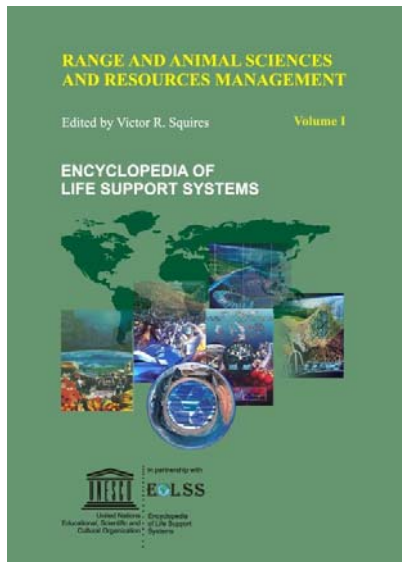


CONTENTS

RANGE AND ANIMAL SCIENCES AND RESOURCES MANAGEMENT



Range and Animal Sciences and Resources Management - Volume 1

No. of Pages: 408

ISBN: 978-1-84826-370-3 (eBook)

ISBN: 978-1-84826-820-3 (Print Volume)

Range and Animal Sciences and Resources Management - Volume 2

No. of Pages: 424

ISBN: 978-1-84826-371-0 (eBook)

ISBN: 978-1-84826-821-0 (Print Volume)

For more information of e-book and Print Volume(s) order, please [click here](#)

Or [contact : eolssunesco@gmail.com](mailto:eolssunesco@gmail.com)

CONTENTS

VOLUME I

Range and Animal Sciences and Resources Management 1
 Victor R. Squires, *University of Adelaide, Australia*

1. What are Rangelands?
2. Global distribution of rangelands
3. Brief Description of Major Rangeland Vegetation Types
4. Global Rangelands: Some Common Features
5. Range Livestock Systems of the World
 - 5.1. Herd Composition
 - 5.2. Constraints to Livestock Production on Rangelands
6. History of Rangeland Science as a Discipline
 - 6.1. Plant Succession
 - 6.2. Holistic Resource Management
7. Role of Ecology in the Management of Rangeland Habitats
 - 7.1. The Landscape Approach as a Basis for Rangeland Management
 - 7.1.1. The Concept of Landscape Health
8. Range/Livestock Interactions
 - 8.1. Effects on Plant-community Production
9. Key Issues in Rangeland Management

People in Rangelands: Their Role and Influence on Rangeland Utilization and Sustainable Management 36
 Victor R. Squires, *University of Adelaide, Australia*

1. Introduction
2. The Economics of Common Property Resources
 - 2.1. Case study The Grassland Law and its Implementation in China
 - 2.2. Carrying Capacity –An Elusive Concept
3. Drivers of Change
 - 3.1. Climate Variability
 - 3.1.1. Climate change
 - 3.2. Land Use and Tenure
 - 3.3. Movement and Migration
 - 3.3.1. Adaptation to Rangeland Degradation
 - 3.3.2. Herd management strategies
 - 3.4 Introduced plants and animals
4. Challenges for the Future

Rangeland Grazing In North American Commercial Ranching 60
 L. Huntsinger, *University of California, Berkeley USA*
 P.F. Starrs, *University of Reno, USA*

1. Introduction: Commercial Livestock Production in North America
2. Land Tenure and Landscape Fragmentation
3. The Ranch Level
4. Cost of Landownership
5. Cost of Capital
6. Ranch Land and Ecosystem Services
7. Homogenous Products
8. Transportation and Mobility
9. Markets

10. Scientific Management
11. Grazing Management
12. Range Improvements
13. Conclusions

Range Livestock Production Systems in the Near East

92

Mahgoub G. Zaroug, *Natural Resources Consultant, Sudan*

Mohamed M. Mirreh, *FAO Regional Range Management and Fodder Production Officer for the Near East, Egypt*

1. Introduction
2. Production Systems
 - 2.1. General
 - 2.2. Sedentary Livestock Production Systems
 - 2.3. Semi-nomadic System
 - 2.4. Transhumant System
 - 2.5. Nomadic Pastoral Production System
3. Constraints and Challenges
4. Conclusion
5. Options for the Future

Rangeland Plants (Grasses, Forbs, Shrubs and Trees): Role and Function

136

Gail Berg, *Mountain Research Consulting, British Columbia CANADA*

1. The Role of Plants in Native Rangeland Ecosystems
 - 1.1. What are Ecosystems?
 - 1.2. What is Rangeland then?
 - 1.3. What is a Plant Community?
2. Goods and Services Provided By Rangeland Plants
 - 2.1. What Services do Rangeland Plants Offer to Keep Ecosystems Functioning?
 - 2.1.1. Photosynthesis
 - 2.1.2. Food Source for Grazers
 - 2.1.3. Maintenance of Soils
 - 2.1.4. Regulation of Fresh Water Supplies within the Hydrological Cycle
 - 2.1.5. Symbiotic Nitrogen Fixation
 - 2.1.6. Natural Control of Pathogenic and Parasitic Organisms (Pest Control)
 - 2.1.7. Habitat for Wild Animals and Birds Including Reptiles and Amphibians
 - 2.1.8. Maintenance of Inland Fisheries
 - 2.1.9. Indicators of Range Condition and Soil Types
 - 2.1.10. Carbon Sequestration
 - 2.2. Goods and Services to Local Residents and Other Land Users
 - 2.2.1. Aesthetic, Cultural, Spiritual Renewal
 - 2.2.2. Food
 - 2.2.3. Building Materials
 - 2.2.4. Bedding
 - 2.2.5. Poisons
 - 2.2.6. Fibers and Dyes
 - 2.2.7. Fuel
 - 2.2.8. Pharmaceuticals and Medicines
 - 2.2.9. Sites for Wind and Solar Power Generation
 - 2.2.10. Recreational Services
3. Classification of Rangeland Plants
 - 3.1. Grasses
 - 3.2. Forbs
 - 3.3. Grass-like Plants Sedges (Cyperaceae) and Rushes (Juncaceae)
 - 3.4. Shrubs
 - 3.5. Trees

- 3.6. Mosses
- 3.7. Ferns
- 3.8. Lichens
- 4. Plant reproduction
 - 4.1. Asexual Reproduction
 - 4.1.1. Runners and Stolons
 - 4.1.2. Rhizomes
 - 4.1.3. Suckers
 - 4.1.4. Bulbs or Corms
 - 4.2. Sexual-cross Pollination
 - 4.2.1. Wind Pollination
 - 4.2.2. Bees
 - 4.2.3. Beetles
 - 4.2.4. Moths and Butterflies
 - 4.2.5. Birds
 - 4.2.6. Bats
 - 4.3. Spore Production
- 5. Strategies and Adaptations for Survival
 - 5.1. Growth Form
 - 5.2. Fire Resistance
 - 5.3. Variety of Root Systems
 - 5.4. Presence of Hairs or Waxy Coatings
- 6. How do Plants Disperse?
 - 6.1. Wind-borne
 - 6.2. Water-borne
 - 6.3. Self-propelled
 - 6.4. Animal Transport
- 7. How do Plants Respond to Different Disturbances and Stresses?
 - 7.1. Grazing
 - 7.2. Compaction
 - 7.3. Soil Disturbance
 - 7.4. Fire
 - 7.5. Drought
- 8. Conclusion

Rangeland Communities: Structure, Function, and Classification

170

Kurt O. Reinhart, *United States Department of Agriculture- Agricultural Research Service, Fort Keogh Livestock and Range Research Laboratory, USA*

- 1. Vegetation composition, structure, and life-history
 - 1.1. Composition
 - 1.2. Structure
 - 1.3. Life-History Traits
 - 1.4. Structure and Composition Linkage
- 2. Ecosystem function
 - 2.1. Structure and Function Linkage
 - 2.2. Diversity and Function Linkage
- 3. Vegetation classification
 - 3.1. Introduction
 - 3.2. Basis for Classifying Vegetation
 - 3.3. Major Classes of Vegetation
- 4. Rangeland classification systems
 - 4.1. Range Succession Model
 - 4.2. Ecological Sites Model
 - 4.3. Landscape Function Analysis
 - 4.4. Interpreting Indicators of Rangeland Health
- 5. Current state of vegetation classification systems

Rangelands as a Sink for Carbon

193

Victor R Squires, *University of Adelaide, Australia*E.P. Glenn, *University of Arizona, USA*Ruijun Long, *Lanzhou University, China*

1. The International context
 - 1.1. Potential and Actual Carbon Storage Densities of the Drylands
 - 1.2. Rationale for Sequestering Carbon in Drylands
 - 1.2.1. Methane Oxidation in Desert Soils
 - 1.3. Dryland Soils as a Carbon Sink
 - 1.4. Creating an Economic Linkage between Dryland Restoration and Carbon Sequestration
 - 1.5. Carbon Offsets: What are They and How do They Help?
 - 1.6. Validation and Verification of Carbon Stores
2. Increasing Carbon Sequestration in Rangelands: Prospects and Problems
 - 2.1. Rationale for Using Halophytes to Extend the Area of World Biofuels Production
 - 2.2. Halophytic Shrub Plantations

Rangeland Improvements

217

Henry Noel Le Hou  rou, *International Consultant: Ecology, Management and Development of Arid Lands, Montpellier, France*

1. General introduction and definitions
2. Rangeland types
3. A Case study of the US Rangelands.
 - 3.1. Economic Impact of Wild-Life Related Activities
- 4 Role of rangeland legislation
 - 4.1. Impact of the Taylor Grazing Act
5. Land degradation processes: action-reaction chains
 - 5.1. Role of Permanent Exclosures
 - 5.1.1. Short and Medium Term Exclosures
6. Game ranching
7. Establishing drought tolerant fodder shrubs
8. Soil and water conservation work in conjunction with revegetation
9. Range re-seeding
10. Monitoring

Rangeland Ecophysiology

231

Jenesio I. Kinyamario, *University of Nairobi, School of Biological Sciences, Nairobi, Kenya*Victor R. Squires, *University of Adelaide, Australia*

1. Implications of plant physiology for rangeland ecosystems
 - 1.1. Plant Level Interactions
 - 1.2. Management Implications:
2. Photosynthesis
 - 2.1. C3, C4 Pathways in Photosynthesis
 - 2.2. Crassulacean Acid Metabolism (CAM)
3. Geographical and ecological distribution of different photosynthetic pathway plants
4. Comparative analysis of photosynthetic pathways
 - 4.1. CO2 Compensation Point
 - 4.2. Light Saturation
 - 4.3. Light Compensation Point
 - 4.4. Temperature Optima
 - 4.5. Water Use Efficiency
 - 4.6. Nitrogen Use Efficiency
 - 4.7. Photorespiration
5. Photosynthetic capacity, quantum yield, and productivity
6. Implications for Rangeland Management

- 6.1. Herbivory
- 6.2. Carbohydrate Reserves
- 6.3. Drought and Overgrazing Combine to Cause Much Stress
- 6.4. Climate Change
- 6.5. Invasive Species
- 6.6. Fires
- 7. Conclusions

Habitat and Riparian Management in Rangeland Ecosystems

251

Haikai Tane, *Watershed Field Research Station, New Zealand*

- 1. Introduction
 - 1.1 Geographic Perspectives
 - 1.2. Cultural Ethos
 - 1.3. Environmental Health
- 2. Ecological Approach to Rangelands
 - 2.1. Ecological Dimensions of Rangeland Ecosystems
 - 2.2. Culture, Ecology and Landscape
- 3. Rangeland Habitats and Riparian Ecotones
 - 3.1. Rangeland Habitats and Soil Landscapes
 - 3.2. Mapping Habitats and Riparian Ecotones
 - 3.3. Modeling Relationships between Habitats-Regoliths-Aquifers
- 4. Ecological Energetics and Microclimates
 - 4.1. Heat, Light, Wind and Water Energies
 - 4.2. Habitat Biodiversity and Rangeland Microclimates
- 5. Riparian Ecotones and Rangeland Ecosystems
 - 5.1. Habitat Ecography
 - 5.2. Catchment Infrastructures; Watershed Ecostructures
 - 5.3. Cultural Ecosynthesis
- 6. Rangeland Habitats and Resource Systems
 - 6.1. Plant Resource Systems
 - 6.2. Animal Resource Systems
 - 6.2.1. Pastoral Rangelands
 - 6.3. Soil Based Systems
 - 6.4. Water Resource Systems
 - 6.5. Village Communities
- 7. Sustainable Rangeland Futures
 - 7.1. Nature Conservation and Conservation Biology
 - 7.2. Resource Conservation and Natural Resource Management
 - 7.3. Environmental Conservation and Sustainable Development
 - 7.4. Qinling Rangelands Case Study
- 8. Resource Assignment and Rangeland Management
 - 8.1. Planning for Change - Managing Uncertainty
 - 8.2. Cultural Ecosynthesis and Rangeland Watersheds
- 9. Conclusion

Environmental Soil Management

303

J.E. Herrick, *USDA, Agricultural Research Service, Jornada Experimental Range, USA*

- 1. Introduction
- 2. Key concepts
 - 2.1. Relatively Static vs. Dynamic Soil Properties
 - 2.2. Resilience
 - 2.3. Soil Chemical Properties
 - 2.4. Soil Physical Properties
 - 2.5. Soil Biological Properties

- 2.6. Soil-Plant-Animal Feedbacks
- 2.7. Multi-scale Management
- 3. Soils and ecosystem services
 - 3.1. Forage Production
 - 3.2. Wildlife Habitat
 - 3.3. Biodiversity Conservation
 - 3.4. Water Quality and Quantity
 - 3.5. Air Quality
 - 3.6. Carbon Sequestration
- 4. Causes and consequences of environmental soil degradation in rangelands
- 5. Rangeland soil remediation
- 6. Supporting sustainable soil management with inventory monitoring and assessment
 - 6.1. Rapid, Quantitative Field Tests
 - 6.2. Standardized Qualitative Observations of Soil Surface and Sub-Surface Characteristics.
 - 6.3. Measurements of Soil Surface and Vegetation Patterns
 - 6.4. Remote Sensing
- 7. Environmental soil management and sustainable development: an integrated approach

Behavior – The Keystone in Optimizing Free-Ranging Ungulate Production 327

D. M. Anderson and R. E. Estell, *USDA-ARS, Jornada Experimental Range Las Cruces, New Mexico, U.S.A.*

- 1. Introduction
- 2. Defining Animal Behavior
- 3. Concepts Fundamental to Foraging
 - 3.1. Stocking rate
 - 3.2. Animal density and stocking pressure
- 4. Foraging Behavior
 - 4.1. Spatial concepts
 - 4.2. From Specialized Individuals To Unique Groups – Flocks, Herds And Mixed Species Groups
 - 4.3. Group Cohesiveness
- 5. The Central Role of Plant Chemistry in Foraging Behavior
- 6. Ethics, Laws, Health, Safety and Animal Welfare
- 7. Low-Stress Management Strategies
- 8. Animal Behavior and 21st Century Range Animal Ecology
 - 8.1. Technological Advancements – Animal + Machine
 - 8.2. Choices and Consequences

Index 347

About EOLSS 353

VOLUME II

Beef Cattle Nutrition in Commercial Ranching Systems 1

Greg Lardy, *Department Head, and Co-Director, Beef Systems Center of Excellence, North Dakota State University, Fargo, North Dakota, USA*

Joel Caton, *Ruminant Nutrition, Co-Director, Center for Nutrition and Pregnancy, North Dakota State University, Fargo, North Dakota, USA*

- 1. Introduction
- 2. Factors Affecting Forage Quality
 - 2.1. Seasonal Changes in Nutrient Quality of Native Range
 - 2.2. Other Factors Affecting Forage Quality

- 2.3. Dormant Season Grazing
3. Nutrient Requirements of Beef Cattle
4. General Considerations for Supplementation
5. Protein Supplementation
 - 5.1. Non-Protein Nitrogen Supplements
 - 5.2. Effects of Feeding True Protein Supplements
 - 5.3. Provision of Microbial Growth Factors
 - 5.4. Feeding to Meet the Metabolizable Protein Needs
 - 5.5. Supplementation Frequency
 - 5.6. Interaction Between Supplemental Degradable Protein and Energy
 - 5.7. Supplement Form
6. Supplementation of Gestating Beef Cows
7. Supplementation of the Lactating Beef Cows
8. Mineral Supplementation
 - 8.1. Primary vs. Secondary Deficiencies
 - 8.2. Reduced Productivity
 - 8.3. Diagnostic and Laboratory Tests
9. Behavioral Considerations for Optimizing Supplementation Programs
10. Conclusion

Nutrition of Small Ruminants on Rangelands

25

Victor R. Squires, *University of Adelaide, Australia*

1. Introduction
2. Digestive system of sheep and goats
 - 2.1. Development of the Four Stomach Compartments
 - 2.1.1. Rumination
 - 2.1.2. Rumen Microbiology
3. Nutritional needs of small ruminants
 - 3.1. Nutrition of the Ewe
 - 3.1.1. Requirements during Gestation
 - 3.1.2. Interactions between Nutrient Regimes and Reproductive Performance
4. Minerals in the diet of sheep and goats
 - 4.1. Mineral Nutrition for Small Ruminants at Pasture
5. Nutritional disorders of sheep and goats
6. Grazing behavior and diet selectivity
 - 6.1. Diet – What Sheep and Goats Choose To Eat

Nutrient Metabolism of Non Ruminants in Rangeland Systems

48

Tanja Hess, *Colorado State University, USA*

1. Introduction
2. Feeding habits comparing equids to ruminants
3. Extracting nutrients from plant tissue
4. Factors that affect digestibility of forages in equids
 - 4.1. Animal Factors
 - 4.2. Forage Factors
 - 4.2.1. Passage Rate
5. Digestive system: digestion and absorption
 - 5.1. The Mouth
 - 5.2. Saliva
 - 5.3. Teeth
 - 5.4. Stomach
 - 5.5. Small Intestine
 - 5.6. Hindgut
6. Nutrients

- 6.1. Water
- 6.2. Carbohydrates
 - 6.2.1. Carbohydrates Fiber
 - 6.2.2. Carbohydrates Non Fiber
- 6.3. Fat
- 6.4. Protein
- 6.5. Minerals
 - 6.5.1. Macrominerals
 - 6.5.2. Microminerals
- 6.6. Vitamins
- 7. Feeding value of pasture in horses
 - 7.1. Pasture and Nutrient Requirements
 - 7.2. Pasture
 - 7.3. Behavior of Horses on Pastures
 - 7.4. Eliminative Behavior
 - 7.5. External Factors
 - 7.6. Internal Factors

Science and the Community: Role of the Ecological Approach in Sustainable Rangeland Management **84**

Hugh Milner, *International Water Management Consultant, Australia*

- 1. Definition of the ecological approach
 - 1.1. The Concept of the Ecological Approach
 - 1.2. Role of the Ecological Approach in Sustainable Rangeland Management
 - 1.3. The Role of the Ecological Approach in Optimizing the Use of Natural Resources
- 2. Participatory implementation of the ecological approach
 - 2.1. Participation
 - 2.1.1 Participatory Scientific Management
 - 2.1.2. Development of the Participatory Approach
 - 2.1.3. Participatory Plan Development
- 3. A Village-based Catchment Management Plan
 - 3.1. Annual Planning
 - 3.2. The Annual Plan Meeting
 - 3.3. Plan Implementation
 - 3.4. Plan Monitoring
 - 3.4.1. Socio-economic monitoring
 - 3.4.2. Ecological monitoring
 - 3.4.3. Training Support for the Planning System

Catchment Management – A Framework for Managing Rangelands **102**

Hugh Milner, *International Water Management Consultant, Australia*

- 1. Introduction
- 2. Why should RMP be based on catchments
- 3. Catchments and watersheds – definition of terms
 - 3.1. Catchments and Water Bodies
- 4. Catchment management plans and rangelands
 - 4.1. Manage Rangelands by Catchment
 - 4.1.1. Management Zones
 - 4.2. Consider Catchment Processes
 - 4.2.1. Natural Processes
 - 4.2.2. Human Processes
 - 4.3 Apply the Precautionary Principle
 - 4.4 Encourage Participation
 - 4.5 Promote Development which Reduces Land Pressure

- 4.5.1 Planning Rural Village Development
- 4.6. Manage Grazing
- 5. An example of applying catchment management to RMP – China
- 6. Conclusions

Fire Effects and Management in African Grasslands and Savannas

121

Winston S.W. Trollope and Lynne A. Trollope, *Working On Fire International Nelspruit, South Africa*

- 1. Introduction
- 2. Ignition Sources of Fire in Africa
- 3. Fire Ecology of African Grasslands and Savannas
 - 3.1. Type of Fire
 - 3.2. Fire Intensity
 - 3.3. Season of Burning
 - 3.4. Frequency of Burning
- 4. Interactions between Fire and Herbivory
 - 4.1. Serengeti-Mara Ecosystem in East Africa
 - 4.2. Arid Savannas of the Eastern Cape Province in South Africa
- 5. Fire Management in African Grasslands and Savannas
 - 5.1. Fire Regime
 - 5.1.1. Type of Fire
 - 5.1.2. Fire intensity
 - 5.1.3. Season of Burning
 - 5.1.4. Frequency of Burning
 - 5.2. Fire Management for Domestic Livestock Systems
 - 5.2.1. Reasons for Burning
 - 5.2.2. Ecological Criteria for Prescribed Burning
 - 5.2.3. Post-Fire Range Management
 - 5.3. Fire Management for Wildlife Management Systems
 - 5.3.1. Range Condition Burning System
 - 5.3.2. Post-Fire Range Management
- 6. Conclusions

Fire in Rangelands and Its Role in Management

146

E.J.B. van Etten, *Centre for Ecosystem Management, School of Natural Sciences, Edith Cowan University, Perth, Australia*

- 1. Introduction
- 2. Global Patterns – Which Rangelands Burn?
- 3. Landscape Scale Patterns of Rangeland Fire
- 4. Rangeland Fire Regimes
- 5. Fire History of Rangeland Ecosystems
 - 5.1. Pre-Human and the Role of Climatic Fluctuations
 - 5.2. Role of Indigenous People
 - 5.3. Trends following European Colonization
- 6. Biotic Effects of Fire in Rangelands
- 7. Fire Behavior Models for Rangelands
- 8. Fire – Grazing Interactions
- 9. Exotic Species
- 10. Fire Management Considerations in Rangelands
 - 10.1. Burning to Reduce Fuels
 - 10.2. Burning to Increase Productivity
 - 10.3. Burning to Control Woody Plants and Exotics
 - 10.4. Burning to Protect or Enhance Biodiversity Values
 - 10.5. Burning for Carbon Storage Benefits

Invasive Rangeland Plants**171**Jane Mangold, *Montana State University, USA*Tom Monaco and Roger Sheley, *Forage and Range Research Laboratory (USDA-ARS) in Logan, Utah, USA*Ron Sosebee, *Department of Natural Resources Management Texas Tech University in Lubbock, Texas, USA*Tony Svejcar, *USDA-Agricultural Research Service unit in Burns, Oregon, USA*

1. Introduction
2. Extent of Invasion and Impacts on Ecological and Economic Systems
3. Successional Theory
 - 3.1. Invasion Process
 - 3.2. Theory of Biotic Resistance to Invasion
 - 3.2.1. Mechanisms of Biotic Resistance to Invasion
 - 3.2.2. Theory of Fluctuating Resources
 - 3.2.3. Synthesis of Community Invasibility Theories
4. Tools Used to Manage Succession toward Desirable Plant Communities
 - 4.1. Successional Management Framework
 - 4.1.1. Site Availability
 - 4.1.2. Species Availability
 - 4.1.3. Species Performance
 - 4.2. Tools That Modify Key Ecological Conditions and Processes
 - 4.2.1. Biological Control
 - 4.2.2. Fire
 - 4.2.3. Grazing
 - 4.2.4. Herbicides
 - 4.2.5. Revegetation
 - 4.3. Ecologically-Based Invasive Plant Management
5. Managing Performance of Invasive Rangeland Species in the Southern Great Plains and Southwestern U.S.A.
 - 5.1. Energy Allocation in Plants
 - 5.2. Annuals
 - 5.2.1. Summer Annuals
 - 5.2.2. Winter Annuals/Biennials
 - 5.3. Perennial Herbaceous Weeds
 - 5.3.1. Rosette-Forming Weeds
 - 5.3.2. Non-Rosette-Forming Weeds
 - 5.3.3. Suffrutescent Shrubs
 - 5.4. Woody Weeds (Brush)
 - 5.4.1. Long-/Short-Shoot Growth
 - 5.4.2. Non-Basal Sprouting Woody Plants
 - 5.4.3. Basal and Root Sprouting Woody Plants
6. Climate Change and Invasive Species – What might the future hold?
 - 6.1. Increasing CO₂
 - 6.2. Temperature and Precipitation
 - 6.3. Fire and Climate Change
 - 6.4. Coping with Climate Change
7. Conclusion

Mixed Domestic and Wild Ungulate Systems in South Africa**205**MT Mentis, *Consultant, PostNet Suite 10102, Private Bag X1005, 3650 Hillcrest, Republic of South Africa*

1. Introduction
2. Domestic and Wild Ungulate Mixes
3. Success and Failure
4. Deciding On the Choice of Species

5. Stocking Rate
6. Optimizing
7. Counting
8. Age and Sex Classification
9. Harvesting
10. Habitat Management
11. Predator Control

From Inventory to Monitoring In Semi-Arid and Arid Rangelands

237

G. Gintzburger, *Range ecologist, Mariginiup, WA 6065, Australia*

S. Saïdi, *Range ecologist, 10, rue de Florette, 30250 Villevieille, France*

1. Introduction
2. Definitions
3. Rangeland Inventory and Analysis
 - 3.1. Early Botanical Inventory
 - 3.2. Recent Rangeland Inventory and Analysis
 - 3.2.1. Office Preparation
 - 3.2.2. Field Work - Preliminary Field Reconnaissance / Exploration
 - 3.2.2.1. Preliminary Field Reconnaissance and Exploration
 - 3.2.2.2. Field Vegetation Survey – Ecological Survey
 - 3.2.2.3. Characterizing the Environment and the Vegetation
 - 3.2.3. Characterizing the Relationship between the Environment and the Vegetation
 - 3.2.3.1. The European Phytosociological-Phytoecological Method
 - 3.2.3.2. The Climax Vegetation Concept in North America
 - 3.2.3.3. The Landscape and Land Systems Approach in Australia
 - 3.2.4. Describing the Vegetation Structure
 - 3.2.4.1. On a Limited Area
 - 3.2.4.2. On a line (Line Intercept Measurements - LIM)
 - 3.2.4.3. Using the Discrete Point Sampling Methods
 - 3.2.5. Measuring the Above-Ground Biomass or the Range Net Primary Production (RNPP)
 - 3.2.5.1. The Clipping Method
 - 3.2.5.2. The Bowen Ratio-energy Balance Method
 - 3.2.6. Output: Rangeland Vegetation Maps and Rangeland Development
 - 3.2.7. Assessing the Range Condition and Health
 - 3.2.8. The Rain Use Efficiency (RUE) to Evaluate the Current Rangeland Health
4. Rangeland Monitoring
 - 4.1. Ground-Based Rangeland Monitoring
 - 4.1.1. The Western Australian Range Monitoring System (WARMS)
 - 4.2. Satellite-Based Rangeland Survey and Monitoring Systems
 - 4.2.1. Satellite-Based Vegetation Surveys: A Static Eagle's View of the Rangeland Types and Production
 - 4.2.2. Remote Sensing – Satellite-Based Range Monitoring
 - 4.2.3. The VegMachine™
5. Conclusions

Dryland Analysis and Monitoring

274

Robert A. Washington-Allen, *Department of Ecosystem Science and Management, Texas A&M University, College Station, Texas USA*

Sujith Ravi, *B2 Earthscience & University of Arizona Biosphere 2, University of Arizona, Tuscon, Arizona USA*

1. Introduction
2. Definitions
3. Theory
4. Procedure for Dryland Monitoring and Assessment

- 4.1. Paleocological Methods
- 4.2. Contemporary Methods
 - 4.2.1. Climate
 - 4.2.2. Vegetation Field Methods
 - 4.2.3. Soil Field Methods
 - 4.2.4. Remote Sensing
- 5. New Directions
 - 5.1. Remote Sensing
 - 5.2. LADA
 - 5.3. Digital Public Databases

Economically Efficient Rangeland Management to Sustain Ecosystem Function And Livelihoods **302**

W. R. Teague, *Texas AgriLife Research and Department of Ecosystem Science and Management, Texas A&M University System, Vernon, TX, USA*

U.P. Kreuter, *Department of Ecosystem Science and Management, Texas A&M University, College Station, TX, USA*

W. E. Fox, *Texas AgriLife Research and Department of Ecosystem Science and Management, Texas A&M University System, Temple, TX, USA*

- 1. Introduction
- 2. Global Sustainability of Ecosystems
- 3. Management for Sustainability rather than just Financial Profits
 - 3.1. The Industrial Model of Agricultural Production
- 4. Ecosystem Goods and Services Derived from Rangelands
 - 4.1. Maintaining Ecosystem Processes and Functions on Rangelands
 - 4.2. States, Transitions and Thresholds
 - 4.3. Valuing Ecosystem Goods and Services
 - 4.4. Management to Sustain Goods and Services
- 5. Managing Ranch Businesses to Make a Profit and Sustain Ecosystem Services
 - 5.1. Planning and Managing to be More Sustainable
 - 5.2. Managing For Resilience and Biodiversity
 - 5.3. Treat the Cause and not the Symptoms
 - 5.4. Minimizing Cost versus Maximizing Production
 - 5.5. Coping with Climatic and Market Variability
- 6. Future Research and Development Needs
- 7. Conclusions

Integrated Rangeland Management Systems **327**

Tidiane Ngaido, *Environment, Production and Technology Division, International Food Policy Research Institute (IFPRI), Washington D.C., USA*

- 1. Introduction
 - 1.1. Misconceptions about Pastoral Systems
- 2. Framework for Integrated Rangeland Management
 - 2.1. Improving the Natural Resource Dimension
 - 2.2. Improving the Human Dimension
 - 2.3. Improving the Legal and Institutional Dimension
- 3. Implications on integrated rangeland management systems
 - 3.1. Recognition of Tribal/Group Rights and Rangeland Management Systems
 - 3.2. Pastoral Perimeters
 - 3.3. Rangeland Management Cooperatives
 - 3.3.1. Cooperative Is Inclusive To All Members and Manages the Totality of Group Resources
 - 3.3.2. Cooperative Includes Only Part of the Members but Manage the Totality of Group Resources
 - 3.3.3. Cooperative Is Inclusive To All Members but Manages Parts of the Group Resources

- 3.3.4. Cooperative Includes Part of the Members but Manages Parts of the Group Resources
4. Concluding remarks

New Thinking in Range Ecology **343**
G.A. Heshmati, *Gorgan Agricultural and Natural Resource Sciences University, Iran*
Victor Squires, *University of Adelaide, Australia*

1. Introduction
2. Ecosystems Dynamics and the New Paradigm
3. Thresholds
4. Characteristics of Non-Equilibrial Systems
5. Reconciling Complex Systems
6. New Ecology and the Social Sciences
7. Will the Future Work?

Index **361**

About EOLSS **369**