

Cruise Report in Support of Maritimes Region Research Project: Use of Passive Acoustics to Quantify Fish Biodiversity and Habitat Use

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ABSTRACT

Kenchington, E., Lirette, C. and De Clippele, L.H. 2021. Cruise Report in Support of Maritimes Region Research Project: Use of Passive Acoustics to Quantify Fish Biodiversity and Habitat Use. Can. Manusc. Rep. Fish. Aquat. Sci. 3231: iv + 52 p.

The Department of Fisheries and Oceans in collaboration with the University of Edinburgh and the Ocean Tracking Network successfully deployed three benthic landers in the Sambro Bank Sponge Conservation Area. These landers are equipped with camera systems and passive acoustic receivers to record the soundscape on the *Vazella pourtalesii* sponge grounds. This document provides the necessary background information for the mission (HUDSON2021-048) which also completed three associated CTD casts and a number of photo transects using a drop camera system (4K Camera) to characterize the benthic habitats.

RÉSUMÉ

Kenchington, E., Lirette, C. and De Clippele, L.H. 2021. Cruise Report in Support of Maritimes Region Research Project: Use of Passive Acoustics to Quantify Fish Biodiversity and Habitat Use. Can. Manusc. Rep. Fish. Aquat. Sci. 3231: iv + 52 p.

Pêches et Océans Canada, en collaboration avec l'Université d'Édimbourg et Ocean Tracking Network, a déployé trois sondes en milieu benthique dans la zone de conservation des éponges du banc Sambro. Ces sondes sont équipées de caméras et de récepteurs acoustiques passifs pour enregistrer le paysage sonore des récifs d'éponges *Vazella pourtalesii*. Ce document présente le contexte nécessaire pour la mission (HUDSON2021-048), pendant laquelle on a aussi déployé trois sondes de conductivité, de température et de profondeur de même que plusieurs transects de photos à l'aide d'un système de caméra lestée (Caméra 4K) afin de caractériser les habitats benthiques.

HUDSON2021-048 MISSION DETAILS

The Commanding Officer for the CCGS *Hudson* mission (Hudson2021-048) was Captain Fergus Francey of the Canadian Coast Guard. Captain Francey and his crew were instrumental to the success of this mission. CCGS *Hudson* was originally scheduled to run from 9-13 September, 2021, however, the region was hit by a Category 3 major hurricane, Larry (Figure 1), which delayed departure until 11 September, 2021. The hurricane first formed on the 31st of August and dissipated by the 13th of September, being designated an extratropical cyclone after the 11th of September. The highest winds reached 205 km/h and produced significant swells. Nevertheless, the CCGS *Hudson* mission successfully completed 15 operations: 9 4K Camera transects, 3 CTD casts and 3 lander deployments. These operations completed the core activities planned for the mission, and one of the additional planned 4K Camera transects was completed in a previously assessed area. Details of those operations are provided in this report, and the Cruise Planning Document completed prior to sailing, which outlines the objectives of the mission in detail, is summarized in Appendix 1. A Navigation Warning was prepared and posted to warn of the mooring locations even though they are in an area closed to bottom-contact fishing (Appendix 2).



Figure 1. Map plotting the track and intensity of the storm, according to the Saffir–Simpson scale. Images from Wikipedia , the free encyclopedia [Hurricane Larry - Wikipedia](#) [Accessed 10/7/2021].

This research project is registered in the DFO DMApps under Project 835 (Ocean Ecology Section, Ecosystem Assessment, Benthic Biodiversity and Ecology) and was approved by DFO management. The end date of the project is 29 March 2024. The project is a collaboration between DFO, the University of Edinburgh, the Ocean Tracking Network (OTN) and the iAtlantic project. The iAtlantic project is funded by the European Union’s Horizon 2020 research and innovation programme under Grant Agreement no. 818123, and is an accepted project under the United Nations Ocean Decade initiative.

Scientific Cruise Participants

This mission involved at-sea participation of 11 scientists (Table 1). All but one of the participants were employees of Fisheries and Oceans, Canada (DFO) at the time of sailing. The DFO team was joined by Dr. Laurence De Clippele of the University of Edinburgh who is a principle investigator on the research project.

Table 1. Cruise participants and responsibilities.

Name (Affiliation)	Duty
1. Kenchington, Ellen (DFO)	Chief Scientist
2. Lirette, Camille (DFO)	Data Manager
3. MacDonald, Barry (DFO)	Operational Lead, 4K Cam, Lander Cameras and fittings, CTD
4. Xu, Jinshan (DFO)	Lander Operational Lead
5. De Clippele, Laurence (Edinburgh)	Lander Deployment, 4K Cam
6. Barthelotte, Jay (DFO)	Lander Deployment
7. Theriault, Christiane (DFO)	Lander Deployment
8. Bouchard Marmen, Marieve (DFO)	4K Cam operation, CTD
9. Murillo, Francisco Javier (DFO)	4K Cam operation, CTD
10. Staniforth, Calisa (DFO)	Science Support, marine mammals
11. Odenthal, Brigid (DFO)	Science Support, marine mammals

CATALOGUE OF OPERATIONS

The mission completed 15 operations related to this project which are summarized in Table 2. Each operation is assigned a consecutive operation number (CON) for which the data/time, latitude/longitude and depth were recorded along with other metadata. The general location of these operations is shown in Figures 2 and 3. All of the physical oceanographic data collected on this mission as well as the full Cruise Planning Document are deposited in Mendeley and can be retrieved from: <https://data.mendeley.com/datasets/wcs8mjt27d/draft?a=febb07e2-0178-4e93-ae7a-cddd09388fa7> All maps shown in this report were created in ARCGIS using a NAD83 UTM 20N projection.

Table 2. Metadata associated with each operation completed on HUDSON2021-048.

Station	CON	Julian Day	Julian Day GMT*	GPS Date	Instrument	Attached	Action	Sounding Depth (m)	Sea Bird Depth (m)	Latitude	Longitude	Author**
HDV_LS1	001	254	254182411	2021-09-11	CTD		Deployed	152.913		43.88668	-63.09503	LDC
HDV_LS1	001	254	254183208	2021-09-11	CTD		Bottom	153.690		43.88753	-63.09262	LDC
HDV_LS1	001	254	254183928	2021-09-11	CTD		Recovered	152.850		43.88797	-63.08952	LDC
HDV_LS1	002	254	254191016	2021-09-11	4K Cam	SBE39	Deployed	157.563		43.88270	-63.09955	LDC
HDV_LS1	002	254	254191946	2021-09-11	4K Cam	SBE39	On Bottom		158.81	43.88423	-63.09610	LDC
HDV_LS1	002	254	254193747	2021-09-11	4K Cam	SBE39	Off Bottom		156.17	43.88814	-63.09182	LDC
HDV_LS1	002	254	254194501	2021-09-11	4K Cam	SBE39	Recovered	150.670		43.88974	-63.09037	LDC
HDV_LS1	003	254	254202244	2021-09-11	4K Cam	SBE39	Deployed	146.363		43.88634	-63.10486	LDC
HDV_LS1	003	254	254202755	2021-09-11	4K Cam	SBE39	On Bottom	146.770	149.26	43.88666	-63.10262	LDC
HDV_LS1	003	254	254211526	2021-09-11	4K Cam	SBE39	Off Bottom		148.24	43.89077	-63.09041	LDC
HDV_LS1	003	254	254212125	2021-09-11	4K Cam	SBE39	Recovered	147.350		43.88996	-63.08850	LDC
HDV_LS1	004	254	254215033	2021-09-11	4K Cam	SBE39	Deployed	152.130		43.88282	-63.09830	LDC
HDV_LS1	004	254	254215549	2021-09-11	4K Cam	SBE39	On Bottom		157.64	43.88401	-63.09710	LDC
HDV_LS1	004	254	254222549	2021-09-11	4K Cam	SBE39	Off Bottom	144.840	148.70	43.89143	-63.09005	FJM
HDV_LS1	004	254	254223222	2021-09-11	4K Cam	SBE39	Recovered	144.650		43.89274	-63.08846	FJM
HDV_LS1	005	255	255105242	2021-09-12	Deploy Lander		Deployed	152.520		43.88673	-63.09575	FJM
HDV_LS1	005	255	255110015	2021-09-12	Deploy Lander		Bottom	152.330		43.88717	-63.09600	FJM
DV_LS2	006	255	255115313	2021-09-12	4K Cam	SBE39	Deployed	151.453		43.90073	-63.07364	LDC
DV_LS2	006	255	255120034	2021-09-12	4K Cam	SBE39	On Bottom	137.190	138.15	43.90000	-63.07475	LDC
DV_LS2	006	255	255130110	2021-09-12	4K Cam	SBE39	Off Bottom		146.10	43.89322	-63.08418	LDC
DV_LS2	006	255	255130849	2021-09-12	4K Cam	SBE39	Recovered	144.650		43.89249	-63.08522	LDC
DV_LS2	007	255	255135612	2021-09-12	4K Cam	SBE39	Deployed	145.530		43.89679	-63.07712	MBM
DV_LS2	007	255	255140054	2021-09-12	4K Cam	SBE39	On Bottom		156.41	43.89783	-63.07710	MBM
DV_LS2	007	255	255141200	2021-09-12	4K Cam	SBE39	Off Bottom	142.690	144.62	43.90112	-63.07646	MBM
DV_LS2	007	255	255141733	2021-09-12	4K Cam	SBE39	Recovered	154.920		43.90340	-63.07692	MBM
DV_LS2	008	255	255153332	2021-09-12	4K Cam	SBE39	Deployed	154.763		43.90038	-63.07882	MBM

DV_LS2	008	255	255153858	2021-09-12	4K Cam	SBE39	On Bottom		153.20	43.89918	-63.07878	MBM
DV_LS2	008	255	255160603	2021-09-12	4K Cam	SBE39	Off Bottom		156.03	43.89710	-63.07982	MBM
DV_LS2	008	255	255161214	2021-09-12	4K Cam	SBE39	Recovered	146.180		43.89842	-63.08039	MBM
DV_LS2	009	255	255163052	2021-09-12	CTD		Deployed	145.353		43.89514	-63.08097	LDC
DV_LS2	009	255	255163756	2021-09-12	CTD		Bottom	153.330		43.89548	-63.08032	LDC
DV_LS2	009	255	255164549	2021-09-12	CTD		Recovered	153.940		43.89694	-63.07951	LDC
DV_LS2	010	255	255173128	2021-09-12	Deploy Lander		Deployed	151.230		43.89635	-63.08041	FJM
DV_LS2	010	255	255173650	2021-09-12	Deploy Lander		Bottom	151.860		43.89619	-63.07943	FJM
LDV_LS3	011	255	255182206	2021-09-12	4K Cam	SBE39	Deployed	168.793		43.90617	-63.06506	MBM
LDV_LS3	011	255	255182935	2021-09-12	4K Cam	SBE39	On Bottom	214.410	215.60	43.90831	-63.06386	MBM
LDV_LS3	011	255	255185654	2021-09-12	4K Cam	SBE39	Off Bottom		225.37	43.91549	-63.05676	MBM
LDV_LS3	011	255	255190622	2021-09-12	4K Cam	SBE39	Recovered	222.940		43.91808	-63.05586	MBM
LDV_LS3	012	255	255194345	2021-09-12	4K Cam	SBE39	Deployed	224.973		43.90306	-63.05876	MBM
LDV_LS3	012	255	255195048	2021-09-12	4K Cam	SBE39	On Bottom		221.66	43.90481	-63.05860	MBM
LDV_LS3	012	255	255202117	2021-09-12	4K Cam	SBE39	Off Bottom		223.55	43.91433	-63.05935	MBM
LDV_LS3	012	255	255202856	2021-09-12	4K Cam	SBE39	Recovered	226.690		43.91673	-63.05900	MBM
LDV_LS3	013	255	255212352	2021-09-12	CTD		Deployed	220.963		43.91121	-63.05915	MBM
LDV_LS3	013	255	255213212	2021-09-12	CTD		Bottom	220.710		43.91172	-63.05880	MBM
LDV_LS3	013	255	255214013	2021-09-12	CTD		Recovered	220.840		43.91279	-63.05844	MBM
LDV_LS3	014	255	255215415	2021-09-12	Deploy Lander		Deployed	220.973		43.91323	-63.05768	FJM
LDV_LS3	014	255	255220338	2021-09-12	Deploy Lander		Bottom	221.870		43.91448	-63.05733	FJM
VS_5	015	256	256093104	2021-09-13	4K Cam	SBE39	Deployed			44.05599	-63.17314	LDC
VS_5	015	256	256093603	2021-09-13	4K Cam	SBE39	On Bottom		141.79	44.05473	-63.17209	LDC
VS_5	015	256	256101839	2021-09-13	4K Cam	SBE39	Off Bottom		167.96	44.04548	-63.16341	LDC
VS_5	015	256	256102530	2021-09-13	4K Cam	SBE39	Recovered	163.660		44.04561	-63.16230	MBM

*DDDHMMSS D = Day of Year, H = Hour, M = Minute, S = Second (Time is recorded as GMT - Greenwich Mean Time); **LDC=Laurence De Clippele; FJM= Francisco Javier Murillo; MBM=Marieeve Bouchard Marmen.

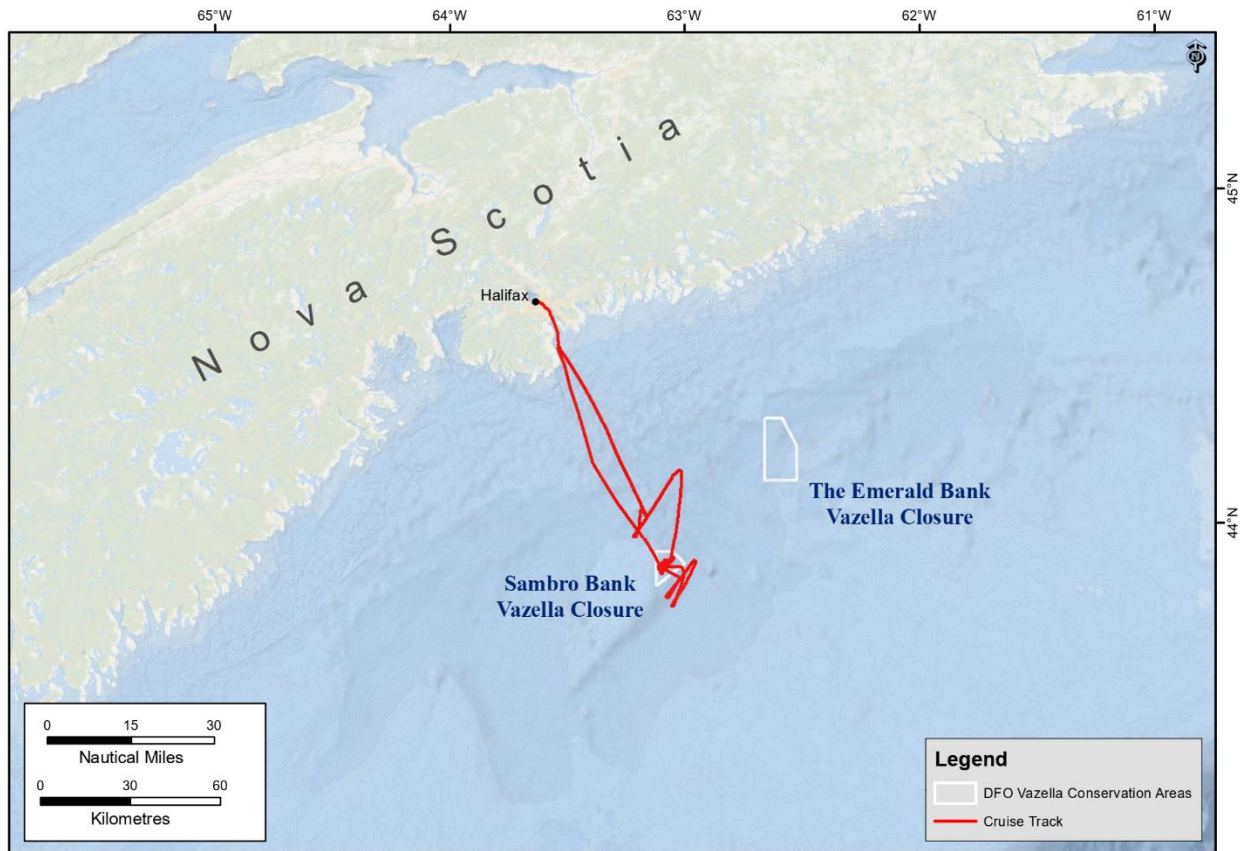


Figure 2. Cruise track (red) for CCGS *Hudson* mission Hudson2021-048, 11-13 September, 2021. The location of the Sambro and Emerald Bank Sponge Conservation Areas are indicated in white outline. Fishing with bottom-contact gears is prohibited in those areas.

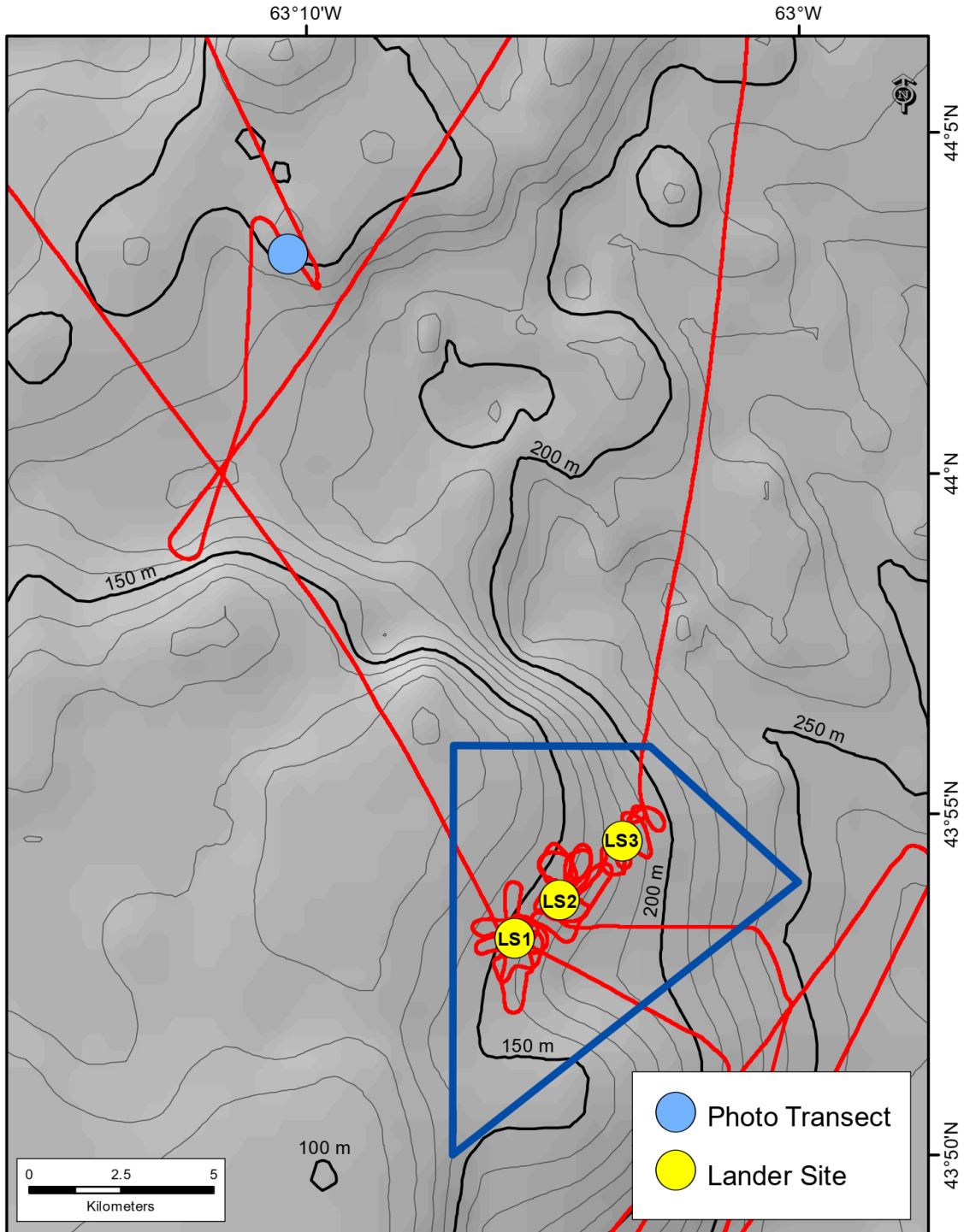


Figure 3. The cruise track (red) for CCGS *Hudson* mission Hudson2021-048, 11-13 September, 2021 showing details of the lander deployment sites (LS1-3) and the location of the additional photo transect (VS-5, CON 015 see Table 2) completed with the 4K Camera. The Sambro Bank Sponge Conservation Area is outlined in blue. Depth contours at 10 m intervals are indicated.

Lander Site 1 (LS1) Overview of Operations

Three 4K Camera photo transects were completed at LS1 (Figure 4), along with a CTD cast and deployment of the lander.

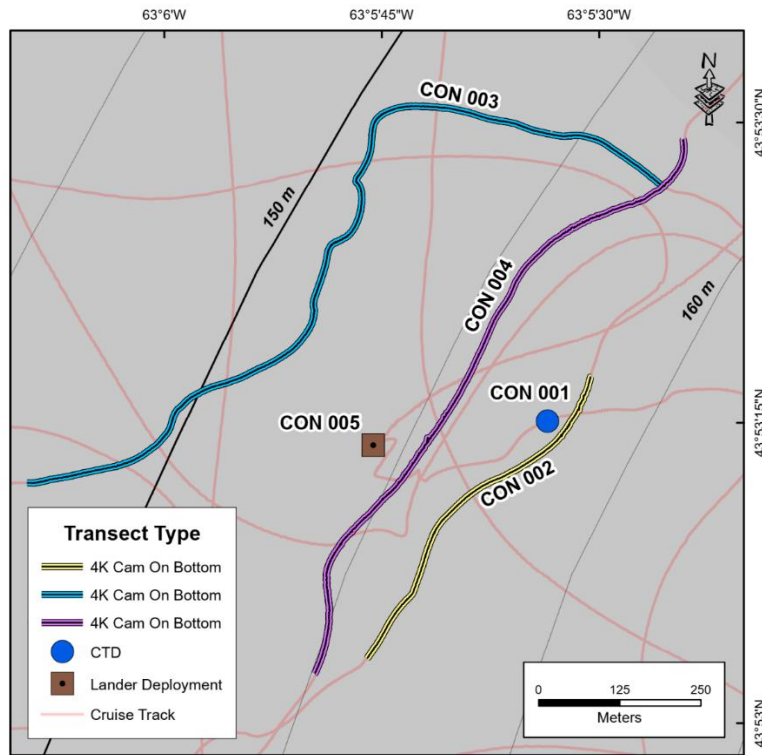


Figure 4. Location of the five operations completed in support of data collection at Lander Site 1. See Table 2 for associated metadata.

Lander Site 1 (LS1) Overview of 4K Camera Operations

Details of the three 4K Camera photo transects from LS1 are found in Figures 5-7. In total 113 photos were taken of which 106 were considered to be of good quality. Of the 106 photos, 31 had live *Vazella pourtalesii* present (29.24 %). The density of live *V. pourtalesii* based on these transects (Table 3) was 0.83 individuals/m². The photos were noticeably darker during these three operations which was attributed to poorer light penetration in the water column due to the after-effects of the hurricane.

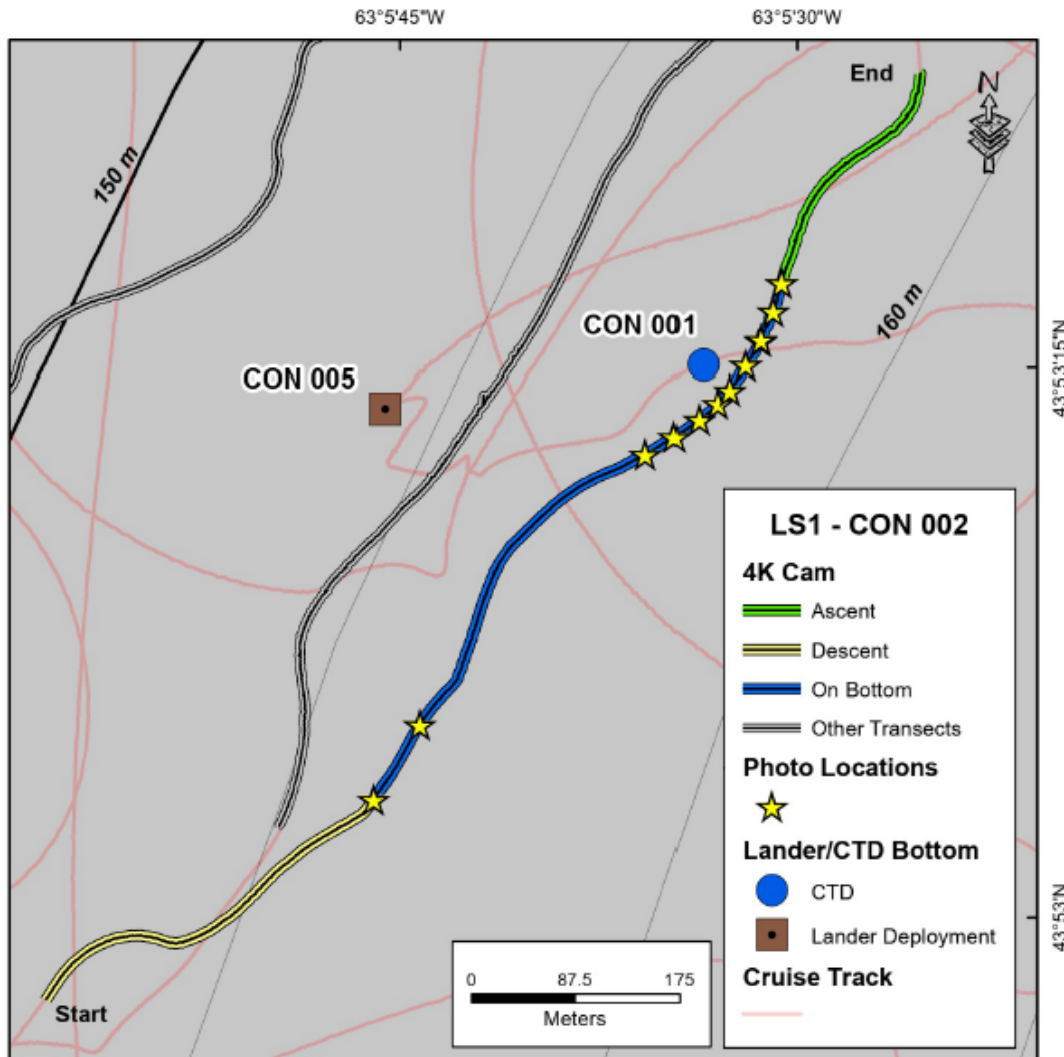
Table 3. Density of live *V. pourtalesii* by photo transect (CON see Table 2, Figures 4-7) at LS1.

	CON 002	CON 003	CON 004
Density of <i>V. pourtalesii</i> (individuals/m ²)	0.58	0.64	1.14

Station: Lander Site 1

CON 002

Gear Type: 4KCam

**Con 002**

<i>Location</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Time</i>
In Water	43.882697	-63.099553	254191016
On Bottom	43.884225	-63.096102	254191946
Off Bottom	43.888137	-63.091823	254193747
Out of Water	43.889738	-63.090372	254194501
Time On Bottom (h:mm)	0:18		

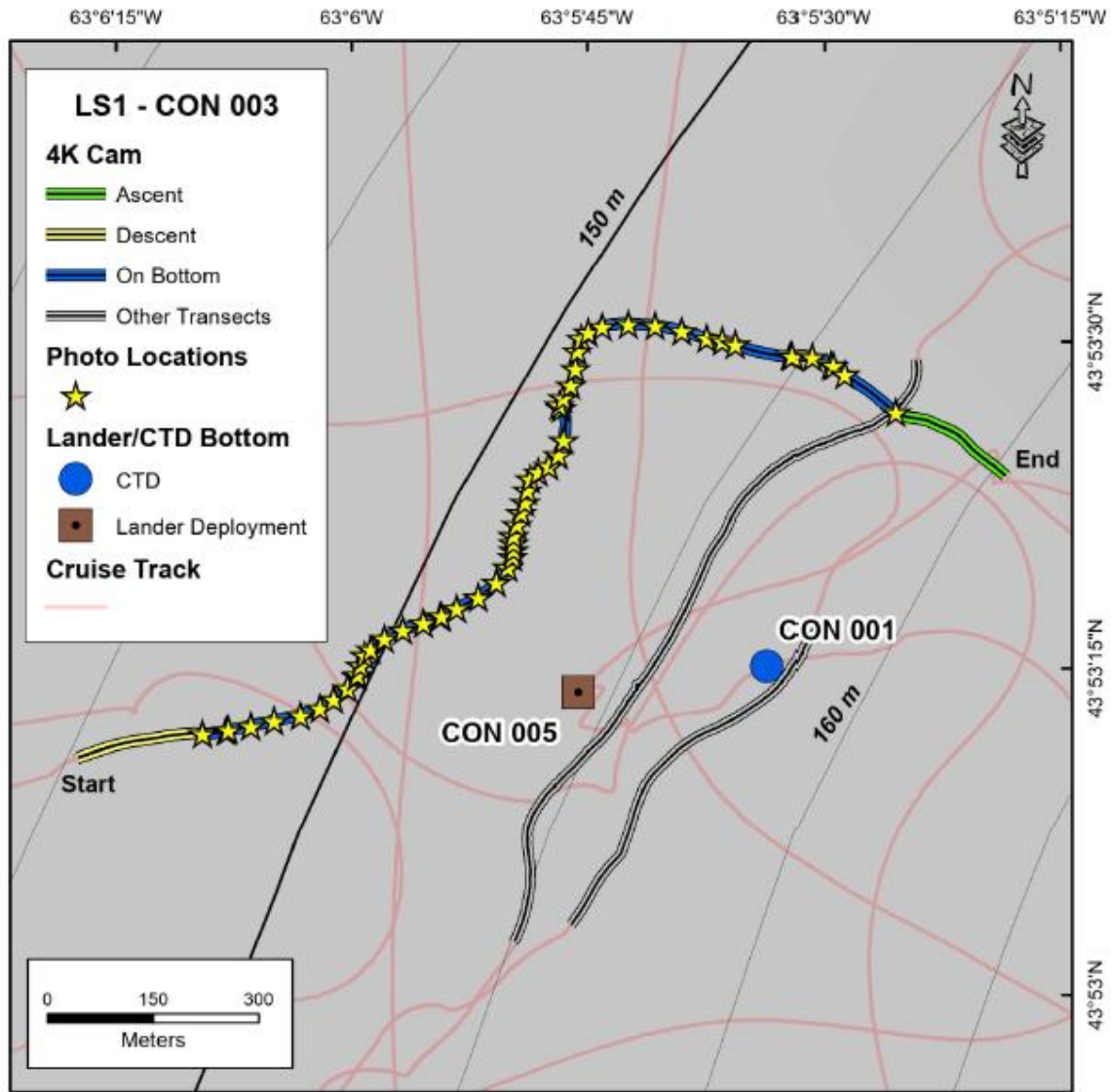
<i>Dive Length ~ on bottom – off bottom</i>	<i>On Bottom Depth (m)</i>	<i>Off Bottom Depth (m)</i>	<i>Number of Photos</i>
Approx – 625 metres	159	156	12 = 10 good + 2 dark

Figure 5. Details of CON 002 4K Camera deployment in support of data collection at Lander Site 1. See Table 2 for additional associated metadata. Lack of photos in the first half of the transect was due to technical issues with the pinger receiver system.

Station: Lander Site 1

CON 003

Gear Type: 4KCam



Con 003

Location	Latitude	Longitude	Time
In Water	43.886343	-63.10486	254202244
On Bottom	43.886657	-63.102623	254202755
Off Bottom	43.890769	-63.090408	254211526
Out of Water	43.889962	-63.088497	254212125
Time On Bottom (h:mm)	0:47		

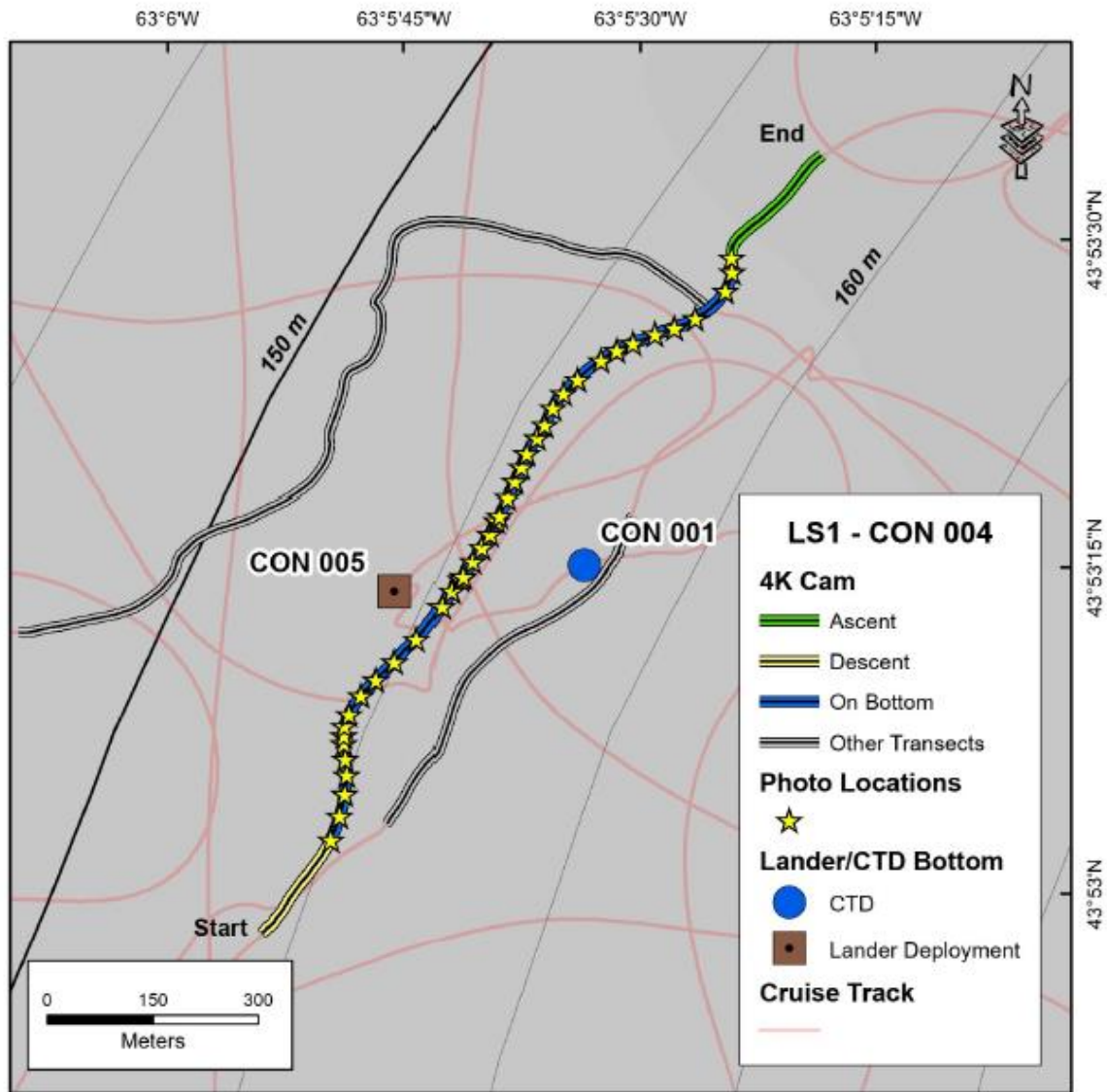
Dive Length ~ on bottom – off bottom	On Bottom Depth (m)	Off Bottom Depth (m)	Number of Photos
Approx – 1440 metres	149	148	59 = 55 good + 4 dark

Figure 6. Details of CON 003 4K Camera deployment in support of data collection at Lander Site 1. See Table 2 for additional associated metadata.

Station: Lander Site 1

CON 004

Gear Type: 4KCam

**Con 004**

Location	Latitude	Longitude	Time
In Water	43.882823	-63.098302	254215033
On Bottom	43.884013	-63.0971	254215549
Off Bottom	43.891433	-63.090053	254222549
Out of Water	43.892735	-63.088463	254223222
Time On Bottom (h:mm)	0:30		

Dive Length ~ on bottom - off bottom	On Bottom Depth (m)	Off Bottom Depth (m)	Number of Photos
Approx - 1440 metres	149	158	42 = 41 good + 1 dark

Figure 7. Details of CON 004 4K Camera deployment in support of data collection at Lander Site 1. See Table 2 for additional associated metadata.

Lander Site 2 (LS2) Overview of Operations

Three 4K Camera photo transects were completed at LS2 (Figure 8), along with a CTD cast and deployment of the lander.

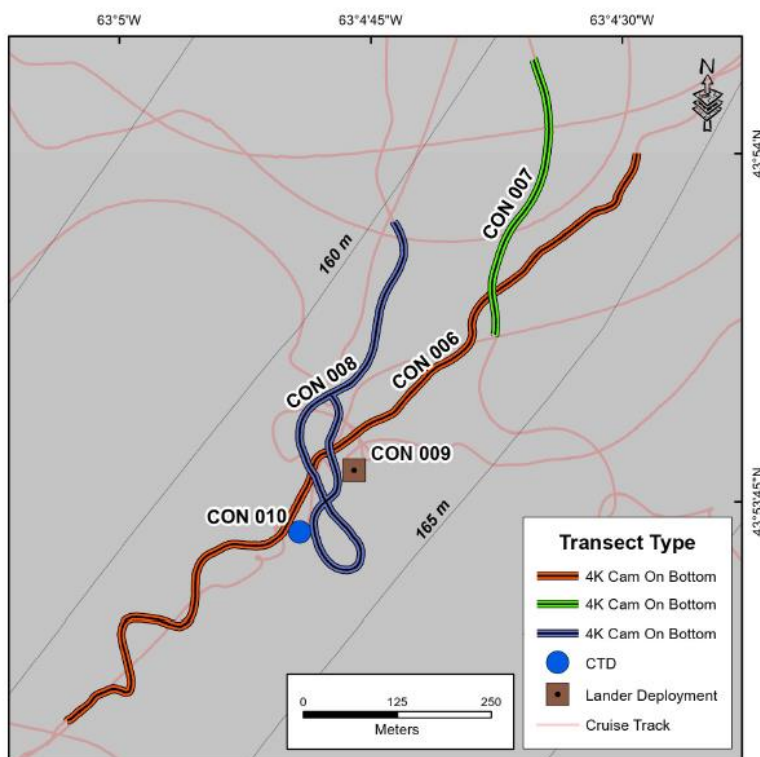


Figure 8. Location of the five operations completed in support of data collection at Lander Site 2. See Table 2 for associated metadata.

Lander Site 2 (LS2) Overview of 4K Camera Operations

Details of the three 4K Camera photo transects from LS2 are found in Figures 9-11. In total 131 photos were taken of which 127 were considered to be of good quality. Of the 127 photos, 40 had live *Vazella pourtalesii* present (31.50 %). The density of live *V. pourtalesii* based on these transects (Table 4) was the highest at 1.74 individuals/m². The photos were noticeably brighter during these three operations than from the previous day although no camera settings were altered.

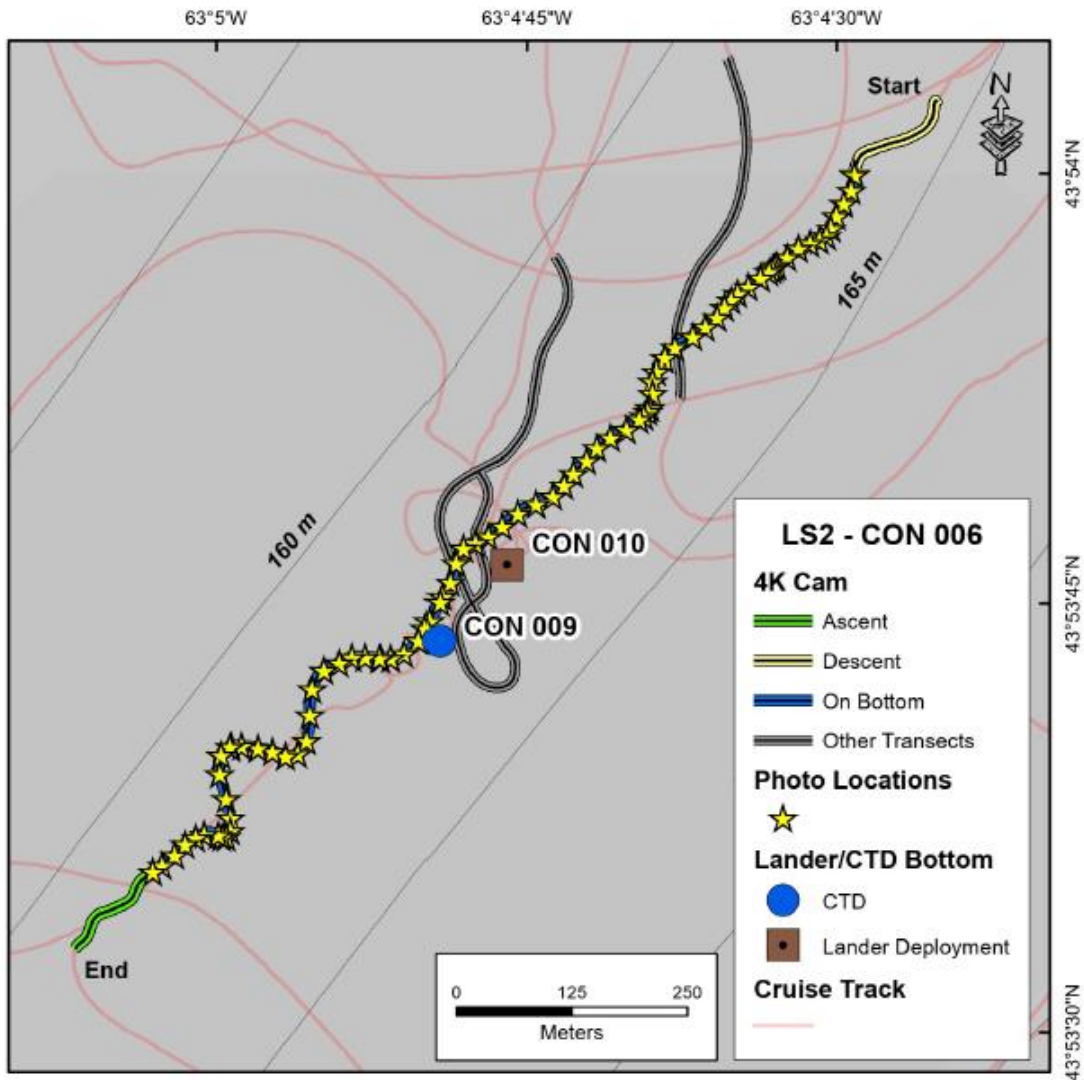
Table 4. Density of live *V. pourtalesii* by photo transect (CON see Table 2, Figures 8-11) at LS2.

	CON 006	CON 007	CON 008
Density of <i>V. pourtalesii</i> (individuals/m ²)	2.24	1.05	0.78

Station: Lander Site 2

CON 006

Gear Type: 4KCam

**Con 006**

Location	Latitude	Longitude	Time
In Water	43.900727	-63.073643	255115313
On Bottom	43.900004	-63.074754	255120034
Off Bottom	43.893223	-63.08418	255130110
Out of Water	43.892492	-63.085218	255130849
Time On Bottom (h:mm)	1:01		

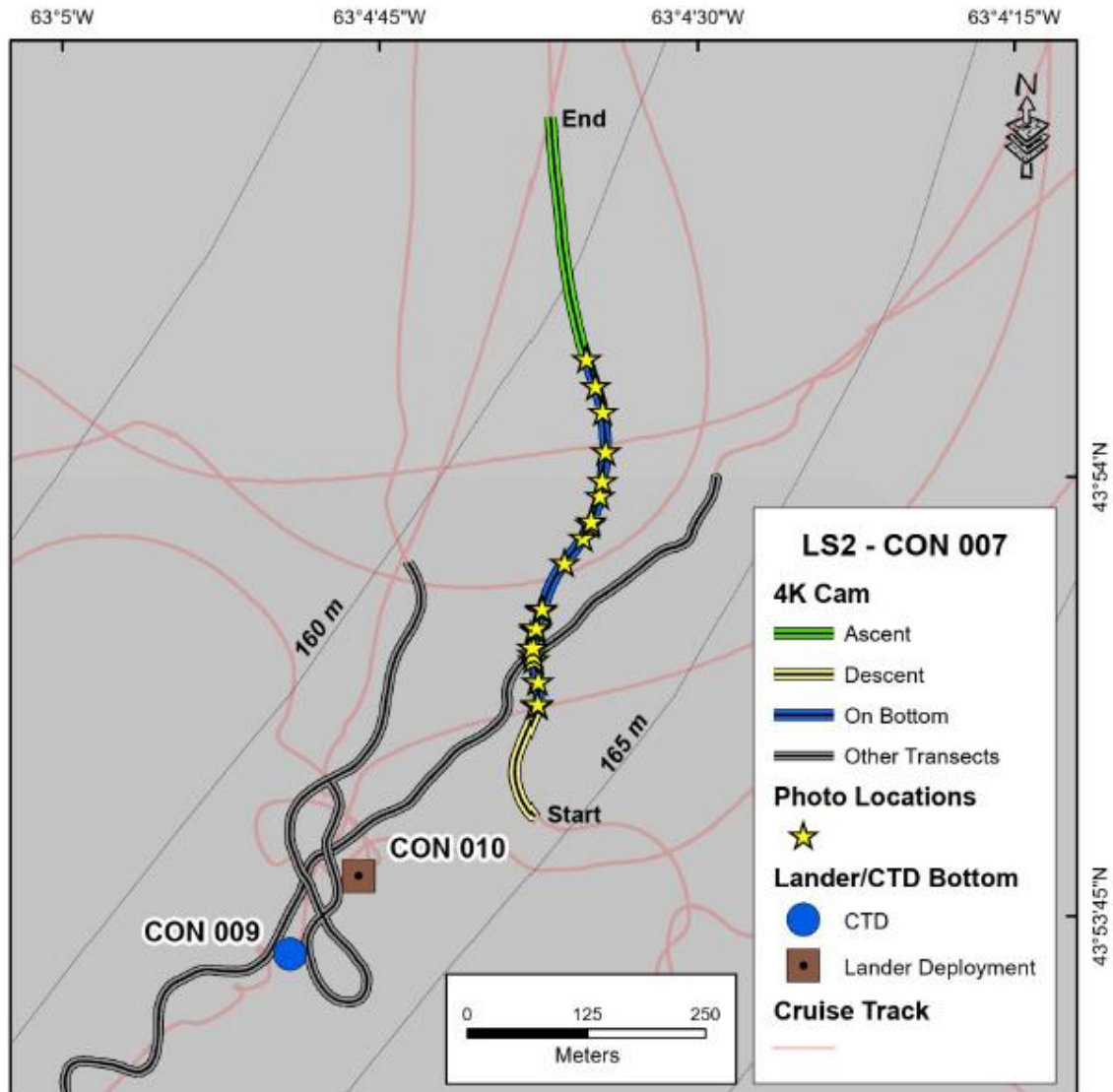
Dive Length ~ on bottom - off bottom	On Bottom Depth (m)	Off Bottom Depth (m)	Number of Photos
Approx - 1440 metres	138	146	84 = 80 good + 4 dark

Figure 9. Details of CON 006 4K Camera deployment in support of data collection at Lander Site 2. See Table 2 for additional associated metadata.

Station: Lander Site 2

CON 007

Gear Type: 4KCam

**Con 007**

Location	Latitude	Longitude	Time
In Water	43.896785	-63.07712	255135612
On Bottom	43.897831	-63.077102	255140054
Off Bottom	43.901124	-63.076462	255141200
Out of Water	43.903402	-63.076915	255141733
Time On Bottom (h:mm)	0:11		

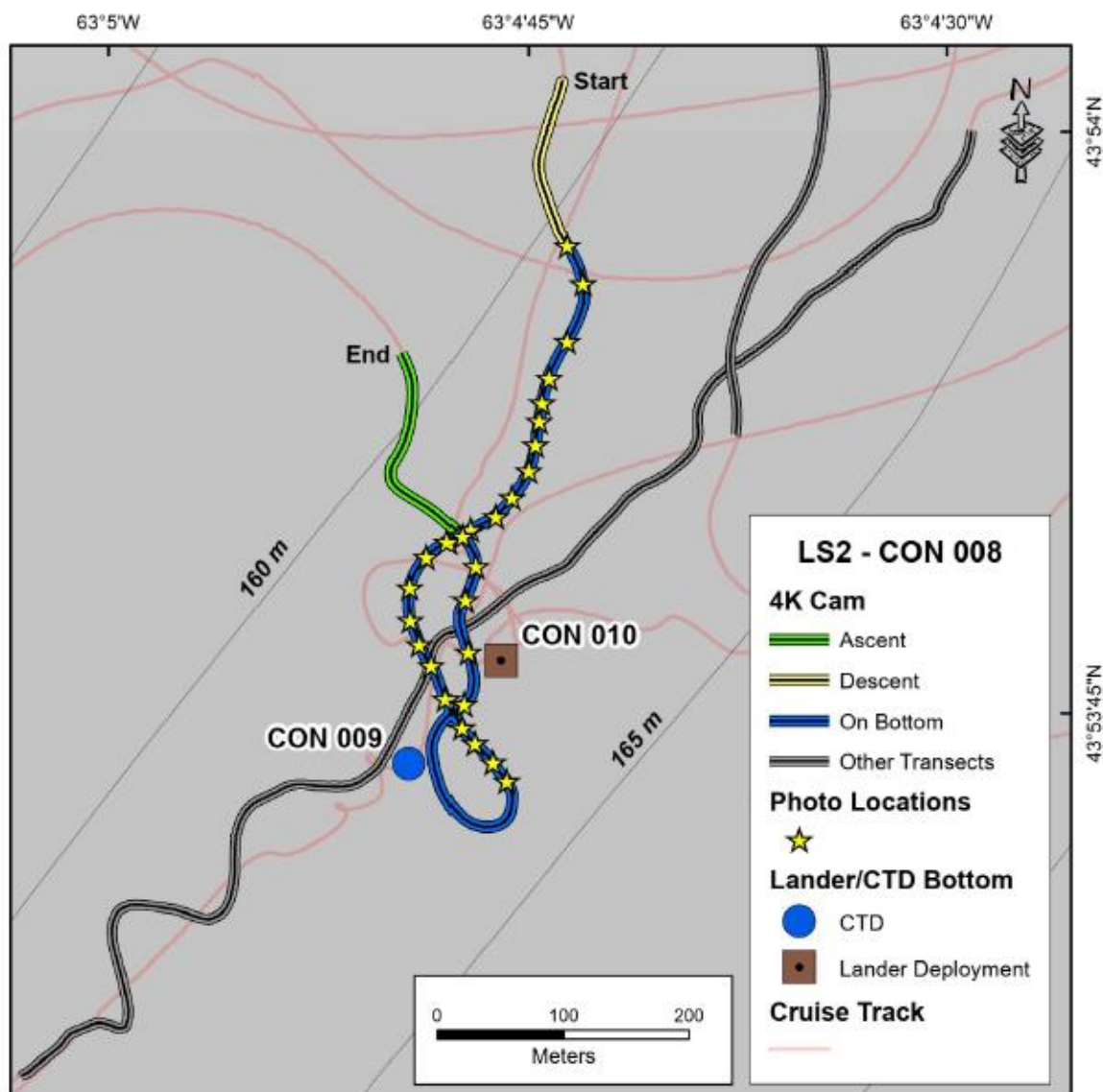
Dive Length ~ on bottom - off bottom	On Bottom Depth (m)	Off Bottom Depth (m)	Number of Photos
Approx - 392 metres	156	145	20 = 20 good

Figure 10. Details of CON 007 4K Camera deployment in support of data collection at Lander Site 2. See Table 2 for additional associated metadata.

Station: Lander Site 2

CON 008

Gear Type: 4KCam

**Con 008**

Location	Latitude	Longitude	Time
In Water	43.900383	-63.078818	255153332
On Bottom	43.899179	-63.078779	255153858
Off Bottom	43.897103	-63.079818	255160603
Out of Water	43.898417	-63.08039	255161214
Time On Bottom (h:mm)	0:27		

Dive Length ~ on bottom - off bottom	On Bottom Depth (m)	Off Bottom Depth (m)	Number of Photos
Approx - 853 metres	153	156	27 = 27 good

Figure 11. Details of CON 008 4K Camera deployment in support of data collection at Lander Site 2. See Table 2 for additional associated metadata.

Lander Site 3 (LS3) Overview of Operations

Two 4K Camera photo transects were completed at LS3 (Figure 12), along with a CTD cast and deployment of the lander.

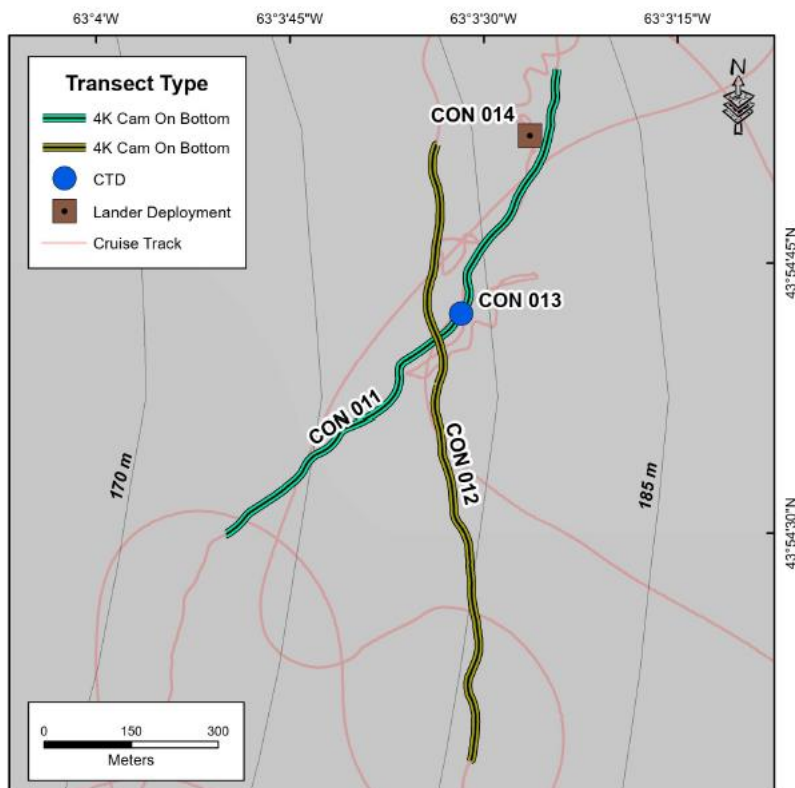


Figure 12. Location of the five operations completed in support of data collection at Lander Site 3. See Table 2 for associated metadata.

Lander Site 3 (LS3) Overview of 4K Camera Operations

Details of the two 4K Camera photo transects from LS3 are found in Figures 13 and 14. In total 69 photos were taken of which 65 were considered to be of good quality. Of the 65 photos, 8 had live *Vazella pourtalesii* present (12.31 %). The density of live *V. pourtalesii* based on these transects was the lowest at 0.27 individuals/m² (Table 5).

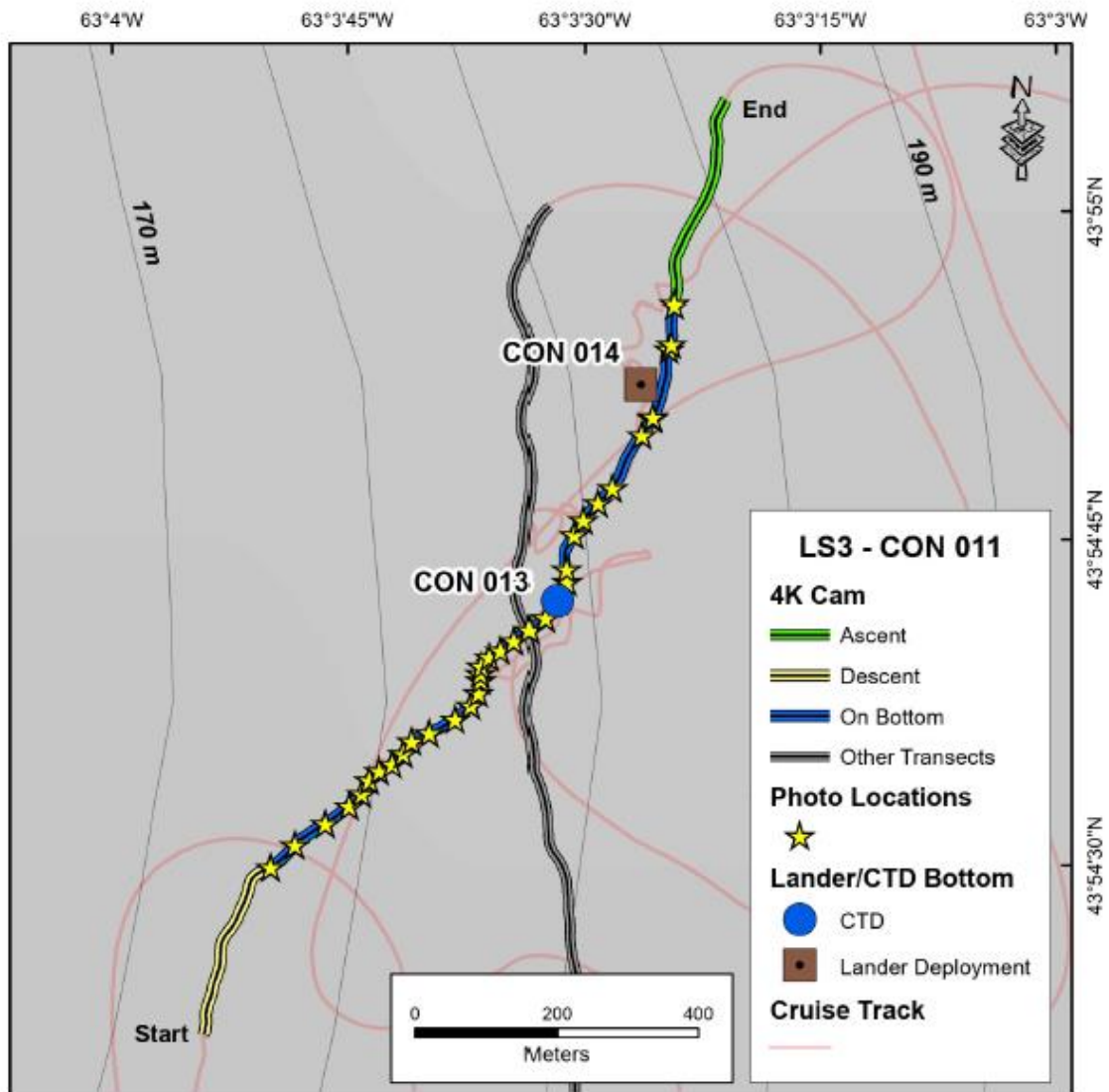
Table 5. Density of live *V. pourtalesii* by photo transect (CON see Table 2, Figures 12-14) at LS3.

	CON 011	CON 012
Density of <i>V. pourtalesii</i> (individuals/m ²)	0.19	0.34

Station: Lander Site 3

CON 011

Gear Type: 4KCam

**Con 011**

<i>Location</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Time</i>
In Water	43.906173	-63.065055	255182206
On Bottom	43.90831	-63.063861	255182935
Off Bottom	43.915493	-63.056756	255185654
Out of Water	43.918077	-63.05586	255190622
Time On Bottom (h:mm)	0:27		

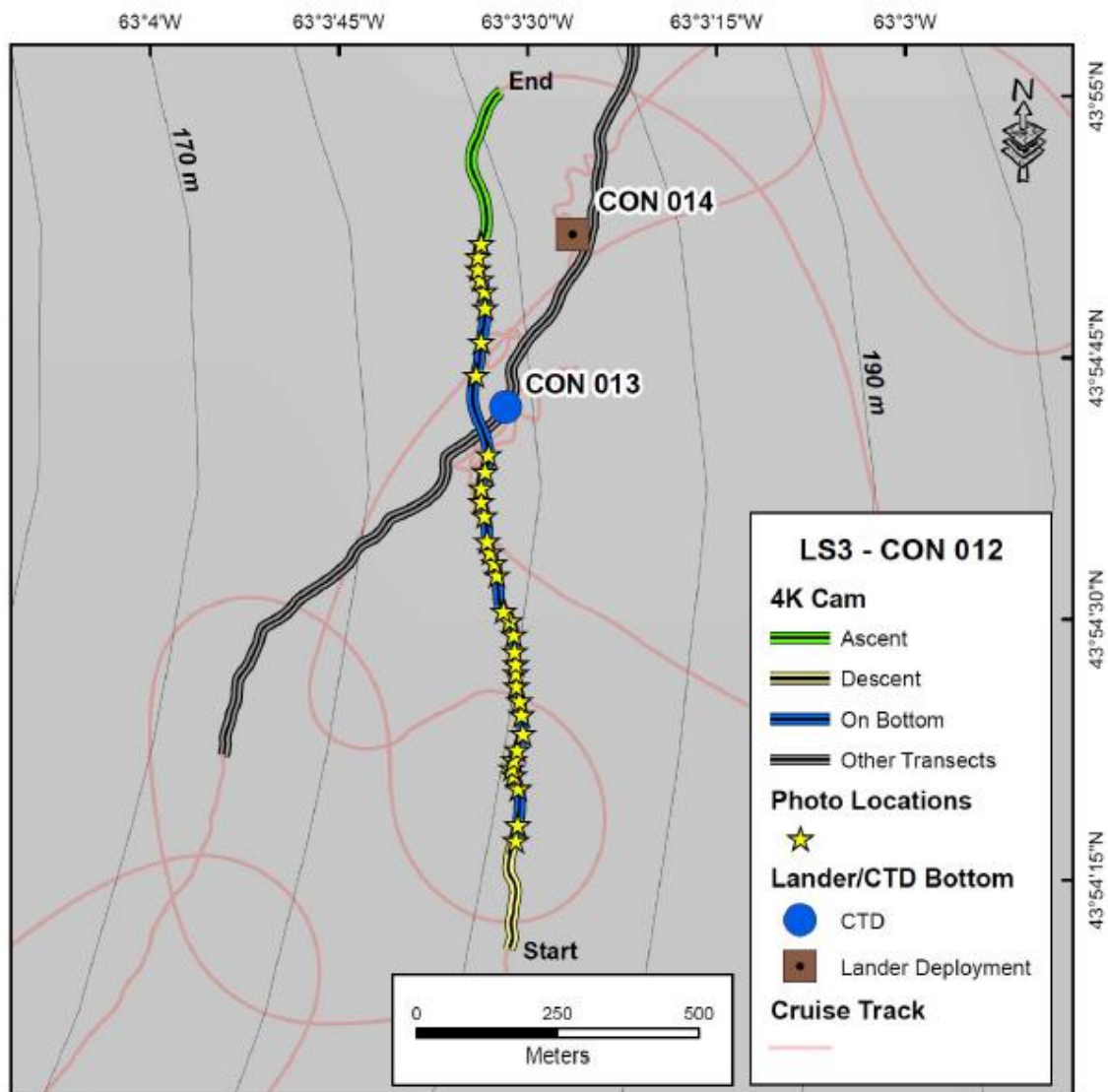
<i>Dive Length ~ on bottom – off bottom</i>	<i>On Bottom Depth (m)</i>	<i>Off Bottom Depth (m)</i>	<i>Number of Photos</i>
Approx – 1075 metres	216	225	35 = 33 good + 2 dark

Figure 13. Details of CON 011 4K Camera deployment in support of data collection at Lander Site 3. See Table 2 for additional associated metadata.

Station: Lander Site 3

CON 012

Gear Type: 4KCam

**Con 012**

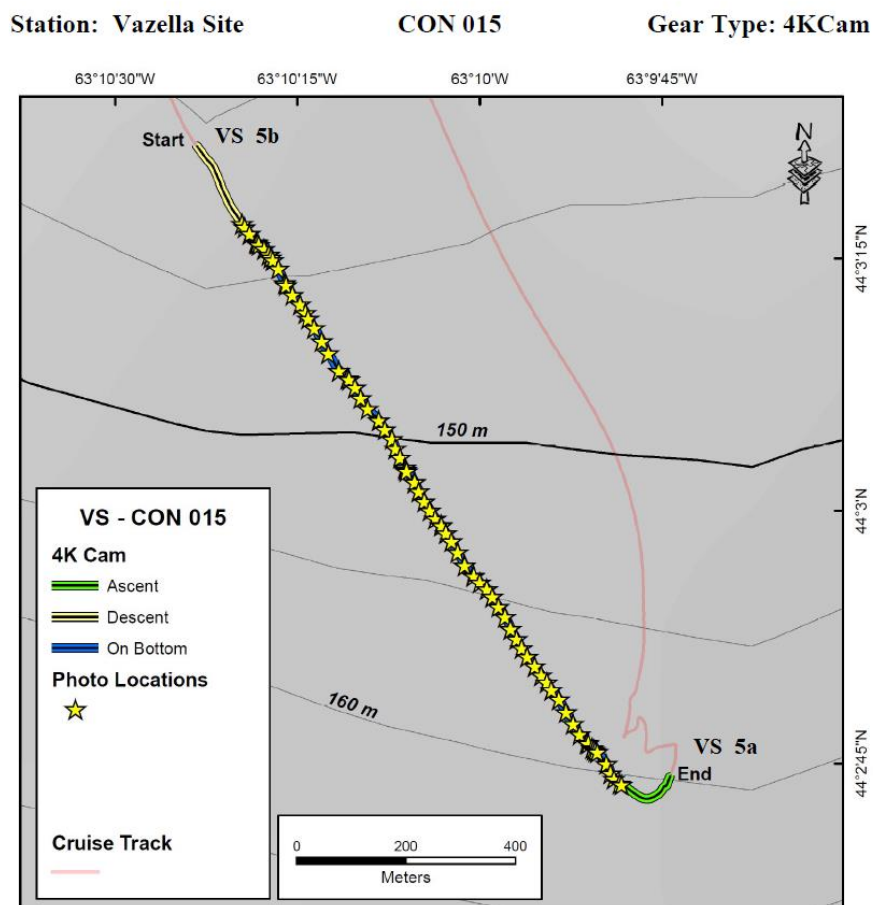
Location	Latitude	Longitude	Time
In Water	43.90306	-63.058755	255194345
On Bottom	43.904806	-63.058595	255195048
Off Bottom	43.914326	-63.059349	255202117
Out of Water	43.916727	-63.059002	255202856
Time On Bottom (h:mm)	0:30		

Dive Length ~ on bottom - off bottom	On Bottom Depth (m)	Off Bottom Depth (m)	Number of Photos
Approx - 1125 metres	222	224	34= 34 good

Figure 14. Details of CON 012 4K Camera deployment in support of data collection at Lander Site 3. See Table 2 for additional associated metadata.

Repeat Sampling of a Transect Sampled in 2011

A single 4K Camera photo transect completed in 2011 was resampled with the 4K Camera (69 good quality photos) as an additional sampling location (CON22 during the HUD2011-014 mission). The start and end waypoints correspond to VS_5b and VS_5a respectively in the Cruise Planning Document (Appendix 1). This transect had the presence of both live and dead *V. pourtalesii* in 2011. Of the 69 photos taken in September 2021, 25 had live *V. pourtalesii* present (36.23 %). The density of live *V. pourtalesii* based on this transect was 1.05 individuals/m².



Con 015

Location	Latitude	Longitude	Time
In Water	43.90306	-63.058755	256093104
On Bottom	44.054726	-63.172093	256093603
Off Bottom	44.045481	-63.163407	256101839
Out of Water	43.916727	-63.059002	256102530
Time On Bottom (h:mm)	0:43		

Dive Length ~ on bottom – off bottom	On Bottom Depth (m)	Off Bottom Depth (m)	Number of Photos
Approx – 1125 metres	142	168	82 = 69 good + 13 dark

Figure 15. Details of CON 015 4K Camera deployment. See Table 2 for additional associated metadata.

NEW SETTING FOR THE AMAR

Dr. Jinshan Xu made changes to the AMAR Settings on Lander 3 (Figure 16) prior to deployment. These settings replace the settings detailed in the Cruise Planning Document (Appendix 1). The new setting for the AMAR (three channel now, SN 772) is:

560 second @ 64kHz, 340 second sleep for 900 second (15 mins) period. The battery endurance is 288 days, and memory endurance is 324 days. The AMAR was configured to start sampling at 10:55:00 UTC on Sep 12 2021.



Figure 16. Photo of Lander 3 prior to deployment. The AMAR can be seen (black cylinder) with three hydrophones covered by yellow clothes on the top.

FORMALIN SOLUTION FOR THE SEDIMENT TRAPS

The pdf listing the instructions for the sediment traps in the Cruise Planning Document (“FIXO3_BP_Annex_Sediment_traps.pdf”) was not to be followed for the preparation of the sediment traps because we want a 4 % concentration (not 2 % as presented in the pdf). Also, instead of the deep seawater of 35 ppt, we used saltwater from the Bedford Basin sampled at 8 ft below the low tide level that was 29.7 ppt. Therefore more salt was added to adjust the salinity.

The following steps were applied:

- 9L of saltwater was filtered on GF/C filters and then mixed with 100g of sodium chloride to ensure that the salinity would be around 40 ppt.
- 1L of formaldehyde (37-40 %) was mixed with 5 g of Borax.
- 24 hours later (following total dissolution), the buffered formalin solution was mixed in the saltwater (total volume of the preservative solution = 10 L).

The solution was kept at 4 °C until put in the sediment trap bottles immediately prior to sailing.

APPENDIX 1: ABRIDGED CRUISE PLANNING DOCUMENT

The full Cruise Planning Document is 65 pages in length and included details of the study sites, equipment and permits:

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Here we have included sections 1.1, 3.1 and the introduction to 3.2. The full cruise report can be found at: <https://data.mendeley.com/datasets/wcs8mjt27d/draft?a=febb07e2-0178-4e93-ae7a-cddd09388fa7>

Principal Researchers and Collaborators

The principal investigators associated with the project, and their email addresses are as follows:

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Dr. Fred Whoriskey	Ocean Tracking Network	FWhoriskey@Dal.Ca
Dr. Ellen Kenchington	DFO-BIO	Ellen.Kenchington@dfo-mpo.gc.ca
Prof. George Wolff	University of Liverpool	wolff@liverpool.ac.uk
Dr. Christian Mohn	Aarhus University	chmo@bios.au.dk

The OTN collaboration will enable us to capture information on the presence of a suite of species that will complement the acoustic data. OTN has fitted a wide range of aquatic species — e.g., salmon, tuna, whales, sharks, crabs, and seals — with small electronic transmitters that are surgically implanted or attached externally, and can operate for up to 20 years. The acoustic receivers, roughly the size of kitchen food processors, will be attached to the landers (one per lander) and will pick up coded acoustic signals identifying each tagged animal that passes within half a kilometre. The data are subsequently uploaded to a central database, resulting in current and reliable global records that can be analysed and along with similar data from the [OTN Halifax line](#) to document species in the sponge grounds (Whoriskey et al., 2009). “The OTN Halifax line spans the entire width of the continental shelf off Halifax and consists of hydrophone moorings at 800 m spacing over a total length of almost 205 km. This makes it the largest single fixed oceanographic monitoring system in the world. The line meanders to avoid areas of intense trawling activity such as the Emerald Basin. In addition to acoustic receivers, several of these moorings contain benthic pods: instrumented packages that provide time series of bottom pressure (sea level height), temperature and salinity. This massive undertaking took four years to fully deploy. Data stored on receivers or benthic pods are retrieved via autonomous vehicles (gliders), as well as manned vessels. Marine species tagged in over 20 OTN projects have been detected on this line to date” (Whoriskey et al., 2009).

References

Whoriskey, F., Hebert, D., Barthelotte, J., O'Dor, R., Stokesbury, M., and Branton, R. 2009. Ocean Tracking Network Halifax Canada Line Metadata and Data Set. <https://members.oceantrack.org/OTN/project?ccode=HFX>

Details of Research

Objectives

Vazella pourtalesii is a relatively large sponge (up to 50 cm) that can form dense biogenic habitats and locally enhances invertebrate biodiversity. Fourteen fish species in trawl catches have been found to be significantly associated with these sponge grounds, including commercially important silver hake, redfish, haddock and northern shortfin squid. Since fish may use these sponge grounds for feeding, spawning, and nursery areas there is a need to collect more information on fish use of this key benthic habitat in order to support decision-making following an ecosystem approach.

To better understand these sponge grounds, this study will compare their health and biodiversity using passive acoustic recordings. Acoustic landscapes, or soundscapes, are composed of biological, geophysical and anthropogenic sounds, and in some environments, such as tropical coral reefs, biological components dominate the soundscape. Due to the more remote and inaccessible nature of open ocean or deep-sea ecosystems, soundscape recordings have been limited.

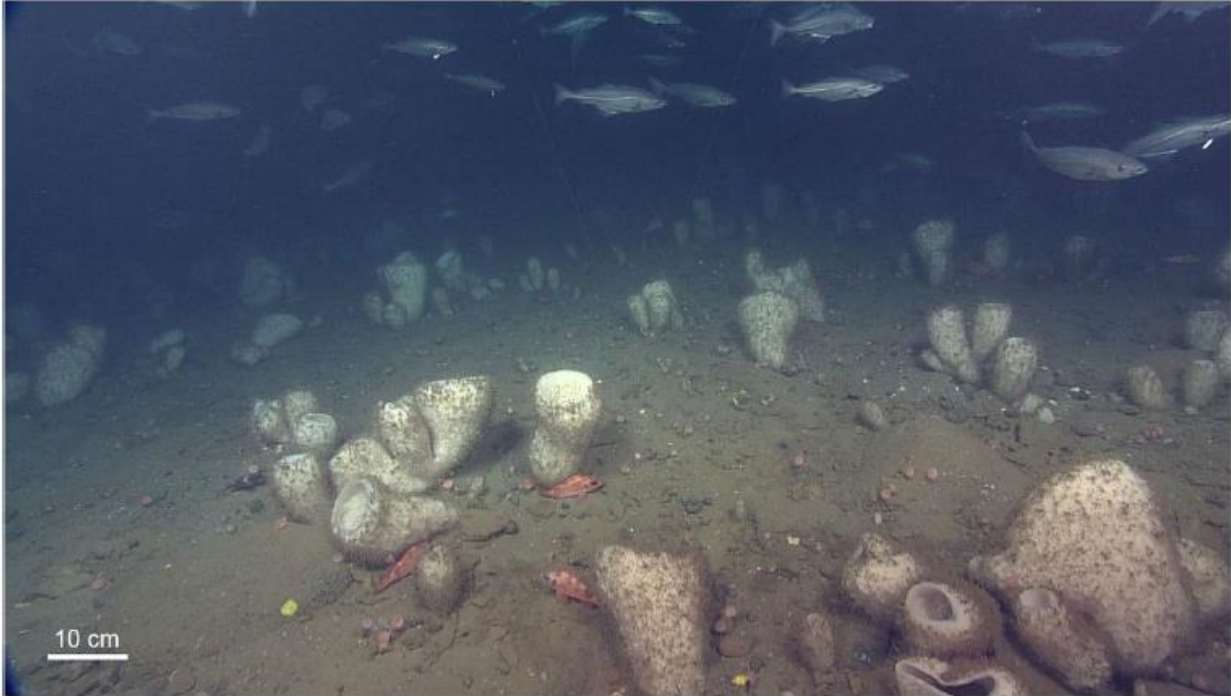


Figure 1. Sponge grounds formed by *Vazella pourtalesii* in the Sambro Bank Sponge Conservation Area, Emerald Basin, NS. Depth is 155 m. A school of Pollock is swimming over the sponges and redfish are seen on the seabed taking shelter at the sponge bases.

The project has five overall objectives:

Objective 1: *Characterize the biological sounds at the Sambro Bank Basin* – led by Laurence De Clippele

Biological sound emissions will be catalogued in the wild using combined acoustic and photo recordings (Mouy et al., 2018). This combined approach will allow us to associated/ correlate sounds of fish (e.g., pollock, redfish) with their behaviours (e.g., mating, scaring off predators, territorial protection) visible in the photos in order to inform ecosystem management decision-making. The pollock are believed to spawn in the fall so we are hopeful that the timing of our landing deployment will enable us to capture this event.

The biological acoustic data will be annotated and classified using Raven Pro software. The 1/3 Octave frequency bands will be generated using a Hann window at 1-second resolution, without overlap, using PAMGuide (Merchant et al., 2015) in the Matlab software version R2018a, yielding a 1 Hz frequency resolution for the purpose of identifying soundscape components. Since most fish vocalize and hear in the low frequency range (Amorim, 2006), audio recordings may require down-sampling. Sound types will be divided into 2 main categories following Amorim (2006) and Desiderà et al. (2019): (1) frequency-modulated signals, (2) series of at least 3 short broadband transient pulses that can be either stereotyped or irregular.

The image data will be annotated using BIIGLE or a similar online annotation software. The presence of fish, and their density will be correlated to the biological sounds. Fish sounds will also be cross-referenced with the video and nearby OTN data (<https://oceantrackingnetwork.org/>) to establish a library for each species observed.

Objective 2: *Characterization of ambient noise levels on the sponge grounds*- led by Jinshan Xu and Laurence De Clippele

Sound pressure energy (or ambient noise level) is usually much higher in the low frequency range, and then decreases as frequency increases up to the 20 kHz frequency range. Distant ship traffic is one of the dominant noise sources for frequencies of around 100 Hz, while wind-induced surface noise is the main source between 1 kHz and 30 kHz where fish vocalize. We will analyse power spectrum densities (see Archer et al. 2018, Breeze et al. 2021) from the recorders and cross-reference with Automatic Information System (AIS) data for shipping traffic, surface wind data from the Canadian Operational Network of Coupled Environmental Prediction Systems (CONCEPTS) project, *in situ* current data from the ADCP, and CTD data to estimate how much shipping and meteorological processes are contributing to ambient noise. Particulate Organic Matter (POM) data can be used to account for variation in the ambient noise levels due to the amount of suspended particles in the water column.

Objective 3: *Evaluate the use of sound as an indicator of fish biodiversity* – led by Laurence De Clippele

Passive acoustic monitoring was put forward as a non-invasive monitoring technique at a recent CSAS meeting (Neves et al., 2020). Desiderà et al. (2019) found a strong relationship between taxonomic and acoustic diversity as measured by richness, diversity and community similarity indices. Overall, acoustic communities showed stronger differences between sites and a higher discriminating potential. We will calculate acoustic indices to evaluate the use of sound as a biodiversity and health indicator of the Vazella sponge grounds (Desiderà et al., 2019; Pieretti & Danovaro, 2020; Righini & Pavan, 2020; Dimoff et al., 2021). The fish sound repertoire will be organized into a dichotomous tree based on acoustic characteristics (Amorim, 2006) for use as a biodiversity indicator for resource monitoring and management. The biodiversity will also be cross-referenced with the fish and crustacean presence/absence and density and the environmental data, i.e., POM, current speed, current direction, temperature, shipping traffic, windspeed and sponge density.

Objective 4: *Screen the acoustic signals for presence of North Atlantic Right Whale* – led by Jinshan Xu

The North Atlantic Right Whale is an endangered species. This objective is shared with Project 557 in DMApps, OPP Science - Marine Environmental Quality (Jinshan Xu). The signals from other baleen whales' calls will be also studied under this project.

Objective 5: *Collect environmental data to explain patterns of high and low sponge density* – led by Laurence De Clippele, Christian Mohn, George Wolff

The landers will be placed in areas of high and low sponge density and in an area where dead sponges were observed. Sediment traps will be placed on the landers that are located in the high and dead sponge areas to determine environmental differences that may be responsible for the differences in sponge density and condition.

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Pieretti, N., and Danovaro, R.. 2020. Acoustic indexes for marine biodiversity trends and ecosystem health. *Philosophical Transactions of the Royal Society B* 375: 20190447.

Righini, R., and Pavan, G. 2020. A soundscape assessment of the Sasso Fratino integral nature reserve in the Central Apennines, Italy. *Biodiversity* 21: 4-14.

Study Locations and Operations

The Sambro Bank Sponge Conservation Area (<https://www.dfo-mpo.gc.ca/oceans/oecm-amcepz/refuges/emerald-meraude-eng.html>) is located ~100 km from Halifax (Canada) on the Scotian Shelf and protects *Vazella pourtalesii* sponge grounds from bottom-contact fishing. Sambro bank was selected for three reasons:

- (1) it is removed from major cargo shipping lanes, therefore reducing the amount of noise pollution in the sound recordings;
- (2) it is protected from bottom trawling, therefore reducing the risk of equipment being lost and/or damaged;
- (3) by deploying the sound recorders in the same area the variability in ambient noise is reduced which will make biodiversity indices comparisons more robust.

Hanz et al. (2020) deployed a single lander in this area under the SponGES EU Horizon 2020 project. Their lander was equipped with temperature and oxygen sensors, a current meter, a sediment trap and a video camera. They found: “Over the course of the lander deployment, temperature fluctuated between 8.8–12°C with an average of $10.6 \pm 0.4^\circ\text{C}$. Dissolved oxygen concentration was on average 6.3 mg l^{-1} , and near-bottom current speed was on average 0.12 m s^{-1} with peaks up to 0.47 m s^{-1} . Semi-diurnal tidal currents promoted constant resuspension of particulate matter in the benthic boundary layer. Surface storm events episodically caused extremely turbid conditions on the seafloor that persisted for several days, with particles being resuspended to more than 13 m above the seabed. The carbon flux in the near-bottom sediment trap peaked during storm events and also after a spring bloom in April, when fresh phytodetritus was observed in the bottom boundary layer” (Hanz et al., 2020).

Three deployment locations for the three benthic landers (on loan from the University of Edinburgh), with varying degrees of sponge ground health have been selected based on the sponge densities measured from CAMPOD video and still photo data collected during the 2011 DFO Emerald Basin expedition (Characterization of VME for Assessment of Significant Adverse Impact by Bottom Trawling and Development of Encounter Protocols; HUD2011-014). That data

was presented in an unpublished report “Analysis of *Vazella pourtalesii* Emerald Basin” DFO Ecosystems Research Division September 2011 undertaken by the offshore benthic ecology group (lead Dr. E. Kenchington). The areas are designated as follows: High Density Sponge, Low Density Sponge and Dead Sponge. [Note that the density of sponges from the 4K Camera photos were processed at sea and these designations were changed post-hoc].



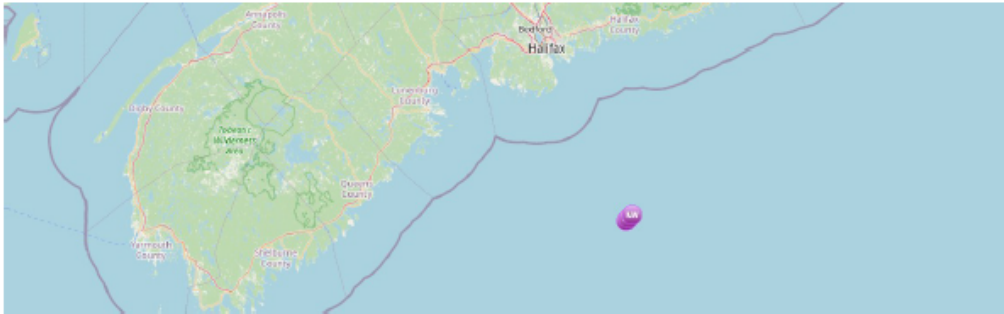
Figure 2. Photo showing a dead sponge (upper left) from the Sambro Bank Sponge Conservation Area. Dead *V. pourtalesii* are readily distinguishable from the living sponges (Figure 1). Green lasers are approximately 10 cm apart for scale.

References

Hanz, U., Beazley, L., Kenchington, E., Duineveld, G., Rapp, H.T., and Mienis, F. 2020. Seasonal variability in near-bed environmental conditions in the *Vazella pourtalesii* glass sponge grounds of the Scotian Shelf. *Frontiers in Marine Science*, 08 January 2021 <https://doi.org/10.3389/fmars.2020.597682>

APPENDIX 2: NAVIGATION WARNING

Navigational Warnings (NAVWARNs) replace Notices to Shipping (NOTSHIPS) and shall be construed as Notices to Shipping



ID NW-M-1780-21

Date 2021-09-22 14:05 UTC

Status Published

Title Obstruction

Areas LaHave Bank

Categories Subsurface Moorings

Description 3 sub-surface moorings established in

1: 43 53.230N 063 05.762W

2: 43 53.771N 063 04.767W

3: 43 54.869N 063 03.441W

Each mooring is an aluminum bottom-mount tripod frame (2m x 2m x 2m) with yellow buoys and instrumentation extending 2 metres from the ocean floor.

Position 43° 53.230'N 063° 05.762'W
43° 53.771'N 063° 04.767'W
43° 54.869'N 063° 03.441'W

Charts 4012(NAD83), 8007(NAD83)

APPENDIX 3: METADATA FOR INDIVIDUAL 4K CAMERA PHOTOS

Metadata associated with each photo (N=395) taken with the 4K Camera completed on HUDSON2021-048. See Table 2 for more metadata for each CON (Consecutive Operating Number).

CON	Latitude (DD)	Longitude (DD)	Photo Name	Photo Date	Julian Day	Photo Time	JDayGMT	Sea Bird Depth (m)	Sea Bird Temperature (°C)
CON002	43.88423	-63.0961	IMG_1306.JPG	2021:09:11	254	19:19:46	254191946	158.81	11.2672
CON002	43.88479	-63.0956	IMG_1307.JPG	2021:09:11	254	19:21:47	254192147	159.38	11.3866
CON002	43.88685	-63.0932	IMG_1308.JPG	2021:09:11	254	19:30:53	254193053	155.94	11.2989
CON002	43.88698	-63.0929	IMG_1309.JPG	2021:09:11	254	19:31:51	254193151	155.53	11.2604
CON002	43.88711	-63.0927	IMG_1310.JPG	2021:09:11	254	19:32:48	254193248	155.46	11.3332
CON002	43.88723	-63.0925	IMG_1311.JPG	2021:09:11	254	19:33:39	254193339	155.80	11.3251
CON002	43.88733	-63.0924	IMG_1312.JPG	2021:09:11	254	19:34:18	254193418	154.82	11.2709
CON002	43.88752	-63.0922	IMG_1313.JPG	2021:09:11	254	19:35:11	254193511	155.14	11.3091
CON002	43.88770	-63.0920	IMG_1314.JPG	2021:09:11	254	19:36:02	254193602	155.96	11.2947
CON002	43.88771	-63.0920	IMG_1315.JPG	2021:09:11	254	19:36:04	254193604	156.17	11.3513
CON002	43.88793	-63.0919	IMG_1316.JPG	2021:09:11	254	19:36:55	254193655	155.99	11.3386
CON002	43.88814	-63.0918	IMG_1317.JPG	2021:09:11	254	19:37:47	254193747	156.17	11.3489
CON003	43.88666	-63.1026	IMG_1321.JPG	2021:09:11	254	20:27:55	254202755	149.26	11.0189
CON003	43.88670	-63.1022	IMG_1322.JPG	2021:09:11	254	20:28:48	254202848	149.87	11.1096
CON003	43.88671	-63.1022	IMG_1323.JPG	2021:09:11	254	20:28:52	254202852	150.77	11.1238
CON003	43.88676	-63.1018	IMG_1324.JPG	2021:09:11	254	20:29:41	254202941	149.66	11.1753
CON003	43.88682	-63.1014	IMG_1325.JPG	2021:09:11	254	20:30:29	254203029	150.74	11.1532
CON003	43.88689	-63.1009	IMG_1326.JPG	2021:09:11	254	20:31:17	254203117	151.05	11.2792
CON003	43.88698	-63.1006	IMG_1327.JPG	2021:09:11	254	20:32:02	254203202	152.81	11.3709
CON003	43.88710	-63.1003	IMG_1328.JPG	2021:09:11	254	20:32:39	254203239	153.37	11.3354
CON003	43.88724	-63.1001	IMG_1329.JPG	2021:09:11	254	20:33:17	254203317	153.02	11.3892
CON003	43.88740	-63.0999	IMG_1330.JPG	2021:09:11	254	20:33:55	254203355	152.57	11.3108
CON003	43.88741	-63.0999	IMG_1331.JPG	2021:09:11	254	20:33:59	254203359	154.34	11.3651

CON003	43.88753	-63.0998	IMG_1332.JPG	2021:09:11	254	20:34:32	254203432	151.52	11.2187
CON003	43.88766	-63.0998	IMG_1333.JPG	2021:09:11	254	20:35:16	254203516	151.56	11.2597
CON003	43.88773	-63.0996	IMG_1334.JPG	2021:09:11	254	20:36:02	254203602	151.11	11.2399
CON003	43.88788	-63.0994	IMG_1335.JPG	2021:09:11	254	20:36:57	254203657	151.08	11.0622
CON003	43.88799	-63.0991	IMG_1336.JPG	2021:09:11	254	20:37:49	254203749	150.94	11.2100
CON003	43.88807	-63.0987	IMG_1337.JPG	2021:09:11	254	20:38:41	254203841	150.39	11.1252
CON003	43.88816	-63.0984	IMG_1338.JPG	2021:09:11	254	20:39:29	254203929	150.33	11.2015
CON003	43.88816	-63.0984	IMG_1339.JPG	2021:09:11	254	20:39:33	254203933	151.08	11.3411
CON003	43.88826	-63.0981	IMG_1340.JPG	2021:09:11	254	20:40:17	254204017	150.33	11.2721
CON003	43.88840	-63.0978	IMG_1341.JPG	2021:09:11	254	20:41:11	254204111	150.61	11.3369
CON003	43.88859	-63.0974	IMG_1342.JPG	2021:09:11	254	20:42:01	254204201	150.49	11.2546
CON003	43.88879	-63.0972	IMG_1343.JPG	2021:09:11	254	20:42:48	254204248	149.71	11.2210
CON003	43.88892	-63.0972	IMG_1344.JPG	2021:09:11	254	20:43:26	254204326	148.96	11.2130
CON003	43.88901	-63.0971	IMG_1345.JPG	2021:09:11	254	20:44:11	254204411	148.60	11.1396
CON003	43.88909	-63.0971	IMG_1346.JPG	2021:09:11	254	20:45:05	254204505	148.54	11.1536
CON003	43.88919	-63.0971	IMG_1347.JPG	2021:09:11	254	20:45:51	254204551	148.81	11.1503
CON003	43.88933	-63.0971	IMG_1348.JPG	2021:09:11	254	20:46:38	254204638	148.69	11.1771
CON003	43.88948	-63.0970	IMG_1349.JPG	2021:09:11	254	20:47:26	254204726	149.35	11.1878
CON003	43.88961	-63.0969	IMG_1350.JPG	2021:09:11	254	20:48:07	254204807	148.94	11.1807
CON003	43.88977	-63.0969	IMG_1351.JPG	2021:09:11	254	20:48:56	254204856	148.66	11.1288
CON003	43.88991	-63.0968	IMG_1352.JPG	2021:09:11	254	20:49:49	254204949	148.46	11.1467
CON003	43.89000	-63.0967	IMG_1353.JPG	2021:09:11	254	20:50:41	254205041	148.34	11.1513
CON003	43.89008	-63.0965	IMG_1354.JPG	2021:09:11	254	20:51:28	254205128	148.02	11.0125
CON003	43.89022	-63.0963	IMG_1355.JPG	2021:09:11	254	20:52:23	254205223	148.25	11.0962
CON003	43.89041	-63.0962	IMG_1356.JPG	2021:09:11	254	20:53:17	254205317	147.63	11.0560
CON003	43.89082	-63.0963	IMG_1357.JPG	2021:09:11	254	20:55:09	254205509	147.42	10.9161
CON003	43.89085	-63.0963	IMG_1358.JPG	2021:09:11	254	20:55:55	254205555	147.43	10.9961
CON003	43.89095	-63.0963	IMG_1359.JPG	2021:09:11	254	20:56:48	254205648	147.73	10.8763
CON003	43.89111	-63.0961	IMG_1360.JPG	2021:09:11	254	20:57:38	254205738	147.72	10.9185
CON003	43.89132	-63.0960	IMG_1361.JPG	2021:09:11	254	20:58:30	254205830	147.70	11.0250
CON003	43.89154	-63.0960	IMG_1362.JPG	2021:09:11	254	20:59:18	254205918	147.82	10.9937

CON003	43.89170	-63.0959	IMG_1363.JPG	2021:09:11	254	21:00:13	254210013	147.91	11.0042
CON003	43.89178	-63.0958	IMG_1364.JPG	2021:09:11	254	21:01:04	254210104	147.76	11.0680
CON003	43.89186	-63.0956	IMG_1365.JPG	2021:09:11	254	21:01:59	254210159	147.89	11.1025
CON003	43.89189	-63.0951	IMG_1366.JPG	2021:09:11	254	21:03:03	254210303	147.91	11.0742
CON003	43.89187	-63.0946	IMG_1367.JPG	2021:09:11	254	21:04:03	254210403	148.42	11.0764
CON003	43.89180	-63.0942	IMG_1368.JPG	2021:09:11	254	21:04:59	254210459	147.38	10.9816
CON003	43.89171	-63.0937	IMG_1369.JPG	2021:09:11	254	21:06:04	254210604	146.52	10.9360
CON003	43.89167	-63.0934	IMG_1370.JPG	2021:09:11	254	21:07:05	254210705	146.96	11.0717
CON003	43.89163	-63.0932	IMG_1371.JPG	2021:09:11	254	21:07:55	254210755	146.81	11.1329
CON003	43.89148	-63.0922	IMG_1372.JPG	2021:09:11	254	21:10:30	254211030	147.59	10.9882
CON003	43.89148	-63.0922	IMG_1373.JPG	2021:09:11	254	21:10:36	254211036	148.37	11.1812
CON003	43.89147	-63.0919	IMG_1374.JPG	2021:09:11	254	21:11:36	254211136	147.16	11.0750
CON003	43.89137	-63.0916	IMG_1375.JPG	2021:09:11	254	21:12:35	254211235	147.62	11.1196
CON003	43.89136	-63.0915	IMG_1376.JPG	2021:09:11	254	21:12:42	254211242	147.39	11.1551
CON003	43.89125	-63.0913	IMG_1377.JPG	2021:09:11	254	21:13:22	254211322	146.41	11.0214
CON003	43.89100	-63.0908	IMG_1378.JPG	2021:09:11	254	21:14:32	254211432	147.38	11.0744
CON003	43.89077	-63.0904	IMG_1379.JPG	2021:09:11	254	21:15:26	254211526	148.24	11.1439
CON004	43.88401	-63.0971	IMG_1394.JPG	2021:09:11	254	21:55:49	254215549	157.64	11.3804
CON004	43.88432	-63.0969	IMG_1395.JPG	2021:09:11	254	21:56:46	254215646	158.40	11.3916
CON004	43.88460	-63.0969	IMG_1396.JPG	2021:09:11	254	21:57:37	254215737	158.27	11.3818
CON004	43.88485	-63.0968	IMG_1397.JPG	2021:09:11	254	21:58:25	254215825	157.00	11.3784
CON004	43.88505	-63.0968	IMG_1398.JPG	2021:09:11	254	21:59:09	254215909	154.74	11.3810
CON004	43.88525	-63.0969	IMG_1399.JPG	2021:09:11	254	22:00:05	254220005	153.77	11.3779
CON004	43.88535	-63.0969	IMG_1400.JPG	2021:09:11	254	22:00:57	254220057	153.93	11.2120
CON004	43.88547	-63.0969	IMG_1401.JPG	2021:09:11	254	22:01:58	254220158	154.63	11.2033
CON004	43.88562	-63.0968	IMG_1402.JPG	2021:09:11	254	22:02:47	254220247	155.01	11.1932
CON004	43.88586	-63.0966	IMG_1403.JPG	2021:09:11	254	22:03:49	254220349	155.99	11.3697
CON004	43.88606	-63.0963	IMG_1404.JPG	2021:09:11	254	22:04:41	254220441	155.83	11.2876
CON004	43.88629	-63.0960	IMG_1405.JPG	2021:09:11	254	22:05:41	254220541	154.78	11.3288
CON004	43.88658	-63.0956	IMG_1406.JPG	2021:09:11	254	22:06:55	254220655	154.45	11.3553
CON004	43.88682	-63.0953	IMG_1407.JPG	2021:09:11	254	22:07:50	254220750	156.42	11.3604

CON004	43.88700	-63.0952	IMG_1408.JPG	2021:09:11	254	22:08:29	254220829	156.92	11.2978
CON004	43.88720	-63.0950	IMG_1409.JPG	2021:09:11	254	22:09:08	254220908	155.87	11.3125
CON004	43.88735	-63.0948	IMG_1410.JPG	2021:09:11	254	22:09:42	254220942	155.04	11.2517
CON004	43.88738	-63.0948	IMG_1411.JPG	2021:09:11	254	22:09:49	254220949	155.98	11.3210
CON004	43.88738	-63.0948	IMG_1412.JPG	2021:09:11	254	22:09:50	254220950	156.28	11.3213
CON004	43.88758	-63.0946	IMG_1413.JPG	2021:09:11	254	22:10:28	254221028	154.44	11.2768
CON004	43.88775	-63.0945	IMG_1414.JPG	2021:09:11	254	22:11:04	254221104	154.10	11.3363
CON004	43.88792	-63.0943	IMG_1415.JPG	2021:09:11	254	22:11:39	254221139	153.87	11.3166
CON004	43.88809	-63.0942	IMG_1416.JPG	2021:09:11	254	22:12:11	254221211	153.34	11.1438
CON004	43.88815	-63.0942	IMG_1417.JPG	2021:09:11	254	22:12:23	254221223	153.38	11.3077
CON004	43.88838	-63.0940	IMG_1418.JPG	2021:09:11	254	22:13:07	254221307	154.26	11.2797
CON004	43.88857	-63.0939	IMG_1419.JPG	2021:09:11	254	22:13:45	254221345	154.07	11.3189
CON004	43.88876	-63.0938	IMG_1420.JPG	2021:09:11	254	22:14:21	254221421	152.93	11.3130
CON004	43.88893	-63.0937	IMG_1421.JPG	2021:09:11	254	22:14:53	254221453	151.60	11.2871
CON004	43.88913	-63.0935	IMG_1422.JPG	2021:09:11	254	22:15:35	254221535	150.55	11.3277
CON004	43.88929	-63.0934	IMG_1423.JPG	2021:09:11	254	22:16:09	254221609	149.66	11.1076
CON004	43.88951	-63.0932	IMG_1424.JPG	2021:09:11	254	22:16:51	254221651	149.47	11.0154
CON004	43.88970	-63.0930	IMG_1425.JPG	2021:09:11	254	22:17:32	254221732	149.49	10.9667
CON004	43.88988	-63.0928	IMG_1426.JPG	2021:09:11	254	22:18:14	254221814	149.72	11.1144
CON004	43.89012	-63.0924	IMG_1427.JPG	2021:09:11	254	22:19:17	254221917	149.00	11.2226
CON004	43.89025	-63.0921	IMG_1428.JPG	2021:09:11	254	22:19:57	254221957	149.49	11.2220
CON004	43.89034	-63.0918	IMG_1429.JPG	2021:09:11	254	22:20:34	254222034	149.27	11.1789
CON004	43.89045	-63.0914	IMG_1430.JPG	2021:09:11	254	22:21:23	254222123	148.69	11.1781
CON004	43.89053	-63.0911	IMG_1431.JPG	2021:09:11	254	22:22:07	254222207	149.02	11.1690
CON004	43.89066	-63.0907	IMG_1432.JPG	2021:09:11	254	22:22:54	254222254	148.58	11.0883
CON004	43.89100	-63.0902	IMG_1433.JPG	2021:09:11	254	22:24:16	254222416	149.41	11.0372
CON004	43.89125	-63.0900	IMG_1434.JPG	2021:09:11	254	22:25:07	254222507	149.06	11.2666
CON004	43.89143	-63.0901	IMG_1435.JPG	2021:09:11	254	22:25:49	254222549	148.70	11.1979
CON006	43.90000	-63.0748	IMG_1445.JPG	2021:09:12	255	12:00:34	255120034	138.15	11.3600
CON006	43.89999	-63.0748	IMG_1446.JPG	2021:09:12	255	12:00:38	255120038	138.58	11.3641
CON006	43.89984	-63.0748	IMG_1447.JPG	2021:09:12	255	12:01:23	255120123	138.56	11.3600

CON006	43.89971	-63.0749	IMG_1448.JPG	2021:09:12	255	12:02:04	255120204	139.10	11.3615
CON006	43.89959	-63.0750	IMG_1449.JPG	2021:09:12	255	12:02:44	255120244	139.84	11.3613
CON006	43.89947	-63.0751	IMG_1450.JPG	2021:09:12	255	12:03:24	255120324	140.84	11.3613
CON006	43.89940	-63.0751	IMG_1451.JPG	2021:09:12	255	12:04:02	255120402	141.67	11.3646
CON006	43.89936	-63.0752	IMG_1452.JPG	2021:09:12	255	12:04:39	255120439	142.10	11.3628
CON006	43.89932	-63.0754	IMG_1453.JPG	2021:09:12	255	12:05:18	255120518	143.24	11.3637
CON006	43.89927	-63.0755	IMG_1454.JPG	2021:09:12	255	12:06:01	255120601	144.33	11.3623
CON006	43.89919	-63.0757	IMG_1455.JPG	2021:09:12	255	12:06:46	255120646	145.81	11.3629
CON006	43.89911	-63.0758	IMG_1456.JPG	2021:09:12	255	12:07:23	255120723	145.00	11.3610
CON006	43.89909	-63.0758	IMG_1457.JPG	2021:09:12	255	12:07:30	255120730	146.24	11.3544
CON006	43.89907	-63.0759	IMG_1458.JPG	2021:09:12	255	12:07:38	255120738	145.97	11.3560
CON006	43.89905	-63.0759	IMG_1459.JPG	2021:09:12	255	12:07:48	255120748	146.19	11.3558
CON006	43.89899	-63.0760	IMG_1460.JPG	2021:09:12	255	12:08:11	255120811	146.67	11.3603
CON006	43.89890	-63.0762	IMG_1461.JPG	2021:09:12	255	12:08:49	255120849	148.10	11.3494
CON006	43.89884	-63.0763	IMG_1462.JPG	2021:09:12	255	12:09:27	255120927	149.10	11.3558
CON006	43.89877	-63.0764	IMG_1463.JPG	2021:09:12	255	12:10:05	255121005	149.51	11.3338
CON006	43.89870	-63.0765	IMG_1464.JPG	2021:09:12	255	12:10:40	255121040	150.69	11.3539
CON006	43.89860	-63.0766	IMG_1465.JPG	2021:09:12	255	12:11:18	255121118	151.25	11.3636
CON006	43.89851	-63.0768	IMG_1466.JPG	2021:09:12	255	12:11:58	255121158	151.92	11.3545
CON006	43.89842	-63.0769	IMG_1467.JPG	2021:09:12	255	12:12:38	255121238	152.02	11.3574
CON006	43.89831	-63.0772	IMG_1468.JPG	2021:09:12	255	12:13:25	255121325	154.28	11.3542
CON006	43.89821	-63.0773	IMG_1469.JPG	2021:09:12	255	12:14:05	255121405	154.98	11.3298
CON006	43.89809	-63.0774	IMG_1470.JPG	2021:09:12	255	12:14:53	255121453	156.19	11.3117
CON006	43.89800	-63.0775	IMG_1471.JPG	2021:09:12	255	12:15:37	255121537	155.89	11.3164
CON006	43.89788	-63.0775	IMG_1472.JPG	2021:09:12	255	12:16:23	255121623	156.58	11.2971
CON006	43.89774	-63.0775	IMG_1473.JPG	2021:09:12	255	12:17:08	255121708	156.81	11.3089
CON006	43.89771	-63.0775	IMG_1474.JPG	2021:09:12	255	12:17:19	255121719	156.17	11.3044
CON006	43.89766	-63.0776	IMG_1475.JPG	2021:09:12	255	12:17:35	255121735	156.10	11.3053
CON006	43.89763	-63.0777	IMG_1476.JPG	2021:09:12	255	12:17:49	255121749	156.47	11.3005
CON006	43.89753	-63.0778	IMG_1477.JPG	2021:09:12	255	12:18:31	255121831	156.72	11.3030
CON006	43.89745	-63.0780	IMG_1478.JPG	2021:09:12	255	12:19:17	255121917	155.74	11.2985

CON006	43.89735	-63.0782	IMG_1479.JPG	2021:09:12	255	12:20:04	255122004	156.43	11.2972
CON006	43.89723	-63.0784	IMG_1480.JPG	2021:09:12	255	12:20:53	255122053	155.97	11.3016
CON006	43.89710	-63.0785	IMG_1481.JPG	2021:09:12	255	12:21:51	255122151	156.32	11.2941
CON006	43.89699	-63.0787	IMG_1482.JPG	2021:09:12	255	12:22:42	255122242	155.61	11.2917
CON006	43.89688	-63.0788	IMG_1483.JPG	2021:09:12	255	12:23:38	255122338	156.07	11.2946
CON006	43.89680	-63.0790	IMG_1484.JPG	2021:09:12	255	12:24:32	255122432	156.18	11.2942
CON006	43.89671	-63.0793	IMG_1485.JPG	2021:09:12	255	12:25:27	255122527	156.12	11.2973
CON006	43.89659	-63.0795	IMG_1486.JPG	2021:09:12	255	12:26:20	255122620	155.93	11.2833
CON006	43.89649	-63.0797	IMG_1487.JPG	2021:09:12	255	12:27:11	255122711	155.08	11.2847
CON006	43.89642	-63.0799	IMG_1488.JPG	2021:09:12	255	12:28:02	255122802	154.56	11.2895
CON006	43.89637	-63.0800	IMG_1489.JPG	2021:09:12	255	12:28:55	255122855	154.27	11.2878
CON006	43.89623	-63.0801	IMG_1490.JPG	2021:09:12	255	12:29:51	255122951	153.59	11.2916
CON006	43.89604	-63.0802	IMG_1491.JPG	2021:09:12	255	12:30:44	255123044	153.63	11.2985
CON006	43.89590	-63.0803	IMG_1492.JPG	2021:09:12	255	12:31:22	255123122	153.76	11.2898
CON006	43.89585	-63.0803	IMG_1493.JPG	2021:09:12	255	12:31:37	255123137	152.94	11.2959
CON006	43.89567	-63.0805	IMG_1494.JPG	2021:09:12	255	12:32:28	255123228	154.15	11.2923
CON006	43.89559	-63.0805	IMG_1495.JPG	2021:09:12	255	12:32:47	255123247	154.25	11.2914
CON006	43.89547	-63.0806	IMG_1496.JPG	2021:09:12	255	12:33:19	255123319	154.25	11.2980
CON006	43.89535	-63.0808	IMG_1497.JPG	2021:09:12	255	12:34:12	255123412	153.55	11.2958
CON006	43.89530	-63.0810	IMG_1498.JPG	2021:09:12	255	12:35:00	255123500	153.35	11.2838
CON006	43.89530	-63.0811	IMG_1499.JPG	2021:09:12	255	12:35:37	255123537	151.90	11.2871
CON006	43.89530	-63.0811	IMG_1500.JPG	2021:09:12	255	12:35:43	255123543	151.76	11.2860
CON006	43.89531	-63.0813	IMG_1501.JPG	2021:09:12	255	12:36:40	255123640	150.65	11.2968
CON006	43.89531	-63.0815	IMG_1502.JPG	2021:09:12	255	12:37:38	255123738	150.52	11.2835
CON006	43.89526	-63.0817	IMG_1503.JPG	2021:09:12	255	12:38:31	255123831	150.68	11.2987
CON006	43.89518	-63.0819	IMG_1504.JPG	2021:09:12	255	12:39:21	255123921	150.65	11.2732
CON006	43.89500	-63.0820	IMG_1505.JPG	2021:09:12	255	12:40:18	255124018	149.13	11.2746
CON006	43.89475	-63.0821	IMG_1506.JPG	2021:09:12	255	12:41:16	255124116	149.27	11.2632
CON006	43.89450	-63.0821	IMG_1507.JPG	2021:09:12	255	12:42:10	255124210	150.15	11.2468
CON006	43.89437	-63.0822	IMG_1508.JPG	2021:09:12	255	12:42:59	255124259	149.87	11.2632
CON006	43.89435	-63.0824	IMG_1509.JPG	2021:09:12	255	12:43:52	255124352	150.86	11.2562

CON006	43.89439	-63.0826	IMG_1510.JPG	2021:09:12	255	12:44:55	255124455	149.86	11.2632
CON006	43.89443	-63.0828	IMG_1511.JPG	2021:09:12	255	12:45:43	255124543	148.06	11.2504
CON006	43.89445	-63.0830	IMG_1512.JPG	2021:09:12	255	12:46:33	255124633	147.09	11.2318
CON006	43.89445	-63.0831	IMG_1513.JPG	2021:09:12	255	12:47:14	255124714	146.00	11.2320
CON006	43.89444	-63.0831	IMG_1514.JPG	2021:09:12	255	12:47:21	255124721	145.89	11.2333
CON006	43.89436	-63.0833	IMG_1515.JPG	2021:09:12	255	12:48:18	255124818	145.06	11.2610
CON006	43.89417	-63.0833	IMG_1516.JPG	2021:09:12	255	12:49:14	255124914	146.06	11.2383
CON006	43.89394	-63.0832	IMG_1517.JPG	2021:09:12	255	12:50:07	255125007	147.21	11.2372
CON006	43.89375	-63.0831	IMG_1518.JPG	2021:09:12	255	12:50:56	255125056	146.89	11.2357
CON006	43.89363	-63.0831	IMG_1519.JPG	2021:09:12	255	12:51:43	255125143	146.16	11.2466
CON006	43.89357	-63.0832	IMG_1520.JPG	2021:09:12	255	12:52:41	255125241	146.60	11.2434
CON006	43.89357	-63.0832	IMG_1521.JPG	2021:09:12	255	12:53:35	255125335	146.03	11.2477
CON006	43.89358	-63.0833	IMG_1522.JPG	2021:09:12	255	12:54:29	255125429	145.78	11.2489
CON006	43.89359	-63.0835	IMG_1523.JPG	2021:09:12	255	12:56:29	255125629	146.11	11.2529
CON006	43.89355	-63.0836	IMG_1524.JPG	2021:09:12	255	12:57:27	255125727	145.60	11.2360
CON006	43.89349	-63.0837	IMG_1525.JPG	2021:09:12	255	12:58:23	255125823	146.12	11.2503
CON006	43.89339	-63.0839	IMG_1526.JPG	2021:09:12	255	12:59:16	255125916	146.06	11.2619
CON006	43.89329	-63.0841	IMG_1527.JPG	2021:09:12	255	13:00:19	255130019	146.22	11.2534
CON006	43.89322	-63.0842	IMG_1528.JPG	2021:09:12	255	13:01:10	255130110	146.10	11.2511
CON007	43.89783	-63.0771	IMG_1532.JPG	2021:09:12	255	14:00:54	255140054	156.41	11.3161
CON007	43.89785	-63.0771	IMG_1533.JPG	2021:09:12	255	14:00:58	255140058	158.02	11.3029
CON007	43.89806	-63.0771	IMG_1534.JPG	2021:09:12	255	14:01:41	255140141	156.89	11.3065
CON007	43.89827	-63.0771	IMG_1535.JPG	2021:09:12	255	14:02:21	255140221	155.22	11.3349
CON007	43.89832	-63.0772	IMG_1536.JPG	2021:09:12	255	14:02:31	255140231	155.21	11.3279
CON007	43.89838	-63.0772	IMG_1537.JPG	2021:09:12	255	14:02:44	255140244	155.45	11.3283
CON007	43.89855	-63.0771	IMG_1538.JPG	2021:09:12	255	14:03:22	255140322	154.25	11.3480
CON007	43.89857	-63.0771	IMG_1539.JPG	2021:09:12	255	14:03:28	255140328	154.78	11.3448
CON007	43.89873	-63.0771	IMG_1540.JPG	2021:09:12	255	14:04:05	255140405	152.51	11.3484
CON007	43.89875	-63.0770	IMG_1541.JPG	2021:09:12	255	14:04:10	255140410	152.71	11.3479
CON007	43.89919	-63.0767	IMG_1542.JPG	2021:09:12	255	14:05:47	255140547	150.99	11.3433
CON007	43.89943	-63.0765	IMG_1543.JPG	2021:09:12	255	14:06:39	255140639	150.57	11.3519

CON007	43.89956	-63.0764	IMG_1544.JPG	2021:09:12	255	14:07:05	255140705	149.71	11.3575
CON007	43.89958	-63.0764	IMG_1545.JPG	2021:09:12	255	14:07:10	255140710	150.17	11.3552
CON007	43.89982	-63.0763	IMG_1546.JPG	2021:09:12	255	14:07:57	255140757	147.42	11.3567
CON007	43.89997	-63.0763	IMG_1547.JPG	2021:09:12	255	14:08:23	255140823	146.54	11.3544
CON007	43.90024	-63.0762	IMG_1548.JPG	2021:09:12	255	14:09:13	255140913	142.59	11.3488
CON007	43.90062	-63.0763	IMG_1549.JPG	2021:09:12	255	14:10:21	255141021	141.64	11.3332
CON007	43.90086	-63.0763	IMG_1550.JPG	2021:09:12	255	14:11:09	255141109	142.38	11.2979
CON007	43.90112	-63.0765	IMG_1551.JPG	2021:09:12	255	14:12:00	255141200	144.62	11.2838
CON008	43.89918	-63.0788	IMG_1556.JPG	2021:09:12	255	15:38:58	255153858	153.20	11.2983
CON008	43.89892	-63.0786	IMG_1557.JPG	2021:09:12	255	15:40:09	255154009	154.17	11.2732
CON008	43.89850	-63.0788	IMG_1558.JPG	2021:09:12	255	15:41:34	255154134	155.63	11.2688
CON008	43.89824	-63.0790	IMG_1559.JPG	2021:09:12	255	15:42:22	255154222	154.93	11.2932
CON008	43.89806	-63.0790	IMG_1560.JPG	2021:09:12	255	15:43:04	255154304	155.62	11.2854
CON008	43.89793	-63.0791	IMG_1561.JPG	2021:09:12	255	15:43:43	255154343	155.44	11.2761
CON008	43.89776	-63.0791	IMG_1562.JPG	2021:09:12	255	15:44:33	255154433	156.01	11.2864
CON008	43.89757	-63.0792	IMG_1563.JPG	2021:09:12	255	15:45:20	255154520	156.13	11.3206
CON008	43.89738	-63.0793	IMG_1564.JPG	2021:09:12	255	15:46:15	255154615	156.53	11.3289
CON008	43.89725	-63.0795	IMG_1565.JPG	2021:09:12	255	15:46:57	255154657	155.50	11.3338
CON008	43.89715	-63.0797	IMG_1566.JPG	2021:09:12	255	15:47:46	255154746	155.27	11.3276
CON008	43.89706	-63.0800	IMG_1567.JPG	2021:09:12	255	15:48:26	255154826	154.16	11.3008
CON008	43.89695	-63.0802	IMG_1568.JPG	2021:09:12	255	15:49:06	255154906	153.69	11.2928
CON008	43.89673	-63.0803	IMG_1569.JPG	2021:09:12	255	15:50:00	255155000	152.92	11.2865
CON008	43.89650	-63.0803	IMG_1570.JPG	2021:09:12	255	15:50:50	255155050	153.16	11.3224
CON008	43.89632	-63.0802	IMG_1571.JPG	2021:09:12	255	15:51:33	255155133	153.24	11.3209
CON008	43.89617	-63.0801	IMG_1572.JPG	2021:09:12	255	15:52:20	255155220	154.16	11.3113
CON008	43.89593	-63.0800	IMG_1573.JPG	2021:09:12	255	15:53:13	255155313	155.63	11.2941
CON008	43.89573	-63.0798	IMG_1574.JPG	2021:09:12	255	15:54:05	255155405	157.10	11.2913
CON008	43.89562	-63.0797	IMG_1575.JPG	2021:09:12	255	15:54:48	255155448	155.84	11.2854
CON008	43.89548	-63.0795	IMG_1576.JPG	2021:09:12	255	15:55:39	255155539	155.69	11.2734
CON008	43.89534	-63.0794	IMG_1577.JPG	2021:09:12	255	15:56:22	255155622	155.30	11.2727
CON008	43.89589	-63.0798	IMG_1578.JPG	2021:09:12	255	16:01:58	255160158	156.50	11.3196

CON008	43.89627	-63.0798	IMG_1579.JPG	2021:09:12	255	16:03:03	255160303	156.81	11.3189
CON008	43.89665	-63.0798	IMG_1580.JPG	2021:09:12	255	16:04:23	255160423	156.60	11.2700
CON008	43.89689	-63.0797	IMG_1581.JPG	2021:09:12	255	16:05:19	255160519	156.69	11.2506
CON008	43.89710	-63.0798	IMG_1582.JPG	2021:09:12	255	16:06:03	255160603	156.03	11.2826
CON011	43.90831	-63.0639	IMG_1589.JPG	2021:09:12	255	18:29:35	255182935	215.60	10.8356
CON011	43.90860	-63.0634	IMG_1590.JPG	2021:09:12	255	18:30:38	255183038	216.23	10.8323
CON011	43.90887	-63.0629	IMG_1591.JPG	2021:09:12	255	18:31:48	255183148	217.66	10.8290
CON011	43.90909	-63.0625	IMG_1592.JPG	2021:09:12	255	18:32:39	255183239	217.71	10.8261
CON011	43.90925	-63.0623	IMG_1593.JPG	2021:09:12	255	18:33:14	255183314	218.58	10.8233
CON011	43.90942	-63.0621	IMG_1594.JPG	2021:09:12	255	18:33:54	255183354	219.14	10.8213
CON011	43.90954	-63.0619	IMG_1595.JPG	2021:09:12	255	18:34:28	255183428	220.09	10.8203
CON011	43.90963	-63.0617	IMG_1596.JPG	2021:09:12	255	18:34:59	255183459	219.63	10.8211
CON011	43.90977	-63.0615	IMG_1597.JPG	2021:09:12	255	18:35:34	255183534	219.85	10.8176
CON011	43.90992	-63.0614	IMG_1598.JPG	2021:09:12	255	18:36:08	255183608	220.44	10.8161
CON011	43.91002	-63.0611	IMG_1599.JPG	2021:09:12	255	18:36:42	255183642	220.41	10.8153
CON011	43.91020	-63.0606	IMG_1600.JPG	2021:09:12	255	18:37:26	255183726	221.51	10.8132
CON011	43.91038	-63.0603	IMG_1601.JPG	2021:09:12	255	18:38:03	255183803	221.52	10.8110
CON011	43.91054	-63.0602	IMG_1602.JPG	2021:09:12	255	18:38:34	255183834	222.11	10.8085
CON011	43.91070	-63.0601	IMG_1603.JPG	2021:09:12	255	18:39:06	255183906	222.39	10.8083
CON011	43.91079	-63.0602	IMG_1604.JPG	2021:09:12	255	18:39:28	255183928	222.83	10.8067
CON011	43.91088	-63.0601	IMG_1605.JPG	2021:09:12	255	18:39:59	255183959	222.29	10.8057
CON011	43.91100	-63.0600	IMG_1606.JPG	2021:09:12	255	18:40:37	255184037	223.36	10.8040
CON011	43.91108	-63.0598	IMG_1607.JPG	2021:09:12	255	18:41:10	255184110	222.87	10.8042
CON011	43.91120	-63.0596	IMG_1608.JPG	2021:09:12	255	18:41:47	255184147	222.89	10.7988
CON011	43.91134	-63.0593	IMG_1609.JPG	2021:09:12	255	18:42:22	255184222	223.23	10.7913
CON011	43.91150	-63.0590	IMG_1610.JPG	2021:09:12	255	18:43:03	255184303	222.19	10.7797
CON011	43.91172	-63.0588	IMG_1611.JPG	2021:09:12	255	18:43:43	255184343	222.84	10.7694
CON011	43.91196	-63.0587	IMG_1612.JPG	2021:09:12	255	18:44:25	255184425	223.54	10.7648
CON011	43.91212	-63.0587	IMG_1613.JPG	2021:09:12	255	18:44:57	255184457	223.34	10.7607
CON011	43.91256	-63.0585	IMG_1614.JPG	2021:09:12	255	18:46:49	255184649	223.62	10.7626
CON011	43.91275	-63.0584	IMG_1615.JPG	2021:09:12	255	18:47:29	255184729	223.40	10.7548

CON011	43.91297	-63.0581	IMG_1616.JPG	2021:09:12	255	18:48:13	255184813	223.51	10.7583
CON011	43.91315	-63.0578	IMG_1617.JPG	2021:09:12	255	18:48:53	255184853	223.72	10.7483
CON011	43.91384	-63.0573	IMG_1618.JPG	2021:09:12	255	18:51:06	255185106	223.66	10.7427
CON011	43.91405	-63.0571	IMG_1619.JPG	2021:09:12	255	18:51:46	255185146	224.96	10.7329
CON011	43.91406	-63.0571	IMG_1620.JPG	2021:09:12	255	18:51:49	255185149	227.46	10.7307
CON011	43.91493	-63.0568	IMG_1621.JPG	2021:09:12	255	18:54:50	255185450	224.92	10.7422
CON011	43.91499	-63.0568	IMG_1622.JPG	2021:09:12	255	18:55:10	255185510	225.77	10.7296
CON011	43.91549	-63.0568	IMG_1623.JPG	2021:09:12	255	18:56:54	255185654	225.37	10.7403
CON012	43.90481	-63.0586	IMG_1634.JPG	2021:09:12	255	19:50:48	255195048	221.66	10.7929
CON012	43.90506	-63.0585	IMG_1635.JPG	2021:09:12	255	19:51:37	255195137	221.69	10.7925
CON012	43.90564	-63.0585	IMG_1636.JPG	2021:09:12	255	19:53:15	255195315	222.27	10.7920
CON012	43.90585	-63.0586	IMG_1637.JPG	2021:09:12	255	19:53:56	255195356	221.99	10.7944
CON012	43.90596	-63.0587	IMG_1638.JPG	2021:09:12	255	19:54:27	255195427	222.72	10.7917
CON012	43.90610	-63.0586	IMG_1639.JPG	2021:09:12	255	19:55:06	255195506	221.96	10.7995
CON012	43.90626	-63.0586	IMG_1640.JPG	2021:09:12	255	19:55:43	255195543	222.37	10.8022
CON012	43.90651	-63.0584	IMG_1641.JPG	2021:09:12	255	19:56:33	255195633	222.42	10.7996
CON012	43.90681	-63.0585	IMG_1642.JPG	2021:09:12	255	19:57:22	255195722	222.82	10.8017
CON012	43.90703	-63.0585	IMG_1643.JPG	2021:09:12	255	19:58:01	255195801	222.25	10.8060
CON012	43.90727	-63.0586	IMG_1644.JPG	2021:09:12	255	19:58:45	255195845	222.98	10.8024
CON012	43.90748	-63.0586	IMG_1645.JPG	2021:09:12	255	19:59:25	255195925	223.32	10.8018
CON012	43.90762	-63.0586	IMG_1646.JPG	2021:09:12	255	19:59:59	255195959	222.61	10.8029
CON012	43.90782	-63.0586	IMG_1647.JPG	2021:09:12	255	20:00:40	255200040	223.54	10.8050
CON012	43.90809	-63.0586	IMG_1648.JPG	2021:09:12	255	20:01:26	255200126	223.57	10.8052
CON012	43.90831	-63.0587	IMG_1649.JPG	2021:09:12	255	20:02:08	255200208	223.12	10.8066
CON012	43.90847	-63.0589	IMG_1650.JPG	2021:09:12	255	20:02:45	255200245	222.44	10.8064
CON012	43.90904	-63.0590	IMG_1651.JPG	2021:09:12	255	20:04:39	255200439	223.28	10.8115
CON012	43.90923	-63.0591	IMG_1652.JPG	2021:09:12	255	20:05:21	255200521	223.22	10.8125
CON012	43.90940	-63.0591	IMG_1653.JPG	2021:09:12	255	20:05:59	255200559	223.02	10.8124
CON012	43.90958	-63.0592	IMG_1654.JPG	2021:09:12	255	20:06:37	255200637	223.12	10.8126
CON012	43.90998	-63.0593	IMG_1655.JPG	2021:09:12	255	20:07:56	255200756	222.82	10.8148
CON012	43.91021	-63.0594	IMG_1656.JPG	2021:09:12	255	20:08:38	255200838	221.67	10.8140

CON012	43.91043	-63.0594	IMG_1657.JPG	2021:09:12	255	20:09:21	255200921	223.34	10.8141
CON012	43.91069	-63.0593	IMG_1658.JPG	2021:09:12	255	20:10:07	255201007	222.94	10.8136
CON012	43.91096	-63.0592	IMG_1659.JPG	2021:09:12	255	20:10:53	255201053	223.52	10.8126
CON012	43.91223	-63.0595	IMG_1660.JPG	2021:09:12	255	20:14:30	255201430	222.83	10.8100
CON012	43.91275	-63.0594	IMG_1661.JPG	2021:09:12	255	20:15:58	255201558	222.58	10.8065
CON012	43.91329	-63.0593	IMG_1662.JPG	2021:09:12	255	20:17:31	255201731	222.69	10.8045
CON012	43.91357	-63.0593	IMG_1663.JPG	2021:09:12	255	20:18:19	255201819	223.60	10.7995
CON012	43.91376	-63.0594	IMG_1664.JPG	2021:09:12	255	20:19:00	255201900	223.02	10.7927
CON012	43.91393	-63.0594	IMG_1665.JPG	2021:09:12	255	20:19:38	255201938	222.20	10.7907
CON012	43.91412	-63.0594	IMG_1666.JPG	2021:09:12	255	20:20:26	255202026	223.35	10.7863
CON012	43.91433	-63.0593	IMG_1667.JPG	2021:09:12	255	20:21:17	255202117	223.55	10.7821
CON015	44.05473	-63.1721	IMG_1678.JPG	2021:09:13	256	09:36:03	256093603	141.79	11.3116
CON015	44.05467	-63.1720	IMG_1679.JPG	2021:09:13	256	09:36:18	256093618	142.50	11.3076
CON015	44.05456	-63.1719	IMG_1680.JPG	2021:09:13	256	09:36:45	256093645	142.61	11.3081
CON015	44.05442	-63.1718	IMG_1681.JPG	2021:09:13	256	09:37:23	256093723	143.10	11.3078
CON015	44.05439	-63.1717	IMG_1682.JPG	2021:09:13	256	09:37:30	256093730	143.95	11.3068
CON015	44.05437	-63.1717	IMG_1683.JPG	2021:09:13	256	09:37:37	256093737	144.08	11.3065
CON015	44.05431	-63.1716	IMG_1684.JPG	2021:09:13	256	09:38:06	256093806	142.73	11.3122
CON015	44.05422	-63.1715	IMG_1685.JPG	2021:09:13	256	09:38:41	256093841	144.21	11.3072
CON015	44.05422	-63.1715	IMG_1686.JPG	2021:09:13	256	09:38:43	256093843	144.00	11.3068
CON015	44.05421	-63.1715	IMG_1687.JPG	2021:09:13	256	09:38:45	256093845	144.41	11.3075
CON015	44.05417	-63.1714	IMG_1688.JPG	2021:09:13	256	09:39:05	256093904	145.11	11.3068
CON015	44.05417	-63.1714	IMG_1689.JPG	2021:09:13	256	09:39:04	256093905	145.11	11.3068
CON015	44.05412	-63.1714	IMG_1690.JPG	2021:09:13	256	09:39:22	256093922	143.72	11.3120
CON015	44.05398	-63.1713	IMG_1691.JPG	2021:09:13	256	09:40:12	256094012	144.02	11.3149
CON015	44.05375	-63.1711	IMG_1692.JPG	2021:09:13	256	09:41:08	256094108	145.30	11.3028
CON015	44.05371	-63.1711	IMG_1693.JPG	2021:09:13	256	09:41:16	256094116	145.96	11.3063
CON015	44.05356	-63.1709	IMG_1694.JPG	2021:09:13	256	09:41:49	256094149	145.15	11.3081
CON015	44.05339	-63.1708	IMG_1695.JPG	2021:09:13	256	09:42:35	256094235	145.47	11.3126
CON015	44.05326	-63.1706	IMG_1696.JPG	2021:09:13	256	09:43:19	256094319	146.71	11.3074
CON015	44.05316	-63.1706	IMG_1697.JPG	2021:09:13	256	09:43:50	256094350	146.22	11.3040

CON015	44.05301	-63.1704	IMG_1698.JPG	2021:09:13	256	09:44:38	256094438	145.56	11.3183
CON015	44.05279	-63.1703	IMG_1699.JPG	2021:09:13	256	09:45:25	256094525	147.26	11.3120
CON015	44.05259	-63.1701	IMG_1700.JPG	2021:09:13	256	09:46:01	256094601	146.40	11.3037
CON015	44.05230	-63.1699	IMG_1701.JPG	2021:09:13	256	09:46:49	256094649	145.39	11.3189
CON015	44.05217	-63.1697	IMG_1702.JPG	2021:09:13	256	09:47:25	256094725	145.55	11.3055
CON015	44.05216	-63.1696	IMG_1703.JPG	2021:09:13	256	09:47:31	256094731	147.35	11.3056
CON015	44.05202	-63.1695	IMG_1704.JPG	2021:09:13	256	09:48:08	256094808	145.77	11.3340
CON015	44.05185	-63.1694	IMG_1705.JPG	2021:09:13	256	09:48:50	256094850	146.97	11.3242
CON015	44.05168	-63.1692	IMG_1706.JPG	2021:09:13	256	09:49:32	256094932	147.07	11.3257
CON015	44.05149	-63.1690	IMG_1707.JPG	2021:09:13	256	09:50:21	256095021	150.61	11.3206
CON015	44.05134	-63.1688	IMG_1708.JPG	2021:09:13	256	09:50:59	256095059	149.55	11.3012
CON015	44.05117	-63.1687	IMG_1709.JPG	2021:09:13	256	09:51:42	256095142	148.59	11.2998
CON015	44.05103	-63.1686	IMG_1710.JPG	2021:09:13	256	09:52:19	256095219	149.15	11.2980
CON015	44.05087	-63.1685	IMG_1711.JPG	2021:09:13	256	09:52:59	256095259	149.32	11.2949
CON015	44.05071	-63.1684	IMG_1712.JPG	2021:09:13	256	09:53:39	256095339	149.64	11.2952
CON015	44.05067	-63.1683	IMG_1713.JPG	2021:09:13	256	09:53:47	256095347	150.49	11.2954
CON015	44.05064	-63.1683	IMG_1714.JPG	2021:09:13	256	09:53:53	256095353	148.93	11.2898
CON015	44.05048	-63.1681	IMG_1715.JPG	2021:09:13	256	09:54:38	256095438	151.11	11.2927
CON015	44.05047	-63.1681	IMG_1716.JPG	2021:09:13	256	09:54:40	256095440	150.97	11.2942
CON015	44.05046	-63.1681	IMG_1717.JPG	2021:09:13	256	09:54:42	256095442	152.11	11.2955
CON015	44.05032	-63.1680	IMG_1718.JPG	2021:09:13	256	09:55:18	256095518	148.63	11.3022
CON015	44.05015	-63.1679	IMG_1719.JPG	2021:09:13	256	09:56:03	256095603	150.73	11.2913
CON015	44.05000	-63.1678	IMG_1720.JPG	2021:09:13	256	09:56:45	256095645	151.26	11.2909
CON015	44.04987	-63.1677	IMG_1721.JPG	2021:09:13	256	09:57:25	256095725	151.79	11.2907
CON015	44.04976	-63.1675	IMG_1722.JPG	2021:09:13	256	09:58:05	256095805	151.24	11.2906
CON015	44.04975	-63.1675	IMG_1723.JPG	2021:09:13	256	09:58:08	256095808	153.42	11.2897
CON015	44.04962	-63.1674	IMG_1724.JPG	2021:09:13	256	09:58:49	256095849	152.17	11.2876
CON015	44.04949	-63.1673	IMG_1725.JPG	2021:09:13	256	09:59:28	256095928	151.96	11.2889
CON015	44.04930	-63.1672	IMG_1726.JPG	2021:09:13	256	10:00:12	256100012	152.51	11.2912
CON015	44.04910	-63.1670	IMG_1727.JPG	2021:09:13	256	10:00:55	256100055	151.97	11.2848
CON015	44.04909	-63.1670	IMG_1728.JPG	2021:09:13	256	10:00:57	256100057	153.06	11.2854

CON015	44.04893	-63.1668	IMG_1729.JPG	2021:09:13	256	10:01:39	256100139	153.93	11.2906
CON015	44.04892	-63.1668	IMG_1730.JPG	2021:09:13	256	10:01:43	256100143	155.19	11.2900
CON015	44.04881	-63.1666	IMG_1731.JPG	2021:09:13	256	10:02:19	256100219	152.44	11.2885
CON015	44.04870	-63.1665	IMG_1732.JPG	2021:09:13	256	10:03:00	256100300	153.67	11.2878
CON015	44.04858	-63.1664	IMG_1733.JPG	2021:09:13	256	10:03:40	256100340	154.78	11.2895
CON015	44.04842	-63.1662	IMG_1734.JPG	2021:09:13	256	10:04:28	256100428	155.70	11.2868
CON015	44.04825	-63.1661	IMG_1735.JPG	2021:09:13	256	10:05:11	256100511	154.43	11.2874
CON015	44.04805	-63.1659	IMG_1736.JPG	2021:09:13	256	10:05:57	256100557	154.50	11.2843
CON015	44.04788	-63.1658	IMG_1737.JPG	2021:09:13	256	10:06:41	256100641	155.06	11.2853
CON015	44.04773	-63.1657	IMG_1738.JPG	2021:09:13	256	10:07:23	256100723	156.00	11.2842
CON015	44.04759	-63.1656	IMG_1739.JPG	2021:09:13	256	10:08:02	256100802	154.76	11.2839
CON015	44.04743	-63.1654	IMG_1740.JPG	2021:09:13	256	10:08:48	256100848	157.05	11.2846
CON015	44.04728	-63.1652	IMG_1741.JPG	2021:09:13	256	10:09:33	256100933	156.73	11.2841
CON015	44.04717	-63.1651	IMG_1742.JPG	2021:09:13	256	10:10:11	256101011	156.74	11.2841
CON015	44.04705	-63.1650	IMG_1743.JPG	2021:09:13	256	10:10:55	256101055	158.97	11.2825
CON015	44.04689	-63.1648	IMG_1744.JPG	2021:09:13	256	10:11:43	256101143	160.05	11.2848
CON015	44.04668	-63.1647	IMG_1745.JPG	2021:09:13	256	10:12:30	256101230	160.94	11.2846
CON015	44.04649	-63.1645	IMG_1746.JPG	2021:09:13	256	10:13:16	256101316	161.75	11.2841
CON015	44.04631	-63.1644	IMG_1747.JPG	2021:09:13	256	10:13:59	256101359	162.33	11.2826
CON015	44.04617	-63.1642	IMG_1748.JPG	2021:09:13	256	10:14:40	256101440	162.38	11.2815
CON015	44.04617	-63.1642	IMG_1749.JPG	2021:09:13	256	10:14:42	256101442	163.74	11.2808
CON015	44.04609	-63.1641	IMG_1750.JPG	2021:09:13	256	10:15:01	256101501	163.22	11.2809
CON015	44.04606	-63.1640	IMG_1751.JPG	2021:09:13	256	10:15:08	256101508	163.37	11.2799
CON015	44.04604	-63.1640	IMG_1752.JPG	2021:09:13	256	10:15:15	256101515	163.32	11.2801
CON015	44.04602	-63.1640	IMG_1753.JPG	2021:09:13	256	10:15:22	256101522	163.25	11.2802
CON015	44.04583	-63.1637	IMG_1754.JPG	2021:09:13	256	10:16:13	256101613	165.27	11.2782
CON015	44.04568	-63.1637	IMG_1755.JPG	2021:09:13	256	10:17:01	256101701	165.68	11.2774
CON015	44.04567	-63.1636	IMG_1756.JPG	2021:09:13	256	10:17:03	256101703	168.00	11.2762
CON015	44.04559	-63.1636	IMG_1757.JPG	2021:09:13	256	10:17:44	256101744	168.18	11.2725
CON015	44.04550	-63.1634	IMG_1758.JPG	2021:09:13	256	10:18:29	256101829	167.09	11.2725
CON015	44.04548	-63.1634	IMG_1759.JPG	2021:09:13	256	10:18:39	256101839	167.96	11.2735

APPENDIX 4: EXAMPLE 4K CAMERA PHOTO



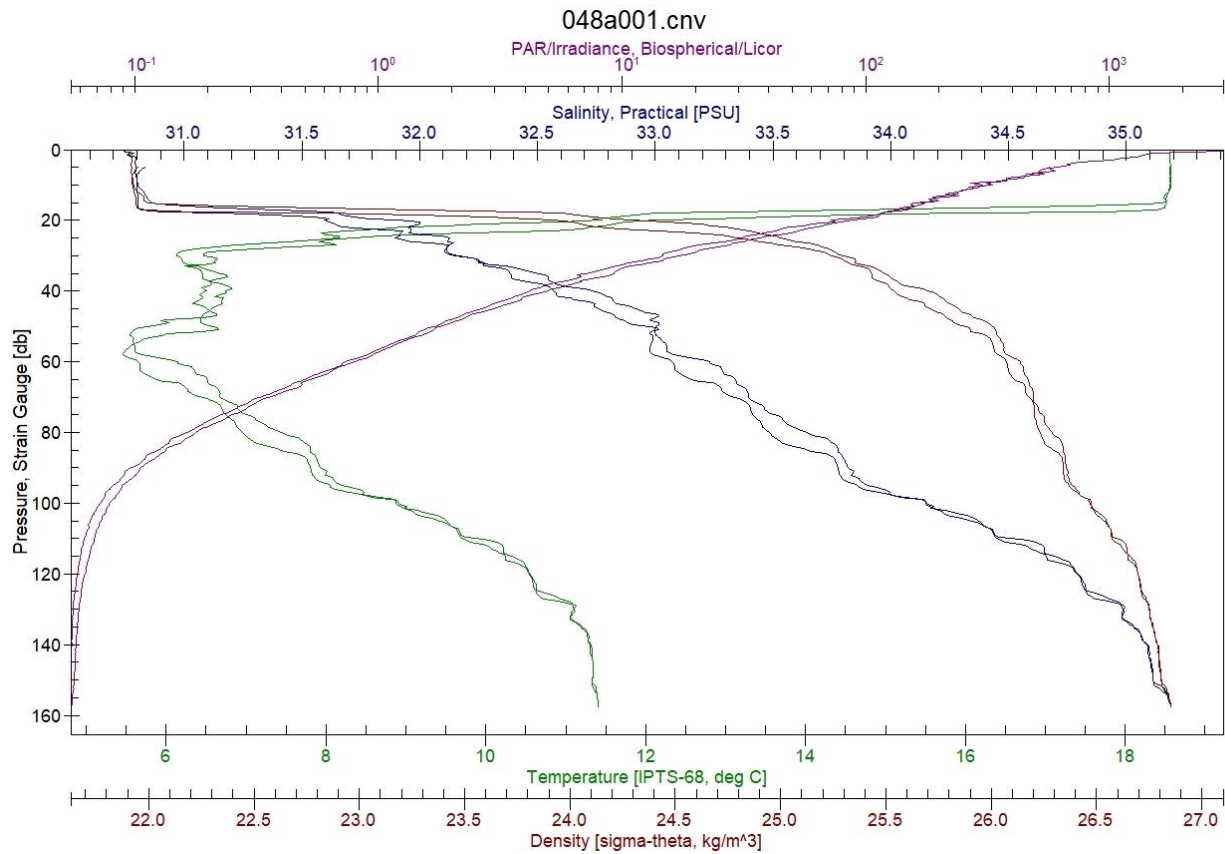
This photo is of IMG_1460.jpg. Metadata associated with the photo can be found in Appendix 3 by searching under the image name. The original photo was enhanced in Word by increasing brightness by 24% and increasing contrast by 7%. The laser dots were enhanced (red closed circles) for scaling (10 cm). The drop weight shown in the image is 10 cm in diameter as shown in the next photo below. The weight can be used to scale the field of view or to estimate the size of features shown in the photos if the lasers are not visible. The image shows the presence of 5 colonies of *Vazella pourtalesii* (bright white vase sponge).

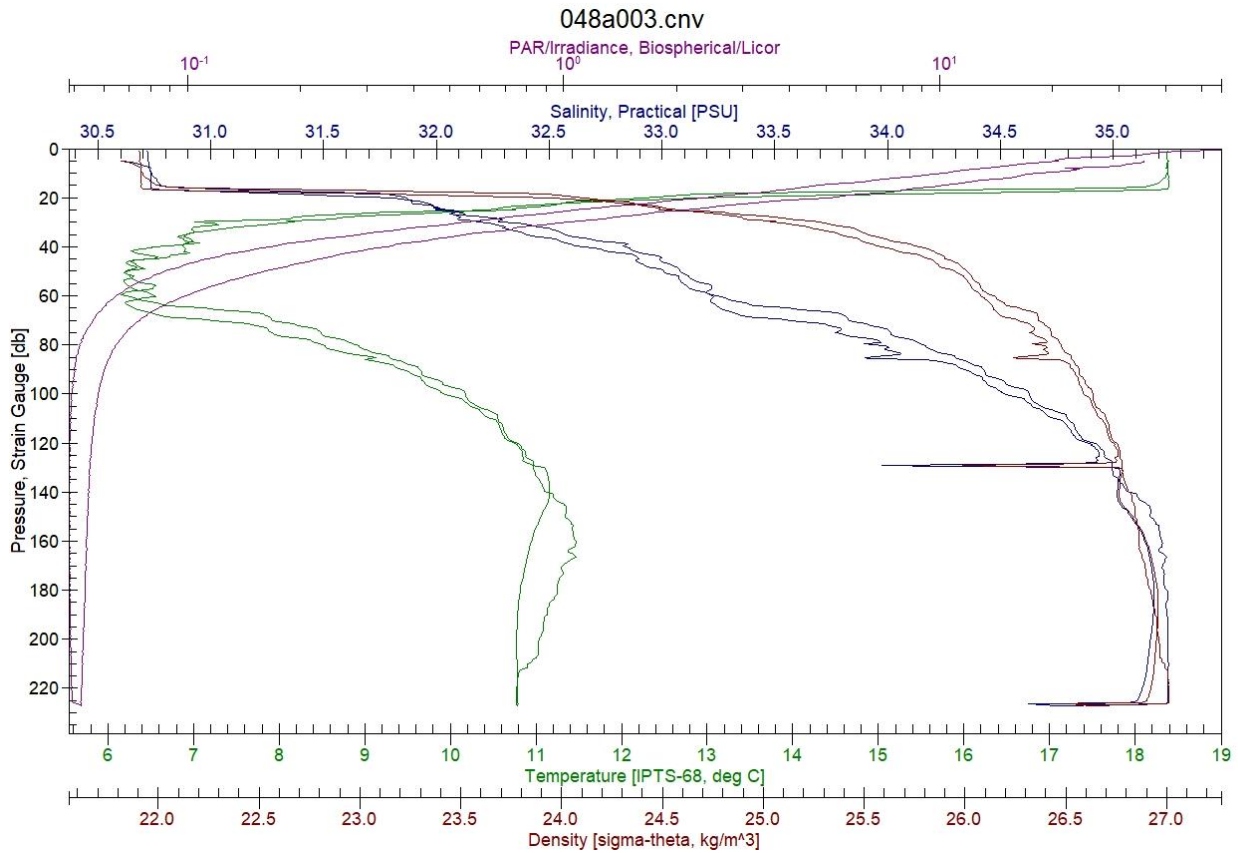
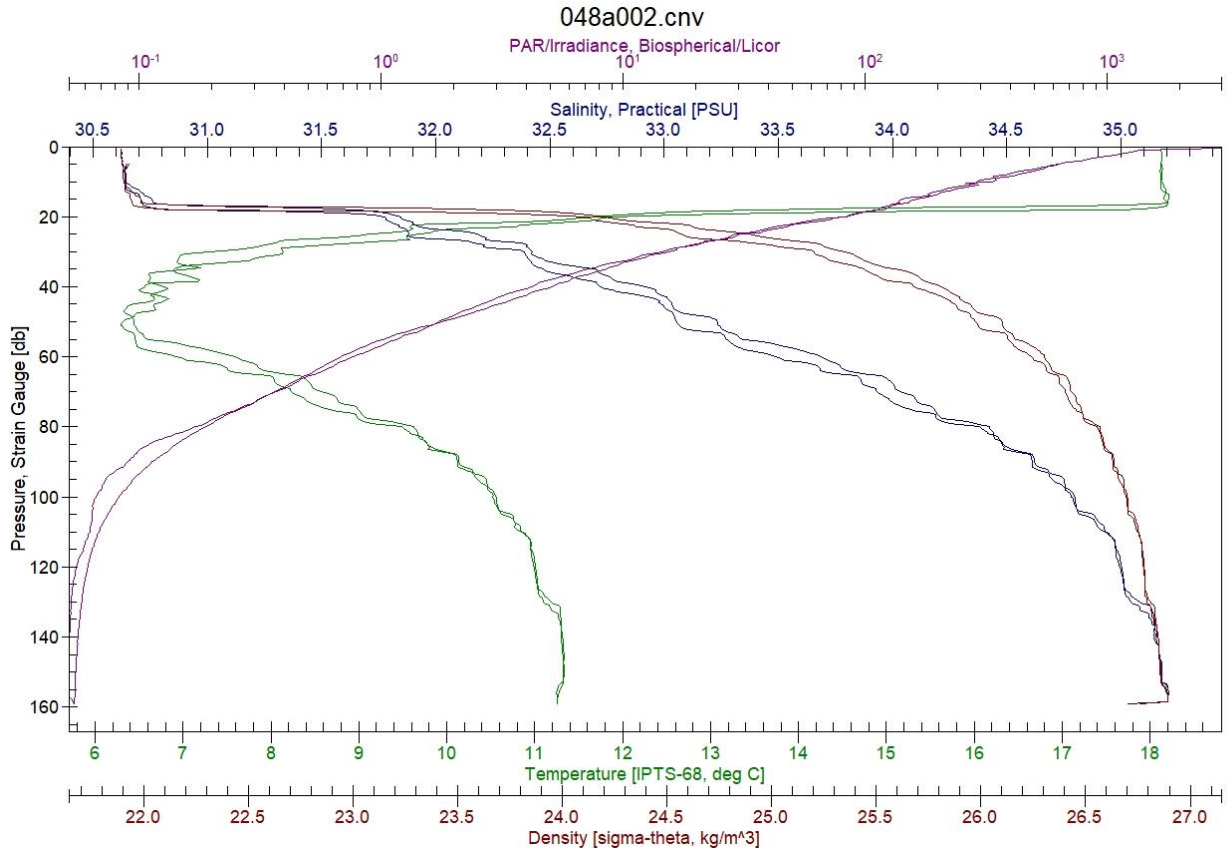


Image of the drop weight used to trigger a photo with the 4K Camera. The weight is 10 cm in diameter and can be used as back-up scale if the lasers are not visible.

APPENDIX 5: CTD PLOTS

The three CTD stations (Table 2) were CON 001 (LS1), CON 009 (LS2) and CON 013 (LS3). The CTD data (including the PAR sensor) were post processed by Dr. Edward Horne, and the graphics prepared by Barry MacDonald, both of the Bedford Institute of Oceanography, Dartmouth, Nova Scotia and are shown below in sequence (LS1-3).





APPENDIX 6: HUD2021-048 - TIME LAPSE CAMERA SYSTEM

Overview

This overview was provided by Kirk Phelan, Bedford Institute of Oceanography, Dartmouth, Nova Scotia after the Cruise Planning Document was finalized and so is included here for future use. Three time lapse camera systems have been developed by the Ocean Engineering and Technology Section (OETS) in support of this mission. The cameras on the Landers are set to take an image at the top and bottom of every hour (2 images/hr). The three camera systems are identical and were mounted to the three separate landers. Each camera system consists of three components:

1. Camera pressure housing
 - a. Sony RX0 15MP DSLR;
 - b. Custom designed embedded controller;
 - c. Custom acetyl pressure case with acrylic flat port. Depth rating of 500 meters.
2. Battery housing
 - a. Battery pack containing 15 (x5 series, x3 parallel) Saft LHS20 lithium primary batteries (18V nominal). Excell Battery Company PN: 2EXL1910.
 - b. Custom ORing diode PCB;
 - c. Custom acetyl pressure housing. Depth rating of 500 meters.
3. DeepSea Power and Light LED SeaLite Sphere – PN: LSL-2075
 - a. 5k lumen output (low power mode), 75 degree beam angle, daylight white;
 - b. 10-48VDC input, 53W in low power mode (<18VDC);
 - c. Aluminum housing with anodes, sapphire port. Depth rating of 4,000 meters.



Figure 1. Time Lapse camera system mounted to lander for test deployment.

Deployment Schedule Settings

The Time Lapse custom embedded controller puts the system into a very low power sleep state between image captures. The controller determines the schedule on which the system will wake up to capture an image. This schedule is set via a menu accessed by a serial interface to the embedded controller. The controller will be put in deployment mode before the landers are loaded on the vessel. The deployment procedure and first wake will be captured by a serial terminal application. A general deployment procedure is located in the body of this document. The image capture schedule is as follows.

Time zone	UTC
Daylight savings	Off
Image (wake) interval	30 minutes
Initial wake time	Top of the hour. Note: an image is captured approximately 10 seconds after the system wakes.

Clocks

The time lapse camera system has two independent clocks, one is internal to the Sony RX0 camera and the other is internal to the embedded controller. The still image EXIF data and file naming use the RX0 internal clock while the embedded controller clock determines the system wake time. These two clocks will drift during deployment. To determine the clock drift during post processing the exact time each clock was set needs to be recorded. Clocks are to be set to UTC.

Lander #	Time Lapse #	Time the RX0 clock was set (YYYY-MM-DD-HH:MM:SS)	Time the controller clock was set (YYYY-MM-DD-HH:MM:SS)
Lander 1	TL-001	UTC	UTC
Lander 2	TL-002	UTC	UTC
Lander 3	TL-003	UTC	UTC

Note: Without the primary external battery pack and Sony RX0 internal clock will reset within a few days. Do not leave the system unplugged for extended periods of time.

SD Card and Battery

Each camera stores images to a 128GByte SD card. The still images will be recorded as JPEGs which can vary in size due to compression. The maximum JPEG size recorded during testing was just over 9Mbytes. Although the SD card can store more than 14,000 images, the embedded controller limits the total images taken to 13,500 images. This limit is for various engineering purposes. Images will be taken every 30 minutes for the 9 month deployment (274 days), which totals 13,152 images.

The calculated capacity of the battery pack in 27Ah at 2 degrees Celsius and the estimated power consumption for 13,000 images is 14Ah, leaving a roughly 50% safety factor.

Mounting Details

The following describes the details of how the camera and light are mounted to each lander.

Mounting Details - Lander 1 (TL-001) & Lander 2 (TL-002) & Lander 3 (TL-003)

Camera height off bottom (to center of viewport)	108cm
Camera angle from horizontal	-30 degrees
LED height off bottom (to center of port)	164cm
LED angle from horizontal	-25 degrees
LED vertical offset from camera	20cm
LED angle along z-axis (pointing toward camera)	7 degrees

Sony RX0 Camera Setting

The following describes the camera image settings for the Sony RX0 for each lander.

Sony RX0 Settings - Lander 1 (TL-001) & Lander 2 (TL-002)

Setting	Selection	Note
Shoot Mode	Program Auto	Selected using Memory Recall 1
Aperture	f/4.0	Sony RX0 has no aperture control and is fixed at f/4.0
Shutter Speed	Auto	
ISO	3200	Fixed ISO
EV (Exposure Value)	-1.0	Reduces the default brightness, which will increase shutter speed reducing smearing of moving fish
Recording Format	JPEG only	
Image size	L:15	Large - 15 Megapixels
Image quality	Extra Fine	Highest quality JPEGs available
Aspect ratio	3:2	Full sensor size
Focus	Manual: ~1.5 m	Bar selector: 5 clicks right of the 0.7 m marker
Zoom	Max Wide	Bar selector: all the way to the left

Sony RX0 Settings - Lander 3 (TL-003) - Unique Settings (All other setting are the same as Lander 1 & 2)

Setting	Selection	Note
Shoot Mode	Program Auto	Selected using Memory Recall 1
Shutter Speed	Auto	
ISO	4000	Fixed ISO
EV (Exposure Value)	-1.0	Reduces the default brightness, which will increase shutter speed reducing smearing of moving fish

Additional Sony RX0 Specifications

Specification	Value	Note
Aperture	f/4.0	Sony RX0 has no aperture control and is fixed at f/4.0
Effective Pixels	15.3MP	
Horizontal Angle of View	84 degrees	When underwater the horizontal angle of view will be reduced by the flat port (magnification of approximately 25%).
RAW images		
Still Image Recording Formats	JPEG, RAW	All still images on this deployment will be JPEGs.

General Deployment Procedure

The initial deployment date-time is store in volatile memory. If the battery is unplugged after the deployment schedule has been set, the camera should be manually redeployed. If the camera is not manually redeployed it will automatically deploy waking 30 minutes from the time the battery was plugged in.

To manually deploy the camera plug in the Time Lapse MCIL8F user interface cable and then to a laptop with a serial port. A terminal program must be used to set the deployment parameters. Setting up the deployment parameters and deploying the camera should be captured to a file using a terminal program.

The time lapse camera serial port communication settings are as follows.

Baudrate	115,200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

If **RE**-deploying it is recommended to unplug the primary battery pack, wait 30 seconds, and then plug the battery pack back in.

Once power is applied a countdown will begin on the terminal program and two tildas (~) are required to display the user menu. The system will automatically go back to sleep in 10 seconds if two tildas are not received. If this occurs press the button on the user interface cable three times to wake the system and start the countdown again. A user menu should appear on the terminal once two tildes are received.

The steps to deploy the system are below:

Step	Menu command	Input data	Description
1	“GETCK”	Nil	Check the system clock
2	If required “SETCK”	“YYYY-MM-DDTHH:MM:SS”	If required set the clock to the current time in UTC. Record the exact time the clock was set. The clock will drift during deployment so this value will be required for post processing.
3	“SETWI”	“00-00:30:00”	30 minute wake interval. The system default is 30 minutes.
4	“SETDT”	“YYYY-MM-DDTHH:MM:SS”	Set the deployment time. It is recommend to deploy the system so the user can watch and record the first deployment on a terminal application.
5	“DPLY”	“Y” to deploy “N” to cancel	Deploy the system. Review and current system time, deployment date, and wake interval for accuracy.

Please note, the Sony RX0 camera settings are saved to its internal non-volatile memory and cannot be changed using the user interface cable. The camera settings can only be changed by using Sony’s Imaging Edge Mobile application for Android or ISO operating systems or directly on the camera body.

Recovery Procedure

The time lapse camera system engineering data is stored to the embedded controller volatile memory and will be lost if the system loses power. Do not unplug the battery until engineering data has been recovered. The camera images are saved to a separate SD card which is non-volatile.

To download the engineering data plug in user Time Lapse interface cable (MCIL8) to the camera and then to a laptop with a serial port. A terminal program must to used to capture the engineering data.

The time lapse camera serial port communication settings are as follows.

Baudrate	115,200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

Set the terminal application to record/capture to file.

Press the button on the user interface cable three times within 5 seconds to wake up the system. A countdown will begin on the terminal application and two tildas (~) are required to fully wake the system and display the user menu. If the system goes back to sleep repeat the button presses and tildes. When the user main menu appears on the terminal application enter the engineering menu by types “ENG”. Once in the engineering menu capture the output from the following commands:

“GETRC”, “GETEVT”, “GETERR”, “GETWC”, “GETAH”

Save the recording/capture to file. The battery can now be disconnected.

Time Lapse Camera - Deployment Checklist

Lander #: _____ Time Lapse #: _____		
Check each parallel battery (x3) for correct voltage		Y/N
Install desiccant in battery housing		Y/N
Battery voltage (at MCBH2F connector)		Volts
Configure ALL RX0 menu settings according to <i>RX0 Time Lapse Settings</i> spreadsheet and <i>HUD2021-048 - Time Lapse Camera System</i> word document.		Y/N
Format SD card and ensure inserted correctly. SD card can be inserted backwards!		Y/N
Set RX0 clock to UTC and record time set.	YYYY:MM:DD- HH:MM:SS _____	Time
Using ALCOHOL FREE lens cleaner, clean inside of pressure housing viewport and inspect for debris.		Y/N
Clean RX0 lens.		Y/N
Install desiccant in camera housing.		Y/N
Inspect and re-lubricate end-cap O-rings.		Y/N
Assemble camera housing using #10-32 ¾” Titanium bolts.		Y/N
Fill camera housing with argon via purge plug.		Y/N
Inspect all underwater cables.		Y/N

Camera height (center of port)		cm
Camera angle (from horizontal)		deg
LED light height		cm
LED vertical offset from camera		cm
LED light angle (from horizontal)		deg
LED light angle (z-axis)		deg
Tighten all camera mounting fasteners		Y/N
Tighten all LED light mounting fasteners		Y/N
Tighten all battery pack mounting fasteners		Y/N
Using ALCOHOL FREE lens cleaner, clean outside of pressure housing viewport and inspect for debris.		Y/N
Using MCIL8F interface cable connect to camera and begin file capture on serial terminal application.		Y/N
Using the Imaging Edge Mobile application on an Android/IOS tablet, ensure SD cards show 9,999 images remaining.		Y/N
Manually take test image and ensure LED light flashes and image is correctly displayed on tablet. Manually disable camera and unplug battery.		Y/N
Manually enable LED and record system current. Disable LED.		Amps
Set controller clock to UTC and record time set.	YYYY:MM:DD- HH:MM:SS	Time
Set deployment time to top of the hour		Y/N
Deploy camera		Y/N
Record first deployment. Save file. Name to match lander#.		Y/N
Flash visible during first deployment?		Y/N