Dactylorhiza incarnata (L.) Soó subsp. *ochroleuca* (Wüstnei ex Boll) P. F. Hunt and Summerh. (Orchidaceae): A comparison of British and European plants

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ABSTRACT

A brief summary is given of the occurrence of *Dactylohiza incarnata* subsp. *ochroleuca* in Britain and continental Europe and examples of the very few remaining native British plants have been compared to those at three European localities. Although the sample size at the British locality was inevitably extremely small, it is tentatively concluded that plants at all the localities are conspecific.

KEYWORDS: morphometrics, diagnostic characters.

INTRODUCTION

Known in Britain under the name *Dactylorhiza incarnata* subsp. *ochroleuca*, this plant has been placed at differing taxonomic levels by many authors. Relatively rare and widely scattered from central Europe to Scandinavia, the only genuine British records are from eastern England (East Anglia) where it now appears to be reduced to one small population. As the subspecific epithet implies, the flower colour is pale yellow and both in Britain and on the continent, it has been over-recorded through confusion with yellow flowered, anthocyanin-lacking forms of other subspecies of *D. incarnata*, especially subsp. *pulchella*. Flower colour alone, therefore, is not sufficient to distinguish it and previous authors (e.g. Pugsley 1939; Nannfeldt 1944; Heslop-Harrison 1956; Rajchel 1964; Lundqvist 1967; Bateman & Denholm 1983, 1985) have variously used a combination of characters in its taxonomic delimitation. These include its relatively robust habit, tall, broad stem, large leaves and bracts, and relatively large, pale yellow, unmarked and trilobed labella, frequently having notched lateral lobes. It is a plant with a precise habitat requirement, growing in the drier parts of rich fens where it occupies a distinct ecological niche.

As *Orchis incarnata* var. *ochroleuca*, it was first described by Boll (1860) from plants seen by Wüstnei at Sternberg (in Mecklenburg), Germany in 1854. From his record (Wüstnei 1854), it is not clear in exactly what type of habitat they grew and, because of this, reservations have been expressed (Bateman & Denholm 1985) regarding the true identity of the plants upon which the name *ochroleuca* is based. However, an examination of preserved specimens collected by Wüstnei (Mecklenburg, *Wüstnei*, s.d. (**W**!)), similar to those on which Boll based his original description, confirms that at least one of them is referable to this subspecies. This is the central specimen of the three mature specimens on the sheet and bears the label "*Orchis incarnata* L. var. *floribus ochroleucis*.....In Mecklenburg. K Wüstnei".

The first definite British record was made in 1935 from the upper Ouse/Waveney valley area (Blo Norton Fen, 23.vi.1935, *Lousley* (**BM**!)) and shortly afterwards it was also found at various nearby fens within the same general area of East Anglia. Previous to this, however, the Stephensons had tentatively recorded it from both Kidwelly, South Wales as well as from an unlocalised site in East Anglia (Stephenson & Stephenson 1923). Although no preserved specimens collected by the Stephensons from the latter area have been traced and the Kidwelly locality has not been re-found, a Stephensons' specimen, labelled "(b)? v. ochroleuca", does exist (Kidwelly, 27.vi.1919 (**TOR**!)). In general habit this does show some affinity to less robust plants of subsp. *ochroleuca,* but its labella are line-marked and almost entire and these are characters not found in that plant**.** So, other than for the few known East Anglian localities, the plant has not been

confirmed elsewhere in Britain although erroneous records proliferate due to confusion with similar coloured forms of other subspecies of *D. incarnata*.

Mainly due to habitat drainage, subsp. *ochroleuca* is now a highly endangered British plant. There appear to have been no recent records at Blo Norton/Thelnetham and it may now be extinct there. Further east at Redgrave there were reports of a few plants until the late 1980s but none have been seen recently, although a single specimen was recorded at Market Weston Fen in June 1995 (M. Sanford, pers. comm., 2000). At Chippenham, perhaps now the only extant British site, there were as many as 50 flowering plants in the early 1980s but now, even in a good year, there are rarely more than five.

Subsp. *ochroleuca* is also known from several parts of continental Europe, especially Germany (Lubs 1968; Füller 1983), Poland (Rajchel 1964) and the central Alps (Hegi 1939) and reaches as far north as southern Sweden (Nannfeldt 1944; Wiefelspütz 1976) and Estonia (Kuusk 1991) and eastwards into Russia (L. Averyanov, pers. comm., 1990). Pale-yellow flowered plants from species-rich fens in the Picardy area of north-eastern France have sometimes been recorded as subsp. *ochroleuca* but these appear referable to pigment-lacking variants of the type or of subsp. *pulchella*. Further evidence for this was gained during a visit to the area in 1991.

A MORPHOMETRIC COMPARISON OF BRITISH AND EUROPEAN PLANTS

Whether the British plant is the same as that of continental Europe has sometimes been questioned (e.g. Stephenson & Stephenson 1923; Landwehr 1977). In order to examine this, the opportunity has been taken to compare the morphology of the few remaining examples of the only apparently extant British population with others occurring at localities in Scandinavia and mainland Europe. Due to its great scarcity, however, the number sampled in Britain was extremely small and, because of this, any conclusions drawn can only be tentative.

To carry out this comparison, plants from three European populations - Storsund, Gotland (Sweden), Viidumäe, Saaremaa (Estonia) and Murnau, Bayern (Germany), all apparently referable to subsp. *ochroleuca*, were morphologically compared to those at Chippenham (England) for those characters considered most useful in separating *D. incarnata* subsp. *ochroleuca* from closely allied taxa. Under precise conditions and in a similar manner to the method of Bateman & Denholm (1985), data were obtained in a non-destructive manner for the following characters: 1. plant

TABLE 1. MORPHOMETRIC COMPARISON OF BRITISH AND EUROPEAN PLANTS OF *DACTYLORHIZA INCARNATA* SUBSP. *OCHROLEUCA* - POPULATION MEANS AND STANDARD ERRORS

	Chippenham (England)	Storsund, Gotland (Sweden)	Viidumäe, Saaremaa Island (Estonia)	Murnau, Bayern (Germany)
No. of plants measured (n)	5	10	10	13
1. Plant height	338·3 ± 23·8	235·1 ± 20·3	321·8 ± 19·1	291·5 ± 7·9
2. Inflorescence length	42·3 ± 4·9	47·0 ± 2·9	62·3 ± 3·9	59·1 ± 2·8
3. Stem width near base	6·1 ± 0·6	6·8 ± 0·5	7·5 ± 0·4	5·7 ± 0·3
4. Stem width below inflorescence	3·8 ± 0·4	4·7 ± 0·4	4·9 ± 0·6	4·4 ± 0·2
5. Longest leaf (length)	118 ± 9·5	127·1 ± 7·7	117·6 ± 6·3	108·5 ± 3·7
6. Longest leaf (max. width)	17·8 ± 0·4	22·7 ± 1·7	22·4 ± 1·0	22·9 ± 1·1
7. Bract length	20·7 ± 0·5*	33·9 ± 2·8	29·4 ± 1·3	26·1 ± 1·0
8. Bract width	4·8 ± 0·3*	6·8 ± 0·6	6·5 ± 0·3	4·5 ± 0·2
9. Labellum width	6·5 ± 0·1*	8·1 ± 0·4	8·2 ± 0·3	6·3 ± 0·3
10. Labellum length	5·9 ± 0·2*	6·4 ± 0·1	6·4 ± 0·2	6·3 ± 0·1
11. Trilobed character	1·0 ± 0·0*	0·9 ± 0·1	0·6 ± 0·1	0·7 ± 0·1
12. Lateral lobe notching	1·0 ± 0·0*	1·0 ± 0·0	0·7 ± 0·1	0·8 ± 0·1

(all measurements in mm)
* n=3

height, 2. inflorescence length, 3. stem width near base, 4. stem width below the inflorescence, 5. length of longest leaf, 6. maximum width of longest leaf, 7. length of lowest floral bract, 8. maximum width of lowest bract, 9. maximum width of labellum, 10. maximum length of labellum, 11. presence of distinct labellum sinuses (i.e. a measure of the degree of the trilobed character), 12. presence of notching on lateral lobes of labellum. The last two characters listed (11, 12) were scored as: 0 = character absent; 0·5 = present, but not highly developed; 1 = very noticeably developed whilst, in all cases, the flowers measured were those towards the base of the inflorescence. In addition all plants were checked for the presence/absence of line or dot markings on the labella and for leaf spotting.

Wherever possible at least ten plants were assessed, chosen in as random a manner as possible so as to avoid selection bias. Unfortunately in Britain, where the population is now very small (five plants in that year), random selection could not be applied; furthermore, flowers of two of these could not be fully assessed due to partial damage, possibly by vermin. At all the localities the plants formed homogenous populations and were not interspersed with other subspecies of *D. incarnata* or different colour forms.

At the British locality and at Storsund, populations were measured by the author. For the Estonian and German plants, vegetative characters were, under rigorous guide-lines, respectively measured by V. Kuusk (Tartu) and H. R. Reinhard (Zurich), whilst the floral characters were assessed by the author on material supplied on the same plants. For reference purposes, the same data (characters 1–12) were also obtained for a population of typical *D. incarnata* subsp. *incarnata* of normal flower colour (Hodbarrow, Cumbria, England).

All these data were subjected to Principal Components Analysis (PCA) using the Clustan 4 computer programme (Wishart 1987) with the results shown in Figure 1. By this technique, each specimen measured is located in a multidimensional array, in which the number of dimensions is equal to the number of characters measured, and where the most similar specimens are placed closest together. The axes of greatest variation are extracted from the multidimensional space, thereby simplifying it to a few (usually two or three) dimensions and allowing the location of each specimen to be visualised. The respective mean and standard errors were calculated for each population (Table 1).

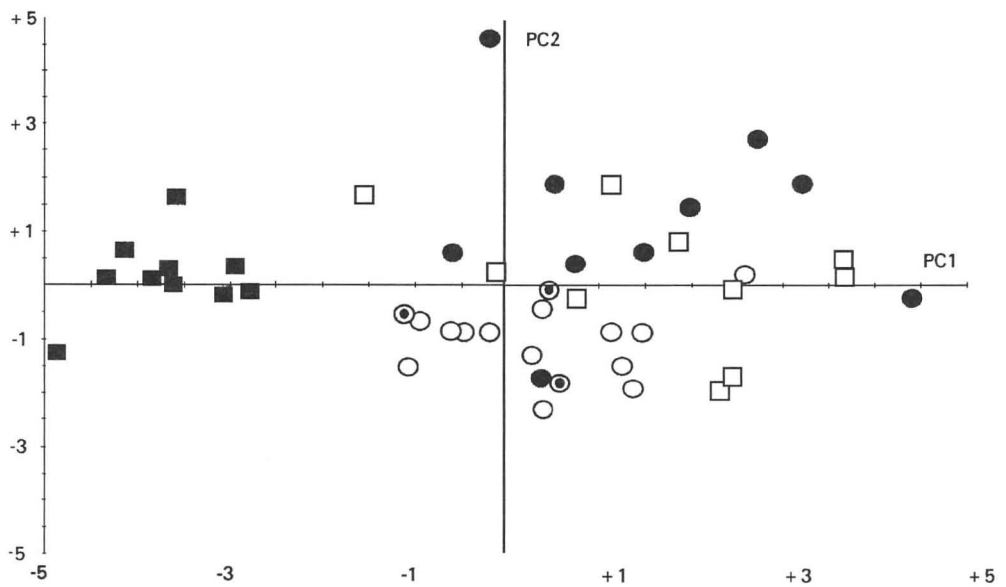

FIGURE 1. PC1 : PC2 for individual plants of four populations of *Dactylorhiza incarnata* subsp. *ochroleuca* ⊙ Chippenham, Cambs. (England), □ Vidumäe (Estonia), ○ Murnau (Germany), ● Storsund, Gotland (Sweden), compared to one of typical *D. incarnata* subsp. *incarnata* ■ Hodbarrow, Cumbria (England).

DISCUSSION

In Fig. 1 the variance accounted for by the PC1 axis is 47·3%, that for the PC2 axis is 15·1%. In each case, characters making a significant contribution towards the variance include plant height and stem, inflorescence and labellum dimensions. By examining the plotted values in Fig. 1, it can be seen that the British plants lie especially close to those from Germany and plants of both these populations appreciably overlap with those from Sweden and Estonia. There is, therefore, no overall separation between the four populations on the PC1 axis but all are well separated from the control population of normal *D. incarnata* subsp. *incarnata* on this same axis. On the secondary axis (PC2) there is again broad overlap between the four subsp. *ochroleuca* populations with a slight shift and a greater spread for those from Sweden and Estonia. For the characters measured, therefore, the British plants lie morphologically very close to those from the three European populations.

The character means of all four populations (Table 1) are also closely comparable. Perhaps surprisingly, the mean plant height was not as great as is often quoted. Higher values for labellum width have also been recorded (Bateman & Denholm 1985) but the British and German plants were similar in this respect. A fully trilobed labellum is also apparently not mandatory for every plant within a population but, despite this, it was most frequently present. Distinctly notched lateral lobes were also not evident in every case and it is possible that the presence of both of these characters may vary between the flowers on a single plant. However, most of the characters used to separate subsp. *ochroleuca* from closely-related taxa were found to occur in all of the plants sampled at the four populations. All of them were yellow-flowered and none had line-marked labella or spotted leaves.

On the island of Öland (Sweden), plants of similar habit and with flowers of a deep violet coloration with unmarked, dark-centred labella, and of similar shape to subsp. *ochroleuca* occur, very occasionally, as isolated individuals amongst normal subsp. *ochroleuca* (Lundqvist 1967). The existence of a saturated reddish purple-based colour form in subsp. *ochroleuca* had been anticipated by Nannfeldt (1944) who predicted a coloration comparable to *D. sambucina* (L.) Soó rather than that typical of subsp. *incarnata*. So far, these plants appear to be known from only two localities to the east of Färjestaden and have been observed only very intermittently. According to Lundqvist (pers. comm.) and the colour illustration in Mossberg & Lundqvist (1994), they appear to be otherwise indistinguishable from normal subsp. *ochroleuca*. This suggests the presence of colour dimorphism in subsp. *ochroleuca* in a similar manner to that within other *Dactylorhiza* taxa (e.g. *D. sambucina* and *D. sulphurea* (Link) Franco) but with a very much smaller incidence of the violet form.

SUMMARY

Most populations of this quite rare plant are inevitably rather small. The three sampled in continental Europe contained only 20–50 plants whilst at Chippenham there were only five available. Admittedly, and especially for the latter, this is a very small number on which to base any conclusions and those given for the British plant can only be tentative. Nevertheless, for the diagnostic characters measured, the Chippenham plants were found to be morphologically very similar to those from the three European populations, and all of them could be defined by the characters attributable to *D. incarnata* subsp. *ochroleuca*. However, additional confirmation via molecular data would be useful in supporting this conclusion.

ACKOWLEDGMENTS

I am very grateful to H. R. Reinhard and V. Kuusk for their cooperation and help with the morphological measurements of their local populations; to M. S. Porter for assistance in the field and with translations; to L. Farrell and M. Wright for permission to examine the Chippenham plants; to the curators of the Natural History Museum (**BM**), Torquay (**TOR**) and Vienna (**W**) herbaria for allowing me to examine their specimens, and to D. M. Turner Ettlinger, R. Lidberg, Å. Lundqvist, W. Wiefelspütz and H. Wittzell for relevant information.

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(Accepted January 2000)