

WLF 201
Lecture 17 - Forage
Next Time: Diseases

We can meet 3 different objectives by managing food resources (habitats):

- Conserve threatened or endangered species
- Support a large enough population for continued harvest
- Control pest populations

We need to know the availability of the food and requirements of the animals to meet these objectives.

Food is the essential source of energy and nutrients.

Energy

- Fuel for metabolic processes
 - Heat
 - Mechanical Energy - muscles contractions, growth

How much energy does an animal need?

- Measured in calories or joules
 - Bomb calorimeter
- Varies by body size
 - $BMR = 70 W^{0.75}$

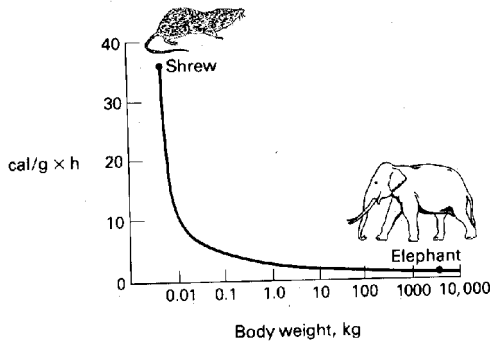
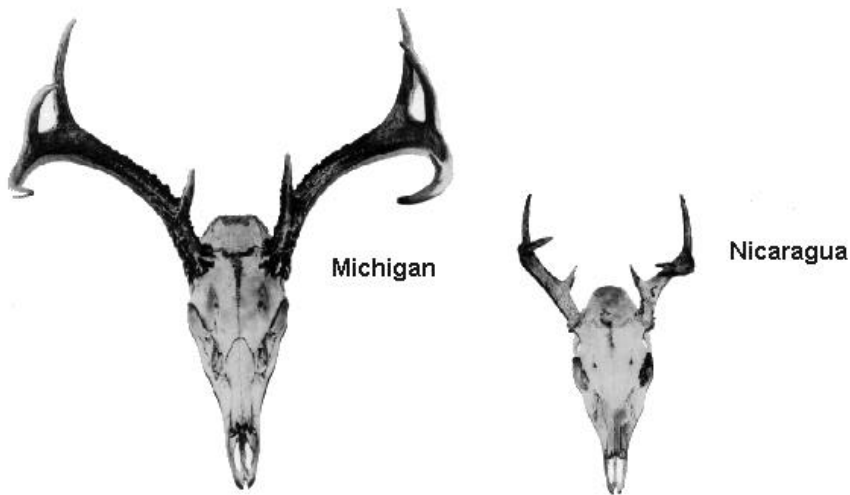


Figure 5.5
 When minimum metabolic rate of mammals is expressed per gram body weight and plotted on semilogarithmic coordinates, energy expenditure rates per gram increase exponentially with decreasing body weight (after Schmidt-Nielsen, 1970).

- Constant changes - lower for less active animals (torpor, hibernation)
 - Surface area to volume ratio?
 - Hummingbird
1,400-1,600 kcal/day
 - Taxonomic Differences

- Bergmann's Rule



Latitudinal Variation in White-Tailed Deer (*Odocoileus virginianus*) (Cervidae)

White-tailed deer (*Odocoileus virginianus*) extend from Canada through Central America into South America north of the Amazon River basin. There is a strong size gradient, with the largest animals in the temperate north (left) and the smallest in the warm neotropics (right). Antler growth is positively allometric with respect to skull size: the smaller animal has disproportionately small antlers. (From: <http://www.mun.ca/biology/>).

- Activity
 - Cost of locomotion varies by body size
 - $LC = 31.1 W^{-0.34}$
 - Flight 3-12 BMR
- Stage of life cycle
 - Breeding or not breeding

How do you get energy?

- Eating ...

Table 7.1: Approximate energy content of food components. (After Robbins 1983)

Food component	Energy (kcal/g)
Fat	9.45
Protein	5.65
Starch	4.23
Cellulose	4.18
Sucrose	3.96
Urea	2.53
Leaves	4.23
Stems	4.27
Seeds	5.07

- Protein
 - major components of cell walls, enzymes, hormones, lipoproteins
 - Not abundant in most plant foods, except legumes
 - Provide essential amino acids

- Carbohydrates
 - Quick energy - metabolized fast (see content of energy bar)
 - Cellulose, starches, and sugars
 - Some sources are available to few animals - lignin

- Fats
 - Highest energy
 - Not readily metabolized

- Vitamins
 - Fat Soluble - stored
 - Water Soluble - constantly available
 - Ex. Excesses of dietary protein and vitamin deficiency may occur in birds due to extensive feeding on agricultural grains rather than natural food sources. Visceral gout may result (Fig. 51.17). Under experimental conditions, substances that are toxic to the kidneys (nephrotoxic agents) and diets deficient in Vitamin A and high in calcium have caused avian gout.

- Minerals
 - macro and micronutrients
 - Calcium - bones and egg shells
 - Sodium - mineral licks

- Water
 - Major body component
 - Free, preformed, and metabolic



Variation in food supply

- Seasonally
 - Highest availability and quality for herbivores during plant growth
 - Switch from grazing to browsing seasonally
 - Breeding cycles tied to food supplies
 - Ex. Lion births during wildebeest breeding
- Annual
 - Seed crops - mast
 - Red squirrels and white spruce cone mast
 - Plant food availability also affects carnivores
 - Hare and lynx
 - Quality and availability vary in response to levels of secondary compounds

Measuring food supply

- Direct
 - Survey of available prey for Carnivores and Insectivores
 - Plots for herbivores
 - Do we actually measure what is available to consumers?
- Indirect
 - Behavioral Observations
 - Determine composition of food consumed

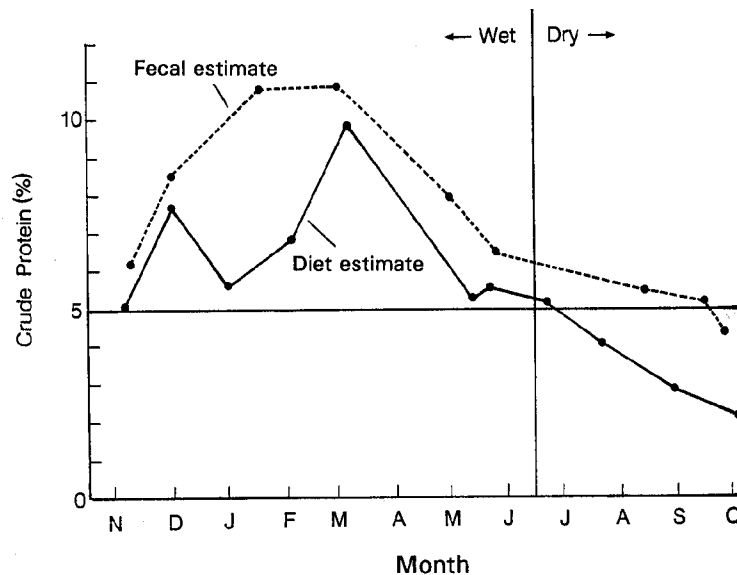


Fig. 7.3 The proportion of crude protein in the diet of African buffalo declines below the estimated 5% minimum requirement in the dry season. Estimates from diet selection with 95% confidence limits (—); estimates from fecal protein (-----). (After Sinclair 1977.)

• Physiological from feces

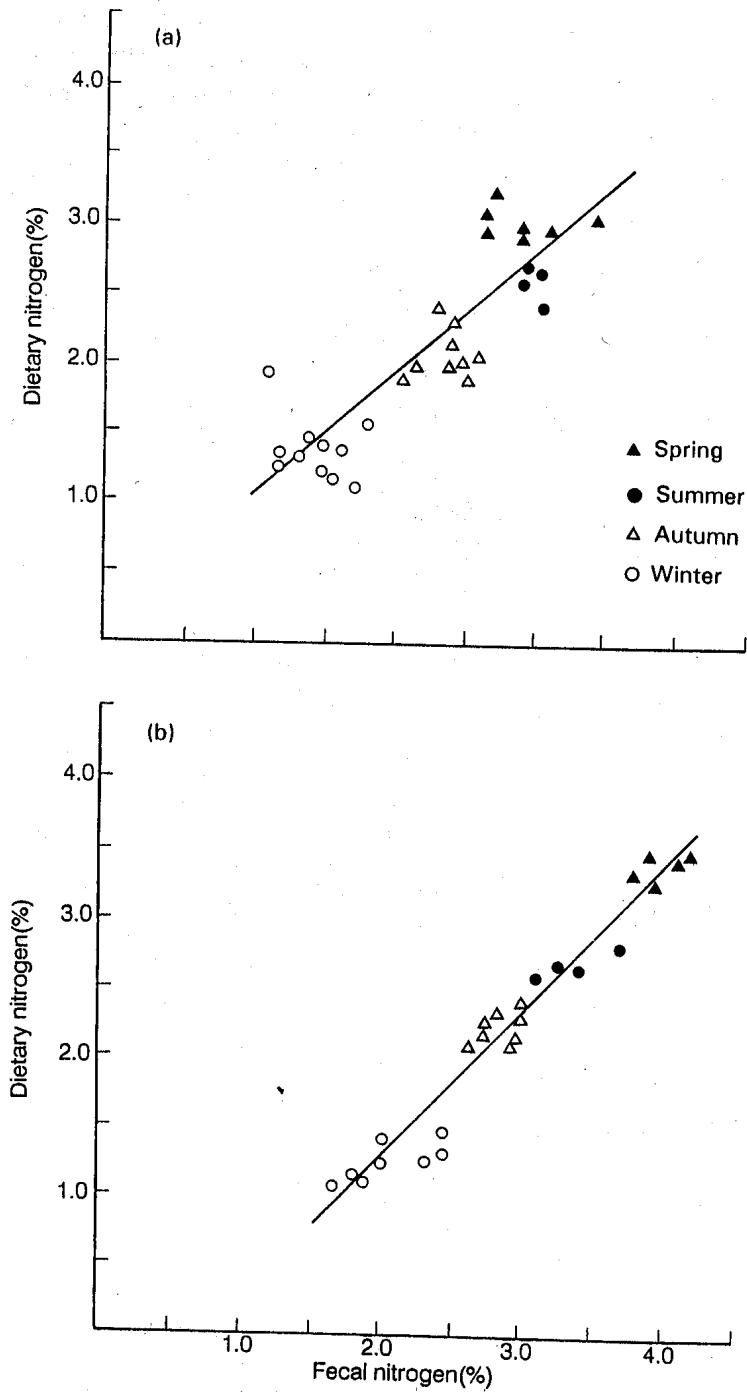


Fig. 7.4 Correlation of dietary nitrogen with fecal nitrogen in (a) elk and (b) black-tailed deer. Nitrogen increases with season. Spring (▲), summer (●), fall (△), winter (○). (After Leslie and Starkey 1985.)

Indices of Body Condition

- Body weight
 - Varies seasonally
 - Depends on body size
 - Difficult to weigh larger mammals
 - Organ or bone marrow fat
 - Blood Indices
 - Careful calibration

Daily Energy Expenditure for 4 Species of Geese