**FOD+AG Bristol Botanic Garden Limestone grassland report. No 1 2012**

One of the most interesting features of the Botanic Garden, for those to whom conservation is of vital importance, is the area devoted to the plants of the habitats of South West England. In the words of the curator, Nick Wray, this “Local flora and rare native plants collection is central to the vision for a garden of conservation and will help to fulfil the Garden’s commitment to the ‘Global Strategy for Plant Conservation”

FOD+AG has put forward a proposal and been fortunate enough to be allowed to carry out a project to monitor the development of the part of this section of the Garden in which an attempt is being made to introduce a limestone meadow plant community representing Clifton-Durdham Down.

What follows is a report on the first year of this project from the initial seeding of an area previously stripped of topsoil and covered with limestone chippings in April 2012.

**1 General.**

**Weather in 2012** It was an exceptionally wet year finishing up with a record 50% more rain than the long-term average since 1853. April and June were also both record months for rainfall. Unsurprisingly summer temperatures were close to or a little below normal.

**Management**  Seeds were sown on 2 April, and the area was roped off. It was subsequently twice used for public events on 15 July and 5-7 September. It was mown on 3rd September, and re-sown on 19 September.

**2 Survey**

Methods.

Ten random quadrats were established, and visited eight times, starting on July 11th, and at fortnightly intervals to Sept 19th then on Oct 3rd and Nov 11th. Photos and counts of all plants were taken. These were subdivided into grasses and others, and the grasses themselves were counted when they had reached sufficient size to be clearly differentiated. Three quadrats had sufficient grass to be defined by % cover rather than number of plants. Other seedlings were tentatively identified early on, and later a very few were positively identified by flowering. Some Cowslips, planted as plugs, were also noted.

In addition, four surveys of all non-grass species present on the plot took place between August 8th and Sept 19th.

**3 Results**

**Grass**. Countable grass plants per quadrat increased from 12 per quadrat on July 11th to 20 per quadrat by August 8th, and numbers were then stable.

**Other seedlings.** These increased from 3.2 to 4.0 per quadrat between July 11th and Aug 8th, and then remained roughly stable until October, but had jumped to 6.5 per quadrat by Nov 14th.

**Total non-grass species.** A total of 35 species were found on the entire plot, 33 of them on Aug 22nd, but only 15 remained after the Bee weekend in September. 16 of the 35 managed to both flower and fruit, and hence may germinate next year. Many of the species found may have moved into the plot from its edges, including plants such as Petty Spurge, Black Medick, Swinecress, Knotgrass, Scarlet Pimpernel, Self-heal, Speedwell and Groundsel. The only identified species characteristic of limestone grassland was Goatsbeard.

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**4 Comment**. The combination of heavy rainfall and normal temperatures should have encouraged germination, but the late sowing, or the use of seeds that had been dried over winter, may have caused low germination rates. Some seeds may not germinate until next year after being frosted. The evidence from November suggests that the second sowing was more successful. An interesting question will be how far the grasses manage to dominate the other plant species.

Richard Bland & Martin Collins. Nov 2012

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**FOD+AG Bristol Botanic Garden Limestone grassland report. No 2 2013**

One of the most interesting features of the Botanic Garden, for those to whom conservation is of vital importance, is the area devoted to the plants of the habitats of South West England. In the words of the curator, Nick Wray, this “Local flora and rare native plants collection is central to the vision for a garden of conservation and will help to fulfil the Garden’s commitment to the ‘Global Strategy for Plant Conservation”

FOD+AG has put forward a proposal and been fortunate enough to be allowed to carry out a project to monitor the development of the part of this section of the Garden in which an attempt is being made to introduce a limestone meadow plant community representing Clifton-Durdham Down. What follows is a report on the second year of this project from the initial seeding of an area previously stripped of topsoil and covered with limestone chippings in April 2012 and re-seeded in September 2012.

**1 General.**

**Weather in 2013** January to October. This was a year of huge contrasts. January and February were normal, but March was the coldest since 1919 with snow cover and 16 frost nights. Spring events were three weeks late in consequence. April, May, and June were normal in temperature, but April and June were very dry. Three weeks of very hot dry weather followed in July, broken by much needed rain in the last week. This saw plants coming into flower and then seeding at great speed. August was very dry, and a degree above normal, and the October was two degrees above normal, but at last very wet.

**Management** Overwinter some grasses grew very strongly, and in the SE corner the dense Wall barley was thinned in early April prior to the first monitoring visit on 10th. An extra quadrat was added to check on how that area responded. There was a very vigorous germination of Yellow Rattle. Grass grew rapidly and flowered well, and the site was mown just before the Bee Festival on August 30th. This caused a substantial change in the species recorded. There was a massive further germination in early September.

**2 Survey Methods**

Eleven new random quadrats were established, and visited 13 times between April 10th and Oct 30th, at fortnightly intervals through the main growing season. On each occasion the total plant cover was estimated, the number of large grass plants counted, the number of identifiable dicots counted, and the number of tiny unidentifiable seedlings were counted or estimated. A whole site dicot species survey was also made on each occasion, and each quadrat was photographed. Grass species were identified when in flower, and are listed below.

**3 Survey Results**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Visit | Ap | My | My | Ju | Ju | Jy | Jy | Jy | Au | Au | Se | Oc | Oc |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Avg |
| Grass Total | 272 | 207 | 230 | 247 | 214 | 219 | 205 | 276 | 223 | 115 | 241 | 209 | 259 | 224 |
| Dicot total | 121 | 132 | 125 | 144 | 130 | 146 | 84 | 372 | 546 | 1220 | 437 | 1042 | 1045 | 426 |
| Cover Av % | 21 | 33 | 33 | 33 | 37 | 44 | 45 | 51 | 43 | 60 | 45 | 62 | 65 | 44 |

**Table 1** Lists the 13 visits, total number of grass plants, total of all dicots, and average percentage cover.

3

**a) Grass**. Individual grass plants became increasingly difficult to count as they grew, but varied between an average maximum of 25 per quadrat in April to a minimum of ten in August at the height of their growth before mowing. More significant was the total plant cover, which was, for the most part, dominated by the grasses. The average percentage cover per quadrat began at 21%, in April rose to 60% in August, fell to 45% after the mowing, but by the end of October was back to 65%. Twelve species were identified, Upright Broom, Wall Barley and Creeping Bent being the commonest.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| species/quadrat | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| Wall Barley | P | P | P |  |  | P | P |  |  | P | P | 7 |
| Common Bent | P |  |  |  |  |  |  |  | P | P |  | 3 |
| Creeping Bent | P |  | P | P | P |  | P | P | P |  |  | 7 |
| Soft Brome |  | P | P | P |  |  | P |  |  |  | P | 5 |
| Upright Brome |  | P | P | P | P | P | P | P | P |  | P | 9 |
| Cocksfoot |  |  |  |  |  |  |  |  |  |  |  |  |
| Crested Dog's Tail | P | P |  | P | P |  | P |  |  | P |  | 6 |
| False Oat |  |  |  |  |  |  | P |  |  |  |  | 1 |
| Red Fescue |  |  |  |  |  |  |  |  |  | P |  | 1 |
| Yorkshire Fog |  |  |  | P | P |  |  |  |  |  |  | 2 |
| Quaking Grass |  |  |  | P |  |  |  |  |  |  |  | 1 |
| Perennial Rye |  | P |  | P |  |  |  |  |  |  |  | 2 |
| Total | 4 | 4 | 4 | 7 | 4 | 2 | 6 | 2 | 3 | 4 | 3 |  |

Table 2 Grasses present in each quadrat

**b) Dicots.** The average number of dicots, both identified and unidentified, was 11 per quadrat in April, the majority of them being Yellow Rattle which grew rapidly, flowered, set seed and vanished, and this average reached a maximum of 13 in early July, then fell to 8 as the Rattle died off and the hot dry three weeks killed off any plant or seedling without deep roots. The rain at the end of the month saw an explosion of new germination in August, with the average rising to 110 per quadrat just before the mowing. This fell to just 40 after the bee festival, but the warmth of September and October, combined with the heavy rainfall in October saw the average jump to an average of 95 per quadrat by the end of October, with almost every quadrat recording an estimate of 100+ seedlings.

**c) Identified Dicots in the quadrats. See Table 3 at the end.**

A total of 23 species were identified within the quadrats during the season, but the maximum number at any one time was 16 species in July and the minimum 4 species in early May.

The total number of plants in all 11 quadrats rose from 9 in April to 104 in June, fell to 41 at the end of August, fell to just 28 after the bee weekend and finished at 41 at the end of October. The turnover of species was surprising. I think we expected that a specific perennial plant would become a permanent feature of a quadrat. Some of the variation was caused as seedlings grew and came into flower. Our skills at vegetative ID were constantly challenged, especially by the compositae.

The results were analysed in three ways;- Population structure, percentage distribution, and duration.

**Population Structure**. During the season 664 identifiable dicots were counted and Yellow Rattle formed 46% of that total. Ribwort Plantain represented 11%, Knapweed 9%, Cowslip 7% and Goatsbeard 6%. The other 18 species were present in small numbers.

4

**Distribution** was measured as the proportion of the 11 quadrats in which each species appeared, Yellow Rattle and Ribwort Plantain were in 8, Rough Hawkbit in 7, Catsear in 6 and, Knapweed, Goatsbeard and Dandelion in 5. Eight species only appeared in a single quadrat.

**Duration** was the number of visits in which the species was found. Catsear, Cowslip and Ribwort Plantain were the only species found on every visit. It was notable that there were very big differences between the number of dicot species in each quadrat. Quadrat 4 had 11 species, quadrat 10 had ten species and quadrat 5 only two. It is likely that each quadrat will become dominated by a small number of species. It will be interesting to see whether this apparent variation in distribution persists and if so whether an explanation for the unevenness can be discovered

**d) Total site species count. See Table 4 at the end.**  A whole site species survey was carried out each week. The number of unidentifiable species varied with the date of observation, and the mowing and Bee Festival made a large difference.

In 2012 a total of 34 species were found during August and September- the whole site survey was not carried out in earlier months. In 2013 25 of those species re-appeared but 8 did not. In total in 2013 61 species were identified, 37 of which were not located in the quadrats. 43 species flowered at some point, most of which also set seed, and 12 were recorded as present but did not flower. Only 8 species were recorded on every visit, and each species was present on average on 5 visits. 19 species were only recorded one or twice. Numbers increased from 8 species in April to 39 in July but fell to 18 after the mowing and Bee Festival and rose to 21 in October. The most remarkable plant was a single Chicory plant which grew to two feet and full flower before the mowing. 15 of 42 species that are associated with the Downs turf have so far been identified. Others may not have been part of the original seed collected, or may take longer to germinate.

**4 Comment.** This was a far more successful year than 2012, and by the end of it there was something close to 70% cover of the whole site, with a mass of tiny seedlings which may give complete cover early in 2014. There was a surprising degree of change from week to week in the structure. It seems likely that there will be more stability in future

Richard Bland & Martin Collins.

**Appendix**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species | Count  | % | Dist | Weeks |
| Beaked Hawksbeard | 3 | 1 | 1 | 4 |
| Birds-foot Trefoil | 2 | 0 | 1 | 7 |
| Catsear | 27 | 4 | 6 | 13 |
| Common Mouse-ear | 1 | 0 | 1 | 3 |
| Cowslip | 49 | 7 | 3 | 13 |
| Dandelion | 25 | 4 | 5 | 12 |
| Dwarf Thistle | 12 | 2 | 2 | 10 |
| Goatsbeard | 41 | 6 | 5 | 12 |
| Great Plantain | 4 | 1 | 2 | 9 |
| Hedge Bedstraw | 1 | 0 | 1 | 1 |
| Knapweed | 59 | 9 | 5 | 11 |
| Ladies Bedstraw | 1 | 0 | 1 | 1 |
| Least Hawkbit | 6 | 1 | 2 | 7 |
| Meadow Buttercup | 3 | 0 | 1 | 6 |
| Oxeye Daisy | 3 | 0 | 1 | 3 |
| Prickly Sowthistle | 5 | 1 | 2 | 8 |
| Red Clover | 3 | 0 | 1 | 4 |
| Ribwort Plantain | 74 | 11 | 8 | 13 |
| Rough Hawkbit | 19 | 3 | 7 | 7 |
| Self-heal | 4 | 1 | 3 | 12 |
| Smooth Hawksbeard | 3 | 0 | 2 | 2 |
| Umbellifer sp | 9 | 1 | 2 | 4 |
| Yellow Rattle | 305 | 46 | 8 | 6 |
| Total | 664 |  |  |  |

Table 3 Dicots identified in thr Quadrats

Column 1 : Number of plants recorded/species during the whole season.

Column 2 : % contribution to dicot community during the whole season.

Column 3 : Number of quadrats in which species was recorded at least once during the whole season.

Column 4 : Number of weeks in which species was recorded during the whole season.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2012 | Flower | Total | Quad |  |  | 2012 | Flowered | Total | Quad |
| Beaked Hawksbeard |   | f | 4 | x |  | Hoary Willowherb |   | f | 1 |   |
| Birds-foot Trefoil |   | f | 7 | x |  | Hop Trefoil |   | f | 5 |   |
| Black Medick |   | f | 2 |   |  | Kidney Vetch |   |   | 5 |   |
| Broad-leaved Willowherb | x | f | 3 |   |  | Knapweed |   | f | 11 | x |
| Buddleia | x |   | 1 |   |  | Knotgrass | x | f | 3 |   |
| Catsear | x | f | 13 | x |  | Ladies Bedstraw |   |   | 1 | x |
| Chickweed |   | f | 3 |   |  | Lesser hawkbit | x | f | 7 | x |
| Chicory |   | f | 6 |   |  | Lesser Trefoil | x | f | 7 |   |
| Clary |   |   | 2 |   |  | Meadow Buttercup |   | f | 6 | x |
| Coltsfoot | x |   | 4 |   |  | Ox-eye Daisy |   |   | 3 | x |
| Columbine | x |   | 2 |   |  | Pale Flax |   | f | 8 |   |
| Common Mouseear | x | f | 3 | x |  | Prickly Sowthistle |   | f | 8 | x |
| Common Speedwell | x | f | 2 |   |  | Purple Toadflax |   | f | 7 |   |
| Corn Salad |   | f | 1 |   |  | Ragwort |   |   | 1 |   |
| Cowslip | x | f | 13 | x |  | Red Clover | x | f | 12 | x |
| Creeping Buttercup | x | f | 12 |   |  | Ribwort Plantain | x | f | 13 | x |
| Creeping Cinquefoil | x | f | 8 |   |  | Rough Hawkbit |   | f | 7 | x |
| Daisy |   | f | 3 |   |  | Salad Burnet |   |   | 1 |   |
| Dandelion | x | f | 13 | x |  | Sallow | x |   | 2 |   |
| Dwarf Thistle |   | f | 10 | x |  | Self Heal | x | f | 12 | x |
| Fairy Flax |   | f | 1 |   |  | Small-flowered Cranesbill |   | f | 8 |   |
| Field Maple |   |   | 1 |   |  | Smooth Hawksbeard |   | f | 2 | x |
| Goatsbeard | x | f | 12 | x |  | Smooth Sowthistle | x | f | 4 |   |
| Great Mullein | x |   | 8 |   |  | St Johns Wort sp | x |   | 1 |   |
| Great Plantain | x | f | 9 | x |  | Thyme-leaved Speedwell |   | f | 2 |   |
| Groundsel | x | f | 4 |   |  | Tutsan |   |   | 1 |   |
| Hairy Bittercress |   | f | 4 |   |  | Umbellifer sp |   |   | 4 | x |
| Hedge Bedstraw |   |   | 1 | x |  | White Clover |   | f | 4 |   |
| Herb Robert | x | f | 1 |   |  | Yarrow |   | f | 7 |   |
|  |  |  |  |  |  | Yellow Rattle |   | f | 6 | x |

Table 4 lists all dicots identified on the whole plot in 2013.

Column 2 shows those present in 2012.

Column 3 shows those species that flowered.

Column 4 shows the number of visits (total 13) in which they were identified.

Column 5 shows with an x those that were identified in the quadrats.

Martin Collins, Richard Bland Nov 2013

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**FOD+AG Bristol Botanic Garden Limestone grassland report. No 3 2014**

One of the most interesting features of the Botanic Garden, for those to whom conservation is of vital importance, is the area devoted to the plants of the habitats of South West England. In the words of the curator, Nick Wray, this “Local flora and rare native plants collection is central to the vision for a garden of conservation and will help to fulfil the Garden’s commitment to the ‘Global Strategy for Plant Conservation”

FOD+AG has put forward a proposal and been fortunate enough to be allowed to carry out a project to monitor the development of the part of this section of the Garden in which an attempt is being made to introduce a limestone meadow plant community representing Clifton-Durdham Down. What follows is a report on the third year of this project from the initial seeding of an area previously stripped of topsoil and covered with limestone chippings in April 2012 and re-seeded in September 2012.

**1 General.**

**Weather in 2014, January to October**. Every month except August was two degrees C above average, and at the end of October the twelve-month average was 16.1C, cf the average since 1853 of 13.7C. January and February were exceptionally wet, March dry, August the wettest month of the year and September the driest since 2003. By the end of October the rainfall figure for the previous twelve months was c 1000mm cf the long term average of c 900mm. July was hot throughout, but marginally less hot than 2013, and had only 30 mm of rain. August had three month’s worth of rain and slightly below average temperature. The results was dramatic growth from the more aggressive plants especially Knapweed and Carrot which at the time of the mowing at the end of August were dominant. September average maximum temperature was four degrees above normal and dry with just 15mm of rain which all fell in one night. However, the recovery from the mowing was strong. October had average rainfall, and was two degrees above average in temperature.

**Management.** Overwinter some plantain was removed by individual application of weed killer. In May Smooth Sowthistle was weeded by hand from the southern marginal strip. In July some plantains were weeded by hand. In August some seed heads were removed from the Knapweed. The whole site was close mown at the end of August. Seeds of a few species were collected and germinated to produce plugs for planting in Spring 2015. None of these actions were applied to the quadrats.

**2 Survey Methods**

The 11 quadrats surveyed in 2013 were continued and a twelfth added in the SW corner to include the Kidney Vetch and Flax that was growing there and nowhere else. 13 visits were made between March 26th and Oct 28th at fortnightly intervals through the main growing season. There was no visit in September, as the mowing for the bee festival altered the situation dramatically. On each occasion the total plant cover was estimated, and the species of dicots in each quadrat recorded. A whole site dicot species survey was also made on each occasion, and each quadrat was photographed.

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**3 Survey Results**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Ma | Ap | Ap | My | My | Ju | Ju | Jy | Jy | Jy | Au | Oc | Oc |
|  Visit | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Site total sp | 26 | 32 | 34 | 34 | 35 | 33 | 37 | 41 | 40 | 40 | 35 | 22 | 28 |
| Dicot per quad | 2.8 | 3.8 | 3.9 | 3.4 | 5.6 | 5.4 | 5.9 | 5.9 | 6.6 | 6.3 | 6.6 | 5.6 | 6.6 |
| Quad total sp | 11 | 19 | 19 | 17 | 19 | 21 | 23 | 26 | 28 | 27 | 23 | 17 | 17 |
| Quad % of tot | 42 | 59 | 56 | 50 | 54 | 64 | 62 | 63 | 70 | 68 | 66 | 77 | 61 |
| Quad Cover Av % | 56 | 51 | 59 | 60 | 59 | 67 | 61 | 63 | 64 | 64 | 74 | 67 | 75 |

**Table 1** Lists the 13 visits, the total species in the whole site, the average number of dicot species per quadrat, the total number of species in all quadrats, the percentage that this is of all the species seen on the site on that visit, and the average plant cover of all quadrats.

**a) Dicots.** These were identified by species but not counted.During the year 62 species were found on the site, but the number on individual visits grew from 26 in March to 41 in July, before falling to 22 in early October. A total of 36 species were found in the quadrats. The average number of species per quadrat rose from 2.8 in March to 6.6 from July to October. The percentage of the species on the whole site that were found in the quadrats varied from 42% in March to a maximum of 77% in early October. This shows that the quadrats gave a good impression of the whole site. The overall plant cover recorded in the quadrats rose from around 50% to 75% by the end of October. The amount of change between visits was large, and resulted from the rapid growth of seedlings unidentifiable in March, and the mowing in August dramatically changed the number of identifiable species. Just 14 of the 36 species were effectively permanent residents. Species present peaked in July.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|   | Visits | Quads |   |   | Visits | Quads |
| Yellow Rattle | 10 | 10 |   | Dwarf Thistle | 13 | 2 |
| Red Clover | 12 | 10 |   | Chickweed | 1 | 2 |
| Ribwort | 13 | 10 |   | Cowslip | 13 | 2 |
| Catsear | 13 | 9 |   | Pale Flax | 8 | 2 |
| Knapweed | 13 | 8 |   | Groundsel | 3 | 2 |
| Birds-foot Trefoil | 12 | 7 |   | Hop trefoil | 4 | 2 |
| Goatsbeard | 13 | 6 |   | Meadow Buttercup | 5 | 2 |
| Lesser Trefoil | 7 | 5 |   | Prickly Sowthistle | 6 | 2 |
| Nipplewort | 4 | 5 |   | Beaked Hawksbeard | 1 | 1 |
| Carrot | 13 | 4 |   | Black Medic | 3 | 1 |
| Dandelion | 12 | 4 |   | Gt Knapweed | 2 | 1 |
| Gt plantain | 5 | 4 |   | Hedge Bedstraw | 2 | 1 |
| Lesser Hawkbit | 5 | 4 |   | Kidney Vetch | 6 | 1 |
| Moss | 10 | 4 |   | Oxeye | 13 | 1 |
| Rough Hawkbit | 8 | 4 |   | Self Heal | 3 | 1 |
| Mouseear | 11 | 3 |   | Small Scabius | 2 | 1 |
| Smooth Sowthistle | 7 | 3 |   | Smooth Hawksbeard | 2 | 1 |
|   |   |   |   | Yellowwort | 1 | 1 |

Table 2 Lists the 36 species recorded in the quadrats by the number of visits in which they were present out of 13, (Col 2), and the number of quadrats in which they were seen out of 12, (Col 3).

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**Comment on species**. The Yellow Rattle is an annual which dies down completely by August. Goatsbeard was already in flower at the first visit in March, as was Knapweed, and six other species. Seedlings grew and flowered rapidly. Nipplewort was a new species this year. The Carrots were seedlings in 2013, and became very dominant by August. Moss was very frequent in March after the very wet winter. Dwarf Thistle was scarce, but flowered well. Cowslips were originally planted as plugs in 2012, but have now seeded well. The Pale Flax is spreading. Black Medic seeded copiously, and began to dominate a few areas. All the species that were only present in a single quadrat are good limestone species.

**b) Total site survey**

Over three years a total of 78 species have been recorded on the site. In 2012 there were 34, and grasses were dominant. In 2013 there were 62 species, and the same in 2014. Of the 2012 species, twenty-one have survived, but only nine of them are likely to be from the original sowing, as the other twelve are normal “weed” species such as Groundsel, Petty Spurge and Dandelion. The sowing in the autumn of 2012 was far more productive of limestone species. There were eleven losses this year including the single Chicory plant that was so striking in 2013, the Great Mullein, and Fairy Flax, which is always elusive. The eleven gains were interesting. They include Great Knapweed, with two plants, Hogweed, which only appeared on the very last visit in October, Nipplewort, and Oak and Sycamore seedlings that were mown off, Small Scabius, and a single plant of Yellow Wort. Before the mowing at the end of August the site was dominated by Knapweed and Carrot. It is probable that their deep roots enabled them to tap into water in the soil beneath the chippings bed. It is a fairly striking feature that the centre of the plot, where the chippings are deepest, is the area so far with the lowest plant coverage, and the edges have the highest. Obviously, a heap of limestone chippings is a rather different habitat to the limestone soil built up over 1000 years of grazing which was the habitat of the original plants sown.

Other features of the year were that dicots have become dominant over the grass, which dominated in the first year. The increase in Yellow Rattle may be a factor in this. Also there has been a marked increase in Red and White Clover, Black Medic, and Birds-foot Trefoil, legumes whose combination of vegetative propagation and nitrogen-fixing capacity has clearly given them an edge. By the end of the year, following an exceptionally warm October, Plantains and Compositae had expanded their rosettes rapidly, whereas grass did not recover from the close mowing.

The total flowering period was also measured, though it was artificially ended by the mowing in late August. Five species were in flower from early May until they were mowed, and were producing seeds for much of this time.

The method of simply recording the presence of dicots in the quadrats, as counting them has become impossible, gives a rather crude measure of their relative dominance. In future it may be possible to assess the percentage cover that a major species represents in each quadrat, though at present each quadrat has a wide variety of species.

The appendix gives a total list of all species recorded since 2012

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**c) Grasses**

The grass species in each quadrat were identified. One new species, Cocksfoot, was found that was not seen in 2013, and two, False Oat Grass and Red Fescue, that were present in 2013 had gone. The table shows the number of quadrats, out of 12, in which each species was identified in each year.

|  |  |  |
| --- | --- | --- |
| Grass species | Quads 2013 | Quads 2014 |
| Upright Brome |  11 |  11 |
| Wall Barley |  7 |  6 |
| Creeping Bent |  7 |  3 |
| Soft Brome |  7 |  9 |
| Crested Dog’s tail |  6 |  3 |
| Common Bent |  3 |  7 |
| Perennial Rye |  2 |  2 |
| Yorkshire Fog |  2 |  1 |
| False Oat |  1 |  0 |
| Red Fescue |  1 |  0 |
| Quaking Grass |  1 |  1 |
| Cocksfoot |  0 |  1 |

Table 3 The number of quadrats in which each species was found in 2013 and 2014.

Richard Bland & Martin Collins. Nov 2014

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**Appendix**

Table 4 lists all dicots identified on the whole plot since 2012.

Column 2 shows those present in 2012.

Column 3 Those present in 2013.

Column 4 those present in 2014.

Column 5 shows those species that flowered in 2014. **F** indicates that they did not flower in 2013.

Column 6 shows the duration of the flowering period in weeks. The maximum is 18.

Column 7 gives number of visits (total 13) in which they were identified.

Column 8 Shows the species present in the Quadrats.

.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| aa | 2012 | 2013 | 2014 | Flower | Wks | Total | Quad |
| Beaked Hawksbeard |   | x | x | f | 6 | 5 | x |
| Birds-foot Trefoil |   | x | x | f | 16 | 12 | x |
| Black Medick |   | x | x | f | 10 | 7 | x |
| Broad-leaved Willowherb | x | x | x | f |   | 1 |   |
| Buddleia | x | x |   |   |   |   |   |
| Carrot |   | x | x | F | 10 | 13 | x |
| Catsear | x | x | x | f | 18 | 13 | x |
| Chickweed |   | x | x | f | 4 | 3 | x |
| Chicory |   | x |   |   |   |   |   |
| Clary |   | x | x | F | 8 | 13 |   |
| Coltsfoot | x | x |   |   |   |   |   |
| Columbine | x | x |   |   |   |   |   |
| Common Mouse Ear | x | x | x | f | 12 | 11 | x |
| Common Speedwell | x | x |   |   |   |   |   |
| Corn Salad |   | x | x | f | 2 | 3 |   |
| Cowslip | x | x | x | f | 6 | 13 | x |
| Creeping Buttercup | x | x | x | f | 4 | 10 |   |
| Creeping Cinquefoil | x | x | x | x |   | 2 |   |
| Daisy |   | x | x | f | 10 | 6 |   |
| Dandelion | x | x | x | f | 10 | 13 | x |
| Dwarf Thistle |   | x | x | f | 6 | 13 | x |
| Fairy Flax |   | x |   |   |   |   |   |
| Feverfew | x |   |   |   |   |   |   |
| Field Maple |   | x |   |   |   |   |   |
| Goatsbeard | x | x | x | f | 12 | 13 | x |
| Great Knapweed |   |   | x | F | 2 | 7 | x |
| Great Mullein | x | x |   |   |   |   |   |
| Great Plantain | x | x | x | x |  | 6 | x |
| Groundsel | x | x | x | f | 6 | 4 | x |
| Hairy Bittercress |   | x | x | f | 2 | 4 |   |
| Hedge Bedstraw |   | x | x | F | 2 | 12 | x |
| Herb Robert | x | x | x | f |   | 3 |   |
| Hoary Willowherb |   | x | x | f |   | 1 |   |
|  | 2012 | 2013 | 2014 | Flower | Wks | Total | Quad |  |
| Hogweed |   |   | x | x |  | 1 |   |
| Hop Trefoil |   | x | x | f | 8 | 6 | x |
| Kidney Vetch |   | x | x | F | 6 | 12 | x |
| Knapweed |   | x | x | f | 14 | 12 | x |
| Knotgrass | x | x | x | f | 8 | 4 |   |
| Ladies Bedstraw |   | x | x | F | 4 | 2 |   |
| Lesser hawkbit | x | x | x | f |   | 7 | x |
| Lesser Trefoil | x | x | x | f | 12 | 8 | x |
| Meadow Buttercup |   | x | x | f | 6 | 8 | x |
| Moss |   |   | x | x |   | 9 | x |
| Nipplewort |   |   | x | F | 4 | 4 | x |
| Oak | x |   | x | x |   | 1 |   |
| Old mans beard | x |   |   |   |   |   |   |
| Ox-eye Daisy |   | x | x | F | 6 | 12 | x |
| Pale Flax |   | x | x | f | 10 | 11 | x |
| Pendulous sedge | x | x |   |   |   |   |   |
| Petty Spurge | x | x | x | F | 4 | 3 |   |
| Poppy Long headed |   |   | x | F |   | 1 |   |
| Prickly Sowthistle |   | x | x | f | 8 | 10 | x |
| Purple Toadflax |   | x | x | f |   | 1 |   |
| Quaking grass |   | x | x | f |   | 8 | x |
| Ragwort |   | x | x | x |  | 2 |   |
| Red Clover | x | x | x | f | 14 | 12 | x |
| Ribwort Plantain | x | x | x | f | 14 | 12 | x |
| Rough Hawkbit |   | x | x | f | 14 | 8 | x |
| Salad Burnet |   | x | x | F | 4 | 5 |   |
| Sallow | x | x | x | x |   | 5 |   |
| Scarlet pimpernel | x |   |   |   |   |   |   |
| Self Heal | x | x | x | f | 6 | 10 | x |
| Small Scabius |   |   | x | F | 8 | 2 | x |
| Small-flowered Cranesbill |   | x | x | f | 8 | 5 |   |
| Smooth Hawksbeard |   | x | x | f | 8 | 5 | x |
| Smooth Sowthistle | x | x | x | f | 8 | 11 | x |
| Spear thistle | x |   | x | x |   | 1 |   |
| St Johns Wort  | x | x | x | F | 2 | 4 |   |
| Swinecress | x |   |   |   |   |   |   |
| Swinecress | x |   |   |   |   |   |   |
| Sycamore |   |   | x | x |   | 5 |   |
| Thalecress |   |   | x | F |   | 1 |   |
| Thyme-leaved Speedwell |   | x |   |   |   |   |   |
| Toadflax sp | x |   |   |   |   |   |   |
| Tutsan |   | x |   |   |   |   |   |
| White Clover |   | x | x | f | 6 | 4 |   |
| Yarrow |   | x | x | f |   | 7 |   |
| Yellow Rattle |   | x | x | f | 10 | 11 | x |
| Yellowwort |   |   | x | F |   | 2 | x |
| zTotals | 34 | 62 | 62 |   |   |   | 36 |

**13**

**FOD+AG Bristol Botanic Garden Limestone grassland report. No 4 2015**

In the autumn of 2011 an experimental area of about 200 square metres in the University Botanic Garden was stripped of its topsoil, and covered to a depth of about 10cm with limestone chippings. Seed was collected from the hay cut on the Downs in July 2011 and the seeds were sown in April 2012. Germination was poor and a second seeding was made with fresh seed in September 2012. The purpose was to recreate an area of limestone grassland within the garden. The changes in vegetation have been recorded for four years, using two approaches. Firstly a whole site visit at fortnightly intervals from March to October recording every species within the plot. Secondly the establishment of 12 random quadrats in which the species were identified and the total area covered in vegetation estimated on a fortnightly basis.

Over time the chippings have consolidated, but there is no soil as such, or worms. And the removal of the whole hay cut annually keeps fertility very low. Rain drains straight through the chippings. One result has been that deep-rooted plants, which can reach the sub soil below the chippings, have an advantage; another that leguminous plants, (9 out of 48 species, 19%), that produce their own nitrates have an advantage over others.

**1 General.**

**Weather in 2015, January to October**. This year was cooler than 2014, with an overall average of maximum daily temperature of 15.9ºc cf 16.1ºc last year. Both years have been well above the annual average since 1853 of 13.8ºc. By October 2015 the total rainfall over the previous twelve months was c 800mm cf 1000mm in 2014. Since 1853 the average annual Bristol rainfall has been 900mm. The winter was warm, though a degree colder than the previous year, spring was average for recent years, with a warm April and cooler May, Summer was very close to the long-term average. March and April were dryer than normal, January and August wetter.

2 **Management.** Overwinter plugs of Clary and Small Scabius were planted, though their success was limited. In August the seed heads of Knapweed were removed. As usual the whole site was close mown at the end of August and the site prepared for the Bee Festival.

3 **Survey Methods.** Quadrat number 3 was lost irretrievably**,** so that 11 quadrats continued to be monitored. 12 visits were made between 25th March and October 21st at fortnightly intervals. There was no visit in September, as the mowing for the bee festival altered the situation dramatically. On each occasion the total plant cover was estimated, and the species of dicots in each quadrat recorded. A whole site dicot species survey was also made on each occasion, and each quadrat was photographed.

**4 Quadrat Survey Results**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Visit 2015 | Ma | Ap |  | Ap | My | My | Ju | Ju | Jy | Jy | Au | Au | Oc | Av |
|   | 1 | 2 |  | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |   |
| Site total sp | 25 | 25 |  | 25 | 28 | 35 | 34 | 35 |   |   | 39 |   | 16 |   |
| Dicot/quad | 7.6 | 8.4 |  | 7 | 6.3 | 8 | 8 | 7 | 8.9 | 8.2 | 7.6 | 7.5 |   | 7.7 |
| Quad sp | 18 | 20 |  | 17 | 20 | 21 | 26 | 26 | 25 | 25 | 23 | 27 | 13 | 21.8 |
| Quad % of tot | 72 | 80 |  | 68 | 71 | 60 | 77 | 74 |   |   | 59 |   | 81 | 71.4 |
| Cover Av % | 67 | 68 |  | 69 | 73 | 71 | 74 | 79 | 80 | 79 | 80 | 80 | 75 | 74.6 |

Table 1

14

Table 1 summarises the results of the 12 visits. The total number of species in the whole site is shown in row 3, and increased from 25 to 39 over the summer. The overall total was 51 species, down from 62 last year.

Row four shows the average number of species per quadrat, which averages around 8, but varies considerably from a maximum of 15 to a minimum of 4.

Row five shows the total number of species recorded in the quadrats. The total was 36. This changed little from 2014

Row 6 shows the percentage that the quadrat species were of the whole-site species. The average was 70%. The final row shows what proportion of the quadrats was vegetated. This has increased since 2014 to 75% from 63% in 2014. Despite the growth of plants in the season, the figure only increased over the year from 67% in March to 80% just before mowing in August. Several quadrats on the edge of the plot now have 100% cover, but the centre of the plot, where the chippings are deepest remains fairly barren.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 2015 |   | Visits | Quads | F | Rating |
| *Trifolium pratense* | Red Clover | 12 | 10 | 120 |   |
| *Centaurea nigra* | Knapweed | 12 | 9 | 108 | \*\* |
| *Plantago lanceolata* | Ribwort Plantain | 12 | 9 | 108 |   |
| *Daucus carota* | Carrot | 12 | 8 | 96 |   |
| *Hypochaeris radicata* | Catsear | 9 | 10 | 90 | \*\* |
| *Lotus corniculatus* | Birds-foot Trefoil | 11 | 8 | 88 | \*\* |
| *Cerastium fontanum* | Common Mouse Ear | 12 | 7 | 84 |   |
| *Trifolium dubium* | Lesser Trefoil | 9 | 9 | 81 |   |
| *Rhinanthus minor* | Yellow Rattle | 11 | 7 | 77 | \*\*\* |
| *Taraxacum agg* | Dandelion | 11 | 6 | 66 |   |
| *Tragopogon pratensis* | Goatsbeard | 11 | 5 | 55 | \*\*\* |
| *Primula veris* | Cowslip | 12 | 3 | 36 | \*\* |
| *Leontodon hispidus* | Rough Hawkbit | 8 | 4 | 32 | \*\* |
| *Leontodon saxatalis* | Lesser Hawkbit | 6 | 5 | 30 | \*\* |
| *Medicago lupulina* | Black Medick | 7 | 4 | 28 | \* |
| *Cirsium acaule* | Dwarf Thistle | 12 | 2 | 24 | \*\*\*\* |
| *Ranunculus acris* | Meadow Buttercup | 10 | 2 | 20 |   |
| *Cardamine hirsuta* | Hairy Bittercress | 2 | 8 | 16 |   |
| *Crepis versicaria* | Beaked Hawksbeard | 4 | 3 | 12 | \* |
| *Scabiosa columbaria* | Small Scabius | 6 | 2 | 12 | \*\* |
| *Trifolium campestre* | Hop Trefoil | 6 | 2 | 12 | \*\*\* |
| *Galium mollugo* | Hedge Bedstraw | 5 | 2 | 10 | \*\* |
| *Linum bienne* | Pale Flax | 5 | 2 | 10 |  \*\*\*\* |
| *Crepis capillaris* | Smooth Hawksbeard | 3 | 3 | 9 |   |
| *Lapsana communis* | Nipplewort | 3 | 3 | 9 |   |
| *Leucanthemum vulgare* | Ox-eye daisy | 7 | 1 | 7 | \*\* |
| *Anthyllis vulnereria* | Kidney Vetch | 6 | 1 | 6 | \*\*\*\* |
| *Linum catharticum* | Fairy Flax | 3 | 2 | 6 | \*\*\*\* |
| *Centaurea scabiosa* | Great Knapweed | 5 | 1 | 5 | \*\* |
| *Salvia verbenaca* | Clary | 4 | 1 | 4 | \*\*\*\* |
| *Sonchus oleraceus* | Smooth Sowthistle | 3 | 1 | 3 |   |
| *Trifolium repens* | White Clover | 1 | 3 | 3 |   |
| *Stellaria media* | Chickweed | 2 | 1 | 2 |   |

Table 2

15

Table 2 Lists the 33 dicot species recorded in the quadrats in order of their Frequency in Col 5. This is calculated by multiplying the number of quadrats in which they were present, Col 4, by the number of visits in which there were found, Col 3. It gives a good idea of the dominance achieved by Red Clover, Common Knapweed, Carrot, and Ribwort Plantain, and reflects a common pattern in the natural world of a ratio of 20:80. Twenty percent of a population will normally supply eighty percent of the total numbers. To put it another way, most species are rare. Col 6 is a star rating, listing species that are a key part of the limestone grassland of the Downs. Species with no stars are common grassland plants anywhere

**5 Whole Site Survey results**

|  |  |  |  |
| --- | --- | --- | --- |
|   | F | V | Rating |
| Columbine |  | 1 |  |
| Common Speedwell | f | 3 |  |
| Creeping Buttercup |  | 2 |  |
| Daisy | f | 3 |  |
| Hogweed |  | 4 |  |
| Ladies Bedstraw |  | 2 | \*\* |
| Meadow Vetchling | f | 2 | \*\* |
| Prickly Sowthistle | f | 5 |  |
| Salad Burnet |  | 3 | \*\*\* |
| Sallow |  | 1 |  |
| Self Heal | f | 5 |  |
| Small-flowered Cranesbill | f | 3 | \* |
| St Johns Wort sp | f | 6 |  |
| Yarrow | f | 9 |  |
| Yellowwort | f | 2 | \*\*\*\* |

Table 3

Table 3 lists the 15 dicot species recorded in 2015 in the whole site survey, which were not present in any of the quadrats. They are listed in alphabetical order. Col 2 indicates those that flowered. Col 3 shows the number of visits in which they were seen. Col 4 gives them a rating indicating which are important Down’s species.

**6 Comparisons with previous years**

|  |  |  |  |
| --- | --- | --- | --- |
|   | Total sp | Cover % | Dicot/quad |
| 2012 | 34 | 25  | 2.1  |
| 2013 | 62 | 41 | 3.8  |
| 2014 | 62 | 63 | 5.3 |
| 2015 | 51 | 75 | 7.7 |

Table 4

Table 4 Summarises the changes in numbers of species present, shown in Col 2. The average cover recorded in the quadrats, Col 3. The average number of species per quadrat Col 4. It does not show the major change in structure which has been the decline of grasses that dominated the plot in 2012, and have almost completely disappeared this year. This is probably caused by the problem that shallow rooted grasses have in establishing themselves on the very dry substrate.

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Table 5 lists the 30 species that have been recorded between 2012 and 2014, but are no longer present. They are all common plants that will have come with the original two seedings, or as invaders from the margins of the plot. None of them is part of the key limestone grassland species on the Downs and probably all have been defeated by the difficulties of establishing on a substrate of chippings.

|  |  |
| --- | --- |
| Broad-leaved Willowherb | Old Mans Beard |
| Buddleia | Pendulous sedge |
| Chicory | Petty Spurge |
| Coltsfoot | Poppy, Long headed |
| Columbine | Purple Toadflax |
| Corn Salad | Ragwort |
| Creeping Cinquefoil | Scarlet Pimpernel |
| Feverfew | Spear Thistle |
| Field Maple | Swinecress |
| Great Mullein | Sycamore |
| Great Plantain | Thalecress |
| Herb Robert | Thyme-leaved Speedwell |
| Hoary Willowherb | Toadflax sp |
| Knotgrass | Tutsan |
| Oak |  |

Table 5

**7 Whole site survey comment.** 51 species were found of which 42 flowered, and presumably produced seed that could germinate next year. However the spread of Red Clover, Birds-foot Trefoil and Black Medick may inhibit the germination of some species. Three new species were added to the list, Common Speedwell, Columbine, and Fairy Flax. Fairy Flax may have been missed in earlier years, as it is a tiny plant, but it is common on the Downs. The grading system is entirely subjective, but it does show that the site has 25 species that are significant limestone grassland plants, and many common grassland plants have failed to establish. That raises the issue of whether we should seek to import some of the Limestone grassland species of the Downs that are not present. Downs soil is, in part, the result of 1000 years of grazing, and hence a consequence both of nitrogenous input by animals, and the result of selective grazing by them. Limestone chippings are a very different habitat, more akin to a level scree.

There are 17 species that form part of the Downs meadows that might be included. In alphabetical order, Autumn Hawkbit, Betony, Burnet Saxifrage, Calamint, Centaury, Dropwort, Harebell, Hoary Plantain, Marjoram, Mouse-ear Hawkweed, Orchids- which are a law unto themselves, Pale St Johns Wort, Red Bartsia, Rock Rose, Spring Cinquefoil, Thyme and Vervain.

This is a question for the Botanical Garden, which probably already has all these species as part of its local collection. But the chippings have been managed in minor ways from the start and the introduction of selected species would therefore not be unprecedented. The plant structure is becoming much more settled as areas free from competition are fewer.

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**c) Grasses**

**The** grass species, listed in table 6 in frequency order, were the same as those found in 2014. However they were far less vigorous, and played a diminished role in the overall structure that was not effectively measured.

|  |
| --- |
| Grass species |
| Upright Brome |
| Wall Barley |
| Creeping Bent |
| Soft Brome |
| Crested Dog’s tail |
| Common Bent |
| Perennial Rye |
| Yorkshire Fog |
| Cocksfoot |
| Quaking Grass |

Table 6

Richard Bland & Martin Collins. Nov 2015

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**FOD+AG Bristol Botanic Garden Limestone grassland report. No 5 2016**

In the autumn of 2011 an experimental area of about 200 square metres in the University Botanic Garden was stripped of its topsoil, and covered to a depth of about 10cm with limestone chippings. Seed was collected from the hay cut on the Downs in July 2011 and the seeds were sown in April 2012. Germination was poor and a second seeding was made with fresh seed in September 2012. The purpose was to recreate an area of limestone grassland within the garden. The changes in vegetation have been recorded for five years, using two approaches. Firstly a whole site visit at fortnightly intervals from March to October recording every species within the plot. Secondly the establishment of 12 random quadrats in which the species were identified and the total area covered in vegetation estimated on a fortnightly basis.

Over time the chippings have consolidated, but there is no soil as such, or worms. The site is mown annually shortly before the September Bee Festival on the first weekend of the month. Otherwise there is almost no management, though Ragwort has been removed, and some Plantain, and some knapweed seed heads are removed. The removal of the whole hay cut annually keeps fertility very low. Rain drains straight through the chippings very rapidly. One result has been that deep-rooted plants, which can reach the sub soil below the chippings, have an advantage; another that leguminous plants, (9 out of 52 species, 19%), that produce their own nitrates have an advantage over others. The site is also slightly domed, so that the chippings are deepest in the centre, and, though cover of the “soil” is now total around the edge, in the centre bare ground can still be found. The 10 quadrats surveyed this year have an average of 91% cover, but for the whole site the figure is now probably 80%.

**1 General.**

**Weather in 2016, January to September**. The average maximum temperature in the first eight months was 15.2⁰C, and in 2015 was 15.3⁰C. Total rainfall in the same period was 534mm this year and 543mm in 2015. In other words the two years have essentially been very similar. This itself is unusual. The temperatures are a degree above the Bristol average since 1853 for the period of 14.2⁰C. The long-term average rainfall for the eight months is 548mm, so the rainfall has been normal but the temperature warmer.

The **winter** was unusual, because December was the warmest since 1853, and many early spring flowers came into bloom at record early dates. January and February, by contrast, had average temperatures that were just a degree above normal. Winter rainfall was 20% greater than average.

**Spring w**as a degree warmer than the long-term average, and rainfall was normal**.**

**Summer** was slightly warmer than normal but July was very dry and the three summer months had a third less rain than normal.

2 **Management.** In August the seed heads of Knapweed were removed, and Ragwort and Hogweed plants were pulled. As usual the whole site was close mown at the end of August and the site prepared for the Bee Festival.

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3 **Survey Methods.** Quadrat number 3 was re-found, having been lost in 2015, but nos 1 and 7 were lost. 10 quadrats were monitored. Eight visits were made between 5 May and 17 August at fortnightly intervals. A whole site dicot species survey was also made on each occasion, and each quadrat was photographed.

**4 Quadrat Survey Results**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Visit 2016 | My | My | Ju | Ju | Jy | Jy | Au | Au |
| Visit no | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Site total species | 24 | 32 | 37 | 37 | 44 | 31 | na | 33 |
| Dicot/quad | 5.9 | 7.1 | 8.5 | 7.6 | 8.5 | 7.9 | 8.6 | 8.0 |
| Quad sp | 17 | 24 | 23 | 22 | 25 | 24 | 24 | 22 |
| Quad % of tot | 71 | 75 | 62 | 59 | 57 | 77 | na | 67 |
| Cover Av % | 68 | 80 | 82 | 89 | 90 | 90 | 91 | 91 |

Table 1

Table 1 summarizes the results of the 8 visits. The total number of species in the whole site is shown in row 3, and increased from 24 to 44 in early July. The overall total was 55 species, up from 51 last year. New species for the site which are Downs species were Centaury, and Ploughman’s Spikenard. Also three species that must have blown in, Forget-me-not, a short lived Maple seedling, and Ragwort. Sallow seedlings have been found every year, and this year the largest has reached 10cm. Four invasive species have not been seen this year, Groundsel, Chickweed, Speedwell, Creeping buttercup, and Yellowwort, that appeared last year, has not been seen this.

**Row four** shows the average number of species per quadrat, which averages around 8, the same as last year, but it has become very stable, variation being caused by the difficulty in July of discovering small species hidden by the dominant Red Clover, trefoils and vetches.

**Row five** shows the total number of species recorded in the quadrats. The total was 29, below last year’s figure of 36. This is a result of the increasing dominance of a few species, notably Ribwort Plantain, Red Clover, Knapweed, Carrot, Black Medic and Birds Foot Trefoil. Oddly only one quadrat contained Kidney Vetch that has expanded fast. It was a poor year for Yellow Rattle and Goatsbeard, both annuals. Interesting plants that are now established included Hedge Bedstraw, Great Knapweed, Dwarf Thistle, Pale Flax, Hop Trefoil and Small Scabious. Clary, which was put in as plugs in 2015, has not survived well.

**Row six** shows the percentage that the quadrat species were of the whole-site species. The average was around 70%, as last year, and shows that the quadrats are measuring the way the site is changing quite well. At the height of the season the proportion fell because several rarer species were identified when they came into flower.

**Row seven** shows what proportion of the quadrats was vegetated. This has increased from 63% in 2014, to 75% in 2015 and to 90% by the end of the season this year. The site is dominated by dicots, but the grasses, which provide most of the cover on the Downs, are finding it very hard to compete. This is primarily because the site is neither mown nor grazed, and because there is as yet no real soil.

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|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|   | aa | Visits  | Quads | F | Rank 2016 | Rank 2015  | Change |
| *Daucus carota* | Carrot | 8 | 10 | 80 | 1 | 4 | Inc |
| *Trifolium pratense* | Red Clover | 8 | 10 | 80 | 1 | 1 |   |
| *Centaurea nigra* | Knapweed | 8 | 9 | 72 | 3 | 2 |   |
| *Hypochaeris radicata* | Catsear | 7 | 10 | 70 | 4 | 5 |   |
| *Cerastium fontanum* | Common Mouse-ear | 8 | 8 | 64 | 5 | 7 | Inc |
| *Plantago lanceolata* | Ribwort Plantain | 8 | 8 | 64 | 5 | 2 | Dec |
| *Lotus corniculatus* | Birds-foot Trefoil | 8 | 7 | 56 | 7 | 6 |   |
| *Trifolium dubium* | Lesser Trefoil | 8 | 6 | 48 | 8 | 8 |   |
| *Medicago lupulina* | Black Medick | 6 | 6 | 36 | 9 | 15 | Inc |
| *Primula veris* | Cowslip | 8 | 3 | 24 | 11 | 12 |   |
| *Taraxacum agg* | Dandelion | 8 | 3 | 24 | 11 | 10 |   |
| *Rhinanthus minor* | Yellow Rattle | 8 | 3 | 24 | 11 | 9 | Dec |
| *Tragopogon pratensis* | Goatsbeard | 5 | 4 | 20 | 14 | 11 | Dec |
| *Ranunculus acris* | Meadow Buttercup | 8 | 2 | 16 | 15 | 17 |   |
| *Lapsana communis* | Nipplewort | 4 | 4 | 16 | 15 |   | Inc |
| *Leontodon saxatalis* | Lesser Hawkbit | 5 | 3 | 15 | 17 | 14 |   |
| *Crepis versicaria* | Beaked Hawksbeard | 4 | 3 | 12 | 18 | 19 |   |
| *Cirsium acaule* | Dwarf Thistle | 8 | 1 | 8 | 19 | 16 |   |
| *Galium mollugo* | Hedge Bedstraw | 4 | 2 | 8 | 19 |   |   |
| *Trifolium campestre* | Hop Trefoil | 4 | 2 | 8 | 19 | 19 |   |
| *Leucanthemum vulgare* | Ox-eye | 8 | 1 | 8 | 19 |   |   |
| *Linum bienne* | Pale Flax | 7 | 1 | 7 |   |   |   |
| *Anthyllis vulnereria* | Kidney Vetch | 6 | 1 | 6 |   |   |   |
| *Leontodon hispidus* | Rough Hawkbit | 3 | 2 | 6 |   | 13 | Dec |
| *Sonchus asper* | Prickly Sowthistle | 2 | 1 | 2 | N |   |   |
| *Crepis capillaris* | Smooth Hawksbeard | 1 | 2 | 2 |   |   |   |
| *Scabiosa columbaria* | Small Scabious | 1 | 1 | 1 |   | 19 |   |
| *Sonchus oleraceus* | Smooth Sowthistle | 1 | 1 | 1 |   |   |   |

Table 2

Table 2 Lists the 28 dicot species recorded in the quadrats in order of their Frequency in Col 5. This is calculated by multiplying the number of quadrats in which they were present, Col 4, by the number of visits in which they were found, Col 3. Col 6 gives them a rank order and Col 7 the rank order in 2015 Col 8 indicates which species have apparently increased and which decreased. There were only 8 visits this season compared with 12 in 2015, and one quadrat, missed in 2015, was found but two that were in use in 2015 have vanished this year, so that the comparison is not exactly like with like. Five species, found in the quadrats in 2015, have not been found this year. They are Fairy Flax, Great Knapweed, Clary, White Clover and Chickweed.

**5 Whole Site Survey results**

55 species were found in the whole site survey. New were Centaury, Forget-me-not, an Acer species seedling, and Ploughman’s spikenard. Five species were lost from 2015. A further 12 species have not been seen since 2014, and 13 species that had appeared in 2012 and 2013 have not been seen since. They were all common species, which were unable to survive the harsh conditions in which they had germinated.

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|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|   | Flower | Visits |   |   | Flower | Visits |
| Centaury | F | 2 |   | Maple seedling |   | 2 |
| Clary | F | 9 |   | Meadow Vetchling | F | 3 |
| Columbine |   | 1 |   | Ploughmans Spikenard |   | 1 |
| Corn Salad | F | 5 |   | Ragwort | F | 8 |
| Creeping Cinquefoil |   | 1 |   | Salad Burnet |   | 1 |
| Daisy | F | 3 |   | Sallow |   | 9 |
| Fairy Flax | F | 2 |   | Self Heal | F | 1 |
| Forget me not | F | 1 |   | Small-flowered Cranesbill | F | 1 |
| Great Knapweed | F | 5 |   | Smooth Hawksbeard | F | 1 |
| Great Plantain | F | 2 |   | St Johns Wort  | F | 3 |
| Hairy Bittercress | F | 2 |   | White Clover | F | 3 |
| Hogweed | F | 6 |   | Yarrow | F | 9 |
| Ladies Bedstraw | F | 2 |   |   |   |   |

Table 3

Table 3 lists the 25 dicot species recorded in 2016 in the whole site survey, which were not present in any of the quadrats. They are listed in alphabetical order. Col 2 indicates those that flowered. Col 3 shows the number of visits in which they were seen. Only four of them were present throughout. The others, mostly small species, were probably smothered by the Red Clover, but may well prove to have survived.

**6 Comparisons with previous years**

|  |  |  |  |
| --- | --- | --- | --- |
|   | Total sp | Cover % | Dicot/quad |
| 2012 | 34 | 25  | 2.1 |
| 2013 | 62 | 41 | 3.8 |
| 2014 | 62 | 63 | 5.3 |
| 2015 | 51 | 75 | 7.7 |
| 2016 | 55 | 91 | 7.8 |

Table 4

Table 4 summarizes the changes in numbers of species present, shown in Col 2. The average cover recorded is the quadrats, Col 3. The average number of species per quadrat Col 4. It does not show the major change in structure which has been the decline of grasses that dominated the plot in 2012, and have almost completely disappeared this year. This is probably caused by the problem that shallow rooted grasses have in establishing themselves on the very dry substrate.

**7 Whole site survey comment.** 55 species were found of which 47 flowered, and presumably produced seed that could germinate next year. However, the spread of Red Clover, Birds-foot Trefoil and Black Medick may inhibit the germination of some species due to their growth habit creating ground cover which excludes light from smaller seedlings. Equally, however, the nitrate enrichment of the substrate which characterizes those which support the growth of plants capable of “fixing” nitrogen from the air, might encourage other species to survive.

There are 16 species that form part of the Downs meadows that are not present on the site, and might be included. In alphabetical order, Autumn Hawkbit, Betony, Burnet Saxifrage, Calamint, Dropwort, Harebell, Hoary Plantain, Marjoram, Mouse-ear Hawkweed, Orchids, which are a law unto themselves, Pale St John’s Wort, Red Bartsia, Rock Rose, Spring Cinquefoil, Thyme and Vervain.

This is a question for the Botanical Garden, which probably already has all these species as part of its local collection. But the chippings have been managed in minor ways from the start and the introduction of selected species would therefore not be unprecedented. The plant structure is becoming much more settled as areas free from competition are fewer.

**c) Grasses**

**The** grass species, listed in table 6 in frequency order, were similar to those found in 2015. Column 2 was calculated by dividing the number of quadrats in which the grass was seen by the total number of quadrats sampled, over five visits and expressed as a percentage. This does however give a slightly false impression because it is based on a present/absent record. Individual plants were very small in number in every case and hence grasses continue to be a very limited contributor to the meadow community despite the decline in numbers of Yellow Rattle. Red Fescue was not detected this year.

|  |  |
| --- | --- |
| Grass species | % occurence |
| Upright Brome | 50 |
| Crested Dog’s tail | 46 |
| Wall Barley | 36 |
| Quaking Grass | 32 |
| Creeping Bent | 26 |
| Soft Brome | 24 |
| Perennial Rye | 22 |
| Yorkshire Fog | 22 |
| Cocksfoot | 14 |
| Common Bent | 14 |
| False Oat | 10 |

Table 6 “

Richard Bland & Martin Collins. Nov 2016

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**FOD+AG Bristol Botanic Garden Limestone grassland report. No 6 2017**

In the autumn of 2011 an experimental area of about 200 square metres in the University Botanic Garden was stripped of its topsoil, and covered to a depth of about 10cm with limestone chippings. Seed was collected from the hay cut on the Downs in July 2011 and the seeds were sown in April 2012. Germination was poor and a second seeding was made with fresh seed in September 2012. The purpose was to recreate an area of limestone grassland within the garden. The changes in vegetation have been recorded for six years, using two approaches. Firstly, a whole-site visit at fortnightly intervals from March to October recording every species within the plot. Secondly, the establishment of 12 random quadrats in which the species were identified and the total area covered in vegetation estimated on a fortnightly basis.

Over time the chippings have consolidated, but there is no soil as such, or worms. The site is mown annually shortly before the September Bee Festival on the first weekend of the month. Otherwise there is almost no management, though Ragwort has been removed, and some Ribwort Plantain, and some Knapweed seed heads are removed. The removal of the whole hay cut annually keeps fertility very low. Rain drains straight through the chippings very rapidly. One result has been that deep-rooted plants, which can reach the sub soil below the chippings, have an advantage; another that leguminous plants, (9 out of 52 species, 19%), that produce their own nitrates, have an advantage over others. The site is also slightly domed, so that the chippings are deepest in the centre, and, though plant cover of the chippings is now total around the edge, in the centre bare ground can still be found. The 11 quadrats surveyed this year have an average of 95% cover by the end of the season.

**1 General.**

**Weather in 2017, January to September**. The winter was mild, with 17 frost nights, and an average maximum above the average of the past decade, and it was the driest since 1992. Spring was the warmest since 2011, and almost two degrees above the decadal average, and exceptionally dry, as there was no rain in April. Summer began with very hot spells in May and early June so that by mid-June a drought was threatening, but the second half of July was very wet, with 50% more rain than average. August was relatively cool with almost daily light rainfalls, and everything sprang back to life.

The average maximum temperature in the first eight months was 15.9ºC compared with 15.2ºC in 2016 and 15.3ºC in 2015. Total rainfall in the same period was 411mm this year compared with 534mm in 2016, and 543mm in 2015. The figure for the previous twelve months in 2017 was the lowest since 1976 throughout the year. The impact of this weather sequence was to encourage early rapid growth and flowering.

2 **Management.**. As usual the whole site was close mown on August 16th in preparation for the Bee Festival.

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3 **Survey Methods.** Quadrat number 7 was lost but all the other 11 were monitored. There were five visits to the quadrats between April 24 and August 16, and eight whole site surveys were made, distinguishing between species in flower and those present.

**4 Quadrat Survey Results**

Table 1 shows the average number of quadrats in which each species was found between 2014 and 2017. This is a way of measuring changes in a species abundance. The species found in a quadrat will differ over the course of a year as the most dominant species conceal the smaller ones. Each year new species have been found in the quadrats, and others have been lost. The quadrats measure the relative abundance of about 60% of the species found in the whole site survey.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |
| aa | 2014 | 2015 | 2016 | 2017 |  |  | 2014 | 2015 | 2016 | 2017 |
| Knapweed | 5.4 | 7.5 | 7.1 | 8.6 |  | Oxeye | 1.1 | 0.6 | 1.0 | 0.8 |
| Ribwort | 6.0 | 8.5 | 7.6 | 8.6 |  | Hairy Bittercress |   | 1.3 | 0.0 | 0.6 |
| Red Clover | 6.9 | 9.0 | 8.8 | 8.6 |  | Small Scabius | 0.2 | 0.6 | 0.1 | 0.6 |
| Carrot | 2.3 | 5.7 | 8.0 | 8.2 |  | Clary |   | 0.4 | 0.0 | 0.4 |
| Catsear | 6.5 | 5.2 | 6.8 | 7.2 |  | Smooth Sowthistle | 0.8 | 0.3 | 0.1 | 0.4 |
| Birds-foot Trefoil | 2.7 | 4.0 | 5.0 | 6.6 |  | Lesser Trefoil | 1.9 | 4.4 | 3.3 | 0.4 |
| Yellow Rattle | 7.7 | 5.1 | 2.3 | 5.0 |  | Yarrow |   |   |   | 0.4 |
| Moss | 2.0 | 2.6 | 2.8 | 4.8 |  | Hop trefoil | 0.5 | 0.8 | 0.6 | 0.2 |
| Black medic | 0.3 | 1.8 | 4.3 | 4.0 |  | Groundsel | 0.3 | 0.1 |   | 0.2 |
| Mouseear | 1.8 | 4.2 | 4.3 | 3.8 |  | Burnet saxifrage |   |   |   | 0.2 |
| Dandelion | 4.6 | 3.4 | 2.0 | 3.0 |  | Fairy Flax |   | 0.4 |   | 0.2 |
| Goatsbeard | 3.9 | 2.6 | 1.5 | 2.0 |  | Creeping Buttercup |   |   |   | 0.2 |
| Meadow Buttercup | 0.6 | 1.4 | 1.6 | 1.8 |  | Smooth Hawksbeard | 0.2 | 0.6 | 0.3 |   |
| Kidney Vetch | 0.6 | 0.6 | 0.8 | 1.4 |  | Prickly Sowthistle | 0.6 |   | 0.3 |   |
| Cowslip | 2.2 | 1.7 | 2.1 | 1.4 |  | Lesser Hawkbit | 1.2 | 1.4 | 0.9 |   |
| Hedge Bedstraw | 0.2 | 0.6 | 0.6 | 1.2 |  | Great Knapweed | 0.1 | 0.5 |   |   |
| Nipplewort | 0.9 | 0.6 | 1.1 | 1.2 |  | Chickweed | 0.3 | 0.2 |   |   |
| Beaked Hawksbeard | 0.1 | 0.9 | 0.9 | 1.0 |  | Self-Heal | 0.3 |   |   |   |
| Pale Flax | 1.1 | 0.6 | 0.9 | 1.0 |  | Great Plantain | 0.6 |   |   |   |
| Dwarf Thistle | 1.2 | 1.2 | 1.0 | 1.0 |  | White Clover |   | 0.3 |   |   |
| Rough Hawkbit | 1.6 | 1.4 | 0.5 | 0.8 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |

Table 1

25

**Quadrat Summary for 2017**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Visit 2017 | Ap | My | Ju | Au | Au |
| Visit no | 1 | 2 | 3 | 4 | 5 |
| Site total sp | 31 | 34 | 38 | 37 | 37 |
| Dicot/quad | 9.4 | 8.7 | 8.8 | 8.6 | 8 |
| Quad sp | 18 | 23 | 25 | 22 | 27 |
| Quad % of tot | 58 | 68 | 66 | 59 | 70 |
| % Cover | 90 | 84 | 91 | 94 | 90 |

Table 2

Table 2 summarizes the results of the five visits. The total number of species in the whole site is shown in row 3, and increased from 31 to 37 in early July.

**Row four** shows the average number of species per quadrat, which averaged 8.7.

**Row five** shows the total number of species recorded in the quadrats. The total was 29, below last year’s figure of 36.

**Row six** shows the percentage that the quadrat species were of the whole-site species. The average was around 64%, as last year, and shows that the quadrats are measuring the way the site is changing quite well.

**Row seven** shows what proportion of the quadrats was vegetated. This has increased from 63 % in 2014, to 75% in 2015 and to 90% by the end of the season this year. The site is dominated by dicots, and grasses, which provide most of the cover on the Downs, are finding it very hard to compete. This is primarily because the site is neither mown nor grazed, and also the fact that there is as yet no soil.

**Dicot frequency ranked.**

Table 3 Lists the 25 dicot species recorded in the quadrats in order of their frequency which is calculated by multiplying the number of quadrats in which they were present by the number of visits in which they were found.

The top twenty species are listed in their frequency rank order in 2015. This is a simple way of measuring changes in abundance on the site. The last column highlights species that are increasing or declining. Lesser Trefoil, Lesser Hawkbit, and Hop Trefoil have gone from the quadrats, Kidney Vetch and Pale Flax have come in, and Catsear and Black Medick have increased since 2015

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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Rank 2015  | Rank 2016 | Rank 2017 | Change |
| Red Clover | 1 | 1 | 1 |   |
| Knapweed | 2 | 3 | 3 |   |
| Ribwort Plantain | 2 | 5 | 1 |   |
| Carrot | 4 | 1 | 3 |   |
| Catsear | 5 | 4 | 3 | Inc |
| Birds-foot Trefoil | 6 | 7 | 6 |   |
| Common Mouse-ear | 7 | 5 | 9 |   |
| Lesser Trefoil | 8 | 8 |   | Dec |
| Yellow Rattle | 9 | 11 | 8 |   |
| Dandelion | 10 | 11 | 7 | Dec |
| Goatsbeard | 11 | 14 | 11 |   |
| Cowslip | 12 | 11 | 14 |   |
| Rough Hawkbit | 13 |   | 20 | Dec |
| Lesser Hawkbit | 14 | 17 |   | Dec |
| Black Medick | 15 | 9 | 10 | Inc |
| Dwarf Thistle | 16 | 19 | 18 |   |
| Meadow Buttercup | 17 | 15 | 12 |   |
| Beaked Hawksbeard | 19 | 18 | 17 |   |
| Hop Trefoil | 19 | 19 |   |   |
| Small Scabius | 19 |   | 20 |   |
| Hedge Bedstraw |   | 19 | 16 |   |
| Nipplewort |   | 15 | 15 |   |
| Oxeye |   | 19 |   |   |
| Kidney Vetch |   |   | 13 | Inc |
| Pale Flax |   |   | 18 |   |

Table 3

27

**5 Whole-site Survey results 2017**

Since 2012 eighty species have been found in the whole site survey. 29 appeared in 2012, and a further 31 in 2013. Since then a further 11 have been found and 15 have gone, these being seedlings of species swept on to the site from the surroundings, including Buddleia, Chicory, Coltsfoot, Great Mullein, Herb Robert, Hoary Willowherb, Knotgrass, Oak, Old Man’s Beard, Petty Spurge, Long-headed Poppy, Scarlet Pimpernel, Spear Thistle, Swinecress, Sycamore, Thalecress, and Thyme-leaved Speedwell.

Three new species were identified in 2017. A single Harebell, three plants of Burnet Saxifrage, which is a common late flowering Downs resident whose identity had been a puzzle, and Creeping Buttercup. The following species present in 2016 were not found; Self-heal, which, if present, was invisible by the time it came into flower; Daisy, which had clung on to a tiny spot in 2016, and Centaury, a new plant in 2016.

There are ten species that are annuals, which are found in the early surveys but die off in the course of the summer. They are Columbine, Common Speedwell, Corn Salad, seedlings of Field Maple, and Sallow, Groundsel, Hairy Bittercress, Smooth Sowthistle, Ragwort, which is regularly pulled, and Tutsan. The bulk of the population is now the 39 species that have been found every year, though, as the quadrats show, in varying quantities.

Other significant species are Yellow Rattle, an annual, which is declining as grasses have largely vanished, Common Mouse-ear, a very persistent annual, and Black Medick. Goatsbeard which grows as an annual but can be biennial, has had a poor year, Kidney Vetch continued to spread but has only reached one of the quadrats. Pale Flax, Dwarf Thistle, Oxeye Daisy, Clary, Small Scabius, and Cowslip, all key components of the Downs flora, maintain a clear presence, but have largely failed to spread.

Table 4 lists all the species that have been recorded in each year.

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Whole Site record 2012-217

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 12 | 13 | 14 | 15 | 16 | 17 |  |  | 12 | 13 | 14 | 15 | 16 | 17 |
| BeakHawksbeard |   | x | x | x | x | x |  | Meadow Buttercup |   | x | x | x | x | x |
| Birds-ft Trefoil |   | x | x | x | x | x |  | Meadow Vetchling |   |   | x | x | x | x |
| Black Medick |   | x | x | x | x | x |  | Moss sp |   |   | x | x | x | x |
| Br L Willowherb | x | x | x |   |   |   |  | Nipplewort |   |   | x | x | x | x |
| Buddleia | x | x |   |   |   |   |  | Oak  | x | x | x |   |   |   |
| Burnet Saxifrage |   |   |   |   |   | x |  | Old Man’s beard | x |   |   |   |   |   |
| Carrot |   | x | x | x | x | x |  | Ox-eye Daisy |   | x | x | x | x | x |
| Catsear | x | x | x | x | x | x |  | Pale Flax |   | x | x | x | x | x |
| Centaury |   |   |   |   | x |   |  | Perf St Johns Wort  | x | x | x | x | x | x |
| Chickweed |   | x | x | x |   |   |  | Petty Spurge | x | x | x |   |   |   |
| Chicory |   | x |   |   |   |   |  | Plough Spikenard |   |   |   |   | x | x |
| Clary | x | x | x | x | x | x |  | Poppy, Long-headed |   |   | x |   |   |   |
| Coltsfoot |   | x |   |   |   |   |  | Prickly Sowthistle | x | x | x | x | x | x |
| Columbine |   | x | x | x | x | x |  | Purple Toadflax |   | x | x |   |   |   |
| C Mouseear |   | x | x | x | x | x |  | Ragwort |   | x | x |   | x | x |
| C Speedwell |   | x | x | x | x | x |  | Red Clover | x | x | x | x | x | x |
| Corn Salad |   | x | x | x | x | x |  | Ribwort Plantain | x | x | x | x | x | x |
| Cowslip | x | x | x | x | x | x |  | Rough Hawkbit |   | x | x | x | x | x |
| Cr Buttercup |   |   |   |   |   | x |  | Salad Burnet |   | x | x | x | x | x |
| Cr Cinquefoil | x | x | x | x | x | x |  | Sallow  | x | x | x | x | x | x |
| Daisy |   | x | x | x | x |   |  | Scarlet Pimpernel | x |   |   |   |   |   |
| Dandelion | x | x | x | x | x | x |  | Self Heal | x | x | x | x | x |   |
| Dwarf Thistle |   | x | x | x | x | x |  | Small Scabius |   |   | x | x | x | x |
| Fairy Flax |   | x | x | x | x | x |  | Sm-flowCranesbill |   | x | x | x | x | x |
| Field Maple  |   | x | x | x | x | x |  | Smooth Hawksbeard |   | x | x | x | x | x |
| Forget me not |   |   |   |   | x |   |  | Smooth Sowthistle | x | x | x | x | x | x |
| Goatsbeard | x | x | x | x | x | x |  | Spear Thistle | x |   |   |   |   |   |
| Great Knapweed |   |   | x | x | x | x |  | Swinecress | x |   |   |   |   |   |
| Great Mullein | x | x |   |   |   |   |  | Sycamore  |   |   | x |   |   |   |
| Great Plantain | x | x | x | x | x | x |  | Thalecress |   |   | x |   |   |   |
| Groundsel | x | x | x | x | x | x |  | Thy-leaf Speedwell |   | x |   |   |   |   |
| Hairy Bittercress |   | x | x | x | x | x |  | Tutsan | x | x | x | x | x | x |
| Harebell |   |   |   |   |   | x |  | White Clover |   | x | x | x | x | x |
| Hedge Bedstraw |   | x | x | x | x | x |  | Yarrow |   | x | x | x | x | x |
| Herb Robert | x | x | x |   |   |   |  | Yellow Rattle |   | x | x | x | x | x |
| Hoary Willowherb |   | x | x |   |   |   |  | Yellowwort |   |   | x | x | x | x |
| Hogweed |   |   | x | x | x | x |  | z Loss |   | 6 | 13 | 23 | 24 | 27 |
| Hop Trefoil |   | x | x | x | x | x |  | z New |   | 31 | 10 |   | 4 | 3 |
| Kidney Vetch |   | x | x | x | x | x |  | z Total | 29 | 60 | 65 | 53 | 56 | 55 |
| Knapweed |   | x | x | x | x | x |  |  |  |  |  |  |  |  |
| Knotgrass | x | x | x |   |   |   |  |  |  |  |  |  |  |  |
| Ladies Bedstraw |   | x | x | x | x | x |  |  |  |  |  |  |  |  |
| Lesser Hawkbit | x | x | x | x | x | x |  |  |  |  |  |  |  |  |
| Lesser Trefoil | x | x | x | x | x | x |  |  |  |  |  |  |  |  |

Table 4

29

**6 Comparisons with previous years**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total sp | Cover % | Dicot/quad |
| 2012 | 34 | 25 | 2.1 |
| 2013 | 62 | 41 | 3.8 |
| 2014 | 62 | 63 | 5.3 |
| 2015 | 51 | 75 | 7.7 |
| 2016 | 54 | 91 | 7.8 |
| 2017 | 55 | 90 | 8.7 |

Table 5

Table 5 Summarises the changes in numbers of species present, shown in Col 2. The average cover recorded in the quadrats, Col 3. The average number of species per quadrat Col 4. It does not show the major change in structure which has been the decline of grasses that dominated the plot in 2012, and have almost completely disappeared this year. This is probably caused by the problem that shallow rooted grasses have in establishing themselves on the very dry substrate.

**7 Whole-site survey comment.** 55 species were found of which 47 flowered, and presumably produced seed that could germinate next year. There are 13 species that form part of the Downs meadows that are not present on the site, and might be included. In alphabetical order, Autumn Hawkbit, Betony, Calamint, Dropwort, Hoary Plantain, Marjoram, Mouseear Hawkweed, Pale St Johns Wort, Red Bartsia, Rock Rose, Spring Cinquefoil, Thyme and Vervain. This is a question for the Botanical Garden, which probably already has all these species as part of its local collection. But the chippings have been managed in minor ways from the start and the introduction of selected species would therefore not be unprecedented. The plant community structure is becoming much more settled as areas free from competition are fewer.

**8 Comment on the changes in an individual quadrat, no 5**

It is instructive to examine the records of a single quadrat. Over the years 25 species have been found in quadrat five. In the course of 2014 18 species were recorded but 40% did not survive into 2015, when 16 were recorded, five of them new. In 2016 there were only 11 species, of which 5 were new and 7 (44%) had gone. In 2017 the total was 13, of which 4 were new and 3 had gone (30%). Only six species were recorded every year, Birds-foot Trefoil, Catsear, Goatsbeard, Knapweed, Red Clover, and Ribwort Plantain. The rate of turnover of species is remarkable. This might have been influenced by the location of quadrat 5, which is very close to the eastern boundary of the plot and is thus more subject to invasive species.

**9 Grasses**

**The** grass species, listed in table 6 in frequency order for 2016, were the same as those found in 2014. However they were far less vigorous, and played a diminished role in the overall structure that was not effectively measured. In 2017 the rank order of occurrence has changed slightly but numbers of plants overall has continued to decline. Species showing a marginal increase in rank are Quaking Grass, Yorkshire Fog and Perennial Rye whilst those in significant decline are Crested Dogstail, Wall Barley and Cocksfoot.

|  |  |  |
| --- | --- | --- |
| Grass species | 2016 | 2017 |
| Upright Brome | 10 | 10.5 |
| Crested Dog’s tail | 9.2 | 6 |
| Wall Barley | 7.2 | 4.5 |
| Quaking Grass | 6.4 | 7.5 |
| Creeping Bent | 5.2 | 6 |
| Soft Brome | 4.8 | 4.5 |
| Perennial Rye | 4.4 | 7.5 |
| Yorkshire Fog | 4.4 | 6 |
| Cocksfoot | 2.8 | 1.5 |
| Common Bent | 2.8 | 3 |

Table 6 “

Martin Collins, Richard Bland 7/11/17

**FOD+AG Bristol Botanic Garden Limestone grassland report. No 7. 2018**

This is the seventh report on the monitoring of the changes in the vegetation of the experimental limestone plot in the Botanic Gardens.

**General.** In 2018 the site was visited roughly fortnightly on eight occasions between April 18 and August 8, and there was an additional early site visit on April 11. Eleven quadrats were surveyed in detail, and a whole site survey was carried out on each occasion to ensure no species were missed.

**The weather, January to August.** Avery remarkable year of huge contrastswhich posed **a** challenge to the plants surviving on this barren site.

It was a cool **winter**, with an average maximum temperature for the three winter months of 8.4℃, the lowest figure since 2013. March, technically part of spring, was the coldest since 2013, and the winter total of 44 frost nights was one of the highest this century. Ice cover on ponds lasted for 24 days, and there were 13 days at the end of February and early March, that had continuous ice cover. This included the coldest day of the year on March 1 when the maximum temperature was -3.0℃, the coldest day since 2010. Rainfall was normal, which ensured that the figure for the previous twelve months almost reached average in April, a marked contrast to the previous dry year.

As a result of these conditions **spring** events began early, and then became later and later to the start of April. March and April were wetter than average; April was warm and May the hottest since 1852, with an average of 19.6℃, and 20% more sunshine than usual, at 6.8 hours a day. But it saw the start of a 100-day drought, as rain only fell on four occasions.

**Summer.** June was the hottest June ever, and the whole summer averaged of 23.6℃, just below 1976. June and July had just 27 mm of rain, though August ended the drought with 94mm, close to average. Summer sunshine hours were 6.9 hours a day, 20% above the normal. The Downs turned yellow, and plant activity slowed to a minimum. The drought came to an end on August 9℃, with a return to lower temperatures and irregular rainfall. It was one of seven very dry summers with less than 40mm of rain a month since 1950.

**The site.** It is worth emphasising that the site is an extreme one. There is no soil, no soil invertebrates or fungi, no nutrients and it is very free draining. There is a very small build-up of detritus from dead plants, and material dropped at the Bee festival and on other occasions. But all the hay cut is composted, and not returned to the site. The chippings have consolidated over the years, assisted by the growth of moss. There has been no maintenance apart from the annual cut, and plants are free to compete fiercely for their space. It is thus a marked contrast with the rest of the gardens where everything is orderly, defined, named. Every year is different, but the basic structure of the population is now well established.

**The species.** 57 species were found this year, six of them new, just above the total in 2016. 46 species flowered, for an average of 13 weeks, a contrast with the 16 weeks in 2016, probably a reaction to the drought. Six species identified in 2017 were not found this year.

|  |  |  |
| --- | --- | --- |
| **New 2018** |   | **Lost 2018** |
| Beech seedling |   | Creeping Buttercup |
| Bulbous Buttercup |   | Creeping Cinquefoil |
| Cleavers |   | Fairy Flax |
| Love in the Mist |   | Nipplewort |
| Dropwort |   | Ploughman’s Spikenard |
| Meadow Cranesbill, white |   | Tutsan |

**Table 1**

**Comment. The gains.** It is a surprise the there have not been more **Beech** seedlings before. **Buttercups**. Initially there was a single **Meadow Buttercup** but the numbers and species are increasing. **Cleavers** is a hedgerow scrambler, and could cause problems if it began to spread. **Love-in-the-Mist** is a common garden annual, very good at spreading itself in gutters etc. **Dropwor**t is an uncommon Downland plant and its arrival at two sites is welcome. The **Meadow Cranesbill** was a part of the flora of the original lawn, which has found a niche at the western tip of the site. It is not a species present in the Downs meadows.

**The losses. Creeping Cinquefoil** invades from the mown lawn, which is invisible once growth gets under way. **Fairy Flax,** a tiny plant with grass-like stems, which is easily missed. **Nipplewort.** A very common late-flowering weed, with distinctive leaves, which may well have been mistaken for Smooth Hawksbeard, which has very similar flowers and fruit, but different leaves. **Ploughman’s Spikenard.** An uncommon, tall, late-flowering species, which is more a cliff edge plant than a meadow plant. Easily missed late in the season. **Tutson.** A very attractive shrubby hypericum which would be mown off if it ever became common.

**The quadrat survey.**

The general result of the eight quadrat surveys this summer are summarised in Table 2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Visits 2018 | Apr | May | May | Jun | Jun | Jul | Jul | Aug |
| Visit no | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Site total sp | 24 | 33 | 39 | 37 | 42 | 37 | 32 | 32 |
| Dicot/quad | 9 | 7.2 | 9.4 | 9 | 9 | 7 | 8 | 6.5 |
| Quad sp | 21 | 21 | 26 | 24 | 23 | 25 | 24 | 20 |
| Quad sp % of tot | 88 | 64 | 67 | 65 | 55 | 68 | 75 | 63 |
| % Cover | 89 | 95 | 90 | 89 | 96 | 79 | 84 | 89 |
|  |  |  |  |  |  |  |  |  |

**Table 2**

**Comment** The cover in one or two central quadrats remained below 100%, and the impact of the drought by the end of July was significant. The fact that there is no mowing, grazing, or trampling ensures that plants grow strongly vertically, leaving areas of open limestone below them. The fall in the number of plant species recorded per quadrat over the summer was also a consequence of the drought, and a contrast with last year.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | 14 | 15 | 16 | 17 | 18 |  |  |   | 14 | 15 | 16 | 17 | 18 |
| Knapweed | 5.4 | 7.5 | 7.1 | 8.6 | 10.3 |  |  | Lesser Trefoil | 1.9 | 4.4 | 3.3 | 0.4 | 1.5 |
| Carrot | 2.3 | 5.7 | 8 | 8.2 | 8.5 |  |  | Burnet Saxifrage |   |   |   | 0.2 | 1.3 |
| Moss | 2 | 2.6 | 2.8 | 4.8 | 7.9 |  |  | Smooth Sowthistle | 0.8 | 0.3 | 0.1 | 0.4 | 1.3 |
| Red Clover | 6.9 | 9 | 8.8 | 8.6 | 7.6 |  |  | Dwarf Thistle | 1.2 | 1.2 | 1 | 1.0 | 1.0 |
| Catsear | 6.5 | 5.2 | 6.8 | 7.2 | 6.5 |  |  | Oxeye | 1.1 | 0.6 | 1 | 0.8 | 1.0 |
| Birds-foot Trefoil | 2.7 | 4 | 5 | 6.6 | 6.4 |  |  | Small Scabius | 0.2 | 0.6 | 0.1 | 0.6 | 1.0 |
| Ribwort | 6 | 8.5 | 7.6 | 8.6 | 6.1 |  |  | Great Plantain |   |   |   | 0.0 | 1.0 |
| Hairy Bittercress | 0 | 1.3 | 0 | 0.6 | 5.7 |  |  | Prickly Sowthistle | 0.6 |   | 0.3 | 0.0 | 1.0 |
| Mouseear | 1.8 | 4.2 | 4.3 | 3.8 | 4.5 |  |  | Dropwort |   |   |   | 0.0 | 1.0 |
| Yellow Rattle | 7.7 | 5.1 | 2.3 | 5.0 | 4.4 |  |  | Clary |   | 0.4 | 0 | 0.4 | 1.0 |
| Goatsbeard | 3.9 | 2.6 | 1.5 | 2.0 | 4.2 |  |  | Groundsel | 0.3 | 0.1 |   | 0.2 | 1.0 |
| Smooth Hawksbeard | 0.2 | 0.6 | 0.3 | 0.0 | 4.0 |  |  | Harebell |   |   |   | 0.0 | 1.0 |
| Kidney Vetch | 0.6 | 0.6 | 0.8 | 1.4 | 3.1 |  |  | Self-Heal | 0.3 |   |   |   | 1.0 |
| Dandelion | 4.6 | 3.4 | 2 | 3.0 | 2.8 |  |  | Beaked Hawksbeard | 0.1 | 0.9 | 0.9 | 1.0 | 2.0 |
| Black Medic | 0.3 | 1.8 | 4.3 | 4.0 | 2.8 |  |  | Nipplewort | 0.9 | 0.6 | 1.1 | 1.2 | 0.0 |
| Lesser Hawkbit | 1.2 | 1.4 | 0.9 | 0.0 | 2.8 |  |  | Hop trefoil | 0.5 | 0.8 | 0.6 | 0.2 | 0.0 |
| Meadow Buttercup | 0.6 | 1.4 | 1.6 | 1.8 | 1.9 |  |  | Pale Flax | 1.1 | 0.6 | 0.9 | 1.0 | 0.0 |
| Cowslip | 2.2 | 1.7 | 2.1 | 1.4 | 1.8 |  |  | Yarrow |   |   |   | 0.4 | 0.0 |
| Hedge Bedstraw | 0.2 | 0.6 | 0.6 | 1.2 | 1.7 |  |  | Fairy Flax |   | 0.4 |   | 0.2 | 0.0 |
| Rough Hawkbit | 1.6 | 1.4 | 0.5 | 0.8 | 1.5 |  |  | Creeping Buttercup |   |   |   | 0.2 | 0.0 |

**Table 3 The average number of quadrats in which each species was found.**

**Comment. Moss** was much commoner after a cold wet winter than previously, and seems to have survived the drought. Only six species are present in more than half the area**. Red Clover** sprawls over wide areas, but is only counted in a quadrat if it is rooted there. **Birds Foot Trefoil**, the great success of 2017, has begun a retreat. **Catsear** fell back, unable to meet the competition of taller plants. **Yellow Rattle**, an annual partially parasitic on grass, has held its own. **Kidney Vetch** has been spreading fast, but until this year avoided the quadrats**. Black Medic** has fallen back remarkably, overshadowed by the Clover. **Nipplewort** is a mystery. It flowers at the same time as Smooth Hawksbeard, and the flowers can be confused. I am now uncertain whether it has ever been present.

**Comment on the changes in an individual quadrat, no 5.**

In 2018 a total of 15 species were present at some point, five of them not present in 2017, and two new to the quadrat. One was Burnet Saxifrage, which finally flowered. We have been watching this plant for four years without being able to be certain of its identity, and it has finally flowered. It is a very late-flowering umbellifer, smooth-stemmed and ten cm high. Normally it will be mown off before it has had a chance to ripen its seed. The second was a tiny plant of Prickly Sowthistle that barely survived a fortnight . Table 4 gives the details.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a | 14 | 15 | 16 | 17 | 18 |   |  |   |  | 14 | 15 | 16 | 17 | 18 |
| Beaked Hawksbeard | x |   |   |   |   |   |  |   | Lesser Hawkbit | x |   |   |   | x |
| Birds-foot Trefoil | x | x | x | x | x |   |  |   | Lesser Trefoil | x | x | x |   |   |
| Black Medic |   |   | x |   |   |   |  |   | Moss |   | x | x | x | x |
| Burnet Saxifrage |   |   |   |   | x |   |  |   | Mouse-ear | x | x |   |   | x |
| Carrot |   | x | x | x | x |   |  |   | Nipplewort | x |   | x |   |   |
| Catsear | x | x | x | x | x |   |  |   | Prickly Sowthistle |   |   |   |   | x |
| Chickweed | x | x |   |   |   |   |  |   | Red Clover | x | x | x | x | x |
| Clary | x |   |   |   |   |   |  |   | Ribwort Plantain | x | x | x | x | x |
| Dandelion | x |   |   | x | x |   |  |   | Rough Hawkbit | x | x |   |   |   |
| Fairy Flax |   | x |   |   |   |   |  |   | Smooth Hawksbeard | x |   |   |   |   |
| Goatsbeard | x | x | x | x | x |   |  |   | Smooth Sowthistle | x |   |   |   | x |
| Great Plantain | x |   |   |   |   |   |  |   | White clover |   | x |   |   |   |
| Haury Bittercress |   | x |   | x | x |   |  |   | Yellow Rattle | x | x |   | x | x |
| Kidney Vetch |   |   |   | x | x |   |  |   | zgone |   | 7 | 7 | 3 | 0 |
| Knapweed | x | x | x | x | x |   |  |   | znew |   | 5 | 2 | 4 | 2 |
|   |   |   |   |   |   |   |  |   | ztotal | 18 | 16 | 11 | 13 | 17 |

**Table 4 Species in Quadrat 5.**

**Annual summary of Quadrat Survey results.**

|  |  |  |  |
| --- | --- | --- | --- |
|   | Total sp | Cover % | Dicot/quad |
| 2012 | 34 | 25 | 2.1 |
| 2013 | 62 | 41 | 3.8 |
| 2014 | 62 | 63 | 5.3 |
| 2015 | 51 | 75 | 7.7 |
| 2016 | 54 | 91 | 7.8 |
| 2017 | 55 | 90 | 8.7 |
| 2018 | 57 | 98 | 8.1 |

**Table 5**

**9 Grasses**

**The** grass species, listed in table 6 in frequency order for 2016, were the same as those found in 2014. However they were far less vigorous, and played a diminished role in the overall structure that was not effectively measured. In 2017 the rank order of occurrence has changed slightly but numbers of plants overall has continued to decline. Species showing a marginal increase in rank are Quaking Grass, Yorkshire Fog and Perennial Rye whilst those in significant decline are Crested Dogstail, Wall Barley and Cocksfoot.

|  |  |  |  |
| --- | --- | --- | --- |
| Grass species | 2016 | 2017 | 2018 |
| Upright Brome | 10 | 10.5 |   |
| Crested Dog’s tail | 9.2 | 6 |   |
| Wall Barley | 7.2 | 4.5 |   |
| Quaking Grass | 6.4 | 7.5 |   |
| Creeping Bent | 5.2 | 6 |   |
| Soft Brome | 4.8 | 4.5 |   |
| Perennial Rye | 4.4 | 7.5 |   |
| Yorkshire Fog | 4.4 | 6 |   |
| Cocksfoot | 2.8 | 1.5 |   |
| Common Bent | 2.8 | 3 |   |

Table 6

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