Marmoset nutritional needs and daily dietary management

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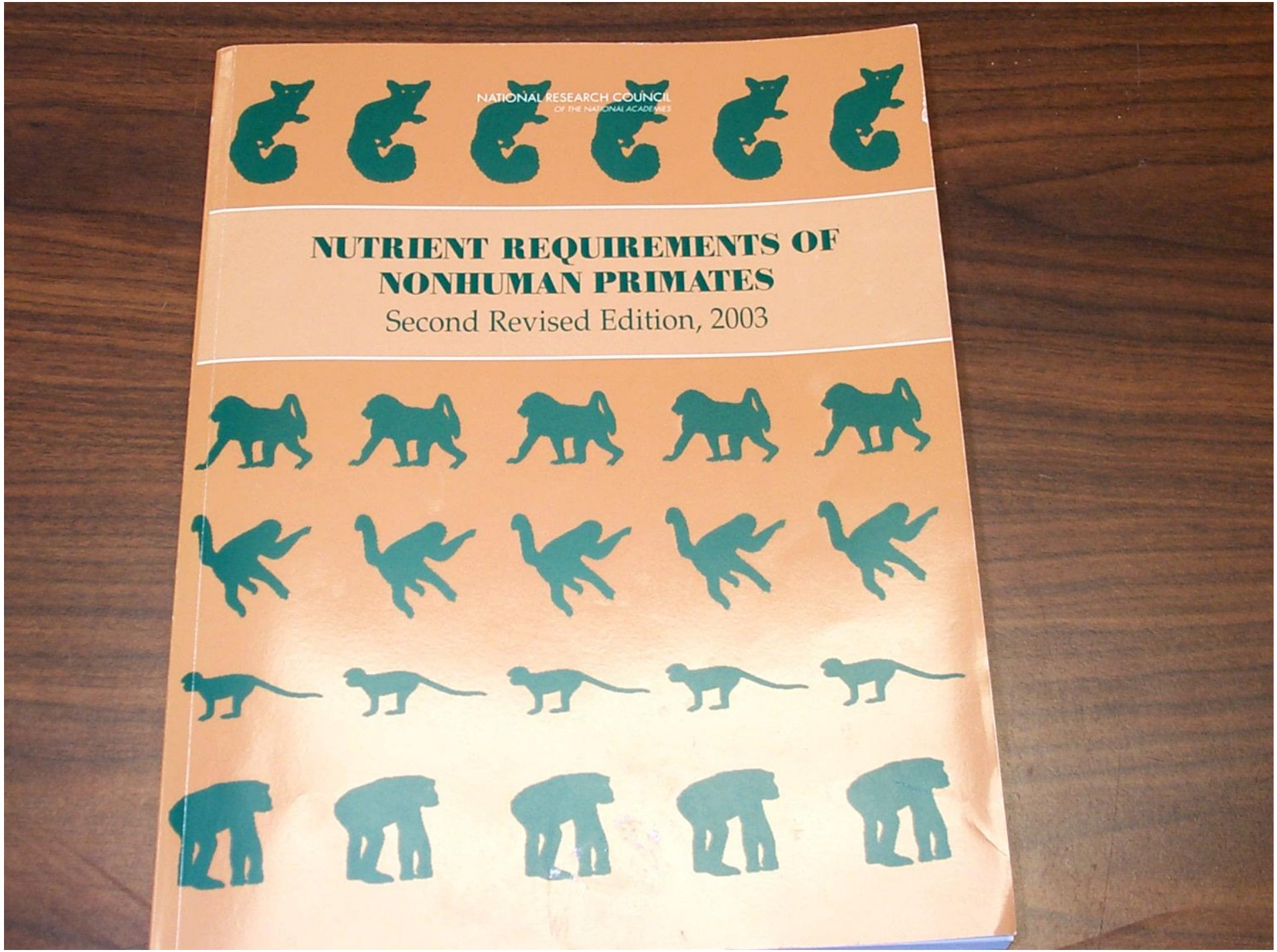
NATIONAL RESEARCH COUNCIL
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NUTRIENT REQUIREMENTS OF
NONHUMAN PRIMATES
Second Revised Edition, 2003

TABLE 11-1 Estimated Nutrient Requirements (in Dietary DM) of Primate Models Species Fed Purified or Semipurified Diets[a]

Nutrient	Cercopithecidae		Cebidae		Callitrichidae		Colobinae	Strepsirrhini	Pongidae and Hominidae[b]	
	Macaque	Baboon	Squirrel monkey	Cebus	Howler	Marmoset, Tamarin	Colobus, Langur	Lemur	Chimpanzee	Humans
Crude protein, %[c]	8_m	—	$8\text{-}21_g$	7_m $7\text{-}10_g$		7_m $12\text{-}18_g$	—	—	14_g[d]	6
Taurine, %[e]	—	—	—	—	—	—	—	—	—	—
Essential n-3 fatty acids, %[f]	0.5	—	0.5	0.5	—	—	—	—	0.5	—
Essential n-6 fatty acids, %[g]	2	—	2	2	—	—	—	—	2	—
NDF, %[h]	10	—	—	—	30	10	30	20	20	
ADF, %[i]	5	—	—	—	15	5	15	10	10	—
Ca, %	0.55_m	—	—	—	—	—	—	—	—	0.22
P, %	0.33_m	—	—	—	—	—	—	—	—	0.14
Mg, %	0.04_m	—	—	—	—	—	—	—	—	0.074
K, %	—	0.24_m[d]	—	—	—	—	—	—	—	—
Na, %	—	0.25_m[d]	—	—	—	—	—	—	—	—
Cl, %	—	0.27_m[d]	—	—	—	—	—	—	—	—
Fe, mg·kg^{-1}	100_g	—	—	—	—	—	—	—	—	16
Cu, mg·kg^{-1}	15[d]	—	—	—	—	—	—	—	—	1.8
Mn, mg·kg^{-1}	44[d]	—	—	—	—	—	—	—	—	4.1
Zn, mg·kg^{-1}	20_g 13_m	—	17_g	—	—	—	—	—	—	19
I, mg·kg^{-1}	—	—	—	—		0.65[d]	—	—	—	0.3
Se, mg·kg^{-1}	0.11	—	0.11	—			—	—	—	0.11
Cr^{+3}, mg·kg^{-1}	—	—	>0.09	—			—	—	—	0.06
Vitamin A, IU·kg^{-1}	5,000	—	12,000[d]	—	—	—	—	—	—	5,333
Vitamin D_3, IU·kg^{-1}	1,000	—	1,250[d]	1,000	—	2,400[d]	—	—	—	800
Vitamin E, mg·kg^{-1} [j]	68[d]	—	—	—	—	>95-130[d]	—	—	—	30
Vitamin K, mg·kg^{-1} [k]	>0.06-3.0[d]	—	—	—	—	—	—	—	—	0.3
Thiamin, mg·kg^{-1}	1.1	—	—	—	—	—	—	—	—	2.3
Riboflavin, mg·kg^{-1}	1.7	—	—	1.7	—	—	—	—	—	2.4
Pantothenic acid, mg·kg^{-1}	20[d]	—	20[d]	—	—	—	—	—	—	10
Niacin, mg·kg^{-1}	16	—	—	—	—	—	—	—	—	30
Vitamin B_6, mg·kg^{-1}	4.4[d]	3.1[d]	—	$2\text{-}4_g$	—	—	—	—	—	2.9
Biotin, mg·kg^{-1}	0.11	—	—	—	—	—	—	—	—	0.06
Folacin, mg·kg^{-1}	1.5[d]	—	1.5_g 3.3_r	1.5_g 3.3_r	—	—	—	—	—	0.8
Vitamin B_{12}, mg·kg^{-1}	0.011	0.011	—	—	—	—	—	—	—	0.005
Vitamin C, mg·kg^{-1}	110	—	—	—	—	—	—	—	—	170

[a] Estimated from published data in prior chapters, assuming apparent metabolizable energy at 4.0 kcal·g^{-1} of dry matter, high nutrient bioavailability, and little to no adverse nutrient interactions. Values with following subscripts were derived from studies concerned with maintenance (m) of adults, reproduction (r), or growth (g) of young. Values without a subscript were presumed adequate for all life stages.

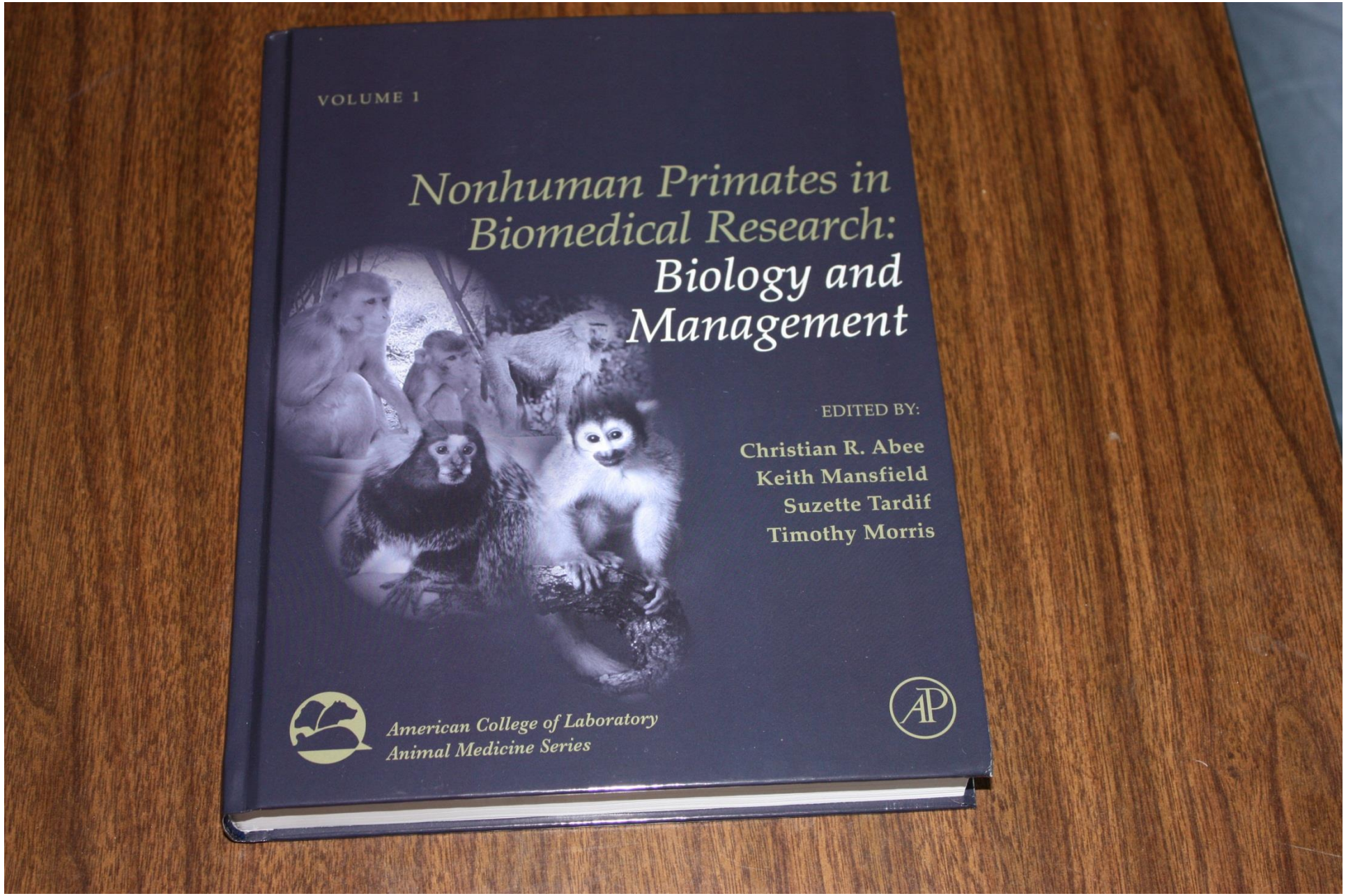
[b] For comparison, recommended dietary allowances or adequate intakes for humans (approximate means of non-reproducing adult age and sex categories), assuming a daily intake of 500 g of dietary dry matter (NRC, 1989 [protein only]; Institute of Medicine, 1997, 1998, 2000, 2001).

[c] Protein requirement depends on amounts and proportions of essential amino acids. Growth requirements decline with age.

[d] Lowest concentration tested.

[e] Taurine appears to be required in the diet during the first post-natal year.

[f] Essential n-3 fatty acid requirements met by indicated concentration of α-linolenic acid. If supplied by eicosapentaenoic acid and/or docosahexaenoic acid, required concentration may be less (see Chapter 5).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Chapter 10

Nutrient Requirements and Dietary Husbandry Principles for Captive Nonhuman Primates

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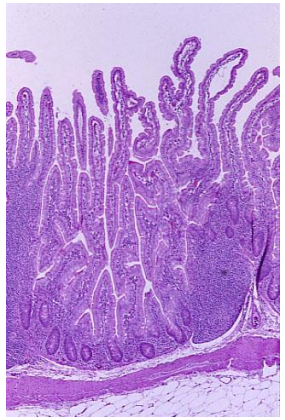
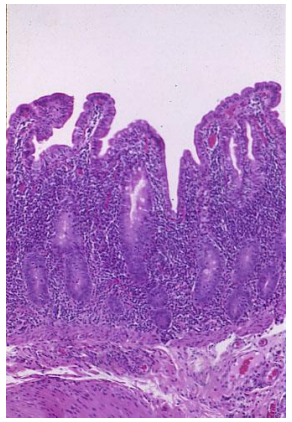
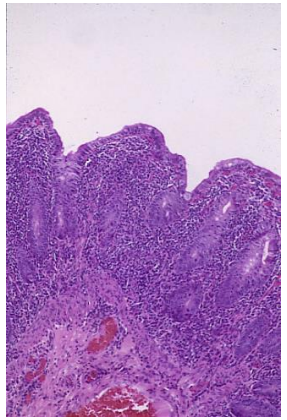
Chapter Outline

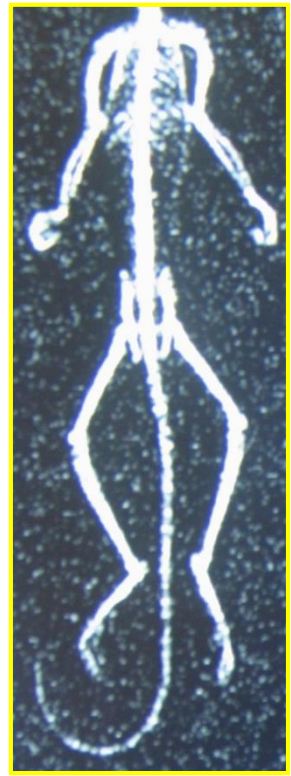
Husbandry challenges past and present

- Nutrient requirements not well established (but may not be very different from other monkeys)
- Diets vary considerably across colonies, with dietary husbandry informed more by anecdote and “lore” than by science
- Questions concerning vitamin D metabolism and requirement
- Marmoset wasting syndrome
- Metabolic bone disease









Obesity

Male marmoset 630 grams

17 month old marmosets

Normal Female marmoset - 370 grams

Variation in digestive abilities has nutritional consequences

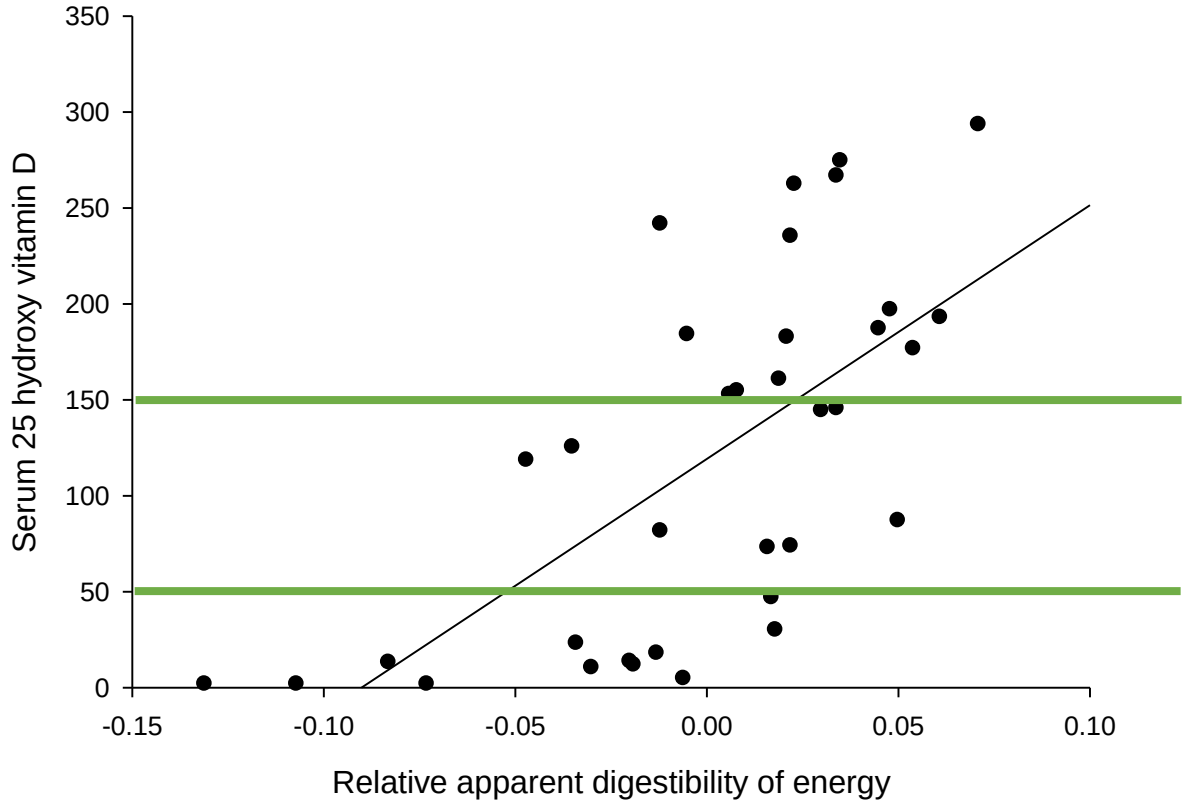


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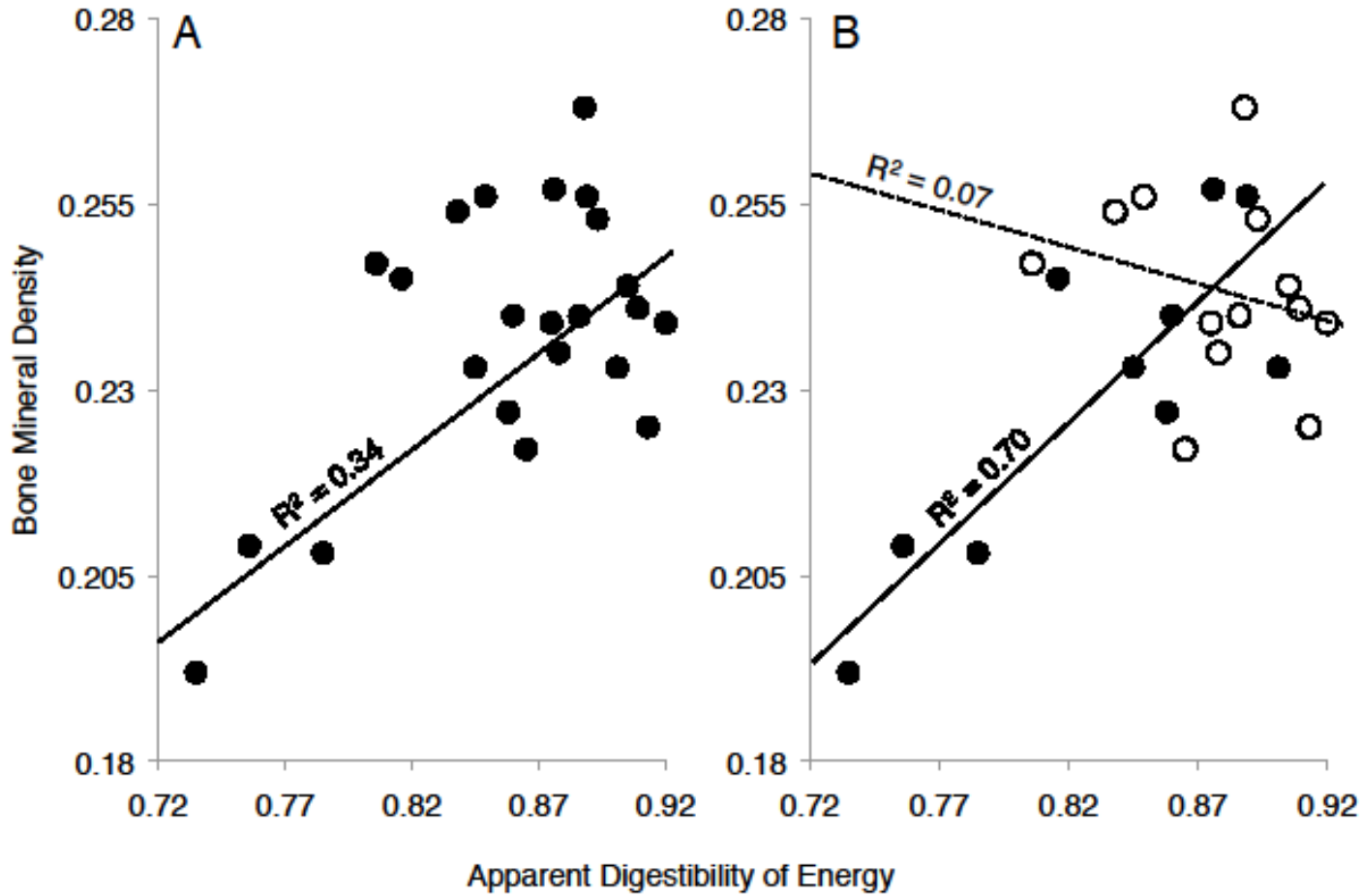
Figure 3



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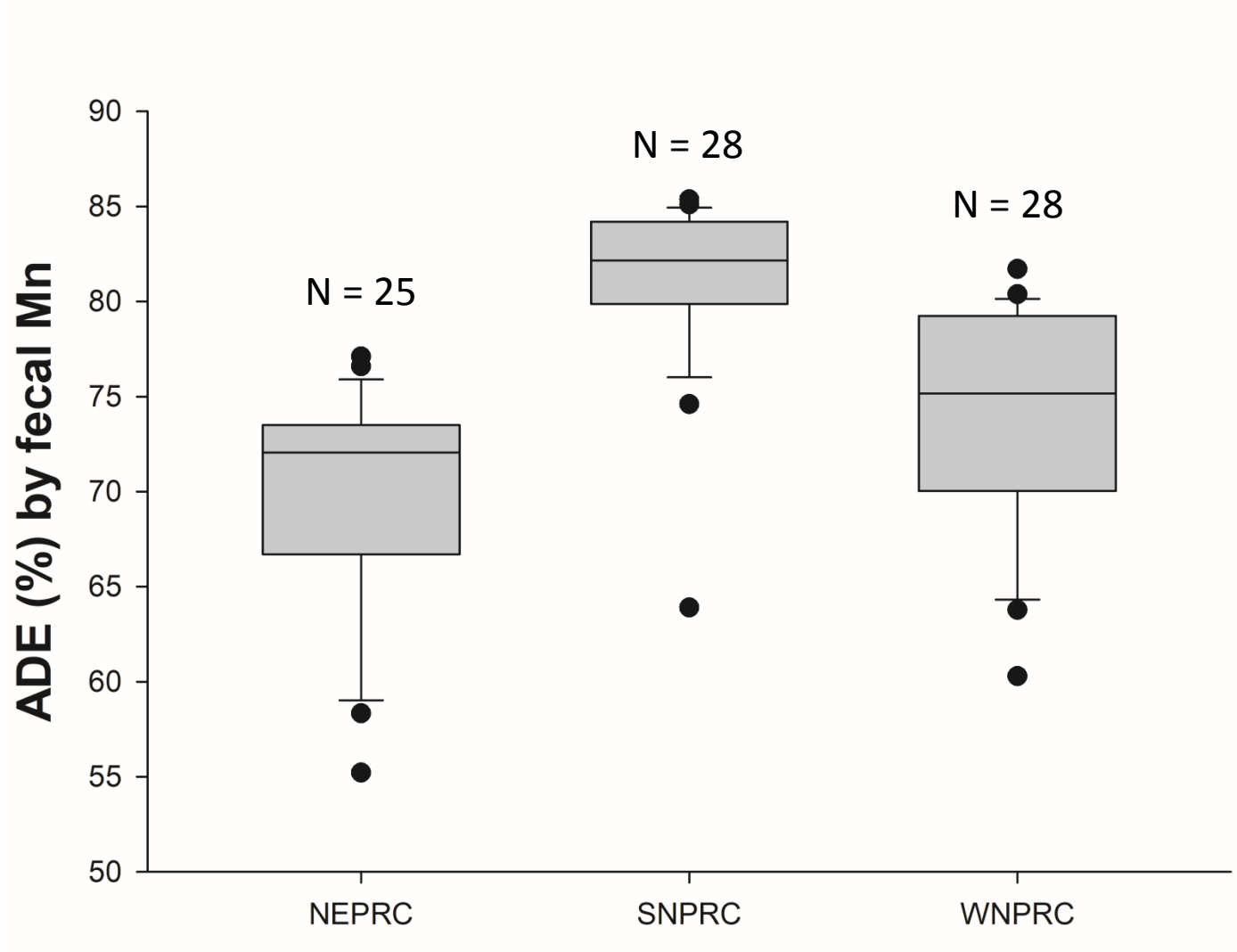
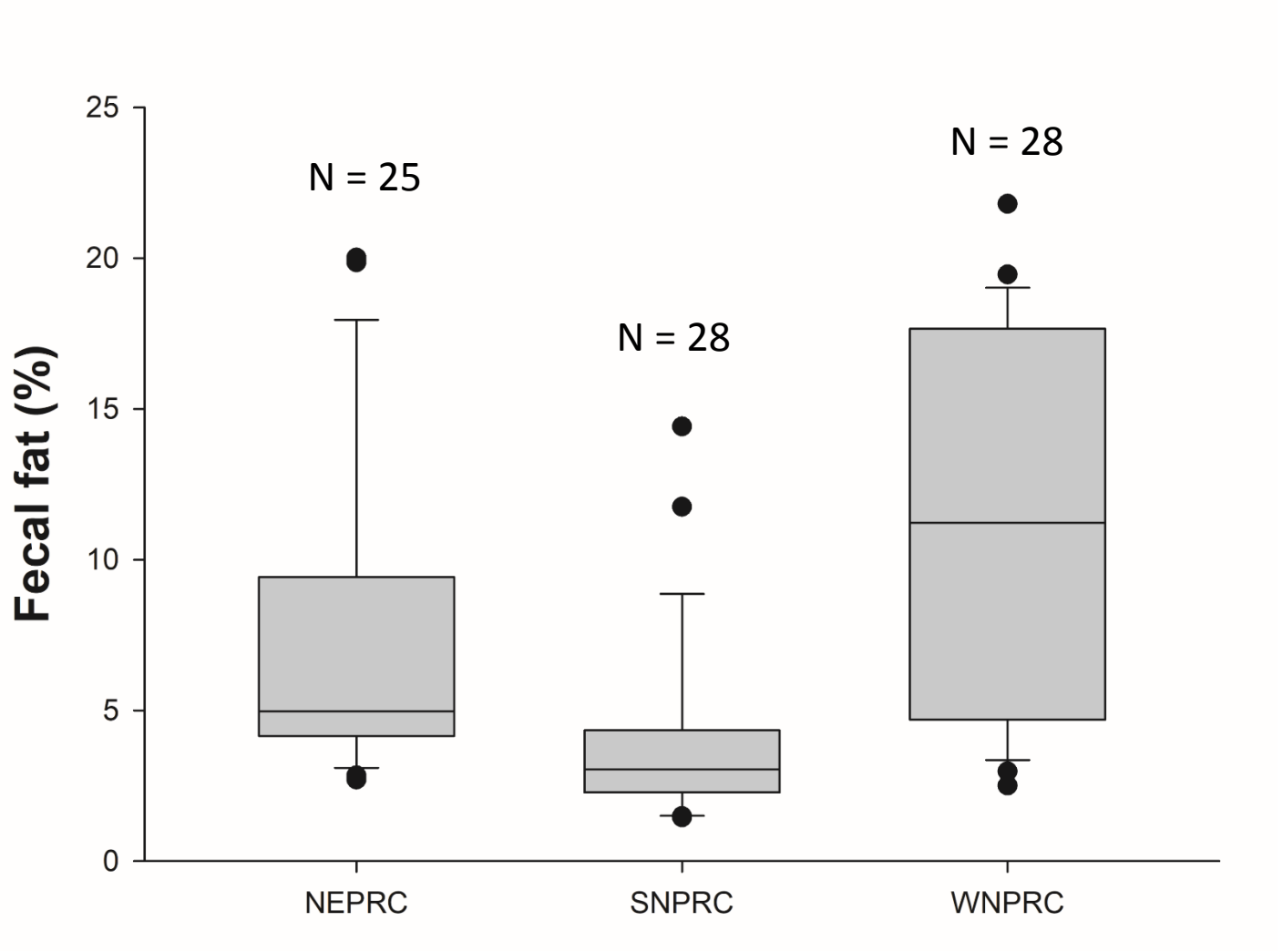
Apparent digestibility of energy is variable within and between diets

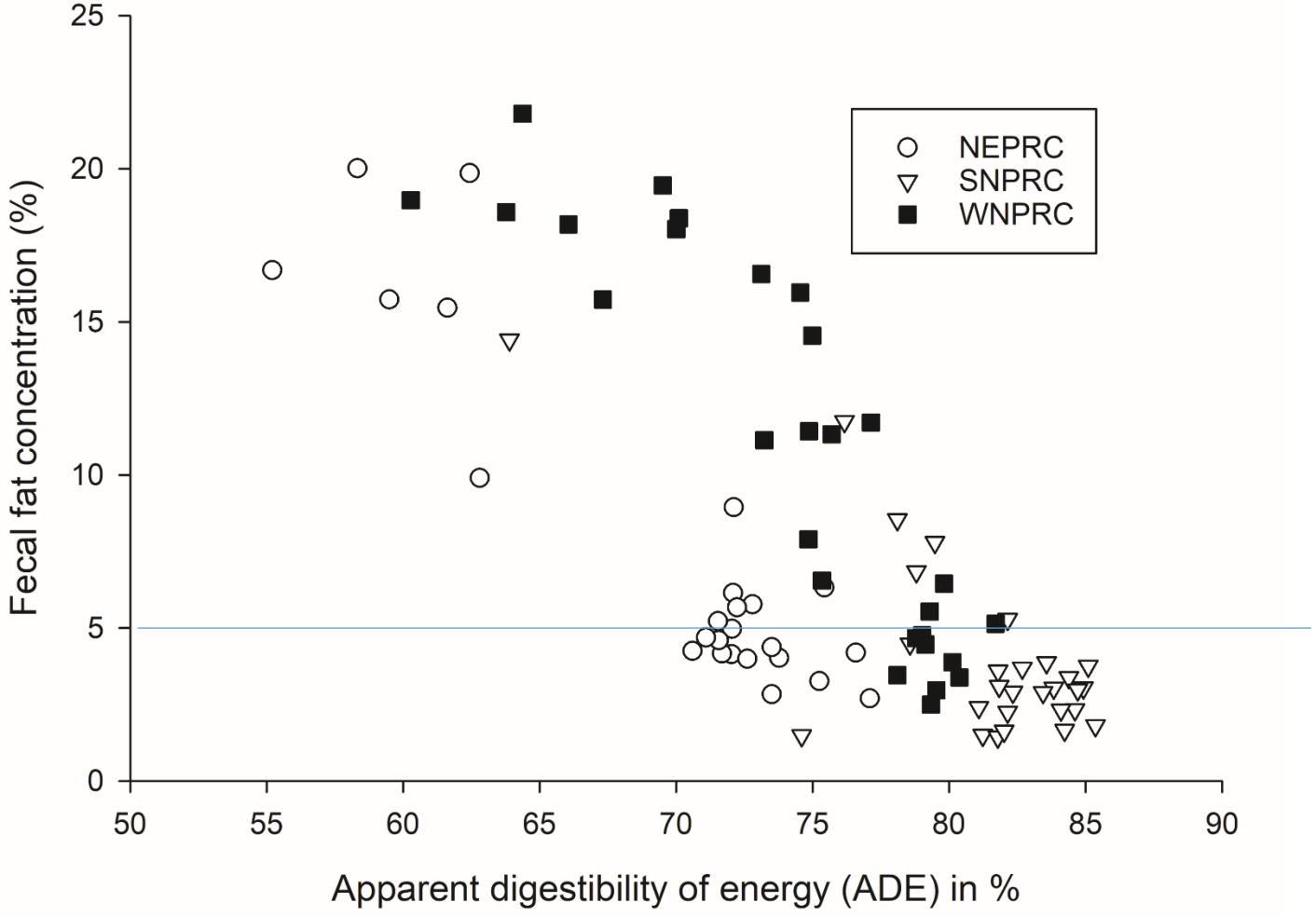


Fecal fat differed by diet

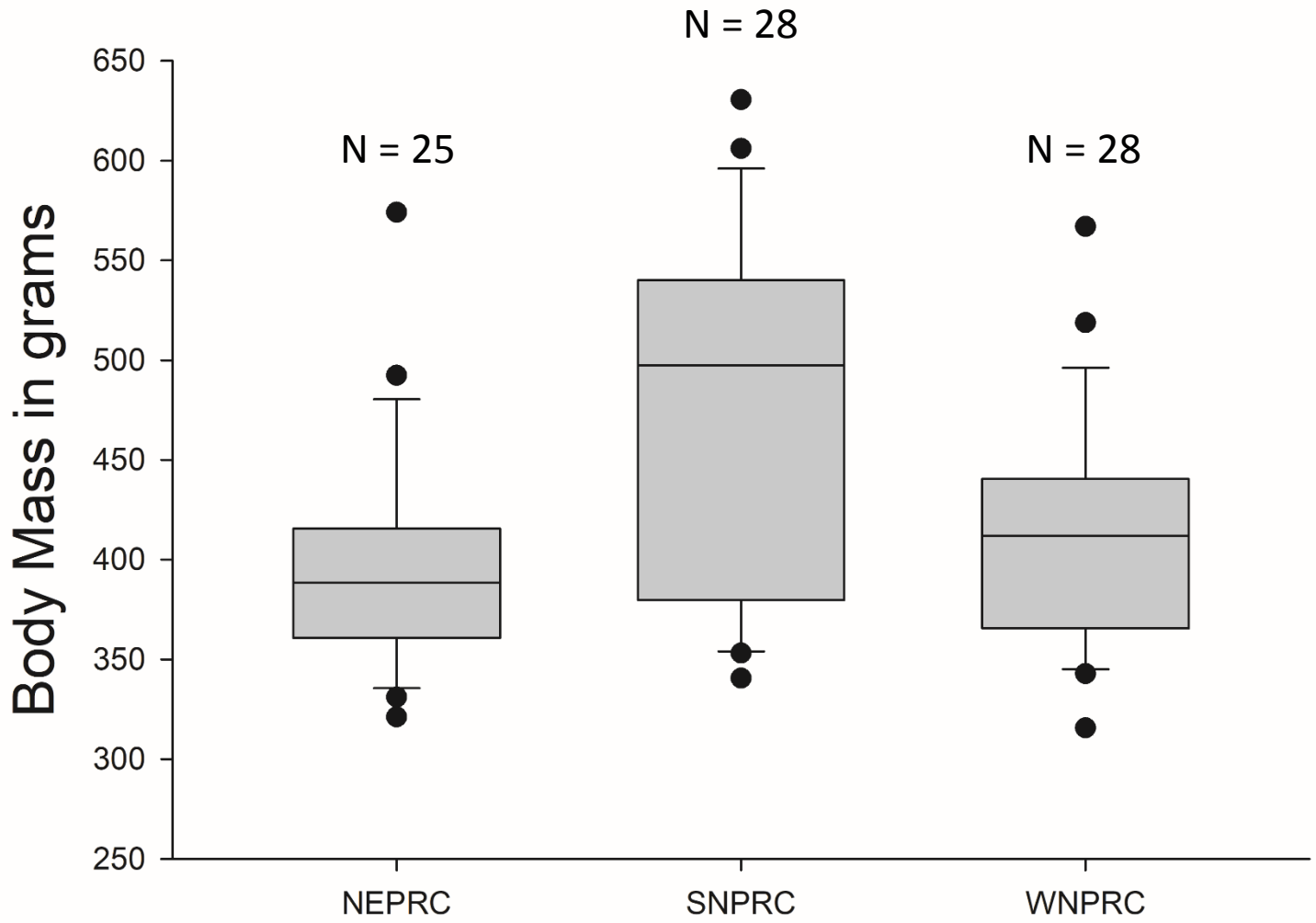


Fecal fat correlated with ADE

For animals with low ADE and high fecal fat there will be concern about all the fat soluble vitamins (A, D, E and K)

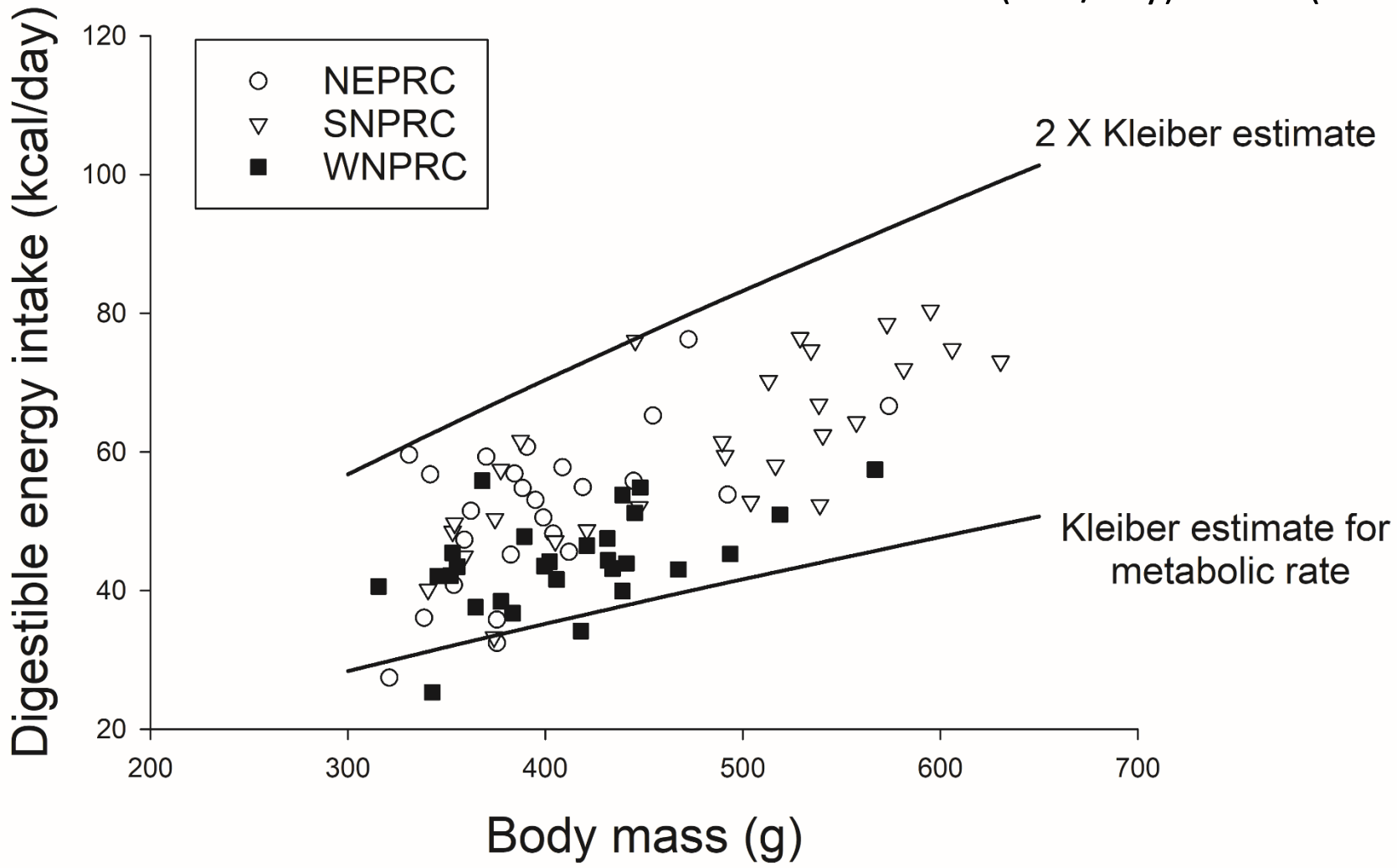


Diet and obesity risk



Energy intake and obesity

Kleiber (kcal/day) = 70 X (body mass in kg)$^{0.75}$



Summary

- Marmoset nutrient requirements for animals with healthy guts not different from other primates
- Animals can compensate for digestive difficulties by ingesting more food; but concern over fat soluble vitamins
- Daily energy requirement about 1.5 Kleiber (43 – 58 kcals/day for 300 – 450g animals)
- Differences in nutritional plane between animals in your colony may affect health, AND may create unaccounted for variation in research results

Dietary husbandry basics

- Marmosets do NOT need a complex diet; could be fed a single item, nutritionally complete diet
- All food items eaten need to be accounted for in the diet, and need to serve a purpose (preferably nutritional, in addition to any other purpose)
- Food is not a good enrichment item unless used in creative ways (e.g. puzzle boxes, reinforcing natural behaviors)
- Food can be used for training (which can be enriching), but should not compromise nutrition
- The simpler the diet, the more likely you can use nutritionally “good” foods as training treats

Does gum have a place in the diet?

- Positives: natural behavior, provides a fermentable substrate, not bad nutritionally
- Negatives: provides only energy and minerals (calcium), and the calcium content is lower than most complete feeds
- Unknowns: would it improve intestinal health? Affects on microbiome?

Is gluten bad?

- A small proportion of humans are gluten sensitive or possibly reactive to some factor in wheat (there is controversy)
- Likely that a small proportion of all primates are “wheat” sensitive
- No need for gluten
- No good data that marmosets or other callitrichids are particularly prone to gluten sensitivity
- Testing whether removing gluten can improve digestive ability; but past experience tells that animals on a purified diet are not immune from digestive difficulties or intestinal lesions