

# Index

|                                                      |                                                        |
|------------------------------------------------------|--------------------------------------------------------|
| absolute abundance, microbial species 169–171        | biodiversity characteristics                           |
| abundance                                            | macroscopic organisms 169                              |
| and metabolic rate 8–9                               | microbial species 169                                  |
| consumer:producer                                    | biogeography and size <i>see</i> microbial species     |
| ratios 11–12                                         | biological scaling relations 1–4                       |
| distribution across species 2                        | biomass                                                |
| <i>Acartia tonsa</i> (copepod) 24–25                 | and body size (stream communities) 56, 57, 60, 61,     |
| acidification effects in freshwaters 112–113         | 62, 68–71                                              |
| adaptive dynamics                                    | and diversity 246–247                                  |
| evolutionarily unbeatable strategy 36                | consumer:producer ratios 11–12                         |
| fitness definition 36                                | distribution across species 2                          |
| frequency and density dependence 36–37               | estimates 42                                           |
| relationship of traits to fitness 35–36              | biomass invariance mechanisms 146, 148–152             |
| trade-offs among traits 35–36                        | biomass per unit volume, consistency of 245            |
| adaptive dynamics life history model 35–36           | biomass production rates, individual organisms 5       |
| Allee effect 236–237                                 | biomass turnover (P/B)                                 |
| allometric equations, form of 1–2                    | factors affecting <u>000</u>                           |
| allometric scaling strategies 227–228                | range of rates <u>000</u>                              |
| alternative states and body size distributions       | biomass turnover (P/B) and body size                   |
| 235–239                                              | (stream communities) <u>000</u>                        |
| aquatic ecosystems                                   | application of the MTE 60, 62–68                       |
| body size as a structuring force 98–99               | biomass 56, 57, 60, 61, 62, 68–71                      |
| individual biomass production rates 5                | biomass turnover rate (P/B) predictions and            |
| individual metabolic rate and body size 4–5          | results 56, 57, 61, 62, 63, 66, 68–71                  |
| temperature corrections 3–4                          | differences in temperate and subtropical streams       |
| aquatic invertebrates (dispersal and body size)      | 60, 62–68                                              |
| 188–193, 195, 196, 198, 200, 201                     | discussion 60, 62–68                                   |
| active dispersers in freshwaters 188–189             | metabolic theory of ecology 55–56                      |
| active dispersers in freshwaters (case studies) 188, | population density 56, 60, 61–62, 65,                  |
| 193–196                                              | 68–71                                                  |
| dispersal in marine systems 191–193                  | predictions 56–57, 68–71                               |
| dispersal in marine systems (case studies) 199–203   | production (P) 56, 57, 61, 63, 64, 68–71               |
| passive dispersers in freshwaters 188, 190–191       | results 60–62, 63, 64, 65, 66                          |
| passive dispersers in freshwaters (case studies)     | secondary production rate 55–56,                       |
| 188, 196–199                                         | 68–71                                                  |
| Arctic char 236, 237                                 | study streams 57–59                                    |
| Atlantic silverside ( <i>Menidia menidia</i> ) 41    | tests of predictions 59–60                             |
| <i>Avelia martinicensis</i> 175                      | bluegill sunfish ( <i>Lepomis macrochirus</i> ) 39, 40 |
|                                                      | body size                                              |
| B (mass-specific metabolic rate) 2                   | adaptive plasticity in Cladocera 37–39                 |
| b (scaling exponent) 1–44, 45                        | correlation with characteristics of organisms 1–2      |
| <i>Bacillus cereus</i> 247                           | early writings and studies ix–x                        |
| <i>Bacillus subtilis</i> 247                         | link to patterns in natural systems 98                 |
| bacteria, body size 1                                | range of variation among organisms 1                   |
| barndoor skate ( <i>Dipturus laevis</i> ) 267–268    | relation to metabolic rate 1–2                         |

- body size (cont.)
  - relationship with temperature 42
  - variation within species 226
- body-size distribution (BSD) in communities 140
  - effects of shifts in 112–113
  - multifractal properties 155–156, 157, 158–159
- body-size increase, costs and benefits in suspension feeders 19–24
- body-size measurement, difficulties in suspension feeders 17
- Boltzmann-Arrhenius factor 2
- Boltzmann's constant ( $k$ ) 2
- brown trout 236, 237
- BSD *see* body-size distribution
- cannibalistic system 233–234, 235
- capelin 237
- carbon cycle, and metabolism of organisms 9–11
- carbon:phosphorus:nitrogen ratio 9–10
- carbon:phosphorus ratio
  - influence on growth rate 6
  - relation to body size 6
- carbon turnover and plant size 10–11
- Cladocera, adaptive plasticity in body size 37–39
- common skate (*Dipturus batis*) 267–268
- community consequences of body size (microbial systems) 249–250, 252–256, 257, 258, 259, 260, 261–262
- community size distributions 110–112
  - and food web construction 110–112
  - distinct multiple nodes 111–112
  - factors affecting size structure 112
  - invertebrate macrofauna 111–112
  - megafauna 111–112
  - meiofauna 111–112
  - vertebrate macrofauna 111–112
- Condylotoma reichi* 175
- consumer:producer ratios
  - abundance 11–12
  - biomass 11–12
  - metabolic energy flux 11–12
- copepods
  - body size in relation to prey size 24–25
  - estimation of global patterns of mortality 46–47, 48
- Coregonus albula* 229
- cosmopolitan-biogeography transition
  - size 171–172
  - general validity 180–181
- cosmopolitan distribution theory (microbial species) 168, 172–180
  - 'biogeography' of microbes 180
  - cosmopolitan genotypes (rDNA) 178–180
  - diversity of cryptic protists exceeds active species 172–174
  - endemic species 168, 175–178, 179
  - habitat influence on species composition 168, 175–176
  - habitat selects for cryptic or active phase 172–174
  - local:global species ratios 176, 177
  - random dispersal of free-living protists 168, 174
  - similar species inventories irrespective of geographical distance 174
  - species concepts 178
  - undersampling problem 176–178, 179
- Cyclidium glaucoma* 178–179, 181
- density and biomass scaling 146–148
- density-body-mass scaling 144–145
  - with sample area 145–146, 147
- density dependence (strength of compensation), response to additional mortality 270–273
- determinate growth 228
- diatom communities, influences on species composition 175–176
- Dipturus batis* (common skate) 267–268
- Dipturus laevis* (barndoor skate) 267–268
- dispersal
  - challenges for aquatic organisms 187–188
  - microbial species 169–171
- dispersal ability
  - macroecological significance 187
  - traits which influence 187
- dispersal and body size (aquatic invertebrates)
  - 188–193, 195, 196, 198, 200, 201
  - active dispersers in freshwaters 188–189
  - active dispersers in freshwaters (case studies) 188, 193–196
  - dispersal in marine systems 191–193
  - dispersal in marine systems (case studies) 199–203
  - passive dispersers in freshwaters 188, 190–191
  - passive dispersers in freshwaters (case studies) 188, 196–199
- distribution, cosmopolitan-biogeography transition
  - size 171–172
- disturbance, effects on marine species diversity 216, 218–220, 221
- diversity *see* species diversity
- Dreissena* spp. (mussels) 289
- Dyar's constant 211, 212
- E-state (environmental state) 231
- ecological stoichiometry and nutrient relations 2
- ecosystems
  - application of MTE 9–12
  - biomass invariance mechanisms 146, 148–152
  - body-size distribution (BSD) 140
  - body-size scaling relationships 98
  - carbon turnover and plant size 10–11
  - consequences of body size (microbial systems) 250–251, 256–259, 260, 262–263
  - effects of community size spectrum 43
  - element turnover rate and metabolic rate 9–10
  - energy and materials flow in food webs 11–12
  - flux and storage of elements 9–12
  - flux and storage of energy 9–12
  - fractal geometry framework for patterns and relationships 141–143
  - influence of body size 225–226
  - influence of body-size attributes 140
  - particle-size distribution (PSD) in benthic habitats 142
  - power-law behaviour 140–143

- role of metabolism in trophic relationships 11–12
- scale-invariance and fractal properties of SADs 141–142
- scale-invariance and fractal properties of SARs 141–142
- scale-invariance properties 140–143
- species-abundance distribution (SAD) mechanisms 146, 148–152
- storage of elements in living biomass 9–10
- stressor-induced size-spectrum changes 112–113
- stressor-induced species loss 112–113
- egg hatch times
  - and egg protection strategy 48–49
  - model 47–49
- egg-to-adult times, model 47–49
- endothermy and individual growth rate 228
- energy availability models 273–274
- energy equivalence rule 8–9
- energy flux, consumer:producer ratios 11–12
- energy transfer in predator–prey interactions 274
- energy use across species 2
- energy use of populations, and body size 8–9
- environmental gradients
  - and body size 78
  - biomonitoring tools 94
  - body size patterns 90–94
  - in stream ecosystems 78
- environmental gradients and body size (stream studies) 78–85
  - agricultural and mining pollution 84–85
  - altitude 82–83
  - catchment land use 82
  - chemical contaminants 84–85
  - descriptive studies of abiotic gradients 79–81
  - descriptive studies of biotic gradients 81–82
  - descriptive studies of complex gradients 82–83
  - disturbance regime 79–80
  - experimental studies 83–85
  - floods 81
  - hydraulic stress 81
  - New Zealand streams database 85–88, 89, 90, 91, 92
  - phosphate availability 81–82
  - predation 82, 83–84
  - primary productivity 82
  - substrate particle size 80, 83–84
- evolution
  - fisheries-induced 40–41
  - of body size *see* life history analysis; life history theory
- feeding and size
  - factors affecting variation in prey choice 101–105
  - individual level processes 100–105
  - ontogenetic dietary shifts in predators 104–105
  - scaling to species 105–110
  - size constraints on predation 100–105
- fish eggs, ontogenetic development rate and body size 5–6
- fish species, mortality selection for smaller size at maturity 40–41, 42
- fisheries
  - describing and predicting community responses 274–280
  - genetic shifts in mature size of fish 40–41
  - modelling effects on community size structure 274–280
  - shifts in fish community size spectrum 43
  - size-based responses to fishing 274–280
- fisheries-induced evolution 40–41
- fisheries management
  - changes in size-spectra slopes 269
  - extinction of marine species 267–268
  - ‘fishing down the food web’ 268
  - indirect effects of fishing 269
  - magnitude of fishing effects 267–268
  - population and community effects of exploitation 266, 267–268
  - seabed damage by fishing gear 268, 269
  - significance of body size 266
  - size-related effects of fishing 268–269
  - size-related responses to exploitation 268–269
  - state of the world’s fisheries 267–268
- flow regime (Reynolds number, *Re*), and body size 17–18
- food availability, and body size (suspension feeders) 21, 26–28
- food-chain body sizes
  - lower limit to mass of host and parasite 307
  - metaphoetesis 306–307
  - parasite chains 306–308
  - parasitoid chains 306, 307
  - power-law relationships 306, 307
  - predator chains 306–308
  - predator–prey size relationships 306–308
  - social hunters 306–307
  - upper limit to mass of predators and prey 307
- food-chain body sizes data
  - differences between terrestrial and coastal communities 310, 314, 321–322
  - empirical values of the exponent 310, 314, 321–322
  - examination of Hutchinson’s (1959) arguments 319–321
  - limits to mass of host and parasite 310, 314, 321–323
  - limits to mass of predator and prey 310, 314, 321–323
  - power-law relationships 310, 314, 321–323
- food-chain body sizes theory 308–313
  - maximal and minimal body masses 308–311
  - predicted value of the exponent 311–312
  - ratios and differences of consumer mass and resource mass 312–313
  - see also* food webs data
- food-dependent development 235–239
- food-dependent growth 228
- food webs 2
  - application of MTE conceptual framework 11–12
  - body size structure 11–12
  - construction of size-based models 113–114
  - construction related to community size distributions 110–112
  - feeding loops 110

- food webs (cont.)
  - 'life history' omnivory 110
  - masking of size-related effects 107, 108, 109–110
  - rates of energy and material flow 11–12
  - role of metabolism 11–12
  - species-averaging effects 105–110
  - structure by size rather than species 110
  - synthesis of approaches to 12
- food webs data 313–319
  - studies of a well-defined community 313–317
  - studies that pool multiple communities 314, 317–319
- fractal geometry framework for patterns in ecosystems 141–143
- fractal properties of size-structured communities 152–159
- Gadus morhua* (North Atlantic cod) 237
- Gadus morhua* (northern cod) 40–41
- global patterns of life history, prediction 47–49
- global patterns of mortality in copepods, estimation 46–47, 48
- growth and development patterns 226–229
  - allometric scaling strategies 227–228
  - classification of growth types 228
  - determinate growth 228
  - endothermy and individual growth rate 228
  - food-dependent growth 228
  - indeterminate/plastic growth 228
  - link between individual traits and community attributes 229
  - population-level feedback and dynamics 229
  - scaling constraints 227–228
  - see also ontogenetic development
- growth-rate hypothesis 6
- habitat complexity
  - and predator–prey interactions 129–132
  - and species complexity 129–132
  - and trophic cascades 129–132
- hatching rate and body mass 5–6
- Hubbell's unified theory of biodiversity (UTB) 149–152
- Hutchinson's (1959) arguments, food chain body size and diversity 319–321
- Hutchinsonian ratio 211
- i*-state (individual) distribution models 230–231
- indeterminate/plastic growth 228
- individual body size and population dynamics 229–240
  - alternative states and body size distributions 235–239
  - cannibalistic system 233–234, 235
  - E-state (environmental state) 231
  - emergent Allee effect 236–237
  - extensions to more complex configurations 239–240
  - food-dependent development 235–239
  - i*-state (individual) distribution models 230–231
  - modelling framework 230–231
  - ontogenetic development and community structure 235–239
  - ontogenetic development dynamics 231–234, 235
  - p*-state (population state) 230–231
  - physiologically structured population models (PSPMs) 230–231
  - size-dependent predation 235–239
  - size-structured consumer-resource system 231–233, 234
  - structured biomass community model 239–240
  - tritrophic food chains 235–239
- individual organism
  - biomass production 5
  - influence of body size on performance 225
  - metabolic rate and body size 4–5
- intrinsic rate of increase ( $r_{max}$ ), response to additional mortality 270–271
- intrinsic rate of increase in a habitat ( $r$ ) 34–35, 38–39
- invariant quantities 44
- invertebrate macrofauna 111–112
- Leeuwenhoek, Antonie van 167
- Lepomis gibbosus* (pumpkinseed sunfish) 39, 40
- Lepomis macrochirus* (bluegill sunfish) 39, 40
- life histories
  - and body size 269–271
  - and population dynamics 269–271
  - and responses to exploitation 270–271
  - trade-offs 270–271
  - see also growth and development patterns
- life history analysis 33
  - biomass estimates 42
  - body size relationship with temperature 42
  - ecological applications 40–43
  - ecosystem function and community size spectrum 43
  - fisheries-induced evolution 40–41
  - prediction of body size variation within species 40–41, 42
  - shifts in community size spectrum 43
  - temperature-size rule (TSR) 42
- life history analysis and scaling relationships
  - ecological applications 46–49
  - estimation of global patterns of mortality 46–47, 48
  - intra- and interspecific allometries 45–46
  - invariant quantities 44
  - key elements 43–44
  - methodological issues 44–46
  - prediction of global patterns of life history 47–49
  - scaling exponents 43–44, 45
  - selection effects on scaling exponents 45
- life history theory
  - adaptive dynamics model 35–37
  - adaptive plasticity in life histories 37–39
  - fitness definition 34–35, 36
  - frequency and density dependence 36–37
  - interpretation of phenotypic variation 39
  - intrinsic rate of increase in a habitat ( $r$ ) 34–35, 38–39
  - key elements 34–36
  - lifetime reproductive success (LRS) 34–35, 38–39

- methodological issues 36–39
- optimality (optimization) model 34–35, 36–37
- phenotypic plasticity 37–39
- prediction of life history plasticity 37–39
- reaction norms 37–39
- relationship of traits to fitness 35–36
- trade-offs among traits 35–36
- life history traits, stream habitats 77–78
- lifespan
  - and body size 6–7
  - and temperature 6–7
- lifetime reproductive success (LRS) 34–35, 38–39
- Lindeman efficiency 11–12
- local:global species ratios, size dependence 181–182
- Lontra canadensis* (river otter) 292–293
- Loxodes rex* 175
- macroecological patterns
  - acidification effects in freshwaters 112–113
  - aquatic ecosystems 186–187
  - effects of individual level processes 99–100
  - effects of shifts in body-size distribution 112–113
  - effects of species dispersal ability 187
  - influence of body-size relationships 186
  - size-spectrum changes in stressed ecosystems 112–113
  - stressor-induced species loss 112–113
- macroscopic organisms, characteristics of
  - biodiversity 169
- marine communities
  - describing and predicting responses to mortality 274–280
  - energy availability models 273–274
  - energy transfer in predator–prey interactions 274
  - modelling fishing effects on size structure 274–280
  - PPMR (ratio of mean predator size to mean prey size) 274
  - size-based features of aquatic food webs 273
  - size-based responses to fishing 274–280
  - size-based structuring 273–274
  - size-spectra emergence models 273–274
  - slope of size spectra 273–280
  - see also* fisheries
- marine systems, similarities to terrestrial systems 210
- marine systems species diversity
  - benthic species adult body size distributions 212–216, 217, 218, 219
  - benthic species all-animal body size distributions 216–217, 219, 220
  - Dyar's constant 211, 212
  - effects of disturbance 216, 218–220, 221
  - effects of pollution 216, 218–220, 221
  - evolutionary influences 214–216, 217, 218, 219
  - Hutchinsonian ratio 211
  - influence of feeding traits 215–216, 217, 218, 219
  - influence of habitat architecture 213–214, 215
  - influence of life history characteristics 214–216, 217, 218, 219
  - number of co-occurring species in a guild 211–212, 213
  - pelagic species size distributions 218, 220
  - relationship with body size 210–211
  - size difference between competing species 211, 212
  - species guilds 211–212, 213
- mass-specific metabolic rate (B), equation for 2
- maximal population growth rate ( $r_{\max}$ ) 7, 8
- megafauna 111–112
- meiofauna 111–112
- Menidia menidia* (Atlantic silverside) 41
- metabolic energy flux, consumer:producer ratios 11–12
- metabolic rate
  - and body size in aquatic ecosystems 4–5
  - effect of temperature 2
  - factors affecting 3
  - relation to body size 1–2
- metabolic theory of ecology (MTE) 98, 226
  - and body size (summary) 327–329
  - application to biomass turnover (P/B) and body size 60, 62–68
  - applications 2–3, 13
  - conceptual framework 3
  - development of 1–2
  - effects of body size 2–3
  - flow of energy and materials between trophic levels 11–12
  - food web structure and body size 11–12
  - in aquatic ecology 2–3
  - predictions 3
  - quantitative links from individual to ecosystem levels 10–11
  - synthesis of approaches to food webs 12
- metaphoetesis 306–307
- microbial species
  - absolute abundance and dispersal 169–171
  - cosmopolitan-biogeography transition size 171–172
  - cosmopolitan distribution hypothesis 167–169
  - endemism question 169
  - general validity of geographical distribution data 180–181
  - geographical restriction hypothesis 167–169
  - neutral dispersal hypothesis 167–169
  - neutral theory of community structure 181–182
  - size dependence of local:global species ratios 181–182
  - size effects on biodiversity 169
  - size effects on dispersal and distribution 167–169
  - size range 170
  - see also* cosmopolitan distribution theory
- microbial systems (experimental) 246–247
  - community consequences of body size 249–250, 252–256, 257, 258, 259, 260, 261–262
  - description of the experiments and data sets 248–249
  - discussion 259–263
  - ecosystem consequences of body size 250–251, 256–259, 260, 262–263
  - methods 247–251

- microbial systems (experimental) (cont.)
  - population consequences of body size 249, 251–252, 253, 254, 255, 259–261
  - results 251–259, 260
  - species choice 247–248
- mortality rate and body mass 7–8
- mortality selection in fish species, evolutionary responses 40–41, 42
- MTE *see* metabolic theory of ecology
- multifractal behaviour in ecosystems 142–143
  - empirical applications 142
- multifractal properties of PSDs in river ecosystems 156–159
- multifractal SARs 159–163
- multifractality of BSDs in river ecosystems 155–156, 157, 158–159
- mussels (*Dreissena* spp.), nutrient excretion 289
- Mycoplasma*, body size 1
- Neobursaridium gigas* 175, 181
- neutral theory of community structure 181–182
- New Zealand streams database analysis 85–88, 89, 90, 91, 92
  - algal productivity effects 88, 90, 92
  - biomonitoring tools 94
  - body size patterns 90–94
  - disturbance effects 88, 90
  - factors affecting body size 88, 89, 90, 91, 92
  - fish 85
  - fish-predation effects 88, 92
  - land-use effects 88, 91
  - macroinvertebrates 85–86
  - methods 85–86
  - physicochemical conditions 86, 87
  - Principal Components Analysis 88, 92
  - results 88, 89, 90, 91, 92
  - statistical analyses 86
  - study sites 85
  - substrate effects 88, 90, 92
- normalization constant 1–2
- North Atlantic cod (*Gadus morhua*) 237
- northern cod (*Gadus morhua*) 40–41
- nutrient cycling in aquatic systems
  - consequences of variation by size 293–300
  - direct and indirect regulation 286–287
  - effects of harvesting-induced changes in size structure 298–300
  - influence of body size 287
  - nutrient flux estimation from biomass size distributions 294–296
  - predator impact on prey size structure 296–297, 298
  - regulation by aquatic animals 286–287
  - variation in body-size distributions 293–294
- nutrient excretion in aquatic systems
  - chemical form of excreted N and P 287
  - fed and unfed animals 288–289, 290
  - influence of body size 287–292
  - influence of temperature 288–289, 290
  - rates of N and P excretion 287–290, 291
  - ratios of N and P excretion 291–292
  - taxonomic differences 289–290, 291
- nutrient relations and ecological stoichiometry 2
- nutrient translocation in aquatic systems
  - and body size 292–293
  - and speed of movement 292–293
  - behavioural constraints on home range 292–293
- Onchorhynchus* spp. (Pacific salmon) 292–293
- ontogenetic development
  - and community structure 235–239
  - dynamics 231–234, 235
  - rate and body size 5–6
  - see also* growth and development
- ontogenetic dietary shifts in predators 104–105
- ontogenetic size refugia for prey species 107, 108, 109–110
- ontogenetic variation in body size 226
- optimality (optimization) model (of life history) 34–35
  - fitness definition 34–35
  - frequency and density dependence 36–37
  - intrinsic rate of natural increase (*r*) 34–35, 38–39
  - lifetime reproductive success (LRS) 34–35, 38–39
  - relationship of traits to fitness 35
  - trade-offs among traits 35, 36
- P *see* production
- p*-state (population state) 230–231
- Pacific salmon (*Onchorhynchus* spp.) 292–293
- Paraphysomonas* 172, 181
- parasite and host, lower limit to
  - mass of 307, 310, 314, 321–323
- parasite chains 306–308
- parasitoid chains 306, 307
- particle-size distributions (PSDs)
  - in benthic habitats 142
  - multifractal properties in river ecosystems 156–159
- perch (*Perca fluviatilis*) 234, 235, 238
- phenotypic plasticity in life histories 37–39
- phenotypic variation
  - co-gradient 88
  - counter gradient 39, 40
  - interpretation 38, 39
- phosphorus, as a growth-limiting nutrient 6
- physiologically structured population models (PSPMs) 230–231
- Plagiopyla frontata* 174
- Poecilia reticulata* (Trinidadian guppy) 41, 42
- Polarella glacialis* 181
- pollution, effects on marine species diversity 216, 218–220, 221
- Polycentropus flavomaculata* 24
- population consequences of body size (microbial systems) 249, 251–252, 253, 254, 255, 259–261
- population density and body size (stream communities) 56, 60, 61–62, 65, 68–71
- population density at steady state, and metabolic rate 8–9
- population dynamics
  - and body size 269–271
  - and life histories 269–271

- and species interactions 2
- intrinsic rate of increase ( $r_{max}$ ) 270–271
- responses to additional mortality 270–273
- strength of compensation (density dependence) 270–273
- population dynamics and individual body size 229–240
  - alternative states and body size distributions 235–239
  - cannibalistic system 233–234, 235
  - E-state (environmental state) 231
  - emergent Allee effect 236–237
  - extensions to more complex configurations 239–240
  - food-dependent development 235–239
  - i*-state (individual) distribution models 230–231
  - modelling framework 230–231
  - ontogenetic development and community structure 235–239
  - ontogenetic development dynamics 231–234, 235
  - p*-state (population state) 230–231
  - physiologically structured population models (PSPMs) 230–231
  - size-dependent predation 235–239
  - size-structured consumer-resource system 231–233, 234
  - structured biomass community model 239–240
  - tritrophic food chains 235–239
  - see also* adaptive dynamics life history model
- population-level feedback and dynamics 229
- population maximal growth rate ( $r_{max}$ ) 7, 8
- population turnover rate, and metabolic rate 7–8
- Power Fraction (PF), niche-assembly model 148–152
- power-law and scaling relationships in ecosystems 144–145
- power-law behaviour in ecosystem features 140–143
- power-law relationships
  - food-chain body sizes 306, 307
  - food-chain body sizes data 310, 314, 321–323
- PPMR (ratio of mean predator size to mean prey size) 274
- predator chains 306–308
- predator–prey interactions
  - and trophic cascades 129–132
  - energy transfer 274
  - factors influencing variation in prey choice 101–105
  - feeding loops 110
  - individual level processes 100–105
  - 'life history' omnivory 110
  - networks structured by size 110
  - ontogenetic dietary shifts in predators 104–105
  - ontogenetic size refugia for prey species 107, 108, 109–110
  - particle capture by suspension feeders 24–26
  - PPMR (ratio of mean predator size to mean prey size) 274
  - predator impact on prey size structure 296–297, 298
  - scaling to species 105–110
  - size-dependent foraging 100–105
  - size-dependent predation 235–239
  - size relationships 24–26, 306–308
  - species-averaging effects in food webs 105–110
  - upper limits to mass of predator and prey 307, 310, 314, 321–323
- production (P) (whole organism metabolic rate) and body size (stream communities) 56, 57, 61, 63, 64, 68–71
  - equation for 2
  - individual organisms 5
- Proteus vulgaris* 247
- PSDs *see* particle-size distributions
- PSPMs (physiologically structured population models) 230–231
- pumpkinseed sunfish (*Lepomis gibbosus*) 39, 40
- quarter-power exponents (*b*), explanation for 1–2
- r* (intrinsic rate of increase in a habitat) 34–35, 38–39
- $r_{max}$  (intrinsic rate of increase), response to additional mortality 270–271
- $r_{max}$  (maximal population growth rate) 7, 8
- Re see* Reynolds number
- reaction norms 37–39
- Redfield ratio 9–10
- resource supply and abundance 8–9
- Reynolds number (*Re*) 17–18, 293
  - collecting elements of suspension feeders 19, 20, 21
- river ecosystems
  - data collection 143–144
  - density and biomass scaling 146–148
  - density-body mass scaling 144–145
  - density-body mass scaling with sample area 145–146, 147
  - fractal properties of size-structured communities 152–159
  - multifractal behaviour 142–143
  - multifractal properties of BSDs 155–156, 157, 158–159
  - multifractal properties of PSDs 156–159
  - multifractal SARs 159–163
  - power-law and scaling relationships 144–145
  - scale-related patterns 142–143
- river otter (*Lontra canadensis*) 292–293
- RNA, influence on growth rate 6
- roach (*Rutilus rutilus*) 238
- SADs *see* species-abundance distributions
- sapuara (*Semaprochilodus kneri*) 293
- SARs *see* species-area relationships
- scale-invariance of power laws 144–145
- scale invariance properties of ecosystems 140–143
  - fractal properties of size-structured communities 152–159
- scaling constraints 227–228
- scaling exponent (*b*) 1–2, 43–44, 45
- secondary production rate and biomass turnover rate 55–56, 68–71
- self-similarity, fractal properties of size-structured communities 152–159
- Sequoia* trees, size of 1
- Serratia marcescens* 247

- Simulium* (blackfly) larvae, feeding strategy 28
- size-spectrum changes in stressed ecosystems 112–113
- size-structured consumer-resource system 231–233, 234
- social hunters 306–307
- solid–fluid interfaces, and body size 21, 26–28
- species-abundance distributions (SADs)
  - mechanisms 146, 148–152
  - scale-invariance and fractal properties 141–142
- species-area curves 141–142
- species-area relationships (SARs)
  - multifractal properties 159–163
  - scale-invariance and fractal properties 141–142
- species-averaging in food webs 105–110
- species complexity
  - and habitat complexity 129–132
  - and trophic cascades 129–132
- species diversity, and total biomass 246–247
- species diversity (marine systems)
  - benthic species adult body size distributions 212–216, 217, 218, 219
  - benthic species all-animal body size distributions 216–217, 219, 220
- Dyar's constants 211, 212
- effects of disturbance 216, 218–220, 221
- effects of pollution 216, 218–220, 221
- evolutionary influences 214–216, 217, 218, 219
- Hutchinsonian ratio 211
- influence of feeding traits 215–216, 217, 218, 219
- influence of habitat architecture 213–214, 215
- influence of life history characteristics 214–216, 217, 218, 219
- number of co-occurring species in a guild 211–212, 213
- pelagic species size distributions 218, 220
- relationship with body size 210–211
- size difference between competing species 211, 212
- species guilds 211–212, 213
- species interactions and population dynamics 2
- stoichiometry, whole body carbon:phosphorus ratio 6
- stream habitats
  - and life history traits 77–78
  - community size structure 78
  - species traits related to disturbance regimes 78
  - trophic roles 77
  - see also biomass turnover; environmental gradients
- streams database analysis (New Zealand) 85–88, 89, 90, 91, 92
  - algal productivity effects 88, 90, 92
  - biomonitoring tools 94
  - body-size patterns 90–94
  - disturbance effects 88, 90
  - factors affecting body size 88, 89, 90, 91, 92
  - fish 85
  - fish-predation effects 88, 92
  - land-use effects 88, 91
  - macroinvertebrates 85–86
  - methods 85–86
  - physicochemical conditions 86, 87
  - Principal Components Analysis 88, 92
  - results 88, 89, 90, 91, 92
  - statistical analyses 86
  - study sites 85
  - substrate effects 88, 90, 92
- strength of compensation (density dependence), response to additional mortality 270–273
- stressor-induced size-spectrum changes 112–113
- stressor-induced species loss 112–113
- structured biomass community model 239–240
- Sugihara Fraction (SF), niche-assembly model 148–152
- suspension feeders
  - active 16–17
    - body size and flow regime (Reynolds number,  $Re$ ) 17–18
    - body size and food availability 21, 26–28
    - body size and solid–fluid interfaces 21, 26–28
    - body-size measurement difficulties 17
    - body size relation to food particle size 24–26
  - collecting elements 16
  - colonial or clonal animals 22–23
  - costs and benefits of feeding structure size increase 19–24
  - dependence on flow characteristics 17–18
  - deposit-suspension feeders 16–17
  - development of gelatinous bodies 24
  - feeding structure 16
  - hydrodynamic implications of body size 17–18
  - influence on local sediment deposition 26–27
  - limits to maximum body size 19–24
  - modification of body parts into feeding structures 23–24
  - ontological shifts between flow regimes 19
  - overcoming velocity gradients 27–28
  - particle capture as predator–prey relationship 24–26
  - particle encounter mechanisms 18
  - passive 16–17
  - range of feeding adaptations 18
  - $Re$  of collecting elements 19, 20, 21
  - role in ecosystem energy transfer 16
  - roles in the food web 16
  - transport of particles to feeding structure (particle flux) 16–17
  - use of external capture apparatus 24
  - vortex shedding rate and body size 26–27
- temperature
  - and lifespan 6–7
  - effect on metabolic rate 2
- temperature correction 3–4
- temperature-size rule (TSR) 42
- terrestrial ecosystems
  - role of body size 98–99
  - trophic cascades 134
- Tracheloraphis caudata* 174
- Trichoptera (caseless caddis flies) larvae, use of external feeding structures 24
- Trinidadian guppy (*Poecilia reticulata*) 41, 42
- tritrophic food chains 235–239

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| trophic cascades                               | system productivity and food web structure     |
| alternative equilibria 132–133                 | 122–124, 125–126                               |
| and biomass distribution 122                   | turnover rate of primary producers 127–131     |
| and habitat complexity 129–132                 | trophic roles, in stream ecosystems 77         |
| and predator–prey interactions                 |                                                |
| 129–132                                        | unified theory of biodiversity (UTB) 149–152   |
| and species complexity 129–132                 |                                                |
| body-size disparity between predators and prey | vertebrate macrofauna 111–112                  |
| 119–122                                        | vortex shedding rate, and                      |
| body-size effects 133–134                      | body size 26–27                                |
| body size of primary producers                 |                                                |
| 127–128                                        | whales, body size 1                            |
| conditions which lead to 119                   | within-species variation in body size 226      |
| definition 118–119                             |                                                |
| effects of herbivory 127–128                   | Zero-Sum Multinomial (ZSM) distribution,       |
| in terrestrial ecosystems 134                  | dispersal-assembly model 148, 149–152          |
| predation effects 118                          | zooplankton eggs, ontogenetic development rate |
| shape of the trophic pyramid 128–131           | and body size 5–6                              |