



Results of the squirrel monitoring programme, spring 2017



Red squirrels captured on a trail camera during monitoring at Smardale Gill, Cumbria, May 2017

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Summary

This report details the results of red and grey squirrel range monitoring organised by Red Squirrels Northern England (RSNE) in spring 2017 in 294 sites.

Monitoring in spring 2017 found that the number of sites with red squirrels was slightly higher than in 2016. Red squirrels were detected in 45.2% of surveys in 2017, and in 43.6% of surveys the previous year. This slight increase in red squirrel detection is excellent news, suggesting that for the third year running, red squirrel range has been maintained.

We reported in 2016 that grey squirrel site occupancy had dropped considerably compared to the previous year. In 2016 they were detected in 36.8% of surveys. The number of sites in which greys were detected in 2017 increased to 42.8%. This total is still lower than 2015 levels. Red squirrels were present in a higher number of overall sites than greys.

Analysis for spring 2017 looked at the site occupancy of red and grey squirrels across the whole project area, but also looked at the performance of the red squirrel reserve and stronghold areas compared to sites in the wider landscape (sites outside of the strongholds but within current red squirrel range). Red squirrels were found in 50.8% of survey sites within strongholds, and in 36.2% of sites outside of stronghold areas. Grey squirrels were recorded in 37.5% of surveys located within strongholds, and in 51.3% of surveys outside of stronghold areas.

Proportionally red squirrels occupied more survey sites within strongholds than in the wider landscape. In contrast, grey squirrels occupied more survey sites within the wider landscape than in the strongholds. There was much variation in red and grey squirrel site occupancy between the seven different stronghold areas, with results showing that red squirrels were more frequently recorded in some strongholds, with grey squirrels dominating in others.

Results for sites surveyed within 15 out of 17 red squirrel reserves were also analysed. Red squirrels were detected in 12 of these reserves, and grey squirrels in five. Reds were present in 51.4%, and grey squirrels were present in 23.5% of all surveys within reserves. Nine of the reserves were red squirrel only. Both species were observed in three of the reserves. Two of the reserves were grey squirrel only.

Maps were created using all data recorded between March and May 2017 from standardised surveys, conservation activity records and public sightings to provide a snapshot in time of the distribution of both species. Red squirrels were recorded in 404 tetrads and grey squirrels were recorded in 490 tetrads during this three month window.

Over 150 people were involved in the programme. A number of new volunteers were recruited and trained resulting in an increase in the number of surveys completed by

volunteers compared to previous years. This is good news for the future sustainability of the programme.

Acknowledgements

Fieldwork on this scale would not have been possible without the vast number of volunteers and staff who contributed their valuable time and energy to making this happen. In addition, we greatly appreciate access granted to woodlands by land managers throughout the project area. We would also like to praise the contribution of hundreds of red squirrel conservationists who contributed additional records during the survey window, helping us to document current squirrel range in northern England.

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1 Introduction

The aim of the annual monitoring programme is to build a standardised, long-term dataset that will evidence changes that may occur to red and grey squirrel range over time. The geographical focus is northern England, in interface areas where both species may occur, and in areas where grey squirrels are managed to help preserve the status of reds. In this context, the programme acts as an independent measure of performance, and results should help demonstrate the impact of red squirrel conservation activity on the distribution of both species.

Data is collected in the same locations using the same methods each time, recording both positive and negative data based on detection or non-detection of squirrels at fixed points and along survey routes. By repeating and standardising the survey methods we can have greater confidence in the results, and the longer this programme runs, the more reliable our interpretation of these results becomes.

The Red Squirrels Northern England (RSNE) Monitoring Strategy, written in 2012, identified that a minimum sample size of 200 monitoring sites would be necessary to be able to reasonably detect changes in squirrel populations over a three year period. 255 surveys were carried out in spring 2012, and in each year since 2012 around 290 surveys have been completed.

The monitoring takes place each year between 1st March and 31st May. Conservation activity records and sightings from a variety of sources for the same period are also used to ensure that the maps illustrate up-to-date distributions of both squirrel species.

It is important to monitor squirrel distributions in a standardised way. Grey squirrel control records, red and grey squirrel monitoring data (where methods are not standardised and repeatable) and public sightings are often difficult to use for comparisons over time because of the huge variation in effort, both in time and space. Additional records are invaluable, however, for providing a far more complete picture of the distributions of red and grey squirrels than would be possible with standardised monitoring alone.

All the survey work and data compilation was focused in those geographical areas within current known red squirrel range in northern England. No standardised monitoring was carried out in east Lancashire, other parts of Yorkshire or lowland County Durham as there is no current evidence of red squirrel occupation in these regions, therefore it should be noted that grey squirrel range represented here is grey squirrel range within feasible red squirrel range only. We assume that greys are widely present in other areas of northern England.

Standardised monitoring methods

The three squirrel survey methodologies are described in detail on the RSNE website, available to download as pdfs at: <http://rsne.org.uk/squirrel-monitoring-programme>.

In brief, within each tetrad (2 x 2km square), one survey was carried out during a 15 day period, using one of the following methods: baited trail camera, baited visual transect or observed feeder. The survey takes place in the same location each year, and the survey method is kept the same wherever possible to enable comparisons over time. There were a small number of changes to methods or exact locations this year for a number of reasons: for example due to recent felling work, or issues over site access.

Additional data

Current red and grey squirrel range maps produced in this report were compiled from a variety of data sources. In addition to standardised monitoring data, conservation activity data was used. This includes grey squirrel control and non-standardised red and grey squirrel monitoring (monitoring that does not adhere to the same methods used in the RSNE monitoring programme). Records of squirrels trapped, shot or observed are collected by the RSNE team of red squirrel rangers and contractors, by local volunteer red squirrel conservationists (mostly operating within the network of groups under the banner of Northern Red Squirrels (NRS)) and by individuals working for other conservation organisations or private estates. These records are submitted periodically to RSNE using standardised recording forms. All records submitted to RSNE by June 30th 2017, documenting red squirrel conservation activity between 1st March and 31st May 2017, were used to compile distribution maps.

The maps also include adhoc sightings of red squirrels submitted directly to RSNE via the sightings page on the RSNE website, <http://rsne.org.uk/sightings>. Sightings of both red and grey squirrels are also compiled by the NRS local groups and by other organisations. These are then submitted to RSNE, and verified as far as possible. Verification of public sightings is generally limited to a check to ensure the place names submitted match the map location selected by record submitters on the website, followed by a check of the fit with known recent red squirrel range. Unusual sightings are followed up to seek additional information, such as a description and photograph. Public sightings failing these checks have not been included in this analysis.

Red squirrel reserves and strongholds

In 2006, 17 red squirrel reserves in England were selected by the government for protection as safe havens. The red squirrel reserves consist of largely coniferous forestry plantations where red squirrels were thought to be at less of a competitive disadvantage to grey squirrels than in the surrounding landscape. Around these reserves, the Forestry Commission designated buffer zones in which landowners were able to apply for English Woodland Grant Scheme (EWGS) funding to carry out control of grey squirrels. This scheme closed in 2014, and has now been replaced by Countryside Stewardship. Red squirrels are listed as a priority species under the new

scheme and as such are eligible for funding not just within these previously designated areas, but across northern England wherever the species occurs.

The reserve and buffer zones are collectively referred to as 'strongholds'. These strongholds are still important areas for red squirrels, and because of the historical investment of both time and money in conserving reds in these areas, it is appropriate for us to continue to look at these geographical areas to continue to assess whether they function as well as or better than other non-designated areas.

Several of the strongholds merge together, forming seven different strongholds and stronghold complexes that are geographically connected: (i) Kyloe, (ii) Harwood and Raylees complex, (iii) Kielder complex, (iv) Slaley complex, (v) North Lakes complex, (vi) Yorkshire Dales complex and (vii) Sefton Coast (see Appendix for map).

The wider landscape

Red squirrels are present throughout northern England in areas outside of the designated strongholds. These areas are referred to in this report as 'the wider landscape'. The opening up of funding eligibility for red squirrel conservation across the species' range in northern England now recognises the importance of these populations, and the need for conservation effort wherever red squirrels still occur. For the purpose of this report, results will, as in previous years, be broken down into reserve, stronghold and wider landscape, to help assess the functionality of these different zones.

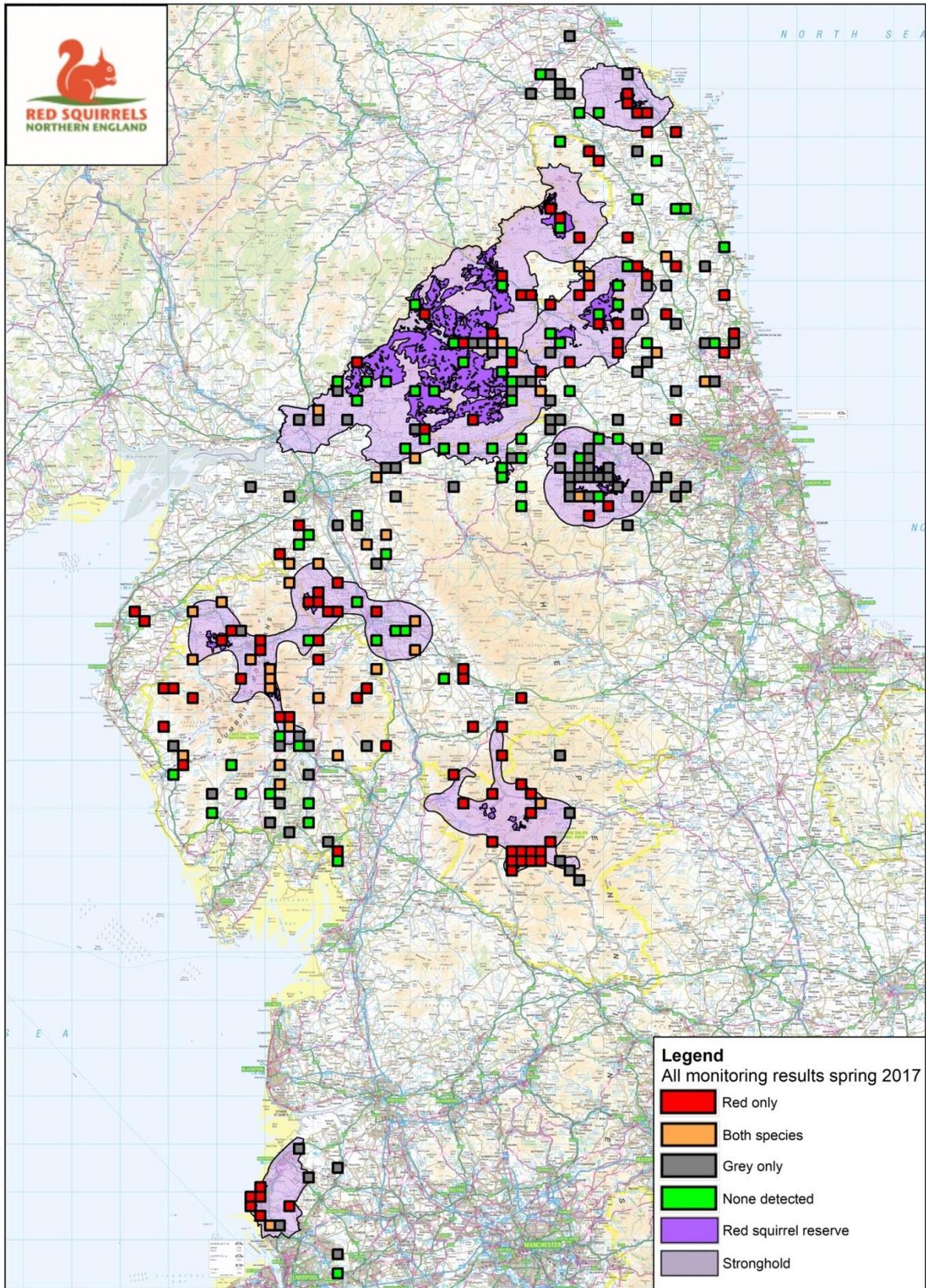
2. Results

2.1 Standardised monitoring

294 surveys were completed and results returned in time for this report. This is once again very similar to the total number of surveys in previous years. The number of surveys per method is as follows: 236 trail cameras surveys, 39 visual transects and 19 observed feeder surveys.

Red squirrels were detected in 45.2% of surveys, and grey squirrels were observed in 42.8% of the total number of surveys. 33.6% of sites were red only, 31.2% were grey only, and both species were detected at the same site in 11.5% of surveys. No squirrels were observed in 23.4% of surveys. Fig. 1 shows the geographical distribution and results of all surveys, and additional maps are provided at the end of the report showing red squirrel detection and non-detection (Fig. 7) and grey squirrel detection and non-detection (Fig. 8) at all survey sites.

Fig. 1. Results for all 294 survey tetrads spring 2017



181 surveys were located within red squirrel stronghold areas, and 113 were distributed across the wider landscape (Table 1).

Table 1. Results of systematic monitoring in spring 2017, broken down into red squirrel strongholds and the wider landscape.

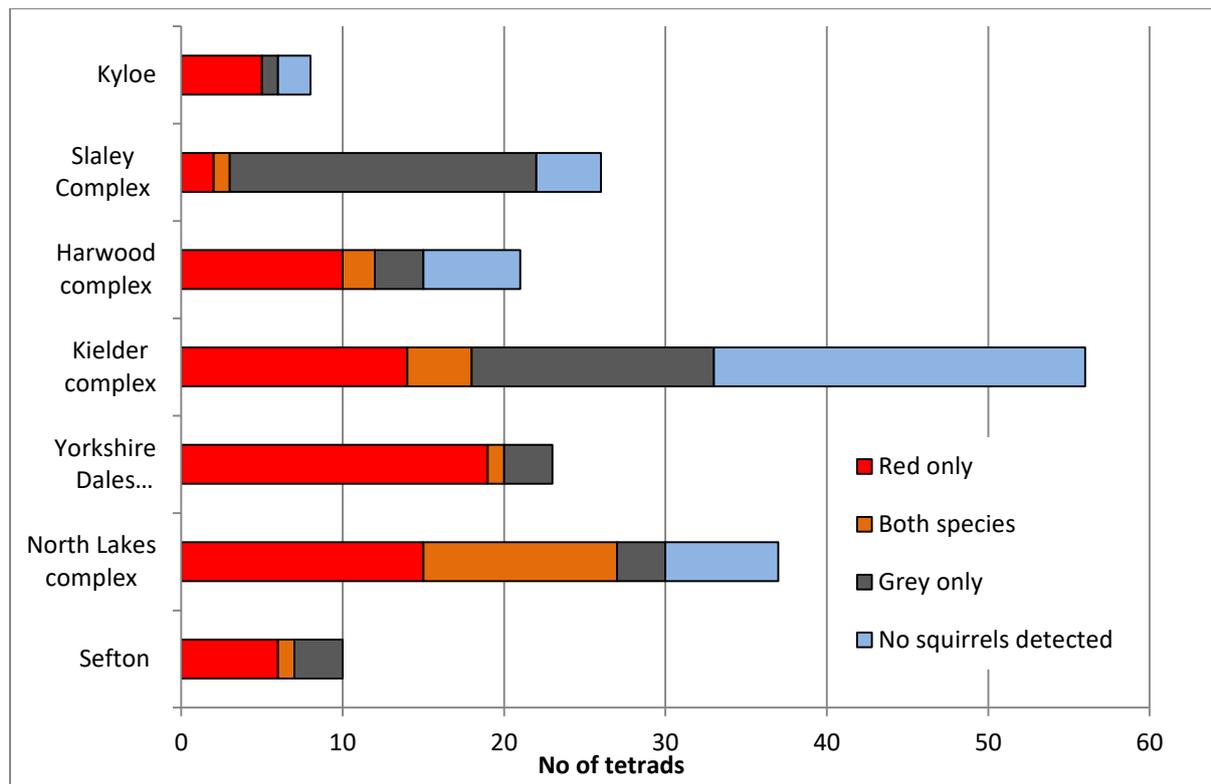
Result	Strongholds	Wider landscape	Total
Red squirrels only	71 (39.2%)	28 (24.7%)	99
Red & grey squirrels	21 (11.6%)	13 (11.5%)	34
Grey squirrels only	47 (25.9%)	45 (39.8%)	92
No squirrels	42 (23.2%)	27 (23.8%)	69
Total red sites	92 (50.8%)	41 (36.2%)	
Total grey sites	68 (37.5%)	58 (51.3%)	
Total number of tetrads	181	113	294

Red squirrels were detected in more sites within the stronghold areas than grey squirrels, with reds detected in 50.8% of surveys, and greys observed in 37.5% of sites. Outside of strongholds, in the wider landscape, grey squirrels were detected in more sites than reds, with reds detected in 36.2% of surveys, and greys observed in 51.3%.

Proportionately, red squirrels were detected in a higher percentage of stronghold sites (50.8%) compared to wider landscape sites (36.2%). In contrast, grey squirrels were detected in a higher percentage of wider landscape sites (51.3%) compared to stronghold survey sites (37.5%). However this is a somewhat coarse comparison between designated and non-designated areas. In reality, the likelihood of encountering red or grey squirrels varies greatly depending on geography, both within strongholds and in the wider landscape.

Results show that there is much variation in the status of the strongholds, with some functioning better than others as red squirrel areas. Fig. 2 illustrates the performance of the seven stronghold complexes, showing the number of tetrad surveys completed in each area, and the result of these surveys. The number of surveys in each complex varies greatly, reflecting the difference in size of these areas.

Fig. 2. Systematic monitoring within the seven stronghold complexes in spring 2017, showing number of sites and results within each complex.



Red squirrels were detected in 86.9% of sites in the Yorkshire Dales, the highest percentage total of all the complexes. Detection of greys was low in this stronghold, with greys observed in 17.3% of sites. Only Kylee had a lower percentage detection rate, with greys observed in 12.5% of surveys, although it should be noted that Kylee also has the lowest total number of survey sites (8 in total). Results were also good for the North Lakes stronghold, with reds detected in 72.9% of surveys, and similarly for Sefton, with reds detected in 70% of sites.

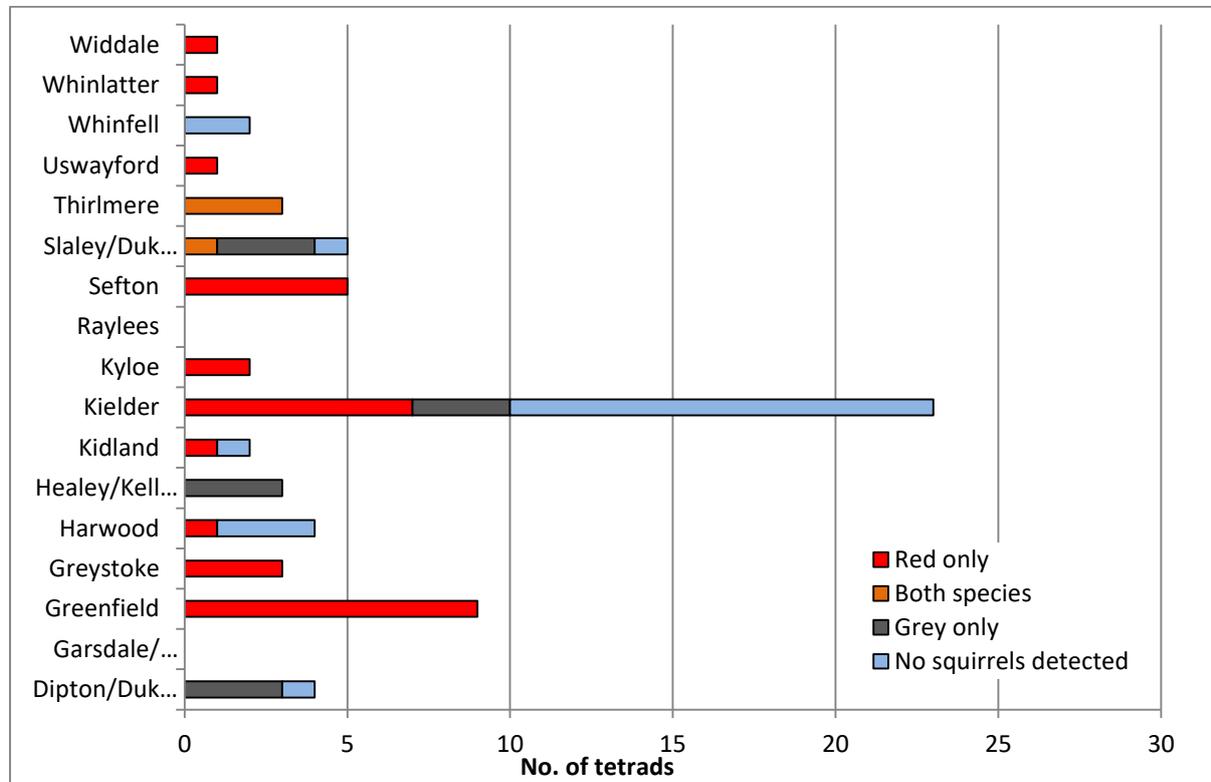
Harwood performed well, with reds detected in 57.1% of sites, whilst in contrast grey squirrel detection remained fairly low at 23.8%. Detection rates of either species remain low, as in previous years, within the Kielder complex. Red and grey squirrel detection rates were very similar across this stronghold as a whole, with reds observed in 32.1% of sites and greys in 33.9%.

Results were poor in the Slaley stronghold, with red squirrels detected in only 11.5% of surveys. In contrast, grey squirrel detection was high, with greys observed in 76.9% of surveys, by far the highest detection percentage of greys of all the strongholds.

68 survey sites were located within the 17 designated red squirrel reserves. Two of the reserves were not surveyed (Garsdale and Raylees) and only one site was surveyed at Whinlatter due to felling and access restrictions. Red squirrels were detected in 12 out of 15 of the reserves, and grey squirrels detected in 5 out of 15. Reds were present in 51.4% of all surveys within reserve woodlands, and grey squirrels in 23.5%. Several of the reserves were red squirrel only: Widdale, Whinlatter, Uswayford, Sefton, Kylee,

Kidland, Harwood, Greystoke and Greenfield. Greys were detected in all three of the reserves within the Slaley complex. Two of these sites (Healey/Kellas and Dipton/Dukesfield) were grey only, and both species were detected in Slaley/Dukesfield.

Fig. 3. Results of systematic monitoring in the 17 red squirrel reserves in spring 2017.



2.2 Compiled records: Systematic monitoring, conservation activity records & public sightings

Separate distribution maps for red and grey squirrels are included at the end of this report (Figs. 9 and 10). These maps were put together by combining the information from conservation activity records and public sightings between the dates of 1st March and 31st May 2017 with standardised monitoring results. The contribution made by the addition of control and sightings records submitted to RSNE is detailed in Table 2.

Additional data helped to document red squirrel presence in a further 271 tetrads. Grey squirrels were recorded in an additional 364 tetrads over the same period. This vast demonstration of red and grey squirrel range, recorded over a relatively short time period, highlights the scale of the conservation effort across northern England. It is worth noting that much of the grey squirrel distribution data comes from the documentation of grey squirrel management. The total number of tetrads in which grey squirrels were recorded is higher than the total number of tetrads in which red squirrels were recorded. Crucially, these additional records help us to demonstrate red range in areas where they were not detected during standardised monitoring, or in areas where there are no existing standardised survey sites. The total of 404 red tetrads is the highest since the monitoring programme began in 2012.

Table 2. The number of tetrads with recorded red and grey squirrel presence for the period March to May 2017. This data was combined to produce compiled distribution maps (Figs. 9 and 10).

	Number of tetrads		
	Standardised monitoring	Conservation activity records & public sightings	Total
Red squirrel	133	271	404
Grey squirrel	126	364	490

2.3 Comparison of systematic monitoring results between spring 2016 and spring 2017

The number of surveys completed in 2016 and 2017 was very similar, with 293 delivered in 2016, and 294 during this year's programme. The breakdown of these results is provided in Table 3. The number of surveys in which red squirrels were detected increased, from 43.6% in 2016 to 45.2% in 2017. The number of sites in which grey squirrels were detected increased considerably, from 36.8% in 2016 to 42.8% in 2017. Although this is a significant increase for grey squirrels, it should be noted that the result in 2016 was extremely poor for greys. This year's result shows a return to similar levels of site occupancy for greys compared to the result in 2015. Site occupancy over time (2012-2017) is further explored in section 2.4.

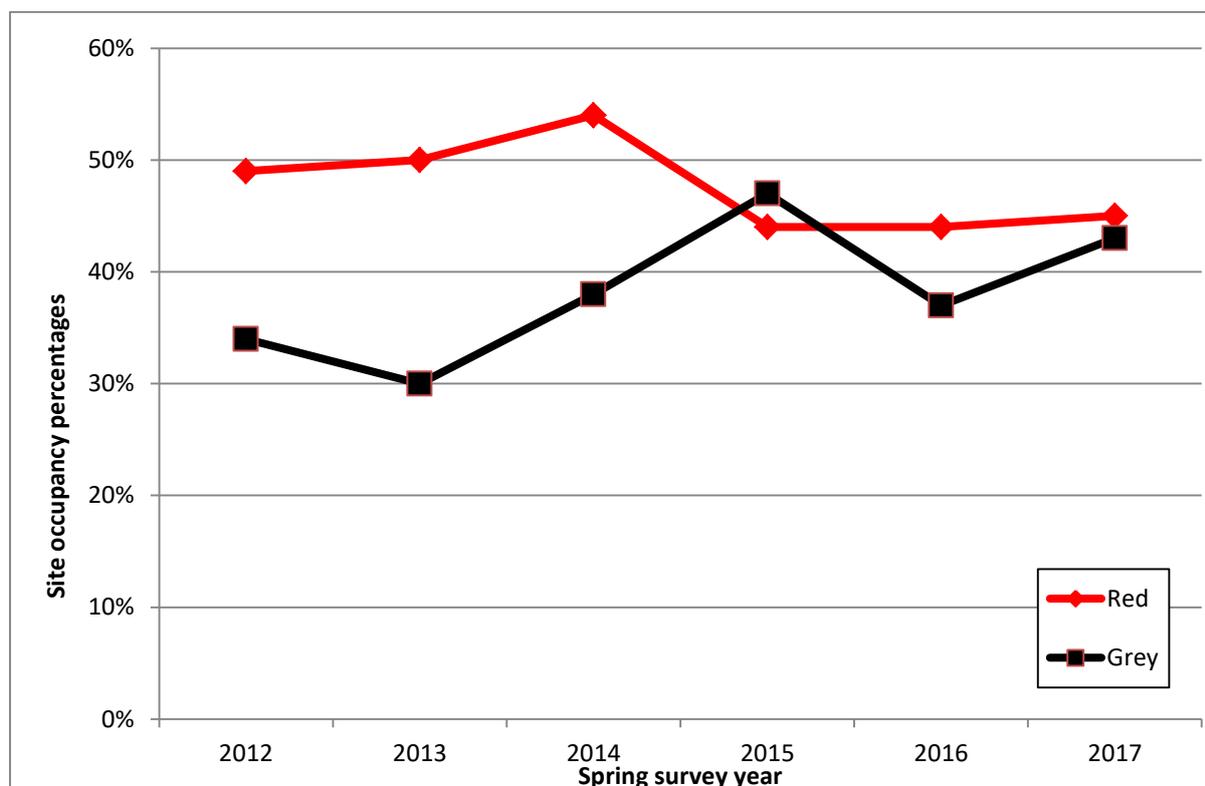
Table 3. Comparison of overall results between spring 2016 and spring 2017.

Result	Number of tetrads & percentage of total number of sites		
	Spring 2016	Spring 2017	Change
Red only	104 (35.4%)	99 (33.6%)	-5
Both red and grey	24 (8.1%)	34 (11.5%)	+10
Grey only	84 (28.6%)	92 (31.2%)	+8
No squirrels	81 (27.6%)	69 (23.4%)	-12
Total red occupancy	128 (43.6%)	133 (45.2%)	+5
Total grey occupancy	108 (36.8%)	126 (42.8%)	+18

2.4 Spring monitoring results 2012 to 2017

The survey programme has now been running since spring 2012, providing systematic monitoring for six years. An overall comparison of results each year for spring 2012 to 2017 is presented here (see Fig. 4). For the purpose of this comparison, results of the two autumn survey rounds (2012 and 2013) are not included. Spring 2012 is the baseline for the programme: however it is worth noting that there were considerably fewer surveys (255) carried out in that year, as the programme was established. Following this, the number of surveys completed was remarkably similar in each of the following years.

Fig. 4. Red and grey squirrel site occupancy for all spring surveys 2012-2017. Site occupancy is shown as a percentage of the total number of surveys completed each year.



In 2012, red squirrels were detected in 48.6% of surveys and grey squirrels were detected in 34.1%. In 2013 there was a slight increase in site occupancy, with reds detected in 50.3%. Grey squirrel site occupancy decreased, with greys detected in 30.3% of surveys, although it should be noted that the overall number of surveys in 2013 increased by 35, which may have influenced these percentage changes.

In 2014, following a mild winter and an excellent natural food supply, red squirrel site occupancy increased to 53.6%. Grey squirrel site occupancy also increased to 38.4%. This increase continued for grey squirrels in 2015 following a consecutive year in which environmental factors helped create the right conditions for the species to thrive, in particular with a bumper broadleaved seed crop. This is likely to have given grey squirrels a temporary advantage over reds, as their ability to outcompete red squirrels in broadleaved woodlands is well documented. Grey squirrel site occupancy jumped to

46.5%. This is in stark contrast to red squirrel occupancy, with reds detected in 43.7% of surveys, representing a considerable decline between 2014 and 2015. 2015 was the only year since the programme began where the number of sites where greys were detected outweighed the number of sites in which reds were observed.

Last year we reported that site occupancy for red squirrels had stabilised, with red squirrels detected in 43.6% of sites, almost identical to the overall result in 2015. In 2017 site occupancy has increased slightly to 45.2% which is once again welcome news. Site occupancy for grey squirrels has fluctuated considerably in the last two years. We were able to report a significant drop in site occupancy in 2016, with greys detected in 36.8% of sites. The number of sites where greys were detected increased in 2017 to 43%.

2.5 Reserves 2012 to 2017

It is worth considering the merits of the red squirrel reserves as we continue to assess their status as designated red squirrel forests. Table 4 details the overall result for each of the forests in each of the six spring monitoring rounds to date. It should be noted that the number of survey sites per reserve varies considerably, for example Widdale has only a single survey site due to the small size of this forest. In contrast, Kielder reserve has up to 25 survey sites, thus increasing the likelihood that we will encounter both species. Nevertheless, Table 4 provides a useful snapshot of reserve performance over time.

Table 4. Overall combined result per red squirrel reserve for spring surveys 2012-2017. The result is represented by the following colours: Red = red only, Orange = both species, Grey = grey only.

Reserve	2012	2013	2014	2015	2016	2017
Dipton/Dukeshouse	None					
Garsdale/Mallerstang						0 survey
Greenfield						
Greystoke						
Harwood				None		
Healey/Kellas						
Kidland		None				
Kielder						
Kyloe	None					
Raylees	None	None	None	None	0 survey	0 survey
Sefton						
Slaley/Dukesfield						
Thirlmere						
Uswayford	None	None				
Whinfell						None
Whinlatter						
Widdale						

Grey squirrels have never been detected in several of the reserves during standardised surveys: in Greystoke, Harwood, Kidland, Kylee, Sefton, Uswayford, Whinlatter and Whinfell. Both species have been detected in Kielder in all six years. This is partly due to the increased likelihood of detecting both species, with Kielder being the largest of the reserves with the most survey sites. It does not mean though that both species are equally abundant.

Results at Greenfield were excellent in 2017, and for the first time since 2014, no grey squirrels were detected. The reserve woodlands within the Slaley stronghold complex performed poorly again in 2017, although reds were detected at one site in Slaley/Dukesfield for the first time since 2014. Dipton/Dukeshouse was once more grey only, and Healey/Kellas has remained grey only in each of the six survey rounds. Results were disappointing at Whinfell Forest, where for the first time since the programme began, red squirrels were not detected. This was predicted however, following a prolonged outbreak of squirrelpox virus within the forest over the last year.

2.6 Strongholds 2012 to 2017

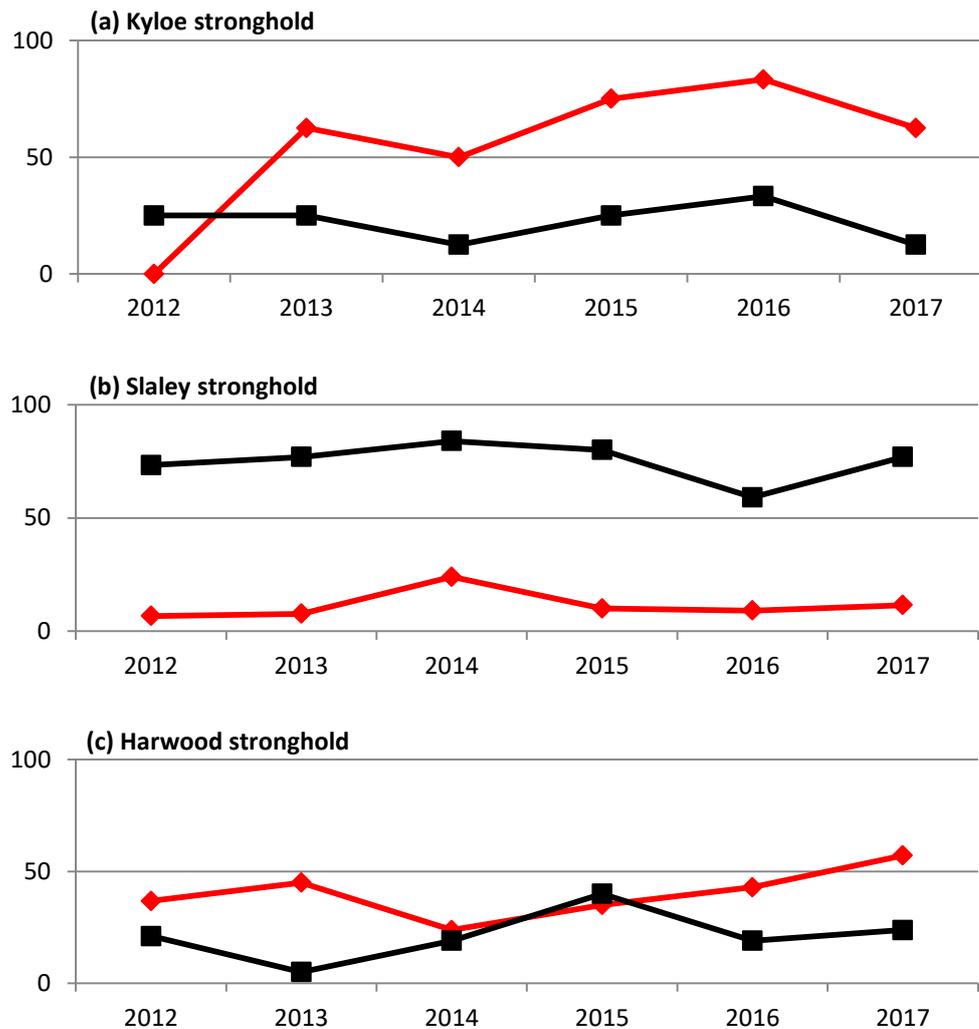
Monitoring results for the seven stronghold complexes between 2012 and 2017 are shown in Fig. 5. In the majority of complexes, red squirrel site occupancy is higher than grey squirrels. The difference in detected site occupancy is most pronounced in the Yorkshire Dales stronghold, with reds detected in 86.9% of surveys, and greys in only 17.3% in 2017. Red squirrel occupancy in this stronghold has increased in each of the last three years, whilst grey occupancy has declined over the same time period (Fig. 5g). Results continue to improve within the Harwood stronghold (Fig. 5c) where red occupancy has increased in each year between 2014 and 2017, reaching a high of 57.1% in 2017. Grey occupancy was relatively low (23.8%) this year: a positive result considering grey squirrel occupancy was slightly higher than red in 2015 (35% red, 40% grey occupancy).

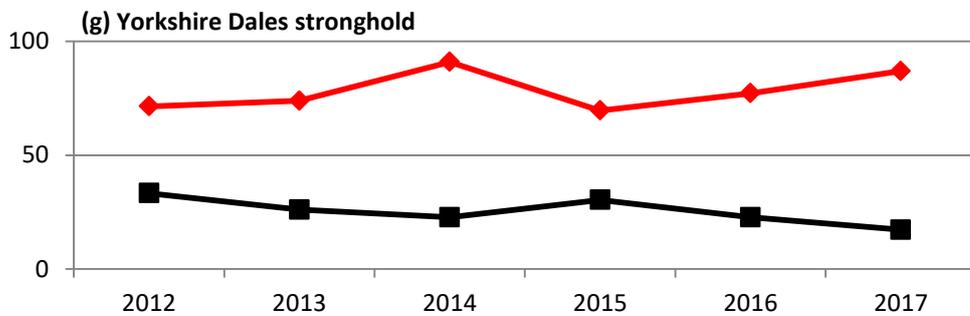
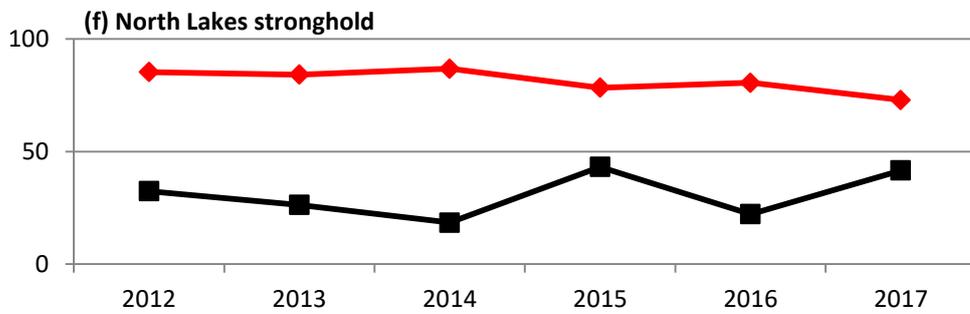
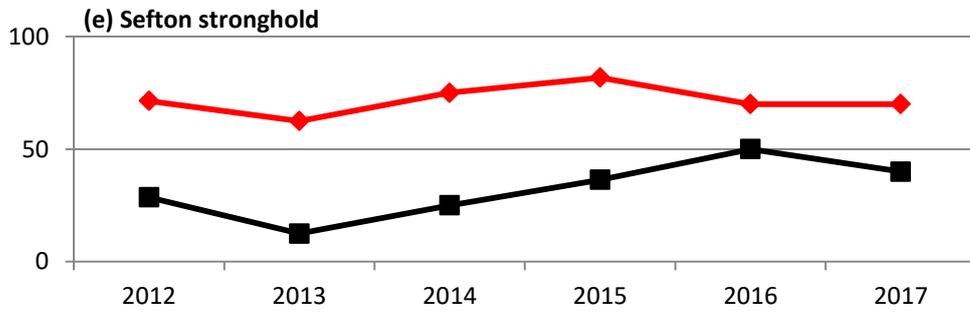
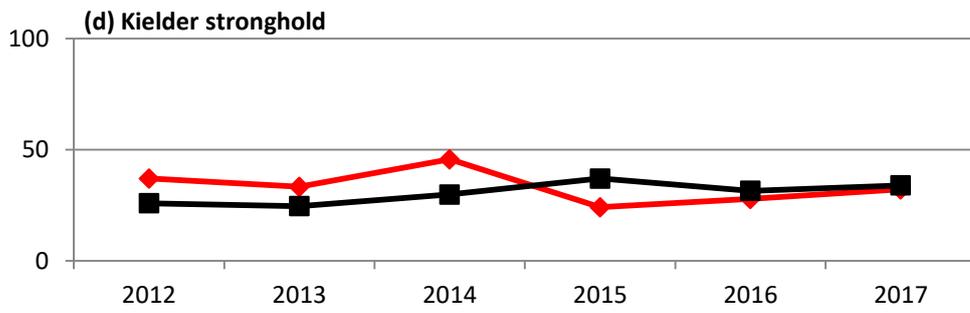
Results for Kielder stronghold (Fig. 5d) again show that red and grey squirrel occupancy is very similar across the complex as a whole. Red squirrel site occupancy in this stronghold hit a low in 2015, where reds were detected in only 24.1% of surveys. There has been a steady improvement each year since. Greys have been detected in more sites than red squirrels in each of the last three years (2015-2017), a concerning trend which highlights the need for a greater concentration of conservation effort in and around the UK's largest red squirrel reserve.

Red squirrel site occupancy has remained consistently high in the North Lakes stronghold (Fig. 5f) between 2012 and 2017, with detection rates above 70% each year, although this year saw a very slight drop to a low of 72.9%. In contrast, grey squirrel site occupancy increased from 22.2% in 2016 to 41.6% in 2017. Results were also positive in the Sefton (Fig. 5e) and Kylee (Fig. 5a) strongholds although the relatively low number of survey sites in these two areas means that any slight change results in a greater apparent swing in occupancy percentages.

Results for red squirrels in the Slaley stronghold were poor once again. 2014 saw the best results for red squirrels, with an overall occupancy of 24%. That year was the exception, and in each of the other five survey rounds, red squirrel occupancy has been extremely low, in contrast to grey site occupancy, which has remained high each year, despite a slight dip in 2016 (Fig. 5b).

Fig. 5. Red and grey squirrel site occupancy in all stronghold complexes for all spring surveys 2012-2017. Site occupancy is shown as a percentage of the total number of surveys completed each year. Red line = red squirrel. Black line = grey squirrel.

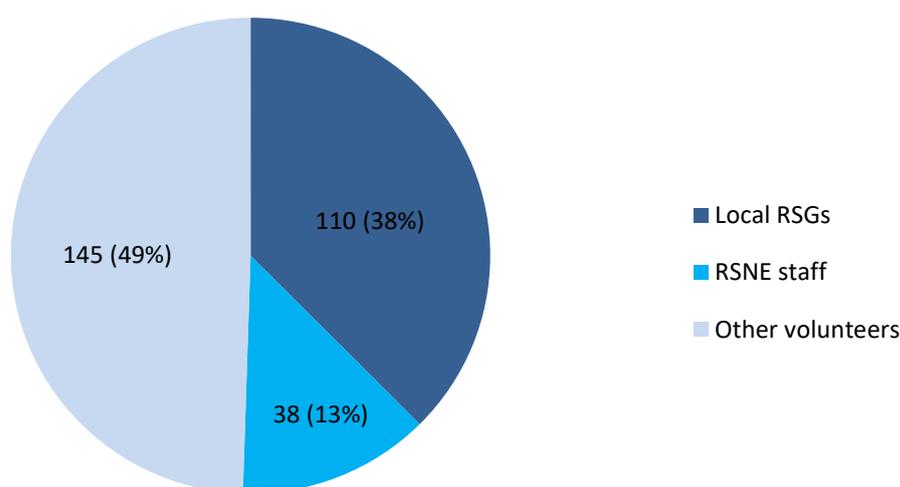




2.7 Community involvement

The monitoring programme would not be possible without the help of so many volunteers who are willing to carry out surveys each year. This year the number of people participating reached an all-time high, with over 150 people involved in the delivery of surveys, camera analysis, and arranging access or delivering equipment. A number of new volunteers were recruited and trained, and this resulted in a significant reduction in the number of surveys being completed by RSNE staff. This figure dropped from 77 surveys (26%) in 2016 to just 38 surveys (13%) in 2017. Once again, local red squirrel groups made a fantastic contribution to the programme, accounting for 110 (38%) of surveys delivered. The remaining 145 (49%) of surveys were delivered by a multitude of different groups, including individual volunteers not linked to volunteer red squirrel groups, private estates and other conservation organisations (Fig. 6).

Fig. 6. Community involvement: the contributions of different groups to the overall delivery of the spring 2017 monitoring programme out of a total of 294 surveys.



3. Discussion

More people than ever participated in the 2017 monitoring, leading to an increase in the number of surveys delivered by volunteers. This is fantastic news for the future sustainability of the programme. The ambition for the programme has always been longevity, to ensure that red and grey squirrel distribution is documented, and any changes to this measured in a standardised way. Increasing involvement of volunteers is crucial if we are to sustain this work, and RSNE need to continue to move away from investing staff time in survey delivery. The biggest cost to the project is increasingly in managing and coordinating this effort.

The programme is documenting the fluctuation of red and grey squirrels across northern England over time. The factors that are likely to influence this fluctuation

include environmental variation (natural food supply, weather) and human conservation intervention (the suppression of grey squirrel numbers through control). Although we cannot directly link any of these factors to monitoring results, they help provide some context.

Once again, the key message to take from these results is that red squirrel range is being maintained across northern England, despite the sustained threat that grey squirrels pose. Red squirrel conservation success is judged on this premise, and not on numbers of grey squirrels controlled, although the management of grey squirrels in and around interface areas where the two species are present is likely to be one of the determining factors in the maintenance of red range.

The number of sites occupied by greys did increase in 2017, but not to the level seen in 2015, when we reported that super-abundance of nut crops (particularly beech mast in late summer and autumn 2014) was likely to have favoured grey squirrels, as their ability to outcompete reds in broadleaved woodlands is well documented. Autumn food supply in 2016 was universally reported as low to medium, however the results suggest that greys have fared well, perhaps once again helped by a mild winter.

Maintaining conservation effort is becoming increasingly difficult, and funding sources are currently dwindling. Countryside Stewardship provides the potential to support red squirrel conservation, however it should be noted that this scheme seeks to support the delivery of a range of objectives, as opposed to its' predecessor, the English Woodland Grant Scheme, which in particular offered stand-alone red squirrel Woodland Improvement Grants. Much of the good work delivered between 2012 and 2017 by RSNE and other organisations was funded by this scheme.

The effort of volunteer red squirrel groups, some of them operating on little budget but driven by goodwill and determination to ensure red squirrels survive locally, becomes increasingly important as funded projects are having to downscale, and it is vital that community efforts and impacts are recognised, celebrated and rewarded. That said, it is crucial that collectively we find ways to maintain effort, and consistent financial input is required if we are to be effective in conserving red squirrels long-term. Monitoring programme results suggest we are succeeding, but we cannot afford for investment to slip. As resources become tighter, the importance of sustaining the monitoring programme increases. Results are our best way of demonstrating gains, losses, and areas where the status quo is being maintained. It provides a focus that can help those organisations involved to make informed decisions as purse strings continue to tighten.

From the analysis detailed in this report it is clear that the status of some of the red squirrel reserves and strongholds is questionable. The Slaley stronghold continues to produce poor results although there is some encouragement to be taken from the fact that reds were detected in a small number of surveys, and additional records have helped us document areas of this complex where reds are persisting. However, significant resources have been invested in this area, and as these resources begin to dwindle, it is appropriate that we assess the status and future of this stronghold.

Some of the strongholds remain as strong as ever, with good results in the Yorkshire Dales, Kyloe and Sefton. Reds were once again detected widely in surveys in the North Lakes, although the increase in the number of sites where greys were detected is a concern. Several sites to the south of this complex were grey only, whereas in previous years reds have been detected. This is an interface area where significant resources have been invested in previous years to reduce numbers of grey squirrels to allow reds to thrive. This is perhaps a good example of how fragile some red populations can be if investment and effort is not maintained.

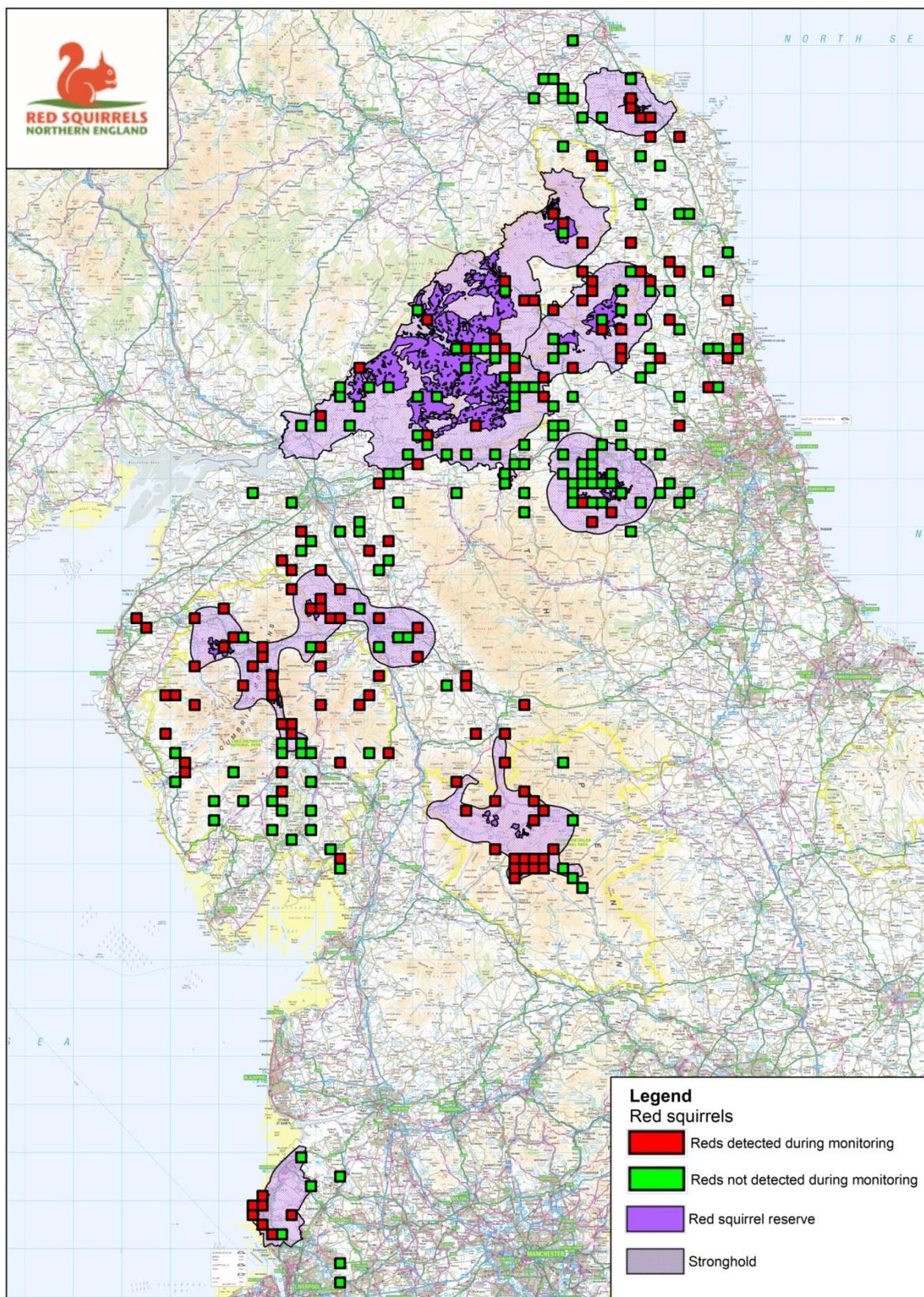
Kielder, the largest red squirrel reserve in England remains a concern, and red and grey squirrels were detected in almost an equal number of sites across the stronghold. This brings into sharp focus the need for increased effort in these areas to push back the threat. RSNE's involvement with Red Squirrels United, a UK-wide initiative, is providing some much needed resources in this area. Hopefully this will have an impact over the next two years that will be reflected in the results of future monitoring.

Much of the analysis in this report focuses on the stronghold areas, as consistent measurable units. It is more difficult to analyse the wider landscape, and as mentioned earlier, it is crude to lump all non-strongholds surveys into one unit ('the wider landscape'). In reality, there are many areas across red squirrel range, outside of the strongholds, where red squirrels continue to thrive. There were notable red-only results in Northumberland, for example in Ashington, Widdrington, Swarland, Thrunton and in sites near Wooler. In Cumbria, there were red-only results in parts of west Cumbria, in the valleys of Ennerdale and Haweswater, and in all surveys in the Upper Eden Valley area. In many of these areas work is driven by local volunteer groups, and the persistence of reds here serves as a reminder of the value of community-led conservation work.

The compilation of range maps would not be possible without the documented contribution of hundreds of red squirrel conservationists working tirelessly to help red squirrels across the northern counties, and we would like to praise those people for carrying out this fieldwork and recording it. We must also highlight and praise the work put in by all of those responsible for compiling and submitting these records, as without their commitment, we would not be able to produce these maps. It helped us demonstrate red squirrel range in areas where they were not detected during surveys, for example in the Allen Valleys, Northumberland, and in woodlands in south Cumbria.

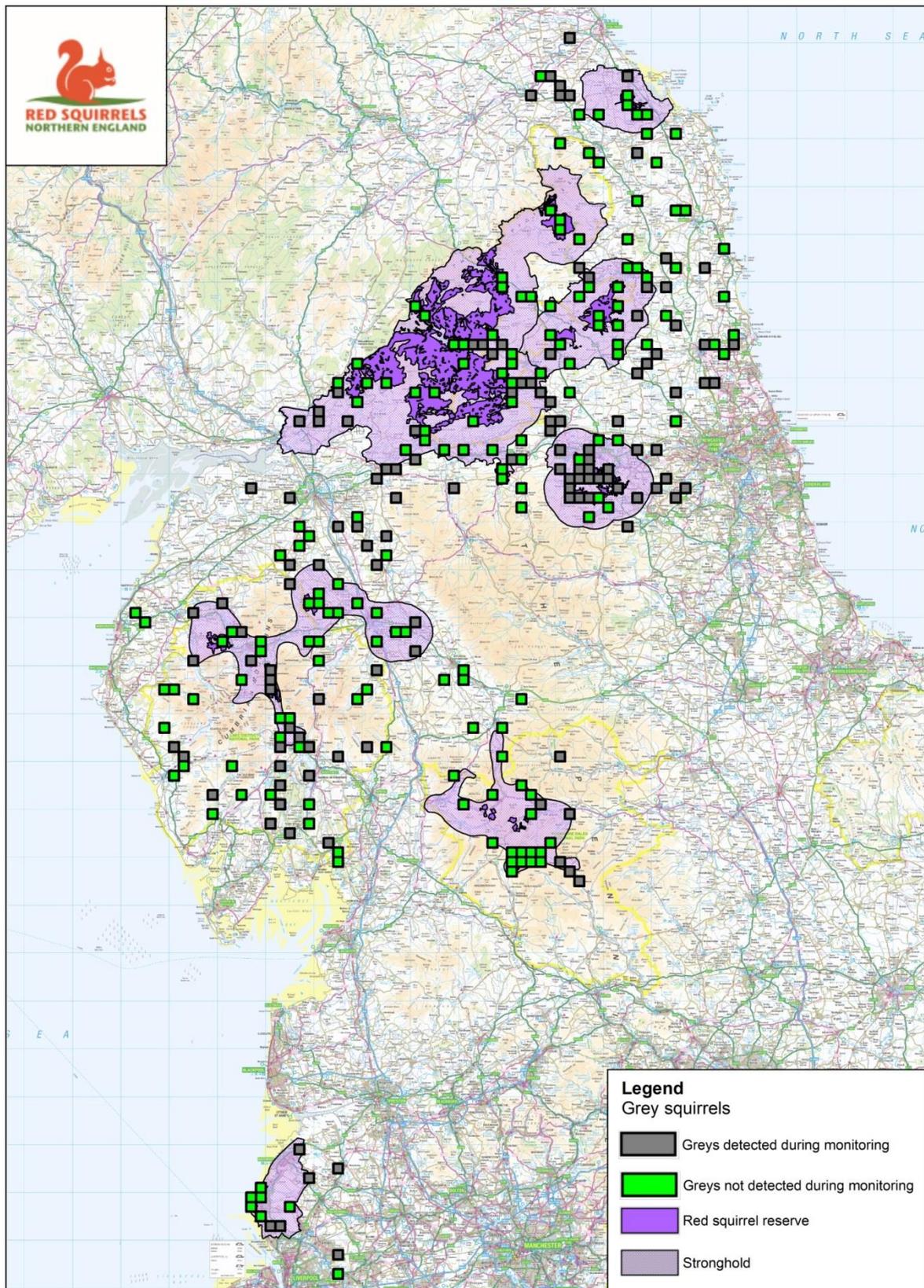
Finally, it is worth celebrating the completion of the spring 2017 monitoring programme as a huge achievement. It was an exercise in organization, logistics, and in personal commitment for all those involved. Surveying almost 300 sites in a three month period is a huge task, one that is perhaps unparalleled in scale in UK mammal conservation. To repeat this effort on an annual basis shows the passion and dedication of a huge number of people.

Fig. 7. Tetrad locations where red squirrels were detected or not detected during spring 2017 surveys.



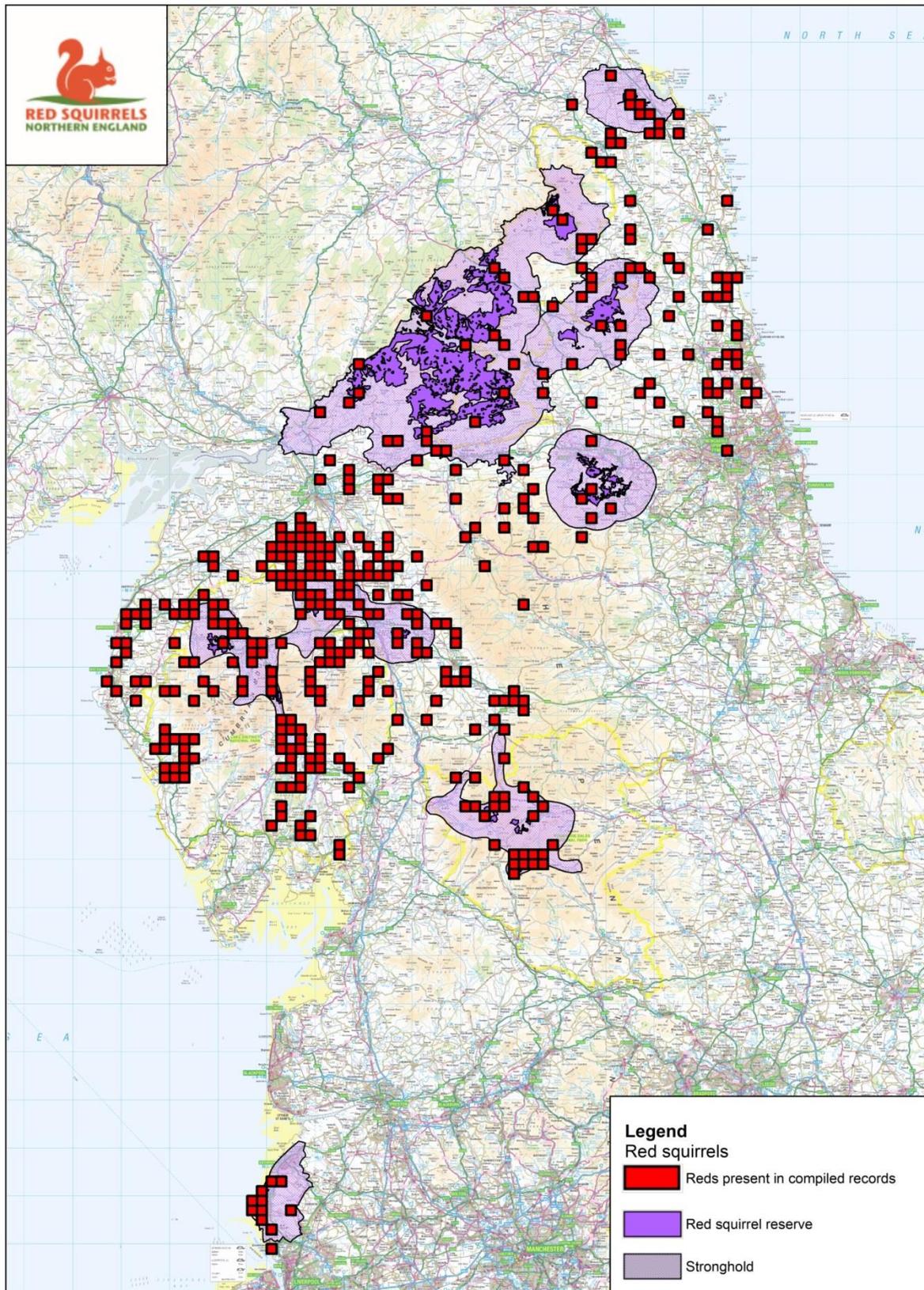
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Fig. 8. Tetrad locations where grey squirrels were detected or not detected during spring 2017 surveys.



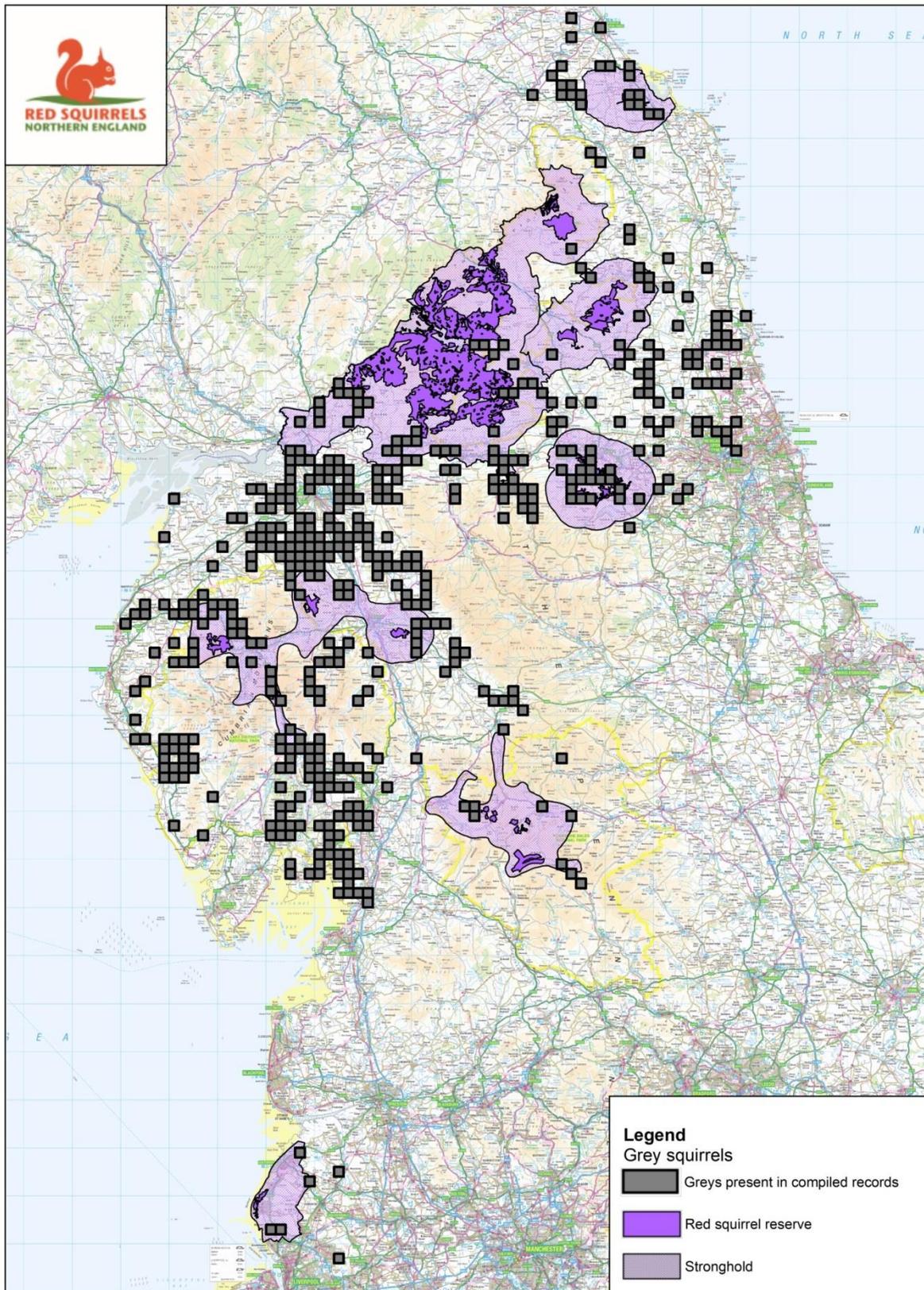
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Fig. 9. Distribution of red squirrels recorded March - May 2017 in tetrads across northern England. Records compiled from standardised monitoring, conservation activity records and public sightings submitted to RSNE directly or via NRS groups.



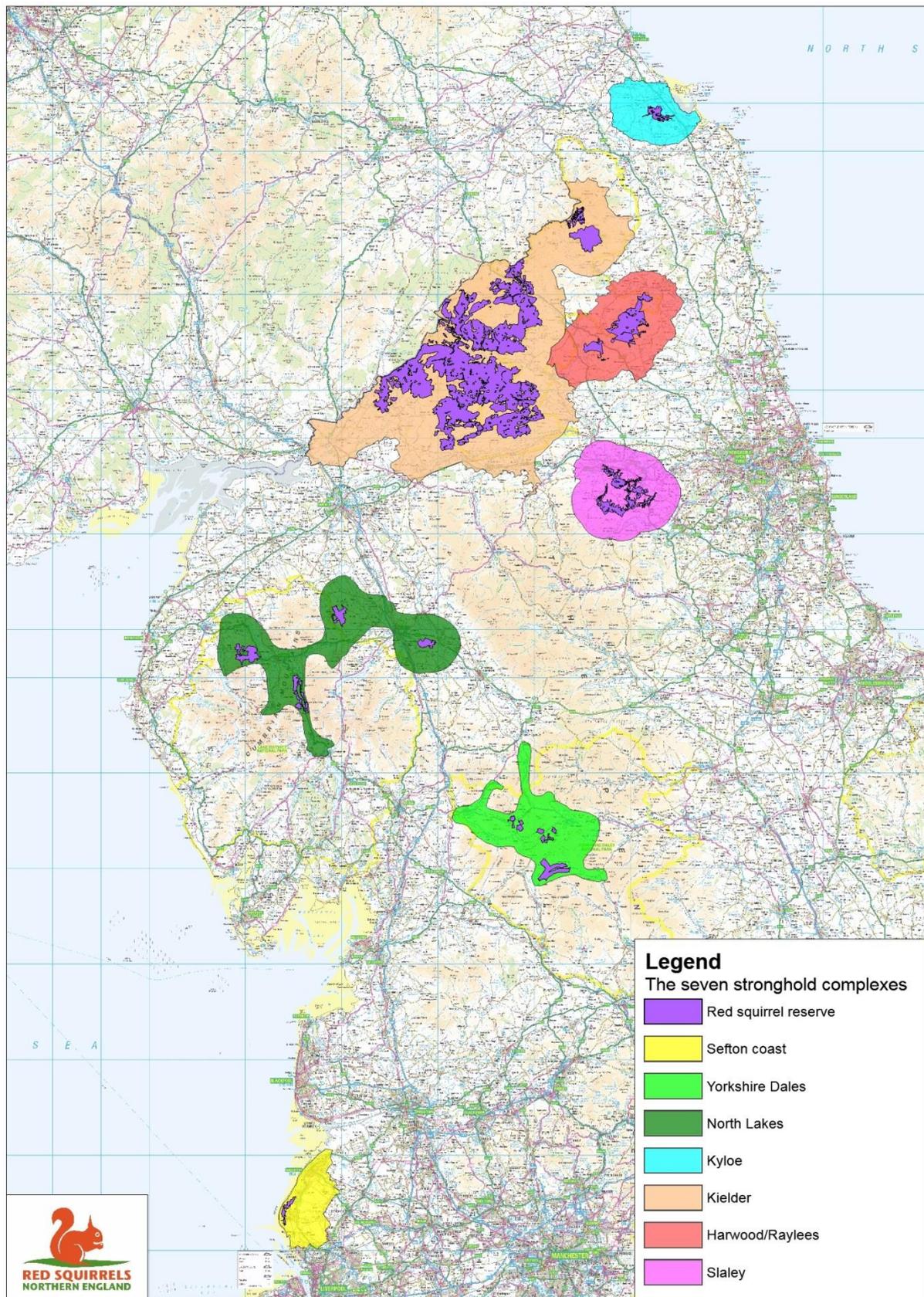
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Fig. 10. Distribution of grey squirrels recorded March - May 2017 in tetrads across northern England. Records compiled from standardised monitoring, conservation activity records and public sightings submitted to RSNE directly or via NRS groups.



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Appendix: Map of the seven stronghold complexes: The 17 strongholds are grouped together where there is geographical connectivity forming seven 'stronghold complexes'.



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