Journal of Arid Environments 110 (2014) 60–68

Contents lists available at ScienceDirect

Journal of Arid Environments

journal homepage: www.elsevier.com/locate/jaridenv

Utility of a forage-productivity model for predicting herbivore abundance in the eastern Karoo, South Africa, varies among habitats

A. De Fortier [a, b, *], M. Landman [a], G.I.H. Kerley [a]

[a] Centre for African Conservation Ecology, Department of Zoology, Nelson Mandela Metropolitan University, PO Box 77000, Port Elizabeth, 6031, South Africa

[b] Department of Zoology, University of Zululand, Private Bag x1001, Kwadlangezwa, 3886, South Africa

ARTICLE INFO

Article history:
Received 31 October 2013
Received in revised form
26 March 2014
Accepted 23 June 2014
Available online 12 July 2014

Keywords:
Carrying capacity
Large stock unit (LSU)
Model testing
South Africa
Stocking density
Wildlife management

ABSTRACT

The question of how many herbivores an area can support for long-term persistence is fundamental to managing wildlife in increasingly fragmented landscapes. Species-specific spatial requirement information is scarce, so many studies have used models to predict carrying capacities for indigenous herbivores based on forage productivity estimates and metabolic requirements of the herbivores. Testing such models against empirically derived observations is, however, rare in the peer-reviewed literature. We modeled predicted relative abundances of the medium- to large-sized herbivore community of a reserve in the semi-arid eastern Karoo, South Africa, following Boshoff et al. (2001, 2002a). We also addressed the overestimation abundance of small species by incorporating an adjustment factor based on the relationship between body size and population metabolic rate. We tested both model's outputs against empirically derived game count data for the same herbivore community which revealed significant differences in species relative abundances predicted by the two models. Habitat-specific regression analyses revealed that incorporating a population metabolism adjustment factor into the model resulted in a generally better fit than the original model. Furthermore, the model performed best for apparently structurally simple habitats. These results support the use of forage-based productivity models to estimate potential abundances of indigenous herbivores.

1. Introduction

How many animals can an ecosystem support? This fundamental question troubles many a wildlife manager and ecologist alike (McLeod, 1997). In particular, wildlife management initiatives require information on habitat-specific species' space requirements to manage for the long-term persistence of populations and/or the sustainable use of biodiversity (Boshoff et al., 2001, 2002a; McNeely et al., 1990). Moreover, with escalating fragmentation and isolation of wildlife areas (through fencing or by creating other barriers to dispersal; Hayward et al., 2009) and the consequent need for information on how to manage such systems, this question is becoming increasingly significant (Fynn and Bonyongo, 2011; Ortega-Huerta and Peterson, 2004).

Because ground–surveys are both expensive and time consuming, comprehensive, empirically derived abundance information is not available for many species or areas (Boshoff et al., 2001). Thus, a commonly-used approach (with much variety in techniques and definition; MacNab, 1985) is to predict potential herbivore abundances for areas using the species' metabolic requirements and estimates of food availability and quality – the so-called carrying capacity (Boshoff et al., 2001, 2002a; Bothma et al., 2004; Dekker, 1997; Hobbs and Swift, 1985; Hobbs et al., 1982; Mentis and Duke, 1976; Muya et al., 2013; Potvin and Huot, 1983; Wallmo et al., 1977). The carrying capacity concept is a productivity-based theory developed for domestic herbivores that, when applied in a wildlife context, needs to be adapted to different management objectives and for indigenous herbivores. The concept is generally considered unsuitable for describing plant–herbivore dynamics in systems with substantial environmental variance (e.g. semi-arid systems characterized by high degrees of climatic unpredictability; McLeod, 1997). Thus, considering the stochastic nature of most natural systems, this concept may be of limited use in many instances. Therefore, it is critically important to assess the

* Corresponding author. present address: Department of Zoology, University of Zululand, Private Bag x1001, Kwadlangezwa, 3886, South Africa. Tel.: +27 35 9026743; fax: +27 35 9026750.

E-mail addresses: DeFortierA@UniZulu.ac.za, avancauter@gmail.com (A. De Fortier), Marietjie.Landman@NMMU.ac.za (M. Landman), Graham.Kerley@NMMU.ac.za (G.I.H. Kerley).

http://dx.doi.org/10.1016/j.jaridenv.2014.06.004
0140-1963/