Ontologies for Plant Communities. A New Approach to Knowledge Representation in Vegetation Science

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1. Introduction

Identifying plant communities during field work proves to be a difficult task, especially for beginners or less trained professionals. Although plant communities are well described in the literature, it is difficult to map this knowledge instantly to the situation found in the field. Increasing computational power and the emergence of mobile computing environments give hope that in the near future at nearly every place information can be made available, at least from a technical point of view. However, just transferring the knowledge represented in books into a digital environment without restructuring the underlying knowledge representation will not improve the possibilities to identify plant communities during field work. The usability of the knowledge will not increase. This paper investigates the potential of ontologies to improve the usability of knowledge for field work.

2. Motivation and Focus

While experts in vegetation science have large parts of the domain knowledge available in their mind, beginners have only partial access to that knowledge. To fulfil a certain task, in many cases only a frac-

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tion of the domain knowledge is needed. Especially for beginners, the question of how efficient a task can be fulfilled depends on the availability of the required fraction of domain knowledge. A knowledge representation that supports the identification and extraction of this fraction is needed.
The conventional way for beginners or less trained professionals to identify plant communities involves two steps. The fist step is to collect data during field work. The second step is to analyse the collected data with the help of tables. The second step is undertaken with considerable distance in time and location from the first step. This is unsatisfactory to environmental planners, hobby botanists and students of vegetation science because analysis, planning or learning is always more promising when done in direct contact with the subject of interest. The motivation of this paper is to find ways to merge these two processes.
The reason for the separation is seen in the current knowledge representation. Therefore, the focus of the paper is to develop an ontology for plant communities leading to an architecture for an ontology-based knowledge representation. The requirements for the ontology and architecture are specified by the requirements of a proposed mobile service for identifying plant communities. The mobile service is designed to merge the two processes in practice, but its implementation will be left to future work.

3. Hypothesis

The paper poses the following hypothesis:
A knowledge representation for plant communities based on the ontology developed in this paper increases knowledge usability for the task of identifying plant communities during field work.

4. Methods and Expected Results

To verify the hypothesis the work is structured into four phases:

- The current knowledge representation is analysed through a literature review and highlighted by scenarios.
- The modified methodology of Grüninger and Fox (1995) is used to built an ontology of plant communities. This methodology incorporates scenario analysis, creation of competency questions and formalisation with OXML (Erdmann 2001).

The scenarios identify the tasks ideally needed to identify plant communities during field work. The competency questions are based on the scenarios and can be considered as expressiveness requirements. Once the informal competency questions are available, the set of informal terms used in the ontology can be extracted from these questions. These terms will serve as a basis for specifying the terminology in the formal language OXML. Axioms constrain the meaning of the used terms, their taxonomic and non-taxonomic relations preventing ambiguities and finally form the ontology. A prototypically implemented knowledge base, which includes only an exemplary set of instance data is used to evaluate the soundness and completeness of the ontology and its axioms.

- The developed ontology and knowledge base serves for describing the architecture, potential and possibilities of an ontology-based knowledge representation.
- The developed representation is compared with the current form of knowledge representation in respect to their usability during field work.

Results are a knowledge representation on ontological level which is located between the epistemological- and conceptual-level (Guarino 1994). Since currently the knowledge about plant communities is described explicitly only on natural language level. This paper contributes to a clarification of the terminology and structure of the knowledge in plant sociology and presents a knowledge representation, which may form the basis for the implementation of location based services for identifying plant communities during field work.

References

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