

Contents

Preface	xiii
Acknowledgments	xv
1 Introduction	1
Remote Sensing for Biodiversity and Wildlife Management.....	1
A Remote-Sensing Approach across Disciplines.....	1
Remote Sensing and Wildlife	4
Remote Sensing and Biodiversity	6
Definitions and Context.....	7
Remote-Sensing Science	7
Wildlife Management	8
Biodiversity	8
Habitat	9
Landscape Level or Landscape Scale.....	10
Interface of Management and Research	12
Early Developments.....	13
Field-Based Remote Sensing.....	13
Aerial Remote Sensing.....	15
Satellite Remote Sensing	16
Growing Confidence in Remote-Sensing Applications	17
Current Status	20
Critical Remote-Sensing Contributions.....	20
Biodiversity Indicators.....	20
Linking to Animal-Based Data Sets.....	22
Purpose and Organization of the Book.....	23
Chapter Summaries	24
2 Management Information Needs and Remote Sensing	27
Information Requirements for Management	27
Types of Information Required.....	27
Sampling Strategy	30
Science Team Dynamics	31
The Role of Leadership	38
Application Framework	40

Ecosystem Structure and Process.....	43
Land Cover	43
Land-Cover Change.....	45
Habitat Attributes.....	45
Habitat Patches.....	48
Spatial Heterogeneity and Fragmentation	50
Energy and Productivity.....	51
Water Resources and Quality	53
Ecosystem Health and Integrity.....	54
Habitat and Biodiversity Indicators	56
Habitat Suitability	56
Monitoring Programs.....	57
Limitations of Remote Sensing.....	63
3 Remote-Sensing Data Collection and Processing...	67
Image Characteristics.....	67
Image Formation	67
Image Resolution	74
Image Scale	76
Image Acquisition.....	77
Field Instruments	77
Aerial Sensors and Platforms	78
Current Satellite Systems.....	84
Image Analysis	87
Image Radiometry	87
Image Geometry	91
Image Classification	92
Vegetation Indices	94
Data Fusion and Synergy	95
Change Detection.....	96
Geomatics Solutions: Remote Sensing, GIS, GPS, and Spatial Models	97
GIS Integration	97
Location Sensing Technology	99
Spatial Models.....	102
4 Remote Sensing of Ecosystem Process and Structure	107
Land Cover and Vegetation Structure.....	107
Land Cover	107
Species and Species Assemblages	111
Understory Plants and the Forest Floor	116
Invasive Alien Species	118

Vertical Complexity, Canopy Gaps and Structure	121
Dead and Damaged Trees	129
Chemical Constituents of Vegetation, Soils, and Water	130
Foliar Chemistry and Stress (Health)	130
Food Resource Availability and Quality	134
Soil Processes and Conditions	136
Water Quality	137
Ice and Snow Conditions	140
Ecosystem Processes	141
Gross and Net Primary Productivity	141
Phenology	144
Fragmentation	147
5 Remote Sensing in Wildlife Management	151
Remote-Sensing Reviews, Case Studies, and Illustrative Examples	151
Recent Reviews	151
Remote Sensing of Habitat Indicators	159
Direct Animal Sensing and Counting	162
Remote Sensing of Habitat Resources	166
General Habitat Suitability Mapping	166
Species Distribution Models	169
Multiscale Habitat Structure	174
Habitat Fragmentation	174
Spatial Heterogeneity	179
Anthropogenic Change and Disturbances	184
Linear Features	184
Partial Land-Cover Change	187
Animal and Human Health Studies	190
Case Study: Landscape Change and Grizzly Bear Health in Alberta	195
Land Cover, Structure, and Resource Selection	195
Health and Change	198
Management Implications	201
6 Remote Sensing in Biodiversity Monitoring	203
A Wide Range of Examples and Case Studies	203
Biodiversity Reviews	203
Remote Sensing of Freshwater Fish Biodiversity	212

Biodiversity Indicators.....	213
Trends in Habitat and Ecosystem Extent	213
Threatened Species Habitat.....	215
Trends in Invasive Alien Species	218
Patterns of Biodiversity	221
Plant Species Richness.....	221
Animal Species Richness.....	225
Biodiversity and Fragmentation.....	228
Biodiversity Monitoring Programs	230
Alberta Biodiversity Monitoring Institute	230
New Zealand Biodiversity Monitoring Program.....	232
Australia Biodiversity Monitoring Program ...	234
Circumpolar Biodiversity Monitoring Program ...	239
7 Conclusion	245
Remote Sensing Across Disciplines—Revisited.....	246
Technological Innovation in Data and Image Processing.....	247
Applications Insights.....	249
Future.....	251
I Annotated Bibliography of Selected Reference Books Documenting the Development of Remote Sensing in Environmental Applications.....	255
II Common and Scientific Names of Species Mentioned in the Text.....	261
III A Selection of Past, Current, and Planned Remote-Sensing Satellites.....	265
IV A Selection of Past, Current, and Planned Sensor Payloads on Remote-Sensing Satellites	273
References.....	289
Index	335