Research *You Can Use*

Golf Courses Help Save Burrowing Owls

Golf courses can play a positive role in the conservation of this threatened species.

BY MATTHEW D. SMITH AND COURTNEY J. CONWAY

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.[1,2] They are currently listed as an endangered species in Canada and a species of national conservation concern in the United States.[3,4]

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.[6] To compensate for the shortage of natural burrows, managers and researchers often use artificial burrows to provide nesting sites for burrowing owls.[7]

Artificial burrows on golf courses had the same percent of successful nesting attempts as the other three burrow types. However, nests on golf courses produced fewer offspring per nesting attempt than nests off golf courses.

GOLF COURSES PROVIDE HABITAT

Burrowing owls typically nest and forage in short-grass open areas and avoid areas with a high density of trees, shrubs, or tall grass.[5] The characteristic large, open areas of manicured short grass on golf courses attract burrowing owls. Indeed, burrowing owls often are seen foraging and 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 may 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.,[1] effective conservation efforts should be implemented immediately to reverse declining population trends.

We examined the efficacy of installing artificial nesting burrows on golf courses as a way to help restore local burrowing owl populations.[9,10] We examined whether burrowing owls would locate and occupy artificial burrows installed on eight 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 (tendency to return to the same nesting site) of owls nesting in artificial burrows on golf courses to those nesting in natural and artificial burrows off golf courses, as well as natural burrows on golf courses.[9]

OCCUPANCY AND REPRODUCTIVE SUCCESS

We repeatedly visited each of 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

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.

	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

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.[9]

Two years after installing artificial burrows, the number of nests on golf courses increased by only one. However, the total number of 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 three burrow types. In contrast, nests on golf courses produced fewer offspring (average of 2.3) per nesting attempt than nests off golf courses (average of 3.9).[9]

FACTORS INFLUENCING OCCUPANCY

We placed artificial burrows at a variety of locations on each of our participating golf courses. Burrowing owls used 8 of the 130 artificial burrows on golf courses. Four of these eight occupied burrows were used as nests, and four were used by unpaired males. Burrowing owls used only one artificial burrow in a maintained area; the other seven 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 1).[9]

ANNUAL FIDELITY

Leg bands were placed on owls on the study site and surveys were conducted in 2001 and 2002 to locate all returning owls. We banded 74 owls in 2000, 300 owls 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).[9]

WHAT DO THESE RESULTS MEAN?

Owls did not use a great number of the artificial burrows on golf courses (8 of 130), and they only occupied artificial burrows on two of our eight participating 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 (i.e., regional) scale. Such efforts are warranted as golf courses may provide benefits for owls.

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 borrows,[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

Table 2

Mean (*0*) 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. (2005).

Landscape Feature	Unoccupied Burrows	Nest Burrows	Occupied Burrows
	0 ± SE	*0* ± SE	*0* ± 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 ($P < 0.05$).

features that cause poor success). In conclusion, some golf courses can enhance existing nesting opportunities for burrowing owls, and they subsequently may help to reverse local declines of owl populations.

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 (described below).
- *Install artificial burrows in appropriate areas.* For golf courses with nesting owls within ~0.5km of non-maintained areas, burrows should be placed in areas that have suitable owl foraging habitat, are 43 yards away from any sprinkler head, are 38 yards away from all maintained areas, and have relatively low golfer traffic.
- *Provide native habitat.* Providing areas with native vegetation and unmanicured areas near artificial nests will increase foraging habitat and may help attract burrowing owls.
- *Maintain artificial borrows.* 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.

Eight golf courses were used in south central Washington to see if burrowing owls would use artificial burrows for nesting and producing fledglings.

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