

HALLO

Managing annotated acoustic data *with Korus*

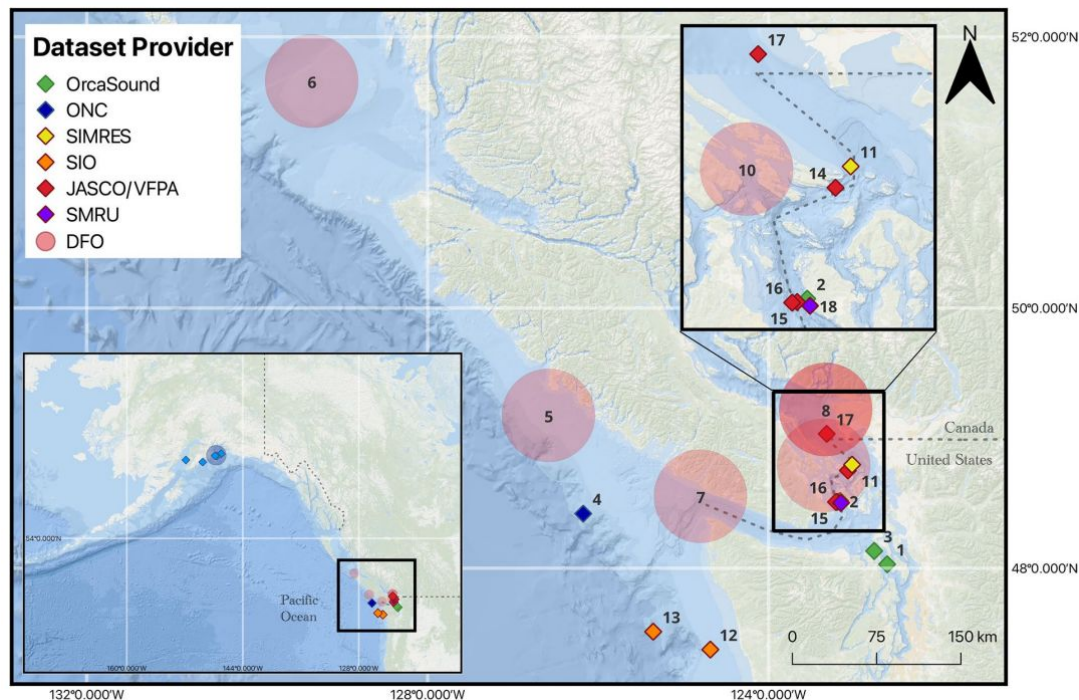
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Motivation

We need large *and* diverse datasets for developing strong acoustic detectors and classifiers.

But, keeping track of data from multiple sources, annotated by different individuals, quickly becomes a challenge.



K. J. Palmer *et al.* A Public Dataset of Annotated Orcinus orca Acoustic Signals for Detection and Ecotype Classification, Scientific Data (2025) 12:1137, <https://doi.org/10.1038/s41597-025-05281-5>

HALLO acoustic data inventory

Last updated: 2025-11-03 05:34:44

Overview

no. audio files	57041
combined duration (HH:MM:SS)	204 days, 11:11:41
no. annotations	551745
annotation density	1.3%
deployments	- DFOCRP_H50bjRcb-WCV1 - DFOCRP_KkHK0R2F-NML1 - JASCO-ULS - JASCO_BoundaryPass - Malahat Stn 1 - Malahat Stn 2 - Malahat Stn 3 - Malahat Stn 4 - Malahat Stn 5 - Malahat Stn 6 - SoGEast_JascoAMARArray_ULS1_2015-09 - VFPA Haro Strait Northbound - VFPA Haro Strait Southbound - BarkleyCanyon_UpperSlope_IP_South_Hydrophone_2013-05 - Orcasound_Lab - EastPoint2022 - MonarchHead2022 - LimeKiln

By Species

Species	No. annotations (confident/tentative)
KW	133976/530
HW	357110/606

By KW Ecotype

KW Ecotype	No. annotations (confident/tentative)
SRKW	24897/2401
NRKW	24999/33
TKW	26265/1233

By KW Sound Type

KW Sound Type	No. annotations (confident/tentative)
TC	86041/49
PC	11789/17
W	544/33

Metadata and annotations

Which metadata do we wish to capture?

1. Acoustic data

- When and where was the hydrophone deployed?
- At which depth?
- Was the hydrophone duty-cycled?
- Where are the audio files stored?
- Any known technical issues?
- Who owns the data?
- What are the terms of the data-sharing agreement?
- etc.

2. Annotations

- Do we have a standardized set of labels for annotating sounds? (Yes, hopefully!)
- How do we quantify confidence?
- Which level of 'granularity' do we use? (call, window, encounter, etc.)
- What was the annotation 'protocol'? (Annotate all occurrences, only some, etc.)
- etc.

Existing tools

Tethys: tethys.sdsu.edu

"A freely available, open source, temporal-spatial database for metadata related to acoustic recordings."

Used by a number of U.S. research institutes.

Proposed set of standards submitted to ASA/ANSI.

Limitations:

- Tethys client software in multiple languages (Matlab, Java, Python, R) and runs on all platforms, *but* server software runs on Windows only.
- Tethys is a general-purpose tool. It lacks specialized functionalities for creating machine-learning datasets.

Roch *et al.* (2016). "Management of acoustic metadata for bioacoustics," Ecol. Inform. 31. 122-136. <https://doi.org/10.1016/j.ecoinf.2015.12.002>



BSR/ASA S3/SC1-2025

AMERICAN NATIONAL
STANDARD

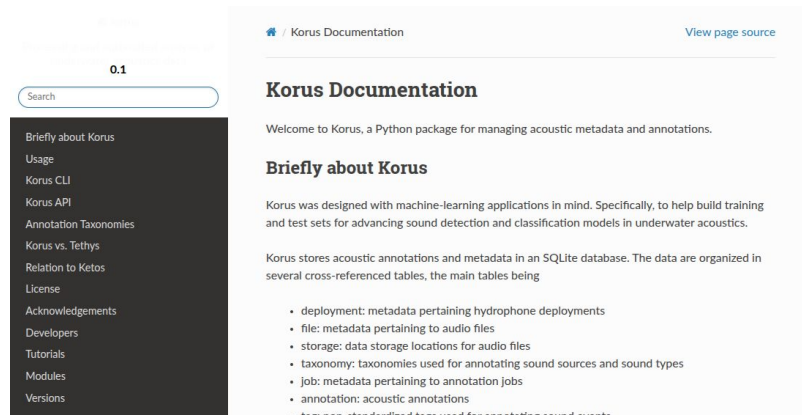
**Standards for Acoustic Metadata for Passive Acoustic
Monitoring**

Korus

An open-source Python package for managing acoustic annotations and metadata.

Highlights:

- Hierarchical & versioned annotation taxonomy
- Specialized functionalities for creating machine-learning datasets
- Integrates nicely with [Ketos](#)
- SQLite database (local instance)
- Python API
- CLI app (terminal)



<https://meridian-analytics.github.io/korus/>

Labels

- You build your own annotation taxonomy of **standardized labels**
- Sounds are labelled by their *source and type*, e.g., NARW, upcall
- Each sound source has its own tree of sound types.
- The taxonomy is **hierarchical**, e.g., *NARW* is a special instance of *Whale*
- The taxonomy is **versioned** and may evolve over time, e.g., add, remove, rename, merge, and split classes.

Example:

View the taxonomy used by the acoustic analyst for labelling sound sources,

```
>>> tax = db.taxonomy.current
>>> tax.show(append_name=True)
Unknown
├ Anthro [Anthropogenic]
│   └ Boat
│       ├── Engine
│       └ Prop [Propeller]
└ Bio [Biological]
    └ Whale
        ├── HW [Humpback whale]
        └ NARW [North Atlantic right whale]
```

and the taxonomy used for labelling NARW vocalisations,

```
>>> tax.sound_types("NARW").show(append_name=True)
Unknown
├ GS [Gun shot]
└ TC [Tonal call]
    └ Upcall
```

Tags

In addition to (or instead of) using standardized labels, you can also use non-standardized 'tags' to annotate your data.

Examples tags:

- Aberrant
- Masked
- Faint
- High-SNR

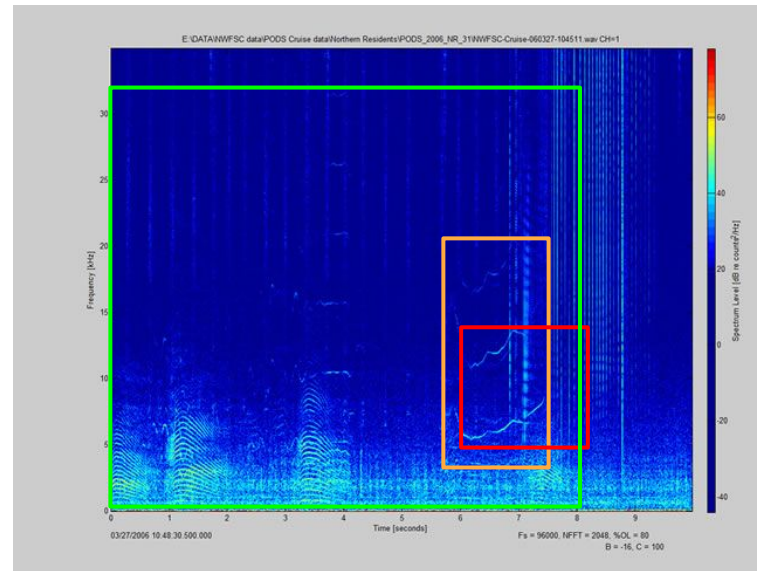
Label 'types'

Every annotation has several 'types' of labels,

- Confident ("it is this")
- Tentative ("it could be this")
- Ambiguous ("it is one of these")
- Excluded ("it is definitely not any of these")
- Multiple ("it is all of these")

Granularity levels

- **Unit:** Annotation of a single vocalisation/sound. Bounding box drawn snugly around a single vocalisation/sound. Overlapping sounds may be present.
- **Window:** Annotation of a single vocalisation/sound. Box width does not necessarily match sound duration. Sound may be fully or only partially within the box. Overlapping sounds may be present.
- **Batch:** Annotation of multiple vocalisations/sounds.
- **File:** Annotation spanning precisely the duration of a single audio file.
- **Encounter:** Annotation of an entire (biological) acoustic encounter.



cetosresearch.org/

RavenPro template (.tsv)

Bioacousticians typically use RavenPro for annotating acoustic data.

To facilitate ingestion of annotations into Korus, we have a template .tsv file:

Selection, View, Channel, Begin Path, Begin File, File Offset (s), Delta Time (s), Low Freq (Hz), High Freq (Hz), Sound Source, Sound Type, Tentative Sound Source, Tentative Sound Type, Batch Annotation, Comments

Slash (/) should be used for ambiguous source/type assignments.

Ampersand (&) may be used for multiple assignments (although the preferred approach is to create multiple annotations.)

How to use Korus

CLI app

- Type commands in the terminal
- Useful for viewing and adding data, and making minor edits

Python API

- Write your own scripts in Python
- Full control
- Necessary for creating and editing the annotation taxonomy
- Useful for making programmatic queries and creating machine-learning datasets

CLI

```
>>> $ korus-cli db.sqlite
>>>
>>> Welcome to the Korus command-line-interface v0.1.0.
>>> Connected to: test.sqlite
>>> Use the prompts to view, add, or edit data.
>>> To return to the previous prompt or exit the program, hit Ctrl+C
>>> https://meridian-analytics.github.io/korus/
>>>
>>> [?] [main] Select table:
>>> > deployment
>>> storage
>>> file
>>> job
>>> taxonomy
>>> tag
>>> granularity
>>> annotation
```

Python API

Search the database for NARW upcalls,

```
>>> indices = db.annotation.filter(select=("NARW", "Ucall")).indices
>>> print(indices)
[1, 4, 12]
```

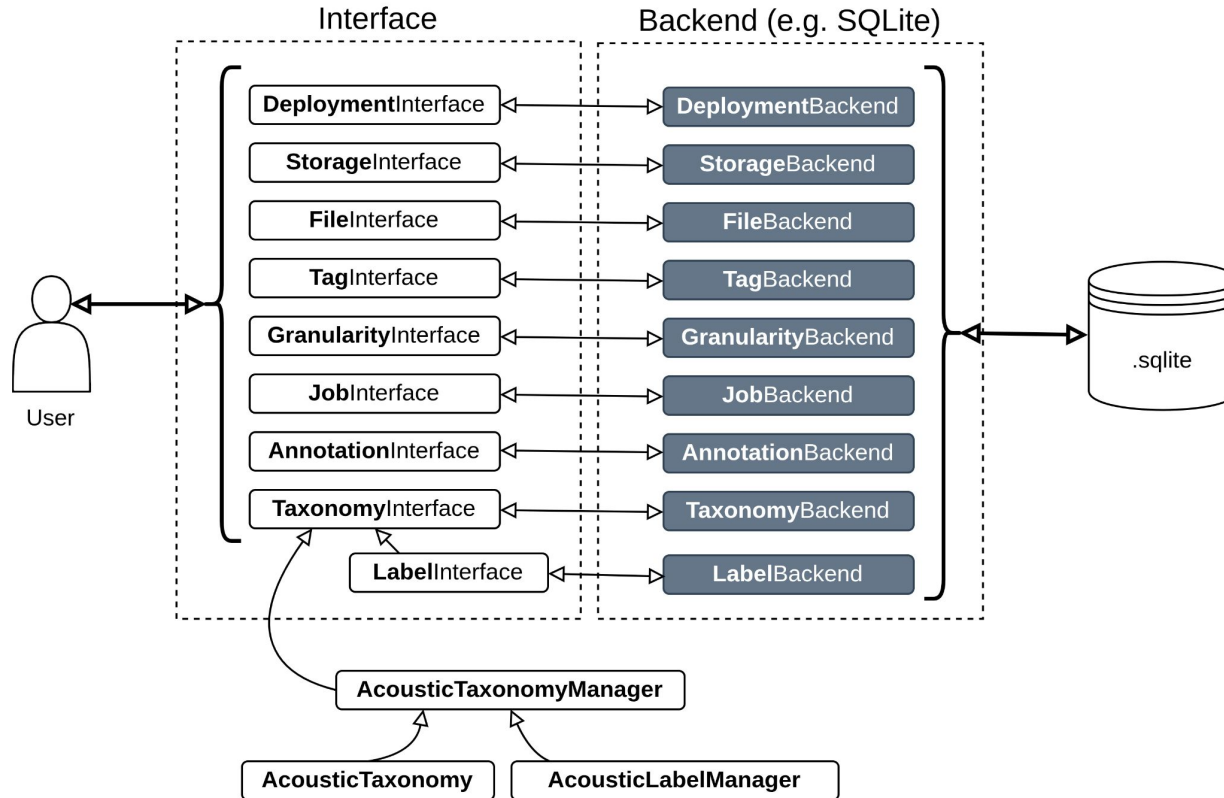
Export the annotations to a plain text file in the standard (RavenPro-compatible) Korus format,

```
>>> db.annotation.to_raven("annotations.tsv", indices)
```

Or - to create a training set for a machine-learning model - generate a set of uniformly-sized selection windows in the format expected by [Ketos](#),

```
>>> df = db.annotation.create_selections(indices, window=3.0)
>>> print(df)
  sel_id  filename  start  end  annot_id
0      0  20130623/audio_20130623T080000.116Z.flac  1127.340  1130.340      0
1      1  20130623/audio_20130623T080000.116Z.flac  1152.026  1155.026      1
2      2  20130623/audio_20130623T080000.116Z.flac  1195.278  1198.278      2
```

Korus software diagram



It's time for a little demo



What's next

- Start using Korus to create ML datasets
- And use the datasets to develop improved detection & classification models!
- Maybe publish a software paper about Korus?
- Maybe organize a Ketos/Korus workshop?

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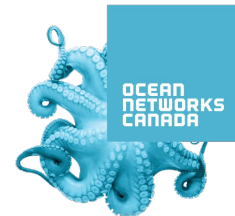
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