

Remarks on Estonian orchids

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Abstract. DELFORGE, P. & KREUTZ, C.A.J.- *Remarks on Estonian orchids.* During a field trip of 11 days in Estonia, 30 orchids species and numerous varieties, forms and hybrids were observed on 75 sites occurring both on the mainland and on the three main islands. From our observations, we conclude that Estonia possess a great richness in orchids, with very important localities for *Dactylorhiza baltica*, probably the last population of the extremely rare *D. ruthei* and, next to *D. ochroleuca*, the remarkable presence of 6 varieties of *D. incarnata*. However, *D. praetermissa*, occasionally reported, is not present in Estonia, the presence of *D. cruenta* seems doubtful, and *D. maculata* s. str. seems very rare, its frequency being overvalued. The nature richness of Estonia is considerable. The recent political changes have led to rapid changes in the economical situation and agricultural practices so that protection and management of natural and semi-natural habitats are necessary. A list of the 30 species, 12 interspecific hybrids, and 75 localities prospected on 20 June - 1 July 2005 is given.

Résumé. DELFORGE, P. & KREUTZ, C.A.J.- *Remarques sur les orchidées d'Estonie.* Lors d'un voyage de 11 jours dans le plus septentrional des pays baltes, 30 espèces d'orchidées sur les 36 que compte le pays ont été observées sur 75 sites répartis aussi bien sur le continent que dans les trois principales îles. De nos observations, il ressort que l'Estonie possède une grande richesse en orchidées, avec de très importantes stations de *Dactylorhiza baltica*, probablement la dernière population relativement 'pure' de l'extrêmement rare *D. ruthei* et, en plus de *D. ochroleuca*, la remarquable présence de 6 variétés et formes de *D. incarnata*. Néanmoins, *D. praetermissa*, parfois considéré comme faisant partie de l'orchidoflore estonienne à la suite de déterminations erronées, n'existe pas en Estonie, la présence de *D. cruenta* est douteuse et la fréquence de *D. maculata*, que nous n'avons pas trouvé, est certainement surévaluée. La richesse de l'Estonie en milieux naturels et semi-naturels est considérable et les récents bouleversements politiques ayant entraîné des changements rapides dans l'économie et dans les pratiques agricoles, la protection et la gestion des habitats les plus intéressants s'imposent. Une liste des 30 espèces, 12 hybrides interspécifiques et 75 localités prospectées du 20 juin au 1^{er} juillet 2005 est donnée.

Ülevaade. DELFORGE, P. & KREUTZ, C.A.J.- *Märkmed Eesti orhideede kohta.* Eestis 11 päevase välitöö perioodi jooksul vaadeldi 30 orhideeliiki ja arvukalt varieteete, vorme ja hübriide 75-s leiukohas mandril ja kolmel põhilisel saarel. Meie vaatluste tulemusena võib kokkuvõttes öelda, et Eestis omab suurt orhideerikkust, sealjuures *Dactylorhiza baltica* väga tähtsad leiukohad, tõenäoliselt viimane populatsioon äärmiselt haruldast *D. rutheid*, lisaks *D. ochroleuca*, *D. incarnata* 6 varieteedi märkimisväärne olemasolu. Sellest hoolimata, *D. praetermissa*, millest on vahel teatatud, ei esine Eestis, *D. cruenta* olemasolu on kahtlane ja *D. maculata* s. str. näib olevat haruldane ja selle esinemine on ülehinnatud. Loodusrikkus

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Eestis on märkimisväärne. Käimasolevad poliitilised muutused on viinud kiiretele muutustele majanduses ja põllumajandustegevuses, mistõttu looduslike ja poollooduslike koosluste kaitse ja korraldamine on vajalik. 30 liigi, 12 liikidevahelise hübriidi ja perioodil 20. juunist - 1. juulini 75 külalastatud leiukoha nimekiri on lisatud.

Key-Words: *Orchidaceae*; flora of Estonia.

Introduction

Estonia, the northernmost and smallest Baltic state, 45,000 km² for 1,800,000 inhabitants, is lying between 57°30' and 59°30' N, at the latitude of Stockholm. Its capital, Tallinn, is situated at 370 km east of Stockholm and 90 km south of Helsinki; other main cities are Parnu, 'the summer capital', on the baltic seashore, and Tartu, an Hanseatic and intellectual old center, in the mainland (Fig. 1).

Estonia is a flat country; its highest point reaches 318 m in its south-eastern part, near Haanja, not far from the Latvian border. The northern part of the mainland as well as the largest islands (Saaremaa, Muhu, and Hiiumaa) are constituted of limestone outcropping in places; the same calcareous stratum emerges on the other side of the Baltic sea where it forms the Swedish islands of Gotland and Öland. The southern part of Estonia is built of acidic rocks and sands, but in the mainland the thin soil is frequently calcareous or neutrocline because of morainic deposits.

Due to its geography and its relatively low human population density, Estonia possesses large forests, numerous coastal meadows, wooded meadows (alvars), wet meadows, as well as wetlands; 10% of the country is covered with bogs, fens, mires and swampy forests. Most of the natural and semi-natural habitats have not been touched by industrial agriculture or intensive forestry during the 51 years of the Soviet period, which had an end in 1991. Since the opening of the country, the economic changes have rapidly given rise to important modifications in the agro-pastoral activities so that species-rich habitats have been recently destroyed or abandoned. These areas are now in high need of protection and management.

The northern location of the country leads to severe winters in the central and eastern parts of the mainland whereas the maritime influences give rise to a much milder climate in the islands and the littoral areas, with a mean annual temperature reaching 6°C in the island of Saaremaa (KUUSK 1996). Consequently, the central and eastern Estonian mainland belongs to the Sarmatic floristic region whereas the islands, the western and northern mainland coastal areas belong to the Baltic (or north-central European) one (MEUSEL et al. 1965). This duality is perfectly reflected by the distribution of the orchids, most of them being concentrated in the islands and the western calcareous mainland, where they find mild climate and suitable habitats. For example, 34 of the 36 orchid species traditionally recorded for Estonia are growing on Saaremaa (2671 km²) (e.g. AZAROV 2005; PIKNER 2005A; REITALU 2005), where some of them reach their northernmost limit of distribution.

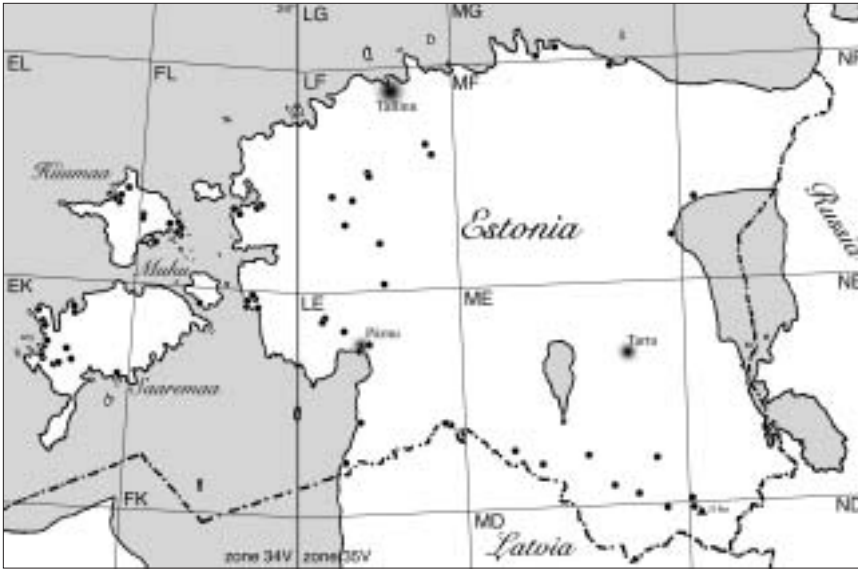


Fig. 1. Map of Estonia with localisation of the 75 sites visited in 2005.
(UTM grid 100 km × 100 km; zones 34V and 35V)

Orchidology in Estonia

In the last decades, except for the work of KLINGE (1893, 1898, 1899) who studied Estonian *Dactylorhiza*, publications on Estonian orchids were very few and locally distributed. During the Soviet period, studies on orchids were hard to undertake because of the most interesting parts of the country, the coasts and, particularly, the islands, were strictly prohibited military areas. The most comprehensive publication for this period is certainly the chapter *Orchidaceae* in the 'Eesti NSV Flora' (KUUSK 1984). Despite all this, an Estonian Orchid Protection Club (*Eesti Orhideekaiste Klubi*) was founded in 1985 and counts, today, about 80 members (SCHMEIDT 1994; TRUUS 2005).

The opening of the country after 1990 have increased the field investigations made by Estonian (e.g. KUKK 1994a; TUULIK 1994, 1995; KUUSK 1995; VALVEE 1996) or other Western European botanists. Some monographs about Estonian orchids were published in Estonia (KULL 1994; SCHMEIDT 1996; TUULIK 1998; REITALU 2001; KULL & TUULIK 2002), a new local Flora updated the taxonomic treatment of the Estonian *Orchidaceae* (KUUSK et al. 2003), and some articles, written by both local and foreign orchidologists, were published in specialized European journals (e.g. HANSSON 1993; DIEKJOBST & HENNECKE 1996; KUUSK 1996; RÜCKBRODT & RÜCKBRODT 1996; TALI 1996; BREINER et al. 1998).

Orchids in Estonia

According to local publications, the Estonian orchidoflora comprises 35 species plus one recently extinct, *Dactylorhiza sambucina* (KUUSK 1996; SCHMEIDT 1996; KULL & TUULIK 2002), or 36 species plus 3 extinct: *D. sambucina*, *Ophrys*

Table 1. The 30 orchid species seen in 2005 with frequency and remarks		
Taxa	nb. of sites (on 75)	Remarks and treatment in Estonian literature (KUKK 1994A, B; KUUSK 1996; SCHMEIDT 1996; KULL & TUULIK 2002; KUUSK et al. 2003; KUKK 2005)
<i>Anacamptis pyramidalis</i>	-	
1. <i>Cephalanthera longifolia</i>	4	
2. — <i>rubra</i>	3	
<i>Coeloglossum viride</i>	-	
3. <i>Corallorhiza trifida</i>	1	
4. <i>Cypripedium calceolus</i>	3	
5. <i>Dactylorhiza baltica</i>	19	[<i>D. longifolia</i> in DELFORGE 1994, 2001, 2005]
— <i>cruenta</i>	-	[questionable presence in Estonia according to us]
6. — <i>curvifolia</i>	11	mentioned as <i>D. russowii</i> (KLINGE) J. HOLUB
7. — <i>fuchsii</i> var <i>fuchsii</i>	36	
— — cf. var <i>meyeri</i>	3	mentioned as <i>D. maculata</i> (for the sites we visited)
8. — <i>incarnata</i> [total]	44	
— — var. <i>incarnata</i>	28	
— — var. <i>borealis</i>	27	var. <i>serotina</i> (mentioned only by KUUSK et al. 2003)
— — var. <i>hyphaematodes</i>	8	<i>D. cruenta</i> [for the sites we visited in 2005]
— — var./f. <i>sublatifolia</i>	?1	? var. <i>macrophylla</i> by KUUSK et al. 2003 ?
— — var. <i>reichenbachii</i>	3	var. <i>haematodes</i> (only in KUUSK et al. 2003)
— — f. <i>ochrantha</i>	6	sometimes mentioned as var. <i>ochrantha</i>
— <i>maculata</i>	-	numerous reports pertain to <i>D. fuchsii</i> var. <i>meyeri</i>
— — subsp. <i>elodes</i>	-	mentioned only by KUUSK et al. 2003
9. — <i>ochroleuca</i>	12	frequently as <i>D. incarnata</i> subsp. or var. <i>ochroleuca</i>
10. — <i>osiliensis</i>	3	never mentioned, even as <i>D. praetermissa</i>
— <i>praetermissa</i>	-	[not in Estonia, see <i>D. fuchsii</i> × <i>D. incarnata</i>]
11. — <i>ruthei</i>	1	sometimes mentioned as <i>D. ×ruthei</i>
— <i>sambucina</i>	extinct	
— <i>fuchsii</i> × <i>D. incarnata</i>	8	mentioned as <i>D. praetermissa</i> [on Hiiumaa only]
12. <i>Epipactis atrorubens</i>	11	
13. — <i>helleborine</i>	3	
14. — <i>palustris</i>	21	
<i>Epipogium aphyllum</i>	-	
15. <i>Goodyera repens</i>	1	
16. <i>Gymnadenia conopsea</i>	32	
— — cf. var <i>densiflora</i>	1	mentioned only by KUUSK et al. 2003
17. — <i>odoratissima</i>	2	
18. <i>Herminium monorchis</i>	8	
19. <i>Liparis loeselii</i>	6	
20. <i>Malaxis monophyllos</i>	2	
21. — <i>paludosa</i>	1	sometimes <i>Hammarbya paludosa</i> (L.) SWARTZ
22. <i>Neottia cordata</i>	1	<i>Listera cordata</i> (L.) R. BROWN
23. — <i>nidus-avis</i>	4	
24. — <i>ovata</i>	40	<i>Listera ovata</i> (L.) R. BROWN
<i>Ophrys fuciflora</i>	extinct	mentioned only by KUUSK et al. 2003
25. — <i>insectifera</i>	15	
26. <i>Orchis coriophora</i>	extinct	mentioned only by KUUSK et al. 2003
— <i>mascula</i>	2	
27. — <i>militaris</i>	27	
— <i>morio</i>	-	
28. — <i>ustulata</i> [total]	2	
— — A early flowering	1	not mentioned
— — B late flowering	1	not mentioned
29. <i>Platanthera bifolia</i>	24	
30. — <i>chlorantha</i>	16	

fuciflora, and *Orchis coriophora* (KUUSK et al. 2003). The difference between the number of species known at present in Estonia, 35 or 36, is due to the different taxonomic status given to *Dactylorhiza ochroleuca*, species for KUUSK et al. (2003), subspecies or variety of *D. incarnata* for the other authors.

With the very competent and enthusiast help of Estonian specialists, we have been able to see 30 species of orchids and some remarkable infraspecific taxa in June 2005 in less than two weeks (Table 1, Appendix). Our observations confirm largely the conclusions already published in the works cited above. However, we have also made some notings which differ from the common opinion. The aim of our paper is to give our point of view about some critical taxa, as our Estonian hosts have explicitly wished.

Material and methods

We examined and photographed wild orchids in Estonia on 21 June - 1 July 2005. Hiiumaa, Saaremaa, Muhu and the mainland were visited. About 2800 km was travelled; 75 sites, divided into 71 1 km × 1 km UTM squares, were listed. Plants studied in the field were photographed on KODACHROME 64 film, by PD using 2 OLYMPUS OM2n boxes with ZUIKO 50 and 80 macro lens, extension tubes 65-116 mm, additional extension tube 25 mm, 1 OLYMPUS T32 flash, and 1 OLYMPUS T10 ring flash, by CK using 2 OLYMPUS OM4 boxes with ZUIKO 50 et 80 macro lens, additional front lenses, extension tubes and 2 OLYMPUS T32 flashes. Some specimens were collected by CK and deposited at L (Nationaal Herbarium Nederland, Universiteit Leiden, The Netherlands). For orchids, nomenclature follows DELFORGE 2005, for other plants KUKK 2005 was followed.

Remarks on Estonian orchids

All Estonian taxa are listed in Table 1. During our field trip, we did not see *Anacamptis pyramidalis*, *Coeloglossum viride*, *Epipogium aphyllum*, and *Orchis morio*, which are very rare and start blooming later, in July, or earlier, in May (*Orchis morio*). These species do not pose here any taxonomical problems. Likewise, we have not seen *Dactylorhiza cruenta*, *D. maculata*, and *D. praetermissa*, but it is well known that the systematics of the genus *Dactylorhiza* are difficult and the lack of observations denotes some taxonomical problems which we will discuss below. Apart from *Dactylorhiza*, we have seen 23 species which necessitate no further comments, with the exception of *Gymnadenia conopsea* and *Orchis ustulata*. We will begin with the latter two.

Gymnadenia conopsea

We have observed *Gymnadenia conopsea* on 32 sites. In Saaremaa, on the site 22, next to normal plants, we found several robust individuals, taller, with more flowers, but without the floral morphology of *G. conopsea* var. *densiflora*. To point out these plants, we used 'cf. var. *densiflora*' in table 1 and in the list of personal observations (Appendix). Karyological investigations are needed to confirm that these individuals belong to the polyploid *G. conopsea* var. *densiflora*. The presence of *G. conopsea* var. *densiflora* in the Baltic states is evoked, without precision, by KUUSK et al. (2003: 373), and by Kõiv (1996), but, in the last case, for diploid individuals.

Orchis ustulata

In Estonia, *Orchis ustulata* flowers in two temporally well separated waves, the first one in June, the second from July to mid-August. We have seen 3 plants of the first wave, almost faded, on Muhu island (site 35, 28 June), and one individual of the second wave, with very small buds, near Pivarootsi (site 41, 21 June). Our observations are too scanty to make any effective conclusions. The two taxa have been studied in detail by TALI (1994, 1995, 1996) who notes that the early flowering populations are distributed essentially in the islands of Saaremaa and Muhu while the late-flowering ones are found mainly on the mainland with some presence also in Saaremaa. Both taxa possess the same small flowers but there are notable differences in the heights of the plants and the lengths of the inflorescences. However, large intrapopulation variations in height and length have been observed, even for the same individuals in two consecutive years, so that it seems not possible to make a distinction between the two taxa on the basis of morphometric characters and they could appear as ecotypes (TALI 1994, 1995, 1996). We therefore think it not appropriate to assign the name *Orchis ustulata* var. (or subsp.) *aestivalis* KÜMPFEL to the late-flowering taxon.

Dactylorhiza

Dactylorhiza incarnata species group

Dactylorhiza ochroleuca

We saw *Dactylorhiza ochroleuca* on 12 sites, on 10 of these it cooccurred with *D. incarnata*. In these cases, the two taxa were well separated by ecological exigences, habitus, floral and foliar morphology, and phenology, and their hybrids were rare. These observations fit well with those published in recent works (e.g. REINHARD et al. 1991; DELFORGE 1994, 1995A, B, 2001, 2002, 2005; BOURNÉRIAS 1998; HEDRÉN 2001; HEDRÉN et al. 2001; BAUMANN et al. 2005). The delimitation of the two species is particularly well-defined in relation to the genus so that it seems paradoxical that *D. ochroleuca* is so frequently considered as a subspecies or even as a variety of *D. incarnata* by numerous botanists. This can be understood mainly if a traditional morphological species concept is used in a broad sense. Because of the inclusion of the distribution of *D. ochroleuca* in the repartition area of *D. incarnata*, the consideration of the former as 'geographical race' of the latter seems inconsistent. With a biological and, a fortiori, an evolutionary or a phylogenetical species concept, it seems not consistent to consider two synchronous and sympatric taxa as subspecies if they maintain their own characters and produce no or few hybrids. This situation reveals indeed that efficient isolation mechanisms separate them and thus that they are best considered as species, which is the case with *D. incarnata* and *D. ochroleuca* when they are syntopic. As *D. incarnata* and *D. ochroleuca* are interfertile and act by deceit, it has been suggested that the difference in overall flower colour may possibly imply that the two taxa are pollinated by bumblebees focused on different search images evoked by rewarding species with corresponding flower colour (PEDERSEN 1998).

As already mentioned above, in the Estonian literature, *Dactylorhiza ochroleuca* is considered as a species only by KUUSK et al. (2003), as a subspecies of *D. incarnata* notably by SCHMEIDT (1996), TUULIK (1998), KULL and TUULIK (2002), and KUKK (2005) and, more surprisingly, as a variety of *D. incarnata*, which equals with *D. incarnata* var. *ochrantha*, by JAGIELLO et al. (1989). We found that last position inconsistent because *ochrantha* is only an hypochromic form of *D. incarnata* occurring very occasionally in all the distribution range of *D. incarnata* whereas *D. ochroleuca* possesses its own distribution, as well as particular ecology, morphology and phenology distinct from *D. incarnata*.

Dactylorhiza incarnata

Dactylorhiza incarnata is relatively abundant and remarkably varied in Estonia, and sometimes present in 3 or even 4 varieties or forms often linked by transitional individuals on a single site. This variability is not mentioned in the Estonian monographs, with the notable exception of KUUSK et al. (2003).

As frequently, there are some nomenclatural difficulties if we want to precisely define and correctly name the different varieties and forms of *Dactylorhiza incarnata* which we observed. In Estonia, we saw 6 infraspecific taxa of *D. incarnata* of which 3 do not give rise to problems while the others are much debated.

1. The nominative variety and form is characterized by long, straight, erect, cucullated, unspotted leaves reaching at least the base of the inflorescence, long bracts and pale pink, or somewhat pale purple, flowers.

2. Plants with long, straight, erect, cucullated, leaves spotted on both sides and, frequently, flowers darker than those of var. *incarnata* are identified as *Dactylorhiza incarnata* var. *hyphaematodes* (Pl. 1, p. 37).

3. Individuals with flowers very pale yellow to creamy or whitish and with an unmarked lip represent an hypochromic occasional form of *Dactylorhiza incarnata* and are identified to *D. incarnata* f. *ochrantha* (see above).

4. Extremely robust and rather dwarfed plants seen on site 15 (Pl. 1, p. 37) are probably mentioned by KUUSK et al. (1993) under the name of *Dactylorhiza incarnata* var. *macrophylla* (SCHUR) Soó. The variety described by SCHUR (1866) represents a very robust and tall *D. incarnata* (e.g. SENGHAS 1968; FULLER 1972; BRENDIKE 1994) while the Estonian plants which we saw were very robust but dwarfed, somewhat like *D. incarnata* var. *lobelii*. *D. incarnata* var. *sublatifolia* (REICHENBACH f. em. ASCHERSON & GRAEBNER) Soó, which concerns a robust but low plant is probably a more adequate name for the individuals we saw, if they must be named. The rank of *forma* for this taxon would certainly be more appropriate.

5. Plants with long, straight, erect, cucullated, leaves spotted only on the upper side are currently named *Dactylorhiza incarnata* var. *haematodes*. We prefer the name *D. incarnata* var. *reichenbachii* GATHOYE & TYTECA 1994 because *D. incarnata* var. *haematodes* (REICHENBACH) Soó is based on the illegitimate *Orchis*

haematodes REICHENBACH (VERMEULEN 1947; GATHOYE & TYTECA 1994: 21; DELFORGE 2001, 2002, 2005).

6. The case of the last taxon is more complex. On 28 sites, we observed plants of *Dactylorhiza incarnata* with rather dark purple, and not pink, flowers, and relatively short leaves, sometimes a little bit spotted. On 13 sites, they were growing together with the nominative variety and we did not observe differences in flowering, size of flowers or ecology between the two taxa. In Estonia, the plants with dark flowers and somewhat shorter leaves are identified as *D. incarnata* var. *serotina* (HAUSSKNECHT) Soó by KUUSK et al (2003), and, probably, as *D. incarnata* lusus *purpurea* by JAGIELLO et al. (1989), a taxonomic status certainly questionable because this taxon does not represent individuals with occasional morphological aberration.

Orchis incarnata var. *serotina* is described by HAUSSKNECHT in “Die Orchideen Deutschlands...” (SCHULZE 1894: n°19, 7) as a slender plant, smaller than the nominative variety, with few pale purple flowers, and blooming, as the epithet *serotinus* refers to, 14 days later. No *typus* is indicated; HAUSSKNECHT’s preserved specimens coming from northern Germany (Weimar, Erfurt, Offenbach, Berlin, and Usedom, fide BAUMANN et al. 2002, 2005). This variety is generally considered as a slender *Dactylorhiza incarnata*, with an habitus evoking *D. traunsteineri*, somewhat shorter leaves, and smaller and darker flowers. It flowers 2-3 weeks (e.g. SENGHAS 1968; PRESSER 2000; KREUTZ 2003; BAUMANN et al. 2005) or 3-4 weeks (REINHARD et al. 1991) after *D. incarnata* var. *incarnata*. It is found mainly in boggy areas and heaths with rather more acidic conditions than var. *incarnata* (e.g. CAMUS & CAMUS 1921-1929; SENGHAS 1968; FULLER 1972). At the varietal rank, the correct name of this taxon seems to be *Dactylorhiza incarnata* var. *haussknechtii* (KLINGE) BUTTLER, based on *Orchis angustifolia* var. *haussknechtii* KLINGE 1893, cited as synonym in the HAUSSKNECHT’s description (BUTTLER 2004).

HESLOP-HARRISON (1956) has suggested that *Orchis incarnata* var. *serotina* is synonymous of *O. incarnata* var. *pulchella* DRUCE 1918, described from Hampshire (England). That identification is adopted e.g. by BATEMAN and DENHOLM (1985), REINHARD et al. (1991), GATHOYE and TYTECA (1994), QUENTIN (1995), BOURNÉRIAS (1998), and KREUTZ and DEKKER (2000), regarded as questionable e.g. by DEVILLERS-TERSCHUREN and DEVILLERS (1986), DELFORGE (1994, 1995A, B, 2001, 2002, 2005), and ETTLINGER (1997), and rejected e.g. by SENGHAS (1968), LANDWEHR (1977, 1982), WIEFELSPÜTZ (1977), DAVIES et al. (1983, 1988), PRESSER (2000); KREUTZ (2003, 2004), VÍČKO et al. (2003), and BAUMANN et al. (2005) who consider ‘*pulchella*’ as a British endemic. *Dactylorhiza pulchella* differs from *D. incarnata* mainly by the slender habitus, somewhat smaller and narrower leaves, fewer-flowered and shorter inflorescence, purplish suffused bracts, and rather large dark purple flowers. It is also found in more acidic conditions than *D. incarnata*, i.e. acid *Sphagnum* bogs where it is ecologically isolated, but also in neutral or even moderately alkaline wetlands where it grows in the less basic microhabitats. It flowers 4 to 14 days

after *D. incarnata* (e.g. SUMMERHAYES 1951, 1968; ETTLINGER 1976, 1997; LANG 1980, 1989; BATEMAN & DENHOLM 1985; ALLAN et al. 1993).

Synonyms or not, it is obvious that neither '*serotina-haussknechtii*' nor '*pulchella*' correspond to the taxon we observed in Estonia, which did not possess the habitus of *Dactylorhiza traunsteineri*, nor smaller or larger flowers, and was blooming at the same time as *D. incarnata* var. *incarnata* in the same alkaline habitats. Among the numerous other subspecific taxa of *D. incarnata* already described, it appears that apparently *Orchis incarnata* var. *borealis*, described from Sweden by NEUMAN (1909), could be used best for the Estonian taxon.

The diagnose of *Orchis incarnata* var. *borealis* is: «*O. incarnata* L. var. *borealis* NEUMAN a planta typica his notis distincta: cauli graciliore, minus costato; foliis planioribus, patentibus, angustioribus, minoribus, remotis, 1-2 cm supra basin latissimis; floribus saepissime violaceo-purpureis apice labelli elongato. Habitat multis locis Sueciae» (NEUMAN 1909: 244). This taxon possesses shorter and flatter leaves than those of *Dactylorhiza incarnata* var. *incarnata* and its flowers are most often purple-violet, with a lip with an elongated median lobe; it is not rare in Sweden. Nothing is said about flowering or ecological exigences. A contour drawing of the NEUMAN's type specimen, conserved in Lund, was published by VERMEULEN (1947: 160a) who also measured the leaves and the flowers on the exsiccatum. Habitus as well as vegetative and floral size and features could correspond to the Estonian taxon. CAMUS and CAMUS (1921-1929: 225) cite *Orchis incarnata* var. *borealis* among others varieties; KELLER et al. (1930-1940: 209) treat it as a form of *O. incarnata* var. *serotina*; VERMEULEN (1947: 162), followed by SENGHAS (1968), consider it synonymous with *O. incarnata* var. *serotina*, but only «for the greater part». We propose, tentatively, to name *Dactylorhiza incarnata* var. *borealis* (NEUMANN) HYLANDER the Estonian variety of *D. incarnata* with rather dark purple flowers, and relatively short leaves. This name was also re-used in Sweden again, recently (HEDRÉN 2001; HEDRÉN et al. 2001).

Dactylorhiza cruenta

Dactylorhiza cruenta, described from Denmark (as *Orchis cruenta* MÜLLER 1782), is a diploid taxon, and a member of the *D. incarnata* species group. It is considered as a species (e.g. VERMEULEN 1947; SENGHAS 1968A; FULLER 1972; NELSON 1976; LANDWEHR 1977, 1982; BAUMANN & KÜNKELE 1982, 1988; DANESCH & DANESCH 1984; DELFORGE & TYTECA 1984A, B, C, D; REINHARD 1985; BUTTLER 1986, 1991; DEVILLERS-TERSCHUREN & DEVILLERS 1986; AVERYANOV 1988; TYTECA & GATHOYE 1988; REINHARD et al. 1991; DELFORGE 1994, 1995A, B, 2001, 2002, 2005; GATHOYE & TYTECA 1994; BOURNÉRIAS 1998; PRESSER 2000), a subspecies (e.g. BISSE 1963; NILSSON & MOSSBERG 1979; SUNDERMANN 1970, 1975, 1980; BATEMAN & DENHOLM 1985; DAVIES et al. 1983, 1988; BAUMANN et al. 2002; KREUTZ 2004; BAUMANN et al. 2005) or a variety (e.g. SOÓ 1962; HEDRÉN 1996A, 2001) of *Dactylorhiza incarnata*.

Whatever taxonomic rank adopted, all these authors observed that *Dactylorhiza cruenta* differs from *D. incarnata* by a smaller and robuster stem, shorter,

wider, patent and curved leaves, usually spotted on both sides, shorter inflorescence, with less flowers and shorter purplish bracts, and smaller, darker, purple flowers with blood-red loops and dashes marking the lip and the sepals. In most cases, *D. cruenta* is restricted to very calcareous fens (pH 8,2-8,4) (SENGHAS 1968; HEDRÉN et al. 2001) where it grows in the wettest places, while *D. incarnata* occurs in a wider range of habitats, from varied rich fens to moist meadows, so that mixed populations of *D. incarnata* and *D. cruenta* are rather rare. In the latter situation, the intermediates are usually uncommon (REINHARD 1985; DELFORGE 1994, 1995A, B, 2001, 2002, 2005; HEDRÉN 1996B). The main characters of *D. cruenta* are depicted in plate 1 (p. 37) and e.g. in NELSON (1973: Taf. 37, Sweden and Norway); LANDWEHR (1977: 154-155, Sweden and Switzerland), PLAN (1983: France); DANESCH and DANESCH (1984: 32/15, Switzerland) DELFORGE and TYTECA (1984A, B, C, D: 37, France), BUTTLER (1986 and 1991: 93, Switzerland and Sweden), REINHARD et al. (1991: 181, Switzerland), DELFORGE (1994 and 1995A, B: 145, Sweden and Italy, 2001 and 2002: 175, France and Italy, 2005: 188, France and Italy), BOURNÉRIAS (1998: 160, France), and PRESSER (2000: 144-145, Switzerland and Italy).

We visited 8 sites with individuals of *Dactylorhiza incarnata* s.l. having leaves spotted on both sides. We were particularly keen to detect the presence of *D. cruenta* in these sites, but were not successful in this. We even visited the site 23 (Koruse, Saaremaa) from where the illustrations of *D. cruenta* in KULL and TUULIK (2002: 58-59) are derived, twice. This site is cut in half by a track; on the southern part, in a small wet rich fen, we noted *D. incarnata* var. *incarnata*; on the northern part, a moist meadow on sands, we saw a very varied population of *D. incarnata* with var. *incarnata*, var. *borealis*, var. *reichenbachii*, var. *hyphaematodes*, and f. *ochrantha*. Our guide tried to find individuals fitting the description of *D. cruenta* evoked above, but the sole individual having purple flowers with somewhat red dashes possessed straight, erect, cucullated, narrow and long leaves, as in the var. *hyphaematodes*, and the 4 individuals with rather short and somewhat curved leaves possessed unspotted leaves, long inflorescence and green bracts, and flowers with purple, and not blood-red, dashes, which we identified as *D. incarnata* var. *borealis* (Pl. 1, p. 37).

The difficulties to separate *Dactylorhiza cruenta* from *D. incarnata* var. *hyphaematodes* on the basis of morphology in rare situations, principally in mixed populations, is sometimes evoked (e.g. BATEMAN & DENHOLM 1985; REINHARD 1985; KALTEISEN & REINHARD 1986; TYTECA & GATHOYE 1988; BUTTLER 1991; HEDRÉN et al. 2001). In 2005 on the site 23, however, we saw no population of *D. cruenta*, nor single individual or suitable habitat for this very hygrophilous species. We made similar observations on other sites where *D. cruenta* is said to grow.

We did not visit all Estonian sites from where *Dactylorhiza cruenta* was observed in the past. As some plants of the population of *Dactylorhiza incarnata* of the site 23 were considered as representatives of *D. cruenta* by the Estonian botanists, though, we think that numerous reports of *D. cruenta* in Estonia pertain in fact to *D. incarnata* var. *hyphaematodes*, something which

KUUSK et al. (2003: 380) have also pointed out. The presence of *D. cruenta* in Estonia is probably doubtful and must thus be reconsidered.

***Dactylorhiza majalis* species group**

Dactylorhiza baltica

AVERYANOV (1988) considers *Orchis latifolia* subsp. *baltica* KLINGE 1898, described from Estonia, as a synonym of *O. longifolia* NEUMANN 1909, described from Scania (Southern Sweden), which was followed by DELFORGE (1994, 1995A, B, 2001, 2002, 2005), who presents this species under the name *Dactylorhiza longifolia* (NEUMANN) AVERYANOV, synonym: *D. baltica* (KLINGE) ORLOWA ex AVERYANOV. It now seems that *Orchis longifolia* NEUMANN represents only a local hybrid swarm (V. KUUSK, pers. comm. to PD) and that the Estonian taxon is to be found, in Sweden, only in the Baltic island of Gotland (HANSEN et al. 1993; HANSSON 1993; KREUTZ 1993). The correct name at the specific rank for the Estonian taxon is therefore *Dactylorhiza baltica* (KLINGE) ORLOWA ex AVERYANOV, as it is used in most specialized publications, and the name *Dactylorhiza longifolia* (NEUMANN) AVERYANOV must be deleted in future editions of the DELFORGE's field guide.

Dactylorhiza baltica is an allopolyploid species (*D. incarnata* × *D. maculata* s.l.; $2n=80$) of the *D. majalis* species group (e.g. DELFORGE 1994, 1995A, B, 2001, 2002, 2005; HEDRÉN 2001) and for this reason very varied, with some individuals showing habits and floral features reminiscent of robust *D. incarnata*, whereas others are more similar to of *D. maculata* (Pl. 2, p. 38). It grows on moist or wet places of meadows and fens, with slightly acidic, neutral or slightly calcareous substrata. Its distribution reaches from the Baltic islands, Åland (Finland) and Gotland (Sweden), to the center of Russia and, perhaps, Siberia. The Baltic states and particularly Estonia seem to contain the highest number of individuals and should thus be considered as the most important part of the distribution area of this species. In Estonia, we saw *Dactylorhiza baltica* on 19 sites, sometimes in large populations, sometimes in micro-populations of few individuals. As most sites are littoral, they are endangered by the urbanization of the Baltic coasts, where moist meadows are now rapidly being transformed into gardens and lawns (pers. obs. on site 48); another threat are water-rats which eat the tubers (KUUSK 1996).

***Dactylorhiza traunsteineri* species group**

Dactylorhiza curvifolia

Dactylorhiza curvifolia is an allopolyploid species ($2n = 80, 120, 122$) of the *D. traunsteineri* species group [e.g. VERMEULEN 1947 (as subsp. of *D. traunsteineri*); DELFORGE 1994, 1995A, B, 2001, 2002, 2005; KREUTZ 2004 (as subsp. of *D. traunsteineri*)] and for this reason extremely varied, notably in habit, shape and curvature of leaves and size of the flowers (Pl. 3, p. 43). This taxon was described from the Baltic states ('Livonia'), probably from Saaremaa, as *Orchis latifolia* var. *russowii* by KLINGE (1893). In contrast to KLINGE's and VERMEULEN's opinions, we think that the 11 sites in Estonia that we visited is so wide that it certainly includes *O. curvifolia*, described from Finland by NYLANDER (1844) as well as the plants we identified as *Dactylorhiza curvifolia*

in Sweden and Finland during various field trips. The species is named *Dactylorhiza russowii* (KLINGE) J. HOLUB in the Estonian specialized literature and also e.g. by LANDWEHR (1977, 1982), BAUMANN and KÜNKELE (1982), BUTTLER (1986, 1991), MOSSBERG and NILSSON (1987), HANSSON (1993), and HEDRÉN (2001). At the specific rank, *Orchis russowii* (KLINGE 1893) KLINGE 1898 is a later synonym of *Orchis curvifolia* F. NYLANDER 1844. Therefore, the correct name for this taxon at the specific rank is *Dactylorhiza curvifolia* (F. NYLANDER) CZEREPANOV (e.g. BAUMANN & KÜNKELE 1988; DELFORGE 1994, 1995A, B, 2001, 2002, 2005; KREUTZ 2002; BAUMANN & LORENZ 2005).

***Dactylorhiza praetermissa* species group**

Dactylorhiza osiliensis

This taxon was only recently discovered and is therefore not mentioned in the Estonian literature up till now. It is described and discussed in a separated paper in this issue (PIKNER & DELFORGE 2005).

***Dactylorhiza* ‘*praetermissa*’**

In June 1989, about 80 plants of an apparently not recorded *Dactylorhiza* were discovered by T. TUULIK in the north-east of the island of Hiiumaa, concentrated in a small area (100 m²), and identified first as *D. ruthei*, then as *D. praetermissa* (TUULIK 1990, 1994; KUUSK 1994, 1996), an Atlantic and sub-Atlantic medio-European species not known in the Baltic area (e.g. BUTTLER 1986, 1991; TYTECA & GATHOYE 1993; DELFORGE 1994, 1995A, B, 2001, 2002, 2005; HEDREN 1996A; KREUTZ 1999; KREUTZ & DEKKER 2000; BAUMANN et al. 2005). From 1989, the presence of *D. praetermissa* in the country is taken into account in Estonian publications (e.g. TUULIK 1994, 1998; SCHMEIDT 1996; KULL 2000; KULL & TUULIK 2002; KUUSK et al. 2003; KUKK 2005).

With R. KURBEL, A.-R. SERVET and T. TUULIK, we visited all the known sites of *Dactylorhiza praetermissa* which lie in Hiiumaa, near Kõrgessaare (our sites 1, 3, 5, and 6). On site 1, we saw several clonal plants, polymorphic and robust, looking like occasional hybrids between *D. fuchsii* and very varied *D. incarnata*, both present in abundance on or near the site (Pl. 5, p. 53). On site 3, where *D. praetermissa* was discovered in 1989, about 20 plants were observed, but along with 30 individuals of *D. incarnata*. Our guides were disappointed to find so little *D. ‘praetermissa’* which, furthermore, seemed to be strongly influenced by *D. incarnata*. Apparently, the rather large population of *D. ‘praetermissa’* of 1989 has turned into a small population of *D. incarnata* with hybrids evidently at a different level of backcrossing (F₁, F₂, and perhaps F₃). On site 5, a small botanical garden, we saw one single slender plant presented as *D. praetermissa*, but it was obviously an hybrid without any floral or vegetative diagnostic characters of *D. praetermissa* (cf. PIKNER & DELFORGE 2005: pl 6, p. 72). On site 6, an inundated *Alnus glutinosa* wooded rich fen, which is not an usual habitat for *D. praetermissa*, we saw about 50 individuals of *D. incarnata* var. *borealis*, the same number of *D. ‘praetermissa’* with narrow spotted and unspotted leaves and numerous transitional individuals, a configuration evoking the situation at site 3, but at a stage where all F₁ hybrids were not yet backcrossed

by *D. incarnata*. When spotted, the leaves possess solid spots and not annular ones, as in *D. praetermissa* var. *junialis*. In the center of Hiiumaa (site 8 and 9), few plants tentatively identified to *D. praetermissa* were also seen, but these represent another taxon, very probably occasional hybrids of *D. baltica* × *D. incarnata*; we have seen some plants belonging apparently to this hybrid cultivated in a garden in Hiiumaa.

It is well-known and demonstrated that *D. praetermissa* is an hybridogeneous allotetraploid species with *D. incarnata* and *D. fuchsii* as parents (e.g. HESLOP-HARRISON 1953; HEDRÉN 1996A, C). It is thus understandable that individuals of hybrid swarms between the latter two species look more or less like *D. praetermissa*. In Hiiumaa, however, we did not see any individuals which could be identified as *D. praetermissa* as described in the standard literature and as we frequently observed on many places in England, Belgium, France, The Netherlands and Germany.

Karyological investigations on *D. fuchsii* × *D. incarnata* in Saaremaa revealed a chromosome number of $2n=40$ (JAGIELLO et al. 1989), which may explain the possibility of easy backcrossing of these hybrids with the diploid *D. incarnata*. Some of these hybrids may have been allotetraploid as some individuals were very robust. Backcrossing with a diploid parent should still be possible, though, as hybrids were also observed in mixed populations of the diploid *D. fuchsii* and the allotetraploid *D. purpurella* (HESLOP-HARRISON 1954; ROBERTS 1975, LYE 1977) with identifications of aneuploid backcrosses (LORD & RICHARDS 1977).

We identified the individual we have seen on site 5 with as a putative diploid F_1 *D. fuchsii* × *D. incarnata*; some individuals of site 1 pertained to the same combination. The other individuals, robust to very robust, frequently with dark purple inflorescence, sometimes growing in cluster, seemed to represent clonal tetraploid hybrids, probably *D. fuchsii* × *D. incarnata* var. *borealis*, but presence of genetic material coming from *D. baltica* could not be excluded. The clonal aspect of this hybrid swarm is reflected by the great morphological homogeneity of its members and also by their evanescence, with a brutal installation of numerous almost identical plants on a very small area followed by a rapid decline, probably due to a suspected temporary infertility of recent allotetraploids (GILL 1991) sometimes followed by backcrossing with a diploid parent resulting in loss of fertility (STACE 1975). Such hybrid swarms or clonal small populations of *Dactylorhiza* and their dynamics have been observed in detail notably in Belgium and in France (e.g. COULON 1989, 1990, 1999; CHARPIN & JORDAN 1990; TYTECA et al. 1991, DIEMER 1992; TYTECA 1993; TYTECA & GATHOYE 1993; ANDRÉ et al. 1998; ROBERDEAU et al. 1998; DELFORGE et al. 2001).

From our observations in Hiiumaa we conclude that *Dactylorhiza praetermissa* is not present in the island and thus in Estonia.

Dactylorhiza ruthei

Orchis ruthei M. SCHULZE ex RUTHE is a tetraploid taxon ($2n=80$, BÄSSLER in ROTHMALER 2002) described from Swinemünde, Usedom, Pomerania (Baltic zone, formerly in Germany, today in Poland) (RUTHE 1897). It was considered as a stabilized hybridogeneous species endemic of Usedom (e.g. RUTHE 1897; KELLER & SCHLECHTER 1928: 170-171; BISSE 1959; FÜLLER 1962) or, ambiguously, as a subsp. (?) of *O. maculata* (ASCHERSON & GRAEBNER 1907). More frequently, it was regarded as an unstabilized hybrid swarm of complex origin (probably *O. incarnata* × *O. majalis* × *O. maculata*) (e.g. CAMUS 1908: 242; FUCHS & ZIEGENSPECK 1927; CAMUS & CAMUS 1921-1929; KELLER et al. 1930-1940: 258; Soó 1960, 1962; BISSE 1963; FÜLLER 1972). It was sometimes cited in synonymies (e.g. Soó 1980; DELFORGE 1994, 1995A, B), but more often not taken into account in the Floras nor in the specialized monographs. At the same time, from 1903 to 1996, the RUTHE's dactylorchis was not found in its 3 known localities and it was therefore considered as extinct.

In 1952 an unidentifiable *Dactylorhiza* was recollected in Estonia (our site 37). The population is rediscovered in 1974 and identified as *Dactylorhiza ruthei* (M. SCHULZE ex RUTHE) Soó (KUUSK 1984, 1994, 1996). All features of the rediscovered Estonian population seemed to coincide with those described for the Usedomian ones, tetraploidy included (JAGIELLO et al. 1989); comparisons with exsiccata from Usedom corroborate the identification (RÜCKBRODT & RÜCKBRODT 1996). The Estonian population, surveyed each year since 1974, seems morphologically stable, which does not corroborate the hypothesis of an unstabilized hybrid swarm (e.g. RÜCKBRODT & RÜCKBRODT 1996). *D. ruthei* was taken into account in the local Floras and monographs (SCHMEIDT 1996; KULL 2000; KULL & TUULIK 2002; KUUSK et al. 2003; KUUSK 2005), as well as in standard works (e.g. DELFORGE 2001, 2002, 2005), and hybrids with *D. baltica*, *D. fuchsii*, and *D. incarnata* were described (JAGIELLO & KUUSK 1988; DIEKJOBST & HENNECKE 1996; BREINER et al. 1998).

Dactylorhiza ruthei is also reported from Wzgorze and Wizany (northern Poland) by BERNACKI (1989), but these identifications are disputed (KUUSK 1996; BAUMANN et al. 2005). More recently, it was discovered in numerous localities in Slovakia (VLČKO et al. 2003: 37), also with various hybrids (notably with *D. lapponica*: ibid. 98). *D. ruthei* was rediscovered in 1997 near Peenemünde, on the German part of Usedom, and it was taken again into account in the recent German literature (e.g. WISSKIRCHEN & HAEUPLER 1998; PRESSER 2000; SCHMEIL & FITSCHEN 2000; BAUMANN et al. 2002; KREUTZ 2002; ROTHMALER 2002), but as a species endemic of Usedom (BAUMANN et al. 2005).

One of us (CK) had the opportunity to visit in June 2001 the 3 scattered populations of *Dactylorhiza ruthei* on the unique site presently known near Peenemünde (Usedom), and about 500 blooming individuals have been observed and photographed. Most of these plants were taller and robuster than the Estonian ones, with lips sometimes very deeply 3-lobed (Figs in KREUTZ 2003: 80-81), a lip shape that we have seen also in Estonia (Pl. 4, p. 44). The 3 populations are growing on secondary disturbed habitats, in process of eutrophica-

tion (PRESSER 2000; KREUTZ 2002; BAUMANN 2005), which is favourable for absorption or introgression of specialized species by others, less linked to narrow ecological exigences. Evident occasional hybrids between *D. 'ruthei'*, *D. majalis*, and *D. incarnata* were also seen (DICKMANN 2004). The populations observed in 2001 were so polymorphic that they seemed to represent unstabilized hybrid swarms between *D. majalis*, *D. incarnata*, and perhaps remainders of *D. ruthei* were involved. Sizes and both vegetative and floral morphologies of most of these plants were not in agreement with neither the description nor the RUTHE's exsiccata of *Orchis ruthei*, with some notable exceptions as, by example, one individual photographed by PRESSER (2000: 125b). It is thus possible that the original few populations of *Dactylorhiza ruthei* disappeared since 1903, and that the plants rediscovered in another site almost one century later constitute hybrid swarms in which hardly any traces of *D. ruthei* are present anymore. As explained above, in the Estonian population, on the other hand, the about 50 plants blooming each year seems very stable, with features in complete adequation with both description and herbarium specimens of *Orchis ruthei*.

As pointed out by BAUMANN et al. (2005), the Estonian and the former Usedomian populations are very isolated, and separated by about 750 km. This seems a curious distribution even if the shared littoral habitats of the Baltic see are taken into account. The possibility of stabilized hybrid swarms evolving separately must therefore be considered. In that case, the Estonian population represents another taxon, not described, as well as, probably, the Slovakian populations. Genetic analysis could probably test the conspecificity of the different populations attributed to *Dactylorhiza ruthei*. If no 'pure' *D. ruthei* is present in Usedom anymore, however, complete sampling for such a study seems impossible.

Whatever investigations could be made, the small Estonian population, which is perhaps the only one left of *Dactylorhiza ruthei* (KUUSK 1996), is very precious and needs active protection. It is effectively endangered by its critically low number of individuals, hybridizations with other species, swamping by invasive reed patches, and also by drift material brought in by the sea during storms under which some individuals are sometimes buried (KUUSK 1996). The site should certainly be managed by mowing with export of the mowed materials and the possibility of hand-made cross-pollinations of 1-2 flowers by inflorescence could be envisaged.

***Dactylorhiza maculata* species group**

Dactylorhiza fuchsii* / *D. maculata

On the islands and in the mainland, we saw *Dactylorhiza fuchsii* on 36 sites representing very calcareous to neutrocline habitats, as different as alkaline rich fens, meadows, woodlands and dry to wet roadsides. On 3 sites (16, 42, 55), numerous plants with the typical labellum shape (labellum deeply 3-lobed, median lobe prominent, as wide and longer than side lobes, labellum shape index >1,3) were accompanied by a few plants with less typical labellum shape (labellum with shallower division into 3 lobes, the central lobe smaller, label-

lum shape index 1,25, which is nevertheless too high for *D. maculata* s. str.) (For labellum shape index, see e.g. DELFORGE 2005: 229). Our local guides identified these individuals as *D. maculata*, an identification we could not confirm.

It is well-known that in numerous situations mainly in northwestern Europe, the calciphilous *Dactylorhiza fuchsii* can be easily separated from the acidiphilous *D. maculata*, but also that, frequently, the differentiation is less obvious, at least with the sole help of the floral morphology (e.g. HESLOP-HARRISON 1951; BISSE 1963; NELSON 1976; WIEFELSPÜTZ 1977; REINHARD 1985, 1990; DEVILLERS-TER-SCHUREN & DEVILLERS 1986; BATEMAN & DENHOLM 1989; TYTECA & GATHOYE 1990; DUFRÉNE et al. 1991; DELFORGE 1994, 1995A, B, 2001, 2002, 2005; BOURNÉRIAS 1998; PEDERSEN 1998; KREUTZ & DEKKER 2000; BAUMANN et al. 2002; BAUMANN et al. 2005). However, karyology and use of molecular markers such as allozymes, ITS sequencing, cpDNA, and AFLP fingerprints support the long-standing hypothesis (e.g. VERMEULEN 1938, 1947; HAGERUP 1944; HESLOP-HARRISON 1951) that the two species are clearly distinct, with *D. fuchsii* being an ancestral diploid species, and *D. maculata* a younger autotetraploid species which evolved from *D. fuchsii* (e.g. HEDRÉN 1996C; BATEMAN et al. 1997, 2003; HEDRÉN et al. 2001; BATEMAN & DENHOLM 2003; DEVOS et al. 2003).

During our visit, our local guides frequently stated that 2005 was not a favourable year to *Dactylorhiza maculata* because they were not able to find back plants previously reported from bogs (e.g. in somewhat acidic local bogs of our large site 45), transitional mires or woodlands. This could indeed have been the case. In karyological investigations on Estonian orchids, JAGIELLO et al. (1989: 323) reported $2n=80$ for specimens from Saaremaa, recollected very likely in transitional mires enclosed in a general calcareous environment. Nevertheless, in each case in which a few slender individuals in a large *D. fuchsii* population have been presented to us as *D. maculata*, we concluded that the floral morphology of these specimens was effectively transitional, but not identical, to *D. maculata*, and that, on the contrary, the shape of the leaves and the ecology were those of *D. fuchsii*.

In *D. fuchsii*, the lowest leaf is short, broader in the distal half, with a broad rounded tip, whereas in *D. maculata*, the lowest leaf is narrower, broader in the basal half, with an acute tip (Auct. plur.). The shape of the lowest leaf was not used by our guides. With the help of the leaf character in case of less evident '*fuchsii* labellum shape' individuals, we demonstrated in the field that these individuals belonged to *D. fuchsii*, identifications corroborated by the ecology (Pl. 5, p. 53). To indicate the existence of individuals transitional between *D. fuchsii* and *D. maculata* in our lists, we named these *D. fuchsii* «cf. var. *meyeri*», a name probably without real taxonomic value, as it seems to be synonymous with *D. fuchsii* var. *fuchsii*. Similar taxa have been reported from various parts of Europe, and no adequate name seems to be available, if at all necessary. We consider these individuals part of *D. fuchsii* s. str. The same conclusions have been recently drawn based on multivariate statistical analyses of similar plants from Famenne (Belgium) (TYTECA & GATHOYE 2005). We have



Plate 1. *Dactylorhiza incarnata* and *D. cruenta* (from Italy).

Above left: *Dactylorhiza incarnata* var. *hyphaematodes*, Saaremaa, Koruse. 28.VI.2005; right: *D. incarnata* var. *sublatifolia*, Saaremaa, Undva. 28.VI.2005. **Below** left: *D. incarnata* cf. var. *borealis*, Läänemaa. Laelatu. 22.VI.2005; right: *Dactylorhiza cruenta*. Italy, Belluno, 6.VII.1989.

(photos P. DELFORGE)



Plate 2. Orchids of Estonia. *Dactylorhiza baltica*

Above left: Pärnumaa. Treimani. 23.VI.2005; **right:** Pärnumaa. Pärnu. 20.VI.2005.

Below left: Pärnumaa. Pärnu. 20.VI.2005; **right:** Saaremaa, Undva, 26.VI.2005.

(photos P. DELFORGE)

also made some research by ourself in the southern mainland, on acidic base rocks, but we did not find any *D. maculata* individuals there, either.

It is obvious that we have not seen *Dactylorhiza maculata* in Estonia in 2005. From our Estonian experience, we conclude with KUUSK (1996) that *D. maculata* is rarer than *D. fuchsii* in the country as in other central European and Baltic states (as e.g. Poland, JAGIELLO 1988, or Germany, BAUMANN et al. 2005) and that, very probably, its presence is overrated.

Conclusions

As stated above, our remarks on Estonian orchids principally concern the genus *Dactylorhiza*. This genus constitutes a «young polyploid complex» (HEDRÉN 2001), with many morphologically polymorphic, poorly delimited taxa, and frequent hybrids (e.g. BATEMAN & DENHOLM 1983, 1988, 2003; TYTECA 2001; HEDRÉN 1996C, 2001; BATEMAN et al. 2003; DEVILLERS in DELFORGE et al. 2005). This makes the taxonomic treatment of the genus difficult and very varied. Nevertheless, all modern specialists stress the necessity of a populational approach for taxonomic treatment of *Dactylorhiza*. We remark that the few problems we detected for the genus in Estonia are due mainly to the overemphasis of characters exhibited by a few extreme individuals occurring in a population of one polymorphic species, or in colonies where different species with varied phenotypes flower and hybridize. That led, at least on sites we visited in 2005, to misidentifications of one or two individuals as *D. cruenta* in populations of *D. incarnata* with spotted and unspotted leaves, and also to reports of *D. praetermissa*, and even of *D. traunsteineri* or *D. lapponica*, in mixed colonies where polymorphic *D. baltica*, *D. curvifolia*, *D. incarnata*, or *D. fuchsii*, and various hybrids were blooming.

We have been deeply impressed by the richness of the orchid sites we visited, particularly on the islands and the western coastal regions of the mainland. As the economy drastically changed after the end of the Soviet period, most of these areas are now in high need of protection and, sometimes, management. In numerous regions, in spite of the mosquitos, Estonia seemed to us a paradise for orchidologists and other botanists or ornithologists. We also enjoyed the enthusiasm and receptiveness of the members of the Estonian Orchid Protection Club (*Eesti Orhideekaiste Klubi*) and we are sure that they will do everything they can to preserve the habitats and environment of their beautiful country.

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Plate 3. Orchids of Estonia. *Dactylorhiza curvifolia*

Above left, center: Saaremaa, Viidu. 26.VI.2005; right: Läänemaa. Alemaa, 24.VI.2005.
Belowleft: Saaremaa, Viidu. 26.VI.2005; right: Saaremaa, Viidamäe national park. 28.VI.2005.

(photos P. DELFORGE)



Plate 4. Orchids of Estonia. *Dactyloriza ruthei*

Läänemaa. Puutu nature reserve. 21.VI.2005.

(photos P. DELFORGE)

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Appendix. Personal observations

List of species

1. *Cephalanthera longifolia* (L.) FRITSCH
(*Ce. long*): 18, 21, 33, 39.
2. *Cephalanthera rubra* (L.) L.C.M. RICHARD
(*Ce. rubr*): 12, 33, 40.
3. *Corallorhiza trifida* CHATELAIN
(*Co. trif*): 43.
4. *Cypripedium calceolus* L.
(*Cy. calc*): 4, 21, 39.
5. *Dactylorhiza baltica* (KLINGE) ORLOWA ex AVERYANOV
(*Da. balt*): 10, 15, 18, 21, 24, 43, 48, 49, 50, 51, 58, 62, 66, 67, 69, 70, 73, 74, 75.
6. *Dactylorhiza curvifolia* (F. NYLANDER) CZEREPANOV
Da. curv): 19, 23, 28, 29, 30, 31, 32, 33, 55, 56, 65.
7. *Dactylorhiza fuchsii* var *fuchsii* (DRUCE) Soó nom. cons. prop.
(*Da. fuch*): 1, 8, 9, 16, 24, 25, 26, 28, 29, 33, 34, 36, 37, 38, 39, 40, 43, 44, 45, 49, 47, 54, 55, 57, 58, 59, 60, 63, 64, 65, 66, 69, 71, 72, 75.
Dactylorhiza fuchsii cf. var *meyeri* (REICHENBACH f.) Soó: 16, 55, 59.
8. *Dactylorhiza incarnata* (L.) Soó
(*Da. inca*) [total]: 1, 2, 3, 5, 6, 10, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 27, 28, 29, 30, 31, 32, 34, 35, 37, 38, 42, 44, 48, 49, 50, 52, 54, 55, 56, 57, 58, 59, 60, 61, 65, 68, 69, 75.
Dactylorhiza incarnata var *incarnata* (L.) Soó: 1, 2, 3, 13, 15, 16, 23, 24, 28, 29, 30, 31, 32, 34, 35, 37, 38, 42, 44, 52, 56, 57, 58, 60, 61, 65, 68, 69.
Dactylorhiza incarnata var *borealis* (NEUMANN) NYLANDER: 1, 3, 5, 6, 10, 13, 15, 17, 18, 19, 20, 21, 22, 23, 24, 29, 32, 38, 42, 44, 48, 49, 55, 56, 57, 59, 61, 65.

- Dactylorhiza incarnata* var. *hyphaematodes* (NEUMANN) LANDWEHR: 22, 23, 24, 27, 37, 38, 57, 58.
- Dactylorhiza incarnata* var. *sublatifolia* (REICHENBACH f. em. ASCHERSON & GRÄBNER) SOÓ: 15.
- Dactylorhiza incarnata* var. *reichenbachii* GATHOYE & TYTECA: 23, 27, 37.
- Dactylorhiza incarnata* f. *ochrantha* LANDWEHR: 23, 24, 30, 31, 32, 42.
9. *Dactylorhiza ochroleuca* (WÜSTNEI ex BOLL) J. HOLUB
(*Da. ochr*): 13, 16, 17, 22, 24, 28, 29, 30, 31, 32, 42, 55.
 10. *Dactylorhiza osiliensis* PIKNER
(*Da. osil*): 16, 19, 20.
 11. *Dactylorhiza ruthei* (M. SCHULZE ex RHUTE) SOÓ
(*Da. ruth*): 37.
 12. *Epipactis atrorubens* (HOFFMANN ex BERNHARDI) BESSER
(*Ep. atro*): 5, 7, 9, 12, 13, 18, 25, 26, 33, 40.
 13. *Epipactis helleborine* (L.) CRANTZ
(*Ep. hell*): 18, 27, 33.
 14. *Epipactis palustris* (L.) CRANTZ
(*Ep. palu*): 1, 2, 3, 5, 13, 15, 16, 17, 18, 23, 24, 28, 29, 32, 43, 50, 55, 56, 57, 59, 65.
 15. *Goodyera repens* (L.) R. BROWN
(*Go. repe*): 33.
 16. *Gymnadenia conopsea* (L.) R. BROWN
(*Gy. cono*): 2, 5, 13, 14, 16, 18, 19, 21, 22, 23, 24, 28, 29, 30, 31, 32, 33, 34, 36, 37, 38, 39, 40, 41, 44, 49, 47, 55, 56, 59, 61, 65.
Gymnadenia conopsea cf. var. *densiflora* (WAHLENBERG) LINDLEY: 22.
 17. *Gymnadenia odoratissima* (L.) L.C.M. RICHARD
(*Gy. odor*): 28, 59.
 18. *Herminium monorchis* (L.) R. BROWN
(*He. mono*): 5, 11, 13, 18, 22, 24, 32, 33.
 19. *Liparis loeselii* (L.) L.C.M. RICHARD
(*Li. loes*): 13, 24, 32, 33, 42, 61.
 20. *Malaxis monophyllos* (L.) SWARTZ
(*Ma. mono*): 33, 61.
 21. *Malaxis paludosa* (L.) SWARTZ
(*Ma. palu*): 60.
 22. *Neottia cordata* (L.) L.C.M. RICHARD
(*Ne. cord*): 4.
 23. *Neottia nidus-avis* (L.) L.C.M. RICHARD
(*Ne. nidu*): 13, 18, 19, 36.
 24. *Neottia ovata* (L.) BLUFF & FINGERHUTH
(*Ne. ovat*): 1, 2, 3, 4, 5, 9, 12, 15, 16, 17, 18, 19, 21, 22, 24, 26, 27, 28, 33, 34, 35, 36, 37, 39, 40, 42, 43, 49, 47, 48, 49, 51, 53, 58, 61, 62, 63, 64, 65, 75
 25. *Ophrys insectifera* L.
(*Op. inse*): 1, 2, 3, 4, 5, 11, 13, 21, 28, 29, 39, 41, 55, 56, 61.
 26. *Orchis mascula* (L.) L.
(*Or. masc*): 37, 47

27. *Orchis militaris* L.
(*Or. mili*): 2, 4, 5, 8, 11, 12, 13, 14, 15, 16, 17, 18, 21, 22, 24, 25, 26, 37, 38, 39, 40, 41, 43, 45, 46, 57, 61.
28. *Orchis ustulata* L.
(*Or. ustu*): A (early flowering): 35; B (late flowering): 41.
29. *Platanthera bifolia* (L.) L.C.M. RICHARD
(*Pl. bifo*): 1, 3, 5, 13, 16, 18, 19, 22, 23, 25, 26, 33, 34, 35, 41, 42, 44, 46, 47, 53, 58, 61, 65, 72, 75.
30. *Platanthera chlorantha* (CUSTER) REICHENBACH
(*Pl. chlo*): 4, 5, 11, 13, 16, 18, 19, 21, 22, 33, 35, 39, 55, 57, 68, 73.

List of hybrids

1. *Dactylorhiza baltica* × *D. fuchsii*: 24, 43, ?48, ?49, 66.
2. *Dactylorhiza baltica* × *D. incarnata* (*D. ?xishorica* AVERYANOV): ?8, ?9, 15, 50.
3. *Dactylorhiza curvifolia* × *D. fuchsii* (*D. ×megapolitana* (KLINGE) Soó): 65.
4. *Dactylorhiza curvifolia* × *D. incarnata* (*D. ×lehmannii* (KLINGE) Soó): 32, 56 .
5. *Dactylorhiza fuchsii* × *D. incarnata* (*D. ×kerniorum* (Soó) Soó): 1, 3, 5, 6, 32, 38, 44, 58.
6. *Dactylorhiza fuchsii* × *D. ochroleuca* (*D. ×lillsundica* KREUTZ): 29, 55.
7. *Dactylorhiza fuchsii* × *D. osiliensis*: 16.
8. *Dactylorhiza fuchsii* × *D. ruthei* (*D. ×estonica* JAGIELLO & KUUSK): 37.
9. *Dactylorhiza incarnata* × *D. ochroleuca* (*D. ×versicolor* (SCHMIDT & LUCHER) GATHOYE & D. TYTECA): 29, 42.
10. *Dactylorhiza incarnata* × *D. osiliensis*: 16, 19.
11. *Dactylorhiza incarnata* × *D. ruthei* (*D. ×reitaluae* HENNECKE, E. BREINER & R. BREINER): 37.
12. *Platanthera bifolia* × *P. chlorantha* (*P. ×hybrida* BRÜGGER): 16, 19.

List of sites

Prospected sites are classified by UTM (Universal Transverse Mercator) coordinates, used in studies of repartition of European plants notably in the frame of the OPTIMA project. The UTM coordinates of the sites were determined in the field by GPS set to wgs84 norm. Localisation of the sites was made in reference to kilometric coordinates of UTM 100 km × 100 km squares (the 2 letters define the 100 km × 100 km square in the zones 34V and 35V; the first two digits define the longitude in the square, the latter two the latitude). Distances are given in a straight line from the localities used as landmarks, after the Regio Eesti teede atlas 2005/2006 1:200 000 and 1:150 000. A short description of the environment, the date of observation and the enumeration of the orchids follow the altitude.

Zone 34V

Islands

Hiiumaa

1. EL8537 1 km ESE Kõrgessaare. 4 m. Basicline fen with *Betula pendula*, *Eriophorum angustifolium*, *Geum rivale*, *Pinus sylvestris*, *Salix* sp. 25.VI.2005: *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata* and var. *borealis*), *Da. fuch* × *Da. inca*, *Ep. palu*, *Ne. ovat*, *Op. inse*, *Pl. bifo*.

2. EL8538 1.3 km ESE Kõrgessaare. 1-2 m. Basicline fen with *Juniperus communis*, *Primula farinosa*, *Trichophorum cespitosum*. 24.VI.2005: *Da. inca* (var. *incarnata*), *Ep. palu*, *Gy. cono*, *Ne. ovat*, *Op. inse*, *Or. mili*.
3. EL8538 1.4 km ESE Kõrgessaare. 4 m. Calcareous wet *Alnus glutinosa* woodland with *Betula pubescens*, *Iris pseudacorus*, *Salix* sp. 25.VI.2005: *Da. inca* (var. *incarnata* and var. *borealis*), *Da. fuch* × *Da. inca*, *Ep. palu*, *Ne. ovat*, *Op. inse*, *Pl. bifo*.
4. EL8538 1.5 km ESE Kõrgessaare. 2-4 m. *Picea abies*, *Pinus sylvestris* woodland with *Juniperus communis*. 24.VI.2005: *Cy. calc*, *Ne. cord*, *Ne. ovat*, *Op. inse*, *Or. mili*, *Pl. chlo*.
5. EL8538 Small botanical garden 1,2 km ESE Kõrgessaare. 2-3 m. Basicline fen. 24.VI.2005: *Da. inca* (var. *borealis*), *Da. fuch* × *Da. inca*, *Ep. atro*, *Ep. palu*, *Gy. cono*, *He. mono*, *Ne. ovat*, *Op. inse*, *Or. mili*, *Pl. bifo*, *Pl. chlo*.
6. EL8738 Pihla. 5 m. Calcareous inundated *Alnus glutinosa* woodland and wooded rich fen with *Betula pendula*, *Carex vesicaria*, *Frangula alnus*, *Fraxinus excelsior*, *Geum rivale*, *Juniperus communis*, *Menyanthes trifoliata*, *Pinus sylvestris*, *Salix* sp. 25.VI.2005: *Da. inca* (var. *borealis*), *Da. fuch* × *Da. inca*.
7. EL9242 8 km WNW Kärkla. 15 m. Sparse calcareous *Pinus sylvestris* woodland with *Calluna vulgaris*. 24.VI.2005: *Ep. atro*.
8. FL0032 3 km SSW Tubala. 25 m. Roadsides in neutrocline *Pinus sylvestris*, *Betula pendula* mixed woodland. 25.VI.2005: *Da. fuch* (var. *fuchsii*), ?*Da. balt* × *Da. inca*, *Or. mili*.
9. FL0232 2 km W Nõmba. 25 m. Roadsides in neutrocline *Pinus sylvestris*, *Betula pendula* mixed woodland with *Calluna vulgaris*, *Pteridium aquilinum*, *Vaccinium myrtillus*. 25.VI.2005: *Da. fuch* (var. *fuchsii*), ?*Da. balt* × *Da. inca*, *Ep. atro*, *Ne. ovat*.
10. FL0617 2 km W Kassari. 1 m. Coastal basicline fen with *Juniperus communis*. 25.VI.2005: *Da. balt*, *Da. inca* (var. *borealis*).
11. FL1426 2.3 km ESE Suuremoisa. 10 m. Calcareous *Calluna vulgaris* heath with prostrate *Juniperus communis*, and *Pinus sylvestris*, *Stellaria crassifolia*. 26.VI.2005: *He. mono*, *Op. inse*, *Or. mili*, *Pl. chlo*.
12. FL1627 Sarve. 5 m. Edge of *Betula pendula* woodland with *Juniperus communis*. 26.VI.2005: *Ce. rubr*, *Ep. atro*, *Ne. ovat*, *Or. mili*.
13. FL1724 1 km WNW-NW Heltermaa. 2 m. Coastal sparse *Pinus sylvestris* woodland and alkaline rich fen with prostrate *Juniperus communis*, and *Pinguicula vulgaris*, *Primula farinosa*. 26.VI.2005: *Da. inca* (var. *incarnata* and var. *borealis*), *Da. ochr*, *Ep. atro*, *Ep. palu*, *Gy. cono*, *He. mono*, *Li. loes*, *Ne. ovat*, *Op. inse*, *Or. mili*, *Pl. bifo*, *Pl. chlo*.
14. FL1823 2 km SSE Heltermaa. 2-3 m. Coastal sparse *Pinus sylvestris* woodland on stony soil with *Juniperus communis*. 26.VI.2005: *Ep. atro*, *Gy. cono*, *Or. mili*.

Saaremaa

15. EK5386 0.5 km W Undva. 1-2 m. Coastal rich fen with *Carex flava*, *C. pulicaris*, *C. rostrata*, *Eriophorum angustifolium*, *Iris pseudacorus*, *Phragmites australis*, *Salix* sp., *Scirpus tabernaemontanii*; inland edges of the fen with *Juniperus communis* scrubs and *Pinus sylvestris* woodland on stony soil. 26 & 28.VI.2005: *Da. balt*, *Da. inca* (var. *incarnata*, var. *borealis*, and var. *sublatifolia*), *Da. balt* × *Da. inca*, *Ep. palu*, *Ne. ovat*, *Or. mili*.

16. EK5562 4 km WNW Lümanda. 10 m. Roadsides and neutrocline rich fen with *Betula pubescens*, *Juniperus communis*, *Eriophorum angustifolium*, *Menyanthes trifoliata*, *Myrica gale*, *Pinguicula vulgaris*, *Primula farinosa*. 27.VI.2005: *Da. fuch* (var. *fuchsii* and cf. var. *meyeri*), *Da. inca* (var. *incarnata*), *Da. ochr*, *Da. osil*, *Da. fuch* × *Da. osil*, *Da. inca* × *Da. osil*, *Ep. palu*, *Gy. cono*, *Ne. ovat*, *Or. mili*, *Pl. bifo*, *Pl. chlo*, *Pl. bifo* × *Pl. chlo*.
17. EK5563 5 km WNW Lümanda. 5 m. Rich fen with *Eriophorum angustifolium*. 27.VI.2005: *Da. inca* (var. *borealis*), *Da. ochr*, *Ep. palu*, *Ne. ovat*, *Or. mili*.
18. EK5565 Kuusnõmme. 1-4 m. Clearing in coastal *Picea abies* and *Pinus sylvestris* woodland. 27.VI.2005: *Ce. long*, *Da. balt*, *Da. inca* (var. *borealis*), *Ep. atro*, *Ep. hell*, *Ep. palu*, *Gy. cono*, *He. mono*, *Ne. nidu*, *Ne. ovat*, *Or. mili*, *Pl. bifo*, *Pl. chlo*.
19. EK5662 4.2 km WNW Lümanda. 10 m. Wet *Pinus sylvestris* bog woodland with streams and neutrocline rich fen with *Frangula alnus*, *Juniperus communis*, *Eriophorum angustifolium*, *Paris quadrifolia*, *Molinia caerulea*, *Carex hostiana*, *C. panicea*, *C. davalliana*, *C. flava*, *Eleocharis palustris*, *E. quinqueflora*, *Sesleria caerulea*, *Calamagrostis stricta*, *Deschampsia cespitosa*, *Succisa pratensis*, *Potentilla erecta*, *Primula farinosa*, *Galium boreale*. 27.VI.2005: *Da. curv*, *Da. inca* (var. *borealis*), *Da. osil*, *Da. inca* × *Da. osil*, *Gy. cono*, *Ne. nidu*, *Ne. ovat*, *Pl. bifo*, *Pl. chlo*, *Pl. bifo* × *Pl. chlo*.
20. EK5663 4.6 km WNW Lümanda. 10 m. as site 19. 27.VI.2005: *Da. inca* (var. *borealis*), *Da. osil*.
21. EK5667 Kuusnõmme. 5 m. *Pinus sylvestris* woodland with *Convallaria majalis*, *Geranium sylvaticum*, *Juniperus communis*, *Primula farinosa*. 27.VI.2005: *Cy. calc*, *Ce. long*, *Da. balt*, *Da. inca* (var. *borealis*), *Gy. cono*, *Ne. ovat*, *Op. inse*, *Or. mili*, *Pl. chlo*.
22. EK5673 Koruse. 3-5 m. Rich fen partly ploughed during the Soviet period with *Briza media*, *Eriophorum angustifolium*, *Juniperus communis*, *Pinus sylvestris*. 26.VI.2005: *Da. inca* (var. *borealis* and var. *hyphaematodes*), *Da. ochr*, *Gy. cono* (var. *conopsea* and cf. var. *densiflora*), *He. mono*, *Ne. ovat*, *Or. mili*, *Pl. bifo*, *Pl. chlo*.
23. EK5679 1 km W Koruse. 10 m. Moist meadow and rich fen with *Eriophorum angustifolium*, *Juniperus communis*, *Menyanthes trifoliata*, *Myrica gale*, *Salix* sp. 26 & 28.VI.2005: *Da. curv*, *Da. inca* (var. *incarnata*, var. *reichenbachii*, var. *borealis*, var. *hyphaematodes* and f. *ochrantha*), *Ep. palu*, *Gy. cono*, *Pl. bifo*.
24. EK5766 Kiirasaare. 1 m. Calcareous wet *Alnus glutinosa* woodland and rich fen with *Eriophorum angustifolium*, *Menyanthes trifoliata*, *Myrica gale*, *Pinguicula vulgaris*, *Primula farinosa*. 27.VI.2005: *Da. balt*, *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata*, var. *borealis*, var. *hyphaematodes*, and f. *ochrantha*), *Da. ochr*, *Da. balt* × *Da. fuch*, *Ep. palu*, *Gy. cono*, *He. mono*, *Li. loes*, *Ne. ovat*, *Or. mili*.
25. EK6260 2.8 km ESE Lümanda. 30 m. Edge of *Pinus sylvestris* woodland on stony soil. 27.VI.2005: *Da. fuch* (var. *fuchsii*), *Ep. atro*, *Or. mili*, *Pl. bifo*.
26. EK6360 3 km E-ESE Lümanda. 30 m. Edge of *Pinus sylvestris* woodland on stony soil. 27.VI.2005: *Da. fuch* (var. *fuchsii*), *Ep. atro*, *Ne. ovat*, *Or. mili*, *Pl. bifo*.
27. EK6361 Viidamäe national park. 30 m. *Pinus sylvestris* woodland and spring fen with *Cladium mariscus*, *Rhinanthus osiliensis*, *Schoenus ferrugineus*, *Tofieldia calyculata*. 28.VI.2005: *Da. inca* (var. *reichenbachii* and var. *hyphaematodes*), *Ep. hell*, *Ne. ovat*.

28. EK6362 Viidamäe national park. 20 m. Fen with *Betula pubescens*, *Carex davalliana*, *C. lasiocarpa*, *C. limosa*, *C. nigra*, *C. panicea*, *Drosera anglica*, *Frangula alnus*, *Juniperus communis*, *Menyanthes trifoliata*, *Phragmites communis*, *Primula farinosa*, *Schoenus ferrugineus*. 28.VI.2005: *Da. curv*, *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata*), *Da. ochr*, *Da. curv* × *Da. inca*, *Ep. palu*, *Gy. cono*, *Gy. odor*, *Ne. ovat*, *Op. inse*.
29. EK6460 4 km E-ESE Lümanda. 30 m. Rich fen with *Betula pubescens*, *Carex rostrata*, *Eleocharis uniglumis*, *Eriophorum angustifolium*, *Juniperus communis*, *Menyanthes trifoliata*, *Myrica gale*, *Primula farinosa*. 27.VI.2005: *Da. curv*, *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata* and var. *borealis*), *Da. ochr*, *Da. fuch* × *Da. ochr*, *Da. inca* × *Da. ochr*, *Ep. palu*, *Gy. cono*, *Op. inse*.
30. EK6660 0.5 km W Viidu. 40 m. Rich fen in places wooded (*Betula pendula*, *Pinus sylvestris*) with *Carex flava*, *Eriophorum angustifolium*, *Juniperus communis*, *Menyanthes trifoliata*, *Myrica gale*. 26.VI.2005: *Da. curv*, *Da. inca* (f. *incarnata* and f. *ochrantha*), *Da. ochr*, *Gy. cono*.
31. EK6661 0.7 km W Viidu. 40 m. Rich fen in places wooded (*Betula pendula*, *Pinus sylvestris*) with *Carex flava*, *Eriophorum angustifolium*, *Juniperus communis*, *Menyanthes trifoliata*, *Myrica gale*. 26.VI.2005: *Da. curv*, *Da. inca* (f. *incarnata* and f. *ochrantha*), *Da. ochr*, *Gy. cono*.
32. EK7284 4 km N Mustjala. 0-1 m. Coastal rich fen and mires with *Carex flava*, *C. lepidocarpa*, *C. hostiana*, *C. rostrata*, *Eriophorum angustifolium*, *Menyanthes trifoliata*, *Pinguicula vulgaris*, *Pinus sylvestris*, and *Juniperus communis* scrubs. 28.VI.2005: *Da. curv*, *Da. inca* (var. *incarnata*, var. *borealis*, and f. *ochrantha*), *Da. ochr*, *Da. curv* × *Da. inca*, *Da. fuch* × *Da. inca*, *Ep. palu*, *Gy. cono*, *He. mono*, *Li. loes*.
33. EK7285 5.6 km N Mustjala. 0-1 m. Coastal *Pinus sylvestris* woodland and its edges, in places wet, with *Convallaria majalis*, *Paris quadrifolia*, *Pyrola rotundifolia*. 28.VI.2005: *Ce. long*, *Ce. rubr*, *Da. curv*, *Da. fuch* (var. *fuchsii*), *Ep. atro*, *Ep. hell*, *Go. repe*, *Gy. cono*, *He. mono*, *Li. loes*, *Ma. mono*, *Ne. ovat*, *Pl. bifo*, *Pl. chlo*.
34. EK8345 2 km ENE Nasva. 5 m. Roadsides and edge of a wet deciduous woodland. 28.VI.2005: *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata*), *Gy. cono*, *Ne. ovat*.

Muhu

35. FK8345 0.8 km WNW Aljava. 5 m. *Juniperus communis* shrubs and calcareous grassland with *Gentiana glomerata*, *Geranium sanguineum*. 28.VI.2005: *Da. inca* (var. *incarnata*), *Ne. ovat*, *Or. ustu A*, *Pl. bifo*, *Pl. chlo*.

Mainland

36. FK4893 Läänemaa. Puhtu nature reserve. 1-5 m. Old mixed woodland with *Acer platanoides*, *Betula pendula*, *Picea abies*, *Frangula alnus*, *Fraxinus excelsior*, *Larix decidua*, *Quercus robur*, *Tilia cordata*, and *Allium ursinum*, *Asperula odoratum*, *Convallaria majalis*, *Fragaria moschata*, *Geranium sanguineum*, *Lilium martagon*, *Paris quadrifolia*, *Polygonatum odoratum*, *Vincetoxicum hirsutinaria*. 22.VI.2005: *Da. fuch* (var. *fuchsii*), *Gy. cono*, *Ne. nidu*, *Ne. ovat*.
37. FK4894 Läänemaa. Puhtu nature reserve. 1-2 m. Littoral wet meadow with *Betula pendula*, *Crepis praemorsa*, *Deschampsia caespitosa*, *Eriophorum* sp., *Geum rivale*, *Helictotrichon pubescens*, *Melica mutans*. 21.VI.2005: *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata*, var. *reichenbachii*, and



Plate 5. Orchids of Estonia.

Above. *Dactylorhiza incarnata* × *D. fuchsii* (*D. praetermissa* auct. Eston. non (DRUCE) SOÓ).
Hiiumaa. Kõrgessaare. 25.VI.2005.

(photos P. DELFORGE)

Below. *Dactylorhiza fuchsii* cf. var. *meyeri*. Läänemaa. Alemaa. 29.VI.2005.

(photos C.A.J. KREUTZ)

- var. *hyphaematodes*), *Da ruth*, *Da. fuch* × *Da. ruth*, *Da. inca* × *Da. ruth*, *Gy cono*, *Ne. ovata*, *Or. masc.*, *Or. mili*.
38. FK4996 Läänemaa. Laelatu. 1-2 m. Littoral wet grassland and edges of woodland with *Betula pendula*, *Frangula alnus*, *Quercus robur*, and *Crepis praemorsa*, *Juniperus communis*, *Viola elatior*. 22.VI.2005: *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata*, var. *hyphaematodes*, and var. *borealis*), *Da. fuch* × *Da. inca*, *Gy cono*, *Or. mili*.
39. FK4997 Läänemaa. Laelatu nature reserve. 2-3 m. Woodland in places wet and managed with *Betula pendula*, *Frangula alnus*, *Fraxinus excelsior*, *Quercus robur*, and *Euphorbia palustris*, *Geranium sanguineum*, *Geum rivale*, *Juniperus communis*. 22.VI.2005: *Ce. long.*, *Cy. calc.*, *Da. fuch* (var. *fuchsii*), *Gy cono*, *Ne. ovata*, *Op. inse.*, *Or. mili*, *Pl. chlo.*
40. FK5093 Läänemaa. Pivarotsi. 15 m. Meadow and sparse *Betula pendula* woodland with *Carex tomentosa*, *Filipendula vulgaris*, *Gentiana cruciata*, *Juniperus communis*, *Polygala comosa*, *Polygonatum odoratum*, *Primula officinalis*, *Veronica* sp., *Teucrium scordium*. 21.VI.2005: *Ce. rubra*, *Ep. atro.*, *Da. fuch* (var. *fuchsii*), *Gy. cono*, *Ne. ovata*, *Or. mili*.
41. FK5193 Läänemaa. Pivarotsi. 12 m. Calcareous grassland and *Juniperus communis* scrubs with *Antennaria dioica*, *Asperula tinctoria*, *Astragalus danicus*, *Brizia minor*, *Campanula glomerata*, *Carex glauca*, *C. tomentosa*, *Crepis praemorsa*, *Filipendula vulgaris*, *Frangula alnus*, *Inula salicina*, *Sesleria caerulea*, *Trifolium montanum*. 21.VI.2005: *Gy cono*, *Ne. ovata*, *Op. inse.*, *Or. mili*, *Or. ustulata*, *Pl. bifo.*
42. FK6495 Läänemaa. Tuhu. 25 m. Rich fen, in places acidic, and transitional mires with *Carex flava*, *C. lasiocarpa*, *Eriophorum angustifolium*, *Juniperus communis*, *Menyanthes trifoliata*, *Myrica gale*, *Pinguicula vulgaris*, *Pyrola rotundifolia*. 21.VI.2005: *Da. inca* (var. *incarnata*, var. *borealis*, and f. *ochrantha*), *Da. ochr.*, *Da. inca* × *Da. ochr.*, *Li. loes.*, *Ne. ovata*, *Pl. bifo.*
43. FK6496 Läänemaa. Tuhu. 25 m. Rich fen, in places wooded (*Betula pubescens*, *Pinus sylvestris*...) and tracksides with *Angelica sylvestris*, *Filipendula ulmaria*, *Geum rivale*, *Thelypteris palustris*. 21.VI.2005: *Co. trif.*, *Da. balt.*, *Da. fuch* (var. *fuchsii*), *Da. balt* × *Da. fuch*, *Ep. palu.*, *Ne. ovata*, *Or. mili*.
44. FL4135 Läänemaa. 3 km NNW Haapsalu. 0-1 m. Littoral basicline wet grassland and edge of scrubs of *Alnus glutinosa*. 24.VI.2005: *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata* and var. *borealis*), *Da. fuch* × *Da. inca*, *Gy. cono*, *Pl. bifo.*
45. FL4234 Läänemaa. 1 km S Pullapää. 1 m. Dry calcareous grassland on limestone with *Pinus sylvestris*. 24.VI.2005: *Da. fuch* (var. *fuchsii*), *Or. mili*.
46. FL5037 Läänemaa. 3 km E Haapsalu. 10 m. Clearing in a *Betula pendula-Quercus robur* woodland. 24.VI.2005: *Da. fuch* (var. *fuchsii*), *Gy cono*, *Ne. ovata*, *Or. mili*, *Pl. bifo.*

Zone 35V

47. LE2992 Pärnumaa. Nedrema. 25 m. Managed wooded bog with *Betula pendula*, *B. pubescens*, *Corylus avellana*, *Frangula alnus*, *Quercus robur*, and *Betonica officinalis*, *Carex panicea*, *C. tomentosa*, *Centaurea jacea*, *Cirsium heterophyllum*, *Filipendula vulgaris*, *Hypericum maculatum*, *Juncus articulatus*, *Juniperus communis*, *Leontodon hispidus*, *Linum catharticum*, *Luzula multiflora*, *Melampyrum pratense*, *Pinguicula vulgaris*, *Plantago media*, *Polygonum viviparum*, *Primula officinalis*, *Pyrola rotundifolia*, *Rubus saxatilis*, *Scorzonera humilis*, *Sesleria caerulea*. 22.VI.2005: *Da. fuch* (var. *fuchsii*), *Gy cono*, *Ne. ovata*, *Or. masc.*, *Pl. bifo.*

48. LE4522 Pärnumaa. Treimani. 1 m. Littoral, salty, wet, acidocline meadow on sands with *Festuca rubra*, *Equisetum arvense*, *Phragmites australis*, *Ranunculus acris*, *Salix* sp., *Sedum acre*, *Valeriana officinalis*. 23.VI.2005: *Da. balt*, *Da. inca* (var. *borealis*), ?*Da. balt* × *Da. fuch*, *Ne. ovat*.
49. LE5139 Pärnumaa. Häädemeeste. 0-1 m. Coastal salty, wet, acidocline meadow partly ploughed with *Geranium palustre*, *G. pratense*, *Urtica dioica*. 23.VI.2005: *Da. balt*, *Da. inca* (var. *borealis*), ?*Da. balt* × *Da. fuch*, *Ne. ovat*.
50. LE5472 Pärnumaa. Pärnu. 0-1 m. Coastal salty, wet, basicline meadow managed by mowing, with *Angelica palustris*, *Equisetum arvense*, *Ophioglossum vulgatum*, *Rumex acetosa*, *Thalictrum lucidum*, *Triglochin maritimum*, *Vicia cracca*. 20.VI.2005: *Da. balt*, *Da. inca* (var. *incarnata*), *Da. balt* × *Da. inca*, *Ep. palu*.
51. LE5677 Pärnumaa. Pärnu. 5 m. Clearings in wet mixed woodland with *Alnus incana*, *Betula pendula*, *Fraxinus excelsior*, *Pinus sylvestris*, and *Iris pseudacorus*, *I. sibericus*, *Lychnis flos-cuculi*, *Polemonium caeruleum*, *Thalictrum aquilegifolium*, *T. lucidum*. 23.VI.2005: *Da. balt*, *Ne. ovat*.
52. LE8938 Viljandimaa. 1 km N Lilli. 80 m. Wet sparse *Pinus sylvestris* woodland, drained raised bog with *Calluna vulgaris*, clearing with *Epilobium angustifolium* at the Latvian border. 1.VII.2005: *Da. inca* (var. *incarnata*), *Ep. palu*, *Pl. bifo*.
53. LE8939 Viljandimaa. 3.4 km WSW Moisakula. 80 m. Wet sparse *Pinus sylvestris* woodland and drained raised bog with *Calluna vulgaris*. 1.VII.2005: *Ne. ovat*, *Pl. bifo*.
54. LF3041 Läänemaa. 2 km S Ritsi. 40 m. Wooded edge of a destroyed rich fen. 24.VI.2005: *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata*).
55. LF4752 Läänemaa. Alemaa. 20 m. Rich fen, raised bog and transitional mires, in places wooded (*Betula pendula*, *Pinus sylvestris*) with *Juniperus communis*, *Menyanthes trifoliata*, *Pinguicula vulgaris*, *Tofieldia calyculata*, *Trichophorum cespitosum*. 29.VI.2005: *Da. curv*, *Da. inca* (var. *borealis*), *Da. fuch* (var. *fuchsii* and cf. var. *meyeri*), *Da. ochr*, *Da. fuch* × *Da. ochr*, *Ep. palu*, *Gy. cono*, *Op. inse*, *Pl. chlo*.
56. LF4753 Läänemaa. Alemaa equiped nature reserve. 15 m. Rich fen and transitional mires, in places wooded (*Betula pendula*, *Pinus sylvestris*) with *Juniperus communis*, *Menyanthes trifoliata*, *Primula farinosa*, *Trichophorum cespitosum*. 24.VI.2005: *Da. curv*, *Da. inca* (var. *incarnata* and var. *borealis*), *Da. curv* × *Da. inca*, *Ep. palu*, *Gy. cono*, *Op. inse*.
57. LF4753 Läänemaa. Alemaa. 16 m. Edges of the nature reserve with *Betula pendula*, *Calluna vulgaris*, *Picea abies*, *Pyrola rotundifolia*, *Quercus robur*. 24.VI.2005: *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata*, var. *borealis*, and var. *hyphaematodes*), *Ep. palu*, *Or. mili*, *Pl. chlo*.
58. LF5501 Pärnumaa. 1.5 km N Päärdu. 25 m. Wet mowed roadside and edge of mixed woodland with *Betula pendula*, *B. pubescens*, *Fraxinus excelsior*, *Picea abies*, *Pinus sylvestris*, and *Briza media*, *Equisetum arvense*, *Geranium sylvaticum*, *Melampyrum arvense*. 24.VI.2005: *Da. balt*, *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata* and var. *hyphaematodes*), *Da. fuch* × *Da. inca*, *Ne. ovat*, *Pl. bifo*.
59. LF5763 Harjumaa. 4 km S Ääsmäe. 20 m. Wooded rich fen, transitional mires, and edges of *Pinus sylvestris* woodland with *Juniperus communis*. 29.VI.2005: *Da. inca* (var. *borealis*), *Da. fuch* (var. *fuchsii* and cf. var. *meyeri*), *Ep. palu*, *Gy. cono*, *Gy. odor*.
60. LF8159 Harjumaa. 3.6 km WSW Oru. 20 m. Rich fen, transitional mires, and floating *sphagnum* raft with *Geum rivale*, *Menyanthes trifoliata*, *Pinguicula*

- alpina*. 29.VI.2005: *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata*), *Ma. mono*, *Ma. palu*.
61. LF9675 Harjumaa. 3 km WNW Pikavere. 20 m. Rich fen, transitional mires, and floating sphagnum rafts with *Carex davalliana*, *Eriophorum latifolium*, *Menyanthes trifoliata*, *Pinguicula alpina*, *Saussurea esthonica*. 29.VI.2005: *Da. inca* (var. *incarnata* and var. *borealis*), *Gy. cono*, *Li. loes*, *Ma. mono*, *Ne. ovat*, *Op. inse*, *Or. mili*, *Pl. bifo*.
62. MD8998 Võrumaa. 3 km ESE Sänna. 150 m. Roadside in a wet *Salix* sp. woodland. 1.VII.2005: *Da. balt*, *Ne. ovat*.
63. ME1331 Viljandimaa. 1 km N Lilli. 80 m. Wet *Betula pubescens* - *Picea abies* - *Pinus sylvestris* mixed woodland, with *Epilobium angustifolium*, *Lychnis flos-cuculi*, *Melampyrum nemorosum*, *Pteridium aquilinum*, *Thalictrum aquilegifolium*. 1.VII.2005: *Da. fuch* (var. *fuchsii*), *Ne. ovat*.
64. ME1928 Valgamaa. 1.5 km NNW Taagepera. 92 m. Wet *Betula pubescens* - *Picea abies* - *Pinus sylvestris* mixed woodland, small bogs and roadsides with *Epilobium angustifolium*, *Geum rivale*, *Juniperus communis*, *Lychnis flos-cuculi*, *Melampyrum nemorosum*. 1.VII.2005: *Da. fuch* (var. *fuchsii*), *Ne. ovat*.
65. ME4930 Valgamaa. 3 km W Kuigatsi. 80 m. Wet *Betula pubescens* - *Picea abies* - *Pinus sylvestris* mixed woodland and bog with *Eriophorum angustifolium*, *Geranium palustre*, *Geum rivale*, *Juniperus communis*, *Lychnis flos-cuculi*, *Oxycoccus palustris*. 1.VII.2005: *Da. curv*, *Da. fuch* (var. *fuchsii*), *Da. inca* (var. *incarnata* and var. *borealis*), *Da. curv* × *Da. fuch*, *Ep. palu*, *Gy. cono*, *Ne. ovat*, *Pl. bifo*.
66. ME5814 Valgamaa. 3 km E Laatre. 100 m. Moist *Betula pubescens*-*Picea abies* mixed woodland and fen with *Lychnis flos-cuculi*. 1.VII.2005: *Da. balt*, *Da. fuch* (var. *fuchsii*), *Da. balt* × *Da. fuch*.
67. ME7509 Võrumaa. 2 km E Kollino. 125 m. Roadside in a wet *Alnus glutinosa* - *Betula pubescens* woodland. 1.VII.2005: *Da. balt*.
68. ME7629 Tartumaa. 4.4 km SE Pilkuse. 150 m. Moist meadow and wet ditches with *Eriophorum angustifolium*, *Geum rivale*. 1.VII.2005: *Da. inca* (var. *incarnata*), *Pl. chlo*.
69. MF6998 Lääne-Virumaa. 1.5 km SSE Toolse. 10 m. Eutrophic grazed wetland with *Urtica dioica*. 30.VI.2005: *Da. balt*, *Da. inca* (var. *incarnata*), *Da. fuch* (var. *fuchsii*).
70. MF9619 Jõgevamaa. Raja. 30 m. Small rich fen in the village with *Carex distachia*, *C. flava*. 30.VI.2005: *Da. balt*.
71. MG3603 Lääne-Virumaa. 4 km ENE Vihasoo. 30 m. Moist *Picea abies*-*Pinus sylvestris* woodland with *Pteridium aquilinum*. 30.VI.2005: *Da. fuch* (var. *fuchsii*).
72. MG4407 Lääne-Virumaa. 3 km NNE Võsu. 20 m. Edge of moist *Picea abies*-*Pinus sylvestris* woodland with *Pteridium aquilinum*. 30.VI.2005: *Da. fuch* (var. *fuchsii*), *Pl. bifo*.
73. ND0397 Võrumaa. 0.8 km SSE Haanja. 250 m. Moist meadow and stream edges with *Lychnis flos-cuculi*. 1.VII.2005: *Da. balt*, *Pl. chlo*.
74. NE0301 Võrumaa. 5 km NNW Haanja. 150 m. Roadside in a wet *Betula pubescens* woodland. 1.VII.2005: *Da. balt*.
75. NF0938 Ida-Virumaa. 1 km WSW Rannapungerja. 30 m. Edges of mixed woodland (*Betula pendula*, *Pinus sylvestris*) and wet roadside ditches with *Eriophorum angustifolium*, *Geum rivale*, *Lychnis flos-cuculi*. 30.VI.2005: *Da. balt*, *Da. inca* (var. *incarnata*), *Da. fuch* (var. *fuchsii*), *Ne. ovat*, *Pl. bifo*.