

Contents

Preface	vii
Acknowledgements	ix
1 Introduction and general aspects	1
1.1 Phenomena of bird migration	1
1.2 History of the study of control mechanisms	12
1.3 Current applied methods	13
1.4 Crucial questions	23
1.5 Some definitions	25
1.6 Morphological and physiological prerequisites for migrants	27
2 Control mechanisms and ecophysiology	34
2.1 Nocturnality, fat deposition and migratory restlessness	34
2.2 Circadian and circannual rhythms	49
2.3 Endogenous time-programs	57
2.4 Genetic control	67
2.5 The role of photoperiod	79
2.6 Endocrine and neuronal mechanisms	90
2.7 Metabolic adaptations	100
2.8 Flight ranges, long-distance flights, and energy balance	114
2.9 Feeding, nutritive and assimilation strategies	125
2.10 Thermoregulation and water balance	138
2.11 Adaptations to high altitude	142
2.12 Control of flight altitudes	148
2.13 General behavioural aspects	152
2.14 Control of the mode and speed of locomotion	163
2.15 Minimum and real stopover periods: their control, and migratory episodes	173
2.16 Overcoming migration barriers	180
2.17 Immediate effects of weather and climate	184

2.18	Effects of population density and social rank	199
2.19	Influences of the resource availability	207
2.20	Choice of goal areas as a result of programmed and facultative movements	213
2.21	Habitat preferences, niche segregation and competition during migration and wintering	220
2.22	Interactions with other annual events	232
3	Orientation mechanisms	245
3.1	Types of orientation, routes and accuracy, traditional and preprogrammed directions	245
3.2	Landmarks and piloting	249
3.3	Compass mechanisms	249
3.4	Sensory basis	255
3.5	Navigation hypotheses, map and compass concept	259
3.6	Orientation as a complex redundant system	264
3.7	Orientation mechanisms and environmental influences	269
4	Current microevolutionary processes	273
4.1	Control of novel migratory habits in the blackcap	274
4.2	Developments in other species and prospects	279
5	Synopsis: control of migration, the present view	284
	References	299
	Species index	341
	Subject index	347