

Life at Extremes: Environments, Organisms and Strategies for Survival

Elanor M. Bell (ed.)

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An international team of authors consisting of 60 people under the leadership of Dr. Elanor M. Bell (Editor) wrote a comprehensive book on the topic that has received much attention within last decade. Extreme environments and biota thriving there attract interest of scientist because of many reasons. At least some of those environments are exceptional and hardly accessible (e.g. bottom of deep ocean, deep sea hydrothermal vents, subglacial caves). Therefore, history of scientific achievements in such environments is rather short and only limited knowledge has been gained. On the other hand, some of extreme environments have been studied for more than one century (e.g. high mountains and polar ecosystems). Thus scientific data from such extreme environments are much more available. The book brings an overview of extreme environments on Earth starting with a chapter devoted to the definition and recent perception of the terms „*Extreme environment*“ and „*Extremophilic organism*“. Then an excellent insight into particular extreme environments is given in each chapter (the book consists of 26 chapters) with detailed description of ecosystem(s), energetic and trophic relations, and typical organisms living there. The reader thus can learn a lot about deep sea fish and invertebrates, deep seafloor communities, hot vents bacteria, snow algae, organisms thriving in polar lakes, biospeleothems, endolithic microbial communities. Attention is also given to the organisms thriving in hypersaline and acidic environment and many other organisms related to extreme environments. In each chapter, information are presented in schemes, figures, tables and accompanied by numerous high-quality photographs documenting peculiarities of particular extreme environments.

In the book, there are several chapters devoted partially or exclusively to polar regions and scientific knowledge gained there. They involve (1) Polar Marine Ecosystems, (2) Sea Ice, (3) Terrestrial Ecosystems, (4) Lakes including Subglacial Lakes, (5) Glaciers, (6) Polar Deserts, (7) High UV Radiation Environments, and (8) Extreme Environments as Analogues for Astrobiology. In this review, I would like to pay attention mainly to them, because the readers of the Czech Polar Reports belong to polar scientists community. In the chapter devoted to *Polar Marine Ecosystems*, a summary of seabed animals, mainly invertebrates is given. The animals are classified according to sea characteristics (shelf, slope, deep sea) with many examples. The *Sea Ice* chapter brings an overview of sea ice formation, physics of sea ice and, last but not least, examples of sea diatoms and bacteria living in cavities in the ice or associated with ice bottom. Special attention is devoted to physiological antifreezing mechanisms, such as e.g. production of extracellular polymeric substances, which helps the biota to thrive in such environment. Variety of polar habitats is overviewed in the *Polar Terrestrial Environments* chapter, which brings a classification of the environments, their location in Arctic and Antarctic polar regions and description of terrestrial organisms living there. The chapter is full of photographs documenting richness of fauna and flora associated

with polar terrestrial ecosystems, as well as some rare habitats such as *e.g.* geothermally active areas in the Arctic and Antarctica. An excellent summary of living strategies of the organisms of polar terrestrial ecosystems is given in the chapter. In the book, there are two chapters related to lakes, the first one entitled *High Altitude and Latitude Lakes*, the second one entitled *Subglacial Lakes*. Both they bring information of lake distribution and yearly patterns in their physico-chemical properties. The former one focus to primary and secondary production of autotrophic organisms and bacterial communities, respectively. Special attention is devoted to changes in availability of dissolved organic carbon, N and P, which are the limiting factors of microbial communities development in such lakes. Unfortunately, due to editorial deadline of the book, the most recent information about successful drills to two subglacial lakes: Lake Vostok and Lake Ellesmere are not included. One of the next chapters entitled *Glacier Surface Habitats* focus mainly cryoconite holes and the communities of microorganisms inhabiting such small-scale ecosystem of the upper surface of a glacier. Several examples are given from Svalbard, Greenland, Canadian Arctic and Antarctica of annual changes in a cryoconite hole, nutrient cycling, organism biodiversity and primary production. Attention is also devoted to cryolakes formed on the glaciers that, due to lack of outflow channels, might be considered „large-scale cryoconite holes“. The *Polar Deserts* chapter is devoted mainly to biodiversity of organisms in Antarctic Dry Valleys, *i.e.* locations typical by permanent deglaciation, extremely limited amount of precipitation and permanent subzero air temperature. For this specific ecosystem, an overview of organism is given, together with food web scheme and carbon cycle flow diagram. A question is raised about the stability of the ecosystem when global climate changes persist in several next decades. *High Ultraviolet Radiation Environment* represents a general chapter, in which, however, substantial attention is given to polar plant adaptation and acclimation to UV radiation. Several examples from long-term case studies from Abisko (Sweden) and Zackenberg (Greenland) are reported and the results discussed. Responses of organisms ranging from soil microbiota to aquatic animals to UV are also reported in this chapter. Polar environments, and the organisms thriving there in particular, are considered analogues for life on other planets of Solar system, Mars in particular. This is the main focus of the last chapter that gives examples of the most important extreme polar ecosystems and extremophilic organisms used in experiments mimicking extraterrestrial conditions. Moreover, orbital open space experiments, such as *e.g.* BIOPAN, EXPOSE-E are reported and the responses of lichens (model symbiotic organisms) to low pressure, low temperature, UV and shortwave radiation.

The book represents a perfect compendium of recent knowledge in the field of investigation of Earth's extreme environments. It could be recommended to the specialists and professionals dealing with global issues, university students and also to general public with interests in polar regions and extreme environments. For a Czech reader, there is some special reason to buy the book. Some Czech and Slovak scientists contributed to the chapters and were authors of photographs. In general, the book is an attractive reading for biologists, ecologists and professional community involved into global issues.

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