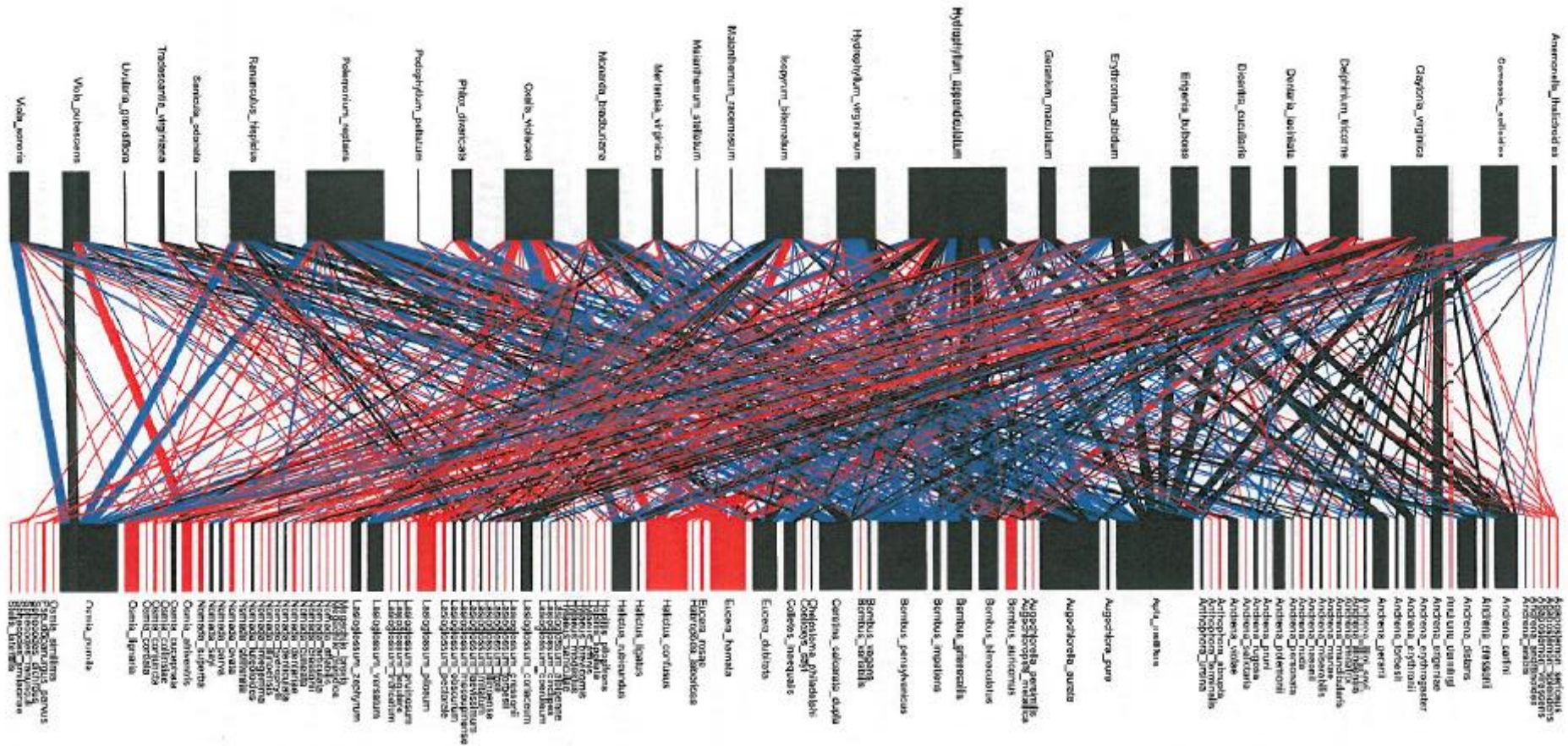


Implementing a semantic mediator to integrate flower-visiting records from SA natural history museums

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Potential to automate construction of interaction networks (flower-visiting networks and pollination networks)



From: Burkle, L.A, Marlin, J.C. and Knight, T.M. 2013. Plant-pollinator interactions over 120 years: loss of species, co-occurrence and function. *Science* 339 (6127): 1611-1615

Objectives

- 1) Standardize concepts in the domain of flower-visiting
 - Semantic enrichment
 - Semantic mediation
- 2) Automate the construction of interaction networks
- 3) Query, inferencing, analysis

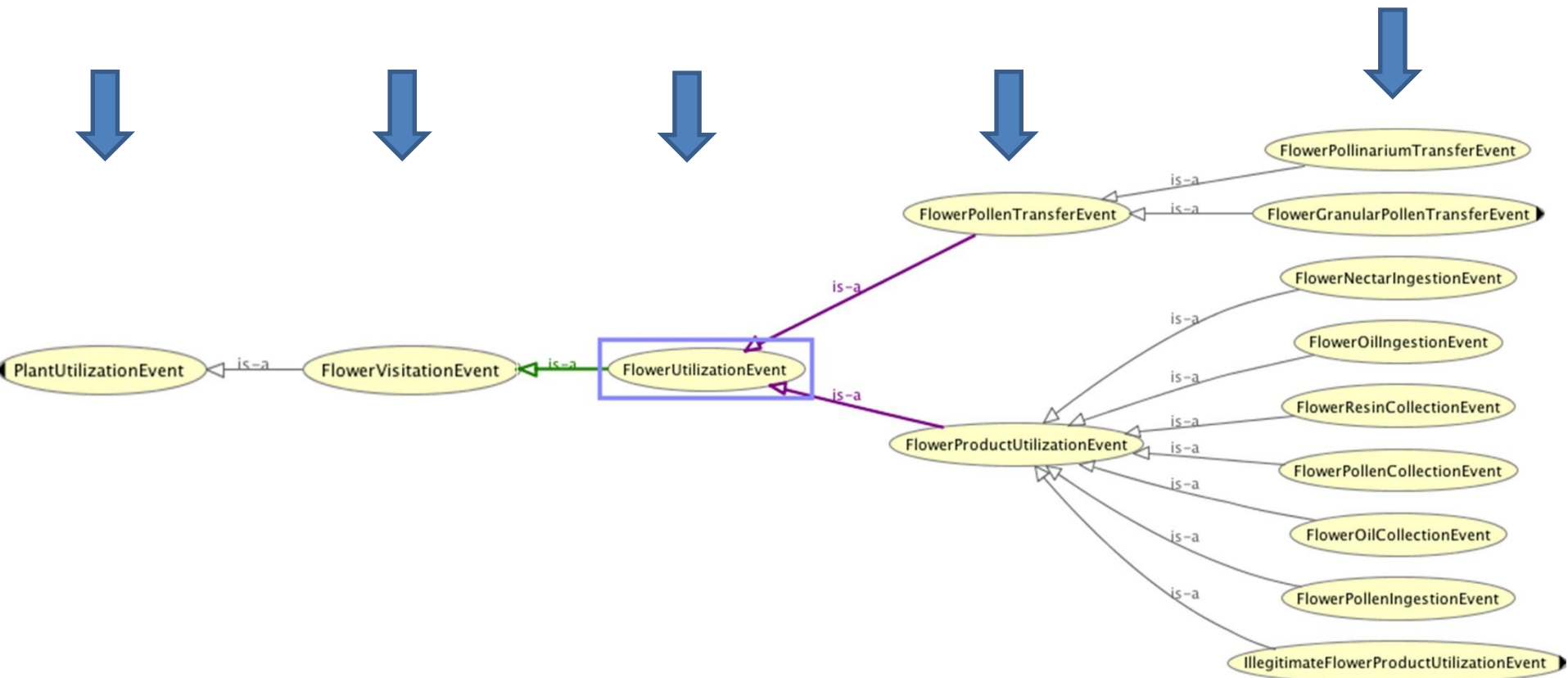
Relevant data attributes from the three data-stores

	SAM sample data (n=2 094) 3% FV	SANC sample data (n=219) 4% FV	AM sample data (n=21 159) 97% FV
Host Type	host-plant	host-plant	host-plant
Host Taxon	<i>Diascia capensis</i>	<i>Ruschia indecora</i>	<i>Indigofera nigromontana</i>
Sampling Method	flowers	swept from flowers	hand net
Insect Behaviour	foraging on nectar	[no data]	visiting flowers
Flower Colour	[no data]	[no data]	deep pink

Unstructured descriptions of insect behaviour

# records	Behaviour
1	Collecting pollen on yellow flowers
1	Patrolling Corymbium. With pollenaria
1	Feeding on Brunia laevis pollen
1	Foraging on nectar of Euphorbia flowers
1	Taking resin from Dalechampia capensis
# records	Behaviour
137	Visiting extrafloral nectaries
95	On foliage
8	On stem of plant
20135	Visiting flowers
380	In flowers
22	On flowers
16	Sheltering in flower
8	In copula on flowers

Hierarchy of classes subsumed by fv:PlantUtilizationEvent

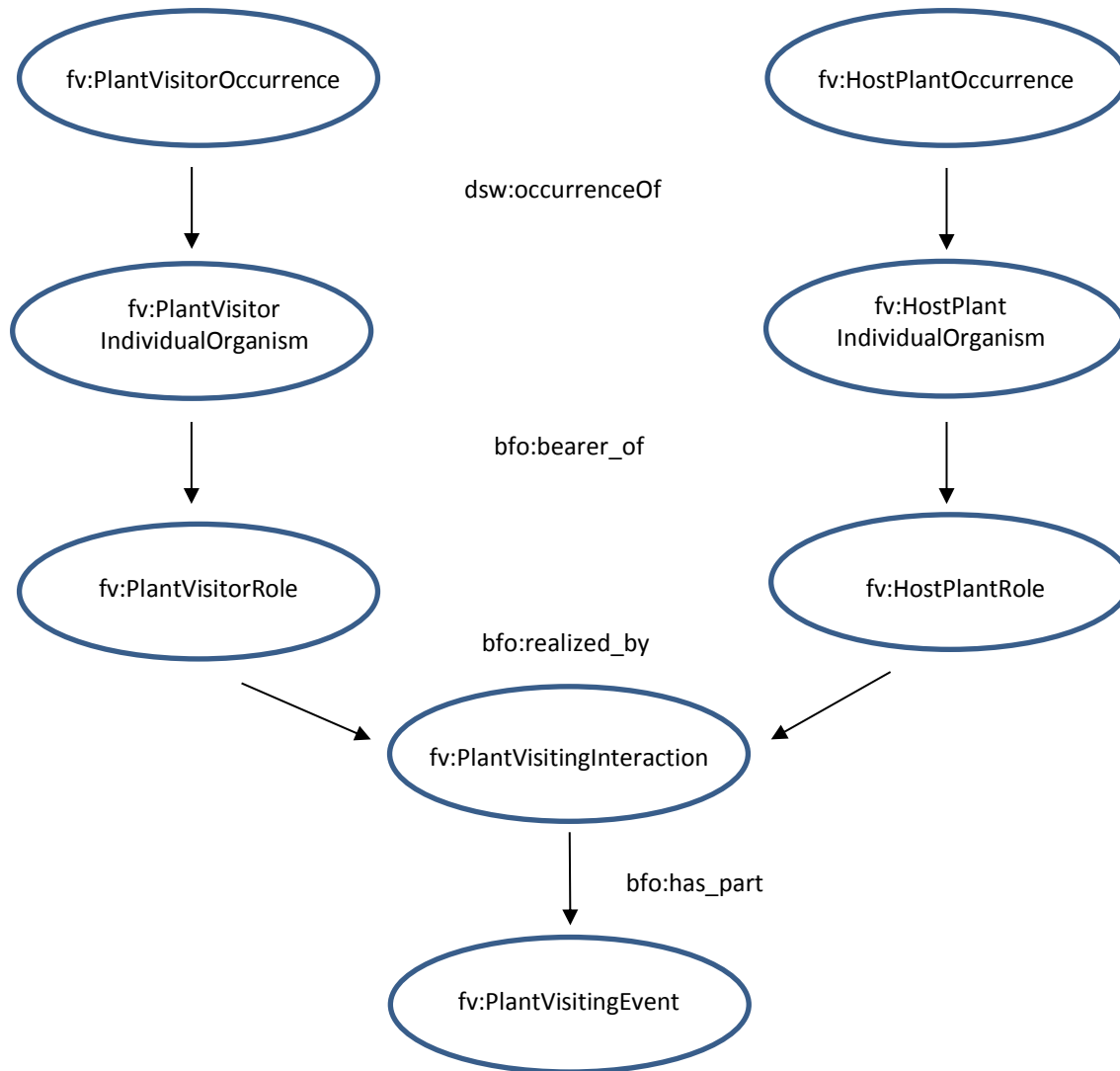


Linking the data to classes in the ontology

# records	'behavior string' \approx dwc:behavior	Class (fv:)
1	Collecting pollen on yellow flowers	FlowerPollenCollectionEvent
1	Patrolling Corymbium. With pollinaria	FlowerPollinariumCollectionEvent
1	Feeding on Brunia laevis pollen	FlowerPollenIngestionEvent
1	Foraging on nectar of Euphorbia flowers	FlowerNectarIngestionEvent
1	Taking resin from Dalechampia capensis	FlowerResinCollectionEvent

# records		
137	Visiting extrafloral nectaries	PlantUtilizationEvent
95	On foliage	PlantUtilizationEvent
8	On stem of plant	PlantUtilizationEvent
20135	Visiting flowers	FlowerProductUtilizationEvent
380	In flowers	FlowerUtilizationEvent
22	On flowers	FlowerUtilizationEvent
16	Sheltering in flower	FlowerUtilizationEvent
8	In copula on flowers	FlowerUtilizationEvent

Linking fv:PlantUtilizationEvent and subclasses to dsw:Occurrence



Class hierarchy: HostPlantOccurrence

- Thing
 - Agent
 - Document
 - Event
 - FlowerVisitingGroup
 - Identification
- IndividualOrganism
 - HostPlantIndividualOrganism
 - PlantVisitorIndividualOrganism
- InterspeciesInteractionBetweenTwoOrganism
- Location
- Occurrence
 - HostPlantOccurrence**
 - PlantVisitorOccurrence
- PlantVisitationEvent
 - PlantUtilizationEvent
 - FlowerVisitationEvent
 - FlowerUtilizationEvent
 - FlowerPollenTransferEvent
 - FlowerProductUtilizationEvent
 - FlowerNectarIngestionEvent
 - FlowerOilCollectionEvent
 - FlowerOilIngestionEvent
 - FlowerPollenCollectionEvent
 - FlowerPollenIngestionEvent
 - FlowerResinCollectionEvent
 - IllegitimateFlowerProductUtilizationEvent
- Role

Members list: Albany_hostplant_occurrence

- Albany_hostplant_occurrence136
- Albany_hostplant_occurrence137
- Albany_hostplant_occurrence138
- Albany_hostplant_occurrence139
- Albany_hostplant_occurrence14
- Albany_hostplant_occurrence140**
- Albany_hostplant_occurrence141
- Albany_hostplant_occurrence142
- Albany_hostplant_occurrence143
- Albany_hostplant_occurrence144
- Albany_hostplant_occurrence145
- Albany_hostplant_occurrence146
- Albany_hostplant_occurrence147
- Albany_hostplant_occurrence148
- Albany_hostplant_occurrence149
- Albany_hostplant_occurrence15
- Albany_hostplant_occurrence150
- Albany_hostplant_occurrence151
- Albany_hostplant_occurrence152
- Albany_hostplant_occurrence153
- Albany_hostplant_occurrence154
- Albany_hostplant_occurrence155
- Albany_hostplant_occurrence156
- Albany_hostplant_occurrence157
- Albany_hostplant_occurrence158

Annotations

Usage

Annotations: Albany_hostplant_occurrence140

Annotations +

Property assertions: Albany_hostplant_occurrence140

Object property assertions +

occurrenceOf Albany_hostplant_organism140 ? @

Data property assertions +

Negative object property assertions +

Description: Albany_hostplant_occurrence140

Types +

HostPlantOccurrence ? @ x o

Same Individual As +

Different Individuals +

fv (http://cair.cs.ukzn.ac.za/fv)

Search for entity

Active Ontology

Entities

Classes

Object Properties

Data Properties

Annotation Properties

Class matrix

Property matrix

Individuals

Individuals matrix

OWL Viz

Class hierarchy

Class hierarchy (inferred)

Class hierarchy: FlowerPollenCollectionEvent

IndividualOrganism

- HostPlantIndividualOrganism
- PlantVisitorIndividualOrganism

InterspeciesInteractionBetweenTwoOrganism

- PlantVisitationInteraction

Location

Occurrence

- HostPlantOccurrence
- PlantVisitorOccurrence

PlantVisitationEvent

- PlantUtilizationEvent
 - FlowerVisitationEvent
 - FlowerUtilizationEvent
 - FlowerPollenTransferEvent
 - FlowerProductUtilizationEvent
 - FlowerNectarIngestionEvent
 - FlowerOilCollectionEvent
 - FlowerOilIngestionEvent
 - FlowerPollenCollectionEvent
 - FlowerPollenIngestionEvent
 - FlowerResinCollectionEvent
 - IllegitimateFlowerProductUtiliz

Role

- HostPlantRole
- PlantVisitorRole

Specimen

- Taxon
- Token

Members list

Members list (inferred)

Members list: Albany_pvevent140

Albany_pvevent140

ARC_pvevent142

ARC_pvevent143

ARC_pvevent32

Annotations

Usage

Annotations: Albany_pvevent140

Annotations

Property assertions: Albany_pvevent140

Object property assertions

part_of Albany_interaction140

Data property assertions

behavior "Collecting pollen"^^string

Negative object property assertions

Description: Albany_pvevent140

Types

FlowerPollenCollectionEvent

Same Individual As

Different Individuals

Reasoner active ☒ Show Inferences

fv (http://cair.cs.ukzn.ac.za/fv)

Search for entity

Active Ontology

Entities

Classes

Object Properties

Data Properties

Annotation Properties

Class matrix

Property matrix

Individuals

Individuals matrix

OWLViz

Class hierarchy

Class hierarchy (inferred)

Class hierarchy: FlowerProductUtilizationEvent

- PlantVisitorOccurrence
 - PlantVisitationEvent
 - PlantUtilizationEvent
 - FlowerVisitationEvent
 - FlowerUtilizationEvent
 - FlowerPollenTransferEvent
 - FlowerProductUtilizationEvent**
 - FlowerNectarIngestionEvent
 - FlowerOilCollectionEvent
 - FlowerOilIngestionEvent
 - FlowerPollenCollectionEvent
 - FlowerPollenIngestionEvent
 - FlowerResinCollectionEvent
 - IllegitimateFlowerProductUtilizationEvent

Object property hierarchy

Data property hierarchy

Object property hierarchy:

- topObjectProperty

Class Annotations

Class Usage

Annotations: FlowerProductUtilizationEvent

Annotations	
-------------	--

Description: FlowerProductUtilizationEvent

Albany_pvevent127	? @ x
Albany_pvevent128	? @ x
Albany_pvevent129	? @ x
Albany_pvevent130	? @ x
Albany_pvevent131	? @ x
Albany_pvevent132	? @ x
Albany_pvevent133	? @ x
Albany_pvevent140	? @ x
Albany_pvevent141	? @ x
Albany_pvevent142	? @ x
Albany_pvevent143	? @ x
Albany_pvevent144	? @ x
Albany_pvevent145	? @ x
Albany_pvevent146	? @ x
Albany_pvevent147	? @ x
Albany_pvevent148	? @ x
Albany_pvevent149	? @ x
Albany_pvevent155	? @ x
Albany_pvevent157	? @ x
Albany_pvevent158	? @ x

Reasoner active

☒ Show Inferences

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Search for entity

Active OntologyEntitiesClassesObject PropertiesData PropertiesClass matrixAnnotation PropertiesIndividualsProperty matrixIndividuals matrixOWLviz

Class hierarchyClass hierarchy (inferred)

Class AnnotationsClass Usage

Class hierarchy

▼

Plan

▼

▼

Object property

Object property

▼ topObject

Explanation for Albany_pvent140 Type FlowerProductUtilizationEvent

☒ Show regular justifications

☒ All justifications

☐ Show laconic justifications

☐ Limit justifications to

2

Explanation 1

☐ Display laconic explanation

Explanation for: Albany_pvent140 Type FlowerProductUtilizationEvent

Albany_pvent140 Type FlowerPollenCollectionEvent

FlowerPollenCollectionEvent SubClassOf FlowerProductUtilizationEvent

OK

Reasoner active☒ Show Inferences

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Search for entity

Active Ontology

Entities

Classes

Object Properties

Data Properties

Annotation Properties

Class matrix

Property matrix

Individuals

Individuals matrix

OWL Viz

Class hierarchy

Class hierarchy (inferred)

Class hierarchy: PlantVisitationInteraction

- Thing
 - Agent
 - Document
 - Event
 - FlowerVisitingGroup
 - Identification
 - IndividualOrganism
 - HostPlantIndividualOrganism
 - PlantVisitorIndividualOrganism
 - InterspeciesInteractionBetweenTwoOrganism
 - PlantVisitationInteraction**
 - Location
 - Occurrence
 - HostPlantOccurrence
 - PlantVisitorOccurrence
 - PlantVisitationEvent
 - PlantUtilizationEvent
 - FlowerVisitationEvent
 - FlowerUtilizationEvent
 - FlowerPollenTransferEvent
 - FlowerProductUtilizationEvent
 - FlowerNectarIngestionEvent
 - FlowerOilCollectionEvent
 - FlowerOilIngestionEvent
 - FlowerPollenCollectionEvent
 - FlowerPollenIngestionEvent
 - FlowerResinCollectionEvent
 - IllegitimateFlowerProductUtiliz

Members list

Members list (inferred)

Members list: Albany_interaction140

- Albany_interaction136
- Albany_interaction137
- Albany_interaction138
- Albany_interaction139
- Albany_interaction14
- Albany_interaction140**
- Albany_interaction141
- Albany_interaction142
- Albany_interaction143
- Albany_interaction144
- Albany_interaction145
- Albany_interaction146
- Albany_interaction147
- Albany_interaction148
- Albany_interaction149
- Albany_interaction15
- Albany_interaction150
- Albany_interaction151
- Albany_interaction152
- Albany_interaction153
- Albany_interaction154
- Albany_interaction155
- Albany_interaction156
- Albany_interaction157
- Albany_interaction158

Annotations

Usage

Annotations: Albany_interaction140

Annotations

Property assertions: Albany_interaction140

Object property assertions

- has_part Albany_pvevent140
- realizes Albany_pvrole140
- realizes Albany_hprole140
- has_part Albany_pvevent140

Description: Albany_interaction140

Types

- PlantVisitationInteraction**

Same Individual As

Different Individuals

Reasoner active

☒ Show Inferences

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Search for entity

Active OntologyEntitiesClassesObject PropertiesData PropertiesAnnotation PropertiesClass matrixProperty matrixIndividualsIndividuals matrixOWL Viz

Class hierarchyClass hierarchy (inferred)

Class hierarchy: PlantVisitorRole

- IndividualOrganism
 - HostPlantIndividualOrganism
 - PlantVisitorIndividualOrganism
- InterspeciesInteractionBetweenTwoOrganism
 - PlantVisitationInteraction
- Location
- Occurrence
 - HostPlantOccurrence
 - PlantVisitorOccurrence
- PlantVisitationEvent
 - PlantUtilizationEvent
 - FlowerVisitationEvent
 - FlowerUtilizationEvent
 - FlowerPollenTransferEvent
 - FlowerProductUtilizationEvent
 - FlowerNectarIngestionEvent
 - FlowerOilCollectionEvent
 - FlowerOilIngestionEvent
 - FlowerPollenCollectionEvent
 - FlowerPollenIngestionEvent
 - FlowerResinCollectionEvent
 - IllegitimateFlowerProductUtiliz
- Role
 - HostPlantRole
 - PlantVisitorRole
- Specimen
 - Taxon
 - Token

Members listMembers list (inferred)

Members list: Albany_pvrole140

- Albany_pvrole134
- Albany_pvrole135
- Albany_pvrole136
- Albany_pvrole137
- Albany_pvrole138
- Albany_pvrole139
- Albany_pvrole14
- Albany_pvrole140
- Albany_pvrole141
- Albany_pvrole142
- Albany_pvrole143
- Albany_pvrole144
- Albany_pvrole145
- Albany_pvrole146
- Albany_pvrole147
- Albany_pvrole148
- Albany_pvrole149
- Albany_pvrole15
- Albany_pvrole150
- Albany_pvrole151
- Albany_pvrole152
- Albany_pvrole153
- Albany_pvrole154
- Albany_pvrole155
- Albany_pvrole156

AnnotationsUsage

Annotations: Albany_pvrole140

Annotations +

Property assertions: Albany_pvrole140

Object property assertions +

- inheres_in Albany_plantvisitor_organism140
- realized_in Albany_interaction140
- realized_in Albany_interaction140
- inheres_in Albany_plantvisitor_organism140

Data property assertions +

Description: Albany_pvrole140

Types +

- PlantVisitorRole

Same Individual As +

Different Individuals +

Reasoner activeShow Inferences

fv (http://cair.cs.ukzn.ac.za/fv)

Search for entity

Active OntologyEntitiesClassesObject PropertiesData PropertiesClass matrixAnnotation PropertiesProperty matrixIndividualsIndividuals matrixOWL Viz

Class hierarchyClass hierarchy (inferred)

Class hierarchy: FlowerProductUtilizationEvent

- Event
 - FlowerVisitingGroup
 - Identification
 - IndividualOrganism
 - HostPlantIndividualOrganism
 - PlantVisitorIndividualOrganism
 - InterspeciesInteractionBetweenTwoOrganisms
 - PlantVisitationInteraction
 - Location
 - Occurrence
 - HostPlantOccurrence
 - PlantVisitorOccurrence
 - PlantVisitationEvent
 - PlantUtilizationEvent
 - FlowerVisitationEvent
 - FlowerUtilizationEvent
 - FlowerPollenTransferEvent
 - FlowerProductUtilizationEvent
 - FlowerNectarIngestionEvent
 - FlowerOilCollectionEvent
 - FlowerOilIngestionEvent
 - FlowerPollenCollectionEvent
 - FlowerPollenIngestionEvent
 - FlowerResinCollectionEvent
 - IllegitimateFlowerProductUtilizationEvent
 - Role
 - HostPlantRole
 - PlantVisitorRole
 - Specimen

DL query:

Query (class expression)

FlowerProductUtilizationEvent

ExecuteAdd to ontology

Query results

Albany_pvevent281	?	<input type="checkbox"/>
Albany_pvevent284	?	<input type="checkbox"/>
Albany_pvevent283	?	<input type="checkbox"/>
Iziko_pvevent64	?	<input type="checkbox"/>
Albany_pvevent141	?	<input type="checkbox"/>
Albany_pvevent140	?	<input type="checkbox"/>
Albany_pvevent143	?	<input type="checkbox"/>
Albany_pvevent289	?	<input type="checkbox"/>
Albany_pvevent142	?	<input type="checkbox"/>
Albany_pvevent145	?	<input type="checkbox"/>
ARC_pvevent56	?	<input type="checkbox"/>
ARC_pvevent143	?	<input type="checkbox"/>
Albany_pvevent144	?	<input type="checkbox"/>
Albany_pvevent47	?	<input type="checkbox"/>
Albany_pvevent41	?	<input type="checkbox"/>
Albany_pvevent42	?	<input type="checkbox"/>

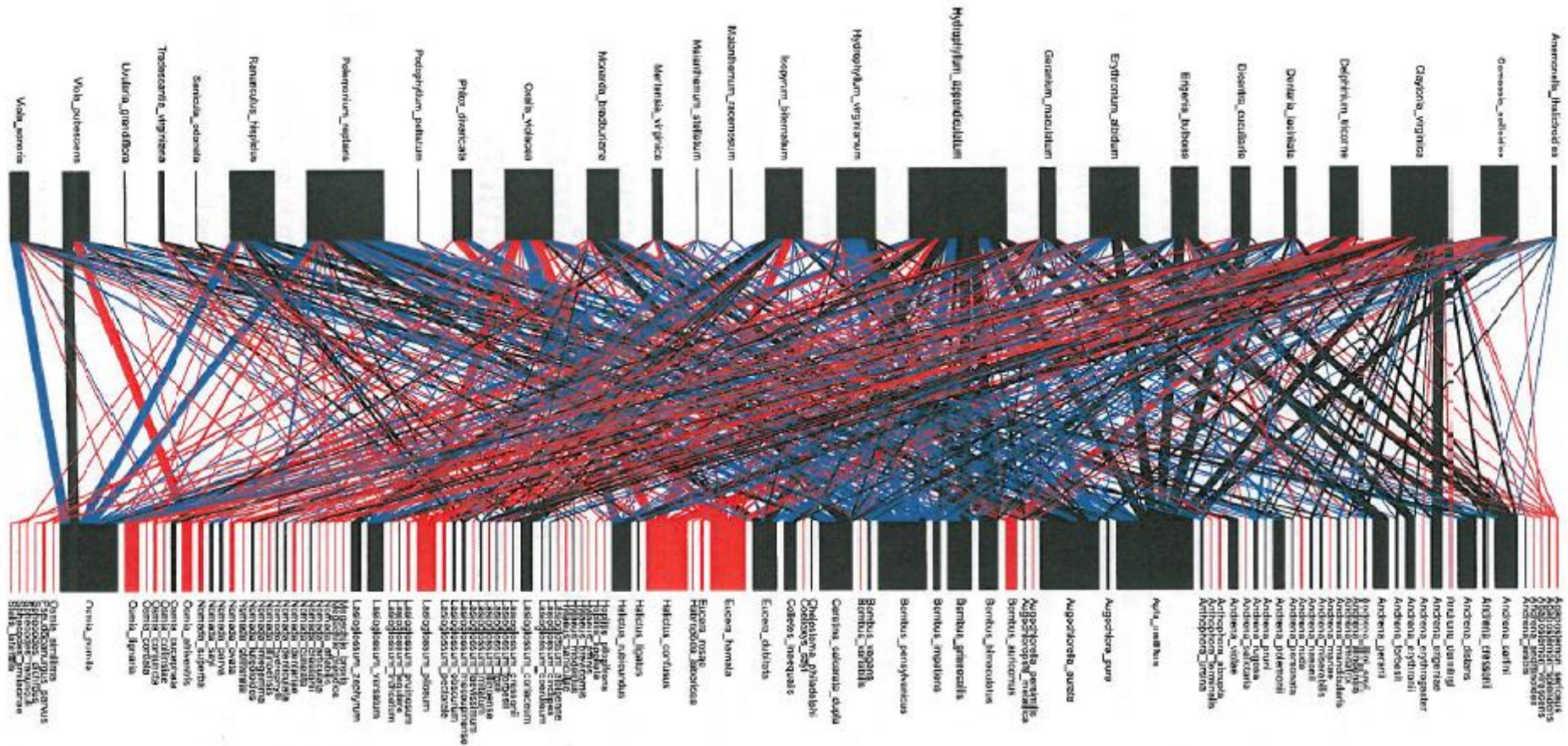
☐ Direct super classes☐ Super classes☐ Equivalent classes☐ Direct sub classes☐ Sub classes☒ Instances

Description: FlowerProductUtilizationEvent

Equivalent To +

Reasoner activeShow Inferences

Potential to automate construction of interaction networks (flower-visiting networks and pollination networks)



From: Burkle, L.A, Marlin, J.C. and Knight, T.M. 2013. Plant-pollinator interactions over 120 years: loss of species, co-occurrence and function. *Science* 339 (6127): 1611-1615

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