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Scientific Research Documentation - An Information Server for the National Park Hunsrück-Hochwald

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Abstract: Within the world network of nature reserves, a national park is a park in use for conservation purposes. Beside it’s high value for nature and biodiversity, national parks are serving as sites for research, environmental monitoring, education and training. In order to ensure a long-lasting, central and efficient access to the literature and data on such a nature reserve for all scientists from the respective institutions, a research information portal was established for the National Park Hunsrück-Hochwald. Based on a user requirements analysis, a client-server architecture using open source components was set up. Core modules are a metadata-management component and a geospatial data and map service. Beside their own data, the system is interfacing with external data sources (e.g. semantic network service) using standardized protocols to optimize the information retrieval. Main goal of the system developed is to avoid expensive, redundant data acquisition as well as time-consuming information retrieval for the individual research teams. Furthermore, research becomes more transparent, thus allowing better use of possible synergy effects.

Keywords: environmental information system; software reuse; national park management; research documentation; data quality

1 INTRODUCTION

The world network of nature reserves has remarkable high natural values (high ecological integrity, high biodiversity, limited human use, rather unstressed systems, no extraction-oriented resource management, etc.) but also high cultural values. Within this world network of nature reserves, a national park is a park in use for conservation purposes. Behind all national parks worldwide, there is a common idea: the conservation of ‘wild nature’ for posterity (Europarc Federation (eds.) 2009). The International Union for Conservation of Nature (IUCN) discusses the parameters, which define a national park. In 1969, the IUCN declared a national park to be a relatively large area (> 1000 ha) with the following defining characteristics (Gulez 1992):

- One or several ecosystems not materially altered by human exploitation and occupation, where plant and animal species, geomorphological sites
- and habitats are of special scientific, educational, and recreational interest or which contain a natural landscape of great beauty;
• Highest competent authority of the country has taken steps to prevent or eliminate exploitation or occupation as soon as possible in the whole area and to effectively enforce the respect of ecological, geomorphological, or aesthetic features which have led to its establishment; and
• Visitors are allowed to enter, under special conditions, for inspirational, educative, cultural, and recreative purposes.

In addition, national parks can be used as laboratories for research and demonstrate ways to re-establish its original, natural state. In general, the performance oriented applied research in nature reserves and national parks is as important as the traditional monitoring. It includes socio-scientific areas as well as economic- and environmental sciences.

In order to ensure central and efficient access to the literature and data of the national parks for all scientists from the respective institutions and for a long-lasting period, a “research server” is being established. The system serves future researchers as a scientific information portal for the National Park Hunsrück-Hochwald. The goal is to avoid expensive, redundant data acquisition as well as time-consuming information retrieval for the individual teams. Furthermore, research becomes more transparent and allows better use of possible synergistic effects.

2 NATIONAL PARK HUNSRÜCK-HOCHWALD

"To Leave Nature Nature" – this principle shall be realized in the most recent national park in Germany.

After several years of planning, the National Park Hunsrück-Hochwald was officially opened in May 2015. It is a part of the nature park Saar-Hunsrück and comprises approximately 10,000 hectare, or more explicitly, 5% of the total area. The National Park Hunsrück-Hochwald is located in the southwest Germany and connects the federal states of Rhineland-Palatinate and Saarland (see fig.1). A low mountain range with an almost never-ending forest area characterizes the Hunsrück and differentiate the area from the surrounding best wine-growing regions of Germany: the Moselle, the Rhine, the Nahe and the Saar. The Federal Agency for Nature Conservation already counts the Hunsrück as a "hot spot region for biodiversity". Therefore, visitors can especially experience one thing: forest and wilderness.

Research plays, in accordance with the concept of the national park, an important role in the park. Nature conservation, forest development and ecology as well as local added value and the acceptance of the national park by the regional population are examined. At the official webpages, you will find general information of the national park and further information of current research activities (http://www.nationalpark-hunsruesscharkwald.de/).
3 SYSTEM ARCHITECTURE

The national park research server is based on the PortalU software platform, InGrid, which was designed, developed and used by the former national portal for accessing environmental data in Germany (VKoopUIS 2016). Because of the customization for the management of environment-related data and information, the basic software components are recently in use for different environmental information systems, such as the GS Soil project, the environmental data portal of the different federal states in Germany (e.g. Mecklenburg-Vorpommern, Hamburg) or the Unesco MaB Biosphere reserve Bliesgau (Fischer-Stabel et al. 2010). In addition to its special design - which is promoting a reuse of the software for similar tasks in different organizations - the open interfaces of the InGrid-software are strongly supporting compatibility with other information systems.

The research server for the National Park Hunsrück-Hochwald consists of several components (see fig. 2):

- The portal web application for search and presentation
- A meta-data editor and database to manage the metadata related to national park research activities (e.g. title of the study, authors, period and location etc.)
- A GeoServer and a map viewer to visualize and promote geospatial information as download-services (e.g. WFS, WCS) and presentation service (WMS)
- Additional various extensions, e.g. interfaces for import and export, accessing external databases

InGrid uses only Open Source software. All components use a central information broker: The iBus, which works as a distributing hub between search requests and data sources. It receives a search request by an interface, e.g. the portal, processes the request and delivers it to the attached data source modules called iPlugs. The iBus finally collects the results and delivers a composite result to the client.
iPlugs are interfaces to different data sources. In our case we use the DSC-iPlug (DSC = Data Source Client) to integrate the InGrid Catalog (IGC) database into the system. The SNS iPlug (SNS=Semantic Network Service, provides a huge collection of common environmental terms including geographic names) is used to support user interaction throughout the system with geo-thesaurus data. E.g. if you search for “Lurch”, similar search terms like “Amphibien” are offered, helping improve the search.

The CSW iPlug (CSW = Web Catalog Service, a XML-based standard for catalog data exchange) is used to integrate search results from CSW standard compliant sources all over the internet. The Open Search Interface allows others to use the National Park Hunsrück-Hochwald research server as Open Search compliant data source, for example in the environmental information system of Rhineland-Palatinate, to increase sustainability.

The portal provides a user administration framework, the search interface and other portal functions like RSS-feeds, personal settings and so on. It embeds a browser-based client for map display and allows the easy administration of provided WMS layers.

In addition, it also provides access to the InGrid Editor (IGE). The IGE is the user interface of an InGrid Catalog (IGC) database, the most important part of the research server. IGC allows fully ISO 19115 and ISO 19119 compliant description and management of geographic data and services. In some cases it is necessary to provide the described data itself. For that case, a file upload tool similar to Rapidshare is planned, to allow easy access to otherwise not accessible data.

To provide the community with the relevant geospatial data, a Geoserver is included in the architecture, communicating maps and geospatial data via the OGC-standardized interfaces (WebMapService WMS, WebFeatureService WFS and WebCoverageService WCS).
As mentioned above, the software environment is based on open source tools: Ubuntu 10.04 LTS, Apache Webserver, MySQL for InGrid, Postgresql with PostGIS-Extension for keeping GIS Data, Geoserver, Java 1.8 and Apache Tomcat 6.

4 CORE FUNCTIONALITY AND USER INTERFACE

Beside the collection of the research related data by the content managers (using the metadata-editor), the standard use-case of the research server can be divided in four functional components at the front-end:

- **Information of recently ongoing research**: listed at the home page as R&D-project of the month and, in addition, as newsfeeds of open research opportunities
- **Free search using the search interface**: can be done using keywords or combinations of them, availability of spatial and temporal filters
- **Search by catalogue**: ability to scroll through the data-catalogue; the objects are listed in a thematic and an alphabetical order
- **Composing and displaying maps**: the cartographic interface allows the user a combination of user-created maps of the region. Beside the base data (e.g. topographic maps, aerial photographs, zooming of the national park), there are some thematic layers as geology, trials, research infrastructure, etc. The list of available layers is continuously increasing

Regarding the graphical design of the front-end, there exists some corporate identity requirements of the national park office but also of the Europarc Deutschland (http://www.europarc-deutschland.de/), which has to be considered.

Best way to explore the usability and the functionality of the system will be done by using it. The prototype of the system is accessible under: http://tomcat.issgeo.org:8080/; starting in June 2016, the operational research server will be available under: http://www.nationalpark-hunsruess-hochwald.de/

Figure 3: Screenshot of the home page of the information portal
5 REUSABILITY AND DATA QUALITY ASPECTS

The system described was developed for the documentation of research activities at the National Park Hunsrück-Hochwald. But, because all of the nature reserves have a need in similar documentation processes (e.g. meta-data management, collection and provision of cartographic information), the system design and the software components can be easily transferred and reused at any park location. It is only the content of the database, which will be a specific one of a dedicated national park (e.g. National Park Hunsrück-Hochwald).

If there will be a need in an interoperability between the documentation systems of different parks (using different servers), this can be realized by using the dedicated interfaces like e.g. Web Catalogue Service (CSW) or OpenSearch.

Regarding the maintenance of the database, in the case of the research server National Park Hunsrück-Hochwald, we realized a decentral maintenance. Each research group is responsible for the population of the metadata base, but also for the data quality management regarding their data.

The population of the database can be done after the users are registered and served with accounts. To guarantee a high data quality (e.g. accuracy, relevance, completeness, accessibility and actuality), a detailed guideline for the data collection was defined, but also some software based mechanisms were implemented additionally. The definition of the guidelines was finally done in close collaboration with the responsible department in the national park office.

Problems with data quality during initial data acquisition lead to a huge additional effort to resolve. Practical experience showed that essential quality standards can easily be fulfilled by help of guidelines for data collection. Hence, corresponding guidelines should be worked out before the beginning of the operational collection. Additionally it must be defined how the data will be rechecked and actualised continuously.

6 SUMMARY AND OUTLOOK

The documentation of the research in a nature reserve is difficult to organize. Especially in large reserves as national parks or biosphere reserves, lots of activities are ongoing and triggered by different organizations or individuals, often not knowing about the activities of other groups done recently or in the past. To avoid expensive, redundant data acquisitions, as well as time-consuming information retrieval regarding the research of the park, an information portal for the documentation of the research was established. With this infrastructure, research becomes more transparent, thus allowing better use of possible synergy effects.

In a first phase, the documentation is done for the research activities within the reserve up to the time of the opening ceremony of the park. The next phase will bring the information system into an operational phase, including the organization of the workflow to feed the database with the research-related information in a continuous and a comprehensive way.

A lot of other nature reserves have similar problems regarding the accessibility of research information available over the protected site. Therefore, the concept of the developed research information portal, but also the re-use of the included software components has a great potential to be implemented in other reserves.

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