

From: Kuhn Linda linda@mbari.org

Subject: Video requests for automation and understanding what is in the VARS database

Date: July 1, 2016 at 11:26 AM

To: Nancy Jacobsen-Stout jana@mbari.org, Duane Edgington duane@mbari.org, Danelle Cline dcline@mbari.org, Dallas Hollis dhollis@mbari.org, Brian Schlining brian@mbari.org, Kyra Schlining schlin@mbari.org, Lonny Lundsten lonny@mbari.org, Susan vonThun svonthun@mbari.org

LK

This is a lot of info, but I think it's important to get this all down in one document. I'm hoping that midwater annotators and Lonny will add additional information that will help explain the VARS database (now at 5.1 million observations!). Because I understand this, I may not be the best person to describe it! I may be leaving out details that are needed to understand what I'm talking about and so please, please feel free to ask questions. I'm trying to hit all of the bases and not just address the current requests (Google and SRI). Dallas has been a great help in thinking about all of this! He is writing up a protocol that will help make this smoother.

Sources of discrepancy we've identified, or are potential issues (has not been brought up yet, but I could see there there might be confusion) for outside groups matching annotations to the position of an individual animal are:

1) The digital file start is delayed by a little due to the way that BlackMagic capture starts actually recording and when you push the play button. Dallas has a method in mind that avoids this and is writing this up in the procedure.

2) Three of the SRI clips are good examples of dives that are complicated in that the annotations were made from the standard definition tapes, but transect portions of the dives were recorded in HD (this was back in the day when HD tapes were very expensive and only used to record "highlights" of a dive). When the SRI request came through, I made the video clips from the HD tapes so that SRI would have the best video to work with, not having recognized at the time that a VARS query with annotations from SD would be given to them that have a different timecode than the HD tapes. Luckily someone caught this before we gave the info and files to SRI. Solution to this is below in recommendations.

V3165-01 HD clip start = 04:41:40:00, on SD tape (annotations) timecode started at = 00:00:00:01

V3165-02 HD clip start = 05:41:56:00, SD tape (annotations) timecode started at = 01:00:22:06

V3138-01 HD clip start = 16:50:06:29, SD tape (annotations) timecode started at = 01:26:32:15

V3483-01 HD clip start = 00:00:00:00 annotations are in HD (same time code)

3) The VARS queries being sent to collaborators with the elapsed time added to it did not have an output for the "camera direction" or "annotation mode" which would indicate where in the video file collaborators can expect one-for-one annotations (when camera direction = transect), and where the annotations are more general and can't be matched very closely to a specific time code (when camera direction is anything else). There are also differences in outline vs. detailed annotation modes.

Outline annotations include animals discernible at approximately 2x real-time tape speed. The level (species, genus, family, etc.) and certainty of identification depends on current knowledge of deep-sea organisms and physical factors, such as ROV speed, camera setting, or visibility. Outline annotation also includes characterization of major habitats, such as seep or canyon wall, and geological features such as rock outcrop, sand, or fault at least every 5 minutes or so and at transitions from one habitat to another. Not every animal is annotated, but rather a general story of the dive - habitats, and which animals make up the biological community over the dive track. For organisms that are abundant (example: one annotation of *Sebastes saxicola* with an association of population quantity 999 (which means something more than 3 in the immediate vicinity of the annotation), or dense.

Detailed annotations when used on primarily midwater dives include all discernible organisms, behaviors, and habitats possible at real-time speed. Most primarily midwater dives are annotated in this mode, whereas benthic dives are only labeled as "detailed" if they contain transects. When used on benthic dives, it indicates that transects were conducted during the dive. Some parts of the dive may be annotated in outline.

Camera direction: There are lots of them, but **transect**, and **off transect** are of particular import.

Transect indicates that we are moving through the ecosystem while controlling the field of view so that we can calculate an area of seafloor (usually 1 meter across) or a volume of seawater visualized as consistently as possible and can be calculated. This is the only way to quantitatively compare the biological community in different areas or over different time periods. Compare this to detailed midwater dives. In both, all discernible animals are being annotated, but in detailed mode the field of view might be wide, narrow, might be staring at an animal for up to 30 + minutes, collecting samples, etc.

Off transect is used when I want to note that an animal is present in transect footage but it cannot be counted on the transect (it is rare, an exceptional view of it, etc.). See #4

4) Benthic transect footage: animals observed in the upper corners of the field of view may be visible on video, but are not counted on transects if the animal does not cross the lasers (due to the necessity of keeping a 1 m wide field of view). These animals would appear to be "missing" from the annotations. This is because benthic footage is filmed at an oblique angle (vs midwater transects that are filmed straight ahead). You can see this page for details (second paragraph under Linear Measurements of objects in VARS. https://mwww.mbari.org/itd/video/Benthic_transects.html)

5) For benthic transects annotated by Linda: animals may, but are not necessarily annotated in the order they are seen on the video (I'm annotating in a way that is most efficient ways for me; example: my eye will see three of something and I click a concept 3 times vs. waiting for them each to cross the laser midline). so observations may not be mapped at the exact time code (elapsed time) as in

the files. The tape may be rolling at a slow speed as annotations are done and in quick tests I did today, you could generally expect that that animal could potentially be +/- 1 second (60 frames) from when it is centered on the screen in transect mode (depending on the speed of the ROV) - maybe a max of 2 seconds. Dallas is running some tests - sounds like there was an outline video where things were off by 30 seconds. That is some other type of problem that I'll trouble shoot this afternoon.

6) Not all benthic transects are created equal. For some projects, every animal in the community is annotated, others may have a list of species that are annotated (ex: Station M dives; all eventually have every animal). Not every object seen in video is of interest, and thus not annotated. Very small objects, non-living animals (examples: empty snail shells, empty bivalve shells, individual polychaete tubes where we don't know if they contain a live animal, etc.). Dives where we measured animals on a transect are particularly good because the animal has to be lined up with the lasers and will be in the center of the frame for the timecode listed. I just gave Dallas info on 4 of these types of dives that I finished this week.

7) Shouldn't cause much confusion: Nothing is always perfect. If the ROV gets pulled back by the boat and goes out of control for a moment, a human can account for this sudden temporary change in the field of view and not annotate objects that are beyond the target 1 meter width in the field of view. Effect: an object might be observable at the edges of a section of video, but not annotated as part of the transect. The same with footage where the ROV is "porpoising" up and down for a little while from currents (or new ROV pilots). We can't cut out all of that footage from the study, so I adjust a bit to make it usable.

8) Be aware that transects may not have been fully annotated yet. At sea, staff are listing where the start and stop of transects occur and perhaps taking framegrabs and annotating some objects on the transect. Later as a project becomes a priority, these sections are more fully annotated, but in the meantime there is no real way for a non-VL person to know that an individual annotation marked as a being on a transect is or is not part of a transect where we have finished all of the the work.

Recommendations/things to consider. With the goal of software engineering being able to pull and make files independent of video lab staff (the current goal as I understand it) these are things I think would help (Dallas and I have talked about most or all of these):

- Exclude data annotated in standard definition if possible (when you do a VARS query tape numbers that do not have HD behind them (example V3138-01 vs V3138-01HD))
- When deciding on animals that might be a good subject for study, consider if they are rare - at least for an initial testing phase
- VARS queries: always check the box to return results for Camera Direction, and Annotation Mode (both on the advanced tab).
- When looking in the database dive tapes with lots of a specific animal on them, make sure to exclude multiple instances of the same animal (the same "identity-reference number" for a given concept within the same dive number).
- For partners that are just starting out with MBARI video, consider sticking to benthic transect data and supplying them with a routine information sheet that includes some of the info from #3, #4 and #5 above. This would give the best chance of them finding and analyzing the footage.
- If non-transect footage is needed (what does the animal look like far away), consider having VL staff go ahead and re-annotate every animal observed in outline footage sections. This wouldn't be greatly time consuming (2 hours or less for the SRI request example) and would give the best chance of a collaborator having the information they need to get up and running.
- The VARS database has been annotated over many, many years, by many, many people. In my experience there will always be changes and differences in how annotations occurred over time and a lot of the knowledge about what and when things were happening is in our video lab heads or is documented in worksheets derived from VARS data for specific projects. There are ways for us to set up new coding so that non-VL people can know what is/was happening and perhaps this can be worked on in the future.
- Feel free to invite collaborators to come watch us annotate if that helps!
- Regarding #7, it would be great to do a project that tracks the width of the lasers in relation to the width of the field of view so we can calculate area more accurately and automatically for benthic dives.

LINDA KUHNZ
MONTEREY BAY AQUARIUM RESEARCH INSTITUTE (MBARI)
7700 SANDHOLDT ROAD
MOSS LANDING, CALIFORNIA 95039
PHONE 831.775.1840
FAX 831.775.1620
WWW.MBARI.ORG

