

PARNASSIA PALUSTRIS IN THE NETHERLANDS¹

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SUMMARY

Some Dutch populations of *Parnassia palustris* L. were studied cytologically and morphologically. Diploid and tetraploid plants both belong to the subspecies *palustris*. The diploid plants were found in different places along the coast and in one locality in the province of Noord-Brabant. The tetraploids occur in the provinces of Overijssel and Gelderland.

1. INTRODUCTION

Parnassia palustris L. is a variable species characterized by two chromosome numbers, $2n = 18$ (diploid) and $2n = 36$ (tetraploid). ERLANDSSON (1942).

ERLANDSSON (1942) showed that in Sweden both cytotypes occur. According to him the diploids are separable from the tetraploids and within the tetraploid type two distinct forms can be distinguished, one of which had previously received taxonomic recognition: variety *tenuis* Wahlenberg (WAHLENBERG, 1812). The diploid and tetraploid plants (with the exception of variety *tenuis*) have been placed by Erlandsson in *Parnassia palustris* L. f. *typica*.

In Sweden the diploids have a predominantly southerly distribution, whereas the tetraploids occur in the North. Erlandsson suggested that the diploid plants migrated from the South into southern Sweden during the period that the South of Sweden and the Danish Islands were connected with each other and with continental Europe.

Diploid plants occur also in Denmark (ERLANDSSON 1942), Finland (SORSA 1963), France (HAMEL 1953), Japan (MATSUURA & SUTO 1935), North Africa (QUÉZEL 1957), Poland (BANACH-POGAN 1956), Russia (ROZANOVA 1940; SOKOLOVSKAJA 1958; SOKOLOVSKAJA & STRELKOVA 1960).

Tetraploid plants have been reported from Scandinavia (ERLANDSSON, 1942), Iceland and E. Canada (A. LÖVE 1950), Russia (ROZANOVA 1940; SOKOLOVSKAJA 1958) and Scotland (HEDBERG 1958).

A. Löve (1950) studied herbarium material from many parts of the area of the species and expressed as his opinion that the tetraploid has a circumpolar distribution, the diploid having a more southerly Eurasian one. This corresponds with the theory of the distribution of polyploids by HAGERUP (1931). Löve is also of the opinion that the diploids and the tetraploids are separated from each other by strong barriers of sterility. For that reason he considers the differences between the diploids and tetraploids to be on the specific level. He placed the

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diploid plants in *Parnassia palustris* L. The tetraploid plants (not including the variety *tenuis*) have the same characters as those collected on the Isle of Kolgujev (locus classicus) that were described by RUPRECHT (1845) as *Parnassia obtusiflora* Rupr.. The tetraploid variety *tenuis* is regarded by Löve as an arctic-montane race of *Parnassia obtusiflora* and given subspecific rank. In short, in Löve's opinion in Europe two species occur, *Parnassia palustris* L. ($2n = 18$), and *Parnassia obtusiflora* Rupr. with subsp. *obtusiflora* and subsp. *tenuis* (Wahlb.) Löve (both $2n = 36$).

WEBB (1961), after examining many herbarium specimens, arrived at the conclusion that constant differences can be demonstrated between Central European and Arctic plants; on the other hand, Arctic European plants prove to be intermediate between *Parnassia obtusiflora* in its American form and typical *Parnassia palustris*. Webb is of the opinion that there is no sufficient correlation between morphological characters and chromosome number and therefore regards the diploid and the tetraploid plants as conspecific. The tetraploid arctic European plants are assigned by him to *Parnassia palustris* L. subsp. *obtusiflora* (Rupr.) Webb, the diploids to *Parnassia palustris* L. subsp. *palustris*. In *Flora Europaea I* Webb states: "the relation between phenotypic, ecotypic and geographic variation and their relation to chromosome number is not yet clear. Two European subspecies may be recognized but intermediates are found in the Alps and elsewhere."

GADELLA & KLIPHUIS (1963) found some tetraploid plants in the Netherlands. As this population occurs far South of the circumpolar distribution of the other tetraploid plants, it was decided to study some other Dutch populations. KLIPHUIS, GADELLA & DORRAT-HAAKSMA (1965) studied nine different populations, five of which consisted of diploid and four of tetraploid plants. The diploid plants are restricted to the coastal regions, whereas all investigated inland populations proved to consist of tetraploid plants. In view of the taxonomic considerations given above it was decided to study the diploid and tetraploid plants more in detail. The herbarium material of the State University of Leyden was also examined. Furthermore some additional chromosome counts of plants originating from the French Alps and Spain were made.

2. MATERIAL AND METHODS

In each population some plants were fixed directly, others were dug out and grown in pots. Karpechenko's fixative was used. Only the roottips were fixed. The roottips were sectioned at 15 micron and stained according to Heidenhain's haematoxylin method.

Herbarium material of all investigated plants has been deposited in the Utrecht Herbarium.

3. RESULTS

3.1. Cytological data

Table 1 gives a survey of the results of the chromosome counts, together with the collection numbers and the origin of the material.

Table 1. The chromosome numbers of the investigated plants.

Boschplaat, Isle of Terschelling	
coll. no.: G. et K. 1067-1076	2n = 18.
Wytidune, Isle of Terschelling	
coll. no.: G. et K. 5717*	2n = 18.
Dune valley near Hoornse Bos, Isle of Terschelling	
coll. no.: G. et K. 5734*	2n = 18.
Noordsvaarder, Isle of Terschelling	
coll. no.: G. et K. 1056-1066	2n = 18.
coll. no.: G. et K. 5738*	2n = 18.
NE. of Oosterburen, Isle of Schiermonnikoog	
coll. no.: G. et K. 1102-1108	2n = 18.
coll. no.: G. et K. 4731-4739; 4743; 4744-4750*	2n = 18.
coll. no.: G. et K. 4744*	2n = 27.
Near Bergen aan Zee, in the dunes, (prov. of Noord-Holland)	
coll. no.: G. et K. 4857*	2n = 18.
Groene Punt, Isle of Voorne, (prov. of Zuid-Holland)	
coll. no.: G. et K. 1077-1086	2n = 18.
Former airstrip near Oost-Voorne, (Prov. of Zuid-Holland)	
coll. no.: G. et K. 1087-1093	2n = 18.
"Blackstonia valley", Isle of Voorne, (Prov. of Zuid-Holland)	
coll. no.: G. et K. 5773*	2n = 18.
Wilhelmina kanaal, near Moergestel, (Prov. of Noord-Brabant)	
coll. no.: G. et K. 487; 6545-6551*	2n = 18.
France, near Bessans, Haute Savoie, 1700 m.	
coll. no.: G. et K. 5386, 5387, 6562, 6563*	2n = 18.
France, near Bonneval sur Arc, Haute Savoie, 2200 m.	
coll. no.: G. et K. 5322, 5323, 6554*	2n = 18.
Spain, near Covedonga, (Prov. of Oviedo)	
coll. no.: G. et K. 4531-4534	2n = 18.
Amsveen, near Enschede, (Prov. of Overijssel)	
coll. no.: G. et K. 1094-1096	2n = 36.
"Het Buurserzand", E. of Haaksbergen, (Prov. of Overijssel)	
coll. no.: G. et K. 1097-1101	2n = 36.
Near Ootmarsum, (Prov. of Overijssel)	
coll. no.: G. et K. 6555, 6556*	2n = 36.
SE. of "De Grote Otterskooi", W. of Giethoorn, (Prov. of Overijssel)	
coll. no.: G. et K. 1109-1115	2n = 36.
coll. no.: G. et K. 6558, 6559*	2n = 36.
Beltschutsloot, Nature Reserve "de Wieden", (Prov. of Overijssel)	
coll. no.: G. et K. 6560-6563*	2n = 36.
Nature Reserve "Korenburgerveen" (Prov. of Gelderland)	
coll. no.: G. et K. 6557*	2n = 36.
Nature Reserve "Bennekomse Meent", (Prov. of Gelderland)	
coll. no.: G. et K. 6564*	2n = 36.
Near Putten, (Prov. of Gelderland)	
coll. no.: G. et K. 1041-1055; 3991-3998	2n = 36.
coll. no.: G. et K. 4823-4827*	2n = 36.

* counted by Miss M. Mommers.

It appears that the diploid plants occur in different places along the coast and in one locality in the province of Noord-Brabant, near Moergestel. The tetraploid plants occur in various places in the provinces of Gelderland and Overijssel. The map, figure 1, shows the distribution of the diploids and tetraploids.

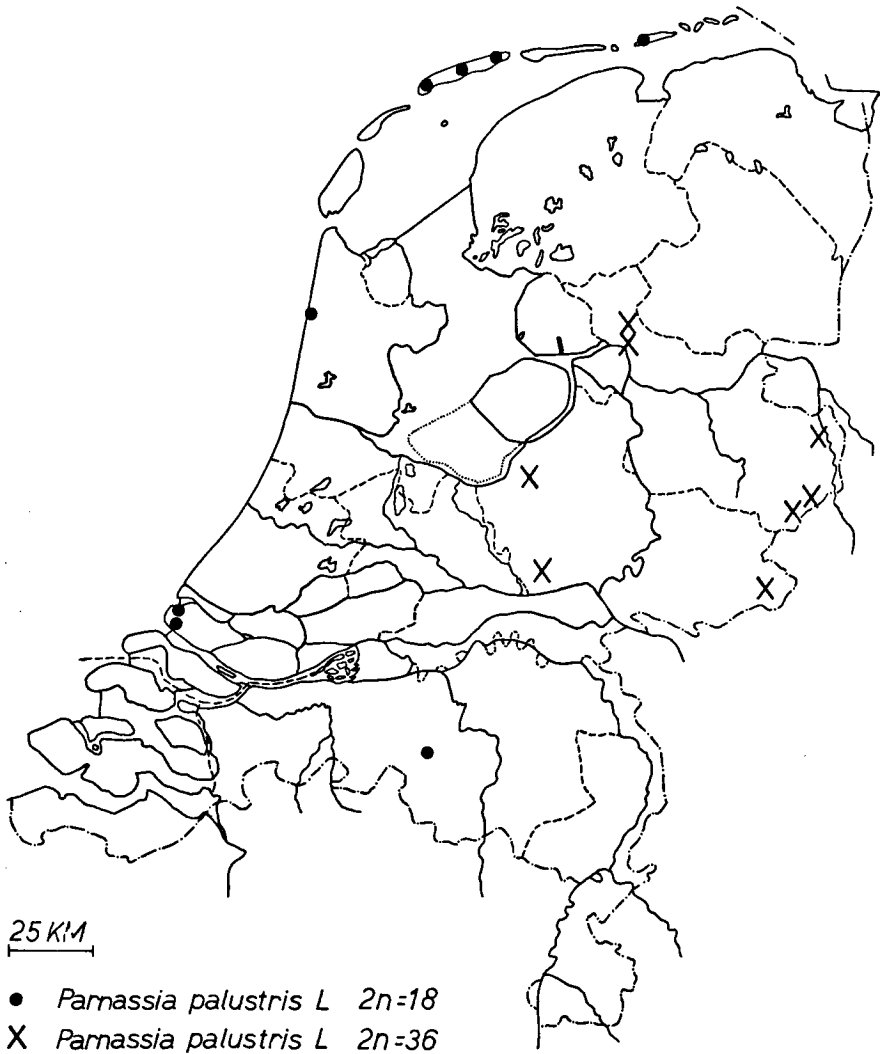


Fig. 1. Map showing the distribution of the investigated diploid and tetraploid plants in the Netherlands.

3.2. Morphological studies

Webb gives the following description of the subspecies *palustris* and *obtusiflora*: subsp. *palustris*: cauline leaf ovate-orbicular, cordate-amplexicaul, not far below the middle of the stem. Sepals considerably shorter than the petals or capsule; throughout the range of the species, except the extreme North. $2n = 18$. subsp. *obtusiflora*: cauline leaf often absent, if present near the base of the stem and usually somewhat deltate, with truncate base, not amplexicaul. Sepals nearly as long as the petals and capsule; Arctic – and Subarctic Europe. $2n = 36$.

The Dutch material of the Leyden herbarium was examined and compared with the cytologically investigated specimens, using the description given above. Not only the cauline, but also the basal leaves were closely examined.

a. basal leaves

Figure 2 gives an impression of the different shape of the basal leaves. In the Dutch populations the basal leaves are always cordate at the base, acute or obtuse at the apex. No correlation between chromosome number and shape of the apex of the leaves could be found. From Iceland some plants, kindly supplied by Mr. P. Oosterveld, were studied morphologically. The chromosome numbers could not be determined, but according to LÖVE (1950), Icelandic plants are tetraploid and belong to *Parnassia obtusiflora*. Both truncate and cordate basal leaves were present in the Icelandic plants.

b. cauline leaves

Figure 2 also shows the shape of some cauline leaves of the studied Dutch, French, Spanish, and Icelandic plants. The Icelandic plants must be regarded as belonging to *Parnassia obtusiflora* (WEBB 1961). All Dutch plants have a cordate base of the cauline leaves (which are generally attached at or somewhat below the middle of the stem). With respect to the base of the cauline leaves the Dutch populations show typical characters of *Parnassia palustris* subsp. *palustris*. This is equally true for diploid and tetraploid plants.

c. length of the sepals

In Dutch plants the sepals are considerably shorter than the petals or the capsule, with the exception of three plants of the Leyden Herbarium: Balke, s.n., (1933), collected at Oost-Voorne; Hoogenraad, 536, (1910), collected at Noordwijk; Ogterup, s.n., (1894), collected at Haamstede. In these plants, however, the other characters, viz. shape and place of attachment of the cauline leaves, agree with the description given for subsp. *palustris*. Moreover all these plants originated from the coastal region where, as far as is known, the populations consist of diploid plants. On the basis of the length of the sepals the Dutch plants should also assigned to *Parnassia palustris* L. subsp. *palustris*.

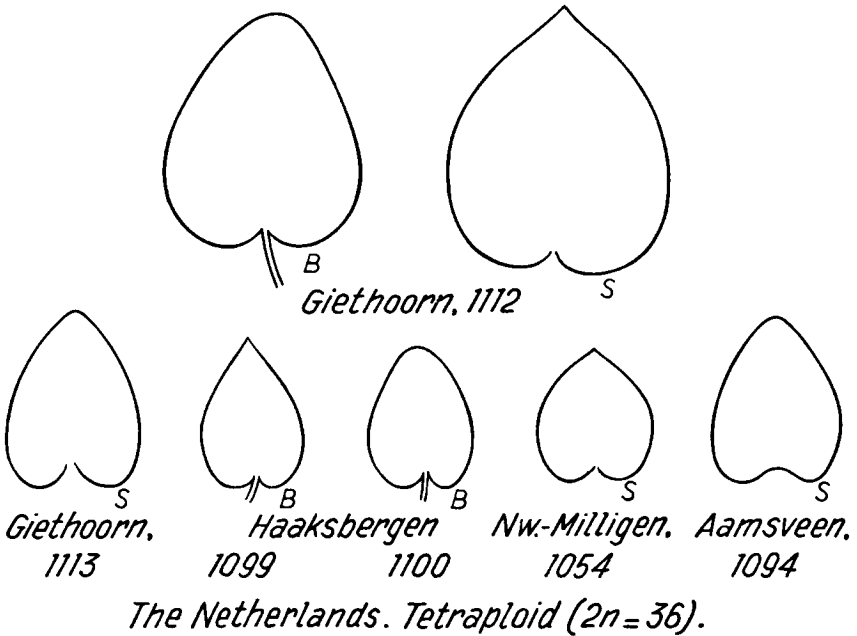
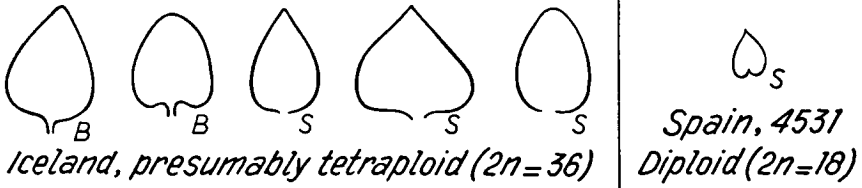
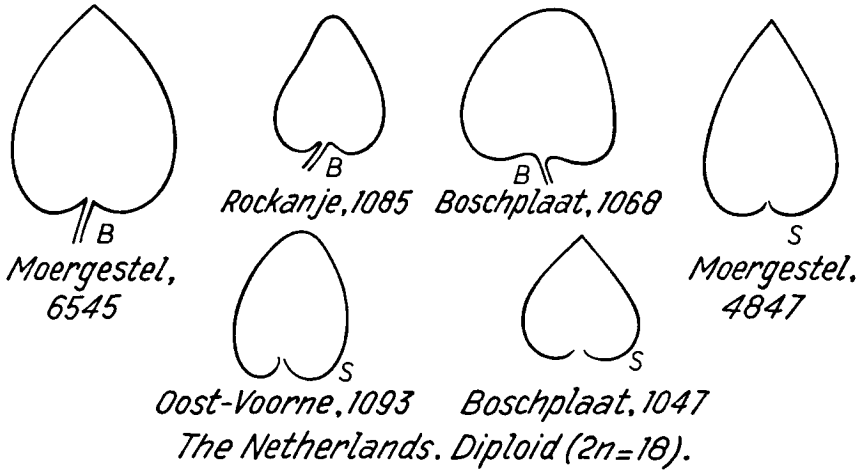


Fig. 2. The shape of the basal (B) and stem (S) leaves of some investigated diploid and tetraploid plants.

4. DISCUSSION

It proved impossible to distinguish between the investigated diploid and tetraploid plants in qualitative respects. Furthermore, the tetraploid Dutch plants differ largely from "typical" *Parnassia palustris* L. subsp. *obtusiflora* (Rupr.) Webb and agree completely with Löve's and Webb's descriptions of *Parnassia palustris* L. and *Parnassia palustris* L. subsp. *palustris*, respectively. Our conclusion is, therefore, that *Parnassia palustris* L. is represented in the Netherlands by diploids and tetraploids which do not show significant morphological differences.

An interesting problem is formed by the geographic distribution of the diploids and tetraploids. In Europe, according to A. Löve (1950), tetraploids have an arctic or subarctic distribution. These tetraploids, however, differ from the Dutch plants. In South Sweden tetraploids occur in those regions which were not submerged during the transgression of the sea after the last period of glaciation when the Baltic Ice-lake was formed. In Erlandsson's opinion (1942), the diploid plants migrated into South Sweden from the South, before the Ancylus-lake had come into existence. In that period South Sweden was connected with Denmark and the continent of Europe.

It is remarkable that in the Netherlands tetraploid plants have only been found in regions which were subjected to glaciation. The only diploid inland population (near Moergestel) occurs in the province of Noord-Brabant which was unglaciated during the Riss glaciation period. It is very difficult to give a satisfactory explanation of the distribution of the two cytotypes in the Netherlands. Cytological data of some other inland populations in the southern provinces of the Netherlands are needed.

SPECIMENS EXAMINED

- Prov. of Groningen: Winschoten, Schipper, s.n., (1886).
 Prov. of Friesland: Isle of Terschelling, Boedijn, s.n. (1918); idem, Mart. Duiven, 2039, (1948); idem, Vink, 613, (1954); idem, Koegelwieck, Lucas, 128, (1949); Isle of Vlieland, de Vries, s.n., (1937).
 Prov. of Drente: Gasteren, van Borssum Waalkes, 5321; Lieveren, Gaasenbeek, s.n.
 Prov. of Overijssel: Borne, Posthumus, s.n., (1895); Denekamp, van Hattem, s.n., (1947); Lemelerveld, Bakker & van Ooststroom, 17922, (1954); Lemseler Maten, Hoogland, s.n., (1947); Marienberg, van Soest, 16516, (1932); Raalte, Lako, s.n., (1894); Wanneperveen, Van Borssum Waalkes, 5276, (1948).
 Prov. of Gelderland: Apeldoorn, Kok Ankersmit, s.n., (1875); Brummen, Icke, s.n., (1902); Ede, Jansen & Wachter, s.n., (1902); Elspeet, van Ooststroom, 466, (1926); Empese Heide, Meyer Drees, s.n., (1927); Hoewelaken, des Tombe, s.n., (1907); Lochem, Henrard, s.n., (1908); Korenburgerveen, Kern & Reichgelt, s.n., (1925); van Embden, s.n., (1872).
 Prov. of Utrecht: Musschendorp near Amersfoort, van Raalte & van Ooststroom, 467, (1927).
 Prov. of Noord-Holland: Bergen aan Zee, Koster, 3799, (1920); Egmond, Kloos, s.n., (1933); Kennemer Duinen, van Ooststroom, 17431, (1953); Isle of Texel, van Iersel, s.n., (1939); idem, Kloos, s.n., (1913); idem Meeuse, s.n., (1937).
 Prov. of Zuid-Holland: de Beer, van Hattum, s.n., (1948); idem, Jacobs, s.n., (1950); Noordwijk, Hoogenraad, 536, (1910); Oost-Voorne, Balke, s.n., (1933); idem, Hoogenraad, 1482, (1902); idem, Jansen & Wachter, s.n., (1919); idem, des Tombe, s.n., (1900); Ouddorp,

- Weevers, s.n., (1919); Rockanje, Hoogenraad, 1481, (1910); idem, Hoogland, 2127, (1949); Wassenaar, Jongmans, s.n., (1900).
 Prov. of Zeeland: Haamstede, Ogterop, s.n., (1894); Walcheren, Oranjezon, de Bruyn, 139-140;
 Prov. of Noord-Brabant: Eersel, Bakhuizen van den Brink, s.n., (1899); Schijndel, Jansen, s.n., (1932).
 Prov. of Limburg: Oud Valkenburg, Rieter, s.n., (1905).

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