

Mosses – Biological Antifreeze?

by Joe Elliott

from Kelsey, Winter 2003

Many mosses are as green and delectable looking as your average sedge, root, or flower, but very few insects, birds or mammals deign to eat them. This selective avoidance of mosses has puzzled many biologists and has prompted a few short notes in scientific journals when a keen observer has actually documented an animal eating a moss.

Why do so few invertebrates and vertebrates eat mosses, even though the nutritional and caloric values of mosses are similar to those of higher plants? Part of the answer may be that mosses contain high concentrations of less-easily digested components, such as polyphenolic, lignin-like compounds. These compounds have antibiotic properties that could affect grazers either directly or indirectly by inhibiting gut microorganisms. These chemicals in cell walls of mosses may prevent digestion of cellulose and polysaccharides.

A couple of years ago, I started working with the late Jim Reichel of the Montana Natural Heritage Program on a study of the food habits of the northern bog lemming, a rare mammal that inhabits moss-dominated fens. Northern bog lemmings in Montana are often found in rich fens (i.e., peatlands with high concentrations of sodium bicarbonate, calcium, and magnesium; high electrical conductivities; and neutral or basic pH values). Ground cover in rich fens is dominated by *Sphagnum warnstorffii* and "brown" mosses (*Amblystegiaceae*). Common vascular plants include sedges, often with a shrub canopy dominated by bog birch (*Betula glandulosa*).

Little is known about northern bog lemming life history or food habits. Dense moss communities provide cover for bog lemmings, evidenced by tunnels in the moss carpet, but mosses are not known to be an important food.

In analyzing the stomach contents of bog lemmings, Jim and I were surprised to find that mosses made up from 20 to more than 90 percent of the stomach contents. A literature search turned up reports of brown lemmings in Scandinavia also eating mosses.

Based on the low amounts of digestible energy that lemmings appear to derive from mosses, one biologist suggested that lemmings and other vertebrates of cold climates eat mosses for reasons other than nutrition. He hypothesized that ingestion of a highly un-saturated fatty acid, arachidonic acid, may be an adaptive mechanism that helps protect against low temperatures. Animals do not synthesize arachidonic acid and its concentration in mosses (up to 35 percent of fatty acids) is the highest reported in plants.

This compound may help protect cell membranes against very low temperatures. If this is true, moss consumption may be an adaptive mechanism despite these plants' low digestibility. Habitats that harbor bog lemmings are cold environments that may be *refugia*, with microclimates similar to those of cooler and wetter periods like the Pleistocene, 10,000 years ago, when glaciers receded. Adaptation of bog lemmings to cold fen habitats may be partially associated with cold resistance resulting from mosses providing large amounts of arachidonic acid. This could be a wild hypothesis and it appeals to my sense of moss mystery, but I'm not sure that snacking on mosses to avoid hypothermia is something that I would recommend for the winter sports enthusiast.