BSBI New Year Plant Hunt 2019

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Summary

- The BSBI's eighth New Year Plant Hunt (NYPH) took place between Saturday 29th December 2018 and Tuesday 1st January 2019. Volunteers submitted lists of native and non-native plants they found in flower in the wild during a three-hour walk at locations throughout Britain and Ireland. The results were submitted online via smartphones and other electronic devices.

- Almost 1500 recorders took part submitting 14,193 records of 627 plant species on 712 lists (exactly 100 more than in 2018). List lengths varied dramatically (0-120 species) but 19.9 species were recorded in flower, on average, almost four more species (per list) than in 2018.

- The four species most frequently recorded in flower in 2019 were identical to previous years: in rank order these were Daisy *Bellis perennis*, Groundsel *Senecio vulgaris*, Dandelion *Taraxacum* agg., and Annual Meadow-grass *Poa annua*. Shepherd's-purse *Capsella bursa-pastoris* and Chickweed *Stellaria media* were tied in fifth place, an increase of two and three places respectively. In comparison, Gorse *Ulex europaeus*, ranked fifth in 2018, fell six places to eleventh in 2019.

- In 2019 twice as many species recorded were flowering late (58%) rather than early (24%), as opposed to 7% which would be expected to flower at New Year. When expressed as the proportion of all flowering records made (rather than as a proportion of all species recorded) 41% were flowering late, 39% as expected and only 7% early.

- These proportions of species flowering early, late or as expected were almost identical to previous years, suggesting that the vast majority of plant species flowering out of season are 'autumn stragglers' that continue to flower in the winter due to mild weather.

- These proportions do not appear to change significantly from year to year although the overall numbers of plants in flower increase during milder winters, most notably in 2016 and to a lesser extent 2015 and 2019, when temperatures were well above average in November and December.

Introduction

Since 2012, the Botanical Society of Britain & Ireland (BSBI) has run an annual hunt for plants in flower during a four-day period over New Year (Marsh, 2015, 2016; Walker & Marsh, 2017, 2018). The scheme has grown steadily and in 2018 around 900 volunteers took part at 612 locations across the whole of Great Britain and Ireland (Walker & Marsh, 2018). In The Netherlands, the Dutch botanical society (FLORON) runs a very similar scheme modelled on NYPH, which has has become very popular with over 1,000 lists completed each year ('Year End Plant Hunt'; Sparrius, 2019).

Although the NYPH was originally intended to provide a fun and competitive activity for botanists during a quiet period, it is now helping to build-up a picture of 'normal' winter flowering as well the response of plants to 'unseasonal' weather conditions which are increasingly being reported from around the globe. As such, NYPH is helping to improve our knowledge of how wildlife is responding to rising temperatures and changing weather patterns. Through the use of new technology, social media and online recording applications, the NYPH is also raising the profile of the BSBI and introducing its work to new audiences.

Method

For NYPH 2019 volunteers picked a day between Saturday 29th December 2018 and Tuesday 1st January 2019 and recorded all native and non-native plants (excluding obviously planted species in private gardens) that they found in flower in the wild on a walk not exceeding 3 hours (excluding breaks and time travelling between sites). Recorders were encouraged to restrict their recording to a single area or site but in a few cases multiple sites were visited within the three hour period (for example at stops along a motorway). In a few cases recorders followed fixed routes that they had taken in previous years. Recorders were encouraged to check that plants were actually flowering, for example by checking that catkins were open, that grasses had open florets with stigmas or anthers etc. All ferns and fern-allies were excluded from lists.

In 2019 the majority of NYPH lists were submitted via a smartphone, tablet or PC, allowing simultaneous visualisation of the results as they came in (Fig. 1). This substantially increased the efficiency of data entry, reduced errors during data processing and allowed people to see their finds displayed in real time on an interactive map. Data validation prior to analyses included checking the completeness of the lists and that the site details submitted were correct, identifying unidentified species from photographs, checking doubtful records and that taxa matched those given by Stace (2010), and removing ferns and fern-allies and any taxa identified to genus only. Subspecies and varieties (including colour variants, 'flora pleno', etc.) were aggregated to species-level as were microspecies of hawkweeds

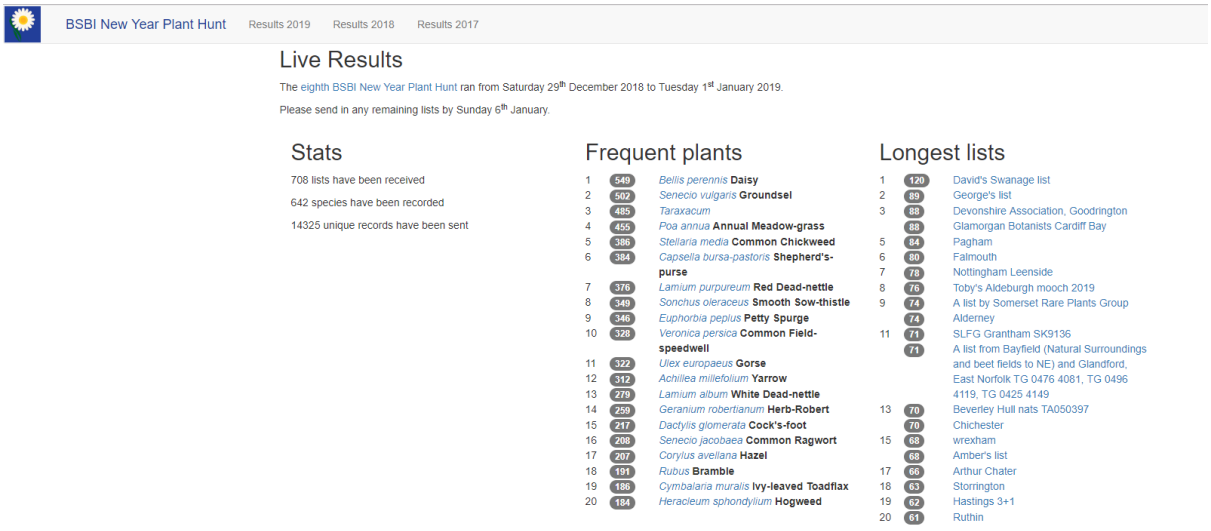
Hieracium, brambles *Rubus* and dandelions *Taraxacum*. Aggregates were also used for a number of species where closely related taxa are generally not recorded consistently (e.g. *Arenaria leptoclados/serpyllifolia*, *Aphanes arvensis/australis*, *Galanthus* spp., *Galeopsis bifida/tetrahit*, *Hedera helix/hibernica*, *Polygonum aviculare*). Non-native crops with native subspecies (e.g. *Beta vulgaris*, *Brassica rapus*) were not usually differentiated for the purposes of analyses.

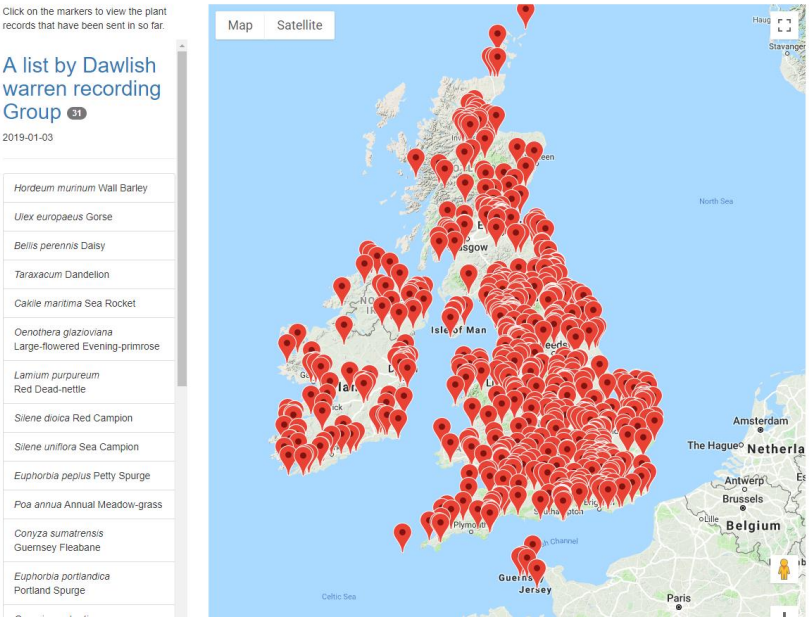
For the purposes of the analyses presented here, we only included NYPH lists compiled since 2015, as the sample size of earlier lists were too small to allow for us to make meaningful comparisons. Once lists had been submitted, species were categorised as native or alien (Preston *et al.*, 2002) with 'native' including species classified as 'native or alien'. 'Alien' species included long-established aliens (archaeophytes) and those introduced since 1500 (neophytes). A species flowering phenology was allocated to one of four categories based on normal flowering phenology (Table 1) with the typical flowering months taken from Clapham *et al.* (1987) and Sell & Murrell (1996-2018). Species were categorised as 'expected' if they normally flower at New Year; 'early' if the number of months from New Year to first flowering month is less than the number of months from the last flowering month to New year; and 'late' if the number of months from the last flowering month to New Year is less than the number of months from New Year to the first flowering month. Where the number of months from the first and last flowering months to New Year were equal, species were classified as 'early or late'. Examples of each category are given in Table 1.

Table 1. Classification of flowering at New Year (red shading) based on their typical flowering months (grey shading).

Species	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Mar	Jun
Daisy *Bellis perennis* (0, expected)												
Yarrow *Achillea millefolium* (+3, late)												
Hairy bitter-cress *Cardamine hirsuta* (-1, early)												
Red campion *Silene dioica* (-2, +2, early or late)												

Figure 1. Screenshot of the New Year Plant Hunt 2019 webpage showing live results and locations of plants hunts across Britain and Ireland.





Results

Number of participants

In 2019, 1471 recorders took part in NYPH, around 400 more participants than took part in 2018 (Table 2). However, much of this increase may simply reflect more precise reporting via the online form which for the first time allowed recorders to input the size of the group taking part. Many people opted to join one of the 30 group hunts advertised in advance via the BSBI website, and comments on social media suggest that others opted to go out recording with family and friends, making the NYPH a social event as much as an exercise in recording.

Table 2. The number of individuals participating in the New Year Plant Hunts, 2015-2019.

2015	2016	2017	2018	2019
c.300	405	416	>800	1471

Number of lists

In 2019, 712 lists were submitted, mainly in England but with nearly 100 lists completed in Scotland and Ireland (Table 3). One hundred more lists were completed than in 2018, mostly in England (+39) and Scotland (+38) (Table 3). The 2019 lists were recorded in 572 hectads compared to 521 in 2018 (Fig. 2). Although the majority of NYPH lists were recorded in the more populated lowlands of Britain and Ireland, good numbers were also completed in more remote regions, such as southwest England and southern and western Ireland, Cumbria, eastern Scotland, etc.

Table 3. The number of lists submitted for the New Year Plant Hunt, 2015-2019, broken down by region.

Lists	2015	2016	2017	2018	2019
England	101	297	282	427	466
Wales	10	19	28	33	41
Scotland	9	64	43	57	94
Ireland	21	50	104	94	99
Channel Isles	2	2	3	2	6
Isle of Man	0	0	0	0	6
Total	143	432	460	612	712

Number of species

In 2019, 627 species were recorded in flower; this is the highest total ever recorded during the NYPH, being 95 more than in 2018 and 16 more than in 2016 when a then record-breaking total of 611 species were recorded in flower (Table 4a). As in previous years, this total was roughly equally distributed between natives and aliens: in 2019 aliens comprised 48% of all the species recorded in flower which is comparable, and certainly not significantly different, from the numbers recorded in previous years when they represented between 45% and 49% of all the species recorded.

Number of records

In 2019 14,193 individual records of species in flower were submitted, over 4,000 more than in 2018 (Table 4b). As in previous years, the number of records of native species accounted for roughly two-thirds of all the records submitted (64%).

Figure 2. Map of the New Year Plant Hunt lists received in 2019. Each dot represents a hectad (10 × 10 km grid square) in which at least one NYPH list was recorded.

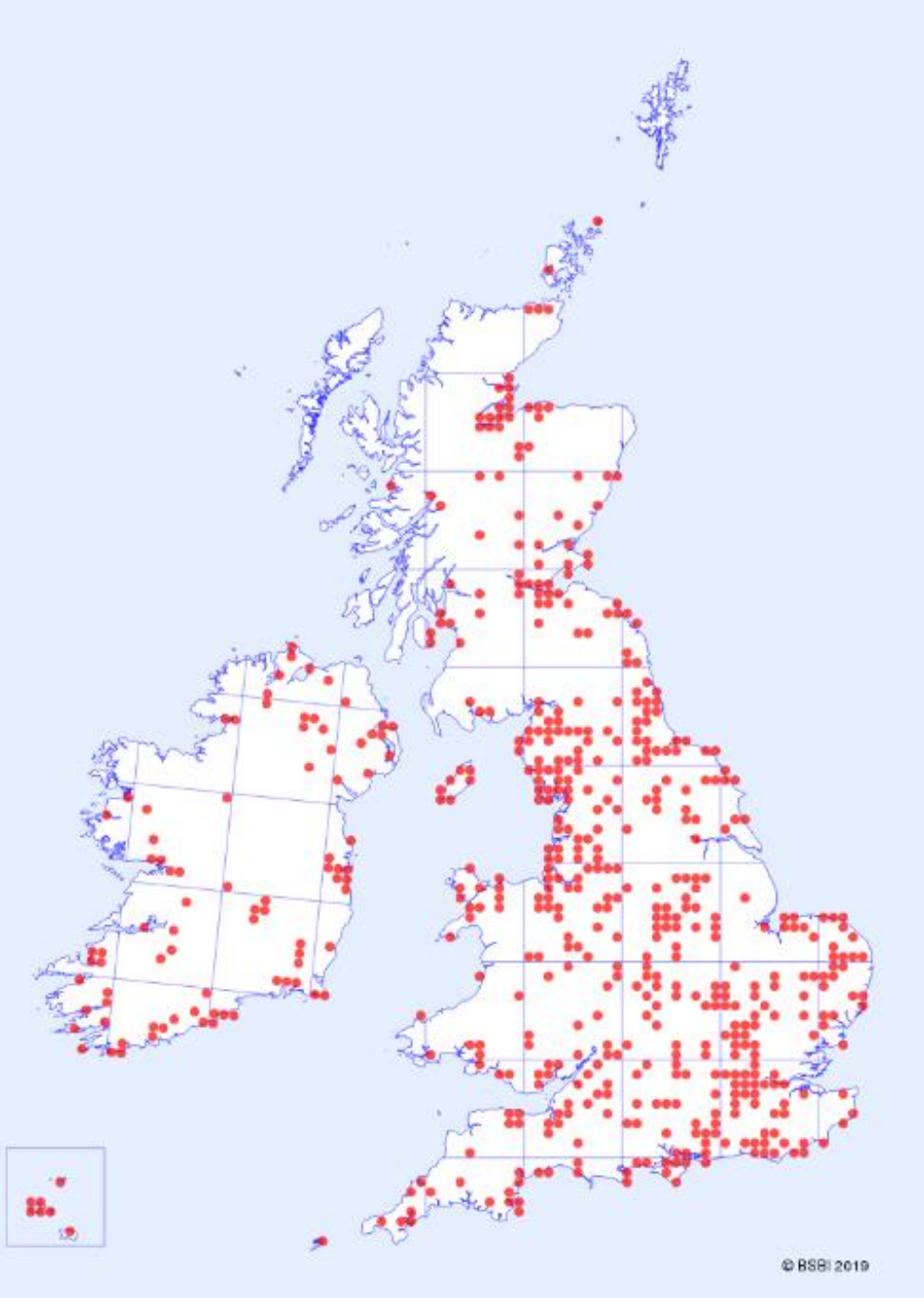


Table 4. The number of plant species recorded in flower during the New Year Plant Hunt, 2015-2019. The percentages are given in parentheses.

	2015	2016	2017	2018	2019
(a) Species					
Native	206 (56%)	313 (51%)	264 (54%)	290 (55%)	327 (52%)
Alien	160 (44%)	298 (49%)	228 (46%)	242 (45%)	300 (48%)
Total	366	611	492	532	627
(b) Records					
Native	1874 (65%)	6210 (68%)	4509 (63%)	6376 (64%)	9055 (64%)
Alien	1019 (35%)	2950 (32%)	2614 (37%)	3531 (36%)	5138 (36%)
Total	2893	9160	7123	9907	14193

List length

Average lists contained 19.9 species recorded in flower at New Year in 2019, comprising 12.7 native and 7.2 non-native species (Table 5; Fig. 3). The total number of species recorded per list was significantly higher than 2017 and 2018 but not 2015 and 2016 when slightly more species per list were recorded on average (Fig 3a). This pattern was the same for both native and alien species although the overall differences were less marked for alien species (Fig 3c).

Table 5. The average number of species recorded per list on the NYPH, 2015-2019.

Year	Lists	All species		Native species		Alien species	
		Mean	SE	Mean	SE	Mean	SE
2015	143	20.2	1.31	13.1	0.78	7.1	0.60
2016	432	21.2	0.92	14.4	0.55	6.8	0.44
2017	460	15.5	0.72	9.8	0.44	5.7	0.33
2018	612	16.2	0.66	10.4	0.39	5.8	0.31
2019	712	19.9	0.63	12.7	0.37	7.2	0.29

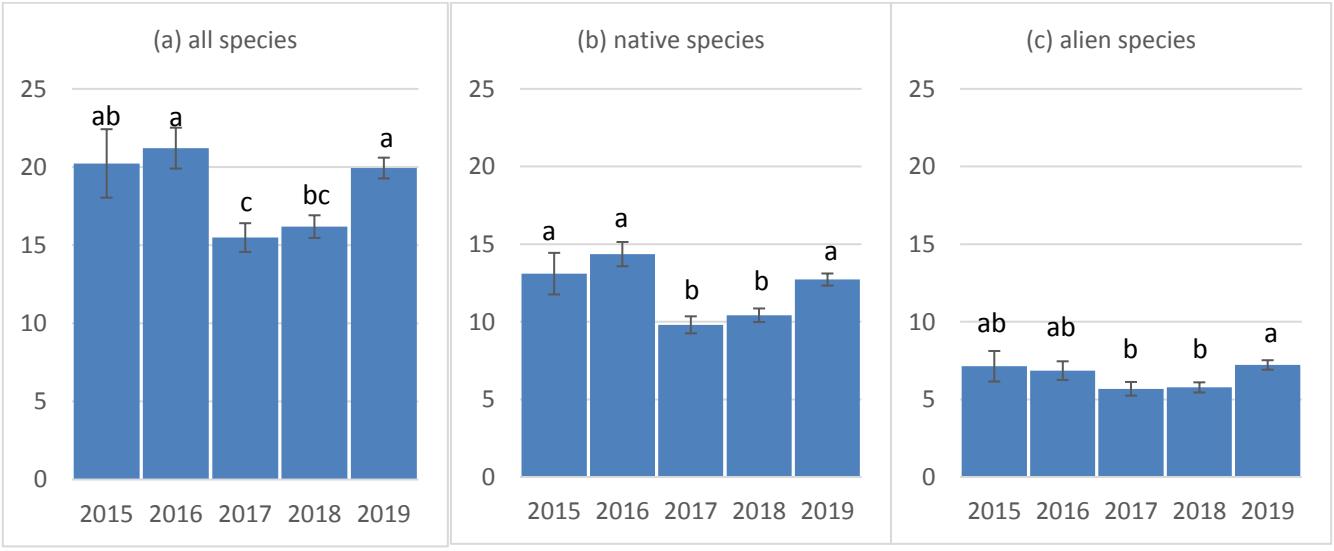


Figure 3. The average list length (number of species recorded in flower at New Year), 2015-2019. The significance of the differences between years was tested using a One-way ANOVA with Tukey's HSD used to test for significant differences between means: total species, $F = 10.96$, $P < 0.001$; native species, $F = 16.72$, $P < 0.001$; alien species, $F = 4.49$, $P < 0.01$. Means that share the same letter on each graph are not significantly different from one another.

Species rank

In 2019 the five species most frequently recorded in flower, in order of frequency, were Daisy (*Bellis perennis*), Groundsel (*Senecio vulgaris*), Dandelion (*Taraxacum* agg.), Annual Meadow-grass (*Poa annua*) and Gorse (*Ulex europaeus*) (Table 6). This rank order was identical to 2017 and almost identical to 2016. Compared to 2017 White Dead-nettle *Lamium album* was the only top-ten ranked species that was markedly more frequent in 2018 (ranked 16th in 2017).

Table 6. The species recorded most frequently in flower at New Year in 2019. Species are listed in their rank order in 2019 and shown against their positions in 2015-2018. The top 10 ranked species in each year are given in bold; '=' indicates equal rank.

Scientific name	Common name	2015	2016	2017	2018	2019	% lists	Change
Bellis perennis	Daisy	**1=**	**1**	**1**	**1**	**1**	77.1	=
Senecio vulgaris	Groundsel	**3**	**3**	**2**	**2**	**2**	70.5	=
Taraxacum agg.	Dandelion	**1=**	**2**	**3**	**3**	**3**	68.1	=
Poa annua	Annual Meadow-grass	**4**	**4**	**4**	**4**	**4**	63.9	=
Capsella bursa-pastoris	Shepherd's-purse	**6**	11	**6**	**7**	**5=**	53.9	+2
Stellaria media	Chickweed	**10=**	29	**8**	**8**	**5=**	53.9	+3
Lamium purpureum	Purple Dead-nettle	13	**8=**	**9**	**6**	**7**	52.8	-1
Sonchus oleraceus	Smooth Sow-thistle	**7**	**6**	11	14	**8**	49.0	+6
Euphorbia peplus	Petty Spurge	**8**	14	**7**	**10**	**9**	48.6	+1
Veronica persica	Common Field-speedwell	12	22	**10**	13	**10**	46.1	+3
Ulex europaeus	Gorse	**5**	**5**	**5**	**5**	11	45.2	-6
Achillea millefolium	Yarrow	14	15	12	13	12	43.8	+1
Lamium album	White Dead-nettle	**9**	**10**	16	**9**	13	39.2	-4
Geranium robertianum	Herb Robert	23	**8=**	29	29	14	36.4	+15
Dactylis glomerata	Cock's-foot	22	26	21	22	15	30.5	+7
Senecio jacobaea	Ragwort	16	**7**	15	21	16	29.2	+5
Corylus avellana	Hazel	25	17	20	18	17	29.1	+1
Cymbalaria muralis	Ivy-leaved Toadflax	19	21	13	15	18	26.1	-3
Heracleum sphondylium	Hogweed	**10=**	12	18	11	19	25.8	-8
Rubus fruticosus agg.	Bramble	27=	19	43	31	20	24.7	+11

Phenology

Of the species recorded in flower in 2019, 58% were flowering late, 24% were flowering early, whereas 7% were flowering as expected at New Year (Table 6a; Fig. 4a). For 12% of species it was not possible to say with certainty whether a species was flowering early or late at New Year. These percentages were almost identical to previous years, the only notable difference being the slightly higher proportion of species flowering early in 2016.

When the same figures are presented in terms of the individual occurrences of flowering (Table 6b; Fig. 4b) a slightly different pattern emerges with a similar proportion flowering late (41%) and as expected (39%) as the latter make up the bulk of the flowering occurrences at New Year despite including a much smaller number of species. In comparison, early flowering only made up 7% of the records made, highlighting the relative insignificance of spring flowering species in flower at New Year when compared to winter flowerers and autumn stragglers.

Table 6. The % of species recorded at New Year that were flowering early, late or as expected, 2015-2018. See Table 1 for an explanation of the categories.

Phenology	2015	2016	2017	2018	2019
(a) % species					
Early	20	27	22	23	24
Early or late	14	11	13	13	12
Expected	8	7	7	7	7
Late	59	54	58	56	58
(b) % records					
Early	9	12	9	10	7
Early or late	13	13	13	13	14
Expected	38	32	39	39	39
Late	40	42	38	38	41

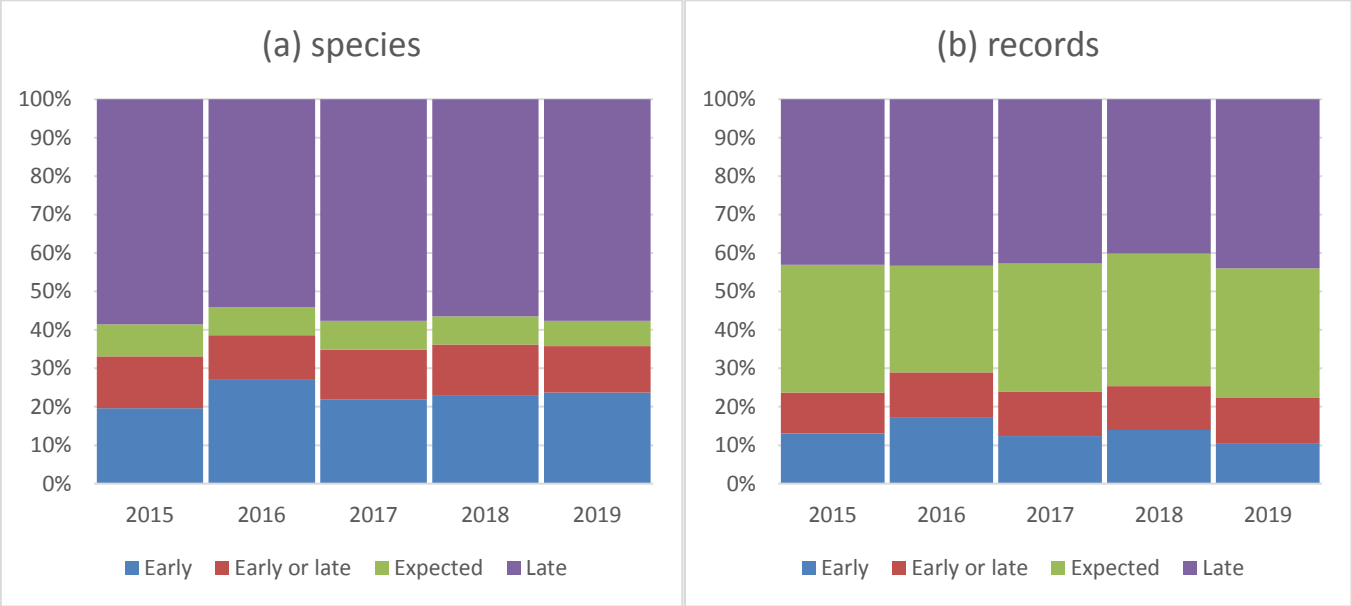


Figure 4. (a) The % of plant species that were flowering early, late or as expected at New Year, 2015-2019. (b) The number of individual occurrences of flowering early, late or as expected at New Year, 2015-2019. See Table 1 for an explanation of the categories.

Discussion

During NYPH 2019, far more species were recorded in flower than in the previous two winters (Fig. 3). This was particularly the case for natives (Fig. 3b), whereas the differences for aliens were less marked (Fig. 3c). The reason for this appears to be mild weather experienced in Britain and Ireland in the preceding two months. Temperatures in November and December 2018 were well above the long-term average and there was a notable lack of frosts. The impact of this is clearly shown in Figure 6 where the average list lengths for the last five NYPHs are plotted against the combined temperature anomalies for the two months preceding the hunts; 2019 was similar to 2015 in terms of elevated warmth and the number of species recorded, but lower than 2016 which is possibly the warmest winter on record with both months having average temperature c.4˚C above average. In comparison, the 2017 and 2018 winters, although still above average, were much cooler and saw widespread frosts curtailing the flowering of many species.

Because we lack a historic baseline, we can't tell whether plants are flowering more often now than in the past, as scientists are predicting due to climate change, but what the results above do show is how many plants respond to 'unseasonal' weather. The main effect would seem be a continuation of flowering where milder conditions permit. The implications of this for plant performance are far from clear. The premature spring growth of some arctic-alpine plants during warmer winters (as many gardeners will know) is known to cause severe damage to some species due to the

depletion of carbohydrate reserves over the winter and damage to tender (non-hardy) organs, such as buds, flowers, etc., when exposed to winter snow and frost (Crawford, 1997, 2000). Shifts in flowering time are also predicted to cause asynchrony between flowering and associated pollinator activity with potential knock-on effects for plant and insect productivity (Solga *et al.*, 2014). However, for the vast majority of species the impacts of changing weather patterns on plant performance have yet to be investigated and so further work is needed before the ecological implications of warmer winters can be fully understood.

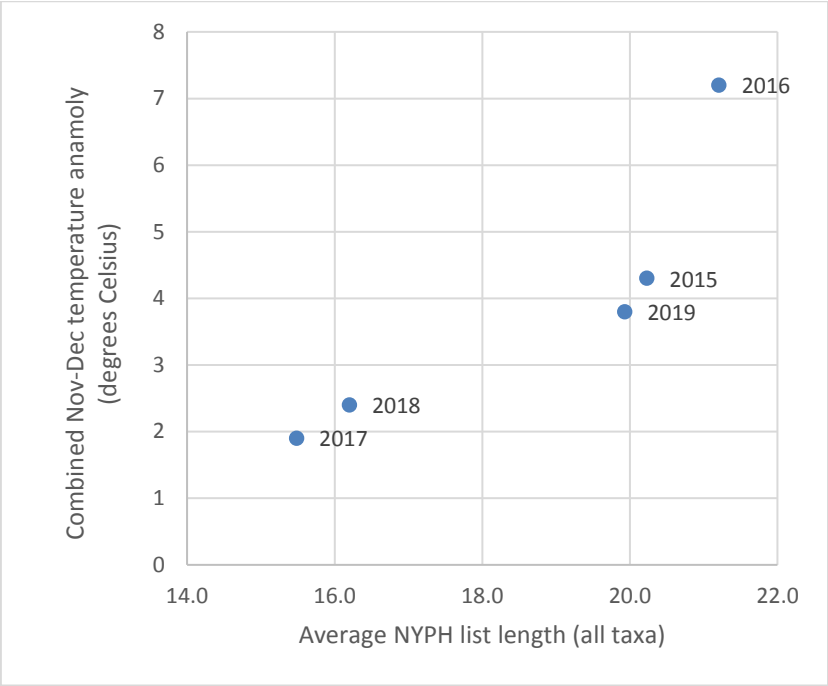


Figure 6. The combined UK mean temperature anomalies for November and December plotted against the average NYPH list lengths, 2015-2019. Temperature data from UK Met Office (http://www.metoffice.gov.uk/climate/uk/summaries).

One of the assumptions often made about warmer winters is that it will advance the first flowering of spring-flowering (vernal) species. There is good evidence for this in the UK with a wide range of plant species displaying earlier first flowering dates due to climate change (Fitter & Fitter, 2002; Amano *et al.*, 2010). However, the evidence from NYPH is more equivocal with only a few species flowering earlier rather than late. This is presumably because significant advances in first flowering would be needed for the vast majority of species to be in flower at New Year, given that the majority of temperate species typically start to flower in late-March and April. In addition. Many vernal species require periods of freezing temperatures (stratification) followed by warming in order to break dormancy and stimulate spring growth; consequently, phenological responses to warming will not be straightforward to predict (Crawford, 1997, 2000). The mild conditions recorded in 2015, 2016 and 2019 may therefore have suppressed rather than stimulated earlier flowering of some species. Consequently, further work is needed to better understand the links between milder weather and the unseasonal flowering events revealed by the NYPH. Such work should focus on correlations between flowering and climate data, while taking into account the potentially confounding effects of latitude, the built environment and survey effort.

One of the most intriguing findings of the NYPH has been the sheer numbers of species in flower at New Year. British ID books and Floras suggest that only around 2% of native British and Irish species should be in flower at New Year; the numbers have been significantly higher than this in each year of the survey. The large numbers of alien plants in flower has also been a notable feature of the survey. This is in part due to where most NYPH searches take place: in urban and suburban areas close to people's homes where alien plant diversity is highest. In these areas, aliens (and natives) benefit from the higher temperatures which are maintained a degree or two above those in the surrounding countryside by human occupation (the so-called 'urban heat island-effect').

Acknowledgments
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