

Contents

<i>List of contributors</i>	<i>xi</i>
<i>Preface</i>	<i>xiii</i>
<i>Acknowledgments</i>	<i>xv</i>

1. Bacterial community composition in lakes 1

Ajar Nath Yadav, Neelam Yadav, Divjot Kour, Akhilesh Kumar,
Kritika Yadav, Amit Kumar, Ali A. Rastegari, Shashwati Ghosh Sachan,
Bhanumati Singh, Vinay Singh Chauhan and Anil Kumar Saxena

Introduction	1
Historical perspective of lake bacterial communities	3
Study of bacteria in lake environments; why is it so important?	3
Bacterial biogeography in lakes	6
Biodiversity and abundance of bacteria from freshwater lakes	8
Bacterial alpha diversity	8
Bacterial beta diversity	10
Bacterial abundances and spatial patterns	10
Bacterial population dynamics	12
Diversity-productivity relationship in freshwater bacterial communities	13
Microbial dormancy	24
Influence of habitat heterogeneity and submerged macrophytes on bacterial community composition in freshwater lakes	25
Top-down and bottom-up induced shifts in bacterial abundance production and community composition	26
Zooplankton and aquatic bacterial linkages in freshwater lakes	27
Bacterial community resistance and resilience in lakes	31
Novel bacteria from freshwater lake ecosystems	33
Case studies of bacterial community of lake ecosystems	33
Comparative study of some freshwater lakes in India	53
Conclusions	54
Acknowledgments	56
References	57

2. Bacterial diversity of the rock-water interface in freshwater ecosystem 73

Rubiya Dar, Suhaib A. Bandh, Sana Shafi and Nowsheen Shameem

Introduction	73
Sessile bacteria	75

Attachment of freshwater bacteria to solid surfaces	75
Microbial epilithic and endolithic biofilms	76
Microbial dynamics of epilithic mat communities	80
Role of epilithic and endolithic microbes	82
Colonization pattern of bacterial communities in endolithic habitats	83
Epilithic bacteria and mineral formation	84
Chemolithotrophic microbial mats on subsurface rocks	85
Microbial life in deep granitic rocks	87
Identification of lithic bacteria	89
Effect of different factors on bacterial attachment to submerged rock surfaces	90
Case study	91
Conclusions	93
References	94
3. Impact of environmental changes and human activities on bacterial diversity of lakes	105
M.M.M. Islam, Sana Shafi, Suhaib A. Bandh and Nowsheen Shameem	
Introduction	105
Sources of bacteria in lake water	107
Association of lake bacterial diversity with changing environmental features	109
Human activities and lake bacterial diversity	120
Climatic variables and lake bacterial diversity	121
Socioeconomic factors and lake bacterial diversity	123
Fecal contamination of surface waters	124
Advances in aquatic microbial detection and quantification	126
Conclusions	127
References	128
4. Spatio-temporal patterns of bacterial diversity along environmental gradients and bacterial attachment to organic aggregates	137
Suhaib A. Bandh, Sana Shafi, Nowsheen Shameem, Rubiya Dar, Azra N. Kamili and Bashir A. Ganai	
Introduction	137
Spatio-temporal distribution of microbial communities	138
Drivers of microbial communities in lakes	141
Effect of grazers on bacterial community structure and production in trophic lakes	147

Diversity-functioning relationships in lake bacterial communities	148
Environmental heterogeneity and diversity-functioning relationship	150
Organic aggregates in surface water bodies	151
Structural composition of aggregate-associated bacterial communities	153
Diversity of organic aggregate-attached bacteria in lakes	153
Aggregate-associated organic matter and bacterial turnover	158
Ecological significance of organic aggregate-attached bacteria	160
Conclusions	161
References	162

5. Metagenomic insights into the diversity and functions of microbial assemblages in lakes **175**

Lateef B. Salam

Introduction	175
Metagenomics: historical perspectives	177
Sequencing technologies	181
Metagenomics of freshwater lakes—basic steps	185
Freshwater lakes metagenomic studies	197
Conclusions	208
References	210

6. Depth distribution of microbial diversity in lakes **225**

Halil Kurt

Introduction	225
The neuston layer	230
Planktonic freshwater prokaryotes	234
Phototrophic bacteria	235
Sediment layer	239
Vertical distribution of sulfate-reducing bacteria	243
Vertical distribution of iron-oxidizing bacteria	245
Vertical distribution of manganese-oxidizing bacteria	246
Vertical distribution of ammonia-oxidizing archaea in lakes	246
Case studies	248
Conclusions	252
References	253
Further reading	262

7. Exploring bacterial diversity: from cell to sequence	263
Rupeya Nazir, Sabeehah Rehman, Marofull Nisa and Uqab ali Baba	
Introduction	263
Microbial diversity and its importance	263
Microbial cell structure	265
Bacillus	266
Coccus	267
Vibrio	267
Spirilla	268
Structural components of a bacterial cell	269
Plasma membrane	270
Cytoplasm	272
Surface appendages	272
Bacterial genome	274
Exploring microbial diversity	275
Phenotypic approach	276
Plate counting	277
Community level physiological profiling	278
Phospholipid fatty acid analysis	279
Fatty acid methyl ester analysis	280
Identification of microorganisms using fatty acid methyl ester analysis	280
Molecular approach	281
Barcodes/molecular markers of microbial world	281
16S rRNA gene	281
gyrB	282
23S rRNA gene	282
rpoB	282
dnaK	283
dsrAB	283
16S-23S rDNA ISR	284
Molecular tools for exploring microbial diversity	284
Polymerase chain reaction	284
Basic concept of PCR	285
Steps in PCR	286
Types of PCR	288
Denature gradient gel electrophoresis (DGGE)	291
Terminal restriction fragment length polymorphisms (T-RFLP)	292
Single-strand conformation polymorphism	293
Amplified ribosomal DNA restriction analysis (ARDRA)	293
Fluorescent in situ hybridization	293
Clone libraries	294

Gel electrophoresis	294
Polyacrylamide gel electrophoresis	295
Sequencing of DNA	296
Conclusions	299
References	300
Further reading	305
8. Bacterial biofilms: the remarkable heterogeneous biological communities and nitrogen fixing microorganisms in lakes	307
<i>Rugeya Nazir, Mir Riasa Zaffar and Insha Amin</i>	
Introduction	307
Availability of biofilms in fresh water systems	309
Biofilm diversity	310
Biofilm structure	312
Biofilm formation	313
Biofilm maturation	314
Factors influencing bacterial biofilm formation	315
Quorum sensing and biofilm development	317
General stress response	319
Persisters	319
Culturing biofilms	320
Methods for characterization of biofilms	322
Techniques for studying biofilms	324
Role of biofilms in bioremediation	328
Types of pollutants remediated by biofilms	331
Nitrogen fixing microorganisms in lakes	332
Conclusions	333
References	334
9. Microbial diversity in freshwater ecosystems and its industrial potential	341
<i>Preeti Sharma, Parvez Singh Slathia, Neelu Raina and Deepali Bhagat</i>	
Freshwater lake characteristics	342
Microbial diversity of cyanobacteria	344
Classification of microalgae and its significance	350
Biotechnological importance of Cyanobacteria and microalgae	356
Future industrial potentials of Cyanobacteria (blue-green algae) and microalgae	368
Industrial processes for microalgae and cyanobacteria	377
Conclusions	379
References	380

10. Bacteria: the natural indicator of environmental pollution	393
Qazi A. Hussain	
Introduction	393
Air pollution	394
Water pollution	395
Fresh water pollution	396
Marine pollution	397
Fecal contamination of fresh and marine waters	399
Eutrophication	402
Soil and land pollution	404
Antibiotic-resistant bacteria as pollution indicators	407
Pollutant-specific bacterial indicators	408
Conclusions	411
Acknowledgments	411
References	412
Further reading	420
 Index	 421