



Index

- advection–diffusion–reaction (ADR) models, 141–143, 146, 147
- allometric scaling in ecology, 354
- allopatric speciation, 10
- bankfull discharge
 - and total contributing area at-a-site, 56
- Bayesian calibration, 218
- bifurcation analysis, 363
- biodiversity
 - evolution of dispersal strategies , 359
 - evolutionary stable strategies, 360
 - fundamental number, 4
 - loss, xvi
 - index, 4
 - patterns, 1, 2
- biodiversity measures, 30
 - α , β , and γ diversities, 17
 - β diversity, 25
- biodiversity patterns
 - directional connectivity
 - laboratory tests, 25
 - neutral, 17
 - neutral metacommunity model
 - on networks, 17
- biological invasions, xvi, 2, 114
 - demographic stochasticity, 178
 - and directional dispersal, 46
 - and heterogeneity, 176
 - and heterogeneity
 - spatially correlated resource fields, 177
 - and landscape structure, 115
 - and phototaxis, 176
 - and species coexistence, 114
- birth–death processes, 4
- branching random walk (BRW), 140–144, 146–148
 - front speed, 141
 - local and global survival, 140
- Burkina Faso, 294–297, 337, 339
- carbon sequestration
 - and fluvial ecological corridors, 354
- carbon sinks in rivers
 - mitigation strategies, 354
 - scaling studies, 356
- cholera
 - and climate, 332
 - and rainfall, 332
 - epidemic, 227, 228, 241, 243, 265, 332
 - geography of disease, 248
 - Haiti, 241, 249, 265
 - Juba, South Sudan, 332
 - Kwa Zulu Natal, South Africa, 244, 245
 - loss rate of acquired immunity, 244
 - rainfall drivers, 334
 - Senegal, 290
 - transient spread, 261
 - Zimbabwe, 241

- epidemicity, 265
 - Persistence during lull periods, 346
- contact processes, 9, 140, 143–147
 - and BRW or ADR, 146
 - and Markov chains, 143
 - and reaction–diffusion models, 146
- continuous time random walk
 - Hamilton–Jacobi formalism, 41, 166
 - jump length distribution, 166
 - model, 167
 - on Peano network, 41
 - speed of traveling waves, 166
- dendritic connectivity
 - and community composition, 29
 - and local habitat capacity, 27
- diarrheal diseases
 - and WB pathogens, 227
- diffusion–reaction models
 - and population demography, 35
 - Fisher’s model, 115
 - on Peano and OCNs, 115
 - range expansion speed, 33
 - speed of traveling waves, 115
- digital terrain models
 - Alpes Vaudoises, 109
 - and basin width functions, 213
 - and drainage density, 380
 - drainage directions, 76, 211
 - fluvial form extraction, 15, 211, 213, 271, 272, 379
 - Gran Paradiso national park, 109
 - slope–area law, 76, 379
 - Swiss alpine regions, 93
 - threshold for channel initiation, 379
 - total contributing area at a point, 49
 - finite size scaling, 379
 - unchanneled areas, 15
- direct tributary area (DTA), 51
- directional dispersal, 1
- dispersal, 10
- dispersal kernel, 16, 49, 50, 52, 67, 73, 76, 94, 96
- dispersal vectors
 - biotic and abiotic, 9
- drainage density, 12, 33, 64, 84, 88, 103, 115
- ecohydrology, xiii, xvi
 - framework, 2
 - integrated framework, xiii, 341
 - interfaces, 341
- ecological competition
 - interspecific, 4
 - intraspecific, 4
 - mutualism and commensalism, 85
- ecological corridors, xiii, xvi
- ecological dynamics
 - and directional dispersal, 25
- ecological function, 3
- ecological interactions, 1, 9
- ecological niches, 10, 85
- ecological niches
 - realized niche, 86
- ecological patterns, 1
- ecology
 - spatially explicit, 1, 2, 71, 88, 106
 - and benthic invertebrate abundance, 58
 - and directional dispersal, 2
 - and epidemiology, 2
 - and habitat suitability models, 61
 - and metacommunity models, 3, 25, 48
 - and metapopulation dynamics, 106
 - and metapopulation persistence, 52
 - patch occupancy model, 110
- eDNA, 213
 - and river networks, 358
 - bryozoans, 216
 - concentration, 217
 - decay in rivers, 214, 215, 360
 - detection of rare invasive or parasitic species, 358
 - dispersion, 213
 - heterogeneous production of, 358
 - intermittency of emission, 358
 - myxozoan parasite, 216
 - production
 - and local species’ abundance, 359
 - source biomass, 216
 - in rivers, 213
 - sampling, 360
 - sampling and measurements, 213
 - sessile vs. mobile sources, 217
 - signals, 213
 - source tracking, 215
 - spatial patterns of sources, 358
- elevational gradients of biodiversity, 84, 85, 87, 91
 - altitude-specific drivers, 88
 - within fluvial landscapes, 86
 - hump-shaped patterns, 89
 - metacommunity patterns, 94
 - and OCN landscapes, 84
- epidemic cholera
 - case-area targeted interventions, 345
 - geographic targeting of vaccinations, 348
 - point-of-use water treatment, 347
- epidemiology
 - of macroparasites, 226
 - spatially explicit, 2
 - computational tools, 386, 391, 396, 400
 - and endemic schistosomiasis, 309

- epidemiology (cont.)
 and epidemic cholera, 265
 and generalized reproduction numbers, 242
 network models of WR disease spread, 228
 and next-generation matrices (NTM), 247
 and periodic forcings, 252
 and PKD in salmonid fish, 316, 318, 322
 and SIB models on networks, 251
 and the Wigger case study, 322
 stability of disease-free conditions, 246
 and WB disease transmission in Peano networks, 249
 and WB disease transmission models, 339
 and WB transmission models, 225
- evolutionary processes, 10
- fair distribution of water, xvi
- fish diversity patterns
 and the neutral model, 49
 hierarchical metacommunity model, 48
 in the Mississippi–Missouri river system, 47
- fluvial ecosystem processes
 linkages between flow regime and biota, 354
- fluvial landscapes, 84, 85, 88, 89, 92, 93, 96, 98, 103
- fluvial metapopulation capacity, 96, 97, 99, 103
 and connectivity, 99
 and evolving network configurations, 99
 and OCNs, 100
- fractal river basins, 15
- freshwater ecosystems
 conservation plans, 2
- genetic diversity, 3
- habitat fragmentation, 10
- habitat suitability, 9
- habitat suitability models, 218
- Hack's law, 381
- hierarchical habitat features, 2
- human mobility
 census and mobile phone data, 301
 comparative studies, 290
 flux matrices, 228, 242, 243, 249–251, 255, 274, 291, 296, 298, 299, 301, 303, 310, 333
 gravity model, 243, 250, 252, 253, 255, 268, 272, 274, 290
 high-resolution tracking, 290
 mass gatherings, 290
 radiation model, 290, 301
 in Senegal, 312
 tracking by mobile phone data, 290
- human range expansions
 and structure of river networks, 44, 46, 116
 western colonization of nineteenth-century United States, 44
- human-mediated dispersal
 and rewiring of networks, 359
- hydrologic connectivity, 13
 transport matrix, 228, 242, 243, 255, 269, 273, 302, 303, 333
- hydrologic controls
 on biota, xiii
- hydrologic ephemerality
 and host survival by aestivation, 350
 periods of desiccation, 349
 and schistosomiasis, 350
 and WR disease epidemiology, 350
- infection spread, 225
- infectious diseases of humans, 225
- Keller–Segel taxis, 176
- Kleiber's law, 354
- landscape effects
 on biodiversity, 9
- landscape-forming discharge, 14, 30
- local species richness, 25–27, 30
- macroecological laws, 1
- macroparasites
 ecology, 226
 schistosomiasis transmission cycle, 296
- mayfly species, 63, 64
- metabolic principles of river basin organization, 354
- metabolic regimes
 of flowing waters, 356
 intermittent productivity, 356
- metacommunity, xiii
 dynamics, xiii
 and hydrology, 352
 predictions, xiii
- metacommunity ecology, 225
 spatially explicit ecological framework, 3
- metapopulation capacity, 72, 80, 98–103, 105
- metapopulation dynamics
 in fluvial ecosystems, 97
- metapopulation ecology, 225
- metapopulation model
 and river networks, 97
- metapopulation persistence, 64, 70, 75, 80, 341
 along-stream and overland dispersal processes, 78
 amphibians in a river system, 73
 connectivity and dispersal, 67
 criteria, 68
 dominant eigenvector, 82
 and the drift paradox in ecology, 65
 in fluvial ecosystems, xiii
 geography of population spread, 82

- of salamander species, 65
- and spread of riverine populations, 65
- role of dispersal pathways, 72
- role of environmental matrix, 76
- role of network structure, 71
- spatial, 97
- spatial patterns, 79
- spatially explicit criteria, 71
- theoretical approach, 66
- metapopulations
 - persistence in branching networks, 360
 - stability in branching river networks, 360
- metzler matrices, 82, 366
- microbial diversity
 - hydrologic controls on, 351
- microparasites
 - ecology, 226
 - ecology of disease transmission, 268
- migration fluxes, 164
- migrations, 9
- mining natural capital, xvi
- model laboratory species
 - protozoan *Euglena gracilis*, 1, 164, 176
 - protozoan community
 - Blepharisma sp.*, *Chilomonas sp.*, *Colpidium sp.*,
 - Euglena gracilis*, *Euplotes aediculatus*, *Paramecium aurelia*, *Paramecium bursaria*, *Spirostomum sp.* and *Tetrahymena sp.*, 29
 - rotifer *Cephalodella sp.*, 29
- mountain whitefish *Prosopium williamsoni*, 361
- natural capital, xvi
- natural streamflow regimes, 58
- neutral metacommunity model, 52
- neutral model
 - of biodiversity, 3, 8
 - of networks, 8
- neutral theory
 - biodiversity patterns, 8
 - of biodiversity, 3, 9
 - Hubbell's, 3
 - of molecular evolution, 3
 - on networks
 - metacommunity model, 16
 - Fisher's logseries, 4
 - individual-based model, 12
- optimal channel networks, 71, 84, 102, 116, 374, 375
 - chance and necessity, 383
 - definitions, 13
 - dynamic accessibility, 374
 - and ecological statistical mechanics, 16, 381
 - elongation, 380
 - feasible optimality, 379
 - finite size scaling, 380
 - and fractals, 381
 - and Hack's law, 381
 - invariance under coarse graining, 385
 - landscapes, 15
 - and landscape evolution, 14
 - mathematical foundations, 375
 - and real river networks, 13, 376
 - and scaling, 376
 - and spanning trees, 374
 - and their landscapes, 382
 - and total contributing area, 377
 - upstream length distributions
- oral cholera vaccination (OCV), 278
- Peano network, 41, 67, 71, 115, 116, 165–169, 174, 205, 250, 251, 254
 - stage of construction, 251
 - width function, 251–253
- Perron–Frobenius theorem, 69, 82, 98, 99, 101, 105, 246, 248, 366
- PKD bryozoan host *Fredericella sultana*, 213, 216–219, 222, 322, 316, 323, 330
 - eDNA measurements, 222, 224, 322–325, 330
- PKD parasite *Tetracapsuloides bryosalmonae*, 213, 216–219, 222, 223, 316, 317, 324, 326
 - eDNA measurements, 224
- policy analysis, xvi
- population migrations, xiii, xiv, xvi, 116, 164
 - front speed, 115
 - spawning, 187
 - and taxis, 177
- power laws, 1, 377
 - finite size scaling, 379
 - collapse of distributions, 381
 - and stream channel geometry, 54
- proliferative kidney disease in salmonid fish, xiii, 216, 222, 343, 361
 - local extinction threats, 361
 - epidemiology, 316
 - and eDNA, 322, 323
 - covert infections, 316
 - epidemiological metacommunity model, 325–327, 329, 330
 - field surveys, 324
 - fish mobility, 329
 - freshwater bryozoans, 222
 - impact, 316
 - incidence, 316
 - life cycle completion, 316
 - life cycle of causative agent, 322
 - local model, 316
 - stability of disease-free equilibrium, 317
 - mortality, 316

- proliferative kidney disease in salmonid fish (cont.)
 overt infection stages, 316
 parasite bryozoan hosts, 316
 parasite life cycle, 316
 parasite transmission from bryozoans to fish, 316
 significance of environmental covariates, 322
 space-explicit modeling, 318
 spatial distribution, 222
 spatial metacommunity model, 318
 spread in idealized networks, 318
 spread in OCNs, 320
 statoblasts, 316
 tracking parasites' eDNA, 222
 the Wigger catchment project, 322
 data collection protocols, 324
- rank-abundance curves, 17
 reaction random walk, 115
 reaction-telegraph model, 170, 172
 reactive transport on networks
 exact solutions, 32
 hydrochory, 32
 invasion wavefronts, 32
 and migration fronts, 32
 US colonization in the nineteenth century, 32
- river flow regimes, 59, 62, 64
 and invertebrate habitat suitability, 63
 and shear stresses, 63
- river metabolism
 and space-time variability of flow regimes, 354
- river networks
 function, xiii
 and the global carbon cycle, 355
 imprints on stream microbial communities, 352
 dendritic ecological matrices, 1
 hydrologic dynamics, 2
 and makeup of microbial diversity, 351
 metacommunities
 β diversities, 17
 structure, 2
 as substrate for ecological interactions, 16, 25
 as templates of disease spread, xvi
- runoff production, 48–52
 and fish habitat capacity, 51
- salamander species, 65, 73–75, 77
 overland dispersal, 76
 tracking, 75
- scale invariance, 1
 scaling theory, 1
- schistosomiasis, xv, 294, 295, 297
 in Burkina Faso, 296, 297
 and climate, 332
 diagnostic tools for elimination, 351
 control, 294, 295
 disease range expansion
 and water resources development, xv, 297, 307, 308
 disease transmission
 space-explicit, 296
 elimination, 295
 endemic, 332
 and water resources development, 335
 human–snail contact, 295
 interrupting transmission cycles, 350
 life cycle of parasites, 335
 persistence, 296
 poverty-reinforcing infections, 313
 preventive treatment, 294
 proxies of snail abundance, 350
 and rainfall, 332, 335
 reinfection after treatment, 295
 seasonal transmission cycles, 295, 339
 in Senegal, 296, 309, 312, 313
 and human mobility, 313
 and streamflow ephemerality, 348
 targeting freshwater snails, 350
 transmission cycle, 294–296
 transmission model
 space-explicit, 295, 297
 space-implicit, 295
 urinary and intestinal forms, 294
 urogenital, 313
 in Senegal, 312
- SIB models, 241, 250, 252
 dynamics on networks, 242, 250, 251, 268
 space-explicit, 268
 time varying, 254
- SIRB models
 space-explicit
 computations of stability and reactivity, 391
 MATLAB code, 400
 numerical solution, 386
 space-implicit
 numerical solution, 386
- SIRBV models, 278
 including vaccinations, 278
- slope–area law, 15
- spatial biodiversity
 effect of directional dispersal, 12
- spatially explicit epidemiology of WR disease
 cholera vaccinations, 348
 epidemic cholera, 344
 stochastic individual-based approaches, 346
 tracking human mobility, 345
 transmission hotspots, 345
- spatially explicit models of WB disease
 development scheme, 333
- spatially explicit stochastic patch occupancy, 110, 111

- and habitat suitability models, 113
- metapopulation studies, 113
- speciation processes
 - geographic and ecological, 10
- species abundance distributions
 - Malthusian demography, 5
- species dispersal
 - directional, 2
- species distributions
 - in space, 10
- species diversity
 - in neutral metacommunities, 9
- species persistence times, 2, 17
 - conservation perspective, 24
 - mean field exact results, 19
 - neutral model
 - finite size scaling, 18
 - observational distributions, 22
 - probability distribution, 20
 - and species–area relations, 24
 - and topology of the substrate, 18
- species range dynamics
 - and fluvial landscapes, 103, 107
 - fair comparison among species, 104
 - fluvial landscape effects, 103
 - and metapopulation extinction, 106
- stability of disease-free equilibrium (DFE), 302, 304, 305, 307, 391
 - bifurcation analysis for WB disease models, 304
 - dominant eigenvector analysis, 306
 - macroparasitic WB diseases, 304
 - parasite invasion conditions, 302, 307
 - reactivity, 303, 304, 396
 - schistosomiasis, 304, 306
- stability of dynamical systems, 363
 - bifurcation of cycles, 373
 - bifurcation of equilibria, 370
 - bifurcations, 364
 - equilibria and cycles, 370
 - Hopf bifurcation, 372
 - linear time-invariant systems, 363
 - nonlinear problems, 367
 - Poincaré maps, 366
 - positive systems, 366
 - saddle-node bifurcation, 371
 - time-varying periodic systems, 366
 - transcritical bifurcation, 371
- stability of linear systems
 - continuous vs. discrete time, 363
- stream biofilms, 57
- stream ecology, 2
- sub-Saharan Africa, xv, 294, 295, 299, 309, 335, 339
- susceptibles–infected (SI) models, 229, 230
 - with Malthusian demography, 230
- susceptibles–infected–recovered (SIR) models, 235
 - including bacteria in water reservoirs (SIRB models), 266, 271, 335
- susceptibles–infected–recovered–bacteria models (SIRB)
 - and bacterial dynamics in water reservoirs, 228
- sympatric speciation, 10
- topographic curvatures, 15
- topographic gradients, 15
- trait diversity, 1
- traveling waves, 116
 - biased diffusion, 170
 - dynamics, 33
 - Fisher–Kolmogorov speed, 43, 116
 - and human range expansions, 44
 - propagation speed, 42
 - propagation speed
 - slowing by branching paths, 43
- water resources
 - management plans, xvi
- waterborne (WB) and water-related (WR) diseases, 225, 227
 - pathogens, hosts, and life cycles, 225
 - on transmission modes, 226
- waterborne disease
 - and fluvial ecological corridors, 225
 - directly transmitted, 226
 - ecology of, 225
 - epidemics
 - optimal control, 2
 - human, 2
 - hydroclimatological forcings, 331
 - immunization, 226
 - macroparasitic, 226
 - microparasitic, 226
 - neglected, xvi
 - spread, xvi, 1
 - transmission, 227
 - zoonoses, 2
- waterborne disease spread
 - drivers and controls, 332
- water-related disease
 - vector-based, 344
 - data assimilation, 348
 - data-driven contact networks, 345
 - disease spread geography, 345
 - generalized reproduction numbers, 345
 - helminths, 342
 - hydrologic controls on transmission, 350
 - macroparasites and hydrology, 342
 - multiplex connectivity networks, 347
 - optimal control of interventions, 347
 - soil moisture controls, 343
 - soil-transmitted infections, 343

438 **Index**

spatially explicit descriptions, 228
spatially explicit epidemiology, 342
tracking human mobility, 344
viral, bacterial and parasitic infections, 342

Zebra mussel, 32, 65, 114, 148–152, 154–156
 as biomonitoring tool, 351
 invasions, xiii, 2, 80
 veligers, 153