Aquilina Environmental Quality

New Forest Medicinal leech (*Hirudo medicinalis* Linnaeus, 1758) Survey Report

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Summary

Surveys for Medicinal leech (*Hirudo medicinalis*) were carried out at four selected locations within the New Forest HLS agreement area during 2016. The purpose was to assess the population status of Medicinal leech within these ponds and assess the habitat suitability of outlying ponds within the current known locations.

A standardised method was used based on previous surveys carried out by the Hampshire & Isle of Wight Wildlife Trust during 1998 and 1999. Measurement of extended length and posterior sucker diameter were recorded.

The four ponds surveyed were Hatchet marl pits, Sheepwash, Standing Hat and Woodfidley ponds together with outlying ponds in close proximity.

Medicinal leech were found in three of the target ponds but not in Sheepwash pond. Compared with 1999, populations in 2016 appeared greater in Woodfidley and Standing Hat and lower in Hatchet. It was not found in any of the outlying ponds in spite of several of them appearing suitable.

Introduction

The Medicinal leech (*Hirudo medicinalis*) is a rare leech across the whole of Western Europe. It is legally protected under Appendix II in the CITES listing 1987; Appendix II in the Berne Convention; Annex Va in the Habitats and Species Directive; and Schedule 5 of the Wildlife and Countryside Act 19817. It is also on the Red Data List (RDB3 Rare).

It has declined in number across the whole of the UK, with a number of populations having been lost, although it has been declared extinct in the UK twice in the 20th century but subsequently being refound.

The current estimate is of twenty isolated populations remaining in the UK with the main centres in the New Forest, Dungeness, the Lake District, South Wales, Anglesey and the west of Scotland (Elliot and Dobson, 2015).

Surveys carried out by the Hampshire & Isle of Wight Wildlife Trust during 1998 and 1999 found only four extant populations from 24 known historical locations within the New Forest (Reeves, 1999).

Reasons for its decline are explored in the Medicinal leech SAP for Hampshire (Wickes and Reeves, 2003), but are thought to be strongly linked to the use of anti-worming agents, avermectins, in livestock. Other potential factors are the spread of the non-native invasive *Crassula helmii* causing shading and deoxygenation at night; scrub encroachment causing shading, drainage of ponds, climate change and over-poaching of pond margins causing loss of cocoon laying sites.

The purpose of this project was to survey the remaining four known locations within the New Forest HLS agreement area for the presence of Medicinal leech and to explore the suitability of outlying ponds closeby. The suitability was assessed based on a limited number of environmental parameters which appear to be important as well as actual surveys.

These surveys were carried out under Natural England licence 2016-20362-SCI-SCI. The original planned dates for the surveys were June to October 2015 but delays in applying for the licence prevented the work from starting until April 2016.

Methodologies are discussed below.

Natural history

Medicinal leech feed on the blood of mammals (including humans) but also fish, water birds and amphibians. In fact amphibians may be a vital factor in their breeding success as juvenile leeches are unable to pierce mammalian skin for the first two feeds and therefore rely on tadpoles for food (Elliott and Dobson, 2015).

Laboratory studies have shown that feeding leeches take between two and five times their own weight in blood and that this is digested slowly over the subsequent months. For a large part of the year when water temperatures are low, medicinal leeches are quiescent and remain buried in mud or under submerged objects at the edge of the water. Water temperature at which 10 % of the population becomes active is 11.9 º C, 50% at 19 º C and 90 % at 22.9 º C. Water temperature requirements for growth are 22-25 º C and breeding 25.5 – 27.5 º C (Elliott and Dobson, 2015). Thus warm, shallow margins are a prerequisite for enabling activity to begin.

Prey is detected initially though vibration, with the leech responding to low-amplitude surface waves of about 1mm high. Closer range detection occurs through heat sensors at the anterior end of the leech. Thus the survey methodology relies on 'splashing' to emulate prey entering the water.

Medicinal leech take a minimum of two years to reach sexual maturity and may not breed until 3 or 4 years old. There is a delay of between one and nine months between copulation and cocoon deposition. Cocoons are laid mainly in July and August in a damp place just above the water line on the pond bank. Over a twelve day period, a mature leech will lay 1 to 8 cocoons each with usually 12-16 eggs. Hatching time was temperature dependent but between 4 to 10 weeks (Elliott and Dobson, 2015).

Identification

Medicinal leeches are prominently striped large leeches with a yellow/orange blotched underside. The only native leech that is of similar appearance is the Horse leech (*Haemopis sanguisuga*) which occurs in similar habitats and is often found out of the water (more so at night) hunting insects as it does not feed on blood. However it has a black back and a lighter lateral stripe with none of the coloration of the medicinal leech.

There is a non-native medicinal leech present in the UK (*Hirudo verbena*), with similar coloration but the underside is lighter and without blotches and the dorsal stripes are missing or obscured by a much broader blotched pattern of orange color.

Hirudo medicinalis Dorsal view

Hirudo medicinalis Ventral view

Locations

The locations surveyed are given in the table below.

Main pond	GR	Outlying ponds	GR
Sheepwash Pond	SZ364975	Lily Pond	SZ365976
Hatchet marl pit Pond	SU367017	Hatchet Triangle Pond	SU368013
		Hatchet Middle Pond	SU365010
		Hatchet Little Pond	SU365011
Woodfidley	SU340036		
Standing Hat	SU313036	Standing Hat front pond	SU313036

Initial site visits were made with the Sonia Lorenzo Martin and Jonathon Cook, keeper, who suggested including Hatchet Triangle Pond. Site visits were also made with Naomi Ewald who helped with discussions on locations as well as technique. Later discussions were had with Richard Reeves on the ecology and behaviour of the medicinal leech.

The ponds are discussed below. Aerial photographs of the ponds with survey locations plotted are presented in Appendix 2.

Sheepwash Pond

Sheepwash pond

Sheepwash pond is small, heavily shaded and dominated by *Crassula helmsii* to the exclusion of native vegetation except water lily (probably planted) and invading

sallows. It is surrounded by mature trees and scrub and has a large amount of leaf litter present which may also be discouraging medicinal leech. No signs of poaching or other signs of disturbance from grazing animals suggests that this may result in a lack of food for leeches. Similarly, the pond has declined in suitability for amphibians through shading and the spread of *Crassula.* Sheepwash is a roadside pond and some road runoff is likely to enter the pond which is undesirable.

The only outlying pond nearby which retains water throughout the year is the Lily Pond which would appear to be suitable for medicinal leeches and is visited by grazing animals in some numbers.

Lily Pond

Woodfidley Pond

Woodfidley pond is relatively isolated by the railway and is an open well-vegetated pond that appears very suitable for Medicinal leech. No grazing animals were seen during the survey visits but the surrounding turf is clearly well-grazed.

Standing Hat Ponds

Standing Hat front pond

Standing Hat main pond

The two ponds at Standing Hat are well-vegetated with high biodiversity. The main pond is partially sheltered by mature trees but the edge and the adjoining front pond have been cleared of encroaching scrub within the last couple of years making them open and sunny. In fact too much scrub has probably been cleared from the front pond as this is now accessible on all sides whereas a small shelterbelt on one side would have been better left.

No outlying ponds were identified from maps or on the ground in the proximity of these ponds.

Hatchet marl pits pond

Hatchet marl pits pond

Hatchet pond is a very large pond with two very different habitats. The main pond is an oligotrophic acid heath pond which does not support medicinal leech. To the north and adjoining the main pond is an area of old marl pits which are now flooded and contiguous with the main pond. This dog leg is well-vegetated with shallow clay basins which are very suitable for the medicinal leech as they warm up quickly. The whole pond is visited by large numbers of grazing animals.

There are three outlying ponds within a short distance of Hatchet main pond. They are the two fishing ponds (Hatchet Middle and Hatchet Little Ponds) to the south east but north of the Lymington road. These are both basins in sand and gravel and as such are similar to the main pond proper. Hatchet Triangle Pond is to the south west of the main pond across the Lymington road and is a very shallow well-vegetated pond that dries down considerably but not completely in the summer. It

appears to have a peat/silt base and so is rather different in character from both the main pond and the marl pits pond.

Hatchet Middle Pond

Hatchet Little Pond

Hatchet Triangle Pond

Methods

Each of the main pond sites were visited monthly between April and July 2016 with outlying ponds surveyed at least once during this period. The survey consisted of the collection of environmental data (water temperature, pH and conductivity using a Hach HQ40D multimeter), location data using a Garmin GPS 60, followed by the survey for leeches.

This used the 'splash' technique used in previous surveys (Reeves, 1999) which consisted of entering the water at a suitable location (shallow, preferably bare but surrounded by vegetation) and gently raising and lowering alternate feet in emulation of livestock entering the water to drink. Additionally gentle surface splashing with a net was used if no leeches were seen after five minutes. A timed ten minutes was spent at each location. Any leeches seen during this period were caught with a standard D-frame pond net and placed in a large plastic bucket with a lid. Capturing swimming leeches continued beyond the ten minutes if they were still approaching.

Each of the main ponds was surveyed in a different location on each visit in order to sample as much of the pond as possible but also to reduce the risk of repeat sampling of the same individuals. Subsequent conversation with Richard Reeves suggests that this may have been only partially successful as he states that the leeches move around the ponds.

Once the capture period was finished, the leeches were removed from the bucket one at a time and placed in a 2 litre plastic drinks container with the bottom cut off and label removed. The posterior sucker diameter as measured using Draper Expert digital callipers through the bottle. The leech was also measured as it extended itself in search of the exit by holding a tape on the outside of the bottle. This usually gave an opportunity to take two or three measurements and the greatest was recorded.

Further collection of environmental parameters (pH, conductivity, % emergent vegetation, % perimeter shaded, % overall shade, substrate, area and distance from source pond) was carried out on outlying ponds when they were surveyed.

Results

Environmental parameters

The following environmental parameters were collected.

date	location	GR	pH	conductivity	temp
17.6.16	Hatchet Marl pits end	SU36756 01706	7.03	0.27	21
25.7.16	Hatchet Marl pits end	SU36756 01706	7.06	0.30	
1.8.16	Hatchet Marl pits north side	SU 36841 01697	7.60	0.14	16.6
12.4.16	Hatchet Pond - marlpits end (N side of north dog leg)	SU3678601710	6.43	0.16	12.4
12.5.16	Hatchet Pond (S side of north dog leg)	SU3675201663	6.77	0.22	21
1.8.16	Hatchet marl pits south side	SU 36850 01560	7.69	0.09	20
25.7.16	Hatchet middle pond	SU 36577 01106	7.00	0.19	21
25.7.16	Hatchet little pond	SU 36570 01199	6.38	0.13	19.6
12.4.16	Hatchet triangle pond	SU3687801297	6.83	0.14	15
17.6.16	Hatchet triangle pond	SU36865 01318	8.05	0.20	20
17.6.16	Lily Pond	SZ36572 97661	6.87	0.16	18
12.5.16	Sheepwash (west end)	SZ3643097629	7.29	0.24	18
17.6.16	Sheepwash pond (east end)	SZ3643497624	6.84	0.22	18.0
12.4.16	Sheepwash pond (east end)	SZ3643497624	7.45	0.27	16.8
16.7.16	Standing Hat front pond	SU31354 03659	6.83	0.23	27.7
17.6.16	Standing Hat front pond	SU31354 03659	7.23	0.28	17
19.5.16	Standing Hat front pond	SU32767 05166	7.14	0.26	21
17.6.16	Standing Hat main pond	SU31325 03668	7.08	0.27	15
26.4.16	Standing Hat main pond	SU3132503670	7.57	0.37	16.1
16.7.16	Woodfidley pond (south side centre)	SU3401103650	6.71	0.25	25
26.4.16	Woodfidley pond (south side centre)	SU3401103650	6.59	0.22	13.2
17.6.16	Woodfidley pond (east end)	SU34063 03671	6.65	0.22	16.9
19.5.16	Woodfidley pond (north side centre)	SU34041 03673	6.76	0.31	19

Table 1. Environmental parameters.

The variation throughout the survey season and between the ponds in the pH is not significantly far from neutral varying from 6.39 at Hatchet Little Pond to 8.05 at Hatchet triangle pond. Similarly variation in conductivity is from 0.09 at Hatchet main pond (south of marl pits) to 0.37 mS/cm at Standing Hat which are all in the low to moderate range, but it should be noted just how variable the same site can be depending on factors such as rain and disturbance by animals prior to the survey. Conductivity reflects the levels of minerals leached from the clay (marl) substrate and habitat preference is towards the moderate end of this range where plant growth would be more diverse.

Water temperature was generally lower than for optimum activity during these surveys but all were well within the zone of activity and early in the season the leeches would be more likely to search for food at lower temperatures because they had starved over winter and a hungry leech is more active than a fed leech.

Further environmental parameters were collected at each of the outlying ponds in order to help determine their likely suitability for medicinal leeches. These parameters were based on the preferences for well-vegetated ponds with shallow bare margins important for warmth as they heat up quickly and for cocoon deposition. The substrate is less significant but there appears to be a preference in the New Forest at least for marl pit ponds although this may not be a direct effect of the substrate.

A table of these parameters is given below.

Pond	Emergent vegetation (%)	perim. Shade (%)	overall shade (%)	% substrate				Area (m^2)	distance from main pond (m)
				clay	gravel / sand	silt/peat	leaf litter		
Standing Hat main	75	66	50	100				1408	
Standing Hat front pond	90	20	10	100				608	2
Woodfidley	95	5	5	100				800	
Sheepwash	90	100	50				100	307	
Lily Pond	50	33	5		100			3126	150
Hatchet Triangle Pond	85	33	5			100		1613	50
Hatchet Marl pits end	80	25	10	100				4800	
Hatchet Middle Pond	15	2	1		100				75
Hatchet Little Pond	75	15	10		100				100

Table 2. Extended environmental parameters of ponds (collected 17.6.16)

Apart from Standing Hat at which the two ponds become one at high water levels, there is considerable difference between ponds that are otherwise close together. The most notable difference being completely different substrates. Thus the Hatchet Triangle pond would appear to be suitable for medicinal leech from Hatchet marl pits but is in fact on peat and silt rather than clay.

No data could be found on the distance that medicinal leech could travel overland between ponds so the significance of this parameter is uncertain, however it is known that they feed on water birds, so presumably could be transported between ponds in this manner. Feeding takes up to 40 minutes so attaching to a grazing animal just as it is leaving a pond could allow transfer of some considerable distance. Note that the medicinal leech has a robust thick skin which allows it to survive dessication if it drops from a grazing animal when sated and survive whilst making its way to the nearest pond (unless homing instinct acts to make it return to its home pond).

Biological data

	April	May	June	July	Total	1999
Sheepwash	0	0	0	0	0	108
Standing Hat	81	21	7	17	126	56
Hatchet	0	2	1	7	10	79
Woodfidley	3	11	4	3	21	8

Table 3. Summary of results: Total leeches recorded

The total captures are presented above but note that the search effort is not constant for each visit as a new location was surveyed at each pond if no captures were made at the first. This was repeated if the second location also yielded no animal. In the case of Hatchet pond a maximum of four repeats was made whereas at Sheepwash only a single repeat was made as the pond was so small.

None of the outlying ponds yielded any leeches and these were subject to the same repeated surveys at locations around the perimeter of each.

Each leech captured was measured (extended length and posterior sucker diameter) in order to assess population structure. Full data are presented in an appendix but this is summarised below into size class data so that it can be compared with the results of the 1999 survey.

In terms of total numbers, comparison with the 1999 results is not straightforward as many more visits were undertaken over a longer period of time in 1999. However restricting the results to the same period gives 6 visits in 1999 compared with 4 in 2016 and the totals are posted in Table 3 above.

Figure 1. Distribution of leeches in length size classes

	Extended length size class (in cms)						
	2-3.9	4-5.9	6-7.9	8-9.9	10-11.9	12-13.9	14-15.9
Woodfidley	0	1	0	6	8	6	0
Standing hat	1	16	26	52	22	8	1
Hatchet	0	0	2	3	3	0	2

Table 4. Length size classes

	Extended length (cm)		PSD (mm)	
	mean	sd	mean	sd
Hatchet	10.20	2.73	6.72	1.96
Standing hat	8.48	2.20	5.58	1.31
Woodfidley	10.40	2.13	6.42	1.31
All	8.85	2.34	5.76	1.40

Table 5. Summary statistics for length and posterior sucker diameter.

Compared with the 1999 survey data, the mean extended length is very similar (1999 mean = 8.58 , sd = 3.42) with a rather larger posterior sucker diameter in the current survey (1999 = 4.76, sd= 1.85).

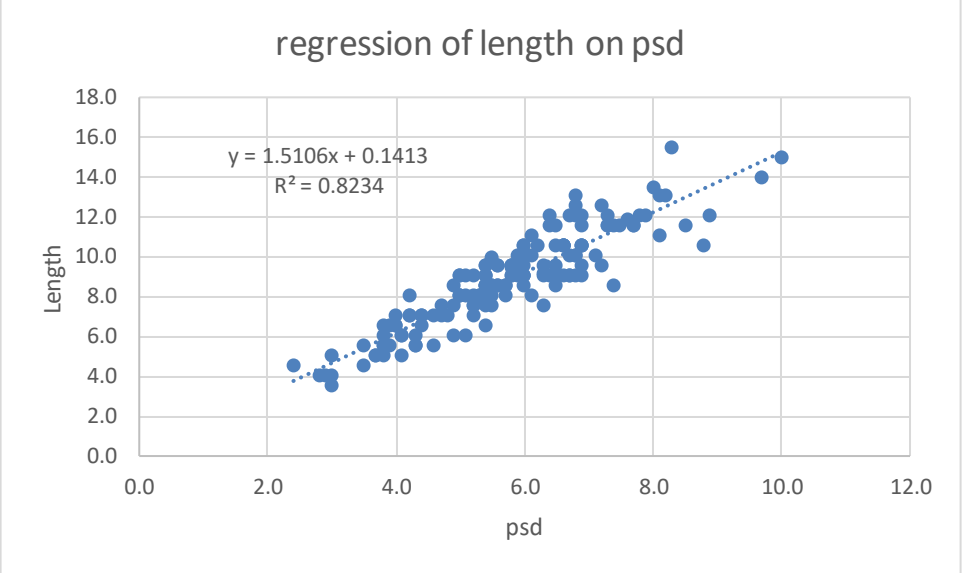

Figure 2. Regression of length on psd

A regression equation of extended length against posterior sucker diameter is presented above for all leech data combined. It appears that the relationship is less robust than was found in 1999, but then a much greater number of leeches were captured which would have had a smoothing effect on the regression line. Originally planned to allow age class distinction, this was not found possible in 1999 and no signs are apparent here either.

Discussion

Medicinal leeches appear to have increased in population size in two of the ponds, decreased in one and become extinct in the fourth since the 1999 surveys. The comparison of total numbers is however not entirely straightforward as the sampling effort in 1999 was much greater. Not only was it spread over a longer period but there were more visits within the same months as the 2016 survey and each visit consisted in greater sampling effort (8 locations per pond in 1999 compared with a maximum of 4 in 2016).

Otherwise size class distribution was similar and posterior sucker diameter was slightly greater in 2016.

Reasons for the changes in population counts are not definite but there are strong indications to suggest a cause and effect in some of the ponds. Standing Hat has had a lot of scrub cleared (especially from the front pond) which has resulted in much less shade and therefore warmer water which is important to leeches. Both Standing Hat ponds are visited regularly by livestock and the margins are well poached (it is not known how this compares with 1999). It appears that the increase in leech numbers is strongly associated with this habitat management work. No other ponds were identified as outliers to Standing Hat.

Woodfidley appears not to have changed significantly over the past few years based on a discussion with a local photographer. Leech numbers are higher than in 1999 but how much this can be attributed to population increase is difficult to answer. At any rate the leech population appears to be healthy in terms of numbers. There were no ponds close enough to investigate as an outlier to Woodfidley.

There was considerable year on year variation in numbers caught mentioned in the 1999 survey report so definite conclusions from a single years survey are difficult to justify. Hatchet pond would appear to have suffered a decline in numbers of medicinal leech however a discussion with Richard Reeves suggests that this may not be so clearcut. This is because leeches move around the pond much more than was anticipated when the survey was designed and therefore more sampling locations on each visit would probably have improved captures. This having been said, more sampling effort took place at Hatchet than at the other ponds as it had the greatest perimeter length in spite of only the marl pits section being sampled. There is no apparent reason for such a decline although the structure of the habitat is unlike the other ponds in that there are extensive bare areas between stands of vegetation which may be unsuitable for leeches. Clearly Hatchet Pond is also a lot more disturbed by visitors although no evidence for the impacts on leeches is known. The outlying ponds surveyed were Hatchet Triangle, Hatchet Middle and Hatchet Little Ponds, none of which yielded any medicinal leech.

Sheepwash has almost certainly lost its population of medicinal leech. This is probably due to the extensive carpet of *Crassula helmsii* that now dominates the pond leaving less than 10% open. The pond is quite shaded although it would appear always to have been. No signs of grazing animals were seen on any of the visits. Lily pond was surveyed as an nearby outlier to Sheepwash but without any medicinal leech being found. Initial assessment had suggested that it might be suitable for medicinal leech. Richard Reeves suggests that a boggy area behind Sheepwash may have medicinal leech, but this discussion was held after all the survey work was completed and so has not been followed up.

Management of the scrub in 2000 at Standing Hat pond has been very successful in terms of an increased medicinal leech population. Further work in 2013 has opened up the pond even more which may not be desirable as it is now liable to disturbance without the protection of some scrub around the margins. There is a concern that *Crassula* is present at Standing Hat, although currently it appears to be suppressed

by Hampshire purslane (*Ludwigia palustris*), however if it is not controlled then it will infiltrate the vegetation and become impossible to eradicate.

Neither Hatchet or Woodfidley suffer from excess scrub encroachment and therefore do not require such action. Hatchet does suffer from high visitor numbers and disturbance of the margins is common. Scrub should be retained and even encouraged to create areas of lesser visitor intensity around some of the marl pit pools.

Sheepwash is suffering from the invasive *Crassula helmsii* which is shading out other native vegetation and appears to have caused the decline or extinction of medicinal leech probably through lowering the dissolved oxygen levels overnight. Whilst it would be desirable to remove this invasive non-native plant, the pond is still very shaded by mature trees and scrub which causes the water temperatures to be lowered, to the detriment of medicinal leech. Ideally a program of *Crassula* eradication combined with shade removal would improve the suitability of Sheepwash for medicinal leech, a pond which once had the greatest population of medicinal leech in the New Forest (1999). If they are present in the surroundings then recolonization into suitable conditions seems likely. However, another problem with Sheepwash appears to be a lack of grazing animals using the pond. This may be associated with *Crassula* but other ponds in the New Forest have been similarly invaded and still attract grazing animals. It may require a more general opening of the wooded surrounds to make the pond accessible and attractive to animals again. Water quality may also be an issue at Sheepwash with road runoff entering the pond and the nearby stream known to flood the pond carrying poor quality water from the local sewage treatment works. It is questionable whether Sheepwash can be restored to suitable conditions for medicinal leech.

Whilst the populations in Standing Hat and Woodfidley ponds appear to be robust it is clear that year on year variations are normal for this animal and it is envisaged that a series of years with adverse weather conditions together with negative habitat change or even a one-off event such as newly wormed animals depositing dung in or near one of these ponds could eliminate a population. Climate change could potentially have a positive impact in increasing summer temperatures which might stimulate additional breeding, however it should be noted that there is an optimum temperature for reproduction (25.5 – 27.5 ^{o}C) and hand-in-hand with increased summer temperatures will be increased drying of ponds. The effects of wetter, warmer winters are debatable and so overall climate change must be seen as a potential risk. With so few populations left in the New Forest (and a decline across the country as a whole), then plans to improve resilience are vital.

A reintroduction program is vital as a way to increase resilience and safeguarding the survival of the New Forest populations, especially in the absence of data on natural colonisation of ponds. Former ponds which housed medicinal leech should be surveyed for current suitability and management directed towards returning them to former condition if required.

As suggested in the 1999 report there are a number of marl pit areas that would appear suitable that do not hold medicinal leech (Marlborough Deeps, Hollands Wood and Crockford for example). These areas should be surveyed and management considered to open up these areas. However, the primary route for reintroduction should be via former medicinal leech sites.

Summary of required management actions

The following table draws together the recommendations and comments discussed above.

Action	Requirement	Comments
Research	Research to investigate natural means of colonisation between ponds	Data review ?
	Discussion with Natural England on reintroduction protocols (captive breeding versus cocoon / adult transfers)	
Survey	All historical sites should be resurveyed as it is now 16 years since the last such survey. In particular the boggy area behind Sheepwash should be investigated as leeches have been reported from here (after the field surveys were completed).	Possibly as a volunteer project with Freshwater Habitats Trust. Environmental parameters should be included to help develop a model of suitable ponds.
	Potential reintroduction sites should be surveyed (both for animals and environmental parameters). In particular strong populations of toads and newts are essential as feeding animals for juvenile leeches and as replacement prey if grazing animals are in short supply.	Potential sites include:- Hatchet Triangle pond Hatchet Middle pond Sheepwash outliers incl. Lily pond. Hollands Wood Marlborough Deeps * Crockford * **scrub clearance may be required to reduce shade and so needs coordination against other species interest at these sites.*
Habitat management	The success of habitat management at Standing Hat	1.Scrub clearance must be carefully planned to retain

	should be used as a model for restoring those former historical sites that have suffered from similar scrub encroachment.	boundary and marginal scrub in places to hinder or prevent public access. Ideally scrub and shade on the south should be reduced to allow sunlight to reach northern edges of the pond whilst retaining the scrub along the northern shore, except for discrete watering stations for grazing animals. 2. Shallow warm margins are required with aquatic/emergent vegetation close by for cover. A shallow depth profile is required to allow the water to warm quickly and also to encourage grazing animals to enter the water to drink (and thus offer feeding opportunity to leeches). 3. Egg cocoon laying sites are an additional habitat requirement and suitable ponds need at least a patch of emergent vegetation which a layer of leaf litter (such as Typha or Iris).This dense thatch of vegetation has been successfully replaced by hay bales elsewhere (N.Ewald, *pers. comm.)*
Site-specific management:	Sheepwash. 1. Investigate water quality issues. 2. Crassula removal and control 3. Shade reduction 4. Open up pathways through the forest to open grazing to encourage animals to use pond. 5. Scrub clearance of nearby ponds in order to encourage natural colonisation if any animals are still present locally.	Sheepwash may not be amenable to restoration due to the number of problems it faces. Option 5 may be the optimal.

	Hatchet pond. 1. Reduce access to waterside in marl pits area to reduce disturbance, through path closure. 2. Encourage egg-cocoon laying by providing hay bales surrounded by emergent vegetation planting.	
	Standing Hat. 1. Crassula control 2. Monitor disturbance, especially of the front pond and create barriers through dead timber placement through which scrub can regrow.	

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Denise Eccles for providing the aerial photographs.

Appendix 1. *Hirudo medicinalis* extended length and posterior sucker diameter

Site	Woodfidley south side centre		Woodfidley north side centre		Woodfidley east end		Woodfidley south side centre	
Date	26.4.16		19.5.16		17.6.16		16.7.16	
	rsd(mm)	length(cm)	rsd(mm)	length(cm)	rsd(mm)	length(cm)	rsd(mm)	length(cm)
	6.9	11.5	7.3	12.0	6.0	9.0	7.3	11.5
	6.6	9.0	5.0	9.0	7.2	12.5	6.2	10.5
	5.7	8.5	6.1	11.0	6.6	10.5	2.8	4.0
			6.7	12.0	6.8	13.0		
			8.0	13.5				
			6.9	10.5				
			8.9	12.0				
			6.0	9.0				
			7.7	11.5				
			4.2	8.0				
			5.9	10.0				

Site	Standing Hat		Standing Hat front pond		Standing Hat main		Standing Hat front pond	
Date	26.4.16		19.5.16		17.6.16		16.7.16	
	rsd(mm)	length(cm)	rsd(mm)	length(cm)	rsd(mm)	length(cm)	rsd(mm)	length(cm)
	3.8	6.5	4.0	6.5	4.2	7.0	8.1	11.0
	7.9	12.0	6.0	10.0	5.0	9.0	4.9	7.5
	4.0	7.0	6.7	10.0	3.0	4.0	4.4	7.0
	5.8	9.0	5.6	8.5	3.0	5.0	7.3	11.5
	4.7	7.5	5.4	8.5	4.4	6.5	5.4	8.5
	6.1	8.0	6.1	10.0	2.4	4.5	7.1	10.0
	6.3	9.1	4.1	6.0	5.2	9.0	5.9	9.0
	5.5	9.9	4.2	7.0			5.4	7.5
	5.8	9.4	6.0	10.0			6.5	10.5
	5.7	8.0	6.9	9.0			4.9	8.5
	3.8	5.5	5.8	9.0			5.0	8.0
	6.7	9.0	5.2	7.0			5.1	9.0
	5.5	8.5	2.9	4.0			4.6	5.5
	3.7	5.0	5.6	9.5			6.4	12.0
	5.1	6.0	3.0	3.5			5.4	9.0
	5.3	8.0	6.0	9.0			6.5	11.5
	5.3	8.0	3.7	5.0			5.4	9.5
	4.3	5.5	6.5	8.5				
	5.5	8.0	8.2	13.0				
	3.9	6.5	5.4	9.0				

	6.7	9.0	6.9	10.5				
	6.0	8.5						
	7.6	11.8						
	3.9	5.5						
	3.8	5.0						
	4.3	6.0						
	7.2	9.5						
	5.2	7.5						
	5.4	6.5						
	6.8	12.0						
	6.9	9.5						
	3.5	4.5						
	7.4	8.5						
	5.8	9.5						
	6.0	10.5						
	5.5	8.5						
	4.1	6.0						
	4.1	5.0						
	4.6	7.0						
	6.6	10.5						
	3.5	5.5						
	4.7	7.0						
	5.5	7.5						
	7.7	11.5						
	5.8	9.5						
	8.3	15.5						

	6.0	10.5						
	5.4	8.5						
	4.3	5.5						
	8.1	13.0						
	4.9	6.0						
	5.2	8.0						
	6.3	9.0						
	8.8	10.5						
	5.6	9.5						
	5.8	9.5						
	5.2	7.5						
	3.8	5.5						
	6.3	9.5						
	6.3	7.5						
	5.4	8.5						
	5.0	8.0						
	6.8	9.0						
	8.5	11.5						
	5.0	8.0						
	4.4	7.0						
	6.6	10.5						
	3.8	6.0						
	6.5	9.0						
	7.4	11.5						
	6.4	9.0						
	5.1	8.0						

	5.7	8.5						
	6.8	12.5						
	6.0	9.5						
	6.4	11.5						
	6.8	10.0						
	6.9	12.0						
	5.4	8.0						
	6.6	10.5						
	7.8	12.0						

Site	Hatchet marl pits Pond	Hatchet marl pits pond		Hatchet marl pits pond		Hatchet marl pits pond		Hatchet Middle pond	Hatchet Little pond	Hatchet Triangle pond	Hatchet Triangle pond
Date	12.4.16	12.5.16		16.6.16		25.7.16		25.7.16	25.7.16	12.4.16	17.6.16
	none	rsd(mm)	length(cm)	rsd(mm)	length(cm)	rsd(mm)	length(cm)	none	none	none	none
		10.0	15.0	5.4	9.5	5.6	8.5				
		4.0	6.5			6.5	9.5				
						6.9	10.5				
						6.8	10.0				
						7.5	11.5				
						9.7	14.0				
						4.8	7.0				

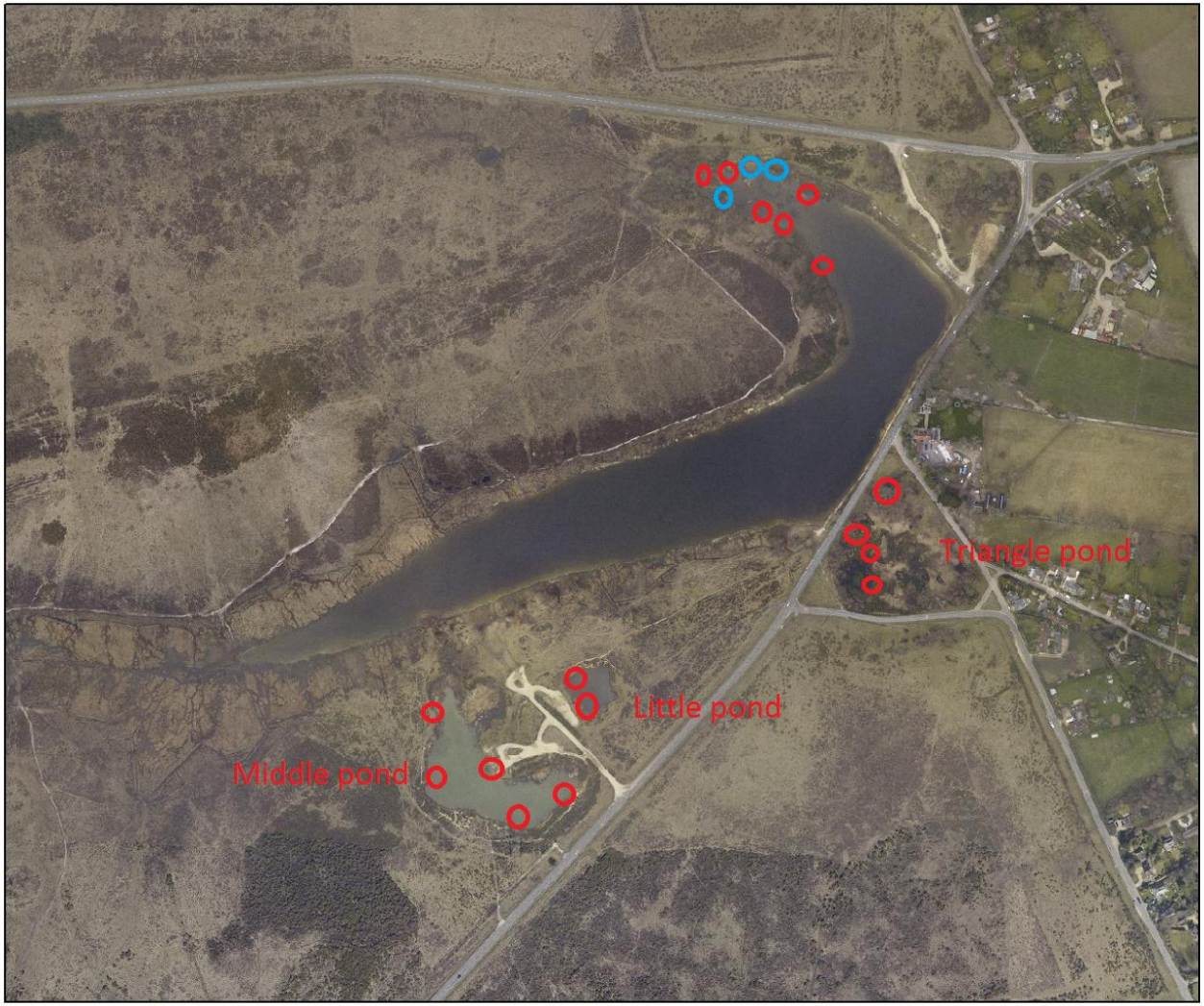
Site	Sheepwash	Sheepwash	Sheepwash	Sheepwash	Lily pond
Date	12.4.16	12.5.16	16.6.16	1.8.16	17.6.16
	none	none	none	none	none

Appendix 2. Aerial photographs showing survey locations (red=negative; blue=positive results)

Forestry Commission
England
South England
Forest District

Woodfidley
Medicinal Leech

1:500



Forestry Commission
England
South England
Forest District

Hatchet Pond
Medicinal Leech

1:5,000

Approximate extent of pond outlined in orange

Approximate extent of pond outlined in orange. NB photo prior to extensive scrub clearance.