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Animal Welfare 2012, 21: 27-31
ISSN 0962-7286

Further evidence for the post-release survival of hand-reared, orphaned bats based on radio-tracking and ring-return data

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Abstract

*We recently used radio-tracking to demonstrate short-term, post-release survival of five orphaned, hand-reared pipistrelle bats. Here, we present further evidence of short-term, post-release survival and also demonstrate longer term survival using re-sighting data of ringed common (*Pipistrellus pipistrellus*) and soprano (*Pipistrellus pygmaeus*) pipistrelle bats. Ten bats (five common and five soprano pipistrelles) were radio-tracked for between one and ten days. Three of these were retrieved after one, two and four days, respectively. In addition, five of the 39 (13%) ringed bats returned to their release boxes between 38 and 1,389 days after release, at least two of which survived over the winter in the wild. A sixth ringed bat was retrieved 27 days after release after becoming trapped in a house. We also identified potential barriers to successful rehabilitation. Two of the ten bats radio-tracked in the current project became trapped within buildings and another bat had to be retrieved following entanglement with debris. We therefore recommend that attention be paid to giving bats the opportunity, prior to release, in identifying and using small exit holes similar to those found in buildings and loft spaces. We also recommend allowing bats to self-release following prolonged pre-release flight training in a large flight cage situated in suitable bat habitat.*

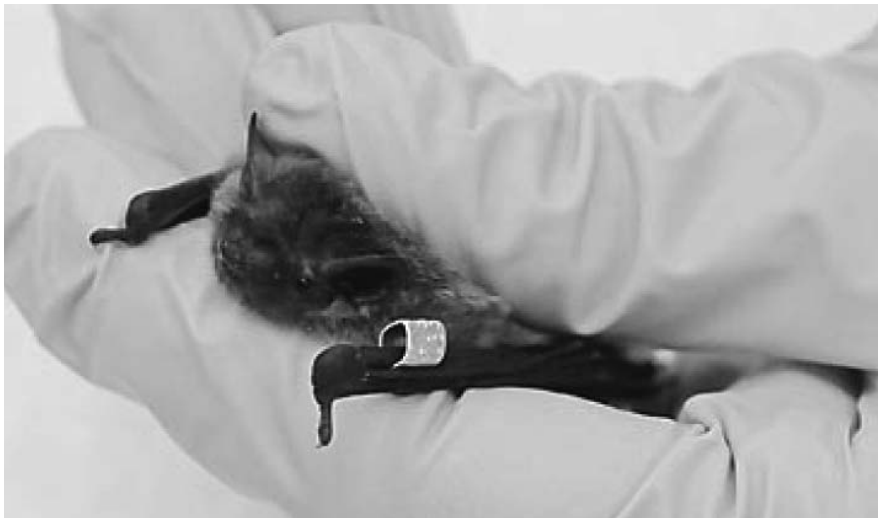
Keywords: *animal welfare, pipistrelle bat,* Pipistrellus *spp, post-release survival, radio-tracking, wildlife rehabilitation*

Table 1 Characteristics of radio-tracked bats.

Species	Sex	Ring number	Admission weight (g)	Release weight (g)	Forearm length (mm)	Condition index
Common	F	Z3283	2.7	5.2	31.4	0.17
Common	F	Z3288	2.9	6.0	32.4	0.19
Common	F	Z2945	2.7	4.5	30.1	0.15
Common	M	Z3255	2.2	4.3	27.5	0.16
Common	M	Z3259	2.6	5.1	31.0	0.16
Soprano	F	Z3263	1.9	4.8	30.2	0.16
Soprano	F	Z3278	1.4	5.2	31.7	0.16
Soprano	F	Z2939	2.3	5.1	31.6	0.16
Soprano	M	Z3251	1.9	4.9	30.8	0.16
Soprano	M	Z3281	2.3	4.8	32.2	0.15

Condition index was calculated as bodyweight/forearm length.

Figure 1



Pipistrelle bat showing C ring. Photograph© RSPCA Photo Library.

release flight training in a large flight cage. More recently, Serangeli *et al* (2012) demonstrated post-release survival of between four to 14 nights for 19 of 21 (90%) hand-reared Kuhl's pipistrelles (*Pipistrellus kuhlii*) in Italy. They also demonstrated that the rehabilitated bats showed typical habitat use, foraging behaviour and were able to join existing roosts.

In this paper, we add to the evidence that hand-reared pipistrelle bats can survive independently in the wild, following rehabilitation. We radio-tracked a further ten hand-reared pipistrelle bats (five common [*Pipistrellus pipistrellus*] and five soprano [*Pipistrellus pygmaeus*]) to measure their post-release survival. In addition, we present data on six ringed bats sighted alive following release in bat boxes at the release site, demonstrating longer-term survival.

Materials and methods

All of the bats in this study were admitted in from disturbed or abandoned roosts as non-independent juveniles, ranging in weight from 1.4 to 2.9 g. All bats required hand-rearing (see Kelly *et al* 2008 for protocol). Once fully grown and able to fly, the bats were allowed to exercise freely in an outdoor flight cage (see Kelly *et al* 2008 for details) prior to release and roosted in a bat box fitted to the wall of the cage. The bat boxes were made of untreated wood, measuring 25 × 19 × 19.5 cm (height at back × width × height at front to allow for sloped roof) and consisted of a sloping, hinged lid for easy access and a back board carved with 1-mm grooves and a 1.5-cm gap for the bats to access by.

Radio-tracking

Ten bats were fitted with 0.35-g radio transmitters in late August/early September 2007, using the same methods as in

Table 2 The number of nights each bat was tracked for and the fate of each bat.

Species	Sex	Ring number	Release date	Last date tracked	Number of nights tracked	Fate
Common†	F	Z3283	01/09/07	11/09/07	10	Lost signal
Common	F	Z3288	31/08/07	08/09/07	8	Lost signal
Common	F	Z2945	10/09/07	11/09/07	1	Retrieved
Common	M	Z3255	31/08/07	02/09/07	2	Retrieved
Common	M	Z3259	10/09/07	14/09/07	4	Retrieved
Soprano	F	Z3263	31/08/07	04/09/07	4	Lost signal
Soprano‡	F	Z3278	31/08/07	10/09/07	10	Lost signal
Soprano	F	Z2939	10/09/07	16/09/07	6	Lost signal
Soprano	M	Z3251	31/08/07	04/09/07	4	Lost signal
Soprano	M	Z3281	31/08/07	06/09/07	6	Lost signal

† Recorded alive in bat box after 53 days; ‡ Recorded alive in bat box after 1,389 days (see Table 3).

Figure 2

Pipistrelle Z3255 showing debris attached to radio transmitter antenna. Photograph courtesy of Kevin Eatwell, RSPCA.

Table 3 Post-release survival of six ringed bats released at Stapeley Grange in 2007.

Species	Sex	Ring number	Release weight (g)	Release date	Date last observed	Number of days
Common	F	Z3283	5.2	01/09/2007	24/10/2007	53
Common	M	Z3254	4.2	05/09/2007	28/10/2007	53
Common	M	Z2943†	4.5	11/09/2007	08/10/2007	27
Soprano	F	Z3279	4.5	31/08/2007	08/10/2007	38
Soprano	F	Z3280	4.8	31/08/2007	23/04/2008	236
Soprano	F	Z3278	5.2	31/08/2007	20/06/2011	1,389

† Retrieved day 27 after becoming trapped in building.

Kelly *et al* (2008). The characteristics of the radio-tracked bats are shown in Table 1. The bats were allowed to self-release from their original bat boxes which were moved to the outside of the bat flight. All of the radio-tracked bats were active on the night they were allowed to self-release. Bats were tracked continuously until the bat was retrieved or the signal lost. The bats were tracked again during the day to confirm the location of roosts. For those bats for which the signal was lost, attempts were made to relocate them on each consecutive night, until 48 h after the estimated battery life of the transmitter (maximum 14 days).

Ringing

Between 2006 and 2007, thirty-nine fully grown juvenile bats (all of which were admitted as non-independent juveniles) were fitted with individual numbered 2.9-mm (internal width when fitted) aluminium 'open C' bat rings (Figure 1). Bat boxes fixed externally to the bat flight were checked on a daily basis by a licensed bat worker and any ringed bats roosting in the boxes were recorded.

Results

Radio-tracking

The ten bats were radio-tracked for between one and ten days (median = 5), (see Table 2). Three bats (Z2945, Z3255 and Z3259) were retrieved after one, two and four nights, respectively. Z3283 (female common pipistrelle) and Z3278 (female soprano pipistrelle) were both tracked for ten days following release until the signal was lost. Both were observed alive in a bat box at the release site, 53 and 1,389 days post-release, respectively. Z3255 was tracked for two nights following release. On day three, the signal was stationary and the bat was subsequently retrieved from a roof space five days after release. On retrieval, the bat weighed 3.7 g, having lost 0.6 g since release (14% of its bodyweight). The antenna of the transmitter was found to be contaminated with cobwebs and dirt weighing 0.7 g (Figure 2). Z2945 was tracked for one night before it became trapped in a chimney and subsequently retrieved. Z3259 was tracked for four nights before becoming trapped in a house about 2 km from the release site. All three retrieved bats were over-wintered and subsequently re-released in April 2008.

Ring returns

Five ringed bats (13%) were observed alive in bat boxes on the outside of the bat flight cage 38 to 1,389 days following release (see Table 3). Three of these bats (Z3278, Z3279 and Z3280) were originally from the same roost. A sixth ringed bat was retrieved 27 days following release after becoming trapped in a building close to the release site.

Discussion

Although we had to retrieve three of the radio-tracked bats, the other seven were successfully radio-tracked for between four and ten days. Combined with the data in our previous report (Kelly *et al* 2008), 80% survived for at least four days. Taking a more conservative view to account for the fact that bats may survive for four days without feeding, 60% survived for at least six days, at which stage they must be feeding independently as they were active on consecutive nights.

However, although radio-tracking is a good indicator of short-term survival, the battery life of the transmitters (10–14 days) is limited by the size of the transmitters and is insufficient for us to measure longer-term survival. The observation of six ringed bats 27–1,389 days after release is further evidence that these bats have been able to survive independently. Z3278 and Z3280, observed 1,389 and 236 days after release, respectively, had survived and hibernated successfully, albeit the former in an unusually mild winter. Z3278 has now survived three winters including the harsh winter of 2010–2011 and on the last sighting was observed to be lactating so may have entered the breeding population. Interestingly, three of the observed ringed bats (all soprano pipistrelles) observed together in the bat box were originally from the same roost.

Our study has also highlighted a potential barrier to successful release: the apparent inability of some bats to find their way out of buildings and loft spaces. Three of the ten radio-tracked bats became trapped, and another bat which was ringed but not radio-tracked had to be retrieved from a rarely used room in a nearby house 27 days after release. However, it is not clear if this is due to the bats being rehabilitated or not. We are not aware of any studies that have examined the likelihood of non-rehabilitated juvenile bats becoming trapped or being unable to find an

exit from a building or loft space. One of the retrieved bats, Z3255, was found to have its transmitter antenna covered in cobwebs and debris (Figure 2). The weight of the debris was significant (0.7 g) and could have compromised its ability to fly. However, upon re-release, with a considerably shortened antenna, the bat was recorded static in the attic space at Stapeley Grange and was retrieved on day three. This implies that the accumulation of debris is likely to have occurred as a result of the bat having difficulty finding an appropriate exit from the building. However, it also highlights one of the direct dangers that radio-tracking can pose to the welfare of individual animals. These findings have led us to modify our bat flight cage to include an enclosed area resembling a roof space with various sizes of entrances/exits for bats to learn to negotiate.

We suggest that further work with ringing bats is required to allow better estimates of longer-term survival to be made. The current project was unusual in having a number of bats return to the release site. It is possible that this is because the training in the flight cage took place at the release site, and bats were able to return to the conditioning site after release. In contrast, when animals are moved to new sites for release, even with bat boxes to which they are habituated and with a soft-release protocol in which support food is provided, they rarely if ever return to the release box, perhaps as a result of forced dispersal (Swaisgood 2010). Forced dispersal is a widespread problem in animal relocations where the released animals move away from the release site rapidly, possibly because the animal perceives itself to be in an unsuitable habitat and disperses to find more suitable habitat. Rapid dispersal makes the provision of supplementary food impossible, reduces the probability that released bats (and other social species) will remain in social groups formed in captivity, possibly compromising survival, and it also makes long-term monitoring difficult. We therefore suggest that every effort is made to build flight cages in locations suitable for release, so that where original roost locations are not known bats may be released directly from the flight cage. We have presented further evidence that hand-reared and rehabilitated bats can survive in the wild, both in the short term (radio-tracking) and longer term (ring returns). However, we do not know if the bats are able to integrate fully with the population and display normal behaviour. Further work is required to determine whether hand-reared bats are able to locate and join existing roosts.

Animal welfare implications

The release of rehabilitated wild animals back to their natural habitat has important implications for animal welfare. Given the large numbers of animals involved, wildlife rehabilitators should, ideally, invest in post-release monitoring studies to test their protocols and to demonstrate that the welfare of the animals involved is not compromised. At the very least, rehabilitators who are unable to conduct post-release studies should seek to educate themselves about the findings of published studies and adjust their rehabilitation protocols accordingly.

Acknowledgements

The authors would like to thank the staff at RSPCA Stapeley Grange Wildlife Centre, particularly Katie Stevens and Wendy Northrop. Thanks also to three anonymous reviewers for comments which improved the original manuscript.

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