MAMMAL COMMUNICATIONS Volume 5 ISSN 2056-872X (online)

An improved identification marking method for hedgehogs

Nigel Reeve, Clare Bowen and John Gurnell

An improved identification marking method for hedgehogs

Nigel Reeve[1*], Clare Bowen[2] and John Gurnell[3]

ABSTRACT

As part of a long-term study of hedgehogs in The Regent's Park (London, U.K.) begun in May 2014, we developed and tested an improved identification marking method using 10 mm lengths of yellow plastic sleeving (heatshrink polyolefin) bearing pre-printed animal identification numbers. During twice-yearly study periods, six spines on each hedgehog were marked with duplicate numbers in a single central patch just behind the crown of the head; easily visible in both active and rolled-up hedgehogs. From May 2016 (animals marked in September 2015) to May 2018, the mean number of tags remaining in the pelage after eight months (September to May) was 3.78 (SE = 0.24, n = 45) and 4.16 (SE = 0.31, n = 25) after four months (May to September). In five additional cases, individuals were easily identified after periods of one year or more. The tags have minimal welfare implications, do not interfere with the function of the spines and can be easily read by anyone finding the animal. We conclude that this method is very effective, requires minimal handling and is suitable for use by volunteer field workers. Only one marked spine allows correct identification, making it especially suitable for identifying road-killed, partially eaten or decomposed hedgehogs.

INTRODUCTION

There are a wide variety of identification marking methods suitable for capture-recapture studies of mammals (see Twigg, 1975; Powell & Proulx, 2003; Silvy *et al.* 2005). Methods that have been used on hedgehogs include: applying numbered ear tags (e.g. Kristiannsson, 1990; Rautio, 201; Huijser, 2000), subcutaneously injected passive integrated transponder (PIT) tags (e.g. Jackson, 2006; Haigh *et al.,* 2013), clipping spines short in a coded array of patches (e.g. Morris, 1969; Campbell, 1973; Reeve, 1982), applying paint to spines (e.g. Brockie, 1958; Campbell, 1973) and threading coloured plastic sleeving onto spines (Wroot, 1984). In this paper we consider a modification of the method used by Wroot (1984) who attached three lengths of 3.5 cm heat-shrink plastic sleeving to spines, each with an individual identification number written in Indian ink. Plastic sleeving threaded over a spine is more durable than paint and can persist in the pelage until the spine is moulted. Spines are moulted and replaced individually and, although there may be periods of more intensive spine loss and replacement, are generally long lived with a lifespan of 18 months or more (studies reviewed by Reeve, 1994). For example, in the Hebrides, Jackson & Green (2000) marked five spines in each of three positions and found that some marked spines were retained for up to three years (Digger Jackson, pers. comm., 2001). Biewald *et al.* (1999) found marked spines on hedgehogs up to five years later. Typically, in such studies, unique individual marks are created by using colour-coded combinations of these plastic sleeves. For example, Cassini and Krebs (1994) glued 30 mm long heat-shrink plastic sleeves over nine spines, combining four colours of sleeves with five

[1.] *2 Paxton Gardens, Woking, Surrey GU21 5TR**
[2.] *The Royal Parks, The Old Police House, Hyde Park, London, W2 2UH*
[3.] *School of Biological and Chemical Sciences, Queen Mary University of London, London E1 4NS*
**Corresponding author: hedgehogs@ntlworld.com*

Key words: hedgehog, identification marking, tags, capture-recapture

Reeve N., Bowen C. & Gurnell J. (2019) An improved identification marking method for hedgehogs. Mammal Communications 5: 1-5, London.

colours of reflective tape. Haigh *et al.* (2013) glued 15 plastic sleeves in three regions of the spiny pelage. Similarly, Mori *et al.* (2015) used 20 mm long strips of plastic adhesive tape (10 colours) wound around each of 20 spines.

Since 2014, we have been surveying hedgehogs in The Regent's Park (London, UK) using repeat spotlighting field surveys in early May and early September each year i.e. four or eight months between surveys (Gurnell *et al*., 2017). We needed a durable, individual identification marking system that could be applied in the field by 'citizen scientists' (trained volunteers) simply and with minimal handling time. Therefore, we ruled-out the use of numbered ear tags and injected PIT tags as both require skilled application to avoid potential animal welfare issues. Furthermore, PIT tags have the disadvantages that they are not externally visible, and that individual identification is not possible without a PIT tag reading device. Initially, we trialled the use of colour combinations of plastic sleeving (red, white, blue or yellow) using five 10mm long sleeves of the same colour filled with cyanoacrylate adhesive ('superglue') and threaded over five spines in a small area of pelage located on either the crown of the head, left or right shoulder, left or right hip, or the middle rear back (in line with the tail). Animal numbers were coded using combinations of these six locations and four colours. Fifty-four individuals were marked in this way in 2014. Although these tags themselves were robust, after four months in the field, with the effects of dirt and some moulting of spines, misreading of the code on recaptured animals by field workers was common. Hedgehogs that were found dead and incomplete were hard or impossible to identify and incidental finds (alive or dead) between surveys by grounds maintenance staff could not be identified by them without the code. Consequently, from 2015 onwards we adapted Wroot's (1984) method in a way suggested by Reeve & Bristow (2002) to ensure a durable mark that could be easily seen and simply read without the need for decoding. The aim of this study was to test this improved identification marking system under field conditions.

METHOD

Hedgehogs were caught in the field, under licence from Natural England, by searching with a hand-held torch or with the aid of a FLIR E60 thermal camera as described in Gurnell *et al.* (2017). The park was divided into eight zones which were each searched by groups of about five volunteers along fixed routes for approximately eight hours (in two four-hour shifts) per night. Each year, searches were conducted on two consecutive Fridays in early May and also in early September. We tagged hedgehogs with 10 mm lengths of yellow plastic sleeving (heatshrink polyolefin) of 1.6 mm internal diameter, bearing pre-printed animal identification numbers in black text (a series of 200 numbers each duplicated 20 times, supplied uncut by Printasleeve, Crewkerne, UK; cost approximately £0.06 per tag as of March 2015). Each printed number was prefixed by a hash symbol (#) to ensure that the number would not be read backwards or upside down. To ensure the durability of the printed numbers under field conditions, before being cut into 10 mm lengths, the sleeving was sprayed with acrylic resin fixative (Perfix Colourless Fixative, Daler-Rowney Ltd). The lengths of sleeving were laid, numbers uppermost, on adhesive tape to secure them while spraying.

To attach each numbered tag, it was gripped by the edge with tweezers, partially filled with cyanoacrylate adhesive ('superglue') and threaded over the spine, leaving the sharp spine tip protruding so that the spine remained functional (Figure 1). The glue bonded within a few seconds. We considered using a portable soldering iron to heat-shrink the tags to the spines, but the shrinkage might have distorted the number or affected its durability and we wanted to avoid the risk of burns to either hedgehogs or field workers.

Six spines were marked with duplicate numbers in a single central patch at the back of the neck, just behind the crown of the head, where it was easy to see the tags in both active and rolled-up hedgehogs. Spare copies of the numbers were carried in the field to refresh the marks on recaptured animals as spines were moulted during the study.

To quantify the depletion of marked spines, from May 2016 until May 2018 we asked field workers to record the number of remaining marked spines on recaptured hedgehogs before topping-up the mark to six spines and re-releasing the animal. F-tests for equality of variance, t-test (equal variances) and Welch's t-test (unequal variances) were carried out in Excel.

RESULTS

In all, 70 recapture events from a total of 34 individuals were recorded after three periods of eight months and two of four months, from May 2016 (animals marked in September 2015) to May 2018. Of the six tags per hedgehog at the start of each period, the mean number of tags remaining in the pelage after eight months was 3.78 (SE = 0.24, n = 45), and 4.16 (SE = 0.31, n = 25) after four months (Table 1).

The mean tag loss rate was 4.63% (SE = 0.03, n = 45) per month over the September-May periods and significantly higher at 7.67% (SE = 1.31, n = 25) per month over May-September periods (Welch's-t = 2.17, p = 0.038, 2-tailed). However, the September-May sample included recently recruited youngsters whose spine-moulting may differ from adults. Therefore, to see if age was a factor in the rate at which tags were lost, young hedgehogs under 700 g were compared with older individuals. The mean monthly rate of tag loss from September to May was slightly higher in the young animals (5.73% per month, SE = 0.93, n = 12) than in the older animals (4.23% per month, SE = 0.58, n = 33) but the difference was not significant (t = -1.35, p = 0.183, 2-tailed).

Additional to the recaptures above, there were also four instances (three individuals) of animals tagged in May and not recaptured until the following May (12 months elapsed). In each case only two of the tags had been lost during the year. Another individual was tagged in May

2015 and not recaptured until September 2016 (16 months elapsed) but still retained three of six original tags. One individual in 2016 had lost all six numbered tags but was identifiable as a recapture because it retained a coloured marker from 2014. During the survey period September 2015 to May 2018, 12 unmarked individuals were found that could have been either previously undetected animals or may have been recaptures that had lost all their tags.

Table 1. The number of tags found on recaptured hedgehogs after three periods of eight months (n = 45) and two of four months (n = 25) from September 2015 to May2018.

Time from marking to recapture	Number of hedgehogs recaptured with 1-6 tags						N	% tag loss	Nº tags remaining	
	1 tag	2 tags	3 tags	4 tags	5 tags	6 tags			Mean	S.E.
8 months	4	9	5	8	13	6	45	37.04	3.78	0.24
4 months	1	5	1	6	6	6	25	30.67	4.16	0.32

Figure 1. Hedgehog spines marked with pre-printed numbered plastic sleeves.

DISCUSSION

Our identification marking method is low cost and creates a durable identification mark which can be placed in the same location on every hedgehog and is thus easy to see without being obtrusive. Recaptured hedgehogs retained a mean of 3.78 (± S.E. 0.24) after 8 months; 4.16 (± S.E. 0.31) after 4 months. The significantly slower rate of spine moulting during the September-May periods may possibly be explained by lower metabolic activity during the hibernation period.

The distribution of the number of tags retained in recaptured animals could result from individual variation in spine replacement. For example, some individuals may have undergone a flush of spine replacement, as reported in some studies (Reeve, 1994), hence forming a group of animals retaining relatively few tags. How efficient our spotlighting surveys were in terms of the proportion of the population sampled is not known, and so it is not possible to know whether some of the 12 unmarked individuals first captured as adults had been marked but had lost all their tags or simply had not been previously captured.

We believe the tagging method we have used is very effective. The tags have minimal welfare implications, do not interfere with the function of the spines and can be easily read by anyone finding the animal. Only one marked spine on a recaptured individual allows correct identification, making it especially suitable for identifying road-killed, partially eaten or decomposed hedgehogs. Applying a mark requires minimal handling time in the field making it a very appropriate method for volunteer workers.

The choice of only six duplicate tags as a starting number was somewhat arbitrary but considered both economy and the need to minimise handling time. However, it seems to have been enough in this study to ensure that recaptured hedgehogs remained identifiable. The longevity of the marks themselves is evidenced by the five instances of a year or more between recaptures. Should greater redundancy be required or longer periods between recaptures anticipated, such as in the study of released rehabilitated hedgehogs, more tags could be used. If reports of sightings from the public are needed a contact telephone number could be also be printed on the other side of each tag, which could be lengthened to 15mm without compromising spine function.

ACKNOWLEDGEMENTS

We are grateful to the staff of The Royal Parks, over 100 'Hedgehog Hero' volunteers each year, the Zoological Society of London, the Garden Wildlife Health Project team, The Central Parks Wildlife Group, Sue Kidger, Benugo, and John Reynolds of FLIR Systems. The Regent's Park hedgehog study was made possible by the support of the Meyer Family.

REFERENCES

Biewald, U., Fiolka, F., Schicht-Tinbergen, M. & Schubert, M. (1999) *Ergebnisse von Freilandbeobachtungen sowie von parasitologischen un bakteriologischen Untersuchungen bein in menschlicher Obhut überwinterten juvenilen Igeln* (Erinaceus europaeus L., 1758). Neumünster, ProIgel e.V.

Brockie, R.E. (1958) *The ecology of the hedgehog* (Erinaceus europaeus L.) *in Wellington, New Zealand*, MSc. Thesis, Victoria University of Wellington. 148 pp.

Campbell PA (1973) The feeding behaviour of the hedgehog *(Erinaceus europaeus* L.) in pasture land in New Zealand. *Proceedings of the New Zealand Ecological Society* 20:35–40.

Cassini, M.H. & Krebs, J.R. (1994) Behavioural responses to food addition by hedgehogs. *Ecography* 17: 289–296.

Gurnell, J., Reeve, N., Bowen, C. & The Royal Parks Foundation (2017) *A Study of Hedgehogs in The Regent's Park, London – May and September 2016*. The Royal Parks Foundation, London. 53pp. https://www.royalparks.org.uk/managing-the-parks/conservation-and-improvement-projects/hedgehogs/hedgehog-research-reports

Haigh, A., O'Riordan, R. M. and Butler, F. (2013) Habitat selection, philopatry and spatial segregation in rural Irish hedgehogs (*Erinaceus europaeus*). *Mammalia,* 77: 163-172.

Huijser, M. P. (2000) *Life on the edge: hedgehog traffic victims and mitigation strategies in an anthropogenic landscape.* Ph.D. Thesis, University of Wageningen, 165 pp.

Jackson D. B. (2006) The breeding biology of introduced hedgehogs (*Erinaceus europaeus*) on a Scottish Island: lessons for population control and bird conservation. *Journal of Zoology* 268**:** 303–314.

Jackson, D.B. & Green, R.E. (2000). The importance of the introduced hedgehog (*Erinaceus europaeus*) as a predator of the eggs of waders (*Charadrii*) on the machair in South Uist, Scotland. *Biological Conservation* 93: 333–348.

Kristiansson H. (1990) Population variables and causes of mortality in a hedgehog (*Erinaceus europaeus*) population in southern Sweden*. Journal of Zoology* 220: 391–404.

Mori, E., Menchetti, M., Bertolino, S., Mazza, G. & Ancillotto, L. (2015) Reappraisal of an old cheap method for marking the European hedgehog. *Mammal Research* 60: 189-193.

Morris, P.A. (1969) *Some aspects of the ecology of the hedgehog* (Erinaceus europaeus). Ph.D. thesis, University of London. 260 pp.

Powell, R. A. & Proulx, G. (2003) Trapping and marking terrestrial mammals for research: integrating ethics, performance criteria, techniques, and common sense. *ILAR Journal* 44: 259-276.

Rautio A., Valtonen, A. & Kunnasranta, M. (2013) The effects of sex and season on home range in European hedgehogs at the northern edge of the species range. *Annales Zoologici Fennici* 50: 107-123.

Reeve, N. J. (1982) Home range of the hedgehog as revealed by a radio tracking study*. Symposium of the Zoological Society of London* 49: 207-230.

Reeve, N. J. (1994) *Hedgehogs*. T & A.D. Poyser, London. 313 pp.

Reeve, N. J. & S. Bristow (2002) Feasibility study on a small-scale translocation of hedgehogs from the Uists to mainland Scotland: a non-lethal alternative to humane killing to achieve hedgehog population reduction. *Scottish Natural Heritage Commissioned Report F01LC03.* http://www.snh.org.uk/pdfs/publications/commissioned_reports/CR%20F01LC03.pdf

Silvy, N., R. Lopez, R. & Peterson, M. (2005) Wildlife marking techniques. Pages 339-376 in: C. Braun (ed.) *Techniques for wildlife investigations and management, 6th Edition*. The Wildlife Society, Bethesda, Maryland, USA.

Twigg, G. I. (1975) Marking Mammals. *Mammal Review* 5: 101-116.

Wroot, A. (1984) Feeding ecology of the European hedgehog, *Erinaceus europaeus*. PhD thesis, University of London, London. 420 pp.