SYSTEMATICS AND REPRODUCTIVE BIOLOGY

OF <u>DODECATHEON</u> <u>PULCHELLUM</u> s.l.

(PRIMULACEAE)

by

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We accept this thesis as conforming
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ABSTRACT

Taxonomic relationships were investigated in *Dodecatheon pulchellum* s.l., a group of spring-blooming perennials centered in the Pacific Northwest of North America. A number of taxa have been recognized in the *D. pulchellum* group but their relationships and appropriate taxonomic treatments were unresolved.

The group shows considerable morphological variation and includes three ploidy levels with chromosome numbers $2n$ = 44, $2n$ = 88, and $2n$ = 132. In this study 48 chromosome counts are reported; ploidy levels have been estimated from pollen grain diameters for a further 313 specimens. A series of multivariate procedures, including principal components analysis and discriminant analysis, have been applied to morphological data obtained from specimens collected in British Columbia and adjacent areas. Environmental and genetic components of morphological and ecological characters for six populations were investigated in a common garden. Most morphological characters, including many used in taxonomic keys, showed phenotypic plasticity and there were strong genetic differences in ecological tolerance among the populations. On the basis of the morphological, cytological and ecological evidence this study has demonstrated patterns of variation corresponding

to three taxa: Dodecatheon pulchellum (Raf.) Merrill var. pulchellum, Dodecatheon pulchellum var. watsonii (Tidestrom) C.L. Hitchcock, and Dodecatheon cusickii Greene. Dodecatheon pulchellum s.l. contains diploids, tetraploids and hexaploids. This species is glabrous to slightly pubescent. Dodecatheon pulchellum var. pulchellum is morphologically variable and is found in open, rocky areas that experience summer drought or in estuarine mudflats that are wet all year round. Dodecatheon pulchellum var. watsonii is found in subalpine habitats and is characterized by a short, delicate scape, small leaves and few flowers. Dodecatheon cusickii is a diploid species, consistently glandular-pubescent, and is found in dry habitats of southern British Columbia, Washington and Oregon between the Cascade and Coast mountain ranges.

Phenology and reproductive ecology of three D. pulchellum populations (two of var. pulchellum and one of var. watsonii) on Vancouver Island were also studied. Development from visible buds to ripe capsules takes 15-17 weeks (March to July) for the low-elevation D. pulchellum var. pulchellum populations and 9-10 weeks (July to September) for the D. pulchellum var. watsonii population. Individual plants of Dodecatheon pulchellum have a short blooming period (1-3 weeks at low elevations) but because of low synchrony in blooming period among plants the total blooming season extends to 5-7 weeks. The plants of D. pulchellum var. watsonii set considerably fewer seeds per capsule per plant

than either of the other populations. Fruit set consistently exceeded 70% in the low-elevation populations but was more variable in the high-elevation population (88% and 27% in the two years examined). Reproductive losses in the low-elevation populations were from predation and in the high-elevation population from abortion of flowers. In one *D. pulchellum* var. *pulchellum* population, aspects of the breeding system were studied in detail. Plants were found to be self-fertile but only if pollen was actively transferred to the stigma. Self-fertilized plants set significantly lower mean number of seeds per capsule per plant than outcrossed plants, indicating that barriers to selfing exist and that *D. pulchellum* var. *pulchellum* is predominantly outcrossed. Plants receiving additional pollen had similar seed set to naturally pollinated plants, indicating that seed set was not pollen limited.

Best total seed germination for *D. pulchellum* and *D. cusickii* was achieved with seven or eight weeks of cold, moist stratification. The proportion of seeds that germinated varied considerably between populations. Germination of seeds of *D. cusickii* was more rapid in response to stratification than those of *D. pulchellum*. *Dodecatheon pulchellum* var. *watsonii* seeds required considerably longer periods of stratification for germination than *D. pulchellum* var. *pulchellum* seeds.

The reproductive differences between *D. cusickii*, *D. pulchellum* var. *pulchellum* and *D. pulchellum* var. *watsonii* supports recognition of these taxa.

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CHAPTER 1. SYSTEMATICS OF DODECATHEON PULCHELLUM s.l.

INTRODUCTION

The *Dodecatheon pulchellum* group reaches its greatest complexity in western North America. Although there are at most three species involved, there has been much taxonomic confusion, especially within *D. pulchellum*.

Dodecatheon L. (Primulaceae) is a genus of 16 species (Thompson 1953, Fassett 1944, Olah and DeFillips 1968) of spring-blooming perennial herbs distributed across North America, with one species extending into easternmost Siberia. The plants are of simple morphology. A short rootstock gives rise to a basal rosette of leaves and a slender flower stalk that bears an umbel of one to twenty-five flowers. The flowers are nodding at anthesis and petal color ranges from magenta-purple through pink to white. The striking features of the flowers are the strongly reflexed corolla lobes, the protruding stamens with fused filaments and the scalloped markings on the throat of the corolla tube.

Thompson (1953) recognized three sections in the genus *Dodecatheon*: *Capitatum*, *Purpureo-tubulosa* and *Dodecatheon*. He considered each section to represent an evolutionary line within the genus, as indicated by the morphological, ecological and distributional differences among them.

Species of section Capitatum inhabit wet, often boggy sites from Alaska south through the Cascade Mountains to the Sierra Nevada, east to the mountains of Montana, Idaho and in the Great Basin region. This section is characterized by capsules opening by means of longitudinal terminal slits, thus leaving sharp-tipped teeth (=valves), enlarged stigmas, rugose (roughened) connectives, dark filaments that are free or slightly united, angular seeds with a thin membrane along the edges, and first true leaves that form from the base of the cotyledons.

Section Purpureo-tubulosa is centered along the Pacific slope of the Cascade-Sierra Mountains of western North America, where the plants are found on moist hillsides and plains. Two species are found in more continental areas, one in Arctic regions and the other in the plains and mountains of northwestern United States and Canada. This section is characterized by capsules opening by means of a small terminal cap (=operculum), the subsequent longitudinal slits creating valves with blunt teeth, stigma not enlarged, smooth or rugose connectives, yellow or dark filaments which are free or united into a tube, seeds without a membrane along the edges, and first true leaves forming from the hypocotyl below ground.

Dodecatheon section Dodecatheon is widely distributed in North America, with disjunct occurrences in both east and west. Its eastern range is the eastern United States, extending west to Wisconsin and Illinois; its western range covers a large area, from southern Alaska to northern California and along the western Cordillera as far south as Mexico. This section is characterized by capsules opening by sharp-tipped valves, stigma not enlarged, smooth connectives, yellow filaments free or joined into a long tube, seeds without a membrane along the edges, and first true leaves forming from the hypocotyl just above the ground.

Within section Dodecatheon Thompson (1953) recognized five species: D. dentatum Hook., D. meadia L., D. poeticum Henderson, D. cusickii Greene and D. pulchellum (Raf.) Merrill [D. radicatum Greene]. Dodecatheon dentatum is distinct in having consistently white corolla lobes and thin leaves with dentate margins and subcordate bases. The remaining species appear to be closely related and are among the most taxonomically difficult species in the genus.

Related species in eastern North America include D. meadia, considered by Thompson (1953) to be a regional offshoot of D. pulchellum. Morphological (Voight and Swayne 1955) and cytotaxonomic (Olah and DeFillips 1968) studies of eastern Dodecatheon have also established the existence of D. frenchii (Vasey) Rydberg, a species related to D. meadia and possibly of polyhaploid origin. Fassett (1931, 1944) recognized another species, D. amethystinum, though Thompson (1953) reduced this to synonomy with D. pulchellum.

Dodecatheon pulchellum is a morphologically variable species and occurs in a diverse array of habitats from sea level to alpine. Various morphological races have been given formal taxonomic status, and since the early 1800's, between 30 and 35 specific and subspecific epithets have been published. Most of these have been reduced to synonomy, but seven are currently used in literature applicable to the Pacific Northwest (Table 1).

The reported variation in chromosome number indicates that *D. pulchellum* forms a polyploid complex. Chromosome numbers of n = 22, 44 and 66 have been reported (Thompson 1953, Beamish 1955, Taylor and Mulligan 1968, Reveal and Styer 1974). There appears to be some degree of relationship between chromosome number, geographical distribution and morphology (Beamish 1955) but this has not been well investigated.

The taxonomic treatment of the genus *Dodecatheon* by Thompson (1953) is the most widely accepted treatment of this group and is used as the point of departure for this study. Thompson characterized *D. pulchellum* as glabrous to very slightly glandular-pubescent with entire, upright, oblanceolate leaves, the blade gradually tapering to the petiole. The flowers have yellow filaments joined into a long tube. The connective tissue of the anthers is dark maroon to black and smooth, though often longitudinally wrinkled upon drying.

Table 1. Partial comparison of nomenclatural usage in the *Dodecatheon pulchellum* group in literature currently applicable to the Pacific Northwest. Different authors deal with different geographical areas and not all taxa are treated by all authors. Circumscription of taxa varies with author even when the same name is used.

Thompson (1953) (North America)	Beamish (1955) (western N.A.)	Hitchcock *et al.*(1959) (Pacific Northwest)
D. radicatum Greene	*D. radicatum* Greene	*D. pauciflorum* (Durand)Greene
ssp. *radicatum*	ssp. *radicatum*	var. *pauciflorum*
	ssp. *macrocarpum* (Gray)Beamish	var. *alaskanum* (Hult.)C.L Hitchc.
ssp. *watsonii* (Tidestrom) H.J. Thompson	ssp. *watsonii* (Tidestrom) H.J. Thompson	var. *watsonii* (Tidestrom) C.L. Hitchcock
ssp. *monanthum* (Greene) H.J. Thompson		var. *monanthum* Greene
D. cusickii Greene	*D. cusickii* Greene	var. *cusickii* (Greene) Mason ex St. John

Hulten (1968) (Alaska)	Calder & Taylor (1968) (Queen Charlotte Is.)	Hitchcock & Cronquist (1973) (Pacific Northwest)
D. pulchellum (Raf.)Merrill	*D. pulchellum* (Raf.)Merrill	*D. pulchellum* (Raf.)Merrill
ssp. *pulchellum*	ssp. *pulchellum*	var. *pulchellum*
ssp. *alaskanum* (Hult.)Hulten	ssp. *pulchellum*	var. *pulchellum*
ssp. *pauciflorum* (Greene)Hulten	ssp. *pulchellum*	var. *pulchellum*
ssp. *superbum* (Pennell & Stair) Hulten	ssp. *pulchellum*	var. *pulchellum*
	ssp. pulchellum	var. *watsonii* (Tidestrom) C.L. Hitchcock
		var. *monanthum* Greene
	ssp. *cusickii* (Greene) Calder & Taylor	*D. cusickii* Greene

Welsh (1974) (Alaska)	Taylor & MacBryde (British Columbia)	Porsild & Cody (1980) (N.W. Territories)
D. pulchellum (Raf.)Merrill	*D. pulchellum* (Raf.)Merrill	*D. pulchellum* (Raf.)Merrill
var. *pulchellum*	ssp. *pulchellum*	ssp. *pulchellum*
var. *alaskanum* (Hult.)B. Boi.	ssp. *macrocarpum* (A. Gray) Taylor & MacBryde	[ssp. *pauciflorum* (Durand)Hulten ?]
var. *pulchellum*		ssp. *pauciflorum* (Durand)Hulten
var. *alaskanum* (Hult.)B.Boi.		[ssp. *pauciflorum* (Durand)Hulten ?]
	ssp. *cusickii* (Greene) Calder & Taylor	

Dodecatheon cusickii Greene is a consistently glandular pubescent plant found in dry areas east of the Coast and Cascade mountains in British Columbia to Oregon. It is considered a distinct species by some authors, and others place it within D. pulchellum. Dodecatheon pulchellum ssp. monanthum, found in semi-desert regions from Oregon to Utah, has a dark filament tube but otherwise resembles typical D. pulchellum (Thompson 1953).

Dodecatheon pulchellum ssp. watsonii is a dwarf, few-flowered form found at high elevations (Thompson 1953). Calder and Taylor (1968) included ssp. watsonii in ssp. pulchellum, stating that few-flowered, depauperate plants growing on a treeless maritime island could not be distinguished from similar plants found in subalpine habitats.

On the basis of six chromosome counts from widely separated areas, Beamish (1955) recognized distinct diploid and polyploid forms of D. pulchellum. Dodecatheon pulchellum ssp. macrocarpum is characterized as polyploid, strictly coastal and with anthers 5.5-7.0 mm long, more than twice as long as the filaments. Low elevation interior plants, assignable to D. pulchellum ssp. pulchellum, are diploid and have anthers 3.5-5.0 mm long, about twice as long as the filaments.

Hitchcock et al. (1959) recognized all large-leaved, polyploid coastal plants as D. pulchellum var. alaskanum, though Hitchcock and Cronquist (1973) reduced var. *alaskanum* to synonomy with *D. pulchellum* var. *pulchellum*.

The three subspecies of *D. pulchellum* recognized by Hulten (1968) are based on scape and leaf lengths. *Dodecatheon pulchellum* ssp. *superbum* has oblong-lanceolate leaves, with very long petioles; the flowers are large with the filament tube comparatively short. *Dodecatheon pulchellum* ssp. *alaskanum* has ovate leaves, about half as long as the scape and *D. pulchellum* ssp. *pauciflorum* has small, elliptic leaves and scapes several times longer than the leaves. Welsh (1974) recognized all coastal plants as *D. pulchellum* ssp. *alaskanum* and interior plants with shorter anthers as *D. pulchellum* ssp. *pulchellum*. Porsild and Cody (1980) placed all plants of the region into *D. pulchellum* ssp. *pauciflorum* which has elliptic leaves, the blades gradually tapering to the petioles.

Dodecatheon poeticum is a well differentiated species restricted to the Cascade Mountains along the Columbia River of Washington and Oregon and extending north along the east slope for about ninety miles. In an attempt to account for its restricted range and specific morphology (dark filament tube and densely glandular-pubescent leaves) Thompson (1953) suggested that *D. poeticum* could be a hybrid between *D. cusickii* and *D. hendersonii* ssp. *hendersonii* (section *Purpureo-tubulosa*).

Another source of confusion is *Dodecatheon conjugens* Greene var. *viscidum* (Piper) H.J. Thompson (section *Purpureo-tubulosa*), a species sympatric with *D. cusickii*. Though quite morphologically distinct these two species are often mistaken for one another.

The aims of this study were: 1) to examine the morphological and chromosomal variation in Pacific Northwest populations of the *Dodecatheon pulchellum* group, 2) to determine how morphology and chromosome number are related in these populations, and 3) assess the validity of taxa of the *Dodecatheon pulchellum* group.

MATERIALS AND METHODS

Morphology

Many of the data for this study were collected from herbarium specimens. Approximately 1400 specimens were examined from LEA, DAO, PMAE, ALTA, ALA, UBC, CAN, WS, WTU, UAC, IDS, ID and UVIC (herbarium abbreviations are according to Stafleu (1981)). Plant material was also collected from southern British Columbia, Washington, northern Oregon and western Idaho in April and May of 1983, 1984 and 1985.

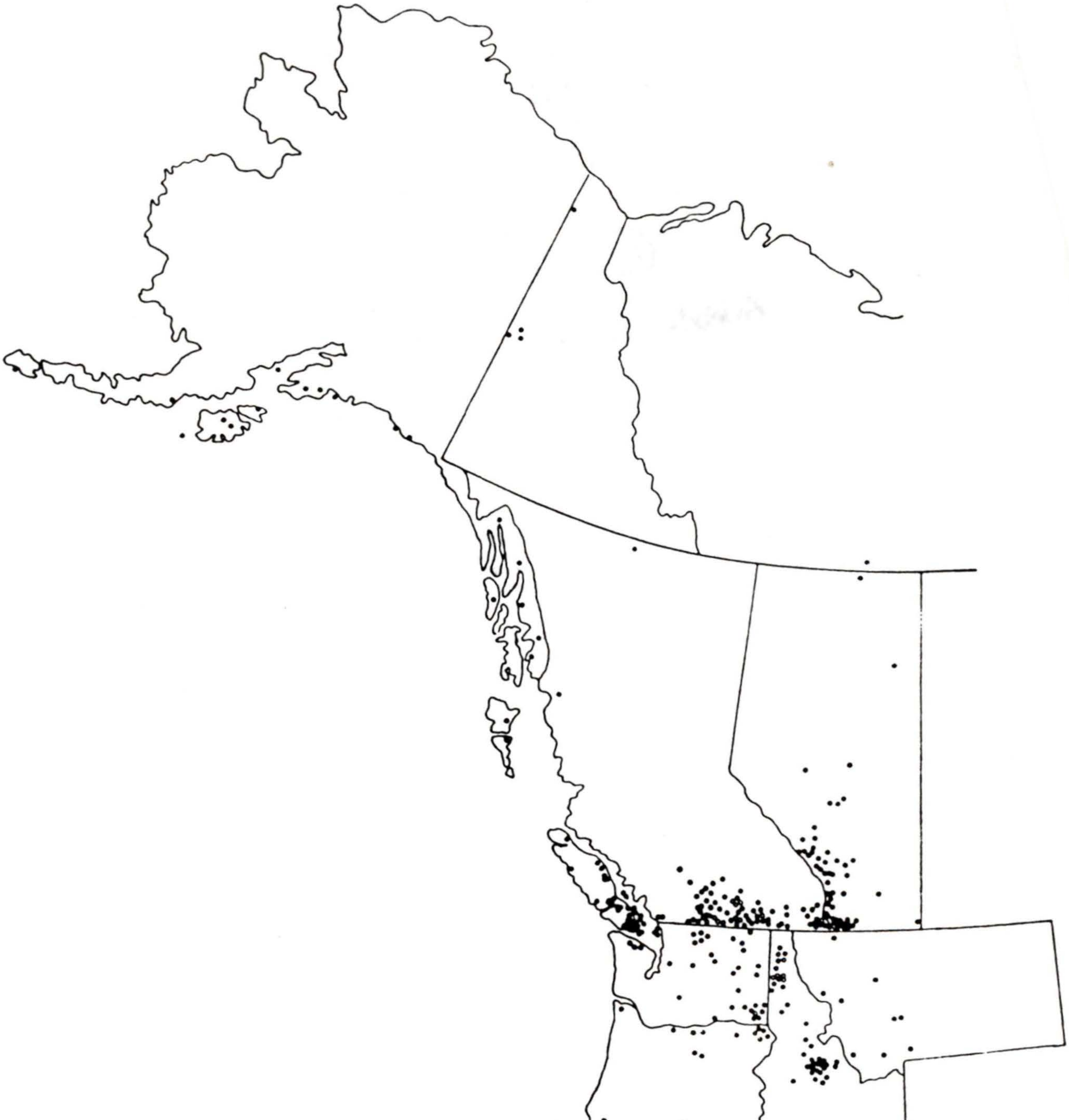
A sample of 383 specimens was selected for morphometric analysis. These represented the range of morphological and geographical variation found in *Dodecatheon pulchellum* sensu lato and *D. cusickii* distributed from Alaska to southern Oregon and east to Montana.

Collection locations for these specimens are shown in Figure 1. Specimens of *D. poeticum* and *D. conjugens* var. *viscidum* were also included, *D. poeticum* because of its possible relationship to *D. cusickii* and *D. conjugens* var. *viscidum* because it is sympatric with *D. cusickii* and often confused with it. A total of 36 specimens of *D. conjugens* var. *viscidum* were used: 23 from Waterton Lakes National Park and adjacent areas of southern Alberta, two from south central Alberta, three from southeastern British Columbia, and one each from Cypress Hills, Saskatchewan, Gallatin Co.,

Figure 1. Collection locations for *Dodecatheon pulchellum* and *D. cusickii* specimens from northwestern North America used in morphometric analysis.

● *D. pulchellum* s.l.

o *D. cusickii*



Montana, Custer Co., Idaho, Clearwater Co., Idaho, and Umatilla Co., Oregon. Seven specimens of D. poeticum were used: three from Klickitat Co. Washington, one from Yakima Co., Washington, two from Hood River Co., Oregon and one from Waco Co., Oregon.

Each specimen used for morphological study was coded for a total of 22 characters, 7 vegetative and 15 floral (Table 2; Appendix 1). Details of flower morphology are shown in Figure 2. A series of multivariate analyses, primarily principal components analysis and discriminant analysis (Sneath and Sokal 1973, Neff and Marcus 1980, Reyment et al. 1984) were utilized to explore relationships within the data. All analyses were done on standardized data.

Initially, existing specimen names were used to assign individuals to groups and discriminant analysis of these groups was carried out to locate grossly misidentified individuals (outliers). There were four initial groups: D. pulchellum s.l., D. cusickii, D. poeticum and D. conjugens var. viscidum.

Various combinations of groups were subsequently analyzed as follows: 1) ordination by principal components analysis (without rotation) to arrange individuals along axes of maximum variation, 2) discriminant analysis and canonical discriminant analysis to investigate differences among groups and 3) stepwise discriminant analysis to

Table 2. Morphological characters used for multivariate analysis of Dodecatheon pulchellum group.

1	SCAPEL	scape length from base to umbel (mm)
2	NOFL	number of flowers (including large buds)
3	LEAFHRS	number of hairs/mm, measured over 5 mm along center of leaf margin
4	INVOLHRS	number of hairs/mm, measured over 1-5 mm along edge of involucre bract
5	BLADEL	length of leaf blade (mm)
6	PETIOLEL	length of leaf petiole (mm)
7	LEAFL	total leaf length (mm)
8	LEAFL/W	length÷width ratio of leaf
9*	FILRIBL	length of filament rib visible from corolla to top of anther (mm)
10*	FILRIBL/W	length÷width ratio of filament rib (9÷a)
11*	FILGRVL	shortest length of visible filament groove (mm)
12*	FILTUBERT	filribl÷filgrvl
13*	ANTHERL	length of anther (=length of connective) (mm)
14	ANTFIL	antherl÷filribl
15*	CONNECL/W	length÷width ratio of connective (13÷b)
16	CONNSURF	surface texture of connective:1=crosswise rugose 2=smooth or longitudinally wrinkled
17*	CONNPOS	position of connective colour in relation to a refernce line across the top of anther: 1=above 2=at the line 3=below
18	CABC	colour of filament rib above connective
19	CBCFR	colour of filament rib below corolla
20	CBCFG	colour of filament groove below corolla
21	CMRFR	colour of midregion of filament rib
22	CMRFG	colour of midregion of filament groove

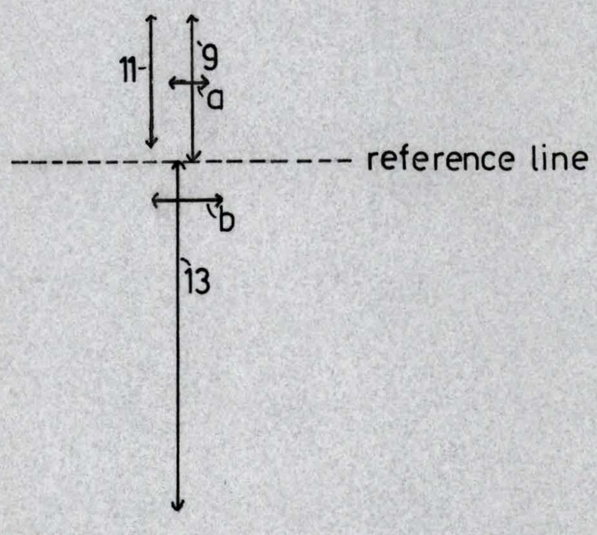
(all colours scored:1=yellow 2=some red present 3=some yellow present 4=red/purple)

* see corresponding notation in Figure 2.

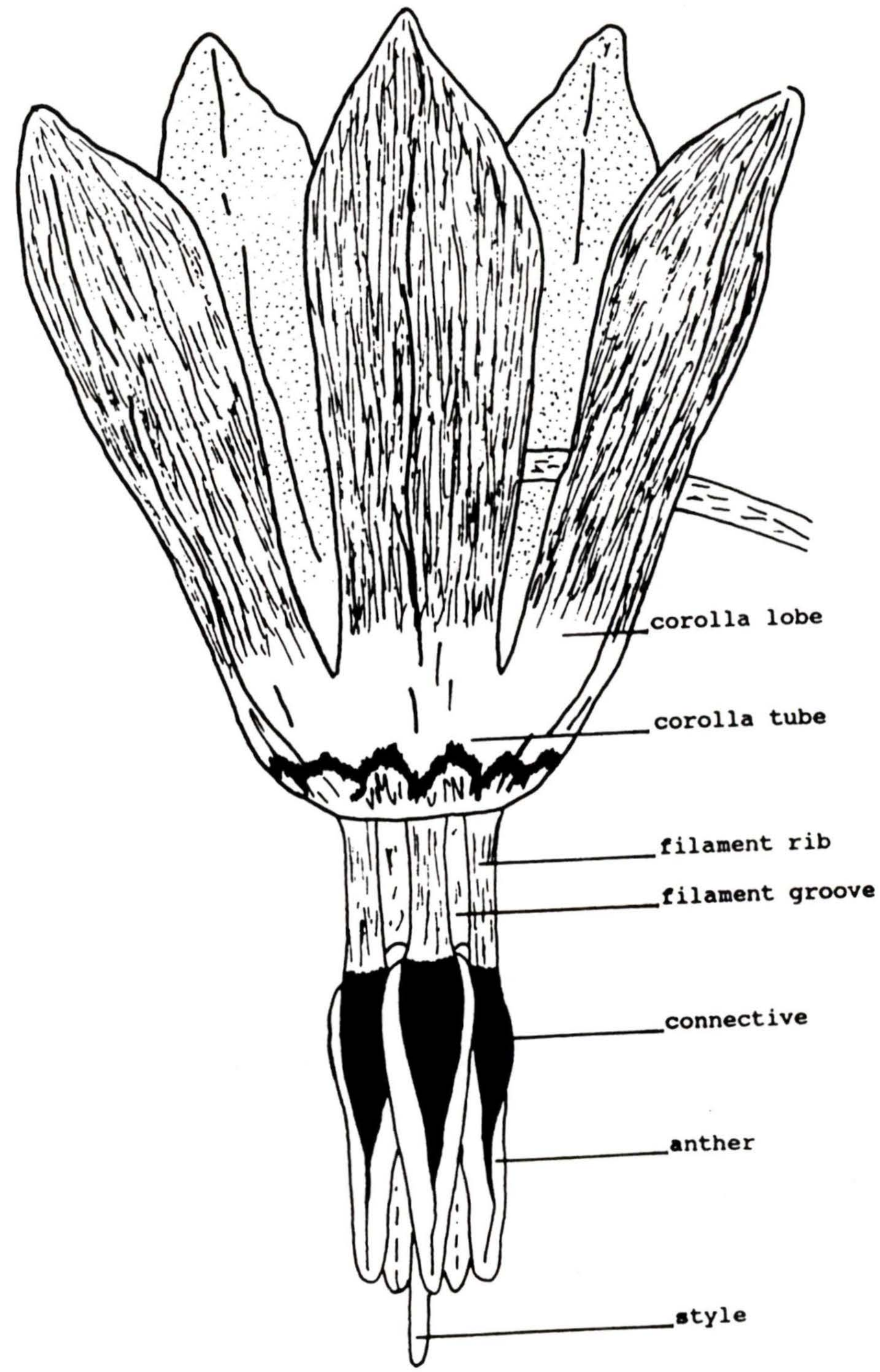
Figure 2. Details of Dodecatheon flower morphology.

Details on transparency are used in conjunction with Table 2:

- 9, 10 and 13 are character measurements
- a and b measurements used in characters 10 and 15
- reference line is used for characters 9, 13 and 17.



11
9
a
reference line
b
13


corolla lobe
corolla tube
filament rib
filament groove
connective
anther
style

identify subsets of characters that provided the best separation between given pairs of groups.

To avoid scoring a character twice, all mathematically correlated characters should be scored as one (Davis and Heywood 1963). For each analysis in this study, if any two characters were highly correlated ($r > 0.7$) one of them was dropped from the analysis. Thus different sets of characters were used in different analyses.

All analyses were done using programs in the Statistical Analysis System (SAS) (SAS Institute Inc. 1985). The programs included: CORR, PRINCOMP, CANDISC, DISCRIM, and STEPDISC.

Probabilistic interpretations possible with multivariate analyses require that specific assumptions be met (Pimentel 1979, Neff and Marcus 1980). All statistical tests assume random sampling, multivariate normality and homogeneity of variance-covariance matrices, but given the nature of the data, these conditions cannot be assumed. Therefore the hypothesis-testing statistics generated were not considered.

These methods were used here for exploratory purposes, essentially "pattern analysis", and violation of the assumptions may not be critical. Principal components analysis, for instance, when used to display interrelationships between individuals or variables, requires no assumptions (Neff and Marcus 1980).

Chromosome number and pollen diameter

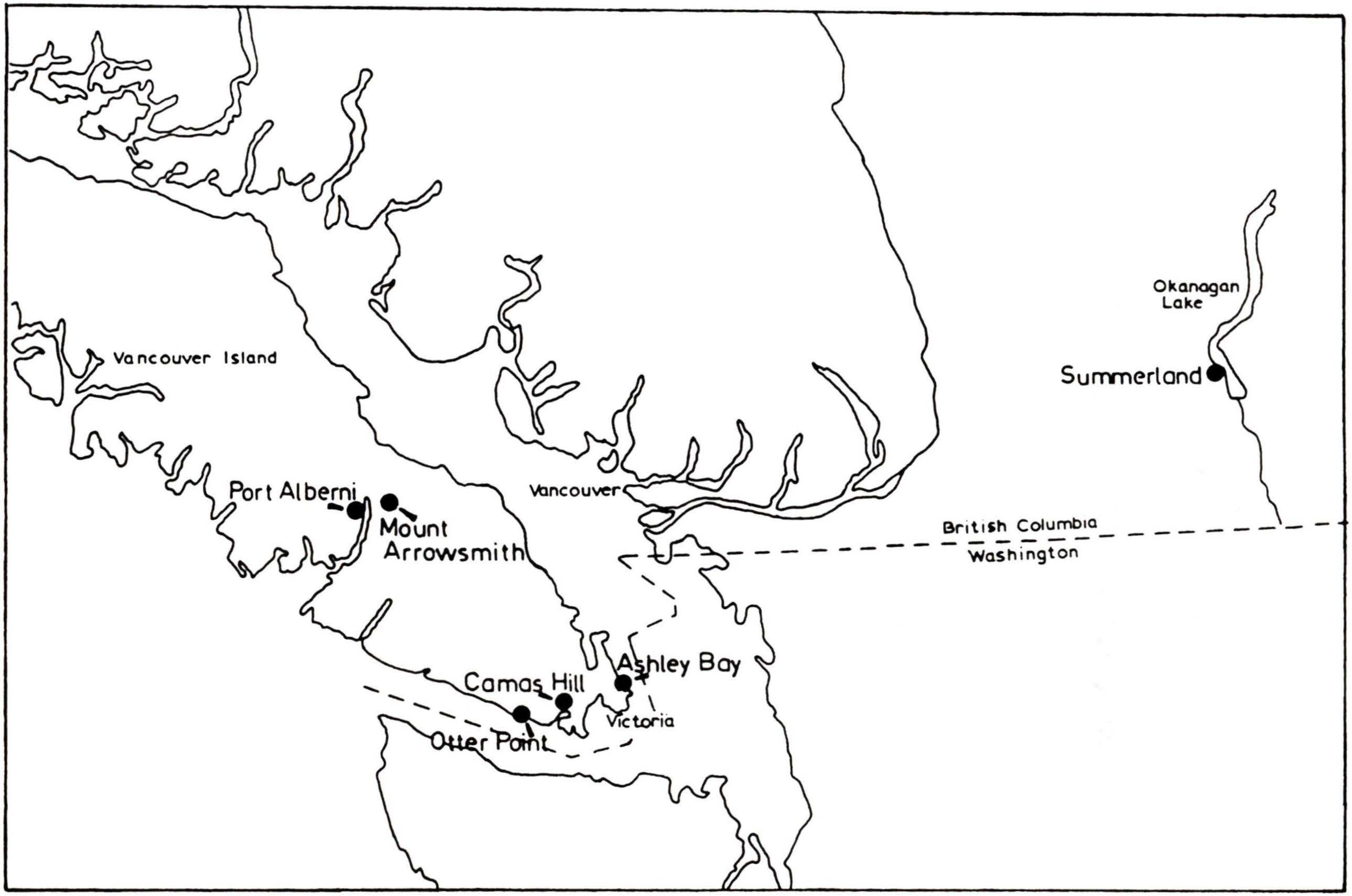
Chromosome numbers were determined using mitotic material. Root tips from potted plants or recently germinated seedlings were collected in cold distilled water, pretreated with α-bromonaphthalene saturated water for 3 to 4 hours at 4°C, and then fixed in ethanol:acetic acid (3:1). They were then hydrolysed for 10 minutes in 1 N HCl at 60°C, stained in leuco-basic fuschin for 1 to 3 hours and squashed in 45% acetic acid.

Dried pollen samples were collected from each plant for which a chromosome count had been determined and from most of the *D. pulchellum* sensu stricto, *D. pulchellum* ssp. *watsonii* and *D. cusickii* specimens used in the morphometric analysis. Pollen was tapped into a drop of lacto-phenol in aniline blue and allowed to hydrate for 10-15 minutes. Viable grains stained dark blue. For increased accuracy an image of the pollen grains was transmitted to a video monitor and all measurements were made directly on the monitor screen. The maximum diameter of 20 viable grains was measured to the nearest 0.7μm.

Common garden experiment

A common garden was established on the University of Victoria campus in early spring of 1984. Fifteen plants from each of six populations were transplanted to the garden between February and April 1984. Plants were set out randomly on 20 cm centers in rows 20 cm apart. Locations for the populations from which these plants were taken are shown in Figure 3. The Summerland locality (elevation 360 m, aspect east, slope 5%) is a dry grassland with scattered Ponderosa pine; it is heavily infested with knapweed (*Centaurea* sp.). The Mount Arrowsmith site (elevation 1500 m, aspect north, slope 0) is a flat rock outcrop with thin soil in a steep hillside. The Port Alberni site (elevation sea level, aspect east, slope 0) is an estuarine mudflat that, unlike the other sites, remains wet year round. The Otter Point site (elevation 8 m, aspect south, slope 0-2%) is a maritime rock headland fully exposed to wind and salt spray from the Strait of Juan de Fuca. The Ashley Bay site (elevation 10 m, aspect east-southeast, slope 0-5%) is a maritime grass field affected by wind or salt spray only during severe storms from the southeast. The Camas Hill site (elevation 150 m, aspect south, slope 5-20%) is a very rocky grass field surrounded by *Arbutus menziesii* and *Pseudotsuga menziesii*.

Figure 3. Locations of <u>Dodecatheon</u> populations in British Columbia from which plants were transplanted to a common garden.


Vancouver Island
Port Alberni
Mount Arrowsmith
Vancouver
Okanagan Lake
Summerland
British Columbia
Washington
Ashley Bay
Camas Hill
Victoria
Otter Point

Two sets of analyses were done. The first was an examination of morphological differences between plants that bloomed in the garden in 1986 and _in situ_ plants collected from the initial locations in 1985. This addressed the question: did the garden plants become more alike than their _in situ_ counterparts? Convergence on a common morphology would indicate that plants from different ecological situations had similar genotypes, and that differences in _in situ_ morphology are due to phenotypic responses to various environmental conditions.

The second analysis examined differences in morphology among plants that bloomed in the common garden in 1985 and in 1986. The first comparison, involving common-garden and _in situ_ plants, is complicated by the use of many individual plants and an unknown diversity of genotypes. In the second experiment the same individuals were followed over two years, allowing a closer examination of the environmental influences on specific genotypes. The question addressed is: if there is a phenotypic response, is it in the direction of a common morphology?

The morphological data used are described in Table 2 except that anther-filament ratio and connective surface were not used. The data were analyzed as follows: 1) discriminant analysis and canonical discriminant analysis to investigate differences among groups and 2) stepwise discriminant analysis to select subsets of characters that provided the best separation between given pairs of groups.

RESULTS

Morphology

Principal components analysis (PCA) of morphological data from 426 specimens of Dodecatheon showed a clear separation between specimens assigned to D. conjugens var. viscidum and all the remaining specimens (Figure 4). Separation of D. poeticum was not as clear. The first principal component accounted for 23.1% of the variance, the second principal component for 16.2% and the third principal component for 12.0%. Not all the variation in morphology was accounted for, and the groups actually could be better separated than Figure 4 suggests.

The characters most important in arranging the specimens along each axis can be determined by examining the factor loadings (Table 3). In this PCA, filament tube color had a high loading on the first axis, with dark-colored D. poeticum and D. pulchellum var. monanthum separated from the remaining yellow-colored specimens. The two morphs were connected by a number of intermediate-colored specimens. Dodecatheon conjugens var. viscidum was separated from D. pulchellum s.l. and D. cusickii along the second and third axes. Arrangement of specimens along the second axis was based on leaf hairs, filament rib size and shape and connective surface and separation along the third axis was

Figure 4. Plot of first three principal components for specimens of *Dodecatheon pulchellum* s.l., *D. cusickii*, *D. poeticum* and *D. conjugens* var. *viscidum*.

○ *D. pulchellum* s.l.

□ *D. cusickii*

✚ *D. poeticum*

◇ *D. conjugens* var. *viscidum*

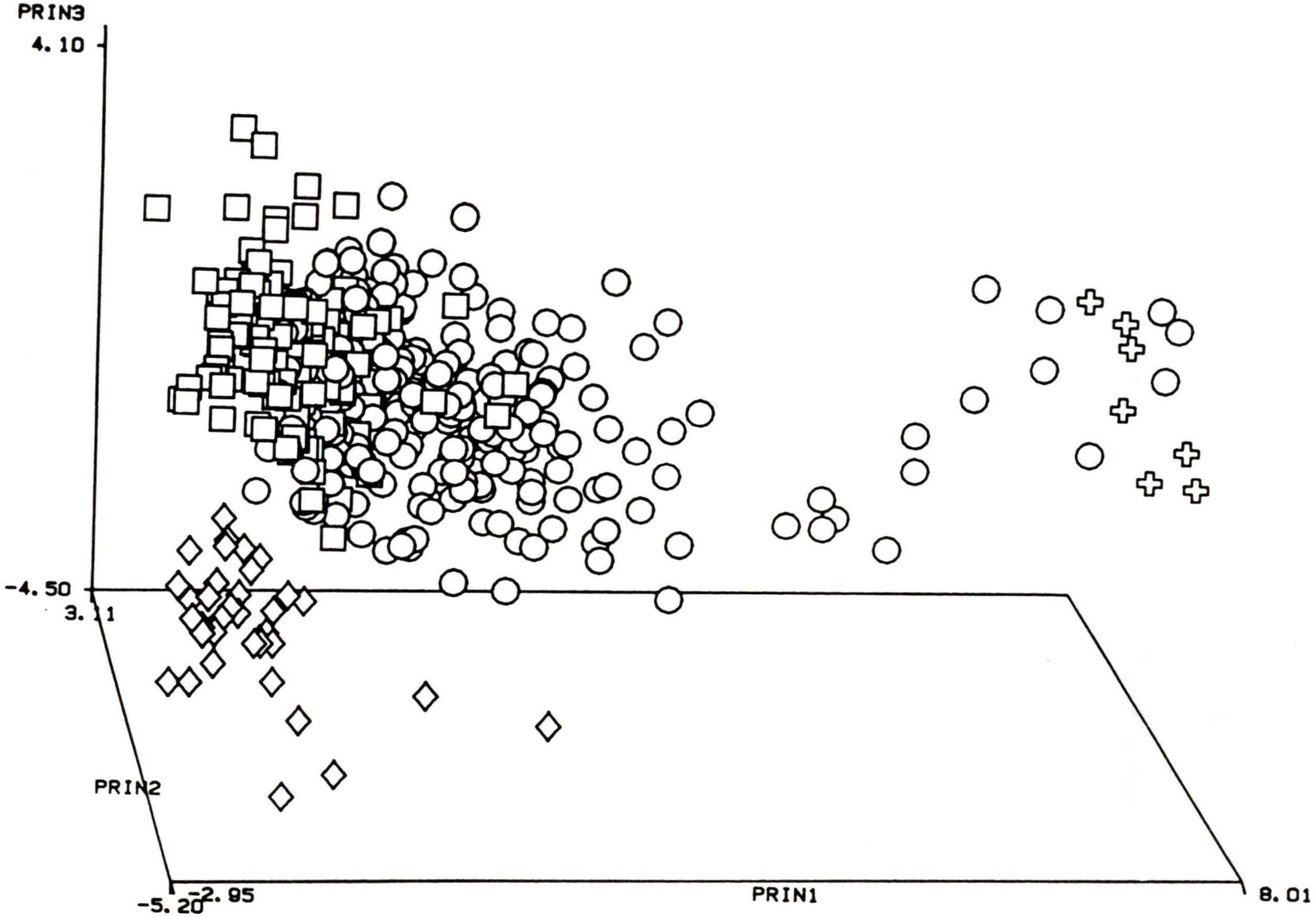

PRIN3
4.10
-4.50
3. 1
PRIN2
-5.20
-2.95
PRIN1
8.01

Table 3. Factor loadings for first three principal components from principal components analysis of *Dodecatheon pulchellum* s.l., *D. cusickii*, *D. poeticum* and *D. conjugens* var. *viscidum*. Character abbreviations and units are described in Table 2.

Variable	PC1	PC2	PC3
FILRIBL	0.222	0.394	0.149
FILRIBL/W	0.037	0.322	0.424
ANTHERL	0.143	-.144	-.522
CONNECL/W	0.109	-.029	-.197
SCAPEL	0.190	0.274	-.314
INVOLHRS	-.171	-.160	0.183
LEAFHRS	-.228	-.368	0.183
LEAFL/W	0.100	0.224	-.042
CONNPOS	0.200	0.138	0.036
CABC	0.408	-.210	0.084
CBCFR	0.420	-.247	0.089
CMRFR	0.419	-.268	0.120
CMRFG	0.405	-.237	0.180
NOFL	0.187	0.193	-.153
CONNSURF	0.154	0.334	0.316
FILTUBERT	0.089	0.197	-.008
eigenvalue	3.703	2.602	1.701

based on involucre hairs, filament rib size and connective surface.

Dodecatheon conjugens var. viscidum was well separated from the other three groups (D. pulchellum s.l., D. cusickii and D. poeticum) by canonical discriminant analysis (Figure 5). The standardized canonical coefficients indicate the relative importance of each variable to each canonical discriminant function. Along the first axis D. conjugens var. viscidum was separated from the other groups by connective surface. Dodecatheon cusickii was separated from D. pulchellum s.l. and D. poeticum along the second axis by involucre hairs. Along the third axis filament groove color separated D. pulchellum var. monanthum and D. poeticum to some degree from the yellow-colored specimens.

Discriminant analysis shows how well individual specimens are reclassified back into the four groups. In the analysis of 426 specimens, all specimens were reclassified back into their original groups at better than 96%. Misclassifications were highest for those plants in the D. pulchellum s.l. group with dark-colored filament tubes; these specimens were placed with D. poeticum.

Stepwise discriminant analysis selected connective surface as best separating D. conjugens var. viscidum from the other groups. The connective surfaces of D. cusickii, D. pulchellum s.l. and D. conjugens var. viscidum are quite different (Figure 6). D. conjugens var. viscidum has

Figure 5. Plot of three canonical discriminant functions for specimens of *Dodecatheon pulchellum* s.l., *D. cusickii*, *D. poeticum* and *D. conjugens* var. *viscidum*.

○ *D. pulchellum* s.l.

□ *D. cusickii*

✚ *D. poeticum*

◇ *D. conjugens* var. *viscidum*

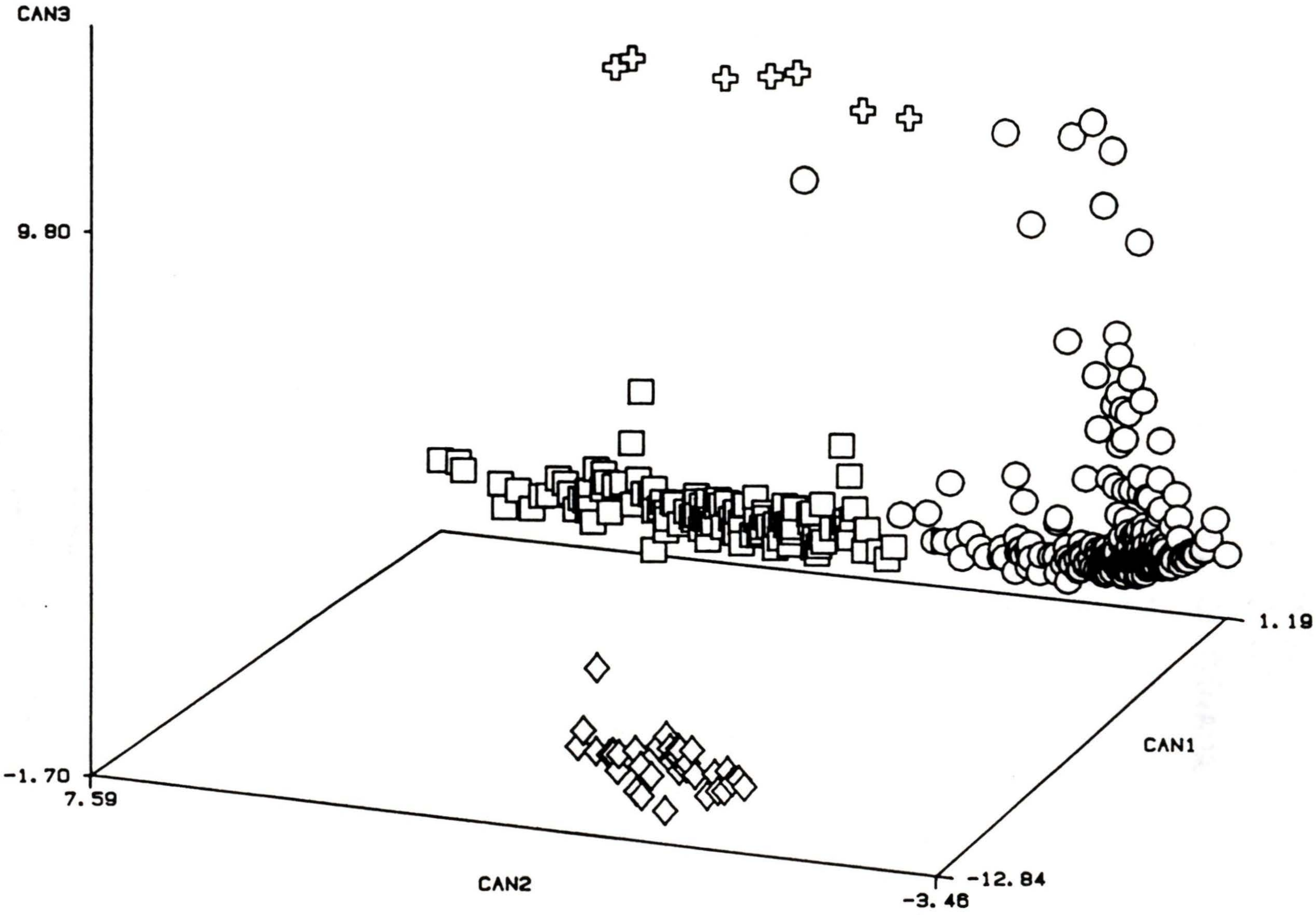

CAN3
9.80
-1.70
7.59
CAN2
-3.46
-12.84
CAN1
1.19

figure5

Figure 6. Leaf hairs and flower details of Dodecatheon cusickii and D. conjugens var. viscidum

a) glandular pubescent leaf hairs of D. cusickii

b) glandular flattened leaf hairs of D. conjugens var. viscidum

c) D. cusickii

d) D. conjugens var. viscidum

c: connective tissue

a: anther

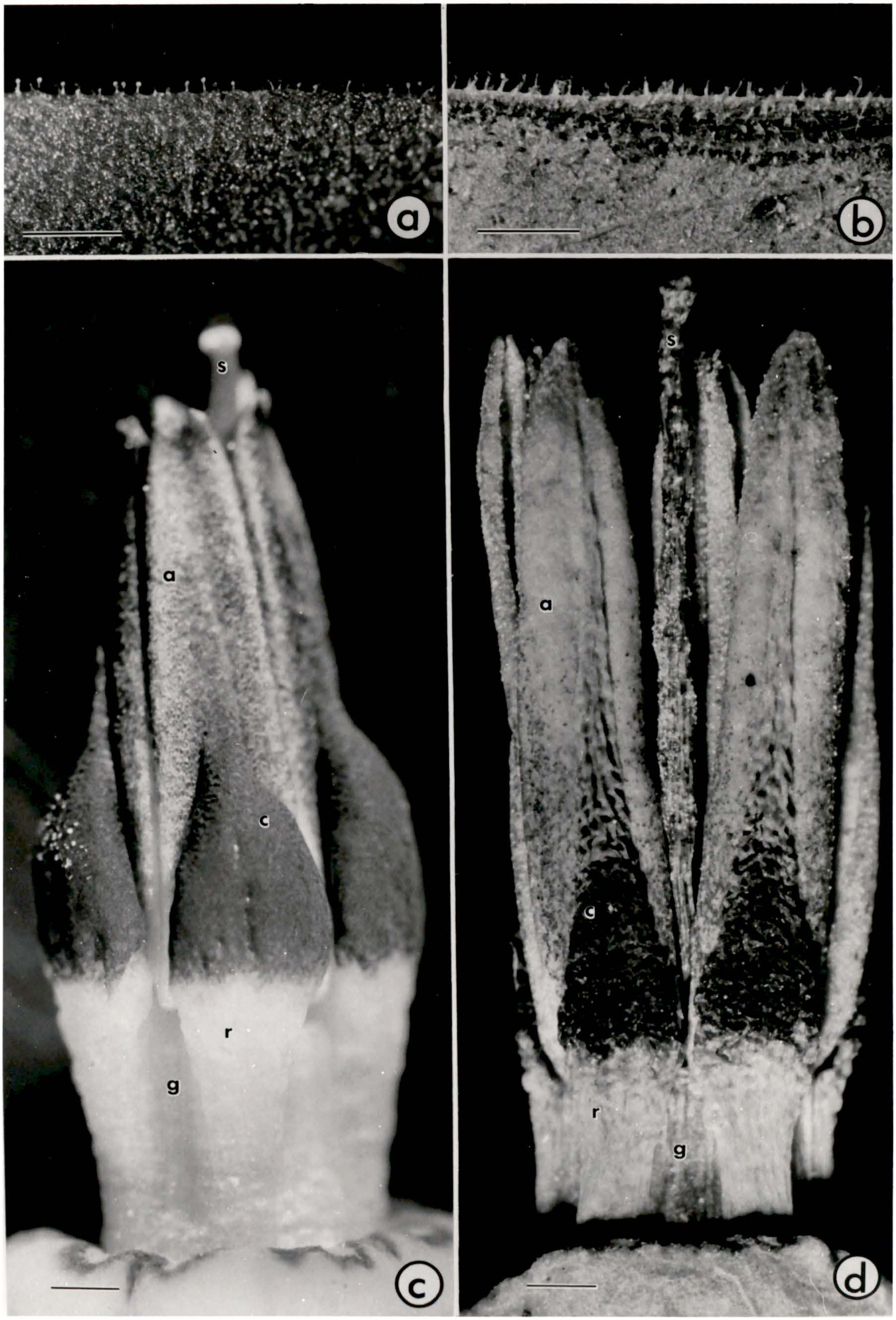
s: style

r: filament rib

g: filament groove

a) and b) bar=1.0 mm

c) and d) bar=0.5 mm


a
b
s
a
c
r
g
c
s
a
c
r
g
d

connectives with deep crosswise wrinkles, whereas D. pulchellum s.l. and D. cusickii have connectives that are either smooth or have shallow longitudinal wrinkles.

The distribution of hairs on the leaves and involucre was also found to be effective in distinguishing between D. conjugens var. viscidum, D. pulchellum s.l. and D. cusickii (Figure 7). Dodecatheon cusickii has many hairs on both the leaves and involucre, D. pulchellum s.l. has few hairs on either surface, and D. conjugens var. viscidum has many leaf hairs and few involucre hairs. The pubescences of D. conjugens var. viscidum and D. cusickii are also of different types (Figure 6). Both groups have glandular-tipped hairs but those of D. conjugens var. viscidum are flattened and relatively long, whereas D. cusickii has shorter, terete (i.e. round in x-section) hairs. My results indicate that Dodecatheon conjugens var. viscidum has a large, multi-character disjunction from both D. pulchellum s.l. and D. cusickii.

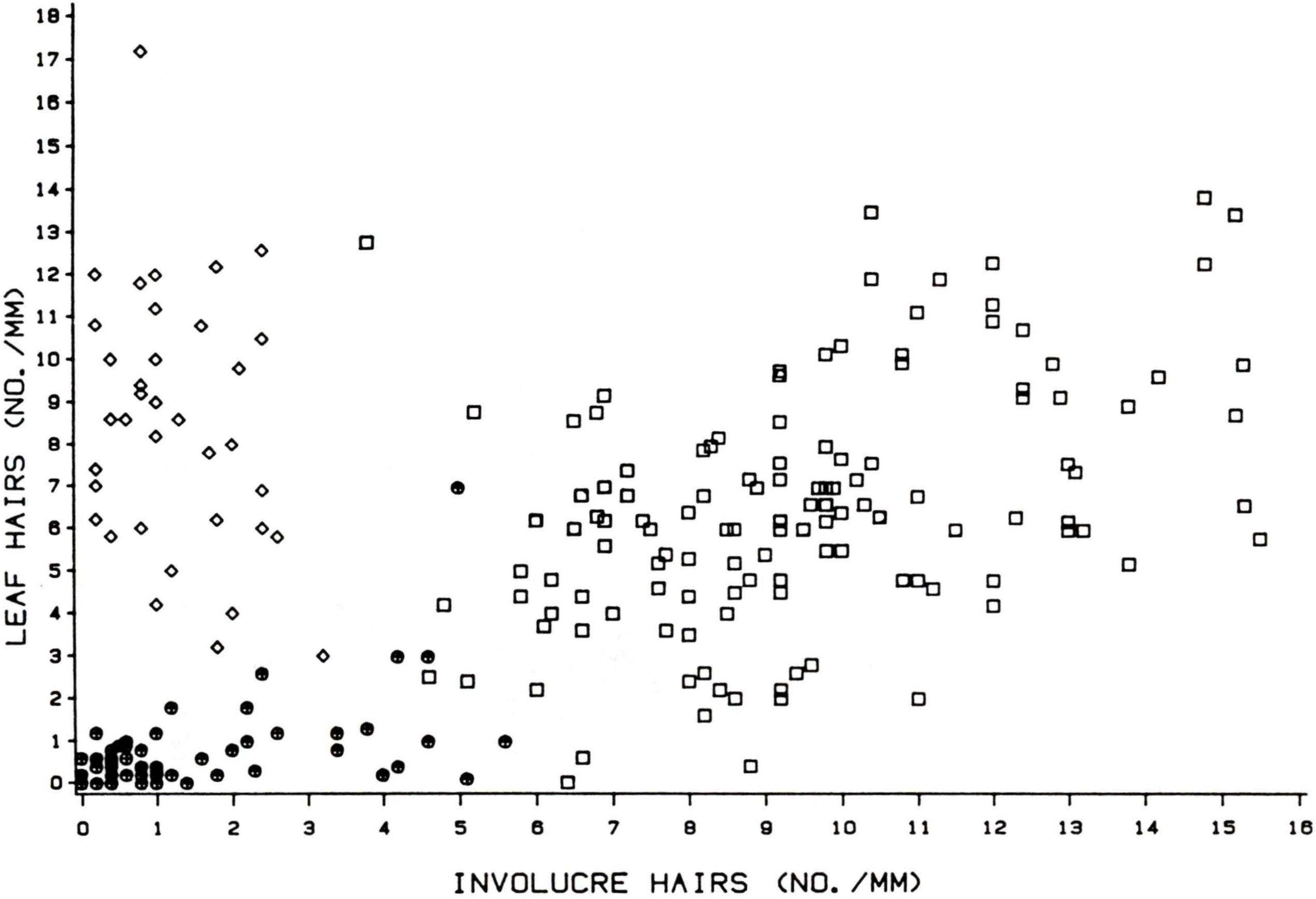
The small number of D. poeticum and D. pulchellum var. monanthum that were sampled in this study did not allow for firm conclusions of morphological relationships between the two groups, but some tentative comments can be made. Dodecatheon pulchellum var. monanthum has pubescence patterns typical of D. pulchellum whereas D. poeticum has abundant hairs on both the leaves and involucre bracts. Dodecatheon poeticum has consistently dark-colored filament

Figure 7. Plot of number of involucre hairs *vs* leaf hairs for specimens of *Dodecatheon pulchellum* s.l., *D. cusickii* and *D. conjugens* var. *viscidum*.

⊕ *D. pulchellum* s.l.

□ *D. cusickii*

◇ *D. conjugens* var. *viscidum*


LEAF HAIRS (NO./MM)
INVOLUCRE HAIRS (NO./MM)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

tubes and although D. pulchellum var. monanthum typically has dark-colored filament tubes, the color is quite variable. Thompson (1953) found populations of the latter taxon in southern Oregon with plants of intermediate color. Of the nine intermediate-colored specimens between D. poeticum, D. pulchellum var. monanthum and the yellow-colored specimens in Figures 4 and 5, eight are from coastal locations of Alaska, British Columbia and Washington and the other is from southwestern Utah.

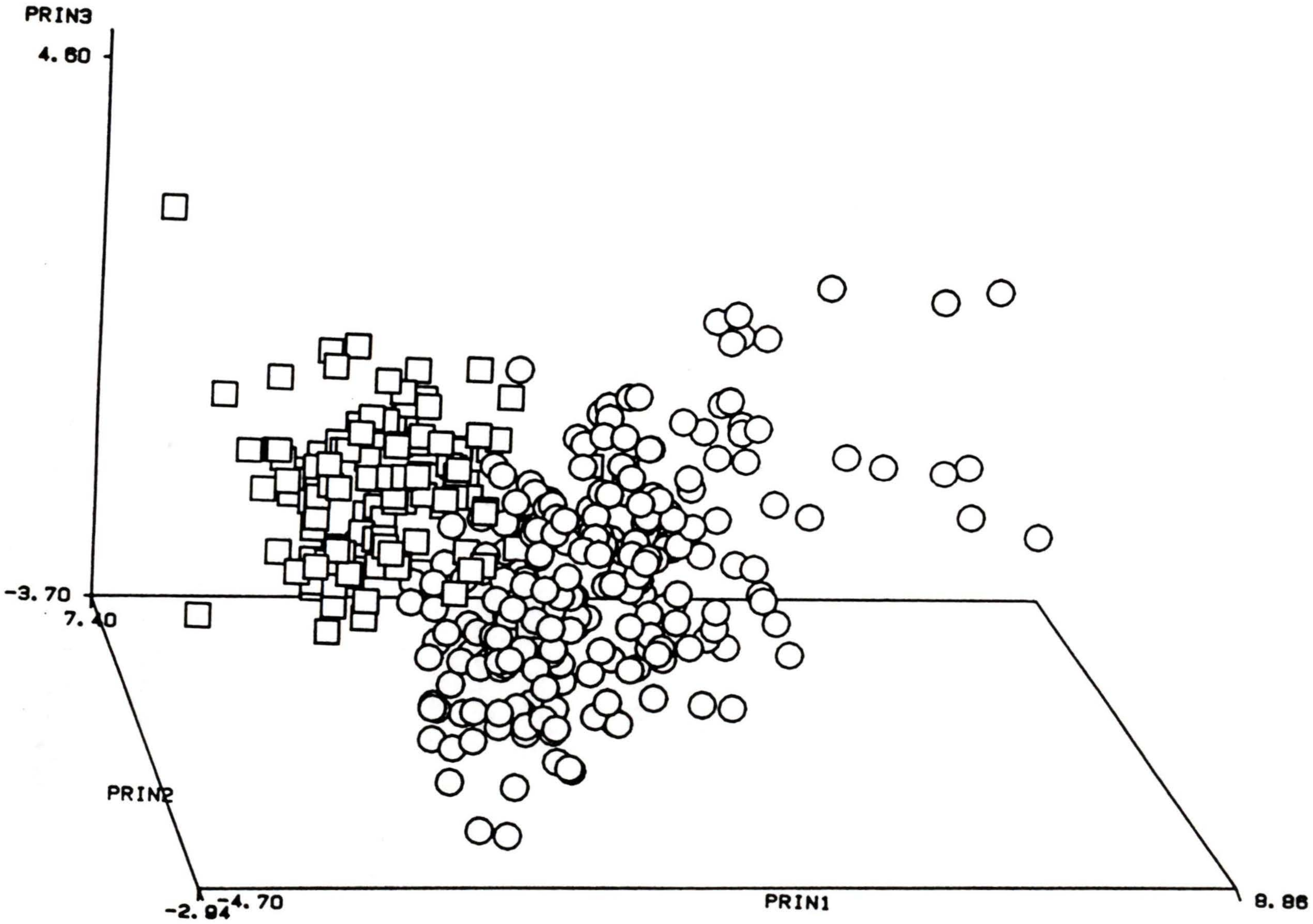
Six specimens of D. pulchellum s.l. were deleted from further analyses. Two were out of the geographical range of this study; two others were of unusual morphology and had been annotated by Beamish as possibly being a new taxon. The last two specimens were from a population from the Columbia River gorge. Both specimens had characteristics of D. poeticum but one plant had a yellow filament tube and the other a dark-colored tube. These specimens could not be placed in any particular group with confidence.

For subsequent analyses the data set consisted of D. pulchellum s.l. (n=243) and D. cusickii (n=129). Principal components analysis of these plants showed good separation of the D. cusickii and D. pulchellum s.l. groups (Figure 8). The first principal component accounted for 24.3% of the variance, the second principal component for 13.5% and the third principal component for 12.6%. Specimens were arranged on the first two axes based on leaf and involucre

Figure 8. Plot of first three principal components for specimens of *Dodecatheon pulchellum* s.l. and *D. cusickii*.

○ *D. pulchellum* s.l.

□ *D. cusickii*


PRIN3
4. 60
-3. 70
7. 40
PRIN2
-2. 94
-4. 70
PRIN1
8. 86

hairs (Table 4). This separated D. cusickii from D. pulchellum s.l. The coastal specimens of D. pulchellum s.l. with dark- or intermediate-colored filament tubes were also separated on the first axis. Position on the third axis was based on scape length and flower number but no well-defined groups were found.

Discriminant analysis showed 99% reclassification into the originally assigned group of D. cusickii specimens and 100% reclassification of D. pulchellum s.l.. Stepwise discriminant analysis selected involucre and leaf hairs as best distinguishing between these two groups; filament rib size and shape and connective shape were of less value. The pattern of involucre and leaf hair distribution separates D. cusickii from D. pulchellum s.l. although there is a small amount of overlap between the groups (Figure 7).

For canonical discriminant analysis D. pulchellum s.l. was subdivided into D. pulchellum ssp. watsonii (n=17) and D. pulchellum ssp. pulchellum (n=226). This was to obtain a graphic display in two dimensions. The specimens selected to represent D. pulchellum ssp. watsonii fit the concept of the taxon defined by Thompson (1953): scape less than 6 cm, leaves less than 4 cm, single to few flowers and growing at high elevation. Canonical discriminant analysis of all D. pulchellum s.l. and D. cusickii showed good separation of specimens of D. cusickii and D. pulchellum s.l. but considerable intergradation of D. pulchellum ssp. pulchellum

Table 4. Factor loadings for first three principal components from principal components analysis of Dodecatheon pulchellum s.l and D. cusickii. Character abbreviations and units are described in Table 2.

Variable	PC1	PC2	PC3
FILRIBL	0.198	-.449	-.131
FILRIBL/W	-.103	-.281	-.052
ANTHERL	0.298	0.071	0.276
CONNECL/W	0.126	0.011	0.192
SCAPEL	0.223	-.216	0.528
INVOLHRS	-.361	0.309	0.188
LEAFHRS	-.361	0.320	0.182
LEAFL/W	0.042	-.191	0.387
CONNPOS	0.178	-.234	-.261
CABC	0.322	-.202	-.089
CBCFR	0.364	0.300	-.083
CMRFR	0.340	0.344	0.022
CMRFG	0.314	0.326	-.102
NOFL	0.150	-.079	0.490
FILTUBERT	0.161	-.121	0.186
eigenvalue	3.646	2.032	1.896

and D. pulchellum ssp. watsonii (Figure 9). Dodecatheon cusickii and D. pulchellum s.l. were separated on the first axis on the basis of the density of involucre hairs, and these two taxa showed a minimum of overlap. The D. cusickii group and the D. pulchellum s.l. group are consistently separable, though the differences in morphology are not as striking as between these groups and D. conjugens var. viscidum.

Subsequent analyses dealt with D. pulchellum s.l. and its infraspecific taxa (n=243). Eighty herbarium specimens had infraspecific designation: ssp. or var. watsonii (n=17), ssp. pauciflorum (n=1), ssp. or var. alaskanum (n=3), ssp. superbum (n=4), ssp. macrocarpum (n=21) and ssp. or var. pulchellum (n=34). These specimens conform to descriptions in the appropriate literature (Beamish 1955, Hulten 1968, Hitchcock and Cronquist 1973, Welsh 1974).

Principal components analysis of these eighty specimens placed ssp. watsonii at one end of the morphological gradient but did not reveal separation of any other infraspecific taxa (Figure 10). The first principal component accounted for 28.2% of the variance and the second component for 14.5%. Specimens were arranged on the first axis on the basis of filament tube color, anther length and scape length (Table 5). Arrangement on the second axis was based on filament rib length and filament rib shape. Canonical discriminant analysis (Figure 11) did not offer

Figure 9. Plot of two canonical discriminant functions for specimens of Dodecatheon pulchellum ssp. pulchellum, D. pulchellum ssp. watsonii and D. cusickii.

⊕ D. pulchellum ssp. pulchellum

● D. pulchellum ssp. watsonii

□ D. cusickii

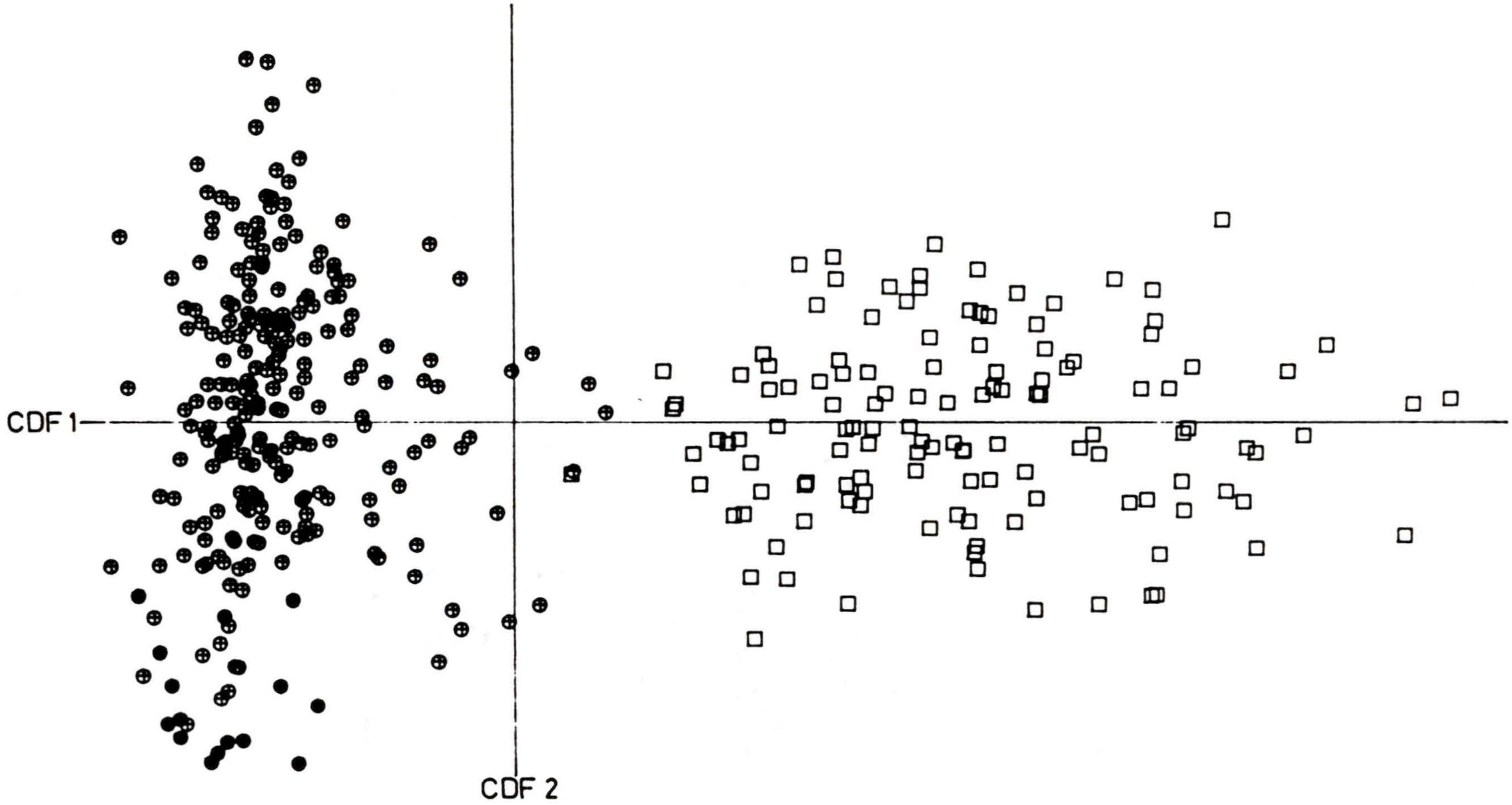

CDF 1
CDF 2

Figure 10. Plot of first two principal components for specimens of six infraspecific taxa of Dodecatheon pulchellum.

● alaskanum

■ pauciflorum

□ superbum

▲ macrocarpum

▽ watsonii

○ pulchellum

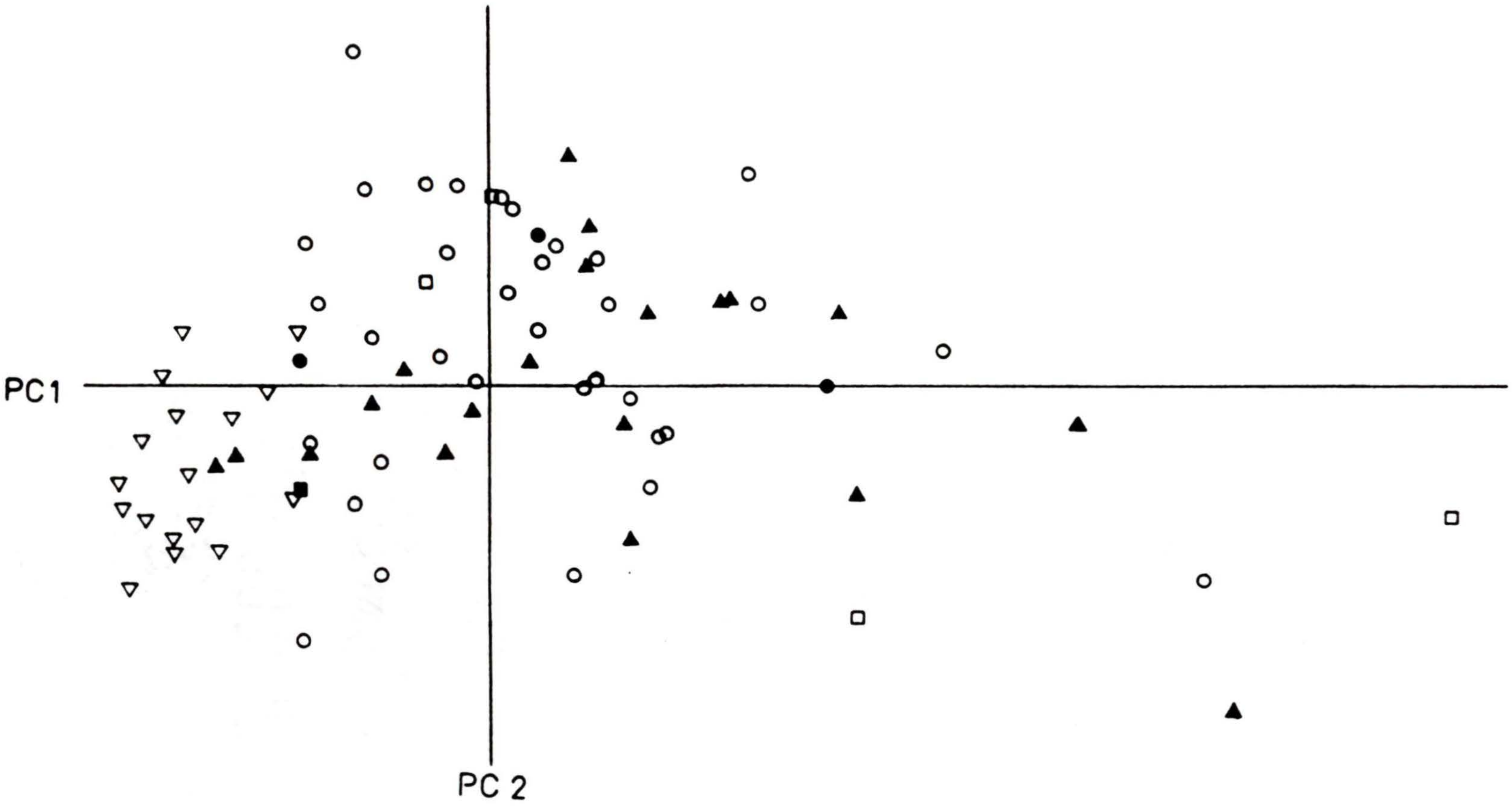

PC1
PC 2

Table 5. Factor loadings for first two principal components from principal components analysis of six infraspecific taxa of *Dodecatheon pulchellum*. Character abbreviations and units are described in Table 2.

Variable	PC1	PC2
FILRIBL	0.134	0.442
FILRIBL/W	-.011	0.501
ANTHERL	0.331	0.055
CONNECL/W	0.153	0.318
SCAPEL	0.379	0.251
INVOLHRS	-.528	0.132
LEAFHRS	-.075	0.093
LEAFL/W	0.288	0.231
CONNPOS	-.014	-.008
CABC	0.319	-.247
CBCFR	0.384	-.223
CMRFR	0.398	-.235
CMRFG	0.348	-.257
NOFL	0.291	0.272
FILTUBERT	0.000	0.000
eigenvalue	3.951	2.025

Figure 11. Plot of first two canonical discriminant functions for specimens of six infraspecific taxa of *Dodecatheon pulchellum*.

● alaskanum

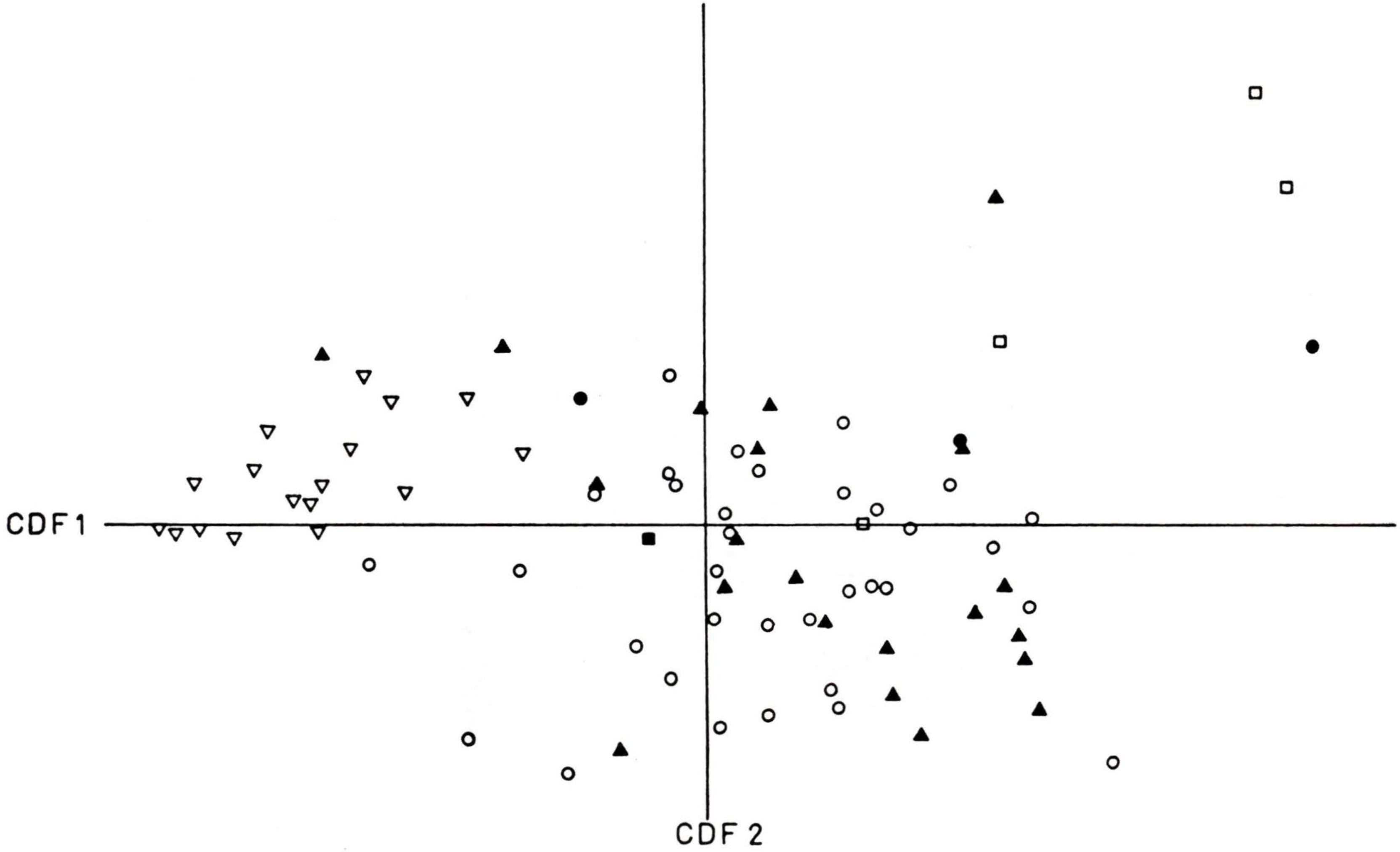
■ pauciflorum

□ superbum

▲ macrocarpum

▽ watsonii

○ pulchellum


CDF 1
CDF 2

any clearer evidence for distinct infraspecific groups. The groups were separated along the first axis on the basis of anther length and along the second axis primarily on scape length and to a lesser degree by flower number and filament tube color. In both analyses ssp. watsonii was separated somewhat from the other specimens by short scapes, consistently yellow filament tube and small flowers.

Discriminant analysis showed low reclassification back into the originally assigned groups for all specimens, between 53% and 75%, except ssp. watsonii, which reclassified at 100%.

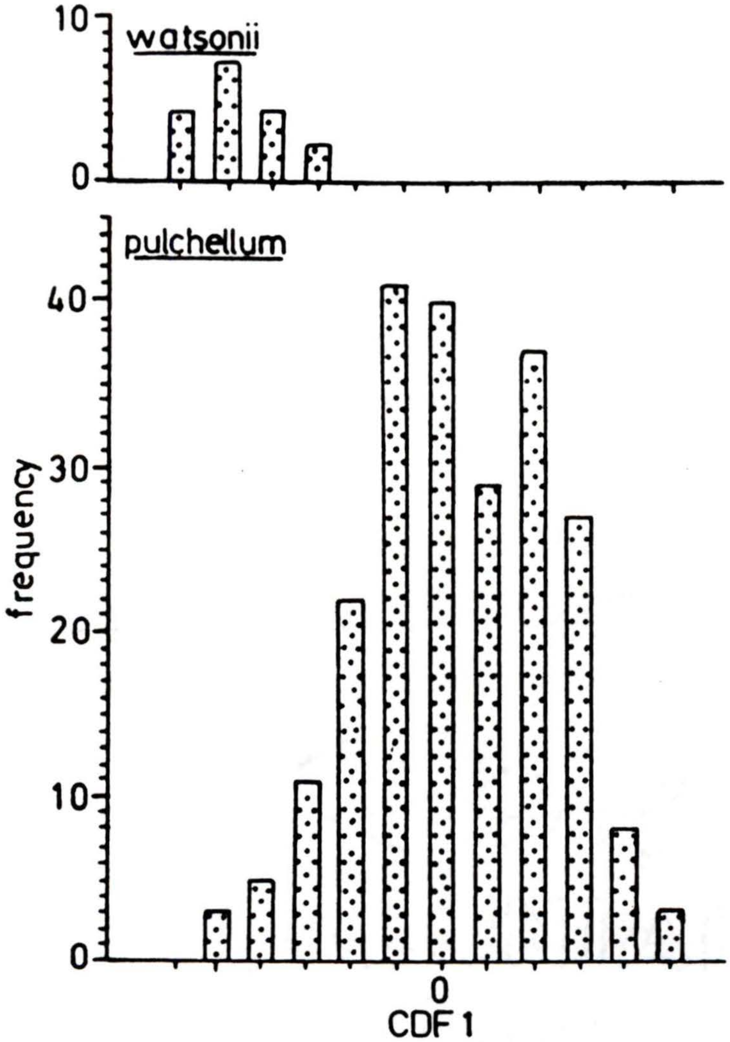
The 163 specimens without subspecific designation were then included in the discriminant analysis and classified into one of the five infraspecific taxa. Classification was between 8.5% and 30%. Such low classification rates could be the result of a high overlap in the morphology of the existing taxa such that each plant has a high probability of belonging to more than one group. Alternatively, the existing groups may be stable and the unknowns may actually belong to groups not among the taxa included. On the basis of the analyses done I conclude that the subspecific taxa of D. pulchellum s.s., with the possible exception of ssp. watsonii, are diffuse, confluent and not morphologically distinct.

The high successful reclassification rate of ssp. watsonii was reason for closer examination of this group in relation to the rest of D. pulchellum s.s. Canonical discriminant analysis (Figure 12) shows considerable overlap of this subspecies with the rest of the species. The standardized canonical coefficients show that ssp. watsonii and the rest of D. pulchellum s.s. differ mainly in scape length and to a lesser degree in anther length and filament shape.

Discriminant analysis showed 100% reclassification of specimens of ssp. watsonii and 89.4% for those of D. pulchellum. Of the 24 specimens reclassified from D. pulchellum into ssp. watsonii, 20 were from alpine or subalpine sites. Of the remaining four specimens, three grew at sea level on maritime islands and the fourth one grew at 500 m in an interior Ponderosa pine-grassland forest.

The morphological features of ssp. watsonii are certainly at one end of the continuum represented by D. pulchellum but the ssp. watsonii form seems to occur in a number of ecological situations other than subalpine or alpine ones.

Figure 12. Frequency of specimens of *Dodecatheon pulchellum* ssp. *pulchellum* and *D. pulchellum* ssp. *watsonii* on first canonical discriminant function.


10
0
watsonii
pulchellum
40
30
20
10
0
frequency
0
CDF 1

Chromosome number and pollen diameter

Chromosome numbers for the Dodecatheon pulchellum s.l. group have been reported by several authors (Thompson 1953, Beamish 1955, Taylor and Mulligan 1968, Reveal and Styer 1974). This study reports chromosome numbers for 48 plants in 39 populations; these are listed in Table 6. Tetraploids occur both in the interior and on the coast. Diploids occur strictly east of the Cascade Mountains and hexaploids are only found in maritime environments.

For 29 plants of known ploidy level the diameters of 580 pollen grain diameters (20 per plant) are shown in Figure 13. Mean pollen diameter (± 1 s.d.) of diploid plants was 13.76µm ± 0.17 and of polyploid plants was 15.91µm ± 0.14. The variances of the diploid (n=340) and polyploid (n=240) samples were equal ($0.05<P(F\geq2.21)<0.10$) and the mean pollen diameters of the two groups were significantly different ($P(t\geq21.70)<0.001$). For both tests $\alpha=0.05$.

Mean pollen diameters for each of the 29 plants of known chromosome number are listed in Table 7. While there is considerable overlap in mean pollen grain diameter in the midsize range, the ends of the size gradient are assignable as either diploids or polyploids (small grains belong to diploids, large ones to polyploids). On the basis of these pollen grain measurements, 3 size categories were

Table 6. New chromosome number reports and locations for the Dodecatheon pulchellum group. Collection numbers are those of the author; vouchers are at UVIC.

2n	collection number	material collected	locality
Dodecatheon poeticum			
44	1-1	live plant	WA. Klickitat Co. 9.0 km north of Satus Pass. Apr. 15, 1983.
44	1-3	live plant	
Dodecatheon pulchellum			
44	20-3	live plant	B.C. 3 km south of Canal Flats west of Hwy. 95. May 6, 1984.
44	20-5	live plant	
44	20-6	live plant	
44	22-1	live plant	B.C. 10 km north of Wardener, on road to Norbury Lakes. May 6, 1984.
44	22-3	live plant	
44	22-4	live plant	
44	9-3	live plant	ID. Adams Co. 27.7 km north of New Meadows on ID 95. May 14, 1983.
44	10-2	live plant	ID. Owyhee Co. 30.9 km east of Jordon Valley OR., on road to Silver City ID. May 15, 1983.
44	10-3	live plant	
44	2-1	live plant	OR. Wasco Co. 12.4 km east of Mayer State Park on Hwy 30. Apr. 15, 1983.
88	12-1s	seed	B.C. north of ridge between Mt. Copely and Mt. Arrowsmith, Vancouver Island.
88	13-2	live plant	B.C. west side of hill on east side of Nanoose Bay, Vancouver Island. Apr. 22, 1984.
88	16-4	live plant	B.C. 37 km north of Rock Creek on Hwy. 33. May 4, 1984.
88	18-1	live plant	B.C. east of Castlegar, north of junction of Hwy 3A and road to Robson. May 5, 1984.
88	18-5	live plant	

88	29-3	live plant	B.C. mouth of Kennedy River, Vancouver Island. Apr. 23, 1984.
88	33-1s	seed	B.C. Manning Provincial Park, 3.4 km past end of pavement on Blackwell Road.
88	38-1s	seed	B.C. University of Victoria, Victoria, near junction of Gordon Head Road and Cedar Hill-X Road.
88	40-1s	seed	B.C. Chinese Cemetary, Oak Bay, Vancouver Island.
88	41-1s	seed	B.C. Uplands Park, Oak Bay, Vancouver Island.
88	43-1s	seed	B.C. near Mt. Tzuhalem Ecological Reserve east of Duncan, Vancouver Island.
88	45-1s	seed	B.C. east end of Gordon Head Road, Saanich, Vancouver Island.
88	46-1s	seed	B.C. rocky headland west of Otter Point, 7.5 km west of Sooke, Vancouver Island.
88	48-1s	seed	B.C. 3.2 km north of juction of Humpback Road and Sooke Road, Vancouver Island.
88	50-1	live plant	B.C. D'Arcy Island, east of Saanich, Vancouver Island. March 17, 1984.
88	11-3	live plant	OR. Malheur Co. west of Crooked Creek, north of bridge on Hwy 95. May 16, 1983.
88	7-2	live plant	ID. Lewis Co. 10.3 km north of Kamiah on ID 64. May 13, 1983.
88	5-1	live plant	WA. Garfield Co. 24.2 km south of Pomeroy on Mountain Road. May 12, 1983.

132	44-1A	live plant	B.C. Trial Island, south of Oak Bay, Vancouver Island. Apr. 21, 1985.
132	44-1s	seed	B.C. Trial Island, south of Oak Bay, Vancouver Island.
132	49-5	live plant	B.C. west side of mouth of Somass River, south of airfield, Port Alberni, Vancouver Island. Apr. 24, 1984.
132	49-1s	seed	B.C. west side of mouth of Somass River, south of airfield, Port Alberni, Vancouver Island.

<u>Dodecatheon cusickii</u>

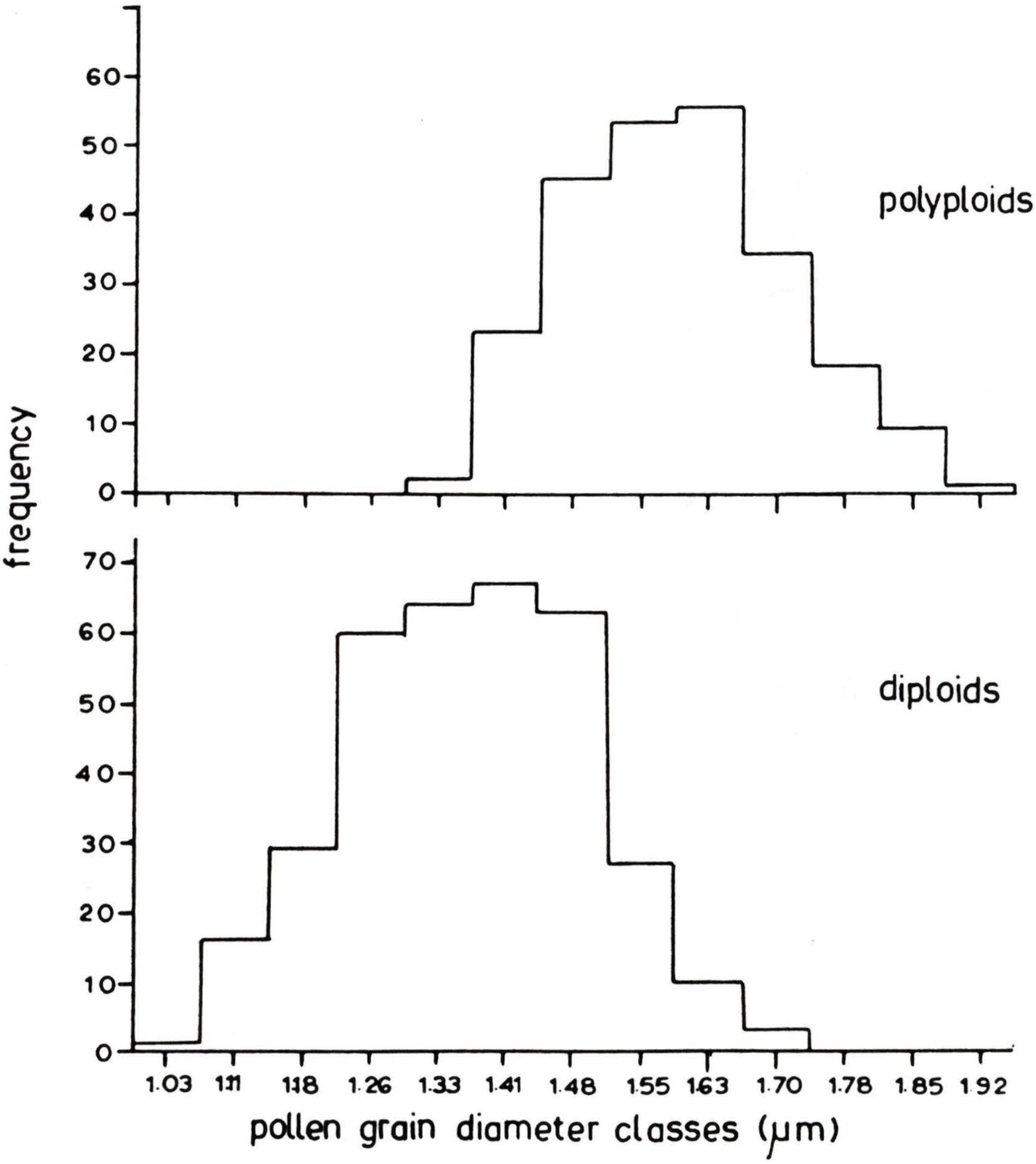
44	15-2	live plant	B.C. road to Inkaneep Campground, north of Oliver. Apr. 25, 1985.
44	17-2	live plant	B.C. 5.2 km east of Christina Lake. May 4, 1984.
44	19-3	live plant	B.C. east of Hwy 95 at turn to Lumberton, south of Cranbrook. May 6, 1984.
44	26-5	live plant	B.C. Kalamalka Lake Provincial Park, south of Vernon. May 9, 1984.
44	27-3	live plant	B.C. north of Lac du Bois, northwest of Kamloops. May 9, 1984.
44	28-1	live plant	B.C. hillside east of Nicola Lake. May 10, 1984.
44	34-1s	seed	B.C. rock outcrop at Anarchist Mountain viewpoint, east of Osoyoos on Hwy 3.
44	36-1s	seed	B.C. east side of Vaseaux Lake, on road to mountain sheep feeding station.

44	37-1s	seed	B.C. 5.8 km north on Westside Road. from junction with Hwy 97.
44	47-1s	seed	B.C. Agriculture Canada station, west of Summerland.
44	6-5	live plant	ID. Latah Co. 2 km east of junction of ID 95 and Skyline Drive. May 13, 1983.
44	3-3	live plant	WA. Stevens Co. 6.4 km north of junction of WA 25 and WA 251. May 10, 1983.
44	4-2	live plant	WA. Stevens Co. 30.8 km north of Evans. May 10, 1983.
88	25-1	live plant	B.C. 12 km east of Stagleap Provincial Park on Hwy 3. May 7, 1984.

Figure 13. Distribution of diameter of 20 pollen grains from each of 29 plants of known chromosome number.

diploids: n=340 pollen grains

polyploids: n=240 pollen grains



frequency
60
50
40
30
20
10
0
polyploids
70
60
50
40
30
20
10
0
diploids
1.03
1.11
1.18
1.26
1.33
1.41
1.48
1.55
1.63
1.70
1.78
1.85
1.92
pollen grain diameter classes (μm)

Table 7. Mean pollen grain diameter (1 s.d.) for 29 plants of known chromosome number (n per plant = 20 grains).

chromosome number	collection number	diameter(µm) mean	sd
44	20-3	11.72	0.61
44	22-3	11.80	0.71
44	22-4	12.16	0.53
44	19-3	13.03	0.61
44	28-1	13.29	1.03
44	9-3	13.29	0.86
44	20-6	13.36	0.82
44	26-5	13.48	0.80
44	3-3	13.70	0.74
44	22-1	14.06	0.80
44	2-1	14.10	0.88
44	6-5	14.14	0.94
44	27-3	14.33	0.64
44	20-5	14.46	0.91
44	10-2	14.84	0.73
44	11-2	14.92	0.86
44	10-3	15.68	0.78
88	11-3	14.89	0.85
88	25-1	14.91	0.53
88	16-4	14.98	0.56
88	7-2	15.83	0.61
88	18-1	15.86	0.66
88	50-1	16.06	0.65
88	18-5	16.35	0.87
88	13-2	16.45	0.85
88	5-1	16.80	0.81
88	17-2	17.70	0.86
132	49-5	14.62	0.85
132	44-1A	16.87	0.83

established: diploid (mean pollen diameter < 14.40µm), polyploid (mean pollen diameter ≥ 16.00µm) and an intermediate group that could be either diploid or polyploid (mean pollen diameter ≥ 14.40µm to < 16.00µm).

Pollen grain measurements were then made from 313 D. pulchellum s.s., D. pulchellum ssp. watsonii and D. cusickii plants used previously in the morphometric analysis. Some plants did not have sufficient pollen for sampling. On the basis of mean pollen grain diameter each plant was assigned to one of the three above ploidy categories. Another 52 specimens, from which pollen grains were not measured, were placed in the intermediate category and included in the analysis.

Initially a canonical discriminant analysis of the three taxonomic groups (n=365) was carried out, using the same characters as in the earlier analyses. The relationship between ploidy level of each specimen and its position on the first and second axes is shown in Figure 14. Dodecatheon cusickii consisted mostly of diploids, with 81% of the specimens in this category; 2% of the specimens were polyploid. Dodecatheon pulchellum ssp. watsonii had 88% in the diploid category and 6% in the polyploid category. D. pulchellum s.s. had 48% diploids and 14% polyploids.

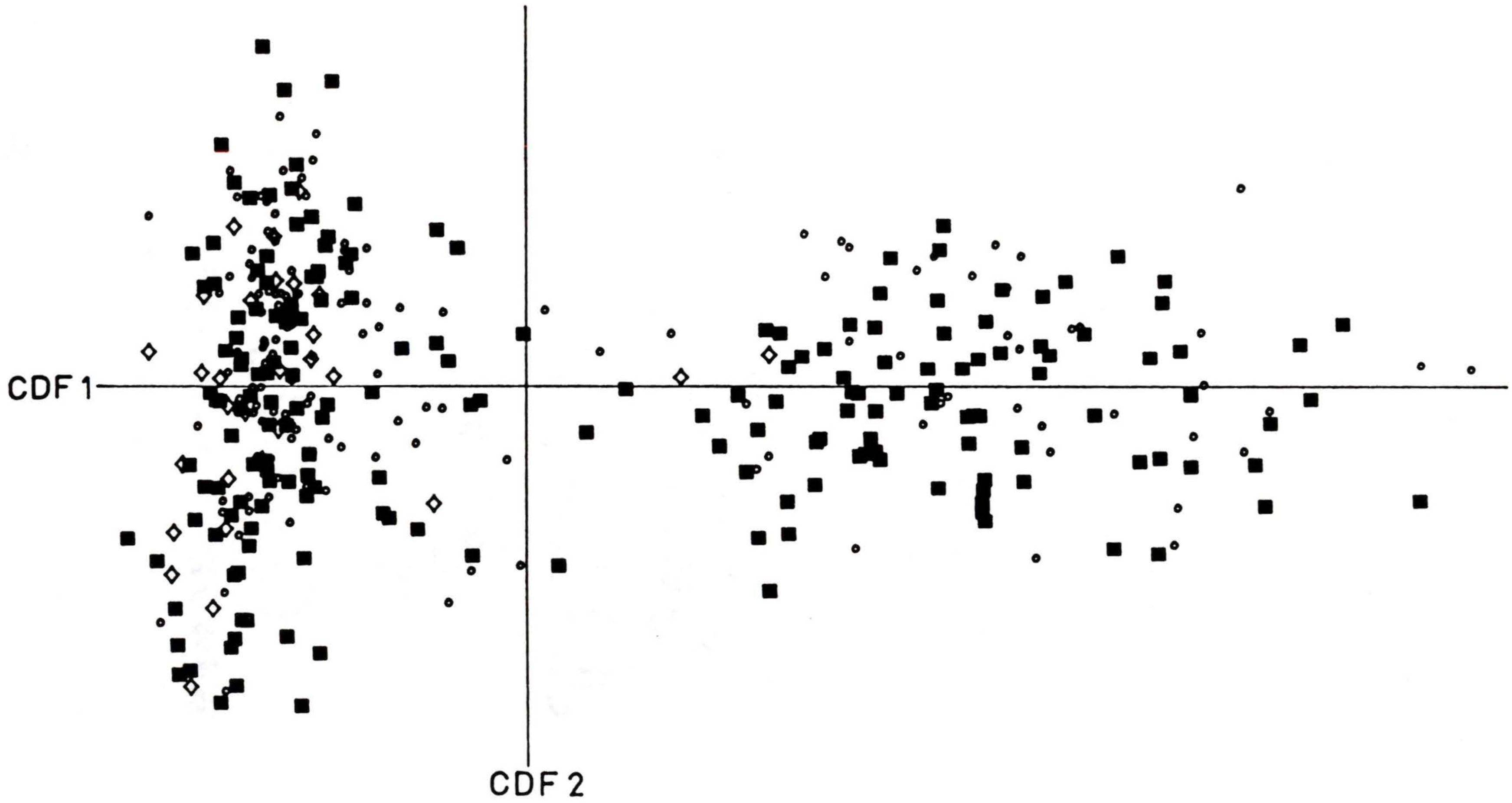
Further analyses examined diploid and polyploid specimens in D. pulchellum s.l. (n=144, including D. pulchellum ssp. watsonii). Canonical discriminant analysis

Figure 14. Plot of two canonical discriminant functions for three ploidy groups of specimens of *Dodecatheon pulchellum* (including ssp. *watsonii*) and *D. cusickii*.

■ diploid

◇ polyploid

○ not assigned


CDF 1
CDF 2

(Figure 15) showed considerable overlap between the two ploidy groups. What little separation existed along the axis was based primarily on flower number and to lesser degree on filament rib length and color. Stepwise discriminant analysis selected flower number, anther length and filament tube color as best discriminating between the two groups, though none of the characters was considered to be very effective. Discriminant analysis showed approximately 20% misclassification of both diploids and polyploids.

Spearman rank correlations between mean pollen diameter and the other morphological characters were calculated for *D. pulchellum* s.l. specimens. Mean pollen grain diameter was not significantly correlated with any morphological character.

Common garden experiment

Three ecological types are evident from the mortality and blooming rates of the transplants in the common garden (Table 8). The four low elevation coastal populations (Camas Hill, Port Alberni, Otter Point and Ashley Bay) grew well in the common garden, with an overall increase in the percentage of plants blooming each year. The high elevation plants from Mount Arrowsmith (assignable to *D. pulchellum* ssp. *watsonii*) had high mortality over all years; the scape

Figure 15. Frequency of diploid and polyploid members of specimens of *Dodecatheon pulchellum* ssp. *pulchellum* and *D. pulchellum* ssp. *watsonii* on first canonical discriminant function.

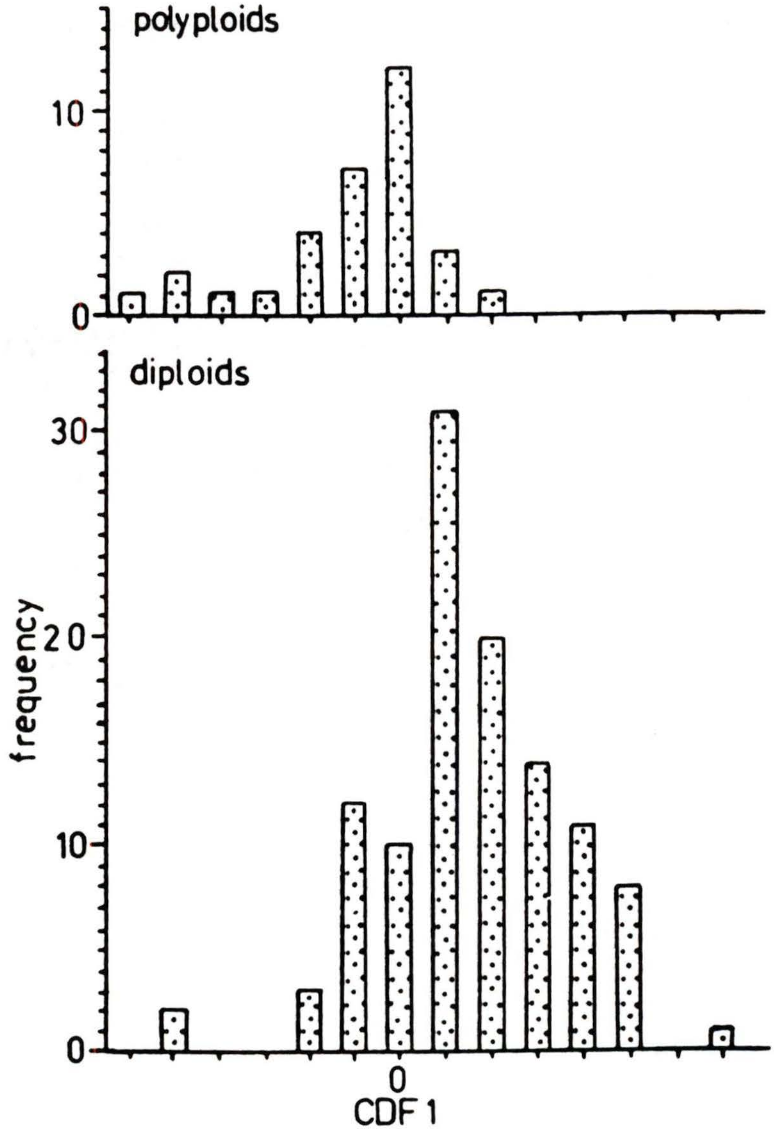

polyploids
10
0
diploids
30
20
10
0
frequency
0
CDF 1

Table 8. Mortality and blooming rates for populations of common garden plants over three years. "Alive" values are percentage of plants surviving from the previous growing season. "Bloom" values are percentages of plants alive the current season.

population	1985		1986		1987	
	alive	bloom	alive	bloom	alive	bloom
Camas Hill	100	60	93	86	100	86
Ashley Bay	100	53	100	100	100	100
Otter Point	100	80	100	60	100	93
Port Alberni	100	53	100	80	100	87
Summerland	80	92	100	42	25	0
Mount Arrowsmith	100	0	67	10	13	0

produced by the single plant that bloomed in 1986 was abnormally short. The interior plants from Summerland (assignable to *D. cusickii*) did well for the first two years, but suffered high mortality during the third winter. The weather that winter was milder and wetter than the previous two, possibly causing the plants to rot.

Plants from Ashley Bay, the site closest to the common garden, grew the best overall. There is evidence of ecological plasticity in the Port Alberni plants, which did reasonably well in a habitat considerably different than that from which they were taken.

In all morphometric analyses the *in situ* and garden plants from Summerland (*D. cusickii*) were morphologically distinct from the other plants because of the abundant leaf and involucre hairs of this species.

Comparisons of *in situ* plants with 2 year old garden plants showed varying degrees of morphological divergence for all populations. Canonical discriminant analysis indicated that the common garden plants had not converged on a common morphology (Figures 16 and 17) and that there was no apparent consistency in the morphological changes that had occurred. The populations illustrated in Figure 17 were separated on the first axis by scape length. This appears to have a large genetic component, because the *in situ* and garden samples for each population retained the same relative position along the first axis: Otter Point plants

Figure 16. Plot of first two canonical discriminant functions for five _in situ_ and five 1986 common garden samples of _Dodecatheon pulchellum_ and _D. cusickii_.

◆ Summerland _in situ_

◇ Summerland common garden

Circles indicate positions of the remaining _in situ_ and common garden samples.

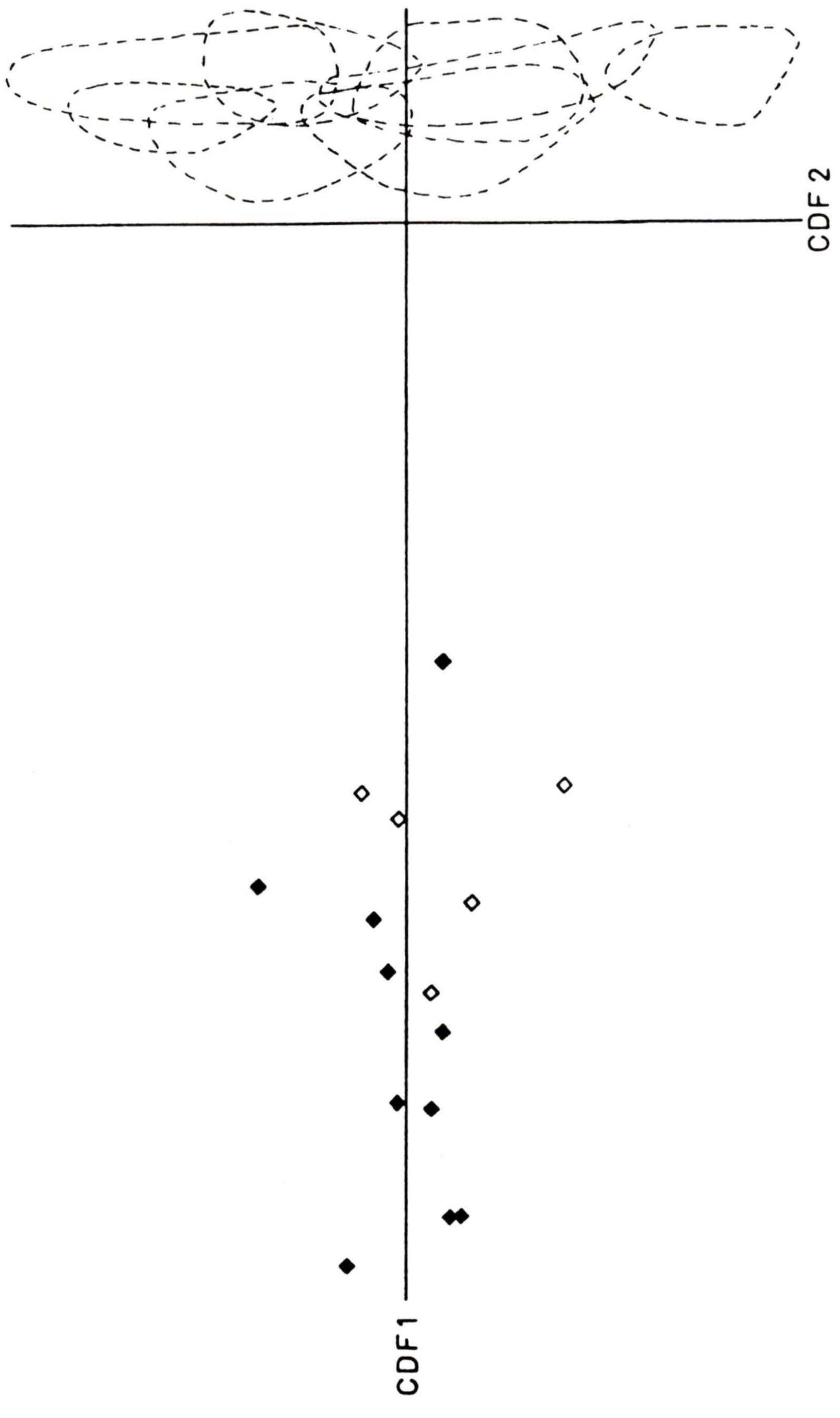
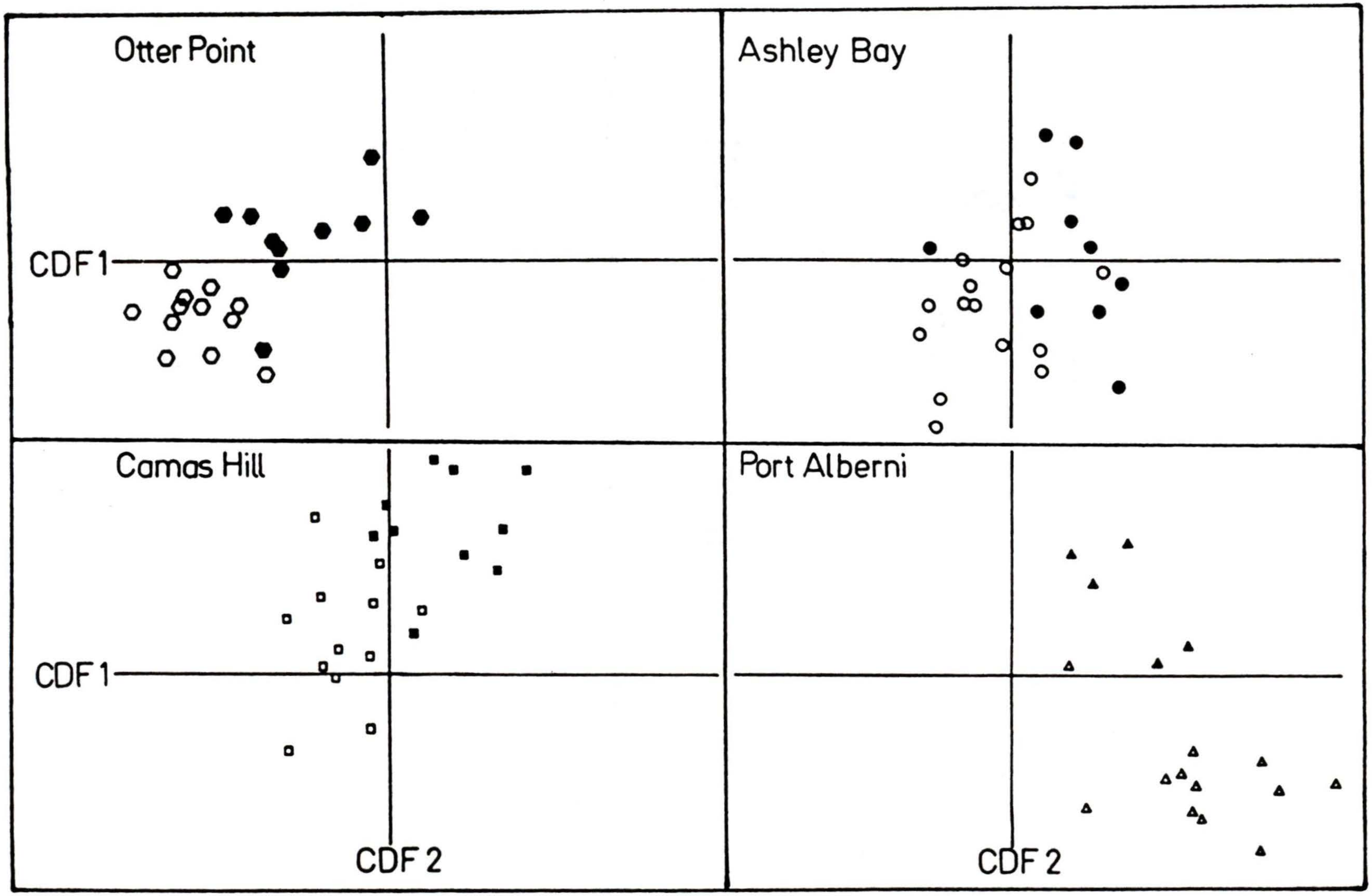

CDF 2
CDF 1

Figure 17. Plot of first canonical discriminant functions for four *in situ* and four common garden samples of *Dodecatheon pulchellum*.

closed symbols = *in situ*

open symbols = common garden


Otter Point
Ashley Bay
Camas Hill
Port Alberni
CDF 1
CDF 1
CDF 2
CDF 2

always have shorter scapes than Port Alberni plants. The garden samples were separated from their in situ counterparts along the second axis by filament rib length, with the garden plants having longer filament ribs.

Stepwise discriminant analysis selected a different subset of characters as best distinguishing between garden and in situ plants for each population (Table 9).

Plants from the common garden in 1985 and 1986 showed considerable morphological divergence. Canonical discriminant analysis (Figures 18 and 19) indicated that the general direction of morphological change from 1985 to 1986 in each population was the same although there was no apparent convergence on a common morphology. In Figure 19 the populations were separated on the first axis by scape length, which appears to be genetically determined. Samples between years were separated on the second axis on the basis of three characters: scape length, the 1986 samples generally being shorter; involucre hairs, the 1986 samples having a greater density of hairs; and total leaf length, the 1986 samples having longer leaves. The coastal populations all had an increase in involucre hairs, otherwise each population showed variability in a different set of characters (Table 10).

The characters selected by the stepwise discriminant analysis and canonical discriminant analysis as separating the various samples have phenotypic plasticity. There

Table 9. Mean (1 sd) and range for characters selected using stepwise discriminant analysis of *in situ* and 1986 common garden plants. Character abbreviations and units are described in Table 2.

	character	in situ	common garden
Camas Hill		(n=10)	(n=12)
	leafl/w	6.52(1.03)	3.65(0.87)
		4.47-7.72	2.69-5.26
	connpos	2.30(0.68)	1.62(0.71)
		1.00-3.00	1.00-3.00
Ashley Bay		(n=10)	(n=15)
	cbcfr	2.23(0.23)	1.59(0.27)
		2.00-3.00	1.00-2.00
	cmrfg	1.12(0.38)	1.11(0.26)
		1.00-2.30	1.00-2.00
	cbcfg	1.72(0.70)	1.43(0.36)
		1.00-3.00	1.00-2.30
	filribl/w	2.41(1.01)	2.75(0.73)
		1.00-4.50	1.70-3.94
	involhrs	0.46(0.46)	0.89(0.52)
		0-1.40	0.20-2.00
	antherl	6.08(0.61)	6.00(0.47)
Otter Point		(n=10)	(n=12)
	involhrs	0.21(0.21)	0.70(0.31)
		0-0.60	0-1.20
	connecl/w	5.00(0.65)	6.03(0.79)
		3.97-6.30	4.83-7.82
	filribl	1.96(0.46)	2.24(0.25)
		1.30-2.75	1.59-2.60
	filribl/w	2.07(0.57)	2.26(0.42)
		1.36-3.24	1.62-3.26
	filtubert	1.00(-)	0.98(0.09)
		---	0.70-1.00
	cmrfg	1.35(0.63)	1.12(0.29)
		1.00-3.00	1.00-2.00
Port Alberni		(n=5)	(n=12)
	filribl	1.84(0.20)	2.59(0.34)
		1.50-2.00	1.78-3.05
	leafl/w	7.80(1.86)	6.31(1.24)
		6.13-11.00	4.48-8.92
	leafhrs	0.16(0.17)	0.12(0.16)
		0-0.40	0-0.50
Summerland		(n=10)	(n=5)
	leafhrs	11.04(2.39)	8.54(0.96)
		6.00-13.60	7.80-10.10
	leafl/w	5.96(1.36)	4.63(0.39)
		4.64-8.92	4.19-5.19

Figure 18. Plot of first two canonical discriminant functions for five 1985 and 1984 common garden samples of Dodecatheon pulchellum and D. cusickii.

◇ Summerland 1985

◆ Summerland 1986

Circles indicate positions of the remaining common garden samples.

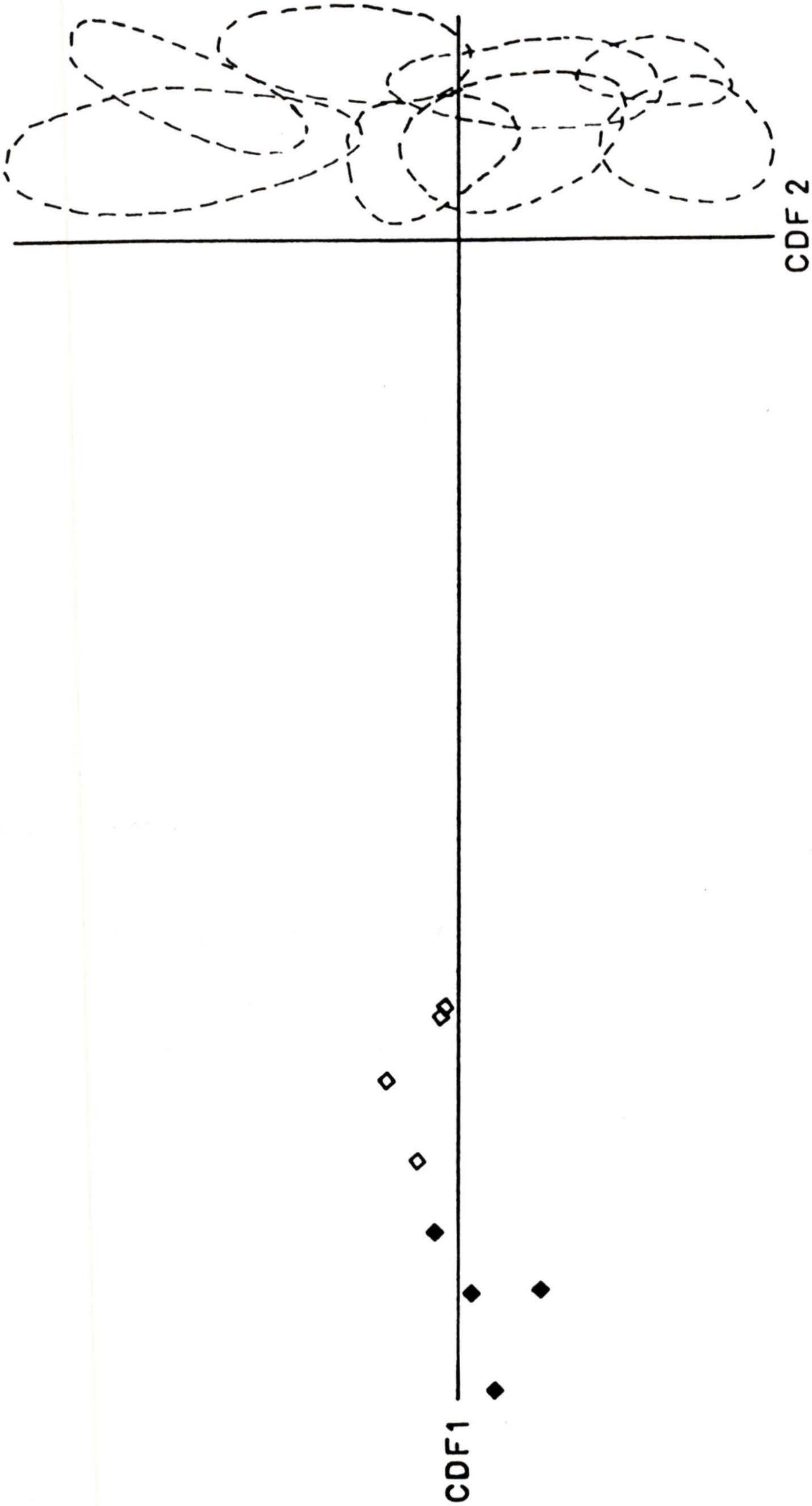

CDF 2
CDF1

Figure 19. Plot of first two canonical discriminant functions for four 1985 and 1986 common garden samples of Dodecatheon pulchellum.

□ Camas Hill

○ Ashley Bay

⬡ Otter Point

△ Port Alberni

open symbols = 1985

closed symbols = 1986

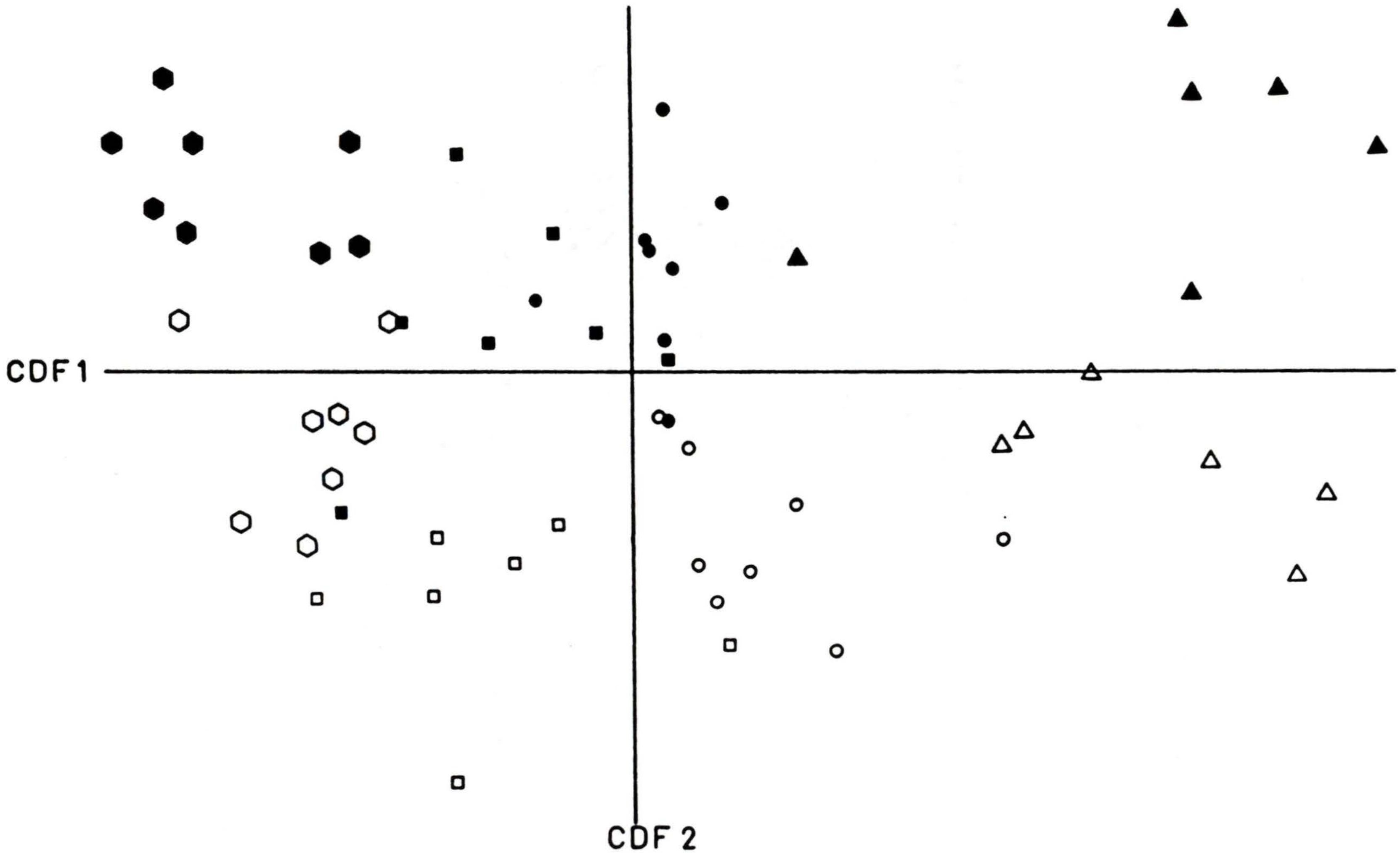

CDF1
CDF 2

Table 10. Mean (1 sd) and range for characters selected using stepwise discriminant analysis of 1985 and 1986 common garden plants. Character abbreviations and units are described in Table 2.

	character	1985	1986
Camas Hill (n=7)	involhrs	0.14(0.19) 0-0.40	0.73(0.51) 0.20-1.60
	cabc	2.26(0.59) 1.50-3.00	1.67(0.96) 1.00-3.50
Ashley Bay (n=8)	involhrs	0.23(0.19) 0-0.60	0.82(0.34) 0.60-1.60
	cbcfr	2.00(0.60) 1.00-3.00	1.64(0.26) 1.20-2.00
	nofl	4.88(0.52) 3-9	5.25(1.04) 3-6
Otter Point (n=8)	connecl/w	4.55(0.52) 3.73-5.25	6.00(0.54) 4.94-6.68
	involhrs	0.05(0.11) 0-0.30	0.69(0.38) 0-1.20
	cmrfg	1.00(-) ---	1.16(0.35) 1.00-2.00
	leafl	58.73(16.02) 33.00-83.00	63.09(21.19) 35.30-89.80
	filtubert	1.00(-) ---	0.96(0.10) 0.70-1.00
Port Alberni (n=5)	leafl/w	5.06(0.63) 4.05-5.70	6.48(0.83) 5.4-7.32
	involhrs	0.03(0.08) 0-0.20	0.80(0.57) 0-1.40
	filribl/w	2.94(0.28) 2.65-3.33	2.95(0.62) 2.15-3.96
	cbcfr	2.08(1.20) 1.00-4.00	2.83(0.92) 1.50-3.80
	connecl/w	6.06(1.52) 4.40-8.38	6.13(0.81) 4.82-6.90
	connpos	1.83(0.75) 1.00-3.00	1.33(0.52) 1.00-2.00
	filribl	2.68(0.23) 2.40-3.00	2.59(0.41) 1.78-2.89
Summerland	leafl	55.18(3.78) 52.50-60.70	41.48(7.20) 35.60-50.80
	scapel	152.75(8.23) 141.50-161.00	109.25(24.76) 74.0-130.00
	nofl	4.25(1.50) 3-6	3.75(1.70) 2-6

appears to be a strong genetic control on scape length with consistent differences between populations, though scape length can vary within a population. *Dodecatheon pulchellum* appeared to be more variable than *D. cusickii*, possibly because the populations of the former are polyploid while the latter is diploid.

DISCUSSION

Morphology

The species concept used in this research is a pragmatic one. The attempt has been to describe phenetic relationships ("natural", but not necessarily phylogenetic, groups), that will result in a clear, useable taxonomy with which to identify unknown specimens of Dodecatheon. While phenetic relationships are ideally based on current total similarity within groups, this study emphasizes morphology with supporting evidence from cytology, ecology and geography.

Classical taxonomic hierarchy is based on the species as a group of organisms worthy of recognition as a distinct kind. The criteria for recognition will of necessity differ from species to species and taxonomist to taxonomist. Just what criteria are most important and how universally they should be applied has led to the current debate of 'taxonomic' vs 'biological' vs 'evolutionary' concepts of species recognition (Grant 1981, Sokal and Crovello 1970, Sokal 1974, Cronquist 1975, 1978; Wiley 1978 and Levin 1979). The various theories are often in conflict with the practice of giving the required binomial to a distinct kind of organism. The difficulties of using the biological species concept in angiosperm taxonomy are discussed by

Sokal and Crovello (1970), Cronquist (1978), Jonsell (1984) and Sokal (1974).

Ideally a dual approach is preferable, in which morphological evidence is used to recognize species which are defined in genetic terms (Davis and Heywood 1963). These would be 'natural' groups in the best sense of the word. However the correlation between morphological markers and the genetic units breaks down in a large number of cases. Therefore, at least in angiosperm taxonomy, the working consensus is that if two things cannot be told apart they belong to the same species regardless of any reproductive or cryptic morphological differences that might exist. Cronquist (1978) stated this best: "Species are the smallest groups that are consistently and persistently distinct and distinguishable by ordinary means". The task of the taxonomist is to recognize the clusters of similar phenetic variants and the gaps of discontinuity that separate them.

The distinction between species, subspecies and varietal differences has to do with the degree of morphological, ecological and/or geographical distinctness between the taxa being considered. Subspecies and varieties should represent groups of plants that are distinct morphologically, and that are at least partially isolated ecologically, geographically or both. Ecotypes are members of the same species that are adapted to different habitats and may or may not differ morphologically. As such their taxonomic importance would lie below the level of variety (Rosatti 1987). Whether subspecies or variety is used depends on the philosophy of the taxonomist, though subspecies tends to be used for large scale, regional differences, whereas variety is used for more localized, small scale patterns of variation or in situations where the variation is more difficult to explain (Davis and Heywood 1963).

The results of this study show that D. conjugens var. viscidum is a good taxonomic species, quite distinctive from the other specimens. This species is distinct in a number of characters (Table 11), the most obvious being the texture of the connective surface, and the density and type of hairs. The flowers of D. conjugens var. viscidum have shorter and broader filament tubes than D. pulchellum and its allies and the leaf blades are more ovate to elliptic.

Dodecatheon conjugens var. viscidum is not ecologically distinct from D. cusickii. During this study a mixed population of these two species was found in eastern British Columbia. Intermediate forms are not generally found, however. Thus it appears that the morphological differences between these species are maintained by reproductive isolation. Difficulty in distinguishing between D. conjugens var. viscidum and D. cusickii is probably due to misinterpretation of the characters referred to in the keys. The keys are based primarily on the texture of the

Table 11: Mean (1 sd) and range of morphological characters for four species of Dodecatheon. Character abbreviations and units are described in Table 2.

character	conjugens (n=36)	poeticum (n=7)	pulchellum* (n=254)	conjugens (n=129)
scapel	141.04(54.65)	183.29(32.17)	203.19(95.32)	171.93(59.93)
	43.00-250.00	115.00-211.00	19.00-579.00	24.00-337.00
nofl	2.31(1.12)	5.29(2.98)	4.67(1.12)	4.25(2.01)
	1-5	2-11	1-15	1-10
leafhrs	8.47(3.05)	7.74(3.02)	0.32(1.21)	6.53(2.90)
	3.00-17.20	3.60-11.20	0-14.20	0-14.00
involhrs	1.26(0.82)	7.81(2.40)	0.88(1.18)	9.46(2.56)
	0.20-3.20	4.60-11.30	0-7.40	3.80-15.50
bladel	48.15(21.78)	58.03(15.85)	54.28(27.05)	41.70(12.64)
	19.00-108.00	33.00-79.00	8.00-157.00	12.00-85.00
petiolel	28.17(16.50)	57.79(18.24)	45.54(29.02)	34.03(14.22)
	7.00-78.00	31.50-83.00	3.10-92.80	7.00-74.00
leafl	76.3236.59)	115.82(32.14)	99.82(53.51)	75.73(24.16)
	29.00-186.00	64.50-162.00	12.00-318.80	19.00-140.00
leafl/w	4.58(1.56)	6.72(1.11)	5.97(2.03)	5.96(1.76)
	2.30-9.18	4.94-8.06	1.78-14.93	2.62-11.90
filribl	1.29(0.31)	2.04(0.46)	2.11(0.52)	1.68(0.37)
	0.82-1.87	1.41-2.56	0.78-3.61	0.95-2.87
filribl/w	1.62(0.59)	2.87(0.74)	3.24(1.17)	3.72(1.25)
	0.73-3.03	1.45-3.64	1.06-9.28	1.58-8.20
filgrvl	1.17(0.39)	2.00(0.45)	2.10(0.53)	1.58(0.40)
	0-1.87	1.41-2.56	0-3.61	0-2.87
antherl	5.78(0.97)	5.49(0.65)	5.05(0.90)	4.69(0.74)
	4.48-8.83	4.48-6.35	3.13-7.96	3.09-7.17
connecl/w	5.74(1.11)	6.54(2.06)	5.76(1.29)	5.56(1.34)
	3.83-9.54	5.20-11.10	2.47-11.23	2.27-11.16
connsurf	rugose	rugose/smooth	smooth	smooth
connpos	1.35(0.57)	2.00(-)	1.80(0.65)	1.36(0.56)
	1.00-3.00	---	1.00-3.00	1.00-3.00
cabc	1.12(0.48)	4.00(-)	1.44(0.77)	1.06(0.26)
	1.00-3.50	---	1.00-4.00	1.00-3.00
cbcfr	1.01(0.08)	4.00(-)	1.36(0.71)	1.01(0.08)
	1.00-1.50	---	1.00-4.00	1.00-1.50
cbcfg	0.97(0.17)	3.93(0.19)	1.28(0.61)	1.00(0.16)
	0-1.00	3.50-4.00	0-4.00	0-2.50
cmrfr	1.04(0.18)	4.00(-)	1.26(0.65)	1.02(0.19)
	1.00-2.00	---	1.00-4.00	1.00-3.00
cmrfg	1.00(0.24)	4.00(-)	1.17(0.54)	1.01(0.17)
	0-2.00	---	0-4.00	0-2.00
antfilrt	4.76(1.43)	2.85(0.87)	2.59(0.93)	2.92(0.74)
	2.58-8.46	1.83-3.97	1.14-7.17	1.41-4.85
filtubert	0.90(0.21)	0.98(0.04)	0.99(0.07)	0.94(0.12)
	0-1.00	0.88-1.00	0-1.00	0-1.00

*includes ssp. monanthum and outliers

connective (smooth or crosswise rugose), and it is important in this context to distinguish between the connective and the filament rib. The texture of the connective is consistent, but the filament rib may or may not be wrinkled. The pattern of hair distribution on the leaves and involucre is quite distinct for each of the two species and identification can be based on these characters alone.

It is not possible from the results of this study to make firm conclusions about the relationships of D. poeticum and D. pulchellum ssp. monanthum to the rest of the group. Observations indicate that the connective surface in D. poeticum is not as consistent a character as it is in the other species. Tissue appearing rugose in fresh material of D. poeticum was often smooth when dried. This could create confusion in distinguishing specimens of D. poeticum and D. pulchellum var. monanthum; the latter has smooth connectives although the more abundant pubescence of D. poeticum should separate the two taxa. The occurrence of plants with intermediate filament tube color, both within and outside the range of D. pulchellum ssp. monanthum, indicates that the genetic determination of color may merit further study.

Several authors (Hitchcock et al. 1959; Calder and Taylor 1965, 1968) have reduced D. cusickii to an infraspecific taxon of D. pulchellum. This reflects the close relationship of these taxa. This study shows a consistent morphological difference between the two taxa:

higher density of leaf and involucre hairs in D. cusickii. In addition flowers of D. cusickii are generally smaller, the filaments are shorter and narrower, and filament length is less variable than in D pulchellum. The connectives are also slightly narrower and the filament tubes are more consistently yellow (Table 12). My observations of the ecology of D. cusickii indicate that these plants consistently occur in prairies and open forests of the dry interior between the Coast and Rocky Mountains. Unlike the sites preferred by D. pulchellum, those occupied by D. cusickii seldom have visible surface water or saturated soil during the growing season. Dodecatheon cusickii and D. pulchellum seem to be well differentiated both morphologically and ecotypically.

The consistent separation of D. cusickii from D. pulchellum seen in the morphometric analyses was also apparent in the common garden experiments. Over the three years of the common garden study those plants assignable to D. cusickii remained morphologically distinct from the remainder. The plants were also ecologically different, showing a high rate of mortality in comparison with the low-elevation coastal D. pulchellum. These consistent morphological and ecological differences are of sufficient magnitude to justify recognition of D. cusickii as a species distinct from D. pulchellum. The correct binomial is Dodecatheon cusickii Greene.

Table 12. Mean (1 sd) and range for morphological characters of Dodecatheon pulchellum and D. cusickii. Character abbreviations and units are described in Table 2.

character	pulchellum* (n=243)	cusickii (n=129)
scapel	204.44(96.18) 19.00-576.00	171.93(59.95) 24.00-337.00
nofl	4.65(2.60) 1-14	4.25(2.01) 1-10
leafhrs	0.19(0.62) 0-.7.00	6.53(2.90) 0-14.00
involhrs	0.81(1.07) 0-5.60	9.46(2.56) 3.80-15.50
bladel	54.69(27.32) 8.00-157.00	41.70(12.64) 12.00-85.00
petiolel	45.84(29.48) 3.00-192.80	34.03(14.22) 7.00-74.00
leafl	100.83(54.23) 12.00-318.80	75.73(24.16) 19.00-140.00
leafl/w	5.98(2.06) 1.78-14.93	5.96(1.76) 2.62-11.90
filribl	2.12(0.50) 0.83-3.61	1.68(0.37) 0.95-2.87
filribl/w	3.24(1.17) 1.06-9.28	3.72(1.25) 1.58-8.20
filgrvl	2.11(0.51) 0.83-3.61	1.58(0.40) 0-2.87
antherl	5.07(0.91) 3.13-7.96	4.69(0.74) 3.09-7.17
connecl/w	5.74(1.27) 2.47-11.23	5.56(1.34) 2.27-11.16
connpos	1.81(0.65) 1.00-3.00	1.36(0.56) 1.00-3.00
cabc	1.37(0.66) 1.00-4.00	1.06(0.26) 1.00-3.00
cbcfr	1.29(0.59) 1.00-4.00	1.01(0.08) 1.00-1.50
cbcfg	1.23(0.48) 0-4.00	1.00(0.16) 0-2.50
cmrfr	1.17(0.46) 1.00-4.00	1.02(0.19) 1.00-3.00
cmrfg	1.11(0.35) 0-3.50	1.01(0.17) 0-2.50
antfilrt	2.58(2.58) 1.14-7.17	2.92(0.74) 1.41-4.85
filtubert	0.99(0.03) 0.73-1.00	0.94(0.12) 0-1.00

* excludes ssp. monanthum and outliers

Morphological and ecological variability within *D. pulchellum* s.s. is continuous for all characters. There appears to be little justification for subspecific taxa: var. *alaskanum* (Hulten) C.L. Hitchcock, ssp. *alaskanum* (Hulten) Hulten, var. *alaskanum* (Hulten) B. Boi., ssp. *superbum* (Pennell and Stair) Hulten, ssp. *pauciflorum* (Durand) Hulten and ssp. *macrocarpum* (Gray) Beamish in the current literature. Morphologically they are confluent (Table 13) and, in my view, all should be included in *D. pulchellum* var. *pulchellum*. This position is supported by the considerable phenotypic plasticity seen in the common garden plants. Characters used in the literature to separate taxa (such as flower size and shape and leaf size and shape) are modified by the environment and therefore are of little use taxonomically because they do not reflect underlying genetic differences.

The one segment of *D. pulchellum* possibly deserving of formal recognition is ssp. *watsonii*. This race is consistently and distinctly separated by the morphometric analyses because of the short scapes and few flowers. The plants assignable to ssp. *watsonii* used in the common garden were ecologically distinct from the other populations in the garden, and were approaching the limits of their tolerance of the growing conditions. On the basis of the morphometric analyses and the ecological inflexibility of the Mount Arrowsmith plants I feel that this morph deserves formal

Table 13. Mean (1 sd) and range for morphological characters of six infraspecific taxa of Dodecatheon pulchellum. Character abbreviations and units are described in Table 2.

character	alaskanum (n=3)	superbum (n=4)	macrocarpum (n=21)
scapel	209.00(124.74) 65.00-284.00	256.5(111.78) 161.00-412.00	231.79(111.58) 51.00-515.00
nofl	5.00(1.73) 3-6	9.00(4.08) 3-12	5.29(2.83) 2-13
leafhrs	0.17(0.29) 0-0.50	0.25(0.50) 0-1.00	0.00(-) ---
involhrs	1.07(1.33) 0.20-2.60	1.35(0.87) 0.20-2.20	0.40(0.48) 0-0.19
bladel	73.17(37.05) 44.50-115.00	104.25(41.08) 65.00-157.00	70.67(35.89) 17.00-151.00
petiolel	70.67(26.76) 41.00-93.00	71.12(39.30) 33.00-124.00	57.47(44.30) 9.00-192.80
leafl	143.83(61.46) 85.5-208.00	175.38(80.23) 98.00-281.00	128.13(74.81) 26.00-318.80
leafl/w	5.66(0.80) 4.76-6.27	6.36(2.33) 3.84-9.45	6.12(2.74) 3.45-14.93
filribl	2.12(0.25) 1.86-2.35	1.90(0.56) 1.13-2.48	2.12(0.60) 0.87-3.61
filribl/w	2.66(0.48) 2.25-3.18	2.28(0.91) 1.06-3.20	2.78(1.05) 1.40-5.54
filgrvl	2.12(0.25) 1.86-2.35	1.90(0.56) 1.13-2.48	2.12(0.60) 0.87-3.61
antherl	6.40(1.04) 5.32-7.39	6.18(0.880 4.96-6.94	5.79(0.66) 4.13-6.78
connecl/w	7.32(0.53) 6.66-7.72	6.77(1.26) 4.96-7.83	5.79(1.010 4.05-8.12
connpos	2.00(1.00) 1.00-3.00	2.00(0.82) 1.00-3.00	1.78(0.51) 1.00-3.00
cabc	1.33(0.58) 1.00-2.00	1.88(1.03) 1.00-3.00	1.59(0.64) 1.00-3.00
cbcfr	1.17(0.29) 1.00-1.50	1.58(0.720 1.00-2.50	1.44(0.54) 1.00-3.00
cbcfg	1.17(0.29) 1.00-1.50	1.50(0.71) 1.00-2.50	1.39(0.47) 1.00-2.50
cmrfr	1.17(0.29) 1.00-1.50	1.58(0.73) 1.00-2.50	1.33(0.53) 1.00-3.00
cmrfg	1.17(0.29) 1.00-1.50	1.50(0.71) 1.00-2.50	1.15(0.32) 1.00-2.00
antfilrt	3.07(0.78) 2.48-3.97	3.42(0.730 2.80-4.48	2.94(0.93) 1.65-6.15
filtubert	1.00(-)	1.00(-)	1.00(-)

character	pauciflorum (n=1)	watsonii (n=17)	pulchellum (n=34)
scapel	140.00	59.85(24.29) 19.00-106.00	231.50(83.86) 60.00-459.00
nofl	2	1.41(0.51) 1-2	5.06(2.75) 1-12
leafhrs	0.00	0.11(0.26) 0-0.90	0.12(-) 0-2.60
involhrs	1.10	0.48(0.41) 0-1.40	0.86(1.25) 0-5.10
bladel	35.00	18.45(6.91) 8.00-38.00	60.26(23.47) 30.50-115.00
petiolel	22.00	13.62(7.09) 3.00-31.00	54.62(30.07) 8.00-143.80
leafl	57.00	32.07(13.51) 12.00-69.00	114.88(51.12) 42.00-249.80
leafl/w	4.07	4.52(1.44) 2.00-8.50	6.23(1.94) 1.78-11.32
filribl	1.30	1.72(0.56) 0.83-2.65	2.13(0.43) 1.17-3.17
filribl/w	2.06	2.48(0.95) 1.25-4.35	3.18(1.520 1.10-9.28
filgrvl	1.30	1.72(0.56) 0.83-2.65	2.13(0.43) 1.17-3.17
antherl	6.33	4.10(0.76) 3.26-5.96	5.34(0.94) 4.00-7.96
connecl/w	4.85	5.17(0.84) 3.56-6.22	5.97(1.25) 4.22-10.50
connpos	1.00	1.94(0.56) 1.00-3.00	1.79(0.69) 1.00-3.00
cabc	1.00	1.00(-) ---	1.46(0.61) 1.00-3.00
cbcfr	1.00	1.00(-) ---	1.31(0.44) 1.00-2.50
cbcfg	1.00	1.00(-) ---	1.25(0.41) 1.00-2.50
cmrfr	1.00	1.00(-) ---	1.24(0.37) 1.00-2.50
cmrfg	1.00	1.00(-) ---	1.07(0.22) 1.00-2.00
antfilrt	4.87	2.75(1.38) 1.35-6.00	2.74(1.09) 1.68-7.17
filtubert	1.00	1.00(-)	1.00(-)

recognition as Dodecatheon pulchellum var. watsonii (Tidestrom) C.L. Hitchcock.

The opinion of Calder and Taylor (1968) notwithstanding, dwarf high-elevation plants can be told apart from dwarf low-elevation maritime plants. The former have slender scapes and small, delicate flowers. Plants from exposed maritime areas are fairly robust with stocky scapes and relatively large flowers. Clarke (1973) suggested that the name D. littorale Hulten was appropriate for the dwarf maritime plants at Otter Point. However, the name was not published according to the Rules of the International Code of Botanical Nomenclature and is therefore illegitimate. Specimens from Trial Island (south of Oak Bay, Vancouver Island) and Saturna and Hornby Islands (both in the Canadian Gulf Islands) have a morphology similar to that of plants from Otter Point and were used in this study. In principal components analysis these specimens were positioned fairly close together and may form a recognizable group. However, more study will be necessary to determine if this dwarf maritime race deserves formal taxonomic recognition.

Chromosome number and polyploidy

Polyploidy, the presence of three or more sets of chromosomes in an organism, occurs in both D. pulchellum and D. cusickii. The base number, indicated by x, is the number of chromosomes in the original genome from which the polyploid or group of polyploid forms or species is known or postulated to have arisen. The base chromosome number for the genus Dodecatheon is x=22, therefore diploids have 2x=2n=44 chromosomes, tetraploids have 4x=2n=88 chromosomes, and hexaploids have 6x=2n=132 chromosomes. Dodecatheon is closely related to the genus Primula on the basis of vascular anatomy, cytology, morphology, petal epidermis characteristics, growth habit, and habitat (Douglas 1936, Thompson 1953, Rosvik 1966, 1968; Stebbins 1971). Primula has a base number of x=11 and tetraploids are also known. Stebbins (1971) speculates that the origin of Dodecatheon is probably the result of extensive diversification of a few tetraploid derivatives of Primula. Dodecatheon then underwent subsequent additional cycles of polyploidy.

Initial polyploidy events can occur in two main ways. The first of these is somatic chromosome doubling as a result of a failure of chromosome separation during mitosis, either in the zygote or in an apical meristem. The second is through non-reduction during meiosis, to produce non-reduced gametes that will have the full chromosome complement of the parent (Grant 1981, deWet 1980). Polyploid formation can occur directly through joining of two non-reduced gametes but it is more likely to involve two or more steps, with non-reduction occurring in one germ line at a time to produce either diploid pollen grains or diploid egg cells. An intermediate triploid is formed which produces non-reduced triploid gametes; these produce a tetraploid when joined with a haploid gamete. Repeated occurrences of this series of steps can lead to higher ploidy levels (deWet 1980, Grant 1980). Polyploids having odd numbers of chromosome sets, such as triploids (3x) and pentaploids (5x) tend to have very low fertility due to the formation of groups of three chromosomes (=trivalents), or the non-pairing of some chromosomes during meiosis. This leads to irregular segregation of chromosomes and gametes unbalanced for whole chromosomes. Tetraploid fertility may also be reduced because of multivalent formation during meiosis, at least initially, although "diploidization" leading to normal pairing behavior of chromosomes may often occur over a number of generations (Grant 1981).

If the chromosome increase occurs within an individual self-fertilizing plant or within a single population so that the increased chromosomes are very similar genetically, the resulting polyploid plant is classified as a strict autopolyploid. Natural autoploids are considered to be quite rare, though synthesis of artificial autoploids is done extensively in agriculture, horticulture and during determination of the parentage of natural polyploids (Stebbins 1947, 1971; Grant 1981).

Polyploidy in plants more commonly involves hybridization of one sort or another (Grant 1981, Stebbins 1971). Hybridization can be defined as "crossing between individuals belonging to populations which have widely different adaptive requirements" (Stebbins 1971). On this basis hybridization could be between ecotypes or subspecies of a species, between different species of a genus or between different genera. Polyploidy involving hybridization between two genetically different genomes, such as two species, is termed allopolyploidy. The initial diploid offspring, containing a chromosome set from each parent, will be sterile because the non-homologous chromosomes do not pair during meiosis. Doubling of the chromosomes to form a tetraploid would restore full fertility in the hybrid, as each chromosome will pair with its homologous counterpart during meiosis.

Intra-specific hybridization, between subspecies or ecotypes of a species, involves two genomes with a majority of chromosomal segments in common but differing to some degree in either chromosome morphology or in genetic content. Stebbins (1971) terms these hybrids "segmental allopolyploids". Fertility of the diploid hybrids between two genetic races of this sort could be low because of multivalent formation, but preferential pairing in a tetraploid would restore full fertility.

Interecotypical hybrid polyploids are morphologically and ecologically intermediate between the parental diploids. The evolutionary success of tetraploid populations is often promoted by their hybrid vigor, and the complexity of inheritance of four alleles in the progeny tends to buffer intermediate genotypes and reduce the effects of genetic segregation. The complexity of tetrasomic inheritance at the tetraploid level gives these genotypes and populations greater stability than the corresponding ones at the diploid level (Stebbins 1971).

Polyploid levels beyond tetraploid can arise from inter-crossing of tetraploids or by back-crossing of tetraploids to one or both of their diploid parents. These processes also will increase both the morphological range of variability and the ecological tolerances of many polyploids, greatly complicating taxonomic relationships that were originally quite simple (Stebbins 1971).

The separation of D. pulchellum and D. cusickii based on morphological variability, ecological preferences and geographical distribution is supported by the known and inferred chromosome numbers. Dodecatheon cusickii is essentially a diploid species, while D. pulchellum contains diploids, tetraploids and hexaploids. The morphological, ecological and geographical variability encompassed by each species may well be a consequence of the ploidy levels within each species. The restricted habitat preferences, fairly small geographical range, and greater morphological uniformity of *D. cusickii* in comparison with *D. pulchellum* fits well with the characteristics of diploids as compared to polyploids. *Dodecatheon cusickii* has less morphological variation in most characters than does diploid *D. pulchellum*, indicating that there may also be some differences in genetic variability between the two species at the same ploidy level.

Polyploidy does occur in *D. cusickii* but at low frequencies. My observations of morphology suggest that most of the specimens with a pollen grain diameter that did not clearly indicate the ploidy level (i.e. with pollen of intermediate size) were diploids; polyploid plants in this species tend to be larger in size than diploid individuals.

The diploids of *D. pulchellum* showed a high level of morphological variability, probably corresponding with the existence of various ecological groups. The polyploids tended to have slightly lower levels of morphological variability in most characters as indicated by comparison of standard deviations in Table 14. This is not an unusual situation in polyploids (Stebbins 1971) but may be an artifact of the smaller number of polyploids sampled in this study. Probably *D. pulchellum* consists of several fairly

Table 14. Mean (1 sd) and range for morpholgical characters of diploid and polyploid members of Dodecatheon pulchellum and D. cusickii. Character abbreviations and units are described in Table 2.

character	pulchellum		cusickii	
	diploid	polyploid	diploid	polyploid
scapel	200.16(102.19)	193.10(83.25)	168.67(60.30)	244.50(17.68)
	19.00-515.00	40.00-338.00	24.00-295.00	232.00-257.00
nofl	5.03(2.93)	3.59(1.74)	4.26(2.11)	3.50(0.71)
	1-13	1-9	1-9	3-4
leafhrs	0.18(0.75)	0.12(0.38)	6.43(2.65)	4.60(0.57)
	0-7.00	0-1.80	0-12.80	4.20-5.00
involhrs	0.85(1.16)	0.50(.067)	9.54(2.57)	5.30(0.71)
	0-5.60	0-3.30	3.8-15.50	4.80-5.80
bladel	53.25(29.16)	54.90(25.92)	41.03(11.87)	71.00(19.80)
	11.00-157.00	8.00-122.00	12.00-70.00	57.00-85.00
petiolel	43.61(27.03)	44.72(23.68)	33.91(14.78)	37.50(30.41)
	3.00-135.00	4.00-95.00	7.00-74.00	16.00-59.00
leafl	96.86(54.33)	99.62(45.71)	74.94(24.54)	108.5(10.61)
	14.00-281.00	12.00-217.00	19.00-144.00	101.00-116.00
leafl/w	5.89(2.01)	6.00(1.88)	6.01(1.86)	4.80(2.32)
	1.78-14.93	2.00-10.15	2.62-11.90	3.16-6.44
filribl	2.10(0.54)	2.23(0.48)	1.64(0.34)	1.89(0.71)
	0.83-3.61	1.50-3.32	0.95-2.35	1.39-2.39
filribl/w	3.29(1.27)	3.14(0.84)	3.59(1.03)	3.03(1.27)
	1.06-9.28	1.56-5.38	1.58-6.28	2.13-3.93
filgrvl	2.10(0.54)	2.23(0.48)	1.57(0.36)	1.56(0.25)
	0.83-3.61	1.50-3.32	0.80-2.35	1.39-1.74
antherl	4.95(0.96)	5.23(0.80)	4.62(0.63)	5.89(0.83)
	3.26-7.96	3.56-6.78	3.09-6.74	5.30-6.48
connecl/w	5.69(1.15)	5.92(1.58)	5.44(1.30)	6.83(1.52)
	3.55-10.50	3.62-11.23	3.13-11.16	5.30-7.45
connpos	1.85(0.69)	1.86(0.74)	1.37(0.58)	1.50(0.71)
	1.00-3.00	1.00-3.00	1.00-3.00	1.00-2.00
cabc	1.25(0.55)	1.31(0.57)	1.02(0.16)	1.00(-)
	1.00-3.00	1.00-3.00	1.00-2.50	---
cbcfr	1.17(0.41)	1.46(0.85)	1.02(0.09)	1.00(-)
	1.00-3.00	1.00-4.00	1.00-1.50	---
cbcfg	1.14(0.36)	1.48(0.78)	1.02(0.16)	1.00(-)
	1.00-2.50	1.00-4.00	1.00-2.50	---
cmrfr	1.14(0.37)	1.07(0.22)	1.04(0.23)	1.00(-)
	1.00-3.00	1.00-2.00	1.00-3.00	---
cmrfg	1.07(0.26)	1.20(0.41)	1.03(0.18)	1.00(-)
	1.00-2.50	1.00-2.50	1.00-2.50	---
antfilrt	2.55(0.98)	2.46(0.72)	2.94(0.74)	3.44(1.73)
	1.27-6.15	1.32-4.06	1.41-4.85	2.22-4.66
filtubert	0.99(0.03)	1.00(-)	0.96(0.08)	0.86(0.19)
	0.73-1.00	---	0.66-1.00	0.73-1.00

distinct diploid groups, together with polyploid hybrids that have arisen in the areas of overlap between the different diploid races. The hybrids are morphologically variable and intermediate, obscuring some of the differences that might otherwise be seen between the diploids.

Common garden experiment and phenotypic plasticity

The phenotype of a plant is the outcome of interactions between the genotype and the environment and environmental modification of phenotypic characters in plants is common (Bradshaw 1965, Briggs and Walters 1984, Morisset and Boutin 1984, Jefferies 1984). A single genotype may produce a number of environmentally induced phenotypes, a response termed 'phenotypic plasticity'. Phenotypic plasticity may contribute to difficulty in forming taxonomic judgements when characters are so highly plastic that environmental influences can obscure genetic relationships (Davis 1983). The recognition of plasticity is necessary in any biosystematic study but is often neglected (Morisset and Boutin 1984). The meristematic growth pattern and sessile habit of plants means that a plant is susceptible to environmental variation over its lifetime and must often respond by changes in morphology or physiology to ensure its survival or maintain its reproductive success. This will be especially true of long-lived perennials, but annuals can show considerable plasticity in response to heterogeneous environments (Bradshaw 1965).

The common garden experiment of this study was an attempt to determine if phenotypic plasticity exists in D. pulchellum and D. cusickii. Plants of all populations growing in the common garden showed morphological changes, although a different set of characters was modified in each population. Dodecatheon cusickii remained morphologically distinct from the four D. pulchellum populations and responded to the garden environment with decreased flower number, scape length, and leaf length. The plants also showed a low tolerance for the common garden environment, reflected in the reduced blooming rate and high mortality. This species inhabits dry areas and experiences winters with sub-zero temperatures and is probably not well adapted to the warm, wet winters typical of the coastal climate of the garden.

The four D. pulchellum populations that bloomed in the garden did not converge on a common morphology. Despite the fact that ranges of character values overlapped for the populations, each maintained a distinct overall phenotype. Apparently each population has undergone some selection in its native habitat resulting in genotypes with a range of phenotypic responses best suited to conditions encountered in that habitat (Jefferies 1984, Bradshaw 1965).

The two populations most morphologically alike originally, Camas Hill and Ashley Bay, showed some convergence. These plants come from ecologically similar habitats and appear to be genetically similar in their physiological tolerances, responding to the garden environment in similar ways.

The Port Alberni and Otter Point plants demonstrate the extremes of adaptation. The estuarine plants from Port Alberni naturally grow among tall grasses and sedges, and have long scapes and long, thin, upright leaves. At Otter Point the plants are exposed to strong winds and salt spray, and have short, stocky scapes and thick, broad leaves that tend to hug the ground. These differences were retained in the garden. The estuarine plants showed considerable physiological adaptability. The native habitat is wet and brackish year round, while the common garden was watered with fresh water during the spring and early summer and then allowed to dry out. These plants wilted more often than those of the other populations but still bloomed well and set large numbers of seeds. At the other extreme, the plants from Mount Arrowsmith showed great physiological intolerance of the garden conditions. Many of the plants died the first year after transplanting to the garden, possibly because of the mild, wet winter. Plants from Otter Point, Camas Hill and Ashley Bay did not show any obvious physiological changes. There are distinct genetic differences, morphological and physiological, among the populations of D. pulchellum grown in the common garden.

Dodecatheon morphology does not provide many characters for taxonomic use. Many of the characters used by Beamish (1955), Hulten (1968) and Hitchcock et al. (1959), such as flower size, leaf size and leaf shape, show phenotypic plasticity. Filament tube color in D. pulchellum was easily modified by environmental conditions of the common garden. This suggests that D. pulchellum ssp. monanthum requires close study. All D. pulchellum plants had an increase in the density of involucre hairs, but not to a sufficient density to cause confusion with D. cusickii. Leaf length and width were modified in some populations of D. pulchellum, as were three components of flower structure (filament rib length, filament rib length/width ratio and connective length/width ratio). These characters are of limited taxonomic value because of their plasticity. Interestingly, scape length (a character that often shows phenotypic plasticity (Daubenmire 1959)) was not modified by environmental conditions. Scapes of Port Alberni plants grown in the common garden were often bent from lack of full turgor pressure but did not differ in length between years. Scape length is variable within populations but may be of taxonomic use in recognizing races from extreme habitats, such as D. pulchellum var. watsonii and the plants found at Otter Point.

Chapter 2. REPRODUCTIVE BIOLOGY OF NATURAL POPULATIONS OF *DODECATHEON PULCHELLUM*

INTRODUCTION

The recognition of taxonomic groups relies on the detection of modes or clusters of similar morphological variants and the discontinuities that separate them. Taxonomic decision-making is helped by knowledge of the breeding system of the organism under study because various patterns of morphological variation are created and maintained by different methods of reproduction.

Non-morphological characters are also important in taxonomic decision-making. Characters such as phenology (the timing of growth and reproduction), requirements for seed germination, patterns of reproductive effort, and type of breeding system are also genetically determined (at least in part), and may be useful in supporting the recognition of morphologically determined taxa.

Reproduction in natural populations of plants takes place by four common methods: 1) cross-fertilization (=outcrossing), commonly between neighbouring plants that may also be related; 2) self-fertilization (=autogamy), resulting in highly inbred offspring; 3) vegetative propagation; and 4) production of seeds with embryos that develop from maternal tissue without fertilization

(=agamospermy.) The first two methods are sexual, involving meiosis and fertilization; the latter two are asexual methods, collectively termed apomixis. Reproduction in most vascular plant species involves a combination of these methods (Grant 1981).

Sexual outcrossing promotes genetic heterozygosity within individuals, and tends to create patterns of continuous variation between populations while also creating considerable diversity among individuals. Continuous selfing in a population has the opposite effect on the pattern of variation. Heterozygosity is reduced and the population is split into numerous more or less pure lines. Homozygosity of alleles determining morphological traits leads to uniformity within populations and often sharp discontinuities between populations. Apomictic reproduction perpetuates individual genotypes and creates groups of identical individuals that differ from one another in minor characteristics and that do not exchange genetic information. Pure apomixis (with no sexual reproduction at all) is quite rare but many plant species have predominantly asexual reproduction (Davis and Heywood 1963, Jones and Luchsinger 1986, Grant 1981).

Little information has been accumulated to date on the reproductive biology of Dodecatheon pulchellum. The species occurs over a wide variety of habitats, which vary in environmental harshness and predictability. Variation in flowering and reproductive patterns between populations would be expected in such an ecologically diverse species.

Turner and Quarterman (1968) found a considerable difference in the number of seeds per plant in two ecologically diverse but spatially close populations of *D. meadia*. Woodland plants set less than half the number of seeds set by plants growing in a cedar glade.

Thompson (1953) speculated that undisturbed flowers of *Dodecatheon* would be self-pollinated because the orientation of the anthers and stigma would permit pollen to fall on the stigma. However, undisturbed flowers of *D. meadia* (Macior 1964, Turner and Quarterman 1968) and *D. amethystinum* (Macior 1967) failed to set seed, whereas plants exposed to insects set abundant seed. *Dodecatheon meadia* is pollinated by solitary bees and bumblebees; pollen is vibrated from the anthers and falls on all parts of the insect. After grooming, some pollen remains in the anterior ventral region of the abdomen of the insect, which contacts the stigma of subsequent flowers during pollen collection (Macior 1964).

The aims of this study were to examine four components of the reproductive biology of *Dodecatheon pulchellum* in British Columbia. These are: 1) breeding system, 2) phenology, 3) reproductive effort, and 4) seed germination.

MATERIALS AND METHODS

Three populations were studied for phenology and reproductive effort; these were located at Ashley Bay, Camas Hill and Mount Arrowsmith and are described on page 21 (see also Figure 3). All the sites have wet soil during the growing season. The low elevation sites, Ashley Bay and Camas Hill, become very dry later in the season; the high elevation site at Mount Arrowsmith dries out in some years, depending on summer weather patterns.

Phenology

Phenological observations were made at weekly to bi-monthly intervals at all three sites in 1984 and at Camas Hill in 1985. The following data were collected: 1) number of flowers per plant; 2) stage of flowering [(i) buds, (ii) open flowers (petal lobes reflexed and stigma fully exposed), (iii) withered flowers (petal lobes withered and pollen sacs empty), (iv) immature capsules (green with red apex), and (v) mature capsules (brown and beginning to dehisce)]; and 3) flowering period (including start, peak and finishing dates).

Reproductive Effort

Data on fruit set were collected at all three sites in 1984, at Mount Arrowsmith and Camas Hill in 1985 and at Camas Hill in 1986. Data included: 1) number of flowers per plant; 2) number of mature capsules per plant; 3) percentage of flowers per plant that produced capsules; 4) total number of seeds per plant; 5) number of seeds per capsule per plant; and 6) reason for lack of flower or capsule success (abortion or predation).

Breeding System

The breeding system of Dodecatheon pulchellum was studied at the Camas Hill site. Ten plants were used for each of the following treatments: 1) 'control': to test for natural cross-pollination and to determine normal seed set; 2) 'self-pollination': pollinators excluded and then the flowers left alone to test for passive self-pollination; 3) 'self-compatibility': pollinators excluded and then each flower self-pollinated to test for self-compatibility, (normal seed set would indicate self-pollination and self-fertility); and 4) 'hand-pollination': each flower hand-pollinated with a mixture of pollen from five widely separated plants to determine if seed set was pollen-limited. Insects were excluded with white, fine-mesh nylon netting. The netting was held away from the flowers by a narrow, horizontal metal hoop supported by three equally spaced bicycle spokes. The netting was tied around the scape well below the flowers. Each flower receiving pollen was pollinated at least twice during its 'open' stage.

Mature capsules were collected from all plants and the total numbers of seeds per plant and number of capsules per plant were recorded.

Seed Germination

Seeds from six populations of *D. pulchellum* and one population of *D. cusickii* were used for study of germination requirements. The effects of increased length of cold, moist stratification on germination rates was examined. The six *D. pulchellum* populations were from the following localities: Otter Point, Ashley Bay, Camas Hill, Duncan, University of Victoria campus and Mount Arrowsmith; *D. cusickii* was collected at Summerland. The Otter Point, Ashley Bay, Camas Hill, Mount Arrowsmith and Summerland sites have been described in Chapter 1. The other two sites were arbutus-Douglas fir parklands typical of ephemerally wet *D. pulchellum* habitats on southern Vancouver Island. *Dodecatheon cusickii* was included because it is a part of the *D. pulchellum* complex in British Columbia.

Seed was collected from all six sites in July and August of 1984 and stored at ambient conditions in the lab. In September of 1985, 800 seeds from each population were divided into 16 fifty-seed lots, and two lots were used for each of eight treatments. Each seed lot was placed in a moisture-tight plastic box (four lots to a box). Each lot was in a small filter-paper boat; in order to maintain high humidity the boxes were lined with creped cellulose saturated with double-distilled water. All seeds were then placed in a dark refrigerator at 4°C. Over an eight week period, two lots (100 seeds) per week from each population were placed into a growth chamber with a thermoperiod of 10 -28°C and photoperiod of 12 hours. Each seed lot remained in the growth chamber for four weeks; the number of seeds germinated was recorded twice a week.

Seed lots from Summerland had no 2- or 4-week treatments and those from Duncan had no 2-week treatment because of an insufficient number of seeds.

RESULTS

Phenology

The phenology of the study populations is summarized in Figure 20. Development from visible buds to mature capsules takes 15-17 weeks (mid-March to early July) at Ashley Bay and Camas Hill, and 9-10 weeks (mid-July to early September) at Mount Arrowsmith. The date of first bloom at Camas Hill was 10 days later in 1985 than in 1984 possibly because of a between-year differences in spring temperatures. The early part of the growing season in 1985 was much colder and drier than in 1984 (Table 15). A more striking effect of weather was seen at Mount Arrowsmith in 1985. When the population was visited on July 20, the start of the blooming season the year before, only immature capsules were found. The site was already drier than at any time in 1984. Mount Arrowsmith plants grown in the common garden emerged at the same time as the low elevation plants, not four months later, as is typical in the native habitat. Between 35% and 40% of the flowers were open at peak bloom in the low elevation populations; 50% of the flowers were open at peak bloom in the high elevation population.

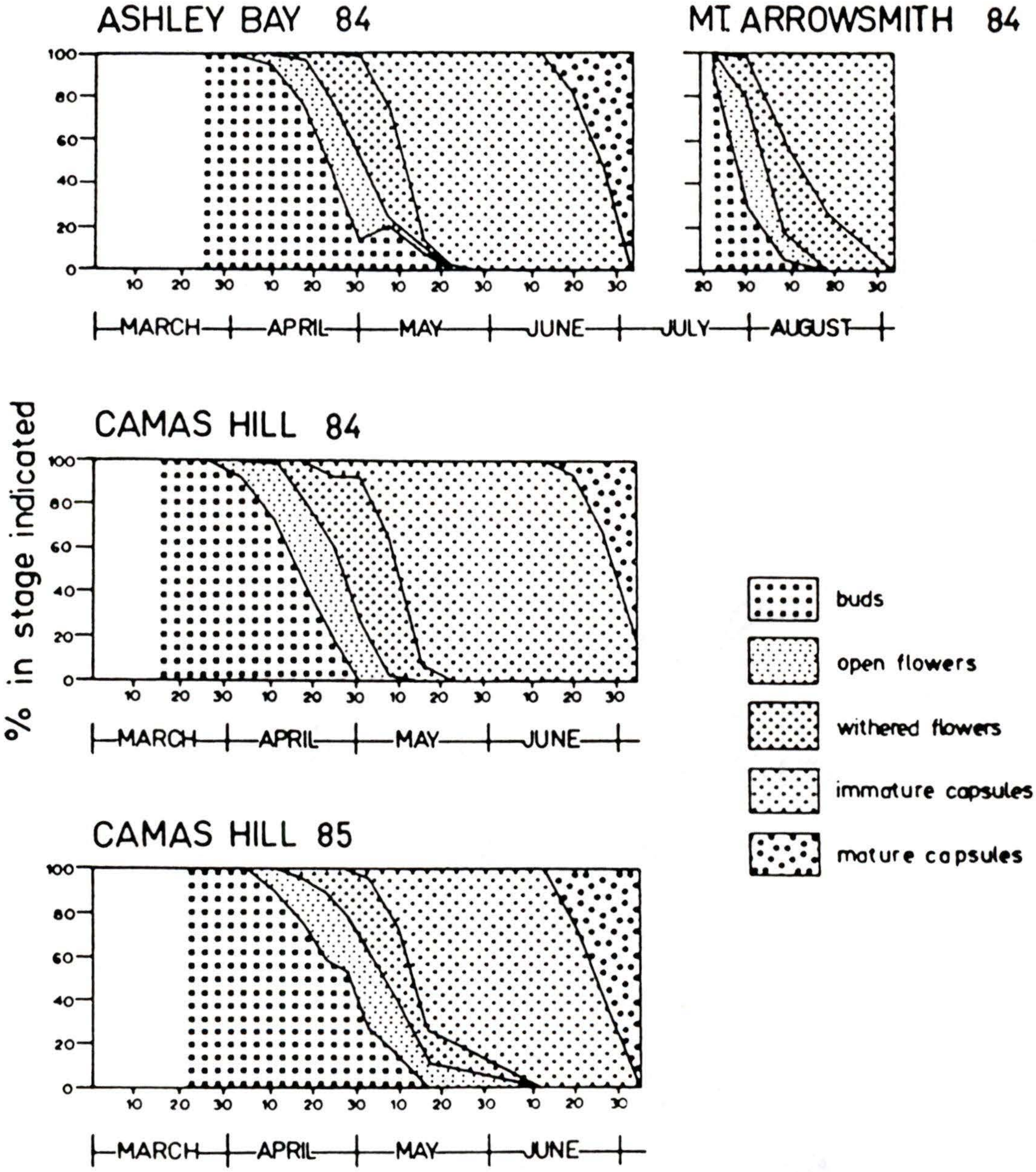
Individual flowers at Camas Hill were in the 'open' stage for five to seven days and individual plants had a short blooming period of one to three weeks (Figure 21).

Figure 20. Flowering phenology of three *Dodecatheon pulchellum* populations on Vancouver Island, British Columbia.

Camas Hill = 28 plants

Ashley Bay = 13 plants

Mount Arrowsmith = 18 plants

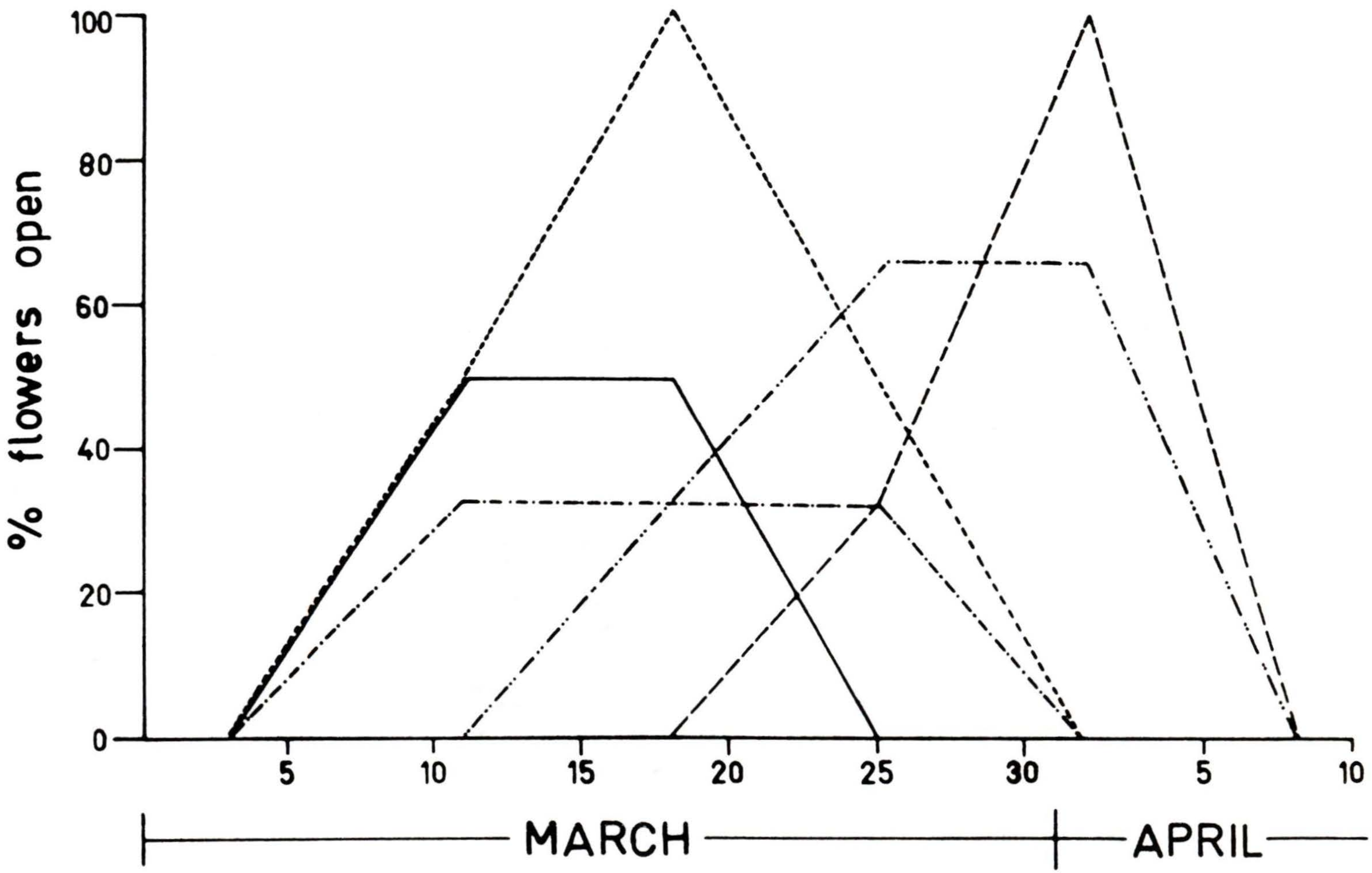


ASHLEY BAY 84
MT. ARROWSMITH 84
CAMAS HILL 84
CAMAS HILL 85
% in stage indicated
100
80
60
40
20
0
10 20 30 10 20 30 10 20 30 10 20 30
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
buds
open flowers
withered flowers
immature capsules
mature capsules

Table 15. Summary of weather data from Glintz Lake station, applicable to Camas Hill, Vancouver Island. (Atmospheric Environment Service, Environment Canada, per. comm.)

	$\bar{x}$ daily temperature(°C)		$\bar{x}$ daily precipitation(mm)	
	$\bar{x}$ (sd)	$\bar{x}$ (sd)	$\bar{x}$(total)	$\bar{x}$(total)
January	4.0(3.2)	1.3(1.9)	8.7(269.8)	0.8(27.0)
February	5.0(2.0)	1.9(2.8)	5.0(144.7)	3.9(110.3)
March	6.3(1.4)	3.4(1.4)	3.8(117.3)	2.9(88.9)
April	6.8(2.1)	6.5(2.3)	2.9(85.8)	4.2(127.1)
May	8.9(2.0)	10.0(3.0)	3.2(100.9)	1.0(31.2)
June	11.9(2.0)	12.5(2.4)	2.0(60.0)	1.4(42.4)
July	14.9(2.4)	17.1(2.4)	0	0.3(10.0)

Figure 21. Flowering phenology of five indiviual _Dodecatheon_ _pulchellum_ plants at Camas Hill in 1984.


% flowers open
100
80
60
40
20
0
5
10
15
20
25
30
5
10
MARCH
APRIL

The low synchrony among plants resulted in a blooming period of five to seven weeks for the population.

Reproductive effort

All populations contained non-blooming individuals (Table 16). Of 28 plants observed at Camas Hill for three years, six bloomed each year, five bloomed twice, 12 bloomed once, and five did not bloom at all. Of the five that bloomed twice, three bloomed in alternate years and two in consecutive years.

The two low-elevation populations had good capsule production over the three years examined; at least 72% and usually more than 80% of the flowers produced seed. The high elevation population had equally good capsule production in 1984, but possibly of the early drying of the site in 1985 only 27% of the flowers set seed. None of the 18 plants observed at Mount Arrowsmith in 1984 produced seed in 1985. Reproductive losses in the low elevation plants were from predation of ovaries and capsules by insect larvae, and in the high elevation plants from abortion of flowers, often with loss of the entire inflorescence.

In 1984, at Camas Hill, there was a significant positive correlation ($r=0.70$, $0.025<P<0.01$) between the date of peak bloom (setting day 0 as the day of first bloom in the population) for nine individual plants and the mean number

Table 16. Summary of reproductive effort for three populations of <u>Dodecatheon pulchellum</u>.

	Camas Hill			Mount Arrowsmith		Ashley Bay
	1984	1985	1986	1984	1985	1984
number of plants blooming	15	11	16	18	16	13
(% of plants observed)	53	39	57	100	50	100
number of plants set seed	12	10	13	16	5	13
(% of number blooming)	80	91	81	89	31	100
number of capsules	31	37	48	36	8	59
(% of flowers)	72	83	94	88	27	86
$\bar{x}$ capsules/plant (sd)	2.6(0.7)	3.7(2.7)	3.8(1.8)	2.2(1.1)	1.6(2.9)	4.5(2.1)
range	1-6	1-9	1-7	1-5	1-3	2-10
$\bar{x}$ seeds/plant (sd)	*131.0(81.5)	169.5(249.4)	79.5(83.5)	11.1(14.0)	17.2(17.7)	157.2(119.5)
range	31-291	18-862	13-304	0-48	0-41	15-354
$\bar{x}$ seeds/capsule/plant (sd)	47.2(20.3)	37.6(23.8)	21.8(17.9)	4.9(5.2)	9.8(11.5)	32.3(20.3)
range	15.5-74.3	18-95.8	3.2-50.7	0-16	0-30	50-70.8

* based on 10 plants

of seeds per capsule per plant (Figure 22). In all populations there were no significant correlations between the number of flowers per plant and the percentage of flowers that produced seed. Losses of fruits appeared to occur independently of plant vigour.

Breeding System

Results are summarized in Table 17. None of the undisturbed flowers produced capsules while all other treatments resulted in seed production. The flowers receiving additional pollen and the naturally pollinated flowers did not differ significantly in the mean number of seeds/capsule/plant. The self-pollinated flowers set significantly fewer mean number of seeds/capsule/plant than either outcrossing treatment (self-pollinated *vs* hand pollen: Mann-Whitney U-test, $P<0.001$; self-pollinated *vs* control: Mann-Whitney U-test, $P<0.001$; both tests, $\alpha=0.05$). The seeds resulting from self-pollination were tested for viability. They were given three weeks of cold, moist stratification; after a further three weeks of 12 hour photoperiod with 10°-28°C thermoperiod, germination was between 16% and 56%. Germination of outcrossed seeds from the Camas Hill population after three weeks of stratification was 11%. All seedlings were lost to damping-off.

Figure 22. Seed production *vs* date of peak bloom for individual plants at Camas Hill.

● 1984 (n=9)

■ 1985 (n=5)

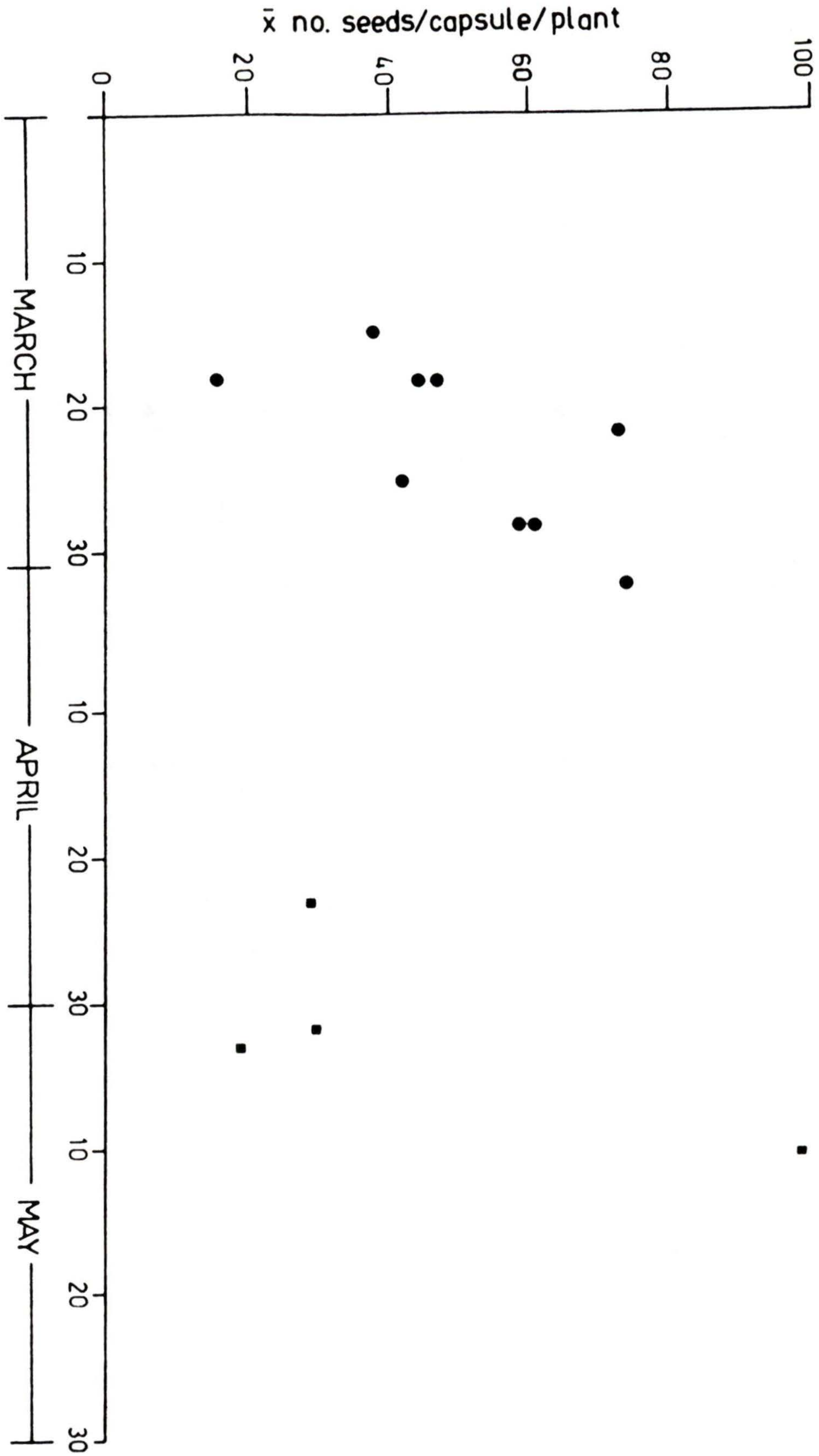

x̄ no. seeds/capsule/plant
0
20
40
60
80
100
10
20
30
MARCH
APRIL
MAY

Table 17. Results of experimental selfing and outcrossing at Camas Hill. Each treatment: n=10. All possible pairs tested by Mann-whitney U-test (α=0.05, 2-tailed); values with the same letter are not significantly different.

Treatment	no. plants setting seed	no. flowers setting seed (% of total no. flowers)	$\bar{x}$ seeds/capsule/plant (sd) range
self-pollination	0	0	---
self-compatibility	10	21 (49)	* 8.3 (8.5) 0-22.5 a
hand-pollinated	10	36 (88)	36.1 (15.9) 10.6-52.6 b
control	10	37 (83)	37.6 (24.8) 18.0-95.8 b

* based on 9 plants (in one plant 3 capsules were lost to predation)

Seed germination

All populations except those from Camas Hill and Duncan had best total germination after eight weeks of stratification; the Camas Hill and Duncan populations had best total germination after seven weeks of stratification (Figure 23). Total germination after eight weeks of stratification differed considerably among populations of D. pulchellum, ranging from 63% for Otter Point to 4% for Mount Arrowsmith. The D. cusickii seeds began to germinate at 4°C during the 8-week treatment. Only the Ashley Bay population had a steady increase in total germination with increased length of stratification. All other low-elevation populations showed some degree of germination depression between four and six weeks.

Germination rates for each treatment were rapid in the first one or two weeks after the seeds were placed in the growth chamber, and then rapidly decreased to zero or very low rates of germination.

Figure 23. Cumulative percent germination of seeds from six Dodecatheon pulchellum populations and one D. cusickii population.

Number of weeks of stratification:

○ 1

□ 2

△ 3

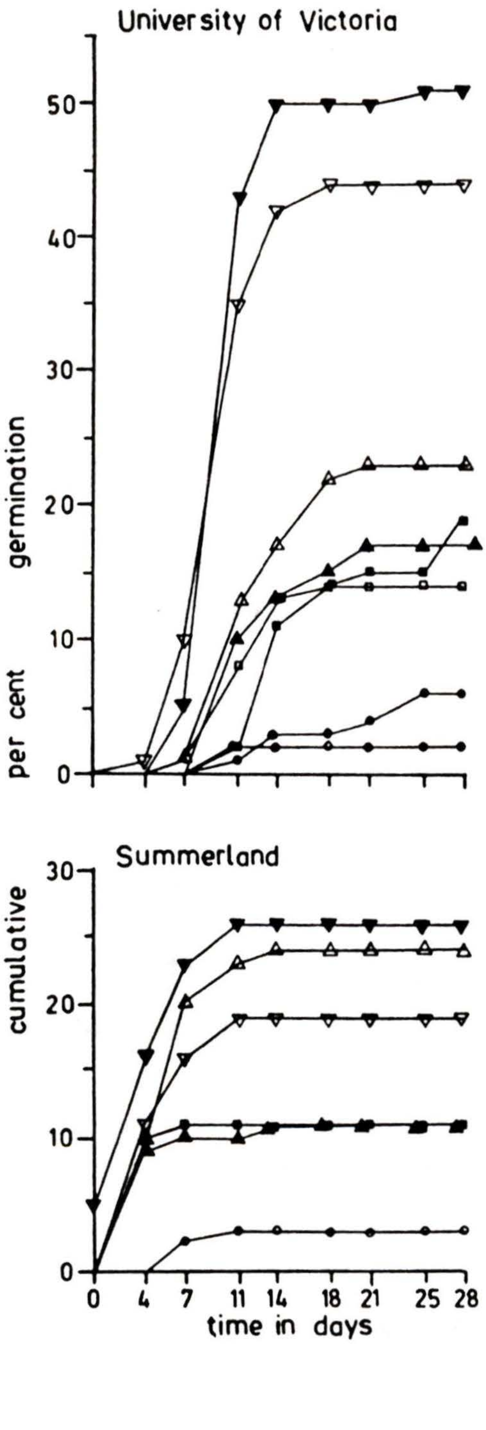
● 4

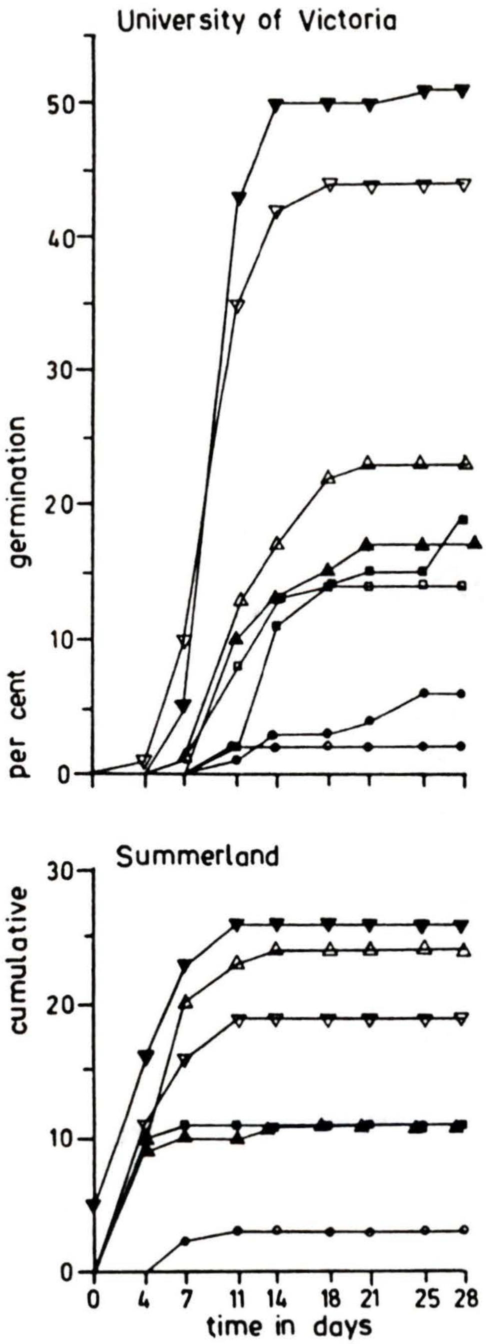
■ 5

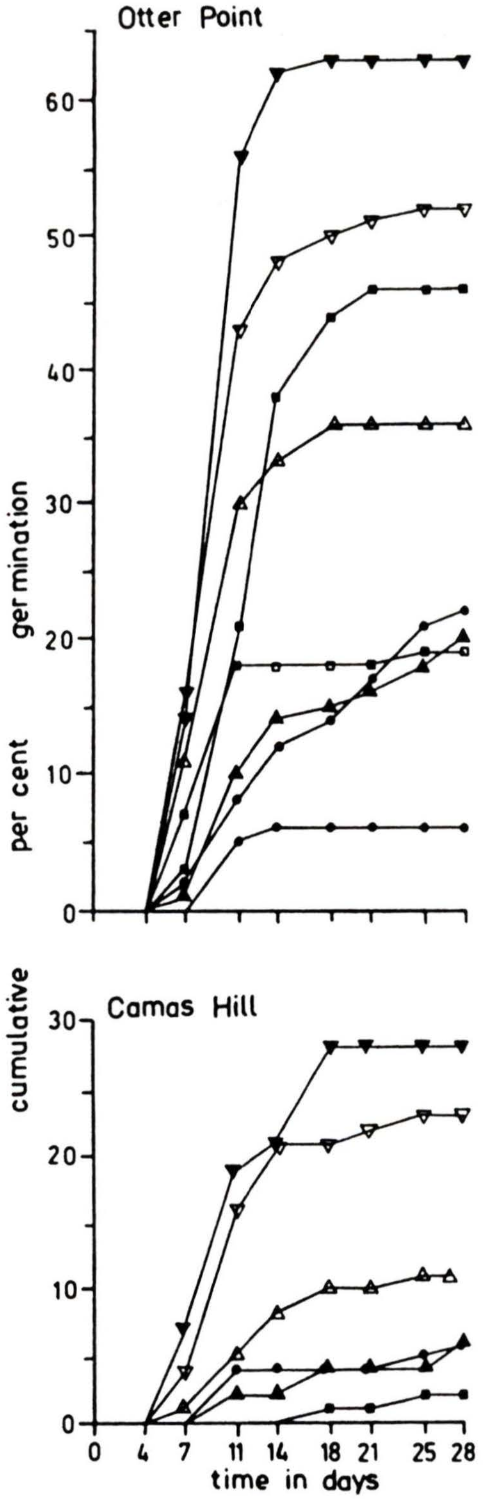
▲ 6

▽ 7

▼ 8


University of Victoria
Summerland
cumulative per cent germination
time in days
0
10
20
30
40
50
0
4
7
11
14
18
21
25
28


University of Victoria
Summerland
cumulative per cent germination
time in days
0
10
20
30
40
50
4
7
11
14
18
21
25
28


Otter Point
Camas Hill
per cent cumulative germination
time in days
0
4
7
11
14
18
21
25
28
0
10
20
30
40
50
60

DISCUSSION

Reproductive Biology

The high number of seeds produced by open-pollinated flowers but not by selfed or pollinator-excluded flowers indicates that *D. pulchellum* at Camas Hill is predominantly outcrossed. The large, brightly coloured flowers are typical of many insect-pollinated plants. Seed set in selfed flowers is very low, indicating that mechanical and/or physiological barriers to self-fertilization exist. Self-pollination occurs only if pollen is actively transferred from the anthers to the stigma; pollen does not fall passively onto the stigma of the same flower. These patterns of low seed set from self-fertilization and non-passive self-pollination are seen as well in *Trientalis borealis*, also in the Primulaceae (Anderson and Beare 1983). Self-pollination in *D. pulchellum* is probably uncommon, because the stigma of a flower probably contacts the residual pollen on the ventral surface of a pollinator before the insect begins to gather pollen from the anthers of that flower.

The number of seeds set in outcrossed plants at Camas Hill does not appear to be limited by the amount of pollen deposited on the stigma; the addition of pollen to otherwise outcrossed plants did not increase the number of seed produced. All capsules in all populations contained aborted seeds and maternal resources may have a more important effect on seed set. Galen _et al_. (1985) found that increased seed set in _Clintonia borealis_ was a balance between maternal resource availability and the amount of outcrossing provided by pollinators. Outcrossing may also be promoted by the low flowering synchrony in _Dodecatheon_ populations, which forces pollinators to fly between distantly spaced individuals, thus avoiding pollen transfer between closer, possibly more related plants.

Early-blooming plants at Camas Hill in 1984 set fewer seeds than later-blooming plants. There are two possible explanations. First, there may be few pollinators early in the season and the flowers may receive insufficient pollen. Second, there may be little pollen from other plants available during the critical period of stigma receptivity; though pollinators may be active, small pollen deposits could limit seed set. Pollinator activity may cause self-pollination if the insect is not carrying sufficient pollen from other plants to coat the stigma of a flower and prevent pollen from the same flower from contacting the stigma. The resulting partial or total self-fertilization would result in lower seed set.

The populations at Camas Hill and Ashley Bay are approximately 50 km apart and share many edaphic and climatic conditions; both grow at or near sea level in open grassy areas; winters are mild and the soil is predictably wet during the blooming season. The Mount Arrowsmith population grows in a much less predictable environment. The site is at an elevation of 1500 m and the accumulation of snow varies from year to year, as does the time it takes the site to become snow-free. The short growing season occurs between snowmelt and the first fall storms, and may be adversely modified by high summer temperatures combined with low snowmelt; soil moisture during the growing season is unpredictable. The similarities in habitat and geographical location of the Camas Hill and Ashley Bay populations are probably the reason for their greater similarity in comparison with the Mount Arrowsmith population.

The lower number of seeds per capsule per plant produced by the Mount Arrowsmith plants could be a response to the unpredictable growing conditions. There could be several advantages to producing a few seeds with certainty of success instead of risking a greater number of seeds (Harper 1977). The plants are physically small and there may be a trade-off between continued vegetative survival and the maternal resources allocated to seed production, such that only a few seeds can be set without depleting the plant's resources and increasing the risk of mortality. An increase in the number of seeds may occur at the expense of seed size, and in the harsh sub-alpine environment larger seeds may have a survival or germination advantage over smaller seeds. There is high variability among individual plants in the number of seeds produced in all populations. This could be because of microsite favorability but may also reflect differing plant vigor and past reproductive history. Not all plants bloom in all years; at Camas Hill the few plants that bloomed in three consecutive years were among the most vigorous in the population. Other plants may require a non-blooming season to accumulate sufficient resources to bloom and set seed successfully.

Reproductive failure in the high elevation population was mainly because of flower abortion, which in turn is probably related to site conditions. In 1985 at least 50% of the plants in this population aborted entire inflorescences. In the more 'stable' low-elevation environments, reproductive losses are mainly from predation of ovaries and immature capsules. Usually not all the flowers in an inflorescence with more than one flower are lost; therefore predation may inadvertently help increase seed set per capsule if maternal resources are limiting seed set.

Phenology

Emergence of *D. pulchellum* plants in the spring appears to be more a function of soil temperature than of photoperiod. In 1984 plants at Camas Hill bloomed 10 days earlier than those at Ashley Bay. Camas Hill is steeper than Ashley Bay and faces due south; the soil warms faster because of greater solar radiation. The spring of 1985 at Camas Hill was later and colder than in 1984 and the plants bloomed about 10 days later. A similar situation occurred at Mount Arrowsmith when the plants bloomed about three weeks earlier in 1985. In the common garden the Mount Arrowsmith plants emerged four months earlier than in their native locality. The *D. cusickii* plants grown in the common garden emerged ten to fourteen days before all populations of *D. pulchellum* in the three years of observation. Dormancy in *D. cusickii* and low-elevation *D. pulchellum* plants could begin as a response to high temperatures during summer drought (Etherington 1984). To prevent premature growth in mild, wet fall weather dormancy could be reinforced by short days. Growth in the spring could be triggered by the longer days and increasing soil temperatures of spring, but require a minimum soil temperature to begin. At high elevations, in response to a short growing season, growth would begin as soon as soil temperatures permit, irrespective of daylength.

Flowering and fruit maturation are closely associated with vegetative growth and are completed before adverse conditions (drought at low elevations and drought or cold weather at high elevations) are encountered. The consequences of the timing of flowering on seed set is discussed under reproductive biology.

Seed Germination

Dodecatheon capsules and seeds have no special adaptations for long distance dispersal. The seeds are dispersed in the mid- to late summer and enter an environment lacking at least some of the requirements necessary for germination (moisture and suitable temperatures). Seed dormancy in some species can be maintained by high summer temperatures (Grime 1979). Germination in the late summer during a mild, wet spell may occur in Dodecatheon and, if so, any plants surviving the first winter would have a size (and possibly a reproductive) advantage over seedlings that did not germinate until the spring (Harper 1977). All populations except Mount Arrowsmith had some seeds that germinated after short periods of stratification. The high variability in germination would allow seeds to take advantage of suitable conditions whenever they occurred. Dodecatheon cusickii responded much more rapidly to the stratification than did

D. pulchellum; germination of D. cusickii began as soon as the seeds were placed in the growth chamber, and in the eight week treatment, germination began at 4°C. The spring conditions suitable for germination of D. cusickii germination may not last long and selection may favour seeds that respond quickly to suitable conditions. The D. pulchellum populations do not seem to have this response suggesting that germination conditions may be favourable for a greater period of time. The seeds from high elevation populations would normally experience a long period of zero and sub-zero temperatures. Mount Arrowsmith seeds require at least seven weeks stratification for best germination. It is possible that better germination could be obtained with longer stratification. The same may be true for D. cusickii seeds.

Taxonomic Implications

This study reports reproductive and ecological differences between D. pulchellum var. pulchellum (the low elevation populations) and D. pulchellum var. watsonii (Mount Arrowsmith population). These differences will have both genetic and environmental components. The genetically based differences are characters that can be important taxonomically. Among these are poor tolerance of D. pulchellum var. watsonii to the common garden environment (indicating a different range of preferred environments), consistently lower flower production and seeds set in the high elevation plants, and the need for long periods of cold, moist stratification for germination to begin. Coupled with the morphological differences reported in the first part of this study, these reproductive differences support recognition of varieties within *D. pulchellum*.

This study indicates that there are ecological and reproductive differences between *D. pulchellum* s.l. and *D. cusickii* as well, though these two species may show variability in these traits. The differences observed include the more rapid germination of *D. cusickii* seeds, the decline in vigour of *D. cusickii* in the common garden environment, and the consistently earlier emergence of *D. cusickii* in the common garden. The latter two traits indicate this species has adapted to an environment different then those preferred by *D. pulchellum* s.l.. These data, combined with the morphological and chromosomal evidence, support recognition of these two taxa as separate species.

GENERAL DISCUSSION

Plant taxomony is a dynamic science and "...uses characteristics and data from many disciplines in carrying out its primary objectives of describing, identifying, and determining relationships..." (Radford et al. 1974). Modern analytical techniques are constantly providing new and more complete information about plants and necessitating the revision of existing identification schemes. This study of the Dodecatheon pulchellum group has presented new evidence from morphology, cytology, geography and ecology to support recognition of three taxa in British Columbia and adjacent areas: D. pulchellum (Raf.) Merrill var. pulchellum, D. pulchellum var. watsonii (Tidestrom) C.L. Hitchcock and D. cusickii Greene.

This study has also suggested areas of research that would help clarify Dodecatheon taxonomy. Electrophoretic separation of enzymes and calculation of allelic frequencies may help in determining the degree of relationship between Dodecatheon pulchellum and Dodecatheon cusickii. The genetics of filament tube colour and its implications of the status of Dodecatheon pulchellum ssp. monanthum are of interest.

Other segments of Dodecatheon pulchellum may deserve formal taxonomic recognition. Candidates for further study include: 1) the plants found at Otter Point and others similar to them and often referred to under the illegitimate name Dodecatheon littorale, and 2) the infraspecific taxa of Hulten (1948) from Alaska and adjacent areas. The latter are based in part on scape length, a character shown to have little phenotypic plasticity and possibly to be of taxonomic value for plants in Alaska and northern Canada.

Further research into the ecology and reproductive biology of Dodecatheon pulchellum and D. cusickii also would shed light on the relationship between these species. The success of cross-pollinations would show the relative degree of gene exchange between the taxa. Similar work between races of Dodecatheon pulchellum might indicate degree of genetic divergence between populations. Combined data from electrophoresis and crossing experiments would provide information on population structure. Comparison of the reproductive characteristics of Dodecatheon pulchellum var. pulchellum and Dodecatheon pulchellum var. watsonii with those of estuarine plants would be of particular interest. Estuarine plants grow in perpetually wet sites and would experience selection pressures different from plants encountering seasonal drought.

Other aspects of the reproductive biology that could be studied include: 1) optimum pollen transfer distances for maximum seed set, 2) factors affecting dormancy to determine if dormancy can be prevented and the reproductive output improved, and 3) if seed set is limited by maternal resources.

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APPENDIX 1. Data for 426 specimens used in morphometric analysis.

Explanation of variable labels:

Appendix	Table 2
lfil	filribl
lwfil	filribl/w
minft	filgrvl
lanth	antherl
lwconn	connecl/w
afrt	antfil
lscp	scapel
invh	involhrs
lfh	leafhrs
lbd	bladel
lpt	petiolel
lwlf	leafl/w
pconn	connpos
cabc	cabc
cbcf	cbcfr
cbcft	cbcfg
cmrf	cmrfr
cmrft	cmrfg
nofl	nofl
sconn	connsurf
llf	leafl
ftrt	filtubert

Variables not in Table 2.

geo : C = coastal
I = interior
pollen : actual measurements are in arbitrary units
: 2.20 = code for diploid specimen
: 4.40 = code for polyploid specimen
class and plant : to designate different subsets of specimens
x = pulchellum
f = cusickii
k = poeticum
z = conjugens
: infraspecific taxa
a = pulchellum
b = alaskanum
c = pauciflorum
d = superbum
e = macrocarpum
j = wastonii

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
1	X01	2.00000	3.08000	1.60000	5.85000	4.88000	2.92000	168.000	0.2000
2	X02	1.00000	1.33000	1.00000	6.25000	7.81000	3.30000	243.500	1.0000
3	X03	2.00000	2.86000	1.75000	6.40000	5.33000	3.20000	357.000	0.0000
4	X04	1.85000	2.06000	1.50000	6.10000	6.10000	3.30000	361.000	1.2000
5	FX05	1.15000	3.83000	1.15000	3.50000	7.78000	3.04000	65.000	11.0000
6	FX06	1.50000	3.33000	1.25000	4.35000	6.21000	2.90000	129.000	12.8000
7	FX07	1.30000	2.36000	1.05000	5.20000	5.20000	4.00000	170.000	12.0000
8	FX08	1.40000	4.67000	1.10000	4.50000	6.92000	3.21000	150.000	8.4000
9	X09	2.00000	3.08000	2.00000	4.50000	7.50000	2.25000	161.000	1.0000
10	X10	2.00000	2.22000	2.00000	5.75000	6.76000	2.88000	279.000	0.2000
11	X11	1.85000	1.95000	1.85000	6.20000	6.20000	3.35000	409.000	0.6000
12	FX12	1.00000	2.50000	0.80000	4.85000	6.47000	4.85000	94.000	14.8000
13	FX13	0.95000	1.90000	0.95000	4.35000	5.44000	4.58000	118.000	11.3000
14	FX14	1.00000	1.82000	0.90000	4.15000	5.19000	4.15000	98.000	12.0000
15	FX15	1.28000	2.86000	1.20000	3.60000	5.34000	2.81000	103.000	12.0000
16	FX16	1.50000	2.73000	1.50000	4.45000	4.45000	2.97000	108.000	12.4000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
1	0.0000	51.000	31.500	3.8900	3	3.00000	2.00000	1.00000
2	0.0000	52.000	41.000	5.1700	2	1.00000	2.00000	1.00000
3	0.0000	86.000	112.000	7.9200	2	3.00000	1.50000	1.50000
4	0.2000	91.500	88.000	6.9000	2	2.00000	3.00000	3.00000
5	6.8000	20.000	15.000	4.3800	2	1.50000	1.00000	1.00000
6	10.0000	35.000	24.000	3.9300	1	1.00000	1.00000	1.00000
7	12.4000	45.000	44.000	5.5600	1	1.00000	1.00000	1.00000
8	8.2000	41.000	53.500	5.2100	1	2.00000	1.00000	1.00000
9	0.0000	49.000	31.000	4.5900	2	2.50000	3.50000	3.00000
10	0.0000	65.000	67.000	11.0000	2	2.00000	1.00000	1.00000
11	0.2000	100.000	91.000	7.3400	1	2.00000	1.00000	1.00000
12	12.4000	23.000	23.000	4.8400	1	1.00000	1.00000	1.00000
13	12.0000	23.000	25.000	6.0000	2	1.00000	1.00000	1.00000
14	11.0000	37.000	17.000	5.4000	1	1.00000	1.00000	1.00000
15	11.4000	23.000	21.000	6.2800	1	1.50000	1.00000	1.00000
16	10.8000	28.000	24.000	4.3700	1	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
1	1.00000	1.00000	5	2	C	4.4400	X	82.500	0.80000
2	1.00000	1.00000	5	2	C	4.4400	X	93.000	1.00000
3	1.00000	1.00000	5	2	C	4.4400	X	198.000	0.87500
4	1.00000	1.00000	7	2	C	4.4400	X	179.500	0.81081
5	1.00000	1.00000	2	2	I	2.2200	F	35.000	1.00000
6	1.00000	1.00000	4	2	I	2.2200	F	59.000	0.83333
7	1.00000	1.00000	4	2	I	2.2200	F	89.000	0.80769
8	1.00000	1.00000	5	2	I	2.2200	F	94.500	0.78571
9	3.50000	3.50000	5	2	C	21.7000	X	80.000	1.00000
10	1.50000	1.00000	7	2	C	19.7500	X	132.000	1.00000
11	1.50000	1.00000	11	2	C	4.4400	X	191.000	1.00000
12	1.00000	1.00000	3	2	I	18.2800	F	46.000	0.80000
13	1.00000	1.00000	2	2	I	17.2000	F	48.000	1.00000
14	1.00000	1.00000	3	2	I	2.2200	F	54.000	0.90000
15	1.00000	1.00000	2	2	I	2.2200	F	44.000	0.93750
16	1.00000	1.00000	5	2	I	2.2200	F	52.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
17	FX17	1.20000	3.00000	1.20000	4.05000	5.06000	3.38000	92.000	8.0000
18	X18	1.70000	1.94000	1.70000	5.80000	4.64000	3.41000	176.000	1.0000
19	X19	2.40000	3.00000	2.40000	6.45000	5.38000	2.69000	211.000	1.4000
20	X20	2.10000	2.00000	2.10000	6.05000	4.48000	2.88000	114.000	0.6000
21	X21	2.00000	3.63000	2.00000	5.60000	8.61000	2.80000	138.000	1.5000
22	X22	2.05000	3.42000	2.05000	6.55000	7.28000	3.20000	272.000	1.2000
23	X23	2.00000	2.22000	2.00000	5.75000	5.48000	2.88000	247.500	0.4000
24	FX24	1.40000	3.50000	1.40000	4.15000	5.93000	2.96000	165.000	14.8000
25	FX25	1.75000	3.87000	1.75000	4.10000	5.47000	2.34000	101.000	11.0000
26	X26	1.12000	1.50000	1.12000	5.35000	5.10000	4.78000	224.000	1.6000
27	X27	2.00000	2.22000	2.00000	6.20000	5.17000	3.10000	160.000	0.5000
28	X28	1.50000	1.58000	1.50000	6.00000	5.45000	4.00000	120.000	0.2000
29	X29	1.70000	2.27000	1.70000	6.15000	6.83000	3.62000	153.000	0.4000
30	X30	2.05000	2.41000	2.05000	5.90000	4.92000	2.87000	69.000	0.0000
31	X31	2.20000	2.44000	2.20000	5.65000	4.52000	2.57000	103.000	0.4000
32	X32	1.60000	1.60000	1.60000	6.75000	5.62000	4.22000	200.000	0.2000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
17	6.4000	32.0000	28.0000	6.67000	2	1.00000	1.00000	1.00000
18	0.0000	74.0000	51.0000	4.63000	3	2.50000	4.00000	4.00000
19	0.0000	77.5000	66.5000	5.77000	2	2.00000	1.00000	1.00000
20	0.0000	33.0000	17.0000	2.78000	2	2.50000	2.00000	1.00000
21	0.0000	60.0000	23.5000	3.09000	2	3.00000	2.50000	2.00000
22	0.0000	67.0000	53.0000	7.06000	2	1.00000	1.50000	1.50000
23	0.0000	80.5000	70.0000	6.84000	1	1.50000	2.00000	1.00000
24	14.0000	45.0000	26.0000	6.45000	2	2.00000	1.00000	1.00000
25	11.2000	33.0000	24.0000	7.12000	1	1.50000	1.00000	1.00000
26	0.6000	61.0000	56.0000	6.50000	1	2.00000	1.00000	1.00000
27	0.0000	71.0000	35.0000	7.31000	2	1.00000	2.00000	1.00000
28	0.0000	42.0000	24.0000	3.57000	1	1.50000	4.00000	3.00000
29	0.0000	54.0000	36.0000	3.46000	1	1.50000	4.00000	2.00000
30	0.0000	46.0000	15.0000	2.90000	2	4.00000	4.00000	3.00000
31	0.0000	50.0000	44.0000	4.48000	2	2.50000	1.50000	1.00000
32	0.0000	93.5000	67.0000	6.98000	1	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
17	1.00000	1.00000	2	2	I	2.2200	F	60.000	1.00000
18	1.00000	1.00000	5	2	C	23.7000	X	125.000	1.00000
19	1.00000	1.00000	4	2	C	4.4400	X	144.000	1.00000
20	1.00000	1.00000	2	2	C	4.4400	X	50.000	1.00000
21	1.50000	1.00000	6	2	C	4.4400	X	83.500	1.00000
22	1.00000	1.00000	5	2	C	4.4400	X	120.000	1.00000
23	3.00000	1.00000	6	2	C	4.4400	X	150.500	1.00000
24	1.00000	1.00000	4	2	I	2.2200	F	71.000	1.00000
25	1.00000	1.00000	3	2	I	2.2200	F	57.000	1.00000
26	1.50000	1.00000	7	2	C	4.4400	X	117.000	1.00000
27	2.00000	1.00000	3	2	C	4.4400	X	106.000	1.00000
28	1.00000	1.00000	5	2	C	22.8000	X	66.000	1.00000
29	3.50000	1.50000	5	2	C	4.4400	X	90.000	1.00000
30	4.00000	3.00000	6	2	C	4.4400	X	61.000	1.00000
31	1.50000	1.00000	4	2	C	4.4400	X	94.000	1.00000
32	1.00000	1.00000	7	2	C	4.4400	X	160.500	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
33	FX33	1.35000	2.77000	1.30000	4.15000	5.94000	3.51000	218.500	10.8000
34	FX34	2.10000	4.20000	1.65000	4.60000	5.75000	2.19000	164.000	15.2000
35	FX35	1.45000	4.14000	1.35000	3.72000	5.56000	2.56000	170.000	10.4000
36	KX36	2.09000	2.40000	2.09000	6.35000	5.84000	3.04000	195.000	6.0000
37	KX37	2.22000	3.64000	1.96000	4.48000	5.72000	2.02000	200.000	7.7000
38	X38	1.65000	2.92000	1.65000	4.22000	6.06000	2.55000	206.000	7.4000
39	X39	1.97000	3.10000	1.97000	4.52000	7.13000	2.38000	198.000	5.6000
40	FX40	2.30000	5.89000	2.04000	4.65000	6.29000	2.02000	243.500	7.0000
41	FX41	1.70000	3.90000	1.70000	5.22000	7.27000	3.08000	290.000	9.2000
42	FX42	1.65000	3.80000	0.00000	4.04000	6.20000	2.45000	242.000	10.2000
43	FX43	1.37000	3.15000	1.37000	3.09000	4.44000	2.25000	238.000	9.7000
44	X44	2.17000	3.57000	2.17000	6.22000	6.81000	2.86000	117.000	1.4000
45	X45	2.13000	3.27000	2.13000	4.17000	4.00000	1.96000	43.000	3.2000
46	FX46	2.35000	4.91000	2.35000	5.47000	5.04000	2.33000	270.000	6.6000
47	FX47	1.78000	4.10000	1.78000	5.13000	5.90000	2.79000	169.000	7.6000
48	X48	1.96000	2.81000	1.96000	5.24000	4.82000	2.68000	281.000	6.6000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
33	10.2000	44.0000	45.0000	6.36000	1	1.00000	1.00000	1.00000
34	13.6000	27.0000	29.0000	5.09000	2	1.00000	1.00000	1.00000
35	13.6000	30.0000	24.0000	5.18000	1	1.50000	1.00000	1.00000
36	4.2000	69.0000	76.0000	8.06000	2	4.00000	4.00000	4.00000
37	6.8000	51.0000	67.0000	7.87000	2	4.00000	4.00000	3.50000
38	6.4000	80.0000	61.0000	6.71000	2	4.00000	4.00000	3.00000
39	6.0000	57.0000	60.0000	5.32000	1	1.00000	1.00000	1.00000
40	4.0000	42.0000	36.5000	4.36000	1	1.00000	1.00000	1.00000
41	2.2000	61.0000	64.0000	7.35000	1	1.00000	1.00000	1.00000
42	7.2000	58.0000	52.5000	5.97000	1	1.00000	1.00000	0.00000
43	7.0000	65.0000	68.5000	7.85000	1	1.00000	1.00000	1.00000
44	1.6000	29.0000	29.0000	6.44000	2	3.50000	3.50000	2.50000
45	1.0000	42.0000	19.0000	3.39000	2	3.00000	4.00000	4.00000
46	3.6000	43.0000	34.0000	3.85000	2	1.00000	1.00000	1.00000
47	5.2000	39.0000	22.0000	4.07000	1	1.00000	1.00000	1.00000
48	0.6000	43.0000	30.0000	4.06000	2	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
33	1.00000	1.00000	10	2	I	2.2200	F	89.000	0.96296
34	1.00000	1.00000	4	2	I	2.2200	F	56.000	0.78571
35	1.00000	1.00000	4	2	I	2.2200	F	54.000	0.93103
36	4.00000	4.00000	7	2	I	1.1100	K	145.000	1.00000
37	4.00000	4.00000	5	2	I	1.1100	K	118.000	0.88288
38	4.00000	3.00000	6	2	I	2.2200	X	141.000	1.00000
39	1.00000	1.00000	4	2	I	19.0500	X	117.000	1.00000
40	1.00000	1.00000	6	2	I	2.2200	F	78.500	0.88696
41	1.00000	1.00000	4	2	I	18.5000	F	125.000	1.00000
42	1.00000	0.00000	9	2	I	2.2200	F	110.500	0.00000
43	1.00000	1.00000	6	2	I	20.1500	F	133.500	1.00000
44	3.50000	2.00000	1	2	I	4.4400	X	58.000	1.00000
45	4.00000	4.00000	5	2	I	22.7000	X	61.000	1.00000
46	1.00000	1.00000	6	2	I	2.2200	F	77.000	1.00000
47	1.00000	1.00000	1	2	I	19.1500	F	61.000	1.00000
48	1.00000	1.00000	6	2	I	4.4400	X	73.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
49	X49	2.17000	5.56000	2.17000	4.74000	6.06000	2.18000	267.000	9.6000
50	X50	2.61000	4.00000	2.61000	4.70000	3.86000	1.80000	241.000	2.0000
51	X51	2.22000	2.83000	2.22000	4.48000	3.68000	2.10000	227.000	2.6000
52	X52	3.47000	7.62000	3.47000	4.61000	7.57000	1.32000	152.500	0.6000
53	X53	3.06000	6.56000	3.06000	4.22000	5.40000	1.38000	203.000	1.2000
54	X54	2.13000	4.45000	2.13000	3.13000	4.11000	1.47000	110.000	0.0000
55	X55	2.26000	3.47000	2.26000	3.26000	5.00000	1.44000	66.000	0.0000
56	X56	2.78000	4.00000	2.78000	4.26000	2.97000	1.53000	300.000	0.0000
57	X57	2.83000	3.82000	2.83000	3.22000	2.47000	1.14000	216.000	1.0000
58	X58	1.97000	2.25000	1.97000	5.74000	6.28000	2.93000	103.000	1.0000
59	X59	2.30000	4.08000	2.30000	3.91000	5.81000	1.70000	73.000	0.0000
60	X60	3.04000	5.00000	3.04000	5.70000	5.95000	1.87000	260.500	0.2000
61	X61	2.04000	3.36000	2.04000	5.78000	6.65000	2.83000	242.000	0.2000
62	FX62	1.65000	4.22000	1.65000	3.70000	5.67000	2.24000	83.000	9.8000
63	FX63	2.35000	6.00000	2.35000	3.30000	4.47000	1.41000	117.000	13.0000
64	XX64	1.87000	3.07000	1.87000	4.43000	5.37000	2.37000	211.000	5.1000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
49	2.8000	35.0000	24.0000	3.93000	2	1.00000	1.00000	1.00000
50	0.0000	37.5000	41.0000	4.36000	1	1.00000	1.00000	1.00000
51	1.2000	38.0000	52.0000	5.00000	2	1.00000	1.00000	1.00000
52	1.0000	34.5000	36.0000	4.41000	2	2.00000	1.00000	1.00000
53	0.0000	53.0000	50.0000	5.04000	1	1.00000	1.00000	1.00000
54	0.6000	25.0000	26.0000	4.64000	2	1.00000	1.00000	1.00000
55	0.0000	31.0000	25.0000	7.00000	2	1.00000	1.00000	1.00000
56	0.0000	43.0000	45.0000	4.89000	1	1.00000	1.00000	1.00000
57	0.2000	38.0000	18.0000	3.29000	1	1.00000	1.00000	1.00000
58	0.4000	33.0000	17.0000	3.57000	2	1.00000	1.00000	1.00000
59	0.0000	31.0000	5.0000	3.27000	3	1.00000	1.00000	1.00000
60	0.0000	90.0000	82.0000	7.82000	3	1.00000	1.00000	1.50000
61	0.0000	75.0000	44.0000	6.26000	1	1.50000	1.00000	1.50000
62	8.0000	29.0000	15.0000	7.33000	2	1.00000	1.00000	1.00000
63	7.6000	50.0000	20.0000	5.83000	2	1.00000	1.00000	1.00000
64	2.4000	58.0000	29.0000	6.44000	2	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
49	1.00000	1.00000	4	2	I	20.8000	X	59.000	1.00000
50	1.00000	1.00000	5	2	I	20.8500	X	78.500	1.00000
51	1.00000	1.00000	3	2	I	21.7500	X	90.000	1.00000
52	1.00000	1.00000	4	2	I	2.2200	X	70.500	1.00000
53	1.00000	1.00000	7	2	I	17.9500	X	103.000	1.00000
54	1.00000	1.00000	5	2	I	20.0500	X	51.000	1.00000
55	1.00000	1.00000	1	2	I	21.2000	X	56.000	1.00000
56	1.00000	1.00000	8	2	I	4.4400	X	88.000	1.00000
57	1.00000	1.00000	7	2	I	20.1500	X	56.000	1.00000
58	1.00000	1.00000	3	2	C	4.4400	X	50.000	1.00000
59	1.00000	1.00000	2	2	C	4.4400	X	36.000	1.00000
60	1.00000	1.00000	3	2	C	4.4400	X	172.000	1.00000
61	1.00000	2.50000	6	2	C	22.3500	X	119.000	1.00000
62	1.00000	1.00000	2	2	I	17.3500	F	44.000	1.00000
63	1.00000	1.00000	3	2	I	17.2000	F	70.000	1.00000
64	1.00000	1.00000	4	2	I	4.4400	X	87.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
65	XX65	2.09000	3.69000	2.09000	7.17000	8.25000	3.44000	176	7.4000
66	X66	1.74000	2.67000	1.74000	5.00000	7.19000	2.88000	138	0.2000
67	X67	1.83000	1.56000	1.83000	5.09000	4.68000	2.79000	90	0.0000
68	FX68	1.39000	2.13000	1.39000	6.48000	7.45000	4.66000	232	4.8000
69	FX69	2.09000	4.00000	2.09000	5.78000	5.32000	2.77000	242	9.4000
70	FX70	2.87000	6.00000	2.87000	4.35000	5.00000	1.51000	150	11.0000
71	FX71	2.04000	3.92000	2.04000	4.22000	5.10000	2.06000	100	7.7000
72	X72	2.43000	5.09000	2.43000	4.00000	6.13000	1.64000	165	2.0000
73	X73	3.00000	4.60000	3.00000	4.13000	5.14000	1.38000	182	0.8000
74	X74	2.30000	5.88000	2.30000	3.52000	6.00000	1.53000	132	0.2000
75	X75	2.17000	3.85000	2.17000	5.30000	7.62000	2.44000	250	0.2000
76	FX76	1.74000	3.33000	1.74000	4.13000	3.96000	2.38000	110	13.2000
77	FX77	2.13000	2.45000	2.13000	4.35000	4.76000	2.04000	156	13.8000
78	FX78	1.39000	2.67000	1.39000	5.13000	8.43000	3.68000	172	7.7000
79	FX79	1.74000	3.33000	1.74000	6.22000	6.50000	3.58000	177	6.9000
80	FX80	2.30000	7.57000	1.78000	4.70000	5.14000	2.04000	206	9.8000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
65	6.2000	59.500	36.000	6.8200	1	1.00000	1.00000	1.00000
66	0.0000	34.000	31.000	5.0000	2	3.00000	1.00000	1.00000
67	0.0000	39.000	8.000	3.9200	2	1.00000	1.00000	1.00000
68	4.2000	85.000	16.000	3.1600	1	1.00000	1.00000	1.00000
69	2.6000	57.000	64.000	5.0400	1	1.00000	1.00000	1.00000
70	2.0000	32.000	14.000	5.7500	1	1.50000	1.00000	1.00000
71	5.4000	30.500	15.000	3.3700	1	1.00000	1.00000	1.00000
72	0.0000	26.000	20.000	5.4100	3	1.00000	1.00000	1.00000
73	0.0000	32.000	23.500	4.6200	3	1.00000	1.00000	1.00000
74	0.4000	34.000	30.000	4.2700	2	1.00000	1.00000	1.00000
75	0.0000	50.000	21.000	5.4600	3	1.00000	1.00000	1.00000
76	6.0000	23.500	14.000	4.1700	1	1.00000	1.00000	1.00000
77	5.2000	25.000	17.000	3.2300	1	1.00000	1.50000	1.00000
78	3.6000	40.000	35.000	5.3600	1	1.00000	1.00000	1.00000
79	6.2000	41.000	35.000	3.8000	1	1.00000	1.00000	1.00000
80	10.2000	48.000	20.000	5.6700	1	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
65	1.00000	1.00000	6	2	I	20.2800	X	95.500	1.00000
66	2.50000	2.50000	1	2	I	4.4400	X	65.000	1.00000
67	1.00000	2.00000	1	2	I	23.9000	X	47.000	1.00000
68	1.00000	1.00000	4	2	I	22.1000	F	101.000	1.00000
69	1.00000	1.00000	4	2	I	21.4500	F	121.000	1.00000
70	1.00000	1.00000	5	2	I	2.2200	F	46.000	1.00000
71	1.00000	1.00000	2	2	I	17.6000	F	45.500	1.00000
72	1.00000	1.00000	3	2	I	19.5500	X	46.000	1.00000
73	1.00000	1.00000	2	2	I	15.8500	X	55.500	1.00000
74	1.00000	1.00000	4	2	I	19.0000	X	64.000	1.00000
75	1.00000	1.00000	7	2	I	16.4500	X	71.000	1.00000
76	1.00000	1.00000	3	2	I	17.1000	F	37.500	1.00000
77	1.50000	1.50000	5	2	I	16.4000	F	42.000	1.00000
	1.00000	1.00000	3	2	I	20.1500	F	75.000	1.00000
79	1.00000	1.00000	4	2	I	4.4400	F	76.000	1.00000
80	1.00000	1.00000	5	2	I	2.2200	F	68.000	0.77391

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
81	FX81	2.22000	5.10000	2.17000	3.74000	4.94000	1.69000	181	10.4000
82	FX82	2.13000	4.90000	2.13000	5.52000	5.52000	2.59000	175	10.0000
83	FX83	1.56000	3.27000	1.56000	5.70000	6.23000	3.64000	172	13.1000
84	FX84	2.20000	3.88000	1.83000	4.61000	4.82000	2.10000	158	10.3000
85	FX85	2.26000	3.71000	2.26000	4.89000	4.89000	2.15000	138	9.8000
86	X86	1.30000	3.75000	1.30000	3.91000	6.92000	3.00000	48	4.0000
87	X87	1.09000	1.78000	1.09000	4.61000	5.89000	4.24000	63	3.4000
88	X88	2.11000	4.41000	2.11000	5.74000	5.28000	2.72000	292	0.8000
89	X89	2.39000	3.93000	2.39000	5.61000	6.14000	2.34000	286	2.0000
90	FX90	1.91000	6.28000	1.26000	4.61000	7.57000	2.41000	217	6.6000
91	FX91	2.17000	3.57000	1.52000	4.70000	5.40000	2.16000	143	10.0000
92	X92	2.39000	2.89000	2.39000	5.22000	5.45000	2.18000	198	1.2000
93	X93	3.04000	5.38000	3.04000	6.17000	7.10000	2.03000	172	0.6000
94	X94	2.22000	3.92000	2.22000	4.39000	5.32000	1.98000	193	0.4000
95	X95	2.35000	4.91000	2.35000	4.56000	4.77000	1.94000	248	0.2000
96	FX96	2.17000	3.33000	2.17000	5.52000	4.23000	2.54000	337	9.5000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
81	12.0000	38.000	15.000	4.4200	2	1.00000	1.00000	1.00000
82	10.4000	43.000	35.000	5.5700	2	1.00000	1.00000	1.00000
83	7.4000	44.000	32.000	6.6100	1	1.00000	1.00000	1.00000
84	6.6000	30.500	30.000	4.8400	2	1.00000	1.00000	1.00000
85	8.0000	32.000	29.000	7.6200	2	1.00000	1.00000	1.00000
86	0.2000	30.500	15.000	7.0000	1	1.00000	1.00000	1.00000
87	1.2000	35.000	19.000	3.8600	1	1.00000	1.00000	1.00000
88	0.0000	99.000	63.000	6.4800	1	1.00000	2.00000	1.50000
89	0.0000	66.000	52.000	7.8700	2	1.00000	2.00000	1.50000
90	6.8000	47.500	29.000	4.7800	1	1.00000	1.00000	1.00000
91	6.4000	44.000	27.000	7.8900	3	1.00000	1.00000	1.00000
92	1.8000	39.000	68.000	7.6400	3	1.00000	2.00000	2.00000
93	1.0000	54.000	35.000	5.2300	3	1.00000	3.00000	3.00000
94	0.8000	50.500	42.000	4.4000	2	3.00000	2.00000	2.00000
95	0.0000	44.000	34.000	4.3300	2	2.00000	3.00000	3.00000
96	6.0000	73.000	67.000	5.6000	1	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
81	1.00000	1.00000	5	2	I	18.2000	F	53.000	0.97748
82	1.00000	1.00000	7	2	I	19.3500	F	78.000	1.00000
83	1.00000	1.00000	4	2	I	2.2200	F	76.000	1.00000
84	1.00000	1.00000	4	2	I	2.2200	F	60.500	0.83182
85	1.00000	1.00000	2	2	I	17.9500	F	61.000	1.00000
86	1.00000	1.00000	2	2	I	4.4400	X	45.500	1.00000
87	1.00000	1.00000	3	2	I	4.4400	X	54.000	1.00000
88	1.00000	1.00000	2	2	C	4.4400	X	162.000	1.00000
89	1.00000	1.00000	1	2	C	4.4400	X	118.000	1.00000
90	1.00000	1.00000	9	2	I	18.3000	F	76.500	0.65969
91	1.00000	1.00000	2	2	I	19.1000	F	71.000	0.70046
92	1.00000	1.50000	2	2	C	22.4500	X	107.000	1.00000
93	1.00000	2.00000	4	2	C	22.7500	X	89.000	1.00000
94	1.00000	1.00000	4	2	C	4.4400	X	92.500	1.00000
95	1.00000	2.50000	5	2	C	4.4400	X	78.000	1.00000
96	1.00000	1.00000	3	2	I	20.5000	F	140.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
97	FX97	1.87000	2.53000	1.30000	7.00000	6.7100	3.74000	224	10.8000
98	X98	2.96000	4.53000	2.96000	4.04000	4.6500	1.37000	220	0.2000
99	X99	2.52000	4.83000	2.52000	4.74000	6.0600	1.88000	152	0.8000
100	FOXO	2.00000	4.18000	2.00000	5.00000	6.3900	2.50000	237	11.5000
101	FOX1	2.04000	4.70000	1.52000	5.65000	6.8400	2.76000	205	9.2000
102	XA01	1.17000	1.50000	1.17000	5.70000	5.7000	4.87000	224	0.4000
103	XA02	2.17000	6.25000	2.17000	4.00000	6.5700	1.84000	230	0.4000
104	XA03	2.46000	2.52000	2.46000	5.88000	5.6500	2.40000	272	0.8000
105	XA04	2.17000	3.56000	2.17000	6.54000	7.9200	3.01000	219	0.0000
106	XA05	1.96000	2.25000	1.96000	6.61000	7.2400	3.37000	345	0.0000
107	XA06	2.24000	3.43000	2.24000	5.39000	6.5200	2.41000	200	1.3000
108	XA07	2.52000	3.41000	2.52000	6.48000	7.1000	2.57000	244	0.8000
109	XA08	1.87000	3.07000	1.87000	5.04000	6.1000	2.70000	232	0.0000
110	XA09	1.94000	2.12000	1.94000	5.52000	5.0800	2.86000	184	0.4000
111	XA10	2.30000	2.30000	2.30000	6.61000	5.4300	2.87000	376	0.0000
112	XA11	2.39000	1.83000	2.39000	7.96000	4.6900	3.33000	459	0.0000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
97	4.80000	68.000	40.000	5.1400	1	1.00000	1.00000	1.00000
98	0.00000	20.000	34.000	3.8600	2	3.00000	2.00000	2.50000
99	0.00000	57.000	60.000	9.0000	2	1.00000	1.00000	1.00000
100	6.00000	44.000	37.000	7.3600	1	1.00000	1.00000	1.00000
101	6.20000	45.000	40.000	8.5000	1	1.00000	1.00000	1.00000
102	0.00000	41.500	48.000	5.5900	2	2.50000	2.00000	2.00000
103	0.00000	39.000	55.000	6.7100	1	1.00000	1.00000	1.00000
104	0.00000	79.000	55.000	8.9300	3	1.00000	1.00000	1.00000
105	0.00000	64.800	53.500	5.4800	1	1.00000	1.50000	1.00000
106	0.00000	106.000	143.000	11.3200	1	1.50000	2.00000	1.50000
107	0.00000	40.000	29.000	5.7500	2	3.00000	1.50000	1.50000
108	0.00000	57.000	70.000	5.6400	2	1.00000	1.50000	1.50000
109	0.00000	40.500	44.000	8.4500	2	1.50000	1.50000	1.50000
110	0.00000	72.000	72.000	7.2000	2	1.50000	1.50000	1.50000
111	0.00000	95.000	135.000	7.1900	3	2.50000	2.50000	2.00000
112	0.00000	115.000	104.000	6.4400	1	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
97	1.00000	1.00000	3	2	I	2.2200	F	108.000	0.69519
98	1.00000	2.00000	3	2	I	19.5000	X	54.000	1.00000
99	1.00000	1.00000	2	2	I	20.6200	X	117.000	1.00000
100	1.00000	1.00000	5	2	I	17.5000	F	81.000	1.00000
101	1.00000	1.00000	4	2	I	2.2200	F	85.000	0.74510
102	1.00000	1.00000	2	2	C	19.3000	X	89.500	1.00000
103	1.00000	1.00000	3	2	I	19.7200	X	94.000	1.00000
104	1.00000	1.00000	8	2	I	19.2800	X	134.000	1.00000
105	1.50000	1.00000	4	2	C	18.1200	X	118.300	1.00000
106	2.00000	1.00000	6	2	C	20.3500	X	249.000	1.00000
107	1.00000	1.00000	3	2	C	19.5000	X	69.000	1.00000
108	1.00000	1.00000	4	2	C	19.2000	X	127.000	1.00000
109	1.50000	1.50000	3	2	C	19.1500	X	84.500	1.00000
110	1.50000	1.50000	5	2	C	20.4000	X	144.000	1.00000
111	2.50000	2.00000	5	2	C	20.5000	X	230.000	1.00000
112	1.50000	1.00000	9	2	C	18.7200	X	219.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
113	XA12	1.61000	1.23000	1.61000	4.78000	4.2200	2.97000	60.000	0.40000
114	XA13	1.74000	1.67000	1.74000	5.43000	5.0000	7.17000	121.000	1.00000
115	XA14	1.74000	2.10000	1.74000	6.70000	5.9200	3.85000	292.000	0.60000
116	XA15	2.46000	3.59000	2.46000	4.99000	7.4000	2.02000	373.000	0.20000
117	XA16	1.78000	2.41000	1.78000	5.09000	4.5000	2.86000	237.000	6.80000
118	XA17	2.04000	3.35000	2.04000	4.74000	4.7400	2.32000	222.000	5.10000
119	XA18	2.00000	3.07000	2.00000	5.22000	5.7100	2.61000	232.000	2.00000
120	XA19	2.48000	3.56000	2.48000	5.30000	6.7800	2.14000	224.000	0.00000
121	XA20	1.17000	2.69000	1.17000	4.35000	6.2500	3.72000	270.000	3.40000
122	XA21	3.17000	4.56000	3.17000	5.34000	4.3900	1.68000	184.000	0.00000
123	XA22	2.43000	3.29000	2.43000	5.41000	5.9200	2.23000	174.000	0.60000
124	XA23	2.13000	1.85000	2.13000	5.67000	4.8300	2.66000	131.000	0.20000
125	XA24	1.78000	2.93000	1.78000	4.13000	5.9400	2.32000	112.000	1.80000
126	XA25	2.56000	4.54000	2.56000	4.56000	6.5600	1.78000	248.000	0.40000
127	XA26	2.65000	3.81000	2.65000	5.48000	6.6300	2.06000	265.000	0.00000
128	XA27	1.91000	5.50000	1.91000	4.56000	8.4000	2.39000	194.000	7.60000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
113	0.00000	34.000	8.000	1.7800	2.00000	1.50000	1.50000	1.00000
114	0.00000	77.000	45.000	3.9300	1.00000	2.00000	1.00000	1.00000
115	0.00000	103.000	93.000	7.0000	1.00000	1.00000	1.00000	1.00000
116	0.00000	103.800	89.000	8.5600	2.00000	1.50000	1.00000	1.00000
117	6.30000	52.500	55.000	6.4200	2.00000	2.50000	1.00000	1.00000
118	0.10000	51.800	55.000	7.1200	2.00000	1.00000	1.50000	1.00000
119	0.80000	48.000	53.000	5.9400	1.00000	1.50000	1.50000	2.00000
120	0.00000	62.000	61.000	6.1500	2.00000	1.00000	1.00000	1.00000
121	0.00000	58.500	56.000	6.3600	1.00000	1.00000	1.00000	1.00000
122	0.00000	76.000	54.000	3.6100	2.00000	1.50000	2.50000	2.50000
123	0.00000	58.000	62.000	5.0000	3.00000	2.50000	2.00000	2.00000
124	0.00000	36.000	22.000	4.4600	1.00000	1.00000	1.00000	1.00000
125	0.00000	30.500	21.000	4.2900	2.00000	3.00000	1.00000	1.00000
126	0.00000	80.500	40.000	5.0200	2.00000	1.50000	1.00000	1.00000
127	0.00000	68.000	64.000	7.7600	1.00000	1.50000	1.00000	1.00000
128	4.60000	30.000	46.000	9.5000	2.00000	3.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
113	1.50000	1.00000	1	2	C	18.9000	X	42.000	1
114	1.00000	1.00000	3	2	C	19.8000	X	122.000	1
115	1.00000	1.00000	7	2	I	17.3000	X	196.000	1
116	1.50000	1.00000	12	2	I	18.1500	X	192.800	1
117	1.50000	1.00000	3	2	I	17.7200	X	107.500	1
118	1.50000	1.00000	8	2	I	17.7000	X	106.800	1
119	2.00000	1.00000	5	2	C	18.4000	X	101.000	1
120	1.00000	1.00000	5	2	I	21.2800	X	123.000	1
121	1.00000	1.00000	6	2	I	18.3800	X	114.500	1
122	1.00000	1.50000	3	2	C	17.4000	X	130.000	1
123	1.50000	1.00000	4	2	C	19.2800	X	120.000	1
124	1.00000	1.00000	2	2	I	19.5500	X	58.000	1
125	1.00000	1.00000	3	2	I	16.9800	X	51.500	1
126	1.00000	1.00000	10	2	I	16.1000	X	120.500	1
127	1.50000	1.00000	4	2	C	25.0500	X	132.000	1
128	1.00000	1.00000	2	2	I	19.9800	X	76.000	1

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
129	XA28	1.52000	1.10000	1.52000	6.86000	4.7800	4.51000	111.000	0.0000
130	XA29	1.74000	4.45000	1.74000	4.22000	4.4100	2.42000	93.000	6.2000
131	XA30	2.30000	3.78000	2.30000	5.00000	6.7600	2.17000	210.000	4.0000
132	XA31	1.83000	3.23000	1.83000	4.39000	4.5900	2.40000	226.000	2.4000
133	XA32	2.83000	9.28000	2.83000	4.87000	7.0000	1.72000	152.000	0.4000
134	XA33	1.96000	2.15000	1.96000	5.24000	5.4800	2.67000	241.000	0.0000
135	XA34	2.48000	3.56000	2.48000	4.43000	5.9900	1.79000	339.000	0.4000
136	XA35	1.91000	2.93000	1.91000	4.22000	4.6200	2.21000	285.000	0.0000
137	XA36	2.33000	4.46000	2.33000	4.09000	4.9500	1.76000	223.000	0.2000
138	XA37	2.04000	3.13000	2.04000	4.56000	10.5000	2.33000	191.000	2.0000
139	XB01	2.15000	2.56000	2.15000	5.32000	6.6600	2.48000	65.000	0.4000
140	XB02	2.35000	3.18000	2.35000	6.48000	7.2700	2.76000	278.000	0.2000
141	XB03	1.86000	2.25000	1.86000	7.39000	7.7200	3.97000	284.000	2.6000
142	XC01	1.30000	2.06000	1.30000	6.33000	4.8500	4.87000	140.000	1.1000
143	XD01	1.95000	3.20000	1.95000	6.13000	7.8300	3.14000	192.000	1.8000
144	XD02	2.48000	2.65000	2.48000	6.94000	6.9400	2.80000	161.000	2.2000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
129	0.20000	33.500	16.000	3.3000	2.00000	1.50000	1.50000	1.50000
130	4.80000	35.500	45.000	7.3200	1.00000	1.00000	1.00000	1.00000
131	0.20000	46.000	42.000	7.6500	2.00000	1.00000	1.00000	1.00000
132	2.60000	50.000	28.500	4.3600	1.00000	1.00000	1.00000	1.00000
133	0.00000	44.000	23.000	4.6700	2.00000	1.00000	1.00000	1.00000
134	0.00000	57.000	48.000	6.1700	2.00000	1.00000	1.00000	1.00000
135	0.00000	55.000	37.000	9.2000	3.00000	1.00000	1.00000	1.00000
136	0.00000	57.000	49.000	6.6200	3.00000	2.00000	1.00000	1.00000
137	0.00000	35.500	32.000	5.4000	2.00000	1.00000	1.00000	1.00000
138	0.00000	34.000	50.000	8.4000	1.00000	1.00000	1.00000	1.00000
139	0.50000	44.500	41.000	4.7600	1.00000	1.00000	1.00000	1.00000
140	0.00000	60.000	78.000	6.2700	3.00000	1.00000	1.00000	1.00000
141	0.00000	115.000	93.000	5.9600	2.00000	2.00000	1.50000	1.50000
142	0.00000	35.000	22.000	4.0700	1.00000	1.00000	1.00000	1.00000
143	0.00000	79.500	52.000	5.7200	1.00000	1.00000	1.00000	1.00000
144	1.00000	65.000	33.000	3.8400	3.00000	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
129	1.00000	1.00000	1	2	I	17.2000	X	49.500	1.00000
130	1.00000	1.00000	1	2	I	16.2000	X	80.500	1.00000
131	1.00000	1.00000	6	2	I	17.8000	X	88.000	1.00000
132	1.00000	1.00000	11	2	I	19.8500	X	78.500	1.00000
133	1.00000	1.00000	3	2	I	17.6000	X	67.000	1.00000
134	1.00000	1.00000	7	2	I	14.9000	X	105.000	1.00000
135	1.00000	1.00000	6	2	I	16.1000	X	92.000	1.00000
136	1.00000	1.00000	7	2	I	14.7000	X	106.000	1.00000
137	1.00000	1.00000	3	2	I	15.9500	X	67.500	1.00000
138	1.00000	1.00000	3	2	I	19.2000	X	84.000	1.00000
139	1.00000	1.00000	3	2	C	18.7000	X	85.500	1.00000
140	1.00000	1.00000	6	2	C	17.1500	X	138.000	1.00000
141	1.50000	1.50000	6	2	C	19.4200	X	208.000	1.00000
142	1.00000	1.00000	2	2	I	16.1500	X	57.000	1.00000
143	1.00000	1.00000	3	2	C	17.7000	X	131.500	1.00000
144	1.00000	1.00000	12	2	C	18.2800	X	98.000	1.00000

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OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
145	XD03	1.13000	1.06000	1.13000	4.96000	4.9600	4.48000	261.000	1.2000
146	XD04	2.04000	2.23000	2.04000	6.70000	7.3400	3.28000	412.000	0.2000
147	XE01	1.95000	3.20000	1.95000	6.34000	6.7800	3.25000	342.000	1.0000
148	XE02	1.89000	2.92000	1.89000	5.94000	8.1200	3.14000	161.000	1.0000
149	XE03	1.91000	2.31000	1.91000	6.65000	6.9500	3.48000	172.000	0.2000
150	XE04	1.52000	1.46000	1.52000	6.09000	5.8300	4.01000	422.000	0.0000
151	XE05	2.74000	3.24000	2.74000	5.26000	4.8400	1.92000	262.000	0.0000
152	XE06	1.74000	2.35000	1.74000	5.13000	5.6200	2.95000	261.000	0.6000
153	XE07	3.61000	5.54000	3.61000	5.96000	5.4800	1.65000	205.000	0.2000
154	XE08	0.87000	2.22000	0.87000	5.35000	6.1500	6.15000	172.000	1.9000
155	XE09	2.96000	4.71000	2.96000	6.66000	5.5200	2.26000	207.000	0.0000
156	XE10	2.13000	2.72000	2.13000	6.22000	6.0800	2.92000	205.000	0.0000
157	XE11	1.65000	2.38000	1.65000	4.13000	5.5900	2.50000	51.000	0.0000
158	XE12	2.09000	2.28000	2.09000	5.78000	4.5900	2.77000	140.500	0.2000
159	XE13	2.70000	4.14000	2.70000	6.78000	7.0900	2.51000	217.000	0.6000
160	XE14	1.91000	1.91000	1.91000	6.09000	5.0000	3.19000	515.000	0.0000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
145	0.0000	115.500	75.500	6.4200	2.00000	3.00000	1.80000	1.50000
146	0.0000	157.000	124.000	9.4500	2.00000	2.50000	2.50000	2.50000
147	0.0000	83.000	90.000	7.5200	1.00000	1.00000	1.00000	1.00000
148	0.0000	50.000	21.000	5.4600	2.00000	1.00000	1.80000	1.80000
149	0.0000	42.000	33.000	5.5600	1.00000	3.00000	3.00000	2.00000
150	0.0000	89.000	135.000	14.9300	2.00000	2.50000	2.00000	1.00000
151	0.0000	126.000	192.800	12.2600	2.00000	2.50000	1.50000	1.50000
152	0.0000	62.000	29.500	4.2600	1.00000	1.00000	1.00000	1.00000
153	0.0000	80.000	74.000	7.0000	2.00000	2.00000	1.00000	1.00000
154	0.0000	40.000	32.000	6.0000	2.00000	1.00000	1.00000	1.00000
155	0.0000	49.000	46.000	5.2800	2.00000	1.80000	2.00000	1.80000
156	0.0000	122.000	53.500	3.6300	1.00000	1.50000	1.50000	2.50000
157	0.0000	17.000	9.000	5.2000	3.00000	1.00000	1.00000	1.00000
158	0.0000	50.000	31.000	6.2300	2.00000	2.00000	1.50000	1.50000
159	0.0000	53.000	38.000	5.0600	2.00000	1.00000	2.00000	2.00000
160	0.0000	131.500	104.000	5.6700	2.00000	1.00000	1.50000	1.50000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
145	1.80000	1.50000	10	2	C	16.8000	X	191.000	1.00000
146	2.50000	2.50000	11	2	C	18.9200	X	281.000	1.00000
147	1.00000	1.00000	8	2	C	18.7500	X	173.000	1.00000
148	1.00000	1.20000	3	2	C	22.9800	X	71.000	1.00000
149	3.00000	2.00000	3	2	C	19.3000	X	75.000	1.00000
150	2.00000	1.00000	8	2	C	17.6500	X	224.000	1.00000
151	1.00000	1.00000	6	2	C	21.4200	X	318.800	1.00000
152	1.00000	1.00000	7	2	C	17.7000	X	91.500	1.00000
153	1.00000	1.00000	5	2	C	18.7000	X	154.000	1.00000
154	1.00000	1.00000	2	2	C	16.0200	X	72.000	1.00000
155	1.20000	1.00000	3	2	C	21.7200	X	95.000	1.00000
156	2.00000	2.00000	9	2	C	23.7500	X	175.500	1.00000
157	1.00000	1.00000	2	2	C	0.0000	X	26.000	1.00000
158	1.50000	1.50000	3	2	C	20.3500	X	81.000	1.00000
159	1.00000	1.00000	3	2	C	20.5500	X	91.000	1.00000
160	1.00000	1.00000	13	2	C	19.5000	X	235.500	1.00000

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OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
161	XE15	2.60000	2.71000	2.60000	5.47000	4.0500	2.10000	237.000	0.0000
162	XE16	2.34000	2.36000	2.34000	5.34000	5.3400	2.28000	156.000	0.2000
163	XE17	1.52000	2.33000	1.52000	4.73000	6.4000	3.11000	58.000	0.4000
164	XE18	1.83000	1.40000	1.83000	5.87000	4.5000	3.21000	277.000	0.2000
165	XE19	2.61000	4.00000	2.61000	5.87000	7.1000	2.25000	338.000	0.6000
166	XE20	2.06000	2.06000	2.06000	6.43000	5.2800	3.12000	151.000	0.8000
167	XE21	1.94000	2.08000	1.94000	5.56000	5.2200	2.90000	318.000	0.4000
168	FO1	1.73000	5.00000	1.73000	3.86000	4.6800	2.22000	216.000	8.0000
169	FO2	1.48000	2.83000	1.48000	4.43000	5.5100	3.00000	154.500	6.5000
170	FO3	2.04000	6.71000	1.52000	3.87000	4.6800	1.89000	81.000	6.9000
171	FO4	1.98000	3.04000	1.52000	4.17000	3.4200	2.11000	195.000	10.5000
172	FO5	1.34000	2.80000	1.19000	4.39000	4.8000	3.28000	58.000	6.0000
173	FO6	1.24000	3.16000	1.24000	4.70000	5.1400	3.92000	98.000	9.8000
174	FO7	1.36000	1.87000	1.36000	5.37000	4.2600	3.55000	153.000	9.2000
175	FO8	1.42000	4.16000	1.19000	4.26000	5.0300	2.76000	125.000	8.2000
176	FO9	1.74000	3.64000	1.35000	4.96000	4.5600	2.85000	170.000	8.0000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
161	0.0000	68.000	58.5000	5.0600	2.00000	1.50000	1.00000	1.00000
162	0.0000	51.500	27.5000	7.1800	1.00000	2.00000	1.00000	1.00000
163	0.0000	22.000	16.0000	3.4500	2.00000	1.00000	1.00000	1.00000
164	0.0000	57.000	33.0000	4.0900	2.00000	1.50000	1.00000	1.00000
165	0.0000	75.000	66.0000	5.8800	2.00000	1.50000	2.00000	2.00000
166	0.0000	65.000	34.0000	4.3000	2.00000	1.00000	1.00000	1.00000
167	0.0000	151.000	83.0000	4.5900	1.50000	2.50000	1.50000	1.50000
168	4.4000	47.000	49.0000	6.4000	1.00000	1.00000	1.00000	1.00000
169	6.0000	36.000	31.0000	5.8300	1.00000	1.00000	1.00000	1.00000
170	7.0000	24.000	18.0000	6.4600	1.00000	1.00000	1.00000	1.00000
171	6.3000	47.000	46.0000	6.2000	1.00000	1.00000	1.00000	1.00000
172	6.2000	17.500	8.0000	3.1900	1.00000	1.00000	1.00000	1.00000
173	6.6000	31.000	23.0000	7.2000	2.00000	1.00000	1.00000	1.00000
174	9.7000	42.500	40.0000	8.2500	1.00000	1.00000	1.00000	1.00000
175	7.9000	24.800	26.5000	5.7500	1.50000	1.00000	1.00000	1.00000
176	5.3000	45.500	52.0000	6.7200	1.00000	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
161	1.50000	1.00000	3	2	C	21.5500	X	126.500	1.00000
162	2.00000	1.00000	6	2	C	18.6800	X	79.000	1.00000
163	1.00000	1.00000	3	2	C	18.3000	X	38.000	1.00000
164	1.00000	1.00000	6	2	C	18.9200	X	90.000	1.00000
165	1.50000	1.50000	6	2	C	22.2000	X	141.000	1.00000
166	1.00000	1.00000	4	2	C	21.6500	X	99.000	1.00000
167	1.20000	1.00000	8	2	C	20.1500	X	234.000	1.00000
168	1.00000	1.00000	3	2	I	18.6500	F	96.000	1.00000
169	1.00000	1.00000	3	2	I	20.7800	F	67.000	1.00000
170	1.00000	1.00000	2	2	I	20.5500	F	42.000	0.74510
171	1.00000	1.00000	2	2	I	18.6000	F	93.000	0.76768
172	1.00000	1.00000	1	2	I	17.6000	F	25.500	0.88806
173	1.00000	1.00000	2	2	I	16.7500	F	54.000	1.00000
174	1.00000	1.00000	4	2	I	15.8000	F	82.500	1.00000
175	1.00000	1.00000	2	2	I	14.8000	F	51.300	0.83803
176	1.00000	1.00000	4	2	I	16.4000	F	97.500	0.77586

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OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
177	F10	1.70000	3.26000	1.70000	4.48000	4.2900	2.64000	147.000	9.2000
178	F11	1.58000	3.55000	1.46000	4.22000	5.3800	2.34000	171.000	9.2000
179	XF12	1.43000	3.29000	1.04000	3.91000	4.5000	2.73000	139.000	2.3000
180	F13	1.17000	2.24000	1.17000	4.26000	4.5600	3.64000	118.000	12.9000
181	F14	1.65000	2.23000	1.65000	5.48000	4.3500	3.32000	127.500	14.2000
182	F15	1.26000	3.62000	1.26000	4.78000	6.1100	3.79000	187.000	5.8000
183	F16	1.86000	3.89000	1.86000	6.34000	6.0800	3.41000	171.000	9.8000
184	F17	1.09000	2.00000	1.09000	4.91000	4.7100	4.50000	84.000	15.3000
185	XF18	1.85000	2.66000	1.63000	4.35000	5.2600	2.35000	110.000	5.6000
186	F19	1.13000	1.58000	1.13000	5.30000	4.6900	4.69000	135.000	8.0000
187	F20	1.52000	3.88000	1.35000	4.46000	5.2600	2.93000	278.500	6.9000
188	F21	1.74000	3.64000	1.74000	5.13000	5.6200	2.95000	226.000	8.6000
189	F22	1.35000	3.88000	1.35000	4.78000	6.8700	3.54000	199.000	9.2000
190	F23	1.56000	3.99000	1.56000	5.11000	6.1800	3.28000	274.000	10.0000
191	F24	1.22000	2.98000	1.22000	4.27000	6.1000	3.56000	179.000	6.8000
192	F25	2.35000	3.86000	2.35000	4.65000	4.6500	1.98000	202.000	15.3000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
177	7.6000	40.0000	35.5000	7.6400	2.00000	1	1	1
178	8.6000	48.0000	38.0000	8.1900	2.50000	1	1	1
179	0.3000	35.5000	28.0000	4.2400	2.00000	1	1	1
180	9.2000	31.0000	17.0000	3.2000	1.00000	1	1	1
181	9.7000	33.5000	28.2000	6.3500	1.00000	1	1	1
182	4.4000	54.0000	65.0000	11.9000	2.00000	1	1	1
183	5.5000	54.8000	41.5000	8.5600	2.00000	1	1	1
184	6.6000	32.0000	27.0000	6.2100	1.00000	1	1	1
185	1.0000	39.0000	21.0000	6.3200	2.00000	1	1	1
186	2.4000	52.0000	13.0000	2.8300	2.00000	1	1	1
187	5.6000	52.8000	53.0000	6.7100	2.00000	1	1	1
188	2.0000	48.0000	40.0000	6.7700	2.00000	1	1	1
189	7.2000	42.0000	48.5000	6.6000	3.00000	1	1	1
190	5.5000	58.8000	71.5000	10.3500	1.00000	1	1	1
191	8.8000	44.0000	20.0000	5.3300	1.00000	1	1	1
192	10.0000	50.8000	42.5000	5.8800	1.00000	1	1	1

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
177	1.00000	1	6	2	I	15.7200	F	75.500	1.00000
178	1.00000	1	6	2	I	15.7000	F	86.000	0.92405
179	1.50000	1	5	2	I	16.1800	X	63.500	0.72727
180	1.00000	1	6	2	I	16.1200	F	48.000	1.00000
181	1.00000	1	2	2	I	15.7800	F	61.700	1.00000
182	1.00000	1	3	2	I	15.8800	F	119.000	1.00000
183	1.00000	1	3	2	I	16.3200	F	96.300	1.00000
184	1.00000	1	2	2	I	15.7000	F	59.000	1.00000
185	1.00000	1	2	2	I	18.5800	X	60.000	0.88108
186	1.00000	1	3	2	I	14.9000	F	65.000	1.00000
187	1.00000	1	7	2	I	15.9200	F	105.800	0.88816
188	1.00000	1	5	2	I	18.7000	F	88.000	1.00000
189	1.00000	1	8	2	I	15.6500	F	90.500	1.00000
190	1.00000	1	3	2	I	17.3000	F	130.300	1.00000
191	1.00000	1	7	2	I	15.9000	F	64.000	1.00000
192	1.00000	1	3	2	I	17.0000	F	93.300	1.00000

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
193	F26	1.85000	3.61000	1.85000	4.79000	5.2600	2.60000	192.500	10.8000
194	F27	1.22000	2.81000	1.11000	3.83000	4.1900	3.14000	153.000	9.0000
195	XF28	1.17000	2.07000	1.17000	5.91000	8.5000	5.05000	280.000	4.6000
196	F29	1.43000	3.13000	1.43000	4.74000	4.9600	3.31000	162.000	7.2000
197	F30	1.74000	4.00000	1.74000	4.59000	7.0400	2.64000	166.000	6.6000
198	XF31	1.30000	2.50000	1.30000	4.65000	5.3500	3.57000	154.500	3.8000
199	F32	1.78000	5.12000	1.78000	4.60000	11.1600	2.59000	152.000	12.0000
200	F33	1.88000	4.22000	1.88000	3.50000	4.3000	1.87000	122.500	7.2000
201	F34	2.35000	6.00000	2.35000	4.39000	4.3900	1.87000	147.000	13.0000
202	F35	1.96000	4.53000	1.82000	4.08000	4.0800	2.09000	100.000	10.4000
203	F36	1.77000	3.22000	1.70000	5.56000	5.2900	3.14000	244.000	11.2000
204	JF37	2.04000	3.61000	2.04000	3.72000	6.1100	1.82000	37.000	0.6000
205	F38	1.70000	3.91000	1.70000	4.43000	4.7400	2.60000	69.000	10.0000
206	F39	1.91000	3.38000	1.91000	4.65000	5.3500	2.43000	180.000	15.2000
207	F40	1.48000	3.78000	1.48000	4.52000	5.7800	3.05000	77.000	8.8000
208	F41	1.28000	2.80000	0.86000	4.70000	5.0400	3.84000	205.000	6.9000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
193	10.0000	49.0000	46.0000	8.6400	2.00000	1.00000	1.00000	1
194	5.4000	59.0000	50.0000	9.0600	1.00000	1.00000	1.00000	1
195	3.0000	71.0000	88.0000	7.9500	1.00000	1.00000	1.00000	1
196	7.4000	41.0000	33.0000	4.9300	1.00000	1.00000	1.00000	1
197	4.4000	44.0000	35.0000	4.3900	1.00000	1.00000	1.00000	1
198	1.3000	33.0000	17.0000	4.1700	1.00000	1.00000	1.00000	1
199	4.8000	33.0000	31.5000	7.3800	1.00000	1.00000	1.00000	1
200	6.8000	36.8000	14.8000	4.5700	1.00000	1.00000	1.00000	1
201	6.0000	63.0000	43.0000	10.6000	2.00000	1.00000	1.00000	1
202	7.6000	31.8000	36.0000	6.7800	1.50000	1.00000	1.00000	1
203	4.6000	48.2000	44.0000	5.2100	2.00000	1.00000	1.00000	1
204	0.6000	16.0000	8.0000	4.0000	1.00000	1.00000	1.00000	1
205	7.7000	23.2000	15.0000	3.9600	1.00000	1.00000	1.00000	1
206	8.8000	35.0000	33.0000	6.2800	1.00000	1.00000	1.00000	1
207	7.2000	17.8000	16.0000	5.6200	1.00000	1.00000	1.00000	1
208	9.2000	40.8000	33.5000	5.0300	1.00000	1.00000	1.00000	1

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
193	1.00000	1.00000	6	2	I	17.7000	F	95.000	1.00000
194	1.00000	1.00000	5	2	I	16.1200	F	109.000	0.90984
195	1.00000	1.00000	5	2	I	20.2200	X	159.000	1.00000
196	1.00000	1.00000	3	2	I	16.1200	F	74.000	1.00000
197	1.00000	1.00000	3	2	I	17.7500	F	79.000	1.00000
198	1.00000	1.00000	6	2	I	19.7000	X	50.000	1.00000
199	1.00000	1.00000	4	2	I	17.4500	F	64.500	1.00000
200	1.00000	1.00000	5	2	I	16.0500	F	51.600	1.00000
201	1.00000	1.00000	3	2	I	16.7500	F	106.000	1.00000
202	1.00000	1.00000	3	2	I	20.7500	F	67.800	0.92857
203	1.00000	1.00000	7	2	I	15.5800	F	92.200	0.96045
204	1.00000	1.00000	1	2	I	18.8200	J	24.000	1.00000
205	1.00000	1.00000	2	2	I	16.6800	F	38.200	1.00000
206	1.00000	1.00000	5	2	I	16.6500	F	68.000	1.00000
207	1.00000	1.00000	2	2	I	16.9000	F	33.800	1.00000
208	1.00000	1.00000	8	2	I	16.7800	F	74.300	0.67188

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
209	ZF42	1.44000	1.49000	1.44000	6.33000	5.9800	4.66000	193.000	2.4000
210	XF43	2.35000	3.18000	2.35000	5.04000	5.2700	2.14000	176.000	5.0000
211	F44	1.42000	2.91000	1.37000	4.56000	3.8500	3.20000	202.000	6.0000
212	F45	1.43000	3.65000	1.00000	4.65000	7.6400	3.25000	151.000	7.5000
213	F46	1.61000	3.70000	1.61000	4.78000	7.3300	2.97000	212.000	8.3000
214	F47	1.26000	2.44000	1.26000	5.16000	4.4800	4.19000	279.000	8.6000
215	F48	2.35000	7.72000	2.22000	4.59000	7.0400	1.95000	124.000	9.2000
216	F49	1.43000	2.99000	1.43000	4.15000	4.5400	2.90000	138.000	8.4000
217	F50	1.52000	2.29000	1.52000	5.60000	4.8600	3.70000	137.000	8.6000
218	F51	1.30000	3.06000	1.30000	4.54000	6.1700	3.58000	256.000	9.8000
219	F52	2.00000	3.02000	2.00000	5.15000	4.1600	2.58000	173.000	9.2000
220	F53	1.74000	6.67000	1.74000	5.39000	9.5400	3.10000	123.000	4.6000
221	F54	1.39000	2.91000	1.39000	5.91000	7.5600	4.25000	193.000	6.2000
222	F55	1.39000	2.28000	1.39000	4.26000	4.1700	3.06000	161.000	12.3000
223	F56	1.74000	2.19000	1.74000	5.20000	6.0700	2.98000	221.500	9.2000
224	F57	1.41000	3.11000	1.32000	5.94000	6.2600	4.23000	178.000	9.6000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
209	12.6000	59.500	34.5000	5.4400	1.50000	1.00000	1.00000	1.00000
210	7.0000	30.500	45.0000	10.0700	2.00000	1.00000	1.00000	1.00000
211	2.2000	55.000	28.0000	3.9500	1.00000	1.00000	1.00000	1.00000
212	6.0000	46.000	30.0000	6.9000	2.00000	1.00000	1.00000	1.00000
213	8.0000	50.000	50.0000	6.6700	1.00000	1.00000	1.00000	1.00000
214	6.0000	70.000	35.5000	4.4800	1.00000	1.00000	1.00000	1.00000
215	4.8000	40.500	30.0000	4.0800	1.00000	1.00000	1.00000	1.00000
216	2.2000	33.000	34.2000	5.9800	1.00000	1.00000	1.00000	1.00000
217	4.5000	33.500	22.0000	3.5300	1.00000	1.00000	1.00000	1.00000
218	6.6000	55.200	32.0000	5.1300	1.00000	1.00000	1.00000	1.00000
219	6.2000	29.000	30.0000	7.3800	1.50000	1.00000	1.00000	1.00000
220	2.5000	36.000	32.5000	6.0800	3.00000	1.00000	1.00000	1.00000
221	4.0000	46.000	36.0000	5.8600	1.00000	1.00000	1.00000	1.00000
222	6.3000	60.300	46.5000	9.7600	2.00000	1.00000	1.00000	1.00000
223	4.5000	57.200	47.5000	6.3400	1.50000	1.00000	1.00000	1.00000
224	6.6000	49.000	40.0000	6.6000	1.00000	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
209	1.00000	1.00000	3	1	Z	1.1100	Z	94.000	1.00000
210	1.00000	1.00000	4	2	I	17.2000	X	75.500	1.00000
211	1.00000	1.00000	9	2	I	0.0000	F	83.000	0.96479
212	1.00000	1.00000	6	2	I	16.7200	F	76.000	0.69930
213	1.00000	1.00000	4	2	I	17.6500	F	100.000	1.00000
214	1.00000	1.00000	8	2	I	17.3500	F	105.500	1.00000
215	1.00000	1.00000	5	2	I	21.2500	F	70.500	0.94468
216	1.00000	1.00000	2	2	I	18.5200	F	67.200	1.00000
217	1.00000	1.00000	7	2	I	18.5500	F	55.500	1.00000
218	1.00000	1.00000	6	2	I	15.1800	F	87.200	1.00000
219	1.00000	1.00000	5	2	I	20.9000	F	59.000	1.00000
220	1.00000	1.00000	1	2	I	0.0000	F	68.500	1.00000
221	1.00000	1.00000	2	2	I	20.7700	F	82.000	1.00000
222	1.00000	1.00000	4	2	I	19.9500	F	106.800	1.00000
223	1.00000	1.00000	6	2	I	17.2800	F	104.700	1.00000
224	1.00000	1.00000	5	2	I	21.0200	F	89.000	0.93617

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
225	F58	1.65000	4.44000	1.65000	4.00000	4.0200	2.50000	203.000	13.0000
226	F59	1.14000	2.24000	0.95000	4.92000	5.6600	4.32000	196.000	6.1000
227	F60	1.41000	2.70000	1.39000	5.13000	5.1300	3.64000	223.000	8.9000
228	F61	1.13000	3.25000	1.13000	4.19000	5.6700	3.71000	214.000	12.4000
229	XF62	1.80000	2.72000	1.80000	5.11000	4.3600	2.86000	253.000	2.9000
230	XF63	1.46000	2.48000	1.46000	5.37000	6.9000	3.78000	266.500	0.2000
231	F64	1.39000	2.78000	1.39000	4.83000	4.8300	3.47000	145.000	8.6000
232	F65	2.39000	3.93000	1.74000	5.30000	5.3000	2.22000	257.000	5.8000
233	KO1	2.48000	3.36000	2.48000	5.26000	5.5000	2.12000	175.000	6.4000
234	KO2	2.56000	3.28000	2.56000	4.96000	5.7000	1.93000	115.000	11.3000
235	KO3	1.41000	3.05000	1.41000	5.58000	11.1000	3.97000	211.000	8.3000
236	KO4	1.45000	1.45000	1.45000	5.69000	5.2300	3.92000	200.000	4.6000
237	KO5	2.04000	2.93000	2.04000	6.09000	6.6700	2.98000	187.000	10.4000
238	XLO1	3.37000	5.16000	3.37000	4.82000	6.1600	1.38000	296.500	1.0000
239	XMO1	2.48000	3.93000	2.48000	4.09000	3.9200	1.65000	134.000	1.0000
240	ZNO1	0.87000	1.00000	0.00000	5.00000	6.0500	5.75000	97.000	1.7000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
225	6.2000	44.000	37.000	7.7100	1	1.00000	1.00000	1.00000
226	3.7000	53.000	50.000	7.1200	1	1.00000	1.00000	1.00000
227	7.0000	48.000	44.000	6.1300	1	1.00000	1.00000	1.00000
228	9.4000	50.500	64.000	9.5400	1	1.00000	1.00000	1.00000
229	0.0000	76.800	48.500	5.0100	1	1.00000	1.00000	1.00000
230	1.2000	84.200	46.000	3.4200	3	1.00000	1.00000	1.00000
231	5.2000	23.500	17.000	6.2300	1	1.00000	1.00000	1.00000
232	5.0000	57.000	59.000	6.4400	2	1.00000	1.00000	1.00000
233	9.7000	49.000	45.500	7.2200	2	4.00000	4.00000	4.00000
234	10.6000	33.000	31.500	5.8600	2	4.00000	4.00000	4.00000
235	8.1000	71.200	49.500	4.9400	2	4.00000	4.00000	4.00000
236	3.6000	54.000	52.000	6.6200	2	4.00000	4.00000	4.00000
237	11.2000	79.000	83.000	6.4800	2	4.00000	4.00000	4.00000
238	0.0000	45.000	50.000	7.9200	2	4.00000	1.00000	1.00000
239	0.0000	45.000	47.000	4.8400	1	1.00000	1.00000	1.00000
240	7.8000	26.000	14.000	4.4400	2	1.50000	1.50000	0.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
225	1.00000	1.00000	8	2	I	18.3800	F	81.000	1.00000
226	1.00000	1.00000	5	2	I	16.6500	F	103.000	0.83333
227	1.00000	1.00000	7	2	I	18.7000	F	92.000	0.98582
228	1.00000	1.00000	6	2	I	16.8200	F	114.500	1.00000
229	1.00000	1.00000	7	2	I	15.4200	X	125.300	1.00000
230	1.00000	1.00000	8	2	I	18.4500	X	130.200	1.00000
231	1.00000	1.00000	3	2	I	18.5500	F	40.500	1.00000
232	1.00000	1.00000	3	2	I	29.8800	F	116.000	0.72803
233	4.00000	4.00000	4	2	I	1.1100	K	94.500	1.00000
234	4.00000	4.00000	2	2	I	1.1100	K	64.500	1.00000
235	4.00000	4.00000	11	2	I	1.1100	K	120.700	1.00000
236	4.00000	4.00000	5	2	I	1.1100	K	106.000	1.00000
237	4.00000	4.00000	3	2	I	1.1100	K	162.000	1.00000
238	4.00000	3.50000	5	2	I	1.1100	X	95.000	1.00000
239	1.00000	1.00000	6	2	I	17.5500	X	92.000	1.00000
240	1.50000	0.00000	1	1	Z	1.1100	Z	40.000	0.00000

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OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
241	XO01	0.78000	1.50000	0.00000	5.13000	7.8700	6.58000	156.000	2.0000
242	XQ01	1.39000	1.88000	1.39000	4.33000	4.3300	3.11000	145.000	3.1000
243	XR01	1.09000	1.92000	1.09000	4.78000	8.4600	4.40000	121.000	1.6000
244	XS01	1.52000	2.91000	1.52000	3.96000	5.0600	2.60000	75.000	0.2000
245	XT01	2.17000	3.57000	2.17000	4.78000	5.5000	2.20000	85.000	0.0000
246	XU01	1.74000	2.50000	1.74000	6.17000	6.6000	3.54000	262.000	0.0000
247	XG01	1.74000	2.86000	1.74000	4.56000	5.5300	2.62000	132.000	0.0000
248	XG02	3.13000	3.35000	3.13000	4.13000	4.4200	1.32000	111.000	0.0000
249	XG03	2.52000	5.27000	2.52000	5.26000	8.0600	3.86000	220.000	0.2000
250	FG04	0.96000	2.44000	0.96000	3.52000	5.4000	3.67000	165.000	9.9000
251	FG05	1.35000	3.45000	1.35000	3.61000	4.8800	2.67000	141.000	12.4000
252	XG06	2.09000	3.70000	2.09000	3.91000	4.7300	1.87000	188.000	0.2000
253	XG07	1.89000	4.83000	1.89000	3.65000	5.2500	1.93000	264.000	0.4000
254	FG08	1.78000	2.73000	1.78000	5.09000	4.6800	2.86000	245.000	9.2000
255	XG09	1.87000	3.31000	1.87000	4.70000	5.4000	2.51000	142.000	2.2000
256	FG10	1.78000	5.85000	1.78000	5.04000	7.7300	2.83000	209.000	8.0000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
241	1.8000	40.000	48.000	4.4000	2	3.50000	3.50000	0.00000
242	2.6000	34.500	22.000	3.7700	1	1.00000	1.00000	1.00000
243	14.2000	30.000	25.000	5.5000	1	1.00000	1.00000	1.00000
244	0.0000	30.000	15.000	4.5000	1	1.00000	1.00000	1.00000
245	0.0000	28.000	13.000	2.4100	1	3.00000	2.00000	2.00000
246	0.0000	72.500	44.000	5.3000	1	2.50000	1.00000	1.00000
247	0.0000	26.000	35.000	5.1900	2	1.00000	1.00000	1.00000
248	0.0000	48.000	29.000	5.9200	3	1.00000	1.00000	1.00000
249	0.0000	40.000	46.000	5.0800	2	3.00000	2.00000	2.00000
250	7.0000	36.000	23.000	3.6900	1	1.00000	1.00000	1.00000
251	9.2000	28.000	27.000	7.8600	1	1.00000	1.00000	1.00000
252	0.0000	35.000	30.000	5.0000	2	1.00000	1.00000	1.00000
253	0.0000	59.000	66.000	9.6100	2	1.00000	1.00000	1.00000
254	2.0000	34.000	27.000	3.5900	2	1.00000	1.00000	1.00000
255	0.0000	33.500	27.500	5.0800	2	1.00000	1.00000	1.00000
256	3.5000	32.000	25.000	6.0000	1	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
241	3.50000	0	1	2	C	21.6800	X	88.000	0.00000
242	1.00000	1	7	2	I	18.4000	X	56.500	1.00000
243	1.00000	1	3	2	I	18.5200	X	55.000	1.00000
244	1.00000	1	4	2	I	16.6000	X	45.000	1.00000
245	1.00000	1	4	2	C	22.2800	X	41.000	1.00000
246	1.00000	1	8	2	C	20.9500	X	116.500	1.00000
247	1.00000	1	3	2	I	21.6200	X	61.000	1.00000
248	1.00000	1	3	2	I	17.3200	X	77.000	1.00000
249	1.00000	1	2	2	C	21.1000	X	86.000	1.00000
250	1.00000	1	4	2	I	17.2500	F	59.000	1.00000
251	1.00000	1	3	2	I	16.4200	F	55.000	1.00000
252	1.00000	1	5	2	I	17.3500	X	65.000	1.00000
253	1.00000	1	9	2	I	16.4500	X	125.000	1.00000
254	1.00000	1	4	2	I	17.3000	F	61.000	1.00000
255	1.00000	1	2	2	I	16.3800	X	61.000	1.00000
256	1.00000	1	6	2	I	16.0500	F	57.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
257	FG11	2.00000	3.28000	2.00000	4.26000	4.2600	2.13000	295.000	8.2000
258	XG12	1.87000	2.26000	1.87000	4.92000	4.5600	2.65000	333.000	0.4000
259	XG13	2.13000	3.27000	2.13000	4.43000	4.8600	2.08000	163.000	0.4000
260	XG14	2.26000	3.71000	2.26000	5.65000	6.1900	2.50000	144.000	0.8000
261	XG15	2.26000	3.46000	2.26000	4.78000	5.7800	2.12000	100.000	0.6000
262	XG16	2.39000	4.23000	2.39000	4.74000	7.2700	1.98000	129.000	1.0000
263	XG17	2.04000	2.61000	2.04000	3.96000	4.7900	1.94000	125.000	0.0000
264	XG18	2.43000	4.31000	2.43000	5.61000	7.1700	2.30000	347.000	0.4000
265	FG19	1.39000	2.78000	1.39000	4.54000	4.9800	3.26000	186.000	9.2000
266	FG20	1.30000	5.00000	1.30000	5.00000	8.2100	3.85000	86.500	8.5000
267	XG21	1.70000	3.90000	1.70000	4.13000	6.3300	2.43000	61.000	5.2000
268	XG22	2.13000	2.88000	2.13000	4.43000	4.6400	2.08000	283.000	0.0000
269	JG23	1.43000	2.19000	1.43000	3.65000	4.6600	2.55000	52.000	0.8000
270	XG24	1.78000	2.92000	1.78000	4.00000	4.3800	2.25000	260.000	0.8000
271	XG25	1.96000	3.00000	1.96000	5.72000	5.4800	2.92000	173.500	0.0000
272	XG26	2.35000	6.00000	2.35000	4.22000	7.1900	1.80000	309.000	0.8000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
257	2.6000	52.000	43.000	6.7800	2.00000	1.00000	1.00000	1.00000
258	0.0000	108.500	91.000	8.3100	1.00000	1.00000	1.00000	1.00000
259	0.0000	45.000	49.000	6.9600	2.00000	1.00000	1.00000	1.00000
260	0.0000	52.000	42.000	7.8300	2.00000	1.00000	1.50000	1.50000
261	0.0000	40.000	25.000	4.3300	3.00000	1.00000	1.00000	1.00000
262	0.2000	32.000	34.000	10.1500	1.00000	1.00000	1.00000	1.00000
263	0.0000	25.000	38.000	7.8800	2.00000	1.00000	1.00000	1.00000
264	0.0000	97.000	61.500	5.1500	2.00000	1.00000	1.00000	1.00000
265	6.0000	30.000	35.000	6.1900	2.00000	1.00000	1.00000	1.00000
266	6.0000	33.500	30.000	3.9700	1.00000	1.00000	1.00000	1.00000
267	8.8000	27.000	15.000	2.6200	1.00000	1.00000	1.00000	1.00000
268	0.0000	61.000	45.000	6.6200	1.00000	1.00000	1.00000	1.00000
269	0.0000	17.000	8.000	3.8500	2.00000	1.00000	1.00000	1.00000
270	0.0000	61.000	57.000	10.7300	3.00000	1.00000	1.00000	1.00000
271	0.0000	56.000	12.000	2.5200	1.00000	1.00000	1.00000	1.00000
272	0.4000	108.000	155.000	10.1200	2.00000	1.00000	1.00000	1.50000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
257	1.00000	1.00000	6	2	I	17.5500	F	95.000	1.00000
258	1.00000	1.00000	3	2	I	22.7200	X	199.500	1.00000
259	1.00000	1.00000	2	2	I	21.5200	X	94.000	1.00000
260	1.00000	1.00000	2	2	C	21.6500	X	94.000	1.00000
261	1.00000	1.00000	4	2	I	18.0000	X	65.000	1.00000
262	1.00000	1.00000	4	2	I	25.3500	X	66.000	1.00000
263	1.00000	1.00000	2	2	I	22.4500	X	63.000	1.00000
264	1.00000	1.00000	7	2	I	19.4500	X	158.500	1.00000
265	1.00000	1.00000	5	2	I	19.9200	F	65.000	1.00000
266	1.00000	1.00000	2	2	I	17.6800	F	63.500	1.00000
267	1.00000	1.00000	2	2	I	18.1500	X	42.000	1.00000
268	1.00000	1.00000	7	2	I	18.9200	X	106.000	1.00000
269	1.00000	1.00000	2	2	I	0.0000	J	25.000	1.00000
270	1.00000	1.00000	7	2	I	19.6500	X	118.000	1.00000
271	1.00000	1.00000	3	2	C	19.6800	X	68.000	1.00000
272	2.00000	1.00000	3	2	C	20.5200	X	263.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
273	XG27	1.91000	2.58000	1.91000	4.80000	5.0200	2.51000	157.000	0.4000
274	XG28	2.09000	4.36000	2.09000	5.46000	8.9600	2.61000	200.000	0.0000
275	XG29	2.26000	2.48000	2.26000	4.56000	3.6200	2.02000	292.000	0.0000
276	XG30	2.83000	4.07000	2.83000	3.96000	5.0600	1.40000	120.000	0.0000
277	ZG31	1.09000	1.14000	1.09000	4.96000	6.7100	4.55000	111.000	2.0000
278	XG32	3.00000	3.45000	3.00000	5.35000	3.8400	1.78000	273.000	0.6000
279	XG33	1.56000	3.27000	1.56000	6.35000	11.2300	4.06000	221.000	0.8000
280	XG34	2.83000	3.82000	2.83000	5.44000	4.6300	1.92000	194.000	0.2000
281	XG35	2.39000	5.00000	2.39000	4.26000	4.9000	1.78000	181.000	3.6000
282	XG36	2.61000	5.46000	2.61000	4.48000	4.1200	1.72000	235.000	0.8000
283	FG37	1.52000	3.18000	1.52000	3.83000	4.4000	2.52000	148.000	8.8000
284	XG38	1.56000	1.99000	1.56000	5.04000	4.6300	3.23000	128.500	0.8000
285	FG39	1.78000	3.42000	1.78000	4.09000	3.1300	2.30000	118.000	6.5000
286	XG40	1.87000	3.91000	1.87000	4.39000	5.0500	2.35000	170.000	4.2000
287	XG41	1.68000	1.98000	1.68000	6.20000	7.3100	3.62000	324.000	0.4000
288	XG42	2.17000	3.85000	2.17000	3.63000	4.3900	1.67000	272.000	1.0000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
273	0.6000	38.000	26.000	4.5700	2.00000	1.00000	1.00000	1.00000
274	0.0000	61.000	48.000	9.0800	2.00000	2.50000	2.00000	2.00000
275	0.0000	63.000	59.000	6.9700	2.00000	1.00000	1.00000	1.00000
276	0.0000	45.000	34.000	6.8700	3.00000	1.00000	1.00000	1.00000
277	4.0000	34.000	27.000	5.0800	1.00000	1.00000	1.00000	1.00000
278	0.0000	55.000	52.000	5.3500	2.00000	1.00000	1.00000	1.00000
279	0.2000	93.000	65.000	7.9000	1.00000	1.00000	1.00000	1.00000
280	0.4000	33.000	19.000	5.7800	2.00000	3.00000	1.00000	1.00000
281	0.0000	49.000	34.500	6.4200	2.00000	1.00000	1.00000	1.00000
282	0.0000	42.000	37.000	5.6400	1.00000	1.00000	1.00000	1.00000
283	4.8000	42.000	36.000	4.8800	1.00000	1.00000	1.00000	1.00000
284	0.8000	62.000	26.000	4.0000	2.00000	1.00000	1.00000	1.00000
285	8.6000	40.000	32.000	4.7300	1.00000	1.00000	1.00000	1.00000
286	3.0000	38.500	38.000	5.1000	1.00000	1.00000	1.00000	1.00000
287	0.4000	103.500	126.000	6.3800	1.00000	1.00000	1.00000	1.00000
288	0.0000	38.000	50.000	7.3300	3.00000	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
273	1.00000	1.00000	4	2	I	19.8000	X	64.000	1.00000
274	2.00000	2.00000	3	2	C	20.3000	X	109.000	1.00000
275	1.00000	1.00000	4	2	I	22.4800	X	122.000	1.00000
276	1.00000	1.00000	2	2	I	22.3500	X	79.000	1.00000
277	1.00000	1.00000	2	1	Z	19.0100	Z	61.000	1.00000
278	1.00000	1.00000	3	2	I	20.2500	X	107.000	1.00000
279	1.00000	1.00000	5	2	C	22.0000	X	158.000	1.00000
280	1.00000	1.00000	4	2	I	20.0800	X	52.000	1.00000
281	1.00000	1.00000	3	2	I	16.8500	X	83.500	1.00000
282	1.00000	1.00000	7	2	I	17.7500	X	79.000	1.00000
283	1.00000	1.00000	5	2	I	16.6500	F	78.000	1.00000
284	1.00000	1.00000	8	2	C	18.6500	X	88.000	1.00000
285	1.00000	1.00000	5	2	I	16.1500	F	72.000	1.00000
286	1.00000	1.00000	3	2	I	18.9000	X	76.500	1.00000
287	1.00000	1.00000	7	2	C	20.4000	X	229.500	1.00000
288	1.00000	1.00000	6	2	I	16.3500	X	88.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
289	FG43	1.65000	4.22000	1.65000	4.26000	5.44000	2.58000	163.000	15.5000
290	XG44	1.87000	4.78000	1.63000	4.37000	8.09000	2.34000	184.000	3.8000
291	XG45	1.56000	2.99000	1.56000	5.17000	6.25000	3.31000	152.000	0.8000
292	XG46	1.65000	2.00000	1.65000	5.09000	5.09000	3.08000	276.000	1.0000
293	XG47	1.91000	2.58000	1.91000	5.00000	6.05000	2.62000	218.000	0.4000
294	XG48	2.48000	4.39000	2.48000	4.30000	7.06000	2.85000	217.000	3.4000
295	XG49	2.26000	4.73000	2.26000	4.48000	9.37000	1.98000	225.000	1.0000
296	XG50	2.39000	4.23000	2.39000	5.39000	4.96000	2.26000	370.000	0.0000
297	XG51	1.87000	3.31000	1.87000	4.83000	5.55000	2.58000	166.000	2.2000
298	XG52	1.91000	2.59000	1.91000	4.98000	5.20000	2.60000	364.000	0.6000
299	JG53	1.91000	2.93000	1.91000	4.35000	5.88000	2.28000	106.000	0.4000
300	XG54	2.17000	2.94000	2.17000	5.26000	8.07000	2.42000	579.000	0.0000
301	XG55	2.61000	4.62000	2.61000	4.83000	6.94000	1.85000	206.500	0.4000
302	XG56	2.17000	5.55000	2.17000	4.43000	7.28000	2.04000	105.500	0.0000
303	XG57	2.34000	4.48000	2.34000	4.74000	7.27000	2.02000	169.000	1.8000
304	XG58	3.32000	4.14000	3.32000	4.42000	3.98000	1.32000	226.000	0.4000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
289	5.8000	30.000	39.000	5.3100	1.00000	1.00000	1.00000	1.00000
290	12.8000	40.500	37.000	7.7500	1.00000	1.00000	1.00000	1.00000
291	0.0000	37.000	20.000	5.7000	1.00000	1.00000	1.00000	1.00000
292	0.3000	58.800	57.500	7.6400	1.00000	1.00000	1.00000	1.00000
293	0.0000	56.000	46.000	5.3700	2.00000	1.00000	1.00000	1.00000
294	0.8000	41.000	37.000	6.2500	2.00000	1.00000	1.00000	1.00000
295	0.2000	37.000	41.000	8.6700	1.00000	1.00000	1.00000	1.00000
296	0.0000	101.000	110.000	10.5500	2.00000	1.00000	1.00000	1.00000
297	1.8000	40.000	20.000	3.7500	1.00000	1.00000	1.00000	1.00000
298	0.0000	85.000	64.000	9.9300	2.00000	2.00000	1.50000	1.00000
299	0.2000	38.000	31.000	5.7500	2.00000	1.00000	1.00000	1.00000
300	0.0000	126.000	120.000	9.4200	1.00000	1.00000	1.50000	1.50000
301	0.6000	43.500	33.000	4.0300	2.00000	3.00000	1.50000	1.50000
302	0.0000	34.000	28.000	3.6500	2.50000	1.00000	1.00000	1.00000
303	0.0000	54.000	60.000	9.5000	2.00000	1.00000	1.00000	1.00000
304	0.0000	60.000	74.000	6.0000	2.00000	1.50000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
289	1.00000	1.00000	2	2	I	17.7000	F	69.000	1.00000
290	1.00000	1.00000	5	2	I	17.8000	X	77.500	0.87166
291	1.00000	1.00000	4	2	I	20.8800	X	57.000	1.00000
292	1.00000	1.00000	4	2	I	20.9000	X	116.300	1.00000
293	1.00000	1.00000	4	2	I	22.7200	X	102.000	1.00000
294	1.00000	1.00000	3	2	I	19.5200	X	78.000	1.00000
295	1.00000	1.00000	3	2	I	20.8500	X	78.000	1.00000
296	1.00000	1.00000	5	2	I	19.4800	X	211.000	1.00000
297	1.00000	1.00000	6	2	I	20.8500	X	60.000	1.00000
298	1.50000	1.00000	10	2	I	21.2000	X	149.000	1.00000
299	1.00000	1.00000	2	2	I	18.0800	J	69.000	1.00000
300	1.50000	1.00000	7	2	C	19.9200	X	246.000	1.00000
301	1.00000	1.00000	3	2	C	20.2000	X	76.500	1.00000
302	1.00000	1.00000	2	2	I	19.4500	X	62.000	1.00000
303	1.00000	1.00000	3	2	I	19.3500	X	114.000	1.00000
304	1.00000	1.00000	2	2	I	25.6500	X	134.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
305	XG59	1.60000	3.00000	1.60000	3.46000	4.79000	2.48000	149.000	4.6000
306	XG60	1.83000	2.63000	1.83000	5.87000	6.43000	3.21000	419.000	0.0000
307	XG61	1.76000	3.68000	1.76000	5.70000	6.89000	3.23000	257.000	0.2000
308	FG62	1.52000	4.12000	1.52000	3.96000	4.33000	2.60000	215.000	8.5000
309	XG63	1.52000	1.94000	1.52000	4.78000	4.99000	3.14000	126.000	2.0000
310	XG64	1.48000	2.27000	1.48000	4.70000	5.40000	3.18000	161.000	0.0000
311	XG65	2.26000	2.89000	2.26000	5.00000	5.48000	2.21000	311.000	1.0000
312	JG66	2.65000	4.35000	2.65000	3.65000	6.22000	1.38000	19.000	0.0000
313	XG67	2.76000	4.88000	2.76000	4.78000	5.24000	1.73000	367.000	0.0000
314	XG68	2.17000	3.84000	2.17000	4.17000	3.55000	1.92000	280.000	1.0000
315	XG69	1.87000	2.53000	1.87000	4.35000	5.00000	2.33000	162.000	0.0000
316	XG70	2.17000	2.56000	2.17000	5.30000	5.80000	2.44000	140.000	0.8000
317	XG71	1.35000	1.94000	1.35000	5.54000	7.50000	4.10000	206.000	1.0000
318	XG72	2.28000	3.74000	2.28000	3.85000	6.32000	1.69000	236.000	0.4000
319	XG73	1.78000	4.09000	1.78000	5.20000	5.98000	2.92000	162.000	0.0000
320	XG74	1.96000	2.50000	1.96000	4.74000	4.95000	2.42000	250.000	0.6000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
305	1.00000	28.000	30.000	4.9400	2.00000	1.00000	1.00000	1.00000
306	0.20000	93.000	82.500	7.0200	2.00000	2.50000	2.50000	2.00000
307	0.00000	77.000	95.000	6.6100	2.00000	1.50000	1.50000	1.50000
308	4.00000	48.000	44.000	5.4100	1.00000	1.00000	1.00000	1.00000
309	0.80000	85.000	34.000	4.2500	2.00000	2.50000	2.00000	2.00000
310	0.00000	53.000	43.000	5.0500	2.00000	1.00000	1.00000	1.00000
311	0.00000	56.000	36.000	7.6700	1.00000	1.00000	1.00000	1.00000
312	0.00000	11.500	3.000	3.6200	3.00000	1.00000	1.00000	1.00000
313	0.00000	79.500	57.000	4.5500	1.00000	1.00000	1.00000	1.00000
314	0.00000	35.000	30.000	6.5000	1.00000	1.00000	1.00000	1.00000
315	0.00000	33.000	30.000	5.7300	1.00000	1.00000	1.00000	1.00000
316	0.40000	32.000	25.000	5.4300	1.00000	1.00000	1.00000	1.00000
317	0.00000	41.000	33.000	4.6200	1.00000	1.00000	1.00000	1.00000
318	0.00000	49.000	57.000	7.5700	1.00000	1.00000	1.00000	1.00000
319	0.00000	51.000	36.000	6.6900	3.00000	1.00000	1.00000	1.00000
320	0.00000	62.000	73.000	9.0000	1.00000	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
305	1.00000	1.00000	2	2	I	21.6000	X	58.000	1
306	2.50000	2.00000	14	2	C	0.0000	X	175.500	1
307	1.00000	1.00000	3	2	C	23.4800	X	172.000	1
308	1.00000	1.00000	8	2	I	17.2500	F	92.000	1
309	1.50000	1.50000	4	2	C	20.2200	X	119.000	1
310	1.00000	1.00000	3	2	I	15.7000	X	96.000	1
311	1.00000	1.00000	10	2	I	15.8500	X	92.000	1
312	1.00000	1.00000	1	2	I	19.1500	J	14.500	1
313	1.00000	1.00000	6	2	I	16.1000	X	136.500	1
314	1.00000	1.00000	8	2	I	16.6500	X	65.000	1
315	1.00000	1.00000	5	2	I	18.9500	X	63.000	1
316	1.00000	1.00000	4	2	I	23.1800	X	57.000	1
317	1.00000	1.00000	2	2	I	20.3000	X	74.000	1
318	1.00000	1.00000	3	2	I	16.5800	X	106.000	1
319	1.00000	1.00000	2	2	I	15.5000	X	87.000	1
320	1.00000	1.00000	3	2	I	21.9800	X	135.000	1

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
321	XG75	1.52000	2.18000	1.52000	5.26000	4.84000	3.46000	250.000	1.8000
322	XG76	2.52000	4.14000	2.52000	4.26000	4.90000	1.69000	131.000	0.4000
323	XG77	1.78000	2.92000	1.78000	4.00000	4.38000	2.25000	163.000	0.2000
324	XG78	2.74000	4.20000	2.74000	6.22000	5.50000	2.27000	184.000	0.2000
325	XG79	1.96000	3.21000	1.96000	5.50000	7.44000	2.81000	79.000	0.2000
326	XG80	3.17000	4.06000	3.17000	5.35000	4.24000	1.68000	154.000	1.0000
327	XG81	1.91000	3.38000	1.91000	4.39000	5.61000	2.30000	115.000	3.0000
328	FG82	2.30000	4.41000	2.30000	4.63000	7.61000	2.01000	224.000	8.8000
329	XG83	1.61000	2.64000	1.61000	4.96000	4.96000	3.08000	141.000	3.3000
330	XG84	2.15000	3.53000	2.15000	4.33000	4.98000	2.01000	104.000	0.0000
331	XG85	2.83000	4.07000	2.83000	5.17000	4.76000	1.83000	164.000	0.4000
332	XG86	2.48000	2.85000	2.48000	5.09000	4.68000	2.05000	457.000	0.0000
333	XG87	2.09000	3.42000	2.09000	4.61000	6.62000	1.35000	312.000	0.4000
334	XG88	2.65000	3.58000	2.65000	4.04000	5.16000	1.52000	94.000	0.4000
335	XG89	3.22000	4.63000	3.22000	4.09000	5.53000	1.27000	165.000	1.0000
336	XG90	2.70000	4.13000	2.70000	5.13000	5.24000	1.90000	271.000	0.4000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
321	0.20000	45.000	20.000	4.0600	2.00000	1.00000	1.00000	1.00000
322	0.00000	21.000	16.000	6.1700	3.00000	1.00000	1.00000	1.00000
323	0.00000	36.000	37.000	9.1200	2.00000	1.00000	1.00000	1.00000
324	0.00000	46.500	25.000	4.1600	2.00000	1.00000	2.00000	2.00000
325	0.00000	29.000	14.000	4.7800	3.00000	1.00000	1.50000	1.50000
326	0.00000	37.000	25.000	4.4300	2.00000	3.00000	1.00000	1.00000
327	0.00000	21.000	20.000	6.8300	2.00000	1.00000	1.00000	1.00000
328	0.40000	42.000	31.500	3.6800	3.00000	1.00000	1.00000	1.00000
329	0.00000	36.000	40.000	7.6000	1.00000	1.00000	1.00000	1.00000
330	0.00000	38.000	19.500	3.8900	1.00000	1.00000	1.00000	1.00000
331	0.20000	106.000	66.000	9.5600	1.00000	1.00000	1.00000	1.00000
332	0.00000	90.000	100.000	10.5600	2.00000	1.00000	1.00000	1.00000
333	0.00000	43.000	55.000	8.1700	1.00000	1.00000	1.00000	1.00000
334	0.00000	24.000	13.000	3.3600	2.00000	1.00000	1.00000	1.00000
335	0.00000	39.000	29.000	5.6700	3.00000	1.00000	1.00000	1.00000
336	0.00000	55.000	43.000	6.5300	2.00000	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
321	1.00000	1.00000	5	2	I	19.7800	X	65.000	1.00000
322	1.00000	1.00000	3	2	I	19.3000	X	37.000	1.00000
323	1.00000	1.00000	3	2	I	20.4500	X	73.000	1.00000
324	1.50000	1.00000	4	2	C	21.7200	X	71.500	1.00000
325	1.00000	1.00000	3	2	C	23.2500	X	43.000	1.00000
326	1.00000	1.00000	4	2	I	20.6500	X	62.000	1.00000
327	1.00000	1.00000	3	2	I	15.2800	X	41.000	1.00000
328	1.00000	1.00000	4	2	I	18.6500	F	73.500	1.00000
329	1.00000	1.00000	1	2	I	22.9200	X	76.000	1.00000
330	1.00000	1.00000	3	2	I	15.9500	X	57.500	1.00000
331	1.00000	1.00000	11	2	I	17.9800	X	172.000	1.00000
332	1.00000	1.00000	9	2	I	19.5800	X	190.000	1.00000
333	1.00000	1.00000	7	2	I	15.6000	X	98.000	1.00000
334	1.00000	1.00000	5	2	I	16.9500	X	37.000	1.00000
335	1.00000	1.00000	7	2	I	16.1500	X	68.000	1.00000
336	1.00000	1.00000	6	2	I	19.9200	X	98.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
337	XG91	3.42000	4.69000	3.42000	5.36000	5.36000	1.56000	344.000	1.0000
338	XG92	2.26000	2.89000	2.26000	4.70000	5.40000	2.08000	256.000	1.0000
339	XG93	2.39000	3.06000	2.39000	6.78000	7.80000	2.84000	315.000	0.8000
340	XG94	2.08000	3.24000	2.08000	4.48000	4.91000	2.15000	129.500	1.0000
341	XG95	2.70000	4.13000	2.70000	5.74000	7.33000	2.12000	256.000	0.6000
342	XG96	2.18000	2.92000	2.18000	5.56000	5.60000	2.62000	129.000	0.0000
343	XG97	2.39000	2.50000	2.39000	6.24000	5.74000	2.61000	128.000	0.6000
344	XG98	2.17000	2.63000	2.17000	5.48000	5.25000	2.52000	292.000	0.6000
345	XG99	1.34000	2.05000	1.34000	5.43000	7.22000	4.05000	162.000	0.6000
346	XOG0	2.55000	3.08000	2.55000	4.39000	4.38000	1.73000	160.000	0.2000
347	XOG1	2.17000	3.56000	2.17000	4.56000	6.99000	2.10000	291.000	0.6000
348	XOG2	2.65000	4.69000	2.65000	4.48000	4.68000	1.69000	107.000	0.2000
349	XOG3	3.17000	3.48000	3.17000	5.65000	5.65000	1.62000	292.000	0.4000
350	XOG4	2.00000	3.54000	2.00000	4.74000	4.36000	2.37000	138.000	11.0000
351	XOG5	1.56000	3.60000	1.56000	4.78000	5.50000	3.06000	264.000	6.4000
352	XOG6	2.52000	5.80000	2.52000	4.26000	7.00000	2.69000	145.000	0.0000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
337	0.00000	57.800	52.000	8.6000	2.50000	2.20000	1.00000	1.00000
338	1.20000	54.000	33.000	3.8700	1.00000	1.00000	1.00000	1.00000
339	0.00000	69.000	72.000	6.5600	3.00000	1.00000	1.00000	1.00000
340	0.00000	26.500	28.000	6.9100	1.00000	1.00000	1.00000	1.00000
341	0.00000	56.000	41.000	8.8200	2.00000	1.00000	1.00000	1.00000
342	0.00000	38.000	20.500	5.8500	2.00000	1.00000	1.00000	1.00000
343	0.00000	61.000	22.000	2.8200	1.00000	1.50000	2.00000	1.50000
344	0.00000	102.500	98.000	5.2700	2.00000	1.00000	1.00000	1.00000
345	0.00000	36.000	26.000	6.2000	1.00000	1.00000	1.00000	1.00000
346	0.00000	53.000	60.000	5.9500	2.00000	1.00000	1.00000	1.00000
347	0.00000	88.000	86.000	8.2800	2.00000	1.00000	1.00000	1.00000
348	0.00000	37.000	20.000	4.7500	2.00000	1.00000	1.00000	1.00000
349	0.00000	75.000	45.000	5.7100	2.00000	3.00000	1.00000	1.00000
350	4.80000	59.000	34.000	7.7500	1.00000	1.00000	1.00000	1.00000
351	0.00000	45.000	74.000	6.6100	1.00000	1.00000	1.50000	1.00000
352	0.00000	42.000	35.000	5.7000	3.00000	1.00000	2.00000	2.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
337	1.50000	1.00000	6	2	I	18.2500	X	109.800	1.00000
338	1.00000	1.00000	7	2	I	21.3800	X	87.000	1.00000
339	1.00000	1.00000	5	2	C	23.5200	X	141.000	1.00000
340	1.00000	1.00000	4	2	I	20.3500	X	54.500	1.00000
341	1.00000	1.00000	8	2	I	20.7800	X	97.000	1.00000
342	1.00000	1.00000	3	2	C	23.3500	X	58.500	1.00000
343	2.00000	1.50000	5	2	C	18.9500	X	83.000	1.00000
344	1.00000	1.00000	6	2	C	19.4500	X	200.500	1.00000
345	1.00000	1.00000	6	2	I	16.5000	X	62.000	1.00000
346	1.00000	1.00000	5	2	I	16.6000	X	113.000	1.00000
347	1.00000	1.00000	5	2	I	20.1500	X	174.000	1.00000
348	1.00000	1.00000	3	2	I	20.8800	X	57.000	1.00000
349	1.00000	1.00000	4	2	I	23.6800	X	120.000	1.00000
350	1.00000	1.00000	5	2	I	18.0800	X	93.000	1.00000
351	3.00000	1.50000	2	2	I	19.0700	X	119.000	1.00000
352	1.00000	1.00000	3	2	I	16.6200	X	77.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
353	XOG7	2.28000	3.62000	2.28000	5.39000	4.77000	2.36000	412.000	0.0000
354	XOG8	2.17000	2.56000	2.17000	4.87000	4.67000	2.24000	282.000	1.0000
355	XOG9	2.22000	3.40000	2.22000	6.48000	7.10000	2.92000	182.000	0.2000
356	X1G0	2.09000	3.00000	2.09000	4.13000	5.94000	1.98000	190.500	0.0000
357	X1G1	1.39000	3.56000	1.39000	3.78000	7.25000	2.72000	244.000	0.4000
358	X1G2	3.00000	3.63000	3.00000	5.00000	4.60000	1.67000	298.000	0.0000
359	X1G3	2.24000	2.78000	2.24000	5.65000	5.41000	2.52000	181.000	0.4000
360	X1G4	2.78000	3.76000	2.78000	4.09000	3.92000	1.47000	176.000	0.0000
361	X1G5	2.35000	3.34000	2.35000	4.70000	5.53000	2.04000	173.000	0.4000
362	X1G6	1.87000	4.30000	1.87000	4.48000	4.91000	2.40000	115.000	0.6000
363	X1G7	1.96000	3.00000	1.96000	6.09000	8.00000	3.11000	301.000	0.8000
364	X1G8	1.74000	5.71000	1.46000	4.35000	6.25000	2.50000	98.000	9.8000
365	X1G9	2.20000	5.61000	1.87000	3.83000	4.63000	1.74000	235.000	0.0000
366	X2G0	2.43000	3.73000	2.43000	4.39000	4.81000	1.81000	315.000	1.0000
367	X2G1	2.04000	4.70000	2.04000	6.61000	8.94000	3.23000	260.000	0.4000
368	X2G2	1.96000	4.09000	1.96000	4.74000	4.96000	2.42000	245.000	4.2000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
353	0.0000	77.000	73.000	10.0000	1.00000	1.00000	1.00000	1.00000
354	0.0000	45.000	41.000	8.6000	2.00000	1.00000	1.00000	1.00000
355	0.0000	78.800	53.500	5.9300	2.00000	3.00000	3.00000	2.50000
356	0.0000	29.000	21.000	3.7000	1.00000	1.00000	1.00000	1.00000
357	0.0000	46.000	82.000	9.8500	2.00000	1.00000	1.00000	1.00000
358	0.0000	61.000	40.000	3.8800	2.00000	1.00000	1.00000	1.00000
359	0.0000	51.000	39.000	6.0000	2.00000	2.50000	1.50000	1.50000
360	0.0000	42.500	44.000	8.6500	2.00000	1.00000	1.00000	1.00000
361	0.0000	40.000	18.000	2.9000	2.00000	3.00000	1.00000	1.00000
362	0.0000	21.000	19.000	3.4700	1.00000	1.00000	1.00000	1.00000
363	0.0000	110.000	101.000	5.7000	2.00000	1.00000	1.00000	1.00000
364	6.2000	41.000	22.000	4.0600	1.00000	1.00000	1.00000	1.00000
365	0.0000	56.000	49.000	7.0000	1.00000	1.00000	1.00000	1.00000
366	0.0000	37.000	49.000	4.9100	2.00000	1.00000	1.00000	1.00000
367	0.0000	45.000	40.000	7.7300	1.00000	1.00000	1.50000	1.50000
368	0.4000	60.000	53.000	5.8100	1.00000	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
353	1.00000	1.00000	6	2	I	19.0500	X	150.000	1.00000
354	1.00000	1.00000	7	2	I	21.5000	X	86.000	1.00000
355	3.00000	2.50000	7	2	C	17.7500	X	132.300	1.00000
356	1.00000	1.00000	4	2	I	19.3200	X	50.000	1.00000
357	1.00000	1.00000	4	2	I	21.3800	X	128.000	1.00000
358	1.00000	1.00000	11	2	I	15.7500	X	101.000	1.00000
359	1.00000	1.00000	3	2	C	19.5500	X	90.000	1.00000
360	1.00000	1.00000	2	2	I	22.4200	X	86.500	1.00000
361	1.00000	1.20000	4	2	C	20.4200	X	58.000	1.00000
362	1.00000	1.00000	5	2	I	21.2000	X	40.000	1.00000
363	1.00000	1.00000	9	2	C	18.8000	X	211.000	1.00000
364	1.00000	1.00000	7	2	I	16.5800	X	63.000	0.83908
365	1.00000	1.00000	10	2	I	17.1200	X	105.000	0.85000
366	1.00000	1.00000	3	2	I	23.4000	X	86.000	1.00000
367	1.00000	1.00000	3	2	C	20.6500	X	85.000	1.00000
368	1.00000	1.00000	6	2	I	20.8000	X	113.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
369	X2G3	2.63000	4.40000	2.63000	5.02000	5.06000	1.91000	352.000	0.5000
370	X2G4	2.63000	2.88000	2.63000	5.00000	5.23000	1.90000	174.000	0.2000
371	X2G5	1.43000	2.20000	1.43000	5.70000	5.70000	3.97000	223.000	12.0000
372	X2G6	1.74000	3.63000	1.74000	5.61000	8.60000	3.22000	190.000	8.2000
373	X2G7	1.74000	3.34000	1.74000	5.09000	7.80000	2.92000	388.000	0.6000
374	F2G8	1.65000	2.38000	1.65000	6.74000	5.17000	4.08000	291.000	8.2000
375	XH01	2.83000	4.34000	2.83000	5.06000	4.66000	1.79000	236.000	0.8000
376	XH02	1.91000	3.99000	1.91000	3.87000	8.90000	2.03000	255.000	0.4000
377	XH03	2.44000	3.73000	2.44000	4.04000	5.10000	1.67000	159.000	1.4000
378	J01	1.30000	1.30000	1.30000	3.56000	3.56000	2.77000	82.500	0.4000
379	J02	1.22000	1.56000	1.22000	4.26000	5.16000	3.49000	58.000	0.2000
380	FJ03	1.43000	5.50000	1.17000	3.09000	4.06000	2.15000	24.000	9.2000
381	J04	1.67000	2.40000	1.67000	3.26000	4.16000	1.95000	56.000	0.8000
382	J05	2.63000	3.36000	2.63000	4.22000	4.85000	1.60000	54.000	0.4000
383	J06	1.96000	2.65000	1.96000	4.00000	5.75000	2.04000	65.000	0.0000
384	J07	2.41000	3.26000	2.41000	3.43000	3.59000	1.42000	32.000	0.4000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
369	0.0000	65.500	64.0000	7.7600	1.00000	1.00000	1.00000	1.00000
370	0.6000	30.000	23.0000	6.6200	2.00000	1.00000	1.00000	1.00000
371	4.2000	44.000	31.0000	6.0000	3.00000	1.00000	1.50000	2.50000
372	1.6000	41.000	16.0000	5.1800	1.00000	1.00000	1.00000	1.00000
373	0.9000	131.200	95.5000	9.0000	2.00000	1.00000	1.00000	1.00000
374	6.8000	63.000	62.0000	5.0000	1.00000	1.00000	1.00000	1.00000
375	0.0000	31.200	27.5000	4.6700	2.00000	4.00000	4.00000	4.00000
376	0.0000	79.000	47.0000	6.4600	3.00000	3.50000	3.50000	4.00000
377	0.1000	30.000	39.5000	7.1600	2.00000	4.00000	4.00000	4.00000
378	0.0000	11.000	10.0000	3.5000	2.00000	1.00000	1.00000	1.00000
379	0.0000	17.000	12.5000	4.2100	2.00000	1.00000	1.00000	1.00000
380	9.8000	12.000	7.0000	3.1900	1.00000	1.00000	1.00000	1.00000
381	0.0000	20.000	11.0000	3.4400	2.00000	1.00000	1.00000	1.00000
382	0.0000	18.000	16.0000	8.5000	2.00000	1.00000	1.00000	1.00000
383	0.2000	17.000	20.0000	5.2900	1.00000	1.00000	1.00000	1.00000
384	0.0000	14.000	9.0000	4.6000	3.00000	1.00000	1.00000	1.00000

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
369	1.00000	1.00000	7	2	I	20.4000	X	129.500	1.00000
370	1.00000	1.00000	5	2	I	21.9800	X	53.000	1.00000
371	1.00000	2.50000	6	2	I	18.2200	X	75.000	1.00000
372	1.00000	1.00000	7	2	I	19.2500	X	57.000	1.00000
373	1.00000	1.00000	9	2	I	19.5000	X	226.700	1.00000
374	1.00000	1.00000	7	2	I	17.9200	F	125.000	1.00000
375	4.00000	4.00000	4	2	C	19.9200	X	58.700	1.00000
376	3.50000	4.00000	15	2	I	15.5000	X	126.000	1.00000
377	4.00000	4.00000	6	2	I	16.1000	X	69.500	1.00000
378	1.00000	1.00000	2	2	I	16.6500	J	21.000	1.00000
379	1.00000	1.00000	1	2	I	21.4000	J	29.500	1.00000
380	1.00000	1.00000	1	2	I	17.7800	F	19.000	0.81818
381	1.00000	1.00000	2	2	I	19.1800	J	31.000	1.00000
382	1.00000	1.00000	2	2	I	15.7000	J	34.000	1.00000
383	1.00000	1.00000	2	2	I	17.1500	J	37.000	1.00000
384	1.00000	1.00000	1	2	I	17.5800	J	23.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
385	J08	2.04000	2.76000	2.04000	3.56000	4.82000	1.74000	40.000	0.0000
386	J09	1.61000	2.85000	1.61000	4.13000	5.13000	2.56000	66.500	0.0000
387	J10	1.30000	1.42000	1.30000	5.33000	4.90000	4.10000	66.500	0.5000
388	J11	1.30000	1.50000	1.30000	5.96000	5.48000	4.58000	92.000	1.0000
389	FJ12	1.74000	3.64000	1.74000	4.30000	4.30000	2.47000	100.000	13.8000
390	J13	0.83000	1.41000	0.83000	4.04000	6.19000	4.87000	71.000	1.4000
391	J14	0.87000	1.25000	0.87000	5.22000	6.00000	6.00000	92.000	1.0000
392	J15	2.00000	3.28000	2.00000	3.30000	5.43000	1.65000	28.000	0.2000
393	Z01	1.04000	0.75000	1.04000	8.83000	5.97000	8.46000	137.000	0.8000
394	Z02	1.09000	2.27000	0.78000	5.50000	6.66000	5.06000	174.000	0.8000
395	Z03	1.11000	1.70000	1.11000	6.83000	6.04000	6.16000	143.000	0.4000
396	FZ04	1.78000	8.20000	1.78000	4.04000	2.27000	2.29000	116.000	9.8000
397	Z05	1.00000	1.15000	1.00000	5.78000	5.78000	5.78000	150.000	1.8000
398	Z06	1.08000	1.31000	1.08000	4.65000	5.35000	4.30000	90.000	1.0000
399	Z07	1.26000	1.38000	1.26000	5.09000	5.20000	4.04000	79.000	0.2000
400	Z08	1.52000	1.75000	1.52000	5.09000	4.36000	3.35000	46.000	0.4000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
385	0.0000	8.000	4.0000	2.0000	2.00000	1.00000	1	1
386	0.0000	20.000	19.0000	4.3300	2.00000	1.00000	1	1
387	0.9000	24.200	13.5000	4.3300	2.00000	1.00000	1	1
388	0.0000	24.500	18.0000	6.0700	1.00000	1.00000	1	1
389	9.0000	23.000	29.0000	5.2000	1.00000	1.00000	1	1
390	0.0000	21.000	16.0000	3.8900	2.00000	1.00000	1	1
391	0.0000	23.500	22.5000	3.7900	2.00000	1.00000	1	1
392	0.0000	13.000	10.0000	5.7500	2.00000	1.00000	1	1
393	6.0000	59.000	35.0000	4.2700	1.00000	1.00000	1	1
394	9.2000	46.000	30.0000	4.7500	1.00000	1.00000	1	1
395	5.8000	42.500	33.0000	5.2100	1.00000	1.00000	1	1
396	7.0000	43.000	29.0000	10.2800	1.00000	1.00000	1	1
397	6.2000	67.000	34.0000	9.1800	1.00000	1.00000	1	1
398	11.2000	22.500	18.0000	3.6800	1.00000	1.00000	1	1
399	12.0000	27.000	20.0000	4.2700	2.00000	1.00000	1	1
400	8.6000	19.000	10.0000	3.8700	2.00000	1.00000	1	1

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
385	1	1	1	2	I	22.8800	J	12.000	1.00000
386	1	1	1	2	I	17.9200	J	39.000	1.00000
387	1	1	1	2	I	18.6800	J	37.700	1.00000
388	1	1	1	2	I	19.2000	J	42.500	1.00000
389	1	1	1	2	I	17.4000	F	52.000	1.00000
390	1	1	2	2	I	14.8200	J	37.000	1.00000
391	1	1	1	2	I	17.6000	J	46.000	1.00000
392	1	1	1	2	I	17.8800	J	23.000	1.00000
393	1	1	1	1	Z	1.1100	Z	94.000	1.00000
394	1	1	1	1	Z	1.1100	Z	76.000	0.71560
395	1	1	3	1	Z	1.1100	Z	75.500	1.00000
396	1	1	3	2	I	0.0000	F	72.000	1.00000
397	1	1	3	1	Z	1.1100	Z	101.000	1.00000
398	1	1	1	1	Z	1.1100	Z	40.500	1.00000
399	1	1	1	1	Z	1.1100	Z	47.000	1.00000
400	1	1	1	1	Z	1.1100	Z	29.000	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
417	Z25	0.82000	0.73000	0.82000	6.52000	5.77000	7.89000	163.000	3.20000
418	Z26	1.26000	1.61000	0.87000	5.70000	6.39000	4.52000	65.000	2.60000
419	Z27	1.78000	3.03000	1.78000	5.68000	5.12000	3.21000	176.000	1.60000
420	Z28	1.22000	1.47000	1.22000	7.17000	7.17000	5.89000	250.000	1.00000
421	Z29	1.48000	2.27000	1.48000	5.87000	6.75000	3.98000	88.500	1.20000
422	Z30	1.74000	2.10000	1.74000	5.43000	5.00000	3.12000	94.000	0.20000
423	Z31	1.00000	1.21000	1.00000	4.56000	5.25000	4.56000	165.000	0.80000
424	Z32	1.87000	2.53000	1.87000	4.87000	5.10000	2.61000	119.000	2.00000
425	Z33	1.74000	2.35000	1.00000	4.48000	5.72000	2.58000	127.000	1.30000
426	Z34	1.09000	0.86000	0.65000	7.48000	4.30000	6.88000	212.000	1.80000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
417	3.0000	98.000	34.0000	3.77000	2	3.50000	1	1
418	5.8000	26.500	16.0000	2.83000	1	1.00000	1	1
419	10.8000	39.000	18.5000	5.62000	1	1.00000	1	1
420	12.0000	108.000	78.0000	7.29000	1	1.00000	1	1
421	5.0000	40.000	18.5000	3.65000	2	1.00000	1	1
422	7.4000	38.000	12.5000	2.80000	2	1.00000	1	1
423	11.8000	31.000	16.0000	3.62000	1	1.00000	1	1
424	8.0000	44.000	24.0000	4.25000	1	1.00000	1	1
425	8.6000	38.000	15.0000	2.79000	1	1.00000	1	1
426	3.2000	67.000	33.0000	4.00000	3	2.50000	1	1

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
417	1	1	3	1	Z	1.11000	Z	132.000	1.00000
418	1	1	1	1	Z	1.11000	Z	42.500	0.69048
419	1	1	2	1	Z	1.11000	Z	57.500	1.00000
420	1	1	5	1	Z	1.11000	Z	186.000	1.00000
421	1	1	3	1	Z	1.11000	Z	58.500	1.00000
422	1	1	2	1	Z	1.11000	Z	50.500	1.00000
423	1	1	2	1	Z	1.11000	Z	47.000	1.00000
424	1	1	1	1	Z	1.11000	Z	68.000	1.00000
425	1	1	1	1	Z	1.11000	Z	53.000	0.57471
426	2	2	4	1	Z	1.11000	Z	100.000	0.59633

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
401	Z09	1.34000	1.51000	1.34000	5.96000	7.03000	4.44000	163.500	2.40000
402	Z10	1.09000	1.25000	1.09000	5.13000	4.72000	4.71000	232.000	1.00000
403	Z11	0.89000	1.20000	0.89000	5.26000	5.86000	5.91000	110.000	2.40000
404	Z12	1.39000	1.60000	1.39000	8.30000	9.54000	5.97000	159.000	0.20000
405	Z13	0.87000	0.77000	0.87000	6.17000	5.46000	7.09000	43.000	0.80000
406	Z14	1.41000	2.59000	1.41000	5.17000	6.10000	3.72000	163.000	0.20000
407	Z15	1.74000	2.67000	1.74000	5.34000	4.91000	3.07000	109.000	1.00000
408	Z16	1.33000	1.22000	1.33000	5.48000	4.50000	4.12000	229.000	0.80000
409	Z17	1.09000	1.25000	0.85000	5.30000	3.93000	4.86000	93.000	0.20000
410	Z18	1.61000	1.61000	0.87000	5.83000	3.83000	3.62000	148.500	0.60000
411	Z19	1.65000	2.10000	1.30000	5.83000	6.38000	3.53000	106.000	1.00000
412	Z20	0.87000	1.11000	0.61000	5.37000	5.37000	6.17000	203.000	2.40000
413	Z21	1.04000	1.84000	1.04000	5.39000	6.20000	5.18000	70.000	1.80000
414	Z22	1.50000	1.72000	1.50000	5.35000	5.35000	3.57000	167.000	1.00000
415	Z23	1.39000	2.13000	1.26000	6.04000	7.72000	4.34000	166.000	2.10000
416	Z24	1.73000	1.59000	1.73000	6.22000	5.11000	3.60000	236.000	0.40000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
401	6.9000	37.500	20.5000	3.32000	1.50000	1.00000	1	1
402	4.2000	72.000	67.0000	8.69000	1.00000	1.00000	1	1
403	10.5000	41.000	20.5000	4.10000	1.00000	1.00000	1	1
404	6.2000	86.500	55.0000	5.60000	1.00000	1.00000	1	1
405	17.2000	24.000	7.0000	2.30000	1.00000	1.00000	1	1
406	10.8000	41.000	22.5000	4.89000	1.50000	1.00000	1	1
407	8.2000	42.000	18.0000	4.44000	1.00000	1.00000	1	1
408	9.4000	83.500	42.5000	5.47000	3.00000	1.00000	1	1
409	7.0000	39.000	27.0000	3.47000	1.00000	1.00000	1	1
410	8.6000	43.500	23.0000	6.65000	1.00000	1.00000	1	1
411	9.0000	35.000	25.0000	5.45000	1.00000	1.00000	1	1
412	6.0000	62.000	20.0000	2.74000	1.00000	1.00000	1	1
413	12.2000	24.000	13.0000	2.64000	2.00000	1.00000	1	1
414	10.0000	58.000	40.0000	4.90000	1.00000	1.00000	1	1
415	9.8000	43.000	24.0000	4.19000	1.00000	1.00000	1	1
416	10.0000	69.500	68.0000	5.29000	1.00000	1.00000	1	1

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
401	1	1	3	1	Z	1.11000	Z	58.000	1.00000
402	1	1	4	1	Z	1.11000	Z	139.000	1.00000
403	1	1	3	1	Z	1.11000	Z	61.500	1.00000
404	1	1	3	1	Z	1.11000	Z	141.500	1.00000
405	1	1	3	1	Z	1.11000	Z	31.000	1.00000
406	1	1	3	1	Z	1.11000	Z	63.500	1.00000
407	1	1	1	1	Z	1.11000	Z	60.000	1.00000
408	1	1	4	1	Z	1.11000	Z	126.000	1.00000
409	1	1	2	1	Z	1.11000	Z	66.000	0.77982
410	1	1	3	1	Z	1.11000	Z	66.500	0.54037
411	1	1	1	1	Z	1.11000	Z	60.000	0.78788
412	1	1	3	1	Z	1.11000	Z	82.000	0.70115
413	1	1	1	1	Z	1.11000	Z	37.000	1.00000
414	1	1	3	1	Z	1.11000	Z	98.000	1.00000
415	1	1	3	1	Z	1.11000	Z	67.000	0.90647
416	1	1	2	1	Z	1.11000	Z	137.500	1.00000

SAS

OBS	PLANT	LFIL	LWFIL	MINFT	LANTH	LWCONN	AFRT	LSCP	INVH
417	Z25	0.82000	0.73000	0.82000	6.52000	5.77000	7.89000	163.000	3.20000
418	Z26	1.26000	1.61000	0.87000	5.70000	6.39000	4.52000	65.000	2.60000
419	Z27	1.78000	3.03000	1.78000	5.68000	5.12000	3.21000	176.000	1.60000
420	Z28	1.22000	1.47000	1.22000	7.17000	7.17000	5.89000	250.000	1.00000
421	Z29	1.48000	2.27000	1.48000	5.87000	6.75000	3.98000	88.500	1.20000
422	Z30	1.74000	2.10000	1.74000	5.43000	5.00000	3.12000	94.000	0.20000
423	Z31	1.00000	1.21000	1.00000	4.56000	5.25000	4.56000	165.000	0.80000
424	Z32	1.87000	2.53000	1.87000	4.87000	5.10000	2.61000	119.000	2.00000
425	Z33	1.74000	2.35000	1.00000	4.48000	5.72000	2.58000	127.000	1.30000
426	Z34	1.09000	0.86000	0.65000	7.48000	4.30000	6.88000	212.000	1.80000

OBS	LFH	LBD	LPT	LWLF	PCONN	CABC	CBCF	CBCFT
417	3.0000	98.000	34.0000	3.77000	2	3.50000	1	1
418	5.8000	26.500	16.0000	2.83000	1	1.00000	1	1
419	10.8000	39.000	18.5000	5.62000	1	1.00000	1	1
420	12.0000	108.000	78.0000	7.29000	1	1.00000	1	1
421	5.0000	40.000	18.5000	3.65000	2	1.00000	1	1
422	7.4000	38.000	12.5000	2.80000	2	1.00000	1	1
423	11.8000	31.000	16.0000	3.62000	1	1.00000	1	1
424	8.0000	44.000	24.0000	4.25000	1	1.00000	1	1
425	8.6000	38.000	15.0000	2.79000	1	1.00000	1	1
426	3.2000	67.000	33.0000	4.00000	3	2.50000	1	1

OBS	CMRF	CMRFT	NOFL	SCONN	GEO	POLLEN	CLASS	LLF	FTRT
417	1	1	3	1	Z	1.11000	Z	132.000	1.00000
418	1	1	1	1	Z	1.11000	Z	42.500	0.69048
419	1	1	2	1	Z	1.11000	Z	57.500	1.00000
420	1	1	5	1	Z	1.11000	Z	186.000	1.00000
421	1	1	3	1	Z	1.11000	Z	58.500	1.00000
422	1	1	2	1	Z	1.11000	Z	50.500	1.00000
423	1	1	2	1	Z	1.11000	Z	47.000	1.00000
424	1	1	1	1	Z	1.11000	Z	68.000	1.00000
425	1	1	1	1	Z	1.11000	Z	53.000	0.57471
426	2	2	4	1	Z	1.11000	Z	100.000	0.59633

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Sutherland, J.R., W. Lock, T.A.D. Woods and T. Suttill. Sirococcus blight not seed-borne on seratinous Lodgepole pine. Canad. For. Ser. Research Notes 2:20-21.

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Title of Thesis:

Systematics and Reproductive Biology of Dodecatheon pulchellum s.l. (Primulaceae).

[redacted]

Terri-Ann Suttill

December 22, 1987