Subject Index

A
Absolute disturbance index (ADI), 103-104
Acclimated fish avoidance, 161-162
Accumulation factors, 107-108
NTA uptake and, 110
$P_{ow}$ factors, 116-117
Acute toxicity bioassays, 138-139
Adenosine triphosphatase (ATPase)
cadmium ions and, 113
measurement of activity, 108-109
phenol inhibition of, 114-117
reference chemicals influence on, 113
toxicity testing, 107
Alcohols
lowest-observed-effect levels (LOELs), 92-93
straight-chain, 94
Algae biomass
complex effluent testing and, 84
excessive fertilization and, 25
fish yields and, 19-21
metal tolerance and co-tolerance, 224-225
phosphorus loading and, 22
phosphorus loading and chlorophyll concentration, 18-22
as rapid bioassay, 68-71
variability in, 25-26
weighted, in photosynthesis testing, 78-84
Algal stoichiometry, 18-22
Alkaline phosphatase activity (APA), 43
aquatic sediments, 47-50
decomposition monitoring, 51
microbial growth and, 45
Aluminum toxicants
Brillouin diversity index, 206-208
individual population response, 192, 209-216
leaf-pack bioassays, 198-205
Amides
hazard ranking, 94
lowest-observed-effect levels (LOELs), 93
Analysis of covariance, photosynthesis testing, 82-83
Analysis of variance (ANOVA)
avoidance testing, 149-150
field versus laboratory testing, 151-152, 158
leaf-pack bioassays, seasonal variations, 192, 197
macroinvertebrate microcosms, 169, 173
microbial enzyme activity and, 45
Anilines
hazard ranking, 94
lowest-observed-effect levels (LOELs), 93
Aquatic ecosystem
functional testing, 97-104
microbial enzyme activity in, 45
microcosm studies and, 47-50
organic matter pulses, 51
physicochemical partitioning, 5-6
toxicant tolerance in, 221-223
Aquatic toxicity assays, 123-124
Arsenate
community tolerance, 222-223
cotolerance, 225
Arsenic, microbial enzyme activity tests, 43
Arsenite, DHA response to, 50
Artificial substrates
microbial colonization testing, 57-59
protozoan species dispersal, 56-57
Association coefficient, 5
Atrazine
community tolerance and cotolerance, 224-225
microbial colonization testing, 62-64
protozoan production and loss, 65-66
Automated biomonitoring system for hazard evaluation, 120-126
Automated fish biomonitoring system (AFIRMS), 120-126
schematic, 122
field testing, 124-126
Avoidance testing, 138-163
field conditions, 145-146, 150-154
in-stream, 146-148
laboratory conditions, 142-145, 156-158
length of exposure to metals, 149-150, 153
regression coefficients, 149, 151
results at higher levels, 149, 153
seasonal responses in field testing, 160-161
toxicant tolerance and, 220
water chamber diagram, 144-145

B
BACI (before and after discharge) design, 102-103
Bacterial uptake, functional testing, 131
Bioaccumulation
  of contaminants, 6
  naphthalene, 12
Bioassays
  acute lethality, 139
  acute toxicity, 138–139
  aquatic toxicity assays, 123–124
  evaluation of, 166–167
  field results and, 192
  in situ studies, 98–99
  leaf-pack (See Leaf-pack bioassay)
  limits of, 217
  reliability, 70
  Selenastrum capricornutum as, 68–71
Bioavailability, ecosystem productivity and, 7, 9–10
Bioassays
  acute lethality, 139
  acute toxicity, 138–139
  aquatic toxicity assays, 123–124
  evaluation of, 166–167
  field results and, 192
  in situ studies, 98–99
  leaf-pack (See Leaf-pack bioassay)
  limits of, 217
  reliability, 70
  Selenastrum capricornutum as, 68–71
Bioavailability, ecosystem productivity and, 7, 9–10
Biomass production, particulate organic matter (POM) concentration, table, 13
Breathing rates, biomonitoring systems and, 123–126
Brillouin diversity index
  dissolved oxygen and phenolic derivatives, 183–185
  leaf-pack bioassays, seasonal variations, 192, 197

C
Cadmium
  avoidance response to, 156, 158
  exposure effects of, 1–3
  fish avoidance and, 158
  in littoral communities, 98–99
  microbial response patterns, 50
  protozoan dispersal and, 59–61
Cadmium chloride, microbial colonization testing, 59
Cadmium ions (Cd²⁺)
  characteristics, 109–110
  glucose presence, 110
  influence on ATPase, 113
  transport system, 111
  uptake experiments, 108, 110
Carbon-14-bicarbonate testing method, 77
Carbon-14-labeled carbon dioxide, bioassay testing, 68–71
Carbon-14 uptake, 68–71
  limits of, 83
Carbon-referenced association coefficient, 5
  sorption and, 9–10
Casein-peptone-starch medium (CPS), microbial enzyme activity, 43–44
Chemicals
  biomembranes and, 106–118
  hazard ranking, 86–87
  radioactive labeling of, 117–118
  reference, 107
  structural groups of, 89–90
Chlorinated phenols, 111–113
  influence on growth and functional membrane proteins, 114
  initial uptake rates, 113
Chlorine
  microcosm testing and, 62–63
  protozoan production and loss, 65–66
Chlorophyll concentration
  microbial colonization testing, 62–63
  phosphorus loading and, 18–23
  photosynthesis testing and, 83
  water-body ecosystem response and, 22–23
Chlorophyll response
  toxicity management and, 24–25
  variability in, 26
Chronic exposure effects assessments, 139
Combined fates and effects model (CFEM), 12–13
Community tolerance, pollution-induced, 219–229
Compartmentalized microcosms
  analytical methods and data evaluation, 33–38
  chemical-induced community responses in, 28–40
  operating conditions, 31–32
Complex effluents
  photosynthesis and, 74–84
  storage problems, 134–135
  zooplankton grazing and, 128–137
Concentrated fates and effects simulation, 15
Contaminants (See also Toxicants)
  bioavailability and toxic effects, 3–15
  hydrophobicity of, 5–6
  photosynthesis testing and, 83
Controlled ecosystem pollution experiment (CEPEX) program, 221–223
Copper
  avoidance testing and, 156, 158
  fish avoidance and, 158
  microbial colonization testing, 59
  microbial response patterns, 50
  protozoan species dispersion, 62
Copper chloride, rapid bioassay testing, 68–71
Co-tolerance in populations and communities, 223–225
Coulter counter combination, 33
“Critter counting,” 1

D
Decomposition, monitoring microbial enzyme activities, 41–54
Dehydrogenase activity (DHA), 43
aquatic sediments, 47-50
decomposition monitoring, 51
Detoxifying mechanisms, co-tolerance and, 224
2,4-Dichloroaniline (DCA), 32-33
localization and concentration estimates, 38
Dimethylsulfoxide (DMSO), 32-33
as DCA solvent, 38-39
Dispersal testing, microbial colonization, 59-62
Dissolved organic matter (DOM)
binding and contaminant accumulation, 6-7
contaminant binding on POM, 10-11
defined, 5
Dissolved oxygen (DO)
Brillouin diversity index, 183-185
ecosystem level effects and, 95
as ecosystem state variable, 87-89
leaf-pack bioassays, 176-192
species richness and, 177-191
Diuron, community tolerance and co-tolerance, 224-225
Dunnett's least significant difference
illustration, 91
state changes in microecosystems, 89-91

E

$EC_{max}/EC_{min}$ ratio of community tolerance, 222-223
Ecosystem functioning
automated biomonitoring system, 120-127
complex effluents and, 128-137
condition versus performance, 1
evaluation models, 17-18, 22-25
in situ studies, 97-104
integrity of, 139
microbial activities and, 42-43
microbial colonization parameters, 55-66
partitioning and bioavailability, 7, 9-10
perturbation of, 29
sensitivity of relationships, 25-26
single-toxicant testing, 75
toxic stress and, 65-66
variables, 87-89
Ecosystem-level testing versus other testing
methods, 94-95
Ecosystem modeling
compartmentalized microcosms, 29-40
conceptual model, illustration, 88
fate and effects simulations, 10-13
Vollenweider-OECD model of ecosystem functioning, 17-26
Ecotoxicology, pollution-induced community
tolerance, 219-229
Effective concentrations of protozoan species, 60, 62
Eh measurements, microbial enzyme activities, 44-45
Elutriates, bioassay testing, 68-71
Environmental dimension concept, 104
Environmental Protection Agency (EPA),
Vollenweider-OECD modeling and, 24-25
Eutrophic systems
algal biomass and, 25
ecosystem productivity and, 7, 9-10
photosynthesis response and, 84
toxic effects in, illustration, 4
Extinction tolerance, 220
"Extrapolation problem" in compartmentalized microcosms, 40

F

Fate and effects model of ecosystem productivity (See also Combined fate and effects model), 10-13
Fathead minnow toxicity data base, 87, 89
Field evaluations
of fish avoidance, 139
versus laboratory bioassays, 192-196
versus leaf-pack bioassays, 192, 198-205
pollution-induced community tolerance (PICT), 227-228
resistant populations in, 217
as verification of laboratory results, 166-167
Filter feeder community, 98-101
Filtering rates
changes relative to complex effluent additions, table, 132
zooplankton grazing, 130-132
Fish avoidance
acclimated fish, 161-162
behavioral assessment of pollutants, 138-163
field conditions, 145-146
in-stream testing, 146-148
laboratory conditions, 142-145
low metal blend concentrations, 149-150
materials and methodology, 140-149
prior metals exposure and, 162-163
specific metals, 156, 158
stream bank conditions and animal presence, 160-161
unexposed fish, 151, 155-156
Fish yields, 23
agal biomass and, 19-21, 26
Fish yields (cont.)
a atrazine concentration and, 65–66
avoidance behavior and, 138–163
biomonitoring systems, 121–123
Fitness and pollution-induced community tolerance (PICT), 229
Flow rate manipulation, microcosm assessment, 39–40
Flow-through testing of leaf-pack bioassays, 175–176
seasonal variations, 197
Free diffusion rate, 106
Functional biological testing, 121–126
organismal and community parameters, 56
toxicant effects on littoral communities, 97–104
zooplankton grazing, 128–137
Functional measurements of ecosystems, 1–2
Functional membrane proteins
chlorinated phenols, 114
HCB influence on, 113–114
NTA influence on, 113
toxicity testing and, 107
F values table, avoidance testing, 151, 157

G
Glucose preincubation, 109
Glucose transport measurement, 109
Grazing pressure
hazard evaluations and, 128–129
inhibition estimation procedures, 129–131
in microcosms, 39–40
pollution-induced community tolerance (PICT), 228
Great Lakes (See also specific lakes)
planktonic systems in, 128–129
Gross primary production, 100

H
Hardness parameter and metals toxicity, 160
Hazard evaluation
automated biomonitoring system, 120–126
compartmentalized microcosms, 28–40
complex effluents and zooplankton grazing, 128–137
fish behavioral assessment, 138–163
freshwater macroinvertebrate microcosms, 167–217
in situ system, 97–104
laboratory microecosystems, 86–95
microbial colonization parameters, 55–66
microbial enzyme activities, 41–54
pollution-induced toxicant tolerance, 219–229
rapid bioassay, 68–71
trophic status, 31–35
uptake influence on membrane function, 106–118
Vollenweider-OECD modeling, 17–26
Hazard rankings
chemical groups, 94–95
ecosystem versus fathead minnow, 92–93
methodology, 87
Herbivores, grazing inhibition and, 129–131
Hexachlorobenzene (HCB), 111–113
influence on cell growth, 114
initial uptake rates, 113
Hotelling statistic, NOR calculation, 33
Hyperactivity response, metals acclimation, 158
Hypoactivity response, metals acclimation, 158

I
Indexes (See also specific indexes)
use of in toxicity testing, 101
Inhibition
reversal, illustration, 136
zooplankton grazing, 131–132
Insect toxicity resistance, 192
In situ system of hazard evaluation, 97–104
description and diagram, 98–99
In-stream avoidance testing, 146–148
Interaction pathways, microbial enzyme activities, 42–43
nutrient-toxicant, 79–82

L
Laboratory microecosystems, 86–95
hazard rankings, 95
Lake Erie
complex effluents and photosynthesis inhibition, 74–84
photosynthesis stimulation in, 78
zooplankton grazing on, 128–137
Lake Huron
complex effluents and photosynthesis inhibition, 74–84
grazing rates in, 129
photosynthesis stimulation in, 78
Lead levels, leaf-pack bioassays, 198–205
Brillouin diversity index, 206–208
individual population response, 192, 209–216
Leaf-pack bioassays, 167–169
comparison with field results, 192
dissolved oxygen and phenolic derivatives, 177-182
flow-through testing, 175-176
results, 170-173
seasonal variations, 174-175, 192-196
structure and characteristics, 167-169
Least squares regression model and microbial colonization, 59
Life-cycle strategies and toxicant tolerance, 221-223
Littoral communities
cadmium exposure, 98
experimental communities, 99-100
toxicity effects on, 97-104
Lowest-observed-effect level (LOEL)
alcohol group, 92-93
amides, 93
aniline group, 93
hazard rankings and, 92-94
state changes in microecosystems, 89-91
MacArthur-Wilson theory of island colonization, 59, 63-65
Macrobenthos microcosms, 167-217
Membrane functions and uptake kinetics, 106-118
Mercury, fish behavior towards, 156, 158
Mesocosm testing, 1-2
Metabolism
conversion studies, 108
measurements in settling panel communities, 102
toxicity effects on, 97-104
uptake mechanisms and, 107-108
Metallothionein levels
co-tolerance and, 224
metals acclimation and, 162
Metals acclimation
dose dependency, 158
field exposure, 140, 142, 162
laboratory exposures, 140-141, 162
length of exposure period, 149-150, 153
prior exposure and fish avoidance behavior, 163
resistance to toxicity and, 154, 159
response to blend versus controls, 158-160
results at higher levels, 149, 153
toxicity testing, 148-149
Metals concentrations in leaf-pack bioassays, 174-175
seasonal variations, 197
Michaelis constant, 110
Microbial colonization
density and enzyme activity, 50-51
dispersal experiments, 56, 58-59
ecosystem function, 55-66
experimental design and analysis, 59
toxic materials and, 59, 64-65
Microbial enzyme activity
APA activity and, 45
decomposition process monitoring, 41-54
ecosystem decomposition activity and biomass, 42-43
functions of, 41-42
inhibition table, 49
microbial density and, 45
statistical precision, 45
Microcosm analysis
of aquatic sediments, 45
design characteristics table, 32
ecosystem-level testing, 94-95
ecosystem modeling, 29-30
elasticity and inertia, 39
freshwater invertebrate, 167-217
grazing pressure measurements, 39-40
group operations, 44
laboratory microecosystems, 86-95
microbial colonization and, 62-63
micro-ecosystem (MES), 29-33
mixed-flask culture, 88-89
operating conditions, 29-33
protozoan species and net production, 65-66
rationale diagram, 30
smaller inertia of, 39
soil slurries, 44
discard species and production, 56-57
testing protocol for, 87
testing system diagram, 58
time-series analysis
standing stock data, 33-34
three-dimensional normalized strain, 35-36
Micro-ecosystem (MES) (See Microcosm)
Microorganism toxicity testing, 107
Mixed-function oxygenase systems, co-tolerance and, 224
Mobile bioassay trailer facilities, 121
Multidimensional state space transitions,
chemically-induced community responses, 28-40
Multispecies testing, 166-167
versus single species testing, 220-221
Naphthalene
bioaccumulation of, 12
removal through sorption, 13-14
Natural selection, pollution-induced community tolerance (PICT), 229
Nickel, avoidance response to, 156, 158
Nitrilotriacetic acid (NTA)
  initial uptake rates, 110
  properties of, 109
  uptake experiments, 108
No-effect concentration (NEC), pollution-induced community tolerance (PICT), 225-227
Normal operating range (NOR), microcosm evaluation and, 33-38
Nutrient excretion
  absolute disturbance index, 104
  toxicity exposure and, 79-82, 101
Nutrient supplements, photosynthetic response and, 82

O
Octanol/water partition coefficient, 5, 106-107
Oligotrophic systems
  ecosystem productivity and, 7, 9-10
  photosynthesis response and, 84
  toxic effects in, illustration, 4
Organization for Economic Cooperation and Development (OECD) test guidelines, 107
Oxygen/nitrogen ratio, 97-98
  cadmium exposure, 101
Oxygen/phosphorus ratio, 101

P
Paraquat, community tolerance and co-tolerance, 225
Particulate organic matter (POM)
  biomass productivity reduction, table, 12-13
  defined, 6
  DOM and contaminant binding, 10-11
PCP uptake experiments, 108
Performance of ecosystems, 1-2
Periphyton communities
  arsenate stress, 223-226
  co-tolerance patterns with arsenate, 225-226
  toxicant tolerance and, 222-223
Perturbation index (PI)
  absolute disturbance index and, 104
  BACI design and, 102-103
  calculation methods, 100-101
  microcosm models and, 32-33
Phenol derivatives
  Brillouin diversity index, 183-185
  leaf-pack bioassays, 176-192
  species richness and, 177-191
pH levels
  ecosystem level effects and, 95
  as ecosystem state variable, 87-89
  leaf-pack bioassays, 169, 173
    Brillouin diversity index, 206-208
    individual population response, 192, 209-216
    seasonal variations, 174-175, 192, 197
  microbial enzyme activities, 44-45
Phosphorus loading
  calculation methods, 22-25
  chlorophyll concentration and, 18-23
  primary productivity and, 21-22
  toxicity management and, 24-25
  water body productivity, illustration, 20, 22
Photosynthesis
  arsenate inhibition, 222, 225
  atrazine effects on, 65-66, 68
  carbon uptake measurement, 77
  complex effluents and, 74-84
  Selanastrum capricornutum, 71
  toxicant tolerance and, 221-223
Physicochemical partitioning
  in aquatic environment, 5-6
  ecosystem productivity and, 7, 9-10
Phytoplankton
  grazing inhibition and, 129-131
  gross photosynthesis, 131
  toxicant tolerance and, 221-223
Plasma membrane, 106-107
Pollution
  automated biomonitoring system, 120-121
  fish behavioral assessment of, 138-163
Pollution-induced community tolerance (PICT), 219-229
  assessment principle, 225-226
  field applications, 227-228
  limits and methodology, 221-225
  population tolerance approach, 220-221
  potential applications, 225-228
  primary versus secondary effects, 228
  toxicant mode of action estimations, 228
  validation, 222-223
Polychlorinated biphenyls (PCBs), photosynthesis and, 75-77
Polycyclic aromatic hydrocarbons (PAHs)
  bioaccumulation, 6-7
  fate and effects model simulations, 10-13
  illustration, 7
  time course for uptake, illustration, 7-8
  uptake efficiency, illustration, 7, 9
Population tolerance, 220-221
Portable avoidance chamber, 146, 148
$P_{ow}$ values, accumulation factors and, 116–117

Primary effects of toxicants, 228
water-body ecosystem response and, 23

Propagule dispersal, 56

Proteolysis
decomposition monitoring, 51
microbial enzyme activity and, 50

Protozoan species
cadmium and, 59–61
copper and dispersion, 62
dispersal effects, 56–57
limits of as test populations, 66
production and loss in microcosms, 65–66
as test organisms, 58–59

Purine transport measurement, 109

$P$ values table, avoidance testing, 158

Quantitative structure-activity relationships (QSARs), 87, 89

Rapid test system, uptake experiments, 106–108

Redox potential as ecosystem state variable, 87–89

Reference chemicals, 107
influence on plasma membrane ATPase, 113

Regression coefficients
avoidance testing, 149, 151
table, 151, 157

Resistant species, 192

Respiration
absolute disturbance index, 104
toxicity exposure and, 100–101

River Raisin
complex effluents, 128–137
geographical features, 75–77
photosynthesis, 74–84

Sediments
bioassay testing, 68–71
microbial enzyme activity, 43

Selanastrum capricornutum, 68–71

Selection pressure, pollution-induced community tolerance (PICT), 228–229

Selenium ions, fish avoidance, 158

Selenite, microbial response patterns, 50

Simulated toxic stress test, 123

Single-species, single-toxicant testing, 75
ecosystem-level tests, 94
versus multi-species testing, 220–221
photosynthesis inhibition and, 83–84

Soil slurries, 44
microcosm microbial performance and, 45–46

Sorption
carbon-referenced association coefficient, 9–10
combined fate and effects model, 12–13
metals acclimation and, 160
naphthalene removal, 13
oligotrophic versus eutrophic systems, 7, 9–10

Species diversity indexes, leaf-pack bioassays, 176, 183–186

Species interaction
standing stock data, 37
stress on populations and, 32–33

Species richness
ecosystem function, 1–2
field results versus leaf-pack bioassays, 192, 206–208
leaf-pack bioassays, 174–175
phenol derivatives and dissolved oxygen, 177–191
seasonal differences, 192–196

State changes in laboratory microecosystems, 86–95

Statistical analysis
avoidance testing, 149
microbial colonization, 59
microcosm models, 29–30

Stimulation of zooplankton grazing, 131–132

St. Lawrence River, rapid bioassay testing, 68–71

Stoichiometry, algal, 18–22

Stress (See Toxic stress)

Sublethal effects, assessments of, 139

Subsidy effect of toxins, 66

Substrate variations
passive diffusion and, 112–113
uptake experiments, 109–110

Subsurface soil bacteria
microbial enzyme activity, 43
summary of microcosm performance, 46
Sulfite ions, community tolerance and co-tolerance, 225
Synergism, copper-zinc in avoidance response, 156, 158

T
Test systems, criteria for, 107
Time series analysis of compartmentalized microcosms, 34-36
Titanium citrate, microbial enzyme activity, 43-44
Tolerance (See Toxicant tolerance)
Total plate counts, microbial growth, 45
Toxicant tolerance
  co-tolerance, 223-225
  occurrence and measurement, 221-223
  pollution-induced, 219-229
Toxicity
  increased POM and, 13-14
  metals acclimation and, 154, 159, 162
  photosynthetic response and, 82
  pollution-induced community tolerance (PICT), 228
  rapid bioassay screening, 68-71
  species production and survival, 64-65
Toxicity testing, 123-126
  criteria for, 107
  fish avoidance, 148-149
  freshwater macroinvertebrate microcosms, 167-217
  limits of, 28-29
  macroinvertebrate microcosms, methods and materials, 166-167
  quantitative structure-activity relationships (QSARs), 87, 89
  simulated toxic stress test, 123
  Vollenweider-OECD modeling and, 24-25
Toxic stress
  in balanced ecosystems, 28-29
  leachate stress tests, 126
  microbial dispersal rates, 56
  Toxic Substances Control Act of 1976, 138
Trophic status of community, contaminant bioavailability and toxic status, 3-15

U
Uptake experiments
  membrane functions and, 106-118
  methodology, 108
  radioactively labeled chemicals, 117-118
  results and discussion, 109-113

V
Variability in ecosystem functioning, 25-26
Vollenweider-OECD model of ecosystem functioning, 17-26
  history and background, 18-19

W
Water quality parameters
  ecosystem response, 22-23
  field avoidance testing, 142-143, 150-154
  fish avoidance and, 160
  laboratory avoidance testing, 140, 142
  macroinvertebrate microcosm testing, 174
  microbial enzyme activity and, 51
  modifications of ecosystem modeling and, 24
  Weighted algal biomass, photosynthesis testing, 78-84

Y
Yeast cells, uptake mechanisms and toxicity testing, 107-108

Z
Zinc, fish avoidance and, 158
Zooplankton grazing
  complex effluents and, 128-137
  reproduction rates, 131-132