing a large portion of open habitat, although it was difficult to see in the darkness. This bird species is currently listed as Special Concern in Michigan (Table 3). This observation marks the first record of this recently added special concern species for the Upper Peninsula in MNFI's Natural Heritage Database (MNFI 2022).

Nest Searching

When time allowed, we revisited survey stations where owls had been detected during daylight hours to search for cavities, stick nests, and evidence of owl activity (e.g., pellets) under potential nesting sites (Figure 4). Due to time constraints, we prioritized occupied stations that were easily accessible. No nests were found during our searches. When potential cavities were located, we did not find any evidence of

nesting activity in the immediate area. Nest searching visits were made to station PR02, PR18, and PR28. We focused efforts around PR18, located along Little Beaver Lake Road. At least one Barred Owl was detected at this station during both nocturnal surveys, and an owl was spotted perching above the road on a separate occasion, while we were traveling to the main road after completing surveys for the night (Figure 4). On this occasion, the individual flew down into the road and performed what appeared to be a distraction display. We hypothesized that the individual may be attempting to draw our attention away from a nearby nest. Bird and Wright (1977) described a similar display given by a female owl in response to humans approaching a nesting site with young. Despite these observations and repeated nest searching visits, we found no evidence of nesting in the surrounding area.

Figure 4. Barred owl perched above Little Beaver Lake Road (left). Diurnal searching for evidence of nesting beneath a suitable cavity located near station PR28 (right). Photos by Lydia Mehlhose.

Discussion

Given PRNL is dominated by mature forest, we expected Barred Owls to be the most common owl species detected and were not surprised by the lack of detections of other species. The lack of owl species that forage in open and edge habitats, such as Great Horned Owl and Long-eared Owl, suggests that changes to forest structure associated with BBD have not resulted in a major shift in owl species use of PRNL.

We recorded an average of approximately 0.2 Barred Owls per point, which appears to be within the range of numbers reported by similar surveys in the Great Lakes region. The Western Great Lakes Owl

Survey, conducted in Wisconsin and Minnesota, reported an average number of Barred Owls per route ranging from about 0.3 to 1.1 during 2005 to 2014; approximately 0.9 Barred Owls detected per route in 2013 and 2014 (Grosshuesch and Brady 2015). With a typical route consisting of 10 survey points, an average of 0.9 Barred Owls per route would translate to about 0.1 Barred Owls per point. That detection rate is lower than what we observed in PRNL, but it is important to note that the Western Great Lakes survey protocol uses a five-minute point count without broadcasts. The MNFI conducted statewide owl surveys during 2004-2006 in support of the Michigan Breeding Bird Atlas II project. Points were located along Breeding Bird Survey routes, with points in northern Michigan being surveyed three times between early March to mid-May. During those surveys, the average number of Barred Owl detections per point in the Upper Peninsula was 0.2 in 2004 (Monfils and Pearman 2004), 0.2 in 2005 (Monfils 2005), and 0.4 in 2006 (Monfils 2006). The greatest detection rate for the Upper Peninsula (0.9 Barred Owls per point) was recorded during the last survey period (early to mid-May). Although more monitoring of Barred Owls in PRNL would be valuable, we are encouraged that our results are consistent with past surveys despite the changes caused by BBD.

Recommendations for future research

Overall, Barred Owl detections were concentrated in the Beaver Basin area, with one pair located along Beaver Lake, and other observations scattered throughout this central area of the park. In future studies, we suggest moving stations inland from the lakeshore to increase radius of detectability and decrease the noise associated with waves and wind on the shoreline. We were able to survey lakeshore stations during the few most quiet (e.g., low wind) nights (Figure 5), but every detection from those stations came from so far inland that it was difficult to later triangulate where the owl and/or cavity nest may have been. However, survey stations were located along the Lake Superior lakeshore because that is where the North Country Trail is located, which offered one of the primary means of access to central portions of the PRNL.

Data collected in 2022 and presented in this report represent baseline data for occurrences of Barred Owls at PRNL. This park-wide survey effort has shown that this species occurs in five primary areas, with Beaver Lake Basin containing most owl sightings, and occurrences also at Miners Lake, Sable Creek, Mosquito Falls, and Sand Point Road. These data can be used to inform future surveys by concentrating efforts in areas with Barred Owl occurrences. We recommend incorporating new techniques and methods in these efforts if time and funding allow. With a goal of locating cavity nest trees used by owls, one possible next step is setting up an array of acoustic recording units (ARUs) in focal areas to triangulate locations of owls, then use these data to search for and identify which tree species are being used by owls. At least four SM4-TS (Wildlife Acoustics 2022) devices would be needed to conduct this work at a given location. With recent technological advances, it is now more feasible to estimate the locations of bird detections with GPS-synchronized ARUs through a process called hyperbolic localization. By approximating bird locations, we can then estimate bird densities as would be done with traditional surveys. At least four units are needed to accurately estimate the position of a bird detection on a two-dimensional plane. We would situate four-unit ARU arrays around predetermined points to determine owl locations for later nest searching.

Figure 5. We surveyed sites along Lake Superior during nights with low winds and a calm lake. Photo by Eric Branch.

Acknowledgements

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Appendix

Appendix A. Coordinates and number of surveys conducted at each survey station.

Station ID	Latitude	Longitude	Number of Surveys
PR01	46.42593696	-86.62112501	1
PR02*	46.43589147	-86.60579930	1
PR03	46.45409587	-86.59142422	1
PR04	46.45971204	-86.57518236	1
PR05	46.47374419	-86.53786244	2
PR06	46.48105513	-86.55310996	2
PR07	46.48855824	-86.53929248	2
PR08	46.51374866	-86.48865103	2
PR09	46.51638836	-86.51159771	1
PR10	46.50218521	-86.52898283	2
PR11	46.52369454	-86.44146556	1
PR12	46.53835231	-86.44692776	1
PR13	46.52754122	-86.36776494	2
PR14	46.53169448	-86.48980253	1
PR15	46.52111179	-86.46859422	2
PR16	46.54886745	-86.43732671	1
PR17	46.53810849	-86.33018429	2
PR18*	46.54347349	-86.35921600	2
PR19	46.54853285	-86.30647075	2
PR20	46.55179624	-86.46045062	1
PR21	46.54454213	-86.47844330	1
PR22	46.55466317	-86.32931707	1
PR23	46.56175882	-86.39488435	1
PR24	46.57724749	-86.31313657	1
PR25	46.55525555	-86.41664537	1
PR26	46.55688495	-86.35951775	2
PR27	46.55342510	-86.28243752	2
PR28*	46.56118655	-86.27478006	1
PR29	46.56348811	-86.31376449	1
PR31	46.56911273	-86.37135945	2
PR33	46.57640590	-86.34983171	1

PR34	46.58371245	-86.33552170	1
PR37	46.62229096	-86.08149371	1
PR38	46.60592361	-86.28806697	1
PR39	46.59670926	-86.30613936	1
PR41	46.64626353	-86.04870112	1
PR42	46.63402280	-86.22899600	1
PR43	46.62544560	-86.24780610	1
PR44	46.64299744	-86.20870284	2
PR45	46.64220997	-86.18798570	1
PR46	46.64762143	-86.02755269	2
PR47	46.65083795	-86.11049027	1
PR48	46.64053294	-86.09313194	2
PR49	46.64399091	-86.06819246	2
PR51	46.65613542	-86.18229462	2
PR52	46.66394674	-86.16604627	2
PR53	46.67022063	-86.14893089	1
PR54	46.64506301	-86.14942931	2
PR55	46.65731062	-86.02047626	2
PR56	46.67181570	-86.00063637	1
Other/NA	46.53986621	-86.35775328	1
Other/NA	46.57668758	-86.28142373	1
Other/NA	46.55843121	-86.33699809	1
Other/NA	46.44399913	-86.44021674	1
Other/NA	46.42724520	-86.59490245	1
Total	**---**	**---**	**76**

*Indicates that diurnal nest searching efforts occurred at the survey station. Multiple nest searching visits were made to PR18.