
Contents

Foreword	xi
Stéphanie THIÉBAULT and Françoise GAILL	
Introduction	xiii
Anne-Geneviève BAGNÈRES and Martine HOSSAERT-MCKEY	
Chapter 1. Biodiversity and Chemical Mediation	1
Bertrand SCHATZ, Doyle MCKEY and Thierry PÉREZ	
1.1. Systematic and integrative taxonomy from chemical ecology	2
1.2. Scent communication between sexual partners	4
1.3. Scent communication between species	6
1.4. Chemical mimicry, to enhance reproduction	8
1.5. A dialog that sometimes evolves into an interaction network	10
1.6. Conclusions	18
1.7. Bibliography	18
Chapter 2. Chemical Ecology: An Integrative and Experimental Science	23
Anne-Marie CORTESERO, Magali PROFFIT, Christophe DUPLAIS and Frédérique VIARD	
2.1. Semiochemicals	23
2.2. Chemical ecology in multitrophic networks and co-evolution between species	28
2.3. Contribution of chemical ecology to the study of tropical plant diversification	32

2.4. When chemical ecology sheds light on the process of biological invasion – an example demonstrating integration between chemistry and ecology	36
2.5. Protection is in the air: how plants defend themselves against phytophagous insects through VOC emissions	40
2.6. Conclusions.	43
2.7. Bibliography	43
Chapter 3. Scents in the Social Life of Non-Human and Human Primates	47
Marie CHARPENTIER, Guillaume ODONNE and Benoist SCHAAL	
3.1. Primate societies and their complex systems of communication.	47
3.2. The role of odors in human communication.	53
3.2.1. Human odors convey a large panel of cues.	53
3.2.2. Body odors reflect internal states	55
3.2.3. What are the functions of social smells in human daily life?	56
3.2.4. Human pheromones, fact or fiction?	59
3.3. The senses of smell and taste in the search for food and remedies	61
3.3.1. Interactions between senses and food in primates.	61
3.3.2. Senses and self-medication in animals	62
3.3.3. Senses in human therapies.	63
3.3.4. An evolutionary conception of the link between senses and health	65
3.4. Conclusions – the adaptive functions of the sense of smell in “microsmatic” species	66
3.5. Bibliography	68
Chapter 4. Microbiota and Chemical Ecology	71
Soizic PRADO, Catherine LEBLANC and Sylvie REBUFFAT	
4.1. The protagonist microorganisms of chemical ecology	71
4.2. Strategies for the study of microbiota	72
4.2.1. How should the microbiota be characterized?	72
4.2.2. What tools are available to help understand the roles of the microbiota?	73

4.3. The molecular dialog of microorganisms	75
4.3.1. Language and social life of microorganisms	75
4.3.2. The AMPs, main actors in the equilibrium of bacterial communities	78
4.3.3. Fungi and bacteria communicate to better help each other	79
4.3.4. When helping each other degenerates into chemical warfare between bacteria and fungi	80
4.3.5. The Trichoderma fungi: heavy artillery against pathogenic fungi	80
4.4. Chemical communication between microorganisms and their hosts.	81
4.4.1. Plant–bacteria relationships: essential interactions with different partners	81
4.4.2. Plants also establish intimate relations with fungi.	83
4.4.3. Mutualist actinobacteria provide care to insects	85
4.4.4. Chemical communication between microorganisms and their host in the marine environment	87
4.5. Regulations and evolution of the interactions in changing ecosystems and environments	89
4.5.1. Contribution of chemical ecology to the understanding of biosynthesis mechanisms of chemical mediators	90
4.5.2. Metabolic networks: new tools for studying the evolution of host/microbiota interactions.	91
4.6. Conclusions – from chemical ecology to future applications: impacts of the study of the microbiota	91
4.7. Bibliography	92
Chapter 5. From Chemical Ecology to Ecogeochemistry	95
Catherine FERNANDEZ, Virginie BALDY and Nadine LE BRIS	
5.1. Balance between primary and secondary metabolism	96
5.2. Role of secondary metabolites in biotic interactions and community structure	99
5.3. Secondary metabolites and ecosystem functioning: plant soil relation – brown food chain	103
5.4. Integration of biotic and abiotic dynamics: benthic marine microhabitats	109
5.5. Conclusions.	114
5.6. Bibliography	114

Chapter 6. Omics in Chemical Ecology	117
Sylvie BAUDINO, Christophe LUCAS and Carole SMADJA	
6.1. Introduction: the different “omic” technologies	118
6.2. From “omics” to signals: identifying new active molecules.	120
6.3. From “omics” to the ecology of communities: identifying chemical interactions of organisms in their environment	121
6.4. From “omics” to molecular bases: revealing the genetic and molecular bases of chemical interactions	122
6.5. From “omics” to physiology: characterizing the modes of production and the modes of reception of active molecules	127
6.6. From “omics” to the role of environment: understanding the impact of biotic and abiotic factors on interactions	128
6.7. From “omics” to evolution: understanding and predicting the adaptive value of chemical interactions	131
6.8. Conclusions and perspectives	133
6.9. Bibliography	134
Chapter 7. Metabolomic Contributions to Chemical Ecology	139
Philippe POTIN, Florence NICOLÈ and Olivier P. THOMAS	
7.1. Definition of metabolomics	139
7.2. Different strategies of the metabolomic approaches	140
7.3. The different steps for conducting a metabolomic study	141
7.3.1. Experimental design and sampling.	142
7.3.2. Analytical approaches	144
7.3.3. Data processing	144
7.4. Applications of metabolomics.	151
7.4.1. Chemical biodiversity and chemotaxonomy	151
7.4.2. Study of the regulation and evolution of metabolic/ biosynthesis pathways	152
7.4.3. Contributions to functional ecology	155
7.4.4. Application of metabolomics to the study of environmental disturbances	157
7.5. Conclusions.	157
7.6. Bibliography	158

Chapter 8. Chemical, Biological and Computational Tools in Chemical Ecology	161
Nicolas BARTHÈS, Jean-Claude CAISSARD, Jérémy JUST and Xavier FERNANDEZ	
8.1. Chemical tools	161
8.1.1. Analytical tools of chromatography	161
8.1.2. Analytical approach by nuclear magnetic resonance	168
8.1.3. Secondary metabolite imagery techniques	170
8.2. Sequencing tools	173
8.2.1. Principles, strengths and limitations of NGS	174
8.2.2. Major domains of NGS applications	175
8.3. Databases: biodiversity in silico	179
8.3.1. Databases of chemical compounds and general ecology	180
8.3.2. Databases for the omics that can be used in chemical ecology	181
8.4. Conclusions	183
8.5. Bibliography	183
Chapter 9. Academic and Economic Values of Understanding Chemical Communication	185
Bernard BANAIGS, Ali AL MOURABIT, Guillaume CLAVE and Claude GRISON	
9.1. Nature as a model	185
9.2. Nature as a model for development of new molecules of interest	187
9.2.1. From chemical mediators to new bioactive structural archetypes	188
9.2.2. Biosynthesis and biomimetic synthesis	192
9.2.3. Chemical mediators and ligand/receptor interactions: to the discovery of new cellular receptors and biochemical tools	195
9.3. Chemical ecology and sustainable development	196
9.3.1. Bio-control	198
9.3.2. Bio-inspired chemistry and remedial phytotechnologies	200
9.4. Conclusions	205
9.5. Bibliography	205

Conclusion	207
Martine HOSSAERT-MCKEY and Anne-Geneviève BAGNÈRES	
Glossary	213
List of Authors	217
Index	221