Environment and Rural Affairs Monitoring & Modelling Programme (ERAMMP)

ERAMMP Technical Annex-105TA1S11: Wales National Trends and Glastir Evaluation Supplement-11: Summary of Historic Environmental Asset (HEA) condition and threats

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UK Centre for Ecology & Hydrology

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Supplement-11: Summary of Historic Environmental Asset (HEA) condition and threats

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Approved by Bridget Emmett (UKCEH)
James Skates (Welsh Government)

Abbreviations Used in this Report

CADW	Welsh Government's historic environment service; Meaning of the word is “to keep” or “to protect”
CEH	Centre for Ecology and Hydrology
GMEP	Glastir Monitoring and Evaluation Programme
HEA	Historic Environment Asset
HEF	Historic Environment Features
SAM	Scheduled Ancient Monument
TG	Targeted Squares
UKCEH	UK Centre for Ecology & Hydrology
WAT	Welsh Archaeological Trusts
WW	Wider Wales

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1 HISTORIC ENVIRONMENT ASSET DATA AND ANALYSES

Two classes of Historic Environment Assets (HEAs) were assessed:

1. **Scheduled Ancient Monuments** (SAMs) which are nationally important with statutory protection under the Ancient Monuments and Archaeological Areas Act, and
2. **Historic Environment Features** (HEFs) which ware regionally important but without statutory protection.

During the two projects, GMEP (2013-16) and ERAMMP (2021-23), surveyors were trained by staff from CADW or the Welsh Archaeological Trusts (WAT) each year before the surveys started. They were trained in HEA condition assessment, and the assessment of threats to the HEAs. The condition was assessed in six categories, threats were assessed in four categories and extent and severity scores were assigned to the threats. The field process is detailed in the Field-Survey Handbook for Historic Features (Halfpenny et al. 2021).

HEAs were photographed, and their condition was assessed in six categories:

1. **Excellent condition**: Stable grass sward (no over or under grazing), no invasive species (bracken, bramble, gorse etc.) or tree/scrub growth, no evidence of erosion or poaching, no fencing or feeders.
2. **Sound with long standing defects**: Generally good condition, no erosion or scrub – long standing issues – would be mature tree cover or pre-existing fence, established track way through the site etc.
3. **Sound with minor defects**: Generally good condition – minor defects would be – localised poaching, surface trample – along stock or footpath routes, small amounts of invasive vegetation / scrub, minor wear around base of standing stones, minor vehicle track (not rutting), molehills, small amount of rubbish.
4. **Signs of potential deterioration**: Larger areas of trample, poaching that may well be persistent (i.e. not seasonally repairing), smaller active erosion scrapes, particularly on earthwork banks (active scars are where there does not appear to be any self-repairing taking place), tyre tracks (particularly on slopes) that have developed into established ruts, larger areas of established invasive vegetation and scrub, satellite badger setts, localised rabbit burrowing, dumping / fly tipping.
5. **Major signs of deterioration**: Large active badger setts, large rabbit warrens, vehicle ruts along slopes that have developed into water / run-off channels, large areas of active / persistent erosion (includes active and self-repairing areas), extensive bracken, bramble and gorse cover, extensive / established scrub / tree regen, ploughing, encroachment, cultivation.
6. **Damaged**: This will be as a result of human actions, either a single event or a series of inter-related activities that have resulted in damage to the site. For example excavation with a machine, quarrying, development over the site, stone robbing, over enthusiastic ditch clearance, ploughing etc.

Categories 1 to 3 can be summarized into **Excellent or sound condition**, categories 4 to 6 can be categorized into **Deteriorated or damaged**.

Threats to HEAs were assessed in four categories:

1. **Agricultural Operations**: Ploughing, Pasture improvement, Stone clearance, Tyre tracks - rutting, Farm track, Tyre tracks - surface, Building deterioration, No data, Dumping - FYM, agricultural machinery, agricultural waste/rubbish etc, Agricultural buildings, Drainage

2. **Other**: Natural decay, Development, Quarrying, Stone removal, Water channel erosion, Coastal erosion, Footpath wear, No data, Rubbish / Flytipping, Utility poles

3. **Stock**: Stock wear, Stock path wear - surface, Stock path wear - bare ground, Stock path wear - eroded areas, Erosion, Burrowing animals - rabbits, Burrowing animals - moles, No data, Poaching

4. **Vegetation**: Windblown trees, Gorse, Rushes, Dying trees, Bracken, Afforestation - broadleaf, Scrub - broadleaf, Afforestation - mixed, Bramble, Dead trees, Wind throw hazard, Afforestation - conifer, Scrub - mixed, No data, Scrub - conifer

The extent of the threat (low, medium, high) and the severity (scores 1 to 6 with 1 being the least severe and 6 the most severe) were assessed. Unfortunately, in 2013-16, information on extent and severity were rarely reported. For the current analysis, extent and severity are not considered.

The original 300 GMEP squares are composed of 150 Wider Wales (WW) squares, and 150 Targeted Squares (TG). The WW squares were chosen using stratified random sampling; these squares are used to analyse the Welsh National Trend of HEA condition over time. The 150 TG squares were chosen to capture Glastir options for assessing the impact of the Glastir agri-environment scheme. HEAs were assessed in the same way in both square types.

During GMEP, CADW (2013), the Archaeological Trust (2014) and the Centre for Ecology & Hydrology (CEH, 2015-2016) provided information on HEAs within the 300 GMEP survey squares. A total of 148 of the 300 squares had at least one HEA located within them. In the 300 GMEP squares, 461 HEAs documentations were available to surveyors. Not all HEAs were surveyed, mainly because of refused access to the land holding the HEAs. The 2021-23 re-survey of the original 300 squares in GMEP covered 234 squares. Out of these 234 squares, 95 squares had HEAs located within them.

In 2013-16, HEA information (ID, map, description of HEA) was provided on paper copies, and the HEA assessment was carried out in writing on survey sheets. A maximum of seven HEAs were surveyed in each square even if more HEAs were present. Survey sheets were returned to CEH, data was transferred to Microsoft Excel (.xls), and data was checked for completeness and correctness given the information and scoring provided. Only one entry on condition was allowed for each found HEA. If more than one condition was recorded (e.g. for a tramway with sections showing different conditions), the worst condition was kept because this was seen as being the limitation for a better condition score.

In 2021-23 surveyors received the same (printed) field sheets as the surveyors in 2013-16, but survey data were entered on a rugged field tablet using the ArcGIS software Survey123. Incoming data was checked for completeness of information and consistency. Surveyors were contacted before the field survey seasons had finished if data entries were incomplete or notes unclear. After the 2021-23 survey had finished, HEA data from Survey123 were exported as .csv files:

- One file contained general surveying information, HEA condition, notes, and a unique record ID. This file was checked for consistency with historic records on square and unique HEA IDs, for notes and survey information. Notes were read,

and entries were changed accordingly; e.g. the surveyor ticked that the HEA was found, but the notes say it wasn't found. Only one entry on condition was allowed for each found HEA with the worst condition being kept for analysis.

- Four more files were created, one for each threat category. These contained information on threat severity and extent related to the unique HEA record IDs. The four "threat" files were combined into one .csv file by introducing a column called "threat type" using R (version 4.4.0). The unique HEA record ID was used to merge datasets to assess the impacts of threats on HEA condition.

All changes to the raw data entries were logged in a change log (Excel file) for each of the survey years (2021-2023). Data were combined and analysed using R (version 4.4.0).

Two R Markdown scripts were produced, documenting the Welsh National Trends and Glastir analyses respectively. This Supplement represents the word output of both Markdown outputs combined, including tables, figures and statistical outputs. These analyses provide the basis for Section 7.2 of the ERAMMP Technical Annex-105TA1: Wales National Trends and Glastir Evaluation (Emmett et al., 2025).

1.1 Statistical analyses

1.1.1 Notes on HEA data and data analyses

HEA condition and threat data are recorded in categories (as opposed to continuous variables). This means that the data analysis looks different from that of other Supplements (Jarvis et al., 2025). An ordinal regression analysis is applied to the HEA condition and threat data. The analysis was adapted from UCLA Ordinal Logistic Regression[1]. This analysis does not allow for the inclusion of error terms. Error terms in a model would e.g. include information when multiple HEAs were located in one square. Further, HEA conditions and threats cannot easily be analysed on a broad habitat basis as 1) this information was not collected in the field, and 2) HEAs vary considerably in size and may or may not extend across more than one broad habitat (e.g. a standing stone vs. a tramway).

The HEA dataset contains the two time periods 2013-16 and 2021-23 (all HEA data) (Figure 1-1). Data fall into the categories: WW and TG squares. A number of WW and TG squares were surveyed for HEAs during both time periods. Only HEA data from WW squares were analysed for the Welsh National Trend, looking at all HEA data, or data on re-surveyed HEAs only. For the Glastir analysis, data from both, WW and TG squares, were used and analysed for all HEA data and re-surveyed HEAs only.

Looking at both, all HEA data compared to re-surveyed HEAs, allows us to understand if a trend seen for all data is supported by information on direct re-surveys of HEAs (and vice versa).

[1] www.stats.oarc.ucla.edu/r/dae/ordinal-logistic-regression/

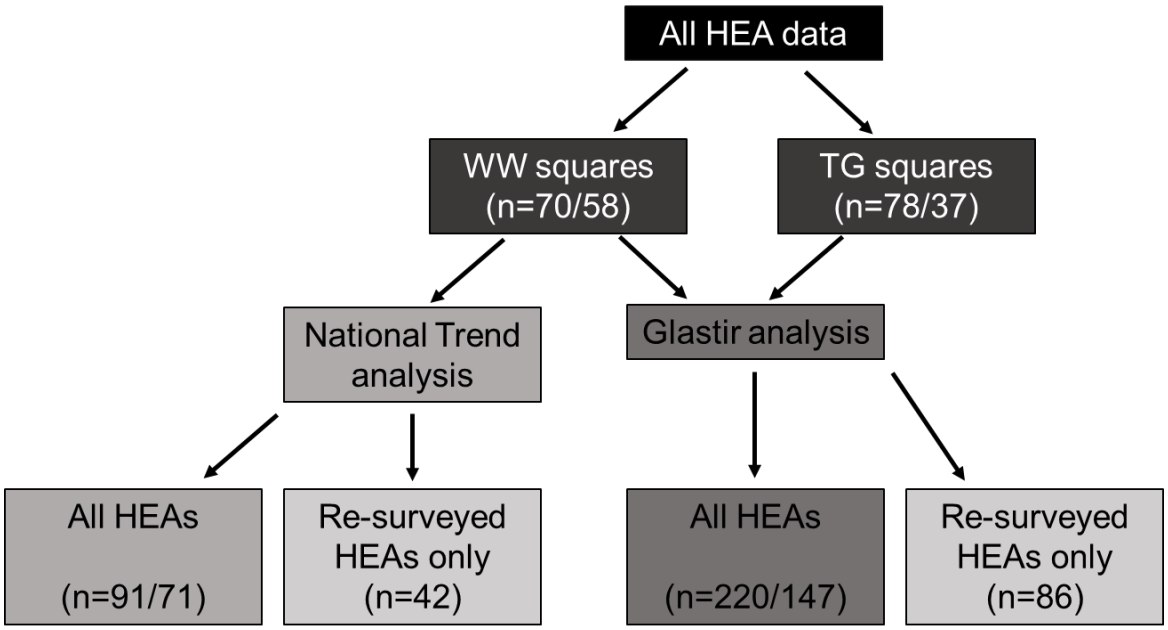

Figure 1-1: Conceptual diagram of data subsets for different statistical analyses of Historic Environment Assets (HEAs). WW = Wider Wales, TG = Targeted; numbers in brackets show values for 2013-16/2021-23.

1.1.2 Notes on the ordinal and binomial analyses

The R package “MASS” and the function “polr” within was used for statistical analyses. For binomial regression, the package “aod” with the function “glm” was used.

A condition score (CONDITION_SCORE) was assigned to each HEA condition with 1 being excellent to 6 being damaged. The statistical significance is interpreted based on the 2.5% and the 97.5% intervals: if both values of the test are negative or positive, the result is statistically significant. If the two values span a range overlapping zero, the result is not statistically significant.

A binomial regression was performed for the condition data in two categories (CONDITION_3) when the conditions were grouped into “Excellent or sound condition” and “Deteriorated or damaged”. Statistical significance is again displayed by values of the 2.5% and 97.5% intervals not overlapping zero.

2 RESULTS

2.1 National Trends

The data analysis of this chapter was performed on data from WW squares only (Figure 1-1). Presented are a set of tables, figures and statistical analyses.

2.1.1 Survey status of HEAs in Wider Wales squares

Data entries for HEAs were classed in three categories:

0 = not found / no information

1 = surveyed

2 = no access Note: in 2013-16, information on HEAs was not always available at the time the square was surveyed; also information on "no access" was actively recorded in 2021-23 but in 2013-16.

Table 2-1 National trend overview of all surveyed Historic Environment Assets (HEAs) for each survey period; 0 = not found / no information, 1= surveyed, 2 = no access, blue cells show the number of surveyed HEAs.

National Trend	Survey status	Count
2013-16	0	78
	1	91
	2	48
2021-23	0	10
	1	71
	2	78

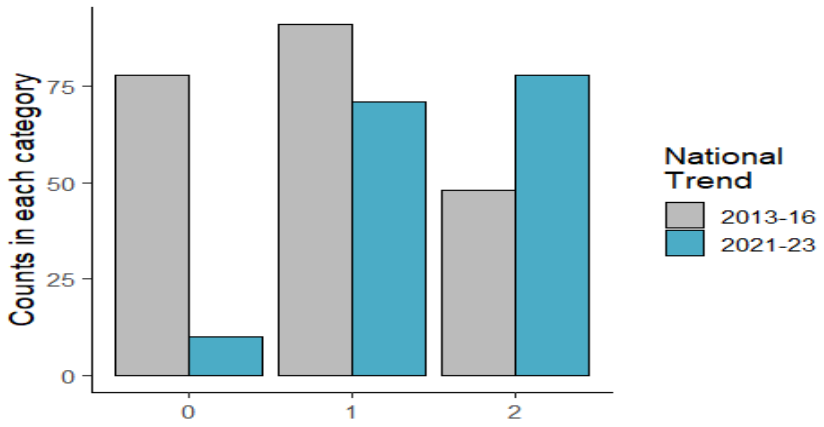

Figure 2-1 National trend counts of all surveyed Historic Environment Assets; 0 = not found / no information, 1= surveyed, 2 = no access.

In total, 91 HEAs were surveyed in 2013-16 (42%) compared to 71 HEAs in 2021-23 (45%). In 2013-16 most HEAs were not surveyed due to missing information or HEAs were not found. In 2021-23, most of the none surveyed HEAs were in areas without landowner access permission.

2.1.2 National trend counts of re-surveyed HEAs

Table 2-2 National trend count for re-surveyed Historic Environment Assets (HEAs) for 2013-16 and 2021-23.

National Trend	Re-surveyed HEAs	Count
2013-16	No	49
	Yes	42
2021-23	No	30
	Yes	42

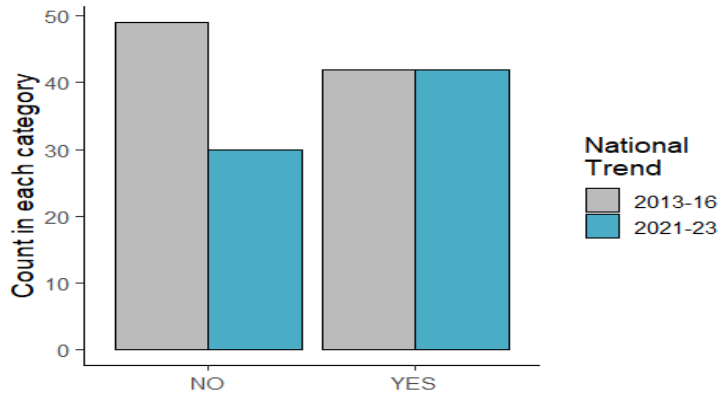

Figure 2-2 Counts of re-surveyed Historic Environment Assets.

Out of the 91 HEAs surveyed 2013-16, 42 were re-surveyed in 2021-23 (46%).

2.1.3 National Trend of HEA condition

Table 2-3 National trend of Historic Environment Asset conditions count.

National trend	Condition	Count
2013-16	Damaged	9
	Excellent condition	11
	Major signs of deterioration	14
	Signs of potential deterioration	14
	Sound with long standing defects	14
	Sound with minor defects	29
2021-23	Damaged	5
	Excellent condition	10
	Major signs of deterioration	11
	Signs of potential deterioration	17
	Sound with long standing defects	17
	Sound with minor defects	12

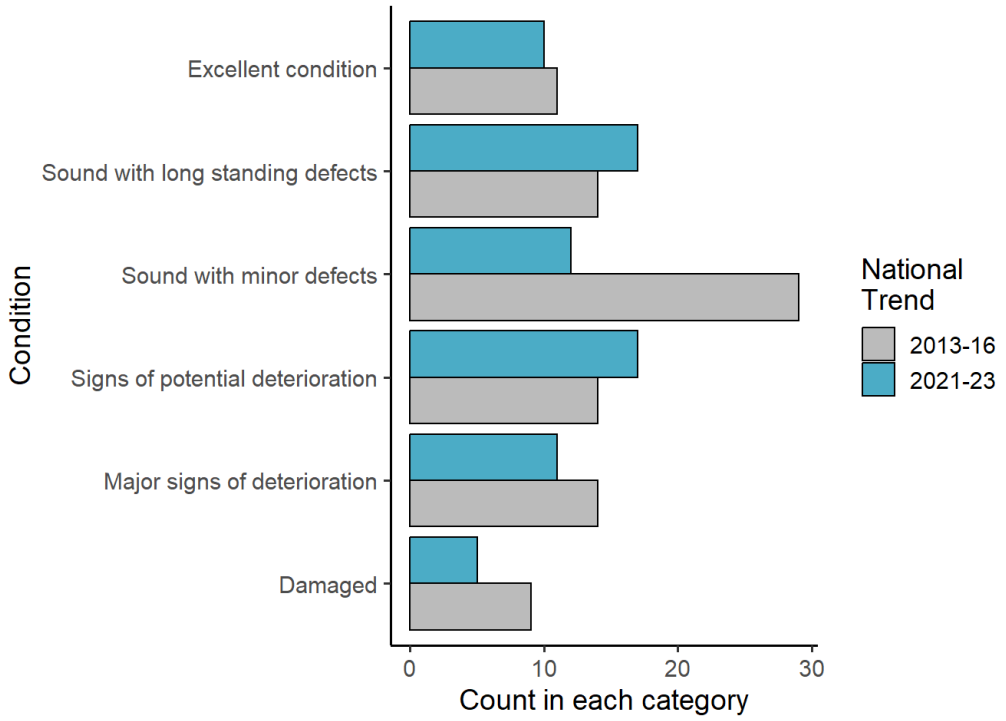

Figure 2-3 National Trend of Historic Environment Asset condition counts over time.

2.1.4 Ordinal analysis of all HEA conditions - National Trends

```
## Call: Six condition categories
## polr(formula = CONDITION_SCORE ~ PROJECT, data = m3.1_input,
##     Hess = TRUE)
##
## Coefficients:
##                   Value Std. Error t value
## PROJECT2021-23 -0.1399     0.2791 -0.5012
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -1.9747  0.2666    -7.4081
## 2|3 -0.8187  0.2072    -3.9511
## 3|4  0.2241  0.1983     1.1300
## 4|5  1.0952  0.2204     4.9702
## 5|6  2.3044  0.3039     7.5817
##
## Residual Deviance: 567.2765
## AIC: 579.2765

##                       2.5 %    97.5 %
## PROJECT2021-23 -0.6868281 0.4071005 Not significant
```

The ordinal model tests if time (2013-16 vs 2021-23) has an effect on HEA condition (six condition classes). The output suggests that time had no effect on HEA condition. (This can be seen in the 2.5% and 97.5% intervals overlapping zero).

2.1.5 HEA condition in WW squares in two categories

Table 2-4 National trend of Historic Environment Asset conditions count in two categories.

National Trend	Condition	Count
2013-16	Deteriorated or damaged	37
	Excellent or sound condition	54
2021-23	Deteriorated or damaged	33
	Excellent or sound condition	39

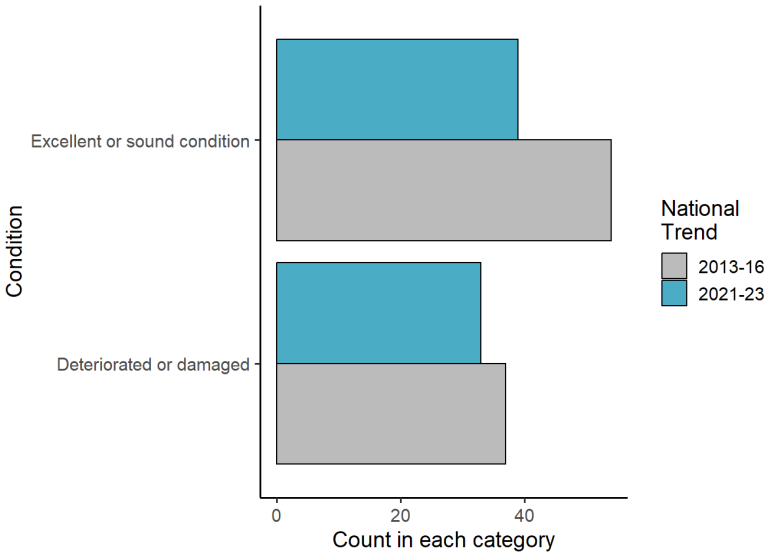

Figure 2-4 Historic Environment Asset condition counts in two categories over time.

2.1.6 Binomial regression

```
## Call: Two condition classes
## glm(formula = CONDITION_3 ~ PROJECT, family = "binomial", data = binomial)
##
## Coefficients:
##                Estimate Std. Error z value Pr(>|z|)
## (Intercept)      0.3781     0.2134   1.772   0.0765 .
## PROJECT2021-23  -0.2110     0.3186  -0.662   0.5077
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 222.71  on 162  degrees of freedom
## Residual deviance: 222.27  on 161  degrees of freedom
##   (213 observations deleted due to missingness)
## AIC: 226.27
##
## Number of Fisher Scoring iterations: 4

##                       2.5 %    97.5 %
## (Intercept)     -0.03628901 0.8033798
## PROJECT2021-23 -0.83757664 0.4139721 Not significant
```

The binomial model shows that the two categories are not significantly different from each other (2.5% and 97.5% intervals overlapping zero). Time also has no impact on the two-category condition.

2.1.7 National trend: condition of re-surveyed HEAs

Below is the same conditional analysis as above, but on the re-surveyed subset of HEAs (n=42).

Table 2-5 Condition of re-surveyed Historic Environment Assets over time.

National Trend	Condition	Count
2013-16	Damaged	6
	Excellent condition	6
	Major signs of deterioration	6
	Signs of potential deterioration	8
	Sound with long standing defects	4
	Sound with minor defects	12
2021-23	Damaged	2
	Excellent condition	5
	Major signs of deterioration	6
	Signs of potential deterioration	12
	Sound with long standing defects	8
	Sound with minor defects	9

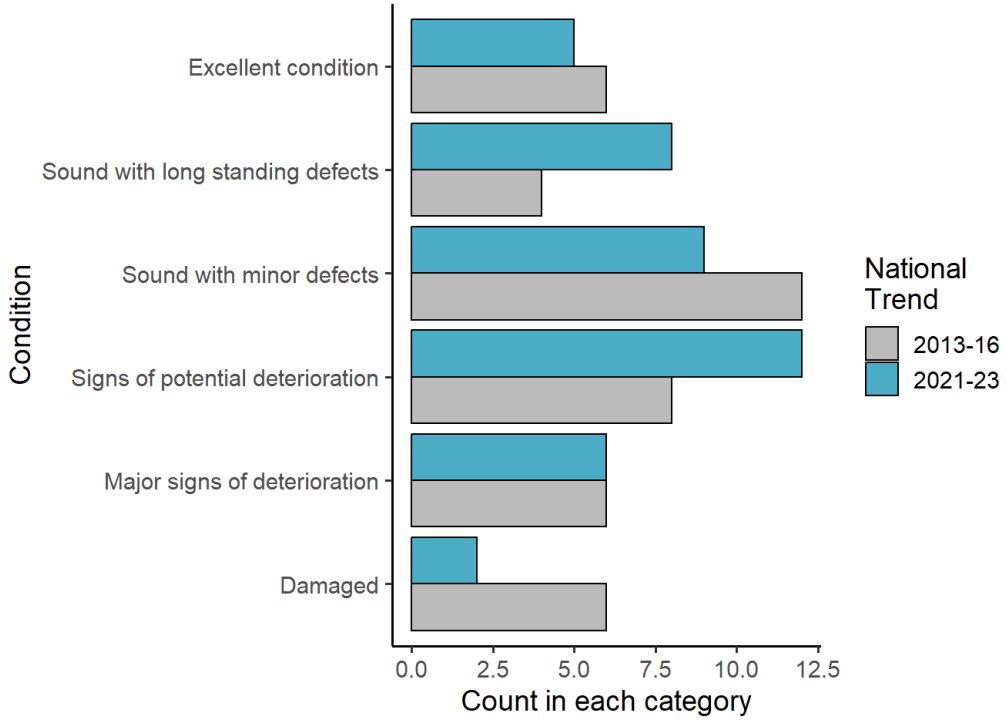

Figure 2-5 National Trend condition counts of re-surveyed Historic Environment Assets over time.

2.1.8 Ordinal regression for re-surveyed HEAs

```
## Call: Six condition classes
## polr(formula = CONDITION_SCORE ~ PROJECT, data = m4.1_input,
##     Hess = TRUE)
##
## Coefficients:
##                  Value Std. Error t value
## PROJECT2021-23 -0.252     0.3865  -0.652
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -2.0282  0.3865    -5.2481
## 2|3 -1.1085  0.3203    -3.4614
## 3|4 -0.0358  0.2970    -0.1204
## 4|5  1.0327  0.3238     3.1893
## 5|6  2.1266  0.4166     5.1050
##
## Residual Deviance: 290.9519
## AIC: 302.9519

##                    2.5 %    97.5 %
## PROJECT2021-23 -1.009585 0.5055732 Not significant
```

The ordinal model tests if time has an effect on HEA condition (six classes). Time in this case is the difference between the two projects, 2013-16 and 2021-23. The output suggests time had no effect on HEA condition. (This can be seen in the 2.5% and 97.5% intervals overlapping zero). Thus, the result is the same for the full set of HEAs and the re-surveyed subset.

2.1.9 Condition of re-surveyed HEAs in two categories

Table 2-6 National trend of Historic Environment Asset conditions count for re-surveyed assets between 2013-16 and 2021-23 in two categories.

Condition	Count
Deteriorated or damaged	20
Excellent or sound condition	22

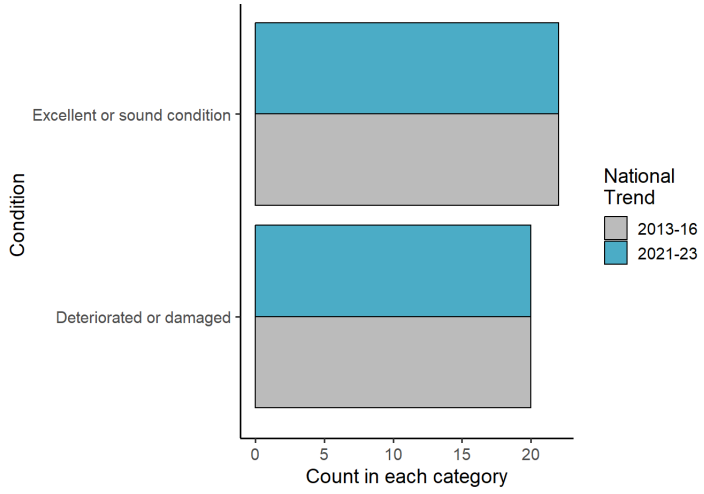

Figure 2-6 National Trend for Historic Environment Asset condition counts for re-surveyed assets in two categories over time.

2.1.10 Binomial regression for re-surveyed HEAs

```
## Call: Two condition classes
## glm(formula = CONDITION_3 ~ PROJECT, family = "binomial", data = binomial)
##
## Coefficients:
##                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)     9.531e-02  3.090e-01   0.308    0.758
## PROJECT2021-23 -1.552e-15  4.369e-01   0.000    1.000
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 116.26  on 83  degrees of freedom
## Residual deviance: 116.26  on 82  degrees of freedom
## AIC: 120.26
##
## Number of Fisher Scoring iterations: 3

##                      2.5 %    97.5 %
## (Intercept)    -0.5119551 0.7084569
## PROJECT2021-23 -0.8596832 0.8596832 Not significant
```

The binomial model shows that the two categories are not significantly different from each other (2.5% and 97.5% intervals overlapping zero). Time also has no impact on the two-category condition. This is the same result for the complete set of HEAs in WW squares.

2.1.11 National Trend direction of change for re-surveyed HEAs

For re-surveyed HEAs, we can check if the condition of the HEAs has improved or worsened over time. For this, the six condition categories were converted to numbers 1 to 6 with 1 being Excellent condition and 6 being damaged. The difference in condition scoring was calculated by subtracting the ERAMMP condition score from the 2013-16 condition score.

In Figure 2-7, a score of 0 shows that the re-survey of the HEAs was assigned the same condition in both project. A positive score shows an improvement in condition, and a negative score a worsening in condition.

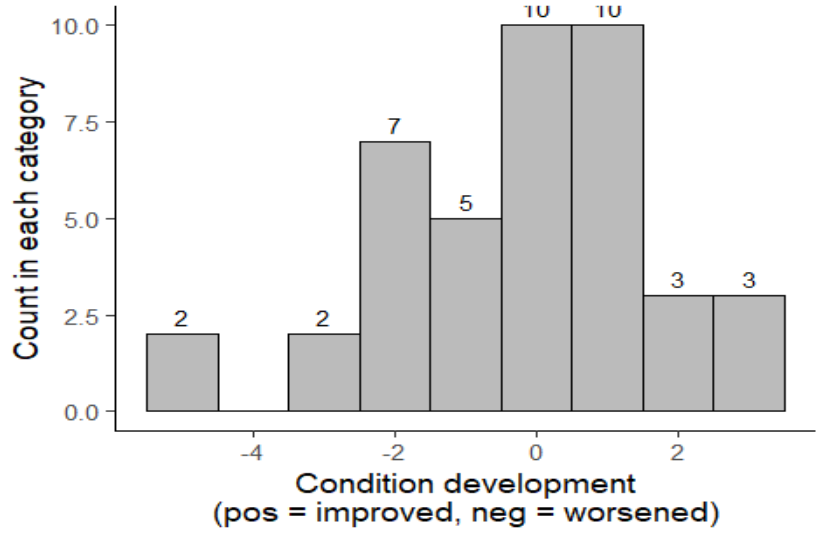

Figure 2-7 National trend Historic Environment Asset condition development from 2013-16 to 2021-23.

There is no clear direction in condition development overall, although condition scores change over time, and there are more extreme declines in condition than improvements.

2.1.12 Overview of HEA types in WW squares

The HEA type was aggregated into broader categories. For example, the category **Settlement** is comprised of: Medieval settlement, Hut circle settlement, Medieval deserted rural settlement, Pre-historic hut circle settlement, Pre-historic settlement, Iron age hut circle settlement. Or **Enclosures** is an aggregate of: Enclosure, Post-medieval deserted rural settlement, unknown enclosure, Medieval enclosure, Pre-historic enclosure.

Table 2-7 List and count of Historic Environment Asset types for 2013-16 and 2021-23.

National Trend	HEA type	Count
2013-16	Barrow	2
	Building	3
	Colliery	2
	Cottage	6
	Earthwork	2
	Enclosure	10
	Farmstead	9
	Field system	1
	Fort	2
	Grounds	1
	House	7
	Hut	3
	Kiln	2
	Level	2
	Mine	1
	Motte	2
	Other	3
	Quarry	5
	Ridge and furrow	4
	Stone	2
	Transport	6
	Unknown	3
	Water body	13
2021-23	Barrow	1
	Building	2
	Cottage	4
	Dyke	1
	Earthwork	3
	Enclosure	6
	Farmstead	7
	Field system	2

National Trend	HEA type	Count
	Fort	2
	Grounds	3
	House	3
	Hut	2
	Kiln	2
	Leat	1
	Level	1
	Mill	1
	Mine	2
	Mound	1
	Other	4
	Quarry	4
	Ridge and furrow	1
	Settlement	1
	Transport	9
	Unknown	1
	Water body	7

2.1.13 HEA types surveyed in 2013-16 in WW squares

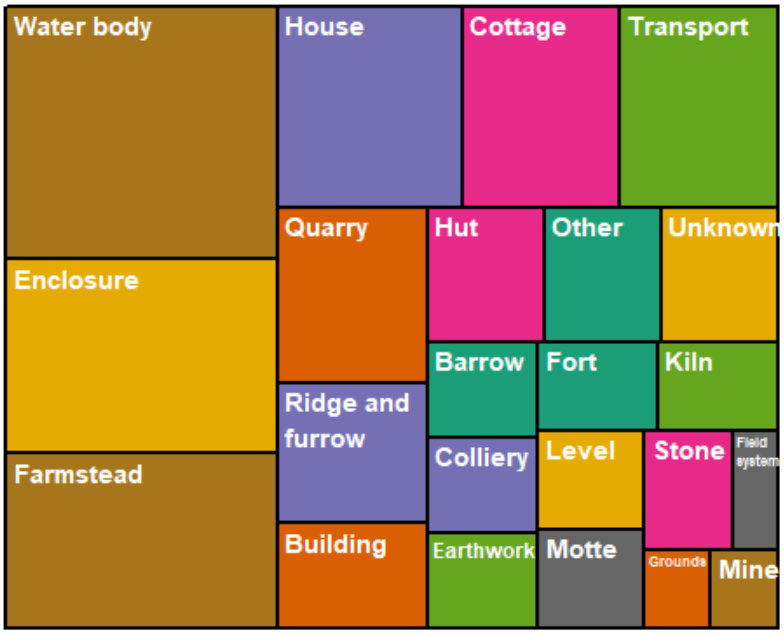

Figure 2-8 Historic Environment Asset types 2013-16 (n = 96); size of boxes represent count of asset type.

2.1.14 HEA types surveyed 2021-23 in WW squares

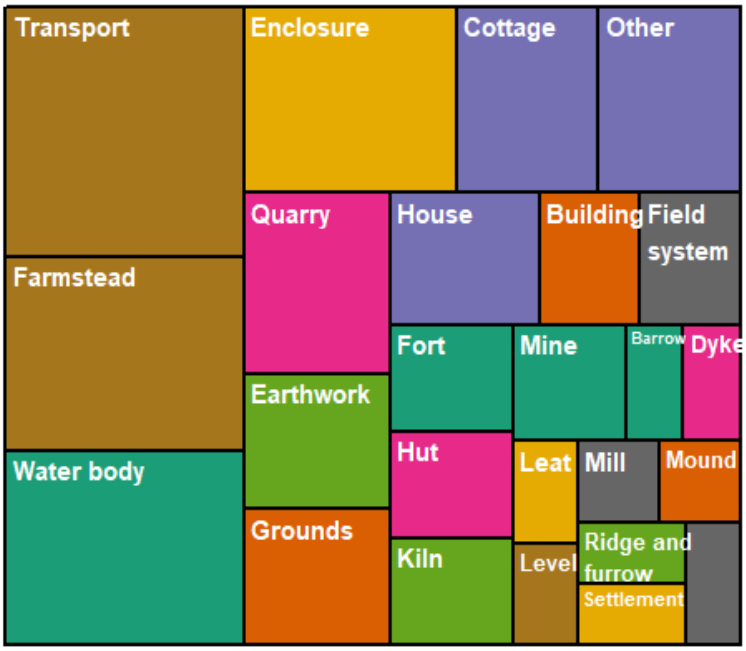

Figure 2-9 Historic Environment Asset types 2021-23 (n = 71); size of boxes represent count of asset type.

2.1.15 Re-surveyed HEA types in WW squares

Table 2-8 List and count of Historic Environment Asset types for re-surveyed assets between 2013-16 and 2021-23.

Asset type	Count
Building	1
Colliery	1
Cottage	4
Earthwork	2
Enclosure	6
Farmstead	7
Field system	1
Fort	2
House	3
Hut	2
Kiln	2
Level	1
Mine	1
Other	1
Quarry	3
Transport	3
Water body	2

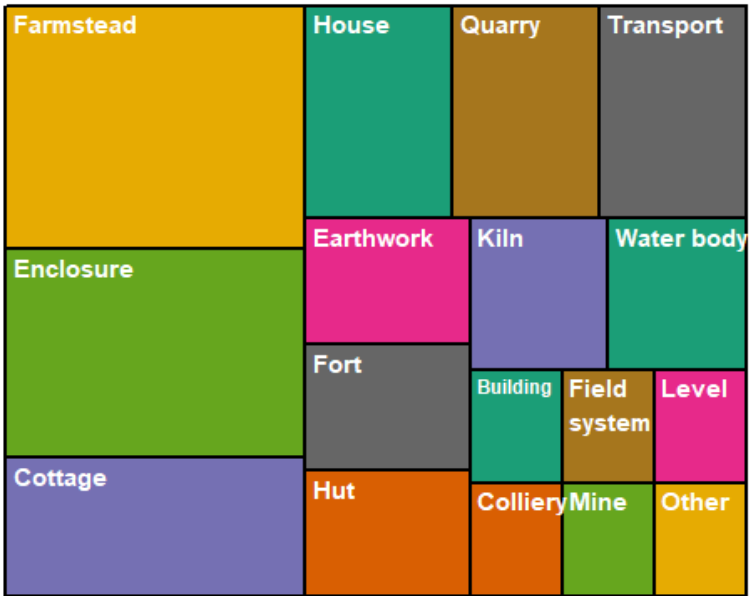

Figure 2-10 Historic Environment Asset types for re-surveyed assets (n=42); size of boxes represent count of asset type.

2.1.16 National trend - Threats analysis

Table 2-9 Count of Historic Environment Assets (HEAs) without threats 2013-16 and 2021-23. A total of 7 re-surveyed HEAs had not threats associated with them.

National Trend	Count
2013-16	16
2021-23	11

Table 2-10 Count of threats per threat category for all, and re-surveyed Historic Environment Assets.

National Trend	Re-surveyed	Threat category	Count
2013-16	No	Agricultural Operations	30
		Other	13
		Stock	54
		Vegetation	69
	Yes	Agricultural Operations	20
		Other	16
		Stock	29
		Vegetation	49
2021-23	No	Agricultural Operations	16
		Other	12
		Stock	15
		Vegetation	26
	Yes	Agricultural Operations	12
		Other	14
		Stock	14
		Vegetation	37

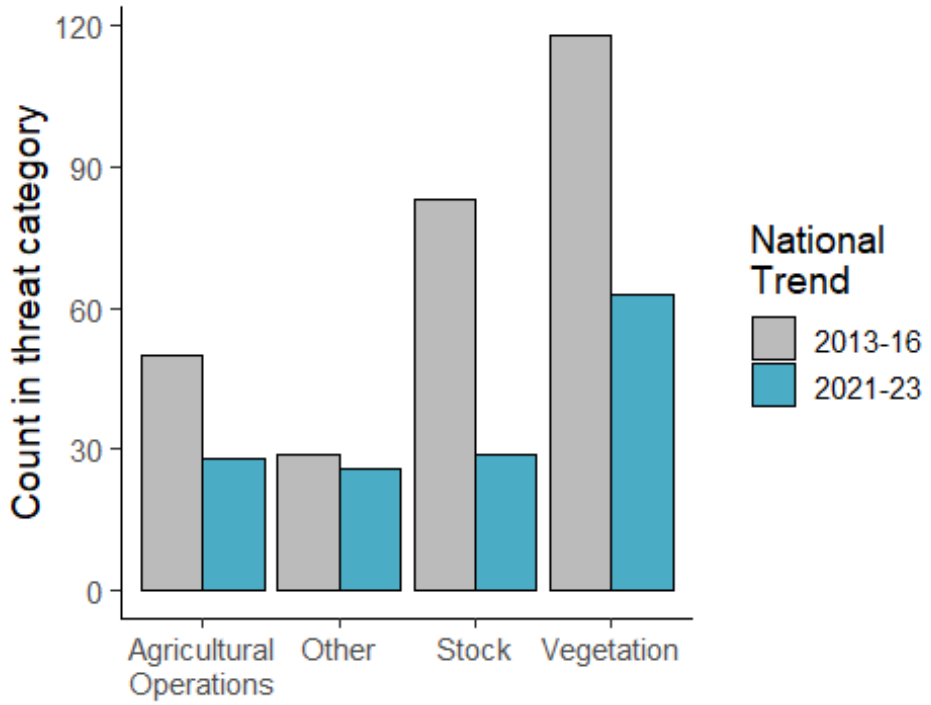

Figure 2-11 National Trend for threat counts per threat category 2013-16 and 2021-23.

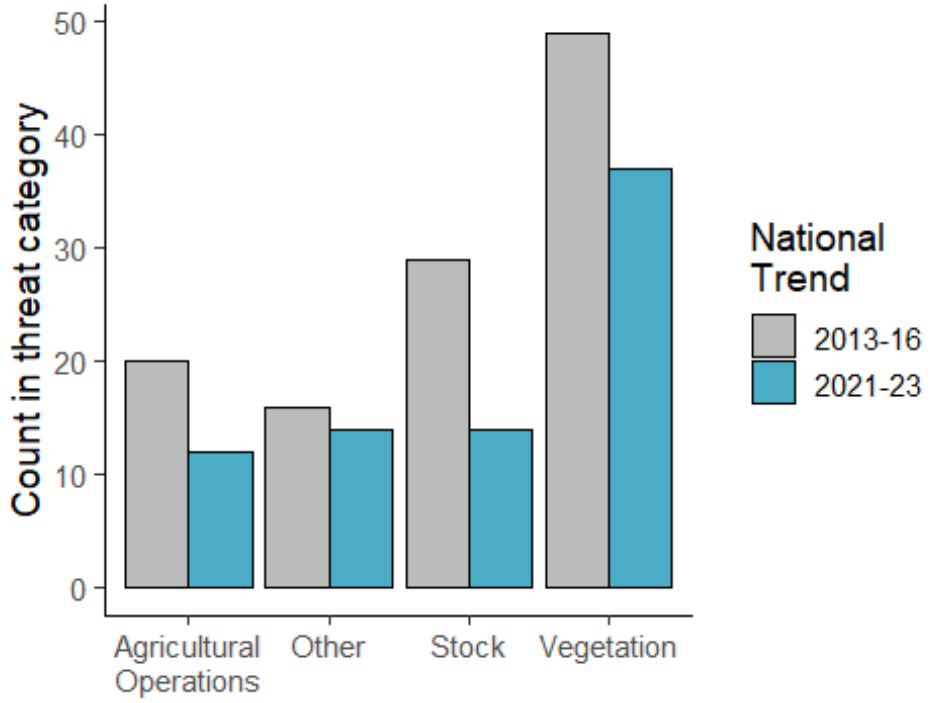

Figure 2-12 National trend of threat counts per threat category 2013-16 and 2021-23 for re-surveyed assets.

Vegetation was the dominant threat in to HEAs in 2013-16 and 2021-23. In 2013-16, this was followed by Stock, Agricultural operations, and other threats. In 2021-23, Stock, Agricultural operations and stock threats were observed about equally frequently.

2.1.17 Visual analysis of threat combinations

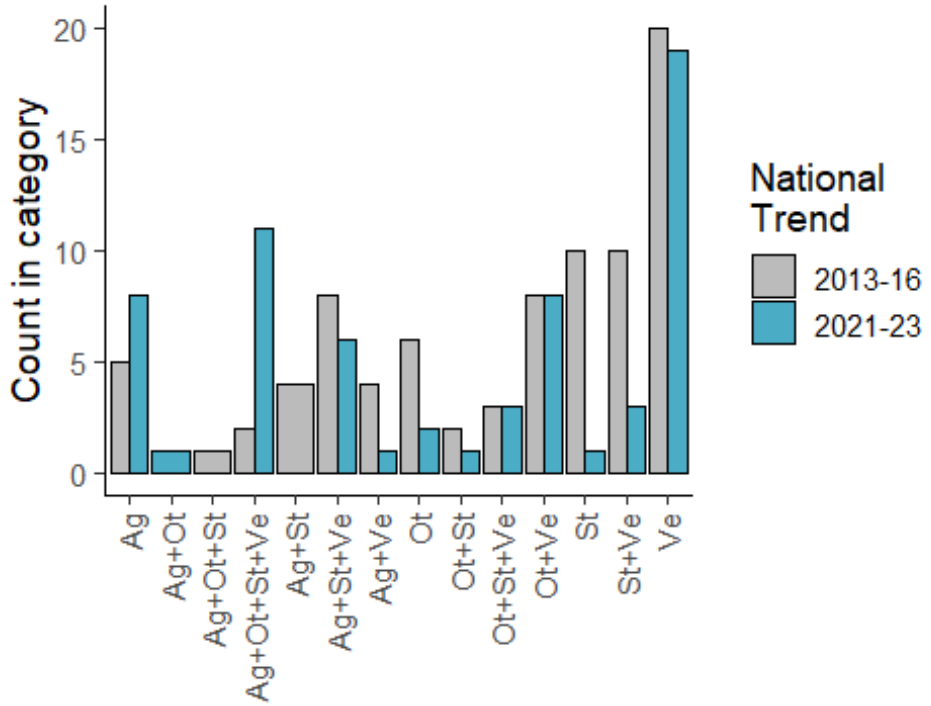

Figure 2-13 National Trend of counts for threat combinations for 2013-16 and 2021-23.

Threats to HEAs could occur in parallel. All threats were recorded. Vegetation threat alone was the most likely threat in both projects.

2.1.18 Threat combinations observed in 2013-16 and 2021-23

Table 2-11 Count of threat combinations for Historic Environment Assets for 2013-16 and 2021-23 sorted by highest to lowest counts.

National Trend	Threat combinations	Count
2013-16	Ve	20
2021-23	Ve	19
2021-23	Ag+Ot+St+Ve	11
2013-16	St	10
2013-16	St+Ve	10
2013-16	Ag+St+Ve	8
2013-16	Ot+Ve	8
2021-23	Ag	8
2021-23	Ot+Ve	8
2013-16	Ot	6
2021-23	Ag+St+Ve	6
2013-16	Ag	5
2013-16	Ag+St	4
2013-16	Ag+Ve	4
2013-16	Ot+St+Ve	3
2021-23	Ot+St+Ve	3
2021-23	St+Ve	3
2013-16	Ag+Ot+St+Ve	2
2013-16	Ot+St	2
2021-23	Ot	2
2013-16	Ag+Ot+St	1
2021-23	Ag+Ot	1
2021-23	Ag+Ve	1
2021-23	Ot+St	1
2021-23	St	1

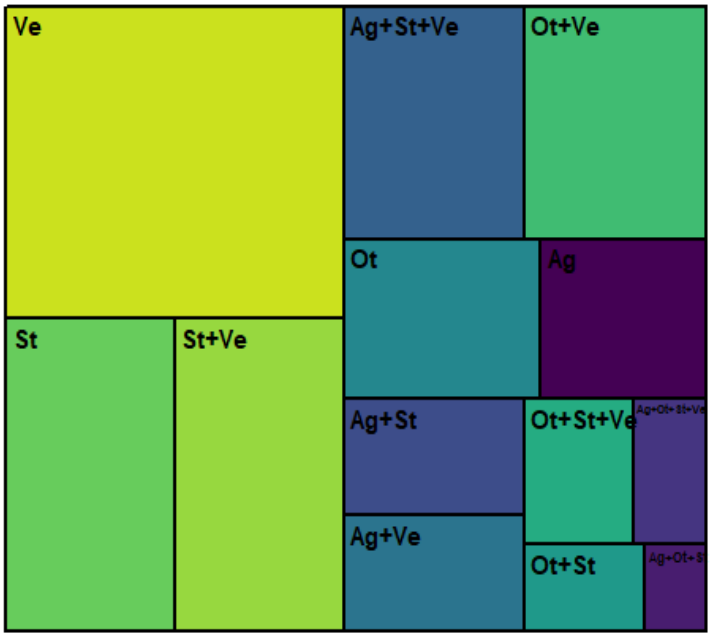

Figure 2-14 National Trend threat combinations observed 2013-16; size of squares represent count of observation.

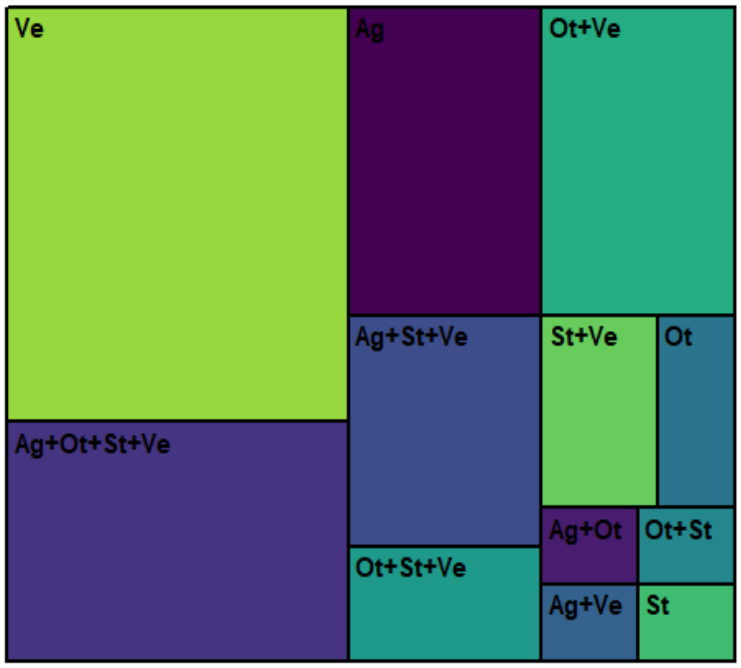

Figure 2-15 National trend threat combinations observed 2021-23; size of squares represent count of observation.

2.1.19 Threat types within threat categories for all and re-surveyed HEAs

Below, threat types are visualized per one of the four threat categories. This was done for all surveyed HEAs, and for the re-surveyed HEAs only.

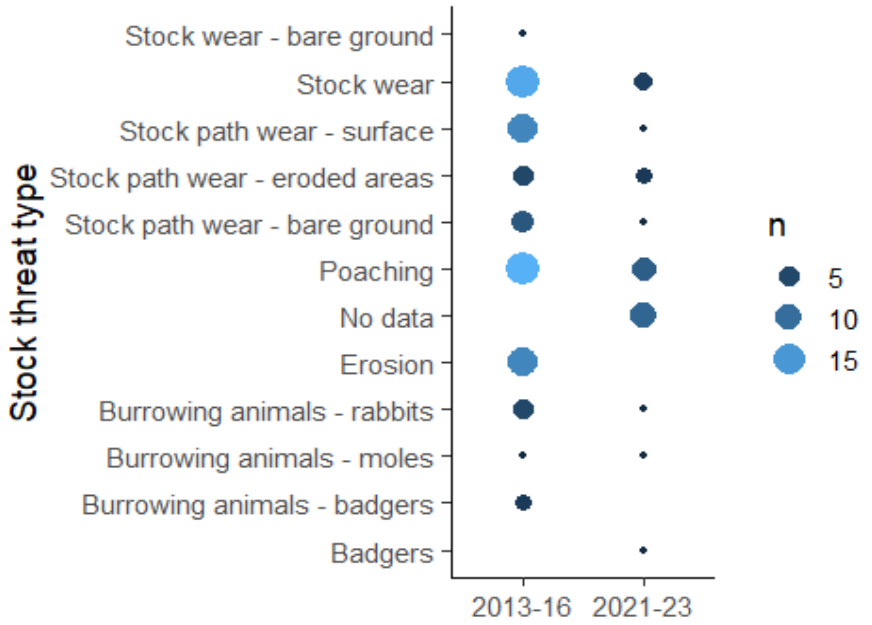

Figure 2-16 National trend of all Stock threat types observed in 2013-16 and 2021-23.

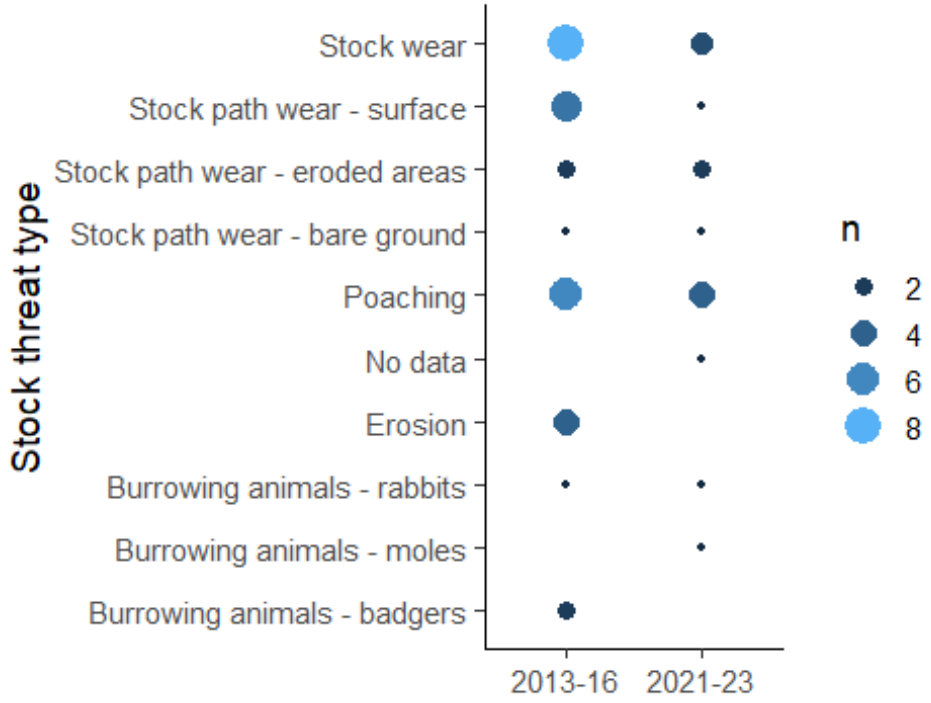

Figure 2-17 National trend of stock threat types observed in 2013-16 and 2021-23 for re-surveyed assets

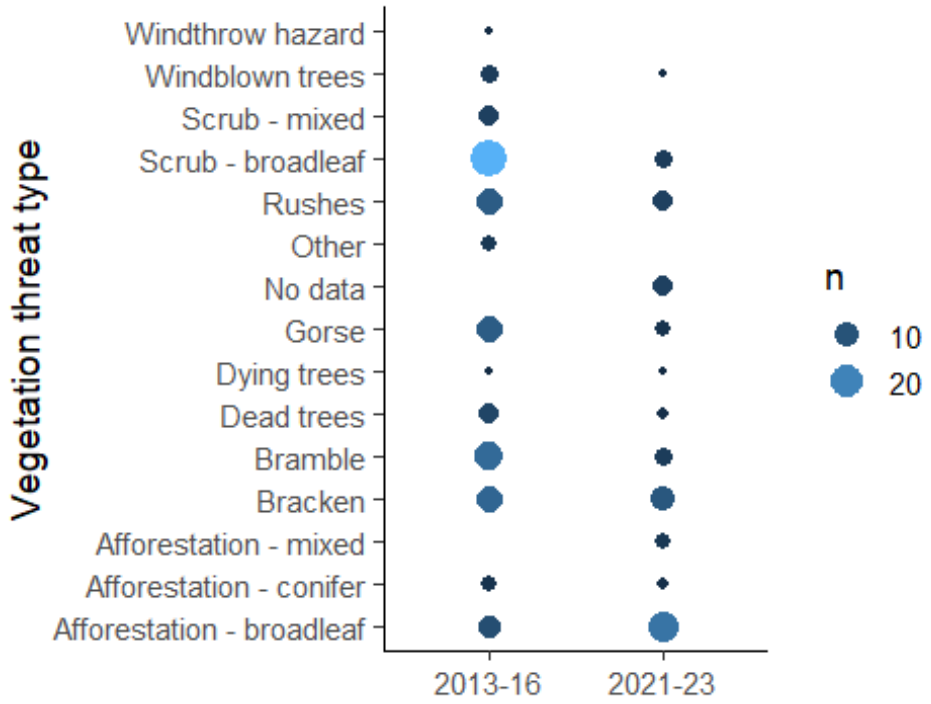

Figure 2-18 National trend of all vegetation threat types observed in 2013-16 and 2021-23.

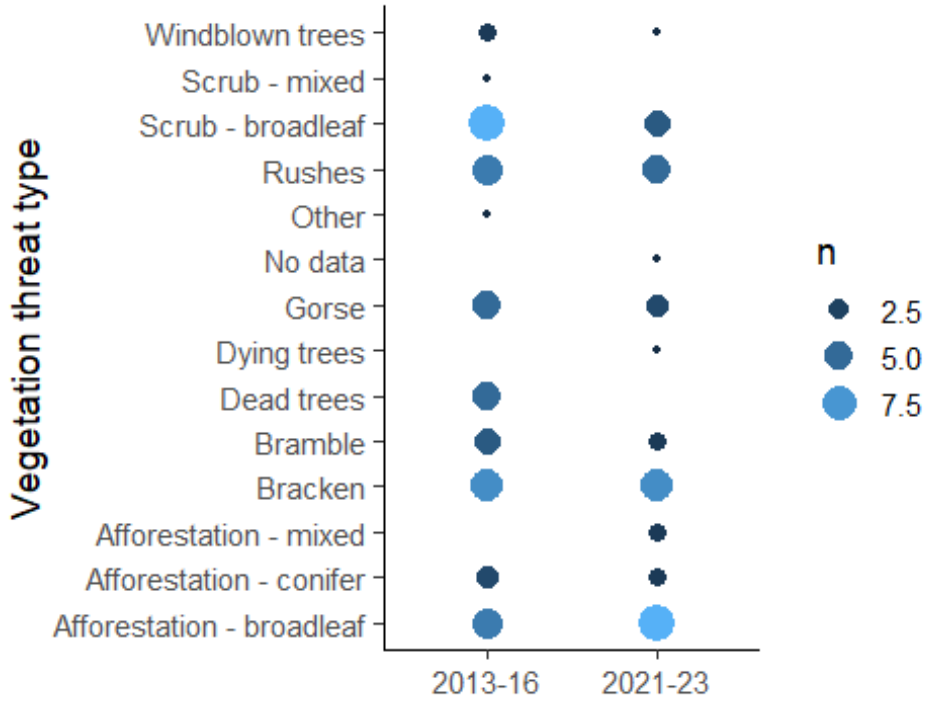

Figure 2-19 National trend of vegetation threat types observed in 2013-16 and 2021-23 for re-surveyed assets.

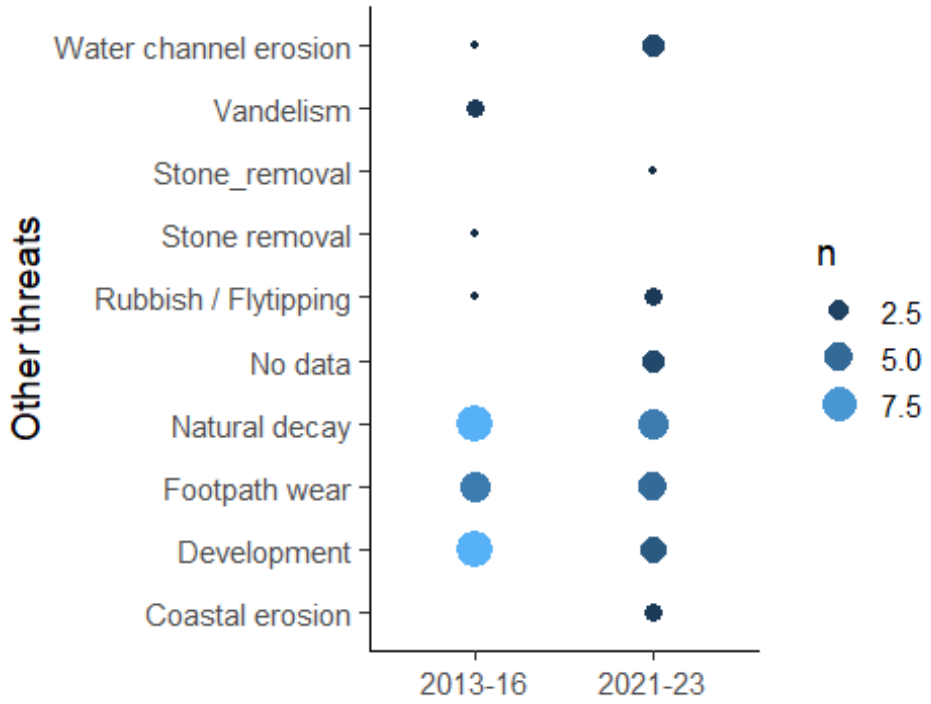

Figure 2-20 National trend of all other threat types observed in 2013-16 and 2021-23.

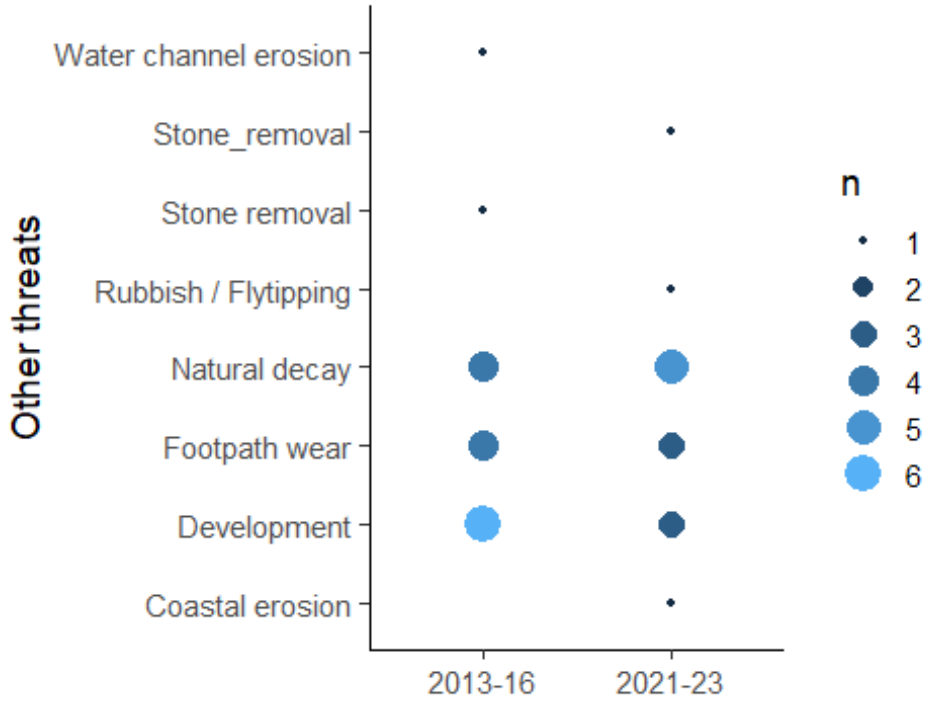

Figure 2-21 National trend of other threat types observed in 2013-16 and 2021-23 for re-surveyed assets.

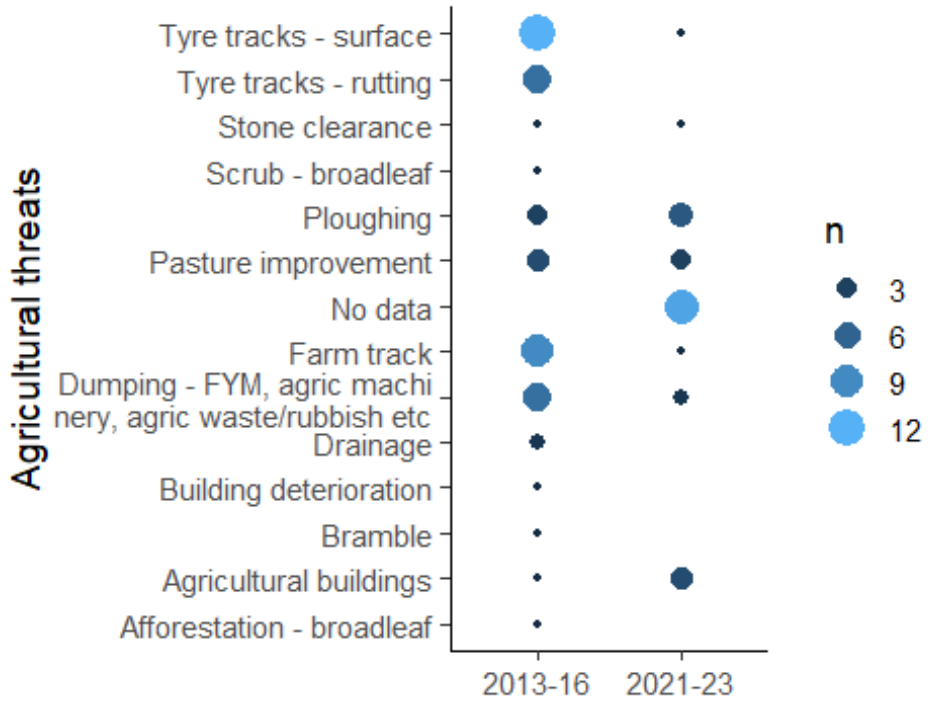

Figure 2-22 National trend for all agricultural threats observed in 2013-16 and 2021-23.

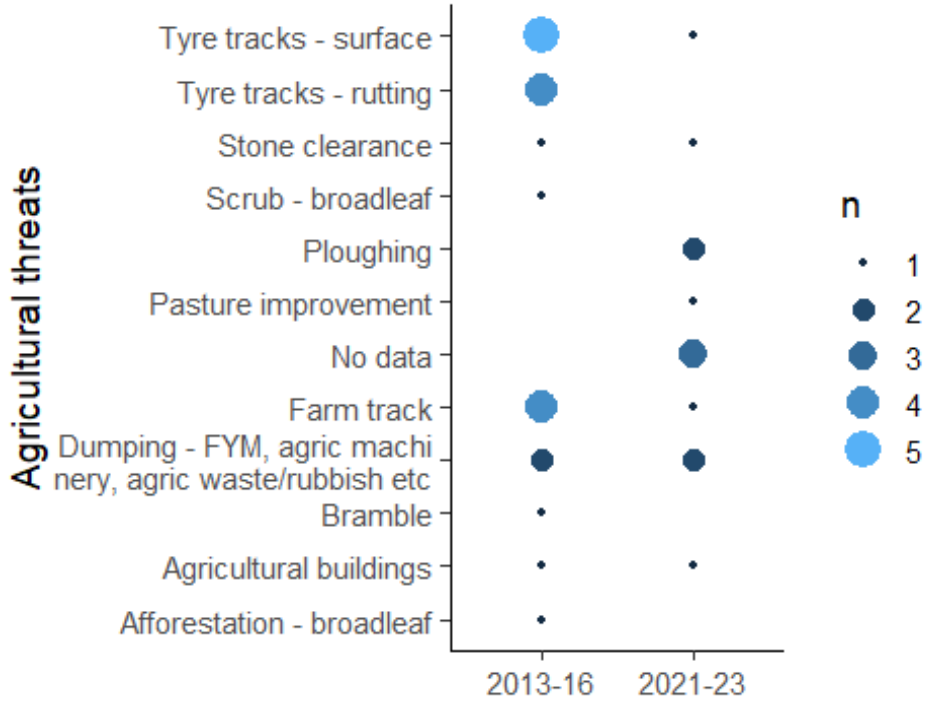

Figure 2-23 National trend for agricultural threats observed in 2013-16 and 2021-23 for re-surveyed assets.

2.1.20 HEA conditions vs threats

Figures 2-24 and 2-25 show counts of threat combinations associated with HEA condition. Figure 2-24 shows 2013-16 and 2021-2023 data together (WW squares only). This decision was taken after data were plotted separately and no obvious pattern between the time

points was observed. These two figures show the Threat combinations for 2013-16 and 2021-23 separately, as well as for the re-surveyed assets together.

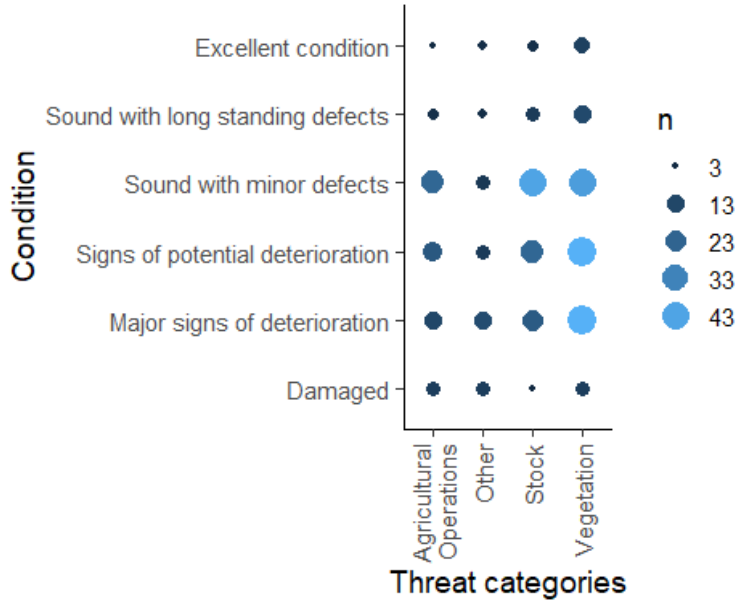

Figure 2-24 Link between Historic Environment Asset condition and threats combined for 2013-16 + 2021-23.

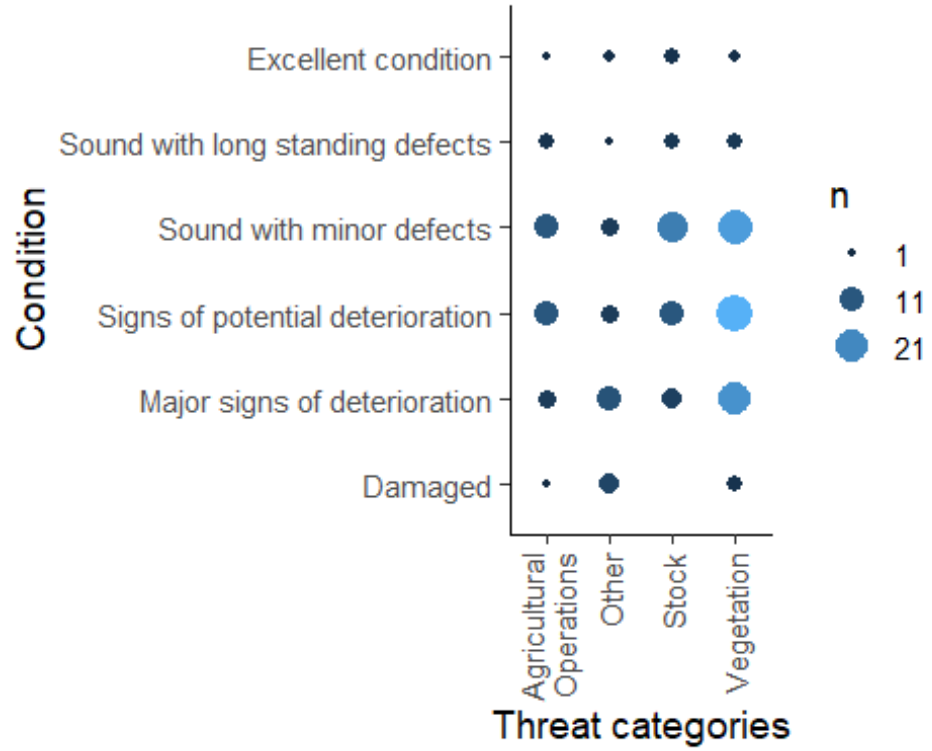

Figure 2-25 Link between Historic Environment Asset condition and threats combined for 2013-16 + 2021-23 for re-surveyed assets.

2.1.20.1 Historic Environment Asset conditions vs threats combinations

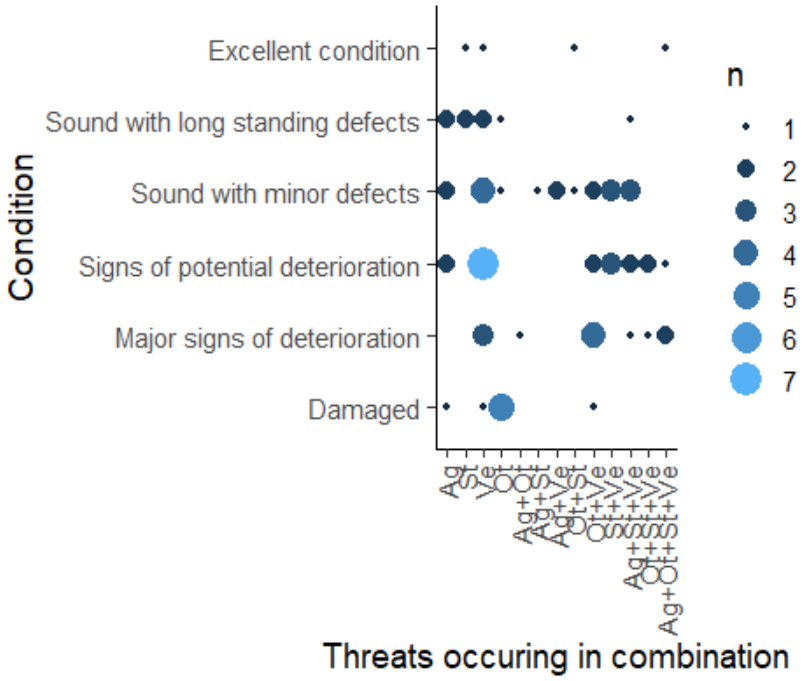

Figure 2-26 Link between Historic Environment Asset condition and threats combinations combined for 2013-16 + 2021-23 for re-surveyed assets.

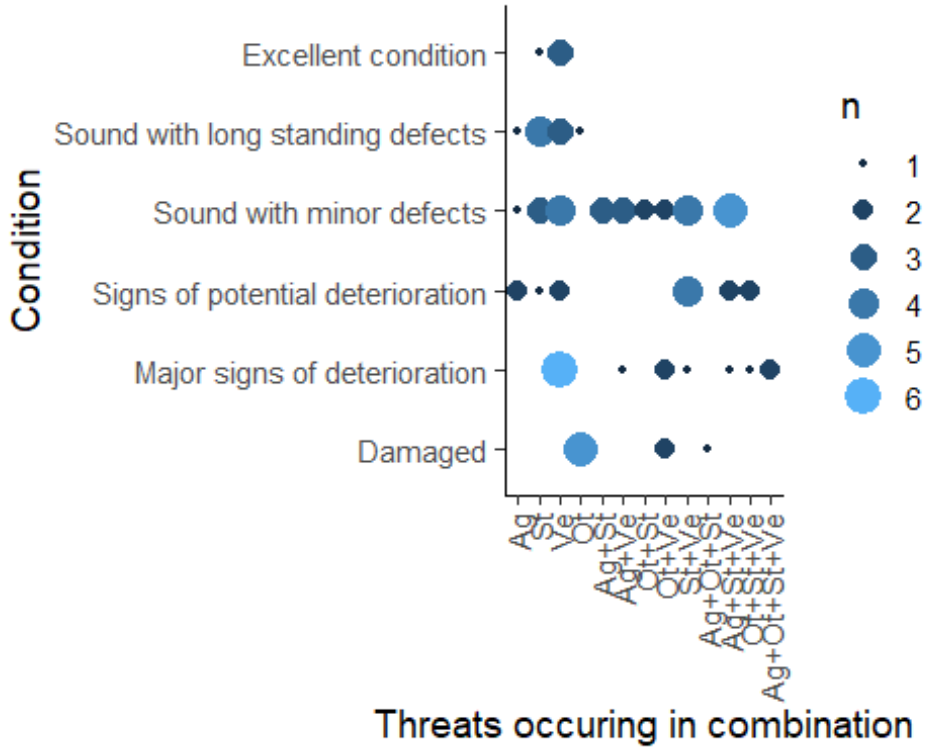

Figure 2-27 Link between Historic Environment Asset condition and threats combinations for 2013-16 .

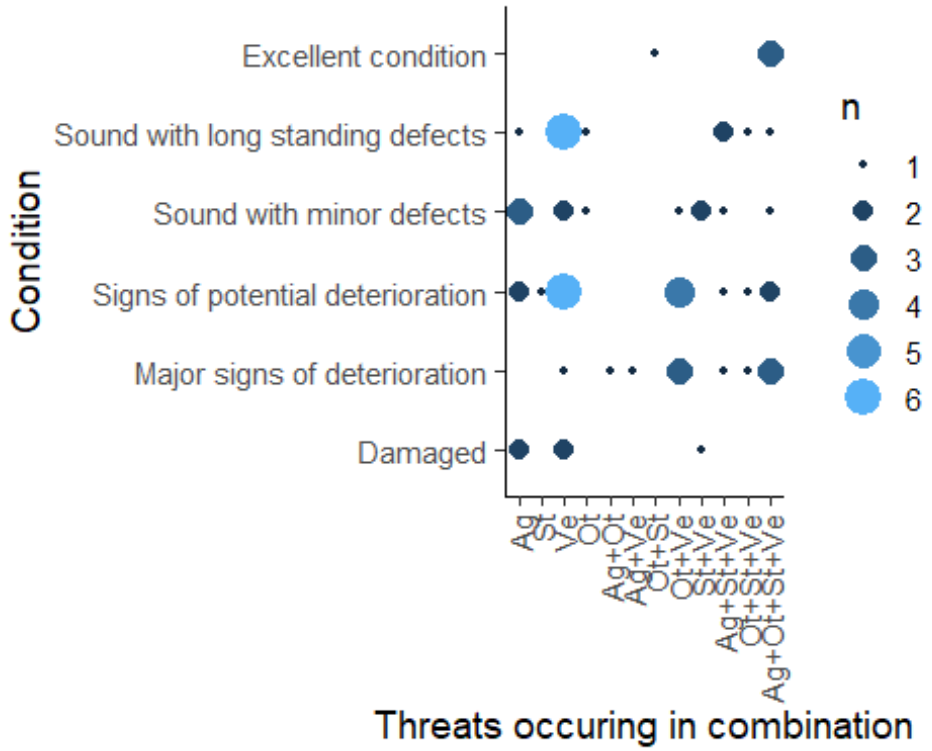

Figure 2-28 Link between Historic Environment Asset condition and threats combinations for 2021-23.

Threats in 2021-23 were observed in fewer combinations than in 2013-16 (Figure 2-28). Threats were associated with every HEA condition. Although not shown, the extent and severity of these threats may vary between condition categories. Again, the single vegetation threat is found in every condition class. Both, excellent conditions and damaged HEAs have only few threats associated with them. But note, only few observations were made in the excellent and damaged categories.

2.1.21 National trend statistics: Condition as impacted by threats and time

2.1.21.1 National trend on all WW squares

```
## Call: Six condition categories
## polr(formula = CONDITION_SCORE ~ THREAT_AG + THREAT_VE + THREAT_OT +
##     THREAT_ST + PROJECT, data = m.threat.1_input, Hess = TRUE)
##
## Coefficients:
##                   Value Std. Error t value
## THREAT_AG       0.35494     0.1696  2.0924
## THREAT_VE       0.36554     0.1225  2.9851
## THREAT_OT       1.00004     0.2981  3.3552
## THREAT_ST      -0.08541     0.1263 -0.6764
## PROJECT2021-23 -0.06139     0.2965 -0.2070
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -1.3757  0.3019    -4.5574
## 2|3 -0.1236  0.2668    -0.4634
## 3|4  1.0930  0.2866     3.8143
## 4|5  2.1281  0.3254     6.5395
## 5|6  3.4965  0.4097     8.5352
##
## Residual Deviance: 534.4103
## AIC: 554.4103

##                       2.5 %    97.5 %
## THREAT_AG       0.02246964 0.6874049 Significant neg effect
## THREAT_VE       0.12553382 0.6055476 Significant neg effect
## THREAT_OT       0.41586414 1.5842222 Significant neg effect
## THREAT_ST      -0.33288326 0.1620711 Not significant
## PROJECT2021-23 -0.64253783 0.5197630 Not significant
```

The ordination analysis tests if time and the different threats (not the threat combinations) affect the condition score. As seen before, time (i.a. project) does not significantly affect the condition score. Neither does the stock threat. However, threats posed by agricultural operations, vegetation and other have a significant impact on the condition score (the 2.5% and 97.5% intercept do not cross 0). As the condition score ranks from 1 = excellent to 6 = damaged a positive effect is negatively affecting HEA condition i.e. moving away from excellent condition.

2.1.22 National trend on re-surveyed HEAs in WW squares

```
## Call: Six condition categories
## polr(formula = CONDITION_SCORE ~ THREAT_AG + THREAT_VE + THREAT_OT +
##     THREAT_ST + PROJECT, data = m.threat.2_input, Hess = TRUE)
##
## Coefficients:
##                   Value Std. Error t value
## THREAT_AG        0.1309     0.3089  0.4236
## THREAT_VE        0.4325     0.1733  2.4952
## THREAT_OT        1.3268     0.3943  3.3652
## THREAT_ST       -0.1926     0.1970 -0.9778
## PROJECT2021-23 -0.1118     0.4103 -0.2724
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -1.3814  0.4609    -2.9972
## 2|3 -0.3646  0.4343    -0.8395
## 3|4  0.9232  0.4575     2.0179
## 4|5  2.2607  0.5155     4.3857
## 5|6  3.5406  0.6023     5.8785
##
## Residual Deviance: 269.1282
## AIC: 289.1282

##                       2.5 %    97.5 %
## THREAT_AG      -0.47465738 0.7363951 Not significant
## THREAT_VE       0.09276902 0.7722281 Significant neg effect
## THREAT_OT       0.55406980 2.0996155 Significant neg effect
## THREAT_ST      -0.57864790 0.1934572 Not significant
## PROJECT2021-23 -0.91605065 0.6924768 Not significant
```

For the re-surveyed HEAs in WW squares, the ordination analysis tests if time and the different threats (not the threat combinations) affect the condition score. As seen before, time (i.a. project) does not affect the condition score. Neither does the stock threat or agricultural operations. Threats posed by vegetation and other threats have a significant impact on the condition score (the 2.5% and 97.5% intercept do not cross 0). As the condition score ranks from 1 = excellent to 6 = damaged a positive effect is negatively affecting HEA condition i.e. moving away from excellent condition.

2.2 Glastir analysis

The data analysis of this chapter was performed on data from WW and TG squares combined (Figure 1-1).

2.2.1 Glastir information

The mean Glastir area for each square was calculated as follows; All option uptake areas across Glastir schemes were dissolved by option uptake year. This operation gives an area for each square bounded between 0 km^2 and 1 km^2. For each square, these areas were summed across years and then divided by the temporal extent of Glastir option uptake across all schemes (i.e.13 years, 2012-2024) to give the **average Glastir extents** (%). HEA-related options are part of all Glastir options. However, no detailed information related to HEAs in Glastir was extracted as it is unknown to us if the surveyed HEAs was part of the claim. The same Glastir extents are used for analyzing the periods 2013-16 and 2021-23; it is acknowledged that Glastir extents might vary slightly between the 2013-16 and 2021-23.

For the exploratory analysis, Glastir extents and Glastir categories were used to explore the effect of average Glastir extents on HEAs. Five Glastir categories were derived from the Glastir extents in each square:

- 0% = no(ne) land in Glastir, including squares with average Glastir extents below 1%,
- < 25% = bit(s) of land in Glastir,
- < 50% = some land in Glastir,
- < 75% = much land in Glastir,
- = or > 75% = most land in Glasir.

2.2.2 HEA distribution across Glastir categories

Table 2-12 Distribution of all Historic Environment Assets (HEAs) across Glastir categories for time periods 2013-16 and 2021-23. This includes HEAs which were not surveyed (see Tables 2-13 and 2-14 for more information).

Time period	Glastir category	Count
2013-16	none	109
	bit	189
	some	112
	much	42
	most	9
2021-23	none	84
	bit	99
	some	56
	much	10
	most	3

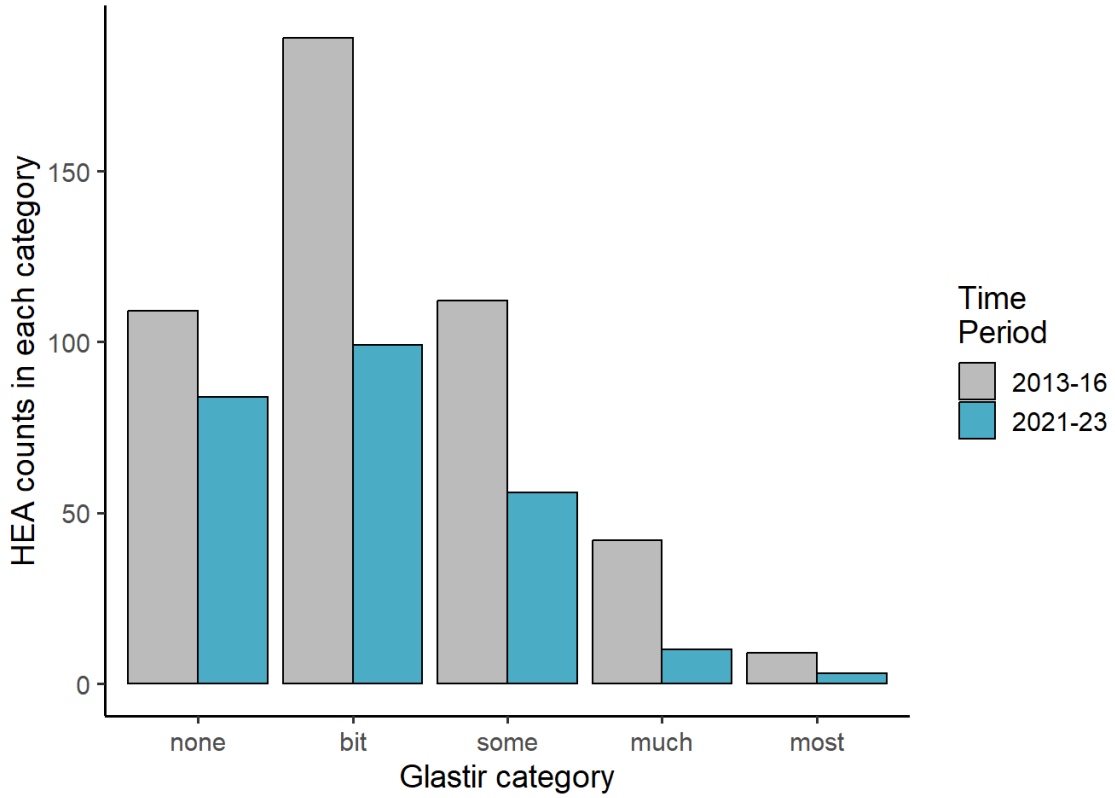

Figure 2-29 Distribution of all Historic Environment Assets (HEAs) across Glastir categories for time periods 2013-16 and 2021-23. This includes HEAs which were not surveyed (see Tables 2-13 and 2-14 for more information).

HEA counts peaked on land with average Glastir extent of up to 25% and decreased with increasing average Glastir extent. This was the case for both time periods.

2.2.3 Survey status of HEAs

As for the National Trend, all HEA records were classified into three categories:
0 = not found / no information
1 = surveyed
2 = no access Note: in 2013-16, information on Historic Environment Assets was not always available at the time the square was surveyed; also information on no access was actively recorded in 2021-23.

Table 2-13 Overview of all surveyed Historic Environment Assets (HEAs) for each survey period; 0 = not found / no information, 1= surveyed, 2 = no access, blue cells highlight the number of HEAs assessed.

Time period	Survey status	Count
2013-16	0	164
	1	220
	2	77
2021-23	0	25
	1	147
	2	80

Table 2-14 Overview of all surveyed Historic Environment Assets (HEAs) in five Glastir categories for each survey period; 0 = not found / no information, 1= surveyed, 2 = no access, , blue cells highlight the number of HEAs assessed. Data are plotted in Figure 2-30.

Time period	Survey status	Glastir category	Count
2013-16	0	none	33
		bit	69
		some	48
		much	12
		most	2
	1	none	51
		bit	92
		some	47
		much	23
		most	7
	2	none	25
		bit	28
		some	17
		much	7
		most	6
2021-23	0	none	8
		bit	8
		some	3
		much	31
		most	64
	1	none	42
		bit	7
		some	3
		much	47
		most	27
	2	none	6
		bit	29
		some	10
		much	4
		most	6

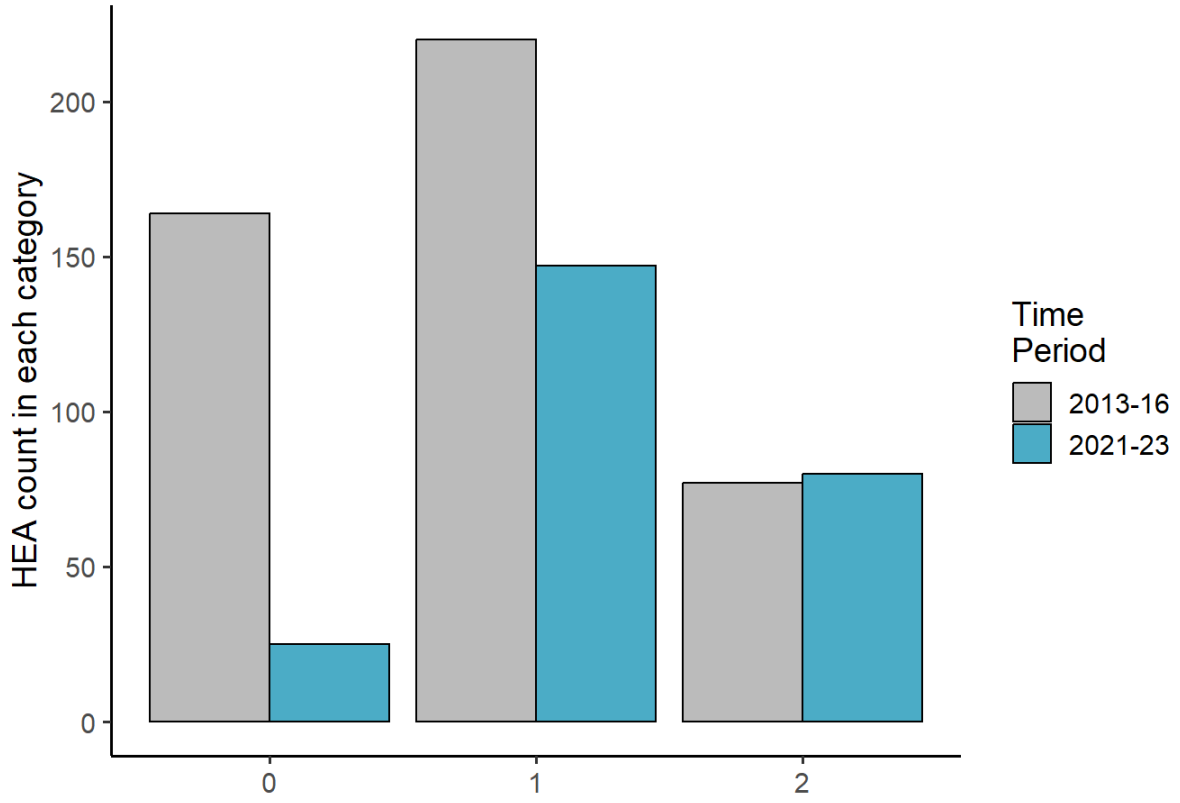

Figure 2-30 Survey status overview for all Historic Environment Assets (HEA) in 2013-16 and 2021-23.

A total of 220 HEAs were assessed in 2013-16 (48% of all HEAs documented in the 300 GMEP squares), compared to 147 HEAs in 2021-23 (58%). In 2013-16 most HEAs were not surveyed due to missing information or HEAs were not found. In 2021-23, most of the none surveyed HEAs were in areas without landowner access permission.

2.2.4 HEA survey status in relation to Glastir category and extent

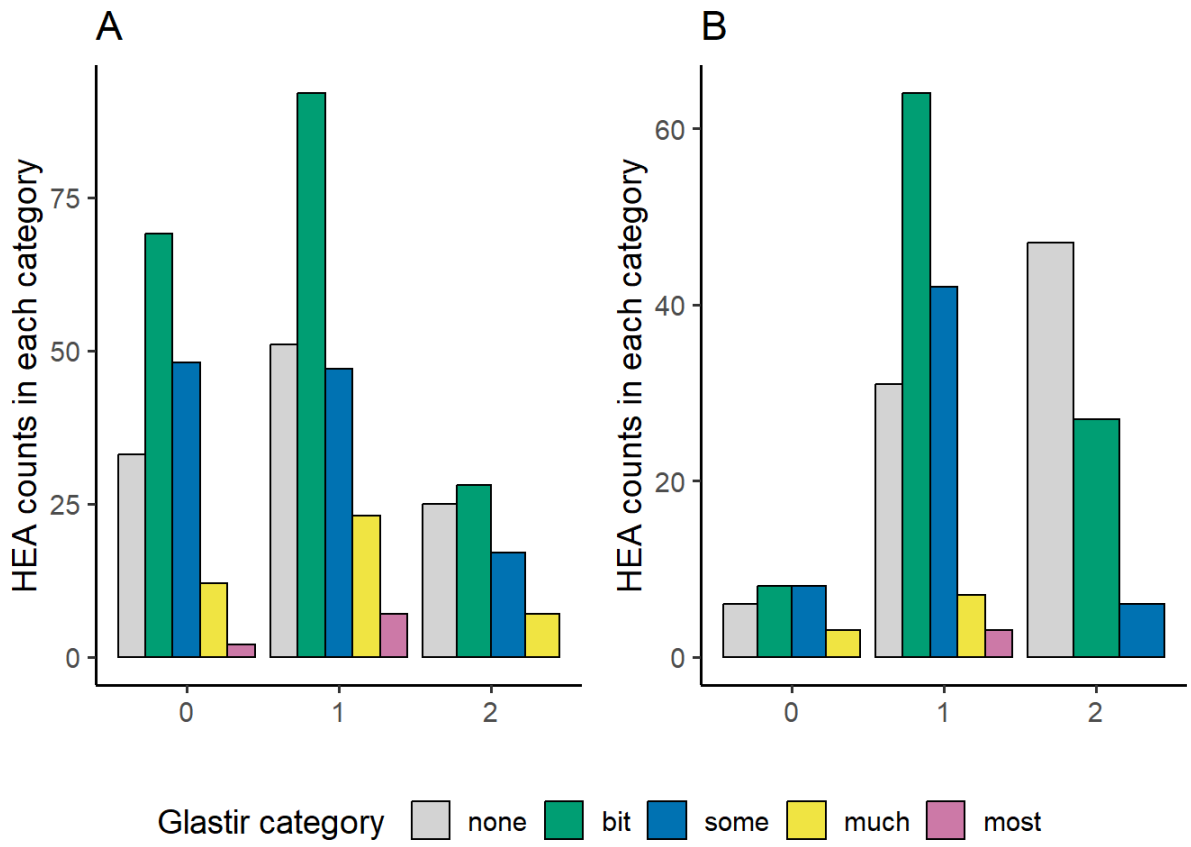

Figure 2-31 Historic Environment Asset (HEA) counts in each survey status and Glastir category for A) 2013-16 and B) 2021-23.

Ideally, we would see as many entries in category 1 (surveyed), and as few as possible in categories 0 or 2. In general, about half the HEAs were not accessible (categories 0 or 2) in 2013-16 and 2021-23. In 2021-23, only a few HEAs in Glastir categories above 50% extents were in categories 0 and 2.

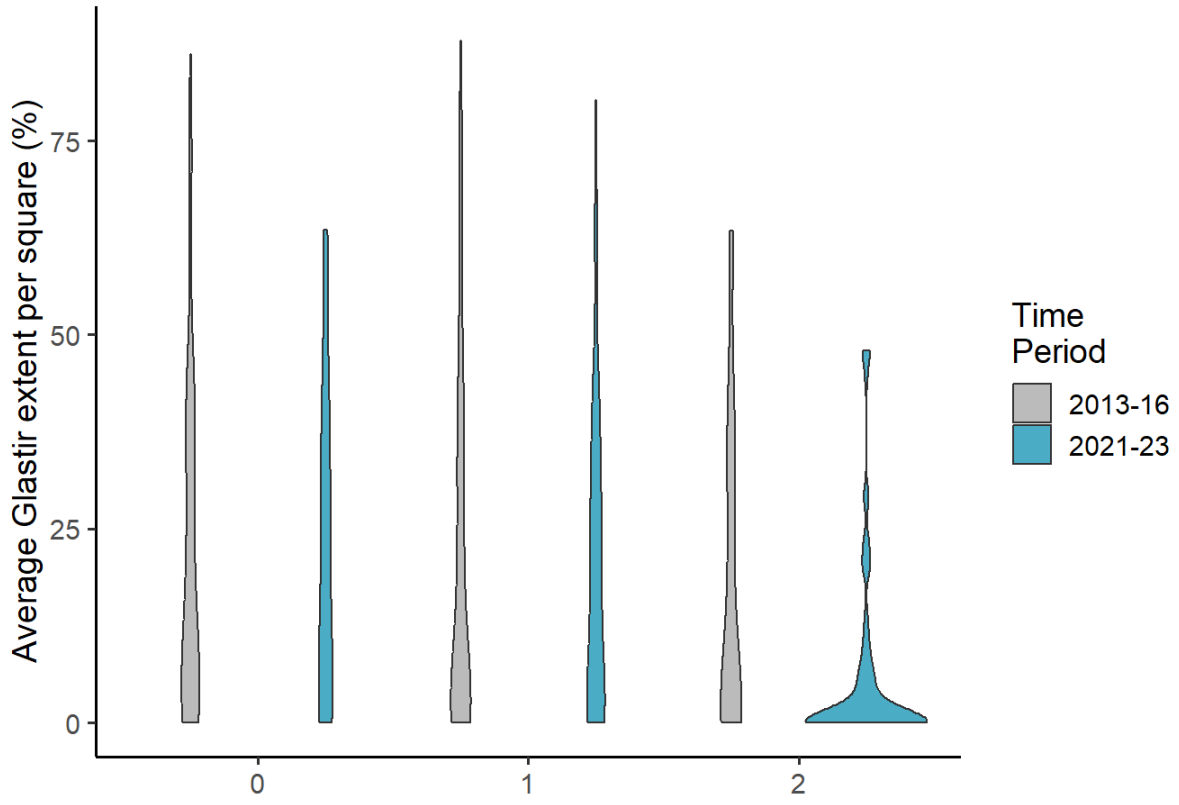

Figure 2-32 Distribution of Historic Environment Assets which were not found / no information (0), surveyed (1), or not surveyed due to lack of access (2) as a function of average Glastir extent (%) in each survey square.

The violin plot showing average Glastir extents for survey status categories 0, 1 and 2 shows a bias in refused access to HEAs on land with less Glastir extents/uptake. This picture may be biased by the higher frequency of HEAs observed on land with an average Glastir extent of up to 25% (Figure 2-29).

2.2.5 Overview of re-surveyed HEAs between 2013-16 and 2021-23

Table 2-15: Overview of re-survey status for all Historic Environment Assets (HEAs) in 2013-16 and 2021-23.

Time period	Re-survey of HEAs	Count
2013-16	No	134
	Yes	86
2021-23	No	58
	Yes	86

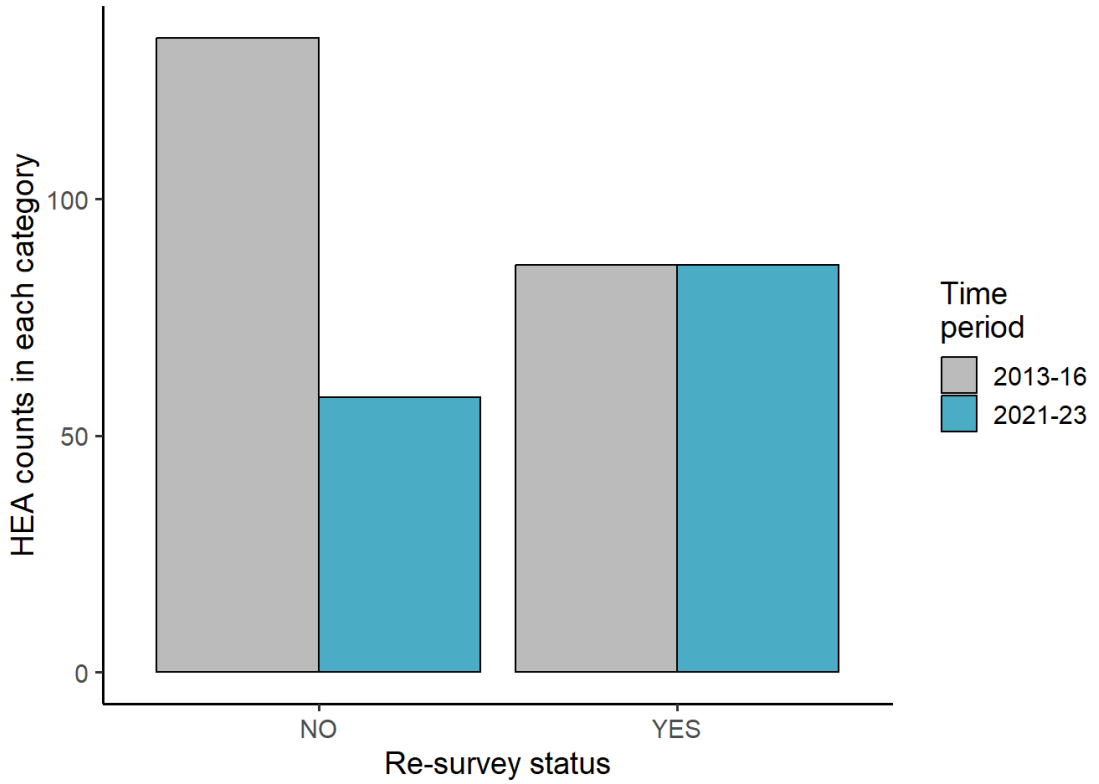

Figure 2-33 Counts of all surveyed Historic Environment Assets (HEAs) in 2013-16 and 2021-23.

Table 2-15 Glastir categories the re-surveyed Historic Environment Assets fall into. See also Figure 2-34.

Glastir category	Count
None	16
Bit	41
Some	21
Much	5
Most	3

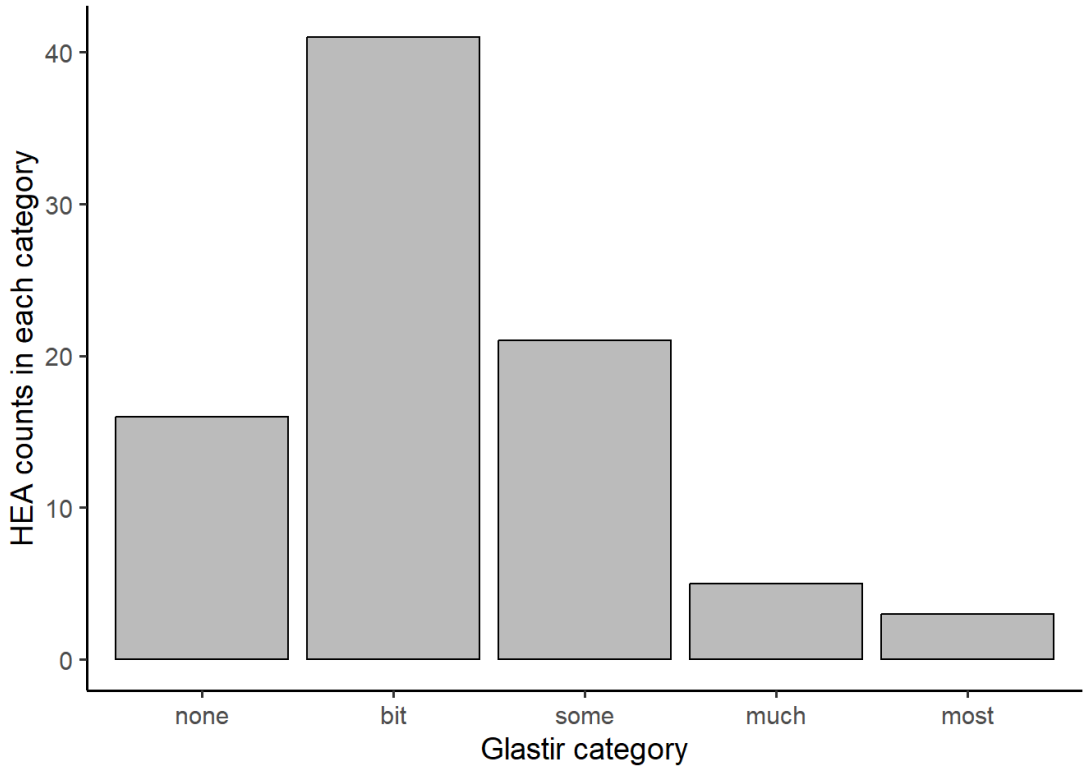

Figure 2-34 Glastir categories re-surveyed Historic Environment Assets fall into.

A total of 86 HEAs were re-surveyed between 2013-16 and 2021-23. This is 39% of surveyed HEAs in 2013-16 and 60% of surveyed HEAs in 2021-23. The lowest numbers of re-surveyed HEAs were in squares with an average Glastir extent of up to 25%.

2.2.6 Average Glastir extent and time impact on HEA condition

Table 2-16 Historic Environment Asset counts in condition categories in 2013-16 and 2021-23.

Time period	Condition	Count
2013-16	Damaged	16
	Major signs of deterioration	41
	Signs of potential deterioration	36
	Sound with minor defects	73
	Sound with long standing defects	35
	Excellent condition	19
2021-23	Damaged	9
	Major signs of deterioration	23
	Signs of potential deterioration	38
	Sound with minor defects	26
	Sound with long standing defects	31
	Excellent condition	17

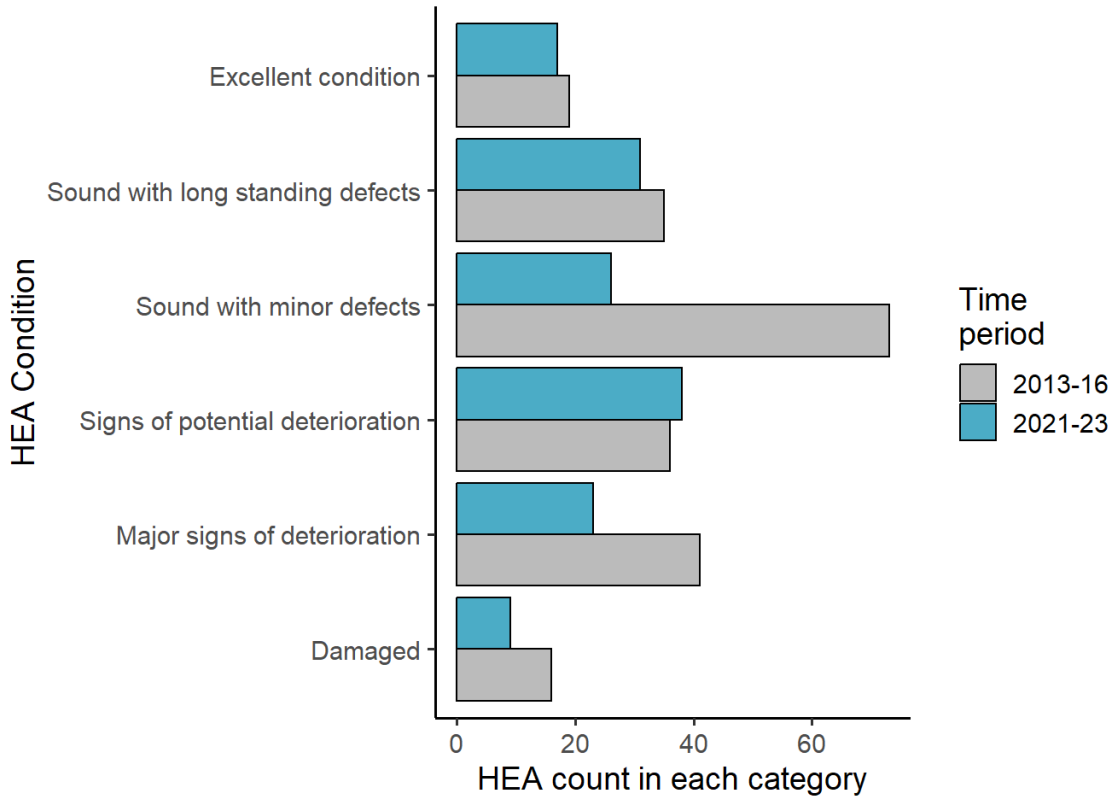

Figure 2-35 Historic Environment Asset condition for 2013-16 and 2021-23.

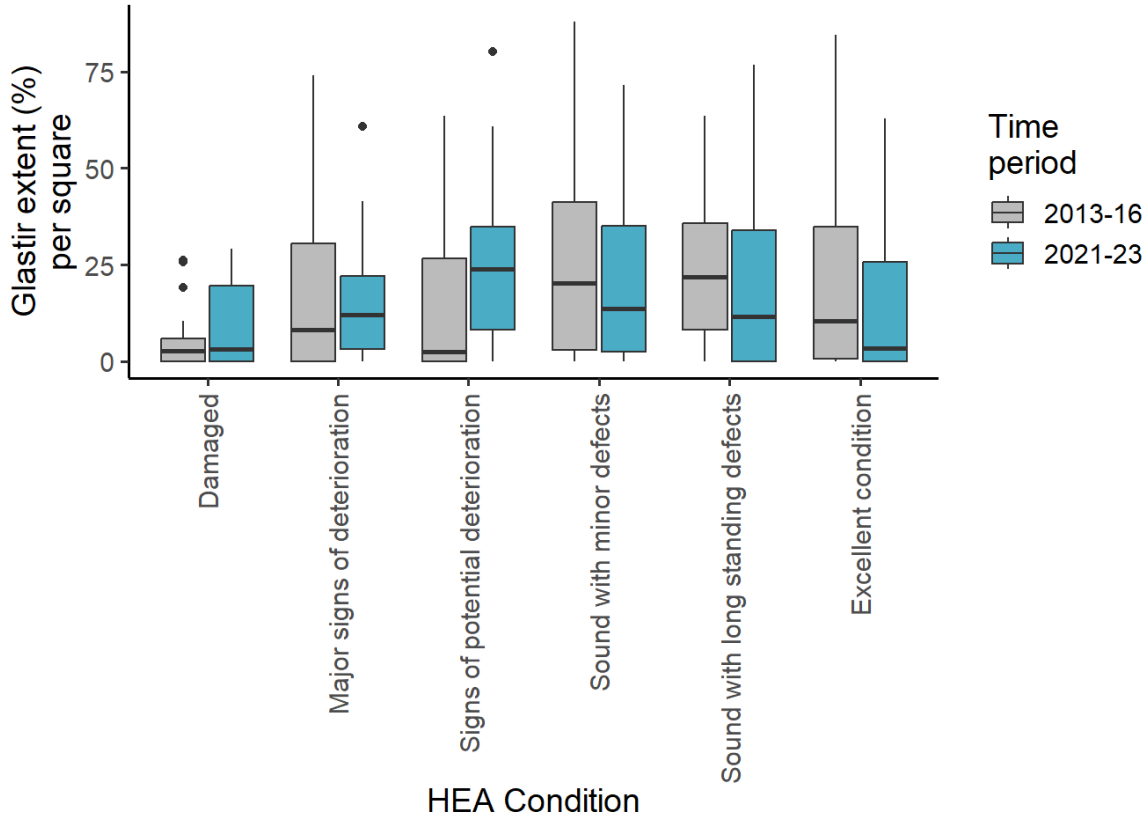

Figure 2-36 Historic Environment Asset condition against average Glastir extents (%) in squares in 2013-16 and 2021-23.

2.2.6.1 Ordinal regression

```
## Call: Six condition categories
## polr(formula = CONDITION_SCORE ~ PROJECT * perc_land_in_glastir,
##     data = m3.1_input, Hess = TRUE)
##
## Coefficients:
##                                     Value Std. Error t value
## PROJECT2021-23                    -0.38037   0.269899  -1.409
## perc_land_in_glastir              -0.01446   0.004991  -2.898
## PROJECT2021-23:perc_land_in_glastir  0.01221   0.008986   1.359
##
## Intercepts:
##     Value    Std. Error t value
## 1|2  -2.5924   0.2265   -11.4470
## 2|3  -1.3200   0.1811    -7.2881
## 3|4  -0.1481   0.1680    -0.8817
## 4|5   0.7878   0.1748     4.5064
## 5|6   2.2851   0.2386     9.5780
##
## Residual Deviance: 1233.05
## AIC: 1249.05

##                                         2.5 %       97.5 %
## PROJECT2021-23                    -0.909363981  0.148620035 Not significant
## perc_land_in_glastir              -0.024243658 -0.004680488 Sig Pos
## PROJECT2021-23:perc_land_in_glastir -0.005402808  0.029819785 Not significant
```

Note: The effect of perc_land_in_glastir is negatively correlated with HEA condition. HEA condition is coded as: 1 = best and 6 = worst. Thus, a negative effect in perc_land_in_glastir means that it is positively associated with better HEA condition.

The ordinal regression tests if time (2013-16 vs. 2021-23) and average Glastir extents (%) influence HEA condition (in 6 categories). Time (2013-16 and 2021-23) did not affect HEA condition. Neither did HEA condition change with time in Glastir (neither improved nor worsened). However, HEA condition was better when average Glastir extent was higher, which is similar to GMEP findings that land entering Glastir was already in better condition (Emmett et al. 2017), which seems to be valid for HEAs too.

2.2.7 Glastir and time impact on HEA condition in two categories

Table 2-17 Historic Environment Asset counts in two condition categories in 2013-16 and 2021-23.

Time period	Condition	Count
2013-16	Deteriorated or damaged	93
	Excellent or sound condition	127
2021-23	Deteriorated or damaged	70
	Excellent or sound condition	74

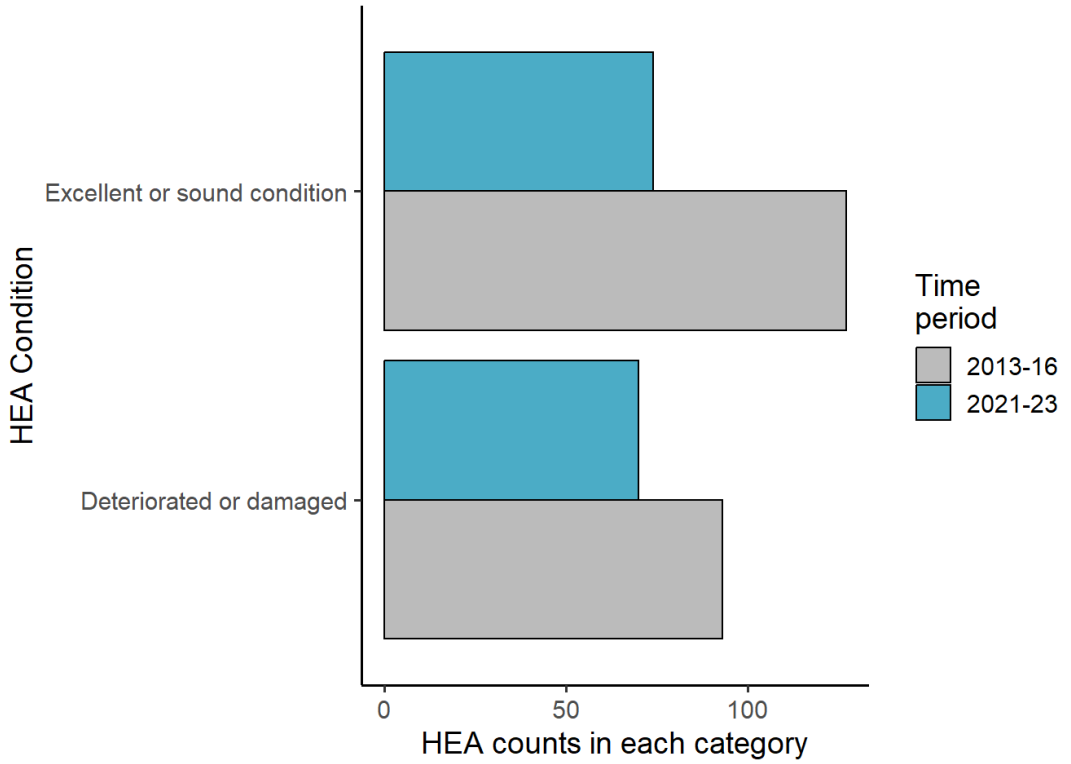

Figure 2-37 Historic Environment Asset condition in two categories for 2013-16 and 2021-23.

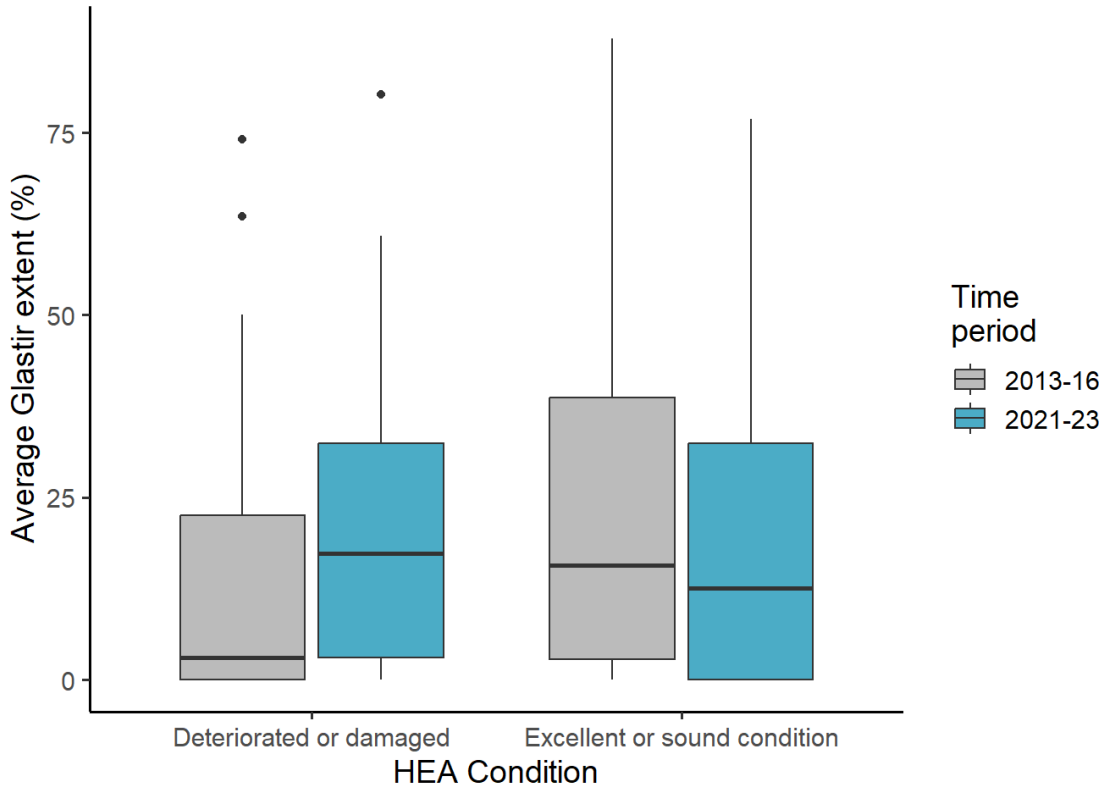

Figure 2-38 Historic Environment Asset condition in two categories by average Glastir extent in squares in 2013-16 and 2021-23.

2.2.7.1 Binomial regression

```
##            PROJECT
## CONDITION_3 2013-16 2021-23
##           0      93      70
##           1     127      74

##
## Call: Two condition categories
## glm(formula = CONDITION_3 ~ PROJECT * perc_land_in_glastir, family = "binomial
",
##     data = binomial)
##
## Coefficients:
##                                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)                      -0.112673   0.182903  -0.616 0.537876
## PROJECT2021-23                    0.206556   0.297633   0.694 0.487686
## perc_land_in_glastir              0.022077   0.006677   3.306 0.000945 ***
## PROJECT2021-23:perc_land_in_glastir -0.024044   0.010798  -2.227 0.025965 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 500.64  on 363  degrees of freedom
## Residual deviance: 486.86  on 360  degrees of freedom
##   (349 observations deleted due to missingness)
## AIC: 494.86
##
## Number of Fisher Scoring iterations: 4

##                                         2.5 %       97.5 %
## (Intercept)                      -0.473027853  0.245552746 not significant
## PROJECT2021-23                   -0.376567115  0.792131042 not significant
## perc_land_in_glastir              0.009462433  0.035757140 Sig pos
## PROJECT2021-23:perc_land_in_glastir -0.045517013 -0.003020686 Sig neg
```

Note: The effect of perc_land_in_glastir is positively correlated with HEA condition. HEA condition in two categories is coded as: 0 = deteriorated and 1 = sound. This is the opposite direction to the 6 category assessment. Thus, a positive effect in perc_land_in_glastir means that it is positively associated with better HEA condition.

In 2013-16, 58% of all surveyed HEAs were in Excellent or sound condition, compared to 51% in 2021-23. Time itself (project) had not significant impact on HEA condition. Average Glastir extent in squares was positively associated with HEA condition (legacy effect) and higher average Glastir extents was associated with worse HEA condition over time when only looking at two condition classes (deteriorated or sound). This time x average Glastir extent is visible in Figure 2-36, but is not significant for the 6 category scoring.

2.2.8 Glastir extent and time impact on HEA condition (re-surveyed)

Below is the same conditional analysis as above, but on the re-surveyed subset of HEAs (n=86).

Table 2-19 Re-surveyed Historic Environment Asset counts in condition categories in 2013-16 and 2021-23.

Time period	Condition	Count
2013-16	Damaged	8
	Major signs of deterioration	11
	Signs of potential deterioration	13
	Sound with minor defects	32
	Sound with long standing defects	13
	Excellent condition	9
2021-23	Damaged	4
	Major signs of deterioration	12
	Signs of potential deterioration	25
	Sound with minor defects	18
	Sound with long standing defects	19
	Excellent condition	8

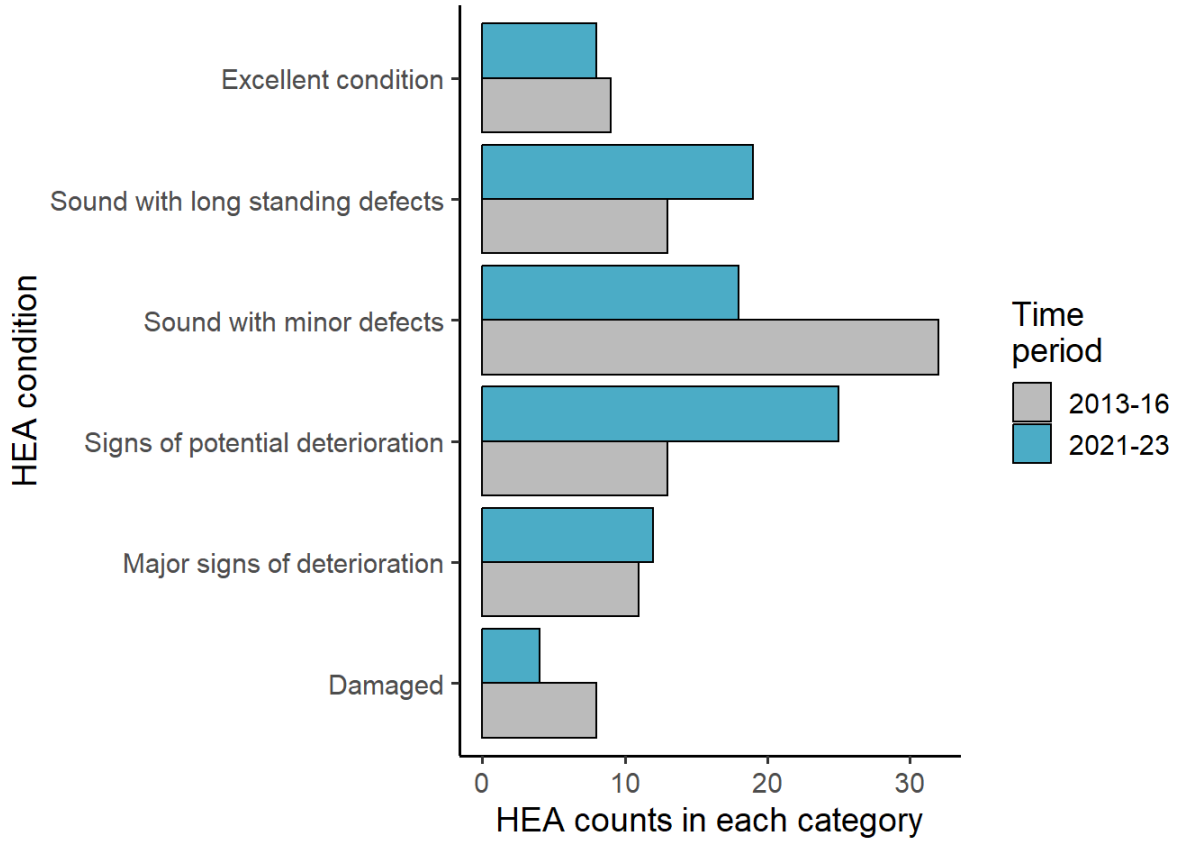

Figure 2-39 Re-surveyed Historic Environment Asset condition for 2013-16 and 2021-23

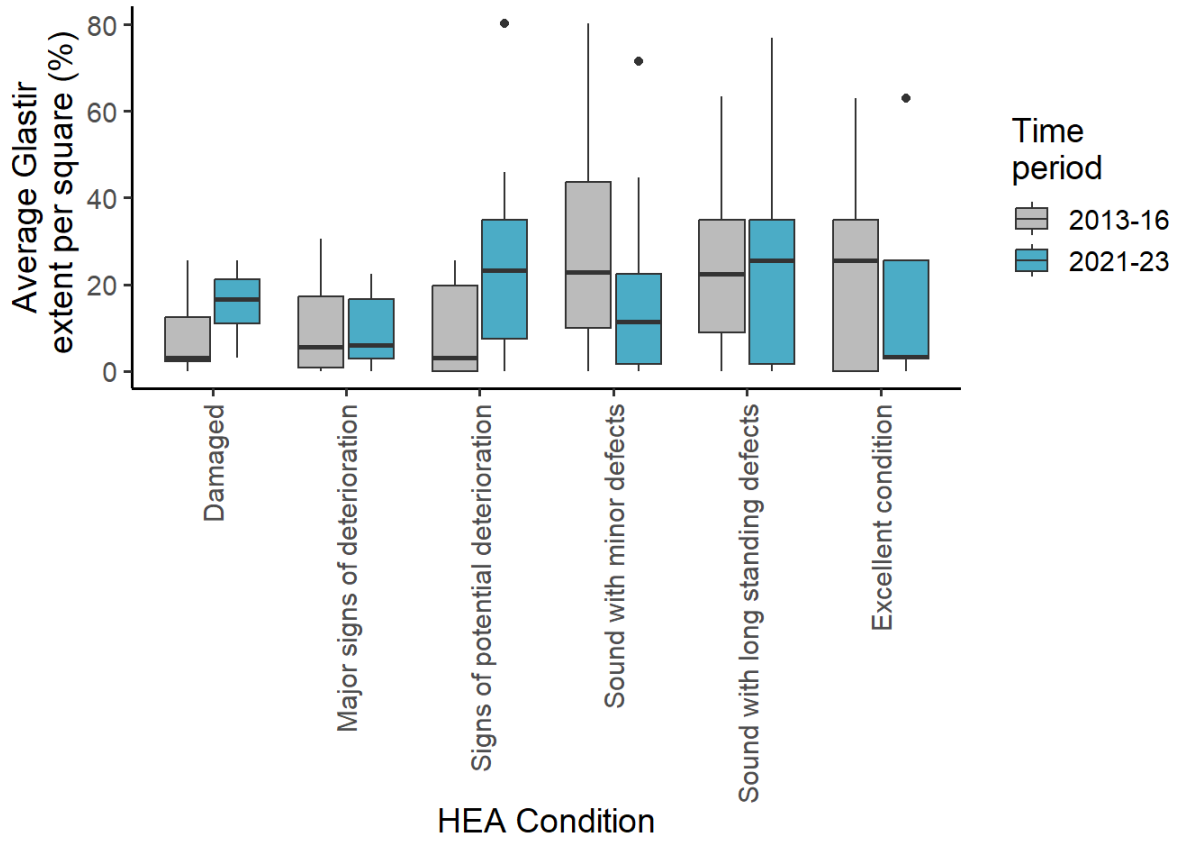

Figure 2-40 Re-surveyed historic Environment Asset condition by average Glastir extents in squares in 2013-16 and 2021-23.

2.2.8.1 Ordinal regression (re-surveyed HEAs)

```
## Call: Six condition categories
## polr(formula = CONDITION_SCORE ~ PROJECT * perc_land_in_glastir,
##     data = m4.1_input, Hess = TRUE)
##
## Coefficients:
##                                     Value Std. Error t value
## PROJECT2021-23                    -0.27912    0.38286  -0.729
## perc_land_in_glastir              -0.02249    0.00886  -2.538
## PROJECT2021-23:perc_land_in_glastir  0.01331    0.01254   1.062
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -2.7379  0.3598    -7.6088
## 2|3 -1.4432  0.3010    -4.7941
## 3|4 -0.1770  0.2814    -0.6292
## 4|5  0.9253  0.2942     3.1453
## 5|6  2.1769  0.3688     5.9030
##
## Residual Deviance: 573.373
## AIC: 589.373

##                                         2.5 %       97.5 %
## PROJECT2021-23                    -1.02950952  0.471268243 Not significant
## perc_land_in_glastir              -0.03985090 -0.005120577 Sig positive
## PROJECT2021-23:perc_land_in_glastir -0.01126594  0.037889270 Not significant
```

The effect of time and average Glastir extent in squares is the same for the full HEA population and the re-surveyed population: The ordinal regression tests if time (2013-16 vs.

2021-23) and average Glastir extents (%) influence Historic Environment Asset condition. Time (2013-16 and 2021-23) did not significantly affect HEA condition. Neither did HEA condition change with time in Glastir (neither improved nor worsened). However, HEA condition was better when Glastir extent was higher, which is similar to GMEP findings that land entering Glastir was already in better condition, which seems to be valid for HEAs too.

2.2.9 Glastir and time impact on HEA condition in two categories (re-surveyed HEAs)

Table 2-18 Re-surveyed Historic Environmental Asset counts in two condition categories in 2013-16 and 2021-23.

Time period	Condition	Count
2013-16	Deteriorated or damaged	32
	Excellent or sound condition	54
2021-23	Deteriorated or damaged	41
	Excellent or sound condition	45

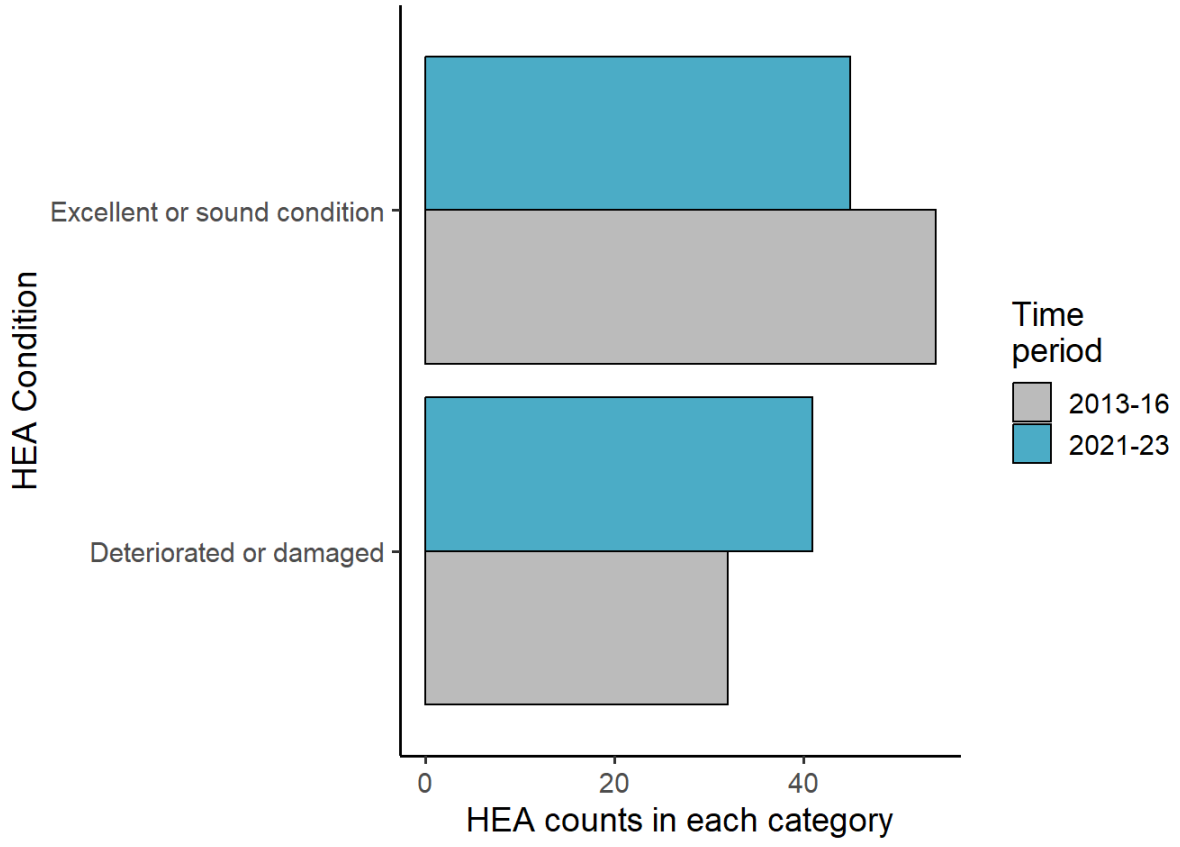

Figure 2-41 Re-surveyed Historic Environment Asset condition in two categories for 2013-16 and 2021-23.

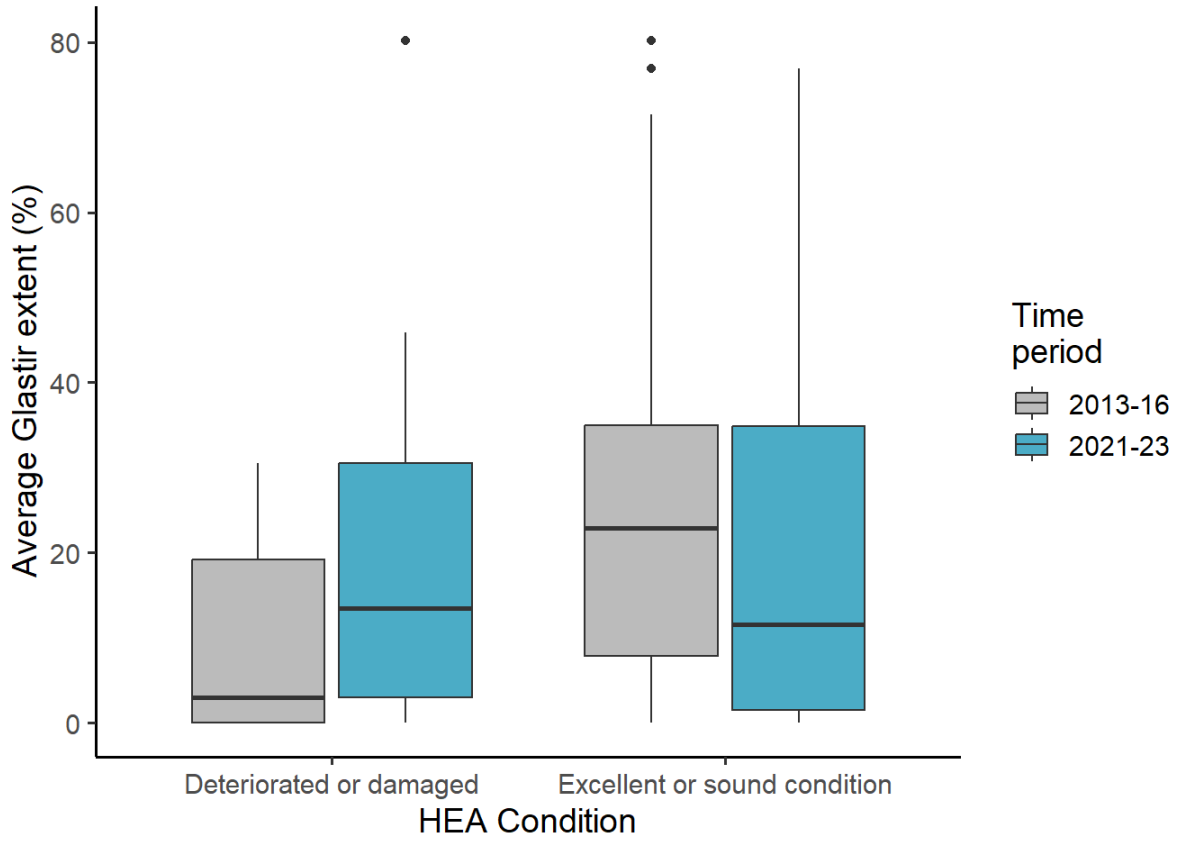

Figure 2-42 Historic Environment Asset (HEA) condition categories for re-surveyed HEAs against average Glastir extents (%) in 2013-16 and 2021-23. With the average Glastir extent in the square having a positive impact on overall HEA condition.

2.2.9.1 Binomial regression (re-surveyed HEAs)

```
## Call: Two condition categories
## glm(formula = CONDITION_3 ~ PROJECT * perc_land_in_glastir, family = "binomial
",
##     data = binomial)
##
## Coefficients:
##                                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)                       -0.43945    0.33654  -1.306 0.191624
## PROJECT2021-23                     0.43125    0.45076   0.957 0.338718
## perc_land_in_glastir               0.05943    0.01801   3.300 0.000965 ***
## PROJECT2021-23:perc_land_in_glastir -0.05439    0.02079  -2.617 0.008876 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 234.50  on 171  degrees of freedom
## Residual deviance: 215.61  on 168  degrees of freedom
## AIC: 223.61
##
## Number of Fisher Scoring iterations: 5

##                                         2.5 %      97.5 %
## (Intercept)                       -1.11890802  0.20954927 Not significant
## PROJECT2021-23                    -0.44697745  1.32607962 Not significant
## perc_land_in_glastir               0.02775615  0.09863906 sig pos
## PROJECT2021-23:perc_land_in_glastir -0.09814504 -0.01608683 sig neg
```

As for the full HEA data population, the re-surveyed HEAs showed that time itself (project) had no significant impact on HEA condition. Average Glastir extent in squares was positively associated with HEA condition (legacy effect) and higher average Glastir extents was associated with worse HEA condition over time when only looking at two condition classes (deteriorated or sound). This time x average Glastir extent is visible in Figure 2-40, but is not significant for data in six condition categories.

2.2.10 Direction of change in HEA condition for re-surveyed HEAs

For re-surveyed HEAs, we can check if the condition of the HEAs has improved or worsened over time. For this, the six condition categories were converted to numbers 1 to 6, with 1 being Excellent condition and 6 being damaged. The difference in condition scoring was calculated by subtracting the 2021-23 condition score from the 2013-16 condition score.

In the below Figure 2-43, a score of 0 shows that the re-survey of the HEAs was assigned the same condition in both projects. A positive score shows an improvement in condition, and a negative score a degradation in condition.

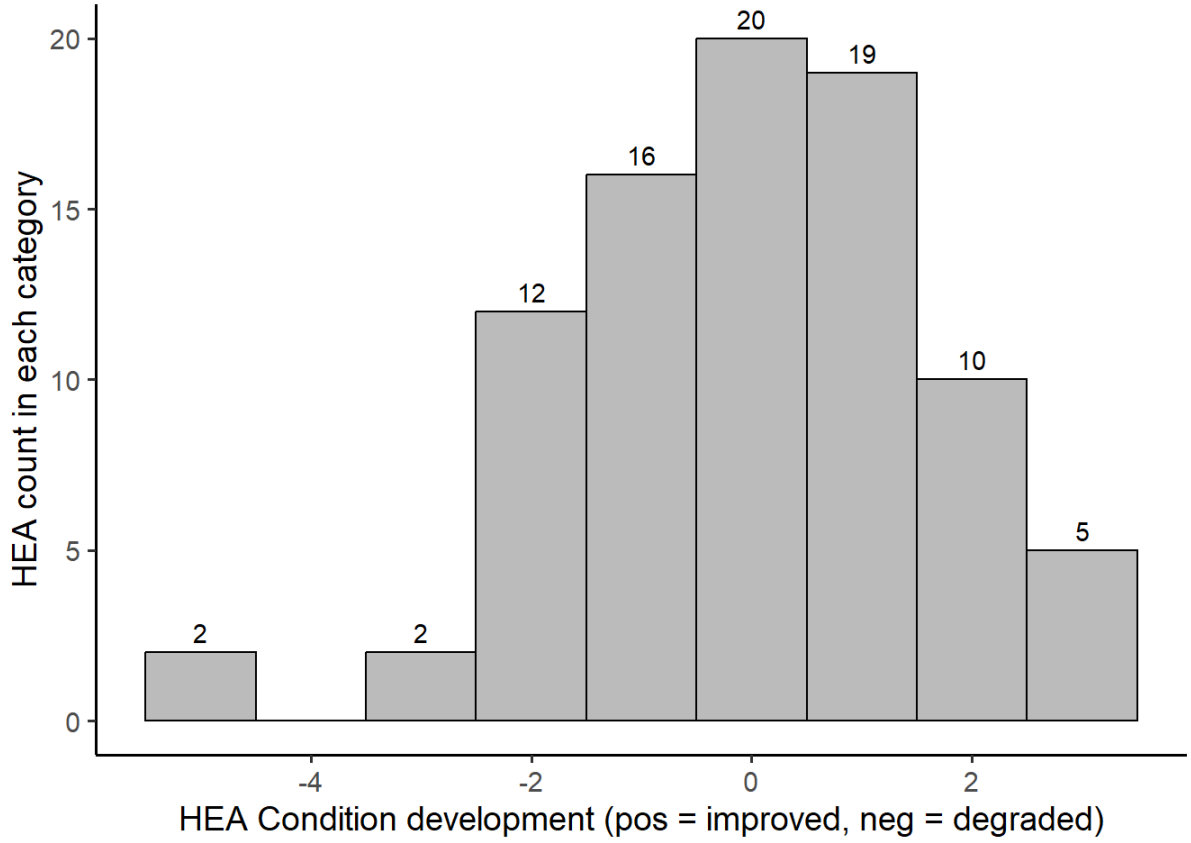

Figure 2-43 HEA condition development from 2013-16 to 2021-23.

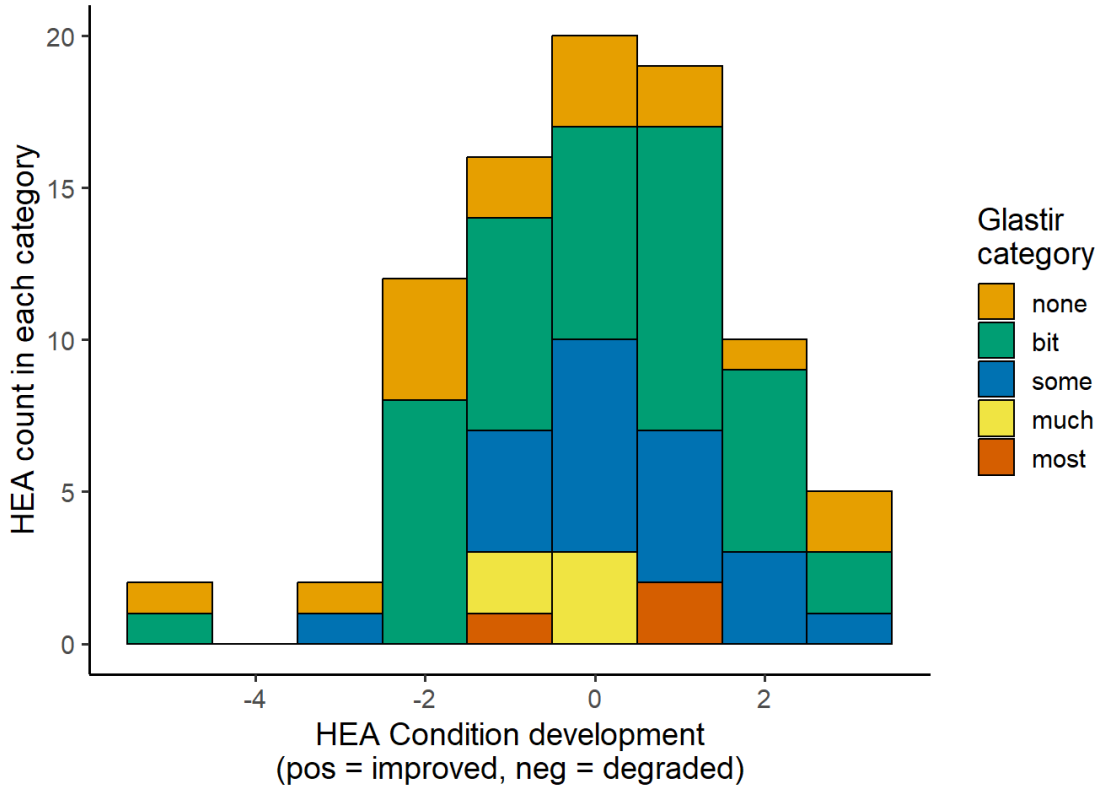

Figure 2-44 HEA condition development in Glastir categories from 2013-16 to 2021-23.

Figure 2-44 shows that higher average Glastir extents were not associated with severe deterioration of HEA condition, neither with considerable improvements. The same is illustrated in a different way in Figure 2-45 below.

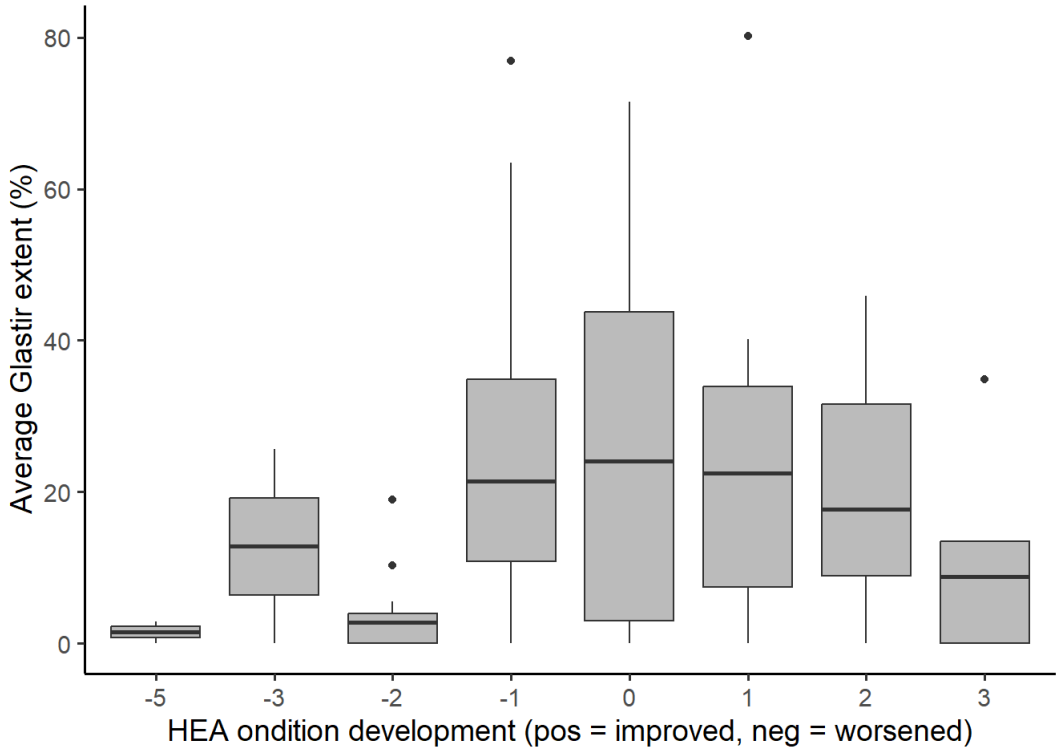

Figure 2-45 HEA condition development between 2013-16 and 2021-23 for re-surveyed HEAs as a function of average Glastir extent (%).

2.2.10.1 Ordinal regression

```
## Call: Condition development score (-5 to +3)
## polr(formula = CONDITION_DEVELOPMENT ~ perc_land_in_glastir,
##     data = m5.1_input, Hess = TRUE)
##
## Coefficients:
##                        Value Std. Error t value
## perc_land_in_glastir 0.01048   0.008758   1.197
##
## Intercepts:
##       Value   Std. Error t value
## -5|-3 -3.5473  0.7320    -4.8458
## -3|-2 -2.8273  0.5358    -5.2769
## -2|-1 -1.2557  0.3304    -3.8006
## -1|0  -0.2813  0.2997    -0.9385
## 0|1    0.6741  0.3042     2.2160
## 1|2    1.8027  0.3543     5.0875
## 2|3    3.0260  0.5049     5.9934
##
## Residual Deviance: 316.9242
## AIC: 332.9242

##                              2.5 %     97.5 %
## perc_land_in_glastir -0.006682101 0.02764831 Not significant
```

The logistic regression tests if average Glastir extent (%) impacted the HEA condition development over time (analysis only possible for re-surveyed HEAs). The test suggests that average Glastir extents can neither explain improvement nor worsening of HEA condition. (Note, time (project) was not included in the analysis as the condition scores were derived by difference in condition scores between 2013-16 and 2021-23).

2.2.11 Overview of HEA types over time

The Asset type was aggregated into broader categories. For example, the category **Settlement** is comprised of: Medieval settlement, Hut circle settlement, Medieval deserted rural settlement, Pre-historic hut circle settlement, Pre-historic settlement, Iron age hut circle settlement. Or **Enclosures** is an aggregate of: Enclosure, Post-medieval deserted rural settlement, unknown enclosure, Medieval enclosure, Pre-historic enclosure.

Table 2-19 Count of Historic Environment Assets in 2013-16 and 2021-23.

Time period	Count
2013-16	220
2021-23	147

Table 2-20 List and count of Historic Environment Asset types in 2013-16. Survey of 220 HEAs.

Asset type	Count
Water body	25
Quarry	16
Enclosure	14
House	14
Transport	14
Farmstead	13
Cottage	11
Stone	10
Hut	9
Barrow	7
Cairn	7
Fort	7
Building	6
Leat	6
Other	6
Ridge and furrow	6
Settlement	6
Colliery	4
Kiln	4
Mine	4
Motte	4
Mound	4
Earthwork	3
Shelter	3
Unknown	3
Well	3
Field system	2
Grounds	2
Level	2
Mill	2
Dyke	1
Platform	1
Structure	1

Table 2-21 List and count of Historic Environment Asset types in 2021-23. Survey of 147 HEAs.

Asset type	Count
Transport	13
Water body	11
Farmstead	10
Hut	10
Quarry	10
Enclosure	9
Building	7
Cottage	7
Leat	7
Settlement	6
Field system	5
House	5
Other	5
Cairn	4
Fort	4
Kiln	4
Earthwork	3
Grounds	3
Mine	3
Mound	3
Barrow	2
Dyke	2
Mill	2
Motte	2
Ridge and furrow	2
Shelter	2
Hollow way	1
Level	1
Platform	1
Stone	1
Structure	1
Unknown	1

Table 2-22 List and count of Historic Environment Asset types for re-surveyed HEAs between 2013-16 and 2021-23. Survey of 86 HEAs.

Asset type	Count
Transport	13
Water body	11
Farmstead	10
Hut	10
Quarry	10
Enclosure	9
Building	7
Cottage	7
Leat	7
Settlement	6
Field system	5
House	5
Other	5
Cairn	4
Fort	4
Kiln	4
Earthwork	3
Grounds	3
Mine	3
Mound	3
Barrow	2
Dyke	2
Mill	2
Motte	2
Ridge and furrow	2
Shelter	2
Hollow way	1
Level	1
Platform	1
Stone	1
Structure	1
Unknown	1

2.2.12 Glastir Threats analysis

Table 2-23 Number of Historic Environment Assets (HEAs) without threat records in 2013-16 and 2021-23. A total of 8 re-surveyed HEAs had not threats associated with them.

Time period	Count
2013-16	24
2021-23	13

2.2.13 Glastir - threats vs Glastir extents

Table 2-24 Count of threats per threat category for re-surveyed and not re-surveyed Historic Environment Assets in 2013-16 and 2021-23.

Time period	Threat category	Re-surveyed	Count
2013-16	Agricultural Operations	No	81
		Yes	66
	Other	No	51
		Yes	68
	Stock	No	171
		Yes	120
	Vegetation	No	285
		Yes	220
2021-23	Agricultural Operations	No	46
		Yes	74
	Other	No	68
		Yes	80
	Stock	No	62
		Yes	100
	Vegetation	No	152
		Yes	200

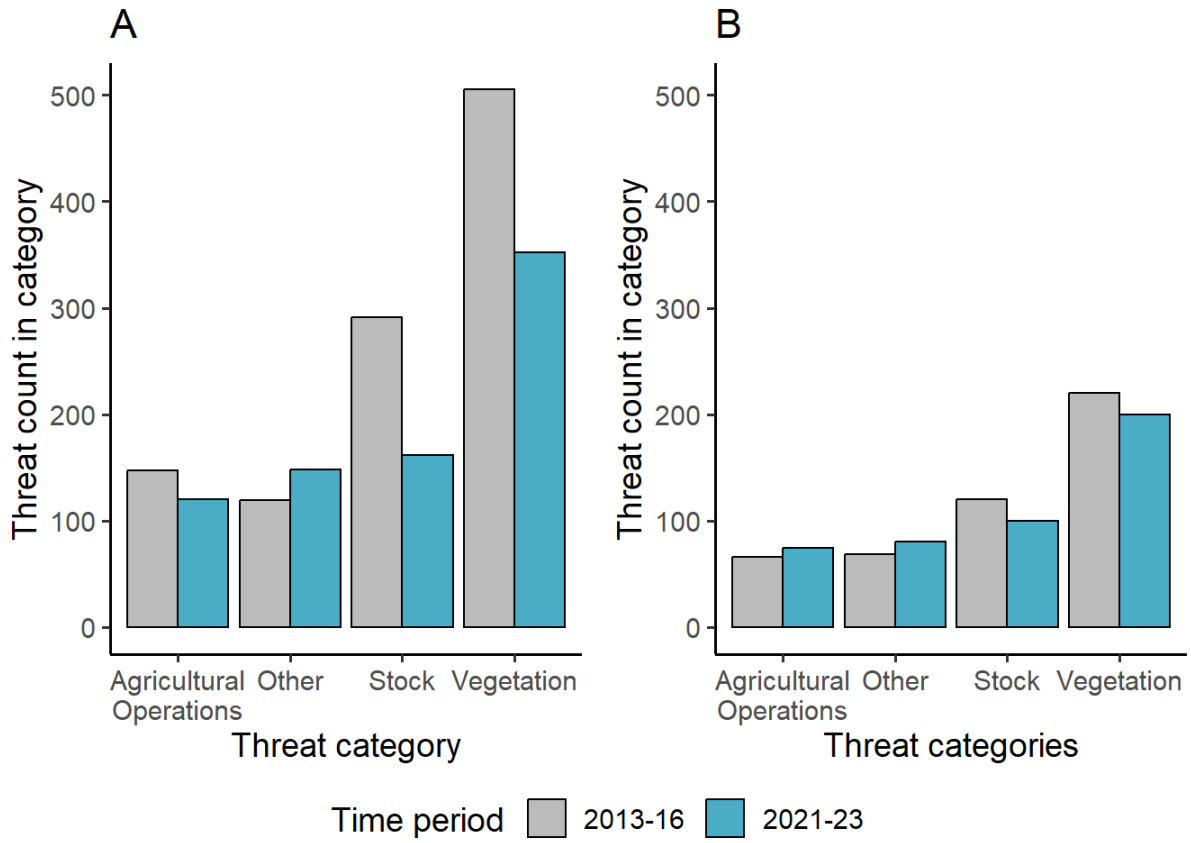

Figure 2-46 Number of threats in each of the four threat categories in 2013-16 and 2021-23 for A) all Historic Environment Assets (HEAs), and B) re-surveyed HEAs. Higher bars in A) for the time period 2013-16 are associated with the higher number of squares visited and HEAs surveyed. Panel B) gives an idea of impact of time on threat counts.

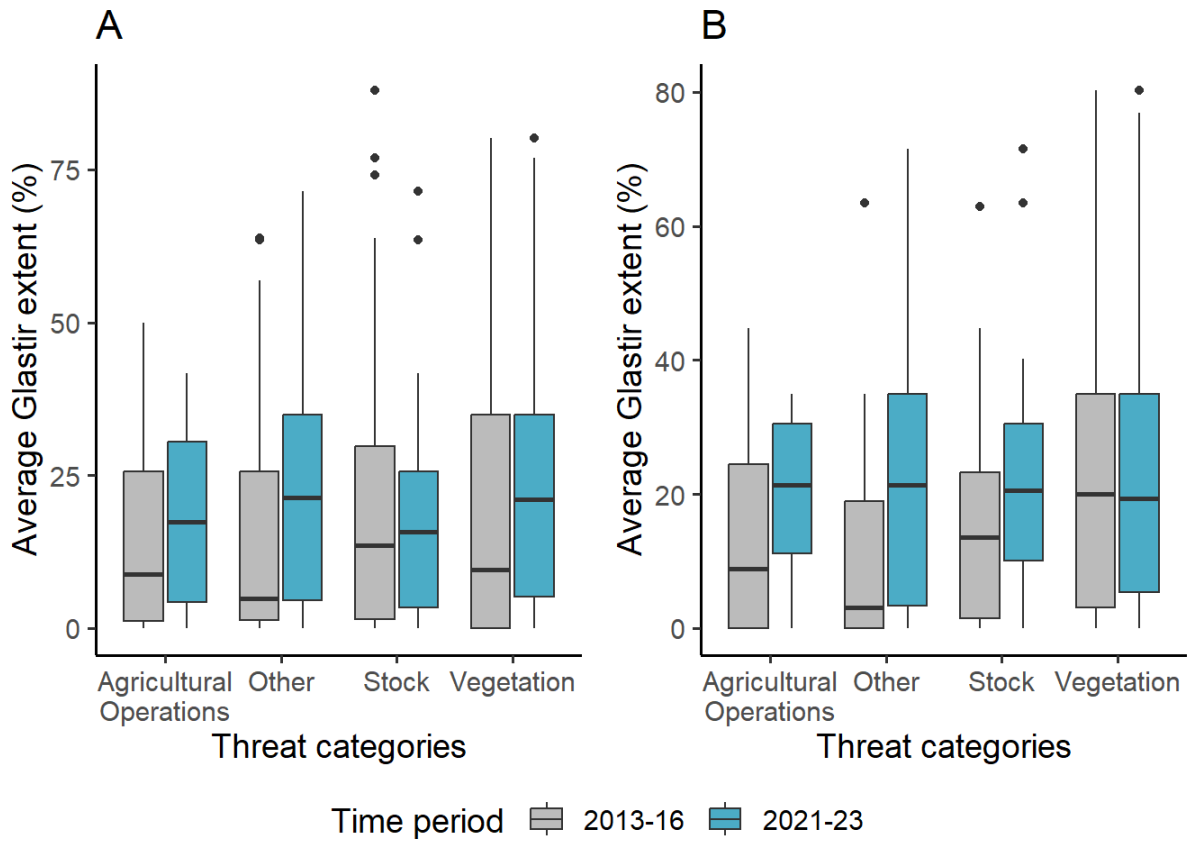

Figure 2-47 Average Glastir extent (%) in squares for each threat category in 2013-16 and 2021-23 for A) all Historic Environment Assets (HEAs), and B) re-surveyed HEAs.

Vegetation was the dominant threat type in 2013-16, followed by stock (Figure 2-46). In 2021-23, Vegetation was the dominant threat type, and other threats were equally often. Average Glastir extent was fairly constant across threat types (Figure 2-47).

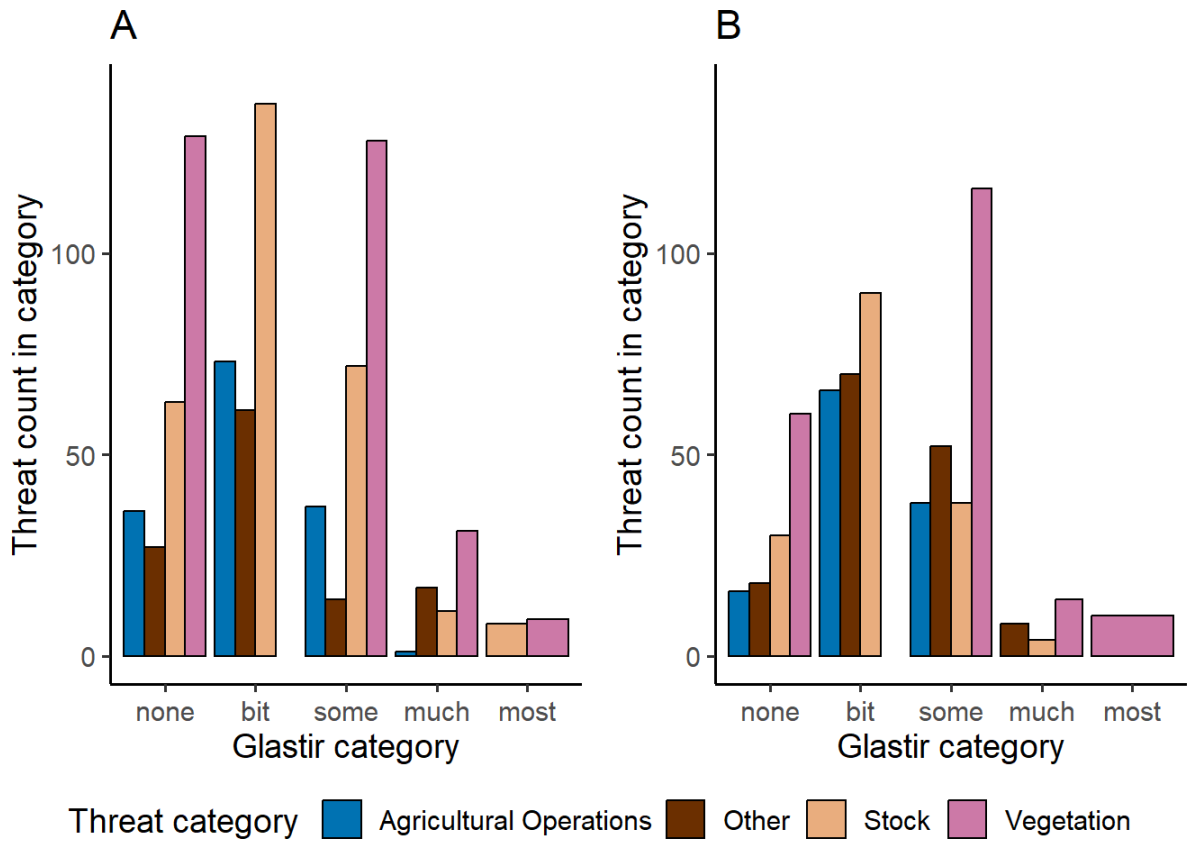

Figure 2-48 Number of threats per threat category within the five Glastir categories for A) 2013-16 and B) 2021-23.

In 2013-16, vegetation threats were highest in all but one Glastir category. Vegetation threats were not recorded in the most abundant Glastir category (up to 25% average uptake). The most abundant Glastir category had Stock as main threat associated. Stock was the second most common threat to HEAs in 2013-16. In squares an average Glastir uptake > 50%, Agricultural operation threats were mostly absent, and in squares with >75% Glastir uptake, only stock and vegetation threats were recorded. This lack of other and agricultural threats in the >75% Glastir extent category is likely associated with only a few squares having had this high uptake, and thus the likelihood of observing the less common threats is lower.

In 2021-23, the threat profile was similar across Glastir categories, with the vegetation threat being the most prominent one, even in squares with an average Glastir extent of up to 25%. Stock threat in this category were less abundant compared to 2013-16.

2.2.14 Ordinal regressions looking at Glastir and time effects on threat categories separately

The rationale behind looking at average Glastir extent and time effects on threat categories is to understand if Glastir / time were changing the threats. This could be used e.g. if average Glastir extent had reduced some threats but not others, to report this improvement.

Notes: the below analyses use 1) all data (model m1_input) or data associated with 2) re-surveyed HEAs (model m2_input). The threat category data are the sum of threats in each category recorded against each HEAs (thus it's not presence / absence data). These data can be categorized as 0 (best) to 8 (worst).

2.2.14.1 Ordinal regression - threats through agricultural operations

```
## Call: all HEAs
## polr(formula = THREAT_AG ~ PROJECT * perc_land_in_glastir, data = m1_input,
##     Hess = TRUE)
##
## Coefficients:
##                                       Value Std. Error t value
## PROJECT2021-23                     0.495226   0.318989  1.5525
## perc_land_in_glastir              -0.009077   0.007497 -1.2107
## PROJECT2021-23:perc_land_in_glastir -0.002304   0.012078 -0.1907
##
## Intercepts:
##     Value   Std. Error t value
## 0|1  1.0556  0.2125     4.9689
## 1|2  2.6967  0.2770     9.7361
## 2|3  3.8374  0.3991     9.6160
## 3|4  4.8317  0.6061     7.9719
## 4|8  5.9358  1.0168     5.8378
##
## Residual Deviance: 566.0535
## AIC: 582.0535

##                                         2.5 %      97.5 %
## PROJECT2021-23                     -0.12998013 1.120432641 Not significant
## perc_land_in_glastir               -0.02377212 0.005617224 Not significant
## PROJECT2021-23:perc_land_in_glastir -0.02597615 0.021368549 Not significant

## Call: Re-surveyed HEAs
## polr(formula = THREAT_AG ~ PROJECT * perc_land_in_glastir, data = m2_input,
##     Hess = TRUE)
##
## Coefficients:
##                                       Value Std. Error t value
## PROJECT2021-23                     0.19627    0.45668  0.4298
## perc_land_in_glastir              -0.01997    0.01428 -1.3986
## PROJECT2021-23:perc_land_in_glastir  0.01284    0.01809  0.7100
##
## Intercepts:
##     Value   Std. Error t value
## 0|1  0.7265  0.3423     2.1221
## 1|2  2.5651  0.4318     5.9400
## 2|3  3.9125  0.6529     5.9926
## 3|4  5.0245  1.0453     4.8067
##
## Residual Deviance: 274.7296
## AIC: 288.7296

##                                         2.5 %      97.5 %
## PROJECT2021-23                     -0.69880398 1.091339294 Not significant
## perc_land_in_glastir               -0.04794680 0.008013585 Not significant
## PROJECT2021-23:perc_land_in_glastir -0.02260857 0.048290188 Not significant
```

For both data populations (full dataset and re-surveyed HEAs only), there were no significant effects of time or average Glastir extent in the squares on agricultural operations threats.

2.2.14.2 Ordinal regression - Other threats

```
## Call: All HEAs
## polr(formula = THREAT_OT ~ PROJECT * perc_land_in_glastir, data = m1_input,
##     Hess = TRUE)
##
## Coefficients:
##                                      Value Std. Error t value
## PROJECT2021-23                    0.610212    0.31352  1.9463
## perc_land_in_glastir             -0.001412    0.00677 -0.2086
## PROJECT2021-23:perc_land_in_glastir  0.008063    0.01063  0.7587
##
## Intercepts:
##     Value   Std. Error t value
## 0|1  1.0947  0.2110     5.1886
## 1|2  3.3677  0.3113    10.8192
## 2|3  4.4398  0.4520     9.8216
##
## Residual Deviance: 558.3982
## AIC: 570.3982

##                                          2.5 %     97.5 %
## PROJECT2021-23                    -0.004275246 1.22469934 Not significant
## perc_land_in_glastir              -0.014680983 0.01185666 Not significant
## PROJECT2021-23:perc_land_in_glastir -0.012766654 0.02889239 Not significant

## Call: Re-surveyed HEAs
## polr(formula = THREAT_OT ~ PROJECT * perc_land_in_glastir, data = m2_input,
##     Hess = TRUE)
##
## Coefficients:
##                                      Value Std. Error t value
## PROJECT2021-23                    -0.18236    0.44073 -0.4138
## perc_land_in_glastir              -0.02620    0.01384 -1.8933
## PROJECT2021-23:perc_land_in_glastir  0.02906    0.01710  1.6995
##
## Intercepts:
##     Value   Std. Error t value
## 0|1  0.3548  0.3285     1.0801
## 1|2  2.3279  0.4083     5.7014
## 2|3  3.4823  0.5740     6.0663
##
## Residual Deviance: 290.4487
## AIC: 302.4487

##                                          2.5 %       97.5 %
## PROJECT2021-23                    -1.046186971 0.6814583936 Not significant
## perc_land_in_glastir              -0.053326195 0.0009226368 Not significant
## PROJECT2021-23:perc_land_in_glastir -0.004453572 0.0625686341 Not significant
```

For both data populations (full dataset and re-surveyed HEAs only), there were no significant effects of time or average Glastir extent in the squares on Other threats.

2.2.14.3 Ordinal regression - Stock threats

```
## Call: All HEAs
## polr(formula = THREAT_ST ~ PROJECT * perc_land_in_glastir, data = m1_input,
##     Hess = TRUE)
##
## Coefficients:
##                                       Value Std. Error  t value
## PROJECT2021-23                     0.1288401   0.291495  0.44200
## perc_land_in_glastir              -0.0002219   0.005921 -0.03748
## PROJECT2021-23:perc_land_in_glastir -0.0062286   0.010345 -0.60208
##
## Intercepts:
##     Value   Std. Error t value
## 0|1  0.4814  0.1862     2.5858
## 1|2  1.9350  0.2188     8.8435
## 2|3  2.6087  0.2560    10.1916
## 3|4  3.5680  0.3539    10.0828
## 4|5  3.7968  0.3875     9.7985
## 5|6  4.5011  0.5243     8.5842
##
## Residual Deviance: 778.162
## AIC: 796.162

##                                         2.5 %     97.5 %
## PROJECT2021-23                     -0.44247992 0.70016003 Not significant
## perc_land_in_glastir               -0.01182695 0.01138309 Not significant
## PROJECT2021-23:perc_land_in_glastir -0.02650494 0.01404766 Not significant

## Call: Re-surveyed HEAs
## polr(formula = THREAT_ST ~ PROJECT * perc_land_in_glastir, data = m2_input,
##     Hess = TRUE)
##
## Coefficients:
##                                       Value Std. Error t value
## PROJECT2021-23                     -0.34954    0.42238 -0.8276
## perc_land_in_glastir               -0.01390    0.01096 -1.2681
## PROJECT2021-23:perc_land_in_glastir  0.01552    0.01485  1.0455
##
## Intercepts:
##     Value   Std. Error t value
## 0|1  0.1259  0.3052     0.4126
## 1|2  1.5801  0.3382     4.6727
## 2|3  2.3072  0.3886     5.9378
## 3|5  3.7498  0.6323     5.9304
## 5|6  4.8603  1.0326     4.7070
##
## Residual Deviance: 365.2856
## AIC: 381.2856

##                                         2.5 %      97.5 %
## PROJECT2021-23                     -1.17738277 0.478301576 Not significant
## perc_land_in_glastir               -0.03538525 0.007584527 Not significant
## PROJECT2021-23:perc_land_in_glastir -0.01357903 0.044626357 Not significant
```

For both data populations (full dataset and re-surveyed HEAs only), there were no significant effects of time or average Glastir extent in the squares on stock threats.

2.2.14.4 Ordinal regression - Vegetation threats

```
## Call: All HEAs
## polr(formula = THREAT_VE ~ PROJECT * perc_land_in_glastir, data = m1_input,
##     Hess = TRUE)
##
## Coefficients:
##                                       Value Std. Error t value
## PROJECT2021-23                     -0.534035   0.265585  -2.011
## perc_land_in_glastir               -0.004298   0.005307  -0.810
## PROJECT2021-23:perc_land_in_glastir  0.015378   0.008957   1.717
##
## Intercepts:
##     Value   Std. Error t value
## 0|1 -1.1195  0.1883    -5.9469
## 1|2  0.5067  0.1819     2.7855
## 2|3  1.6174  0.2028     7.9768
## 3|4  2.3166  0.2375     9.7540
## 4|5  3.5112  0.3616     9.7104
## 5|6  4.6280  0.5938     7.7936
##
## Residual Deviance: 1074.098
## AIC: 1092.098

##                                         2.5 %       97.5 %
## PROJECT2021-23                     -1.05457136 -0.013497761 sign negative
## perc_land_in_glastir               -0.01469945  0.006102827
## PROJECT2021-23:perc_land_in_glastir -0.00217768  0.032934214

## Call: Re-surveyed HEAs
## polr(formula = THREAT_VE ~ PROJECT * perc_land_in_glastir, data = m2_input,
##     Hess = TRUE)
##
## Coefficients:
##                                       Value Std. Error   t value
## PROJECT2021-23                     -1.045e-01   0.391785 -0.266715
## perc_land_in_glastir                1.227e-02   0.009176  1.336704
## PROJECT2021-23:perc_land_in_glastir  1.361e-05   0.012618  0.001079
##
## Intercepts:
##     Value   Std. Error t value
## 0|1 -0.6752  0.3032    -2.2270
## 1|2  0.8992  0.3099     2.9019
## 2|3  2.2082  0.3495     6.3177
## 3|4  2.9175  0.4047     7.2094
## 4|6  5.3733  1.0349     5.1923
##
## Residual Deviance: 484.3621
## AIC: 500.3621

##                                           2.5 %     97.5 %
## PROJECT2021-23                     -0.872379393 0.66338949 Not significant
## perc_land_in_glastir               -0.005718809 0.03024906 Not significant
## PROJECT2021-23:perc_land_in_glastir -0.024718133 0.02474536 Not significant
```

For the full dataset, time increased vegetation threats, which is a negative outcome for HEAs. This can be seen in Figure 2-47A. Vegetation threats had the highest number of occurrences and is the most likely threat category to pick up statistical changes over time. However, the re-surveyed data population did not show the same significant effect of time on vegetation threat counts. There were no significant effects of average Glastir extent or time x average Glastir extents on vegetation threats.

2.2.15 Threat combinations across all HEAs

Threats to a HEA can be multiple. To visualize the development of threats to HEAs over time, threat categories were combined if they were recorded for a single HEA. For example, if only vegetation was recorded, then this is abbreviated with “Ve”. If stock and vegetation threats were recorded (in any number), then this is summarized in the category “St+Ve” (etc.). The number of threats in each category are irrelevant in this visualization.

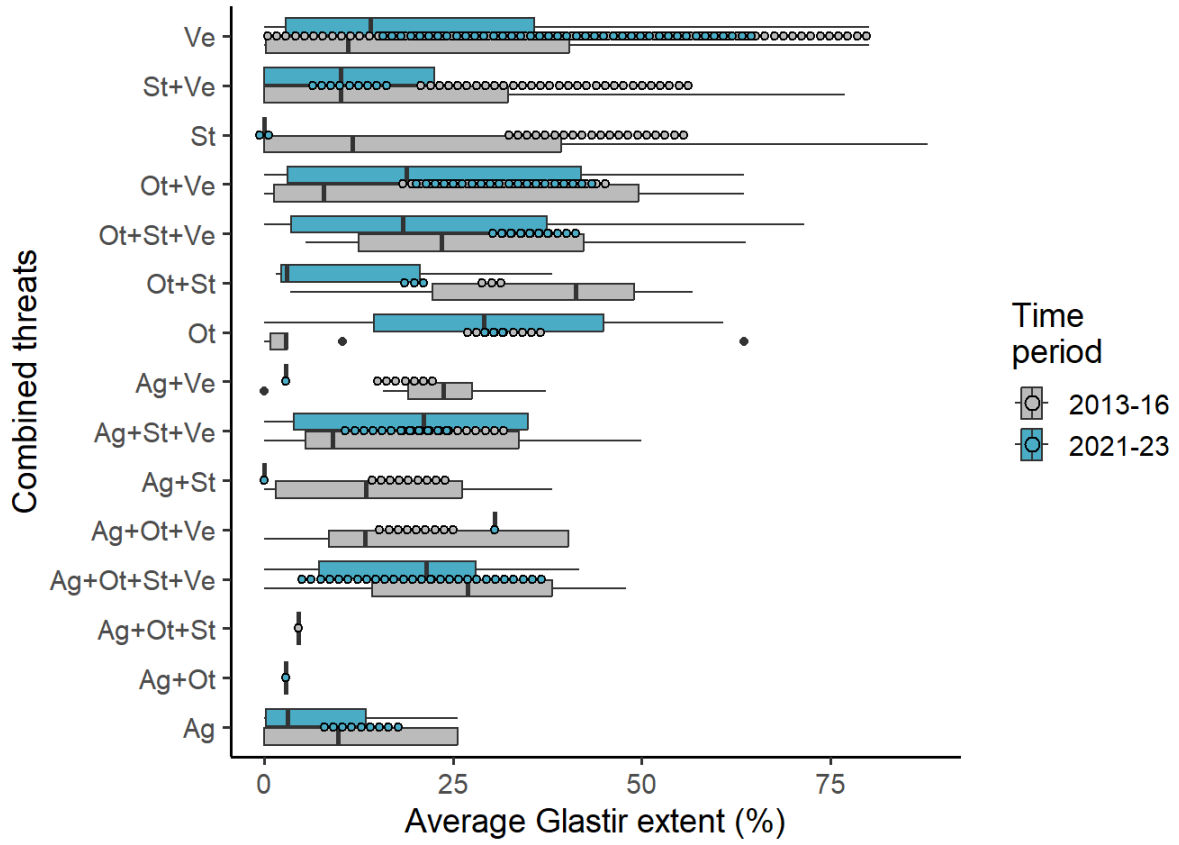

Figure 2-49 Threat combinations observed as a function of average Glastir extent (%) in the square for all Historic Environment Assets.

2.2.16 Threat combinations across re-surveyed HEAs

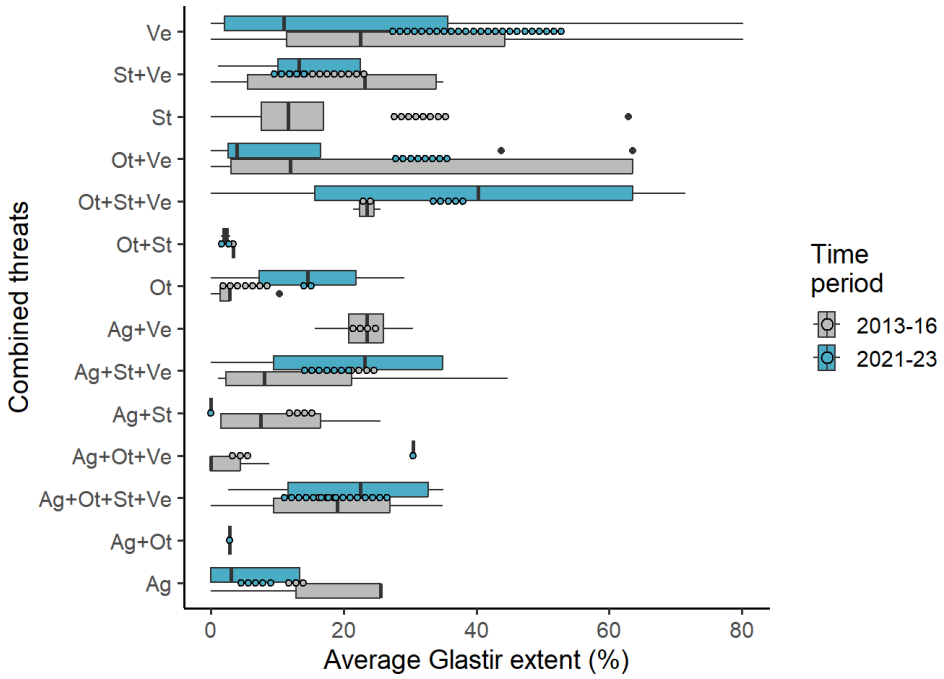

Figure 2-50 Threat combinations observed as a function of average Glastir extent (%) in the square for re-surveyed Historic Environment Assets.

2.2.17 Glastir trend analysis - impact of Glastir on threat categories

Below, threat types are visualized for each of the four threat categories. This was done for all HEAs, and for re-sampled HEAs only.

2.2.17.1 Stock threats

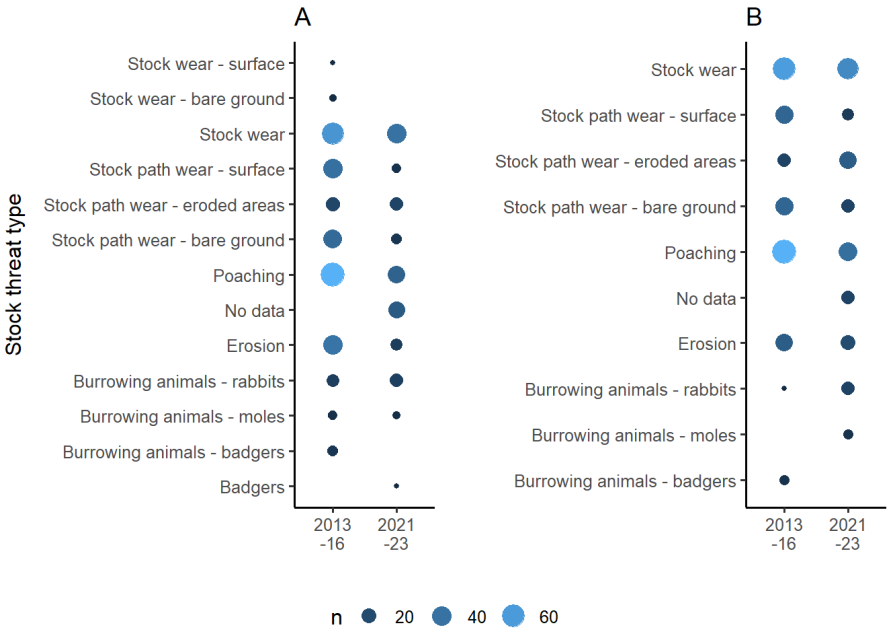

Figure 2-51 Stock threats for A) all Historic Environment Assets (HEAs), and B) re-surveyed HEAs.

It does not look like that there was a big change in stock threats between 2013-16 and 2021-23. It may be noted that in 2021-23, about 20 cases on stock threats were recorded where no threat type was assigned.

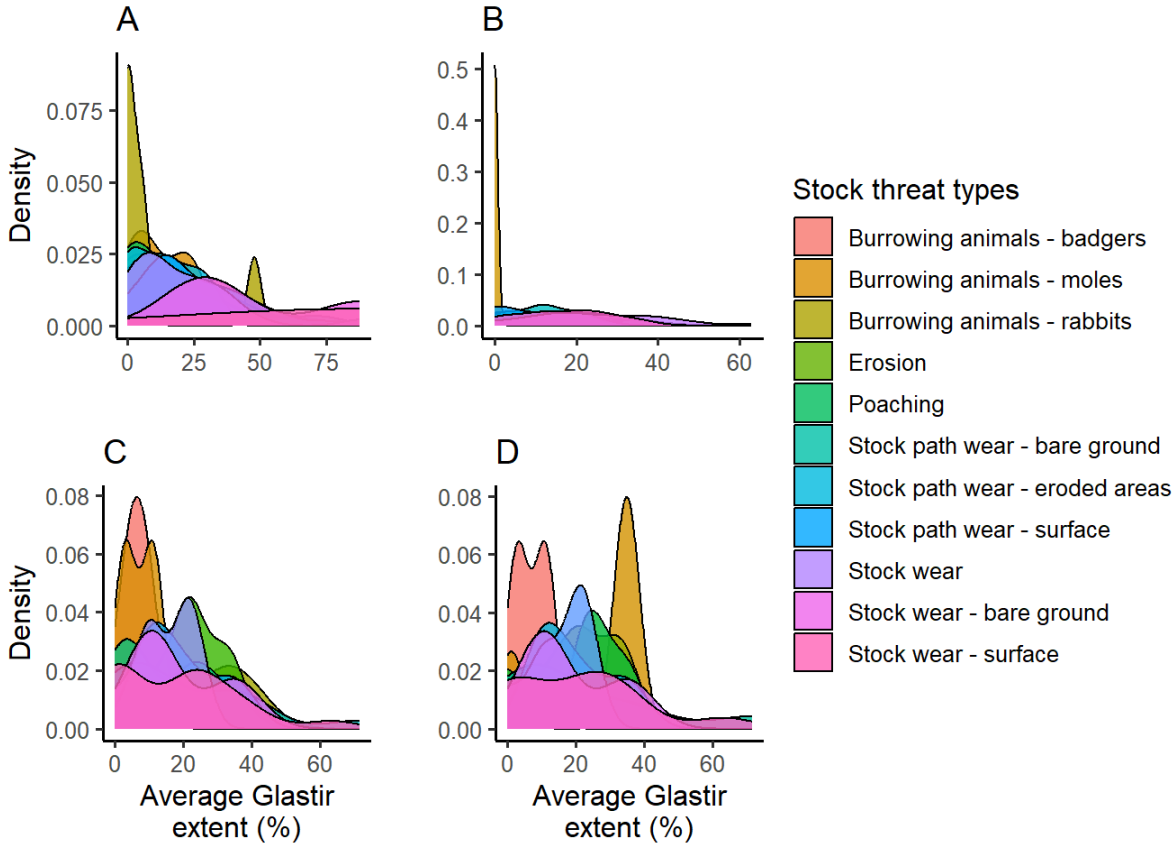

Figure 2-52 Stock threat type density plots for A) 2013-16 all HEAs, B) 2013-16 re-surveyed HEAs, C) 2021-23 all HEAs, and D) 2021-23 re-surveyed HEAs.

In 2013-16 (Figure 2-52 A and B), burrowing animals were prominent in squares with low average Glastir extent, and stock wear was continuously present across all average Glastir extents. Otherwise, no clear distinction of threats by average Glastir extent is visible.

In 2021-23 (Figure 2-52 C and D), different types of burrowing animals seem to be associated with low average Glastir extents in the full dataset, but this shifts in the re-surveyed dataset. Stock wear, stock path ware, and erosion threats peak around 20% average Glastir extent.

2.2.17.2 Vegetation threats

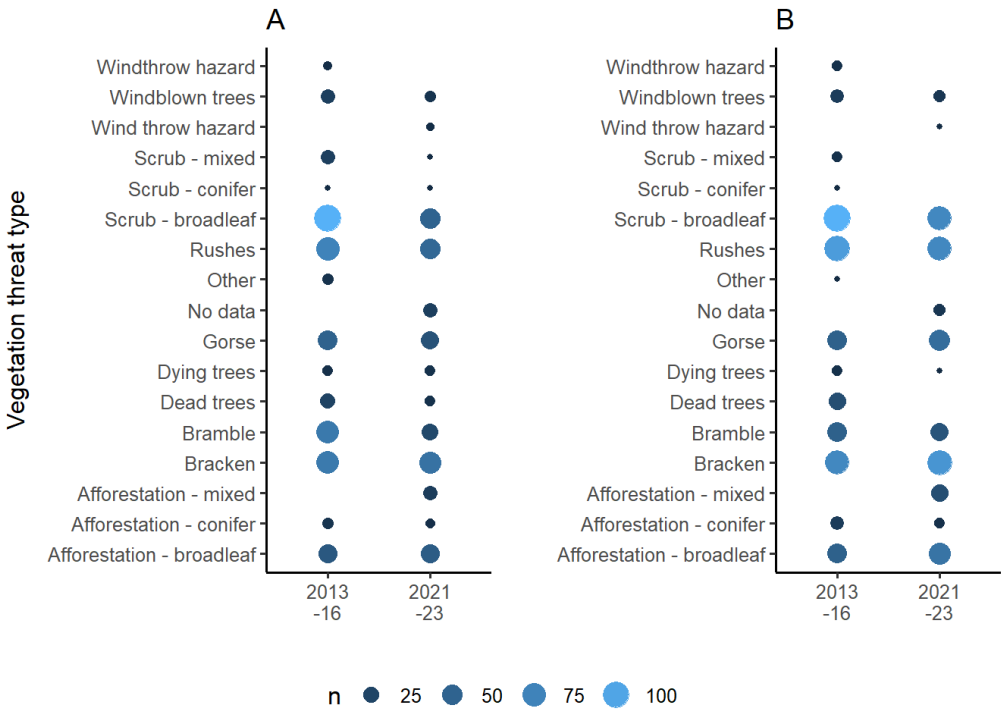

Figure 2-53 Vegetation threats for A) all Historic Environment Assets (HEAs), and B) re-surveyed HEAs.

The distribution of vegetation threats in all HEAs and re-surveyed HEAs are very similar. There is a change in some vegetation threats between 2013-16 and 2021-23. Again, in 2021-23, vegetation threats were recorded without assigning a threat type (No data category).

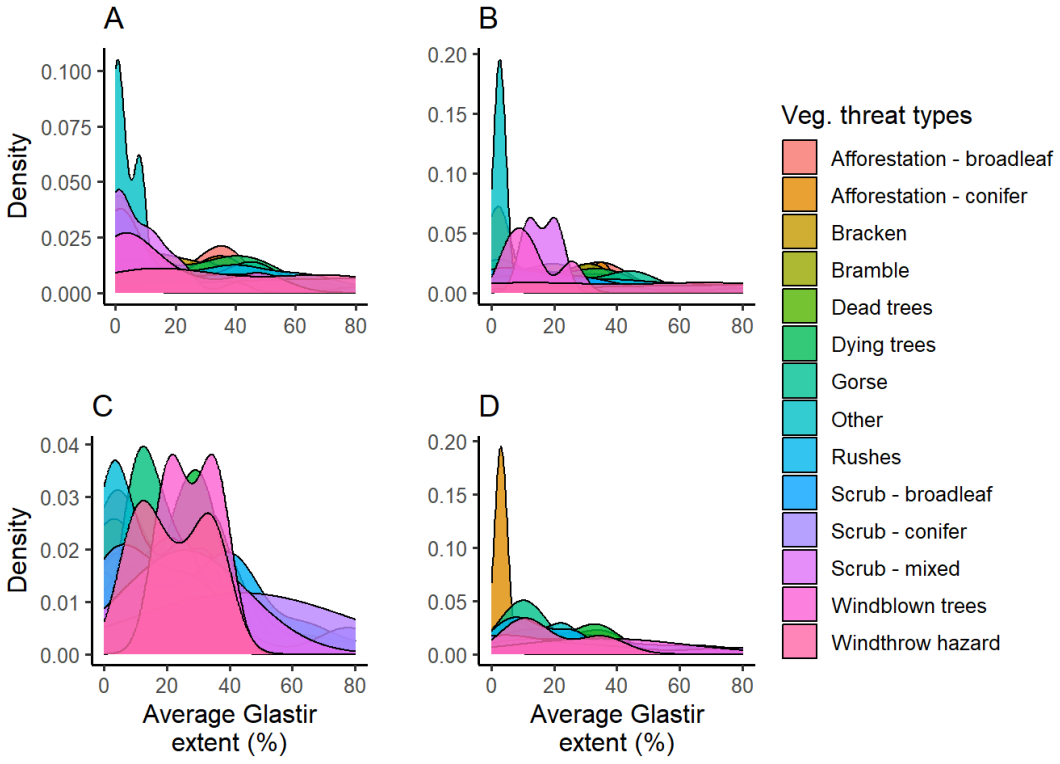

Figure 2-54 Stock threat type density plots for A) 2013-16 all HEAs, B) 2013-16 re-surveyed HEAs, C) 2021-23 all HEAs, and D) 2021-23 re-surveyed HEAs.

In 2013-16 (Figure 2-54 A and B), vegetation threats in the category “other” peak at very low average Glastir extents in both, the full and the re-surveyed dataset. The windblow hazard was present across all average Glastir extents. Scrub (conifer and mixed) is a noticeable vegetation threat below an average Glastir extent of 50% for the full dataset, and peaking at about 20% for the re-surveyed dataset.

In 2021-23 (Figure 2-54 C and D), the full dataset shows a generally even distribution of vegetation threats across average Glastir extents below 50%, and declining thereafter. The same is true for the re-surveyed dataset with the exception afforestation (conifer) at lower average Glastir extents.

2.2.17.3 Other threats

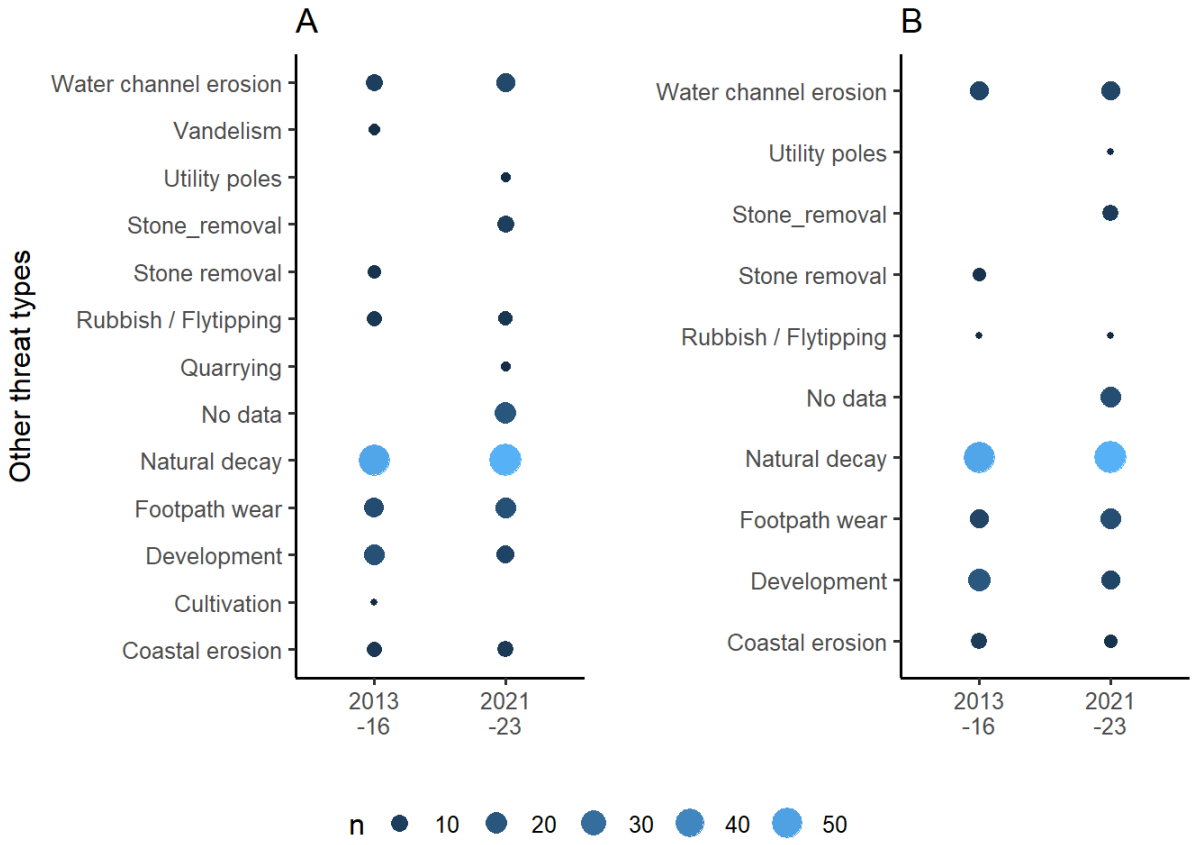

Figure 2-55 Other threats for A) all Historic Environment Assets (HEAs), and B) re-surveyed HEAs.

The distribution of other threats in all HEAs and re-surveyed HEAs are very similar. There is a change in some threats between 2013-16 and 2021-23. Again, in 2021-23, threats were recorded without assigning a threat type (No data category).

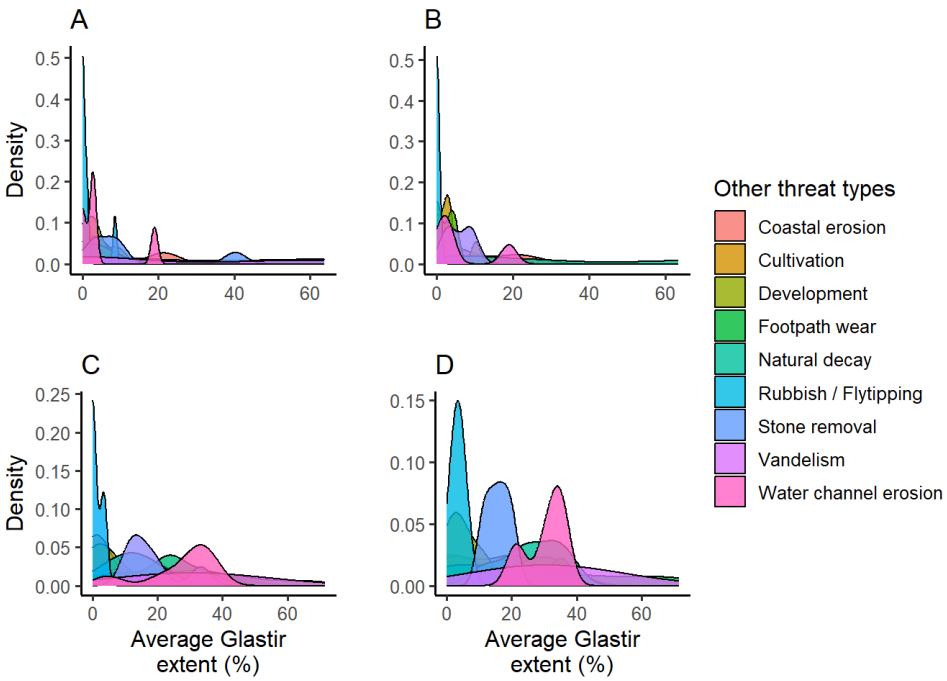

Figure 2-56 Other threat type density plots for A) 2013-16 all HEAs, B) 2013-16 re-surveyed HEAs, C) 2021-23 all HEAs, and D) 2021-23 re-surveyed HEAs.

In 2013-16 (Figure 2-56 A and B), rubbish / flytipping peaked at low average Glastir extents, followed by water channel erosion and cultivation. Footpath wear was continuously present across all average Glastir extents.

In 2021-23 (Figure 2-56 C and D), rubbish / flytipping peaked at low average Glastir extents. Stone removal was associated with average Glastir extents below 20%, and Water channel erosion was present for average Glastir extents of 15-45%. Vandalism was present across all average Glastir extents.

2.2.17.4 Agricultural threats

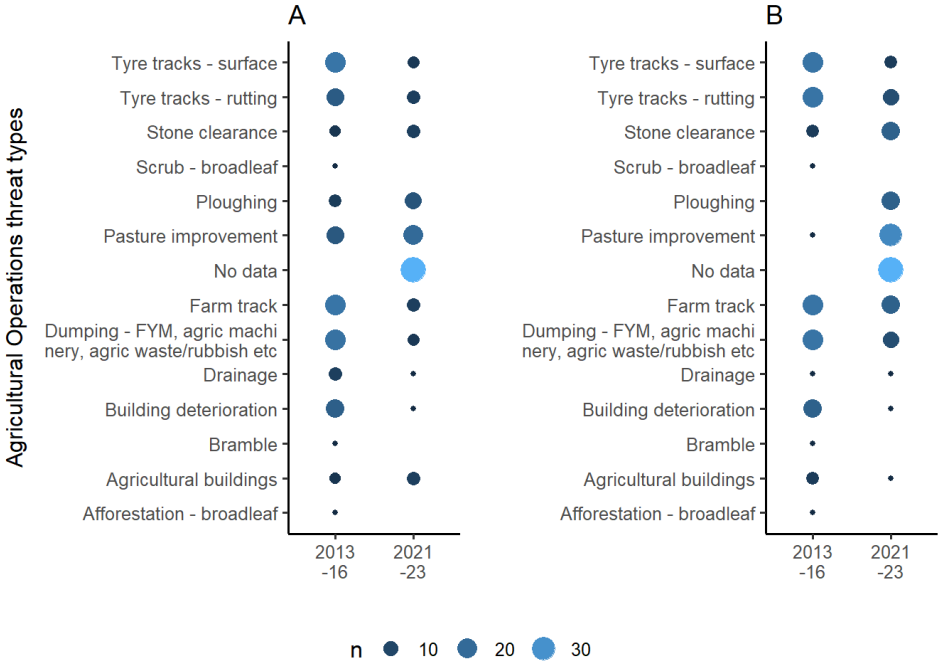

Figure 2-57 Threats to HEAs from Agricultural Operations for A) all Historic Environment Assets (HEAs), and B) re-surveyed HEAs.

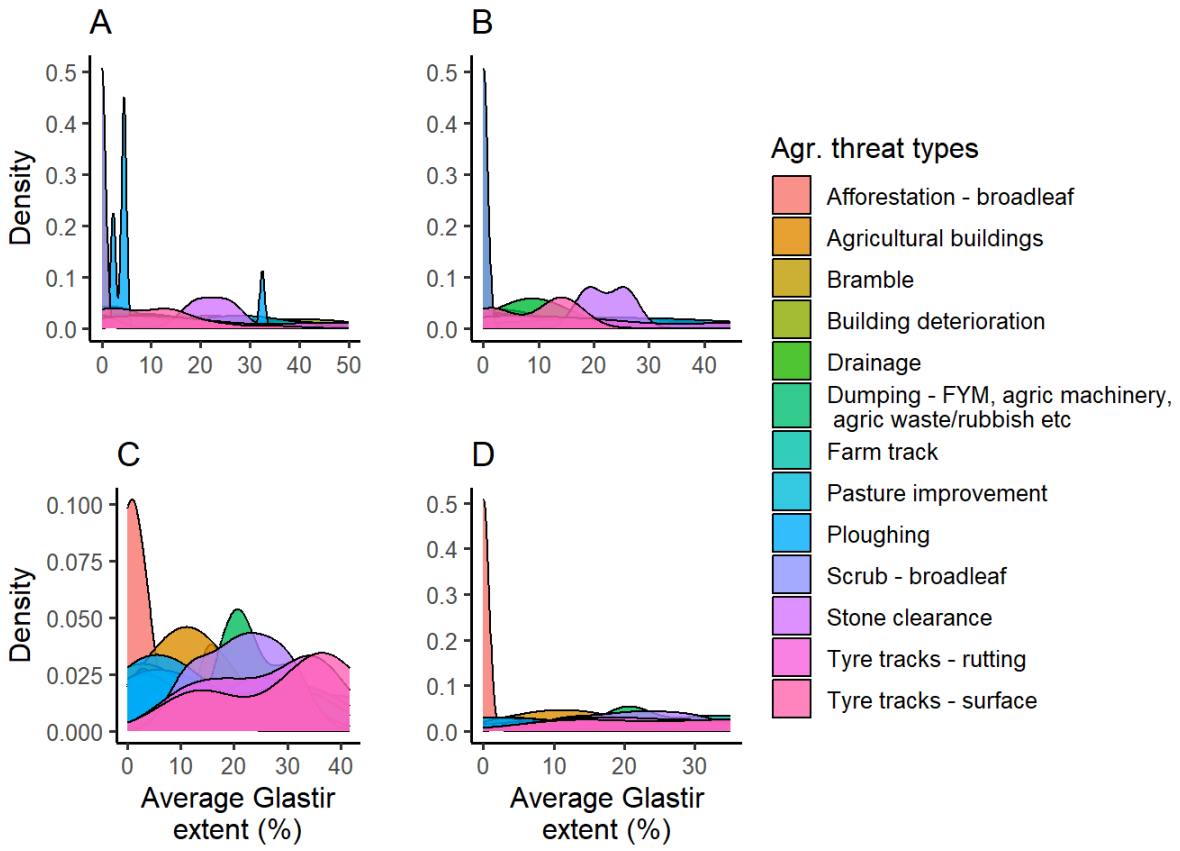

Figure 2-58 Density plots for threats through Agricultural Operations for A) 2013-16 all HEAs, B) 2013-16 re-surveyed HEAs, C) 2021-23 all HEAs, and D) 2021-23 re-surveyed HEAs.

In 2013-16 (Figure 2-58 A and B), scrub - broadleaf (only full dataset) and ploughing (both datasets) were associated with very low average Glastir extents. Threats of tyre tracks were present for average Glastir extents up to ~20%, and threats of stone clearance were present at average Glastir extents of 15-30%.

In 2021-23 (Figure 2-58 C and D), agricultural threats were not associated with any specific average Glastir extent besides afforestation (broadleaf) only occurring at very low average Glastir extents.

2.2.18 Threats associated with HEA conditions

The below figures show counts of threat combinations associated with HEA conditions. The first figure shows GMEP and ERAMMP data together (Figure 2-59). The following figures show the threat combinations for 2013-16 and 2021-23 separately.

In all of the below plots, HEAs in excellent condition and damaged condition had the lowest threats against them. This partly due to limited threats on HEAs in excellent condition, and low numbers of damaged HEAs, which is likely linked to few HEAs being in these categories. The sole vegetation threat was the most prominent threat recorded against all six HEA condition categories. In 2021-23, the combined threat class Ag+Ot+St+Ve was recorded against all HEA conditions (Figure 2-61).

2.2.18.1 Conditions vs threat combinations

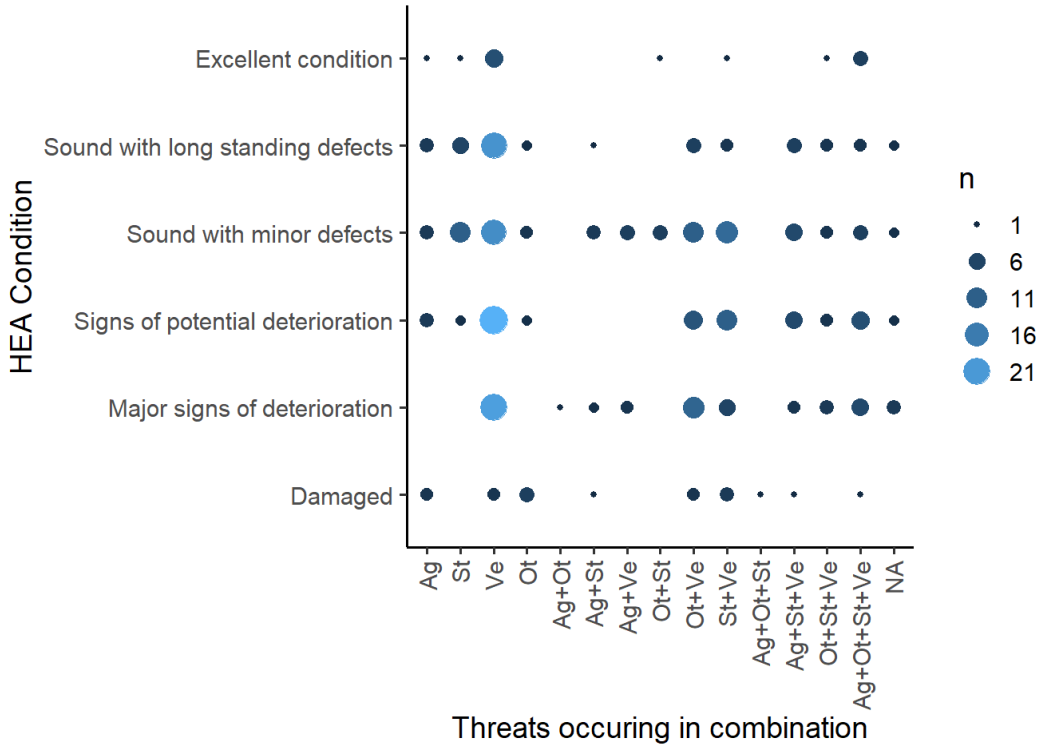

Figure 2-59 Threats associated with Historic Environment Asset condition for all data (2013-16 + 2021-23).

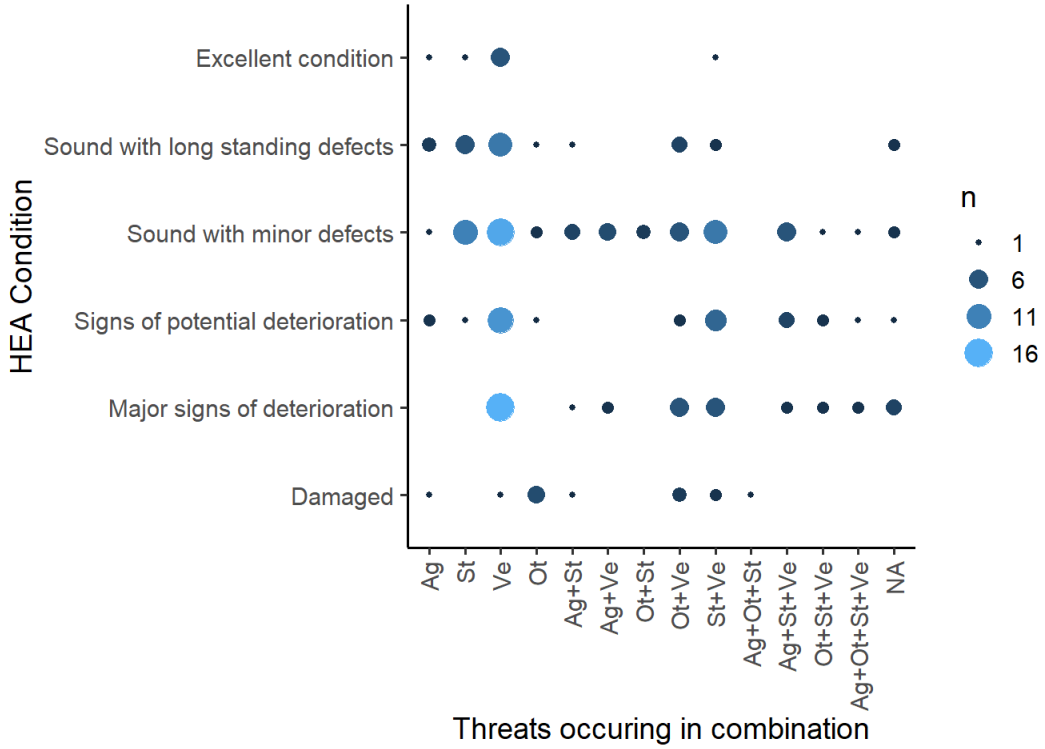

Figure 2-60 Threats associated with Historic Environment Asset condition 2013-16.

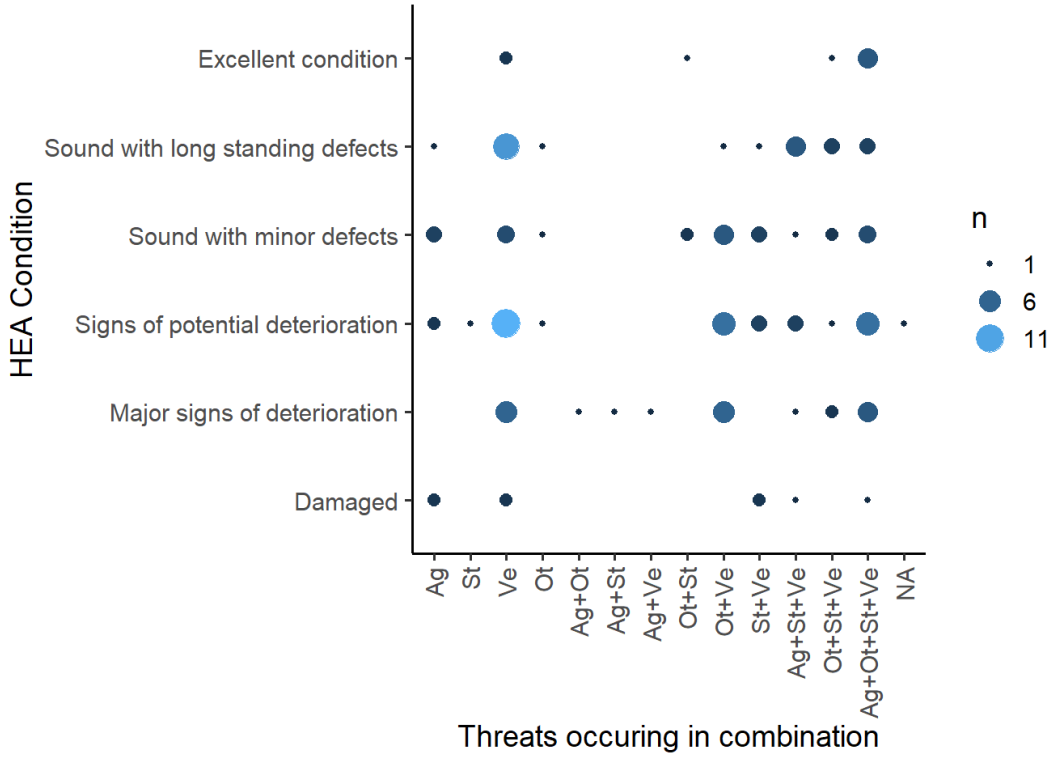

Figure 2-61 Threats associated with Historic Environment Asset condition 2021-23.

2.2.18.2 Threat categories by average Glastir extent

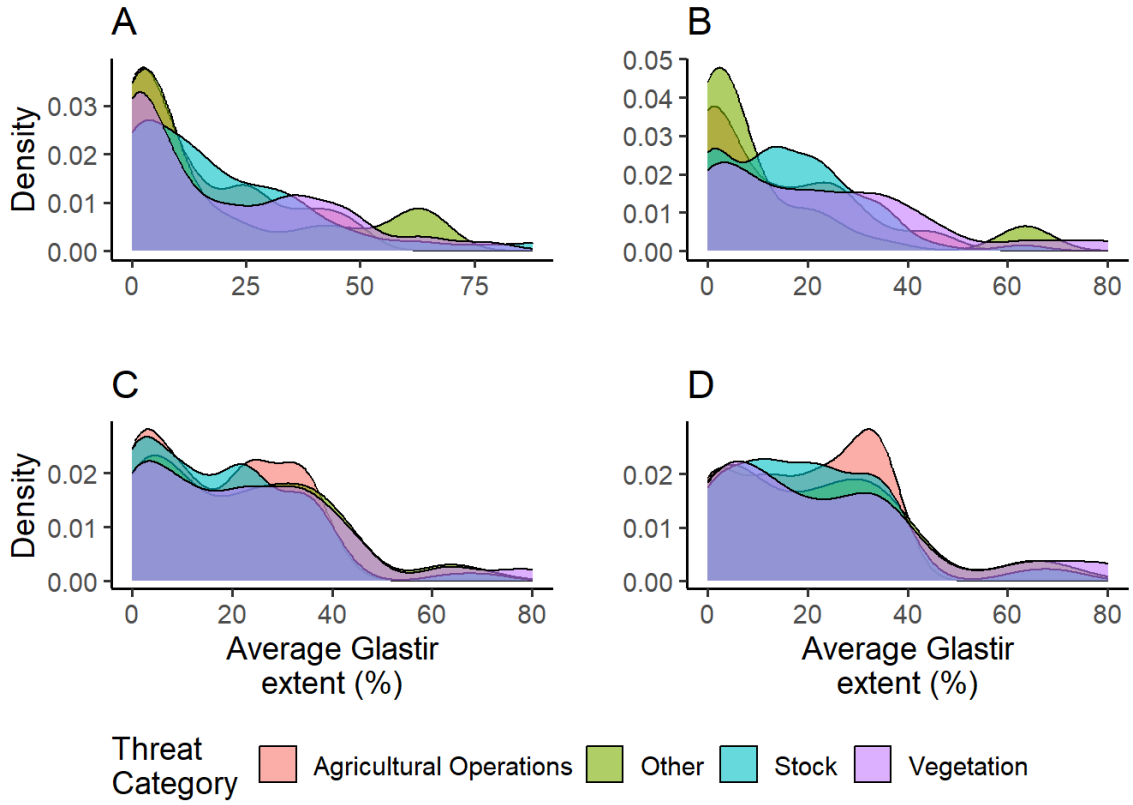

Figure 2-62 Threat category densities by average Glastir extent (%) in squares for A) all HEA data in 2013-16, B) re-surveyed HEAs in 2013-16, C) all HEA data in 2021-23, and D) re-surveyed HEAs in 2021-23.

2.2.19 Glastir: Condition as impacted by threats and time

2.2.19.1 Ordinal regression with Glastir extent for all HEAs

```
## Call: All HEAs
## polr(formula = CONDITION_SCORE ~ THREAT_AG + THREAT_VE + THREAT_OT +
##     THREAT_ST + PROJECT * perc_land_in_glastir, data = m.threat.1_input,
##     Hess = TRUE)
##
## Coefficients:
##                                      Value Std. Error t value
## THREAT_AG                          0.197024   0.134093  1.4693
## THREAT_VE                          0.308246   0.076499  4.0294
## THREAT_OT                          0.354942   0.152988  2.3201
## THREAT_ST                         -0.025655   0.086202 -0.2976
## PROJECT2021-23                    -0.288218   0.277560 -1.0384
## perc_land_in_glastir              -0.012255   0.005043 -2.4302
## PROJECT2021-23:perc_land_in_glastir  0.006679   0.009197  0.7263
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -2.0537  0.2525    -8.1349
## 2|3 -0.7300  0.2193    -3.3294
## 3|4  0.5231  0.2197     2.3806
## 4|5  1.5230  0.2336     6.5193
## 5|6  3.0577  0.2894    10.5650
##
## Residual Deviance: 1203.50
##                                          2.5 %       97.5 %
## THREAT_AG                          -0.06579354  0.459841090 Not significant
## THREAT_VE                           0.15831058  0.458182184 Sig neg
## THREAT_OT                           0.05509147  0.654792226 Sig neg
## THREAT_ST                          -0.19460776  0.143296993 Not significant
## PROJECT2021-23                     -0.83222515  0.255788372 Not significant
## perc_land_in_glastir               -0.02213844 -0.002371238 sig pos
## PROJECT2021-23:perc_land_in_glastir -0.01134622  0.024704588 Not significant
```

significant effects on HEA condition: vegetation and other threats decrease condition score (negative effects), and average Glastir extent in square increases condition score (positive effect)

none significant effects on condition: time, agricultural and stock threats

2.2.19.2 Ordinal regression with Glastir extent for re-surveyed HEAs

```
## Call: Re-surveyed HEAs
## polr(formula = CONDITION_SCORE ~ THREAT_AG + THREAT_VE + THREAT_OT +
##     THREAT_ST + PROJECT * perc_land_in_glastir, data = m.threat.2_input,
##     Hess = TRUE)
##
## Coefficients:
##                                      Value Std. Error t value
## THREAT_AG                          -0.026428   0.212630 -0.1243
## THREAT_VE                           0.320943   0.124933  2.5689
## THREAT_OT                           0.407714   0.211817  1.9248
## THREAT_ST                          -0.064280   0.136983 -0.4693
## PROJECT2021-23                     -0.169606   0.390520 -0.4343
## perc_land_in_glastir               -0.022125   0.009074 -2.4382
## PROJECT2021-23:perc_land_in_glastir  0.008942   0.012845  0.6962
##
```

```
## Intercepts:
##     Value   Std. Error t value
## 1|2 -2.2698  0.3997    -5.6782
## 2|3 -0.9247  0.3591    -2.5749
## 3|4  0.4194  0.3593     1.1673
## 4|5  1.5826  0.3791     4.1746
## 5|6  2.8561  0.4405     6.4839
##
## Residual Deviance: 561.2563
## AIC: 585.2563

##                                            2.5 %       97.5 %
## THREAT_AG                           -0.443173954  0.390318620 Not significant
## THREAT_VE                            0.076078396  0.565808204 sig neg effect
## THREAT_OT                           -0.007439589  0.822867751 Not significant
## THREAT_ST                           -0.332762182  0.204202752 Not significant
## PROJECT2021-23                      -0.935011650  0.595799202 Not significant
## perc_land_in_glastir                -0.039911029 -0.004339767 sig pos effect
## PROJECT2021-23:perc_land_in_glastir -0.016234076  0.034118760 Not significant
```

significant effects on condition: vegetation threats decrease condition score (negative effects), and average Glastir extent in square increases condition score (positive effect)

none significant effects on condition: time, agricultural, other and stock threats

2.2.20 Summary of the statistical results

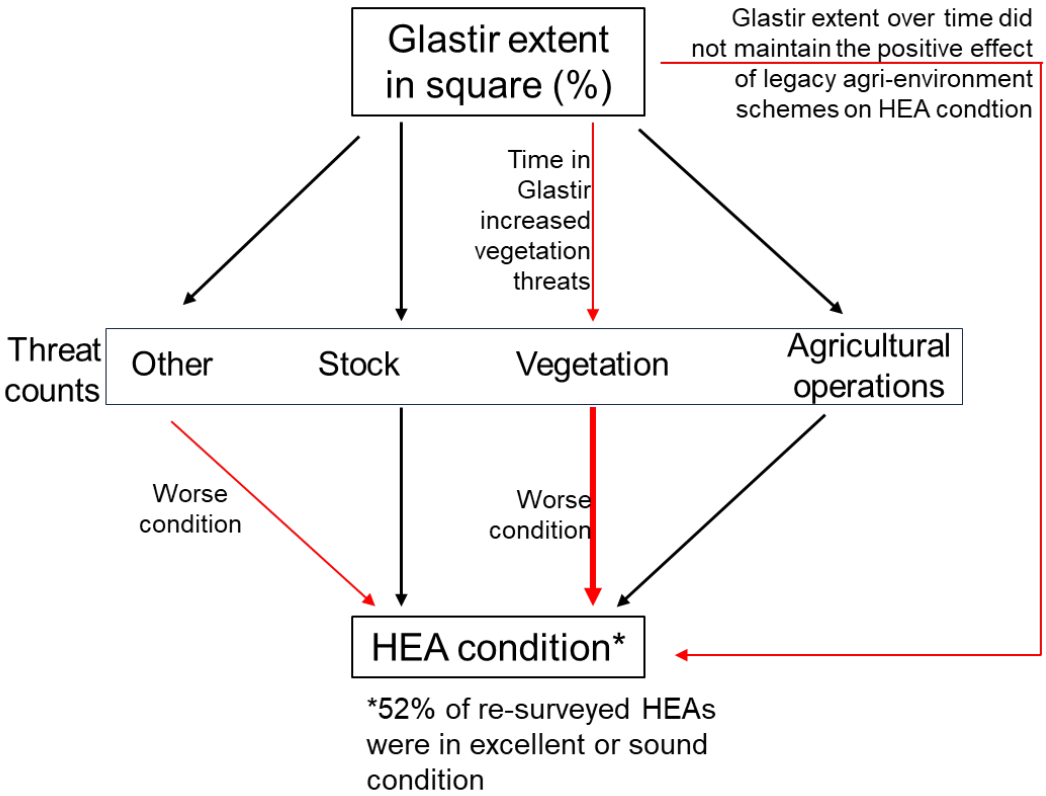

Figure 2-63 Visualisation of the statistical results for the *potential co-benefits of average Glastir extent in squares on threats and Historic Environment Asset (HEA) condition. Statistical analysis was performed on all HEA data, and on the re-surveyed subset: Red arrow = negative effect. Thin arrows indicate a significant effect in either the full or the re-surveyed HEA data population. Thick arrows indicate a significant effect in both data populations.*

3 REFERENCES

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