

Growth Rates of Important Reindeer Forage Lichens on the Seward Peninsula, Alaska

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ABSTRACT. The average annual linear rates of growth of *Cladonia alpestris*, *C. rangiferina*, and *C. sylvatica* on the Seward Peninsula, Alaska, were determined to be 5.0, 5.3, and 5.4 mm. respectively. These averages are higher than those of northern Canada and some areas in the U.S.S.R. *Cladonia rangiferina* reaches the podetium renewal period in 5.9 years which is almost half the time required by the other two species.

RÉSUMÉ. Taux de croissance d'importants lichens fourragers du renne, dans la Péninsule de Seward, Alaska. Les taux linéaires moyens annuels de croissance de *Cladonia alpestris*, *C. rangiferina* et *C. sylvatica* dans la péninsule de Seward, Alaska, ont été établis respectivement à 5, 5.3 et 5.4 mm. Ces moyennes sont plus grandes que celles du nord du Canada et de quelques régions de l'U.R.S.S. *Cladonia rangiferina* atteint sa période de renouvellement du podétium en 5.9 années, ce qui est à peu près la moitié du temps requis par les deux autres espèces.

РЕЗЮМЕ. Интенсивность роста важных лишайниковых кормов оленей на п-ове Сиуорд (Аляска). Как показали исследования, среднегодовая линейная скорость роста *Cladonia alpestris*, *C. rangiferina*, и *C. sylvatica* на п-ове Сиуорд составляет соответственно 5,0, 5,3 и 5,4 мм, что выше значений, полученных в Северной Канаде и в некоторых районах СССР. Период возобновления подетия для *Cladonia rangiferina* наступает через 5,9 лет, т.е. почти в два раза быстрее чем для *C. alpestris* и *C. sylvatica*.

INTRODUCTION

It is widely held that lichens are the principal component of the diet of reindeer and caribou (*Rangifer tarandus*). They may constitute two-thirds of the total food eaten by reindeer (Andreev 1954) and are especially important during the winter. Range management practices for reindeer and caribou must be based on principles that incorporate lichen biology.

Certain fruticose species of *Cladonia* are the principal lichens in reindeer and caribou management either due to their abundant occurrence or to their palatability, or both. Three species, *Cladonia alpestris*, *C. rangiferina*, and *C. sylvatica* may comprise from 75 to 90 percent of all lichens eaten by reindeer (Andreev 1954). Knowledge of the growth rates of these species is essential to determine carrying capacity, rates of recovery, and patterns for rotational grazing of reindeer rangelands.

In North America, only a limited number of range studies have included growth rate data. Scotter (1963 and 1964) in the Northwest Territories and Northern Saskatchewan, respectively, and Ahti (1959) in Newfoundland, are

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the principal investigators of lichen growth rates. In Alaska, growth-rate data are apparently completely lacking aside from a casual statement by Palmer (1926) that lichens grow from $\frac{1}{8}$ to $\frac{1}{4}$ inch per year. In the U.S.S.R., growth rate data have been extensively collected in conjunction with other studies concerning reindeer management. Andreev (1954) reviewed growth-rate studies throughout the U.S.S.R., which included over 37,000 measurements taken under a myriad of vegetative, climatic, and edaphic conditions. He included many management recommendations based on the information gained in these studies.

The Soviet studies indicate that fruticose *Cladonia* lichens have three distinct growth periods. The first is the growth accumulation period during which the podetium increases in length for an average of 10 to 15 years. Igoshina (1939), Gorodkov (1936), Glinka (1939), and others, marked several podetia of fruticose species of *Cladonia*, and they found that branching of the podetium generally occurred once each year. The new branch forms at the top of the podetium so that each node along the podetium represents one year's growth, with the oldest node at the base. Growth of the podetium consists of the apical and the intercalary growth.

The second period of growth is the podetium renewal period. The algal and fungal cells at the base of the podetium become moribund and eventually die. This decaying of the base occurs at approximately the same rate as that at which the living portion of the podetium is growing. Thus the length of the living portion of the podetium remains fairly constant for several decades until the third stage, the podetium degeneration period, is reached. This occurs when the base decomposes faster than the new growth accumulates on the top. Eventually the podetium dies.

METHODS

Since the podetium branches once each year, the average annual linear growth rate can be obtained by dividing the length of the living portion of the podetium by the number of nodes on it. The living portion is distinguishable owing to a colour change in the region where the podetium is decaying. The formula:

$$\frac{\text{Length of living podetium}}{\text{Number of nodes on living podetium}} = \text{Average annual linear growth rate of the podetium}$$

was used to measure 100 podetia each of *Cladonia alpestris*, *C. rangiferina*, and *C. sylvatica* at three different localities on the Seward Peninsula, Alaska. Podetia with decay at their bases, which were in the podetium renewal period, were used for the measurements. They were measured while moist and fully expanded as podetia shrink when dry and become very brittle. For comparative purposes, it is imperative that only moist podetia be measured.

Site number one is in the foothills west of the Snake River, 6 miles northwest of Nome, Alaska. This is in the dwarf shrub-lichen vegetation type composed mainly of fruticose lichens, *Cladonia rangiferina*, *C. sylvatica*, *C. amaurocraea*, *C. gracilis*, *Cetraria cucullata*, and *C. islandica*, with interspersed small shrubs of bog blueberry (*Vaccinium uliginosum*), narrow-leaved Labrador tea (*Ledum*

decumbens), crowberry (*Empetrum nigrum*), and dwarf alpine birch (*Betula nana exilis*). This type covers most of the foothills from the coast inland to the Kigluaik Mountains. It is the most important winter range for reindeer herds on the western portion of the Seward Peninsula.

The second site is Dexter Creek, 7 miles north of Nome. It is similar to the Snake River site except the lichens are more abundant, especially *Cladonia alpestris*.

The third site is in a white spruce-lichen sub-type near Koyuk, Alaska. The lichens are more abundant and robust than at the two sites near Nome. *Cladonia alpestris* occurs in large uniform stands in open areas in the forest, particularly on high knolls. Dwarf alpine birch, bog blueberry, crowberry, and narrow-leaved Labrador tea are present, but lichens compose a larger portion of the total flora. This is the most important winter range type on the eastern portion of the Seward Peninsula.

RESULTS AND DISCUSSION

As seen in Table 1, the average annual linear growth rates of *Cladonia rangiferina* and *C. sylvatica* are similar in the three localities. The growth of *Cladonia alpestris* was notably more in the white spruce-lichen sub-type: 5.8 mm. as opposed to 4.6 mm. in the dwarf shrub-lichen type. Andreev (1954) noted that lichens growing in uniform stands generally had greater growth rates than those in mixed stands. *Cladonia alpestris* seems to be the most susceptible to damage by grazing of the three species studied. Apparently it has not fully recovered from past reindeer use on the range near Nome.

TABLE 1. Average annual linear growth rate of *Cladonia alpestris*, *C. rangiferina* and *C. sylvatica* on the Seward Peninsula, Alaska.

Location	Average annual linear growth rate (mm)			Average length of growth accumulation period (years)		
	<i>C. alp.</i>	<i>C. rang.</i>	<i>C. sylv.</i>	<i>C. alp.</i>	<i>C. rang.</i>	<i>C. sylv.</i>
Snake River	4.3	5.3	5.2	11.1	6.6	10.0
Dexter Creek	4.9	5.0	5.5	11.3	5.6	11.7
Koyuk	5.8	5.6	5.5	10.8	5.5	10.3

Growth rates on the Seward Peninsula are greater (Table 2), than those of northern Saskatchewan (Scotter 1964) and the Talston River region, southeast of Great Slave Lake, Northwest Territories (Scotter 1963). The Seward Peninsula, being adjacent to the Bering Sea, has more foggy drizzly days in the summer and therefore more favourable growing conditions for the lichens than interior Canada. The lichens are generally found growing on a moss substrate, principally *Sphagnum* spp. and *Polytrichum* spp., which retains a considerable amount of moisture even when the air is relatively dry. Ahti (1959), working in Newfoundland, reports that lichens usually grow more rapidly in maritime heaths than elsewhere.

The growth rates of lichens in the open forest of the Pechora North, U.S.S.R. (Andreev 1954), are similar to those at Koyuk, while those in subarctic tundra are less than near Nome. The average length of the growth accumulation period

TABLE 2. Average annual linear growth rate of *Cladonia alpestris* and *C. rangiferina* in different regions.

Location	Average annual linear growth rate (mm)		Source	
	<i>C. alp.</i>	<i>C. rang.</i>		
Talston River, N.W.T.	3.4	4.1	Scotter 1963	
N. Saskatchewan	4.1	4.9	Scotter 1964	
Chukotsk Peninsula, USSR	3.3	2.7	Andreev 1954	
Tundra	3.3	3.9	Andreev 1954	
Open Forest	5.0	5.5	Andreev 1954	
Tundra				
Spruce Forest	Seward Peninsula, Alaska	4.6	5.1	Table 1
		5.8	5.6	Table 1

on the Chukotsk Peninsula is 16 years, about 5 years longer than was found to be the case near Nome. The lichen recovery rate should be more rapid on reindeer ranges on the Seward Peninsula than on the Chukotsk Peninsula.

Cladonia rangiferina reaches the period of podetium renewal in about half the time required by either *C. alpestris* or *C. sylvatica*; averages were 5.9, 11.1, and 10.7 years respectively. Since *Cladonia rangiferina* matures earlier than the other two species (Scotter 1963, Andreev 1954, and Table 1) grazing on ranges in which it predominates should be rotated more often to obtain maximum utilization. If a range land with mature lichens is not grazed, the production of lichens will accumulate as peat, and its potential use as forage for reindeer will be lost.

Efforts to increase the lichen growth rates by chemical stimulants have mostly been unsuccessful (Andreev 1954), although Barashkova (1964) reported increases ranging from 137 to 164 per cent with the use of 2,4-D, Thiamine, or ammonium sulphate. Andreev (1954) recommended proper grazing of lichen pastures rather than the use of chemical stimulants to get the maximum growths. He suggests rotating pastures so that reindeer only graze the top $\frac{1}{3}$ of the lichens as complete restoration of the lichen crop under these conditions occurs within 3 to 5 years.

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