A review on the captive propagation and conservation of the Western Burrowing Owl (*Athene cunicularia hypugaea*) in British Columbia, 1983-2017

Revisão sobre a reprodução em cativeiro e conservação da coruja-buraqueira-ocidental (*Athene cunicularia hypugaea*) na Colúmbia Britânica, 1983-2017

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ABSTRACT

The Western Burrowing Owl (*Athene cunicularia hypugaea*), is a Species at Risk in Canada and was extirpated from British Columbia (BC) in the 1980s. In Canada, populations of Burrowing Owls migrate southwards in the fall and winter to Mexico and the southern United States. With a loss or degradation of native habitat, both in nesting and overwintering grounds, along with the decline in fossorial mammals, and the possible effects of climate change, Burrowing Owl populations continue to decrease in BC and Canada. In 1990, volunteers initiated a comprehensive re-introduction program, including three captive breeding facilities, artificial burrow networks and field monitoring research. The Burrowing Owl Conservation Society of BC (formed in 2000) produces over 100 owls each yr to release in the Thompson-Nicola and South Okanagan grasslands of BC. Artificial burrows are installed on private ranch land, provincial land, Non-government Organization properties, and indigenous lands. Improved release techniques, including soft-release caging, have resulted in higher adult survival and greater numbers of wild-hatched offspring. Recent years have seen an increase in the rate of returning owls, however BC still does not have a self-sustainable population. Our next step is to work on understanding their migratory movements and needs to increase survivability. This will involve working across Canada and internationally.

Keywords: *Athene cunicularia hypugaea*, captive breeding, migration, reintroduction, soft release

RESUMO

A coruja-buraqueira-ocidental (*Athene cunicularia hypugaea*) é uma espécie em risco no Canadá e extinta na Colúmbia Britânica (BC) na década de 1980. No Canadá, as populações de corujas-buraqueiras migram para sul no outono, e no inverno migram para o México e para o sul dos Estados Unidos. Com a perda ou degradação do habitat nativo, tanto nas áreas de reprodução como de invernada, juntamente com o declínio de mamíferos fossoriais e os possíveis efeitos das mudanças climáticas, as populações de coruja-buraqueira continuam a diminuir na BC e no Canadá. Em 1990, um grupo de voluntários iniciou um programa abrangente de reintrodução, incluindo três instalações de reprodução em cativeiro, redes de tocas artificiais e monitorização no campo. A *Burrowing Owl Conservation Society* de BC (fundada em 2000) produz mais de 100 corujas por ano para serem libertadas nos campos de Thompson-Nicola e South Okanagan em BC. As tocas artificiais são instaladas em terrenos particulares, em terrenos estatais, em propriedades de organizações não governamentais e em territórios indígenas. Técnicas de libertação aperfeiçoadas, incluindo gaiolas de libertação gradual, contribuíram para o aumento da sobrevivência dos adultos e a produção de um maior número de juvenis selvagens. Nos últimos anos, houve um aumento na taxa de retorno de corujas, no entanto, a BC ainda não possui uma população autossustentável. O nosso próximo passo é estudar os seus movimentos migratórios e as suas necessidades, com objetivo de promover a capacidade de sobrevivência. Para tal, o trabalho terá de abranger todo o Canadá e também outros países.

Palavras-chave: *Athene cunicularia hypugaea*, libertação gradual, migração, reintrodução, reprodução em cativeiro

Introduction

The distribution of the Burrowing Owl (*Athene cunicularia*) has contracted in Canada in recent decades, and they currently breed in the grasslands of Saskatchewan, Alberta, and Manitoba. Historically, they were found in the grasslands of the Thompson-Nicola region and the South Okanagan of British Columbia (BC). In early fall (September and October); the Canadian owls migrate to their overwintering areas in the southern United States and Mexico (Holroyd et. 2001, Wellicome et al. 2014). These owls return to their breeding grounds in BC in March and early April.

In Canada they are endangered, and in British Columbia they were deemed extirpated in the 1980s (Blood and Low 1998). Populations in Alberta and Saskatchewan are still decreasing, and the population in Manitoba was also deemed extirpated in the late 1990s (DeSmet 1997).

There are many potential reasons for declines in Burrowing Owl populations. Some of the more commonly accepted are: loss of habitat due to land development, loss of rodent and insect prey species possibly due to agricultural spraying; and the loss of burrowing animals (badgers, ground squirrels, marmots) which dig the holes Burrowing Owls utilize. In BC at least, survival of owls released in the breeding areas seems reasonably good, but there are apparently large losses during migration, as few birds return in subsequent years. The multiple factors deemed likely responsible for the decline of this species, when combined with possible effects of climate change, make this a complex, multi-national conservation issue.

Methods

In the early 1990s a group of dedicated volunteers led by Mike Mackintosh initiated a captive breeding and reintroduction program for Burrowing Owls in BC. In 2000, the Burrowing Owl Conservation Society of BC (BOCS) was established to facilitate recovery through captive breeding, field activities, education programs and increasing scientific knowledge.

As of 2017 the society monitors 14 active release properties located on private ranch land, provincial crown land, The Nature Conservancy of Canada, The Nature Trust of BC and indigenous lands all located between Kamloops and Merritt, and in the South Okanagan.

Breeding Facilities

The first release of captive-bred owls in BC occurred in 1992 when nine owls were placed into artificial burrows in the Thompson-Nicola region. The breeding and release program has flourished over the last 20 yr, and now close to 50 pairs of young owls are released each year in the Thompson-Nicola and the South Okanagan. Three breeding facilities are found in distinct geographically separate areas in BC to maintain capacity, and to provide additional protection for the limited gene pool of breeding birds.

Genetics, Sexing and Breeding

A stud book is used to help maintain the genetic diversity of owls released to the wild by documenting and recommending pairing of Burrowing Owls in the captive facilities. Wild owls from Washington and Oregon that have been brought in over the years for the purpose of breeding stock and are not released. A few days before the April release, all of the one yr-old male and female owls are caught up to be processed for release (See Processing and Banding section).

Our female breeders are generally productive from one yr-old up to about 7 yr-old, after which the production of eggs decreases dramatically. Males can keep breeding well into old age, which can be 10-12 yr old (Mackintosh et al. 2004).

Processing and Banding

An aluminum green over black alpha numeric band (Acraft Sign and Nameplate Company, Edmonton, Alberta) is placed on the right leg of all released burrowing owls. In April, all of the owls from all of the facilities are brought together, examined, weighted, and paired up for release. Once assessed to be suitable for release, an aluminum U.S. Geological Survey band is placed on the left leg. Each owl is paired with a suitable mate and designated a burrow for release.

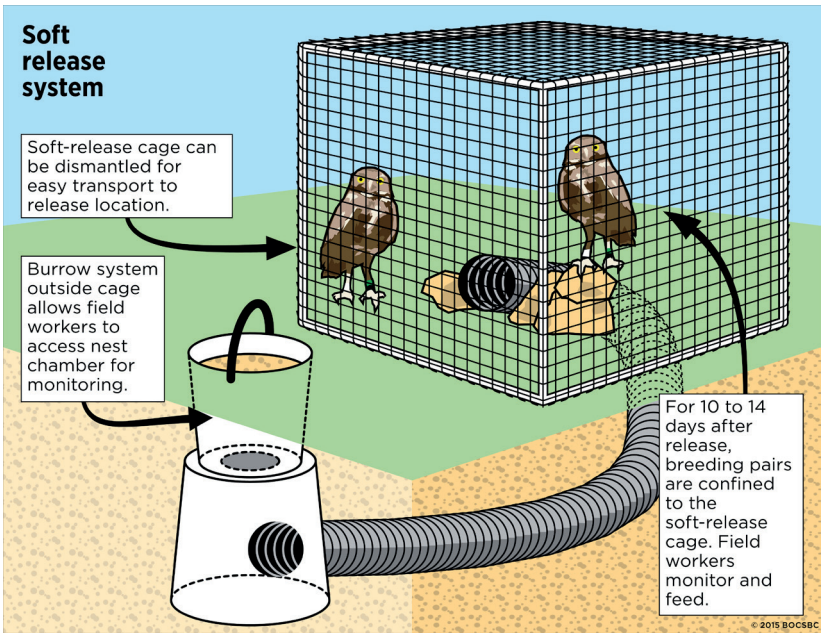
Burrow construction and installation

Most Burrowing Owl recovery strategies take into account the possible need to provide burrows, the perspective being that natural burrows are limited. With the general decline in BC of many fossorial mammals the presumption is that there is a lack of natural burrow systems. Since 1991, the society has built and installed over 800 artificial burrows. The artificial burrow system is constructed using landscaping buckets (#10 Listo Product 38 L) and 3 m long 'Big-O' (15.2 cm diameter) pipe buried (about 0.7 m) in the ground.

Only the entrance to the tunnels and the top of the landscaping bucket are visible above ground. The top of the bucket system can be removed so that the nest chamber can be easily accessed. Burrows are placed in groups of two or three in close proximity, with other groupings being placed approximately 200 m away. All burrows have individual numbers painted on the top lids with matching metal tags on the pipe. The GPS coordinates for each burrow are recorded for mapping and relocation.

Figure 1 - Graphic of burrow system design and soft-release cage (Graphic by Nick Murphy)

Figura 1 - Representação gráfica de um sistema de toca e gaiola de libertação gradual (ilustração de Nick Murphy).



Release techniques

Hard release

In a hard release, yearling owl pairs were placed inside the nest chambers of artificial burrows in which the outer entrances have been blocked and retained there overnight (Leupin and Low, 2001). Owls were released simply by unblocking their burrowing entrances the next day (Mitchell 2008).

Soft release

Soft release involves placing predator-proof enclosures over the artificial burrow in April shortly before the placement of owls at the release sites. The structure is a 1.2×1.2×1.2 m enclosure made with a 12.7 mm PVC pipe frame. Covered with strong nylon mesh (2.5 cm x 2.5 cm) and attached to the ground with 12 cm long spikes, thus securing the cage and also preventing any predators from accessing the cage. Because some enclosures can be destroyed by cattle, electric fencing is used in areas with cattle, set back approximately 1 m from the enclosure. Electric fencing proved to be a safe and effective cattle deterrent.

Pairs are placed inside artificial burrows, in the same manner as in hard releases, with enclosures already installed. Burrow entrances are blocked for the same period of time as in hard releases (overnight). Enclosures are removed approximately 10-14 days after pairs were placed in the enclosures (Fig 1). We consider this a minimum for enclosure time and longer duration is being evaluated with other studies. In 2005 and 2006, both hard-release and soft-release techniques were used equally among the various release sites, ensuring that the two treatments were spatially interspersed and could be compared. Survival and productivity of soft-released birds was about twice that of hard-released birds as of 2007 (Mitchell 2008). Now all birds are soft-released, unless one is needed as a mate for returning birds. In that case, selected birds are hard-released near the burrow occupied by a known returning bird.

Table 1 - Number of Released and Recruited Burrowing Owls in British Columbia, Canada from 1992-2017 (adapted from Mitchell, 2008).
* The number of owls that returned from migration each year
** Years employing the soft-release method

Tabela 1 - Número de corujas-buraqueiras libertadas e recrutadas na Colúmbia Britânica, Canadá, em 1992-2017 (adaptado de Mitchell 2008).

YEAR	NO. RELEASED	NO. PRODUCED	TOTAL NO. RECRUITED TO POPULATION*	WILD-HATCHED JUVENILES PRODUCED PER OWL (CAPTIVE + RECRUITED)
1992	9	0	0	0.00
1993	15	0	0	0.00
1994	21	10	1	0.45
1995	18	11	3	0.52
1996	21	5	2	0.22
1997	24	2	0	0.08
1998	37	7	2	0.18
1999	34	3	2	0.08
2000	33	16	2	0.46
2001	71	60	7	0.77
2002	46	45	7	0.85
2003	29	13	8	0.35
2004	53	46	9	0.74
2005**	81	103	10	1.13
2006**	91	130	15	1.23
2007**	120	200	18	1.45
2008**	116	132	16	1.00
2009**	103	213	15	1.81
2010**	99	168	23	1.38
2011**	89	259	19	2.40
2012**	81	167	21	1.64
2013**	84	130	15	1.31
2014**	100	191	17	1.63
2015**	67	189	50	1.62
2016**	53	160	40	1.72
2017**	96	183	27	1.49

Supplemental feeding

The diets of released owls in the soft-release cages are supplemented every 3–4 days during regular nest visits, with the equivalent of 1.5 food items (frozen laboratory mice, *Mus musculus,* and domestic chicks, *Gallus gallus domesticus*), averaging 42.5 g per adult per day, from immediately after placement in burrows through to fledging of chicks, which is defined as 28–35 days-post-hatch. Although the pairs not housed in enclosures are free to hunt for natural prey items, both groups are provided equivalent amounts of supplemental food. After fledging, only one food item per bird observed is provided at each visit. Once the wild-hatched juveniles of the released owls reach 4-5 wk-old they are banded with a U.S. Geological Survey aluminum band and a metal green/black alpha-numeric (Acraft) band (Mitchell 2008).

Results

Survival and Productivity of released owls

The use of the soft release technique (or enclosure-based soft-releases) showed that owls released in this manner were more likely to survive and produce offspring (Table 1). The average breeding season survival (e.g., April to August) of released owls after the introduction of the soft-release method in 2005 increased from 50% for hard-released birds to 70% for soft-released birds. Productivity of released owls also increased by 40% for clutches initiated, 26% for eggs hatched, and 16% for juveniles fledged (Mitchell et al. 2011). Since 2005, the number of juveniles produced per released bird has ranged from 1.0 up to 2.4 (Table 1).

Returning and Migrating Owls

Returning Owls

Since 1992, 329 Burrowing Owls have returned to release sites. Summary from work comparing soft- and hard-release birds from 2005-2007 showed that more offspring from soft-release pairings returned than those from hard-release. From 2005-2007, 0.17 offspring were recruited into the local wild breeding population per soft-released pair, compared to 0.05 local recruits per hard-released pair (Mitchell et al. 2011). Over these years of study, wild-hatched offspring also returned at a higher rate than captive-hatched owls.

Sightings of Migrating Owls

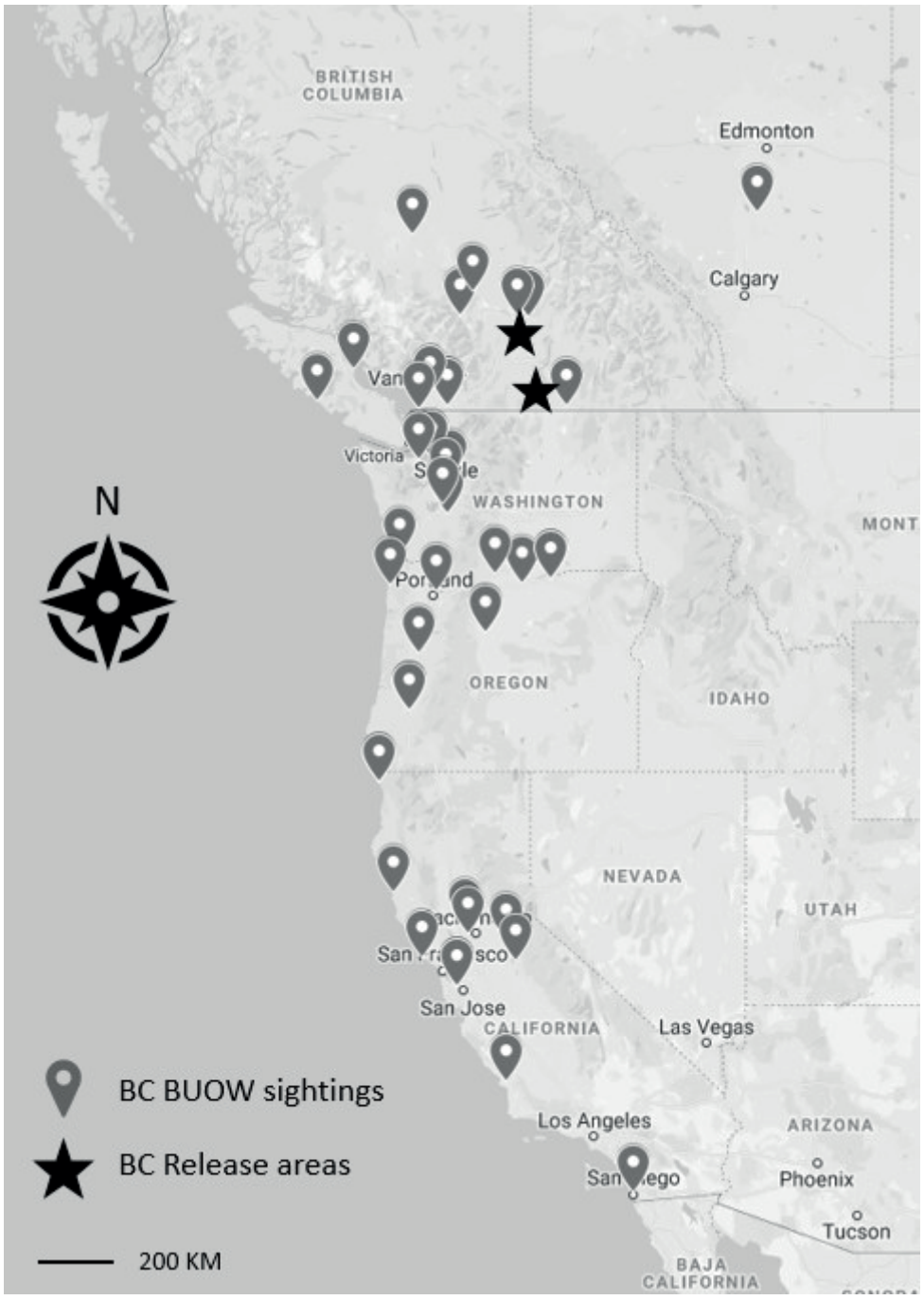
From 1989 to 2017, 47 BC Burrowing Owls have been encountered within BC and throughout the coastal western US, with most encounters occurring in October and November. While most owls were encountered once, two owls were encountered two years in a row. The furthest sighting has been reported in San Diego, California, very close to the Mexican border at 1,960 km; the average distance to encounter was 627 km. Evidence from encounters appears to indicate a selection for a coastal rather than an interior migration route for BC Burrowing Owls (Fig. 2). Results also show that wild-hatched owls (32 of 47; 68%) were more frequently encountered than captive-hatched owls (9 of 47; 20%). There were 6 (6 of 47; 13%) owls that were not able to be defined as their band numbers were not able to be read, however they were confirmed to have green over black bands (BC specific).

Comparisons to other areas

From USGS Bird Banding Laboratory data, for the period of 1 January 1992 through to 31 December 2017, a total of 42,163 Burrowing Owls were banded; during this same time a total of 428 (1.02%) banded owls were 'encountered' (e.g., band recoveries, re-sightings, etc.) (David H. Johnson pers. comm. 2019). For banded owls released and wild-hatched in British Columbia from 1992-2017, 375 (46 sighted during 1992 to 2014

Figure 2 - Encounters (band re-sights and recoveries) of 47 British Columbia Burrowing Owls from 1989 to 2017.

Figura 2 - Registos (recapturas visuais de anilhas e recapturas de aves) de 47 corujas-buraqueiras na Colúmbia Britânica de 1989 a 2017.



migration and 329 returned to release sites from 1992 to 2017) out of 4,034 or 9.3% were encountered. Juvenile return rates in particular appear higher in BC owls, with 71 of 1,797 (3.95%) banded juveniles returning to the Regina Plain area of Saskatchewan from 1992 to 2001 and 7 of 121 (5.78%) in the study years 2005-2007 in BC (Troy Wellicome pers. comm. 2017, Mitchell et al. 2008).

Discussion

Restoring imperiled species is a complex and difficult task which implies growing scientific basis for wildlife reintroductions, including captive breeding and release (Jachowski et al. 2016). In terms of owls, captive breeding and release is uncommon thus far. For example, the Northern Spotted Owl Breeding Programme in BC is currently perfecting the breeding process and has yet to release any individuals (Jasmine McCulligh pers. comm. 2018). In Manitoba, although currently on a small scale (n>15), efforts are being made in an attempt to increase Burrowing Owl breeding, and there are hopes of improved funding and release opportunities (Alexandra Froese pers. comm. 2019). In Europe there has been successful breeding and releasing of Ural Owls into the forests of Germany (Ingrid Kohl pers. comm. 2018).

The longest running captive breeding and release program for Burrowing Owls in North America has been with the Burrowing Owl Conservation Society of BC. Many years have been spent developing multi-faceted approaches to applied conservation. The society continues to be successful at producing and releasing captive-hatched owls (n=100) and improving released owl survival, nesting success, and the number of wild-hatched young produced. Some of the methods developed and improved upon through the years in BC are being utilized in other translocation and conservation programs, e.g., captive breeding methods as well as design of artificial burrow design, installation and maintenance. Translocation and release programs in California, Arizona, Florida, Minnesota, Oregon, Manitoba and Alberta have benefited from this program.

Ongoing Burrowing Owl recovery work in BC will focus on continuing to monitor and survey released and returning owls, increasing our knowledge of their migration route, identifying factors contributing to decline, working cooperatively to implement mitigation measures on a continental scale, expanding public education about grassland ecology, and supporting landowners in their stewardship efforts. Future effort will include greater scientific analyses of the program and how it fits into the overall recovery of the Burrowing Owl in North America.

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