CAMBRIDGE

Cambridge University Press
978-0-521-64651-2 - Theoretical Ecosystem Ecology: Understanding Element Cycles
Goran Agren and Ernesto Bosatta
Table of Contents
More information

Contents

Preface		xii
List of important symbols		xiv
PART I. PRELUDE		1
1	**Introduction**	3
1.1	Theoretical ...	3
1.1.1	The language	3
1.1.2	The tool	4
1.1.3	The model	6
1.2	... Ecosystem ecology	6
1.2.1	The problems	7
1.3	Setting a perspective	9
2	**Element cycling**	12
2.1	Elemental distribution	12
2.2	Carbon and nitrogen	13
PART II. THE SOIL		17
3	**Theory for homogeneous substrates**	19
3.1	Main concepts	19
3.2	Carbon and nitrogen dynamics	20
3.3	A particular solution	26
3.4	Lag-time effects	29
3.5	From single litter cohorts to the soil	30
4	**Theory for heterogeneous substrates**	34
4.1	Substrate quality	35
4.2	Basic equations for carbon	35
4.3	Two particular solutions	39
4.4	The moment expansion	42
4.5	Basic equations for N, P and S	45
4.6	One litter cohort	47
4.7	Models for decomposer functions	51
4.8	Model I	52
4.8.1	One litter cohort	52

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-0-521-64651-2 - Theoretical Ecosystem Ecology: Understanding Element Cycles
Goran Agren and Ernesto Bosatta
Table of Contents
More information

4.8.2	Several litter cohorts	54
4.9	Model II	55
4.9.1	One litter cohort	57
4.9.2	Several litter cohorts	58
4.10	Comparison with other approaches	59
5	**Carbon and nitrogen - applications**	61
5.1	Single litter cohorts	61
5.2	Steady state of soil organic matter	68
5.3	Correlation between carbon and nitrogen turnover	70
5.4	Steady state of a Scots pine forest	70
5.5	An agricultural application	72
5.6	Decomposer biomass	73
6	**Carbon, nitrogen, phosphorus and sulphur - applications**	79
6.1	C-N-P-S interactions	79
6.2	C, P and N dynamics in single litter cohorts	80
6.3	Stabilisation of C, N, P and S in the soil	82
6.4	C, N, P and S mineralisation	85
7	**Interactions with abiotic factors**	91
7.1	The problems	91
7.2	Mineralisation-immobilisation in single litter cohorts	92
7.3	N retention in the soil organic matter	97
7.4	Perturbation in carbon accessibility	100
7.5	Variable decomposer growth rate	107
PART III. THE PLANT		111
8	**Theory for plant growth**	113
8.1	Nitrogen productivity	114
8.2	Nitrogen productivity or photosynthesis and respiration	118
8.3	Different uptake models	120
8.3.1	General uptake rate	120
8.3.2	Exponential uptake	124
8.3.3	Fixed amount	126
8.3.4	General uptake rate - revisited	130
8.4	Nitrogen productivity and other nutrients	131
8.5	Variable P_N	133
8.6	Comparison with other approaches	137

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-0-521-64651-2 - Theoretical Ecosystem Ecology: Understanding Element Cycles
Goran Agren and Ernesto Bosatta
Table of Contents
More information

9 Plant growth - applications and extensions 139
9.1 Empirical evidence for nutrient productivities 139
9.1.1 Exponential growth 139
9.1.2 Non-exponential growth 141
9.2 Nitrogen productivity and light 142
9.3 Root:shoot ratios 148
9.4 Nutrient use efficiency and the Piper-Steenbjerg effect 151
9.4.1 Nutrient use efficiency 151
9.4.2 The Piper-Steenbjerg effect 152

PART IV. THE ECOSYSTEM 157
10 Elements of an ecosystem theory 159
10.1 The general terrestrial ecosystem equation 159
10.2 Ecosystem stoichiometry 161
10.3 Comparison with other approaches 164
10.3.1 CENTURY, GEM, G'DAY 165
10.3.2 FORET, LINKAGES 165
10.3.3 MEL 166
11 Ecosystems - applications 167
11.1 Ecosystems and global change 167
11.2 Nitrogen saturation 170
11.3 Short rotation forestry 174
11.4 Other applications 176
11.4.1 Global change - revisited 179
11.4.2 Forest nutrient budgets 180
11.4.3 Acid depositions to forest ecosystems 183
12 Quality - the bridge between plant and soil 186
12.1 Components of quality 186
12.2 Plants and quality 191

Epilogue 193
Appendices 195
A.1 Some properties of the delta function 195
A.2 Numerical solutions to (4.7) and to the moment expansion 196
References 201
Solutions to selected problems 222
Subject index 229

© Cambridge University Press www.cambridge.org