CHAPTER 4B

COMMENTS ON "RESOURCE DISTRIBUTION AND DYNAMICS: MAPPING HERBIVORE RESOURCES"

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What is a resource, how are resources distributed, and how do they change over time, together with the possibilities of mapping these resources through remote sensing, are the subjects of this chapter. Skidmore and Ferwerda (Chapter 4) follow Morrison and Hall (2002) in their definition of what a resource is, namely "*a resource is any biotic or abiotic factor directly used by an organism, and includes food, nutrients, water, atmospheric gas concentrations, light, soil, weather (i.e., precipitation, temperature, evapotranspiration, etc.), terrain, and so on*". The central notion of a resource is that it is used. However, Morrison and Hall and also Skidmore and Ferwerda confuse 'use' in the sense of 'exploit' or 'consume as material' with 'use' in the sense of 'benefit from'. As a matter of fact, the Oxford English Dictionary (OED) defines 'resource' as "stock that can be drawn on, available assets, or means of supplying what is needed". Assets and stock can dwindle if they are used faster than their replenishment rate, and if that happens they are used up. We think that the term 'resource' should be limited to this meaning, and thus disagree with Skidmore and Ferwerda the way they apply this key term: 'weather' cannot be used, 'temperature' is a state variable, and 'terrain' cannot increase or decrease. Where light is a non-depletable resource, weather and temperature are environmental conditions. These are variables that describe an organism's habitat, and are therefore sometimes classified as one of the species' niche dimensions, but not its resource. The second problem with the definition of Skidmore and Ferwerda lies in the word 'factor'; according the OED this word has the meaning of "circumstance, fact, or influence; contributing to a result". A consumer cannot use a 'factor'; instead of 'factor', the concept of 'resource' should include on the one hand physical consumable entities, chemical compounds and

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elements, for which we use the term ‘substance’, and on the other hand usable energy. In other words, we propose to modify their definition to “*a resource is usable energy or any biotic or abiotic substance directly exploited by an organism, which includes food, nutrients, water, atmospheric gas compounds, as well as light, and the use of which can lead to the (temporary) exhaustion of that resource (i.e., depletable and non-depletable resources)*”. The essence of the concept of ‘resource’ is that organisms can compete for a resource (such as competing for light, space, nutrients, water, etc.) and that it can be limiting the growth of individual organisms or of populations.

This aside, their chapter provides startling insight into the new techniques that recently have been developed to measure the distribution of the abundance and quality of vegetation. The combination of remote sensing, field sampling and greenhouse experiments in which foliar quality was manipulated has led to the possibility of constructing maps in which an unheard level of detail can be shown regarding the distribution of potential food of herbivores. This will open further avenues of research into testing theories of foraging. Indeed, optimal foraging theory presupposes an omniscient herbivore that has a complete knowledge of all food items, their quality and their distribution. This extent of knowledge can now be tested because the scientist, observing the behaviour and choices of the herbivore, appears to be approaching this omniscience while measuring resources hyperspectrally and using algorithms to transpose this information into maps of individual plant species, individual shrubs or patches of grass, and the concentration of essential elements or nasty deterrents.

This is an important breakthrough, because scientists could test optimal foraging theory relatively easily on consumers. Most predators feed on discrete prey items, and by counting and putting the information in a spatial context, scientists could get quite a good idea about the distribution of the food on offer. From a predator’s point of view, different individuals of a similar prey species most of the time offer the same quality. The most important discriminative factor characterising different preys is their individual body mass. Animal ecologists could thus quite easily test predictions from foraging theories by focussing on predators and their prey. The new insights presented here, now offer the potential to further foraging theory considerably because, for the first time, the spatial pattern of food quantity and food quality on a large scale is known.

But … omniscient? The chapter of Skidmore and Ferwerda shows how quickly too much information might be garnered from hyperspectral technology or other types of know-how. The technology offers the possibility of mapping each and every individual shrub in a near-infinite area, and to give each and every individual shrub (or leaf) a description of how much nitrogen, phosphorus, potassium or whatever element it contains and how much tannins, lignin or polyphenols it has. However, the total number of chemical compounds to which a herbivore may react, which it needs or which it finds repulsive may be reckoned in the thousands or even tens of thousands. Too many data do not yield better understanding, and the application of know-how without a clear hypothesis to be tested, may easily devalue into a gimmick. Our task is thus to harness this new way of looking at resources, and to use it for testing ecological theories.