Part 2

Use Case: Camera Traps (Camtrap DP)

Status: In Review (Camtrap DP is still evolving)

Conceptual Model

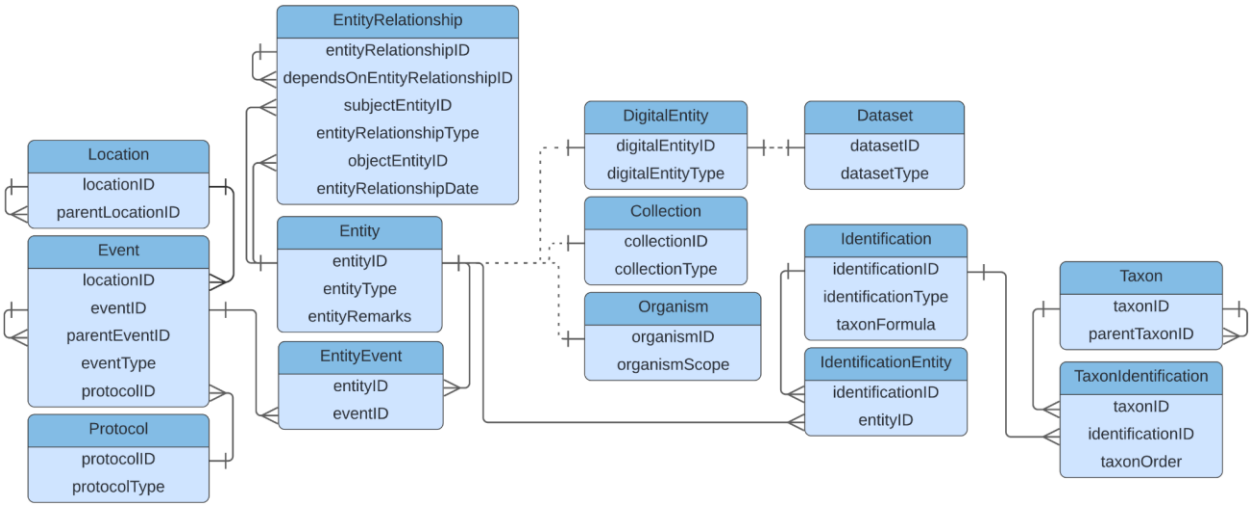

Figure 2: A conceptual model covering the activities associated with a camera trap deployment, in which sequences result from detection triggers. Organism Identification and Occurrence information are interpreted from images by artificial intelligence routines and vetted by human group consensus.

A deployment **Event** spans the period of time a camera is functioning properly in the field at a particular **Location** and may follow a specified **Protocol**. A sequence **Event** is triggered at the same **Location** as the deployment covering the field of view of the camera and spans a specific time period defining the bounds of the **Event**. Each sequence **Event** consists of one or more **StillImages** (each a **DigitalEntity**). An **Organism** (*sensu* Darwin Core; also an **Entity**) may be identified (taxonomically and potentially as a recurring individual) within an image **sequence** or within one or more **StillImages.** These **Organism** observations infer a **Taxon** occurrence (an observation **Event**) at the same time and place as the parent sequence or image **Event**. The observed **Organisms** can have **Assertions** about the count of individuals, lifeStage, sex,

behaviour, etc. Each **Organism** can be given one or more **Taxon Identifications** by expert groups and/or by artificial intelligence processes.

An arbitrary number of **Assertions** can be made about each class. **Assertions** can be quantitative or qualitative and can have **Assertions** made about them as well. **Agents** can have roles with respect to any class as well, including **Assertions**. These two common aspects of all use cases can be found in Common Models.

Publishing Model

The recommended publishing model is CamtrapDP (see https://tdwg.github.io/camtrap-dp/), which is shown in Figure 1.

Mapping to Unified Model

Below is a simple example that demonstrates the mappings from fundamental data in a Camtrap DP data set to the GBIF Unified Model. It is not expected that data publishers will have to do this mapping, as Camtrap DP would be the publishing model and GBIF would have to ingest Camtrap DP and transform it for internal representation. A much more thorough mapping based on example data from the Camtrap DP GitHub repository can be found in the camtrapdp folder of the GBIF model-tests GitHub repository.

Not shown are myriad fields in Camtrap DP that would be shared through Assertion tables attached to various tables in the GBIF Publishing Model. Also not shown are data from the data package metadata, all of which could also be mapped into the Unified Model to capture, for example, the Event associated with an entire project. The required Assertion tables that would be needed to transfer Camtrap DP datasets without loss are AgentAssertion, DigitalEntityAssertion, EventAssertion, IdentificationAssertion, OrganismAssertion, and TaxonAssertion.
Within the resulting GBIF Publishing Model example, further below, values in italics are required values not found in the original data (eventIDs and identificationIDs), and would have to be generated (either by the data publisher or by the publishing tool) to create a viable dataset.

Camtrap DP Publishing Model Example

In this example there are two camera trap deployments, each at a distinct place and time period, as shown in the following table partially simulating the contents of the file deployment.csv in a Camtrap DP data set.

deployment.csv

deploymentID	start	end	locationID
dep1	2020-05-30T04:57:37+02:00	2020-07-01T11:41:41+02:00	loc1
dep2	2020-07-29T07:29:41+02:00	2020-08-08T06:20:40+02:00	loc2

In deployment dep1 a sequence seq1 was triggered and resulted in four images (med1, med2, med3 and med4) to be taken as shown in the following table partially simulating the contents of the file media.csv in a Camtrap DP data set. In deployment dep2 a sequence seq2 was triggered and resulted in four images (med5, med6, med7 and med8).

media.csv

mediaID	sequenceID	deploymentID	timestamp	filePath
med1	seq1	dep1	2020-06-05T20:00:00+02:00	med1.jpg
med2	seq1	dep1	2020-06-05T20:00:02+02:00	med2.jpg
med3	seq1	dep1	2020-06-05T20:00:04+02:00	med3.jpg
med4	seq1	dep1	2020-06-05T20:00:06+02:00	med4.jpg
med5	seq2	dep2	2020-08-05T03:20:40+02:00	med5.jpg
med6	seq2	dep2	2020-08-05T03:20:42+02:00	med6.jpg
med7	seq2	dep2	2020-08-05T03:20:44+02:00	med7.jpg
med8	seq2	dep2	2020-08-05T03:20:46+02:00	med8.jpg

In deployment dep1 observations were recorded at the level of media as shown in the following table partially simulating the contents of the file observations.csv in a Camtrap DP data set. In sequence seq1 the first image was determined by artificial intelligence to contain no targets of interest. In the second image in sequence seq1 there appears an adult Eurasian wild pig as identified by a person. In the third image in sequence seq1 an adult wild pig appears again, but with three additional juveniles, as identified by a person. In the fourth image in sequence seq1 there are no longer any targets of interest as determined by artificial intelligence.

In deployment dep2 observations were recorded at the level of sequences. In sequence seq2 there were two organisms of interest, an adult rat unidentifiable to species and an adult Tawny owl.

observations.csv

observationID	mediaID	sequenceID	scientificName	count	countNew	lifeStage	classificationMethod
obs1	med1	seq1	NULL	NULL	NULL	NULL	machine
obs2	med2	seq1	Sus scrofa	1	1	adult	human
obs3	med3	seq1	Sus scrofa	1	0	adult	human
obs4	med3	seq1	Sus scrofa	3	3	juvenile	human
obs5	med4	seq1	NULL	NULL	NULL	NULL	machine
obs6	NULL	seq2	NULL	NULL	NULL	NULL	machine
obs7	NULL	seq2	Rattus sp.	1	NULL	adult	human
obs8	NULL	seq2	Strix aluco	1	NULL	adult	human
obs9	NULL	seq2	NULL	NULL	NULL	NULL	machine

GBIF Unified Model Example

Event

eventID	eventType	parentEventID	eventDate	locationID
dep1	deployment	proj1	2020-05-30T04:57:37+02:00/2020-07-01T11:41:41+02:00	loc1

dep2	deployment	proj1	2020-07-29T07:29:41+02:00/2020-08-08T06:20:40+02:00	loc2
seq1	sequence	dep1	2020-06-05T20:00:00+02:00/2020-06-05T20:00:06+02:00	loc1
seq2	sequence	dep2	2020-08-05T03:20:40+02:00/2020-08-05T03:20:46+02:00	loc2
med1	image capture	seq1	2020-06-05T20:00:00+02:00	loc1
med2	image capture	seq1	2020-06-05T20:00:02+02:00	loc1
med3	image capture	seq1	2020-06-05T20:00:04+02:00	loc1
med4	image capture	seq1	2020-06-05T20:00:06+02:00	loc1
med5	image capture	seq2	2020-08-05T03:20:40+02:00	loc2
med6	image capture	seq2	2020-08-05T03:20:42+02:00	loc2
med7	image capture	seq2	2020-08-05T03:20:44+02:00	loc2
med8	image capture	seq2	2020-08-05T03:20:46+02:00	loc2
obs1	observation	med1	2020-06-05T20:00:00+02:00	loc1
obs2	observation	med2	2020-06-05T20:00:02+02:00	loc1
obs3	observation	med3	2020-06-05T20:00:04+02:00	loc1
obs4	observation	med3	2020-06-05T20:00:06+02:00	loc1
obs4	observation	med3	2020-06-05T20:00:06+02:00	loc1
obs5	observation	med4	2020-06-05T20:00:06+02:00	loc1
obs6	observation	seq2	2020-08-05T03:20:40+02:00/2020-08-05T03:20:46+02:00	loc2
obs7	observation	seq2	2020-08-05T03:20:40+02:00/2020-08-05T03:20:46+02:00	loc2
obs8	observation	seq2	2020-08-05T03:20:40+02:00/2020-08-05T03:20:46+02:00	loc2
obs9	observation	seq2	2020-08-05T03:20:40+02:00/2020-08-05T03:20:46+02:00	loc2

Entity

entityID	entityType	entityCreated
med1_digent	DigitalEntity	2020-06-05T20:00:00+02:00
med2_digent	DigitalEntity	2020-06-05T20:00:02+02:00
med3_digent	DigitalEntity	2020-06-05T20:00:04+02:00
med4_digent	DigitalEntity	2020-06-05T20:00:06+02:00
med5_digent	DigitalEntity	2020-08-05T03:20:40+02:00
med6_digent	DigitalEntity	2020-08-05T03:20:42+02:00
med7_digent	DigitalEntity	2020-08-05T03:20:44+02:00
med8_digent	DigitalEntity	2020-08-05T03:20:46+02:00
organism1	Organism	
organism2	Organism	
organism3	Organism	
organism4	Organism	

DigitalEntity

digitalEntityID	digitalEntityType	format	accessURI
med1_digent	StillImage	image/jpeg	med1.jpg
med2_digent	StillImage	image/jpeg	med2.jpg
med3_digent	StillImage	image/jpeg	med3.jpg
med4_digent	StillImage	image/jpeg	med4.jpg
med5_digent	StillImage	image/jpeg	med5.jpg
med6_digent	StillImage	image/jpeg	med6.jpg
med7_digent	StillImage	image/jpeg	med7.jpg
med8_digent	StillImage	image/jpeg	med8.jpg

Organism

organismID	organismScope

organism1	individual
organism2	individual
organism3	individual
organism4	individual

EntityEvent

entityID	eventID
med1_digent	med1
med2_digent	med2
med3_digent	med3
med4_digent	med4
med5_digent	med5
med6_digent	med6
med7_digent	med7
med8_digent	med8
organism1	med2
organism1	med3
organism2	med4
organism3	seq2
organism4	seq2

EntityAssertion

entityAssertionID	entityID	entityAssertionType	entityAssertionValue	entityAssertionUnit
entityassertion1	organism1	count	1	individuals
entityassertion2	organism2	count	3	individuals
entityassertion3	organism3	count	1	individuals
entityassertion4	organism4	count	1	individuals
entityassertion5	organism1	lifeStage	adult	
entityassertion6	organism2	lifeStage	juvenile	
entityassertion7	organism3	lifeStage	adult	
entityassertion8	organism4	lifeStage	adult	

Identification

identificationID	identificationType	taxaFormula	verbatimIdentification
idID1	human	A	Sus scrofa
idID2	human	A	Sus scrofa
idID3	human	A sp.	Rattus sp.
idID4	human	A	Strix aluco

IdentificationEntity

identificationID	entityID
idID1	organism1
idID2	organism2
idID3	organism3
idID4	organism4

Taxon

taxonID	kingdom	scientificName
taxon1	Animalia	Sus scrofa Linneaus, 1758

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taxon2  | Animalia | Rattus Fischer de Waldheim, 1803
taxon3  | Animalia | Strix aluco Linneaus, 1758
```

TaxonIdentification

taxonID	identificationID	taxonOrder
taxon1	*idID1*	1
taxon1	*idID2*	1
taxon2	*idID3*	1
taxon3	*idID4*	1

References

https://tdwg.github.io/camtrap-dp/
Common Models
https://tdwg.github.io/camtrap-dp/data/#deployments
https://github.com/tdwg/camtrap-dp/issues/203
https://doi.org/10.5281/zenodo.4893243
https://doi.org/10.13140/RG.2.2.23409.17767
https://tools.gbif.org/dwca-validator/extensions.do
https://github.com/gbif/rs.gbif.org/tree/master/core
https://tools.gbif.org/dwca-validator/extension.do?id=dwc:Event
https://tools.gbif.org/dwca-validator/extension.do?id=dwc:Identification
https://tools.gbif.org/dwca-validator/extension.do?id=http://rs.tdwg.org/ac/terms/Multimedia

https://rs.gbif.org/core/
https://github.com/gbif/rs.gbif.org/tree/master/core
https://rs.gbif.org/extension/
https://tools.gbif.org/dwca-validator/extensions.do
https://tools.gbif.org/dwca-validator/extension.do?id=dwc:Event
https://rs.gbif.org/core/dwc_event_2016_06_21.xml
https://tools.gbif.org/dwca-validator/extension.do?id=dwc:Identification
https://rs.gbif.org/extension/dwc/identification.xml

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Version

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