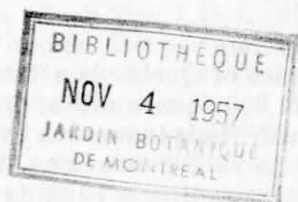


SEDGES AS MATERIAL
for
PHYTOGEOGRAPHICAL STUDIES

with 42 maps in the text

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NOVEMBER
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Résumé

L'auteur a dressé la carte des espèces de *Carex* présentes sur le territoire du Québec et, s'inspirant du travail d'Eric Hultén sur les aires équiformes, a groupé celles dont les aires étaient semblables. Voici très succinctement les phénomènes phytogéographiques qui se dégagent de cette compilation :

1. Les espèces strictement arctiques comme *C. atrofusca*, *C. bicolor*, *C. holostoma*, *C. neurochlaena*, *C. supina*, etc. ont comme limite sud une ligne partant du cap Jones et remontant le long de la côte de la baie d'Hudson jusqu'au golfe de Richmond, pour s'engager à l'intérieur jusqu'à Fort Chimo et sortir sur le Labrador côtier, à Okkak.

2. Les espèces arctiques-alpines (*C. Bigelowii*, *C. capillaris*, *C. glacialis*, etc) fréquentent le même territoire, débordent sur la zone de transition appelée par Rousseau hémiarctique et se retrouvent plus au sud sur les montagnes de la Gaspésie, de la Nouvelle-Angleterre, etc.

3. Il existe aussi des espèces proprement alpines comme *C. atrata*, *C. capitata*, *C. Franklinii*, qui viennent jusqu'à la frange arctique, et (3) : des subalpines à caractère méridional comme *C. aenea* et *C. Backii*.

4. Discussion des espèces amphiatlantiques : *C. adlostoma*, *C. demissa*, *C. Hostiana*, *C. nigra*, etc.

5. Espèces de l'ouest avec micro-aires dans le Québec et espèces de l'est avec micro-aires cordillériennes.

6. Classification et limites des espèces subarctiques. Comme pour les arctiques, les unes ne sortent pas de leur zone; d'autres se retrouvent plus au sud dans les tourbières du Québec et de la Nouvelle-Angleterre.

7. Classification et limites des halophytes : a) boréales; b) méridionales.

8. Une ligne tirée de la baie James le long de la Rupert, passant par le territoire de Mistassini et sortant à l'île Anticosti, constitue une très importante limite nord pour un grand nombre d'espèces tempérées, dont une vingtaine de *Carex*.

9. *C. Cravei*, *C. crinita*, *C. lacustris*, *C. pallescens* var. *neogaea* et quelques autres atteignent par petites colonies isolées les endroits abrités de la Gaspésie, d'Anticosti et du sud-ouest de Terre-Neuve.

10. *C. adusta*, *C. katahdinensis*, *C. ormostachya* atteignent le lac St-Jean.

11. Des espèces de la Prairie et du centre, ne viennent que sur quelques points de la rivière Ottawa. D'autres atteignent le lac St-Pierre. Ressemblance entre la flore du Richelieu et celle de l'Ottawa.

12. Un groupe d'espèces, auquel appartiennent *C. lurida*, *C. conoidea*, *C. granularis*, atteint la ville de Québec.

13. Des espèces apalachiennes comme *C. hirsutella*, *C. virescens*, *C. Swanii* ont comme limite nord les bois rocheux dolomitiques qui occupent les confins sud des comtés de Missisquoi et de Brome.

Enfin, on trouve parmi les laïches du Québec quelques espèces introduites autour des vieux établissements comme Montréal et Québec : *C. flacca*, *C. hirta*, *C. intermedia*, *C. nutans*.

The Province of Quebec is a vast territory of some 594,534 square miles of which 71,000 square miles, or 16%, are covered by fresh water lakes. One naturally finds in an area extending from 45° to 62° 40' Lat. N., and from 57° 07' to 79° 33' 20" Long. W., a host of intermediary vegetational and floristic conditions ranging from the dolomite formations on the Quebec-Vermont frontier, with relatively southern species such as *Woodsia obtusa* (Spreng.) Torr. or *Phytolacca americana* L. at their northernmost limit, to the treeless barren wastes with arctic species such as *Papaver radiculatum* Rottb. or *Ranunculus Pallasii* Schlecht.

* Read at the joint meeting of the Phytogeographical and Taxonomical sections of the VII International Botanical Congress, in Stockholm, Sweden, Friday, July 14, 1950.

On account of its high number of species (i.e., 200 in Quebec), the genus *Carex* L. provides excellent material for the illustration of distributional types in a given area. Each species, as a rule, is taxonomically well-defined, has a distribution of its own, and has developed special ecological requirements. There are wood, bog, marsh, meadow, tundra, rock species, etc. As for their geographical affinities, some are circumpolar, bipolar, siberio-transcanadian, or strictly american, etc.

The method of work, adapted in part from Hultén's "equiformal progressive area" (23) which groups all species exhibiting the same distributional area, has produced what appears to be something of a natural border for each of these natural geographical groups. For instance, Quebec City, the northernmost station known for *Panax quinquefolius* L. and for many other spring-flowering plants, is also the northern limit of *Hamamelis virginiana* L., *Juglans cinerea* L., *Listera australis* Lindl., etc. On the other hand, it is striking to note that the same locality serves as the southernmost limit of a number of boreal species, such as *Astragalus labradoricus* DC., *Oxytropis johannensis* Fern., *Potentilla Egedii* Wormskj., *Primula mistassinica* Michx., *Tofieldia glutinosa* (Michx.) Pers., etc.

The information given here has been compiled from the following sources : Marie-Victorin Herbarium (Montreal), Gray Herbarium (Cambridge, Mass.), National Herbarium (Ottawa) ; several unpublished local lists of plants mostly from northern Quebec, which have been kindly provided by Rev. Ernest Lepage, Dr. Jacques Rousseau, James A. Calder, John Marr, Carl G. Alm and I. Hustich. In almost every instance, the material has been examined by the author before the records were transferred to the appropriate maps.

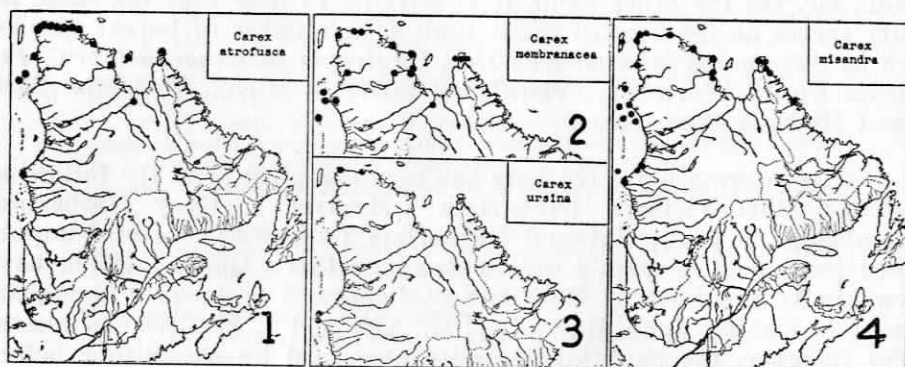
For distribution data from Nova Scotia, Roland's flora (60) was consulted ; from New Brunswick, Macoun's *Catalogue of Canadian Plants* (40) ; and from Maine, Ogden's check list (46), while Dr. Ernest Rouleau, Curator of the Marie-Victorin Herbarium, has provided the author with still unpublished details on the Newfoundland flora. A collection of *Carex* made by Dr. Risto Tuomikoski of the University of Helsinki (Finland) and containing noteworthy additions has also been seen. Mr. James Kucyniak, of the Montreal Botanical Garden, has rendered assistance with the English in the present text, while Mr. Pierre Dugas is responsible for the grouping of the maps. Drs. C. Regel (Zurich) and T. Bocher (Copenhagen), and Mr. P. Senay (Asnières) have been helpful on several technical points. To all of them, the author expresses his sincere thanks.

The world Mercator projection used in some of the circumpolar distributions is Goode's map No. 101M, published by the University of Chicago, which holds the copyright.

The extensive documentation used as source for the circumpolar maps, outside of the herbaria mentioned above, appears in the appended bibliography.

The *Carex* of Quebec, which number some 200 species, may be assembled according to the following phytogeographical groups to which they most appropriately belong :

1. **ARCTIC SPECIES** : they are limited to the arctic zone proper. Some may occur in the arctic patches of the hemiarctic zone defined by Rousseau (61, 62, 63). Most of them are circumpolar : *C. atrofusca* Schk., (map 1), *C. bicolor* Bell. ex All., *C. holostoma* Drejer (28, 29, 45), *C. maritima* Gunner., *C. membranacea* Hook. (map 2), *C. rotundata* Wahl., *C. saxatilis* L. [mostly represented with us by var. *laxa* (Trautv.) Ohwi], *C. stans* Drejer, *C. supina* Willd., *C. ursina* Dewey, (map 3), *C. misandra* R. Br. (map 4).



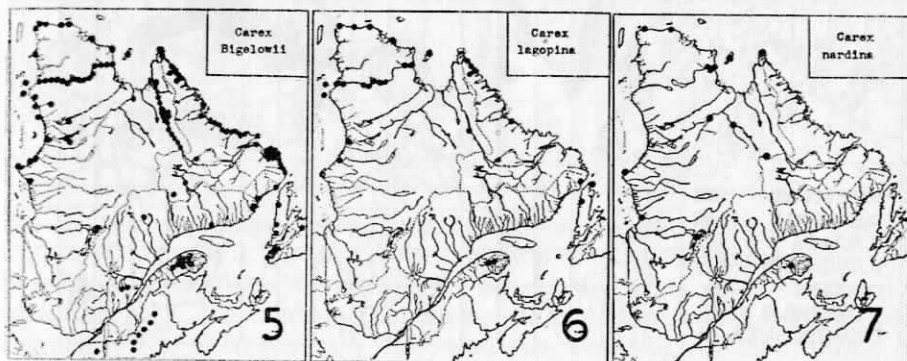
C. neurochlaena Holm is exclusively Canadian (9, 10), while *C. Williamsii* Britton [including the Kamtchatkan *C. Novagrabenovii* Komarov] is restricted to eastern Asia and northern North America (58).

In grouping the maps of these arctic species, we find that the southern limit of the arctic zone proper in Quebec follows a line drawn from Cape Jones to Richmond Gulf continuing along the Leaf River to Fort Chimo and proceeding as far south as Okkak on the Labrador coast, after jutting out northward to include the Kaumajet mountains (27).

Richmond Gulf and Fort Chimo are two critical points as both northern and southern types are found there, probably because of a mixture of micro-climates.

In the general flora, *Eriophorum callitrix* Cham., *Papaver radicum* Rottb., *Pedicularis lanata* Cham. & Schl., *Ranunculus Pallasii* Schl., *Juncus arcticus* Willd. are good examples of species restricted in Quebec to the arctic zone.

2. **ARCTIC-ALPINE SPECIES**: frequent in the arctic zone, they also occur in arctic outposts, such as mountain summits, bogs, river flats, cliffs, or other cold or exposed habitats in both the subarctic and the temperate zones, and at sea level specially along the north and the south shores of the Gulf of St. Lawrence: *C. Bigelowii* Torr. ex Schwein. (map 5), *C. capillaris* L., *C. glacialis* Mack. [including *C. terrae-novae* Fern.], *C. lagopina* Wahl. (map 6), *C. nardina* Fries (map 7), *C. norvegica* Retz. var. *inserrulata* (Kalela) Raymond, *C. rariflora* J. E. Smith, *C. rupestris* Bell. ex All.



This group is well represented in the general flora by *Dryas integrifolia* Vahl, *Epilobium latifolium* L., *Lycopodium Selago* L. (extending southward on rockslides in Virginia), *Poa alpina* L., *Potentilla Chamissonis* Hultén, *P. Egedii* Wormskj., *P. hyparctica* Malte, *P. nivea* L., etc.

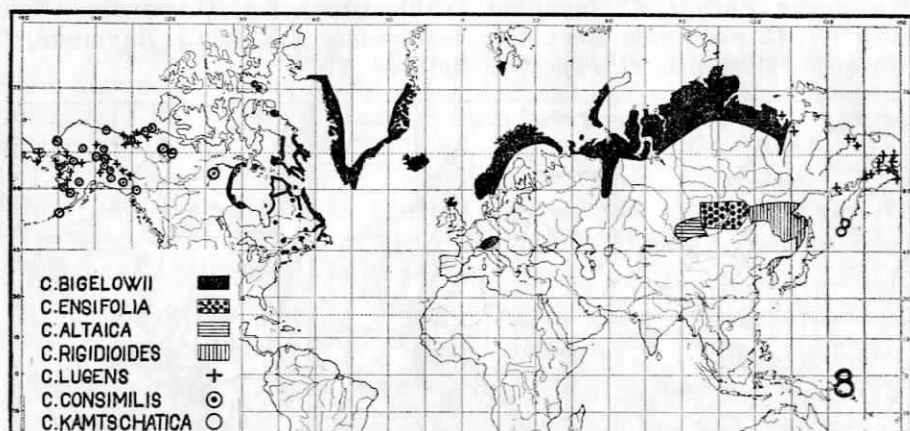
Carex capillaris L., common on grassy capes at sea level all around the Gaspé coast, has also been reported in Quebec from as far south as the Magdalen Islands, off Nova Scotia, as well as in New Brunswick, Maine and Vermont. It is as much arctic as alpine and, at times, is referred to as a steppe plant (2).

Carex norvegica Retz. belongs to the ALPINAE, a subsection of the ATRATAE Kunth, the taxonomy and distribution of which have been cleverly discussed by Kalela (29). In Europe, as well as in North America, *C. norvegica* occurs simultaneously in the arctic regions as well as on mountain summits further to the south. It has a strictly alpine segregate in Colorado: *C. Stevenii* (Holm) Kalela, and others still in Asia: *C. oligantha* Steud. emend. V. Krecz., *C. infuscata* Nees, *C. mimula* V. Krecz.

Carex Bigelowii Torr. ex Schwein. s. s. (map 8) seems to be a strictly northern-atlantic type (†), like *Alchemilla vestita* (Buser)

(†) Hultén (24) and Porsild (48) have different opinions concerning the distribution of *Carex Bigelowii* west of Hudson Bay. I have distributed either under *Carex consimilis* Holm or under *Carex lugens* Holm (= *C. Sozocaveana* Gorodkov) all the "*C. Bigelowii*" cited from

Raunk., *Cassiope hypnoides* (L.) D. Don, *Lychnis alpina* L., etc., though it is represented in western America and in eastern Asia (18) by very closely related alpine types. On the mountains of Gaspé, New Hampshire and Maine, as well as in Lappland, it forms dense meadows and very often, intermixed with patches of *Luzula spicata* (Lam.) DC., it covers large sectors of dry "herb-fields".



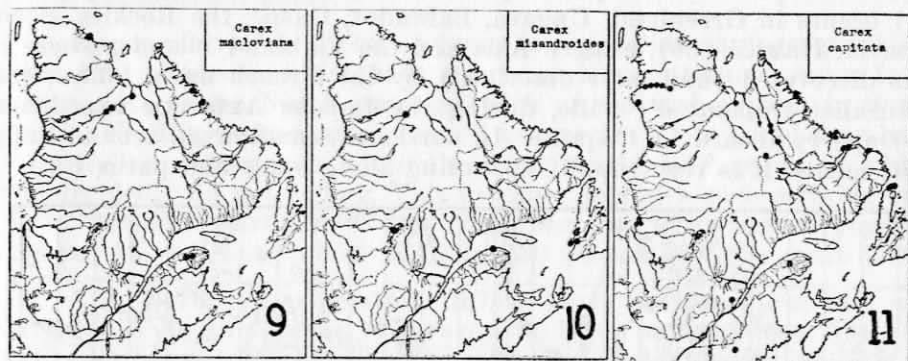
3. **ALPINE SPECIES** : a group difficult to define with us, because of the sporadic occurrence of some of them in the arctic. However, when a map of their general distribution is drawn, it conclusively shows that they are more common on mountains than in the arctic zone. (Such is the case of *C. macrorhiza* D'Urv. (map 9), *C. misandroides* Fern. (map 10), *C. atrata* L., *C. capitata* L. (map 11) [incl. *C. arctogena* H. Smith, the status of which is still vague in North America, though seemingly that of an alpine (†) ecotype], *C. microglochin* Wahl., *C. praticola* Rydb., *C. scirpoidea* Michx.

A look at the map (map 12) of *Carex atrata* L. and its close Eurasian relatives (31) shows a species of the arctic zone of Europe, represented southward in some of the Asiatic mountain chains by related species, such as the graceful *Carex caucasica* Stev., in cultivation at the Montreal Botanical Garden and, further east, by *C. decaulescens* V. Krecz. and *C. Duthiei* C. Clarke. Mackenzie (39) gives to *Carex atrata* L. the following area : "arctic or alpine meadows in calcareous districts, Greenland to Alberta, and southward to Colorado and Neva-

Alaska and the Northwest Territories, pending further clarification which may result from growing them side by side in a botanical garden. Vegetatively, the western and eastern material show noteworthy differences. Chromosome counts would render additional help. Böcher (2) and Heilborn (19) have found $2n = 70$, with "atlantic" material, but the "pacific" races are still unworked.

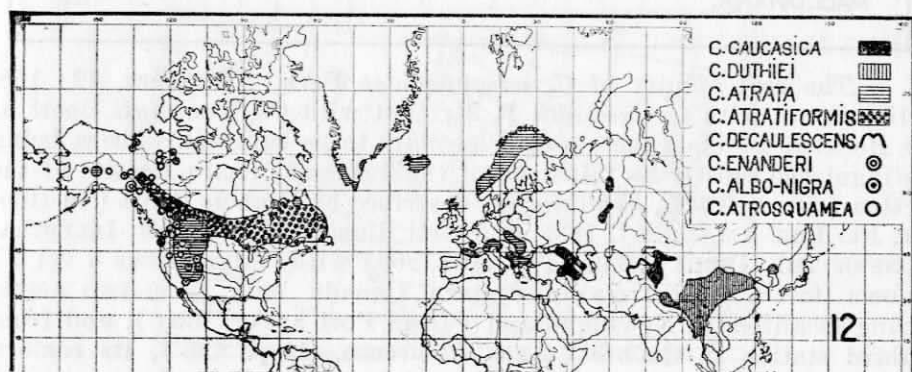
(†) For which there was already a name: f. *alpicola* Andersson (1849).

da". Hultén (24) cites it from McKinley Park, Alaska. In Quebec, it is known so far only from Richmond Gulf (Dutilly & Lepage) and Fort Chimo (Calder).



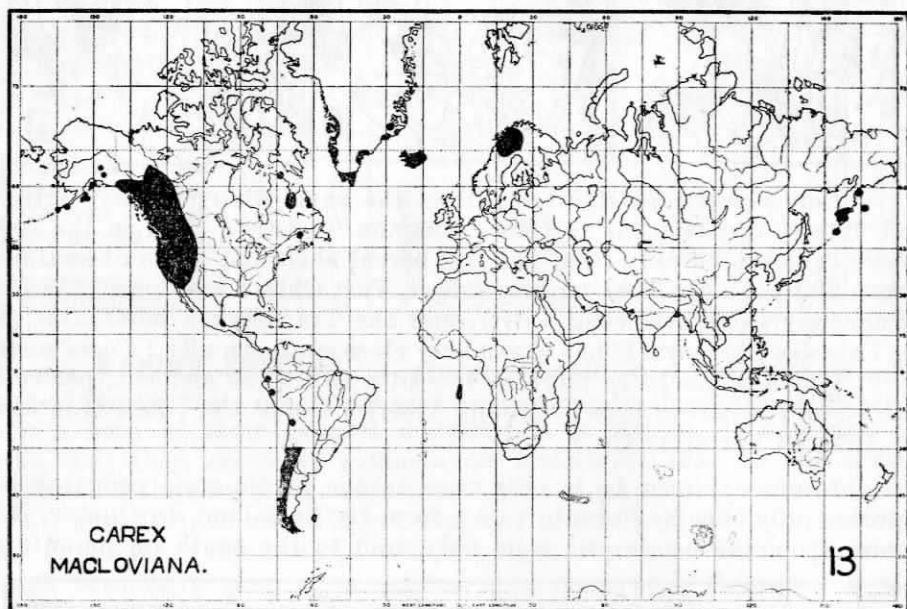
Carex praticola Rydb., exhibits the same distributional pattern and, like *C. atrata* L., is far more common westward than in the east, where it is known only from the less boreal sheltered parts of southern Greenland (2), the Hudson Bay shores, Fort Chimo, southern Labrador (Saguenay Co.), Anticosti (57), and the Tracadigash mountains, on the Baie des Chaleurs. It has also a very close southern ally : *Carex aenea* Fern., which seems to be more or less of a subalpine element, perfectly at ease on the barren tops of Mount Albert (Gaspé Co.) and Montagne des Ilets (Charlevoix Co.).

Carex capitata L. is very rare in the arctic zone proper being reported only once by Polunin (48) from Baffin Island. In Quebec, it is known from the hemiarctic zone only, and to the south on mountains



such as St. Urbain (Charlevoix Co.), Logan (Matane Co.), Katahdin (Maine), Washington (New Hampshire), and again in Mexico, Argentina, Patagonia. With *C. lagopina* Wahl., *C. macloviana* D'Urv., *C. magellanica* Lam., *C. maritima* Gunner., and *C. microglochin* Wahl., it shares the feature of occurring also in the Southern Hemisphere, in

addition to exhibiting odd disrupted ranges indicating ancient dispersal (53). Du Rietz (11) has contributed a highly intelligent paper on the mysterious problem of bipolar species. *C. macloviana* for example (fig. 13) occurs in Greenland, Ungava, Labrador, Gaspé, the Rockies, Scandinavia, Hawaii (66), eastern Asia and the Falkland Islands, where it was discovered (and later described) by the French naval officer and naturalist Dumont d'Urville, during the famous Antarctic expedition of Duperry aboard *La Coquille*. In northern Scandinavia, around Lapp settlements, it is very rapidly spreading along roads and paths (1).



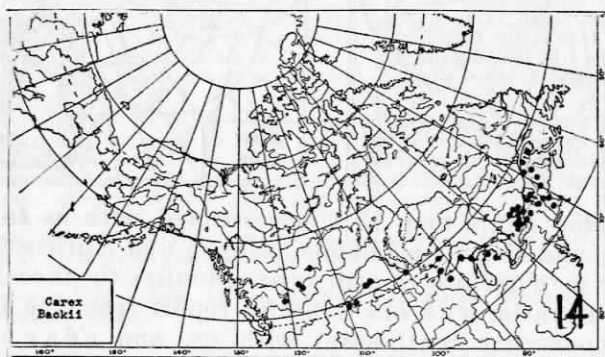
The real affinity of *C. misandroides* Fern. (Rhodora, 17: 158. 1915) is not with *C. misandra* R. Br., but with *C. Franklinii* Boott of the Rockies, which it too closely resembles to be kept apart from, being distinguished mostly by 2 instead of the 3 stigmas characteristic of the section (58a). But *C. Franklinii* is described by Francis Boott (in Hooker, FL. BOR.-AM. 2: 217. 1839, and well illustrated in Boott, ILLUSTRATIONS OF THE GENUS CAREX II: 77. 1860) with "stigmatibus 3 vel 2". Known for a long time in eastern Canada only from two neighboring localities in Newfoundland (from Port à Port Bay), and from a third station in Quebec (Anse Pleureuse, Gaspé Co.), its eastern range has been broadened during the past few years. It has been reported from Larch River, in Ungava, near the timberline, and further south, from the Lake Mistassini area, while a new locality, fifty miles north of the two earliest ones, has been recently found in Newfoundland by Rouleau (ined.). The species grows at the base of cliffs, on knolls, eboulis, rock-slides, etc., and is strictly alpine. Hence, *C. Franklinii*,

named in memory of the unfortunate Arctic explorer, is another of those trans-canadian species, whose alleged strongly disrupted range has been made more or less continuous through further exploration and more careful taxonomical study.

Carex scirpoidea Michx. belongs to a peculiar phytogeographical group, that of species which have a more or less continuous range from eastern Asia across North America, with an isolated outpost in Scandinavia. Nordhagen has called them "west-arctic" (44) and they have at times been incorporated into the "amphi-atlantic" group to which they decidedly do not belong. This category includes such striking species as *Arenaria humifusa* Wahl., *Carex nardina* Fries and *Dryopteris fragrans* (L.) Schott, which Kalliola (30) has studied in great detail.

The European population differs from the American one and Kükenthal's distinction as var. *europaea* is to say the least justified (38). Nathorst inferred that the species reached Norway by way of Greenland, during the glacial epoch (22). In North America, it is a complex. Holm (20, 21, 22) explained that the variants of the species originated in the Rocky Mountains. It is certainly very variable and most abundant there. We have in the Coast Range of California a var. *gigas* Holm and in the Rocky Mountains a var. *stenochlaena* Holm and a var. *scirpiformis* (Mack.) O'Neil & Duman, the latter invading Quebec, from the west (8). There is also a var. *convoluta* Kük. which is found notably along the calcareous shores of Lake Huron (16).

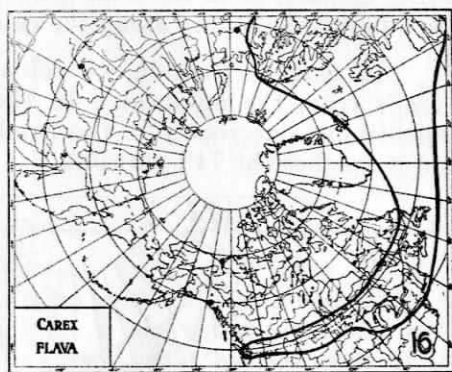
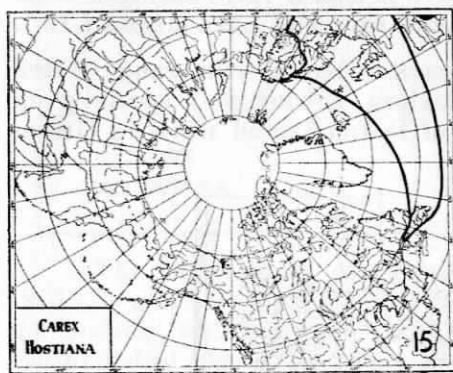
In eastern Canada, *C. scirpoidea* s. s. has a wide range which extends from the mountains in the Eastern Townships (specially on serpentinous outcrops) to the tundra of Devon Island while in Greenland it reaches the 74th parallel.



3a. A special note should be made here on **LOW-SUBALPINE SPECIES** such as *C. Beckii* Boott (51), which grows in the lower subalpine zone of such widely separated mountains as the Rocky Mountains, in Alberta, the Monteregian hills in the Montreal flood plain Belœil, Rougemont, Mount Johnson) and the Tracadigash mountains

in the Baie des Chaleurs area (map 14) ; — and *C. deflexa* Hornem., with a very broad eastern area, from Massachusetts, New York and Vermont, across Quebec to Fort Chimo, thence to Greenland, as far north as the 65th parallel, but always growing in more or less mountainous situations.

4. **AMPHI-ATLANTIC SPECIES** are oceanic and distributed on both sides of the Atlantic Ocean. However, their European area is usually more extensive than the American one. With us, they are restricted to Labrador and adjacent Quebec, and sometimes penetrate as far south as the north shore of the Gulf of St. Lawrence, the tip of Gaspé Peninsula, Nova Scotia and the coast of Maine. Among them are found northern types likes *C. adelostoma* V. Krecz., known only from Fort Chimo in Ungava (Calder) and Hebron in Labrador (Hustich). Others are : *C. lepidocarpa* Tausch., limited to Newfoundland, adjacent Quebec and the Magdalen Islands ; *C. nigra* (L.) Reichard, strictly halophytic ; *C. demissa* Hornem., the species probably responsible for the frequent and doubtful reports of *C. viridula* Michx. for Greenland (†) ; *C. serotina* Mérat, known only locally from Newfoundland and the Magdalen Islands, in North America ; *C. Hartmani* Cajander, known so far only from Anticosti Island (57).

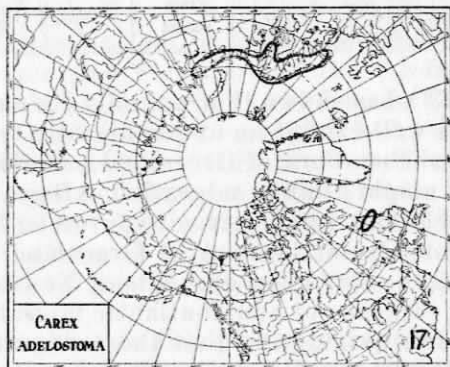


C. Hostiana DC. (map 15) is restricted with us to Newfoundland, St. Pierre and Miquelon Islands, Mingan and Anticosti. Wiinstedt (69) treats it as a mediterranean type. Finally, *C. flava* L., more or less oceanic in Eurasia, with one doubtful report from the Lake Baikal region, is pronouncedly continental with us, and reaches British Columbia (map 16).

(†) And equally responsible for futile supposedly taxonomical comments as well. For instance, Połunin, in Journ. Linn. Soc., Botany 52 (No 345) : 374. 1943, with dubious material from Greenland, compared with wrongly determined specimens from Newfoundland, rejects *C. serotina* Mérat in favor of *C. viridula* Michx., to replace *C. Oederi* Retz. It is perfectly clear now that *C. serotina* Mérat, *C. demissa* Hornem. and *C. viridula* Michx. are three distinct species, each with an area of its own, of which only *C. demissa* occurs in Greenland. See Raymond (57) and Pierre Senay, in Bull. Muséum Hist. Nat. 2e série, 22 (No 5) : 618-625. 1950.

Carex adelostoma V. Krecz. (map 17) belongs to the PHANEROLEPIS group (33) of the LONANIZA (Raf.) V. Krecz., which is the ATRATAE Kunth of most authors. These are, in North America : *C. Buxbaumii* Wahl., *C. Hartmani* Caj., *C. Morrisseyi* Porsild and *C. adelostoma* V. Krecz.

If we eliminate *C. Morrisseyi* Porsild (49), a purely Canadian segregate occurring from Great Bear Lake (N. W. T.) to Labrador, the three remaining species, which exhibit a number of slight morpho-



logical differences, also show peculiarities in their ecology, distribution, and probably in number of chromosomes, at least in Fennoscandia. Concerning them, Levan and Löve (37) write as follows :

The three types are distinguished by a number of slight morphological differences, the most evident of which concern the shape and length of the spikes and the sizes and appearance of the floral parts.

They show differences, however, also in their geographical distribution. *C. Hartmani* has a decidedly southern distribution in Scandinavia, *C. Buxbaumii* has its main area in the pine-wood region of the middle and northern Sweden and in eastern Finland, and *C. adelostoma* is limited to the alpine mountain region and to the most northern parts of Scandinavia (cf. Cajander, 1936).

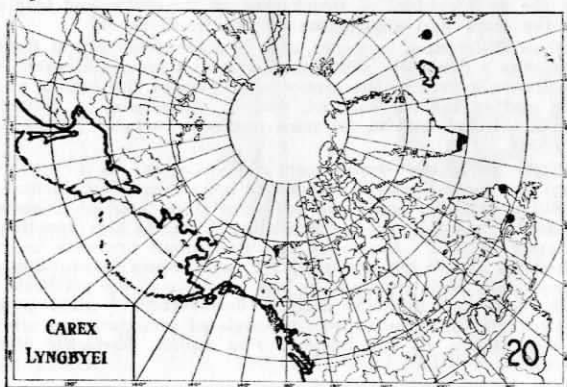
The three "polygama" types seem also to differ as to their ecology. *C. Hartmani* is a typical eutroph and needs a warm and continental climate. *C. Buxbaumii* is probably a eutroph too, even if its need of calcareous soil is not so absolute as that of the preceding form. It also requires a continental climate. Both *C. Hartmani* and *Buxbaumii* are rare in maritime regions; they are boreal but not arctic. *C. adelostoma* is probably a mesotroph. It needs only little lime and is less sensitive to the maritime climate. It may probably be designated an arctic or boreo-arctic form. It goes as far down southwards as to Oland, where the isolated occurrence of other alpine species is also known, as for instance *Poa alpina*, *Bartschia alpina* and *Pinguicula alpina*.

Hultén for one (23) has rejected the idea of a transatlantic bridge, considering the amphi-atlantic species as reduced circumpolars. The continuous series of distributional types connecting the two extremes which he has so ably compiled, are surely convincing : the Bering area as the centre from which migrations to Eurasia and to North America have taken place, such as shown by the "progressive" areas of *C. pribylovensis* J. M. Macoun (map 18) and *C. lugens* Holm (map 19).

But perhaps the examples chosen have not been selected among the true amphiatlantics, at least not of the indisputable category of, let us say, *Carex Hostiana* DC, or *Carex demissa* Hornem.



Nannfeldt (43) has shown that not only the same species but the same microspecies as well exhibit an amphiatlantic type of distribution. A study of the macrolichen flora of Greenland has also given Dahl (6) the impression of an amphiatlantic migration. After a long exposé of the different theories, Selander (65) seems to favor both. And, of course, the American components in the flora of Greenland (4) and Iceland (38, 38a), as well as the European elements of Newfoundland and eastern Quebec are good evidence of amphiatlantic migrations. And we may all agree with Hultén's assumption that those migrations did not take place during the interglacials but during the glaciation. In fact, as he explains, sea level being at that time 200 m. lower, continents were larger than now, and islands more numerous. Such migrations could easily then have taken place. The scattered distribution of the genus *Alchemilla* in Labrador and eastern Quebec (55) surely favors some European intru-



sion in the American flora, while the actual distribution of *Carex Lyngbyei* Hornem. (map 20) shows not only a migration from the Bering centre to eastern America and western Europe, but also atlantic migration of later date. The fact that the Pacific area population constitutes a race different from the Atlantic [ssp. *cryptocarpa* (C. A. Meyer) Hultén] surely indicates a two-timed process.

5. **WESTERN SPECIES REACHING QUEBEC.** Euryatlantic species, as a rule, are restricted to the easternmost part of Quebec and Labrador. In contrast, the western part of Quebec (the shores of the Hudson and James bays) serves as easternmost extension of many so-called " western " species, i.e., species which have been described from the Rockies ! Hudson Bay is a natural divide, as one may easily understand, between two highly differentiated floras : the eastern and the western. But a number of western species reach the eastern shores of Hudson Bay, some going as far inland as Lake Mistassini, while others have persisted during glacial times in the Anticosti and Mingania district where they still survive: *Cypripedium passerinum* Richards., *Draba aurea* J. Vahl, *Cirsium minganense* Victorin (of the " foliosum-group "), etc. Along the coastal plain of James Bay, and even in Ungava, one may find such western species as *Aquilegia brevistyla* Hook., *Cicuta mackenzieana* Raup, *Eleocharis kamtschatica* (C.A. Meyer) Komarov, *Lactuca pulchella* DC., *Salix alaxensis* (Anderss.) Cov., while the Lake Mistassini region, brought to the fore by the travels of André Michaux (1792), is favoured with the presence of such western species as *Salix arbusculoides* Andrews., *S. Maccalliana* Rowlee and *Ribes hudsonianum* Richards.

As sedges belonging to this phytogeographical category, one may cite the already discussed *C. Franklinii* Boott, *C. Richardsonii* R. Br. in Richards., found on James Bay, in eastern Ontario and western New York, *C. supina* Wahl. reaching Ungava, Baffin Island and Greenland and *C. filifolia* Nutt. isolated in Labrador.

This state of affairs finds its reverse in these eastern species which have western outposts: *Carex lacustris* Willd., collected by Lyall, in 1861, at Pend-d'Oreille (Idaho), *C. tincta* Fern. (Alberta and Washington), *C. projecta* Mack. (17).

6. **HIGH-SUBARCTIC SPECIES:** they never occur southward in bogs of the temperate zone. Restricted to the upper part of the subarctic zone they sometimes penetrate into the arctic: *C. concinna* R. Br. *C. Garberi* Fern., *C. Heleonastes* L. f., *C. miliaris* Michx. and its var. *major* Bailey, *C. media* R. Br. (map 21), *C. Raeana* Boott, *C. stylosa* C.A. Meyer (map 22) which, incidentally, is also an " oceanic " type limited to eastern Asia, western and eastern North America (54). Its alleged presence in Norway has recently been discounted (25).

In the general flora, *Eriophorum brachyantherum* Trautv. & Meyer (58c), *Lonicera involucrata* (Richards) Banks may serve as good examples of high-subarctic species.

6a **LOW-SUBARCTIC SPECIES:** inhabiting the subarctic zone, they are also common in bogs, or other cold habitats in southern Quebec and adjacent New England: *C. atratiformis* Britton, *C. Buxbaumii*

Wahl, (map 23), *C. canescens* L., *C. castanea* Wahl. (52), *C. chordorrhiza* Ehrh., *C. diandra* Shrank. *C. exilis* Dewey, *C. gynocrates* Wormsk. ex Drejer, *C. limosa* L., *C. livida* (Wahl.) Willd., *C. magellanica* Lam. [including *C. irrigua* Wahl.], *C. Michauxiana* Boeckl., *C. oligosperma* Michx., *C. pauciflora* Lightf., *C. sterilis* Willd., *C. tenuiflora* Wahl., *C. trisperma* Dewey, *C. vaginata* Tausch. (with a " jump " in Greenland), etc. (34).

In the general flora, *Eriophorum spissum* Fern., *Betula pumila* L. and *B. Michauxii* Spach, extending southward to St. Pierre and Miquelon Islands and Nova Scotia (63), are good examples of low sub-arctic types.

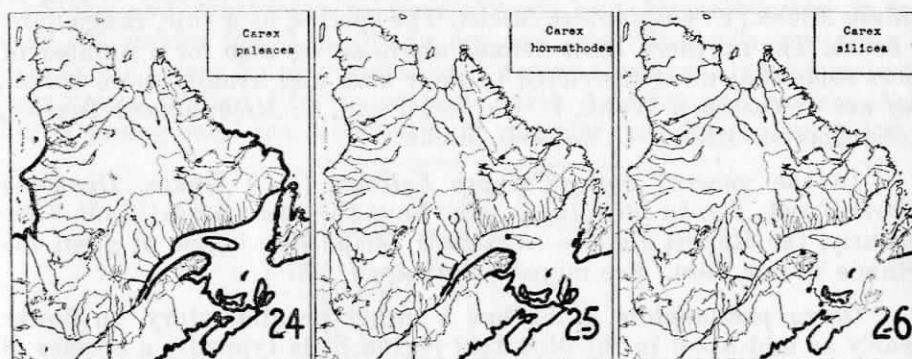


Our subarctic zone as a whole has been poorly understood until recently. Numerous field-trips have brought to attention a tremendous amount of material which shows that the old idea of summarizing the subarctic zone as an area wherein a small number of species occur in great abundance was, to say the least, a very sketchy one. First, the transition between the arctic and the subarctic zones is not abrupt but gradual and the definition by Rousseau of an hemiarctic zone, extending from 60° to 55° Lat. N., seems justified (62).

7. **HALOPHYTES.** From St. Jean Port Joli eastwards to the tip of the Gaspé Peninsula and the Maritime Provinces and northward to southern Labrador and sometimes reappearing along the coast of James Bay, the shores harbour an halophytic flora among which the following sedges occur. The species fall into two groups :

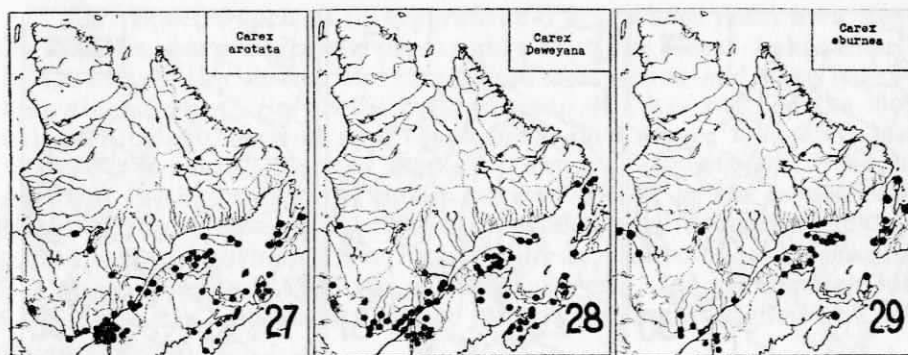
7a. **BOREAL HALOPHYTES** : a few reach even into the arctic and on a strictly phytogeographical basis they could be placed in some of the previously enumerated categories. They are *C. subspathacea* Wormskj., *C. recta* Boott, *C. salina* Wahl., *C. glareosa* Wahl., *C. marina* Dewey (13), *C. paleacea* Wahl. (map 24) and *C. Lyngbyei* Hornem. The last species occurs only on Anticosti Island, in Quebec, and in La-

brador, only on Gready Island. Then it reaches into Greenland, Iceland and the Faroe Islands.



7b. **TEMPERATE HALOPHYTES:** others follow the Atlantic shoreline, at times quite far southwards. They are *C. hormathodes* Fern., which has a wide range: from Saint Jean Port John and Newfoundland to Virginia (map 25), and *C. silicea* Dewey (map 26) occurring rather quite infrequently with us (Gaspé and the Magdalen Islands) though its range extends from Newfoundland to Delaware.

8. The **TEMPERATE-BOREAL** species fall into at least two groups. First, species such as *Carex aquatilis* Wahl., *C. arcta* Boott, *C. leptalea* Wahl., *C. rostrata* Stokes, etc. are known to occur quite far north. Their northern limit follows a line drawn from Richmond Gulf along Lower Seal Lake, Larch and Koksoak Rivers to Fort Chimo. Another group has as northern limit a line which runs from James Bay along Rupert River, across central Quebec, to Anticosti Island: *C. arctata* Boott (map 27), *C. Bebbii* Olney, *C. Crawfordii* Fern., *C.*



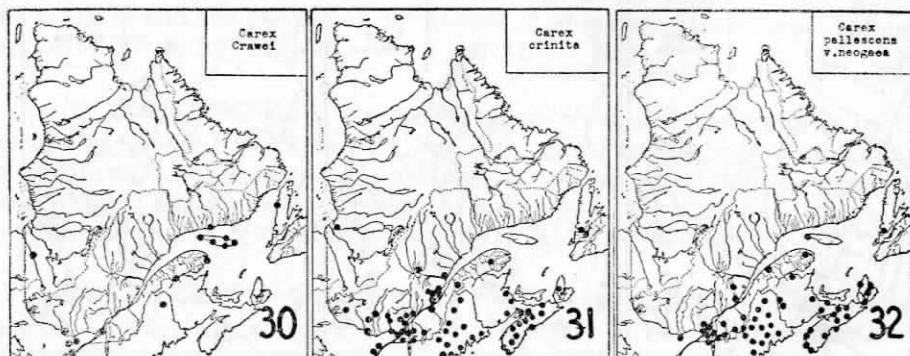
erinita Lam., *C. debilis* Michx. var. *Rudgei* Bailey, *C. Deweyana* Schwein. (map 28), *C. eburnea* Boott (map 29), *C. Haydenii* Dewey, *C. Houghtonii* Torr., *C. intumescens* Rudge var. *Fernaldii* Bailey, *C. lasiocarpa*

Ehrh. var. *americana* Fern., *C. lenticularis* Michx., *C. leptonevria* Fern., *C. normalis* Mack., *C. pedunculata* Muhl., *C. prairea* Dewey, *C. retrorsa* Schwein., *C. scoparia* Schk., *C. stipata* Muhl. *C. tribuloides* Wahl., *C. viridula* Michx., *C. vulpinoidea* Michx. The species, as a rule, range quite far south. The northern limit defined above serves also for a number of others somewhat more restricted in their area and usually more boreal. They are *C. castanea* Wahl., *C. Garberi* Fern., *C. Michauxiana* Boeckl., *C. oligosperma* Michx., *C. miliaris* Michx.

In the general flora, *Calypso bulbosa* (L.) Oakes, *Gentiana linearis* Froel., *Typha latifolia* L., etc., have the same boreal limit. Consequently, the Rupert River — Anticosti Island line is one of great importance in our flora. See maps in Raymond (57).

Carex pedunculata Muhl. has a rather peculiar story. In flower as early as mid-April in the Montreal region, it is typically a species of the *Acer saccharophorum* — *Fagus grandifolia* association. It covers large tracts of maplewoods in the inhabited part of Quebec. Outside of the sugar-maple area, *Carex pedunculata* Muhl. seeks refuge away from woods, probably to fully assure its annual dose of light. We find it on cornices at Percé and in bogs along the York River, in Gaspé County (7). The same may be said of *Carex leptonevria* Fern., frequent in clearings and subalpine meadows of Gaspé.

9. A group of species extends, but only locally and in sheltered spots, to Gaspé, the Lake St. John district, Anticosti, and sometimes reaches the southern half of western Newfoundland. To the group belong *Carex Crawei* Dewey (map 30), *C. crinita* Lam. (map 31), *C. pallescens* L. var. *neogaea* Fern. (map 32) and *C. lacustris* Willd. (fig. 33). They usually occur throughout Nova Scotia and presumably New Brunswick, though the information on the New Brunswick flora is extremely scanty.



* *C. Crawei* and *C. lacustris* are both recent additions to the flora of Newfoundland, thanks to the bryologist Risto Tuomikoski (Helsinki).

10. *Carex ormostachya* Wiegand presents a most interesting distribution which extends from Bic and western Nova Scotia across southern Quebec, northward to the height of land, westward to Minnesota and Michigan and southward to Pennsylvania and Massachusetts. It is a clear cut species found mostly in dry soil and frequently occurring in open sandy places, in pine woods or in recent clearings. It belongs to the LAXIFLORAE limited (†) to eastern North America and eastern Asia, with a strong southern distributional character, but for the exception of



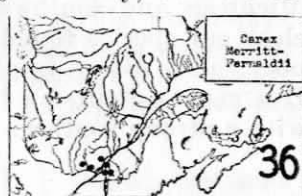
two species: *Carex leptonevia* Fern. reaches the Lake Mistassini area, Anticosti Island, Gaspé and Newfoundland. *C. ormostachya* Wiegand extends northward to the Lake Dumoine-district (Hustich), Lake St. John area (Kennedy), Quebec City (an old specimen in Boott's herbarium, collected by Mrs. Sheppard), and Bic (Forbes). See Raymond (58b).

The sand-loving *C. adusta* Boott and *C. katahdinensis* Fern. (the latter with its very restricted range: Newfoundland to Lake St. John, Quebec and Maine) have also the same northern limit as *C. ormostachya* Wiegand.

11. Species such as *C. argyrantha* Tuck. whose main area lies in the Prairies, have migrated, presumably from the Great Lakes area, to the Ottawa Valley during the Champlain Sea period and have survived there since then. *C. Sartwellii* Dewey (map 34) has reached the Montreal Archipelago, as well as *C. sychnocephala* Carey (map 35), while *C. Merritt-Fernaldii* Mack. (map 36) and *C. Muhlenbergii* Schk. are abundant in the sand dunes along Lake St. Peter, at the mouth of the Richelieu River. They grow there in association with species highly localized with us, such as *Aster linariifolius* L., *Convolvulus spithameus* L., *Cyperus filiculmis* Vahl var. *macilentus* Fern., *Juncus Greenei* Oakes & Tuck., *Lechea intermedia* Leggett var. *laurentiana* Hodgdon or *Lilium philadelphicum* L.

(†) Except for *Carex Hendersonii* L.H. Bailey, ranging from Sonoma County, California, to southwestern British Columbia, including Vancouver Island.

Through the same procedure, other species have migrated not only to the Ottawa Valley, but to the Richelieu Valley as well. These are: *C. Grayii* Carey, *C. hirtifolia* Mack., *C. platyphylla* Carey, *C. Hitchco-*

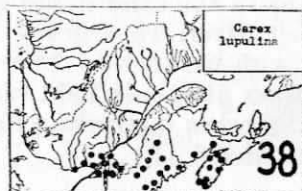
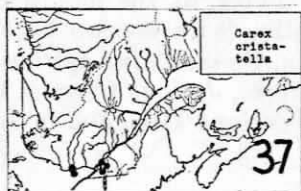


ckiana Dewey, *C. Sprengelii* Dewey and *C. typhina* Michx. Concerning this, McLaughlin's (39a) explanation of the presence of coastal elements in the Great Lakes area seems to present some useful clues to our own problem:

According to Taylor, during the Lakes Chicago and Warren Stage of the glacial Great Lakes there existed a connective across the Grand River Valley of southern Michigan. Lake Chicago was draining southwestward through the Chicago outlet. Lake Warren, in the Erie Basin, extended eastward into the Finger Lakes district of New York. At the Lakes Chicago and Lundy Stage the ice had withdrawn in part from the western end of the Superior Basin leaving Glacial Lake Duluth with an outlet through the Brûlé and St. Croix Rivers. Lake Chicago continued to drain through the Chicago outlet, but the Grand River connective had ceased to function, and Lake Lundy in the Erie Basin had found an outlet eastward past the ice margin down the Mohawk and Hudson River Valleys. From the present flora of the Ottawa River Valley, the Hudson and Mohawk Valleys, and the Grand River Valley, Peattie finds evidence that these connectives were formerly paths of westward migration for coastal plain species...

Nowadays, in Quebec, the aforementioned species are seldom if ever found outside the Ottawa and the Richelieu Valleys with the Montreal Archipelago as a northernmost limit attained by only a few of them. A fairly representative number of vascular plants have penetrated into Quebec via this route, among which many important trees belonging to the genera *Carya*, *Celtis* and *Quercus*.

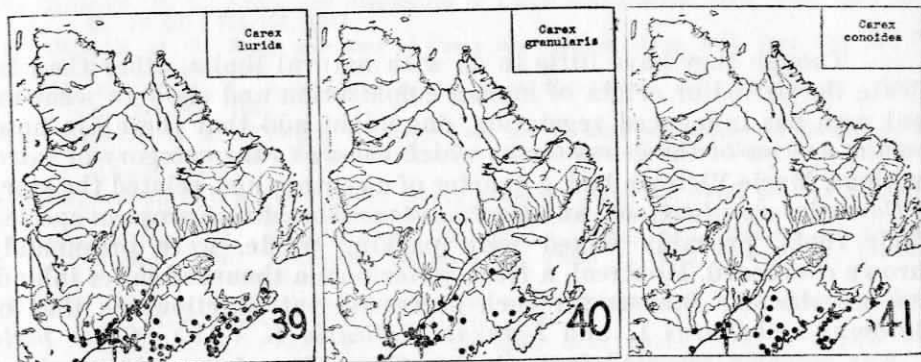
Lake St. Peter is an important limit for these species which inhabit the *Aceretum saccharophori laurentianum* climax of Dansereau (6a) such as *C. albursina* Sheldon, *C. alopecoidea* Tuck., *C. amphibola* Steud. var. *turgida* Fern., *C. blanda* Dewey, *C. folliculata* L., *C. formosa* Dewey, *C. laxiflora* Lam., *C. plantaginea* Lam., *C. prasina* Wahl., etc., but which do not follow the Sugar Maple to its Laurentian or Gaspesian outposts.



It serves also as northeastern limit for species which play a part in the *Aceretum saccharophori caryosum* such as *Carya ovata* (Mill.)

K. Koch, *C. cordiformis* (Wang.) K. Koch, *Celtis occidentalis* L., *Desmodium glutinosum* (Muhl.) Wood, *Gentiana Andrewsii* Griseb., *Habenaria flava* (L.) A. Gray var. *herbiola* (R. Br.) Ames & Correll, *Hydrophyllum virginianum* L., *Menispermum canadense* L., *Quercus alba* L., *Q. bicolor* Willd., *Q. macrocarpa* Michx., *Salix amygdaloides* Anderss., *Uvularia grandiflora* J. E. Sm., *Trillium grandiflorum* Michx., *Viola canadensis* L., etc. *Carex Grayii* Carey and *C. typhina* Michx., restricted to the Ottawa and Richelieu Valleys, as well as *C. lupulina* Muhl. (map 38) must be cited again here in connection with this quasi-climax as they are components of the herbaceous layers.

12. *Carex lurida* Wahl. (map 39), *C. granularis* Muhl. (map 40), and *C. conoidea* Schk. (map 41) extend quite far south, the first two reaching Florida and Texas, the third, North Carolina. They are not known to occur further northeastward than Quebec City, which itself



is an important limit for a number of vascular plants such as *Allium tricoccum* Ait., *Aquilegia canadensis* L., *Celastrus scandens* L., *Hamelis virginiana* L., *Juglans cinerea* L., *Panax quinquefolius* L., *Pedicularis canadensis* L., *Carex granularis* Muhl. The last species, one of moist meadows in calcareous districts, very often grows with *C. conoidea* Schk. and *C. pallescens* L. var. *neogaea* Fern. in the Montreal region, but does not appear in Nova Scotia.



13. Finally, the mostly dolomitic hills of the southern part of Brome and Missisquoi Counties serve as northernmost limit for many

southern types not known to occur elsewhere in Quebec, such as *Carex Baileyi* Britton, *C. hirsutella* Mack., *C. virescens* Muhl. and *C. Swanii* (Fern.) Mack. (map 42).

Other elements of the general flora, *Asplenium platyneuron* (L.) Oakes, *Dryopteris simulata* Davenp., *Muhlenbergia tenuiflora* (Willd.) BSP., *Phytolacca americana* L., *Viola rostrata* Pursh, *Woodsia obtusa* (Spreng.) Torr., etc. behave the same way.

* * *

Though they have little to do with natural limits, other than indicate the period or origin of human colonization and show to what extent man has influenced vegetation, one might add that there are noteworthy species of the genus *Carex* which belong to the category of introductions. Marie-Victorin had, a quarter of a century ago, related the story of *Carex intermedia* Good. and *Carex nutans* Host, two European species. Their roots, probably mixed with packing waste, were presumably thrown overboard. Montreal, a fresh water port a thousand miles inland, has now become famous for such successful introductions as that of *Butomus umbellatus* L. and *Lythrum Salicaria* L. (41). *Carex hirta* L. was recently reported from Quebec City. There is an old specimen of *Carex flacca* Schreb. (*C. diversicolor* Crantz) collected by Burgess, in Lachine, in 1886 (51).

As a rule, sedges do not have the reputation of introducing themselves freely though, in North America, such European species as *Carex spicata* Huds., *C. virens* Lam., *C. leporina* L., *C. caryophyllea* Latourr., *C. panicea* L., *C. sylvatica* Huds., *C. acutiformis* Ehrh., firmly established themselves especially along the Atlantic sea board, quite a long time ago. The Japanese *Carex Kobomugi* Ohwi grows in the sandy dunes of New-Jersey, while the American *Carex vulpinoidea* Michx. was found in France, at La Bresse, in 1857 (36), only to be described as a new species!

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