Turfgrass and Environmental Research Online

...Using Science to Benefit Golf

Research being conducted at eight golf courses in south-central Washington is investigating if artificial burrows installed on golf courses can help slow the population decline of burrowing owls in North America.

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PURPOSE

The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 290 projects at a cost of $25 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

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Use of Artificial Burrows on Golf Courses for Burrowing Owl Conservation

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SUMMARY

Burrowing owls have suffered population declines in many portions of their North American range. Research conducted in south central Washington state investigated the use of artificial burrows on golf courses as a means to help limit this population decline. To date, the research indicates:

- In 2001, 56 burrows were used as nests, 14 were occupied by unpaired males, and 50 burrows were used temporarily. In 2002, 72 burrows were used as nests, 17 were occupied by unpaired males, and 37 burrows were used temporarily
- Though less frequently, owls did occupy and nest in the other three burrow types, including artificial burrows on golf courses.
- Burrowing owls used fewer artificial burrows on golf courses (6.5%) compared to artificial burrows off golf courses (18%). However, they used 35% of artificial burrows that were installed in non-maintained areas and were within 200 meters of a natural nest.
- Artificial burrows on golf courses had the same percent of successful nesting attempts as the other three burrow types. In contrast, nests on golf courses produced fewer offspring per nesting attempt than nests off golf courses.

Burrowing owls are intriguing birds because, unlike most owls, they are readily visible during daylight hours and are tolerant of human presence. Their conspicuousness and peculiar nesting habits have made burrowing owls a popular bird in the western United States. Yet, burrowing owls have suffered population declines in many portions of their North American range (3, 10). They are currently listed as an endangered species in Canada and a species of national conservation concern in the United States (6, 9).

Burrowing owls lay their eggs in underground burrows that have been abandoned by mammals such as prairie dogs (*Cynomys ludovicianus* and *Cynomys leucurus*) and American badgers (*Taxidea taxus*) (5). A shortage of suitable burrows due to a decline in these mammals is thought to be one factor contributing to declines in burrowing owl populations (4). To compensate for the shortage of natural burrows, managers and researchers often use artificial burrows to provide nesting sites for burrowing owls (1).

Burrowing owls typically nest and forage in short-grass open areas and avoid areas with high density of trees, shrubs, or tall grass (5). The characteristic large, open areas of manicured, short grass on golf courses attracts burrowing owls. Indeed, burrowing owls often are seen foraging and even nesting on golf courses (8). However, burrowing owls generally like to forage close to their nest burrow and golf courses often lack suitable burrows required by owls. Golf courses might be able to aid burrowing owl conservation by providing artificial nesting burrows. Because burrowing owls are still present in many areas throughout the western U.S. (3), effective conservation efforts should be implemented immediately to reverse declining population trends.

Researchers examined whether burrowing owls would locate and occupy artificial burrows installed on 8 golf courses in south-central Washington (near the cities of Pasco, Kennewick, Richland, and Moses Lake).

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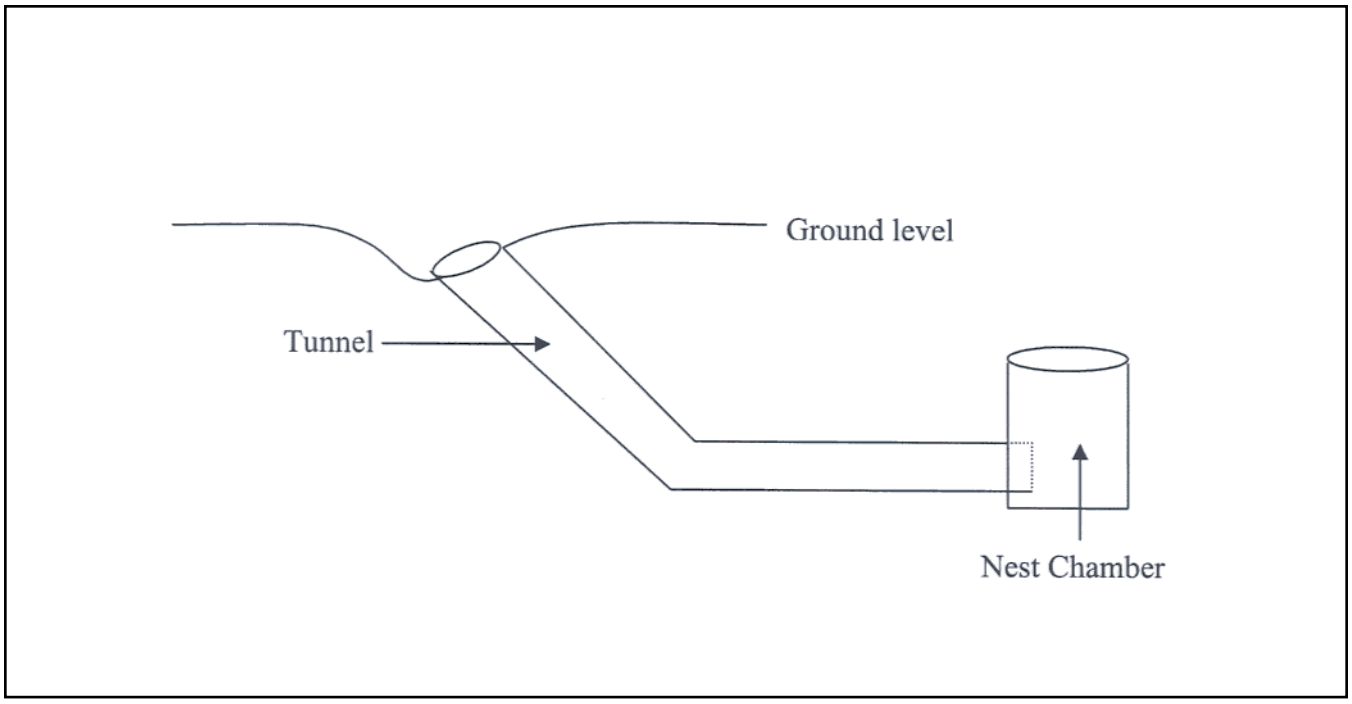

Figure 1. Design of artificial nesting burrows constructed on golf courses in south-central Washington. The tunnel entrance is flush with the ground to allow mowing equipment to pass over. The 3 m nest tunnel is made from 10-cm (4 inch) diameter, slotted irrigation tubing. The tunnel drops ~ 45º to a depth of 1 m, then turns ~90º and travels to the nest chamber. The nest chamber is a 22-liter (5-gallon) bucket buried upside-down.

We examined the efficacy of installing artificial nesting burrows (Figure 1) on golf courses as a way to help restore local burrowing owl populations (2, 7). We examined whether burrowing owls would locate and occupy artificial burrows installed on 8 golf courses in south-central Washington (near the cities of Pasco, Kennewick, Richland, and Moses Lake). We also wanted to know which golf course features (such as proximity to fairways or sprinklers) influenced the probability that owls would use an artificial burrow. We compared the reproductive success and annual fidelity of owls nesting in artificial burrows on golf courses to those nesting in natural burrows off golf courses, natural burrows on golf courses, and artificial burrows off golf courses (7).

Occupancy and Reproductive Success

We repeatedly visited each our 405 study-burrows (130 artificial burrows on golf courses, 86 artificial burrows off golf courses, 14 natural burrows on golf courses, and 86 natural burrows off golf courses) every 2-4 days throughout the breeding season (February 1 through August 31) in 2001 and 2002. During these nest visits, we recorded the number of adult and juvenile owls visible, or any signs of occupancy such as feathers, pellets, or feces.

We found many burrowing owls in natural burrows off golf courses. In 2001, 56 burrows were used as nests, 14 were occupied by unpaired males, and 50 burrows were used temporarily. In 2002, 72 burrows were used as nests, 17 were occupied by unpaired males, and 37 burrows were used temporarily. Though less frequently, owls did occupy and nest in the other 3 burrow types (Table 1), including artificial burrows on golf courses. Burrowing owls used fewer artificial burrows on golf courses (6.5%) compared to artificial burrows off golf courses (18%). However, they used 35% of artificial burrows that were installed in non-maintained areas and were within 200 meters of a natural nest (9).

Two years after installing artificial burrows, the number of nests on golf courses increased by only one. However, total number of

	Nests		Occupied by Unpaired Males		Used Temporarily	
	2001	2002	2001	2002	2001	2002
Natural off golf course	56	72	14	17	40	37
Natural on golf course	7	9	2	0	2	4
Artificial off golf course	6	5	10	2	7	1
Artificial on golf course	2	2	1	4	6	2

Table 1. Number of burrows used by burrowing owls in south-central Washington, 2001-2002. Each year, we recorded whether burrows were: 1) used as nests, 2) occupied by an unpaired male, 3) used temporarily by owls (i.e., we rarely observed owls but found signs of use such as pellets or feathers), or 4) not used by owls.

adults on golf courses increased by 24% (from 21 to 26 owls), and the percent of golf course owls occupying artificial burrows increased slightly (from 24% to 31%). Artificial burrows on golf courses had the same percent of successful nesting attempts as the other 3 burrow types. In contrast, nests on golf courses produced fewer offspring (2.3 average) per nesting attempt than nests off golf courses (3.9 average) (7).

Factors influencing occupancy

We placed artificial burrows at a variety of locations on each of our partner golf courses. Burrowing owls used 8 of the 130 artificial burrows on golf courses. Four of these 8 occupied burrows were used as nests, and 4 were used by unpaired males. Burrowing owls used only 1 artificial burrow in a maintained area, the other 7 were in non-maintained areas. Owls preferred artificial burrows that were further from maintained areas (those with frequent mowing, watering, and golfer traffic), fairways, and sprinklers, and those that were closer to existing natural burrows (Table 2) (7).

Annual Fidelity

We put leg bands on owls on our study site and then conducted surveys in 2001 and 2002 to locate all returning owls. We banded 74 owls in 2000, 300 owl in 2001, and 280 owls in 2002. Our results suggest that owls nesting on golf courses (including both artificial and natural burrows) were more likely to return the next year (following migration) compared to owls nesting off golf courses (55% and 33% respectively) (7).

Discussion

Owls did not use a great number of the artificial burrows on golf courses (eight of 130), and they only occupied artificial burrows on 2 of our eight partner golf courses. In fact, these two courses already had owls nesting in natural burrows on their property prior to our study. Hence, large-scale efforts to install artificial burrows on golf courses do not appear to be an efficient use of resources. Installing artificial burrows only on golf courses with owls nesting nearby holds some potential and should be evaluated on a larger (ie, regional) scale. Such efforts are warranted as golf courses may provide benefits for owls. For exam-

Landscape Feature	Unoccupied burrows	Nest burrows	Occupied burrows
	Mean SE	Mean SE	Mean SE
Distance to maintained area†	18 ± 3	48 ± 24	34 ± 15
Distance to rough†	15 ± 2	57 ± 33	34 ± 18
Distance to fairway†	35 ± 3	74 ± 34	47 ± 19
Distance to sprinkler†	23 ± 2	60 ± 26	43 ± 14
Distance to nearest natural burrow†	579 ± 25	149 ± 68	180 ± 43

†differed between occupied and unoccupied burrows based on one-tailed Mann- Whitney U-tests ($P < 0.05$).

Table 2. Mean and standard error (SE) of distance (m) to landscape features between burrowing owl nests (n = 4) and unoccupied burrows (n = 120) and between occupied (n = 8) and unoccupied (n = 120) artificial burrows on golf courses in south-central Washington. Adapted from Smith et al. (7).

ple, nesting attempts in artificial burrows on golf courses appeared to be more successful compared to other burrow types.

Indeed, nests in artificial burrows tend to have lower depredation than natural burrows (11), and annual site fidelity at golf course burrows was slightly higher than at burrows off golf courses. Conversely, golf course burrows fledged fewer young than burrows off golf courses, and we need to pay close attention to this to ensure that golf courses are not detrimental to owls (i.e., they have features that entice owls to attempt nesting, but contain other features that cause poor success). In conclusion, some golf courses can enhance existing nesting opportunities for burrowing owls, and subsequently may help to reverse local declines of owl populations.

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Recommendations to enhance success of artificial nesting burrows on golf courses

- *Evaluate each golf course individually*. Artificial nest installation should be considered only for courses that presently have burrowing owls nesting nearby and that have suitable areas for nesting.

- *Install artificial burrows in appropriate areas.* For golf courses with nesting owls within ~ 0.5 km of non-maintained areas, burrows should be placed in areas that: 1) have suitable owl foraging habitat, 2) are 40 m away from any sprinkler head, 3) are 35 m away from all maintained areas, and 4) have relatively low golfer traffic.

- *Provide natural vegetation.* Providing areas with native vegetation and un-manicured areas near artificial nests will increase foraging habitat, and may help attract burrowing owls.

Burrowing owls are attracted to golf courses for foraging because they prefer short-grass, open areas. Golf courses across the country could play a role in helping to restore burrowing owl populations if nesting burrows were made available on local golf courses.

- *Provide burrow maintenance.* Artificial burrows require periodic maintenance because the substrate around the entrance commonly erodes. Once the tunnel entrance protrudes from the ground, young nestlings cannot retreat to the safety of the burrow. Burrows should also be cleared annually to prevent debris from plugging the entrance, which happens frequently to burrows on golf courses.

- *Ensure that burrows are not destroyed when changing course layout.* Also, consider timing of construction: owls appear to be sensitive to large-scale construction during the nesting season (March to July), and may nest elsewhere if construction is occurring nearby during the breeding season.

- *Inform golfers about your project.* Most golfers were excited at the prospect of seeing owls during a round of golf. Golfers and course staff also should know that burrowing owls may need a few years to either locate newly constructed burrows, or to increase in population size to fill the new nest sites.

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