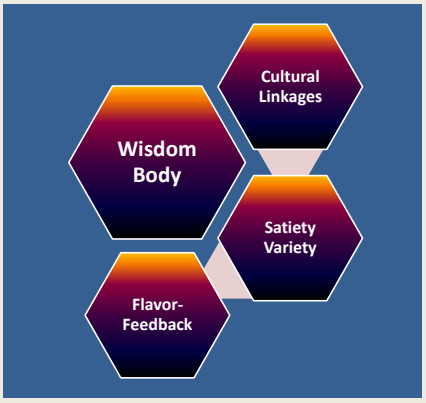
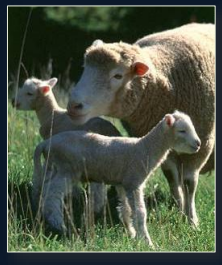
Satiety, Variety, Biodiversity

Wisdom of the Body
Satiety, Variety, Biodiversity

Palates Link Animals with Landscapes



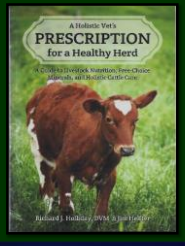
Why do sheep prefer to eat clover in the morning…



…and grass in the afternoon and how does that affect production?

Does what's fed in the barn influence what dairy cows eat on pasture?

What caused abnormal eating, abortions, and death in Carl's cattle?



Satiety, Variety, Biodiversity

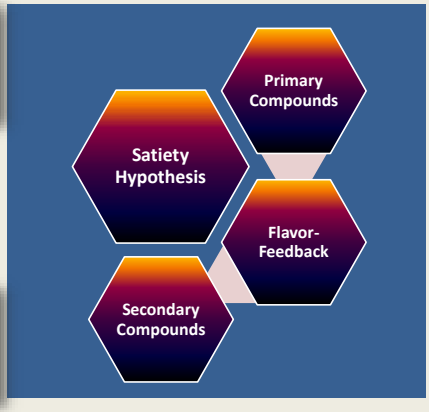
- Total Mixed Ration
  - ground and mixed
  - corn, barley, alfalfa, corn silage
- Free Choice
  - corn, barley, alfalfa, corn silage

How did food intake, animal performance and costs differ?

Why do dairy cows drink so much water, given the amount of water they get from ryegrass?

Ryegrass (Set Stocking)	Case 1	Case 2
Water Eaten (L/d)	65	62
Water Drank (L/d)	19	36
Urinations (d)	6	8

Explanations for why animals eat a variety of foods.



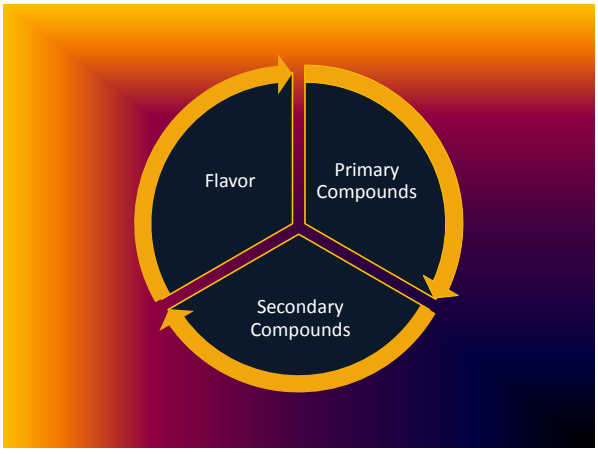
Eating any food to satiety causes a transient food aversion based on interactions among flavor, primary, and secondary compounds.

Landscapes with diverse arrays of plants are nutrition centers and pharmacies with vast arrays of primary and secondary compounds.

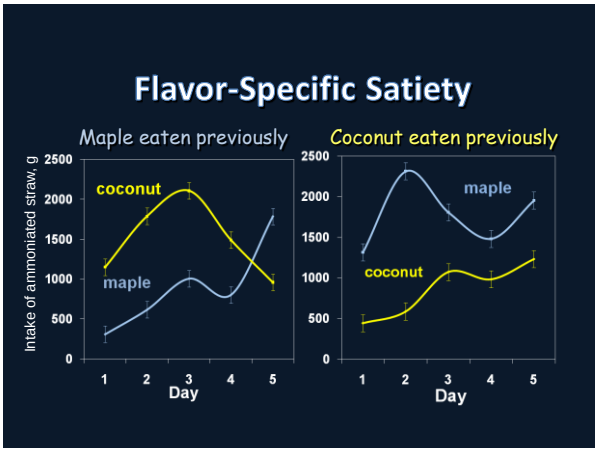
Nothing is more important for health through nutrition than…

…eating a variety of foods and foraging in a variety of places for herbivores.

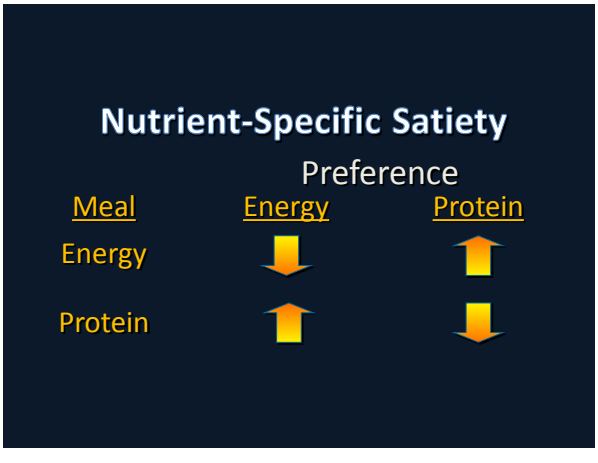
Satiety, Variety, Biodiversity



Flavor-Specific Satiety



Nutrient-Specific Satiety



What's fed in the barn influences what dairy cows eat on pasture.

Mixed rations high protein fed in the barn cause cattle to eat less clover and high-protein plants and plant parts on pasture.

Satiety, Variety, Biodiversity

Why do dairy cows drink so much water, given the amount of water they get from ryegrass?

Ryegrass (Set Stocking)	Case 1	Case 2
Water Eaten (L/d)	65	62
Water Drank (L/d)	19	36
Urinations (d)	6	8

Why do dairy cows drink so much water, given the amount of water they get from ryegrass?

Ryegrass (Set Stocking)	CP (20%)	CP (30%)
Water Eaten (L/d)	65	62
Water Drank (L/d)	19	36
Urinations (d)	6	8

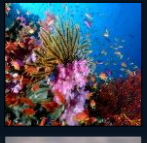
Secondary Compound-Specific Satiety

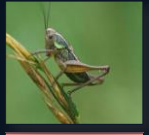
All plants contain secondary compounds

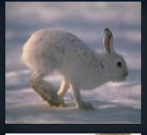
Secondary compounds limit how much of any particular plant an animal can eat.

Primary Roles for Secondary Compounds in Diet Selection

Secondary compounds limit intake by insects, fish, birds, and mammals.

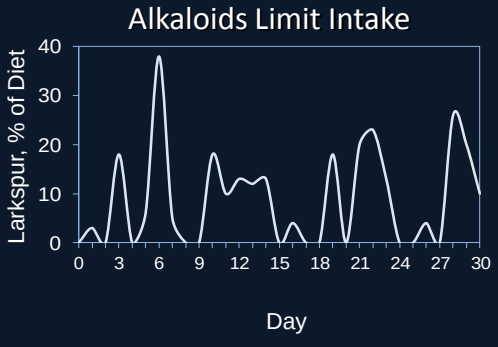






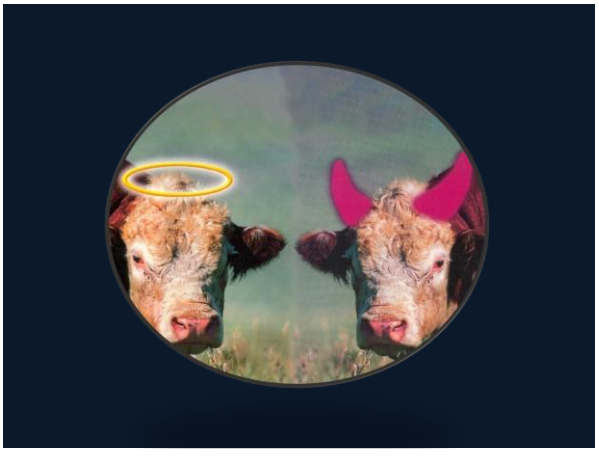
Ecology → Defenses

Agriculture → Toxins

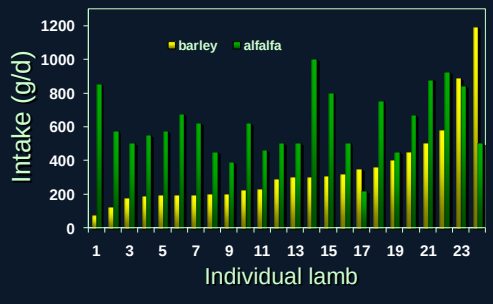


Satiety, Variety, Biodiversity

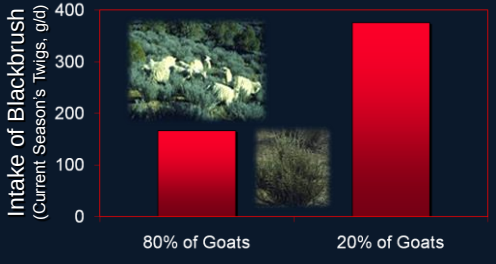
Biodiversity Enables Individuality



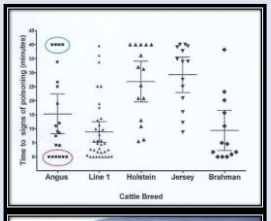
Variation among Lambs



Variation among Goats



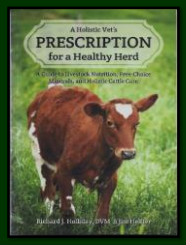
Variation among breeds and individuals with respect to larkspur toxicity.



Overeating in Quest of Nutrients in Short Supply

Satiety, Variety, Biodiversity

What caused abnormal eating, abortions, and death in Carl's cattle?



➢Total Mixed Ration
ground and mixed
corn, barley, alfalfa, corn silage

➢Free Choice
corn, barley, alfalfa, corn silage

How did food intake, animal performance and costs differ?

➢Total Mixed Ration
ground and mixed
corn, barley, alfalfa, corn silage

➢Free Choice
corn, barley, alfalfa, corn silage

- ✓ Choice ate less than mixed
- ✓ Gained weight at same rate
- ✓ Choice cost less to feed than mixed ($1.49/kg gain vs. $1.84/kg gain)

Interactions among Primary and Secondary Compounds

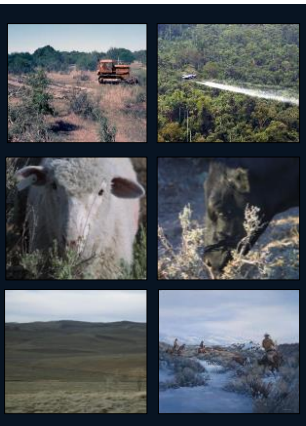




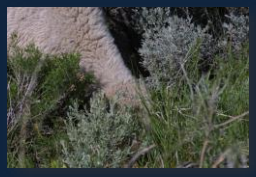
The Ax, the Cow, the Plow, and the People Managing Livestock Grazing for Biodiversity

Rejuvenating Sagebrush-Steppe

Turning cattle and sheep into low-cost rejuvenators of sagebrush-steppe Oregon, Montana, Nevada, Wyoming and Utah.



Satiety, Variety, Biodiversity



Spring grazing → favors sagebrush over grasses/forbs → young sagebrush avoided → leads to re-establishment of sagebrush with time

Increase sage, Decrease herbs

Less plant and animal diversity

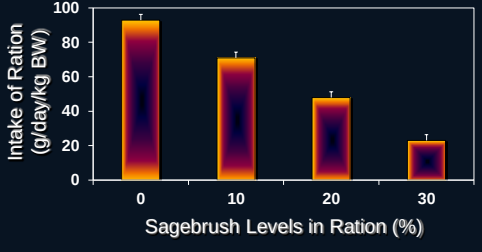
Decrease in nitrogen
Increase lignin and terpenoids

Decrease rates of plant decomposition and nutrient cycling

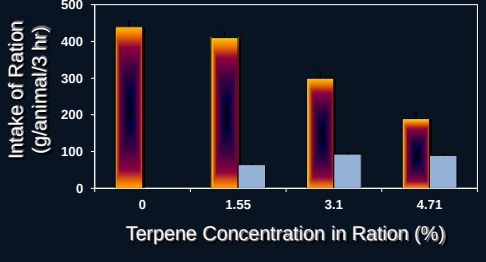
Timing of Grazing
Fall and winter best for herbs, sagebrush, herbivores and ranchers.

Terpene concentrations in sagebrush lowest in late fall and winter.

Sagebrush limits intake of a palatable ration…

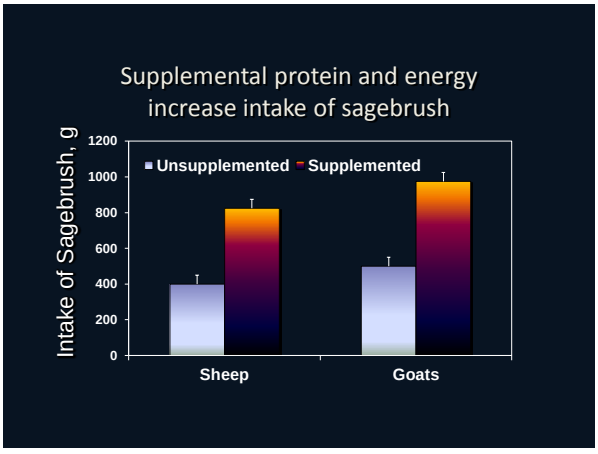


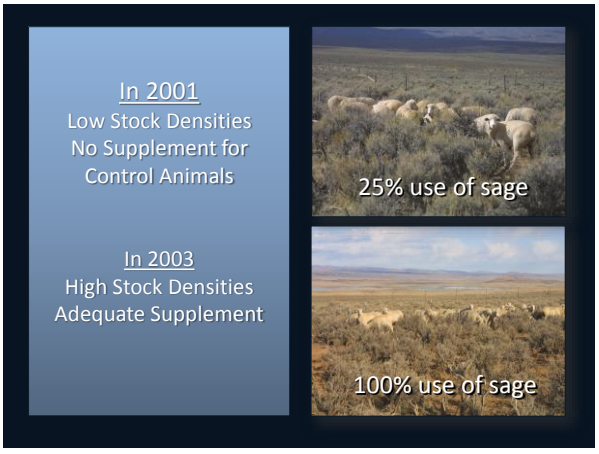
…and terpenes limit intake of sagebrush

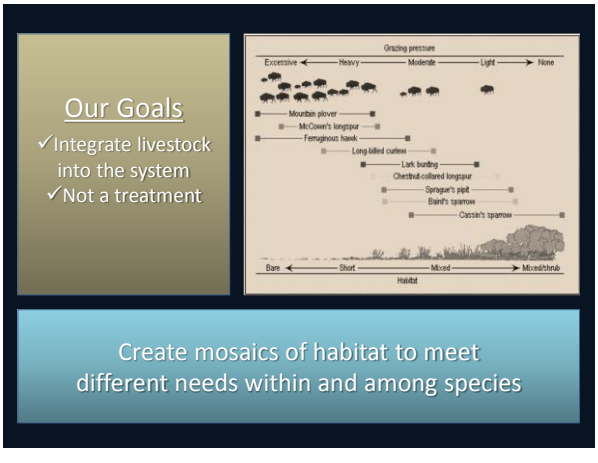


Supplemental energy and protein enhance intake of foods containing secondary compounds

Satiety, Variety, Biodiversity







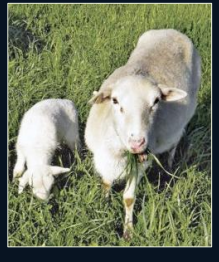
Satiety, Variety, Biodiversity

Mat Carter
Crown Cattle Company

From sagebrush as a costly nuisance to sagebrush as a forage resource in winter

Complimentarities and Sequences

Why do sheep prefer to eat clover in the morning…



…and grass in the afternoon and how does that affect production?

Why do cattle perform so well on the mix of plants from hell?

Cattle learn to "clean their plates"

Ray's cows learned to "mix the best with the rest" rather than "eat the best and leave the rest"

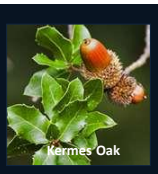
Biochemically diverse diets enable sequences that compliment one another, enhancing nutrition and health

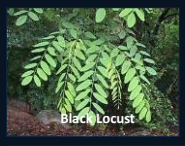
An appetizer of trefoil (sainfoin) helps the fescue go down.

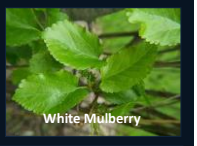
An appetizer of bitterbrush helps the sagebrush go down.

Satiety, Variety, Biodiversity

In Mediterranean Woodlands, goats ate: kermes oak + black locust + white mulberry (650 g) > kermes oak + black locust (530 g) > kermes oak + white mulberry (441 g) > kermes oak (287 g).



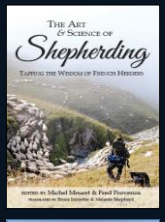




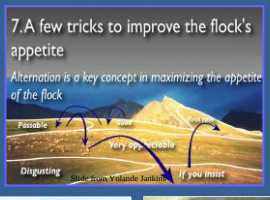
Goats fed with browse combinations gained weight while those fed only kermes oak lost weight.

Livestock producers find that morbidity and mortality of stockers decrease…

…when cattle forage on diverse mixtures of forages as opposed to monoculture pastures.



When art and science meet: Integrating experiential knowledge of herders with science of foraging behavior for managing grazing lands. Rangeland Ecology & Manage Meuret and Provenza



Four Actions Implemented by Herders

Teach naïve animals about forages and herding conditions (time: years)

Teach herd to respect boundaries of grazing sectors (time: months)

Modulate temporary palatability scoring of various forages (time: weeks)

Design grazing circuits to create food synergies by meal sequencing (time: day, minutes)

Herders try to avoid two situations…

Satiety, Variety, Biodiversity

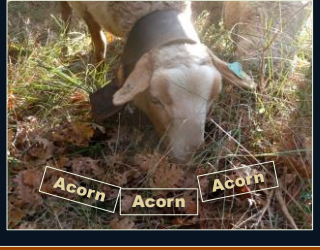
Offering a highly desirable, but rare, forage can lead to frustration and reduce food intake.

Offering a limited array of forages can lead to wariness and lower daily food intake.

To avoid frustration and wariness…

Herders make use of different vegetation patches. They do so predictably during a day or half-day.

Herders end each circuit with highly appreciated forage(s). That prevents animals from searching for them during the day.

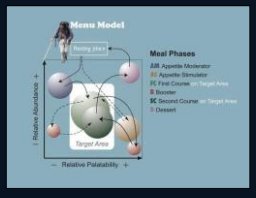


Herders ration access to the 'best spots', such as riverbanks or tree fruits, during each grazing circuit, to reinforce the herd's reliance on and trust of the herder.

Satiety, Variety, Biodiversity

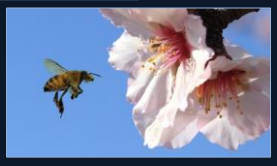
Grazing Circuits

- Stimulate appetite/intake
- Enables individuals to regulate intake of primary and secondary compounds
- Target grazing to enhance/ maintain biodiversity



While pesticides and pathogens pose clear threats to honey bee health, the need of bee colonies for balanced nutrition is gaining increasing appreciation.

Colonies experience nutritional deficits when foraging on one pollen source.

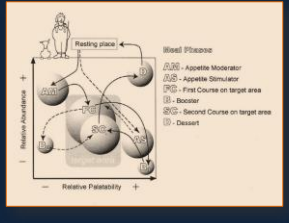


In California almond orchards, for instance, 1.6 million colonies are kept every year, despite risk of low floral diversity, which can reduce the life expectancy of bees.

Stockmanship Management- Intensive Grazing

Weeds - Australia

Watersheds - Namibia



Stockmanship to move and place cattle to improve habitat for mule deer and elk at Hardware Ranch

Graze Herbs

Late Vegetative

Early Reproductive

Winter use by mule deer

Spring use by cattle

Satiety, Variety, Biodiversity

Stockmanship to change bottom dwellers into upland aficionados