

Contents

Preface	vii
1 Introduction to the polar regions	1
1.1 Introduction	1
1.2 The energy balances of the polar regions	2
1.3 Climate	17
1.4 Thermohaline circulation	22
1.5 El Niño Southern Oscillation	23
1.6 Arctic and North Atlantic Oscillations	25
1.7 Magnetic and electrical phenomena	26
2 Stress, adaptation, and survival in polar regions	28
2.1 Introduction	28
2.2 Life at low temperatures	30
2.3 Desiccation	39
2.4 The effects of radiation	42
2.5 Biological rhythms in the polar environment	49
3 Periglacial and terrestrial habitats in polar regions	53
3.1 Introduction	53
3.2 Substrata	54
3.3 Communities	65
3.4 The physiological ecology of polar plants and invertebrates	90
3.5 Specialized communities	92
3.6 Comparison of Arctic and Antarctic terrestrial habitats and communities	97
4 Glacial habitats in polar regions	101
4.1 Introduction	101
4.2 Life in the interior of polar ice sheets and glaciers	102
4.3 Life at the margin	107

4.4	The snow alga community	112
4.5	Wider perspectives	115
5	Inland waters in polar regions	116
5.1	Introduction	116
5.2	Arctic lakes	118
5.3	Antarctic lakes	125
5.4	Streams and rivers	139
5.5	Conclusions	142
6	Open oceans in polar regions	143
6.1	Introduction	143
6.2	Gradients in waters	143
6.3	The plankton	146
6.4	The physiological ecology of polar phytoplankton	154
6.5	The zooplankton	165
6.6	Squid	172
6.7	Fish	173
6.8	The polar marine pelagic systems	175
7	Frozen oceans in polar regions	179
7.1	Introduction	179
7.2	The physical characteristics of sea ice	180
7.3	The biology of sea ice	192
7.4	The ice edge	209
7.5	Polynyas	213
7.6	The wider significance of sea ice biology	214
8	Marine benthos in polar regions	220
8.1	Introduction	220
8.2	The littoral zone	222
8.3	The shallow sublittoral zone	226
8.4	The benthos of deep waters	244
8.5	Benthos under ice shelves	246
8.6	Seasonality and dynamics of benthic communities	248
8.7	Comparisons and conclusions	254
9	Birds and mammals in polar regions	259
9.1	Introduction	259
9.2	Seabirds	259

9.3	Seals	270
9.4	Whales	277
9.5	Bears and foxes	280
10	Climate change in polar regions	284
10.1	Introduction	284
10.2	Changes during geological time: the ice ages	285
10.3	Biological responses to long-term changes	287
10.4	Present-day global climate change and polar regions	295
11	Human impact on polar regions	301
11.1	The first invasions by humans	301
11.2	The ecology of pre-industrial humans in the Arctic	302
11.3	Sealing and whaling	303
11.4	Hunting	307
11.5	Fishing	308
11.6	Pastoral and agriculture development	311
11.7	Introduction of non-native organisms by humans	314
11.8	Mineral and oil extraction	316
11.9	Pollution	320
11.10	Tourism	323
11.11	Military uses of the polar regions	326
11.12	Conservation	327
12	Some conclusions	332
	Further reading and web resources	338
	References	344
	Index	377