Natura 2000 and the new EU approach for protected sites management have enforced the link between nature conservation and geo-information. This has generated the need for accessible, interoperable and harmonised datasets, also addressed by the INSPIRE Directive (2007/2/EC) that pursues an EU Spatial Data Infrastructure (SDI) to support environmental policies.

The NATURE-SDIplus Network started in October 2008. It aims to enable and improve the harmonisation of national datasets on nature conservation, making them accessible and exploitable. Thus, it supports the implementation of the INSPIRE Directive in this field.

NATURE-SDIplus Newsletters are addressed to all the members of the network and all the stakeholders operating in the field of nature conservation data management.

The NATURE-SDIplus Newsletter no. 4 offers a general overview of the NATURE-SDIplus results, achieved during the project, and the envisaged network follow up.

Inside this issue:

- Introduction to NATURE-SDIplus
- User Perspective in Nature Conservation
- The NATURE-SDIplus Metadata Profiles and Data Model
- The NATURE-SDIplus Solution for Harmonisation and Validation
- The NATURE-SDIplus Common Thesaurus Framework
- The NATURE-SDIplus Infrastructure
- The NATURE-SDIplus Good Practices Catalogue
- The NATURE-SDIplus Training Framework
- Links and Contribution to INSPIRE
- The NATURE-SDIplus Network Future Perspective
Introduction to NATURE-SDIplus

Natura 2000 and the new EU approach for nature management have enforced the link between nature conservation and geoinformation. This has generated the need for interoperable, accessible and harmonised datasets, also addressed by the INSPIRE Directive (2007/2/EC) that pursues European Spatial Data Infrastructure (SDI) to support environmental policies.

The NATURE-SDIplus Thematic Network started in October 2008. Through state-of-the-art methodologies, it aimed at the support and the improvement of harmonization of the national datasets for nature conservation, consequently making them accessible and exploitable.

NATURE-SDIplus contributes to the implementation of the INSPIRE Directive with targeted reference to the nature conservation cluster of data themes of the INSPIRE Annexes:
- Protected sites (PS, Annex I.9)
- Biogeographical regions (BR, Annex III.17)
- Habitats and biotopes (HB, Annex III.18)
- Species distribution (SD, Annex III.19)

Main Objectives

The main objectives of NATURE-SDIplus are:
- To establish a Network on Geographical Information for nature conservation;
- To share experience and good practice;
- To stimulate the community of nature conservation stakeholders at improving the harmonisation, the exploitation, and the access to their datasets;
- To evaluate a common metadata profile and a data model for the addressed data themes in supporting the INSPIRE Directive implementation at EU level.

Project Development and Outcomes

During the project the partnership has achieved several results and outcomes:
- User needs analysis (also extended to a survey about usability and accessibility of data sets on nature conservation);
- Analysis of a rich range of nature conservation datasets (contributed by the several Data Providers present in the network) with regards to the INSPIRE provisions;
- The development of a own European-sighted metadata profile and data model for datasets on nature conservation;
- Multilingual and multicultural tools for a simpler and standardised access to spatial data;
- Geoportal as an INSPIRE compliant demonstration infrastructure, supported by web services and providing access to the available datasets and services;
- Training Framework with modules to acquire the knowledge needed to operate in the field and to transfer the knowledge of the results achieved by NATURE-SDIplus;
- Catalogue of Good Practices in the management of nature conservation data, for sharing experiences within the Community.

The initial surveys (user needs, data availability and accessibility, datasets analysis) greatly contributed to the development of the metadata profile and data model.

Subsequently, a remodelling methodology was put forth to support the procedures for the implementation of the proposed metadata profile and data model as target from the already existing ones.

To guarantee accessibility and usability of the harmonised data, NATURE-SDIplus Infrastructure (with the NATURE-SDIplus Geoportal as core element) was developed. From the multilingual and multicultural point of view, the infrastructure is supported by a thesaurus framework for standardised spatial data exploitation.

Finally, the last stage of the project was dedicated to the development of a validation methodology and to its application.

As an umbrella assuring the dissemination and awareness of the collected knowledge, the NATURE-SDIplus Training Framework for the NATURE-SDIplus Community has been built up. It provides help to the users to understand the problems in nature conservation, together with standards and technology issues. The training is based on e-learning capabilities, and is accessible through a dedicated portal containing information on the covered topics and courses’ metadata.

The network members contributed as well to a collection of Good Practices, being it an effective tool to learn from existing experience (dimension of projects, reasons and objectives, implementation): a lesson available to the network.

NATURE-SDIplus Now

NATURE-SDIplus is an open network and has broadened from the initial 30 contractual members (17 countries) to 60 members from 20 countries, aiming at the creation of a community of stakeholders. Such community is intended to be active at European and National level, interested and involved in INSPIRE and SDI implementation, to facilitate the approach to the Directive and related guidelines and the exchange of opinions and experiences.

The NATURE-SDIplus Network is continuing after the conclusion of the project, to support the implementation of the INSPIRE Directive for the nature conservation aspects.

Any stakeholder interested to join the NATURE-SDIplus Community is more than welcome.

We wish you all a fruitful reading!

The NATURE-SDIplus Consortium
User Perspective in Nature Conservation

Traditionally, nature conservation data have been regarded as the preserve of state level conservation agencies and as such have often been seen as inaccessible by other stakeholders. Today, a demand for interoperable, accessible and harmonised datasets for a broad range of user groups is driven by new environmental policies and legislation (e.g. Public access to Environmental Information Directive), the growing importance of trans-national nature conservation networks, and a general political commitment for citizen involvement. A Spatial Data Infrastructure (SDI) serves as a fundamental gateway to enable data sharing and thus has become an indispensable tool within a spatially enabled society. The assessment of user needs and the specification of user requirements is then a prerequisite for the development of such a user-centric SDI, able to assure modern standards of usability.

The first phase of the NATURE-SDIplus project was therefore dedicated to gain an in-depth understanding of the expected nature of its manifold user groups, their tasks and context of use. An analysis of user needs was carried out to provide a good understanding to support the further technical activities in the following implementation phase. In particular, three aspects were considered:

- An overview on user needs;
- A status quo analysis of existing datasets, covering the cluster of the INSPIRE Data Themes in the scope of the project;
- A review of good practices and legal foundations of nature conservation.

The user needs survey, realised with the help of the NATURE-SDIplus partners, allowed to identify a broad range of target user groups. Usability of a Spatial Data Infrastructure is not provided merely through a geoportal’s Graphical User Interface (GUI): all its underlying components (data, metadata, services) need to follow a user-centric design and the user needs analysis gave important insights into the specific user requirements in terms of these three SDI components.

User Needs Survey Findings

The NATURE-SDIplus user needs survey was carried out through a detailed online questionnaire, and resulted in 314 responses from 23 countries across Europe.

As expected, a high number of nature-conservationists use and need spatial data in their work (around 85%), but the results also revealed the rather striking fact that the transboundary collaboration is rare (i.e. most users work at the regional/national level), showing that most of the problems with data integration are reported as relating to different institutions rather than to different countries.

On the other hand nature conservationists work with a great variety of data and so integration of data from the four nature conservation themes (PS, BR, HB, SD) with the other INSPIRE themes is essential. Further, monitoring is a very important task in nature conservation, thus historical data and time series data is needed.

The most widely used tools to handle data are querying and viewing (basic tools), but usually users also need advanced tools for their tasks (e.g. coordinate transformation, spatial analysis, modelling).

The main derived requirements/needs for NATURE-SDIplus are summarised in the following schema, upon the user and data related aspects.

**User & data situation | Demand & need for Nature-SDIplus**

<table>
<thead>
<tr>
<th>user needs in terms of DATA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Users and producers of nature conservation data</td>
<td>Data models should pay attention to and integrate temporal aspects. Its geoportal not only contains basic information, but also historical data should be presented (e.g. time series).</td>
</tr>
<tr>
<td>Many have no metadata at all</td>
<td>The usability of metadata edit is important</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>user needs in terms of METADATA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Data portals should offer different (hierarchical) visualisations for different user types</td>
<td>Geoportals should be open for data provision from all user groups (not only public administration)</td>
</tr>
<tr>
<td>The usability of metadata edit is important</td>
<td>A number of demands have been derived from the insights gained in the status quo analysis of existing datasets and the NATURE-SDIplus survey on user requirements</td>
</tr>
</tbody>
</table>

Summary Considerations from the Survey

- Diverse levels of expertise of target users reflect a demand for:
  - Simplification of the systems (usability) and
  - User qualification (training).
- Nature conservation data are frequently updated. This anticipates a positive environment for the adoption of new standards and functionalities.
- The added value of NATURE-SDIplus for the INSPIRE process lays upon:
  - Realisation of a user-centred SDI for nature conservation;
  - Awareness raising and training.
The NATURE-SDIplus Metadata Profiles and Data Model

NATURE-SDIplus Metadata Profiles

The NATURE-SDIplus Metadata profiles have been defined considering the requirements from the project’s target users, as identified during the surveys conveyed on user needs and the datasets and data policies analysis. The proposed metadata specification is tied up with the work on the multilingual and multicultural aspects necessary for indexing interoperable data and in parallel with a work on data model specification. The metadata proposal also considers the specification and implementation of harmonization criteria, having the information suitable for evaluating the quality and suitability of the available datasets for any intended use.

The profiles have been constructed to be compliant with the INSPIRE metadata implementing rules and to meet the individuated needs of the target community. The ISO 19115 standard has been complemented by a certain number of metadata elements, collectively called extended metadata.

To produce the metadata as a function of a data theme and to ease the implementation of the specification, it was proposed define this specification for each considered data theme (PS, BR, HB, SD). This means that there is a corresponding metadata profile containing the entities and metadata elements specific to that theme. To this, a generic metadata profile was added that allows geographic web services to be documented. The following picture presents an overview of the contents and rationale behind the construction of each metadata profile.

To conclude, five different metadata profiles have been specified: one for each data theme and one describing web services.

![Metadata Profile Diagram](Image)

The definition of the NATURE-SDIplus Metadata Profile

The NATURE-SDIplus Solution for Harmonisation and Validation

Harmonisation of metadata, data models and related datasets and the related validation are critical steps for the creation of a SDI in nature conservation (but as well in any thematic SDI). NATURE-SDIplus has identified and developed solutions for data harmonisation and validation that have been packaged in the NATURE-SDIplus Harmonisation Kit and in the Validation Briefcase respectively, incorporating the methodology, the tools and many examples.

A dedicated Data Harmonisation Technical Working Group (DH-TWG), established by the project Consortium, has coordinated the NATURE-SDIplus data transformation tasks, starting with the development of the procedures for metadata profiles and data models implementation and following with the support given to the project partners playing the role of Data Providers (DPs)/National Coordinators (NCs) and dealing with the remodelling procedures.

The NATURE-SDIplus validation methodology covered four aspects:

i. INSPIRE validation of the data specification encoding (for the three Annex III data models developed in the project) and INSPIRE validation of the data and metadata encoding (for more than 200 datasets and metadata harmonised in the project);

ii. Assessment of data accessibility and data usability applied to the data and metadata available in the project geoportal;

iii. Assessment of Data Quality;

iv. Generalisation of datasets from the local level to the national/ European level.

NATURE-SDIplus Data Models

The elaboration of the data model followed as close as possible the methodology defined by the INSPIRE Drafting Team (DT) on Data Specifications (Generic Conceptual Model, Methodology for the development of data specifications, Guidelines for the encoding of spatial data).

This methodology is based on a step-by-step approach in which user requirements are analysed and form the basis for the development of the use cases (in reality the selected use cases influence the development of the specifications in the opposite direction as well), along with an analysis of the situation ‘as-is’ and of the gaps as related to those requirements.

Based on the experience of the INSPIRE Data Specifications on Protected Sites, it was decided to analyse and elaborate the potential use cases in more detail. Information on the use cases was collected through dedicated interviews with users of nature conservation data and involved in related policy processes; but also through input from partners of the network and the analysis of documents.

The use cases were documented using a standard template used by the INSPIRE Thematic Working Groups (TWGs).

In a following step, the required spatial features and attributes were detected and described taking into account placeholders and candidate types, the voidable characteristics, possible code lists and enumerations, and stereotypes.

UML was used to describe the application schema and data model (Enterprise Architect environment). The INSPIRE consolidated UML model (version October 2009) served as a starting point for the work. Freemind was used to prepare graphical overviews of the data model allowing non-expert users to read and understand the conceptual model.

Finally, the models were transformed and encoded as GML application schemas. An important aspect in this phase was the involvement and contribution of project partners for achieving broadly accepted data specifications. The data model is a key input to the INSPIRE data specification process and therefore was uploaded as reference material for the Thematic Working Group on Biogeographical Regions, Habitats and Biotopes and Species Distribution (TWG BR-HB-SD).

Harmonisation Kit

The general methodological approach is presented below:

![Harmonisation Kit Diagram](Image)

The methodology for Data Harmonisation

The Harmonisation Kit contains:

- Procedures for Data and Metadata Transformation (Guidance Document)
- Matching Tables (Spread Sheets)
- Transformation Tools (Software)
- Examples (NATURE-SDIplus Training Framework)
The **transformation process** can be summarised in four (or five) steps:
- To identify and to characterize the source and target information;
- To compare source and target information using a matching table, documenting differences as essential input for the transformation and geoportal publication steps;
- To choose the most suitable tools (ideally from a selection of tested and offered within the NATURE-SDIplus project) and to perform the transformation (remodelling);
- To create the services and catalogue services for publishing the information under the NATURE-SDIplus Geoportal.

**Matching Tables**

In general terms a matching table is the way to establish the relation between the source information and the target information model. It is, therefore, a useful tool for each data provider in order to harmonise his own information and publish it later on.

The matching table of Data and Metadata should be a helpful tool to know how to structure the information that every data provider already has or wants to create under NATURE-SDIplus Metadata profile or Data Model.

**Transformation Tools**

Several tools (among them, also open source), provided by the NATURE-SDIplus partners or other available sources, have been analysed and offered (commercial ones free of charge) for the use by the data providers, to support the harmonisation efforts within NATURE-SDIplus project.

Transformation tools for metadata:
- MDweb, INSPIRE Metadata Editor, CatMDEdit, GeoNetwork, MIG Metadata Editor, disy Preludio

Transformation tools for spatial datasets:
- GeoConverter, GeoMedia Fusion, Humboldt Alignment Editor, Go Publisher

**Statistics**

Once processed, harmonised, transformed and made accessible through the geoportal, spatial datasets, metadata and network services have been validated (accessibility and usability).

In the following figure the final statistics of the harmonised metadata and datasets are shown, divided by data theme.

**Validation Briefcase**

The NATURE-SDIplus Validation Briefcase has been designed, developed and tested as a tool, consisting of a main guideline document and annexed template reports, examples, tutorials and schematron files, describing step by step the validation process and covering both data specification and data encoding.

The Validation Briefcase (VB) contains:
- Main guideline document;
- Folder with the necessary metadata profiles and data models in the *.xsd file format (XML schema definition of the feature classes);
- Folder with the necessary schematron files (for semantic validation);
- Folder containing a template and an example of Validation Report
- Folder containing tutorials for self validation;
- Folder containing the Validation Reports filled-in by the Data Providers (as an example for other DPs).

The metadata and data specification validation process includes the following steps:
- Data Model Validation: assures that all relevant standards have been taken into account for the individual elements of the data model;
- Schema Validation: assures that the schema that has been derived from the data model is a valid schema according to the W3C XML Schema Specification;
- Validation of Transposition: assures that all elements from the Data Specification have been properly transposed to the XML Schema;
- Validation of Validatability: assure that all elements from the Data Specification have been transposed to the XML Schema in a manner that allows for correct semantic interpretation and validation.

For the validation of the metadata and data encoding, the following steps are covered:
- Schema Validation (syntactic): validation of the metadata or data document against the corresponding XML schema;
- Schematron Validation (semantic): validation of non-syntactic requirements using semantic rules defined in the Schematron.

Regarding the metadata and data specification validation process, the VB has been applied to the INSPIRE PS Annex I Data Model, to the three Annex III Data Models (BR, SD, HB) and to the NATURE-SDIplus metadata profile. Their application turned into effective feedback towards the three (INSPIRE Annex III) data models development and thus strongly contributed to their updating.

Regarding the validation of the metadata and data encoding, the VB was extensively applied by the DPs for their self-validation. It has to be highlighted that the VB can be also used by any European Data Provider aiming at validating her/his Protected Sites datasets against INSPIRE PS Data Specification, but the methodology it is built upon can be easily generalised to any other INSPIRE data theme.

**Assessment of Data Accessibility and Usability**

In terms of data accessibility, a multilevel criteria assessment
The NATURE-SDIplus Common Thesaurus Framework

Data sharing in a SDI is affected by multilingual and cultural barriers in the use and reuse of geographical data at global level. It needs to publish and exploit geographic data in a standardised way and with a common nomenclature both in a multicultural and a multilingual context. Knowledge Organization Systems, such as thesauri, classification and taxonomy, are proposed to share standard technological and scientific terms of geographic data understandable by different user communities operating in the geo-information field.

In this respect, one of the objective of NATURE-SDIplus project is to face with multilingual and multicultural issues in data sharing for Nature Conservation: the two specific scenarios on “data resource annotation and publication” and “information search and retrieval” are considered and a best practice thesaurus based solution is proposed.

In the current state of play, different communities, which have a large spectrum of competencies are involved in the treatment and the management of information pertaining to the Nature Conservation; many terminologies have been already developed and adopted in the past for covering part of these competencies; more than one terminology can be available for a given competency; terminologies adopted have often a national origin, so they are not uniform in all the European countries and often even stakeholders from the same country can adopt different terminology in everyday practice. Considered the above situation, NATURE-SDIplus proposes a multi-thesauri solution for the four data themes: Protected Sites, Biogeographical Regions, Habitats & Biotopes, Species Distribution.

The result is a Common Thesaurus Framework for Nature Conservation where different well known knowledge organization systems for nature conservation are shared and assembled with the intent of providing an integrated thesaurus for the four data themes covered by the project.

The methodology has been extended to assess the Data Quality of the harmonised datasets vs. the source datasets and applied to four datasets, one for each of the data themes covered by the project.

Datasets Generalisation

The method applied has been based on the design of an off-line questionnaire to collect the feedback of the Data Providers about the usability of the PS, BR, HB and SD Data Models and of the NATURE-SDIplus Metadata Profile when harmonising data and metadata at local level and aiming at generalising them from the local to the national/European level. In particular, the feedback focused on two main aspects:

- If DPs have noticed the need/opportunity to extend/modify the target data models, in order to better take into account local aspects;
- If DPs have noticed the need/opportunity to extend/modify the source data models, in order to facilitate INSPIRE compliance.

The first aspect is coherent with the Annex F (Example for an extension to an INSPIRE application schema) of the INSPIRE Data Specification D2.5 Generic Conceptual Model, according to which the INSPIRE data specifications can be modified at local level, in terms of data model, in order to take into account local aspects. The feedback collected on the second aspect can support local communities engaged in implementing INSPIRE.

Test criteria and items

The data usability has been assessed by means of an on-line questionnaire focusing on the data search functionalities implemented in the geoportal and on the usability of the datasets both within the geoportal (using its functionalities implemented) and outside the geoportal (downloading the data via the geoportal and using them inside a user application and/or consuming the WMS-Web Map Service/WFS-Web Feature Service directly in a user application).

Data Quality (DQ) Evaluation

A four-steps methodology has been developed:

1. Select the DQ elements and sub-elements (cross-checking INSPIRE PS Data Specifications, NATURE-SDIplus Metadata profile and EN ISO 19113);
2. For each sub-element define a DQ measure (in adherence to ISO/TS 19138);
3. For each sub-element define a DQ reporting (in adherence to EN ISO 19114 and EN ISO 19115);
4. For each sub-element provide an example of DQ evaluation.

The methodology has been extended to assess the Data Quality of the harmonised datasets vs. the source datasets and applied to four datasets, one for each of the data themes covered by the project.

Framework elements

The method, schematized below, includes more than 200,000 concepts covering the INSPIRE data themes addressed by NATURE-SDIplus. Most of these concepts come from existing specific domain...
knowledge organization system: EUNIS database for species and habitat types, IUCN classification for protected sites, DMEER classification for the biogeographical regions. EARTH (Environmental Application Reference Thesaurus) provided by the Environmental Knowledge Organization laboratory (EKOLAB-CNRE) is employed as general-purpose thesaurus in the environmental/geographical field because it reviews and extends GEOMET adding more than 7000 new concepts. Several interlinking among concepts of distinct thesauri included in the framework have been provided: EARTH is interlinked both with internal thesauri (e.g. biogeographical regions) and with external thesauri (e.g. GEOMET thesaurus), EUNIS Species have been interlinked to EUNIS Habitat Types and vice versa. All concepts included in the framework are in English except for Species in Latin. Moreover, official languages of other EU countries have been considered according with the availability translation of the existing thesauri (e.g. species and habitat types are available in more than 25 languages).

Framework design features

The framework outcome fulfils the following requirements:

- **Modularity** – Each knowledge organization system included in the framework is intended as a module plugged in the NATURE-SDIplus solution. In particular, modularity should be preserved in order to manage updates on existing terminologies;

- **Openness** – Each knowledge organization system should be easily extendable in order to add (as separated modules) new concepts and terms while keeping the original terminology separated;

- **Exploitability** – Each knowledge organization systems has been encoded in a standard and flexible format, in order to encourage the adoption and the eventual enrichment from third party systems;

- **Interlinking** – Terms and concepts in the considered knowledge organization systems are interlinked in order to harmonize the term usage. In particular, interlinking is important when a term is referring to the same concept in more than one thesaurus, since it enables the access to the same concept from a multicultural point of view.

Technological aspects

Linked Data and Simple Knowledge Organization Systems (SKOS) have been adopted to meet the aforementioned requirements.

SKOS captures much of the thesaurus structure similarity by providing a common model to represent KOS resources in the Resource Description Framework (RDF). RDF is a very flexible way to structure data, which is now considered the standard model for publishing and interchange of data on the Web.

Linked Data refers to a style of publishing and interlinking RDF structured data on the Web. It has been employed in the thesaurus framework to expose, share, and connect SKOS concepts from different sources. Combining SKOS and Linked Data satisfies the requirements of modularity, openness, exploitability, and interlinking. In particular, the resource translation to SKOS homogenizes the representation of concepts coming from different KOS. It allows inclusion of the sub-thesauri in the framework as separated modules. For each concept, the SKOS model keeps track of the KOS from which the concept has been originated (i.e. concepts from different KOS are included within the framework using different URI namespace). That makes concepts distinguishable according to their origin and therefore makes the task of adding new sub-thesaurus easier as well as removing those already included. Adhering to Linked Data ensures framework openness. A dereferenceable URI is associated with each concept made available in the framework. Thus, third parties can extend the exposed sub-thesaurus by referring to their concept URI in the SKOS fragments published everywhere in the Data Web.

Finally, publishing SKOS/RDF according to Linked Data makes the framework remotely accessible, it enables both humans and third parties’ applications to access and query its content by HTTP and SPARQL ensuring higher exploitability.

The adoption of Linked Data best practices enlarges the visibility of the Common Thesaurus Framework for Nature Conservation both within and outside of the NATURE-SDIplus consortium pushing it as an example of best practice in the definition and reuse of KOS thesauri.

Within NATURE-SDIplus, the Common Thesaurus Framework for Nature Conservation has been exploited as controlled vocabulary to annotate and search geographical datasets. The NATURE-SDIplus Metadata Editing Tool and the NATURE-SDIplus Geoportal, which respectively serve as metadata editor to document dataset and web portal to search them, provide auto-completion services to expand keywords as the user types. Such services provide suggestions about correct spelling, synonyms and related concepts of typed keywords easing the adoption of terms that are consistent to concepts included in the Common Thesaurus Framework for Nature Conservation.

Besides the Common Thesaurus Framework is available as standalone component at CNR-IMATI server http://linkeddata.ge.imati.cnr.it:2020, where it can be accessed by html browser as well as semantic web browser (e.g. Tabulator), and by SPARQL queries through the SPARQL end point set at http://linkeddata.ge.imati.cnr.it:2020/sparql.


The NATURE-SDIplus Infrastructure

NATURE-SDIplus, as an operational implementation of the INSPIRE paradigm, addresses the aspects strictly related to the data, driving the solution to a data centric vision of the implemented SDI.

In this perspective, a strong attention has been paid to:

- Harmonisation of the data and related metadata with the aim to publish them according to the INSPIRE Guidelines;

- Services to discover the data;

- Services to view metadata and data;

- Services to recover the data by the SDI users for further exploitation in proper environment.

All the above has been embedded within the NATURE-SDIplus Infrastructure, a network of distributed SDI nodes, represented by data providers and service providers.

The data providers make their own data on nature conservation available to the community. The available datasets are harmonized according to the NATURE-SDIplus methodology utilizing the NATURE-SDIplus Metadata profiles and Data Models, and subsequently the validation procedure. Voluntarily provided data are exposed in standardized format and through standardized services.

The service providers represent the data providers, able to expose their own services (WMS, WFS) to make accessible their data, and the technological partners, who make accessible national geoportal through the NATURE-SDIplus Geoportal (hereafter also ref. as the Geoportal), including the set of services and tools permitting to the users to discover, view, and download the data distributed through the infrastructure.

Architecture

The infrastructure architecture is designed as a set of interoperable components with the possibility to integrate a new component through standard services.

The infrastructure is distributed according to the idea of maintaining the data in its original location. Each data provider exposes the data through standard services. The related metadata are maintained using the national and central catalogue.
The NATURE-SDIplus Geoportal Environment and Integrated Tools

Data providers are supported by the NATURE-SDIplus Infrastructure to publish their data through a set of tools and services, including:

- Data harmonization tools
- Metadata editor
- Thesaurus web service
- Web services publication tools

The users can discover and exploit the data collected into the infrastructure by the central and national geo-portals permitting them to access and use the exposed web services, like CSW (Catalogue Service for Web), WMS, WFS, and download services.

To publish a new dataset in the infrastructure, the data provider undergoes the following steps:

- To produce the metadata according to the project profile;
- To remodel the dataset according to the common shared data model defined by INSPIRE and the NATURE-SDIplus Data Models;
- To publish the metadata into the national or central catalogue by contacting the geo-portal administrator;
- To publish standard view service (WMS) to make available the map data to the community;
- To publish standard GML dataset for the download service (according to the data provider IPR rules).

The following infrastructure tools have been integrated launching the data and metadata publication procedures:

- MDWeb, a metadata editor service, for data providers, to maintain the metadata (related to data and/or services) using own editing tool or exploiting this editor;
- The Geoportal Catalogue that incorporates published metadata and federated national catalogue services managed by the Catalogue Administration Tool. The Geoportal Catalogue Client permits to perform search to recover metadata related to the data published in the NATURE-SDIplus Infrastructure, looking into the central and federated catalogues of the entire infrastructure. Like the metadata editor, the Geoportal Catalogue Client exploits the Thesaurus Framework services giving:
  - the auto-compilation functionality in inserting the search keywords;
  - the possibility to search keywords and related synonyms;

The Geoportal permits to display the found metadata files and to eventually display the WMS services exposed by data provider and related to the recovered metadata;

- The Geoportal Web Client is a browser interface including several facilities to search, display and download metadata and data exposed into the NATURE-SDIplus Infrastructure. The client interface is multilingual and the browser automatically sets the interface language according to the browser setup (the user can select the preferred language). The Geoportal Web Client permits to manage the map content by Adding/Removing external web services;

  - Metadata validator represents a web service available on the central geo-portal to validate the metadata according to the following set of metadata profile:
    - ISO profile
    - INSPIRE profile
    - and as defined by NATURE-SDIplus:
    - Protected site profile
    - Habitat and biotopes profile
    - Species distribution profile
    - Biogeographical region profile

- Download service permits, exploiting the discovery service (CWS client), to access the data (in GML format) provided by the data providers to the infrastructure administrator (considering the IPR constraints);

- 3D GeoBrowser is a client that allows navigation of published information in a 3D environment. The client is able to link the published web services and to integrate the received information in a 3D environment, permitting to the user to navigate the 3D environment and query the published information.

The left side bar of the Geoportal Web Client includes the interface to exploit the catalogue functionalities in order to query and retrieve the information collected in the NATURE-SDIplus Infrastructure.

Using the search interface, the user is able to retrieve metadata entering a free text. The system queries the connected/federated catalogues and lists the set of metadata found. While entering the free text into the search text box, The auto-completion functionality suggests the possible keywords to end users which are retrieved from Thesaurus web service of MDweb. This service is based on the GEMET’s Web services specifications which offers an access to the terms and relations of Thesaurus Framework using normalizing request methods.

The Geoportal Web Client allows to link web services into the Geoportal interface: it is possible to list the linked data sources, to add a new data source, and to remove the attached data source. Namely the following type of services can be linked to the Geoportal:

- CSW – Catalogue service for Web
- WMS – Web Map Service
- WFS – Web Feature Service
- WFS-G – Gazetteer service
- Google Maps – service to include Google Maps into the client map
- Virtual Earth – service to integrate Virtual Earth into the client map

The Geoportal Web Client includes standard zoom and pan functionalities to navigate the map.

In addition there are the following functionalities to manage the map content:

- Visibility scale: selects the range of scale in which each feature layer will be displayed. This avoid the system to overload the server with displaying the data in the map;
- Context: saves the context of the map (i.e. the list of services, the extent of the map, etc.) that could be reloaded in a next session;
- Print: a simple facility for printing the displayed map;
- Transparency: sets the level of transparency for each layer.
The NATURE-SDIplus Good Practice Catalogue

Sharing Good Practices (GP) is considered an important added value in the Network: the NATURE-SDIplus Good Practice Catalogue has been organised in order to represent an efficient tool to learn from existing experience about the dimension of projects, reasons and objectives implementation.

Good Practices are intended as technical, organizational and data sharing cases/experiences and indeed they represent a good approach to review how to regulate the flow of geo-information in nature conservation.

They are collected into an on-line database (accessible from the project website), based on the input received by the Members of the NATURE-SDIplus network and by the targeted stakeholders in the field.

The information for the Catalogue is collected with a structured template and, in case it is necessary, it is further refined with personal interviews.

Structure

The Good Practices Catalogue aims at:
- Explaining the practice experience;
- Showing the regulation of the geographic information flow in nature conservation;
- Offering relevant quantitative and categorical comparable information.

More specifically the information, offered by The Catalogue includes:
- General Information
- Technical Implementation/Solutions
- Data Aspects
- Actors/Roles present in the GP
- GP processes
- Information on the Implementation
- Reference
- Possible additional Material

The Catalogue can be examined, using a search engine, by searching for a particular term or by selecting predefined keywords of the template.

So far, the NATURE-SDIplus GP Catalogue includes 38 practices collected from 14 different countries (plus 3 international practices). The most reported keywords are environmental monitoring, reporting, data access, management, metadata management, dataset harmonisation; the GPs cover application areas, such as planning & management, biodiversity, species distribution, and natural resources sustainable exploitation.

Considering its objective of transferring experiences and allowing to learn lessons, the NATURE-SDIplus Good Practice Catalogue has been also included in the NATURE-SDIplus Training Framework.

The NATURE-SDIplus Training Framework

The Training Framework has been designed with the aim to provide training material about the results of the project and in order to allow the acquisition of the required background knowledge for operating on the different topics addressed by the project. Both technical and nature conservation aspects are covered by the Training Framework.

Training Framework Schema

The NATURE-SDIplus Training Portal (www.nature-sdi.eu/training), accessible through the project web site, is the gateway to the NATURE-SDIplus Training Framework that includes:

1. the NATURE-SDIplus Training Package, describing the training offer and related structure, organised in different levels of training (1. Background Knowledge; 2. SDI and Nature Conservation, 3. Applications). Each level has a list of courses (training modules) documented through metadata.
2. the e-Learning platforms, representing the infrastructure that hosts the training material. The NATURE-SDIplus Training Framework is based upon a network of distributed platforms that could be hosted in different servers with different technologies.
3. the Training material organised in modules, as indicated in the NATURE-SDIplus Training Package.
Training Material

The NATURE-SDIplus Training Framework includes 13 modules, structured into the 3 levels of the Training Package. They are modular and can be organized into different learning paths as is more appropriate for the requirements of the trainees. The training material, based on the textual and video with voice formats, includes tutorial and exercises, integrated within the e-learning platforms.

Training Actions

As already remarked, nature conservation is managed with a more and more integrated approach, reflecting both scientific achievements and the European and international regulations; to-day geoinformation plays a key role, but with geospatial data showing heterogeneous nature and a large variation in logical schemas, geometric types, attributes and values.

All the above requires proper skills and there is a strong demand for training in this field.

It is then appropriate to define various Training Paths, customised according to the different target audience, by selecting all or a subset of the modules included in the NATURE-SDIplus Training Framework.

At the end of the project, a set of combined NATURE-SDIplus eLearning Training Actions „Nature Conservation and INSPIRE” was carried out in five countries (Bulgaria, Hungary, Italy, Poland, Portugal), tutored by the NATURE-SDIplus partners national coordinators in those Countries.

The actions were addressed to the operators in Geographical Information and Nature Conservation Data Management. Their Training Path was designed, selecting 8 modules of the Training Framework, to offer an overview of the nature and biodiversity policies (implemented by NATURA 2000) and of the INSPIRE Directive for geodata management. Such introduction was followed by the basic concepts of spatial data infrastructures and geo-data processing, with the link between nature conservation and INSPIRE, and the concepts, methods, procedures and tools for data harmonisation. The final aim of the Training Actions was the compliance under INSPIRE for the themes of Protected sites, Habitats and biotopes, Species distribution and Bio-geographical regions.

The modules, selected for these Training Actions “Nature Conservation and INSPIRE”, were:
- Nature Conservation and Natura 2000 Network
- The INSPIRE Directive
- Metadata, Concepts and Standards
- Web Services
- Nature Conservation and INSPIRE
- Data Harmonisation
- Procedures and Tools for Data and Metadata Harmonisation
- Data Remodelling: Practical Experience

In each Country, the Training Action consisted of a training, organised to introduce and to give instruction on the use of the Training Framework, followed by a two months self-learning of the proposed training modules and, at the end of the action, by individual evaluation reports.

A total of about 150 stakeholders in SDI and nature conservation participated and were registered under the training action.

Links and Contribution to INSPIRE

NATURE-SDIplus has constituted a Community acting as a reference for INSPIRE for nature conservation issues and throughout the already registered INSPIRE Spatial Data Interest Community (“NATURE-GIS” SDIC), has supported the development of data specification for the cluster of the nature conservation data themes considered in INSPIRE.

A well-established and profitable collaboration with INSPIRE has been considered as a very important option for the project, with a continuous operational link with JRC/IES, and in particular with the data specifications TWGs (Thematic Working Groups).

That collaboration supported the achievement of the project objectives and ensured a very positive impact towards the INSPIRE Community both at a European and at a National level, even beyond the initial expectation.

The project initial phase was temporally aligned with the JRC call for testing of the intermediate release of the INSPIRE Data Specification for Annex I Protected Sites (I.9 PS). In the testing the project carried out the analysis of 99 data sets from 23 data providers of 15 European Countries and submitted to JRC all the relevant reference material (project deliveries and user requirements/use cases).

The resulting data specification, the INSPIRE data model: “D2.8.I.9 – INSPIRE Data Specifications on Protected Sites – Guidelines” (D2.8.I.9, 2009), has been adopted as reference DATA Model for Protected Sites within NATURE-SDIplus.

Moreover, as described in the previous article about Metadata Profile and Data Model, the project consortium elaborated data specifications for the cluster of the Annex III themes (III.17 BR, III.18 HB, III.19 SD), which results have been proposed to the related INSPIRE TWG.

Two project scientist partners, Margaret Carlisle of University of Aberdeen (UK) and Diederik Tiry of SADL KU Leuven (BE), were appointed as representatives in the Thematic Working Group for Data Specification on the aforementioned ANNEX III data themes.

In its last phase NATURE-SDIplus was aligned with the INSPIRE Roadmap in order to contribute to the INSPIRE Data Specification testing of the Annex II and III data themes, focusing on the “own” biodiversity themes.

The collaboration will go beyond the lifecycle of the project, with a continuous cooperation and support with the nature protection stakeholders at European and national level to support the INSPIRE implementation process, in particular regarding:
- Thematic metadata profile extension (proposal and implementation);
- Testing of the INSPIRE Data Specifications (transformation and application);
- Deployment of INSPIRE network services;
- Awareness raising, including training and
- Further development of the NATURE-SDIplus network to include new stakeholders in the Community.
The NATURE-SDIplus Network Future Perspective

The mission of the NATURE-SDIplus Network is in general to foster a cooperation among stakeholders of spatial data harmonisation. This is done with specific actions, both technical and of networking that are:

- To support data harmonisation in the nature conservation sector;
- To improve and to stimulate exploitation and re-use of information on nature conservation;
- To share experience (e.g. Good Practices) and reference material (e.g. Deliverables) with the INSPIRE team;
- To keep contact with INSPIRE and inform the members about new trends in SDI and geo-data harmonisation;
- To hold information events and participate in conferences/events to foster information exchange;
- To involve stakeholders and to promote/organise Training Actions towards the operators;
- To cooperate with the members to promote new initiatives and projects.

NATURE-SDIplus has focused at the creation of a community of stakeholders, at European and National level, interested to and involved in INSPIRE and SDI implementation for nature conservation issues, facilitating in this way their approach to the Directive.

The network is open to all the stakeholders operating in nature conservation data management: from the initial 30 contract members in nature conservation and natural data management: from the initial 30 contract members (17 countries) has now got to 60 members from 20 countries (ref. July 2011). These Members represent the following categories of operators in nature conservation and natural data management:

- Data providers at national, regional and local level, from organisations in charge of the production of the spatial information;
- Technological partners that implement and maintain advanced operational tools and ensure the vision of future ICT trends;
- Researchers that maintain the touch of the current and future research fields;
- User representatives using spatial information for nature conservation.

This composition ensures that the members of the network are composed by both technical and non-technical organisations and are able to contribute with input and feedback to the processes undertaken within the project, especially remodelling activities, validation procedures, and as well expertise outlook in metadata/data models specification and implementation.

In such a way NATURE-SDIplus supports the INSPIRE implementation even after the conclusion of the EU project, also in its role of thematic Spatial Data Interested Community (SDIC).

A NATURE-SDIplus Secretary has been established to assure the operativeness of the network after the conclusion of the project and to continue supporting the INSPIRE implementation.

The Network exploitation is intended both at European and at national level, with particular emphasis to the Good Practice collection, the training, exploiting and deploying the on-line Training Framework and the deployment of the NATURE-SDIplus Infrastructure.

That in order to support not only INSPIRE, but also the new European initiatives for the environment, such as those considered within GMES and SEIS (Shared environmental Information System).

Moreover, for the exploitation of the network and its follow-up, a clustering and link with other initiatives and networks is considered as a strategy, in view of a comparison of results by state-of-the-art analysis, data and Good Practices sharing, validation and testing of results asking for mutual cooperation with other networks in order to tune upon common methodologies and rules.

On the nature conservation side, important links are:

- EIONET ETC/BD (European Topic Centre on Biological Diversity).
- GBIF (Global Biodiversity Information Facility)
- The Pan-European Species Directories Infrastructure (PESI)
- The GMES initiative Biodiversity

Among the liaisons, and apart of the already mentioned links with INSPIRE, very important is that one with CEN/TC 287, that was engaged to exploit the Training Package on the methodology for data harmonisation and validation.

In the context of different workshops for Interoperability promoted by JRC and CEN/TC 287 it has been proposed maintaining relevant deliverables from EU-funded projects on Geographic Information by creating a repository of reference material on interoperability. In such a repository, future projects can find state-of-the-art information on interoperability. At the same time, new projects can then add new reference material as they progress in the work programmes.

Following this proposal and this idea to rationalize and pool the EU deliverables and project outcomes on Geoinformation, it was also proposed to emphasize the training and better exploit the training material developed. In this view, it was agreed to exploit the Training Framework schema to create a reference portal for the GI training in Europe, in connection with the CEN/TC 287.

Regarding the metadata and data specification validation process within NATURE-SDIplus, the Validation Briefcase (VB) has been applied to the INSPIRE PS Annex I Data Model, to the three Annex III Data Models (BR, SD, HB) and to the NATURE-SDIplus metadata profile and its application to the three Annex III Data Models has strongly contributed to their updating. A stimulating interest has been already registered, especially because the methodology the VB is built upon can be easily generalised to any other INSPIRE data theme although it has been specifically designed for and applied to the four data themes relevant to nature conservation.

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"Imagine how our life would be if we couldn't enjoy the beauty of nature, the presence of animals, the magnificence of the mountains and the expanse of the oceans”

(Dalai Lama)