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## **ABIOTIC NATURE OF THE TATRA MOUNTAINS: A NEW CARTOGRAPHIC PICTURE**

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### **Abstract**

The *Atlas of the Tatra Mountains* is published by the Tatra National Park. This excellent work was elaborated by a team of 130 scientists from Poland and Slovakia. Abiotic nature in these mountains is depicted on 82 maps and 165 accompanying illustrations. The maps illustrate both the Polish and Slovak parts of the Tatras, and contain explanations in three languages: Polish, Slovak and English.

### **Key words**

physico-geographic regions • climate • waters • geological setting and underground waters • relief • soils and types of natural environment • Poland • Slovakia • Tatra Mountains

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The unique high-mountain landscape of the Tatras has been attracting the interest of naturalists since the 16th century at least. Studies on particular components of inanimate and animate nature have been coupled with attempts to present the Tatra massif cartographically in the form of regional maps. The oldest accepted image of the Tatra Mountains is present on a Lazarus map of 1528. That image did not portray local relief, doing nothing more than locating the Tatras in

relation to other mountain ranges of the Western Carpathians. The oldest efforts to present the Tatras on maps gave rise to Tatric cartography. Not only were maps on various scales and of differing spatial extents illustrating the relief drawn up, but thematic maps were also prepared as different cartographic techniques came into being. The natural history of the Tatras was the subject of studies carried out “irrespectively from south and north” – somehow in relation

to a political border that has divided the massif throughout recorded history. However, the examination of the Tatras commenced earlier on the south-facing side of the massif, especially in the Liptov Basin.

While scientific syntheses were developed separately for the south-facing or north-facing flanks of the range, comprehensive studies of the whole massif were undertaken only sporadically – particularly in the time up to the second half of the 20th century. The Slovak and Polish topographic surveys continued to produce separate cartographic images for their territories, notwithstanding the fact that the Tatras had been brought under protection in adjacent national parks (abbreviated to TANAP and the TPN).

The first complete presentation of the natural history of the Polish Tatras was given in the *Atlas of the Tatra National Park* (Trafas 1985). The idea of devising the *Atlas* came from the Scientific Board of the (Polish) Tatra National Park (TPN), while its completion was the result of collaboration between the Park and the Kraków-based Polish Society of Friends of Earth Sciences. The accomplishment of this cartographic task reflected the contribution of 42 outstanding professionals carrying out research in the Tatra Mountains in the fields of the Earth sciences and/or biological sciences. The basic maps of the *Atlas* were devised at a scale of 1:50,000, drawing upon diverse studies performed on detailed scales. This *Atlas* comprises 32 charts, and at the moment of its publication represented an outstanding achievement in an international context. However, even at the time, naturalists began to express regret that the *Atlas* was confined to the Polish part of the Tatras.

Thirty years later, a new atlas entitled the *Atlas of the Tatra Mountains – Abiotic Nature* (Dąbrowska & Guzik 2015), dealing with the whole area of the Tatras and fragments of the adjacent basins, was elaborated, and subject to publication in autumn 2015. This represents a team effort under the editorship of Katarzyna Dąbrowska and Marcin Guzik, employees of the Tatra National Park. The

Polish Society of Friends of Earth Science, Kraków Branch, and representatives of TAN-AP in Slovakia participated in the conceptual elaboration of the maps. In their preface to the *Atlas*, the Editors rightly emphasized that: “creating this publication, for the first time dealing with the Tatra Mountains as entity, required close collaboration of the scientists from both countries. In many cases, combining research results proved to be an extremely difficult task because of the differing methodologies, data collection procedures or terminology. Nevertheless, no effort has been spared to make the maps compatible”.

The *Atlas* confines its considerations to elements of inanimate nature. However, in the near future, the TPN publishers intend to compile a second part devoted to animate nature as broadly understood, all the more so given that professionals working in the biological sciences have a thorough knowledge of the Tatras based on modern research.

It should be emphasised that the explanations in the *Atlas* are given in three languages: Polish, Slovak and English. Standardisation of terminology was a real challenge for the authors of charts and related commentaries. Topographic names follow the originals, in line with the obligatory rules applying to Slovakia and Poland. Only in the border and transborder areas has dual-naming been engaged in.

The source materials for the maps were: high-resolution *Ikonos* satellite images and a digital elevation model made available to the authors by TPN, as well as Landsat images and aerial photos. Thanks to this, it proved possible to delimit precisely the forms of relief (landforms) and other elements of inanimate nature.

The team working on the *Atlas* comprised 130 professionals. On 28 sheets there are 82 maps and 165 accompanying illustrations.

The charts present the main elements of inanimate nature, as assigned to seven fundamental subdivisions: (I) The Tatras as a physico-geographic region; (II) Climate; (III) Waters; (IV) Geological setting and underground waters; (V) Relief; (VI)

Soils; (VII) Types of natural environment. Each subdivision comprises sheets of maps at the scales of 1:1,000,000 and 1:250,000, as well as large-scale maps. The cartographic materials are accompanied by descriptions, numerous tables, graphs, photos and references crucial to the subject matter presented (an example shown on Fig. 1).

Starting from a geocological approach to the Tatras and their immediate vicinity, the first part of the *Atlas* encompasses a set of maps illustrating physico-geographic regions of the Western Carpathians. The Tatras with the surrounding regions are shown at the scale 1:250,000. An effort has been made to demonstrate ethnographic regions in the area near the Tatras, as well as regions delimited by landscape types. Separate maps show orographic features. Moreover, the division of the Tatras *per se* into physico-geographic regions is shown on a map at the scale of 1:100,000. The regional divisions given in part (I) demonstrate the Kraków physical geographers' own ideas. The Tatras are subdivided into 29 microregions, yet their names, as duly noted by the authors, should be treated as proposals for further discussion.

In the second part referring to the Tatra Mountain climate, issues presented in 7 charts are: solar radiation, temperature and thermal indices, precipitation and snow cover, cloudiness, wind and selected further meteorological phenomena. An innovative input into this part is a presentation of data on synoptic situations in Europe that bring about extreme weather phenomena. A division by climatic regions and weather types provides for a summary of climatic issues. The climate section is summed up via reconstructions of the climate in recent centuries, as based on dendrochronology for trees originating at high altitudes, and as related to the mean annual air temperature and precipitation totals.

The Tatra massif is characterised by a high degree of differentiation of water resources. The hydrological part (Part III) of the *Atlas* presents maps on the scale 1:100,000 and 1:250,000, and there are also a number

of graphs relating to water issues, the diurnal and monthly patterns they assume, trends for annual discharge and runoff, the thermal properties of waters, ice phenomena and the chemical composition of waters.

The geology of the Tatras is presented in a map of scale 1:100,000. This is the outcome of the generalisation of the earlier Slovak-Polish map of the whole massif at the scale 1:50,000, which was printed in 1994 by *Geologický ústav Dionýza Štúra* in Bratislava (Nemčok et al. 1994). The map is followed up by a tectonic sketch of the Polish Tatras, as well as geological cross-sections of the Polish High and Western Tatras. Another complement to the map is a chart, also at the scale 1:100,000, showing the settings of boreholes for groundwater, and their discharges, as well as their subdivisions into fresh or thermal waters. The locations of springs and boreholes reveal areas of differing permeability.

The part of the *Atlas* referring to relief as broadly construed (i.e. Part V) is really outstanding, given its rich content and the presence of new study results obtained over the last 20 years. The geomorphological map is adapted to the scale (of 1:100,000) adopted for the *Atlas* as a whole. The previous maps of M. Klimaszewski (1985) and M. Lukniš (1973) were very detailed, but prepared according to different legends for the Polish and Slovak parts. In contrast, the current map for the first time comprises the entire area of the Tatras, as well as fragments of the adjacent basins, and was devised in accordance with a common Polish-Slovak legend. It depicts morphometric and morphogenetic features of landforms, though without giving their ages. Certain landforms not shown previously are presented in this map, for instance: rock glaciers, nival moraines and landslides. As a digital map – it was developed from an orthophoto map, digital elevation model and the fieldwork results of many geomorphologists. The main map (chart) is accompanied by maps of landform complexes, as well as depictions of glacial, periglacial, fluvial and erosional-denudation processes.

For the first time, a map of debris flows and avalanche tracks has been elaborated in accordance with the uniform Polish-Slovak legend for the entire Tatras.

A map worthy of special attention, due to the innovative methodological approach that underpins it, is that of the Tatra Mountain glaciers from the maximum extent of the Last Glaciation. A 3-D model of the Tatras with the geometry of glaciers at the scale 1:50,000 has been developed here.

Cartographic presentation of caves and karst phenomena is provided by a main map at 1:100,000, while fragments of the Tatras are shown at the 1:18,000 – 1:50,000 scales. Sketches and cross-sections of the caves are important elements of the *Atlas*, as the visuals ably document the ongoing progress of cave exploration over the most recent 30-year period.

Part (VI) illustrates Tatric soils at the scale 1:100,000. A complete characterisation of soils across the entire Tatra Mountains was published in the monograph entitled *Tatry – przyroda* published by the Baset publishing house in 2010. The map in the *Atlas* is elaborated on the basis of verified manuscripts and material published by the Slovak-Polish team.

The last chart in the *Atlas* presents types of natural environment. It is a synthetic overview of the Tatra landscape that is the outcome of overlaying subdivisions of three spatial realms and zonal patterns, tectonic units and vertical zonation.

The *Atlas* needs to be seen as the outstanding achievement of both Polish and Slovak naturalists. For the first time, scientific collaboration has crossed the divisions relating to the national borders dividing this massif, allowing naturalists to present a unified cartographic synthesis. As the devised maps are based on state-of-the-art achievements in the natural sciences, they may reveal authors' ideas not always concurring with thoughts formulated in the 20th century. Comparison

of opinions of current investigators in the Tatras with earlier ideas given in the geomorphic literature can thus offer a basis for lively scientific discussion on the genesis and age of landforms, the extent of the Pleistocene glaciations and the Late-Glacial and Holocene evolution of relief. Such discussions have in fact been initiated already – in September 2015 just following publication of the *Atlas*, the occasion being the 5th Polish Scientific Conference on “Nature of the Tatra National Park and Man”, as organised in Zakopane to commemorate the Park's 60th anniversary.

The intensive process by which the results of Polish and Slovak studies have been combed through has required standardisation of both the methodologies and terminologies used on both sides of the mountain range. As the Editors point out, the course of work within the framework of the *Atlas* project saw new ideas arise in regard to the elaboration of innovative syntheses which might in future result in a broader, yet-more comprehensive characterisation of elements of nature in the region. This is thought to be particularly true of climate in the Tatra Mountains.

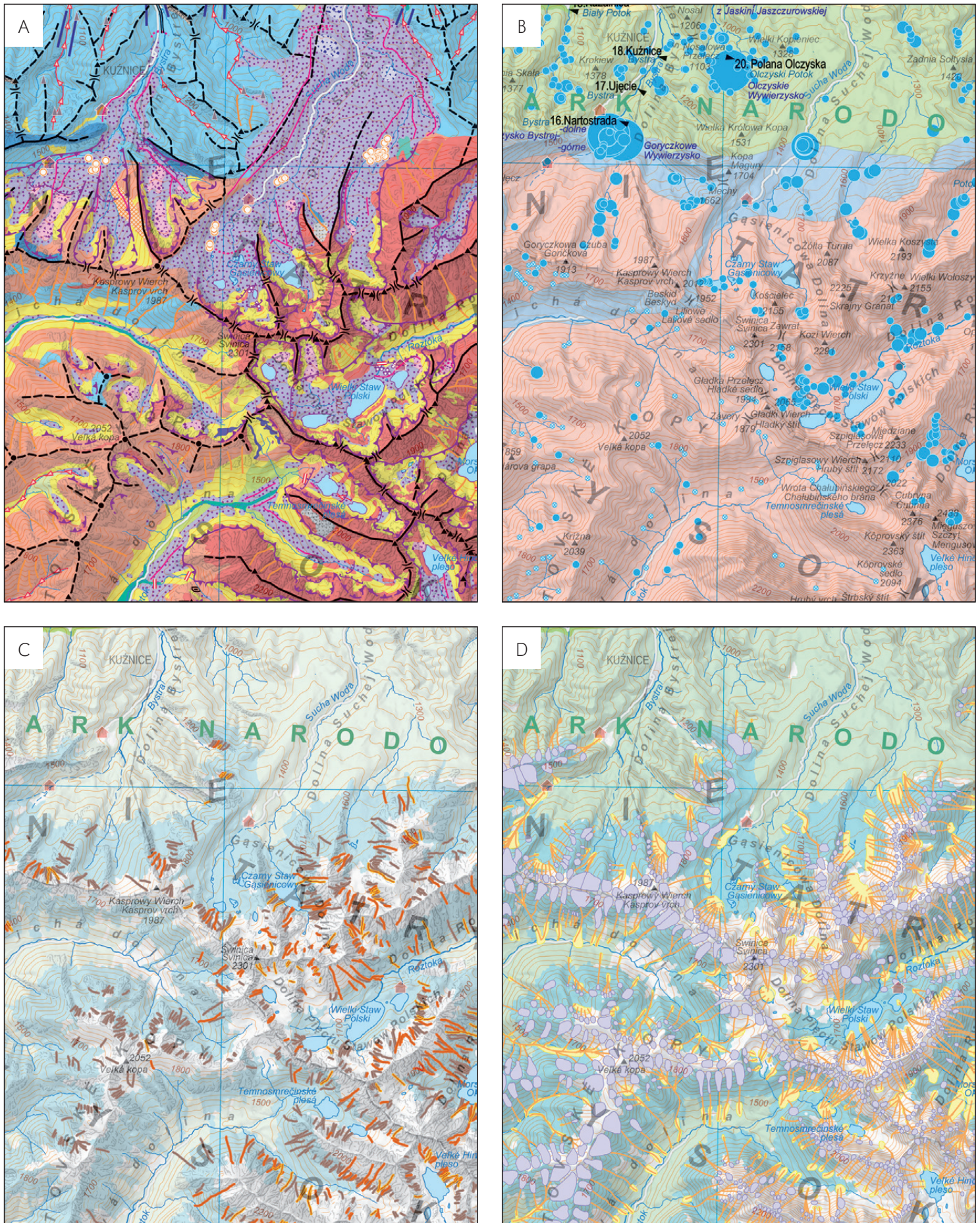
The *Atlas* marks the first incidence of the publication for the entire Tatras of 1:100,000-scale review maps showing the distribution of rock-glacier and avalanche tracks, the maximum extent of the Last Glaciation and the distribution of older glacial deposits. A further innovative contribution is the set of charts depicting water phenomena. The *Atlas* reflects the most recent knowledge on the Tatras and will be of interest to a wide audience comprising both the professionals working in the Mountains and a larger group of ‘fans’ of the natural environments there.

Editors' note:

Unless otherwise stated, the sources of tables and figures are the author's, on the basis of their own research.

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**Figure 1.** Fragment of the Tatra Mountains – Kasprovy Wierch area – shown on 1:100,000 maps  
 A. relief (geomorphological map), authors: Wojciech Rączkowski, Martin Boltžiar, Zofia Rączkowska; B. hydrological conditions, authors: Mirosław Żelazny, Janusz Siwek, Soňa Liová, Viliam Šimor, Katarzyna Dąbrowska, Anna Wolanin, Joanna Pociask-Karteczka, Łukasz Pęksa, Agnieszka Gajda, Joanna Paulina Siwek, Bartłomiej Rzonca, Ján Gavurník; C. debris flows, authors: Michał Długosz, Juraj Kapusta; D. potential snow avalanches, authors: Miroslav Žiak, Michał Długosz  
 Source: Dąbrowska K., Guzik M. (eds.), 2015. *Atlas of the Tatra Mountains*. Zakopane: Tatrzański Park Narodowy.

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