Developing the Animals in Context Ontology

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In attempting to arrive at the truth, I ... applied everywhere for information, but in scarcely an instance have I been able to obtain hospital records fit for any purposes of comparison.

Florence Nightingale
Opportunities for animal data analysis increased w/ use of integrated ontologies

Can biomedical researchers interpret agricultural research data?

Can phenotype and genotype be connected accurately?

Can I send animal information to another system?

How many heifers do I see in my clinic? Dairy cattle?

Is this drug approved for this pasture steer?
Problem: Animal nomenclature beyond the Linnaean and Cladistics classification is used.

Cow for milk production

Livestock management software
Methods: Create animal ontology by following OBO Foundry Principles

Reviewed: OBO Foundry principles

Edited: Initial SNOMED subset editing, created text definitions

Discussed: Substitution and integration of external ontology classes

Built: Ontology with Protégé, imported classes with OntoFox

Evaluated: Unofficial evaluation by OBO members
Results: Animals in Context Ontology conforms with most of OBO principles.
**Text Definitions**

- "Bear which lives in a zoo"
- "26451000009103"

**Formal Definitions**

- ‘bearer of some taxon quality’
- ‘bearer of some physical volume’
- ‘bearer of some physical mass’
- ‘material object’
- ‘material entity’
- ‘particular’
- ‘entity’
- ‘bearer of some KingdomAnimalisQuality’
- ‘Vertebrata’
- ‘Metazoa’
- ‘flat object part’
- ‘object’
- ‘object aggregate’
- ‘continuant’
- ‘or current’
- ‘material entity’
- ‘or object_boundary’
- ‘or site’
- ‘dependent continuant’
- ‘or independent continuant’
- ‘or spatial region’

**Orthogonal**

- BFO
- BioTopLite

**Single Inheritance**
## Results: Animals in Context Ontology

<table>
<thead>
<tr>
<th>Ontology</th>
<th>Use</th>
<th>Number</th>
<th>Example Class</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Animals in Context (ACO)</strong></td>
<td>Animal classes, animal roles, taxon qualities</td>
<td>216 (unique) 500 (total)</td>
<td>Chicken for meat production</td>
</tr>
<tr>
<td><strong>Basic Formal Ontology (BFO) 1.1</strong></td>
<td>Upper level hierarchy</td>
<td>39</td>
<td>Continuant</td>
</tr>
<tr>
<td><strong>BioTopLite (BTL)</strong></td>
<td>Top domain hierarchy and relations</td>
<td>49</td>
<td>Organism, Bearer of</td>
</tr>
<tr>
<td><strong>NCBI Taxonomy</strong></td>
<td>Taxonomy (Linnaean)</td>
<td>40</td>
<td>Gallus gallus</td>
</tr>
<tr>
<td><strong>Environment Ontology (EnvO)</strong></td>
<td>Environment sites</td>
<td>15</td>
<td>Farm</td>
</tr>
<tr>
<td><strong>Gene Ontology (GO)</strong></td>
<td>Biological processes</td>
<td>8</td>
<td>Lactation</td>
</tr>
<tr>
<td><strong>Phenotypic Quality Ontology (PATO)</strong></td>
<td>Phenotypic qualities and functions</td>
<td>18</td>
<td>Female</td>
</tr>
</tbody>
</table>
## Integrating animal class w/ scientific ontologies

| ACO Animal Class: Female cattle prior to birth of first calf  
|  
|  
|  
| Heifer  
|  
| Text def.: Female cattle from birth through the birth of her first calf  
<p>|<br />
|<br />
|</p>
<table>
<thead>
<tr>
<th></th>
<th>Relation</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bearer of</td>
<td>Female PATO:0000383</td>
</tr>
<tr>
<td></td>
<td>Bearer of</td>
<td>Immature PATO:0001501</td>
</tr>
<tr>
<td></td>
<td>Bearer of</td>
<td>Nulliparous PATO:0002368*</td>
</tr>
<tr>
<td></td>
<td>Is a</td>
<td>Bovinae NCBITaxon:27592</td>
</tr>
<tr>
<td></td>
<td>Bearer of</td>
<td>Subfamily Bovinae quality</td>
</tr>
</tbody>
</table>
Discussion: successes and challenges

**Successes**
- Compliance and collaboration
- Improvements

**Challenges:**
- Text definitions
- Measuring compliance
- Current content of OBO ontologies
- Funding of ontologies
Discussion: **future directions identified**

- **Addition and refinement of classes**
  - Animal production classes (e.g. broiler chicken)
  - Grouping classes (e.g., shellfish, nonhuman primate, antelope)

- **Formal evaluation by OBO Foundry**

- **Deliver to communities**
ACO:

• Created following solid OBO Foundry guidelines and using tools
• Challenges should facilitate future animal ontologies
• Interoperable with OBO ontologies, allowing for data analysis and knowledge discovery
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