Trees in the Tundra[1]

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Abstract.--In Alaska, due to two containerized nurseries, reforestation is rapidly developing. A brief review of needs and projected development indicates growth **in** this area.

ALASKAN PERSPECTIVE

Trees were planted in Alaska while Lewis and Clark were still trying to cross the lower 48! The first trees were planted by the Russians in 1805 at Unalaska Island (Lutz, 1963). Since that time these Sitka spruce (Picea stitchensis) have been revisited many times and several are still growing (Tindall, 1979). The treeless Aleutians have drawn many test plantings over the past 150 years, from the early Russian plantings through various World War II efforts (Bruce and Court, 1945), and more recently with experimental plantings made near Sand Point from nursery stock grown by the Alaska State Forest Nursery. This part of Alaska is an active area for tree growth with natural westward expansion of spruce stands occurring on Kodiak Island (Griggs, 1934). Other reforestation efforts have been made in the interior of Alaska.

The famous forester Bob Marshall made two plantings along the south slope of the Brooks Range in the 1930's (Marshall, 1956). Seed from native white spruce (Picea lauca) was first tried and, later, white spruce seed from the Lake States Forest Experiment Station in St. Paul, Minnesota was sown on hand prepared seedbeds. The first experiment had **little** success, according to the author, and to date no one has returned to the second site.

The first known nursery in Alaska was a bare-root facility developed by foresters with the USDA's Alaska Fire Control Organization, later merged into the Department of Interior's Bureau of Land Management. It was operated as a "personal interest" test for about five years in the late 1940's and early 50's at the old CCC camp on the Fort Richardson military base near Anchorage. Over 25 species, including several exotics, were grown, particularly Scotch pine. Seeds were collected and hand processed; two foresters were sent to Iceland with Alaskan seed for exchange.[3]

Forest management on the Tongass Nat ional Forest began in 1953 with a 50 year timber sale to the Ketchikan Pulp Company. The state, however, has only recently begun programs in fire protection, harvesting, and reforestation. Most of the coastal forest is managed by the U.S. Forest Service while state forest lands (currently being selected) will be concentrated in the interior. Each forest type has its own unique characteristics.

ALASKAN FOREST TYPES Coastal

The highly productive forests of coastal Alaska include Sitka spruce, western hemlock (Tsu a heterophylla), western redcedar (Thu a plicata), and Alaska yellow cedar (Chamaecyparis nootkatensis) with lesser amounts of hardwoods

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such as red alder (Alnus rubra) and black cottonwood Populus trichocarpa)(Harris, 1974). This forest type extends northward to the tip of the Alaskan panhandle and westward to Kodiak Island. The northern edge of this forest is about 95 km (60 miles) south of Anchorage adjacent to Cook Inlet (Viereck and Little, 1974).

The coastal forest is a prolific seeder with artificial regeneration primarily required along alluvial stream terraces and steep, unstable slopes (Harris, 1974). One experiment with a 700 acre (283 ha) clearcut found (eight years after logging) stocking on a milacre (5 M^2) basis averaged 69% with an average stem density of 12,385 stems per hectare (5012 stems per acre) (Harris, 1967).

The majority of the coastal forest is managed by the U.S. Forest Service and it contains the two largest national forests in the United States, the Tongass National Forest in southeast Alaska and the Chugach National Forest in southcentral Alaska. The Alaska Native Claims Settlement Act (ANCSA) of 1971 and the Alaska Statehood Act of 1959 will result in the transfer of over 1 million acres of this forest land into private and state ownership. About 2.75 million m^3 (535 MMBF) are harvested annually from this land, primarily by clearcuttings totaling about 7200 ha (18,000 acres) though this will likely be reduced by recent federal land withdrawals (USFS, 1979).

Interior

Alaska's interior forests are an extension of the North American boreal forest (also called "taiga" in Russian). Species include white spruce, paper birch (Betula papyrifera), aspen Populus tremuloides), and on poorly drained sites with or without permfrost, black spruce (Picea mariana), and tamarack (Larix laricinia). Hardwoods such as balsam poplar (Populus balsamifera), black cottonwood Populus trichocarpa), and over 30 willow species (Salix spp.) are found along with several alders (Alnus spp.) throughout the interior.

The boreal forest extends from the Brooks Range in the north (70°N) to the coastal forest in the south (60°N); the eastern boundary is the Canadian border and the western boundary is the maritime treeline near the Bering and Chukchi Seas (Zasada, 1976). This vast area contains about 9.1 million hectares (22.5 million acres) of forested land that is capable of producing 1.40 m^3 per hectare per year (20 cubic feet per acre per year) (Galea, et. al., 1976). Land ownership patterns are fluid and will be affected by the Statehood Act, ANCSA and especially the 22.6 million hectares (56 million acres) established as National Monuments by President Carter in December 1978.

Regeneration in the Interior is more difficult than the coastal forest due to harsher sites, less rainfall, permafrost, and variable seed supply (Zasada, 1976). Regeneration surveys near Fairbanks on land harvested since 1954 indicate stocking is very inconsistent and artificial planting will likely be needed on many sites. Average stocking was 502 on a milacre ($5m^2$) basis with an equal distribution of spruce and hardwoods (Clautice, 1978).

About 68,000 m^3 (12 MMBF) are harvested annually in the Interior with over 80% originating on a salvage sale near Anchorage. Fuelwood is a primary use of the forest in the Interior and has been for many years. One forester estimated that in the early 1900's Fairbanks had an annual 60,000 cord consumption in addition to wood burned by the railroad and Yukon River steamers (Kellogg, 1910).

REFORESTATION

Starting with the BLM nursery in the late 1940's, Alaskan foresters have been attempting to secure a reliable source of nursery stock for reforestation and other uses. Bareroot stock from the Lake States and the Pacific Northwest was planted on several sites but poor survival indicated a need for locally grown trees.

The State of Alaska's forest nursery originated with a 1974 containerized symposium in Denver, Colorado. John Sturgeon, forester, and Joe Stehlik, represented the State Division of Agriculture and returned with plans for growing containerized seedlings in Alaska. The selected site was at the State Division of Agriculture's Plant Materials Center, near Palmer. Situated near the early Matanuska farm colonies that were set up by the U.S. Department of Agriculture in the 1930's, the area is also known for its 65 pound cabbages! A cooperative agreement between the State Forester and State Division of Agriculture set an initial three year period (1975-1977) for testing and evaluation of containerized growing methods and techniques. Funds were provided by the federal government, through the U.S. Forest Service, for the pilot project. The first major state funding came in May of 1978; a full time nursery manager was hired in September of that year. A forest technician was added as a second staff member in 1979 after enactment of a Forest Resources and Practices Act that placed stronger legal emphasis on reforestation. The

State Forest Nursery is currently testing twocrop production with a maximum single crop capacity of 153,600 seedlings. The state has also signed a cooperative agreement with the U.S. Forest Service providing for seedling exchange. The Stikine Nursery in Petersburg will provide planting stock for state lands in southeast Alaska and the state will provide tree seedlings for the Chugach National Forest.

The first major planting on harvested forest land took place in October, 1977. Over 20,000 Sitka spruce seedlings were grown under contract for the Chugach National Forest; they were planted on the Perenosa Timber Sale, located on Afognak Island northeast of Kodiak. Another similar planting followed in 1978 while other seedlings were planted on state lands near Anchorage, Fairbanks, and Haines. Seedlings were also made available to the public, the Native corporations, the University of Alaska, and for public and private research purposes. A recent 30,000 acre burn on agricultural lands near Delta Junction has stimulated interest in seedlings and rooted hardwood cuttings for windbreaks and shelterbelts.

FACILITIES

State Nursery

Palmer is within a transition area between maritime and continental climatic zones. Temperatures range from -35 to 90°F with an average annual precipitation of 17", including 42" of snow. The growing season is 106 days with a total heat requirement of about 12,000 degree days (65°F base). Palmer is generally free of permafrost though isolated masses may be found. At 61°31' north latitude and 149°05' west longitude, the site receives almost continuous sunlight and twilight from May 15 to July 15 (Selkregg, 1974). Warm, drying spring winds at velocities up to 65 miles per hour originate off the Knik glacier; winter, however, is usually calm. The sun does not rise over the Chugach mountains from November 20 to January 20 each winter, leaving the nursery and PMC in darkness.

The basic greenhouse structure is double-walled, plastic covered and wood framed. Two small adjustable blowers inject interior air between sheets of 6 mil film for inflation throughout the year and during the nursery growing season, March to October. The greenhouse was lengthened 38' in late 1978 to its present size of 24' x 100'. An additional greenhouse is ready for erection when funding permits.

The nursery uses Ray-Leach tubes for seedling production; styro-block and Root Trainer books were used during the test period. Generally, Alaskan seedlings will be shipped by air at least once and the Ray-Leach tubes provide a higher ratio of seedlings per cubic volume shipped. The tubes are cleaned with steam and sterilized with a 5% solution of Clorox. Benches are built for an eight tray width and a 48 bench length, utilizing 64% of the maximum growing space.

A 1:1 ratio of peat to vermiculite is used, although it varies depending on whether local or Canadian peat is available. Fertilizer is injected with irrigation water through a traveling water boom. A boom trolley uses a 12 volt starter motor; the power source consists of a carriage mounted battery, which automatically recharges itself at the end of each circuit.

Heat is currently provided by two oilfired heaters with underbench air tube dispersion. The high cost of propane caused a switch to oil although adjacent coal mines provide a potential source of fuel at $25.00 per ton. Cooling is provided by evaporative aspen pads and sump water dispersion. Four fans sequentially draw air across the benches. Well water for cooling and irrigation is stored in a 500 gallon steel tank painted black for heat absorption.

A propane fired CO_2 generator has been installed recently and a humidifier will be operating prior to the end of the growing season. An Acme Team II Controller will be installed after the end of the current season.

Stikine Forest Nursery

The U.S. Forest Service is building a containerized nursery complex at Petersburg, near the southern terminus of the Alaskan panhandle; it is located on a University of Alaska Fur Farm site under long term lease. Petersburg is located in the maritime zone of Alaska at 56°46' north latitude and 132°57' west longitude. The 106" of precipitation, including 103" of snow, reflects its "wetness". Temperature extremes are -19 to 84°F with a heat demand of 8409 degree days. The growing season is 172 days with maximum sunlight of about 18 hours. There is no permafrost in the southern panhandle (Selkregg, 1974).

When completed, the nursery will consist of six, quonset style, double-layer polyethylene covered, "Nexus" greenhouses. The headhouse and greenhouses will be connected by a 12' x 255' corridor, spanning the length of the six greenhouses on the north side. The

headhouse is 50' x 60' and includes areas for sowing, packing, cone processing, lavatories, washrooms, and an office. A pumphouse is centrally located adjacent to the corridor.

Each greenhouse is 30' x 96' with added four-foot sidewalls. One 36" and two 42" fans were installed in the south end of the single finished house along with four inlet shutters in the north end. Heat is provided by separate oil-fired unit heaters installed about 5" from two special shutter-box assemblies that enable intake of fresh air or recirculation of heated air and subsequent distribution down the poly tubes.

There are 28 - 12' x 5' benches per house. The current crop consists of 94% twocubic inch and 6% five-cubic inch styro-blocks. Lighting is provided by 250 watt incandescent bulbs that provide 20-40 foot candles at tree level. Watering and nutrient injection were initially accomplished with "Hozon" syphon and garden hose; however, a Smith R-8 nutrient injector was recently installed. A moving water boom system will be operational later this year.

Sowing of the 147,000 cavities was completed between March 14 and 29, 1979. A plexiglass "shaker box" was used in conjunction with a homebuilt compactor, soil bin, and dibbler. A template for top dressing with perlite was also used and will be modified.

EVALUATION

By the end of 1978 the trial project had reached most of its original goals. It showed that seedlings can be successfully grown in Alaska using containerized techniques. Findings indicated that the planting stock cost about $125 per acre. Unit costs were $0.243 per tree based on variable costs only. The Red Rock Nursery at Prince George, British Columbia is currently growing white spruce for tests near Fairbanks. A single attempt to grow bare root stock at Palmer failed due to winter desiccation, but evaluation is continuing.

Preliminary data from plantings made at Afognak and Tyonek, across Cook Inlet from Anchorage, suggest we will experience the same problems that prevent successful regeneration in the lower 48. Animal damage, insect infestation, disease, frost heave, desiccation, winter-kill, snow break, and poor planting have all been found to one degree or another, in test plantings. Too many variables exist to properly pinpoint successful
planting techniques, plant size, and planting times. These will be determined by 1985 and a firmer estimate will be made then.

PROJECTIONS

As Alaska enters the Forest Practices era, increasing emphasis on reforestation will create a demand of about one million seedlings by 1985. If bare root trials are successful, potential growing sites north of the Alaska Range may be developed, possibly in conjunction with the State Plant Materials Center. Other demands upon the State Nursery are emerging.

The Department of Natural Resources has signed a cooperative agreement with the Usibelli Coal Mine (UCM) near Mount McKinley. The mine has had an active program of vegetation testing and stabilization since 1970. Seedlings were sent to UCM for evaluation and testing this past spring. Recent political emphasis on the Alaskan natural gas pipeline will stimulate further research and production of plants for revegetation. Seed and cuttings will be gathered this fall.

Tree improvement work is just beginning and cooperative research and testing with the U.S.Forest Service's Institute of Northern Forestry at Fairbanks will develop a broad base for future work. Foreign seed exchange programs with high latitude countries will grow as the program develops.

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