Rangeland Health Status and Condition Two Different Yet Complementary Concepts: National Reserve Pampa Galeras Barbara D´Achille Case

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Abstract

Pampa Galeras Barbara D´Achille National Reserve has an extension of 21,030 hectares constituted mainly by puna rangeland and has played a key role in the recovery of the vicuña (*Vicugna vicugna*) population from extinction. This reserve is divided into two zones, known as the Rigid zone with a total area of 6,500 ha, and the Buffer zone of 14,530 ha. The present study aimed to implement an Ecological Response Unit system (ERU) to create an evaluation and monitoring system of rangeland health and condition, that could serve as a model for the rest of the Protected National Areas destinated for the conservation of vicuña. A total of 29 ERUs were delimited combining fieldwork and spatial information analysis. The results revealed that rangeland health is still at risk due to domestic herbivorous pressure. This suggests the need to implement a Reference Area system (RA) to evaluate and monitor rangeland health and condition indicators and thus improve management and livestock grazing control systems. In this manner, the bases for the execution of an adaptative management plan will settle with the participation of Servicio Nacional de Áreas Naturales Protegidas (SERNANP) and the local rural communities, landowners, and usufructuaries of the economic value of the vicuña fiber.

Introduction

The National Reserve of Pampa Galeras Barbara D'Achille (NRPG) was created in 1,966 as a participative strategy between the Peruvian government and the rural Communities to protect the vicuña from extinction and also to serve as a knowledge center in matters of conservation and management of natural ecosystems. Its area is 6,500 ha of Rigid Zone and has a direct influence over a surrounding area of 14,530 ha of lands owned by the local communities that are managed according to open and semi-closed schemes in fenced areas denominated Sustainable Management Areas (Lichtenstein et al., 2002) in contrast with the first one where the management regime is open. As a result of an intensive control program of poaching, repopulation, and wildlife management improvement starting with the existing nucleus of species in the reserve and the command of strict protection norms, the initial population of 5000 animals concentrated in the province of Lucanas – Ayacucho progressively increased a total number of 218 000 nationwide (Gonzáles 2020). In the '80s, researchers from the Agraria La Molina National University conducted an exhausting inventory of rangeland condition in NRPG, a combination of tussock grasslands and shrubs, and concluded that rangeland condition varied between poor and very poor condition (Florez and Malpartida, 1980), due to alterations in soil potential and vegetation caused mainly by grazing pressure of domestic local animals, on which there is not solid strategies or mechanisms by the government to control their number. The goal of this study was to evaluate the conservation status of rangelands using two approaches, one of this based on the structure of the vegetation (Ruyle & Dyess 2016) and the other one, on ecological processes (Pyke, 2002) and thus assess the consistency and complementarity degree between both of them to be used as tools for monitoring and management of rangelands.

Study Area and Research Methods

The research was carried out in the Rigid and Buffer Zones of the Pampa Galeras National Reserve (NRPG), located at an altitude between 3,900 and 4,200 meters above sea level in the Puna ecoregion of the southern high Andes with an average rainfall of 450 mm and relative humidity of 90% (rainy season) and 50% (dry season). The vegetation was dominated by a complex of grasslands, shrubs, puna grass, relict Polylepis, wetlands, and protected areas. All of them belong to the Subtropical Montane Steppe, Subtropical Subalpine Humid Paramo, and Subtropical Subalpine Very Humid Paramo life zones. The climate is dry and cold with minimum temperatures of -8 °C between April and September and maximum temperatures of 16 °C. On the other hand, from January to March is the rainy season, with temperatures ranging between a minimum of 2 °C and a maximum of 14 °C. The soils are mainly formed by slopes of alluvial deposits, and shallow and superficial horizons rich in organic matter and acids. The reserve is made up of a rigid zone of 6,500 ha and a buffer zone of 14,732 ha. The rigid zone is under the control and management of Servicio Nacional de Áreas Naturales Protegidas (SERNANP) and the buffer zone by Servicio Nacional Forestal y de Fauna Silvestre (SERFOR). This last one is part of an extensive area that includes the entire Pampa Galeras plateau, where the largest population of vicuña is concentrated and involves land of the rural communities of Lucanas, Hualhua, San Cristobal, Saisa, Santiago de Vado, and Ccochapata in the Ayacucho Region, Peru, which owns the lands.

The study area was divided into Ecological Response Units (ERUs) which were used as sampling strata of range condition and health status. The delimitation was done by superimposing layers of topographic, geological, and physiographic data and climatic information, using the Qgis software as a tool (Wahlberg et al, 2013). In each ERUs, the type of vegetation, floristic composition, soil phases, condition, health, and trend of the grassland was determined through the Rapid Assessment Methodology (Zarria, 2015).

The condition was estimated based on the percentage of desirable and undesirable species, plant cover, and vigor (Florez and Malpartida, 1980), while health was estimated based on the attributes of biotic integrity, site stability, and hydrological function, and their respective indicators (Pyke, 2002), combining objective and visual measurements along linear transects located in central key areas and within each ERU (Ruyle and Dyess, 2016). Likewise, reference areas were identified in each ERU that represented areas with the best range conditions under current management conditions to be taken as a reference point when estimating rangeland health indicators.

Results and Discussion

A total number of 29 ERUs were delimited, made up of 72.7% tussock grassland, 11.9% shrubs, 6.5% puna grass, 3.2% relict Polylepis forest, 0.9 % wetlands, and 4. 8 % of protection zones (slopes, rocky areas, rivers) with an average size of 760.24 ha. The majority of the rangelands are in poor condition for vicuñas and their health is at risk; no rangelands were found in healthy condition in any of the zones inside the reserve (Table 1).

When the degree of correspondence between the health status and range condition of the ERUS was analyzed, it was found that 90% of all UREs presented a poor condition and qualified as being at risk. No ERU in poor condition was rated as healthy. There was a positive correlation between most of the health and condition indicators (Table 2), but the values, although significant, in some cases, were low averaging 32%. The highest correlation between indicators of both models was found between the percentage of

desirable species and biotic integrity (0.40). The correlation between rangeland health attributes was significantly high averaging 79%.

Table 1. Range Condition and Health Status of the Rigid and Buffer Zones

Zone	Condition				Health status		
	Desirable (%)	Forage Value Index (%)	Plant Cover (%)	Vigor (%)	Biotic integrity	Hydrological function	Site stability
Rigid	17.6	34.2	57.4	10	3.1	3.3	3.3
Buffer	17.9	36.0	58.7	11	3.0	3.0	3.2
Average	17.8	35.1	58.1	10.5	3.1	3.2	3.3
Result	**Poor**				**Risk**		

Table 2. Pearson's correlation matrix for indicators of the condition and health status of rangelands

	D %	FVI %	Cov. %	Vigor %	BI %	HF %	SS %
Desirable %	1						
Forage Value Index %	0.72 **	1					
Plant Cover %	0.44 *	0.45 *	1				
Vigor %	-0.29 ns	-0.43 *	0.008 ns	1			
Biotic Integrity %	0.40 *	0.33 ns	0.390 *	0.093 ns	1		
Hydrological Function %	0.31 ns	0.29 ns	0.22 ns	0.17 ns	0.79 **	1	
Site Stability %	0.34 ns	0.38 *	0.31 ns	0.17 ns	0.68 **	0.91 **	1

(ns) The probability of significance is greater than 0.05
(*) The probability of significance is between 0.05 and 0.01
(**) The probability of significance is lower than 0.01

There were no notable differences between the rangeland condition of the grasslands in the rigid and buffer zone, but in the latter, there was a higher proportion of sites in regular condition than in the former, mainly due to differences in the pressure of domestic herbivores by the communities in both areas. Time has passed and the unawareness by the communities and society in general about the ecological and economic benefits associated with good health and condition rangelands remains (Barrantes and Flores 2013).

Table 3. Area of the Pampa Galeras National Reserve according to the state of health and condition of the rangeland

Zone	Health Status			Condition		
	Healthy	Risk	Not Healthy	Regular	Poor	Very Poor
Rigid (%)	0	100	0	8.3	85.3	6.4
Buffer (%)	1.8	98.2	0	18	73.3	8.7

Conclusion

Rangeland's condition and health status are different but complementary concepts. Both provide valuable information, one on the structure and condition for grazing, and the other on the state of ecosystem processes. The Ecological Response Unit (ERU) constitutes the basic mapping, management, and monitoring unit, and is delimited based on the soil, climate, and vegetation conditions in strategic areas inside it. The use of Spatial Information Techniques GIS and Remote Sensing (RS) constitute a valuable instrument for delimitation and monitoring. Monitoring permanent radial transects located in strategic areas within the ERUs will allow settling the foundations for the execution of an adaptive management plan in

response to changes in management and climate conditions, prevailing inside the reserve, ensuring its adequate conservation.

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