Totternhoe's Chalk Specialists: Orchids

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Summary

Volunteers have been helping reserve staff to survey populations of the rare man orchid *Orchis anthropophora*, musk orchid *Herminium monorchis* and frog orchid *Dactylorhiza viridis*, as well as other chalk specialist species, around Totternhoe Nature Reserve in south Bedfordshire. Man and musk orchids were surveyed at this site during 1960s-90s and have since suffered serious declines. Recent surveys show that the population of musk orchids has suffered most, whilst the man orchids appear to have moved to other areas of the site. The effect of caging individual plants was also investigated for man and musk orchids and was shown to increase survival without decreasing reproductive success.

Introduction

Totternhoe Nature Reserve in south Bedfordshire consists of a complex of chalk grassland, scrub, woodland and bare chalk. It incorporates Totternhoe Knolls SSSI (including The Little Hills area), Totternhoe Stone Pit SSSI, Totternhoe Chalk Quarry SSSI and connecting land. This includes ex-arable land undergoing habitat restoration to permanent grassland. The reserve is home to many chalk specialists including orchids, great pignut *Bunium bulbocastanum* and Chiltern gentian *Gentianella germanica* as well as other rare flora and fauna of woodland, scrub, grassland and arable fields. A group of volunteers help staff monitor these important taxa to determine local population trends and ensure our management at the site benefits them all.

At The Little Hills, Totternhoe Knolls, an area long ago subject to quarrying for chalk and stone, there are two rare and one locally rare orchid. The musk orchid *Herminium monorchis* now only occurs in a few square metres of grassland on The Little Hills. In the past it was also recorded at Sharpenhoe on the roadside chalky banks that were also once quarried. Man orchid *Orchis anthropophora* also now only occurs in a few locations around Totternhoe, having declined in numbers over the last century. The frog orchid *Dactylorhiza viridis* has a limited distribution in Bedfordshire and has become scarce on The Little Hills in recent years.

Why do these orchids have such a limited distribution and why have their colonies reduced in size in recent years? For some of these species the opportunity to colonise chalk grassland beginning to establish on disturbed quarry areas may be significant and they don't do well in mature grassland. The abandoned Totternhoe Quarry, only a field away from The Little Hills, has many bare chalk areas that would have been the condition of The Little Hills once quarrying ceased. It is hoped that musk, man and frog orchid can spread into this developing grassland. First we must find out how many plants are left, try to halt further decline and ensure that seed is being produced by the remaining colonies.

Figure 1 Musk, man and frog orchids at Totternhoe (left to right)

Historical data

Local naturalist and scientist Terry Wells studied musk orchid from 1966 to 1994 (Wells 1994; Wells *et al*. 1998) and man orchid from 1966 to 1986 at The Little Hills. Individual plants of both species were monitored within defined areas of The Little Hills, so actual numbers present on the whole site were likely to be greater than indicated. Following these periods of intensive study, very little monitoring occurred prior to 2012. An occasional visit was made to ensure that the plants were still present.

Numbers of both species reached their peak in the 1980s, with 1,989 musk orchids in 1988 and 339 man orchids in 1980. Musk orchid numbers fluctuated widely (Figure 2); probably influenced by the weather, with the lowest counts of 278 in 1977 when no plants flowered following the severe drought of 1976. Just under a third flowered in 1988, of which 40% were bitten off by rabbits. The percentage that flowered each year varied between 0%-38%, with a 29 year average of just under 16%. The highest percentage was in the first year and some of the lowest percentages, excluding the drought years, were in each of the last five years of the study.

Terry Wells considered plants that were absent for three consecutive years to have died (Wells, 1994), and estimated recruitment by the appearance of previously unknown plants. During the 25 year study period, over 6,000 plants were recruited to the population and more than 5,000 died. From these figures he calculated a measure of life expectancy called the half-life; the length of time by which 50% of those recruited in any one year will have died. Prior to 1975 the half-life varied from 2.3-6.6 years, whereas after the drought years of 1975 and 1976 the half-life varied between 12.5-16.9 years. It is interesting to note that 12 plants present in 1966 survived at least 27 years.

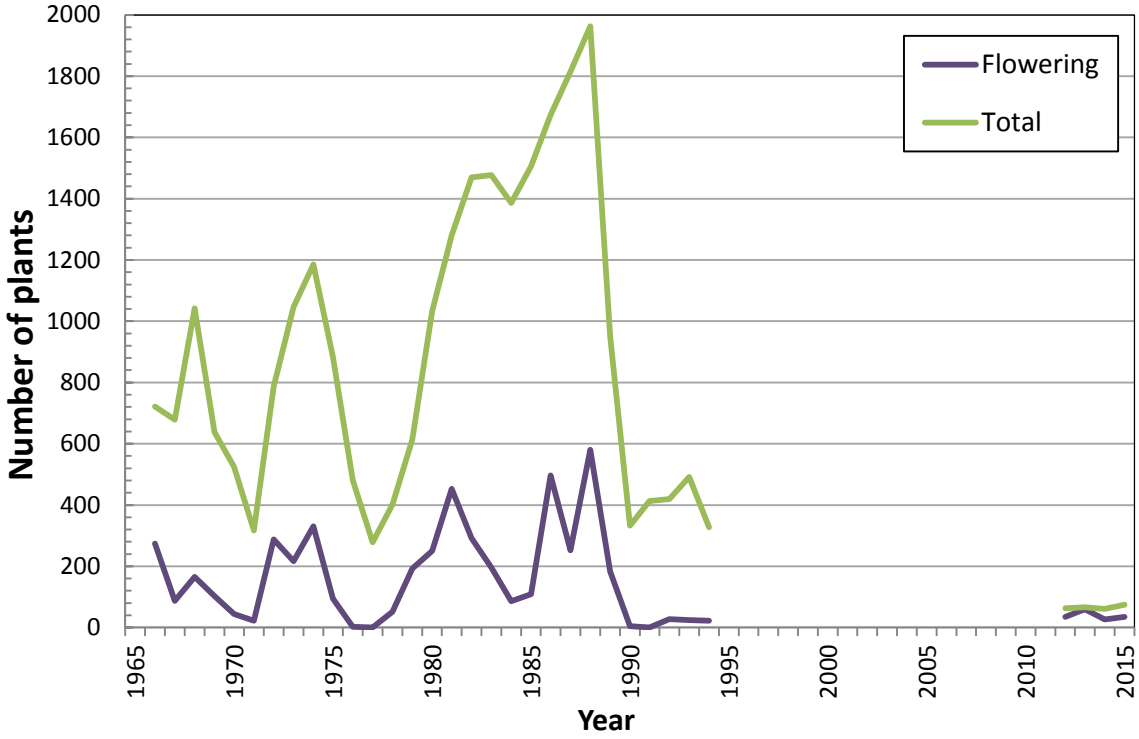


Figure 2 Number of musk orchids at Totternhoe Little Hills area

Man orchid numbers fluctuated less widely (Figure 3), but increased from around 100 in the 1960s, to over 200 in 1973, and up to 339 in 1980, before starting to decline in the mid-1980s. The percentage of flowering plants varied from 10% to 73%, with an average of 34% over the 21 year study; the highest percentages being in the first two years and the lowest in the last two years. Wells' Little Hills study ceased in 1986, but casual records suggest that this decline continued. It was known to still be present on The Little Hills in most (but not all) years during this period, but only in low numbers. A maximum of 20 plants were seen in 2004.

However, in the nearby Totternhoe Quarry SSSI, Steve Oakes-Monger recorded 49 man orchids in 2002, 20 in 2003, 14 in 2004 and 39, plus an additional nine on the edge of a nearby track in 2008.

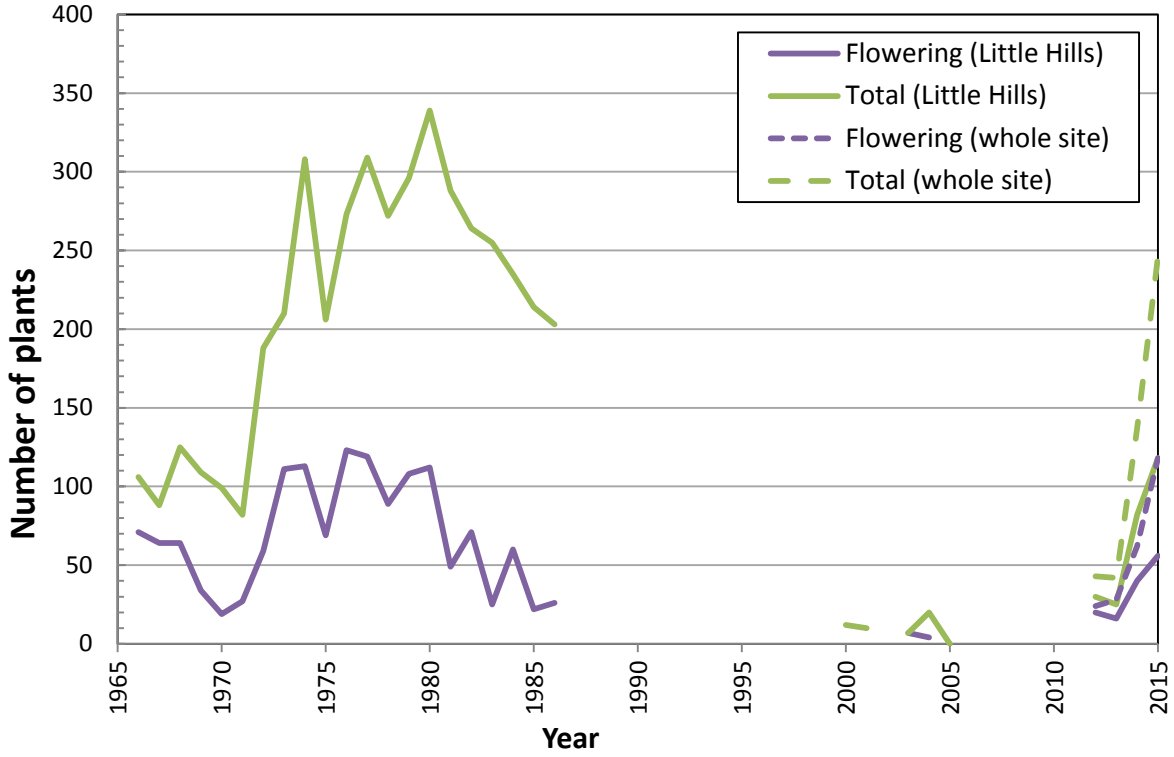


Figure 3 Number of man orchids at Totternhoe Little Hills and whole site

Recent methods

In 2012 a group of Wildlife Trust BCN volunteers was set up to determine the current status and distribution of these rare species across the whole reserve. This was done by training volunteers to identify the target species then equipping them with record sheets and GPS units. During May and June from 2012 to 2015, staff led four survey days during which volunteers spread out across designated areas searching for orchids. Each plant was then recorded together with its location, habitat, slope, aspect and reproductive state (non-flowering, flowering, fertilised). Any pollinators observed were also noted and photographed. Surveyors also recorded any damage to the plant from grazing and/or trampling. During 2013-15, individual plants were identified with numbered tags allowing their reproductive progress to be tracked over the summer. During 2014-15, early spring visits were also conducted to find wintergreen rosettes of man orchids. These were tagged and searched for during the later surveys. This in part explains the higher counts of non-flowering plants during these years.

During 2013-15 small chicken wire cages were placed around some of the musk, man and frog orchids in an attempt to prevent damage from trampling and grazing and to increase the amount of seed produced. The major concern over caging was that it would discourage pollinators. To determine the benefit of the use of cages the proportions of fertilised/unfertilised and damaged/undamaged plants were compared for plants with and without cages. Unfortunately, the cages were often moved by people taking photographs or knocked over by livestock and therefore needed constant monitoring. The results were analysed using Pearson's Chi-squared test or

Fisher's Exact Test (depending on sample size); since Fisher's Exact Test is better suited for contingency tables with small sample sizes.

Figure 4 Caging individual or small groups of orchids to protect them from grazing

Results

Population size and distribution

The musk orchid is now found only on a single slope of short grassland at The Little Hills area. During Wells' study musk orchids were found here but also over a much larger area of the reserve. As well as this range contraction, much lower numbers of musk orchid are now found at Totternhoe (Figure 2), the maximum count in recent years being 75 plants in 2015; well below even the lowest count Wells made of 278 in 1977. Numbers have stayed fairly consistent across the last four years with 60-75 plants being found each year.

It is interesting to note that in most years of Wells' study more than 80% of musk orchids were vegetative (producing no flower spikes), compared with the recent studies where only 44%, 9%, 57% and 56% were vegetative in 2012, 2013, 2014 and 2015 respectively. This may be a result of the Wells' method of checking each known plant from fixed points in the ground, compared to the current method of visual searching only; which is prone to missing tiny vegetative individuals.

Table 1 Rare orchids and proportion flowering found at Totternhoe

	Musk Orchid		Man Orchid		Frog Orchid	
Year	Total	Flowering	Total	Flowering	Total	Flowering
2012	63	35 (56%)	43	24 (56%)	5	2 (40%)
2013	66	60 (91%)	42	28 (67%)	14	10 (71%)
2014	61	26 (43%)	137	62 (45%)	26	24 (92%)
2015	75	35 (43%)	246	118 (48%)	4	4 (100%)

Table 2 Man orchid distribution at Totternhoe and nearby Sewell Disused Railway

	Man Orchids by site					
	The Little Hills		Totternhoe Quarry		Sewell Disused Railway	
Year	Total	Flowering	Total	Flowering	Total	Flowering
2012	30	20 (67%)	13	4 (31%)		
2013	25	16 (64%)	17	12 (71%)	17	1 (7%)
2014	82	41 (50%)	55	21 (38%)	10	3 (30%)
2015	118	56 (47%)	128	62 (48%)	15	7 (47%)

Man orchids were mostly in one area of The Little Hills, but with scattered individuals and small groups elsewhere around this site. Whilst a few are still found in Wells' study areas, the main population is now several tens of metres to the north. Several man orchids were also found at the adjacent Totternhoe Quarry and nearby Sewell Disused Railway but it is not known how long these populations have existed. Most plants outside of The Little Hills were less likely to flower or be fertilised and were prone to damage, with the exception of plants on a privately owned part of Totternhoe Quarry (only searched during 2014/15).

These studies also show the problems of assessing number of plants present by counting flowering spikes, particularly with orchids when a largely unknown proportion of the population is resting or developing below ground.

Few frog orchids were found, mainly from two areas of The Little Hills. Although numbers found increased in 2014; the maximum counted on a visit in the 1970s was 77. The low counts in 2015 may be due to their late emergence this year.

Effects of caging orchids

During 2013 and 2014, chicken wire cages were put around 80 musk orchids (individually or in small groups) and these along with 17 uncaged plants were monitored until after fertilisation. Since cages were added after flowering, only levels of fertilisation and plant damage were compared between caged and uncaged plants. Caged plants showed lower levels of damage and very similar levels of plants being fertilised, although neither of these were statistically significant (damaged: Fisher's Exact Test p=0.114; fertilised: Fisher's Exact Test p=0.486). Interestingly, caged plants that had been fertilised had, on average, more fertilised seed pods per plant than uncaged plants.

Table 3 Effect of caging on musk orchid survival and reproduction

Flowering Musk Orchids		% damaged	% surviving plants with fertilised pods	Average number of fertilised seed pods per plant
Caged	56	33.8	95.0	12.0
Uncaged	12	52.9	90.9	4.7

In 2013, cages were placed around 13 man orchids with developing fertilised seed pods. 50% of uncaged plants were lost compared to 25% of the caged plants. Several plants were damaged by people lifting the cages to take photographs then roughly replacing the cage.

In April 2014 and 2015, wintergreen rosettes of man orchid were caged to test the effect of caging on different growth stages. 258 plants were included in this study: 69 were caged, 19 with black plastic mesh, 1 with a sturdy green wire cage and 49 with chicken wire. The results are summarised in table 4. A greater proportion of uncaged plants were damaged or lost (66% compared to 32% of caged plants; χ^2 Pearson's =14.742, p<0.001), presumably due to grazing (although at least one was trampled). Grazing damage in caged plants was mostly due to the high numbers of slugs and snails seen in 2014.

Table 4 Effect of caging on Man Orchid survival and reproduction

Man Orchids		% damaged	% that flowered	% with flower spike fertilised
Caged	69	32.0	50.7	65.7
Uncaged	189	65.9	46.6	55.7

Slightly higher proportions of man orchids flowered when caged while still rosettes (51% compared to 47% of caged plants); of which most were fertilised (66% compared to 56% of uncaged plants). These differences were not statistically significant (flowering: χ^2 Pearson's =0.351, p=0.553; fertilised: χ^2 Pearson's =1.96, p=0.162).

Five frog orchids were caged in 2013 with a further nine uncaged for comparison. Interestingly, 80% of both groups were lost, presumably through grazing and trampling. Only two plants, one caged and one uncaged plant, set seed.

Interestingly, the caged frog orchid also produced more seed pods per plant than the uncaged one. The caged frog orchid produced 12 pods compared to only four on the uncaged plant.

Reserve management

By mapping the locations of these rare orchids from year to year we can ensure that the management of these areas is suitable and then attempt to recreate similar habitat in other areas. Whilst the man orchid will grow along scrub edges, musk and frog orchids require open grassland. A major issue on all our chalk grassland sites is invading scrub. Using the orchid distribution maps we can target our scrub control to open areas around musk and frog orchid populations. We can then ensure that man orchid areas are cut rotationally to prevent them becoming over shaded. This also

allows more accurate counts of the number of non-flowering rosettes which were previously hidden under scrub. The increase in numbers of man orchids at Little Hills area between 2014 and 2015 may in part be to the extensive scrub work carried out over winter.

Figure 5 Volunteers surveying man orchids 2014 (left), the same area cleared and fenced in 2015 withcanes indicating individual orchids (right)

Another major issue, especially at The Little Hills area, is the increase in rosebay willowherb *Chamerion angustifolium* and clematis *Clematis sp*. Summer grazing was desirable to these invasive plants, but not at the expense of the rare plants. Our detailed maps of orchid distribution were used to set up temporary fencing around the key areas for musk and man orchids. With ongoing monitoring, any plants coming up outside these fences were caged. This allowed a high proportion of the orchids to survive the summer grazing, to flower and produce seed.

Figure 6 Grazing helps tackling invasive species which would otherwise be detrimental to the reserve (here willowherb); caging or fencing orchids allows them to survive summer grazing without preventing pollination

Whilst we know that seed is being produced we don't know whether the plants we are recording are new recruits or old plants which have been dormant or missed in previous years. A lack of recruitment would be a warning that something is wrong and intervention is required. Although in some populations the number of plants shows high variation from year to year (as with the musk orchid); some individuals may live for decades. It is a concern that it is these long-lived individuals that we regularly count without there being significant recruitment for many years.

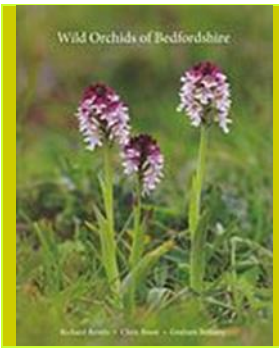
One solution could be to manually collect the seed pods and spread them onto other areas of the reserve, or even other nearby reserves, where suitable habitat has been created by recent management work. Great care would be needed in choosing appropriate receptor sites and ensuring that enough seed is left at the donor areas.

References

Wells, T.C.E. (1994). Population ecology of British terrestrial orchids In: Pridgeon (ed.) *Proceedings of the 14th world orchid conference*, London, HMSO, 170-175

Wells T.C.E., Rothery, P., Cox, R and Bamford, S. (1998). Flowering dynamics of *Orchis morio* L. and *Herminium monorchis* (L.) R. Br. at two sites in eastern England. *Botanical Journal of the Linnean Society* 126 39-48.

Revels R., Boon, C. and Bellamy G. (2015). *Wild Orchids of Bedfordshire*. Bedfordshire Natural History Society.



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We would like to thank the Bedfordshire Natural History Society for kindly donating some of the profits from this book to fund the continued monitoring of Totternhoe's rare orchids.