

1. Geology stripped bare	51
1.1 Both drought and heat [H.N. Le Houérou and J.M. Camarasa]	53
1.1.1 The hot dry deserts [H.N. Le Houérou and J.M. Camarasa]	53
The dominant high temperatures	53
The extreme scarcity of rains	53
High potential evapotranspiration	54
The violent and persistent wind	54
1.1.2 Distance from the sea and the hot desert climate [H.N. Le Houérou]	55
The oceanic influence	55
The effects of continentality	56
1.2 Little soil but many stones [H.E. Dregne, J. Porta, R.M. Poch and H.N. Le Houérou]	57
1.2.1 The difficulties of soil formation [H.E. Dregne, J. Porta, R.M. Poch and H.N. Le Houérou]	57
The factors leading to soil formation	57
Accumulations of carbonates, gypsum, salts, and silica	57
The slow weathering processes	58
Vulnerability to erosion	59
The unusual geomorphology of the subdeserts	60
The role of biological crusts	60
1.2.2 The soil types [H.E. Dregne, J. Porta and R.M. Poch]	61
Soils in mountain deserts	62
Erg soils	62
Soils in stony deserts—regs	63
Soils in rocky deserts—hamadas	64
Sabkha soils	64
Clay and alluvial soils	65
1.3 The world's hot deserts and subdeserts [J.M. Camarasa, J. Cepeda, H.N. Le Houérou and F. Petter]	66
1.3.1 The hot deserts and subdeserts of the Old World [H.N. Le Houérou and J.M. Camarasa]	66
The Sahara Desert	66
The deserts of the Middle East and the Indian subcontinent	69
The Danakil Desert	70
The Somali Desert	70
The Namib, Karoo, and Kalahari deserts	71
1.3.2 The hot deserts and subdeserts of the Americas [J.M. Camarasa, J. Cepeda, H.N. Le Houérou and F. Petter]	73
The deserts in the Americas	73
The Mojave, Sonoran, and Chihuahuan deserts	73
The Peruvian-Chilean coastal deserts: the Sechura, Tamarugal, and Atacama deserts	76
The subdeserts of the Argentinean monte	77
The subdeserts of northeastern Brazil and Venezuela	78
1.3.3 The hot deserts and subdeserts of Australia [J.M. Camarasa]	79
The Great Sandy Desert, Gibson Desert, Great Victoria Desert, Simpson Desert, and the Sturt Desert	80
2. Life in hot deserts and subdeserts	81
2.1 The ecological functioning of the hot deserts [H.N. Le Houérou and H.E. Dregne]	83
2.1.1 Living with almost no water [H.N. Le Houérou]	83
Scarce, intermittent surface water resources	83
The decisive importance of the water table	83
Strategies for efficient catchment and use of available water	85
The influence of the soil on water shortage	86

2.1.2	The low availability of nutrients	[H.N. Le Houérou and H.E. Dregne]	86
	The nutrients in short supply		87
	Soil fertility and biological productivity		87
	Precarious nutrient recycling		88
2.2	Flora and plantlife	[H.N. Le Houérou, J. Cepeda and G.E. Wickens]	89
2.2.1	The origins and diversity of the hot desert and subdesert flora	[H.N. Le Houérou]	89
	The multiple origins of the arid flora		89
	Undiscovered diversity		89
2.2.2	The biological types and the plant growth-forms	[G.E. Wickens]	91
	The biological types		91
	The forms of germination and dispersal		91
	• <i>Welwitschia mirabilis</i>	[S. Davis and M. Vigo]	92
	The different life-forms		97
2.2.3	Strategies to optimize use of water resources	[G.E. Wickens]	98
	Water uptake from the soil and water table		98
	Leaf architecture and water economy		101
	The role of spininess and succulence in water control		102
2.2.4	The diverse vegetation of the hot deserts and subdeserts	[H.N. Le Houérou, J. Cepeda and G.E. Wickens]	106
	Perennial desert plants		106
	The subdesert vegetation		107
	Sporadic flowering: the case of the Atacama Desert		108
	• The strange world of the Didiereaceae	[P. Phillipson]	110
	A reminder of a better past		114
2.3	The fauna and animal populations	[J.L. Cloudsley-Thompson, J. Cepeda and F. Petter]	115
2.3.1	Strategies for survival in arid conditions	[J.L. Cloudsley-Thompson]	115
	Different forms of inactivity and dormancy		115
	Heat control		116
	Physiological optimization of water intake		117
	The protective cuticle and anatomy of arthropods		118
2.3.2	The struggle between predators and prey	[J.L. Cloudsley-Thompson]	120
	The forms of mobility of reptiles and their tactical value		121
	The difficulties facing predators		121
	Concealment and warning coloration—the art of deception		123
2.3.3	The rhythm of animal life	[J.L. Cloudsley-Thompson]	125
	Animals active by day or by night		125
	Synchronization of favorable circumstances		126
2.3.4	The fauna of the Saharo-Sindian deserts	[F. Petter]	127
	Wildlife of the Sahara		128
	The important role of reptiles		129
	• Asps: cobras or vipers?	[J.L. Cloudsley-Thompson]	130
	Nesting and transitory birds		134
	The mammals		135
2.3.5	The fauna of the Namib and Kalahari deserts	[F. Petter]	137
	The birds and reptiles		137
	The highly diverse fauna of large mammals		139
2.3.6	The fauna of the hot deserts of North America	[F. Petter]	139
	The diversity of snakes and lizards		139
	The nesting birds and birds of passage		142
	The mammals		143
2.3.7	The fauna of the hot deserts of South America	[J. Cepeda and F. Petter]	143
	The reptiles of the Atacama		143
	The birds and mammals of the coastal desert		144
	The most noteworthy arthropods		145
2.3.8	The fauna of the Australian deserts	[F. Petter]	145
	The remarkable reptiles and amphibians		145
	The endemic birds		146
	The mammals		147

2.4 Life in and around bodies of water	[W.D. Williams, F. Petter and H.E. Dregne]	149
2.4.1 Water bodies in hot deserts	[W.D. Williams]	149
The variety and scarceness of bodies of water		149
Episodic bodies of freshwater		149
Permanent bodies of freshwater		151
Saline lakes		151
2.4.2 Pools, riverbanks, and oases	[W.D. Williams, F. Petter and H.E. Dregne]	152
Life in episodic and permanent bodies of water		152
The fish and amphibians		153
Oases— islands of water		154
3. Humans in hot deserts and subdeserts		157
3.1 Human settlement of the hot deserts and subdeserts	[J.M. Camarasa and C. Junyent]	159
3.1.1 Technological and social adaptations to a difficult environment	[J.M. Camarasa]	159
Sedentary life and the control of water resources		159
Nomadic life and control of routes through the desert		160
The crisis arising from the spatial and functional division of resource usage		161
3.1.2 Humans in the hot North African deserts	[J.M. Camarasa and C. Junyent]	162
The ancient settlers of the Sahara		162
The Tuaregs and other current inhabitants		162
3.1.3 The humans of the hot deserts of southern Africa	[J.M. Camarasa and C. Junyent]	164
The Khoisan peoples		165
The Bantu peoples		166
European colonists		166
3.1.4 Humans in the hot deserts of Asia	[J.M. Camarasa and C. Junyent]	167
The hydraulic civilizations and the nomadic herders		167
• Imported fertility	[M. Vigo]	168
The Indo-European peoples		173
The Semitic or Afro-Asiatic populations		173
3.1.5 The humans of the hot Australian deserts	[J.M. Camarasa and C. Junyent]	175
The Aborigine population		176
The European colonists		176
3.1.6 The humans of the hot deserts of North America	[J.M. Camarasa and C. Junyent]	177
The Uto-Aztecan peoples of the Mojave Desert and northern Mexico		177
The Hokan peoples of the Lower Colorado and Baja California		178
The southern Athabascan peoples		178
The recent arrivals		178
3.1.7 The humans of the South American hot deserts	[J.M. Camarasa and C. Junyent]	179
The peoples of the Peruvian coastline		179
• Toward the sea, to the west	[R. Folch, V.N. Basilov and M. Vigo]	180
The Atacaman peoples		185
3.1.8 Sickness and health in the hot deserts	[C. Junyent]	185
Acclimatization phenomena		185
Morphological and cultural adaptations		186
Recurrent famine		186
Eye infections		188
3.2 The use of plant resources	[J.M. Camarasa, H.N. Le Houérou and G.E. Wickens]	189
3.2.1 Harvesting without planting	[J.M. Camarasa, H.N. Le Houérou and G.E. Wickens]	189
The desert larder		189
Curative, poisonous, and aromatic plants		191
• The powers of peyote	[M. Vigo]	192
Dye and tannin producing plants		197
Fibers and wickerwork		197
Timber and firewood		199
Ornamental plants		200

3.2.2	Grazing in arid areas	[H.N. Le Houérou and G.E. Wickens]	200
	The deserts and subdeserts of North Africa		200
	The Sahel		201
	The deserts and subdeserts of southern Africa		203
3.2.3	Sylvo-pastoral plantations	[H.N. Le Houérou and G.E. Wickens]	204
	African repopulated pastures		204
	The Australian mulga		204
3.2.4	Agricultural activity	[H.N. Le Houérou and G.E. Wickens]	205
	Dry farming		205
	Irrigation-based agriculture		206
	• Edible cacti	[E. Hoyt]	210
3.3	The use of animal resources	[J.M. Camarasa and H.N. Le Houérou]	214
3.3.1	The exploitation of the native fauna		214
	Fishing in the middle of the desert		214
	Hunting activity		216
	The domestication and rearing of the ass		216
	The domestication and breeding of the dromedary camel		217
3.3.2	Stockraising activity		218
	Northern Africa		218
	The Sahel		218
	Eastern Africa		219
	• Two for the price of one	[A. Minelli, V.N. Basilov, K. Rogovin and M. Vigo]	220
	Southern Africa		224
	Southwest Asia		224
	The North American and Argentine deserts		225
	The Australian subdeserts		225
3.4	Management conflicts and environmental problems	[J.M. Camarasa, H.N. Le Houérou, J. Cepeda and A. Rogers]	226
3.4.1	The human contribution to desertification	[J.M. Camarasa and H.N. Le Houérou]	226
	The uncertain effects of the current climate change		226
	The inevitability of human desertification		228
	• Taliesin West	[R. Pesci]	230
3.4.2	The impact of wild-gathering	[J.M. Camarasa, H.N. Le Houérou and J. Cepeda]	234
	From balance to risk		234
	The increasing consumption of firewood		234
3.4.3	Minimal agriculture	[J.M. Camarasa, H.N. Le Houérou and A. Rogers]	235
	Subsistence dry farming		236
	The salinization of irrigated ground		238
	Large hydraulic schemes		238
	Irrigation with fossil water		240
3.4.4	Grazing in adverse conditions	[J.M. Camarasa and H.N. Le Houérou]	241
	Overgrazing around water points		241
	Agro-pastoral degradation of oasis margins		242
3.4.5	The exploitation of mineral resources	[J.M. Camarasa]	243
	Extractive activity		243
	• Open cast mining	[T. Foskett]	244
	The environmental impact of mining		248
4.	Protected areas and biosphere reserves of the hot deserts and subdeserts		249
4.1	Protected hot deserts	[A. Rogers]	251
4.1.1	General considerations		251
	Biological diversity and the protected deserts		251
	The sustainable management of desert ecosystems		252
	Protection from desertification		254
4.1.2	The protected parks and areas		255
	The protected deserts in the Old World		255
	The protected deserts of the New World and Australia		256

4.2 UNESCO biosphere reserves in hot deserts and subdeserts	[A. Rogers, J.M. Camarasa, J. Culverwell and L. Hernández]	257
4.2.1 Biosphere reserves in hot deserts and subdeserts	[J.M. Camarasa]	257
4.2.2 Biosphere reserves in hot deserts and subdeserts of North America	[L. Hernández and A. Rogers]	257
The case of the Mapimí Biosphere Reserve		258
4.2.3 Biosphere reserves in the hot South American deserts and subdeserts	[A. Rogers]	265
Biosphere reserves in the Argentinean monte		266
The biosphere reserves in the Peruvian-Chilean coastal deserts		267
4.2.4 The biosphere reserves in the African hot deserts and subdeserts	[A. Rogers]	268
The case of the Tassili N'-Ajjer Biosphere Reserve		268
4.2.5 Biosphere reserves in the hot Asian deserts and subdeserts	[A. Rogers]	273
The case of the Lal Suhanra Biosphere Reserve		273
4.2.6 The biosphere reserves in the hot deserts and subdeserts of Australia	[J. Culverwell and A. Rogers]	278
The case of the Uluru-Kata Tjuta Biosphere Reserve		279

The subtropical cold deserts and subdeserts

287

1. Frozen drought		289
1.1 Dryness and extreme cold	[B. Abaturov]	291
1.1.1 The cold dry deserts		291
The unusual conditions of the cold deserts		291
Little rain and almost no snow		291
1.1.2 Cold winters and cold summer nights		293
Extreme temperature changes		293
The action of wind and fog		294
1.2 Gypsum, salt, and fine dusts	[B. Abaturov]	296
1.2.1 Little-developed soils		296
Humus-poor soils		296
Soil salts and gypsum		296
Takyrs		297
Loess		298
1.2.2 The different soil types		298
Sandy desert soils		298
Clay soils		299
Takyr soils and solonchaks		300
Nonsaline gray soils		300
1.3 The world's cold deserts and subdeserts	[B. Abaturov, J.M. Camarasa and A. Rogers]	301
1.3.1 The cold deserts and subdeserts of central Asia	[B. Abaturov]	301
The deserts of central Asia		301
The Takla Makan Desert		301
The A-la Shan Desert		303
The Bei Shan Desert		304
The Ordos Desert		304
The Tsaidam Basin		305
The Gobi Desert and other gobis		305
1.3.2 Cold deserts and subdeserts of Inner Asia and Kazakhstan	[B. Abaturov]	306
The middle Asian desert space		306
The Karakum, Kyzyl Kum, and other sand deserts		307
The Betpak-Dala Steppe, or the Steppe of Hunger, and other stone and gypsum deserts		308
The solonchak and takyr deserts		309
The loess deserts		309
1.3.3 The cold deserts and subdeserts of southwestern Asia	[J.M. Camarasa]	309
The deserts and subdeserts of the Iranian and Afghan-Baluchistan plateaus		310
The subdeserts of Anatolia		310

1.3.4	The cold deserts and subdeserts of North America	[B. Abaturov and J.M. Camarasa]	311
	The North American cold desert space		311
	The deserts of the Great Basin		311
1.3.5	The cold deserts and subdeserts of South America	[J.M. Camarasa and A. Rogers]	313
	The South American cold desert space		313
	The deserts of Patagonia		313
2.	Life in the cold deserts and subdeserts		315
2.1	The ecological functioning of the cold deserts and subdeserts	[B. Abaturov]	317
2.1.1	Making use of insufficient or unreachable water resources		317
	The importance of the soil texture		317
	The exuberant growth of spring ephemerals		318
	Deep roots and water-conserving leaves		319
2.1.2.	Low production, low productivity		321
	Biomass and production		321
	The nutrient cycles		321
2.1.3	The high efficiency of the consumers		322
	The high proportion of vertebrates		323
	The importance of browsing		323
	The role of trampling		323
2.1.4	The dynamics that reinforce desertification		324
	Changes linked to external factors		324
	Changes linked to intrinsic factors		325
	• Tree that does not cast a shadow	[R.V. Kamelin and I.A. Gubanov]	326
2.2	The flora and the vegetation	[R.V. Kamelin and I.A. Gubanov]	331
2.2.1	Biological types		331
	Cyanobacteria, algae, lichens, and bryophytes		331
	The vascular plants		331
2.2.2	Plant life-forms		333
	The scarcity of trees		333
	The abundance of shrubs		334
	The clear dominance of the subshrubs		335
	The abundance of ephemerals and ephemeroïds		336
	The minor role of the succulents		337
2.2.3	The surprisingly diverse flora of cold deserts		338
	Geographical variety and ecological diversity		339
	The vegetation of the saline and gypsum soils		339
	The vegetation of the sands		340
	The vegetation of clay substrates and stone substrates		340
	The vegetation on the edges of the cold deserts		340
	The vegetation of rivers and temporary watercourses		341
2.2.4	The annual cycle		341
	The climatic rhythm		341
	• A spring day	[K. Rogovin]	342
	Bursting into bloom		346
2.3	Fauna and wildlife	[K. Rogovin]	347
2.3.1	The distribution and diversity of the fauna		347
	The origin of the deserts and the process of animal colonization		347
	The faunistic centers of irradiation		347
	The causes of fauna diversity		350
	The factors governing fauna abundance		350
2.3.2	Convergence in life-forms		351
	The small mammals		352
	The birds		353
	The lizards		354
	The invertebrates		354

2.3.3 Resistance to cold, drought, and hunger	354
Physiological adaptations	355
Hibernation and estivation	356
Seeking out shade and shelter	357
Storing food for lean times	358
Displacements and migrations	359
• The dinosaurs of the Gobi [K. Rogovin]	360
Regulation of the reproductive cycle	364
2.4 Life in lakes and rivers [A.M. Ghilarov and J.M. Camarasa]	365
2.4.1 Immense lakes and impermanent rivers [A.M. Ghilarov]	365
Salt water basins with no outlets	365
The remarkable flora and fauna of lakes and freshwater	366
2.4.2 The Caspian Sea [A.M. Ghilarov]	366
Evaporation and salinity	366
The complex origins of the fauna	366
The high levels of productivity	368
2.4.3 The Aral Sea and its water inputs [A.M. Ghilarov]	369
The low water inputs	369
The remarkable biota of the Aral Sea	369
Low productivity and the death of the Aral Sea	372
2.4.4 Lake Balkhash [A.M. Ghilarov]	372
The composition of the waters	372
The plants and animals	373
2.4.5 The Great Salt Lake [A.M. Ghilarov and J.M. Camarasa]	373
The effects of hypersalinity	374
The extremely poor biota	374
3. Humans in the cold deserts and subdeserts	375
3.1 Human settlement of the cold deserts and subdeserts [V.N. Basilov, J.M. Camarasa, C. Junyent, R. Armengol and A.M. Ghilarov]	377
3.1.1 Environmental conditions and human settlement [V.N. Basilov, J.M. Camarasa, C. Junyent and A.M. Ghilarov]	377
Deserts on the move	377
The pre-Neolithic cultures	377
The first farmers and stockraisers	378
The emergence and consolidation of nomadic cultures	379
Links between nomads and sedentary peoples	381
3.1.2 The peoples of the cold deserts of Eurasia [J.M. Camarasa and C. Junyent]	382
The ancient Indo-European peoples	383
The emergence of the Turkish peoples	385
The hour of the Mongols	386
• Samarkand [R. Folch]	388
Between the Chinese and the Russians	392
3.1.3 The peoples of the cold North American deserts [J.M. Camarasa and C. Junyent]	393
The Uto-Aztecan peoples of the Great Basin and the neighboring regions	393
The southern Athabascan peoples	394
The Sahaptin peoples of the Columbia Plateau	396
The interior Salish	396
The European arrivals	397
3.1.4 The peoples of the cold deserts of South America [J.M. Camarasa and C. Junyent]	398
The people of Patagonia and Tierra del Fuego	398
The most recent arrivals	399
3.1.5 Illness and health in the cold deserts [R. Armengol and C. Junyent]	399
Vitamin deficiencies	399
• Fiber or drug? [R. Folch]	400
Mineral deficiencies	404

3.2 The use of plant resources	[I.A. Gubanov]	405
3.2.1 Grazing and spontaneous harvests		405
Grazing		405
Edible plants and fungi		407
Medicinal plants and insecticides		407
Plant sources of tannin		409
Dye plants		409
• Karez	[R. Folch]	410
Fuel plants		414
3.2.2 Agricultural activity		414
Cultivation in oases		416
Plantations of cotton and other textile fibers		416
Cereals and fodder		417
Vegetable gardens, vineyards, and orchards		417
3.3 The use of animal resources	[V.N. Basilov, K. Rogovin and A. Rogers]	419
3.3.1 Hunting and extensive stockraising	[V.N. Basilov, K. Rogovin and A. Rogers]	419
Early records of hunting		419
Stockraising strategies in middle Asia		420
Stockraising in Patagonia		420
The role of water		421
The grazing herds		423
Grazing routes		425
The life of the herders and caring for their animals		426
3.3.2 Livestock products	[V.N. Basilov and K. Rogovin]	429
Wool and leather		429
Milk products		430
Meat		431
3.4 Management conflicts and environmental problems	[A.M. Ghilarov, K. Rogovin and V.N. Basilov]	432
3.4.1 The spread of the deserts	[A.M. Ghilarov, K. Rogovin and V.N. Basilov]	432
The increase in grazing pressure		432
The advance of the dunes		434
The growing settlement of the nomads		435
3.4.2 Large animals in danger	[K. Rogovin and V.N. Basilov]	435
The conflict between livestock and wild ungulates		436
Abusive hunting		437
3.4.3 Disturbances due to major hydraulic projects	[A.M. Ghilarov and K. Rogovin]	437
Diverted waters		437
Vanished deltas		439
Lakes that have evaporated		440
Salinization out of control		441
3.4.4 Poisoning of the environment	[A.M. Ghilarov]	442
The effects of fertilizers and pesticides on ecosystems		443
• The Tragedy of the Aral	[A.M. Ghilarov]	444
The effects of agricultural chemicals and industrial pollution on public health		448
3.4.5 From underpopulated to overcrowded	[A.M. Ghilarov and V.N. Basilov]	449
Changes in traditional land use patterns		449
Incremental population growth		449
4. Protected areas and biosphere reserves in the cold deserts and subdeserts		451
4.1 The protected cold deserts	[A. Rogers]	453
4.1.1 General considerations		453
Threats to the environmental conservation objectives		453
Research in protected areas		453

4.1.2	The protected parks and areas	454
	Protected areas in middle and central Asia	454
	Protected cold deserts in North and South America	456
4.2	The UNESCO biosphere reserves in the cold deserts and subdeserts [A. Rogers, K. Rogovin and J.M. Camarasa]	458
4.2.1	The biosphere reserves in the cold deserts and subdeserts [J.M. Camarasa]	458
4.2.2	The biosphere reserves in the cold deserts and subdeserts in the Americas [A. Rogers]	458
	The Desert Experimental Range Biosphere Reserve	459
4.2.3	The biosphere reserves in the cold deserts and subdeserts of Asia [A. Rogers and K. Rogovin]	465
	The Repetek Biosphere Reserve	465
	Bibliography	471
	Indexes	475
	Species' index	477
	Thematic index	489

