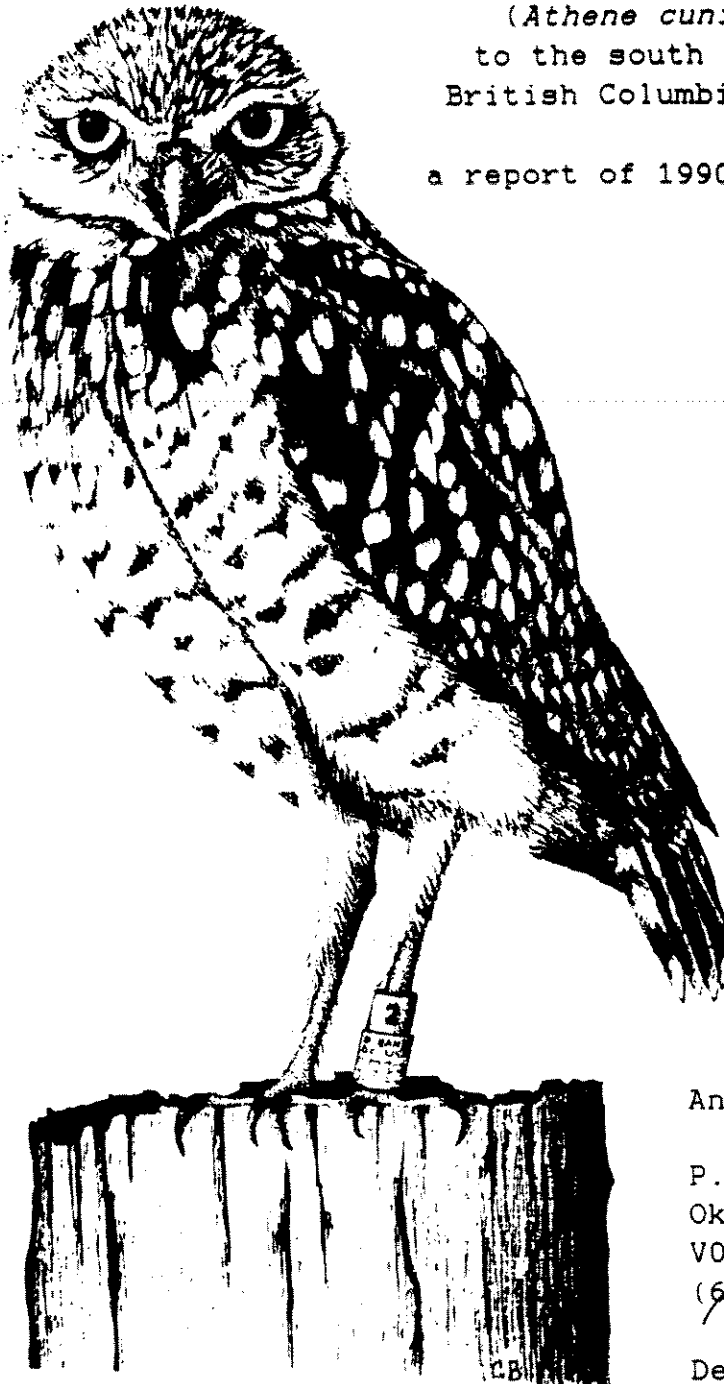


FINAL REPORT

Reintroduction of Burrowing Owls
(*Athene cunicularia*)
to the south Okanagan,
British Columbia, Canada:
a report of 1990 activities



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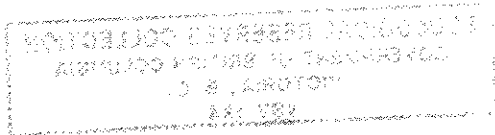
ABSTRACT

Reintroduction of burrowing owls (*Athene cunicularia*) to the south Okanagan continued in 1990. Sixteen adults and 79 young were captured in Washington State; all adults and 62 young were released at Osoyoos. Fledging success of transplanted families (30/62 owlets=48%) was not significantly different from previous years. However, large numbers of owls at Osoyoos, combined with limited manpower, made it difficult to record all fledged birds.

At least 25 owls returned to Osoyoos on their own, including two unbanded females, and one male released as a yearling near Kamloops in 1989. Returned pairs made nine breeding attempts and fledged a minimum of 21 young. In addition, one transplanted female mated with a returned male and produced a second clutch of four. Two nest-attempts by returned pairs were unsuccessful; predation accounted for one, and eggs were abandoned at another. One returned female did not attempt to nest, and at least three territorial males did not attract mates.

Data from 1985-1990 indicate that returned pairs fledge significantly fewer young than transplanted families (2.5 young/pair and 5.3 young/pair respectively). Returned owls select burrows as far distant from other pairs as possible given available burrows; pairs attempting to nest <100 metres from their nearest neighbour show significantly reduced fledging success (0.5 young/pair and 2.6 young/pair respectively). Low female return rate is limiting the reintroduced population. This may be the result of limited habitat (territory) availability.

Further work is needed on habitat identification, monitoring of returned birds, prey availability, and provision of steady supplies of funds and owls for continued releases.



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Funding was provided by the B.C. Habitat Conservation Fund (HCF) and administered through the Okanagan Region Wildlife Heritage Fund Society. Pipe for artificial burrows was generously donated by the Big "O" Corporation of Abbotsford. C. Bryant drew the pen-and-ink owl.

INTRODUCTION

Burrowing owls (*Athene cunicularia*) historically bred in arid grasslands of British Columbia north to Kamloops, east to Cranbrook and west to Princeton. Winter records exist for Vancouver, Vancouver Island and the lower mainland; there is some suspicion that owls have bred there as well (Bryant 1990). The highest density of breeding owls in B.C. probably occurred in the Okanagan region (Howie 1980).

Burrowing owls were listed as endangered by the province of British Columbia in 1980 (Munro *et al.* 1984). Dunbar (1983) designed a preliminary recovery plan, with a target population of ten breeding pairs to be achieved by 1990. A provincial Burrowing Owl Recovery Team was formed in early 1990; an updated recovery plan is in preparation.

This report describes results of the 1990 reintroduction in the south Okanagan.

Prior recovery efforts

In 1983, one family of burrowing owls (2 adults and 9 young) was captured in Washington State, transported north, and released on property managed by the Canadian Wildlife Service (CWS) on the west side of Vaseux Lake. At least 6 of 9 young (67%) fledged successfully (Baird 1984).

In 1984, three families (5 adults and 24 young) were captured in Washington State and released at Vaseux Lake. A total of 20/24 young (83%) fledged (Baird 1984).

In 1985, five families (10 adults and 46 young) were captured in Washington State. Five owlets died in transit; the remainder (10 adults and 41 young) were released at a new site (managed as a grazing lease by the Ministry of Forests) at the north end of Osoyoos Lake. At least 38/41 young (92%) fledged (Turner 1985).

In 1986, no transplant was carried out. However, two pairs returned to the Osoyoos site and fledged 1 young each. These birds are assumed to have originated from the 1985 transplant (Morgan 1988).

In 1987, five families (10 adults and 41 young and 4 eggs) were transplanted to Osoyoos Lake. At least 30/41 young fledged (73%). Young at one burrow were lost (probably to a predator). Two siblings originally released as juveniles in 1985 returned on their own and fledged 4 young (Morgan 1988).

In 1988, ten families (20 adults and 95 young) were released at the Osoyoos site. At least 65/95 young (68%) fledged successfully. Three pairs of owls returned on their own; two pairs bred and fledged 6 young (Leung 1988).

In 1989, ten families (20 adults and 78 young) were captured in Washington State; all adults and 75 young were released at the Osoyoos site. At least 57/75 (76%) young fledged. One adult was killed after becoming entangled in a habituation net, another was injured, and four others were entangled but released without injury. One family was lost to predation and starvation. At least 16 owls returned to Osoyoos, made four breeding attempts and fledged a minimum of 13 young.

Study Objectives

In addition to the transplant, this project was designed to test several hypotheses concerning burrowing owl ecology, suitability of potential B.C. reintroduction sites, and efficacy of current transplant methods. Specific objectives were to:

- 1) determine if reproductive rates of Washington State owls have remained stable from year-to-year.
- 2) determine if returning owls are density-dependent; i.e., whether nests close together are less successful than those farther apart.
- 3) determine if productivity of transplanted birds is different from that of birds returning on their own.
- 4) determine small mammal prey availability at actual and potential release sites.

METHODS

Project timing

Observations began at Osoyoos on March 1st. Nineteen observation-days were spent, on a volunteer basis, prior to the "official" May 15th project start; these provided early-spring observations of territoriality, burrow use and pair formation. Observations continued through August 31st.

Release sites

Six artificial burrows were installed on Lot 953 (hereafter called the "white" section), approximately three kilometres north of the primary release site at the north end of Osoyoos Lake. Two burrows were installed in the Osoyoos Lake Ecological Reserve ("red section"). Ten habituation pens (Leung 1988) were installed at orange #3 and #8, at red #3 and #4, and at white #1-6. All pens were in place by May 22nd. Existing artificial burrows were not excavated or cleaned this spring.

Transplant methods

Adult owls were captured, as in previous years, by placement of 7"x7"x24" Havahart live-traps (Havahart Corporation, Littitz, Pennsylvania) at burrow entrances (Turner 1985). Young were excavated from artificial or natural burrows.

After capture, owls were taken to the Broadway Veterinary Clinic in Moses Lake, where they were examined and dusted with flea powder (Mycodex), and where the "Certificate for Poultry or Hatchling Eggs for Export" (U.S. Department of Agriculture) was signed. Captured owls travelled north by Landcruiser, BCMOE station wagon or extended crew-cab pickup. No delays were encountered at the border in 1990.

Owls were banded with standard #4 aluminum U.S. Fish and Wildlife Service bands (USFWS, Washington, D.C.). In addition, adults and young were colour-banded with plastic "wrap-around" bands (National Band and Tag Company, Newport, Kentucky) placed above the USFW band. Adults were given red bands and young were given blue. All 1990 bands were placed on the right leg.

Several transplanted, and all returned families were recaptured in June to estimate juvenile survivorship, and to band young owls that had been too small to band at time of initial capture. Band numbers of all burrowing owls released in the Okanagan are included as Appendix III.

Feeding

As in past years, transplanted burrowing owls were fed daily. Food consisted of day-old chicks ("mink food", Esaw Enterprises, Abbotsford) which were left at the entrances of

burrows. Numbers of chicks were adjusted daily depending on how many were left uneaten from the previous day (Morgan 1988). The feeding program was ended after juveniles had fledged (July 15th).

Density-dependence

Green (1986) and Green and Anthony (1989) suggest that burrowing owls are density-dependent; specifically, that owl nests within 100 metres of their nearest neighbour are likely to be abandoned. I tested this hypothesis by monitoring early-spring territorial behavior and movements, together with reproductive success. To facilitate this all burrows were mapped, and between-burrow distances were measured with compass and a 100 metre tape.

Small mammal availability

A 12 x 12 grid of Sherman #1 live-traps, spaced 15.2 metres apart, was used to estimate small mammal availability at three sites (Osoyoos, White Lake and Lot 953). The 1990 White Lake grid was located 600 metres southwest of the 1989 grid; the Osoyoos location was identical in both years. Traps were baited with bird seed (millet and sunflower seeds). Species identification was made using a dichotomous key (see Bryant 1989) based on Banfield (1974), McTaggart-Cowan and Guiget (1972), Burt and Grossenheider (1977) and Forsyth (1985). Small mammals were marked with "orange-red"

or "chartreuse" pigments (Radiant Color, Richmond, Ca.). Trapping at all sites took place on three consecutive evenings under similar weather conditions. Catch-per-unit-effort statistics were used to assess small mammal abundance (Brewer and McCann 1982).

Statistics

Statistical procedures follow Zar (1974). Test statistics were performed using QUATTRO (Borland Inc. 1988) on an IBM-compatible microcomputer. Significance of results was assessed at the 95% confidence level.

RESULTS

Returned owls

At least 25 burrowing owls returned to Osoyoos on their own in 1990. The relationship between total numbers of owls "released" and "returned" at Osoyoos from 1985 through 1990 is shown as Figure 1.

First birds-of-the-year in 1990 were seen on March 18th at purple #3 (AB and CB). At least nine owls were present on March 26th, and by April 10th there were at least 15 (AB). Four pairs apparently returned already pair-bonded (at purple #3, blue #1, yellow #1 and orange #2); respective dates-of-first-observation were March 18th, April 10th, April 10th and June 2nd (AB). Other pairs were apparently comprised of single birds which formed pairs after arrival. This was particularly obvious at purple #1, orange #5 and green #1, at which males were extremely vocal.

Twenty-five confirmed owls at Osoyoos included 23 banded and two unbanded birds (Table 1). Reports of a solitary owl on Highway 97 two km south of Penticton (CB), one at Keremeos (OD) and "several" singing males east of the release sites (D. Cleave Osoyoos resident, pers. com.) should not be discounted. As numbers of owls increase, monitoring becomes less of a "census", and more of a "sampling" exercise. Results presented here should be interpreted in that light. My personal estimate of owls returned to Osoyoos in 1990 is closer to 30 than 25.

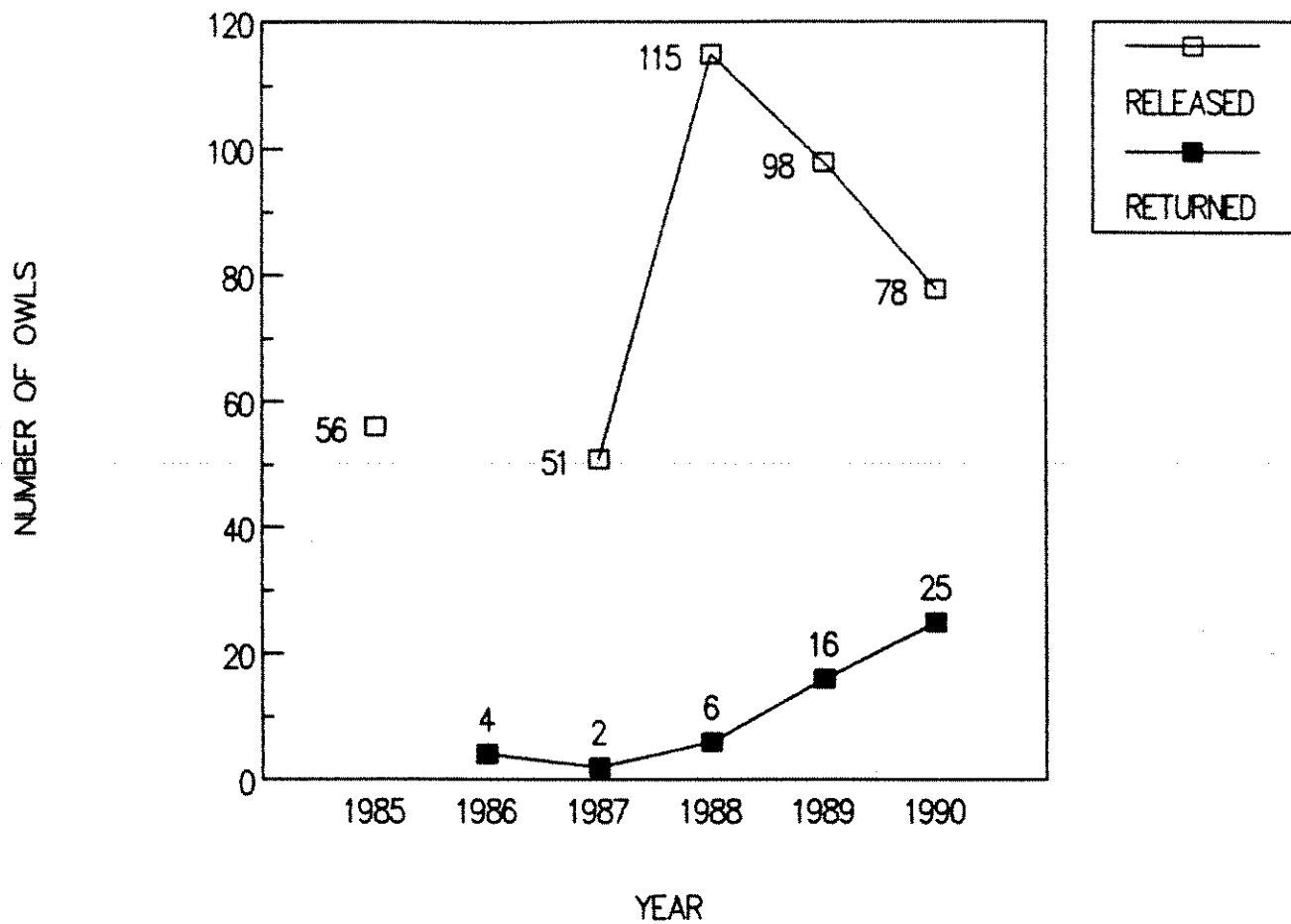


Figure 1: Total numbers of owls released and returned to Osoyoos, 1985-1990. Data include both young and adults. No release occurred in 1986.

Table 1: Band numbers and age of returned owls in 1990.

#	Site	Sex	Band #	Leg	Age	Reproduction
1.	Purple #1	m	614-79945	l	1	6 owlets
2.	" " "	f	614-79861	l	2	
3.	Purple #2	m	614-79837	l	2	2 owlets ^a
4.	" " "	f	UNBANDED		?	
5.	Purple #3	m	614-79952	l	2+	unsuccessful ^b
6.	" " "	f	614-79813	l	2	
7.	Blue #1	m	614-79902	r	2+	3 owlets
8.	" " "	f	614-79984	r	1	
9.	Blue #4	m	614-65161	l	2	4 owlets
10.	" " "	f	614-79894	r	1	
11.	Yellow #1	m	614-65180	r	3	2 owlets
12.	" " "	f	614-79836	l	2	
13.	Green #1	m	614-79987	r	1	2 owlets
14.	" " "	f	614-79908	r	1	
15.	Orange #2	m	614-65092	r	2	6 owlets ^c
16.	" " "	f	UNBANDED			
17.	Orange #5	m	614-79928	r	1	unsuccessful ^d
18.	" " "	f	614-79957	r	1	
19.	White #3	m	614-79893	r	2	4 owlets ^e
20.	Purple #1	m	614-79949	r	1	disappeared
21.	Purple #1a	m	614-79992	r	1	disappeared
22.	Purple #4	m	614-79876	l	2	single male
23.	Green	m	614-79924	r	1	single male
24.	Yellow #3	m	614-79977	l	2	did not pair-bond?
25.	" " "	f	614-79834	l	2	" " " "

^a Predation. Remains of one owlet and eggs found when excavated.

Two unbanded juveniles later observed. Both adults disappeared.

^b Predation. Remains of at least 2 owlets found.

^c Very late nest. Only two owlets known to have "fledged" (both now in the Kamloops Wildlife Park).

^d Seven eggs found abandoned. Both adults disappeared.

^e Originally territorial at yellow #3 site. Eventually mated with "double-clutch" transplanted female (614-79998) at white #3.

Of 25 confirmed owls, 10 (40%) were female, including four yearlings, four two-year-olds, and two unbanded birds (at purple #2 and orange #2). Of 15 males, seven were yearlings, four were two-year-olds, and one was a known three-year-old. In addition, two returned males (614-79902 and 614-79952) were transplanted as adults in 1989, making them at least two-year-olds. Another known two-year-old (614-65092) was captive-bred in Vineland, Ontario, and released as a yearling near Kamloops in 1989 (D. Jury, BCMOE Kamloops, pers. com.).

From 1985 through 1990, a minimum of 29 banded owls returned to the Osoyoos area, for a total number of 39 "return-records". These totals do not include unbanded birds, unidentified banded birds, or the Kamloops-released bird. Three females and six males are known to have returned more than once; the record for persistence is currently held by male 614-65180, a three-year-old which returned in 1988, 1989 and 1990, pairing with a different female each time. Age and sex-structure of all return-records at Osoyoos is shown in Figure 2. Band-numbers of burrowing owls released in the south Okanagan from 1983-1990 are listed in Appendix III; band-numbers of returned birds recorded at Osoyoos are given in Appendix IV.

Transplanted owls

A total of 62 young and 16 adults were released at Osoyoos in 1990. Table 2 provides a summary of owls captured, transported and released.

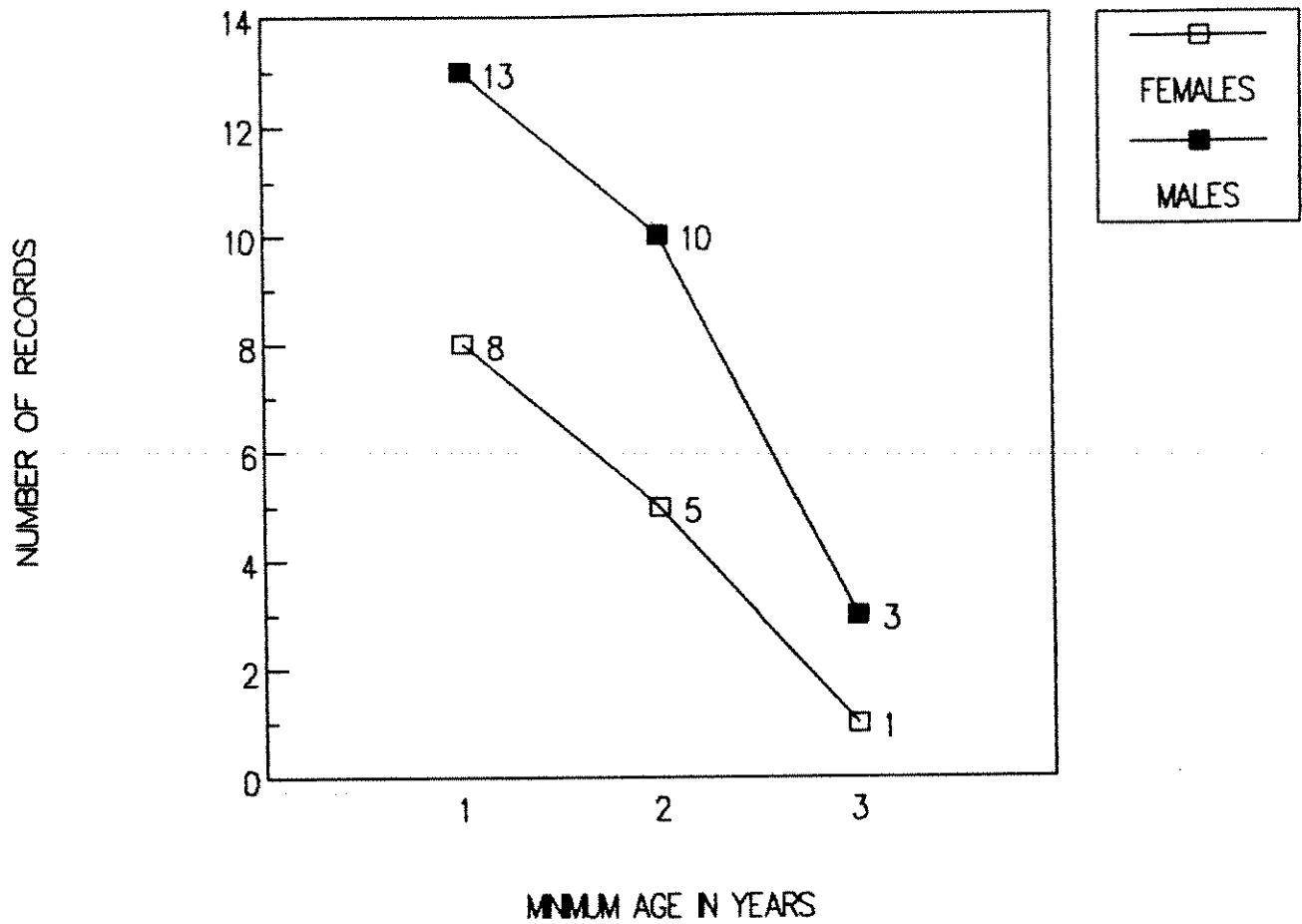


Figure 2: Sex and age-structure of banded owls returned to the Osoyoos area, 1985-1990. Data are return-records, not individuals. Three females and six males have returned more than once.

TABLE 2: Transplant summary, 1990

#	DATE ^a	SITE	MALE #	FEMALE #	SIZE ^b	ALIVE ^c
1.	24/05	Frenchman#4	----- ^d	614-80000	10	10
2.	" "	Frenchman#12	614-79995	614-79996	9	9
3.	" "	Frenchman#16	614-86535	614-86536	7 ^b	3
4.	25/05	Oingo Boingo	614-86548	614-86547	11	10
5.	" "	Frenchman #7	----- ^d	614-86537	9	9
6.	24/05	Moses Airport	614-79997	614-79998	5	0
7.	" "	Sugar Mill	----- ^d	----- ^d	11	2
8.	31/05	Tri-City West	614-86569	614-86570	9	9
9.	" "	Tri-City East	614-86572	614-86571	6	6
10.	30/05	Russell Road	614-86555	----- ^e	4	4
TOTALS:			7	9	81	62

Notes:

^a date of entry into Canada.^b brood size excluding eggs. Two owlets were found dead.^c at time of release in Osoyoos.^d adult not captured.^e female 614-79901 was captured at the identical site in 1989.

Despite cold, wet weather, lack of a confirmed CITES permit, and incomplete burrow installation at release sites, a BCMOE trapping crew (BL, MS and OD) travelled south on Monday, May 22nd. CITES approval was obtained upon arrival. On the evening of May 23rd, OD and MS trapped Frenchman #1 adults; five young and four eggs were found in this burrow on the morning of May 24th. Adults were released immediately; no young were taken from this nest. Similarly, only one adult was captured from Frenchman #14; this burrow was not excavated and the adult was released (OD).

During the same (May 23rd/24th) trapping session, one female and ten owlets from Frenchman #4, both adults and nine owlets from Frenchman #12, and both adults and seven owlets from Frenchman #16 were taken. At the latter burrow, two young were found dead (apparently from hypothermia), five were taken and four were banded. The unbanded bird died on the night of May 24th (OD).

On the evening of May 23rd, BL excavated five young from "Airport", after capturing both adults. All five owlets died that night, presumably from hypothermia. On the morning of the 24th, BL excavated 11 young from "Sugar-mill" to cross-foster with the remaining "Airport" adults (BL).

Four families (Frenchman #4, #12, #16 and Airport/Sugar-mill) were transferred from OD to AB at Bridgeport. Transport was accompanied by extensive mortality, including loss of an additional owlet from Frenchman #16, and death of 9/11 owlets from Sugar-mill. The latter was particularly

distressing, as Sugar-mill owlets were large and apparently healthy when captured. Unfortunately they were transported in a small box with minimal ventilation; nine were found dead south of Oroville when the box was checked. Remaining owls from Frenchman #4, #12 and #16 were released at white #5, #4 and #2 respectively (AB and AH).

On the evening of the 24th, OD captured the female and excavated nine young from Frenchman #7. Also on the 24th, BL and MS captured both adults and 11 young from Oingo Boingo. These birds were transported by OD and released at white #6 and #7 respectively on May 25th. One owlet from Oingo Boingo died in transit (BL and MS).

On May 28th, AB and W. Lamphier (volunteer) arrived in Ephrata; trapping was postponed due to rain. On the evening of May 29th, AB and WL captured one adult at Othello Orchard. The 2nd adult was not captured; the burrow was not excavated. On the same evening, R. Friesz and B. Cole (WDW personnel) captured adults from Russell Road and transferred them to AB and WL. Curiously, the adult female (614-79901) found at Russell Road had been captured at the identical location in Washington, and released at Osoyoos in 1989. AB and WL excavated four young from Russell Road on the morning of the 24th. These birds were picked up by OD at Dry Falls, transported north and released at orange #3 (AB).

On May 30th, AB and WL trapped both adults and excavated young from Tri-city-east and Tri-city-west burrows. The latter burrow was particularly interesting, measuring 6.8

metres in length with a maximum depth of 1.6 metres. Nine and six owlets were captured respectively, and released at orange #8 and red #4 sites (AB).

Recruitment

Mean brood size of Washington State owls was 7.8 in 1990 (s.d.=2.5, $n=11$). Cumulative data indicate that brood size has not changed during the 1985-1990 period ($x=7.8$, s.d.=2.4, $n=43$, ANOVA: $F=0.35$ with 5/43 df, $p>0.05$). In addition, there is no difference in size of broods found in natural and artificial burrows ($x=8.0$ and 7.6 , $n=30$ and $n=20$ respectively, Mann-Whitney $U=271$, $p>0.05$). Replacement of natural with artificial burrows has not influenced brood size of Washington State owls. Unfortunately, it is not possible to compare brood sizes of "returned" and Washington State owls, since burrows of Osoyoos birds are generally not excavated until well after the young have hatched.

Nine pairs of burrowing owls which returned to Osoyoos and pair-bonded in 1990 raised at least 21 young to near-fledging age ($x=2.3$ young/pair, s.d.=1.9). Inclusion of the "double-clutch" at white #5 (the result of a "returned" male and "transplanted" female) changes these statistics to $n=10$ breeding attempts, $n=25$ young, $x=2.5$ fledged young/pair, and s.d.=1.8 (Table 3).

Nine families transplanted in 1990 fledged a minimum of 30/62 young. Neither the number of young fledged/pair ($x=3.3$

Table 3: Reproductive success of 1990 burrowing owls.

#	Site	Pair	released ^a	fledged ^b	rate(%)
1.	White #5	Frenchman #4	10	3	30%
2.	White #4	Frenchman #12	9	5	56%
3.	White #3	Frenchman #16	3	0	0%
4.	White #2	Oingo Boingo	10	2	20%
5.	White #6	Frenchman #7	9	4	44%
6.		Moses Lake Airport	0	0	0%
7.	White #1	Sugar Mill	2	0	0%
8.	Orange #8	Tri-City West	9	6	67%
9.	Red #4	Tri-City East	6	6	100%
10.	Orange #3	Russell Road	4	4	100%
11.	Purple #1	returned pair	6	6	?
12.	Purple #2	" " "	3(1) ^c	2	?
13.	Purple #3	" " "	1	0	0%
14.	Blue #1	" " "	3	3	?
15.	Blue #4	" " "	4	4	?
16.	Yellow #1	" " "	2	2	?
17.	Green #1	" " "	2	2	?
18.	Orange #2	" " "	6	2 ^d	?
19.	Orange #5	" " "	(7)	0	0%
20.	White #3	Double-clutch ^e	4	4	?

NOTES:

^a Minimum number released or observed; see Appendix I.

^b Based on band-numbers read. This is a minimum count.

^c Numbers in parentheses are eggs.

^d Two owlets transferred to the Kamloops Wildlife Park are the only birds known to have fledged from this brood.

^e Returned male (614-79893) produced young with a transplanted female (614-79998) which lost her brood at white #3.

young/pair, s.d.=2.3), nor overall fledging success (48%), differs significantly from values reported in previous years (ANOVA: $F=2.14$ with 4/32 df, $p>0.05$, and CHI-SQUARE: $\chi^2=4.62$ with 4 df, $p>0.05$). However, statistics do not disguise the fact that 1990 fledging rates were comparatively poor; some discussion of this is warranted.

As in 1989, fledging data are based on band-numbers confirmed by spotting scope. Prior to 1989, fledging rates were based on simple counts. The change in technique was made because newly-fledged young were discovered to wander widely, and use burrows other than their natal ones (Bryant 1989). Fledging rates reported prior to 1989 may be overestimated for this reason. Rates in 1989 and 1990 are probably underestimated. In particular, presence of 19 owl families this year, combined with the need to monitor an additional release site, made it difficult to provide a thorough census with available manpower. I suspect that actual fledging success was likely higher, particularly at the white #6, #5 and #2 burrows, which were difficult to approach without disturbing birds.

Despite limitations, cumulative data from 1985-1990 indicate that returned owls fledge significantly fewer young than owls transplanted with their broods ($\bar{x}=2.5$ and 5.3 respectively, $n=20$ and $n=42$ respectively, Mann-Whitney $U=662$, $p<0.01$; Figure 3).

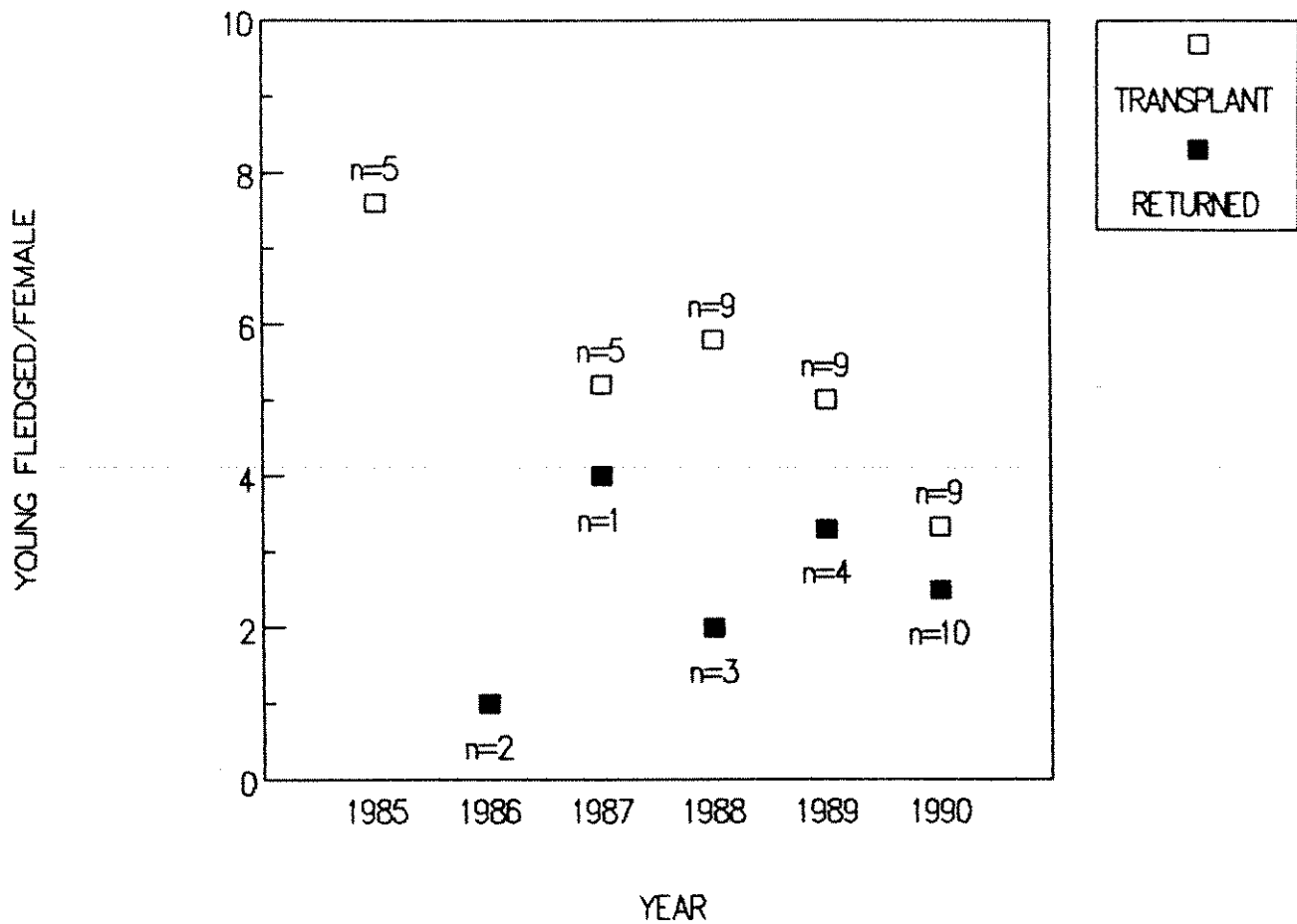


Figure 3: Owl recruitment, 1985-1990. Returned pairs fledge significantly fewer young than pairs transplanted with their broods. Data do not include broods "augmented" with young from other families.

Age-specific reproductive rates

It has been suggested that returned owls are mostly comprised of young, inexperienced birds, and that breeding success will increase as older birds return. This hypothesis is not supported by existing data, although age-specific sample sizes are small. Regression of known-age parents against reproductive success reveals no significant relationship between breeding success and age for either males ($r^2=0.001$, $F=0.02$, 1/17 df, $p>0.05$) or females ($r^2=0.002$, $F=0.03$, 1/13 df, $p>0.05$; see Figure 4).

Density-dependence

Density-dependence may limit success of reintroduced owls. In all years, returned pairs selected burrows virtually as far distant from neighbours as possible, given burrows available in March and April (mean inter-pair distance=147 metres, s.d.=60, $n=21$ cases in which at least two pairs returned to provide a measurable distance). With the extreme clustering of burrows at release sites (particularly in the orange, green and yellow sections, which were the only ones available prior to 1989), this suggests that returned owls do not select breeding burrows randomly.

A plot of reproductive success and inter-pair distance suggests a threshold effect (Figure 5). Of the few ($n=4$) pairs which selected burrows within 100 metres of their nearest neighbour, only one resulted in a successful nest.

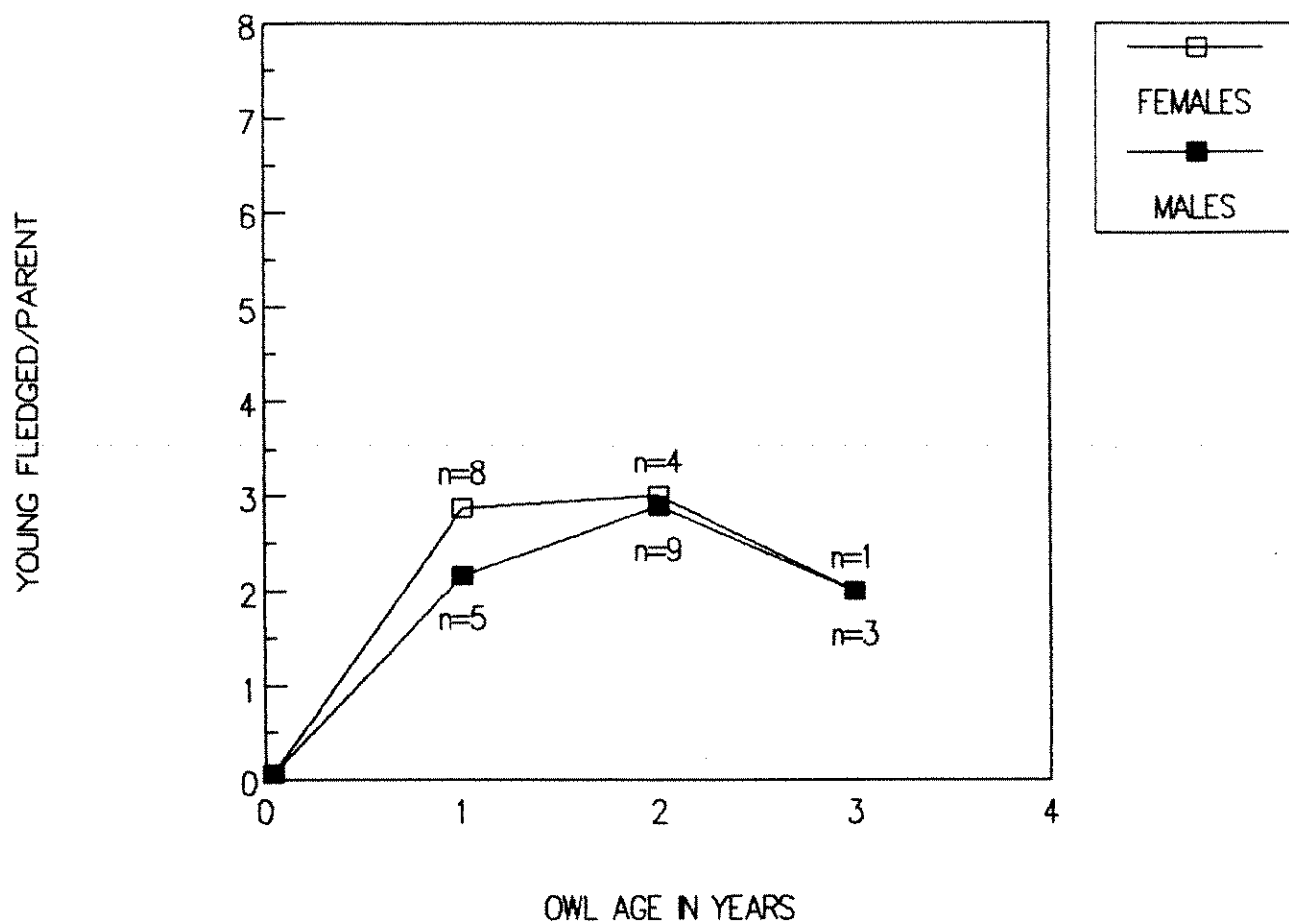


Figure 4: Recruitment as a function of age. Data do not support a hypothesis of increasing age-specific fecundity for either females or males.

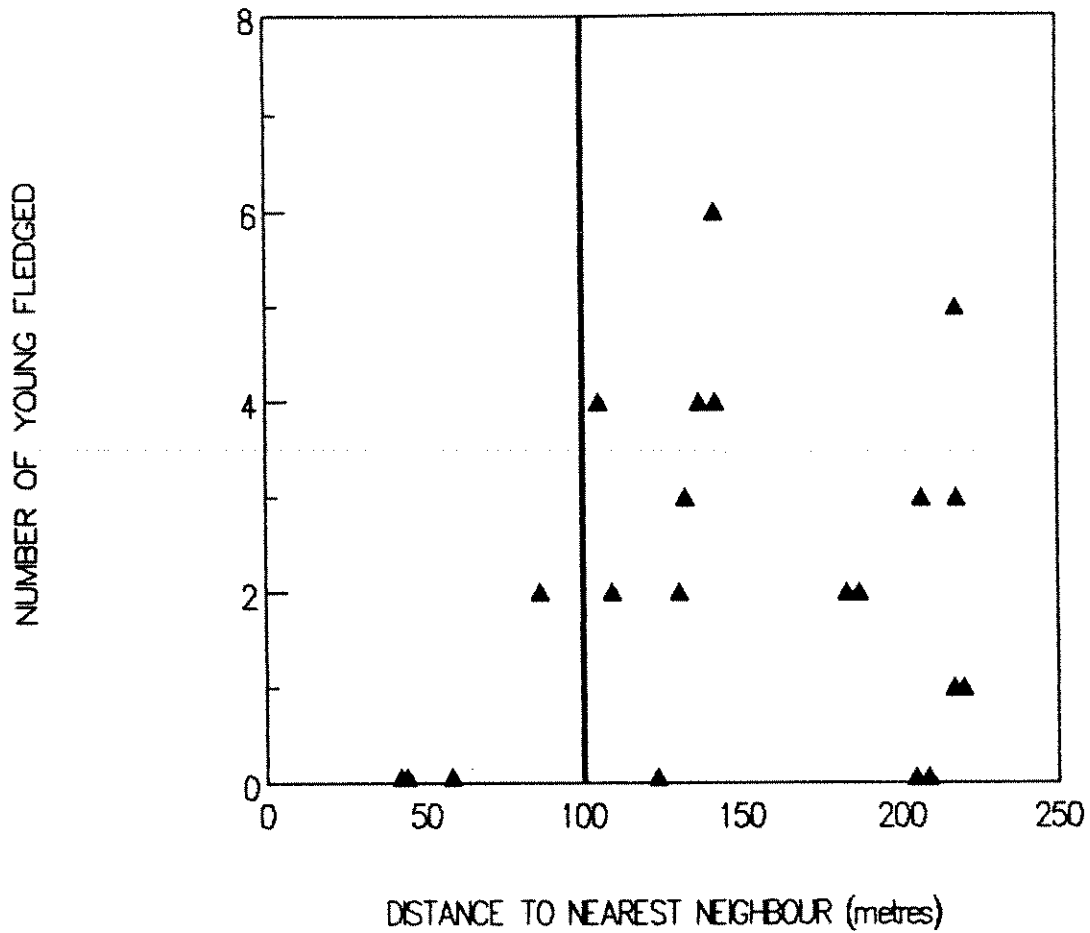


Figure 5: Recruitment as a function of inter-nest distance. Data support a hypothesis of density-dependence. Owls attempting to nest closer than 100 metres from their nearest neighbour fledge significantly fewer young.

Mann-Whitney U-test shows that returned owls attempting to nest within 100 metres of their nearest neighbour fledge significantly fewer young than do owls farther apart ($x=0.5$ young/pair versus 2.7 young/pair, $U(4,16)=60.5$, $p<0.05$). The 100 metre "yardstick" proposed by Green (1986) appears to be a reasonable estimate of minimum burrowing owl territory requirements in Okanagan *Purshia/Chrysothamnus/Artemesia* habitat.

A hypothesis of density-dependence is also congruent with observed behavior. In 1989, one pair seen early in the year at green #1 either did not pair-bond or abandoned that site, which was 140 metres from the successful green #4 nest. In 1990, the purple #1a and yellow #3 burrows were abandoned by territorial males, and seven eggs at orange #5 were found shortly after the Russell Road brood was released at orange #3 (48 metres distant). These data are of some concern, given the limited quantity of habitat currently confirmed for owl recovery purposes.

Small mammal prey-availability

Small mammal trapping in 1990 took place at the "primary" release site at Osoyoos, the new release site at Lot #953, and White Lake. Almost all animals captured, and all taken at Osoyoos, were Great Basin pocket mice *Perognathus parvus* ($n=295$). Western harvest mice *Reithrodontomys magalotis* ($n=2$), meadow voles *Microtus pennsylvanicus* ($n=4$) and deer mice *Peromyscus maniculatus* ($n=5$) were captured rarely at other sites.

Ratio of captures/trap-night at the Osoyoos grid was unchanged from 1989 ($\chi^2=1.21$, 1 df, $p>0.05$; Figure 6). Similarly, ratio of captures/trap-night at Osoyoos and the new grid at White Lake in 1990 was not significantly different ($\chi^2=0.28$, 1 df, $p>0.05$). The latter data suggest that portions of the White Lake area could provide a reasonable prey base for burrowing owls. That so few mice were captured at White Lake in 1989 could be the result of poor grid placement (i.e., in the most severely overgrazed and soil-compacted area, due north of the lake). There were significantly more small mammals at Lot #953 than at either Osoyoos or White Lake ($\chi^2=21.3$, 2 df, $p<0.01$). It would be interesting to determine whether this site is colonized preferentially by returning owls in 1991.

Life-table analysis

Data from 1985-1990 can be used to construct a life-table for *Athene cunicularia*, and so assess the likelihood of eventual reintroduction success. Demographic parameters follow Begon and Mortimer's (1986) life-table methods and nomenclature, and are presented for both males and females (Table 4).

Standardized survivorship (l_x) of male and female owls younger than 4-years-old are estimated directly from return data (Appendix IV). Lacking better data, I assumed that immigration=emigration; six unidentified females and seven males which returned between 1985 and 1990 are therefore treated as yearling "returned" birds (but may have been

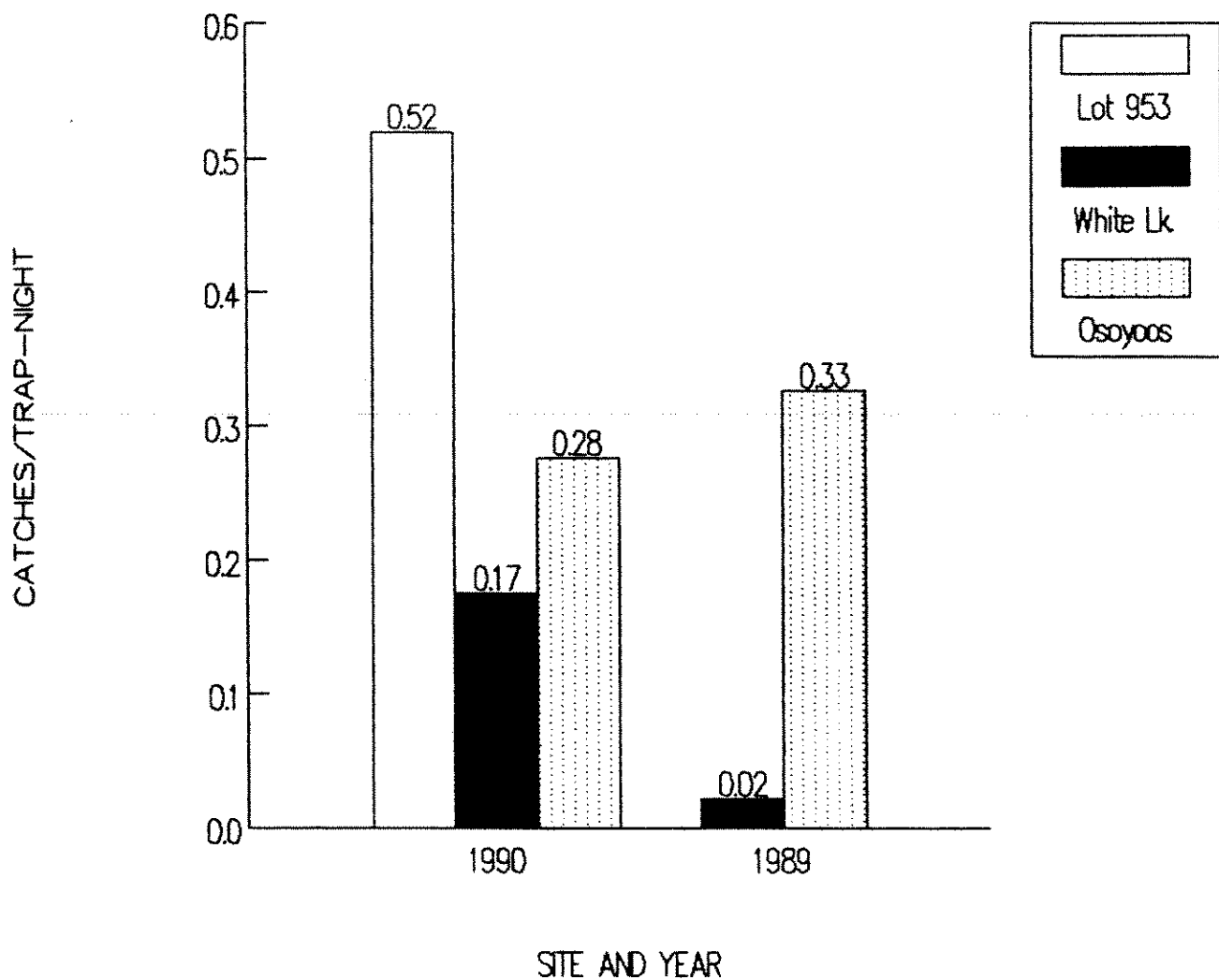


Figure 6: Small mammal availability at three sites. Data are expressed as number of captures/trap-night. Results from Osoyoos were not significantly different in 1989 and 1990. The 1990 White Lake grid was located 600 metres from the 1989 grid.

Table 4: Preliminary life-table for *Athene cunicularia*.

FEMALES

AGE	n_x	l_x	d_x	q_x	b_x	v_x
0	95	1000	832	0.832	0	0
1	16	168	93	0.553	1.286	0.216
2	5	75	46	0.613	1.286	0.096
3	1	29	15	0.613	1.286	0.037
4	-	14	7	0.613	1.286	0.018
5	-	7	4	0.613	1.286	0.009
6	-	3	2	0.613	1.286	0.004
7	-	1	1	0.613	1.286	0.001
8	-	0	0	1.000	1.286	0.000

$R_0=0.381$

MALES

AGE	n_x	l_x	d_x	q_x	b_x	v_x
0	95	1000	716	0.716	0	0
1	27	284	134	0.471	0.697	0.197
2	10	150	91	0.607	0.697	0.104
3	2	59	36	0.607	0.697	0.041
4	-	23	14	0.607	0.697	0.016
5	-	9	5	0.607	0.697	0.006
6	-	4	2	0.607	0.697	0.002
7	-	2	1	0.607	0.697	0.001
8	-	1	1	1.000	0.697	0.001

Assumptions:

- immigration=emigration. Six unidentified females and seven males which appeared at Osoyoos are treated as 1-year-old "survived" birds.
- mortality rate (q_x) values for birds older than three are assumed to be constant.
- maximum age=8 years (after Kennard 1975).

older). Since no birds older than 3-years-old have been confirmed at Osoyoos, survivorship of older birds is tentatively estimated with a constant mortality rate (qx) calculated from the 3-year-old return data. Maximum lifespan is assumed to be eight years (after Kennard 1975).

Fecundity (bx) is expressed as number-of-female-young-FLEDGED/known-age-female. Because regression showed no relationship between age and reproductive success, bx is estimated in the following manner. A total of 36 fledged young resulted from 14 known-age female return-records. Assuming equal sex-ratio of owlets, $36/14*0.5$ yields a $bx(\text{female})=1.286$. Inclusion of six unbanded or unidentified females alters these statistics to 46 fledged young/20 return-records, and a $bx(\text{female})=1.150$. Note that 19/20 female returns resulted in breeding attempts (95%), and 15 nests were successful. Male reproductive success is substantially lower. Thirty-three returns between 1985-1990 resulted in the same 19 breeding attempts and 46 fledged young, yielding a nest-attempt rate of 68% and a $bx(\text{male})=0.696$ fledged young males/returned male.

Overall population growth rate R_0 of the reintroduced Osoyoos burrowing owl population=0.381, suggesting a swift decline to extinction if now abandoned to its own devices (i.e., if releases are discontinued). For several reasons, this assessment almost certainly underestimates the true population trend.

Estimated survivorship rates are biased by small numbers of pre-1988 released owls ($n=68$ fledged owls at Osoyoos between 1985 and 1987). It is unrealistic to expect that many three or four-year-old owls should have returned by now; five, six or seven-year-old owls cannot reasonably be expected at all. With existing sample sizes, even a small increase in the number of older birds dramatically increases age-specific survivorship, and hence population growth rate (R_0). For example, treatment of six unidentified females as three yearling birds, two two-year-olds and a single three-year old increases R_0 to 0.516.

In addition, prior to 1990, no efforts were made to read band-numbers of returned owls before June. Thus, most return-records represent owls which persisted "on-site" throughout most of a summer season. If, as appears likely from 1990 data, individuals regularly abandon nests, or otherwise disappear without establishing territories, existing return rates are underestimated.

The assumption of equal immigration:emigration is also suspect. More owls probably emigrate from the newly-established Osoyoos population than immigrate into it. This is particularly true given location of release sites at the northern periphery of current *Athene cunicularia* range, existence of large areas of suitable habitat farther south, and possible absence of well-developed migration skills or behavior.

Despite limited data, several interesting trends are emerging. *A. cunicularia* displays a Type III survivorship curve, in which mortality is concentrated in the youngest age class. Females are clearly a limited resource in the reintroduced Osoyoos population. Female return rates are depressingly low compared to males. However, 19/20 female return-records (95%) resulted in breeding attempts, whereas only 19/33 of male return-records did (68%).

Several factors could account for the low female return rates, including density-dependence (inability of males to attract a mate given nearby pairs), unequal male/female emigration from the population, or unequal male/female survivorship.

Miscellaneous observations

At least two artificial burrows (at green #1 and purple #4) were excavated by owls themselves this year after having been filled by shifting sands. Indeed, I was completely unaware of the existence of the latter burrow (an old wooden type) until a large mound of fresh soil announced its presence.

At two burrows (yellow #1 and green #5), I found egg sacks of black widow spiders (*Lactrodectus mactans*) strung from the roof of the big "O" pipe. Emergence of hundreds (thousands?) of spiderlets on July 28th was a spectacular event. Burrowing owls were not observed using either burrow.

Entanglement in habituation nets was not a problem this year. One female (614-86537) was entangled, treated for a cut to its leg, released and observed on many occasions thereafter. I cannot explain the high injury rate in 1989; nets were installed in identical fashion this year. Predation in the purple section (at #2 and #3) reinforces my belief that artificial burrows should not be placed adjacent to wetland areas, in which mustelid predators occur.

First observed flight by a juvenile was on June 8th at orange #3. In general, juveniles from the second (May 30/31st) batch of transplanted owls exhibited higher survivorship to fledging age than did their comrades transplanted one week earlier. Although transplant dates are by necessity dictated by weather and other factors, "later" appears to be preferable to "sooner".

The "double-clutch" by adult female 614-79998 may be the first ever recorded in this species. Other significant observations include lack of pair-bond persistence by male 614-65180 (paired with three females in three years), recovery of female 614-79901 at Russell Road (from which she was removed in 1989), and the banded owl (614-79847) found dead at Longview, Washington. The latter bird was reportedly found on a log-loading dockyard, in February of 1990, along with several othered apparently poisoned raptors (R. Friesz, WDW, pers. com.).

CONCLUSIONS

Status and prognosis

The Okanagan reintroduction of burrowing owls is now entering its 9th year. Through this project, BCMOE has compiled important demographic data on *Athene cunicularia*, pioneered transplant methods, protected natural habitats, and demonstrated an encouraging ability to work cooperatively with other agencies. Alas, the central question ("is it working?") remains difficult to answer.

Data from 1985-1990 support a hypothesis of density-dependence and habitat limitation. Nest failures or abandonment, the 100 metre "yardstick", together with the small number of returned females, suggest that some returned males are not attracting mates, and that existing release sites are "full".

Estimated population growth (R_0) is discouragingly low but, for reasons already discussed, probably underestimates the true population trend. I can offer no explanation as to why non-reproductive females should suffer preferential mortality. Preferential emigration is a better hypothesis, particularly given the limited quantity of burrows, habitat and, (given the 100 metre "yardstick") territories available to returned owls in any year of the project. If as many females survive as males, but move elsewhere to breed, then essentially we have been "reintroducing burrowing owls to Washington State". This is not a bad thing; application of

male survivorship to female reproductive rates yields a population ~~Ro~~ close to 0.70, a value far more encouraging. In fact, establishment of nearby colonies is desirable if such colonies result in immigrants to balance emigration from Osoyoos (where did six unbanded females come from?).

Lower reproductive success amongst "returned" versus "transplanted" owls is interesting. Several hypotheses are possible, including: 1) Washington State habitats are "better" qualitatively than those near Osoyoos, 2) density-dependence is depressing reproductive performance of the Osoyoos population, 3) transplanted owls are provided with a superabundant food supply and otherwise "babied", leading to artificially-high fledging rates, and 4) fledging rates are low because of immature age-structure. Unfortunately there are few data with which to examine these hypotheses.

No comparable Washington State/B.C. data exist to provide an index of habitat quality (eg., relative small mammal availability). Similarly, I cannot compare Washington/B.C. fledging rates because Washington data do not exist, and I cannot compare brood sizes for the reverse reason. Observed reproductive performance of returned owls at Osoyoos (2.5 fledged young/nest) is similar to that reported for Saskatchewan by Haug and Oliphant (1987), but less than that reported by James (1990) for the same province (2.5 and 3.6 fledged young/nest, respectively). Rates of 3.9 and 4.9 fledged young/nest have been reported for California (Thomsen 1973) and New Mexico (Martin 1973) respectively.

Available data do not support a hypothesis of increasing age-specific reproductive success, but samples of >1 year-old birds are meagre. Lacking comparative data from Washington State, it is impossible to determine whether current Osoyoos reproductive rates are lower than "normal". If anything, reproductive success of transplanted owls (5.3 fledged young/nest-attempt) is higher than rates reported in the literature, perhaps lending some credence to the "babying" hypothesis.

Low female return rate, as opposed to fecundity, is the principal factor limiting reintroduced owls at Osoyoos. Unfortunately, it is impossible to ascertain whether this reflects a "real" survivorship trend or emigration (as would be the case if males do not attract mates). Note that if existing release sites are "full", as suggested by 1990 data, female return rates will remain low (or decrease) despite further Osoyoos releases. This would yield an increasingly pessimistic, but perhaps unfounded, outlook on the success of the reintroduction program. Low numbers of pre-1988 releases, and absence of early-spring monitoring (except in 1990) further frustrate survivorship and age-structure estimates.

Is it working? Maybe. Discouraging statistics mask some very positive trends, including steadily increasing numbers of returned and reproductive owls, development of migration skills, site-fidelity and attraction of immigrants. Observed territoriality and density-dependence may explain otherwise discouraging female return rates.

Making predictions is the arena of fools. Accordingly, I predict that 1991 will see close to five pairs in the primary release site (red-blue-orange-yellow-green), three pairs in "purple" and three at "white". Given the 100 metre "yardstick" and a dose of naturalist instinct, this is my estimate of carrying-capacity k for the lands currently managed as owl habitat in the south Okanagan.

Success of the Okanagan reintroduction program requires securing a larger k (i.e., fairly large parcels of breeding habitat which can be managed for owls). Finding out whether the reintroduction is working requires early-spring monitoring in B.C., and comparable demographic and habitat research in Washington State. Recovery of B.C. burrowing owls, ultimately, depends on identifying and protecting habitats within and outside B.C.

RECOMMENDATIONS

Transplants

- 1) No more releases at the primary Osoyoos site.
- 2) Pursue an Okanagan burrowing owl transplant in 1991, based on continuing availability of Washington State owls, a cooperative B.C./Washington State research initiative, and a new release site.

Habitat

- 1) Obtain a new release site(s).
- 2) Continue placement of artificial burrows in non-transplant sites (>100 metres apart), particularly on the Inkaneep lands adjacent to the primary site. All burrows should be in place by March 15th.

Research

- 1) Continue early-spring monitoring and band-reading, recording of reproductive success, and banding at Osoyoos.
- 2) Continue small mammal trapping at potential owl release sites throughout the potential range of the species in the Okanagan, and at selected sites in Washington State.
- 3) Determine size of nocturnal foraging ranges through use of radio-telemetry of adult and juvenile birds at Osoyoos and Washington State sites.
- 4) In cooperation with Canadian and U.S. researchers, establish a protocol which would increase the likelihood that Canadian-banded owls might be found on their overwintering grounds (i.e., joint funding for posters and publications, agreement on future banding schemes, genetic studies).

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APPENDIX I:

Burrowing Owl Capture Data, 1990.

Red colour bands were used for adults and blue for young. Bands were placed on the right leg above the aluminum USFW band. Birds marked "*" died in transit. Birds marked "***" were too small to be banded at original capture, and later were missing. Birds marked "****" were banded after recapture in Osoyoos

#	Date	Time	F+W Band	Colour	Age	Sex	Notes
<u>Frenchman#4</u>							
1.	24/05/90	8:00 a.m.	614-80000	Red #27	Adult	F	
2.	24/05/90		614-86510	Blue #79	Owlet		
3.	24/05/90		614-86511	Blue #80	Owlet		
4.	24/05/90		614-86512	Blue #81	Owlet		
5.	24/05/90		614-86513	Blue #82	Owlet		
6.	24/05/90		614-86514	Blue #83	Owlet		
7.	24/05/90		614-86515	Blue #84	Owlet		
8.	24/05/90		614-86516	Blue #85	Owlet		
9.	24/05/90		614-86517	Blue #86	Owlet		
10.	24/05/90		614-86518	Blue #87	Owlet		
11.	24/05/90		614-86519	Blue #88	Owlet		

Notes:

1 adult and 10 owlets released at White #5. KNOWN SURVIVAL=1
ADULT AND 3 JUVENILES.

Frenchman #12

12.	23/05/90	8:30 p.m.	614-79995	Red #23	Adult	M	
13.	24/05/90	8:00 a.m.	614-79996	Red #24	Adult	F	
14.	24/05/90		614-86501	Blue #70	Owlet		
15.	24/05/90		614-86502	Blue #71	Owlet		
16.	24/05/90		614-86503	Blue #72	Owlet		
17.	24/05/90		614-86504	Blue #73	Owlet		
18.	24/05/90		614-86505	Blue #74	Owlet		
19.	24/05/90		614-86506	Blue #75	Owlet		
20.	24/05/90		614-86507	Blue #76	Owlet		
21.	24/05/90		614-86508	Blue #77	Owlet		
22.	24/05/90		614-86509	Blue #78	Owlet		

Notes:

2 adults and 9 owlets released at White #4. KNOWN SURVIVAL=2
ADULTS and 5 JUVENILES.

Frenchman #16

23.	23/05/90	8:45 p.m.	614-86535	Red #28	Adult	M
24.	23/05/90	8:45 p.m.	614-86536	Red #29	Adult	F
25.	24/05/90		614-86531	Blue #100	Owlet	
26.	24/05/90		614-86532	Blue #101	Owlet	
27.	24/05/90		614-86533	Blue #102	Owlet	
28.	24/05/90		614-86534	Blue #103	Owlet	
29.	24/05/90				Owlet	
30.	24/05/90				Owlet	

Notes:

One owlet was found dead at the site. Two others died of hypothermia shortly after capture (Blue #103 and one unbanded juvenile.). 2 adults and 3 owlets released to White #3. Blue #101 was found dead on May 27th, and another (Blue #103) on May 30th. KNOWN SURVIVAL=2 ADULTS AND 0 OWLETS.

Oingo Boingo

31.	24/05/90	7:45 p.m.	614-86548	Red #32	Adult	M	
32.	25/05/90	7:30 a.m.	614-86547	Red #31	Adult	F	
33.	25/05/90	8:00 a.m.	614-86549	Blue #137	Owlet		***
34.	25/05/90	8:00 a.m.	614-86550		Owlet		**
35.	25/05/90	8:00 a.m.	614-86551	Blue #138	Owlet		***
36.	25/05/90	8:00 a.m.	614-86552	Blue #134	Owlet		***
37.	25/05/90	8:00 a.m.	614-86553	Blue #135	Owlet		***
38.	25/05/90	8:00 a.m.	614-86554		Owlet		**
39.	25/05/90	8:00 a.m.	614-86579	Blue #132	Owlet		***
40.	25/05/90	8:00 a.m.	614-86580	Blue #133	Owlet		***
41.	25/05/90	8:00 a.m.	614-86581	Blue #136	Owlet		***
42.	25/05/90	8:00 a.m.			Owlet		**
43.	25/05/90	8:00 a.m.			Owlet		*

Notes:

2 adults and 10 owlets released at White #2. One owlet died in transit. Owlets were colour-banded on June 9, at which time three were missing. KNOWN SURVIVAL=2 ADULTS and 2 JUVENILES.

Frenchman #7

44.	24/05/90	10:45 p.m.	614-86537	Red #30	Adult	F
45.	25/05/90	7:00 a.m.	614-86538	Blue #104	Owlet	
46.	25/05/90	7:00 a.m.	614-86539	Blue #105	Owlet	
47.	25/05/90	7:00 a.m.	614-86540	Blue #106	Owlet	
48.	25/05/90	7:00 a.m.	614-86541	Blue #107	Owlet	
49.	25/05/90	7:00 a.m.	614-86542	Blue #108	Owlet	
50.	25/05/90	7:00 a.m.	614-86543	Blue #109	Owlet	
51.	25/05/90	7:00 a.m.	614-86544	Blue #110	Owlet	
52.	25/05/90	7:00 a.m.	614-86545	Blue #111	Owlet	
53.	25/05/90	7:00 a.m.	614-86546	Blue #112	Owlet	

Notes:

1 adult and 9 owlets released at White #6. On June 6th, adult female Red #30 was found entangled in the net, treated by K. Lindsey (D.V.M.) of Penticton, and released the same day. KNOWN SURVIVAL=1 ADULT and 4 JUVENILES.

Moses Lake Airport

54.	23/05/90		614-79998	Red #26	Adult	F
55.	23/05/90	9:00 p.m.	614-79997	Red #25	Adult	M
56.	24/05/90				Owlet	*
57.	24/05/90				Owlet	*
58.	24/05/90				Owlet	*
59.	24/05/90				Owlet	*
60.	24/05/90				Owlet	*

Notes:

2 adults released at White #1 with the 2 remaining "Sugar Mill" owlets. KNOWN SURVIVAL=2 ADULTS and 0 JUVENILES.

Sugar Mill

61.	24/05/90	10:00 a.m.	614-86520	Blue #89	Owlet	*
62.	24/05/90	10:00 a.m.	614-86521	Blue #90	Owlet	*
63.	24/05/90	10:00 a.m.	614-86522	Blue #91	Owlet	*
64.	24/05/90	10:00 a.m.	614-86523	Blue #92	Owlet	*
65.	24/05/90	10:00 a.m.	614-86524	Blue #93	Owlet	*
66.	24/05/90	10:00 a.m.	614-86525	Blue #94	Owlet	dead
67.	24/05/90	10:00 a.m.	614-86526	Blue #95	Owlet	
68.	24/05/90	10:00 a.m.	614-86527	Blue #96	Owlet	*
69.	24/05/90	10:00 a.m.	614-86528	Blue #97	Owlet	*
70.	24/05/90	10:00 a.m.	614-86529	Blue #98	Owlet	*
71.	24/05/90	10:00 a.m.	614-86530	Blue #99	Owlet	*

Notes:

Adults were not captured. Nine of 11 owlets died in transit. 2 owlets (Blue #94 and Blue #95) released with Moses Lake Airport adults at White #1. On June 9th, Blue #94 was found dead at the burrow. KNOWN SURVIVAL=0 JUVENILES.

Tri-City West

72.	30/05/90	11:30 p.m.	614-86569	Red #34	Adult	M
73.	31/05/90	6:00 a.m.	614-86570	Blue #35	Adult	F
74.	31/05/90	11:00 a.m.	614-86560	Blue #117	Owlet	
75.	31/05/90	11:00 a.m.	614-86561	Blue #118	Owlet	
76.	31/05/90	11:00 a.m.	614-86562	Blue #119	Owlet	
77.	31/05/90	11:00 a.m.	614-86563	Blue #120	Owlet	
78.	31/05/90	11:00 a.m.	614-86564	Blue #121	Owlet	
79.	31/05/90	11:00 a.m.	614-86565	Blue #122	Owlet	
80.	31/05/90	11:00 a.m.	614-86566	Blue #123	Owlet	
81.	31/05/90	11:00 a.m.	614-86567	Blue #124	Owlet	
82.	31/05/90	11:00 a.m.	614-86568	Blue #125	Owlet	

Notes:

2 adults and 9 owlets released at Orange #8. KNOWN SURVIVAL=2 ADULTS and 6 JUVENILES.

Tri-City East

83.	31/05/90	7:00	a.m.	614-86572	Red #37	Adult	M
84.	31/05/90	8:00	a.m.	614-86571	Red #36	Adult	F
85.	31/05/90	12:00	p.m.	614-86573	Blue #126	Owlet	
86.	31/05/90	12:00	p.m.	614-86574	Blue #127	Owlet	
87.	31/05/90	12:00	p.m.	614-86575	Blue #128	Owlet	
88.	31/05/90	12:00	p.m.	614-86576	Blue #129	Owlet	
89.	31/05/90	12:00	p.m.	614-86577	Blue #130	Owlet	
90.	31/05/90	12:00	p.m.	614-86578	Blue #131	Owlet	

Notes:

2 adults and 6 owlets released at Red #4 (Ecological Reserve).
KNOWN SURVIVAL = 2 ADULTS AND 6 OWLETS.

Russell Road

91.	29/05/90	11:00	p.m.	614-79901	Red #1	Adult	F
92.	29/05/90	11:00	p.m.	614-86555	Red #33	Adult	M
93.	30/05/90	8:00	a.m.	614-86556	Blue #113	Owlet	
94.	30/05/90	8:00	a.m.	614-86557	Blue #114	Owlet	
95.	30/05/90	8:00	a.m.	614-86558	Blue #115	Owlet	
96.	30/05/90	8:00	a.m.	614-86559	Blue #116	Owlet	

Notes:

2 adults and f4 young released at Orange #3. KNOWN SURVIVAL=2
ADULTS and 4 OWLETS.

Purple #1 (returned pair)

99.	21/06/90	11:00	a.m.	614-86582	Blue #139	Owlet	
100.	21/06/90	11:00	a.m.	614-86583	Blue #140	Owlet	
101.	21/06/90	11:00	a.m.	614-86584	Blue #141	Owlet	
102.	21/06/90	11:00	a.m.	614-86585	Blue #142	Owlet	
103.	21/06/90	11:00	a.m.	614-86586	Blue #143	Owlet	
104.	21/06/90	11:00	a.m.	614-86587	Blue #144	Owlet	

Notes:

KNOWN SURVIVAL=6 JUVENILES.

Purple #2 (returned pair)

97.						Owlet	
98.						Owlet	

Notes:

One dead and decomposed owlet, and one egg, were found on June 21st. Two unbanded juveniles were observed here on July 19th, but could not be captured. KNOWN SURVIVAL=2 JUVENILES.

Purple #3 (returned pair)

Notes: One dead and decomposed owlet was found on June 21st, as well as fresh, meaty fecal matter, perhaps from a mustelid. The two adults were not seen again. KNOWN SURVIVAL=0 JUVENILES.

Blue #1: (returned pair)

105.	24/06/90	12:00	p.m.	614-86588	Blue #145	Owlet
106.	24/06/90	12:00	p.m.	614-86589	Blue #146	Owlet
107.	24/06/90	12:00	p.m.	614-86590	Blue #147	Owlet

Notes:

In addition to three owlets, juvenile Blue #128 (from Tri-City-East) was found in the burrow. KNOWN SURVIVAL=3 JUVENILES.

Blue #4: (returned pair)

108.	21/06/90	4:00	p.m.	614-86591	Blue #148	Owlet
109.	21/06/90	4:00	p.m.	614-86592	Blue #149	Owlet
110.	21/06/90	4:00	p.m.	614-86593	Blue #150	Owlet
111.	21/06/90	4:00	p.m.	614-86594	Blue #151	Owlet

Notes:

In addition to the four owlets, one egg was found. KNOWN SURVIVAL=4 JUVENILES.

Yellow #1: (returned pair)

112.	21/06/90	7:00	p.m.	614-86595	Blue #152	Owlet
113.	21/06/90	7:00	p.m.	614-86596	Blue #153	Owlet

Notes:

KNOWN SURVIVAL=2 JUVENILES.

Green #1: (returned pair)

114.	22/06/90	4:00	p.m.	614-86597	Blue #154	Owlet
115.	22/06/90	4:00	p.m.	614-86598	Blue #155	Owlet

Notes:

KNOWN SURVIVAL=2 JUVENILES.

Orange #2: (returned pair)

116.	22/06/90	5:00	p.m.	614-80801	Owlet	
117.	22/06/90	5:00	p.m.	614-80802	Owlet	
118.	22/06/90	5:00	p.m.	614-80803	Owlet	**
119.	22/06/90	5:00	p.m.	614-80804	Owlet	**
120.	22/06/90	5:00	p.m.	614-80805	Owlet	
121.	22/06/90	5:00	p.m.	614-80806	Owlet	

Notes:

This burrow was dug on July 13th; only two owlets were found. Both (614-80801 and 614-80805) were transferred to the Kamloops Wildlife Park to assist their captive-breeding efforts. Two bands (614-80802 and 614-80806) were found. KNOWN SURVIVAL=2 JUVENILES.

Orange #5: (returned pair)

Notes:

This burrow was dug on June 24th and seven eggs were found. The burrow was also occupied by three transplanted juveniles (Blue #s 118, 126 and 127). KNOWN SURVIVAL=0 JUVENILES.

White #5: (returned male and transplanted female)

122.	27/08/90	7:00 p.m.	614-80807	Blue #156
123.	27/08/90	7:00 p.m.	614-80808	Blue #157
124.	27/08/90	7:00 p.m.	614-80809	Blue #158
125.	27/08/90	7:00 p.m.	614-80810	Blue #159

Notes:

A returned male mated with a transplanted female which had lost her original brood at White #1. KNOWN SURVIVAL=4 JUVENILES.

Transplant Summary:

- total adults = 16 (released).
- total young = 80 (62 transplanted successfully).

Returned Owl Summary:

- total adults returned = 25 (minimum count)
- total number of pairs formed = 10 (minimum count)
- total number of young fledged = 25 (minimum count)

APPENDIX II:

Young owls captured, released and fledged in the Okanagan.
Numbers in parentheses refer to eggs. A positive "+" or negative "-" sign denotes owlets moved among families prior to release ("augmented" brood). Brood sizes and survivorship (fledging) statistics described in text do not include augmented broods or those in which eggs were found.

Pair	burrow type	brood size	# rels'd	# fldg'd	site	notes
<u>1983</u>						
Farm Site	n	9	9	6	Vaseux	
<u>1984</u>						
Martha Lake	n	10	10	8	Vaseux	
Frenchman Hill	n	10	10	7	Vaseux	
Game	n	4	4	4	Vaseux	
<u>1985</u>						
Kern	n	9	8+1	9	Osoyoos	
Still	n	10	9	9	"	
Pivot	n	9	9-1	8	"	1 DOA
Section 16	n	8	8	8	"	
A-team	n	10	6	4	"	4 DOA
Mae Valley	n	(4)	-	-		not taken
<u>1986</u>						
Natural 1!	a	-	-	1	orange 6	
Natural 2!	a	-	-	1	green 4	
<u>1987</u>						
Klamath	n	8	8	8	orange 7	
Frenchman	n	10	10	0	orange 5	starved
Gun Range	n	5(4)	5(4)	0	orange 2	predation?
Bandsite	n	9	9	9	orange 1	
South Front	n	9	9	9	green 1	
Upper Gun range	n	(4)	-	-	-	eggs only
Frenchman Young	a	5	-	-	-	not taken
Natural 3!	a	-	-	4	green 4	
<u>1988</u>						
Cow site	n	9	9	7	orange 8	
Cutoff	n	7	7	5	orange 3	
Pit	n	8	8	6	green 2	
Swanson	n	8	8	7	yellow 4	
Artificial	a	9	9	7	yellow 3	
Bitterbrush	n	9	9	6	yellow 2	
Oingo Boingo	n	9	9	5	yellow 6	
Dent Road	n	8	8	6	yellow 5	
East	n	9	9	3	blue 5	
Consolidated	n	2	2+18	16	yellow 1	
Augment #1	n	2	2-2	-	yellow 1	
Augment #2	n	8	8-8	-	yellow 1	
Augment #3	n	10	8-8	-	yellow 1	
Migrant A!	a	6+	-	4	green 4	
Migrant B!	a	-	-	2	orange 5	
Migrant C!	a	-	-	0	orange 10	

Pair	burrow type	brood size	# rels'd	# fldg'd	site	notes
<hr/>						
1989						
North Ditch	a	10	10-1	9	blue 1	
Guy Wire	a	5(2)	5+1	5	blue 4	
Horse Pasture	n	11	8	6	purple 2	3 DOA
Frenchman #2	a	7(1)	7	4	red 1	
Frenchman #3	a	8	8	6	blue 2	
Middle Field	a	2	2+4	6	yellow 1	
Frenchman #4	a	9	4-4	-	yellow 1	
Frenchman #5	a	4(1)	4	4	red 2	
Othello Orchard	n	6(2)	6	6	blue 3	
Pasco 2-pipe	a	10	10	0	black 1	predation
Pasco 1-pipe	a	11	11	11	purple 2	
Sagehill Road	n	(5)	-	-	-	to Kamloops
Frenchman #1	a	(9)	-	-	-	not taken
Green 4!	a	-	-	5	green 4	
Blue 5!	a	-	-	3	blue 5	
Yellow 4!	a	-	-	5	yellow 4	
Orange 5!	a	-	-	0	orange 5	
<hr/>						
1990						
Frenchman #4	a	10	10	3	white 5	
Frenchman #12	a	9	9	5	white 4	
Frenchman #16	a	7	3	0	white 3	1 DOA
Oingo Boingo	a	11	11	2	white 2	
Frenchman #7	a	9	9	4	white 6	
Moses Airport	a	5	0	0		5 DOA
Sugar Mill	n	11	2	0	white 1	9 DOA
Tri-city west	a	9	9	6	orange 8	
Tri-city east	a	6	6	6	red 4	
Russell Road	n	4	4	4	orange 3	
Purple 1!	a	-	-	6	purple 1	
Purple 2!	a	3(1)	-	2	purple 2	predation
Purple 3!	a	-	-	0	purple 3	predation
Blue 1!	a	-	-	3	blue 1	
Blue 4!	a	4(1)	-	4	blue 4	
Yellow 1!	a	-	-	2	yellow 1	
Green 1!	a	-	-	2	green 1	
Orange 2!	a	6	-	2	orange 2	to Kamloops
Orange 5!	a	(7)	-	0	orange 5	abandoned
White 5!	a	-	-	4	white 5	2nd clutch
<hr/>						

APPENDIX III:

Band-numbers of owls released in the Okanagan, 1983-1990.

Numbers of young (*n of yng.*) refer to those actually released (note that all young were not necessarily banded). An exclamation (!) denotes a returned pair; see Appendix IV for band-numbers of returned adults.

Brood	Male	Female	Juveniles	<i>n of</i> yng.
<hr/>				
<u>1983</u>				
Farm site	-	-	-	9

1984

Martha Lake ^a	614-03381	614-03382	614-03371 to 614-03380	10
Frenchman	-	614-03399	614-03389 to 614-03398	10
Game	614-03388	614-03387	614-03383 to 614-03386	4

Notes:

^a band # 614-03379 was not used; one juvenile was too small to be banded.

1985

Kern ^a	614-01831	614-01830	614-01944 to 614-01950	8
Still ^b	614-01828	614-01829	614-01935 to 614-01943	9
Pivot ^c	614-01824	614-01825	614-01918 to 614-01926	9
Section 16	614-01827	614-01826	614-01927 to 614-01934	8
A-team	614-01842	614-01843	614-01832 to 614-01841	10

Notes:

^a one "Kern" bird was banded out-of-sequence (614-01823).

^b band 614-01942 slipped off during transit; the bird was not rebanded.

^c band 614-01922 slipped off during transit; the bird was not rebanded.

1986

(no owls banded or released in the south Okanagan)

1987

Klamath	<i>not taken</i>	614-65195	614-65187 to 614-65194	8
Frenchman ^a	614-01911	614-01912	614-01904 to 614-01910	10
Gun Range ^b	614-65151	614-65152	-	5
Bandsite ^c	614-01826	614-65183	614-65175 to 614-65182	9
South Front ^d	614-65163	614-65164	614-65165 to 614-65172	9

Notes:

^a three juveniles were too small to be banded.

^b all five young were too small to be banded.

^c one young was too small to be banded.

^d one young was too small to be banded.

1988

Cow Site ^a	614-79830	614-79829	614-79831 to 614-79837	9
Cutoff	614-79838	614-79839	614-79876 to 614-79882	7
Pit	614-79841	614-79840	614-79842 to 614-79849	8
Swanson ^b	614-79863	614-79864	614-79851 to 614-79557	8
Artificial	614-79872	614-79873	614-79850 to 614-79871	9
Bitterbrush ^c	614-79875	614-79874	614-79858 to 614-79861	9
Oingo Boingo ^d	614-65199	614-65200	-	9
Dent Road	614-01914	614-01913	614-65155 to 614-65162	8
East ^e	614-65198	614-65197	614-79801 to 614-79808	9
Consolidated	614-65154	614-65153	614-79809 to 614-79828	20
Migrant A ! ^f	-	614-79892	614-79883 to 614-79887	6
Migrant B !	-	-	614-79888 to 614-79889	2
Migrant C !	-	-		0

Notes:

^a two juveniles were not banded.

^b one juvenile was not banded.

^c five young were transplanted without being banded; 3 of these (614-79890, 614-79891 and 614-79893) were banded as juveniles.

^d young were banded with a hodge-podge of numbers, including 614-01844 to 614-01846 (3), 614-65184 to 614-65186 (3), 614-65173, 614-65174 and 614-019515.

^e one juvenile (614-65196) was banded out of sequence. One band was lost in transit (614-79808).

^f one juvenile was too small to be banded.

1989

North Ditch ^a	614-79902	614-79901	614-79903 to 614-79911	10
Guy Wire	614-79917	614-79918	614-79912 to 614-79916	5
Horse Pasture ^b	614-79919	614-79920	614-79923 to 614-79932	11
Frenchman #2 ^c	614-79921	614-79922	614-79933 to 614-79928	7
Frenchman #3	614-79947	614-79948	614-79939 to 614-79946	8
Middle Field	614-79952	614-79951	614-79949 to 614-79950	2
Frenchman #4	-	-	614-79953 to 614-79956	4
Frenchman #5 ^d	614-79960	614-79959	614-79957 to 614-79858	4
Othello Orchard	614-79967	614-79968	614-79961 to 614-79966	6
Pasco 2-pipe ^e	614-79976	614-79975	614-79969 to 614-79974	10
Pasco 1-pipe	614-79988	614-79989	614-79977 to 614-79987	11
Green #4 !	-	-	614-79894 to 614-79898	5
Blue #5 !	-	-	614-79990 to 614-79992	3
Yellow #4 ! ^f	-	-	-	5
Orange #5 !	-	-	-	0

Notes:

^a one young was too small to be banded.

^b one young was too small to be banded.

^c one young (614-01847) was banded out of sequence.

^d two young (614-01849 and 614-79899) were banded out of sequence.

^e four young were too small to be banded.

^f three young (614-79999, 614-79993 and 614-79994) were banded.

1990

Frenchman #4	<i>not taken</i>	614-80000	614-86510 to 614-86519	10
Frenchman #12	614-79995	614-79996	614-86501 to 614-86509	9
Frenchman #16	614-86535	614-86536	614-86531 to 614-86534	3
Oingo Boingo ^a	614-86548	614-86547	614-86549 to 614-86554	10
Frenchman #7	<i>not taken</i>	614-86537	614-86538 to 614-86546	9
Moses Airport	614-79997	614-79998	-	0
Sugar Mill	-	-	614-86520 to 614-86530	2
Tri-City West	614-86569	614-86570	614-86560 to 614-86568	9
Tri-City East	614-86572	614-86571	614-86573 to 614-86578	6
Russell Road ^b	614-86555	-	614-86556 to 614-86559	4
Purple #1 !	-	-	614-86582 to 614-86587	6
Purple #2 !	-	-	- ^c	2
Purple #3 !	-	-	-	0
Blue #1 !	-	-	614-86588 to 614-86590	3
Blue #4 !	-	-	614-86591 to 614-86594	4
Yellow #1 !	-	-	614-86595 to 614-86596	2
Green #1 !	-	-	614-86597 to 614-86598	2
Orange #2 !	-	-	614-80801 to 614-80806	6
Orange #5 !	-	-	-	0
White #3 ! ^d	-	-	614-80807 to 614-80810	4

Notes:

^a five juveniles were too small to be banded.

^b adult female 614-79901 was captured at the identical site (Russell Road) in 1989.

^c the young could not be captured.

^d a transplanted female produced a 2nd clutch with a returned male.

Appendix IV:

Band-numbers of returned owls, 1985-1990.

#	ID	Site	Age	sex	origint	1986	1987	1988	1989	1990
1	614-01844	Dingo Boing	1	f	1988				1	
2	614-01937	Still	3	f	1985		2	3		
3	614-79836	Cow site	2	f	1988				1	2
4	614-79834	Cow Site	2	f	1988					2
5	614-79957	French #5	1	f	1989					1 Blue 54
6	614-79984	Pasco-1	1	f	1989					1 Blue 9
7	614-79894	Green #4!	1	f	1989					1 blue 58
8	614-79861	Bitterbrush	2	f	1988					2
9	614-79908	North Ditch	1	f	1989					1 Blue 20
10	614-65159	Dent Road	1	f	1988				1	
11	614-79813	Consolidate	2	f	1988				1	2
12	614-01938	Still	3	m	1985		2	3		
13	614-79928	Horse Pastu	1	m	1989					1 Blue 14
14	614-79924	Horse Pastu	1	m	1989					1 Blue 15
15	614-79992	Blue#5!	1	m	1989					1 Blue 65
16	614-79949	Middlefield	1	m	1989					1 Blue 47
17	614-79977	Pasco-1	1	m	1989					1 Blue 10
18	614-79945	French#3	1	m	1989					1 Blue 32
19	614-79987	Pasco-1	1	m	1989					1 Blue 6
20	614-65161	Dent Road	2	m	1988				1	2
21	614-79837	Cow site	2	m	1988				1	2
22	614-65180	Bandsite	3	m	1987			1	2	3
23	614-79824	Consolidate	1	m	1988				1	
24	614-79893	Bitterbrush	2	m	1988					2
25	614-79876	Cutoff	2	m	1988				1	2
26	614-79865	Artificial	1	m	1988				1	
27	614-65092	Captive-bre	2	m	1989 !					2 Red 17
28	614-65163	South Front	3	m	1987 !			2	3	
29	614-79902	North Ditch	2	m	1989 !					2 Red 2
30	614-79952	Middlefield	2	m	1989 !					2 Red 12