Edina Trust Bulb Project Extension
Report for Teachers and Project Leaders

A big thank you!

Well done to all schools that sent data for the Bulb Project this year! Your input has been invaluable in looking at our hypotheses. Even if you did not manage to get data to us this year we hope that this project has been fun and useful for teaching various curriculum topics! We have a **quick survey online** where we would love to get your feedback: https://www.surveymonkey.co.uk/r/EdinaBulbs2016

The National Museum of Wales (NMW) will produce a paper on the results of the bulbs planted in pots for all schools. This will be distributed to the schools involved and can be accessed on the NMW website: www.museumwales.ac.uk/spring-bulbs/

This paper focuses on the 101 schools that took part in the fifth year of the Edina Trust's Extension Bulb Project, which involves comparing results from bulbs planted in pots with those they planted in the ground. This year we received data from one third of the schools that took part in the project. We hope that in future more schools will return data on our Moodle website. If any teachers or project leaders have suggestions on how to encourage more schools to do this, please let us know!

Table 1: Data sets for the Edina Trust Bulb Project Evaluation

	Schools in Extension Project	**Schools in Scotland**	**Schools in England**
All Schools	101	73	29
Schools that provided flowering data on bulbs in the ground. They will be referred to in this paper as "our special schools".	31 (31%)	18 (25%)	13 (45%)
Schools that provided flowering data on bulbs in the ground AND bulbs in pots. They will be referred to as "our **very** special schools".	15 (15%)	9 (12%)	6 (21%)

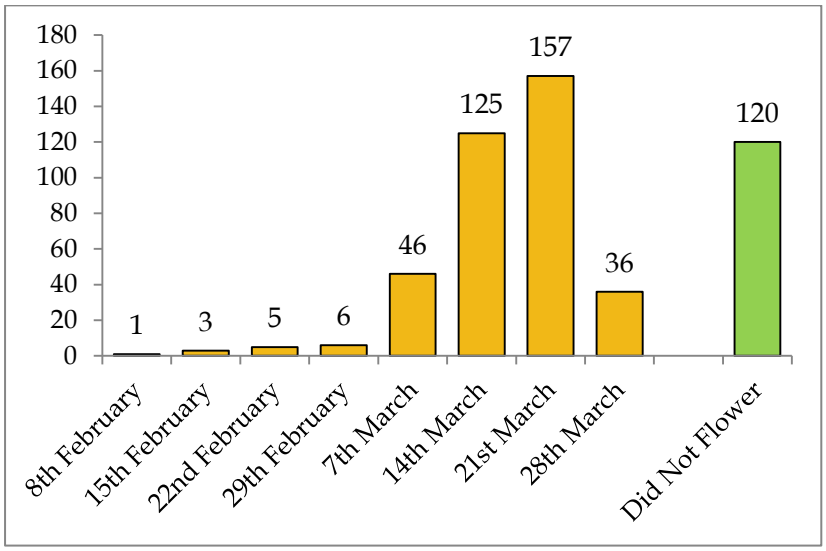
Our 31 special schools provided data on a total of 750 bulbs that flowered as well as recording a total of 120 bulbs that did not flower before the deadline! This year we did not have any Welsh schools on the extension Bulb Project, so we have separated the data into the following areas, rather than by country:

- West Scotland: Inverclyde, North Ayrshire, and Renfrewshire
- Central Scotland: North and South Lanarkshire
- East Scotland: Dundee and Fife
- North England: Lancashire, Hartlepool, Middlesbrough, and Sunderland
- South England: Oxfordshire.

This year's data will be compared with previous years of the Bulb Project to test our hypotheses, which examine the impact of temperature and rainfall on:
i. the flowering dates, and,
ii. the heights of daffodils at the time of flowering.

i. Impact of temperature on flowering dates.

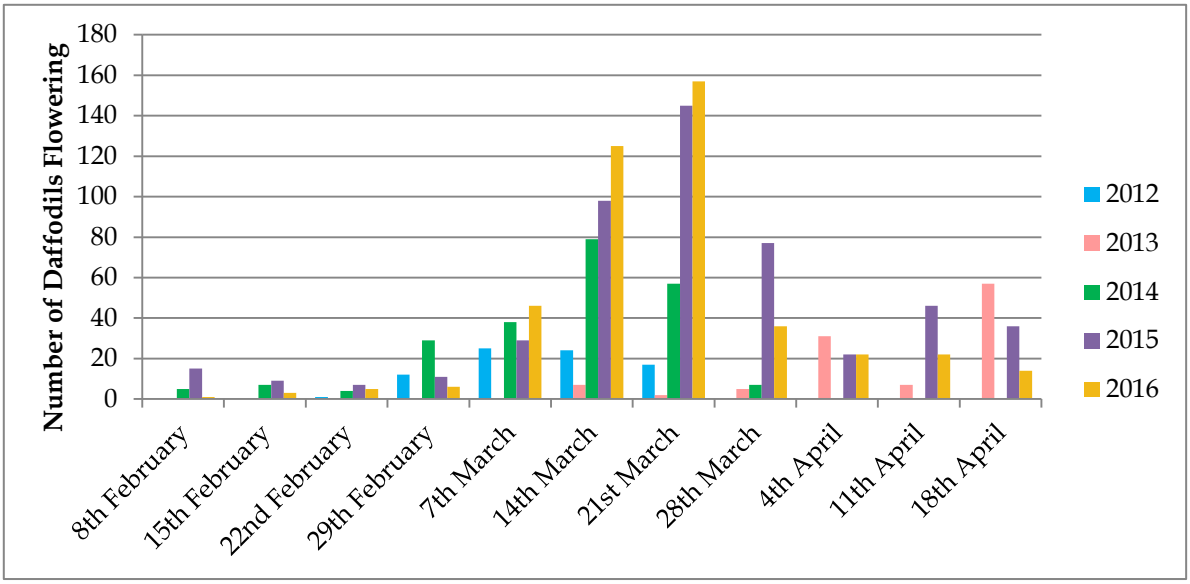
Chart 1: Number of Daffodils vs Date of Flowering (per week) – Feb and Mar 2016



Source information: Chart shows the number of daffodils flowering between 8th February and 31st March. No schools reported flowers earlier than 8th February. Our special schools reported 58 bulbs that flowered after the cut-off date of 31st March, which are included in the 'Did Not Flower' bar.

Chart 1 shows that the majority of bulbs flowered in March this year. This includes daffodils in all of our areas.

Chart 2: Number of Daffodils vs Date of Flowering (per week) – 2012-2016



Source information: Data from all five years of the Bulb Project, since 2011-12. As the project ends at different times each year (depending on Easter), flowers reported after the cut-off date (31st March) this year are shown on this chart.

Chart 2 shows the following:

- In four out of the five years of the Bulb Project, most daffodils flowered in March.
- In 2013 the flowering dates were delayed due to the widespread cold weather.
- In 2016 the flowering dates are more concentrated in the middle of March.

On a related note, although it did not happen to our flowers in the Bulb Project, there were reports in the news this year of daffodils flowering as early as December!

In the charts and tables that follow we have coloured data for Scottish schools in blue and for English schools in red. To distinguish between data on daffodils in pots and in the ground we have used the following symbols: in pots:  , and in the ground:  .

Hypothesis 1: Daffodils in coastal schools will flower before those in non-coastal schools. This will be because coastal areas do not experience such cold nights during the winter, because the sea acts like a blanket warming up the coast.

For the Bulb Project, "coastal schools" means schools that are within two miles of the coastline. This year we only had enough data to compare coastal and non-coastal schools in one area: Lancashire. We like to compare the average flowering dates for this hypothesis for schools in the same area so that we know other factors (e.g. which areas of the country schools are in) are not influencing the results. These results only look at bulbs that were planted in the ground.

This year's average flowering dates for Lancashire were:

2 Coastal Schools	12 Non-Coastal Schools
12th March	21st March

As you can see, in Lancashire, **the average flowering date for coastal schools was nine days before the flowering date for non-coastal schools.** In fact both coastal schools reported flowering before any of the non-coastal schools.

The two coastal schools reported an average temperature of 7.9°C in December and January whereas the twelve non-coastal schools reported an average temperature of 7.2°C over the same period. So the coastal schools were a little warmer, by 0.7°C. We would need to find out the temperatures at night as well to test whether the reasoning in our hypothesis is correct. 0.7°C may not seem like very much of a difference, but remember, the current climate change goal is for an average global temperature rise of just 2°C because a higher rise is judged too dire to contemplate.[1]

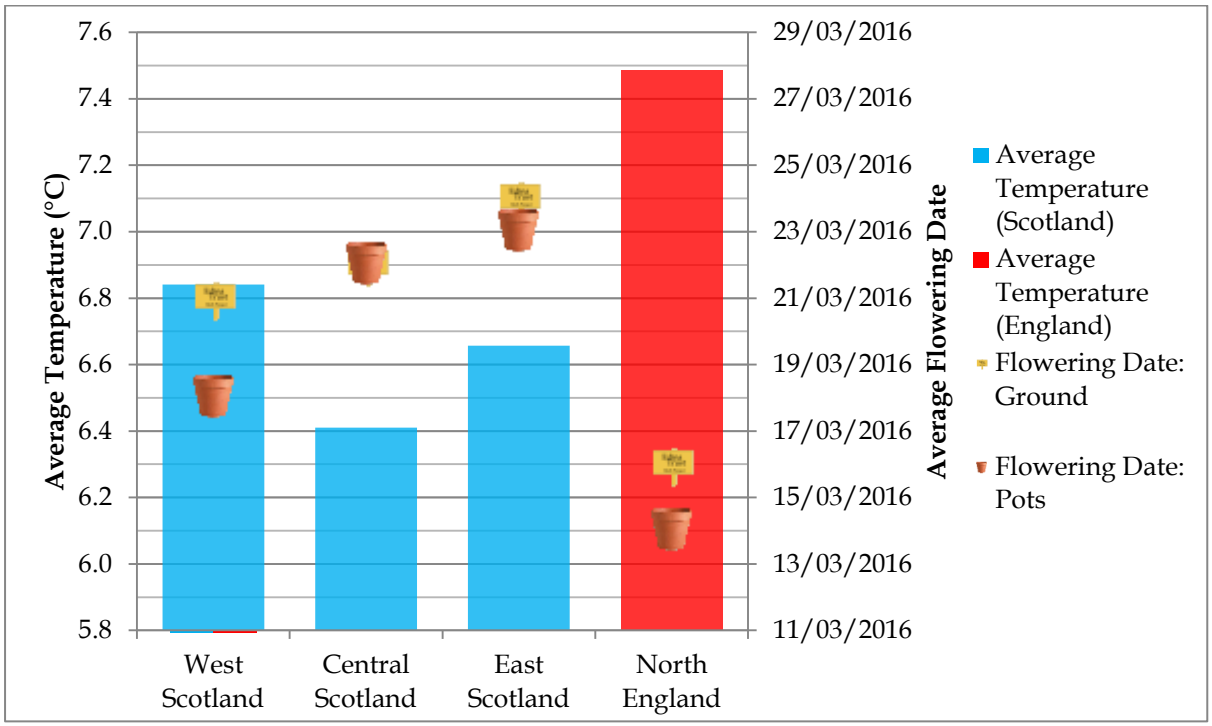
Of course, data from two schools is a small data set but it still supports our hypothesis. Looking back at previous years, the data has always been quite limited because we do not have many coastal schools on the project.

There are many other factors that affect flowering dates, which could be as, or more, important than the average temperature of the area. We ask schools to tell us where bulbs are planted, such as 'in an open area' or 'near to a heated building'. Were your bulbs planted in a shaded area or a sunny area? Were they sheltered near a wall or were they in an open space? Soil quality and type might also have an effect. Can you think of any other reasons? We would need to have more schools in the samples to be able to test which factors have the biggest effect on daffodil flowering dates.

[1] For more information take a look at this website:
https://www.climate.gov/teaching/resources/impact-global-temperature-rise-2c

Hypothesis 2: Schools that record higher temperatures during the months of December and January will have the earliest flowering daffodils. The effect of temperature will be more pronounced with the daffodils in pots compared to those in the ground.

Chart 3: Average flowering date and average December and January temperature – by area.



Source information: The flowering date only includes data from our very special schools that sent in flowering information for both bulbs in the ground and in pots. The weather recordings are from the 91 schools that sent in weather recordings for December and January. We did not receive enough data to include South England this year.

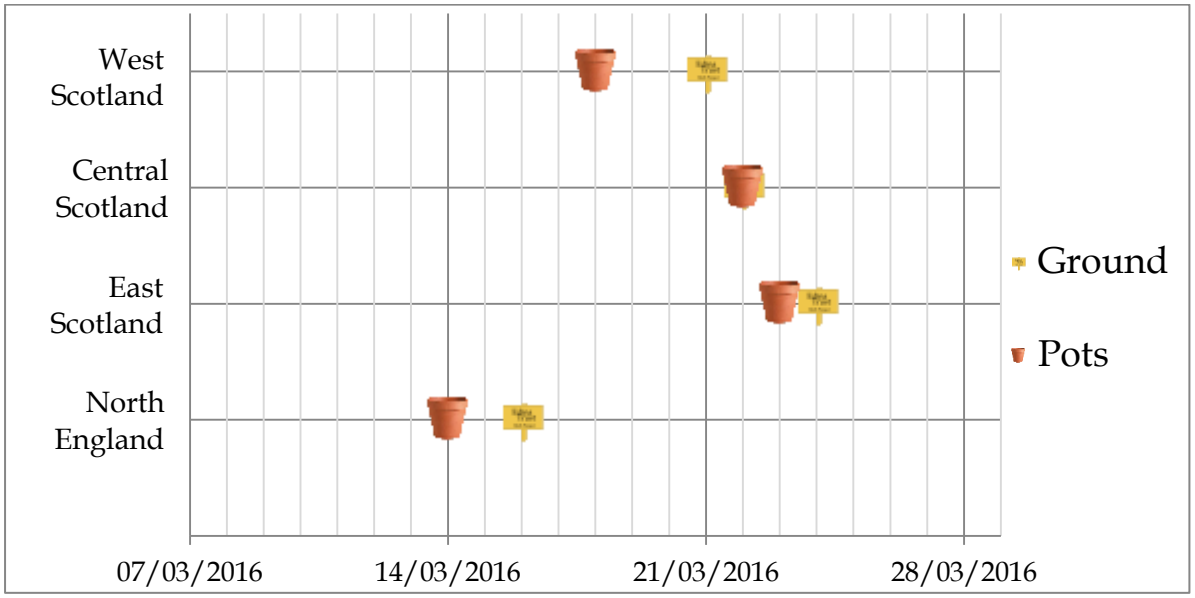
Chart 3 shows that schools in North England reported daffodils flowering earlier in March than in Scotland. North England was also the warmest area in December and January. So **this data supports our hypothesis that daffodils in areas with a higher temperature during the winter months will flower earlier.**

This year the bulbs planted in pots followed the same pattern as the bulbs flowering in the ground. This has not always been the case in previous years of the project, when the flowering dates of bulbs in the ground could be quite different. Looking at the data from 14 schools that sent flowering data for bulbs in the ground and in pots as well as weather recordings in December and January, a statistical test showed that **the correlation between temperature and flowering date was more pronounced for bulbs in the ground**. This was an unexpected result but the dates are very close. There was only three days' difference at most (in West Scotland).

This year's data does not fully support our hypothesis. However these results match our hypothesis better than they did in 2014-15. We will continue look at the data over multiple years in future Bulb Projects to make the best judgement.

Hypothesis 3: On average, daffodils in pots will flower before those planted in the ground.

Chart 4: Average flowering dates in each area, for bulbs in the ground and in pots.



Source information: This data comes from our 15 very special schools, who returned data for both bulbs in the ground and those in pots.

We think bulbs planted in pots will flower first because bulbs in the ground are better insulated from changes in temperature and therefore take longer to 'wake up' when the weather gets warm. Chart 4 supports our hypothesis, as this was what happened in all areas apart from Central Scotland, where, on average, both groups flowered on the same day.

The average flowering dates <u>across all areas</u> were:

- 19th March for bulbs planted in pots.
- 21st March for bulbs planted in the ground.

This means there was only a difference of two days between our two sets of data. We ran a statistical test on the number of flowers recorded each week in pots and in the ground to see if there is a mathematically significant difference between the two groups, or whether it was more likely that the bulbs in pots flowered first by coincidence. **The test revealed that there was <u>not</u> a significant difference, so this data does not support the hypothesis.**

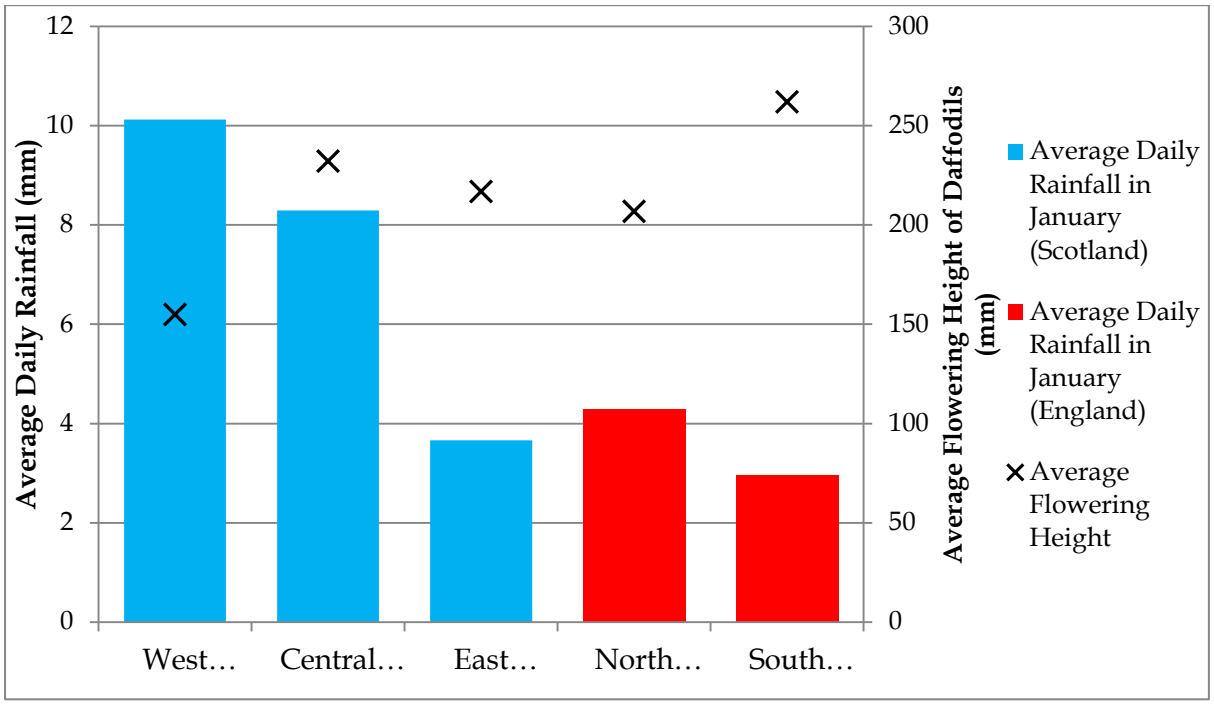
Chart 4 also shows that bulbs planted in North England flowered seven days earlier on average than bulbs in Scotland. Bear in mind that planting day is one week earlier in England than in Scotland (because of how half term holiday dates fall in Scotland), so this may be all, or part, of the reason why bulbs flowered earlier, rather than differences in the weather.

An interesting point this year is that the largest differences in flowering dates between bulbs in the ground and bulbs in pots were in West Scotland and North England – the areas that also recorded the largest amount of rainfall. This may be a coincidence but it is something we could look at in future years, to see if this pattern continues.

ii. Height of plants at the time of flowering.

Hypothesis 4.1: Schools in the area with the highest level of rainfall in the month of January will record taller daffodil flowering heights.

Chart 5: Average Daily Rainfall for January vs Average Daffodil Height in each area.



Source Information: The average flowering height includes results from the 31 schools that reported the heights of their bulbs in the ground. The amount of rainfall is taken from all the schools that sent in weather recordings for January.

Schools in West Scotland recorded the most rain in January this year, with Central Scotland not far behind. In England, more rain was recorded in the North than in the South.

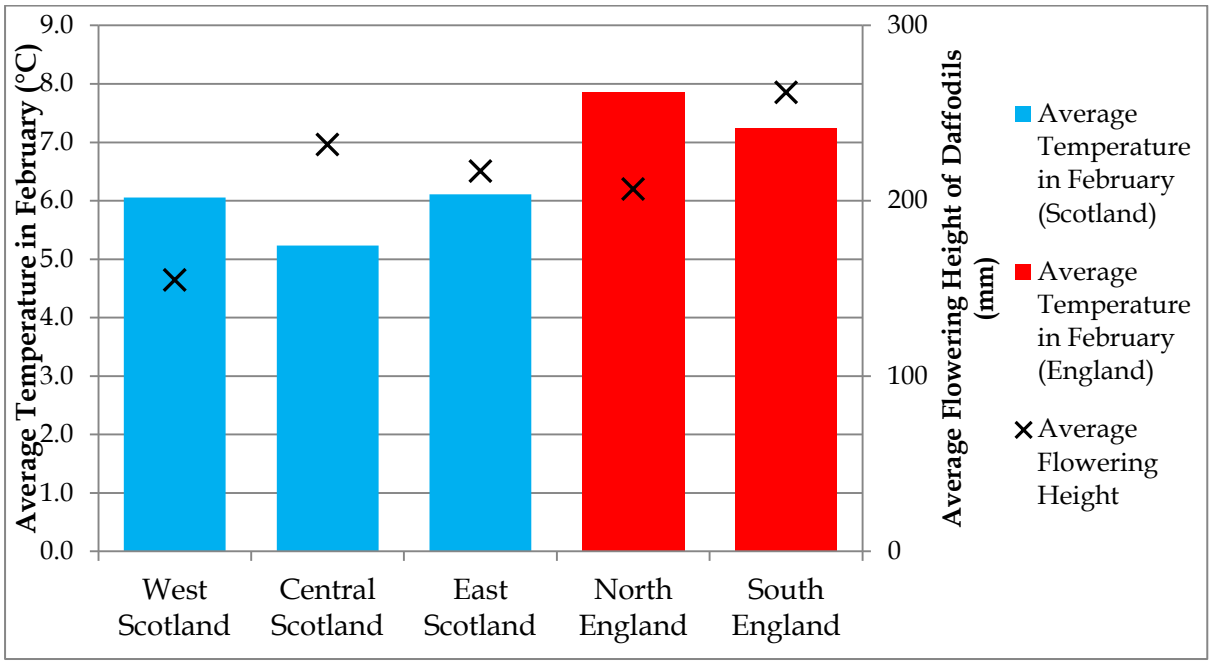
The tallest daffodils were recorded in South England, and the shortest in West Scotland. The data from this year is the complete opposite to what we predicted! Analysing the data with a statistical test showed that there was a weak negative correlation between the rainfall and flowering height. **Schools in the area with the more rainfall reported shorter daffodils.**

The overall rainfall during the months of the Bulb Project was very high, with areas across the UK affected by severe flooding. The Met Office reported that January 2016 was the fourth-wettest January since 1910[2]. So our surprise result this year could be because there was simply too much rain in Scotland and North England for the bulbs, and the daffodils did not grow as tall. But this is just an idea – we would need to do further experiments to see if there is an amount of rainfall that is "just right" for daffodils.

[2] From the Met Office website: http://www.metoffice.gov.uk/climate/uk/summaries/2016/January

Hypothesis 4.2: Schools in areas with higher temperatures during February will record taller daffodil flowering heights.

Chart 6: Average temperature in February vs Average flowering height in each area.



Source Information: As above, the average flowering date is from bulbs in the ground and in pots, and the temperature is taken from all of the schools that sent in their weather recordings for February.

From Chart 6 we can see that North England reported the highest temperatures in February, while Central Scotland was the coldest. Again the results don't quite match our expectations. North England had the second-shortest daffodils and Central Scotland had the second-tallest! A statistical test showed that there is really no correlation between February temperatures and the flowering height this year. **The temperature in February seemed to have no effect on the flowering height.**

Chart 6 makes it look like there was quite a range of temperatures but, on closer examination, you will see that the lowest average temperature was about 5°C and the highest was about 8°C. There was not much of a difference between the areas when it came to temperature, so it may be that there was not enough variability to have had an effect on the daffodils' heights. It may be that other factors that affect daffodil height were more important.

Summary

Well done to all of the schools that sent data for the Bulb Project this year! Your input has been invaluable in looking at our hypotheses. Even if you did not manage to get data to us this year we hope that this project has been fun and useful for teaching various curriculum topics! We have a survey online where we would love to get your feedback:

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Now that we have looked at the various effects the weather has on the daffodils, it has made us a lot more aware of its effects on our surroundings. We hope to see you again next year!