Dispersal and Survival of Three Captive-bred Great Horned Owls *Bubo virginianus* in Southeastern Minnesota

Karla A. Bloem and Hein Bloem

*In November 2013, we released three captive-bred juvenile Great Horned Owls (*Bubo virginianus*) near Houston, Houston County, Minnesota. The owls were siblings hatched on 15, 17, and 21 March 2013. They were fitted with tail-mounted transmitters that enabled us to track their dispersal and survival. We tracked the oldest owl (a female) for 4 days, the middle owl (a male) for 36 days, and the youngest owl (a female) for 204 days. The oldest owl may have made a long-distance dispersal movement out of the study area. The middle owl did not leave the immediate release area before his central tail feathers broke off at the transmitter attachment point. The youngest owl wandered until settling for the winter 30 km east of the release site. In the spring she followed the Mississippi River Valley and settled 32 km northwest of her wintering area until her signal was lost. We relocated the signal and transmitter (which was attached to a molted tail feather) in the fall after leaf drop. We did not document any mortality or breeding attempts.*

Captive-bred owls reared by adults of their own species with minimal human contact develop a natural fear of humans and can be successfully released to the wild after training on live prey in a flight pen (McKeever 1987). Captive-bred Eurasian Eagle Owls *(Bubo bubo)* and Eurasian Pygmy-Owls *(Glaucidium passerinum)* have even been used to successfully reintroduce viable populations of their species into the wild in Germany (Radler and Bergerhausen 1988; König 1998).

As part of our research on the vocal development of juvenile Great Horned Owls, we bred a pair of wild, non-releasable birds that were injured as adults and had retained their natural fear of humans. The young were raised essentially wild by their parents, with minimal human contact, to ensure their vocal development was as natural as possible. This rearing protocol was important for the research and resulted in offspring that were poorly suited for a life in captivity and best suited for release to the wild after vocal maturity.

We obtained permits from the Minnesota Department of Natural Resources and U.S. Fish and Wildlife Service to release a brood of three captive-bred Great Horned Owls and used telemetry to track their dispersal and survival.

Materials and Methods

We acquired two non-releasable Great Horned Owls in 2010, each with sight in only one eye, from the Raptor Education Group, Inc. (REGI) in Antigo, Wisconsin. The owls had demonstrated a preference for each other while housed with other Great Horned Owls at REGI and were thus considered a suitable pair for this study. Blood tests confirmed that one was male and one was female (Zoogen, Inc., Davis, California). Each bird was injured as an adult and demonstrated natural fear of humans.

The owls were housed on our property 6 km northwest of Houston in the Root River Valley in the Blufflands subsection of the eastern broadleaf forest (Minnesota Department of Natural Resources 2000). The facilities consisted of a breeding and release training aviary complex as recommended by Katherine McKeever of The Owl Foundation (pers. com.). The breeding pen was 3.7 m x 11 m and the release training pen was 3 m x 18 m, both with

Figure 1. Non-releasable wild adult Great Horned Owls in the breeding and release training facility near Houston, Minnesota.

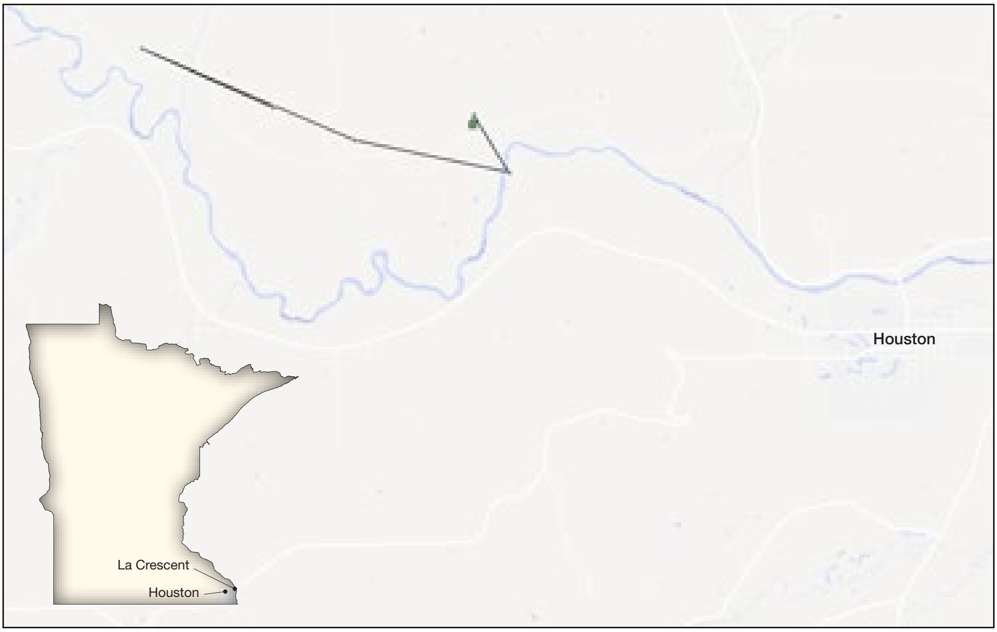

Figure 2. Mapped locations of older female "Pandora" relocated on four days. Each dot represents one location. Green square is the release site. Inset map shows Houston County and the towns of Houston and La Crescent.

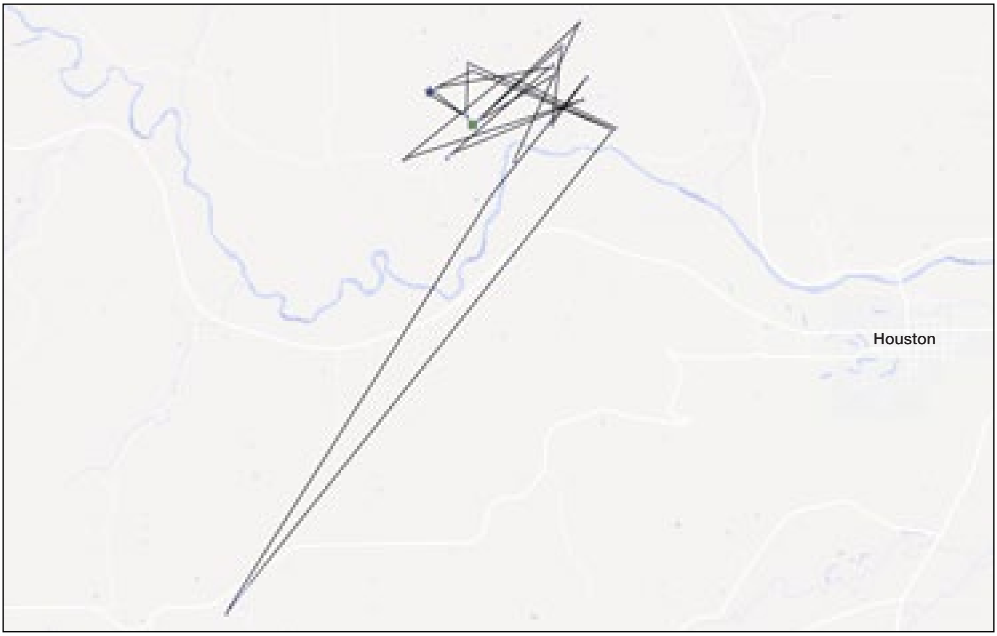

Figure 3. Mapped locations of male "Patrick" relocated on 23 days. Each dot represents one location. Green square is the release site. Star represents location where we recovered his transmitter.

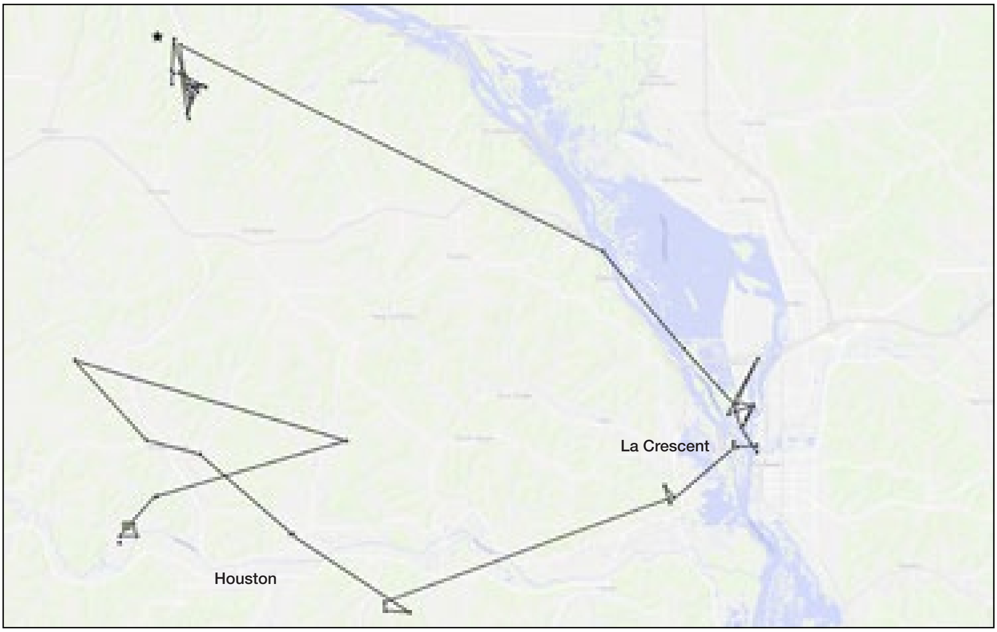

Figure 4. Mapped locations of younger female "Patience" relocated on 64 days. Each dot represents one location. Green square is the release site. Star represents location where we recovered her transmitter.

a 3.7 m high ceiling. The two aviaries were connected by a 1.2 m x 0.6 m door located 2.4 m above floor level. When the door was open, the owls could fly the entire 29 m length of the structure. The walls of the structure were made of a combination of wooden slats and chain link fencing. The entire structure was covered with screen on the exterior to exclude insects and the diseases they transmit (Figure 1).

We, along with many volunteers, remotely observed the captive owls using two Vivotek SD8362E pan/tilt/zoom cameras and five Vivotek FD8361 fixed cameras.

In 2013, the captive breeding pair laid three eggs that hatched on 15, 17, and 21 March. We placed yellow zip-tie U.S. Fish and Wildlife Service bands on the owlets on 28 April and took blood samples for genetic sex testing (Zoogen Inc., Davis, California). The older ("Pandora") and younger ("Patience") owlets were females and the middle owlet was male ("Patrick").

The owlets remained with their parents with very minimal human contact and full access to the flight and breeding pens through fledging and the introduction of live prey. We separated the owlets into the flight pen and the adults into the breeding pen on 12 August and closed the door between the pens. We continued to provide a combination of captive-reared live rats and some dead natural prey items (plains pocket gophers, *Geomys bursarius*, and eastern chipmunks, *Tamias striatus*) to the owlets until they were released.

All three juvenile owls produced the primary song of the species in a normal adult voice by late October 2013 and thus we considered them vocally mature.

On 5 November, we captured the juveniles and affixed tail-mounted radio transmitters with a one-year battery life (L. L. Electronics, Mahomet, Illinois) on the central rectrices of each owl with the assistance of Robert Anderson and Amy Reis of the Raptor Resource Project. The transmitters weighed 18 g each, less than 3% of the birds' body weight, as recommended by Kenward (2001).

We remotely observed the juvenile owls in their flight pen for three days and saw no evidence that the owls noticed their transmitters. We opened the flight pen's release door on 8 November after dark and allowed the young owls to leave on their own. We left the release door open and continued to provide food for several days, but no owls returned to the flight pen. A wild pair of Great Horned Owls entered the flight pen multiple times, however.

We tracked the owls during the day using a hand-held radio receiver with a three-element Yagi antenna and a rooftop omnidirectional antenna (F. L. Electronics, Mahomet, Illinois). We tracked the owls daily for the first week, then at least twice weekly until we could no longer find the signals. We flew over the dispersal area in an airplane three times to relocate lost signals (2 December 2013, 21 March, and 12 May 2014).

Results

We tracked the older female owl ("Pandora") until 12 November (4 days), the male owl ("Patrick") until 14 December (36 days), and the younger female owl ("Patience") until 31 May 2014 (204 days). All stayed within the Blufflands subsection, even though the distances dispersed would have allowed at least one owl to leave the Blufflands (Figures 2–4).

The older female ("Pandora") moved to the northwest 4.2 km over four days before we lost her signal. We were not able to relocate the signal even by flying circles in a 24 km radius from the release site on 2 December. The transmitter may have failed, dropped off in an area of dense vegetation that could not be penetrated by the transmitter signal, or the owl may have rapidly dispersed a long distance.

The male owl ("Patrick") stayed almost exclusively within 2.0 km of the release site. When his signal stopped moving we located his transmitter, still affixed to his central rectrices, on the ground. The feathers were broken off at the upper attachment point of the transmitter. This may indicate that the owl bit off his own tail feathers to shed the transmitter or that the string attaching the transmitter was too tight and pinched the feather shafts causing them to eventually break (Figure 5).

The younger female owl ("Patience") moved around repeatedly. She settled into a small area (6.4 km^2) on the Mississippi River bottoms adjacent to the city of La Crosse, Wisconsin, about 30 km from the release site, from 16 December 2013 to 6 March 2014. When the weather began to warm up, she moved north and settled in a valley south of Winona, Minnesota, by 21 March, about 32 km northwest

Figure 5. Transmitter from the male owl, Patrick, showing rectrices broken at the upper points of attachment.

of her wintering area and about 25 km north of the release site. She remained in an area 4.4 km long by 1.6 km wide until we could no longer find her signal. The last signal recorded was on 31 May 2014.

We attempted to re-find her signal in the fall after leaf drop. On 20 October 2014, we relocated the signal and on 27 October we located the transmitter on the ground atop a forested bluff, still attached to one rectrix that appeared to be naturally molted. The loss of the transmitter signal on 31 May corresponded with the central tail feather molt of three other captive Great Horned Owls (24 May to 7 June) at our facility.

In October and November 2014, a male and female Great Horned Owl sang regularly in the general area where we recovered the younger female's transmitter. Recordings of the owls' spontaneous calling did not match the primary song pattern of any of the three released owls when analyzed spectrographically (Spectrogram 14, Visualization Software LLC).

We were not able to collect pellets for prey analysis because the owls appeared to roost in different trees each night, even when staying in a local area. This lack of habitual roost trees in non-territorial floaters corresponds with the findings of Rohner (1997).

Discussion

Survival rates of wild first-year Great Horned Owls vary from year to year. Around Cincinnati, Ohio, the first year survival rate was as much as 72% (Artuso et al. 2014). In the Yukon, after dispersal in autumn, mortality of non-territorial floaters was similar to adult territory holders in years of good prey abundance, averaging 90.5% ± 7.3 SE, but as low as 40% when prey was scarce (Rohner 1996). First year survival of our brood of captive-bred owls was at least 33%, but may have been as high as 100% as we did not find any dead owls.

Dispersal of juvenile Great Horned Owls from their natal territories varied in different studies. In South Dakota, Dunstan (1970) found one wild juvenile that did not disperse from its natal territory until after the onset of the next breeding season, but three other wild juveniles made flights up to 12 km from their natal territory. In Texas, Johnston (2007) tracked juveniles that had been admitted to a rehabilitation facility, reared by adults of their species, and trained on live prey. The owls that were tracked at least over the winter months ranged distances of 3–10 km from the release site. There was no clear wandering phase before settlement, as exhibited by our younger female owl. Kimmel and Zwank (1983) found that human-reared and imprinted owlets in Louisiana did not travel more than 0.5 km from the release site through November when signals were lost.

Rohner (1996) found that by their first spring 29–45% of radio-tracked juvenile Great Horned Owls dispersed less than 35 km from their natal territories in the Yukon, with the higher proportion dispersing >35 km during a low in the snowshoe hare (*Lepus americanus*) cycle. Recoveries within the first year after banding for Great Horned Owls banded as nestlings by Houston in Saskatchewan showed that most stayed within 25 km of the banding site (76% in high snowshoe hare years and 55% in low years, Houston 1995). Extreme long-distance movements of >500 km were much more common for owls hatched in years of low prey abundance (28% in low years and 6% in high years).

Great Horned Owls were more sedentary in Ohio. Austing and Holt (1966) noted that most young owls recovered from their banding study were within 32 km of their natal territory, and few dispersed to adjacent states.

More intensive dispersal research exists for the closely related Eurasian Eagle Owl. For Eurasian Eagle Owls hatched in Switzerland, Aebischer et al. (2010) found that the initial dispersal phase from their natal territories lasted an average of 29.8 days (n=16). They settled on wintering grounds an average of 46.1 km from their natal territories. Four individuals (of nine) that were tracked beyond the first winter left their wintering area between the end of March and mid-April and spent the next summer in areas at least 20 km away from their wintering area. Two wintered where they had the previous year. The movements of our younger female owl ("Patience") resemble this dispersal pattern.

However, del Mar Delgado et al. (2009) found that the Eurasian Eagle Owls they studied in southwest Spain did not end the initial wandering phase of dispersal until they were around one year old (395±109.86, range=181–640 days old). In contrast, juvenile Eurasian Eagle Owls in the Netherlands settled in autumn rest places (locations where they stayed for 30 or more days) an average distance of 53 km (range 5.7–149.5, n=10) from the nest they were hatched in only 8–44 days after leaving their natal territory. Most Dutch birds left these fall stopping places between early November and early March and eventually settled in other locations (Wassink 2014). Perhaps the different dispersal behaviors in each different region are related to weather. Of these three European regions, the weather in Switzerland is most similar to Minnesota.

The maximum single-night movement of a Eurasian Eagle Owl during the dispersal phase in Switzerland was 34 km (Aebischer et al. 2010). If Great Horned Owls are capable of similar movements, it is possible that we lost the signal on our older owl ("Pandora") due to rapid, long-distance dispersal from the area.

Rohner (1996) documented 3 of 20 Great Horned Owls (all females) breeding in their first year. We did not document breeding in any of our released owls, despite an unmated wild male occupying a territory immediately adjacent to the aviaries where the owlets were raised and released. This male was single from the time we found his mate injured in July 2012 (she died at The Raptor Center at the University of Minnesota) until he disappeared from our acoustic monitoring record in 2015.

This study shows that it is possible for a captive-bred Great Horned Owl to disperse normally and survive in the wild at least through its first spring despite extreme winter conditions. The winter of 2013–2014 had the 5th lowest average winter temperature and the 2nd most days with measurable snowfall ever recorded in La Crosse, WI (http://www.crh.noaa.gov) through that year. We documented no mortality, injuries, or habituation to humans.

Acknowledgments

We thank the Minnesota Department of Natural Resources and U.S. Fish and Wildlife

Service for permits to conduct this research, the Raptor Education Group, Inc. for non-releasable owls to breed, and 50+ private foundations and individuals for funding. Roger Meyer and Laurel Oien constructed the aviary complex and Alan Stankevitz installed the security cameras. Numerous volunteers helped with observations in the aviaries prior to release. Dave Noble and Sue Fletcher assisted with banding. Ken Fordahl and Crystal Gehring assisted with tracking, and Dale Scobie provided airplane tracking. Audio recordings in the vicinity of the transmitter recovery site were made by Peggy Rausch. We thank the late Katherine McKeever of The Owl Foundation for advice on aviary design and release training protocols, and the late Robert Anderson and Amy Ries of the Raptor Resource Project for advice and assistance affixing the transmitters. Jeff Matejka provided permission and assistance in locating the molted transmitter. Marjon Savelsberg and especially Tex Sordahl provided comments to significantly improve the manuscript.

Literature cited

Aebischer, Adrian, Peter Nyffeler, and Raphaël Arlettaz. 2009. Wide-range dispersal in juvenile Eagle Owls (*Bubo bubo*) across the European Alps calls for transnational conservation programmes. *Journal of Ornithology* 151:1–9.

Artuso, Christian, C. Stuart Houston, Dwight G. Smith, and Christoph Rohner. 2014. Great Horned Owl (*Bubo virginianus*), The birds of North America online (A. Poole, Ed.). Cornell Lab of Ornithology. Ithaca, NY. Retrieved from the birds of North America online: http://bna.birds.cornell.edu/bna/species/372

Austing, G. Ronald and John B. Holt Jr. 1966. The world of the Great Horned Owl. J. B. Lippincott Company, Philadelphia, PA and New York, NY. 158 pp.

del Mar Delgado, María, Vincenzo Penteriani, Vilis O. Nams, and Letizia Campioni. 2009. Changes of movement patterns from early dispersal to settlement. *Behavioral Ecology and Sociobiology* 64:35–43.

Dunstan, Thomas C. 1970. Post-fledging activities of juvenile Great Horned Owls as determined by radio-telemetry. Ph.D. dissertation. University of South Dakota, Vermillion. 110 pp.

Houston, C. Stuart. 1995. Survival of Great Horned Owls in relation to the snowshoe hare cycle. *The Auk* 112:44–59.

Johnston, Jennifer Lynn. 2007. Home range analysis of rehabilitated and released Great Horned Owls (*Bubo virginianus*) in Denton County, Texas, through radio telemetry. Masters Thesis. University of North Texas, Denton. 36 pp.

Kenward, Robert E. 2001. A manual for wildlife radio tagging. Academic Press. San Diego, CA. 311 pp.

Kimmel, Frederick and Phillip J. Zwank. 1983. Post-release survivorship, dispersal and food habits of captive reared Great Horned Owls. *In* Proceedings of the Second Annual National Wildlife Rehabilitation Symposium. Paul Beaver, editor. Exposition Press, Inc. Smithtown, NY. 188:104–108.

König, Claus, 1998. Ecology and population of pigmy owls *Glaucidium passerinum* in the Black Forest (S.W. Germany). *Holarctic Birds of Prey* pp. 447–450.

McKeever, Katherine. 1987. Care and rehabilitation of injured owls. Page 164. W. F. Rannie. Lincoln, Ontario. 196 pp.

Minnesota Department of Natural Resources. 2000. Ecological classification system. https://www.dnr.state.mn.us/ecs/222Lc. Accessed 11/24/19.

Radler, Karl and Wilhelm Bergerhausen. 1988. On the life history of a reintroduced population of Eagle Owls (*Bubo bubo*). *In* Proceedings of the international symposium on raptor reintroduction, 1985. Institute for Wildlife Studies. David K. Garcelon and Gary W. Roemer, eds. pp 83–94.

Rohner, Christoph. 1996. The numerical response of Great Horned Owls to the snowshoe hare cycle: consequences of non-territorial 'floaters' on demography. *Journal of Animal Ecology* 65:359–370.

Rohner, Christoph. 1997. Non-territorial 'floaters' in Great Horned Owls: space use during a cyclic peak of snowshoe hares. *Animal Behaviour* 53:901–912.

Wassink, Gejo. 2014. Dispersie van jonge oehoes in beeld gebracht met satellietzenders en GPS-loggers. *Limosa* 87:91–98.

International Owl Center, 126 East Cedar Street, Houston, MN 55943.