

MBARI Media Management

Tools for Turning Video into Data

Brian Schlining

MBARI Media Management

Video Annotation and Reference System

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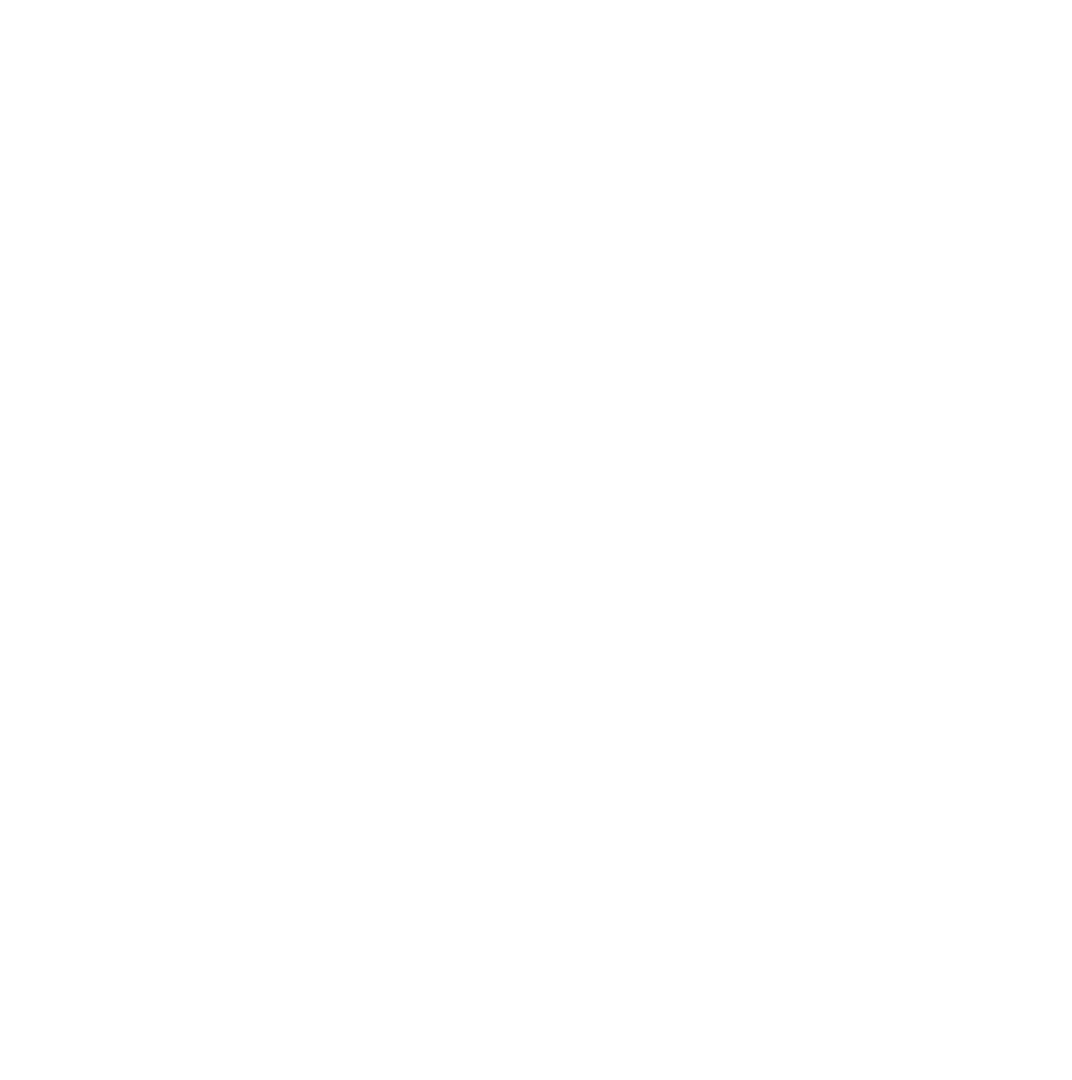
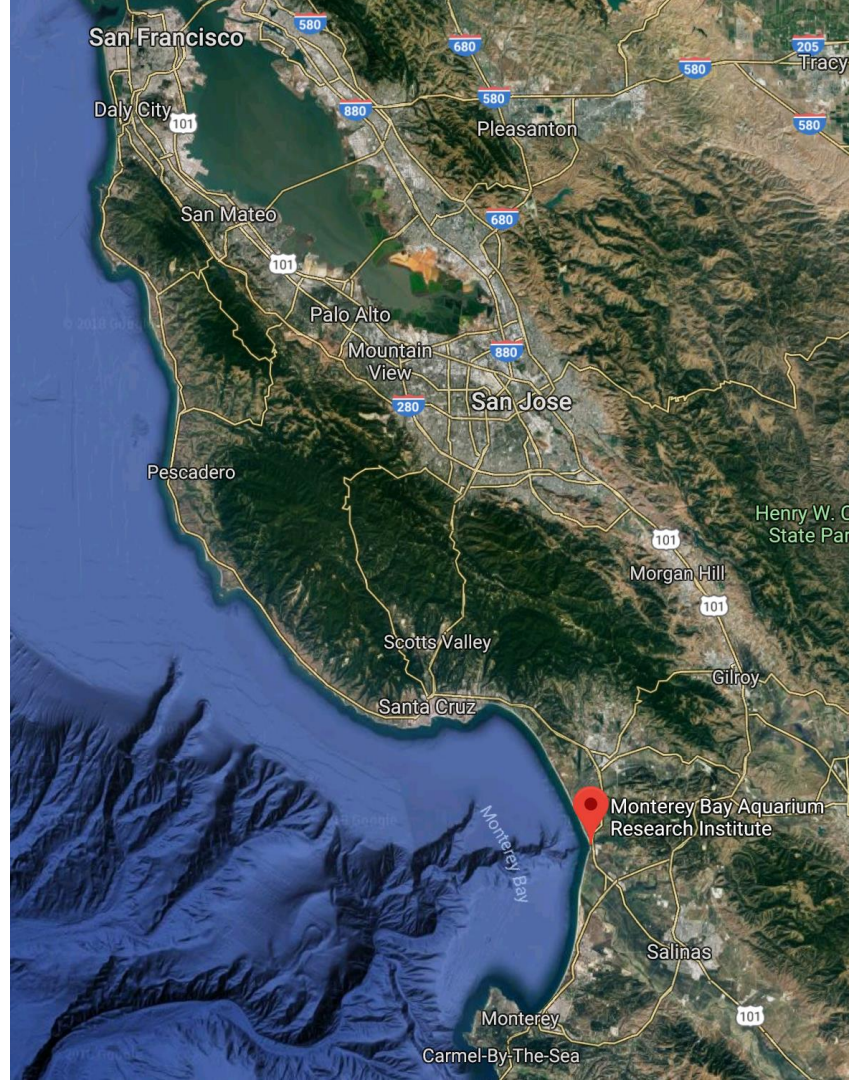
M3

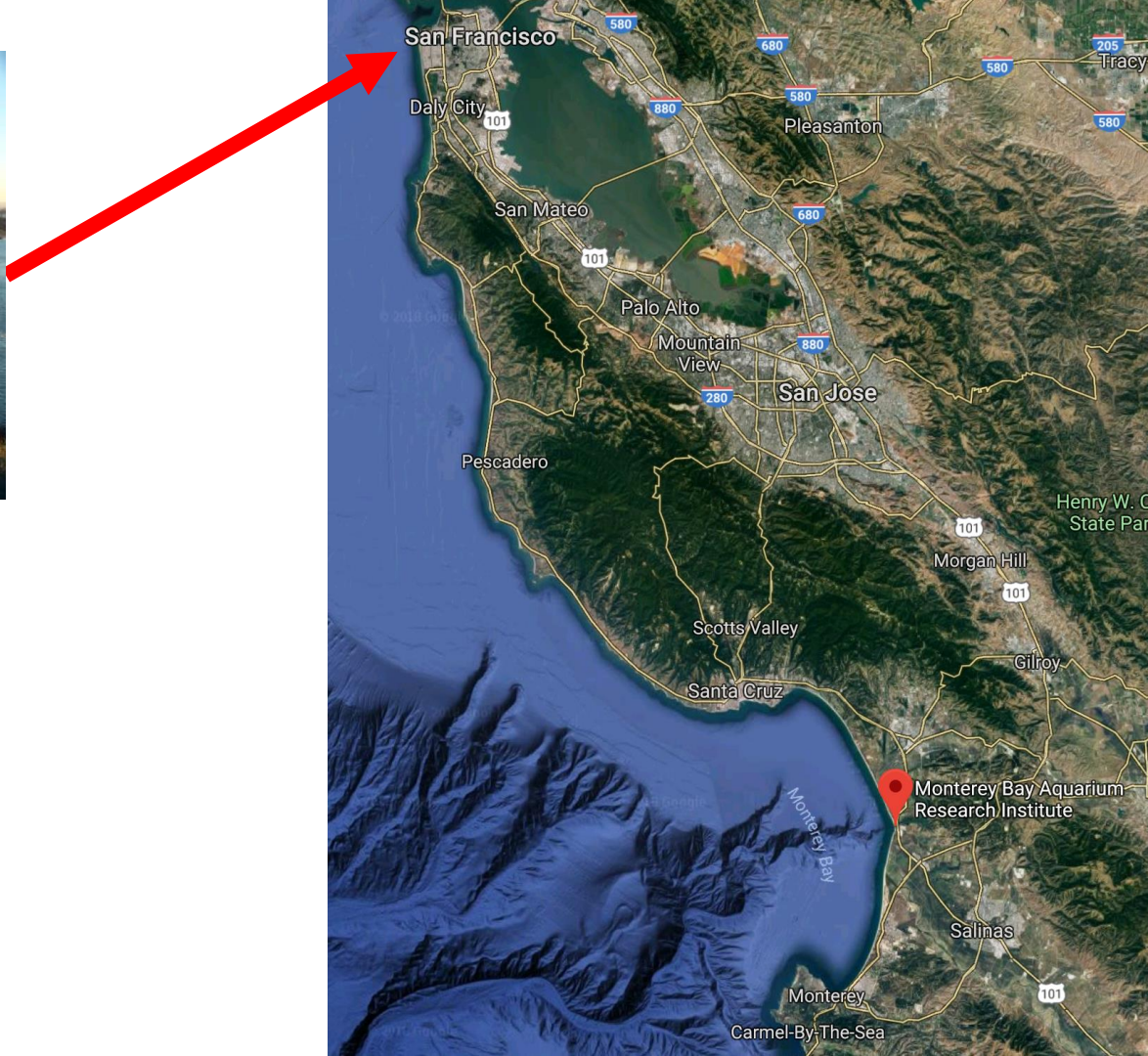
Video Annotation and
Reference System

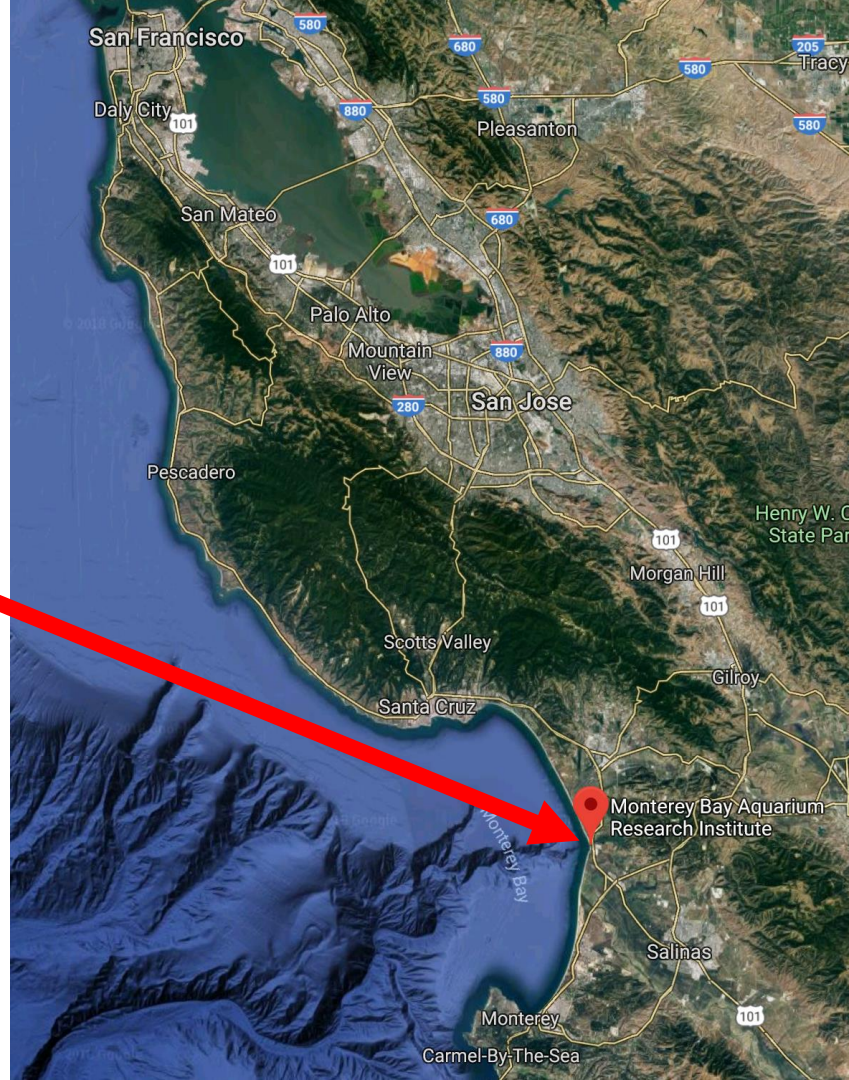
VARs

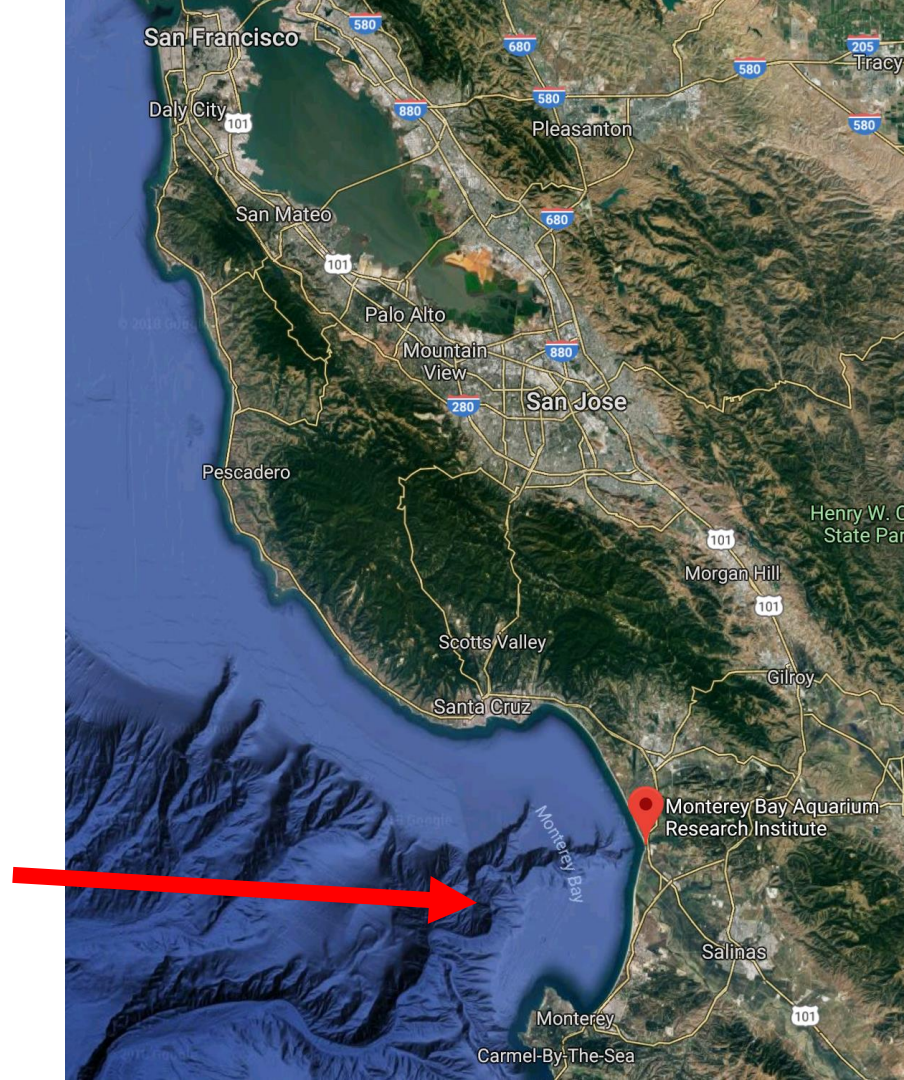
Brian Schlining

About MBARI







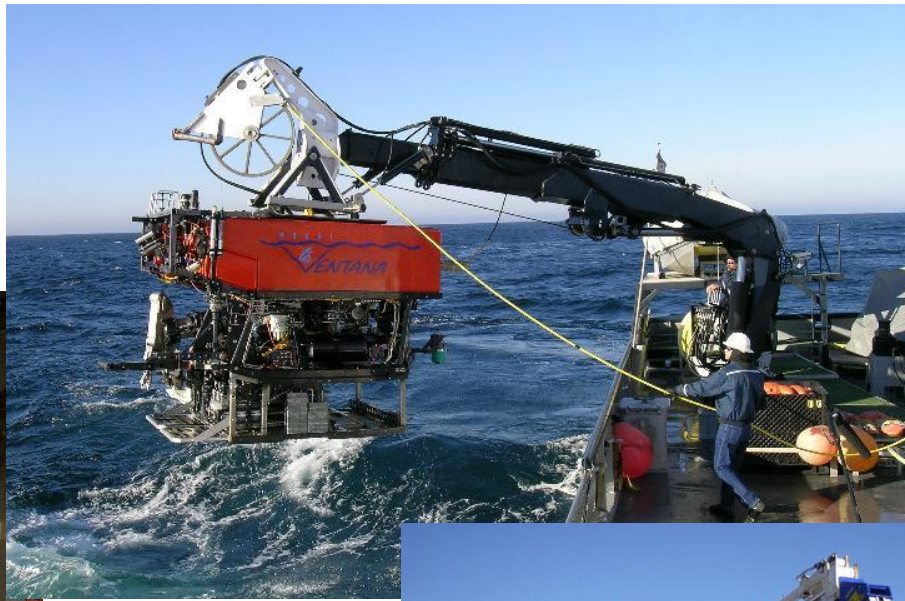


underwater video ...

A novel approach

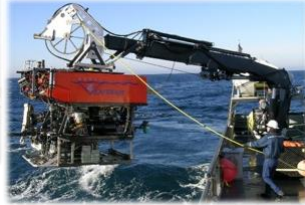
- Collect a lot of video
- Systematically catalogued = easily retrievable
- Managed as institutional resource





TODD WALSH (c) 2009 MBARI

Video workflow



At sea...



Control Room - video recording & preliminary analysis



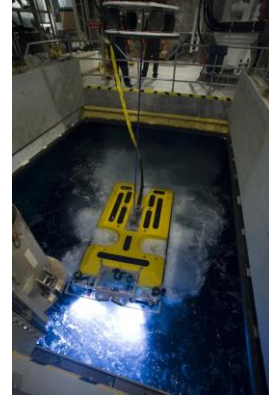
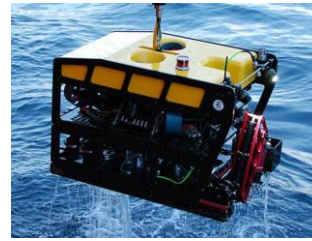
Onshore -
video
archiving



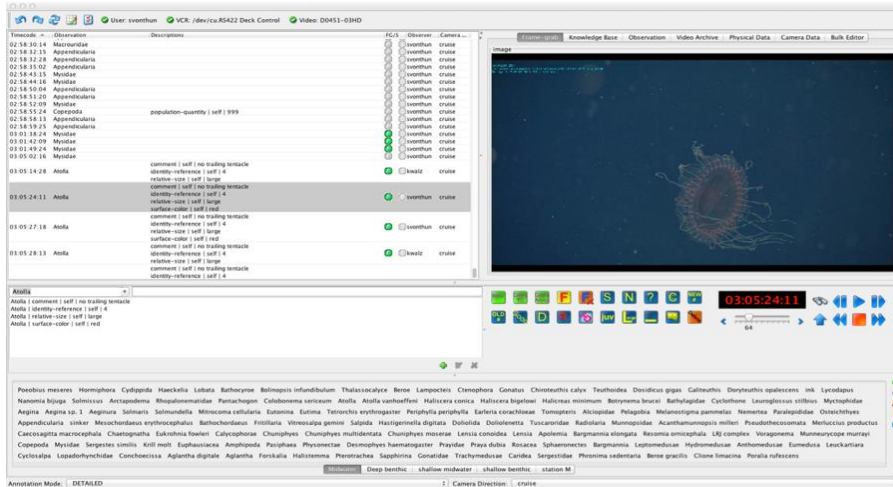
Video Lab - comprehensive annotation

Today - scientific value

- Annotation expertise
- Video Annotation and Reference (VARS) software



- 27,000 hours of video
- 6+ million observations

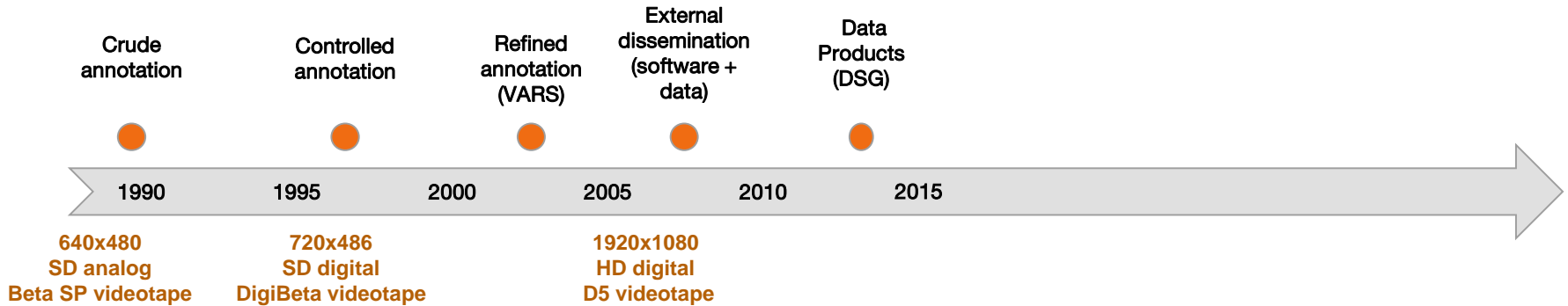


Central management & careful cataloguing =

- Exploration, discovery, biodiversity baselines, long term monitoring
- 400+ peer-reviewed publications

Visualize and understand...ecosystem dynamics, biogeochemical cycles, and human impacts

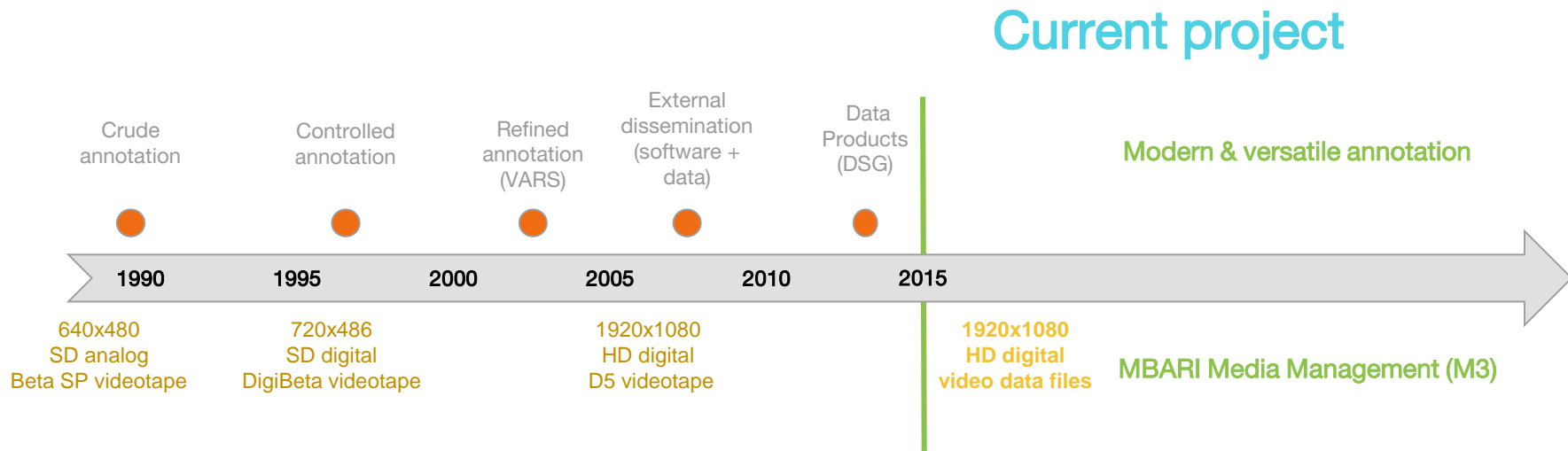
Program development history



Single platform support - ROV video recordings

Single media type - TAPES

Program development history



Single platform support - ROV video recordings

Single media type - TAPES

Multiple platform support - MiniROV, AUV, Rover, observatory, etc.

Multiple media types - TAPES, FILES, and STILL IMAGES

Exploring the field

→ Institutions

- ◆ Ocean Networks Canada (Neptune)
- ◆ *Okeanos Explorer* (NOAA)
- ◆ *Nautilus*
- ◆ WHOI (*Alvin*)
- ◆ R/V Thompson, MARS cable network
- ◆ Pacific Research Platform (Cinegrid industrial collaboration)
- ◆ Schmidt Ocean Institute
- ◆ JAMSTEC

→ Industry (news and film)

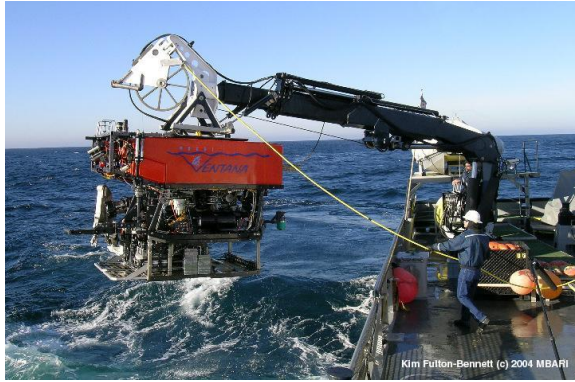
- ◆ NHK, CNN, KQED
- ◆ National Geographic
- ◆ WWF
- ◆ Field experts: Adam Wilt, Larry Jordan

→ Museums

- ◆ USC Digital Library
- ◆ US Holocaust Museum
- ◆ Smithsonian Institution Archives

Relevancy, failures, success in technology and workflow

So ... what did MBARI build?



1. Video Capture and Archiving



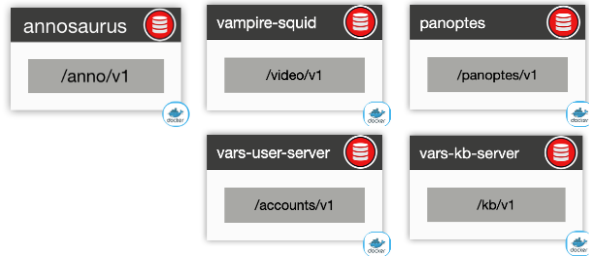
So ... what did MBARI build?



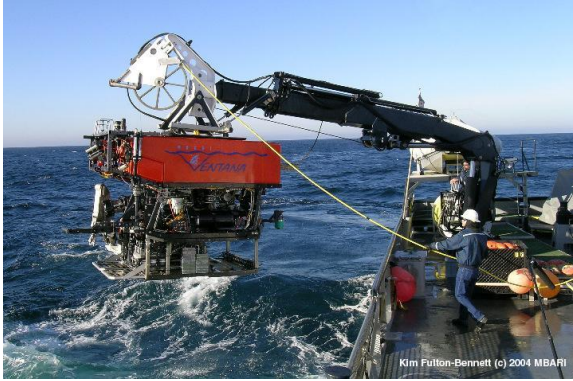
1. Video Capture and Archiving



2. Video and Annotation Management Services



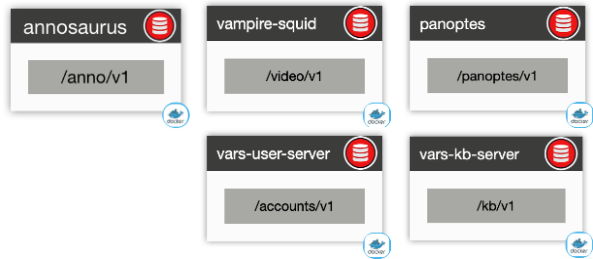
So ... what did MBARI build?



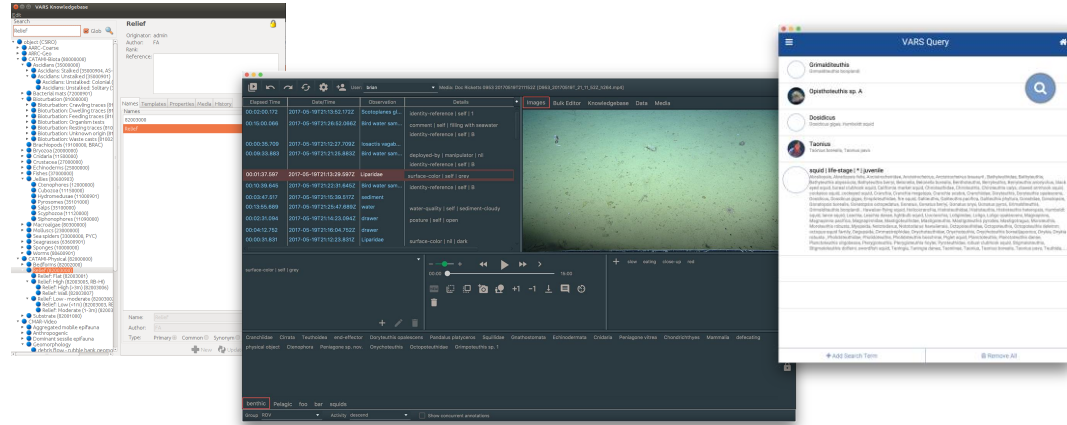
1. Video Capture and Archiving

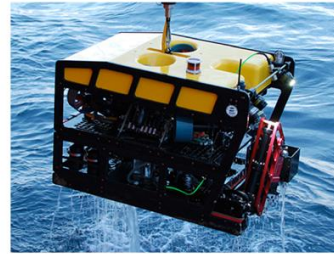


2. Video and Annotation Management Services



3. Video Annotation applications

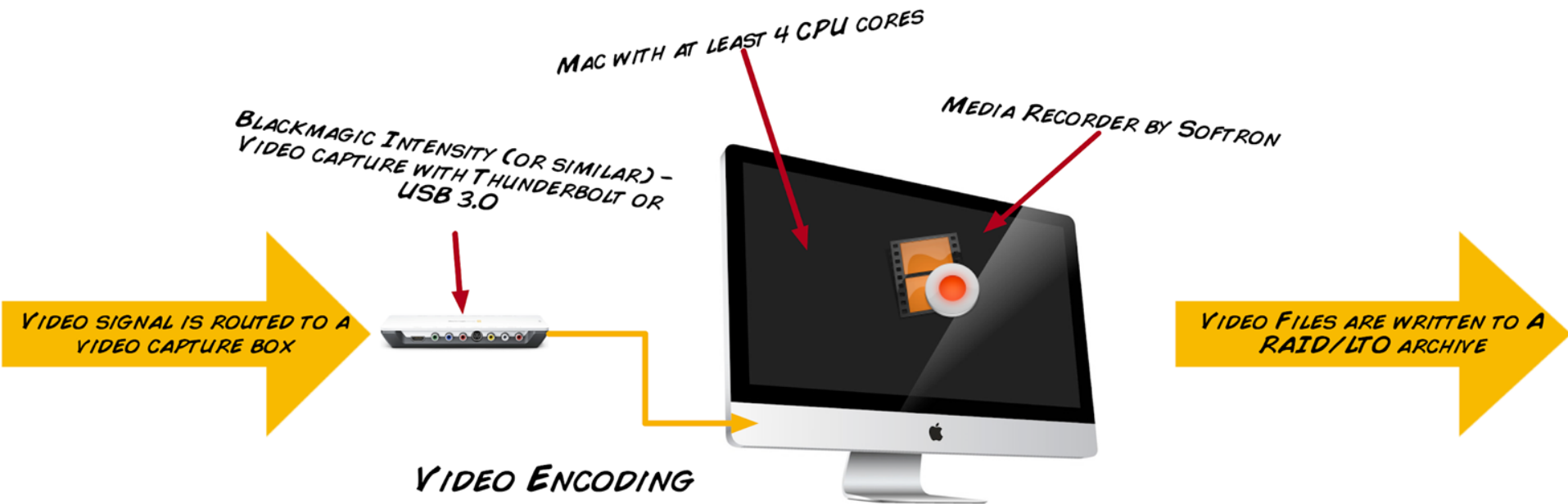




VIDEO SIGNAL IS ROUTED TO A VIDEO CAPTURE BOX

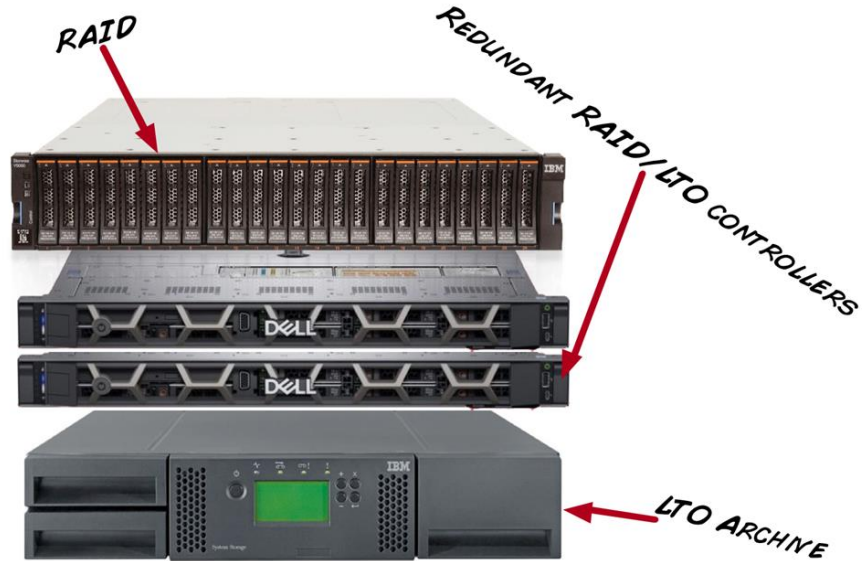


Video Capture



Video Capture

VIDEO FILES ARE WRITTEN TO A
RAID/LTO ARCHIVE



Video Capture

Video is recorded in 15 minute chunks

**VIDEO FILES ARE WRITTEN TO A
RAID/LTO ARCHIVE**



ProRes HQ



H264/MP4



Video Capture

Video is recorded in 15 minute chunks

*VIDEO FILES ARE WRITTEN TO A
RAID/LTO ARCHIVE*



ProRes HQ
~ 25GB



H264/MP4
~ 2.5GB

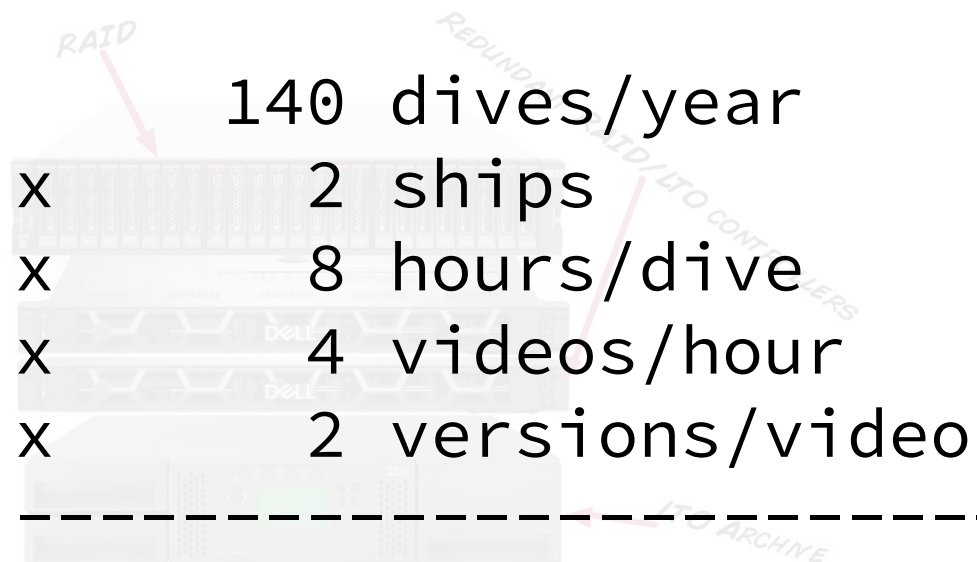
Video Capture

Each video has correct *creation-time* metadata



Video Capture

VIDEO FILES ARE WRITTEN TO A
RAID/LTO ARCHIVE

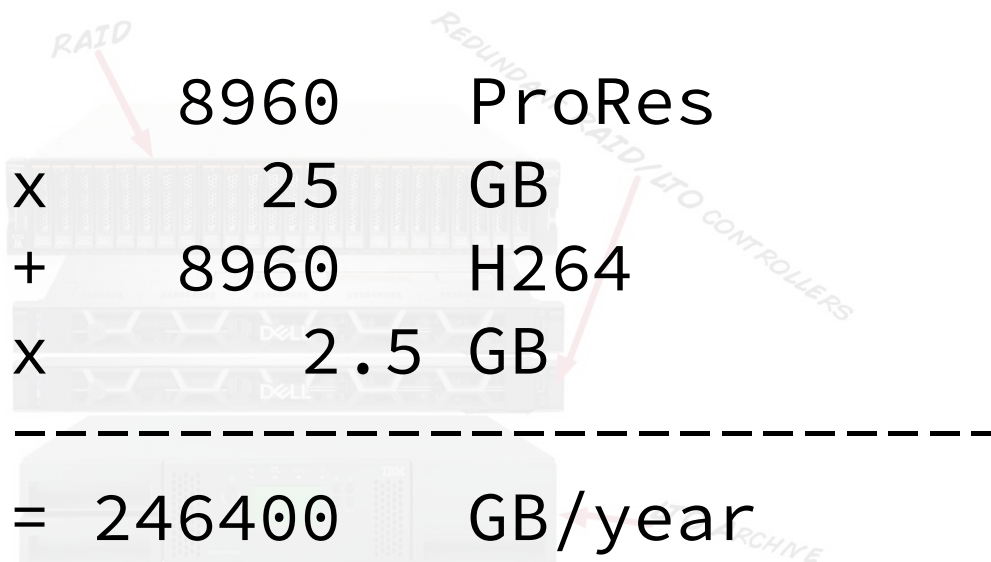


140 dives/year
x 2 ships
x 8 hours/dive
x 4 videos/hour
x 2 versions/video

= 17920 videos/year

Video Capture

VIDEO FILES ARE WRITTEN TO A
RAID/LTO ARCHIVE

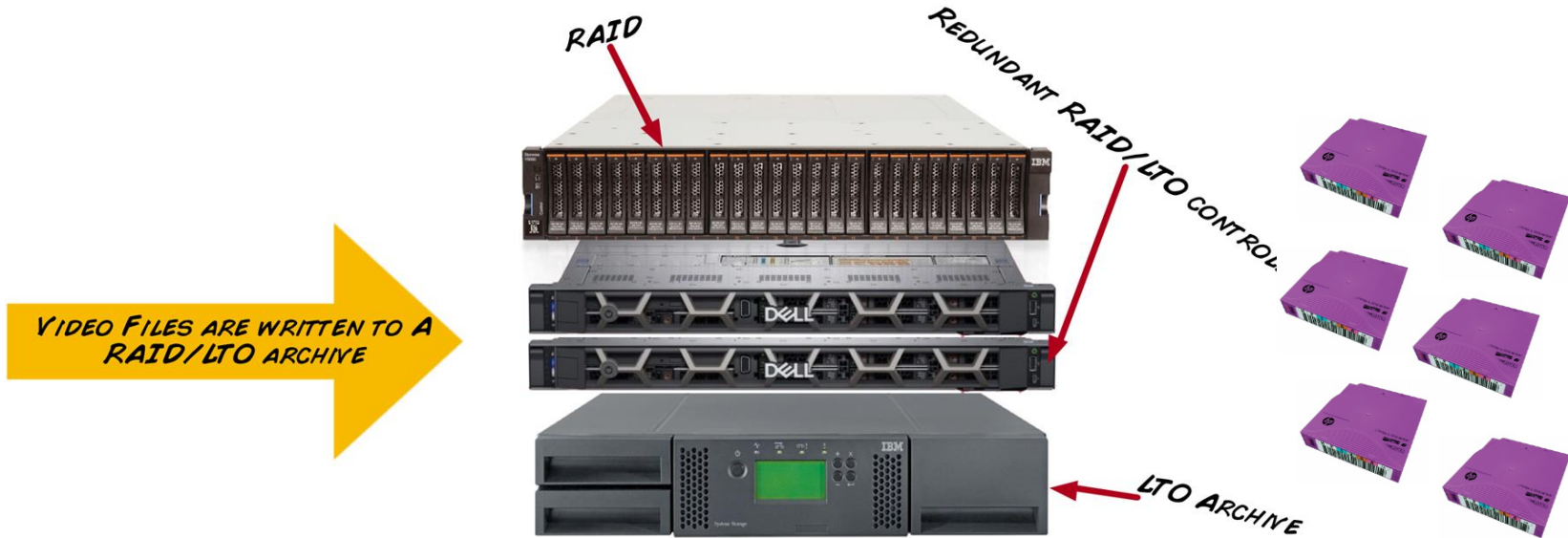


8960 ProRes
x 25 GB
+ 8960 H264
x 2.5 GB

= 246400 GB/year
= 246.4 TB/year



Video Capture



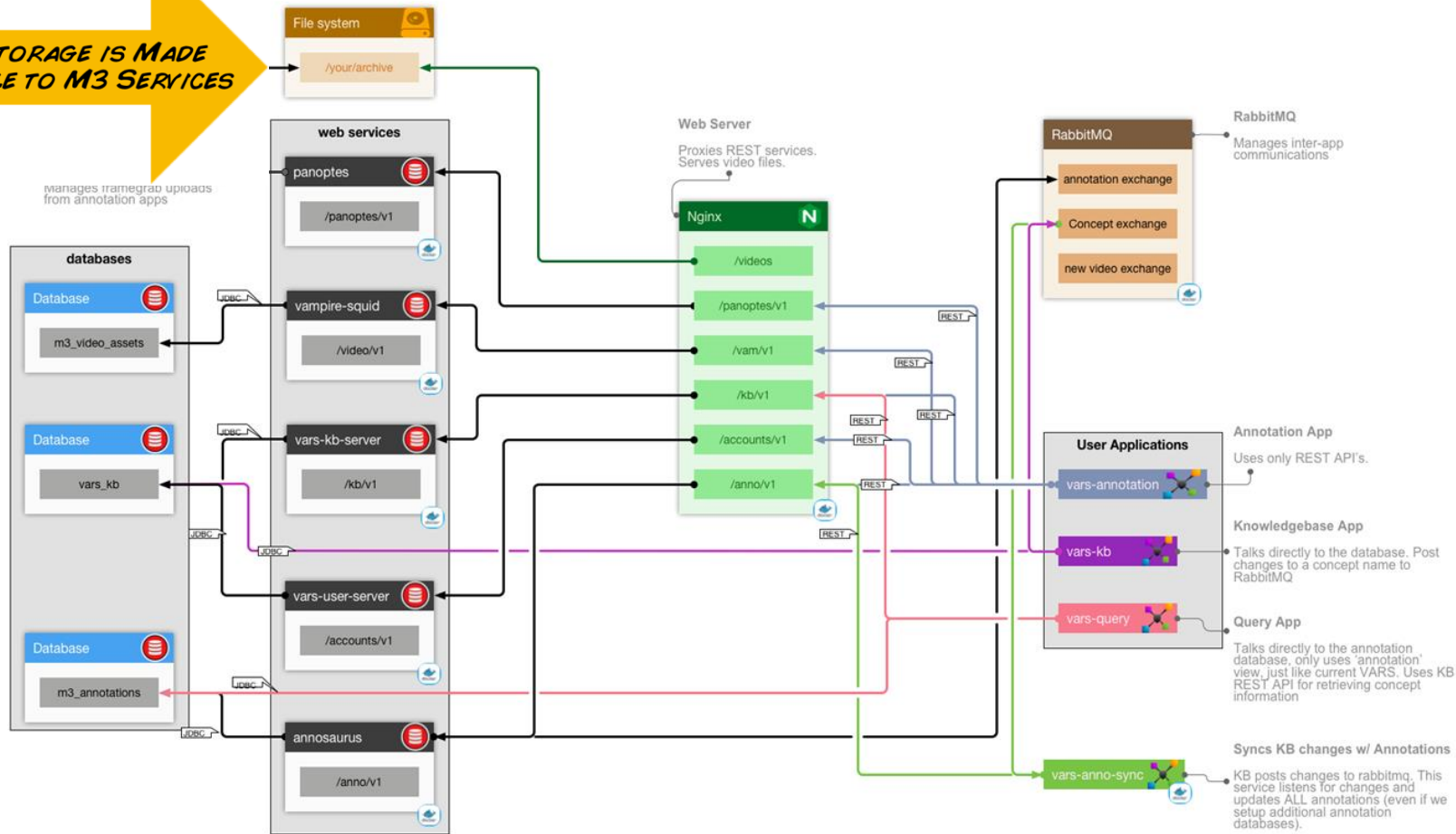
Video Capture



***FILE STORAGE IS MADE
AVAILABLE TO M3 SERVICES***



FILE STORAGE IS MADE AVAILABLE TO M3 SERVICES



FILE STORAGE IS MADE AVAILABLE TO M3 SERVICES

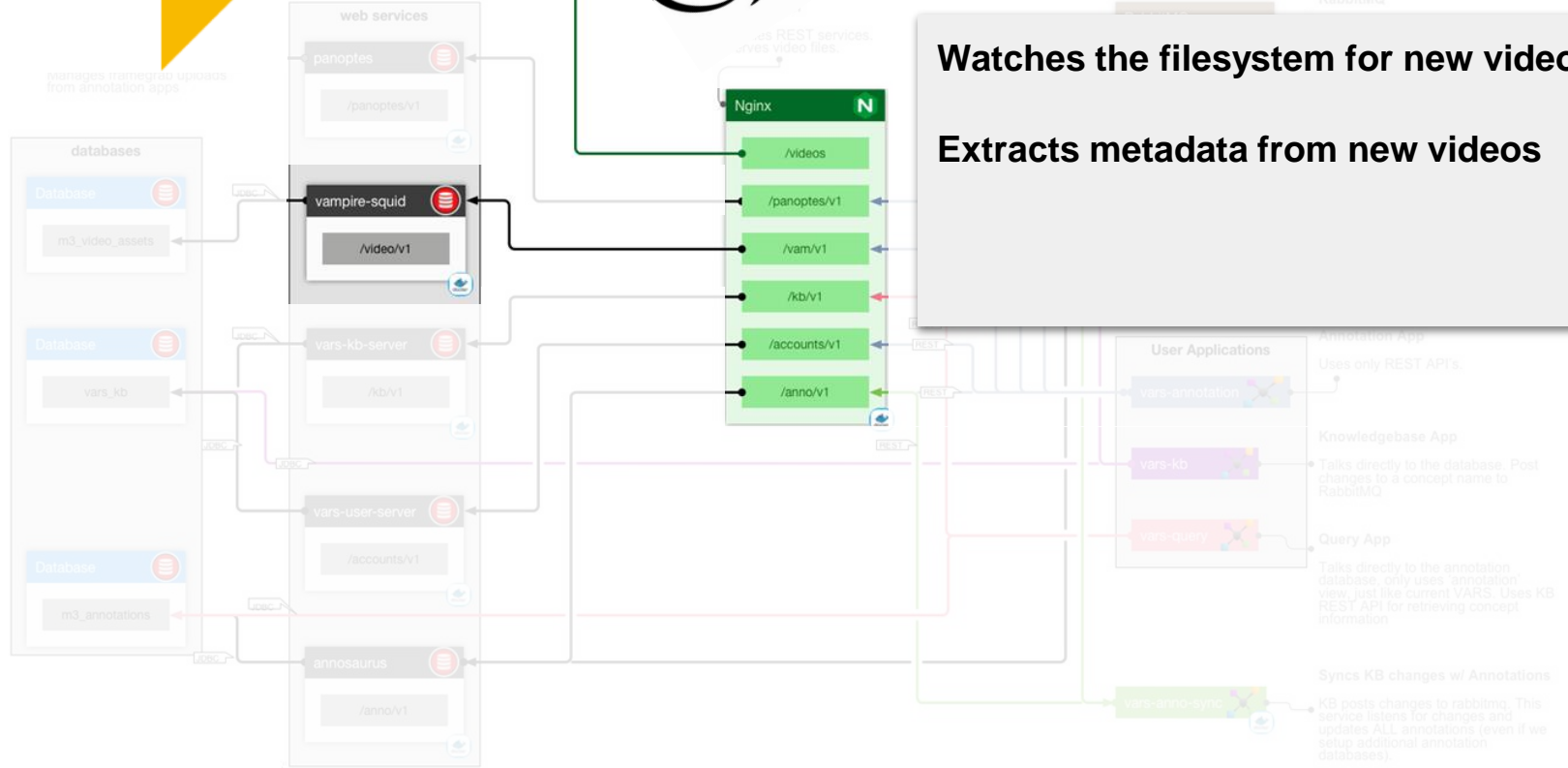


m3-registrar



RabbitMQ

**Watches the filesystem for new videos.
Extracts metadata from new videos**



FILE STORAGE IS MADE AVAILABLE TO M3 SERVICES

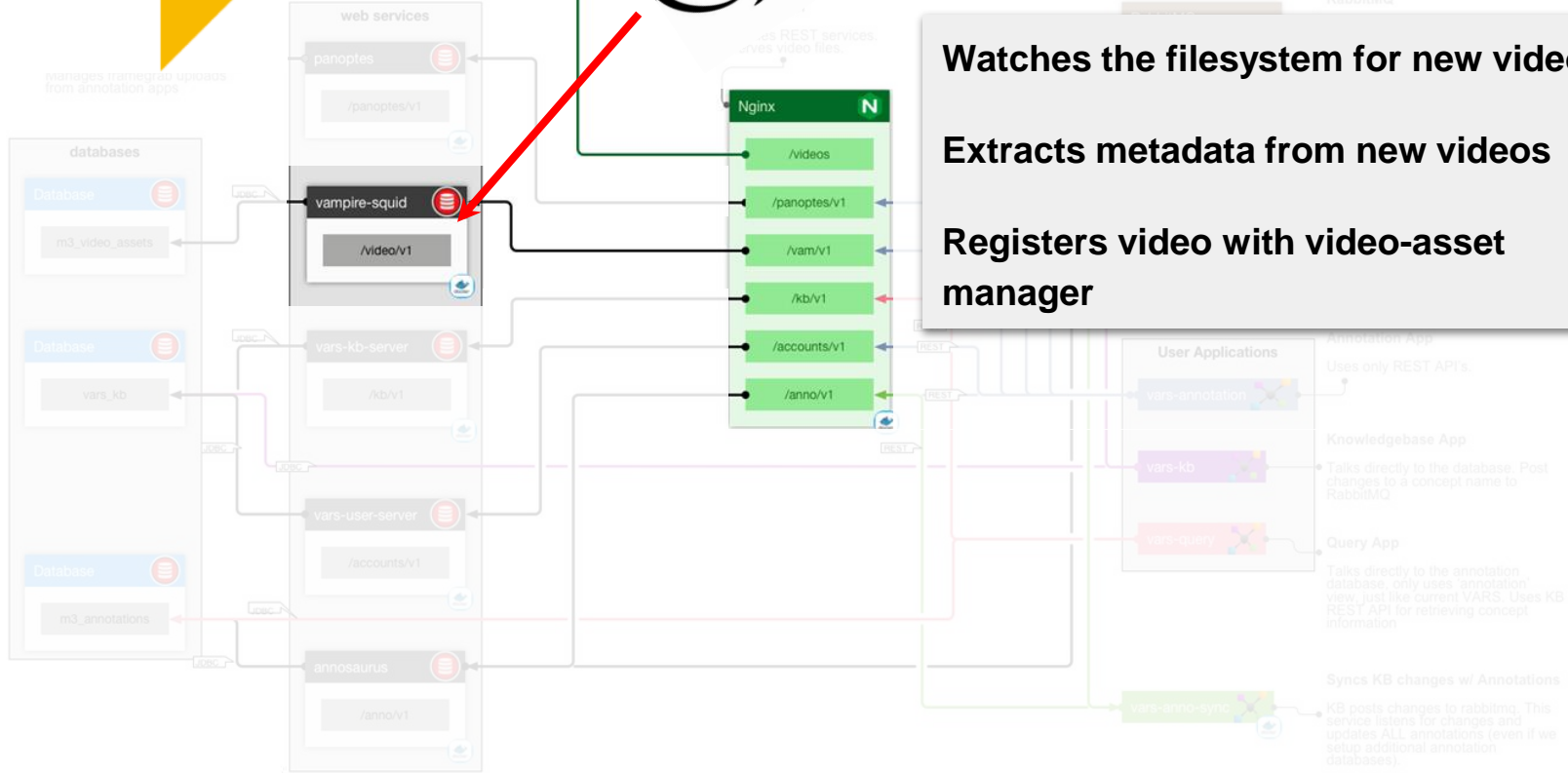


m3-registrar



RabbitMQ

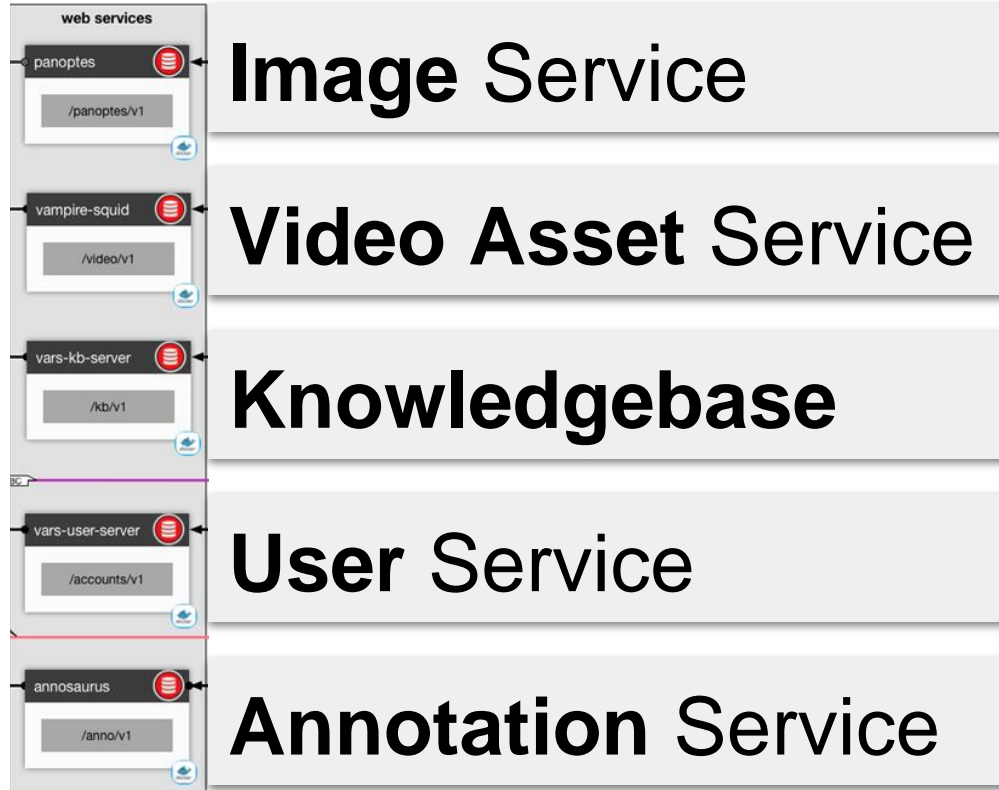
Watches the filesystem for new videos.
Extracts metadata from new videos
Registers video with video-asset manager



User Applications

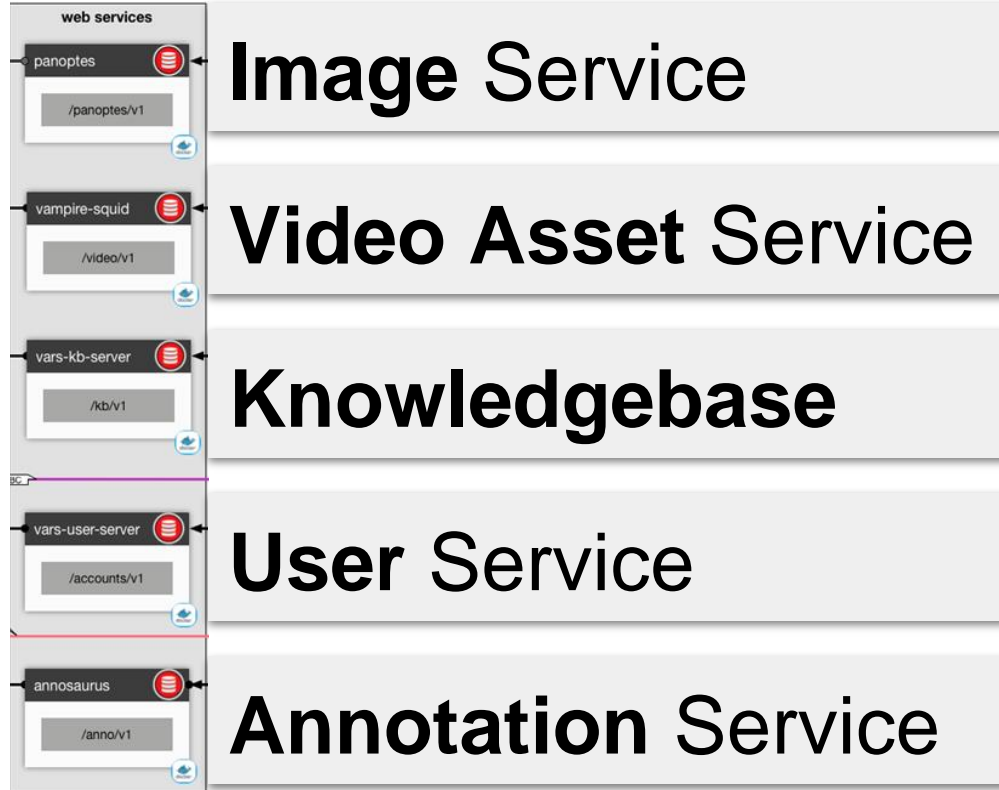
- vars-annotation**: Uses only REST APIs.
- vars-kb**: Knowledgebase App. Talks directly to the database. Post changes to a concept name to RabbitMQ.
- vars-query**: Query App. Talks directly to the annotation database, only uses 'annotation' view, just like current VARS. Uses KB REST API for retrieving concept information.
- vars-anno-sync**: Syncs KB changes w/ Annotations. KB posts changes to rabbitmq. This service listens for changes and updates ALL annotations (even if we setup additional annotation databases).

M3 Microservices



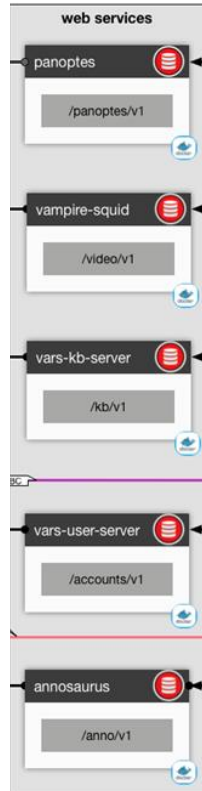
M3 Microservices

Toolkit for building video annotation applications



Discrete microservices

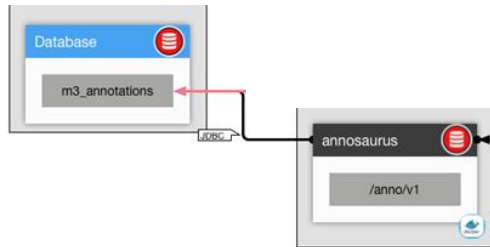
- A microservice
 - provides a web API
 - owns its own data
 - does one thing and does it well
 - Independent of other services



Microservices pros:

1. Independent

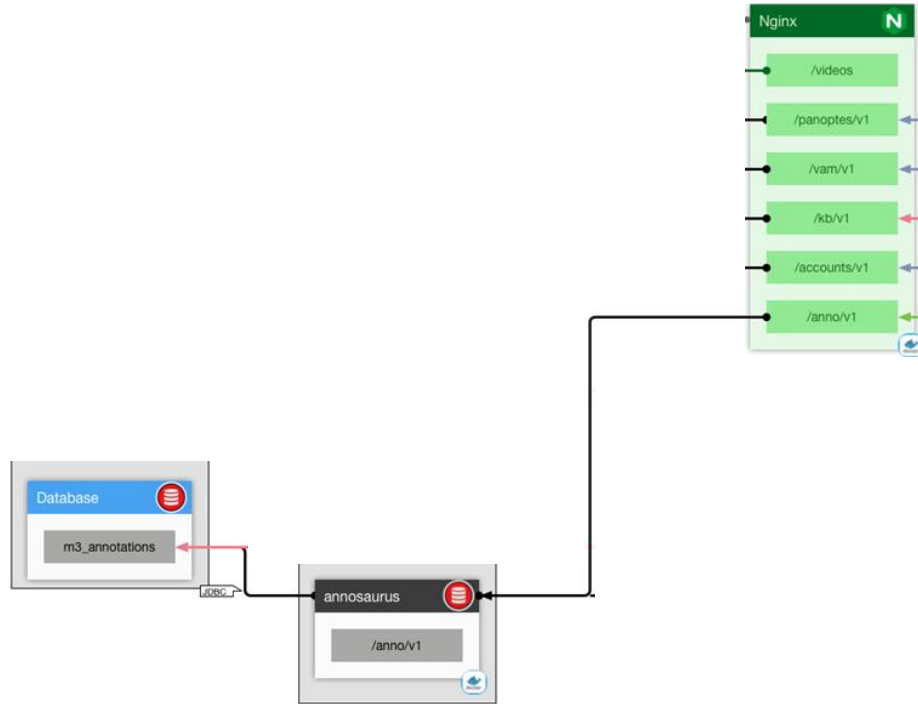
- Do not need to understand entire system
- Services can be written in different programming languages
- Use appropriate data-store (database, text file, NoSQL)
- Easy to upgrade and deploy



Microservices pros:

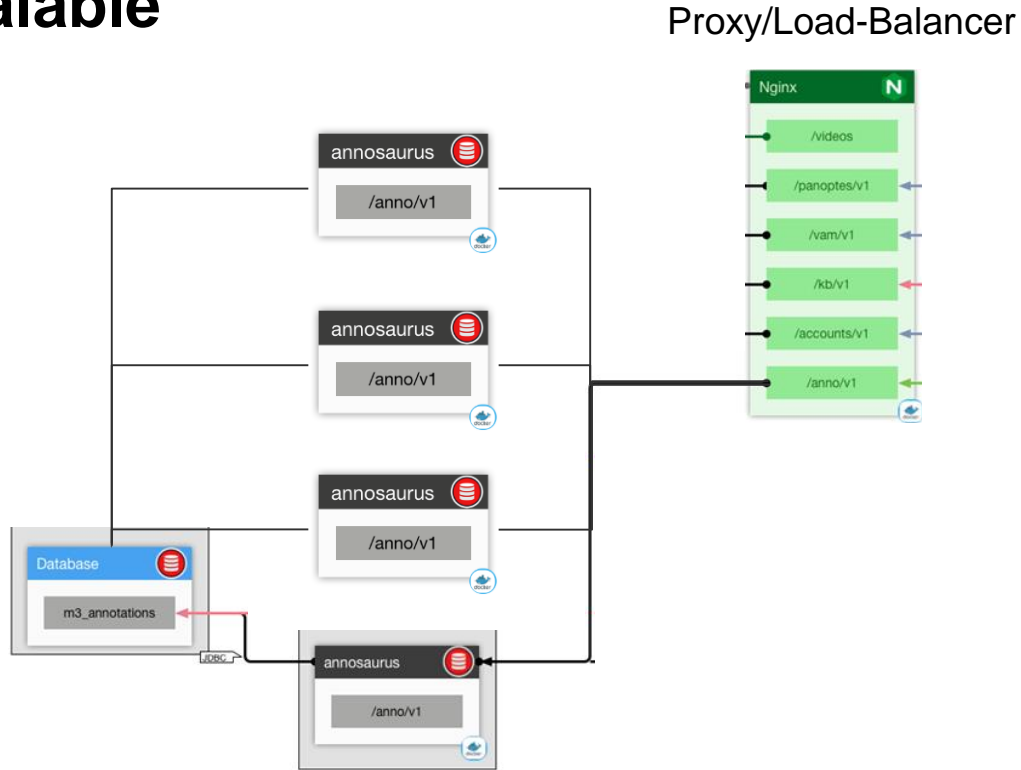
1. Independent
2. Scalable

Proxy/Load-Balancer



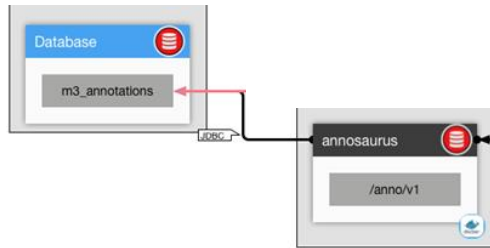
Microservices pros:

1. Independent
2. Scalable



Microservices pros:

1. Independent
2. Scalable
3. Language Agnostic
 - a. HTTP
 - b. REST
 - c. JSON



Python:

```
j = requests.get('http://foo.org/concept/Nanomia')  
.json()
```

Matlab:

```
j = webread('http://foo.org/concept/Nanomia')
```

R:

```
j <- fromJSON(  
  readLines('http://foo.org/concept/Nanomia'))
```

Perl:

```
$j==0&&($C++,$C>=$a&&($C=0));$j==2&&($C||($C=$a),$C--);  
$j==3&&($R++,$R>=@B&&($R=0));$j==1&&($R||($R=@B),$R--);}  
KP($){push@S,shift}KJ(){pop@S||0}KX(){@S[-1,-2]=@S[-2,-  
1]}KR(){push@S,$S[-  
1]}KW($){"Z".$_[0]."Z,K{".$_[1]."}"}KG($){($_)=(a)=@_;y^`/>/;W$a  
," X;P(J$ _ J)}KD($){($a)=@_;W$a,ZP Z.$a}KE($){($_)=(a)  
=@_;y/0123/>^<v/;W $ _,"N $a"};
```

Microservices pros:

1. Independent
2. Scalable
3. Language Agnostic
4. Easy to Customize (via Docker)

```
# Dockerfile  
  
FROM mbari/annosaurus  
  
ADD conf ${APP_HOME}/conf  
  
ADD lib ${APP_HOME}/lib  
  
EXPOSE 8080  
  
ENTRYPOINT ${APP_HOME}/bin/jetty-main
```



Microservices pros:

1. Independent
2. Scalable
3. Language Agnostic
4. Easy to Customize (via Docker)

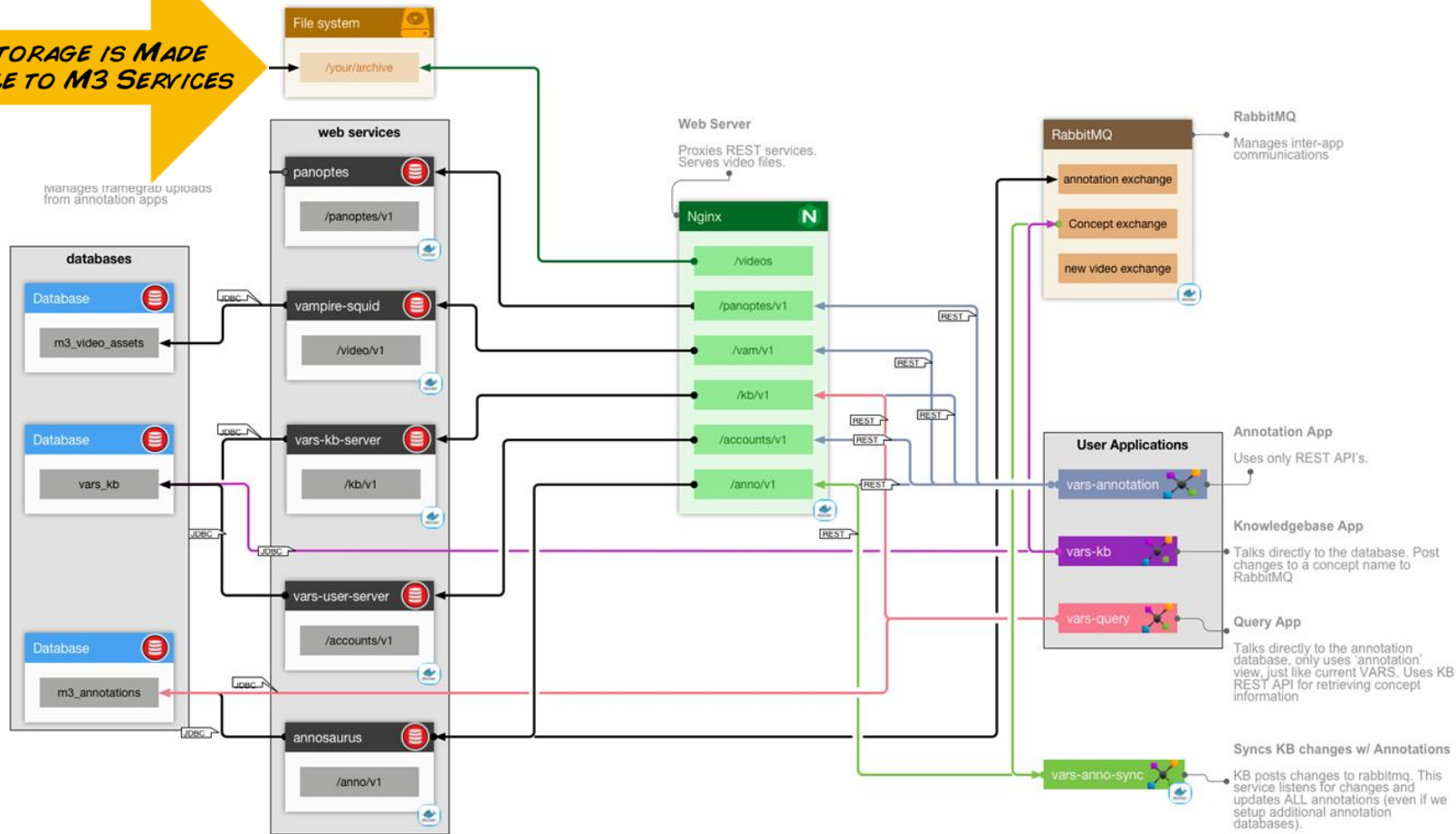
```
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FROM mbari/annosaurus  
  
ADD conf ${APP_HOME}/conf  
  
ADD lib ${APP_HOME}/lib  
  
EXPOSE 8080  
  
ENTRYPOINT ${APP_HOME}/bin/jetty-main
```



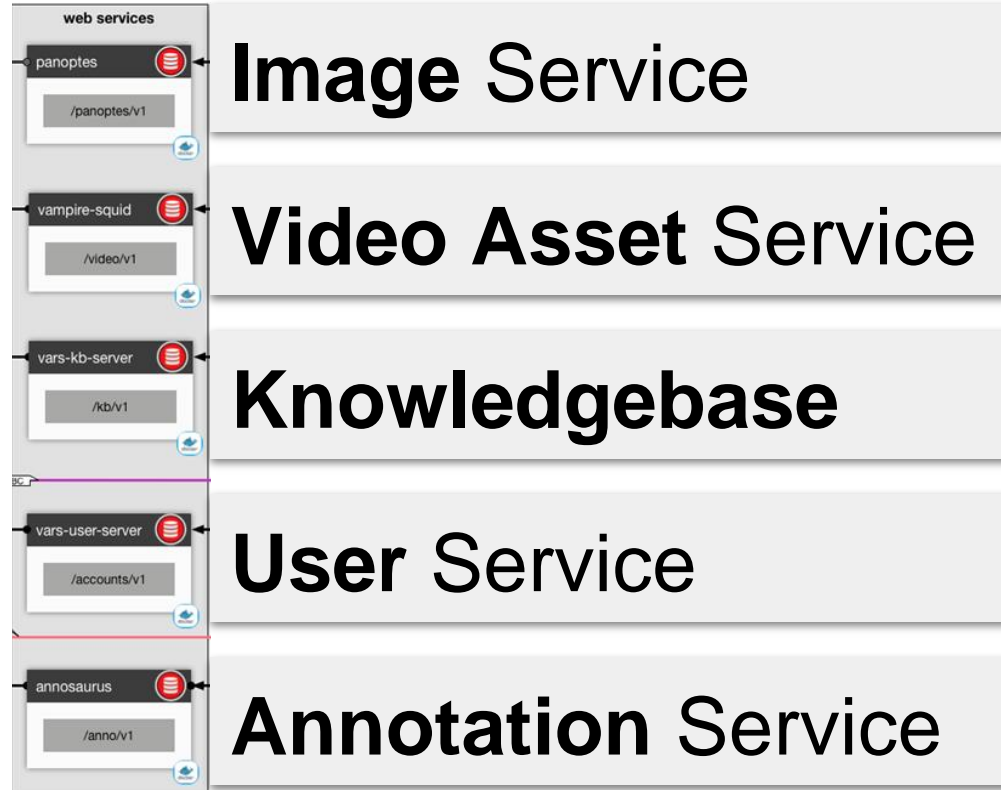
```
.  
├── Dockerfile  
├── conf  
│   ├── application.conf  
│   └── logback.xml  
└── lib  
    └── postgresql-  
        42.2.5.jar
```

```
docker build -t m3/annosaurus .  
docker run -p 8080:8080 m3/annosaurus
```

FILE STORAGE IS MADE AVAILABLE TO M3 SERVICES



M3 Microservices





Video Asset Service

Answers the questions:

Where is the video?

What recorded the video?

When was the video recorded?

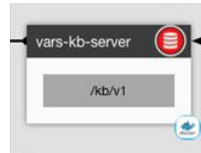
What is the video's deployment id?

... other video metadata

M3 Microservices

- Defines annotation terms
- Provides hierarchy (e.g. phylogeny)

Greatly improves consistency and searchability of annotations



Knowledgebase

Spelling Matters

Quiz time - Which is the correct spelling for the cockatoo squid's family?

- A. Cranchiidae
- B. Cranciidae
- C. Cranchida
- D. Crancidae



Spelling Matters

Quiz time - Which is the correct spelling for the cockatoo squid's family?

- A. Cranchiidae
- B. Cranciidae
- C. Cranchida
- D. Crancidae



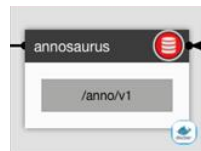
Spelling Matters

Quiz time - Which is the correct spelling for the cockatoo squid's family?

- A. Cranchiidae
- B. Cranciidae
- C. Cranchida
- D. Crancidae

Wouldn't it be great if you could just use 'cockatoo squid'?





Annotation Service

Anatomy of an Annotation



Media Identifier (UUID)



Anatomy of an Annotation



Media Identifier (UUID)

Index into Media (Elapsed time)

65432 millis



Anatomy of an Annotation



Media Identifier (UUID)

Index into Media (Elapsed time)

Concept name (constrained by knowledgebase terms)

Grimpoteuthis

65432 millis



Anatomy of an Annotation



Media Identifier (UUID)

Index into Media (Elapsed time)

Concept name (constrained by knowledgebase terms)

Other data (date/time, position, CTD, description, etc.)

65432 millis

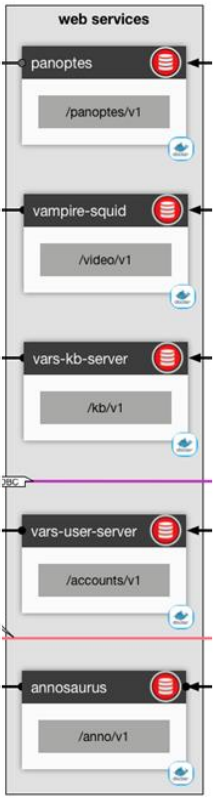
Grimpoteuthis 2013-05-06T03:20:03Z, 36.21111, -121.3322, surface-color | self | white, ...



Document
M3 Simple Deployment

Modified
Sat Sep 09 2017

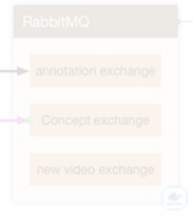
Panoptes
Manages framgrab uploads
from annotation apps.



Web Server
Proxies REST services.
Serves video files.



RabbitMQ
Manages inter-app
communications.



Annotation App
Uses only REST APIs.

Knowledgebase App

Talks directly to the database. Post
changes to a concept name to
RabbitMQ

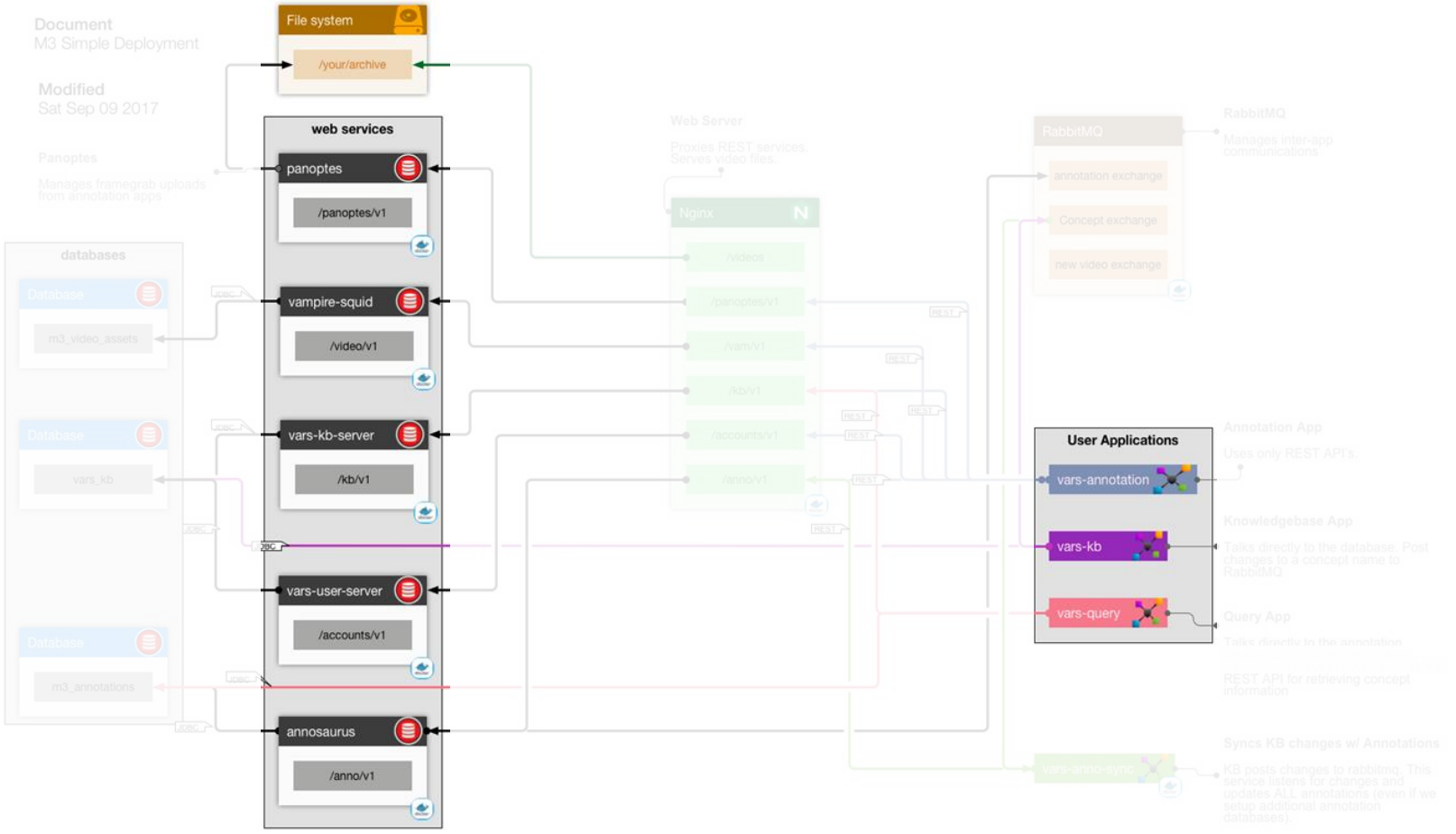
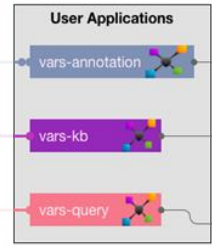
Query App

Talks directly to this annotation

REST API for retrieving concept
information

Syncs KB changes w/ Annotations

KB posts changes to rabbitmq. This
service listens for changes and
updates ALL annotations (even if we
setup additional annotation
databases).



VARS/M3

Vars Knowledgebase

Search: Relief

Relief

Originator: admin
Author: FA
Rank:
Reference:

Names Templates Properties Media History

Relief

Name: Relief
Author: FA
Type: Primary Common Synonym Former

+ New Update Delete

- object (C5iRO)
- ABRC-Coarse
- ABRC-Geo
- CATAM-Biota (8000000)
- Ascidians (3500000)
- Ascidians: Stalked (35000994, AS-)
- Ascidians: Unstalked (35000901)
- Ascidians: Unstalked: Colonial (
- Ascidians: Unstalked: Solitary (
- Bacterial mats (72000901)
- Bioturbation (81000000)
- Bioturbation: Crawling traces (81)
- Bioturbation: Dwelling traces (81)
- Bioturbation: Feeding traces (81)
- Bioturbation: Organism tests
- Bioturbation: Nesting traces (81)
- Bioturbation: Unknown origin (81)
- Bioturbation: Waste casts (81002)
- Brachiopods (19100000, BRAC)
- Bryozoa (20000000)
- Cnidaria (11500000)
- Crustacea (27000000)
- Echinoderms (25000000)
- Fishes (37000000)
- Gillies (80500903)
- Glucosiphon (12000000)
- Cubozoa (11500000)
- Hydromedusae (11000901)
- Hydromedusae (35101000)
- Salps (3510000)
- Scyphozoa (11120000)
- Siphonophores (11090000)
- Macroalgae (80300000)
- Molluscs (23000000)
- Sea spiders (33000000, Pyc)
- Seasprays (83600901)
- Sponges (10000000)
- Worms (80600901)
- CATAM-Physical (82000000)
- Bedforms (82002000)
- Relief (82003000)
- Relief: Flat (82003001)
- Relief: High (82003005, RB-H)
- Relief: High (>3m) (82003006)
- Relief: Wall (82003007)
- Relief: Low - moderate (8200300)
- Relief: Low (<1m) (82003003, RE)
- Relief: Moderate (1-3m) (82003)
- Substrate (82001000)
- CMAR-Video
- Aggregated mobile epifauna
- Archirogogenic
- Dominant sessile epifauna
- Geomorphology
- debris flow - rubble bank oceanog

Media: Doc Ricketts 0983 20170519T211152Z [D983_20170519T_21_11_52Z_h264.mp4]

Elapsed Time	Date/Time	Observation	Details
00:02:00.172	2017-05-19T21:13:52.172Z	Scotoplanes gl...	identity-reference self 1
00:15:00.066	2017-05-19T21:26:52.066Z	Bird water sam...	comment self filling with seawater
00:00:35.709	2017-05-19T21:12:27.709Z	Isosactis vagab...	identity-reference self B
00:09:33.883	2017-05-19T21:25:883Z	Bird water sam...	deployed-by manipulator nil
00:01:37.597	2017-05-19T21:13:29.597Z	Liparidae	surface-color self grey
00:10:39.645	2017-05-19T21:22:31.645Z	Bird water sam...	identity-reference self B
00:03:47.517	2017-05-19T21:15:39.517Z	sediment	
00:13:55.689	2017-05-19T21:25:47.689Z	water	water-quality self sediment-cloudy
00:02:31.094	2017-05-19T21:14:23.094Z	drawer	posture self open
00:04:12.752	2017-05-19T21:16:04.752Z	drawer	
00:00:31.831	2017-05-19T21:12:23.831Z	Liparidae	surface-color nil dark

surface-color | self | grey

Cranchiidae Cirrata Tenthoides end-effector Doryteuthis opalescens Pandalus platyceros Squillidae Gnathostomata Echinodermata Cnidaria Peniagone vitrea Chondrichthyes

physical object Ctenophora Peniagone sp. nov. Onychoteuthis Octopoteuthidae Grimpoteuthis sp. 1

benthic Pelagic fof bar squids

Group ROV Activity descend Show concurrent annotations

Annotation

VARS Query

- Grimalditeuthis
Grimalditeuthis bonplandii
- Opisthoteuthis sp. A
- Dosidicus
Dosidicus gigas, Humboldt squid
- Taonius
Taonius borealis, Taonius pavo
- squid | life-stage | * juvenile
Bathypolysia albatrossalis, Bala, Aequorea cheloniidae, Ancistroteuthis, Ancistroteuthis leuaurii, Bathyliteuthidae, Bathyliteuthis, Bathyliteuthis abyssicola, Bathyliteuthis berry, Belonella, Belonella borealis, Berthoteuthis, Berthoteuthis, Berthoteuthis anonychus, black eyed squid, boreal clubhook squid, California market squid, Chiroteuthidae, Chiroteuthis, Chiroteuthis calyx, clawed armhook squid, coolwater squid, coolwater squid, Cranchia, Cranchia megalops, Cranchia scabra, Cranchiidae, Doryteuthis, Doryteuthis spalescens, Dosidicus, Dosidicus gigas, Eupoloteuthidae, fire squid, Galiteuthis, Galiteuthis pacifica, Galiteuthis phyllura, Gonistidae, Gonistidae, Gonistopsis borealis, Gonistopsis octopodoides, Gonistopsis, Gonistopsis berry, Gonistopsis unyx, Gonistopsis pyros, Grimalditeuthis, Grimalditeuthis bonplandii, Hawaiian flying squid, Helicoverteuthis, Histiototeuthidae, Histiototeuthis, Histiototeuthis heteropsis, Humboldt squid, lance squid, Leachia, Leachia danae, lightbulb squid, Lirocranchia, Loliginidae, Loligo, Loligo opalescens, Magnapinna, Magnapinna pacifica, Magnapinnidae, Mastigoteuthidae, Mastigoteuthis, Mastigoteuthis pyrosoma, Mastigoteuthis, Mastigoteuthis, Mastigoteuthis robusta, Myopsoida, Notoledaridae, Notoledaridae hawaiiensis, Octopoteuthidae, Octopoteuthis, Octopoteuthis delator, octopus-squid family, Oegopsidae, Ormmastroteuthidae, Oryctoteuthidae, Oryctoteuthis, Oryctoteuthis borealijapponica, Onkyia, Onkyia robusta, Phidippoteuthidae, Phidippoteuthis, Phidippoteuthis boschmani, Piglet squid, Planctoteuthis, Planctoteuthis danae, Planctoteuthis olidopsis, Pterygoteuthis, Pterygoteuthis hoyae, Proteoteuthis, robust clubhook squid, Stigmatoteuthis, Stigmatoteuthis dofleini, swordfish squid, Taringia, Taringia danae, Taoniniae, Taonius, Taonius borealis, Taonius pavo, Teuthidae, ...

+ Add Search Term Remove All

Knowledgebase

Query

VARS Knowledgebase

The screenshot shows the VARS Knowledgebase interface. On the left is a tree view of taxonomic categories, with 'Relief (82003000)' selected. The main panel displays details for 'Relief', including its originator (admin), author (FA), and rank. A search bar at the top contains the text 'Relief'. Below the details are tabs for 'Names', 'Templates', 'Properties', 'Media', and 'History'. The 'Names' tab is active, showing a list of names with 'Relief' highlighted. At the bottom, there are input fields for Name, Author, and Type, along with 'New', 'Update', and 'Delete' buttons.

The screenshot shows a Mozilla Firefox browser window displaying JSON data for 'CATAMI-Physical'. The browser's address bar shows the URL 'oa-idx-vars-hba.it.csiro.au:8083'. The page has tabs for 'JSON', 'Raw Data', and 'Headers', with 'Raw Data' selected. The JSON data is as follows:

```
{
  "name": "CATAMI-Physical",
  "alternative_names": [
    "82000000"
  ],
  "children": [
    {
      "name": "Substrate",
      "alternative_names": [
        "82001000"
      ],
      "children": [
        {
          "name": "Consolidated (hard)",
          "alternative_names": [
            "82001001"
          ],
          "children": [
            {
              "name": "Boulders",
              "alternative_names": [
                "82001003",
                "SU-BOL"
              ]
            }
          ]
        },
        {
          "name": "Cobbles",
          "alternative_names": [
            "82001004",
            "SU-COB"
          ]
        }
      ]
    },
    {
      "name": "Rock",
      "alternative_names": [
        "82001002",
        "SU-ROK"
      ]
    }
  ]
},
{
  "name": "Biogenic reef substrate",
  "children": [
    {
      "name": "Coral reef substrate",
      "alternative_names": [
        "SU-RCOR"
      ]
    }
  ]
}
```



VARs Knowledgebase

Edit:

Search: Relief

Relief

Originator: admin
Author: FA
Rank:
Reference:

Names Templates Properties Media History

Names

82003000

Relief

Name: Relief
Author: FA
Type: Primary Common Synonym Former

New Update Delete

- object (CSIRO)
 - AARC-Coarse
 - AARC-Geo
 - CATAMI-Biota (80000000)
 - Ascidians (35000000)
 - Ascidians: Stalked (35000904, AS-
 - Ascidians: Unstalked (35000901)
 - Ascidians: Unstalked: Colonial (
 - Ascidians: Unstalked: Solitary (
 - Bacterial mats (72000901)
 - Bioturbation (81000000)
 - Bioturbation: Crawling traces (81000000)
 - Bioturbation: Dwelling traces (81000000)
 - Bioturbation: Feeding traces (81000000)
 - Bioturbation: Organism tests (81000000)
 - Bioturbation: Resting traces (81000000)
 - Bioturbation: Unknown origin (81000000)
 - Bioturbation: Waste casts (81002000)
 - Brachiopods (19100000, BRAC)
 - Bryozoa (20000000)
 - Cnidaria (11500000)
 - Crustacea (27000000)
 - Echinoderms (25000000)
 - Fishes (37000000)
 - Jellies (80600903)
 - Ctenophores (12000000)
 - Cubozoa (11150000)
 - Hydromedusae (11000901)
 - Pyrosomes (35101000)
 - Salps (35100000)
 - Scyphozoa (11120000)
 - Siphonophores (11090000)
 - Macroalgae (80300000)
 - Molluscs (23000000)
 - Sea spiders (33000000, PYC)
 - Seagrasses (63600901)
 - Sponges (10000000)
 - Worms (80600901)
 - CATAMI-Physical (82000000)
 - BedForms (82002000)
 - Relief (82003000)
 - Relief: Flat (82003001)
 - Relief: High (82003005, RB-H)
 - Relief: High (>3m) (82003006)
 - Relief: Wall (82003007)
 - Relief: Low - moderate (82003002)
 - Relief: Low (<1m) (82003003, RB-L)
 - Relief: Moderate (1-3m) (82003004)
 - Substrate (82001000)
 - CMAR-Video
 - Aggregated mobile epifauna
 - Anthropogenic
 - Dominant sessile epifauna
 - Geomorphology
 - debris flow - rubble bank geomorp

VARs Knowledgebase

Search: Grimp

Grimpoteuthis tuftsi

Originator: linda
Author: Voss & Pearcy, 1990
Rank: species
Reference:

Names Templates Properties Media History

Names

Grimpoteuthis tuftsi

Name: Grimpoteuthis tuftsi
Author: Voss & Pearcy, 1990
Type: Primary Common Synonym Former

New Update Delete

- (root)
- lvior
- .file
- in zone
- ical object (physical-object)
- iological structure
- oundary
- hemical
- quipment
- geological feature
- arine organism (marine-organism)
 - Archaea
 - Subacteria
 - Eukaryota
 - Animalia (metazoa)
 - Annelida (annelid, worm)
 - Arthropoda
 - Brachiopoda (lamp shell)
 - Bryozoa (bryozoan, ectoproct, ectoprocta, mos)
 - Chaetognatha (arrow worm)
 - Chordata
 - Cnidaria (cnidarian)
 - Ctenophora (comb jelly)
 - Echinodermata (echinoderm)
 - Hemichordata
 - Mollusca
 - Aplacophora
 - Bivalvia (bivalve, clam, pelecypoda)
 - Cephalopoda
 - Coleoidea
 - Decapodiformes
 - Octopodiformes (octobranchia)
 - Octopoda
 - Cirrata (Cirrina)
 - Cirroteuthidae
 - Opisthoteuthidae
 - Grimpoteuthis
 - Grimpoteuthis bath
 - Grimpoteuthis sp. 1
 - Grimpoteuthis sp. 4
 - Grimpoteuthis sp. 5
 - Grimpoteuthis tuftsi
 - Opisthoteuthis
 - Incirrata (Incirrina)
 - Vampyromorpha (Vampyromorpt
 - Gastropoda (gastropod, snail)
 - Polyplocophora (Amphineura, Loricata)
 - Scaphopoda (tusk shell)
 - Nemertea (proboscis worm, Rhynchocoela, ribb)
 - Phoronida
 - Platyhelminthes (flatworm)
 - Porifera (sponge)
 - Sipuncula (peanut worm, shore worm, sipuncul)
 - Xenurbellida
 - Chromista (stramenopile)

VARS Annotation

The screenshot displays the VARS software interface. At the top, the user is identified as 'brian' and the media file is 'Doc Ricketts 0953 20170519T211152Z [D953_20170519T_21_11_52Z_h264.mp4]'. The main window is divided into several sections:

- Observation Table:** A table with columns for Elapsed Time, Date/Time, Observation, and Details. The row for 'Liparidae' at 00:01:37.597 is highlighted.
- Video Player:** A large video window showing a greenish underwater scene. The 'Images' tab is selected in the top right of the video player area.
- Annotation Controls:** A control bar below the video player with a progress slider (00:00 to 15:00), play/pause buttons, and various tool icons.
- Taxonomic Tree:** A list of taxonomic groups at the bottom, including Cranchiidae, Cirrata, Teuthoidea, end-effector, Doryteuthis opalescens, Pandalus platyceros, Squillidae, Gnathostomata, Echinodermata, Cnidaria, Peniagone vitrea, Chondrichthyes, Mammalia, defecating, physical object, Ctenophora, Peniagone sp. nov., Onychoteuthis, Octopoteuthidae, and Grimpoteuthis sp. 1.
- Bottom Bar:** A navigation bar with 'benthic' selected, and other options like 'Pelagic', 'foo', 'bar', and 'squids'. It also shows 'Group ROV', 'Activity descend', and a 'Show concurrent annotations' checkbox.

VARS Annotation

Customizable
by each user

The screenshot displays the VARS software interface. At the top, the user is identified as 'brian'. The main window shows a video player with a greenish underwater scene. The video player has a progress bar and various control icons. Below the video player, there is a list of annotations. The annotations are organized into a grid with columns for taxonomic groups and specific annotations. The 'benthic' annotation is highlighted in the bottom left corner. The interface also includes a search bar and a 'Show concurrent annotations' checkbox.

| Elapsed Time | Date/Time | Observation | Details |
|--------------|--------------------------|-------------------|---|
| 00:02:00.172 | 2017-05-19T21:13:52.172Z | Scotoplanes gl... | identity-reference self 1 |
| 00:15:00.066 | 2017-05-19T21:26:52.066Z | Bird water sam... | comment self filling with seawater
identity-reference self B |
| 00:00:35.709 | 2017-05-19T21:12:27.709Z | losactis vagab... | |
| 00:09:33.883 | 2017-05-19T21:21:25.883Z | Bird water sam... | deployed-by manipulator nil
identity-reference self B |
| 00:01:37.597 | 2017-05-19T21:13:29.597Z | Liparidae | surface-color self grey |
| 00:10:39.645 | 2017-05-19T21:22:31.645Z | Bird water sam... | identity-reference self B |
| 00:03:47.517 | 2017-05-19T21:15:39.517Z | sediment | |
| 00:13:55.689 | 2017-05-19T21:25:47.689Z | water | water-quality self sediment-cloudy |
| 00:02:31.094 | 2017-05-19T21:14:23.094Z | drawer | posture self open |
| 00:04:12.752 | 2017-05-19T21:16:04.752Z | drawer | |
| 00:00:31.831 | 2017-05-19T21:12:23.831Z | Liparidae | surface-color nil dark |

Annotations in the bottom panel:

- Cranchiidae
- Cirrata
- Teuthoidea
- end-effector
- Doryteuthis opalescens
- Pandalus platyceros
- Squillidae
- Gnathostomata
- Echinodermata
- Cnidaria
- Peniagone vitrea
- Chondrichthyes
- Mammalia
- defecating
- physical object
- Ctenophora
- Peniagone sp. nov.
- Onychoteuthis
- Octopoteuthidae
- Grimpoteuthis sp. 1

Search bar: benthic Pelagic foo bar squids

Group: ROV Activity: descend Show concurrent annotations:

VARS Annotation

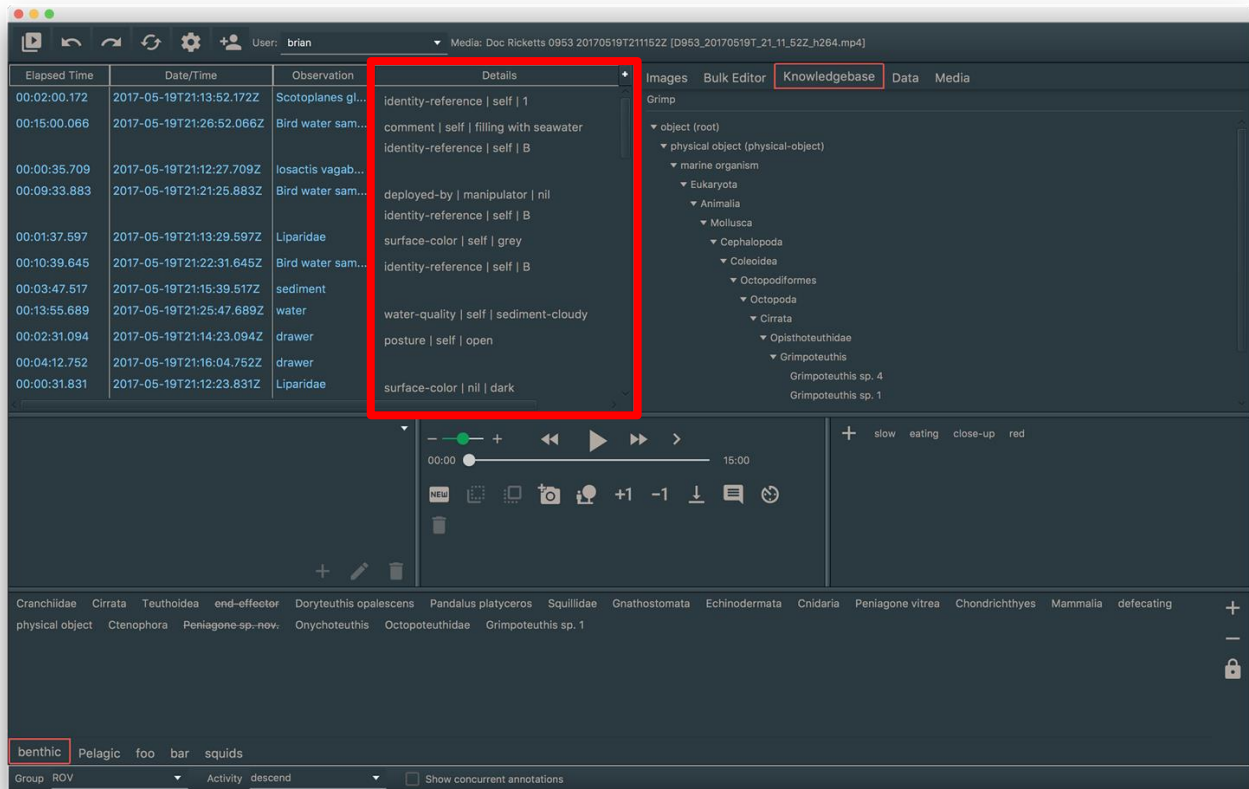
Customizable
by each user

Constrained
vocabulary

The screenshot displays the VARS software interface. The top section features a table with columns for Elapsed Time, Date/Time, Observation, and Details. The 'Observation' column contains various biological terms like 'Scotoplanes gl...', 'Bird water sam...', 'losactis vagab...', 'Lipariidae', 'sediment', 'water', 'drawer', and 'Lipariidae'. The 'Details' column shows associated metadata such as 'identity-reference | self | 1', 'comment | self | filling with seawater', 'deployed-by | manipulator | nil', 'surface-color | self | grey', and 'water-quality | self | sediment-cloudy'. Below the table is a media player with a progress bar and playback controls. The right side of the interface shows a 'Knowledgebase' tab with a taxonomic tree for 'Grimp', including categories like 'physical object', 'marine organism', 'Eukaryota', 'Animalia', 'Mollusca', 'Cephalopoda', 'Coleoidea', 'Octopodiformes', 'Octopoda', 'Cirrata', 'Opisthoteuthidae', and 'Grimpoteuthis'. The bottom section contains a list of taxonomic terms such as 'Cranchiidae', 'Cirrata', 'Teuthoidea', 'end-effector', 'Doryteuthis opalescens', 'Pandalus platyceros', 'Squillidae', 'Gnathostomata', 'Echinodermata', 'Cnidaria', 'Peniagone vitrea', 'Chondrichthyes', 'Mammalia', 'defecating', 'physical object', 'Ctenophora', 'Peniagone sp. nov.', 'Onychoteuthis', 'Octopoteuthidae', and 'Grimpoteuthis sp. 1'. A search bar at the bottom left shows 'benthic' entered, and a dropdown menu below it lists 'Pelagic', 'foo', 'bar', and 'squids'. The bottom right corner includes a 'Group' dropdown set to 'ROV' and an 'Activity' dropdown set to 'descend', along with a 'Show concurrent annotations' checkbox.

| Elapsed Time | Date/Time | Observation | Details |
|--------------|--------------------------|-------------------|---|
| 00:02:00.172 | 2017-05-19T21:13:52.172Z | Scotoplanes gl... | identity-reference self 1 |
| 00:15:00.066 | 2017-05-19T21:26:52.066Z | Bird water sam... | comment self filling with seawater
identity-reference self B |
| 00:00:35.709 | 2017-05-19T21:12:27.709Z | losactis vagab... | |
| 00:09:33.883 | 2017-05-19T21:21:25.883Z | Bird water sam... | deployed-by manipulator nil
identity-reference self B |
| 00:01:37.597 | 2017-05-19T21:13:29.597Z | Lipariidae | surface-color self grey |
| 00:10:39.645 | 2017-05-19T21:22:31.645Z | Bird water sam... | identity-reference self B |
| 00:03:47.517 | 2017-05-19T21:15:39.517Z | sediment | |
| 00:13:55.689 | 2017-05-19T21:25:47.689Z | water | water-quality self sediment-cloudy |
| 00:02:31.094 | 2017-05-19T21:14:23.094Z | drawer | posture self open |
| 00:04:12.752 | 2017-05-19T21:16:04.752Z | drawer | |
| 00:00:31.831 | 2017-05-19T21:12:23.831Z | Lipariidae | surface-color nil dark |

VARS Annotation



Customizable
by each user

Constrained
vocabulary

Add details to
each annotation

VARS Annotation

The screenshot shows the VARS software interface. At the top, there's a menu bar with 'Images', 'Bulk Editor', 'Knowledgebase', 'Data', and 'Media'. Below this is a table of annotations with columns for 'Elapsed Time', 'Date/Time', 'Observation', and 'Details'. The 'Observation' column contains terms like 'Scotoplanes gl...', 'Bird water sam...', 'losactis vagab...', 'Liparidae', 'Bird water sam...', 'sediment', 'water', 'drawer', and 'Liparidae'. The 'Details' column contains terms like 'identity-reference | self | 1', 'comment | self | filling with seawater', 'identity-reference | self | B', 'deployed-by | manipulator | nil', 'identity-reference | self | B', 'surface-color | self | grey', 'identity-reference | self | B', 'water-quality | self | sediment-cloudy', 'posture | self | open', and 'surface-color | nil | dark'. The 'Liparidae' row is highlighted in red. Below the table is a video player with a red box around the 'Images' button. The video player shows a greenish underwater scene. At the bottom, there's a taxonomic tree with 'benthic' highlighted in red. The bottom right corner has a 'Show concurrent annotations' checkbox.

| Elapsed Time | Date/Time | Observation | Details |
|--------------|--------------------------|-------------------|---|
| 00:02:00.172 | 2017-05-19T21:13:52.172Z | Scotoplanes gl... | identity-reference self 1 |
| 00:15:00.066 | 2017-05-19T21:26:52.066Z | Bird water sam... | comment self filling with seawater
identity-reference self B |
| 00:00:35.709 | 2017-05-19T21:12:27.709Z | losactis vagab... | |
| 00:09:33.883 | 2017-05-19T21:21:25.883Z | Bird water sam... | deployed-by manipulator nil
identity-reference self B |
| 00:01:37.597 | 2017-05-19T21:13:29.597Z | Liparidae | surface-color self grey |
| 00:10:39.645 | 2017-05-19T21:22:31.645Z | Bird water sam... | identity-reference self B |
| 00:03:47.517 | 2017-05-19T21:15:39.517Z | sediment | |
| 00:13:55.689 | 2017-05-19T21:25:47.689Z | water | water-quality self sediment-cloudy |
| 00:02:31.094 | 2017-05-19T21:14:23.094Z | drawer | posture self open |
| 00:04:12.752 | 2017-05-19T21:16:04.752Z | drawer | |
| 00:00:31.831 | 2017-05-19T21:12:23.831Z | Liparidae | surface-color nil dark |

Customizable
by each user

Constrained
vocabulary

Add details to
each annotation

Capture Images
from Video

VARs Annotation

The screenshot shows a software window with a dark theme. At the top, it displays a time range from 2/21/2018 5:45 AM to 2/21/2018 5:45 AM. Below this is a list of video annotations. The first column lists categories like 'Doc Ricketts', 'Mini ROV', 'Test', etc. The second column lists individual video IDs. The third column shows a list of video IDs, with 'Doc Ricketts 0953 20170519T211152Z' highlighted in red. The fourth column shows a list of URLs, with 'http://m3.shore.mbari.org/videos/M3_...' highlighted in red. The fifth column lists metadata fields like 'Camera ID', 'Deployment', 'Video', 'Start', 'End', 'Duration', 'URI', 'Size', 'Dimensions', 'Frame Rate', 'Video Type', and 'Annotation Count'. The 'Annotation Count' is 51. At the bottom right, there are 'CANCEL' and 'OK' buttons.

| Category | Video ID | Video ID | URL | Metadata |
|--------------|-------------------|------------------------------------|---|--|
| Doc Ricketts | Doc Ricketts 0746 | D0953-01HD | http://m3.shore.mbari.org/videos/M3_... | Camera ID: Doc Ricketts |
| Mini ROV | Doc Ricketts 0760 | D0953-02 | http://m3.shore.mbari.org/videos/M3_... | Deployment: Doc Ricketts 0953 |
| Test | Doc Ricketts 0772 | D0953-02HD | | Video: Doc Ricketts 0953 20170519T211152Z |
| Unknown | Doc Ricketts 0788 | Doc Ricketts 0953 20170519T212652Z | | Start: 2017-05-19T21:11:52Z |
| Ventana | Doc Ricketts 0829 | Doc Ricketts 0953 20170519T214153Z | | End: 2017-05-19T21:26:52.070Z |
| i2MAP | Doc Ricketts 0855 | Doc Ricketts 0953 20170519T215653Z | | Duration: 00:15:00.070 |
| | Doc Ricketts 0872 | Doc Ricketts 0953 20170519T221153Z | | URI: http://m3.shore.mbari.org/videos/M3_DocRick |
| | Doc Ricketts 0879 | Doc Ricketts 0953 20170519T222653Z | | Size: 844.77 MB |
| | Doc Ricketts 0888 | Doc Ricketts 0953 20170519T224153Z | | Dimensions: 1920 x 1080 |
| | Doc Ricketts 0896 | Doc Ricketts 0953 20170519T225653Z | | Frame Rate: 0.0 |
| | Doc Ricketts 0904 | Doc Ricketts 0953 20170519T231153Z | | Video Type: video/mp4 |
| | Doc Ricketts 0921 | Doc Ricketts 0953 20170519T232653Z | | Annotation Count: 51 |
| | Doc Ricketts 0928 | Doc Ricketts 0953 20170519T234153Z | | |
| | Doc Ricketts 0953 | Doc Ricketts 0953 20170519T235653Z | | |
| | Doc Ricketts 0955 | | | |
| | Doc Ricketts 0960 | | | |

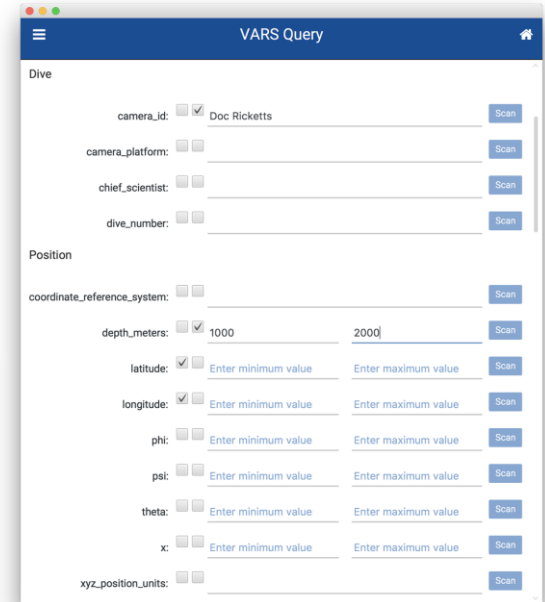
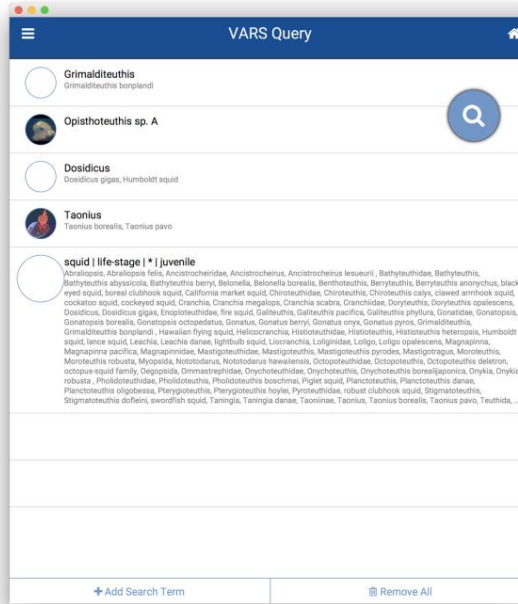
VARS Query

Simple, Flexible Query tool

Q: Find all squid eating something between 500 and 1200 meters.

Q: Find all jellies seen on expedition IN2017.

Q: Find a particular species of sea cucumbers on rocky substrate.



Future Proofing

Video Asset
Manager

Annotation service

Image Archiver

Knowledgebase

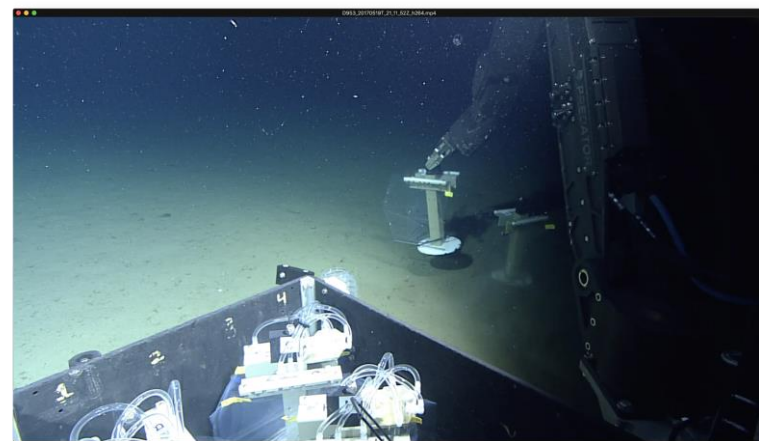
The screenshot shows a software interface with a table of observations, a video player, and a taxonomic classification list.

| Elapsed Time | Date/Time | Observation | Details |
|--------------|--------------------------|-------------------|---|
| 00:02:00.172 | 2017-05-19T21:13:52.172Z | Scotoplanes gl... | identity-reference self 1 |
| 00:15:00.066 | 2017-05-19T21:26:52.066Z | Bird water sam... | comment self filling with seawater
identity-reference self 0 |
| 00:00:35.709 | 2017-05-19T21:12:27.709Z | Isopoda vagab... | identity-reference self 0 |
| 00:09:33.883 | 2017-05-19T21:21:25.883Z | Bird water sam... | deployed-by manipulator nil
identity-reference self 0 |
| 00:01:37.597 | 2017-05-19T21:13:29.597Z | Liparidae | surface-color self grey |
| 00:10:39.645 | 2017-05-19T21:22:31.645Z | Bird water sam... | identity-reference self 0 |
| 00:03:47.517 | 2017-05-19T21:15:39.517Z | sediment | |
| 00:13:55.689 | 2017-05-19T21:25:47.689Z | water | water-quality self sediment-cloudy |
| 00:02:31.094 | 2017-05-19T21:14:23.094Z | drawer | posture self open |
| 00:04:12.762 | 2017-05-19T21:16:04.762Z | drawer | |
| 00:00:31.831 | 2017-05-19T21:12:33.831Z | Liparidae | surface-color nil dark |

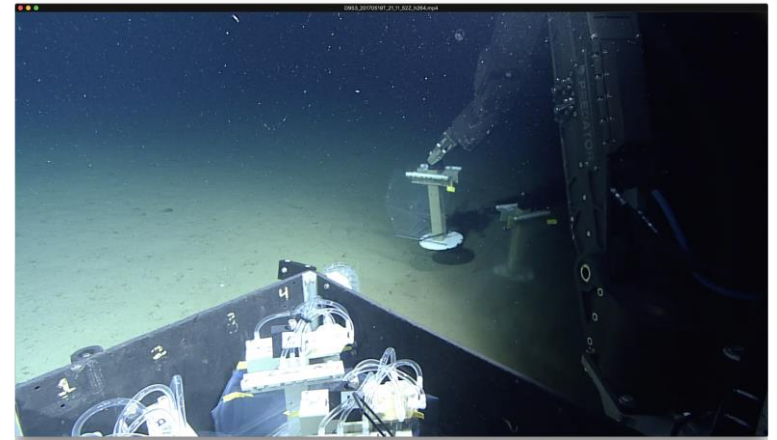
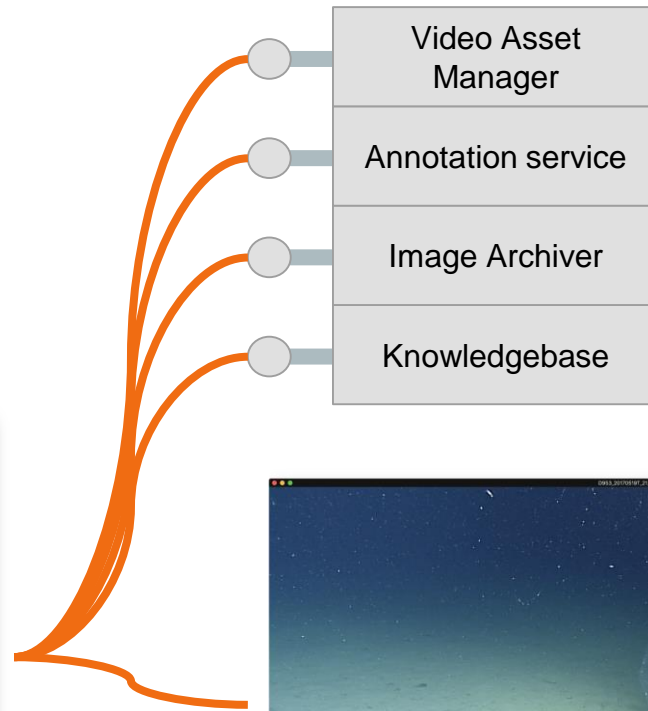
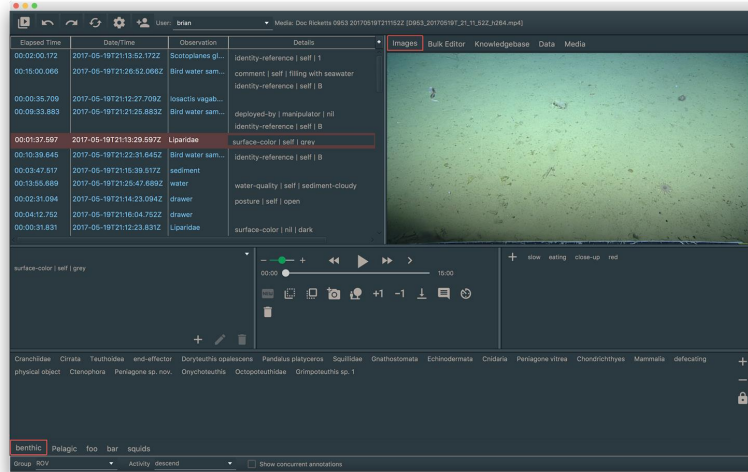
Below the table is a video player showing a greenish underwater scene. At the bottom, there is a taxonomic classification list:

- Ornanchidae
- Cirrata
- Tenellidae
- end-effector
- Doryteuthis opalescens
- Pandalus platyceros
- Squillidae
- Orathostomata
- Echinodermata
- Cnidaria
- Penagone vitrea
- Chondrichthyes
- Mammalia
- defecating
- physical object
- Chlorophyta
- Penagone sp. nov.
- Gryphoteuthis
- Octopoteuthidae
- Grimpoteuthis sp. 1

At the very bottom, there are labels: **identific**, Pelagic, foo, bar, squids, and a dropdown menu set to 'group: ROV'.



Future Proofing



Independently Evolving Components

Future Proofing

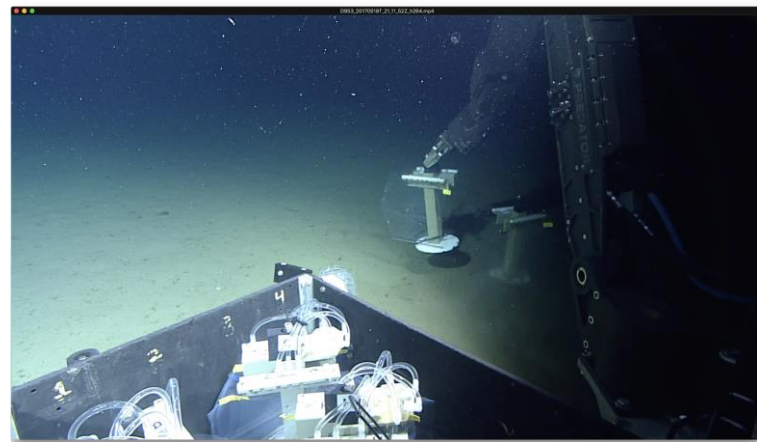
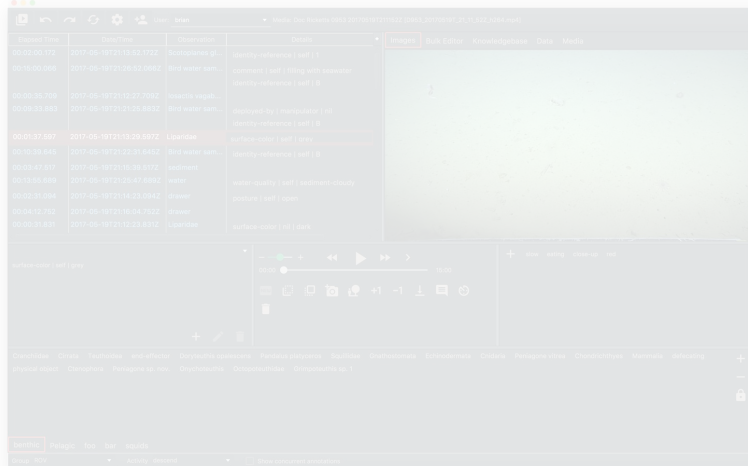
Native Video Players for different needs

Video Asset
Manager

Annotation service

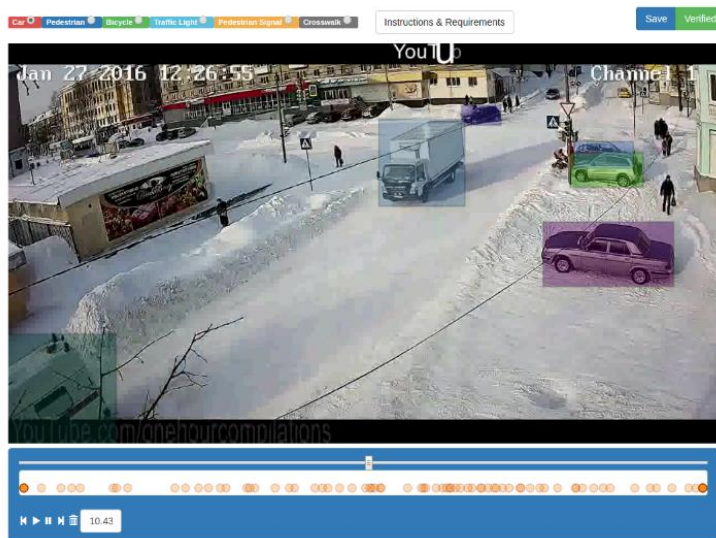
Image Archiver

edgebase



Future Proofing

Integrate or Create Custom Annotation Applications



Video Asset
Manager

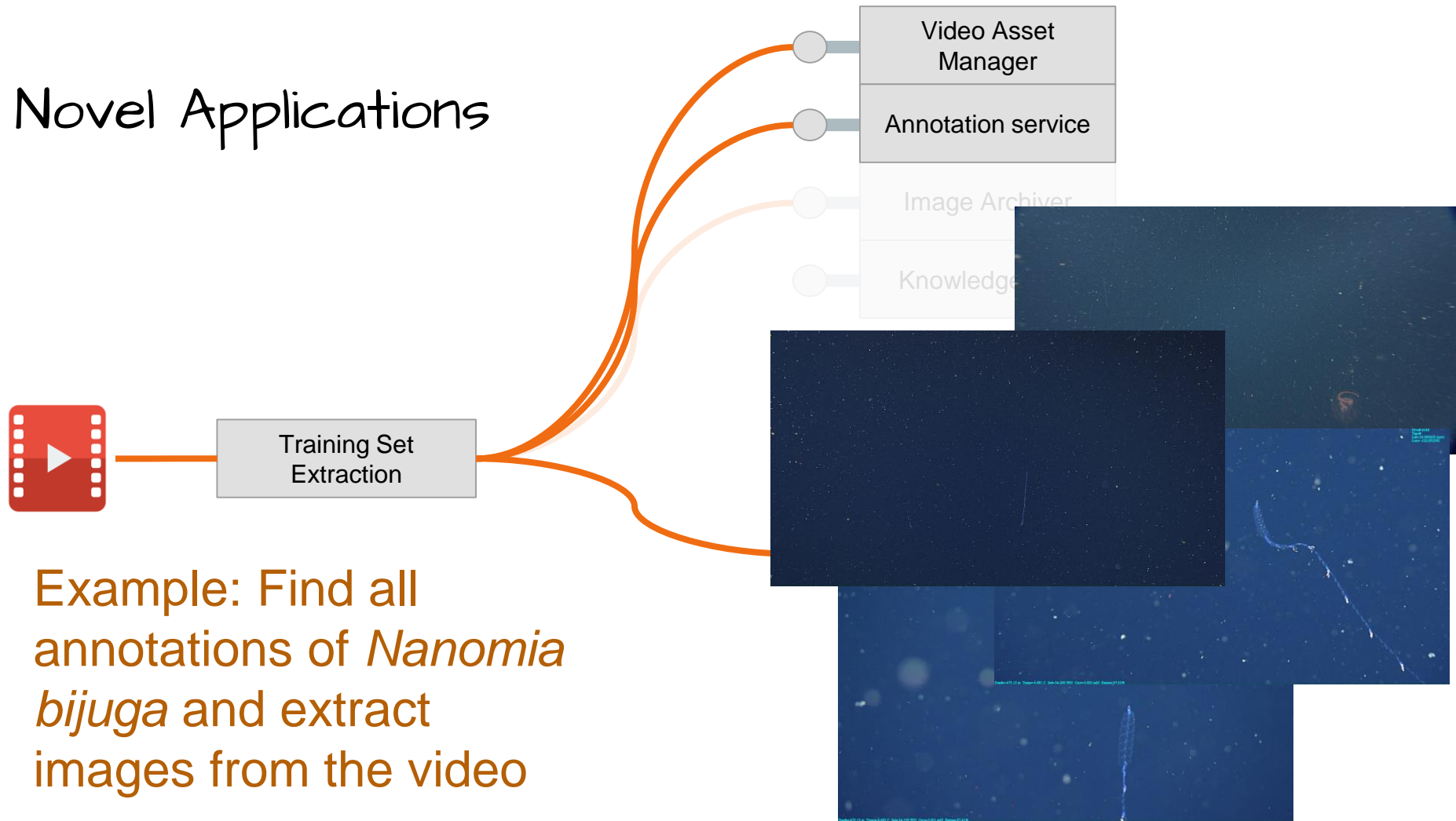
Annotation service

Image Archiver

Knowledgebase



Novel Applications



Novel Applications



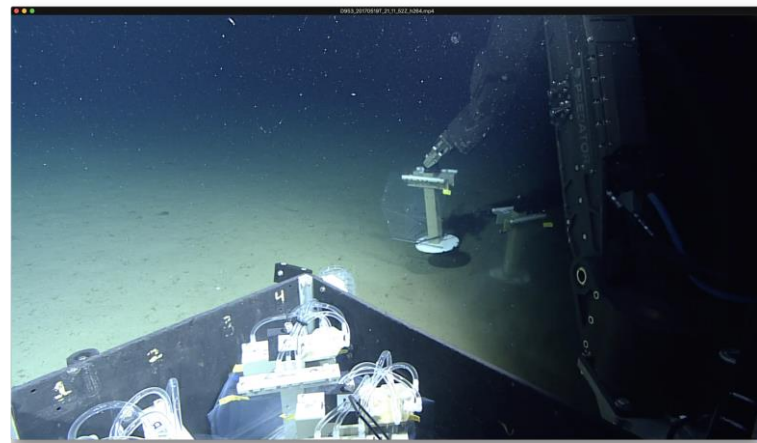
Automated Detector
and Classifier

Video Asset
Manager

Annotation service

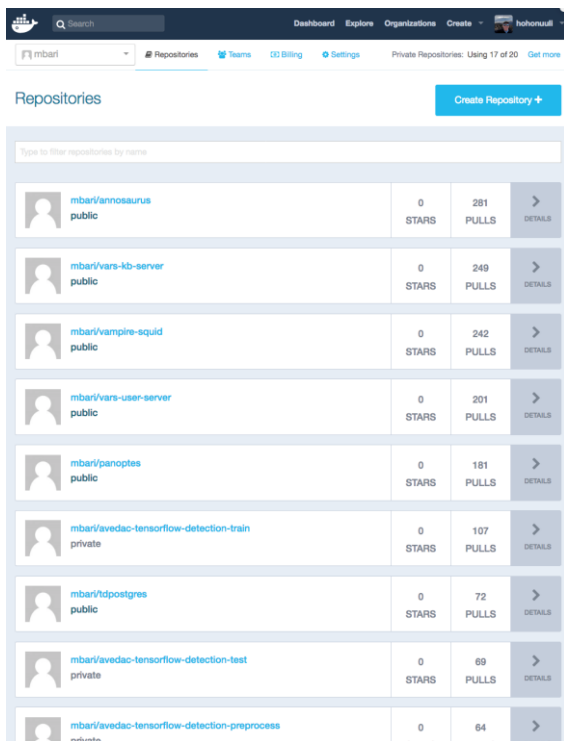
Image Archiver

Knowledgebase



Open-source

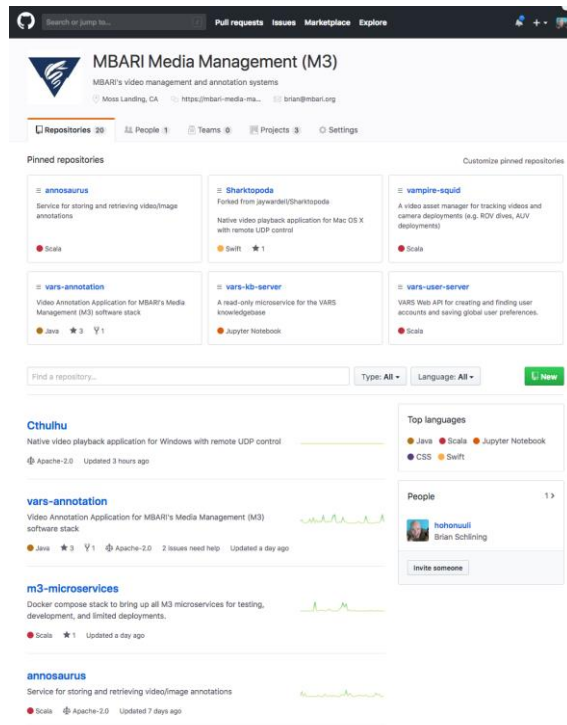
<https://hub.docker.com/u/mbari/>



The screenshot shows the Docker Hub profile for the user 'mbari'. The profile includes a search bar, navigation tabs for Repositories, Teams, Billing, and Settings, and a 'Create Repository' button. Below this is a list of repositories with columns for repository name, visibility, stars, pulls, and a details link.

| Repository Name | Visibility | Stars | Pulls | Details |
|--|------------|-------|-------|---------|
| mbari/annosaurus | public | 0 | 281 | > |
| mbari/vars-kb-server | public | 0 | 249 | > |
| mbari/vampire-squid | public | 0 | 242 | > |
| mbari/vars-user-server | public | 0 | 201 | > |
| mbari/panoptes | public | 0 | 181 | > |
| mbari/avedac-tensorflow-detection-train | private | 0 | 107 | > |
| mbari/tdpostgres | public | 0 | 72 | > |
| mbari/avedac-tensorflow-detection-test | private | 0 | 69 | > |
| mbari/avedac-tensorflow-detection-preprocess | private | 0 | 64 | > |

<https://github.com/mbari-media-management>



The screenshot shows the GitHub repository page for 'MBARI Media Management (M3)'. The repository is owned by 'mbari-media-management' and is located in Moss Landing, CA. It has 28 repositories, 1 person, 3 teams, and 3 projects. The page displays a grid of pinned repositories, including 'annosaurus', 'Sharktopoda', 'vampire-squid', 'vars-annotation', 'vars-kb-server', and 'vars-user-server'. It also features a search bar, filters for repository type and language, and a 'New' button. The 'Top languages' section shows Java, Scala, and Jupyter Notebook. The 'People' section lists 'ihonoull' and 'Brian Schilling'.

Acknowledgements

the David &
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 **MBARI** Monterey Bay Aquarium
Research Institute

Current MBARI team



For more information:

Brian Schlining

brian@mbari.org

<https://www.mbari.org/schlining-brian/>



M B A R I

M O A R I







M B A R I

The logo for the Monterey Bay Aquarium Research Institute (MBARI). It consists of the letters "M B A R I" in a white, sans-serif font, arranged in a slightly curved line. Below the letters is a stylized white graphic of a fish or a similar marine creature.

Thank you!