The Species of *Carex* in the Himalayan-Japanese Link
Taxonomic study of Cyperaceae 10**

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§22. A group of Japanese plants called the Himalayan-Japanese species is an example of a disjunct distribution. As illustrated in Fig. 21, the main area of such plants spreads widely over the highland of Himalaya with very isolated small areas in Japan and its surrounding regions. The common geographical characteristic of these plants is that they are quite absent from central and northern Chinese lowlands. The main area usually covers all over the Himalaya Mountain Range from Kashmir westwards to Afghanistan, or further eastwards to Yunnan and Szetchuan in China. Rather in many cases, the high mountains of Ceylon, the southern part of Deccan Peninsula, west coast of Sumatra, and Java are also marked as the isolated small areas. Further it is notable that the plants of the Himalayan-Japanese link are never found in the Philippines, Borneo, Celebes, and New Guinea, where they are replaced by a more common other group, the plants in the Indian-Malaysian link. Although the areas of these two different distribution types overlap one another in the southern part of India, Ceylon, Sumatra and Java, these two are generally distinct phytogeographically.

The Japanese flora being relatively well known, the data from Japan enable us to draw a fairly accurate boundary of the distribution area of each entity as for the area in Japan, while it is often very difficult to fix especially the northern and the easternmost boundaries of the main area, owing to the problems of the Himalayan Carices in Tibet left still in the vague, and to the lack of data available from the northern part of Thailand. The main area, therefore, may be actually more continuous in its southeastern end, and its northern boundary facing Tibet may extend far more northwards.

On account of its large number of species, the genus *Carex* provides us with very good materials for the phytogeographical observations in taxonomy. Among some 200 Japanese species of *Carex*, those of the typical Himalayan-Japanese link are represented by nine, viz. *C. fedia*, *C. Jackiana-parcisflora* complex, *C. ligulata*, *C. maculata*, *C. nubigera*, *C. olivacea-confertiflora* complex, *C. pruinosa-Maximowiczii* complex, *C. Rochebruni*, and *C. teinogyna*. The following are the taxonomical observa-

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tions made on these nine entities.

In preparing this paper, my heartfelt thanks are due to Dr. G. Taylor (Director) and Mr. E. Nelmes of Kew, for their kindness in sending me several Indian and Malaysian Carices on loan, which were indispensable to me for the final criticism of some species. The collection made by the Japanese-Himalayan Expedition and various small collections from China, both kept in the Kyoto University (KYO), and Dr. Hayata's Indo-Chinese collection in the University of Tokyo (TI) were of great use. Almost all the Far Eastern specimens used in this study are preserved in my private herbarium. I am also grateful to Professor H. Hara and Dr. J. Ohwi who are always at hand with kindness and encouragement.

(1) Carex fedia Nees ex Wight—Fig. 21.

Indian C. fedia, more commonly known as C. Wallichiana, has Japanese and Korean variants in the Far East often referred to var. Miyabei and var. pilifera respectively. Though rather isolated geographically, the typical var. fedia, var. Miyabei, and var. pilifera are strikingly akin except for a few characters mentioned in the table below.

Comparing var. Miyabei with var. pilifera, I have a strong impression that they are independent from an evolutionary point of view, and in the general aspect var. pilifera comes closer to Indian var. fedia than to var. Miyabei itself.

Table showing the characteristic differences among the 3 variants of C. fedia Nees.

<table>
<thead>
<tr>
<th>Parts</th>
<th>Taxon</th>
<th>Fedia</th>
<th>Pilifera</th>
<th>Miyabei</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basal sheaths</td>
<td></td>
<td>coriaceous,</td>
<td>rigid, reddish-brown.</td>
<td>rigid later,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>chestnut-purple.</td>
<td></td>
<td>reddish-brown.</td>
</tr>
<tr>
<td>Female spikelets</td>
<td></td>
<td>short-peduncled (less than 5 mm.) to sessile, the body 6-7 mm. thick with very dense flowers, the uppermost one often with staminate part.</td>
<td>nearly sessile or the lowest with short peduncle inclosed in bract sheath, dense-flowered, 6-7 mm. thick, sex distinct.</td>
<td>peduncle elongate to 2 cm., body 5-6 mm. thick with flowers rather loosely disposed, sex usually distinct.</td>
</tr>
<tr>
<td>Perigynia</td>
<td></td>
<td>coriaceous, ovate, 5-6 mm. long with an upright beak about 1 mm. long, wholly very hairy thus nerves being very obscure.</td>
<td>subcoriaceous, ovate, 5-6 mm. long, abruptly contracted to an upright beak almost 1 mm. long, very loosely hairy.</td>
<td>herbaceous, ovate-elliptical, 4-5 mm. long, with gradually narrowed 1.5 mm. long beak, less hairy thus faintly nerved.</td>
</tr>
</tbody>
</table>
except for its nearly glabrous perigynia, though on the map (Fig. 21) their areas are seen as if there were an evolutionary relationship between var. pilifera of Korea and var. Miyabei in Kyushu, Japan. However, it is natural to consider that var. Miyabei in northern Honshu, and western Hokkaido spread to Japan from the north, possibly through Saghalien. Further a special mention is needed as to its occurrence in Kyushu. The Kyushu plants in such a pattern of distribution are usually connected with the Korean-Japanese link, however, in this sedge, no close taxonomical relationship is found between var. Miyabei in Kyushu and var. pilifera in Korea as stated above, and Kyushu is only regarded as the southernmost locality of the northern var. Miyabei. Accordingly, all var. Miyabei in Japan would have migrated into Japan only through the northern route of distribution or the so-called Saghalien-Hokkaido Stepping. Really at present, such a northern plant as Scirpus Wichurai is collected in northern Kyushu. Korean var. pilifera, by the way, seems not to have reached Kyushu, though the Kyushu individuals were once referred to C. glabrescens, a synonym of var. pilifera.

(2) Carex pruinosa Boott—Fig. 22.

C. pruinosa is represented in Japan by well known C. Maximowiczii. Up to the present the former has been known only from Himalaya and Java. The recent discovery of C. pruinosa from the Indo-Chinese peninsula connected the very remote two localities though incompletely, suggesting that the distribution pattern of C. pruinosa might come close to that of C. Maubertiana (cf. T. Koyama in Act. Phytotax. et Geobot. 16: 38, f. 5. 1955).

Although C. Maximowiczii resembles C. pruinosa s. str. in the general appearance, it is fairly well differentiated morphologically from the latter, hence most specialists concerned have treated it to be specifically distinct from the latter. Kükenthal, however, was the first who found the taxonomical similarity between these two, treating C. Maximowiczii as a subspecies of C. pruinosa. Both from geographical and morphological observations, I agree with the opinion of Kükenthal that the two must have been originated from their common ancestor thought to be similar to C. pruinosa s. str. in the present day. The main differences between them are keyed as follows:

A. Spikelets 4 to 5 to a culm, suberect to subcoriaceous, the body 2 to 5cm. in length and 4 to 7mm. in width; perigynia elliptical 3-4mm. by 1.8-2.2mm., with an elliptical-ovate scale. ............................................................. Subsp. pruinosa.

AA. Spikelets 2 to 4 to a culm, pendulous, the body 1.5 to 3.5cm. in length and 7 to 10mm. in width; perigynia broadly ovate, to rhombic-ovate, 3.5-4.5mm. by 2-2.5mm., with an oval scale ending in a 2mm. long awn. .......................... Subsp. Maximowiczii.

To the Eastern-Asiatic C. Maximowiczii are attributed two local variations, var. suifunensis originally reported from the easternmost part of Manchuria, and var. levisaccus from Japan. The latter is characterized by quite smooth perigynia and often thicker spikelets, but its area is perfectly included within that of C. Maximo-
wiczii s. str. Var. suifunensis with very cinereous smaller perigynia less than 3.5 mm long and fewer spikelets on more rigid culm is a northern Korean population, and is recently found at one locality in central Honshu of Japan as a quite local existence. As illustrated in Fig. 17, C. Maximowiczii s. str. covers all Japan and also extends as far as to central Korea, where it contacts with var. suifunensis, of which area extends northwards up to Suifun in eastern Manchuria. The southernmost record of C. Maximowiczii s. str. from Okinawa is based only upon a specimen collected there by Sakaguchi (KYO!), but since then no other person has found it in Okinawa nor has ever been recorded in the islands lying between Okinawa and the southern part of the mainland of Kyushu, the datum is doubtful to some extent.

The migration route of C. Maximowiczii into Japan is explicable by the Korean-Japanese Land Bridge. It has long been said that at least by the late Tertiary, the mainland of Japan is believed to be connected with the Korean Peninsula by a land bridge, through which many continental plants might have reached Japan. But on the other hand, the distribution of var. suifunensis gives us a clue to analyze the process of speciation of C. Maximowiczii s. lat. Var. suifunensis was found at the foot of M. Yatsugatake in central Japan (cf. T. Koyama in Journ. Jap. Bot. 30: 134. 1955), where we have noticed many northern Chinese plants, for instance Crataegus pinnatifida Bunge, Geranium soboliferum Komarov, etc. The group of plants is thought to have once occupied a more larger area in Japan in the Tertiary. Var. suifunensis, therefore, would have also spread in Japan at the time or so, and now its area must have restricted owing to the climatic factors, being followed by the differentiation of var. Maximowiczii s. str. Var. levisaccus, the smallest local popula-
tion, would have been born further from *C. Maximowiczii* s. str. It is interesting that some morphological characters in the following tendency also correlated well with this series of specific differentiation as given below.

(3) *Carex nubigera* D. Don—Fig. 23.

*C. nubigera* presents a typical distribution pattern of Himalayan-Japanese Elements. Its main area spreads widely over the highland of Himalaya from Afghanistan eastwards to Hupeh and Yunnan in China. The fragmental branch areas are scattered in montane regions of Ceylon and southern India, Sumatra and Java, Formosa, and in the lowlands in Japan. Two morphologically differentiated variants are found, *C. albata* of the northern Japan, and var. *Franchetiana* of the western Japan. In *C. nubigera* s. str. from Himalaya ovate-elliptical pale perigynia 4 to 5 mm. in length compose rather dense spikes with an elongate leaflike bract at the base. Japanese *C. albata* differs from typical *C. nubigera* chiefly in its larger habit, more dense inflorescence, brown-tinged scales, and deltoid-lanceolate perigynia terminated by a longer brownish beak, up to 5.5 mm. long. Var. *Franchetiana*, intermediate between the two, comes closer to *C. nubigera* than to *C. albata*, and differs from the former by its shorter perigynia 4 to 4.5 mm. long and spikes without any leaflike bract at the base. Fig. 23, bottom indicates the different processes of migration of the two into Japan. The area of *C. albata*, lying in northern Japan rather on the Japan Sea side, proves that the plant was distributed to Japan through the northern route, whereas the area of var. *Franchetiana* shows that it is the typical continental element, extended into Japan through the Korean-Japanese Land Bridge. Var. *Franchetiana* has once been wrongly treated as a variety under *C. albata*, but from this view both *C. Franchetiana* and *C. albata* should be coordinate infraspecific taxa attributed to the Indian *C. nubigera*.

Another similar case is observed in *C. Jackiana* Boott and its Japanese population, subsp. *parciflora* Kükenthal. As its taxonomy has already been discussed (T. Koyama in Bot. Mag. Tokyo 70: 352-357. 1957), subsp. *parciflora* includes two large variants, var. *parciflora* and var. *macroglossa*. The former, a typical Boreal-Japanese Element, is interpreted as having migrated to Honshu from northwards, while the latter is thought to have entered into Honshu through Korea and afterwards ex-
tended northwards to Hokkaido (Fig. 24). In *Carex nubigera*, the morphological differences among its local populations are still very slight so that they are treated as varieties, however, the more advanced speciation seen in Japanese ssp. *parciflora* makes it possible to grant a subspecific status for it.

(4) *Carex ligulata* Nees ex Wight—Fig. 25.

In the phytogeographical respect, the occurrence of *C. ligulata* in Shikoku, western Japan, is the only difference from the above mentioned cases of *C. fedia* and *C. pruinosa*. Also a notable thing is that *C. ligulata* var. *austro-koreensis* is known as a variant in southern Korea. Since all the specimen from the mainland of Japan quite well agrees with those from India and China taxonomically, the Korean variety differing from typical one in more glaucous leaves and culms with more densely flowered spikelets and lighter colour of scales, is regarded to have been relatively newly differentiated from the typical *C. ligulata*.

Therefore, the migration route of this plant into Japan can be the so-called Korean-Japanese land bridge mentioned in the previous paragraphs. This route is just like one which the Japanese botanists have accommodated to a group of Chinese continental plants occurring in western outer Japan, called the Sohayaki elements. But the true Sohayaki elements are a group of relict species distributed in Kyushu, Shikoku, and Kii peninsula, their area sometimes further extending a little eastwards to western Tokai district, while the area of *C. ligulata* is larger, covering also northern Kyushu and Chugoku district of Honshu. Thus *C. ligulata* can not be treated as belonging to the Sohayaki elements.

*C. Rochebruni*, *C. teinogyna*, *C. maculata* and possibly *C. poculisquama* present the similar distribution pattern to that of *C. ligulata*. *C. Rochebruni* has a local variety in northern Formosa, named as var. *remotispicula*. The area of *C. maculata* is more extensive covering also northern Ryukyus, and its arm stretches out also to Java and the Moluccas. The Okinawan variety is named var. *Tetsuoi*. *C. teinogyna*, however, is not much differentiated. I agree with Nelmes in regarding the Japanese plants as quite identical with the Indian plants. *C. poculisquama* Küikenth. is a good ex-
ample of relict, known only from three localities, Nanking in China, Akiyoshidai in the westernmost part of Honshu, and Mt. Iwafune in central Honshu, Japan. This very rare sedge is expected to be found in the Himalayas.

(5) *Carex olivacea* Boott—Fig. 26.

*C. confertiflora* from Japan and *C. recurvisaccus* from Kwantung in China are the closest to *C. olivacea* of Himalaya and Java. Kükenthal and others are of opinion that *C. olivacea* and *C. confertiflora* are identical. Franchet and Ohwi, however, dis-

Table exhibiting the differences among *C. olivacea* and its allies.

<table>
<thead>
<tr>
<th>Part</th>
<th><em>Olivacea</em></th>
<th><em>Recurvisaccus</em></th>
<th><em>Confertiflora</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Perigynia</td>
<td>broadly obovoid or ellipsoid-obovoid, 3-4.5 by 1.5-2 mm., beak about 1 mm long, recurved, conical, bidentulate</td>
<td>broadly ellipsoid or ellipsoid, 3.8-5 by 1.2-1.5 mm., beak conical-cylindrical, less than 1 mm long, obliquely truncate to bidentulate at crifice</td>
<td>broadly obovoid to almost orbicular, 3.8-4 by 2.5-3 mm., beak bented down, cylindrical 1 mm long, bidentulate</td>
</tr>
<tr>
<td>Scale of pistillate flower</td>
<td>brown-red, rounded at muticus apex</td>
<td>brown-red, obtuse at muticus apex</td>
<td>pale, oblong, acute to acuminate at tip with an awn up to 3 mm. long</td>
</tr>
<tr>
<td>Spikelets</td>
<td>5 to 9 of which 1 to 2 being male, the body of female ones 3-16 by 0.5-0.8 cm., rather dense-flowered</td>
<td>5 to 7 of which 1 to 2 male, the body of female one 7 to 11 by 0.6-0.8 cm., rather loose-flowered</td>
<td>3 to 6 of which 1 (-2) male, the body of the female ones 2.5-5 by 0.7-0.9 cm., very dense-flowered</td>
</tr>
<tr>
<td>Leaf sheaths</td>
<td>brown-red</td>
<td>brownish to yellow-brown</td>
<td>brownish-pale</td>
</tr>
</tbody>
</table>

Fig. 26. Distribution of *Carex olivacea* s. lat.

*Himalaya, Jenkins (K)!, Sikkim, Hooker f. (K)!
sively gone out of existence.

Only from the data of distribution of Japanese ssp. confertiflora itself, it is impossible to consider the route by which this plant had migrated into Japan. But, the taxonomical link basing upon the morphological characters between C. olivacea and its ssp. confertiflora gives a credit to regard ssp. confertiflora as it would have been extended into Japan directly from the central Chinese existence which is now much depleted with the retrogression of the area.

As fully discussed above, the three migration routes are observed as to the distribution of the Himalayan-Japanese species of Carices into Japan. The first route coincides with what the Japanese taxonomists named the Central-China-Japan direction to accommodate the so-called Sohayaki Elements. The Carices of this group suggesting this route, always occur in western Japan including southern Kyushu, Shikoku and the Chugoku District, but the reason why it is not adequate to regard them as the true Sohayaki Elements is that they have much larger area where they grow rather luxuriantly, thus seem to be probably younger and not to be relics.

The second route is the so-called Korean-Japanese Land Bridge. The sedges of this group which are thought to have migrated into Japan through this course, have never been noted in Shikoku. Usually their areas agree with those of the Manchurian and northern Chinese Elements distributed in the Chugoku District in Japan, including, for example, Celtis Leveillei Nakai, Rhododendron mucronulatum Turcz. etc.

The third is the northern route passing through Saghalien and Hokkaido southwards. The sedges belonging to this group are found in the northern parts of Honshu centering around the deep snow region just like the so-called Boreal-Japanese Elements.

C. ligulata Nees; C. pruinosa Boott, and C. fedia Nees are examples of the first, the second, and the third geographical category respectively here stated. Further, it is noteworthy that C. nubigera D. Don and C. Jackiana subsp. parciiflora Kükenthal have two geographical local populations each, one belonging to the Boreal-Japanese Elements, and another being a kind of the northern Chinese and Korean Elements found in the Chugoku district of western Japan.

Nomenclatorial treatments

   var. fedia.
   var. pilifera (Kükenthal) T. Koyama, comb. nova—C. Wallichiana Nees var. Miya-bei Kükenthal forma glabrescens Kükenthal, Cyper.-Caric. 749 (1909)—C. drymophila


var. maculata. Japanese name: Tachi-suge.


N. B. As to the name of the section to which C. olivacea belongs, I agree with Nelmes (Reindwardtia 1: 395, 1951), who is of opinion that the section Tumidae Kükenthal is relatively heterogeneous but is difficult to separate into more than two groups. Being Tumidae Kükenthal a later homonym of Tumidae Meinsh., Molliculae Ohwi is nomenclatorically correct to accommodate to this section. A name Confer-tiflorae is the oldest, but in Franchet's opus, this name appears as a nomen nudum without any definite rank, and further, in its original sense, Franchet's Confertiflorae incidentally did not include neither C. confertiflora nor C. olivacea.

ある。この節ではこれらの分類学的な諸考察をまとめている。挿入した分布図が示す様に分布域の中心はヒマラヤ山地にあり、その周辺日本やスマトラ・ジャバに伸び出していて、それらの間に著しい不連続が見られる。中国本部は特に広い干渉地域であって、日本産の植物は本文でそれぞれ亜種や変種の扱いをした様な種々の程度の分化が見られる。この要素のスゲはマレーシアに分布する場合はスマトラ西部からジャバに達する山地帯以外にあらわれないのも一特徴である。結論として得た関係事項は文末の学名変更によってあらわれている。