RELATIONSHIP BETWEEN DIET, ADIPOSE TISSUE, BODY COMPOSITION, AND HIBERNATION IN VANCOUVER ISLAND MARMOT (*MARMOTA VANCOUVERENSIS*) AND MODEL SPECIES THE WOODCHUCK (*MARMOTA MONAX*)

Sarra Gourlie, MSc[1]*, Jessica Aymen, DVM, IPSAV, DVSc Candidate[1,2], Pauline Delnatte DVM, IPSAV, DVSc, DACZM, Dipl. ECZM[1], and Jaap Wensvoort, MSc[1]

[1]Toronto Zoo, 361A Old Finch Ave, Toronto, ON M1B 5K7, CAN.
[2]Department of Clinical Studies, Ontario Veterinary College, University of Guelph, Guelph, ON N1G 2W1, CAN.

Abstract
In situ conservation efforts have been underway for the critically endangered Vancouver Island marmot (VIM) since 1997. These charismatic hibernating herbivores, endemic to Vancouver Island, selectively feed on subalpine meadow plants from April to September (Milko, 1984; Martell & Milko; 1986; McAdie, 2018). Differences exist between captive and free-ranging VIMs, including captive-born marmots hibernating for shorter periods, having higher adipose tissue deposits, a higher prevalence of cardiovascular disease, and, upon release, having lower survival rates (Aymen *et al.*, 2021; McAdie, 2018). Extremely limited data is available regarding wild feeding patterns of VIMs, including species and proportion of plants consumed, plant parts consumed, nutritional analysis of plants, and how intake and chemical composition of plants change over the active season. A comparative approach utilizing data from the wild was necessary to determine a recommended n-6:n-3 PUFA ratio that could support hibernation and overall health of VIM in the breeding program.

The link between PUFA intake on hibernation and torpor robustness has been studied extensively with a myriad of species (Florant, 1998; Ruf & Arnold, 2008; Munro & Thomas, 2004). Omega-3 and omega-6 PUFAs are hypothesized to play a critical role in cardiac function by modulating the function of Ca^{2+}-Mg^{2+} pump in the sarcoplasmic reticulum of the heart (SERCA 2a), protecting against hypothermia induced arrhythmia (Giroud *et al.*, 2013; Ruf & Arnold, 2008). Much of the current research has focused on providing high PUFA diets, with high n-6:n-3 ratios (predominantly from linoleic acid) ranging from 8.7 to 83, with inconclusive results on hibernation and torpor expression (Florant *et al.*, 1993; Giroud *et al.*, 2018; Geiser & Kenagy, 1987; Harlow & Frank, 2001; Munro & Thomas, 2004).

Free-ranging marmots have access to herbaceous plants abundant in PUFAs; however, they may be optimizing intake rather than maximizing (Munro & Thomas, 2004). Plant part analysis of items regularly consumed by free-ranging yellow-bellied marmot (*Marmota flaviventris*) indicate the n-6:n-3 ratio of 0.38, 1.46, and 9.99 in leaves, flowers, and seeds, respectively (Hill & Florant, 1999). FA analysis of stomach contents of wild alpine marmots (*Marmota marmota*) throughout the season indicate higher n-3 PUFA intake in spring and a rise in n-6 PUFA intake in the summer (Ruf & Arnold, 2008; Arnold *et al.*, 2011).

A model species, the woodchuck (*Marmota marmot*), were offered diets that mimicked wild marmot FA fluctuations to assess the impact on hibernation robustness, lipid metabolism, and body composition. The control group was offered a diet with a high n-6:n-3 ratio for the duration of the

active season, the experimental group was offered a diet that started in the spring high in n-3 PUFAs and ended in late summer with the high n-6:n-3 ratio. Hibernation robustness was assessed by using temperatures loggers and measuring hibernation length. There was no influence of treatment on body composition, body weight, or hibernation robustness. However, the experimental diet was able to produce a more favorable fatty acid profile and may be used to further support improved nutritional welfare for the VIM in the future.

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