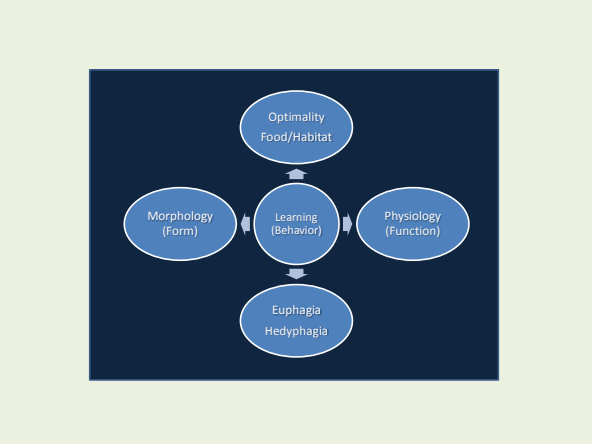
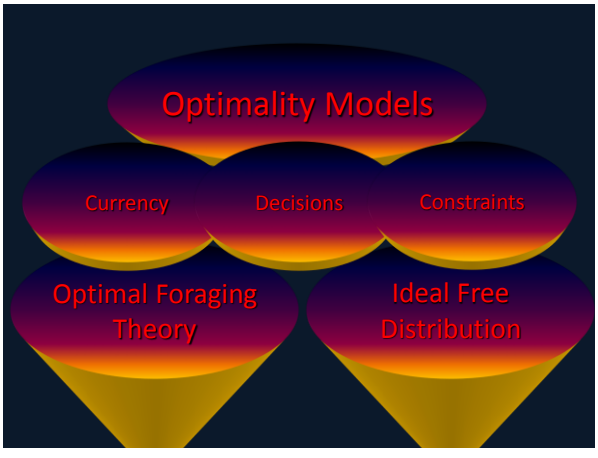
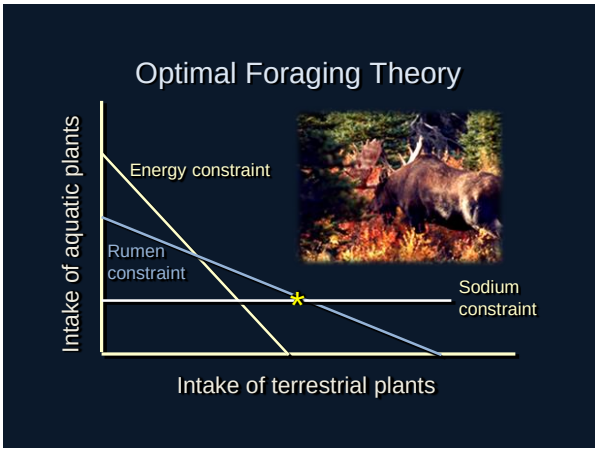
Models of Foraging



What does it mean to say animals optimize?

Do they optimize regarding food and habitat selection, and if so, on what bases?





Spiders can customize their webs to make sure they get the diet they need.

If flies are the only food, spiders adjust their web to catch enough flies to get the protein they need by making a web with bigger catching area and smaller mesh size.
If crickets are the main food, the web gets stronger and stickier to withstand the extra force required to keep crickets captive in the web.

Models of Foraging

Some contend red deer select a diet based on protein others contend they optimize for energy.

Animals exhibit partial preferences. Why?

Ideal Free Distribution

Designed to predict the distribution of organisms among patchy resources or habitats, and to link behavioral and population ecology

Based on the Matching Law

Match - distribute efforts with rewards

Undermatch - under-use better sites

Overmatch - over-use better sites

Observations

Regional (seasonal migrations) → match

Landscape (plant communities) → match

Within plant communities → over-match

Patch (food selection) → under-match

The IFD typically does not correctly predict distributions of foraging animals.

The distribution of animals consistently under-matches the distribution of resources.

Assumption

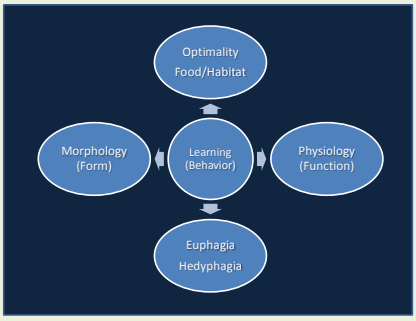
Animals have good knowledge about resource profitability.

The IFD will be less applicable when patch quality fluctuates rapidly or where it is difficult or costly to sample.

Models of Foraging

Assumption
Preferences for diets and habitats are similar for individuals within a species.

This has implications for all facets of life.



Body Size
Digestive Capacity

This model assumes that the relationship between body size and digestive capacity influences food and habitat selection.

Large herbivores have relatively low metabolic requirements, long food retention times in the gut, and large mouth size. This makes them better able to tolerate fiber and consume lower-quality forage.

Ruminants generally require food of a higher quality than non-ruminants. The rumen reduces the rate of passage of digesta through the gastro-intestinal tract, whereas the ceca do not.

Models of Foraging

Body size	Digestive system	Rumen volume (liter/kg)	Mouth size	Example
large (1)	rumen	large (.25)	large	cattle
large (2)	caeca	--	large	zebra
small (3)	rumen	large (.25)	small	sheep
small (4)	rumen	small (.10)	small	goat
large (5)	rumen	small (.11)	large	eland

(1) Cattle: time constrained due to size - tolerate coarse forages.

(2) Zebra (horse): as 1 above, but tolerate coarser forage – not limited by rumen fermentation and rate of passage.

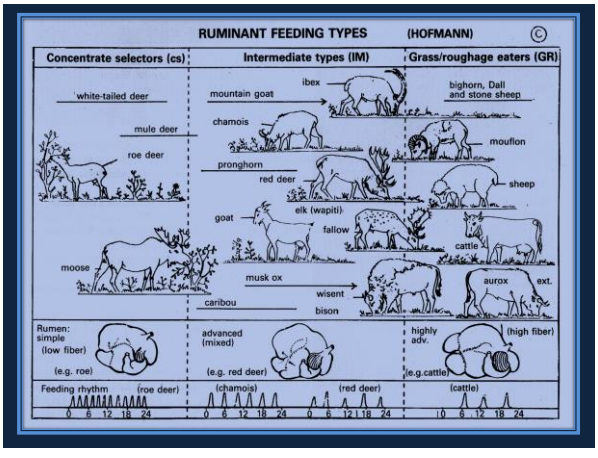
(3) Sheep: less time constrained than 1 and 2 due to small size – can ingest poor quality forage due to large rumen.

(4) Goats (deer): less time constrained than 1 and 2 due to small size – require high-quality forage.

(5) Eland: time constrained due to large size and relatively small rumen volume – requires high-quality diet.

Body Morphology & Physiology

This model classifies ruminants as concentrate selectors, intermediate selectors, and roughage eaters based on morphology and physiology.

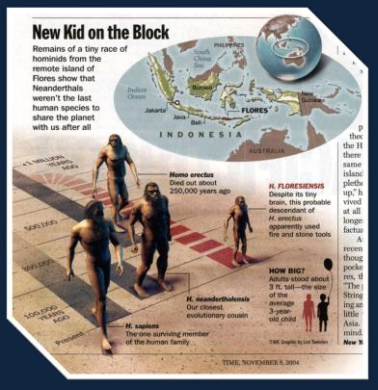


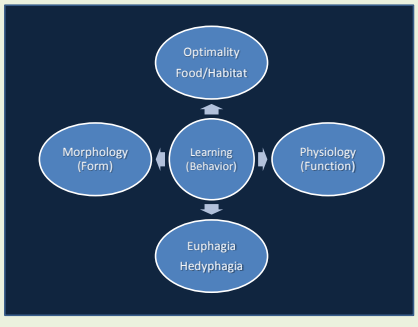
What are the implications of body size, morphology and physiology for mixed-species grazing?

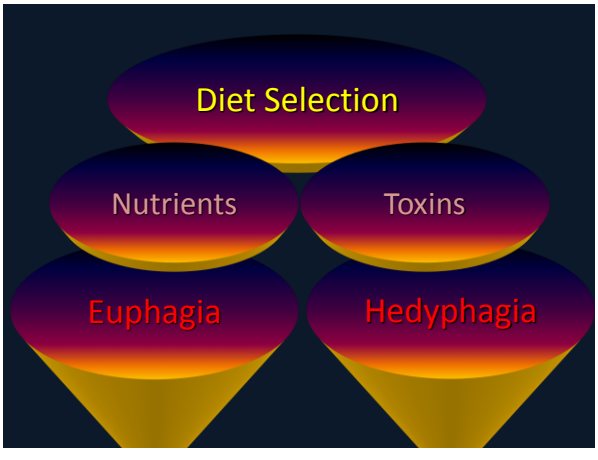
What are the implications of body size, morphology and physiology for selecting replacement animals that match the landscape?

Models of Foraging

How do bison from the tall grass prairie differ from bison in the arid southwest?

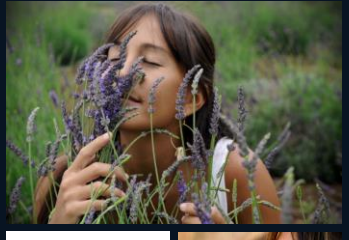


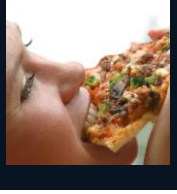




Euphagia

Animals can sense, through smell and taste, nutrients and toxins in plants. Some distinctive gastrointestinal or systemic stimulation during feeding might also be a cue that the diet contains a particular nutrient or toxin.





Hedyphagia

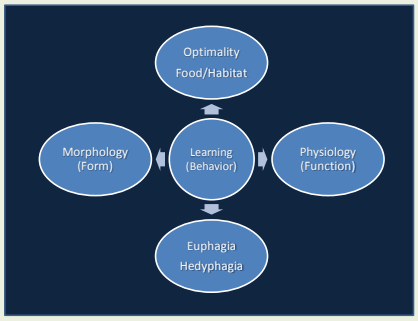
Animals obtain a nutritious diet by selecting vegetation that is immediately "pleasing" to the senses of smell, taste, and touch and avoiding that which is not.

Evolution progresses such that plant compounds that are nutritious ultimately have come to taste (sweet and salty) good and those that are toxic have come to taste bad (bitter and sour), all through natural selection.

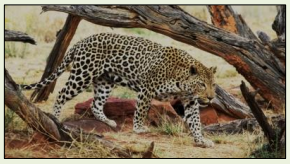
Models of Foraging

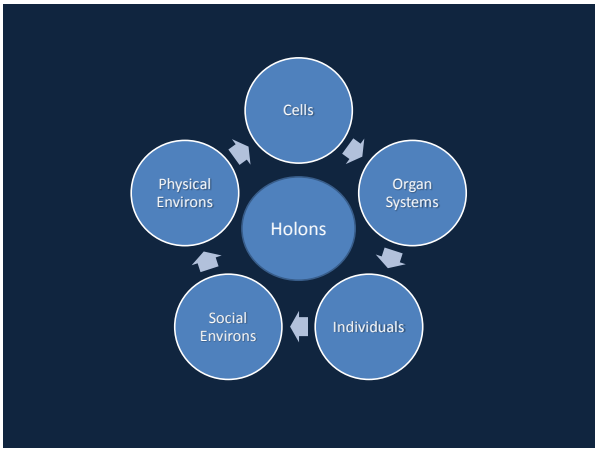
We typically discuss nutrient/toxin content of food and palatability as if they are unrelated. Are they related, and if so, how? Does a body know what it needs, and if so, how?

Do animals eat nutritious foods because they taste good?
OR
Do foods taste good because they are nutritious?



How learning about foods and habitats influences the behavior of herbivores and ecosystems.





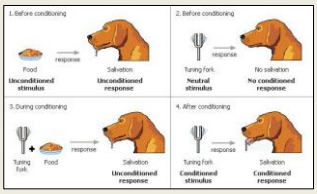
Functionally Integrating Nutrition and Behavior

Nutrition: processes by which organisms takes in and assimilate food to promote growth and replacing worn or injured tissues.

Behavior: furthers the interchange between animals and environments.

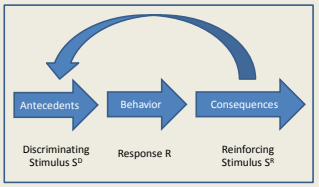
Models of Foraging

Respondent (Pavlovian) Conditioning



Responses prepared in advance by natural selection come under the control of new stimuli.

Operant Conditioning



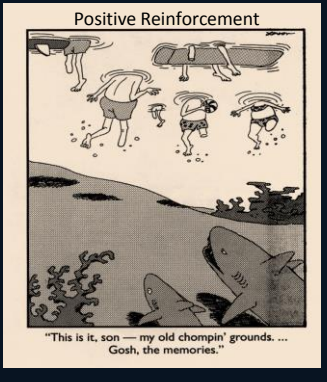
Responses are strengthened by events that follow.

Reinforcement increases rates of responding

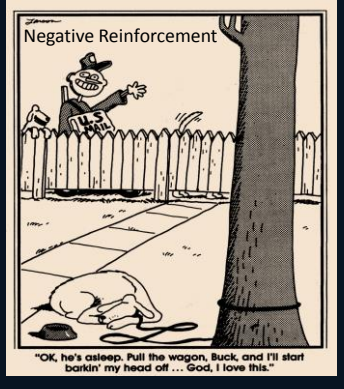
Positive – creature wants

Negative – creature wants to avoid

Positive Reinforcement



Negative Reinforcement

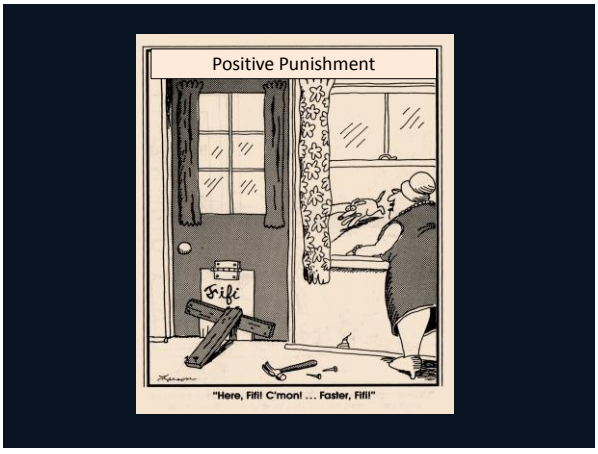


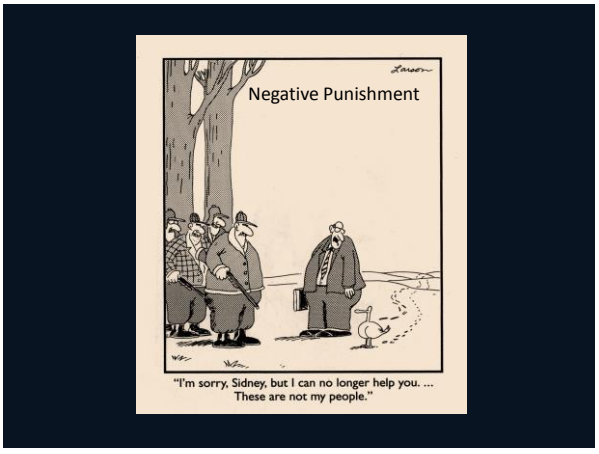
Punishment decreases rates of responding

Positive – present aversive

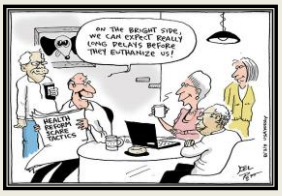
Negative – remove positive

Models of Foraging





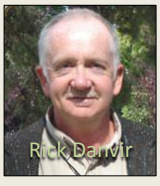
Temporal Contiguity
The more delayed in time or distant in space the consequences, the less likely the consequences will influence the behavior.



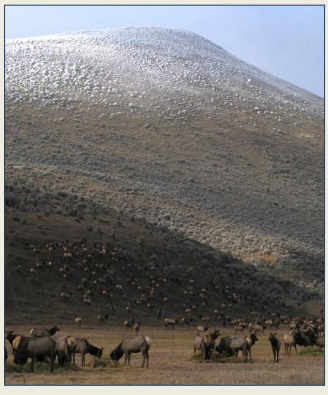
...global warming, credit card debt, eating and obesity, herbivores and poisonous plants...

Changing the Culture of Welfare Elk
Concerns:
costs of feeding 1,000 elk all winter, spread of brucellosis, chronic wasting disease, wolves

DL & L began feeding elk in 1984



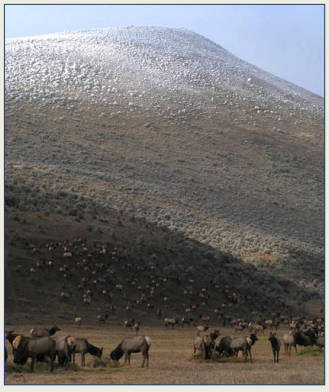
Strategic use of "carrots and sticks" (cattle grazing, supplementation, herding, hunting) changed food and habitat selection behaviors of elk



Areas grazed by cattle early in summer are attractive to elk in fall and winter due to the combination of re-growth and mature forage.

Models of Foraging

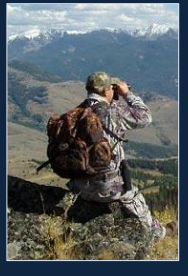
Supplemental energy and protein enable herbivores to eat more sagebrush



Stopped feeding (negative punisher) to encourage elk not to use feed grounds

Used stockmanship to move (negative reinforcement) and place (positive reinforcement) elk in desired locations

Used hunting (positive punisher) to decrease elk use of areas where they were previously fed



Since the project was initiated in 2004, elk have been fed only in 2005 and 2010

Elk were fed occasionally and only in areas they wanted elk

Schedules of Reinforcement

- Continuous (each time)
- Fixed ratio/interval (fixed number/amount of time)
- Variable ratio/interval (variable number/amount of time)

Models of Foraging