

Monitoring of the Atlantic woodland bryophyte assemblage of Ceunant Llennyrch NNR, Meirionnydd



Des Callaghan (Bryophyte Surveys Ltd)

Evidence Report No 1004

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Frontispiece: *Drepanolejeunea hamatifolia*, with *Frullania tamarisci*

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1. Crynodeb gweithredol

Mae Gwarchodfa Natur Genedlaethol Ceunant Llennyrch yn cynnal casgliad o fryoffytau coetir yr Iwerydd o bwysigrwydd cenedlaethol, a arolygwyd yn 2014 drwy fapio rhywogaethau gan ddefnyddio gridiau a thrwy sefydlu lleiniau ffotograffig pwynt sefydlog. Mae'r adroddiad hwn yn rhoi canlyniadau gwaith ail-fonitro cymaradwy cyntaf y casgliad. Mae canlyniadau'n dangos bod y casgliad ar y cyfan wedi aros fwy neu lai yn sefydlog rhwng 2014 a 2026, gyda nifer agrededig y rhywogaethau mwyaf nodedig yn cynyddu ychydig, sef 7%, o 211 i 226 o gelloedd grid 10 m. O fewn y duedd gyffredinol hon, mae rhywogaethau unigol yn dangos rhai gwahaniaethau sylweddol, sy'n cael eu trafod. Yr hyn sy'n bwysig yw presenoldeb pedair rhywogaeth yn 2026 a oedd yn absennol yn 2014, gan gynnwys *Colura calyptrifolia*, *Leptoscyphus cuneifolius*, *Metzgeria leptoneura* a *Pseudomarsupidium decipiens*. Mae darganfod lleoliad newydd ar gyfer *Radula aquilegia* hefyd yn bwysig, gan fod y rhywogaeth brin hon wedi bod yn adnabyddus o'r blaen mewn un lleoliad yn unig o fewn y warchodfa.

2. Executive summary

Ceunant Llennyrch National Nature Reserve supports a nationally important Atlantic woodland bryophyte assemblage, which was surveyed in 2014 by the grid-mapping of species and by the establishment of fixed-point photographic plots. This report provides the results of the first comparable re-monitoring of the assemblage. Results show that between 2014 and 2026 the assemblage generally remained more-or-less stable, with the aggregated abundance of the most notable species increasing slightly, by 7%, from 211 to 226 occupied 10 m grid cells. Within this general trend, individual species show some significant differences, which are discussed. Of note, is the presence of four species in 2026 that were absent in 2014, including *Colura calyptrifolia*, *Leptoscyphus cuneifolius*, *Metzgeria leptoneura* and *Pseudomarsupidium decipiens*. The discovery of a new location for *Radula aquilegia* is also of note, as this rare species has previously been known from only a single location within the reserve.

3. Background

Bryophytes comprise a diverse group of organisms that are sensitive indicators of the state of the environment. Desiccation tolerance varies greatly between species, and some of the most sensitive species are limited to highly oceanic climates. Atlantic (or oceanic) bryophytes are more strongly represented in the British Isles than in any other part of Europe and, due to their general rarity and phytogeographic interest, have received much attention from bryologists and conservationists. The most diverse Atlantic communities are found in sheltered lowland ravines along streams and rivers in west Scotland, north-west Wales (Snowdonia), north-west England (the English Lake District) and west Ireland. The best assemblages trigger the selection of Sites of Special Scientific Interest (SSSI) in Britain (Bosanquet et al. 2018) and are of principal importance for conservation under Section 7 of The Environment (Wales) Act 2016.

The study area comprises the officially designated area of Ceunant Llennyrch National Nature Reserve (NNR) plus the adjacent land that is owned and managed as part of the NNR by NRW (Figures 1 and 2). The main habitat of interest is oceanic woodland, and one of the key features of conservation interest is the exceptional Atlantic bryophyte flora, which has been surveyed very well. According to the bryophyte selection criteria for SSSIs in Britain (Bosanquet et al. 2018), the 'Atlantic woodland bryophyte assemblage' of the site scores 53 points, well above the SSSI selection threshold of 12 points. The assemblage comprises 22 scoring species: *Breutelia chrysocoma* (1 point), *Cephaloziella turneri* (12), *Cololejeunea microscopica* (1), *Colura calyptrifolia* (1), *Drepanolejeunea hamatifolia* (1), *Harpalejeunea molleri* (1), *Heterocladium wulfsbergii* (3), *Jubula hutchinsiae* (1), *Lejeunea lamacerina* (1), *Lejeunea patens* (1), *Lepidozia pearsonii* (1), *Leptoscyphus cuneifolius* (1), *Metzgeria leptoneura* (9), *Plagiochila bifaria* (1), *Plagiochila exigua* (1), *Plagiochila punctata* (1), *Plagiochila spinulosa* (1), *Pseudomarsupidium decipiens* (1), *Radula aquilegia* (1), *Radula voluta* (3), *Scapania gracilis* (1), and *Sematophyllum demissum* (9).

Utilising a grid-mapping methodology (Callaghan 2013), baseline monitoring of Atlantic woodland bryophyte assemblage was undertaken during November–December 2014 by Callaghan (2015). The aim of this study is to undertake the first repeat monitoring, and to assess what population changes may have occurred.

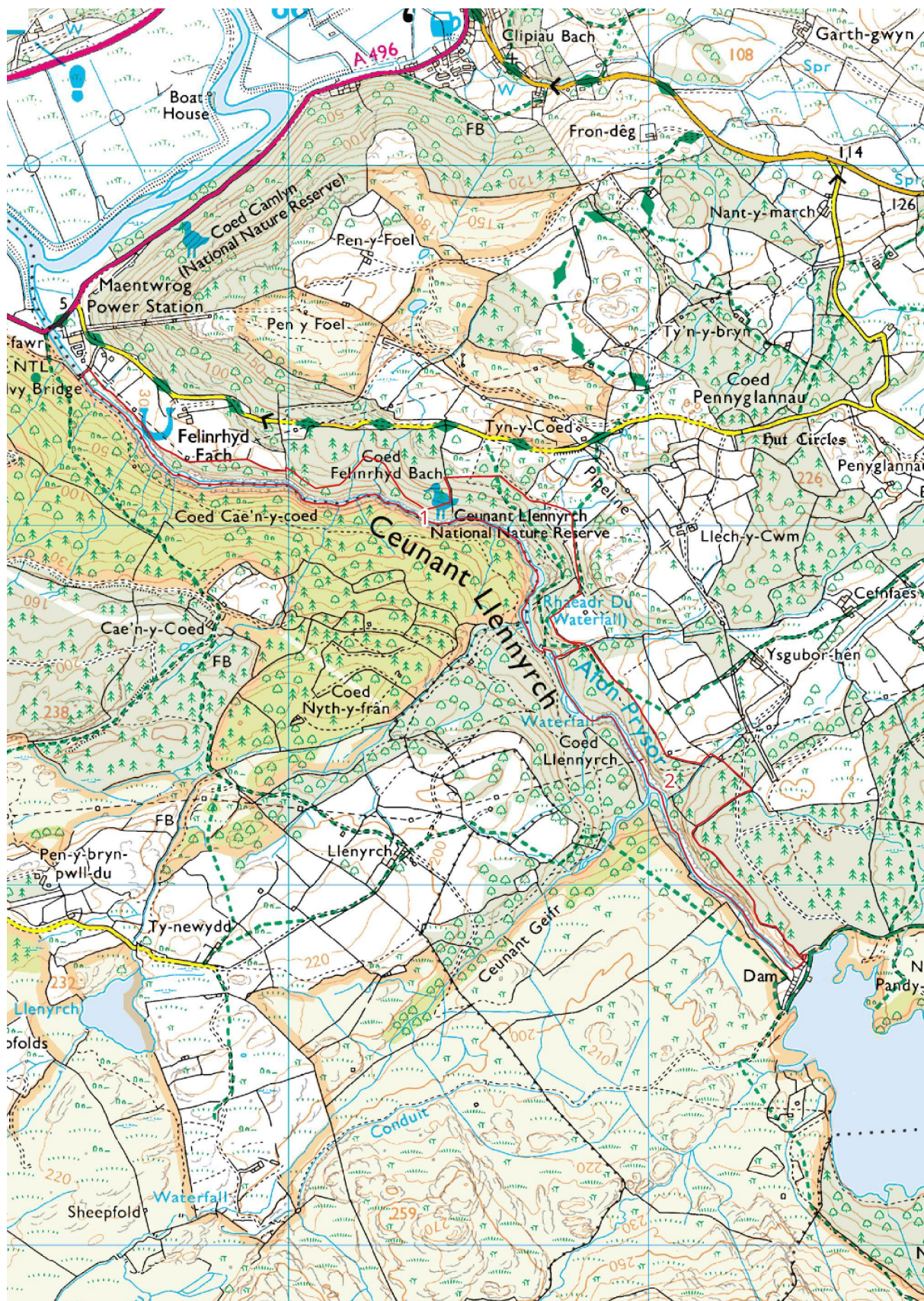


Figure 1 Locations of the survey area, including: (1) Ceunant Llennyrch NNR; and (2) adjacent land owned by NRW and managed as part of the NNR. Note: the boundary of the survey area along the Afon Prysor follows the centre of the river, excluding the true-left bank.



Figure 2 View of the upper ravine of Ceunant Llennyrch from Trawsfynydd dam.

4. Methods

4.1. Taxonomy

Taxonomy follows Blockeel et al. (2021).

4.2. Grid-mapping of species

The same survey route of 2014 was followed, visiting 574 OS 10 m grid cells and covering all of the accessible oceanic ravine woodland within the reserve. GPS waypoints were recorded for all colonies of the most notable Atlantic species, including *Cephaloziella turneri*, *Cololejeunea microscopica*, *Colura calyptrifolia*, *Drepanolejeunea hamatifolia*, *Harpalejeunea molleri*, *Jubula hutchinsiae*, *Leptoscyphus cuneifolius*, *Metzgeria leptoneura*, *Plagiochila exigua*, *Pseudomarsipidium decipiens*, *Radula aquilegia*, *Radula voluta*, and *Sematophyllum demissum*. The waypoints were loaded into GIS to produce maps of OS 10 m grid cells occupied by each species and a count of the number of cells occupied by each species.

4.3. Population change

Percentage change in the number of occupied grid cells between 2014 and 2026 was calculated for each species separately, and as an aggregated assemblage.

4.4. Fixed-point photographic plots

Twelve fixed-point photographic plots that feature key species of the Atlantic woodland bryophyte assemblage were monitored, including four that were first established in 2014, five established in 2020 (Callaghan 2020), and three newly established plots.

5. Results

5.1. GPS data

GPS data collected during the present survey are provided in Appendix 1. All data have been submitted to iRecord (irecord.org.uk).

5.2. Grid-mapping of species

Grid-maps of the 15 species that have been covered during 2014 and/or 2026 are provided in Appendix 2.

5.3. Population change

Table 1 and Figure 3 show counts of the 10 m grid cells occupied in 2014 and 2026 by the species covered, and the percentage change in these counts.

5.4. Fixed-point photographic plots

Results from the monitoring of the fixed-point photographic plots are provided in Appendix 3.

Table 1 Counts of OS 10 m grid cells occupied by the most notable species of the Atlantic woodland bryophyte assemblage at Ceunant Llennyrch in 2014 and 2026.

Species	Count of cells 2014	Count of cells 2026	% change
<i>Cephaloziella turneri</i>	1	1	0%
<i>Cololejeunea microscopica</i>	46	60	30%
<i>Colura calyptrifolia</i>	0	6	n/a
<i>Drepanolejeunea hamatifolia</i>	94	79	-16%
<i>Harpalejeunea molleri</i>	54	46	-15%
<i>Jubula hutchinsiae</i>	6	13	117%
<i>Lepidozia pearsonii</i>	1	0	-100%
<i>Leptoscyphus cuneifolius</i>	0	1	n/a
<i>Metzgeria leptoneura</i>	0	3	n/a
<i>Plagiochila exigua</i>	3	10	233%
<i>Pseudomarsupidium decipiens</i>	0	1	n/a
<i>Radula aquilegia</i>	1	2	100%
<i>Radula voluta</i>	2	1	-50%
<i>Sematophyllum demissum</i>	2	3	50%
<i>Tritomaria exsecta</i>	1	0	-100%
Atlantic woodland assemblage ¹	211	226	7%

¹Sum of counts of all species.

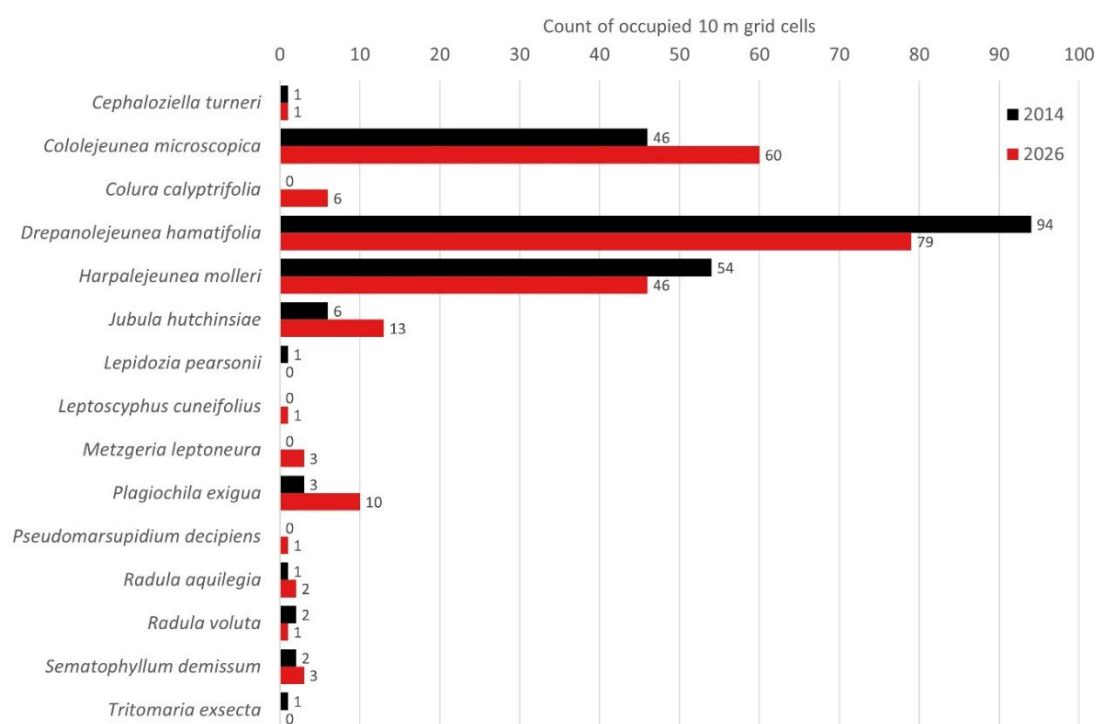


Figure 3 Counts of OS 10 m grid cells occupied by the most notable species of the Atlantic woodland bryophyte assemblage at Ceunant Llennyrch in 2014 and 2026.

6. Discussion

The results of this study show that between 2014 and 2026 the abundance of the Atlantic woodland bryophyte assemblage of Ceunant Llennyrch NNR has, overall, remained reasonably stable, with the aggregated abundance of the most notable species increasing slightly, by 7%, from 211 to 226 occupied 10 m grid cells in the best areas of habitat for these species. Within this general trend, individual species show some significant differences. Perhaps surprisingly, the large populations of *Drepanolejeunea hamatifolia* and *Harpalejeunea molleri* have both undergone a small decline, by -16% and -15%, respectively. Comparable data from across the same time period at Coed Ganllwyd, which also supports large populations of these two liverworts, showed that the former increased dramatically, whilst the latter remained stable (Callaghan 2025). In contrast, *Cololejeunea microscopica*, another tiny hyperoceanic liverwort that occupies a similar niche to these species, underwent a significant increase at Ceunant Llennyrch, by 30% (from 46 to 60 occupied 10 m grid cells), but at Coed Ganllwyd, which supports a surprisingly small population of this species, the trend has been stable. *Colura calyptrifolia* is another tiny hyperoceanic liverwort that is ecologically very similar, and has undergone a significant increase at both sites. Given the general habitat conditions for these species appear to have remained broadly unchanged at both sites, reasons for the differing trends between sites are difficult to understand, and may be related to cryptic ecological differences between sites and/or between species.

Other species that were not found within the survey area at Ceunant Llennyrch in 2014 but were present in 2026 include *Leptoscyphus cuneifolius*, *Metzgeria leptoneura* and *Pseudomarsipidium decipiens*. The former is present in tiny quantity, occupying a single boulder (see Plot 2 of Appendix 3), and will have colonised from nearby Coed-y-Rhygen, located just 1 km south-east and which supports the only substantial population of the species in Wales. Given the species does not produce sporophytes in Europe, it will have dispersed via its tiny caducous leaves, possibly via endozoochory (e.g. on the feet or plumage of birds) or by wind. Regarding *M. leptoneura*, the discovery of two new locations, both supporting large and very healthy colonies (see Plots 7 and 12 of Appendix 3) is notable, as this is a rare species in Wales and populations within sites are generally small. Also particularly notable is the discovery of a second population of *Radula aquilegia* (see Plot 8 of Appendix 3), previously known by only a single colony at Ceunant Llennyrch and where it appears to be at risk from disturbance by gorge-walking activity (see Plot 4 of Appendix 3). The population of *Sematophyllum demissum* remains small but stable, and *Cephaloziella turneri* continues to persist at the same location in extremely small amounts (see Plot 10 of Appendix 3).

7. Acknowledgements

Thanks to Dave Cowley (NRW) for organising the contract.

8. References

Blockeel TL, Bell NE, Hill MO, Hodgetts NG, Long DG, Pilkington SL, Rothero GP. 2021. A new checklist of the bryophytes of Britain and Ireland, 2020. *Journal of Bryology*. 43:1–51.

Blockeel TL, Bosanquet SDS, Hill MO, Preston CD. 2014. *Atlas of British and Irish bryophytes*. Vol. 2. Newbury: Pisces Publications.

Bosanquet SDS, Genney DR, Cox JHS. 2018. Guidelines for the selection of biological SSSIs. Part 2: Detailed guidelines for habitats and species groups. Chapter 12 Bryophytes. Peterborough: Joint Nature Conservation Committee.

Callaghan DA. 2015. Bryophyte survey and assessment of Ceunant Llennyrch NNR, Meirionnydd. Unpublished report to Natural Resources Wales.

Callaghan DA. 2020. Ceunant Llennyrch NNR: bryophyte survey and condition monitoring. Unpublished report to Natural Resources Wales.

Callaghan, D.A. 2025. Monitoring of the Atlantic woodland bryophyte assemblage of Coed Ganllwyd, Merionethshire. NRW Evidence Report, Natural Resources Wales.

9. Appendices

9.1. Appendix 1: GPS data

Species	OS GR
<i>Bartramia halleriana</i>	SH6715938025
<i>Bartramia halleriana</i>	SH6668838816
<i>Blindia acuta</i>	SH6622239090
<i>Campylopus fragilis</i>	SH6703338273
<i>Cephaloziella turneri</i>	SH6621239086
<i>Cololejeunea microscopica</i>	SH6738137786
<i>Cololejeunea microscopica</i>	SH6737237801
<i>Cololejeunea microscopica</i>	SH6736837806
<i>Cololejeunea microscopica</i>	SH6734837828
<i>Cololejeunea microscopica</i>	SH6733837838
<i>Cololejeunea microscopica</i>	SH6705038251
<i>Cololejeunea microscopica</i>	SH6705838237
<i>Cololejeunea microscopica</i>	SH6705638231
<i>Cololejeunea microscopica</i>	SH6705938204
<i>Cololejeunea microscopica</i>	SH6706138206
<i>Cololejeunea microscopica</i>	SH6706138207
<i>Cololejeunea microscopica</i>	SH6706438192
<i>Cololejeunea microscopica</i>	SH6707938162
<i>Cololejeunea microscopica</i>	SH6709738139
<i>Cololejeunea microscopica</i>	SH6709838131
<i>Cololejeunea microscopica</i>	SH6711538077
<i>Cololejeunea microscopica</i>	SH6711838068
<i>Cololejeunea microscopica</i>	SH6712838057
<i>Cololejeunea microscopica</i>	SH6713138057
<i>Cololejeunea microscopica</i>	SH6713338054
<i>Cololejeunea microscopica</i>	SH6713938050
<i>Cololejeunea microscopica</i>	SH6714238045
<i>Cololejeunea microscopica</i>	SH6714538029
<i>Cololejeunea microscopica</i>	SH6715138023
<i>Cololejeunea microscopica</i>	SH6715938016
<i>Cololejeunea microscopica</i>	SH6717338001
<i>Cololejeunea microscopica</i>	SH6702438280
<i>Cololejeunea microscopica</i>	SH6701338284
<i>Cololejeunea microscopica</i>	SH6699838294
<i>Cololejeunea microscopica</i>	SH6699538305
<i>Cololejeunea microscopica</i>	SH6698838328
<i>Cololejeunea microscopica</i>	SH6698338336
<i>Cololejeunea microscopica</i>	SH6697838343
<i>Cololejeunea microscopica</i>	SH6694738406
<i>Cololejeunea microscopica</i>	SH6692938445
<i>Cololejeunea microscopica</i>	SH6690738462
<i>Cololejeunea microscopica</i>	SH6690638465
<i>Cololejeunea microscopica</i>	SH6690538470

Species	OS GR
<i>Cololejeunea microscopica</i>	SH6689738478
<i>Cololejeunea microscopica</i>	SH6687738473
<i>Cololejeunea microscopica</i>	SH6687338477
<i>Cololejeunea microscopica</i>	SH6686338477
<i>Cololejeunea microscopica</i>	SH6681538479
<i>Cololejeunea microscopica</i>	SH6670138668
<i>Cololejeunea microscopica</i>	SH6666638754
<i>Cololejeunea microscopica</i>	SH6668338816
<i>Cololejeunea microscopica</i>	SH6668738827
<i>Cololejeunea microscopica</i>	SH6668938823
<i>Cololejeunea microscopica</i>	SH6668638822
<i>Cololejeunea microscopica</i>	SH6667538807
<i>Cololejeunea microscopica</i>	SH6667138801
<i>Cololejeunea microscopica</i>	SH6666738788
<i>Cololejeunea microscopica</i>	SH6667838903
<i>Cololejeunea microscopica</i>	SH6668038898
<i>Cololejeunea microscopica</i>	SH6666138927
<i>Cololejeunea microscopica</i>	SH6666638921
<i>Cololejeunea microscopica</i>	SH6664938947
<i>Cololejeunea microscopica</i>	SH6659838991
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<i>Cololejeunea microscopica</i>	SH6615139056
<i>Cololejeunea microscopica</i>	SH6563739189
<i>Cololejeunea microscopica</i>	SH6568939146
<i>Cololejeunea microscopica</i>	SH6573839133
<i>Cololejeunea microscopica</i>	SH6574839126
<i>Colura calyptrifolia</i>	SH6737237803
<i>Colura calyptrifolia</i>	SH6706138205
<i>Colura calyptrifolia</i>	SH6714638030
<i>Colura calyptrifolia</i>	SH6698638330
<i>Colura calyptrifolia</i>	SH6665538935
<i>Colura calyptrifolia</i>	SH6641239009
<i>Drepanolejeunea hamatifolia</i>	SH6739137777
<i>Drepanolejeunea hamatifolia</i>	SH6739337773
<i>Drepanolejeunea hamatifolia</i>	SH6738537780
<i>Drepanolejeunea hamatifolia</i>	SH6737837790
<i>Drepanolejeunea hamatifolia</i>	SH6737137801
<i>Drepanolejeunea hamatifolia</i>	SH6737137802

Species	OS GR
<i>Drepanolejeunea hamatifolia</i>	SH6737337798
<i>Drepanolejeunea hamatifolia</i>	SH6736837806
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<i>Drepanolejeunea hamatifolia</i>	SH6713938051
<i>Drepanolejeunea hamatifolia</i>	SH6714238045
<i>Drepanolejeunea hamatifolia</i>	SH6714138031
<i>Drepanolejeunea hamatifolia</i>	SH6714538029
<i>Drepanolejeunea hamatifolia</i>	SH6714738030
<i>Drepanolejeunea hamatifolia</i>	SH6714938027
<i>Drepanolejeunea hamatifolia</i>	SH6715138023
<i>Drepanolejeunea hamatifolia</i>	SH6715938016
<i>Drepanolejeunea hamatifolia</i>	SH6716938009
<i>Drepanolejeunea hamatifolia</i>	SH6704438258
<i>Drepanolejeunea hamatifolia</i>	SH6700038292

Species	OS GR
<i>Drepanolejeunea hamatifolia</i>	SH6699638299
<i>Drepanolejeunea hamatifolia</i>	SH6699238315
<i>Drepanolejeunea hamatifolia</i>	SH6699238322
<i>Drepanolejeunea hamatifolia</i>	SH6698438328
<i>Drepanolejeunea hamatifolia</i>	SH6698438332
<i>Drepanolejeunea hamatifolia</i>	SH6698038351
<i>Drepanolejeunea hamatifolia</i>	SH6695538393
<i>Drepanolejeunea hamatifolia</i>	SH6694838398
<i>Drepanolejeunea hamatifolia</i>	SH6691938453
<i>Drepanolejeunea hamatifolia</i>	SH6691238459
<i>Drepanolejeunea hamatifolia</i>	SH6687738473
<i>Drepanolejeunea hamatifolia</i>	SH6687738478
<i>Drepanolejeunea hamatifolia</i>	SH6685438464
<i>Drepanolejeunea hamatifolia</i>	SH6681538479
<i>Drepanolejeunea hamatifolia</i>	SH6676138593
<i>Drepanolejeunea hamatifolia</i>	SH6676338597
<i>Drepanolejeunea hamatifolia</i>	SH6667038729
<i>Drepanolejeunea hamatifolia</i>	SH6666738742
<i>Drepanolejeunea hamatifolia</i>	SH6669238827
<i>Drepanolejeunea hamatifolia</i>	SH6666738793
<i>Drepanolejeunea hamatifolia</i>	SH6666438775
<i>Drepanolejeunea hamatifolia</i>	SH6667838904
<i>Drepanolejeunea hamatifolia</i>	SH6668038898
<i>Drepanolejeunea hamatifolia</i>	SH6665638933
<i>Drepanolejeunea hamatifolia</i>	SH6666538922
<i>Drepanolejeunea hamatifolia</i>	SH6664338958
<i>Drepanolejeunea hamatifolia</i>	SH6663738962
<i>Drepanolejeunea hamatifolia</i>	SH6659838991
<i>Drepanolejeunea hamatifolia</i>	SH6654139016
<i>Drepanolejeunea hamatifolia</i>	SH6652539021
<i>Drepanolejeunea hamatifolia</i>	SH6647239025
<i>Drepanolejeunea hamatifolia</i>	SH6644939013
<i>Drepanolejeunea hamatifolia</i>	SH6643739012
<i>Drepanolejeunea hamatifolia</i>	SH6641639010
<i>Drepanolejeunea hamatifolia</i>	SH6639039017
<i>Drepanolejeunea hamatifolia</i>	SH6625139134
<i>Drepanolejeunea hamatifolia</i>	SH6625639082
<i>Drepanolejeunea hamatifolia</i>	SH6615139056
<i>Drepanolejeunea hamatifolia</i>	SH6563539187
<i>Drepanolejeunea hamatifolia</i>	SH6567339156
<i>Drepanolejeunea hamatifolia</i>	SH6568239148
<i>Drepanolejeunea hamatifolia</i>	SH6571039148
<i>Drepanolejeunea hamatifolia</i>	SH6574239131
<i>Drepanolejeunea hamatifolia</i>	SH6574539127
<i>Gymnostomum aeruginosum</i>	SH6658538995
<i>Harpalejeunea mollerii</i>	SH6738437780
<i>Harpalejeunea mollerii</i>	SH6737337801

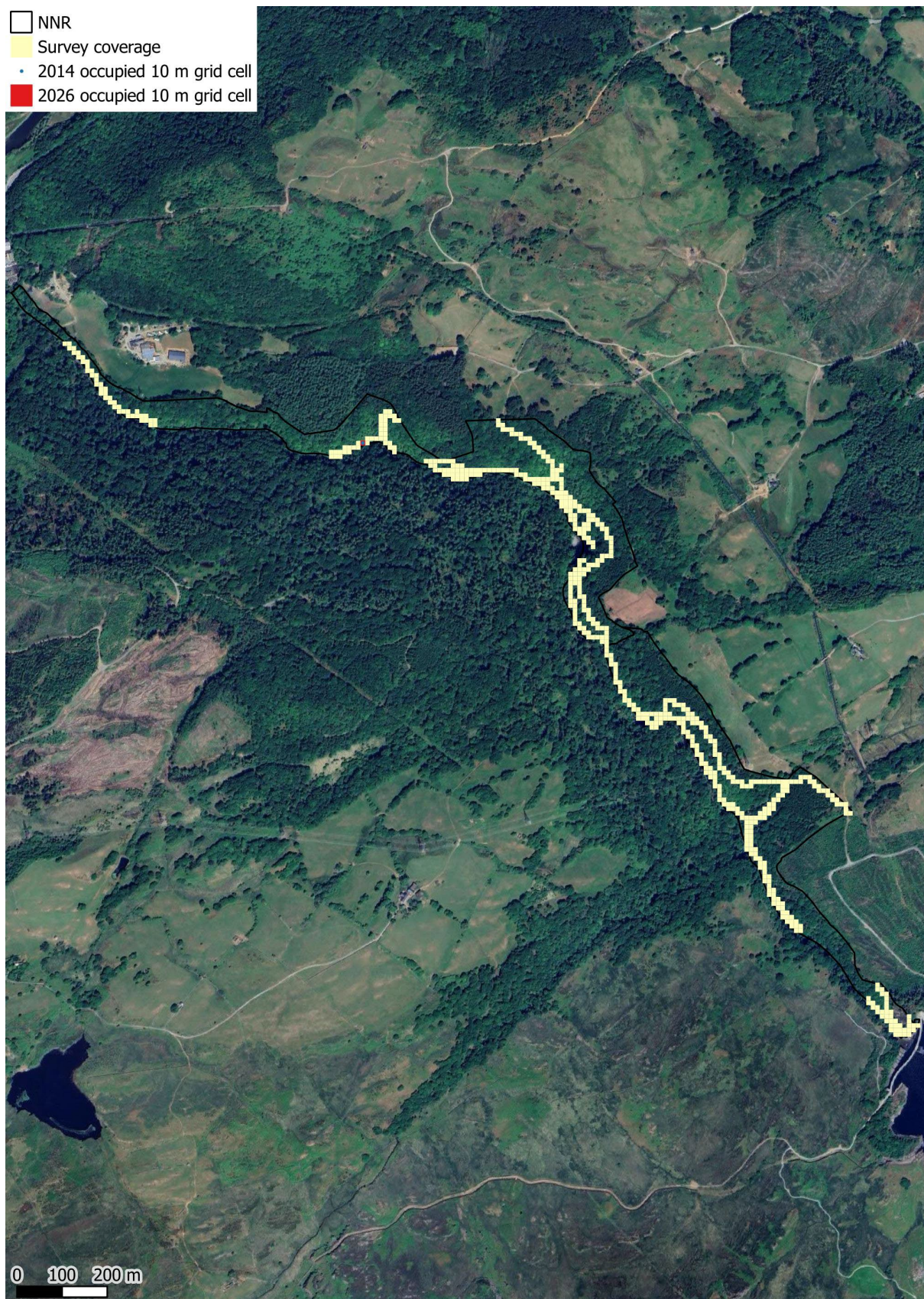
Species	OS GR
<i>Harpalejeunea moller</i>	SH6737037805
<i>Harpalejeunea moller</i>	SH6706138205
<i>Harpalejeunea moller</i>	SH6710238117
<i>Harpalejeunea moller</i>	SH6711538079
<i>Harpalejeunea moller</i>	SH6714138031
<i>Harpalejeunea moller</i>	SH6714738030
<i>Harpalejeunea moller</i>	SH6715338021
<i>Harpalejeunea moller</i>	SH6715938016
<i>Harpalejeunea moller</i>	SH6703238278
<i>Harpalejeunea moller</i>	SH6702438280
<i>Harpalejeunea moller</i>	SH6702038280
<i>Harpalejeunea moller</i>	SH6698238336
<i>Harpalejeunea moller</i>	SH6698138337
<i>Harpalejeunea moller</i>	SH6697838343
<i>Harpalejeunea moller</i>	SH6689538477
<i>Harpalejeunea moller</i>	SH6687538476
<i>Harpalejeunea moller</i>	SH6687738478
<i>Harpalejeunea moller</i>	SH6685538465
<i>Harpalejeunea moller</i>	SH6675838592
<i>Harpalejeunea moller</i>	SH6676338597
<i>Harpalejeunea moller</i>	SH6670238659
<i>Harpalejeunea moller</i>	SH6669438676
<i>Harpalejeunea moller</i>	SH6667038729
<i>Harpalejeunea moller</i>	SH6666638746
<i>Harpalejeunea moller</i>	SH6667938907
<i>Harpalejeunea moller</i>	SH6667338904
<i>Harpalejeunea moller</i>	SH6667238906
<i>Harpalejeunea moller</i>	SH6666238942
<i>Harpalejeunea moller</i>	SH6665838930
<i>Harpalejeunea moller</i>	SH6666238921
<i>Harpalejeunea moller</i>	SH6664938947
<i>Harpalejeunea moller</i>	SH6664038961
<i>Harpalejeunea moller</i>	SH6672138821
<i>Harpalejeunea moller</i>	SH6688138474
<i>Harpalejeunea moller</i>	SH6659838991
<i>Harpalejeunea moller</i>	SH6647239025
<i>Harpalejeunea moller</i>	SH6645339015
<i>Harpalejeunea moller</i>	SH6644939016
<i>Harpalejeunea moller</i>	SH6642539009
<i>Harpalejeunea moller</i>	SH6641339010
<i>Harpalejeunea moller</i>	SH6639139017
<i>Harpalejeunea moller</i>	SH6637839025
<i>Harpalejeunea moller</i>	SH6637139028
<i>Harpalejeunea moller</i>	SH6625139134
<i>Harpalejeunea moller</i>	SH6625239084
<i>Harpalejeunea moller</i>	SH6619539077
<i>Harpalejeunea moller</i>	SH6617239073

Species	OS GR
<i>Harpalejeunea molleri</i>	SH6616239064
<i>Harpalejeunea molleri</i>	SH6615639059
<i>Harpalejeunea molleri</i>	SH6613639056
<i>Harpalejeunea molleri</i>	SH6563739189
<i>Harpalejeunea molleri</i>	SH6567339156
<i>Harpalejeunea molleri</i>	SH6574839126
<i>Jubula hutchinsiae</i>	SH6706238248
<i>Jubula hutchinsiae</i>	SH6712238063
<i>Jubula hutchinsiae</i>	SH6705238246
<i>Jubula hutchinsiae</i>	SH6695738397
<i>Jubula hutchinsiae</i>	SH6666738750
<i>Jubula hutchinsiae</i>	SH6670338879
<i>Jubula hutchinsiae</i>	SH6661538980
<i>Jubula hutchinsiae</i>	SH6661238991
<i>Jubula hutchinsiae</i>	SH6661438992
<i>Jubula hutchinsiae</i>	SH6661839003
<i>Jubula hutchinsiae</i>	SH6662139007
<i>Jubula hutchinsiae</i>	SH6662339013
<i>Jubula hutchinsiae</i>	SH6663539025
<i>Jubula hutchinsiae</i>	SH6664339030
<i>Leptoscyphus cuneifolius</i>	SH6706138206
<i>Marchantia quadrata</i>	SH6685938471
<i>Marchantia quadrata</i>	SH6658738994
<i>Metzgeria conjugata</i>	SH6705038247
<i>Metzgeria conjugata</i>	SH6692838441
<i>Metzgeria leptoneura</i>	SH6690538470
<i>Metzgeria leptoneura</i>	SH6555839304
<i>Metzgeria leptoneura</i>	SH6572239142
<i>Neckera crispa</i>	SH6697138368
<i>Plagiochila bifaria</i>	SH6738137787
<i>Plagiochila bifaria</i>	SH6736737867
<i>Plagiochila bifaria</i>	SH6702638279
<i>Plagiochila exigua</i>	SH6706038205
<i>Plagiochila exigua</i>	SH6707838162
<i>Plagiochila exigua</i>	SH6710238117
<i>Plagiochila exigua</i>	SH6710338093
<i>Plagiochila exigua</i>	SH6714138031
<i>Plagiochila exigua</i>	SH6715938016
<i>Plagiochila exigua</i>	SH6691438458
<i>Plagiochila exigua</i>	SH6675138611
<i>Plagiochila exigua</i>	SH6667338905
<i>Plagiochila exigua</i>	SH6639839013
<i>Plagiochila punctata</i>	SH6738637780
<i>Plagiochila punctata</i>	SH6706338244
<i>Plagiochila spinulosa</i>	SH6712638306
<i>Plagiochila spinulosa</i>	SH6707338253
<i>Plagiochila spinulosa</i>	SH6703238273

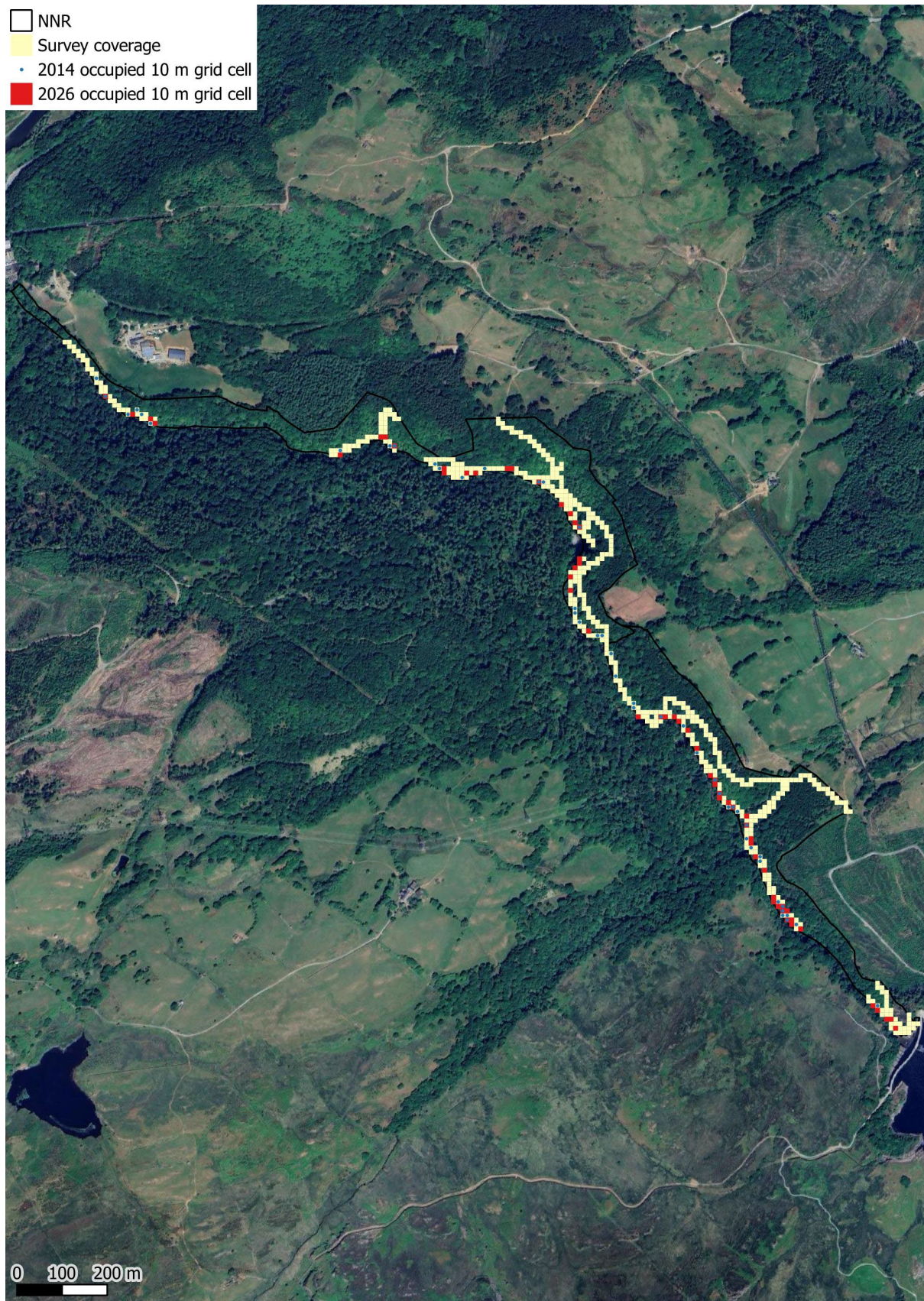
Species	OS GR
<i>Pseudomarsupidium decipiens</i>	SH6738337785
<i>Radula aquilegia</i>	SH6687438473
<i>Radula aquilegia</i>	SH6625439082
<i>Radula voluta</i>	SH6687438473
<i>Sematophyllum demissum</i>	SH6681638480
<i>Sematophyllum demissum</i>	SH6643539010
<i>Trichocolea tomentella</i>	SH6674438630
<i>Trichocolea tomentella</i>	SH6655239011
<i>Trichocolea tomentella</i>	SH6646039017
<i>Trichostomum brachydontium s.str.</i>	SH6702738279

9.2. Appendix 2: Grid-maps of Atlantic bryophyte species

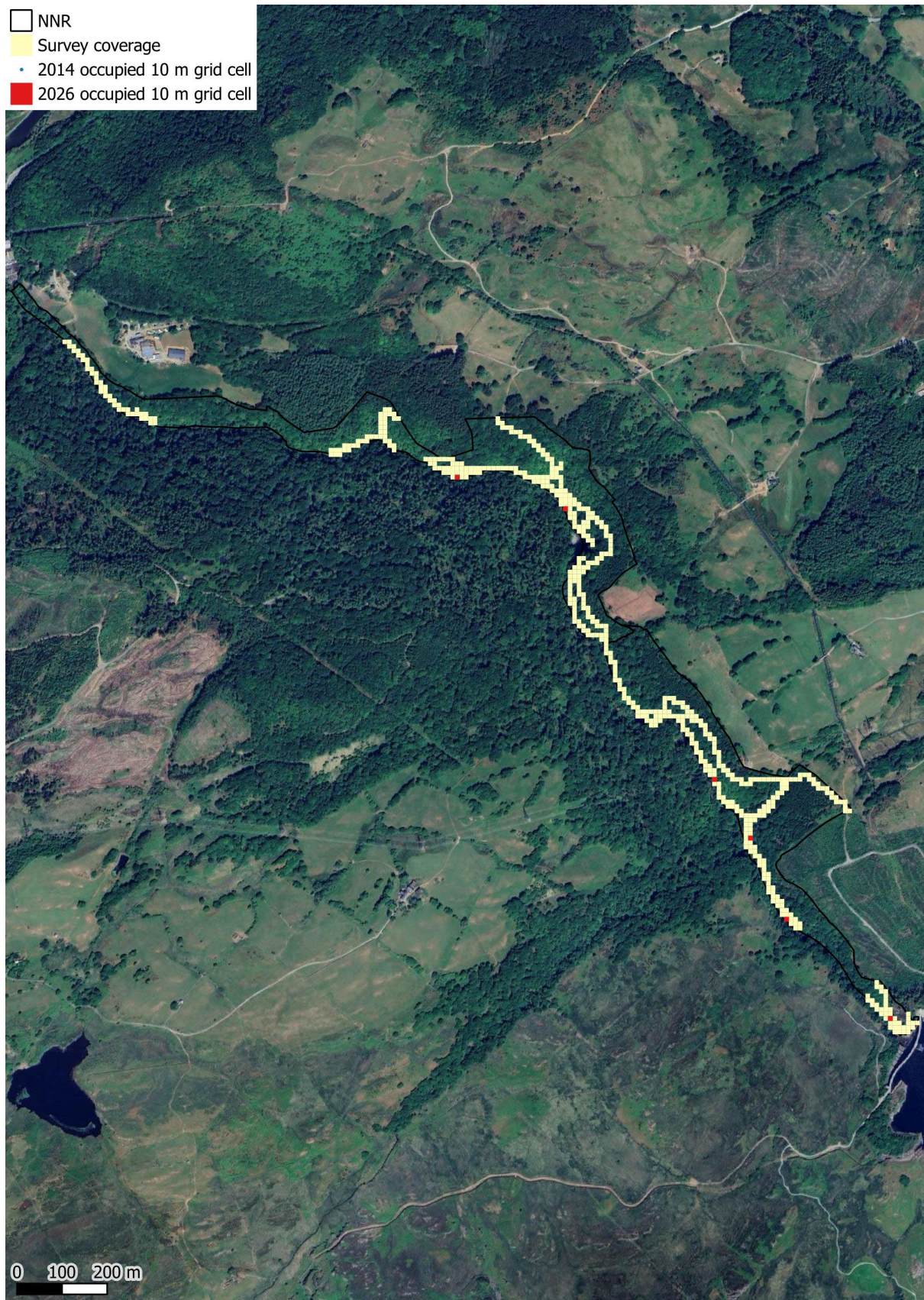
9.2.1. *Cephaloziella turneri*



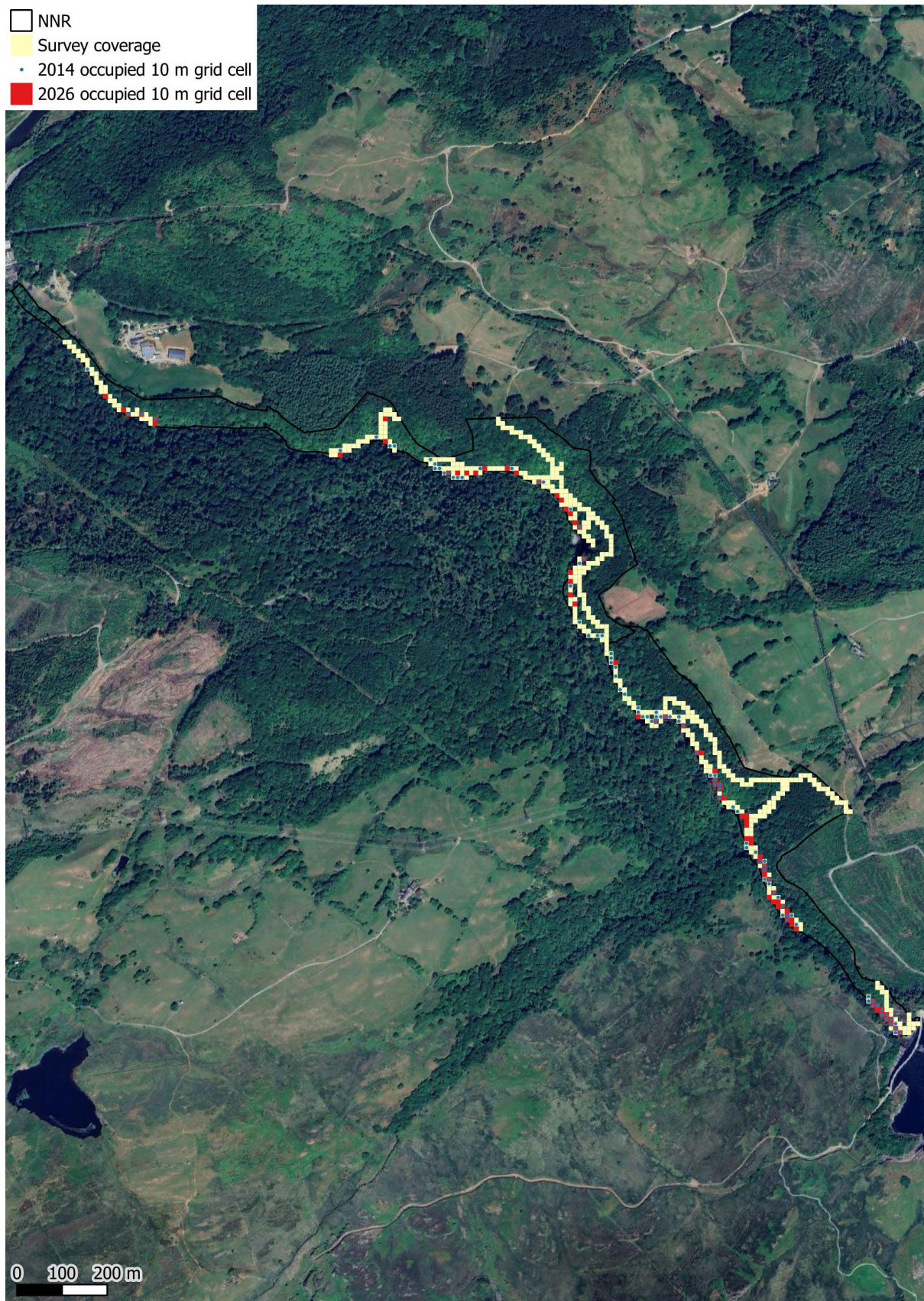
9.2.2. *Cololejeunea microscopica*



9.2.3. *Colura calyptrifolia*



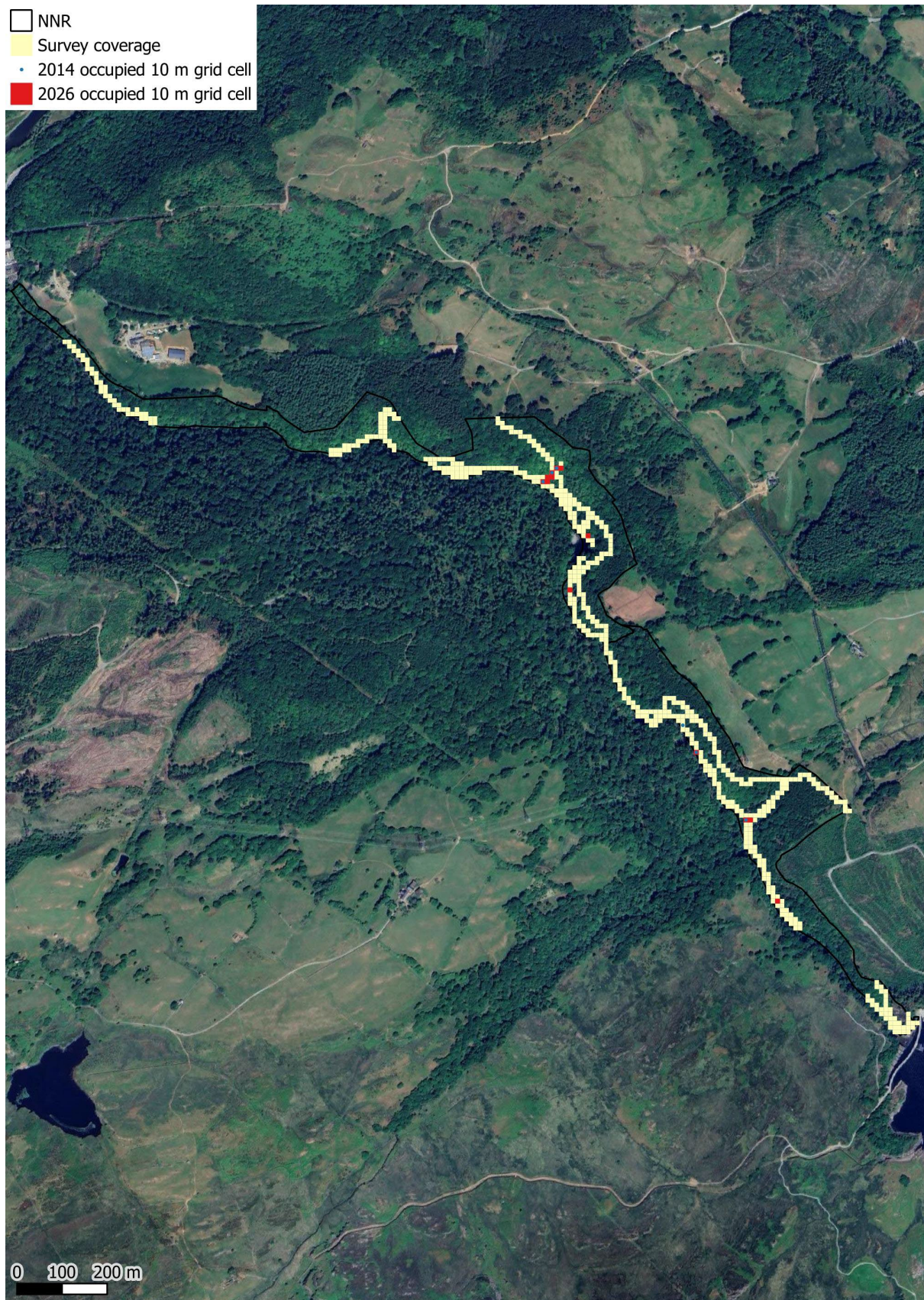
9.2.4. *Drepanolejeunea hamatifolia*



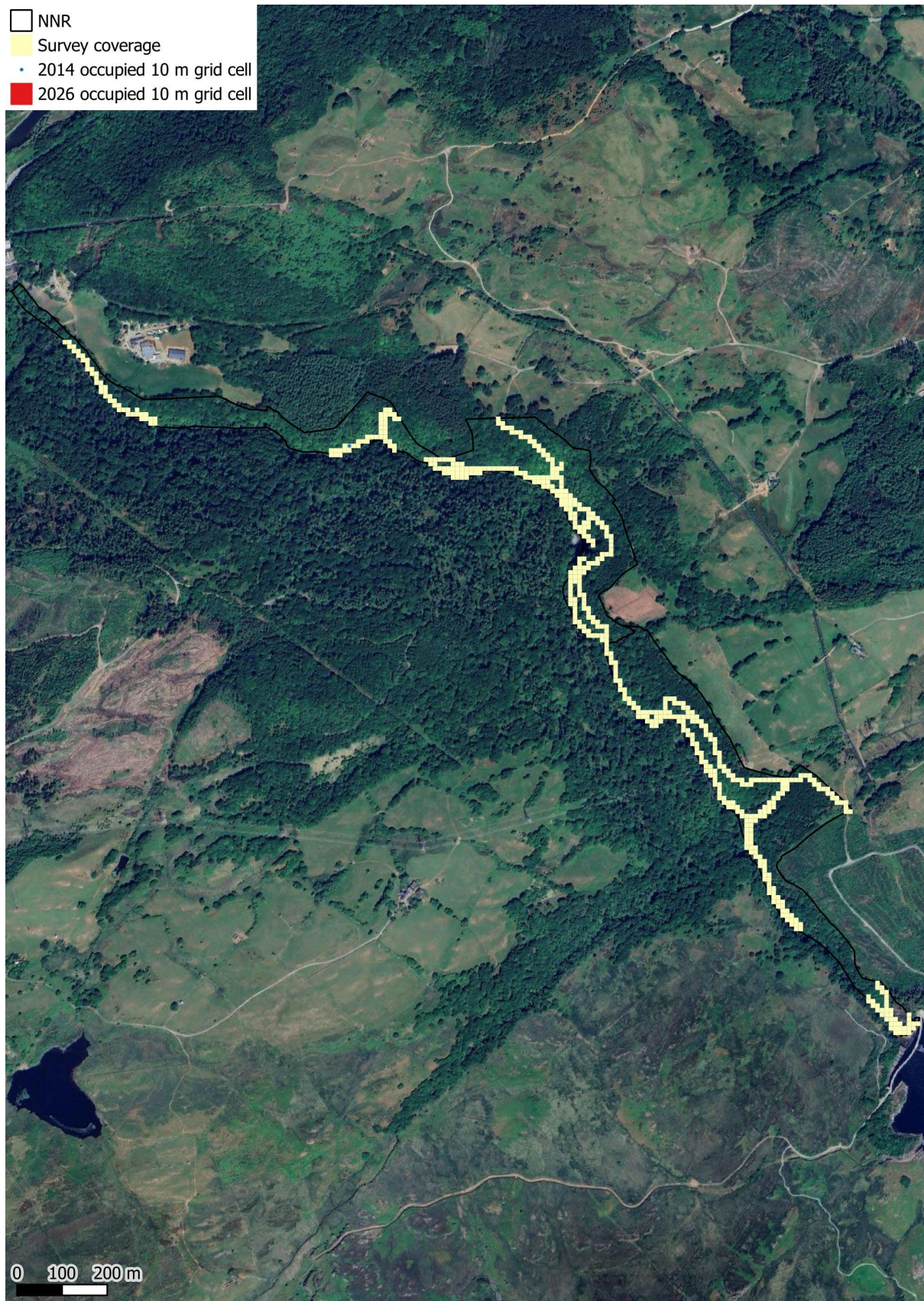
9.2.5. *Harpalejeunea molleri*



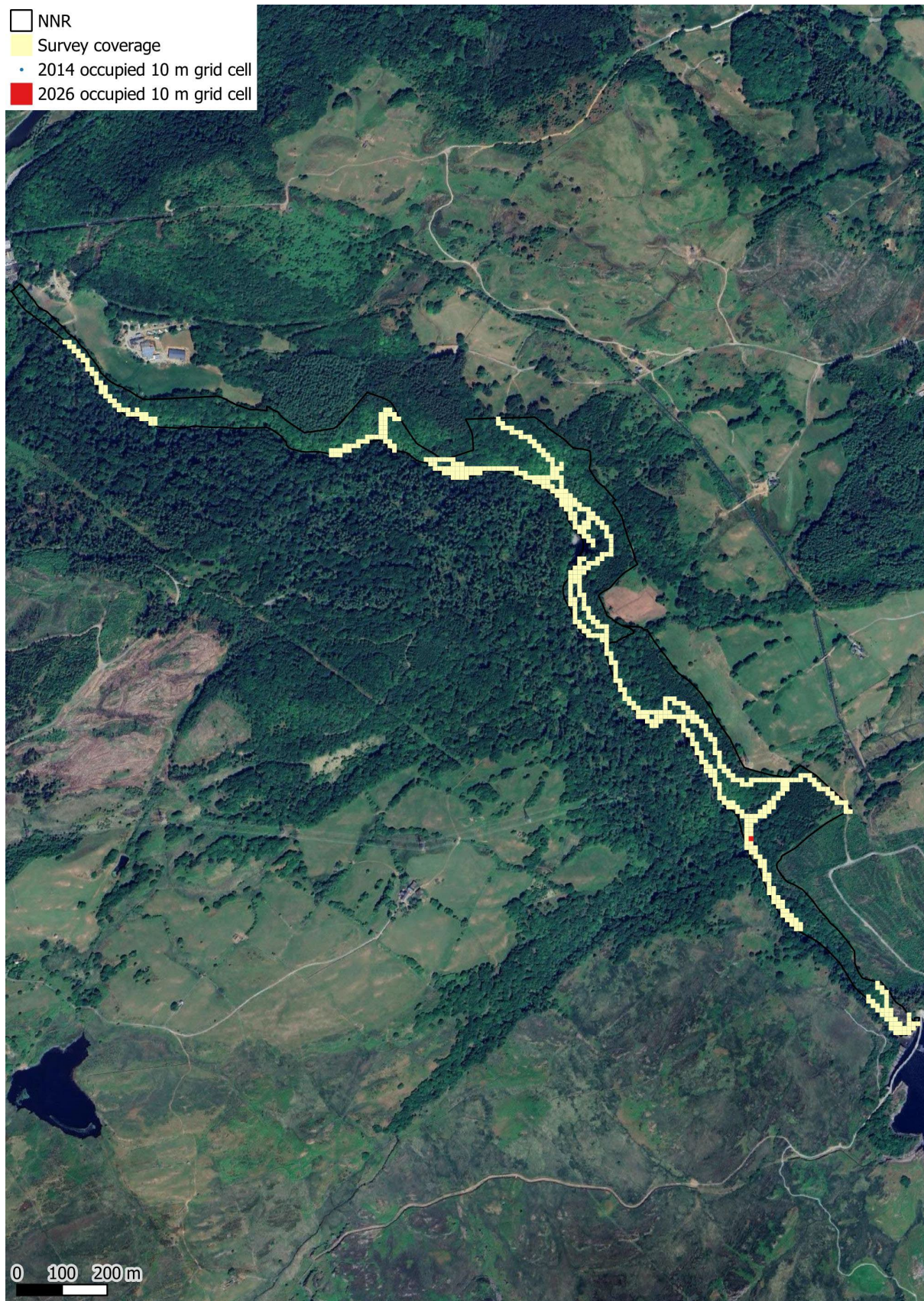
9.2.6. *Jubula hutchinsiae*



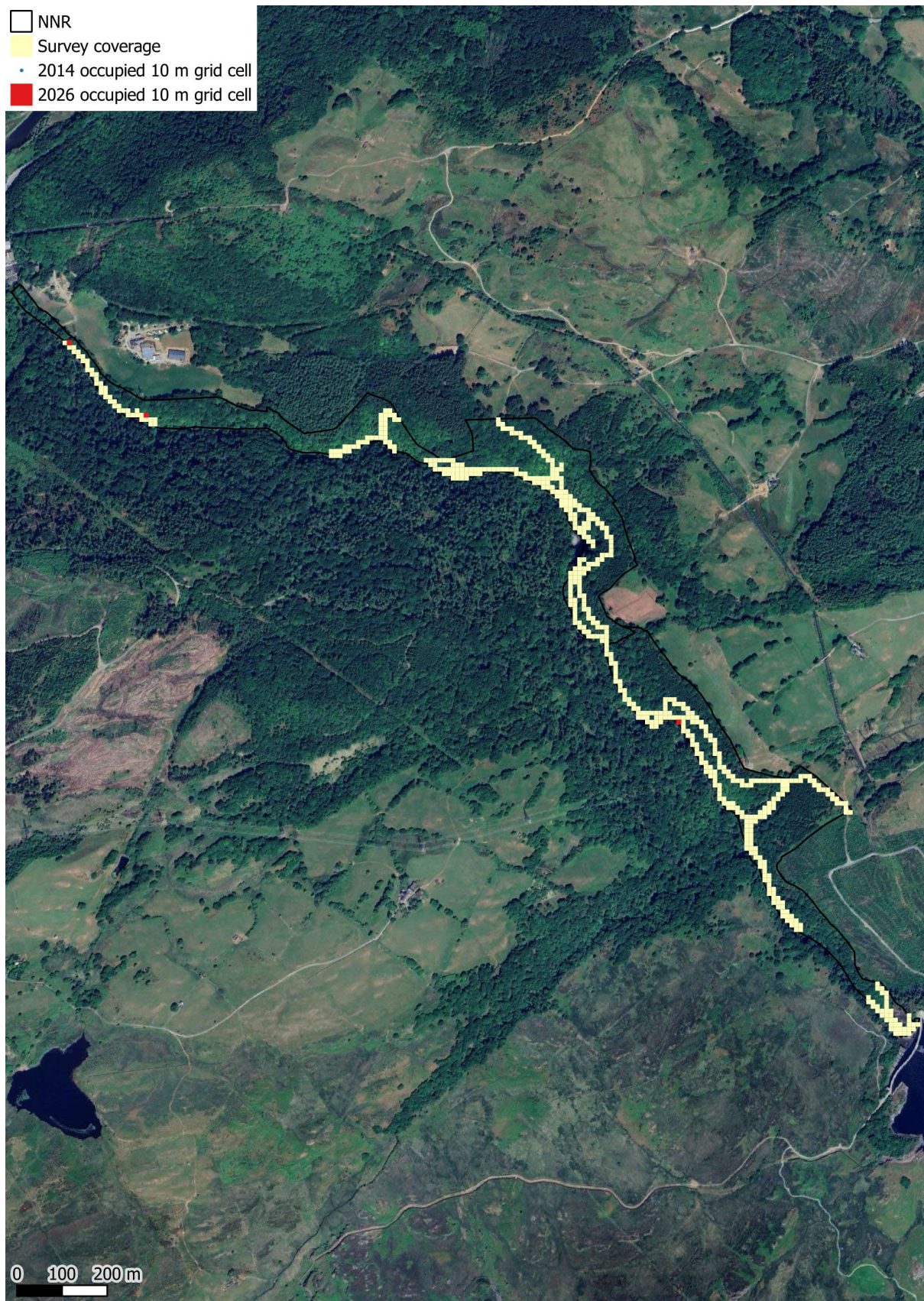
9.2.7. *Lepidozia pearsonii*



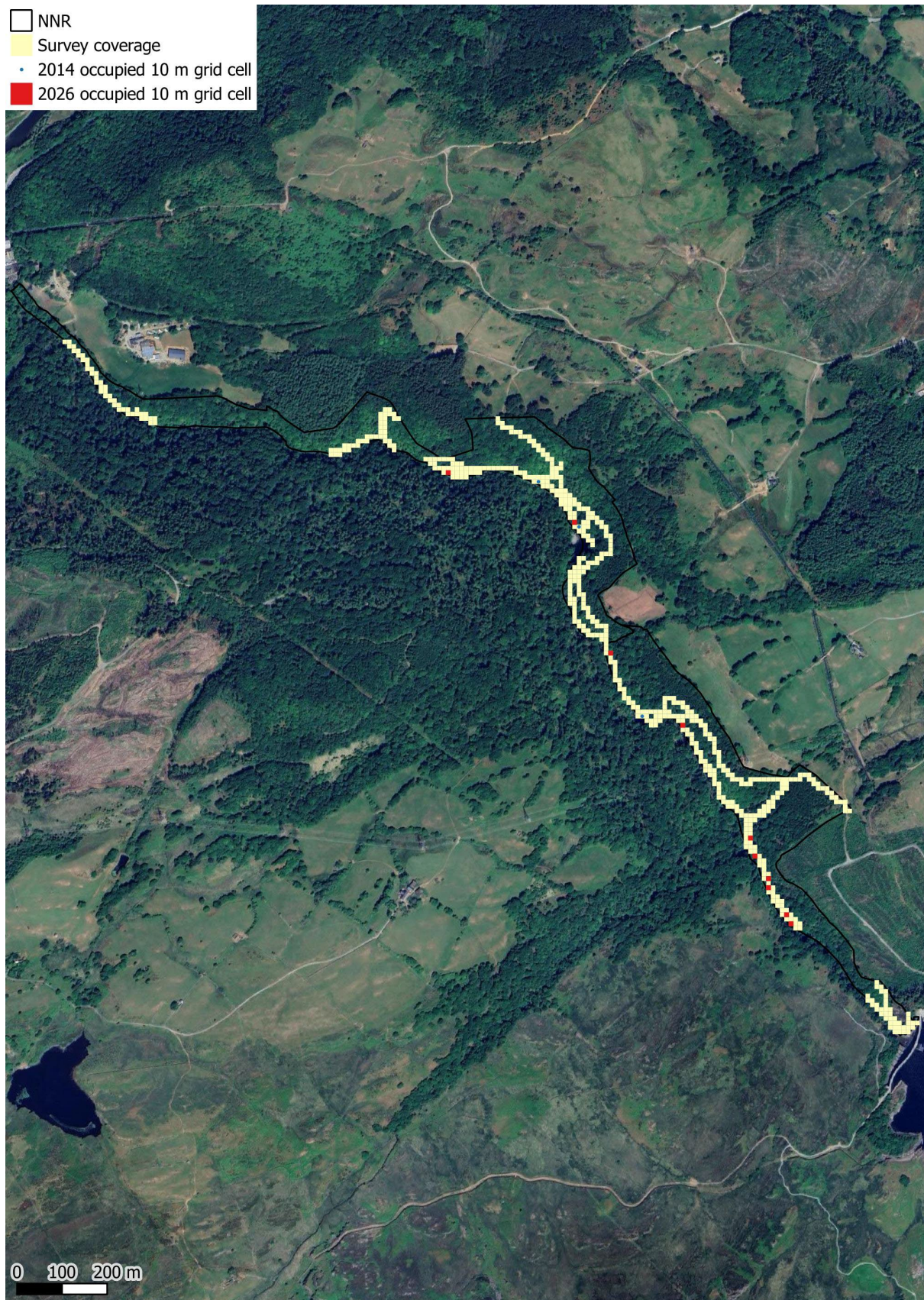
9.2.8. *Leptoscyphus cuneifolius*



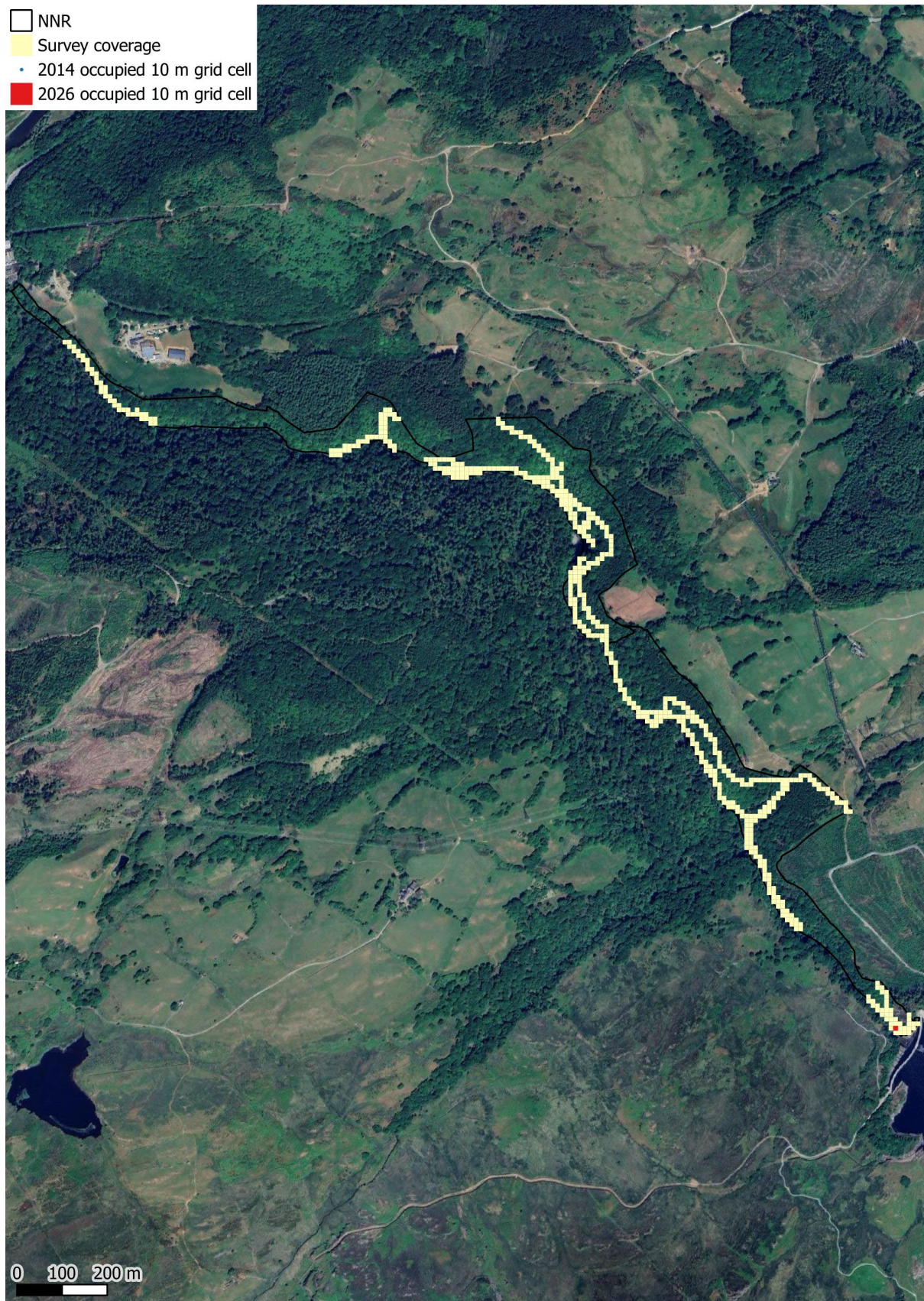
9.2.9. *Metzgeria leptoneura*



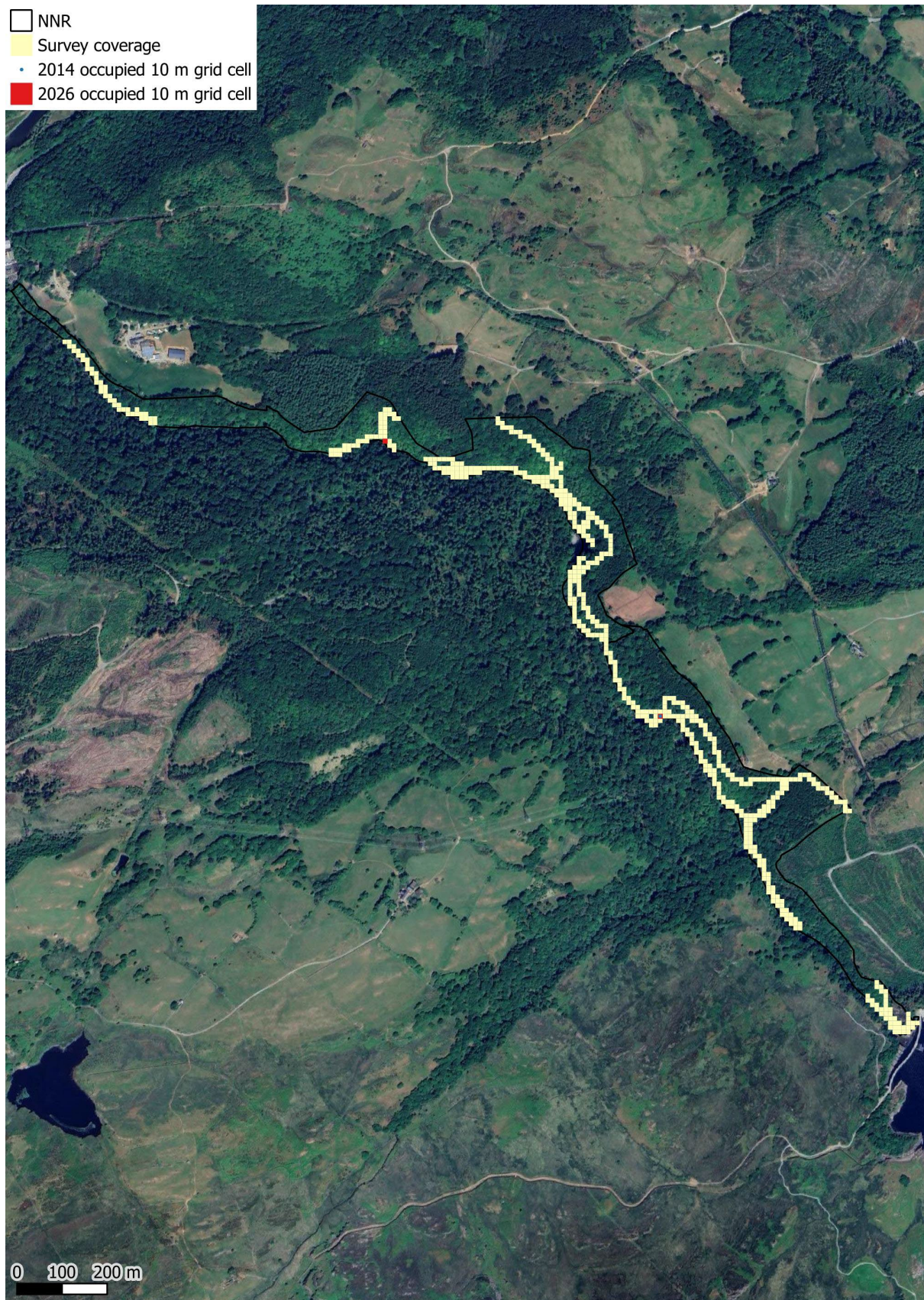
9.2.10. *Plagiochila exigua*



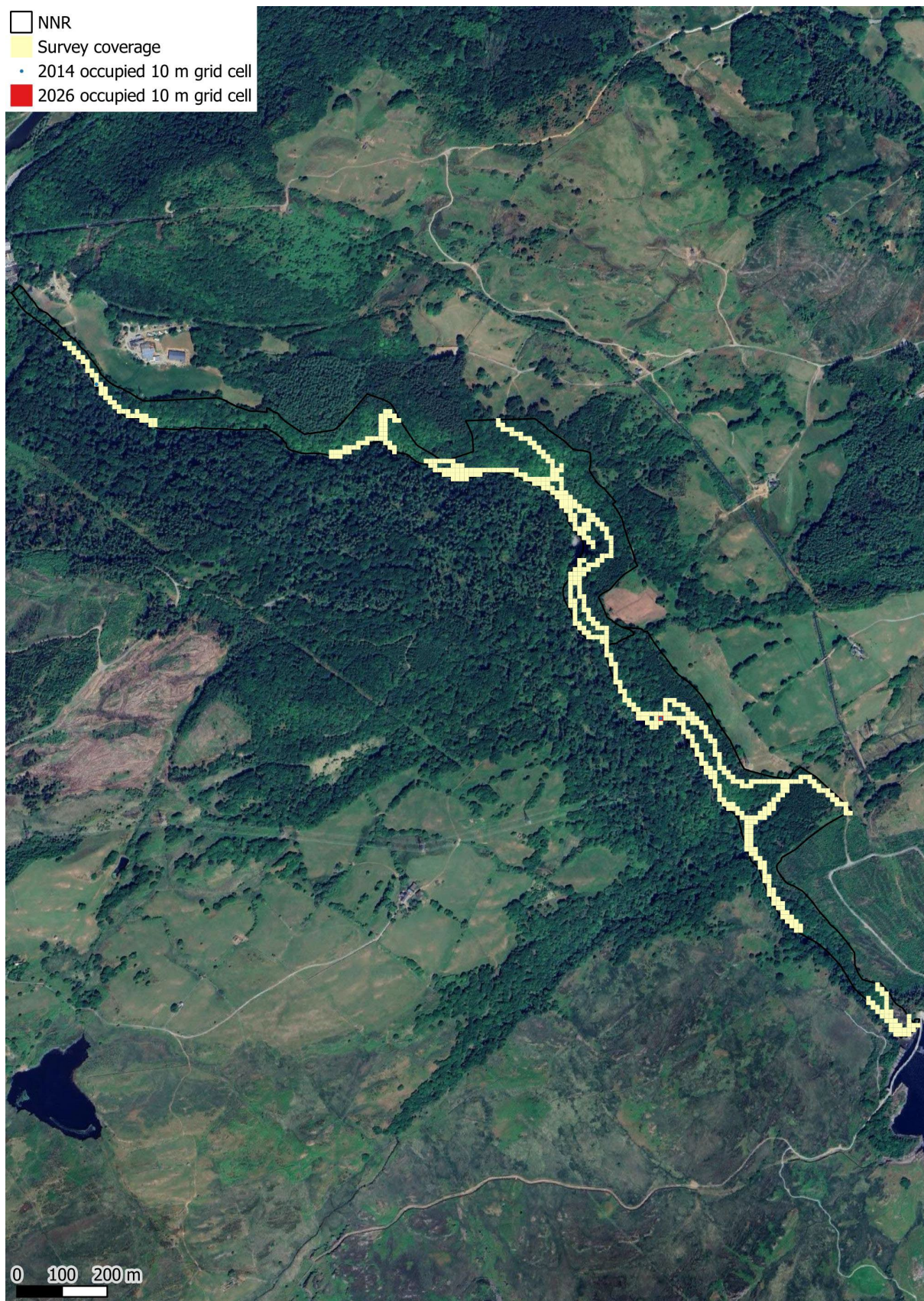
9.2.11. *Pseudomarsupidium decipiens*



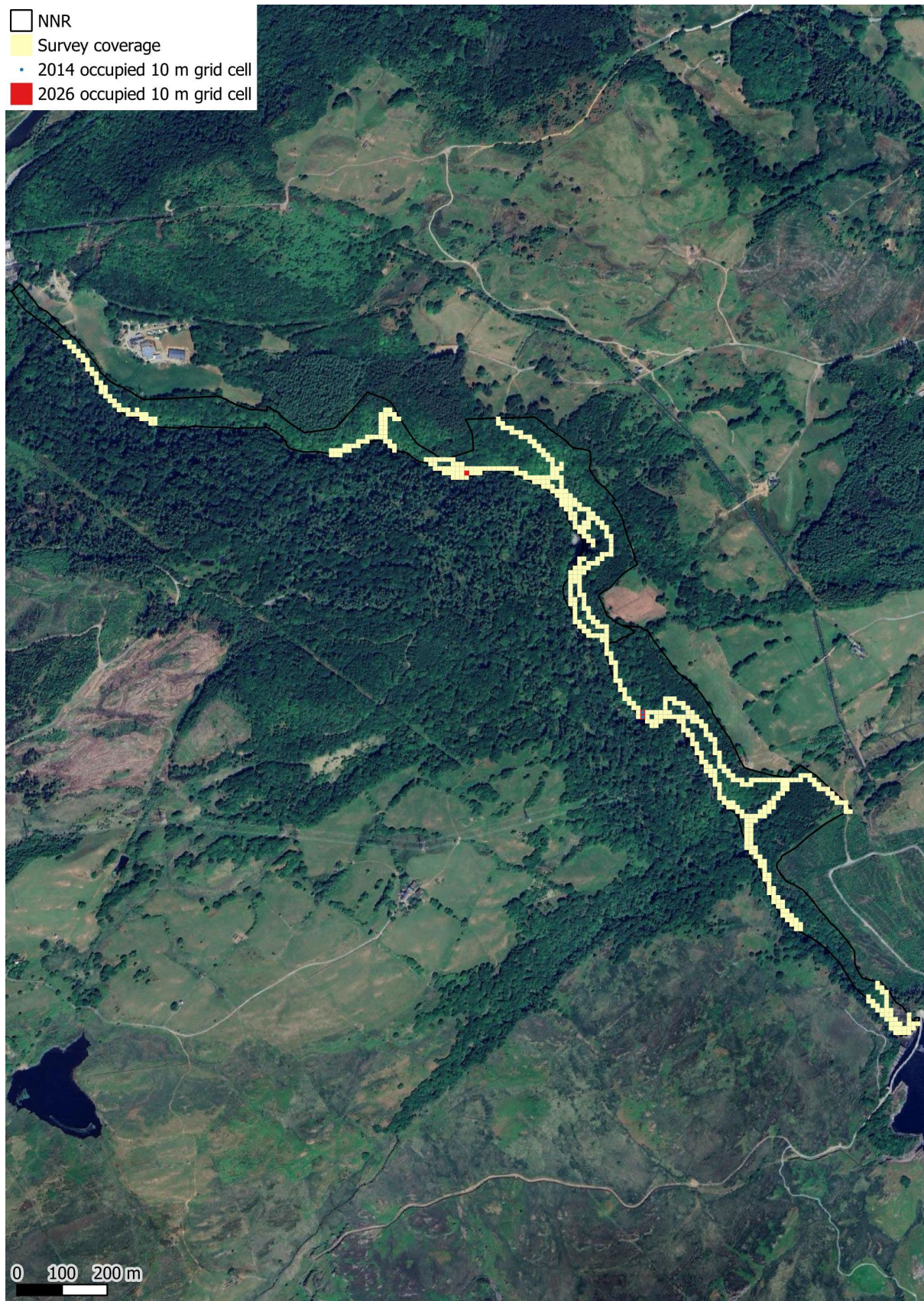
9.2.12. *Radula aquilegia*



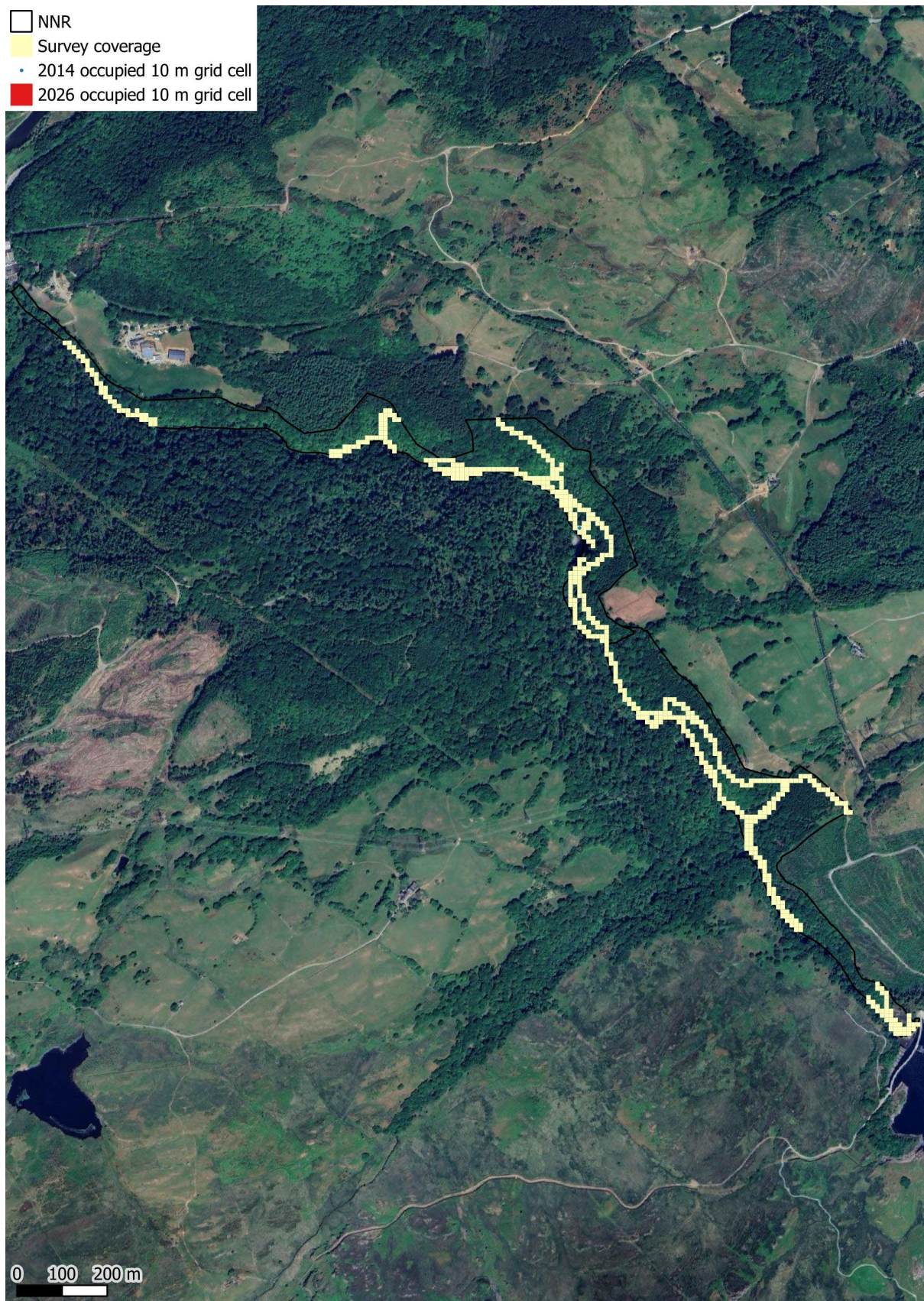
9.2.13. *Radula voluta*



9.2.14. *Sematophyllum demissum*



9.2.15. *Tritomaria exsecta*



9.3. Appendix 3: Fixed-point photographic monitoring plots

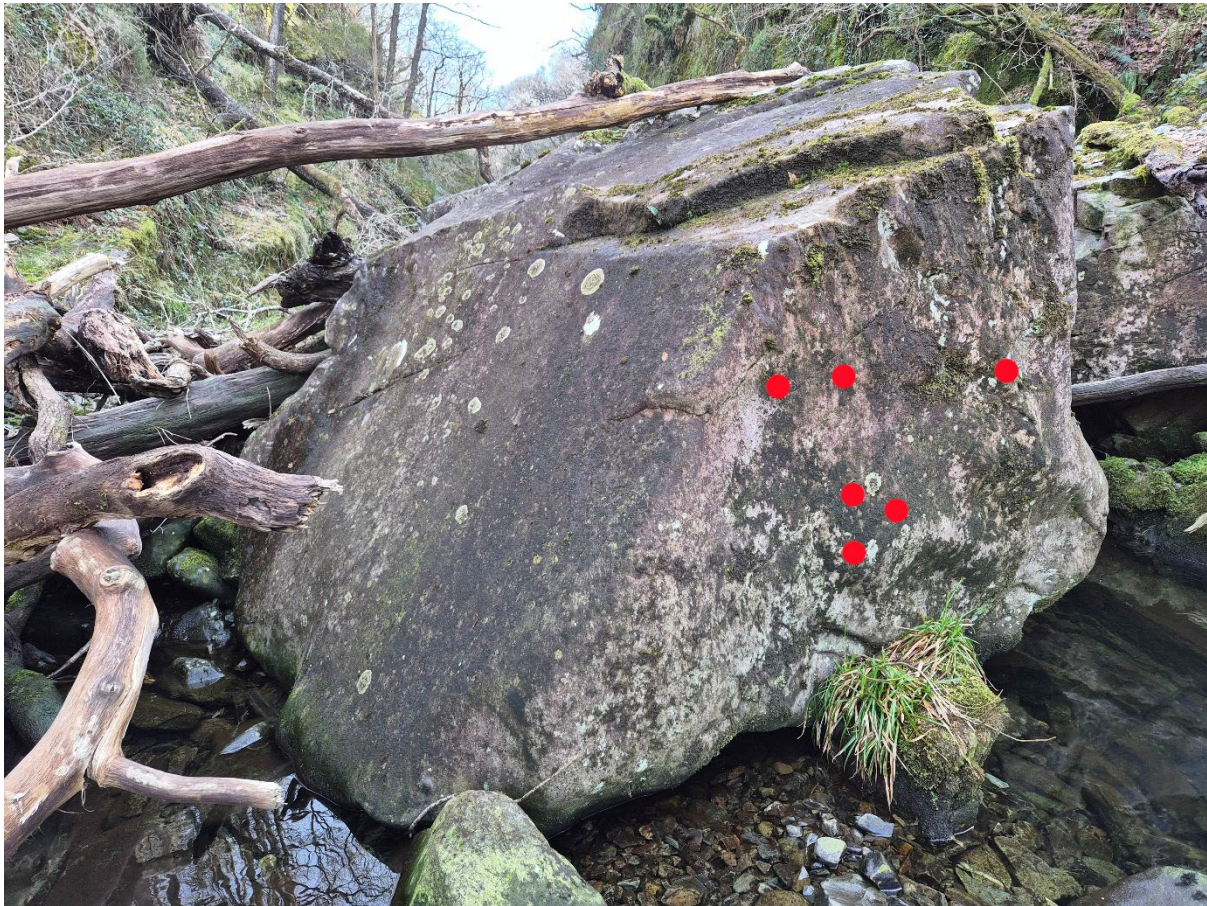


9.3.1. Plot 1



Grid reference	SH6705238246
Species of interest	<i>Jubula hutchinsiae</i> (red) on rockface beside river
Assessment	Plot 1 of Callaghan (2020). A small amount of <i>Metzgeria leptoneura</i> occurred here in 2020, but has now gone for reasons uncertain, but likely normal population dynamics. The abundance of <i>Jubula</i> , which occurs in small quantity, remains unchanged.

9.3.2. Plot 2



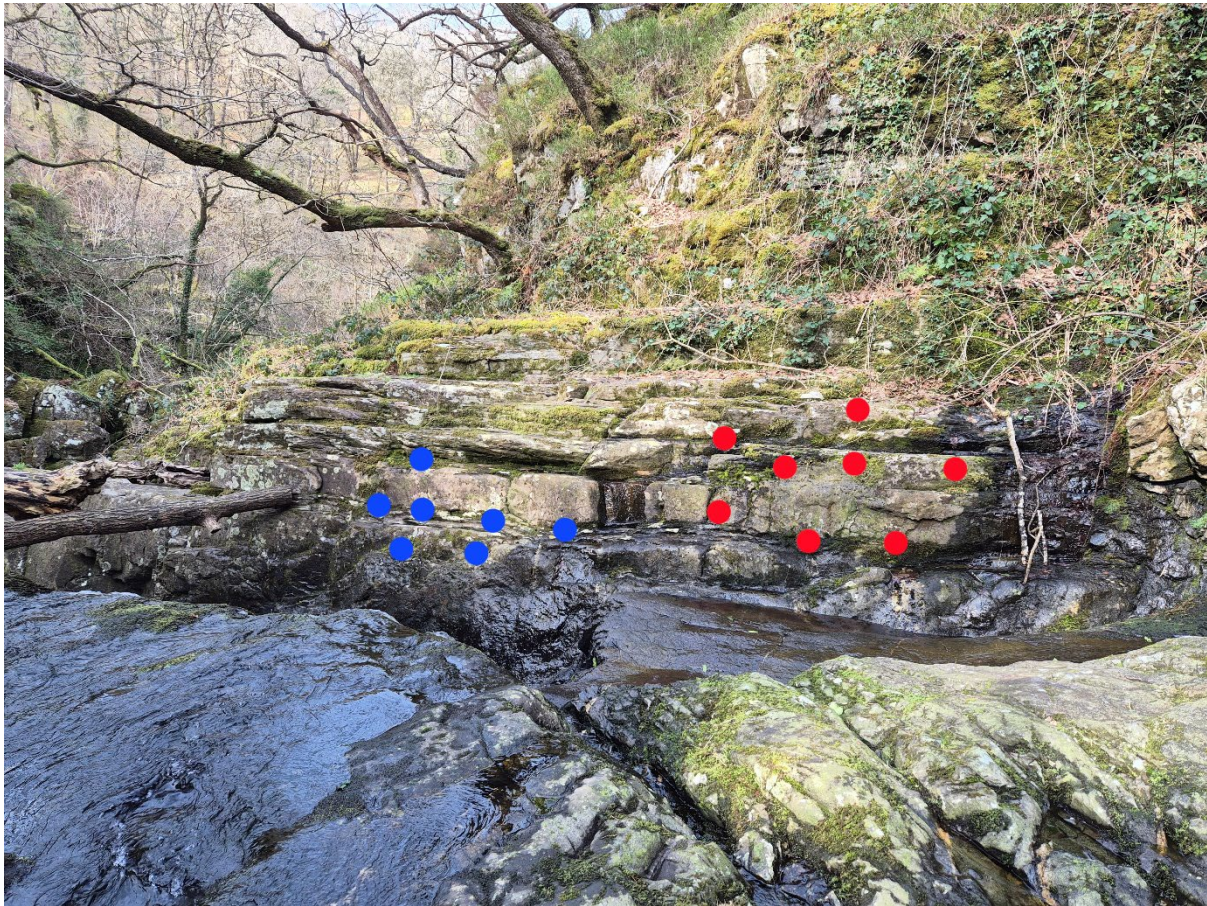
Grid reference	SH6706138202
Species of interest	<i>Leptoscyphus cuneifolius</i> (red) on face a large boulder in river. Also present on the boulder are <i>Colura calyptrifolia</i> (rare), <i>Cololejeunea microscopica</i> (rare), <i>Drepanolejeunea hamatifolia</i> (frequent), <i>Harpalejeunea molleri</i> (frequent), and <i>Plagiochila exigua</i> (rare).
Assessment	Plot 2 of Callaghan (2020). <i>Leptoscyphus cuneifolius</i> has increased and <i>Cololejeunea microscopica</i> has become newly established. The other species remain in similar abundance to 2020. This is the only location for <i>L. cuneifolius</i> in the NNR.

9.3.3. Plot 3



Grid reference	SH6715938025
Species of interest	Two cushions (15 x 10 cm and 7 x 10 cm) of <i>Bartramia halleriana</i> (red) at base of cliff
Assessment	Plot 3 of Callaghan (2020). No change.

9.3.4. Plot 4



Grid reference	SH6686138477
Species of interest	<i>Radula aquilegia</i> (blue) and <i>Radula voluta</i> (red), alongside <i>Cololejeunea microscopica</i> (frequent), <i>Drepanolejeunea hamatifolia</i> (frequent) and <i>Harpalejeunea molleri</i> (rare)
Assessment	Photograph 4.10 of Callaghan (2015) and Plot 4 of Callaghan (2020). Both <i>R. aquilegia</i> and <i>R. voluta</i> presently occur only as very small, scattered colonies at the locations indicated. In 2014, much larger colonies occurred at the same locations. This is a corridor that has become more heavily used by gorge-walkers since 2014, and the decline may be a result of that increased disturbance.

9.3.5. Plot 5



Grid reference	SH6681638480
Species of interest	<i>Sematophyllum demissum</i> (red), plus <i>Drepanolejeunea hamatifolia</i> (occasional) and <i>Cololejeunea microscopica</i> (rare)
Assessment	Photograph 4.12 of Callaghan (2015) and Plot 5 of Callaghan (2020). This is a main corridor used by gorge-walkers. There is evidence of damage to one large colony of <i>S. demissum</i> , but the disturbance keeps the habitat open and likely benefits the species overall. In 2020, <i>S. demissum</i> occupied 10 1 m grid cells, and in 2026 it also occupied 10, indicating no substantial change.

9.3.6. Plot 6



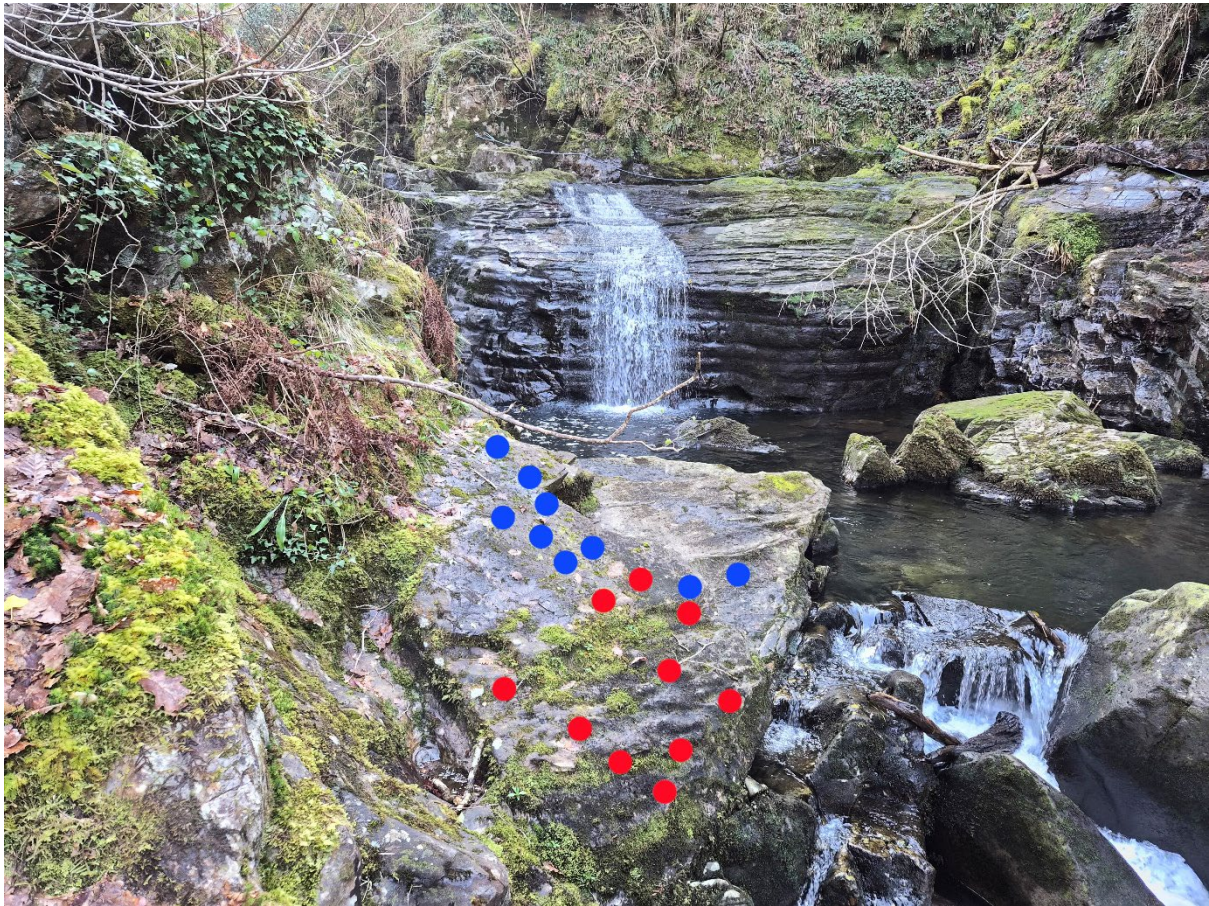
Grid reference	SH6667338817
Species of interest	Two patches (15 x 15 cm and 4 x 7 cm) of <i>Bartramia halleriana</i> (red)
Assessment	Plot 6 of Callaghan (2020). No significant change.

9.3.7. Plot 7



Grid reference	SH6555839304
Species of interest	Large colony of <i>Metzgeria leptoneura</i> (red) along seepage down rockface beside river
Assessment	New plot, and new location for <i>M. leptoneura</i>

9.3.8. Plot 8



Grid reference	SH6625439082
Species of interest	<i>Radula aquilegia</i> (red) and <i>Cololejeunea microscopica</i> (blue) on sloping rockface beside river cascade
Assessment	New plot, and new location for <i>R. aquilegia</i>

9.3.9. Plot 9



Grid reference	SH6706238248
Species of interest	<i>Sematophyllum demissum</i> (red) and <i>Harpalejeunea molleri</i> (blue) on large boulder beside river
Assessment	Same location as Plot 9 of Callaghan (2020). No significant change.

9.3.10. Plot 10



Grid reference	SH6620839089
Species of interest	<i>Cephaloziella turneri</i> (red) in crevices of rockface beside river
Assessment	Same location as Photograph 4.4 of Callaghan (2015) and Plot 10 of Callaghan (2020). <i>C. turneri</i> remains in very tiny amounts, just a few scattered shoots within the crevices, as was the case in 2014 and 2020.

9.3.11. Plot 11



Grid reference	SH6706238248
Species of interest	<i>Jubula hutchinsiae</i> (red) on rocks beside cascade in stream
Assessment	Same location as Photograph 4.5 of Callaghan (2015). Whilst strong colonies remain, <i>Jubula</i> has declined since 2014, for reasons uncertain, as the habitat appears unchanged, so perhaps related to natural population dynamics.

9.3.12. Plot 12



Grid reference	SH6572239142
Species of interest	Large colony of <i>Metzgeria leptoneura</i> (red) along seepage down rockface beside river
Assessment	New plot, and new location for <i>M. leptoneura</i>

10. Data Archive Appendix

Data outputs associated with this project are archived on server-based storage at Natural Resources Wales.

The data archive contains:

[A] The final report in Microsoft Word and Adobe PDF formats.

[B] A spreadsheet of records in Microsoft Excel format.

The metadata for this project is held as record no NRW_DS161544.

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