

Index

A

Active remote sensing/active sensors, 4–5
Adequacy, 214. *See also* Reserve design
Adjacencies, 54, 56
Advice for instructors, vii
Aerial photographs/photography, 21, 23, 25, 27–29, 31, 32, 34
African continent, 326, 328
Agriculture, 24, 158, 161, 277, 323
Anisotropy, 54
Aquatic systems. *See* Coral reefs; Eutrophication; Fisheries; Fish habitat; Reefs; Seascape(s); Water quality; Watershed
ArcGIS/ArcMap, 12, 245, 248
Australia, 211, 224
Autocorrelation/autocorrelograms, 65, 71, 182

B

Bandwidth, 7
Betweenness centrality, 332. *See also* Network analysis
Biodiversity target, 216
Boundary length modifier (BLM), 218, 224
British Columbia, Canada, 29

C

Carbon, 289
 field exercise, 293
 flux, 296–298
 forest fragmentation (impact of), 295–296
 land cover, 294

 Reducing emissions from deforestation and forest degradation (REDD), 298
 scaling, 292
 stock, 290
Centrality measures, 332. *See also* Network analysis
Citizen science, 27, 41
City parks, 283
Classification, 27. *See also* Photointerpretation
 categorical vs. continuous, 175, 187–189
 classification error, 35, 36
 classification scheme, 30, 34, 36, 37
 image thresholding, 16, 187
 National Land Cover Data Set (NLCD), 61, 160, 172
Color channel, 12
Commons governance, 327, 339
Complementarity, 213
Component. *See* Network analysis
Composition. *See* Landscape composition
Conditional probabilities, 139
Conefor software, 191, 230, **241**, 245
 applications and uses, 252
 input, 241
 input extension for GIS, 248, 249
Configuration. *See* Landscape configuration
Connectivity, **definition, 231**
 See also Landscape connectivity
 actual, 195
 comparison between landscape and patch connectivity, 195
 critical threshold(s), 97
 functional, 195
 habitat reachability, **definition, 232, 236, 237**

- Connectivity (*cont.*)
 intrapatch vs. interpatch connectivity,
 definition, 232, 236, 239
 patch, **definition, 51, 52, 58, 67, 83–85**
 potential, 195
 stepping stone patch(es), 231, 244, 246
 structural, 195
- Contagion (C), 54, 55, 98
- Coral reefs, 301, 303, 319
- Cor_len, **definition, 94**
- Correlation coefficient (*r*), 66
- Correlogram(s), 182
- Critical threshold(s), 97
- D**
- Degree centrality, 197, 332
- Dispersal, 198, 246, 248
- Dispersal flux, 243, 244
- Distance decay, 67
- Disturbance, **definition, 30, 146, 175, 176,**
 179, 182
 bark beetle, 177, 179, 180
 fire, 177, 180, 187
 HARVEST Lite model, 145
 Normalized Burn Ratio (NBR), 181
 patch, 146
 recovery, 153
 time since disturbance, 139
- Domain, 197, 204
- Dominance (*D*), 48–51
- Drones. *See* Unmanned aerial vehicles
 (UAVs)
- E**
- Ecosystem processes, 275
- Ecosystem services, 275, 289, 323
 trade-offs, 281, 323
- Edge:area ratio, 52
- Edge density, 52
- Edge/edge habitat/edge width, 52, 145, 147,
 153, 158, 295
- Efficiency, 214. *See also* Reserve design
- Eigenvector, 131
- Eight (8)-neighbor rule. *See* Neighbor rules
- Electromagnetic spectrum, 4
- Equilibrium state, 131
- Equivalent Connectivity, 236–238, 245.
See also Network analysis
- Error(s)
 classification, 35, 36
 geometric, 35
 positional, 35
 radiometric, 35
 relief displacement, 35
- Eutrophication, 276
- F**
- False color composite, 14
- Feedback(s), 304, 323
- Field data/exercise, 65, 72, 293
- Fisheries, 325, 328, 331, 335, 337
- Fish habitat, 23
- Fishing gear(s), 308, 320, 331, 336
- Flightline, 23
- Forest. *See also* Disturbance
 aerial photographs/photography, 21, 23,
 31, 32, 34
 harvest, 177, 179, 180
 HARVEST Lite model, 145, 146, 148
 historical, 23–26, 28–31
 loss, 289
 Markov model, 129, 136, 139
 productivity, 37, 38
 tropical, 255–256, 289–291
- Four (4)-neighbor rule. *See* Neighbor rules
- Fractals, 78
- FRAGSTATS, **instructions, 45, 57–60, 158,**
 176, 186, 188
- Functional connectivity, 195
- G**
- Gaussian random value (GRV), 88
- Geographic Information System (GIS), 79.
See also ArcGIS/ArcMap
- Geometric error(s), 35
- Google Earth, 14, 41, 42
- Grain, 5
- Graph theory. *See* Network analysis
- GS+ software, 176, 182
- H**
- Habitat reachability, **definition, 232, 236, 237**
- Harvest (forest), 177, 179, 180
- HARVEST Lite model, 145
 assumptions, 148
instructions, 146
- Heterogeneity, 35, 68, 175, 279, 280, 289, 329
- High spatial resolution imagery, 6, 27
- History, importance of, 139
- Hub. *See* Network analysis
- Hyperspectral. *See* Remote sensing

I

- Image thresholding, 16, 187
- Information theory, 46
- Instructor's notes, vii
- Integral Index of Connectivity (IIC).
 See Network analysis
- Interior habitat, 145, 153
- Interpatch connectivity, **definition**, **232**,
 236, 239
- Intrapatch connectivity, **definition**, **232**,
 236, 239
- Isotropic, 78, 108

K

- Kriging, 79, 185

L

- Landsat, 12
 - Enhanced Thematic Mapper+ (ETM+), 7
 - Thematic Mapper (TM), 5, 6
- Landscape change, 21, 41, 57, 129, 138, 143
 - transition matrix (P), 130
- Landscape composition, 46, 47, 49, 50, 158.
 See also Landscape metrics
- Landscape configuration, 51, 53, 55, 158. *See also*
 Landscape metrics
- Landscape connectivity, **definition**, 193, 194,
 229, **231**, 243–245. *See also*
 Landscape metrics; Network
 analysis
 - actual, 195
 - functional, 195
 - patch connectivity (comparison with), 195
 - patch, **definition**, **51**, **52**, 58, 67, 83–85
 - potential, 195
 - reachability (habitat reachability concept)
 - connector fraction, 244–245
 - intra-, inter-, flux fraction, 243–245
 - structural, 195
- Landscape metric(s), **definition**, 45, **47**, 106,
 157, 175, 176. *See also* Network
 analysis
 - adjacencies ($q_{i,j}$), **54**, 56
 - comparison with spatial statistics, 188–189
 - Contagion (C), **54**, 55, 98
 - Cor_len, **94**
 - degree centrality (*see* Network analysis)
 - domain (*see* Network analysis)
 - Dominance (D), **48**, 49–51
 - edge:area ratio, **52**

edge density, **52**

FRAGSTATS, **instructions**, 45, **57–60**,
 158, 176, 186, 188

Integral Index of Connectivity (IIC)
 (*see* Network analysis)

largest cluster (L.C.), 94

 L.C. edge, **94**

 L.C. fractal, **94**

 L.C._rms, **94**

 L.C. size, **94**

largest component (*see* Network analysis)

link density (*see* Network analysis)

mean patch size (MPS), **52**

METALAND/Metric Finder, 157, 159,
 167, 169, 171

N matrix, 56

number of patches (NP), **51**

patch, **51**, **52**, 58, 67, 83–85

Perc/freq, **94**

probability of adjacency (q_{ij}), **54**

Probability of Connectivity (PC)
 (*see* Network analysis)

proportion (p_i), 47

Q matrix, 54, 56

Sav size, **94**

S_Freq, **94**

Shannon Evenness Index (SHEI), **48**,
 49–51

TTL clusters, **94**

TTL edges, **94**

Landscape pattern, 43, 46, 105, 143, 153.

See also Landscape metrics

 subjective/qualitative analysis, 159, 181

Landscape position, 36

Landscape replication, 159

Largest Cluster (L.C.) metrics, 94

 L.C. metrics: L.C._rms, L.C. size, L.C.
 edge, L.C. fractal, **definitions**, **94**

Largest component index, 200

Light Detection and Ranging
 (LIDAR), 5

Links. *See* Network analysis

Lyme disease, 158, 166

M

Madison, Wisconsin, USA, 59

Manual interpretation, 27–29.

See also Photointerpretation

Marine landscapes, 46, 206, 273, 305, 325,
 328, 335, 337

Marine protected area (MPA), 206

- Markov (and Markov.exe application)
 chain, 139
 input file, 136
instructions, 136
 model, 129
 output file, 137
 projection, 132
 validation, 138
 verification, 135
- Marxan software, 191, 211, 212, 223
 description, 216–221
 input files, 219–220
instructions, 222
 output files, 221
- Maryland, USA, 100
- Mean Component Size (MCS), 234
- Mean Patch Size (MPS), 52
- MEM. *See* Moran's Eigenvector Mapping (MEM)
- Memory, 139
- Metacommunities, 255, 256
- METALAND, 157, 159, 167, 169, 171
- Metric Finder, 157, 159, 161–165, 171
- Midpoint displacement algorithm, 89
- Misclassification, 36
- Model(s). *See also* Simulation models
 ecosystem processes, 275
 forest harvest, 177, 179, 180
 HARVEST Lite, 145, 146, 148
 Markov.exe, 129, 136, 139
 NetDraw software, **instructions, 330–334**
 People in Ecosystems Watershed
 Integration (PEWI), 323
 projection, 132
 QRULE, **instructions, 84, 88, 90, 94–96**
 Remmel-Fortin code, 108
 Ucinet software, 329
 validation, 138
 verification, 135
 watershed, 275, 323
- Modularity, 334
- Moisture Stress Index (MSI), 181
- Moran's Eigenvector Mapping (MEM),
definition, 264–265, 265, 268
- Multifractal maps, 88
- Multispectral, 6, 7
- Multivariate statistics, 256, 264
- N**
- National Land Cover Data Set (NLCD), 61,
 160, 172
- NDVI. *See* Normalized Difference Vegetation
 Index (NDVI)
- Neighbor rules, 83, 85
 nearest (4) neighbor rule, 51, 53, 58, 59, 85
 next-nearest (8) neighbor rule, 52, 58, 59,
 85, 86
 third-nearest (12) neighbor rule, 85, 86
- NetDraw application, 329
- Network analysis, **definition, 191–207, 195,**
 229, 325
 betweenness centrality, 332
 capercaille, 245–251
 centrality measures, 332
 component, 196
 degree centrality, 197, 332
 domain, 197
 Equivalent Connectivity, 236, **237–238, 245**
example images, 196, 203, 231, 235
 hub, 197
 Integral Index of Connectivity (IIC), 230,
 236, **237**
 interpatch connectivity, **232, 236, 239**
 intrapatch connectivity, **232, 236, 239**
 largest component, 197, 200, 204
 limitations, 233–236
 link density, 197, 200
 links, 195, 197, 198, 204, 231
 mean component size (MCS), 234
 modularity, 334
 node degree, 204
 nodes, **definition, 195, 197, 198, 203,**
230, 231
 number of components (NC), 233
 number of links (NL), 233
 Pajek software, 205
 path, 231
 Probability of Connectivity (PC), 230,
238, 245
 reachability (fractions of habitat
 reachability concept)
 intra-, inter-, flux fraction, 243–245
 topology, 244
 undirected graphs, 231
 visualization, 329–334
 weighted/unweighted, 231
- Neutral landscape model (NLM), 83, 86, 100,
 105, 295
- Neutral model, 84
- New England, USA, 60, 160, 172
- Next-nearest neighbor rule. *See* Neighbor rules
- Niche, **definition, 257**
- NLCD. *See* National Land Cover Data Set
 (NLCD)
- N matrix, 56
- Nodes. *See* Network analysis
- Non-stationarity, 139

Normalization (of landscape metrics), 48
 Normalized Burn Ratio (NBR), 181
 Normalized Difference Vegetation Index (NDVI), 15, 16
 Nugget, **definition**, 70, **182**
 Number of components (NC), 233
 Number of links (NL), 233
 Number of patches (NP), 51

O

Oblique (photography), 32
 Ordination, 259, 261
 Orthophotography/Orthorectification, 28, 29, 32, 33, 35

P

Pacific Northwest, USA, 129, 132
 Pajek software, 205
 Panama, 256, 257, 290, 292
 Panchromatic, 7, 27
 Passive sensors, 4
 Patch, **definition**, **51**, **52**, 58, 67, 83–85
 Pattern analysis, 43. *See also* Landscape metrics
 subjective/qualitative, 159, 181
 Perc/freq, **definition**, **94**
 Percolation threshold, 97
 Philippines, 304, 305, 320
 Phosphorus, 278
 Photointerpretation, 27–29
 Photo pair(s), 25
 Polygon delineation, 27
 Positional error, 35
 Potential connectivity, 195
 Principal component analysis (PCA), 259
 Probability of adjacency (q_{ij}), 54
 Probability of Connectivity (PC). *See* Network analysis
 Productivity, 37
 Proportion (p_i), 47
 Protected areas, 201–207, 211
 design, 223–224

Q

QGIS, 245, 248
 Q matrix, 54, 56
 QRULE software, **instructions**, 84, 88, 90, **94–96**
 Quebec, Canada, 42

R

R (software and/or code), 65, 78, 79, 84, 105, 108, 110, 191, 256
 Radio Detection and Ranging (RADAR), 5
 Radiometric error(s), 35
 Radiometric resolution, 8
 Range, 70, 182
 RDA. *See* Redundancy analysis (RDA)
 Reducing emissions from deforestation and forest degradation (REDD), 298
 Redundancy analysis (RDA), 258–261, 264
 Reefs, 301, 303, 319
 Regime shift, 301, 306, 319
 Relief displacement, 35
 Remote sensing, 3–18, 21–38. *See also* Landsat and Vegetation indices
 active sensors, 4, 5
 aerial photography, 21, 25, 27–29, 31, 32, 34
 bandwidth, 7
 classification, 27, 30, 34–37
 color channel, 12
 electromagnetic spectrum, 4
 error(s), 35, 36
 false color composite, 14
 flightline, 23
 high spatial resolution imagery, 6, 27
 hyperspectral, 7
 image thresholding, 16, 187
 Light Detection and Ranging (LIDAR), 5
 misclassification, 36
 multispectral, 6
 National Land Cover Data Set (NLCD), 61, 160, 172
 Orthophotography/Orthorectification, 28, 29, 32, 33, 35
 passive sensors, 4
 RADAR, 5
 resolution, 5–8
 spectral reflectance/response, 9, 10, 13
 true color composite, 12
 unmanned aerial vehicles (UAVs), 27
 Reserve design, 198–199, 201–207, 223–224, 245. *See also* Marxan
 adequacy, 214
 efficiency, 214
 principles, 213
 representation, 213
 Resolution
 radiometric, 8
 spatial, 5, 6
 spectral, 7, 8
 temporal, 7
 Restoration, 298
 Riparian, 23, 276

S

Sav size, **definition, 94**

Scale. *See also* Resolution

detection, 65

mismatch, 336

Seascape(s), 46, 206, 273, 305, 325, 328, 335, 337

Semivariograms/Semivariance, **definition, 65, 69, 71, 176, 182, 184, 188**
interpretation, 75

Sensitivity analysis, 145, 222

Sensors. *See* Remote sensing

S_Freq, **definition, 94**

Shannon Evenness Index (SHEI), 48–51

Sill, 70, 182

Simple random map, 86–88

Simulated annealing, 218, 219

Simulated landscape(s), 45, 65, 83, 108, 143

Simulation model(s), 143–145

HARVEST Lite, 145, 146, 148

Markov.exe, 129, 136, 139

People in Ecosystems Watershed
Integration (PEWI), 323

QRULE, **instructions, 84, 88, 90, 94–96**

Rommel-Fortin code, 108

watershed, 275, 323

Social networks, 325

betweenness centrality, 332

centrality measures, 332

degree centrality, 332

examples, 333, 337

hub, 328

modularity, 334

NetDraw software, **instructions, 330–334**

nodes (actors), 327

ties (relations), 327, 330

Ucinet software, 329

Software/applications

ArcGIS/ArcMap, 12, 245, 248

Conefor software, 191, 230, **241, 245, 248, 249, 252**

GS+ software, 176, 182

HARVEST Lite, 145, 146, 148

Markov.exe, 129, 136, 139

Marxan, **instructions, 191, 211, 212, 216–221, 222, 223**

NetDraw software, **instructions, 330–334**

Pajek software, 205

People in Ecosystems Watershed
Integration (PEWI), 323

QGIS, 245, 248

QRULE, **instructions, 84, 88, 90, 94–96**

Rommel-Fortin code, 108

R software/code, 65, 78, 79, 84, 105, 108, 110, 191, 256

Spatial analyst extension (in ArcGIS), 15

Ucinet software, 329

Zonae Cogito application, 222, 223

Source-sink dynamics, 314

Spain, 246

Spatial analyst extension (in ArcGIS), 15

Spatial autocorrelation, **definition, 66, 98, 105–124, 263**

Spatial compactness, 214–216, 224

Spatial dependence, 66, 67, 139

Spatial lag, 69

Spatial resolution, 5, 6

Spatial statistics, 66, 175, 179, 182. *See also*
Spatial autocorrelation;
Variography/variogram(s)

comparison with FRAGSTATS, 188–189
kriging, 79, 185

spatial dependence, 66, 67, 139

spatial lag, 69

trend-surface analysis, 264

Species penalty factor (SPF), 218

Spectral

reflectance, 9, 10

resolution, 7, 8

response curve, 10, 13

Stakeholder(s), 224, 326

Stationarity, 139

Steady-state, 131

Stepping stone patch(es), 231, 244, 246

Stereo-

stereo pair(s), 25, 26

stereoscope, 25, 26

stereovision, 25

Stochasticity, 138

Structural connectivity, 195

Systematic conservation planning, **definition, 211, 212. See also** Marxan

T

Temporal resolution, 7

Terrain/terrain class(es), 36

Third-nearest (12) neighbor rule. *See* Neighbor rules

Time since disturbance, 139

Tipping point, 306

Topography/topographic relief, 36, 280

Topology (network topological position), 244

Transition matrix (P), 130

Tree height, 37

Trend-surface analysis, 264

True color composite, 12

TTL clusters, **definition, 94**

TTL edges, **definition, 94**

Twelve (12)-neighbor rule. *See* Neighbor rules

U

UAVs. *See* Unmanned aerial vehicles (UAVs)

Ucinet software, 329

Umbrella species, 201

Uncertainty, 36

Unmanned aerial vehicles (UAVs), 27

Urban systems, 25, 282, 283

V

Vancouver, British Columbia, Canada, 12, 15

Variation partitioning, 266

Variography/variogram(s), **definition, 65, 69,**
71, 176, 182, 184, 188

interpretation, 75

Vegetation indices

Moisture Stress Index (MSI), 181

Normalized Burn Ratio (NBR), 181

Normalized Difference Vegetation Index
(NDVI), 15, 16

Vertical photographs, 32

Visible spectrum, 9, 14

W

Washington State, USA, 23

Water quality, 275

Watershed model, 275, 323

Willamette Valley, USA, 194,
201, 202

Wyoming, USA, 176

Y

Yellowstone, 176

Z

Zonae Cogito application, 222, 223