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DISPERSAL OF GREAT HORNED OWLS BANDED IN SASKATCHEWAN AND ALBERTA

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Abstract.—From 557 recoveries of nestling Great Horned Owls banded in Saskatchewan and 152 banded in Alberta, 176 from Saskatchewan and 51 from Alberta were recovered in an exact month >12 mo post-banding. The mean dispersal distance was 149 km (Saskatchewan, 154 km and Alberta, 131 km). For the five months, April–August, considered to best reflect natal dispersal, the mean dispersal was 75 km; separate median distances for each of these months ranged from 39 to 50 km, equivalent to the width of ten owl territories in average habitat.

I compared calendar years of peak snowshoe hare numbers, 1958–1960, 1967–1970, and 1978–1981, with intervening years of low hare density, and with 1985–1994 when no hare cycle was apparent. At times of low hare density, owls of all ages travel great distances in fall and winter in a remarkably consistent southeast direction. Median dispersal distances were 43 km in high hare years, 56.5 km in low hare years and 72 km in noncyclic years. But in high hare years the only three owls to travel >100 km went northwest or northeast, opposite to the direction in low hare years.

DISPERSIÓN DE BUBO VIRGINIANUS DENTRO DE SASKATCHEWAN Y ALBERTA

Sinopsis.—De 557 de pichones recuperados de Bubo virginianus anillados en Saskatchewan y 157 anillados en Alberta, se recuperaron 176 de Saskatchewan y 51 de Alberta al anillar exactamente a 12 meses. La distancia de dispersión promedio fué de 149 km (Saskatchewan, 154 km y Alberta, 131 km). Para los cinco meses entre abril y agosto, considerados como los que mejor reflejan la dispersión natal, la dispersión fué de 75 km; distancias de separación media para cada uno de esos meses varió entre 39 y 50 km, equivalente al ancho de diez territorios de la especie en habitat promedio.

He comparado los años calendarios de años de mayor población de *Lepus americanus,* 1958–1960, 1967–1970 y 1978–1981, con integración de años de poca población de *Lepus americanus* y con el período de 1985–1994 cuando no se deternino un ciclo de *Lepus americanus* fué aparente. En períodos de baja densidad de *Lepus americanus, Bubo virginianus* de todas las edades viajaron grandes distancias en otoño e invierno con una dirección sudoriental notablemente consistente. Las distancias de dispersión promedio fué de 43 km en años de mucha población de *Lepus americanus,* de 56.5 en años de poca población de *Lepus americanus,* y de 72 km en años no-cíclicos. Sin embargo, en los años de mucha población de *Bubo virginianus,* los únicos tres *Bubo virginianus* en volar >100 km fueron al noreste o al noroeste, opuesta a la dirección en años de baja población en *Lepus americanus.*

In the Canadian prairie provinces, nesting productivity of the Great Horned Owl (*Bubo virginianus*) varies with the ten-year cycle of the snowshoe hare, *Lepus americanus* (Houston 1987, Houston and Francis 1995). In years when hares are in short supply, substantial numbers of owls of all ages move, in a remarkably consistent southeast direction, as far as Nebraska, Kansas, and Iowa (Houston 1975), a pattern of irregular migration not reported among Great Horned Owls elsewhere on the continent (Houston et al. 1998). Are these irregular migrations predominantly during years of low hare production, as seen with the Northern

Goshawk (*Accipiter gentilis*) (Mueller et al. 1977)? Do such movements affect philopatry?

Although there are few comparable samples for natal dispersal in other North American owl species (see below), three items of evidence seemed to support my hypothesis that, in Saskatchewan and Alberta, natal dispersal distances of Great Horned Owls may be substantial or, conversely, that philopatry in this species may be less pronounced. First, in annual visits to owl nests in Saskatchewan, I have attempted to discern whether a band is visible on the tarsus of any adult that perched within 3 or 4 m of the bander (bands tend to be hidden among the thick feathers of the tarsus, and often might be missed by binocular sightings from the ground at a distance of 10 m). An unrecorded number of close looks with the naked eye as close as 1 m has allowed me to be certain that most adult female owls were not wearing a band; only once during banding visits to 3143 successful nests over 40 years did I see a band on an adult owl. Such negative results were meaningful in three Saskatchewan localities, Strasbourg, Yellow Creek, and Kelliher, where in the peak year, 1981, there were maxima of 13, 12, and 11 successful nests, respectively. In each of these three areas (of one to two 93 km^2 townships) half or more of the nestlings were banded each year for 25 years (in other banding areas, nest finding was less consistent). Second, Chris Danilson (1998) studied post-fledging ecology of Great Horned Owl families in the township near Strasbourg, Saskatchewan, mentioned above; all 11 adult owls he captured were unbanded. Finally, near Edmonton, Alberta, E. Pletz (pers. comm.) has banded 1172 nestlings, and has netted 93 adult owls when they swooped near him in defense of occupied nests; only two of these 93 adults had been banded as nestlings.

I undertook to test my hypothesis by analysis of Canadian band recoveries 13–36 and ≥37 mo after nestlings were banded (bands were applied at age 2–6 wk). I was interested particularly in natal dispersal, the distance from natal site to breeding site (Greenwood 1980), but tested for all months of the year. Of eight assumptions in banding analyses, the first and most important is that the banded sample, in this instance of nestlings, is representative of the population at interest (Houston and Francis 1993). In Saskatchewan, Great Horned Owls are known to hoot on territory in February, lay eggs in March, fledge young in late May or early June, and continue supplemental feeding of young into autumn (Houston et al. 1998). Because some females, at least, breed when 11–12 mo of age (Houston et al. 1998), I studied recoveries of owls 13 mo and more after banding.

METHODS

The banding office provided computerized data on 961 Canadian banding recoveries for 953 individual Great Horned Owls recovered through 1994. Ten, though recovered in Canada, had been banded in the USA: three in North Dakota, two each in New York, Michigan, and Minnesota, and one in New Hampshire. Of the Canadian owls recovered, 1 had been banded in New Brunswick, 3 in Nova Scotia, 6 in British Columbia, 9 in Manitoba, 126 in Ontario, 221 in Alberta, and 568 in Saskatchewan. Age at banding was unknown for 41; the now-obsolete designations of immature and juvenile were recorded for 52 and 8, respectively, and 116 were adults, some of which were banded after treatment in rehabilitation facilities in Ontario.

Locals are by definition flightless owls 8 wk of age or less. My analysis was restricted to the 736 recoveries of flightless young, banded as age class "04, local." Of these recoveries, the great majority had been banded in Saskatchewan (I had banded 503 of the 557) and in Alberta (152).

Banding and recovery locations are each reported within a rectangular 10-minute block of latitude and longitude (about 11 km from east to west and nearly 18 km from north to south). A computer program was used to calculate distance between the center of the 10-minute block where the nestling was banded and the center of the 10-minute block where it was recovered, as well as months elapsed from banding to recovery. Recoveries during 0–12 months after banding were excluded. Calculations were made after the following exclusions: individuals with how found code 50 (skeleton, $n = 9$), code 56 (obtained, $n = 3$), and code 98 (band only, $n = 6$). Because dispersal distances are not evenly distributed and a few extreme dispersers may skew (inflate) the results, I calculated median as well as mean distances for each month.

Contact with band finders gave, for owls >1 yr, a more accurate date of death for 12, a more precise cause of death for 39, and corrected the 10-minute block of latitude for 10 and of longitude for 14 (see Houston and Francis 1993). Three owls recovered in May, one in June, and one in September were severely decomposed when found, dead for a month or more before the date of band report; these were also excluded. Two inexact locations, for a one-degree block of latitude and longitude, were assumed to be near the middle of that block.

Only from Saskatchewan (181) and Alberta (51) were there sufficient numbers of owls recovered after 12 months; these included 97 from Saskatchewan and 20 from Alberta ≥37 months. All were unsexed. I excluded five Saskatchewan owls from the monthly calculations, where the recovery gave only a season and not an exact month, including Figure 1 and the first three paragraphs of results, but these five owls were used for the hare-year comparisons in Fig. 2. I looked at both age groups and both provinces separately. Finally, I looked at the special situation of owls recovered in high hare years (1958–1960, 1967–1970, and 1978–1981; Houston and Francis 1995) versus low hare years and 1985–1994 when hares were noncyclic, without major population fluctuations.

I assumed that many or most Great Horned Owls ≥13 mo of age, recovered between April and August, were at or near their potential breeding site. Allowing for a time lag between an owl death and its finding, and recognizing at least three months of supplemental feeding of young by adults after fledging, I chose recoveries from April–August to best indicate natal dispersal distance. Because some owls 13–36 mo post-banding

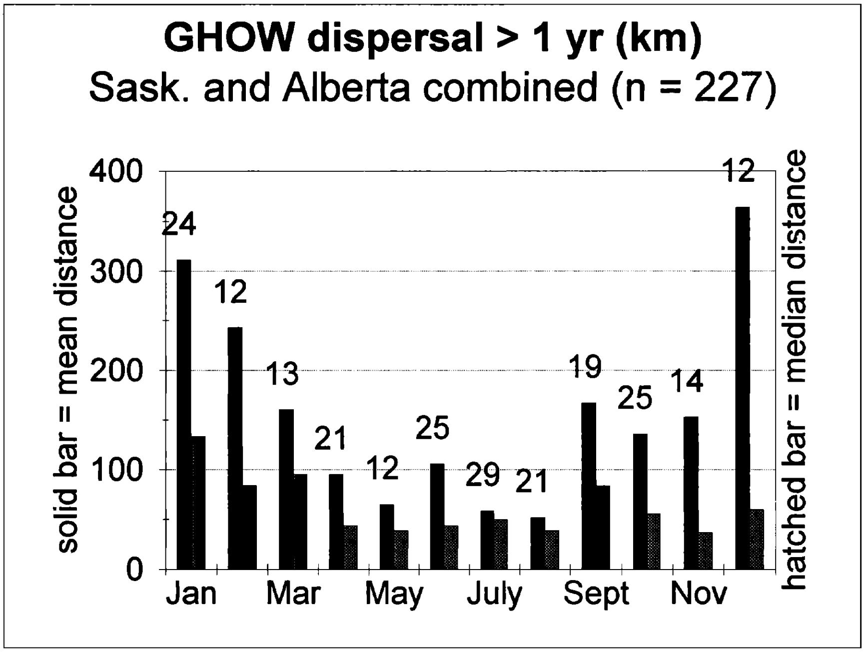

FIGURE 1. Great Horned Owl dispersal >1 yr, in kilometers, Saskatchewan and Alberta combined (n = 227). Solid bar indicates mean distance; hatched bar, median distance.

would not have reached breeding age, I analyzed them separately from those ≥37 mo post-banding.

Finally, to test the possibility of less movement in the years when prey was plentiful, I compared dispersal distances from recoveries during calendar years of peak snowshoe hare numbers, 1958–1960, 1967–1970, and 1978–1981 (Houston and Francis 1995), and compared these with recoveries from low hare years and from 1985–1994, when no hare cycle was apparent. I used a Wilcoxon rank sum test (non-parametric), because of the skewness of the data.

RESULTS

Because results were similar when Alberta and Saskatchewan owls were analyzed separately, owls from the two provinces were lumped together. Mean dispersal was 148 km for owls recovered 13–36 mo post-banding, with a mean for April through August of 66 km. Mean dispersal was 150 km for owls ≥37 mo post-banding, and from April through August was 89 km. Median monthly distances for owls recovered April–August ranged from 34–73 km for 13–36-mo owls and from 22–71 km for the ≥37-mo owls (Table 1). These two age groups have been combined in Figure 1.

Seasonal changes in distance of dispersal from Saskatchewan and Alberta natal sites were similar. Mean dispersal for owls at 13–36 and ≥37

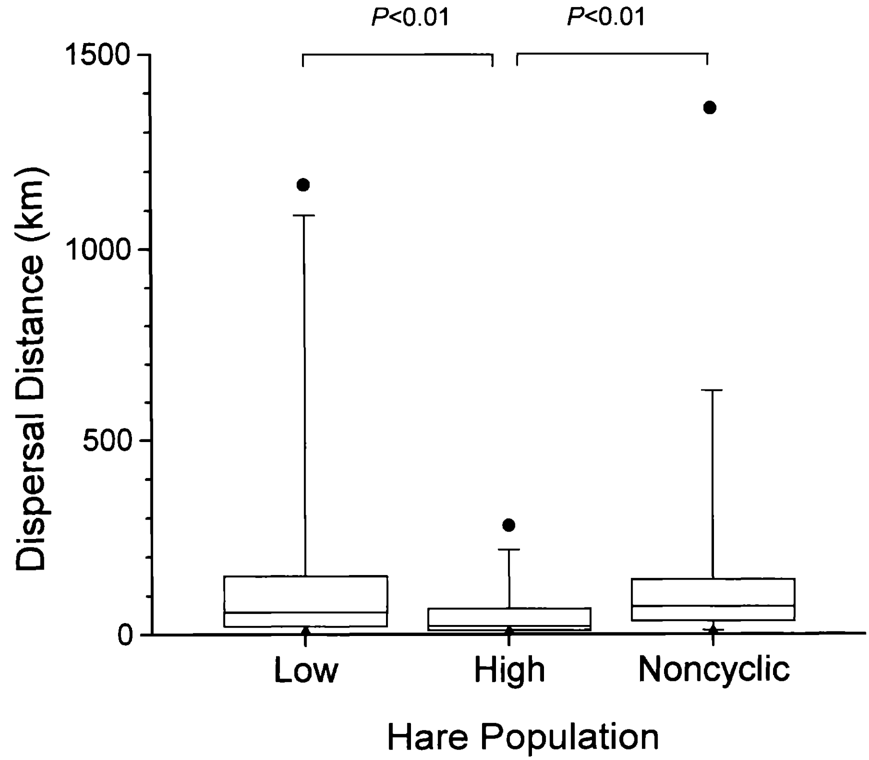

FIGURE 2. Dispersal distance of Great Horned Owls >1 yr in years of low hare population (1957; 1961–1966, 1971–1977 and 1982–1984), high hare years (1958–1960, 1967–1970, 1978–1981), and noncyclic hare years (1985–1994). The box-whisker plot is a modified bar graph showing minimum and maximum values (dots), the 5th and 95th percentiles (ends of the whiskers), the 25th and 75th percentiles (tops and bottoms of the boxes), and the median or 50th percentile (line through the middle of the box).

mo after banding, respectively, was 407 and 279 km in December and 263 and 335 km in January. Median distances for the same two age groups, respectively, were 42 and 78 km in December and 118 and 133 km in January (Table 1, Fig. 1). Combining the two age groups ≥13 mo, recovered owls moved a mean of 364 km from their natal site in December (n = 12) and 301 km in January (n = 24).

Combining all recoveries ≥13 mo, only 15 of 174 (9%) banded in Saskatchewan and 3 of 51 owls (6%) banded in Alberta were recovered in the same 10-minute block where the owls were raised, and only an additional 13% banded in Saskatchewan and 10% banded in Alberta were recovered in any of the four contiguous 10-minute blocks, north, south, east or west of the banding block.

Median dispersal distance, a more useful measure than mean dispersal (because of the skewed distribution, Greenwood and Harvey 1982) dif-

TABLE 1. Dispersal (km) of nestling Great Horned Owls (unsexed) banded in Alberta and Saskatchewan.

	Recovered 13–36 mo after banding				Recovered ≥37 mo after banding			
	n	Range	Mean	Median	n	Range	Mean	Median
Jan	8	0–1195	263	118	16	11–1151	335	133
Feb	7	75–1093	392	195	5	0–93	34	23
Mar	6	23–279	104	73	7	10–628	208	106
Apr	10	12–142	71	73	11	0–954	117	22
May	8	11–259	69	37	4	0–150	57	39
Jun	15	0–660	88	43	10	19–583	132	56
Jul	17	0–168	53	45	12	0–196	67	71
Aug	13	0–141	54	34	8	11–118	48	43
Sep	13	0–777	183	84	6	0–339	131	64
Oct	19	0–492	121	51	6	39–677	182	90
Nov	8	11–1167	242	67	6	0–95	35	30
Dec	8	12–1360	407	42	4	0–959	279	78
	132		148		95		150	

fered significantly between high and low hare years ($P < 0.01$, Wilcoxon rank sum test) and also between high and noncyclic hare years ($P < 0.01$, Fig. 2). Median distances were 43 km in high hare years (n = 43), 56.5 km in low hare years (n = 100), and 72 km in noncyclic years (n = 89). Only three owls recovered in high hare years moved more than 100 km; not one of them moved southeast (280 km northeast at 40 mo post-banding in September, 224 km northwest at 29 mo post-banding in October, 118 km northwest at 123 months in August). Owls recovered in high hare years, 13–36 mo post-banding (n = 34) went a mean distance of 41 km and median distance of 22 km, and those ≥37 mo (n = 8) went mean and median distances of 76 km and 48 km, respectively.

Of 126 Great Horned Owl recoveries, from birds banded in Ontario, only 18 (14%) were banded as "locals", whereas in Saskatchewan 557 of 568 recoveries (98%) were banded as locals. Of 18 recoveries of Great Horned Owls banded as locals in Ontario, eight were recovered in the same 10-minute block of latitude and longitude and two others dispersed for 5 and 403 km, the latter in January; Ontario dispersal averaged 62 km for the eight recovered >12 mo.

DISCUSSION

There was little difference in dispersal distances between owls banded in Saskatchewan and Alberta, nor between owls 13–36 mo post-banding and those ≥37 mo post-banding. There was no correlation, positive or negative, between age and dispersal distance. Between April and August, mean dispersal distance varied from 54 to 71 km and median dispersal distances for these five months varied from 22 to 73 km.

In low hare years, great distances were travelled in winter by owls of all ages, with a rather similar distance pattern for both 13–36-mo and ≥37-

mo adults. It is unknown whether these adults had been territorial or non-territorial in summer, but it is apparent that extensive wandering in search of food occurs in winter in years of prey shortage. In high hare years, the results were entirely different: only three owls were recovered >100 km from the banding site and these had gone in a northerly direction, opposite to the direction of movement in low hare years.

Little is known about philopatry in most North American owl species. In Montana 11 male, but no female, Long-eared Owl (*Asio otus*) nestlings returned to nest within or adjacent to their natal home range in a subsequent year (Marks et al. 1994; Denver W. Holt, pers. comm.). In a local population of Burrowing Owls on a 35.9-km^2 urban study area in Florida (Millsap and Bear 1997), if one can assume that no out-migration occurred, median natal dispersal distance for females was 1116 m (n = 31) and for males, 414 m (n = 28). Near-ideal data for natal dispersal of other owl species are available only from Europe. Korpimäki and Lagerström (1988) recaptured 41 Tengmalm's Owls (*Aegolius funereus*) of unequivocal breeding status at their nest holes in Finland, at a mean distance of 55–70 km and a median distance of 30–56 km from their nest of origin. In North America the best study known to me is Rohner's (1996) in the Yukon, using radio-tagged young Great Horned Owls; he found that 37% of monitored dispersers settled as territorial birds or floaters within the monitoring distance of 35 km.

This study confirms that Great Horned Owls from Saskatchewan and Alberta move farther than those from Ohio (Houston 1975, Holt 1996), and probably farther than those from Ontario. Owls from western Canada travel greater distances at times of low hare density. This data set cannot differentiate between dispersal and cyclical irruption, nor between breeding owls and floaters (Rohner 1996). The lower mean and median distances from April through September argue strongly against the possibility that any appreciable number of individuals involved in irregular migrations may stay at distant sites to breed.

In summary, using median rather than mean distances, and keeping in mind the size of this owl and its territory, I found little support for my hypothesis that natal dispersal is unexpectedly large in Great Horned Owls. Nest density in the best Saskatchewan parkland habitat is one pair per 5 km^2 but elsewhere in the province there may only be one or two pairs in a 93 km^2 township (Houston et al. 1998). A dispersal of 35–100 km from natal site to breeding site would often represent dispersal across only ten home ranges, entirely normal for many species of birds and within the definition of philopatry (Greenwood and Harvey 1982). If direction of dispersal from the natal area to the new breeding area is random, and as much as 100 km, then an individual owl has a choice of (πr^2) 31,416 km^2; hence in parkland there could be up to 6286 owl territories within easy range of dispersal. It is no wonder then that the chance of an individual owl at a given nest already having a band is not large.

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