PROCEDURES AND PRELIMINARY RESULTS OF RESEARCH ON BIOENERGETICS OF BIGHORN SHEEP

By
R. W. Chappel and R. J. Hudson
Department of Animal Science
University of Alberta, Edmonton

Many studies have been undertaken to determine the energy and nutrient requirements of various domestic ruminants (Young and Corbett 1971, Webster 1970) and to disclose the effects of environmental parameters such as cold, wind, and radiation on the energy budgets of these animals (Webster 1970, Young 1972). With few exceptions (Hebert 1973, Thompson et al. 1973, Wesley et al. 1973) little work has been done on the nutrient and energy balances and requirements of wild ruminants. In the majority of these studies estimates of energy requirements have been obtained from examination of forage quality, consumption, digestibility, and liveweight changes. More direct analyses of requirements are often frustrated by difficulties associated with maintaining wild ruminants in a laboratory situation where various physiological techniques and associated equipment can be applied.

This research is directed toward disclosing the energy budgets of Rocky Mountain bighorn sheep on an over-winter basis, utilizing the relationship between oxygen consumption, carbon dioxide production, and metabolic rate. In addition the study explores the effect of various stress factors such as cold, wind, and fasting on energy expenditure and requirements

PROCEDURES

The animals, two subadult rams and two subadult ewes, were born in captivity and have been partially hand reared, primarily by one individual. Accordingly, they are accustomed to handling, and association with the experimenter creates minimal stress. The animals are maintained in a 3-acre fenced pasture between experimental periods and are placed in individual stalls in a shed on the pasture for 2 weeks out of each month.

During the experimental period they are fed a pelleted complete ration (15% protein, 17.5% crude fiber, 2.7% fat, 3.6 Kcal/gm) on an ad lib basis (Fig. 1). Each month the animals are taken into the adjacent environmental laboratory, weighed (Fig. 2) and placed in metabolism crates in an environmental control chamber for indirect calorific measurement of metabolic rate (MR) under three conditions: 1. Resting metabolic rate (RMR) at +10 C (Thermoneutral) 2. Resting metabolic rate at -10 C 3. Fasting metabolic rate (FMR) at -10 C (72-hour fast period).

The animals are instrumented for recording temperatures of body core and six points on their skin surface. An infrared thermometer is used to monitor

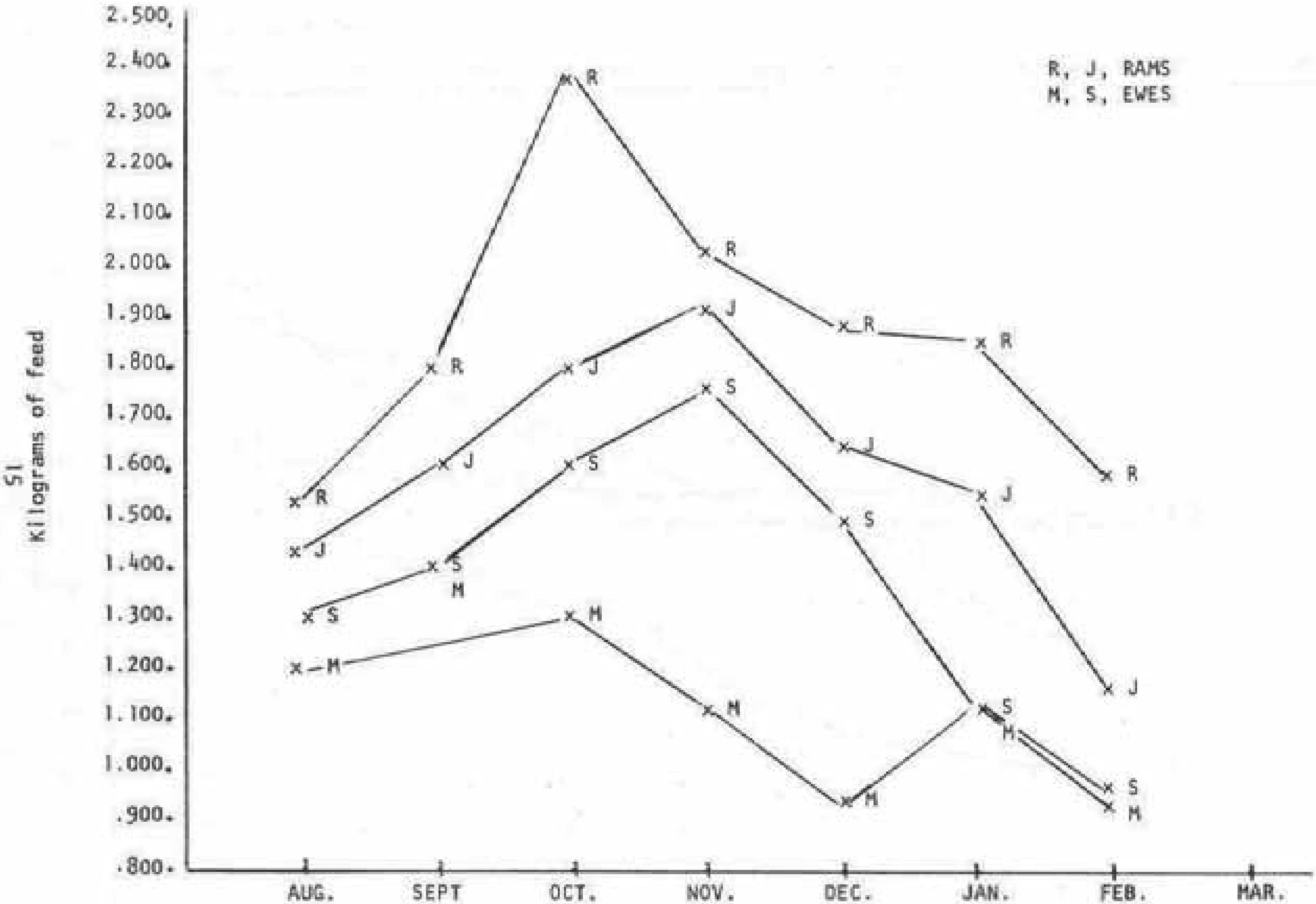

Fig. 1. Mean ad lib daily consumption of pelleted feed in kilograms.

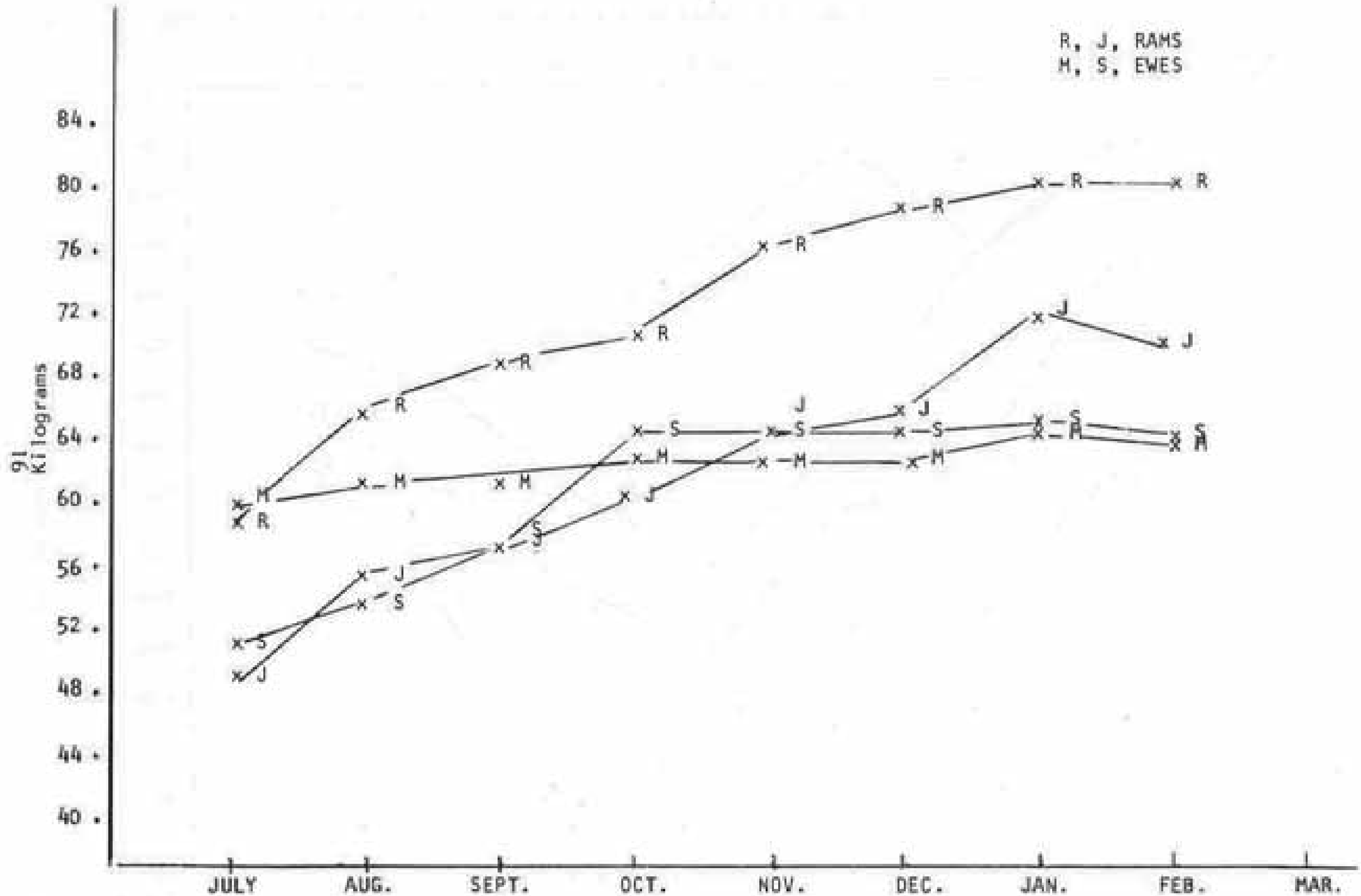

Fig. 2. Weight in kilograms

hair coat surface temperature. Every second month collection of fecal samples is made for analysis of total digestibility by the acid-insoluble ash technique. During January, February, and March 1976 measurements of the effect of wind on metabolic rate at various ambient temperatures will be carried out utilizing an outdoor wind tunnel with wind speeds ranging from 6 to 18 mph.

PRELIMINARY RESULTS

Data from RMR at +10 C (Fig. 3) has been obtained for August, October, and February; data for RMR at -10 C (Fig. 4) and FMR at -10 C (Fig. 5) have been generated for October and February.

Preliminary results show an increase in heat production from August to October and a reduction from October to February to a point below that of August for RMR at +10 C (Fig. 3). These findings are in accord with those of Thompson et al. (1973) who conducted indirect calorific measurements of MR on white-tailed deer. The reduction of RMR at -10 C (Fig. 4) and FMR at -10 C (Fig. 5) from October to February are also in agreement with Thompson's values. The findings differ, however, from those for domestic sheep with similar treatments. Webster et al. (1969) showed an increase in resting heat production of outdoor acclimatized Suffolk wether sheep from October to January.

There appears to be a strong correlation between metabolic rate, whether fasted or resting, and consumption of feed (Fig. 1). With further analysis the gaps will be filled and it may be shown that MR reaches its peak in November when bighorns arrive on their winter range and take advantage of the longer growing season to ready themselves for rut and winter. Seasonal bioenergetic rhythms with periodicity of feed intake, gain, FMR, and RMR may represent important adaptations for survival.

Literature Cited

Hebert, D. M. 1973. Altitudinal migration as a factor in the nutrition of bighorn sheep. Ph.D. Thesis. Univ. of British Columbia, Vancouver. 357pp.

Thompson, C. B., J. B. Holter, H. H. Hayes, H. Silver, and W. E. Urban., Jr. 1973. Nutrition of white-tailed deer. I. Energy requirements of fawns. J. Wildl. Manage. 37(3):301-311.

Webster, A. J. F. 1970. Direct effects of cold weather on the energetic efficiency of beef production in different regions of Canada. Can. J. Anim. Sci. 50(3):563-573.

________________, A. M. Hicks, and F. L. Hayes. 1969. Cold climate and cold temperature induced changes in the heat production and thermal insulation of sheep. Can. J. Phys. and Pharma. 47(6):553-562.

Wesley, D. E., K. L. Knox, and J. G. Nagy. 1973. Energy metabolism of pronghorn antelopes. J. Wildl. Manage. 37(4):563-573.

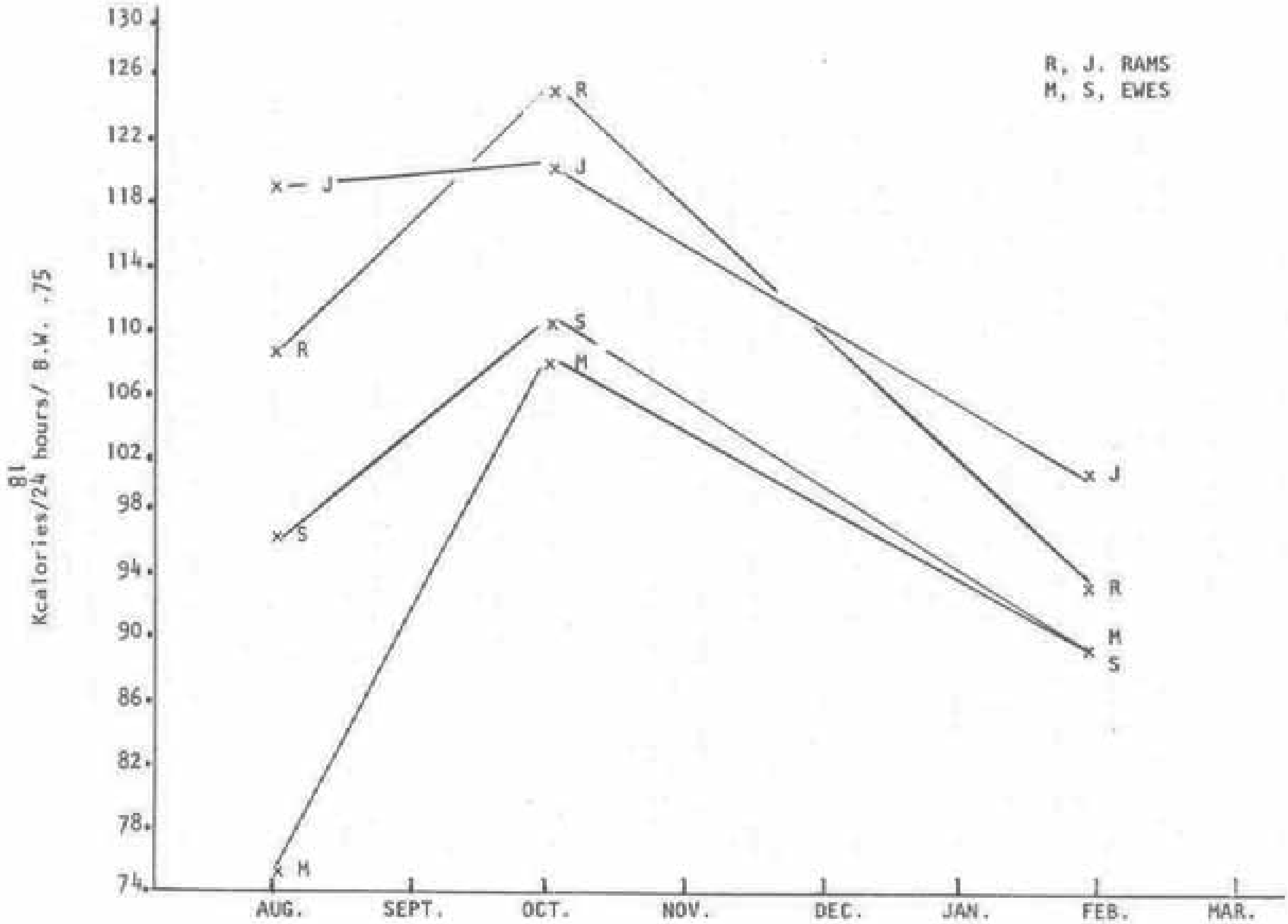

Fig. 3. Resting metabolic rate in Kcalories/24 hours/body weight .75 at +10° C (Thermoneutral).

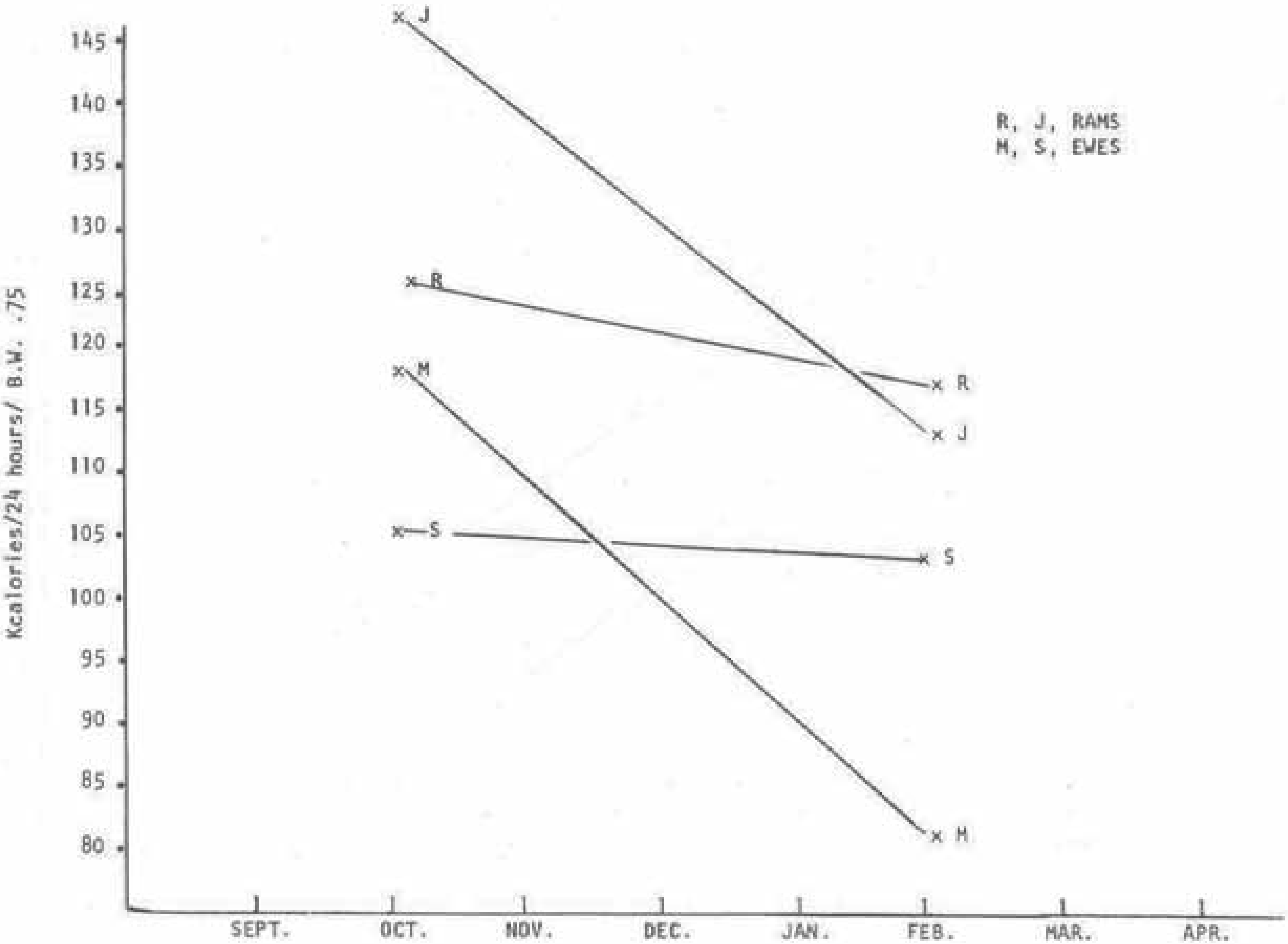

Fig. 4. Resting metabolic rate in Kcalories/24 hours/body weight .75 at -10 C.

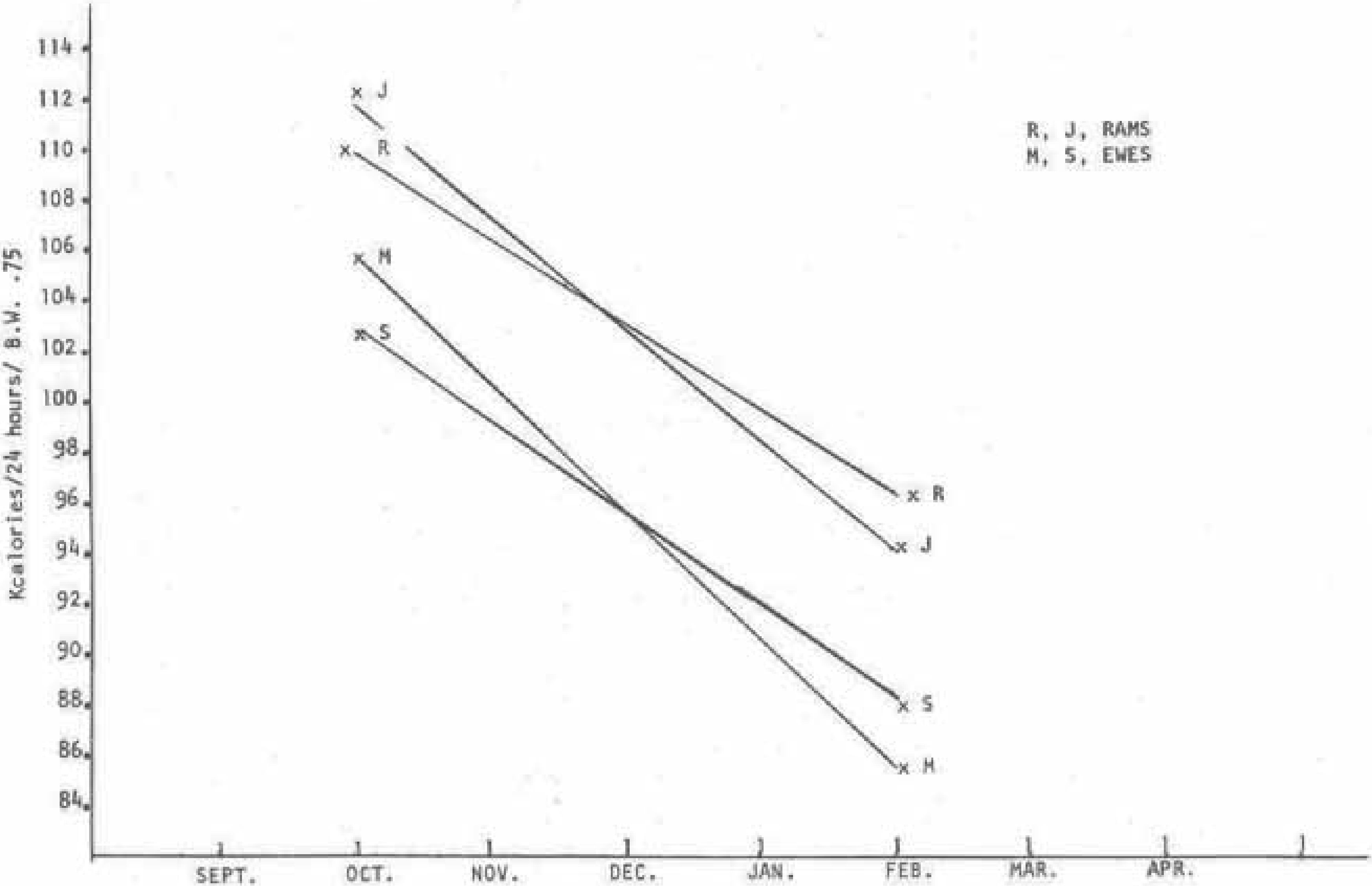

Fig. 5. Fasting metabolic rate in Kcalories/24 hours/body weight .75 at -10° C.

Young, B. A. 1972. Influence of adaptation to cold on resting heat production of beef cows. Proc. Am. Soc. Anim. Sci. 23:270.

__________, and J. L. Corbett. 1971. Maintenance energy requirements of grazing sheep in relation to herbage availability. 1. Calorimetric estimates. 2. Observations on grazing intake. Aust. J. Agric. Res. 23(1):57-85.