

This is the final peer-reviewed accepted manuscript of:

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to the  
handling Editor of  
Nature  
Dr. Armstrong

Unser Zeichen

Datum

Halle, 21.07.2022

Nature manuscript 2021-08-12657C "Plant diversity change over one century in Germany: more losers than winners"

Dear Dr. Armstrong,

thank you again for allowing us to revise the manuscript another time. We are very grateful that we could improve many further aspects of the paper. The input of the reviewers was a tremendous help, which we greatly acknowledge.

Please find the final version of the manuscript attached. Our point-by-point reply has been uploaded as a separate document.

Compared to the previous version, the main improvements are:

- We have shortened the text, rephrased the abstract and introduced hypotheses for the null models.
- We have changed the layout of Fig. 2 and 3.

We have uploaded both a clean version and version in tracking mode.

Yours sincerely, also on behalf of my co-authors

Prof. Dr. Helge Bruelheide

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Senior Editor Nature, Anna Armstrong

Your manuscript entitled "Plant diversity change over one century in Germany: more losers than winners" has now been seen by referees 2 and 3. The referees remain largely happy. But in order to publish the paper we will need you to attend to all of the referees' continued concerns about presentation. No peer reviewed data should be removed altogether when making these changes.

*We are sorry that we did not seem to have met all the expectations of the reviewers. However, we are happy that we have been given the chance to further improve the manuscript. We believe that we now have addressed all the issues raised.*

*We have also uploaded all four "Related Manuscript Files" and made a suggestion for a cover photograph. If the suggestion is chosen, we are prepared to describe the four time series shown on the cover and provide the original photographs with high resolution.*

Referees' comments:

Referee #2 (Remarks to the Author):

The manuscript has improved substantially, I still like it a lot, and I only have minor comments related to writing and visual presentation of the figures. Specifically:

Visual part needs to be improved. Figures 2 and 3 still don't work, they are cluttered, confusing, with many unclear elements. What are the curly brackets for?

*The curly brackets have been removed and the design of both figures has changed completely. In Fig. 2, the aggregation by species is now stated deliberately and illustrated for three plot records, with two species each. We no longer use arrows, but + and - signs to indicate decreases or increases.*

Do sizes of the plants bear any meaning?

*The idea was that plants with a positive and negative change in cover become larger and smaller, respectively, which obviously did not work. We now only show different icon sizes in the very left part of Fig. 2 to show that decreases and increases in cover translate into - and +. Without changing icon sizes in Fig. 3, this figures has become much simpler.*

Can you shrink the plot to a printed page of Nature and will the legends be legible?

Yes, we hope so, in particular as we removed the icons on the left-hand side. However, this will finally only be seen in the proofs.

Moreover, there are at least two different fonts used in the plots, many different sizes of fonts, several levels of thickness of lines, legends are positioned at different places in different panels (compare a with b)...

*Fonts now are all Arial. We have also used the same font size and refrained from using bold fonts (except for the scenarios).*

..., there is a lot of redundancy with red and blue colors explained at least three times in the a-f panels, ...

*We now only use colors for the different assignment of cover changes at the observation or species level. Thus, we do also not explain it repeatedly.*

... and the arrows are all over the place, shifted to various positions (e.g. in Fig. 2).

*The arrows have been removed.*

Further, some panels are labeled by a)b)c), while others (with the plant symbols) aren't.

*In Fig. 2, the labels (a and b) now also comprise the icons. However, this was not possible in Fig. 3, as here the icons refer to the whole columns.*

In Fig. 2b there are “losers” and “winners” labels next to a mix of red and blue arrows, which is confusing.

*We redesigned Fig. 2.*

I have a hard time believing that the graphics has been edited by a graphic designer (as the authors indicate in their reply). I worry that these are things that will be hard to fix at the typesetting stage, as they relate to fundamental design/content problems. Navigating and understanding particularly Figure 3 will be a challenge, and if you combine this with very long figure captions, it’s even more challenging. The authors need to try harder to improve, clarify, and simplify the figures.

*We apologize, but before we had tried really hard to illustrate Fig. 3. Now, we made a new attempt in making them as simple as possible. Here, we had a great input from iDiv’s Media & Communication department (Volker Hahn and Stefan Bernhardt).*

The text is still too long at places. Some of the paragraphs in the Results, Discussion, and figure captions can be shortened, condensed, or removed. I believe that it should be possible. Particularly paragraphs on lines 214-238 and 294-327, and captions to figures 2 and 3 (some of the text there seems to repeat the results section).

*We shortened both paragraphs. However, in the paragraph (previously l 214-238) we had to add the descriptions on the analyses on the effect of observation interval and plot sizes as request of Reviewer #3 in the last review round. To shorten the text, we moved sections of the paragraph (l 294-327) to the Supplementary Methods. This part could also be shortened because we turned the scenarios into hypotheses.*

There is some confusion about the terminology referring to scale. In the intro, I’ve found “local” (lines 151, 157, 162, 180), “plot” (lines 174, 182, 186), “community” (151, 157, 159, 180, 189), “metacommunity” (164, 188), “regional scales” (168), “larger region” (163), “regional studies” (171), “sampled area” (174), “sampling area” (150), “sampling plots” (160, 162), “global scale” (144), “vegetation plot records”(174), “plot-scale” (186), “plot records” (202), and “resurveys & surveys” (172). This also happens in the rest of the paper, e.g. the discussion. There is “species level” (line 373), “species scale” (line 405), “sites” (line 369), “locations” (410), “plots” (407, 413), “coarse spatial scales” (417) and “national scale” (401) etc. In all this, it is unclear which aspects of scale the authors have in mind: Local grain? Local extent? Local support? Region grain or extent?

Metacommunity grain or extent? What is the difference between plot, site, location, survey, sampled area, and community? What is a metacommunity and how it differs from community at a regional scale? What is species level/scale? I usually roughly get what the authors have in mind, but not always. At this final stage of polishing, I suggest simplifying and clarifying this terminology as much as possible.

*Thank you for pointing out our inconsistency in using terms. We have to admit that part of this happened with the many rounds of internal edits among the many co-authors. We have now harmonized the above-mentioned terms:*

- *“Local” is now more sparingly used. When referring to “local” and “regional”, we refer to grain, not extent, which we now make clear at the beginning of the Intro. However, we see no way to omit one of these two terms completely.*
- *The “community” is recorded locally. Nevertheless, we often point out that we here refer to species composition data recorded at fine grain, as this term has been also used across different grain sizes. Community composition is often observed in plots, but not exclusively*

*(there are many marine or freshwater communities that have been recorded plot-less). Thus, when it comes to vegetation time series, we have to mention plots.*

- *“vegetation-plot records” is a record made on a vegetation plot. Thus, we also use “plot record” as an abbreviation. The distinction between a “plot record” and a “plot” becomes necessary when the same plot is recorded more than once. This is common terminology in vegetation science.*
- *Similarly, the terms “survey” and resurvey” have concrete meanings. “Survey” is the act to record the species in a plot, “resurvey” is the act to repeat this in time.*

*In contrast, we removed some terms from the manuscript:*

- *Metacommunity: has been replaced by “regional”*
- *“larger region” has been replaced with “at regional extent”*
- *“regional studies” has been replaced by “large-grain studies”*
- *“sampling area” has been replaced by “sampled area”, which refers to the area of a plot that is sampled*
- *“global scale” has been completely removed*
- *“plot-scale” has been completely removed*
- *“species level” and “species scale” have been removed, except in the Methods when “species level” refers to taxonomic harmonization.*
- *“sites” has been completely removed and was partly replaced by locations.*
- *“coarse spatial scale” has been replaced by “coarse spatial grain”*
- *“national” has been replaced by “regional”*

Line 165: Increase and decrease of what?  
*Added now “of species’ mean cover”*

Lines 176-179: All this seems tangential and unnecessary.  
*Deleted.*

Lines 209-2011: Dtto. Tangential and unnecessary.  
*Deleted.*

Line 224: Log ratio decreased (which seems to be the current message, and which would mean a second derivative of the trend), or SR decreased as indicated by the negative log ratio?  
*Actually, we refer to a decrease in log ratio between species richness observed at the end and the beginning of an observation interval. Extended Data Fig. 2a shows that  $\log_e(SR_{Y2}/SR_{Y1})$  was positive for time spans  $\leq 2$  years (that is, SR increased), while it was negative for time spans  $> 10$  years (that is, SR decreased). Per decade,  $\log_e(SR_{Y2}/SR_{Y1})$  decreased by 0.153. We now added: “indicating that more species were lost with time” (new line number 225).*

Line 235: “only a marginal and” is unnecessary. If it was insignificant, it wasn’t even marginal.  
*Deleted.*

Lines 236-237: I don’t see how no change in median indicates no change in dominance structure. You can have identical median in both time periods, but a pronounced change in the dominance, for example if increase in the dominant (high cover?) species is offset by decrease in species with low cover. In any case, what exactly do you mean by “dominance structure”?  
*We agree and have deleted this sentence, as we explain the discrepancy between mean and median change in cover in the following paragraph.*

Line 180: Typo.  
*Corrected.*

Lines 376-378: I don't see the direct link between homogenization and equality of change among losers and winners. Either prove/show the link mathematically, or drop the statement.

*Probably, this disagreement is based on how we define homogeneity. In our opinion, homogenization is the direct consequence of redistribution of the species' cover. If decreases are distributed more equally (that is also more homogeneously) across many species and increases in cover are concentrated in few species, the latter (that is the winners) will be increasing in many communities. In consequence, the dissimilarity in species composition between these communities has to decrease (given that a quantitative dissimilarity measure is used). Mathematically, this would have to be shown by a decrease in dissimilarity, which however, is difficult to demonstrate across all plot records in our data set as many communities have no species in common. In our opinion, homogenization probably occurs within habitat types, but opening this discussion and carrying out the analysis would open a can of worms. Thus, we have decided to down-tune this statement to: "Homogenisation occurs because, across all time series, few species consistently increase in their cover, meaning that the same species are winning in many communities." (new l 372-374)*

Referee #3 (Remarks to the Author):

As before, I commend the authors on their analyses and believe this paper makes a novel and important contribution by documenting long-term plant biodiversity changes in terms of cover that would have been missed by simply focusing on species richness, as most previous work has done. But while the authors have produced a strong revision of their paper, in my opinion several outstanding issues remain, and some important comments have only been partially addressed. I appreciate the new analyses that the authors have performed, and overall the analyses are appropriate and justified, and data are presented correctly, as far as I can judge. The framing of the study is also now more compelling, and I think the unique value of the dataset and insights arising from it are now harnessed more effectively. That said, I still have some concerns about the framing of the study, explained in my comments below. The Results section has also been improved, but remains difficult to read in places – again, I make specific suggestions below. Overall, while the length appears to have been reduced, the text still seems unnecessarily wordy in places (e.g. in the Results and figure captions).

*Thank you for this positive assessment.*

Another aspect I raised previously and has still not been resolved, in my opinion, is when results are considered to be ecologically relevant or not, and I think there could be greater transparency in the paper about this. This relates to the way the story is set-up, as mentioned in my previous review. Specifically, the authors note that due to the large sample sizes, changes in species richness can be statistically significant even if effect sizes are small, and therefore conclude that directional changes in species richness are "minor at best" (l.231). Yet on the other hand, even though the differences between winners and losers in their Gini coefficients are so small that they are imperceptible in Fig 2a, the authors note that these differences are "highly significant" (l. 245-6) and go on to interpret them. What is the reason for emphasising the ecological relevance of the latter result, but not of the species richness result? I find this troubling, since the set-up of the paper describes the paradox of changing global/regional but not local scale richness, and attempts to resolve that. Yet the paper does in fact describe significant local scale changes in richness. I

think this should be acknowledged more transparently in the paper, and not brushed off; or it should be made clear why the small differences in Gini coefficients are considered important, but not the changes in species richness, even when both are statistically significant.

*We fully agree here and have now down-tuned the emphasis on significances in the Gini coefficient, too. We now write (new l 246): “While the two Gini values were highly significantly different (non-overlapping CIs even at 99.9%), their small difference might not result in ecologically meaningful effects. Nevertheless, the finding that losses in cover were more equally distributed than cover gains might point to an important ecological mechanism. If cover losses tend to occur in more uniform steps while gains result from both small and large increments, many small cover losses in a plot might be offset by a few large cover gains. The significantly different Gini coefficients show that this was at least the case in a considerable number of our change observations.”*

*We also agree that we too much downplayed our observation of decreasing richness. We now write at the beginning of the discussion (new l 344): “While the observed decline in species richness might be linked to the greater number of species that lost than gained cover, our analyses demonstrate that richness change at the plot level is not a necessary prerequisite for this asymmetry.” There are other places, where we also now refer to the finding of richness changes in our paper, too. However, we believe that the strength of our paper is to point to other mechanisms than richness change that can result in large-scale biodiversity change. This maybe explains why we might have too much downplayed species richness.*

#### Specific comments

l.125 This isn't really a research question/problem statement, rather a description of a method. More importantly, I don't think this question (i.e., the discrepancy between declines of species richness at regional and global scales vs marginal changes in community species richness at local scales) is actually addressed – has there been loss of richness at a regional scale in Germany over the last century? The documentation of declines in abundance imply that regional losses will occur, but haven't necessarily done so yet (l.156). I.e., this is why the authors claim that asymmetry of losses/gains in cover could be “early warning signs” of regional species loss (l.189), which implies that regional losses haven't happened yet in Germany. For clarity, I suggest the authors think carefully about the overarching question addressed by the study and rephrase it accordingly.

*Thank you for pointing out these issues. Following your advice, we have completely rewritten the Abstract. The research statement now is: “However, the majority of studies focused on species incidence and did not account for local abundance. Here, we asked whether the analysis of plant species cover changes can reveal yet unrecognized patterns of biodiversity change and provide insights into the underlying mechanisms.”*

l.129 I would advise against using the word “losses” in this context, and more specifically refer to “reductions in cover” or “cover losses” throughout the paper, were relevant. “Loss” by itself implies (to me at least) that a species goes locally extinct at a location (is “lost”), which is not necessarily the case. Greater precision is important to avoid the results being misinterpreted.

*This sentence has been rephrased, too. In addition, we have carefully checked all places in the manuscript, where we refer to “losses” and in most cases now write “cover losses”, except for those places where we draw conclusions on species loss as a consequence of these cover losses.*

1.189 “while many species are lost from a few communities only” should be phrased more like “while rare species (those occurring in a few plots only) are lost completely” – i.e. the current formulation doesn’t necessarily imply regional species richness loss.

*Thank you. We have changed the sentence accordingly.*

1.203 Here a statement is missing of why these null models were developed.

*We agree. As suggested we have also rephrased the null models as hypotheses (see below). We now write (new l 204): “To make sure that the observed patterns are not resulting by chance alone, we further developed null models that kept species richness constant and varied the amount and direction of change and the concentration of cover losses and gains on losers and winners. We hypothesized that the divergence in the distribution between cover losses and gains is driven by i) the proportion of species that undergo changes, ii) the ratio of increasing to decreasing species and iii) the degree to which cover losses are concentrated on a specific subset of species.”*

1.205 Again, why did you do this? What are the hypotheses regarding nativity and habitat affinity? The reason for these analyses becomes clear while reading the paper but is a bit murky to the reader at this point.

*We also agree with this point. We now write (new l 210): “Then, to assess whether losers and winners (i.e. those species that lost or gained cover) differed in their floristic status or habitat requirements, we analysed whether the probability of a decrease or an increase in cover depended on species being native or non-native and their habitat preference.”*

1.221 “net loss of 6.04% of the species).” This should specify “per plot”, right? Although the sentence calls this “close to zero”, I would still consider a 6% loss to be concerning.

*We apologize to have expressed this wrongly. A net decrease in  $\log_e(SR_{Y2}/SR_{Y1}) = -0.062$  corresponds to an absolute decrease of 0.06 species per plot ( $1 - \exp(-0.06233)$ ). This does not refer to the initial richness of that plot. Corrected now.*

1.224-7 I don’t understand why species richness increases slightly when expressed per decade, “in consequence” of annual decreases (expressed on a log scale); perhaps I’m missing something, but please check phrasing here.

*We apologize if this has not been clear enough before. As more species are lost, the longer the observation interval ( $\log_e(SR_{Y2}/SR_{Y1})$  decreased by 0.153 per  $\log_{10}$  years), the positive richness trend for time spans  $\leq 2$  years (Extended Data Fig. 2a) turns into a negative one for time spans  $> 10$  years (Extended Data Fig. 2c). Dividing the log ratio by decade ( $\log_e(SR_{Y2}/SR_{Y1}) \text{ decade}^{-1}$ ) reverses this trend, as, for example, then the observed positive richness trend of periods of 1 or 2 years is multiplied by 10 or 5, respectively. Please, see also our comment to reviewer #1 on the same lines.*

1.228 The phrasing here, and elsewhere in the Results, is challenging to follow. E.g. “While  $\log_e(SR_{Y2}/SR_{Y1})$  decreased by 0.064 per  $\log_{10}$  increase plot area” could be phrased as “While decreases in species richness were greater in larger plots”. It would greatly help readability if results were phrased in plain English wherever possible and backed-up with the statistics.

*Done. We now write (new line 228): “While decreases in species richness were greater in larger plots (mean change in  $\log_e(SR_{Y2}/SR_{Y1}) -0.064$  per  $\log_{10}$  increase in plot area), species richness significantly decreased in all different categories of plot sizes (Extended Data Fig. 4a-4c).”*



L.231 “changes in local richness are minor at best” is misleading – Fig S2 and others show there can be huge changes in local richness, but with no strong average trend towards increasing or decreasing richness. Please check phrasing here (e.g. add “directional”).

*Done. We now write (new l 231): “Because of the overall very small effect sizes, we conclude that directional changes in mean local richness are minor at best, which is in accordance with preceding studies<sup>1,3,4</sup>.”*

L.253 there are three different ways in which this result (l. 250-254) is phrased, which all seem subtly different – it would be clearer if you could express this in one way which captures the message you wish to convey. As mentioned above, the word “losses” is misleading here, because what you mean is cover change, which might or might not entail the loss of a species from a plot.

*We completely rewrote and shortened this section (new line 246): “While the two Gini values were highly significantly different (non-overlapping CIs even at 99.9%), their small difference might not result in ecologically meaningful effects. Nevertheless, the finding that losses in cover were more equally distributed than cover gains might point to an important ecological mechanism. If cover losses tend to occur in more uniform steps while gains result from both small and large increments, many small cover losses in a plot might be offset by a few large cover gains. The significantly different Gini coefficients show that this was at least the case in a considerable number of our change observations.”*

L.267 Should “plants” be “plots” here? If not, then I believe it would be clearer to specify “changes in cover of individual plant species”

*Replaced by “individual cover observations in plots”.*

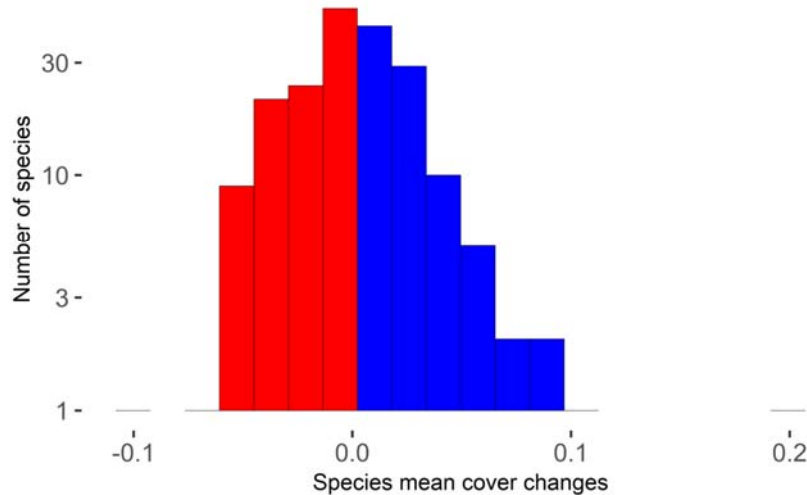
L.294 As mentioned in my previous review, this null model approach is a great addition to the paper. This paragraph remains, however, difficult to follow. I had to carefully consult Fig.3 and the supplementary methods to be able to follow it. I also mentioned previously that the rationale for the three scenarios wasn’t very clear, and this is still the case. One suggestion here would be to describe each scenario as a hypothesis to explain the empirical pattern, and then evaluate whether the null model lends support for that hypothesis or not. Currently the insights of the model are described as a series of results, and the reader is left largely to deduce the relevance of these.

*We are grateful for the suggestion to turn the scenarios into hypotheses, which in our view made the approach much clearer. In addition to the graphical changes we made with Fig. 3 (see our reply to reviewer #1), we are confident that the null models now are much easier to grasp.*

L.314 This result is very interesting, but can you say why non-random cover changes across species lead to inequality in the Gini coefficient in the null model – i.e. what is the mathematical/statistical phenomenon here? And what are the implications of this for the biological interpretation of divergence between losers and winners that then follows from l.328?

*The mathematical phenomenon behind this outcome can be explained as follows: For hypothesis iii) we deliberately kept constant the proportion of species affected by cover change at 0.8 and the proportion of increasing species at 0.5. Thus, we could redistribute exactly the same randomly created negative cover changes as gains to the other species in the community. For these reason, the red and blue curves in Fig. 3c are absolutely identical. As the model first determined the losses and then redistributed the gains, for decreasing species this often meant extinction, for which then new species entered the community (as species richness was kept constant). Extinctions always resulted in deviation from the geometric distribution in cover declines, as the decline could never exceed the current cover of the species. Thus, declines were often smaller and more evenly spread than expected from a geometric distribution. Then, according to this scenario, the species to be selected for a*

negative cover change were chosen non-randomly (i.e. in a directed way), thus, resulting in assigning these more evenly distributed declines more to the same species (please note that this was not deterministically, but simply weighted by using the species' IDs). In contrast, the gains were distributed randomly across all remaining species and new colonizers. This resulted in a larger spread, in particular of large gains, among species. This can be seen from the histogram of this scenario:



Thus, there were more winners with exceptionally high cover gains than losers with exceptionally high cover losses. This can also be seen in the extreme values and quartiles:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-0.0948316	-0.0050650	0.0000000	-0.0004992	0.0012849	0.1155434

We also made the focus on concentrating losses on particular species now also clearer by using the “+” and “-“ icons in Fig. 3.

Overall, we consider the way our model works in this particular aspect highly realistic. In a plot, the lower boundary of cover losses is always given by the extinction of a species in a plot. There is also a maximum that cannot be transgressed for winners, which is a relative cover of 1. However, as in nature, with the broken-stick distribution of initial cover values, there were only very few cases where species reached this upper boundary, and similar cut-off effects were observed as for declining species.

We also now added a clear interpretation of these results at new line 320: “We conclude that environmental changes that threaten specific species drive the inequality of mean cover changes of losers and winners.”

1.348 Does this result refer specifically to the null model, since you did in fact observe significant richness change? This needs to be specified here. See my major comment above about this.

As said above, we changed this section. We now write (new l 341): “Our work reconciles some issues in the debate surrounding the “biodiversity conservation paradox”<sup>12</sup>, i.e. the discrepancy between observing a loss of species at broad scales but marginal changes in species richness at the plot scale. With support of a null model, we showed that the cover changes may affect winners and losers differently, even if plot richness does not change. While the observed decline in species richness might be linked to the greater number of species that lost than gained cover, our analyses demonstrate that richness change at the plot level is not a necessary prerequisite for this asymmetry.”

L.397-400 The wording confused me here – having greater data density in the middle of the time period could give rise to a mid-domain effect, not be a consequence of it; however, the observed pattern of greater divergence could be a consequence of the mid-domain effect, i.e. a statistical artefact. Please check the phrasing (and its implications) here.

*Thank you for pointing this out. We rephrased this as follows: “Second, data density on species change observations was highest in this intermediate period, which could give rise to a mid-domain effect<sup>29</sup>. In consequence, the stronger overlap of time series in the middle of the study period could have strengthened the observed trends.”*

L.878 Units should be displayed in Fig1a x-axis

*The unit is “number of species”. However, we do not find this helpful as the axis is expressed as  $\log_e(SR_{Y2}/SR_{Y1})$ . Thus, we are afraid to refrain from changing this. Any change would also affect all figures in the Extended Data, which are all carefully prepared and provide no more space on the x axes labels for additions. We hope for your understanding.*

1 Cover page

2

3 Title: **Plant diversity change over one century in Germany: more losers than winners**

4

5 Article impact statement:

6 We provide a mechanistic understanding of biodiversity change using detailed time series data over  
7 the past hundred years from 7,738 (semi-)permanent vegetation plots from Germany, comprising  
8 1,794 vascular plant species.

9

10 Running head: **More losers than winners**

11

12

13 Keywords: Biodiversity change, Biodiversity monitoring, Gini coefficient, Temporal change, Vascular  
14 plant species, Vegetation-plot resurveys

15

16 Word count: 4,424

17 Authors:

18 Ute Jandt<sup>1,2,3</sup>, Helge Bruelheide<sup>1,2,3,4</sup>, Florian Jansen<sup>5</sup>, Aletta Bonn<sup>2,6,7</sup>, Volker Grescho<sup>6,2</sup>, Reinhard A.  
19 Klenke<sup>2,1</sup>, Francesco Maria Sabatini<sup>2,1,8</sup>, Markus Bernhardt-Römermann<sup>9,2</sup>, Volker Blüml<sup>10</sup>, Jürgen  
20 Dengler<sup>11,2,12</sup>, Martin Diekmann<sup>13</sup>, Inken Doerfler<sup>14</sup>, Ute Döring<sup>15</sup>, Stefan Dullinger<sup>16</sup>, Sylvia Haider<sup>1,2</sup>,  
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115 **Author contributions**

116 U.J. and H.B. conceived the idea for the project. All authors were involved in collecting datasets,  
117 developing the conceptual framework and interpreting the results. H.B. performed the statistical  
118 analyses and developed the null model. U.J. and H.B. wrote the first draft of the manuscript. All  
119 authors commented on and agreed with the final version of the manuscript.

120 **Competing interests**

121 The authors declare no competing interests.

122

## 123 **Abstract**

124 Recent long-term analyses of biodiversity data highlight a “biodiversity conservation  
125 paradox”: biological communities show substantial species turnover over the last century<sup>1,2</sup>,  
126 but changes in species richness are marginal<sup>1,3-5</sup>. Most studies, however, focused on species  
127 incidence only, neglecting changes in local abundance. Here, we asked whether the analysis  
128 of plant species cover changes can reveal yet unrecognized patterns of biodiversity change  
129 and provide insights into the underlying mechanisms. We compiled and analysed a dataset  
130 of 7,738 (semi-)permanent vegetation plots from Germany that were surveyed between 2  
131 and 54 times from 1927 to 2020 and in total comprised 1,794 vascular plant species. We  
132 found that i) decrements in cover, averaged across all species and plots, occurred more  
133 often than increments, ii) the number of species decreasing in cover was higher than the  
134 number of those increasing, and iii) decrements were more equally distributed among losers  
135 than gains among winners. Null model simulations confirmed that these trends do not  
136 emerge by chance, but are the consequence of species-specific negative effects of  
137 environmental changes. In the long run, these trends might result in significant species  
138 losses at both local and regional scales. Summarising changes by decade shows that the  
139 inequality in species mean cover changes of losers and winners diverged as early as in the  
140 1960s. We conclude that species cover changes in communities convey an important but yet  
141 neglected dimension of biodiversity change and should hence be more routinely considered  
142 in time-series analyses.

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144

145

## 146 **Introduction**

147 Biodiversity loss is one of the most critical environmental problems<sup>6,7</sup>. Globally, the  
148 extinction of many taxa has been well documented<sup>8-10</sup>. However, local-scale studies, that is  
149 those at the fine grain of communities, do not always reflect this global trend<sup>2,3</sup>, which has  
150 sparked intense debates<sup>11-13</sup>. The main reason for this scale discrepancy is that species  
151 losses and gains through time are inherently asymmetric. At any spatial scale, it only takes  
152 one individual of a new species to result in a gain, but requires the loss of all individuals of a  
153 species to lead to a loss<sup>14</sup>. In consequence, at a given sampled area, the loss of all individuals  
154 of one species might be compensated by single individuals of a new colonizer<sup>3,15</sup>. Indeed,  
155 within local communities, species turnover, not species loss, has been identified as the main  
156 aspect of biodiversity change<sup>16</sup>. For example, 28% of species were found to be replaced per  
157 decade in an analysis of global marine and terrestrial community data<sup>2</sup>. However, except for  
158 recent studies from forests<sup>17,18</sup>, these analyses ignored the changes in abundance that  
159 precede species turnover.

160 Time series of local communities often document the abundance of each species, an  
161 information rarely available at larger scales. Yet the strength of these data has been  
162 insufficiently exploited in global biodiversity assessments. In the case of plant communities,  
163 the most common abundance metric is the percentage of ground covered by all individuals



164 of a species on a particular sampling plot. This allows calculating changes as percentage  
165 points of cover lost or gained, which helps nd detecting declines before local extinctions  
166 occur. Aggregating such cover changes across many sampling plots at regional extent allows  
167 calculating the rates of decrease or increase of species' mean cover, that is, identifying losers  
168 and winners. This might in turn help to understand the discrepancies in species richness  
169 trends found at different spatial scales.

170 For plant species, comparisons between losers and winners have only been conducted with  
171 respect to occupancy at larger grain sizes. Studies based on ~5 x 5 km grids reported  
172 contrasting trends in Denmark<sup>19</sup> or in Germany<sup>20</sup>, with increasing and decreasing species  
173 richness, respectively. While both studies detected an imbalance between losers and  
174 winners, it is difficult to ascertain biodiversity changes at regional large-grains, as resurveys  
175 at that spatial resolution often differ in sampling intensity from the initial surveys. In 5 km-  
176 grid cells, species are easily overlooked, resulting in pseudo-turnover with erroneous gains  
177 or losses<sup>21</sup>. In contrast, small-grain vegetation-plot records, ranging from a few to several  
178 hundred square metres<sup>22</sup>, are usually thoroughly checked not only for species presences but  
179 also for absences.

180 In vegetation science, the traditional way of analysing time series of local communities is  
181 following a plot's trajectory through time and aggregating the changing occurrence or cover  
182 of species in the form of plot summary metrics, such as trends in species richness, diversity  
183 indices, or more sophisticated measures, such as changes in species' mean ranks or  
184 abundance curves<sup>23</sup>. This type of analysis revealed both increasing (e.g. <sup>4</sup>) and decreasing  
185 (e.g. <sup>24</sup>) species richness trends, and global syntheses consequently did not detect general  
186 trends in community-scale species richness (e.g.<sup>1,3</sup>). However, constant community-scale  
187 richness may be combined with biodiversity loss at the regional scale. This might for example  
188 happen when few species colonise many communities anew, while rare species (i.e. those  
189 occurring in a few plots only) are lost completely. An early warning-sign of such a  
190 development would be an asymmetry of cover trends across species, i.e. the fact that  
191 increases in cover are concentrated in a subset of species while decreases are distributed  
192 more homogeneously across many species. Indeed, a recent global analysis of local species  
193 turnover has suggested that it is particularly widespread species, often non-native ones, that  
194 are increasing in abundance<sup>25</sup>.

195 Here, we analyse cover changes of individual species in 7,738 vegetation-plot time series,  
196 spanning almost a century and a wide range of habitat types across Germany. Apart from  
197 comparing the magnitude of cover decrements and increments, we tested for the inequality  
198 in the distributions of cover losses and gains across all species. Therefore, we adopted the  
199 Gini coefficient, a metric developed in economics to evaluate the share of incomes across  
200 the inhabitants of countries<sup>26</sup>. Based on the Gini-coefficients we also, we tested whether  
201 cover losses were more evenly spread among losing species than cover gains were  
202 distributed among winning species. We here define losers and winners by their mean change  
203 in cover across all observation intervals and all plot records, which can be either negative or  
204 positive. To make sure that the observed patterns are not resulting by chance alone, we  
205 further developed null models that kept species richness constant and varied the amount  
206 and direction of change and the concentration of cover losses and gains on losers and

207 winners. We hypothesized that the divergence in the distribution between cover losses and  
 208 gains is driven by i) the proportion of species that undergo changes, ii) the ratio of increasing  
 209 to decreasing species and iii) the degree to which cover losses are concentrated on a specific  
 210 subset of species. Then, to assess whether losers and winners (i.e. those species that lost or  
 211 gained cover) differed in their floristic status or habitat requirements, we analysed whether  
 212 the probability of a decrease or an increase in cover depended on species being native or  
 213 non-native and their habitat preference. Finally, we assessed the temporal dynamics of  
 214 cover losses and gains and asked whether they occurred at the same point in time.

215

## 216 Results

217 The 7,738 vegetation-plot time series covered the period from 1927 to 2020 (Extended Data  
 218 Fig. 1). Plot richness change, calculated as the log ratio of species richness (SR) at the end  
 219 and the beginning of the observation time interval (Fig. 1a), varied more than tenfold in  
 220 absolute numbers. Even though we observed a significant decrease in species richness over  
 221 time, the estimated effect sizes were close to zero (mean  $\log_e(SR_{Y2}/SR_{Y1}) = -0.062$ ,  
 222 corresponding to a mean net loss of 0.06 species per plot). There was a tendency of shorter  
 223 observation intervals having significant increases and longer observation intervals significant  
 224 decreases in species richness (Extended Data Fig. 2a-2c). On average,  $\log_e(SR_{Y2}/SR_{Y1})$   
 225 decreased by 0.153 per  $\log_{10}$  years ( $p < 0.001$  according to a mixed model), indicating that  
 226 more species were lost with time. In consequence, the change in species richness was also  
 227 close to zero but significantly positive when richness change was expressed per decade  
 228 (mean  $\log_e(SR_{Y2}/SR_{Y1}) \text{ decade}^{-1} = +0.062$ , Extended Data Fig. 3). While decreases in species  
 229 richness were greater in larger plots (mean change in  $\log_e(SR_{Y2}/SR_{Y1}) -0.064$  per  $\log_{10}$   
 230 increase in plot area), species richness significantly decreased in all different categories of  
 231 plot sizes (Extended Data Fig. 4a-4c). Because of the overall very small effect sizes, we  
 232 conclude that directional changes in mean local richness are minor at best, which is in  
 233 accordance with preceding studies<sup>1,3,4</sup>. Similarly, the effect sizes for Shannon's index of  
 234 diversity, Pielou's index of evenness and the change in the species rank abundance curve (as  
 235 a measure of curve-change<sup>23</sup>) were significantly negative, but of small magnitude (Extended  
 236 Data Fig. 5a, b, c).

237 Across all plots, there were 458,311 change observations, i.e. species x plot records x time  
 238 interval combinations. There were more negative ( $n = 172,252$ ) than positive ( $n = 166,554$ )  
 239 observations, and on average, decrements were larger than increments (4.05 and 3.97  
 240 percentage points, respectively, according to a t-test ( $p = 0.003$ ,  $df = 338,187$ ). For each  
 241 interval, species change was assessed as change in per cent cover, expressed as percentage  
 242 points. Across all observations, the values of both negative and positive cover changes were  
 243 not evenly distributed, which is illustrated by the Lorenz curves (Fig. 2a) and the  
 244 corresponding Gini coefficients. Gini coefficients of 0.712 (95% confidence intervals (CIs)  
 245 0.710 and 0.714) and 0.718 (CIs 0.717 and 0.721) were obtained for negative and positive  
 246 change observations, respectively. While the two Gini values were highly significantly  
 247 different (non-overlapping CIs even at 99.9%), their small difference might not result in  
 248 ecologically meaningful effects. Nevertheless, the finding that losses in cover were more

249 equally distributed than cover gains might point to an important ecological mechanism. If  
250 cover losses tend to occur in more uniform steps while gains result from both small and  
251 large increments, many small cover losses in a plot might be offset by a few large cover  
252 gains. The significantly different Gini coefficients show that this was at least the case in a  
253 considerable number of our change observations. Moreover, cover changes also depended  
254 on interval length. Cover decreased significantly more in longer than in shorter observation  
255 intervals (by -0.042 percentage points per  $\log_{10}$  interval length,  $p < 0.001$  according to a  
256 mixed model) as well as in larger than in smaller plots (by -0.14 percentage points per  $\log_{10}$   
257 area,  $p < 0.001$ ).

258 Across all intervals independent of interval length, there were more losers than winners per  
259 plot, with an average difference of 0.407 species (CIs 0.246 and 0.569, Extended Data Fig.  
260 5d), which corresponds to the observed decrease in plot richness (Fig. 1a). Despite on  
261 average larger decrements than increments and fewer winners than losers in plots there was  
262 a significant increase of 2.5 percentage points in mean cover of all the species in a plot  
263 across all plot records (Extended Data Fig. 5e). In contrast, we observed a (insignificant)  
264 decrease of 0.7 percentage points in median cover (Extended Data Fig. 5f). These opposing  
265 directions of changes in mean and median cover are the direct consequence of a higher  
266 inequality of increments compared to decrements.

267 While these changes of individual cover observations in plots are so subtle that they may  
268 only be detectable in large datasets, they add up when species mean changes are calculated.  
269 Out of the total 1,794 vascular plant species in our study, there were 41% more losers than  
270 winners, with 1011 and 719 species, respectively. In consequence, the median across all  
271 species' mean cover changes was significantly negative (-0.063 percentage points, CIs -0.089  
272 and -0.035,  $p < 0.001$ , Extended Data Fig. 6). Mean cover changes of species did not depend  
273 on their overall frequency in the dataset (regression of species' mean cover change on  $\log_{10}$   
274 frequency,  $p = 0.601$ ). Decreases in species mean cover were also consistent with respect to  
275 observation interval length (Extended Data Fig. 2d-f) and plot size (Extended Data Fig. 4d-f).  
276 In all analyses, there were not only more losers than winners, the amounts of cover losses  
277 and gains were also not distributed equally within both groups. This is demonstrated by  
278 Lorenz curves, which in Fig. 2b are based on mean cover changes per species. The Gini  
279 coefficients for species with mean negative (0.692, CIs 0.660 and 0.718) and positive changes  
280 (0.778, CIs 0.720 and 0.816) differed by almost 0.1. The larger Gini coefficient for winners  
281 indicates that there were a few winners that gained disproportionately more mean cover  
282 than others, while the mean cover losses among losers were more equally distributed.  
283 Comparing Fig. 2a and 2b shows that two factors contributed to the inequality of biodiversity  
284 change. First, decreases occurred in smaller and more equal cover changes than gains.  
285 Second, the gains were concentrated in fewer winning species, while the cover losses were  
286 distributed among more losers.

287 These results also hold when rare species were excluded from the calculations. Fig. 1b shows  
288 the histogram of mean cover changes of the 578 species for which at least 100 time interval  
289 observations were available. Here, the change in mean cover was -0.165 percentage points  
290 ( $p < 0.001$ ), showing that species mean losses in cover were significantly higher than species  
291 mean gains. In other words, there was a redistribution of species: fewer species increased in

292 dominance and frequency while more species decreased in cover and potentially  
293 disappeared locally.

294 To understand the factors that determine the divergence in Gini coefficients between  
295 decreases and increases in cover and to disentangle those from possible species richness  
296 effects, we performed a series of null model simulations to test three different hypotheses.  
297 We hypothesized that the divergence in the distribution between cover losses and gains is  
298 driven by i) the proportion of species that undergo changes, ii) the ratio of increasing to  
299 decreasing species and iii) the degree to which cover losses are concentrated on a specific  
300 subset of species (Fig. 3, for further explanations and a graphical illustration see  
301 Supplementary Methods). In all null models, species richness of each plot was kept constant  
302 to avoid confounding effects of richness change, and only cover changes were redistributed  
303 among losers and winners (for details see Methods). In contrast to hypothesis i), the  
304 divergence in the distribution between cover losses and gains did not depend on the  
305 proportion of species that undergo change. While subjecting more species to cover changes  
306 increased the Gini coefficients for both negative and positive change observations (Fig. 3a),  
307 this did not propagate to the species mean change values (Fig. 3d). We could confirm  
308 hypothesis ii) which posited that the ratio of increasing to decreasing species drives the  
309 divergence in the Gini coefficients of decrements and increments (Fig. 3b). Inequality is  
310 higher for the kind of change that is more frequent. However, in the empirical data the  
311 increments were more unequal (Fig. 2a) although they are less frequent. As a corollary, the  
312 observed divergence of inequality is unlikely to be a mere consequence of the absolute  
313 number of losses and gains. There was also support for hypothesis iii). Concentrating losses  
314 on a specific subset of species did not affect the inequality of decrements and increments  
315 across all species (Fig. 3c). However, it resulted in mean cover losses of losers being more  
316 evenly distributed than the cover gains of winners (Fig. 3f), like in the empirical data (Fig.  
317 2b). This pattern was not obtained by the other two model simulations. Neither was the  
318 proportion of species affected by cover change (Fig. 3d), nor had the proportion of  
319 increasing species (Fig. 3e) significant impacts on the divergence of the Gini coefficients  
320 between losers and winners. We conclude that environmental changes that threaten specific  
321 species drive the inequality of mean cover changes of losers and winners.

322 To determine the identity of losers and winners we focused on the 578 species with at least  
323 100 time-interval observations, of which 161 showed significant differences in cover losses  
324 and gains across all plots (binomial test at  $p < 0.05$ , with Holm correction, Fig. 4). Among  
325 these 161 species with a directional change, native species decreased and neophytes  
326 increased more often than expected by chance (at  $p < 0.05$ ). Comparing the species' habitat  
327 affinities revealed that significant decreases occurred among species of mires and spring  
328 fens (level 1 EUNIS habitat Q), grasslands (R) and arable land (V), while forest species (T)  
329 increased more often than expected by chance.

330

331 The times when cover losses and gains occurred were highly species-specific, as can be  
332 inferred from the temporal course of the Gini coefficients for the 1011 losers and 719  
333 winners (Fig. 5). Changes started to be more unequally distributed among winners than  
334 among losers as early as in the 1960s. Since then, inequality of both gains and losses in cover

335 increased, with cover gains always being significantly more unevenly distributed among  
336 winners than losses among losers until 2010.

337

338

## 339 Discussion

340 Our work reconciles some issues in the debate surrounding the “biodiversity conservation  
341 paradox”<sup>12</sup>, i.e. the discrepancy between observing a loss of species at broad scales but  
342 marginal changes in species richness at the plot scale. With support of a null model,  
343 we showed that the cover changes may affect winners and losers differently, even if plot  
344 richness does not change. While the observed decline in species richness might be linked to  
345 the greater number of species that lost than gained cover, our analyses demonstrate that  
346 richness change at the plot level is not a necessary prerequisite for this asymmetry. Overall,  
347 we found a higher number of losers than winners at the scale of Germany. This depends on  
348 two phenomena. First, cover losses were more evenly distributed than gains at the  
349 community scale. Second, cover losses and gains were concentrated in different species.

350 Finding 41% more losers than winners nationwide might even be considered a conservative  
351 estimate for Germany’s low to mid elevations, and certainly underestimates total plant  
352 biodiversity change. On the one hand, our study also includes plots in the alpine region,  
353 where positive richness changes have been described<sup>27</sup>. On the other hand, our work suffers  
354 of most of the shortcomings noted in other studies on local time series<sup>13,28</sup>, including the  
355 lack of spatial representativeness, varying lengths of observation intervals and a bias  
356 towards habitats that are least affected by human activities (see Extended Data Fig. 7 and 8).  
357 For instance, time series are usually discontinued in case of substantial land-use change,  
358 such as when a (semi-)natural habitat is converted into agricultural or urban land (one of the  
359 few exceptions was Hundt 2001<sup>29</sup>, included in our analysis). In consequence, it is not  
360 surprising that the predicted 30% of local species extinctions due to land conversion<sup>30</sup>  
361 remain mostly unnoticed in vegetation-plot time series like ours. We do not want to address  
362 all the criticism brought forward on calculating biodiversity change from local time  
363 series<sup>13,28</sup>, which we think is mostly justified. Yet, we note that our time series covered about  
364 half the number of vascular plant species that occur in Germany, including rare habitats  
365 which often harbour rare plant species. This means that even if the spatial  
366 representativeness is incomplete for entire Germany, the representativeness at the level of  
367 individual species is unprecedented and grants robustness to our results.

368 Our results show that minor asymmetries of cover losses and gains in communities sum up  
369 when being aggregated by species, potentially hinting at population declines and extinctions  
370 at larger spatial extents. This is in agreement with trends observed across Germany<sup>20,31–33</sup>,  
371 including biotic homogenisation<sup>34</sup>, which was already put forward in earlier studies on time  
372 series<sup>1,3</sup>, but had not yet been properly tested<sup>13</sup>. Homogenisation occurs because, across all  
373 time series, few species consistently increase in their cover, meaning that the same species  
374 are winning in many communities. This supposedly results in a decreasing dissimilarity  
375 between communities. Other studies that analysed species changes conform to our finding  
376 of a prevalence of losers over winners, such as from Denmark<sup>35</sup>, the UK<sup>36</sup> or Germany<sup>20</sup>.

377 Although neophytes were more frequently increasing than decreasing, confirming global  
378 observations<sup>37,38</sup>, most winners were native species, as has been reported already for  
379 German forest communities<sup>39–41</sup>. Similarly, the habitat affinities of declining species being  
380 concentrated in mires, grasslands and arable land reflect both the trends revealed by  
381 Germany's Red List of vascular plants<sup>42</sup> and floristic mapping programmes<sup>20</sup>.

382 Our time series also provide important temporal information on species losses and gains.  
383 The strongest asymmetry between cover losses and gains occurred between the end of the  
384 1960s and the beginning of the 21<sup>st</sup> century, indicating rapid species turnover, most likely as  
385 a result of substantial land-use changes (e.g. <sup>43</sup>). All systematic monitoring programmes on  
386 vegetation, however, started only after year 2000, and thus, cannot provide information on  
387 the second half of the 20<sup>th</sup> century. Our findings confirm the early warnings from the first  
388 Red Lists in Germany<sup>44</sup> as well as estimated richness changes from floristic mapping  
389 programmes when intervals between 1997-2017 were compared to the ones between 1960  
390 and 1987<sup>20</sup>. However, these results have to be interpreted with great caution for several  
391 reasons. First, it is probable that later time series were established at locations and habitats  
392 in the focus of nature conservation efforts, thus receiving a more favourable management  
393 than the average landscape. Second, data density on species change observations was  
394 highest in this intermediate period, which could give rise to a mid-domain effect<sup>28</sup>. In  
395 consequence, the stronger overlap of time series in the middle of the study period could  
396 have strengthened the observed trends. We note, however, that early inequalities in cover  
397 losses and gains at the plot scale will ultimately result in species extinctions at the regional  
398 scale, representing another aspect of extinction debt<sup>45</sup>.

399 Overall, we consider the overarching analysis of numerous local vegetation-plot time series  
400 an important piece of evidence in the ongoing attempts to assess biodiversity change and  
401 understand the underlying mechanisms. We demonstrated that changes in species cover  
402 within communities are a neglected source of information when assessing biodiversity  
403 change at large spatial extents. We advocate therefore the compilation of further existing  
404 community time series worldwide, especially from vegetation plots of which few have  
405 already been mobilised in global databases, such as BioTime<sup>46</sup>. Compared to temporal  
406 database analyses<sup>47</sup> and meta-analyses<sup>48</sup>, repeated observations on the same locations  
407 represent the most sensitive strategy for analysing temporal vegetation changes<sup>49</sup>. However,  
408 a careful quality control is a key prerequisite for this type of analysis<sup>13</sup>. In particular,  
409 aggregating changes across different communities by species rather than aggregating  
410 changes per plot requires much more attention for harmonising different taxonomies to  
411 prevent pseudo-turnover<sup>21</sup>. With appropriate care taken, plot time series of community data  
412 across larger regions should form a crucial backbone in future biodiversity monitoring.  
413 Unravelling the temporal taxonomic turnover at the community scale<sup>1,2</sup> allows insights into  
414 the mechanisms of species losses and gains that monitoring at coarser spatial grains, such as  
415 floristic mapping at grid sizes of several kilometres, alone cannot provide.

416

417

418 **Methods**419 **Data compilation**

420 We compiled as many long-term repeated vegetation-plot records from Germany as we  
 421 could access, including data from published studies, as well as results from grey literature  
 422 and conservation assessments. The data includes 92 projects (Extended Data Table 1, for a  
 423 description of the data see ref<sup>50</sup>).

424 The different steps of data preparation and analysis are summarised in Extended Data Fig. 9.  
 425 Within each project, the plot resurvey ID indicates which plot observations from different  
 426 times were made on the same plot or set of plots at the same site, allowing their comparison  
 427 between different points in time. Plot resurvey IDs either refer to a single plot that was  
 428 repeatedly visited, which was either permanently marked (using poles, magnets etc.) or was  
 429 semi-permanent, e.g. provided with exact coordinates or other ways of descriptions of the  
 430 exact locality. In some cases, when the exact locations were not precise, resurveys used  
 431 several plots to match one previous plot, resulting in a one-to-many relationship. In this  
 432 case, all plot records received the same plot resurvey ID and all plot records for the same  
 433 point in time were combined. There were also resurveys with sets of plots at a site that  
 434 could not be matched by single plots but only by another set of plots, resulting in a many-to-  
 435 many relationship. Such resurveys were done to compare a particular community at a  
 436 particular site at two points in time, each represented by a set of plots, which then all  
 437 received the same plot resurvey ID. Accordingly, all plot records for the same point in time  
 438 were combined by averaging the species cover values and then treated as a single  
 439 observation. Some of our studies included experimental treatments with different  
 440 management of habitats (e.g. abandonment or establishment of grazing, succession and  
 441 disturbance). To exclude treatments that are not representative for biodiversity change in  
 442 Germany, from these studies we included only the control plots<sup>51</sup>, plots that reflected the  
 443 ambient land use at the site<sup>52</sup>, that were unfenced<sup>53</sup> or were subjected to continuous  
 444 grazing<sup>54</sup>. Finally, 7,738 unique plot resurvey IDs remained, comprising a total of 23,641  
 445 vegetation-plot records, ranging from 1927 to 2020. We retrieved coordinates for all  
 446 locations (longitude and latitude), either from the original sources or by looking up plot  
 447 locations from maps. The duration and survey times of each project are shown in Extended  
 448 Data Fig. 1. Since different projects used different cover scales, we converted cover into per  
 449 cent, following the default conversion of the Turboveg 2 program<sup>55</sup>. For example, for the  
 450 seven-grade Braun-Blanquet scale the transformation was r + 1 2 3 4 5 → 1% 2% 3% 13%  
 451 38% 63% 88%, respectively.

452 The location of all plots of all projects is displayed in Extended Data Fig. 7. We assigned the  
 453 individual plot locations to the grid cells of the quadrants of German ordnance maps  
 454 ("MTBQ," 0°10' × 0°6', approximately 5.6 km × 5.9 km in the centre of Germany), and tested  
 455 whether the grid cells analysed differed from those without observations with respect to  
 456 population density, road density, urban cover, cropland cover and protected areas. This  
 457 clearly revealed that the sampled grid cells were not representative for the whole area of  
 458 Germany. Surprisingly, they showed significantly higher human population densities, road  
 459 densities and urban cover, while cover of cropland and the amount of protected area was  
 460 lower, which indicates that many time series were made in regions with higher human  
 461 pressures. Our time series were also biased with respect to habitat types. This was  
 462 illustrated by assigning all plot records of the time series to EUNIS classes, using the expert  
 463 system EUNIS-ESy<sup>56</sup> and the corresponding R code<sup>57</sup>. Each time series was assigned to the

464 habitat type by using the earliest plot record that resulted in level 3 EUNIS classification  
 465 (Extended Data Fig. 8). While the time series covered 92 of the approximately 150 EUNIS  
 466 habitat types encountered in Germany, most of the 23,641 plot records came from  
 467 grasslands (level 1 EUNIS habitat R, n=14,849, 62.8%), followed by forests and other wooded  
 468 lands (T, n= 5,440, 23%). In contrast, arable land, which makes up more than 36% of the land  
 469 cover in Germany, was only represented by 816 plot records (V, vegetated man-made  
 470 habitats, 3.5%).

471

### 472 **Taxonomic harmonisation**

473 All projects were linked to the standardized species list German SL 1.3<sup>58</sup>. The nomenclature  
 474 for vascular plants followed the concepts of Wisskirchen et al.<sup>59</sup>, with additional  
 475 aggregations to higher taxonomic levels according to German SL 1.3<sup>58</sup>. As some authors  
 476 recorded subspecies and other infraspecific taxa, species were aggregated at the species  
 477 level, using vegdata<sup>60</sup>. Some closely related species that, from our experience, were often  
 478 mistaken in the field were merged at the aggregate or genus level. Species aggregates were  
 479 also used when different taxon names of the same aggregate occurred in different projects,  
 480 to prevent that the same taxon might appear under different taxon names. The taxon name  
 481 harmonisation was a crucial step in our approach, as our aim was to assess species cover  
 482 changes across projects (Fig. 1). We used our own R code to merge taxon names and the  
 483 notation of the ESy expert system<sup>56</sup> to protocol all steps. The species harmonisation forms  
 484 the first section of the ESy system and shows which taxon names were aggregated under the  
 485 name of a broader taxonomic concept (Extended Data Table 2). In addition, within single  
 486 projects, we used customised aggregations when the same taxa were reported at different  
 487 taxonomic levels at different points in time in the same plot resurvey IDs (Extended Data  
 488 Table 3). For example, while in all but one year of a time series of a specific plot *Orchis*  
 489 *militaris* was reported, only one year reported *Orchis* spec. at the genus level. Unaccounted  
 490 for, such a leap between taxonomic levels within a time series would result in incorrect  
 491 species change observations. To avoid losing the predominating information at the species  
 492 level by aggregating all records to *Orchis*, we assumed that the taxon was also *Orchis*  
 493 *militaris* in that particular year. If more than one taxon occurred in previous years, we  
 494 equally distributed the cover among those taxa. This happened for example when a record  
 495 was taken late in spring when the two species *Anemone nemorosa* and *A. ranunculoides*  
 496 could no longer be distinguished.

497 The percentage cover values of the same aggregated taxon name as well as those of taxa  
 498 occurring in different layers of the same plot were merged, assuming a random overlap of  
 499 their cover values and making sure that the combined cover values cannot exceed 100%<sup>56</sup>.  
 500 We removed bryophytes and lichens using the vegdata package in R<sup>60</sup>.

501 Finally, the original list of 3,280 taxon names that included bryophytes and lichens was  
 502 reduced to 1,794 taxon names of vascular plants. In the following, for the sake of simplicity,  
 503 we refer to these taxon names as species.

504

### 505 **Temporal change analysis**

506 Instead of fitting trends for individual time series, different intervals of the same time series  
 507 were treated as separate change observations. This was achieved by separating all records  
 508 into 458,311 plot resurvey triplets, i.e. ID x species x time interval observations, where the  
 509 interval designated two subsequent observations between year 1 and year 2 for the start



510 and end of the interval, respectively. Separating a time series in its different intervals avoids  
 511 the problem of establishing a baseline against which the changes are being compared<sup>13,28</sup>.

## 512 **Temporal change analysis at the plot level**

513 At the plot level, the triplets were aggregated into plot resurvey ID x time interval  
 514 combinations (in total n=13,987). With a total of 7,738 plot resurvey IDs, this corresponds to  
 515 on average 1.81 resurvey intervals per plot resurvey ID. This means that, on average, a time  
 516 series had about three observation events. While most plot resurvey IDs were only repeated  
 517 once (one interval, n=6,006), 798 had two intervals, 213 had three intervals and 721 had  
 518 four or more intervals. The longest time series comprised 54 intervals (Uwe Wegener,  
 519 montane Harz meadows<sup>61</sup>). For each interval and plot resurvey ID, we calculated the change  
 520 in species richness (SR), Shannon's index of diversity and Pielou's index of evenness. In  
 521 addition, we calculated the change in the rank abundance curves, using the formula for  
 522 curve-change in ref<sup>23</sup>. The change in rank abundance reflects the area between the two rank  
 523 abundance curves for the later and earlier observation. Rank abundance curves are  
 524 constructed by plotting the species' cumulative relative cover (ranging from 0 to 1) against  
 525 the species' ranks in cover values, calculating ranks from highest to lowest cover and then  
 526 dividing the ranks by the maximum rank (with scaled ranks ranging from 0 to 1).  
 527 Furthermore, we calculated the number of species with decreases and increases in cover as  
 528 well as mean and median cover across all species in a plot record.

529 For all change metrics calculated at the plot level, we calculated log response ratios of the  
 530 metric at time Y2 divided by that at time Y1, except for the change in rank abundance curves  
 531 and losses and gains, where we used the difference between area and number of species,  
 532 respectively. To assess the impact of plot size on the change of species richness, we tested  
 533 the effect of  $\log_{10}(\text{surface area in m}^2)$  on  $\log_e(\text{SR}_{Y2}/\text{SR}_{Y1})$ . Additionally, we analysed the  
 534 distribution of plot records with respect to  $\log_e(\text{SR}_{Y2}/\text{SR}_{Y1})$  separately for small ( $> 25 \text{ m}^2$ ),  
 535 medium-size ( $25 \text{ m}^2$ ) and large plots ( $>25 \text{ m}^2$ ). A similar analysis was carried out for testing  
 536 the effect of the observation length ( $\log_{10}$  interval length in years) on the change of species  
 537 richness and analysing the distribution of plot records separately for short ( $\leq 2$  years),  
 538 medium ( $> 2$  and  $\leq 10$  years) and long observation intervals ( $> 10$  years). We additionally  
 539 expressed richness change per decade (mean  $\log_e(\text{SR}_{Y2}/\text{SR}_{Y1}) \text{ decade}^{-1}$ ). The departure of  
 540 effect sizes and differences from 0 in all these analyses were assessed with mixed effects  
 541 models, using the time-series ID as random factor, thus taking into account the non-  
 542 independence of intervals from the same time series. As there were 13,987 plot resurvey ID  
 543 x time interval combinations, the test statistics tended to be significant, even when the  
 544 mean of the test metric was close to zero. We used mixed models to calculate confidence  
 545 intervals using Wald-test approximation<sup>62</sup>.

546

## 547 **Temporal change analysis by species**

548 In total there were 458,311 plot resurvey ID x species x time interval combinations, for which  
 549 the difference in cover for every species  $k$  and time interval  $m$  was calculated as  $\Delta \text{cover}_{k,m} =$   
 550  $\text{cover}_{k,m,Y2} - \text{cover}_{k,m,Y1}$  and expressed as percentage points. Similar to our analyses for the  
 551 change of species richness, we also tested the effect of  $\log_{10}(\text{surface area in m}^2)$  and of

552 observation length ( $\log_{10}$  interval length in years) on  $\Delta\text{cover}_{k,m}$ , using mixed effects models  
 553 with the time-series ID as random factor.

554 Here,  $Y_2$  and  $Y_1$  refer to the end and the start year of an interval, defined as the two nearest  
 555 points in a time series.

556 To compare the distribution of cover changes across all species, we considered positive and  
 557 negative cover change observations separately ( $n= 184,678$  and  $192,162$  time interval  
 558 observations, respectively). We then sorted the cover changes in each category (positive or  
 559 negative cover changes) according to increasing absolute values and plotted the cumulative  
 560 sums of cover changes against the proportion of observations in each category, thus  
 561 obtaining a Lorenz curve. We calculated the unweighted Gini coefficient for each category,  
 562 according to<sup>63</sup> and using the bias correction implemented in the DescTools package<sup>64</sup>:

$$563 \quad G_{\text{cover}} = \frac{\sum_i^n \sum_j^n |\Delta\text{cover}_i - \Delta\text{cover}_j| \frac{n}{n-1}}{2 \sum_i^n \sum_j^n \Delta\text{cover}_j}$$

564 with  $\Delta\text{cover}_i$  and  $\Delta\text{cover}_j$  being cover changes of change observations  $i$  and  $j$  in plots,  
 565 irrespective of species, and  $n$  the total number of change observations.  $G_{\text{cover}}$  is calculated  
 566 separately for negative or positive change observations, using either only all negative or  
 567 positive change observations. The Gini coefficient is a measurement of inequality in  
 568 distribution<sup>26</sup>, given as a value between 0 and 1 with 0 indicating a perfectly equal  
 569 distribution.

570 Across all plot resurvey IDs, there were 458,311 species x time interval combinations with a  
 571 value for cover change. For species comparisons, we aggregated cover changes by species  
 572 across all plot resurvey IDs and intervals. We counted the number of positive, zero or  
 573 negative cover changes per species and subjected them to an exact binomial test, using the  
 574 stats package. We adjusted the significance levels for multiple testing using Holm correction.  
 575 When showing changes by species in graphs (Fig. 4), we confined the list to those species  
 576 with  $p < 0.05$  after Holm correction and with  $\geq 100$  time interval observations ( $n=161$ ). To  
 577 compare the distribution of cover changes among all species, we calculated the mean cover  
 578 change per species, expressed as percentage points in cover. As the cover changes were  
 579 highly dependent on species and many species occurred only rarely in the time series, we  
 580 tested the probability to increase with a non-parametric exact binomial test. We assigned  
 581 the floristic status native, archaeophyte and neophyte (the latter two being exotic species  
 582 arriving in Germany before or after 1492, respectively) to these 161 species, using the  
 583 BIOLFLOR database<sup>65</sup>. We assigned species to their preferred habitat, using the level 1  
 584 habitats of the EUNIS habitat classification<sup>66</sup>. This was achieved by assigning all 225,606  
 585 vegetation plots in the German Reference Vegetation Database<sup>67</sup> to EUNIS classes, using the  
 586 expert system EUNIS-ESy<sup>66</sup> and the corresponding R code<sup>57</sup>. We then calculated the affinity  
 587 of the 161 species with a significant change to each of the 150 EUNIS classes that occurred in  
 588 Germany, using the  $\Phi$  coefficient of association<sup>68,69</sup>. Then, the habitat preference of a  
 589 species was defined as the EUNIS class to which the species had the highest  $\Phi$  coefficient.  
 590 For further analysis, we used the highest hierarchy of the EUNIS system (level 1). To assess  
 591 which categories of floristic status and EUNIS habitat level 1 preference departed from the  
 592 expected probability to increase, which is 0.5, we scaled the probability response to -1 to 1

593 and calculated linear models without intercept. Additionally, we tested whether mean cover  
 594 changes of species depended on their overall frequency in the dataset and analysed subsets  
 595 of species based on different interval lengths and plot sizes in which the species occurred,  
 596 using the same categories of interval lengths and plots sizes as used for analysing species  
 597 richness.

598 We calculated the Gini coefficient for inequality of changes, separately for species with  
 599 negative and positive mean cover changes (that is losers and winners), respectively. The Gini  
 600 coefficient based on species means was also calculated using the DescTools package<sup>64</sup> and is  
 601 defined as:

$$602 \quad G_{\overline{cover}} = \frac{\sum_i^N \sum_j^N |\overline{\Delta cover}_i - \overline{\Delta cover}_j|}{2 \sum_i^N \sum_j^N \overline{\Delta cover}_j} \frac{N}{N-1}$$

603 with  $\overline{\Delta cover}_i$  and  $\overline{\Delta cover}_j$  being the mean cover changes of species  $i$  and  $j$  and  $N$  the total  
 604 number of species.  $G_{\overline{cover}}$  is calculated separately for losers or winners, using either only all  
 605 negative or positive species mean cover changes. Applied in this way, the Gini coefficient  
 606  $G_{\overline{x}}$  indicates that either the losses or the gains in cover were not distributed equally among  
 607 species. To assess the significance in the difference between the Gini coefficients of losers  
 608 and winners, we calculated 95% confidence intervals from bootstrapping, using percentiles,  
 609 bias correction and 1,000 replicates. For analysing the temporal course of the distribution of  
 610 cover changes in the groups of winners and losers, we calculated the Gini coefficient  $G_{\overline{x}}$  as  
 611 described above using a moving window of five years, using only records from 1945 onwards  
 612 because of data scarcity before this date. Cover changes of all resurvey ID x species x time  
 613 interval combinations were aggregated by species and year for all years that fell into a  
 614 window of five years. In every window, 300 species were resampled by chance, repeated  
 615 100 times, and Gini coefficients were calculated separately for all decrements and  
 616 increments of the means of these 300 resampled species. Temporal trends with confidence  
 617 intervals were calculated from the Gini coefficients from these 100 runs.

### 618 **Null model scenarios**

619 To assess the mechanisms that might drive the inequality of cover changes among losers vs.  
 620 winners, we set up a simple model, serving as a theoretical null expectation (see illustration  
 621 in Supplementary Methods). Corresponding to our data analysis, the null model was not  
 622 spatially explicit. In contrast to previously developed null models, such as in<sup>1</sup>, our aim was  
 623 also not to model stochastic colonization or extinction but stochastic changes in cover, which  
 624 to our knowledge had not been attempted before. Extinction only happened when cover  
 625 decreased below zero, and then, was exactly counterbalanced by colonization. In this way  
 626 we kept species richness constant, which contrasts null models such as in<sup>1</sup>. Our null model  
 627 also differs from traditional null models in community ecology which reshuffle cover values  
 628 across communities and/or species<sup>70-72</sup> but do not allow for random decrease and increase  
 629 in cover.

630

### 631 *Simulating random communities*

632 We simulated random communities and subjected them to different scenarios. First, we  
 633 created a pool of 200 species with frequencies randomly drawn from a log-normal  
 634 distribution, using the `rlnorm` function in R (meanlog = 1.5, sdlog = 1.2). Summing up all  
 635 frequencies resulted in a total of 1,810 occurrences. We then drew random species richness

636 values for 100 communities from a normal distribution, varying the mean and standard  
637 deviation to obtain the same total number of occurrences (1,810), which was achieved by  
638 using a Gaussian distribution with mean=19.13 and sd=9 species). We chose these  
639 parameters in a way to be similar to the richness distribution of our empirical data set  
640 (mean=23.4, sd=13.7). Finally, cover values were randomly assigned to the species in each  
641 community according to a broken-stick distribution<sup>73</sup>, using the drbs function of the sads  
642 package<sup>74</sup>, which resulted in a sum of a total cover of 100% in each community.

643

#### 644 *Introducing cover change: three scenarios*

645 We then introduced different types of change to this random community, using three  
646 different scenarios. In all scenarios species richness was kept constant, which reflected our  
647 own findings and those in refs<sup>1,3-5</sup>. However, we allowed species turnover by replacing  
648 species that – owing to randomly introduced decreases – had cover values <0. Newly  
649 colonising species were randomly selected from the pool of 200 species, with the drawing  
650 probability weighted by the species' frequency. In the scenarios 1 and 2, this made sure that  
651 the species frequency distribution in the species pool remained constant (except for random  
652 noise). Species decreases in cover were introduced by varying three parameters, which  
653 corresponded to the three scenarios in which these parameters were varied: 1) the  
654 proportion of species affected by cover change in a community (to simulate different rates  
655 of turnover in community composition), 2) the proportion of species with increase in cover  
656 among those species affected by change (to simulate differences in the distribution of cover  
657 losses and gains, irrespective of species) and 3) the identity of the species to decrease in  
658 cover (to simulate that cover losses and gains might be concentrated in certain species).  
659 Decrements were either assigned randomly or according to the descending ID of the species,  
660 which resulted in species with higher ID values being more frequently selected for losing  
661 cover than other species.

662 In each community, according to these parameters, species were randomly chosen that  
663 underwent a decrease. The cover of all decreasing species in each community was summed  
664 up and redistributed according to a geometric distribution. For example, in a community of  
665 24 species where 50% of all species were selected to change in cover and 50% of those were  
666 subjected to decrease in cover, the summed cover of these six species was redistributed (but  
667 randomly assigned) to the same six species as 0.125, 0.0625, 0.03125, 0.015625, 0.0078125  
668 and 0.0078125. Note that the smallest change occurred twice to result in a sum of 0.25. If  
669 the decrease in cover assigned to a species was larger than the current cover of that species,  
670 its cover became 0 and the species was replaced as described above. The actually applied  
671 decrements were then assigned to the species that – according to the given parameters –  
672 were selected for increase. The number of increasing species also comprised the newly  
673 colonising species in a community. If the number of decreasing and increasing species was  
674 the same, the exactly same cover changes of decreasing species were randomly assigned as  
675 increments to the increasing species, taking the decrements and changing their sign. In this  
676 case, the absolute values of all increments and decrements across all communities were  
677 exactly the same, and thus, could not result in differences in the equality of their  
678 distribution. If the number of decreasing species was higher than that of increasing species,  
679 each two randomly chosen decrements were combined until the number of required  
680 increments was reached. Vice versa, if the number of decreasing species was lower than that  
681 of increasing species, randomly selected decrements were divided by 2 until the number of  
682 required increments was reached. In the latter two cases, the equality of the distribution of  
683 decrements was no longer the same as that of the increments.

684 For all scenarios, we measured the inequality of increments and decrements by the Gini  
685 coefficient as described above. As in the empirical data, we calculated the Gini coefficient i)  
686 across all cover changes, separately for increments and decrements, but irrespective of  
687 species, and ii) on species-aggregated mean values of increments and decrements.  
688

689 The analyses were calculated in R version 4.0.3 using the packages stats, foreign, reshape2,  
690 data.table, tidyverse, Hmisc, sads and Desctools. Graphs were produced with the packages  
691 ggplot2, egg and vcd.

692

## 693 **Data availability**

694 All data is available as data paper<sup>50</sup> and available at [https://doi.org/10.25829/idiv.3508-](https://doi.org/10.25829/idiv.3508-c17blk)  
695 [c17blk](https://doi.org/10.25829/idiv.3508-c17blk) under the terms specified by CC BY 4.0.

696 A current version of the data paper submitted to Scientific Data has been uploaded. As the  
697 Nature paper might be published before acceptance, we have also submitted the data paper  
698 to bioRxiv (also uploaded).

699 [Please note that the DOI link is not yet activated, which will happen around July 22nd,  
700 2022. In the meantime you can already access the metadata via  
701 <https://idata.idiv.de/ddm/Data/ShowData/3508?version=0> and the full dataset here:  
702 <https://cloud.uni-halle.de/s/wei1ljqnq2Wet0A>

703 This part marked in yellow will then be deleted from the paper]

704

## 705 **Code availability**

706 The R code to retrieve resurvey ID x species x time interval combinations and to calculate the  
707 results of this paper is provided in Supplementary Code 1 and on [https://github.com/idiv-](https://github.com/idiv-biodiversity/ReSurveyGermany_Analysis)  
708 [biodiversity/ReSurveyGermany\\_Analysis](https://github.com/idiv-biodiversity/ReSurveyGermany_Analysis), the R code to produce the null models in  
709 Supplementary Code 2 and on [https://github.com/idiv-](https://github.com/idiv-biodiversity/ReSurveyGermany_null_models)  
710 [biodiversity/ReSurveyGermany\\_null\\_models](https://github.com/idiv-biodiversity/ReSurveyGermany_null_models).

711

712

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878

879

880 **Captions:**

881

882 Fig. 1 | Temporal change in a) plant species richness of plots and b) mean cover change of  
 883 species. The black dashed line shows zero change, while the red solid line in a) shows the  
 884 mean change of richness and in b) the species' mean change in cover in percentage points.  
 885 a) Comparisons of species richness (SR) in plots recorded at subsequent points in time  
 886 ( $n=13,987$ ). An effect size of  $\pm 0.69$  corresponds to double or half the initial number of  
 887 species, while an effect size of  $\pm 2.3$  indicates tenfold or one tenth of the initial number of  
 888 species. Estimated mean overall effect size was  $-0.062$  according to a mixed effects model  
 889 ( $p=2 \times 10^{-16}$ ,  $df=5,310$ ) with a 95% confidence interval between  $-0.071$  and  $-0.053$ . b)  
 890 Comparisons of species' mean cover changes between subsequent records. Only species  
 891 with at least 100 observations of change ( $n=578$ ) were included. The estimated overall mean  
 892 of the species' mean cover change was  $-0.165 \pm 0.089$  according to a t-test ( $p=3.1 \times 10^{-4}$ ,  
 893  $df=577$ ).

894

895 Fig. 2 | Lorenz curves for cover decreases (red) and increases (blue), reported in percentage  
 896 points across the whole observation period from 1927 to 2020 a) across all change  
 897 observations irrespective of species ( $n= 172,252$  and  $166,554$  observations of decrease and  
 898 increase, respectively) and b) aggregated by species, by averaging all change observations  
 899 from a) across all plots and time interval ( $n= 1011$  and  $719$  losers and winners, i.e. species  
 900 with negative and positive mean cover change, respectively). The icons on the left illustrate  
 901 these two types of aggregation of cover changes for six change observations, from which  
 902 each three decreased (-) or increased (+). In a) these decreases are sorted by sign (- or +), in  
 903 b) they are averaged by species, defining losers and winners, exemplified here as one species  
 904 each with negative or positive mean change, respectively. The Lorenz curves show the  
 905 cumulative amount of cover decrease and increase (added in order of their ascending  
 906 absolute values) as a function of the cumulative number of change observations (expressed  
 907 as proportion of the total number of observations). The diagonal black line indicates the  
 908 theoretical curve that would result if all observed changes would be equal in size. The Gini  
 909 coefficient, a measure of inequality, is the area between this diagonal line and the actual  
 910 Lorenz curve divided by the entire area under the diagonal line. Thus, 0 and 1 indicate  
 911 maximal equality and inequality, respectively. The differences between the Gini coefficients  
 912 in both graphs were significant at  $p=0.05$  but the confidence intervals in a) are so small that  
 913 they are invisible in the graph.

914

915 Fig. 3 | Lorenz curves based on null model simulations of changes in species cover. In all  
 916 simulations, the number of species per community was kept constant, but species turnover  
 917 (extinctions and colonisations) was allowed (for details see Methods and Supplementary  
 918 Methods). The graphs in the top row (a, b, c) show cover changes by plot ID x species x time  
 919 interval (corresponding to Fig. 2a), separated into negative (red) and positive (blue) change  
 920 observations. The bottom row of graphs (d, e, f) show mean cover changes per species  
 921 (corresponding to Fig. 2b), separated into species with average cover increase and decrease

922 (losers in red and winners in blue. The columns correspond to ourcr three hypotheses. In  
923 each panel, the blue and red Gini coefficients next to each other refer to the same scenario;  
924 \* indicates a statistically significant difference in the Gini coefficient between the two Gini  
925 coefficients from the same scenario, n.s. not significant (all at  $p=0.05$ ).

926

927 Fig. 4 | Probability of increase in cover for the 161 species with a significantly negative or  
928 positive change (binomial test at  $p < 0.05$ , with Holm correction) and at least 100 change  
929 observations. Decreasing species are those with a probability to increase of  $< 0.5$ , and thus,  
930 increase less often than expected by chance, and their names are plotted to the bottom of  
931 the y-axis at 0.5, while the names of increasing species are plotted to the top. The colours of  
932 taxon names show their floristic status, with black, purple and pink for native, archaeophyte  
933 and neophyte, respectively. The bar colour indicates the species' affinity to level 1 EUNIS  
934 habitats<sup>66</sup> and the error bars indicate the 95% CIs. The three most declining and increasing  
935 species are illustrated by name and photographs. Plant photographs were obtained from  
936 [www.floraweb.de](http://www.floraweb.de).

937

938 Fig. 5 | Temporal course of the Gini coefficient, calculated by a moving window approach  
939 with a window width of five years, separately for losers (species with mean cover losses, red)  
940 and winners (species with mean cover gains, blue) in this time window. The coloured lines  
941 show the mean values of 100 resampling events of 300 species each per time window, while  
942 the confidence bands show the standard deviations across these samples. Non-overlapping  
943 confidence bands indicate significantly different Gini coefficients between losers and  
944 winners. The increasing Gini coefficients indicate increasingly unequal distribution of cover  
945 changes with time.

946

947 **Supplementary Figures**

948 Extended Data Fig. 1 | Temporal coverage of the 92 projects included in the study. The coloured lines  
 949 indicate the start and the end of a project, black diamonds show in which years surveys were made.  
 950 Resurvey type refers to either studies that were repeated within a particular community across a site  
 951 without attempts to match plots (community comparison), or were carried out on matched plots,  
 952 which were either permanently marked or relocated from exact descriptions (semi-permanent). The  
 953 lower graph shows the number of times a particular year was included in any of the time series.

954

955 Extended Data Fig. 2 | Impact of the observation interval length on the temporal change of species  
 956 richness (SR) in plot records (a-c) and mean cover change of species (d-f). The responses are shown  
 957 separately for short ( $\leq 2$  years), medium ( $> 2$  and  $\leq 10$  years) and long observation intervals ( $> 10$   
 958 years). The black dashed line shows zero change, while the red solid line in a) - c) shows the mean  
 959 change of richness and in d) - f) the species' median change in cover in percentage points. According  
 960 to a mixed effects model estimated mean overall effect size was in a)  $+0.025$  ( $p=3.9 \times 10^{-9}$ ,  $df=4,142$ ),  
 961 b)  $+0.007$  ( $p=0.093$ ,  $df=3,903$ ) and c)  $-0.150$  ( $p<2 \times 10^{-16}$ ,  $df=8,612$ ). In d) - f) plot Interval comparisons  
 962 of the mean of all cover changes per species between time points Y1 and Y2 of the start and end  
 963 year, respectively, are shown on an axis with a sign\*sqrt-transformation. According to an  
 964 exact binomial test estimated overall median of cover change was in d) 0 (95 per cent confidence  
 965 interval 0 and 0.007), e)  $-0.02$  (CI  $-0.02$  and 0) and f)  $-0.26$  (CI  $-0.53$  and 0.002).

966

967 Extended Data Fig. 3 | Temporal change of plot records expressed per decade. Interval comparisons  
 968 of species richness (SR) in plot records between time points Y1 and Y2 of the start and end year,  
 969 respectively, and divided by the length of the interval in decades  $((Y2-Y1)*10)$  ( $n=13,987$ ). Estimated  
 970 overall effect size was  $+0.062$  according to a mixed effects model ( $p=1.8 \times 10^{-7}$ ) with a 95%  
 971 confidence interval between  $+0.039$  and  $+0.086$ .

972

973 Extended Data Fig. 4 | Impact of plot surface area on the temporal change of species richness (SR) in  
 974 plot records (a-c) and mean cover change of species (d-f). The responses are shown separately for  
 975 small ( $> 25 \text{ m}^2$ ), medium-size ( $25 \text{ m}^2$ ) and large plots ( $>25 \text{ m}^2$ ). The black dashed line shows zero  
 976 change, while the red solid line in a) - c) shows the mean change of richness and in d) - f) the species'  
 977 median change in cover in percentage points. According to a mixed effects model estimated mean  
 978 overall effect size was in a)  $-0.03$  ( $p=0.064$ ,  $df=487$ ), b)  $-0.031$  ( $p=1.55 \times 10^{-13}$ ,  $df=4,204$ ) and c)  $-0.095$   
 979 ( $p<2 \times 10^{-16}$ ,  $df=9,124$ ). In d) - f) plot Interval comparisons of the mean of all cover changes per  
 980 species between time points Y1 and Y2 of the start and end year, respectively, are shown on an axis  
 981 with a sign\*sqrt-transformation. According to an exact binomial test estimated overall  
 982 median of cover change was in d)  $-0.017$  (95 per cent confidence interval  $-0.065$  and  $-0.001$ ), e) -  
 983  $0.019$  (CI  $-0.043$  and  $-0.006$ ) and f)  $-0.26$  (CI  $-0.134$  and  $-0.050$ ).

984

985 Extended Data Fig. 5 | Temporal change of plot records. The histograms show the interval  
 986 comparisons of plot records between time points Y1 and Y2 of the start and end year, respectively.  
 987 The black dashed line shows the zero change, while the red solid line shows the mean change as  
 988 predicted from a mixed effects model. a) Change in Shannon's index of diversity (H). Estimated mean  
 989 effect size for H  $-0.055$  ( $p=2.2 \times 10^{-16}$ ,  $df=5,462$ , 95% confidence interval  $-0.064$  and  $-0.047$ ). b)  
 990 Change in Pielou's index of evenness (E). Estimated mean effect size for E  $-0.019$  ( $p=2.6 \times 10^{-16}$ , 95%

991 confidence interval -0.024 and -0.015). c) Difference in the area under the rank abundance curves.  
992 Estimated mean difference -0.143 ( $p=0.00211$ , 95% confidence interval -0.194 and -0.091). d)  
993 Difference in the number of cover gains and losses. Estimated mean difference -0.407 ( $p=7.9 \times 10^{-7}$ ,  
994 95% confidence interval -0.569 and -0.246). e) Change in mean cover of all the species in a plot (in  
995 per cent covered ground). Estimated mean effect size for mean cover +0.025 ( $p=1.0 \times 10^{-10}$ , 95%  
996 confidence interval +0.018 and +0.033). f) Change in median cover of all the species in a plot (per  
997 cent of covered ground). Estimated mean effect size for median cover -0.007 ( $p=0.2984$ , 95%  
998 confidence interval -0.021 and +0.007).

999

1000 Extended Data Fig. 6 | Temporal change in mean cover change of all species in percentage points.  
1001 Plot Interval comparisons of the mean of all cover changes per species between time points Y1 and  
1002 Y2 of the start and end year, respectively, shown on an axis with a sign\*sqrt-transformation.  
1003 The black dashed line shows the zero change, while the red solid line shows the median change in  
1004 cover across all species. All species in the dataset were included ( $n=1,794$ ). Estimated overall median  
1005 of cover change was -0.0625 (95 per cent confidence interval -0.089 and -0.035) and significantly  
1006 different from zero according to an exact binomial test ( $p<0.001$ ).

1007

1008 Extended Data Fig. 7 | Map of plot locations of all plots of all projects ( $n=23,641$ ). One or several  
1009 plots are summarised under the same plot resurvey ID ( $n=7,738$ ). Note that the more complete  
1010 coverage of Bavaria resulted from including the grassland monitoring Bavaria which started in 2002<sup>75</sup>.

1011

1012 Extended Data Fig. 8 | Assignment of time series plot records to EUNIS habitat types. Each time  
1013 series was assigned to the habitat type by using the earliest plot record that matched with the level 3  
1014 EUNIS classification. The classification was based on the EUNIS-ESy expert system<sup>56</sup> using the R code  
1015 implementation<sup>57</sup>. ?: plots not assigned to any level 3 EUNIS habitat type, +: assigned to more than  
1016 one level 3 EUNIS habitat type, A: Marine habitats, C: Inland surface waters, H: Inland sparsely  
1017 vegetated habitats or devoid of vegetation, N: Coastal habitats, Q: Wetlands, R: Grasslands and lands  
1018 dominated by forbs, mosses or lichens, S: Heathlands, scrub and tundra, T: Forests and other wooded  
1019 land, V: Vegetated man-made habitats, including arable land. Labels for EUNIS habitats were only  
1020 printed at the top of the corresponding bar section when the number of assigned records was  $\geq 150$ .

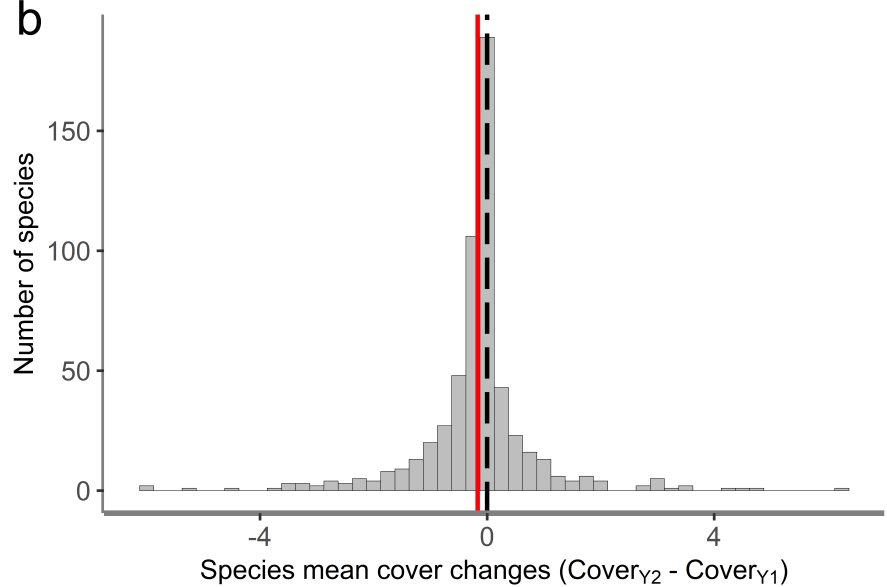
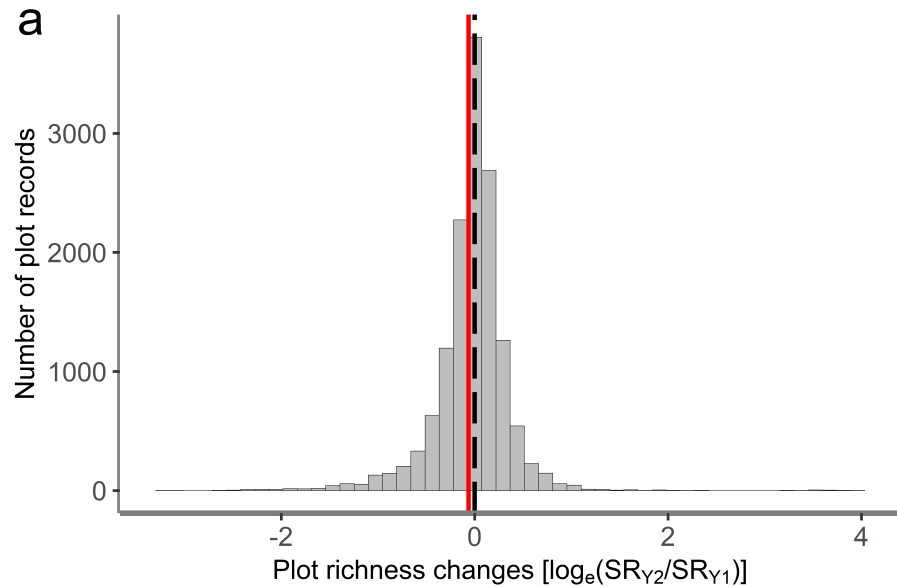
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1022 Extended Data Fig. 9 | Steps of data preparation and analysis.

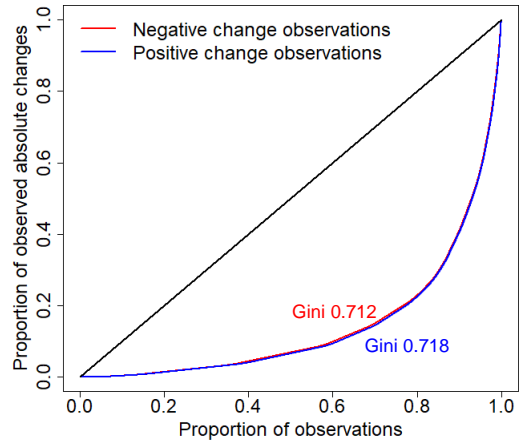
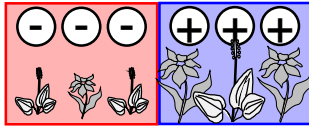
1023

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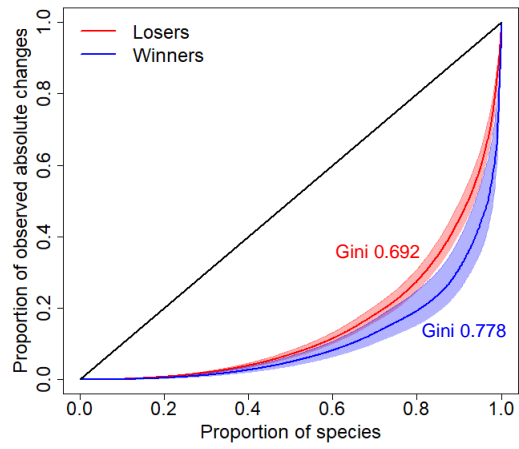
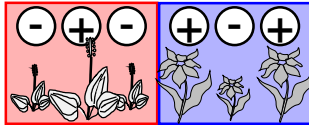




**a** Change observations by Plot ID x species x time interval



**b** Change observations aggregated by species (across all plots and time intervals)



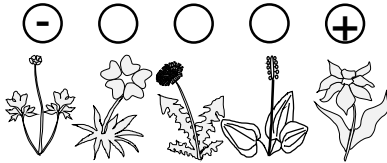
**Hypotheses: The divergence in the distribution between cover losses and gains is driven by ...**

i) ... the proportion of species that undergo changes

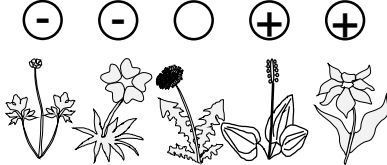
ii) ... the ratio of increasing to decreasing species

iii) ... the degree to which cover losses are concentrated on a specific subset of species

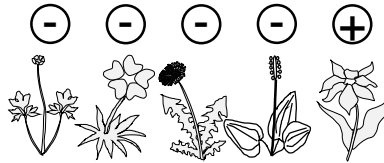
Proportion of species with cover changes 0.4



Proportion of species with cover changes 0.8



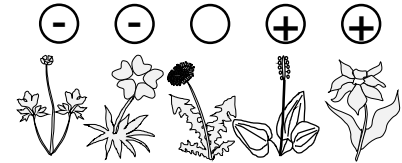
Proportion of increases in all changes 0.2



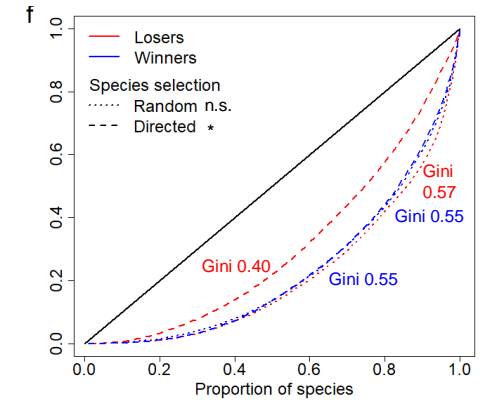
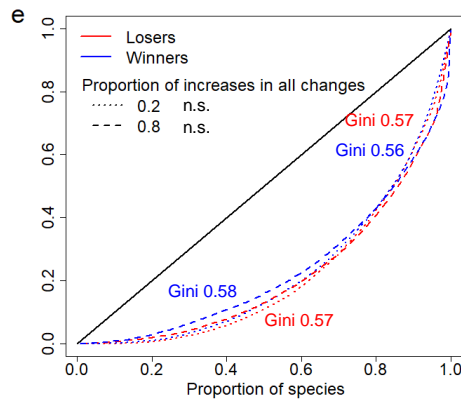
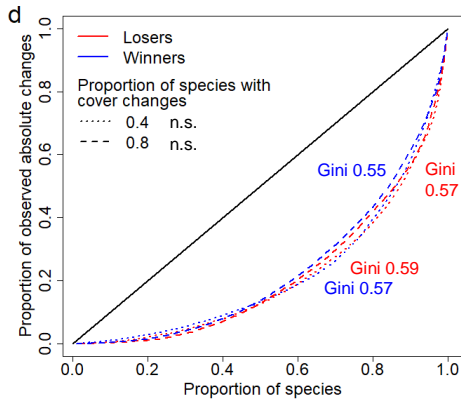
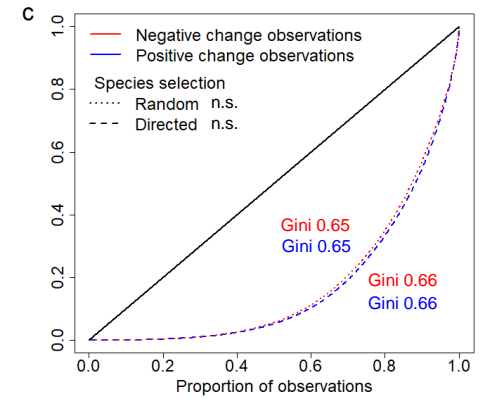
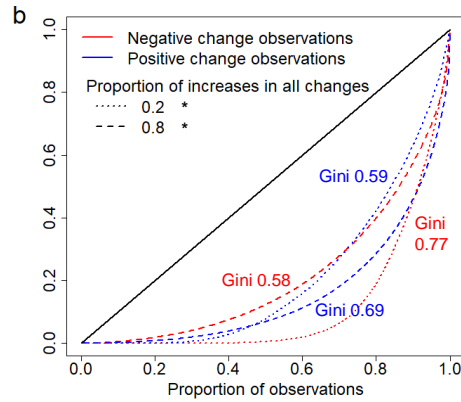
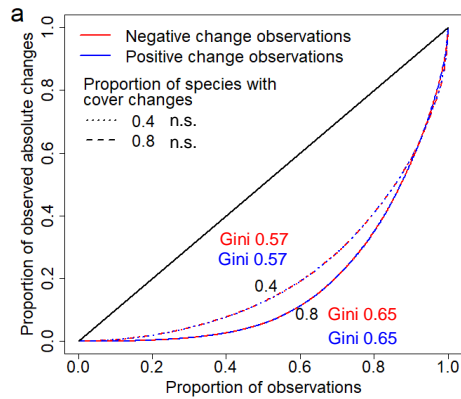
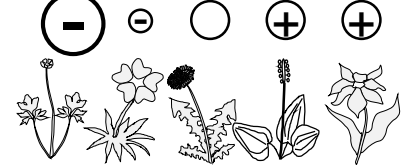
Proportion of increases in all changes 0.8



Random species selection



Directed species selection



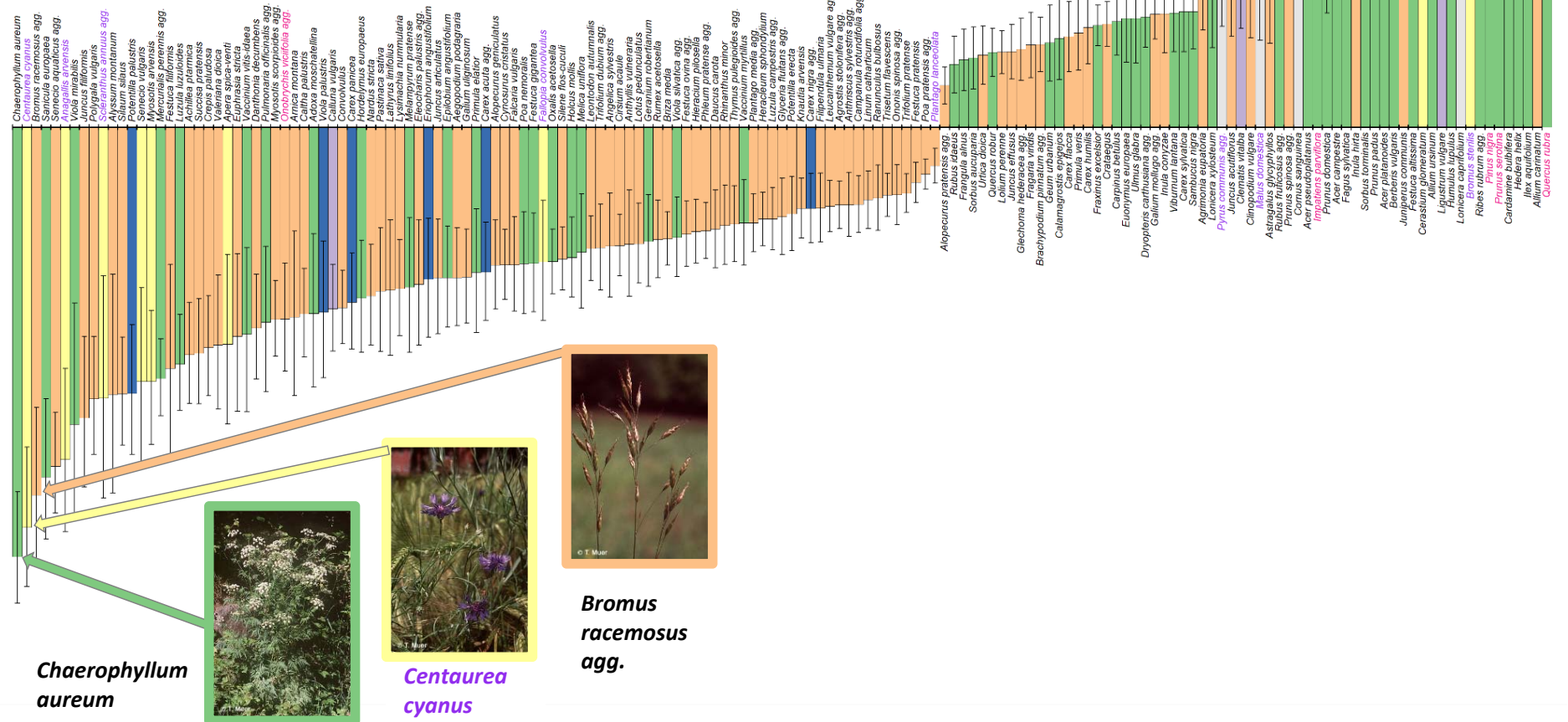
Probability to increase in cover

1  
0.95  
0.9  
0.85  
0.8  
0.75  
0.7  
0.65  
0.6  
0.55  
0.5  
0.45  
0.4  
0.35  
0.3  
0.25  
0.2  
0.15  
0.1  
0.05  
0

Floristic status of taxa

Native  
Archaeophyte  
Neophyte

? Unclassified  
Q Mires and spring fens  
R Grasslands  
S Scrub and dry heath  
T Forest  
V Arable land



*Chaerophyllum aureum*



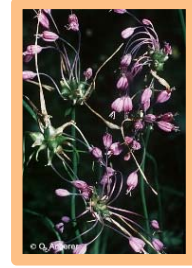
*Centaurea cyanus*



*Bromus racemosus* agg.



*Allium carinatum*

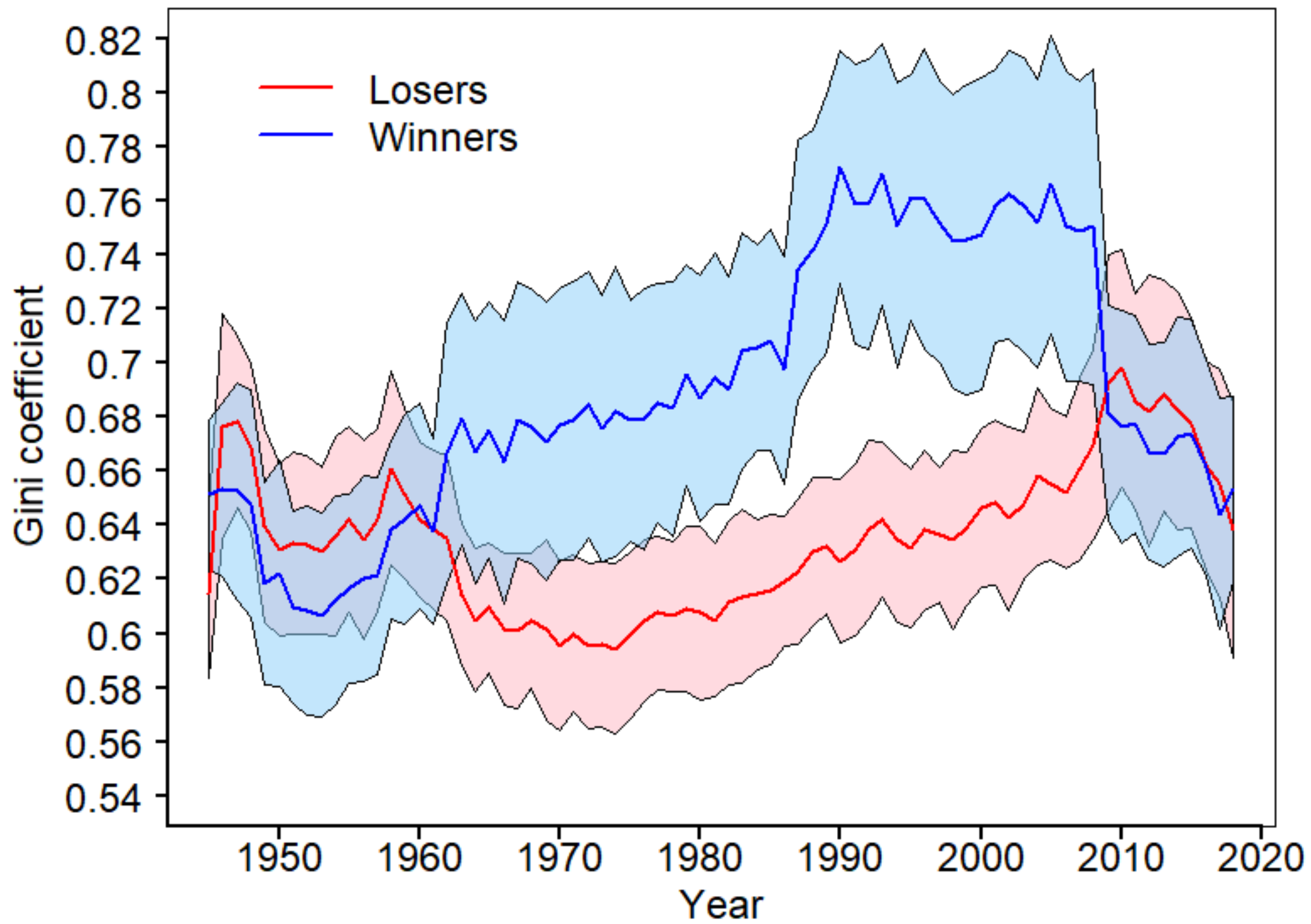


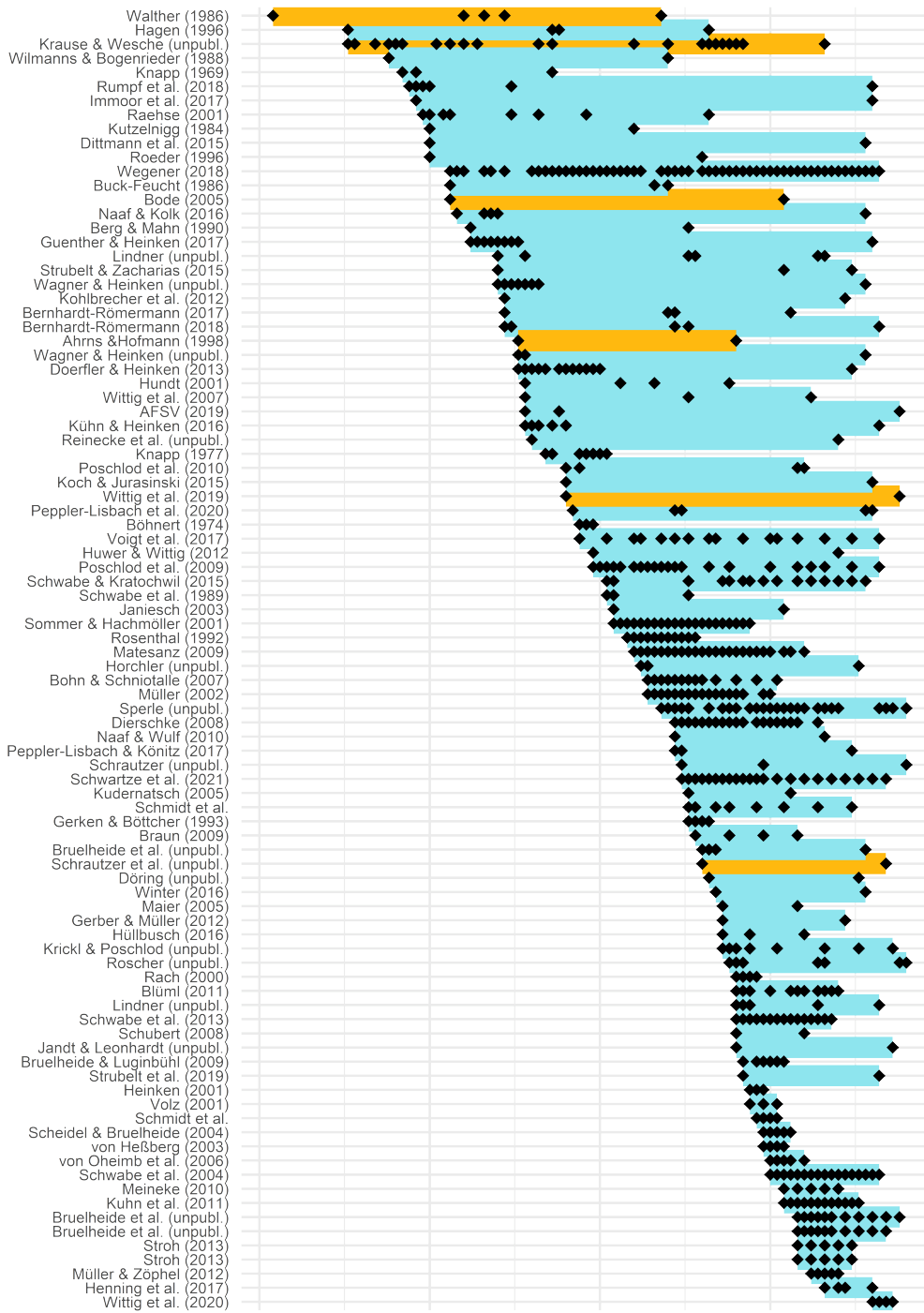
*Ilex aquifolium*



*Quercus rubra*





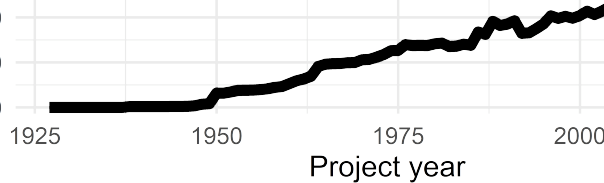


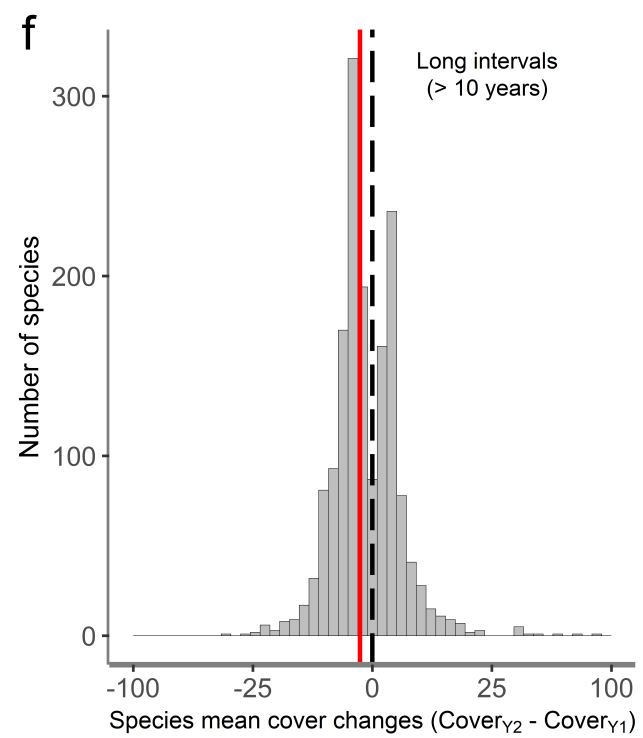
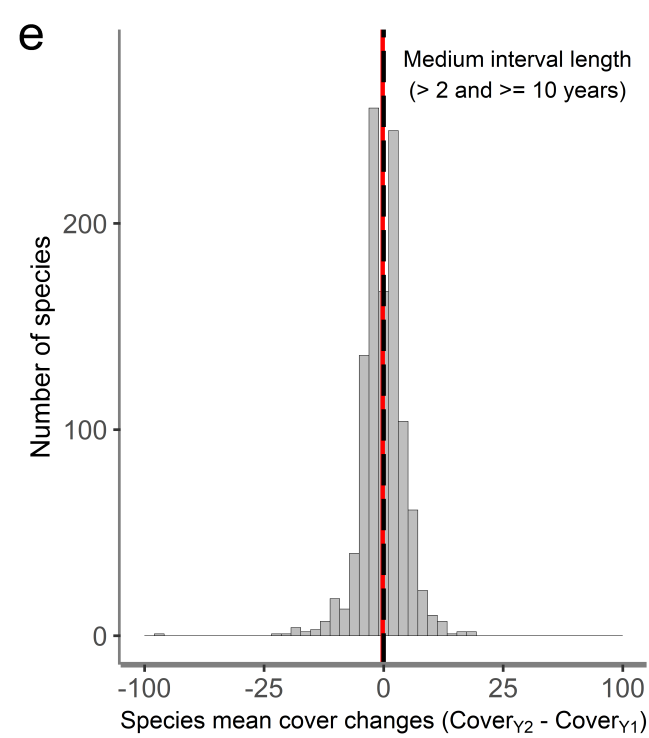
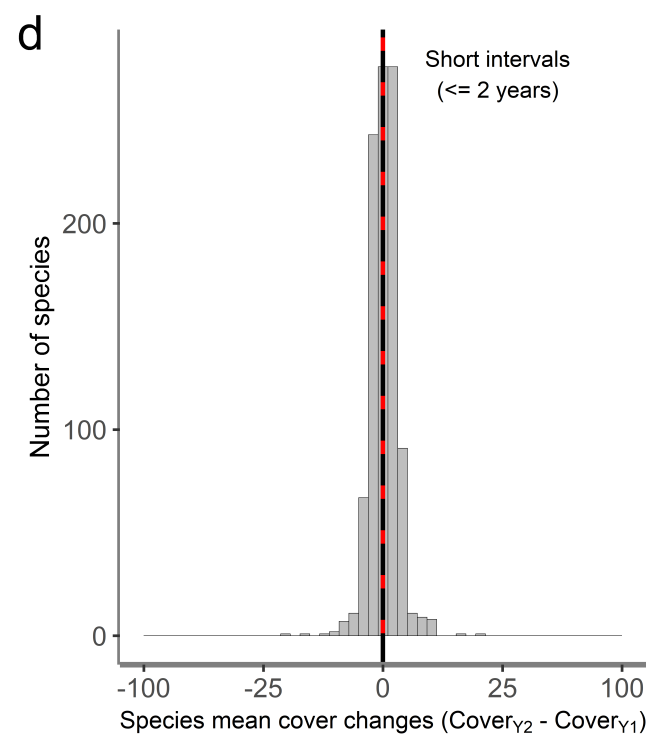
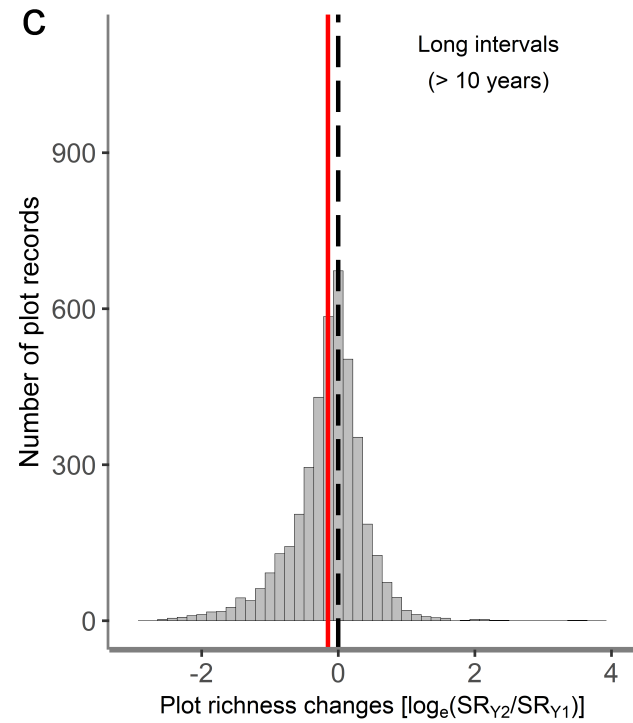
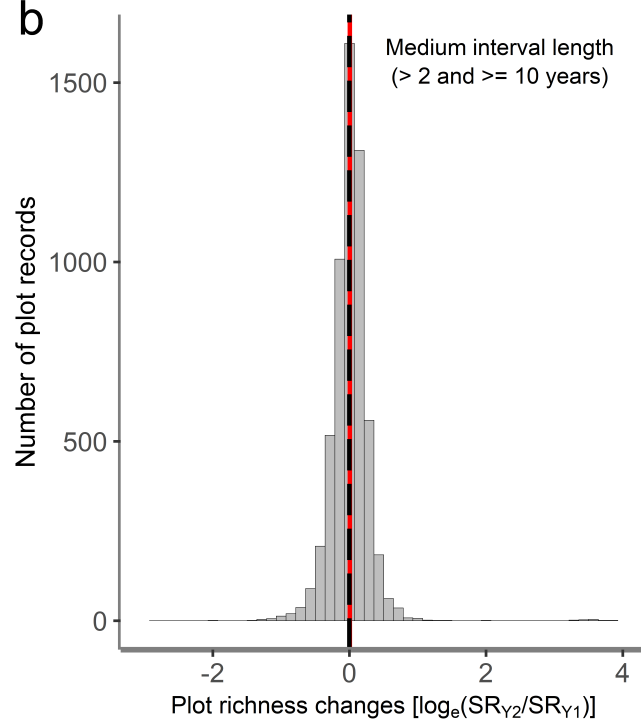
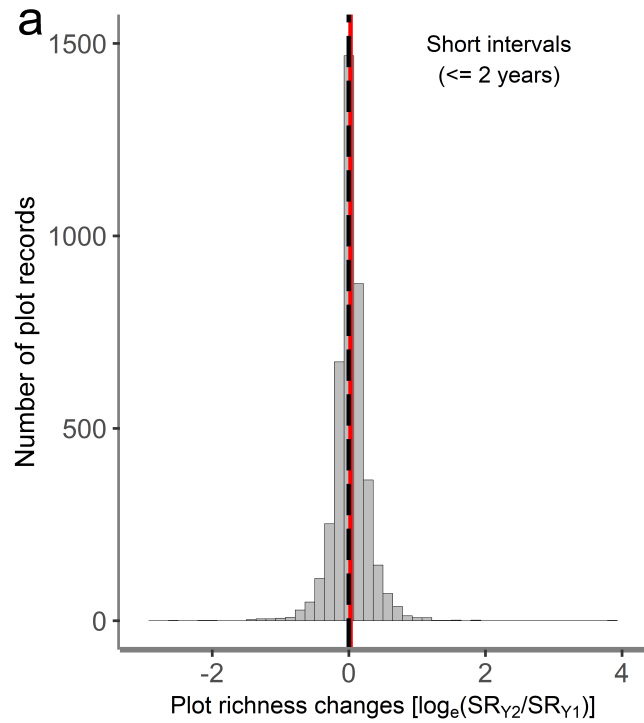
Resurvey\_type

(semi-)permanent plots

community comparison

Number of time series





Number of plot records

1500

1000

500

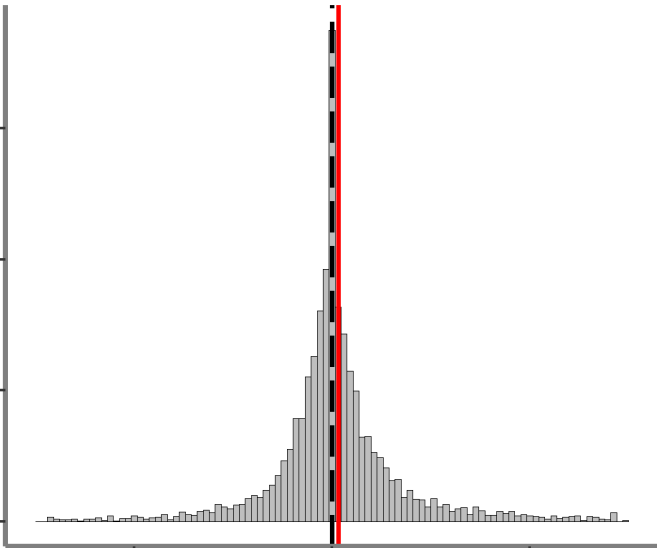
0

-2

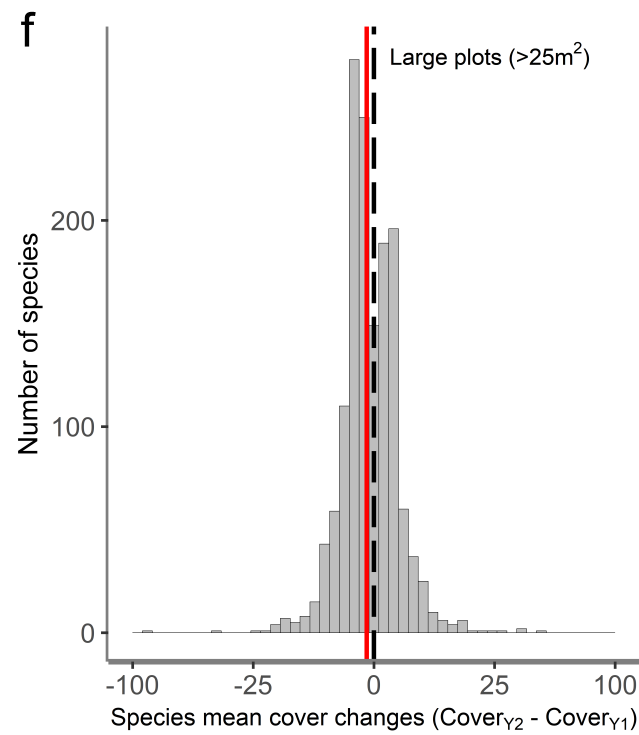
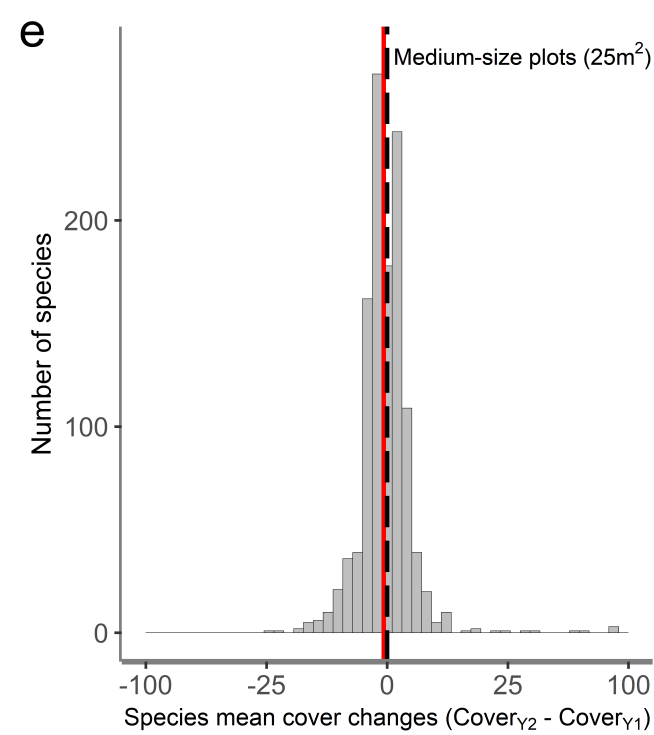
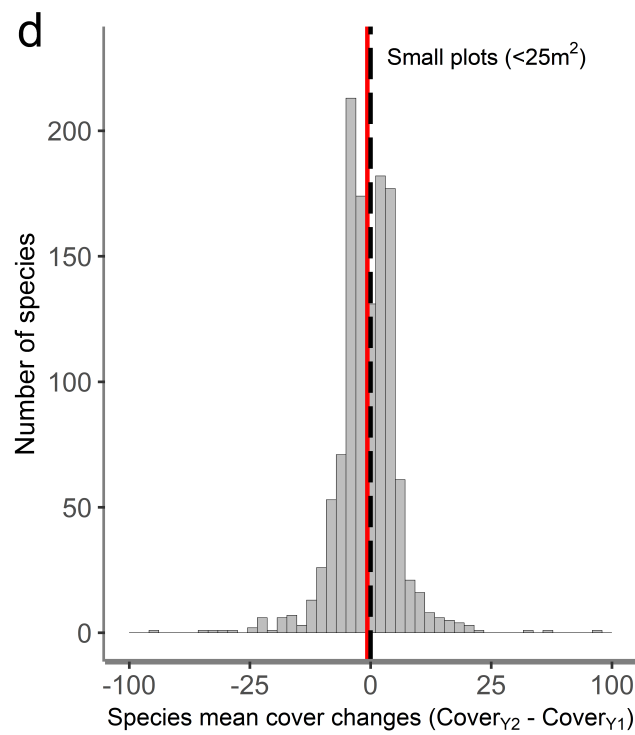
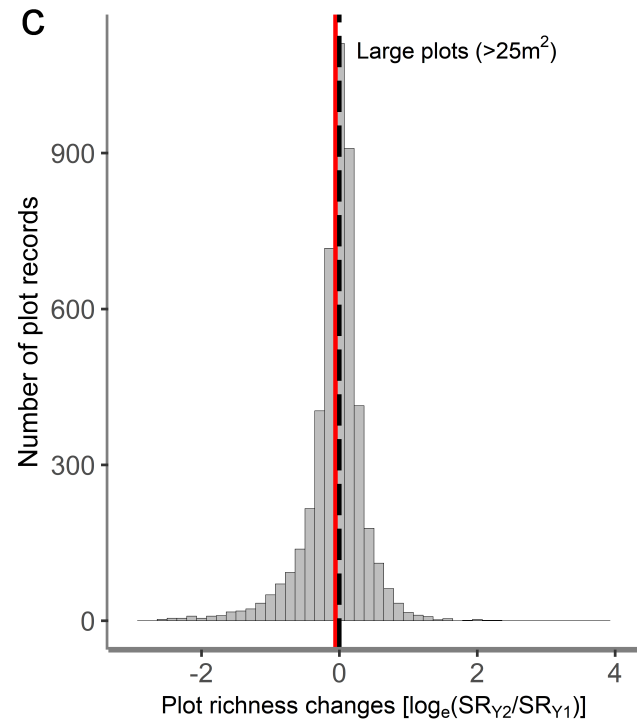
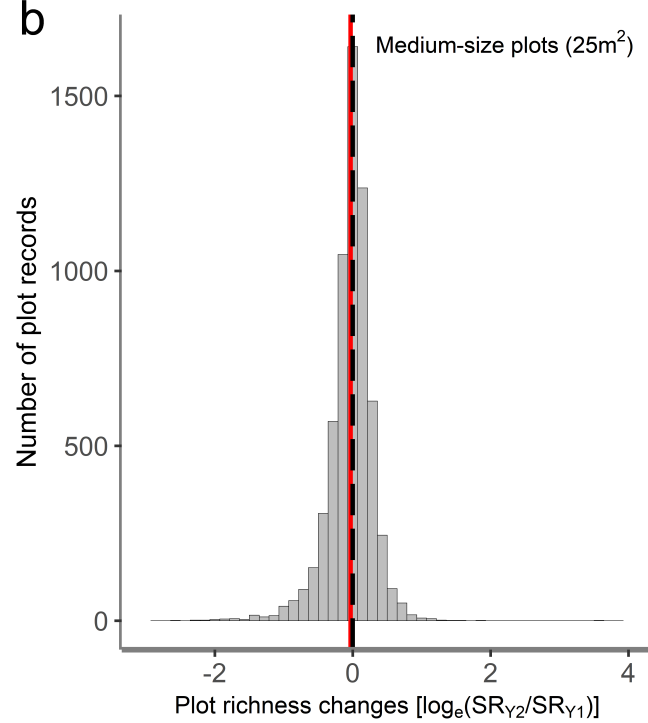
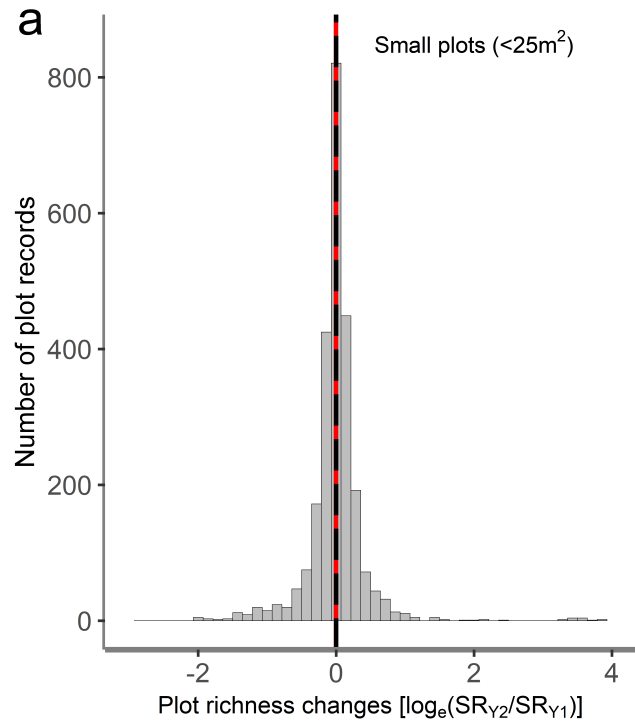
0

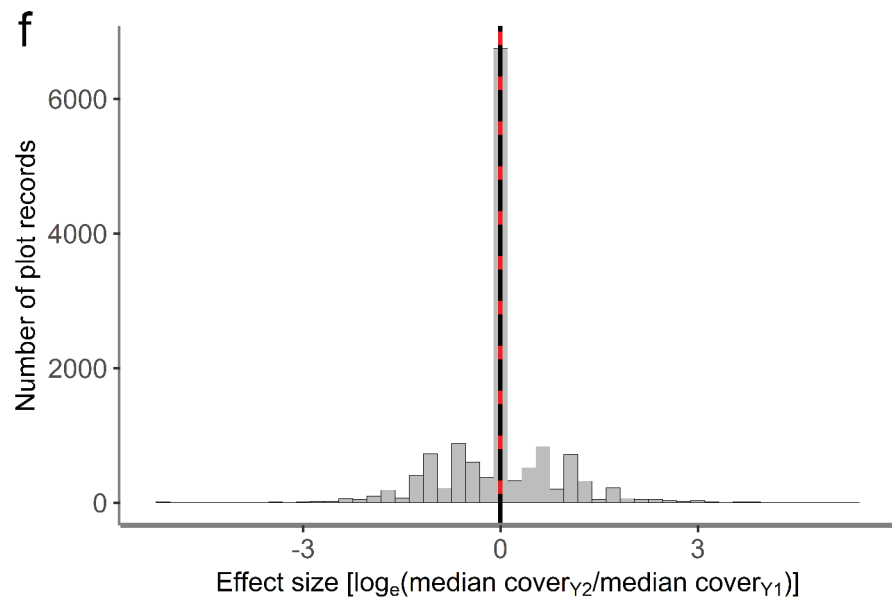
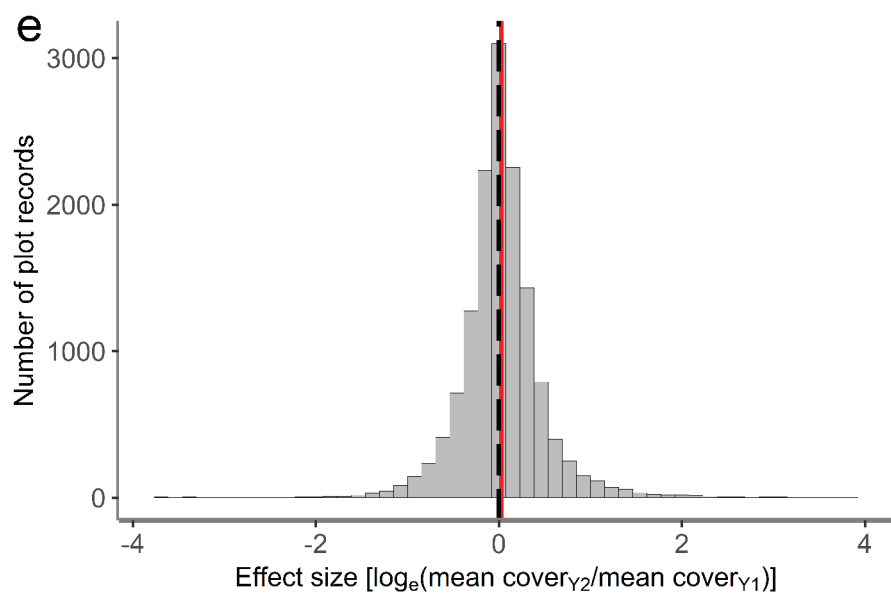
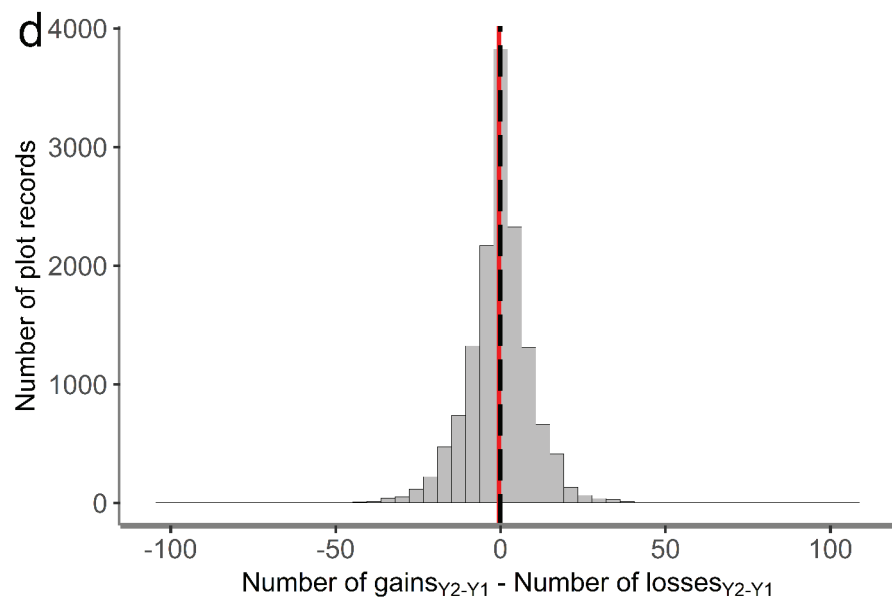
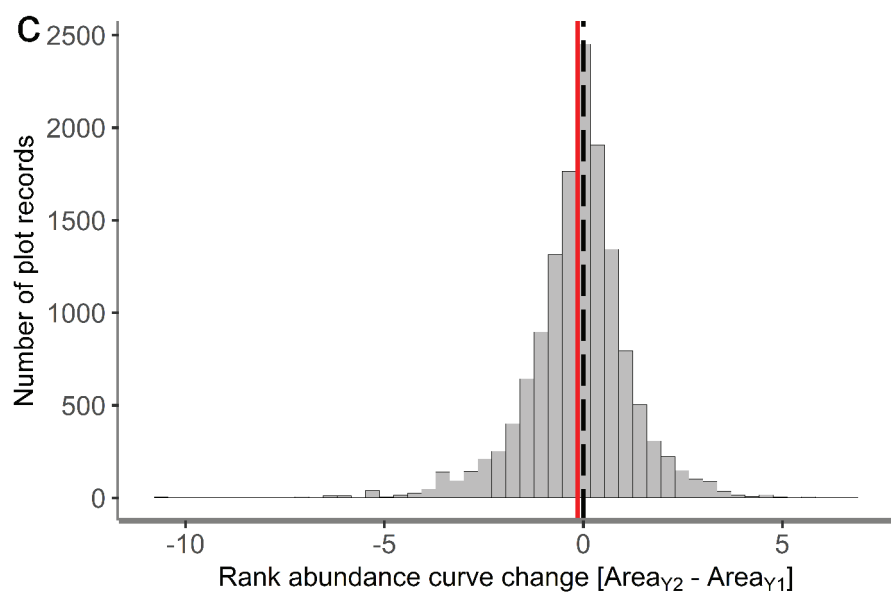
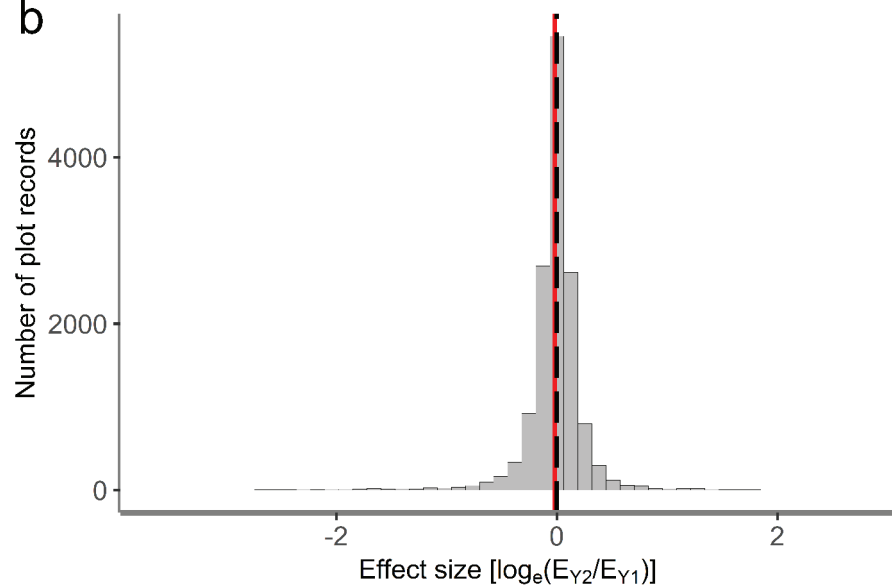
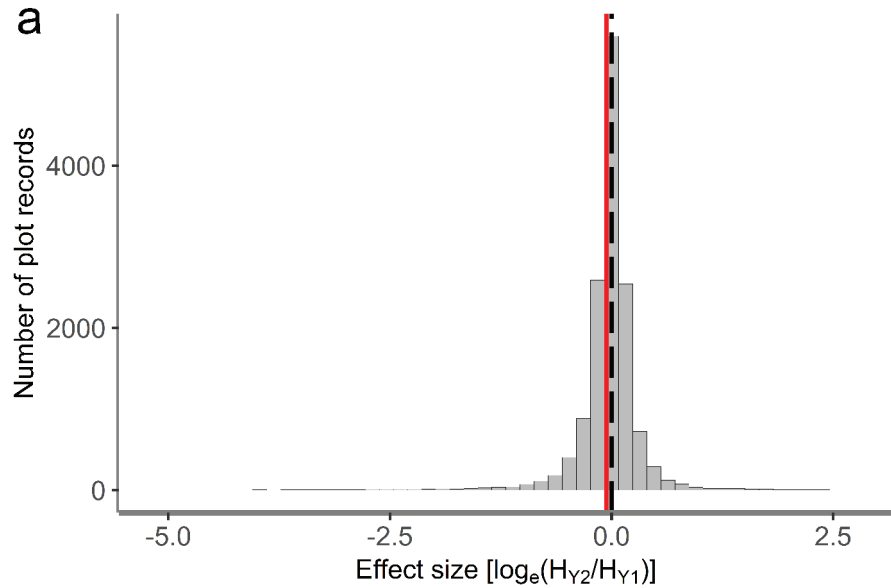
2

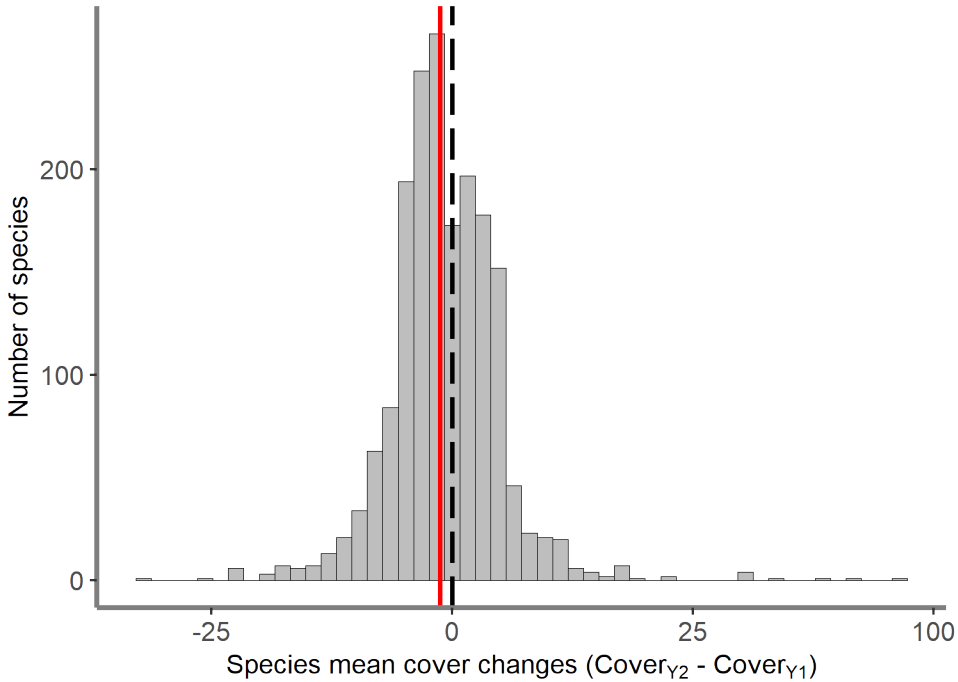
Effect size [ $\log_e(\text{SR}_{Y_2}/\text{SR}_{Y_1}) \text{ decade}^{-1}$ ]

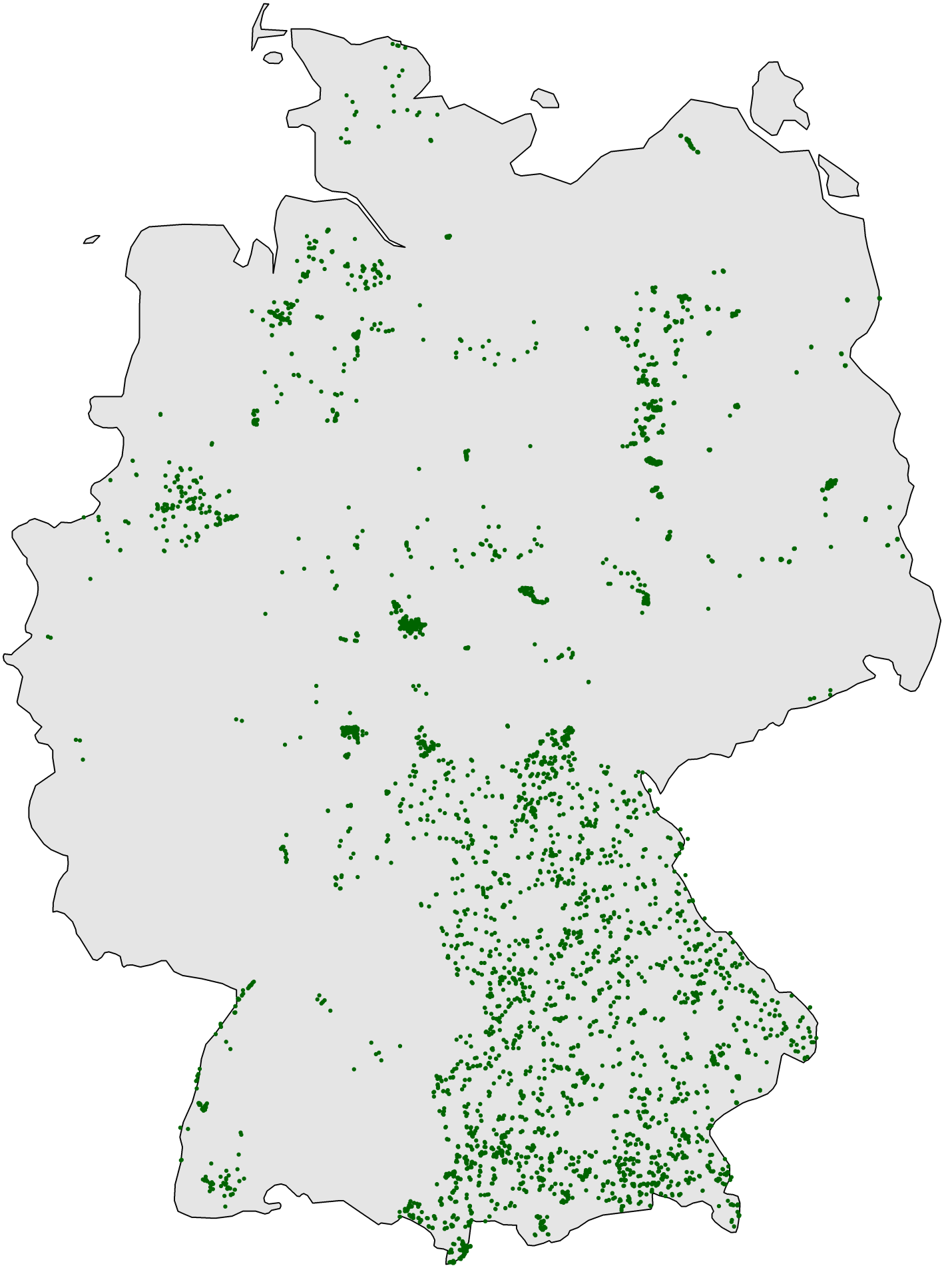












Number of records assigned

15000

10000

5000

0

?

+

A

C

H

N

Q

R

S

T

V

Level 1 EUNIS habitats

?

+

A

C

H

N

Q

R

S

T

V

C35a

H26a

Qa

R55

S42

T35

V38

R23

R35

R22

R21

R1M

R1P

R1A

R16

R

T18

T17

T13

T12

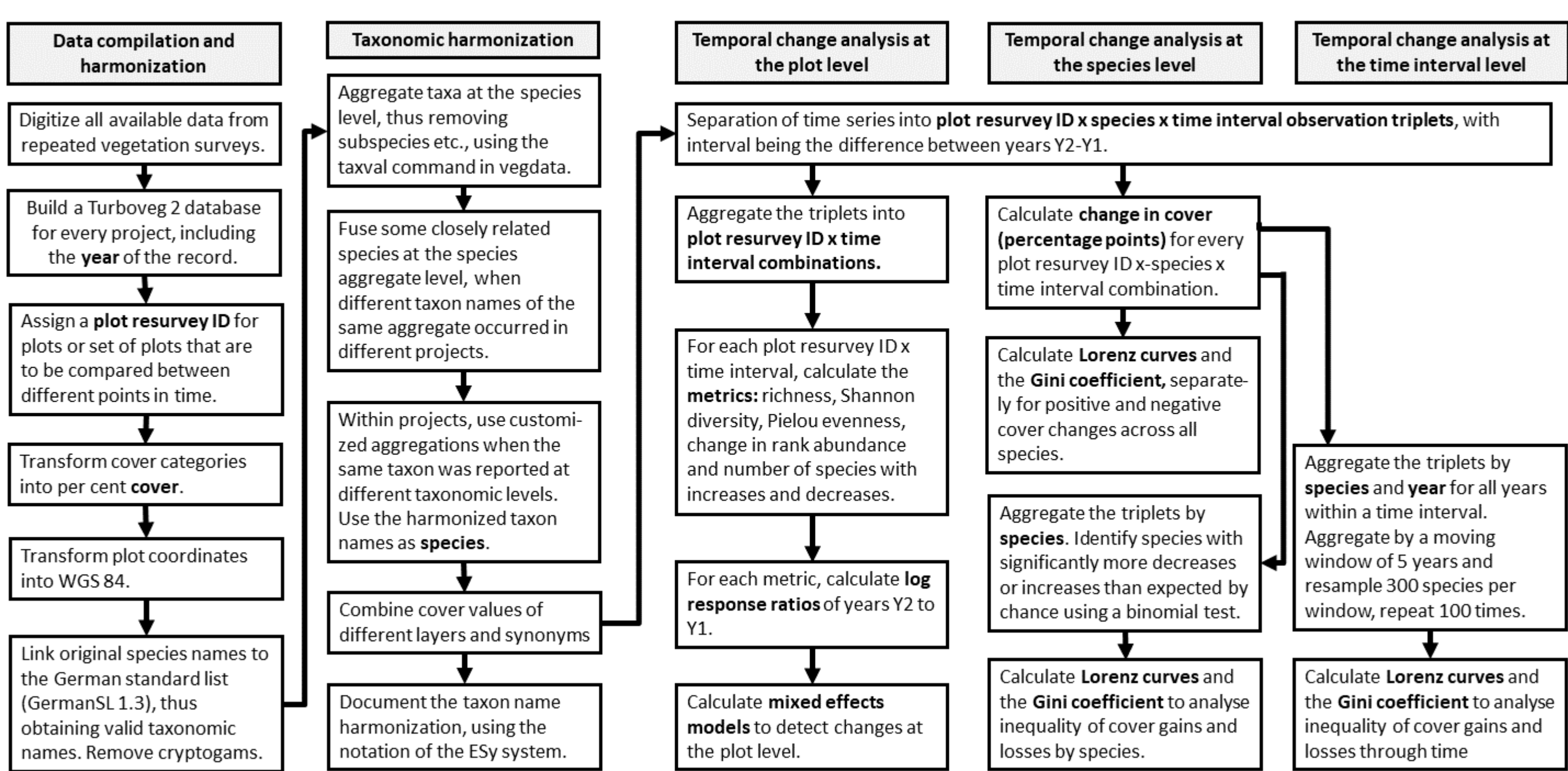
T1E

T1B

T

V15

V38



1 **Supplementary Tables**

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Jandt, U., Bruelheide, H., Jansen, J., Bonn, A., Grescho, V., Klenke, R., Sabatini, F.M.,  
Bernhardt-Römermann, M., Blüml, V., Dengler, J., Diekmann, M., Dörfler, I., Döring, U.,  
Dullinger, S., Haider, S., Heinken, T., Horchler, P., Kuhn, G., Lindner, M., Metzke, K., Müller, N.,  
Naaf, T., Pepler-Lisbach, C., Poschlod, P., Roscher, C., Rosenthal, G., Rumpf, S., Schmidt, W.,  
Schrautzer, W., Schwabe, A., Schwartz, P., Sperle, T., Stanik, N., Storm, C., Voigt, W.,  
Wegener, U., Wesche, K., Wittig, B., Wulf, M. (2022): Plant diversity change over one century  
in Germany: more losers than winners. – Nature

12  
13  
14  
15  
16  
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19  
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22  
23

Extended Data Table 1 | List of all projects included in this study. PROJECT\_ID: internal  
reference number. EUNIS habitat types of time series were assigned to the habitat type by  
using the earliest plot record that resulted in level 3 EUNIS classification. The classification  
was based on the EUNIS-ESy expert system<sup>56</sup> using the R code implementation<sup>57</sup>. When a  
project included several habitat types, they are shown in decreasing numbers of plot  
records. Code for habitat types are ? : plots not assigned to any level 3 EUNIS habitat type, +:  
assigned to more than one level 3 EUNIS habitat type, A: Marine habitats, C: Inland surface  
waters, H: Inland sparsely vegetated habitats or devoid of vegetation, N: Coastal habitats, Q:  
Wetlands, R: Grasslands and lands dominated by forbs, mosses or lichens, S: Heathlands,  
scrub and tundra, T: Forests and other wooded land, V: Vegetated man-made habitats,  
including arable land.

PROJECT_ID	Project Name	Reference	EUNIS habitat type
77	AFSV (2019)	Arbeitsgemeinschaft Forstliche Standorts- und Vegetationskunde (AFSV) (2019) Nordwest-Eifel - Standorte, Waldgesellschaften, Nutzungen gestern und heute. Exkursionsführer der AFSV-Tagung 2019 in der Nordwesteifel. Verlag Dr. Kessel, Remagen-Oberwinter.	T17
1	Ahrns & Hofmann (1998)	Ahrns, C. & Hofmann, G. (1998) Vegetationsdynamik und Florenwandel im ehemaligen mitteldeutschen Waldschutzgebiet "Hainich" im Intervall 1963 - 1995. Hercynia N.F. 31: 33-64.	T17
4	Berg & Mahn (1990)	Berg, C. & Mahn, E.-G. (1990) Anthropogene Vegetationsveränderungen der Strassenrandvegetation in den letzten 30Jahren-die Glatthaferwiesen des Raumes Halle Saale. Tuexenia 10: 185-195.	R22, R
2	Bernhardt-Römermann (2017)	(Echinger Lohe)	T1F, T1E, T13, T
3	Bernhardt-Römermann (2018)	(Sonneberg)	T35, T32, T1F, T18, T17, T, S42, R57, R, ?

5	Blüml (2011)	Blüml, V. (2011) Langfristige Veränderungen von Flora und Vegetation des Grünlandes in der Dümmerndiederung (Niedersachsen) unter dem Einfluss von Naturschutzmaßnahmen. Dissertation, Universität Bremen.	R55, R36, R35, R21, R, Qb, Q52, Q51
6	Bode (2005)	Bode, F. (2005) Subrecenter Vegetations- und Landschaftswandel im Südschwarzwald. Dissertation, Albert-Ludwigs-Universität Freiburg.	S42
92	Bohn & Schniotalle (2007)	Bohn, U. & Schniotalle, S. (2007) Hochmoor-, Grünland- und Waldrenaturierung im Naturschutzgebiet "Rotes Moor", Hohe Rhön 1981 - 2001: Ergebnisse 20-jähriger wissenschaftlicher Begleituntersuchungen im Rahmen und im Anschluss an ein E+E-Vorhaben des Bundes. Bundesamt für Naturschutz, Bonn.	T12, S92, R37, R35, R23!, R23, R1M, Qa, Q24, Q22, ?
78	Böhnert (1974)	Böhnert, W. (1978) Ökologische Untersuchungen auf den Kreidesandsteinhöhen der Harslebener Berge bei Quedlinburg. Naturschutz und naturkundliche Heimatforschung in den Bezirken Halle und Magdeburg 15 (2): 11-23	S42, R
7	Braun (2009)	Braun, W. (2009) Ein Niedermoor wächst über Hochmoortorf. Ber. d. Bayerischen Botanischen Gesellschaft 79: 127-146. München.	Qb, Qa, Q25, Q24, H26a
88	Bruehlheide & Luginbühl (2009)	Bruehlheide, H. & Luginbühl, U. (2009) Peeking at ecosystem stability: making use of a natural disturbance experiment to analyze resistance and resilience. Ecology 90 (5): 1314-1325.	T1F, T1E, T17, T, H25
17	Bruehlheide et al. (unpubl.)	(Bergwiesen)	R55, R37, R35, R23!, R22, R1M, R, Q24, ?
90	Bruehlheide et al. (unpubl.)	(Preuk)	T35, T1B, T, Sa
91	Bruehlheide et al. (unpubl.)	(Schiessplatz)	T35, R
8	Buck-Feucht (1986)	Buck-Feucht, G. (1986) Vergleich alter und neuer Vegetationsaufnahmen im Forstbezirk Kirchheim unter Teck. Mitteilungen des Vereins für forstliche Standortkunde und Forstpflanzenzüchtung (32): 43-49.	T1E, T18, T17, T13, T
76	Dierschke (2008)	Dierschke, H. (2008) Dynamik und Konstanz an naturnahen Flussufern -27 Jahre Dauerflächenuntersuchungen am Oderufer (Harzvorland). Braunschweiger Geobotanische Arbeiten 9: 119-138.	R55



10	Dittmann et al. (2015)	Dittmann, T., Heinken, T. & Schmidt, M. (2018) Die Wälder von Magdeburgerforth (Fläming, Sachsen-Anhalt) – eine Wiederholungsuntersuchung nach sechs Jahrzehnten. Tuexenia 38: 11-42.	T35, T1E, T1B, T18, T17, T15, T13, T12, T
11	Doerfler & Heinken (2013)	Vegetation change of wet and moist forests in NE German nature reserves	T3M, T3J, T35, T1E, T17, T16, T15, T13, T12, T, S92, Qb, Qa, Q53, +, ?
12	Döring (unpubl.)	Feuchtwälder in den Landkreisen Diepholz und Uelzen; Wiederholungsaufnahmen von PD Dr. Wilfried Hakes [NW-FVA] im Rahmen des Forschungsvorhabens "NaLaMa-nT" erhoben	T1E, T16, T15, T13, T12, T
62	Gerber & Müller (2012)	Gerber, L. & Müller, F. (2012) Flora und Vegetation den Naturschutzgebietes Am Galgenteich Altenberg. Berichte der Arbeitsgemeinschaft sächsischer Botaniker N.F. 21: 65-123.	S42, S32, R1M, R
13	Gerken & Böttcher (unpubl.)	Abschlußbericht, unpubl.	V38, R22, R1A, R, H26a, ?
15	Günther et al. (2021)	Günther, K., Schmidt, M., Quitt, H. & Heinken, T. (2021): Veränderungen der Waldvegetation im Elbe-Havelwinkel von 1960 bis 2015. Tuexenia 41: 53-85.	T3M, T35, T1B, T16, T15, T13, T12, T, S92, S42
16	Hagen (1996)	Hagen, T. (1996) Vegetationsveränderungen in Kalk-Magerrasen des Fränkischen Jura. Laufener Forschungsbericht 4. Bayerische Akademie f. Naturschutz u. Landschaftspflege, Laufen, Salzach. 218 S.	R1A, R16, R13
79	Heinken (2001)	Heinken, A. (2001) Vegetationsentwicklung von Auengrünland nach Wiederüberflutung. Diss. Math.-Nat. Fak. Humboldt-Universität Berlin. 161 S.	R36, R22, R21, R, Qb, Q52, Q51
43	Heinrich, Marstaller & Voigt (2012)	Eine Langzeitstudie zur Sukzession in Halbtrockenrasen - Strukturwandlung in einer Dauerbeobachtungsfläche im Naturschutzgebiet "Leutral und Cospoth" bei Jena (Thüringen). Artenschutzreport Jena 30: 1-80.	T36, T1H, T19, T17, T, Sa, S35, R51!, R22, R1A, R16, H26a, ?
68	Henning et al. (2017)	Henning, K.; Lorenz, A.; von Oheimb, G.; Härdtle, W.; Tischew, S. Year-round cattle and horse grazing supports the restoration of abandoned, dry sandy grassland and heathland communities by supressing Calamagrostis. Journal for Nature Conservation 40: 120-130.	V38, S42, R1P, R1A, N19, N15
54	von Heßberg (2003)	von Heßberg, A. (2003) Landschafts- und Vegetationsdynamik entlang renaturierter Flussabschnitte von Obermain und Rodach. Dissertation, Universität Bayreuth.	V15, T13, S91, R55, R21, H25

74	Horchler (unpubl.)	Horchler, P., Henrichfreise, A. Vollmer, I. (2013) Wiederholungsaufnahme von 54 Auenwald-Vegetationsaufnahmen am Oberrhein.	T1H, T1F, T1E, T13, T11, T, Sa, S35, R55, Q52, C23, ?
19	Hüllbusch et al. (2016)	Hüllbusch, E., Brandt, L.M., Ende, P. & Dengler, J. (2016) Little vegetation change during two decades in a dry grassland complex in the Biosphere Reserve Schorfheide-Chorin (NE Germany). <i>Tuexenia</i> 36: 395-412.	R22, R1P, R1B, R1A, R, N15!!
20	Hundt (2001)	Hundt, R. (2001) Ökologisch-geobotanische Untersuchungen an den mitteldeutschen Wiesengesellschaften unter besonderer Berücksichtigung ihres Wasserhaushaltes und ihrer Veränderung durch die Intensivbewirtschaftung. <i>Mitteilungen aus dem Biosphärenreservat Rhön/Thüringen</i> . 3. Monographie. 366 S.	V37, R55, R37, R36, R35, R23!, R22, R1M, R1A, R, Q53, Q43, +
48	Huwer & Wittig (2012)	unpublished data for: Huwer, A. & Wittig, R. (2012) Changes in the species composition of hedgerows. <i>Tuexenia</i> 32: 31-53. Göttingen.	T1E, T1B, T13, T12, T11, T, Sa, S37, ?
21	Immoor et al. (2017)	Immoor, A., Zacharias, D., Müller, J. & Diekmann, M. (2017) A re-visitation study (1948–2015) of wet grassland vegetation in the Stedinger Land near Bremen, North-western Germany. <i>Tuexenia</i> 37: 271-288.	R36, R35, R21, R, Qb
23	Jandt & Leonhardt (unpubl.)	(Kyffhäuser)	S42, R1B!, R1B, R1A, R16, R13
22	Janiesch (2003)	Janiesch, P. (2003) Vegetationsökologische Untersuchungen in einem Erlenbruchwald im nördlichen Münsterland - 25 Jahre im Vergleich. <i>Abhandlungen aus dem Westfälischen Museum für Naturkunde: Vegetation und Fauna in Westfalen</i> (ed Westfälisches Museum für Naturkunde), pp. 71-80, Münster.	T15, T13
70	Knapp (1969)	Knapp, R. (1969) Änderungen in der Vegetation Hessischer Gebirge in den letzten Jahrzehnten. <i>Mitteilungen der Floristisch-Soziologischen Arbeitsgemeinschaft N.F.</i> 14: 274-286	R35, R22, R1M, R
71	Knapp (1977)	Knapp, R. (1977) Dauerflächen-Untersuchungen über die Einwirkung von Haustieren und Wild während trockener und feuchter Zeiten in Mesobromion- Halbtrockenrasen in Hessen. <i>Mitteilungen der Floristisch-Soziologischen Arbeitsgemeinschaft N.F.</i> 19: 269-274	R1A
87	Koch & Jurasinski (2015)	Koch, M. & Jurasinski, G. (2015) Four decades of vegetation development in a percolation mire complex following intensive drainage and abandonment. <i>Plant Ecology &amp; Diversity</i> 8: 49-60	T16, T12, T, R55, R35, Qb, Qa, Q53, Q52, Q51, Q43, Q42, Q41, Q24, C35a, ?

59	Kohlbrecher et al. (2012)	unpublished data for: Kohlbrecher, C., Wesche, K., Hilbig, W., Leuschner, C., Meyer, S. (2012) Veränderungen der Segetalvegetation am Kyffhäusergebirge in den letzten 50 Jahren. Landschaftspflege und Naturschutz in Thüringen 49: 1-9.	V15
24	Krause & Wesche (2011)	unpublished data for: Krause, B., Culmsee, H., Wesche, K., Bergmeier, E. & Leuschner, C. (2011) Habitat loss of floodplain meadows in north Germany since the 1950s. Biodiversity and Conservation 20 (11): 2347-2364.	R22, R21, R1P, R, C35a, A25c
84	Krickl & Poschlod (unpubl.)	(calcareous grasslands SW-Germany)	R1A, R16, H26a
65	Kudernatsch (2005)	Kudernatsch, T. (2005) Auswirkungen der globalen Erwärmung auf die Vegetation alpiner Kalk-Magerrasen im Nationalpark Berchtesgaden. Dissertation TU München, Department für Ökologie, Fachgebiet Geobotanik Weihenstephan. 151 S.	S22, R44, R43!, R
25	Kühn & Heinken (2017)	unpublished data for: Kühn, S.L., Heinken, T. (2017): Vegetationsveränderungen im NSG Bredower Forst im Verlauf von 50 Jahren – Analyse anhand historischer Vegetationsaufnahmen. Natursch. Landschaftspfl. Brandenbg. 26(4): 4-16.	T35, T1E, T1B, T18, T17, T, ?
14	Kuhn et al. (2011)	unpublished data for: Kuhn, G.; Heinz, S.; Meyer, F. (2011) Grünlandmonitoring Bayern, Ersterhebung der Vegetation 2002 - 2008. LfL Schriftenreihe Bayerische Landesanstalt für Landwirtschaft 3.	V38, V37, V15, V, S22, R55, R44, R37, R36, R35, R23!, R23, R22, R21, R1M, R1A, R16, R, Qb, Q53, Q52, Q51, Q43, Q41, C35d, ?
26	Kutzelnigg (1984)	Kutzelnigg, H. (1984) Veränderungen der Ackerwildkrautflora im Gebiet um Moers/Niederrhein seit 1950 und ihre Ursachen. Tuexenia (4): 81-102.	V37, V15
58	Lindner (unpubl.)	(Hechtmoor)	T1B, T16, T, Sb, S92, S41, R, Qb, Qa, Q51, Q42, Q25, Q24, Q21, ?
60	Lindner (unpubl.)	(Süderbrarup)	R55, R52, R22, R1M, R
27	Maier (2005)	Maier, M. (2005) Untersuchung zur Entwicklung von Flora und Fauna in einem Feuchtwiesenschutzgebiet (Naturschutzgebiet Bornhorster Huntewiesen). Diplomarbeit Landschaftsökologie an der Carl von Ossietzky Universität Oldenburg.	R36, R35, Qb, Q53, Q51
28	Matesanz (2009)	Matesanz, S., Brooker, R.W., Valladares, F. & Klotz, S. (2009) Temporal dynamics of marginal steppic vegetation	R16

		over a 26-year period of substantial environmental change. <i>Journal of Vegetation Science</i> 20 (2): 299-310.	
55	Meineke & Menge (2010)	Meineke, T. & Menge, K. (2010) Wirkungskontrolle zum PROFIL Kooperationsprogramm Naturschutz, Teilbereich Besondere Biotoptypen im FFH-Gebiet Bergwiesen und Wolfsbachtal bei Hohegeiß. Im Auftrag des Niedersächsischen Landesbetriebs für Wasserwirtschaft Küsten- und Naturschutz, Hannover.	R23!, R21, R
63	Müller & Zöphel (2012)	Müller, F. & Zöphel, B. (2012) Bestandssituation, Biologie und Ökologie von <i>Gentianella lutescens</i> im Osterzgebirge. <i>Berichte der Arbeitsgemeinschaft sächsischer Botaniker N.F.</i> 21: 139-184	R23!
29	Müller (2002)	Müller, N. (2002) Auswertung der Langzeituntersuchungen von Dauerflächen im Augsburgener Stadtgebiet zur Renaturierung von Lechhaiden. <i>Ber. Bayer. Landesamt Umweltschutz (Hrsg.):</i> 97 S.	V38, V, R55, R37, R22, R1A, R16, N15, H26a
30	Naaf & Kolk (2016)	unpublished data for: Naaf, T. & Kolk, J. (2016) Initial site conditions and interactions between multiple drivers determine herb-layer changes over five decades in temperate forests. <i>For Ecol Manag</i> 366: 153-165.	T1H, T1E, T1B, T18, T17, T15, T13, T12, T, Q51, ?
31	Naaf & Wulf (2010)	Naaf, T. & Wulf, M. (2010) unpublished data for: Habitat specialists and generalists drive homogenization and differentiation of temperate forest plant communities at the regional scale. <i>Biol Conserv</i> 143: 848-855.	T1F, T1E, T17, T13, T12, T, Sa
32	Peppler-Lisbach & Könitz (2017)	Peppler-Lisbach, C. & Könitz, N. (2017): Vegetationsveränderungen in Borstgrasrasen des Werra-Meißner-Gebietes (Hessen, Niedersachsen) nach 25 Jahren – <i>Tuexenia</i> 37: 201-228.	S42, R37, R22, R21, R1M, R
44	Peppler-Lisbach et al. (2020)	Peppler-Lisbach, C, Stanik, N, Könitz, N, Rosenthal, G. (2020) Long-term vegetation changes in <i>Nardus</i> grasslands indicate eutrophication, recovery from acidification, and management change as the main drivers. <i>Applied Vegetation Science</i> 23: 508-521. <a href="https://doi.org/10.1111/avsc.12513">https://doi.org/10.1111/avsc.12513</a>	Sb, Sa, S42, R37, R35, R23!, R23, R22, R1M, R
83	Poschlod et al. (2009)	unpublished data for: Poschlod, P., Schreiber, K.-F., Mitlacher, K., Römermann, C. & Bernhardt-Römermann, M. (2009): Entwicklung der Vegetation und ihre naturschutzfachliche Bewertung. In: Schreiber, K.-F., Brauckmann, H.-J., Broll, G., Krebs, S. & Poschlod, P. (Hrsg.): <i>Landschaftspflege und Naturschutz im Extensivgrünland. 30 Jahre Offenhaltungsversuche Baden-Württemberg. – Naturschutz-Spectrum Themen</i> 97: 243-288.	T1E, R22, R21, R1M, R1A, N19

85	Poschlod et al. (2010)	unpublished data for: Poschlod, P., Kos, M., Roauer, S., Seemann, A., Wiesmann, O., Zeltner, G., Kohler, A. (2006) Long-term monitoring in rivers of south Germany since the 1970ies - macrophytes as indicators for the assessment of water quality. In: Müller, F., Baessler, C., Schubert, H. & Klotz, S. (Eds.): Long-term ecological research. Between Theory and Application. Berlin: Springer, pp. 189-199.	Qb, Q52, Q51, C23, C22b, ?
64	Rach (2000)	Rach, C. (2000) Charakterisierung von Renaturierungsprozessen in Bruchwäldern - Ökologische Untersuchungen in zwei Landschaftsräumen Nordwestdeutschlands. Dissertation Fachbereich Biologie, Geo- und Umweltwissenschaften Universität Oldenburg. 201 S.	T15, T12, T
36	Raehse (2001)	Raehse, S. (2001) Veränderungen der hessischen Grünlandvegetation seit Beginn der 50er Jahre am Beispiel ausgewählter Tal- und Bergregionen Nord- und Mittelhessens. Kassel, University Press GmbH. 222 S.	V15, S42, R55, R37, R36, R35, R22, R21, R1M, R1A, R, Qb, Q53, Q51, N19
37	Reinecke et al. (unpubl.)	unpublished data for: Reinecke, J., Klemm, G., Heinken, T. (2014): Vegetation change and homogenization of species composition in temperate nutrient-deficient Scots pine forests after 45 yr. J. Veg. Sci. 25: 113-121.	T35, T1B, T, S42, R54, ?
80	Roeder et al. (1996)	Röder, H., Fischer, A., Klöck, W. (1996) Waldentwicklung auf Quasi-Dauerflächen im Luzulo-Fagetum der Buntsandsteinrhön (Forstamt Mittelsinn) zwischen 1950 und 1990. Forstw. CB1. 115, 321-335	T35, T1H, T18, T, S42, R, ?
86	Roscher (unpubl.)	(East Thuringia)	R51!, R22, R1A, R16, R
38	Rosenthal (1992)	Rosenthal, G. (1992) Erhaltung und Regeneration von Feuchtwiesen. Vegetationsökologische Untersuchungen auf Dauerflächen. Diss. Bot. 182: 1-283. Berlin, Stuttgart.	V15, R55, R36, R35, R, Q51
67	Rumpf et al. (2018)	unpublished data for: Rumpf, S.; Dullinger, S. (2018) Range dynamics of mountain plants decrease with elevation. PNAS 115(8):1848-1853.	Sb, S42, S22, R56, R55, R44, R43, R41, R23!, R21, R, H32c, H26b, H24, H23
39	Scheidel & Bruelheide (2004)	Scheidel, U. & Bruelheide, H. (2004) Versuche zur Beweidung von Bergwiesen im Harz. Hercynia N.F. 37: 87-101	S32, R35, R, ?
33	Schmidt et al.	Garbitz, D. (1990): Vegetation und Standortsbedingungen im Naturwald "Staufenberg". Dipl.-Arb. Syst.-Geobot. Institut, Universität Göttingen.  Melcher, S. (1999): Flora und Vegetation im Naturwald "Großer Staufenberg" (Forstamt Walkenried, Revier	T3M, T35, T1F, T1E, T18, T17, T, Sa, +, ?

		<p>Staufenberg). Dipl.-Arb. Institut f. Waldbau, Abt. I, Universität Göttingen.</p> <p>Mölder, A., Streit, M., Schmidt, W. (2014): When beech strikes back: How strict nature conservation reduces herb-layer diversity and productivity in Central European deciduous forests. <i>Forest Ecology and Management</i> 319: 51-61.</p> <p>Kohls, K. (1994): Geobotanische Untersuchungen in Wäldern des Forstamtes Sellhorn (Lüneburger Heide). Dipl.-Arb. Syst.-Geobot. Institut, Universität Göttingen.</p> <p>Albrecht, B. (2000): Vegetationskundliche Untersuchungen im Naturwaldreservat "Meninger Holz" unter besonderer Berücksichtigung der Vegetationsentwicklung. Dipl.-Arb. FG Naturschutz, FB Biologie, Universität Hamburg.</p> <p>Happe, E. (1995): Vegetation und Standortverhältnisse im Naturwald und Naturschutzgebiet "Totenberg" (Bramwald).Dipl.-Arb. Institut f. Waldbau, Abt. I, Universität Göttingen.</p> <p>Fischer, C., Parth, A., Schmidt, W. (2009): Vegetationsdynamik in Buchen-Naturwäldern. Ein Vergleich aus Süd-Niedersachsen. <i>Hercynia</i> 42: 45-68.</p>	
34	Schmidt et al.	<p>Kompa T., Schmidt, W. (2005): Buchenwald-Sukzession nach Windwurf auf Zechstein-Standorten des südwestlichen Harzvorlandes. <i>Hercynia N.F.</i> 38: 233-261.</p> <p>Schmidt, W. (2002): Die Naturschutzgebiete Hainholz und Staufenberg am Harzrand – Sukzessionsforschung in Buchenwäldern ohne Bewirtschaftung. <i>Tuexenia</i> 22: 151-213.</p> <p>Schmidt, W., Heinrichs, S. (2012) 13 Jahre nach dem Sturm - Vegetationsentwicklung im Buchen-Naturwald "Königsbuche" (südwestliches Harzvorland, Niedersachsen). <i>Hercynia</i> 45: 81-110.</p>	V39, T1F, T1E, T18, T17, T13, T12, T, Sa, S32, R57, R55, R, ?
73	Schrautzer (unpubl.)	Resurvey Eidertal	R55, R35, Q53, Q52
72	Schrautzer et al. (unpubl.)	Resurvey of Härdtle - Beckmann	T17, T13, T12, T
40	Schubert (2008)	Schubert, R. (2008) Vegetationsdynamik in einigen Naturschutzgebieten Sachsen-Anhalts. <i>Mitteilungen florist. Kart. Sachsen-Anhalt (Halle 2008)</i> 13: 53-75.	V38, T, S42, S38, R55, R35, R22, R1A, R, Q51, ?
42	Schwabe & Kratochwil (2015)	Schwabe, A, & Kratochwil, A. (2015) Pflanzensoziologische Dauerflächen-Untersuchungen im Bannwald "Flüh" (Südschwarzwald) unter besonderer	T18, T, S42, R52

		Berücksichtigung der Weidfeld-Sukzession. standort.wald 49: 5-49	
41	Schwabe et al. (1989)	Schwabe, A., Kratochwil, A. & Bammert, J. (1989) Sukzessionsprozesse im aufgelassenen Weidfeld-Gebiet des "Bannwald Flüh" (Südschwarzwald) 1976-1988 - Mit einer vergleichenden Betrachtung statistischer Auswertungsmethoden. Tuexenia 9: 351-370. Göttingen.	S42, R52, R1M, R, ?
89	Schwabe et al. (2004)	(Grundaufnahmen) unpublished data for: Schwabe, A.; Zehm, A., Nobis, M., Storm, C., Suess, K. (2004) Auswirkungen von Schaf-Erstbeweidung auf die Vegetation primär basenreicher Sand-Ökosysteme. Ber. NNA 1:/2004: 39-54.	V38, V37, V34, V, R1P, R1B, R1A, R13, R, N15!!
57	Schwabe et al. (2013)	unpublished data for Schwabe, A., Suess, K., Storm, C. (2013) What are the long-term effects of livestock grazing in steppic sandy grassland with high conservation value? Results from a 12-year field study. Tuexenia 33: 189-212. Göttingen.	V38, R1P, R1B, R1A, R16, R13, R11, R
69	Schwartz et al. 2021	Schwartz, P., Birkner, L., Velbert, F. & Hölzel, N. (2021) Vielfalt durch extensive Grünlandnutzung. – 30 Jahre Dauermonitoring auf unterschiedlich bewirtschafteten Feuchtgrünlandflächen. Natur in NRW, 1/2021, 16-21. Paderborn. part of unpublished data for: Poptcheva, K., Schwartz, P., Vogel, A., Kleinebecker, T. & Hölzel, N. (2009) Changes in wet meadow vegetation after 20 years of different management in a field experiment (North-West Germany). Agriculture, Ecosystems & Environment, 134 (1-2), 108–114.	R55, R37, R36, R35, R21, R, Q53
61	Sommer & Hachmöller (2001)	Sommer, S. & Hachmöller, B. (2001) Auswertung der Vegetationsaufnahmen von Dauerbeobachtungsflächen auf Bergwiesen im NSG Oelsen bei variierter Mahd im Vergleich zur Brache. Berichte der Arbeitsgemeinschaft sächsischer Botaniker N.F. 18: 99-135	R23!
9	Sperle (unpubl.)		V39, V11, T3K, T12, Sb, S42, S38, R56, R55, R37, R35, R22, R1A, R, Qb, Qa, Q51, Q42, Q41, Q25, Q24, ?
45	Stroh (2013)	Stroh, H.-G. (2013) Wiederholung der vegetationskundlichen Erfassungen an den Dauerbeobachtungsflächen der Kalkmagerrasen des Altendorfer Berges. Bericht für das Jahr 2012. Im Auftrag des Niedersächsischen Landesbetriebs für Wasserwirtschaft Küsten- und Naturschutz, Hannover.	R1A, ?
46	Stroh (2013)	Stroh, H.-G. (2013) Wiederholung der vegetationskundlichen Erfassungen an den	Sa, R1A, ?

		Dauerbeobachtungsflächen der Kalkmagerrasen der Weper und des Gladebergs. Zwischenbericht für das Jahr 2012. Im Auftrag des Niedersächsischen Landesbetriebs für Wasserwirtschaft Küsten- und Naturschutz, Hannover.	
47	Strubelt & Zacharias (2015)	Strubelt, I., Diekmann, M. & Zacharias, D. (2015) Langzeitmonitoring der Vegetation über 52 Jahre im Hartholzauenwald ( <i>Quercus-Ulmetum minoris</i> Issler 1924) im Haseder Busch (Landkreis Hildesheim). Braunschweiger Geobotanische Arbeiten 11: 173-247	T3M, T1F, T1E, T17, T13, T
66	Strubelt et al. (2019)	Strubelt, I., Diekmann, M., Pepler-Lisbach, C., Gerken, A. & Zacharias, D. (2019) Vegetation changes in the Hasbruch forest nature reserve (NW Germany) depend on management and habitat type. <i>Forest Ecology and Management</i> , 444, 78–88.	T1E, T1B, T18, T17, T13, T
56	Volz (2001)	Volz, H. (2001) Vegetationskundliches Monitoring im NSG Lange Rhön Gebiet Leitgraben. Bearbeitungszeitraum 2001. Gutachten Umweltplanung Volz, Giessen, 62 S.	R57, R35
35	von Oheimb et al. (2006)	v. Oheimb, G., Eiseid, I., Finck, P., Grell, H., Härdtle, W., Mierwald, U., Riecken, U., Sandkühler, J. (2006) Halboffene Weidelandschaft Höltingbaum. Perspektiven für den Erhalt und die naturverträgliche Nutzung von Offenlandlebensräumen. <i>Naturschutz und Biologische Vielfalt</i> 36: 1-280. Landwirtschaftsverlag Münster.	V39, T13, T, R55, R52, R36, R35, R22, R21, R1P, R1M, R, Qb, Q53, Q52, N15, C35a, ?
50	Wagner & Heinken (unpubl.)		T3M, T35, T1H, T1E, T1B, T18, T13, T, S42, R, ?
51	Wagner & Heinken (unpubl.)		T35, T1F, T1E, T1B, T18, T17, T13, T12, T, R55, R51, R1M, R, ?
49	Walther (1986)	Walther, K. (1986) Die Vegetation des Maujahn 1984. Wiederholung der vegetationskundlichen Untersuchung eines wendländischen Moores. <i>Tuexenia</i> 6: 145-193. Göttingen.	T1B, R37, R35, R1P, Q51
52	Wegener (2018)	Wegener, U. (2018) Vegetationswandel des Berggrünlands nach Untersuchungen von 1954 bis 2016. Wege zur Erhaltung der Bergwiesen. <i>Abh. und Ber. aus dem Museum Heineanum</i> 11: 35-101.	R23
53	Wilmanns & Bogenrieder (1988)	Wilmanns, O. & Bogenrieder, A. (1986) Veränderungen der Buchenwälder des Kaiserstuhls im Laufe von vier Jahrzehnten und ihre Interpretation - pflanzensoziologische Tabellen als Dokumente. <i>Abhandlungen aus dem westfälischen Museum für Naturkunde</i> 48(2): 55-80	T18, T, ?



81	Winter (unpubl.)	Winter, R. (2016) Flora und Vegetationsentwicklung der Sukzessionsfläche "Wildnis am Bunker Valentin" in der Bremer Weseraue bei Farge. Bachelorthesis Hochschule Bremen, Studiengang Technische und angewandte Biologie, 61 S.	T, S42, Q51
18	Wittig et al. (2007)	unpublished data for: Wittig, B., Waldmann, T., Diekmann, M. (2007) Veränderungen der Grünlandvegetation im Holtumer Moor über vier Jahrzehnte. <i>Hercynia N.F.</i> 40: 285-300.	V38, V37, V15, V11, V, T16, T15, T13, T12, S92, S41, R55, R52, R37, R36, R35, R22, R21, R, Qa, Q53, Q51, Q22
75	Wittig et al. (2019)	Wittig, B., Müller, J., Mahnke-Ritoff, A. (2019) Talauen-Glatthaferwiesen im Verdener Wesertal (Niedersachsen). <i>Tuexenia</i> 39: 249-265. Göttingen	R22
82	Wittig et al. (2020)	Wittig, B., Müller, J., Quast, R., Miehlich, H. (2020) <i>Arnica montana</i> in Calluna-Heiden auf dem Schießplatz Unterlüß (Niedersachsen). <i>Tuexenia</i> 40: 131-146. Göttingen.	S42, R1M

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26 Extended Data Table 2 | List of all taxa that were harmonized across all projects. The format  
 27 of the list follows the rules of the ESy system<sup>56</sup>. The taxon names that were aggregated  
 28 below a broader concept name are indented using five blanks. The number to the right  
 29 shows the German SL 1.3<sup>58</sup> number for each taxon.

30	<i>Achillea atrata</i> agg.	18
31	<i>Achillea atrata</i>	19
32	<i>Achillea atrata</i> agg.	18
33	<i>Achillea millefolium</i> agg.	27
34	<i>Achillea millefolium</i>	31
35	<i>Achillea millefolium</i> agg.	27
36	<i>Achillea millefolium</i> subsp. <i>collina</i>	20096
37	<i>Achillea millefolium</i> subsp. <i>millefolium</i>	32
38	<i>Achillea pannonica</i>	34
39	<i>Achillea setacea</i>	36
40	<i>Acinos arvensis</i>	49
41	<i>Acinos arvensis</i>	49
42	<i>Calamintha acinos</i>	976
43	<i>Satureja acinos</i>	23760
44	<i>Aconitum lycoctonum</i>	14242
45	<i>Aconitum lycoctonum</i>	14242
46	<i>Aconitum lycoctonum</i> subsp. <i>vulparia</i>	20209
47	<i>Aconitum vulparia</i>	68
48	<i>Adonis aestivalis</i>	76
49	<i>Adonis aestivalis</i>	76
50	<i>Adonis aestivalis</i> var. <i>citrinus</i>	27247
51	<i>Agrimonia eupatoria</i>	99
52	<i>Agrimonia eupatoria</i>	99
53	<i>Agrimonia eupatoria</i> subsp. <i>eupatoria</i>	100
54	<i>Agrostis canina</i> agg.	120
55	<i>Agrostis canina</i>	121
56	<i>Agrostis coarctata</i>	20180
57	<i>Agrostis stricta</i>	122
58	<i>Agrostis vinealis</i>	20684
59	<i>Agrostis capillaris</i>	20178
60	<i>Agrostis capillaris</i>	20178
61	<i>Agrostis capillaris</i> subsp. <i>oreophila</i>	7086
62	<i>Agrostis tenuis</i>	130
63	<i>Agrostis vulgaris</i>	20179
64	<i>Agrostis stolonifera</i> agg.	127
65	<i>Agrostis alba</i> var. <i>stolonifera</i>	27181
66	<i>Agrostis gigantea</i>	128
67	<i>Agrostis stolonifera</i>	129
68	<i>Agrostis stolonifera</i> agg.	127
69	<i>Agrostis stolonifera</i> subsp. <i>stolonifera</i>	6550
70	<i>Aira caryophyllea</i>	26920
71	<i>Aira caryophyllea</i>	26920
72	<i>Aira caryophyllea</i> subsp. <i>caryophyllea</i>	20218
73	<i>Alchemilla conjuncta</i> agg.	154
74	<i>Alchemilla conjuncta</i> agg.	154
75	<i>Alchemilla hoppeana</i>	166
76	<i>Alchemilla nitida</i>	10027
77	<i>Alchemilla fissa</i> agg.	177
78	<i>Alchemilla fallax</i>	179
79	<i>Alchemilla fissa</i>	180
80	<i>Alchemilla fissa</i> agg.	177
81	<i>Alchemilla hybrida</i> agg.	190
82	<i>Alchemilla flabellata</i>	194
83	<i>Alchemilla glaucescens</i>	195
84	<i>Alchemilla hybrida</i> agg.	190
85	<i>Alchemilla mollis</i>	200

86	<i>Alchemilla acutiloba</i> var. <i>mollis</i>	20237
87	<i>Alchemilla vulgaris</i> agg.	209
88	<i>Alchemilla acutiloba</i> var. <i>stellata</i>	11694
89	<i>Alchemilla crinita</i>	219
90	<i>Alchemilla glabra</i>	235
91	<i>Alchemilla micans</i>	20278
92	<i>Alchemilla monticola</i>	245
93	<i>Alchemilla subcrenata</i>	265
94	<i>Alchemilla vulgaris</i>	26467
95	<i>Alchemilla vulgaris</i> agg.	209
96	<i>Alchemilla vulgaris</i> auct.	20289
97	<i>Alchemilla xanthochlora</i>	273
98	<i>Alisma plantago-aquatica</i> agg.	275
99	<i>Alisma gramineum</i>	276
100	<i>Alisma lanceolatum</i>	277
101	<i>Alisma plantago-aquatica</i>	278
102	<i>Alisma plantago-aquatica</i> agg.	275
103	<i>Allium scorodoprasum</i>	12756
104	<i>Allium rotundum</i>	310
105	<i>Allium scorodoprasum</i>	12756
106	<i>Allium scorodoprasum</i> subsp. <i>rotundum</i>	20326
107	<i>Allium senescens</i>	6583
108	<i>Allium montanum</i>	294
109	<i>Allium senescens</i>	6583
110	<i>Allium senescens</i> subsp. <i>montanum</i>	20321
111	<i>Allium senescens</i> var. <i>montanum</i>	12712
112	<i>Alopecurus pratensis</i> agg.	334
113	<i>Alopecurus pratensis</i>	336
114	<i>Alopecurus pratensis</i> agg.	334
115	<i>Alyssum alyssoides</i>	345
116	<i>Alyssum alyssoides</i>	345
117	<i>Alyssum calycinum</i>	20351
118	<i>Alyssum montanum</i>	350
119	<i>Alyssum montanum</i>	350
120	<i>Alyssum montanum</i> subsp. <i>gmelinii</i>	26457
121	<i>Alyssum montanum</i> subsp. <i>montanum</i>	26456
122	<i>Anagallis arvensis</i>	393
123	<i>Anagallis arvensis</i>	393
124	<i>Anagallis arvensis</i> subsp. <i>arvensis</i>	394
125	<i>Anemone narcissiflora</i>	434
126	<i>Anemonastrum narcissiflorum</i>	20423
127	<i>Anemone narcissiflora</i>	434
128	<i>Anthoxanthum aristatum</i>	20071
129	<i>Anthoxanthum aristatum</i>	20071
130	<i>Anthoxanthum puelii</i>	466
131	<i>Anthoxanthum odoratum</i> agg.	463
132	<i>Anthoxanthum alpinum</i>	464
133	<i>Anthoxanthum odoratum</i>	465
134	<i>Anthoxanthum odoratum</i> agg.	463
135	<i>Anthriscus sylvestris</i> agg.	469
136	<i>Anthriscus sylvestris</i>	473
137	<i>Anthriscus sylvestris</i> agg.	469
138	<i>Anthriscus sylvestris</i> subsp. <i>alpestris</i>	20460
139	<i>Anthriscus sylvestris</i> subsp. <i>sylvestris</i>	20463
140	<i>Anthyllis vulneraria</i>	477
141	<i>Anthyllis vulneraria</i>	477
142	<i>Anthyllis vulneraria</i> subsp. <i>carpatica</i>	479
143	<i>Anthyllis vulneraria</i> subsp. <i>pseudovulneraria</i>	14783
144	<i>Aphanes inexpectata</i>	494
145	<i>Aphanes inexpectata</i>	494
146	<i>Aphanes microcarpa</i>	6554
147	<i>Aquilegia vulgaris</i> agg.	507
148	<i>Aquilegia atrata</i>	508

149	<i>Aquilegia vulgaris</i>	510
150	<i>Arabis bellidifolia</i>	20511
151	<i>Arabis bellidifolia</i> subsp. <i>bellidifolia</i>	20512
152	<i>Arabis glabra</i>	520
153	<i>Arabis glabra</i>	520
154	<i>Turritis glabra</i>	24405
155	<i>Arabis hirsuta</i> agg.	521
156	<i>Arabis hirsuta</i>	523
157	<i>Arabis nemorensis</i>	20072
158	<i>Arctium minus</i>	13702
159	<i>Arctium minus</i>	13702
160	<i>Arctium minus</i> agg.	547
161	<i>Lappa communis</i>	14348
162	<i>Arenaria serpyllifolia</i> agg.	563
163	<i>Arenaria serpyllifolia</i>	13703
164	<i>Arenaria serpyllifolia</i> agg.	563
165	<i>Armeria maritima</i>	581
166	<i>Armeria elongata</i>	577
167	<i>Armeria maritima</i>	581
168	<i>Armeria maritima</i> agg.	575
169	<i>Armeria maritima</i> subsp. <i>elongata</i>	20584
170	<i>Armeria maritima</i> var. <i>elongata</i>	20590
171	<i>Armeria vulgaris</i>	26026
172	<i>Artemisia campestris</i> agg.	594
173	<i>Artemisia campestris</i>	596
174	<i>Artemisia campestris</i> agg.	594
175	<i>Artemisia campestris</i> subsp. <i>campestris</i>	6466
176	<i>Artemisia vulgaris</i> agg.	616
177	<i>Artemisia vulgaris</i>	618
178	<i>Artemisia vulgaris</i> agg.	616
179	<i>Arum maculatum</i> agg.	622
180	<i>Arum maculatum</i>	625
181	<i>Arum maculatum</i> agg.	622
182	<i>Asplenium ruta-muraria</i>	674
183	<i>Asplenium ruta-muraria</i>	674
184	<i>Asplenium ruta-muraria</i> subsp. <i>ruta-muraria</i>	676
185	<i>Aster lanceolatus</i> agg.	15106
186	<i>Aster lanceolatus</i>	693
187	<i>Aster parviflorus</i>	15085
188	<i>Atriplex prostrata</i> agg.	20706
189	<i>Atriplex calotheca</i>	756
190	<i>Atriplex hastata</i>	20693
191	<i>Atriplex hastata</i> agg.	755
192	<i>Atriplex latifolia</i>	760
193	<i>Atriplex prostrata</i>	762
194	<i>Atriplex sagittata</i>	754
195	<i>Atriplex nitens</i>	20702
196	<i>Aurinia saxatilis</i>	777
197	<i>Alyssum saxatile</i>	354
198	<i>Betonica officinalis</i>	826
199	<i>Betonica officinalis</i>	826
200	<i>Stachys officinalis</i>	24165
201	<i>Betula alba</i> agg.	99014
202	<i>Betula pendula</i>	829
203	<i>Betula verrucosa</i>	20786
204	<i>Betula pubescens</i>	830
205	<i>Betula pubescens</i>	830
206	<i>Betula pubescens</i> subsp. <i>carpatica</i>	6472
207	<i>Betula pubescens</i> subsp. <i>pubescens</i>	6471
208	<i>Bidens frondosa</i>	834
209	<i>Bidens frondosa</i>	834
210	<i>Bidens melanocarpa</i>	20788
211	<i>Bidens tripartita</i>	836

212	<i>Bidens tripartita</i>	836
213	<i>Bidens tripartita</i> subsp. <i>tripartita</i>	838
214	<i>Biscutella laevigata</i>	844
215	<i>Biscutella laevigata</i>	844
216	<i>Biscutella laevigata</i> subsp. <i>kernerii</i>	6652
217	<i>Bistorta officinalis</i>	27744
218	<i>Bistorta officinalis</i>	27744
219	<i>Persicaria bistorta</i>	23029
220	<i>Polygonum bistorta</i>	4420
221	<i>Bistorta vivipara</i>	20801
222	<i>Bistorta vivipara</i>	20801
223	<i>Persicaria vivipara</i>	23045
224	<i>Polygonum viviparum</i>	4437
225	<i>Bolboschoenus maritimus</i>	852
226	<i>Bolboschoenus maritimus</i>	852
227	<i>Schoenoplectus maritimus</i>	23820
228	<i>Bothriochloa ischaemum</i>	854
229	<i>Andropogon ischaemum</i>	20417
230	<i>Bothriochloa ischaemum</i>	854
231	<i>Dichanthium ischaemum</i>	21538
232	<i>Brachypodium pinnatum</i> agg.	862
233	<i>Brachypodium pinnatum</i>	863
234	<i>Brachypodium pinnatum</i> agg.	862
235	<i>Brachypodium rupestre</i>	864
236	<i>Bromus arvensis</i>	883
237	<i>Bromus arvensis</i>	883
238	<i>Bromus arvensis</i> subsp. <i>arvensis</i>	7191
239	<i>Bromus hordeaceus</i> agg.	895
240	<i>Bromus hordeaceus</i>	896
241	<i>Bromus hordeaceus</i> agg.	895
242	<i>Bromus hordeaceus</i> subsp. <i>hordeaceus</i>	897
243	<i>Bromus mollis</i>	901
244	<i>Bromus racemosus</i> agg.	908
245	<i>Bromus commutatus</i>	909
246	<i>Bromus racemosus</i>	910
247	<i>Bromus ramosus</i> agg.	911
248	<i>Bromus benekenii</i>	912
249	<i>Bromus ramosus</i>	913
250	<i>Bromus ramosus</i> agg.	911
251	<i>Callitriche palustris</i> agg.	999
252	<i>Callitriche obtusangula</i>	1003
253	<i>Callitriche palustris</i>	1004
254	<i>Callitriche palustris</i> agg.	999
255	<i>Callitriche stagnalis</i>	1006
256	<i>Campanula rotundifolia</i> agg.	1057
257	<i>Campanula rotundifolia</i>	1072
258	<i>Campanula rotundifolia</i> agg.	1057
259	<i>Campanula scheuchzeri</i>	1073
260	<i>Cardamine bulbifera</i>	20944
261	<i>Cardamine bulbifera</i>	20944
262	<i>Dentaria bulbifera</i>	1896
263	<i>Cardamine heptaphylla</i>	20951
264	<i>Dentaria heptaphyllos</i>	91015
265	<i>Cardamine pratensis</i> agg.	1105
266	<i>Cardamine dentata</i>	20945
267	<i>Cardamine palustris</i>	1109
268	<i>Cardamine pratensis</i>	15133
269	<i>Cardamine pratensis</i> agg.	1105
270	<i>Cardaminopsis arenosa</i>	1114
271	<i>Arabis arenosa</i>	20509
272	<i>Cardaminopsis arenosa</i>	1114
273	<i>Cardaminopsis halleri</i>	1116
274	<i>Arabis halleri</i>	20518

275	<i>Cardaminopsis halleri</i>	1116
276	<i>Cardaminopsis petraea</i>	1117
277	<i>Arabis hispida</i>	20526
278	<i>Carduus nutans</i> agg.	1140
279	<i>Carduus nutans</i>	1143
280	<i>Carduus nutans</i> agg.	1140
281	<i>Carex acuta</i> agg.	26775
282	<i>Carex acuta</i>	20989
283	<i>Carex acuta</i> subsp. <i>tricostata</i>	6685
284	<i>Carex gracilis</i>	1230
285	<i>Carex arenaria</i> agg.	1159
286	<i>Carex arenaria</i>	1160
287	<i>Carex ligerica</i>	1161
288	<i>Carex pseudobrizzoides</i>	1162
289	<i>Carex atrata</i> agg.	1164
290	<i>Carex atrata</i>	14018
291	<i>Carex atrata</i> agg.	1164
292	<i>Carex elata</i>	1204
293	<i>Carex elata</i>	1204
294	<i>Carex elata</i> subsp. <i>elata</i>	1205
295	<i>Carex flacca</i>	1216
296	<i>Carex flacca</i>	1216
297	<i>Carex glauca</i>	21026
298	<i>Carex flava</i> agg.	1219
299	<i>Carex demissa</i>	20011
300	<i>Carex flava</i>	1220
301	<i>Carex flava</i> agg.	1219
302	<i>Carex flava</i> var. <i>oederi</i>	25010
303	<i>Carex lepidocarpa</i>	1222
304	<i>Carex oederi</i>	1223
305	<i>Carex serotina</i>	21070
306	<i>Carex tumidicarpa</i>	1225
307	<i>Carex viridula</i>	6693
308	<i>Carex muricata</i> agg.	1249
309	<i>Carex divulsa</i>	1250
310	<i>Carex leersiana</i>	1251
311	<i>Carex muricata</i>	6687
312	<i>Carex muricata</i> agg.	1249
313	<i>Carex muricata</i> subsp. <i>muricata</i>	6689
314	<i>Carex pairae</i>	1252
315	<i>Carex spicata</i>	1253
316	<i>Carex nigra</i> agg.	1254
317	<i>Carex fusca</i>	21024
318	<i>Carex nigra</i>	1256
319	<i>Carex nigra</i> agg.	1254
320	<i>Carex ornithopoda</i> agg.	1262
321	<i>Carex ornithopoda</i>	1263
322	<i>Carex ornithopoda</i> agg.	1262
323	<i>Carex ovalis</i>	21055
324	<i>Carex leporina</i>	1240
325	<i>Carex ovalis</i>	21055
326	<i>Carex vulpina</i> agg.	1301
327	<i>Carex otrubae</i>	1302
328	<i>Carex vulpina</i>	1303
329	<i>Carex vulpina</i> agg.	1301
330	<i>Carex</i> × <i>elytroides</i>	10122
331	<i>Carex</i> × <i>elytroides</i>	10122
332	<i>Carex acuta</i> × <i>nigra</i>	90526
333	<i>Carex</i> × <i>figertii</i>	90596
334	<i>Carex davalliana</i> × <i>dioica</i>	90549
335	<i>Carex</i> × <i>xanthocarpa</i>	10137
336	<i>Carex flava</i> × <i>hostiana</i>	90562
337	<i>Carlina acaulis</i>	1306

338	<i>Carlina acaulis</i>	1306
339	<i>Carlina acaulis</i> subsp. <i>simplex</i>	1308
340	<i>Carlina vulgaris</i>	1312
341	<i>Carlina vulgaris</i>	1315
342	<i>Carlina vulgaris</i> subsp. <i>vulgaris</i>	21094
343	<i>Castanea sativa</i>	1323
344	<i>Castanea sativa</i>	1323
345	<i>Castanea vesca</i>	21097
346	<i>Caucalis platycarpus</i>	1329
347	<i>Caucalis lappula</i>	21108
348	<i>Caucalis platycarpus</i>	1329
349	<i>Centaurea jacea</i>	1347
350	<i>Centaurea angustifolia</i>	21122
351	<i>Centaurea jacea</i>	1347
352	<i>Centaurea jacea</i> agg.	24981
353	<i>Centaurea jacea</i> subsp. <i>amara</i>	21132
354	<i>Centaurea jacea</i> subsp. <i>angustifolia</i>	1348
355	<i>Centaurea nigra</i>	26577
356	<i>Centaurea nemoralis</i>	21138
357	<i>Centaurea nigra</i>	26577
358	<i>Centaurea nigra</i> subsp. <i>nemoralis</i>	1370
359	<i>Centaurea scabiosa</i>	1390
360	<i>Centaurea scabiosa</i>	1390
361	<i>Centaurea scabiosa</i> subsp. <i>scabiosa</i>	1397
362	<i>Centaurea stoebe</i>	25004
363	<i>Centaurea maculosa</i> subsp. <i>rhenana</i>	21134
364	<i>Centaurea rhenana</i>	21146
365	<i>Centaurea stoebe</i>	25004
366	<i>Centaureum erythraea</i>	1406
367	<i>Centaureum erythraea</i>	1406
368	<i>Centaureum erythraea</i> subsp. <i>erythraea</i>	1407
369	<i>Centaureum umbellatum</i>	21156
370	<i>Centaureum littorale</i>	1409
371	<i>Centaureum littorale</i>	1409
372	<i>Centaureum minus</i>	7104
373	<i>Cerastium arvense</i>	1431
374	<i>Cerastium arvense</i>	1431
375	<i>Cerastium arvense</i> subsp. <i>arvense</i>	1432
376	<i>Cerastium fontanum</i> agg.	1449
377	<i>Cerastium caespitosum</i>	21178
378	<i>Cerastium fontanum</i>	1450
379	<i>Cerastium fontanum</i> agg.	1449
380	<i>Cerastium fontanum</i> subsp. <i>triviale</i>	21187
381	<i>Cerastium holosteoides</i>	1451
382	<i>Cerastium triviale</i>	25269
383	<i>Cerastium vulgare</i>	21213
384	<i>Cerastium pumilum</i> agg.	1460
385	<i>Cerastium glutinosum</i>	1461
386	<i>Cerastium pallens</i>	21198
387	<i>Cerastium pumilum</i>	1462
388	<i>Cerastium pumilum</i> agg.	1460
389	<i>Ceratocarpus claviculata</i>	21221
390	<i>Ceratocarpus claviculata</i>	21221
391	<i>Corydalis claviculata</i>	1670
392	<i>Cerintho glabra</i>	1473
393	<i>Cerintho alpina</i>	21227
394	<i>Chaerophyllum hirsutum</i>	26947
395	<i>Chaerophyllum hirsutum</i>	26947
396	<i>Chaerophyllum hirsutum</i> agg.	1490
397	<i>Chaerophyllum villarsii</i>	1493
398	<i>Chamaecytisus ratisbonensis</i>	1504
399	<i>Chamaecytisus ratisbonensis</i>	1504
400	<i>Cytisus ratisbonensis</i>	21484

401	<i>Chamaecytisus supinus</i>	1506
402	<i>Chamaecytisus supinus</i>	1506
403	<i>Cytisus supinus</i>	21486
404	<i>Chamaespartium sagittale</i>	1509
405	<i>Chamaespartium sagittale</i>	1509
406	<i>Genista sagittalis</i>	21992
407	<i>Genistella sagittalis</i>	2615
408	<i>Chenopodium album</i> agg.	1514
409	<i>Chenopodium album</i>	1515
410	<i>Chenopodium album</i> agg.	1514
411	<i>Chenopodium strictum</i> subsp. <i>striatifforme</i>	6482
412	<i>Cirsium acaule</i>	1556
413	<i>Cirsium acaule</i>	1556
414	<i>Cirsium acaulon</i>	21327
415	<i>Cirsium heterophyllum</i>	1569
416	<i>Cirsium helenioides</i>	21329
417	<i>Cirsium heterophyllum</i>	1569
418	<i>Cirsium vulgare</i>	1579
419	<i>Cirsium lanceolatum</i>	21330
420	<i>Cirsium vulgare</i>	1579
421	<i>Cirsium</i> × <i>rigens</i>	26068
422	<i>Cirsium acaule</i> × <i>oleraceum</i>	90817
423	<i>Clinopodium vulgare</i>	1593
424	<i>Calamintha clinopodium</i>	978
425	<i>Consolida regalis</i>	1627
426	<i>Consolida regalis</i>	1627
427	<i>Delphinium consolida</i>	21510
428	<i>Convolvulus</i>	60816
429	<i>Convolvulus</i>	60816
430	<i>Convolvulus arvensis</i>	1632
431	<i>Conyza canadensis</i>	1638
432	<i>Conyza canadensis</i>	1638
433	<i>Erigeron canadensis</i>	21687
434	<i>Crataegus</i>	61165
435	<i>Crataegus curvisepala</i>	1697
436	<i>Crataegus laevigata</i> agg.	1701
437	<i>Crataegus laevigata</i>	1701
438	<i>Crataegus lindmanii</i>	1699
439	<i>Crataegus monogyna</i>	1707
440	<i>Crataegus monogyna</i> subsp. <i>monogyna</i>	1708
441	<i>Crataegus monogyna</i> subsp. <i>nordica</i>	1709
442	<i>Crataegus monogyna</i> var. <i>monogyna</i>	90937
443	<i>Crataegus oxyacantha</i>	21400
444	<i>Crataegus rhipidophylla</i>	26677
445	<i>Crataegus</i> × <i>macrocarpa</i>	1705
446	<i>Crataegus</i> × <i>media</i>	50021
447	<i>Crataegus calycina</i>	6733
448	<i>Crepis bocconi</i>	21408
449	<i>Crepis pontana</i>	1735
450	<i>Cruciata laevipes</i>	1766
451	<i>Cruciata laevipes</i>	1766
452	<i>Galium cruciata</i>	21963
453	<i>Cystopteris fragilis</i> agg.	1825
454	<i>Cystopteris alpina</i>	21473
455	<i>Cystopteris fragilis</i>	1827
456	<i>Cytisus nigricans</i>	21483
457	<i>Cytisus nigricans</i>	21483
458	<i>Lembotropis nigricans</i>	3333
459	<i>Cytisus scoparius</i>	1837
460	<i>Cytisus scoparius</i>	1837
461	<i>Sarothamnus scoparius</i>	5245
462	<i>Dactylis glomerata</i> agg.	1842
463	<i>Dactylis</i>	397



464	<i>Dactylis aschersoniana</i>	21487
465	<i>Dactylis glomerata</i>	1843
466	<i>Dactylis glomerata</i> agg.	1842
467	<i>Dactylis glomerata</i> subsp. <i>glomerata</i>	13464
468	<i>Dactylis polygama</i>	1846
469	<i>Dactylorhiza maculata</i> agg.	1852
470	<i>Dactylorhiza fuchsii</i>	1853
471	<i>Dactylorhiza fuchsii</i> × <i>maculata</i>	90986
472	<i>Dactylorhiza maculata</i>	1857
473	<i>Dactylorhiza maculata</i> agg.	1852
474	<i>Dactylorhiza majalis</i> agg.	1861
475	<i>Dactylorhiza majalis</i>	1862
476	<i>Dactylorhiza majalis</i> agg.	1861
477	<i>Dactylorhiza majalis</i> subsp. <i>majalis</i>	1866
478	<i>Dactylorhiza traunsteineri</i>	1871
479	<i>Dactylorhiza</i> × <i>carnea</i>	13760
480	<i>Dactylorhiza maculata</i> × <i>incarnata</i>	90995
481	<i>Danthonia decumbens</i>	1874
482	<i>Danthonia decumbens</i>	1874
483	<i>Danthonia decumbens</i> subsp. <i>decumbens</i>	1876
484	<i>Sieglingia decumbens</i>	24019
485	<i>Daucus carota</i>	1886
486	<i>Daucus</i>	61271
487	<i>Daucus carota</i>	1886
488	<i>Daucus carota</i> subsp. <i>carota</i>	6753
489	<i>Deschampsia cespitosa</i> agg.	1903
490	<i>Deschampsia cespitosa</i>	1904
491	<i>Deschampsia cespitosa</i> agg.	1903
492	<i>Deschampsia flexuosa</i>	20725
493	<i>Aira flexuosa</i>	20226
494	<i>Avenella flexuosa</i>	783
495	<i>Deschampsia flexuosa</i>	20725
496	<i>Dianthus gratianopolitanus</i>	1934
497	<i>Dianthus caesius</i>	21522
498	<i>Dianthus gratianopolitanus</i>	1934
499	<i>Dianthus superbus</i>	1949
500	<i>Dianthus superbus</i>	1949
501	<i>Dianthus superbus</i> subsp. <i>superbus</i>	1952
502	<i>Digitalis grandiflora</i>	1960
503	<i>Digitalis ambigua</i>	21540
504	<i>Dipsacus fullonum</i>	1980
505	<i>Dipsacus fullonum</i>	1980
506	<i>Dipsacus sylvestris</i>	20021
507	<i>Draba aizoides</i> agg.	2000
508	<i>Draba aizoides</i>	2001
509	<i>Draba aizoides</i> agg.	2000
510	<i>Drosera longifolia</i>	21588
511	<i>Drosera anglica</i>	2025
512	<i>Drosera longifolia</i>	21588
513	<i>Dryopteris carthusiana</i> agg.	2030
514	<i>Dryopteris</i> × <i>deweveri</i>	50029
515	<i>Dryopteris carthusiana</i>	2032
516	<i>Dryopteris carthusiana</i> × <i>dilatata</i>	91118
517	<i>Dryopteris carthusiana</i> agg.	2030
518	<i>Dryopteris dilatata</i>	2033
519	<i>Dryopteris expansa</i>	2031
520	<i>Dryopteris spinulosa</i>	21604
521	<i>Dryopteris filix-mas</i> agg. s. l.	94728
522	<i>Dryopteris affinis</i>	2038
523	<i>Dryopteris filix-mas</i>	2037
524	<i>Dryopteris filix-mas</i> agg.	2035
525	<i>Eleocharis palustris</i> agg.	2087
526	<i>Eleocharis palustris</i>	2091

527	<i>Eleocharis palustris</i> agg.	2087
528	<i>Eleocharis uniglumis</i>	2094
529	<i>Scirpus palustris</i>	23856
530	<i>Elymus arenosus</i>	27779
531	<i>Elymus repens</i> subsp. <i>arenosus</i>	6543
532	<i>Elymus athericus</i>	27782
533	<i>Elymus pungens</i>	27905
534	<i>Elymus caninus</i>	20145
535	<i>Agropyron caninum</i>	103
536	<i>Elymus caninus</i>	20145
537	<i>Roegneria canina</i>	23598
538	<i>Elymus repens</i>	27778
539	<i>Agropyron repens</i>	27914
540	<i>Agropyron repens</i> subsp. <i>caesium</i>	6541
541	<i>Elymus repens</i>	27778
542	<i>Elymus repens</i> subsp. <i>repens</i>	27781
543	<i>Elytrigia repens</i>	21639
544	<i>Triticum repens</i>	24393
545	<i>Empetrum nigrum</i> agg.	2103
546	<i>Empetrum nigrum</i>	2105
547	<i>Empetrum nigrum</i> agg.	2103
548	<i>Epilobium angustifolium</i>	2113
549	<i>Chamaenerion angustifolium</i>	21237
550	<i>Epilobium angustifolium</i>	2113
551	<i>Epilobium ciliatum</i>	21642
552	<i>Epilobium adenocaulon</i>	2109
553	<i>Epilobium ciliatum</i>	21642
554	<i>Epilobium tetragonum</i>	2126
555	<i>Epilobium tetragonum</i>	2126
556	<i>Epilobium tetragonum</i> subsp. <i>lamyi</i>	2127
557	<i>Epilobium tetragonum</i> subsp. <i>tetragonum</i>	2128
558	<i>Epipactis atrorubens</i>	2130
559	<i>Epipactis atropurpurea</i>	21653
560	<i>Epipactis atrorubens</i>	2130
561	<i>Epipactis rubiginosa</i>	21664
562	<i>Epipactis helleborine</i> agg.	2131
563	<i>Epipactis helleborine</i>	2134
564	<i>Epipactis latifolia</i>	21660
565	<i>Equisetum fluviatile</i>	2143
566	<i>Equisetum fluviatile</i>	2143
567	<i>Equisetum limosum</i>	21674
568	<i>Equisetum</i> × <i>mildeanum</i>	91305
569	<i>Equisetum pratense</i> × <i>sylvaticum</i>	91302
570	<i>Erica carnea</i>	21680
571	<i>Erica carnea</i>	21680
572	<i>Erica herbacea</i>	2163
573	<i>Erigeron acris</i>	2167
574	<i>Erigeron acris</i>	2167
575	<i>Erigeron acris</i> subsp. <i>acris</i>	2168
576	<i>Erigeron annuus</i>	2178
577	<i>Erigeron annuus</i>	2178
578	<i>Erigeron strigosus</i>	21695
579	<i>Erigeron glabratus</i>	21689
580	<i>Erigeron glabratus</i>	21689
581	<i>Erigeron polymorphus</i>	2186
582	<i>Erodium cicutarium</i> agg.	2197
583	<i>Erodium cicutarium</i>	2199
584	<i>Erodium cicutarium</i> agg.	2197
585	<i>Erophila verna</i>	12356
586	<i>Draba verna</i>	21586
587	<i>Erophila verna</i>	12356
588	<i>Erophila verna</i> agg.	2205
589	<i>Erophila verna</i> subsp. <i>verna</i>	21715

590	<i>Erysimum maschallianum</i>	2229
591	<i>Erysimum durum</i>	21726
592	<i>Erysimum odoratum</i>	2234
593	<i>Erysimum erysimoides</i>	21727
594	<i>Erysimum odoratum</i>	2234
595	<i>Euphorbia verrucosa</i>	2309
596	<i>Euphorbia brittingeri</i>	21740
597	<i>Euphorbia verrucosa</i>	2309
598	<i>Euphrasia officinalis</i>	13816
599	<i>Euphrasia officinalis</i>	13816
600	<i>Euphrasia officinalis</i> subsp. <i>rostkoviana</i>	26254
601	<i>Euphrasia rostkoviana</i>	2332
602	<i>Euphrasia rostkoviana</i> agg.	2329
603	<i>Fallopia convolvulus</i>	2359
604	<i>Fallopia convolvulus</i>	2359
605	<i>Polygonum convolvulus</i>	23228
606	<i>Festuca brevipila</i>	26591
607	<i>Festuca brevipila</i>	26591
608	<i>Festuca duriuscula</i>	21820
609	<i>Festuca trachyphylla</i>	2406
610	<i>Festuca filiformis</i>	21824
611	<i>Festuca capillata</i>	21813
612	<i>Festuca filiformis</i>	21824
613	<i>Festuca tenuifolia</i>	2405
614	<i>Festuca ovina</i> agg.	2385
615	<i>Festuca guestfalica</i> et <i>ovina</i>	91404
616	<i>Festuca guestfalica</i>	6483
617	<i>Festuca lemanii</i>	94730
618	<i>Festuca ovina</i>	2396
619	<i>Festuca ovina</i> s. l.	91415
620	<i>Festuca ovina</i> subsp. <i>ovina</i>	91418
621	<i>Festuca ovina</i> var. <i>firmula</i>	21845
622	<i>Festuca ovina</i> agg.	2385
623	<i>Festuca ovina</i> subsp. <i>glauca</i>	10352
624	<i>Festuca pallens</i>	2397
625	<i>Festuca cinerea</i>	2387
626	<i>Festuca glauca</i>	2392
627	<i>Festuca glaucina</i>	91400
628	<i>Festuca pallens</i>	2397
629	<i>Festuca pallens</i> * <i>glaucina</i>	91420
630	<i>Festuca pallens</i> subsp. <i>pallens</i>	6792
631	<i>Festuca quadriflora</i>	21852
632	<i>Festuca pumila</i>	2416
633	<i>Festuca quadriflora</i>	21852
634	<i>Festuca rubra</i> agg.	2417
635	<i>Festuca heteromalla</i>	7346
636	<i>Festuca nigrescens</i>	2420
637	<i>Festuca nigrescens</i> subsp. <i>nigrescens</i>	91414
638	<i>Festuca rubra</i>	2421
639	<i>Festuca rubra</i> agg.	2417
640	<i>Festuca rubra</i> subsp. <i>commutata</i>	21856
641	<i>Festuca rubra</i> subsp. <i>fallax</i>	13510
642	<i>Festuca rubra</i> subsp. <i>rubra</i>	2425
643	<i>Festuca rubra</i> var. <i>genuina</i>	21863
644	<i>Festuca trichophylla</i>	2426
645	<i>Festuca rupicola</i>	2402
646	<i>Festuca rupicola</i>	2402
647	<i>Festuca sulcata</i>	27166
648	<i>Festuca valesiaca</i> subsp. <i>sulcata</i>	10354
649	<i>Festuca valesiaca</i>	13712
650	<i>Festuca pulchra</i>	13523
651	<i>Festuca valesiaca</i>	13712
652	<i>Festuca violacea</i> agg.	2441

653	<i>Festuca norica</i>	2443
654	<i>Festuca violacea</i> agg.	2441
655	<i>Filipendula vulgaris</i>	2462
656	<i>Filipendula hexapetala</i>	21900
657	<i>Filipendula vulgaris</i>	2462
658	<i>Frangula alnus</i>	2472
659	<i>Frangula alnus</i>	2472
660	<i>Rhamnus frangula</i>	23535
661	<i>Fumana procumbens</i>	2486
662	<i>Fumana procumbens</i>	2486
663	<i>Fumana vulgaris</i>	21921
664	<i>Galeopsis ladanum</i> agg.	2520
665	<i>Galeopsis angustifolia</i>	2521
666	<i>Galeopsis ladanum</i>	2522
667	<i>Galeopsis tetrahit</i> agg.	2526
668	<i>Galeopsis bifida</i>	2527
669	<i>Galeopsis tetrahit</i>	2528
670	<i>Galeopsis tetrahit</i> agg.	2526
671	<i>Galium aparine</i> agg.	2532
672	<i>Galium aparine</i>	2533
673	<i>Galium aparine</i> agg.	2532
674	<i>Galium spurium</i>	2534
675	<i>Galium glaucum</i>	2542
676	<i>Asperula glauca</i>	20637
677	<i>Galium glaucum</i>	2542
678	<i>Galium mollugo</i> agg.	2548
679	<i>Galium album</i>	2549
680	<i>Galium album</i> subsp. <i>album</i>	2550
681	<i>Galium mollugo</i>	2555
682	<i>Galium mollugo</i> agg.	2548
683	<i>Galium palustre</i>	2564
684	<i>Galium elongatum</i>	2563
685	<i>Galium palustre</i>	2564
686	<i>Galium palustre</i> agg.	2561
687	<i>Galium palustre</i> subsp. <i>elongatum</i>	21974
688	<i>Galium palustre</i> subsp. <i>palustre</i>	21975
689	<i>Galium pusillum</i> agg.	2569
690	<i>Galium anisophyllum</i>	2570
691	<i>Galium pumilum</i>	2572
692	<i>Galium pusillum</i> agg.	2569
693	<i>Galium valdepilosum</i>	2577
694	<i>Galium rotundifolium</i>	2579
695	<i>Galium scabrum</i>	21982
696	<i>Galium saxatile</i>	2585
697	<i>Galium hircynicum</i>	2543
698	<i>Galium saxatile</i>	2585
699	<i>Galium verum</i> agg. s. l.	94733
700	<i>Galium</i> × <i>pomeranicum</i>	2599
701	<i>Galium verum</i>	2600
702	<i>Galium verum</i> agg.	2598
703	<i>Galium verum</i> subsp. <i>verum</i>	24929
704	<i>Galium wirtgenii</i>	2601
705	<i>Gentiana acaulis</i> agg.	91530
706	<i>Gentiana acaulis</i>	2616
707	<i>Gentiana clusii</i>	2624
708	<i>Gentianella ciliata</i>	2656
709	<i>Gentiana ciliata</i>	22041
710	<i>Gentianella ciliata</i>	2656
711	<i>Gentianopsis ciliata</i>	22040
712	<i>Gentianella germanica</i> agg.	2657
713	<i>Gentiana germanica</i>	22044
714	<i>Gentianella aspera</i>	2659
715	<i>Gentianella germanica</i>	2662

716	<i>Gentianella germanica</i> agg.	2657
717	<i>Gentianella germanica</i> subsp. <i>germanica</i>	7352
718	<i>Gentianella lutescens</i>	2665
719	<i>Geum</i> × <i>intermedium</i>	50040
720	<i>Geum rivale</i> × <i>urbanum</i>	91547
721	<i>Glechoma hederacea</i> agg.	2710
722	<i>Glechoma hederacea</i>	2711
723	<i>Glechoma hederacea</i> agg.	2710
724	<i>Globularia punctata</i>	2718
725	<i>Globularia bisnagarica</i>	2718
726	<i>Globularia elongata</i>	22079
727	<i>Globularia punctata</i>	2718
728	<i>Globularia vulgaris</i>	26117
729	<i>Globularia willkommii</i>	22080
730	<i>Glyceria fluitans</i> agg.	2719
731	<i>Glyceria declinata</i>	2720
732	<i>Glyceria fluitans</i>	2721
733	<i>Glyceria fluitans</i> agg.	2719
734	<i>Glyceria notata</i>	26260
735	<i>Helianthemum nummularium</i>	26596
736	<i>Helianthemum nummularium</i>	26596
737	<i>Helianthemum nummularium</i> agg.	2774
738	<i>Helianthemum nummularium</i> subsp. <i>obscurum</i>	22127
739	<i>Helianthemum nummularium</i> subsp. <i>ovatum</i>	22128
740	<i>Helianthemum ovatum</i>	2780
741	<i>Helictotrichon pratense</i>	20728
742	<i>Avena pratensis</i>	20717
743	<i>Avenochloa pratensis</i>	788
744	<i>Avenula pratensis</i>	20732
745	<i>Helictotrichon pratense</i>	20728
746	<i>Helictotrichon pubescens</i>	20729
747	<i>Avena pubescens</i>	20718
748	<i>Avenochloa pubescens</i>	789
749	<i>Avenula pubescens</i>	20733
750	<i>Helictotrichon pubescens</i>	20729
751	<i>Helictotrichon versicolor</i>	20730
752	<i>Avenula versicolor</i>	20734
753	<i>Hepatica nobilis</i>	2815
754	<i>Anemone hepatica</i>	20422
755	<i>Hepatica nobilis</i>	2815
756	<i>Hepatica triloba</i>	10391
757	<i>Herniaria glabra</i>	2832
758	<i>Herniaria glabra</i>	2832
759	<i>Herniaria glabra</i> subsp. <i>glabra</i>	2833
760	<i>Hieracium angustifolium</i>	25621
761	<i>Hieracium glaciale</i>	2885
762	<i>Hieracium caespitosum</i>	2866
763	<i>Pilosella caespitosa</i>	12173
764	<i>Hieracium lactucella</i>	2899
765	<i>Hieracium auricula</i>	2857
766	<i>Hieracium lactucella</i>	2899
767	<i>Pilosella lactucella</i>	12147
768	<i>Hieracium murorum</i>	25659
769	<i>Hieracium murorum</i>	25659
770	<i>Hieracium sylvaticum</i>	2942
771	<i>Hieracium pilosella</i>	2923
772	<i>Hieracium pilosella</i>	2923
773	<i>Pilosella officinarum</i>	14992
774	<i>Hieracium piloselloides</i>	2924
775	<i>Hieracium piloselloides</i>	2924
776	<i>Pilosella piloselloides</i>	12226
777	<i>Hieracium rothianum</i>	25654
778	<i>Hieracium setigerum</i>	12219

779	Hieracium subramosum	10562
780	depr. Hieracium subramosum	94848
781	Hippocrepis emerus	21379
782	Coronilla emerus	1655
783	Hornungia petraea	2993
784	Hornungia petraea	2993
785	Hutchinsia petraea	22188
786	Hypericum maculatum agg.	3027
787	Hypericum x desetangsii	3029
788	Hypericum maculatum	20046
789	Hypericum maculatum agg.	3027
790	Hypericum maculatum subsp. maculatum	20047
791	Hypericum perforatum	3036
792	Hypericum perforatum	3036
793	Hypericum perforatum subsp. angustifolium	22208
794	Hypericum tetrapterum	3042
795	Hypericum quadrangulum	22214
796	Hypericum tetrapterum	3042
797	Inula conyzae	22227
798	Inula conyza	3069
799	Inula conyzae	22227
800	Jasione laevis	3117
801	Jasione perennis	22240
802	Juncus alpinus	22243
803	Juncus alpinoarticulatus	91853
804	Juncus alpinus	22243
805	Juncus articulatus	3136
806	Juncus articulatus	3136
807	Juncus supinus	22278
808	Juncus bufonius agg.	3140
809	Juncus bufonius	3141
810	Juncus bufonius agg.	3140
811	Juncus compressus agg.	3147
812	Juncus compressus	3148
813	Juncus gerardii	3149
814	Juncus trifidus	26603
815	Juncus monanthos	3165
816	Juncus trifidus subsp. monanthos	22281
817	Juniperus communis	3168
818	Juniperus communis	3168
819	Juniperus communis subsp. communis	3170
820	Kobresia myosuroides	22299
821	Elyna myosuroides	2102
822	Kobresia myosuroides	22299
823	Koeleria pyramidata agg.	3233
824	Koeleria	61398
825	Koeleria cristata	22305
826	Koeleria gracilis	22312
827	Koeleria macrantha	3235
828	Koeleria pyramidata	3236
829	Koeleria pyramidata agg.	3233
830	Lamium galeobdolon agg.	22337
831	Galeobdolon argentatum	21942
832	Galeobdolon luteum	20026
833	Galeobdolon luteum agg.	91498
834	Galeobdolon montanum	20027
835	Lamiastrum galeobdolon	3256
836	Lamiastrum montanum	3257
837	Lamium argentatum	24905
838	Lamium galeobdolon	22338
839	Lamium galeobdolon agg.	22337
840	Lamium montanum	22340
841	Larix decidua	3272

842	<i>Larix decidua</i>	3272
843	<i>Larix europaea</i>	10606
844	<i>Lathyrus linifolius</i>	3301
845	<i>Lathyrus linifolius</i>	3301
846	<i>Lathyrus montanus</i>	22390
847	<i>Ledum palustre</i>	3328
848	<i>Ledum palustre</i>	3328
849	<i>Rhododendron tomentosum</i>	28144
850	<i>Leontodon helveticus</i>	3346
851	<i>Leontodon helveticus</i>	3346
852	<i>Leontodon pyrenaicus</i> subsp. <i>helveticus</i>	7365
853	<i>Leontodon hispidus</i>	3347
854	<i>Leontodon hastilis</i>	25306
855	<i>Leontodon hispidus</i>	3347
856	<i>Leontodon hispidus</i> subsp. <i>hastilis</i>	22413
857	<i>Leontodon hispidus</i> subsp. <i>hispidus</i>	6837
858	<i>Leontodon saxatilis</i>	3354
859	<i>Leontodon saxatilis</i>	3354
860	<i>Leontodon taraxacoides</i>	22424
861	<i>Leucanthemum atratum</i> agg.	3375
862	<i>Leucanthemum atratum</i> agg.	3375
863	<i>Leucanthemum halleri</i>	3378
864	<i>Leucanthemum vulgare</i> agg.	3381
865	<i>Chrysanthemum leucanthemum</i>	21299
866	<i>Leucanthemum ircutianum</i>	3384
867	<i>Leucanthemum maximum</i>	3386
868	<i>Leucanthemum vulgare</i>	3387
869	<i>Leucanthemum vulgare</i> agg.	3381
870	<i>Linaria vulgaris</i> agg.	3429
871	<i>Linaria vulgaris</i>	3433
872	<i>Linaria vulgaris</i> agg.	3429
873	<i>Lindernia dubia</i>	3434
874	<i>Gratiola anagallidea</i>	13832
875	<i>Linum perenne</i> agg.	3454
876	<i>Linum austriacum</i>	3455
877	<i>Linum leonii</i>	3458
878	<i>Linum perenne</i>	26993
879	<i>Lithospermum arvense</i>	3475
880	<i>Buglossoides arvensis</i> subsp. <i>sibthorpiana</i>	20947
881	<i>Lithospermum arvense</i>	3475
882	<i>Lotus corniculatus</i> agg.	3505
883	<i>Lotus corniculatus</i>	3508
884	<i>Lotus corniculatus</i> agg.	3505
885	<i>Lotus corniculatus</i> subsp. <i>corniculatus</i>	22509
886	<i>Lotus corniculatus</i> var. <i>ciliatus</i>	25841
887	<i>Lotus tenuis</i>	3510
888	<i>Lotus pedunculatus</i>	22517
889	<i>Lotus pedunculatus</i>	22517
890	<i>Lotus uliginosus</i>	3516
891	<i>Luzula campestris</i> agg.	3530
892	<i>Luzula campestris</i>	3531
893	<i>Luzula campestris</i> agg.	3530
894	<i>Luzula campestris</i> subsp. <i>multiflora</i>	22525
895	<i>Luzula multiflora</i>	11817
896	<i>Luzula pallescens</i>	25388
897	<i>Luzula sudetica</i>	3536
898	<i>Luzula luzuloides</i>	3541
899	<i>Luzula albida</i>	3526
900	<i>Luzula luzuloides</i>	3541
901	<i>Luzula luzuloides</i> subsp. <i>rubella</i>	14424
902	<i>Luzula sylvatica</i>	3547
903	<i>Luzula sylvatica</i>	3547
904	<i>Luzula sylvatica</i> subsp. <i>sylvatica</i>	3549

905	<i>Lycopersicon esculentum</i>	3558
906	<i>Lycopersicon esculentum</i>	3558
907	<i>Solanum lycopersicum</i>	24088
908	<i>Lycopus europaeus</i>	3562
909	<i>Lycopus europaeus</i>	3562
910	<i>Lycopus europaeus</i> subsp. <i>europaeus</i>	3563
911	<i>Malus sylvestris</i> agg.	3580
912	<i>Malus sylvestris</i>	3582
913	<i>Malus sylvestris</i> agg.	3580
914	<i>Matricaria</i>	60765
915	<i>Chamomilla</i>	67025
916	<i>Matricaria</i>	60765
917	<i>Matricaria discoidea</i>	3597
918	<i>Chamomilla suaveolens</i>	21249
919	<i>Matricaria discoidea</i>	3597
920	<i>Matricaria recutita</i>	21248
921	<i>Chamomilla recutita</i>	21247
922	<i>Matricaria recutita</i>	21248
923	<i>Medicago sativa</i> agg.	3616
924	<i>Medicago</i> × <i>varia</i>	3620
925	<i>Medicago falcata</i>	3617
926	<i>Medicago sativa</i>	11820
927	<i>Medicago sativa</i> agg.	3616
928	<i>Melampyrum pratense</i>	3638
929	<i>Melampyrum pratense</i>	3638
930	<i>Melampyrum pratense</i> subsp. <i>pratense</i>	13853
931	<i>Melica ciliata</i> agg.	3643
932	<i>Melica ciliata</i>	3644
933	<i>Melica ciliata</i> var. <i>nebrodensis</i>	13015
934	<i>Melica nutans</i> agg.	3648
935	<i>Melica nutans</i>	3650
936	<i>Melica nutans</i> agg.	3648
937	<i>Melica picta</i>	3651
938	<i>Mentha spicata</i> agg.	3676
939	<i>Mentha longifolia</i>	3677
940	<i>Mentha suaveolens</i>	3680
941	<i>Mercurialis perennis</i> agg.	3691
942	<i>Mercurialis ovata</i>	3692
943	<i>Mercurialis perennis</i>	3694
944	<i>Minuartia hybrida</i>	3720
945	<i>Alsine tenuifolia</i>	25807
946	<i>Minuartia rubra</i>	22674
947	<i>Minuartia fastigiata</i>	3715
948	<i>Minuartia rubra</i>	22674
949	<i>Minuartia verna</i>	26607
950	<i>Minuartia verna</i>	26607
951	<i>Minuartia verna</i> subsp. <i>gerardii</i>	22675
952	<i>Minuartia verna</i> subsp. <i>hercynica</i>	6499
953	<i>Molinia caerulea</i> agg.	3756
954	<i>Molinia</i>	61408
955	<i>Molinia arundinacea</i>	3757
956	<i>Molinia caerulea</i>	3758
957	<i>Monotropa hypopitys</i> agg.	3762
958	<i>Monotropa hypophegea</i>	3763
959	<i>Monotropa hypopitys</i>	3764
960	<i>Monotropa hypopitys</i> agg.	3762
961	<i>Montia fontana</i>	3765
962	<i>Montia fontana</i>	3765
963	<i>Montia fontana</i> subsp. <i>chondrosperma</i>	3767
964	<i>Mycelis muralis</i>	3781
965	<i>Lactuca muralis</i>	22329
966	<i>Mycelis muralis</i>	3781
967	<i>Myosotis arvensis</i>	3782



968	<i>Myosotis arvensis</i>	3782
969	<i>Myosotis arvensis</i> subsp. <i>arvensis</i>	3783
970	<i>Myosotis discolor</i>	3785
971	<i>Myosotis discolor</i>	3785
972	<i>Myosotis versicolor</i>	22757
973	<i>Myosotis ramosissima</i>	3792
974	<i>Myosotis hispida</i>	22735
975	<i>Myosotis ramosissima</i>	3792
976	<i>Myosotis scorpioides</i> agg.	20051
977	<i>Myosotis caespitosa</i>	22731
978	<i>Myosotis laxa</i>	6500
979	<i>Myosotis laxiflora</i>	3788
980	<i>Myosotis multiflora</i>	12098
981	<i>Myosotis nemorosa</i>	3789
982	<i>Myosotis nemorosa</i> subsp. <i>brevisetacea</i>	22741
983	<i>Myosotis palustris</i>	22743
984	<i>Myosotis palustris</i> agg.	3786
985	<i>Myosotis palustris</i> s. l.	15315
986	<i>Myosotis scorpioides</i>	3791
987	<i>Myosotis scorpioides</i> agg.	20051
988	<i>Myosotis scorpioides</i> subsp. <i>scorpioides</i>	12104
989	<i>Myosotis stricta</i>	3804
990	<i>Myosotis micrantha</i>	22740
991	<i>Myosotis stricta</i>	3804
992	<i>Myosotis sylvatica</i> agg.	3793
993	<i>Myosotis alpestris</i>	3794
994	<i>Myosotis decumbens</i>	3795
995	<i>Myosotis sylvatica</i>	3802
996	<i>Nigritella nigra</i> agg.	3851
997	<i>Nigritella nigra</i>	7167
998	<i>Nigritella nigra</i> agg.	3851
999	<i>Odontites luteus</i>	3863
1000	<i>Euphrasia lutea</i>	21768
1001	<i>Odontites luteus</i>	3863
1002	<i>Orthanthella lutea</i>	3863
1003	<i>Odontites vernus</i> agg.	12023
1004	<i>Odontites ruber</i>	13749
1005	<i>Odontites vernus</i>	3866
1006	<i>Odontites vernus</i> agg.	12023
1007	<i>Odontites vulgaris</i>	3867
1008	<i>Onobrychis viciifolia</i> agg.	3906
1009	<i>Onobrychis arenaria</i>	3907
1010	<i>Onobrychis sativa</i>	93791
1011	<i>Onobrychis viciifolia</i>	3912
1012	<i>Ononis spinosa</i> agg.	3920
1013	<i>Ononis procurrens</i>	22831
1014	<i>Ononis repens</i>	3922
1015	<i>Ononis repens</i> subsp. <i>procurrens</i>	3923
1016	<i>Ononis spinosa</i>	3925
1017	<i>Ononis spinosa</i> agg.	3920
1018	<i>Ononis spinosa</i> subsp. <i>maritima</i>	22837
1019	<i>Ophrys holoserica</i>	3955
1020	<i>Ophrys fuciflora</i>	22852
1021	<i>Ophrys holoserica</i>	3955
1022	<i>Ophrys insectifera</i>	3956
1023	<i>Ophrys insectifera</i>	3956
1024	<i>Ophrys muscifera</i>	22859
1025	<i>Oreopteris limbosperma</i>	22909
1026	<i>Dryopteris montana</i>	21597
1027	<i>Lastrea limbosperma</i>	22377
1028	<i>Oreopteris limbosperma</i>	22909
1029	<i>Thelypteris limbosperma</i>	5910
1030	<i>Orthilia secunda</i>	4054

1031	<i>Orthilia secunda</i>	4054
1032	<i>Pyrola secunda</i>	23440
1033	<i>Oxalis stricta</i>	22973
1034	<i>Oxalis fontana</i>	4065
1035	<i>Oxalis stricta</i>	22973
1036	<i>Oxytropis montana</i> agg.	4080
1037	<i>Oxytropis jacquinii</i>	4084
1038	<i>Oxytropis montana</i> agg.	4080
1039	<i>Papaver dubium</i>	10700
1040	<i>Papaver dubium</i>	10700
1041	<i>Papaver dubium</i> subsp. <i>lecoqii</i>	22999
1042	<i>Pedicularis palustris</i>	4158
1043	<i>Pedicularis palustris</i>	4158
1044	<i>Pedicularis palustris</i> subsp. <i>palustris</i>	13828
1045	<i>Persicaria amphibia</i>	23027
1046	<i>Persicaria amphibia</i>	23027
1047	<i>Polygonum amphibium</i>	4413
1048	<i>Persicaria dubia</i>	11734
1049	<i>Persicaria dubia</i>	11734
1050	<i>Persicaria mitis</i>	23041
1051	<i>Polygonum mite</i>	4429
1052	<i>Persicaria hydropiper</i>	23032
1053	<i>Persicaria hydropiper</i>	23032
1054	<i>Polygonum hydropiper</i>	4422
1055	<i>Persicaria lapathifolia</i>	23034
1056	<i>Persicaria lapathifolia</i>	23034
1057	<i>Persicaria lapathifolia</i> subsp. <i>pallida</i>	13950
1058	<i>Polygonum lapathifolium</i>	4423
1059	<i>Persicaria maculosa</i>	23038
1060	<i>Persicaria maculosa</i>	23038
1061	<i>Polygonum persicaria</i>	4435
1062	<i>Persicaria minor</i>	23039
1063	<i>Persicaria minor</i>	23039
1064	<i>Polygonum minus</i>	4428
1065	<i>Petrorhagia prolifera</i> agg.	4185
1066	<i>Petrorhagia prolifera</i>	4187
1067	<i>Tunica prolifera</i>	24402
1068	<i>Petrorhagia saxifraga</i>	4189
1069	<i>Petrorhagia saxifraga</i>	4189
1070	<i>Tunica saxifraga</i>	24403
1071	<i>Phegopteris connectilis</i>	23065
1072	<i>Gymnocarpium phegopteris</i>	12299
1073	<i>Phegopteris connectilis</i>	23065
1074	<i>Thelypteris phegopteris</i>	5912
1075	<i>Phleum alpinum</i> agg.	4215
1076	<i>Phleum alpinum</i>	25110
1077	<i>Phleum alpinum</i> agg.	4215
1078	<i>Phleum phleoides</i>	4222
1079	<i>Phleum boehmeri</i>	23073
1080	<i>Phleum phleoides</i>	4222
1081	<i>Phleum pratense</i> agg.	4223
1082	<i>Phleum bertolonii</i>	4224
1083	<i>Phleum pratense</i>	4225
1084	<i>Phleum pratense</i> agg.	4223
1085	<i>Phleum pratense</i> subsp. <i>pratense</i>	27013
1086	<i>Phragmites australis</i>	4229
1087	<i>Phragmites australis</i>	4229
1088	<i>Phragmites communis</i>	23084
1089	<i>Phyteuma orbiculare</i>	26610
1090	<i>Phyteuma orbiculare</i>	26610
1091	<i>Phyteuma orbiculare</i> subsp. <i>orbiculare</i>	24940
1092	<i>Phyteuma spicatum</i>	4264
1093	<i>Phyteuma spicatum</i>	4264

1094	Phyteuma spicatum subsp. occidentale	14758
1095	Phyteuma spicatum subsp. spicatum	4266
1096	Phyteuma spicatum var. coeruleum	23091
1097	Picea abies	4269
1098	Picea abies	4269
1099	Picea excelsa	23106
1100	Picris hieracioides	4274
1101	Picris hieracioides	4274
1102	Picris hieracioides agg.	4272
1103	Pimpinella major	4277
1104	Pimpinella major	4277
1105	Pimpinella major subsp. major	23108
1106	Pimpinella saxifraga agg.	4279
1107	Pimpinella saxifraga	4282
1108	Pimpinella saxifraga agg.	4279
1109	Plantago lanceolata	4320
1110	Plantago lanceolata	4320
1111	Plantago lanceolata subsp. sphaerostachya	23153
1112	Plantago lanceolata var. sphaerostachya	25683
1113	Plantago major	4321
1114	Plantago intermedia	23150
1115	Plantago major	4321
1116	Plantago major subsp. intermedia	4322
1117	Plantago major subsp. major	4323
1118	Plantago maritima agg.	4325
1119	Plantago alpina	4326
1120	Plantago maritima	27766
1121	Plantago strictissima	23161
1122	Plantago media agg.	4332
1123	Plantago media	4333
1124	Plantago media agg.	4332
1125	Poa annua agg.	4343
1126	Poa annua	4344
1127	Poa annua agg.	4343
1128	Poa supina	4345
1129	Poa pratensis agg.	4366
1130	Poa angustifolia	4367
1131	Poa humilis	7372
1132	Poa pratensis	4368
1133	Poa pratensis agg.	4366
1134	Poa pratensis subsp. angustifolia	23193
1135	Poa trivialis	26611
1136	Poa trivialis	26611
1137	Poa trivialis agg.	4372
1138	Poa trivialis subsp. trivialis	7161
1139	Polygala amara agg.	4390
1140	Polygala amara	4391
1141	Polygala amara agg.	4390
1142	Polygala amara subsp. amarella	23205
1143	Polygala amarella	4394
1144	Polygala vulgaris	4405
1145	Polygala oxyptera	23212
1146	Polygala vulgaris	4405
1147	Polygala vulgaris s. str.	10745
1148	Polygala vulgaris subsp. oxyptera	4406
1149	Polygala vulgaris subsp. vulgaris	4407
1150	Polygonatum odoratum	4410
1151	Polygonatum odoratum	4410
1152	Polygonatum officinale	27134
1153	Polygonum aviculare agg.	4415
1154	Polygonum aviculare	4417
1155	Polygonum aviculare agg.	4415
1156	Populus x canadensis	50080

1157	Populus × canadensis	50080
1158	Populus × euamericana	10760
1159	Potentilla argentea agg.	4490
1160	Potentilla argentea	4491
1161	Potentilla argentea agg.	4490
1162	Potentilla erecta	4511
1163	Potentilla erecta	4511
1164	Potentilla tormentilla	23354
1165	Potentilla heptaphylla agg.	4515
1166	Potentilla heptaphylla	4517
1167	Potentilla rubens	23350
1168	Potentilla incana	25757
1169	Potentilla arenaria	4539
1170	Potentilla cinerea	25853
1171	Potentilla cinerea subsp. incana	15377
1172	Potentilla incana	25757
1173	Potentilla × subarenaria	50084
1174	Potentilla palustris	4528
1175	Comarum palustre	21352
1176	Potentilla palustris	4528
1177	Potentilla verna agg.	4538
1178	Potentilla neumanniana	4541
1179	Potentilla pusilla	4542
1180	Potentilla tabernaemontani	20053
1181	Potentilla verna	23355
1182	Potentilla verna agg.	4538
1183	Potentilla verna subsp. vulgaris	28077
1184	Primula veris	4570
1185	Primula officinalis	23378
1186	Primula veris	4570
1187	Primula veris subsp. veris	4575
1188	Primula × digenea	92537
1189	Primula elatior × vulgaris	92534
1190	Primula × media	50085
1191	Primula elatior × veris	92533
1192	Pritzelago alpina	26680
1193	Hutchinsia alpina	3000
1194	Pritzelago alpina	26680
1195	Prunus avium	4582
1196	Cerasus avium	21216
1197	Prunus avium	4582
1198	Prunus avium subsp. avium	24942
1199	Prunus cerasus agg.	4585
1200	Cerasus vulgaris	21220
1201	Prunus cerasus	4586
1202	Prunus mahaleb	4592
1203	Cerasus mahaleb	21219
1204	Prunus mahaleb	4592
1205	Prunus padus	4593
1206	Padus avium	22980
1207	Prunus padus	4593
1208	Prunus spinosa agg.	4597
1209	Prunus × fruticans	4598
1210	Prunus spinosa	4599
1211	Prunus spinosa subsp. fruticans	23396
1212	Pseudolysimachion longifolium	23400
1213	Pseudolysimachion longifolium	23400
1214	Veronica longifolia	6261
1215	Pseudolysimachion spicatum	23404
1216	Pseudolysimachion spicatum	23404
1217	Veronica spicata	6286
1218	Pseudorchis albida	4601
1219	Leucorchis albida	3390

1220	<i>Pseudorchis albida</i>	4601
1221	<i>Pulmonaria officinalis</i> agg.	4636
1222	<i>Pulmonaria obscura</i>	4637
1223	<i>Pulmonaria officinalis</i>	4638
1224	<i>Pulmonaria officinalis</i> agg.	4636
1225	<i>Pulsatilla alpina</i>	15385
1226	<i>Pulsatilla alpina</i> agg.	4642
1227	<i>Pulsatilla vulgaris</i>	26617
1228	<i>Anemone pulsatilla</i>	20428
1229	<i>Anemone pulsatilla</i> subsp. <i>grandis</i>	20429
1230	<i>Pulsatilla vulgaris</i>	26617
1231	<i>Pulsatilla vulgaris</i> agg.	4656
1232	<i>Pulsatilla vulgaris</i> subsp. <i>grandis</i>	23437
1233	<i>Pyrus communis</i> agg.	4669
1234	<i>Pyrus communis</i>	6936
1235	<i>Pyrus communis</i> agg.	4669
1236	<i>Pyrus communis</i> subsp. <i>pyraster</i>	23449
1237	<i>Pyrus pyraster</i>	4671
1238	<i>Quercus petraea</i> agg.	4678
1239	<i>Quercus petraea</i>	4680
1240	<i>Quercus sessiliflora</i>	23468
1241	<i>Quercus robur</i>	4685
1242	<i>Quercus pedunculata</i>	23466
1243	<i>Quercus robur</i>	4685
1244	<i>Ranunculus acris</i> agg.	4689
1245	<i>Ranunculus acris</i>	4690
1246	<i>Ranunculus acris</i> agg.	4689
1247	<i>Ranunculus aquatilis</i> agg.	4697
1248	<i>Ranunculus aquatilis</i>	4698
1249	<i>Ranunculus aquatilis</i> agg.	4697
1250	<i>Ranunculus peltatus</i>	12030
1251	<i>Ranunculus auricomus</i> agg.	4709
1252	<i>Ranunculus auricomus</i>	11978
1253	<i>Ranunculus auricomus</i> agg.	4709
1254	<i>Ranunculus auricomus</i> s. l.	4710
1255	<i>Ranunculus biformis</i>	27241
1256	<i>Ranunculus kochii</i>	10821
1257	<i>Ranunculus rectus</i>	6956
1258	<i>Ranunculus bulbosus</i>	4717
1259	<i>Ranunculus bulbosus</i>	4717
1260	<i>Ranunculus bulbosus</i> subsp. <i>bulbosus</i>	12015
1261	<i>Ranunculus ficaria</i>	4721
1262	<i>Ficaria verna</i>	21893
1263	<i>Ranunculus ficaria</i>	4721
1264	<i>Ranunculus ficaria</i> subsp. <i>bulbilifer</i>	4722
1265	<i>Ranunculus flammula</i> agg.	4726
1266	<i>Ranunculus flammula</i>	4727
1267	<i>Ranunculus flammula</i> agg.	4726
1268	<i>Ranunculus reptans</i>	4728
1269	<i>Ranunculus montanus</i> agg.	4743
1270	<i>Ranunculus breyninus</i>	23477
1271	<i>Ranunculus montanus</i>	4747
1272	<i>Ranunculus montanus</i> agg.	4743
1273	<i>Ranunculus polyanthemus</i> agg.	4758
1274	<i>Ranunculus nemorosus</i>	4759
1275	<i>Ranunculus nemorosus</i> subsp. <i>polyanthemophyllus</i>	23501
1276	<i>Ranunculus polyanthemoides</i>	4760
1277	<i>Ranunculus polyanthemophyllus</i>	4761
1278	<i>Ranunculus polyanthemus</i>	4762
1279	<i>Ranunculus polyanthemus</i> agg.	4758
1280	<i>Raphanus raphanistrum</i> agg.	4778
1281	<i>Raphanus raphanistrum</i>	4780
1282	<i>Raphanus sativus</i>	4781

1283	<i>Rhinanthus angustifolius</i>	23544
1284	<i>Rhinanthus angustifolius</i>	23544
1285	<i>Rhinanthus angustifolius</i> subsp. <i>angustifolius</i>	23545
1286	<i>Rhinanthus angustifolius</i> subsp. <i>grandiflorus</i>	6569
1287	<i>Rhinanthus serotinus</i>	4832
1288	<i>Rhinanthus aristatus</i> agg.	4817
1289	<i>Rhinanthus aristatus</i>	23551
1290	<i>Rhinanthus glacialis</i>	4819
1291	<i>Rhinanthus minor</i>	4828
1292	<i>Alectorolophus minor</i>	20304
1293	<i>Rhinanthus minor</i>	4828
1294	<i>Ribes rubrum</i> agg.	4850
1295	<i>Ribes rubrum</i>	4851
1296	<i>Ribes rubrum</i> agg.	4850
1297	<i>Rosa canina</i> agg. s. l.	94740
1298	<i>Rosa canina</i>	26665
1299	<i>Rosa canina</i> agg.	4872
1300	<i>Rosa canina</i> agg. s. l.	94740
1301	<i>Rosa corymbifera</i>	26666
1302	<i>Rosa obtusifolia</i>	4897
1303	<i>Rosa rubiginosa</i> agg. s. l.	92752
1304	<i>Rosa elliptica</i>	4887
1305	<i>Rosa micrantha</i>	4893
1306	<i>Rosa rubiginosa</i>	4902
1307	<i>Rosa rubiginosa</i> agg. s. l.	92752
1308	<i>Rosa spinosissima</i>	23649
1309	<i>Rosa pimpinellifolia</i>	4899
1310	<i>Rosa tomentosa</i> agg. s. l.	92754
1311	<i>Rosa tomentosa</i>	4912
1312	<i>Rosa tomentosa</i> agg.	4907
1313	<i>Rosa villosa</i> agg.	4908
1314	<i>Rubus canescens</i>	4952
1315	<i>Rubus canescens</i>	4952
1316	<i>Rubus tomentosus</i>	25709
1317	<i>Rubus grabowskii</i>	7078
1318	<i>Rubus thyrsanthus</i>	5056
1319	<i>Rubus latiarcuatus</i>	24749
1320	<i>Rubus vulgaris</i> var. <i>mollis</i>	11374
1321	<i>Rubus montanus</i>	24778
1322	<i>Rubus candicans</i>	4951
1323	<i>Rubus montanus</i>	24778
1324	<i>Rubus plicatus</i>	5024
1325	<i>Rubus affinis</i>	4931
1326	<i>Rubus plicatus</i>	5024
1327	<i>Rubus</i> sect. <i>Rubus</i>	11351
1328	<i>Rubus fruticosus</i> s. l.	11886
1329	<i>Rubus</i> sect. <i>Rubus</i>	11351
1330	<i>Rumex acetosa</i> agg.	92799
1331	<i>Rumex acetosa</i>	5073
1332	<i>Rumex thyrsiflorus</i>	5108
1333	<i>Rumex acetosella</i>	26619
1334	<i>Rumex acetosella</i>	26619
1335	<i>Rumex acetosella</i> agg.	5074
1336	<i>Rumex acetosella</i> subsp. <i>acetosella</i>	26618
1337	<i>Rumex acetosella</i> subsp. <i>tenuifolius</i>	27201
1338	<i>Rumex tenuifolius</i>	5077
1339	<i>Rumex arifolius</i>	20080
1340	<i>Rumex alpestris</i>	5078
1341	<i>Rumex arifolius</i>	20080
1342	<i>Rumex pseudoalpinus</i>	23661
1343	<i>Rumex alpinus</i>	5079
1344	<i>Rumex</i> × <i>pratensis</i>	50156
1345	<i>Rumex</i> × <i>pratensis</i>	50156

1346	<i>Rumex crispus</i> × <i>obtusifolius</i>	92814
1347	<i>Salix fragilis</i> agg.	5167
1348	<i>Salix</i> × <i>rubens</i>	5169
1349	<i>Salix fragilis</i>	5168
1350	<i>Salix myrsinifolia</i>	5185
1351	<i>Salix myrsinifolia</i>	5185
1352	<i>Salix nigricans</i>	23730
1353	<i>Salix repens</i> agg.	27193
1354	<i>Salix repens</i>	27194
1355	<i>Salix repens</i> agg.	27193
1356	<i>Salix repens</i> s. l.	5191
1357	<i>Salix repens</i> subsp. <i>repens</i>	5193
1358	<i>Salix retusa</i> agg.	5196
1359	<i>Salix retusa</i>	5198
1360	<i>Salix retusa</i> agg.	5196
1361	<i>Salix serpillifolia</i>	5199
1362	<i>Salix</i> × <i>multinervis</i>	27195
1363	<i>Salix</i> × <i>multinervis</i>	27195
1364	<i>Salix aurita</i> × <i>cinerea</i>	92857
1365	<i>Salix</i> × <i>smithiana</i>	27196
1366	<i>Salix</i> × <i>smithiana</i>	27196
1367	<i>Salix caprea</i> × <i>viminalis</i>	92873
1368	<i>Salix</i> × <i>wimmeriana</i>	50108
1369	<i>Salix caprea</i> × <i>purpurea</i>	92872
1370	<i>Salsola kali</i>	5208
1371	<i>Salsola kali</i> subsp. <i>tragus</i>	5211
1372	<i>Salsola tragus</i>	23749
1373	<i>Sanguisorba minor</i>	5231
1374	<i>Sanguisorba minor</i>	5231
1375	<i>Sanguisorba minor</i> subsp. <i>minor</i>	5232
1376	<i>Scabiosa columbaria</i> agg.	5337
1377	<i>Scabiosa columbaria</i>	5338
1378	<i>Scabiosa columbaria</i> agg.	5337
1379	<i>Scabiosa lucida</i>	5342
1380	<i>Scleranthus annuus</i> agg.	5376
1381	<i>Scleranthus annuus</i>	5377
1382	<i>Scleranthus annuus</i> agg.	5376
1383	<i>Scleranthus polycarpus</i>	5378
1384	<i>Scleranthus</i> × <i>intermedius</i>	92980
1385	<i>Scleranthus annuus</i> × <i>perennis</i>	92978
1386	<i>Securigera varia</i>	21382
1387	<i>Coronilla varia</i>	1662
1388	<i>Securigera varia</i>	21382
1389	<i>Sedum rupestre</i> agg.	5429
1390	<i>Sedum reflexum</i>	5433
1391	<i>Sedum rupestre</i>	23907
1392	<i>Sedum rupestre</i> subsp. <i>reflexum</i>	23910
1393	<i>Sedum sexangulare</i>	5437
1394	<i>Sedum boloniense</i>	23894
1395	<i>Sedum mite</i>	23901
1396	<i>Sedum sexangulare</i>	5437
1397	<i>Sedum telephium</i> agg.	5440
1398	<i>Hylotelephium maximum</i>	7126
1399	<i>Sedum maximum</i>	5441
1400	<i>Sedum telephium</i>	27746
1401	<i>Sedum telephium</i> agg.	5440
1402	<i>Sedum telephium</i> subsp. <i>maximum</i>	23912
1403	<i>Senecio alpinus</i>	5467
1404	<i>Senecio alpinus</i>	5467
1405	<i>Senecio cordatus</i>	23945
1406	<i>Senecio aquaticus</i> agg.	5468
1407	<i>Senecio aquaticus</i>	5469
1408	<i>Senecio aquaticus</i> agg.	5468

1409	Senecio erraticus	5470
1410	Senecio incanus	5485
1411	Senecio carniolicus	23942
1412	Senecio jacobaea	5494
1413	Jacobaea vulgaris	25789
1414	Senecio jacobaea	5494
1415	Senecio nemorensis agg.	5496
1416	Senecio fuchsii	5498
1417	Senecio hercynicus	5499
1418	Senecio nemorensis	94860
1419	Senecio nemorensis agg.	5496
1420	Senecio ovatus	23947
1421	Senecio ovatus subsp. alpestris	7006
1422	Serratula tinctoria	27047
1423	Serratula tinctoria	27047
1424	Serratula tinctoria agg.	5524
1425	Seseli libanotis	5540
1426	Libanotis montana	22460
1427	Libanotis sibirica	22463
1428	Seseli libanotis	5540
1429	Sesleria varia agg.	5558
1430	Sesleria albicans	23996
1431	Sesleria albicans subsp. albicans	27051
1432	Sesleria albicans var. albicans	15414
1433	Sesleria caerulea	25028
1434	Sesleria caerulea subsp. calcaria	13441
1435	Sesleria varia	24991
1436	Setaria pumila	24008
1437	Setaria glauca	5563
1438	Setaria pumila	24008
1439	Silene	60691
1440	Lychnis	60681
1441	Silene	60691
1442	Silene acaulis agg.	5578
1443	Silene acaulis	5579
1444	Silene acaulis agg.	5578
1445	Silene coronaria	11625
1446	Lychnis coronaria	3551
1447	Silene flos-cuculi	24031
1448	Lychnis flos-cuculi	3552
1449	Silene flos-cuculi	24031
1450	Silene latifolia	7012
1451	Melandrium album	22627
1452	Silene alba	5581
1453	Silene latifolia	7012
1454	Silene latifolia subsp. alba	22546
1455	Silene pratensis	20058
1456	Silene noctiflora	5603
1457	Melandrium noctiflorum	22630
1458	Silene noctiflora	5603
1459	Silene nutans agg.	5604
1460	Silene nutans	5606
1461	Silene nutans agg.	5604
1462	Silene viscaria	11627
1463	Lychnis viscaria	3554
1464	Silene viscaria	11627
1465	Viscaria vulgaris	24569
1466	Silene vulgaris	5629
1467	Silene cucubalus	24029
1468	Silene inflata	25277
1469	Silene vulgaris	5629
1470	Silene vulgaris agg.	20067
1471	Silene vulgaris subsp. vulgaris	5634



1472	<i>Silene vulgaris</i> var. <i>humilis</i>	24046
1473	<i>Soldanella alpicola</i>	24100
1474	<i>Soldanella pusilla</i> s. l.	5678
1475	<i>Solidago virgaurea</i>	5682
1476	<i>Solidago virgaurea</i>	5682
1477	<i>Solidago virgaurea</i> subsp. <i>virgaurea</i>	5684
1478	<i>Sonchus asper</i>	5690
1479	<i>Sonchus asper</i>	5690
1480	<i>Sonchus asper</i> subsp. <i>asper</i>	5691
1481	<i>Sorbus aria</i> agg.	5696
1482	<i>Sorbus aria</i>	5697
1483	<i>Sorbus aria</i> agg.	5696
1484	<i>Sorbus aucuparia</i>	5700
1485	<i>Sorbus aucuparia</i>	5700
1486	<i>Sorbus aucuparia</i> subsp. <i>aucuparia</i>	5701
1487	<i>Spergula pentandra</i> agg.	5730
1488	<i>Spergula morisonii</i>	5731
1489	<i>Spergula vernalis</i>	24154
1490	<i>Spergularia media</i>	5734
1491	<i>Spergularia maritima</i>	24145
1492	<i>Spergularia media</i>	5734
1493	<i>Stellaria alsine</i>	5769
1494	<i>Stellaria alsine</i>	5769
1495	<i>Stellaria uliginosa</i>	5782
1496	<i>Stellaria aquatica</i>	24917
1497	<i>Myosoton aquaticum</i>	3805
1498	<i>Stellaria aquatica</i>	24917
1499	<i>Stellaria media</i> agg.	5774
1500	<i>Stellaria media</i>	5775
1501	<i>Stellaria media</i> agg.	5774
1502	<i>Stellaria pallida</i>	5777
1503	<i>Stellaria nemorum</i>	5778
1504	<i>Stellaria nemorum</i>	5778
1505	<i>Stellaria nemorum</i> subsp. <i>nemorum</i>	5780
1506	<i>Stellaria palustris</i>	11573
1507	<i>Stellaria glauca</i>	24184
1508	<i>Stellaria palustris</i>	11573
1509	<i>Stipa calamagrostis</i>	24197
1510	<i>Achnatherum calamagrostis</i>	47
1511	<i>Stipa pennata</i> agg.	5787
1512	<i>Stipa joannis</i>	5797
1513	<i>Stipa pennata</i>	24203
1514	<i>Stipa pennata</i> var. <i>mediterranea</i>	13411
1515	<i>Stipa pulcherrima</i>	13746
1516	<i>Symphytum officinale</i>	26629
1517	<i>Symphytum officinale</i>	26629
1518	<i>Symphytum officinale</i> agg.	5823
1519	<i>Tanacetum corymbosum</i> agg.	5841
1520	<i>Chrysanthemum corymbosum</i>	21294
1521	<i>Tanacetum corymbosum</i>	5843
1522	<i>Tanacetum parthenium</i>	5845
1523	<i>Chrysanthemum parthenium</i>	21315
1524	<i>Tanacetum parthenium</i>	5845
1525	<i>Tanacetum vulgare</i>	5846
1526	<i>Chrysanthemum vulgare</i>	21314
1527	<i>Tanacetum vulgare</i>	5846
1528	<i>Taraxacum</i> sect. <i>Alpina</i> et <i>Hamata</i> et <i>Ruderalia</i>	93219
1529	<i>Taraxacum</i> sect. <i>Alpina</i>	7424
1530	<i>Taraxacum officinale</i> agg.	7442
1531	<i>Taraxacum</i> sect. <i>Alpina</i> et <i>Hamata</i> et <i>Ruderalia</i>	93219
1532	<i>Taraxacum</i> sect. <i>Ruderalia</i>	7434
1533	<i>Taraxacum officinale</i>	14513
1534	<i>Taraxacum</i> sect. <i>Erythrosperma</i>	7428

1535	Taraxacum erythrospermum	14460
1536	Taraxacum laevigatum	14457
1537	Taraxacum levigatum agg.	14458
1538	Taraxacum sect. Erythrosperma	7428
1539	Taraxacum sect. Palustria	7433
1540	Taraxacum palustre	25514
1541	Taraxacum sect. Palustria	7433
1542	Tephroseris helenitis	23949
1543	Senecio helenitis	5482
1544	Tephroseris helenitis	23949
1545	Tephroseris integrifolia	23953
1546	Senecio integrifolius	5492
1547	Tephroseris integrifolia	23953
1548	Teucrium scorodonia	5889
1549	Teucrium scorodonia	5889
1550	Teucrium scorodonia subsp. scorodonia	5891
1551	Thalictrum minus agg.	5896
1552	Thalictrum minus	5898
1553	Thalictrum minus agg.	5896
1554	Thalictrum minus subsp. saxatile	5902
1555	Thlaspi caerulescens	5928
1556	Noccaea caerulescens	22785
1557	Thlaspi cepaeifolium	25000
1558	Thlaspi rotundifolium	5940
1559	Thlaspi perfoliatum	5938
1560	Microthlaspi perfoliatum	22667
1561	Thlaspi perfoliatum	5938
1562	Thymus praecox agg.	5955
1563	Thymus praecox	5957
1564	Thymus praecox agg.	5955
1565	Thymus praecox subsp. polytrichus	5959
1566	Thymus praecox subsp. praecox	5960
1567	Thymus serpyllum subsp. praecox	13239
1568	Thymus pulegioides agg.	5964
1569	Thymus pulegioides	5965
1570	Thymus pulegioides agg.	5964
1571	Thymus pulegioides subsp. pulegioides	7053
1572	Thymus serpyllum subsp. chamaedrys	13255
1573	Thymus serpyllum agg.	6456
1574	Thymus angustifolius	24265
1575	Thymus serpyllum	5966
1576	Thymus serpyllum agg.	6456
1577	Tragopogon pratensis	7141
1578	Tragopogon minor	5999
1579	Tragopogon orientalis	6000
1580	Tragopogon pratensis	7141
1581	Tragopogon pratensis agg.	5998
1582	Tragopogon pratensis subsp. orientalis	24325
1583	Tragopogon pratensis subsp. pratensis	7100
1584	Trichophorum cespitosum	27072
1585	Trichophorum cespitosum	27072
1586	Trichophorum cespitosum subsp. germanicum	24330
1587	Trifolium dubium agg.	6028
1588	Trifolium dubium	6029
1589	Trifolium dubium agg.	6028
1590	Trifolium minus	24352
1591	Trifolium pratense	6057
1592	Trifolium pratense	6057
1593	Trifolium pratense subsp. pratense	6061
1594	Tripleurospermum maritimum agg.	6096
1595	Matricaria inodora	22000
1596	Matricaria maritima	22580
1597	Matricaria perforata	22003

1598	<i>Tripleurospermum inodorum</i>	20061
1599	<i>Tripleurospermum maritimum</i>	6098
1600	<i>Tripleurospermum perforatum</i>	6097
1601	<i>Ulmus glabra</i>	6137
1602	<i>Ulmus glabra</i>	6137
1603	<i>Ulmus montana</i>	24424
1604	<i>Ulmus scabra</i>	24425
1605	<i>Ulmus minor</i> agg.	6139
1606	<i>Ulmus campestris</i>	24420
1607	<i>Ulmus minor</i>	6140
1608	<i>Utricularia minor</i> agg.	6152
1609	<i>Utricularia minor</i>	6154
1610	<i>Utricularia minor</i> agg.	6152
1611	<i>Vaccinium oxycoccos</i> agg.	6161
1612	<i>Oxycoccus palustris</i>	4070
1613	<i>Vaccinium oxycoccos</i>	6163
1614	<i>Vaccinium oxycoccos</i> agg.	6161
1615	<i>Vaccinium uliginosum</i>	6166
1616	<i>Vaccinium uliginosum</i>	6166
1617	<i>Vaccinium uliginosum</i> agg.	6164
1618	<i>Valeriana officinalis</i> agg.	6177
1619	<i>Valeriana officinalis</i>	6178
1620	<i>Valeriana officinalis</i> agg.	6177
1621	<i>Valeriana pratensis</i>	6179
1622	<i>Valeriana procurrens</i>	6180
1623	<i>Valeriana wallrothii</i>	6183
1624	<i>Veronica agrestis</i> agg.	93432
1625	<i>Veronica agrestis</i>	6226
1626	<i>Veronica persica</i>	6271
1627	<i>Veronica polita</i>	6272
1628	<i>Veronica anagallis-aquatica</i> agg.	6231
1629	<i>Veronica anagallis-aquatica</i>	6232
1630	<i>Veronica anagalloides</i>	6233
1631	<i>Veronica catenata</i>	6234
1632	<i>Veronica austriaca</i> agg.	6237
1633	<i>Veronica austriaca</i>	13751
1634	<i>Veronica austriaca</i> subsp. <i>dentata</i>	24471
1635	<i>Veronica austriaca</i> subsp. <i>teucrium</i>	25019
1636	<i>Veronica prostrata</i>	13869
1637	<i>Veronica teucrium</i>	6243
1638	<i>Veronica chamaedrys</i>	13752
1639	<i>Veronica chamaedrys</i>	13752
1640	<i>Veronica chamaedrys</i> agg.	6248
1641	<i>Veronica hederifolia</i>	26766
1642	<i>Veronica hederifolia</i>	26766
1643	<i>Veronica hederifolia</i> agg.	6257
1644	<i>Veronica hederifolia</i> subsp. <i>hederifolia</i>	7101
1645	<i>Veronica sublobata</i>	6259
1646	<i>Veronica verna</i> agg.	6292
1647	<i>Veronica dillenii</i>	6293
1648	<i>Veronica verna</i>	6294
1649	<i>Veronica verna</i> agg.	6292
1650	<i>Vicia cracca</i> agg.	6301
1651	<i>Vicia cracca</i>	6302
1652	<i>Vicia cracca</i> agg.	6301
1653	<i>Vicia tenuifolia</i>	6306
1654	<i>Vicia sativa</i> agg.	6328
1655	<i>Vicia angustifolia</i>	6329
1656	<i>Vicia sativa</i>	6334
1657	<i>Vicia sativa</i> agg.	6328
1658	<i>Vicia sativa</i> subsp. <i>nigra</i>	24521
1659	<i>Vicia sativa</i> var. <i>nigra</i>	24518
1660	<i>Vicia tetrasperma</i> agg.	6338

1661	<i>Vicia tenuissima</i>	6340
1662	<i>Vicia tetrasperma</i>	6341
1663	<i>Vicia tetrasperma</i> agg.	6338
1664	<i>Vincetoxicum hirundinaria</i> agg.	6349
1665	<i>Cynanchum vincetoxicum</i>	21465
1666	<i>Vincetoxicum hirundinaria</i>	6351
1667	<i>Vincetoxicum officinale</i>	24536
1668	<i>Viola canina</i> agg.	24994
1669	<i>Viola canina</i>	6367
1670	<i>Viola canina</i> subsp. <i>canina</i>	6368
1671	<i>Viola persicifolia</i>	6386
1672	<i>Viola persicifolia</i>	6386
1673	<i>Viola stagnina</i>	6394
1674	<i>Viola silvatica</i> agg.	94746
1675	<i>Viola</i> × <i>bavarica</i>	7420
1676	<i>Viola reichenbachiana</i>	6390
1677	<i>Viola reichenbachiana</i> × <i>riviniana</i>	93487
1678	<i>Viola riviniana</i>	6391
1679	<i>Viola silvatica</i>	24559
1680	<i>Viola tricolor</i> agg.	6397
1681	<i>Viola arvensis</i>	6398
1682	<i>Viola arvensis</i> × <i>tricolor</i>	93457
1683	<i>Viola arvensis</i> subsp. <i>arvensis</i>	7208
1684	<i>Viola tricolor</i>	6402
1685	<i>Viola tricolor</i> subsp. <i>tricolor</i>	6405
1686	<i>Viola tricolor</i> var. <i>arvensis</i>	12796
1687	× <i>Festulolium krasanii</i>	93548
1688	<i>Festuca arundinacea</i> × <i>Lolium multiflorum</i>	91392
1689		

1690 Extended Data Table 3 | List of all taxon names that were adapted within projects, in  
 1691 addition to the harmonisation across all projects, as shown in Extended Data Table 2.  
 1692 PROJECT\_ID and Project\_Name refer to the project in Extended Data Table 1, RS\_PLOT is the  
 1693 plot resurvey ID, which identifies the groups of plots compared in time, RELEVE\_NR is the  
 1694 plot observation ID in the Turboveg 2 database. Taxon\_name\_old is the name given by the  
 1695 original author, while Taxon\_name\_new\_1 and Taxon\_name\_new\_2 refer to newly assigned  
 1696 taxon names. In case of two new names the cover values of the old taxon were equally  
 1697 divided among the two new taxa.

PROJECT_ID	Project_Name	RS_Plot	RELEVE_NR	Taxon_name_old	Taxon_name_new_1	Taxon_name_new_2
6	Bode (2005)	HEIDE	331	Cuscuta	Cuscuta	epithymum
6	Bode (2005)	HEIDE	270	Fagus	Fagus	sylvatica
6	Bode (2005)	HEIDE	271	Fagus	Fagus	sylvatica
23	Jandt & Leonhardt (unpubl.)	32	138	Tragopogon	Tragopogon	pratensis
23	Jandt & Leonhardt (unpubl.)	63	190	Pulsatilla	Pulsatilla	pratensis
23	Jandt & Leonhardt (unpubl.)	56	182	Anthericum	Anthericum	ramosum
23	Jandt & Leonhardt (unpubl.)	80	214	Epipactis	Epipactis	atrorubens
23	Jandt & Leonhardt (unpubl.)	123	6	Trifolium	Trifolium	repens
23	Jandt & Leonhardt (unpubl.)	138	36	Epipactis	Epipactis	atrorubens
23	Jandt & Leonhardt (unpubl.)	146	38	Achillea	Achillea	millefolium agg.
23	Jandt & Leonhardt (unpubl.)	146	38	Tragopogon	Tragopogon	pratensis
23	Jandt & Leonhardt (unpubl.)	205	118	Tragopogon	Tragopogon	pratensis
23	Jandt & Leonhardt (unpubl.)	246	120	Epipactis	Epipactis	atrorubens
23	Jandt & Leonhardt (unpubl.)	251	128	Epipactis	Epipactis	atrorubens
23	Jandt & Leonhardt (unpubl.)	367	166	Tragopogon	Tragopogon	pratensis
23	Jandt & Leonhardt (unpubl.)	373	176	Tragopogon	Tragopogon	pratensis
16	Hagen (1996)	G04	180	Festuca	Festuca	rupicola
16	Hagen (1996)	G09	171	Anemone	Anemone	vulgaris
16	Hagen (1996)	G15	183	Anemone	Anemone	vulgaris
16	Hagen (1996)	G23	290	Epipactis	Epipactis	atrorubens

16	Hagen (1996)	Z20	377	Epipactis	Epipactis atrorubens
43	Heinrich, Marstaller & Voigt (2012)	A_CF5	857	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	CAT_16A	2014	Orchis	Orchis x hybrida
43	Heinrich, Marstaller & Voigt (2012)	CAT_14C	2004	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	CAT_16B	2015	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	CAT_18A	2026	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	CAT_18D	2029	Orchis	Orchis purpurea
43	Heinrich, Marstaller & Voigt (2012)	CAT_18E	2030	Orchis	Orchis purpurea
43	Heinrich, Marstaller & Voigt (2012)	CAT_19A	2032	Orchis	Orchis purpurea
43	Heinrich, Marstaller & Voigt (2012)	CAT_19B	2033	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	CAT_19D	2035	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	CAT_20A	2038	Platanthera	Platanthera chlorantha
43	Heinrich, Marstaller & Voigt (2012)	CAT_20C	2040	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	CAT_20D	2041	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	CAT_21B	2045	Orchis	Orchis x hybrida
43	Heinrich, Marstaller & Voigt (2012)	CAT_21C	2046	Orchis	Orchis purpurea
43	Heinrich, Marstaller & Voigt (2012)	CAT_22A	2050	Orchis	Orchis purpurea
43	Heinrich, Marstaller & Voigt (2012)	CAT_22B	2051	Platanthera	Platanthera chlorantha
43	Heinrich, Marstaller & Voigt (2012)	CAT_22E	2054	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	CAT_23A	2056	Orchis	Orchis purpurea

43	Heinrich, Marstaller & Voigt (2012)	CAT_23B	2057	Platanthera	Platanthera chlorantha
43	Heinrich, Marstaller & Voigt (2012)	CAT_28A	2086	Orchis	Orchis militaris
43	Heinrich, Marstaller & Voigt (2012)	M_CF3	471	Ulmus	Ulmus glabra
43	Heinrich, Marstaller & Voigt (2012)	M_CF3	495	Ulmus	Ulmus glabra
43	Heinrich, Marstaller & Voigt (2012)	M_CF3	519	Ulmus	Ulmus glabra
43	Heinrich, Marstaller & Voigt (2012)	M_CF4	568	Orchis	Orchis x hybrida
43	Heinrich, Marstaller & Voigt (2012)	M_CF6	570	Orchis	Orchis militaris
74	Horchler (unpubl.)	67	93	Callitriche	Callitriche palustris agg.
74	Horchler (unpubl.)	68	94	Callitriche	Callitriche palustris agg.
19	Hüllbusch et al. (2016)	MW9	28	Tragopogon	Tragopogon pratensis
14	Kuhn et al. (2011)	4350724.00_5487257 .00	1608	Campanula	Campanula rapunculoides
14	Kuhn et al. (2011)	4365134.20_5531963 .60	1300	Primula	Primula veris
14	Kuhn et al. (2011)	4365183.00_5532063 .00	1301	Campanula	Campanula rapunculoides
14	Kuhn et al. (2011)	4365308.00_5532308 .00	1302	Campanula	Campanula rapunculoides
14	Kuhn et al. (2011)	4377860.10_5547643 .00	1357	Primula	Primula veris
14	Kuhn et al. (2011)	4395362.00_5271657 .00	2024	Primula	Primula elatior
14	Kuhn et al. (2011)	4415784.00_5532303 .00	832	Primula	Primula veris
14	Kuhn et al. (2011)	4420009.00_5433917 .00	3580	Agrimonia	Agrimonia eupatoria
14	Kuhn et al. (2011)	4421750.00_5573096 .00	34	Ajuga	Ajuga reptans
14	Kuhn et al. (2011)	4450612.00_5509207 .00	769	Ajuga	Ajuga reptans
55	Meineke & Menge (2010)	DBF 4	16	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 4	17	Alchemilla	Alchemilla vulgaris agg.

55	Meineke & Menge (2010)	DBF 4	18	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 4	19	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 8	36	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 8	37	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 8	38	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 8	40	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 10	46	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 10	47	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 10	48	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 10	50	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 11	51	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 11	52	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 11	53	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 11	55	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 13	61	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 13	62	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 13	63	Alchemilla	Alchemilla vulgaris agg.
55	Meineke & Menge (2010)	DBF 13	65	Alchemilla	Alchemilla vulgaris agg.
29	Müller (2002)	K/SH1	119	Thymus	Thymus praecox agg.
32	Peppler-Lisbach & Könitz (2017)	N 86-192	56	Euphorbia stricta	Euphrasia stricta
32	Peppler-Lisbach & Könitz (2017)	N 86-193	57	Euphorbia stricta	Euphrasia stricta
36	Raehse (2001)	M546/50	880	Fragaria	Fragaria vesca



	Schmidt et al.					Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_37	1825	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_40	1828	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_41	1829	Anemone		Anemone nemorosa	Anemone ranunculoides
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_42	1830	Anemone		Anemone nemorosa	Anemone ranunculoides
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_43	1831	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_44	1832	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_45	1833	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_46	1834	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_47	1835	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_48	1836	Anemone		Anemone nemorosa	Anemone ranunculoides
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_49	1837	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_50	1838	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF1_51	1839	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF2_30	1869	Anemone		Anemone nemorosa	Anemone ranunculoides
33	(unpubl.) Schmidt et al.	Hünstollen_KF2_32	1871	Anemone		Anemone nemorosa	Anemone ranunculoides
33	(unpubl.) Schmidt et al.	Hünstollen_KF2_34	1873	Anemone		Anemone nemorosa	Anemone ranunculoides
33	(unpubl.) Schmidt et al.	Hünstollen_KF2_35	1874	Anemone		Anemone nemorosa	Anemone ranunculoides
33	(unpubl.) Schmidt et al.	Hünstollen_KF2_37	1876	Anemone		Anemone nemorosa	Anemone ranunculoides
33	(unpubl.) Schmidt et al.	Hünstollen_KF2_41	1880	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF2_42	1881	Anemone		Anemone nemorosa	
33	(unpubl.) Schmidt et al.	Hünstollen_KF2_43	1882	Anemone		Anemone nemorosa	
33	(unpubl.) Strubelt & Zacharias	Hünstollen_KF2_44	1883	Anemone		Anemone nemorosa	
47	(2015)	8	41	Campanula		Campanula trachelium	

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1 **Supplementary Methods**

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