A metadata convention for animal acoustic telemetry data

Version 1.2

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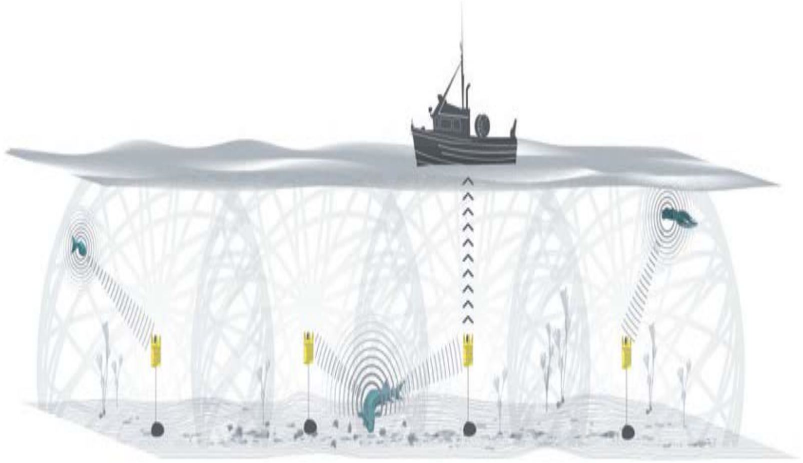

Source POST

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Introduction

The goal of IOOS Animal Acoustic Telemetry Observations (AAT) project is to develop a community standard for animal acoustic telemetry data so that data may be shared between projects nationally and internationally. At the time of writing, one company, Vemco (www.vemco.com), based in Halifax, Nova Scotia, Canada) has about 95% of the market for acoustic tags and receivers. This standard unavoidably reflects that bias to some extent, but is intended to be useful for equipment made by other manufacturers as well.

INTENDED AUDIENCE

It has become increasingly common for acoustic telemetry researchers to submit their tag and receiver data to regional databases, and receive detections and other data in return. Therefore, although this standard may be used by individual researchers, we envision it as being most useful for local or regional database operators who are sharing records with each other, or sharing data with large "discovery" databases. Each local database may have its own internal structure, data input forms, quality control procedures, and user interface, and as a result, local databases may be in a position to shield their member researchers from change, if they wish.

ORIGIN OF THE STANDARD

The standard is based on data input forms from POST, OTN, GLATOS, Hydra, and AATAMS, with additional feedback from other individual researchers and database operators such as TOPP and Kintama Research.

GOALS OF THE STANDARD

This document describes a minimum set of data that --we propose--should be included any time data are passed from one database or project to another. Fields are described as "required" or "optional". We assert that without the "required" fields, the data would not be internally consistent or would be too ambiguous to be useful. Optional fields are also important, but may be omitted for various reasons.

The purpose of the community standard is to ensure that:

- Enough information is transmitted to make data understandable (hence "required" fields)
- The origin of the data is clear, and credit (attribution) is maintained
- The receiving system can interpret the transmitted data without human intervention, including if necessary how flat files can be reassembled into a structure such as linked database tables.

SIMPLICITY VS. COMPLEXITY

The data chosen represent an attempt to find a reasonable compromise between simplicity and realistic detail. The main *benefit* of limiting the number of fields is simplicity, which is a critical determinant of whether the standard will be used or will languish in obscurity. Every additional field causes work for database administrators who must make the translation from their internal structure to the standard. The main *drawback* to simplicity is that it limits the types of data that can be *automatically* understood by the recipient and that can be easily queried across databases or projects. Accordingly, we decided that the size of this standard should be defined by 1) what we are likely want to communicate and 2) the amount of work we are collectively willing to do to make translations to it.

KEY FIELDS

Key fields are generally indicated by names that end in "_id", for example "deployment_id". Key fields have two functions: 1) to limit the complexity of this standard and 2) to indicate possible connections between records.

How key fields limit the complexity of this standard

Key fields may indicate the existence of additional information that is not specified in this standard. For example, a few projects collect information about the surgery needed to implant a tag, such as the concentration and type of anesthetic and buffer used, the temperature of the water baths, the number of sutures used, the identity of the person doing the surgery, and so on. Rather than specify all of those fields, we have included a "surgery_id", which serves as a link to other information. This decision limits our ability to automatically transfer surgery data and our ability to search surgery data across databases, but it simplifies the standard and leaves open the door to adding that information in the future.

How key fields indicate connections between records

Databases use key fields to connect tables. For example, if a tag was deployed on an animal, a database could have one internal table with information about the *tag* (model, serial number, programming, battery type, etc.), a second table with information about the *animal* (species, sex, length, weight, etc.), and a third table with information about the *deployment* (date, time, conditions, etc.). In this example, a *deployment* record could contain an *animal_id* that linked to the *animal* table and a *tag_id* that linked to the *tag* table. Alternatively, the links could point in the other direction: the *animal* and *tag* tables could each contain the same *deployment_id*. Some databases might opt to combine some of the information into one table, or to split it into even more tables. This standard does not aim to represent any particular structure, rather to make it clear which pieces of data go together, regardless of how they are kept in any particular database.

Format of key fields

A key field may be a key value for a database table such as a serial integer, a concatenated field such as a date+serial_number, a URL, or some other descriptor with which one could link to any amount of information.

Uniqueness of key fields

A key field does not have to be globally unique, as long as it is unique within a uniquely named project within a uniquely named datacenter. For example, POST and GLATOS could both have a (internally unique) dataset called HAD and both HAD datasets could call a deployment “deployment_35” and it would not cause any confusion within this standard. NOTE: some datacenters may only have a single project, is these cases the datacenter and project details would be the same.

Permanence of key fields

One of the responsibilities of a database manager is to make it possible to update or replace records. The systems that make this possible can be very complex. Permanent keys make updating or replacing records easier, and organizations that often share data with each other usually come to agreement on some way of handling updates. However, in the interests of universality and simplicity, this standard is agnostic about whether the key fields are permanent, or how long they are good for. Therefore the main function of key fields as specified in this standard is to link different types of information during any *one* transfer of data.

DATA CATEGORIES

We envision that telemetry projects might want to share data in one or more categories, from a total of 8 categories. Our goal has been to collect the fields required for each of the 8 categories to stand on its own, so that if you share data in one category, you don’t need to share other data to make sense of it. Those categories are:

1. Tag Releases (renamed from deployments): information about the release (deployment) of tags on animals or manmade platforms such as buoys, underwater moorings, gliders, AUVs or vessels

2. Receiver Deployments: information about the deployment and recovery of receivers. As with tags, receivers may be deployed on various platforms, including mobile platforms and animals.

3. Machine Logfiles: Receivers and some tags generate log files that include status information such as battery level, error logs or detection counts. Vemco refers to these as “events” (in the past they were also the “header” information in .csv formatted detection files). Other manufacturer’s equipment may generate similar files.

4. Detections: detections from receivers. Note that there are two fields (tag_deployment_id and receiver_deployment_id that can be used to link detections to a receiver file and/or known tag deployment.

5. Project Attributes: Within each datacenter specific project level information about the project data and people who created the data. The information is this table may end up going in a sort of header so that it doesn’t have to be repeated.

6. Tracks: The goal here is to make it easy to share tracks of animals once the data have been assembled and completed. In other words, we define a format for sharing fully-analyzed data, rather than the raw data in categories 1-5.

7. Datacenter Attributes: this is high-level information about the datascenter and people who manage the data held within the datacenter. The information in this table may also end up going in a sort of header so that it doesn’t have to be repeated.

8. Tag Approximate Release: Some taggers may be reluctant to submit the details of their tag releases. This table of minimal data will allow deployment operators to identify researchers whose tags may have been detected. This will facilitate communication between researchers and foster the sharing of data.

The contents of this category may be merged with Tag Releases including a flag marking as approximate record.

Key Tables

Data Type: S = string, N = numberic, and B = Boolean, D=Date

Datacenter Attributes

Attribute name	Description	Required	Data Type	Units	Authority
datacenter_reference	Unique code (must be unique within implemented standard, e.g. OTN in standard demo NANOOS Project) for this datacenter	required	S		
datacenter_name	Datacenter name (must be unique within implemented standard)	required	S		
datacenter_abstract	Paragraph describing the datacenter's goals, methodology, etc.	required	S		ICES Acoustic Metadata
datacenter_citation	The citation to be used in publications using the data from this datacenter should follow the format:"DatacenterName. [year-of-data-download], [Title], [Data access URL], accessed [date-of-access]". Manually generated attribute.	required	S		
datacenter_PI	Principal investigator (person) ultimately responsible for the datacenter data	required	S		ICES Acoustic Metadata
datacenter_pi_organization	Organization to which the datacenter principal investigator belongs	required	S		
datacenter_pi_contact	Email and/or other contact information for the datacenter principal investigator	required	S		
datacenter_infoURL	URL to datacenter information website.	required	S		ERDDAP
datacenter_keywords	A comma separated list of key words and phrases for the datacenter. GCMD vocabulary (Olsen et al., 2007) is recommended. The GCMD keywords list can be downloaded from: http://gcmd.nasa.gov/Resources/valids/archives/keyword_list.html Non-GCMD keywords may be used	optional	S		NACDD

	at your discretion				
datacenter_keywords_vocabulary	if you are following a guideline for the words/phrases in your datacenter keywords attribute (e.g., GCMD Science Keywords), put the name of that guideline here.	optional	S		ACDD
datacenter_DOI	Digital Object Identifier (DOI) for the datacenter	optional	S		IDF
datacenter_license	Describe the datacenter restrictions to data access and distribution. For example visit Australian National Data Service website AusGoal licensing framework (http://www.ands.org.au/publishing/licensing.html) which incorporates Creative Commons licences (http://creativecommons.org/).	required	S		NACDD
datacenter_distribution_statement	Statement describing data distribution policy:Re-packagers of the datacenter data should include a statement that information about data quality and lineage is available from the metadata record and a statement that data, products and services from are provided "as is" without any warranty as to fitness for a particular purpose	optional	S		
datacenter_date_modified	the date on which the datacenter data was last modified	optional	S	YYYY-MM-DD	ACDD
datacenter_geospatial_lon_min	Westernmost longitude of bounding box of the datacenter data. A value between -180 and 180 decimal degrees East. Note is it possible for the numeric value of the geospatial_lon_max to be less than the numeric value of the geospatial_lon_min. In that instance the bounding box will have crossed the 180 degree longitude boundary between West and East.	optional	N	degrees_east	CF
datacenter_geospatial_lon_max	Easternmost longitude of bounding box of the datacenter data. A value between -180 and 180 decimal degrees East. Note is it possible for the numeric value of the geospatial_lon_max to be less	optional	N	degrees_east	CF

	than the numeric value of the geospatial_lon_min. In that instance the bounding box will have crossed the 180 degree longitude boundary between West and East.				
datacenter_geospatial_lat_min	Southernmost latitude of bounding box of the datacenter data. A value between -90 and 90 decimal degrees North. Will vary with each data file, possibly automatically generated.	optional	N	degrees_north	CF
datacenter_geospatial_lat_max	Northermost latitude of bounding box of the datacenter data. A value between -90 and 90 decimal degrees North. Will vary with each data file, possibly automatically generated.	optional	N	degrees_north	CF
datacenter_time_coverage_start	Start date of the datacenter data in UTC Date format is ISO 8601. For example, a local time of 18:00 on the 24th of October 2008 would be represented as 2008-10-24T08:00:00Z +10 (local). Will vary with each data file, possibly automatically generated.	optional	S		
datacenter_time_coverage_end	see datacenter_time_coverage_start	optional	S		

Project Attributes

Attribute name	Description	Required	Data Type	Units	Authority
project_reference	Unique code (within datacenter) for this project	required	S		
datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
project_name	Unique name (within the datacenter) for this project	required	S		
project_abstract	Paragraph describing the project's goals, methodology, etc.	required	S		ICES Acoustic Metadata
project_citation	The citation to be used in publications using the data from the project should follow the	required	S		IMOS

	format:"ProjectName. [year-of-data-download], [Title], [Data access URL], accessed [date-of-access]". Manually generated attribute.				
project_PI	Principal investigator (person) ultimately responsible for the project data	required	S		ICES Acoustic Metadata
project_pi_organization	Organization to which the project principal investigator belongs	required	S		
project_pi_contact	Email and/or other contact information for the project principal investigator	required	S		
project_infoURL	URL to project information website.	required	S		ERDDAP
project_keywords	A comma separated list of key words and phrases for the project. GCMD vocabulary (Olsen et al., 2007) is recommended. The GCMD keywords list can be downloaded from: http://gcmd.nasa.gov/Resources/valids/archives/keyword_list.html Non-GCMD keywords may be used at your discretion	optional	S		NACDD
project_keywords_vocabulary	if you are following a guideline for the words/phrases in your project keywords attribute (e.g., GCMD Science Keywords), put the name of that guideline here.	optional	S		ACDD
project_references	Published or web-based references that describe the data or the methods used to produce the data from the project. Multiple references should be separated with a semicolon ";" If available DOI's (Digital Object Identifiers) should be given.	optional	S		CF
project_DOI	Digital Object Identifier (DOI) for the project	optional	S		IDF
project_license	Describe the project restrictions to data access and distribution. For example visit Australian National Data Service website AusGoal licensing framework (http://www.ands.org.au/publishing/licensing.html) which incorporates Creative Commons licences (http://creativecommons.org/).	required	S		NACDD

project_distribution_statement	Statement describing data distribution policy:Re-packagers of the project data should include a statement that information about data quality and lineage is available from the metadata record and a statement that data, products and services from are provided "as is" without any warranty as to fitness for a particular purpose	optional	S		
project_date_modified	the date on which the project data was last modified	optional	S	YYYY-MM-DD	ACDD
project_datum	Projection datum for geospatial bounding box positions. Most commonly the global datum WGS84 (NIMA 2000), but other localized datum may be encountered in some circumstances.	optional	S		
project_geospatial_lon_min	Westernmost longitude of bounding box of the project data. A value between -180 and 180 decimal degrees East. Note is it possible for the numeric value of the geospatial_lon_max to be less than the numeric value of the geospatial_lon_min. In that instance the bounding box will have crossed the 180 degree longitude boundary between West and East.	optional	N	degrees_east	CF
project_geospatial_lon_max	Easternmost longitude of bounding box of the project data. A value between -180 and 180 decimal degrees East. Note is it possible for the numeric value of the geospatial_lon_max to be less than the numeric value of the geospatial_lon_min. In that instance the bounding box will have crossed the 180 degree longitude boundary between West and East.	optional	N	degrees_east	CF
project_geospatial_lat_min	Southernmost latitude of bounding box of the project data. A value between -90 and 90 decimal degrees North. Will vary with each data file, possibly automatically generated.	optional	N	degrees_north	CF
project_geospatial_lat_max	Northermost latitude of bounding box of the	optional	N	degrees_north	CF

	project data. A value between -90 and 90 decimal degrees North. Will vary with each data file, possibly automatically generated.				
project_linestring	OGC:SFS/WKT compliant LINESTRING geometry representing each transect of the project data. A LineString consists of a sequence of two or more vertices, along with all points along the linearly-interpolated curves (line segments) between each pair of consecutive vertices	optional	S		
geospatial_vertical_min	Minimum depth of measurements of the project data. Will vary with each data file, possibly automatically generated.	optional	N		
geospatial_vertical_max	Maximum depth of measurements of the project data. Will vary with each data file, possibly automatically generated.	optional	N		
geospatial_vertical_positive	Direction in which geospatial vertical increases, "up" or "down" of the project data	optional	S		
project_time_coverage_start	Start date of the project data in UTC Date format is ISO 8601. For example, a local time of 18:00 on the 24th of October 2008 would be represented as 2008-10-24T08:00:00Z +10 (local). See also Appendix D: Time formats. Will vary with each data file, possibly automatically generated.	optional	S		
project_time_coverage_end	see project_time_coverage_start	optional	S		

Manmade Platform

Attribute name	Description	Required	Data Type	Units	Authority
platform_project_reference	Reference to the (unique within datacenter) project to which this platform belongs	required	S		
datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
platform_reference_id	Project-specific (UNIQUE) reference to manmade	required	S		

	platform				
platform_guid	globally unique identifier for this platform record	required	S		
platform_type	Type of platform. See Appendix A	required	S		
platform_depth	Depth of manmade platform, if fixed	optional	N	m	
platform_name	Usually Name per position within grouping	Optional	S		
platform_latitude	Nominal latitude of manmade platform, if fixed	required if fixed	N	degrees_north	CF
platform_longitude	Nominal longitude of manmade platform, if fixed	required if fixed	N	degrees_east	CF

Receiver Deployment

Attribute name	**Description**	**Required**	**Data Type**	**Units**	**Authority**
deployment_project_reference	Reference to the (unique within datacenter) project to which this receiver deployment belongs.	required	S		
datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
deployment_id	Project-specific ID for the receiver deployment	required	S		
deployment_guid	globally unique identifier for this receiver record	required	S		
receiver_manufacturer	Name of manufacturer of receiver	required	S		
receiver_model	Receiver model. See Appendix A	required	S		
frequencies_monitored	Frequencies monitored by the receiver. Separate multiple frequencies with a semicolon	optional	S	kHz	
receiver_coding_scheme	Manufacturer specification of coding scheme. For Vemco receivers, either the name of a codemap or a list of tag codespaces, separated by commas. See Appendix A for list of allowed terms	optional	S		
receiver_serial_number	Serial number of receiver. Note: Vemco has been inconsistent in reporting legacy serial numbers that include non-numeric characters; the letters could be a prefix or suffix to a number. Put letters before the number (i.e., H3886, not 3886H).	required	S		

deployment_latitude	Latitude where receiver entered the water, in decimal degrees	required	N	degrees_north	CF
deployment_longitude	Longitude where receiver entered the water, in decimal degrees	required	N	degrees_east	CF
deployment_datetime_utc	Date and time of deployment, in ISO 8601 format.	required	S		CF
recovery_datetime_utc	Date and time of receiver recovery in UTC, in ISO 8601 format	required if recovered or declared lost	S		
array_name	Name for an array/line/grouping of receivers	optional	S		
receiver_reference_type	Identifier for which parent table to link with (currently ANIMAL or Manmade Platform)	required	S		
receiver_reference_id	Link to reference_id in Manmade Platform or Animal table (see receiver_reference_type)	required	S		
bottom_depth	Bottom depth at the site of the deployment	optional	N	meters	CF
receiver_depth	Depth of the receiver at deployment	required	N	meters	CF
deployment_comments	Free text comments regarding the deployment and/or recovery	optional	S		
deployed_by	Name of the person (technician, etc.) in charge of the field deployment	optional	S		
expected_receiver_life	Expected battery life of the receiver, in days from deployment	optional	N	days	

Receiver Offload/Recovery Details

Attribute name	Description	Required	Data Type	Units	Authority
recovery_project_reference	Reference to the (unique within datacenter) project to which this receiver offload/recovery belongs	required	S		

datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
recovery_id	Project-specific ID for this particular receiver offload/recovery	required	S		
deployment_id	Project-specific ID for the receiver deployment	required	S		
recovery_guid	globally unique identifier for this record	required	S		
recovery_latitude	Latitude where receiver was actually recovered, or nominal station latitude	required			CF
recovery_longitude	Longitude where receiver was actually recovered or nominal station longitude	required			CF
recovery_datetime_utc	Date and time of recovery in UTC, in ISO 8601 format	required			CF
recovery_outcome	Type and outcome of recovery. See Appendix A for controlled list of terms. Note: this field reflects the understanding of the researcher at the time of fieldwork; the current status of a receiver may change with time, for example from “presumed lost” to “lost and found”.	required			
data_offloaded	Were data offloaded from the receiver (Y/N)	required	B		
offload_datetime_utc	Date and time (UTC) of receiver offload, in ISO 8601 format.	required	S		
log_filenames	If data were downloaded, the name(s) of the files produced	optional	S		
recovery_comments	Free text comments regarding the recovery/offload	optional	S		
clock_synchronized	Was the receiver clock re-set during the offload?	optional	B		
recovered_by	Technician in charge of field recovery	optional	S		

Equipment Logs

Attribute name	Description	Required	Data Type	Units	Authority

equipment_project_reference	Reference to the (unique) project to which this equipment logfile belongs	required	S		
datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
equipment_manufacturer	Manufacturer of device that generated the logfile	required	S		
equipment_serial_number	Serial number of device that generated the logfile	required	S		
event_name	Name of the event recorded	required	S		
event_datetime_UTC	Date/time of the event, in ISO 8601 format	required	S		
event_data	Data if any	optional	S		
event_units	Units of the data, if applicable	optional	S		
log_filename	Filename in which the event was recorded	optional	S		
deployment_id	Project-specific ID for the receiver deployment	optional	S		
recovery_id	Project-specific ID for this particular receiver offload/recovery	optional	S		

Animal Details

Attribute name	**Description**	**Required**	**Data Type**	**Units**	**Authority**
animal_project_reference	Reference to the (unique within datacenter) project to which this animal belongs	required	S		
datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
animal_reference_id	Project-specific (UNIQUE) animal identifier	required	S		
animal_guid	globally unique identifier for this animal record	required	S		
vernacularName	A common or vernacular name for the taxon observed	optional	S		Darwin Core

scientificName	The taxonomic identification of the animal as either 1) Genus and species (and subspecies if provided) in Latin binomial nomenclature form, or 2) the lowest-level taxonomic name to which the observation is identified, expressed in Latin form. Authorities, references and procedures for making identifications should be documented in metadata.	required	S		Darwin Core
taxonRank	The taxonRank term is a companion to the scientificName term. taxonRank identifies the taxonomic level of the lowest-level name in the scientificName term, if the ScientificName refers to a level above Genus.	optional	S		Darwin Core
aphiaID	A unique taxon identifier obtained by validation of the taxon name with the World Register of Marine Species (WoRMS), www.marinespecies.org.	optional	N		Darwin Core
tsn	A unique taxon identifier obtained by validation of the taxon name with the Integrated Taxonomic Information System (ITIS), www.itis.gov.	optional	N		
animal_origin	Origin of the animal. Either Wild or Hatchery.	optional	S		
stock	Stock if known (e.g. northern DPS)	optional	S		
length	Length of animal	optional	N		Darwin Core
length_type	Type of length measured (e.g., total length, fork length, carapace length, etc.)	optional	S		
length_units	Units in which length is measured	optional	S	recommend m	
weight	Wet weight of whole animal	optional	N		
weight_units	Units in which weight is expressed	optional	S	recommend kg	
life_stage	An expression or description of age or lifestage of biological individual(s) in the observation record. .	optional	S		
age	Age of animal, in specified age_unit	optional	N		
age_units	Units in which age is expressed; days, months, years	optional	S		
sex	Sex of animal: Male or Female	optional	S		Darwin Core

Capture/Surgery/Experim Details

Attribute name	Description	Required	Data Type	Units	Authority
capture_project_reference	Reference to the (unique) project to which this capture/surgery/experim belongs	required			
datacenter_reference	Reference to the datacenter to which this record belongs	required			
capture_reference_id	Project-specific (UNIQUE) reference to animal for this capture/surgery/experim	required			
capture_location	Name of location where animal was captured	optional	S		
capture_latitude	Latitude of capture site, in decimal degrees	optional	N	degrees_north	CF
capture_longitude	Longitude of capture site, in decimal degrees	optional	N	degrees_east	CF
capture_depth	Depth at which animal was captured	optional	N		CF
capture_datetime_utc	Date and time of capture, in UTC, in ISO 8601 format.	optional	S		CF
pre-op_holding_period	Period in days between capture and tag attachment	optional	N		
post-op_holding_period	Period in days between tag attachment and release	optional	N		
surgery_id	Reference to further details on the animal surgery that was performed in order to attach the tag to the animal for the current deployment	optional			
tagger	Name of individual who tagged the animal	optional	S		
attachment_method	Tag attachment method (values: internal or external)	optional	S		
experimental_treatment	Name of experimental treatment, if any, applied to this animal	optional	S		
release_group	Name of release group, if any, which this tag release was a part	optional	S		

other_samples_taken	Reference to other samples taken when animal was handled for tagging	optional	S		

Tag Release

Attribute name	Description	Required	Data Type	Units	Authority
release_project_reference	Reference to the (unique within datacenter) project to which this tag release belongs	required	S		
datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
tag_device_id	Project-specific (UNIQUE) tag release id	required	S		
release_guid	globally unique identifier for this tag release record	required	S		
release_reference_id	Project-specific (UNIQUE) reference to either animal or manmade platform table, per reference_type	required	S		
release_reference_type	Identifier for which parent table to link with (currently ANIMAL or Manmade Platform)	required	S		
release_latitude	Latitude of the site where the tagged animal was released in decimal degrees	required	N	degrees_north	CF
release_longitude	Longitude of the site where the tagged animal was released in decimal degrees	required	N	degrees_east	CF
release_datetime_UTC	Date and time (UTC) of the release in ISO 8601 format	required	S		CF
expected_enddate	Date when transmitter will stop transmitting	required	D		
manufacturer	Name of tag manufacturer	required	S		
tag_model	Manufacturer model name, exactly as specified; e.g. V9, V9-6L, V9TP or V9-xx	required	S		
tag_serial_number	Serial number of tag	required	S		
tag_frequency	Frequency on which tag transmits. Separate multiple frequencies with semicolons	optional	S	kHz	

tag_coding_system	How the signal is coded (manufacturer-specific). For Vemco, this is the "codespace"	Required if Vemco	S		
transmitted_id	ID code transmitted by the tag	Required if Vemco	S		
transmittername	Either Pinger or SensorTransmitter as it appears on Vendors detection software processing	required	S		
transmitter_type	pinger, depth, temp, oxygen, satellite, archival, chlor, irrad, etc.	required	S		
tag_programming_id	Reference to further information about the tag programming on this deployment. Not yet defined	optional	S		

Tag Recovery Details

Attribute name	Description	Required	Data Type	Units	Authority
tag_recovery_project_reference	Reference to the (unique) project to which this tag recovery belongs	required	S		
datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
tag_device_id	tag release unique id	required	S		
tag_recovery_latitude	Latitude of the site where the tag was recovered in decimal degrees	optional	N	degrees_north	CF
tag_recovery_longitude	Longitude of the site where the tag was recovered in decimal degrees	optional	N	degrees_east	CF
tag_recovery_datetime_UTC	Date and time (UTC) of the tag recovery in ISO 8601 format	optional	S		CF
tag_recovery_location	Name of the site where tag aws recovered	optional	S		
tag_recovery_comments	Free text comments regarding tag recovery (e.g., method of recovery)	optional	S		

Detections

Attribute name	**Description**	**Required**	**Data Type**	**Units**	**Authority**
detection_project_reference	Reference to the (unique within datacenter) project to which this detection belongs	required	S		
datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
detection_serial_number	Serial number of receiver that recorded the detection. Note: Vemco has been inconsistent in reporting legacy serial numbers that include non-numeric characters; the letters could be a prefix or suffix to a number. Put letters before the number (i.e., H3886, not 3886H).	required	S		
detection_id	Project-specific (UNIQUE) detection id	required	S		
detection_guid	globally unique identifier for this record	required	S		
detection_timestamp_utc	Timestamp for when detection was recorded, in UTC, in ISO 8601 format	required	S		
detection_latitude	latitude of deployed receiver to which this detection belongs	required	N	degrees_north	CF
detection_longitude	longitude of deployed receiver to which this detection belong	required	N	degrees_east	CF
tracker_reference	Reference to the (unique) project/datacenter which released the detected instrument	required if matched to release	S		
detection_reference_id	Project-specific (UNIQUE) reference to either animal or manmade platform table, per reference_type	required if matched to release	S		
detection_reference_type	Reference type (currently ANIMAL, MANMADE)	required if matched	S		

		to release			
transmitter_codespace	Coding scheme of transmitter	Required if Vemco	S		
transmitter_id	Transmitted ID that was detected	Required if Vemco	S		
detection_transmittername	Either Pinger or SensorTransmitter as it appears on Vendors detection software processing	required	S		
sensor_data	Data from sensor, if applicable	optional	S		
sensor_data_units	Units for the sensor data	optional	S		
receiver_log_id	Reference to receiver logfile from which detection originates	optional	S		
deployment_id	Project-specific ID for the receiver deployment	optional	S		
detection_quality	Quality control flag for the detection (suspected false, time problem, OK, etc.)	optional	S		
depth	Depth of track point, if known. Can be inferred from the receiver depth, or measured by a tag that transmits depth information	optional	N	meters	CF
position_data_source	Free text description of the source of the position estimate. Example: "receiver position plus detection radius". Position estimates may come from a separate device (e.g. a satellite tag, on a double-tagged animal)	required	S		
uncertainty_in_latitude	Estimated error term for latitude, in decimal degrees	optional	N	degrees_north	
uncertainty_in_longitude	Estimated error term for longitude, in decimal degrees	optional	N	degrees_west	

depth_data_source	Data source for depth estimate	optional	S		
uncertainty_in_depth	Estimated error in depth (s.d.)	optional	N		
other_position_data	Reference to additional position data for this point, such as the platform's compass orientation, course, pitch/yaw, etc.	optional	S		
dataset_quality	Indicates how much the data have been processed. Degrees of processing could include correction of positions, flagging of false detections and other improvements	optional	S		

Tag_Approximate_Releases

The contents of this category may be merged with Tag Releases including a flag marking as approximate record.

Attribute name	**Description**	**Required**	**Data Type**	**Units**	**Authority**
approximate_project_reference	Reference to the (unique) project to which this tag approx. release belongs .	required	S		
datacenter_reference	Reference to the datacenter to which this record belongs	required	S		
approximate_transmittername	Transmitter as it will appear in output from Manufacture'rs detection software processing. Eg. for Vemco tags this will be code space plus tag id formatted like A69-1303-123456.	required	S		
approximate_manufacturer	Name of manufacturer of transmitter	required	S		
approximate_release_date	Date animal was tagged.	required	D		
approximate_expected_end date	Date when transmissions are expected to stop	required	D		
approximate_latitude	to nearest degree of latitude (no decimal places): offsets to obscure release locations are acceptable	optional	N		CF
approximate_longitude	to nearest degree of longitude (no decimal places): ooffsets to obscure release locations are acceptable	optional	N		CF

approximate_release_area	general release area: sound, channel, bay, river...	Required	S		

Appendix A: Controlled Vocabularies for Terms

Category: Receiver deployments: receiver_model

Manufacturer	Model	Notes
Vemco	VR2	Original VR2 (pre-VR2W)
Vemco	VR2W	
Vemco	VR2W-180	180 KHz VR2W
Vemco	VR3-UWM	
Vemco	VR3-ARGOS	
Vemco	VR-C	Cabled VR2
Vemco	VR4	
Vemco	VR100	Mobile tracking receiver
Vemco	VMT	Vemco mobile transceiver (combines a transmitter and a miniature receiver)

Category: Receiver deployments: coding scheme

Note: this category currently only applies to Vemco. Their "tag codespace" describes a coding system for tag transmissions. Every transmission has one and only one codespace, but a tag may transmit on more than one codespace. A "receiver codemap" describes a list of tag codespaces for which a receiver listens, i.e. the codemap is a shorthand for that list.

Tag codespace
A69-1005
A69-1008
A69-1105
A69-1107

A69-1204
A69-1206
A69-1303
A69-1304
A69-1601
A69-9001
A69-9002
A69-9003
A69-9004
A69-9005
A81-1008
A81-1105
A81-1204
A81-1206
A81-1303
A180-1701
A180-1702

Receiver codemap

110
112
209
210
309
310
311
411
413

Categories: 1) Receiver deployments: platform_type, 2) Tag deployments: platform_type

Underwater mooring
Surface buoy
Animal
Glider
AUV
Drifter
Vessel

Category: Receivers: recovery_outcome

Term	Definition
DOWNLOAD_ONLY	Applies only to receivers with modems. Data downloaded without removing the receiver from the water; receiver functioning correctly
FAILED_DOWNLOAD	Applies only to receivers with modems. The receiver did not respond when interrogated by remote modem. You may or may not know the position of the receiver.
RECOVERED	Receiver was successfully retrieved from the water
FAILED_RECOVERY	The receiver is still in position and functioning properly but an attempt to physically recover it was unsuccessful
PRESUMED_LOST	Receiver could not be recovered and its condition and/or position is unknown, or it was destroyed.
LOST_AND_FOUND	The receiver was recovered far out of position (for example, on a beach or in a fishing net, etc.), after having been considered lost. It may or may not be functional.
MALFUNCTION	The receiver was recovered from its proper position, but was not functioning