

Feeding and Nutrition

Food

- Energy
- Fuels metabolic processes
- Can be derived from fats, carbohydrates or proteins
 - calories (\neq Calories = Kcal)
 - Fats: ~ 9.5 cal/g
 - Carbohydrates: ~ 4 cal/g
 - Protein: ~ 5.5 cal/g

Protein

- Nitrogen-based biomolecules
- Primary component of cell walls, enzymes, hormones
- More abundant in animal tissues than in plants
- Amino acids
 - Building blocks of proteins
 - Most can be synthesized
 - Those that cannot are called “essential amino acids”
 - Must come from the diet
 - Differs from species to species

Carbohydrates

- Readily available energy
- Sugar, cellulose, starches

Minerals

Small (5%) but essential component of bodies

- **Macronutrients**

- Calcium
- Phosphorus
- Potassium
- Sodium
- Magnesium
- Chlorine
- Sulfur

- **Micronutrients**

- Iron
- Zinc
- Manganese
- Copper
- Molybdenum
- Iodine
- Selenium
- Cobalt
- Flouride
- Chromium



Vitamins

- Essential organic compounds that cannot be synthesized by animals
- Fat soluble (can be stored)
 - A, D, E, K
- Water soluble (cannot be stored)
 - B, C

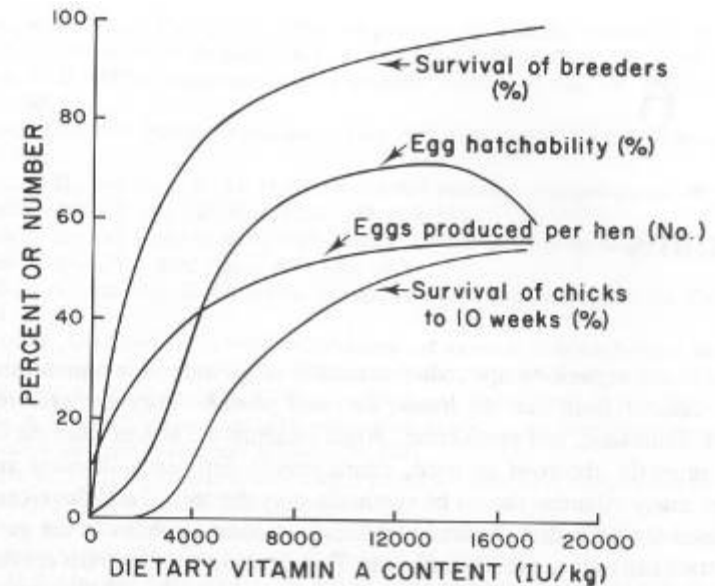


Fig. 6.1. Effects of vitamin A on survival and reproduction of captive bobwhite quail. (From Nestler, 1946, courtesy of the Wildlife Management Institute.)

Water

- 3 sources
 - Free water
 - Preformed water
 - Found in food
 - ~70% in fleshy tissues
 - ~3-7% in fat
 - Metabolic water
 - Produced in the body from oxidation of organic compounds
 - Catabolize 1g fat and get 1.07g water

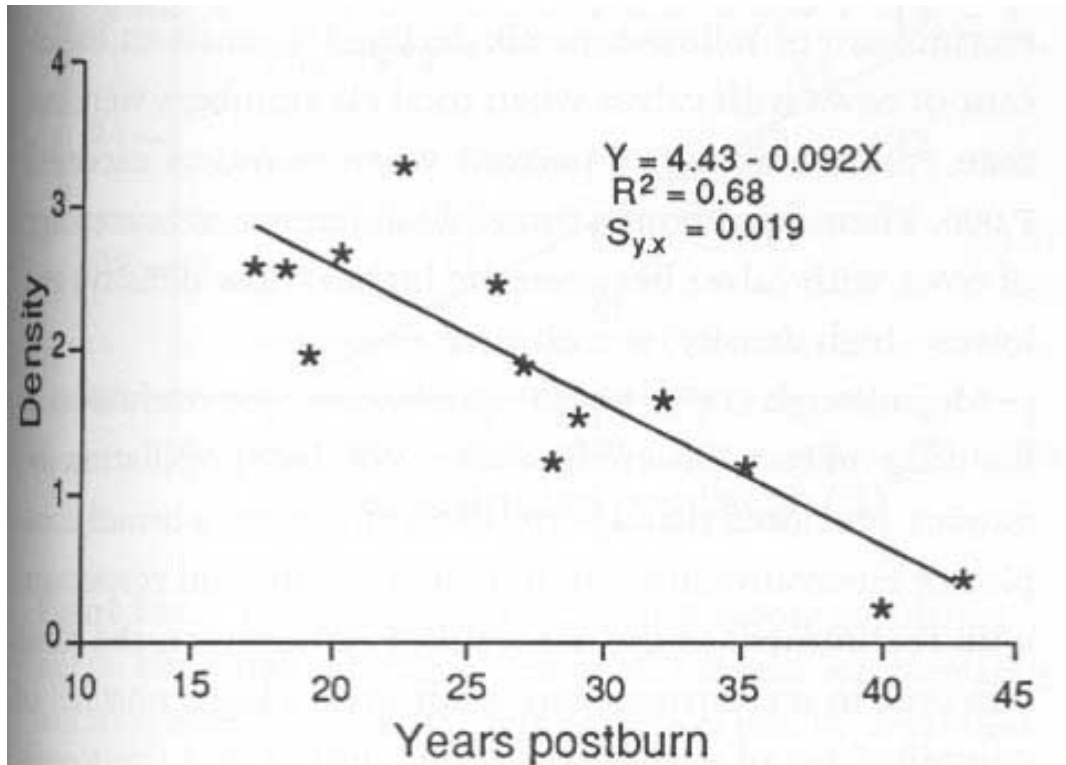




Herbivory

- Succession
- Seasonality
- Secondary compounds
- Feeding rate
 - Intake rate
 - Bite size
- Gut capacity and passage rate
- Browser—grazer continuum
 - Hofmann classification

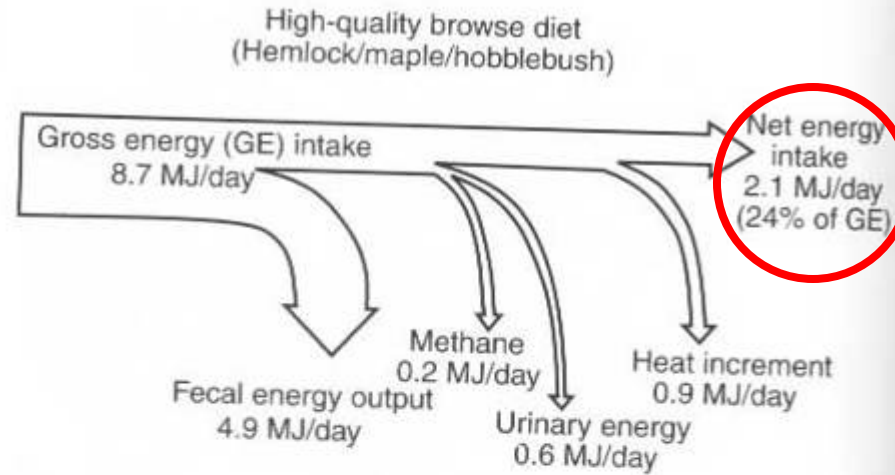
Succession



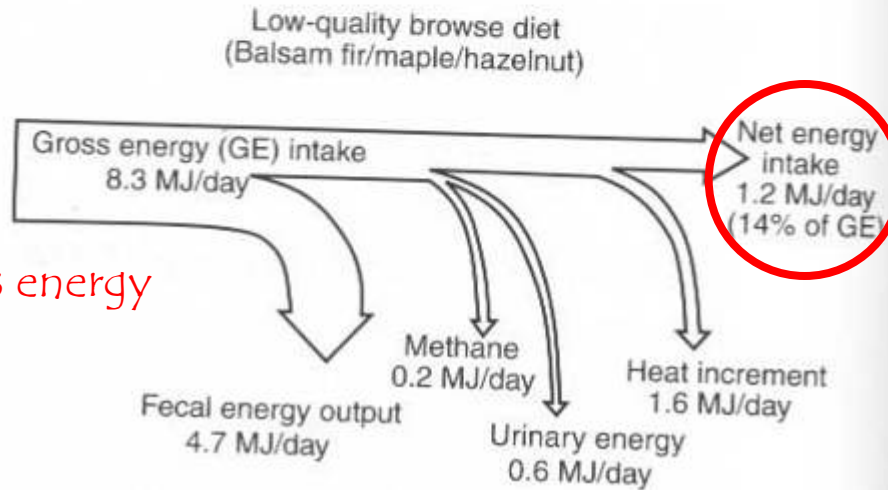
Food quantity

Figure 101. Relationship of forest age and moose density (moose/km²) during winter in the 1947 burn on the Kenai Peninsula, Alaska. A linear decline of about 9 percent per year is evident from 17 to 43 years postburn (from Loranger et al. 1991).

Diet quality



Wow! Almost twice as much!!



5% less gross energy

Changes in quality—bigger isn't better

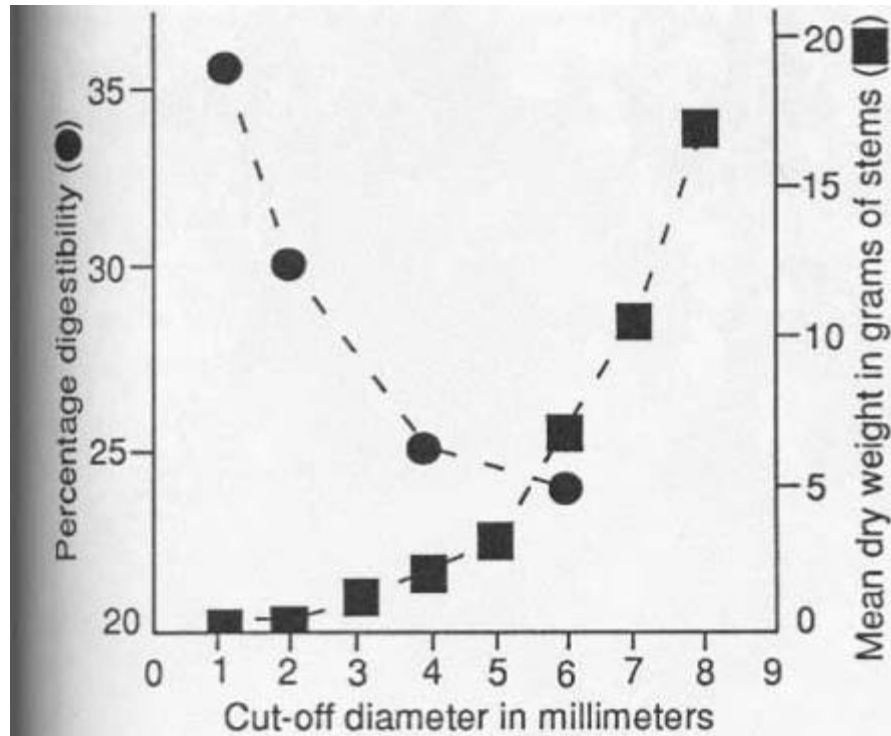


Figure 162. As moose eat larger diameter stems, they consume more dry matter per bite (from Vivas and Saether 1987). However, there is a tradeoff. As bite size increases, the nutrient quality of each bite decreases, and so does dry matter digestibility. These relationships between bite size, in vitro dry matter digestibility of the diet, and yield of dry matter influence how a moose uses available forage.

Seasonal variation in quality

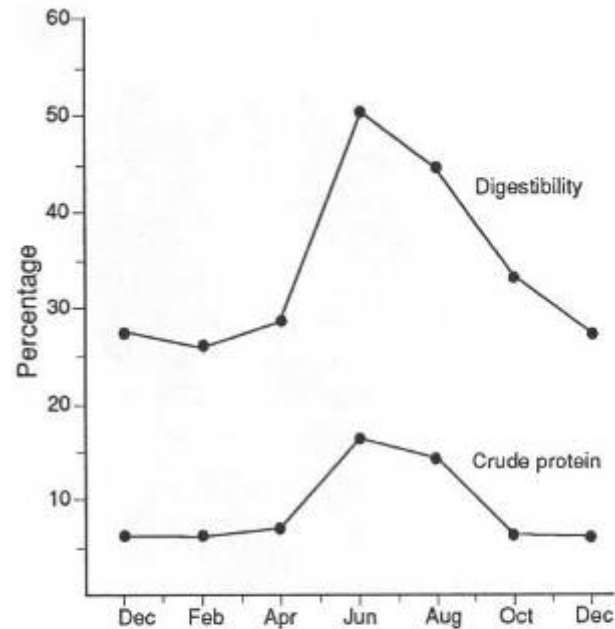


Figure 171. The quality of moose food changes with the seasons. Plants are most nutritious during the early part of the growing season when cells are rapidly expanding as the plant is growing. As the plant nears maturity, forage quality declines. Dormant plants in winter have the lowest nutrient content. This seasonal pattern of crude protein content and dry matter digestibility of moose foods illustrates the typical pattern (from Regelin et al. 1987a).

Seasonal changes in intake

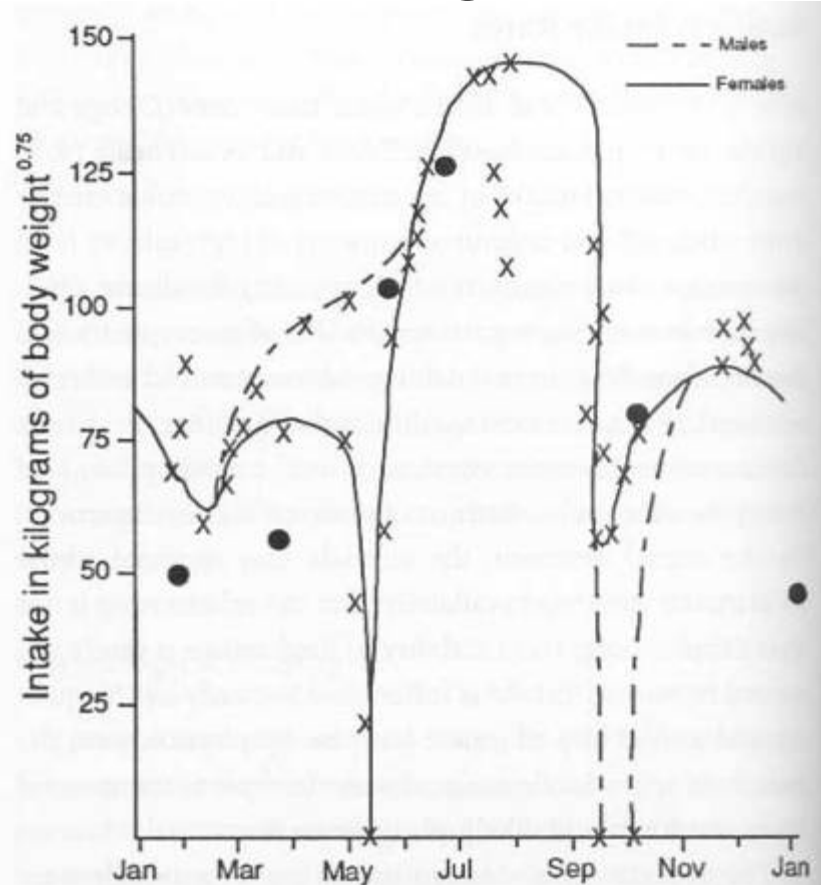
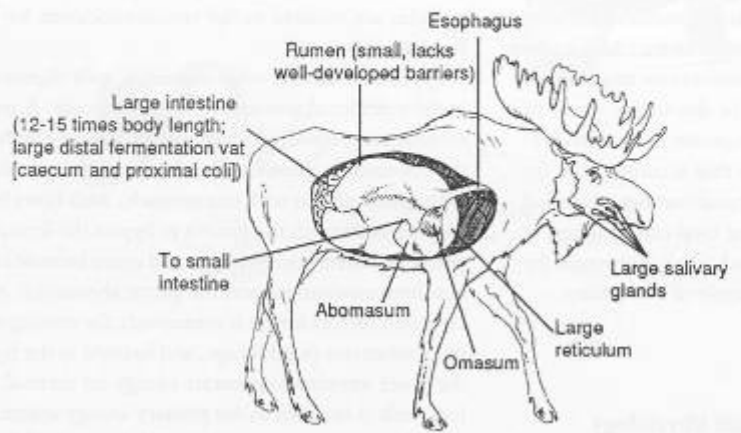
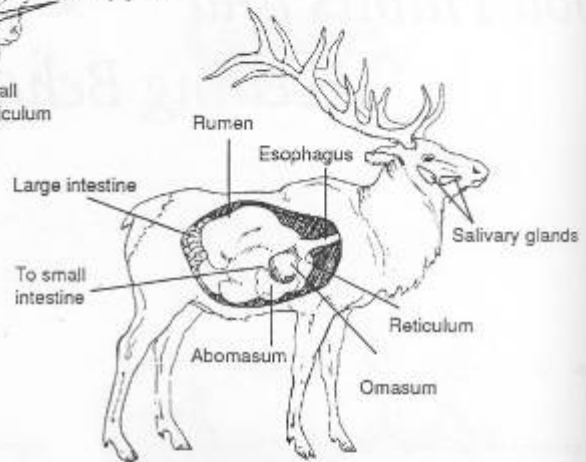
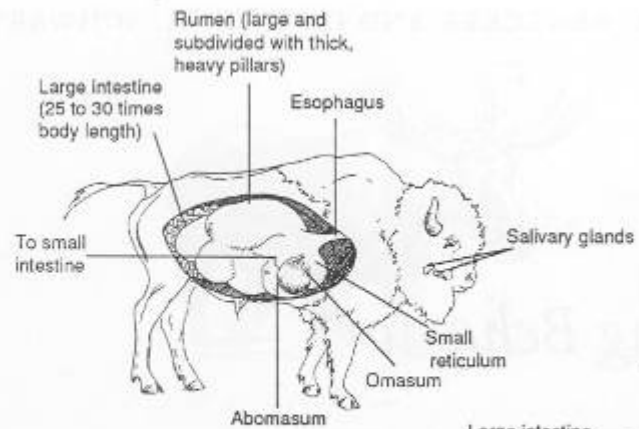


Figure 173. Moose eat different amounts seasonally. Peak rates of food consumption occur in spring and early summer when forage quality and digestibility are high. Bulls do not eat during the autumn rut and cows reduce their intake during estrus. Winter intake rates are about half those during summer (from Schwartz et al. 1987c). Baseline graph (crosses) from Schwartz et al. (1984); intake data (solid circles) from Renecker and Hudson (1985a).



Function of ruminant stomach

- Rumen
 - fermentation vat
 - absorbs VFAs excreted by rumen flora
- Reticulum
 - moves particles into rumen or omasum
 - causes regurgitation
 - collects foreign objects (hardware disease)
- Omasum
 - grinds ingesta
 - removes fluid from ingesta
- Abomasum
 - true stomach



Density-dependent effects through nutrition

- Forage quantity/quality affects growth and reproduction
- ♀♀ in poor nutritional condition ovulate fewer ova
- May undergo spontaneous abortion late in pregnancy
- Fawns may be born at lower weight
- Sex ratios change

	High nutrition	Low nutrition
♀♀ examined	27	22
♀♀ not bred	0	2
♀♀ bred but unproductive	3	1
Fawns produced	47	21
Litters (1:2:3)	2:21:1	17:2:0
Fawns per doe	1.74	0.95
Fawns per pregnant doe	1.96	1.11
Percent male fawns	36	68

Two aspects of density-dependent reproduction in moose

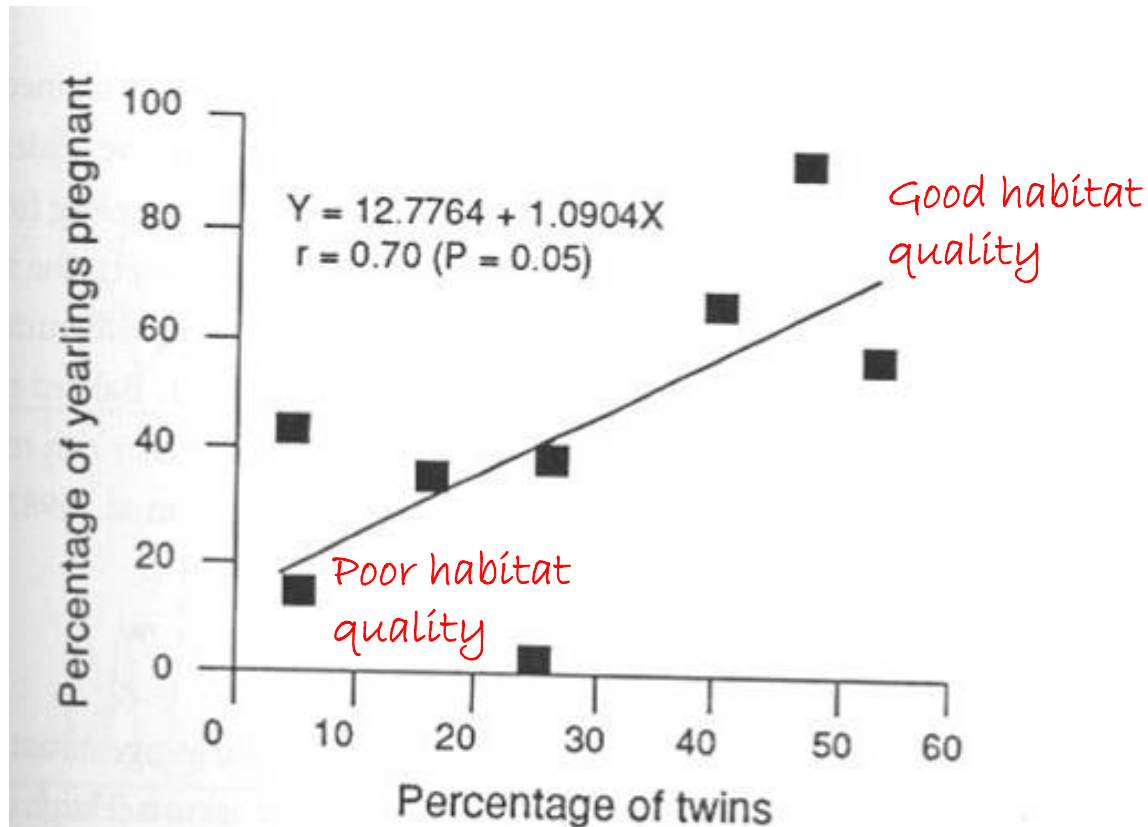


Figure 58. Relationship between twinning rates for adult female moose and pregnancy of yearling females (from Boer 1992a).

Other aspects of habitat

- Cover
- Access



Tongass Forest issues





Habitat quality for Sitka black-tailed deer in SE Alaska

Forest stand age

<u>Habitat characteristic</u>	<u>Old growth</u>	<u>Second growth</u>	<u>Clearcut</u>
Snow interception	High	High	Low
Sunlight penetration	Moderate	Low	High
Forage availability	Moderate	Low	High
Tannin concentration in forage	Low	Low	High

What to do about it

- Habitat management
- For browsers, return habitat to early successional stage
 - Fire
 - Physical means
 - Timber management
 - Not always good (Sitka black-tailed deer)
- For water dependent species, manage water sources
 - Prevent livestock access
 - Create new water sources
- For wilderness-dependent species, maintain roadless areas