

# Classification of Herbivores

REM 456 –University of Idaho –Sergio Arispe

## Classification of Herbivores

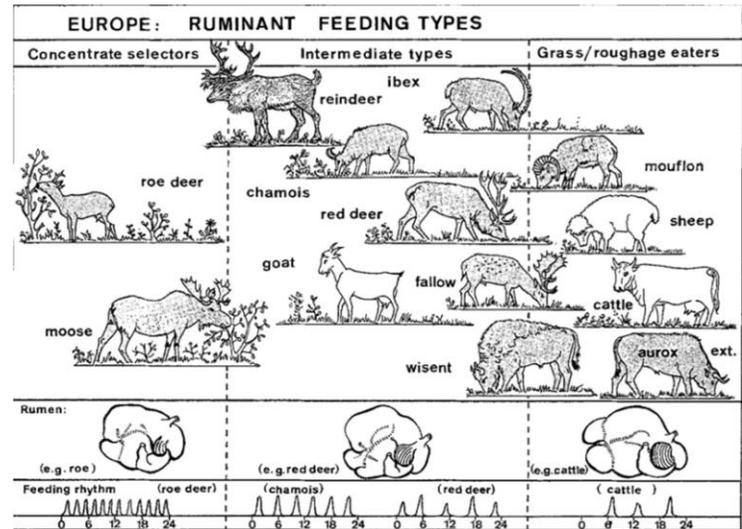
- ◆ Foregut fermenters versus hindgut fermenter
- ◆ Feeding Types of Ruminants
  - Concentrate Selectors (CS)
  - Intermediate Feeders (IM)
  - Roughage Feeders or Grazers (GR)

## Feeding Types of Ruminants

- ◆ Concentrate Selectors (CS)
  - Cannot tolerate large amounts of fiber in their diet
    - Consume plants with high cell contents and low cell wall contents
  - Rapid Rate of fermentation
    - Rumination is less important
  - Feeds on smaller amounts frequently

## Feeding Types of Ruminants

- ◆ Intermediate Feeders (IM)
  - Adapted to either browsing or grazing
  - Shifts feeding behavior according to plant availability
  - Eats less frequently than CS and more frequently than GR
  - Large variation in dietary fiber content between species
- ◆ Grazers or Roughage Feeders (GR)
  - Eat mostly grass
  - Large rumens to process forages
  - Longest retention time necessary to digest high percentage of cell wall contents
  - Cellulolytic activity > Amylolytic activity



## Mouth and Head

- ◆ Mouth tissue is cornified in all ruminants
  - Protect mouth from rough and sharp plant surfaces
  - GR mouths and lips are more cornified
  - More selective feeders have softer, more delicate tissue
  - The shape of the head and dexterity of the lips and tongue are determined by the animal's selectivity

## Different Cell Types

- ◆ Two basic types of acinar epithelial cells exist
  - Serous cells, which secrete a watery fluid, essentially devoid of mucus
  - Mucous cells, which produce a very mucus-rich secretion

## Salivary Glands

- ◆ 0.1-0.2% of total body weight in CS
- ◆ 0.03-0.1% of total body weight in GR
- ◆ Salivary glands more serous in CS
  - More of the CS diet is soluble
  - Saliva may wash soluble ingesta straight into abomasum

## Head, Lips, and Tongue

- ◆ More Selective Feeders
  - Longer, thinner heads, longer lips, and larger mouths
  - Longer, more pointed tongues
  - Prehensile lips and tongue allow for sorting through plant material
  - The design of the head and mouth allows the animal to pick out leaf and seeds
- ◆ Less Selective Feeders
  - Shorter, wider heads, smaller mouths, and short lips
  - Short, fat, blunt tongue
  - GR don't need to pick through their food and find seeds and leaves, since they eat plants with high CWC

## Teeth and Jaw

### ◆ Concentrate Selectors

- CS teeth are more fragile, but more firmly attached at the root
- Low grass/high concentrate means less surface attachment for masticatory muscles
- Intense initial chewing and short rumination alternate with short feeding period of CS
- Grass/Roughage Eaters
- GR teeth are tougher, but more easily lost
- More grass in the diet means a larger attachment surface for masticatory muscles
- GRs have wide, shovel shaped incisors; molars with high, sharp ridges
- Brief initial chewing, long rumination in GR

## Rumen: Size and Volume

- ◆ GR rumen larger, more subdivided and complex than CS rumen
  - Rumen extends into pelvic inlet in GR, but not in CS
- ◆ Greater amount of attachment, more fibrous attachments on GR rumen than in CS rumen
  - Dorsal sac more easily contracted in CS than in GR because less dorsal attachment
    - CS less likely to develop bloat than GR

## Ruminal Lining

- ◆ Reticulum:
  - Deeper, more subdivided papillae in GR than in CS
  - CS have shallow papillae that are rarely subdivided
- ◆ Omasum:
  - Much larger laminae, greater absorptive capacity in GR
    - Papillae blunt and spaced out in GR; long, claw-like, and dense in CS

## Rumen: Papillae and Ruminoreticular Groove

- ◆ Rumen papillae:
  - CS: evenly distributed, entire rumen surface covered with papillae
  - IM: density and placement of papillae change with seasonal and diet changes
  - GR: uneven distribution, more dense ventrally
- ◆ Ruminoreticular groove much wider in more selective species
  - More effective food passage delay in species with higher fiber diets

## Body Length: Intestinal Length Ratio

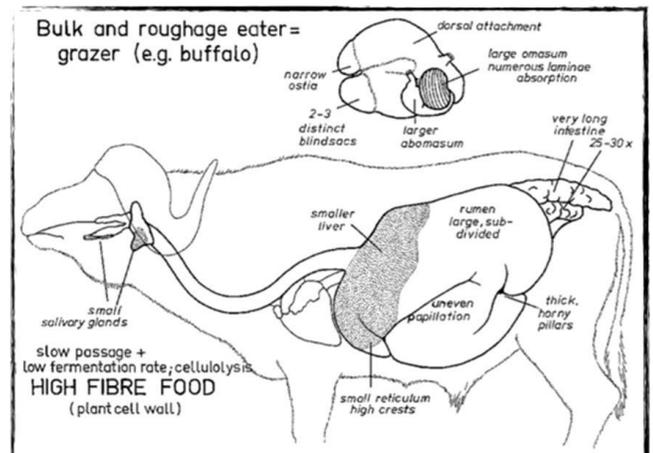
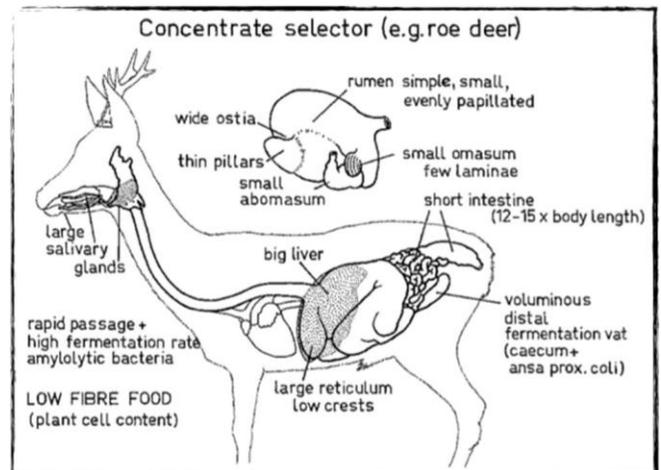
- ◆ GR: 1:22 - 1:30
- ◆ IM: 1:15 - 1:20
- ◆ CS: 1:12 - 1:15
- ◆ Conclusion - Species with a greater proportion of fiber to concentrate in the diet will have longer intestines

## Cecum vs. Rumen

- ◆ Cecum: Rumen ratio
  - CS = 1:6 - 1:10
  - IM = 1:9 - 1:24
  - GR = 1:15 - 1:30
  - Conclusion - Since more unfermented food leaves the rumen in a CS, the CS must have a larger cecum to ferment the greater relative amount of left over fiber

## Summary

- ◆ There are three distinct types of ruminants based on their feeding strategies—CS, IM, GR
- ◆ CS's digestive anatomy is adapted for diets high in cell contents and low in cell wall contents. MRT is shortest
- ◆ IM's diets adjust with changes in forage production and quality
- ◆ GR's digestive anatomy is adapted for diets high in cell wall contents and low in cell contents. MRT is longest



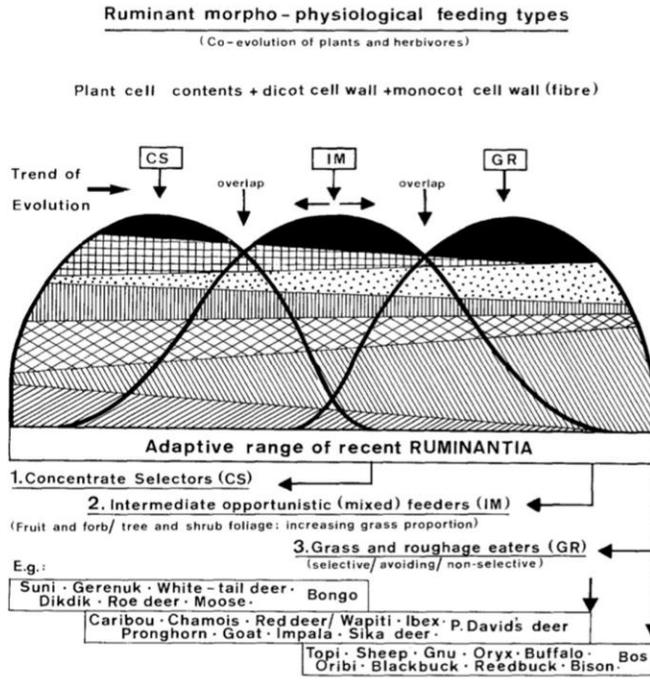
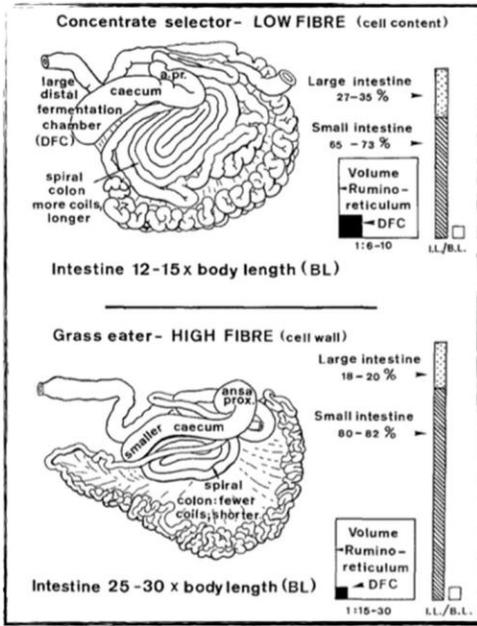


Fig. 15. Schematic representation of ruminant specialisation, with adaptation to their feeding plants, during evolution. While the basic structural and functional design is retained, the increasing ability to digest plant cell wall carbohydrates (trend to the right) causes regression of some, but development of other components of the digestive system and changes of feeding strategy. Overlapping morpho-physiological criteria ensure the retention of safeguards (e.g. for nutritional bottle-necks) and a wide adaptive range. Separating limitations are found on both ends of the range. Intermediate species can switch seasonally from one strategy to the other. Selectivity for plant cell contents; Fibre digestion (cellulolysis) in rumen; HCl-producing tissue in abomasum; proportion of salivary gland tissue of b.weight; postruminal (caecocolic) fibre digestion; ruminal amylolysis, possibly bypass of solubles (retic. groove); effective food passage delay structures and mechanisms; total intestinal length; papillary surface enlargement on dorsal ruminal wall; rumino-reticular capacity and weight relative to b.weight; Ref. Hofmann and Stewart 1972; Hofmann 1973, 1976, 1983, 1984; Van Soest 1982; Hofmann and Schnorr 1982

