

# Biology of the Springtails (Insecta: Collembola)

---

STEPHEN P. HOPKIN

*School of Animal and Microbial Sciences  
University of Reading*

Technische Universität Darmstadt  
FACHBEREICH 10 — BIOLOGIE  
— Bibliothek —  
Schnittspahnstraße 10  
D-64287 Darmstadt

Inv.-Nr. 14850  
.....

Oxford New York Tokyo  
OXFORD UNIVERSITY PRESS

1997

---

# Contents

---

1	General introduction	1
1.1	Overview	1
1.2	Key facts about Collembola	2
1.3	Ecological importance	5
1.4	Background reading	6
2	Review of the literature on springtails	8
2.1	Introduction	8
2.2	Publications before <i>Systema naturae</i> of Linnaeus (1758)	8
2.3	Linnaeus (1758) to Lubbock (1873)	12
2.4	Lubbock (1873) to Salmon (1964)	14
3	Evolution, systematics and biogeography	19
3.1	Introduction	19
3.2	Evolution of Collembola	19
3.3	Systematics of the Class Collembola	26
3.4	Families of Collembola	28
3.5	Biogeography	42
4	Ecomorphology and anatomy	46
4.1	Introduction	46
4.2	Morphology	47
4.3	Internal anatomy	58
4.4	Sense organs	64
4.5	Structure and function of the 'spring'	70
5	Taxonomic methods and the species concept in Collembola	73
5.1	Introduction	73
5.2	Methods of defining species	74
5.3	Problems of defining species boundaries	85
5.4	The Subfamily Onychiurinae	93
5.5	Conclusions and recommendations	96
6	Interactions between Collembola and the abiotic environment	98
6.1	Introduction	98
6.2	Temperature	99
6.3	Water and salt balance	103
6.4	Gaseous exchange and metabolism	109

7	Interactions between Collembola and the biotic environment	113
7.1	Introduction	113
7.2	Feeding behaviour	113
7.3	Interactions between Collembola and other animals	123
7.4	The roles of Collembola in decomposition processes	127
7.5	Collembola as pests	129
8	Reproduction, development and life histories	133
8.1	Introduction	133
8.2	Reproductive organs, gametes and chromosomes	134
8.3	Mating behaviour and oviposition	136
8.4	Embryology	142
8.5	Postembryonic development and life histories	150
8.6	Ecomorphosis, epitoky and cyclomorphosis	153
8.7	Parthenogenesis and sex ratios	156
9	Ecology and conservation	158
9.1	Introduction	158
9.2	Observation and sampling techniques	158
9.3	Distribution of Collembola in space and time	160
9.4	Collembola as ecological indicators	173
9.5	Conservation	178
9.6	Cave Collembola	180
10	Ecotoxicology	183
10.1	Introduction	183
10.2	Laboratory toxicity tests with Collembola	183
10.3	Risk assessment	189
10.4	Effects of chemicals on Collembola in the field	192
10.5	Assimilation of chemicals by Collembola	196
10.6	Evolution of genetic resistance to chemicals	200
10.7	Conclusions	201
Appendix A	World genera of Collembola	202
Appendix B	Regional checklists of Collembola	221
Appendix C	Laboratory and field studies on the effects of chemicals on Collembola	226
References		232
Subject index		323
Systematic index		326