Domain Formal Modelling

Space domain extension for protected areas

Outline

- ITO (Input - tools - output)
- Definition of the task
- Scenarios considered
- Data gathering considerations
- Related Work
- Informal modelling
- Formal modelling
- Lexical Mapping
- Demo queries
- Future Work

ITO

1. Inputs: Protected sites + Species + Transportation points
2. Tools Used:
    a. yED (informal modelling and TLO mapping)
    b. Protegè (formal modelling)
    c. Wordnet (lexycal mapping)
    d. GraphDB (data visualisation, data query)
3. Outputs:
    a. Report
    b. Ontology unifying concepts related to the different domain considered

Task definition

To bind **protected sites** (lakes, national parks or similar) to **means of transportation** in their neighbourhood.

- all protected areas within Italy are concerned
- … data targeting the Trentino-Alto Adige region for simplicity

Scenarios considered (generalised)

1. The user wants to find all national parks within a administrative division from where she actually is.
   All movements should be performed by public means of transportations.
2. The user is planning a long trip and wants to have a list of all maritime areas reachable by plane, spanning the entire Italian peninsula.
3. A local administrator wants to have a list of all protected areas reachable by using only the public infrastructure, in order to highlight weak spots.

Use cases

1. To retrieve protected sites within an administrative division.
2. To have a list of all transportation points reaching a given protected site.
3. To allow filtering for a specific kind of transportation means based on the service offered.
4. To know which are the species housed on a given protected site.
5. more…

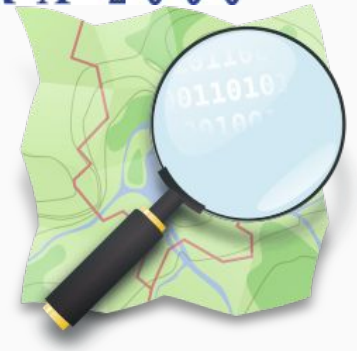
Data gathering

Standards

- INSPIRE (WDPA)
- NATURA 2000

Data sources

- Protected planet
- Natura 2000
- OpenStreet Map



Related Work

What we found out

- There is a lot of work on spatial ontologies, but not for our scenario
- Some work on INSPIRE compliant ontologies
- SmOD, but it’s just a vocabulary

Data Modelling

Informal Data model

Why?

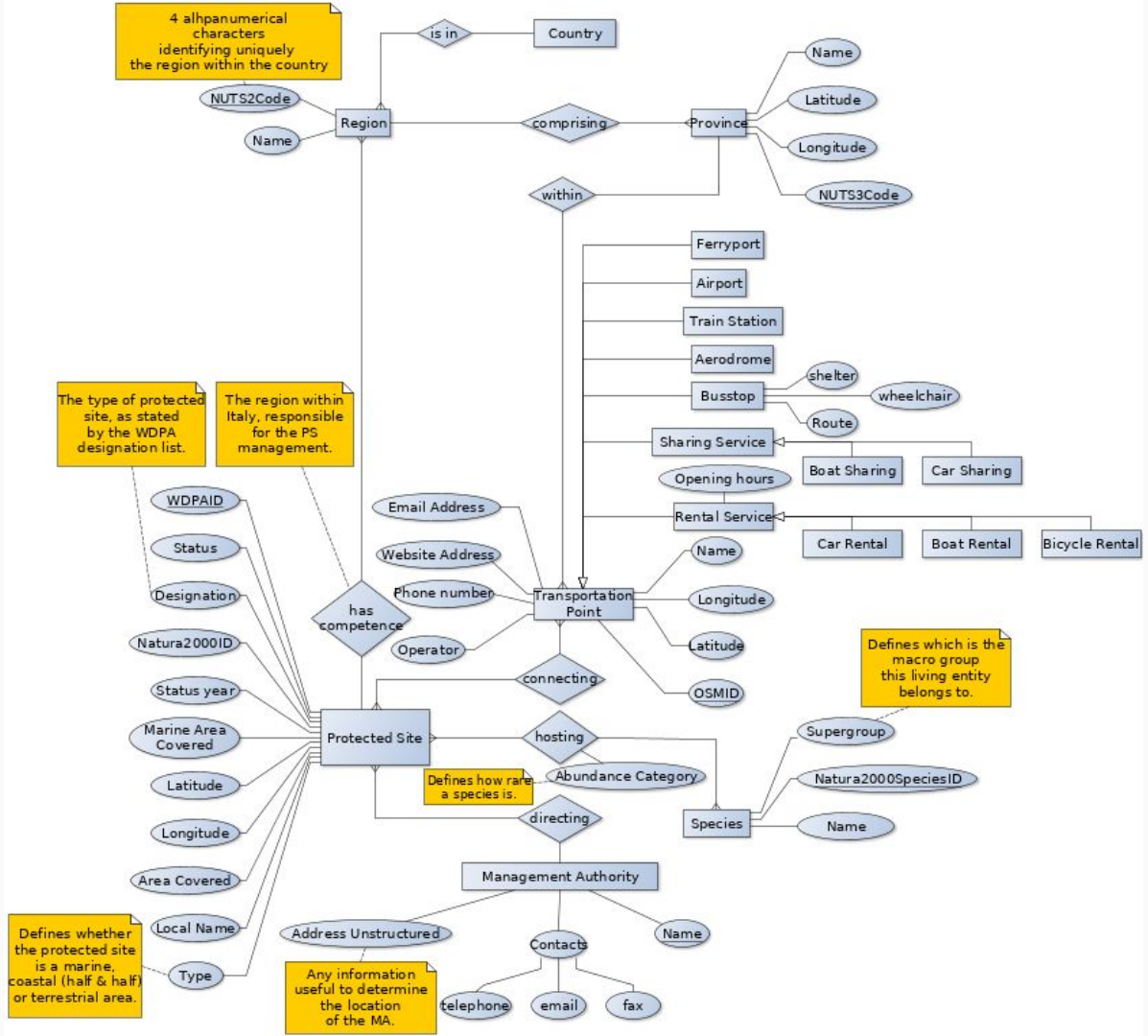
- Not required strictly for our task
- … but required in order to understand the context and have a glimpse on what data is available to build **ground knowledge** for our queries.

What?

- Understand how concepts could be aggregated
- Enlighten entities involved according to our queries
- Produce a (more) formal representation of our ground knowledge

How?

- By means of an ER model
  - focusing concepts and data available
  - not hierarchy

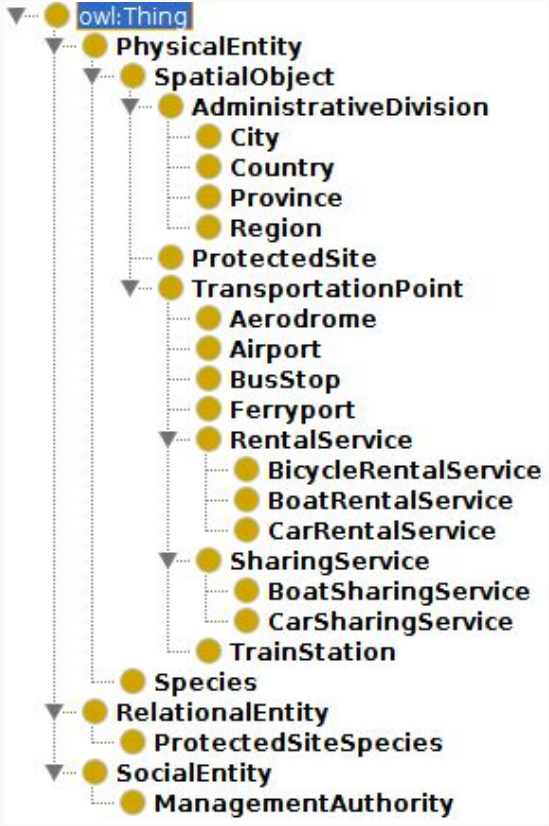


- Detailed in Appendix A

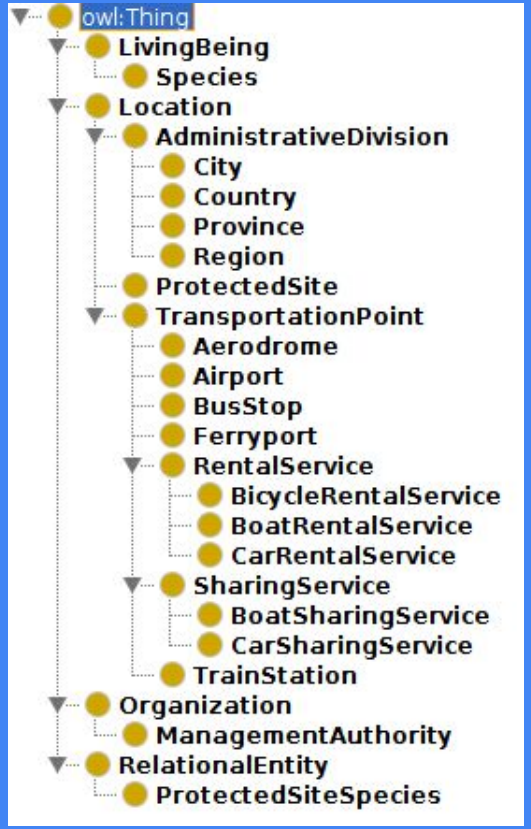
Formal Modelling
&
Grounding

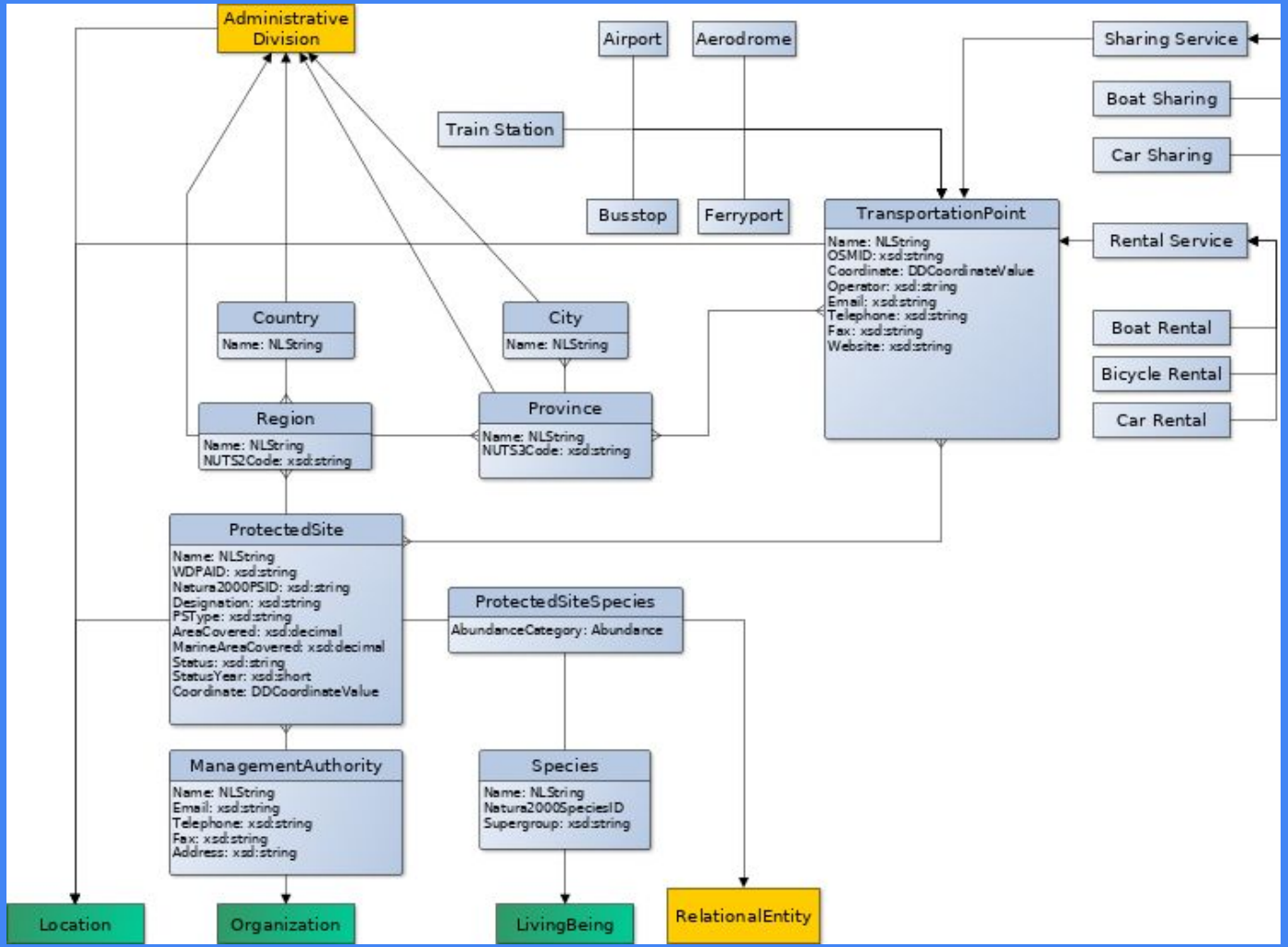
- Main DS Entities
  - ProtectedSite
  - TransportationPoint
  - Species

First approach to Formal Modelling



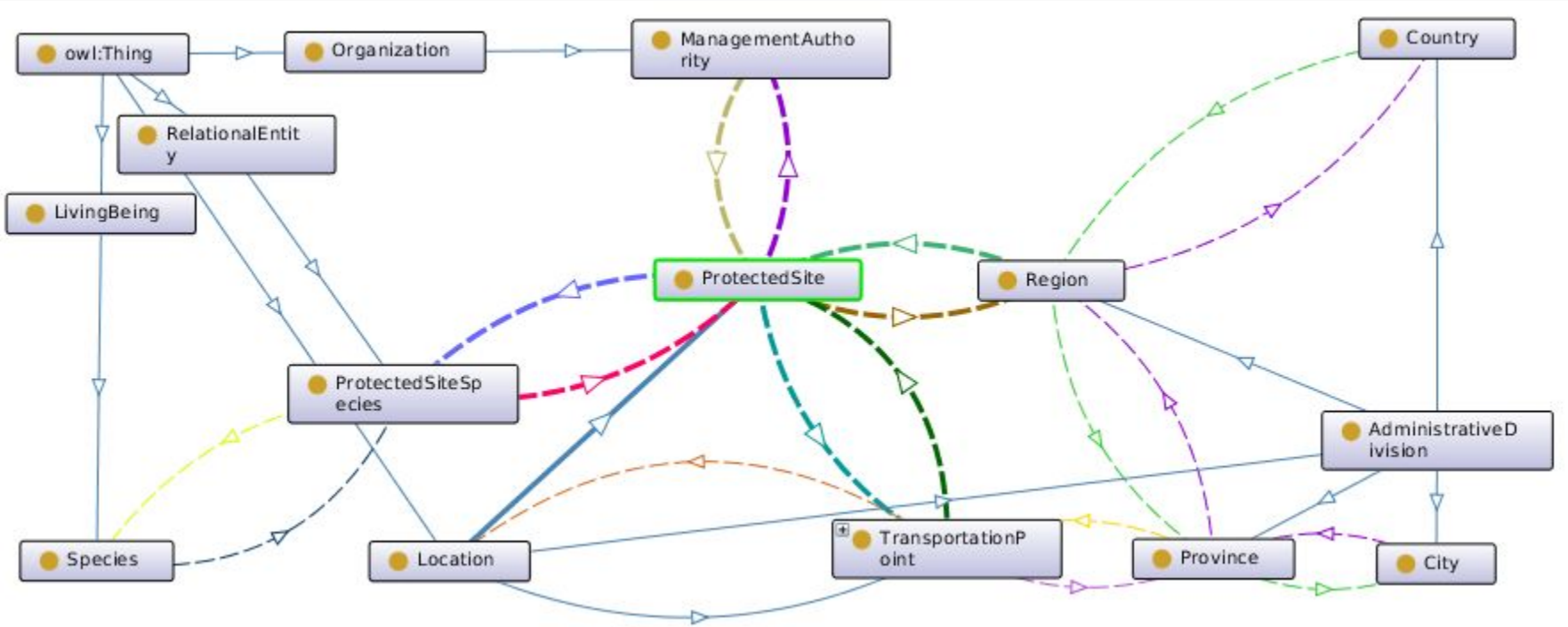
Result after applying the methodology





- Deletion of:
  - PhysicalObject
- Equivalence:
  - SocialEntity ≡ Organisation
  - SpatialObject ≡ Location
- Subsunction:
  - Species **in** LivingBeing

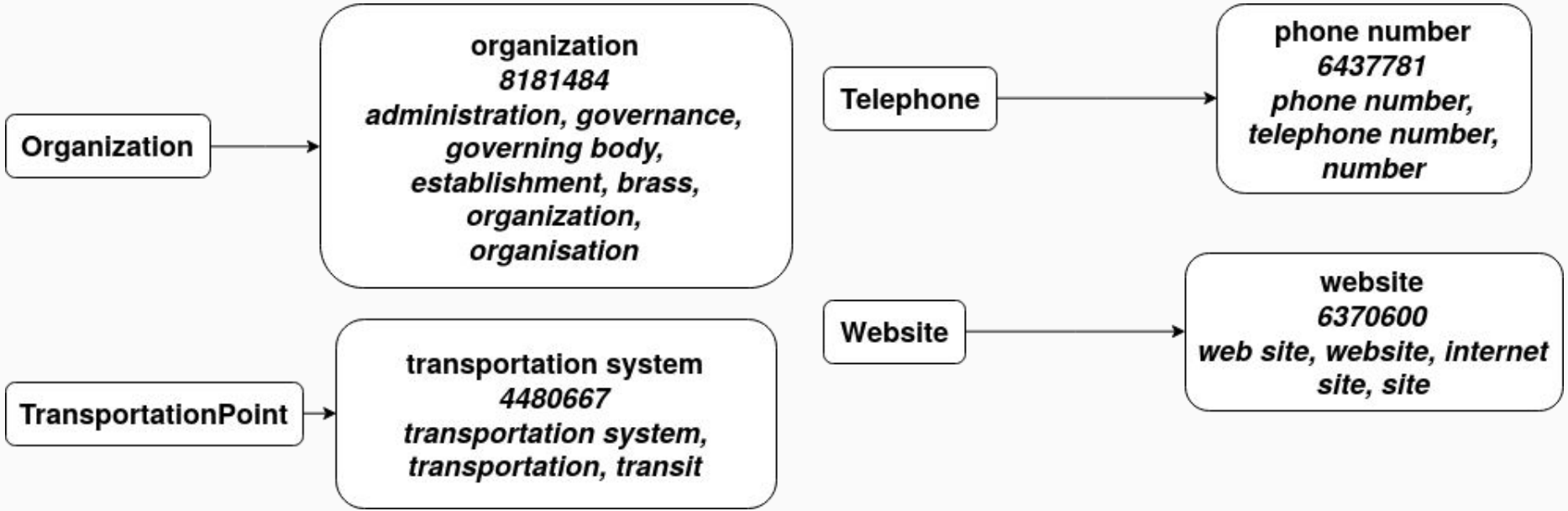
Ontograf's Ontology Representation



Lexical Mapping

All concepts mapped:

- either directly to a synset
- or to a parent concept (new synset built)



Demo

Find all public transports that are reaching protected sites in a given region:

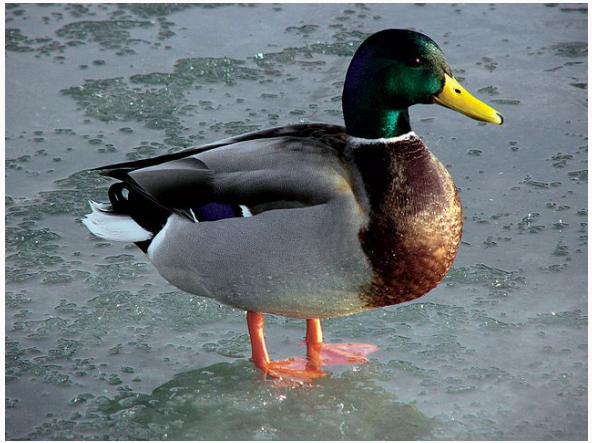
```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX psso: <http://www.semanticweb.org/lubuntu/ontologies/2018/10/psso/#>
SELECT distinct ?tpoint_name ?name ?psite_name
WHERE {?psite rdf:type psso:ProtectedSite;
        psso:IsReachableBy ?tpoint;
        psso:LocalName ?psite_name.
        ?tpoint psso:Covers ?province;
        rdf:type ?tpoint_type;
        psso:Name ?tpoint_name.
        ?province psso:IsComprised ?region.
        ?region psso:Name ?name.
        FILTER (?tpoint_type IN (psso:BusStop, psso:TrainStation) &&
        ?name IN ("Trentino-Alto Adige")
        )
}
```

Find all species and their rareness within protected sites present in Trentino:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX psso: <http://www.semanticweb.org/lubuntu/ontologies/2018/10/psso/#>
SELECT distinct ?psite_name ?species_name ?region_name ?rareness
WHERE {?psite rdf:type psso:ProtectedSite ;
        psso:CompetenceUnder ?region;
        psso:LocalName ?psite_name.
        ?psite psso:Hosts ?relation .
        ?region rdfs:label ?name;
        psso:Name ?region_name .
        ?relation psso:HasSpecies ?species ;
        psso:AbundanceCategory ?rareness .
        ?species psso:Name ?species_name.
        FILTER (?name IN ("Trentino-Alto Adige"@en)
        )
}
```

Find where the Anas platyrhynchos (germano reale) can be found and how it can be reached:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX psso: <http://www.semanticweb.org/lubuntu/ontologies/2018/10/psso/#>
SELECT ?psite_name ?tpoint_name ?province_name ?region_name
WHERE {?species rdf:type psso:Species;
                psso:Name ?species_name;
                psso:IsHosted ?relation.
       ?relation psso:HasProtectedSite ?psite.
       ?psite psso:LocalName ?psite_name;
       psso:IsReachableBy ?tpoint;
       psso:CompetenceUnder ?region.
       ?region psso:Name ?region_name.
       ?tpoint psso:Name ?tpoint_name;
       psso:Covers ?province.
       ?province psso:Name ?province_name.
       FILTER (?species_name IN ("Anas platyrhynchos"))
}
```



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Future Work

Further Improvements

The design is easily open to further work

1. Extend the transportation side, to be more compliant with other standards
2. Add archeological sites of interest or other peculiar kind of areas
3. Try to integrate different datasets (with same subject) to further evaluate our output
4. Extend other spatial modelling ontologies with this one

Thank you for the attention!

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- Diego Lobba