Burrowing Owl (*Speotyto cunicularia*) Monitoring and Management Activities in Manitoba, 1987-1996

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Abstract.—Monitoring of Burrowing Owl (*Speotyto cunicularia*) populations in Manitoba from 1987-1996 revealed a continuous population decline from 34 known nesting pairs to only one. Management activities are discussed including public awareness programs, reintroductions, habitat protection and provision of artificial nest burrows. Nest reuse in consecutive years ranged from 7 percent for 57 failed nests to 23 percent for 122 successful nests. Only 14 percent of unsuccessful territories were reused compared to 51 percent of successful sites. Higher nest reoccupancy rates were noted for artificial burrows (44 percent; n=27) than for natural nests (13 percent; n=152). Low return rates of banded juveniles (3.5 percent; n=538) and adults (32.7 percent; n=165) suggest that reduced survivorship may be a contributing factor to observed declines. Adult males returned more frequently (40.2 percent) than females (24.4 percent). Males were more frequently re-encountered at the same nest (51 percent) or within 1 km (94 percent) than females (33 percent and 56 percent, respectively). Average dispersal distances between years were 3.0 km for adult males (n=35) and 10.9 km for adult females (n=18). Average dispersal distances for juveniles ranged from 1-77 km, averaging 29.5 km for 9 males and 33.7 km for 9 females. Average brood size (5.1 yg/pr) and overall productivity (3.4 yg/nesting pr) appeared adequate for population maintenance.

BACKGROUND

Wildlife that inhabit North America's plains have suffered greater losses since settlement than any other group. Some prairie species have been extirpated throughout much of their range. Others like the Burrowing Owl are rapidly disappearing. This article will: (1) summarize Burrowing Owl monitoring and management efforts in Manitoba from 1987-1996; and (2) relate observed population trends to reproductive success and return rates.

Historic records of Burrowing Owl (*Speotyto cunicularia*) numbers and distribution in Manitoba are limited. The species was probably always present in extreme southwestern Manitoba. Although it was not listed in Seton's (1890) "Birds of Manitoba", this publication overlooked a number of other uncommon birds for south-western Manitoba, including the Ferruginous Hawk (*Buteo regalis*), Rough-winged Swallow (*Stelgidopteryix semipennis*), Say's Phoebe (*Sayornis saya*), Indigo Bunting (*Passerina cyanea*), Lark Bunting (*Calamospiga melanocorys*), Mountain Bluebird (*Sialia currucoides*), Lark Sparrow (*Chondestes grammacus*), Grasshopper Sparrow (*Ammodramus sanannarum*), and Nelson's Sharp-tailed Sparrow (*Ammodramus nelsoni*) (all listed as specialties in the Birder's Guide to south-western Manitoba (Cuthbert *et al*. 1990)). Some of these oversights were corrected in later publications (Seton 1893, 1908), but a shortage of observers from the extreme southwest resulted in minimal information for this region. As was the case with many of the southwestern specialties, initial Burrowing Owl reports were from south-central Manitoba (two specimens were taken near Portage la Prairie in 1897 and two more in 1899 (Seton 1908)). Indications of declines started in the late 1920's, when they were observed "becoming scarce" north of Winnipeg

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(Lawrence 1927). By the mid-1930's, the species "had greatly increased in numbers in its original stronghold in the southwest corner of the province" and it had reached its eastern limits just east of Winnipeg and north to Dauphin (Lawrence 1937). Ongoing declines since then have been attributed to habitat loss and degradation brought on by modern agricultural practices, larger farms, fields and machinery, and elimination of fence lines and waste areas (Wellicome and Haug 1995).

A mid-1970's Canadian status report prepared by Wedgwood (1978) gave an estimate of 110 nesting pairs for Manitoba. This educated guess undoubtedly under-estimated the actual population size at this time, which may have exceeded 500 nesting pairs. Limited surveys, begun in 1982 and based primarily on widespread public awareness and follow-up of reports, revealed a known population of 76 pairs (Ratcliff 1987). This number was probably still several times lower than the actual total—even with more widespread and intensive surveys, increased public awareness, audio-playback, and better knowledge on how and where to look for owls, totals during the late 1980's and 1990's were still believed to account for less than half of the actual nesting pairs (De Smet 1992a). Similar surveys in 1983 and 1984 revealed a decline to 35 known pairs and a significant range reduction (Ratcliff 1987). Thomson (1988) conducted limited monitoring in 1986 and installed 32 wooden artificial nest burrows (ANBs) in seven occupied pastures. He also prepared a provincial recovery plan which called for continued monitoring, reduced use of certain insecticides, mitigation of burrows lost to cultivation, reintroductions to supplement declining wild populations, protection of nesting sites, and more widespread public awareness and involvement.

1987-1996 SUMMARIES

Work on the present study began in 1987, when conservation efforts for Burrowing Owls and other rare, threatened and endangered grassland birds in Manitoba were integrated. Somewhat diluted Burrowing Owl surveys revealed 14 nesting pairs, 6 singles and many unsubstantiated reports (De Smet, unpubl. data). Reintroductions were started near Oak Hammock Marsh (north of Winnipeg); 16 young and 2 adults from the Owl Research and Rehabilitation Foundation (Ontario) and from roadsides near Regina (Saskatchewan) were held in preconstructed pens for 1 week, released and subsequently fed on a daily basis until natural food remains were found in the pellets (Hiltz 1987). Some critical nesting areas for Burrowing Owls and other threatened grassland species were afforded protection from cultivation and spraying via paid or voluntary 5- to 10-year leases between landowners and the Manitoba Habitat Heritage Corporation.

In 1988, two field crews conducted threatened grassland bird and Burrowing Owl monitoring and management activities. Burrowing Owl surveys were more intensive, but focused on historic nesting areas. An audio-playback technique was employed to assist in locating territorial Burrowing Owls (Haug and Didiuk 1993). Increased search effort and improved techniques resulted in 28 pairs and 6 singles being found (Haug and Churchward 1989). Releases at Oak Hammock were continued (10 yg from Ontario) and a separate release was conducted near Lyleton in extreme southwestern Manitoba (29 yg/ads from Saskatchewan).

More widespread and intensive surveys in 1989 included following up reports, checking historic areas and scanning suitable-looking sites using audio-playback (De Smet and Conrad 1989). Suitable, but previously unoccupied, sites accounted for almost half of the pairs located during this and later years, thus demonstrating the importance of combining scans of previously unoccupied pastures with surveys in historic or traditional sites. Public awareness included a mail-out of a brochure and insecticide alert, newspaper articles, year-end reports and summaries, posters, several TV and radio appearances, involvement of local interest groups and landowners, information booths, displays, tours and public presentations. Enhanced public awareness and search effort resulted in 34 pairs being found. Monitoring of reproductive success and banding efforts were also increased; a total of 109 young and 31 adults were banded with aluminum and colored plastic leg bands (these numbered bands permitted identification of returning owls without having to recapture them). To increase reporting rates on migration and the wintering areas, selected primaries of some of the young were color-marked. Notices were placed in major ornithological journals and were sent to biologists and birdwatchers throughout western North America. Totals of

23 young and 5 adults from Saskatchewan were released near Broomhill in southwest Manitoba. Wooden ANBs from 1986 were cleaned out; many had rotted and were replaced with plastic ANBs consisting of 6-inch drainage tile piping leading into a plastic pail with a short post near the entrance for perching.

Poor spring survey conditions in 1990 resulted in reduced surveys and a 44 percent reduction to 19 nesting pairs (De Smet 1991). Expanded releases included 48 yg and 4 adults from roadsides or partial families from larger broods in Saskatchewan. Eleven adults and 93 young were banded and most nesting adults were checked on an annual basis to assess banding status and return rates. Limited color-marking and widespread publicity was also employed, but this was discontinued due to few winter or migration reports (one color-marked young recovered alive in November on an oil derrick barge 20 miles off the south coast of Louisiana in the Gulf of Mexico represents the only winter or migrant report from 538 young and 94 adults from natural nests and 261 released yg/ads that were banded during this study).

In 1991 two university students began grassland bird studies in southwestern Manitoba (Davis 1994, Hellman 1994). A slight increase in nesting Burrowing Owl populations was attributed to ideal spring survey conditions (De Smet 1992a). The 23 nesting pairs included a released juvenile male from 1990. A monitoring and release program was initiated in prairie dog colonies in southwestern North Dakota. Sufficient numbers of pairs and young were located to justify relocating 50 young (partial families from larger broods) to Broomhill (De Smet *et al*. 1992). A special effort was made to contact all landowner and municipalities to notify them about nesting owls and thus lessen the chances of nest failures due to use of hazardous insecticides.

In 1992, a Natural Resources office was set up in southwest Manitoba (Melita) to facilitate endangered grassland bird management, awareness and public participation. Encouraging signs included 27 nesting pairs, five small "colonies", and a pair nesting in a 1989 ANB for the second consecutive year (De Smet 1992b). But, lowered productivity was noted due to cool, wet weather patterns that reduced food supplies (pairs were observed hunting for extended periods in sites where grasshoppers were normally abundant) and several nests were lost to badgers, including all four nests in one colony. Although adequate burrows were available, 40 additional ANBs were provided near active nests, in suitable pastures or at historic sites to lessen depredation losses. A new release technique was employed involving 16 one-year-old Burrowing Owls from Ontario; immediate success was observed as five pairs nested and one raised four young.

A slight population decline to 23 pairs was observed in 1993 despite extended mid-summer surveys (De Smet 1993). Incessant rainy, cool mid-summer weather resulted in low nesting success (30 percent) and reduced brood sizes ($\bar{X}$=3.1). Several pairs deserted clutches during late incubation and many young starved. Ultimately, less than one young was produced per nesting pair. Two separate releases were conducted with 26 one-year-olds from Ontario and the Alberta Birds of Prey Centre. Again, five nesting pairs were formed, including two wild-release pairings, but bad weather contributed to all failing. The only good news was that four wild pairs selected ANBs. To take advantage of the additional protection afforded to eggs, young and adults in ANBs, most of the other wild pairs were relocated from natural nests to ANBs using a technique originally employed in Idaho (Olenick 1990). Although nests were usually replaced during pre-laying stages, four that were replaced during early egg-laying and six during brood-rearing were all readily accepted. A total of 82 additional ANBs were provided.

A slight population decline was anticipated in 1994 due to the poor 1993 reproductive success, but the observed 65 percent decline to eight pairs was most discouraging (De Smet 1994). A brochure and information request sent to 4,000 households in southwest Manitoba resulted in only two valid sightings. Some encouragement was afforded by five of the eight pairs selecting ANBs. Two other pairs were relocated into ANBs. This, plus some supplemental feeding during wet, cool weather, resulted in excellent nest success (the eight nesting pairs produced twice as many young as had been produced by 23 pairs in 1993). Over 100 additional ANBs were provided. A total of 20 one-year-old owls from Alberta and Ontario were released. Despite a late release due to export problems, at least six pairs nested and two pairs raised young (including a two female-one male "three-some"). A native prairie/

endangered grassland bird preserve was acquired in extreme southwest Manitoba. Habitat leases were curtailed; this program, now conducted through the Critical Wildlife Habitat Program (CWHP), had resulted in a total of 67 sites (3,455 ha) being temporarily secured for threatened grassland birds. Nineteen CWHP-leased sites supported Burrowing Owls; these 19 sites harbored nearly half of the Burrowing Owls (90 pairs and 17 singles) found during this study.

As Burrowing Owl populations continued to dwindle in 1995 and 1996, monitoring and management were reduced. Surveys included checking previously-used sites, ANBs, and public reports. Four pairs were found in 1995 and only one in 1996 (De Smet 1995, 1996). Extremely low Burrowing Owl densities were also suggested by the scarcity of public reports which arose from newspaper articles, posters, information booths, public presentations and discussions with landowners. Banding of young and adults was also reduced—from 1987-1996, 87 percent of the young were banded and at least 48 percent of the nesting adults were or had been previously banded. Releases in 1995 followed a less labor-intensive technique used in British Columbia where no holding or familiarization pens were employed, but the seven 1-year-old owls all vanished overnight. In 1996, 11 owls from Ontario were released using traditional techniques; five pairs nested including a wild-release pair and threesome, but again only one pair raised young. Given the low reproductive success and poor return rates for released owls, reintroductions were discontinued.

NEST AND TERRITORY REOCCUPANCY

Early studies contended that Burrowing Owls were usually philopatric to nest sites, returning to the same nest year after year. Banding data from this and other recent studies, however, reveal that most burrows are used only once and that what appears to be returning owls are often a totally different pair (Rich 1984, Schmutz 1988, Wellicome and Haug 1995). Of 152 different nest burrows used from 1987-1995, only 26 (17 percent) were reused (including 6 that were reoccupied by unmated adults). Overall, 32 of 179 nests (18 percent) were reused in successive years. Territory reuse was also minimal as only 38 of 101 nesting locales were reused; 39 percent were reoccupied in consecutive years, but less than one-third (32 percent) were reused by nesting pairs.

Percentages that returned to successful nest sites differed from percentages returning to unsuccessful sites. Successful nests were more than three times as likely to be reoccupied the following year (28 of 122; 23 percent) than failed nests (4 of 57; 7 percent). Percentages that returned to the same territory (but not the same nest) were four times greater for successful (28 percent) than for unsuccessful nests (7 percent). Combining nest and territory returns, 51 percent of successful sites were reoccupied compared to only 14 percent of unsuccessful sites.

Preference for ANBs over natural burrows was demonstrated by the frequency with which ANBs were selected even when abundant natural burrows were available. Owls that selected ANBs were often unbanded suggesting no previous exposure to ANBs. Despite six ANBs in 1993 that failed due to weather-related causes and were not reused, the 44 percent reoccupancy rate for ANBs in consecutive years (n=27) greatly exceeded the 13 percent rate observed for natural nests (n=152). Less than 1 percent of natural nests were used for more than 2 consecutive years (one used for 3 years), as compared to 13 percent for ANBs (including one used for 4 and another for 5 years in succession). Although no failed natural nest was reused during this study, four ANBs were reused the following year and another was reoccupied 2 years after it had failed.

RETURN RATES AND MOVEMENTS

Low return rates for banded owls from 1987-1996 point to low adult and juvenile survivorship as the underlying cause of observed declines in Manitoba. Only 3.5 percent of 538 banded young from natural nests returned (11 males, 9 females). The overall return rate for banded adults was 32.7 percent; ranging from an average 40.2 percent for males (n=87) to 24.4 percent for females (n=78). Much lower return rates were recorded for released Burrowing Owls during the present study (0.6 percent for 169 juveniles; 0 percent for 18 adults, 69 one-year-olds and 9 young raised by released pairs).

Although some owls probably returned but were not found and others may have nested at

sites outside of the study area, studies conducted in a similar fashion elsewhere have noted higher return rates for young and adults. In Saskatchewan, for example, James *et al*. (in press) reported adult return rates of 37-51 percent. They noted that these return rates, which they incorrectly equated to survival rates, were much lower than survival rates for other similar-sized raptors (Newton 1979), but similar to rates for other declining Burrowing Owl populations. Adult return rates for study areas in Alberta (47-58 percent; Schmutz 1988) and for non-migratory populations in Florida (59-68 percent; Millsap and Bear 1992) and California (81 percent; Thomsen 1971) were even higher, suggesting abnormally low return rates and low year-to-year survival of adult owls from Manitoba. Clayton and Schmutz (1995) noted high juvenile mortality in Alberta; the 67 percent mortality rate recorded during the 3-month post-fledging span was similar to 70 percent mortality rates observed for the entire over-winter period in California (Thomsen 1971) and equivalent to annual mortality rates for most other small raptors (Newton 1979).

Movements of adults and juveniles from 1 year to the next complicates calculations of survival from return rates. Differences in return rates of adult males and females, for example, may be due to greater movements among females from 1 year to the next resulting in fewer females being re-encountered. Indeed, 16 percent of females had a 2 or more year interval between encounters as compared to 9 percent for males. Returning males (n=35) were also much more inclined to return to the same nest (51 percent) or to within 1 km of their previous year's nest (94 percent), compared to 33 percent and 56 percent for 18 returning females. Adults generally moved after nesting unsuccessfully, but at least three females moved 3-28 km after nesting successfully. The average distance moved by males was 3.0 km, but this was reduced to 0.2 km if a 99 km move was excluded. Females moved an average of 10.9 km. Two extra-ordinary movements are worth highlighting. A juvenile male banded in the southwest in 1988, was found nesting near Brandon (77 km away) in 1990 and returned unmated to this site in 1991; 2 years later it was re-encountered nesting in the southwest (99 km away). An adult female that was banded in 1989 returned unmated to the same site in 1990 but subsequently moved 52 km (overnight); in 1991 this female nested successfully 45 km from the latter site, and in 1992 it nested at another site 8 km away.

In contrast to adults, returning juveniles were invariably found in sites other than where they were raised. The average juvenile movement from natal sites was 32 km (n=18), ranging from 6-77 km for nine males ($\bar{X}$=29.5) and from 1-67 km ($\bar{X}$=33.7) for nine females. Not included was a 1984 juvenile male that was 120 km from its natal site when initially found in 1988 and a juvenile female from Saskatchewan that was found nesting in Manitoba (a 350 km move). No juvenile exhibited natal fidelity, whereas a study in southern Saskatchewan found that two-thirds of 24 young returned to the same pasture (James, in Haug *et al*. 1993). There was no evidence of greater natal fidelity among juvenile males as was reported in Florida (Millsap and Bear 1992) and in Alberta (Schmutz 1988).

POPULATION MODELS

Survival, productivity and dispersal data are important constituent parameters in population dynamics models. These models highlight stages in the life cycle where conservation actions may be most critical. An overly idealistic model by Thomson (1988) showed that population trends in Manitoba could be reversed given return/survival rates of 80 percent for adults and 20 percent for juveniles, productivity of 5 yg/nesting pair, and all owls mating and nesting to 4 years of age. James *et al*. (in press) used a combination of actual and derived numbers to predict extinction of Burrowing Owls near Regina, Saskatchewan, given observed productivity of 3.3 yg/nesting pair, a 37-51 percent return rate for adults and an estimated survival rate of 20 percent for juveniles.

Despite elevated brood sizes observed during the present study, overall productivity appeared barely adequate for population maintenance. Brood sizes from 1987-1996 ($\bar{X}$=5.1; n=122) exceeded those reported in most other studies, including the 2.9 to 4.9 range listed in Haug *et al*. (1993). Clayton and Schmutz (1995) suggested that reduced reproductive success may be contributing to owl declines in Alberta, presenting evidence of a significant decline in brood sizes from 5.7 in 1986 to 3.5 in 1995. Brood sizes also declined during the present study, dropping from an average 5.5 in 1987-1991 (n=88) to 4.1 in

1992-1996 (n=34), however, much of this decline was attributed to differing weather patterns during the latter period. Including failed nests, the average productivity for the present study was 3.4 yg/nesting pair—similar to that observed by James *et al*. (in press) and well within the range of 1.6-4.9 given in Haug *et al*. (1993).

Percentages of Burrowing Owls that nest are reflected by numbers of unmated owls, age of first breeding and maximum breeding age. From 1987-1996, 21 percent of the sites where Burrowing Owls were found were occupied by unmated "singles". Nesting by 1-year-olds appeared normal, especially among females. Nine returning juvenile females all nested during their first year, whereas only 36 percent of juvenile males nested (three other 1-year-old males were unmated and four were not encountered until their second year). Four banded males during the present study were at least 5 years old when last encountered; the oldest Burrowing Owl recorded in the literature was 8.5 years (Haug *et al*. 1993). Although some populations exhibit frequent mate switching (Haug *et al*. 1993), 92 percent of pairs remained together in Florida (Millsap and Bear 1992). During the present study, mate fidelity was exhibited by four banded pairs that retained the same mate from 1 year to next (one for 3 years), whereas three pairs switched mates despite having nested successfully and all returned to the previous year's nest site.

DISCUSSION

Among various limiting factors that have been blamed for Burrowing Owl declines, losses to predators, vehicles and inclement weather seem to have had the largest influence during the present study (De Smet, in prep.). There was less evidence of declines due to insecticides, shooting or to habitat loss and degradation, but these influences can be harder to detect. Although over 700 suitable nesting pastures have been identified in southwest Manitoba (De Smet 1992a), the quality of these pastures has never been examined.

Westworth and Brusnyk (1990) indicated that landowners frequently fail to report owls because they feel they might be asked to restrict agricultural practices or because of a desire to protect the owls from disturbance. Some have gone so far as to blame current declines on monitoring and management activities, insisting that pairs which do not return have left because they were disturbed and that current declines are directly related to management and public awareness activities. These arguments ignore the fact that Burrowing Owls regularly shift nesting sites, that many adults do not survive the rigours of migration and overwintering, that declines are widespread, and that these declines are not a recent phenomenon. Even unmanipulated populations like those monitored by landowners involved in Operation Burrowing Owl (OBO) are demonstrating precipitous declines. Saskatchewan OBO data for 1987-1993, for example, showed: (a) declines in 88 percent of reported sites; (b) 99 percent of the significant trends were downward; (c) disappearing populations throughout the eastern and northern periphery; and (d) numbers in core sites have dropped drastically (Hjertaas in press). Burrowing Owls show little evidence of being affected by human activities and the species is renowned for its tolerance to human activities. Some of the highest densities occur in areas of intensive development; in many areas it is more common to find nesting pairs along busy roadways and in urban parks, lawns and small farmyard pastures than in remote prairie expanses.

The decline of Burrowing Owls is not unique to Manitoba. Despite intense efforts to reverse declines over the past decade, the species is now essentially extirpated in the province. Other populations across the Canadian Prairies are also exhibiting non-reversible declines. Limiting factors show little sign of reversal. An Alberta Land Base Study, for example, indicated that 93 percent of the prime Burrowing Owl habitat in the province is suitable for agricultural expansion and predicted that much of this habitat could disappear in the next 30-50 years (Westworth and Brusnyk 1990). Unless limiting factors change, it appears inevitable that peripheral populations will continue to be extirpated and that core breeding populations throughout the northern Great Plains are in danger of becoming peripheral and eventually extirpated. Although management efforts have resulted in some local improvements, these efforts can be likened to fixing a leaking radiator—as hard as it is to find the holes, it is even more difficult to plug them before all the water drains out.

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