Pack-rafting to Qinngua Forest
Studying the woody plants of southern Greenland

Authors: Paul Bartlett & Marcin Kowalczyk

A Plant Study expedition to Greenland in August 2022 to study the native dwarf shrub birches, rowans and willows of the northern tundra, their habitat and associated flora. To explore the remote Qinngua valley, Greenland's only natural forest.

Fig.1: Arriving at Qinngua by pack-raft

The authors

Paul Bartlett is the Garden Manager at Stone Lane Gardens, an arboretum containing National Collections of *Betula* and *Alnus* near Chagford, Devon, UK.
Marcin Kowalczyk is a Music Publisher from Krakow, Poland. He is a keen dendrologist who carries out many plant study expeditions in the wild.

Acknowledgements

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Contents

Introduction by Paul Bartlett

Stone Lane Gardens holds National Collections of *Betula* (Birch) and *Alnus* (Alder). The late Kenneth Ashburner became an acknowledged expert on *Betula* and, since the formation of the Stone Lane Gardens charity after his death, we have achieved some notable success in making the organisation better known for our specialist knowledge of Birch.
We are now regularly contacted by other specialists around the world, and have built up some useful international contacts. One of these, Marcin Kowalczyk of Poland, invited me to accompany him on this expedition to study the trees of the harsh tundra landscape of Greenland. Marcin has a keen interest in Birch and has organised many plant study expeditions.
I welcomed this opportunity to study the unusual and interesting dwarf birch of this region. Due to the remote and extreme conditions of their natural habitat, they are an under-studied group of woody plants. Whilst lacking the stature and bark of the commonly available tree birch, their tiny leaves and fruits, ground-hugging shape and twisted stems give these shrubs an appeal that make them attractive plants in their own right, and deserving of wider recognition.

The expedition was planned for the summer of 2020, but, owing to the global uncertainties of the COVID pandemic, it had to be postponed until August 2022.

Sponsors

I am grateful for the support of the Stanley Smith (UK) Horticultural Trust, Plant Heritage National Office and Plant Heritage Devon Group. Also our pack-raft sponsor, Pinpack.

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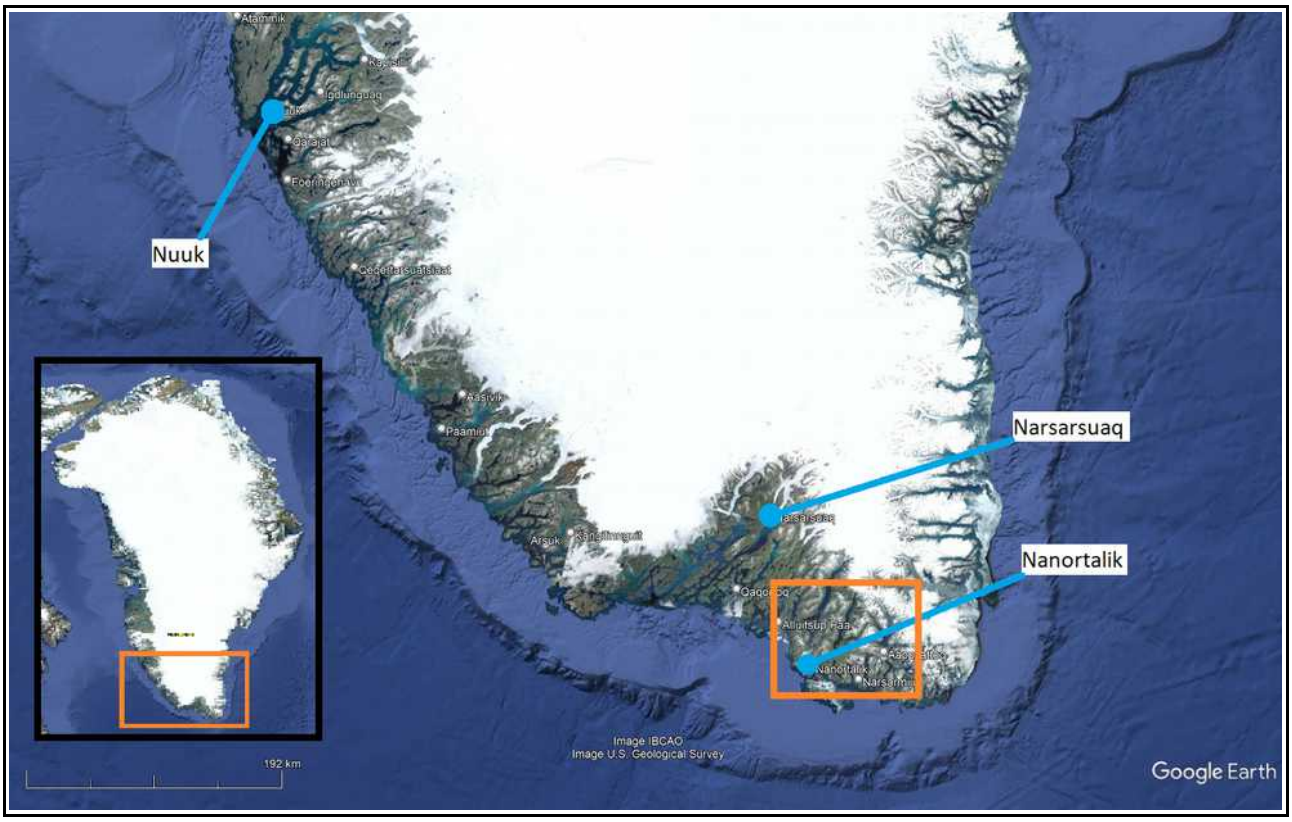
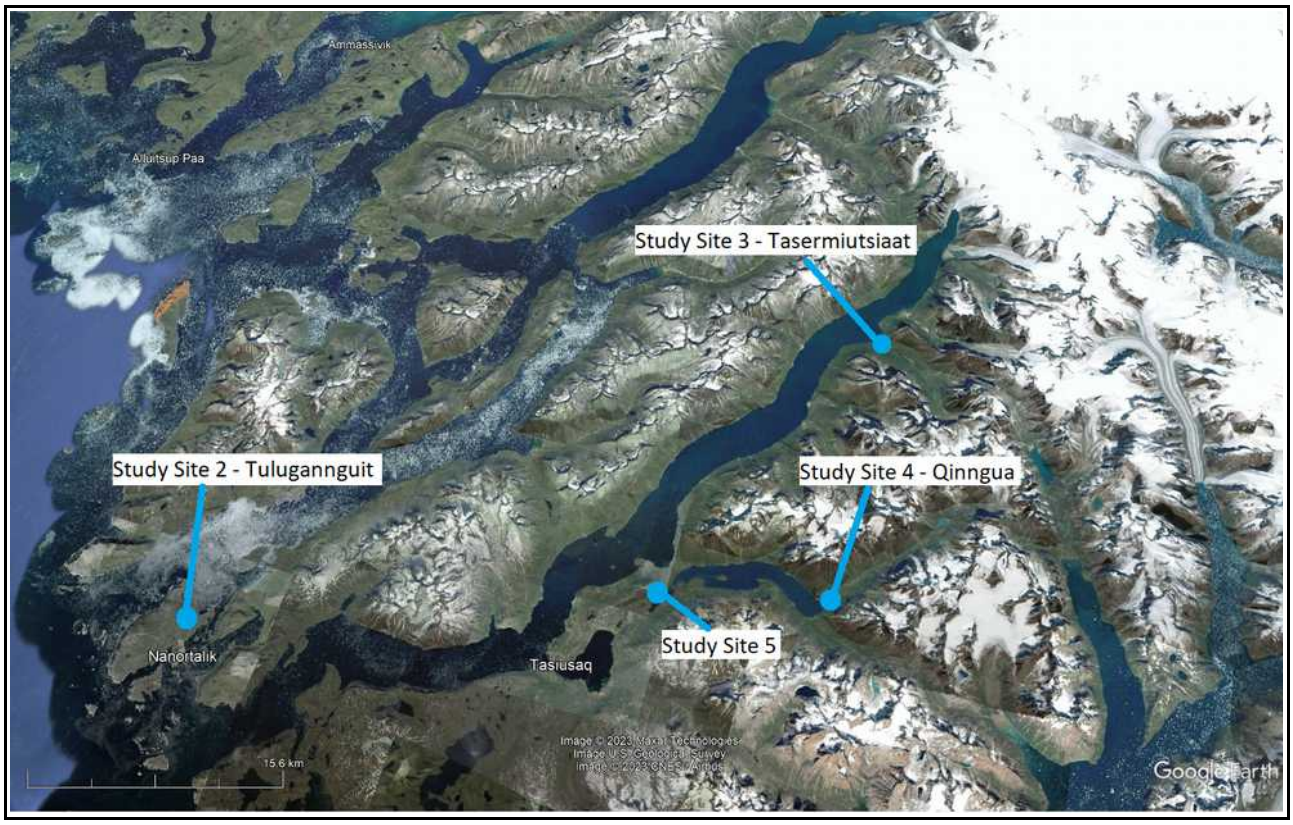
The Study areas





Study Site 1 - Narsarsuaq arboretum
N 61.159921° W 45.410468°

A deliberately planted arboretum. The purpose of this arboretum is to trial introduced non-native woody species for their suitability to the Greenland climate. The arboretum surrounds the north-eastern side of the town, beginning just above sea level and continuing up the slopes above the town and dropping into the next valley to the north. Highest elevation is approx 400m. Some of the tree labels appear to be missing, though we did find quite comprehensive records on-line.
Amongst the plantings we found self sown Birch (*Betula*), Rowan (*Sorbus*) and Willow (*Salix*). *Betula pubescens* var *pumila* and *Betula glandulosa* were present, along with many intermediate shrubs that we assumed to be hybrids of the two. These were the dominant native woody species of the area.
Sorbus decora was present in small numbers. The *Salix* genus was represented by two species, an occasional dwarf *Salix uva-ursi* and the more common *Salix glauca*.
Although we did study the native plants here, there is a slight risk of cross contamination by pollen of introduced species, so we would be wary of any unusual plant forms in this location.

Study Site 2 - Nanortalik – Tulugannguit
N 60.157850° W 45.256677°

We spent several hours studying the woody plants on the slopes of a low group of hills called Tulugannguit, north of Nanortalik. The study area went from just above sea level to the summit of Quassik (308m). The gently angled hills are covered in grasses. The soil is thin with many rock outcrops. The plants encountered would suggest a slightly acidic soil. Numerous streams create boggy areas. Sheep graze the area.
The vegetation was similar throughout the area, with the following observations. Shrubby birch were absent at sea level, but present from the lower slopes all the way up to the summit. At the summit, all the genera were dwarf and prostrate, probably due to the exposed and elevated situation. This may account for an anomaly found with the fruit of *Betula glandulosa* studied there (see Summary and Fig.8).
Woody shrubs were noticeably smaller on the eastern slope of these hills.
We found *Betula glandulosa, Salix glauca, Vaccinium uliginosum, Juniperus communis* var *saxatilis* and *Kalmia procumbens* (this last only found on the rocky summit).
Betula pubescens and *Sorbus decora* were noticeably absent.

Study Site 3 - Klosterdalen – Tasermiutsiaat
N 60.445959° W 44.540891°

This was our first campsite. We spent the morning studying the plants here, mainly focussing on the flat valley floor. Vegetation was very dense, mainly shrubby birch, making progress very slow and difficult. The soil is thin. Well drained in some areas and boggy in others. No evidence of grazing.
The main component was *Betula pubescens* var *pumila*. This was the tallest species. In the drier areas, *Betula glandulosa* grew well, though prostrate. Amongst them were many intermediate shrubs, thought to be hybrids of the two species, with varying characteristics of both. *Salix glauca* was also common.

Study Site 4 - Qinnguadalen – Qinngua forest
N 60.266738° W 44.538985°

Our ultimate destination and intended main study area. Unfortunately, the earlier delays to our schedule meant we were only able to study here for one afternoon and evening, with further study the next morning.
The forest at Qinngua is supposedly Greenland's only natural woodland (several sources). I imagine it has received this title because the uniquely sheltered site has enabled much taller tree growth, particularly of *Betula pubescens* var *pumila*. It begins on the banks of Tasersuaq lake and runs back up the Qinnguadalen valley for some distance, initially covering the entire valley floor and extending about halfway up the surrounding slopes.
The geography of the shoreline is initially quite confusing. The flat sandy river-mouth is prone to flooding, which moves sediment and occasionally changes the path of the river. This results in many small streams and ponds to the sides of the main river, impeding progress and making route-finding confusing. The valley floor is thus a mixture of dry, sandy areas and waterlogged, boggy areas.
The drainage is improved as you ascend the valley sides.
This was the most species-rich area that we studied. The main components were *Betula pubescens* var *pumila* and *Salix glauca*. In the drier areas *Betula glandulosa* was common as were the hybrid birch. *Rhododendron groenlandicum* formed a low, sparse shrub that appeared throughout the woodland. *Sorbus decora* was absent from the valley floor but appeared as we ascended the slopes, usually as an occasional group of trees, never as a dominant species. *Juniperus communis* var *saxatilis* was seen occasionally. Due to the lack of time (see 'Difficulties encountered') we could not study as large an area as we would have liked. This meant we did not find *Alnus crispa*, although it is reported to exist here.

Study Site 5 - Tasersuaq – western shore below summit of Qaqqatsiaq
N 60.251100° W 44.723102°

A small woodland investigated on our return journey across Tasersuaq lake. This extended about 1km along the shoreline and roughly 300m up the slope. An established, dense woodland with trees of a similar height to those found at Qinngua. It was interesting, but not surprising, to note that Qinngua is therefore **not** the only forest in Greenland. I suspect that similar small woodland areas exist in many sheltered parts of south Greenland. This woodland was again mainly Birch. *Betula glandulosa* dominated the well-drained, sandy shoreline, with hybrid birch directly behind and a tall canopy of misshapen and often multi-stemmed *Betula pubescens* var *pumila* making up the majority of the woodland. *Rhododendron groenlandicum* and *Salix glauca* were common here.

Study Site 6 – Nuuk – hillside above airport
N 64.191779° W 51.667721°

Barren, exposed hillside to the east of Nuuk airport. Rocky ground with thin sandy soil. Free-draining. Westerly aspect. *Betula nana* was the most common woody plant.

Flora - The Birch

Betula glandulosa

Fig.2: Betula glandulosa on the shore of Lake Tasersuaq

We examined this species in 5 study areas. Commonly this species is found in poor, free-draining, sandy soil. In coastal areas it exists on the mountainside away from the shoreline, where it co-exists with numerous other small woody plants. Inland, where *Betula pubescens* var *pumila* is present, it appears only on drier ground nearby, as *B. pubescens* always dominates in damper, richer soils. Inland and on the shores of the fjords, it grows at the very edge of the shoreline, where the soil is again poor, free-draining and sandy. In these niche habitats it appears to thrive, usually growing as a spreading carpet of crossing branchlets, prostrate to 30cms high (see Fig.2). On one plant at the summit of Quassik we found all fruits had only one seed per scale (see Fig.8 and Summary).

Hybridisation
As is detailed in a following section, we found countless examples of suspected hybridising between *B. pubescens* var. *pumila* and *B. glandulosa*, wherever we found the two species together.

Observations
Using 'The Genus *Betula*' (Ashburner K and McAllister H.A. 2013) as our guide, the plants we studied in Greenland differ slightly from the text. We never saw specimens taller than 90cms. Anything over that appeared to be a hybrid. Very occasionally the 1 year old shoot growth was pubescent, but usually with many prominent resin glands (Figs.4&5). Buds equal to or less than width of twig. Petiole red. Leaves mostly obovate. Male catkins terminal, usually solitary, occasionally two.

Companion species
Betula pubescens var *pumila, Salix glauca, Vaccinium uliginosum,*

(Betula glandulosa cont/d)
Juniperus communis var *saxatilis, Kalmia procumbens, Rhododendron groenlandicum, Empetrum nigram.*

Fig.3: B. glandulosa leaves

Fig.4: B. glandulosa - new shoot

Fig.5: B. glandulosa - immature male catkin on terminal growth

Fig.6: B. glandulosa fruits

Fig.7: B. glandulosa seeds and scales

Fig.8: B. glandulosa anomaly with single seed per scale

Betula pubescens var *pumila*

Fig.9: Betula pubescens var. pumila on western shore of Tasersuaq below summit of Qaqqatsiaq

We examined this variety of *B. pubescens* in 3 study areas. It is by far the largest native tree in Greenland. In sheltered areas it forms an upright tree to12 metres high. But in most locations it is smaller and multi-stemmed with twisted, suppressed stems. It is the dominant plant in moist soils at a low elevation in the relatively sheltered valleys of South Greenland. Common along the banks of streams, lakes and fjords, but absent from more coastal locations in South Greenland, and noticeably absent from the more northerly latitude of Nuuk. Its ability to grow well in the uniquely sheltered location of Qinngua, has given rise to the suggestion that this is Greenland's only native forest. (numerous sources) However, we identified another location at the other end of Tasersuaq lake, 10km away from Qinngua, that also has tall trees and a definite 'woodland' ecology. It is likely that 'forests' occur in other sheltered valleys in the area.

Hybridisation

As is detailed in a following section, we found countless examples of suspected hybridising between *B. pubescens* var. *pumila* and *B. glandulosa*, wherever we found the two species together.

Observations

Again, using 'The Genus *Betula*' as our guide, we noted a few additional observations that differed or were missing from that description. Trees in Greenland could be up to 12m high and were not always twisted or multi-stemmed. Where the trees were growing well, young shoots were longer and more hairy (Fig.11). Usually one male catkin at the terminal bud of a shoot, occasionally two. Fruits could be pendant or horizontal, only rarely erect (Fig.13). On older trees the bark at the base of the trunk could be grey with thick, short, prominent lenticels.

(*Betula pubescens* var. *pumila* cont/d)

Companion species
Betula glandulosa, Salix glauca, Vaccinium uliginosum, Juniperus communis var *saxatilis, Rhododendron groenlandicum, Empetrum nigram.*

Fig.10: B. pubescens var. pumila leaves

Fig.11: B. pubescens var. pumila - new shoot showing pubescence

Fig.12: B. pubescens var. pumila - immature male catkin at terminal bud

Fig.13: B. pubescens var. pumila fruit

Fig.14: B. pubescens var. pumila bark

Fig.15: B. pubescens var. pumila seeds and scales

Betula nana

Fig.16: Betula nana just above Nuuk airport

This species was absent from South Greenland, although there are apparently some provenances in the South-west. (Fredskild 1991) We only studied it in one location just outside Nuuk. Here it was a truly dwarf shrub, creeping very low over the rocks, with tiny leaves and fruits. Noticeably smaller than *B. glandulosa*. At this latitude, all other shrubs were also dwarf, so it did not appear to be out-competed for light and nutrients. We found it growing in extremely exposed conditions, in very thin, well-drained rocky soil, often in small hollows with little shelter.

Observations

Using 'The Genus *Betula*' as our guide, we noted a few additional observations that differed or were missing from that description. In this location, *B. nana* grew no more than 5cm above the ground. Growth was almost entirely horizontal. Leaves were consistently orbicular and less than 1cm broad (Fig.17). Stipules are persistent at leaf bases, very noticeable on 1 year old shoots – brown with long hairs on margins (Fig.18). Wing of seed almost absent.

Companion species

Salix uva-ursi, Salix arctica, Empetrum nigram, Diapensia lapponica.

(*Betula nana* cont/d)

Fig.17: Betula nana leaves showing pen nib for scale

Fig.18: B. nana - new shoot showing pubescence and persistent stipules

Fig.19: B. nana - immature male catkins on spurs of previous years growth, not at terminal bud

Fig.20: B. nana fruit

Fig.21: B. nana seeds and scales

Betula pubescens var. *pumila* x *glandulosa* hybrid

Fig.22: Betula pubescens var. pumila x glandulosa hybrid at Tasermiutsiaat, Klosterdalen

Wherever we saw *B. glandulosa* and *B. pubescens* var *pumila* together, we always found many bushes with intermediate characteristics. Purely on morphological grounds, we concluded that these plants are likely to be hybrids caused by cross-pollination between the two species. There was great variety of physical characteristics, as might be expected with hybrids. This conclusion seems reasonable, given this well-documented tendency of *Betula* as a genus. Indeed, it would be unlikely that this intermediate could possibly maintain as a separate species, given the close proximity of the two parent species.

Observations

As a general rule, the hybrids were significantly larger than *B. glandulosa*, growing as small, bushy shrubs up to 1.5m high. Although multi-stemmed, they had a well-defined base, up to 5cm diameter. 1 year old shoots had short hairs but were also covered in resin glands (Fig.24). Shoot growth was more vigorous than *B. glandulosa*. Leaf shape was intermediate between the two species, but noticeably larger than *B. glandulosa*. Never orbicular as always with a slightly pointed tip (Fig.23). Fruits were larger than *B. glandulosa* but retained the very upright habit of that species (Fig.26). In common with both parents, male catkins terminal on 1 year growth, usually solitary but occasionally as a pair.

Seeds had a more obvious wing than *B. glandulosa*, the wing being at least half the width of the nut-let, often larger (*B. glandulosa* had wings of no more than a quarter of the nut-let width).

Fig.23: Betula hybrid leaves

Fig.24: Betula hybrid - pubescence and resin glands on new shoot

Fig.25: Betula hybrid- immature male catkins on terminal bud

Fig.26: Betula hybrid fruits

Fig.27: Betula hybrid seeds and scales

Flora - Other woody plants

Salix glauca

This was the largest and most common willow seen, although absent from the Nuuk study area. It appeared in all the locations we visited, and is clearly visible on the hillsides, due to the silvery-grey colour of its leaves.

Fig.28: Salix glauca at Qinngua

Salix uva-ursi

This tiny prostrate willow was seen in Narsarsuaq and Nuuk. It was only found on elevated, exposed rocky ground with thin sandy soil, where competition was almost non-existent. Growing only a few cms above the ground, the leaves were no more than 1cm long. Plants were very compact with little extension growth.

Fig.29: Salix uva-ursi high in Narsarsuaq arboretum (note pen nib for scale)

Salix arctica

This dwarf Willow was found in our study area outside Nuuk. A prostrate dwarf shrub with much bigger leaves than *S. uva-ursi* but similarly slow, ground-hugging growth. Found growing in thin, well-drained sandy soil on exposed rocky ground.

Fig.30: Salix arctica above Nuuk airport

Rhododendron groenlandicum

A short, multi-stemmed shrub, that grows commonly below other woody plants. The stems are bare, with most leaves borne at the tips. No more than 1m high, with many flower heads. Autumn colour was a rich flame red. Absent from the Nuuk study area.

Fig.31: Rhododendron groenlandicum at Qinngua

Vaccinium uliginosum

Common in all our study areas (apart from Nuuk) as a very low-growing shrub.

Fig.32: Vaccinium uliginosum on Quassik above Nanortalik

Kalmia procumbens

Only seen on the summit of Quassik near Nanortalik. This compact, prostrate woody plant with tiny, fleshy leaves grew in thin sandy soil on rock in an exposed position at a high elevation.

Fig.33: Kalmia procumbens on the summit of Quassik, above Nanortalik

Sorbus decora

We saw this mountain ash at Narsarsuaq, Qinngua and on the surrounding hillsides. It never appeared in large numbers, probably out-competed by birch, though small groups were quite common. It is seldom found on the valley floor, but trees up to 5m high appeared on the drier slopes above. The fruits were surprisingly green and immature in August– we had expected them to be further advanced. It was absent from the coastal hills around Nanortalik.

Fig.34: Sorbus decora at Qinngua

Juniperus communis var *saxatilis*

A small, prostrate shrub common on the hillsides around Nanortalik. The only conifer native to Greenland.

Fig.35: Juniperus communis var. saxatilis on Quassik, above Nanortalik

Summary of expedition findings and observations

Fig.36: Upright B. pubescens at Qinngua

Studying plants in extreme climates and terrains is always exciting. Observing how plants survive in such places, and the forms they take in response to extreme growing conditions, increases our knowledge and understanding. By revealing hitherto unknown variations it broadens our acceptance of how a species grows.

Relatively few published studies of Greenland's woody plants are accessible, and these tend to describe plants in isolation, omitting the importance of the bigger environment in which they survive. The purpose of our expedition was to study these plants in a variety of locations in the wild, recording their very variable physical characteristics, and trying to build a picture of the hierarchy within each ecological landscape. Our study centred on the *Betula* genus, but we noted their companion woody species.

One of our main findings was the amount of apparent hybridising between *Betula pubescens* and *Betula glandulosa*. We found that where-ever the two species co-existed, shrubs of hybrid appearance were extremely common, in some cases more numerous than the parent species. A study by Fredskild (1991) also found hybrids of *B. glandulosa* with *B. nana* on the west coast, but this was outside our study area.

The discovery of an additional area of woodland by Tasersuaq lake dispels the commonly cited mantra that Qinngua is Greenland's only native forest. We were surprised by the large number of relatively upright *B. pubescens* found (Fig.36), as most descriptions are of small and misshapen specimens. We are confident that study of other sheltered valleys will reveal more 'woodlands' that are as yet undocumented.

The most common woody plant was undoubtedly *Salix glauca*. This very successful small to medium multi-stemmed shrub can be found almost everywhere in the south. Other Salix species occur in Greenland, though we saw no evidence of hybridising. However it would be reasonable to suppose hybrids could occur and it would be interesting to study this.

A surprising discovery was a specimen of *Betula glandulosa* on the summit of Quassik, just outside Nanortalik. Examination of the fruits back in the UK revealed only one seed per scale. *Betula*, with just one exception (*B. michauxii)*, have 3 seeds per scale. And all our other collections of *B. glandulosa* had 3 seeds per scale. A very thorough double-check confirmed just 1 seed per scale on the Quassik summit plant. The plant was on exposed rocks right at the summit, and it is possible that environmental stress has caused this anomaly. It would be useful to check other plants in such exposed conditions to confirm whether this is an isolated incident or a common stress-induced outcome.

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Wikipedia – Qinngua valley - https://en.wikipedia.org/wiki/Qinngua_Valley#:~:text=Qinngua%20Valley%2C%20also%20called%20Qinnquadalen%2C%20Kanginsap%20Qinngua%20and,north%20to%20south%20and%20terminating%20at%20Tasersuag%20Lake.

Difficulties encountered

We had been warned by a Danish botanist that travel in Greenland was complicated by the weather and that we should therefore build in a few days leeway into our schedule. It was fortunate that we did. The helicopter that should have whisked us to Nanortalik had broken down. The long boat journeys that replaced the helicopter resulted in us arriving at our first campsite a day and a half late.
We were lucky to have any stove gas, as the promised supplies of gas in Nanortalik had run out (you can't carry it in helicopter luggage). Luckily some kind Danish kayakers in our hotel gave us two gas bottles.
We had calculated that the pack-raft journey down the Tasermiut fjord (25km) would take one day, as long as we could take advantage of an outgoing tide. However, the delay in arriving in the fjord meant that the tide on the first day was against us, resulting in much harder paddling and less headway. This resulted in the journey taking two days.
The delays we encountered meant less study time at Qinngua. We could have spent several productive days there, but were limited to the afternoon and evening of one day and a few hours of the next day.
The lost days at the start of the expedition meant no time for resting between pack-rafting. We paddled for about 6 hours every day, for four days. I suffered temporary inflammation of my lower left arm and wrist on the third day that required strapping. Fortunately I was able to continue paddling.
The last days of our expedition were spent apart, as Air Greenland put us on separate schedules from Nanortalik (by boat) back to Nuuk (by air). A lot of flights had been cancelled, so things were a little chaotic.

The biggest obstacle to thorough study of any area in the south of Greenland is the lack of paths and the density of vegetation. Once you are away from the coast, the vegetation grows with more vigour and without any cropping by sheep. Walking through this vegetation, even when only waist high, is extremely slow and difficult, made worse by the invisible but uneven, stony ground. This is also ultimately very tiring. So travel by boat is usually more efficient.

Pack-rafting

The decision to use Pack-rafts to travel between study sites was suggested by expedition partner Marcin Kowalczyk, based on his previous experiences with these craft.

A Pack-raft is a very lightweight inflatable dinghy. It is inflated using a large bag to capture and force in air, so has no need for a heavy and cumbersome pump. The lightweight paddles disassemble for transport. Pack-rafts are designed to pack down small for carrying in a rucksack while walking, but can be quickly inflated when water is reached, with anchor points for securing the rucksack (Fig.38).

They are an invaluable aid whenever travelling by water would prove quicker and more efficient than walking.

For our expedition, they allowed us to travel in straight lines, rather than detouring round obstacles. Walking the same route would have involved fighting our way through almost impenetrable undergrowth with a heavy pack, and fording fast-flowing streams. There were also occasions when sheer rock-faces would have meant a lengthy detour on land (Fig.37). So for both efficiency and safety, the Pack-rafts proved their worth.

The only occasion when they were less efficient was on our first day, when we had to paddle against a rising tide. Being broader than a kayak, a Pack-rafts drag makes it less efficient against a strong current.

A safety consideration with our Pack-rafts was the single-chamber design. One puncture would deflate the whole craft. Therefore, for additional safety, we used manually inflatable life-vests (Fig.38), of the compact type used for snorkelling. While not as buoyant as a full specification buoyancy aid, they could be packed down for travelling and did not require gas canisters (not allowed on many flights).

Fig.37: showing difficult terrain behind Marcin.

Fig.38: showing Paul's life-vest and secured baggage.

Itinerary

Day 1 - Landed in Narsarsuaq - Afternoon in the Greenland arboretum.

Day 2 - Boat from Narsarsuaq to Nanortalik via Qaqatoq (due to broken helicopter!)

Day 3 - Day in Nanortalik – studying flora of surrounding hills. Boat up Tasermiut fjord in evening to campsite at Klosterdalen.

Day 4 – studying flora of Klosterdalen. Pack-rafted back down Tasermiut fjord to campsite.

Day 5 – Pack-rafted down Tasermiut fjord to next campsite on Kuussuaq river.

Day 6 – Pack-rafted the length of Tasersuaq lake to Qinngua. Studied flora of Qinngua forest.

Day 7 – More study of Qinngua flora. Pack-rafted back across Tasersuaq lake. Studied flora of another forest below Qaqqatsiaq. Deflated pack-rafts and walked to Tasiusaq. Boat back to Nanortalik.

Day 8 – Marcin took boat to Narsarsuaq. Paul stayed in Nanortalik. (helicopter still inoperable)

Day 9 – Marcin studied flora on walk to Kuussuup glacier, Narsarsuaq. Paul took boat to Narsarsuaq. Paul flew to Nuuk.

Day 10 – Paul studied flora on hill above Nuuk. Paul flew to Copenhagen via Kangerlussuaq. Marcin flew to Nuuk. Marcin studied flora outside Nuuk.

Day 11- Marcin flew to Copenhagen via Kangerlussuaq, Paul flew to UK.

Day 12 – Marcin flew to Poland.

Plant list

Greenland 2022

Collection no.	Species	Date collected	Location	Coordinates (GPS in phone – Locus Map)	comments
MKPB001	Betula glandulosa	09/08/2022	Narsarsuaq arboretum	N 61.159921° W 45.410468°	
MKPB002	Betula glandulosa	09/08/2022	Narsarsuaq arboretum	N 61.161535° W 45.408242°	
MKPB003	Salix uva-ursi	09/08/2022	Narsarsuaq arboretum	N 61.161251° W 45.408880°	summit of hill
MKPB004	Betula glandulosa	09/08/2022	Narsarsuaq arboretum	N 61.161245° W 45.409432°	summit of hill – possible hybrid with B. pubescens
MKPB006	Betula glandulosa	11/08/2022	Nanortalik – Tulugannguit	N 60.153638° W 45.252727°	path to Quassik (308m)
MKPB007	Betula glandulosa	11/08/2022	Nanortalik – Tulugannguit	N 60.157850° W 45.256677°	path to Quassik (308m)
MKPB008	Kalmia procumbens	11/08/2022	Nanortalik	N 60.164895° W 45.260642°	summit of Quassik (308m)
MKPB009	Betula glandulosa	11/08/2022	Nanortalik	N 60.164891° W 45.260553°	summit of Quassik (308m) - this plant showed fruits where only one seed per scale. Consistant throughout all fruits gathered.
MKPB010	Vaccinium uliginosum	11/08/2022	Nanortalik – Tulugannguit	N 60.160296° W 45.257099°	path to Quassik (308m)
MKPB011	Betula pubescens var. pumila	12/08/2022	Klosterdalen – Tasermiutsiaat	N 60.446915° W 44.541264°	samples taken around campsite. Birch extend densely up the valley and up both sides of the valley right down to the water's edge.
MKPB012	Betula glandulosa	12/08/2022	Klosterdalen – Tasermiutsiaat	N 60.446616° W 44.541138°	low, spreading, covering large areas between Betula pubescens and numerous probable hybrids
MKPB013	Betula glandulosa/pubescens hybrid?	12/08/2022	Klosterdalen – Tasermiutsiaat	N 60.446608° W 44.541059°	many forms of birch between pubescens and glandulosa, showing characters of both in varying degrees. Almost certainly hybrids.
MKPB014	Betula pubescens var. pumila	12/08/2022	Klosterdalen – Tasermiutsiaat	N 60.445959° W 44.540891°	
MKPB015	Salix glauca	14/08/2022	Qinnguadalen – Qinngua forest	N 60.266738° W 44.538985°	
MKPB016	Rhododendron lapponicum	14/08/2022	Qinnguadalen – Qinngua forest	N 60.266887° W 44.538392°	
MKPB017	Betula glandulosa	14/08/2022	Qinnguadalen – Qinngua forest	N 60.267134° W 44.538437°	
MKPB018	Betula glandulosa/pubescens hybrid?	14/08/2022	Qinnguadalen – Qinngua forest	N 60.267669° W 44.538624°	as with MKPB013, many forms showing characters of both pubescens and glandulosa
MKPB019	Betula pubescens var. pumila	14/08/2022	Qinnguadalen – Qinngua forest	N 60.268161° W 44.538079°	
MKPB020	Betula pubescens var. pumila	14/08/2022	Qinnguadalen – Qinngua forest	N 60.268357° W 44.537530°	
MKPB021	Sorbus decora	14/08/2022	Qinnguadalen – Qinngua forest	N 60.267215° W 44.532308°	on eastern slope above valley floor with NW aspect.
MKPB022	Betula pubescens var. pumila	14/08/2022	Qinnguadalen – Qinngua forest	N 60.267123° W 44.532121°	on eastern slope above valley floor with NW aspect. These trees appeared more mature with dark grey bark, possibly due to lichen/algae covering the bark surface. Branchlets also grey. The sample tree had very pendulous twigs, though other nearby trees lacked this.
MKPB023	?	14/08/2022	Qinnguadalen – Qinngua forest	N 60.266755° W 44.531342°	
MKPB030	Betula glandulosa	15/08/2022	Tasersuaq – western shore below summit of Qaqqatsiaq	N 60.251100° W 44.723102°	
MKPB031	Rhododendron lapponicum	15/08/2022	Tasersuaq – western shore below summit of Qaqqatsiaq	N 60.251144° W 44.723307°	
MKPB032	Betula pubescens var. pumila	15/08/2022	Tasersuaq – western shore below summit of Qaqqatsiaq	N 60.251144° W 44.723307°	at this location there was a sizeable woodland with many tall trees, similar to Qinngua forest.
MKPB033	Betula glandulosa/pubescens hybrid?	15/08/2022	Tasersuaq – western shore below summit of Qaqqatsiaq	N 60.251144° W 44.723307°	
MKPB034	Betula glandulosa	14/08/2022	Qinnguadalen – Qinngua forest	?	
MKPB035	Betula pubescens var. pumila	14/08/2022	Qinnguadalen – Qinngua forest	?	
MKPB051	Juniperus communis	17/08/2022	Narsarsuaq – trail to Kuussuup Sermia	N 61.203373° W 45.322214°	110 masl; the only shrub in the area with ripe dark "fruits"
MKPB052	Betula pubescens x glandulosa (?)	17/08/2022	Narsarsuaq – trail to Kuussuup Sermia	N 61.210610° W 45.309030°	290 masl; growing next to MKPB053; twigs with numerous glands and relatively long hairs
MKPB053	Betula glandulosa	17/08/2022	Narsarsuaq – trail to Kuussuup Sermia	N 61.210610° W 45.309030°	290 masl
MKPB054	Betula pubescens x glandulosa (?)	17/08/2022	Narsarsuaq – trail to Kuussuup Sermia	N 61.203560° W 45.319414°	195 masl
MKPB055	Betula pubescens	17/08/2022	Narsarsuaq – trail to Kuussuup Sermia	N 61.203468° W 45.322520°	90 masl
MKPB056	Betula pubescens x glandulosa (?)	17/08/2022	Narsarsuaq – trail to Kuussuup Sermia	N 61.191976° W 45.347967°	20 masl
MKPB057	Betula nana	19/08/2022	Nuuk – trail north of the airport	N 64.200517° W 51.659525°	50 masl; wet slope
MKPB058	Epilobium (Chamaenerion) latifolium	19/08/2022	Narsarsuaq – next to airport entrance	none	10 masl
MKPB080	Betula nana	18/08/2022	Nuuk – hill slope above airport	none	Many small clumps of Betula nana at this location. Extremely small and ground hugging.
MKPB081	Salix sp.	18/08/2022	nuuk – hill slope above airport	none	dwarf form of salix. Not glauca or uva-ursi.

Budget

Travel	£2,990.00
Trains: £136 International air fare: £1808 Greenland domestic travel: £1046	
Food (including dehydrated rations)	£350.00
Accommodation (Denmark and Greenland)	£700.00
Total costs	**£4,040.00**
Grants received	
Stanley Smith UK Horticultural Trust	£1,000.00
Plant Heritage head office	£350.00
Plant Heritage Devon Group	£250.00
Total grants received	**£1,600.00**
Personal costs	**£2,440.00**