

THE GEOPARK CONCEPT AND LANDSCAPE SUSTAINABILITY, CASE STUDY IN BOHUSLÄN, SWEDEN

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ABSTRACT

A Geopark is a demarcated area with particularly interesting geologic heritage. Since the physical landscape is intimately related to both cultural and ecological characteristics, knowledge about geological sites can be essential for management of the resources in these settings. In this context, we suggest the term “Landscape Geopark” in order to stress the regional system perspective. Therefore, various stakeholders need to be included in Geopark planning, including researchers, tourists, seasonal and permanent residents, government offices, NGOs, and local industry. The archipelago and coastal landscape in Bohuslän, along the Swedish west coast, have uniquely influenced historical development of and changes in fishing, farming, and tourism. Stakeholder influence is centrally important for the sustainable, landscape-scale management of both economy and geoheritage. We use conceptual modelling of “system” components and processes to include the qualitative and quantitative information from relevant research and local stakeholders. In particular, the model aims to address the likely consequences in 20 years if a Geopark is or is not established. Although geoheritage is always site specific, Geopark models will allow comparisons between sites and information exchange, for instance in the ongoing PLATFORM project.

Keywords: Geopark, coastal area, conceptual modelling tools, geo-cultural heritage

INTRODUCTION

Geoparks are single, unified geographical areas where sites and landscapes of international geological significance, where it is important to create a holistic concept of protection, education, and sustainable development. A Geopark should complement rather than compete with other non-geological destinations in the area. The local geology can instead function as an important element in an otherwise diverse range of places to visit [1]. In a similar way, the geopark should contribute to the overall sustainability of a region, where environmental, economic, and cultural aspects need to be integrated within a holistic perspective. Since this is often most valid on a landscape scale. We suggest the term “Landscape Geopark” to stress this regional sustainability connection. A Landscape Geopark is simply a variety of the more general Geopark concept, but it is unusual and merits, therefore, the extra emphasis on the connection between geology and geomorphology that has a widespread influence on the ecology, natural resources and cultural development over time and space.

For example, by developing sustainable tourism, related hospitality industries and the general socio-economic well-being of the area. One of the main differences from nature reserves is the emphasis upon the combined economic and environmental sustainability of Geopark regions, which is most consistent with landscape-wide perspectives on resource management and societal development. Although Sweden does not have any UNESCO Geoparks, the “Platåbergens Geopark” (www.platabergensgeopark.se, 2021) is nationally established and aims toward this acceptance, with support from the Swedish Geological Survey. Considering the importance of responsible management, many regions where geo-heritage and cultural heritage are vulnerable would benefit by benefit by systematic

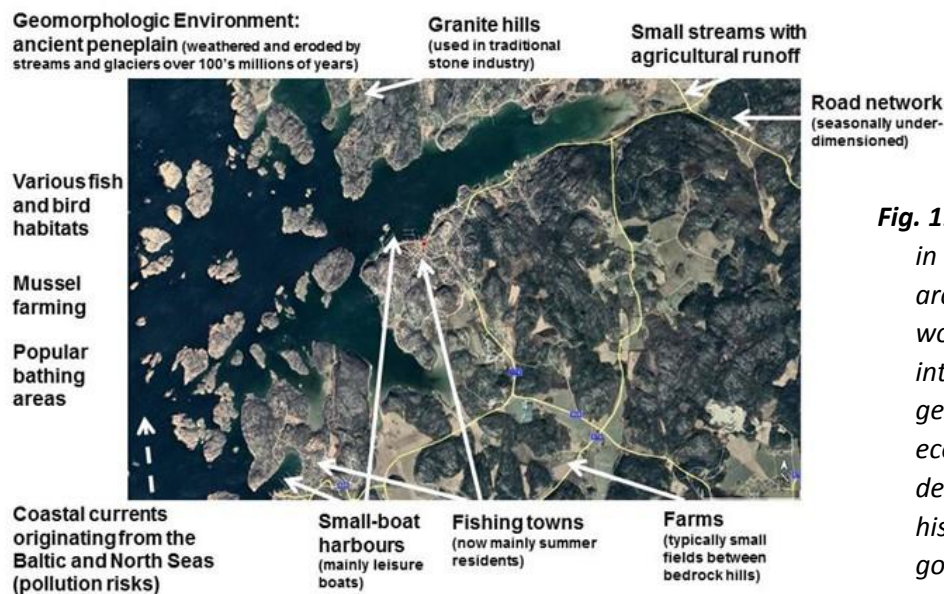


Fig. 1. A Landscape Geopark in the Swedish archipelago setting would illustrate the close interplay between geology, geomorphology, economic and cultural developments, both historical and those on-going today.

evaluation of landscape dynamics and projected development trends.

We present below a general Geopark model that relates physical and societal components. This model is made together with PLATFORM partners, including also some that are working with Geopark case studies in their own countries. In Sweden, the concept of a “Landscape Geopark” is proposed and applied to the coastal archipelago setting in SW Sweden, where the geo-heritage of both geology and geomorphology have produced a landscape with that has defined the historical and modern ecological and societal character. The planned Geopark models will allow comparisons to increase understanding of the settings and system-conditions of each case studies, e.g., along the Volga River in Russia [2]. The methodology for model development is further explained below.

International networks of Geoparks have existed since 2004, and since 2015, Geoparks with international geological values have been included as part of UNESCO's geoscience program IGGP (International Geoscience and Geoparks Program) [1]. A new and unique type of Geopark area, a “Landscape Geopark”, is envisioned below, exemplified by the Swedish archipelago environments (Fig. 1). In order to integrate the diverse stakeholder

perspectives and goals and to adapt these to allow sustainable landscape management, we have constructed an initial, conceptual model of the “system” within which the Landscape Geopark would exist. This first model does not give a final solution to the question of whether a Geopark should be established, but it does identify important, influencing variables to consider. The model also illustrates different scenarios where the consequences of the socio-environmental setting and the system dynamics may be initially evaluated, with and without Geopark development. If nothing else, the modeling exercise provides a basis of communication between actors and a methodology for incorporating crucial information from diverse sources, both quantitative data and qualitative knowledge. The purpose is to illustrate useful steps in problem analysis, progressing from system characterization (analytical phase) to predictive modeling (synthesis phase), as shown in the diagram below. Simplified and assumed conditions are necessary in all modeling, but the results intend to also suggest improvements regarding both documentation and for understanding complex systems. We assume that the conceptual modeling tools and international cooperation in the PLATFORM project would help connect the scientific and applied aspects of landscape management. The Landscape Geopark models would provide decision support for governmental offices and strengthen the arguments for lifting the Swedish Geoparks into the UNESCO classification.

BACKGROUND: SETTING AND HISTORY OF THE ARCHIPLAGO COASTAL ZONE

Although the Bohuslän archipelago coastal zone is, in several ways, a unique setting as a Geopark, its natural and cultural heritage are very consistent with the overall purpose of a Geopark. The unusual aspect is that it is the landscape, rather than specific sites or features, that provide special interest. This feature is related to the integrated and interacting character of geology, geomorphology, ecology, and culture. The Swedish archipelago coastal zone includes both marine and terrestrial environments with special attributes and special needs for management with changing lifestyles and environmental impacts.

The most widespread bedrock Bohus granite, was formed when the Baltic rock shield collided with a slab under the sea about 900 million years ago. The very oldest rocks in the landscape were formed about 1.8 billion years ago, from weathered material from a former continent, and from volcanic activity [3]. The landscape had been shaped by river and glacial erosion in the fractured, gneiss and granitic bedrock. A unique character of exposed rock hills separated by relatively narrow valleys that have clayey marine deposits in the fjords and clays soils that have been intensely farmed where the land has been uplifted above the sea. The geology and geomorphology have also created a coastal environment that attracts many visitors, so that proactive management is increasingly necessary if the valuable natural and cultural heritage is to be preserved and in order to maintain as an open landscape.

At the end of the 1960s, herring fishing in the North Sea deteriorated significantly because of excessive fishing pressure and a reduction in herring stocks. Most Swedish fishermen

left the fisheries. Although many harbours became empty of fishing boats, the demand for marinas increased through the so-called plastic revolution in the recreational boat sector. Because of the expansion of leisure marinas along many coasts, the ports formally used for year-round fishing are often dominated today by recreational boats for only seasonal use. A parallel trend occurred in the fishing villages themselves, where seasonal residents became increasingly predominant. This difference is accompanied by an opposite change in the permanent local populations, and this has resulted in a rapidly changing demand on societal service. Also, the environmental impacts have changed. The socio-economic conditions, the geo-heritage and the environment need to be integrated into the same landscape-scale model to help decision makers anticipate trends and necessary measures for a balanced management.

CONCEPTUAL MODELING METHODS AND RESULTS

This study is within the PLATFORM project, which is testing a multidisciplinary network and activity infrastructure for cooperation for project initiation [2,4]. The knowledge exchange between case-study groups enhances the research within each specific case study being developed, such as the Swedish Geoparks and Landscape case study. The activities also stress the need for a general structure and communication tools that help to include diverse perspectives and to allow a continual improvement in the theoretical and applied understanding for the topics. The development steps in conceptual modeling are suggested to be important tools in this aspect.

System Structural Analysis

By using variables related to the system character, the system dynamics are evaluated from their impact relationships. The relative values (0-3 scale) of the impacts between variables, shown in the matrix below (Fig. 2), are based on theory, expert experience, and literature information that was jointly considered in a PLATFORM group discussion. The Cause-Effect plot and relationships diagram graphically illustrate the system, which contains mainly high-active variables. The lack of zeros, or near-zero values, in the matrix indicates that all variables have influence on and are impacted by all of the others. The similar interactivity of the variables makes the system structural analysis more difficult to interpret, at least without greater detail that can be added with revision [4].

The interactive character also stresses the importance of identifying positive feed-back loops that can create system instability if strong trends are self-strengthening. Recognizing negative loops is also important in that these create stability but may weaken the effects intended management changes. In this first model, positive feed-back is connected to the three variables seasonal Tourism, Seasonal Residents and Protection Reserves, which have negative relationship variables and the loops often have two negative connections (positive when combined). For instance, increasing Seasonal Residents (or Tourism or Protection reserves) decreases Permanent Population, which in turn decreases Fishing, Farming and other Local Industry not related to tourism. These latter variables may, themselves, have a limiting effect on seasonal residents, thus creating a positive feed-back loop (with two negative relationships). However, the negative effect on the number of Seasonal Residents is not obvious or necessarily strong, and a deepened evaluation is well motivated.

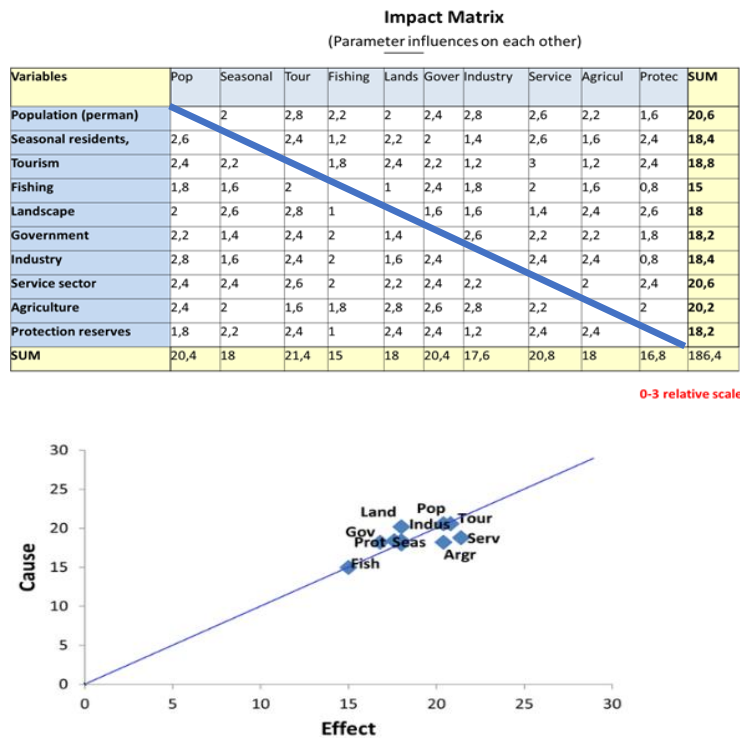


Fig. 2. System structural analysis for this Landscape Geoparks case study. Left: Matrix values, where the impact of each variable on the others is given along the corresponding row. Left (below): Cause-Effect diagram summarizes the impacts specified in Table 1. The variables highest in the diagram have the largest impact in the project system and those to the left are most vulnerable to change. As is evident for the variable in this study, those along the diagonal line have an increasing amount of both impact (cause) and change (effect), and these are important for the dynamics of the system.

One step would be to consider the regional economy and driving factor within socio-economic systems. Although this was not done in our system structural analysis, it is focused on in the scenario modeling with MCE, below.

Another variable that has an uncertain relationships to the others is Landscape Attractiveness. Landscape Attractiveness could be either negatively or positively affected by traditional livelihoods and by variables related to new trends related to the landscape resource. The overall effect of a Landscape Geopark for the regional economy is considered in the next modeling step.

Multi-Criteria Evaluation

Multi-criteria evaluation is a structured step used for rational decision-making processes. The purpose of evaluation is to provide transparent information regarding the strengths, weaknesses, and overall utility of each scenario to allow their comparison. Multi-criteria evaluation gives total utility values that are based on aggregated utilities derived for each variable (each criteria) and the weights of each variable (criteria, which are not equally important). The MCE modeling is done using the equation:

$$\sum_i w_i \cdot u_i = \text{Total "utility"} \quad (\text{used to rank different scenarios})$$

For each of the parameters considered, the weights (w_i) are assigned according to their relative importance for the question/issue considered (pair-wise matrix comparisons) and the utility (u_i) is the impact with the site-specific conditions of each parameter within the range of natural values between alternatives. Each scenario is evaluated with respect for the

DISCUSSION

The effects that the introduction of a Landscape Geopark could have on a coastal region in Bohuslän are related to the system components and their possible combinations. The example above deals with selected project components. By considering multiple scenarios, and their optimal combination for achieving the Landscape Geopark goals can be evaluated. Although it is greatly simplified and initially speculative, this is common in project during conceptualization and scoping. Modeling is usually beneficial for organizing diffuse ideas. In a particular project, it can also be a way of specifying known and unknown conditions, leading to the research needs and motivation. However, the interpretations of this, can be a way forward and a general basis to discuss the project.

If a Landscape Geopark is established on the Bohus coast, one of the most positive effects would likely be an increase in local businesses activities throughout the year. This is partly because tourism would be protracted by attractions that are not so seasonally restricted. Today, the tourism season is largely limited to a few summer months when sun and swimming are the main attraction. A Landscape Geopark would ideally offer a combination of interests, including historical reenactments, active experiences in archeological and traditional livelihoods (fishing, farming, maritime trade and boat building, sailing, stone industries and various ecological adventures), and new innovative ideas (such as “colony sea gradens” and community-generated, “Science Shop” projects (cf. www.livingknowledge.org).

Another important factor for the local economy is to maintain or increase the proportion of permanent residents in the coastal municipalities. As it is today, and as it has been for the past 50 years, the proportion of seasonal residents has increased at the expense of the permanent population, which has meant that the tax base for both local services and business has decreased. In some coastal communities, this has resulted in a decrease in permanent residents by 50 percent over few decades. Thus, service industries, such as mail delivery bank offices, pharmacies, medical care centers, doctor's offices, dentists, bakeries, flower shops, state liquor stores, and schools, have decreased or entirely disappeared. The traditional fishing villages are also losing permanent residents. In neighboring Denmark and Norway, on the other hand, the municipality requires that you live at least half the time in the locality in order to be allowed to buy a house build for permanent residence. This is not the case in Sweden. Reversing the depopulating trend of permanent residents in coastal communities presumably requires more than the establishment of a Landscape Geopark, but each step can also be assumed to be important for this goal.

In addition, the impact of a Landscape Geopark needs to be further investigated with more specific variable related to various local businesses, all of which would probably not benefit. The stone industry might have limited space for quarrying stone, limitations on new hotels or summer houses could decrease building activity, and farm and fishing economy could be hampered by traditional methods or limited areal scale.

If the reverse were to happen, i.e., if a Landscape Geopark would not be established, the development along the Bohus coast would probably follow the same trends as in the last 40-50 years: decreasing permanent resident population and increasing in seasonal

populations, a general deterioration of the community services and in related industry services for much of the year, since the Swedish summer is itself limited to 2-4 months, depending upon the definition.

CONCLUSIONS

The MCE scenario utilities suggest that with the described conditions, the establishment of Landscape Geoparks can economically improve the tourism and service sector, as well as the permanent population. It is uncertain whether Landscape Geoparks would have a decisive and lasting effect on permanent population trends. Most specifically, Landscape Geoparks might contribute to new types of tourism that have a longer seasonal interest in the Swedish archipelago environments. An increased ecotourism could, for instance, utilize the unique nature a Landscape Geopark in Bohuslän can offer. At the same time, an extended season for the hospitality industry would have a better financial basis for both the service sector and local businesses in the area. However, in Landscape Geopark planning, various stakeholders such as researchers, tourists, seasonal and permanent residents, government offices, non-governmental organizations and local industry should be included. Stakeholder influence is essential for sustainable, landscape management of both the economy and geoheritage. Conceptual modeling of “system” components and processes helps include both qualitative and quantitative information from both relevant research and local stakeholders. In particular, the modeling aims to address important, decision-support questions like consequences in 20 years if a Landscape Geopark is established or not.

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