## Index

*aAD* see adjusted average deviation  
Aare River, Switzerland 80–2, 100–5  
abrasion erosion 246  
acoustic Doppler current profilers (ADCPs)  
149, 151, 433  
acoustic Doppler velocimeters (ADVs)  
19–20, 24, 149–50, 433  
acoustic telemetry 151, 161, 433  
active telemetry 187  
ACT ograms 110, 112, 120–1  
AD see average deviation  
Adaptive Management 277  
adaptive strategies  
anchorage and breakage strength 262–3, 264–5  
aquatic macrophytes 247–8, 261–73  
community adaptations 266–8  
mesoscale macroinvertebrate data 369  
minimizing drag 263–4  
morphological adaptations 247–8, 263–6  
patch-scale adaptations 262–6  
plastic responses to stress 265–6  
ADCPs see acoustic Doppler current profilers  
adjusted average deviation (*aAD*) 99–104  
ADVs see acoustic Doppler velocimeters  
aerial photography 116–17  
auger 408, 411  
algal blooms 235–6, 240  
estuarine wetlands 384–6  
filamentous algae 12, 216, 230–7, 240, 384  
habitat associations 101, 207–8  
impacts on macroinvertebrate populations 225–6  
mat-forming algae 12, 240, 380, 386  
periphyton communities 229–43  
Allier River, France 395–401  
altered flow regimes  
biomass 232–5  
case studies 236–9  
impact on periphyton 229–43  
key principles of flow regimes 231  
periphyton proliferations 235–6, 240  
species composition and abundance 231–2  
American eel 151  
American shad 145, 147  
amphibians 193–211  
Amphipoda 363  
analysis of variance (ANOVA) 216–18, 221  
arctic ice 179–80, 182  
anchorage strength 246, 262–3, 264–5  
Ancylidae 215, 223, 225–6  
giosperms 246, 261, 264–5, 268–9  
ANOVA see analysis of variance  
aquatic macrophytes 245–59  
abundance, biodiversity, and succession 261–2, 268–9  
anchorage and breakage strength 262–3, 264–5  
biodiversity patterns 261–2  
case study 239–55  
classification and terminology 248  
community adaptations 266–8  
data analysis 250–1  
depth preferences 252–5  
flow conditions 246–8  
habitat–macrophyte relationships 251–2  
hydrodynamic stress and disturbances 261–73  
indirect effects of flow 266  
life forms in running waters 248–9  
management application of ecohydraulics 249–55  
minimizing drag 263–4  
morphological adaptations 247–8, 263–6  
patch-scale adaptations 262–6  
plastic responses to stress 265–6  
rapid flow fluctuations 324  
response traits to hydrodynamic forces 262–6  
sampling strategy 250  
study site 250  
taxonomy and characterisation 246  
aquatic zone 408–409  
ArcGIS 198, 202  
ASPT see Average Score per Taxon  
Atlantic salmon  
downstream passage 310–12  
habitats in winter conditions 182–5  
hydrodynamics 11, 20–2, 24–5  
rapid flow fluctuations 326–8  
species–habitat interactions 162–3, 167–9  
see also salmonids  
Australian National Water Initiative 432  
AutoCAD Land Desktop 339, 341  
average deviation (*AD*) 99–104  
Average Score per Taxon (ASPT) 220–1, 225  
averaging techniques 49  
BACH see Biotic–Abiotic Constraining Hypothesis  
Baetidae 223, 226, 362  
bank zone 408–09  
Bar-tailed Godwit 376  
bathymetry 52–4, 58–60, 64  
beaded samphire 378  
species–habitat interactions 162–3, 167–9  
biogenic barriers 146–7, 309, 314–16  
benthic macroinvertebrates see macroinvertebrates  
bio-acoustic fish fences 314–16  
Biobio River, Chile 61–2  
biodiversity  
altered flow regimes 230–2  
anthropogenic impacts 1–2  
aquatic macrophytes 249, 261–2, 268–9  
dynamic floodplain model 409–10  
surface flow types 220–1  
biological indicators 110–14  
biological monitoring working party (BMWP) scores 225  
biomass 232–5  
bio-monitoring studies 358, 370  
biota–physical relationships  
aquatic macrophytes 251–2  
CASiMiR multivariate fuzzy modeling approach 75, 80–2, 88–9  
hydrodynamics 11–12  
surface flow types 213–16

---

438 Index

Biotic–Abiotic Constraining Hypothesis (BACH) 162–3
biotopes
- spatial-scale units 129–31, 132–3, 135, 138
- surface flow types 214–15
Black-tailed Godwit 376
BMWP see Biological Monitoring Working Party
bog forests 417, 419
bogs 410
border ice 179, 181
boundary conditions
- hydraulic modeling 44–5, 55–6, 58
- shorebird habitat restoration 384–5
- spatial-scale units 136
Bray–Curtis coefficient of similarity 239
breakage strength 262, 264–5
break-up processes 178, 181–2, 183
breeding sites
- breakage strength 262, 264–5
- chironomids 223
- Chironomidae 223
- Chinook salmon 23, 278–87, 338, 344–9
- Chironomidae 23, 223–6
- Classification and Regression Trees (CART)
- algorithm 118–19
- climate change 418–21
- cluster analysis 116
- COG see Centre of Gravity
- coherent flow structures (CFSs) 14–18, 25
- cross-sectional derived bathymetry 54, 58–9
- cross-sectional geotope units 135, 138
- Cortle Sandpiper 376
- Cottonwoods 61, 395, 408, 411, 413
- Courant–Friedrichs–Lewy (CFL) criterion 39–40
- Creck–Nicolson scheme 39–40
- critical swimming speed 145
- cross-sectional bathymetry 54, 58–9
- cross-sectional geotope units 135, 138
- dam operations 1–2
- altered flow regimes 230, 236–9
- downstream passage 309
- dynamic floodplain model 420–3
- environmental flow regimes 278–81
- fish passage criteria 143–4
- hydraulic modeling 61–2, 300–6
- MesoHABSIM simulation model 119
- rapid flow fluctuations 323
- DANP see Donau Aus National Park
- Danube River 249–55
- dark brown algae 101
- data-driven fuzzy habitat models 93–107
- case studies 100–5
- data-driven knowledge acquisition 95
- ecological boundaries 93–4
- fuzzy rule-based modeling 95–6, 101–2
- fuzzy rule-based optimisation 96–100
- fuzzy sets optimisation 97
- hill-climbing algorithms for rule-based training 97–9, 104
- interdependence of variables 94

CFD see computational fluid dynamics
CFL see Courant–Friedrichs–Lewy
CFR see cyclic floodplain rejuvenation
CFSs see coherent flow structures
CGUs see Channel Geomorphic Units
Channel Geomorphic Units (CGUs) 213–14, 227
channel morphology
- hydraulic modeling 60, 62–4
- riffle–pool relief design 338, 345–6
- spatial-scale units 131–7
- channelization 1–2
- chi-square tests 198, 201–2, 222–3
- Chinook salmon 23, 278–84, 338, 344–9
- Chironomidae 223, 225–6
- Classification and Regression Trees (CART)
- algorithm 118–19
- climate change 418–21
- cluster analysis 116
- COG see Centre of Gravity
- coherent flow structures (CFSs) 15–18, 25
- Coho salmon 278, 280–1, 283
- common carp 148
- Common Greenshank 376
- community adaptations 266–8
- compensatory stocking 311–12, 319
- competition
- aquatic macrophytes 266
- habitat selection 159–60, 162–5, 170
- ice processes 182–4
- spatial-unit units 127–8
- see also resource acquisition and competition
- computational fluid dynamics (CFD) 32–66
- boundary conditions 44–5, 55–6, 58
- case studies 65–4
- discretization methods 34, 38–41
- initial conditions 45
- mathematical model 33–8
- mesh/grid characteristics 34, 41–4, 48, 55–6
- model parameters/parameterization 45–7, 49, 57
- non-numerical models 32–3, 60
- one-dimensional models 32–3, 44–6, 50–3, 57–9, 61, 65–6
- river floodplain interaction 39–60
- scaling and averaging 49
- three-dimensional models 32–3, 44–6, 49–35, 64–6
- two-dimensional models 32–3, 44–6, 50–3, 55–7, 61–6
- validation 48–9, 57
- Computer Aided Simulation Model for Instream Flow Requirements (CASiMiR) 33, 61–2, 75–91
- advantages and limitations of fuzzy approach 78–9
- background and development 75, 76–7
- biota–physical relationships 75, 80–2, 88–9
- calibration of fuzzy approach 78
- case studies 80–2, 83–4, 86–9, 326, 328–9
- dynamic floodplain model 408, 416–24
- functional principle 77–8
- fuzzy logic in ecohydraulic modeling 76
- meso- to basin-scale modeling 85–7
- morphodynamic processes 82–4
- multivariate and univariate preference function comparison 80–2, 88–9
- physical habitat modeling principles 75–6
- rapid flow fluctuations 326, 328–9
- spawning activities 80–4, 87
- confusion matrix 99–100
- connectivity with floodplain 249, 250, 399–401, 405
- contingency tables 218–19
- continuum view of stream networks 126–7
- Correctly Classified Instances (CCI) 99–104
- cortisol 326, 331
- cottonwoods 61, 395, 408, 411, 413
- Courant–Friedrichs–Lewy (CFL) criterion 39–40
- Courant–Friedrichs–Lewy (CFL) criterion 39–40
- Crick–Nicolson scheme 39–40
- crevice stems 263
- critical swimming speed 145
- cross-sectional derived bathymetry 54, 58–9
- cross-sectional geotope units 135, 138
- Curlew Sandpiper 376
- cutthroat trout 184
- cyanobacteria 229, 231–2, 234, 237, 240
- cyclic floodplain rejuvenation (CFR) 403–5
- cyprinids 146–7, 318
- dam operations 1–2
- altered flow regimes 230, 236–9
- downstream passage 309
- dynamic floodplain model 420–3
- environmental flow regimes 278–81
- fish passage criteria 143–4
- hydraulic modeling 61–2, 300–6
- MesoHABSIM simulation model 119
- rapid flow fluctuations 323
- DANP see Donau Aus National Park
- Danube River 249–55
- dark brown algae 101
- data-driven fuzzy habitat models 93–107
- case studies 100–5
- data-driven knowledge acquisition 95
- ecological boundaries 93–4
- fuzzy rule-based modeling 95–6, 101–2
- fuzzy rule-based optimisation 96–100
- fuzzy sets optimisation 97
- hill-climbing algorithms for rule-based training 97–9, 104
- interdependence of variables 94
knowledge acquisition bottleneck 94–5
knowledge-based versus data-driven models 93
performance criteria 99–105
species distribution models 93–5, 101
De Saint–Venant equations 49, 57–8
deep oxbows 417, 419
defuzzification 78–9
degree of fulfilment (DOF) 78–9
DEMs see digital elevation models
depth preferences
aquatic macrophytes 252–5
data-driven fuzzy habitat models 103–4
habitat selection 165–6
ice processes 185
macroinvertebrates 213–27
riffle–pool relief design 344–5
surface flow types 213–27
depth ratio 294
depth–velocity profiles 213–27, 249, 359–66
dGPS see differential Global Positioning Satellite
diatoms 12, 230–5, 237, 240
differential Global Positioning Satellite (dGPS) 216
digital elevation models (DEMs) 338–9, 344, 346–7
Diptera 12, 223, 359, 361–2, 364
direct numerical simulation (DNS) 346
Directive 2000/60/EC (dGPS) 216
Early Successional Woodland Phase 411–14, 417, 419–23
Eastern Curlew 375, 376
ECMs see electromagnetic current meters
eco-geomorphology 125–7, 378–2, 391
ecohydrology 2–3
ecological boundaries 93–4
Ecologically Sustainable Water Management Framework (ESWM) 122
efficiency
fish guidance
fish ladders and racks with unknown function 310–11
guiding/skimming walls 318–19
historical context in Sweden 290–12
inclined racks and bypasses/traps 316–18
migration and Kungsadra 310
racks and spill gates 312–13, 314–16
see also fish passage criteria
drag coefficients 46, 262–4, 414–15
dynamic floodplain model 407–27
applications of the model 417–23
climate change 418–21
disturbance regime approach 415–17, 418
flow requirements and dam operations 420–3
linking fluvial processes to vegetation 415–17
physical habitat effects on floodplain vegetation 408–10
response of floodplain vegetation to fluvial processes 414–15
river restoration 418
succession phases and environmental context 410–16, 417, 420–3
e-flow see environmental flow regimes
Early Successional Woodland Phase 411–14, 417, 419–23
Eastern Curlew 375, 376
ECMs see electromagnetic current meters
eco-geomorphology 125–7, 378–2, 391
ecohydrology 2–3
ecological boundaries 93–4
Ecologically Sustainable Water Management Framework (ESWM) 122
eddies
fish passage criteria 147–8, 149–50
hydraulic modeling 36–7, 46–7, 57
hydrodynamics 14–15, 17, 21–2, 24–5
eel 15, 147–8, 151, 310–11, 314–19
electrofishing 161
electromagnetic current meters (ECMs) 19
electromyography 21–2
Elmidae 215, 223, 225–6
Endangered Species Act (ESA) 280–1
endurance tests 144–5
energy cascade (EC) 14–15
environmental flow regimes 277–92
discussion of findings 290
flow-and-habitat-based integration 284
habitat time series-based flow regimes 284
hydrology-based flow regimes 283–4
implementation issues 282–3
peer review of Hardy et al. 285
real-time management 278, 285–91
spatial-scale units 129
study site 278–81
underlying science 283–5
water allocation strategies 281–2
Water Resource Integrated Modeling System 285–90
environmental guilds 112
Environmental Protection Agency (EPA) 2
Ephemeroptera 113–14, 359, 361–2
ESA see Endangered Species Act
esocosids 318
Established Forest Phase 411–12, 417, 419–23
estuarine wetlands
discussion and recommendations 389–2
ecohydraulic and ecogeoecomorphic characterisation 378–81, 391
hydraulic drivers for vegetation distribution 380, 382–88
hydrodynamic modeling 382–92
implications for wetland rehabilitation 381–2
shorebird habitat restoration 375–94
study results 385–88
study site 377–9
vegetative resistance 380–81, 385–6
water level, surface elevation and vegetation dynamics 379, 384–88
ESWM see Ecologically Sustainable Water Management Framework
European ed 23, 148, 151, 310–11, 314–19
European grayling 77–8, 80–4, 101–5, 182–6, 326–8
eutrophication 235–6, 268
FDM see finite difference model
Federal Energy Regulatory Commission (FERC) 280–1
feeding see resource acquisition and competition
FEM see finite element model
fens 410
FERC see Federal Energy Regulatory Commission
FESWMS see Finite Element Surface Water Modeling System
FGE see fish guidance efficiency
field measurements
habitat selection 160–1
hydraulic modeling 47, 48, 52, 60
MesoHABSIM simulation model 116–18, 122
mesoscale macroinvertebrate data 339–65
rapid flow fluctuations 327, 331–3
shorebird habitat restoration 378–82, 391
turbulence 18–20, 23–5
filamentous algae 12, 216, 230–7, 240, 384
filamentous green algae 230–7, 240
fine-spaced racks with bypasses/traps 316–18
fine-spaced racks without bypasses 312–14
finite difference model (FDM) 38–41, 50–2
finite element model (FEM) 38, 40–1, 50–2, 101, 383
Finite Element Surface Water Modeling System (FESWMS) 343–4, 346
finite volume model (FVM) 38, 40–1, 50–2
<table>
<thead>
<tr>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>440</td>
<td>Index</td>
</tr>
</tbody>
</table>

- fish guidance efficiency (FGE) 315
- fish ladders and racks 310–11
- fish passage criteria 143–56
- criticisms of traditional approach 147–9
- ecoregional approach 149–51
- future challenges 152
- hydraulic conditions 147–8, 149–50
- swimming performance 145–9, 150–2
- traditional approach 144–9
- fixed velocity tests 144–5
- flat-line flows 278, 281
- flooding
  - altered flow regimes 230, 232–4
  - aquatic macrophytes 246, 248, 266–7, 269
  - dynamic floodplain model 409–10, 415–17
  - hydraulic modeling 300
  - ice processes 181–2
  - floodplain zone 408–9
- floodplains
  - applications of dynamic model 417–23
  - aquatic macrophytes 245–6, 249–55
  - cyclic floodplain rejuvenation 403–5
  - disturbance regime approach 415–17, 418
  - dynamic floodplain model 407–27
  - dynamics of meandering rivers 397–9
  - floodplain vegetation in Korea 293–307
  - hydraulic modeling 59–60, 293–307
  - landscape-scale ecodehydrologics 395–406
  - linking fluvial processes to vegetation 415–17
  - physical habitat effects on floodplain vegetation 408–10
  - response of floodplain vegetation to fluvial processes 414–15
- restoration in a heavily regulated river 401–3
- succession phases and environmental context 410–14, 417, 420–3
- temporal (dis)continuity along regulated rivers 399–401, 405
- flow–biota interactions 11–12
- flow fluctuations 236–37
- flow–habitat relationships 32, 284
- flow ratio 325–6
- flow-regulation 1–2
- altered flow regimes 231, 233
- aquatic macrophytes 246
- ice conditions 181
- impact on periphyton 231, 233
- landscape-scale ecodehydrologics 397, 399–405
- rapid flow fluctuations 324
- flow variability 34, 56, 230–3, 237, 291, 370
- flume experiments 23
- flushing flow scenarios 420–3
- Foothill Yellow-legged frog 193–211
- fractional step methods 49
- flail 178–81, 182, 187
- freeze-up processes 178–80, 182–3
- frequency analysis 199–200
- fright bias 160–1
- Froude numbers 249, 359
- FST-hemispheres 76
- functional units 132–3, 135
- fuzzification 77
- fuzzy logic modeling
  - advantages and limitations of fuzzy approach 78–9
  - applications in ecohydrological modeling 76
  - background and development 76–7
- calibration of fuzzy approach 78
- case studies 80–2, 83–4, 86–9, 100–5
- CASiMiR multivariate fuzzy approach 75–91
- data-driven fuzzy habitat models 93–107
- data-driven knowledge acquisition 95
  - ecological boundaries 93–4
  - functional principle 77–8
  - fuzzy rule-based modeling 95–6, 101–2
  - fuzzy rule-based optimisation 96–100
  - fuzzy sets optimisation 97
- habitat modeling 75–91, 93–107
- hill-climbing algorithms for rule-based training 97–9, 104
- interdependence of variables 94
- knowledge acquisition bottleneck 94–5
- knowledge-based versus data-driven models 93
- meso- to basin-scale 83–7
- morphodynamic processes 82–4
- multivariate and univariate preference function comparison 80–2
- performance criteria 99–105
- rapid flow fluctuations 333
- species distribution models 93–5, 101
- FVM see finite volume model
- Gammaridae 223, 225–6
- Gammarus 12
- Gastropoda 12
- GCI see grid convergence index
- geographic information system (GIS)
- hydraulic modeling 59
- MesoHABSIM simulation model 116–17
- riffle-pool relief design 357
- stream habitat associations of *Rana boylii* 196, 198, 202
- geomorphic units 132–3, 135
- geomorphology
  - defining scale units 131–9
  - eco-geomorphology 125–7, 378–82, 391
- evolution of geomorphic scale hierarchy 127–31
- future research priorities 139
- meso scale 127–33, 138
- reach scale 127–31, 134–6, 138
- segment scale 127–31, 136–9
- shorebird habitat restoration 378–2, 391
- spatial-scale units 125–39
- GES see Good Ecological Status
- GHSI see global habitat suitability index
- GIS see geographic information system
- global habitat suitability index (GHSI) 344–9
- global positioning system (GPS)
- MesoHABSIM simulation model 116–18
- shorebird habitat restoration 379, 383
- stream habitat associations of *Rana boylii* 196
- surface flow types 216
- Good Ecological Status (GES) 230
- GPS see global positioning system
- gravel abstraction 233
- gravel-bed rivers
- CASiMiR multivariate fuzzy modeling approach 83–4
- hydrodynamics 15–17, 23
- ice processes 186
- riffle-pool relief design 337–55
- grayling 77–8, 80–4, 101–5, 182–6, 326–8
- see also salmonids
- green algae 230–7, 240
- grey mangrove 378
- Grey-tailed Tattler 376
- grid characteristics 34, 41–4, 48, 55–6
- grid convergence index (GCI) analysis 44, 48
- ground-penetrating radar 187
- groundwater levels 410
- groundwater tables 302–3
- gudgeon 20
- guiding/skimming walls 318–19
- guild approach 112–13
- habitat fragmentation and connectivity
  - aquatic macrophytes 249, 250
  - CASiMiR multivariate fuzzy modeling approach 86–7
  - fish passage criteria 143–56
  - landscape-scale ecodehydrologics 399–401, 405
- habitat heterogeneity 208–9
- habitat-hydraulic models 160
- habitat–macrophyte relationships 251–2
- habitat modeling
  - adjusting templates to reflect reference habitat 119
  - aquatic macrophytes 245
Index 441
Index

hydrodynamics (Continued)
  rapid flow fluctuations 326
  research needs and prospects 432–3
  response traits to hydrodynamic forces 262–6
  riffle–pool relief design 343–4, 346, 351–2
  shorebird habitat restoration 382–92
  standard ecohydraulic variables 10–11
  statistical descriptions of turbulence 13–15
  stream habitat associations of *Rana boylii* 197, 199–200, 204–7
  surface flow types 213–28
  swimming performance 11, 20–2, 24
  turbulence 10–25
hydromecology 9
  hydrology 125–7, 132–4
hydromorphology 332
  hydromorphological units (HMUs) 85, 109–10, 114–19
  hydrology-based flow regimes 283–4
hydrorheic zone
  hypsometric curves 380
  ice processes 177–92
  acclimatization in winter 182–3
  break-up 178, 181–2, 183

freeze-up 178–80, 182–3
  future research prospects 186–8
  main winter 178, 180–1, 183
  processes in running waters 178–82
  salmonids in winter ice conditions 182–6
  size-dependent and size-independent habitat use 184–5
  winter habitat criteria 183–6

IFIM see Instream Flow Incremental
  Methodology
  impoundments 1–2
  altered flow regimes 233, 236, 239
  dynamic floodplain model 420–3
  hydraulic modeling 304–6
  inclined racks and bypasses/traps 316–18
  Indicator Species Analysis (ISA) 249, 250–3
  inference system 78
  initial conditions 45
  Initial Phase 31–2, 75, 337
  interdisciplinary research 1–2, 433–4
  iPOM framework 20–4
  irrigation
    altered flow regimes 230
    environmental flow regimes 279–80
    mesoscale macroinvertebrate data 370
  ISA see Indicator Species Analysis
Kappa statistic 99–104
Kärman gaiting 21–2
  kelts 312–15, 318
  Klamath Basin Restoration Agreement (KBRA) 285–6
  Klamath River basin, USA 278–91
  knowledge-based fuzzy habitat models 93
  Kooragang Island, NSW, Australia 377–92
  Kootenai River, Idaho, USA 61
  Kriging 54
  Kruskal–Wallis non-parametric ANOVA
    216–18, 221
  Kungsåra 310
  laboratory studies 326–7, 331–2
  lampry 23, 113–14, 122, 147–8
  land cover transitions 397
  landscape-scale ecohydraulics 395–406
  cyclic floodplain rejuvenation 403–5
  dynamics of meandering rivers 397–9
  ecohydraulic and ecomorphologic processes 397, 405

flooding restoration in a heavily regulated river 401–3
  steady-state or meta-climax concept 397–9
  temporal (dis)continuity along regulated rivers 399–401, 405
  vegetation dynamics 395–7
  large Eddy Simulations (LES) 36
  lateral eddy viscosity 46–7, 57
  LES see Large Eddy Simulations
  Lesser Sand Plover 376
  lichens 261, 265
  LiDAR 54, 58, 60, 434
  LIFE see Lotic-invertebrate Index for Flow Evaluation
  life stage associations 196–204, 207–9
  light preferences 166–8
  Limnephilidae 215, 360
  link–node structure 126
  logistic regression analysis 196–8, 199–201
  lotic ecosystems
    anthropogenic impacts 1–2
    aquatic macrophytes 261–2, 266–9
    mesoscale macroinvertebrate data 357–75
    Lotic-invertebrate Index for Flow Evaluation (LIFE) 220–3, 358, 366–9, 371
    low shrubs 408
  macrohabitat, definition 161
  macroinvertebrates
    Ancylidae 215, 223, 225–6
    Baetidae 223, 226, 362
    biota–physical relationships 213–16
    case study 216–23
    CASiMiR multivariate fuzzy modeling approach 76–7
    Chironomidae 223, 225–6
    Diptera 12, 223, 359, 361–2, 364
    discussion of findings 223–6
    Elmidae 215, 223, 225–6
    Ephemeroptera 113–14, 359, 361–2
    Gammaridae 223, 225–6
    Gammarus 12
    Gastropoda 12
    grazing habits 225–6
    Hemiptera 359–60
    Heptageniidae 215, 223, 236
    hydraulic variables 216–18
    hydrodynamics 10–12
    Hydrodynamica 215, 223, 361
    identification and measurement of SFTs 216
    Limnephilidae 215, 360
    linking ecohydrology and traits-based approaches 365–6
    macroscale ecosystem assessment 371
    MesoHABSIM simulation model 113–14

hydropower
  altered flow regimes 231, 236–9
  aquatic macrophytes 248
  data-driven fuzzy habitat models 101
  downstream passage 309–22
  environmental flow regimes 278–81
  fish passage criteria 143–4
  hydraulic modeling 62–4
  ice processes 181
  MesoscaleHABSIM simulation model 122
  mesoscale macroinvertebrate data 370
  rapid flow fluctuations 323–36
  Hydroscyphidae 223, 226, 361, 364
  HydroSignature analysis 217–18, 223, 227
  hyporheic zone 169, 170
  hypsometric curves 380
  ice processes 177–92
  acclimatization in winter 182–3
  break-up 178, 181–2, 183
patterns in response to hydraulic variables 359–66
Plecoptera 12
rapid flow fluctuations 324, 332
river management 357–75
site details and study method 216
substrate size 218
surface flow types 213–28
trait variation in LIFE flow groups 366–9
Trichoptera 12, 215, 359–64, 366–71
upsampling from ecohydraulics to
management 370–71
wider implications of study 226–7
macrophytes; aquatic macrophytes
macroscale ecosystem assessment 371
maceroturbulent structures 16–18, 21
mangroves 375–6, 378–2, 385–92
Mann–Whitney U Test 217, 219
Marsh Sandpiper 376
mass–momentum equations
Marsh Sandpiper 376
Mat-forming algae 12, 240, 380, 386
Mature Mixed Forest Phase 411–14, 417, 419–23
mechanical break-up 181–2, 183
mesh characteristics 34, 41–4, 48, 55–6
Mature Mixed Forest Phase 411–14, 417, 419–23
mesohabitat, definition 161
mesohabitat associations 196–8, 199–202, 204–7
MesoHABSIM simulation model 109–24
adjusting templates to reflect reference
habitat 119
establishing habitat suitability criteria 112, 114–15, 119, 122
habitat survey 117–18
habitat time series analysis 119–21
identifying biological targets and
indicators 110–14
interpretation and application 121–3
mapping and evaluation of instream
habitat 115–17
reference flow time series 119
scenario comparison 121
surface flow types 226
upsampling 118–19
mesoscale geomorphology 127–35, 138
meta-climax concept 397–9
microhabitat, definition 161
microscale geomorphology 127–31, 138
migration
CasiMiR multivariate fuzzy modeling
approach 85–7
downstream passage 309–22
fish passage criteria 145–6
hydrodynamics 11–12, 23
MesoHABSIM simulation model 112
shoalbird habitat restoration 375–94
migratory shorebirds; see shoalbird habitat
restoration
mixed-bed rivers 15
mixed boundary conditions 44
model parameters/parameterization 45–7, 49, 57
Monte Carlo simulation 251
morphodynamic processes 82–4
morphological adaptations 247–8, 263–6
morphological bathymetry 54–5
morphological units 132–3, 135
Mote Hydropower Plant (HPP Mote)
237–9
Mur River, Austria 83–4, 89
Nakdong River, Korea 300–6
National Marine Fisheries Service (NMFS)
280–1
National Water Initiative 2
Natural Resources Conservation Service
(NRCS) 281
Navier–Stokes (NS) equations
hydraulic modeling 33–8, 49, 56, 297–8
hydrodynamics 13
shoalbird habitat restoration 383
nearest neighboring 54
Neckar River, Germany 86–8
network analysis 126–7
Neumann conditions 44
nMDS see non-metric multidimensional
scaling
NMFS see National Marine Fisheries Service
nocturnal behaviours, ice processes 182–3
non-metric multidimensional scaling
(nMDS) 369–70, 380
non-numerical models 32–3, 60
non-parametric analysis of variance
(ANOVA) 216–18, 221
NRCS see Natural Resources Conservation
Service
NS see Navier–Stokes
numerical diffusion 40–1
nutrient loadings 235–6, 268
observation bias 160–1
one-dimensional models 32–3, 44–6, 50–3,
57–9, 61, 65–6
one-sample t-tests 198, 202
open channel flow properties 34–8
Pacific Golden Plover 376
Pacific salmon 150
PaciﬁCorp 280–1
PARMA see Periodic Autoregressive Moving
Average
partial differential equations (PDEs) 36–41
particle imaging velocimeters (PIVs) 19, 21,
24, 149–50
passive integrated transponder tags (PITs)
161, 433
passive telemetry 187
patch-scale adaptations 262–6
PCA see Principle Component Analysis
PDEs see partial differential equations
peaking see hydropeaking
pebble clusters 16
perch 20, 147
percids 146–7, 318
Periodic Autoregressive Moving Average
(PARMA) model 283
periphyton
altered flow regimes 229–43
biomass 232–5
case studies 236–9
definitions and characteristics 229
periphyton proliferations 235–6, 240
species composition and abundance 231–2
PHABSIM see Physical Habitat Simulation
Model
phenotypic plasticity 265–6
physical habitat; see habitat
Physical Habitat Simulation Model
(PHABSIM) 2, 75
data-driven fuzzy habitat models 94
hydraulic modeling 33, 59
MesoHABSIM simulation model 122
riffle-pool relief design 337
spatial-scale units 129
physical habitat units 132–3, 135
physical screens 146–7
pike 147
Pioneer Phase 411–14, 417, 419–23
PISO model 49
PITs see passive integrated transponder tags
PIVs see particle imaging velocimeters
plant communities; see aquatic macrophytes;
vegetation dynamics
plastic responses to stress 265–6
Plecoptera 12
pool/riffle systems 127–34
poplar 395, 408, 411, 413
population densities 198–9
power spectra 14–15
predation
data-driven fuzzy habitat models 103, 105
fish passage criteria 144, 146
habitat selection 161, 163
hydrodynamics 11–12
ice processes 183, 184, 187
spatial-scale units 127–8
stream habitat associations of Rana boyli
193
444 Index

presence–absence models 96, 100
primary succession 410–13, 420–2
Principle Component Analysis (PCA) 218, 220
propagule dispersion 267–8
quadrant analysis 17
racks
fine-spaced racks without bypasses 312–14
fish ladders and racks with unknown function 310–11
inclined racks with bypasses/traps 316–18
and spill gates 314–16
Radio Frequency Identification (RFID) 434
radio telemetry 151, 161, 185–6
Radio Frequency Identification (RFID) 434
see also
Radio Frequency Identification (RFID) 434
Radio telemetry 151, 161, 185–6
RANS see Reynolds-averaged Navier–Stokes
rapid flow fluctuations 323–36
Rapid Habitat Mapping 226
RCC see River Continuum Concept
reach-scale geomorphology 127–31, 134–6, 138
reach-scale habitat associations 196–7, 198, 202–6, 207–8
real-time management (RTM) definition and characteristics 278
discussion of findings 290
environmental flow regimes 278, 285–91
implementation example 287
performance 287–90
rearing sites 194, 204–7
Receiver Operational Characteristics (ROC) curves 115
red algae 232, 385
Red-necked Stint 375
redds 64–5, 169–70
reeds 408–09, 411–12, 417, 420
Reference Fish Community (RFC) 111–12
reference flow time series 119
regulatory frameworks 2–3
rehabilitation techniques 1
remote sensing data hydraulic modeling 54, 58, 60
shorebird habitat restoration 378–9
reservoirs 248, 324, 330–2
resource acquisition and competition aquatic macrophytes 266
habitat selection 164–5
hydrodynamics 11–12, 21
ice processes 182–4, 187
Resource Modelling Associates (RMA-2) model 382–90
retention basins 330–2
Reynolds numbers
dynamic floodplain model 415
habitat quality 338, 344–9, 351–2
shorebird habitat restoration 383
RFID see River Continuum Concept
RFFD see Radio Frequency Identification
riffle-pool relief design 337–51
actual design selection 352
baseline testbed reach 340
design concepts and tools 340–1
discussion and conclusions 351–2
ecohydrological analysis 337–8
experimental design 338–47
experimental riffle-pool assemblages 341–3
future prospects 352
habitat quality 338, 344–9, 351–2
hydrodynamic modeling 343–4, 346, 351–2
iterative design and construction 352
numerical experimentation 351–2
sediment transport 338, 345–7, 349–51
study results 347–51
test analyses and outcome indicators 346–7
Riverror management linking ecohydraulics and traits-based approaches 366
lotic macroinvertebrates in a management context 358
macroscale ecosystem assessment 371
mesoscale macroinvertebrate data 357–75
patterns in macroinvertebrate response to hydraulic variables
research needs and prospects 435
trait variation in LIFE flow groups 366–9
upscaling from ecohydraulics to management 369–71
river restoration 1
dynamic floodplain model 418
landscape-scale ecohydraulics 395–406
rapid flow fluctuations 330–2
Riverine Ecosystem Synthesis 127
RMA-2 see Resource Modelling Associates
roach 20
robustness, data-driven fuzzy habitat models 95
ROC see Receiver Operational Characteristics
roosting habitats 375–6
roughness coefficients
dynamic floodplain model 414
hydraulic modeling 45–7, 55–7, 60
riffle-pool relief design 344
roughness layer/sublayer 10–11, 17
round-off errors 40–1
RSM see Reynolds stress model
RTM see real-time management
Sava River, Switzerland 62–4, 328–9
SAI see swimming ability index
salamanders downstream passage 309–12, 314–18
fish passage criteria 143–5, 147, 150
habitat selection 159–76
habitats in winter conditions 177–92
hydrodynamics 11–12, 20–5
modeling salmon redds 49, 64
rapid flow fluctuations 323–30, 333
riffle-pool relief design 338–51
saltmarsh plains 375–6, 378–2, 385–92
saltwater couch 378–9
sand-bed rivers 24–5, 186
Sava Dolinka River, Slovenia 237–9
scaling techniques 49, 58
seasonal variability model 111–12
sedge 381, 411
sediment analysis 303–5
sediment transport aquatic macrophytes 266
dynamic floodplain model 409–10
hydraulic modeling 61, 295–6
landscape-scale ecohydraulics 395–6
riffle-pool relief design 338, 345–7, 349–51
segment scale geomorphology 127–31, 136–9
sensitivity analysis 94
SFTs see surface flow types
dhad 145, 147
shallow oxbows 417, 419
shallow water equation modeling 296–7, 327, 330, 345, 347–9, 352
shallow water hypothesis 49
Shannon–Wiener diversity 220–1
Shrub Phase 411, 417, 419–3
shorebird habitat restoration 375–94
difficulties and limitations 129–31
true skill statistic (TSS) 99–104
TPWD see Texas Instream Flow Program
TSCS see surface flow types
TPWD see Texas Instream Flow Program
trajectories-based approaches 366–9
traps 316–18
trash deflector systems 314–16
Trianglular Inflow Network 54
Trichoptera 12, 215, 359–64, 366–71
Trinity River, California, USA 339–52
trot see individual species; salmonids
truite–physical relationships 213–16
case study 216–23
discussion of findings 223–6
hydraulic variables 216–18
identification and measurement of SFTs 216
macroinvertebrates 213–28
site details and study method 216
spatial-scale units 133–5
substrate size 218
wider implications of study 226–7
surface roughness 129–31
Surna River, Norway 327–8
suspended sediment transport model 295–6
Swider River, Poland 116
swimming ability index (SAI) 145
swimming performance
critical swimming speed 145
fish passage criteria 144–5, 147–9, 150–2
habitat selection 168–9
hydrominics 11, 20–2, 24
Tailed frog 193
Target Fish Community (TFC) 111–12
temporal scales 434–5
terrestrial laser scanners (TLS) 129–31
Texas Instream Flow Program (TPWD) 277–8
TFC see Target Fish Community
terrestrial break-up 181–2, 183
thermo-peak 333
two-dimensional models 32–3, 44–6, 49–55, 64–6
time series analysis see habitat time series
TIN see Trianglular Irregular Network
TKE see Turbulent Kinetic Energy
TLS see terrestrial laser scanners
topographical features 41–6, 52–5, 58–9, 64–6
TPWD see Texas Instream Flow Program
traits-based approaches 366–9
transients 316–18
trash deflector systems 314–16
Trianglular Irregular Network (TIN) 54
tributaries 137–9, 203, 206
Trichoptera 12, 215, 359–64, 366–71
Trinity River, California, USA 339–52
trot see individual species; salmonids
truite skill statistic (TSS) 99–104
transient 316–18
trash deflector systems 314–16
Trianglular Irregular Network (TIN) 54
tributaries 137–9, 203, 206
Trichoptera 12, 215, 359–64, 366–71
Trinity River, California, USA 339–52
trout see individual species; salmonids
true skill statistic (TSS) 99–104

## 446 Index

<table>
<thead>
<tr>
<th>Concept</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>truncation errors</td>
<td>40–1</td>
</tr>
<tr>
<td>TSS</td>
<td>see true skill statistic</td>
</tr>
<tr>
<td>turbine intakes</td>
<td>309, 311–14</td>
</tr>
<tr>
<td>turbulence</td>
<td>10–25</td>
</tr>
<tr>
<td>coherent flow structures</td>
<td>15–18, 25</td>
</tr>
<tr>
<td>field measurements</td>
<td>18–20, 23–5</td>
</tr>
<tr>
<td>fish passage criteria</td>
<td>147–8, 149–50</td>
</tr>
<tr>
<td>flow–biota interactions</td>
<td>11–12</td>
</tr>
<tr>
<td>habitat selection</td>
<td>11–12, 22–5</td>
</tr>
<tr>
<td>hydraulic modeling</td>
<td>36–8, 44, 46–7</td>
</tr>
<tr>
<td>IPOS framework</td>
<td>20–4</td>
</tr>
<tr>
<td>macroturbulent structures</td>
<td>16–18, 21</td>
</tr>
<tr>
<td>research needs and prospects</td>
<td>432–3</td>
</tr>
<tr>
<td>standard ecohydraulic variables</td>
<td>10–11</td>
</tr>
<tr>
<td>statistical descriptions</td>
<td>13–15</td>
</tr>
<tr>
<td>surface flow types</td>
<td>214–15</td>
</tr>
<tr>
<td>swimming performance</td>
<td>11, 20–2, 24</td>
</tr>
<tr>
<td>theory, structure and measurement</td>
<td>11–20</td>
</tr>
<tr>
<td>Turbulent Kinetic Energy (TKE)</td>
<td>14, 16, 23–5</td>
</tr>
<tr>
<td>two-dimensional models</td>
<td>32–3, 44–6, 50–3, 55–7, 61–6</td>
</tr>
<tr>
<td>UCUT</td>
<td>see Uniform Continuous-Under-Threshold</td>
</tr>
<tr>
<td>unbroken standing waves</td>
<td>214–23</td>
</tr>
<tr>
<td>underwater photography</td>
<td>160–1</td>
</tr>
<tr>
<td>Uniform Continuous-Under-Threshold (UCUT) curves</td>
<td>110–11, 119–21</td>
</tr>
<tr>
<td>United States Bureau of Reclamation (USBR)</td>
<td>279–81, 285</td>
</tr>
<tr>
<td>unsteady flow</td>
<td>33–4</td>
</tr>
<tr>
<td>upstream migration</td>
<td>22, 290, 310</td>
</tr>
<tr>
<td>upwelling surface flow</td>
<td>214–23</td>
</tr>
<tr>
<td>US EPA</td>
<td>see Environmental Protection Agency</td>
</tr>
<tr>
<td>USBR</td>
<td>see United States Bureau of Reclamation</td>
</tr>
<tr>
<td>validation</td>
<td>48–9, 57</td>
</tr>
<tr>
<td>vegetation dynamics</td>
<td></td>
</tr>
<tr>
<td>altered flow regimes</td>
<td>233–4</td>
</tr>
<tr>
<td>climate change</td>
<td>418–21</td>
</tr>
<tr>
<td>dynamic floodplain model</td>
<td>407–27</td>
</tr>
<tr>
<td>floodplain vegetation in Korea</td>
<td>293–307</td>
</tr>
<tr>
<td>hydraulic modeling</td>
<td>61, 293–307</td>
</tr>
<tr>
<td>landscape-scale ecohydrologistics</td>
<td>395–7</td>
</tr>
<tr>
<td>shorebird habitat restoration</td>
<td>379–4, 385–6</td>
</tr>
<tr>
<td>see also aquatic macrophytes</td>
<td></td>
</tr>
<tr>
<td>vegetative resistance</td>
<td>380–2, 385–6, 414</td>
</tr>
<tr>
<td>vertical structure modeling</td>
<td>297–300</td>
</tr>
<tr>
<td>volume of fluid (VOF) model</td>
<td>44</td>
</tr>
<tr>
<td>vorticity</td>
<td>14–17, 147–8, 150</td>
</tr>
<tr>
<td>Waal River, Netherlands</td>
<td>401–5</td>
</tr>
<tr>
<td>water allocation strategies</td>
<td>281–2</td>
</tr>
<tr>
<td>Water Framework Directive (WFD)</td>
<td>2</td>
</tr>
<tr>
<td>CASiMiR multivariate fuzzy modeling approach</td>
<td>82, 85</td>
</tr>
<tr>
<td>environmental flow regimes</td>
<td>277</td>
</tr>
<tr>
<td>MesoHABSIM simulation model</td>
<td>122</td>
</tr>
<tr>
<td>periphyton</td>
<td>229, 230, 240</td>
</tr>
<tr>
<td>research needs and prospects</td>
<td>432</td>
</tr>
<tr>
<td>Water Framework and Habitats Directive</td>
<td>255</td>
</tr>
<tr>
<td>water levels</td>
<td>379, 387, 410</td>
</tr>
<tr>
<td>water quality</td>
<td>332</td>
</tr>
<tr>
<td>Water Resource Integrated Modeling System (WRIMS)</td>
<td>285–90</td>
</tr>
<tr>
<td>water surface elevation (WSE)</td>
<td>343–4</td>
</tr>
<tr>
<td>weighted usable area (WUA)</td>
<td></td>
</tr>
<tr>
<td>CASiMiR multivariate fuzzy modeling approach</td>
<td>76, 88</td>
</tr>
<tr>
<td>hydraulic modeling</td>
<td>32, 59</td>
</tr>
<tr>
<td>MesoHABSIM simulation model</td>
<td>118</td>
</tr>
<tr>
<td>Western spotted frog</td>
<td>193</td>
</tr>
<tr>
<td>wet–dry transition zones</td>
<td>231–2</td>
</tr>
<tr>
<td>wetland zone</td>
<td>408–409</td>
</tr>
<tr>
<td>wetlands</td>
<td>408–09, 412, 414, 417</td>
</tr>
<tr>
<td>willow</td>
<td>395, 408, 408, 413, 415</td>
</tr>
<tr>
<td>winter ice processes</td>
<td>see ice processes</td>
</tr>
<tr>
<td>woody pioneers</td>
<td>408</td>
</tr>
<tr>
<td>World Commission on Dams</td>
<td>1</td>
</tr>
<tr>
<td>WRIMS</td>
<td>see Water Resource Integrated Modeling System</td>
</tr>
<tr>
<td>WSE</td>
<td>see water surface elevation</td>
</tr>
<tr>
<td>WUA</td>
<td>see weighted usable area</td>
</tr>
<tr>
<td>zero-equation model</td>
<td>36–8, 57</td>
</tr>
</tbody>
</table>