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Multimapping Design of Complex Sensor Data in Environmental Observatories

H.Hajj-Hassan, N.Arnaud, A.Castelltort, L.Drapeau, A.Laurent, O.Lobry, C.Khater
Environmental resources

- air quality, water quantity, birds, ...
- need for data to understand fundamental questions such as **global change**
- collecting data: sensors + human as a sensor (HaaS)
- need for data sharing, data publishing
- data models and formats have emerged
- need for data crossing
O-Life

- The Mediterranean basin is a priority area and a leading area for the analysis of environmental data
- shared observatory between France and Lebanon
- with the aim of collecting, perpetuating, sharing, and valorizing environmental information
- creation of an ambitious Circum-Mediterranean observatory network

Objectives of O-Life

- Conduct simultaneously: Observation, Research, Training and Valorization
- Federate skills through common tools and objects
- Organize, share, sustain and enhance environmental data
Priorities

- **Build environmental databases** of the critical zone in consideration
- Conduct **monitoring services**: Provide instruments, equipment, assist in the operation and monitoring of sites
- **Enhance environmental data** and research among scientists, public policy makers, and the public in general, to promote a coordinated approach to sustainable development
- **Facilitate the prospective approach and exchange through innovative web services**
- Be a force of exploration and proposal for relevant calls for projects
Building environmental databases

- crossing heterogeneous data
  - formats
  - context
- collected for a primary goals and not for publication
Sensor Data

- Observations and Measurements (O&M) framework
- SOS: Sensor Observation Service
- proposed by the OGC (Open Geospatial Consortium) within the Sensor Web Enablement (SWE)
- Several frameworks, our choice: 52°North
Concepts

- Feature of interest
- Phenomenon time
- Result time
- Procedure
- Observed property
- Result
- Unit of Measure
The need for crossing points of view

- one observation model is meant as to correspond to one feature of interest
- however, it may be the case that several points of view can be considered
- Example
  - following species

<table>
<thead>
<tr>
<th>Species</th>
<th>Observators</th>
<th>Date of observation (dd/mm/yyyy)</th>
<th>Common name English</th>
<th>Village</th>
<th>Phenology at time of observation</th>
<th>Nb_of_individuals</th>
<th>Sex</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dama</td>
<td>A.A.</td>
<td>1/1/2015</td>
<td>Fallow deer</td>
<td>Faraya</td>
<td>Adulte</td>
<td>4</td>
<td>M &amp; F</td>
<td>Gray</td>
</tr>
<tr>
<td>Panthera pardus tulliana</td>
<td>C.K.</td>
<td>4/3/2015</td>
<td>Anatolian leopard</td>
<td>Ehden</td>
<td>Young</td>
<td>1</td>
<td>F</td>
<td>Hairy</td>
</tr>
<tr>
<td>Dama</td>
<td>S.C.</td>
<td>5/12/2015</td>
<td>Fallow deer</td>
<td>Bsharre</td>
<td>Young</td>
<td>3</td>
<td>M</td>
<td>Long Tail</td>
</tr>
</tbody>
</table>
Multi-mappings

- with the goal to consider alternative features of interest
- some parts of the SSN ontology are refined in order to be able
  - to represent multiple mappings and
  - to point out the existence of multimapping to the users
### Example: Mapping 1

<table>
<thead>
<tr>
<th>Species</th>
<th>Observers</th>
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<td>Young</td>
<td>3</td>
<td>M</td>
<td>Long Tail</td>
</tr>
</tbody>
</table>

**Mapping _1**

<table>
<thead>
<tr>
<th>ObservedProperty</th>
<th>Procedure</th>
<th>samplingTime</th>
<th>phenomenon_description</th>
<th>featureOfInterest</th>
<th>propertyValueProvider</th>
<th>propertyValueProvider</th>
<th>propertyValueProvider</th>
<th>propertyValueProvider</th>
</tr>
</thead>
</table>


### Example: Mapping 2

<table>
<thead>
<tr>
<th>Species</th>
<th>Observers</th>
<th>Date of observation (dd/mm/yyyy)</th>
<th>Common name English</th>
<th>Village</th>
<th>Phenology at time of observation</th>
<th>Nb_of_individuals</th>
<th>Sex</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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<td>1/1/2015</td>
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<td>M</td>
<td>Long Tail</td>
</tr>
</tbody>
</table>

**Mapping_2**

<table>
<thead>
<tr>
<th>featureOfInterest</th>
<th>Procedure</th>
<th>samplingTime</th>
<th>phenomenon_description</th>
<th>propertyValueProvider</th>
<th>propertyValueProvider</th>
<th>ObservedProperty</th>
<th>propertyValueProvider</th>
<th>propertyValueProvider</th>
</tr>
</thead>
</table>

Note: The table above includes data on species observed, their common names, dates of observation, villages, and other related details. The data is structured to provide a clear overview of the observations made.
Representing multiple mappings

- introduction of ssn:alternative
- alternative observation
- alternative feature of interest
- alternative observed property
<table>
<thead>
<tr>
<th>Description</th>
<th>Proposed Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative Observation</td>
<td>mssn:AltObservationDesign</td>
</tr>
<tr>
<td>Alternative Feature of Interest</td>
<td>mssn:altFeatureOfInterest</td>
</tr>
<tr>
<td>Alternative Observed Property</td>
<td>mssn:altObservedProperty</td>
</tr>
<tr>
<td>Alternative Observed By</td>
<td>mssn:altObservedBy</td>
</tr>
</tbody>
</table>

- introduction of RDF triplets like:

```text
fauna:species mssn:altFeatureOfInterest ssn:FeatureOfInterest
```
Conclusion and Perspectives

- importance of data crossing in the context of environmental data and climate change
- extension of the SSN ontology in order to make it possible to represent multiple mappings
- Need to offer a methodology
- Need to address other examples and frameworks