

Discover the Ocean. Understand the Planet.

SeaTube: Overview and Demonstration

Adrian Round | Workshop On Sea Operations – EMSO ERIC

A UNIVERSITY OF VICTORIA INITIATIVE

Presentation Overview

Main Topics

- Video Annotations – Why? and Overview
- SeaTube Features
- Use of SeaTube in your Organization

A large school of fish, likely salmon, swimming in deep blue water. The fish are densely packed and moving in various directions, creating a dynamic and textured scene. The lighting is somewhat dim, highlighting the silvery scales of the fish against the dark background.

SeaTube

Video Annotations – An Overview

OCEAN
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CANADA

Video Annotations – Why?

Why are they required?

- ❑ Oceanographic institutes worldwide conduct many varied expeditions to study the ocean
- ❑ Deep ocean environments represent the least known areas of planet earth, and video observations are required to characterize the subsea flora, fauna and biota
- ❑ An integral and critical component of these exploration cruises is the ability to reliably and accurately annotate ROV dives in conjunction with video, audio and other sensor data recordings
- ❑ These video observations require experts in relevant fields of study to identify items of interest (biological, geological, physical, etc.)
- ❑ Annotation quality (or lack thereof) will directly impact the amount and quality of the science that can be conducted

Video Annotations Overview

Problem Statements

- ❑ Video data are information rich, expensive to collect, massive in size and difficult to search/ browse/ analyze
- ❑ Video annotations are laborious to create yet are critical for scientific analysis and O&M activities
- ❑ Annotations need experts but with limited space onboard vessels, it is difficult to sail with all the required expertise onboard
- ❑ Many dives are exploring unknown oceans where there is no prior expectation as to what will be encountered
- ❑ Ability to analyze captured annotations is limited without use of structured vocabularies
- ❑ Availability and distribution of captured video and annotation data can be challenging and involve sometimes lengthy delays

Key Features Demanded by Scientists

NOAA OER conducted a study to determine the key features that their scientific community needed to address these problems. The key features were:

- ❑ Ability to capture ***real time annotations*** as observations are being made during the ROV dive
- ❑ Ability to ***view annotations with associated video and sensor data*** (ROV position, depth, temperature, salinity, etc.) in an ***easily accessible environment*** during and after the dive
- ❑ ***Enhanced collaboration*** via the ability to ***engage and utilize remote scientific resources onshore*** (potentially with a ***world-wide distribution***) both during and post-cruise
- ❑ Ability to ***filter, search and export the annotations*** (along with snapshot imagery), with the full ability to edit the contents
- ❑ ***Cloud-based*** to support ***real time access during dives***, and ***full archival access post-cruise***

SeaTube – Main Features

SeaTube addresses these challenges by providing:

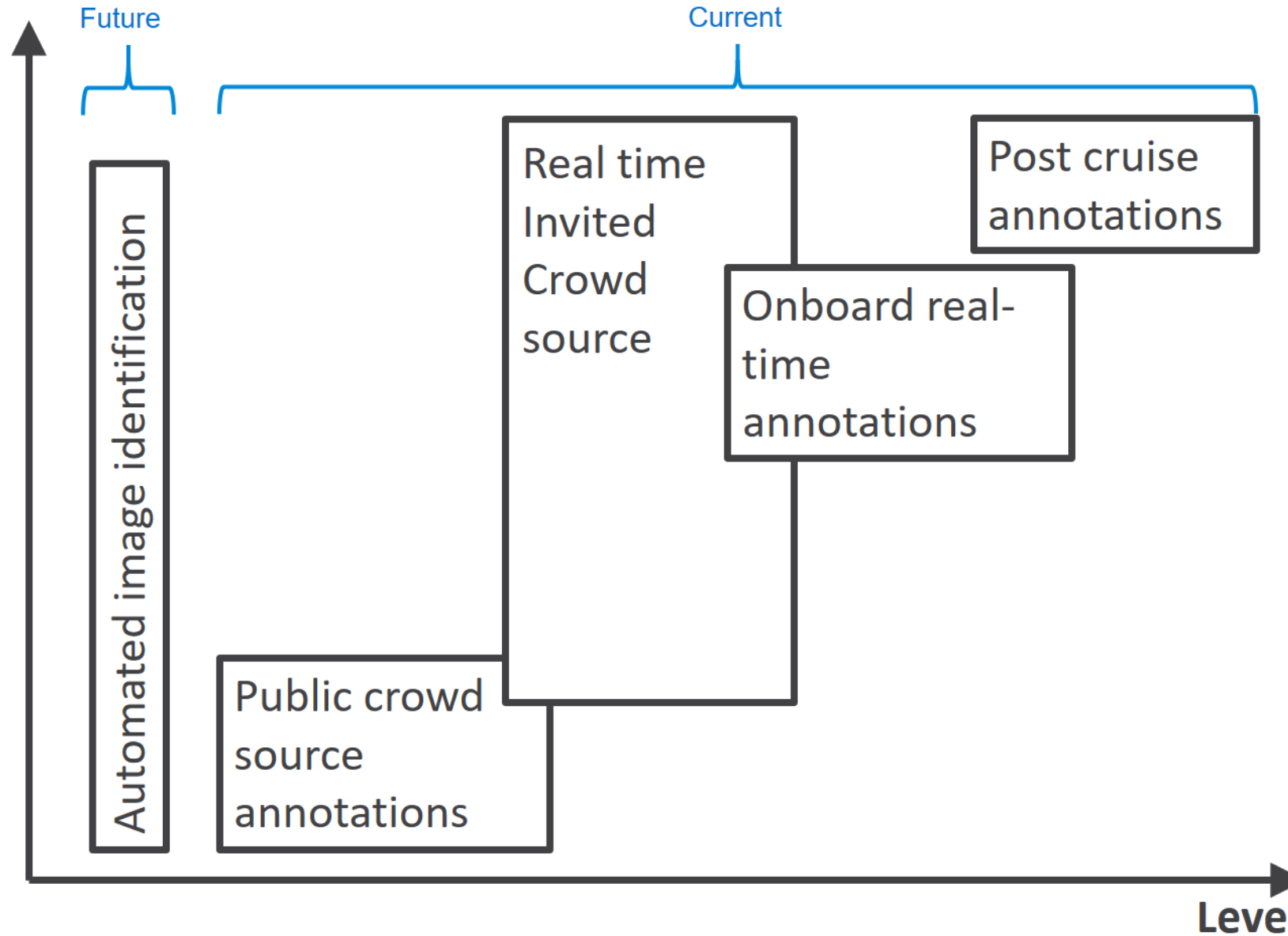
- ❑ **Web-based, telepresence** platform that enables **real time streaming of video and sensor data**
- ❑ Support for both **vessel-based and remote users (distributed worldwide)**, with **real time synchronization of data** between all users (“invited” crowdsourced video annotations)
- ❑ Integration with **defined taxonomies** (i.e. WoRMS, CMECS, etc.) and ability to create **customized, structured vocabularies**. In addition, provides support for **free-form comments**.
- ❑ **Integration with OBIS** for real time detection and alerting of observations not previously recorded in the area of interest
- ❑ **Synchronized data display** of dive map (ROV and annotation location) and other sensor data (i.e. temperature, depth, salinity, etc.)
- ❑ User interface structured for **ease of use** and **quick entry** of annotations, critical for real time dive annotation creation
- ❑ Full ability to **filter, search and export** annotations for further processing outside of SeaTube
- ❑ Ability to create **playlists** of key observations, useful for **science collaboration, public outreach via social media**
- ❑ **User interface fully customizable**, allowing display of only the panels of interest and in location/size they want
- ❑ Ability to further **engage public “Citizen Scientists”** through use of game-ified tool (Digital Fishers) for additional crowdsourced annotations
- ❑ **Mobile** support

“Invited” Crowdsourced Annotations – What Is It?

- A distributed annotation model: Interested and vetted scientists participate in real time ROV dives
- Telepresence brings the ship’s control room to labs and offices.
- Real time annotations online through a web-browser



Accuracy / Completeness



Onboard real time annotations suffer from limited availability of expertise

Invited crowd source annotations through telepresence enables access to broad range of scientists

Level of effort



SeaTube

User Interface Overview

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CANADA

Videos Playlists Dive

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 PI: Kennedy, Brian
 Area: Winslow Reef Complex PIPA
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Camera #1

OKEANOS EXPLORER 2017

Video Pane

2019-09-11 12:28:03

Annotations Search Show Filter

Auto-Refresh 219 / 219

- 19:51 Sand: sediment is two tone 1527 m
- 19:52 Porifera Hexactinellida (Glass Sponge): 1528 m
- 19:57 Arthropoda Crustacea Maxillopoda Thecostraca Cirripedia (Barnacle):on the dead stalk 1522 m
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- 19:59 Rock:Mn-crust: 1521 m
- 19:59 Echinodermata Crinoidea Articulata (Crinoid): 1522 m
- 20:00 Cnidaria Anthozoa Hexacorallia Scleractinia (Stony Coral): white fan enallopsammia 1522 m
- 20:02 Arthropoda Crustacea Malacostraca 1521 m
- 20:03 Cnid (Sea Pen): 1521 m
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- 20:18 Chordata Actinopterygii (Ray-Finned) 1515 m

Sensor Values Hide Sensor Values

2017 Mar 21 20:14:30
 Latitude -1.70414 Longitude -175.20548
 Depth (m) 1520.9 Heading 19

Temperature: (C) 2.84897 2017 Mar 21 20:14:59
 Oxygen Concentration: (ml/l) 2.280411 2017 Mar 21 20:14:59
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DCEL Buttons Auto-Save Keyboard Entry ##

1.Gorgonian	2.Isidiidae	3.Paramuricea	4.Callogorgia	5.Iridogorgia	6.Swiftia	7.Plumarella	8.Chrysogorgiidae	9.Paragorgiidae	10.Primnoidae
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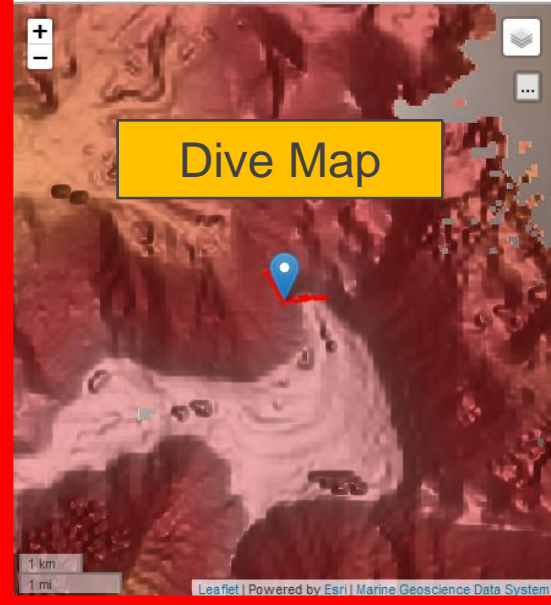
Time Capture Time To Be Reviewed Insite Pacific Zeus Annotation Entry Hide Quick Entry

Select a Taxonomy... Type First Three Characters... Add Attribute

Enter free text here...

Save Save/Keep Time Clear

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Annotations Search Show Filter

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Time To Be Reviewed

Insite Pacific Zeus Plus Camera on ROV Deep Discov. Device Data

Select a Taxonomy... Type First Three Characters...

Add Attribute

Enter free text here...

Sensor Values

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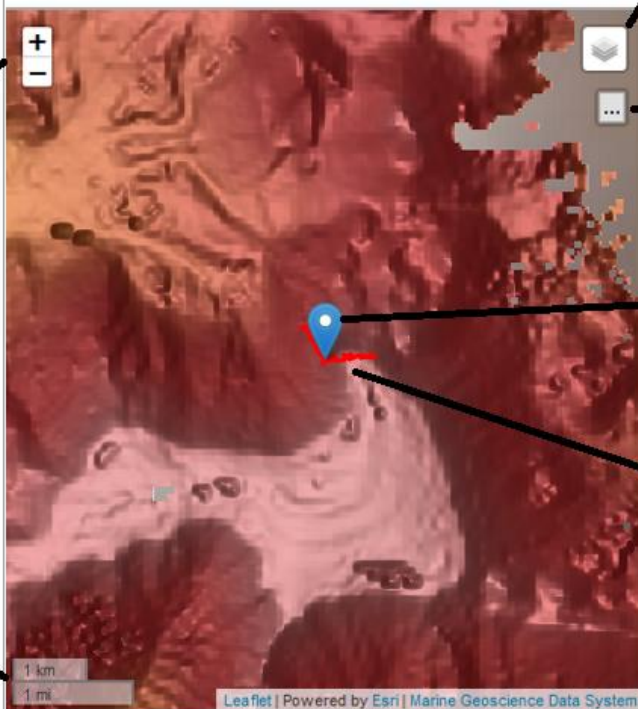
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Dive Map

Dive Metadata

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Zoom



Scale

- GMRT
- Google
- Bing
- NCEI Bathymetry Mosaic
- Bathy
- EXTest
- NOAA: OE_IOCM
- NOAA: deep_sea_corals (MapServer)

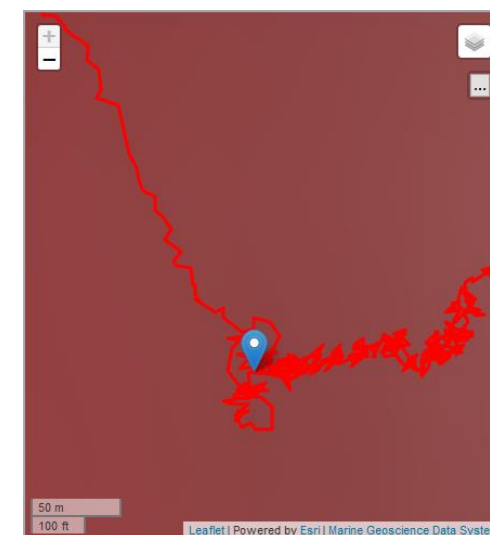
Map Layers

- Bathymetries
 - Bathy (https://gis.ngdc.noaa.gov/arcgis/rest/services/multibeam_mosaic_hillshade/ImageServer)
 - EXTest (https://gis.ngdc.noaa.gov/arcgis/rest/services/oceanos_explorer_grids/ImageServer)
 - NCEI Bathymetry Mosaic (https://gis.ngdc.noaa.gov/arcgis/rest/services/multibeam_mosaic/ImageServer)
 - NOAA: deep_sea_corals (MapServer) (https://gis.ngdc.noaa.gov/arcgis/services/deep_sea_corals/MapServer)
 - NOAA: OE_IOCM (https://gis.ngdc.noaa.gov/arcgis/services/OceanExploration/OE_IOCM/MapServer)

Map Servers

Current Annotation Location

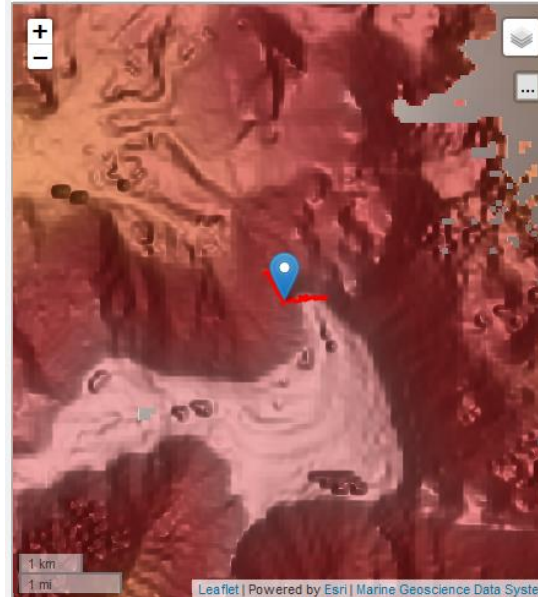
Dive Track



Videos Playlists Dive

Hide Map Hide Video

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Save Save/Keep Time Clear

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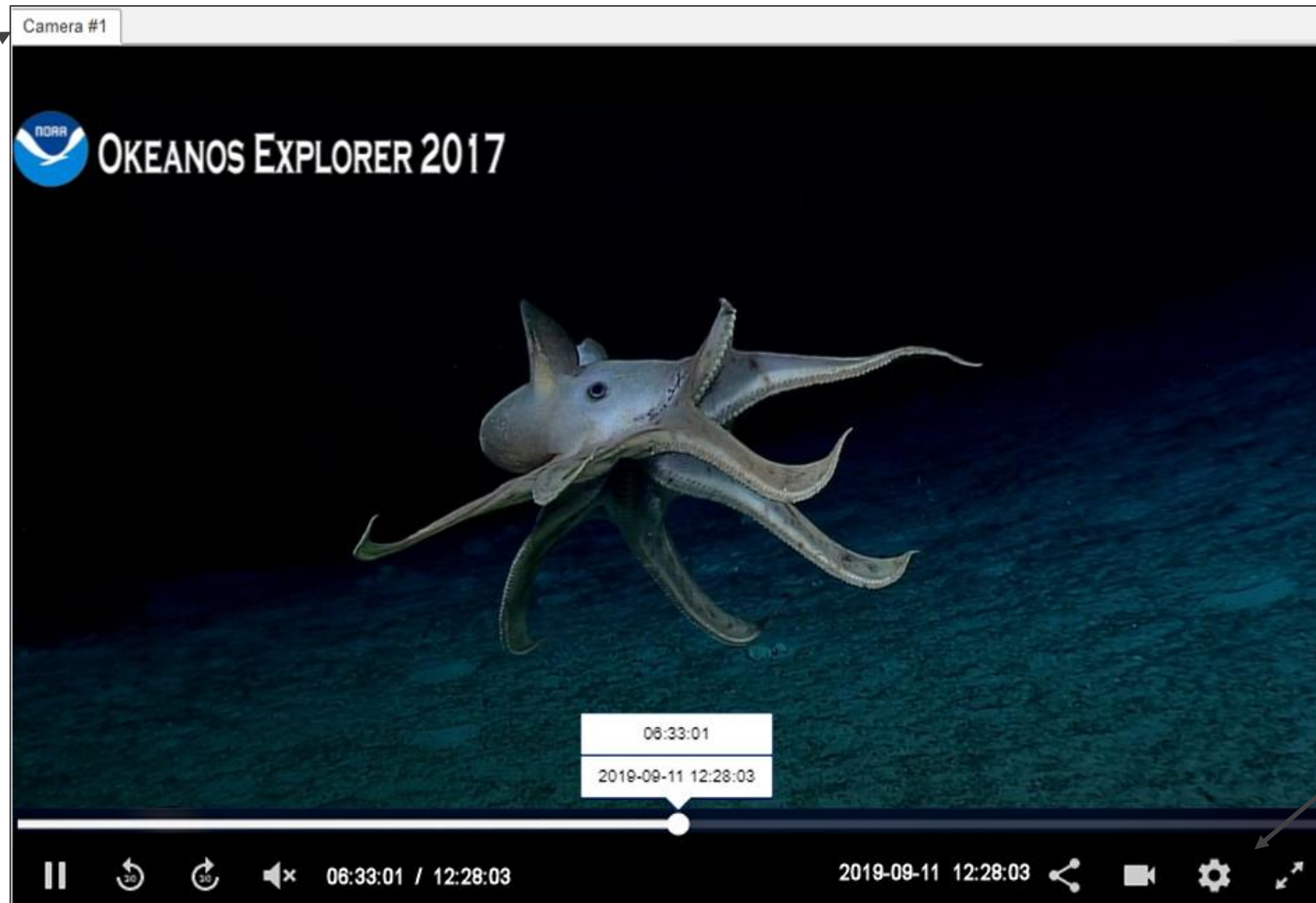
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Video Pane

Support for multiple streams



Speed, Resolution & Snapshots

Playlist Recording

Social Media

Elapsed Time & UTC time

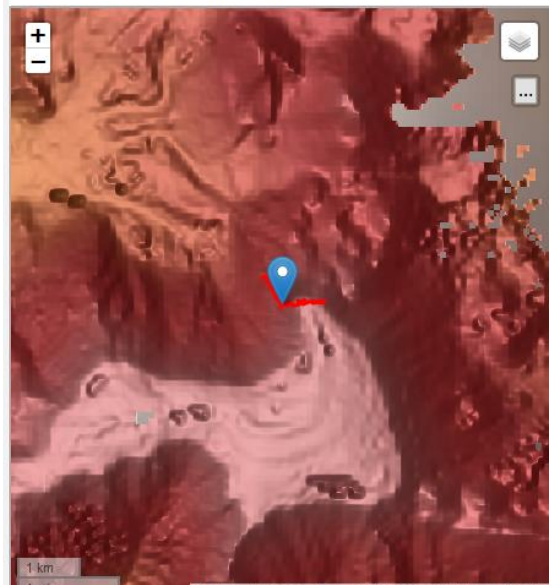
Rewind/Fast Forward

Videos Playlists Dive

Hide Map Hide Video

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Camera #1



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Auto-Refresh 219 / 219

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Time Capture Time To Be Reviewed

Select a Taxonomy... Type First Three Characters...

Add Attribute

Insite Pacific Zeus **Annotation Entry** Hide Quick Entry

Enter free text here...

Save Save/Keep Time Clear

0:14 Cnidaria Anthozoa Octocorallia Pennatulacea (Sea Pen):Umbellula sea pen below dumbo octopus 1521 m 👤🔍✍️

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Annotation Entry

Customizable button sets

Quick entry buttons

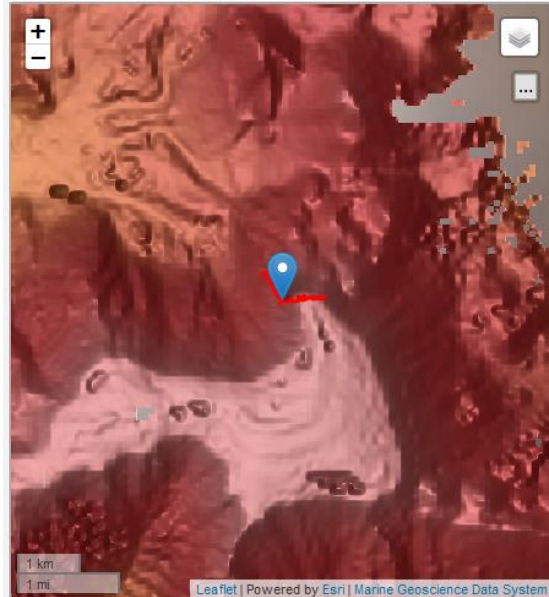
Keypad quick entry

The screenshot shows the DCEL Buttons interface. At the top left, there is a dropdown menu labeled 'DCEL Buttons' and an 'Auto-Save' checkbox. Below this is a grid of 40 buttons, numbered 1 to 40, each with a different background color. The buttons are arranged in four rows and ten columns. The first row contains: 1.Gorgonian, 2.Isididae, 3.Paramuricea, 4.Callogorgia, 5.Iridogorgia, 6.Swiftia, 7.Plumarella, 8.Chrysogorgiidae, 9.Paragorgiidae, 10.Primnoidae. The second row contains: 11.Black Coral, 12.Leiopathes, 13.Stichopathes, 14.Bathypathes, 15.Tanacetipathes, 16.Antipathes, 17.Stylopathes, 18.Paracalypt, 19.Nicella, 20.Plexauridae. The third row contains: 21.Scleractinian, 22.Lophelia, 23.Madrepora, 24.Oculina, 25.Enallopsammia, 26.Dendrophyllia, 27.Madracis, 28.Solenosmillia, 29.Schizopathidae, 30.Acanthogorgiida. The fourth row contains: 31.Sylasterid, 32.SoftCoral, 33.SeaPen, 34.Unknown, 35.+Count, followed by three empty buttons, 38.Porifera, 39.Hexactinellida, and 40.Demosponge. Below the grid is a 'Time' section with two input fields, a 'Capture Time' button, and a 'To Be Reviewed' checkbox. To the right of this section are two dropdown menus: 'Insite Pacific Zeus Plus Camera on ROV Deep Discov.' and 'Device Data'. Further right is a 'Keyboard Entry ##' field and a 'Hide Quick Entry' link. Below the 'Time' section is a 'WoRMS' dropdown menu with 'Ctenophora' selected. To the left of the dropdown is an 'Add Attribute' button. Below the dropdown is a list of taxonomy options: 'Fragilariaceae/Ctenophora', 'Fragilariaceae/Ctenophora', 'Bacillariophyceae incertae sedis/Ctenophora', and 'Animalia/Ctenophora'. To the right of the dropdown is a text input field labeled 'Enter free text here...'. At the bottom right of the form are three buttons: 'Save', 'Save/Keep Time', and 'Clear'.

Customizable structured vocabulary/ taxonomies

Free form comments

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DCEL Buttons Auto-Save

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Keyboard Entry ##

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Insite Pacific Zeus Plus Camera on ROV Deep Discov. Device Data

Select a Taxonomy... Type First Three Characters...

Enter free text here...

Annotations Search Show Filter

Auto-Refresh 219 / 219

19:51	Sand: sediment is two tone	1527 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19:52	Porifera Hexactinellida (Glass Sponge):	1528 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19:57	Arthropoda Crustacea Maxillopoda Thecostraca Cirripedia (Barnacle):on the dead stalk	1522 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19:58	Arthropoda Crustacea Maxillopoda Thecostraca Cirripedia (Barnacle):on dead coral stalk	1523 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19:59	Rock:Mn-crust:	1521 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19:59	Echinodermata Crinoidea Articulata (Crinoid):	1522 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:00	Cnidaria Anthozoa Hexacorallia Scleractinia (Stony Coral): white fan enallopsammia	1522 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:02	Arthropoda Crustacea Malacostraca	1521 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:03	Cnid (Sea Pen)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:03	Cnid (Sea Pen)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:04	Foraminifera Xenophyophorea:	1522 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:04	Cnidaria Anthozoa Octocorallia Pennatulacea (Sea Pen):	1522 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:07	Mollusca (Mollusc):Octopus!	1520 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:14	Cnidaria Anthozoa Octocorallia Alcyonacea Isididae (Bamboo Coral): whip? passed by octopus	1521 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:14	Cnidaria Anthozoa Octocorallia Pennatulacea (Sea Pen):Umbellula sea pen below dumbo octopus	1521 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20:18	Chordata Actinopterygii (Ray-Finned)	1515 m	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Sensor Values Hide Sensor Values

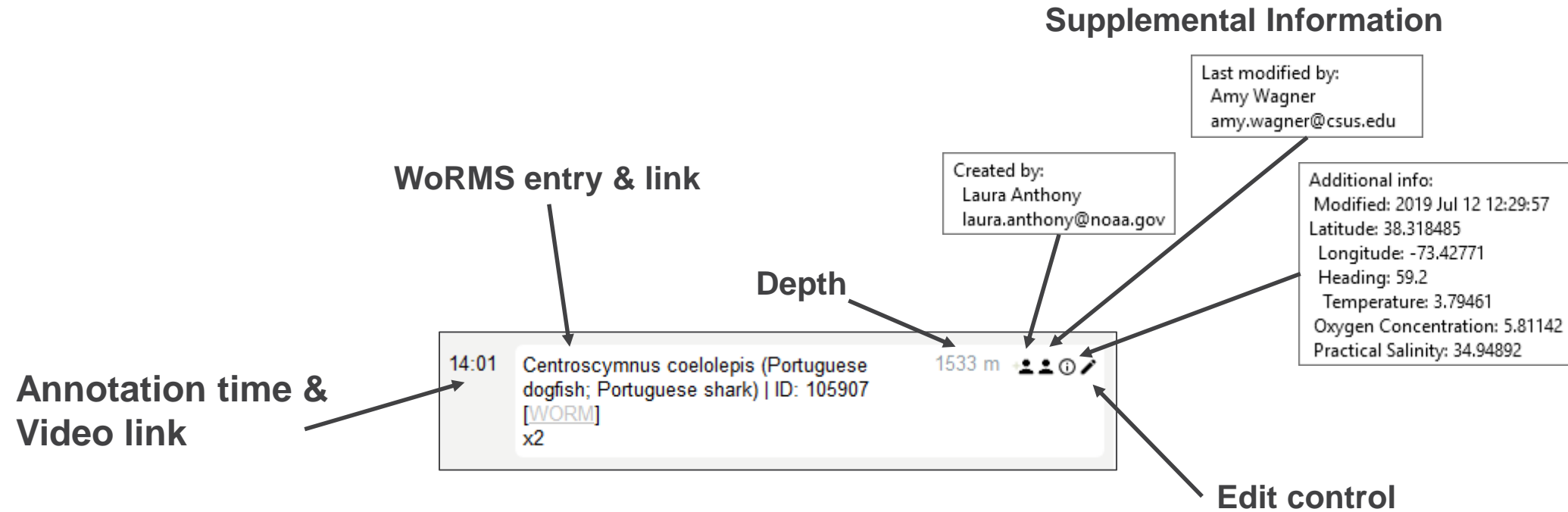
2017 Mar 21 20:14:30

Latitude	-1.70414	Longitude	-175.20548
Depth (m)	1520.9	Heading	19

Temperature: (C)	2.84897	2017 Mar 21 20:14:59
Oxygen Concentration: (ml/l)	2.280411	2017 Mar 21 20:14:59
Practical Salinity: (psu)	34.60682	2017 Mar 21 20:14:59

Annotation List / Sensor Data

Annotation List Item



Annotation List Filter

Annotations Search Hide Filter

Filter Text To Be Reviewed

Creators

Modifiers

Depth

Temperature

Oxygen Conc.

Practical Salinity

OBIS Count

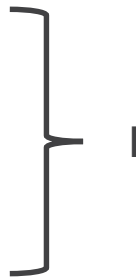
Auto-Refresh 2 / 73

18:31 octopus on local rock high showing extensive fossil burrow/conduit preservation 1420 m ^

18:32 Muusoctopus | ID: 527126 [WORM] 1420 m



Filter criteria

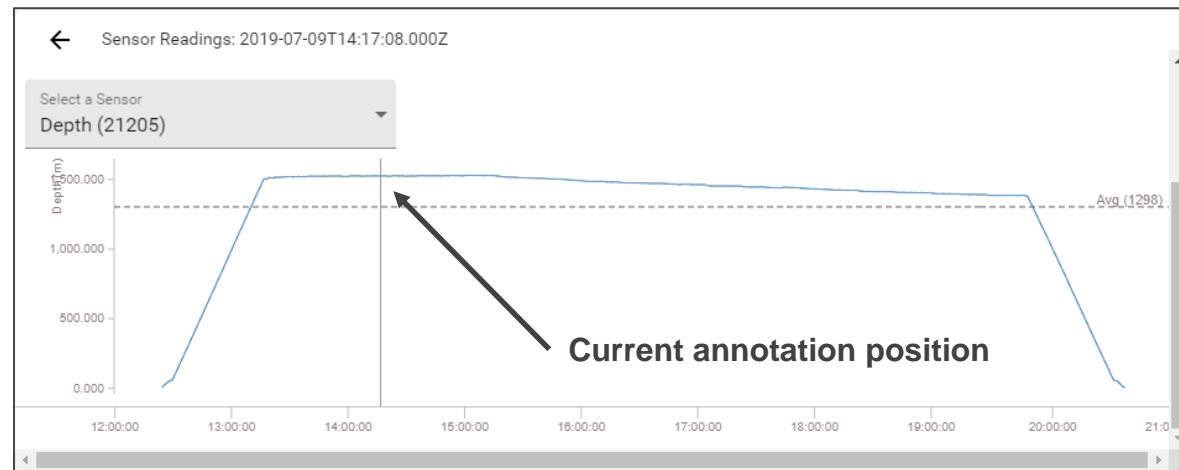



Filter results

Sensor data synched with annotation and video time

Sensor Values		Hide Sensor Values
2019 Jul 09 14:01:30		
Latitude	38.31822	Longitude -73.42786
Depth (m)	1533.3	Heading 36.9
<hr/>		
Temperature: (C)	3.79329	2019 Jul 09 14:01:59
Oxygen Concentration: (ml/l)	5.788881	2019 Jul 09 14:01:59
Practical Salinity: (psu)	34.95061	2019 Jul 09 14:01:59

Sensor Plots synched with annotation and video time





SeaTube

Annotation Tools

OCEAN
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CANADA

Annotation Search

Search across
cruise/
multiple dives

Play video/show
annotation

Export annotations
& images

Search criteria

Search results

Create composite
playlist segments

The screenshot shows the SeaTube Search interface. At the top, there are filter fields for Cruise, Dive, and Text. The Cruise field is set to 'NOAA OER Southeast US ROV (EX19...'. The Dive field contains two entries: 'EX1903L2_Dive03' and 'EX1903L2_Dive06'. The Text field contains 'octopus'. A 'Search' button is located to the right of the filter fields. Below the filters is a table of search results with columns for Date, Text, Dive, and Cruise. The table contains eight rows of results, all with the same text: 'Cephalopoda (cephalopods; squids, oct...'. Below the table is a pagination bar showing 'Page 1 of 3' and a 'Next' button. At the bottom, there are buttons for 'Export as CSV', 'Add to Existing Playlist', and 'Create New Playlist'. There are also checkboxes for 'Include Special Characters <,>,&' and 'Include Video Snapshots', and input fields for 'Snapshots Per Annotation (1-9)' (set to 1) and 'Time Between Snapshots (Seconds)' (set to 5). An 'Export' button is at the bottom right.

Customizable Taxonomies

Imported/external Taxonomies
(i.e. WoRMs, CMECS, etc.)

User defined taxonomies

Ocean Networks Canada
Oceans 2.0

Data Preview | Data Search | Plotting Utility

- Imported Taxonomies
 - CMECS
 - Geoform Component
 - Substrate Component
 - Anthropogenic Substrate
 - Biogenic Substrate
 - Geologic Substrate
 - Water Column Component
 - Biogeochemical Feature
 - Hydroform
 - Layer
 - Salinity
 - Temperature
 - WoRMS
 - Biota
 - Animalia
 - Archaea
 - Bacteria
 - Biota incertae sedis
 - Chromista
 - Fungi
 - Monera
 - Plantae
 - Protozoa
 - Viruses
- User-Defined Taxonomies
 - DFO
 - Digital Fishers
 - ONC
 - ROV Operations
 - Simplified CMECS
 - Coarse
 - Coarse fine
 - Coarse rock
 - Fine
 - Fine coarse
 - Fine rock
 - Rock
 - Rock coarse
 - Rock fine
 - WoRDSS

Add User Defined Taxonomy



Customizable Quick Entry Button Sets

Ocean Networks Canada
Oceans 2.0

Data Preview | Data Search | Plotting Utility | SeaTube | Digital Fishers | Cameras | More | Admin

Taxon Button Sets

- Brian Kennedy
- DCEL
- DCEL Buttons**
- demo
- EX1811_Select Taxonomy
- Gina
- Mashkoor
- Matt
- Meg
- Midwater Fauna
- New Button Set
- New Button Set (1)
- New Button Set (2)
- New Button Set (3)
- New Button Set (4)
- ONC
- ROVstage
- Simplified CMECS
- Tina

Taxon Button Set

Name:

Active:

Order/group buttons

1. Gorgonian	2. Isididae	3. Paramuricea	4. Callogorgia	5. Iridogorgia	6. Swiftia	7. Plumarella	8. Chrysogorg...	9. Paragorgiidae	10. Primnoidae
11. Black Coral	12. Leiopathes	13. Stichopath...	14. Bathypathes	15. Tanacetip...	16. Antipathes	17. Stylopathes	18. Paracalypt	19. Nicella	20. Plexauridae
21. Scleractinian	22. Lophelia	23. Madrepora	24. Oculina	25. Enallopsa...	26. Dendroph...	27. Madracis	28. Solenosm...	29. Schizopat...	30. Acanthogo...
31. Sylasterid	32. SoftCoral	33. SeaPen	34. Unknown	35. +Count			38. Porifera	39. Hexactinel...	40. Demospo...

Button Configuration

Button Type:

Index:

Label: Enter 15 characters or less

Taxonomy:

Taxon:

Colour:

Comment:

Full color palette

Assign taxonomy

Assign structured comment

A large school of fish swimming in deep blue water. The fish are silvery and appear to be moving in a coordinated pattern, creating a sense of depth and movement. The background is a dark, rich blue, and the overall scene is captured from an underwater perspective.

SeaTube

Use by Your Organization

OCEAN
NETWORKS
CANADA

Usage of SeaTube

SeaTube is currently an integrated component of Oceans 2.0 – ONC’s master data acquisition, archive, distribution and visualization system

Options:

1. ONC-Hosted

- System administration by ONC staff
- Data stored at ONC, but fully owned and managed by the user organization

2. Blended

- ONC administered
- Data stored at the client facility

Note - this option currently involves more complexity to setup and configure

ONC is also working on a fully stand-alone SeaTube offering, allowing for full administration and local storage at user organization location.

ONC would also like to foster discussion with other organizations regarding a collaborative, open-sourced platform for SeaTube.

ONC-Hosted Advantages

- ❑ Minimizes initial expenses and time to implement
- ❑ Allows assessment of full capabilities utilizing your own data (Try Before You Buy)
- ❑ SeaTube / Oceans 2.0 has been field proven and represents over a decade of dedicated development
- ❑ Provides robust capability out-of-the-box, and allows for custom expansion of services by client
- ❑ All administration, configuration, archiving, continuity of operations, etc. already exist and would be extended to the client
- ❑ Extra operational support available as required to support client's cruises & dives
- ❑ Avoids the financial and technical risk associated with a large, new, customized development projects undertaken by the client to replicate existing SeaTube / Oceans 2.0 functionality
- ❑ ONC has a large professional software development team dedicated to the continual maintenance and innovative evolution of SeaTube / Oceans 2.0
- ❑ An ONC-hosted solution also allows clients and their users to utilize our extensive computing resources
- ❑ Client data can be protected for only authorized access

Estimated Costs

- Installation model chosen (ONC-hosted or Blended)
- Whether the full system or select components (i.e. SeaTube) will be included
- The number, type and specific oceanographic instruments that will need to be configured and supported
- Estimated data volumes
- Whether extra hardware is required, depending on estimated data volumes and installation model chosen
- Whether existing customer hardware can be utilized for local components
- Whether extra data products are required
- Level of training, administration, data stewardship, QA/QC, etc., services that the client would like ONC to provide
- Extension of the system access to other organizations beyond the original client (i.e. if the client intends the installation to support a national program consisting of multiple member organizations)



Thank You!

For more information:

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