The author acknowledges the assistance of G. Baskerville, Canadian Forestry Service; L. Holt, Bowaters Mersey Paper Company; and field assistants J. Maxwell, R. MacLennan, W. Bauman and W. Prescott.

Forage Yield in Two Forest Zones of New Brunswick and Nova Scotia

E. S. TELFER
Biologist, Canadian Wildlife Service, Fredericton, New Brunswick, Canada.

Highlight

A reconnaissance was made of the forage yield in a series of forest types in New Brunswick and Nova Scotia. Forage yields per acre were comparable to those reported from many studies in western North America, but plant composition differed. Grasslike species constituted a small proportion of total weight in most forest cover types, while ferns provided a high proportion. Correlation of yield with density characteristics of the tree stand was poor.

Considerable literature exists on weight yields of browse and herbage serving as forage for big game and livestock in western and southern North America (Doell and Smith, 1965). Less attention has been given to the food supply, on a weight basis, of herbivores in the wildlands of northeastern America. I conducted a preliminary survey of browse and herbage yield of forest-cover types in northern New Brunswick in July and August 1966, and in southwestern Nova Scotia in 1967.

Study Areas and Methods

Rowe (1959) and Loucks (1962) have discussed physiography and vegetation in New Brunswick and Nova Scotia and Roland (1945) has described the flora of Nova Scotia in detail. Local climate and vegetation are strongly influenced by bodies of salt water and the low, but abruptly rising hill masses. Lowlands cover most of Nova Scotia and eastern New Brunswick and are the most extensive land type in these provinces. Uplands comprise the other prominent land type. They form dissected plateaus from 500 to over 2,000 feet in elevation.

An upland area of northwestern New Brunswick was sampled in or near the Canadian Forestry Service's Research Block No. 3 which has been described by Hughes (1964) at the Green River Field Research Station, and lowlands in southwestern Nova Scotia were sampled on and near the Tobeatic Wildlife Management Area. Sampling in the Green River area was conducted in Loucks' (1962) "sugar maple-yellow birch-fir zone." In the Tobeatic area sampling was in the "red spruce-hemlock-pine zone."

The Green River area displayed a recurring pattern of deciduous stands on ridges, mixed forest on middle slopes, dense coniferous stands on lower slopes and flats. Swamps dominated by northern white cedar (Thuja occidentalis) occurred along creek beds and lake shores. Principal deciduous trees were sugar maple (Acer saccharum), American beech (Fagus grandifolia), white birch (Betula papyrifera) and yellow birch (Betula alleghaniensis). Conifers were white spruce (Picea glauca), black spruce (Picea mariana), northern white cedar and balsam fir (Abies balsamea).

At Tobeatic, areas of impeded drainage form muskegs or swamps. Low ridges carry conifers or mixed forest, and some small pure deciduous stands. Deciduous species were red maple (Acer rubrum), aspens (Populus spp.), red oak (Quercus rubra) and white birch. Conifers were red spruce (Picea rubens), black spruce, balsam fir, eastern hemlock (Tsuga canadensis) and white pine (Pinus strobus).

Sample plots were located randomly in forest stands on maps of Canadian Forestry Service research blocks for the Green River survey, and on provincial forest inventory maps for the Tobeatic survey. Clusters of three plots were established in the field by measuring

Literature Cited

Table 1. Forage yield (lb./acre) by categories in 10 cover types of two forest zones in New Brunswick and Nova Scotia. Height range of 0 to 7.5 ft. Year of study stated for each forest zone.

| Zones and cover types | Evergreen | Deciduous | Grass-like plants | Ferns
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Twigs</td>
<td>Leaves</td>
<td>Twigs</td>
<td>Leaves</td>
<td>Forbs</td>
</tr>
<tr>
<td>Sugar maple—yellow birch—fir zone (1966)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature hardwood</td>
<td>2</td>
<td>10</td>
<td>41</td>
<td>169</td>
</tr>
<tr>
<td>Pole-size softwood</td>
<td>2</td>
<td>6</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>Cedar Swamp</td>
<td>25</td>
<td>99</td>
<td>41</td>
<td>294</td>
</tr>
<tr>
<td>Red spruce—hemlock—pine zone (1967)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dense softwood</td>
<td>6</td>
<td>31</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Open softwood</td>
<td>27</td>
<td>122</td>
<td>48</td>
<td>302</td>
</tr>
<tr>
<td>Dense mixedwood</td>
<td>24</td>
<td>194</td>
<td>12</td>
<td>43</td>
</tr>
<tr>
<td>Open mixedwood</td>
<td>6</td>
<td>26</td>
<td>177</td>
<td>445</td>
</tr>
<tr>
<td>Dense hardwood</td>
<td>17</td>
<td>77</td>
<td>42</td>
<td>207</td>
</tr>
<tr>
<td>Saplings §</td>
<td>5</td>
<td>22</td>
<td>44</td>
<td>282</td>
</tr>
<tr>
<td>Brushland §</td>
<td>—</td>
<td>—</td>
<td>124</td>
<td>723</td>
</tr>
</tbody>
</table>

1 Polypodiaceae and Osmundaceae, mostly Dryopteris spp. and Pteridium spp.
2 Trace, less than 1 lb./acre.
3 Young, regenerating stands on clear or partially cut areas, burns or blowdowns.
4 Deciduous shrub communities occupying rock barren or severely burned areas.

Direction with a hand compass and distance with a steel tape from a topographical feature. Plots were centered 15 feet from the cluster center thus established on magnetic bearings of 0, 120 and 240 degrees.

Yield of the current year at Green River was determined by clipping all herbaceous plants, terminal twig growth and leaves from 3.1 x 3.1 ft. square quadrats. At Tobeatic double sampling (Wilm et al., 1944) was employed, using quadrats of the same size. Green weights of forbs, grass-like plants, the terminal growth of twigs, and leaves of the current year were estimated. One of each six quadrats was also clipped. Clipped material from both study areas was oven dried in a convection oven for 48 hours at 70 C. For the Tobeatic material regressions of actual oven dry weight on estimated green weight were made for leaves, twig terminal growth, grass-like plants, ferns and forbs, by the “ratio-of-means” method described by Blair (1958).

At each plot a point count was taken using a 10-factor wedge prism (Bell and Alexander, 1957). Results were used to estimate basal area and number of trees per acre for stems over 1.5 inch diameter. Mean percentage of crown cover was calculated for each plot from 10 measurements made with a

Table 2. Total forage, winter browse and herbage yields (lb./acre) in 10 forest cover types in New Brunswick and Nova Scotia. Height range 0-7.5 ft. Year of study stated for each forest zone.

<table>
<thead>
<tr>
<th>Zones and cover types</th>
<th>Mean winter browse §</th>
<th>Mean herbage §</th>
<th>Mean total forage §</th>
<th>Std. error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar maple—yellow birch—fir zone (1966)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature hardwood</td>
<td>53</td>
<td>167</td>
<td>220</td>
<td>61</td>
</tr>
<tr>
<td>Pole-size softwood</td>
<td>16</td>
<td>60</td>
<td>90</td>
<td>16</td>
</tr>
<tr>
<td>Cedar swamp</td>
<td>165</td>
<td>77</td>
<td>536</td>
<td>157</td>
</tr>
<tr>
<td>Red spruce—hemlock—pine zone (1967)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dense softwood</td>
<td>48</td>
<td>78</td>
<td>140</td>
<td>37</td>
</tr>
<tr>
<td>Open softwood</td>
<td>197</td>
<td>571</td>
<td>1070</td>
<td>207</td>
</tr>
<tr>
<td>Dense mixedwood</td>
<td>230</td>
<td>256</td>
<td>529</td>
<td>156</td>
</tr>
<tr>
<td>Open mixedwood</td>
<td>209</td>
<td>471</td>
<td>1125</td>
<td>525</td>
</tr>
<tr>
<td>Dense hardwood</td>
<td>136</td>
<td>455</td>
<td>798</td>
<td>137</td>
</tr>
<tr>
<td>Saplings §</td>
<td>71</td>
<td>460</td>
<td>813</td>
<td>275</td>
</tr>
<tr>
<td>Brushland §</td>
<td>124</td>
<td>314</td>
<td>1161</td>
<td>181</td>
</tr>
</tbody>
</table>

§ Deciduous twigs, coniferous twigs and leaves.
§ Ferns, grass-like plants and forbs.
§ Including leaves of deciduous woody species.
4 See type description under Table 1.
“mooschorn” instrument (Garri-son, 1949). Mean stand height was estimated from clinometer measure-
ments and mean age from annual ring counts of several co-
dominant trees at each plot cluster.

Results and Discussion

Forage yields in Nova Scotia and
New Brunswick (Tables 1 and 2) fall into the same range as yields
in western North American forests
(Eddleman and McLean, 1969; Young et al., 1967; Pase and Hurd,
1958). However, composition dif-
fers: grasses and grass-like species
were less prominent in the New
Brunswick and Nova Scotia forests
than in western areas; the weight of ferns was greater than
other classes of herbage in most
forest types. Principal forb species
in terms of biomass in the Green
River area were wood sorrel
(Oxalis montana), Srasparilla (Aralia
nudicaulis), clintonia (Clintonia
borealis), wild lily-of-the-valley
(Maianthemum canadense) and
bunchberry (Cornus canadensis).
With exception of wood sorrel
the same species were important
in the Tobeatic area. Other species
also important in the latter area
were goldenrod (Solidago spp.),
asters (Aster spp.), goldthread
(Coptis groenlandica) and box-
berry (Gaucheria procumbens).
Grass-like species were mostly
sedges (Carex spp.), but were
not classified by species. Bracken
(Pteridium aquilinum) contributed
an important part of the fern
biomass, as did species of the
genus Dryopteris, principally D.
noveboracensis.

Shrubs, and seedlings and sap-
lings of arboreal species in order

Table 3. Characteristics of the tree overstory (stem over 1.5 inches in diameter
at breast height) in stands sampled during forage field reconnaissance in
New Brunswick and Nova Scotia.

<table>
<thead>
<tr>
<th>Zones and cover type</th>
<th>Coniferous basal area (ft² acre)</th>
<th>Deciduous basal area (ft² acre)</th>
<th>Mean crown cover (%)</th>
<th>Mean stand height (ft)</th>
<th>Mean stand age (yr)</th>
<th>Estimated percentage of study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar maple—yellow birch—fir zone (1966):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Mature hardwood</td>
<td>10</td>
<td>80</td>
<td>88</td>
<td>55</td>
<td>97</td>
<td>8</td>
</tr>
<tr>
<td>Pole-size softwood</td>
<td>136</td>
<td>19</td>
<td>90</td>
<td>47</td>
<td>56</td>
<td>58</td>
</tr>
<tr>
<td>Cedar swamp</td>
<td>143</td>
<td>3</td>
<td>68</td>
<td>53</td>
<td>154</td>
<td>8</td>
</tr>
</tbody>
</table>

| Red spruce—hemlock—pine zone (1967): | | | | | | 2 |
| Dense softwood | 134 | 14 | 75 | 42 | 64 | 3 |
| Open softwood | 60 | 6 | 44 | 49 | 87 | 30 |
| Dense mixedwood | 71 | 46 | 73 | 40 | 67 | 4 |
| Open mixedwood | 40 | 33 | 61 | 64 | 62 | 17 |
| Dense hardwood | 8 | 75 | 54 | 36 | 52 | 1 |
| Saplings③ | 39 | 9 | 29 | 21 | 28 | 10 |
| Brushland④ | 2 | 0 | — | — | — | 11 |

① Areas calculated for Research Block No. 3 from Hughes 1961:20.
② Areas calculated from 1956 Provincial Forest Inventory Data supplied by the Nova Scotia Department of Lands and Forests (R. M. Bulmer, personal communication, March 15, 1967).
③ See type description under Table 1.
but it is difficult to compare these data because height ranges and definitions of browse differ.

In some studies, high forage yield has been found to be correlated with open stand conditions (Pase and Hurd, 1967; Eddleman and McLean, 1969; Halls and Schuster, 1965). In this study, average values for forest types show the same general trend (Tables 2 and 3) but regressions of individual plot yields against measures of stand density gave poor correlations. Poor correlation between basal area per acre and browse yield was also found in Virginia (Whelan, 1962). Regressions of forage yield on stand density (Pase and Hurd, 1967; Halls and Schuster, 1965) resemble curves of solar radiation reaching forest understories under varying crown closures (Vezina and Pech, 1964). Miller (1965) stated that transmission of solar radiation through forest canopies depends on the biomass of foliage and branches and the way the biomass is distributed in the space occupied by the crown. Crown biomass and arrangement may have been exceptionally variable in the mixed forests sampled in this study, creating different radiant energy environments and possibly differing yields of understory vegetation in stands of similar density. These differences probably account for much of the standard error within cover types (Table 2).

**Literature Cited**


Doell, D. D., and A. D. Smith. 1965. A selected bibliography of literature applicable to big game range research. Utah State Dep. Fish and Game. 95 p., mimeo.


---

**CLYDE ROBIN**

**NATIVE SEEDS**

Castro Valley, California 94546