Ten Years of Monitoring Butterfly Orchids on Wolstonbury Hill

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It's a little over 10 years since Richard Bateman requested morphology data to be collected from either of the two British native butterfly orchids, *Platanthera chlorantha* and *Platanthera bifolia* (Bateman & Sexton 2007). At that time the society, Friends of Wolstonbury, had been working at the request of National Trust to clear an area of scrub from Wellcombe Bottom on the northeast side of Wolstonbury Hill in Sussex. The scrub clearance, which progressed over a period of three years, had given rise to the reappearance of several orchid species. One of these orchids, *P. chlorantha,* had shown an increasing population year on year. Now enter David Pearce, Katherine Stott and Neville Henderson who thought they would like to provide some of the necessary data for Richard, not realising this activity would eventually span a period of 10 years.

Wolstonbury Hill is an area of grassy chalk-land situated on the South Downs seven miles north of Brighton and within the South Downs National Park. The summit of Wolstonbury reaches an altitude of a little over 200m and offers impressive views across the Sussex Weald. Wolstonbury has twelve species of native orchids, of which seven can be found at Wellcombe Bottom in an area locally known as the 'Orchid Bank' (Figures 1 & 4). This bank is approximately 1.5ha in area and retains the principal population of *P. chlorantha*.

Once the reclaiming of the orchid bank from scrub had started the butterfly orchids soon showed their flowering potential. In the first year this was estimated at 20 plants but by the time Richard made his request the recorded numbers had grown to approximately 45. One of the positive outcomes of 10 years of monitoring has been the recording of plant numbers for our local records. Figure 2 shows the population size over the 10 years with a peak in 2010. During the monitoring period the areas of highest density of flowering plants have drifted from west to east. We now regret that we didn't record the location of plants and associated densities. Although the population is now well below the peak numbers there is presently an even distribution of plants across the Orchid Bank.

Figure 1: Wolstonbury Hill's Orchid Bank and Greater Butterfly Orchids

This research project with the two *Platanthera* orchids was intriguing as both *P. bifolia* and *P. chlorantha* have near identical genetic signatures but vary in many morphological details (Bateman *et al.*, 2012). The plants attract visiting lepidoptera and they provide a nectar reward. This nectar is found in the flower's spur and raises questions about the relationship between spur length and the proboscis of a visiting pollinator (Bateman & Sexton 2008a). The project in its inception was to investigate the geographical location of plants and the significance of spur length. The records taken at Wolstonbury were to provide one of many data sets across a range of latitudes.

In the first year, only spur length of a flower midway within the inflorescence was recorded. Subsequently, following Richard's request (Bateman & Sexton 2008b), we recorded for each plant the overall height, number of flowers and number and width of each leaf. These additional measurements were designed to establish the possible correlation of spur length with local environmental conditions. The measurements have now been taken from a total of 557 stems and have given rise to 10 years of data sets, of which 9 have allowed scatter graphs to be drawn. Figure 3 shows some typical outcomes for data collected in 2014, using linear regression lines to indicate possible trends. An alternative statistical analysis is achieved by determining the correlation coefficients between variables. Table 1 gives all the statistical outcomes from the data sets collected over the 10 year period. When viewing the set of correlation coefficients a modulus value of unity would show a clear dependency with spur length, but as in all cases the values are extremely low it would imply a negligible dependence of spur length on the other measured physical properties of the plant. As a result a more useful indicator might be the coefficient of determination, r^2, which provides a measure of variance in spur length resulting from changes of an independent variable such as leaf width. In nearly all data sets this link was ≤5%, either with respect to leaf width or plant height.

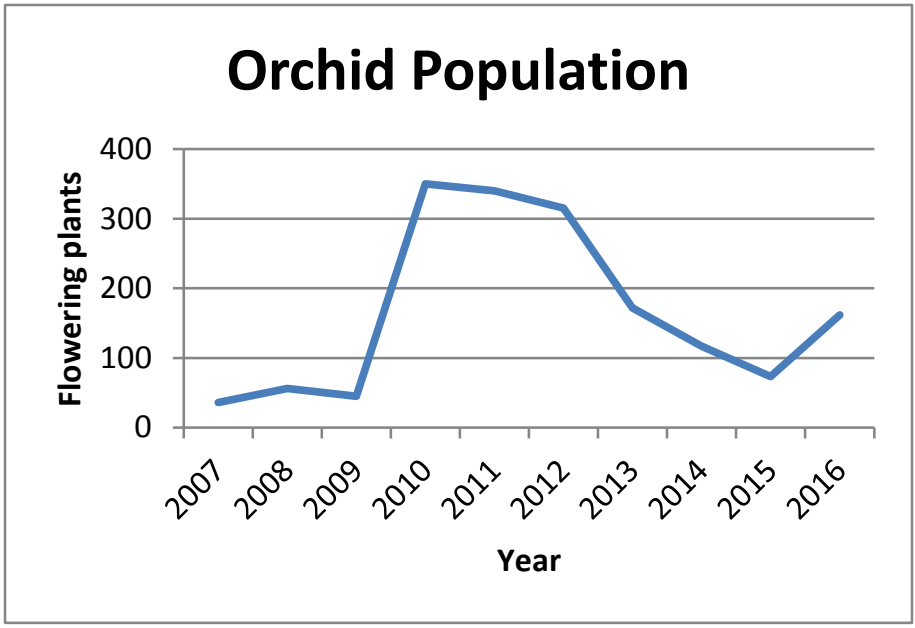
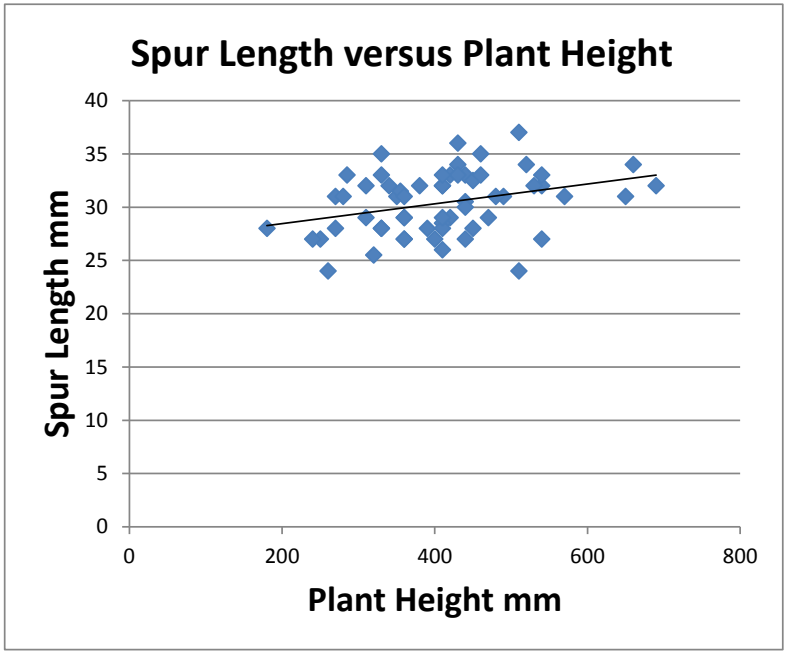
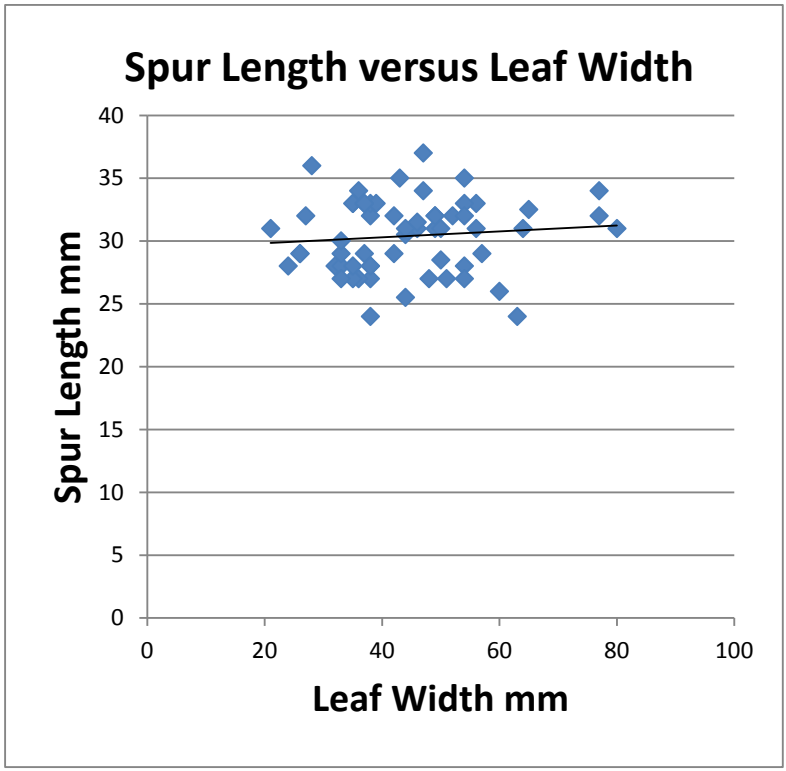


Figure 2 (above): *Platanthera chlorantha* flowering population
Figure 3 (opposite): Scatter graphs for the morphology data collected in 2014


Spur Length versus Plant Height
Spur Length mm
Plant Height mm
0
5
10
15
20
25
30
35
40
0
200
400
600
800


Spur Length versus Leaf Width
Spur Length mm
Leaf Width mm
0
5
10
15
20
25
30
35
40
0
20
40
60
80
100

Another area of interest was with the measurement of spur length itself and in particular the standard deviation within any one data set. In all cases this appears to be relatively large, varying from $\sigma = 2.3$ to 3.6 mm. It's generally accepted that $\pm 2\sigma$ would account for 95% of all measurement readings taken around the overall mean spur length of 29mm. The question therefore arises as to why there is this large deviation in spur length, given that measurement errors should not exceed ±0.5 mm.

Year	Number of Plants Measured	Mean Spur Length (mm)	Standard Deviation (mm)	Correlation Coefficient Spur Length vs Leaf Width	Correlation Coefficient Spur Length vs Plant Height
2007	36	27.5	3.24		
2008	56	28.9	2.77	0.269	0.354
2009	45	29.4	2.69	0.109	0.271
2010	60	28.6	2.66	0.012	0.129
2011	60	27.6	2.77	0.151	0.164
2012	60	28.0	3.60	-0.003	0.161
2013	60	29.7	3.02	0.247	0.088
2014	60	30.4	2.92	0.104	0.329
2015	60	29.9	2.88	0.038	0.189
2016	60	29.4	2.31	0.177	0.126

Table 1: Results from *P. chlorantha* data analysis

In Richard's report (Bateman & Sexton 2009) he discussed the local environmental factors that might influence spur length, many of which may apply to Wolstonbury. The position of the Orchid Bank on Wolstonbury is characterised by tall beech trees on the south side and open grassland on the north side. Typically we have areas varying between heavy shading and full sunlight, the ground is sloping and would offer a range of ground moisture levels together with a potential variation in localised temperatures. The plants may be found in any part of the Orchid Bank, but many are located adjacent to the beech trees. None of these factors was considered when collecting plant data or indeed the stage of a plant's growth or anthesis. These potential variables within a data set and across the span of the monitoring period may account for the large deviations in spur length. It was also noticed when viewing the results illustrated in Table 1, although the correlation of spur length with the two independent variables of leaf width and plant height is poor, the mean spur length

recorded over the ten years was consistently within 5% of the overall mean of 29mm. This would appear to suggest that the spur length is an important property for the plants' continued survival.

Bateman and Sexton have written extensively in regard to spur length of the British species of butterfly orchids, several articles appearing in this journal. For our part at Friends of Wolstonbury we thought this to be an exciting project from the start and, with encouragement from Richard, we have enjoyed extending the data collection across the decade. By providing these additional data sets we hoped to extend the project to encompass the variation of environmental changes that might have occurred due to the changeable British climate. Valuable support has also been received from the local National Trust centre and their wardens, who maintain and conserve the broad spectrum of flora on Wolstonbury.

Figure 4:
Greater Butterfly Orchid
at Wolstonbury Hill

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References

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