RESULTS OF SOME DETAILED ANALYSES OF CARIBOU RUMEN CONTENTS

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Compared to other methods of determining the food habits of game ruminants, analysis of rumen contents appears relatively simple. Samples can be obtained from hunter kills or from animals collected specifically to obtain stomach samples or other biological material, and the analyses can be conducted at leisure in the laboratory.

Judging from published reports of such analyses, the apparent simplicity of the method has led to a rather unquestioning acceptance of its reliability. With one or two exceptions, only the larger plant particles in the rumen samples have ordinarily been identified and measured, the smaller material being discarded as "unidentifiable."

Statements of food habits or relative use of range plants are thus usually based on analyses of only a portion of the rumen contents, and this portion is anything but randomly selected.

If determination of food habits is to be based on analyses of such segments, one of three assumptions must be made:

(1) Plant composition in the smaller, "unidentifiable" particles, the portion of the sample usually discarded, is the same as that in the analysed portion of the sample; or

(2) The larger, "identifiable" plant particles represent the most recently ingested material, and plants are present in this portion of the rumen contents in approximately the same proportions as ingested; or

(3) Over a large number of samples, differences in plant characteristics which might lead, in some cases, to one species or group being present in the gross material in different amounts than in the smaller particles, would be "evened out."

This investigation was designed to determine the validity of the above assumptions and thus to test the reliability of present rumen analysis methods as a means of determining the food habits of caribou.

Details of the methods and equipment used in this study appeared in recent Quarterly Reports of the Alaska Cooperative Wildlife Research Unit. Briefly, each rumen sample was washed through a series of 11 screens of graduated mesh sizes, ranging from four meshes per inch in the top screen to 200 per inch at the bottom. (Eleven screens, of 4, 7, 10, 20, 30, 40, 50, 60, 80, 100, and 200 meshes per inch, were used). The third or 10-mesh screen probably represented the approximate size most commonly used to separate "identifiable" from "unidentifiable" material in work conducted by other investigators. This screen retained material smaller than about 2.5 mm. but larger than about 1.66 mm.; the largest screen retained material larger than 5 mm. and

the smallest retained particles larger than 0.074 mm. but smaller than 0.148 mm. The material passing through the last screen was collected in four experiments and measured by centrifuging in graduated cylinders.

Volumetric measurement of the amount of material retained by each of the screens plus the material passing through all screens indicated that in most cases a screen of 10 meshes per inch, if used alone to separate a sample into "identifiable" and "unidentifiable" portions, would retain less that five per cent of the sample; more than half of each sample consisted of particles so small that they would pass through the smallest screen of 200 meshes per inch! Although it was subsequently found that most of the microscopic material (material smaller than about one-fourth of a millimeter) consisted of protozoa, and that more than half of the entire sample was composed of these organisms, the material commonly used to determine food habits still constitutes less than 12 per cent of the plant material in most rumen samples, and in some cases as little as two per cent would be analysed if only the material larger than about two mm. were saved and the rest discarded as unidentifiable.

The material retained by each of the 11 screens was subjected to varying degrees and methods of separation and measurement, depending on particle size. The "gross" material, or that retained by screens of four, seven, and ten meshes per inch was separated into plant groups, genera, or in some cases species. Material in the smaller-size groups, which was too small to be handled, was "measured" by counting the number of particles of the various types of plants under magnification; at least four counts were made within each size-group for each sample. Separated material in the gross category was both weighed and measured volumetrically by displacement. In three instances actual mechanical separation and subsequent measurement was carried out with the

material in the 20-mesh screen to provide a check on counting versus actual measurement as a means of determining proportions. Although the extreme tediousness of this process precluded wider application, there was no indication that counts of the smaller particles were not comparable to weights or volumetric measurements.

The investigation demonstrated conclusively that the three assumptions mentioned earlier are invalid: the composition of the large "identifiable" plant material is not comparable with that of the smaller particles. Further, the characteristics of the distributions of the various plant types through the various ranges of particle sizes, being more-or-less characteristic for each type of plant, precluded any possibility that the gross material could be composed of recently ingested material or that differences would be evened out over large series of samples. Generalized curves of type distribution according to particle size were as illustrated in figures 1 through 5.

In figures 1 through 12, x is equal to the proportion of plants within size-group expressed in per cent.

In figures 1 through 11, y is equal to <u>decreasing</u> particle size.

The dotted line indicates the approximate separation of "identifiable" and "unidentifiable" material in analyses conducted by other investigators.

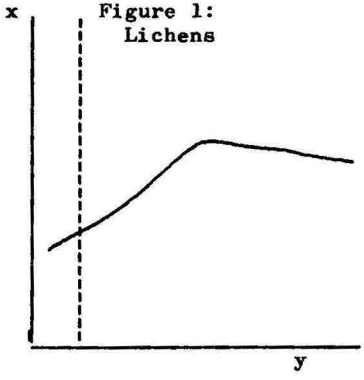


Figure 1:
Lichens

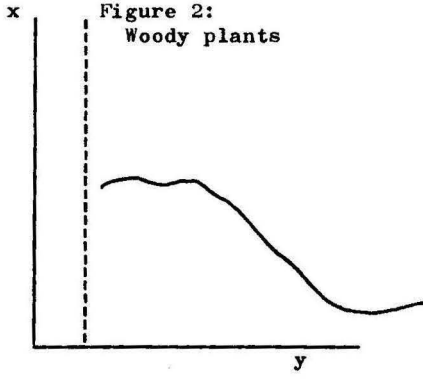


Figure 2:
Woody plants

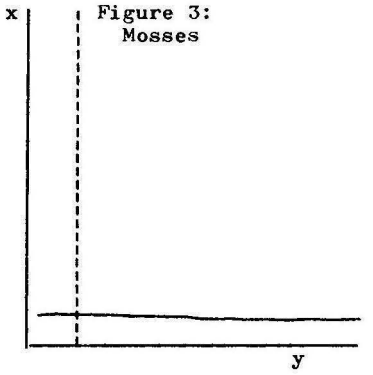


Figure 3:
Mosses

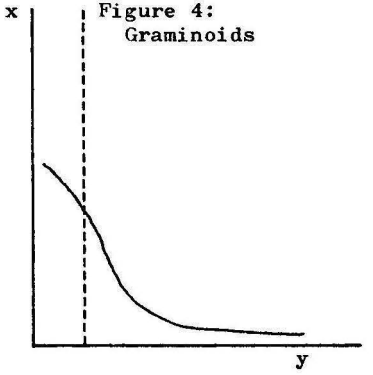


Figure 4:
Graminoids

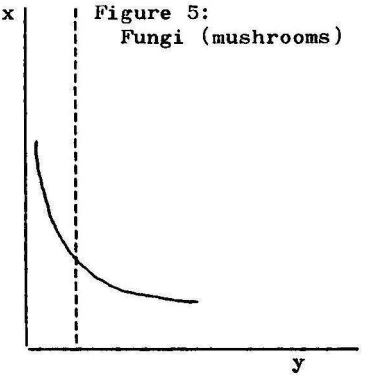


Figure 5:
Fungi (mushrooms)

The general forms of these curves were found to hold regardless of the amount present in the gross material. In other words, the proportion of lichens in the material retained by screens seven and ten meshes per inch was always greater than among the plants retained by a screen of four meshes per inch, regardless of whether the latter size group contained five or 75 per cent lichens. To illustrate, figures 6 through 8 are approximations of actual curves plotted with three samples.

Likewise, the decreases in proportions of graminoids and mushrooms were always apparent with a decrease in particle size regardless of the proportion in the gross material.

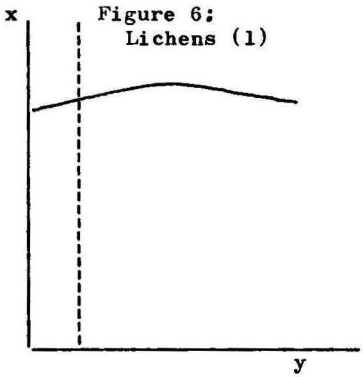


Figure 6:
Lichens (1)

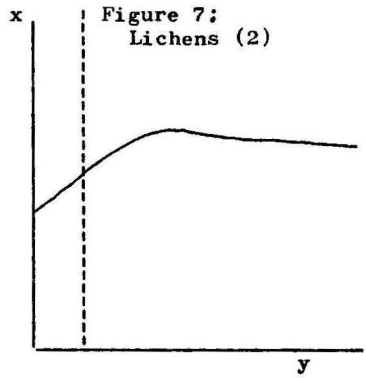


Figure 7:
Lichens (2)

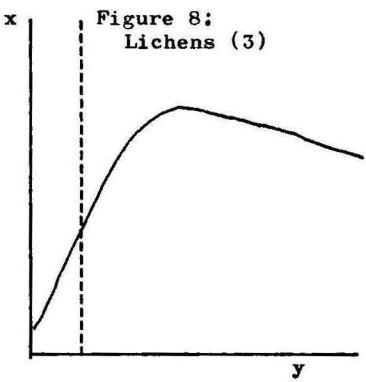


Figure 8:
Lichens (3)

The woody plants were the least predictable group, probably due in part to the greater variety of forms found in this type. Some of the curve forms observed in the distribution of woody material will illustrate this variability: (Figures 9 through 11).

As can be seen, even with this rather unpredictable group the general trend was toward a decrease in particle size, being the reversal of the trend observed for lichens.

The most probable explanation for the changes in proportions of the various plant types with changes in particle size is the relative frangibility of lichens. They are easily broken into small particles when dry, and even when wet are fragmented more easily than any of the other plant types.

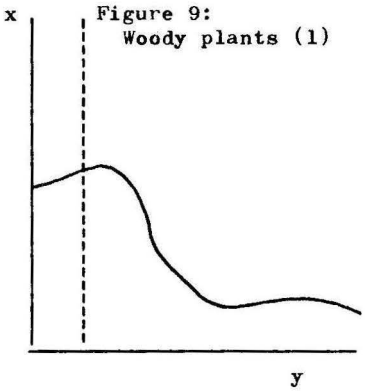


Figure 9:
Woody plants (1)

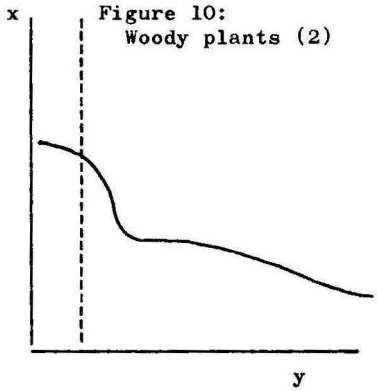


Figure 10:
Woody plants (2)

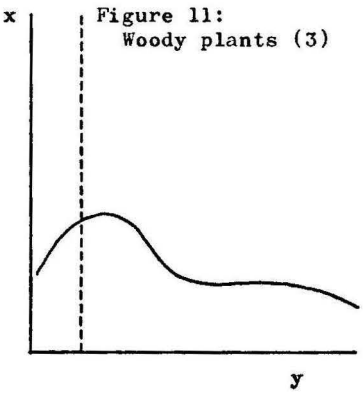
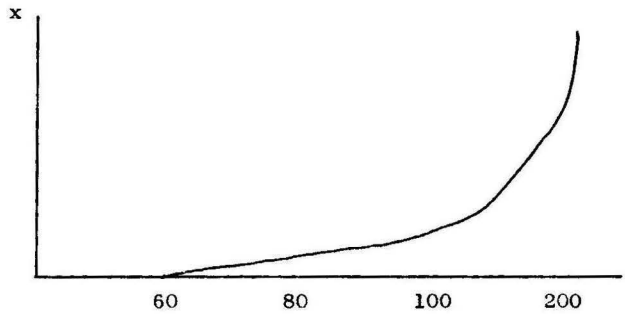


Figure 11:
Woody plants (3)

Initial mastication would thus tend to break the lichens into small pieces, and they would appear in higher amounts within the part of the sample which constitutes the large majority of the bulk of the sample but which is usually assumed to have the same composition as the more easily handled gross material, and discarded. It must therefore be concluded that time-consuming separation and measurement of gross material in caribou rumina is not warranted, and is apt to be highly misleading, as a means of determining the food habits of these animals.

As mentioned previously, protozoa were found to constitute more than half the contents of rumen samples.

Determinations, with varying degrees of completeness, were made of the distribution of these organisms according to size. Only a few individuals were found to be retained by a screen of 60 meshes per inch (openings of slightly less than one-fourth of a millimeter), and most of the volume of the protozoa was concentrated in the smaller material:



Due to the crushed and broken condition of the smaller representatives, the exact proportions could not be determined, either within the smaller size-group (retained by a 200-mesh screen) the material passing through all screens, or in the sample as a whole. However, protein analyses, conducted by Margaret H. Blom of the Alaska Agricultural Experiment Station in Palmer on four rumen samples, showed that whole samples contained slightly less than half as much protein as parts of samples containing only material which would pass through an 80-mesh screen. This substantiated estimates based on the few crude measurements that could be made; the total concentration of protozoa is indicated to be between 50 and 65 per cent.

Samples of protozoa from 12 rumina have been sent to G. Lubinsky of McGill University for identification. In view of their abundance, the role of these organisms in the physiology of caribou appears to offer an extremely interesting

field for study.

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