Amphibian and Reptile Conservation
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NARRS REPORT 2007-2009

Interim results of the UK National Amphibian and Reptile Recording Scheme Widespread Species Surveys

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amphibian and reptile conservation

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The NARRS Widespread Species Surveys Report 2007 – 2009 is dedicated to all the NARRS surveyors, too numerous to list individually, who give up their time to conduct the surveys that provide NARRS data. Without them, this would not be possible.

We think too small, like the frog at the bottom of the well.
He thinks the sky is only as big as the top of the well.
If he surfaced, he would have an entirely different view.

Mao Tse-Tung

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1. INTRODUCTION

The National Amphibian and Reptile Recording Scheme Widespread Species Surveys (NARRS) began in 2007. The term "NARRS" is really an umbrella one, uniting Widespread Species Surveys with existing and novel efforts to record, monitor and report on Britain's rare and alien herpetofauna. In this report, however, the term NARRS is used to refer to volunteer-based efforts to monitor and report on the status of widely-distributed amphibians and reptiles. NARRS is the first scheme of its kind designed to produce robust, repeatable, baseline data on the status of amphibians and reptiles throughout Britain in a way that trends can be detected. The resulting data can be used long-term to provide information contributing to UK Biodiversity Action Plan (BAP) and EU Article 17 status assessments, habitat condition assessments and other measures. Ultimately, it should be possible to use NARRS results to set conservation priorities and targets, and to contribute to local, regional and national Action Plans, as well as to measure the progress of conservation action on the ground.

NARRS is coordinated by Amphibian and Reptile Conservation (ARC) in partnership with the Amphibian and Reptile Groups of the United Kingdom (ARG UK) and a host of other partners including Statutory Agencies (for a full partner list, please see www.narrs.org.uk). The scheme currently operates in Scotland, Northern Ireland, Isle of Man, Wales, England and Jersey.

Central to NARRS is the use of trained volunteers to collect the data. At annual training events, interested volunteers are trained in NARRS species identification, survey methodologies, bio-security, and health and safety, and given survey forms to fill in and other materials facilitating the completion of their survey/s (e.g. identification sheets). To date, more than 100 training events have been conducted across the British Isles, resulting in more than 1500 people being trained in robust methods of amphibian and reptile survey. Over 1800 people are currently signed up, via the NARRS website, as being interested in NARRS.

Each participating survey volunteer is allocated a random 1 km grid square within 5 km of their post code. The current aim is to have surveyed 400 or more 1 km grid squares each (for both amphibians and reptiles) across the participating jurisdictions (excluding Jersey**) during the course of the current NARRS survey cycle. The NARRS survey cycle runs over a six-year period (currently 2007 – 2012 inclusive) in order to fit in with EU reporting responsibilities and UK Biodiversity Action Plan BAP assessments, but this is also a realistic time-frame over which changes might occur and thus be detected. At the end of each survey cycle, the data can be analysed and the cycle begins again with the same protocols and conditions. The results of the second and subsequent cycles may thus be

** Jersey NARRS results are analysed separately, see Wilkinson & Arnell (2010)

compared to those of earlier cycles and information on any apparent changes can be used as a basis for informed conservation actions. The current, and first, NARRS survey cycle of 2007 – 2012 will be used to record the baseline against which all future NARRS cycles will be compared. This report presents the data from NARRS surveys 2007 – 2009, establishing interim baseline data and allowing assessment of progress. NARRS data from 2010 is not included here as, to date (late 2010), not all has been received.

2. METHODS

This section contains a brief description of the NARRS methodology. For detailed survey protocols and full background information, please see www.narrs.org.uk

2.1 Widespread Amphibian Surveys

Amphibian surveyors are asked to identify the pond nearest the south-west corner of their survey square and, where necessary, obtain permission to survey it from the landowner and/or tenant. Letters of introduction are provided if required. Up to four (or more) visits are carried out using (i) visual searching, (ii) netting, (iii) night torching and (iv) -sometimes- bottle-trapping, in order to detect the amphibian species present. Bottle trapping is used by very experienced surveyors only, it is included in the protocols as validation research has demonstrated that all four methods over four survey visits result in the best chance of detecting all species present in a pond (Sewell *et al.*, 2010). Survey conditions (weather etc.), species present and habitat characteristics are recorded. For amphibian surveys, the latter take the form of the Habitat Suitability Index (HSI), developed for use with great crested newt surveys (Oldham *et al.*, 2000). The HSI is also a good indicator of the overall habitat quality of the pond and its surroundings and, as such, is a useful comparative measure for amphibian habitat in general.

2.2 Widespread Reptile Surveys

Reptile surveyors use maps or aerial photographs to identify potential reptile habitat in their survey square and obtain permission to visit promising areas as necessary. Up to three (or more) visits are carried out using (i) visual searching, (ii) checking existing refugia and (ii) checking artificial refugia (where it has been possible to lay these) in order to detect all reptile species present. The use of refugia can be particularly important in finding slow-worms and, sometimes, snakes. Survey conditions, species present and habitat characteristics are recorded. It is particularly important for reptile surveys to be conducted during appropriate conditions (e.g. of sun and temperature) to maximise detection probability. Volunteers are trained in this. A variety of habitat descriptors are recorded in

reptile surveys as no equivalent of the pond HSI is currently available for reptiles. Validation of reptile survey protocols is currently being conducted (D. Sewell, *pers.comm.*).

In the case of surveys for either taxon, if no pond or reptile habitat exists, or survey permission is refused by a landowner, alternative squares are identified by examining the square immediately to the north of the original and, if necessary, moving around that square in a clockwise direction until a suitable one is found

2.3 Metadata

Results from NARRS surveys 2007 – 2010 were checked for duplicates, which were removed, and then grouped by country or region. These data were further grouped into five NARRS Areas based on latitude: Scotland, Northern, Wales and Central, Southern, Jersey (see results). Jersey results are analysed separately because of the different composition on the herpetofauna there, though summary results are presented in this report for comparison; see also Wilkinson and Arnell (2010). Data from the remaining four NARRS Areas are presented separately and collectively in the present Research Report. This "pooling" allows data from areas where few surveys have been conducted to contribute usefully to regional assessments and comparisons. This is desirable in terms of assessing status and trends long-term as well as, potentially, for possible future assessments such as of the effects of climate change.

2.4 Species Data

Occupancy rates (of ponds for amphibians, of squares for reptiles) were calculated for each of the widespread species by NARRS Area and overall. Occupancy rates have been adjusted appropriately for those species not occurring in Northern Ireland and the Isle of Man. Positive and negative NARRS survey locations were plotted in MapInfo (GIS package) and are shown for both groups and for each species individually (Figs. 2 – 12).

Amphibian and reptile species richness by square also was calculated (see 3.3). This is a simple assessment of if and how many species are found in a square and is both repeatable and comparable over time. It is theoretically possible for species occupancy *rates* to remain temporally stable whilst species richness by square changes, thus perhaps indicating a change in habitat characteristics.

2.5 Habitat Descriptors

For amphibians, mean HSI and percentages of ponds with "good" (scoring over 0.7) HSI and "bad" (scoring under 0.3) HSI were calculated. HSI scores were also calculated excluding the "geographic location" factor which is designed specifically to account for areas in which

great crested newts are most likely to be found (see Oldham *et al.,* 2000). This provides a less-biased pond quality score. Reptile habitat was assessed by quantifying the mean and range of survey route length, on the basis that longer surveys are possible in squares with more habitat. Reptile habitat connectivity, isolation and designation status was also quantified.

2.6 Confidence in Survey Results

In addition to species and habitat measures, "confidence" in the NARRS results was assessed. A NARRS Confidence Index (NCI) is used which generates an (essentially) meaningless number that can nevertheless be used to determine a single "target" figure for each group (which would indicate high confidence in the results over the course of a NARRS survey cycle). Importantly, this allows the *cumulative progress* towards these target figures to be measured as more results are generated over the course of a survey cycle. Target figures are therefore derived from "ideal" numbers of unique survey squares and the number of visits per survey:

$$\mathbf{NCI = \log_{10} (mean\ visits\ X\ unique\ squares)}$$

The target NCI values (for areas excluding Jersey) are therefore 3.2 for amphibians and 3.1 for reptiles, based on the "ideal" numbers of visits and squares surveyed in the current NARRS cycle (equivalent targets in Jersey are currently 2.75 and 2.6 respectively).

The relationships between the numbers of species detected by each survey and the numbers of visits and methods used ("survey effort") were also examined using Spearman's rank-order correlation analyses (see Dytham, 1999).

3. RESULTS

3.1 Metadata

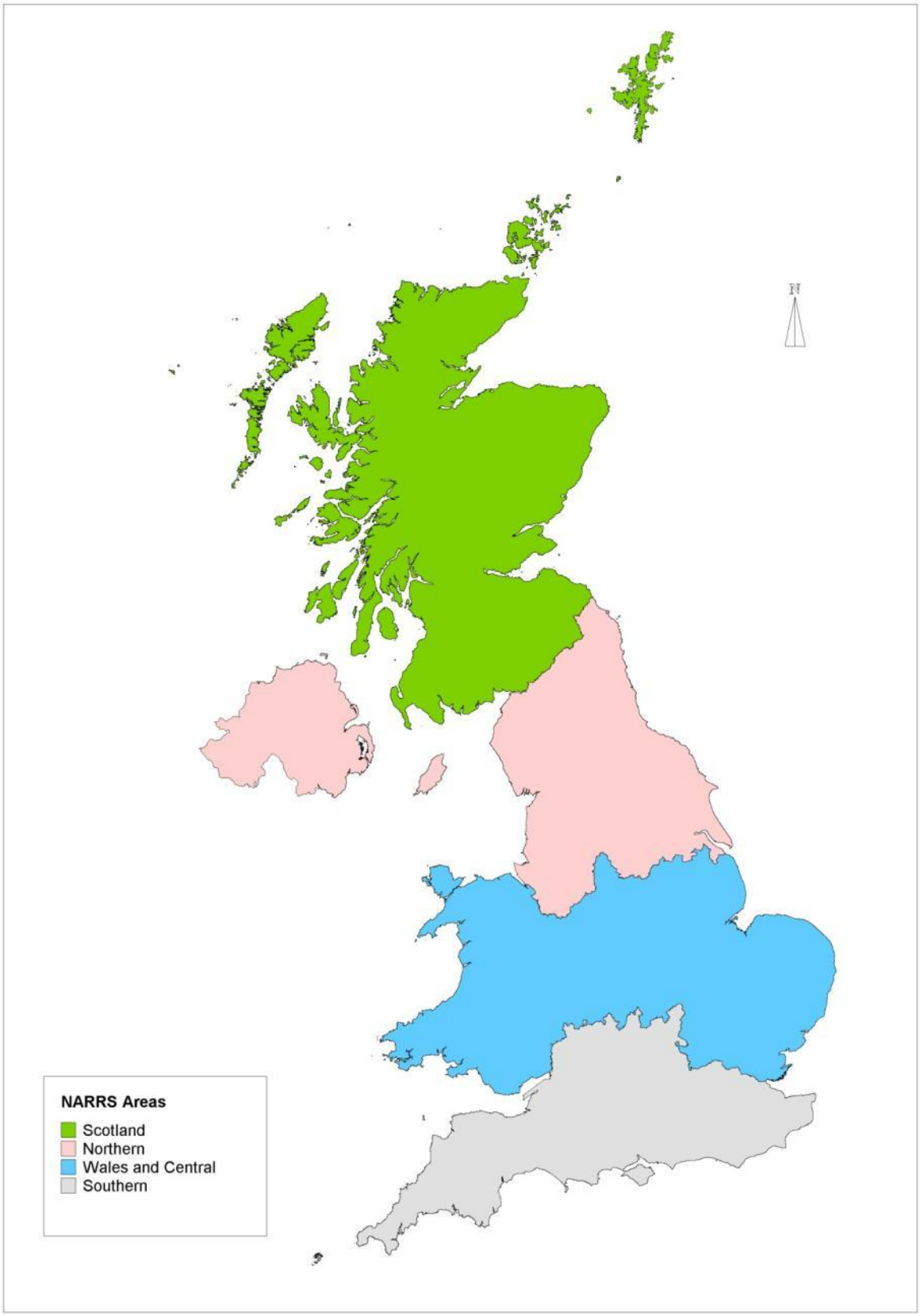
Table 1. Numbers of results received from unique NARRS survey squares 2007-2009 (results from squares surveyed in more than one year have been pooled). Regions are as Natural England Regions, see http://www.naturalengland.org.uk/regions/default.aspx

Country/Region	***Total Surveys 2007-2009***	***Amphibian Surveys 2007-2009***	***Reptile Surveys 2007-2009***
Jersey	**34**	**18**	**16**
Scotland	**126**	**70**	**56**
Northern Ireland	**4**	**2**	**2**
Isle of Man	**3**	**0**	**3**
Wales	**35**	**16**	**19**
England	**323**	**189**	**134**
East Midlands	*38*	*26*	*12*
East of England	*24*	*13*	*11*
London	*6*	*4*	*2*
North East	*13*	*11*	*2*
North West	*38*	*28*	*10*
South East	*82*	*48*	*34*
South West	*82*	*34*	*48*
West Midlands	*21*	*13*	*8*
Yorkshire and Humber	*19*	*12*	*7*
TOTAL (all areas)	**524**	**294**	**230**

Table 2. Numbers of unique NARRS survey squares 2007-2009 grouped by NARRS Area.

NARRS Area	***Total Surveys 2007-2009***	***Amphibian Surveys 2007-2009***	***Reptile Surveys 2007-2009***
Scotland	126	70	56
Northern (NI, IoM, NW, NE, Y&H)	77	53	24
Wales and Central (Wal, WM, EM, EoE)	118	68	50
Southern (SW, SE, Lon)	170	86	84
Jersey	34	18	16
TOTAL (all areas)	**524**	**294**	**230**

Figure 1. The areas by which regional NARRS results were pooled for analyses ("NARRS Areas"). (Jersey not shown.)



3.2 Species Occupancy Rates

Table 3. Pond occupancy rates for amphibians by NARRS Area.

NARRS Area	**Species (% occupancy)**							
	Rana temporaria	***Bufo bufo***	***Triturus cristatus***	***Lissotriton vulgaris***	***Lissotriton helveticus***	***Rana dalmatina***	**Other**	**Overall amphibian occupancy (all spp.)**
Scotland	73%	34%	0%	3%	47%	N/A	1%*	**86%**
Northern (NI, IoM, NW, NE, Y&H)	66%	49%	12%	32%	31%	N/A	0%	**86%**
Wales and Central (Wal, WM, EM, EoE)	60%	35%	16%	39%	18%	N/A	0%	**85%**
Southern (SW, SE, Lon)	44%	22%	21%	31%	26%	N/A	0%	**72%**
Overall (above areas combined)	**60%**	**33%**	**13%**	**26%**	**30%**	N/A**	**<1%**	**81%**
Jersey	N/A	56%	N/A	N/A	44%	11%	0%	**67%**

* Alpine newts
** Native only in Jersey

Figure 2. Locations of NARRS amphibian survey squares 2007 – 2009.

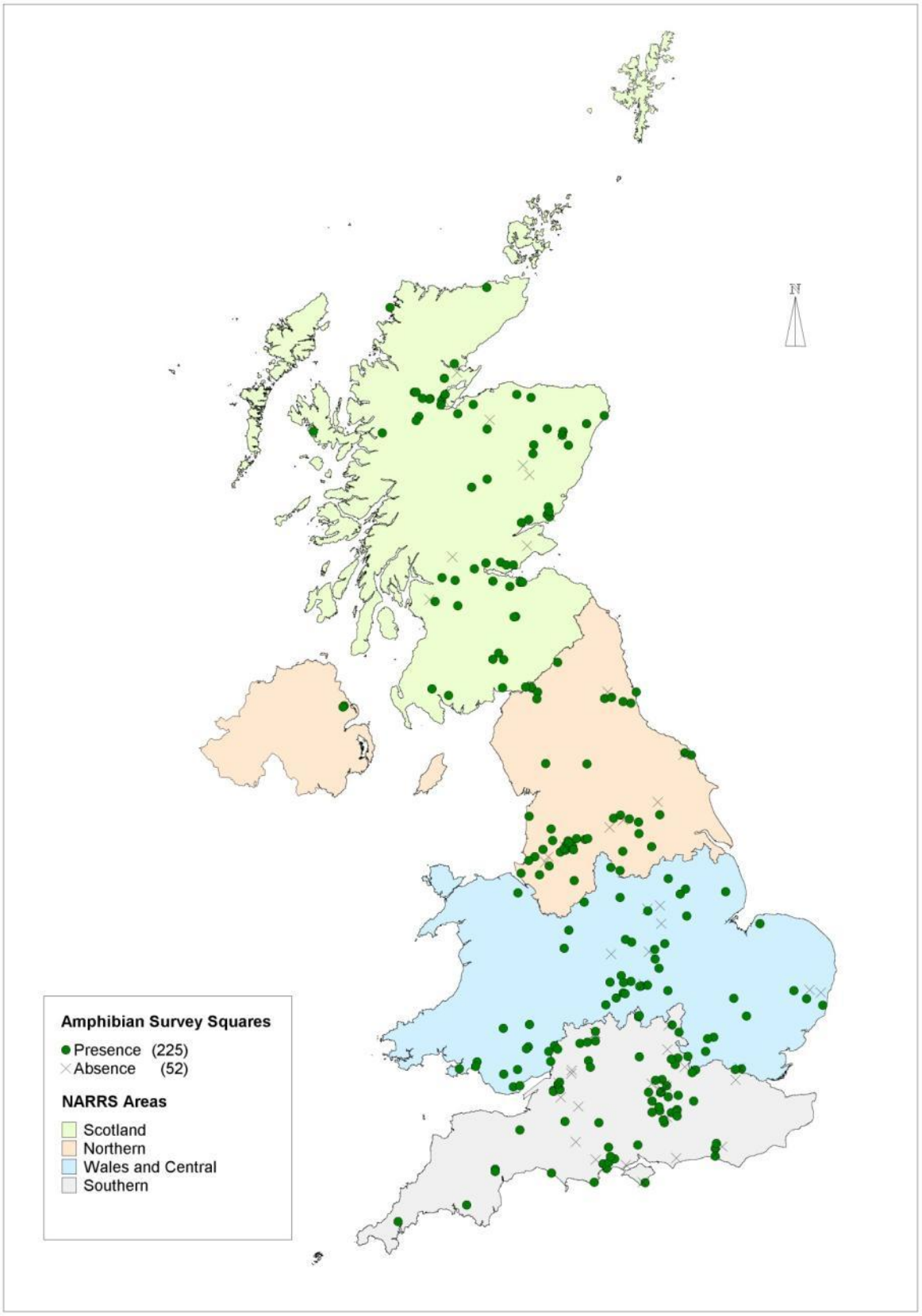


Figure 3. NARRS squares 2007 – 2009 with *Rana temporaria* present.

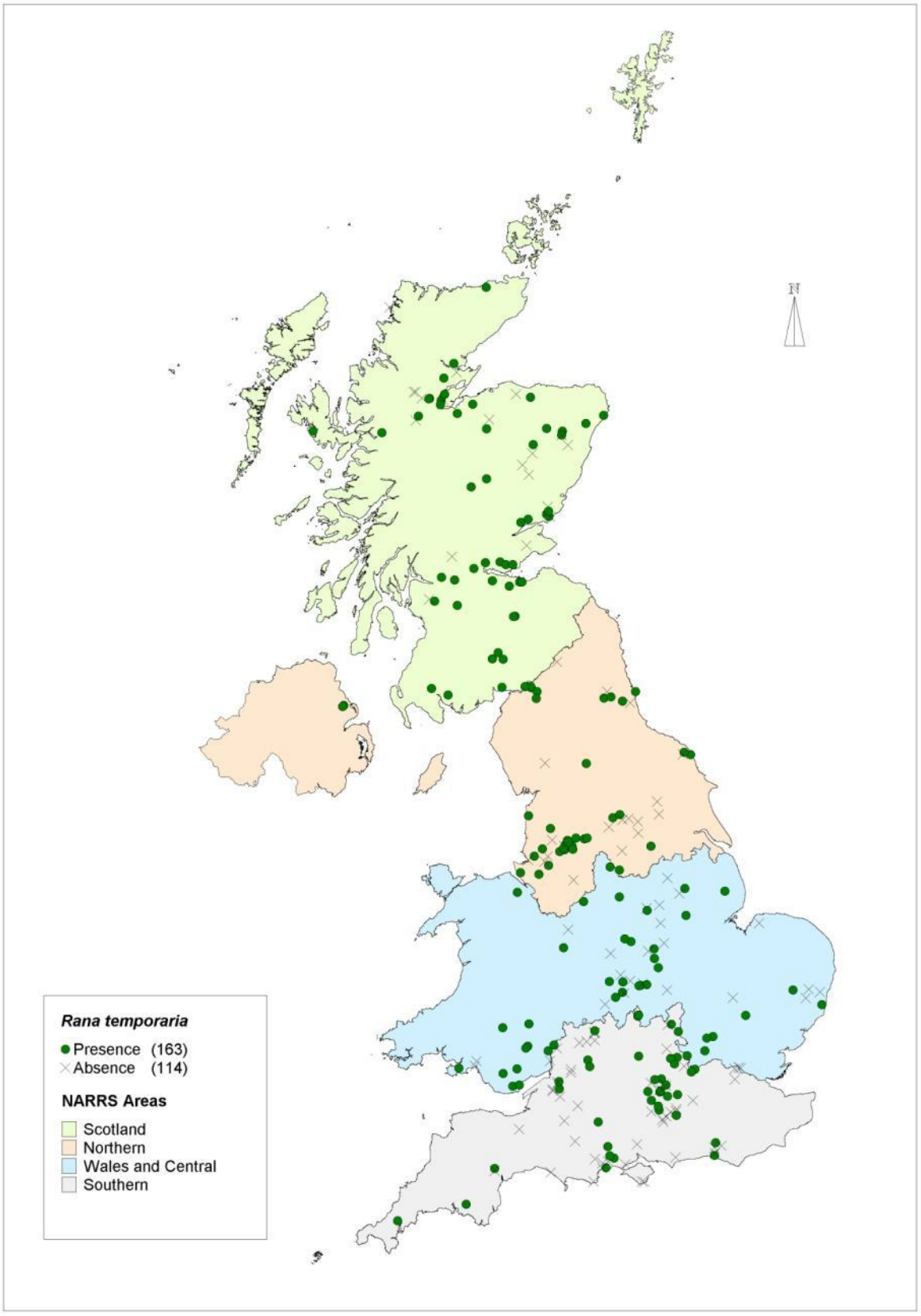


Figure 4. NARRS squares 2007 – 2009 with *Bufo bufo* present.

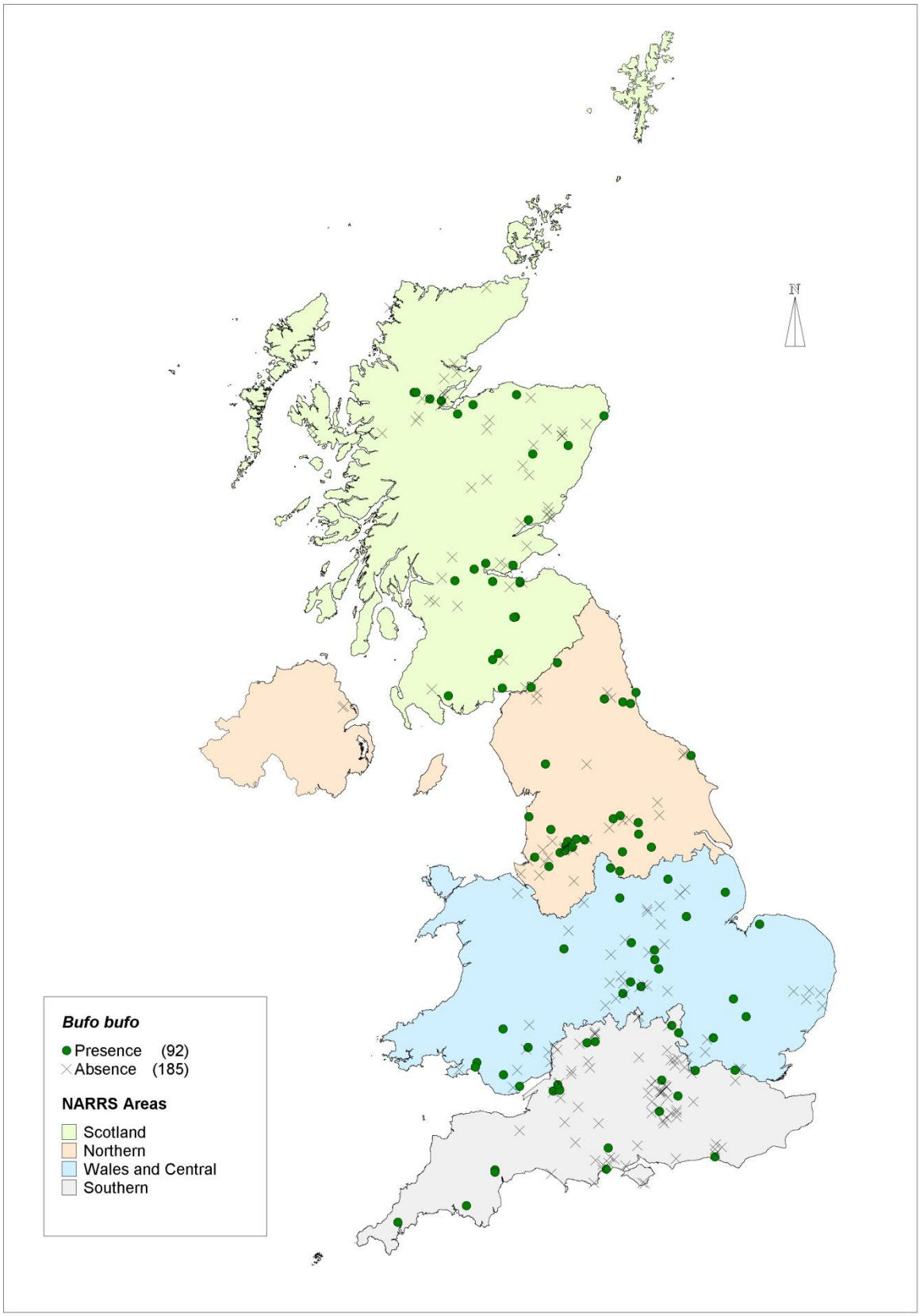


Figure 5. NARRS squares 2007 – 2009 with *Triturus cristatus* present.

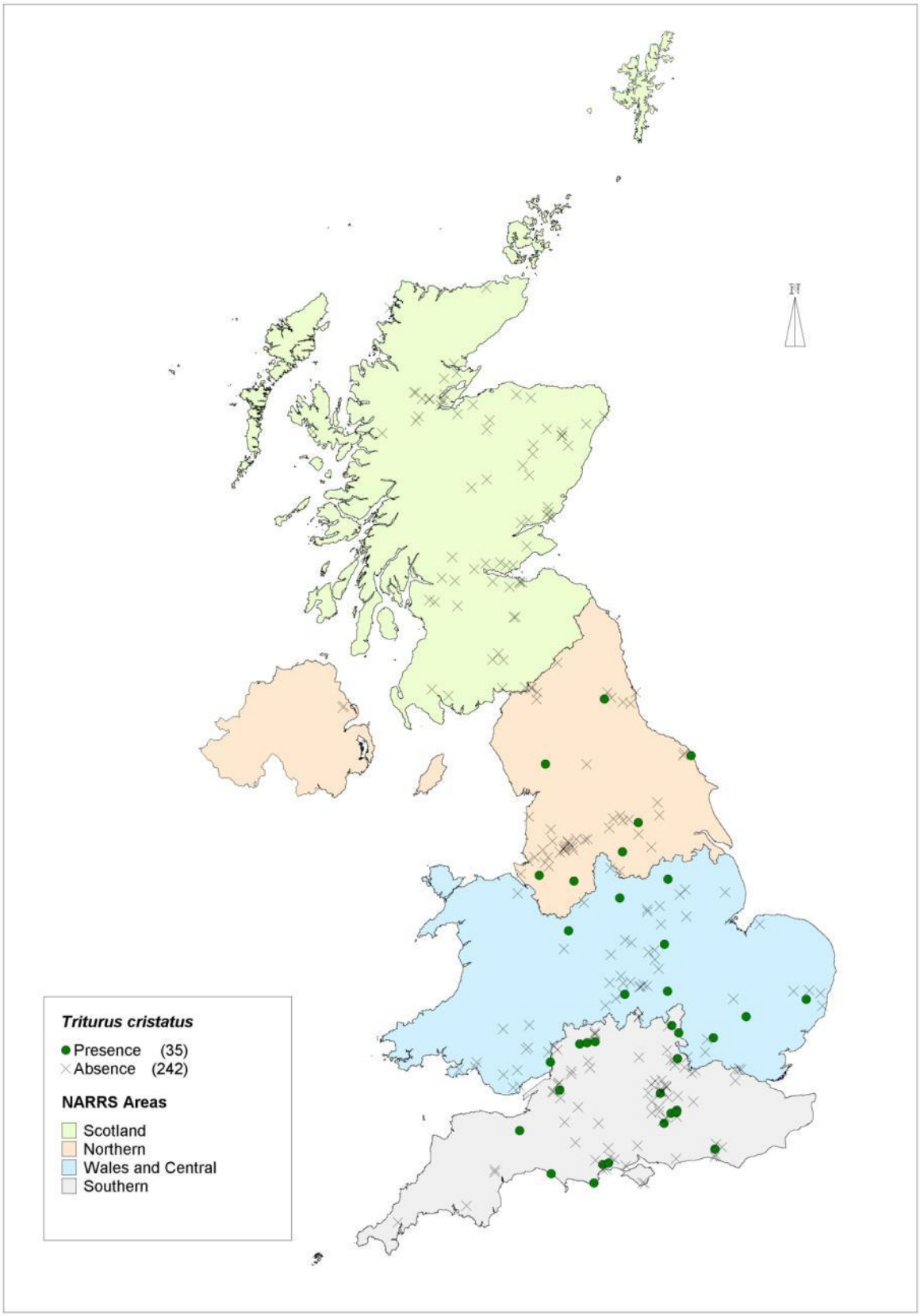


Figure 6. NARRS squares 2007 – 2009 with *Lissotriton vulgaris* present.

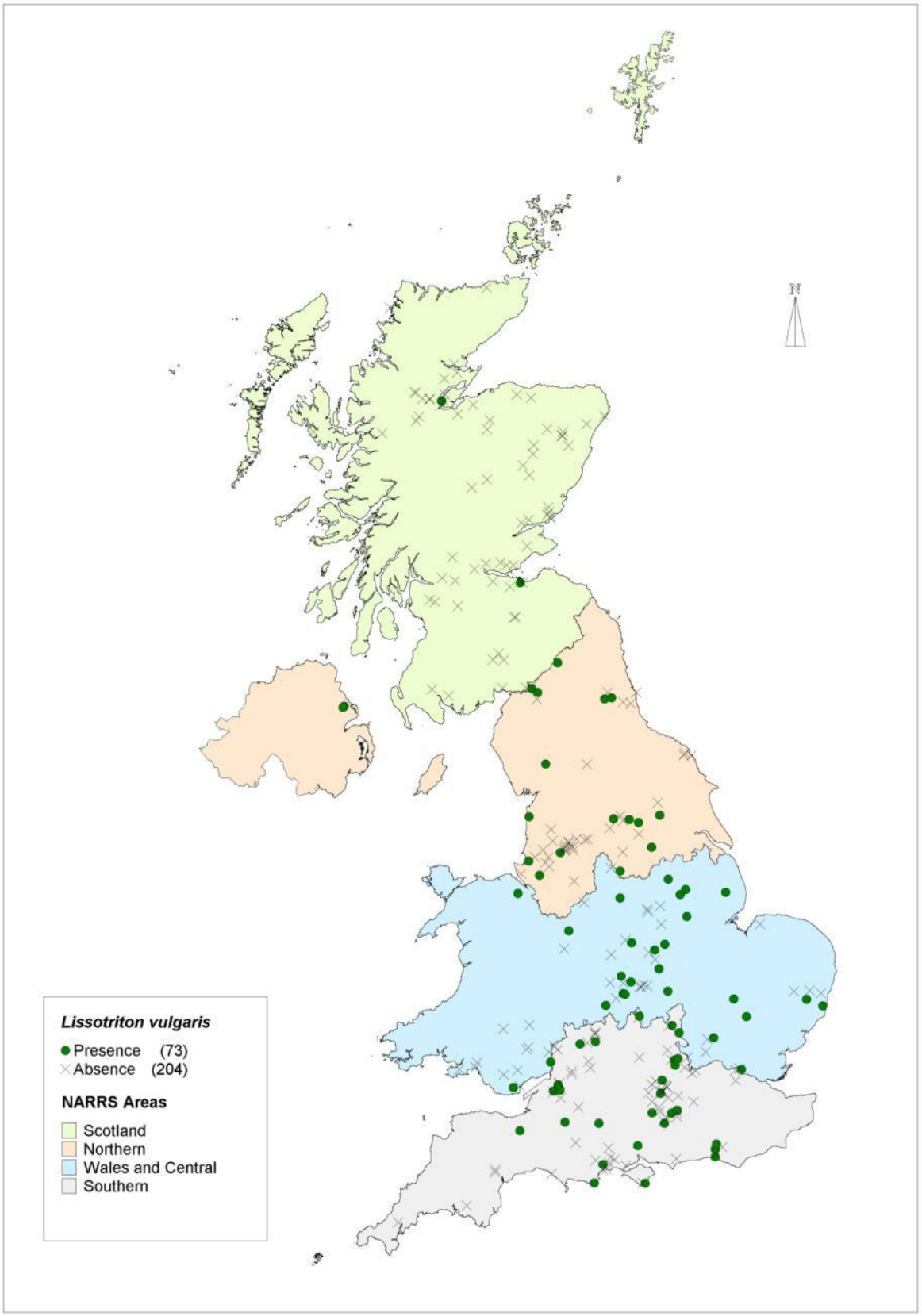


Figure 7. NARRS squares 2007 – 2009 with *Lissotriton helveticus* present.

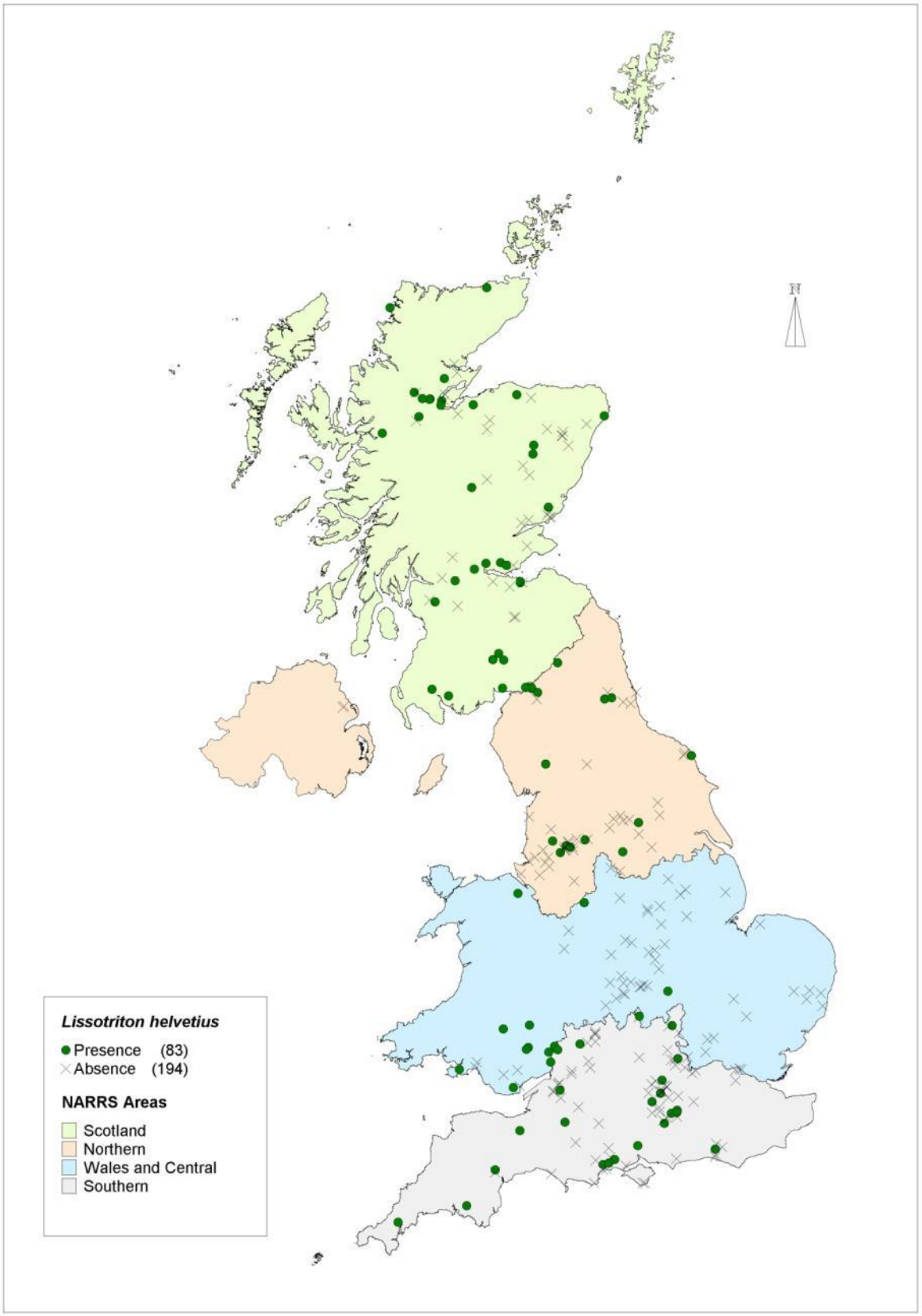


Table 4. Square occupancy rates for reptiles by NARRS Area.

NARRS Area	**Species (% occupancy)**							
	Zootoca vivipara	***Anguis fragilis***	***Natrix natrix***	***Vipera berus***	***Podarcis muralis***	***Lacerta bilineata***	**Other**	**Overall reptile occupancy (all spp.)**
Scotland	55%	21%	0%	5%	N/A	N/A	0%	**57%**
Northern (NI, IoM, NW, NE, Y&H)	17%	14%	23%	5%	N/A	N/A	0%	**42%**
Wales and Central (Wal, WM, EM, EoE)	22%	10%	16%	12%	N/A	N/A	0%	**38%**
Southern (SW, SE, Lon)	27%	32%	33%	6%	N/A	N/A	10%**	**61%**
Overall (above areas combined)	**32%**	**22%**	**19%**	**7%**	**N/A***	**N/A***	**4%****	**52%**
Jersey	N/A	0%	6%	N/A	13%	62%	0%	**69%**

* Native only in Jersey
** Includes rare and non-native spp. detected in Southern England

Figure 8. Locations of NARRS reptile survey squares 2007 – 2009.

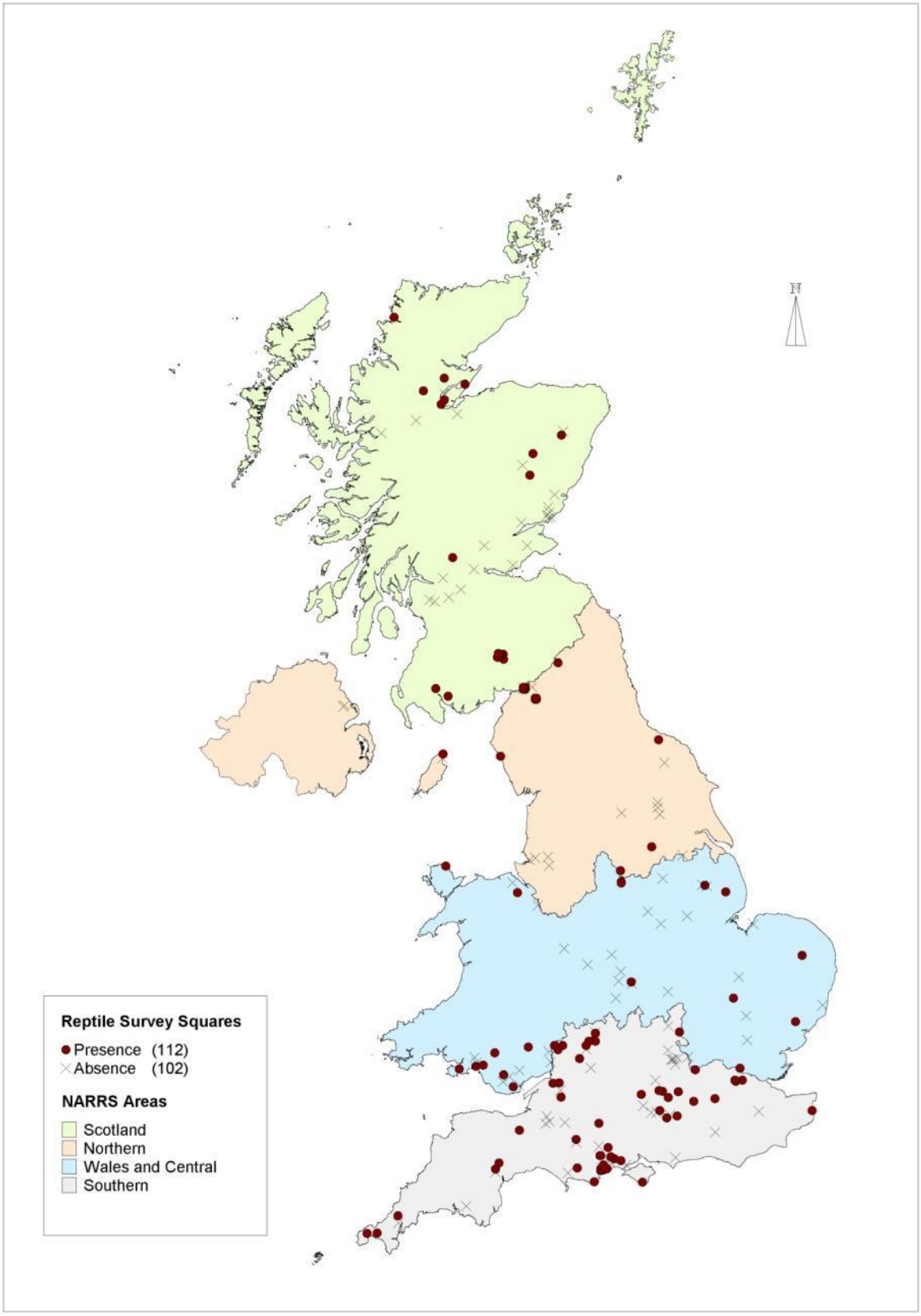


Figure 9. NARRS squares 2007 – 2009 with *Zootoca vivipara* present.

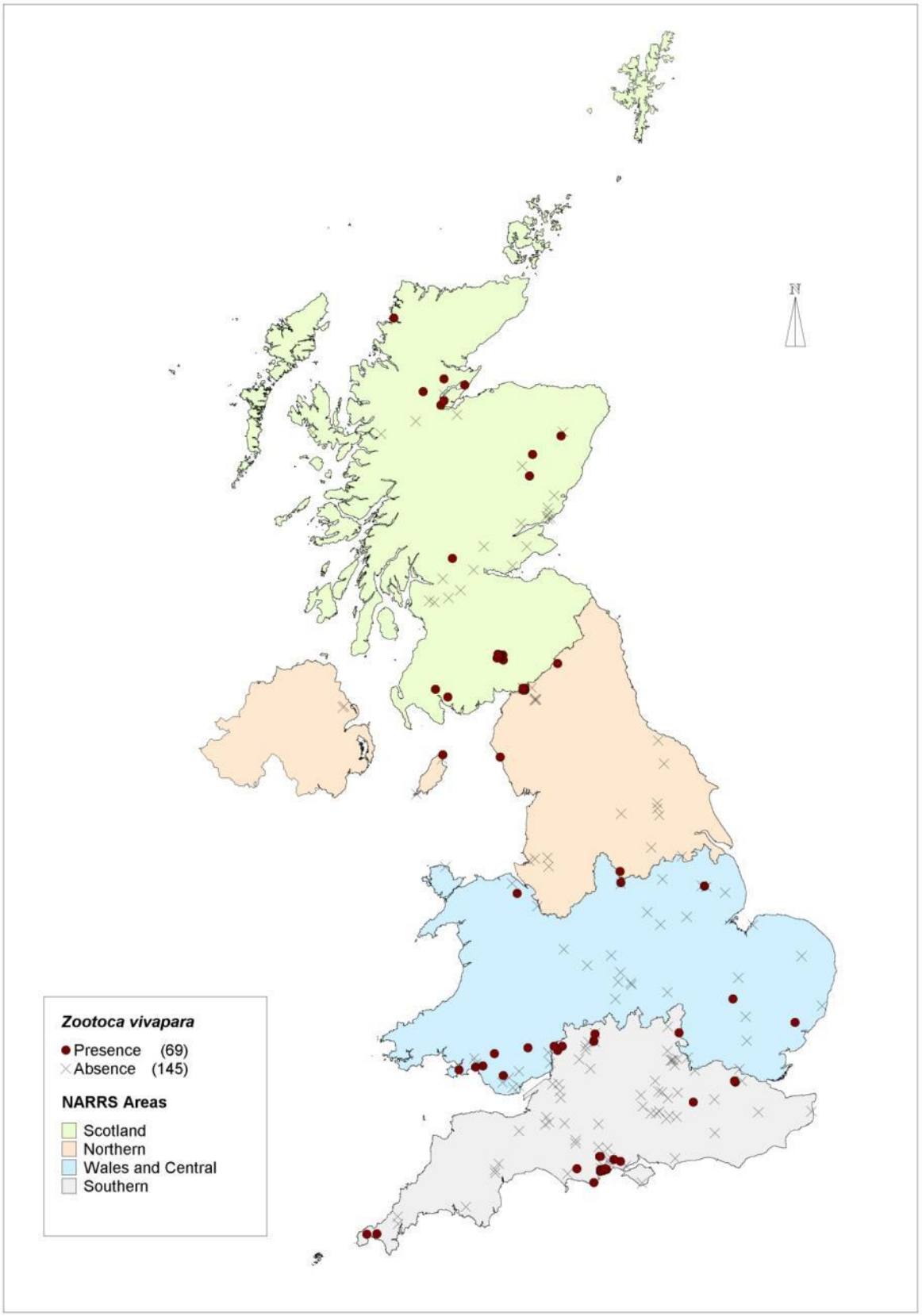


Figure 10. NARRS squares 2007 – 2009 with *Anguis fragilis* present.

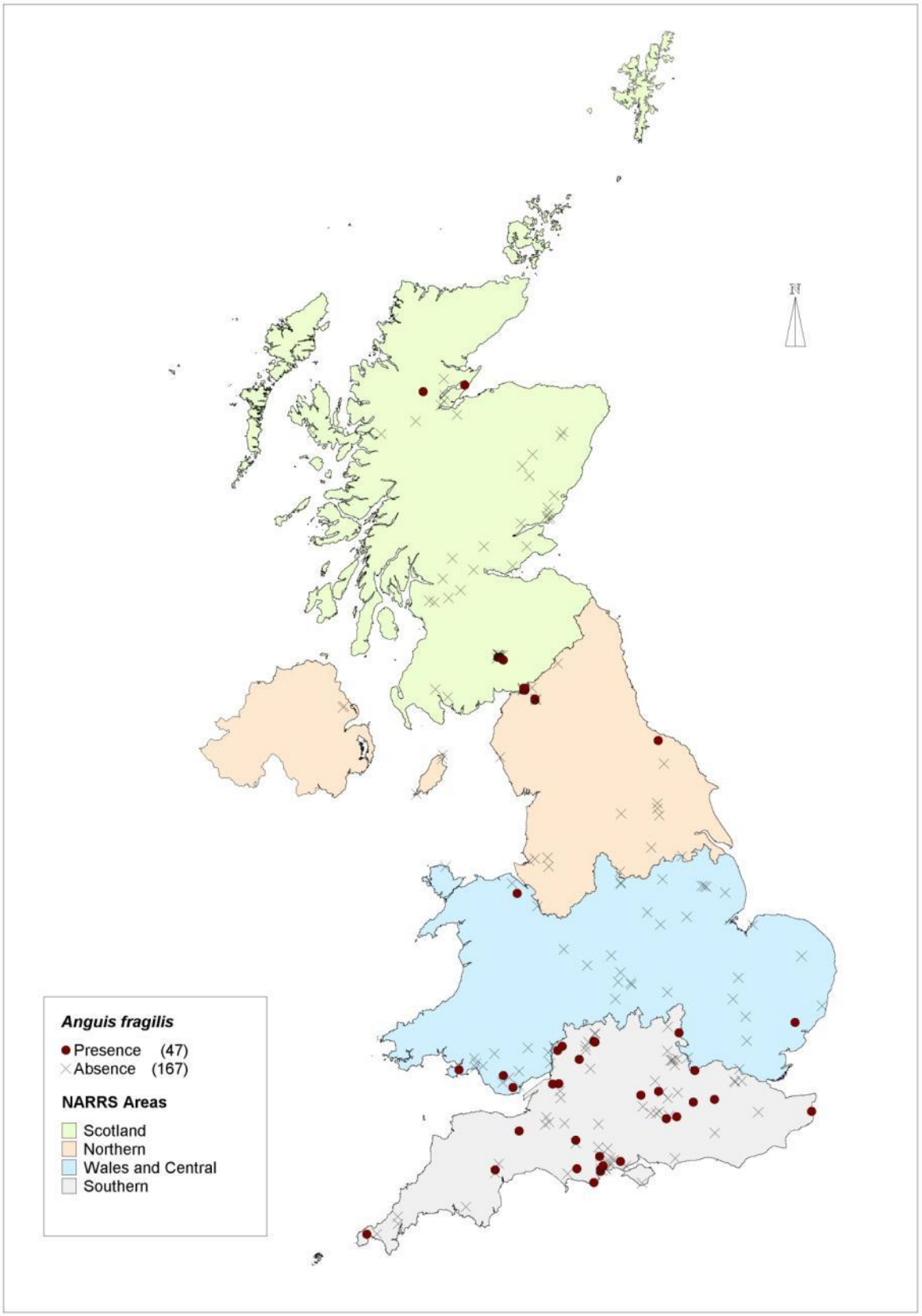


Figure 11. NARRS squares 2007 – 2009 with *Natrix natrix* present.

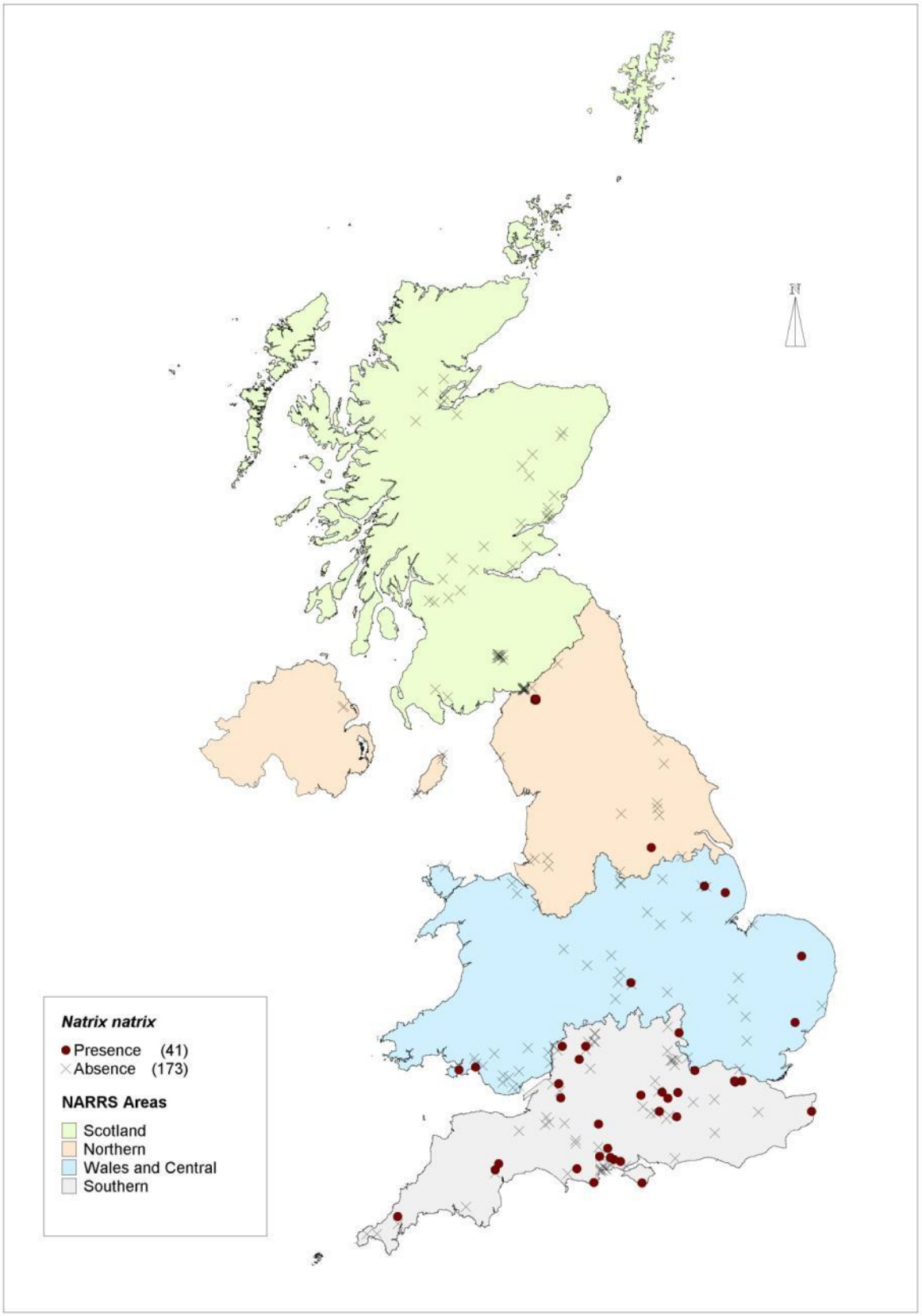
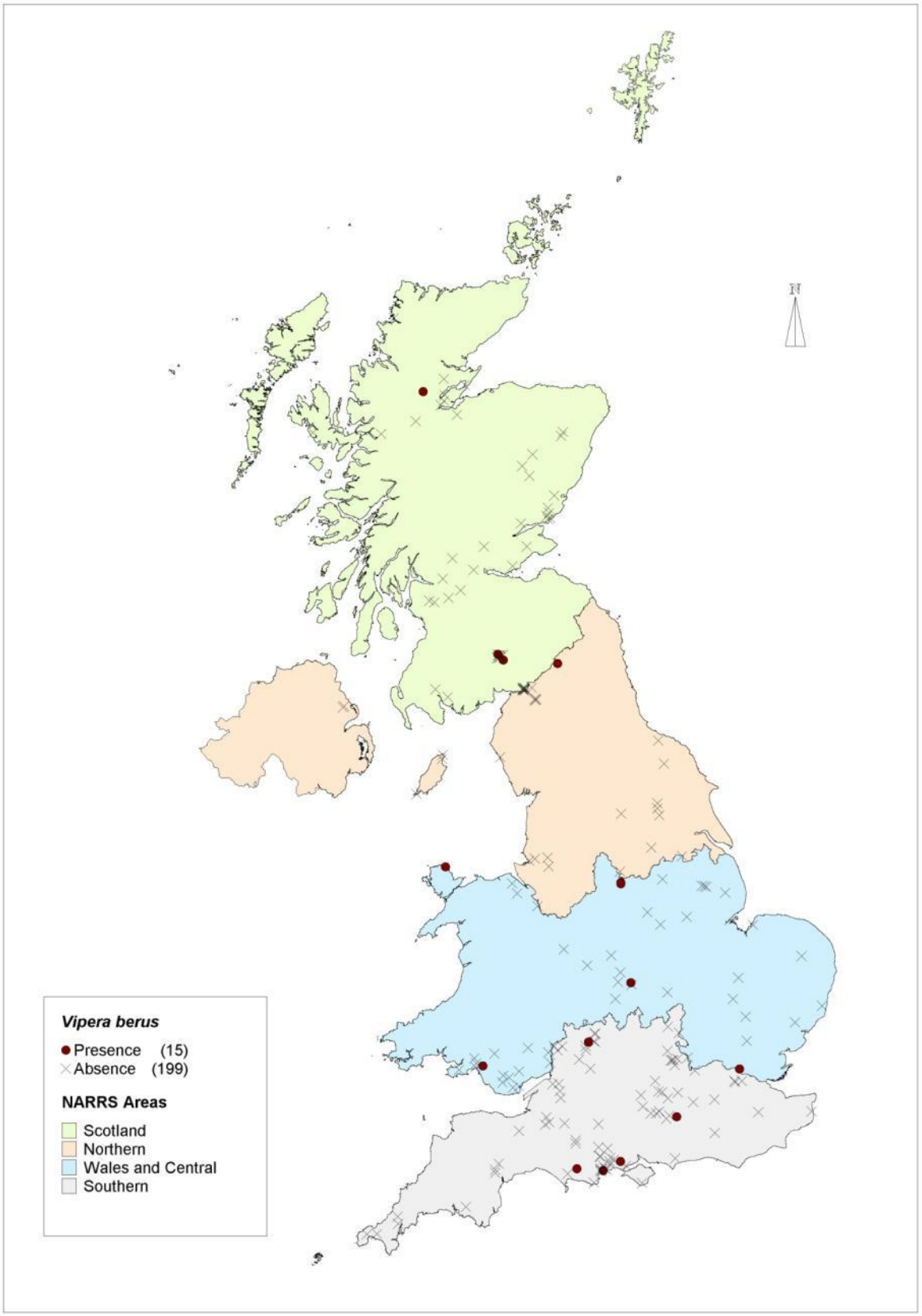


Figure 12. NARRS squares 2007 – 2009 with *Vipera berus* present.



3.3 Species Richness

Figure 13. Amphibian species richness. Percentages of NARRS survey squares 2007 – 2009 with 0 – 5 amphibian species present.

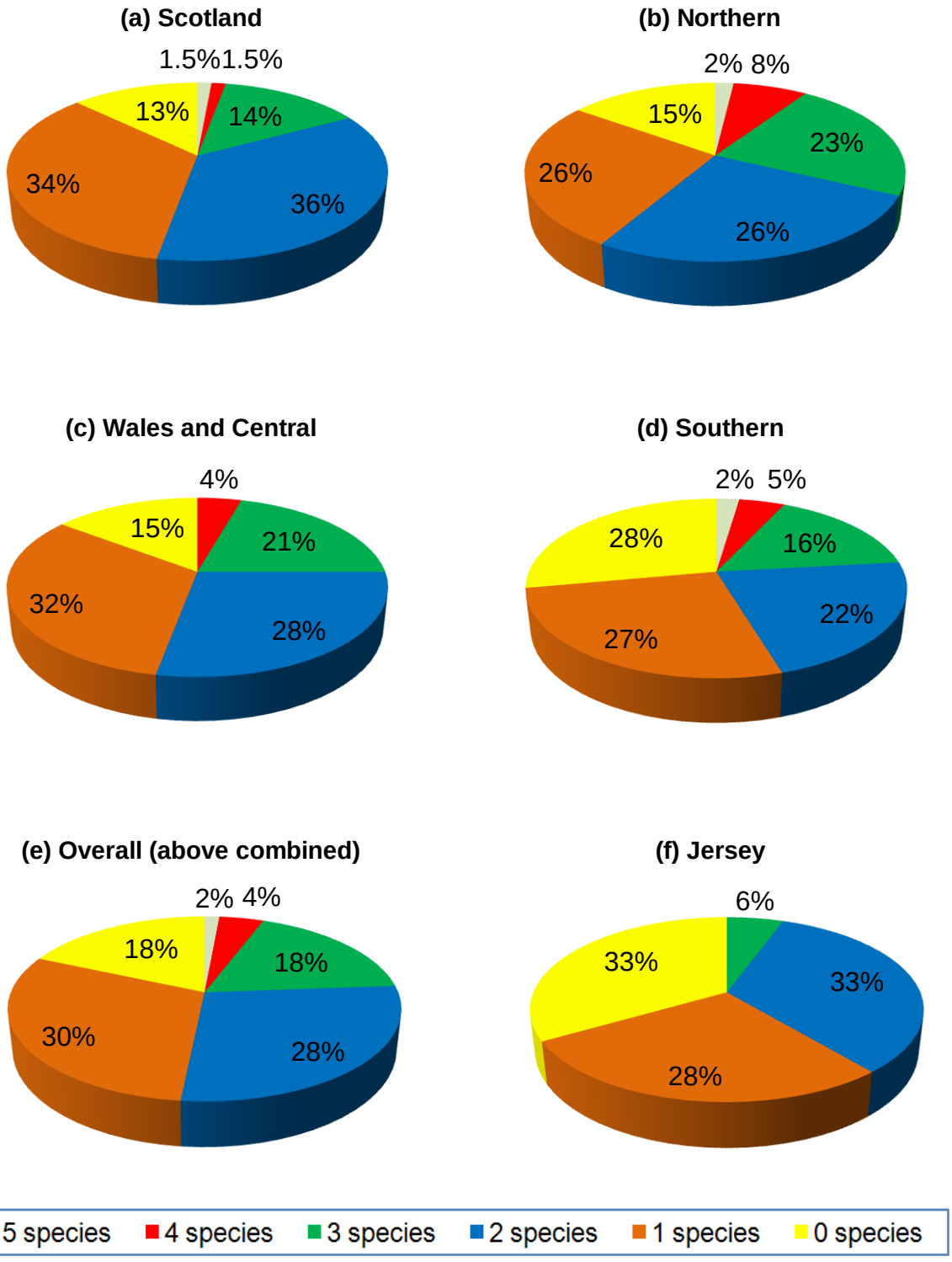
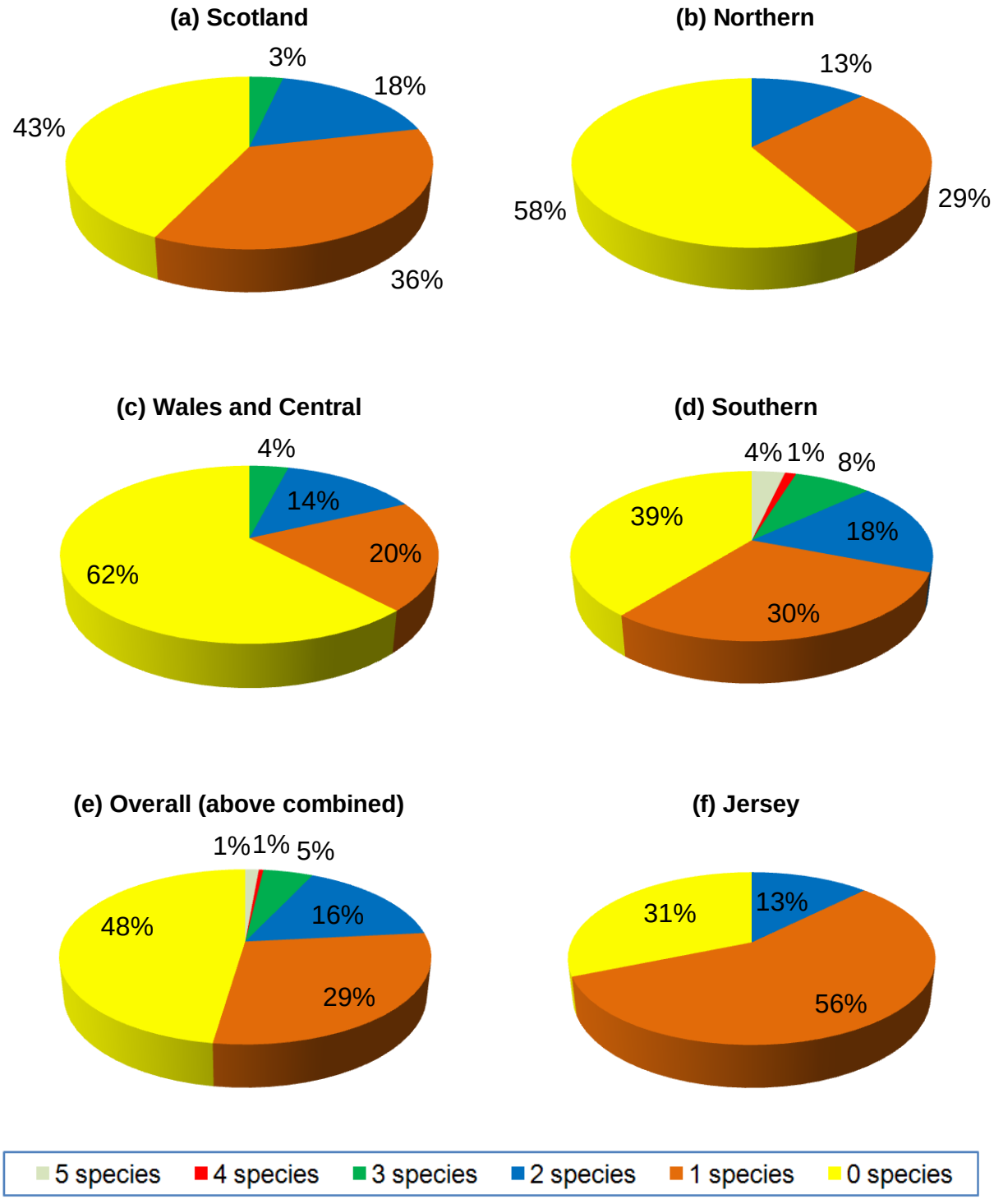


Figure 14. Reptile species richness. Percentages of NARRS survey squares 2007 – 2009 with 0 – 5 reptile species present.



3.4 Habitat Descriptors

Table 5. Descriptors of amphibian habitat (HSI).

NARRS Area	**Mean HSI (Mean HSI without location)**	**Ponds with HSI >0.7 (HSI >0.7 without location)**	**Ponds with HSI <0.3 (HSI <0.3 without location)**
Scotland	0.47 (0.52)	9.84% (18.33%)	19.67% (16.67%)
Northern (NI, IoM, NW, NE, Y&H)	0.55 (0.56)	16.67% (17.78%)	8.33% (4.44%)
Wales and Central (Wal, WM, EM, EoE)	0.54 (0.51)	20.63% (15.87%)	7.94% (9.52%)
Southern (SW, SE, Lon)	0.49 (0.47)	16.25% (15.58%)	16.25% (22.08%)
Overall (above areas combined)	**0.51 (0.51)**	**15.87% (16.73%)**	**13.49% (14.29%)**
Jersey	(0.52)	(5.88%)	(5.88%)

Table 6. Descriptors of reptile habitat.

NARRS Area	Mean length of survey route (range)	Surveys in which reptile habitat was part of larger area of good habitat	Surveys in which reptile habitat was isolated*	Surveys within protected/ designated areas
Scotland	0.28 km (0.1 – 4.8 km)	23.21%	50.00%	10.71%
Northern (NI, IoM, NW, NE, Y&H)	0.98 km (0.2 – 3.0 km)	20.83%	54.17%	5.26%
Wales and Central (Wal, WM, EM, EoE)	1.41 km (0.35 – 5.0 km)	28.00%	46.00%	28.00%
Southern (SW, SE, Lon)	2.94 km (0.3 – 10.0 km)	19.05%	42.86%	26.19%
Overall (above areas combined)	1.74 km (0.1 – 10 km)	**22.43%**	**46.73%**	**20.09%**
Jersey	2.92 km (0.9 – 5 km)	21.43%	50.00%	25.00%

* completely isolated or isolated by sub-optimal habitat

3.5 Confidence in Survey Results

Table 7. Confidence in amphibian survey results.

NARRS Area	Mean number of methods per survey	Mean number of visits per survey	Number of unique survey squares	NARRS Confidence Index
Scotland	2.16	2.13	70	
Northern (NI, IoM, NW, NE, Y&H)	2.19	2.3	53	
Wales and Central (Wal, WM, EM, EoE)	2.15	2.29	68	
Southern (SW, SE, Lon)	2.68	2.55	86	
Overall (above areas combined)	**2.31**	**2.33**	**277**	**2.81**
Jersey	2.22	3.8	18	**1.81**

Table 8. Confidence in reptile survey results.

NARRS Area	Mean number of methods per survey	Mean number of visits per survey	Number of unique survey squares	NARRS Confidence Index
Scotland	2.2	2.19	56	
Northern (NI, IoM, NW, NE, Y&H)	1.99	2.6	24	
Wales and Central (Wal, WM, EM, EoE)	2.3	2.44	50	
Southern (SW, SE, Lon)	2.29	2.8	84	
Overall (above areas combined)	**2.28**	**2.53**	**214**	**2.73**
Jersey	1.78	2.61	16	**1.62**

Table 9. Relationships between survey effort and number of species detected.

	Number of visits per survey	Number of methods per survey
Number of amphibian species detected	$r_s = 0.26$*	$r_s = 0.20$*
Number of reptile species detected	$r_s = 0.15$*	$r_s = 0.12$*

* All weak positive correlations

4. DISCUSSION

The data presented here represent mid-point figures in the 2007 – 2012 NARRS survey cycle, the aim of which is to generate the first repeatable baseline data. As such, there is little opportunity to assess changes in status at this point, though comparisons between NARRS Areas can be made.

4.1 Metadata

The response to the NARRS Widespread Species Surveys has been tremendous, with a total of 524 surveys being carried out across participating regions in 2007 – 2009 (Table 1). Despite this, regional response has been variable (Tables 1 and 2; see also Figs. 2 and 8 for spatial overview). Figs. 2 and 8 clearly display survey gaps which can and should be targeted for future NARRS training events and from which more NARRS records would ensure a better geographic spread of data contributing to baselines for the widespread species. Of the NARRS Areas (excluding Jersey), Table 2 shows that more data from the Northern Area would be particularly beneficial. Absolute total numbers of surveys (Tables 1 and 2), however, currently suggest that the target numbers of surveys required to produce sufficiently robust overall baselines (400 survey squares each for both amphibians and reptiles) will be met by 2012, though see also Section 4.5, below.

4.2 Species Occupancy Rates

Amphibian occupancy rates can be compared to earlier work by Swan and Oldham (1993). Overall occupancy is remarkably similar for most species (Table 10, below), though consistently slightly higher in the NARRS surveys. This is likely to be indicative of a reluctance to submit negative survey results (J.W.W. *pers. obs.*) rather than a general improvement in the fortunes of British amphibians in the last 20 years! This is discussed further below (4.5).

Markedly different occupancy rates are seen for *L. helveticus*, however, and it is possible that the healthy number of NARRS results received from Scotland and the South, where the species tends to be more common than in Central areas (see e.g. Arnold, 1995) has somewhat biased the results. Another possibility is that the general decline in pond quality which we appear to be experiencing (discussed in the latest Countryside Survey results; see Williams *et al.*, 2010) has favoured this species. *L. helveticus* is more tolerant of the acidic conditions associated with agricultural and other pollution than is *L. vulgaris* (Griffiths, 1996). The greatest numbers of low-quality ponds in this study, as measured by HSI score, are indeed found in Scotland and the South (Table 5).

Area differences are also visible for several other amphibians. Though *R. temporaria* shows lower occupancy in the relatively more urban Southern NARRS Area (Table 3), the species often does well in urban garden ponds - which are not usually included in NARRS surveys. *B. bufo* also has lowest occupancy in the Southern Area though, in contrast to the former species, toads do not usually fare well in garden ponds (e.g. Beebee, 2007) and declines of this species in southern and lowland England have been well-documented (see Carrier and Beebee, 2003). It appears that the current NARRS occupancy data reflect this information, though whether these declines are ongoing may not be revealed until the next NARRS cycle. In any case, they remain largely unexplained. It is heartening, however, that the occupancy rate for *B. bufo* in Jersey is relatively high, as the species has also undergone noticeable declines there (e.g. Wilkinson *et al.,* 2007). Jersey surveys, however, do include garden ponds as many ponds in the wider countryside there do not support amphibians. It is also interesting to note that *B. bufo* in Jersey appear to have adapted to breeding in garden ponds on the Island in a way that they have so far failed to do on the British mainland (see also Wilkinson and Arnell, 2010).

Figures for *T. cristatus* by area (Table 3) reflect the increasing scarcity of this species as one travels north. The absence of the species in Scottish NARRS surveys reflects its relative rarity there, rather than its absence. Other current work (Wilkinson *et al., in prep.,* A and B) aims to target surveys and describe the status of this still widespread but sensitive and protected species in GB. Wilkinson *et al.,* (*in prep,* A) suggest that only 0.54% of habitats by area in Scotland are suitable for this species, as opposed to >11% in South East England. It is hoped that NARRS survey data will contribute to assessments of status and target setting for this species in the long-term.

Table 10. Comparisons of pond occupancy rates.

Species	***Rana temporaria***	***Bufo bufo***	***Triturus cristatus***	***Lissotriton vulgaris***	***Lissotriton helveticus***
Pond occupancy (%) Swan & Oldham (1993)	52	30	11	22	11
Pond occupancy (%) NARRS 2007 - 2009	**60**	**33**	**13**	**26**	**30**

Unfortunately, there is no equivalent of Swan and Oldham (1993) that allows for direct comparison of occupancy rates for reptiles. Hilton-Brown and Oldham (1991), however, do describe the relative abundance of the widespread reptiles by region that can

be used for comparison. In that study, *Z. vivipara, A. fragilis* and *V. berus* were common in South West England. *N. natrix* was common in Central Southern England and *Z. vivipara* was also common in East Anglia and Northern Scotland. The latter species was widespread throughout GB but *N. natrix* was widespread only in the southern half of GB. *A. fragilis* and *V. berus* were widespread in the South and West, and the latter was also widespread in North East England and parts of Scotland. Though elements of this pattern are visible in the present NARRS results (Table 4; Figs. 9 – 12), some differences are apparent that may yet prove to reflect genuine changes in status. *Z. vivipara* apparently remains widespread throughout GB but is has highest occupancy by far in Scotland. *A. fragilis* and *N. natrix* have highest occupancy rates in the Southern Area but both show lowest occupancy in the Wales and Central Area, from where they were apparently more widespread in Hilton-Brown and Oldham's (1991) study (N.B. *N. natrix* is virtually absent from Scotland).

Remarkably, *V. berus* has its highest occupancy in the Wales and Central Area and shows very low occupancy in Scotland, Northern and Southern Areas whereas Hilton-Brown and Oldham (1991) showed that it was once common in the South, particularly in the South West. In general, however, it is the overall occupancy rate for *V. berus* that gives most cause for concern in the present NARRS reptile survey results (Table 4). The worryingly-low occupancy rate of 7% overall for this species makes this our rarest widespread reptile by far and, though the species certainly remains locally abundant at some sites, these NARRS results may be the first real evidence for the declines in *V. berus* populations that have long been suspected (e.g. Inns, 2009). Historically, the reasons for this apparent decline may have been due largely to persecution, whereas habitat isolation and loss are likely to be more significant today. These results must be interpreted with caution, however, as the local nature of distribution patterns in this species may simply mean that it is not present in some NARRS surveys purely by chance.

Results for *P. muralis*, *L. bilineata* and other Jersey species are discussed by Wilkinson and Arnell (2010). Of note, however, is the rarity of *N. natrix* on the Island, suggesting the species is in urgent need of study and conservation measures there.

4.3 Species Richness

Species richness results are presented here mainly to establish an interim baseline, to allow comparison with a full baseline in 2012 and to help assess any potential changes apparent in future NARRS survey cycles. What is noticeable, however, is that amphibians are absent from NARRS surveys a great deal less than are reptiles (18% as compared with 48%). This may be due to the relative ease of detection of amphibians, which breed in discrete populations (ponds), or it may be that these results simply reflect how our climate provides better for the less insolation-dependent amphibians than it does for reptiles. The Southern

Area, unsurprisingly, is the most species-rich area of them all. Interestingly, in Jersey, where it is warmer and sunnier than mainland GB, reptiles occur in slightly more surveys than do amphibians (Tables 3 and 4; Figs. 13f and 14f). The Wales and Central Area has the lowest species richness for amphibians, whereas the Northern Area has the lowest species richness for reptiles. This perhaps reflects a general indication in the results of the present report that our herpetofauna is faring less well in Central and Northern regions as compared to elsewhere (see especially Tables 3 and 4, Figs. 2 – 12, and below).

4.4 Habitat Descriptors

The HSI is a convenient method of assessing pond habitat quality for NARRS surveys. For a full description of the methods used to generate HSI scores see Oldham *et al.* (2000), noting that one of the factors employed assigns a higher score to ponds in locations more suitable for great crested newts. In the present study (Table 5), mean HSI scores are very similar overall being mid-range for each NARRS Area. The highest proportion of high HSI scores unbiased by location (Table 5, shown in brackets) is found in Scotland (they would show as the lowest proportion of high-scoring ponds if the bias was left in), though Scotland also has a high proportion of low-scoring ponds. The lowest proportion of low-scoring ponds is found in the Northern Area and the highest in the Southern Area. These results are perhaps reflected in the fact that Northern Area also has some of the highest amphibian species richness by percentage of surveys in this study (see above and Fig. 13). However, amphibian species richness is also high in the Southern Area! The Wales and Central Area also has a low proportion of low-scoring ponds, perhaps indicating that the low species richness apparent in that area (Fig. 13) is as a result of other factors (perhaps reduced connectivity due to development) rather than pond quality *per* se. It should be noted, however, that more HSI score data are required from future NARRS and other surveys in order to fully examine regional differences in pond habitat quality and that the generation of HSI scores should be included in all amphibian surveys, and sent to ARC for analysis if possible.

Assessment of reptile habitat quality is more difficult than for amphibians, as there is currently no agreed method of achieving this. A reptile HSI is being developed (L. Brady *pers. comm.*) and may replace the various measures recorded in NARRS surveys in due course, if its utility can be proven. In the present study, reptile survey routes were longest on average in the Southern Area, which also had the lowest proportion of surveys where the reptile habitat was isolated. Most surveys in isolated habitat were carried out in the Northern Area (Table 6), which also had the lowest number of surveys by far in protected or designated areas. Interestingly, surveys in which reptile habitat were part of a larger area of good habitat were highest in the Wales and Central Area, which had some of the lowest

species occupancy rates, though the fact that this area had the highest occupancy rate for *V. berus* in this study may be related to this factor (Table 4).

It is anticipated that assessments of habitat quality for both amphibians and reptiles will generate data that can be used in BAP and protected species status assessments as these data accumulate. In any case, measures of pond quality and habitat connectivity should prove to be useful comparative measures over time.

4.5 Confidence in Survey Results

NCI target figures for combined NARRS Areas excluding Jersey are 3.2 and 3.1 for amphibians and reptiles respectively. No NCI targets for NARRS Areas or regions have been established. For a discussion of progress towards NARRS targets in Jersey, see Wilkinson and Arnell (2010).

The current NCI figure of 2.81 for amphibians represents good progress towards the target for 2012 at the end of the current NARRS cycle. Additionally, more than half the required number of squares has been surveyed, half-way through the cycle, and the mean number of visits per survey is good for each Area (2.33 on average out of a suggested 3). The mean number of methods used per survey (2.31 on average out of a possible 4) is lower than would be ideal but this is largely due to the fact that many NARRS surveyors are not trained, licensed or confident to use bottle-trapping as one of their methods. It is unlikely that this situation will change as many surveyors see the possible risk to newts and other aquatic organisms as unacceptably high when using this method (especially without substantial experience).

Mean numbers of methods and visits per reptile survey (2.28 and 2.53 respectively out of a possible 3 in each case) are also good, and the total number of reptile surveys to date also exceeds half the total number of surveys required. The current NARRS reptile NCI is 2.73. This should be interpreted with extreme caution, however, as the number of NARRS survey results submitted has declined each year, and this is particularly true for reptile surveys in 2010 (data not presented). Data from fewer than 50 NARRS reptile surveys in 2010 have been submitted at the time of writing (December 2010). If this rate of survey return were to continue, there exists a real possibility that the number of surveys needed to generate robust baselines for the widespread reptiles may not be reached by 2012. This is discussed further below. It is essential that conservation actions are based on robust, repeatable and verifiable data that can be used to establish baselines and set targets, and the NARRS Widespread Species Surveys are currently the only way we have of doing this.

Finally, Table 9 shows small but positive correlations between the number of methods used, the number of visits made, and the detection of species in both amphibian and reptile NARRS surveys. This is some indication that increased survey effort does

produce better results, and that the tremendous effort that many NARRS surveyors put into producing their survey results is worth the time and consideration. That the correlations are not stronger is probably due (again) to some surveyors not submitting negative results after only low numbers of visits either because of time constraints or because they feel that negative results are not of interest. It is impossible to emphasize too much, however, the real importance of including negative results in the analyses of NARRS data so that occupancy rates are not falsely overestimated. This could mask possible future species declines for which action can otherwise be taken if they are picked up by NARRS results.

4.6 Recommendations for the Future

The current NARRS survey cycle, which will establish baseline data for all widespread species of herpetofauna, will be completed in 2012. In order for the scheme to achieve the best possible success, it is recommended that:

- NARRS training in 2011 and 2012 is targeted towards "gap" areas in order to ensure a wide spread of data contributing to baselines;
- ARGs, where possible, undertake to carry out a group NARRS square or squares to raise the numbers of survey results (especially for reptiles) so that baseline values are successfully generated;
- Surveyors are encouraged to submit all NARRS data, including negative (absence) data so that occupancy rates are not falsely inflated;
- The NARRS website is updated to promote easier participation in NARRS, with more feedback to surveyors and emphasis on long-term goals.

It is hoped that production of the present report goes some way to improving feedback to NARRS surveyors. This is otherwise constrained by a lack of ARC staff time due to receiving little or no funding specifically for NARRS. This situation is currently unlikely to improve because of the cuts being experienced by statutory agencies (through no fault of their own). Future assessments of the conservation status and changes in status of our herpetofauna, which may one day form the basis on which Action Plans are written and on which conservation action is prioritised, depend upon the repeatable, robust methods embodied by NARRS and it is particularly important these are used to establish baseline data during the current NARRS cycle. These will be the figures by which future declines (or increases!) in our amphibians and reptiles are measured. The role of the volunteer surveyor cannot be under-emphasized in this and is likely to remain critical to species surveillance efforts for the foreseeable future.

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