

THE RELATIONSHIP BETWEEN WILD PLANTS AND GRAZING LIVESTOCK BEHAVIOR - REVIEW

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Abstract. The region of the Arab peninsula has a diversity of plants and animals. Grazing on natural rangeland plants may have a neutral, positive, or negative impact on both animals and plants as well depending on several factors. Grazing environmental forces includes herbivory, physical impact, and deposition. When animals graze on plants, they show a hierarchy that leads to understanding instinctive responses and behavioral activities. Mouth anatomy of goats gives them the merit of capability of selecting plants in the range, while that of sheep enables them to graze quite near the ground. Preference is a behavioral trait that includes the proportional selection of plant species from a group of two or more. Animal behavioral preference is governed by abundance of a plant species, its morphological features, the animal species in question and the variety of species available. Animals have two distinct acquired behaviors (i.e. evolutionary and field acquired). Forage quality and quantity were inversely proportional to the ratio of spent time to graze in group to the region taken in the landscape, to be concluded that wild plants affect grazing animals by modifying their behaviors to adapt the current situation in the range.

Keywords: *overgrazing, herbivory force, physical impact, deposition*

Introduction

Grazing perturbation trample plants, divides soil surfaces, mixes the seed into the soil and compacts soil via hoof activity, pawing and wallowing. The deposition of urines or dung high in nitrogen can make contribute to the food web by helping grazing animals promoting nutrient cycling.

The ecological dynamics of ungulate pasture - herbivory, physical impacts and deposition - have formed natural habitats throughout the planet. Grassing habitats have developed depending on herbivores, strong hooves, nitrogen deposits and massive migrating ungulates' carcasses. These pressures could change the biological communities and the function of ecosystems if they were introduced to ecosystems which did not evolve with regular pasture and this affects on livestock behavior.

Accordingly, this article reviews the relationship between wild plants and grazing livestock behavior.

Literature review

The term “wild plants” refers to plant species that grow spontaneously without human interference (Chatterji and Fauquet, 2000) in self-maintained natural or semi-natural ecosystems. They are in opposite to plant species “cultivate” or “domesticated” that have arisen because of human activity such as selection or breeding and those depend on their continued existence (FAO, 1999).

There are several geographic regions within the Arab peninsula each with a diversity of plants and animals adapted to their specific habitats (Al-Sodany et al., 2011). These habitats include the country vast mountains, deserts, highlands, steppes, hills and valleys. There are nearly 3,500 plant species in the country, with nearly 1,000 known

plant species from southwest Asir which is an area with higher rainfall (Anthony et al., 2004).

If these plants are suitable for grazing animals, they are called range plants or wild grazing plants (Shaheen et al., 2019). However, the majority of plants in wild life are perennials, grazing on natural rangeland plants may have a neutral, positive, or negative impact on both animals and plants depending on several factors, grazing and browsing livestock and wildlife get their nutrients from rangeland plants, which include proteins, carbohydrates, and sugars made by plant photosynthesis (Lyons and Hanselka, 2001). Since photosynthesis occurs only in green plant tissue, primarily the leaves, animals destroy the leaves (defoliation) during grazing and browsing leading to a reduction plant ability to produce food, at least temporarily (Soder et al., 2007).

Both individual plants and plant populations are affected by grazing and browsing, indicators show which plants are at risk of excessive animal herbivory (Diogo et al., 2016). Drought, flood, burning, and grazing have all harmed rangeland habitats. To a certain degree, depending on time, intensity and disturbance frequency, all disturbances affect the plants directly or indirectly, generally, the more diverse the vegetation, the more disturbed the rangeland (Moller et al., 2020). However, knowing the factors that affect these plants and the available management options allow a better decision on the best actions for a specific site as well as appropriate time to take action (Schueller et al., 2020).

Grazing environmental forces

Such forces include:

Herbivory force: The plant leaves, stalks, flowers, seeds and sometimes roots eaten by herbivores. Herbivorous patterns greatly influence the composition, structure and productivity of the plant community.

Physical impact: Pasture animals crush plants, break up the surfaces of the soil and mix the seed into the earth and tiny soils via hooves, paving and wallowing.

Deposition: The deposition of nitrogen-rich urine and dung by grazing animals contributes to nutrient cycling, and their carcasses can play a significant part in food web.

Animal behavior

When animals graze on plants, they show a hierarchy that leads to understand instinctive responses and behavioral activities (Kuhlmann and Ribeiro, 2016). Animals keep fit through feeding to consume energy and/or other nutrients in the highest possible amount. However, these mechanisms can be traced back to the evolution of species (Callaway et al., 2005).

When animals are born, they possess inherited distinct physiological requirements and legacy capabilities. Such requirements and capacity differ greatly depending on age, species, race, sex, physiological condition, and experience and knowing how such features affect dietary selection, can greatly help to elucidate animal behavior in ranges, animal behaviors can be formed through dietary selection experiences (Burritt and Frost, 2006).

Grazers, such as cattle and horses, feed mostly on grass. Cattle are better suited to grazing than browsing due to their overall size and mouth design (Huang et al., 2016).

Bovines mainly feed on grass as they have a relatively low digestive ability to process significant amounts of feedstuff (Burritt and Frost, 2006). Due to their big lips, muzzle, and tongue, which they use as a prehensile foraging weapon, cattle consume large amounts of forages (Palmer et al., 2003). These big muzzles, however, restrict their forage selection ability (both for the 9 plant as well as plant different parts).

On the other hand, sheep, considered as intermediate grazers since they have relatively big rumen compared to body mass which gives them the merit of having the ability to select plants in the range (Bergman et al., 2001). Sheep also have a small mouth, so they can graze near the ground. They make little bites, for example, to choose certain portions of a plant (i.e. as small leaves or buds) (Dias-Silva and Filho, 2021). Sheep are used to control several weedy forbs. They were successfully used for controlling weeds (Tu et al., 2001). If grasses are abundant or other forage sources are limited, sheep can readily eat grass-dominated diets. As forbs supply increases, sheep prefer to eat more forbs. They find tall dense stands of forage hard to graze than small thick groves, compared to cattle. In addition, sheep are tiny, agile, and well-suited to traversing difficult terrain (Glienke et al., 2016). It is steeper than most livestock that sheep graze and tends to avoid marshy wetlands.

Goats are browsers by nature. They are ideally suited to chew branches and extracting individual leaves from woody stems due to their tiny, muscular mouth and dexterous tongue (Burritt and Frost, 2006). Because of their tiny jaws, goats can eat only the best leaves and stems, resulting in higher-quality meals (Pauler et al., 2020). Goats have larger livers than cattle or sheep in terms of body weight, allowing them to deal with plants that produce secondary compounds such as terpenes or tannins more efficiently. That could give a reason for why goats eat more leafy-spurge than cattle or sheep, which includes a variety of plant-defense compounds (Nielsen et al., 2015). Therefore, preference is a behavioral trait that includes the proportional selection of one plant species from a group of two or more. Indeed, the abundance of a plant species, its morpho/phenological features, the animal species in question and the variety of species available all play a role in its preference status (Amdam and Hovland, 2011). As abiotic influences (such as season and weather conditions) change the essence of the plant population, preferences shift. Some organisms are only chosen under specific circumstances (Dominguez, 2002; Wong and Candolin, 2015). Animal selectivity is a complex, situation-specific operation, so broad generalizations about species selection and preference should be tempered. Recent research, (Akre et al., 2009; Beyer et al., 2010; Amdam and Hovland, 2011) has shown that preference can be quantified for an animal species as well as selection order can be predicted using the relative rank order of absolute preference values. The idea that specialized or concentrated grazing on some plant species may be related to its relative preference rating at the time of active growth is implicit in these findings.

Foraging behaviors of animals

Each animal has a different way of finding food, whether by smelling, seeing, or detecting it chemically (Danchin, et al., 2008), individually and in groups, animals seek food. The available plant species, their spatial arrangement, and structural configuration, (for example, a grassland community with scattered trees less than 1 m in height versus a shrub land with dense shrubs over 3 m high with some grassland filling

the interspaces), are all examples of habitats. Habitats may be divided into patches, containing a more homogeneous community of organisms (Spiesman et al., 2018).

Animals learn how to forage. Learning is a behavioral change based on previous experiences, or a behavioral modification (Raine and Chittka, 2008). One way to learn is to ‘forge innovation’ - an animal that consumes new food or uses a new foraging technology in response to its dynamic living environment (Dugatkin, 2004). Foraging is divided into two main types. The first is solo foraging when animals drink by themselves. The other is group foraging (Pyke, 2019). Group food consumption includes two cases: when this activity is beneficial for the animals (aggregation economy), and when it has adverse effects on them (dispersion economy). After orienting itself in a habitat, the animal must determine when to lower its head and set up a feeding station along its grazing path. The animal must choose which plant species and parts to consume inside the feeding station (Searle and Shipley, 2008). As a result, there are two main levels to the diet selection process that must be distinguished: spatial choice and species choice. They look for the most energy efficient forage sources based on established water sources (Luca et al., 2010). The optimal grazing area is roughly defined as a circle with a radius of less than 0.8 kilometers from the water source. The overall external boundary for a flock of cattle or flock of sheep to balance their needs of water and forage is around 1.6 kilometers (Stephenson, 2010). However, as the forage supply decreases during a drought, the successful grazing area is increased. The amount of time spent grazing per day is determined by the quality of the forage, the thermal balance, and the short-term reliability of the forage supply. As the digestibility of accessible forage decreases as well as the retention time of ingesta rises, animals reduce their daily grazing time (Hummel, et al., 2006). Forage quality and quantity were inversely proportional to the time spent grazing in the group to the region taken in the landscape (Menajovsky et al., 2018). Compared to other communities available to the animal, the higher the density of high-quality food organisms, the slower the grazing velocity and thus the greater residence time and the intake level is attained (Menajovsky et al., 2018). Site choice is amplified when these populations are located near critical water and thermal foci.

Following the establishment of a grazing area, an animal’s familiarity with the accessible forage is used in a species-to-species plant assessment and selection method. This is a mechanism that is unique to each animal species. Herbivores have evolved a preference for plant species (Kempel et al., 2015) from one or more of their primary food classes, grasses, forbs, and browse. As a result, a plant’s grazing value is determined by the animal species in question. It is critical to distinguish between the palatability of a plant and the preference for that plant at this stage (Khan and Hussain, 2012).

Based on the abundance of highly profitable species, one might hypothesize that animals would be drawn to plant communities during rapid growth cycles while studying grazing strategies over time. Animals can minimize species selectivity as phenologies of plant populations become more mixed, focusing their attention on communities that provide the highest harvest rates of green foliage, regardless of species. Once the herbage has gone dormant, the animal’s only choice is to graze on more plentiful plant material, regardless of its greenness.

Impact of plants

Plants are divided into five groups based on their selectivity (preferred, proportional, forced, detrimental, and non-consumable) (Panter et al., 2011). Preferred or favored organisms are those selected in more significant amounts, as a percentage of the diet, than those present in the landscape (as a percentage of composition). Unless they dominate the population, in most cases, particular plant species are not dominant in the diet. Preferable animals, on the other hand, improve the nutritional value of the diet, resulting in better animal output rather than normal. Such species are highly handled by animals and/or have low floristic composition but high nutrient concentrations. The more plentiful species are commonly eaten in proportion to their available abundance and are known as proportional or desired species. Generally, the percentage of species not readily consumed by animals is less than that of the vegetation. This is known as by-consumption and as conditions change, it is believed to react to animal sampling from the environment. No matter the abundance or presence of the associated species, specific plant species are preferred; the preferred species are generally higher in succession.

Some species are consumed in a manner that is highly commensurate with availability and consumption. Another group is the third across all selection divisions, the utilization of which adjusts as weed mass declines from avoidance to preference. These plant species are known as species of variable or secondary preference and generally have morphologic constraints on animal consumption. Lastly, the final group of averted species are selected under their accessibility. Avoided species' selection rates are poorly linked to their inherent abundance. These species generally have unwanted nutritional characteristics.

Generally, there is no consumption other than specific adverse conditions (Attia-Ismail, 2015, 2016). Pods or fruiting bodies may be exempt. These species typically only have an indirect effect on the animal by decreasing the total pasture amplitude but may have a beneficial impact on food (Benvenuti et al., 2009). Shrubs have a primary herbicide-like impact when they produce microclimates for some species which maintain the verdant ingredients or are nutritionally richer state for a cold or dry period of the year, which is particularly the case with shrubbing. Finally, harmful or toxic species are present. When most favorites in the landscape are reduced, the diet is devastated by toxic species. An example of this problem is cyclical toxic plant problems in arid regions (Laca, 2009). Plant species with the highest volume of green leaf density at the highest concentration of nutrients and the lowest secondary content are most likely to be grazed. In general, the drilling quality of the landscape appears to be high with the consequences of increasing time in search, decreasing bite rates and increasing bite size, which can be highly profitable by non-ungulates (Pontes-Prates et al., 2020).

The morphology of plants also influences the likelihood of weeding. When grasses produce an early selective response, selective pressure increases with relative abundance change or phenologies (Carvalho and Stobbs, 2013). Therefore, in the early growing season, municipalities with a high proportion of the forage are more likely to be grazed if environmental conditions favor plant growth.

In grasses, the physical presence of the green blade in relation to the pattern of senescence and culms development appears as morphological features (Larson-Praplan et al., 2015). Grasses with a speed of climax growth and strong, midrib leaf structures are less frequently chosen if long-term, shrunk leaf material is allowed to develop. Sheath development and growth angle by tillers affect the height and position of the

blade material in relation to the soil surface so that the selection by cattle of short or declining species is a much harder one than the selection by sheep (Nunes et al., 2019).

Forbs are distinguished by two temporal presentations: ephemeral and perennial. Ephemeral annual forbs are fast growing and their life cycle is rapidly ending. Therefore, ungulates have a unique problem with them: in the annual production cycle of the animal, forbs have a high value for short periods. Most forbs have nutrient concentrations exceeds ungulates' nutritional requirements. Thus, their distribution in the landscape and standing crops in various communities, together with the bite size, affect animal food tactics from one country to another, while they are a favorite group (Semmartin and Oesterheld, 2001).

Perennial forbs are more resource-based than annual forbs and therefore create greater quality difference between plant parts. Moreover, as shrubby strolls, they generally do not accumulate growth in previous years. As they are present throughout the pasture season, by forbidding non-ungulates, they are especially vulnerable to overuse. This overuse decreases the relative acceptability of plant parts, which makes the plant more attractive to the animal. This eventually, reduces the processing time and increases bite size/quality (Ungar, 2019).

Browse takes many forms: deciduous or always green, spineless, single leaves or compound leaves, short or large, single or multi-stemmed, etc. Selective pressure on this food group again relies on the animal species community associated with it (Aruwayo and Adeleke, 2019). Prehensile and digestive organs were adapted to suit levels where height, spininess and secondary compounds were the principal plant characteristics, which affected the selective pressure in the navy species (concentrates and intermediate feeders; Clauss and Hummel, 2017). In general, selective pressure on evergreen species by using secondary compounds plays a major role. Spininess, leaf size, and secondary compounds, to a lesser extent, are the significant morphological and physiological attributes of feedback species that affect the selection response. The relative significance also depends on the attributes of each animal species.

Conclusion

The review is concluded that wild plants affect grazing animals by making them modify their behaviors to adapt to the current situation in their range. However, to understand solo or group foraging behavior requires a game theory approach. Animals have to find and use resources to succeed and do extraordinary work to achieve this (modifying their behavior, for instance to adapt to the present forages). Animals have two distinct acquired behaviors (i.e. evolutionary and field acquired).

This review recommends, future research in this area should therefore maintain the theoretic approach but recognize the distinction between evolutionarily and behaviorally stable strategies, and focus on the behavioral and cognitive mechanisms involved. In this way, we should understand what group foraging animals do, how they do it and why they behave in this way.

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