Background and most memorable moments of my peat-moss life

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Preface

The term peat-moss in this paper refers to species within the three formal families recognized within the order Sphagnales: (1) the family Sphagnaceae with the single genus *Sphagnum* with many widespread species, (2) the family Ambuchananiaceae with the single genus *Eosphagnum* with one single species, *E. rigescens* (Warnst.) A.J. Shaw & Flatberg known from Patagonian part of Chile, southernmost South America, and (3) the family Flatbergiaceae with the genus *Flatbergium*, with the two known species *F. sericeum* (Müll. Hal.) A.J. Shaw and *F. novocaledoniae* (Paris & Warnst.) A.J. Shaw & Flatberg. The first of these two species is so far recorded from New Guinea, Indonesia, Malaysia and Philippines, and northward to China, while the second species is only known from the island New Caledonia east of Australia.

My background

My fascination for the *Sphagnum* (peat-moss) world started when I made the fieldwork for my cand. real. thesis in botany, during the last years of the 1960-ies, and finished it in 1970. The purpose of this work was to describe the vegetation and some ecological conditions of the mire Nordmyra near Trondheim city, Central Norway. I found this work rather tedious; much more joy gave the fascinating variation in colours and morphological details among the various peat-mosses growing on the mire. During the summers, 1970 and 1971 much of my fieldwork was spent on investigation of mire localities in southern parts of Norway with the purpose to establish a national protection plan for mire reserves in Norway. This was done in collaboration with my close mire friend Asbjørn Moen. This extensive fieldwork gave me the opportunity to learn and identify many of the Norwegian peat-mosses in the field, and to collect taxonomically troublesome plants for indoors microscopic examinations.

When I got a permanent scientific position at the university in Trondheim (now NTNU-Norwegian University of Sciences and Technology) in 1973, and later as a professor at the University Museum (from 1989), my research was mainly concentrated on detailed peat-moss examinations both in the field and under the microscope to clarify intricate taxonomic relationships. This included both revisions of herbarium collections material made by other persons, and material collected by myself and close colleagues during field trips in Norway and afterwards in many other countries worldwide. Taxonomically this activity has resulted in publication of 21new taxa at species level within the family Sphagnaceae, and two non-*Sphagnum* species *Eosphagnum rigescens* and *Flatbergium novocaledoniae*.

Although at the start of my peat-moss life I used much time behind the microscope to identify field- collected plants, my clear ambitions were to learn them in the field when travelling around at peat-moss localities. In this respect, I was highly inspired by an epoch-making paper made by the Finnish expert and field botanist of peatlands professor Risto Tuomikoski (1946). In some way, I got a Nordic version of this paper and it formed my taxonomic attitude. I never joined Risto in the field, but once during the early 1990-ties I had the opportunity to meet him when visiting Helsinki (Koponen et al. 2013). During these years I also got in very close contact with Pekka Isoviita, the eminent Finnish sphagnologist. We had joint excursions together sharing field identification knowledge of peat-mosses, and he also introduced me to the Finnish sauna tradition. Later, I described a new peat-moss species and named it in honour of his name, *Sphagnum isoviitae* Flatberg, now it is often classified as a variety of *S. fallax* (H.Klinggr.) H.Klinggr.

Since that time my field philosophy and practice has been: 1) at a peat-moss locality focusing eyes strongly on the peat-moss surface to discover morphs, which require collecting; 2) preserving all field collections at an institution with scientific herbarium; 3) taking relevant close-up photos in the field showing capitulum morphology and mixed stands of related species.

Discovery-stories of peat-mosses in Norway

Norway including the mainland, and the arctic Svalbard archipelago and Jan Mayen, has the highest number of peat-moss species in Europe, housing all known species except for seven: *S. skyense* Flatberg, *S. lenense* H. Lindb., *S. pylaesii* Brid., *S. mirum* Flatberg & Thingsgaard, *S. recurvum* P. Beauv., *S. tescorum* Flatberg, and *S.nitidulum* Warnst. In Svalbard 14 peat-moss species are found. Nine of them are shared with mainland Norway. All species known at that time were described and illustrated in my book "Norges Torvmoser" (2014), a milestone for me.

Discovery of Norwegian endemic species - *Sphagnum troendelagicum* Flatberg

During the summer 1987 I had the opportunity to investigate the peat-moss flora of many mires north in Trøndelag, central Norway. One day, visiting a mire locality in Høylandet municipality I was walking around with deep eye concentration on the bottom layer bryophytes. My field companion Inga Bruteig later on told me that suddenly I jumped up with a peatmoss in my hands, and shouted: "This can be a new peat-moss species!" The same peat-moss was afterwards found on several new localities in the same district. I decided that this new peat-moss should be named in honour of the most species-rich *Sphagnum* area in Europe, namely the northern part of the Trøndelag province, and I published it as *Sphagnum troendelagicum* sp. nov. Careful morphological and genetic studies proved the distinctness and origin of this species, and it turned out to be a new allodiploid species with *S. balticum* (Russow) C.E.O.Jensen and *S. tenellum* (Brid.) Pers. ex Brid. (female) as parents (Flatberg 1988a). Despite eager search for the species both in Norway and other countries, including Scotland and eastern and western North America, it was not found. Therefore, *S. troendelagicum* is an endemic species, not found outside Central Norway. When and where it had its origin is unknown. Genetical methods have not given a clear answer, although a single origin is supported by Bayesian computation (Stenøien et al. 2011). At present the species is not documented with sporophytes or perichaetial buds, although sometimes plants are found with seemingly antheridial branches, but lacking antheridia. On the other hand, the outer brown-coloured branch ends of such capitulum branches easily break off during late autumn and can function as vegetative diaspores of the species,

In 2015 *Sphagnum troendelagicum* was given national Norwegian protection. This also included economic funding to establish a management plan for monitoring and preservation of the species. This work started in 2016 under the head of the "*Sphagnum* group" in Trondheim organized by Kristian Hassel and has continued near yearly since then. During this work, new localities for the species have also been discovered, but still the species occurs with rather scattered small peatland mats in a geographically discontinuous pattern with preference for nutrient poor lawn and fen mire carpets close to surrounding mineral ground of moist heath and forests. During field search for new localities of the species in 2022, a few small patches of the species were discovered under an electric power line crossing a mineral ground *Pinus*-forested hill and connecting two mire localities with *S. troendelagicum*. The trees were removed before the establishment of the power line, and afterwards small, moist depressions appeared, which were suitable for peat-moss establishment. Moose is common within the distributional area of *S. troendelagicum*. Our hypothesis is that the branch end tips formed during autumn can be fastened to the hairy lower parts of legs of the moose when walking

around, and thus contribute to dispersal of the species to suited microhabitats. This also can explain the spotted geographical occurrences of the species. However, so far we do not know.

Photo 1. *Sphagnum troendelagicum* Flatberg, endemic species. Northern Trøndelag, Grong, Biskoplifjellet, Sept. 1999.

Discoveries on Svalbard

Together with my colleague Arne A. Frisvoll we published *Sphagnum arcticum* Flatberg & Frisvoll as a new species from Svalbard (Flatberg & Frisvoll 1984). However, my first trip to Svalbard was in July 1989, when I got the opportunity to visit some peat-moss localities in the Isfjorden area near Longyearbyen in Spitsbergen, the largest island in the archipelago of Svalbard. I was invited there by the Trondheim professor Olaf I. Rønning, the botanist who first made a survey of the *Sphagnum* flora of the archipelago, published in 1961. In Bjørndalen I got the unforgettable view to see this species for the first time in the field.
During my second stay in Spitsbergen in July 1992 I made field work at the locality Todalen in the Longyearbyen area. When creeping around looking at the brown capitula of *S. arcticum*, I suddenly saw some mixed plants with more soft, rather flat and more brown-green capitula with a faint purple-reddish tinge in the outer parts. Hand-lens examination showed the stem leaves to be narrower at their apices than in *S. arcticum*. More careful microsopic examinations showed other differences in cell structure, and a new species was described (Flatberg 1993a). The epithet name of the species was made in honour of my professor, using his forename. Outside Svalbard *S. olafii* Flatberg is so far found in a few arctic localities in northeastern and northwestern Greenland, and in some localities in Russia. We have strong genetic indications pointing at *S. incundum* Flatberg & Hassel, a new haploid *Acutifolia* species in the *S. subnitens* complex (Kyrkjeeide et al. 2018), as the female parent of both allodiploid *S. arcticum* and *S. olafii.* This species has its known distribution confined to western artic/subarctic areas in W Greenland, Canada in Quebec and Nunavut and North West territories, and in Alaska, but is unrecorded in Svalbard. My so far undocumented hypothesis is that *S. arcticum* has originated as a hybrid between *S. fimbriatum* Wilson and *S. incundum*, and *S. olafii* as a hybrid between *S. girgensohnii* Russow and *S. incundum*.

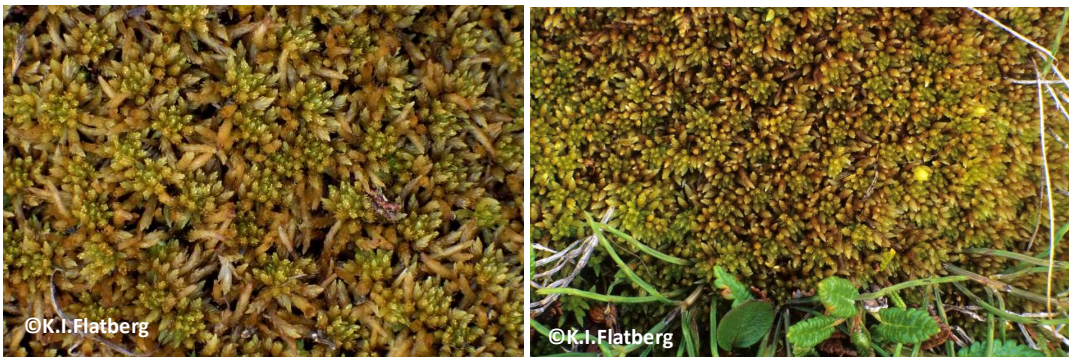

Photo 2. *Sphagnum arcticum* Flatberg & Frisvoll (left) and *Sphagnum olafii* Flatberg (right). Todalen, Spitsbergen, July 1992.

In July 1992 I also visited Endalen in the Longyearbyen area with moist tundra ground furnished with peat-moss patches. To my surprise I discovered plants of typical brown-coloured capitula of *S. teres*, mixed with similar-looking plants but with more greenish-coloured capitula. Hand lens examination showed that the apical divergent branch leaves, which are narrowly involute-pointed and near non-toothed in *S. teres*, were broadly dentate square-cut in the greenish morph. A new species, *S.tundrae*, was discovered (Flatberg 1994). Afterwards Greilhuber et al. (2003) stated that the Svalbard plants of *S. tundrae* and *S. teres* were both haploids with gametophyte chromosome number 19. Flatberg & Thingsgaard (2004) showed that they also differ in isozyme patterns. In my afterwards field trips and by examination of herbarium collections, new records of the species were added from arctic Canada and USA, Alaska, W Greenland, from the Wrangel Island in the East Siberian Sea. Surprisingly, the sexual condition of the species is still unknown and it is to my knowledge not found with sporophytes.

Photo 3. *Sphagnum tundrae* Flatberg mixed with *S. teres* (Schimp.) Ångstr.(left), and terrain in Bolterdalen, Spitsbergen with K. Thingsgaard and S. M. Såstad in August 2006 (right).

Story of *Sphagnum rubiginosum* Flatberg

My peat-moss discoveries have mainly focused on mire and wetland species, and I could not imagine new species for the science to be found in connection to forested habitats in Norway. But in late autumn of 1989 when I performed field work considering effects of "acid rain" on bryophytes in coniferous forests, I visited a climatically humid, N-exposed and sloping Norwegian spruce (*Picea abies*) forest with an element of rock-walls in Trondheim municipality, Central Norway. Then I suddenly discovered on one rock-wall a mixture of typical green plants of *S. girgensohnii* mixed with similar-looking plants but with brown-red

to red-brown capitula. I first thought these plants could just be a colour morph variant of *S. girgensohnii*, but it was recognized in the field by my hand-lens that the shoots occurred with pre-dominantly three spreading branches in the fascicles, while *S. girgensohnii* usually has two. In addition, this morph was very common with sporophytes, while *S. girgensohnii* generally is rather rarely with sporophytes. Morphological details confirmed my field observations, and the new morph undoubtedly was an undescribed new species, in 1993 it was published under the name *Sphagnum rubiginosum* (Flatberg 1993b) including many new records from Norway, and some new discoveries from pacific British Columbia and U.S.A. Alaska. Later on, many new collections of the species were made from humid forested, boreal zone areas, including northeastern Canada. In 2021 it was also discovered new to Sweden (Carlsson & Lönnell 2022). Detailed field and laboratory work on Norwegian material have proven that the species is polyoicous, but now and then also small, pure male plants are present.

In September 2006 I had marvelous peat-moss trips in various regions of China kindly organized and headed by professor Yi Liu, Shanghai University. In the Yunnan Provine we decided to visit the Jiaozixuerhan Mnts., ca. 115 km N of the city Kunming. We had decided to leave our car at "The parking lot by chair lift station", 3532 m a.s.l., and climb higher up along the rather steep mountain slope to reach areas above the tree limit. I was affected by altitudinal sickness and decided not to follow the others. I was just able to creep around on a small plateau dominated by a *Abies-Rhododendron* mixed forest on flat, moist ground. But then suddenly I looked at a mat of a green-reddish *Acutifolia* peat-moss plant. This plant looked quite identical to *S. rubiginosum*. And back home, the microscopic details confirmed this species.

Photo 4. *Sphagnum rubiginosum* Flatberg with brown-reddish capitula bearing sporophytes, mixed with green *S. girgensohnii* Russowi and red *S. russowii* Warnst. Norway, Trøndelag, Trondheim, Eggåsen, Aug. 2011 (left). Flatberg demonstrating the species during the "VIII international meeting on Sphagnum biology" in Norway Sept. 2024 (right).

Sphagnum venustum Flatberg

In 2007 I made fieldwork in northeastern Canada together with my wife Bergfrid. At a particular sloping mire between the villages of Red Bay and Lodge Bay in southern Labrador, I discovered a peculiar small, brownish peat-moss species growing in mats along a small brook, associated with *S. lindbergii* Schimp. and sometimes *S. pylaesii* Brid. Along the borders facing the brook, *S. angermanicum* Melin was also common, reflecting the humid-oceanic climate in the area. Back in Trondheim, microscopic examination confirmed its species distinctness and I published it as new species (Flatberg 2008). And the story continued. During autumn 2011 I visited a mire-rich area in humid-oceanic parts of northern Trøndelag for making photos of various peat-moss species. I ended up at a mire site locality along a small brook with common

occurrence of *S. angermanicum*. The similarity to the Labrador locality of *S. venustum* appeared in my head, and suddenly I saw mats with small brownish to slightly reddish plants of the species with a visible terminal bud in the capitula, new to Europe. This was just unbelievable and I cried! This locality, with the name Henningslettet, was revisited several times afterwards, and it was also found producing sporophytes, and also opened for the opportunity to introduce the species for new peat-moss knowers and researchers. This has resulted in several new localities for the species made by the "Sphagnum group" in Trondheim, and often on mires housing *S. troendelagicum* as well. And several new localities were afterwards reported from Quebec, Canada (Ayotte & Rochefort 2019). In September 2024 the locality of this tiny species at Henningslettet could be demonstrated to near 50 peat-moss enthusiasts from various countries participating in the "VIII international meeting on Sphagnum biology" arranged in Trondheim. As the discoverer of this wonderful tiny species this event was real fun! Until now *S. venustum* is not recorded from other countries in Europe. But in 2023 Karn Imwattana at Duke University identified by DNA screening of a *Sphagnum* collection made by Blanka Aguero at a locality in Honshu Island, Japan to belong to this species, and confirmed morphologically by me from a duplicate specimen at herb. TRH. What a big surprise!

Kyrkjeeide et al. (2023) showed that *S. venustum* is a haploid species and being genetically distinct from morphologically similar species.

Photo 5. *Sphagnum venustum* Flatberg with brown-red capitula furnished with a visible terminal bud, mixed with some shoots of *S. angermanicum* Melin with deep violet capitula. Norway, Trøndelag, Steinkjer, Henningslettet, Sept. 2011.

Sphagnum divinum Flatberg & Hassel

Teaching ground level students in floristics and taxonomy at our university in the last three decades of the 1900-ties, one of the easiest bryophytes to be identified in the field was *S. magellanicum* Brid. "Dear students. Pick up a shoot of this beautiful, large peat-moss with distinctly red-coloured head. Use your hand-lens and look carefully at the leaves covering the branches spreading out from the stem, and you will see that their leaf tips end up hooded (cucullate). None of the other Norwegian peat-mosses combine these characteristics."

But my taxonomic mind changed at the beginning of the next century first years. One day I visited a mire-Oddmyra-close to my home to make a list of peat-mosses growing there, and mapping their distributions. I discovered that the plants of *S. magellanicum* found near the mire margin, poor fen part of the mire, looked surprisingly different in morphological traits from the plants growing abundantly in carpet mats on the open ombrotrofic part of the mire. This was the starting point on a compressive research project over many years to clarify morphological and genetical variation and differentiation within the near worldwide common species know as *Sphagnum magellanicum*, and which was published as a new species from Straith of Magellan

located in Patagonia southernmost part of Chile, by the Swiss/German eminent bryologist Samuel Elisée von Bridel in 1798. In November 2005 I had the opportunity to visit and study the mires and *Sphagnum* flora in Tierra del Fuego, as a participant of a joint international excursion with mire experts. I had of course a particular focus on *S. magellanicum* which looked rather different in habitus compared to what I had observed in the two morphs from Oddmyra in Norway.

Back in Norway, I invited my peat-moss colleague Jon Shaw and others to participate in the project. Reciprocal transplantation and laboratory common garden experiments were performed, and genetic methods were employed. The genomic differentiation between the two morphs was unexpectedly high and corresponded well with the morphological differences found. A central person in this intricate scientific approach in Trondheim was Magni Kyrkjeeide (Kyrkjeeide et al. 2016; Yousefi et. al. 2017). The two morphs of *S. magellanicum* I discovered at the early beginning at Oddmyra in Trondheim, and differing in morphology and mire habitat preferences, are two distinct species, published under the names *S. divinum* Flatberg & Hassel and *S. medium* Limpr., and being specifically separate from *S. magellanicum* Brid. confined in distribution to southernmost South America.

In 2017 members from the peat-moss group in Trondheim (Kristian Hassel, Olena Meleshko, Hans Stenøien, and myself) visited several peat-moss localities in mountainous parts of Austria, kindly invited and guided around by Dr. Christian Schröck. During these days we also had the opportunity to discover and collect material of the two morphs of *S. magellanicum*, easily separable by field morphologic characters. During the last evening, a question came up among us: what should be the epithet name of the new species soon to be published. Various proposals whizzed around in the room, but no agreement. One of us declared that this was a great shame for this heavenly beautiful species. Let's try Google! Reply: Latin adjective *divinus* = heavenly, blissful, divine. All were satisfied. For morphological comparison of *S. divinum*, *S. medium* and *S. magellanicum*, see Hassel et al. (2018).

A following scientific publication of the *S. magellanicum* complex in North America (Shaw et al. 2023), based on the genetic results previously published (Kyrkjeeide et al. 2016), resulted in two new species from USA, *S. diabolicum* A.J. Shaw, Aguero & Nieto-Lugilde and *S. magniae* A. J. Shaw, Aguero & Nieto-Lugilde, the latter with scattered known localities in the coastal plain of eastern North Carolina. My dear peat-moss friend Magni was honoured in this way!

Photo 6. From left *Sphagnum divinum* and *S. medium* in Norway, Trondheim, Oddmyra; *Sphagnum magellanicum*, in Tierra del Fuego, Argentina.

Stories of peat-mosses that do not reside in Norway

Sphagnum skyense Flatberg

In 1987 a student excursion from Trondheim visited Isle of Skye, a small, climatically humid island on the NW coast of Scotland, and with professor John Birks and me as the main guides. A couple of days we stayed at Suardal. Not far from there we had the opportunity to taste the famous "Talisker Single Malt Scotcsh Whisky". The day after I decided to make a small trip to a neighbouring area in Suardal. After creeping up a rather steep, moist heath slope I suddenly discovered a strange- red-coloured peat moss close to my face which looked intermediate between *S. quinquefarium* (Braithw.) Warnst. and *S. subnitens* Russow ja Warnst., both present at the locality, but looking different. Back home, microscopic examinations confirmed the morphological distinctness of this plant, and it was published under the name *S. skyense* (Flatberg 1988b). In retrospective, I have been accused for not naming it *"S. taliskeri"*. With present knowledge *S. skyense* is known from several localities including W Scotland, Ireland and Wales (Hill 2014). but so far it is not discovered outside the British Isles. It took, however, many years before *S. skyense* was accepted by British bryologists after discovering it during a BBC excursion to the Rum Isl. in 2004. At present it is known from scattered localities along western Scotland, W/SW Ireland and from one locality in Wales. Further genetic investigations have shown that *S. skyense* indeed is an allodiploid species with origin in *S. quinquefarium* and *S. subnitens* (Kyrkjeeide et al. 2023).

Photo 7. *Sphagnum skyense* Flatberg. Scotland, Outer Hebrids, Tarbert. Sept. 2011.

Sphagnum mirum Flatberg & Thingsgaard

In August 2001 I visited peat-moss mire localities in southwestern Alaska together with my field work companion Karen Thingsgaard. One of the many mires visited was near the village Bethel in the Yukon-Kuskokwim delta. In a fen mire lawn we came across a mixture of typical brownish plants of *S. teres* mixed with similar-looking but predominantly greenish plants with glossy capitula. It was bearing capsules and separate male plants with antheridial branches were present. We first thought about the possibility of fertile plants of *S. tundrae*. But the branch leaves had narrow involute and non-dentate tips, more approaching *S. teres*. However, further examination of morphological details and documented isozyme differences, defined a separate and new species *Sphagnum mirum* (Flatberg & Thingsgaard 2004). Later on, in August 2007, I was very happy to discover together with my wife Bergfrid a new locality of *S. mirum* in an arctic mire visited in Ivujivik in Quebec, Canada. Here we experienced that the species occurred in both fen lawns and carpets, and had beautiful shining, pale yellow-

brown capitula, really astonishing to look at. At this locality it was found growing together with *S. incundum* Flatberg & Hassel, a new haploid species with a few known localities from western Greenland, Canada and Alaska (Kyrkjeeide et al. 2018).

But back to *S. mirum*. In late July and early August 2017 I was travelling around with peat-moss and mire enthusiasts in subarctic/arctic regions of Nenets Autonomous Okrug in European part of the Russian Federation, as a participant of the International Mire Conservation Group (IMCG). At two localities in Tyndropa and Cape Bolvansky regions of the Naryan-Mar area, I discovered greenish plants in mesotrophic mire habitats that looked very similar to my beloved *S. mirum*. Young sporophytes were seen at Tyndropa. Home again, plants sent to Eva Temsch, Vienna, confirmed its haploid status. Recently it was also reported from Western Siberia (Laphshina et. al. 2023).

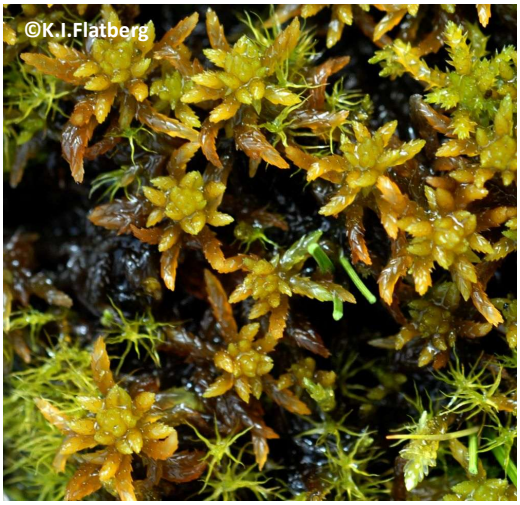

Photo 8. *Sphagnum mirum* Flatberg & Thingsgaard. Canada, Quebec, Ivujivik, Aug. 2007.

<u>*Sphagnum tescorum* Flatberg</u>

During fieldwork conducted in tundra mires in the subarctic part of the Kuskokwim-Yukon Delta of SW Alaska during Aug. 2001, a distinctive brownish plant suddenly appeared in front of my face, partly growing mixed with *S. fimbriatum* and *S. girgensohnii* in mesotrophic, topogenous mire. Back home and in front of my microscope, detailed morphological comparisons and morphometric leaf size studies showed the new morph to be well separated from these two species when growing in field mixtures. Moreover, sexual differentiation showed a dioecious taxon producing sporophytes. Johann Greilhuber (2004), showed this strange gametophyte plant to be diploid with likely chromosome number of n=38. Thus, a new allodiploid species with *S. girgensohnii* and *S. fimbriatum* as the likely parents, was described and published (Flatberg 2007). This was confirmed by Shaw et al. (2012). Herbaria specimens gave new localities from Beringian Sea islands and the Point Barrow district in Alaska, and in the Anadyr district in Chukotka Peninsula, thus defining a possible amphi-Beringian species.

When visiting the Cape Bolvansky arctic area in Nenets Autonomous Okrug in 2017, I found *S. tescorum* with sporophytes in a poor to intermediate fen lawn mire.

Photo 9. Field mixture of *Sphagnum fimbriatum* Wilson with green capitula, *S. tescorum* Flatberg with pale yellow-brown to greenish capitula, and *S. girgensohnii* Russow with rather brownish capitula. Alaska, Kuskokwim Delta, Aug. 2001.

Flatbergium novocaledoniae (Paris & Warnst.) A.J.Shaw & Flatberg

During October 2010 I together with my wife Bergfrid visited the main island of New Caledonia (the Grand Terre), a French overseas territory in the Pacific Ocean lying in SW Pacific Ocean ca. 1500 km E of Australia. The main goal was to re-discover the mysterious peat-moss *Sphagnum novocaledoniae*, seemingly endemic for this island. The designated lectotype specimen was collected by the Louise Le Rat in July 1909 in the mountainous Plateau de Dogny at an altitude of 1072 m. We decided to rediscover the species on this plateau. Before us we had a steep slope of subtropic forest to penetrate before reaching the plateau. On the plateau we found a narrow track maybe made by deer. It was near impossible to walk beside this track, in the slightly sloping terrain tightly covered by thorned shrubs. After about one hour of walk, we reached a brook crossing our path. There Bergfrid got tired and hungry and insisted to have a break. While she prepared the food, I decided to have a look at the plant cover facing the brook. Some peat-moss mats appeared covering the sides of the brook. After hand-lens examination I was in no doubt. This simply had to be the peat-moss searched for, published 101 years ago.

But a new surprise was in appearance. A duplicate of the collected specimen sent to Shaw and genetically screened, surprisingly defined a new *Flatbergium* species, *F. novocaledoniae*! See Shaw et al. (2016). This fascinating species is also found in a few other localities in the main island of New Caledonia, but in no other places so far.

Photo 10. *Flatbergium novocaledoniae* (Paris & Warnst.) A. J. Shaw & Flatberg. Plateau de Dogny in New Caledonia, Oct. 2010.

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