Assessing the effectiveness of bird rehabilitation: temporarily captive-reared Little Owls (Athene noctua) *experience a similar recruitment rate as wild birds*

Olivier Hameau & Alexandre Millon

Journal of Ornithology

ISSN 2193-7192

J Ornithol
DOI 10.1007/s10336-019-01633-2

Journal of Ornithology
https://doi.org/10.1007/s10336-019-01633-2

SHORT COMMUNICATION

Assessing the effectiveness of bird rehabilitation: temporarily captive-reared Little Owls (*Athene noctua*) experience a similar recruitment rate as wild birds

Olivier Hameau[1] · Alexandre Millon[2]

Received: 20 August 2018 / Revised: 10 January 2019 / Accepted: 25 January 2019

Abstract

A large number of young birds are caught each year shortly after having left the nest and subsequently brought to bird care centres. These birds are temporarily hand-raised before release. To date, the effectiveness of this action has remained largely unassessed. Here we monitored the fate of 119 rehabilitated Little Owls (*Athene noctua*) and found that the recruitment rate of the rehabilitated birds was similar to that of wild birds (11.8% of 119 rehabilitated birds vs. 10.7% of 382 wild fledglings). The timing of release, i.e. whether rehabilitated birds were released in the autumn or in the following spring, did not appear to affect recruitment probabilities, although birds released the following spring showed a tendency for reduced breeding success and dispersal compared to wild birds, suggesting that autumn releases may be more favourable.

Keywords Owls · Nocturnal raptor · Bird care centre · Population reinforcement · Breeding success

Zusammenfassung

Wie effektiv sind Rehabilitationsmaßnahmen bei Vögeln? Zeitweise in Gefangenschaft aufgezogene Steinkäuze (Athene noctua) zeigen eine ähnliche Rekrutierungsrate wie Wildvögel

In jedem Jahr wird eine große Zahl Jungvögel kurz nach Verlassen des Nests von Menschen aufgegriffen und in Pflegestationen gebracht. Diese Vögel werden vorübergehend von Hand aufgezogen, bevor sie wieder in die Freiheit entlassen werden. Allerdings ist die Wirksamkeit dieser Maßnahmen bisher weitestgehend unerforscht. Hier verfolgten wir das Schicksal von 119 in Pflege genommenen Steinkäuzen (Athene noctua) und beobachteten eine ähnliche Rekrutierungsrate wie bei Wildvögeln (11,8 % von 119 Pfleglingen verglichen mit 10,7 % von 382 flüggen Wildvögeln). Dabei scheint es die Rekrutierungswahrscheinlichkeit nicht zu beeinflussen, ob die Pfleglinge im Herbst oder im folgenden Frühling freigelassen wurden, obgleich letztere eine Tendenz zu verringertem Bruterfolg und Dismigration zeigten, was andeutet, dass eine Freilassung im Herbst günstiger ist.

Introduction

The period after fledging is a critical phase during which young birds leave their nest with only limited flight skills (Cox et al. 2014). During this period, they are highly vulnerable to predation, but they can also be collected by unaware people and brought to bird care centres. There, they will be hand-reared and usually kept in conditions where they can improve flight skills before being released into the wild.

This ex situ conservation action is widespread, especially for nocturnal raptor species in which chicks leave their nest well before being able to fly. In France, for example, a total of 2333 young owls of seven species were brought to eight bird care centres between 2009 and 2015; in 78% of these

Communicated by F. Bairlein.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10336-019-01633-2) contains supplementary material, which is available to authorized users.

✉ Alexandre Millon
alexandre.millon@imbe.fr

[1] Ligue pour la Protection des Oiseaux Provence Alpes Côte d'Azur (LPO PACA), Villa Saint Jules, 6 Avenue Jean Jaurès, 83400 Hyères, France

[2] Aix Marseille Université, CNRS, IRD, Avignon Université, Institut Méditerranéen de Biodiversité et d'Ecologie (IMBE), Technopôle Arbois-Méditerranée, 13545 Aix-En-Provence, France

Published online: 08 February 2019

cases this action was considered to be unnecessary (A.-L. Dugué and Ligue pour la Protection des Oiseaux, personal communication). However, the effectiveness of this ex situ conservation action has been rarely assessed, and dedicated studies often suffer from a paucity of data and/or the lack of a proper control group (Joys et al. 2003). Whether temporary captivity at young age affects the probability of the bird to recruit into the wild population and successfully reproduce has not been properly investigated to date (Ellis et al. 2000; Goldsworthy et al. 2000).

We have assessed the rehabilitation effectiveness of young Little Owls (*Athene noctua*) by monitoring the fate of birds released in an intensively monitored study area and comparing recruitment probability, dispersal and annual breeding success to those of wild birds. We further tested whether releasing rehabilitated birds in the following spring, instead of in the autumn, can reduce overwinter mortality and therefore possibly enhance the efficacy of reinforcement/reintroduction schemes (Van Nieuwenhuyse et al. 2008; Mitchell et al. 2011).

Methods

Study species, study area and population monitoring

The Little Owl is a small-sized nocturnal raptor native to temperate and Mediterranean regions of the Western Palearctic where the species inhabits open farmland, including vineyards and orchards. Chicks leave their nest at 28–32 days of age, with only limited flight skills (Van Nieuwenhuyse et al. 2008); an additional 10–14 days are required for the owlets to learn to fly properly (Schönn et al. 1991).

We monitored a wild population of Little Owls over a 100-km^2 area in the Apt valley (43°54′11″N 5°17′37″E) of Luberon Nature Park in south-eastern France (Electronic Supplementary Material [ESM] Fig. S1). The area consists of a mix of farming areas, including vineyards, orchards and cereals (74%), with wooded areas (21%). Between 97 and 115 nest-boxes were monitored annually between 2006 and 2017 according to a standardised protocol (see ESM). The number of nest-boxes occupied by a breeding pair increased from five to 24 between 2006 and 2009, then oscillated between 25 and 34 from 2010 onwards. An unknown number of pairs bred outside nest-boxes, in natural cavities or buildings, and were therefore not monitored. Vocal activities peaked in March–April, and the median date of first-egg laying was April 29th ($N=204$). Nest-box monitoring included the capture and ringing of breeding adults and of all chicks when 15–20 days old (see ESM for details on the protocol). We considered an owl to be a recruit when it was caught in a nest-box containing eggs or chicks. Dispersal distances were calculated between the birth nest-box (wild birds) or the release nest-box (rehabilitated birds), and the nest-box used for prime reproduction.

Captive-rearing techniques and release

During the study period, between five and 25 fledglings (mean ± standard deviation: 14 ± 6 individuals), typically 4–6 weeks old, were brought annually to the bird care centre maintained by the Ligue pour la Protection des Oiseaux Provence Alpes Côte d'Azur (LPO-PACA) in Buoux (43°49′55″N 5°22′42″E), 5 km from the centre of the study area. Birds were brought to the center from the PACA region, within a radius of approximately 100 km around Buoux. Standard procedure was to keep the owls indoor for 1 week in a box to ascertain they were able to feed by themselves, following which they were then transferred to small outdoor aviaries (dimensions: length × width × height: $8 \times 6 \times 3$ m) for 4 weeks and finally into a larger pre-release aviary ($30 \times 6 \times 2.5$ m). Contacts with h humans were limited to a once-daily feeding event. The food items provided were a mix of dead 1-day-old chickens and mice (2 prey day^{-1}). No live prey were given.

A total of 119 Little Owls have been released between 2008 and 2015 (Table 1). All 119 birds were fitted with a metal ring (Museum National d'Histoires Naturelles, Paris, France) and sexed using molecular techniques (see ESM); of these 32 birds were additionally fitted with a radio-transmitter weighing 2.5 g glued onto the central tail feathers (see ESM for details). Release events systematically consisted of one female and one male (one exception in 2013; see Table 1) put together in a nest-box that was unoccupied during the previous breeding season. No food was provided in the nest-box. Four cohorts (birds born in 2007–2010; $N=74$) were released in March of the subsequent year $t+1$) i.e. at the start of the breeding season. The rationale behind this later release was to allow the owls to spend the winter under benign conditions, fed ad libitum, to reduce overwinter mortality. Then, three cohorts (birds born in 2013–2015; $N=45$) were released in September of their birth year. This period precedes the autumn peak of vocal activity in the Little Owl, when dispersal and territory acquisition takes place (Exo 1988). No owls born in 2011–2012 were released in the study area.

Statistical analyses

Statistical analyses were run using R 3.4.3 statistical package® Development Core Team 2017). Recruitment probabilities were modelled using generalised linear mixed models with binomial distribution of error and year as random factor (function *glmmPQL*). Dispersal data were modelled using linear models with log10-transformed

Table 1 Numbers of young Little Owls (*Athene noctua*) released annually after being brought to the bird care centre and later recaptured as breeder compared with wild birds monitored in the same study area (Luberon Nature Park)

Cohort	Release period	Number of birds released	Number of rehabilitated birds recruited	Percentage	Number of ringed wild birds	Number of wild birds recruited	Percentage
2007	Spring $t+1$	20	1	5	16	1	6.3
2008	Spring $t+1$	14	3	21.4	37	7	18.9
2009	Spring $t+1$	18	3	16.7	63	8	12.7
2010	Spring $t+1$	22	2	9.1	59	9	15.3
Total in spring $t+1$		74	9	12.2	175	25	14.3
2013	Autumn t	13	2	15.4	65	7	10.8
2014	Autumn t	12	1	8.3	71	5	7
2015	Autumn t	20	2	10	71	4	5.6
Total in autumn t		45	5	11.1	207	16	7.7
Grand total		119	14	11.8	382	41	10.7

Rehabilitated birds were released either in autumn of their first year of life (autumn t) or in next spring (spring $t+1$), after a winter kept in captivity

distances (adding the minimal non-zero recorded distance, δ). Breeding success was measured as the number of fledglings raised by a female Little Owl (male data were too sparse for conducting similar analyses) minus the annual mean number of fledglings per pair, to account for among-year variability. Relative breeding success was then modelled using mixed linear models with female identity as the random factor. Individual age was included as an explanatory covariate (log-transformed). Residuals from Gaussian models (dispersal and breeding success) were checked for normality and homoscedasticity. Regression coefficients (β) were shown ± 1 standard error.

Results and discussion

Recruitment probability

Overall, owls that passed through the care centre had a recruitment probability similar to that of wild birds from the same cohorts (14 recruits out of 119 rehabilitated birds [11.8%] vs. 41 out of 382 wild birds [10.7%]; $\beta = 0.10 \pm 0.33$, $P = 0.76$; Table 1). Annual recruitment rates for the two groups were slightly correlated ($r = 0.74$, $N = 7$, $P = 0.057$), suggesting similar processes were governing temporal variation in recruitment. Transmitters did not seem to affect the probability of an owl to recruit (6 recruits out of 32 birds with transmitters, 3 out of 42 without transmitters; $\beta = 0.68 \pm 0.48$, $P = 0.15$). This result is not surprising given most birds had lost their transmitters before the start of the breeding season, therefore limiting the burden of carrying extra-weight (for details see ESM Fig. S2).

What is the best season for releasing rehabilitated owls?

To answer the question of "What is the best season for releasing rehabilitated owls?" we compared the fate of birds released in autumn t versus those released in the spring $t+1$. Although we acknowledge the optimal setting would have been to release birds from the same cohort in the two seasons, the within-cohort comparison of recruitment probabilities between rehabilitated and wild birds nevertheless provides some relevant information. Among the 79 birds kept in captivity during their first winter, five died overwinter (6.3%), indicating captivity strongly reduced winter mortality, as apparent survival of first-year Little Owls ranges between 8 and 30% (Exo and Hennes 1980; Schaub et al. 2006; Le Gouar et al. 2011). However, recruitment probabilities were not higher for birds released in the spring than for birds released during the autumn of their first year of life (12.2% [spring $t+1$] vs. 11.1% [autumn t]; Table 1). Overall, recruitment probability of wild birds did not differ from that of rehabilitated birds released in either period (spring release: $\beta = 0.19 \pm 0.42$, $P = 0.66$; autumn release: $\beta = -0.40 \pm 0.54$, $P = 0.46$).

Dispersal distances between natal or release and breeding nest-boxes ranged from 0 to 14,010 m (median 1960 m, $N = 86$). Females dispersed slightly further than males (log10-transformed values + $\delta = 190$; $\beta = 0.20 \pm 0.08$, $P = 0.02$). Rehabilitated birds released in the spring had shorter dispersal distances than wild birds ($\beta = -0.56 \pm 0.14$, $P < 0.001$), while there was no such difference when release took place in autumn ($\beta = -0.01 \pm 0.17$, $P = 0.95$; Fig. 1).

Breeding success of female Little Owls increased with age (log-transformed age $\beta = 0.61 \pm 0.26$, $P = 0.02$, $N = 114$ breeding events from 60 known-age females, including

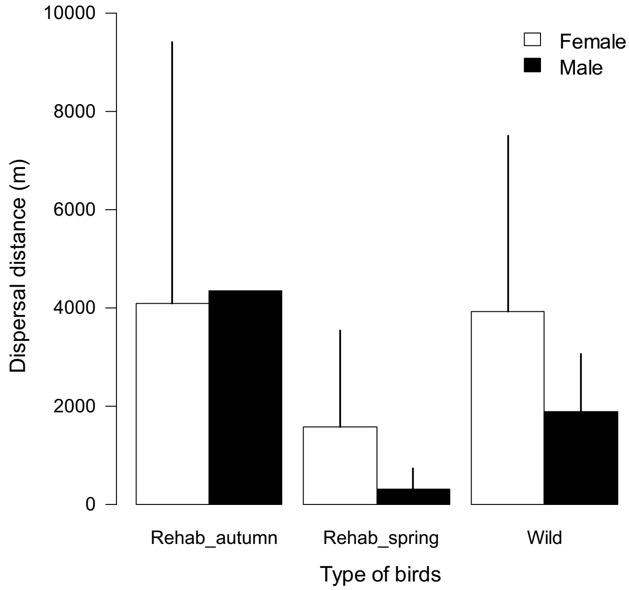

Fig. 1 Dispersal distances (± 1 standard deviation) between natal or release nest-boxes and nest-boxes where first breeding was recorded for Little Owls (*Athene noctua*) according to sex and bird type (rehabilitated birds released in the autumn [*Rehab_autumn*; $N=5$ females, 1 male] or in spring [*Rehab_spring*; $N=5$ females, 4 males], and wild birds [*Wild*; $N=32$ females, 39 males])

rehabilitated birds). Rehabilitated females released in spring $t+1$ tended to have lower breeding success than did wild females ($\beta=-1.21\pm0.70$, $P=0.09$, $N=5$ females for six breeding events [rehabilitated females] vs. 50 females for 99 breeding events [wild females]), while those released in autumn t did not suffer from such a reduction ($\beta=-0.30\pm0.62$, $P=0.63$, $N=4$ females for 9 breeding events).

Towards efficient Little Owl release techniques

We took advantage of the intensive monitoring of a wild population to accurately record the recruitment of rehabilitated young Little Owls released into the wild. The fate of rehabilitated birds is indeed rarely assessed and, when investigated, it relates to survival only, ignoring recruitment (i.e. survival up to effective reproduction). Assessing whether rehabilitated birds are able to reproduce is however crucial to evaluate the effectiveness of bird care centres (Van Nieuwenhuyse et al. 2008). Despite a hard-release protocol (Haase 1993; Mitchell et al. 2011), our results showed that temporarily captive-raised Little Owls had recruitment probabilities similar to those of wild birds and reproduced successfully. We cannot rule out the possibility that wild birds have actually a higher recruitment rate than rehabilitated ones, associated to a higher propensity to successfully disperse outside the study area (Amar et al. 2000). Our dispersal results, however, did not provide evidence for this hypothesis. Contrary to our expectations, birds kept in captivity and thus provided with food throughout winter did not show higher recruitment rates than birds released in the autumn. This result suggests that mortality of juveniles may occur to a large extent shortly after fledging, rather than throughout the winter season (Exo and Hennes 1980; Coles and Petty 1997; Cox et al. 2014; Perrig et al. 2017). Rehabilitated birds, whatever the timing of their release, escaped this critical period. Furthermore, evidence for reduced breeding success and dispersal of birds released in spring suggest it may be preferable to release rehabilitated Little Owls in the autumn, during the dispersal phase, rather than in next year's spring. Under such conditions, the breeding success of rehabilitated birds in our study did not significantly differ from that of wild birds. Spring release might, however, be of interest in a reintroduction program for setting birds locally.

In conclusion, while people should be educated to reduce the unnecessary collection of young birds, our results demonstrate that simple hand-rearing and release techniques are appropriate for rehabilitating young Little Owls.

Acknowledgements We thank the Ligue pour la Protection des Oiseaux (LPO) team from the bird care centre of Buoux and the network of volunteers dedicated to bird rescue in Provence. The care center receives funding from Vaucluse and Bouches-du-Rhône councils, Provence-Alpes-Côte d'Azur region and Direction Régionale de l'Environnement, de l'Aménagement et du Logement-PACA. Owl monitoring received initial support from a LEADER scheme in partnership with Luberon Nature Park and Fondation Nature & Découvertes. Ringing was achieved under a licence delivered by the Centre de Recherche sur la Biologie des Populations d'Oiseaux (CRBPO-Museum Paris). Finally, we thank M. Grüebler and an anynomous reviewer for their helpful and relevant comments.

References

Amar A, Arroyo BE, Bretagnolle V (2000) Post-fledging dependence and dispersal in hacked and wild Montagu's Harriers *Circus pygargus*. Ibis 142:21–28

Coles CF, Petty SJ (1997) Dispersal behaviour and survival of juvenile tawny owls (*Strix aluco*) during the low point in a vole cycle. In: Duncan JR et al (eds) Biology and conservation of owls of the northern hemisphere. General Technical Report NC-190. USDA Forest Service, North Central Forest Experiment Station, St. Paul, pp 111–118

Cox AW, Thompson FRI, Cox AS, Faaborg J (2014) Post-fledging survival in passerine birds and the value of post-ledging studies to conservation. J Wildl Manage 78:183–193

Ellis DH, Sullivan KA, Thomas NJ (2000) Post-realease survival of hand-reared and parent-reared Mississippi Sandhill cranes. Condor 102:104–112

Exo KM (1988) Jahreszeitliche ökologische Anpassungen des Steinkauzes (*Athene noctua*). J Ornithol 129:393–415

Exo KM, Hennes R (1980) Beitrag zur Populationsökologie des Steinkauzes (*Athene noctua*) Eine analyse deutscher und niederländischer ringfunde. Vogelwarte 30:162–179

Goldsworthy SD, Giese M, Gales RP, Brothers N, Hamill J (2000) Effects of the Iron Baron oil spill on little penguins (*Eudyptula minor*). II. Post-release survival of rehabilitated oiled birds. Wildl Res 27:573–582

Haase P (1993) Zur situation und brutbiologie des steinkauzes *Athene n. noctua* SCOP., 1769 im Westhaveland. Naturshcutz Landschatspfl Brand 2:29–37

Joys AC, Clark JA, Clark NA, Robinson RA (2003) An investigation of the effectiveness of rehabilitation of birds as shown by ringing recoveries. British Trust for Ornithology, Thetford

Le Gouar PJ, Schekkerman H, van der Jeugd HP, Boele A, van Harxen R, Fuchs P, Stroeken P, van Noordwijk AJ (2011) Long-term trends in survival of a declining population: the case of the Little Owl (*Athene noctua*) in the Netherlands. Oecologia 166:369–379

Mitchell AM, Wellicome TI, Brodie D, Cheng KM (2011) Captive-reared burrowing owls show higher site-affinity, survival, and reproductive performance when reintroduced using a soft-release. Biol Conserv 144:1382–1391

Perrig M, Grüebler MU, Keil H, NaefDaenzer B (2017) Post-fledging survival of Little Owls *Athene noctua* in relation to nestling food supply. Ibis 159:532–540

R Development Core Team (2017) R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna

Schaub M, Ullrich B, Knötzsch G, Albrecht P, Meisser C (2006) Local population dynamics and the impact of scale and isolation: a study on different Little Owl populations. Oikos 115:389–400

Schönn S, Scherzinger W, Exo KM, Ille R (1991) Der Steinkauz. Die Neue Brehm-Bücherei. Ziemsen Verlag, Wittenberg

Van Nieuwenhuyse D, Genot J-C, Johnson DH (2008) The Little Owl, conservation, ecology and behavior of *Athene noctua*. Cambridge University Press, Cambridge