A metadata convention for animal acoustic telemetry data

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# Introduction

The goal of this IOOS project is to develop national standards for animal acoustic telemetry data, so that data may be shared between projects.

This draft document describes a minimum set of data that --we propose--should be included any time data are passed from one project to another.  Fields are described as “required” or “optional”. We suggest 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.  Many additional fields have not been included at this time; you can see what you are missing at the bottom of the Excel sheets if you are interested.  Any of those additional fields could be added to a file when data are shared, but we are proposing not to worry about creating standard names or formats for the additional fields at this time, generally because few projects collect those data.

WHERE DOES IT COME FROM?

We took the data input forms from POST, OTN, GLATOS, Hydra, and AATAMS, compared the information that was collected by each organization, and then tried to harmonize and simplify the list.

SIMPLICITY VS. COMPLEXITY

The data represent an attempt to find a reasonable compromise between simplicity and realistic detail. For example, animals sometimes carry several tags or marks at the same time as they carry an acoustic tag; these “other” tags may include spaghetti tags, PIT tags, coded-wire tags, satellite tags, brands, and so on. Rather than try to include a field for each “other” tag (which would bring up questions of how many additional fields to create for the ancillary data that goes with each “other” tag), I have included what I think of as a “stub,” in the form of a reference to “other\_tags.” That reference could be a key value for a database table, a URL, or some other descriptor with which you could link to any amount of information. I have done the same thing for other complex fields such as tag programming; all such information may be kept in a table in your database, but at this level all we need is a unique reference to record. The reference does not have to be globally unique, as long as it is linked to a project name that is globally unique. In other words, POST and GLATOS could both call a deployment “deployment number 35,” and it would not cause any confusion as long as the project name was included, and the project names were unique.

We envision that telemetry projects might want to share data in one or more categories, from a total of 6 categories.  Our goal has been to collect the fields required for each of the 6 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. Receiver deployments: information about the deployment and recovery of receivers
2. Tag deployments: information about the deployment of tags (at this point, there are no fields for tag recovery, but we do want to capture the situation in which tags are deployed on a manmade platform such as a buoy or glider)
3. Machine logfiles: these are Vemco “events,” which used to be referred to as the “header” information in the detection files.  I imagine 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 a detection to a receiver file and/or a known tag deployment
5. Dataset Attributes: this is high-level information about the projects and people who created the data.  The information in 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 to define a format for sharing the fully-analyzed data rather than the raw data in categories 1-5.

In other words, POST and GLATOS could both call a deployment “deployment number 35,” and it would not cause any confusion as long as the project name was included and the project names (“POST” and “GLATOS”) were unique.

# 

# Receiver Deployment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Attribute name** | **Description** | **Required** | **Data Type** | **Units** | |
| *project\_reference* | Reference to the (unique) project to which this receiver deployment belongs | required | S |  | |
| 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 | required | 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 | required | 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 | |
| deployment\_longitude | Longitude where receiver entered the water, in decimal degrees | required | N | degrees\_east | |
| deployment\_datetime\_utc | Date and time of deployment, in ISO 8601 format. | required | S |  | |
| *deployment\_id* | Project-specific ID for the deployment | required | S |  | |
| array\_name | Name for an array/line/grouping of receivers | optional | S |  | |
| station\_name | Name for a position within that grouping | optional | S |  | |
| station\_latitude | Nominal latitude of named station | optional | N | degrees\_north | |
| station\_longitude | Nominal longitude of named station | optional | N | degrees\_east | |
| platform\_type | Type of platform (animal or other) to which receiver was attached. See Appendix A for list of terms. | required | S |  | |
| *platform\_reference* | Project-specific reference (ID, URL, etc.) pointing to records about other characteristics of the platform | required | S |  | |
| bottom\_depth | Bottom depth at the site of the deployment | optional | N | meters | |
| receiver\_depth | Depth of the receiver at deployment | required | N | meters | |
| status\_in | Was the receiver functioning immediately after deployment? | optional | S |  | |
| depoyment\_comments | Free text comments regarding the deployment | 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 | required | N | days | |
|  |  |  |  |  | |
| **2. Recovery details** | *Note: conceptually, a "recovery" is either the physical recovery of a receiver OR an event in which data are downloaded without removing the receiver from the water* | | | | |
| *recovery\_id* | | Project-specific ID for this particular recovery | optional | S | |  |
| *deployment\_id* | | A reference to the deployment record to which this recovery applies | required | S | |  |
| recovery\_latitude | | Latitude where receiver was actually recovered, or nominal station latitude | required | N | |  |
| recovery\_longitude | | Longitude where receiver was actually recovered or nominal station longitude | required | N | |  |
| recovery\_datetime\_utc | | Date and time of recovery in UTC, in ISO 8601 format | required | S | |  |
| 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 | S | |  |
| data\_downloaded | | Were data downloaded from the receiver (Y/N) | required | Boolean | |  |
| download\_datetime\_utc | | Date and time (UTC) of receiver download, in ISO 8601 format. | required | S | |  |
| log\_filenames | | If data were downloaded, the name(s) of the files produced | optional | S | |  |
| recovery\_comments | | Field comments by the recovery technician | optional | S | |  |
| recovered\_by | | Technician in charge of field recovery | optional | S | |  |
| proposed\_start\_date | | The start deployment date for a proposed (not existing) deployment, in ISO 8601 format | optional | S | |  |
| proposed\_end\_date | | The end deployment date for a proposed (not existing) , deployment, in ISO 8601 format | optional | S | |  |

# Tag Deployment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Attribute name** | **Description** | **Required** | **Data Type** | **Units** | **Authority** |
| *project\_reference* | Reference to the (unique) project to which this tag deployment belongs | required | S |  |  |
| *platform\_reference* | Project-specific reference to animal (or manmade platform) to which tag is attached | optional | S |  |  |
| release\_latitude | Latitude of the site where the tagged animal was released in decimal degrees | required | N | Degrees\_north |  |
| release\_longitude | Longitude of the site where the tagged animal was released in decimal degrees | required | N | Degrees\_east |  |
| release\_datetime\_UTC | Date and time (UTC) of the release in ISO 8601 format | required | S |  |  |
| vernacularName | A common or vernacular name for the taxon observed. If this term is used, then authorities, references and procedures for making identifications and translating vernacular name to scientific name should be documented in metadata. | optional |  |  | 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. | optional |  |  | 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 |  |  | 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 |  |  | 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 | S |  |  |
| common\_name | Common name in English of the tagged animal | optional | S |  |  |
| 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 | cm |  |
| 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 |  |  |  |  |
| weight | Wet weight of whole animal | optional | N |  |  |
| weight\_units | Units in which weight is expressed |  | S |  |  |
| life\_stage | An expression or description of age or lifestage of biological individual(s) in the observation record. Vocabulary will be consistent within a dataset and will be explained in metadata. Methods of determination (where applicable) will be explained in metadata. | optional | S |  | Darwin Core |
| age | Age of animal, in months | optional | N | months |  |
| sex | Sex of animal: Male or Female | optional | S |  |  |
| *other\_tags* | Reference to other tags carried by the animal. | optional | S |  |  |
|  |  |  |  |  |  |
| **2. Capture details** |  |  |  |  |  |
| capture\_location | Name of location where animal was captured | optional | S |  |  |
| capture\_latitude | Latitude of capture site, in decimal degrees | optional | N | degrees\_north |  |
| capture\_longitude | Longitude of capture site, in decimal degrees | optional | N | degrees\_east |  |
| capture\_depth | Depth at which animal was captured | optional | N | meters |  |
| capture\_datetime\_utc | Date and time of capture, in UTC, in ISO 8601 format. | optional | S |  |  |
| release\_location | Name of location where animal was released | optional | S |  |  |
| 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 |  |  |
|  |  |  |  |  |  |
| **3. Surgery details** |  |  |  |  |  |
| tagger | Name of individual who tagged the animal | optional | S |  |  |
| attachment\_method | Tag attachment method (values: internal or external) | optional | S |  |  |
|  |  |  |  |  |  |
| **4. Experimental details** |  |  |  |  |  |
| 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 |  |  |
|  |  |  |  |  |  |
| **5. Tag device details** |  |  |  |  |  |
| 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 | required | S | kHz |  |
| tag\_coding\_system | How the signal is coded (manufacturer-specific). For Vemco, this is the "codespace" | required | S |  |  |
| transmitted\_ID | ID code transmitted by the tag | required | S |  |  |
| sensor1\_type | Type of sensor1 integrated into the tag. See Appendix A | optional | S |  |  |
| sensor1\_codespace | Coding system used if sensor data are transmitted separately from tagID | optional | S |  |  |
| sensor1\_ID | ID transmitted by sensor 1, if applicable | optional | S |  |  |
| sensor2\_type | Type of sensor2 integrated into the tag. See Appendix A | optional | S |  |  |
| sensor2\_codespace | Coding system used if sensor2 data are transmitted separately from tagID | optional | S |  |  |
| sensor2\_ID | ID transmitted by sensor2, if applicable | optional | S |  |  |
| activation\_date | Date on which tag was activated, in ISO 8601 format. | optional | S |  |  |
| estimated\_tag\_life | Estimated days that tag will function, total (including programmed "off" periods) | required | N | days |  |
| *tag\_programming\_ID* | Reference to further information about the tag programming on this deployment | optional | S |  |  |

# Machine Logfiles

Note: this category is intended to represent the data formerly referred to as “header” information in Vemco receiver files, now called “events” by Vemco. Vemco software makes it possible to export event data as separate .csv files.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Attribute name** |  |  |  |  |
| **Equipment logs (Vemco "events")** | **Description** | **Required** | **Data Type** | **Units** |
| *Project reference* | Reference to the (unique) project to which this logfile belongs | required | S |  |
| Equipment manufacturer | Manfacturer 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 date/time 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 | required | S |  |
| *Deployment\_ID* | Reference to the deployment during which the logfile was generated | optional | S |  |
| *Recovery\_ID* | Reference to the recovery that resulted in capture of the logfile | optional | S |  |

# Detections

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Attribute** | **Description** | **Required** | **Data Type** | **Units** |
| *project\_reference* | Reference to the (unique) project to which this detection belongs | required | S |  |
| receiver\_manufacturer | Manufacturer of receiver | required | S |  |
| receiver\_serial\_number | Serial number of receiver | required | S |  |
| detection\_timestamp\_utc | Timestamp for when detection was recorded, in UTC, in ISO 8601 format | required | S |  |
| transmitter\_codespace | Coding scheme of transmitter | required | S |  |
| transmitter\_id | Transmitted ID that was detected | 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 |  |
| *transmitter\_deployment\_id* | Reference to the particular tag that was detected | optional | S |  |
| *receiver\_deployment\_id* | Reference to the receiver deployment record for this event | optional | S |  |
| detection\_quality | Quality control flag for the detection (suspected false, time problem, OK, etc.) | optional | S |  |

# Dataset Attributes

These are high-level attributes that apply to the entire dataset

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Attribute name** | **Description** | **Required** | **Data Type** | **Units** | **Authority** |
| project\_name | Project name (must be unique) | 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 dataset should follow the format:"ProjectName. [year-of-data-download], [Title], [Data access URL], accessed [date-of-access]". Manually generated attribute. | required | S |  |  |
| project\_PI | Principal investigator (person ultimately responsible for the data) | required | S |  | ICES Acoustic Metadata |
| pi\_organization | Organization to which the principal investigator belongs | optional | S |  |  |
| pi\_contact | Email and/or other contact information for the principal investigator | required | S |  |  |
| keywords | A comma separated list of key words and phrases. 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 |
| references | Published or web-based references that describe the data or the methods used to produce the data. Multiple references should be separated with a semicolon ";" If available DOI's (Digital Object Identifiers) should be given. | optional | S |  | CF |
| DOI | Digital Object Identifier (DOI) for the mission | optional | S |  | IDF |
| citation | The citation to be used in publications using the dataset should follow the format:"ProjectName. [year-of-data-download], [Title], [Data access URL], accessed [date-of-access]". Manually generated attribute. | required | S |  | IMOS |
| license | Describe the 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/). | optional | S |  | NACDD |
| distribution\_statement | Statement describing data distribution policy:Re-packagers of this 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 |  |  |
| dataset\_datum | Projection datum for geospatial bounding box positions. Most commonly the global datum WGS84 (NIMA 2000), but other localised datum may be encountered in some circumstances. | optional | S |  |  |
| geospatial\_lon\_min | Westernmost longitude of bounding box. 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 |  |  |
| geospatial\_lon\_max | Easternmost longitude of bounding box. 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 |  |  |
| geospatial\_lat\_min | Southernmost latitude of bounding box. A value between -90 and 90 decimal degrees North. Will vary with each data file, possibly automatically generated. | optional | N |  |  |
| geospatial\_lat\_max | Northermost latitude of bounding box. A value between -90 and 90 decimal degrees North. Will vary with each data file, possibly automatically generated. | optional | N |  |  |
| dataset\_linestring | OGC:SFS/WKT compliant LINESTRING geometry representing each transect. 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. Will vary with each data file, possibly automatically generated. | optional | N |  |  |
| geospatial\_vertical\_max | Maximum depth of measurements. Will vary with each data file, possibly automatically generated. | optional | N |  |  |
| geospatial\_vertical\_positive | Direction in which geospatial vertical increases, "up" or "down" | optional | S |  |  |
| time\_coverage\_start | Start date of the 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 |  |  |
| time\_coverage\_end | see time\_coverage\_start | optional | S |  |  |

# Tracks

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Attribute** | **Description** | **Required** | **Data Type** | **Units** |
| *project\_reference* | Reference to the (unique) project to which this receiver deployment belongs | required | S |  |
| *deployment\_id* | Reference to the tag deployment that produced this track. May be an animal\_id, platform\_id, or deployment\_id | required | S |  |
| *platform\_id* | Reference to the animal or manmade device to which the tag was attached | optional | S |  |
| latitude | Latitude of one point on the track, in decimal degrees | required | N |  |
| longitude | Longitude of one point on the track, in decimal degrees | required | N |  |
| datetime | Time of track point, in ISO 8601 format | required | 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 |
|  |  |  |  |  |
| **2. Tracks with sensor data** | |  |  |  |
| sensor\_data | Reference to sensor data collected by the tag at the point | optional | N |  |
|  |  |  |  |  |
| **3. Uncertainty in animal position** | |  |  |  |
| position\_data\_source | Free text description of the source of the position estmate. 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\_east |
| depth\_data\_source | Data source for depth estimate | optional | S |  |
| uncertainty\_in\_depth | Estimated error in depth (s.d.) | optional | N |  |
|  |  |  |  |  |
| **4. Details of mobile platform movement** | |  |  |  |
| *other\_position\_data* | Reference to additional position data for this point, such as the platform's compass orientation, course, pitch/yaw, etc. | optional | S |  |
|  |  |  |  |  |
| **5. Data quality** |  |  |  |  |
| 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 |  |
| sequential\_marker | A sequential marker along the track. The purpose is either to cross-validate the sequence, or to accommodate missing information in a track (such as imprecise time stamps). | optional | N |  |

# 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 |

**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 reciever 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 reciever was recovered from its proper position, but was not functioning |