Increased or Decreased Energy for Moose?

The Susitna Hydroelectric Project

By

William B. Collins*

A moose walks out onto a Susitna River gravel bar a few miles downstream from Talkeetna and begins to browse some low-growing willow and balsam poplar shrubs. The animal has spent approximately one-half of its day feeding on similar vegetation. Approximately one-fourth of its day will be spent rechewing its harvest, further converting the woody plants into a form it can use as energy. Energy cannot be created or destroyed, but only changed in form.

Forty-eight miles upstream, an engineer contemplates another form of energy conversion. His plan will alter the flow of the river to harness its energy. The man has selected the location for a dam because it represents a very efficient site for conversion of water power to electricity. The moose has selected its feeding site because, there too, energy conversion is most efficient.

During this study the Agricultural Experiment Station (AES) at Palmer was under contract to Terrestrial Environmental Specialists (TES) of Phoenix, New York, to investigate the possible impacts on vegetation and related habitat values for moose of hydroelectric development on the Susitna River. This effort was part of an overall feasibility study conducted by Acres American Incorporated for the Alaska Power Authority; TES was subcontracted to Acres. A primary concern has been to determine what effect regulated river flow may have on moose habitat within the floodplain downstream of the proposed Devil Canyon damsite. This land is frequently flooded in summer, a phenomenon which some believe may be responsible for maintenance of the vegetation in early successional stages which are highly productive of moose forage. With hydroelectric development, the annual fluctuation in downstream water levels and flooding would be reduced, thereby possibly allowing prime moose habitat to advance to later, less productive successional stages.

*Assistant Professor, Range Management, Agricultural Experiment Station, Fairbanks.

In May 1981, AES personnel began a study of vegetation succession on the Susitna floodplain from the Devil Canyon site downstream approximately 92 miles to the Deshka River. Through reconnaissance of the area and comparison of historical (1951) photographs with 1980 photographs, seven vegetation types were identified which were thought to represent stages of succession from bare ground to climax forest.

Vegetation soils data from each type were collected and analyzed to determine vegetation history as it may relate to flooding. Per cent cover of plant species and density, dimensions, and ages of trees and shrubs were estimated or measured to form the basis for characterizing each vegetation type. Particular effort was made to determine the point in time when each stand began developing. Soils from several pits within each type were analyzed to determine what relationships may exist between vegetation type and soil substrate. Elevations of each stand above the level of the river were measured at various times during the summer to be related to rates of flow (simultaneously being measured by R and M Consultants, another member of the feasibility study team). Eventually this information can be used to predict the extent of flooding under different hydroelectric development options.

Vegetation succession on the floodplain generally occurs in the following sequence (Figure 1). Commonly, horsetail (*Equisetum* spp.) is the first vegetation to become established on bare ground. However, its occurrence is dependent on the presence of fine sands and silts in the surface horizons of the soil. This vegetation is readily invaded by willow (*Salix* spp.) and balsam poplar (*Populus balsamifera*) seedlings. Similar topographic sites which have coarser substrate may never develop horsetail as the dominant species but may be occupied by willow-balsam poplar

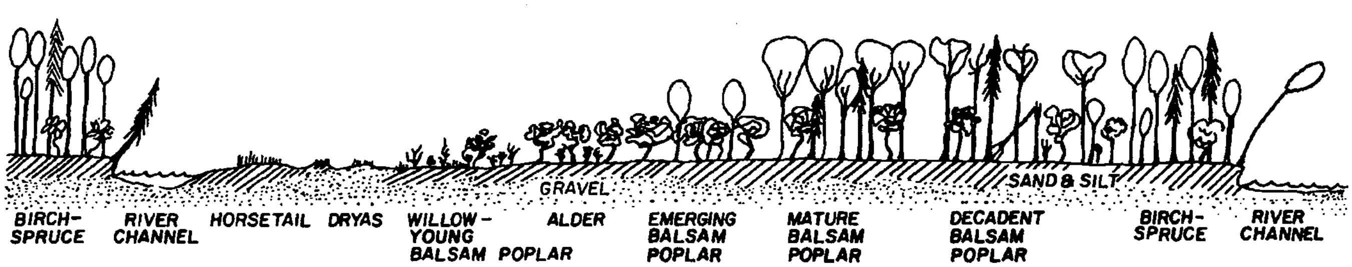

Figure 1. Possible sequence of vegetation succession (left to right) on Lower Susitna River. Horsetail, dryas, or willow-young balsam poplar may occur as the pioneering vegetation type, depending on the substrate, plant propagules present, and other environmental conditions.

Figure 2. Early successional vegetation. Horsetail stand (on left) is the initial pioneering vegetation. At a slightly higher elevation (on right) is a heavily browsed stand of feltleaf willow which is 8 to 10 years old.

Figure 3. Feltleaf willow, balsam poplar, and alder seedlings gain dominance over initial horsetail stand. Alder (the large shrubs) are 3 years old and already overtopping the willow and balsam poplar which are 7 to 10 years old.

directly, or in the case of gravelly or cobbley sites, be pioneered by dryas (*Dryas drummondii*), a nitrogen-fixing plant. In any case, the initial vegetation is important in holding the soil and in reducing the velocity of water and wind for further deposition of substrate.

In time, depending on a number of factors such as siltation and elevation of the surface above the level of frequent flooding, density of alder (*Alnus tenuifolia* and *A. sinuata*), another nitrogen fixer, apparently increases and gains dominance over the balsam poplar and willows. This may be in response to an inherently faster growth rate of alder, or preferential browsing of the other species by moose, or a combination of both. However, some time after the alder achieves maximum height, the balsam poplar emerges through the alder canopy, once again receiving full sunlight and begins fast growth into large trees. Addition of nitrogen to the soil by alder may contribute to the balsam poplar's increased rate of growth. Balsam poplar is shade-intolerant and does not reproduce in its own shade; consequently, most stands are even-aged.

As the balsam poplar forest matures, spruce (*Picea glauca*) may appear in the canopy (a few may become evident as early as the alder stage). Eventually, the balsam poplar becomes decadent and falls, leaving space for development of more balsam poplar or spruce and birch (*Betula papyrifera*). The factors responsible for development of the birch-spruce stands versus continuation of balsam poplar are still unclear but may be better understood after further analyses of soils. Balsam poplar does have a better chance of continuing if the disturbance exposes mineral soil. Elevation surveys of the different types did not indicate that the birch-spruce stands were any less likely to be inundated by high water than were mature balsam poplar stands. Much work still needs to be done to understand more fully the mechanisms underlying each of the apparent successional sequences.

Initial observations by both AES and Alaska Department of Fish and Game (ADF and G) personnel indicate that the willow-balsam poplar sapling type may be the most valuable feeding habitat for moose living on the floodplain. This is being

Figure 4. Substrate determines the type of pioneering vegetation which becomes established. Horsetail and willow readily establish on silty sites (top), while only sparse patches of dryas and balsam poplar are found on gravelly sites (bottom).

Figure 5. Alder thicket with balsam poplar emerging through the top.

Figure 6. After 25 years, a dryas stand (see Figure 4) may accumulate enough alluvial and windblown silt to support a more productive and diverse community of plants. However, the vegetation on siltier soils (background) has advanced to an immature balsam poplar forest in the same amount of time.

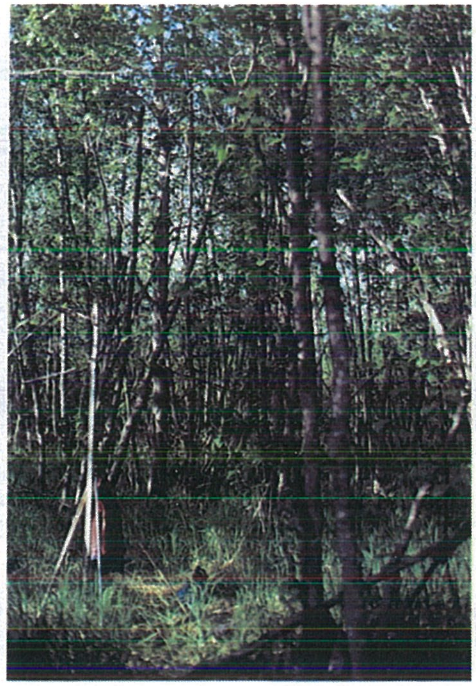

Figure 7. Balsam poplar browse is elevated far above the heads of moose as saplings grown into trees as seen in this immature forest.

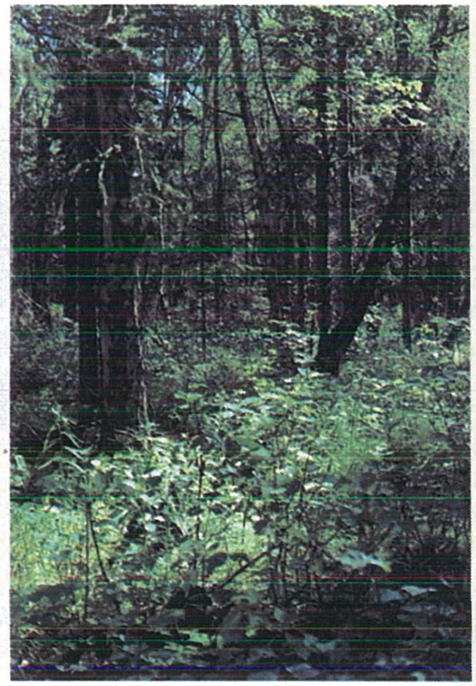

Figure 8. Birch-spruce may be the climax vegetation Susitna River floodplain.

studied by the ADF and G which is responsible for the evaluation of the big game populations and distribution as part of the feasibility study. Since the willow-balsam poplar sapling type occurs early in vegetation succession, it is probably dependent on some form of disturbance to create conditions favorable for its establishment. Such disturbance could result from flooding and subsequent siltation, erosion of banks by ice and redeposition, wind throw, or fire. The relative influence of each of these factors thus is also an important consideration in defining the impact of flooding.

Mature and decadent balsam poplar and birch-spruce stands also produce abundant moose browse and provide security cover. Highbush cranberry (*Viburnum edule*) and prickly rose (*Rosa acicularis*) are important browse species in these forested types, whereas willow species have become much less abundant than in the open types. Paper birch saplings provide additional browse for moose in birch-spruce stands, and alder species may be browsed occasionally in all stands. Devilsclub (*Oplopanax horridus*), which often leaves numerous painful spines imbedded in the legs and hands of hikers, and ostrich-fern (*Matteuccia struthiopteris*) are highly preferred as forage by lactating cows and calves using mature and decadent balsam poplar stands in spring and early summer.

Birch-spruce stands appear to be in dynamic equilibrium or climax for vegetation occurring on the lower Susitna River floodplain. These stands characteristically have four phases which repeat themselves in the following cyclic sequence. The tallest, oldest part of the forest, having a well-developed understory of grasses and forbs but relatively few shrubs, begins to lose paper birch from the canopy as heart rot takes its toll. As the canopy opens up, the spruce apparently becomes more susceptible to windthrow, and large patches of overstory are completely lost. This then leads to the decrease of some shade-tolerant species and the increase of paper birch saplings, highbush cranberry, prickly rose, willow, and thinleaf alder (*Alnus tenuifolia*). As brush fields age, spruce begins to appear and eventually this phase advances to birch-spruce forest. The early

Figure 9. After roughly 150 years, balsam poplar can become decadent, creating space for emerging spruce and/or birch. Newly deposited bar in the foreground shows the successional sequence starting over.

birch-spruce stands characteristically retain more browse in the understory than do more mature stands. As birch-spruce stands age, the cycle apparently is repeated. The close association of brush fields with mature forest in the birch-spruce type appears to provide good overall moose habitat.

AES personnel will begin estimating the forage productivity of each vegetation type. This information, coupled with habitat-preference data collected by ADF and G and vegetation succession information, will be used to assess the effects of changes in vegetation which may occur if hydroelectric development takes place. Then it may be known how development of Susitna hydroelectric energy will affect the availability of an efficient source of energy for moose.

ACKNOWLEDGMENTS

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THE DYNAMIC FORCES OF THE SUSITNA RIVER AT WORK

Figure 10. Siltation during summer flood occurring on dryas, horsetail, and balsam poplar sapling communities. AES personnel discuss the impacts with a wetlands specialist and forester from Sweden.

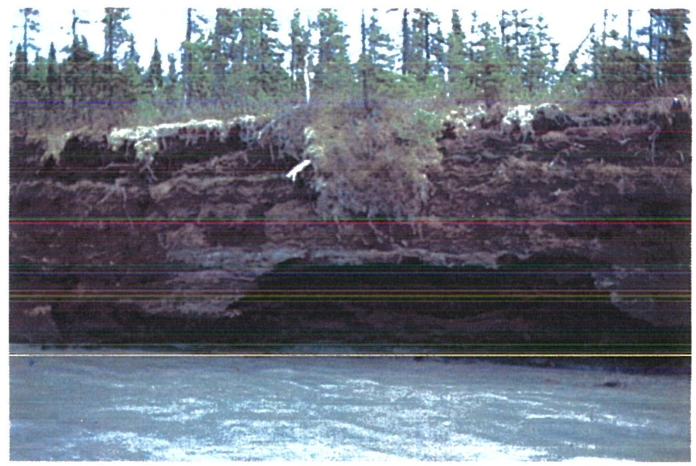

Figure 11. A black spruce peat bog (not considered part of the floodplain) is being undercut and pulled into the river.

Figure 12. Young alder and balsam poplar which were "bulldozed" by ice during spring breakup. Rocks were deposited as the ice block melted from beneath them.

Figure 13. Young balsam poplar trees (center) exhibit "flood-trained" shape as a result of past ice jamming.