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InfoNorth

An Early Tree-Line Experiment by a Wilderness Advocate: Bob Marshall's Legacy in the Brooks Range, Alaska

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Ask any hiker you meet in the Brooks Range of Alaska if he or she has heard about Bob Marshall, and I am sure you will be amazed how well known this name is. His writing inspired many people, set a standard for conservation in northern Alaska, and ultimately led to the establishment of Gates of the Arctic National Park and Preserve, an eight-million-acre wilderness in the central Brooks Range of Alaska.

The man later known as a great conservationist and wilderness advocate, Bob Marshall, was born in 1901. As the son of activist lawyer Louis Marshall, he inherited from his father the urge to stand for what he believed in, be it civil rights or wilderness protection (for a comprehensive tale of Bob Marshall's life, see Glover, 1986). Bob grew up hiking in the Adirondack Mountains, where he developed a special sense for untamed places and the desire to keep them unspoiled. He chose forestry as a profession. In 1930 he came to Alaska for the first time and spent a winter in Wiseman, a small community on the southern slope of the Brooks Range. Back on the East Coast in 1931, he began to write about wilderness issues, deforestation, and conservation. In 1933 he became director of the division of forestry in the Bureau of Indian Affairs. In 1935, Marshall was among the principal founders of the Wilderness Society. Others included Aldo Leopold and Benton MacKaye, who helped establish the Appalachian Trail.

> A visionary in the truest sense of the word, Marshall set an unprecedented course for wilderness preservation in the United States that few have surpassed. His ideas and dreams continue to be realized long after his death at the young age of 38 in 1939… he was among the first to suggest that large tracts of Alaska be preserved, shaped the U.S. Forest Service's policy on wilderness designation and management, and wrote passionately on all aspects of conservation and preservation.
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> The Wilderness Society, 2003

After his first trip to Alaska in 1930, Bob Marshall returned three times before his early death in 1939. His legacy in the Brooks Range includes the mapping of more than 30 000 km^2 of wilderness (Kauffman, 1992) and two books: *Arctic Village* (1933), which he wrote after living in Wiseman for about a year, and *Arctic Wilderness* (1956), which was published after Marshall's death and edited by his brother George. His biggest coup, however, was the naming of two mountains, Frigid Crags and Boreal Mountain: "The mountains became more and more precipitous until finally they culminated in the Gates of the Arctic" (Marshall, 1956:14). He went on to add: "Alaska is unique among all recreational areas belonging to the United States because Alaska is yet largely a wilderness. In the name of a balanced use of American resources, let's keep northern Alaska largely a wilderness."

Bob Marshall's plot in Barrenland Creek, Brooks Range, Alaska, with members of the expedition. Left to right: Joerg Sommer, Martin Wilmking, and Jens Ibendorf. No seeds sprouted and survived from Marshall's planting in 1939, but two seedlings planted by Sam Wright in 1968 are alive and show recent growth on their tips.

THE IMPACT OF BOB MARSHALL'S WRITING

Marshall's call for preservation started a decade-long conservation effort in Alaska. It could be argued that purely the name "The Gates of the Arctic" has instilled a

sense of adventure, wilderness, and freedom into thousands of readers and conservationists. All efforts culminated in the establishment and naming of Alaska's second-biggest national park: Gates of the Arctic National Park and Preserve. Kaufmann (1992:69) stated: "Bob Marshall is to the Brooks Range what Henry Thoreau is to the Maine woods and John Muir to the Sierra Nevada." Gates of the Arctic was awarded national monument status on 1 December 1978, and it became a national park and preserve on 2 December 1980. Bob Marshall's dream of keeping northern Alaska largely a wilderness was at least partly realized.

MARSHALL'S THEORY OF TREE-LINE ADVANCE

Already in the 1930s, Bob Marshall was working on the question of the tree line and tree-line advance in the Koyukuk country of northern Alaska's Brooks Range. His theory was that trees did not have enough time after the last glaciation to occupy their potential growth range. The seed dispersal mechanism, in his view, prevented a fast advance of white spruce into tundra. He calculated the advancement rate of the northern tree line at 1 km per 150 years (Marshall, 1956). This was, as we now know, a strong underestimation. To test his hypothesis, Marshall sowed white spruce seeds north of the tree line in three separate watersheds (Grizzly Creek, Barrenland Creek, and Kinnorutin Creek). Here we present the rediscovery in 2001 of one of his plots—Barrenland Creek.

THE BARRENLAND PLOT: PART OF BOB MARSHALL'S LEGACY IN THE BROOKS RANGE

Bob Marshall spent his last summer in the Brooks Range wilderness of northern Alaska in 1939. Already in earlier years, he had tried to substantiate his theories about the lack of time after glaciation for tree-line advance, but his attempts had failed. In 1930, he had sowed spruce seeds on two plots in Grizzly Creek, twelve miles north of the contemporary tree line (Marshall, 1956). Returning in 1937, he discovered that the seeds had not sprouted. He wrote: "Well, the seeds had not developed; my experiment was a complete, dismal failure on both plots" (Marshall, 1956:123).

However, in 1939, while mapping and exploring the upper Koyukuk area, he repeated his early tree-line experiment by sowing seeds of white spruce (*Picea glauca* [Moench] Voss) about 5 km north of the current tree line on two 3 × 3 m plots in Barrenland Creek. He wrote in his journal: "We stopped for lunch on the edge of foaming white water…It was fascinating in its barrenness, so we called it Barrenland Creek. After lunch I repeated the experiment I had tried with negative results nine years before—the experiment to test my theory that lack of time, not unfavorable climatic conditions, had prevented the progress of the northern timberline" (Marshall, 1956:154). One plot consisted of mineral soil after removal of the vegetation; on the other, Marshall sowed the seeds into undisturbed tundra.

Marshall died four months after this trip (Glover, 1986), and the site was not revisited until Sam Wright and his wife Billie searched for the plot in 1968. On 5 August 1968, Wright (1988:157) wrote: "By seven p.m., rimming up Barrenland Creek's north side, we looked down on the tree planting site where Bob Marshall's stakes still marked his plot after 29 years of arctic freeze and break-up." No trees had grown, so Wright planted 100 four-year-old white spruce seedlings, provided by Les Viereck (pers. comm. April 2001) from a seed stock collected and grown in Fairbanks.

REDISCOVERY IN 2001

In the fall of 2001, our research group from the Forest Science Department at the University of Alaska Fairbanks mounted an expedition into the headwaters of the North Fork of the Koyukuk River. We had two reasons. Our main goal was to study tree-line dynamics in the Brooks Range, but we all knew that we would be within 10 km of Barrenland Creek, and our secret hope was to have enough time to search for the plot of our scientific predecessor. After one week of work on the North Fork, we hiked back to the mouth of Barrenland Creek. After establishing base camp, we crossed the North Fork and climbed up into Barrenland Creek. After a search of the entire valley, we were already on our way back when we finally found the plot—and two seedlings still alive.

However, we could find only one of the plots Marshall had established in Barrenland Creek: the other had probably washed away. The plot is situated at 67˚59.920′ N and 150˚33.815′ W on the north side of Barrenland Creek near the continental divide on top of the Brooks Range, approximately 5 km north of the current tree line and 200 m higher in elevation (1050 m asl). The current tree line is situated at the North Fork of the Koyukuk River on north- and south-facing slopes. White spruce at the North Fork tree line reach 760 m elevation on north-facing slopes and 850 m on south-facing slopes. Preliminary age data suggest establishment before 1700, indicating little or no movement during at least the last 300 years. Barrenland Creek runs west to east in a U-shaped valley completely surrounded by mountains, with large gravel slides on either flank. The plot occupies 3 × 3 m on a floodplain north of Barrenland Creek, shortly before the creek enters its canyon. As of the summer of 2001, the four corners were marked with stone piles and three of the four still had Bob Marshall's original willow sticks protruding 50–80 cm above the ground. An old peanut can in one of the stone piles held a note from Sam Wright, reporting that he had found five spruce seedlings alive in 1989. The soil is stony and shallow and probably underlain by permafrost.

One of the two spruce trees still alive on Bob Marshall's plot in Barrenland Creek. Sam Wright planted this tree as a four-year-old seedling in 1968. In 2001, 37 years old, it measured about 30 cm in height, but showed recent growth on the tips. A sibling of this tree planted at the University of Alaska Fairbanks is 9 m high today (Viereck, pers. comm. September 2001). Visible in the background is Twoprong Mountain.

The two seedlings alive in 2001 were 30 cm in height. They looked healthy and showed recent growth on their tips. An interesting side note is the fact that Les Viereck planted siblings of the seedlings he gave to Sam Wright in 1968 at the University of Alaska Fairbanks. Today they measure about 9 m in height (L. Viereck, pers. comm. September 2001).

Naturally occurring seedlings have been reported several kilometers beyond the last cone-bearing trees (Cooper, 1986), but during our search for the plot, we scanned the entire Barrenland Creek valley and did not find any evidence of other white spruce trees or seedlings. These two seedlings are growing in an environment that probably has not seen trees for tens of thousands of years. Many possibilities emerge to explain the outcome of Bob Marshall's experiment. We do not know how many seeds he sowed on each plot, but Nienstaedt and Zasada (1990) reported a seed-to-seedling ratio of 30–50 seeds per seedling on mineral soil and 500–1000 seeds per seedling on organic soil. The seeds Bob Marshall used were from Chippewa National Forest near Cass Lake, Minnesota. When tested in 1938, they showed a germination rate of approximately 80%, but they were not genetically ideal for this high-latitude site. According to Nienstaedt and Zasada (1990), spruce seeds transplanted to altitudes over 150 m higher than their source tree, or more than three degrees farther north, will probably show effects detrimental to growth.

Seedling survival rates over decades are not well documented for tree-line areas, but it could be argued that two out of 100 is quite normal, or even above average. On the other hand, despite recent warming trends, environmental conditions may just be unfavorable to growth. Soil temperatures might be too low and snowbeds too persistent, making the vegetation period too short. This plot does not meet the criteria for a "safe spot" (usually a south-facing, sheltered depression), a locality most likely to promote survival of seedlings at northern tree lines. In addition, disturbance by animals or humans might be a factor. After we relocated the plot in 2001, we had a chance to meet Sam Wright; he told us that in 1989, he had found evidence of human interference on Bob Marshall's plot. But in 2001, the two surviving seedlings seemed healthy and showed recent growth.

And so, despite all these scientific explanations and thoughts, the legacy of Bob Marshall in the Brooks Range of Alaska will include not only his lifelong work for nature conservation, but also two spruce seedlings growing on his plot about 5 km north of the current tree line. They are a living monument to his research and exploration in what is now called the Gates of the Arctic National Park and Preserve.

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