BURROWING OWL CONSERVATION ON GOLF COURSES IN NORTH AMERICA

U.S. Golf Association - Wildlife Links Program

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by

Courtney J. Conway

and

Matthew D. Smith

Arizona Cooperative Fish and Wildlife Research Unit

104 Biological Sciences East

University of Arizona

Tucson, AZ 85721

Executive Summary

Burrowing Owl populations are declining throughout their range in North America yet large-scale conservation programs to reverse declines are lacking. Burrowing Owls are attracted to golf courses for foraging because they prefer short grass, open areas. Burrowing Owls rely on existing burrows in which to nest and limited burrow availability is thought to be one factor contributing to population declines. Golf courses across the country could play a major role in helping to restore Burrowing Owl populations if nesting burrows were made available on local golf courses. Our project involves installing artificial nesting burrows on 7 golf courses in eastern Washington. We will expand our project nationally to golf courses around the country if our pilot study demonstrates that Burrowing Owls can successfully locate and use artificial nesting burrows on golf courses. The end result will be a publishable pamphlet that can be distributed to superindendents and grounds crews at golf courses around the country instructing them exactly how and where to install successful nesting burrows. The pamphlet will also provide a list of materials needed, cost, and where to purchase the materials. This year was the first year of our Wildlife Links project and we have already installed 104 artificial nesting burrows on our 7 partner golf courses in eastern Washington. We have also installed an additional 86 artificial nesting burrows in areas off golf courses so that we will be able to compare burrow occupancy on and off golf courses. We have also located 133 natural burrows so that we will be able to compare reproductive success of golf course burrows with natural burrows. The first year of our pilot study was focused on installing large numbers of artificial burrows so that we could monitor occupancy and success in years 2 and 3. Most burrows were installed after owls returned from migration (Feb - Apr) so we assumed next year would be the first year that we might observe use by Burrowing Owls. To our surprise, we observed owls at 3 of our artificial burrows already this summer. These were owls that nested elsewhere (in a natural burrow) but were able to find and use the artificial burrow later in the nesting season. These initial observations were surprising (we did not expect owls to locate and use our burrows so quickly) and give us reason to believe that our project shows great promise. In the coming year (2001), we plan to install an additional 40 nesting burrows on partner golf courses in eastern Washington. We also plan to monitor our approximately 400 burrows (natural and artificial both on and off golf courses) weekly so that we can compare occupancy and reproductive success. We are considering expanding our pilot study to include partner golf courses in southern Arizona (Phoenix and Tucson area) for the coming year. Although our project is just getting underway, we have generated substantial positive media coverage for our Wildlife Links project locally, regionally, and nationally. All of this media attention has credited the U.S. Golf Association and the Wildlife Links program in particular.

Golf courses can potentially benefit wildlife populations, but they often lack the information or expertise to implement effective conservation efforts. A well-publicized program that encourages many individual golf courses to contribute to a coordinated national effort could be particularly beneficial to wildlife conservation. The Burrowing Owl (*Athene cunicularia*) is an excellent example of a species of local, regional, and national management concern that could benefit tremendously from coordinated conservation efforts on individual golf courses across North America.

Burrowing Owls in North America have suffered dramatic population declines and significant range contraction (Dechant et al. 1999). Burrowing Owls are considered endangered in Minnesota, Iowa, and Canada, and populations have declined significantly in British Columbia, Alberta, Arizona, California, Colorado, Kansas, Nebraska, Nevada, New Mexico, Utah, and Washington (James and Espie 1997). Many state wildlife agencies are becoming increasingly concerned about declining owl populations. Despite the widespread declines and increased concern for Burrowing Owl populations throughout North America, few range-wide conservation efforts exist to reverse population declines.

Because Burrowing Owls are still present in many areas throughout the west (Dechant et al. 1999), we need to implement effective on-the-ground conservation efforts immediately to reverse declining population trends. Burrowing Owls require short-grass habitats and prefer open areas within deserts, grasslands, and shrub-steppe (Haug et al. 1993). Lack of suitable nesting burrows, due to the eradication of colonial burrowing mammals, limits Burrowing Owl populations (Desmond and Savidge 1996). Hence, a widespread conservation program that provides artificial nesting burrows within short-grass habitats may help recover Burrowing Owl populations.

Golf courses are open, short-grass habitats that might provide ideal nesting and foraging habitat for Burrowing Owls if artificial nesting burrows were made available. Indeed, Burrowing Owls are repeatedly seen foraging on golf courses throughout their North American range (Thomsen 1971). Mowing is thought to increase the attractiveness of nest sites for Burrowing Owls, and regular mowing throughout the nesting season does not appear to disturb nesting owls (Plumpton and Lutz 1993, Dechant et al. 1999). Artificial nesting burrows have been used successfully to augment nesting habitat in local areas (Collins and Landry 1977, Trulio 1997) and may provide safer nest sites than natural burrows (Wellicome et al. 1997). Burrowing Owls appear tolerant of moderate levels of human activity and vehicle traffic because birds can easily retreat to the safety of their burrow. Artificial nesting burrows on golf courses may help restore Burrowing Owl populations but the effects of irrigation, mowing, and periodic golfer activity on nest occupancy and reproductive success has not been examined.

Attracting nesting Burrowing Owls may have additional benefits to local golf courses. Burrowing Owls eat small rodents (mice, voles, pocket gophers) and invertebrates (locusts, beetles, crickets, scorpions, earwigs) (Haug et al. 1993). Hence, resident owls may help control rodent populations and prevent periodic outbreaks of unwanted flying insects on golf courses (Marti 1974, Plumpton 1992). Moreover,

resident Burrowing Owls may enhance the recreational value of a round of golf. Golfers typically enjoy viewing charismatic wildlife, and Burrowing Owls are unique among owls in that they are active throughout the daylight hours and are very tolerant of human activity. Finally, each golf course that participates can gain positive local publicity by helping conserve a high-profile species. Hence, if owls can successfully reproduce in artificial nesting burrows installed directly on golf course grounds, the golf industry can increase the recreational value to golfers and simultaneously help conserve a sensitive wildlife species.

Our project was designed to evaluate the potential for golf courses across North America to contribute to Burrowing Owl conservation efforts. To evaluate the efficacy of artificial nesting burrows, we are comparing occupancy and success between artificial burrows on and off golf courses. One of the main goals of the project in our first year was to install a large number of artificial nesting burrows both on and off golf courses. We developed partnerships with 7 local golf courses in eastern Washington to help conduct our pilot study. We also began working with the local Audubon Society to help us install artificial nesting burrows off golf courses.

Project partners

We have brought together a large group of project partners on our Wildlife Links project. Partners include: U.S.G.A., Washington Department of Fish and Wildlife, Washington State University, Bureau of Land Management, Washington Department of Natural Resources, Kennewick Irrigation District, U.S. Fish and Wildlife Service - Arid Lands National Wildlife Refuge, U.S. Geological Survey - Arizona Cooperative Fish and Wildlife Research Unit, Lower Columbia Basin Audubon Society, and 7 local golf courses. Golf Course partners include Meadow Springs Golf and Country Club and Canyon Lakes Golf Course in Kennewick, WA, Sun Willows Golf Course in Pasco, WA, Buckskin Golf Course and West Richland Municipal Golf Course in West Richland, WA, and Horn Rapids Golf Club and Columbia Point Golf Course in Richland, WA. Personnel working on the project include Dr. Courtney J. Conway, Matthew D. Smith, Gina Grasso, Gwyneth Balmer, and Charlotte Reep (from the Lower Columbia Basin Audubon Society). We had a U.S.G.A. monitoring visit from representatives of the Research Committee 27-28 June 2000 which included Mike Kenna, Jim Moore, Ali Harivandi, and Jerry Pepin.

Burrow placement and installation

We are installing artificial nesting burrows in a variety of landscape settings. We are installing artificial burrows in groups of 2 and we vary burrow placement relative to golfer activity, maintenance levels, or landscape features within a pair of burrows. For example, we are installing artificial burrows both in areas under normal course maintenance (weekly mowing and daily irrigation), and in areas

immediately adjacent to maintained areas that are not mowed or irrigated. We are also installing burrows in locations that vary in golfer activity to evaluate the influence of activity on burrow occupancy and success. We have developed an artificial burrow installation procedure that is relatively easy and are developing detailed instructions including materials required for installation (Appendix 1). The photo on the right shows a typical artificial burrow in a maintained area on one of our partner courses (Columbia Point). An artificial nesting burrow consists of a 19-liter (5-gallon) plastic bucket buried upside-down (without the lid) 1.3 m below ground. We use 3 m of 10-centimeter (4-inch) corrugated drainage tubing to create a sloped tunnel leading from the ground surface down to the nest chamber. The 10-centimeter opening is all that is visible after an artificial burrow is installed; golf course mowers can go right over the burrow entrance. The finalized installation instructions that we produce from the project will target superintendents and grounds crews at golf courses across North America so that they can install their own nesting burrows.

Artificial burrows installed on golf courses

So far we have installed 104 artificial burrows on 7 golf courses in eastern Washington; 61 in maintained areas and 43 in non-maintained areas (Table 1). We purposefully installed some of the artificial burrows close to a tree ($n = 22$) and others far from any trees ($n = 82$) so that we will be able to examine whether proximity to landscaped vegetation influences whether owls will locate and nest in artificial burrows on golf courses. Burrows were installed between February and August with the assumption that owls may locate burrows in fall of 2000 and return to nest in them in spring of 2001. To our surprise, owls found and used some of our artificial burrows by the end of summer 2000 (Table 2). Of the 104 burrows installed, 6 had signs of use (pellets, feathers, tracks) by Burrowing Owls. At 3 of the burrows installed this year we observed ≥ 1 owl present at the burrow entrance during one of our weekly monitoring visits (photo).

Artificial burrows installed off of golf courses

We have installed 86 artificial burrows off of golf courses which will allow us to compare occupancy and reproductive success with our burrows on golf courses. The local Audubon Society (coordinated by Charlotte Reep) has worked with volunteers in the community to help us install these burrows off of golf courses (Table 2). Of the 86 burrows installed, 22 had signs of use by Burrowing Owl use, we observed at least 1 owl at 19 of these burrows, and 6 were used as nest burrows in 2000.

Natural nesting burrows

We have located and monitored 133 natural burrows in southeastern Washington to allow comparison of annual re-occupancy, reproductive success, and burrow fidelity between artificial and natural burrows (Table 2). We saw an owl at 113 of these natural burrows in 2000, 67 of these had a resident male (male present on multiple visits), 56 were active nests (burrows with signs of nesting activity), and 47 of these nests produced young ($\geq$1 nestling seen at burrow entrance). In these 47 natural nesting burrows, the mean number of young produced was 3.0 ± 1.4 (range 1-6). Three of these 47 nesting burrows did not fledge young. The natural nesting burrow at right was near one of our partner golf courses; notice the large number of old divots collected by the resident owls and placed at their burrow entrance.

We visited all nesting burrows (artificial and natural) weekly throughout the breeding season to document occupancy and reproductive success. During each visit, we determined burrow status (occupied, not occupied) and nesting stage. We first observed burrows from >100m away using binoculars to check for owl activity and then approached each burrow on foot to look for pellets, feathers, and presence of cobwebs at burrow entrance. We also used a fiberscope video probe on a subset of burrows to confirm nesting activity. From these weekly visits, we recorded information pertaining to each burrow: signs of owl use, currently occupied or not, successful nest or not, and the number of young fledged. We used an infrared video probe to examine nest contents in a subset ($n = 34$) of our natural burrows. We randomly selected which burrows to examine with the video probe so that we could test whether use of the probe negatively affects nesting owls. At the end of the pilot study, we will have sufficient information to compare occupancy and success rates among four types of burrows: natural burrows both on and off golf courses, and artificial burrows both on and off golf courses.

We sought to trap and individually mark owls so that we could compare annual burrow

fidelity between artificial and natural burrows and also examine annual survival of owls nesting in different burrows. We trapped 44 nests and caught ≥1 owl at 27 nests during 364 trap-hours (228 person hours). We caught a total of 74 owls (6 adult males, 12 adult females, and 56 juveniles). Nick Rodrigues, Superintendent at one of our partner courses, is holding a recently-captured Burrowing Owl at Horn Rapids Golf Course (photo).

Standardized surveys to locate natural nesting burrows

Another aspect of our project requires location of natural nesting burrows so that we can compare success of our artificial burrows with natural burrows. Hence, we had to develop methods for locating natural nesting burrows in areas near our partner golf courses. Hence, we worked with several state and federal wildlife agencies to locate natural burrows on public lands nearby. We conducted 4 line-transect surveys within the Arid Lands National Wildlife Refuge (ALE) and located 44 burrows on 4 transects but none of these burrows showed signs of use by Burrowing Owls. We also investigated 5 historical burrow locations (occupied in 1996-99) on ALE, but did not find Burrowing Owls at any of these historical burrows. Most of the natural burrows we found and monitored were located incidentally. Most natural Burrowing Owl nests were in badger (*Taxidea taxus*) burrows. Of 59 nests occupied in 2000 for which the origin was known/recorded, 40.7% were in badger burrows, 32.3% were in ground squirrel (*Spermophilus* spp.) or marmot (*Marmota flaviventris*) burrows, 3.4% were in coyote (*Canis latrans*) burrows, 10.2% were in artificial nesting burrows, and 13.6% were in some other kind of non-natural structure (e.g., under concrete foundation, in metal culvert).

Breeding phenology

We need to know the time of year when adult owls typically return from migration and search for available nesting burrows so that we have our artificial burrows installed prior to territory settlement each year. Hence, we documented when male and female owls return to natural burrows this past year. A small portion of the population in Washington are year-round residents; some burrows have a single owl present (presumably a male) throughout the winter. However, most of the population is migratory. Of 34 nests monitored weekly beginning on 20 Feb 2000, 12 were already occupied, and mean male arrival date for the remaining 22 nests was 18 March (range 23 February-26 April). Most males (87%) were observed at their burrow

entrance by mid-March. Females arrived later; mean female arrival in 2000 was 28 March (range mid-February through 26 April, $n = 29$ nests). Most females (67%) arrived 15 March-14 April.

Detection-probability trials at active nests

We conducted detection probability trials at active nests so that we could estimate the effectiveness of using 6-minute vocal surveys for detecting nesting Burrowing Owls. A Burrowing Owl was detected on only 23% of passive detection trials and 42% of detection trials using tape playback ($n = 26$). If we exclude trials in which owls were not present (after walking to the nest after the trial), detection probability was 33% for passive trials and 61% for tape playback trials ($n = 18$).

Media coverage and public relations

We have received substantial media and press coverage of our Wildlife Links project. The local newspaper, the *Tri-City Herald*, did a front-page feature story on the project (5 April 2000). The *Seattle Times* also included a feature article on the project including a half-page full-frame picture of an owl on one of our partner golf courses (11 April 2000 issue). The *Seattle Times* article was included in a special feature highlighting great golf courses in the Northwestern U.S. A regional cable television show, *Washington Wildlife*, did an episode for their program on our project this summer. The program is carried by 33 local cable television stations throughout Washington, Oregon, and Idaho. The piece explained the goals and objectives of the project and the unique partnership among the U.S.G.A., state and federal natural resource agencies, the local Audubon Society, the University, and local golf courses. The piece also included interviews with local golfers and the superintendent at one of our partner golf courses (Nick Rodrigues at Horn Rapids; photo above). We also were contacted by *Golf Course News* and asked to write an article for their magazine summarizing our Wildlife Links project; the article appeared in the May 2000 issue and was featured in an inset on the cover of that issue.

Proposed research schedule and anticipated results for the coming year

Our Wildlife Links project is still in the first year and has just gotten underway. In the coming year, we will continue to install artificial nesting burrows on local golf courses in eastern Washington. We will also monitor all installed burrows (approximately 400 of them) weekly from 1 Feb - 30 August 2001 to quantify use of our nesting burrows by Burrowing Owls. We will also

measure a suite of landscape features at all burrows to document the features that influence burrow occupancy and success. Landscape variables will include: irrigated/maintained area (yes/no), grass height and mowing frequency, distance to fairway, distance to nearest tree, distance to nearest cart path, distance to nearest tee box, distance to nearest alternate burrow, relative index of golfer activity in area (1=infrequent, 2=periodic, 3=frequent), tree and shrub density in the 1 hectare area surrounding each burrow, and extent of topographic relief surrounding burrow. These measures will allow us to provide details to other golf course superintendents regarding how and where to install artificial nesting burrows to achieve optimal success. We are making plans to expand the project to Arizona and hope to begin installing artificial nesting burrows on golf courses in Phoenix and Tucson. The end result will be a publishable pamphlet targeting golf course managers and superintendents across western North America that persuades golf courses to participate in the program. We will also publish several scientific articles in peer-reviewed journals summarizing project results and accomplishments.

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Table 1. Distribution of the 104 artificial nesting burrows installed on golf courses in eastern Washington in 2000.

	Golf Course							
	Canyon Lakes	Columbia Point	Horn Rapids	Meadow Springs	Buckskin	West Richland	Sun Willows	**Total**
# of burrows installed	19	10	30	6	4	5	30	104
in maintained areas	16	10	12	6	2	2	13	61
in non-maintained areas	3	0	18	0	2	3	17	43
close to a tree	2	3	6	1	1	1	8	22
far from any trees	17	7	24	5	3	4	22	82

Table 2. Occupancy and success of artificial and natural burrows both on and off golf courses in first year of project. The artificial burrows we installed on golf courses are not expected to attract nesting owls until spring 2001 or 2002.

	Artificial Burrows		Natural Burrows	
	on golf courses	off golf courses	on golf courses	off golf courses
burrows installed prior to '00	5	84		
burrows installed in '00	99	2		
burrows monitored in '00	104	86	10	123
burrows destroyed in '00	0	1	0	10
burrows with no sign of use in '00	98	63	0	19
burrows with owl sign in '00	6	22	10	105
burrows with owl observed in '00	3	19	10	103
burrows with 'resident' male	0	9	8	59
burrows with 2 adults observed	2	6	8	52
burrows used as nest	0	6	8	48
burrows that produced young	0	4	8	39
young/active nest (SD; range)	0	3.0 (1.4; 1-4)	2.5 (1.2; 1-4)	3.2 (1.4; 1-6)
burrows that fledged $\geq$1 young	0	3	8	33
young/fledged nest (SD; range)	0	3.67 (0.6; 3-4)	2.50 (1.2; 1-4)	3.21 (1.4; 1-6)

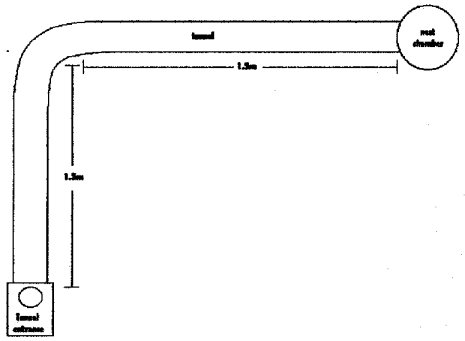
Appendix 1.
Installation Instructions for Artificial Nesting Burrows on a Golf Course

MATERIALS:

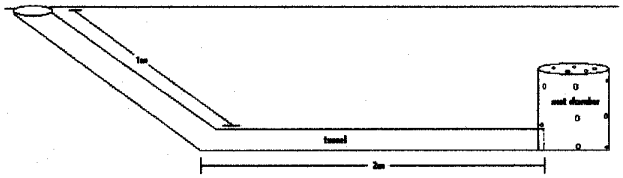
3 meters of 4" (10cm) slotted drainage tubing
New, clean, 5-gallon (19 liter) bucket
Drill and ¼ inch (6.35mm) bit
Small saw to cut bucket
Utility blanket (for dirt pile)
Pic-axe
5" (13cm) trenching shovel
Spade

Install burrows using a trencher, or other mechanical means to save time.

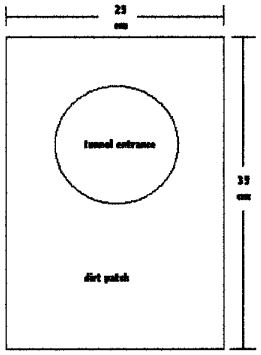
a) Top View



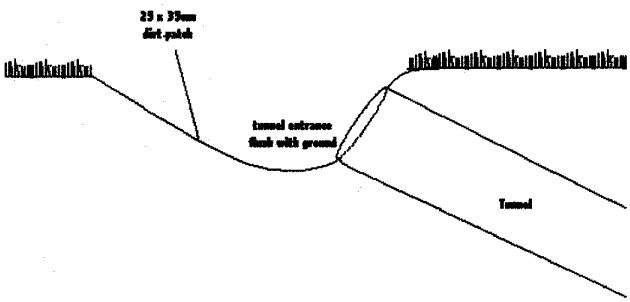
b) Side View



c) Entrance top view



d) Entrance side view



Bucket: Bucket is installed upside down in hole to serve as the nest chamber. Drill 20 to 25 holes in the bucket to allow for moisture to escape. Cut a 10cm x 10cm hole in the lip of the bucket to allow the tubing to enter the bucket.

Tubing/Tunnel: Tunnel is dug to replicate natural burrows. Important features: a 90° curve in drainage tubing to block light and mimic natural burrow [see (a) above]; sharp angle during the first meter [see (b)]; 3 meter length; 1 meter depth.

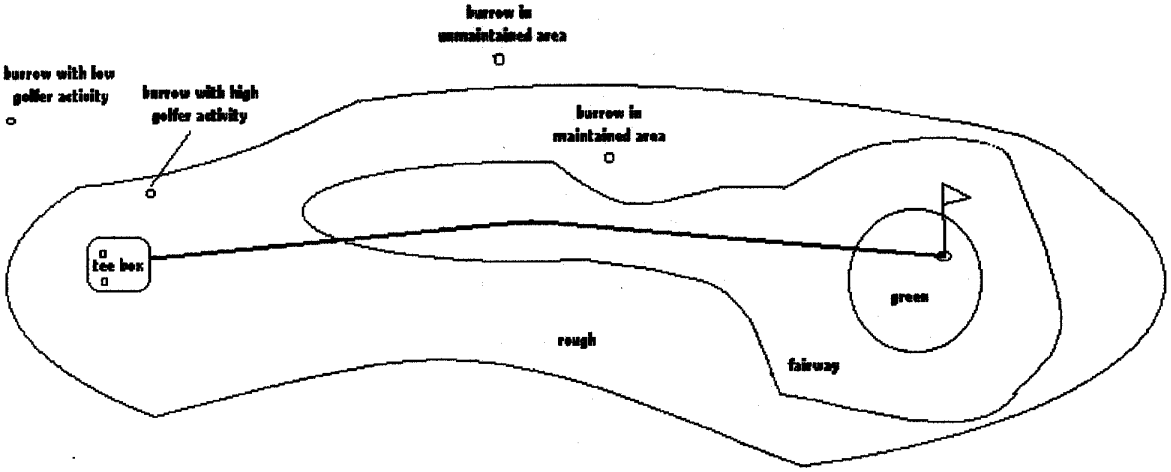
Burrow Entrance: Tunnel opening should not stick out above grass height so that mowing and other maintenance is not disrupted [see (d)]. The 25cm x 35cm patch of dirt at the tunnel entrance [see (c)] provides a search image that owls may use to locate vacant burrows.

WHEN INSTALLING ON GOLF COURSE

- Take care to disrupt the sod as little as possible.
- Be considerate of golfers and try not to disrupt their game.
- Also be careful of golfers, they don't always hit the ball where they intend!
- Watch out for sprinkler lines underground.

WHERE TO PLACE ARTIFICIAL BURROWS ON GOLF COURSES

One purpose of this study is to test where owls will and will not occupy burrows. Burrows should be installed in pairs. The two installation sites within a pair should capture extremes of golfer activity. For example, within a given area (~30m radius) you could place one burrow in a maintained area closer to a fairway or tee-box, and a second burrow in an un-maintained area further away from the fairway or tee-box. Install all burrows as far away from sprinkler heads as possible (at least 15 m).



MONITORING BURROWS

Installed burrows should be visited every 7-10 days to look for signs of use by owls. As you approach a burrow stop 100 meters away and, using binoculars, scan the area for any owls. Continue to stop and scan every 25 meters as you approach the burrow.

If you do not see any owls: proceed to burrow; look for and note any signs of occupancy found around burrow (e.g. feathers, pellets, tracks, or feces). Also note condition of entrance (cobwebs, weeds, trash, looks used, etc). Collect all whole pellets. Store in a Ziplock bag and include a label with site number, date checked, and date of last visit. Remove all partial pellets and all other sign (e.g., feathers, feces) from the immediate area so that the presence of sign on future visits will provide reliable indication of recent use.

If you do see an owl: stop and look for the presence of any additional owls nearby. Record exact location of all owls; i.e. standing on entrance mound, head sticking out of burrow entrance, perched on sage 10m west, etc. Record each owl's behavior. Try not to flush the bird so you can obtain an accurate estimate of the number of owls in a given location. Later in the season when you know all of the location of all nests in the vicinity you may flush the bird to retrieve pellets.