A TAXONOMIC STUDY OF SOME SPECIES OF **RANUNCULUS** L.

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A Taxonomic Study of Some Species of *Ranunculus* L.

by

© Peter John Scott, B.Sc. (First Class Honours)

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requirements for the degree of Doctor of Philosophy

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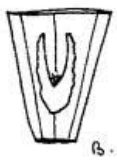
Frontispiece. Variation found in the nectary scale of 128 specimens of Ranunculus gmelinii DC.

Nectary scale forming a pocket: A - 66 specimens : B - 22 : C - 20 : D - 11 : E - 1 : F - 3.

Nectary scale forming a flap: G - 3 : H - 1.

Nectary scale reduced to a rim of tissue: I - 1.


A.


B.


C.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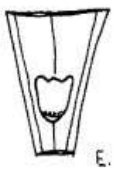
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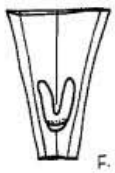
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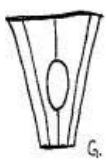
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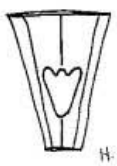
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I.

ABSTRACT

A consideration of the taxonomy of Ranunculus gmelinii DC., R. hyperboreus Rottb., R. eschscholtzii Schlect., R. pedatifidus J.E. Smith, R. pygmaeus Wahl., R. nivalis L., and R. sulphureus Sol. is presented. The role of phenotypic plasticity is indicated as a factor contributing to the range of morphological variation in these species and to the confusion found in their taxonomy. The present work, by a re-examination of representative material collected throughout the North American range of the species, and the use of controlled growth conditions, has suggested new limits for some of the species. This has resulted in modifications of the descriptions of the species and/or the reduction of taxa to synonymy.

The following are suggested to designate North American representatives of the species. Ranunculus gmelinii DC., R. hyperboreus Rottb., R. eschscholtzii Schlect. var. eschscholtzii (for Alberta and north), R. pedatifidus J.E. Smith var. leiocarpus Fern., R. pygmaeus Wahl., R. nivalis L., and R. sulphureus Sol. The following have been reduced to synonymy: R. hyperboreus Rottb. var. turquetilianus Polunin (synonym of R. gmelinii), R. natans C.A. Mey var. intertextus (Green) L. Benson (synonym of R. hyperboreus), R. pedatifidus J.E. Smith var. affinis (R. Br.) L. Benson, R. pygmaeus Wahl. var. langianus Nathorst., and R. sulphureus Sol. var. intercedens Hult.

The chromosome numbers for specimens of the species included in the work and some other species of Ranunculus, each from several localities, have been determined. A technique for staining Ranunculus chromosomes has been developed in this study.

The usefulness of chemotaxonomy in providing characters has been studied and it has been found that secondary metabolic products; such as flavonoids and phenolics, are not suitable.

A discussion of the status of *R. gelidus* Kar. & Kir. and *R. cymbalaria* Pursh var. *alpinus* Hook. has been included.

People who have wild ideas
about how to run the earth ought
to start with a small garden.

— Lou Erickson

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Acknowledgements:

Many have lent assistance to various aspects of this work and I would like to acknowledge their aid.

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I am grateful to Dr. J. Soper of the National Museum of Canada, Ottawa and to Mr. Wm. Cody of the Herbarium, Department of Agriculture, Ottawa for lending me the many specimens for comparison with my own collections.

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INTRODUCTION

Ranunculus, which was validly published by Linnaeus in his Species Plantarum (1753.p.548), is the largest genus in the family Ranunculaceae Jussieu. It is the diminutive of Rana and Pliny possibly applied it to these plants because a number of species grow in marshes or meadows where frogs abound. The type or standard species is Ranunculus acris L.

There are approximately 250 species in the genus and they occur in nearly all arctic and temperate regions and in the mountains of the tropics but are more frequent in the North Temperate Region.

The present members of the genus have received various treatments in the past. Since 1753 eleven other genera have been erected for the species which are now included in the genus Ranunculus but these have now all been reduced to synonymy. The following is a list of the synonyms and locations of publication:

Ranunculus L.

Ranunculus L. Sp. Pl. 548. 1753.

Ficaria Huds. Fl. Angl. ed. 1:213. 1762.

Hecatonia Lour. Fl. Cocinch. 1:370. 1790.

Ceratocephalus Moench, Meth. 218. 1794.

Batrachium S.F. Gray, Nat. Arr. Brit. Pl. 2:720. 1821.

Oxygraphis Bunge, Verz. Suppl. Alt. 46. 1836.

Cyrtorhyncha Nutt. ex Torr. & Gray. Fl. N. Amer. 1:26. 1838.

Flammula Fourr. Ann. Soc. Linn. Lyon II. 16:324. 1868.

Coptidium Beurl. in Gand. Fl. Eur. 234. 1883.

Kumlienia Greene, Bull. Calif. Acad. 1:337. 1886.

Arcteranthis Greene. Pittonia 3:190. 1897.

Beckwithia Jepson, Erythea 6:96. 1898.

Halerpestes Greene, Pittonia 4:207. 1900.

Löve has chosen to recognize some of these genera in past publications (Löve and Löve, 1961; and Löve and Ritchie, 1966) where he used seven genera but in a recent publication (Kapoor and Löve, 1970) he follows Benson's system with the old genera placed in synonymy. The seven genera that Löve used are:

Batrachium S.F. Gray, Nat. Arr. Brit. Pl. 2:720. 1821.

Beckwithia Jepson, Erythea 6:96. 1898.

Cyrtorhyncha Nutt. ex Torr. & Gray. Fl. N. Amer. 1:26. 1838.

Ficaria Huds. Fl. Angl. ed. 1:213. 1762.

Ranunculus L. Sp. Pl. 548. 1753.

Coptidium Beurl. in Gand. Fl. Eur. 234. 1883.

Ceratocephalus Moench, Meth. 218. 1794.

The treatment of this group of plants that is currently in use was proposed by Lyman Benson in 1940. This system uses one genus and nine subgenera and it seems to reflect the natural relationships of the species as far as they are known at present. Benson has retained some of the generic names for his subgenera but a few are new. There are several sections in some of the subgenera but these are not listed.

Benson's system:

Ranunculus L. Sp. Pl. 548. 1753.

Subgenus I. Euranunculus (Gren. & Godr.) A. Gray, Proc. Amer. Acad. 21:366. 1886.

Subgenus II. Cyrtorhyncha (Nutt.) A. Gray, Proc. Amer. Acad. 21:366. 1886.

Subgenus III. Ceratocephalus (Moench) L. Benson, Amer. J. Bot. 27:806. 1940.

Subgenus IV. Oxygraphis (Bunge) L. Benson, Amer. J. Bot. 27:806. 1940.

Subgenus V. Crymodes A. Gray, Proc. Amer. Acad. 21:365. 1886.

Subgenus VI. Batrachium (DC.) A. Gray, Proc. Amer. Acad. 21:363. 1886.

Subgenus VII. Pallasiantha L. Benson, Amer. J. Bot. 27:807. 1940.

Subgenus VIII. Coptidium (Nym.) L. Benson, Amer. J. Bot. 27:807. 1940.

Subgenus IX. Ficaria (Huds.) L. Benson, Amer. J. Bot. 27:807. 1940.

The taxonomic history of some of the species treated in this work is complex because of the history of collecting in North America. It is remarkable that early collectors reached the areas that they did and we are indeed grateful today for the excellent botanical heritage that they have left for us. Valuable as their contributions were, the relative scarcity of their collections and inadequate consideration of the range of these species left gaps which has led to a great deal of confusion. Quite often the extremes were examined and named without a knowledge of the variation throughout the range. Many of the earlier collectors held the philosophy that it was better to 'split' than to 'lump' taxa until specimens could be examined from the entire range of the species that appeared related. It is only in recent years that specimens from a sufficient number of locations have been available to put many of these taxa in perspective. The following examples are given to illustrate the situation.

J.E. Smith based the species Ranunculus pedatifidus on a specimen from an 'unfavorable situation' in Siberia (Fernald, 1934.p.96). Robert Brown examined some material from Melville Island in 1823 which we now know to be more typical of the species R. pedatifidus and named it R. affinis. The situation was further confused when William Hooker illustrated the species R. pedatifidus with a drawing that perfectly matches R. grayi Britt. (R. gelidus Kar. and Kir.) in his Flora Boreali-Americana (1840. plate VIII fig. B.) It was not until 1934 that Fernald showed that R. pedatifidus is a polymorphous species and that R. affinis should be reduced to synonymy with it.

Ranunculus gmelinii D.C., R. hyperboreus Rottb., and R. natans Mey.

make up a group of species with which there are many problems. R. gmelinii has a confusing spectrum of variation and many species have been erected on the basis of the extremes of variation in this species but these were reduced to varieties by Benson (1948). Polunin (1940.p.211) described R. hyperboreus var. turquetilianus which appears to the author, to be based on R. gmelinii judging from the figure in his 1940 publication and from a topotype deposited in DAO. He states in his description of the variety "at least some of the leaves of each plant are almost flabelliform, being reminiscent of those of R. purshii Richardson, which occurs only farther south" (Polunin, 1940). Benson (1954) listed this variety as a synonym of R. hyperboreus but a close examination by the present author shows that it should be listed as a synonym of R. gmelinii.

A closer comparison of R. natans Mey. and R. hyperboreus Rottb. has led to combinations. R. natans Mey. is an Asian species described from Altai and specimens from Alberta to Colorado were referred to variety intertextus of this species. Hitchcock et al (1964) mention that this taxon is very closely related to R. hyperboreus. The two species are separated in Benson's key (1948.p.200) by the larger size and number of achenes in R. natans, but this is to be expected in the more southern locality. Kapoor and Löve (1970.p.586) have reduced R. natans Mey. var. intertextus Greene to a subspecies of R. hyperboreus based on cytology. These are all stages in the process that bring order into the situation. The present author proposes that R. natans var. intertextus be recognized for what it is - a southern extension of the distribution of R. hyperboreus; but this will be referred to again.

Plasticity is the range of variation that is shown by a genotype when it is modified by the environment. These modifications can be morphologi-

cal or physiological and they are interrelated but in a taxonomic study the visually obvious morphological modifications are the more important. Ranunculus gmelinii D.C. shows a bewildering amount of variability depending on the environment in which the plants are growing. This species may be palustrine, totally aquatic, or both, and the leaf shape can vary from deeply parted in an aerial leaf to finely dissected into long segments in a submerged leaf. The mechanisms involved in this sort of heterophylly have not, as yet, been defined as they appear to differ from genus to genus. There appears to be some agreement that turgor pressure is an important factor in the submerged state and can be involved in cases such as Elodea, where cell enlargement is a principal feature of the development of different leaf types. (Allsopp, 1965.p.1239.) This is thought to be due to the effect of cell turgor pressure on the 'production and control of auxin.' (Sculthorpe, 1967.p.243.) In Ranunculus flabellaris, however, the production of different leaf types involves modification of cell division patterns and this is not so convincingly explained by turgor pressure (Bostrack and Millington, 1962). Sculthorpe (1967.p.243.) suggests that this phenomenon may be produced by a temperature - photoperiodic effect as found in Oenanthe or Hippuris (McCully and Dale, 1961 and Johnson, 1967).

Chemotaxonomy has become a useful tool in the past decade, especially in sorting out hybrid complexes (Smith and Levin, 1963). It was hoped that chromatography of phenolics and flavonoids of leaves may provide some insight into the problems of the species studied but the secondary metabolic products in the leaves vary as much in their occurrence as does the morphology of the leaves (see Results). Seed proteins, which are primary metabolic products, are suitable for critical comparisons within a

genus and possibly even within a family because they come from tissue of the same physiological age and they are a direct reflection of the genotype (Denford, personal communication). Comparisons can not always be made between families because seeds are not dispersed with embryos at the same stage of development. Seeds of Phaseolus have a fully differentiated embryo; whereas, those of the Orchidaceae have undifferentiated embryos.

The use of secondary metabolic products has its pitfalls since these chemicals, by nature, may or may not be formed within an individual plant depending upon the environmental conditions in which the plant is growing. A further complication is that the function of phenolics and flavonoids in a plant is not known. Smith (1968.p.426-430) suggests that phenols behave as growth - and germination - regulating substances and as protection against fungal and virus infection. When the function of a substance is not known it is difficult to know what effects its production and what affects its quantities and thus its detectability; that is, if it is present in sufficient quantity to be detected by the method used. The work of Smith and Levin (1963) on Asplenium and of McClure and Alston (1964) on Spirodela showed the usefulness of this phase of chemotaxonomy for distinguishing within hybrid complexes and between species. Research has shown that phenols differ in leaves during development; for example, wheat (El-Basyouni and Towers, 1964.) The environment can also have an effect on the quantity and types of phenols found in leaves. Taylor's investigations (1971 a and b) on Tiarella have shown a change in the phenolic composition of leaves within a population from month to month.

The basic cytology of Ranunculus is known from the results of several workers and the chromosome number of most species is known, at least, from part of their area of distribution. Larter (1932) discussed the chromo-

some variation and behaviour in the genus and on the basis of the chromosome numbers of many species he concluded that the species of Ranunculus fall into two polyploid series which have base numbers of X=7 and X=8. Langlet (1932) examined more than 200 species and he established two subfamilies on the basis of chromosome number and morphology: *Ranunculoideae*, with long chromosomes; and *Thalictroideae*, with short and small chromosomes. Ranunculus falls into the subfamily, Ranunculoideae. The early work on the cytology of the genus has been synthesized by Coonen (1939) and included with his own work to give a comprehensive picture of the chromosomes of Ranunculus. He discussed in detail the complex aneuploid series which are a common feature of the group and he provided karyotype diagrams and chromosome numbers for many species. An extensive list of the chromosome numbers of Ranunculus species has been provided by Löve and Löve (1961). More recently there have been some reports of the cytology of North American species. In addition to chromosome numbers for various localities (Johnson and Packer, 1968; Mulligan and Porsild, 1969; Taylor and Mulligan, 1968; and I.O.P.B. Chromosome Number Reports in Taxon), Goepfert (1970) has recounted the chromosome number and determined the karyotype for several species. Kapoor and Löve (1970) have studied chromosome number and karyotype in nine species from the Rocky Mountains and provided detailed analyses of the karyotypes.

The karyotype analyses of the species in this study are covered in Goepfert's (1970) work. The chromosome numbers have been included in the 'Results' section of this work where they are compared with determinations made by other investigators.

AIMS AND OBJECTIVES

This study was undertaken in an attempt to provide a classification which better reflects the natural relationships of some of the species of the genus Ranunculus. It was found by the author and others that it was difficult to fit, for example, specimens of Ranunculus gmelinii into the varieties proposed by Benson and it was also observed that R. eschscholtzii formed a large complex of varieties. As much information as was felt would be useful has been collected and it has been used to confirm or reject previous taxonomic decisions. It also provides some additional information about the species which will add to the general knowledge of the North American flora. R. gmelinii and R. eschscholtzii were originally chosen for the study but as work progressed five more species were included (R. hyperboreus, R. pygmaeus, R. pedatifidus, R. nivalis, and R. sulphureus).

Phenotypic plasticity is the most perplexing aspect of the plants in this genus. This is especially marked in the vegetative portions of the plants where variation in the degree of pubescence or degree of division of the leaves can be very dramatic in plants from localities with very similar environments. This has led to the erection of new taxa in the past and it is only in recent studies that taxonomists have been able to ascertain the limits of variation in a species using controlled environmental conditions. In this study it has been found that specimens collected in the field show a remarkable amount of variation in leaf shape; however, these same specimens when grown under controlled environmental conditions produced leaves that were quite similar (Figure 1).

This method of study indicated a solution for dealing with the confusing spectrum of variation in R. gmelinii and it also indicated the relationship that exists between R. eschscholtzii, R. pedatifidus, and R. nivalis.

This study includes a discussion of the species, R. gmelinii, and its many varieties. Phenotypic plasticity is of particular interest because it is the source of confusion in this species.

Three varieties of R. gmelinii have been recognized since Benson's treatise (1948) and in this study an attempt is made to verify these and associate them with either chromosome number, morphology, or chemical characteristics. Phenolics and flavonoids, which are secondary metabolic products, have been used; however, seed proteins, which are primary metabolic products, would be ideal for a study such as this but the entire achene production of a large population in nature did not prove sufficient to carry out even the trial runs.

R. hyperboreus was added to the study because it was realized that R. natans was synonymous with it on the basis of coincidence of morphology and chromosome number and a study would provide more correct information concerning the distribution of R. hyperboreus in North America and its relationship with R. gmelinii. R. hyperboreus var. turquetilianus has also been examined and its relationship determined.

The species, R. pygmaeus, R. eschscholtzii, R. pedatifidus, R. nivalis, and R. sulphureus, have been examined and compared to determine if the species are distinct or if there is overlap in their morphology.

A further discussion of R. pedatifidus and R. affinis, and of R. east-

woodianus Benson and *R. vicinalis* Greene is presented. Some doubt is cast on the validity of *R. sulphureus* var. *intercedens* and *R. pygmaeus* var. *petiolulatus*.

Chemotaxonomy has been investigated to ascertain its usefulness in providing characters for a study of these species.

The relationship of these species to one another will be discussed on the basis of the results of the morphological and cytological studies.

MATERIAL AND METHODS

Morphological Studies

The morphological studies were carried out on live and herbarium specimens. Extensive field trips were made in the summer of 1971 in the province of Alberta, south of Peace River - Wabasca - Cold Lake and samples were taken from all localities in which the species were found. The samples taken from each locality include pressed herbarium specimens and living plants. The amount of material collected varied with its abundance. *If abundant specimens were present, then at least five were* pressed and three were dug for the live collection. The living plants were dug with a ball of soil, placed in a plastic bag, and kept moist. All of the plants were washed free of soil, potted, and grown under the same conditions of soil, light, temperature, and humidity. Identical conditions and treatment was stressed in the culture of these plants.

Herbarium studies involved detailed measurements and observations of the specimens in the herbarium of the University of Alberta. Approximately sixteen hundred (1600) specimens were received on loan from the National Museum of Canada (CAN) and the Research Branch, Department of Agriculture, Ottawa, herbarium (DAO) and these were mapped and studied for range of variation. Key characters were noted and measurements were made on each specimen and annotated as necessary.

Cytological Studies:

Counts of chromosome number were the only studies carried out.

Goepfert (1970) determined the karyotype of all of the species studied and, therefore, these determinations were not repeated.

Chromosome number in root tips was determined at metaphase. A modification based on the aceto-orcein squash techniques described by Tjio and Levan (1950) and Kapoor and Löve (1970) was developed and is presented below.

Root tips were harvested between 10:00 A.M. and 11:00 A.M. and placed in 0.002M 8-hydroxyquinoline diluted to two-thirds this concentration with distilled water prior to use. This pretreatment was carried out for one and one-half hours at 18 - 19°C. The root tips were then washed in distilled water, fixed in acetic-alcohol 1:3 for a minimum of four hours. They were then hydrolysed in 1 N hydrochloric acid for twenty minutes at 20°C, stained in aceto-orcein for five minutes, squashed in 45% acetic acid, and the slide made semi-permanent with clear nail polish. At least five and usually ten counts were made for each specimen and as many specimens as possible were counted for each species.

Chromatographic Studies

An assessment of the usefulness of secondary metabolic products as taxonomic characters was investigated. Phenolics and flavonoids were compared in leaves of field - collected specimens and greenhouse - grown plants transplanted from the same locality by means of two - dimensional descending paper chromatography.

Method:

Phenolics:

Three air-dried leaves were taken randomly from the sample and ground

with a mortar and pestle using washed and ignited sea sand. Extraction was carried out for thirty minutes using 85% ethanol at 15°C. in the dark. The supernatant was spotted with a capillary tube as a three-quarter inch spot on Whatman No.1 chromatography paper in duplicate and developed using the descending method. Ten percent acetic acid was used as the solvent in the first direction for three to four hours. The paper was removed and dried at room temperature. The solvent for the second direction was 1 - butanol:acetic acid:water (6.8:2.2:1) and the run took an average of sixteen hours. The chromatograms were dried and then viewed under long-wave ultraviolet light. The size and colour of the spots were noted in pencil on the sheet. One replicate was kept for further work and the second was stained for phenolics with ferric-chloride-ferricyanide reagent (3% $FeCl_3$ and 3% $K_3Fe(CN)_6$ aqueous, mixed 1:1 and diluted ten times when required). The chromatogram was dipped in this solution for approximately forty-five seconds, passed through 10% hydrochloric acid, washed in water, and air-dried. This reagent is reported to be able to detect less than 1 µg of many phenols and tannins (Hathaway,1969). Their presence is indicated by a dark blue spot.

Flavonoids:

Three air-dried leaves were taken randomly from the sample and ground with a mortar and pestle using washed and ignited sea sand. Extraction was carried out in 50% methanol in the dark at approximately 15°C. for twenty-four hours. The supernatant was spotted with a capillary tube as a three-quarter inch spot on Whatman No.4 chromatography paper in duplicate and developed by descending chromatography using t-butanol: acetic acid:

water (3:1:1) in the first direction (sixteen hours) and 15% acetic acid in the second direction (two hours). The chromatograms were viewed under long-wave ultraviolet light and the location and colour of the spots were noted. The spots were also viewed under long-wave ultraviolet light in the presence of ammonia vapour and the colour change, if any, noted.

RESULTS

Morphological Studies

The results of the study of approximately sixteen hundred specimens of seven species has culminated in some proposed changes in the taxonomy of these species and in some modified descriptions of the species. The limits of the species have, if anything, been expanded to allow for the phenotypic plasticity which is an integral feature of the genus.

The results of the morphological study are given in a standard manner. The name given at the beginning of each specific treatment is that suggested for North American members of the species. In some cases a variety is given. A list of synonyms follows and then the description. The description is similar to Benson's for some parts of the plant but in other respects it is different because of the treatment of the species in this work. A 'mean' is given for each range of measurements to indicate the size of the most common specimen of the species. This is actually the mode but in many cases it coincides with the arithmetic mean. The habitat, distribution, and flowering period follows the description. A discussion of the treatment of this species by the author, list of specimens examined, and location of type specimens completes the discussion of each species.

Key to the Species

1. Plants prostrate, palustrine or aquatic, leaves all cauline 2

1. Plants mostly erect, usually in a drier habitat, leaves in a basal rosette and cauline 3

2. *Leaves basically 3-lobed and distally rounded,* achene beak about one-tenth the length of achene body (mean = 0.1 mm.), and receptacle glabrous ..... R. hyperboreus Rottb.

2. Leaves deeply 3-parted with narrow lobes and distally acute, achene beak about one-quarter the length of achene body (mean = 0.4 mm.), and receptacle hirsute .... R. gmelinii DC

3. Pubescence of plant white or faintly yellow 4

3. Pubescence of plant yellow or red-brown 5

4. Sepals densely white-hirsute and 4 - 7 mm. long, achene body with mean length of 2 mm., receptacle hirsute ..... R. pedatifidus Sm. var. leiocarpus Fern.

4. Sepals sparsely white-hirsute and 2 - 4 mm. long, achene body with mean length of 1.2 mm., receptacle glabrous ..... R. pygmaeus Wahl.

5. Pubescence of plant pale yellow, receptacle glabrous .... R. eschscholtzii Schlecht. var. eschscholtzii

5. Pubescence of plant red-brown, receptacle with at least an apical tuft of red-brown hairs 6

6. Leaves 3-lobed, receptacle with an apical tuft of red-brown hairs ..... R. nivalis L.

6. Leaves digitately lobed, receptacle red-brown hirsute ..... R. sulphureus Sol.

Figure 1. Ranunculus gmelinii DC.

A. General habit of the species. Drawn from CAN 55603 (of the type once described as R. purshii Richards. ssp. yukonensis (Britt.) A.E. Porsild). (X1)

B. Nectary scale. Detail of C, showing that it forms a flap over nectary (X 20)

C. Petal showing nectary scale and boundary between glossy upper portion and matte lower portion. Drawn from CAN55603. (X 9)

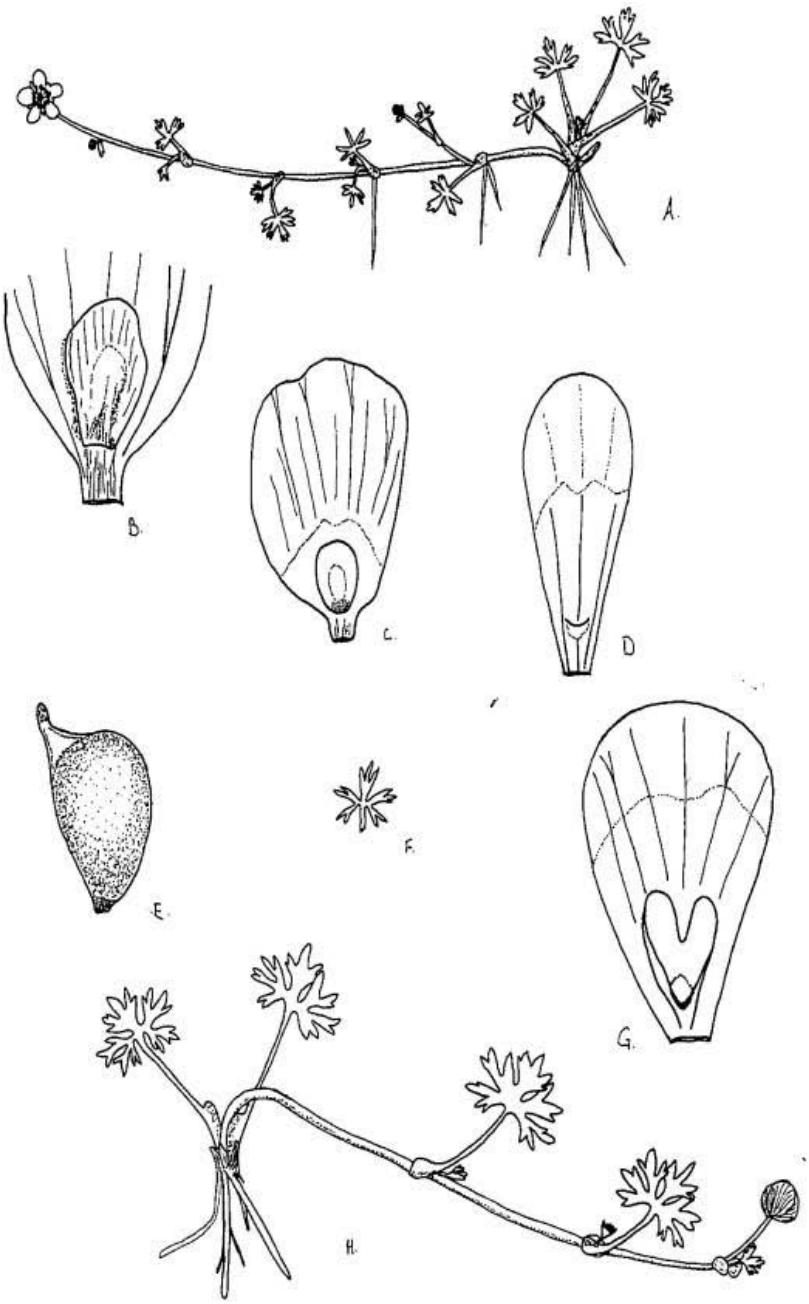
D. Petal showing variation in shape and nectary scale. Drawn from CAN273620. (X 9)

E. Achene. Drawn from CAN55621. (X 20)

F. Leaf of the small, finely-divided type. Drawn from CAN267282. (X 1)

G. Petal showing nectary scale. Drawn from CAN55604. (X 20)

H. General habit of palustrine specimen. Drawn from CAN55605. (X 1)


A.
B.
C.
D
E.
F.
G.
H.

Ranunculus gmelinii DC. Syst.]: 303.]8]8.

Synonyms:

R. gmelinii DC. Syst. 1:303.1818. R. purshii Richards. Bot. App. Frankl. Ist. Jour. ed. 1.751.1823. R. fistulosus Pursh ex Torr. Ann. Lyc. N.Y. 2:163.1826. as syn. R. purshii var. hookeri D. Don in G. Don, Gen. Syst. Gard. 1:33.1831. R. purshii Richards. var. gmelinii D. Don in G. Don, Gen. Syst. Gard. 1:33.1831. R. purshii var. repens Hook. ex D. Don, loc. cit., not R. repens L. in 1753, not R. multifidus Pursh var. repens Hook. ex S. Wats. in 1871. R. limosus Nutt. in Torr. & Gray, Fl. N. Amer. 1:20.1838. R. purshii var. terrestris Ledeb. Fl. Ross. 1:35. 1842. R. multifidus Pursh var. terrestris A. Gray, Man. ed. 5.41.1867, not R. purshii var. terrestris Ledeb. in 1842. R. multifidus Pursh var. repens Hook. ex. S. Wats. in King, Rept. U.S. Geol. Expl. 40th. Par.5:8. 1871, not R. repens L. in 1753, not R. purshii var. repens D. Don in 1831. R. multifidus Pursh var. limosus Lawson, Rev. Canad. Ranunc. 47.1884. R. limoso X sceleratus Greene, Pittonia 2:65.1890. R. lacustris Beck & Tracy var. terrestris McMillan, Metasp. Minn. Valley 247.1892, based on R. multifidus var. terrestris A. Gray. R. delphinifolius Torr. var. *terrestris* Farwell, Ann. Rept. Comm. Parks & Boulev. Detroit 11:63.1900, based on var. terrestris A. Gray. R. yukonensis Britt. Bull. N.Y. Bot. Gard. 2:169.1901. R. *delphinifolius terrestris* Piper, Contr. U.S. Nat. Herb. 11:272.1906, based on var. dissectus A. Gray. R. purshii var. dissectus Lunell, Bull. Leeds Herb. (2):6.1908. R. *purshii* var. *geranioides* Lunell, loc. cit. R. purshii var. radicans Lunell, loc. cit. R. delphinifolius f. terrestris Blake, Rhodora 15:164.1913, based on var. terrestris A. Gray.

R. purshii var. prolificus Fern. Rhodora 19:135.1917. R. gmelinii var. purshii Hara, Rhodora 41:386.1939. R. gmelinii var. limosus (Nutt.) Hara, Rhodora 41:386.1939. R. purshii subsp. yukonensis A.E. Porsild, Rhodora 41:229.1939. R. hyperboreus Rottb. var. turquetilianus Polunin, Canadian Nat. Mus. Bull. (92);211.pl.6. lower left.f.b.1940. R. gmelinii var. prolificus Hara, loc. cit. R. gmelinii var. terrestris L. Benson, Bull. Torrey Club 69:313.1942, based on R. purshii var. terrestris Ledeb. R. gmelinii var. yukonensis L. Benson, Bull. Torrey Club 69:314.1942. R. gmelinii var. terrestris (Ledeb.) L. Benson f. purshii Fassett, Trans. *Wis. Acad. Sci.*38:203.1946. R. gmelinii var. typicus L. Benson, Amer. Midl. Nat. 40(1):206.1948. replaced by var. gmelinii L. Benson, Amer. Midl. Nat. 52(2):362.1954. R. gmelinii var. Hookeri (D. Don) L. Benson, Amer. Midl. Nat. 40(1):209.1948. R. hyperboreus Rottb. f. turquetilianus (Polunin) Savile & Calder, Canadian Field - Naturalist 66:105.1952. R. gmelinii subsp. purshii (Richards.) Hult. Flora of Alaska. 471.1968.

Description of the Species

Perennial herbs, glabrous or hirsute; stems prostrate in palustrine situation or floating in aquatic situation; stems rooting at the nodes, 1 to 4 dm. long and sparsely branched; leaves usually all cauline and alternate, lamina deeply three-parted and the lateral lobes parted again, each of the main lobes usually lobed several times and each lobe is acute or nearly so or in aquatic forms the lobes are narrow (1-3 mm.) and long, basally cordate; leaves 3-14 mm. long (mean = 9 mm.) and 7 - 20 mm. wide (12 mm.) in terrestrial forms and 14 - 35 mm. long (mean = 20 mm.) and 18 - 40 mm. wide in submerged aquatic forms; leaves are generally smaller in more northern or cold localities and larger to the south or in warm localities; lamina usually glabrous above or rarely hirsute on veins and glabrous below or often hirsute especially in younger leaves; stipular leaf base about 1 cm. long and varying from glabrous to hirsute on the margin to hirsute; petiole hirsute becoming glabrous with age; flowers borne singly in axils of leaves; pedicels glabrous or occasionally hirsute, 1-3 cm. long in flower, elongating in fruit; sepals 5, usually glabrous, green with yellowish margin, ovate, 2-5 mm. long (mean = 4 mm.) and 1.5-3 mm. wide (mean = 2 mm.) slightly shorter than petals; petals 5 or occasionally 4, glossy yellow, obovate, 3-9 mm. long (mean = 5 mm.) and 1.5-5 mm. wide (mean = 3 mm.), nectary scale is quite variable (Frontispc.); stamens 10 - 40 (average 20) in number; anthers 0.5-1 mm. long (mean = 0.75 mm.); achenes 20 - 70 in an ovoid head; achene body laterally flattened and obovoid, 1-1.6 mm. long (mean = 1.5 mm.) and 1-1.25 mm. wide (mean = 1 mm.); beak with broad base and narrow, curving tip, 0.2-1 mm. long (mean = 0.4 mm.); achene surface smooth and glabrous;

receptacle ovoid, 1-2 mm. long in flowers, lengthening in fruit, hirsute. Somatic chromosome numbers: 2 N = 16, 32, and 64.

This species is found growing on the mud by pools, sloughs, and lakes that do not dry up completely during the summer. It is also found in the shallow waters of the margins of lakes, sloughs, etc. The species occurs in northern Russia; Siberia, Northern Mongolia; Alaska; Western Canada including the Yukon and Northwest Territories; western United States; and less frequently in eastern Canada and northeastern United States where it is replaced by R. flabellaris Raf. There are a few localities known for Ungava and one locality for Newfoundland. Flowers from late May through the season.

Legend,

G = Glabrous

H = Hirsute

A = Acute

O = Obtuse

Obt. = Obtuse

Table 1

Comparative Morphology of Greenhouse-grown Specimens of Two Chromosome Races of R. gmelinii DC.

					MGD		PJS Collin	MGD	GMcP	PJS Collin	
Collection Numbers	1705	1708	1692	1702	5353	1799	46b	5353	577	84	1706
Stem Pubescence	G	H	H±	H±	G	G	H	G	H	H	G
Leaf											
Length (mm.)	8	8	20	11	9	10	10	9	6	10	8
Width (mm.)	14	15	31	21	16	18	17	15	12	18	16
Base Shape	———	———	———	———	———	———	Cordate	———	———	———	———
Segment Apices	A	-	O	-	A	-	O	A	-	O	A
Pubescence upper	G	G	G	G	G	G	G	G	G	G	G
Pubescence lower	G	G±	G	H±	G	G	H	G	G±	G	G±
Petiole Pubescence	G	G±	G	G	G	G	H	G	G	G	G
Fruit											
Achene body length (mm.)	1.5	1.5	-	-	1.2	-	-	-	1.2	-	-
Achene width (mm.)	1	1.2	-	-	1	-	-	-	1	-	-
Beak length (mm.)	0.4	0.5	-	-	0.4	-	-	-	0.6	-	-
Receptacle pubescence	H	H	H	H	H	H	H	H	H	H	H
Chromosome Number	16	16	32	32	32	32	32	32	32	32	32

Table 1

Comparative Morphology of Greenhouse-grown Specimens of Two Chromosome Races of R. gmelinii DC.

- continued

					MGD		PJS Collin	MGD	GMcP	PJS Collin	
	1705	1708	1692	1702	5353	1799	46b	5353	577	84	1706
Flower											
Pedicel Pubescence	G	G±	G	G	G	G	G	G	G	G	G
Sepal length (mm.)	2.5	2	3	5	4	4	4	3	1.5	4	3
Sepal width (mm.)	1	1	1.5	4	2	2.5	2	2	1	2	2
Sepal pubescence	G	G	G	G	G	G	G	G	G	G	G
Petal length (mm.)	3	2.2	6	6	4	7	4.5	3	1.7	5	5
Petal width (mm.)	1.5	1.4	3	4.5	2	4	2.7	1	1	2	3
Nectary Scale											
Stamen number	10	10	25	25	15	20	15	15	10	20	15
Stamen length	0.5	0.5	1	1	0.9	1	1	1	0.2	0.8	0.9

Table 2

Comparative Morphology of Field-Collected Specimens of Three Chromosome Races of R. gmelinii DC.

	MGD			MGD		PJS Coll'n					
	5353a	1705	1708	5420	1799	1698	84	1706	1702	1710	1692
Stem Pubescence	H	G	G	H	G	H	G	H	G	G	G
Leaf											
Leaf length (mm.)	6	5	4	4	10	6	13	10	10	8	10
Leaf width (mm.)	11	11	10	9	18	12	16	17	17	15	20
Base Shape	Cordate								C	C	C
Segment Apices	Acute	-	-	-	Obt.	-	Acute	Obt.	O	O	O
Pubescence upper	H	G	G	G	G	G	G	G	G	G	G
lower	H	G	G	H	G	H	H	H	G	G	G
Petiole Pubescence	H	G	G	H	H	H	G	H	G	G	G
Chromosome Number	16	16	16	16	32	32	32	32	32	32	32

-

llected Specimens of Three

ł. gmelinii DC.

		MGD			PJS Coll'n							MGD	MGD		MGD
)5	1708	5420	1799	1698	84	1706	1702	1710	1692	1477	53536	5366	1416	5469
3	G	H	G	H	G	H	G	G	G	G	H	H	G	G
5	4	4	10	6	13	10	10	8	10	25	10	9	25	10
1	10	9	18	12	16	17	17	15	20	45	18	14	50	18
		Cordate					C	C	C	C	C	T	T	C
-	-	-	Obt.	-	Acute	Obt.	O	O	O	A	O	O	A	O
G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G	G	H	G	H	H	H	G	G	G	G	H	H	G	G
G	G	H	H	H	G	H	G	G	G	G	G	H	G	G
6	16	16	32	32	32	32	32	32	32	32	32	32	32	64

Table 2

Comparative Morphology of Field-Collected Specimens of Three Chromosome Races of R. gmelinii DC.

	MGD		MGD			PJS Coll'n				
	5353a	1705	1708	5420	1799	1698	84	1706	1702	1710
Flower										
Pedical Pubescence	H	G	H±	H	G	G	-	-	G	G
Sepal length (mm.)	3	2.3	2.3	3	4	4	-	-	3.5	4
Sepal width (mm.)	2	1.5	1.5	1.5	2	3	-	-	2	2
Sepal Pubescence	G	G	G	G±	G	H	-	-		
Petal length (mm.)	3	3	4	3.5	6	6	-	-	5	6
Petal width (mm.)	2	1.5	1.5	2	4	4	-	-	3	3
Nectary scale							-	-		
Stamen number	15	10-15	15	20	20	20	-	-	20	15
Stamen length	0.75	0.5	0.25/0.5	0.6	0.75	1	-	-	0.75	0.75
Achene body length (mm.)	1.5	1	1	-	1.5	-	-	-	-	1
Achene width (mm.)	1	1	1	-	1	-	-	-	-	1
Beak length (mm.)	0.5	0.3	0.3	-	0.75	-	-	-	-	0.25
Receptacle Pubescence	H⁻	H	H⁺	-	H⁻	-	-	-	-	-

llected Specimens of Three

. gmelinii DC.

	MGD				PJS Coll'n						MGD	MGD		MGD	
5	1708	5420	1799	1698	84	1706	1702	1710	1692	1477	5353b	5366	1416	5469	
	$H^{\pm}$	H	G	G	-	-	G	G	G	G	G	$H^{\pm}$	G	-	
.3	2.3	3	4	4	-	-	3.5	4	3	4.5	3.5	5	4.5	-	
.5	1.5	1.5	2	3	-	-	2	2	2	2	2	3	2	-	
	G	$G^{\pm}$	G	H	-	-	Glabrous								
	4	3.5	6	6	-	-	5	6	4.5	6	5	8	7	-	
.5	1.5	2	4	4	-	-	3	3	3	4	3	4	4.5	-	
					-	-								-	
.5	15	20	20	20	-	-	20	15	15	20	20	30	30	-	
.5	0.25 0.5	0.6	0.75	1	-	-	0.75	0.75	0.75	1	0.6	1	1	-	
.	1	-	1.5	-	-	-	-	1	1.5	1.5	1	1.25	1.25	-	
.	1	-	1	-	-	-	-	1	1.25	1.25	1.2	1	1.1	-	
.3	0.3	-	0.75	-	-	-	-	0.25	0.2	1	0.5	0.8	0.6	-	
i	H^{+}	-	H^{-}	-	-	-	-	-	H	H	-	H	H	-	

Taxonomic considerations:

This species has undergone many nomenclatural changes in its history and these changes may be attributed to a plastic genotype that allows the species to inhabit several habitats which may or may not change in a single growing season. The leaf outline and size has been found to vary with the local conditions, rather than geographically, in the specimens examined in the field and in herbaria. The pubescence of the stems, petioles, and leaves also varies considerably. The parts are generally hirsute when immature but the trichomes slough off as growth proceeds. Specimens from cooler waters and areas tend to have more pubescence. Table 1 lists several morphological characters for comparison in two groups based on chromosome number. A poorly defined trend is shown by the characters and, therefore, nothing definite can be said about either group. The diploid specimens tend to be more hirsute and to have smaller leaves with acute apices, smaller flowers, and a reduced nectary gland but these can also be found in the tetraploids, consequently, no varieties or subspecies are warranted. This is a very variable species but it is distinct from other closely related species.

The description of the species which is offered differs from Benson's because the three varieties which Benson uses (vars. gmelinii, hookeri, and limosus) are combined. They have not shown their validity in this study, in fact, one plant may change from variety to variety depending on the season.

In the other species studied the nectary scales are constant for the species but in R. gmelinii they show a great deal of variation (Frontispc.).

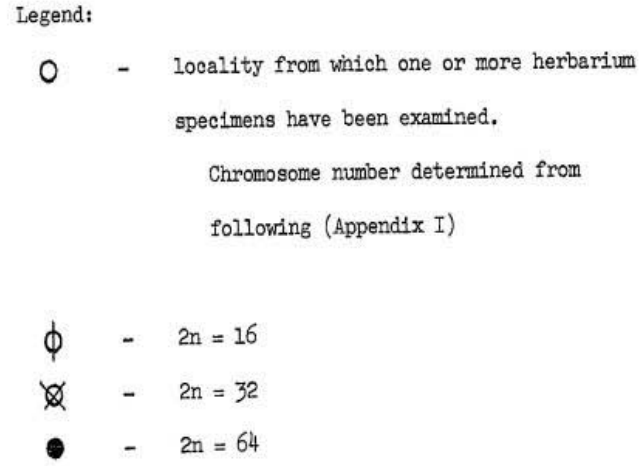
There have been a great many varieties proposed in various species which have since been reduced to synonymy with R. gmelinii when their true

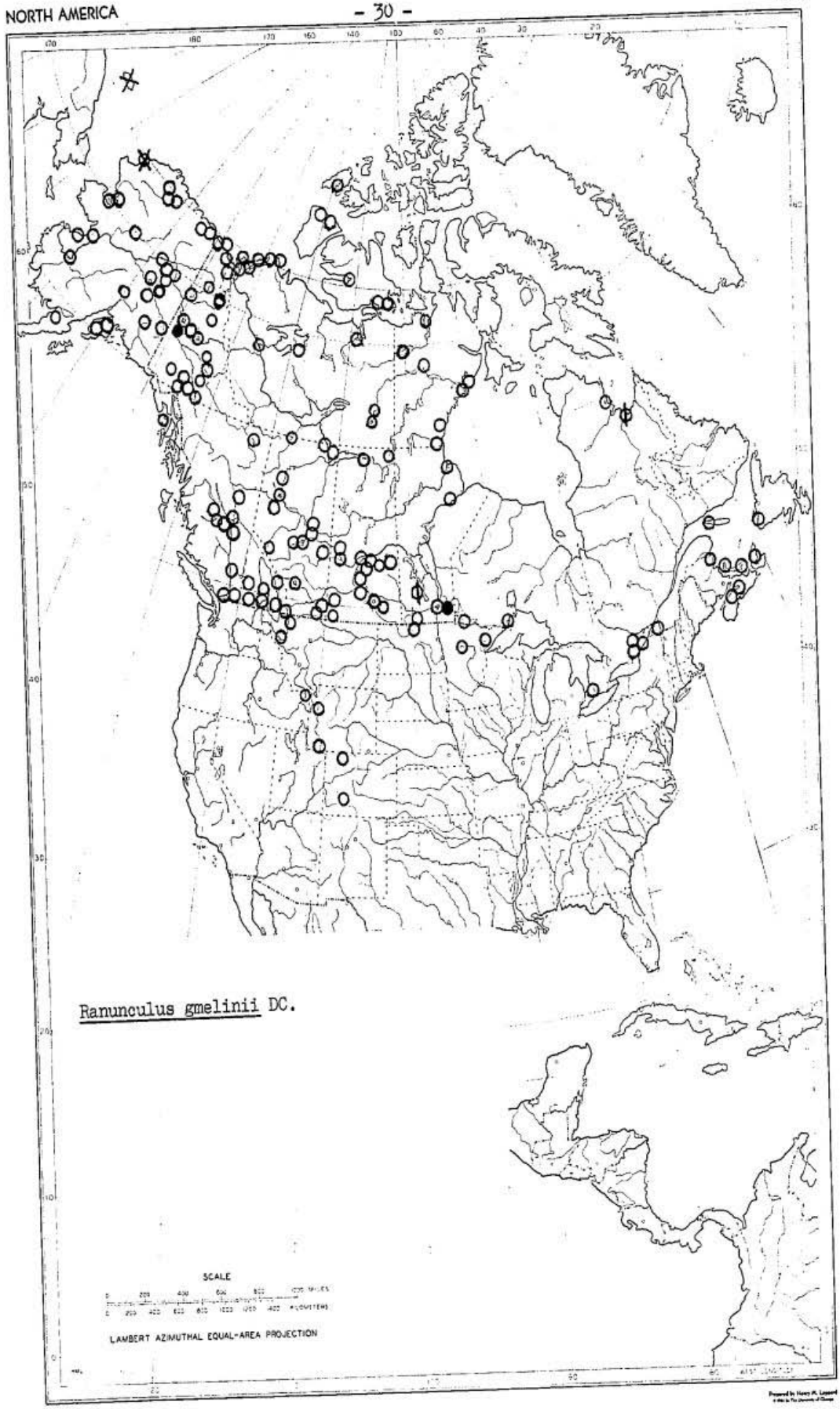
identity was realized. There have also been a number of species proposed which were reduced to varieties and more recently to synonyms. R. gmelinii was described from Siberia by de Candolle in 1818. As workers collected in various areas of North America, new species were proposed. Richardson described R. purshii from the Northwest Territories in 1823, R. limosus was described by Nuttall in 1838 from the Rocky Mountains, and Britton described R. yukonensis from Bonanza Creek at Dawson, Yukon in 1901. These species plus the varieties indicate the confusion that phenotypic plasticity can produce. The present study shows that there is no reliable way to distinguish any groups within the species R. gmelinii DC.; either morphologically or geographically and, consequently, only the species is recognized.

Benson (1948) listed R. hyperboreus var. turquetilianus Polunin as a synonym of R. hyperboreus but an examination of the topotype and specimens cited by Savile and Calder (1952) plus the figure and description offered by Polunin (1940) clearly indicate that this variety should be listed as a synonym of R. gmelinii. The leaves, achenes, and pubescent receptacle in these specimens indicate a misidentification by Polunin and an incorrect assumption when he said that "R. purshii Richardson, (which) occurs only farther south" (Polunin, 1940.p.211).

Topotype: Savile & Watts 1329, DAO: Specimens cited: Savile & Watts 1198, 1187 and Cody 1236, DAO.

Figure 2 Distribution of R. gmelinii DC. in North America.





Ranunculus gmelinii DC.

SCALE

LAMBERT AZIMUTHAL EQUAL-AREA PROJECTION

GOODE BASE MAP SERIES
DEPARTMENT OF GEOGRAPHY
THE UNIVERSITY OF CHICAGO
HENRY M. LEPPARD, EDITOR

Specimens Examined:

R. gmelinii DC.

ALASKA: Alaktak, Spetzman 2469 (CAN). Cape Beaufort, Argus & Chunys 5680 (CAN). Birch L., Cody & Webster 5741 (DAO). Circle, Spetzman 4994 (CAN). Circle Hot Springs R., Smith 1764 (CAN). College, Argus 324 (DAO). Delta Jct., Cody & Webster 5005 (DAO). Dots Lake, Raup & Raup 12859 (CAN). Fossil Creek, White Mts., Gjaerevoll 799 (CAN). Goldstream Ck., Porsild & Porsild 133 (CAN). Holy Cross Mission, Porsild & Porsild 825 (CAN). Kenai Pen., Calder 6997, 5373, 6566 (DAO). King Salmon, Schofield 2713, 2158, 2764 (DAO). Kokrines Mts., Porsild & Porsild 735 (CAN). Lake Peters, Shetler & Stone 3390 (CAN). Northway, Anderson & Brown 10257 (CAN), Anderson 9085 (CAN). Norton Sound, Unalaklet, Porsild & Porsild 1153, 997 (CAN). Ogotoruk Ck., Packer 2235 (ALTA). Quartz L., Cody & Webster 6074 (DAO). Sadlerochit R., Spetzman 1101 (CAN). Sea Bee Creek, Chambers 143 (CAN), Spetzman 2623 (CAN), Wiggins 12906 (CAN). Sears Creek, Spetzman 623 (CAN). Seward Pen., Porsild & Porsild 1571 and 1469 (CAN). Steese Hwy., mi.30, Anderson 2627 (CAN). Umiat, Shetler and Stone 3472 (CAN), Ward 1405 (CAN).

YUKON: Bell R., Youngman & Tessier 616 (CAN). Canol Rd., mi.132, Porsild & Breitung 10035, 9545 (CAN). Hunker Creek, Campbell 147 (DAO). Johnson's Crossing, Porsild 513 (CAN). Komakuk Beach, Parmelee 2821, 2822 (DAO). MacRae, Gillett 3541 (DAO). Mayo, Calder, Billard et al 4068 (DAO). 60 mi. R., Calder & Billard 4390 (DAO). Ross R., Porsild & Breitung 9690 (CAN). Shingle Point, Parmelee 2763 (DAO). Summit L., Packer 1566 (ALTA). Tagish, Gillett 3404 (DAO). Teslin L., Taylor, Szczawinski, & Bell 724 (CAN), Raup & Correll 1117 (CAN). Teslin R., Porsild 748 (CAN).

NORTHWEST TERRITORIES: Adelaide Pen., Macpherson 63 and 122 (CAN). Aklavik, Lindsey 638 (CAN). Atkinson Pt., Porsild & Porsild 2608 (CAN). Banks.: Bernard R., Maher & Maclean 118 (CAN); lake at northeast side, Porsild 17680A (CAN). Bathurst Inlet, Miller 231 (CAN). Beverley L., Pruitt 65 (CAN). Cambridge Bay, Stephens 1099 (CAN). Cape Bathurst, Johansen 97922 (CAN). Chesterfield Inlet, Polunin 2234 (CAN), Paratype of R. hyperboreus var. turquetilianus, Dutilly 346 (CAN), Topotype of R. hyperboreus var. turquetilianus, Savile & Watts 1198, 1329 (DAO), Topotype of R. hyperboreus f. turquetilianus. Eskimo L. Basin, Porsild & Porsild 2982 (CAN). Fort Norman, Lindsey 354 (CAN). Fort Simpson, Cody 8738 (ALTA). Great Bear L., E. shore, Porsild & Porsild 3693 (CAN). Herschel Is., Johansen 97847 (CAN). Inuvik, Yonkin 71 (ALTA). Kittigazuit, Porsild & Porsild 2487 (CAN). Lake on Tha-anne R., Porsild 5584, 5585 (CAN). Limestone Hills, Porsild & Porsild 1918 (CAN). Mackenzie R. delta, Porsild 6881 (CAN), Porsild & Porsild 2220 (CAN), H. Haag 247 (ALTA). Nicholson Is., Porsild & Porsild 2876 (CAN). Norman Wells, Cody 7681 (ALTA). Pelly L., Tener 573 (CAN). Point Separation, Porsild 1918 (ALTA). Prince Albert Sound, Porsild 17440 (CAN). Prince Patrick Is., Mould Bay, Bruggemann 404, 479 (DAO). Sarpik Is., Hudson Bay, Dutilly 4303 (CAN). Steele L., Tener 211 and 212 (CAN). Victoria Is., Mt. Pelly, Stephens 1065 (CAN). Yathkyed L., Porsild 5807, 5805 (CAN). 63°N. and 97°W., Porsild 5805 (ALTA).

BRITISH COLUMBIA: Alaska Hwy., mi.164, Szczawinski(DAO 82757). Armstrong, Fletcher 1432 (DAO). Burns Lake, Calder, Savile & Ferguson 13444, 13418 (DAO). Chilliwack, Eastham 8012 (DAO). Clinton, Calder, Savile &

Ferguson 15442 (DAO). Cranbrook, Eastham (DAO 82764), Calder & Savile 9247 (DAO). Flathead, Bell & Davidson 316, 560 (DAO). Ft. McLeod, Calder, Savile & Ferguson 12446 (DAO). Golden, Szczawinski (DAO 82756). Hixon, Calder, Savile & Ferguson 14342 (DAO). Houston, Calder, Savile & Ferguson 13418 (DAO). Kamloops, Scoggan 15709 (ALTA). Keremeos, Calder, Savile & Ferguson 10725 (DAO). Manning Park, Calder & Savile 11673 (DAO). Naramata, east side of Okanagan L., Calder, Savile & Ferguson 10232(DAO). Perow, Pillsbury 107 (DAO). Popeum Fletcher 1430 (DAO). Reid L., north of Prince George, Groh 612 (DAO). Salmon Arm, Fletcher 29 (DAO). Vanderhoof, Calder, Savile & Ferguson 14435 (DAO). Wardner, Calder, Savile & Ferguson 11390 (DAO).

ALBERTA: Athabasca, Lawrence L., Scott 1710 (ALTA). Beaverlodge, Groh 676 (DAO). Bowden, Willing 1433, 1434 (DAO). Cypress Hills, Newsome 364-63 (DAO), de Vries 2041 (DAO), Scott 1283 (DAO). Fort Fitzgerald, Cody & Loan 4439 (DAO, ALTA). Ft. MacKay, Cody 2618 and 2623 (ALTA). Fort Saskatchewan, Turner 2317, 2430 (DAO). 1.5 mi. SW of Fort Smith, NWT., Cody & Loan 4242, 4325 (DAO). Gull Creek, Dumais 5420 (ALTA). Keg R., Moss 8317 (DAO). Lac la Biche: Cody & Gutteridge 6873 (DAO); Big Is., Dumais 5353a, 5353b (ALTA). Mackenzie Hwy., near NWT border, Moss 8863 (DAO). Ma-Me-O Beach, Turner 7183 (DAO). Manyberries, Groh in 1931 (DAO). Marie L., Dumais 5467, 5468, 5469 (ALTA). Nordegg, Shunda Creek, Scott 1477 (ALTA). Owl R., Dumais 5366 (ALTA). Peace River, Macoun 59521 (CAN). Pinehurst L., Dumais 3570 (ALTA). Pyramid Lake, Jenkins 7987, 6042 (DAO). St. Paul, Scott 1713 (ALTA). Sexsmith, Moss 8462 (DAO). Slave Lake, Scott 1698, 1706, 1705, 1707, 1708 (ALTA).

Swan Hills, Traquair, Aug.10, 1971 (ALTA). Twin Butte, Scott 1417 (ALTA). Valhalla Centre, Scott 1692 (ALTA). Valleyview, Ronning A116 (ALTA). Vermilion, Bird 51, 58 (DAO). Wabasca L., Scott 1702 (ALTA). Waterton, Kuijt 1601 (ALTA), Scott 1408 (ALTA). Wood Buffalo Park, Caribou Mts., Raup 2374 (ALTA).

SASKATCHEWAN: Allan Hills, Russell S58077 (DAO). Battleford, Robbins, July 3, 1911 (DAO). Bjorkdale, Blaircom in Aug. 1941 (DAO), Laycock in June 1941 (DAO). Boggy Creek, Shevkenek on June 11, 1939 (DAO). Bruno, Russell & Mead on June 12, 1935 (DAO). Candle L., Boivin & Breitung 6256 (DAO). Cochin, Ledingham & Hudson 1008 (DAO). Cypress Hills, Senn, Tisdale, & Budd 2418 (DAO), Breitung 4646 (DAO). Dixon, Russell S58155 (DAO). Dunblane, Bahrey & Russell S71071 (DAO). Glaslyn, Brayshaw 336 (DAO). Hansen L. Poad, Mi.64, Argus 4213 (DAO), de Vries 1344 (DAO). Kinley, Hudson 1044 (DAO). Lac la Ronge, Ledingham 49-382 (DAO). McKague, Breitung 1262, 9000 (DAO). Middle Lake, Russell 1134 (DAO). Pasquia Hills, Argus 4661 (DAO). Pike L., Russell 2974 (DAO), Jenkins, Hudson, & Ledingham 1286 (DAO). Ravenscrag, Ledingham 48-631 (DAO). Regina, Carmichael 140 (DAO). Stony Rapids, Maini 298, 625 (DAO).

MANITOBA: Ashern, Scoggan 9274 (ALTA). Brokenhead, Mosquin TM-129 (DAO). Churchill, Gillett & Cody 1816 (DAO), Beckett 3831 (DAO). Delta L., Bird in 1953 (ALTA). Fort Churchill, Gillett 2456, 2520, 1972, 2082, 2385 (DAO). Gillam, Schofield 1385, 962 (DAO). Killarney, Bird 2560 (DAO). Portage-la-Prairie, Scoggan 10684 (ALTA). Riding Mountain National Park, Rowe 82 (DAO). Winnipeg, Macdonald in 1937 (DAO).

ONTARIO. Black Sturgeon L., Fye on July 22, 1962 (DAO). Harris Hill, Garton 8822 (DAO). Perth, Dore & Cody 47-334 (DAO). Pigeon R., Garton 2610 (DAO). Prescott, Dore 18844 (DAO). Seeley Bay, Calder 2755 (DAO). Thunder Bay, McMorine in 1879 (DAO). Waterloo Co., Wrigley's Corner, Montgomery 865 (DAO).

QUEBEC: Anticosti Is., Adams on Sept. 4, 1934 (DAO). Fort Chimo, Calder 2431 (DAO). Lochaber, Senn & Zinck 616 (DAO). Rivière-aux-Feuilles, Legault 6996 (CAN, DAO). Saint-Jean, FF. Marie-Victorin, Rollard-Germain, & Raymond 2112 (DAO).

NEW BRUNSWICK: Gloucester Co., Caraquet, Dore & Gorham 45, 734 (DAO).

PRINCE EDWARD ISLAND: Prince Co., Erskine & Dore 1067 (DAO). Queen's Co., Erskine 1290 (DAO).

NOVA SCOTIA: Baddeck Forks, Smith et al 8184 (DAO). Cloverdale, Smith et al 12687 (DAO). Kenloch, Smith et al 4917 (DAO). Kings Co., Yo-Ho, Roland, Dore & Lewis 1543 (DAO). Trumanville, Schofield 4196 (DAO), Roland 40.410 (DAO). Truro, Roland 1291(DAO), Prince & Atwood 114 (DAO). Victoria Co.: Erskine & Smith 56.379 (DAO); Little Narrows, Smith et al 9783 (DAO). Windsor, Smith et al 4005 (DAO).

NEWFOUNDLAND: Robinson's River, Scott 1799 (ALTA). Locality reported by Kennedy (1931).

MONTANA: Lake Co.: Lake Mary Ronan, Harvey 3548 (DAO). Missoula Co.:

Fort Missoula, Hitchcock 23965 (DAO).

COLORADO: Gunnison Co.: Parlin, Weber & Jones 8566 (DAO). Jackson Co.: Walden, Porter & Porter 7491 (DAO).

MINNESOTA: Hubbard Co.: Kabekona R., Moyle 2149 (DAO). St. Louis Co.: Meadowslands Jct., Lakela 18707, 19411 (DAO).

NORTH DAKOTA: Metigoshe State Park, Stevens 640, 857, 858 (DAO).

WYOMING: South Fremont Co.: Lander, Porter, & Porter 7651 (DAO). Sublette Co.: Green River Lakes, Porter 5090 (DAO).

IDAHO: Fremont Co.: Island Park Reservoir, Porter 7333 (DAO).

Type Collections:

(1) R. gmelinii "In 1950 no specimen was found in the de Candolle Herbarium (Conservatoire et Jardin Botanique, Geneva). Sheet number 46 in the Linnaean Herbarium, London, almost certainly an isotype, is designated as a lectotype. It is labelled on the back, 'Ranunculus folliis duplicato, 3-fidis, caulibus filiformis declinatis. Gmel.' " (Benson, 1954.p.362). (2) R. yukonensis. "Mouth of the Bonanza (Creek, Dawson), June 18, 1899, R.S. Williams (type)" Type, NY (New York Botanical Gardens). (3) R. limosus. "Margins of ponds in the eastern Ranges of the Rocky Mountains, Lewis's River, etc.....Nutt." Type, Nuttall Herbarium, British Museum of National History. (4) R. purshii, " '(W.B.)' " '(W) Denotes the wooded country from lat. 54° to 64° north.' (B) Denotes the Barren Grounds from Point Lake to the Arctic Sea.' "Collected by Richardson" (Benson, 1948.p.210). Type, British Museum of National History.

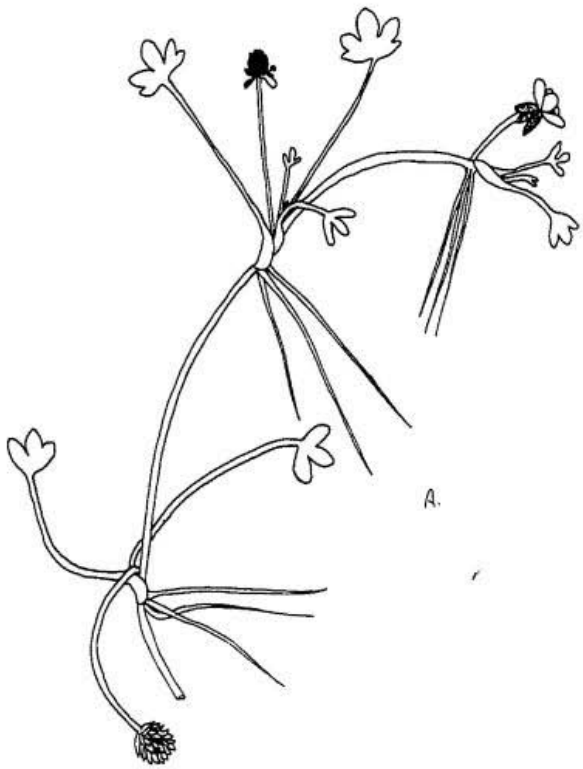
Figure 3. Ranunculus hyperboreus Rottb.

A. General habit of the species. Drawn from DA091588 (flower - from DA091595). (X 1)

B. Achene showing short, curved beak. Drawn from DA091588. (X 10)

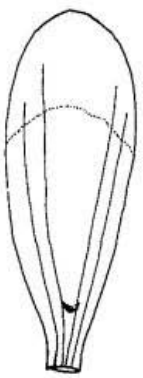
C. Petal showing nectary scale and boundary between glossy upper portion and matte lower portion. Drawn from DA091595. (X 20)

D,E. Leaves. D = basal, E = cauline. Drawn from TYPE of forma integrescens. DA091674. (D X3, E X2)



A.

B.



C.

D.

E.

Ranunculus hyperboreus Rottb. Skrift. Kjoeb. Selsk. 10: 458. 1770.

Synonyms.

R. hyperboreus Skrift. Kjoeb. Selsk. 10:458.1770. R. aquatilis L. var. arcticus Durand, Pl. Kan. No.1, App. to E.K. Kane, Arctic Expl. 2nd. Grinnell Exp. in Search of Sir John Franklin 1853, 54° 55'.2:1856. R. intertextus Greene, Ottawa Nat. 16:33.1902. R. hyperboreus f. fluitans Porsild, Meddel. Grnl. 50:375.1912. R. natans C.A. Mey var. intertextus (Greene) L. Benson, Amer. Midl. Nat. 40(1):202.1948. R. hyperboreus f. integrescens Savile & Calder, Canadian Field - Naturalist 66:105. 1952. R. hyperboreus ssp. intertextus (Greene) Kapoor & Löve. Caryologia 23 (4):586.1970.

Description of the species.

Perennial herb; palustrine or occasionally aquatic; stem glabrous, prostrate, rooting at nodes; basal leaves 3-lobed or occasionally entire and ovate; cauline leaves alternate, petioled, 3-lobed and lateral lobes again lobed; leaf blades proximally truncate and distally rounded giving the impression of three overlapping circles; leaves glabrous, 4-12 mm. long (mean = 6 mm.) and 4-19 mm. wide (mean = 9 mm.); flowers borne singly in axils of leaves; pedicels 1-3 cm. long, longer in fruit; sepals 5, glabrous, green with yellowish margins, ovate, the same length or slightly shorter than petals, 2.5-4 mm. long (mean = 3 mm.) and 1.2-3 mm. wide (mean = 1.5 mm.); petals 5, yellow, obovate and slightly clawed, 2.5-4 mm. long (mean = 3.5 mm.); nectary scale a small flap; stamens 10-15 in number, anther 0.3-1.0 mm. in length (mean = 0.8 mm.); achenes 10-60 in ovoid head;

achene body 0.9-1.4 mm. long (mean = 1 mm.) and 0.6-0.8 mm. wide; beak 0.1-0.3 mm. long (mean = 0.1 mm.) and slightly curved; achene surface smooth and glabrous; receptacle glabrous. 2n = 32

This species grows on the mud or in moss at the margins of pools. The ends of branches may grow in the water, in which case, the leaves of these branches are larger than those of the branches on the mud. R. hyperboreus is circumpolar. The North American distribution includes Alaska, Yukon, the Northwest Territories, Greenland, Labrador, around Hudson Bay, and south through the Rocky Mountains to Colorado. It is quite common in the north but more sporadic in the Rockies. This species flowers from June to August.

Taxonomic considerations:

This species is very distinctive and even in a vegetative state the clover-like leaves allow it to be identified. There has been some confusion concerning the correct identity of the Rocky Mountain members of the species. They have been referred to the Russian species, R. natans C.A. Meyer described from Altai, for quite some time. Greene (1902) described these plants as a separate species, R. intertextus which was reduced by Benson (1948) to a variety of R. natans. It has recently been recognized by Kapoor and Löve (1970) that the Rocky Mountain plants are cytologically distinct from R. natans, the Russian plants, and they have referred the Rocky Mountain plants to R. hyperboreus ssp. intertextus. The author can certainly agree with the transfer to this species but the

morphological studies carried out in the present work do not support the subspecies proposed by Kapoor and Löve. The Rocky Mountain plants have the same chromosome number and the achene number and receptacle size range is the same. The receptacles are glabrous. Since there are no real morphological, cytological, or geographical differences, it is suggested that only R. hyperboreus var. hyperboreus be recognized from North America.

Some specimens described as bearing entire leaves have been referred to a form, integrescens, proposed by Savile and Calder (1952); but upon examination the leaves that seem distinctive appear to be overwintering leaves. On the specimens examined there is a series grading from entire leaves at the base of the stem to typical clover-like leaves in a more distal position. This form of the leaf may have adaptive advantages and it usually disappears before flowering in most specimens.

The description offered in this work for R. hyperboreus differs from Benson's (1948) in the dimensions. The leaves of many of the arctic specimens were found to be quite large, especially, under aquatic conditions. The number and size of the achenes were also found to vary more than suggested by Benson's description.

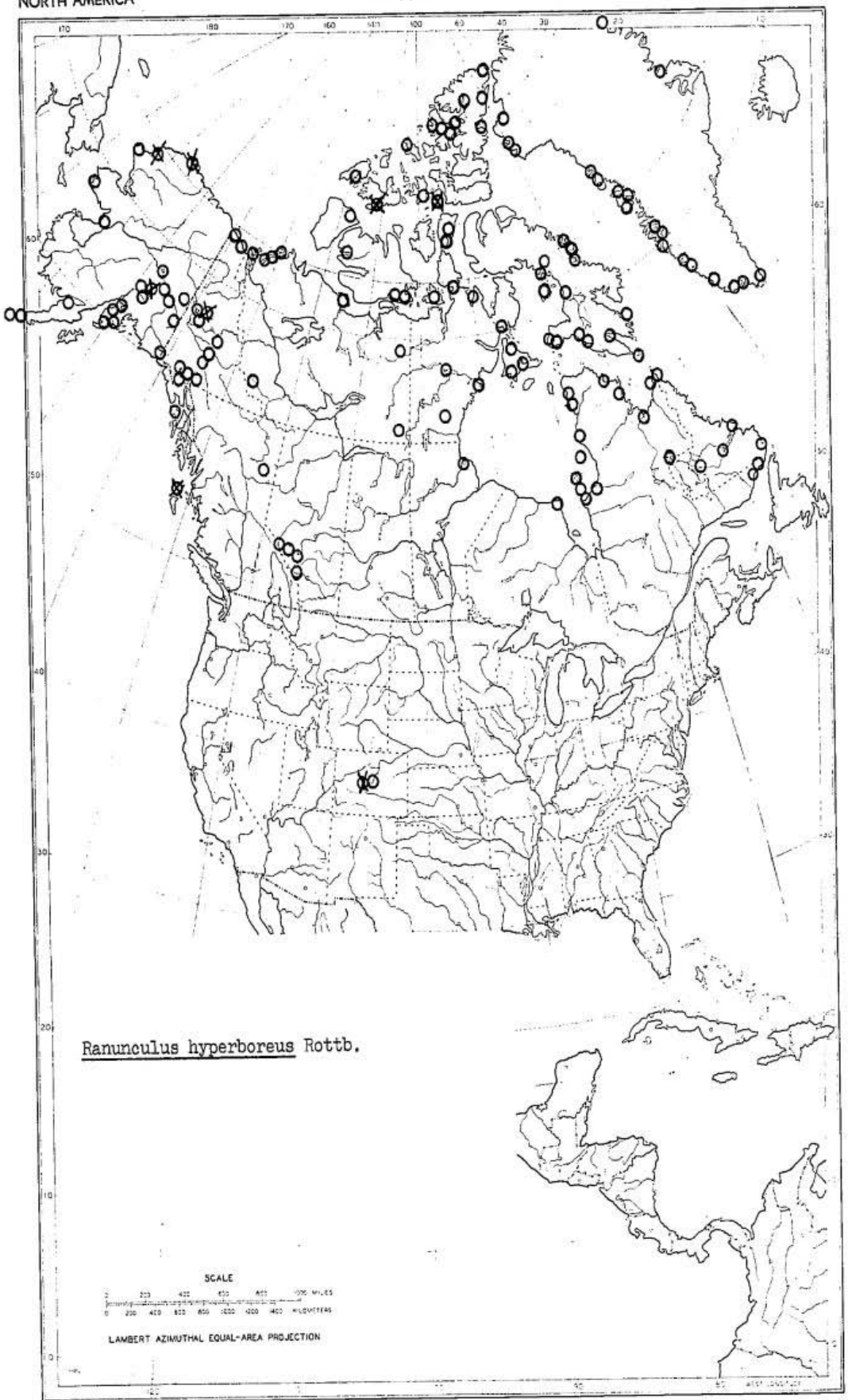
Benson (1948.p.201) gives dimensions for the leaves of 3-8 mm. long and 7-10 mm. broad; whereas, leaves measured on the specimens examined had dimensions of 4-12 mm. long and 4-19 mm. broad. Benson, in the same description gives 10-20 achenes per receptacle with the achene body measuring 0.7 mm. long and 0.6 mm. wide. The variation found in this study was greater than suggested by Benson's measurements and, therefore, they are given to avoid confusion (0.9-1.4 mm. long and 0.6-0.8 mm. wide). The extremes in size and number were not found to be correlated with latitude but were at random.

Figure . Distribution of R. hyperboreus Rottb. in North America.

Legend:

O - locality from which one or more herbarium specimens have been examined. Chromosome number determined from following (Appendix II)

⊗ - 2n = 32



GOODE BASE MAP SERIES
DEPARTMENT OF GEOGRAPHY
THE UNIVERSITY OF CHICAGO
HENRY M. LEPPARD, EDITOR

Ranunculus hyperboreus Rottb.

GREENLAND: Arctic Station, Porsild on July 26, 1943 (CAN). Cape Hedlund, Sörensen 3455 (CAN). Disko Is., Erlanson 3032 (DAO). Egedesmindes, Porsild 116575 (CAN). Frederikshab, Jörgensen & Larsson 430 (CAN). Godhavn: Wood 256 (CAN). Godthaab Fjord, Porsild 8825 (CAN). Ikerasak, Porsild & Porsild on July 9, 1929 (CAN). Itivdleg, Gravensen & Hansen 66-1469 (CAN). Julianhaab, Gröntved 2383 (CAN). Julianihauk, Meldorf on July 28, 1900 (CAN). Kapisigdlit, Porsild 132267 (CAN). Kong Oscars Fjord, Raup, Raup, & Washburn 226 (CAN). Lindenowfjorden, Scholander on July 29, 1932 (CAN). Neria, Eugenius on July 7, 1935 (CAN). Nugsuak Pen., Erlanson 3309 (DAO). Proven, Porsild on Aug. 7, 1943 (CAN). Renssilair Bay, Nygaard in July 1921 (CAN). Sanddalen, Vaaga on Aug. 18, 1930 (CAN). Strindberg, Sörensen 3456 (CAN). Söndre Strömfjord, Erlanson 2512, (DAO), Böcher 87, 88 (DAO), Porsild on Aug. 13, 1941 (CAN). Thule, Nutt 50 (CAN).

FINLAND: Lappland: Enontekiö, Salovius on July 26, 1934 (DAO). Nuolja, Almqvist on July 14, 1907 (DAO).

SWEDEN: Abisko, Alm 1571 (DAO), Lagerwall in 1906 (DAO). Oslersund, Thorné in July 1930 (DAO). Tuolluvaasa, Alm 2430 (DAO).

NORWAY: Böseetrene, Dahl in 1893 (DAO). Bosekop, Lalin in 1883 (DAO).

SPITZBERGEN: Skjemmenes, Lid on Aug. 21, 1920 (DAO).

JAN MAYEN: Fishburn Valley, Russell, Westwood, & Wellington 122, 332 (DAO).

JAN MAYEN: North Lagoon, Russell, Westwood & Wellington 243 (DAO). Wildberg, Russell, Westwood, & Wellington 214, 215, 263 (DAO).

ALASKA: Amchitka Is., Reich 731 (CAN), Reich & McCann 792 (CAN). Anchorage, Dutilly, LePage, & O'Neill 20310 (DAO). Cape Beaufort, Argus & Chunys 5698 (CAN). Cape Thompson, Wood & Wood 516 (CAN). Fairbanks, Schofield 1820 (DAO), Jordal 3516 (CAN). Glenn Hwy., Mi.125, Spetzman 2434 (CAN). Homer, Calder 6939 (DAO). Kaknek, LePage 24062 (CAN), Norberg on July 4, 1943 (CAN). Kenai Pen.: Hope, Calder 5211 (DAO); Kenai L., Calder 5052 (DAO). King Salmon, Schofield 2031, 2706, 2247, 2226 (DAO). Little Tok, Spetzman 2414 (CAN). Nenana Valley, Porsild & Porsild 302 (CAN). Northway, Anderson & Brown 10258 (CAN). Norton Sound, Porsild & Porsild 994, 995, 1107 (CAN). Ogotoruk Creek, Packer 2150 (ALTA). Point Barrow, Wiggins 12997 (CAN). Port Clarence, Seward Pen., Porsild & Porsild 1434 (CAN). Richardson Hwy., mi.188, Webster 17 (DAO). St. George Is., Macoun 18926 (CAN). St. Paul Is., Macoun 18925, 89575 (CAN). Sear Creek, Spetzman 635 (CAN). Seward, Calder 5457 (DAO). Tanana R. Valley, Raup & Raup 12857 (CAN). Taylor Hwy., mi.88, Calder & Gillett 26317 (DAO). Upper Trail L., Beaman 609 (DAO). Wasilla Ck., LePage 23502 (DAO). White Mts., Gjaerevoll 800 (CAN). Wrangell Mts., Murray & Murray 1048 (CAN).

YUKON: Canol Rd., mi.280, Porsild & Breitung 11306, 11424 (CAN); mi.95, Porsild & Breitung 10371 (CAN). Dawson, Calder & Billard 3439 (DAO), Malte 107 (CAN). Gold Run Creek, Macoun 58340 (CAN). Haines Jct., Pearson 141 (CAN). Jensen Flats, Calder & Billard 3176 (DAO). Kluane L., Raup, Drury, & Raup 13811 (CAN). Komakuk Beach, Parmelee 2822, 2832 (DAO). Mackintosh, Schofield & Crum 8182, 8094, 8033 (CAN). MacRae, Gillett 3543

(DAO). Nisutlin R., Porsild & Breitung 10807 (CAN). Ogilvie Mts., Porsild 443 (ALTA), Packer 1969-225 (ALTA). Shingle Point, Parmelee 2779 (DAO).

NORTHWEST TERRITORIES: Axel Heiberg Is.: Parmelee 2073 (DAO); Buchanan L., Beschel 11031 (CAN); Mesa Brook, Beschel 13119, 13356 (CAN); Mokka Fjord, Porsild 18730 (CAN). Thompson Valley, Beschel 10893, 10827, 11197 (CAN); Upper House, Kuc on Aug. 21-22, 1967 (CAN). Baffin Is.: Parmelee & Seaborn 4124, 3900, 3996 (DAO); Acadian Cove, Wynne-Edwards 7250 (CAN); Amadjuak Bay, Soper 125953 (CAN); Cape Dorset, Polunin 265 (CAN), Hainault & Norman 5561 (CAN); Clyde Inlet, Martin 41 (DAO), Wynne-Edwards 9039 (CAN); Flitaway L., Webber 205 (CAN); Frobisher Bay, Senn & Calder 3857 (DAO), Wynne-Edwards 9202 (CAN), Senn 3638 (DAO), Calder 2141 (DAO); Home Bay, Smith VP-90-61 (CAN); Inugsuin Fjord, Hainault 4008 (CAN); Kekerten Is., Soper 125586 (CAN); King Charles Cape, Baldwin 1884 (CAN); Taverner Bay, Manning 16, 63 (CAN). Bathurst Is.: Goodsir Inlet, MacDonald 539 (CAN). NE Banks Is., Porsild 17680 (CAN). Cornwallis Is.: Resolute Bay, Schofield 575 (DAO); Mackay 13 (CAN), Porsild 21675 (CAN). Devon Is., Svoboda in July, 1971 (ALTA). Ellef Ringes Is.: Isachsen, Savile 4248, 4317 (DAO), MacDonald 214 (CAN). Ellesmere Is.: Alert, Harington in 1959 (ALTA); Cape Belknap, Bruggemann 198, 226, 229 (DAO); Eureka, Bruggemann 812 (DAO); Fosheim Pen., Bruggemann 624, 626 (DAO); Hayes Sound, Simmons 1341 (CAN); Hazen Camp, Savile 4668, 4584 (DAO); Tanquary Fjord, Brassard 3130, 1458 (CAN). King William Is., Gjoa Haven, Cooper 228 (CAN). Melville Is.: Bailey Pt., Mosquin & Martin 6485 (DAO). Prince Charles Is.: Foxe Basin, Baldwin 1916 (CAN). Prince Patrick Is.: Intrepid Inlet, Bruggemann 360 (DAO); Mould Bay, Bruggemann 300, 352, 514 (DAO), Macdonald 104 (CAN).

Somerset Is.: Four Rivers Bay, Savile 3622, 3707 (DAO); Port Leopold, Malte 118865 (CAN). Southampton Is.: Coral Harbour, Cody & Senn 1337 (DAO), Cody 1547 (Paratype of R. hyperboreus f. integrescens), 1236, 1545 (DAO), Porsild 21742 (CAN), Brown 579 (CAN); Duke of York Bay, Brown 1674 (CAN); Bear's Cove Pt., Brown 884 (CAN); Boas River Delta, Barry 8 (CAN); Leyson Pt., Manning 4 (CAN). Victoria Is.: Cambridge Bay, Stephens 1149 (CAN); Minto Inlet, Porsild 17390 (CAN), Raup & Soper 9719 (ALTA). Atkinson Pt., Porsild & Porsild 2609 (CAN). Baker L., Rossbach 6992 (CAN). Belcher Is.: North Flaherty Is., Maycock 4649 (CAN). Bernard Harbour, Johansen 97921 (CAN). Boothia Pen.: Pelly Bay, Cooper 143A (CAN). Brintnell L., Raup & Soper 9719 (CAN). Cape Dalhousie, Porsild & Porsild 2753 (CAN). Chesterfield Inlet, Savile & Watts 1017, 1566, 1030, 1176, 1189, 1464 (Type of f. integrescens), 1337 (DAO), Malte 120545, 120500, 120444, 120414 (CAN), Dutilly 541 (CAN), Teucher 725 (CAN). Eskimo L., Porsild & Porsild 2986 (CAN). Hudson's Bay: Kidney Is., Manning on Aug.5, 1971 (DAO); Driftwood Is., Manning on Aug. 31, 1971 (DAO); Kugong Is., Manning on Sept. 8, 1971 (DAO). Kittigayuit, Porsild & Porsild 2488 (CAN). Mackenzie R. Delta, Porsild & Porsild 2216 (CAN). Melville Pen., Repulse Bay, Bruggemann 164, 171 (DAO). Spence Bay, Chillcott 59 (DAO). Western R., Lawson 106 (CAN). Yathkyed R., Porsild 5806 (CAN).

BRITISH COLUMBIA: Beatton R., Raup & Correll 10142 (CAN). Haines Rd., mi.45, Taylor, Szczawinski, & Bell 1553 (DAO). Queen Charlotte Is.; Graham Is.: Calder & Taylor 35871, 36819 (DAO), Calder & Savile 22742 (DAO), Sjörs on Aug. 6, 1960 (CAN).

ALBERTA: Banff, Calder 23950 (DAO). Cadomin: Prospect Creek, Scott 1432

(ALTA), Pegg 2673 (DAO). Coalspur, Malte & Watson 1906, 1908 (CAN). Elk Creek, Scott 1620, 1621 (ALTA). Jasper: Pyramid L., Jenkins 6043 (DAO). Mountain Park, Malte & Watson 2242 (CAN). Nordegg, Brinkman 3835 (DAO), Malte & Watson 1309, 1666 (CAN). Shunda Creek, Nordegg, Scott 1479, 1637 (ALTA). Wabasca, Scott 1700 (ALTA).

MANITOBA: Churchill, Schofield & Crum 6791 (DAO, CAN), 6512 (CAN).

ONTARIO. James Bay: Cape Henrietta Maria, Porsild, Baldwin, et al 19852, 19853 (CAN), Dutilly & LePage 31216, 31335 (DAO).

QUEBEC: Amadjuak Fjord, Bell 18714 (CAN). Blanc Sablon, Fernald & Wiegand 3412 (CAN). Brest, St. John 90460 (CAN). Ft. Chimo, Calder 2434, 2545 (DAO), Sneadborough 16267 (CAN). Great Whale R., Savile 722 (DAO). Hudson Bay: Hiovik R., Low 34223 (CAN). Long Is. Sound, Baldwin, Hustich, et al 618 (CAN). Payne R., Rousseau 205, 1072, 1354, 1155A (DAO). Port Burwell, Malte 118864 (CAN). Port Harrison, Baldwin, Hustich et al 616 (CAN). Saguenay Co.: Boat Is., Lewis 132002 (CAN). Schefferville, Hustich & Kallio 866 (CAN). Smith Is., Baldwin 1817 (CAN). Vieille Romaine, St. John 90459 (CAN). Wakeham Bay, Polunin 1461 (CAN).

LABRADOR: Bowdoin Harbour, Wynne-Edwards 7184 (CAN). Goose Bay, Schofield 751 (DAO), Gillett & Findley 5245, 5345, 5753 (DAO). Indian Harbour, Wetmore 102954 (CAN). Turnavik, Wynne-Edwards 7614 (CAN). Twin Falls, Hustich & Kallio 32 (CAN). Venison Tickle, Waghorne 1685 (CAN). 61°N. and 104°W., Tyrell on July 24, 1893 (CAN).

COLORADO: Boulder Co.: Nederland, Weber 5492 (DAO). Clear Creek Co.: Mount Evans, Weber 7756 (DAO).

WYOMING: Beartooth Pass, Porsild, Johnson, & Darling 22816 (ALTA).

Type Collections:

(1) R. hyperboreus, Greenland. (2) R. intertextus, "Common almost throughout the Rocky Mountains, as an aquatic of subalpine ponds and swamps." "hitherto referred to R. natans of Europe." Lectotype: Upper Bear Creek, Colorado, Greene in 1889. HGr 2682 (Herbarium Greeneanum, University of Notre Dame, Indiana).

Figure 5. Ranunculus pedatifidus J.E. Smith var. leiocarpus Fern.

General habit of the species. Drawn from CAN204755. (X 1)

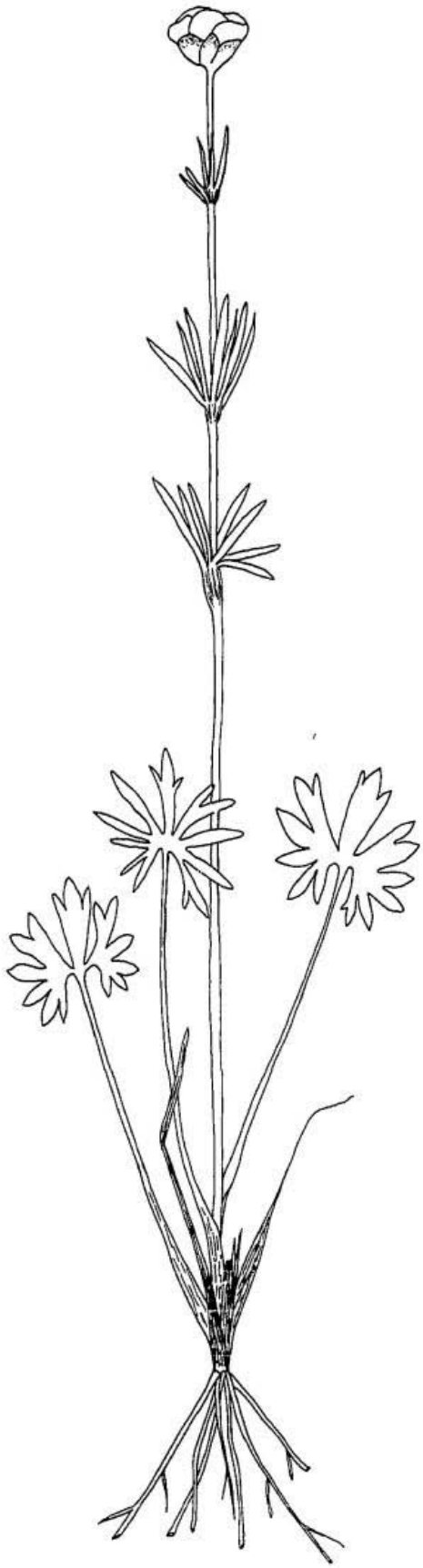


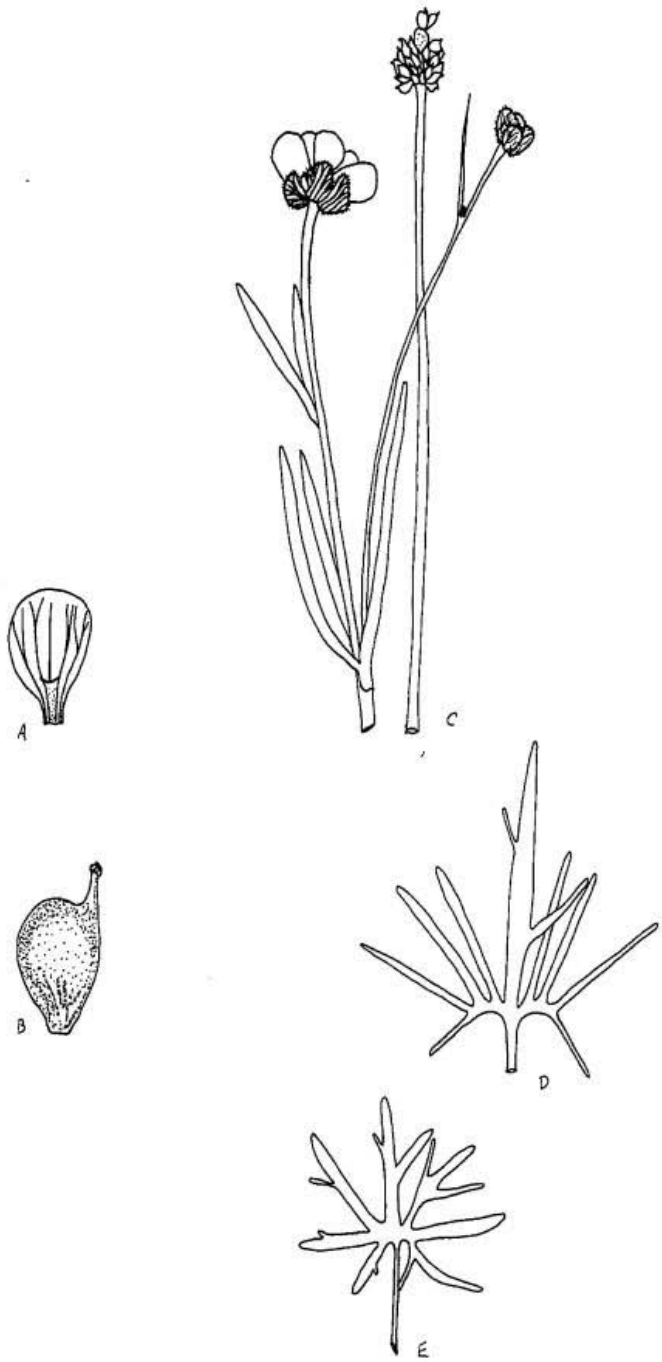
Figure 6. Ranunculus pedatifidus J.E. Smith var. leiocarpus Fern.

A. Petal showing nectary scale. Drawn from CAN204755. (X 3)

B. Achene. Drawn from CAN247374. (X 10)

C. Habit of flowering. Main stem terminated by fruit. Flower developed from axial bud of same stem and it, in turn, produced an axial flower. Drawn from CAN247374. (X 1)

D,E. Finely dissected basal leaves. Drawn from CAN56321. (X 1)


A
B
C
D
E

Ranunculus pedatifidus J.E. Smith var. leiocarpus Fern. Rhodora 19:138.1917.

Synonyms:

R. pedatifidus J.E. Smith in Rees. Cyclop. 29:Ranunculus sp.no.72.1819. R. affinis R. Br. Bot. App. Parry's 1st. Voy. 265.1823. R. arcticus Richards. in Frankl. 1st. Jour. Bot. App. ed. 1.741.1823. R. affinis var. leiocarpa Trautv. Middendorf's Reise 1:62.1847. R. vicinalis Greene, Pittonia 4:145.1900. R. verticillatus Eastw. Bot. Gaz. 33:144.f.3.1902. R. apetalus Farr, Ottawa Nat. 20:110.1906, not R. affinis var. apetalus D. Don in 1831. R. eastwoodianus L. Benson, Amer. J. Bot. 27:804.pl.1.f. 13.1940. R. pedatifidus var. cardiophyllus f. apetalus Boiv. Can. Field Nat. 65:4.1951. R. pedatifidus var. affinis (R. Br.) L. Benson, Amer. Midl. Nat. 52(2):355.1954. R. pedatifidus subsp. affinis (R. Br.) Hult., Flora of Alaska p.480.1968.

Description of the species:

Terrestrial perennial; stem upright, glabrous to sparsely hirsute to hirsute, trichomes white, 1-3.5 dm. tall or occasionally taller, 2-4 mm. in diameter; basal leaves pedately parted into 3 or 5-7 linear divisions which are usually lobed again; lamina proximally cordate and distally acute, usually glabrous except for a few white hairs on the margin, 6-40 mm. long (mean = 16 mm.) and 5-50 mm. wide (mean = 21 mm.); petioles with varying degrees of hirsuteness; cauline leaves alternate, sessile, divided into 5 (3-7) segments; flowers 1-4 or more, borne singly; pedicel hirsute with white trichomes, more densely hirsute directly below flower; sepals 5,

hirsute with white trichomes, green with yellow petaloid margins, 4-7 mm. long (mean = 5 mm.) and 2-5 mm. wide (mean = 3 mm.), about half the length of the petals; petals 5, apetalous forms occur occasionally glossy yellow, obovate, 6-10 mm. long (mean = 8 mm.) and 3-5 mm. wide (mean = 5 mm.), nectary scale forming a small pocket; stamens 15-40, 1-2.2 mm. long (mean = 2 mm.); achenes 20-80 in a cylindroid head; achene body flattened - obovoid, 1.5-2 mm. long (mean = 2 mm.) and 1.2-2 mm. wide (mean = 1.8 mm.), beak 0.3-1.0 mm. long (mean = .5 mm.) and curved; achene surface smooth, glabrous, or occasionally canescent; receptacle cylindroid, hirsute. 2n = 32 and 48.

This species is found in moist meadows on the prairies and in the mountains or on gravel slopes. Labels on herbarium sheets indicate that many arctic specimens are collected on owl hills or eskimeaux ruins. This species is circumpolar with var. pedatifidus in Asia and Europe and var. leiocarpus in North America and Greenland. Var. leiocarpus is found from Alaska to the Arctic Archipelago, Greenland and south through the Rockies to Colorado; Northwest Territories, Alberta, Saskatchewan, and Manitoba. Flowers in June and July.

Table 3. Comparative Morphology of Greenhouse-grown and Field-collected R. pedatifidus.

Table 3

Comparative Morphology of Greenhouse-grown and Field-collected *R. pedatifidus*

	Herbarium						Greenhouse
			J.Hrapko	JGP		E.H.Moss	
	1433	1429	88/366	2586	1560	11001	1429
Stem Pubescence	Glabrous					Hirsute	
Leaf							
Length (mm.)	13	24	15	16	25	17	25
Width (mm.)	16	28	25	21	30	20	45
Base Shape	Cordate						
Segment Apices	Obtuse						
Pubescence	Hairs on Margin						
Petiole Pubescence	Hirsute						
Flower							
Pedicel Pubescence	Hirsute				-	Hirsute	
Sepal length (mm.)	6	5	7	6	-	5	4
Sepal width (mm.)	4	5	4	4	-	3	4
Sepal pubescence	White Hirsute				-	White Hirsute	
Petal length (mm.)	None	7	10	6	-	8	7
Petal width (mm.)	None	4	8	3	-	5	5
Nectary scale					-		
Stamen number	50	30	30	15	-	25	20
Stamen length (mm.)	1.8	2	1	2	-	2	1.5
Fruit							
Achene body length (mm.)	2	2	2	2	2	2	3
Achene width (mm.)	2	2	1.8	1.5	2	1.8	2
Beak length (mm.)	0.7	1	1	0.5	0.4	0.4	1
Receptacle pubescence	Hirsute						
Chromosome Number	32	32	-	-	-	-	32

Taxonomic considerations:

In the first half of the century there was much discussion about whether or not R. affinis was conspecific with R. pedatifidus. Simmons (1906), Fernald (1917 and 1934), and Benson (1948 and 1954). Fernald (1934) provided a very convincing discussion of these two species and he showed that the North American plants match the type specimen of R. pedatifidus from Altai (Siberia) as well as can be expected for the type was apparently collected from an extreme environment. The controversy concerning the specific level has now been resolved to the satisfaction of most; however, the taxonomic designation of the North American specimens has not been completely settled. Benson (1954.p.355) proposed var. affinis for our plants and Hultén (1968.p.480) proposed subsp. affinis. Benson (1954) indicates that the specimens of var. affinis differ from var. pedatifidus by being more robust and having somewhat different leaves. Var. affinis would be a preferable designation for the North American plants because it would reflect the species proposed by R. Brown in 1823. Leiocarpus, however, has priority and it is used in this treatment with a broader description of the characters. It is felt that variety is sufficient recognition of what could be thought of as a geographic race and, therefore, var. leiocarpus is used. Russian and North American plants have a chromosome number of 2n = 32, although some North American plants do have 2n = 48 (see distribution map for the species).

R. eastwoodianus was named by Benson in 1940 and at the time he mentioned that it was closely allied to R. pedatifidus. These two species are separated in the key in Benson's treatise (1948.p.119.) on the basis of the nectary scale and pubescence. A close comparison of the descriptions

of the two species shows that the differences in morphology are not significant when the range shown throughout R. pedatifidus is considered. A specimen of R. eastwoodianus (Bear Creek, Yukon. Abbott 19. DA082832), on which Boivin wrote R. pedatifidus var. leiocarpus in ink in 1948, was studied and it fits into the description of R. pedatifidus. R. eastwoodianus is, therefore, considered a synonym of R. pedatifidus.

R. apetalus Farr and R. pedatifidus var. cardiophyllus f. apetalus are based on the apetalous specimens which are occasionally found in collections. A specimen in the greenhouse collection, which normally produced petals, produced an apetalous flower on one occasion when the weather was overcast and cold. This is further evidence that the form does not warrant varietal or form status.

The isotype of R. vicinalis Greene in CAN. was revised by A.E. Porsild in 1938 to R. affinis R.Br.. Benson annotated it as R. vicinalis = R. pedatifidus in 1947. This specimen was studied and Porsild's decision verified because it had the characters of a typical R. pedatifidus.

Fernald (1917.p.138.) suggested that the North American representatives of R. pedatifidus be known as R. pedatifidus var. leiocarpus. This variety was distinguished by having 'glabrous achenes and characteristic pedately many-cleft basal leaves' (Fernald, 1917.p.138). The material examined in this study does not lend support to this variety. The basal leaves vary tremendously in general outline and size and the achenes are not all glabrous in North American material. In a sample of 111 specimens with fruit from all parts of the continent, 85 had glabrous achenes and 26 had hirsute achenes. One collection (Cape Dalhousie, N.W.T. Porsild & Porsild 2754 in 1927) included specimens with achenes of both sorts and specimens from Söndre Strömfjord, Greenland had glabrous achenes in 1927

and hirsute ones in 1946. It is for these reasons that the description has been broadened.

Figure 7. Distribution of R. pedatifidus J.E. Smith var. leiocarpus Fern. in North America.

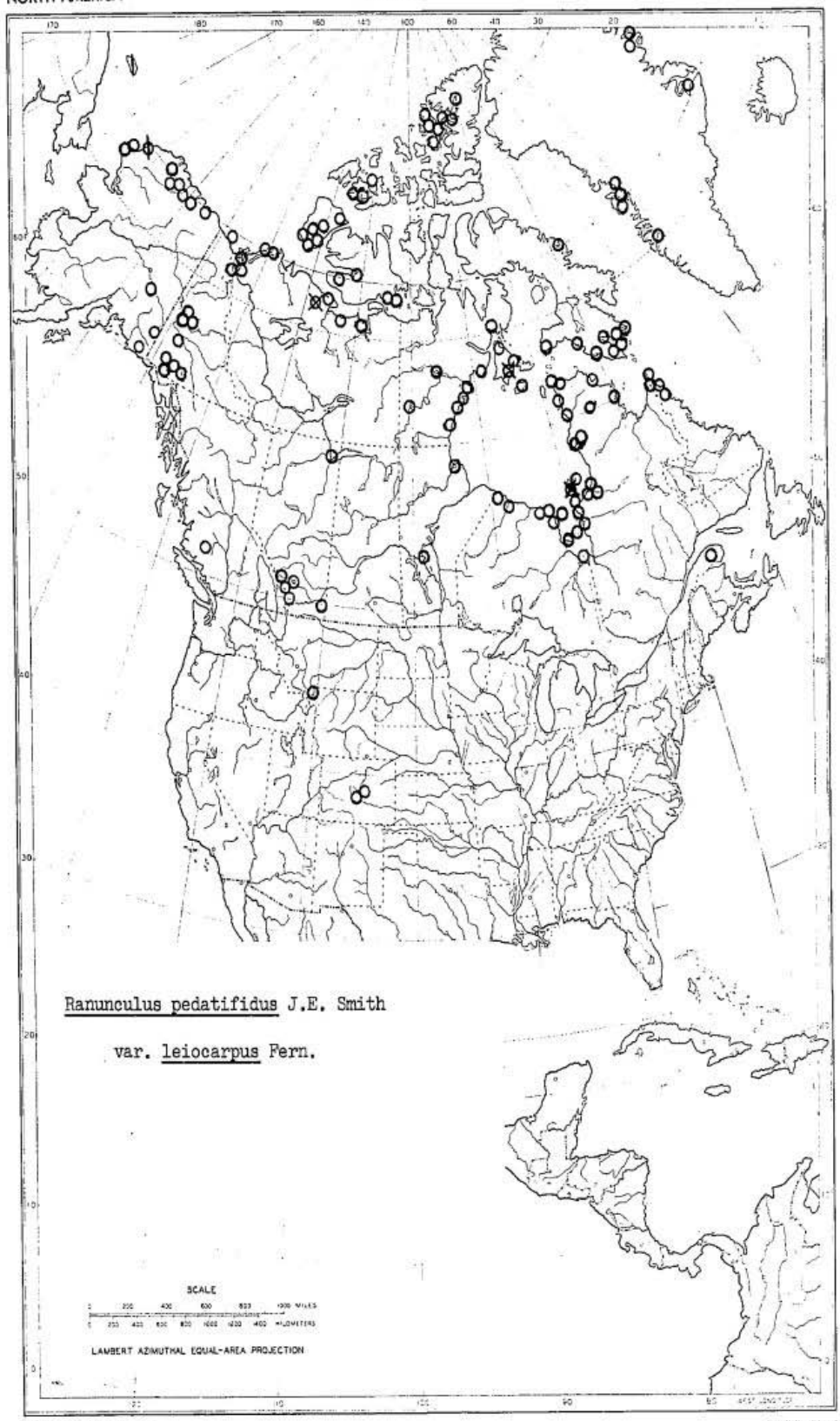
Legend:

O - locality from which one or more herbarium specimens have been examined.

Chromosome number determined from following (Appendix IV)

ϕ - 2n = 32

⊗ - 2n = 48



GOODE BASE MAP SERIES
DEPARTMENT OF GEOGRAPHY
THE UNIVERSITY OF CHICAGO
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Specimens examined:

Ranunculus pedatifidus J.E. Smith var. leiocarpus Fern.

ALASKA: Alaktak, Spetzman 2468 (CAN). Barrow, Ward 1199 (CAN). Cape Beaufort, Argus & Chunys 5481 (CAN). Cape Thompson, Wood & Wood 518 (CAN). Chicken, Spetzman 2415 (CAN). Chitina R., Laing 71, 72 (CAN). Lake Schrader, Spetzman 560, 757 (CAN), Holmen 61-1012 (CAN). Mt. Chamberlin, Shetler & Stone 3405 (CAN). Ogotoruk Creek, Packer 2586 (ALTA), Johnson, Viereck, & Melchior 275 (DAO). Sadlerochit R., Spetzman 886 (CAN). Tuliguk Ck., Spetzman 1843 (DAO, CAN).

YUKON: Alsek R., Raup & Raup 11929 (CAN). Bear Creek, Abbott 19, (DAO), Raup, Raup, & Drury 13141 (CAN). Champagne, Spetzman 160 (CAN). Dawson, Calder, & Billard 3148 (DAO). Dry Gulch, Gorman 1015 (Isotype of R. vicinalis) (CAN). Fort Selkirk, Gorman 1039 (CAN). Gold Run Ck., Macoun 58342 (CAN). Haines Jct., Pearson 13 (CAN). Herschel Is., Wood 158 (CAN), McAllister on July 31, 1960 (CAN). Mackintosh, Schofield & Crum 7336 (CAN). Pine Ck., Raup & Raup 11758 (CAN). St. Elias Mts., Pearson 67 - 12A (CAN).

NORTHWEST TERRITORIES: Axel Heiberg Is.: Parmelee 1194, 2201a, 2201b (DAO); Bastion, Beschel 11570 (CAN); Crusoe R., Beschel 12735 (CAN), Kuc on July 25 and Aug. 22 - 24, 1967 (CAN); Mokka Fjord, Porsild 18668, 18669, 18670 (CAN); Striae Hill, Kuc 163 (CAN); Thompson Valley, Beschel 11109 (CAN); Upper House, Kuc 560 (CAN); Wolf R., Kuc on Aug. 2, 1967

(CAN). Baffin Is.: Amadjuak Bay, Bell 18715 (CAN), Soper 125954 (CAN); Beekman Pen., McLaren 158 (CAN); Cape Dorset, Soper 125950, 125955, 125951 (CAN); Clyde Inlet, Wynne-Edwards 9001 (CAN); Frobisher Bay, Porsild 21547, 21548 (CAN), McLaren 42 (CAN), Wynne-Edwards 9312, 1313-A, 7398 (CAN), Thacker 15 (CAN), Senn & Calder 3666, 3749, 3983, 4028 (DAO), Senn 3660 (DAO); Lake Harbour, Malte 118862, 118863 (CAN). Banks Is.: Porsild 17684 (CAN), Stretton 124, 173 (DAO); Mt. Pelly, Stephens 1163 (CAN); Cape Lambton, Porsild 17563 (CAN); De Salis Bay, Porsild 17623 (CAN); Masik R., Kuc on July 25 - Aug. 1, 1968 (CAN); Sachs Harbour, Porsild 17516 (CAN), Manning & Sparrow 233 (CAN); 73° 24'N. and 117° 00'W., Porsild 17682 (CAN). Coats Is., Collins on July 19 - 20, 1954 (CAN). Ellesmere Is.: Eureka, Bruggemann 817 (DAO); Fosheim Pen., Bruggemann 627, 641, 650, 817 (DAO), MacDonald 299 (CAN); Tanquary Fjord, Brassard 1571 (CAN); Van Hauen Pass, Longton 1746 (CAN). Melville Is.: Ibbett Bay, Tener & Harington 230 (CAN), Tener & Harington 316 (CAN). Queen Elizabeth Is.: Fitzwilliam Owen Is., Kuc on July 15, 1968 (CAN). Southampton Is.: Coral Harbour, Porsild 21744 (CAN), Brown 492 (CAN); Kirchoffer R., Cody 1132 (DAO); Southampton, Malte 120584 (CAN); Cody 1097, 1104, 1223 (DAO). Victoria Is.: Cambridge Bay, Stephens 976, 1098 (CAN); Mt. Pelly, Stephens 1163 (CAN); Prince Albert Sound, Porsild 17441 (CAN). Atkinson Point, Porsild & Porsild 2610, 2611 (CAN); Baker L., Rossbach 6964 (CAN), Porsild 6089 (CAN), Lesiuk in July 1966 (DAO), Savile & Watts 1502 (DAO). Bathurst Inlet, Kelsall 71 (CAN). Belcher Is.: Abbe, Abbe, & Marr 4009 (CAN), Maycock 4528 (CAN); Tukarak Is., Abbe, Abbe, & Marr 4009 (DAO). Bernard Harbour, Johansen 97920 (CAN). Cape Dalhousie, Porsild & Porsild 2753, 2755 (CAN). Cape Fullerton, Beck-

ett 1959 (CAN). Chesterfield, Beckett 1 (CAN), Porsild 6157 (CAN). Chesterfield Inlet, Malte 120467 (CAN), Treuchieu 717 (CAN), Tyrrell 1010, (CAN), Malte 120527 (CAN), Savile & Watts 955, 1183 (DAO), Savile 1364 (DAO), Watts 869, 995, 1072, 1139 (DAO). Coronation Gulf, Cox & O'Neill 97917, 97918 (CAN). Hudson Bay : Rankin Inlet, Macoun 79057 (CAN); Cape Eskimo, Macoun 79058 (CAN); Digges Is., Bell 1011 (CAN). Inuvik, Barry 52 (CAN). James Bay: Bear Is., Baldwin 1722 (CAN). Liverpool Bay, Porsild & Porsild 2878 (CAN). Lower Thelon R., Lawson 105 (CAN). Mackenzie River Delta, Porsild & Porsild 2219 (CAN), Porsild 6667 (CAN). McConnell R., MacInnes 142 (DAO). Mistake Bay, Porsild 5666, 5667 (CAN). Repulse Bay, Bruggemann 36 (DAO). Ross Bay, Code 1429 (DAO). Whale Point, Treuchieu 684 (CAN). Wollaston Land, Jenness 97919 (CAN).

BRITISH COLUMBIA: Marble Mts., Bluster Mt., Thompson & Thompson 392 (CAN).

ALBERTA: Banff, Sanson 22433 (CAN), Brown 87 (CAN), Macoun 1026 (CAN), Calder 23987 (DAO), Mosquin 3426 (DAO), Fowler on June 20, 1887 (DAO). Cadomin: Cheviot Mt., Scott 1433, 1434 (ALTA); Prospect Creek, Packer 2784 (ALTA). Cochrane, McPherson on June 19, 1971 (ALTA). Coleman, Scott 1560 (ALTA). Cypress Hills, de Vries 1968 (DAO). Daybreak Peak, Persimmon Range, Packer 3181 (ALTA). Fort Chipewyan, Raup & Abee 4679 (CAN), Raup 6051 (CAN). Jasper National Park: Willow Creek, Boonstra & Carbyn 62 (ALTA). Signal Mt., Hrapko 88, 366 (ALTA). Jumping Pound Ck., Macoun 18036 (CAN). Moose Mt., Macoun 18035 (CAN). Mountain Park, Scott 1429

(ALTA). Nordegg, Moss 11001 (ALTA). Pembina R., on Nordegg-Hinton Forestry Road, Dumais 2350 (ALTA). Viking, Scott 1189 (ALTA). Waterton Lakes National Park: Knights L., Nagy & Yamashita 3474b (ALTA).

MANITOBA: Churchill, Macoun 79059 (CAN), Porsild 5450 (CAN), Schofield & Crum 6542 (CAN), Dore & Hughes 9912 (DAO), 9953 (CAN), Brown 128 (CAN), Hyde 158 (DAO), Beckett 3776, 4025 (DAO), Dore 9956 (DAO), Mackinnon 29 (DAO), Gillett and Tilt 2097 (DAO). Long Point, Gussoin 9 (CAN, DAO).

ONTARIO: Black Duck R., Moir 2154 (CAN). Cape Henrietta Maria, Porsild, Baldwin, Sjörs & Sjörs 19854 (CAN), Watson 12, 34 (CAN). Fort Severn, Moir 1768 (CAN). Gasket Shoal, Baldwin 1588 (CAN). James Bay, Sutton R., Lumsden 15 (CAN). Lake River, Smith 83 (CAN).

QUEBEC: Attikuan Point, Baldwin, Hustich, et al 609 (CAN). Beaver Is., Baldwin Hustich, et al 611 (CAN). Cairn Is., Abbe 3227 (CAN, DAO). Cape Jones, Baldwin, Hustich et al 608, 610 (CAN). Cape Smith, Polunin 1354 (CAN). Deception Bay, Bartley 75 (CAN). Digges Is., Bell 1011 (CAN). Flovik R., Hudson Bay, Low 23004 (CAN). Great Whale R., Savile 170, 327, 321 (DAO). Knob L., Hustich 454 (CAN). Little Whale R., Low 63131 (CAN). Long Is., Baldwin 1766 (CAN). Merry Is., Johansen 124 (CAN), Maycock 4853 (CAN). Mont-Blanc, LeGallo 1151 (DAO). Payne Bay, Ney & Courtright 2429 (CAN). Port Harrison, Baldwin, Hustich et al 607 (CAN), Malte on Aug. 1 - 2, 1933 (CAN). Poste de Payne Bay, Rousseau 1241 (DAO). Poste de Povognituk, Rousseau 154 (DAO). Richmond Gulf, Sneadborough 16259 (CAN). Salmon R., Baldwin, Hustich et al 606 (CAN).

Smith Is., Baldwin 1818 (CAN). Wakeham Bay, Malte 118861, 126919, 120204, 120216 (CAN). Wolstenholme, Malte 120959 (CAN).

LABRADOR: Bowdoin Harbour, Wynne-Edwards 7188 (CAN). Cape Chidley, Bell 10lla (CAN). Clark Harbour, Wynne-Edwards 7159 (CAN). Hebron, Gillett 8804 (DAO). Ikordlearsuk, Abbe and Odell 128353 (CAN).

GREENLAND: Clavering Is., Sörensen 4331 (CAN). Ella Is., Sörensen 3450 (CAN). Kuanit, Porsild on July 1, 1929 (CAN). Patut, Porsild on Aug. 9, 1921 (CAN). Skaerfjord, Sörensen 2633 (CAN). Söndre Strömfjord, Böcher 1029 (DAO), Erlanson 2619 (DAO). Uvkusigssat, Porsild & Porsild on July 14, 1929 (CAN), Porsild on July 28, 1935 (CAN).

WYOMING: Yellowstone National Park: Swan Lake Valley, Knowlton on July 11, 1888 (DAO).

COLORADO: Gilpin Co.: Rollinsville, Rodeck 123 (DAO). Independence Pass, Packer 4374 (ALTA). Summit Co.: Hoosier Ridge, Weber 6538 (DAO).

Type Collections:

(1) R. pedatifidus, there are four individuals on a sheet in the Linnaean herbarium with "R. pedatifidus Sm. *in Rees' Cyclop. No.72*" written *in Smith's handwriting.* There is an asterisk on the sheet and 'Siberia' pencilled in by Smith. This apparently means that the specimens came from Siberia and were communicated by Gmelin. (Fernald, 1934.p.94.) (2) R. affinis, specimen 987.28 in the Herbarium of J.E. Smith, Linnaean Society, London, labelled "Melville Isld. - Hort. Soc. 1824." (3) R. arcticus, "(B.)" "(B.)" Denotes the Barren Grounds from Point Lake to the Arctic Sea. "Type, Royal Botanic Gardens, Kew. (4) R. vicinalis, "At Fort Selkirk on the Yukon River, in dry gravelly soil. 9 June, 1899, M.W. Gorman." Type, Herbarium Greeneanum, University of Notre Dame, Indiana 8230; Isotype, Can.56323. (5) R. verticillatus, "..... collected at Nome City during the flowering season of 1900." "Plants collected by Dr. F.E. Blaisdell at Nome City, Alaska." Cape Nome according to the type specimen. Type, California Academy of Sciences, San Francisco, 26035. (6) R. apetalus,"By the roadsides at Banff, Alberta," Edith M. Farr, June 28, 1905. Gray Herbarium, Harvard University.

Figure 8. Ranunculus pygmaeus Wahl.

A. General habit of flowering specimen. (X 1)

B. Petal showing nectary scale (X 15)

A,B. Drawn from DA091769.

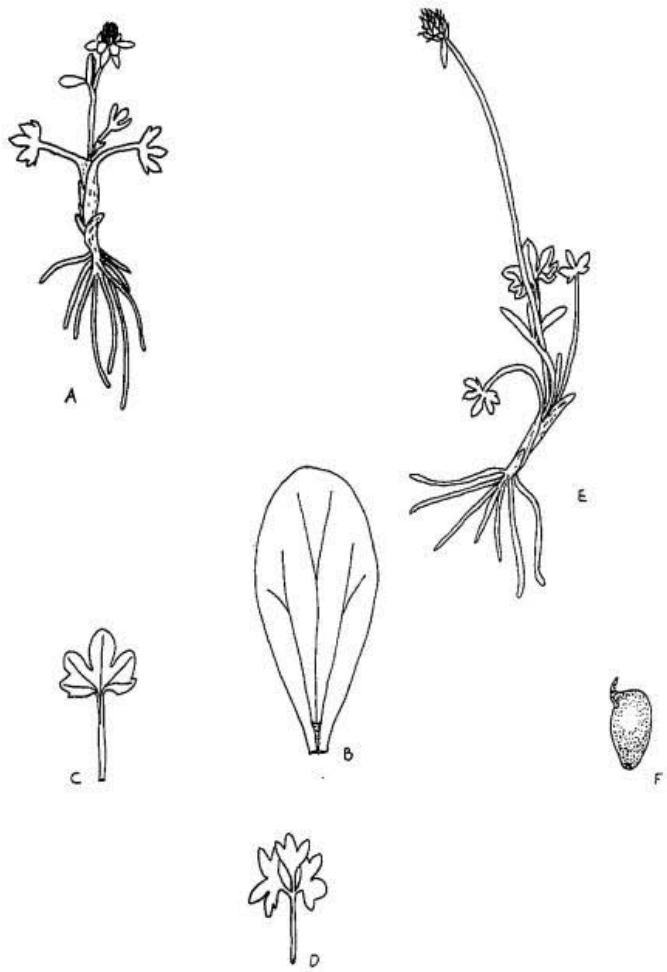
C. Basal leaf. Drawn from DA091772. (X 1)

D. Basal leaf. Drawn from ISOTYPE of var. petiolulatus Fern. CAN56193. (X 1)

E. General habit of fruiting specimen (X 1)

F. Achene. (X 10)

E,F. Drawn from DA091774.


A
B
C
D
E
F

Ranunculus pygmaeus Wahl. Fl. Lapp. 157, 1812.

Synonyms:

R. pygmaeus Wahl. Fl. Lapp. 157.1812. R. pygmaeus var. langianus Nathorst. Ofv. Konigl. Svenska Vet. - Akad. (1):46.pl.1.f.2-5.1884. R. pygmaeus var. petiolulatus Fern. Rhodora 19.137.1917.

Description of the species:

Perennial terrestrial herbs; stems erect or ascending, hirsute to glabrous, trichomes white to slightly yellow, 3-5 cm. in flower and up to 1 dm. in fruit; basal leaves 3-parted or ternately compound, the middle lobe entire or 3-lobed, the lateral lobes often lobed several times, proximally cordate or occasionally truncate and distally the lobes rounded; lamina 3-12 mm. long (mean = 7 mm.) and 5-16 mm. wide (mean = 10 mm.), sparsely hirsute to hirsute on the margins to glabrous; cauline leaves alternate, sessile, divided into 3 linear segments; generally 1-flowered; pedicels densely hirsute (white trichomes) to glabrous; sepals 5, green with yellowish margins, sparsely hirsute to hirsute with white or slightly yellow trichomes, 2-4 mm. long (mean = 3 mm.) and 1-2 mm. wide (mean = 1.5 mm.), slightly shorter to about same length as petals; petals 5, yellow, obovate, nectary scale forming a small pocket 1.5-3 mm. long (mean = 3 mm.) and 1-2 mm. wide (mean = 1.5 mm.); stamens 8-20, anthers 0.5-1.2 mm. long (mean = 0.9 mm.); achenes 30-50 in an ovoid head, receptacle glabrous, 3-4 mm. long in fruit; achene obovoid flattened laterally, 1-1.6 mm. long (mean = 1.2 mm.), 0.8-1.2 mm. wide (mean = 0.8 mm.); beak 0.3-0.8 mm. long (mean = 0.5 mm.), slender and curved. 2n = 16

This species is circumpolar. In North America it occurs from Alaska down the Rockies to Colorado, Arctic Archipelago, Greenland, Coast of Hudson's Bay, Ungava, Labrador, and Gaspé. Flowers from June to September.

Taxonomic considerations:

Some taxa have been reduced to synonymy as a result of this study. An examination of the morphology and distribution of var. langianus suggests that this is a variation worthy of note in the description but not of taxonomic distinction. The segments of the leaves of the isotype (CAN 56193) from Mt. Albert, Gaspé are slightly petiolate but not markedly so although Benson (1948.p.136) reports that Nathorst's collections from Greenland are more extreme. Fernald (1917.p.138) reports in his original description of var. petiolulatus (synonym of var. langianus) that typical R. pygmaeus was also collected with the new variety and mixed on the sheet. The isotype showed variation from lobed to petiolate. There are four or so collections reported in the literature which have been assigned to this variety: Mt. Albert, Gaspé; east and west Greenland; and Glacier National Park, Montana. All of these considerations leads one to the opinion that this variety should be reduced to synonymy as it is a local variation.

This species is very closely related to R. eschscholtzii. It can be thought of as a small version of this species. The colour of the trichomes is slightly different; that is, in R. eschscholtzii the trichomes are a pale yellow and in R. pygmaeus the trichomes vary in colour from white to pale yellow. R. pygmaeus is a diploid species; whereas,

R. eschscholtzii is polyploid and this may suggest a possible relationship but that would require a special study. There is some overlap in the distribution in the Rockies but R. pygmaeus is generally arctic and R. eschscholtzii is mostly alpine (Rocky Mountains). These species have some overlap in characters which has brought forth suggestions that they may be one species (Hultén, 1941) but the present study does not suggest this. The two species were studied at the Cardinal Divide near Cadomin in Alberta and they were quite distinct in size and habitat. R.pygmaeus is very tiny in this area (leaves 6 X 9 mm., petals 4 X 1.8 mm. and height 3.5 cm. / 5.5 cm. in flowering / fruiting specimens) and it grows in a seepage area at the base of a cliff. R. eschscholtzii grows in the snow-melt areas of the meadows and it is much larger (leaves 12 - 18 mm. X 15 mm., petals 6 X 3 mm., and approximately 1 dm. tall). They are distinct, at least, in this area.

R. pygmaeus shows some variation in overall size, leaf and petal size, and leaf outline but whether it varies enough to include R. sabinei would require field and herbarium studies. Benson (1955.p.251) feels that there are two good species; however, Hultén (1941.p.766) feels that there is a species R. pygmaeus and var. sabinei (R.Br.) Kurtz or subsp. sabinei (R.Br.) Hult. (Hultén, 1968.p.478). The two species or species and variety are separated on the basis of R. sabinei being more robust (larger, thicker stem and larger flowers). The lack of clear distinction between these two species suggests the need for a closer study.

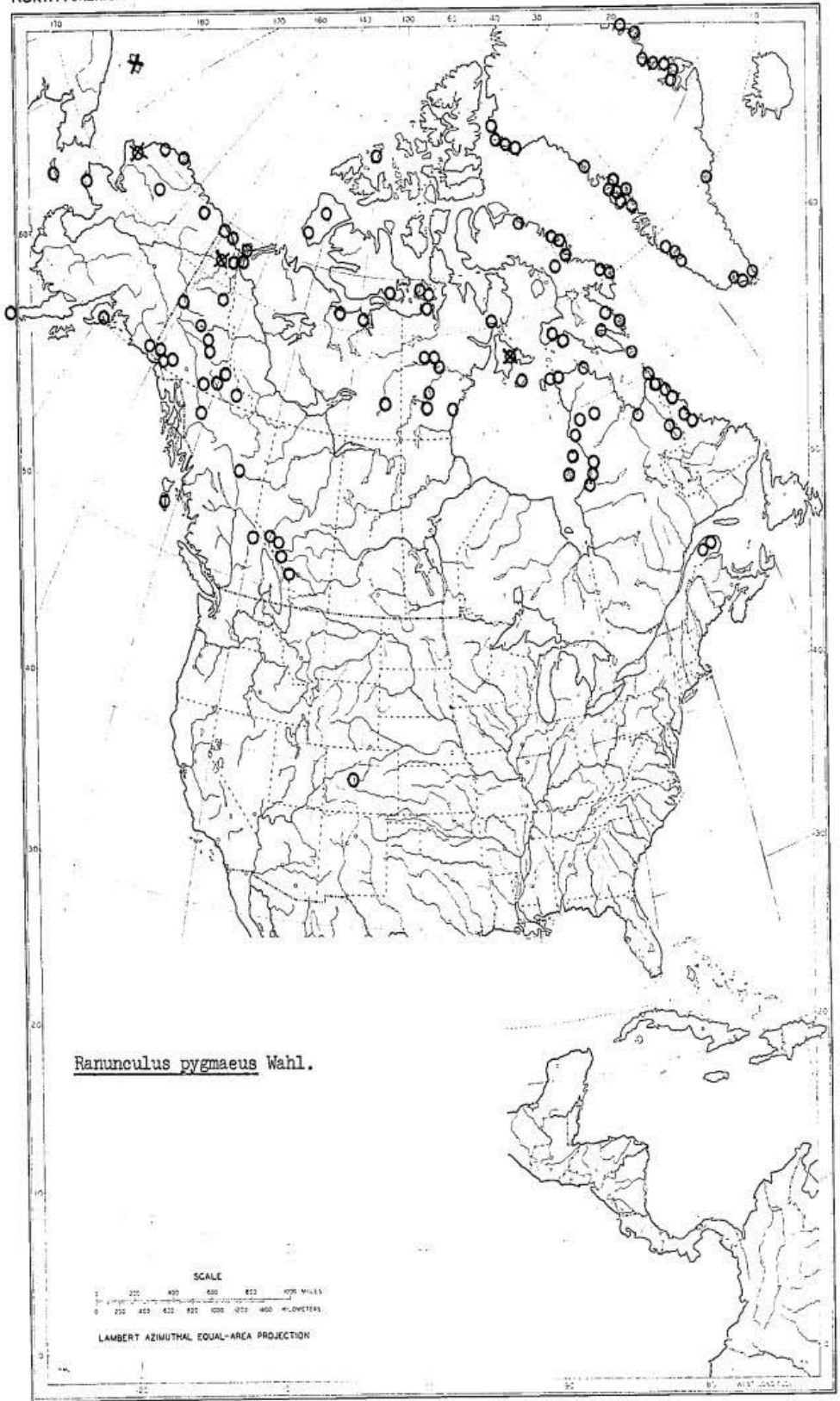
Figure 9. Distribution of R. pygmaeus Wahl. in North America.

Legend:

O - locality from which one or more herbarium specimens have been examined.
Chromosome number determined from following (Appendix V)

⊗ - 2n = 16

× - 2n = 16 Chromosome number cited but no herbarium specimens seen from area.



GOODE BASE MAP SERIES
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Specimens examined:

Ranunculus pygmaeus Wahl.

ALASKA: Barrow, Argus & Chunys 5704 (CAN), Ward 1097 (CAN), Benson 14930 (CAN). Bering Sea, Hall Is., Macoun 18950 (CAN). Cape Thompson, Wood & Wood 519 (CAN). Feniak L., Holmen & Mårtensson 61-1083 (CAN). Kenai Pen., Calder 6106 (DAO). Nome, Porsild & Porsild 1346 (CAN). Ogotoruk Creek, Johnson, Viereck, & Melchior 131, 228 (DAO), Packer 2084 (ALTA). Point Barrow, Dutilly, LePage, & O'Neill 21726 (DAO), Wiggins 12647 (CAN), Spetzman 1523, 2389 (CAN), McIlhenny 40/26267 (CAN), Dutilly, LePage, & O'Neill 21724 (CAN). Sadlerochit R., Spetzman 1050 (CAN). St. Lawrence Is.: Gambell, Young 6 (DAO), Fay on July 1, 1953 (CAN); Boxer Bay, Fay on July 17, 1953 (CAN). Wainwright, Anderson 4368 (CAN). Wrangell Mts., Murray & Murray 1047 (CAN).

YUKON: Dawson, Calder & Billard 4352 (DAO). Herschel Is., Wood 159 (CAN), Stringer 12928 (CAN). Itsi Range, Calder & Kukkonen 27707 (DAO). Keno Hill, Gillett, Calder, et al 4353 (DAO). Kluane L., Murray & Murray 109 (CAN, DAO). Komakuk Beach, Parmelee 2930 (DAO). Little Hyland R., Youngman & Tessier 452 (CAN). Mackintosh, Schofield & Crum 8075 (CAN). Mayo, Bostock 209 (CAN). Mayo L., Green 60 (DAO). McQuestern R., Christie 43 (CAN). Pass between Teslin and Nisutlin R., Porsild & Breitung 10994 (CAN). St. Elias Mts., Murray & Murray 1420 (CAN). Teslin L., Poole in 1952 (DAO). Trout L., Calder 34496 (DAO). Upper Hyland L., Calder & Kukkonen 27910 (DAO). Upper Rose R., Porsild & Breitung 10205,

10894 (CAN).

NORTHWEST TERRITORIES: Baffin Is.: Blacklead Is., Cook 134 (CAN); Cape Dyer, Parmelee & Seaborn 3766(a), 4196, 3738, 4165 (DAO); Cape Searle, Wynne-Edwards 9148 (CAN); Clyde, Martin 3 (DAO), Wynne-Edwards 9050 (CAN), Polunin 2602 (CAN); Dewar Lakes, Parmelee & Seaborn 4026 (DAO); Erik Harbour, Coombs 35 (DAO); Fox Is., Soper 125948 (CAN); Frobisher Bay, Senn & Calder 3729, 3947, 3711 (DAO), Bartley 57 (CAN); Home Bay, Smith VP-66-61 (CAN); Mallik Is., Hainault & Norman 5825 (CAN); Resolution Is., Wynne-Edwards 7226 (CAN); Sorde Inugsuin Fjord, Hainault 3838 (CAN); Winston Bay, McLaren 73 (CAN). Banks Is.: Porsild 17683 (ALTA); Bernard R., Maher & MacLean 81 (CAN); Cape Lambton, Porsild 17564 (CAN). King William Is.: Woodruff 112 (DAO); Terror Bay, Cooper 55A (CAN). Mackenzie King Is., Thorsteinsson 6 (CAN). Southampton Is.: Coral Harbour, Brown 507, 609 (DAO), Calder, Savile & Kukkonen 24227 (DAO), Porsild 21745 (CAN), Brown 585 (CAN). Victoria Is.: Cambridge Bay, Stephens 1181 (CAN), Porsild 17474 (CAN). Aberdeen L., Rossbach 6729 (CAN). Adelaide Pen., MacPherson 55 (CAN). Baker Lake, Rossbach 6925 (CAN). Bathurst Inlet, Kelsall & McEwen 264 (CAN). Belcher Is.: Flaherty Is., Maycock & Freeman 4670 (CAN). Bernard Harbour, Johansen 97846 (CAN). Canol Rd., mi. 111, Wynne-Edwards 8300 (CAN). Hudson Bay: Driftwood Is., Manning on Aug. 31, 1971 (DAO); West Foxe Is., Cooch 12 (DAO); Kidney Is., Manning on Aug. 13, 1971 (DAO); Coats Is., Porsild 5895 (CAN). Mackenzie R. Delta: Richards Is., Porsild & Porsild 2221 (CAN). MacMillan Pass, Porsild & Breitung 11234 (CAN). Mistake Bay, Porsild 5668 (CAN). Plover L., Clarke 772 (CAN). Reindeer Station, Porsild 16753 (CAN). Repulse Bay, Bruggemann 26 (DAO).

Richardson Mts.: Porsild 6811, 6812 (CAN); Summit L., Packer 1463 (ALTA). Schultz L., Rossbach 6843 (CAN). Yathkyed L., Porsild 5803 (CAN), Porsild 6033 (CAN).

GREENLAND: Akornnarmiut, Björlykke on Aug. 6, 1931 (CAN). Ameralik Fjord, Porsild 8225 (CAN). Amerdlog Fjord, Vevers 159 (DAO). Angmagssalik Fjord, Elsley 8/67 (CAN). Arctic Station, Porsild in 1929 (CAN), Erlanson 3060 (CAN). Cape Hedlund, Sörensen 3445 (CAN). Danmarks Hævn, Lundager 80793 (CAN). Disko Is., Godhavn, Wood 258 (CAN), Porsild on Sept. 10 - 20, 1922, 259, 116681 (CAN), Bartlett 69 (CAN). Egedesminde, Beschel 12026 (CAN). Etah, Humphreys 8, 9 (DAO). Faeringerhavn, Porsild 12020 (CAN). Hudson Land, Seidenfaden 883 (CAN). Kuhn Is., Seidenfaden 2646 (CAN). Murchison Sound, Nygaard on July 30, 1921 (CAN). Musk-ox Fjord, Seidenfaden 978 (CAN). Northumberland Is., Bartlett 178 (CAN). Nugssvag, Beschel 12297 (CAN). Nugsuak Pen., Erlanson 3245, 3317, 3204 (DAO). Nukagpiaq, Porsild on Aug. 4, 1941 (CAN). Robertson Bay, Humphreys 10 (DAO), Porsild on Aug. 15, 1943 (CAN), Nutt 53 (CAN). Scoresbysund, Sörensen 98 (DAO). Skaerfjord, Cape Amelie, Sorensen 2651 (CAN). Tasiussaq, Gravesen & Hansen 66-2276 (CAN). Tirztut, Böcher 759 (DAO). Traill Is., Sörensen 3446 (CAN). Traillöya, Vaage on Aug. 7, 1929 (CAN). Tunugdliarfik, Hansen & Petersen 2253 (DAO). Umanaq Ø, Porsild & Porsild on July 7, 1929 (CAN). Umivik, Porsild & Porsild on July 18, 1929 (CAN). Upernavik, Porsild on Aug. 7, 1943 (CAN).

BRITISH COLUMBIA: Dease L., MacDonald 458 (CAN). Mt. Assiniboine, Scamman 6627 (CAN). Mt. Aylmer, Macoun 1087 (CAN). Mt. Selwyn, Raup

Raup & Abbe 4050, 4121 (CAN). Queen Charlotte Is., Moresby Is., Calder & Taylor 23701 (DAO).

ALBERTA: Banff National Park: Sunshine Village, Scotter 10555, 10788 (DAO); Snow Creek Pass, Calder 23990 (DAO). Lake Agnes, Calder 24046 (DAO). Lake Louise, Macoun 64422 (CAN). Cadomin, Pegg 2722 (DAO). Cardinal Divide, Dumais 5150 (ALTA). Forget-me-not Mt., Macoun 18056 (CAN). Highwood Pass, Packer 3895 (ALTA). Jasper National Park: Signal Mt., Scotter 9823 (DAO). Persimmon Range, Packer 3315 (ALTA).

QUEBEC. Digge's Is., Low 22861, 34222 (CAN). Fort Chimo, Mäkinen 67-1091 (CAN). Great Whale R., Baldwin, Hustich et al 613 (CAN). Indian House L., Rousseau 569 (DAO). King George's Sound, Bell 18713 (CAN). Lac Payne, Legault & Brisson 8070 (CAN, DAO). Mt. Albert, Collins & Fernald 67028 (Isotype of R. pygmaeus var. petiolulatus (CAN). Mont Jacques Cartier, Dansereau, Raymond, & Kucyniak 171 (DAO). Port Harrison, Polunin 1683, 1936 (CAN). Richmond Gulf, Abbe 4258 (CAN, DAO). Rivière Kogaluk, Rousseau 368 (DAO). Wolstenholme, Polunin 233 (CAN).

LABRADOR: Cape Chudleigh, Bell 1086 (CAN). Hebron, Wynne-Edwards 7066 (CAN), McAlpine 47 (DAO), Gillett 8628, 8945 (DAO). Ikordlearsuk, Abbe & Odell 335 (CAN). Kangalaksiorvik, Abbe 332 (CAN). Kaumajet Mts., Abbe 336 (CAN). Northern Labrador, Low 18055 (CAN). Okkak, Wynne-Edwards 7505 (CAN). Port Burwell, Jackson on July 20,1970 (DAO), Malte 120017, 120083, 120093, 126825 (CAN), Borsen 62903 (CAN). Ryan's Bay, Abbe & Odell 334 (CAN). Saglek, Gillett 9057 (DAO).

COLORADO: Clear Creek Co., Gray's Peak, Weber 5620 (DAO).

LAPPLAND: Nissontjakko, Almquist on July 19, 1907 (DAO).

SPITZBERGEN: Bellsund Stordalen, Lid on July 15, 1920 (DAO).

JAN MAYEN: Cape Fishburn, Russell, Westwood, & Wellington 138, 139 (DAO). Fishburn Valley, Russell, Westwood, & Wellington 336 (DAO). Guinea Bay, Bird on Aug. 9, 1934 (DAO). South Bay, Russell, Westwood, & Wellington 404 (DAO). Sterneck Toff, Bird on Aug. 21, 1934 (DAO). Wildberg, Russell, Westwood, & Wellington 205, 258 (DAO). Zehn Zelte Bucht, Bird on Aug. 9, 1934 (DAO).

NORWAY: Dovse Storhod, Schents in July 1868 (DAO). Röyrvik Mts., Gjaestad on July 9, 1956 (DAO). Telemark, Trethewy in 1930 (DAO).

FINLAND: Lapponia kemensis, Montell in 1917 (DAO).

SWEDEN: Torne Lappmark, Alm 2146, 1545 (DAO). Abisko, Erdmann on July 10 - 11, 1907 (DAO).

UNION of SOVIET SOCIALIST REPUBLICS: Chukotskiy Region, Rauchua Mts., Shamurin & Yurview on Aug. 7, 1964 (DAO). Chukotskiy Sound, vicinity of Chaplinskie, Bavrilyuk on June 25, 1958 (DAO). Yakutia: Lena R. delta, Palozova on Aug. 2, 1956 (DAO); Olenya R., Yurview on July 26, 1956 (DAO).

Type Specimens:

(1) R. pygmaeus "Etiam in Öhrdalen juxta Hopseidet Finmarkiae Iectus, sed de caetero nunquam extra alpes alteriores." Probably isotype, J.E. Smith Herbarium (987.51), Linnaean Society, London. (2) var. petiolulatus, Mt. Albert, Gaspé, 1905, Collins & Fernald 82. Type, Gray Herbarium, Harvard. (3) var. langiana, "Nordvestra Grönland." "4. Wajattel 69° 45' - 70° 15'." Isotype, University of Minnesota, Minneapolis 114378.

Figure 10. Ranunculus eschscholtzii Schlect. var. eschscholtzii

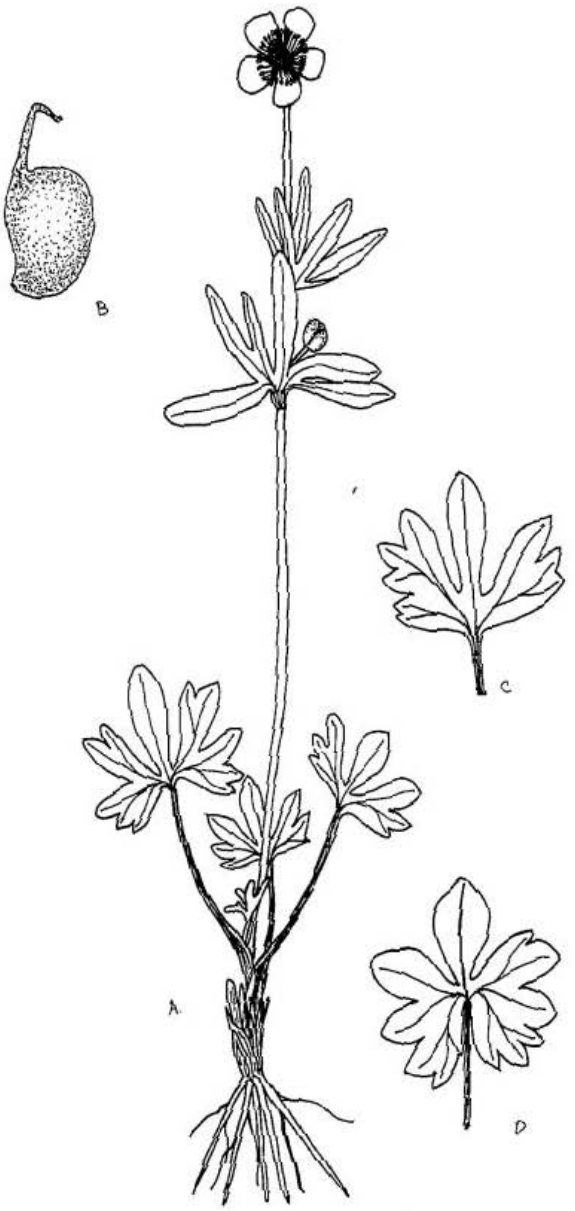
A. General habit of the species.

B. Achene. (X 15)

A,B. Drawn from CAN56124.

C. Basal leaf. Drawn from CAN304952 (X 1)

D. Basal leaf. Drawn from CAN285870 (X 1)


B
C
A
D

Ranunculus eschscholtzii Schlect. var. eschscholtzii Animad. Ranunc. 2:16.pl.1. 1820.

Synonyms:

R. eschscholtzii Schlechtendal Animad. Ranunc. 2:16,pl.1.1820. R. eschscholtzii var. hookeri D. Don in G. Don, Gen. Sys. Gardening 1:1831, neither R. purshii var. hookeri D. Don in 1831 nor R. hookeri Schlecht. in 1834 nor Regel in 1861. R. nivalis L. var. eschscholtzii S. Wats. in King, Rept. U.S. Geol. Expl. 40th. Par. 5:8.1871. R. nivalis L. var. eschscholtzii Lawson, Rev. Can. Ranunc. 84.1884; Trans. Roy. Soc. Can. 2:58.1885. R. ocreatus Greene, Pittonia 4:15.1899. R. helleri Rydb. Bull. Torrey Club 29:158.1902. R. eschscholtzii var. helleri L. Benson, Amer. Jour. Bot. 23:169.1936.

Description of the species:

Terrestrial perennials, glabrous; caudex 1-3 cm. long; stem erect, 5-11 cm. long; basal leaves simple, 3-lobed and lobes 1-3 or more lobed, proximally truncate and distally obtuse-pointed, 4-20 mm. long (mean = 10 mm.) and 11-30 mm. wide (mean = 15 mm.), glabrous except for a few hairs along the margin; cauline leaves alternate, sessile, divided into 3 or occasionally 5 segments; flowers borne singly from the axils of the leaves; pedicels glabrous or very rarely hirsute in young specimens; sepals 5, greenish - purple with a yellow margin, ovate to obovate, 3.5-7 mm. long (mean = 5 mm.) and 1-4 mm. wide (mean = 2.5 mm.), light yellow hairs; petals 5, yellow obovate, nectary scale forming a shallow pocket, 4-13 mm. long (mean = 6 mm.) and 2-7 mm. wide (mean = 3 mm.); stamens 20-30,

Table 4. Comparative Morphology of Greenhouse-grown and Field-collected R. eschscholtzii Schlect.

Legend,

T = Truncate
C = Cordate
G = Glabrous

Table 4

Comparative Morphology of Greenhouse-grown and Field-collected

R. eschscholtzii Schlect.

	Herbarium							Greenhouse		
				PJS Coll'n						
	1541	1532	1639	80	1436	1542	1513	DH2	1639	1532
Stem Pubescence	Glabrous									
Leaf										
Length (mm.)	15	8	14	21	6	9	8	35	25	30
Width (mm.)	24	12	15	23	11	15	15	55	45	45
Base Shape	T	T	T	T	T	C±	T	C	C	C
Segment Apices	Obtuse									
Pubescence	Hirsute on Margin									
Petiole Pubescence	G	G	G	G	G	G±	G±	G	G	G
Fruit										
Achene body length (mm.)	1.7	1.5	-	-	-	1.5	1.5	2	-	-
Achene width (mm.)	1.2	1.1	-	-	-	1.2	1	1.7	-	-
Beak length (mm.)	1	1	-	-	-	0.6	0.6	1	-	-
Receptacle pubescence	G	G	-	-	-	G	G	G	G	G
Chromosome Number	32	32	32	40	32	32	32	32	32	32

Compar

Flower

Pedicel pubesc

Sepal le (mm.)

Sepal wi

Sepal *pubesc*

Petal le (mm.)

Petal wi

Nectary

Stamen r

Stamen l (mm.)

Table 4

Comparative Morphology of Greenhouse-grown and Field-collected

R. eschscholtzii Schlect.

rown and Field-collected lect.		Greenhouse			Herbarium							Greenhouse		
					PJS Coll'n									
1542	1513	DH2	1639	1532	1541	1532	1639	80	1436	1431	1513	DH2	1639	1532
Glabrous					Flower									
					Pedicel pubescence	Glabrous								
9	8	35	25	30	Sepal length (mm.)	5	6	4	7	5	5	5	5	5	5
15	15	55	45	45	Sepal width (mm.)	4	2.5	1.5	3.5	2	2	3	4	4	5
$C^{\pm}$	T	C	C	C											
Obtuse					Sepal pubescence	Yellow Hirsute									
sute on Margin															
$G^{\pm}$	$G^{\pm}$	G	G	G	Petal length (mm.)	-	6.5	6	11	6	5.5	6	8	7	8
					Petal width (mm.)	-	4	3	7	3	2.5	3.5	7	6	7
					Nectary scale	-		← Similar →							
1.5	1.5	2	-	-	Stamen number	20	20	20	30	25	20	20	35	30	30
1.2	1	1.7	-	-	Stamen length (mm.)	1	1	1	1	1	1	1	1	1	1
0.6	0.6	1	-	-											
G	G	G	G	G											
32	32	32	32	32											

anthers 1 mm. long; achenes in an ovoid head; each achene 1.5-2 mm. long (mean = 2 mm.) and 0.8-1.5 mm. wide, laterally flattened, obovate, glabrous or occasionally puberulent, especially, in immature achenes; beak 0.6-1 mm. long (mean = 1 mm.) and curved; receptacle glabrous. 2n = 32, 40, 48, and 56.

This species grows in Arctic and alpine meadows and talus slopes, usually in snow-melt areas; Aleutian Islands, Alaska, down the Rocky Mountains to California. Flowers from June to August.

Taxonomic considerations:

This is quite a variable species in North America. In Canada and Alaska the plants are recognizable as a distinct species but it has the usual variation associated with the genus. The plants are small and the leaves are sparsely lobed in the north and in harsher habitats but in more favourable situations the plants attain maximum size and the leaves have broad lobes and are often quite dissected. A limited number of pressed specimens of the other varieties (i.e. var. suksdorfii (A. Gray) L. Benson, var. eximius (Greene) L. Benson, var. trisectus (Eastw.) L. Benson, and var. oxynotus (A. Gray) Jepson) were studied but this did not allow any decisions to be made about their status. Hitchcock et al (1964.p.383) list three of the varieties used by Benson (1948) and they propose two new varieties: R. eschscholtzii var. adoneus to include R. adoneus and R. eschscholtzii var. alpinus for its variety alpinus. They do not include R. eschscholtzii var. oxynotus (A. Gray) Jepson as it

occurs south of their range or R. eschscholtzii var. hultenianus L. Benson which occurs on the Kamchatka Peninsula and Bering Island, Siberia. Hitchcock considers this "A widespead polymorphic species, in our area differentiated into several phases which, in their extreme forms, are strikingly distinctive and often considered as separate specific taxa. However, because of their tendency to intergrade they are best treated as varieties." (Hitchcock et al, 1964.p.383).

The specimens that were examined from Alaska, Canada, and parts of the Northwestern United States belong to R. eschscholtzii var. eschscholtzii in the author's opinion and represent a distinct taxon. The other varieties appear to be distinctive but would require careful studies of plants grown in a controlled environment chamber before a final judgement could be made. This variety is the 'typical' one for the species and although it may be close enough in morphology to R. nivalis to be considered a variety of it, there is sufficient justification to recognize two species. R. eschscholtzii differs from R. nivalis in the colour of the hairs (pale yellow versus rusty-brown), distribution (Rocky Mountains versus Arctic North American plus circumpolar), and chromosome number (2n = 32, 40, 48, and 56 versus 2n = 40, 48, and 56). Specimens from Alaska and the Yukon are often very close to R. nivalis in the colour of the pubescence on the sepals but the hairs on the leaves and the tip of the receptacle allow a separation on the basis of colour.

The description offered is based on all of the specimens examined and it may include Benson's variety hultenianus but no specimens were available for examination.

Vegetative specimens of R. eschscholtzii and R. pedatifidus in the

greenhouse could only be distingushed by the collection number because the basal leaves were so similar. Specimens of both species have a chromosome number of 2n = 32 and Goepfert (1970) shows karyotype diagrams which appear identical. With this information, reciprocal crosses were attempted. One achene was set on a plant of R. eschscholtzii and it was planted. When after a month there was no sign of germination, an attempt was made to retrieve it to determine if the embryo was present and fully formed. The achene was never located to determine if the hybridization was a success and, therefore, the degree of relationship between these two species has yet to be determined.

Figure 11. Distribution of Ranunculus eschscholtzii Schlect. var. eschscholtzii in North America.

Legend:

○ - locality from which one or more herbarium specimens have been examined.

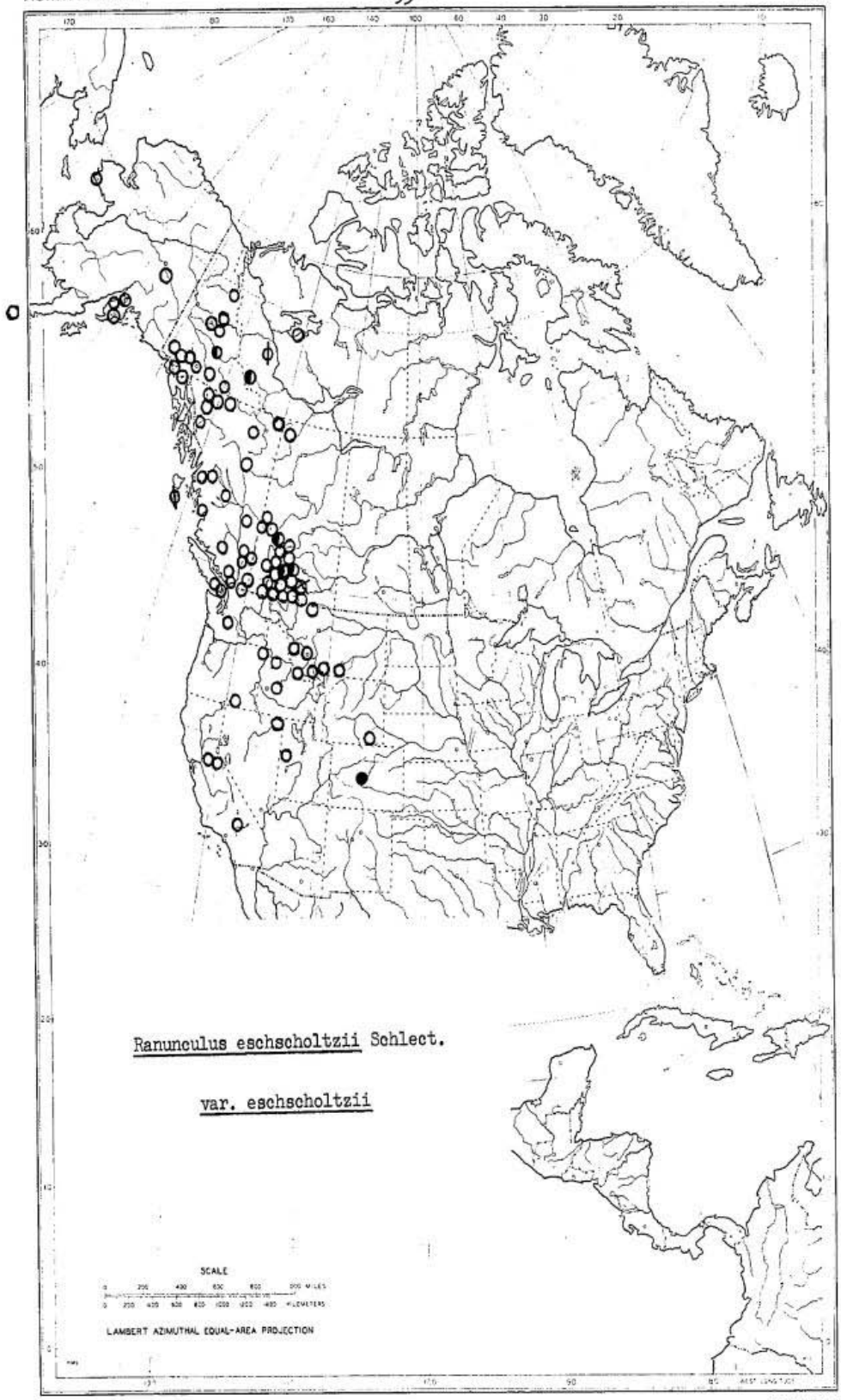
Chromosome number determined from following (Appendix III a and b)

⊕ - 2n = 32

⊗ - 2n = 40

◐ - 2n = 48

● - 2n = 56



GOODE BASE MAP SERIES
DEPARTMENT OF GEOGRAPHY
THE UNIVERSITY OF CHICAGO
HENRY M. LEPPARD, EDITOR

Specimens examined:

Ranunculus eschscholtzii Schlecht. var. eschscholtzii

ALASKA: Anchorage, Dutilly, Lepage, & O'Neill 21145 (CAN). Bering Sea: Ounalaska, Macoun 18933 (CAN). Kenai L., Beaman 647 (DAO). Kubab Bay, Coville & Kearney 1545 (CAN). Nome, Whillans 41 (DAO). Paxon, Porsild & Porsild 539 (CAN). St. Paul Is., Macoun 18927, July 30, 1896, 89579 (CAN). Savoiks, Malaise on July 22, 1928 (CAN). Seward, Anderson 5655 (CAN). Unimak Is., Eyerdam 1963 (CAN).

YUKON: Canol Road: mi.95, Porsild & Breitung 10206, 10168, 10207, 10440, 10455 (CAN); mi. 268, Porsild & Breitung 11347, 11348 (CAN). Cassiar Mts., Poole 104 (DAO). Keno Hill, Gillett & Calder et al 4334 (DAO). Kluane L., Murray & Murray 45 (CAN). Mackintosh, Schofield & Crum 8090 (CAN). Mayo, Bostock 59 (CAN), Broadfoot 24 (DAO). Mayo L., Green 28 (DAO). Mt. Sheldon, Porsild & Breitung 11744, 11615 (CAN). Teslin and Nisutlin R., Porsild & Breitung 11137 (CAN). Whitehorse, Gillett & Mitchell 3419 (DAO).

NORTHWEST TERRITORIES: Brintnell L., Raup & Soper 9539 (CAN). Great Bear L., Porsild 17103 (CAN).

BRITISH COLUMBIA: Alaska Hwy., mi.397, Taylor, Szczawinski, & Bell 169 (DAO). Barkerville, Calder, Savile & Ferguson 14219 (DAO). Bella Coola, Calder, Parmelee, & Taylor 17290 (DAO). Caribou L., Calder, Parmelee &

Taylor 18054 (DAO). Cassiar, Taylor, Szczawinski, & Bell 344 (CAN), 561 (DAO). Cheam, Fletcher on July 31, 1898 (DAO). Chilliwack, Spreadborough 70811 (CAN). Chilliwack L., Macoun 33587 (DAO). Chua Chua, North Thompson Valley, Tisdale 40-395 (DAO). Coryrll, Macoun 63482 (CAN). Dease L., MacDonald 460, 459, 461 (CAN). Field, Calder & Savile 12048 (DAO). Flathead Rd.: mi.19, Bell & Davidson 191 (DAO). Garibaldi, Eastham on August 8, 1938 (DAO), Bostock (DAO 82634). Golden Ears, Henson on July 30, 1935 (DAO). Griffin L., Macoun on Aug. 8, 1889 (CAN). Haines Rd.: mi.60, Taylor, Szczawinski, & Bell 1142 (DAO); mi.83, Taylor, Szczawinski, & Bell 938, 944 (DAO); mi.84, Szczawinski on Aug. 1, 1961 (DAO). Kelsall L., Taylor, Szczawinski, & Bell 1336 (CAN). Kootanie L., Macoun 3061 (DAO), 1077 (CAN), (CAN 56127). Kootenay National Park, Seel 85 (DAO), Eastham on July 29, 1938 (DAO). Lake House at Skagit R., Macoun 69393 (CAN). Lakit Mt., Taylor & Ferguson 2827, 2788 (DAO). Lillooet, Beamish & Vrugtman 61650 (DAO), Calder, Savile & Ferguson 15508 (DAO). Littlefort, Calder, Taylor, & Parmelee 19905 (DAO). Maclennan R., Spreadborough 19230 (CAN). McBride, Eastham 14658 (DAO). Manning Provincial Park, Underhill 762 (DAO), Calder & Savile 10529 (DAO), Scoggan 15872 (CAN). Marble Mts., Thompson & Thomson 403 (CAN), 270, 310 (DAO). Mt. Assiniboine, Scamman 6626 (CAN). Mt. Cheam, Fletcher & Anderson 1426 (DAO). Mt. Queest, Macoun 1427 (DAO). Mt. Revelstoke, Muir 116 (DAO), Calder & Savile 10866, 10911 (DAO), Eastham 16063 (DAO). Mt. Selwyn, Raup & Abbe 4120 (CAN). Nelson, Calder & Savile 11050 (DAO). Penticton, Calder & Savile 10666 (DAO). Pollock, Taylor & Ferguson 2958 (DAO). Princeton, McLean 65 - 43 (DAO). Queen Charlotte Islands, Moresby Is., Calder & Taylor 36461, 36334, 36404 (DAO).

Queert, Macoun 1073 (CAN). Quiniscoe L., Calder, Parmelee, & Taylor 19647 (DAO). Rainbow Mts., Laing 516 (CAN). Roger's Pass, Macoun 100790 (CAN), Szczawinski on Aug. 13, 1964 (DAO), Macoun 44-3061 (DAO). Rossland, Anderson on July 17, 1929 (CAN). Selkirks Glacier, Brown 241 (CAN). Selkirk Mts., Macoun 1078 (CAN). Skagit R., Macoun 69392, 69391 (CAN). Skeena Crossing, Calder, Ferguson, & Savile 15209, 13347, 15172 (DAO). Smithers, Sawitski 35 (DAO). Swift R. at Seagull Ck., Clarke 114 (CAN). Tatla Lake, Calder, Parmelee, & Taylor 19330 (DAO). Terrace, Calder, Savile, & Ferguson 13333 (DAO). Tornado Pass, Taylor & Ferguson 3138 (DAO). Tsi-tsutb Mts., Dawson 33585 (CAN). Tulameen Valley, Rice 36 (CAN). Twin Lake Peaks, Taylor and Ferguson 2359 (DAO). Vancouver Is.: Moat L., Calder & MacKay 32302 (DAO); Burman L., Calder & MacKay 32526 (DAO); Wall L., Taylor, Calder, & Ferguson 3457 (DAO); Mt. Joan, Calder & MacKay 32378 (DAO). Wapta L., Taylor & Ferguson 2416 (DAO). Ymir, Sandercock 89879 (CAN). Yoho Mts., Bostock on July 26, 1927 (DAO). Yoho National Park, Sherk & Taylor 213 (DAO), Calder & Taylor 23827 (DAO). 59° 51'N. and 136° 58'W., Porsild & Porsild 248, 181 (CAN).

ALBERTA: Banff, Scoggan 16486 (CAN), Lewis 91153 (CAN), Lambart 44 (CAN), Dawson 1075, 33586 (CAN), Fletcher on July 8, 1902, 1425 (DAO), Mosquin & Seaborn 7151, 7058 (DAO). Bow Pass, Scott 1541 (ALTA). Cardinal Divide, Silberhorn on August 7, 1971 (ALTA), Scott 1639 (ALTA), Dumais 5091 (ALTA). Cavell Glacier, Moss 4730 (CAN). Cheviot Mt., Cadomin, Scott 1436 (ALTA). Columbia Ice Field, Scott 1532 (ALTA). Crowsnest Forest Preserve, de Vries 2417-64APM II (DAO). Eagles Nest Creek Wilderness Park, Pegg 1756 (DAO). Highwood Pass, Moss 10725 (CAN), Moss

10727 (DAO), Scott 1542 (ALTA). Jasper, Moss 2743 (CAN), Spreadborough 19229 (CAN), Laing 272 (CAN), Scotter 9856 (DAO), Moss 4730 (DAO), Turner 5155 (DAO), Moss 4873 (DAO). Kootanie Pass, Dawson 1074 (CAN), Brown 364 (CAN). Laggan, Malte on July 11, 1913 (CAN). Lake Agnes above L. Louise, Malte & Watson 1173, 1141, 1122 (CAN), Macoun on August 19, 1891 (CAN), Fletcher 1428 (DAO). Lake Louise, Macoun 64413, 64414, 1072 (CAN), Malte & Watson 967 (CAN), Dudley 141 (DAO). Maligne L., Jenkins 7902A (DAO), Scott 1512, 1513, 1514 (ALTA). Miette Hot Springs, Moss 2679 (CAN). Moraine L., Hermann 12696 (CAN). Mt. Alymer, Macoun on August 6, 1891 (CAN). Mt. Edith Pass, Sanson 22322 (CAN). Parker Ridge, Dumais 5708 (ALTA). Pine River Pass, Dawson 1076 (CAN). Pipestone Ck., Macoun 64415 (CAN). Sunwapta Pass, Moss 4911 (CAN). Waterton Lakes National Park: Waterton, Sexsmith 89 (DAO), Sudol 60 (DAO), Senn 2661 (DAO), Moss 972 (DAO); Goat Lake, Denford 60 (ALTA); Lower Twin L., Blais & Nagy 1780 (CAN), Kuijt & Blais 2928 (CAN); Pass Creek, Malte & Watson 2723 (CAN); Ruby L., Blais 2427 (CAN); Sheep Mt., Macoun 10034 (CAN); Upper Twin L., Kuijt & Blais 1244 (CAN), Blais 1926, 2157 (CAN). Wilcox Pass, Moss 4873 (CAN), Dumais 5709 (ALTA). Wilcox Ridge, Jasper, Scotter S-3/7961 (CAN). Yellowhead Pass, Spreadborough 19231 (CAN). Yoho Valley, Macoun 64420 (CAN).

MONTANA: Madison Co.: Lazy Mans Hill, Hitchcock 16918 (CAN); Brandon Lakes, Hitchcock 17022 (CAN); Red Hill, Hitchcock 16929 (CAN). Park Co.: Silver Pass, Hitchcock 16413 (CAN); Beartooth L., Hitchcock 16653 (CAN). Ravalli Co.: Bottom, Hitchcock 17091 (CAN). Stillwater Co.: Haystack Mt., Hitchcock 13436 (CAN). Sweetgrass Co.: Rainbow L., Hitchcock 16425 (CAN).

WASHINGTON: Kittitas Co.: Colochum Pass, Cruise, el al 360 (CAN). Wenachee Mts., Kruckeberg 3085 (CAN).

WYOMING: Albany Co.: Cinnabar Park, Porter & Porter 10251 (CAN).

UTAH: Juab Co., Maguire & Holmgren 21963 (CAN).

NEVADA: Elko Co., Lamille L., Maguire & Holmgren 22144 (CAN).

OREGON: Wallowa-Whitman National Forest, Ice L., Fahselt & Chandhary on August 2, 1904 (CAN).

Ranunculus eschscholtzii Schlecht. var. eximius (Greene) Benson

MONTANA: Meagher Co.: Big Belt Mts., Hitchcock & Muhlick 12410 (CAN).

Ranunculus eschscholtzii Schlecht. var. oxynotus (A. Gray) Jepson

CALIFORNIA: Mono Co.: Saddlebag L., Sharsmith 2752 (CAN). Tulare Co.: Colby Pass, Sharsmith 3847 (CAN). Tuolumne Co.: Mt. Leavitt, Wiggins 9491 (CAN), Sharsmith 2887 (CAN).

Ranunculus eschscholtzii Schlecht. var.suksdorfii (Gray) Benson

IDAHO: Boise National Forest, Hitchcock & Muhlick 10256 (CAN). Elmore Co.: Atlanta, Hitchcock & Muhlick 10145 (CAN).

MONTANA: Beaverhead Co.: Black Lion Mt., Hitchcock & Muhlick 12989 (CAN).

Ranunculus eschscholtzii Schlecht. var. trisectus (Eastw.) Benson

IDAHO: Idaho Co.: Seven Devils Mts., Ownbey & Meyer 2091 (CAN).

OREGON: Wallowa Co.: Wallowa Mt., Maguire & Holmgren 27088 (CAN). Marney Co.: Steens Mts., Maguire & Holmgren 26794 (CAN).

Type collections:

(1) R. eschscholtzii. "Since probably the type specimen was destroyed in the bombing of Germany in the Second World War, the following is designated as a neotype pending discovery of the type: 'Ins. St. Georgii. Esch.,' "(Benson, 1954.p.351.) Hooker Herbarium, Royal Botanic Gardens, Kew. Isotype, Gray Herbarium, Harvard University. (2) var. hookeri, none given, cf. Hooker, Fl. Bor. Amer. 1:18.1829. (3) R. ocreatus, Mt. Hesperus, Colorado, Baker, Earle, & Tracy, July 2, 1898 (n.912.) Type, Herbarium Greeneanum, University of Notre Dame, Indiana (Acc. No.2740). (4) R. helleri, Lake Pend d'Oreille, Idaho, 1898. Sandberg, MacDougal, & Heller 842. Type, listed as being deposited in New York Botanic Gardens, however, Benson could not locate it. Isotypes, Herbarium of the University of California, Berkeley 9532; California Academy of Sciences, San Francisco 134623.

Figure 12. Ranunculus nivalis L.

A. General habit of the species. Drawn from CAN273092. (X 1)

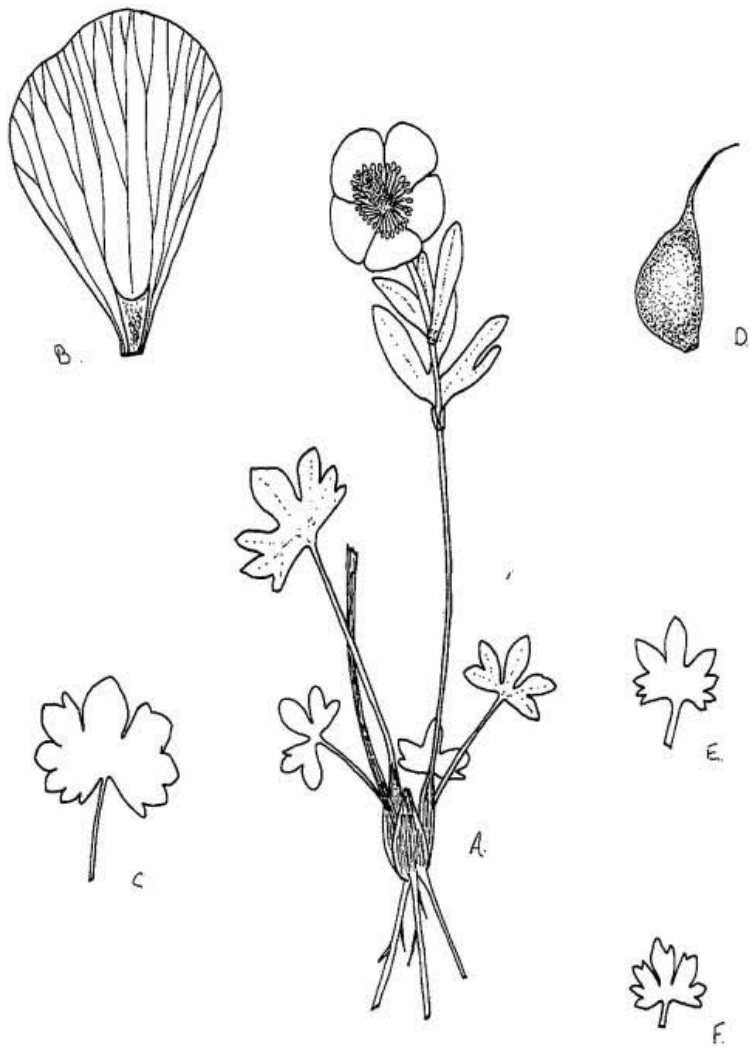
B. Petal, showing nectary scale. Drawn from CAN299511. (X 7)

C. Basal leaf with much-lobed lateral lobes. Drawn from DA091738. (X 1)

D. Achene. Drawn from DA091709. (X 10)

E. Basal leaf. Drawn from DA091705. (X 1)

F. Basal leaf. Drawn from DA091699. (X 1)


B
D
A
C
E
F

Ranunculus nivalis L. Sp. Pl. 553. 1753.

Synonyms:

R. nivalis L. Sp. Pl.553.1753. R. nivalis var. Freilgrathii Bessels, Expl. Polar Amer. Bull. Soc. Geogr. VI.9:297.1875, nom. nud. cited by Simmons, Rept. 2nd. Norweg. Arct. Exped. in "Fram" (16):75.1909. R. nivalis f. subglobosus Polunin, Bull. Nat. Mus. Can. (92) pt.1:215. pl.6. f. (b). upper left 1940.

Description of the species:

Terrestrial perennials, sparsely red-brown hirsute; stems upright 10-20 cm. high; basal leaves basically 3-lobed, lateral lobes again lobed, all of these lobed, glabrous with a few hairs along the margins, 7-22 mm. long (mean = 10 mm.) and 10-31 mm. wide (mean = 15 mm.), distally *obtuse-pointed*, proximally cordate, petioles with a few hairs; cauline leaves alternate, sessile, divided into 5 linear segments; plants 1-3 flowered, pedicels red-brown hirsute, flowers borne singly from the axils of the cauline leaves; sepals 5, green - purple with *paler margins*, densely brown-hirsute, 6-8 mm. long and 4-5 mm. wide; petals 5, yellow, obovate, nectary scale forming a shallow pocket, 5-12 mm. long (mean = 9 mm.) and 3.5-9 mm. wide (mean = 7 mm.); stamens 20-60, anthers 1-1.2 mm. long (mean = 1 mm.); achenes 30-60 *in an ovoid or* cylindrical head, achene 1.5-2 mm. long (mean = 2 mm.), and 1-1.2 mm. wide (mean = 1.2 mm.), laterally flattened, obovate, beak 0.5-2 mm. long (mean = 1 mm.) and straight, surface smooth and glabrous (achenes of specimens from Kong Oscars Fjord, Green-

land are brown-hirsute); receptacle glabrous except for a tuft of brown hairs on the apex, 8-15 mm. long at maturity, usually cylindroid but many misshapen specimens observed - varying from ovoid to a double receptacle connate basally; 2n = 40, 48, and 56.

This species is found in moist, mossy areas. It is circumpolar in distribution. In North America it is found from Alaska, through the Arctic Archipelago to Greenland; south through the Rocky Mountains to Alberta; Yukon; Churchill, Manitoba; Ungava area. R. nivalis blooms from June to August.

Taxonomic considerations:

This species is quite often confused with R. sulphureus but it is distinct once the differences are realized. The presence or absence of pubescence on the receptacle and the shape of the basal leaves are the distinctive characteristics. The two species appear to remain distinct and Benson reports that there appears to be little if any intergradation between the species, however, he has found some indication of hybridization in some Alaska specimens (Benson, 1955.p.247).

A discussion of the similarities of this species to R. eschscholtzii is included in the discussion of the latter species.

Some specimens from Greenland were examined which have brown-hirsute achenes. These have been noted in the description. The shape of the receptacle is very variable.

Polunin (1940.p.215) described a forma subglobosus which differs from

the typical by having a short receptacle. Benson (1948) reduced this to synonymy and the present author would agree with this.

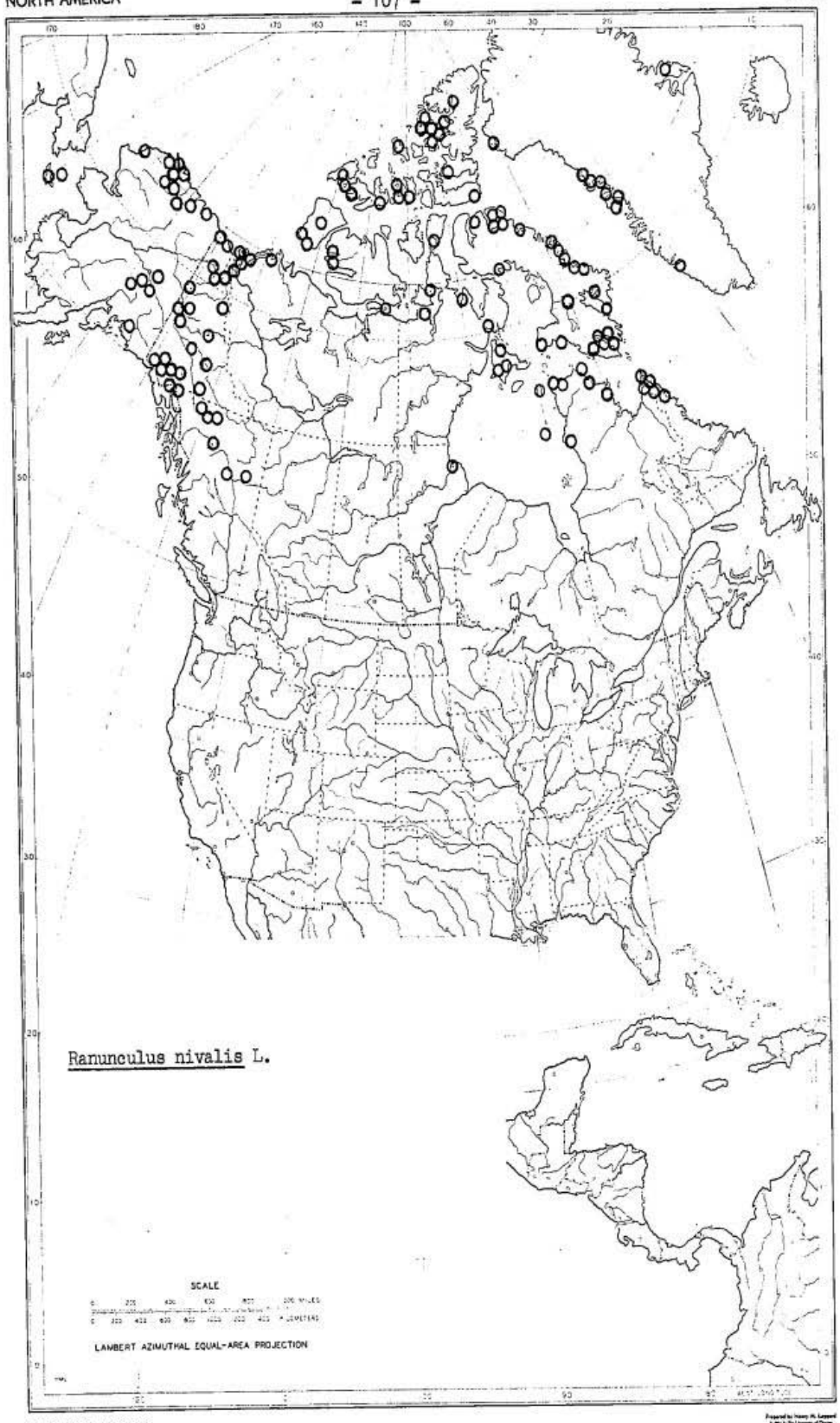
Figure 13. Distribution of *R. nivalis* L. *in North America.*

Legend:

O - locality from which one or more herbarium specimens have been examined.

Chromosome number determined from following (Appendix VI)

Φ - 2n = 48



GOODE BASE MAP SERIES
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Specimens examined:

Ranunculus nivalis L.

ALASKA: Anderson Point, Spetzman 3588 (CAN). Barrow, Holmen 61 - 1822 (DAO), Wiggins 12643 (DAO). Cantwell, Porsild & Porsild 38 (CAN). Cape Beauford, Argus & Chunys 5674 (CAN). Collinson Pt., Johansen 97912, 97916 (CAN). Denali Hwy., mi.30, Spetzman 4075 (CAN). Eagle Summit, Cody & Webster 5303 (DAO). Little Diomede Is., Porsild & Porsild 1694, 1695 (CAN). Maybe Creek, Spetzman 2572 (CAN). Meade R., Argus & Chunys 5338 (CAN). Ogotoruk Creek, Packer, 2093, 1911, 2673 (ALTA). Paxon, Porsild & Porsild 540 (CAN). Point Barrow, Argus & Chunys 5148 (CAN), Suda 230 - 66 (CAN), Holmen 61 - 1822 (CAN), Wood & Wood 362 (CAN), Shetler & Stone 3133 (CAN), Ward & Wiggins 1092, 1098 (CAN), Wiggins 12466 (CAN), Benson 14933 (CAN), Spetzman 2390 (CAN), McIlhenny 42, 44 (CAN). Sadlerochit R., Spetzman 1289 (CAN). St. Lawrence Is.: Boxer Bay, Fay in July 1953 (CAN); Gambell, Young 2 (DAO). Tuliguk Springs, Spetzman 1824 (CAN). Upper Kurupa R. Valley, Hodgdon, Piedman, et al 8100 (DAO). White Mts., Gjaerevoll 375 (CAN). Wrangell Mts., Murray & Murray 1033 (CAN).

YUKON: Big Swede Dome, Calder & Billard 4450 (DAO). Bridge Creek, Raup & Drury 13416 (CAN). Cassiar Mts., Poole on July 21, 1952 (DAO). Champagne, Spetzman 159 (CAN). Chapman L., Youngman & Tessier 487 (CAN). Dawson, Eastwood 393 (CAN). Dempster Hwy., mi.51.5, Packer 1969-88 (ALTA). Haines Jct., Pearson 257A, 179 (CAN). Herschel Is., Wood 156 (CAN). Keno Hill, Gillett, Calder, et al 4334, 4311 (DAO). Kluane L., Raup &

Raup 12530 (CAN), Schofield & Crum 8239 (CAN). Komakuk Beach, Parmelee 2897, 2858, 2861 (DAO). Lower Lapie R., Porsild & Breitung 9610 (CAN). Mackintosh, Schofield & Crum 7842 (CAN). McQuestern, Campbell 200 (CAN). Quill Creek, Freedman on June 4, 1953 (DAO). Runt and Teecat Creek, Cairns 81177 (CAN). St. Elias Mts., Murray & Murray 1380 (CAN). Shingle Point, Parmelee 2770 (DAO), Porsild 7101 (CAN). Teslin and Nisutlin R., Porsild & Breitung 10993 (CAN). Trout L., Calder 34276, 34497 (DAO).

NORTHWEST TERRITORIES: Axel Heiberg Is.: Parmelee 1110, 1091, 1126, 1137, 1103, 2025, 2211 (DAO); Black Crown R., Kuc on June 28, 1967 (CAN); Buchanan L., Beschel 11018 (CAN); Middle Fjord, Beschel 13161 (CAN).
Baffin Is.: Admiralty Inlet, Malte 118868, 118867, 118871, 118869 (CAN); Albert Harbour, Malte 118872 (CAN); Blacklead Is., Soper 125585 (CAN); Botany Bay, Webber 1179 (CAN); Bylot Is., Eclipse Sound, Coombs 131 (DAO); Bylot Is., Button Point, Wilcox 125630 (CAN); Cape Dorset, Soper 125949, 125952 (CAN); Cape Hewett, Hainault 3796 (CAN); Cape Hooper, Parmelee & Seaborn 3815, 3811 (DAO); Clyde, Martin 1 (DAO); Clyde Inlet, Wynne-Edwards 9024, 8830, 8811, 9096,8932 (CAN); Eclipse Sound, Teucher 864 (CAN); Erik Harbour, Coombs 106 (DAO); Fox Is., Soper 125946 (CAN); Foxetrot L., Webber 225 (CAN); Frobisher Bay, Senn & Calder 3895, 3940, 3670, 3909, 3982, 3667 (DAO), Senn 3530, 3595 (DAO), Wynne-Edwards 7279, 7312 (CAN), Hainault & Norman 5453 (CAN), Porsild 21550 (CAN); Gilmore Is., Manning on August 31, 1971 (DAO); Home Bay, Smith VP-22-61 (CAN); Inugsuin Fjord, Parmelee & Seaborn 3832, 3938 (DAO); Lake Harbour, Soper 125783 (CAN); Nettelling L., Soper 125819 (CAN); Pangnirtung, Hockin on June 3, 1960 (DAO), Polunin 545 (CAN); Ponds Inlet, Soper 111508, 111509 (CAN), MacGregor 111526

(CAN); West Foxe Is., Cooch 8 (DAO). Banks Is.: Stretton 125 (DAO); Bernard R., Maher & Maclean 31 (CAN); Cape Lambton, Porsild 17562 (CAN). Devon Is.: Dundas Harbour, Malte 118870, 118874 (CAN). Ellef Ringes Is.: Isachsen, Savile 4130, 4220, 4367 (DAO). Ellesmere Is.: Eureka, Bruggemann 803, 815 (DAO); Fosheim Pen., Bruggemann 561A, 648 (DAO); Goose Fjord, Simmons 3180 (CAN); Tanquary Fjord, Brassard 3322 (CAN). Massey Is.: Blake 14a (DAO). Melville Is.: Bridport Inlet, Tener & Harington 175 (CAN), Tener & Harington 174 (CAN). Prince Patrick Is.: Mould Bay, Bruggemann 301, 312, 326, 452, 328 (DAO), MacDonald 105 (CAN). Queen Elizabeth Is.: Eglinton Is., Kuc on July 8, 1968 (CAN).. Somerset Is.: Four Rivers Bay, Savile 3657 (DAO). Southampton Is.: Duke of York Bay, Parker on August 24 and 30, 1971 (DAO), Brown 1750 (CAN); Kirchoffer R., Brown 591, 597 (DAO). Victoria Is.: Holman Is., Porsild 17289 (CAN); Minto Inlet, Porsild 17391 (CAN). Adelaide Pen., Macpherson 12, 69 (CAN). Anderson R. Delta, Barry 393 (CAN). Bolstead Creek, Wynne-Edwards 8299 (CAN). Canol Rd., mi.290, Porsild & Breitung 11233 (CAN). Dartmouth Bight, Blake 9h (DAO). Finlaysons Is., Stevens 1223 (CAN). Lady Melville L., Chillcott 22 (DAO). Mackenzie R. Delta: Porsild 6543, 6809, 6808, 6668, 7271 (CAN). Richards Is., Porsild & Porsild 2223 (CAN). Pelly Bay, Campbell in August, 1964 (CAN). Reindeer Station, Porsild 16754 (CAN). Repulse Bay, Bruggemann 5 (DAO). Richardson Mts., Summit L., Packer 1534 (ALTA). Tuktuayaktok, Robertson 84 (CAN).

BRITISH COLUMBIA: Cassier, Taylor et al 358, 552 (CAN), Szczawinski on July 27, 1961 (CAN). Mt. Selwyn, Raup & Abbe 3785 (CAN). Tagish L., Christie on July 5 - 10, 1949 (CAN). 59° 51'N. and 136° 58'W., Porsild

& Porsild 184 (CAN).

ALBERTA: Jasper National Park: Signal Mt., Hrapko 67 - 45 (ALTA). Persimmon Range, Packer 3304 (ALTA).

MANITOBA: Churchill, Dutilly 116 (DAO).

QUEBEC: Cape Wolstenholme, Malte 120997 (CAN), Low 22867 (CAN). Deception Bay, Bartley 75A (CAN). Fjord Adloylik, Rousseau 88, 100 (DAO). King George Sound, Bell 18712 (CAN). Mansfield Is., Bell 1117 (CAN). Port Burwell, Malte 120018, 126801, 126829, 126832 (CAN), Macoun 79054 (CAN), Porsild 5964 (CAN). Port Harrison, Polunin 1686 (CAN). Rivières Kogaluk et Payne, Rousseau 361, 363 (DAO).

LABRADOR: Crater L., Gillett 8627A (DAO). Ikordlearsuk, Abbe & Odell 328 (CAN). Kingurutik L., Jackson on July 14, 1970 (DAO). Komaktorvik Fjord, Wynne-Edwards 7129 (CAN). Nachvak Fjord, Wynne-Edwards 7110 (CAN).

GREENLAND: Artisk Station, Porsild 131158 (CAN), Jensen on July 16, 1956 (CAN). Disko Is., Godhavn, Erlanson 2896 (DAO). Gamble Qutdligasat, Beschel 12045 (CAN). Godhavn, Erlanson 3110 (CAN), Wood 257 (CAN). Hoffman Cove, Bartlett 224 (CAN). Kekertarsuak, Ryder 1118 (CAN). Kong Oscars Fjord, Raup, Raup, & Washburn 647 (CAN). Kuanit, Porsild on July 7, 1929 (CAN). Northumberland Is., Bartlett 82 (CAN). Nugruak Pen., Alanikerdluk, Erlanson 3243 (DAO). Nugssuag Halvö, Holmen & Jakobsen on July 9, 1956 (DAO), Holmen & Jakobsen 4 (CAN). Svartenhuk Halvö, Porsild on July 22, 1935 (CAN). Traill Is., Sörensen 3449 (CAN).

Umiarfik Fjord, Porsild 131160 (CAN). Upernaviks Langö, Porsild on August 24, 1943 (CAN).

NORWAY: Knudshe, Warming on July 15, 1887 (DAO). Sör-Tröndelag, Gjaerevoll on July 13, 1951 (DAO). Troms Fylke, Alava, Alho, & Kause 4384 (DAO).

SWEDEN: Abisko, Erdmann on July 10 - 11, 1907 (DAO). Torne Lappmark, Alm 1351, 1544 (DAO), Smith 826 (DAO).

SPITZBERGEN: Advent Harbour, Lacaita 33197 (DAO). Cape Boheman, Lid on August 29, 1920 (DAO).

Type Collections:

(1) R. nivalis. "Found by Linnaeus in Lapland, by the alpine rivulets on the snowy mountains of that country. Martens had previously gathered it in Spitzbergen (Ree's Cyclopedia, volume 29, under "R"). Lectotype, sheet number 38, Linnaean Herbarium, Linnaean Society of London. (2) var. Freilgrathii, Hall Land, 81° 15', Bessels. "The name Freilgrathii, as far as I know, has never been validly published." Simmons, Rept. 2nd. Norweg. Arct. Exped. in "Fram" (16):75.1909. (3) f. subglobosus Wolstenholme, Hudson Strait, Polunin 233, August 27, 1934. Type, British Museum.

Figure 14. Ranunculus sulphureus Sol.

A. General habit of the species. Drawn from DA091849. (X 1)

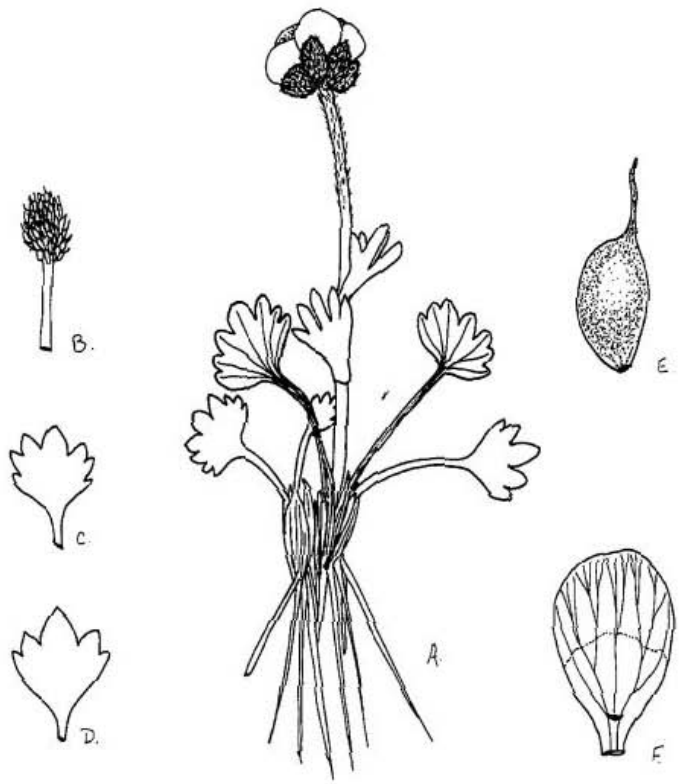
B. Head of achenes. (X 1)

C,B. Basal leaves. (X 1)

E. Achene, showing beak shape. (X 10)

F. Petal, showing nectary scale and boundary between glossy upper portion and matte lower portion of petal. (X 2)

B-F. Drawn from DA091858.


B.
C.
D.
A.
E
F

Ranunculus sulphureus Solander in Phipps., Voy. N. Pole 202. 1774.

Synonyms:

R. sulphureus Soland. in Phipps., Voy. N. Pole 202.1774. R. nivalis L. var. sulphureus Wahl. Fl. Lapp. 157.1812. R. nivalis L. var. sulphureus DC. Syst. 1:273.1818. R. sulphureus Soland. var. *intercedens* Hult. Fl. Kamtch. 2,1928, p.130 fig.11.

Description of the species:

Terrestrial perennials; flowering stems upright, 6-12 cm. tall, sparsely red-brown hirsute; basal leaves glabrous above and red-brown hirsute on the margins and the veins *below*, 3-lobed, lateral lobes again lobed in a digitate manner forming shallow lobes or merely a crenate margin, mid-veins of lobes forming an angle of 45° or less with the mid-vein of the central lobe, proximally truncate and distally obtuse to rounded, 8-23 mm. long (mean = 11 mm.) and 10-32 mm. wide (mean = 14 mm.); petioles red-brown hirsute; cauline leaves sessile, alternate, 3-divided; flowers borne singly in the axils of the leaves; sepals 5, purple - green with *yellowish margins*, *densely* red-brown hirsute dorsally, ovate, 6-8 mm. long (mean = 7 mm.) and 3-4 mm. broad (mean = 4 mm.); petals 5, yellow, obovate, 6-10 mm. long (mean = 9 mm.) and 5-9 mm. wide (mean = 7 mm.); nectary scale forming a shallow pocket; *stamens* 20-50, *anthers* 0.8-1.3 mm. long; achenes 50-90 in an ovoid head, receptacle red-brown hirsute with a tuft of red-brown hairs on the tip; achenes obovoid, laterally flattened,

2-2.5 mm. long and approximately 1.8 mm. wide, beak straight, 1 mm. long, usually glabrous (specimens from Amchitka Is. and St. Paul Is. examined which are brown hirsute). 2n = 42, 80, c.80, 96, and c.98.

This species grows in moist mossy areas. Circumpolar; in North America it occurs from the Aleutians, through Alaska, the Arctic Archipelago, to Greenland. As Benson (1955.p.246) notes, this species occurs farther north than R. nivalis. Flowering occurs from late June to August. This species flowers later than R. nivalis (Benson, 1954.p.350).

Taxonomic considerations:

Ranunculus sulphureus has been described as a variety of R. nivalis on two previous occasions but observations made during the present study show that this species can be readily distinguished from R. nivalis by the pubescence of the receptacle and the lobing of the basal leaves (digitate in R. sulphureus and 3-lobed in R. nivalis).

There is some variation in the degree of lobing in the basal leaves. At one extreme the central lobe is barely distinct and the lateral lobes form a crenate margin. Plants with the other extreme of variation have a distinct central lobe and a relatively deeply-lobed lateral lobe. Hultén has described a variety intercedens Hult. (Fl. Kamtch. 2,1928,p.130 fig.11) which he says is "characterized by deeply three-lobed basal leaves" and occurs in the Aleutian Islands and part of Pribilof Is. (Hultén, 1928. p.130). Benson (1954.p.350) suggests that although this taxon is real, it is only based on one character and should be described but not named. The illustration of var. intercedens which Hultén (1968.p.477) uses in his 'Flora of Alaska' reminds one of R. nivalis. The specimens of R. nivalis from the Aleutians tended to be robust with leaves that were lobed but not as deeply as suggested by Hultén. Variety intercedens Hult. has been placed in synonymy.

Some of the specimens collected on the Aleutian and Pribilof Islands differ from the typical in having achenes that are brown-hirsute. Benson (1948.p.122.) notes this variation and suggests that it is "possibly an undescribed variety." These plants are certainly striking but since they occur with the typical variety and differ only in this one character

they are not worthy of varietal designation. All of the specimens examined from Amchitka Island had hirsute achenes but both glabrous and hirsute achenes were observed on specimens from St. Paul Is.

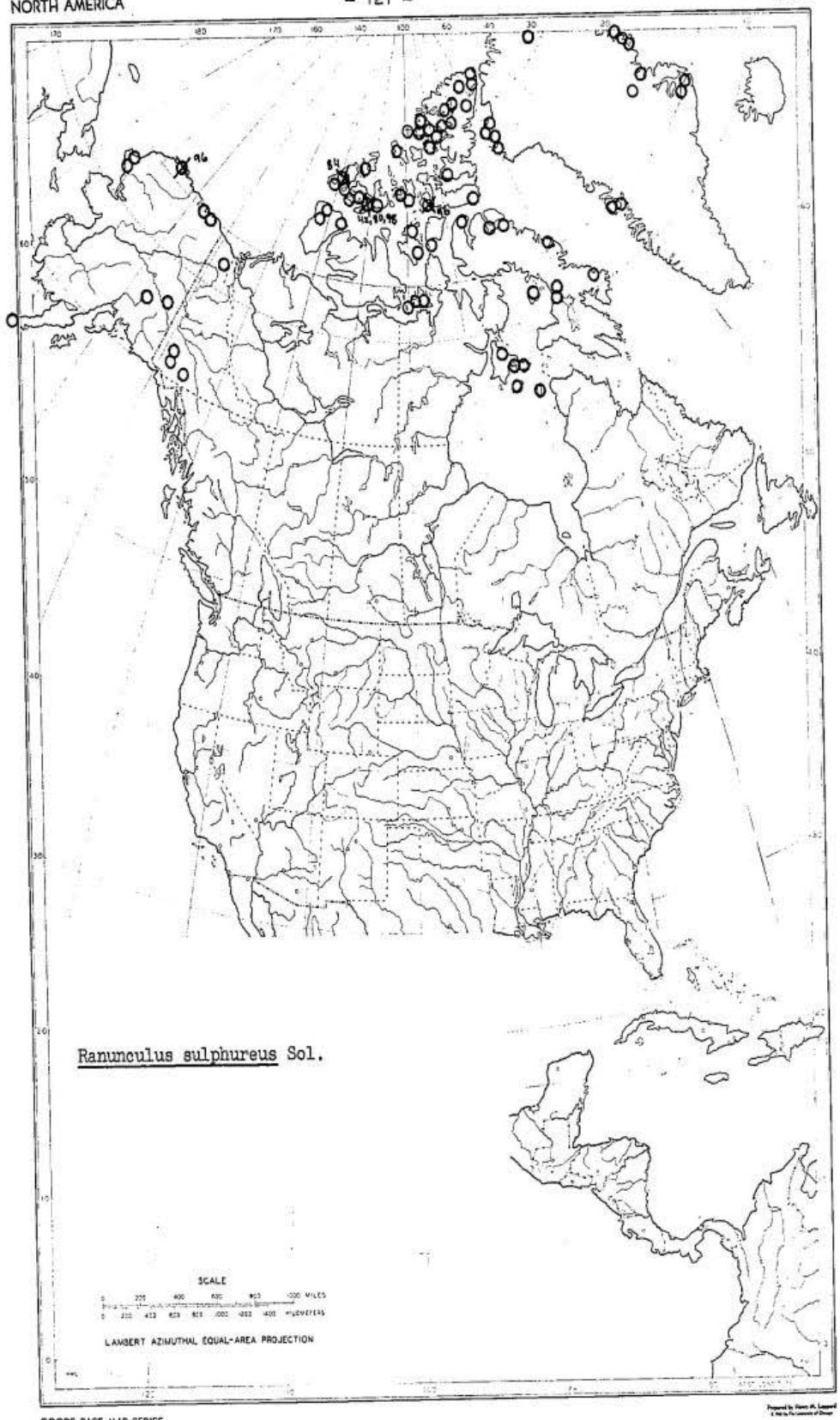
Specimens with this variation examined: Aleutian Islands: Amchitka Island, Reich & McCann 146 and 268 in 1962, CAN. Pribilof Islands: St. Paul Island, Macoun 18921 in 1896 and 89580 in 1914; and Coville & Kearney 1811 in 1899. CAN. (note: Numbers given for Macoun are those of the Herbarium of Geological Survey Department, not collection numbers.)

Figure 15. Distribution of R. sulphureus Sol. in North America.

Legend:

O - locality from which one or more herbarium specimens have been examined.
Chromosome number determined from following (Appendix VII)

$\underset{x}{O}$ - Diploid number noted by locality.



GOODE BASE MAP SERIES
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THE UNIVERSITY OF CHICAGO
HENRY M. LEFFARD, EDITOR

Specimens examined:

Ranunculus sulphureus Sol.

ALASKA: Amchitka Is., Reich & McCann 146, 268 (CAN). Camden Bay, Johansen 97915 (DAO), Johansen 97915 (CAN). Cape Thompson, Wood & Wood 520 (CAN). Chicken, Spetzman 4996 (CAN). Denali Hwy., mi. 14, Spetzman 4034 (CAN). Hall Is., Macoun 18947 (CAN). Lake Schrader, Spetzman 545 (CAN). Ogotoruk Creek, Johnson, Viereck, & Melchior 48 (DAO), Packer 1842 (ALTA). Point Barrow, Argus & Chunys 5990 (CAN), Wiggins 12649 (CAN). Sadlerochit R., Spetzman 1051 (CAN). St. Paul Is., Macoun 89580,18921, 18922 (CAN), Coville & Kearney 1811 (CAN). Tangle L., Gjaerevoll 1346 (CAN).

YUKON: Kluane L., Raup & Raup 12556 (CAN). Mackintosh, Schofield & Crum 8075 (CAN). Mt. Sedgwick, Calder 34427 (DAO). Red Tail L., Raup, Raup, & Drury 13443 (CAN).

NORTHWEST TERRITORIES: Axel Heiberg Is.: Parmelee 1126, 1137, 2154, 2119 (DAO); Crusoe R. Kuc on July 25, 1967, 180 (CAN); Expedition Fjord, Kuc on Aug. 8, 1967 (CAN); Middle Fjord, Beschel 13145 (CAN); Mokka Fjord, Porsild 18731 (CAN); Upper House, Kuc 290 (CAN), Kuc on Aug. 8, 1967 (CAN). Baffin Is.: Cape Searle, Wynne-Edwards 9132 (CAN); Clyde, Martin 2 (DAO); Eclipse Sound, Teucher 864 (CAN); Hantzsch R., Manning 176 (CAN); Lancaster Sound, Borden 62906 (CAN); Pond Inlet, Joy in 1924 (CAN); Pond Inlet, Cockburn Is., Borden 62905 (CAN); Taverner Bay, Manning 60 (CAN). Banks Is.: Cape Crozier, Manning & MacPherson 156 (CAN); Castel Bay,

Jenness 63 (CAN); Mercy Bay, Manning & Sparrow 202 (CAN), Porsild 17739 (CAN). Bathurst Is.: Blake 33c, 44e (DAO), Jenness 5 (CAN); Bracebridge Inlet, Tener & Harington 70 (CAN), Tener & Harington 71 (CAN); Cape Cockburn, Blake 8b (DAO); Goodsir Inlet, Gill 4 (CAN), Lamothe & Gray 9 (ALTA); May Inlet, Blake 20f (DAO). Cornwallis Is.: Mackay 14 (CAN); Allen Bay, Schofield 201 (DAO); Resolute Bay, Schofield 85, 86, 215 (DAO), MacClement C1883 (CAN), Aime 3 (CAN), Collins 186, 145, 159 (CAN), Porsild 21676 (CAN), Wheeler in July, 1920 (CAN), Beschel 10653, 10698 (CAN), Harington 255 (ALTA); Resolute L., Edwards on July 16, 1955 (DAO). Devon Is.: Svoboda 120 (ALTA); Dundas Harbour, Malte 118873, 118874 (CAN). Ellef Ringes Is.: Isachsen, Savile 4366, 4221, 4228 (DAO), MacDonald 219 (CAN), Harington 422 (CAN). Ellesmere Is.: Alert, Harington in 1959 (ALTA); Cape Sheridan, Harington 96 (CAN), MacDonald 28 (CAN), Bruggemann 204, 228 (DAO); Eureka, Bruggemann 816 (DAO); *Fosheim Pen.*, Bruggemann 649, 561B, 572 (DAO); Gåse Fjord, Fosheim in 1901 (CAN); Goose Fjord, Simmons 3180, 3265 (CAN); Hazen Camp, Savile 4593, 4556, 4467 (DAO), Maher 84 (DAO); Hilgard Bay, Bruggemann 210, 191, 214 (DAO); Lake Hazen, Harington on July 1, 1958 (ALTA), Kevan on July 21, 1966 (ALTA); Mount Pullen, MacDonald 30 (CAN); Slidre Fjord, Tener 67, 68 (CAN); Tanquary Fjord, Brassard 1521, 3322 (CAN), 1898, 3063, 3325a (CAN), Hattersley-Smith on Aug. 15, 1964 (CAN); Van Hauen Pass, Longton 1744 (CAN), Brassard 3013 (CAN). Jenny Lind Is., Stephen 893 (CAN). King Williams Is., Cooper 65, 114 (CAN). Melville Is.: Bailey Point, Mosquin & Martin 6424, 6438 (DAO); Bridport Inlet, Tener & Harington 174 (CAN); Ibbett Bay, Tener & Harington 314 (CAN), 299 (CAN); Liddon Gulf, Jenness 25 (CAN); Winter Harbour, McMillan 77295 (CAN), Tener & Harington 136 (CAN). Prince Charles Is.:

Foxe Basin, Baldwin 1958 (CAN). Prince of Wales Is.: Browne Bay, MacPherson 187, 188 (CAN); MacPherson 191 (CAN). Prince Patrick Is.: Mould Bay, Mosquin & Martin 6397 (DAO), Handley on Aug. 23, 1949 (DAO), Bruggemann 440, 327 (DAO), Harington 229 (CAN), MacPherson 28,29 (CAN), MacDonald 15, 109 (CAN); Wilkie Point, MacPherson 27 (CAN). Queen Elizabeth Is.: Eglinton Is., Kuc on July 6 - 10, 1968 (CAN); Fitzwilliam Owen Is., Kuc on July 10 - 17, 1968 (CAN); Meighen Is., Kuc on Aug. 25, 1968 (CAN). Somerset Is., Savile 3562, 3634, 3771 (DAO), Schroeder & Burlock 20 (DAO). Southampton Is.: Bear's Cove Point, Brown 973 CAN); Native Point, Collins 233 (CAN). Coats Is., Collins on July 19 - 20 in 1954 (CAN). Mansel Is., Leechman 2255 (CAN).

GREENLAND: Arktisk Station, Porsild on July 27, 1929 (CAN). Brönlund Fjord, Holmen 6559 (DAO), Holmen 6593(CAN). Cape Hatherton, Haig-Thomas 3019 (DAO). Etah, Humphreys 4, 5, 6, 7 (DAO), Nutt 57 (CAN). Hurry Fjord, Taggart 31 (CAN). Kapp. Herschel, Vaage on July 19, 1930 (CAN). Kedelkrogelv, Fredskild 284 (DAO). Koldeway Is., Sörensen 2654 (CAN). Kuanit, Porsild on July 16, 1927 (CAN). Northumberland Is., Bartlett 202 (CAN). Qasigigssat, Porsild 116682 (CAN). Rinssilair Bay, Nygaard on July 9, 1921 (CAN). Robertson Bay, Nutt 55 (CAN). Scoresby Sound, Pedersiv on July 30, 1925 (CAN). Skaerfjord, Sörensen 2643 (CAN). Stormkap, Lundager 80850 (CAN). Thule, Rosing on Aug. 4, 1946 (CAN).

NORWAY: Finnmark, Nannfeldt on Aug. 6, 1935 (DAO). Fium, Kemps in July 1901 (DAO). Nordreisa, Hedberg on Aug. 4, 1946 (DAO), Ehm, Peters, & Selander on July 25, 1905 (DAO). Troms Fylke, Alava, Alho, & Kause

4390 (DAO).

SWEDEN: Lake Torneträsk, Samuelsson 827 (DAO).

SPITZBERGEN: Bell Sund, Lynge on July 22, 1926 (DAO). Murchison Bay, Keith on July 29 and Aug. 4, 1936 (DAO). Treurenberg Bay, McCormick on July 22, 1827 (DAO).

UNION of SOVIET SOCIALIST REPUBLICS: Bear Is., Bertram & Lack on July 20, 1932 (DAO). Chukotskiy Region: Chaunskaia Inlet, Shamurin & Yurciev in June, 1964 (DAO); Severoaniviiskii Mts., Yurciev on June 16, 1965 (DAO); Chukotskiy Sound, Chaplinskie Mt., Gavrilyuk on June 23, 1957 (DAO). Severnaya Zemlya Archipelago, Is. of the October Revolution, Ssei on July 10-18, 1958 (DAO). Yakutia: Bulun district, Chekanovskyi Ridge, Yurciev on Aug. 6, 1960 (DAO); Lena River near Tiksi, Tolmachev, Polozova, & Yurchiev on July 8, 1956 (DAO).

Type collection:

(1) R. sulphureus, Spitzbergen, Low Island, Solander, July 29, 1774.

(see Benson, 1948.p.123)

Cytological Results

Chromosome counts were made on as many native species as possible. The list that follows includes all of the counts that were made of the species included in this study and of several others. Voucher specimens have been deposited in the herbarium of the Department of Botany, University of Alberta (ALTA). 'P.J. Scott Collection Number' represents a number assigned to a plant in the greenhouse which did not have a field collection number.

Taxon	Chromosome Count	Collection Data
R. gmelinii DC	2n = 16	Alberta: Touchwood Lake, at South Gull Creek. June 5, 1971. M.G. Dumais et al 5420.
	2n = 16, 32.	Alberta: Lac la Biche, Big Island, June 5, 1971. M.G. Dumais et al 5353.
	2n = 32	Alberta: Pinehurst Lake, June 5, 1971. P.J. Scott collection 46b.
	2n = 32	Alberta: Marie Lake, by turnoff to cottages. June 6, 1971. M.G. Dumais et al 5469.

Taxon	Chromosome Count	Collection Data
R. gmelinii DC	2n = 32	Alberta: Owl River roadside ditch. June 4, 1971. M.G. Dumais et al 5366.
	2n = 32	Alberta: Swan Hills, 2 mi. south of Sarah Creek, August 10, 1971. J. Traquair (P.J. Scott collection 84).
	2n = 32	Alberta: Valhalla Centre. August 4, 1971. P.J. Scott 1692.
	2n = 32	Alberta: Wabasca area, Nipisi Lake, August 6, 1971. P.J. Scott 1698.
	2n = 32	Alberta: Wabasca, Recreation Area, August 6, 1971. P.J. Scott 1702.
	2n = 16	Alberta: mi. 44 on road from Slave Lake to Wabasca. August 6, 1971. P.J. Scott 1705.
	2n = 32	Alberta: mi. 34.5 on road from Slave Lake to Wabasca. August 6, 1971. P.J. Scott 1706.

Taxon	Chromosome Count	Collection Data
R. gmelinii DC	2n = 16	Alberta: mi. 27.6 on road from Slave Lake to Wabasca. August 6, 1971. P.J. Scott 1708.
	2n = 32	Alberta: Lawrence Lake Provincial Park, Near Athabasca. August 6, 1971. P.J. Scott 1710.
	2n = 32	Alberta: Twin Butte, marsh north of town. June 17, 1971. P.J. Scott 1416.
	2n = 32	Alberta: Nordegg, in Shunda Creek by Recreation Area. July 9, 1971. P.J. Scott 1477.
	2n = 32	Saskatchewan: Ft. St. John, 5 mi. east of Alberta - Saskatchewan border. August 30, 1971. G. McPherson 557.
	2n = 32	Newfoundland, pool by mouth of Robinson's River. August 24, 1971. P.J. Scott 1799.

Taxon	Chromosome Count	Collection Data
R. gmelinii DC	2n = 16	Northwest Territories: Inuvik. July 27, 1970. From W. Yonkin seed collection. (P.J. Scott collection 93).
R. hyperboreus Rottb.	2n = 32	Alberta: Forestry Trunk Road from Cochrane to Nordegg, 1.5 mi. north of Burnt Timber Creek. July 24, 1971. P.J. Scott 1613.
R. pedatifidus J.E. Smith var. leiocarpus Fern.	2n = 32	Alberta: Cadomin Area, Mountain Park. July 6, 1971. P.J. Scott 1429.
R. eschscholtzii Schlecht. var. eschscholtzii	2n = 32	Alberta: Cadomin Area, Cheviot Mountain. July 7, 1971. P.J. Scott 1433. July 8, 1971. P.J. Scott 1434 and 1436.
R. eschscholtzii Schlecht. var. eschscholtzii	2n = 32	Alberta: Jasper National Park, Maligne Lake, Bald Mountain. July 19, 1971. P.J. Scott 1512 and 1513.
	2n = 32	Alberta: Jasper National Park, Columbia Icefields, across highway from Chalet, July 21, 1971. P.J. Scott 1532.

Taxon	Chromosome Count	Collection Data
R. eschscholtzii Schlecht. var. *eschscholtzii*	2n = 32	Alberta: Banff National Park, Bow Pass Lookout Station, July 21, 1971. P.J. Scott 1541.
	2n = 32	Alberta: 91.5 mi. north of Coleman on Coleman-Kananaskis Forestry Road, July 22, 1971. P.J. Scott 1542 and 1546.
	2n = 32	Alberta: Cadomin Area, Cardinal Divide, July 25, 1971. P.J. Scott 1639.
	2n = 32	Alberta: Jasper National Park, Mt. Edith Cavell, June 19, 1971. J.G. Packer.
	2n = 40	Alberta: Waterton Lakes National Park, Goat Lake, June 27, 1971. K.E. Denford. (P.J. Scott collection 80).
R. sulphureus Sol.	2n = 42	Northwest Territories: Devon Island. August, 1971. J. Svoboda.
R. abortivus L.	2n = 16	Alberta: Touchwood Lake, June 5, 1972. P.J. Scott collection 61.

Taxon	Chromosome Count	Collection Data
R. abortivus L.	2n = 16	Alberta: Rich Lake P.O., June 6, 1972. M.G. Dumais et al 5437.
	2n = 16	Alberta: Cypress Hills, Provincial Park, Reesor Lake, June 16, 1971. P.J. Scott 1285.
	2n = 16	Alberta: Iosegun River on Highway 43, June 29, 1971. P.J. Scott 1426.
	2n = 16	Labrador: Churchill Falls, spray zone, August 11, 1972. O.A. Olsen.
R. acris L.	2n = 14	Alberta: Cypress Hills Provincial Park, Battle Creek Campgrounds, June 15, 1971. P.J. Scott 1279.
	2n = 14	Alberta: Waterton Lakes National Park, Bosporus Strait, June 17, 1971. P.J. Scott 1349 and 1412. Waterton, June 16, 1971. P.J. Scott 1323.
	2n = 14	Alberta: Twin Butte, June 17, 1971. P.J. Scott 1413.

Taxon	Chromosome Count	Collection Data
R. acris L.	2n = 14	Alberta: Whitecourt, road to Whitecourt Mountain Fire Tower, June 29, 1971. P.J. Scott 1424.
	2n = 14	Alberta: Banff National Park, Weeping Wall, July 21, 1971. P.J. Scott 1537.
	2n = 14	Alberta: 42.5 miles north of Coleman on Coleman - Kananaskis Forestry Road, July 22, 1971. P.J. Scott 1559.
	2n = 14	Alberta: Lovett, south of Robb, July 25, 1971. P.J. Scott 1638.
	2n = 14	Newfoundland: Table Mountain, Port-au-Port Peninsula, August 24, 1971. P.J. Scott 1791.
	2n = 14	Newfoundland: Southeast of Red Indian Lake, June 29, 1972. O.A. Olsen.

Taxon	Chromosome Count	Collection Data
R. acris L.	2n = 14	Newfoundland: Bonavista Bay, Hare Bay, July 12, 1972. P.J. Scott.
R. aquatilis L.	2n = 16	British Columbia: 1.1 miles south of Wasa, July 11, 1971. G. McPherson.
R. cardiophyllus Hook.	2n = 32	Alberta: 5 miles north of junction of Forestry Trunk Road and road to Lundbreak, June 20, 1971. G. McPherson.
	2n = 32	Alberta: Ghost River on Forestry Trunk Road, June 20, 1971. G. McPherson.
	2n = 32	Alberta: Cypress Hills Provincial Park, Graburn Cairn, June 16, 1971. P.J. Scott 1277 and 1307.
R. cymbalaria Pursh	2n = 16	Alberta: Beaverhill Lake, mud, south shore, May 19, 1971. P.J. Scott collection 22.

Taxon	Chromosome Count	Collection Data
R. cymbalaria Pursh	2n = 16	Alberta: Miquelon Lake, recreation campsite, June 13, 1971. M.G. Dumais.
	2n = 16	Alberta: Cypress Hills, junction of *Highways 1 and 48, June 15, 1971.* P.J. Scott 1269.
	2n = 16	Alberta: Nordegg, Shunda Creek Recreation Area, July 9, 1971. P.J. Scott 1480.
	2n = 16	Saskatchewan: Frenchman Creek near Val Marie, July 29, 1971. G. McPherson.
	2n = 16	Saskatchewan: Ruddell, ditch near grain elevators, June 20, 1971. P.J. Scott 1418.
	2n = 16	Newfoundland: Northern Peninsula, Main Brook (Hare Bay), August 8, 1971. J. Maunder.
	2n = 16	Newfoundland: Stephenville Crossing, August 24, 1971. P.J. Scott 1796.

Taxon	Chromosome Count	Collection Data
R. flammula L. var. *ovalis* (Bigel.) L. Benson	2n = 24	Alberta: Jasper National Park, Maligne Lake, July 19, 1971. P.J. Scott 1523.
var. *filiformis* (Michx.) Hook. (=*R. reptans* L.)	2n = 32	Newfoundland: Indian River Provincial Park, August 26, 1971. P.J. Scott.
R. gelidus Kar. & Kir.	2n = 16	Alberta: Jasper National Park, Maligne Lake, Bald Mountain, July 19, 1971. P.J. Scott 1507.
R. inamoenus Greene	2n = 32	Alberta: Jasper National Park, Maligne Lake, near outlet, July 19, 1971. P.J. Scott 1522.
	2n = 32	Alberta: Forestry Trunk Road from Cochrane to Nordegg, Burnt Timber Creek, July 24, 1971. P.J. Scott 1614.

Taxon	Chromosome Count	Collection Data
R. lapponicus L.	2n = 16	Alberta: Long Lac Provincial Park, July 26, 1971.
R. macounii Britt.	2n = 34	Alberta: Touchwood Lake, June 5, 1971. P.J. Scott collection 65.
	2n = 48	Alberta: Touchwood Lake, June 5, 1971. P.J. Scott collection 66.
	2n = 48	Alberta: Gooseberry Lake Provincial Park, near Consort, June 15, 1971. P.J. Scott 1229.
	2n = 34	Alberta: Acadia Valley, June 15, 1971. P.J. Scott 1241.
	2n = 34	Alberta: Cypress Hills, Provincial Park, Battle Creek Campgrounds, June 15, 1971. P.J. Scott 1280.
	2n = 34	Alberta: Whitecourt, road to Whitecourt Mountain fire tower, June 29, 1971. P.J. Scott 1425.

Taxon	Chromosome Count	Collection Data
R. macounii Britt.	2n = 48	Alberta: Fairfax Lake on Forestry Trunk Road, July 9, 1971. P.J. Scott 1476.
	2n = 12	Newfoundland: Northern Peninsula, Eddies Cove, August 1971. J. Maunder.
R. occidentalis Nutt.	2n = 20	British Columbia: Queen Charlotte Islands, 8 miles north of Skidegate Mission, June 8, 1971. K.E. Denford.
R. repens L.	2n = 14	Newfoundland: Colinet area, junction of South Rocky River and Markland Road, July 13, 1972. O.A. Olsen.
R. sceleratus L.	2n = 56	Alberta: Lac la Biche, Big Island, June 3, 1971. M.G. Dumais et al 5354.
	2n = 56	Alberta: Cold Lake, Frenchman Bay, June 8, 1971. M.G. Dumais et al 5499.

Taxon	Chromosome Count	Collection Data
R. sceleratus L.	2n = 32	Alberta: Dillberry Lake, June 14, 1971. P.J. Scott 1206.
	2n = 32	Alberta: Lawrence Lake Provincial Park, near Athabasca, August 6, 1971. P.J. Scott 1709.
	2n = 32	Alberta: Elk Point, near Vermilion, August 6, 1971. P.J. Scott 1712.
	2n = 32	Saskatchewan: Ft. St. John, 5 miles east of Alberta - Saskatchewan border, August 30, 1971. G. McPherson 557.
	2n = 32	Northwest Territories: Enterprise, 1971. S. Talbot.
	2n = 32	Yukon: mile 942 Alaska Highway, 1969. J.G. Packer.

Chromatographic Studies:

Chromatographic studies were carried out using the leaves of field-collected and greenhouse-grown plants. Comparisons between the two sets of chromatograms should allow an assessment of the effect of the environment on the production of phenolics and flavonoids. The results, however, are negative as they show very low "S" values even within a specimen and since the synthetic pathways are not known for these compounds it is not possible to discuss the reasons for these results. The collections of R. gmelinii (P.J. Scott 1702 and 1706), which have the same chromosome number, were collected from localities thirty miles apart and grown under the same conditions. A comparison of the phenolics gave an "S" value of 0.36. This value indicates that there is virtually no relationship between the two specimens as a minimum "S" value of 0.80 is required before the results are considered significant (Denford, personal communication). These two collections should theoretically, have an "S" value of near 1.0 since they came from approximately the same locality and they were subsequently grown under identical conditions. One would assume that the chromatograms would reflect the genotype which would not, theoretically, vary enough to produce differences in the chromatogram pattern of these secondary metabolic products; but for some unknown reason, this was not the case. McPherson (personal communication) carried out a similar study on Viola adunca and he got near identical results for plants of each chromosome race regardless of whether they were field-collected or greenhouse-grown. This would indicate that there is some factor which causes the variability in Ranunculus that can only be termed, for want of knowledge, phenotypic

plasticity.

The initial results of this part of the study have been tabulated and included in the Appendix. Each spot observed has been denoted by its two R_f coordinates and the colour under UV light and after staining or exposing to ammonia vapour.

The R_f value is calculated using the following formula:

$$R_f = \frac{\text{Distance travelled by the compound}}{\text{Distance travelled by the solvent system}}$$

The first-mentioned R_f value in each case is the value for the first solvent system and the second for the second solvent system.

The "S" value is determined by the following formula:

$$S = \frac{\text{Similarities}}{\text{Similarities + Dissimilarities}}$$

The "S" values are given in figures 16-20.

Figure 16 : "S" values for phenolics of greenhouse-grown *R. gmelinii*

1706	.36				
1692	.4	.3			
1710	.4	.3	.5		
1799	.3	.7	.2	.38	
84	.4	.3	.5	1	.38
	1702	1706	1692	1710	1799

Figure 16.

Figure 17. : "S" values for phenolics of *greenhouse-grown* R. eschscholtzii, R. pedatifidus, and R. gelidus

1434	1			
80	.53	.53		
1429	.66	.66	.63	
1507	.26	.26	.21	.21

1433	1434	80	1429

Figure 17.

Figure 18.: "S" values for flavonoids of greenhouse-grown *R. eschscholtzii*, *R. pedatifidus*, and *R. gelidus*

1434	.63			
1433	.81	.5		
1429	.64	.5	.64	
1507	.66	.43	.66	.65
	80	1434	1433	1429

Figure 18.

Figure 19. : "S" values for flavonoids of field-collected specimens

JGP4199	0										
HH265	.28	.17									
1523	.06	.25	.24								
1413	.3	.1	.15	.14							
WY98	.05	.05	.16	.04	0						
1695	0	.15	.14	.11	.07	.33					
ER2760	.14	.17	.2	0	.08	0	.12				
GB2013	.12	.13	.33	.1	.2	.13	.29	.23			
331	.07	.08	.21	.19	.08	.48	.29	.06	.18		
337	.01	.01	.17	.15	.01	.19	.21	.01	.21	.17	
1205	.25	.12	.26	.09	.19	.17	.28	.29	.32	.16	.24
	1480	JGP 4199	HH265	1523	1413	WY98	1695	ER 2760	GB 2013	331	337

Figure 19.

Figure 20.: "S" values for phenolics of field-collected specimens.

1480	.33										
331	.27	.33									
1413	.25	.3	.25								
JGP4199	.14	.2	.14	.12							
1523	.1	.12	0	.2	0						
WY98	.4	.33	.27	.25	.14	.1					
HH265	.18	.1	.18	.07	0	.11	.3				
1205	0	0	0	.08	0	.12	.09	0			
GB2013	.15	.45	.15	.14	.12	.09	.15	.08	0		
ER2760	.18	.22	.18	.08	.17	0	.18	.09	0	.75	
337	.09	.11	.09	0	0	0	.19	.1	.11	.3	.37
	1695	1480	331	1413	JGP 4199	1523	WY 98	HH 265	1205	GB 2013	ER 2760

Figure 20.

Key to Specimens used in Chromatographic Study:

80 R. eschscholtzii Schlecht. Waterton Lakes Nat. Park, Goat L., Alberta. K.E. Denford, (P.J. Scott collection 80), June 27, 1971.

84 R. gmelinii DC. Swan Hills, Sarah Creek, Alberta. J. Traquair (P.J. Scott collection 84), August 10, 1971.

331 R. repens L. St. John's, Nfld. P.J. Scott 331. July 8, 1968.

337 R. hederaceus L. St. John's, Nfld. P.J. Scott 337. July 9, 1968.

1205 R. circinatus Sibth. var. subrigidus (Drew) Benson. Reflex L., Alberta. P.J. Scott 1205. June 14, 1971.

1413 R. acris L. Twin Butte, Alberta. P.J. Scott 1413. June 17, 1971.

1424 R. acris L. Whitecourt, Alberta. P.J. Scott 1424. June 29, 1971.

1429 R. pedatifidus J.E. Smith var. leiocarpus Fern. Mountain Park, Alberta. P.J. Scott 1429, July 6, 1971.

1433 R. eschscholtzii Schlecht. Cadomin, Cheviot Mt., Alberta. P.J. Scott 1433, July 7, 1971.

1434 R. eschscholtzii Schlecht. Cadomin, Cheviot Mt., Alberta. P.J. Scott 1434, July 8, 1971.

1480 R. cymbalaris Pursh. Nordegg, Alberta. P.J. Scott 1480. July 19, 1971.

1507 R. gelidus Kar. & Kir. Maligne L., Alberta. P.J. Scott 1507. July 19, 1971.

1523 R. flammula L. var. ovalis (Bigel) L. Benson. Maligne L., Alberta. P.J. Scott 1523. July 20, 1971.

1692 R. gmelinii DC. Valhalla Centre, Alberta. P.J. Scott 1692. August 5, 1971.

1695 R. sceleratus L. var. multifidus Nutt. Faust, Alberta. P.J. Scott 1695. August 5, 1971.

1702 R. gmelinii DC. Wabasca, Alberta. P.J. Scott 1702. August 6, 1971.

1706 R. gmelinii DC. 25 mi. South of Wabasca, Alberta. P.J. Scott 1706. August 6, 1971.

Key to Specimens used in Chromatographic Study - continued:

1709 R. gmelinii DC. Athabasca, Alberta. P.J. Scott 1709. August 6, 1971.

1799 R. gmelinii DC. Robinson's R., Nfld. P.J. Scott 1799. August 24, 1971.

JGP4199 R. flammula L. Waterton Lakes Nat. Park, Alberta. J.G. Packer 4199. July 30, 1967.

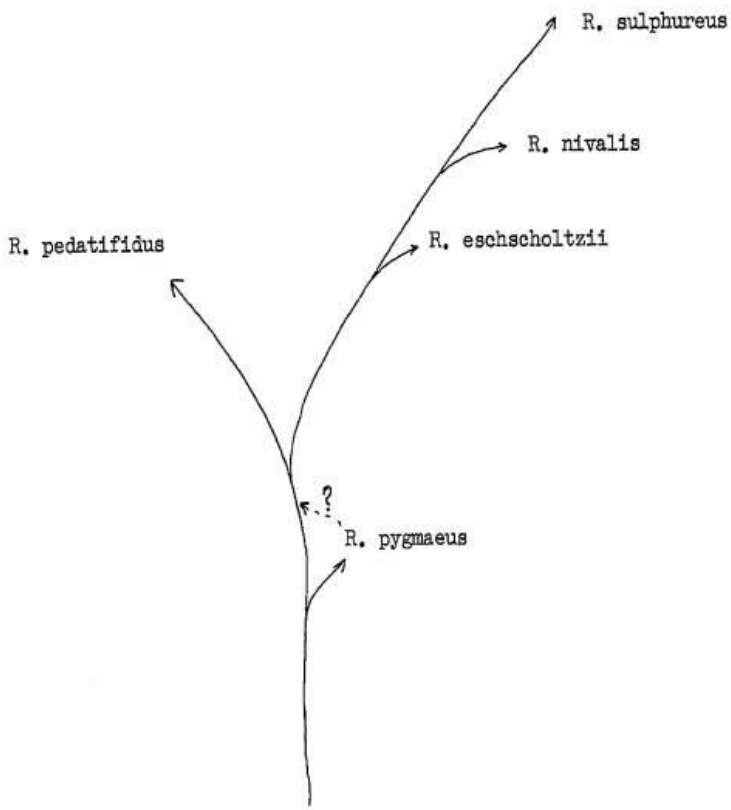
HH265 R. pallasii Schlecht. Tununuk Point, N.W.T. H. Hernandez 265. June 29, 1971.

WY98 R. lapponicus L. Tuktoyaktuk, N.W.T. W. Younkin 98, June 27, 1971.

ER2760 Anemone multifida Poiret, Corner Brook, Nfld. E. Rouleau 2760. June 3, 1952.

GB2013 Clematis virginiana L. Oswego Co., New York. G. Brassard 2013. October 11, 1964.

Figure 21. Suggested Phylogenetic Tree.


R. sulphureus
R. nivalis
R. eschscholtzii
R. pedatifidus
?
R. pygmaeus
Ancestral Form.

DISCUSSION

The five species, Ranunculus pygmaeus Wahl., R. pedatifidus J.E. Smith, R. eschscholtzii Schlect., R. nivalis L., and R. sulphureus Sol., form a complex which shows relationships among the members. There are many similarities, which will be mentioned below, that suggest the possibility of a common ancestry for these species and subsequent divergence.

R. pygmaeus, R. pedatifidus, R. nivalis, and R. sulphureus are circumpolar in distribution and this makes it difficult to suggest a centre of origin for this complex of species but their relationships can be discussed.

Ranunculus pygmaeus is a diploid species with 2n = 16 (base number = 8) and it may be similar to the ancestral type. Its distribution in North America is arctic and alpine with a station on Mt. Albert, Gaspé, which is possibly a refugial area, and the absence of the other species (except R. pedatifidus) may indicate that they are more recent or that they survived the Pleistocene glaciation in North America in a western refugium or even elsewhere. R. pygmaeus has a generalized three-lobed leaf with varying degrees of pubescence on the leaves, pedicel, and sepals. The basal leaves are quite similar to those of R. eschscholtzii and R. nivalis and to those found in some specimens of R. pedatifidus. The colour of the pubescence is one of the distinguishing characteristics in these species but there is some overlap in the range of colours which sometimes requires the use of other characteristics in distinguishing R. eschscholtzii from R. pedatifidus and R. nivalis. The pubescence of

the receptacle is another characteristic which shows the interrelationship of these species. R. pygmaeus has a glabrous receptacle, however, a few hairs were found on one percent of the specimens examined.

R. eschscholtzii and R. pedatifidus are closely related in the author's opinion. They share the chromosome number of 2n = 32 in part of their distribution and the karyotype appears to be identical (Goepfert, 1970). The vegetative portions of the plants are very similar under certain conditions; for example, specimens of these two species grown under identical conditions were inseparable on the basis of leaf shape or size. They could only be positively identified when they flowered or by referring to the identification made in the field. The flowers allow separation of the two species: R. eschscholtzii has yellow hairs on the sepals and matte petals while R. pedatifidus has white hairs on the sepals and glossy petals. The pedicel of R. eschscholtzii is glabrous or sparsely hirsute with yellow hairs while the pedicels of R. pedatifidus is usually densely white-hirsute. These two species are shown to diverge from R. pygmaeus which is placed very close to the ancestral species in the phylogenetic tree presented in Figure 21.

R. pedatifidus and R. eschscholtzii are placed at the base of two diverging lines on the basis of morphology and some information not included here. R. eschscholtzii, R. nivalis, and R. sulphureus form a graded series which shows enough similarities (see below) to suggest an evolutionary line. R. pedatifidus shows many similarities with R. eschscholtzii as discussed below but since it also shows affinities with R. cardiophyllus Hook. which was considered a variety of it at one time, it constitutes the base species for an evolutionary line which

may include R. cardiophyllus Hook., R. inamoenus Greene, R. rhomboideus Goldie, etc.; but this is another study.

The exact relationships of R. pygmaeus and R. eschscholtzii cannot be stated but they appear to be closely related. Hultén (1941.p.752.) has suggested that there is a continuous range of variation linking these two species.

R. eschscholtzii and R. nivalis show many similarities in their morphology. They differ chiefly in the colour of the sepal pubescence. The basal leaves of some R. eschscholtzii from the Yukon and Alaska are extremely similar to those of R. nivalis and can only be distinguished by the pubescence colour. The similarity probably led to Watson's erection of R. nivalis var. eschscholtzii. This has since been reduced to synonymy with R. eschscholtzii but Watson's views of the situation has merit since it indicates the closeness in relationship of these two species. The reasons for recognizing them at the specific level was discussed earlier in this work. Their distributions and chromosome numbers further support Watson's views. R. nivalis and R. eschscholtzii overlap in Yukon-northern Rocky Mountain area and R. nivalis grows farther north while R. eschscholtzii extends south along the Rocky Mountains. It can also be said that R. eschscholtzii has a lower chromosome number than R. nivalis but there is considerable overlap: R. eschscholtzii has 2n = 32, 40, 48, and 56 and R. nivalis has 2n = 40, 48, and 56. This overlap, however, does not occur in North America because only 2n = 48 has been recorded for R. nivalis in Alaska.

There are two main distinguishing characteristics that separate R. nivalis and R. sulphureus. The receptacle of R. sulphureus is hirsute

over its entire surface; whereas, R. nivalis has only a tuft of hairs on the apex and the angle of the lobes of the basal leaves differ. R. nivalis has a basically three-lobed leaf with the mid-veins of the two lateral lobes diverging at approximately 60° or more from the main vein of the central lobe. The lobes of the leaves of R. sulphureus are palmate with the mid-veins of the outer lateral lobe forming an angle of approximately 45° or less with the mid-vein of the central lobe. R. sulphureus tends to have a more northern distribution in the Canadian arctic while R. nivalis occurs more frequently farther south and in the Rocky Mountains. Benson has drawn a similar generalization from his work: "In the summer of 1950 the writer observed this species (R. nivalis) in both Alaska and Swedish Lapland at points approximately 179° of Longitude apart. In both areas it is more common and it ranges farther south than R. sulphureus, which is rare except farther north." (Benson, 1955.p.246).

A comparison of the morphology, chromosome number, and distribution of R. pygmaeus, R. eschscholtzii, R. nivalis, and R. sulphureus suggests a polyploid series. The above discussion indicates the similarity of the morphology of these four species. They show a graded series of changes in leaf shape, pubescence colour, receptacle pubescence, and size. The nectary scale has the same structure in all four species and the achenes differ mainly in size. There is some overlap in the chromosome numbers but there is a definite increase in number. R. pygmaeus is a diploid species with 2n = 16 throughout its range. R. eschscholtzii has 2n = 32, 40, 48, and 56; R. nivalis has 2n = 40, 48, and 56; R. sulphureus has 2n = 42, c.80, c.84, 96, and c.98. The distribution lends support to the hypothesis that these four species form a polyploid and, possibly,

also a phylogenetic series. R. pygmaeus is found generally throughout northern Canada, Alaska, Rocky Mountains, and the Gaspé Peninsula; R. eschscholtzii in the Rocky Mountains; R. nivalis in the northern Rocky Mountains, Alaska, and northern Canada; and R. sulphureus is found farther north than R. nivalis in the Canadian Arctic Archipelago and Alaska.

The opinions expressed by many individuals are summarized by Packer (1969) who concludes that climate is a major factor which affects the distribution of polyploids. Polyploids have been found to be able to invade disturbed areas and to survive more extreme environmental conditions better than diploids and since they often form a larger proportion of the flora in the north, where glaciation has been more extensive, it has been suggested that frequency of polyploids is correlated with latitude. Many authors have shown this not to be true (Morton, 1961 and Packer, 1969).

The extensive distribution and lack of information about the species throughout its range makes it impossible to discuss the origin of this species series but it does not prevent speculation about the past history of this group in North America.

R. pygmaeus or its ancestor is shown as the ancestral form of this series in Figure 21 . Its present distribution includes several 'refugia' two of which are the Gaspé Peninsula and Alaska-southwest Yukon. The only other member of the series that occurs on the Gaspé is R. pedatifidus. All of the series occur in the Alaska-Yukon area and, therefore, this would be a likely site for the centre of dispersal of the group after the glaciers receded. A comparison of the distribution maps show that there is overlap in this area but that there are not many sites where

these species grow together. This would indicate that considerable time has elapsed since these species became distinct.

A more thorough knowledge of the chromosome numbers of these five species would facilitate a better understanding of them by showing trends in the distribution of polyploids. The chromosome numbers are quite variable and obtaining a correct count is a tedious process.

The results of this study indicate an increase of chromosome number from north to south in R. eschscholtzii. These results when used with those of Taylor and Mulligan (1968) and Löve (Taxon, 1967) pointed to a northern area of dispersal for this species. The chromosome counts given by Goepfert (1970), which have been presented in Table A3, do not support this idea and indicate that much more work has to be done.

The nectary scale was considered to be of significance by Benson (1948) and he relied on it quite heavily in his erection of subgenera. It shows considerable variation in R. gmelinii as illustrated in **Frontispiece** but in the R. pygmaeus - R. pedatifidus - R. eschscholtzii - R. nivalis - R. sulphureus group the only difference is in size. This character adds more support to the relationship between these species.

The reasons for the variation shown by the nectary scale of R. gmelinii is not understood. Most of the species of Ranunculus listed by Moss in his Flora of Alberta and a few others were examined and only R. circinatus Sibth., R. flammula L., R. hyperboreus Rottb., and R. gmelinii DC. showed any significant variation in the shape of the nectary scale.

All of these species grow either in the water or by it and the leaves formed in these two environments may provide a further example of the phenotypic plasticity shown by these species. The perplexing part of

this variation is the reason for it. The variation in the morphology and size of vegetative portions of the plant is understandable because these parts must be adapted to the environment of the habitat in which the plant grows and they are affected by the environment as they develop. The reason why parts of the flower, which facilitate pollination, should vary so much; especially, in R. gmelinii is beyond this present work.

Ranunculus gmelinii and R. hyperboreus show some interesting relationships in their distribution pattern which are worthy of mention. R. hyperboreus is essentially a northern species which occurs south through the Rocky Mountains to Colorado, while R. gmelinii is more southern in distribution with some overlap in northern Canada. These two species have the same chromosome number through their common range but there has been no indication of hybridization in the specimens examined. R. flabellaris Raf. shows some morphological similarities to R. gmelinii and it occurs farther south and to the east in North America. R. flabellaris is generally larger with more pronounced corky margins on the achene than R. gmelinii. These three species, on the basis of morphology and distribution, form an interrelated group in North America. Each species shows a morphology which is adapted to a range of environmental conditions and one species becomes replaced by the next from north to south.

R. pedatifidus Hook., non Smith has been placed in R. grayi Britt. at the present time by Tolmachev and Yurtsev (1963) but there is still some doubt about the validity of this judgment which can only be resolved when and if specimens are received from the Soviet Union. This species is found on scattered peaks of the Rocky Mountains and on the arctic coast of western North America and northeast Asia. In 1910, Ostenfeld (see Löve et al, 1971) identified these plants with R. gelidus Kar. & Kir.,

a plant of the Altai Mountains of Central Siberia, and this has been the common treatment of these plants until very recently. (Benson, 1948; Moss, 1959; Hitchcock et al, 1964; Hultén, 1968;). Hultén (1968), however, proposes that they be called R. gelidus Kar. & Kir. var. grayi Hult. Tolmachev and Yurtsev (1963) separate the two species, R. gelidus and R. grayi, on the basis of morphology and geographic segregation. They suggest that R. gelidus has distinctly three-parted leaves, stamens 1.3-2 (mostly 1.5-1.8)mm. long, and fruit up to 2.5 mm. long; while R. grayi has less distinctly three-parted leaves, stamens about 1 mm. long, and fruits up to 1.7 mm. long. Löve et al (1971) agree with these proposals but the present author cannot after examination of Alberta material. The leaves of Albertan specimens match the illustration that Hooker (1840) provides for R. pedatifidus. In this respect it fits into R. grayi, however, the stamens are 1.2-1.5 mm. long and the achenes (excluding beak) are 2.5-2.6 mm. long which puts the Albertan plants closer to R. gelidus. Specimens from Jasper (P.J. Scott 1507) had a chromosome number of 2n = 16 and Löve et al (1971) report the same number. Until a comparative study can be carried out under controlled conditions nothing further can be said about the specific name for these North American plants.

Some further studies of other species show how the environment affects the morphology of the plants of these species and, in turn, the nomenclature.

The results of a study of some specimens of R. cymbalaria Pursh. var. alpinus Hook. from Newfoundland provide a solution to the problems that have surrounded this variety. It differs from the typical variety according to Benson (1948) by having smaller cordate leaves, three-toothed

at the apices and not crenate, and by having smaller flowers. Fernald (1914), in a paper on this species, said that var. alpinus "seems to be merely a dwarfed extreme such as can be found in unfavorable habitats nearly throughout the range" and Benson (1948) mentioned that he had reservations about the validity of the variety. Living specimens of this variety were collected at Main Brook, Northern Peninsula and Stephenville Crossing, Newfoundland from brackish estuaries. All of the leaves of these specimens were small (average 7 mm. long by 6 mm. broad) and the petals were about 2.5 mm. long. They were grown in the greenhouses at the University of Alberta with R. cymbalaria from Alberta and they grew as large or larger than these collections in all respects. The leaves were an average of 18 mm. long by 14 mm. broad and the flowers were of variety cymbalaria size. The leaves were decidedly crenate and there was no indication of reversion to the characters it had under field conditions. It is, therefore, proposed that R. cymbalaria Pursh. var. alpinus Hook. be considered a synonym of R. cymbalaria Pursh. var. cymbalaria.

CONCLUSIONS

This work has been of benefit to the author because it has stimulated thought on such difficult problems for taxonomists as phenotypic plasticity and it has suggested areas for more intensive research which are beyond the scope of this study.

There are, however, problems in the taxonomy of some of the species of Ranunculus, which have been investigated; for which solutions are offered.

Phenotypic plasticity is the source of much confusion in the species treated in this work and the solutions provided are outlined in the 'Results.' These 'solutions' take the form of modifications of the descriptions of the species and/or reduction of taxa to synonymy.

The following are the synonyms created. The three varieties of R. gmelinii DC., vars. gmelinii, hookeri (D.Don) L. Benson, and limosus (Nutt.) Hara, have been reduced to synonyms. It has been suggested that this species should be recognized for what it is; a highly variable species. R. hyperboreus Rottb. var. turquetilanus Polunin has been removed from synonymy with R. hyperboreus and placed as a synonym of R. gmelinii. R. natans C.A. Mey var. intertextus (Greene) L. Benson has been referred to R. hyperboreus Rottb. R. pedatifidus J.E. Smith var. leiocarpus Fern. has been accepted for the North American representatives of the taxon. R. eastwoodianus L. Benson and R. pedatifidus J.E. Smith var. affinis (R. Br.) L. Benson have been reduced to synonymy with it. R. pygmaeus Wahl. var. langianus Nathorst., R. sulphureus Sol. var. intercedens Hult., and R. cymbalaria Pursh var. alpinus Hook. have been listed as synonyms of their respective species.

The interrelationships of the species treated in the work have been discussed and a phylogenetic tree has been proposed (Figure 21.) to graphically illustrate the author's view of the past history of this group of Ranunculus species.

Chromosome numbers for specimens of the species included in the work have been determined from several localities. A staining technique has been developed in this study since other techniques were not found to be adequate.

Chemotaxonomy has been investigated to determine its usefulness in providing characters in the species studied. It has been found that the use of secondary metabolic products; such as, flavonoids and phenolics is not suitable.

It is hoped that this study will be of benefit to those who look at such variable species as R. gmelinii and wonder. They are most perplexing until one realizes the ecological significance of their variability.

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APPENDIX I

R. gmelinii DC.

Chromosome Number	Collection Data	Author	Year
2n = 16	U.S.S.R.: Kamchatka.	Sokolovskaja	1963
2n = 16	Quebec: Ft. Chimo.	Hedberg	1967
2n = 16	Manitoba: Macbride Lake. J.C. Ritchie. 971.DAO.	Löve & Ritchie	1966
2n = 32	Alaska: Ogotoruk Creek	Johnson & Packer	1968
2n = 32	.....	Löve & Löve	1961
2n = 32	U.S.S.R.: Wrangel Is.	Zhukova	1966
2n = 64	Manitoba: Sandilands Forest Reserve.	Goepfert	1970
2n = 64	Yukon: Stewart Plateau, road to Moose Creek, R.T.P. 984.DAO.	Mulligan & Porsild	1969

APPENDIX IIa

R. hyperboreus Rottb.

Chromosome Number	Collection Data	Author	Year
2n = 32	Alaska: Barrow, Pond north of Voth Creek bridge, July 22, 1972, Packer, McPherson, and Galeski 72 - 229, ALTA.	personal communication	
2n = 32	Colorado: Chaffe Co., Poncha Springs, Löve 10743.COLO.	*reported as* R. natans, Taxon 16	1967
2n = 32	Alaska: Ogotoruk Creek	Johnson & Packer	1968
2n = 32	.....	Löve & Löve	1961
2n = 32	U.S.S.R.: Kamchatka.	Sokolovskaja	1963
2n = 32	N.W.T.: Melville Is., Mosquin & Martin 6485. DAO.	Mosquin & Hayley	1966
2n = 32	U.S.S.R.: Chukchi, Cape Schmidt, Apapel'-khino	Zhukova	1966

APPENDIX IIb

R. hyperboreus Rottb.

Chromosome Number	Collection Data	Author	Year
2n = 32	Norway: Dovre Mts.	*Knaben &* Engelskjön	1967
2n = 32	Alaska: White Mts.	Johnson & Packer	1968
2n = 32	N.W.T.: Cornwallis Is.	Hedberg	1967
2n = 32	Colorado: *Boulder Co.,* Poncha Pass. W. Simon, L10743. COLO.	Kapoor & Löve	1970
2n = 32	British Columbia: Queen Charlotte Is., Graham Island, Oeanda River, CT35871 and Yukon Point, CT36819.	Taylor & *Mulligan*	1968
2n = 32	N.W.T.: Resolute Bay	Goepfert	*1970*
2n = 32	Yukon: Ogilvie Mts., mi. 56 of *Dempster Road,* R.T.P. 442. DAO.	Mulligan & Porsild	1969

APPENDIX IIIa

R. eschscholtzii Schlecht. var. *eschscholtzii*

Chromosome Number	Collection Data	Author	Year
2n = c.56	Colorado, Boulder Co., Red Rock Lake. Löve 10896. COLO.	*Taxon* 16	1967
2n = 32	British Columbia: Queen Charlotte Is., Moresby Island, Mt. Moresby, CT 36404 and Mosquito Mt., CT 36461.	Taylor & Mulligan	1968
2n = 32	NWT.: Mackenzie Mts.	Goepfert	1970
2n = 48	Alberta: Banff, Hilda Creek.	Goepfert	1970
2n = 48	British Columbia: Yoho Park.	Goepfert	1970
2n = 48	Alberta: Jasper, Whistler's Mt.	Goepfert	1970
2n = 48	Yukon: Haines Road	Goepfert	1970

APPENDIX IIIb

R. eschscholtzii Schlecht. var. *eschscholtzii*

Chromosome Number	Collection Data	Author	Year
2n = 48	N.W.T.: Mackenzie District	Goepfert	1970
2n = 40	Alberta: Plateau Mt.	Goepfert	1970
2n = 56	Colorado	Goepfert	1970

APPENDIX IV

R. pedatifidus J.E. Smith var. leiocarpus Fern.

Chromosome Number	Collection Data	Author	Year
2n = ca.48	Northwest Territories: Mackenzie District, c.200 ft., above Harding River, Parmelee 3099. DAO.	Mosquin in Taxon 17	1968
2n = 32	Alaska: Ogotoruk Creek	Johnson & Packer	1968
2n = 32	.....	Löve & Löve	1961
2n = 32	U.S.S.R.: Wrangel Is.	Zhukova	1966
2n = 32	U.S.S.R.: Chukchi Mts. (Umkrynnet).	Zhukova	1966
2n = 48	.....	Löve & Löve	1961
2n = 48	N.W.T.: Southampton Is.	Hedberg	1967
2n = 32	U.S.S.R.: Taymir Peninsula	Goepfert	1970
2n = 48	N.W.T.: Belcher Is.	Goepfert	1970

APPENDIX V

R. pygmaeus Wahl.

Chromosome Number	Collection Data	Author	Year
2n = 16	from Bergianischer Garten	Langlet	1932
2n = 16	Alaska: Ogotoruk Creek	Johnson & Packer	1968
2n = 16	.....	Löve & Löve	1961
2n = 16	N.W.T.: Richardson Mts.	Packer	1964
2n = 16	U.S.S.R.: Wrangel Is.	Zhukova	1965
2n = 16	N.W.T.: Southampton Is.	Hedberg	1967
2n = 16	Norway: Dovre Mts.	Knaben & Engelskjön	1967
2n = 16	Poland: Tatra Mts.	Sklinska et al	1968

APPENDIX VI

Ranunculus nivalis L.

Chromosome Number	Collection Data	Author	Year
2n = 48	Alaska: Barrow, July 1972. Packer, McPherson, and Galeski. *ALTA*.	McPherson (Personal *Communcation*)	
2n = 56	from Bergianischer Garten.	Langlet	1932
2n = 40, 48, 56	.....	Löve & Löve	1961

APPENDIX VII

R. sulphureus Sol.

Chromosome Number	Collection Data	Author	Year
2n = c.96	Alaska: Barrow, July, 1972. Packer, McPherson, and Galeski. ALTA.	personal communication	
2n = 96	N.W.T.: Resolute Bay, Char Lake.	Goepfert	1970
2n = c.84	N.W.T.: Prince Patrick Is., Mould Bay, Mosquin & Martin 6397. DAO.	Mosquin & Hayley	1966
2n = c.98	N.W.T.: Melville Is., Mosquin & Martin 6438. DAO.	Mosquin & Hayley	1966
2n = 42 and c.80	N.W.T.: Melville Is., Mosquin & Martin 6424. DAO. (different plants)	Mosquin & Hayley	1966

APPENDIX VIII. Chromatographic Results for phenolics from greenhouse-grown R. gmelinii.

Legend,

Bl = Blue

Pl = Purple

APPENDIX VIII

Rf First Solvent x Rf Second Solvent	0.35 x 0.03	0.72 x 0.03	0.51 x 0.04	0.25 x 0.14	0.59 x 0.23	0.43 x 0.19	0.68 x 0.22	0.27 x 0.34	0.49 x 0.33	0.06 x 0.32	0.21 x 0.75	0.5 x 0.76
Colour under UV	Bl	Bl	Bl	Bl	Bl	Bl	Bl	Pl	Pl	Pl	Pl	Pl
Fe Reagent	-	-	-	+	-	+	+	-	+	-	-	-

1702	X	X	X	X	X			X			X	X
1692		X	X	X	X		X		X			
1709			X	X	X	X		X	X			
1799	X			X		X	X	X				
1706	X	X		X		X	X	X		X		
84			X	X	X	X		X				

APPENDIX IX. Chromatographic Results for phenolics from greenhouse-grown R. eschscholtzii, R. pedatifidus, and R. gelidus.

Legend,

Non Fl. = Non-Fluorescent

Bl = Blue

Pl = Purple

APPENDIX IX

Rf First Solvent		Rf Second Solvent	Colour under UV	Fe Reagent	1433	1434	80	1429	1507
0.68	x	0.03	Bl	-	X	X	X	X	X
0.6	x	0.01	Bl	-			X	X	
0.46	x	0.15	Pl	-	X	X	X	X	X
0.68	x	0.12	Pl	-	X	X		X	
0.34	x	0.11	Pl	+					X
0.5	x	0.22	Bl	+	X	X	X	X	
0.48	x	0.35	Pl	+	X	X	X	X	
0.67	x	0.39	Pl	+	X	X		X	
0.27	x	0.19	Pl	-					X
0.37	x	0.3	Pl	+					X
0.34	x	0.48	Pl	+					X
0.57	x	0.54	Pl	+	X	X	X		
0.57	x	0.46	Pl	-			X		
0.71	x	0.45	Non Fl	+	X	X	X	X	
0.41	x	0.01	Non Fl		X	X	X	X	X
0.77	x	0.09	Non Fl	Fl	X	X			
0.68	x	0.28	Non Fl	Fl	X	X			X

APPENDIX X. Chromatographic Results for flavonoids from greenhouse-grown *R. eschscholtzii*, *R. pedatifidus*, and *R. gelidus*

Legend,

Non Fl	=	Non Fluorescent
Bl	=	Blue
BBl	=	Bright Blue
DBl	=	Dark Blue
Bl-Gr	=	Blue-Grey
Or	=	Orange

APPENDIX X

Rf First Solvent		Rf Second Solvent	Colour under UV	Colour under UV + NH_3				
					80	1434	1433	1429 1597
0.24	x	0.73	Non Fl	Or	X		X	X
0.49	x	0.78	Bl	BBl	X	X	X	X	X
0.61	x	0.78	Bl	BBl	X	X	X	X	X
0.7	x	0.78	Bl	BBl	X		X	X	X
0.77	x	0.82	Bl	BBl	X	X	X	X	X
0.83	x	0.82	Bl	BBl	X	X	X	X	X
0.89	x	0.86	Bl	BBl	X	X	X	X	X
0.79	x	0.65	Bl	BBl	X	X	X	X	X
0.7	x	0.63	Bl	BBl	X		X	X	X
0.83	x	0.47	DBl	Bl-Gr	X	X		X	X
0.6	x	0.71	Bl	BBl		X			
0.75	x	0.09	Bl	-			X	X	X
0.09	x	0.77	Bl	-				X	
0.16	x	0.77	Bl	-				X	
0.2	x	0.82	Bl	-				X	X
0.88	x	0.76	Bl	-					X
0.83	x	0.76	Bl	-					X
0.8	x	0.61	Bl - Gr	-					X

APPENDIX XI. Chromatographic Results for phenolics from Field-Collected *Ranunculi*

Legend,

Q = Quenching

Bl = Blue

DBl = Dark Blue

BBl = Bright Blue

APPENDIX XI

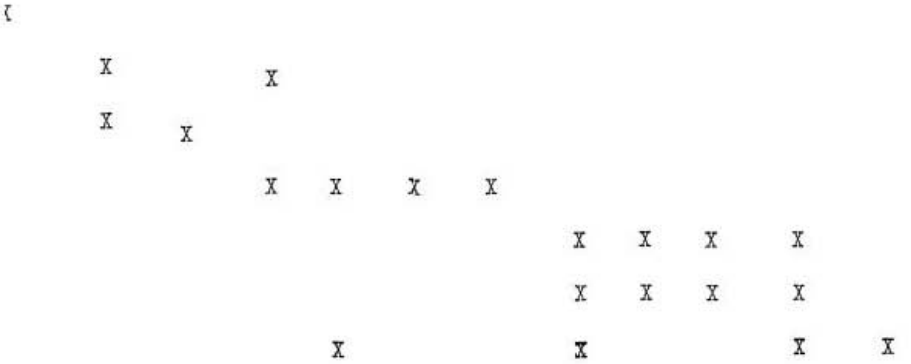
Rf First Solvent	0.58	0.6	0.42	0.49	0.63	0.72	0.33	0.74	0	(
Rf Second Solvent	0.09	0.2	0.38	0.42	0.6	0.75	0.84	0.06	0.66	(
Colour under UV	Q	Bl	Q	Q	Bl	-	Bl	-	Bl	
Fe Reagent	+	+	-	-	+	+	+	+	-	

1695	X	X	X	X	X	X	X			
1480		X			X	X		X	X	
331		X			X	X				
1413				X	X	X		X		
JGP4199					X					
1523							X	X		
WY98		X			X	X	X			
HH265		X					X			
1205										
GB2013		X			X			X	X	
ER2760		X			X					
337		X								

0.72	0.33	0.74	0	0.16	0.29	0.68	0.44	0.47	0.49	0.58	0.08	0.6	0.43	0.6	0.69
0.75	0.84	0.06	0.66	0.5	0.43	0.51	0.59	0.58	0.77	0.84	0.27	0.4	0.92	0.04	0.23
-	Bl	-	Bl	-	-	Bl	-	Bl	Bl	Bl	-	Bl	DBl	Bl	Bl
+	+	+	-	+	+	-	+	-	-	+	+	+	-	-	-

X	X														
X		X	X												
X				X	X	X	X								
X		X		X				X	X	X					
	X	X							X		X				
X	X									X		X		X	
	X						X	X				X	X		
									X					X	X
		X	X												
															X

.08	0.6	0.43	0.6	0.69	0.68	0.72	0.7	0.68	0.61	0.32	0.8
.27	0.4	0.92	0.04	0.23	0.52	0.94	0.05	0.13	0.3	0.76	0.9
-	Bl	DBl	Bl	Bl	-	Bl	Bl	Bl	BBl	Bl	-
+	+	-	-	-	+	-	+	+	+	-	+



APPENDIX XII. Chromatographic Results for flavonoids from field-collected Ranunculi.

Legend,

Q	=	Quench
Or	=	Orange
Y	=	Yellow
Bl	=	Blue
CY	=	Chalk Yellow
Fl	=	Flesh
P Bl	=	Pale Blue
B Bl	=	Bright Blue
D Bl	=	Dark Blue
Gr Bl	=	Green Blue
L Gr	=	Light Green
LY	=	Light Yellow
G	=	Gold
Pl	=	Purple

APPENDIX XII.

Rf First Solvent	0.49	0.61	0.72	0.35	0.45	0.29	0.36	0.32	0.34	0.27	0.4	0.48	0.89	0.85	0.81
Rf Second Solvent	0.1	0.1	0.28	0.09	0.27	0.2	0.92	0.88	0.76	0.68	0.72	0.9	0.73	0.6	0.55
Colour under UV	Q	Q	Q	Bl	Q	-	-	-	Fl	Bl	Q	Bl	B Bl	DBl	Bl
Colour under UV + NH_3	Or	Y	-	Or	-	CY	CY	CY	Fl	BBl	Or	Bl	BBl	Gr Bl	Gr Bl
1480															X
JGP4199	X	X												X	
HH265	X		X								X	X	X		X
1523	X	X	X	X	X										
1413				X										X	X
WY98						X	X	X			X	X			
1695							X	X					X	X	
ER2760													X	X	
GB2013												X	X	X	
331									X	X			X		X
337												X			
1205														X	

0.34	0.27	0.4	0.48	0.89	0.85	0.81	0.81	0.04	0.85	0.82	0.77	0.74	0.74	0.7	0.69	0.61	0.81	0.86	0.71
0.76	0.68	0.72	0.9	0.73	0.6	0.55	0.42	0.87	0.93	0.82	0.76	0.81	0.67	0.55	0.93	0.82	0.84	0.74	0.64
Fl	Bl	Q	Bl	B Bl	DBl	Bl	Bl	-	Bl	Bl	Bl	Bl	PBl	Q	Bl	Bl	Bl	Y	BBl
Fl	BBl	Or	Bl	BBl	Gr Bl	Gr Bl	BBl	Q	BBl	Gr Bl	L Gr	L Gr	Fl	Or	PBl	PBl	G	LY	PBl

						X	X				X	X	X				X	X	
					X									X	X				
		X	X	X		X	X		X	X	X	X	X	X	X	X			
									X				X		X				X
					X	X	X				X								
		X	X												X		X		
				X	X				X						X	X			
				X	X						X	X		X					
			X	X	X		X		X	X	X				X				
t	X			X		X			X						X	X			X
			X					X		X					X	X		X	X
					X		X		X		X	X			X	X	X		

0.81	0.86	0.71	0.75	0.97	0.95	0.92	0.94	0.66	0.77	0.55	0.71	0.75	0.85	0.66	0.74	0.36
0.84	0.74	0.64	0.54	0.17	0.34	0.48	0.53	0.77	0.91	0.86	0.89	0.73	0.53	0.71	0.66	0.5
Bl	Y	BBl	Bl	BBl	Bl	BBl	Bl	-	-	Bl	Q	Q	Pl	BBl	Or	Bl
G	LY	PBl	PBl	BBl	Bl	Bl	BBl	Bl	Gr	Or	-	Or	Bl	LGr	-	Q
X	X															
		X	X													
			X													
X				X	X	X	X	X	X							
						X		X	X							
										X	X	X	X			
								X					X	X	X	
		X														
	X	X	X				X	X	X	X				X		
X							X	X		X		X				X