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Competitive Interactions and Resource Partitioning between Northern Spotted Owls and Barred Owls in Western Oregon: 2009 Progress Report

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This progress report compiles research activities occurring during the years under report. The information is preliminary in nature and has not been peer-reviewed. Users are cautioned to consider carefully the provisional nature of the information, and note that additional data collection and analyses are needed to properly assess all preliminary trends reported.

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By J. David Wiens, Scott A. Graham, Robert G. Anthony, Eric D. Forsman, and Mark R. Fuller

Disclaimer

This progress report compiles research activities completed during the years under report. The information is preliminary in nature and has not been peer-reviewed. Users are cautioned to consider carefully the provisional nature of the information, and note that additional data verification and analyses are needed to properly assess all preliminary trends reported.

Background

The recent barred owl (*Strix varia*) invasion of western North America has raised considerable concern regarding its potential effects on native species, particularly the threatened northern spotted owl (*Strix occidentalis caurina*). As barred owls have rapidly increased their numbers throughout the range of the spotted owl, mounting evidence indicates that they are displacing, hybridizing with, and even killing spotted owls (Kelly et al. 2003, Olson et al. 2005, Anthony et al. 2006). Indeed, range-wide demographic analyses have shown that spotted owl populations have declined by 20–50% in areas where barred owls are most abundant and have been present the longest (Anthony et al. 2006). Despite the apparent magnitude of this threat, nearly all published studies on barred owls in the Pacific Northwest United States have been ancillary to studies being conducted on spotted owls. This shortcoming has not only limited our understanding of how barred owls may contribute to spotted owl population declines, but also how barred owls may be impacting a broad array of native wildlife species through competition, niche displacement, and predation.

In 2007, we initiated a multi-agency investigation of the ecological relationships between northern spotted owls and barred owls in western Oregon. The overall goal of this study is to assess the potential for, and possible consequences of, competition for space, habitat, and food between these ecologically similar species. Using a combination of owl surveys and radiotelemetry methods, the study investigates (1) the amount of overlap between the two species in their use of space, forest composition and structure, and food resources; (2) the influence of each species on the other's population characteristics; and (3) behavioral interactions. The study will allow detailed comparisons to be made between spotted and barred owls in terms of space-use, habitat selection, and dietary composition. This information will then be used to identify the potential effects of resource exploitation or interference by barred owls on the site occupancy, survivorship, and nesting success of spatially associated spotted owls. Herein, we provide a summary of the progress of this study to date.

Research Accomplishments

Study area

Located approximately 30 km (18.6 mi) west of Eugene in the central Oregon Coast Range, the 745 km^2 (288 mi^2) study area comprises a mixed ownership of lands administered by the U.S. Bureau of Land Management (BLM Eugene District; 48%), private timber companies (Roseburg Forest Products, Weyerhaeuser Co., Swanson Superior, Plum Creek; 47%), the Oregon Department of Forestry (3%), and several other small private landowners (2%). Throughout the study area, 2.56 km^2 (1 mi^2) sections of federally owned lands alternate with 2.56 km^2 sections of privately owned lands to produce a checkerboard-like pattern of land ownership (Fig. 1). The study area is bounded by two long-term spotted owl demographic study areas (Oregon Coast Ranges and Tyee; Anthony et al. 2006), which provided historical and concurrent information on the status and distribution of both owl species in the region.

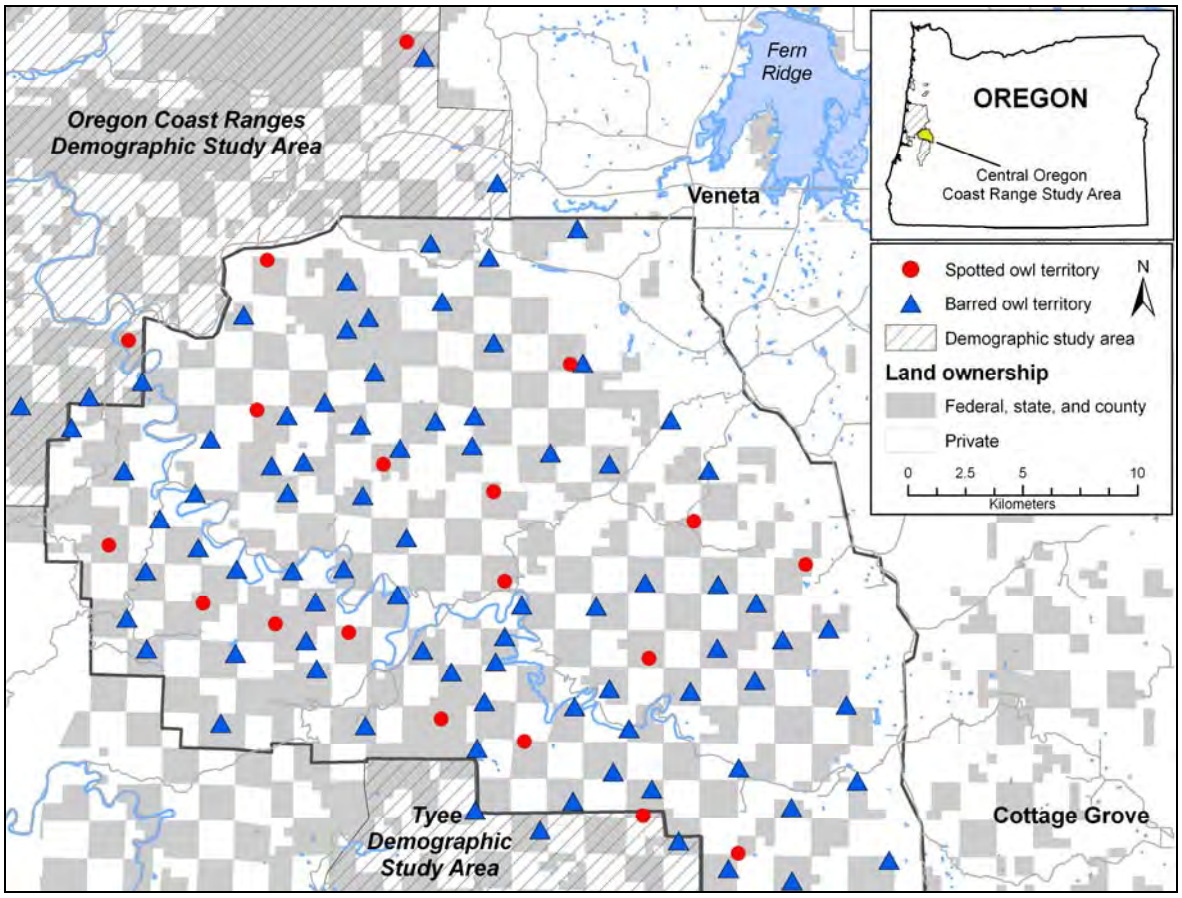

Figure 1. Distribution of territories occupied by northern spotted owls (*n* = 19) or barred owls (*n* = 82) in the central Oregon Coast Range study area in 2009.

Occupancy of historical spotted owl territories

During 2007–2009, we conducted standardized spotted owl surveys within 45 historical spotted owl territories identified in previous studies (Forsman et al. 1984, Thrailkill et al. 1998). We also used barred owl calls to survey territories found to be occupied by spotted owls to increase the likelihood of detecting neighboring barred owls. We followed Lint et al. (1999) in determining occupancy status for both owl species, and considered a territory to be co-occupied by both species if their territory centers (i.e., a nest tree or center of multiple pair detections) were ≤ 1.5 km apart. Preliminary results show that the proportion of historical territories occupied by spotted owls ranged from 0.11 in 2008 (*n* = 14 pairs, 5 single owls) to 0.18 in 2007 (*n* = 13 pairs, 2 single owls), whereas the proportion of territories occupied by barred owls ranged from 0.42 in 2007 (*n* = 25 pairs) to 0.58 in 2009 (*n* = 33 pairs, 2 single owls, Fig. 2). These estimates do not include an additional 2 spotted owl and 47 barred owl pairs that were not associated with historical spotted owl territories. Barred owl surveys were expanded in 2009 to include the entire study area (see below), whereas only a portion of this area was adequately surveyed for barred owls in previous years. Thus, the increase in the observed proportion of historical territories occupied by barred owls in 2009, and the corresponding decrease in the number of territories where no owls were detected, may have been the result of an increase in barred owl detection rates using barred owl calls (J.D. Wiens *unpublished data*).

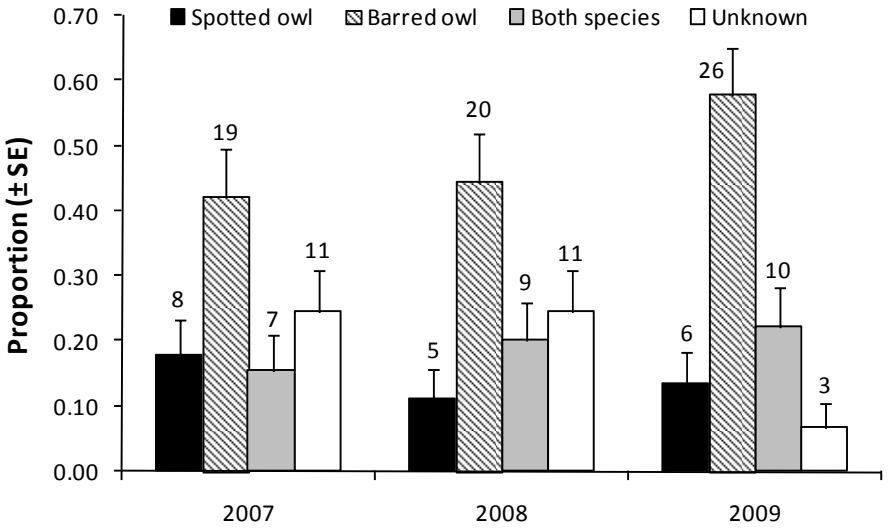

Figure 2. Proportion of historical spotted owl territories (*n* = 45) that were occupied by spotted owls, barred owls, or both species in the central Oregon Coast Range study area during 2007–2009. Also shown are the proportion of territories where occupancy status was "unknown" (no owl responses). Territories were considered to be co-occupied by both owl species if activity centers were located ≤1.5 km apart. Numbers above bars indicate sample sizes.

Barred owl density surveys

In 2009, barred owl surveys were expanded to include the entire 745 km^2 study area. The primary goals of this effort were to: 1) identify all territorial barred owls in the study area; 2) characterize response rate, detectability, and landscape occupancy patterns of barred owls in the

central Oregon Coast Range study area; and 3) provide recommendations to improve strategies for monitoring barred owl presence within the range of the spotted owl. We followed a recently developed draft barred owl survey protocol (USFWS 2009) to locate and monitor individuals or pairs of barred owls. This protocol consisted of alternately listening and broadcasting a series of territorial vocalizations at 30–45 second intervals during a 15 minute sampling period at 659 calling stations placed 500–800 m apart along roads throughout the study area. During 3 complete nighttime surveys of the study area conducted between 1 March and 31 August, we detected a total of 248 males, 184 females, and 23 barred owls of undetermined sex. Preliminary results show that the mean number of barred owls detected in the study area on each survey occasion was 193.7 ± 3.1 ($\bar{x}$ ± SE, range = 190 to 195 owls), which included as many as 82 territorial pairs, 19 single owls, and 12 owls for which we were unable to determine pair status.

Radio marking and tracking

Radiotelemetry studies of spotted owl and barred owl space use, habitat selection, and survival were initiated in March 2007 and completed in September, 2009. During this time we monitored a total of 29 spotted owls (14 females, 15 males) in 16 territories and 28 barred owls (13 females, 15 males) in 21 territories. We attempted to relocate each radio-marked owl three to four times per week to record movements, roost and foraging locations, and habitat use. Preliminary results show that cumulative tracking periods averaged 531 ± 42 days for spotted owls (range = 17–734 days; Appendix A) and 600 ± 37 days for barred owls (range = 21–777 days; Appendix B). Field crews collected a total of 7,870 telemetry locations for both species combined (6,052 nighttime-activity locations, 1,818 daytime roost locations), resulting in an overall average of 128 ± 11 locations per spotted owl (range = 6–213) and 148 ± 10 locations per barred owl (range = 14–208). We documented a total of 13 mortalities of radio-marked owls over a 24-month tracking period (9 spotted owls, 4 barred owls). Based on necropsy results and evidence collected at recovery sites, causes of death included endoparasitism, disease, severe bacterial infection, and predation by great horned owls (*Bubo virginianus*; Appendix A, B). Much of the 2009 breeding season was spent recapturing radio-marked owls to remove backpack radiotransmitters. Field crews successfully removed radiotransmitters from all 20 surviving spotted owls and 12 of 24 surviving barred owls. The remaining barred owls could not be recaptured despite multiple (2–6) trapping attempts.

Nesting success

Reproductive parameters were estimated for each owl species by following the methods described by Lint et al. (1999) or by repeatedly locating pairs of owls during the breeding season and counting the number of young that left the nest. Preliminary results show a dramatic difference in annual measures of nesting success between spotted and barred owl pairs monitored during 2007–2009 (Table 1). Over all three years combined, barred owl pairs nested more often, had a substantially higher nest success rate (89% of barred owls that nested successfully fledged young versus 33% of spotted owls), and produced an average of 1.05 ± 0.15 more young per occupied territory than spotted owls did. Mean number of young fledged per successful nest was 1.86 ± 0.14 for spotted owls (range = 1–2 young) and 2.00 ± 0.11 for barred owls (range = 1–4 young). Note that our estimates of nesting success fall within the range of estimates reported elsewhere for both owl species (Mazur and James 2000, Snetsinger et al. 2008).

Table 1. Preliminary estimates of nesting success for northern spotted owls and barred owls monitored in the central Oregon Coast Range study area during 2007–2009. All estimates are based on territorial pairs for which reproductive output was documented by 31 August.

Year and species	Pairs monitored[a]	Number nesting (%)[b]	Number Successful (%)[c]	Total number of young fledged	Young fledged per pair (±SE)
2007					
Spotted Owl	13	8 (62)	4 (50)	7	0.54 (0.24)
Barred Owl	19	13 (68)	12 (92)	25	1.32 (0.27)
2008					
Spotted Owl	14	10 (71)	1 (10)	2	0.14 (0.14)
Barred Owl	20	15 (75)	14 (93)	26	1.30 (0.23)
2009					
Spotted Owl	15	3 (20)	2 (67)	4	0.27 (0.18)
Barred Owl	20	17 (85)	14 (82)	29	1.45 (0.27)
Three-year means					
Spotted Owl	14	7 (50)	2.3 (33)	4.3	0.31 (0.11)
Barred Owl	20	15 (75)	13.3 (89)	26.7	1.36 (0.14)

[a] Number of territorial owl pairs included in preliminary estimates of reproduction. Estimates for spotted owls are based on all known pairs in the study area, whereas barred owl estimates are based only on those pairs originally identified in 2007 that were monitored between egg-laying and juvenile dispersal of each year.

[b] Percentage of pairs that attempted to breed.

[c] Percentage of nesting pairs that successfully fledged young.

Owl diets

Barred owl food habits study

During the summer and autumn of 2009, a proportion of regurgitated pellets that were previously collected from barred owls in 2007 through 2008 were analyzed in the laboratory. Estimates of mean mass of prey were obtained from a variety of sources, and methods for estimating prey biomass were developed. The proportion of analyzed pellets represented three of 22 family areas and included the sample of pellets that comprised the 2007 and 2008 non-breeding seasons. To evaluate our sufficiency in barred owl pellet sampling, samples from these family areas were used to produce rarefaction and prey taxa accumulation curves (Heck et al. 1975, Gotelli and Colwell 2001). These methodological tools will help determine if sufficient sample sizes of pellets were obtained to adequately reflect diversity of prey in the barred owl diet. For purposes of better understanding the implications of potential changes in diversity and frequency of prey in the barred owl diet, pellets from additional family areas are scheduled to be analyzed during the winter of 2009–2010. Data obtained from barred owl prey preference experiments and the genetic evaluation of owl pellets are currently being summarized for analyses and write-up. A preliminary assessment of dietary samples shows that barred owls are consuming a wide variety of terrestrial and aquatic prey species, indicating that high densities of barred owls may be affecting other wildlife species beyond just spotted owls.

Dietary overlap between spotted and barred owls

In 2009, we continued to collect dietary samples from areas used by spotted or barred owls to determine the amount of overlap in their diets and the potential extent to which the two species compete for food. During a 3-year study period we collected approximately 2,400 diet samples from 20 spotted owl and 35 barred owl territories. Dietary samples included regurgitated pellets, prey remains, and observations of owls with recently killed prey. To date, all prey items in spotted owl diet samples have been keyed and identified in addition to all barred owl diet samples collected in 2009. While most samples were collected during spring and summer, sufficient numbers of samples were collected during fall and winter months from radio-marked owls to examine the potential for seasonal differences in prey selection between the two owl species.

Schedule to Completion

The data collection phase of this study was completed in September, 2009. Remaining research tasks include data entry and verification, lab analysis of barred owl diet samples, accuracy assessment of habitat maps, and data analysis and write-up. Final results of the study are expected to be available in late 2010, with publication of peer-reviewed findings following shortly thereafter.

Dissemination of Preliminary Findings and Public Outreach

- October, 2008. Research highlighted on National Public Radio's Morning Addition: *Spotty recovery* by regional correspondent Tom Banse.
- November, 2008. Research highlighted on ABC News program *Focus earth: the spotted owl* by Peter Imber and Brian Rooney
- January, 2009. Research highlighted in the Smithsonian Magazine: *The spotted owl's new nemesis* by Craig Welch.
- February, 2009. Presentation by Wiens, J.D. *Competition and resource partitioning between northern spotted owls and barred owls.* USGS/FRESC leadership meeting, Corvallis, Oregon.
- March, 2009. Presentation by Wiens, J.D. *Competitive interactions between northern spotted owls and barred owls in western Oregon*. Pacific Lutheran University, Tacoma, Washington.
- April, 2009. Research highlighted on KATU Channel 2 News Portland, Oregon: *Spotted owl threatened again, but not by humans this time* by Dan Tilken.
- June, 2009. Research highlighted on Natural Oregon.com: *Saving the northern spotted owl* by Dennis Newman.
- June, 2009. Presentation and field tour of ongoing research by Wiens, J.D. *Competitive interactions between northern spotted owls and barred owls in western Oregon*. USFWS Barred Owl Stakeholder Group, Veneta, Oregon.
- September, 2009. Presentation by Wiens, J.D. *Overview of the competitive relationship between northern spotted owls and barred owls in western Oregon*. USGS/FRESC/USFWS climate change and sensitive species field tour, Corvallis, Oregon.

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- Plum Creek Timber Company
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This research was approved by the Institutional Animal Care and Use Committees at Oregon State University (Study No. 3516) and Boise State University (Study No. 692-07-004).

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Appendix A.

Preliminary tracking summaries for 29 radio-marked northern spotted owls (14 females, 15 males) monitored in the central Oregon Coast Range during 2007 through 2009.

Owl ID code	Sex	Capture date	End date[a]	Tracking days	Total locations	Fate[b]
BUL_SF	F	6-Jun-2007	3-Apr-2008	297	70	Mortality; disease
BUL_SM	M	29-May-2007	26-Nov-2007	177	42	Mortality; avian predation
CC_SF	F	31-May-2007	7-Jul-2008	397	92	Mortality; endoparasitism
CC_SM	M	23-Mar-2007	17-Mar-2009	714	175	Radio removed
DC_SF	F	12-Apr-2007	8-Apr-2009	716	193	Radio removed
DC_SM	M	17-Apr-2007	26-Mar-2009	699	164	Radio removed
EC_SF	F	8-Mar-2007	13-Mar-2009	725	189	Radio failure; radio removed
EC_SF2	F	19-Mar-2008	6-Apr-2008	17	6	Mortality; avian predation
EC_SM	M	8-Mar-2007	21-May-2007	73	27	Mortality; avian predation
HC_SF	F	29-Mar-2007	6-Apr-2009	727	172	Radio removed
HC_SM	M	29-Mar-2007	30-Mar-2009	721	166	Radio removed
IM_SF	F	24-May-2007	27-Mar-2009	663	142	Radio failure; radio removed
IM_SM	M	24-May-2007	10-Dec-2008	556	119	Mortality; avian predation
LEO_SF	F	30-Apr-2007	11-Apr-2009	701	165	Radio failure; radio removed
LEO_SM	M	30-Apr-2007	13-Apr-2009	703	162	Radio failure; radio removed
LM_SF	F	22-May-2008	19-Aug-2009	447	82	Radio removed
PAT_SF	F	31-Jul-2007	17-Oct-2007	77	16	Mortality; endoparasitism
PAT_SM	M	4-Apr-2007	21-Oct-2007	197	51	Mortality; pneumonia infection
PAT_SM2	M	1-Apr-2008	4-Aug-2009	483	88	Radio removed
PT_SM	M	15-May-2007	16-Dec-2008	571	126	Radio removed
SAL_SF	F	24-Apr-2007	1-Mar-2009	667	177	Radio failure; radio removed
SAL_SM	M	24-Apr-2007	1-Apr-2009	697	174	Radio failure; radio removed
SCW_SF	F	18-May-2007	9-Apr-2009	681	169	Radio removed
SCW_SM	M	18-May-2007	27-Apr-2009	699	155	Radio removed
SHA_SM	M	9-May-2007	2-Dec-2008	563	147	Mortality; avian predation
WC_SF	F	12-Mar-2007	26-Mar-2009	734	213	Radio failure; radio removed
WC_SM	M	3-Mar-2007	10-Mar-2009	727	208	Radio failure; radio removed
WP_SF	F	4-Jun-2008	21-Sep-2009	467	114	Radio removed
WP_SM	M	29-Apr-2008	21-Sep-2009	502	121	Radio removed

[a] Date when the radiotransmitter was either removed or stopped transmitting, or when the owl was found dead.

[b] Cause of death determined by necropsy (performed by the Veterinary Diagnostic Lab, Oregon State University), or by evidence collected at recovery sites in cases where remains were insufficient for necropsy analysis.

Appendix B.

Preliminary tracking summaries for 28 radio-marked barred owls (13 females, 15 males) monitored in the central Oregon Coast Range during 2007 through 2009.

Owl ID code	Sex	Capture date	End date[a]	Tracking days	Total locations	Fate[b]
BC_BM	M	4-Mar-2007	25-Apr-2009	771	101	Radio removed
DC_BM	M	14-May-2008	31-Aug-2009	467	103	Radio still functioning
DH_BM	M	24-Apr-2007	17-Mar-2009	683	174	Radio failure
EC_BF	F	28-May-2007	5-Feb-2009	607	148	Radio failure
EC_BM	M	29-Mar-2007	10-Apr-2009	731	196	Radio failure; radio removed
ELK_BF	F	5-Jul-2007	4-Aug-2009	749	175	Radio failure; radio removed
ELK_BM	M	29-May-2007	26-Jul-2009	777	182	Radio failure; radio removed
FC_BF	F	19-Jun-2007	17-Oct-2008	478	140	Mortality; endoparasitism
FC_BM	M	23-Apr-2007	30-Mar-2009	697	179	Radio failure; radio removed
GC_BM	M	28-Mar-2007	1-May-2009	753	115	Radio failure; radio removed
HP_BM	M	12-Apr-2007	8-May-2009	746	203	Radio failure
IM_BF	F	19-Jun-2007	24-Mar-2009	635	152	Radio failure
KLI_BF	F	9-May-2007	30-Apr-2009	711	186	Radio failure; radio removed
LBC_BF	F	22-May-2007	3-May-2009	701	207	Radio failure; radio removed
LOC_BF	F	30-Apr-2007	5-May-2009	725	171	Radio failure; radio removed
PAT_BF	F	19-Jun-2007	12-Feb-2008	233	59	Mortality; endoparasitism
PC_BF	F	19-Apr-2007	3-Apr-2009	704	173	Radio failure; radio removed
PG_BM	M	14-Sep-2007	1-Jun-2009	617	158	Radio failure
RC_BM	M	21-Mar-2007	11-Dec-2008	620	183	Radio failure
SC_BM	M	3-Apr-2007	28-Feb-2009	685	163	Radio failure; radio removed
SF_BF	F	27-Mar-2007	12-Jan-2009	645	208	Radio failure
SG_BF	F	28-May-2008	17-Sep-2008	109	33	Mortality; bacterial infection
SG_BM	M	28-May-2008	31-Aug-2009	453	102	Radio still functioning
UPC_BF	F	24-Apr-2007	1-May-2009	727	187	Radio failure
UPC_BM	M	24-Apr-2007	1-May-2009	727	197	Radio failure; radio removed
WC_BF	F	18-Apr-2008	31-Aug-2009	493	119	Radio still functioning
WC_BM	M	5-Apr-2007	26-Apr-2007	21	14	Mortality; bacterial infection
WC_BM2	M	11-Mar-2008	31-Aug-2009	530	117	Radio still functioning

[a] Date when the radiotransmitter was either removed or stopped transmitting, or when the owl was found dead.

[b] Cause of death determined by necropsy (performed by the Veterinary Diagnostic Lab, Oregon State University), or by evidence collected at recovery sites in cases where remains were insufficient for necropsy analysis.