Change, the driver of feeding behaviour in (wild) animals

Introduction

The truth of the proverb "*Change is the only constant*" is best illustrated by nature. Wet season is followed by dry season and drought. Times of abundance, when pastures are densely covered by literally tens to hundreds of different plant species, are followed by times of very sparse vegetation cover. The nutritional quality, palatability as well as toxin contents of various plants vary over time, space and even within the different components of a plant (roots, leaves, stems and fruit).

At the same time the physiological status of the animals keeps changing. Young calves and lambs that initially are dependent on mother's milk, undergo changes in their digestive tract and start ingesting plant matter. Females become pregnant, give birth and start lactating while bulls mature and go into rut etc. All these different life- and (re)production stages require ever changing nutritional needs of the individual to be satisfied. Despite of all these challenges herbivores are remarkably adept at selecting plants that meet their nutritional needs while avoiding those that don't or, even worse, are toxic.

Natural disasters (floods, drought, fire) frequently alter the foraging environment rather drastically. Fences and thus artificial range management block natural migration routes, to some extent limiting the exposure of these animals to unfamiliar environments but also cutting them off from traditional migrations to move to "greener pastures" where their dietary needs are better met.

Game translocations and re-introductions often "dump" animals in a habitat with very foreign vegetation. Survival under those circumstances requires great adaptability amongst the animals. How do animals know which plants to eat to best fulfil their nutritional needs while, at the same time avoid poisoning? Knowledge about this process will help you to better understand and manage your game (and livestock).

In an attempt to shed some light on this question I will focus on those aspects that influence **feeding behaviour and food selection** amongst animals.

"INSTINCTIVE" FORAGE SELECTION

For each species there is an inherent genetic code which essentially shapes that animal species and its basic dietary requirements (e.g. Giraffe being browsers and Zebra grazers). Here we are talking of a **learned behaviour** that has evolved **over millennia** through evolution and natural selection. This must be differentiated from **experience**, which is based on what **an animal learns over its lifetime**. The latter is of immediate concern to us in this article.

MATERNAL INFLUENCE

During the first few months of life the mother does not only provide her offspring with milk, she also introduces it to a repertoire of safe and nutritious foods (plants) unique to the environment in which it was born. At weaning, the youngsters thus know a familiar set of "safe" plants which will enable them to survive and thrive without their mothers. This conditioning could obviously inhibit an animal from exploring new food and habitat possibilities (Note: This "comfort with the known" is also a driving force for animals within a herd structure "sticking together" and preferentially using specific home ranges).

Figure 1 Lambs and calves learn from their mother which plants are safe to eat, and which are not © Mariska Bijsterbosch

However, animals also "get bored" with the familiar, thus resulting in the development of an ongoing tension between curiosity of the new and the level of suspicion of it. Animals in a good nutritional state will be content and less inclined to explore new possibilities (this effect is less pronounced in young animals) while those suffering from deficiencies will be more inclined to explore new pastures.

Animals that were "raised" respectively on good or poor **quality** (not quantity) pasture will rapidly adapt and show good food intake when reintroduced to the same vegetation later in life. However, animals are reluctant to spontaneously ingest large quantities of an unknown plant. As a result, animals originating from relatively poor-quality veld are likely to have some adaptational problems (reduced food intake) when suddenly introduced to a pasture of better/more nutritious (**but different**) plant composition (and vice versa). These animals will initially spend most of their foraging time looking for and selecting familiar plants out of a potential choice of many different and possibly more nutritious/palatable species. During the first few days-weeks they are likely to only eat small samples of the new and possibly more nutritious plants.

Dr. Ulf Tubbesing
✉ P.O. Box 50533 Bachbrecht, Windhoek
☎ +264 (0) 81 128 0350 Wildlife Vets Namibia
www.wildlifevetsnamibia.com

The Pavlovian system

We are all familiar with the classic (Pavlovian) conditioning:

*'**Classical conditioning**' is a form of learning where two stimuli are repeatedly presented in close succession, until the response given to one becomes associated with the other. In the best-known example Pavlov repeatedly paired the neutral stimulus of a ringing bell with the positive unconditional stimulus of food, until the ringing bell caused the dog to salivate. In this example the ringing bell became a conditional stimulus once it took on the association with food. It was initially thought that repeated pairings are necessary for conditioning to emerge, however many conditional reflexes can be learned with a single trial as in fear conditioning and taste aversion learning (e.g. people who once had a bad experience with a specific food often refrain from eating that food again for life)*

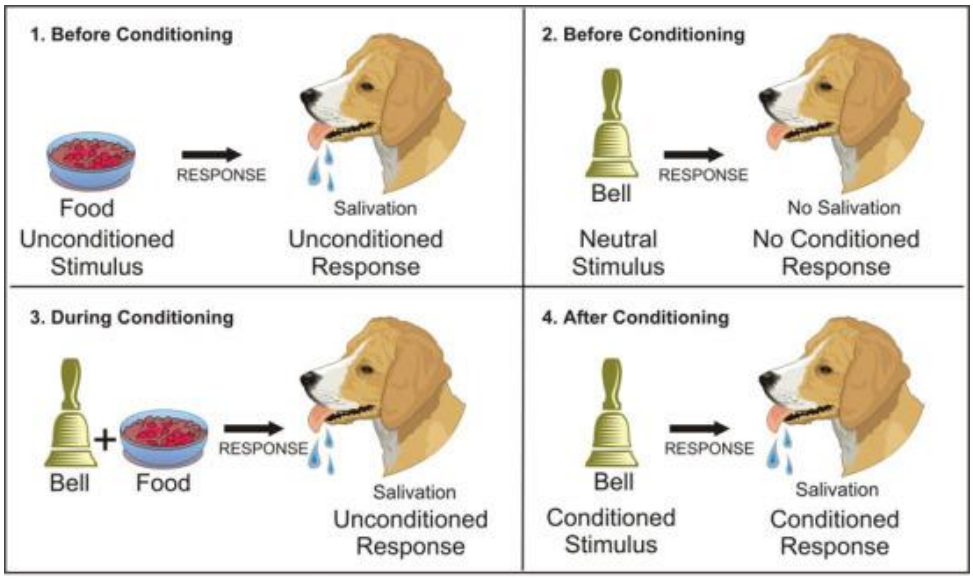

Figure 2 Classical conditioning
© Tarindhi Ratnayake

Few people are aware of the important protective function this subconscious association with good (or bad) food related experiences has for survival. Scientific studies have shown that the bulk of food ingested by herbivores at any time tends to consist of familiar and known "good" plants, while a limited number of unknown plants are sampled in small quantities during any one feeding bout, a 2-3 hour feeding cycle followed by a non-feeding cycle. Depending on the subsequent post-ingestive experience (e.g. symptoms associated with poisoning like nausea, abdominal pain etc. or those of satiety and wellbeing) the animal develops conditioned food aversions or preferences respectively. New plants ingested are "stored in memory" as bad or good fodder options and are subsequently avoided or specifically selected when feeding. Thus, animals too have a long-term memory when it comes to remembering the consequences of good or bad food. This mechanism plays an important role in minimising the risk of plant toxicities and enabling animals to constantly expand their repertoire of edible plants.

Dr. Ulf Tubbesing
✉ P.O. Box 50533 Bachbrecht, Windhoek
☎ +264 (0) 81 128 0350 Wildlife Vets Namibia
www.wildlifevetsnamibia.com

PHYSIOLOGICAL ADAPTATIONS TO FOOD

Few people are aware of the significant anatomical and functional differences that exist between the rumen of species specialised on certain foods (e.g. the Wildebeest as a grazer vs. the Kudu as a browser). These differences help species to better digest the food they normally eat and evolved through evolutionary adaptation over thousands of generations.

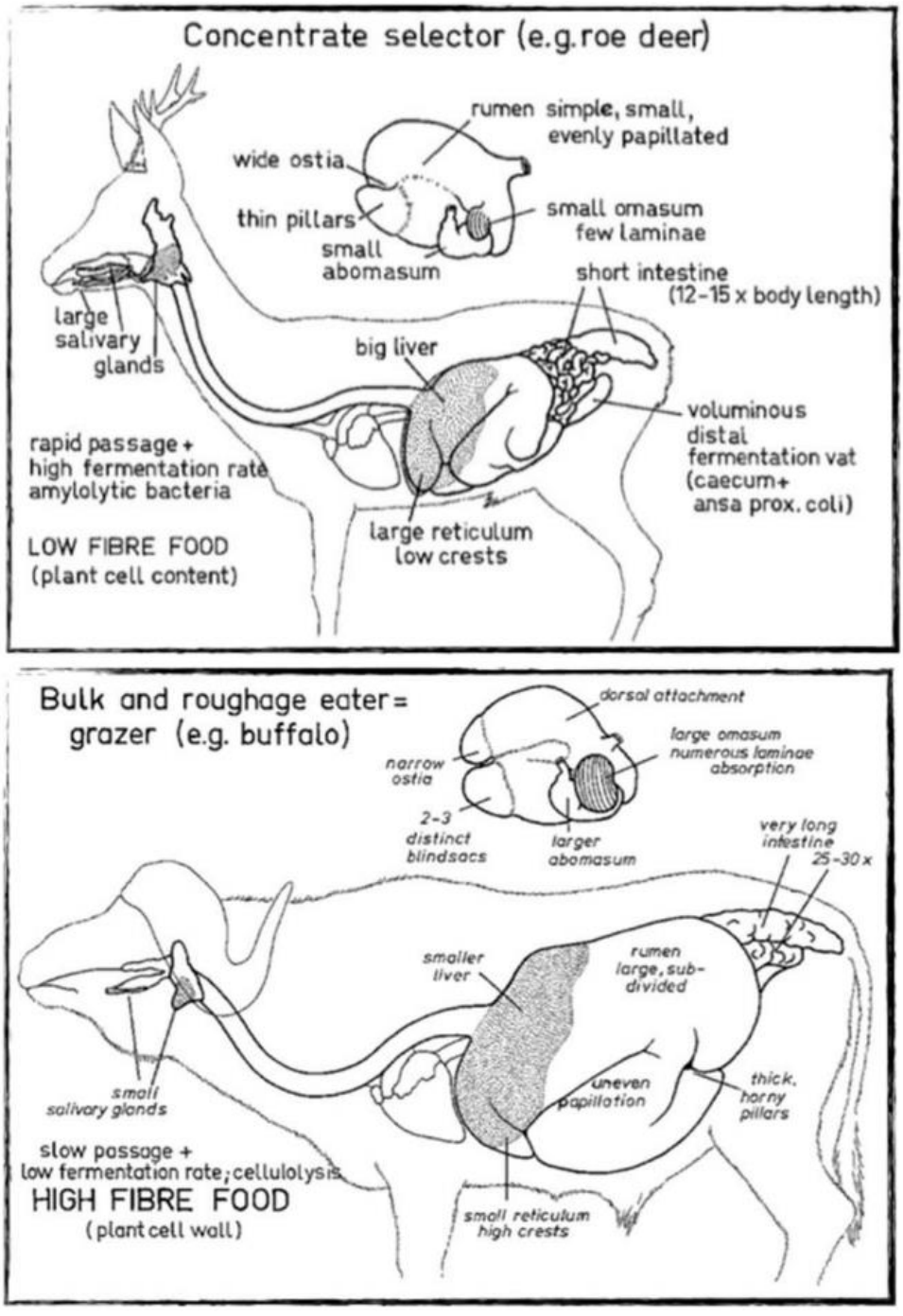

Figure 3 Comparison between a selective feeder (e.g. kudu) and a bulk grazer (e.g. buffalo) © University of Idaho

Dr. Ulf Tubbesing
✉ P.O. Box 50533 Bachbrecht, Windhoek
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www.wildlifevetsnamibia.com

An even less known phenomenon is the fact that, if needed, the digestive tract of an animal can and will undergo anatomical and functional changes to better adapt that animal to a specific food it is routinely exposed to. These changes can range from an increased rumen capacity to accommodate a greater bulk of a poorly digestible plants, to adaptive changes that allow an animal to better digest and tolerate high energy/carbohydrate diets without developing a rumen acidosis (an potentially fatal complication associated with animals, esp. those unaccustomed to high energy, say maize containing diets, over engorging on such a diet) and/or specific adaptations in liver function which enable animals to better detoxify ingested poisonous matter. Needless to say, these adaptations take time to develop and need a constant exposure to the nutritional challenge to take place.

The benefit of such adaptations should be clear. This enables certain animals e.g. the Kudu and black rhino to freely eat from the highly toxic *Euphorbia spp*. found in the arid NW regions of Namibia, without experiencing any ill effects. Likewise, it allows livestock kept under intensive management (dairy, feedlot) to be fed a high energy diet to improve production.

SUPPLEMENTING FOR SPECIFIC NEEDS

When survival depends on change, animals will explore new options and will develop aversions to nutrient-deficient diets. As a result, we occasionally observe animals showing "abnormal" feeding behaviour (e.g. a Giraffe chewing on a bone, a Duiker chasing, killing and eating Guinea fowl chicks etc.). If we had a better insight into the animal's current nutritional status, physiological needs (e.g. pregnancy/ lactation with increased demand for calcium and phosphate), parasite burden (iron and protein deficiency) and its past experience with different foods, this behaviour may seem perfectly rational.

Figure 4 Giraffe chewing on a bone. This behaviour is known as Osteophagia, meaning 'feeding on bone'. This provides animals with the necessary calcium and phosphorous © Richard Du Toit/Minden Pictures

Animals with nutritional deficiencies will seek out new "foods" (plants, bones, soil, faces, wood, stones ...) and, if possible, extend their home range (typically seen in the dry season). Should these adaptations correct their deficiencies (calcium, phosphate, magnesium, iron, sodium), they will form new food preferences, irrespective how odd it appears to us.

Dr. Ulf Tubbesing
P.O. Box 50533 Bachbrecht, Windhoek
+264 (0) 81 128 0350 Wildlife Vets Namibia
www.wildlifevetsnamibia.com

LEARNING HOW TO EAT

Good food intake leads to good productivity (weight gain, high percentage pregnancy and calving rates, good quality trophy). **Food intake as such is a function of bite size and rate combined with time spent grazing or browsing**. Animals that learn to increase their efficiency with bite rate and size will thus have an increased food intake and reach saturation earlier. These animals will spend less time foraging (which is an energy consuming activity) and more resting, thus allowing the additional food eaten to be converted into "meat, calf and trophy".

Figure 5 Young kudu bull browsing © Villiers Steyn

What is the significance of this? Firstly, with an abundance of suitable food around, animals will spend less time looking for food and have a more efficient food intake thus leading to improved production. As food availability dwindles, animals spend more time and roam bigger areas looking for suitable food (e.g. finer grasses for Wildebeest species) thus burning energy that could be used for production.

It has been proven that animals having grown up in a more "hostile" environment have an increased food intake and thus adapt quicker to deteriorating veld conditions than those animals originating from more favourable habitats. Further, young animals are more adept at selecting nutritious portions of plants (e.g. picking leaves out between thorns and in preference to twigs) and have a proportionally increased bite rate when compared to the adults in the same group.

IN CONCLUSION: MANAGEMENT IMPLICATIONS

Free ranging herbivores do not need to maximize consumption of any particular nutrient on a daily basis. They often cope with wide departures from the minimum daily nutritional requirements as suggested by various nutritional experts. Animals respond to excesses, deficits, and imbalances in their diets by cautiously sampling new foods and by making careful adjustments in their food intake in accord with flavour-feedback associations from the gut to the brain. Past dietary exposures cause physiological, morphological, and neurological changes inside the animal, which, in turn, strongly influence future dietary choices. Individual animals thus vary in their acceptance or rejection of certain foods.

This knowledge opens the possibility for managers to become more involved in the process of understanding and shaping animal behaviour over an animal's lifetime to improve management, production and/or the foraging environments.

Dr. Ulf Tubbesing
✉ P.O. Box 50533 Bachbrecht, Windhoek
☎ +264 (0) 81 128 0350 Wildlife Vets Namibia
www.wildlifevetsnamibia.com

Here are a few things that we should consider when faced with introducing game onto a farm, during day to day game management or when animals seemingly show abnormal foraging patterns:

- Where do the animals originate from and what type of vegetation are they used to? How big an adaptation challenge will they be exposed to post release? Ideally you should source animals from areas with a vegetation structure similar to that of the designated release site. Where this is not possible, consider game introductions early in the capture season, while there is still a greater variety of (green) vegetation available for the animals to feed from. This is of particular importance with animals like Impala, Nyala (making use of a significant percentage of browse in their diet!) etc. imported from totally foreign territory (e.g. SA!).
- How might past experiences with a variety of environmental conditions (e.g., drought vs. wet conditions, poisonous plants, pasture diversity, food supplementation) influence current dietary choices? As a general rule, newly translocated animals preferentially select known plants and will avoid unknown foods. It is thus a pretty futile effort to expose freshly released animals or those living under severe drought stress to supplemental feeding unless they have been pre-conditioned to this by early exposure (on the farm of origin, in holding bomas or, in the case of resident game by long term prior feeding).
- What is the current physiological condition of the animal (pregnant, lactating, parasite load)? How might these issues influence current dietary choices? Loss of condition is an obvious symptom of an energy- and protein deficient diet. However, symptoms of diets deficient in minerals and trace elements are frequently far less obvious (e.g. reduced conception/pregnancy carried to full term, poor trophy quality, increased tendency to sustain fractures, dull hair coat and/or change in colour). Once these symptoms become obvious, the damage done is severe and usually of long duration. Typical early warning signs an alert farmer might see are animals spending an abnormal amount of time feeding, moving out of their traditional home range and ingesting "strange foods" like this Kudu ingesting soil from a "natural salt/mineral lick" and the associated abnormally pale faeces pellets from a Kudu that ingested a lot of soil.

Figure 6 When herbivores ingest a lot of soil, the dung changes colour

Dr. Ulf Tubbesing
P.O. Box 50533 Bachbrecht, Windhoek
+264 (0) 81 128 0350 Wildlife Vets Namibia
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If this is observed, investigate the mineral composition of the natural "licks" used by these animals and consider giving salt/mineral supplements. If you farm in known phosphate deficient area, you should consider long-term supplementation. Compared to livestock, game is less conditioned to, and thus also less likely to "instantly" accept supplemental licks – a long term supplementation strategy should thus be implemented. Remember, both low as well as excessive levels of minerals reduce intake while optimal levels increase intake. There is no use in over-supplementing!!

- The same principle applies when you want to administer medications mixed into food (e.g. deworming agents mixed into pellets). If the target species are not conditioned to eating the specific pellets, the medicine intake is going to be negligible and the planned treatment inefficient and the food/medication mix wasted. Before introducing the expensive medicated food, you should expose the target animals to the same pellet brand (without the medication mixed in) for however long it takes for them to readily take in the food.
- Because young animals introduced to a new environment are less averse to trying new foods and tend to learn foraging skills more efficiently than older ones, it may be a good idea to preferentially introduce younger animals into a new and potentially marginal habitat.
- The classic conditioning of livestock to accept supplemental feeding is likely to somewhat reduce their guard towards the ingestion of foreign plants and material. This may well be the reason why free roaming game appears to be less likely to eat and succumb to toxic plants, plastic bags etc. Another reason (at least in some circumstances e.g. Kudu eating *Euphorbia spp*.) is that some game species, due to adaptation over generations, build up a higher tolerance to certain toxins thus allowing them to survive in hostile habitats.
- Game raised under intensive game farming conditions (usually expensive game like Sable and Roan but occasionally also smaller game like Blesbuck, Springbuck and Ostrich originating from smallholdings to be transferred to farms) often are as conditioned to supplemental feeding as livestock in an intensive production system. These animals should undergo a "soft release", where they are initially released into smaller camps. Here they receive the same or very similar supplemental nutrition as they were used to. Once they have settled in, they should be gradually introduced to the vegetation they will ultimately have to cope with. Only once you are sure that the animals are fully adapted should they be released into extensive units where they have to fend for themselves.
- When introducing new game, farmers are faced with the choice of the so called "soft vs. hard release". In the latter case the animals are directly released from the truck into the veld. If the veld conditions are good and with the exception of game originating from "intensive production systems" as discussed above, I personally prefer the hard release method. Here the game is not exposed to the additional stress of a temporary release camp situation (small camp often with poor pasture and animals from different family units forced into close proximity).

Dr. Ulf Tubbesing
P.O. Box 50533 Bachbrecht, Windhoek
+264 (0) 81 128 0350 Wildlife Vets Namibia
www.wildlifevetsnamibia.com

- The smaller your management unit(s), e.g. 200 ha camps for Sable, the less likely it is that the animals in these camps will have a sufficient plant and soil variety available to them to provide in all their dietary needs throughout the different production phases. For optimal production supplemental licks and feeding becomes important.

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