Appendix 1 Equipment list for The Regent's Park Hedgehog Study 2015

Spotlighting	LED Lenser handheld Torch Personal torches AA & AAA batteries
Marking	Garmin handheld GPS tracker Salters spring balance Measuring tape Super glue Tweezers
Volunteer Welfare	High visibility jackets Headtorches Cleaning wipes Sanitising gel Gardening gloves
Camera traps and footprint tunnels	Bushell HD Trophy Cameras SD memory cards Garden wire and cable ties
Radio-tracking	Titley LT5-357, 173MHz, 3g Receivers (Sika, TRX, Mariner) Flexible 3 element Yagi aerial Headphones
GPS tags	Igotu travel trackers - GPS transmitters modified by Mark Ferriman Fast setting epoxy superglue Cable cutters
Thermal imaging	2 x FLIR E60 thermal imaging cameras SD memory cards

Appendix 2a

Spotlighting Proforma – Sep 2015

(Don't forget to hand this proforma into Hedgehog HQ when you leave!)

Date: Date the survey data were collected in the field. Note: the date will change after midnight.	___ ___ / 09 / 2015 D D / MM / YYYY
Time Time the survey data were collected in the field: 00:00	___ ___ : ___ ___
Survey Zone Number Survey zone in which the hedgehog was found (1- 8)	
Hedgehog location on map. Mark the position of the hedgehog on a map & label it with hog number/zone/sex/date-time	*Staple map to this pro forma*
GPS reference: 10 digit NGR code using GPS Enter the hedgehog location e.g. TQ12345 12345	TQ _ _ _ _ _ _ _ _ _ _
Is there any evidence this hedgehog was marked in 2014? *If yes, state colour and location of marks or cut spines….provide photograph if possible (see below)*	Yes / No
Is the hedgehog already marked with yellow number tag(s) from the 2015 survey?	Yes / No *If yes, state number:*
If the hedgehog is <u>not</u> already marked with yellow number tag(s), enter the new number you mark it with.	
Does the hedgehog have a GPS or radio tag attached?	Yes / No *If yes, state number:*
If the hedgehog has no GPS or radio tag and you attach them, enter the new number	
Hedgehog details	
Sex You should specify a sex	Male / Female / Unknown *If unknown, state reason why…*
Weight: Enter weight in grams (g) <u>minus</u> the weight of bag	
Circumference Specify a circumference in centimetres (cm) from the nose to the bottom of a <u>tightly</u> rolled up hedgehog. If hedgehog is not tightly rolled up, don't measure it.	
Ectoparasites Externally visible parasites	None / Ticks / Fleas / Mange / Maggots/ Other *Describe in detail location + type…*

Injuries Check eyes / ears / limbs / body	Yes/No *If yes, describe in detail location + type…*
Action taken with injured hedgehog? Provide details if necessary	Not applicable / Hedgehog left in field / Taken to vet / Other

Habitat

Habitat where hedgehog was found:	Select one location which best describes where hedgehog was found: □ Grass < 10cm tall (excluding sports pitches) □ Grass - cut but > 10 cm tall □ Tussocky rough grassland > 10cm tall □ Sports pitches □ Planted shrubberies/flower beds with mulch □ Planted shrubberies/flower beds without mulch □ Scrub (bramble/bracken, neglected overgrown shrubbery) □ Recent plant-colonised disturbed site □ Tall herbs but not scrub (e.g. willow herbs, dog's mercury, stinging nettle, hogweed, red campion, ferns) □ Reedbeds and marginals □ Hedgerow (under or within 50 cm of base) □ Woodland floor □ Bare soil (not in woodland/flower bed /shrubbery) □ Bare artificial habitat (e.g. tarmac, paved, hardstanding) □ Other (please describe in left panel ←)

Samples and photographs

Spine Sample Taken? If Yes, remember to mark the sample tube with: hog number /zone /sex/date-time	Yes / No
Photograph taken? If you take a photo, place a piece of paper next to the hedgehog stating: hog number/zone/sex/date-time	Yes / No *If yes, who took the photo…*
Comments – *Anything of interest, e.g.:* Breeding: Sexually active male / Lactating female / Recent copulation / Sexually inactive Unusual colour: Nose / Pad / Fur or spines Surroundings: Anything unusual? Behaviour: Was the hedgehog doing anything unusual?	

Proforma completed by:	Name:	Date: __ __ / 09 / 2015
Proforma checked by supervisor:	Name:	Date: __ __ / 09 / 2015
Data inputted into Cartographer by:	Name:	Date: __ __ / __ __ / 2015

Appendix 2b

Radio Tracking Proforma – Sep 2015

(Don't forget to hand this proforma into Hedgehog HQ when you leave!)

Date (DD/MM/YYYY) Date you started radio tracking	___ ___ / 09 / 2015 D D / MM / YYYY	Hedgehog Number		GPS Tag Number	

Sightings					
	Time HH:MM	Location marked? Mark on paper map every 2 minutes	Habitat Use single code if possible, or separate codes with comma (see chart overleaf)	Behaviour Single code (see reverse)	Other behavior Free text
1		Yes/No			
2		Yes/No			
3		Yes/No			
4		Yes/No			
5		Yes/No			
6		Yes/No			
7		Yes/No			
8		Yes/No			
9		Yes/No			
10		Yes/No			
11		Yes/No			
12		Yes/No			
13		Yes/No			
14		Yes/No			
15		Yes/No			
16		Yes/No			

Proforma completed by:	Name:	Date: ___ ___ / 09 / 2015
Proforma checked by supervisor:	Name:	Date: ___ ___ / 09 / 2015
Data inputted into Cartographer by:	Name:	Date: ___ ___ /___ ___ / 2015

	Habitat codes		Behaviour codes	
	GRS	Grass < 10cm tall (excluding sports pitches)	FO	Foraging (investigating grass)
	GRT	Grass - cut but > 10 cm tall	SL	Slow locomotion (walking with a purpose, not investigating grass)
	TG	Tussocky rough grassland > 10cm tall	FL	Fast locomotion (running)
	SP	Sports pitches	ST	Stationary
	PSM	Planted shrubberies/flower beds with mulch	AH	Avoiding another hedgehog
	PS	Planted shrubberies/flower beds without mulch	FH	Fighting another hedgehog
	SB	Scrub (bramble/bracken, neglected overgrown shrubbery)	CH	Courting another hedgehog (circling motion)
	RP	Recent plant-colonised disturbed site	OT	Other (vocalising, self-anointing) Describe in free text box overleaf
	TH	Tall herbs but not scrub (e.g. willow herbs, dog's mercury, stinging nettle, hogweed, red campion. ferns)		
	RM	Reedbeds and marginals		
	HW	Hedgerow (under or within 50 cm of base)		
	WO	Woodland floor		
	BS	Bare soil (not in woodland/flower bed /shrubbery)		
	BAH	Bare artificial habitat (e.g. tarmac, paved, hardstanding)		
	OR	Other (please describe)		

Appendix 2c

Footprint Tunnel – Sep 2015 (Don't forget to hand this proforma into Hedgehog HQ when you leave!)

Tunnel number: Unique number or code for the tunnel inspected		Location: Location of the survey site. 10-digit NGR, e.g. TQ12345 12345		Survey zone number: Where tunnel has been placed (zones 1-8)	6

Habitat - Habitat within 1m of where the footprint tunnel is located. Select ONE that best applies when placing this tunnel:

☐ GRS Grass < 10cm tall (excluding sports pitches) ☐ GRT Grass - cut but > 10 cm tall ☐ TG Tussocky rough grassland > 10cm tall ☐ SP Sports pitches ☐ PSM Planted shrubberies/flower beds with mulch ☐ PS Planted shrubberies/flower beds without mulch	☐ SB Scrub (bramble/bracken, neglected overgrown shrubbery) ☐ RP Recent plant-colonised disturbed site ☐ TH Tall herbs but not scrub (e.g. willow herbs, dog's mercury, stinging nettle, hogweed, red campion. ferns) ☐ RM Reedbeds and marginal ☐ HW Hedgerow (under or within 50 cm of base)	☐ WO Woodland floor ☐ BS Bare soil (not in woodland/flower bed /shrubbery) ☐ BAH Bare artificial habitat (e.g. tarmac, paved, hardstanding) ☐ OR Other (please describe)

Date of inspection	Time of inspection Time the footprint tunnel was inspected in the field 00:00	Footprints identified in tunnel. Select ALL that apply:				Did you take a photo of the footprint sheet? Yes / No Photographers name:	Comments: Was the tunnel disturbed? Other observations regarding the tunnel or its surroundings, etc.	Proforma completed by:
Sun 6 Sep		Hedgehog Mouse/Vole	Fox Bird	Cat Other	Other footprints observed:	Yes / No		
Mon 7 Sep		Hedgehog Mouse/Vole	Fox Bird	Cat Other	Other footprints observed:	Yes / No		
Tues 8 Sep		Hedgehog Mouse/Vole	Fox Bird	Cat Other	Other footprints observed:	Yes / No		
Wed 9 Sep		Hedgehog Mouse/Vole	Fox Bird	Cat Other	Other footprints observed:	Yes / No		
Thurs 10 Sep		Hedgehog Mouse/Vole	Fox Bird	Cat Other	Other footprints observed:	Yes / No		
Fri 11 Sep		Hedgehog Mouse/Vole	Fox Bird	Cat Other	Other footprints observed:	Yes / No		

Proforma checked by	Name:	Date:
Data inputted into Cartographer by	Name:	Date:

Appendix 2d

Camera Trapping Proforma – Sep 2015

(Don't forget to hand this proforma into Hedgehog HQ when you leave!)

Camera number Unique number or code assigned to the camera.		Location Location of the survey site. 10-digit NGR, e.g. TQ12345 12345		Survey zone number Where camera has been placed (zones 1 to 7)	6

Date and Time of Inspection - Date and time camera was set up. The video start times below must lie within the following 24 hours. Format: DD/MM/YYYY 00:00								
Date	Fri 04/09/2015	Sat 05/09/2015	Sun 06/09/2015	Mon 07/09/2015	Tues 08/09/2015	Wed 09/09/2015	Thurs 10/09/2015	Fri 11/09/2015
Time 00:00								
SD Card No.								
Data transfer: Don't forget to complete detailed table on the reverse of this sheet								
No. of videos downloaded off SD Card								
No. of videos with wildlife present								
No. of individuals								
Proforma completed by:								

Data inputted into Cartographer by:	Name:	Date:	Data inputted into Dropbox by:	Name:	Date:

Date	Species	No. videos	No. individuals	Times	Behaviours
05/09/2015	Fox				
	Hedgehog				
	Mouse/Rat				
	Squirrel				
	Other				
06/09/2015	Fox				
	Hedgehog				
	Mouse/Rat				
	Squirrel				
	Other				
07/09/2015	Fox				
	Hedgehog				
	Mouse/Rat				
	Squirrel				
	Other				
08/09/2015-	Fox				
	Hedgehog				
	Mouse/Rat				
	Squirrel				
	Other				
09/09/2015	Fox				
	Hedgehog				
	Mouse/Rat				
	Squirrel				
	Other				
10/09/2015-	Fox				
	Hedgehog				
	Mouse/Rat				
	Squirrel				
	Other				
11/09/2015	Fox				
	Hedgehog				
	Mouse/Rat				
	Squirrel				
	Other				

Appendix 2e

Day Nest Proforma – Sep 2015

(Don't forget to hand this proforma into Hedgehog HQ when you leave!)

Date Date day nest was located in the field: DD/MM/YYYY	___ ___ / 09 / 2015 D D / MM / YYYY
Time Time day nest was sighted in the field: e.g.17:40	___ ___ : ___ ___
Location, was nest marked on attached map?	Yes / No
Location: 10 digit NGR code Location of day nest. 10-digit NGR, e.g. TQ12345 12345	TQ __ __ __ __ __ __ __ __ __ __
Survey Zone Number Survey zone in which the data was collected (1- 8)	
Aspect (If known) The way in which the day nest is facing e.g North, East, South, West	KNOWN? Y / N ASPECT: _____

Habitat where day nest was found:	Select one location which best describes where the day nest was found: ☐ *Can't tell, in a private area of the Park* ☐ Grass < 10cm tall (excluding sports pitches) ☐ Grass - cut but > 10 cm tall ☐ Tussocky rough grassland > 10cm tall ☐ Sports pitches ☐ Planted shrubberies/flower beds with mulch ☐ Planted shrubberies/flower beds without mulch ☐ Scrub (bramble/bracken, neglected overgrown shrubbery) ☐ Recent plant-colonised disturbed site ☐ Tall herbs but not scrub (e.g. willow herbs, dog's mercury, stinging nettle, hogweed, red campion, ferns) ☐ Reedbeds and marginals ☐ Hedgerow (under or within 50 cm of base) ☐ Woodland floor ☐ Bare soil (not in woodland/flower bed /shrubbery) ☐ Bare artificial habitat (e.g. tarmac, paved, hardstanding) ☐ Other (please describe in left panel ←))

Notes E.g. details of type of vegetation, any nearby landmarks, anything unusual about the location, how accessible it is to a dog / human	
Photograph taken? Please take a photo of the nest or the location where you think it is – using the label provided to record the location and date	Yes / No *If yes, who took the photo…*

Proforma completed by:	Name:	Date: __ __ / 09 / 2015
Proforma checked by supervisor:	Name:	Date: __ __ / 09 / 2015
Data inputted into Cartographer by:	Name:	Date: __ __ / __ __ / 2015

Appendix 2f

Fox Sighting Proforma – Sep 2015 (Don't forget to hand this proforma into Hedgehog HQ when you leave!)

Date (DD/MM/YYYY)	___ ___ / 09 / 2015 D D / MM / YYYY

Sightings

	Time of fox sighting in field HH:MM	Number of foxes seen	Location marked? Mark on paper map	Location of fox sighting: 10 digit NGR code e.g. TQ 12345 12345	Survey zone number	Notes Free text
1			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
2			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
3			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
4			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
5			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
6			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
7			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
8			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
9			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
10			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
11			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
12			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		
13			Yes/No	TQ _ _ _ _ _ _ _ _ _ _		

Proforma completed by:	Name:	Date: ___ ___ / 09 / 2015
Proforma checked by supervisor:	Name:	Date: ___ ___ / 09 / 2015
Data inputted into Cartographer by:	Name:	Date: ___ ___ /___ ___ / 2015

Appendix 3

HEDGEHOG RESEARCH PROGRAMME IN THE REGENT'S PARK + PRIMROSE HILL

VOLUNTEER SURVEY GUIDE SEPTEMBER 2015

LEAD PARTNERS

THE ROYAL PARKS FOUNDATION

ZSL LET'S WORK FOR WILDLIFE

THE ROYAL PARKS

ANCILLARY PARTNERS

People's Trust for Endangered Species

Central Royal Parks Wildlife Group

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4. Key Dates
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6. How to Handle a Hedgehog
7. Hedgehog Marking System
8. Hedgehog First Aid
9. Data Management
10. Volunteer Kit List
11. Risk Assessment
12. Hedgehog HQ
13. Emergency Procedure
14. Travel
15. Key Contact Details
16. Project Partners

1. Project Summary

What we're doing

Following a very successful survey in 2014, we are running a second year of our Hedgehog Research Project in The Regent's Park, which aims to provide information on the status of hedgehogs in the Park - how many there are, which habitats they use and whether the population is sustainable. Hedgehogs are a UK Biodiversity Action Plan (BAP) priority species and The Royal Parks is a lead partner in the BAP for Westminster.

We will be carrying out a general survey and an intensive behavioural study on Regent's Park and London Zoo grounds in May and September 2015. In spring 2016, we will share our findings and recommendations in a report. We will also be running a wider programme of educational outreach in 2015 to raise awareness of hedgehog conservation.

Using the research findings, we will recommend ways to manage habitats within the Park to be even more sympathetic to hedgehogs, which may also help wildlife conservation in other green urban spaces.

Who's involved?

This Project is a partnership that brings together the Royal Parks Foundation, The Royal Parks, the Zoological Society of London (ZSL), and expert wildlife biologists Dr Nigel Reeve and Professor John Gurnell, along with our ancillary partners, The People's Trust for Endangered Species and the Central Royal Parks Wildlife Group. The survey and study will be supported by a team of volunteers, ecology students and local neighbours with a keen interest in wildlife and conservation. The survey has been made possible thanks to a very generous gift from a local resident.

What else we hope to achieve

Using education, community engagement and a communications campaign, we hope to inspire local people to take a greater, active interest in urban wildlife conservation. We also hope to positively contribute to the future conservation and education work of The Royal Parks, ZSL and the Royal Parks Foundation.

2. About Hedgehogs

Hedgehogs were once common and familiar animals in rural and suburban British landscapes but there is evidence from a number of sources of a significant and general decline in numbers in recent years. Several factors have been put forward as reasons for this decline:

- Predation, especially by badgers in areas with high badger densities
- Death from traffic on roads or being killed in bonfires
- Changes in agricultural practice and a reduction in invertebrate food availability
- Fragmentation of habitat
- In gardens, the absence of garden compost/wood piles/leaf litter for hibernation sites and the use of fences (rather than hedges) without movement gaps at ground level to allow hedgehog movements. Also drowning in garden ponds without escape ramps, injuries from garden tools and other hazards.
- Becoming trapped in cattle grids or becoming caught in discarded cans, and other debris

The presence of hedgehogs in London's central Royal Parks mirrors this national decline; in the early 1970s they were found in all the central Parks, but since then they have disappeared from all except The Regent's Park.

However, explanations for the loss of hedgehogs are circumstantial and there is a lack of direct scientific evidence about the true extent, scale and causes of the hedgehog decline. This applies as much to London's Parks as to the wider countryside. So, why are hedgehogs able to persist in The Regent's Park and not elsewhere, and what can be done to ensure they survive into the future? This project directly addresses these questions and, from the findings, will draw up habitat management recommendations for The Regent's Park that may also be applied to other urban open spaces.

Since 2007 hedgehogs have been a UK Biodiversity Action Plan (BAP) priority species and also a Westminster BAP species for which The Royal Parks is a lead partner.

Scientific benefits of this survey

We will carry out a series of carefully designed, mutually compatible surveys using different methodologies that focus both on the behaviour of individuals and the population as a whole in Regent's Park. We will obtain detailed scientific measurements on numbers, demography, habitat use and movement of these vulnerable animals. For the first time, the study will provide valuable insights into why hedgehogs are able to persist in Regent's Park, and what can be done to ensure they survive into the future. The following methods will be used: spotlighting, GPS and radio tracking.

Developing habitat management recommendations

This unique study will provide a more detailed understanding of which features and areas of the Park (and its surroundings) are used by hedgehogs and, for example, whether they are used for nesting or foraging for food. This information will be reviewed in the light of our existing understanding of hedgehog habitat requirements to develop detailed recommendations for conserving hedgehogs in the Park and its surroundings. The results will also inform managers of other urban open spaces.

3. Survey Activities Overview

A. Spotlighting & GPS

This is a general nocturnal survey carried out on the first and last Friday of the survey by teams of volunteers to help provide hedgehog population estimates in the Park. Volunteers will be tasked to find active hedgehogs by torchlight, make notes on their health and condition, then mark them with numbered plastic markers on the spines so we can identify each hedgehog for the rest of the survey. Some hedgehogs will also be fitted with GPS and radiotracking packs to gain more detailed behavioural data. Each marked hedgehog will need to be photographed, including in shot the label provided showing hedgehog number, date and zone. *A more detailed how-to-guide for this activity is in the back of your packs.*

B. Radiotracking & Hedgehog Observations

Volunteer teams, led by a supervisor will observe hedgehog movement and behaviour on specific hedgehogs over seven consecutive nights. The teams will obtain detailed observations by using radio tracking equipment to find an individual hedgehog. A thermal imaging camera will then be used to track the animal without intrusion for 30 minutes. Its activity, the habitat it is using and any general observations must be noted on the proforma and its location marked on a map every two minutes for half an hour.

Teams will follow 2-5 hedgehogs each night depending on how many hedgehogs are fitted with radio packs during the spotlighting survey. Radiotracking sessions will run in evening, night time and early morning stints.

We will also use radiotracking to locate hedgehog nests during the day. Once a day nest is located, or its estimated location, a proforma will need to be completed with details of the exact location, the habitat type, aspect if known and noting any other significant features. A photograph of the nest should also be taken – including where possible a label in the first image so that the date and location can be noted.

C. Records of fox sightings

This activity will involve the recording of any fox sightings within the Park to help monitor their activity. Volunteers will help complete proformas with their supervisors and mark on a map where the fox was sighted, what habitat type it was using and what its activity was.

4. Hedgehog September Survey 2015 – Activity Schedule

	Fri 4	Sat 5	Sun 6	Mon 7	Tues 8	Wed 9	Thurs 10	Fri 11
Activity	n/a	n/a	Morning RT	n/a	Morning RT	n/a	Morning RT	n/a
Timing	n/a	n/a	3.15-6am	n/a	3.15-6am	n/a	3.15-6am	n/a
Groups	n/a	n/a	2 groups of 4	n/a	2 groups of 4	n/a	2 groups of 4	n/a
Supervisors	n/a	n/a	2	n/a	2	n/a	2	n/a
Volunteers	n/a	n/a	7	n/a	7	n/a	7	n/a
Activity	n/a	Day nests	Day nests	Day nests	Day nests	Day nests	Day nests	Day nests
Timing	n/a	5.15-7.15pm	5.15-7.15pm	5.15-7.15pm	5.15-7.15pm	5.15-7.15pm	5.15-7.15pm	5.15-7.15pm
Groups	n/a	2 groups of 2	2 groups of 2	2 groups of 2	2 groups of 2	2 groups of 2	2 groups of 2	2 groups of 2
Supervisors	n/a	1	1	1	1	1	1	1
Volunteers	n/a	3	3	3	3	3	3	3
Activity	n/a	Evening RT	Evening RT	Evening RT	Evening RT	Evening RT	Evening RT	n/a
Timing	n/a	7.45-11.15pm	7.45-11.15pm	7.45-11.15pm	7.45-11.15pm	7.45-11.15pm	7.45-11.15pm	n/a
Groups	n/a	2 groups of 4	2 groups of 4	2 groups of 4	2 groups of 4	2 groups of 4	2 groups of 4	n/a
Supervisors	n/a	2	2	2	2	2	2	n/a
Volunteers	n/a	7	7	7	7	7	7	n/a
Activity	n/a	Night RT	n/a	Night RT	n/a	Night RT	n/a	n/a
Timing	n/a	11.45pm-3am	n/a	11.45pm-3am	n/a	11.45pm-3am	n/a	n/a
Groups	n/a	2 groups of 4	n/a	2 groups of 4	n/a	2 groups of 4	n/a	n/a
Supervisors	n/a	2	n/a	2	n/a	2	n/a	n/a
Volunteers	n/a	7	n/a	7	n/a	7	n/a	n/a
Activity	Spotlighting	n/a	n/a	n/a	n/a	n/a	n/a	Spotlighting
Timing	8pm-1am	n/a	n/a	n/a	n/a	n/a	n/a	8pm-1am
Groups	8 groups of 5	n/a	n/a	n/a	n/a	n/a	n/a	9 groups of 5
Supervisors	10	n/a	n/a	n/a	n/a	n/a	n/a	11
Volunteers	32	n/a	n/a	n/a	n/a	n/a	n/a	36

5. Regent's Park + Primrose Hill Maps

We have divided Regent's Park into eight zones, as follows:

Zone 1a	Marylebone Green, Community Wildlife Gardens, Tennis courts, Regent's University
Zone 1b	Avenue Gardens, Park Square Gardens
Zone 2	Cumberland Green, Gloucester Green, Zoo car park
Zone 3 + 4	Sports pitches, Back of nursery, St John's lodge garden, Wetland area, Long Bridge, Open Air Theatre
Zone 5	Hanover Green, water side, Holme Green, Queen Mary's Gardens
Zone 6	Edge of lake, Winter Gardens, Running track, Leafyard Wood
Zone 7	ZSL (London Zoo)
Zone 8	Primrose Hill

You can see these zones clearly marked in the Visitor's Map provided in your pack.

Detailed maps of each area will be located at Hedgehog HQ and given to each group supervisor for the session activity.

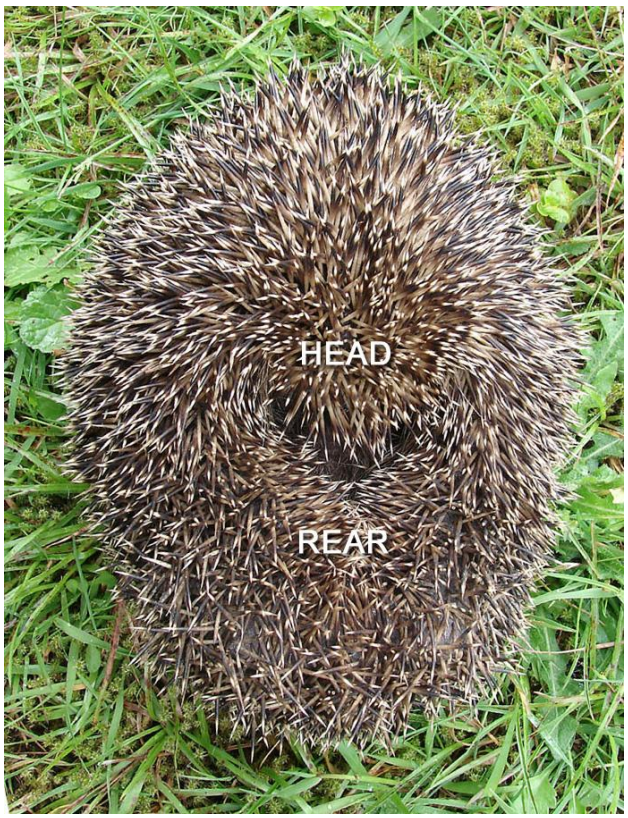
6. How to Handle a Hedgehog

As part of some of the survey activities, we are hoping we will come into contact with hedgehogs in the Park. If you are happy and confident to, there may be the opportunity to handle a hedgehog. Your project supervisor will be able to assist you.

Always wear gloves. Hedgehogs rarely bite but are prickly and normally very dirty. During handling, be quiet and avoid rustling or clicking noises, don't make what you might think of as reassuring noises like tutting or shushing. Ensure any open wounds, cuts or grazes you may have are covered with a plaster and use hand-sanitizing gel or wash your hands after handling them.

When you pick up a wild hedgehog it will usually roll-up into a ball. To examine it, you need to get it to unroll. Various methods exist but this one is relatively easily taught and usually successful. Some individuals are very reluctant to unroll and it can take many minutes just to determine the sex of the animal. The technique (for a right handed person) is as follows:

Gently pick up the hedgehog and hold it face down so that its rear-end is in your right palm and your left hand is under its front end (nose pointing away from you). Gently bounce it up and down in your hands, with luck it will gradually put out its feet and untuck its snout - now you have a crouching hedgehog. Without hurrying, keep bouncing it gently and allow the snout to poke between the thumb and index finger of the left hand and, using gentle but firm pressure, place the thumb on the back of its neck. Now it cannot tuck its head back down. Gently gripping the underside at the rear of the animal with your right fingers, put your right thumb in the small of its back and gently open out the animal by flexing it backwards; keep all movements smooth and slow.

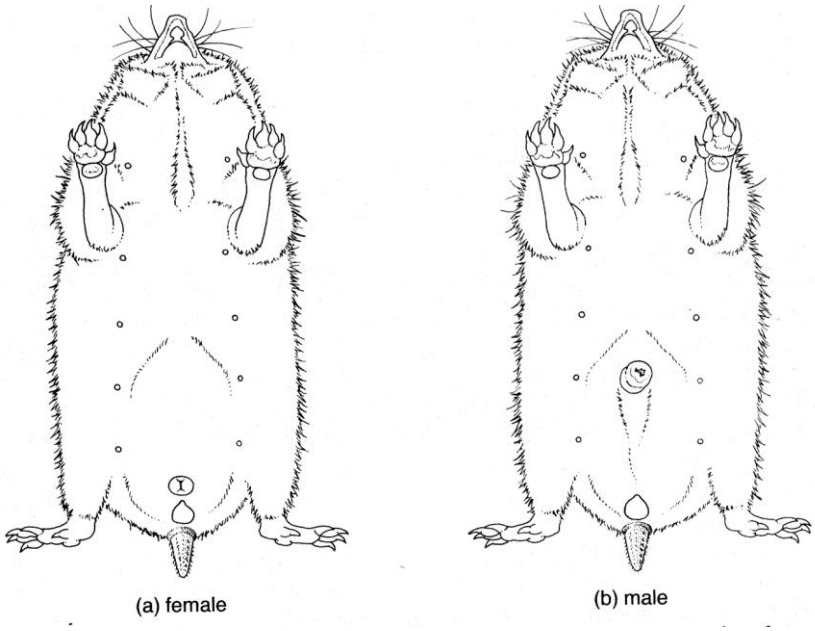


A rolled-up hedgehog on its back.

A wild-caught hedgehog unrolled in the hand.

The sexes can only be told apart by inspecting their genitalia. Luckily the differences are obvious. The male has a conspicuous penis sheath opening well forward on the belly (roughly where one might expect to see the navel), whereas the vulva of the female is very close to the anus. Although the male's testes are abdominal, there is a visible bulge in mature animals. Up to 10 nipples are visible in both sexes, but in pregnant or lactating females they may be more prominent.

If an animal will not unroll in the hand, lay it on its back on the ground. Wait quietly until it begins to unroll. Just as the animal rights itself (as if to run away) it will open up and you stand a good chance of seeing the underside. Because the penis sheath is usually obvious, you can usually determine the sex.



Drawing and photograph of the undersides of the two sexes.
Drawing Source: p. 42 in Reeve N. J. (1994) Hedgehogs, Poyser. Photograph Source: N.J.Reeve

7. Hedgehog Marking System

During the spotlighting activity we will capture and mark the hedgehogs we encounter. Hedgehogs will be marked using short lengths of yellow coloured plastic tubing with a three digit number preceded by a '#' printed on. The marking system below outlines how we will mark the hedgehogs so we can tell which number it is and which zone it was originally found in. Five duplicate numbers will be attached to the spines of the hedgehog on the crown of its head using superglue and tweezers.

Zone	Animal No.
1a	150
1a	151
1a	152
1a	153
1a	154
1a	155
1a	156
1a	157
1a	158
1a	159
1b	160
1b	161
1b	162
1b	163
1b	164
1b	165
1b	166
1b	167
1b	168
1b	169

Zone	Animal No.
2	170
2	171
2	172
2	173
2	174
2	175
2	176
2	177
2	178
2	179
3 + 4	180
3 + 4	181
3 + 4	182
3 + 4	183
3 + 4	184
3 + 4	185
3 + 4	186
3 + 4	187
3 + 4	188
3 + 4	189

Zone	Animal No.
5	190
5	191
5	192
5	193
5	194
5	195
5	196
5	197
5	198
5	199
6	200
6	201
6	202
6	203
6	204
6	205
6	206
6	207
6	208
6	209

Zone	Animal No.
7	210
7	211
7	212
7	213
7	214
7	215
7	216
7	217
7	218
7	219
8	220
8	221
8	222
8	223
8	224
8	225
8	226
8	227
8	228
8	229
Spares	230 to 350

Location of yellow numbering system

Example of plastic tubing marking system used in 2014

8. Hedgehog First Aid

Nic Masters, Head of Veterinary Services at ZSL, has provided a veterinary first aid plan for the Hedgehog survey, in case any hedgehogs found require veterinary attention. The plan is based on three scenarios. Your project supervisor will be able to help you if a hedgehog does need veterinary attention:

1. Moribund or severely injured hedgehog (e.g. Road Traffic Accident or dog attack) requiring euthanasia.
2. Hedgehog with minor issue (e.g. constriction injury to limb) that can be treated effectively with immediate first aid and then released at exactly the same site.
3. Hedgehog with more serious issue that requires temporary hospitalisation followed by either release within a few days at exactly the same site, or rehoming in a rescue centre (agreed beforehand) within a few days.

Types of injuries you may encounter:

- Missing or injured eyes from contact with thorns etc.
- Torn ears
- Bites or grazes on the hedgehog's side flanks
- Missing or damaged limbs
- Skin diseases
- 'Fly blown' wounds (an infected wound, looks like little grains of rice which are fly eggs)

Key contacts during survey:

Nic Masters has arranged the following veterinary support if a hedgehog that needs attention is found:

Friday 4 September (night)	Nic Masters (ZSL)
Saturday 5 Sep to Thursday 10 Sep	During office hours – ZSL (8:00 am to 4.30pm) Out of office hours - Fionah Wells (Practice Manager in Elizabeth Street Veterinary practice - Victoria)
Friday 11 September (night)	Nic Masters (ZSL)

Hospitalisation and care:

Hospitalisation services	ZSL London Zoo or Elizabeth Street practice
Rehabilitation services	Sue Kidger (Twickenham)

9. Data Management

A. COLLECTING AND STORING DATA

Data is an essential part of this project and it's critical we record and store results accurately so they can be analysed to meet the objectives of this project.

For every survey activity, your group will be asked to complete a pro forma to collect data and information. These proformas will be introduced to you at the volunteer training workshop and you will be instructed on how to fill these in. Don't worry, the supervisor on each activity will also be able to remind you how to fill these in and will sign them off after they've been completed.

Once we have all the data collected from the survey, the Supervisors will upload this data to Cartographer and Dropbox. We use two online platforms that make it easy for us to view and analyse the data.

CARTOGRAPHER

WHAT IS IT?

Cartographer is an online platform which securely manages and stores survey data which has been collected and manually inputted by individuals and groups. The platform has been specifically designed to store data collected as part of environmental projects.

WHO WILL BE USING IT?

Supervisors will be given access to Cartographer so they can all see the data after it has been added. The data will be added by the Hedgehog project team.

HOW DO SUPERVISORS USE IT?

To view data collected:

- Visit www.SupportTheRoyalParks.org/hedgehogs
- Click on link directing volunteers to view the data
- Log in using your username and password (these will be sent to you ahead of the first day of the survey)
- Enter in your results
- Log out

Dropbox

What is it?

Dropbox is an online service that lets you share photos and videos. We are using it as it has the capacity to store lots of large files, such as videos and photos which we need for the camera trapping part of the survey.

Who will be using it?

All volunteers will be given access to Dropbox to see results from the surveys, such as videos from the camera trapping and will be able to upload photos they have taken from the survey.

What will it be used for?

Volunteers will use Dropbox to upload photos and / or videos from any of the surveys; they will not use Dropbox to enter any data from the survey. The supervisors will do this on Cartographer.

How to take the first photo of a hedgehog

When taking the first photo of a new hedgehog – it is very important to remember to use the photo label template provided. Complete the label and place it beside the newly marked hedgehog so that it is legible and clear in the photo. Your Supervisor will have a copy of the labels for you.

How to upload photos & videos

So that we all know who took each photo / video, when and where, we will ask you to save all files as follows:

Date_Hog#_Notable Features_Zone(s)_Your Name

An example would look like this:

Fri4Sep_#155_damagedleg_Zone1a_JohnSmith

Fri4Sep is Friday 4 September (as per the dropbox folder title)

Hog # if known, insert the hedgehog number

Notable Features if there's anything we need to know about the hedgehog, e.g. damaged leg, torn ear etc

Zone1a relates to the zone(s) of the park your photo was taken from

Your Name, well it's your name!

Thank you in advance for following these instructions. This way, it will be much easier for us to organise all the data and media collected for the survey, and also easier to acknowledge you if we use your photo in the future. If you have any questions about the above, please get in touch with the Hedgehog Project Team.

10. Volunteer Kit List

VOLUNTEERS WILL NEED TO BRING THE FOLLOWING ITEMS WITH THEM TO EACH SESSION:

- Appropriate clothing for the activity:
    - Stout walking shoes
    - Sun hat if warm during daytime activities
    - Warm clothing for nocturnal activities
    - Wet weather gear if needed
    - Change of clothes if wet *(particularly a change of socks!)*
    - Where possible, please wear non 'rustly' clothing as hedgehogs don't like this noise

- Mobile phone *(fully charged)*

- Water bottle *(you can fill it with tap water at HQ)*

- Snacks if you feel you might need them *(light refreshments will be available at Hedgehog HQ)*

- Camera *(if possible, particularly if it has night vision)*

- Volunteer kit you will be provided with:
    - Personal torch for nocturnal work
    - High viz jacket for nocturnal work
    - Lanyard & volunteer ID card
    - Stationery as needed

11. Risk Assessment

A Risk Assessment for the Hedgehog Survey can be found in the back of your pack. Please ensure you read this ahead of your first volunteer session.

12. Hedgehog Headquarters (HQ)

Location

Hedgehog HQ in September 2015 is based in the ATC room at the Regent's Park Office on the Inner Circle Regent's Park *(please see map in the back of your pack)*.

Security & Access

Hedgehog HQ will be accessible during the times and dates of all survey activities. Hedgehog HQ will be locked at all other times.

Facilities

Hedgehog HQ will have:

- Toilets
- Access to water
- Tea, coffee and light refreshments
- First aid and welfare items
- Location to store your personal belongings whilst out on your survey activity *(although we recommend you don't bring anything too expensive or sentimental with you)*

Bicycle Parking

Hedgehog HQ will have space available for you to lock up any bicycles. Please ensure you bring a bike lock with you.

13. Emergency Procedure

A. In the case of an emergency requiring Regent's Park to close:

- You will be contacted by your supervisor and updated on the situation
- Please follow instructions from your supervisor for next steps

B. In the event you/your group gets lost or separated from your supervisor:

- Please head towards Hedgehog HQ on the Inner Circle to meet up with your supervisor
- If you need directions, please phone Sara Harrison on 07751 817248 or Clare Bowen on 07785 318717
- Before you start an activity, please make a note of your supervisors mobile phone number in your field notebook

C. In the case of accident or injury to you/a team member:

- Please phone 999 if serious
- Then phone Sara Harrison on 07751 817248 or Clare Bowen on 07785 318717 to update them on the situation

14. Travel

Modes of Transport

- Where possible and safe to do so, we would appreciate people use environmentally friendly modes of transport (e.g. walk, cycling or public transport) to get to The Regent's Park
- If required, parking will be available for the survey period. Please get in touch with Sara Harrison on sharrison@royalparksfoundation.org if you would like to drive and require a parking permit for Regent's Park. She will need the make of car, colour and registration number.

Reimbursements

- We are happy to reimburse any reasonable travel expenses incurred during the Hedgehog Survey
- Please ensure you keep any receipts and we will ask you to submit these at the end of the survey period
- If your travel cost will be over £10 per journey please could you let us know before purchasing so we can confirm the cost with you
- We would also ask that any travel which can be covered by a pre-purchased travel card you already own does not get submitted for reimbursement
- We will reimburse you by cheque, this should be sent out to you within 6 weeks of the end of the survey

Late night exit from the Regent's Park

In September, Regent's Park will close to the public at 8pm. During our nocturnal surveys (Spotlighting, GPS and Radiotracking), which will start or finish after 8pm, the entrances and exits from the Park will be:

Pedestrian:

- Chester Gate

Car:

- Chester Gate (in)
- Clarence Gate (out)
- Hanover Gate (in/out)

Please see these marked on the map in the back of your pack.

15. Key Contact Details

Hedgehog Project team

Clare Bowen: Head of Programmes: Royal Parks Foundation
cbowen@royalparksfoundation.org
07785 318717

Sara Harrison: Projects Manager: Royal Parks Foundation
sharrison@royalparksfoundation.org
07751 817248

General Royal Parks Foundation Office Number: 020 7036 8040

On call The Royal Parks Officer: The Regent's Park + Primrose Hill: 07969 726083

16. Project Partners

Lead Partners

THE ROYAL PARKS FOUNDATION

ZSL LET'S WORK FOR WILDLIFE

THE ROYAL PARKS

Independent advisors

- Dr Nigel Reeve
- Emeritus Professor of Ecology John Gurnell

Ancillary Partners

- People's Trust for Endangered Species
- Central Royal Parks Wildlife Group

Appendix 4

Royal Parks Foundation
Regent's Park Hedgehog Survey Risk Assessment
Friday 4 Sep – Friday 11 Sep 2015

Action	Hazard	Who is at risk?	Existing Controls	Risk Rating			Additional Controls Required
				L[1]	C[2]	R[3]	
Using equipment and hand tools	Repetitive movements, sharp edges	Hedgehog Project team and volunteers	Demonstration on how to use the equipment and hand tools at the volunteer training session. Gloves to be worn when appropriate. All tools are well maintained.	3	1	3	First Aid kit and first aiders available.
Handling a hedgehog	Sharp spines, bites and germs	Hedgehog Project team and volunteers	All participants and Hedgehog Project team to wear thick gardening gloves when handling a Hedgehog, all gloves to be sprayed with dettox when returned.	3	2	6	First Aid kit and first aiders available.
Working outdoors in the Park	Bending down, repetitive movements causing repetitive strain injuries	Hedgehog Project team and volunteers	At the training workshop and at start of each activity session participants to be reminded to work within their personal capabilities and to take regular breaks. Project supervisors to monitor.	2	2	4	

Working near roads in Regent's Park	Vehicles, bikes, horses and other Park users	Hedgehog Project team and volunteers	Volunteers briefed to be aware of the roads in Regent's Park and their users at the training workshop and at start of each session. Project supervisors to monitor the roads and volunteers throughout the session and be aware of any concerns. Hedgehog Project team and volunteers to all wear hi-viz jackets when on site and carrying out survey activities.	2	2	4	
Nocturnal working	Working in the dark	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team to each carry a personal torch at all times. Volunteers not to work by themselves and be with another person at all times when working in the Parks. Volunteers have access to the emergency procedure for any problems.	4	2	8	
Working near Regent's Park lake	Proximity of water - falling in	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team briefed not to go near the Regent's Park Lake at the training workshop and at start of each activity session. Hedgehog Project team to monitor the volunteers and direct any away from the lake if necessary. Survey teams not to go close to the lake particularly during nocturnal activities.	1	3	3	
Working outdoors in the Park	Park fabric + uneven ground causing slips, trips or falls	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team advised at the training workshop and at start of each activity session not to run on gravel paths or across Park land as the ground can be uneven and there may be potholes. Walking routes will be clearly defined and appropriate, stout, footwear to be worn by all.	3	1	3	First Aid kit and first aiders available.
Working outdoors in the Park	Heat or cold related illness e.g. Sunburn, sunstroke, chilblains, hypothermia	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team advised at training workshop to wear weather-appropriate clothing. Activities to be stopped if volunteers clothing unsuitable for conditions. Spare clothing to be stored at Hedgehog HQ if required.	3	1	3	

Working outdoors in the Park	Coming into contact with the hazardous plants, e.g. Nettle stings, allergic reaction, poisoning if eaten	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team to be aware of nettles and other stinging plants and advised to avoid them. Volunteers advised not to eat any plants found in the Park. Hand-washing facilities available at Hedgehog HQ.	3	1	3	
Working in the Park	Bird faeces, bacterial infections	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team advised at the training workshop and at start of each activity session not to put hands in their mouths, hand-washing facilities available. Any open wounds, cuts or grazes to be covered with plasters. Project supervisors and/or volunteers to carry hand sanitizing gel. Volunteers instructed to wash hands before eating/ at end of session.	3	2	6	
Working in the Park	Presence of dog faeces, Toxocariasis	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team briefed at the training workshop and at start of each activity session on possible presence of dog faeces and not to touch it.	2	1	2	
Working under and near trees	Falling branches	Hedgehog Project team and volunteers	Regular tree inspections from Park staff. Avoid working under trees in strong wind. Park to close in event of extremely high winds, hedgehog session to be re-scheduled on an alternative day.	1	3	3	
Working near other park users	Violent or aggressive behaviour	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team to be aware of other Park users. If come across any violent or aggressive Park user, make yourself safe, move to a safe distance away, then 999 to be called immediately in case of any violent or aggressive behaviour. Volunteers must not work alone during any survey activity.	1	3	3	
Coming into contact with wildlife	Grazes, bites, infection.	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team advised to not touch wildlife (except Hedgehogs where appropriate) within the Park whilst working on their activity. Particularly waterfowl and dogs. Any open wounds, cuts or grazes to be covered with plasters.	3	2	6	

Working in park land	Coming into contact with small litter in project site.	Hedgehog Project team and volunteers	Regent's Park litter picked daily. Volunteers and Hedgehog Project team must not touch or pick-up used litter, needles or syringes found during a project. Gardening gloves to be worn where appropriate whilst carrying out activities. Charity supervisor to pick up any sharps using gloves and place in hard Tupperware box. Box to then be disposed of in normal rubbish.	1	3	3	Report any needles or syringes found at the project site immediately to the charity supervisor.
Working outdoors in spring and summer	High pollen count	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team advised pre-visit if pollen count is forecast to be high so that people with severe allergies may take/bring appropriate medication. In case of severe reaction, phone 999.	2	2	4	First Aid kit and first aiders available.
Working outdoors in spring and summer	Bee, hornet and wasp stings	Hedgehog Project team and volunteers	Remove bee sting as quickly as possible. Watch closely for symptoms. In event of sudden swelling, breathlessness or increased heart rate, ambulance to be called immediately by phoning 999.	1	3	3	
Working near the Wildfowl collection	Intimidation and pecking	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team to monitor the area throughout the activity time and be aware of any wildfowl encroaching on the space and warn others in their team if coming nearby.	1	3	3	
Add in site specific detail that may affect the risk rating as stated above (include the date, time and weather conditions).							

[1]Likelihood of Occurrence	[2]Likely Consequences	[3]Risk Rating R = L x C
1. Improbable: probability is close to zero	1. Negligible: Trivial injury (requiring minor first aid)	1-5 Tolerable: No additional controls required
2. Remote: Unlikely though conceivable	2. Minor: Minor injury/short term issue	6-10 Low Risk: Probably requiring written guidelines
3. Occasional: Could occur some time	3. Serious: Single severe injury and/or multiple minor injuries	11-15 Medium Risk: Written guidelines required until risk is designed out
4. Probable: Occurs repeatedly/an event to be expected	4. Critical: Single fatality and/or multiple severe injuries	16-20 High Risk: Consider need for activity and additional
5. Frequent: Not surprised if event occurs/will occur several times	5. Catastrophic: Multiple fatalities	

		control methods 21-25 Intolerable Risk: Cease activity
Project Site: Various sites around Regent's Park		
Assessor(s): Sara Harrison		Date: 14.08.2015
Signature(s):		Date for Review: Ongoing during Hedgehog Survey, Fri 4 Sep – Fri 11 Sep 2015

Appendix 5 Thermal imaging camera

Setup of the FLIR E60 used for hedgehog fieldwork.

- Auto calibration option selected on the 'Temperature Scale' menu options
- Photo as separate JPEG: Off (Used in picture-in-picture mode. Determines if a digital photo will be saved as a separate file with a full field of view. If this setting is disabled, the digital photo will be saved with the same field of view as the infrared image.)
- Preview image before saving: Off
- Camera temperature range: -10-120
- Auto orientation: ON
- Display Intensity: LOW (better for night viewing and lower battery consumption)
- Auto Power Off: Off
- Video output format: PAL
- Level span mode: level/max/min
- WiFi: Off
- Bluetooth: Off

Parameter settings:

- Emissivity setting: set to a custom setting of 0.98 on a scale of 0-1 (human skin is 0.97-0.98, a polished mirror about 0.1)
- Distance: set at 15 metres (the atmosphere absorbs IR)
- Relative humidity: Default value is 50% setting. (may need to be set higher if wet weather).
- Atmospheric temp: 16°C (may need to be changed according to weather).
- Window compensation: Off (irrelevant to field work)

Appendix 6 Test on GPS tags - The Regent's Park February 2015

The test

On 29th August 2014 a static test was carried out on 10 I-gotU modified travel trackers (A41JF, Maplin, U.K) in Hyde Park to determine the accuracy of the fixes. Each tag was placed at three different known locations and between 4 and 7 recordings taken at approximate intervals of 5 minutes for each tag in each location. Twenty recordings were taken when the tags were placed out in the open and 10 recordings under shrubbery and within 3 m of buildings. The conclusion was that the tag fixes had an overall error of ± 10 m but bearings or headings were random.
A further static test on 7 tags (numbers 2, 3, 4, 7, 9, 13 and 14) was carried out in The Regent's Park on 5th February 2015 to assess the fix error for tags close to walls, metal railings, tree trunks or under dense vegetation, typical situations where hedgehogs might be found in The Park. All the tags were placed on the ground in locations adjacent to the drive leading to the Old Ironworks from the Inner Circle, Regent's Park. The positions of the tags were: by the base of a tree by the path, by the base of a metal railing, under a holly bush, by a concrete post along a fence, under a fence, by the base of a tall *Leylandii* tree, and under a laural shrub The tags were set to record every 3 min; they were turned on and placed in position between 10.35 and 11.00 and collected in and turned off between 17.55 and 18.05.

The data were downloaded and analysed with respect to how many fixes were recorded by each tag during the ~ 7 hour trail. Then the mean distance to the origin and the mean bearing of each fix were calculated, first for the data set as a whole (termed data set 1) and then after applying two filters to the data based on the elevation or altitude of the recorded fixes. Elevation error tends to be considerably worse than fix or position error[1], but has been found useful at removing bad fix data (unpubl.). The actual elevation of the collars was ~39 m and the first filter removed all fixes that had an elevation of >60 m or <0 m (data set 2). A second filter was carried out removing all fixes that had an elevation of >49 m or <29 m , i.e. 10 m higher or lower than the actual elevation (data set 3).

The findings

Two tags (2 and 3) started recording fixes straight away, but there were slight delays in two tags finding satellites and starting to record (9 and 13) and long delays of ~ 130 minutes in the remaining three tags (4, 7 and 9) (Table 1). Thereafter all the tags lost satellite signals and stop recording for different amounts of time, but the percentage of fixes recorded of the number they theoretically should have recorded varied between varied between 37% and 73% (Table 1). Mean fix interval also varied between 3.8 min and 28 .8 min.

Many fixes in the unfiltered data set were clearly way off target leading to large mean positional or distance to origin errors (Table 1). Applying the first filter removed between 52% and 17% of the fixes but, by direct inspection, had removed most of the very poor positional fixes. These figures exclude those for Tag 4, which only had 12 fixes in the original data set, and only one once these had been filtered. Mean distance or position error for the other six tags varied between 11.9 m and 24.5 m (Table 1) with an overall error of 16.8 m (SD = 12.00 m, N = 336) (Figure 1a). The mean bearings for each of the six tags for data set 2 tended to be in the N-E quadrant (Table 1, Figure 1b), and the bearings were not random for all tags.

The more conservative second filter reduced the number of fixes considerably with a loss of fixes for the six tags varying between 48% and 83% (Table 1). The mean distance to origin varied between 11.7 m and 20.8 m for each tag with an overall mean of 14.9 m (SD = 8.58 m, N = 163).The bearings were random for only one of the six tags (Nos. 7).

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[1] See http://gpsinformation.net/main/altitude.htm Accessed 23/2/15.

Discussion

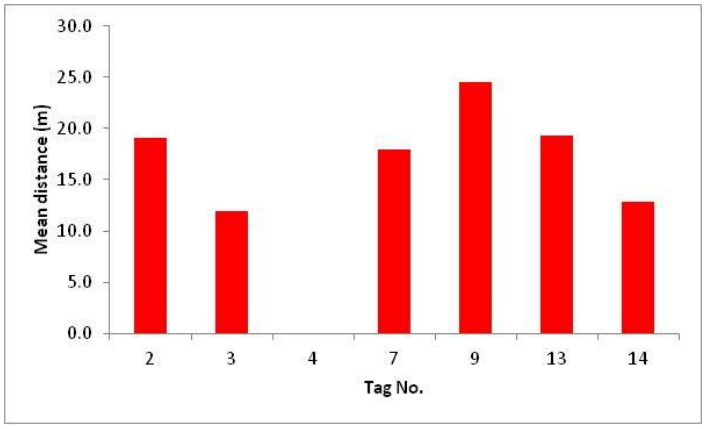
Of the three data sets looked at, data set 2 appeared to be the most efficient one to use; virtually all of the really wild fixes had been removed, but a reasonable proportion of the fixes were retained. However, Tag 4 performed poorly with only 12 fixes taken, only one of which were retailed after the first filter of the data and so was not included in data set 2. The mean distance error was ~17 m but the bearings were not random. The more conservative data set 3 , had an overall lower distance error of ~15 m, but the bearings were not random for four of the six tags and a much higher proportion of fixes were filtered out. Clearly, other ways of filtering the data could be explored.

There was quite a wide variation in the performance of individual tags which is most likely explained by their position with respect to vegetation and objects. Tags have been ranked in Table 2 on the basis of the different measurements of performance that have been made. Tag 4 was the worst tag, as has already been mentioned. Tags 3 and 2 were the best tags. Despite these results, there is no obvious pattern as to why some tags performed better than others. Errors may arise because tags did not receive signals from a sufficient number of satellites, atmospheric disturbances which distort the signals before they reach the tags, and reflections from buildings, trees and other large, solid objects.

Conclusion

The results suggest a fix error of at least ±17 m for hedgehogs under dense vegetation or near solid objects like walls and fences, although it could be considerably larger in certain situations. These errors would be short-lived for animals moving through vegetation or past solid objects, but would become a problem for animals which nest under dense vegetation or near solid objects. In these cases, it appears that bearings may not always be random.

(a) Mean distance



(b) Mean bearing

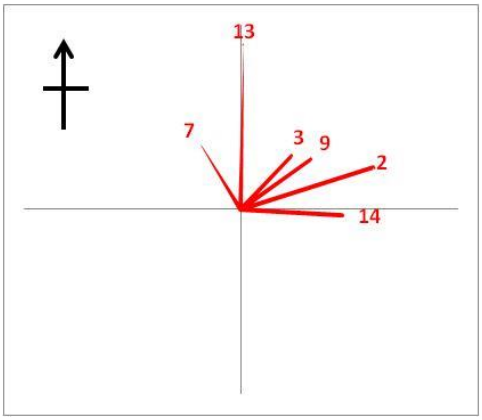


Figure 1 (a) Mean distance to origin error, (b) mean bearing for each tag for data set 2.

			Tag Location/No.						
			Base of tree by path	Base of metal railing	Under holly bush	By concrete post along fence	Under fence	Base of tall Leylandii	Under laural shrub, 20 m from building
Measure	Data set	Statistic	2	3	4	7	9	13	14
(a) Fixes		Delay to first fix (min)	0	0	131	131	13	6	130
		Success rate (%)*	67	65	83	73	37	67	73
		Mean fix interval	3.8	4.3	9.5	4.6	9.4	4.3	28.8
		Standard deviation (SD)	3.56	4.06	6.06	2.47	8.53	5.17	17.82
(b) Distances	1	No. of observations	102	99	12	62	42	93	58
		Mean	6514	6135	4769	25	6592	3574	14
		Standard deviation (SD)	17826.4	17401.7	15854.5	32.5	18044.6	13603.8	9.9
	2	No. of observations	78	74	0	42	20	73	48
		% unfiltered no. obs.	76	75	0	68	48	78	83
		Mean	19.0	11.9		17.9	24.5	19.3	12.9
		Standard deviation (SD)	12.4	8.1		19.2	14.7	8.2	7.7
	3	No. of observations	37	38	0	19	7	32	30
		% unfiltered no. obs.	36	38	0	31	17	34	52
		Mean	16.6	11.7		12.1	20.8	18.2	13.9
		Standard deviation (SD)	7.7	8.0		6.3	19.5	6.6	8.0
(c) Bearings	1	Mean bearing (degrees)	**72**	43	**286**	**337**	24	**358**	**93**
		Circular SD	71	110	58	78	115	48	82
	2	Mean bearing (degrees)	**69**	**38**	-	**331**	**50**	**0**	**94**
		Circular SD	53	81	-	79	76	28	70
	3	Mean bearing (degrees)	**73**	**56**	-	306	12	**1**	**94**
		Circular SD	41	8	-	84	52	24	59
*	= per cent of fixes recorded of all possible fixes since time recording started until the end of the test								

Table 1 Test results for each tag: (a) fixes, (b) distances to origin, (c) bearings - bold values indicates the bearings were not random but tended to be clustered about the mean direction.

Tag No.	Placement	Rank Order
3	Base of metal railing	1
2	Base of tree by path	2
13	Base of tall Leylandii	3
9	Under fence	4
14	Under laural shrub, 20 m from building	5
7	By concrete post along fence	6
4	Under holly bush	7

Table 2 Mean rank order of tag performance, taking into account the ranks of: time to first fix, % fix success, mean distance of fixes to origin and whether the bearings were random or not.

Appendix 7a

The Regent's Park Hedgehog Survey

Thank you for helping with our hedgehog research - this vulnerable urban population needs you! Remember, it's just as important for us to know if you have never seen a hedgehog as if you have so please respond either way.
The response deadline is Sunday 6 September 2015. THANK YOU!

Your postcode:	Do you have a garden? Yes / No

Have you ever seen a hedgehog…?			How many?	Where? (Habitat, street name, postcode)	Dead or Alive?	When?		
						In 2015	2010 – 2014	Pre 2010
…in your garden?	Yes	No						
…on Primrose Hill?	Yes	No						
…in Regent's Park?	Yes	No						
…within a 1km radius of the Regent's Park boundary ?*	Yes	No						
If necessary, please share any additional information on a separate sheet of paper e.g. sighting frequency or behaviour. The more detailed information the better!								

**Areas within 1km of Regent's Park and Primrose Hill include: Belsize Park, Camden Town, Chalk Farm, Fitzrovia, Kentish Town, Lisson Grove, Maida Vale, Marylebone, South Hampstead, St John's Wood, Swiss Cottage.*

Have you ever heard of live hedgehogs being released into Regent's Park or Primrose Hill?	Yes	No	If yes… please give details *(where the hedgehog had come from and date)*

If you are happy for us to contact you about the hedgehog information you have provided, please complete your details below:
Name:
Email:
Telephone:
Would you like to hear more about the Regent's Park hedgehog research and the work of the Royal Parks Foundation, the charity for London's eight amazing Royal Parks? Yes / No (*Your details will not be shared with any third parties and all survey results will be treated as confidential.)*

Appendix 7b

Royal Parks Foundation
Regent's Park Hedgehog Survey Risk Assessment
Residents Questionnaire Delivery
July 2015

Action	Hazard	Who is at risk?	Existing Controls	Risk Rating			Additional Controls Required
				L[1]	C[2]	R[3]	
Working outdoors in the Park and on the roads	Bending down, repetitive movements causing repetitive strain injuries	Hedgehog Project team and volunteers	At the start of each activity session participants to be reminded to work within their personal capabilities and to take regular breaks. Project supervisors to monitor.	2	2	4	
Working outdoors in the Park and on the roads	Vehicles, bikes, horses and other road users	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team briefed to be aware of the roads near Regent's Park and their users at the start of each session. Volunteers should walk on pavements and pathways and use pedestrian crossings where appropriate. Sensible road safety precautions to be used at all times.	2	2	4	
Working outdoors in the Park and on the roads	Park fabric + uneven ground along pavements causing slips, trips or falls	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team advised at the training workshop and at start of each activity session not to run on gravel paths, pavements or across Park land as the ground can be uneven and there may be potholes. Stout, flat, comfortable footwear to be worn by all during delivery sessions.	3	1	3	

Working outdoors in the Park and on the roads	Heat or cold related illness e.g. Sunburn, sunstroke, chilblains, hypothermia	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team advised to wear weather-appropriate clothing, e.g. rain coats / ponchos / sun hats and sun cream. Activities to be stopped if volunteers clothing unsuitable for conditions.	3	1	3	
Working near members of the public	Violent or aggressive behaviour	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team to be aware of other members of the public. If come across any violent or aggressive behaviour, make yourself safe, move to a safe distance away, then 999 to be called immediately. Volunteers to work in pairs where possible.	1	3	3	
Carrying questionnaires for delivery	Strains from excessive weight	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team to only carry the number of questionnaires they are comfortable with. Volunteers to provide their own backpacks to carry the questionnaires safely and comfortably.	1	3	3	
Delivering of questionnaires	Hand injuries from letterboxes	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team to be aware of hinged letterboxes which may snap back quickly, everyone to deliver with caution and not to put their whole hand through the letterbox. If letterbox too stiff, don't deliver a questionnaire	3	2	6	
Delivery of questionnaires	Dog bites	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team to be aware of dogs on the inside of the building delivering to. Everyone to deliver with caution and not to put their whole hand through the letterbox. If hear a dog barking on the inside, then don't deliver a questionnaire.	3	2	6	
Working outdoors in the Park and on the roads	Adverse weather conditions causing injury, e.g. high winds or thunderstorms	Hedgehog Project team and volunteers	Volunteers and Hedgehog Project team to be made aware if Park needs to close due to adverse weather conditions. If there are severe high winds or large thunderstorms, volunteers to make themselves safe and take cover somewhere safe. Questionnaire delivery to be postponed and take place at another time.	2	2	4	
Add in site specific detail that may affect the risk rating as stated above (include the date, time and weather conditions).							

[1]Likelihood of Occurrence	[2]Likely Consequences	[3]Risk Rating R = L x C
1. Improbable: probability is close to zero 2. Remote: Unlikely though conceivable 3. Occasional: Could occur some time 4. Probable: Occurs repeatedly/an event to be expected 5. Frequent: Not surprised if event occurs/will occur several times	1. Negligible: Trivial injury (requiring minor first aid) 2. Minor: Minor injury/short term issue 3. Serious: Single severe injury and/or multiple minor injuries 4. Critical: Single fatality and/or multiple severe injuries 5. Catastrophic: Multiple fatalities	1-5 Tolerable: No additional controls required 6-10 Low Risk: Probably requiring written guidelines 11-15 Medium Risk: Written guidelines required until risk is designed out 16-20 High Risk: Consider need for activity and additional control methods

		21-25 Intolerable Risk: Cease activity
Project Site: Roads and streets local to Regent's Park		
Assessor(s): Sara Harrison		Date: 30.07.2015
Signature(s): Name: Signature: Date:		Date for Review: At next hedgehog questionnaire delivery session

Appendix 7b

THE ROYAL PARKS FOUNDATION

The Regent's Park Hedgehog Research Programme
Residents Questionnaire July 2015
Delivery Volunteer FAQ

1. What is the purpose of the questionnaire?

One of the aims for the 2015 Hedgehog Research Programme is to determine whether or not The Regent's Park hedgehogs are an isolated population. We are asking locals whether or not they have seen a hedgehog, dead or alive, within 1 km of the Park.

It is also a fantastic opportunity for us to spread the hedgehog word and inform locals that there is a small and vulnerable population of hedgehogs on their doorsteps which needs our help to survive.

2. Where are all the questionnaires being delivered?

We are delivering the questionnaires to the roads closest to the Park and to some key contacts within the area.

3. How many questionnaires are being delivered?

We will be delivering 4,000 questionnaires.

4. What is in the questionnaire pack?

The envelopes you are delivering will contain an introduction letter double sided with the questionnaire, a leaflet about the project and a S.A.E for returning the questionnaire.

5. How will I know where to deliver?

You will be provided with a map which will clearly show where you should deliver your leaflets to.

6. What do I need to take when delivering?

Please bring a bag to carry the leaflets in. Please also bring any drinks or refreshments you may need. As the British weather is unreliable please do check the weather forecast and dress appropriately.

7. How many questionnaires do I need to deliver?

We are trying to recruit approximately 40 volunteers to help with the delivery, asking each person to deliver around 100 questionnaires (do let us know if you'd like to do more though!)

8. What date do the questionnaires need to be delivered by?

We'd like all questionnaires distributed by the end of July/beginning August. There will be a mass delivery session on Thursday 30 July 2015, although if volunteers can't make that date then they are welcome to deliver on a date convenient to them.

9. Should I deliver to businesses as well as residents?

Yes! If it seems appropriate to deliver a questionnaire to a local shop owner then please do. Please use your common sense as to whether you feel the business will be interested and happy to complete the questionnaire.

10. What should I do if I need to enter a block of flats?

This is always tricky as blocks of flats tend to have more security; there are a few methods to try to gain access…

1. wait at the entrance until someone comes out and take the opportunity to enter
2. see if there is a porter on duty, explain what you're doing and ask if it would be okay to deliver in the building
3. see if there is a trade/delivery entrance buzzer or door you can enter through
4. buzz into a flat and say "Hi there – here for a delivery"

NB. Sometimes, blocks of flats have pigeon holes in the main foyer to the building, look out for these to save you walking around the whole building!

If you can't get in to the building – please don't worry! Just move on down the road and try elsewhere, just let Sara Harrison know where you weren't able to deliver.

11. What should I do if I think there are multiple flats in a house?

Please use your common sense, if there are 5 doorbells, post 5 questionnaires through the door. If it's not obvious but you think there are multiple flats, please look at its neighbours and post through an average number of envelopes (normally 2 or 3 works for most London houses!). Above all, don't spend too much time worrying about it!

12. The letterbox or door has a 'No junk mail' notice on it

Don't post a questionnaire through these doors.

13. A resident or security guards asks me to leave

Just leave and move onto the next property. Your safety and wellbeing comes first!

14. What should I do if I have questionnaires left over at the end of my road allocation?

If possible, please try to deliver all your questionnaires, feel free to deliver further down the road or in a new area nearby not marked on your map, it's best to have the questionnaires out there! If you have LOTS left over (30+) then please let Sara Harrison know as we could use them elsewhere.

15. What should I do if I run out of questionnaires before I've finished my roads?

Don't worry! Just mark on a map where you got up to and let Sara Harrison know so we can head back another time to finish the area off.

16. I know someone / an organisation who would be a good contact to send a questionnaire to – how shall I go about it?

Great news! Please contact Sara Harrison so we can arrange for the relevant number of packs to be sent directly to the contact or passed to you so you can deliver them.

17. If anyone asks me questions about the questionnaire and I don't know the answer, what should I say?

Please refer them to the Royal Parks Foundation website at www.SupportTheRoyalParks.org If they would like to contact someone, please ask them to email hedgehogs@royalparksfoundation.org

18. Can you only complete a paper version of the questionnaire?

No, we will have an online version of the questionnaire people can complete as well, we will send all hedgehog volunteers the link, feel free to email this to anyone you know local to Regent's Park who would be happy to complete the questionnaire.

19. Should people only complete the questionnaire if they have seen a hedgehog?

No! It is just as valuable for us to know if people HAVE NEVER seen a hedgehog in the area as this will help us when analysing the results.

20. If I feel unsafe in my delivery area, what should I do?

Your safety is the top priority, if you don't feel comfortable where you are, please move away from the area and get yourself to a safe place. If you encounter any issues, your first call should be to **999**, then please let Sara Harrison know on 07751 817248.

21. Who is the main contact in case I have questions when I'm out delivering?

Sara Harrison: Royal Parks Foundation:
07751 817248, sharrison@royalparksfoundation.org
Marion Buggins: Royal Parks Foundation:
07882 890755, mbuggins@royalparksfoundation.org

THANK YOU FOR YOUR HELP!

Appendix 8 Results

Table A.8.1 Numbers of hedgehog individuals captured in each zone. If an animal was captured in more than one zone, this table reports the zone in which the hedgehog was first captured.

							Zone					
Year	Month	Sex	Age	1	2	3	4	5	6	7	8	Total
2014	May	Female	Adult	4	1	1	0	5	1	0	-	12
			Subadult	1	0	0	0	0	0	0	-	1
		Male	Adult	7	1	0	1	1	1	0	-	11
			Subadult	2	0	0	0	0	0	0	-	2
		?	Adult	0	0	0	0	1	0	0	-	1
			Total	14	2	1	1	7	2	0	-	27
2014	Sept	Female	Adult	4	5	1	1	3	1	0	-	15
			Juvenile	0	3	0	0	0	0	0	-	3
			Subadult	3	1	0	0	0	0	0	-	4
		Male	Adult	4	2	0	0	3	0	0	-	9
			Juvenile	0	1	0	0	0	0	0	-	1
			Subadult	3	2	0	0	0	0	1	-	6
		?	Adult	0	1	0	0	0	0	0	-	1
			Juvenile	1	0	0	0	0	0	0	-	1
			Subadult	0	0	0	1	0	0	0	-	1
			Total	15	15	1	2	6	1	1	-	41
2015	May	Female	Adult	4	7	0	0	4	1	0	0	16
			Subadult	0	2	0	0	0	0	0	0	2
		Male	Adult	6	4	0	1	2	1	0	0	14
		?	Adult	0	1	0	0	0	0	0	0	1
			Total	10	14	0	1	6	2	0	0	33
2015	Sept	Female	Adult	1	3	1	1	4	1	0	0	11
		Male	Adult	2	1	2	0	1	0	0	0	6
			Juvenile	0	1	0	0	0	0	0	0	1
			Subadult	0	1	0	1	0	0	0	0	2
			Total	3	6	3	2	5	1	0	0	20

Adult 32 (male), captured in Zones 4, 2 and 5 in May 2014.
Adult 60 (male) captured in Zone 1 in May and Zone 5 in September 2014.
Adult 62 (male) captured in Zone 5 in May and Zones 6 and 5 in September 2014.
Adult 180 (male) captured in zones 4 and 2 in May 2015.
Adult 191 (female caught in zones 5 and 1 in May 2015.
Adult 171 (female) caught in zones 3 and 2 in Sept 2015.
Adult 172 (male) caught in zones 1, 2 and 3 i Sept 2015.
Adult 181 (female) caught in zones 4 and 3 in Sept 2015.
Adult 184 (female) caught in zones 6 and 6 in Sept 2015.
Adult 192 (female) caught in zones 5 and 3 in Sept 2015.
Adult 201 (male) caught in zones 3 and 6 in Sept 2015.
Adult 226 (male) caught in zones 3 and 4 in Sept 2015.

Table A.6.2. Movement and home range summary statistics for all individuals GPS tracked.

					Nightly distance moved (m)		95% MCP (ha)		95% Kernel (ha)	
Year	Month	Number	Sex	No, nights tracked	Mean	SD	Mean	SD	Mean	SD
2014	May	3	M	4	919	141.6	1.6	0.7	1.0	0.4
		56	F	6	662	182.3	1.2	0.7	1.9	1.3
		4	M	6	549	280.1	0.7	0.3	0.9	0.6
		32	M	6	1897	761.9	13.4	7.9	16.7	11.7
		86	M	5	827	359.2	2.5	1.2	2.6	1.0
		54	F	5	355	327.8	1.5	1.9	1.3	1.9
	September	1	F	7	1274	170.4	2.0	0.2	1.7	0.5
		7	F	7	1124	273.1	3.7	0.6	4.0	0.5
		12	F	7	1085	188.8	3.1	0.5	3.4	0.5
		56	F	5	509	62.2	0.9	0.4	1.3	0.7
		60	M	6	683	256.0	1.1	1.3	0.9	1.2
		87	F	6	551	134.5	1.1	0.5	1.2	0.8
		62	F	6	768	174.2	0.9	0.3	1.0	0.3
		16	M	12	544	239.4	0.4	0.3	0.5	0.4
		33	F	6	922	290.5	2.1	0.5	1.7	0.5
		18	F	7	794	357.4	1.1	0.6	1.6	1.1
2015	May	161	F	3	691	5.2	0.9	0.5	1.3	0.8
		150	M	5	1285	468.1	4.8	2.1	6.4	2.7
		181	F	1	583	0.0	1.4		1.1	
		180	M	4	358	222.7	0.2	0.1	0.1	0.1
		190	F	6	677	181.5	1.2	0.5	1.3	0.8
		191	F	4	326	328.8	0.7	1.0	0.6	0.8
		170	F	6	1113	182.6	2.7	1.0	2.0	1.0
		175	M	7	685	246.0	1.0	0.8	1.3	1.1
		167	M	3	1934	691.6	13.5	5.3	13.7	6.7
	September	153	F	4	716	112.9	2.4	1.7	3.6	2.3
		152	F	6	928	247.0	2.5	1.2	1.9	1.2
		222	F	7	1041	242.8	2.4	1.1	2.4	1.3
		192	F	2	736	335.2	2.7	1.9	2.8	2.5
		226	M	6	875	218.6	2.2	1.1	3.1	2.4
		170	F	2	996	232.9	4.6	0.4	3.8	0.4
		171	F	7	1286	349.6	7.0	4.0	9.4	5.9
		162	M	3	143	186.1	0.2	0.3	0.4	0.7
		165	F	3	927	477.9	2.7	1.3	3.2	2.5

Appendix 9 Hedgehog captures in the Zoo Car Park

Table A.9.3 Hedgehog captures in the Zoo Car Park; young = subadult or juvenile.

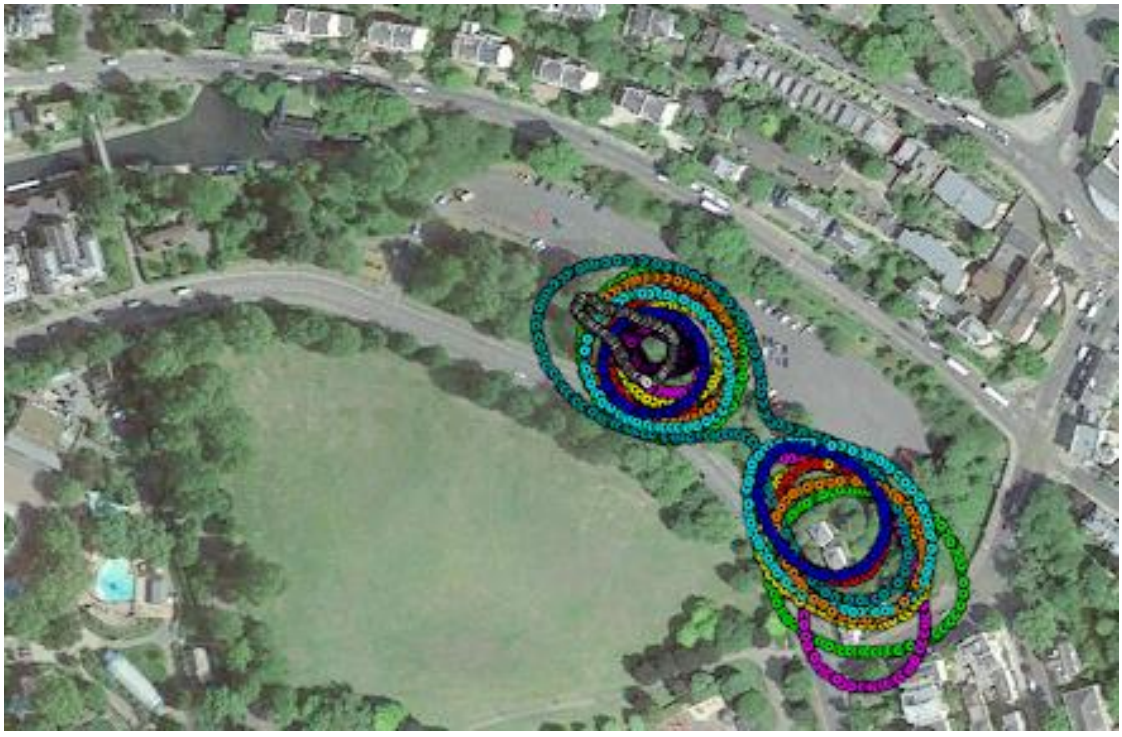
Record No.	Date	Animal Number	Sex	Age	Weight (g)
67	06/09/2014	13	Male	Adult	630
32	08/09/2014	13			
1	12/09/2014	13			
69	05/09/2014	14	Male	Young	220
70	05/09/2014	15	Female	Young	200
28	10/09/2014	15			
4	12/09/2014	15			
41	05/09/2014	16	Male	Adult	820
39	05/09/2014	17	Female	Adult	925
40	05/09/2014	18	Female	Adult	1025
42	06/09/2014	18			
3	12/09/2014	18			
47	06/09/2014	20	Male	Adult	1150
46	06/09/2014	21	Female	Young	530
2	12/09/2014	22	Female	Young	210
25	10/09/2014	25	Female	Adult	940
26	10/09/2014	31	Female	Young	200
31	08/09/2014	88	Unknown	Adult	1005
45	06/09/2014	105	Male	Young	600
30	18/05/2015	160	Female	Young	430
37	20/05/2015	160			
31	18/05/2015	161	Female	Adult	640
50	21/05/2015	161			
62	22/05/2015	161			
20	16/05/2015	173	Female	Adult	650
10	15/05/2015	174	Female	Adult	700
11	16/05/2015	175	Male	Adult	710
36	21/05/2015	175			
60	22/05/2015	175			
34	17/05/2015	177	Male	Adult	950
61	22/05/2015	177			
12	15/05/2015	178	Female	Young	500
55	19/05/2015	178			
24	17/05/2015	182	Unknown	Adult	700
54	19/05/2015	182			
59	23/05/2015	210	Female	Adult	610
43	11/09/2015	156	Male	Young	480
23	09/09/2015	160	Female	Adult	660
9	04/09/2015	215	Male	Young	420
17	08/09/2015	215			
11	04/09/2015	221	Male	Adult	1070

Figure A.9.1 Hedgehog captures in the Zoo car park. Each hedgehog was individually numbered. Yellow- September 2014, orange, May 2015, blue - September 2015.

Figure A.9.2 Location of nest sites of radio-tagged hedgehogs in September 2014 and May 2015. Hedgehogs individually numbered

Figure A.9.3. Location of radio-tagged hedgehogs seen foraging in Zoo car park. Yellow - September 2014, orange = May 2015

(a) No. 16 September 2014



(b) No. 18 September 2015

(c) No. 161 May 2015

(d) No. 175 May 2015

Figure A.9.4 95% kernel range boundaries for two hedgehogs fitted with GPS tags (a) and (b) in September 2014 and two in May 2015 (c) and (d). Each colour represents a different night.

Appendix 10 Veterinary and post mortem reports from the Garden Wildlife Health Project

XT678-15 Male Hedgehog #150
Found dead by gardener in Avenue Gardens on 20/06/15
Examined by Julia Rodriguez-Ramos Fernandez

Gross exam
Examined is the carcass of a male adult European hedgehog (*Erinaceus europaeus*) in thin body condition and with mild autolysis. There are small amounts of subcutaneous and abdominal adipose tissue (fat). There is a partially healed fracture on the proximal right tibia with no soft tissue reaction. There are multiple fractures on the region of the right tarsus with severe oedema and haemorrhage of the subcutaneous tissue. The stomach contains small amounts of watery grey fluid. The small intestine contains small amounts of tan digesta. The large intestine contains large amounts of well-formed brown to green faeces.

Other tests
Radiographs (performed ante-mortem by Nic Masters and Heather Macintosh) also reveal a dislocated right hip, a complete fracture of the right femur near to the stifle (knee), a complete and partially healed fracture of the right olecranon (back of elbow).
Bacterial culture of the skin, liver and small intestine reveals no significant findings. No parasites are seen in wet preparations of the lungs or small intestine.

Morphologic diagnoses
Body as a whole: Thin body condition
Body as a whole: Trauma
Body as a whole: Euthanasia
Right proximal tibia: Fracture, focal, partially healed
Right tarsal region: Fractures, multiple, acute with soft tissue oedema and haemorrhage
Right hip: Dislocation
Right femur: Fracture, focal
Right olecranon: Fracture, focal, partially healed

Comment
This hedgehog was found alive and was euthanized due to the presence of severe injuries. Significant findings in this hedgehog include several hind and forelimb fractures that are in different stages of healing. Some are very acute (recently happened) and others are almost completely healed. The cause could not be determined but potential aetiologies include predation and trauma. The hedgehog was also in thin body condition. This could be due to the presence of an underlying disease or because the fractures were severe enough to compromise the hedgehog's ability to find food. No gross lesions suggestive of the presence of an underlying disease were seen, no significant bacteria were cultured and no parasites were seen on a wet preparation of the lungs or intestinal contents. Microscopic examination of the tissues (histopathology) is pending and may help determine if there was an underlying disease. We will let you know if this test yields additional information.

XT738-15 Female Hedgehog #151
Found injured in English Gardens by the Prince Albert Gate on 08/07/15
Examined by Julia Rodriguez-Ramos Fernandez

Gross exam
Examined is the carcass of a female European hedgehog (*Erinaceus europaeus*) in thin body condition and with mild autolysis. There are small amounts of subcutaneous fat. There is one tick on the fur. The right globe (eye) markedly reduced in size (3mm x 3mm), irregular in shape and tan. The hair around the cranial aspect of left eye is covered in dried yellowish-tan secretion. On the mid-left tibia there is a healed callous (1cm x 1.5cm x 1.5cm). Extending from distal right tibia to tip of the toes the soft tissue is swollen (oedema and inflammation). There is complete luxation (dislocation) of right hock joint and there is an associated circular wound which is 1.5cm wide. The underlying tissue is exposed.

There are minimal amounts of mesenteric adipose tissue (fat). In the stomach are moderate amounts of small green-yellow-brown granular and plant based material. In the small intestine are moderate amounts of tan-brown pasty material. In the large intestine are moderate to large amounts of fibrous dark green-brown plant material. The urinary bladder contains moderate to large amounts of transparent yellow urine.

Other tests
No significant bacteria are cultured from the liver, small intestine or skin.
No parasites are seen on wet preparations of the small intestinal contents and lung.

Morphologic diagnosis(es)
Body as a whole: Euthanasia
Body as a whole: Thin body condition
Right globe: *Phthisis bulbi (shrunken eye)*
Left eye: Conjunctivitis, diffuse, moderate
Right hock: Luxation, focal with locally extensive, severe, subacute oedema and cellulitis and focal wound
Left tibia: Callus, focal, chronic (healed fracture)

Comment
This hedgehog was euthanized due to the presence of severe injuries on the right hind limb and right eye. The right hock was luxated and had an open wound and oedema and inflammation/infection of the associated soft tissue. The right globe was markedly reduced in size and deformed (phthisis bulbi) likely as a result of severe ocular diseases, trauma and/or inflammation/infection. It is most likely that the hedgehog was not able to see through this eye. Additionally, the left hind limb had a healed fracture. This limb was most likely functional at the time of death.

The hedgehog was in thin body condition and had very little fat reserves, indicating that the wounds she suffered were likely making walking and finding food difficult.

XT831 Female Hedgehog #161
Found dead at entrance of Zoo Car Park on 23/07/15
Examined by Julia Rodriguez-Ramos Fernandez

Gross exam
Examined is the carcass of a female adult European hedgehog (*Erinaceus europaeus*) in good body condition and with mild autolysis. There are dozens of ~2mm long ticks multifocally within the fur. The fur around the face is stained with moderate amounts of red opaque material (blood). Within the head are multiple lacerations ranging from 0.3 cm - 0.6 cm in diameter with associated haemorrhage. There is a laceration adjacent to the eye with extrusion of the retrobulbar fat. There are dozen lacerations (post-mortem), ranging from 1 cm - 2.5 cm in the fore limb and hind limb with exposure of the subcutis and skeletal muscle but with no haemorrhage associated. There is abundant subcutaneous adipose tissue. There are multiple fractures in the mandible, maxilla and skull. The mandibular joints are luxated, bilaterally. The last 2 ribs on the left side have transverse, closed fractures near the xiphoid process (post-mortem fractures). There are small blood clots within the oesophagus. There is an abundant content in the stomach and small intestine consisting of insect fragments and pasty tan material. In the large intestine are small amounts of tan material. The gallbladder is empty. The urinary bladder is empty.

Other tests
No parasites are seen on a wet preparation of the intestine or lung.
No significant bacteria are cultured from the small intestine, liver or skin.

Morphologic diagnosis(es)
Body as a whole: Trauma
Skull, mandible and maxilla: Fractures, multifocal, severe
Mandibles: Luxation, bilateral, severe
Skin (head): Lacerations, multifocal, moderate
Oesophagus: Luminal haemorrhage, multifocal, moderate
Skin: Ectoparasitism (ticks), multifocal, moderate
Fore limb and hind limb: Lacerations, multifocal (post-mortem)
Ribs: Fractures, multifocal (post-mortem)

Comment
Death in this hedgehog is due to severe trauma, most likely due to road traffic accident. The hedgehog had multiple fractures and lacerations. The skull and maxillary fractures were incompatible with life. The hedgehog was otherwise in good body condition, with large amounts of subcutaneous fat and food in the digestive tract. There were no gross lesions that would suggest the hedgehog had an underlying disease. Histopathology (microscopic examination of the tissues) will help rule out the presence of underlying disease.

XT830-15 Male Hedgehog #169
Found injured in Winfield House on 22/07/15
Examined by Julia Rodriguez-Ramos Fernandez

Gross description
Examined is the carcass of a male adult European hedgehog (*Erinaceus europaeus*) in good body condition and with minimal autolysis. The soft tissue of the rostral aspect of the snout is missing and a 1.3 cm of nasal bone and maxilla not covered by skin. The edges of the wound are mostly well defined. The skin is missing from the right and left 2nd premolar (maxilla, upper jaw) onwards. There is a 0.5 cm strip of tissue extending to the left incisor. The exposed bone is covered with a thin layer of tan, friable material (fibrin). Similar material is covering the edges of the wound. Approximately 40% of the wound and exposed bone is covered by 0.3 cm long fly larvae and eggs. There are small amounts of blood staining both fore limbs (euthanasia artifact). There is abundant subcutaneous tissue. The stomach is empty. The large and small intestines are mostly empty and partially distended with gas. In the small intestine are small amounts of pasty, tan material. In the large intestine are small amounts of green material. The gallbladder contains large amounts of dark green, opaque fluid (bile). The urinary bladder is empty.

Other tests
No significant bacteria are cultured from the small intestine, skin or liver.
No significant parasites are seen in a wet preparation of the intestinal contents.
Scant nematode larvae (*Crenosoma* spp, presumed) are seen in the wet preparation of the lung.

Morphologic diagnosis(es)
Rostral aspect of the face: Skin loss and bone exposure, locally extensive, subacute, severe with myiasis (fly strike)

Comment
This hedgehog was euthanized due to the presence of a severe soft tissue wound on the rostral aspect of the face with exposure of bone. This wound likely happened a short time before euthanasia (hours-days). Potential differential diagnoses for this type of wound would include trauma with an object with sharp edges or predation. I think, based on the site and type of wound, predation is less likely. Trauma with a strimmer or similar is a possibility.

The hedgehog was otherwise in good body condition. Gross examination did not suggest the hedgehog had an underlying disease however this can only be ruled out with histopathology (microscopic examination of the tissues).

XT924-15 & XT925-15 Female hedgehog #173 and Male hedgehog #167
Both found dead in Zoo Car Park 06/08/15
Examined by Julia Rodriguez-Ramos Fernandez

Gross exam
924-15 Examined is the carcass of an adult European hedgehog (*Erinaceus europaeus*) in good body condition with mild autolysis. Approximately 60% of the haired skin (with no spines) is missing (post-mortem predation). There are large amounts of adipose tissue. There are multiple fractures of the head and jaws. Only parts of the head and left hind limb and forelimb are present (the rest have been predated). The hind limb is present from the tibia to the end of the limb. The fore limb is present from the mid radius/ulna to the end of the limb. There are multifocal fractures on the carpus and phalanges. The muscles have been multifocally scavenged. There are no organs present (post-mortem scavenging).

925-15 Examined is the carcass of an adult European hedgehog (*Erinaceus europaeus*) in good body condition and with moderate autolysis. Approximately 60% of the haired skin (with no spines) is missing (post-mortem scavenging). Only part of the jaw and mandible (with multiple fractures) and the distal left hind limb (from the carpus to the end) are present. The muscles are multifocally predated and mostly absent. No organs are present (post-mortem predation).

Other tests
924-15 and 925-15: No significant bacteria are cultured from the skin.

Morphologic diagnosis(es)
924-15
Body as a whole: Trauma
Mandible, head, left carpus and phalanges: Fractures, multifocal, severe

925-15
Body as a whole: Trauma
Mandible and maxilla: Fractures, multifocal, severe

Comment
Death in these cases is due to severe trauma (most likely road traffic accident). The carcasses had been extensively scavenged, and no internal organs were available for examination. The hedgehogs were in good body condition, based on the presence of large amounts of subcutaneous fat.

XT627-15 – Female Hedgehog #176
Found dead in Wildlife Garden pond on 23/06/2015
Examined by Julia Rodriguez-Ramos Fernandez

Gross exam
Examined is the carcass of a female adult European hedgehog (*Erinaceus europaeus*) (# 176) in good body condition and with advanced decomposition. The dorsal aspect of the body is covered with duckweed. There are dozens of small ticks on the ventral aspect of the skin. There is a non-healed fracture within the right proximal tibia with mild proliferation of firm tissue around the area. The stomach is empty.

Other tests
No significant bacteria are cultured from the liver of small intestine. Moderate *Capillaria* sp. ova are observed in a wet preparation of the lungs. No parasites are seen in a wet preparation of the small intestine.

Morphologic diagnosis
Body as a whole: Found inside pond
Right proximal tibia: Fracture, focal, subacute, severe

Comment
The most significant finding in this case is the presence of a partially healed fracture on the right proximal tibia. The hedgehog was found inside a pond; however, microscopic examination of the tissues (histopathology) will be needed to determine if death is due to drowning or if the hedgehog was placed/fall inside the water after dying. The hedgehog was in good body condition, therefore it appears that it was able to find food even with the broken leg, however it had not consumed food recently. It is not clear if the broken leg is associated with the fact that the hedgehog was found inside a pond.

No significant bacteria were cultured from the small intestine or liver. The presence of *Capillaria* sp ova within the lung suggests the hedgehog likely had lungworm, however no marked changes consistent with pneumonia were noted.

Male Hedgehog #159
Found in respiratory distress in New Lodge garden on 9 May 2015 - Euthanased
Examined by Nic Masters

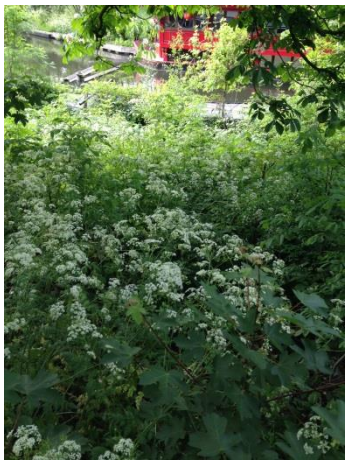
The most significant finding in this case was severe purulent pleuropneumonia. *Pasteurella multocida* was cultured from the lungs, pleural fluid and small intestine. In general these bacteria are considered opportunistic pathogens in mammals however some strains may act as primary pathogens. Strains of this bacterium are often found as commensals of the mouth of mammals and therefore these infections can also occur secondary to a predator attack. However, we need to do histopathology (microscopic examination of the tissues) to figure this out. This test is pending and results may take several weeks. It may help determine if the pneumonia was viral in origin with secondary bacterial infection, or primary bacterial. It is also going to help rule out the presence of lung worms.

Male Hedgehog #230
Found dead on Marylebone Green on 7 May 2015
Examined by Nic Masters

Markedly decomposed and sadly we could not determine the cause of death. It was a male and the weight was 783g, however I wouldn't trust the weight 100% due to the degree of autolysis and due to the fact that it was full of maggots. The hedgehog had fractures on the left mandible and left maxilla, however, we could not determine if these fractures were ante or post mortem (happened before or after the death of the hedgehog) due to the degree of decomposition.

Appendix 11 Regent's Park Hedgehog Day Nests May 2015

17/05/15 Tag #10 Zone 2 - Marion Buggins



17/05/15 Tag #11 Zoo car park - Marion Buggins

19/05/15 Tag #8 Zone 5 Queen Mary's Garden - Clare Bowen –-base of mature tree in carpet of ivy

19/05/15 Tag #8 Zone 5 Queen Mary's Garden - Clare Bowen – close up of hedgehog in nest

20/05/15 Tag #2 Zone 1a Clare Bowen – New Lodge garden

20/05/15 Tag #8 Zone 5 Queen Mary's Garden - Clare Bowen – at base of hedge

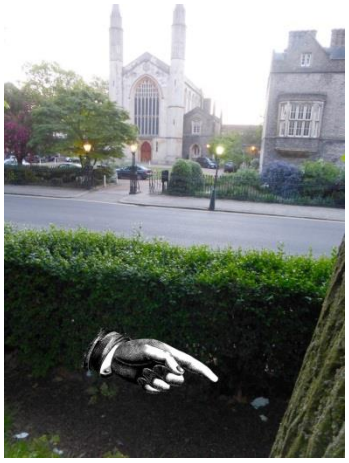

19/05/15 Tag #1 Animal 161 Zone 2 Zoo Car Park - Luke Hirst



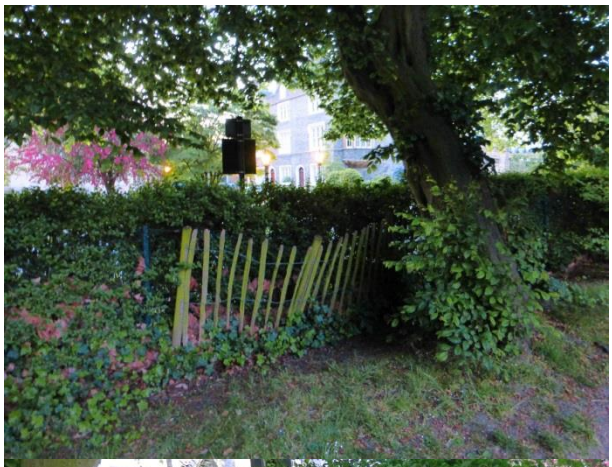
19/05/15 Tag #10 Animal 170 Zone 2 Cumberland Green in hedge along outer circle opposite St Katherine's Church - Luke Hirst

19/05/15 Tag #11 Animal 175 Zone 2 Zoo Car Park - Luke Hirst – in dense vegetation on the banks of the

19/05/15 Tag #1 Animal 161 Zone 2 Zoo Car Park - Tim Matthews - in nest box in dense vegetation on the banks of the canal



19/05/15 Tag #10 Animal 170 Zone 2 Cumberland Green – in hedge on outer circle outside St Katherine's Church – Marion Buggins and Tim Matthews

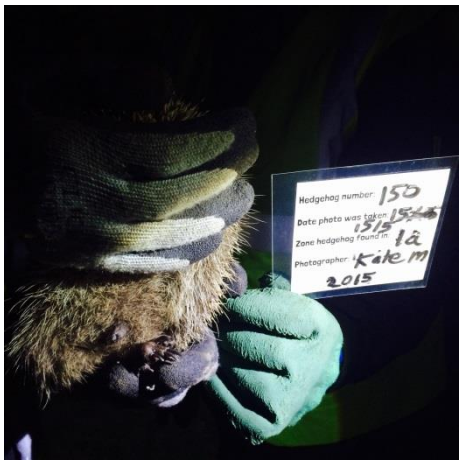


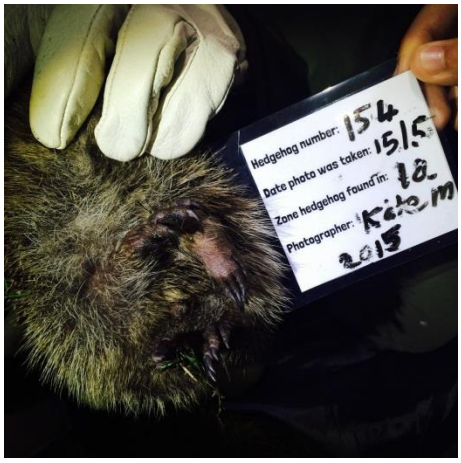
21/05/15 Tag #10 Animal 170 Zone 2 Cumberland Green – Luke Hirst – different nest location to other one above for same animal

16/05/15 Tag #9 Animal 191 Regent's University – Clare Bowen – this animal dropped its tag in the pampas grass after one night

19/05/15 Tag #4 Animal 181 Regent's University – Clare Bowen – under wooden pallets covered by tarpaulin behind the tennis courts

Appendix 12 Individual hedgehog photos May 2015






Hedgehog number: 200
Date photo was taken: 15/05
Zone hedgehog found in: 6
Photographer: TANJA


Hedgehog number: 201
Date photo was taken: 15/05
Zone hedgehog found in: 6


Hedgehog number: 177
Date photo was taken: 17/05/15
Zone hedgehog found in: 2
Photographer: Marion


#181


Hedgehog number: 176
Date photo was taken: 17/5/15
Zone hedgehog found in: 1a
Photographer: TIM MATTHEWS


No. 182
17/05/15
2
Marion


#191


#160


#161
Hedgehog number: 162
Date photo was taken: 19/05
Zone hedgehog found in: 5
Photographer: Marion


Hedgehog number: 184
Date photo was taken: 21/05
Zone hedgehog found in: 5
Photographer: Sara


Hedgehog number: 169
Zone hedgehog found in: 5


Hedgehog number: 151
Date photo was taken: 7/5/15
Zone hedgehog found in: 1A
Photographer: LUKE


#230 – found dead
Hog n° = 230
Date = 7/5/2015
Zone = 1a

Appendix 13 Genetic Analysis of Hedgehogs in Regent's Park

Samples:

A total of 102 samples (spines and hair) were received at Waterford Institute of Technology in 2014 and 2015.

DNA extraction:

Total DNA was isolated from the spine and hair samples using the ZR Genomic DNA™-Tissue MicroPrep (D3041) kit (ZYMO Research, CA, USA) using the protocol for hair DNA extraction (D3040).

DNA analysis:

The quality and quantity of DNA in the extracts was assessed using a SYBR Green qPCR assay with species specific primers EE1F (CCA TTA CTC ACA TTT GCC GAG) and EE1R (CGG CCG ATA TGT AAA AAT AGG) (Moran, 2009 and Moran *et al.* 2008). This assay targets the mitochondrial *cyt*B gene. The complete results of the qPCR assays are shown in Table 1 and a sample set of the data in Figure 1.

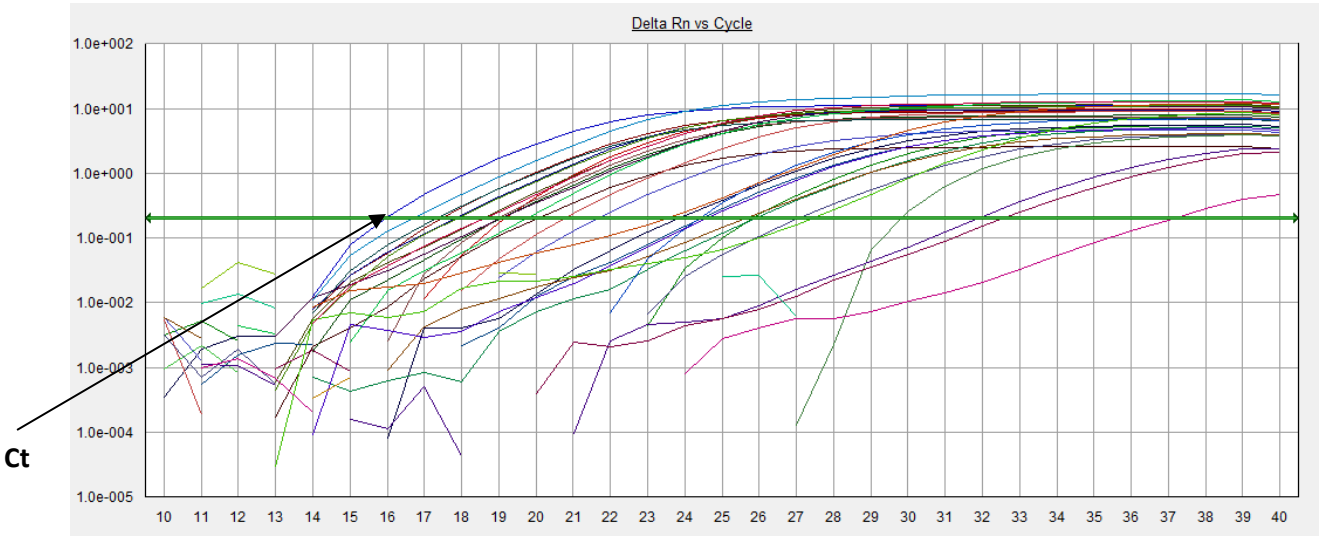


Figure 1: An example of the qPCR assay to assess the quantity and quality of the isolated DNA. The Ct value for each sample indicates the quantity of specific DNA in the sample. The lower the Ct value the more DNA in the sample.

Table 1: qPCR results

Sample no.	Collection Date	Received WIT	Animal no.	Sex	DNA	Ct	Notes
1		WIT Sept. 2014	000	unknown	PT191114.1	21.91	found dead
2		WIT Sept. 2014	1	female	PT191114.2	21.41	
3		WIT Sept. 2014	5	male	PT191114.3	19.52	
4		WIT Sept. 2014	6	male	PT191114.4	20.76	
5		WIT Sept. 2014	7	female	PT191114.5	20.45	
6		WIT Sept. 2014	12	female	PT191114.7	20.08	
7		WIT Sept. 2014	12	female	PT191114.6	25.39	hair sample only taken in May 2014
8		WIT Sept. 2014	13	male	PT191114.8	21.15	
9		WIT Sept. 2014	14	male	PT191114.9	20.00	
10		WIT Sept. 2014	15	female	PT191114.10	20.79	
11		WIT Sept. 2014	16	male	PT191114.11	21.08	
12		WIT Sept. 2014	17	female	PT191114.12	22.39	
13		WIT Sept. 2014	18	female	PT191114.13	20.73	
14		WIT Sept. 2014	19	female	PT191114.14	22.36	
15		WIT Sept. 2014	20	male	PT191114.15	20.22	
16		WIT Sept. 2014	21	female	PT191114.16	20.60	
17		WIT Sept. 2014	22	female	PT191114.17	20.76	
18		WIT Sept. 2014	25	female	PT191114.18	20.35	
19		WIT Sept. 2014	27	female	PT191114.19	20.58	
20		WIT Sept. 2014	31	female	PT191114.20	20.56	
33		WIT Sept. 2014		female	PT191114.1	20.18	
21		WIT Sept. 2014	43	male	PT191114.2	19.30	
22		WIT Sept. 2014	54	female	PT191114.3	20.17	
23		WIT Sept. 2014	56	female	PT191114.4	23.05	
24		WIT Sept. 2014	62	female	PT191114.5	20.04	
25		WIT Sept. 2014	75	male	PT191114.6	20.10	
26		WIT Sept. 2014	83	male	PT191114.7	20.52	
27		WIT Sept. 2014	87	female	PT191114.8	19.71	
28		WIT Sept. 2014	88	unknown	PT191114.9	19.19	
29		WIT Sept. 2014	90	unknown	PT191114.10	19.96	
30		WIT Sept. 2014	91	male	PT191114.11	20.98	
31		WIT Sept. 2014	92	male	PT191114.12	20.75	
32		WIT Sept. 2014	93	female	PT191114.13	20.31	
Sample no.	**Collection Date**	**Received WIT**	**Animal no.**	**Sex**	**DNA**	**Ct**	**Notes**
33		WIT Sept. 2014	94	female	PT191114.14	19.96	
34		WIT Sept. 2014	95	male	PT191114.15	19.11	
35		WIT Sept. 2014	101	female	PT191114.16	20.64	

36		WIT Sept. 2014	102	male	PT191114.17	19.85	
37		WIT Sept. 2014	105	male	PT191114.18	19.10	
1	07-05-15	WIT May 2015	150	M	AF240615.2	34.00	
2	07-05-15	WIT May 2015	151	F	AF240615.3	28.16	
3	07-05-15	WIT May 2015	152	F	AF240615.4	21.54	
4	15-05-15	WIT May 2015	153	M	AF240615.5	26.70	
5	15-05-15	WIT May 2015	154	M	AF240615.6	23.98	
6	15-05-15	WIT May 2015	155	M	AF240615.7	23.43	
7	09-05-15	WIT May 2015	159	M	AF240615.8	28.90	M - euthanased
8	18-05-15	WIT May 2015	160	F	AF240615.9	23.84	
9	18-05-15	WIT May 2015	161	F	AF240615.10	22.62	
10	19-05-15	WIT May 2015	162	M	MF240615.8	25.94	
11	15-05-15	WIT May 2015	165	F	MF240615.4	20.62	
12	19-05-15	WIT May 2015	167	M	MF240615.1	23.81	
13	22-05-15	WIT May 2015	169	M	AF240615.11	20.04	
14	15-05-15	WIT May 2015	170	F	MF240615.10	24.45	
15	15-05-15	WIT May 2015	171	F	MF240615.5	21.44	
16	15-05-15	WIT May 2015	172	M	AF240615.12	22.02	
17	16-05-15	WIT May 2015	173	F	AF240615.13	22.80	
18	15-05-15	WIT May 2015	174	F	AF240615.14	21.10	
19	15-05-15	WIT May 2015	175	M	MF240615.11	26.44	
20	17-05-15	WIT May 2015	176	U	MF240615.3	21.28	
21	17-05-15	WIT May 2015	177	M	AF240615.15	19.40	
22	15-05-15	WIT May 2015	178	F	AF240615.16	20.13	
23	15-05-15	WIT May 2015	180	M	MF240615.14	19.34	
24	16-05-15	WIT May 2015	181	F	MF240615.2	19.27	
25	17-05-15	WIT May 2015	182	U	MF240615.9	25.54	
26	21-05-15	WIT May 2015	184	F	MF240615.6	19.94	
27	15-05-15	WIT May 2015	190	U	MF240615.13	20.31	
28	16-05-15	WIT May 2015	191	F	MF240615.7	21.09	
29	16-05-15	WIT May 2015	192	F	AF240615.17	23.74	
30	15-05-15	WIT May 2015	200	F	MF240615.12	21.20	
31	15-05-15	WIT May 2015	201	M	AF240615.18	21.59	
32	23-05-15	WIT May 2015	210	F	AF240615.19	21.51	
33	07-05-15	WIT May 2015	230	M	AF240615.20	25.48	Male - found dead
	12-09-14	WIT May 2015	10	Male	AF240615.1	31.26	leftover from September 2014 survey
Sample no.	**Collection Date**	**Received WIT**	**Animal no.**	**Sex**	**DNA**	**Ct**	**Notes**
	11 09 2015	WIT Sept. 2015	172	M	JP121015.1	19.12	Previously captured in May
	12 09 2015	WIT Sept. 2015	199	M	JP121015.2	15.91	New animal to the survey
	11 09 2015	WIT Sept. 2015	156	M	JP121015.3	17.38	New animal to the survey

	11 09 2015	WIT Sept. 2015	171	F	JP121015.5	17.77	Previously captured in May
	11 09 2015	WIT Sept. 2015	192	F	JP121015.7	19.04	New animal to the survey
	4 09 2015	WIT Sept. 2015	222	F	JP121015.12	18.99	New animal to the survey
	4 09 2015	WIT Sept. 2015	215	M	JP121015.15	17.30	New animal to the survey
	15 05 2015	WIT Sept. 2015	172	M	JP121015.16	19.04	
	15 05 2015	WIT Sept. 2015	155	M	JP121015.17	18.49	
	16 05 2015	WIT Sept. 2015	181	F	JP121015.21	17.84	
	May-14	WIT Sept. 2015	86	M	JP121015.28	18.53	Hair samples= very small sample
	May-14	WIT Sept. 2015	54	F	JP121015.29	23.47	Hair samples= very small sample
	12 09 2015	WIT Sept. 2015	226	M	JP121015.4	25.77	New animal to the survey
	11 09 2015	WIT Sept. 2015	152	F	JP121015.6	20.01	Previously captured in May
	11 09 2015	WIT Sept. 2015	153	M	JP121015.8	23.80	Previously captured in May
	11 09 2015	WIT Sept. 2015	162	M	JP121015.9	20.69	Previously captured in May
	11 09 2015	WIT Sept. 2015	170	F	JP121015.10		Previously captured in May* Partial spine??
	10 09 2015	WIT Sept. 2015	224	F	JP121015.11	21.57	New animal to the survey
	10 09 2015	WIT Sept. 2015	201	M	JP121015.13	29.69	Previously captured in May
	10 09 2015	WIT Sept. 2015	181	F	JP121015.14	27.03	Previously captured in May
	19 05 2015	WIT Sept. 2015	167	M	JP121015.18	24.36	
	15 05 2015	WIT Sept. 2015	171	F	JP121015.19	31.84	
	15 05 2015	WIT Sept. 2015	201	M	JP121015.20	25.88	
	12092014	WIT Sept. 2015	10	M	JP121015.22	32.47	
	23052015	WIT Sept. 2015	210	F	JP121015.23	25.56	
	16052015	WIT Sept. 2015	192	F	JP121015.24	24.30	
	16052015	WIT Sept. 2015	191	F	JP121015.25	24.51	
	May-14	WIT Sept. 2015	56	F	JP121015.26	27.38	Hair samples= very small sample
	May-14	WIT Sept. 2015	51	M	JP121015.27	19.65	
	30 05 2014	WIT Sept. 2015	66	F	JP121015.30	16.62	Hair samples= very small sample

The qPCR results are presented as C_T values. There is a correlation between the first significant increase in the amount of PCR product and the total amount in the initial target DNA, this means that a sample with a low C_T value has more target DNA than one with a higher C_T value.

The C_T values for the sample set varied from 15.91 to 34 and one sample showed no amplification. Figure 2 shows the range of C_T values in the sample set. Fifty three (52%) samples had a C_T value of < 21 which from previous studies indicates DNA of good quality and quantity. Of these 53 30 were from the samples sent in September 2014, 15 from those sent in September 2015 and 8 from those sent in May

2014. The top 12 samples with lowest C_T values (< 19.04) were from the samples sent in September 2015.

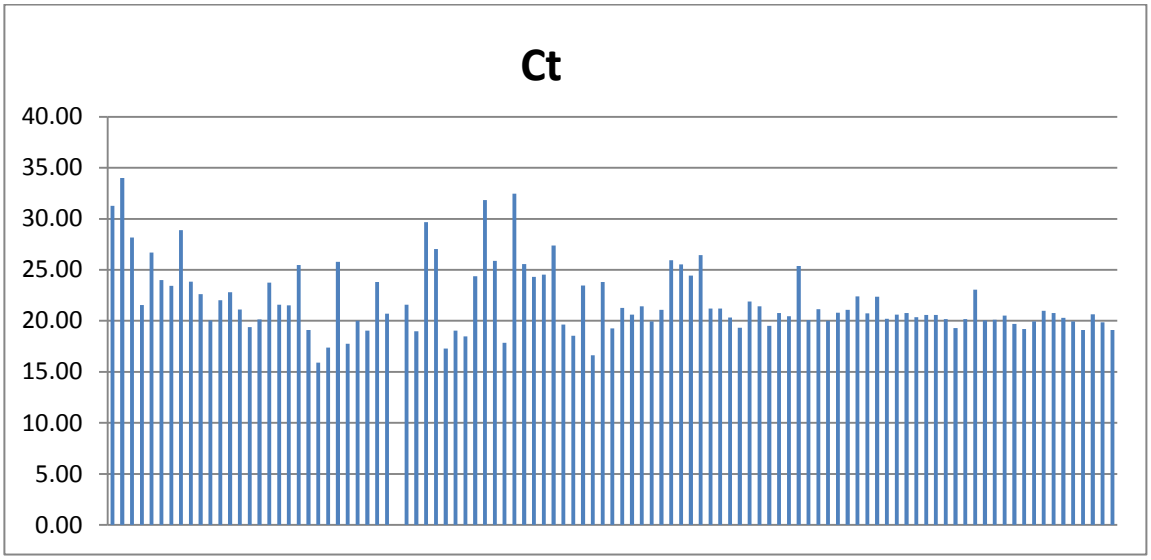


Figure 2: Range of C_T values in sample set.

Microsatellite analysis:

Microsatellites are short tandem repeat nuclear DNA sequences (STRs). These are normally highly variable between individuals and are used in genotyping individuals to assess genetic variability in the population and to identify individual animals.

In this study 11 microsatellite markers were tested. These are listed in Table 2.

Table 2: Microsatellite loci used in this study

Locus	Primer sequences	Reference
EEU1	F: ACCCACATCTTATGCCTTTCAGTGAT	Becher and Griffiths 1998
	R: GTTTCTTAAATGTCAATGGCCATCTGTTATAACAA	
EEU2	F: GTAGGGACCGAGGGCTTGAACTG	Becher and Griffiths 1998
	R: GTTTCTTGACTGGCATTCACCCTAAAACACAT	
EEU3	F: TCAACAGAAGACAGGAGCAGATACAGG	Becher and Griffiths 1998
	R: GTTTCTTGAACTTCCACCAGAACATCAAGGCT	
EEU4	F: GTGGTTAGAGCAGCAAGGACT	Becher and Griffiths 1998
	R: GTTTCTTAGCTCTTAGCACTGGGTCTGA	
EEU5	F: TGCATGAGGAACCAAATTCAA	Becher and Griffiths 1998
	R: GTTTCTTCAGCATGGATGTCCCACTACT	
EEU6	F: CAGTGAAGTTAAGGGTGGCTTT	Becher and Griffiths 1998
	R: GTTTCTTATGCTGGGTGGGTCTCTTCT	
EEU12H	F: CTGCATGTACCTCTCCTCTACCTC	Henderson et al. 2000
	R: TTTTCTTTTTCCACCGGTGTTATC	
EEU36H	F: GACTCTGGAACTCAAAACCAGG	Henderson et al. 2000
	R: GGTAGACAGAGAGATCAAAAGGGA	
EEU37H	F: ATGAGGTGAGGCTTACCAAAAA	Henderson et al. 2000
	R: GGAATCTCACAGATGTAAAGTTCTAGC	
EEU43H	F: CCATGTACAGTGGATTTACCTGC	Henderson et al. 2000
	R: ACCCTAGGAGCAACTTGGAGAT	
EEU54H	F: CATCGGCTCAGCATTCTCTT	Henderson et al. 2000
	R: ATCCCCAGAGTTGTGTTTGC	

Initially all markers were tested on a range of samples spanning the C_T range from 19.01-22.02 and six microsatellites were selected which worked well on these samples. These were EEU1, EEU2, EEU3, EEU5, EEU6 and EEU37H. Using these six loci full genotypes were obtained for 42 (41%) individual animals (identified as individuals in the sample lists). The genotypes are shown in Table 5. The data was analysed using GENALEX version 6 software (Peakall and Smouse 2006). This identified 17 unique genotypes in the 42 samples which indicates that these six loci are not enough to identify individual animals in Regent's Park and shows a lack of genetic diversity in the population. This conclusion is supported when the results obtained are compared to other studies. In Table 3 the results of this current study are compared to other published data. The number of alleles at a given locus is in general low in the Regent's Park samples compared to other studies but more striking are the allele frequencies in the population as shown in Table 4 which shows the dominance of one or two alleles for each loci. The mean expected heterozygosity (HE) was 0.197, and the mean observed heterozygosity (HO) was 0.198.

Table 4: Allele frequencies in the Regent's Park genotyped samples (n=42).

Allele	EEU37	EEU3	EEU2	EEU6	EEU5	EEU1
1	0.012	**0.929**	0.012	**0.988**	**1.00**	**0.607**
2	0.071	0.071	0.155	**0.012**		0.393
3	**0.917**		0.012			
4			0.060			
5			0.012			
6			**0.762**			

Table 3: Allele numbers in the Regent's park samples and other published studies

		EEU1	EEU2	EEU3	EEU4	EEU5	EEU6	EEU12H	EEU36H	EEU37H	EEU43H	EEU54H	
Location	**No. of samples**	**Becher and Griffiths 1998**						**Henderson *et al.* 2000**					**Reference**
Oxford	150	8	7	6	9	8	7						Becher and Griffiths 1998
Devon/Jersey	30	6	5	4	5	4	3						Moran *et al.* 2009
Southampton	132							7	5	6	9	8	Henderson et al. 2000
Ireland	94	1	5	6	4	5		1	1	3	4	7	Haigh 2011
France	11	3	7	5	5	7		4	2	5	7	3	Haigh 2011
Czech and Slovak Republics	131		17	12	14	9	14	4		22	13	12	Bolfiková and Hulva 2012
Regent's Park	**42**	**2**	**5**	**2**	**NT**	**1**	**2**	**NT**	**2***	**5**	**3****	**NT**	**This study**

* only 9 samples tested **only 12 samples tested NT= Not tested

Table 5: Genotypes

Animal no.	Sex	DNA extract	Ct	EEU37		EEU3		EEU2		EEU6		EEU5		EEU1	
5	male	PT191114.3	19.52	266	266	176	180	280	280	165	165	135	135	152	152
6	male	PT191114.4	20.76	266	266	176	176	262	280	165	165	135	135	138	138
7	female	PT191114.5	20.45	266	266	176	176	280	280	165	165	135	135	138	138
12	female	PT191114.7	20.08	266	266	176	176	280	280	165	165	135	135	138	152
14	male	PT191114.9	20.00	266	266	176	176	280	280	165	165	135	135	138	138
15	female	PT191114.10	20.79	266	266	176	176	280	280	165	165	135	135	138	138
16	male	PT191114.11	21.08	266	266	176	176	270	280	165	165	135	135	138	138
17	female	PT191114.12	22.39	266	266	176	176	280	280	165	165	135	135	138	138
19	female	PT191114.14	22.36	266	266	176	176	280	280	165	165	135	135	138	152
22	female	PT191114.17	20.76	254	266	174	176	280	280	165	165	135	135	138	138
25	female	PT191114.18	20.35	254	266	176	176	280	280	165	165	135	135	138	138
27	female	PT191114.19	20.58	266	266	176	176	270	280	165	165	135	135	138	152
43	male	PT201114.2	19.30	266	266	176	176	270	280	165	165	135	135	138	144
51	male	JP121015.27	19.65	266	266	176	180	276	280	165	165	135	135	152	152
54	female	PT201114.3	20.17	266	266	176	176	270	280	165	165	135	135	138	152
66	female	JP121015.30	16.62	266	266	176	176	280	280	165	165	135	135	138	152
75	male	PT201114.6	20.10	266	266	176	176	270	280	165	165	135	135	138	152
83	male	PT201114.7	20.52	266	266	176	176	280	280	163	165	135	135	152	152
86	male	JP121015.28	18.53	266	266	176	176	270	280	165	165	135	135	152	152
90	unknown	PT201114.10	19.96	266	266	176	180	276	280	165	165	135	135	138	152
91	male	PT201114.11	20.98	266	266	176	176	276	280	165	165	135	135	138	152
92	male	PT201114.12	20.75	254	266	176	180	276	280	165	165	135	135	138	152
95	male	PT201114.15	19.11	266	266	176	176	280	280	165	165	135	135	138	152
154	male	AF240615.6	23.98	254	266	176	176	280	280	165	165	135	135	138	138
155	male	JP121015.17	18.49	252	266	176	176	280	280	165	165	135	135	138	152
156	male	JP121015.3	17.38	266	266	176	176	280	280	165	165	135	135	138	138
160	female	AF240615.9	23.84	254	266	176	176	280	280	165	165	135	135	138	138
161	female	AF240615.10	22.62	266	266	176	176	274	280	165	165	135	135	138	138
162	male	JP121015.9	20.69	266	266	176	176	270	280	165	165	135	135	152	152
167	male	MF240615.1	23.81	266	266	176	176	280	280	165	165	135	135	138	138
171	female	JP121015.5	17.77	254	266	176	176	280	280	165	165	135	135	138	152
191	female	MF240615.7	21.09	266	266	176	176	270	280	165	165	135	135	138	152
192	female	JP121015.7	19.04	266	266	176	176	270	280	165	165	135	135	138	152
199	male	JP121015.2	15.91	266	266	176	176	270	280	165	165	135	135	152	152
200	female	MF240615.12	21.20	266	266	176	176	280	280	165	165	135	135	138	152
201	male	AF240615.18	21.59	266	266	176	176	270	280	165	165	135	135	152	152
210	female	AF240615.19	21.51	266	266	176	176	280	280	165	165	135	135	138	138
222	female	JP121015.12	18.99	266	266	176	180	270	276	165	165	135	135	152	152
224	female	JP121015.11	21.57	266	266	176	176	280	280	165	165	135	135	152	152
Tissue 486-15		COR230516.20	15.68	266	266	176	176	270	280	165	165	135	135	138	152
Tissue 627-15		COR230516.21	18.64	266	266	176	180	276	280	165	165	135	135	138	138
Tissue 0925-15		COR230516.27	22.03	266	266	176	176	270	280	165	165	135	135	138	138

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Appendix 14 Hedgehog friendly habitat management in The Regent's Park

A comprehensive list of habitat management recommendations in The Regent's Park were provided in Appendix 9 of Gurnell *et al.* (2015). These covered a wide range of issues that will not be repeated here, including (in summary):

- Retain and enhance habitat suitable for nesting.
- Retaining fallen leaves for nesting material.
- Provide suitable foraging habitat.
- Maintaining and improving habitat continuity.
- Avoiding and reducing hazards to hedgehogs.

Implementation has begun on many of these and this should continue alongside population monitoring to measure any response. As previously recommended, risk to hedgehogs should be an integral factor in evaluating any management procedures or changes of use. This should apply to the whole park but the three 'hotspots' identified should be particularly safeguarded.

The park management team have committed to carry out the following actions in 2015/16. The actions marked with a * will be recorded on a digital map of Regent's Park, which will be useful as a basis for a habitat / species management plan.

1. Installation and assessment of benefits if any of hedgehog boxes.*
2. Identifying areas of grass that can be left to grow long for the summer season*
3. Identifying areas of grass that can be left to grow long permanently or as part of a rotation of compartments to control scrub.*
4. Increasing diversity of floral species in long grass areas.*
5. Building log piles and log stands.*
6. Managing bramble to improve hedgehog habitat, monitoring to see if beneficial.
7. Identifying areas where native hedge planting can be carried out and implementing.*
8. Managing hedges and hedge bases for wildlife/ hedgehogs, making them wider and denser.*
9. Relaxed collection of leaf litter, leaving leaf litter where possible.
10. Managing turf to relieve compaction and increase soil fauna and flora.*
11. Consideration in selection of plants and structure of ornamental planting schemes to have appropriate benefit for wildlife.
12. Managing the gardens using organic means as much as possible.
13. Carrying out spring / summer awareness workshops for wider estate grounds maintenance staff on land management for hedgehogs.
14. Producing a work place poster for various land management mess rooms around the estate as a reminder for staff on sympathetic management of land and works for hedgehogs.
15. Investigating the possibility / locations of hedgehog aware road signs on Outer and Inner Circle.
16. Putting in the facilities for a waste compactor to remove waste being left in the open for scavengers to feed on.
17. Visiting estate land managers on site to review what they are doing and what can be improved.
18. Identifying barriers to hedgehog movement, identifying ways to remove or reduce them and monitoring to see if beneficial.*
19. Identifying potential hazards to hedgehogs and where possible removing them, such as steep lake banks, pits, pest control.
20. Continue to carry out hedgehog surveys to develop an understanding of the hedgehog population dynamics in Regents Park.
21. Regular appraisal of the park to see what we do and what we could do better.
22. Carry out a risk assessment for hedgehogs when considering or planning any project/development/event.

Appendix 15 Habitat improvements and further recommendations for the management team
Following the results of work in 2015, the following elements can be emphasised as of particular importance for this vulnerable and isolated population of hedgehogs.

Further hazard reduction
There is already a work programme to reduce anthropogenic hedgehog hazards throughout the park and this should continue. Potential hazards (reviewed in Gurnell et al., 2015) vary from becoming trapped in waterbodies or pitfalls to pest control measures and all relevant management actions should be risk-assessed with hedgehogs in mind.

Data from 2015 show that road-kill is one of the key risks for hedgehogs. Therefore we recommend that consideration should be given to any measure that may reduce the risk to hedgehogs from traffic as they cross roads to access areas such as the ZSL car park, Park Square Gardens, or the green areas between the canal and the outer circle either side of Macclesfield Bridge. This may involve for example, night-time traffic reduction or calming, signage to raise awareness of hedgehogs crossing, lowered kerbs and the creation of safe crossings (e.g. underpasses).

Data from both 2014 and 2015 show that trauma (usually leg injuries), most likely from predator attack, is a serious risk. Whilst not yet proven, fox attacks are considered most likely to be responsible for the several fatal leg injuries recorded both in 2014 and 2015. Foxes are probably the only significant nocturnal predators of active animals. However, there are also potential losses of young in the nest caused by foxes, or domestic dogs during the day. Currently our understanding of this risk is limited but we recommend an integrated strategy to reduce risk overall comprised of the following components:

- Continue the enhancement and availability of shrubbery/scrub to provide well-concealed semi-natural nest locations.
- Nest boxes – monitoring of the 27 nest boxes currently in use to evaluate their potential value as predator-proof nest sites.
- Asking dog walkers to avoid allowing their dogs to enter undergrowth; where there are likely to be nest sites.
- Record the locations of known fox dens in the park. Currently we have no formal records of these locations and no estimate of fox numbers.
- Management of landscape/habitat structure to reduce the effects of predation risk (see below).

Habitat structure and continuity
As recommended in Gurnell *et al.* (2015) the habitat enhancements already underway in the park (e.g. the creation of headlands alongside hedges) should benefit hedgehogs. However, where current usage permits, we would especially recommend the creation of fine-scale complexity in the habitat structure e.g. breaking up some large open areas with bands of longer grass or scrub/hedgerow/shrubbery.

The study data indicate that hedgehogs are particularly associated with areas where there is a finer-scale matrix of foraging and nesting habitats. This is particularly exemplified by the green space around the ZSL car park, the English Gardens and some other areas. Although Amenity Grassland is a highly preferred foraging habitat, wide-open spaces are relatively avoided. There are clear parallels here to the findings of research in arable landscapes (Hof and Bright, 2010). They found an increased abundance of earthworms and carabid beetles (with fewer gastropods) when grassy field margins were present. Furthermore, Hof *et al.* (2012) showed that hedgehogs, within the 'landscapes of fear' represented by agricultural habitats, stayed closer to edge cover in farms when there was higher risk of predation (more badgers). They recommended enhancing the complexity of the habitat structure (e.g. by increasing the number and density of hedgerows) to mitigate this effect. Therefore the same habitat enhancements in the park may benefit both prey availability and improve resilience in the face of what seems to be a significant predator pressure from foxes.

Appendix 16a Public Awareness – Press Release

Press release: Embargoed until 29 May 2015

Let's protect the last wild hedgehogs of central London's Royal Parks

Survey reveals a small and vulnerable breeding population of hedgehogs in Regent's Park – the last of central London's Royal Parks to have retained a resident population.

One of the UK's biggest inner-city hedgehog studies has revealed the nocturnal lives of one of Britain's best-loved mammals. With hedgehog numbers declining nationwide, the importance of understanding hedgehog needs and behaviour is greater than ever and vital to inform hedgehog-friendly conservation.

The study, run by the Royal Parks Foundation, leading scientists and supported by100 nocturnal volunteers, began in 2014 and confirmed the presence of around 40 animals in Regent's Park. This is a relatively small number for a Park of this size (166 ha) and raises concerns about the viability of the population in the long term.

The hedgehogs have been predominantly found foraging and nesting in a mosaic of grassland, shrubberies and hedges, with analysis showing that they travelled up to 1.5km a night, the same distance as the Underground line between Regent's Park and Angel! The average weight of the hedgehogs surveyed was 960g, well above the national average, suggesting Regent's Park has an abundance of food. Hedgehogs are insectivores, their favourite food including slugs, caterpillars and beetles, giving them the deserved reputation as a real gardener's friend.

This year's survey, which has been filmed by BBC nature programme, Springwatch, again focuses on finding as many hedgehogs as possible in the Park to begin to detect population trends and understand more about their nocturnal behaviour and habitat preferences. Finding out where they make their nest during the day is also a top survey priority this year, as these are key refuges from the eight million people and dogs who visit the Park every year! The findings will help inform hedgehog-friendly habitat management to help safeguard the population's future in Regent's Park and other parklands across the country.

Sara Lom, CEO of the Royal Parks Foundation, the charity for London's eight Royal Parks, said: "This survey brings together expert scientists, wildlife conservation organisations and local volunteers. One of the important aims of the project is to educate the park users about the resident hedgehog population so that they will help protect and support them in future."

Technology played a huge part in 2015's study, with thermal imaging cameras being used, a rarity in these types of projects, along with radio tagging and GPS tracking. A DNA analysis of the hedgehogs' spines is also planned for the summer to find out more about the genetic make-up of this small population.

"Thanks to the exceptional efforts of all those involved, the data we have gathered this May will provide crucial detail about the behaviour of hedgehogs in the Park," states Dr Nigel Reeve, leading hedgehog expert and former Head of Ecology, The Royal Parks. "As well as the use of GPS and radio tracking, thermal imaging has allowed us to detect hedgehogs more reliably and to observe their activities with minimal disturbance."

"Last year's research findings has led to a change in habitat management," says Nick Biddle, Park Manager, The Regent's Park. "Grassland adjacent to hedges will be left to grow longer to provide a richer environment for hedgehog foraging and nesting. The findings from Regent's Park will also be shared with other urban green spaces to help with the creation of more hedgehog friendly-habitats."

The project has been carried out in partnership with The Royal Parks and The Zoological Society of London (ZSL) who provided veterinary support throughout the fieldwork period. The two eminent wildlife scientists, Dr Nigel Reeve and Professor John Gurnell, presented initial findings at the national Mammal Society Conference earlier this year. The survey was made possible thanks to a generous gift from a Regent's Park neighbour, passionate about hedgehog conservation.

To raise awareness about urban hedgehog conservation and to ensure vital ongoing monitoring in the Park continues well into the future, the Royal Parks Foundation is producing limited-edition hedgehog inspired clothing, as well as giving the public the opportunity to virtually adopt one of Regent's Parks' hogs. Please visit www.SupportTheRoyalParks.org/hedgehogs to find out how you can become a Hedgehog Hero!

–ENDS–

The Royal Parks Foundation
The Royal Parks Foundation is the charity that helps support the magic of London's eight amazing Royal Parks. The charity reaches out to make the Parks part of more people's lives and raises funds for a wide variety of heritage, education, wellbeing and nature conservation programmes (registered charity 1097545). For information visit: www.SupportTheRoyalParks.org

The Royal Parks Foundation delivers a wide ranging and accessible outdoor education programme at the Isis Education Centre in Hyde Park. The schools programme for primary and secondary schools is linked to the National Curriculum, and there is a year-round programme of informal activities for individuals and groups to join, from guided walks to hands-on sessions.

The Royal Parks
Almost 77 million Londoners and tourists visit the eight Royal Parks each year. The 5,000 acres of historic parkland provide unparalleled opportunities for enjoyment, exploration and healthy living in the heart of London.

The Royal Parks are: Bushy Park, The Green Park, Greenwich Park, Hyde Park, Kensington Gardens, The Regent's Park and Primrose Hill, Richmond Park and St James's Park. The Royal Parks also manages Victoria Tower Gardens, Brompton Cemetery, Grosvenor Square Gardens and the gardens of 10, 11 and 12 Downing Street. For further information visit: www.royalparks.org.uk.

ZSL
Founded in 1826, the Zoological Society of London (ZSL) is an international scientific, conservation and educational charity whose mission is to promote and achieve the worldwide conservation of animals and their habitats. Our mission is realised through our ground-breaking science, our active conservation projects in more than 50 countries and our two Zoos, ZSL London Zoo and ZSL Whipsnade Zoo. For more information visit www.zsl.org

Appendix 16b Media coverage June 2015

The hedgehog research was incredibly successful in the British media, with a huge number of journalists covering the story. Since distributing the release to key media targets on Monday 1st June, we secured a wide range of coverage, from national newspapers, such as The Times, to specialist blogs, including MyGreenPod. On top of this, there were also excellent broadcast pieces on BBC Breakfast and ITV News.

There was also a huge amount of social media activity around the story, with Alfie the Hedgehog in particular becoming an internet sensation. More importantly though, the research has been shared on social channels, such as Twitter, with thousands of people posting links to the coverage and discussing hedgehogs.

Please see the table below for a breakdown of coverage secured.

No.	Publication	Headline	Circulation	Date
1	WiRED	The fight is on to save London's hedgehogs	1,588,700	1/6/2015
2	Horticulture Week	Last wild hedgehogs of central London's Royal Parks discovered	77,500	1/6/2015
3	Evening Standard	Last 50 wild hedgehogs surviving in central London Royal Parks discovered by researchers	2,913,100	1/6/2015
4	MyGreenPod	Small and vulnerable breeding population of hedgehogs found in Regent's Park	7,000	1/6/2015
5	The Times (Print)	Last of London's Hedgehogs fight for survival	390,962	2/6/2015
6	The Times	Last of London's Hedgehogs fight for survival	3,585,456	2/6/2015
7	Daily Mail	The hedgehogs with road sense: Last colony in London have survived because they are scared of crossing the road in case of evolution in action	220,000,000	2/6/2015
8	Daily Mail (Print)	The hedgehogs with road sense	1,626,322	2/6/2015
9	Guardian	Last hedgehogs in central London 'survived by learning to avoid roads'	85,000,000	2/6/2015
10	Shortlist	London Hedgehogs are Proof that Natural Selection Exists	1,052,600	2/6/2015
11	Pitchcare	Last wild hedgehogs of central London's Royal Parks discovered	84,800	2/6/2015
12	Yahoo News UK	These London Hedgehogs have evolved Road Safety Smarts	3,500,000	2/6/2015
13	London24	Inside the world of London’s last hedgehogs	395,600	3/6/2015
14	Camden New Journal	Meet the last hedgehogs in London	39,800	4/6/2015
15	Hampstead Highgate Express	Hedgehog hunt reveals new stars of Regent’s Park	27,561	4/6/2015
16	BBC Breakfast x3 slots	n/a - Coverage of the research	1,533,000	3/6/2015
17	BBC London	n/a - Coverage of the research	750,000	3/6/2015
18	BBC Newsround	n/a - Coverage of the research	1,000,000	3/6/2015
19	ITV News 6pm news	n/a - Coverage of the research	3,900,000	3/6/2015
20	Daily Express	Ingham's World	6,478,952	5/6/2015
21	BBC London Radio 94.9	Interview with Nigel Reeve	572,000	3/6/2015