

Contents

Contributors	XXI
Abbreviations	XXXI
Introduction	1
1 Understanding Landscapes through Knowledge Management Frameworks, Spatial Models, Decision Support Tools and Visualisation	3
1.1 Introduction	3
1.2 Part 1: Natural Resource Knowledge Management Frameworks and Tools	5
1.3 Part 2: Integrating the Ecology of Landscapes into Landscape Analysis and Visualisation	7
1.4 Part 3: Socioeconomic Dimensions to Landscapes	9
1.5 Part 4: Land Use Change and Scenario Modelling	11
1.6 Part 5: Landscape Visualisation	13
1.7 Future Challenges	15
Part 1: Natural Resource Knowledge Management Frameworks and Tools	17
2 Reading between the Lines: Knowledge for Natural Resource Management	19
2.1 Introduction	19
2.2 Knowledge Hierarchy	20
2.3 Timelag between Question and Answer	23
2.4 Organising the Questions	24
2.5 Integrating Disciplines	26
2.6 Conclusion	27

3	Improving the Use of Science in Evidence-based Policy: Some Victorian Experiences in Natural Resource Management	29
3.1	Context	29
3.1.1	Historical Perspective	30
3.1.2	The Policy Process: Towards Evidence-based Policy	31
3.1.3	Use of Science as Evidence in Policy	32
3.2	Some Victorian Experiences in Natural Resource Management	35
3.2.1	Survey of Policy Analysts	37
3.2.2	Market Research	38
3.2.3	Improving the Utility of Project Outputs	40
3.2.4	Observation of How Policy Decisions Are Made	40
3.3	Case Studies of Successful Science–Policy Influence	41
3.3.1	Sawlogs for Salinity	42
3.3.2	Salinity Investment Framework 3	42
3.3.3	Soil Health	43
3.3.4	Greenhouse in Agriculture	43
3.4	Discussion	44
3.4.1	Toward Better Use of Science in Evidence-based Policy	44
3.5	Conclusion	46
4	The <i>Catchment Analysis Tool</i> : Demonstrating the Benefits of Interconnected Biophysical Models	49
4.1	Introduction	50
4.2	<i>Catchment Analysis Tool</i> : Background and Description	51
4.2.1	The <i>CAT</i> Interface	54
4.2.2	<i>CAT</i> Input Data	56
4.2.3	The <i>CAT</i> Model Components	59
4.2.4	Model Calibration and Conceptualisation	61
4.3	Case Study	61
4.3.1	Hypothetical Case Study	61
4.3.2	Results and analysis	66
4.4	Validation and Model Improvement	68
4.5	Conclusion	69
5	The Application of a Simple Spatial Multi-Criteria Analysis Shell to Natural Resource Management Decision Making	73
5.1	Introduction	74
5.2	Multi-criteria Analysis	74
5.2.1	Spatial Applications	75
5.2.2	The Decision-making Process	77

5.3	The <i>MCAS-S</i> Approach	79
5.3.1	Design Principles	79
5.3.2	Key Functions	80
5.4	Applications	82
5.4.1	Prioritising Revegetation Investment	82
5.4.2	Assessing the Sustainability of Extensive Grazing	85
5.5	Future Trends	89
5.6	Conclusion	90
5.7	Future Research Directions	91
6	<i>Platform for Environmental Modelling Support: a Grid Cell Data Infrastructure for Modellers</i>	97
6.1	Introduction	98
6.2	Background	100
6.3	Methodology	102
6.4	Progress and Discussions	103
6.5	The <i>PEMS</i> Demonstrator Project	105
6.5.1	National Seasonal Crop Monitoring and Forecasting	105
6.5.2	Develop and Demonstrate a Market-based Approach to Environmental Policy on Private Land	108
6.5.3	Wildfire Planning: Consequence of Loss Modelling	109
6.5.4	Land Use Data, Modelling and Reporting	111
6.6	Conclusion	115
Part 2: Integrating the Ecology of Landscapes into Landscape Analysis and Visualisation		119
7	Looking at Landscapes for Biodiversity: Whose View Will Do?	121
7.1	Introduction	122
7.2	To be Human is to Err	122
7.3	What's Good for the Goose?	124
7.4	Consider the Lilies	127
7.5	Best is Bunkum	128
7.6	Varied Perspectives	129
7.6.1	Mapping and Modelling Terrain, Hydrological, Pedological and Geological Features and Climate	129
7.6.2	Vegetation Mapping Using Remotely Sensed Data, Including Vegetation Condition and Temporal Variability	130
7.6.3	Mapping and Modelling Movement	131
7.6.4	Integrating Multiple Perspectives	133
7.7	Conclusion	135

8	Native Vegetation Condition: Site to Regional Assessments	139
8.1	Introduction	140
8.2	Measuring Vegetation Condition at Sites	141
8.3	Measuring Vegetation Condition across Regions	142
8.4	Case Study: Vegetation Condition in the Murray Catchment, New South Wales	143
8.4.1	Study Area	143
8.4.2	Site Data Collection	144
8.4.3	Modelling from the Site to the Region	146
8.5	Results and Discussion for the Murray Catchment Case Study	149
8.6	Conclusion	152
8.7	Future Research Directions	153
9	Towards Adaptive Management of Native Vegetation in Regional Landscapes	159
9.1	Introduction	159
9.2	What Adaptive Management is and is not	161
9.2.1	Step i: Statement of Objectives, Constraints and Performance Measures	163
9.2.2	Step ii: Specification of Management Options	164
9.2.3	Step iii: System Modelling and Model Credibility	165
9.2.4	Step iv: Allocation, implementation and Monitoring — Closing the Loop	165
9.3	Managing and Monitoring Native Vegetation	167
9.3.1	An Example of a Formal Approach to Adaptive Management of Vegetation Condition	169
9.4	Research	175
9.5	Conclusion	176
9.6	Future Directions	177
	Appendix	181
10	Revegetation and the Significance of Timelags in Provision of Habitat Resources for Birds	183
10.1	Introduction	184
10.2	Methodology	186
10.2.1	Model Description	186
10.3	Case Study	191
10.3.1	Results	192
10.3.2	Discussion	197
10.4	Caveats and Extensions	199
	Appendices	204

11	The Application of Genetic Markers to Landscape Management	211
11.1	Introduction	212
11.1.1	The Need for Information on How Biota Occupies and Moves through Landscapes	212
11.1.2	A Spectrum of ‘Genetics’ in Landscape Management and Planning	213
11.1.3	Molecular Population Biology Supplies Information Essential for Landscape Planning and Management	213
11.2	Background	215
11.2.1	Three Levels of Analysis Assess Three Levels in Time and Space	215
11.2.2	Main Molecular Tools in Landscape Molecular Population Biology	217
11.3	Case Studies	220
11.3.1	Impacts of Habitat Fragmentation on Cunningham’s Skinks	220
11.3.2	Dispersal and Gene Flow of Greater Gliders through Forest Fragmented by Pine Plantation	221
11.3.3	Catchments Catch All: Congruent Patterns in Diverse Invertebrate Fauna in Decaying Wood at a Landscape Scale	222
11.4	Future Trends	223
11.5	Conclusion	225
11.6	Future Research Directions	225
	Appendix	231
12	Scenario Analysis with Performance Indicators: a Case Study for Forest Linkage Restoration	235
12.1	Introduction	236
12.2	Background	237
12.3	Linkage restoration	239
12.3.1	Indicator Rule 1: Site Recovery Capacity	240
12.3.2	Indicator Rule 2: Site Biodiversity Value	241
12.3.3	Indicator Rule 3: Landscape Linkage Qualities	242
12.3.4	Indicator Rule 4: Landscape Connectivity	242
12.4	Atherton Tablelands Case Study	243
12.4.1	Restoration scenarios	245
12.4.2	Scenario Evaluation	246
12.5	Conclusion	247

Part 3: Socioeconomic Dimensions to Landscapes	251
13 Strategic Spatial Governance: Deriving Social–Ecological Frameworks for Managing Landscapes and Regions	253
13.1 Introduction	254
13.2 A Potted History of Catchments for Resource Governance	254
13.3 Defining Regions for Resource Governance	256
13.3.1 Principle 1	256
13.3.2 Principle 2	257
13.3.3 Principle 3	259
13.4 Application of Principles to Spatial Analysis	259
13.4.1 Delineating Civic Regions from a Social Surface	260
13.4.2 Deriving a Hierarchy of Civic Regions	262
13.4.3 Deriving Ecoregions	264
13.4.4 Integrating Ecoregions and Civic Regions through Boundary Optimisation	265
13.4.5 Comparing the Performance of Regions	266
13.5 Conclusion: Past, Present and Future Resource Governance	269
13.6 Future Directions	270
14 Placing People at the Centre of Landscape Assessment	277
14.1 Introduction	277
14.2 Background	278
14.3 Methodology	279
14.3.1 Pressure–State–Response Model	279
14.3.2 Driving Forces–Pressure–State–Impact–Response Model	281
14.3.3 Millennium Ecosystem Assessment Framework	281
14.3.4 Indicator Selection	282
14.4 A Landscape Approach for Victoria	283
14.4.1 Definitions of Five Victoria Landscapes	284
14.4.2 The Role of Indicators	285
14.5 Case Study 1: Semi-arid Landscape	285
14.5.1 Overview	286
14.5.2 Employment Indicator	288
14.5.3 Index of Stream Condition Indicator	290
14.5.4 Land Use Diversity Indicator	291
14.5.5 Management Response	293
14.6 Case Study 2: Coastal Landscape	293
14.6.1 Overview	294
14.6.2 Visitors to Parks and Reserves Indicator	295
14.6.3 Ratio of Land Value to Production Value Indicator	296

14.6.4	Land Use Diversity Indicator	297
14.6.5	Policy Response	298
14.7	Overview of Results	299
14.8	Conclusion	299
14.9	Future Research Directions	300
15	The Social Landscapes of Rural Victoria	305
15.1	Introduction	305
15.2	A Narrative of Rural Transformation in Australia	306
15.2.1	International Agricultural Competition	306
15.2.2	Agricultural Restructuring	307
15.2.3	Amenity Values in the Rural Land Market	307
15.2.4	Indicators Derived from the Narrative	308
15.3	From Indicators to Social Landscapes	310
15.3.1	Factor Analysis Using the Principal Components Method	310
15.3.2	Creating a Geography of Amenity and Intensification	314
15.4	Five Social Landscapes	315
15.4.1	The Production Landscape	316
15.4.2	The Transitional Landscape	317
15.4.3	The Amenity Farming Landscape	318
15.4.4	The High Amenity Landscape	319
15.4.5	The Intensive Agriculture Landscape	319
15.5	Conclusion	322
15.6	Future Research Directions	323
16	A Decision Aiding System for Predicting People's Scenario Preferences	327
16.1	Introduction	327
16.2	Background	328
16.3	An Extra Step for the SDSS Discipline	329
16.4	Description of the <i>Preference Prediction</i> Software	331
16.4.1	Finding a Larger Set of Criteria	331
16.4.2	Finding Relationships between Criterion Scores and Overall Scenario Merit	331
16.4.3	The Underlying Assumption	333
16.5	An Urban Planning Case Study Application of the <i>Preference Prediction</i> Software	334
16.5.1	Assigning Criteria Scores to the Scenarios	335
16.5.2	Predicting Scenario Ratings for Overall Merit	336

16.5.3	Checking the Personal Characteristics of the Advisors	338
16.5.4	Predicting Scenario Merit Ratings on Behalf of Past Workshops	338
16.5.5	Exploring How Scenario Ratings Were Derived	339
16.5.6	Searching for Reasons behind Each Scenario Merit Rating	342
16.5.7	Predicting All Groups' Preferences Simultaneously	345
16.6	Future Trends	347
16.7	Conclusion	347
16.8	Future Research Directions	348
Part 4: Land Use Change and Scenario Modelling		351
17	Mapping and Modelling Land Use Change: an Application of the <i>SLEUTH</i> Model	353
17.1	Introduction	353
17.2	Methodology	355
17.3	Results and Discussion	358
17.4	Conclusion	364
18	Uncertainty in Landscape Models: Sources, Impacts and Decision Making	367
18.1	Introduction	368
18.2	Models, Variability and Sources of Uncertainty	369
18.2.1	Model Structure	370
18.2.2	Natural Variability, Temporal Resolution and Spatial Resolution	371
18.2.3	Taxonomic Scale and Data Collection	375
18.2.4	Summary on Models and Sources of Uncertainty	377
18.3	Model Uncertainty and Decision Making	377
18.4	Conclusion	381
19	Assessing Water Quality Impacts of Community Defined Land Use Change Scenarios for the Douglas Shire, Far North Queensland	383
19.1	Context and Case Study Location	384
19.2	Dialogue over Sustainable Future Landscapes and Seascapes	386
19.3	Methodology of an Application of a Social–Ecological Framework for Sustainable Landscape Planning	387
19.3.1	Stage I: Community Perceptions and Visions	387
19.3.2	Stage II: Community-driven Landscape Scenarios	389

19.3.3	Stage III: Modelling of Landscape Scenarios and Assessing Water Quality	389
19.4	Results and Discussion	391
19.4.1	Visions for the Douglas Shire Coastal Landscape	391
19.4.2	Spatially Explicit Land Use Change Scenarios	392
19.4.3	Inputs into <i>SedNet</i> for Water Quality Analysis and Model Results	399
19.5	Conclusion	401
20	Analysing Landscape Futures for Dryland Agricultural Areas: a Case Study in the Lower Murray Region of Southern Australia	407
20.1	Introduction	408
20.2	Futures Thinking and Scenario Analysis	409
20.3	The Lower Murray Landscape Futures study	411
20.3.1	Collaborative and Participatory Approach	412
20.3.2	Defining Targets, Scenarios and Policy Options	413
20.3.3	Landscape Futures Analysis	419
20.4	Results	425
20.5	Risk, Preference and Strategic Policy Adoption	429
20.6	Further Research	430
20.7	Application in Other Regions and Contexts	431
20.8	Conclusion	431
21	Applying the <i>What If?</i> Planning Support System for Better Understanding Urban Fringe Growth	435
21.1	Introduction	435
21.2	The <i>What If?</i> Planning Support System	436
21.2.1	Suitability Module	438
21.2.2	Demand Module	438
21.2.3	Allocation Module	438
21.3	Mitchell Shire Application of <i>What If?</i>	439
21.3.1	Input Data Layers	442
21.3.2	Land Suitability Analysis	445
21.3.3	Demographic Projections and Land Use Demand	447
21.3.4	Future Land Use Allocation Scenarios 2031	449
21.4	Future Work	451
21.5	Conclusion	451

Part 5: Landscape Visualisation	455
22 Understanding Place and Agreeing Purpose: the Role of Virtual Worlds	457
22.1 Introduction	457
22.2 Established Options for Understanding Place	459
22.3 Emerging Options	460
22.4 Development Methodology	461
22.4.1 <i>SIEVE</i>	461
22.4.2 Links to Decision Support Systems	463
22.4.3 Virtual Decision Environment	463
22.5 Conclusion	464
23 Geographic Landscape Visualisation in Planning Adaptation to Climate Change in Victoria, Australia	469
23.1 Introduction	470
23.2 Context of Visualisation and ‘Sense of Place’	471
23.3 Climate Change Predictions and Impacts in South-eastern Australia	472
23.3.1 Climate Change and the Need for Ecological Connectivity	473
23.3.2 Biolink Zones in South-eastern Australia	474
23.3.3 Visualisation Tools for Explaining the Context of Biolinks	474
23.3.4 Visualisation of Environmental Change at a Site over Time	475
23.4 Realism behind Visualisation Technology	479
23.5 Realism at the Front End	480
23.6 Future Directions	483
23.7 Conclusion	484
24 Visualising Alternative Futures	489
24.1 Introduction	490
24.2 The Barwon Heads Peri-urban Development Visualisation Tool	491
24.3 The Central Business District of Melbourne <i>What the City Might Be?</i> Prototype	495
24.3.1 Marvellous Melbourne	495
24.3.2 Melbourne and the Removal of Significant Buildings	497
24.3.3 Prototype World	498
24.3.4 Initial Impressions	502

24.4	Visualising Proposed Landscapes: Sydney Rd, Brunswick	503
24.5	Usefulness of the Prototypes	505
24.6	Conclusion	505
25	Virtual Globes: the Next GIS?	509
25.1	Introduction	510
25.2	Methodology	511
25.3	Results	515
25.3.1	Hardware	515
25.3.2	Background Data	516
25.3.3	GIS Data Import	517
25.3.4	Display and Data Manipulation	519
25.3.5	Data Sharing	522
25.3.6	Openness and Customisation	522
25.3.7	Performance	522
25.4	Discussion	523
25.4.1	Applications	524
25.5	Conclusion	529
26	A Virtual Knowledge World for Natural Resource Management	533
26.1	Introduction	534
26.2	Virtual Worlds	535
26.3	<i>NRM Virtual Knowledge World</i>	536
26.4	<i>Bet Bet Virtual Landscape</i>	537
26.5	<i>Victorian Virtual NRM Knowledge Arcade</i>	544
26.6	Future Work	547
26.7	Conclusion	548
27	Computer Games for Interacting with a Rural Landscape	551
27.1	Introduction	552
27.2	Cognitive Science	554
27.3	Conversation Theory	555
27.4	Visualisations	555
27.4.1	Viewing Simulations	556
27.4.2	Mobile and Computer Games	557
27.5	Game Development	558
27.5.1	<i>Trainz</i>	559
27.5.2	<i>Farcry</i>	561
27.5.3	<i>Unreal Tournament 2004</i>	562
27.5.4	<i>Second Life</i>	563
27.6	<i>The Bushfire Rescue Game</i>	565
27.7	Conclusion	568

28	Automated Generation of Enhanced Virtual Environments for Collaborative Decision Making Via a Live Link to GIS	571
28.1	Introduction	572
28.2	Background	574
28.3	Methodology	576
28.4	Case Study and Discussion	580
28.5	Conclusion and Outlook	587
29	Land Use Decision Making in a Virtual Environment	591
29.1	Introduction	592
29.2	Rational Decision Making	593
29.2.1	Values, Attitudes and Behaviours	593
29.3	Methodology	594
29.3.1	Social: Agent-based Modelling	595
29.3.2	Environmental: Three-dimensional Visualisation	595
29.3.3	Economic: Experimental Economics	596
29.3.4	Experiment Design	597
29.4	Environmental and Economic Efficiency: Results and Discussion	600
29.4.1	Complexity	601
29.4.2	Visualisation	602
29.4.3	Social context (ABM)	604
29.4.4	Value Priorities	605
29.4.5	Experience	606
29.5	Conclusion	606
	Index	609



<http://www.springer.com/978-3-540-69167-9>

Landscape Analysis and Visualisation
Spatial Models for Natural Resource Management and
Planning

Pettit, C.; Cartwright, W.; Bishop, I.; Lowell, K.; Pullar, D.;
Duncan, D. (Eds.)

2008, XXXII, 614 p., Hardcover

ISBN: 978-3-540-69167-9