A Drop Camera Survey of Sambro Ledges, Nova Scotia

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by

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ABSTRACT

Vandermeulen, H. 2018. A drop camera survey of Sambro Ledges, Nova Scotia. Can. Tech. Rep. Fish. Aquat. Sci. 3251: viii + 57 p.

A drop camera system was used to survey bottom type, macrophyte and invertebrate presence on Sambro Ledges (just west of Halifax, Nova Scotia). The nearshore consisted of small islets and reefs with kelp and patches of sand / mud. Deeper regions (30-50 m) were dominated by an extensive reef complex of extreme rugosity and exposure. Many hectares of this reef were covered by coralline algae and a foliose red turf dominated by *Ptilota*. This turf may be an important factor in determining the types of benthic invertebrates found in the area. Sponges and the tunicate *Boltenia* were common on the reef.

RÉSUMÉ

Vandermeulen, H. 2018. Relevé sous-marin de Sambro Ledges, Nouvelle-Écosse. Rapp. tech. can. sci. halieut. aquat. 3251 : viii + 57 p.

Le système de caméra sous-marine ainsi obtenu a permis d'étudier le type de fond, l'étendue des macrophytes et la présence d'invertébrés à Sambro Ledges (tout juste à l'ouest d'Halifax, en Nouvelle-Écosse). La zone littorale était composée de petits îlots et de récifs avec du varech et des plaques de sable ou de vase. Les régions plus profondes (30-50 m) étaient dominées par un vaste complexe récifal d'une rugosité et exposition extrême. Plusieurs hectares de ce récif sont couverts par des algues coralliennes et du gazon rouge feuillu dominé par *Ptilota*. Ce gazon peut être un facteur important au moment de déterminer les types d'invertébrés benthiques qui se trouvent dans la zone. Les éponges et les tuniciers *Boltenia* étaient courants dans le récif.

INTRODUCTION

In June 2016, the Oceans and Coastal Management Division (OCMD) of Maritimes Region's Ecosystem Management Branch outlined research needs for coastal Ecologically and Biologically Significant Areas (EBSAs) in Nova Scotia. This included the Sambro Ledges EBSA, a rock reef complex just to the west of Halifax Harbour (Fig. 1). OCMD noted that the EBSA was known as a whale and dolphin feeding area with healthy kelp beds and *Boltenia* fields (*B. ovifera,* a stalked tunicate). The EBSA was historically important for Atlantic cod & Bluefin tuna and a herring overwintering site. Significant at-sea aggregations of multiple seabird functional guilds are found here, as well as a nesting area for Roseate Tern. A rationale for selecting the site as an EBSA can be found in Doherty and Horsman (2007).

OCMD had supported a benthic survey of a portion of the EBSA (Filbee-Dexter 2016) and the author was approached to expand upon that work over a larger area via a drop camera survey. The objective of the drop camera survey was to collect video to classify bottom type (mud, sand, gravel, etc.), macrophytes and benthic invertebrates. The survey area was large, so a broad grid pattern of target sites was employed. With this method only qualitative observations or classifications could be made and mobile fauna such as fish would not be captured in a reliable manner. The survey began in October 2016 and was completed in March 2017. A GIS package was created from the survey results and is described here.

2.0 MATERIALS AND METHODS

2.1 GIS and Survey Design

The GIS platform was ArcGIS (ESRI ver. 10.2.2). Drop camera targets were inserted into the GIS with a hydrographic chart background[1]. Based upon discussions with OCMD staff and Karen Filbee-Dexter[2], it was determined that the main reef complex for Sambro Ledges occurred within the 50 m depth contour. In order to cover this large area, a rectangular target grid pattern was selected with the spacing of approximately 800 m (Figs. 2-4; Table 1, a total of 166 drop targets). Gaps in the grid represented sites previously surveyed by Filbee-Dexter (2016, Fig. 5). For simplicity and ease of navigation, all drop camera targets were placed at 10 m depth or greater.

Figure 6 confirms the extensive and complex nature of the reef area encompassed by the survey. Figure 7 is a backscatter image of the eastern portion of the survey area, the lighter grey shading on the left indicates a hard and topographically complex reef area within the survey boundary, the darker grey to the right indicates a deep channel and an extensive deeper reef area extending to the east. Figure 8 is a more detailed view, and two more targets were added based upon this imagery, "the wall" (right on the edge of the deep channel) and "deep ridges".

[1] The GIS project described in this report is being maintained by OCMD and is accessible for further analysis and exploration.
[2] Presently with the Norwegian Institute for Water Research (Oslo, Norway).

2.2 Equipment

The 40’ Canadian Coast Guard vessel ‘Sigma-T’ (based at the Bedford Institute of Oceanography) was used as the survey platform (Fig. 9). The drop camera video system and electronics are described in Vandermeulen (2017). The video system was fed positional data by the Sigma-T navigation computer. However, the GPS antenna for the navigation system was mounted on the roof of the wheelhouse approximately 10 m distant from the drop camera when deployed off of the stern gallows. In this manner, all positional information in the video overlay would be offset by at least 10 m. This offset was not accounted for in any subsequent analyses. Drop camera targets from the GIS were labeled and embedded into the Sigma-T navigation computer.

The video electronics were arrayed along the back bench of the wheelhouse as shown in Fig. 10. The drop camera was deployed off of the stern gallows as shown in Fig. 11. Note how the deck hand controls the camera umbilical while the main weight of the camera is held by the wire winch line through the block.

2.3 Survey Methods

All field work was completed with a crew of four – coxswain, winch operator, video controller and drop camera umbilical handler (deck hand). The coxswain was responsible for placing the Sigma-T on station for each of the drop targets and for the general operation and safety of the vessel. The video controller maintained the drop target schedule for each day and handled the electronics and video recording. Once on station the winch operator coordinated with the deck hand to lower the camera for video recording and raise once done.

Approximately 3 minutes of video was recorded at each drop camera target with the camera light turned on. The vessel was allowed to drift in the wind and current while recording as long as the wire winch line remained in a vertical position off of the gallows block. The engines were engaged if the wire angled significantly off vertical, but this was rare. It should be noted that the amount of drift at each drop camera target was extremely variable. At some targets, the drift would only be 5 m or so – while at other targets it could be many tens of meters. There was no post processing of data to correct for this effect. Hence, the survey results are spatially approximate while still providing adequate benthic habitat classifications on a bay scale.

The video controller monitored camera depth during recording and would call out to the winch operator if the camera frame needed to be lowered or raised. In this manner, the camera was held between 10 cm to ~2 m off bottom.

The survey was begun from Sambro Harbour on October 26 & 27, 2016. Operations were then shut down for the winter and a new 80 m umbilical was added. The survey was completed during March 7, 13, 18 and 27, 2017 from BIO.

2.4 Video Analysis

The video clips (*.MOV format) were embedded into the GIS at the drop camera locations. They were then analyzed visually on playback for bottom type, macrophyte

cover and the presence of invertebrates. Example screen shots are shown in figures 12 – 29. The video analysis was presence / absence rather than quantitative.

3.0 RESULTS

3.1 Benthic Classification

The benthic classification arising from the video analysis[3] is summarized in Table 2.

Substrates

Surprisingly, the presence of a mud or sand substrate appeared most commonly in the shallower drop camera locations (Fig. 30). At the deeper sites, where one would expect depositional conditions favoring mud or sand, almost no material of this grain size was seen. This indicates a very energetically active environment along the outer edge of the reef complex near 50 m, especially at the southern drop camera locations. Gravel deposits were more evenly distributed within the survey area (Fig. 31).

Cobble and boulder deposits, plus large expanses of massive ledge formations, dominated the survey area (Figs. 32 & 33). These substrates were extraordinarily rugose and textured, providing a very diverse three-dimensional habitat and complex localized bottom current patterns.

Macrophytes

As would be expected in such an energetically driven environment with abundant hard substrate, coralline algal crusts dominated on almost every available hard surface (Fig. 34). Coralline algae can survive at very low light levels at depth, and these were the only algae seen at one of our deepest sites, 'deep ridges' (Fig. 8). Red turf algae accompanied coralline crusts at most drop locations (Fig. 35). The combination of coralline crust with a short (~10 cm tall) canopy of red turf algae dominated the entire survey area. This particular habitat (red algal crust & canopy) was the backdrop for many benthic invertebrates seen in the video.

The notable absence of green algae in the survey area can be explained by survey design. All of the drop camera sites were at 10 m or greater depths, an environment rarely exploited by green algae along the Atlantic coast of Nova Scotia.

The two kelp genera seen in the area, *Saccharina* and *Laminaria* also prefer shallower waters (Figs. 36 & 37). *Laminaria* tends to be more restricted to areas with strong currents or wave action. The brown alga *Desmarestia* had a somewhat similar distribution to the two kelps (Fig. 38). In the author's experience, *Desmarestia aculeata* tends to occur on rocks in slightly deeper waters which are occasionally scoured by sand movement. *Desmarestia viridis* tends to occur in shallower areas. Figure 39 shows the distribution of the third kelp genus in the area, *Agarum*. This alga prefers deeper water and is usually found at depths of 5 m or greater.

[3] Due to rough weather, drop camera targets S161g&f and S171g&f were abandoned.

Benthic Invertebrates

Invertebrates were difficult to discern in the video as many were quite small, and cryptic. However, a few larger invertebrates were noted and chief amongst those was the stalked tunicate, *Boltenia.* It was widely distributed throughout the survey area (Fig. 40). Sponges were also abundant, as would be expected in such a current swept area (Fig. 41). Anemones were more common at depth (Fig. 42).

As is usual for their habitat, sand dollars had quite a restricted distribution (Fig. 43). Brittle stars were also quite rare (Fig. 44), but they were difficult to discern in the video due to their cryptic coloration and habit. Following Filbee-Dexter (2016), we did not record the presence of other sea stars or scallops. The former were relatively common and the latter quite rare.

DISCUSSION

General Habitat Patterns

The drop camera survey of Sambro Ledges captured major habitat features at the bay-scale (10s of km)[4]. The inshore area was defined by a series of small islands and many shallow reefs which appeared to offer some protection from waves and currents as mud or sand substrates were more common here than further offshore. The deeper portions of the survey area were dominated by large expanses of massive ledge formations which formed a coherent reef complex. This offshore area appeared to be a very energetically active environment, particularly along the outer edge of the reef complex near 40-50 m.

Coralline algal crusts dominated throughout the reef area, along with a short canopy of red turf algae (primarily *Ptilota*). This distinctive algal growth covered many hectares of bottom and was a significant habitat feature.

Sears & Cooper (1978) describe a *Ptilota serrata* dominated bottom in the Gulf of Maine between the depths of 29 to 36 m. The *P. serrata* canopy was 10 to 20 cm high. They proposed that the lower limit of growth for this assemblage may provide a benchmark for monitoring changes in water quality conditions over time, particularly since the assemblage is perennial in character and has seasonal stability (Sears & Cooper 1978).

The long-term presence of *P. serrata* at Sambro Ledges is also likely due to the fact that this alga is not preferred in the diet of larger herbivores such as sea urchins (Keats et al. 1984). Indeed, *Ptilota* appears to be even less palatable than the kelp which occurs at depth at Sambro Ledges, *Agarum* (Keats et al. 1984)[5].

The *Ptilota* canopy at Sambro Ledges has implications for benthic invertebrate settlement and population development at a landscape scale. *Ptilota* species appear to

[4] Although the survey was prosecuted in the fall of one year and then completed in the spring of the next, major habitat features such as kelp beds would still be captured irrespective of season. Benthic populations may change density over time but their spatial location rarely varies within a year.

[5] The avoidance of *Agarum* by herbivores is well known (e.g. Himmelman & Nédélec 1990). *Ptilota* species also appear to be unpalatable to smaller herbivores such as amphipods (Wessels et al. 2006)

be selected as habitat by some invertebrates, including amphipods (Eilertsen et al. 2011; Norderhaug 2004). Harvey et al. (1993) found that scallop spat of *Chlamys islandica* preferred to settle on *P. serrata*, *Phycodrys* and *Phyllophora* over bare substrate in the field. These red turf algae were second only to hydroids (*Tubularia*) as a preferred settlement substrate.

In a more detailed field study, Bégin et al. (2004) found a comparable diversity of invertebrates in *Agarum*, *Alaria* and *Ptilota* canopies even though *Ptilota* has a much smaller thallus than the two kelps. Moreover, the invertebrate community on *Ptilota* fronds was different from that on the kelps. The *Ptilota* canopy held significantly higher densities of *Ophiura robusta*, *Asterias vulgaris*, *Musculus discors laevigatus*, *Strongylocentrotus droebachiensis* and *Mytilus edulis.* Importantly, high densities of juvenile whelks (*Lacuna vincta*) were found in the *P. serrata* habitat, suggesting it provides an important refuge for this species (Bégin et al. 2004).

If the above observations are placed into a landscape context, the *Ptilota* canopy has the ability to modify and control the abundance and composition of the benthic invertebrate community over many hectares of bottom at Sambro Ledges. This has implications for the management and conservation of the area.

The larger brown algae were present in the shallower portions of the survey area, with species of *Laminaria, Desmarestia* and *Saccharina*[6]. *Agarum* was present in the shallows and at depth; it was the most common large macrophyte in the survey area.

Sambro Ledges was surveyed in part because of the presence of the stalked tunicate *Boltenia* (Francis et al. 2014). This invertebrate was found throughout the study area, particularly on ledge surfaces at depth. Sponges were abundant and anemones were common. Brittle stars were difficult to discern in the video but likely quite common. Sand dollars were relatively rare due to their habitat preferences.

Comparison with Filbee-Dexter (2016)

As mentioned in the introduction, Karen Filbee-Dexter surveyed a portion of Sambro Ledges prior to the completion of the present drop camera survey (Filbee–Dexter 2016). She used a combination of video transects, drop camera observations and dive surveys. She also used Species Distribution Models to create probability maps for the presence of certain organisms[7]. Her general observations of the area are similar to those described here in terms of macrophyte cover, substrate and the presence of benthic invertebrates.

However, her methods and equipment were different from the present study and a number of her sites were deeper (more than 90 m) and this has led to some differences in the benthos observed. For example, Filbee–Dexter (2016) observed sea urchin and mussel aggregations, sea urchin barrens, corals and deep faunal turfs. We saw none of those features.

[6] Filbee-Dexter et al. (2016) note that kelp populations along this and other portions of the Nova Scotia shore have been degraded by ocean warming.

[7] The author has some concerns about these maps. For example, the predicted abundance of foliose red algae (Filbee-Dexter 2016, Fig. 5) is far less than that actually observed in this study (Fig. 35).

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Table 1. Geographic coordinates of drop camera locations.

name	longitude	latitude
S11	-63.6528	44.39654
S01	-63.6619	44.39659
S02	-63.6622	44.40276
S03	-63.6622	44.40951
S21	-63.6446	44.39641
S22	-63.6447	44.40289
S32	-63.6355	44.40263
S34	-63.6356	44.41568
S36	-63.636	44.42925
S41	-63.6265	44.39619
S42	-63.6269	44.40232
S52	-63.6161	44.40241
S53	-63.6162	44.40885
S54	-63.6162	44.41568
S61	-63.6084	44.39602
S62	-63.6084	44.40219
S63	-63.6079	44.40858
S66	-63.6076	44.4289
S72	-63.5994	44.40214
S73	-63.5994	44.40849
S74	-63.5994	44.41541
S76	-63.5998	44.42881
S81	-63.5905	44.39615
S81a	-63.5906	44.38984
S82	-63.5904	44.40184
S83	-63.5902	44.40827
S86	-63.5891	44.42886
S87	-63.5892	44.43547
S91a	-63.5814	44.3898
S91	-63.5815	44.39597
S92	-63.5815	44.40188
S96	-63.5811	44.42881
S97	-63.581	44.43529
S101	-63.5723	44.39597
S102	-63.5725	44.40184
S103	-63.5728	44.40814
S104	-63.5728	44.41475
S106	-63.5728	44.42881

S108	-63.5729	44.44128
S111b	-63.5629	44.38265
S111	-63.5635	44.39588
S112	-63.5637	44.40192
S113	-63.5637	44.40796
S121b	-63.5534	44.38256
S121a	-63.5531	44.389
S121	-63.5532	44.39566
S122	-63.5532	44.4017
S123	-63.5534	44.40792
S124	-63.5534	44.41436
S128	-63.5527	44.4412
S131b	-63.5442	44.38239
S131a	-63.5442	44.38896
S131	-63.5443	44.39566
S132	-63.5442	44.40157
S133	-63.5438	44.40766
S134	-63.5439	44.41427
S138	-63.5445	44.44111
S1310	-63.544	44.45349
S1311	-63.5439	44.45983
S1312	-63.5438	44.46604
S141b	-63.5352	44.3823
S141a	-63.5354	44.38878
S141	-63.5355	44.3954
S142	-63.5358	44.40144
S143	-63.5357	44.40761
S144	-63.5357	44.41414
S151e	-63.5261	44.36285
S151d	-63.526	44.36946
S151c	-63.5258	44.37612
S151b	-63.5262	44.38208
S151a	-63.5262	44.3887
S151	-63.5263	44.39522
S152	-63.5264	44.40139
S153	-63.5263	44.40739
S155	-63.5266	44.4215
S161g	-63.517	44.34983
S161f	-63.5169	44.35632
S161e	-63.5172	44.36276
S161d	-63.5176	44.36924

S161c	-63.5178	44.37604
S161b	-63.518	44.38195
S161a	-63.518	44.38861
S163	-63.5187	44.40717
S171g	-63.5078	44.34965
S171f	-63.5078	44.35623
S171e	-63.5079	44.36254
S171d	-63.5079	44.36915
S171c	-63.5082	44.37595
S181g	-63.4988	44.34956
S181f	-63.4988	44.35623
S181e	-63.4986	44.36254
S07	-63.6619	44.4353
S08	-63.6621	44.44136
S18	-63.6524	44.44136
S19	-63.6524	44.44756
S110	-63.6523	44.45396
W12	-63.6718	44.40273
W13	-63.6719	44.40927
W14	-63.6718	44.41575
W15	-63.6716	44.42297
W16	-63.6717	44.42897
W17	-63.6717	44.43517
W18	-63.6717	44.44143
W19	-63.6718	44.44743
W110	-63.6718	44.45396
W23	-63.6812	44.40934
W24	-63.6811	44.41575
W25	-63.6811	44.42297
W26	-63.6812	44.42897
W27	-63.6811	44.4351
W28	-63.681	44.44143
W29	-63.681	44.44736
W210	-63.6812	44.45383
W211	-63.6813	44.4605
W212	-63.6813	44.46581
W33	-63.6896	44.40923
W34	-63.6898	44.41577
W35	-63.6896	44.42286
W36	-63.6896	44.42892
W37	-63.6896	44.43499

W38	-63.6898	44.44153
W310	-63.6899	44.45399
W311	-63.6898	44.46073
W312	-63.6897	44.46597
W43	-63.6972	44.40923
W44	-63.6977	44.41577
W45	-63.6981	44.42279
W46	-63.6986	44.42899
W47	-63.6986	44.43431
W48	-63.6959	44.44159
W49	-63.6984	44.44786
W410	-63.6985	44.45392
W411	-63.6984	44.46066
W412	-63.6986	44.46631
W56	-63.7068	44.42899
W57	-63.707	44.43485
W58	-63.7074	44.44153
W59	-63.7056	44.44779
W510	-63.7074	44.45365
W512	-63.7068	44.46631
W64	-63.7156	44.41591
W65	-63.7156	44.42272
W66	-63.7156	44.42879
W67	-63.7161	44.43485
W68	-63.7158	44.44139
W74	-63.7244	44.41598
W75	-63.7243	44.42286
W76	-63.7243	44.42879
W85	-63.7334	44.42279
W86	-63.7333	44.42886
W87	-63.7331	44.4354
W98	-63.743	44.44173
W106	-63.7541	44.42906
W107	-63.7537	44.43471
W108	-63.7529	44.44146
W109	-63.7529	44.44793
W1010	-63.7531	44.45515
W116	-63.7608	44.42899
W117	-63.7624	44.43451
W1110	-63.761	44.45535
W1112	-63.7614	44.47067

W126	-63.77	44.42879
W127	-63.7696	44.43492
W1210	-63.7701	44.45528
W1211	-63.7705	44.46305
W1212	-63.7703	44.47047
the wall	-63.522915	44.444146
deep ridges	-63.501375	44.433397

Table 2. Benthic classification.

Category	**details**
Substrate	
mud / sand	flat bottom of small grain size, shell hash often present, ripples
gravel	
cobble / boulder	10 cm and larger
ledge	larger blocks of rock, often deeply fissured
Macrophyte[8]	
coralline[9]	*Corallina officinalis* L.; *Lithothamnion glaciale* Kjellman; *Clathromorphum circumscriptum* (Strömfelt) Foslie; *Phymatolithon* spp.
red turf[9]	mainly *Ptilota serrata* Kützing but other possibilities include *Phyllophora pseudoceranoides* (S.G. Gmelin) Newroth & A.R.A. Taylor, *Phycodrys rubens* (L.) Batters, *Bonnemaisonia hamifera* Hariot, *Ceramium* spp., *Antithamnion* spp., *Polysiphonia* spp. and similar
Saccharina[9]	*Saccharina latissima* (L.) C.E. Lane, C. Mayes, Druehl & G.W. Saunders; *S. nigripes* (J. Agardh) Lontin & G.W. Saunders
Laminaria	*Laminaria digitata* (Hudson) J.V. Lamouroux
Agarum	*Agarum clathratum* Dumortier
Desmarestia[9]	mainly *Desmarestia aculeata* (L.) J.V. Lamouroux; some *D. viridis* (O.F. Müller) J.V. Lamouroux
Invertebrate	
Boltenia	*Boltenia ovifera* (L.)
sponge[9]	a variety of species
anemone[9]	a variety of species[10]
sand dollar[9]	*Echinarachnius parma* Lamarck
brittle star[9]	*Ophiura* sp.

[8] Drift material on mud / sand or in deep crevasses was not counted in the classification, although this material may be important to local detrital food webs (Filbee-Dexter and Scheibling 2016).
[9] Grab samples required to confirm species listed in 'details'.
[10] There may be some soft corals in this mix. The video quality was too poor to discern differences and future grab samples will be required to confirm taxonomy.

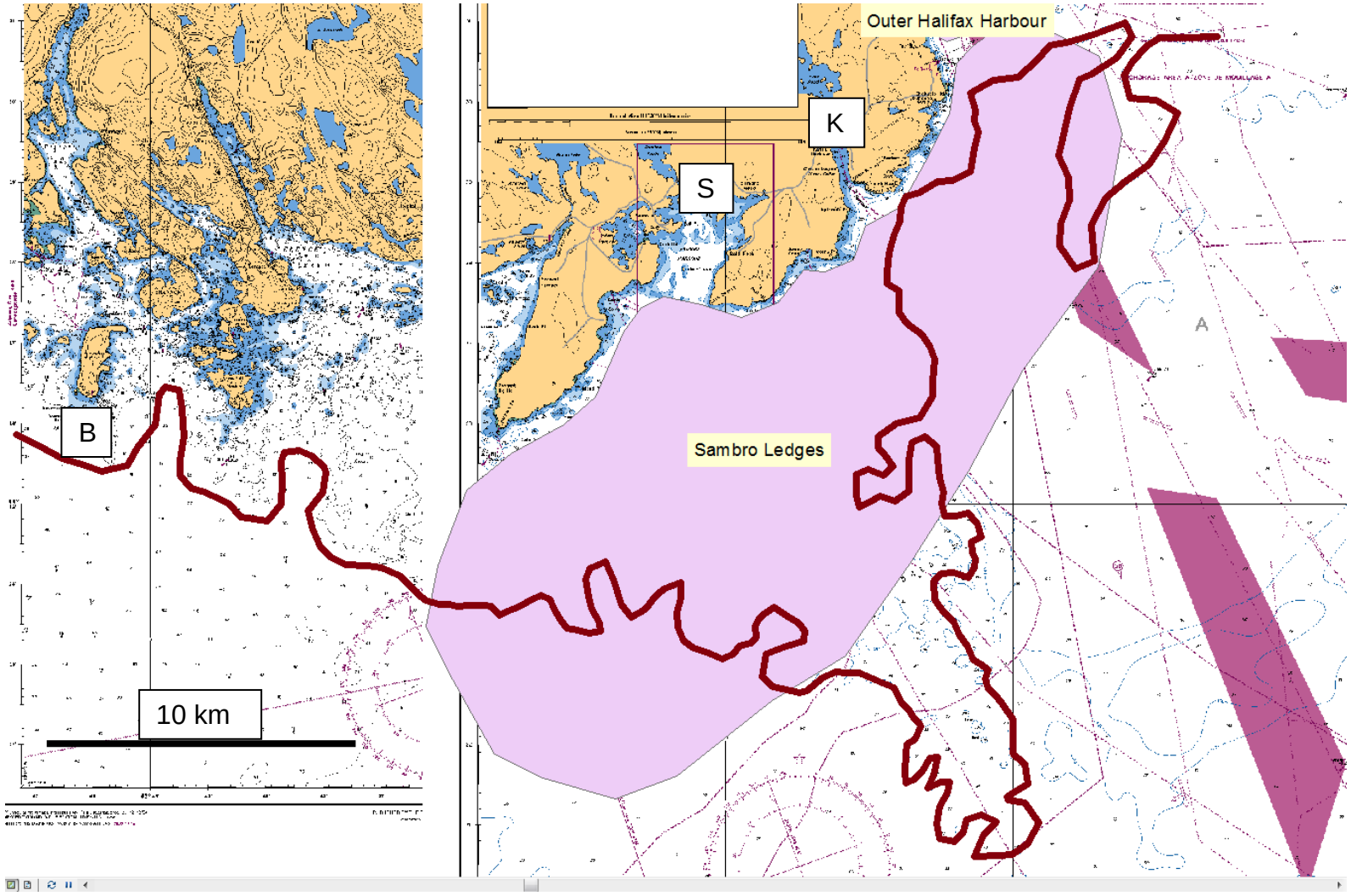

Figure 1: Sambro Ledges EBSA (purple polygon) showing approximate location of 50 m depth contour (red line). **B** = Betty Island; **S** = Sambro Harbour; **K** = Ketch Harbour.

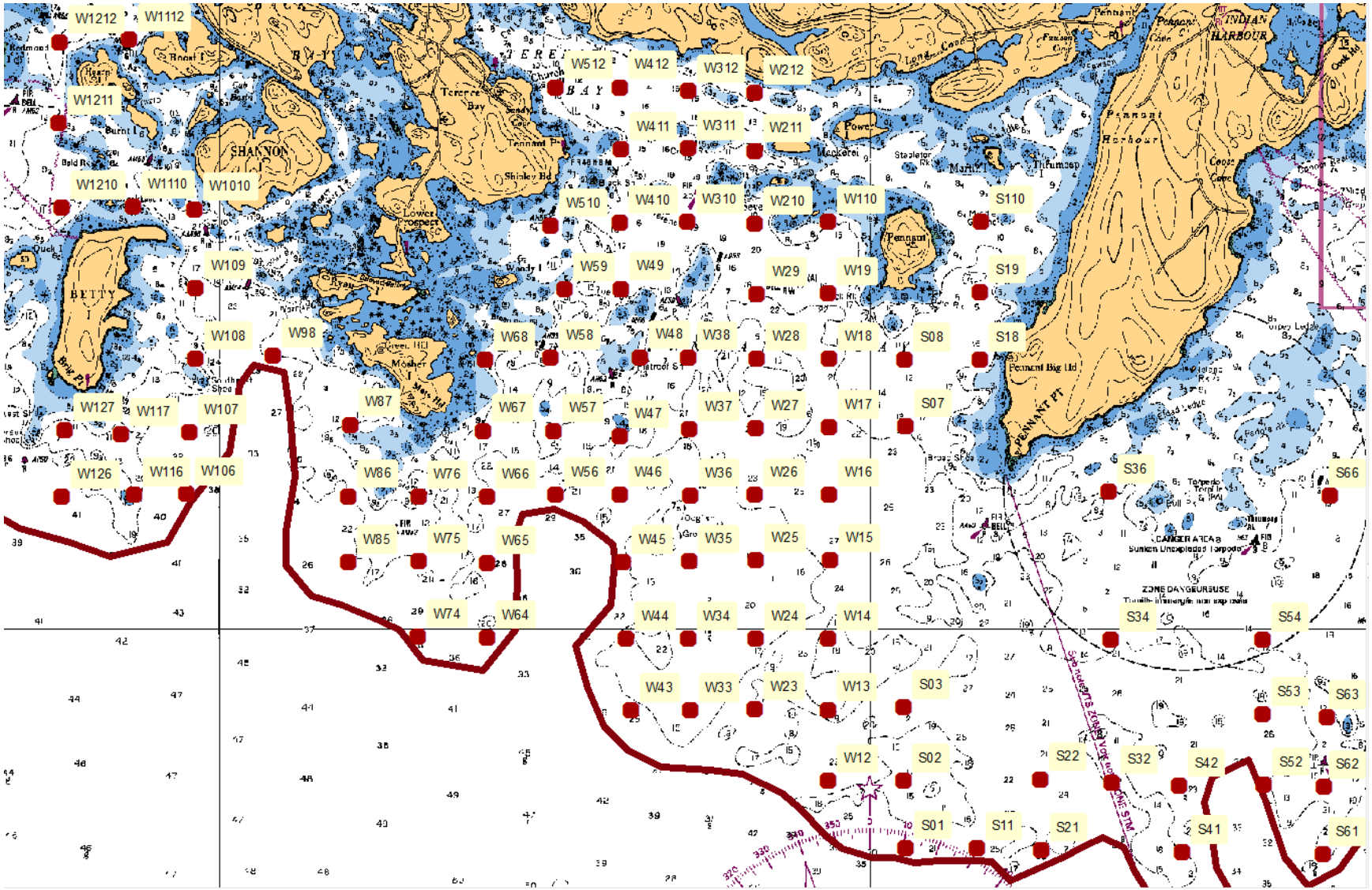

Figure 2: Western drop camera targets.

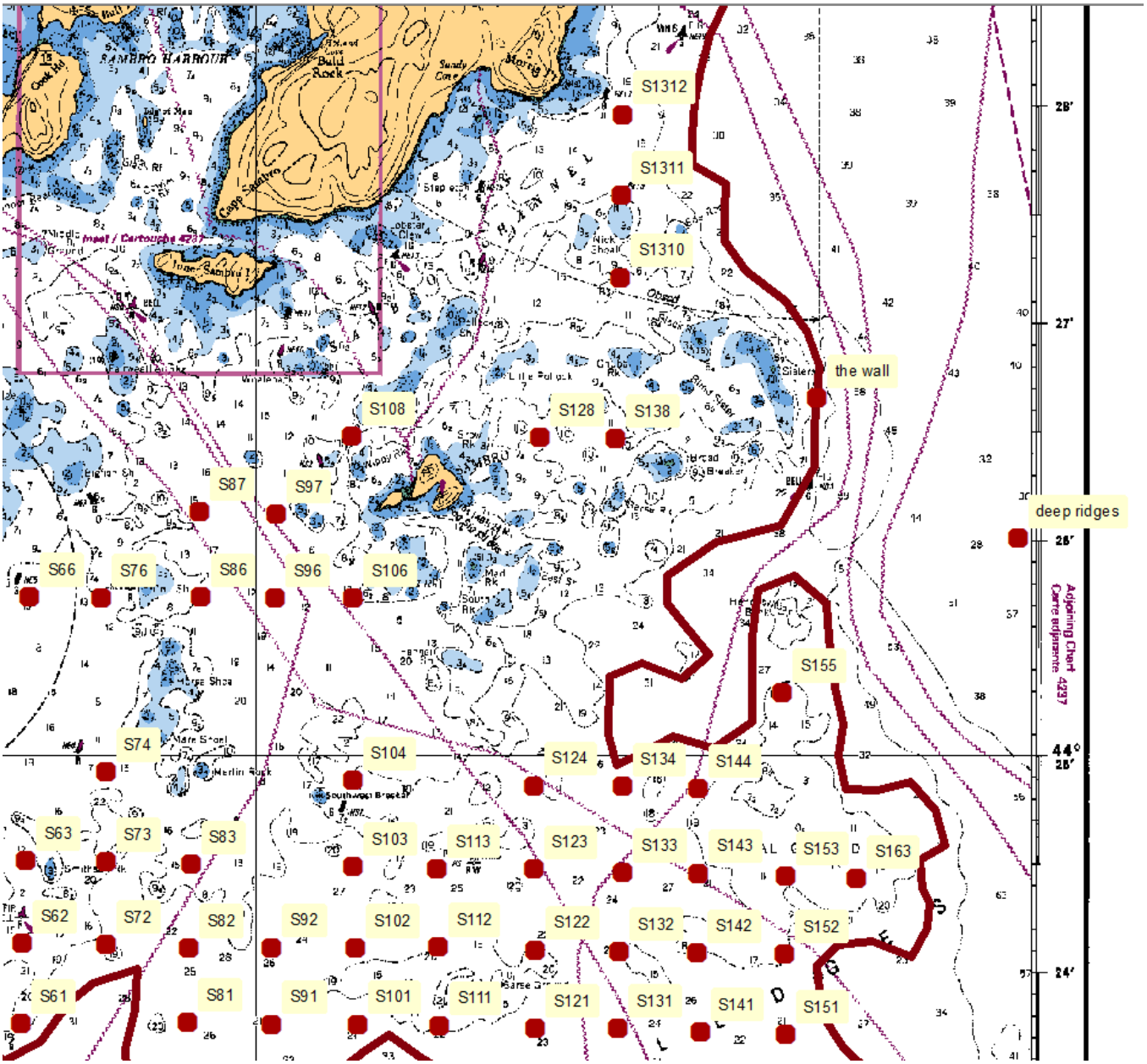

Figure 3: Eastern drop camera targets.

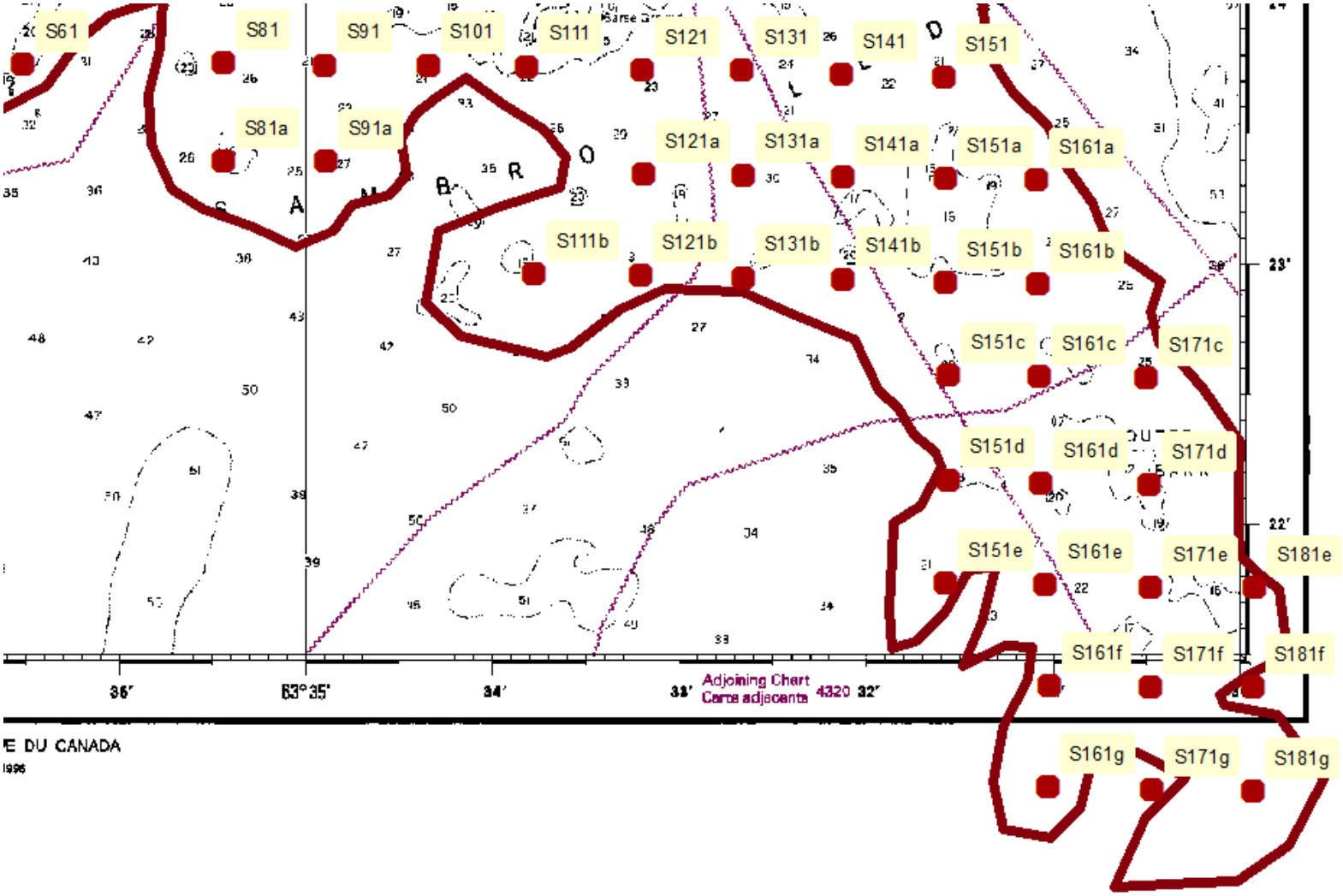

Figure 4: Southern drop camera targets.

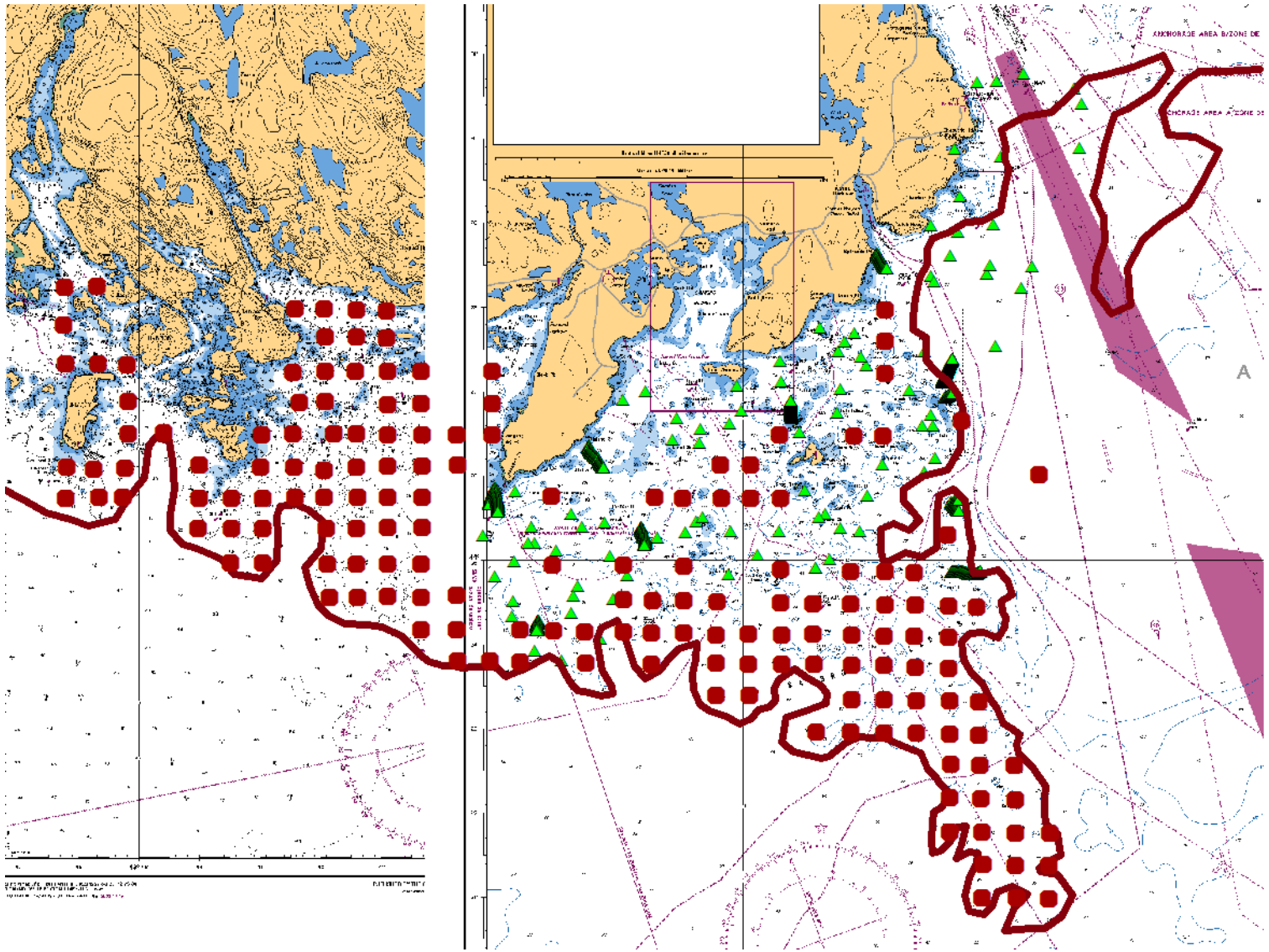

Figure 5: Drop camera targets (red dots) versus video locations from Filbee-Dexter (2016) shown as green triangles.

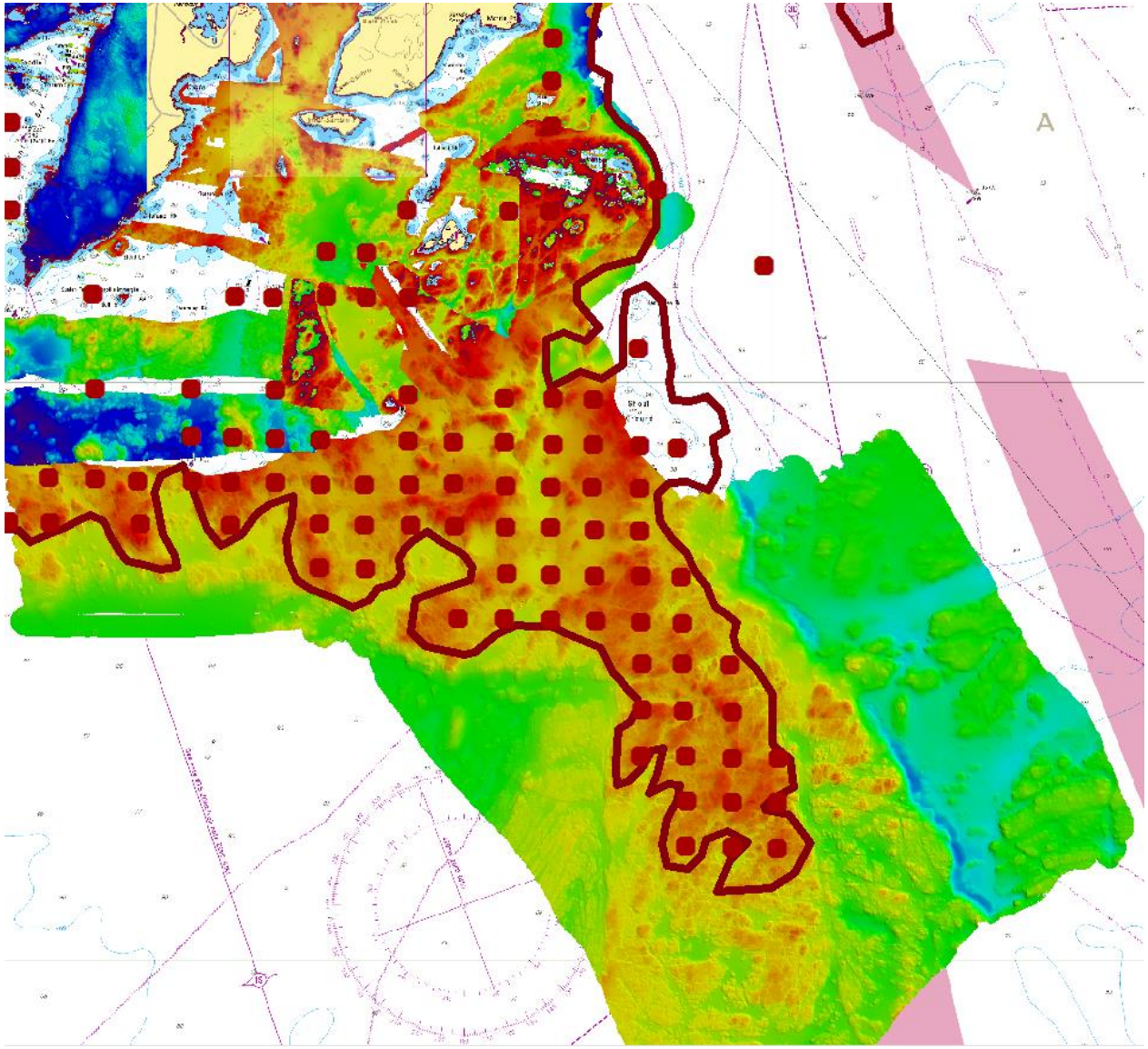

Figure 6: Multibeam image of the southern portion of the survey area indicating an extensive reef complex.

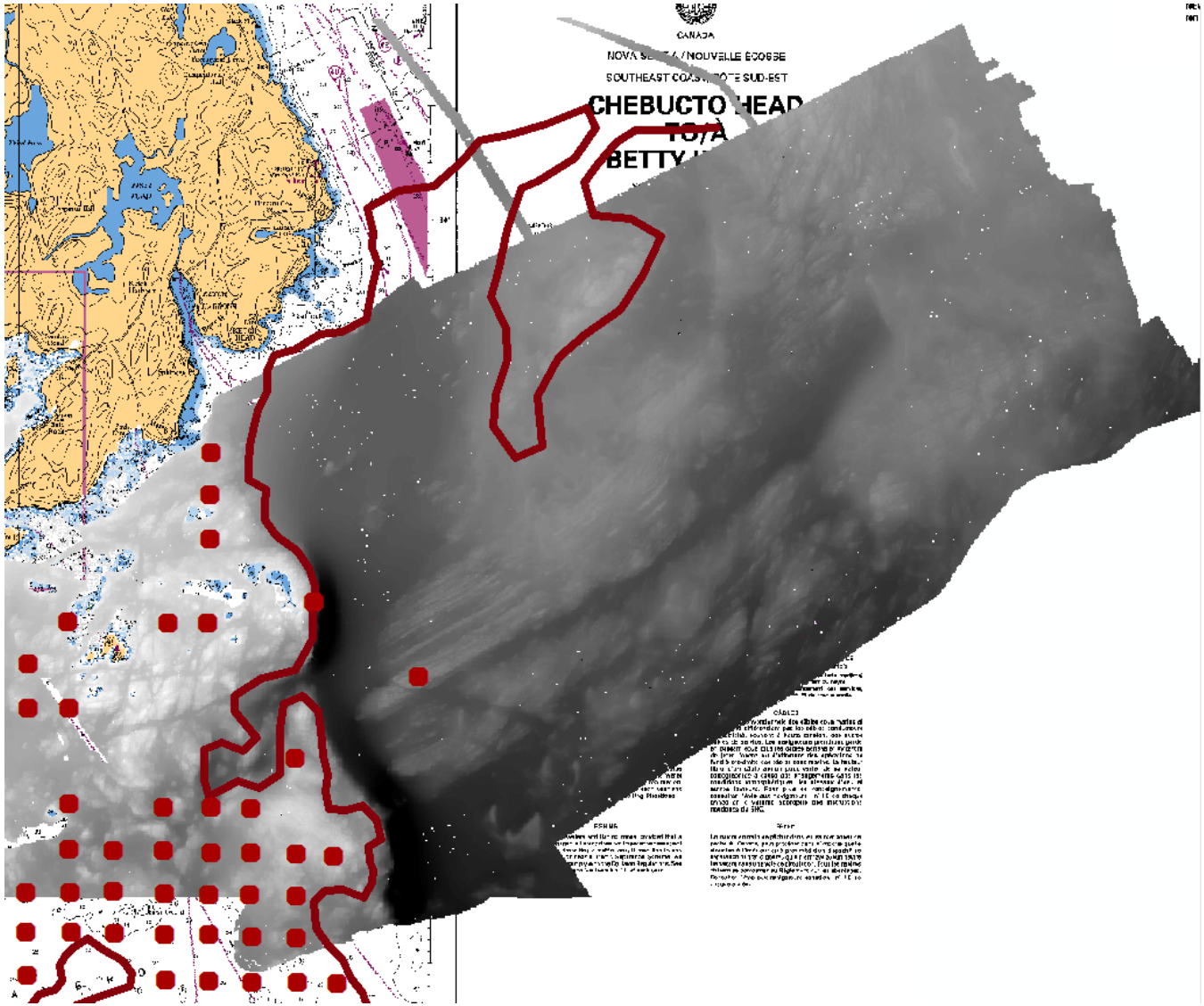

Figure 7: Backscatter image of the eastern portion of the survey area.

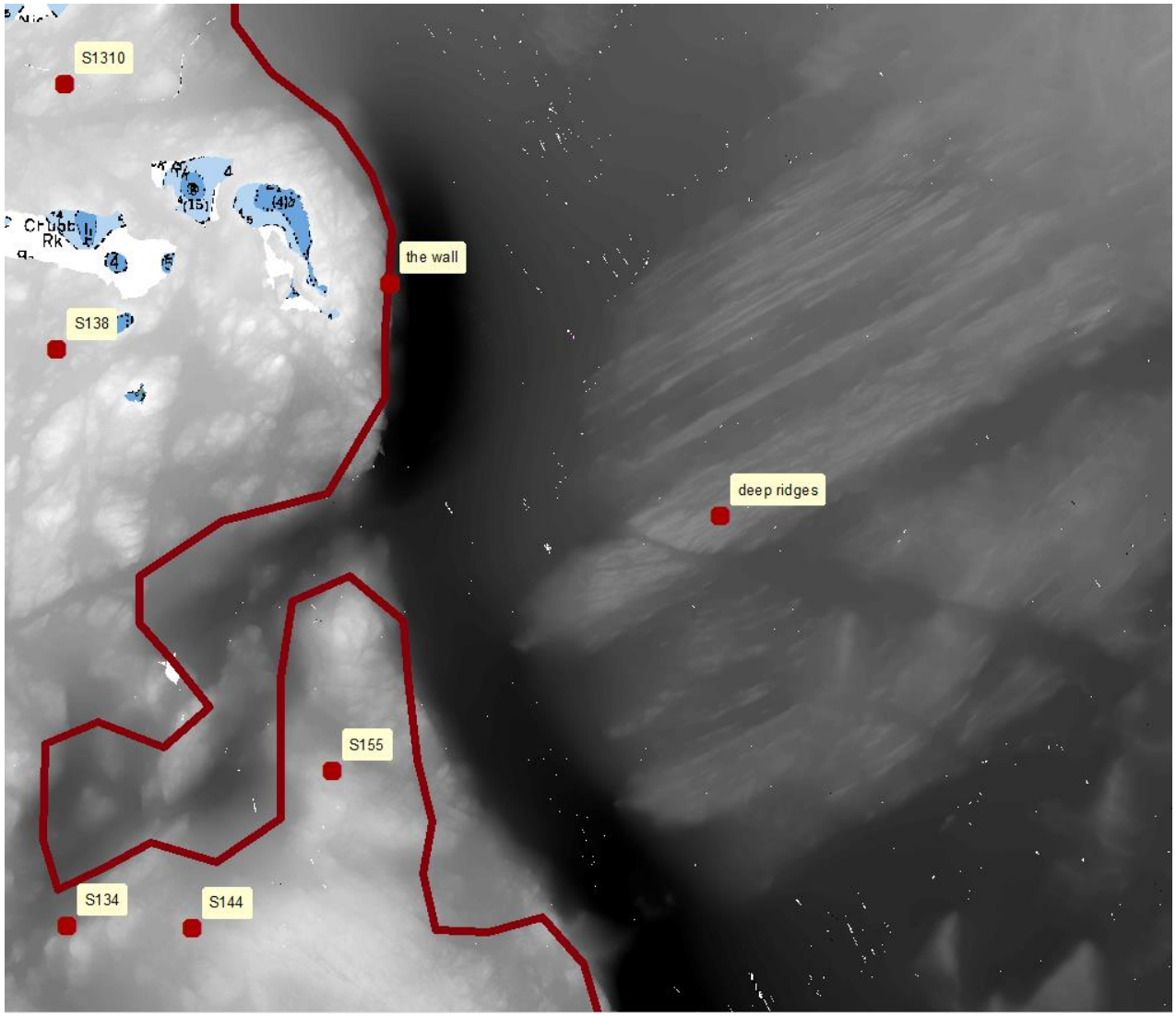

Figure 8: Detail from Fig. 7.

Figure 9: The Sigma-T.

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Figure 10: Video electronics in the wheelhouse.

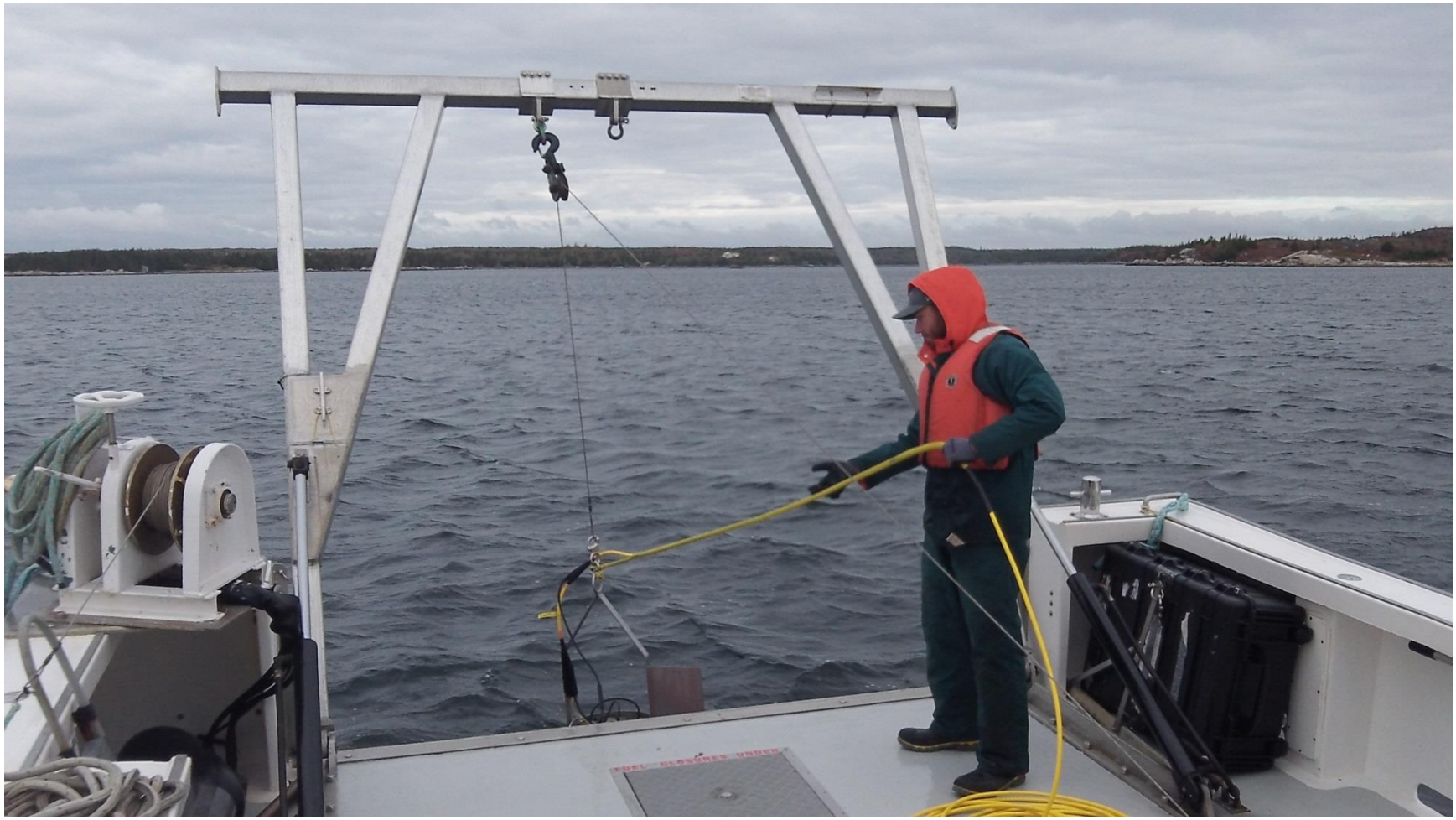

Figure 11: Drop camera being deployed.

Figure 12: Screen shot from video at W46; sand and shell hash. Red 10 cm laser scale visible in middle of image. Overlay on upper left in yellow shows latitude / longitude of GPS antenna on wheelhouse roof (offset of camera position by approximately 10 m); GMT time and date stamp on upper right in white; local time (approximate) and date on lower left in white.

Figure 13: Screen shot from video at W27; sand and gravel. Overlay as in Fig. 12.

Figure 14: Screen shot from video at W19; cobble and boulder with sand on the right. Overlay as in Fig. 12.

Figure 15: Screen shot from video at W57; *Saccharina* (green arrow) and *Desmarestia* (red arrows) on ledge. Overlay as in Fig. 12.

Figure 16: Screen shot from video at W108; *Laminaria* (green arrows) on ledge. Overlay as in Fig. 12.

Figure 17: Screen shot from video at S1312; *Agarum* (green arrows) on ledge. Overlay as in Fig. 12.

Figure 18: Screen shot from video at W44; coralline algae crusts cover a ledge with a ‘red turf’ canopy (red arrows). Overlay as in Fig. 12.

Figure 19: Screen shot from video at S111; coralline algae crusts (red arrows) on boulder. Overlay as in Fig. 12.

Figure 20: Screen shot from video at S74; close up of coralline algae crusts. Overlay as in Fig. 12.

Figure 21: Screen shot from video at S41; close up of coralline algae crusts with *Ptilota* canopy (red arrows). Overlay as in Fig. 12.

Figure 22: Screen shot from video at S07; anemone. Overlay as in Fig. 12.

Figure 23: Screen shot from video at S121a; anemones (red arrows). Overlay as in Fig. 12.

Figure 24: Screen shot from video at S121a; anemone (red arrow) and *Boltenia* (white arrows). Overlay as in Fig. 12.

Figure 25: Screen shot from video at W44; *Boltenia* (white arrows). Overlay as in Fig. 12.

Figure 26: Screen shot from video at W14; sponge (red arrow) on cobble. Overlay as in Fig. 12.

Figure 27: Screen shot from video at S07; sponge (red arrow) on boulder. Overlay as in Fig. 12.

Figure 28: Screen shot from video at S53; brittle stars (red arrows). Overlay as in Fig. 12.

Figure 29: Screen shot from video at S104; sand dollars (red arrows). Overlay as in Fig. 12.

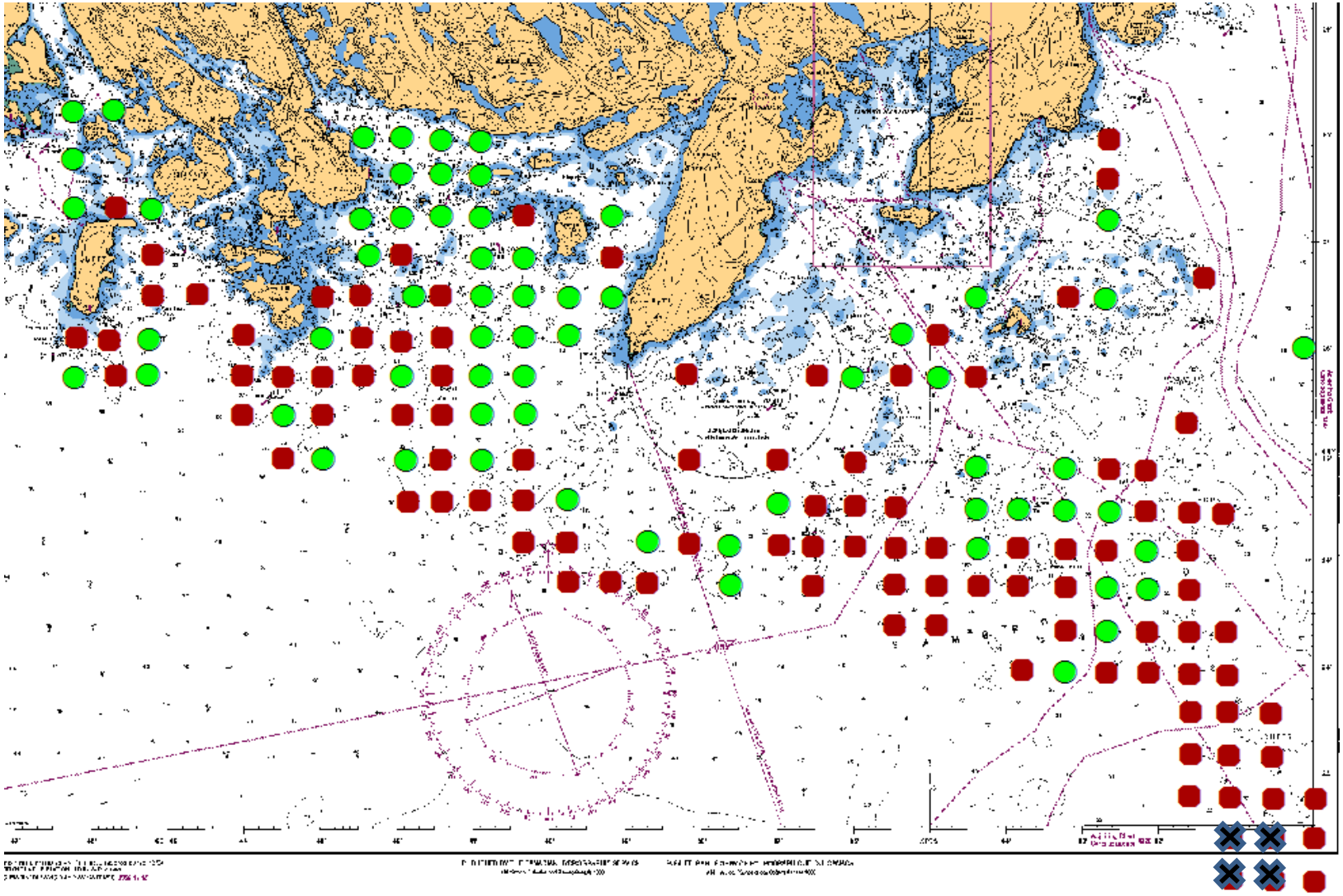

Figure 30: Drop camera locations with a mud / sand substrate seen in video (green circles; red squares=absent; X=no video).

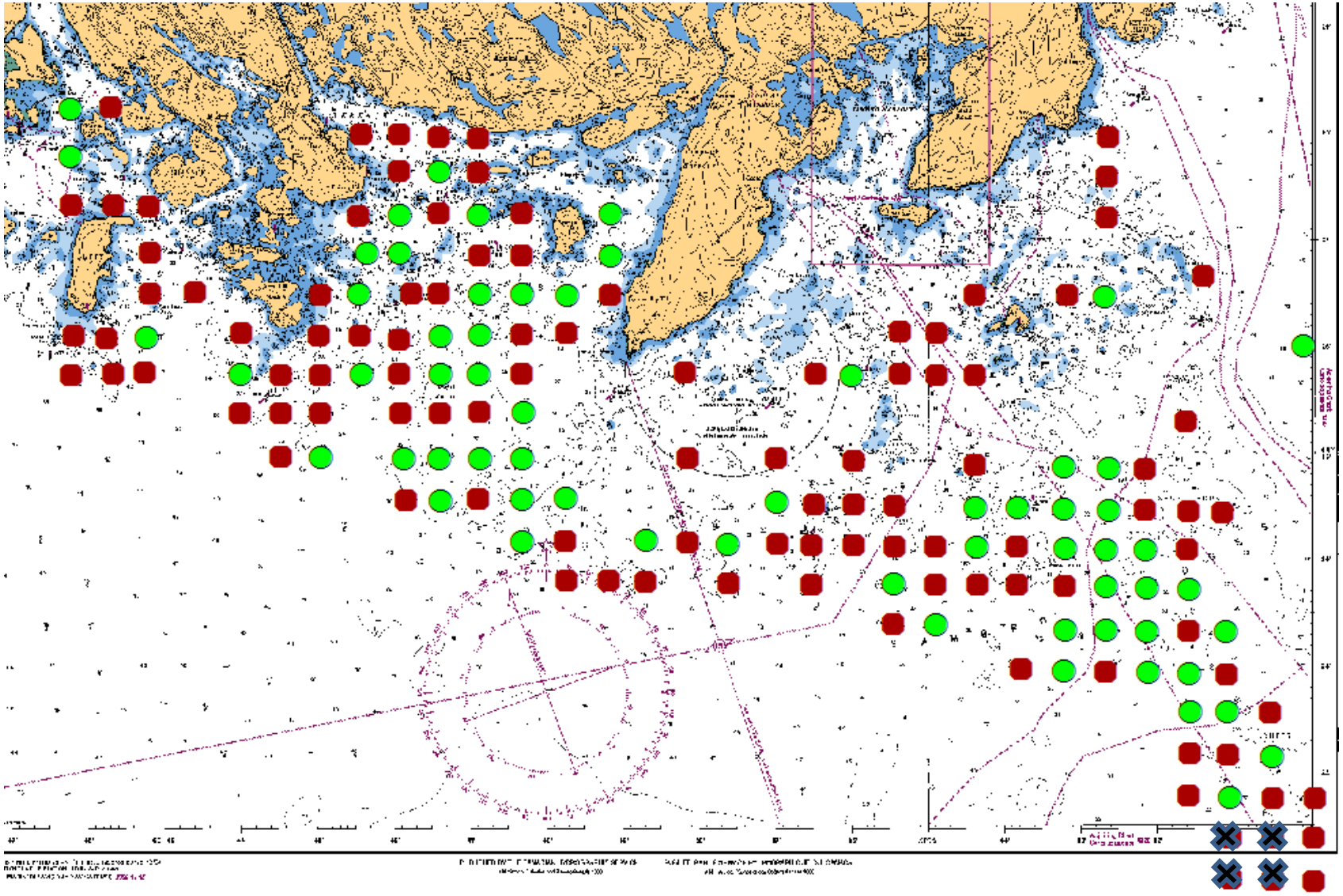

Figure 31: Drop camera locations with a gravel substrate seen in video (green circles; red squares=absent; X=no video).

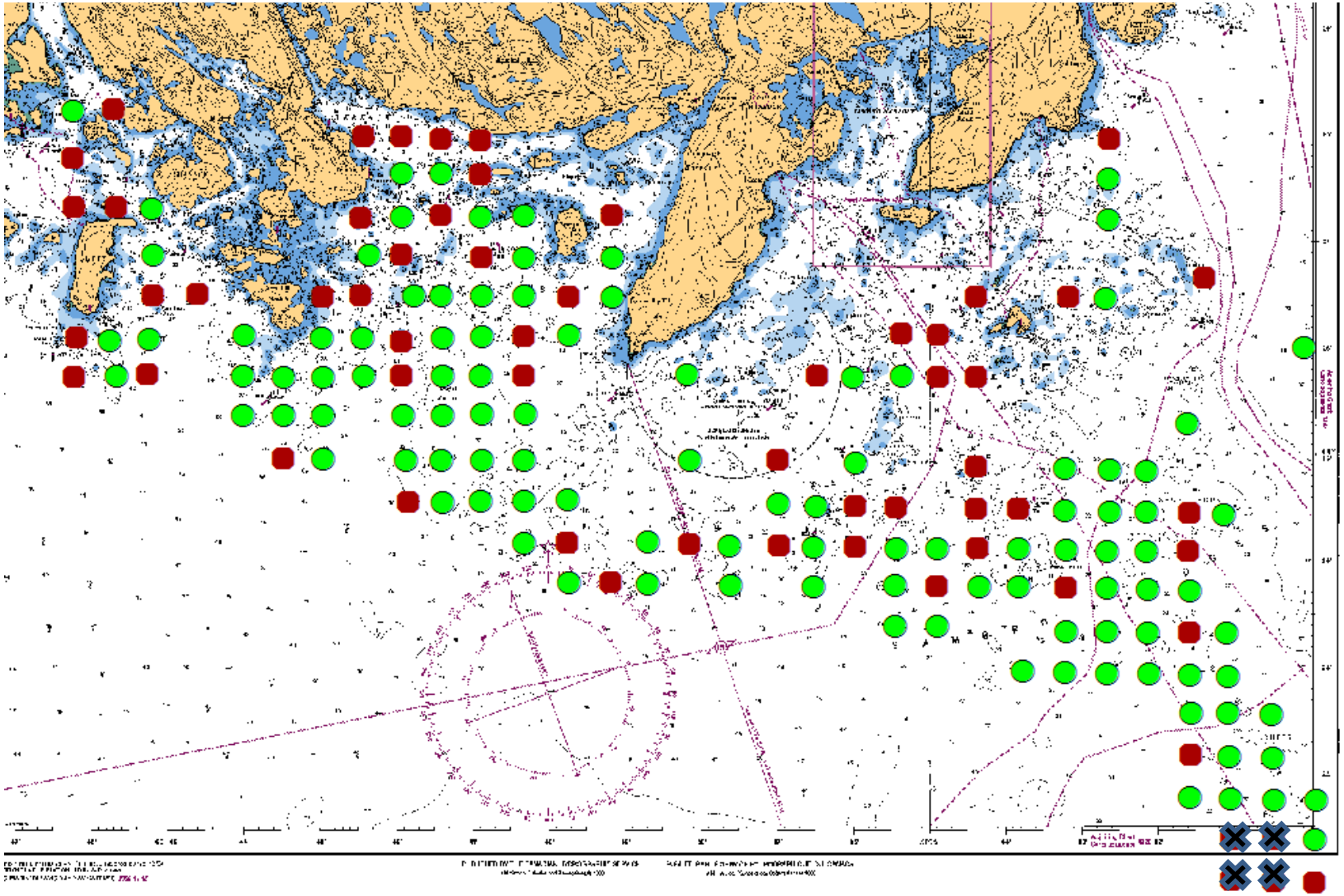

Figure 32: Drop camera locations with a cobble / boulder substrate seen in video (green circles; red squares=absent; X=no video).

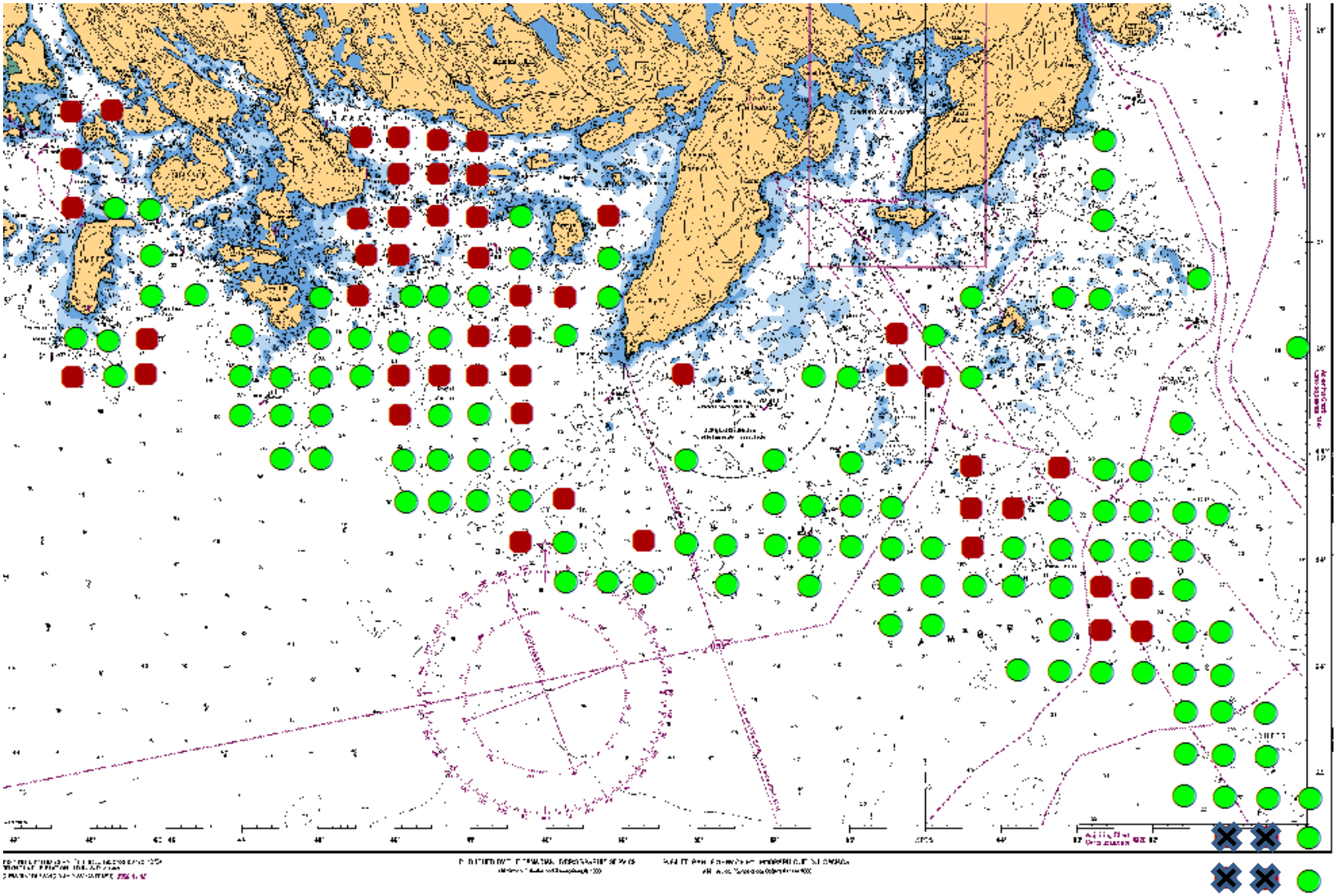

Figure 33: Drop camera locations with a ledge substrate seen in video (green circles; red squares=absent; X=no video).

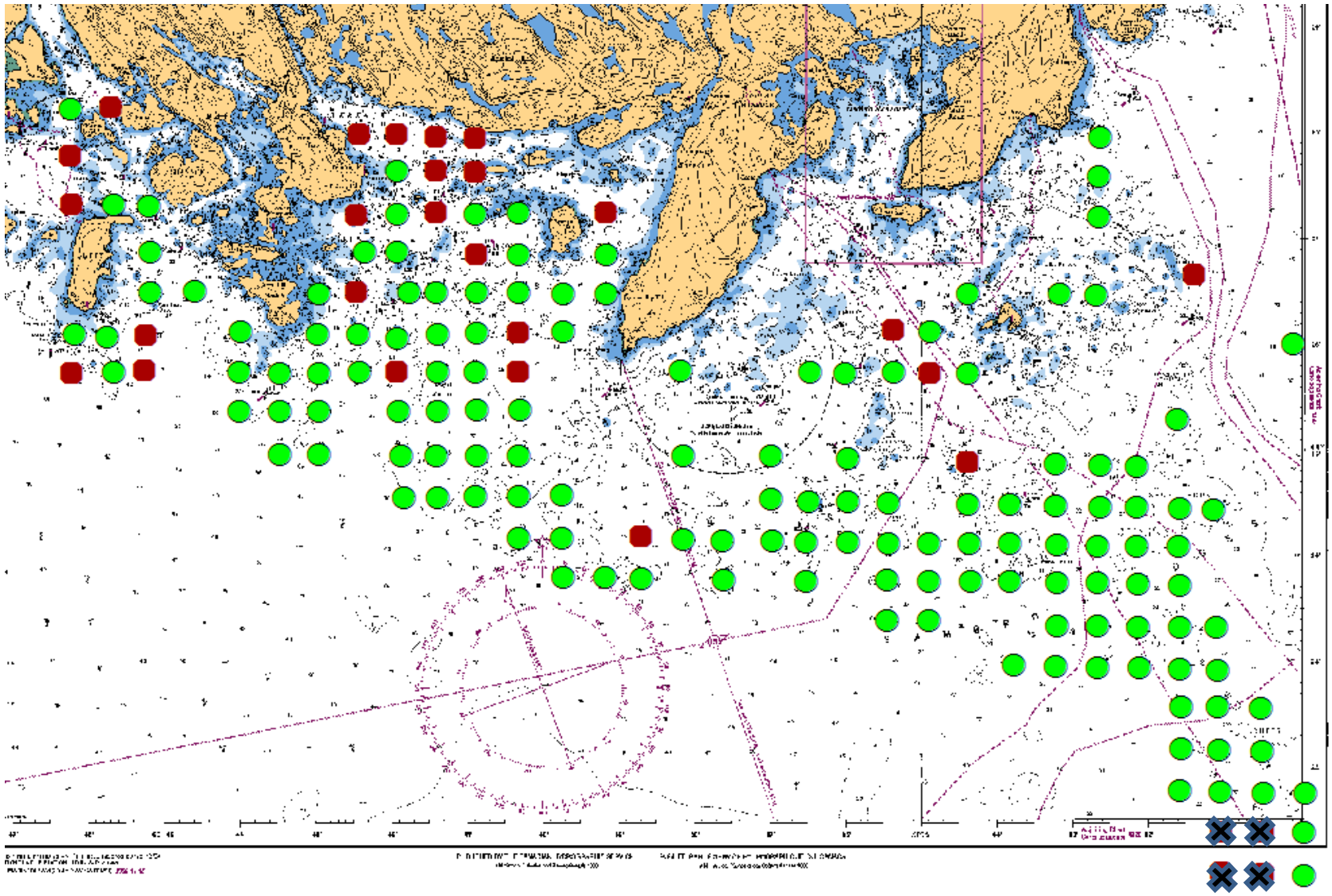

Figure 34: Drop camera locations with coralline crusts seen in video (green circles; red squares=absent; X=no video).

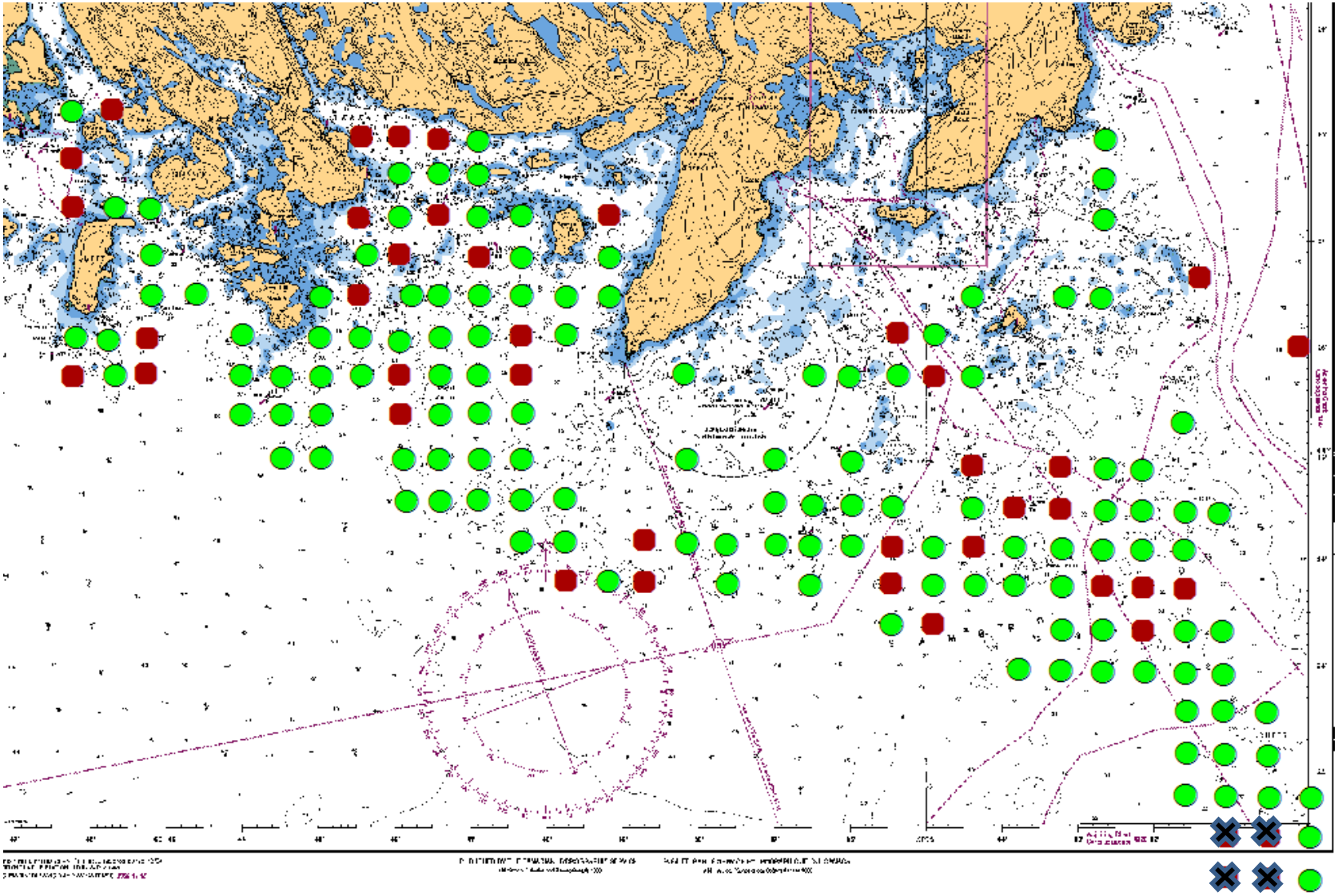

Figure 35: Drop camera locations with red turf seen in video (green circles; red squares=absent; X=no video).

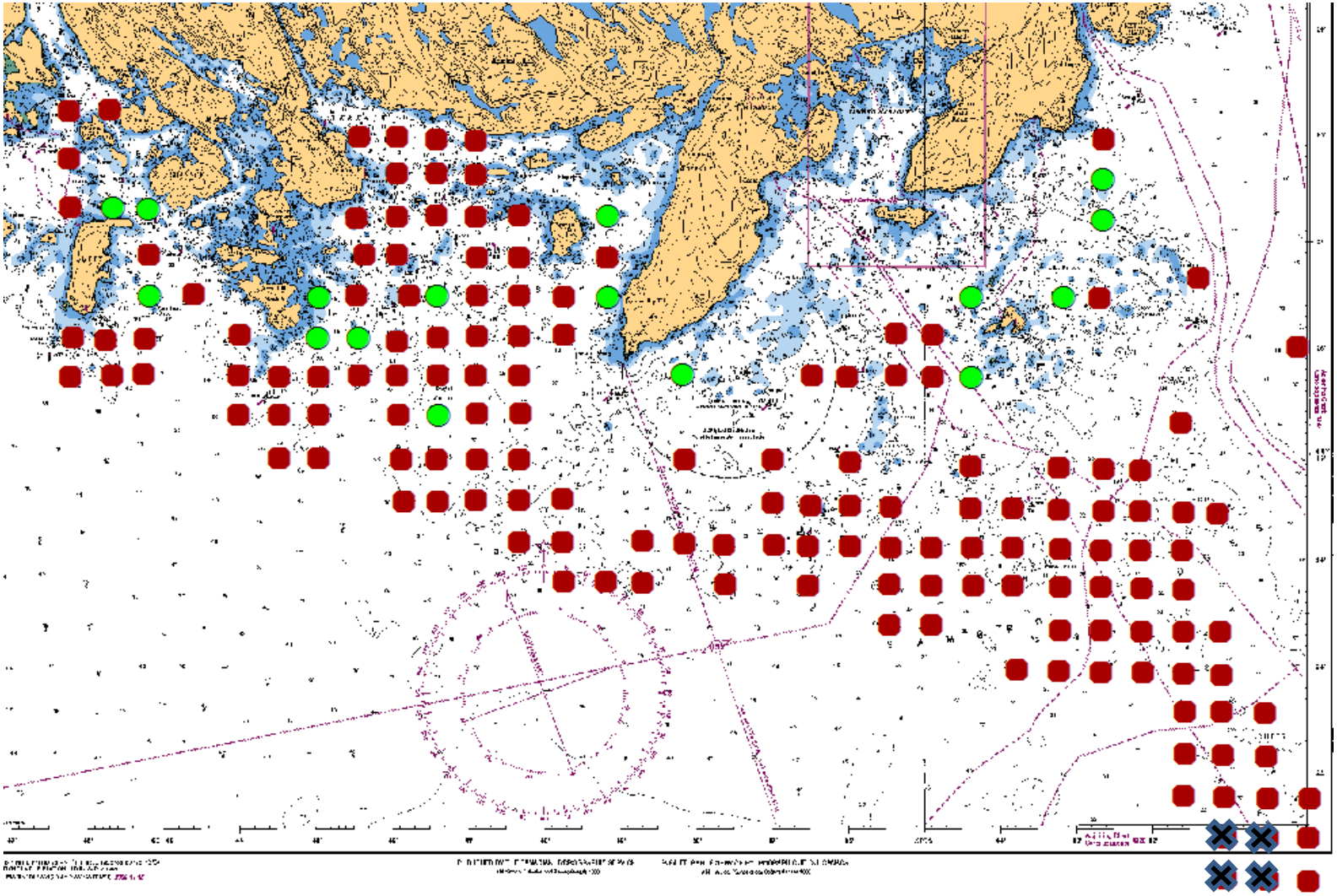

Figure 36: Drop camera locations with *Saccharina* seen in video (green circles; red squares=absent; X=no video).

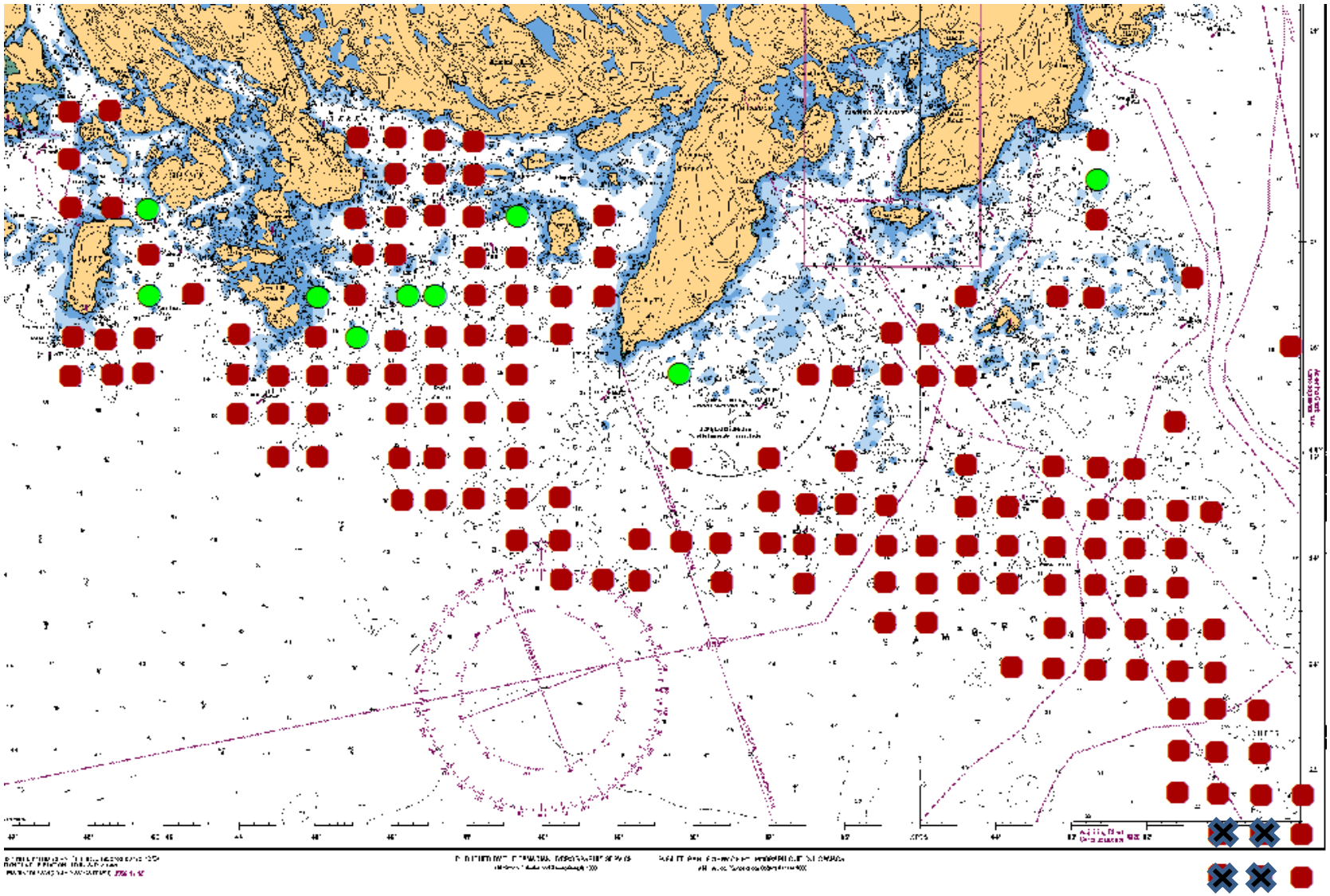

Figure 37: Drop camera locations with *Laminaria* seen in video (green circles; red squares=absent; X=no video).

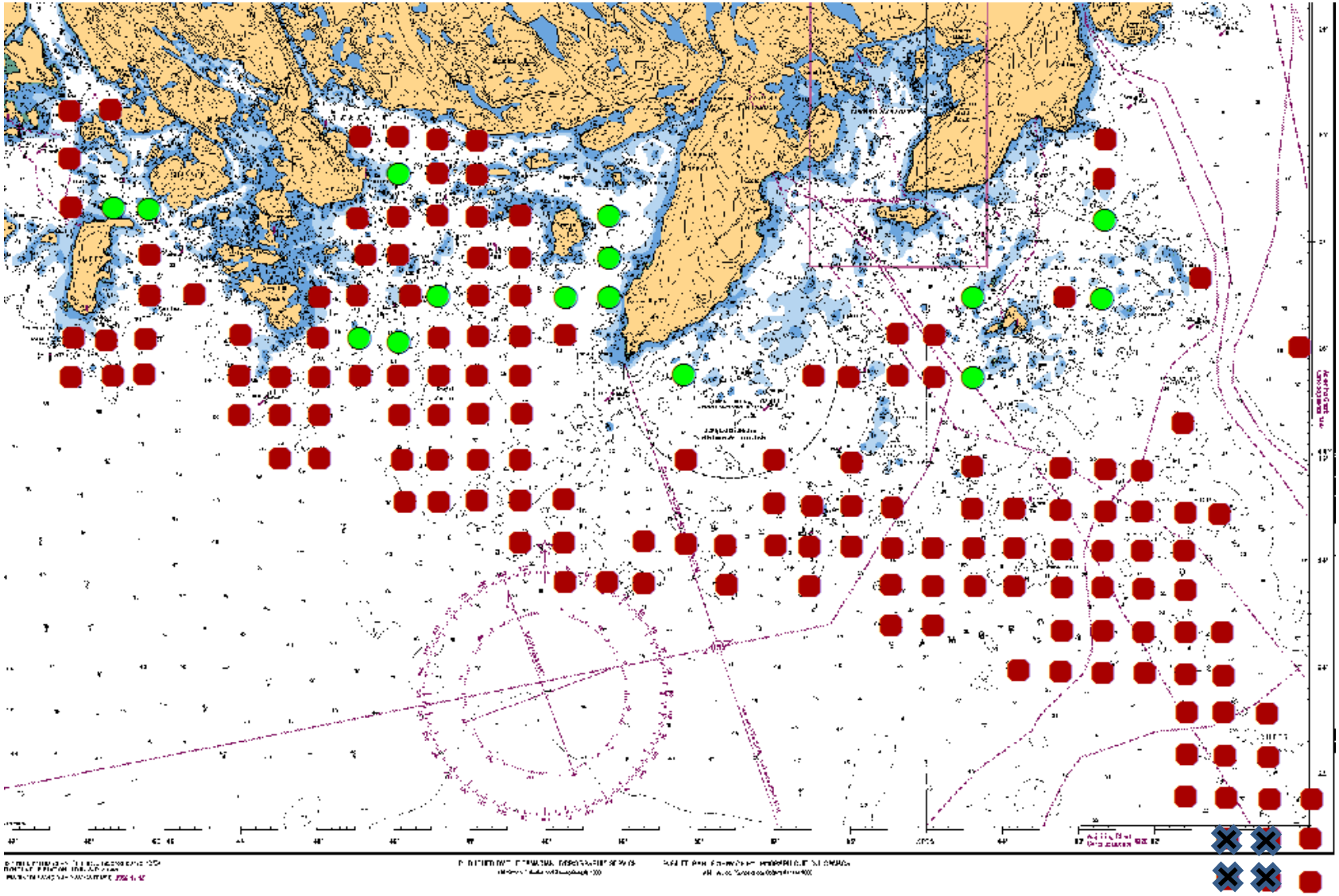

Figure 38: Drop camera locations with *Desmarestia* seen in video (green circles; red squares=absent; X=no video).

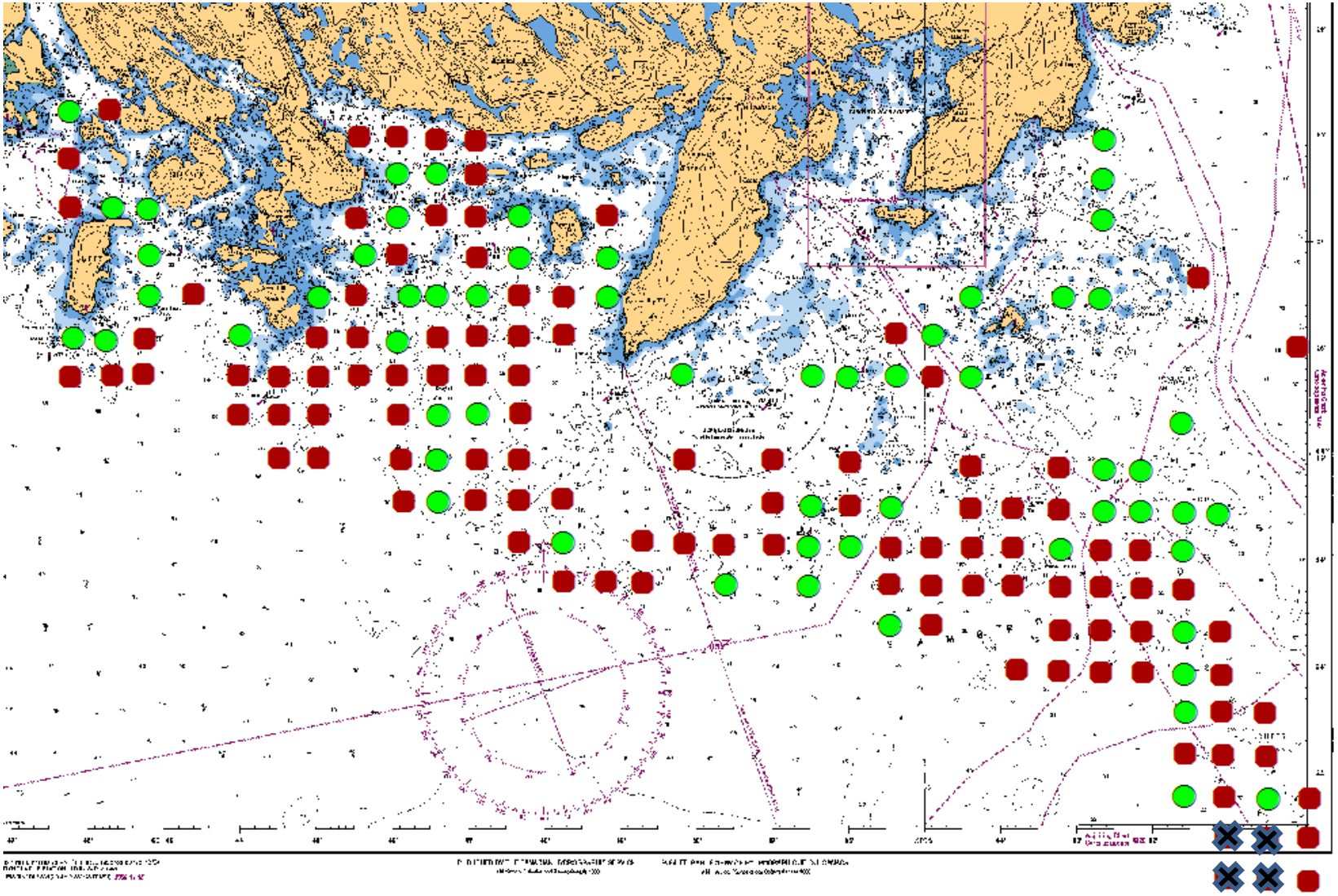

Figure 39: Drop camera locations with *Agarum* seen in video (green circles; red squares=absent; X=no video).

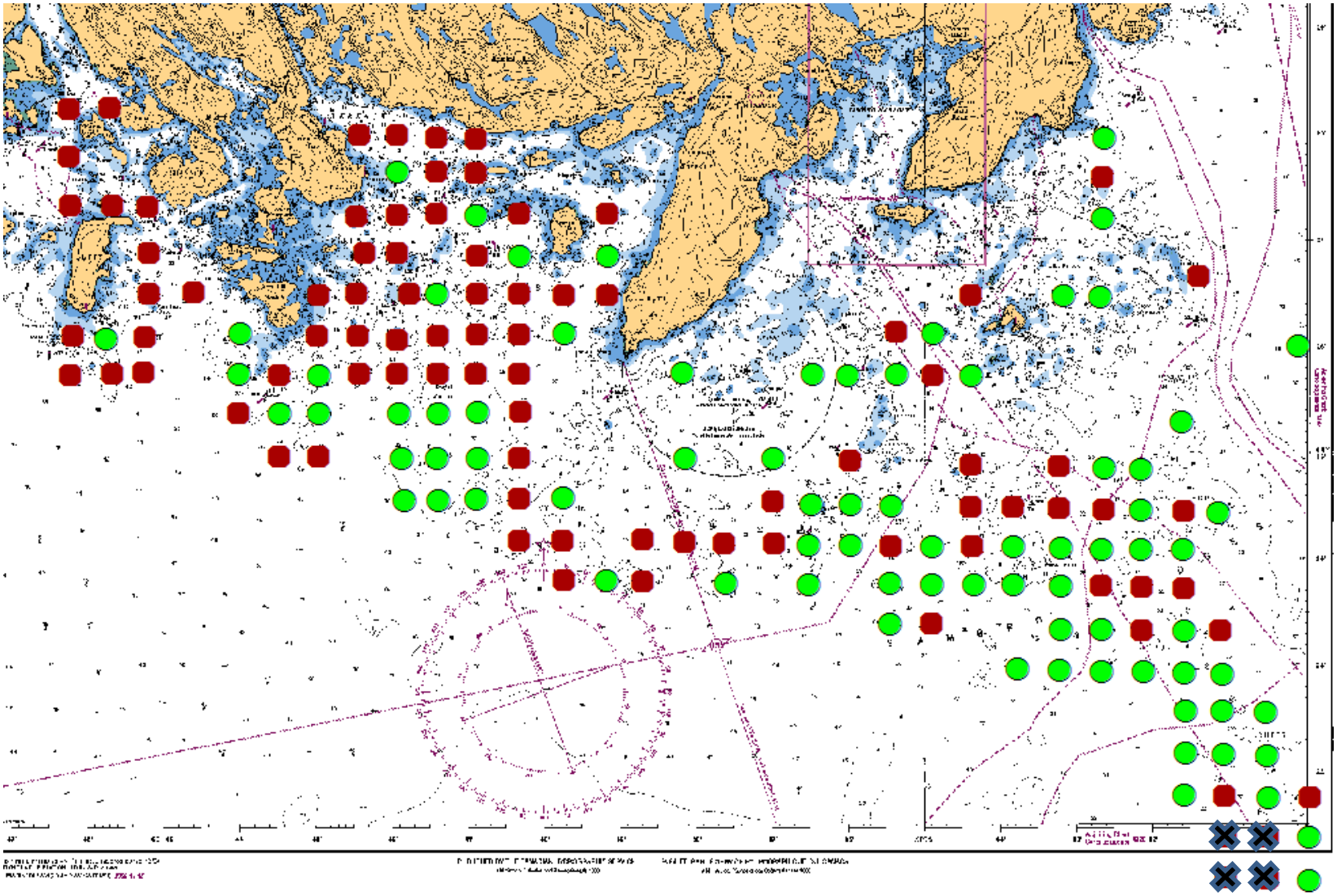

Figure 40: Drop camera locations with *Boltenia* seen in video (green circles; red squares=absent; X=no video).

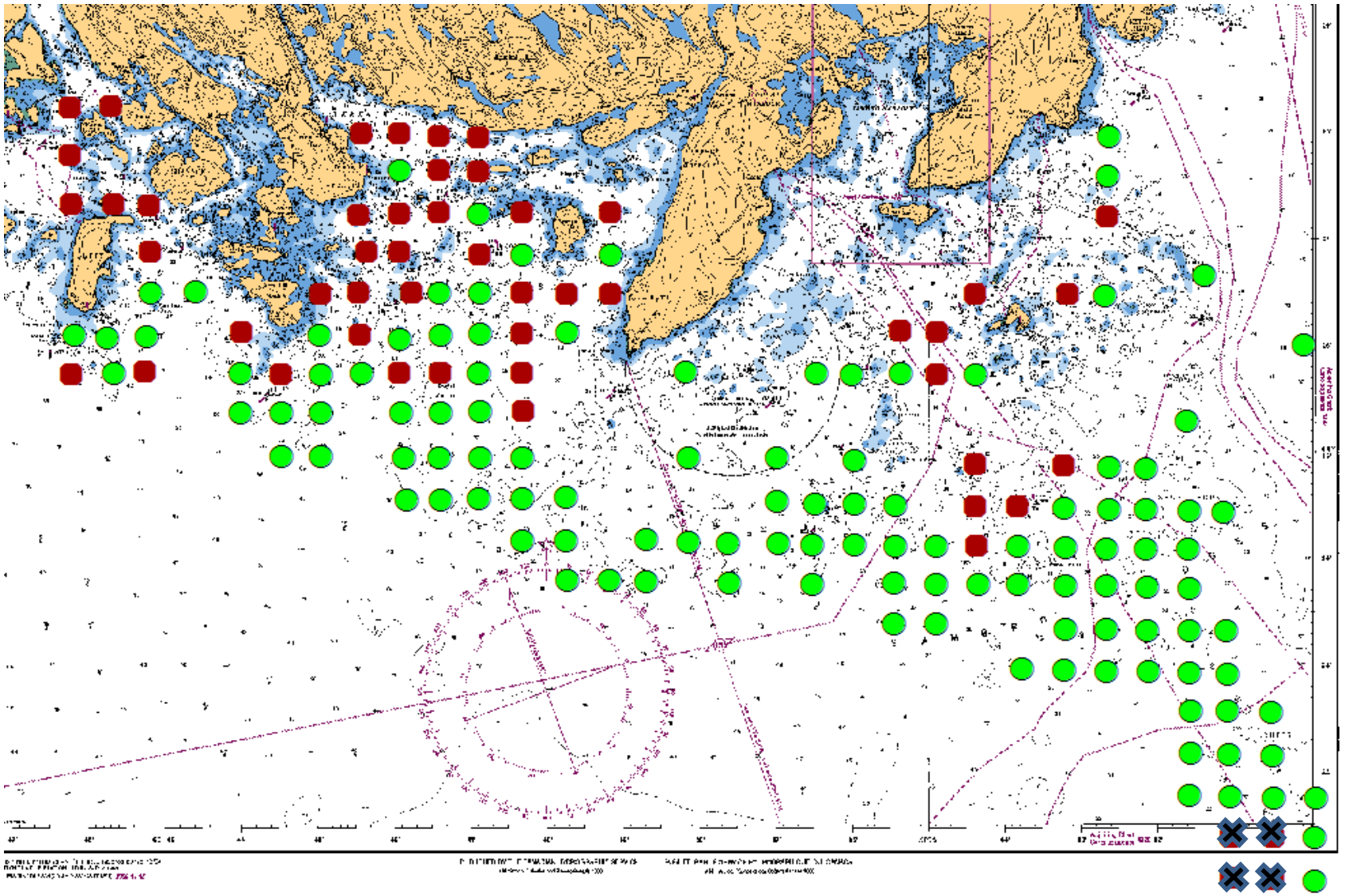

Figure 41: Drop camera locations with sponge seen in video (green circles; red squares=absent; X=no video).

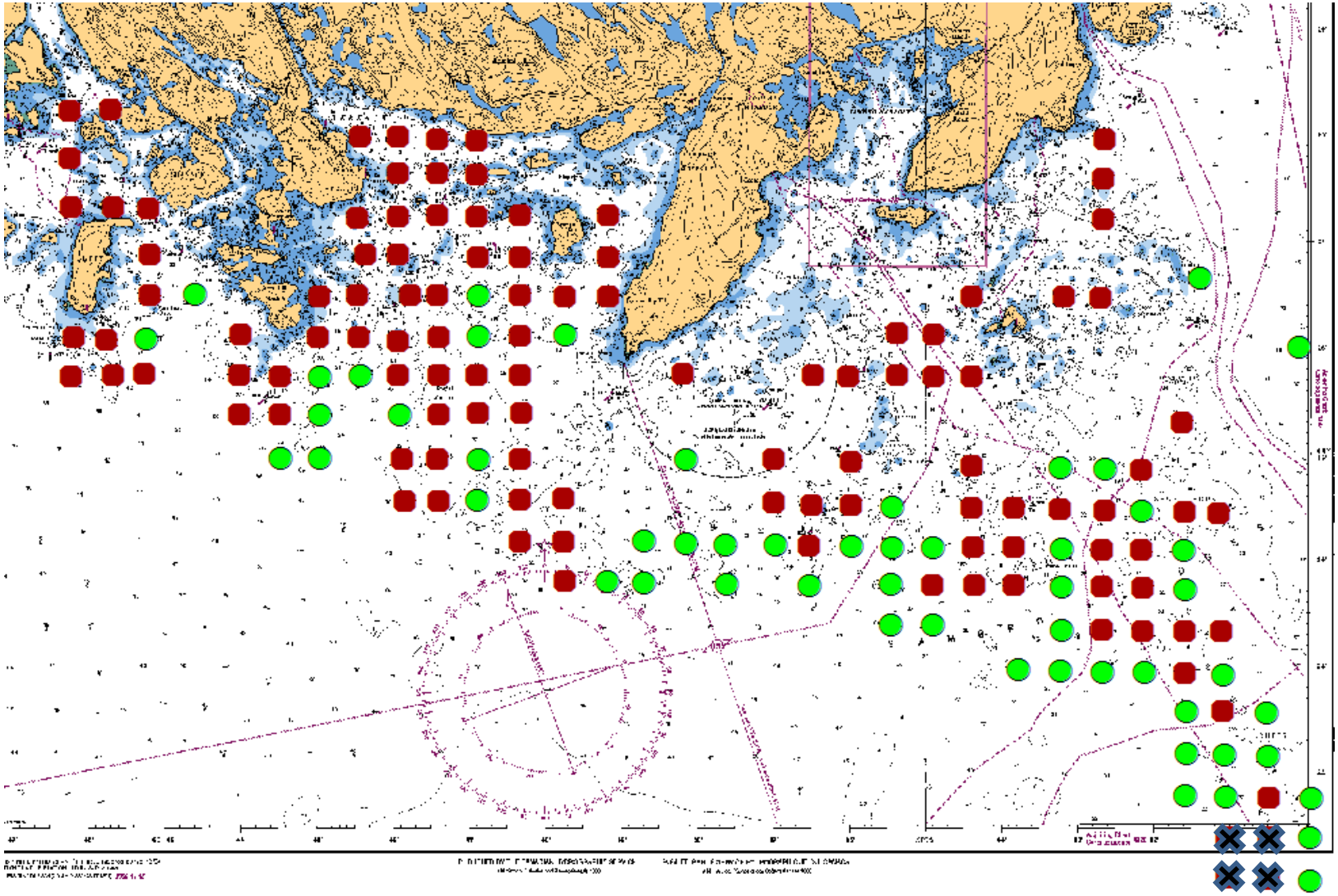

Figure 42: Drop camera locations with anemones seen in video (green circles; red squares=absent; X=no video).

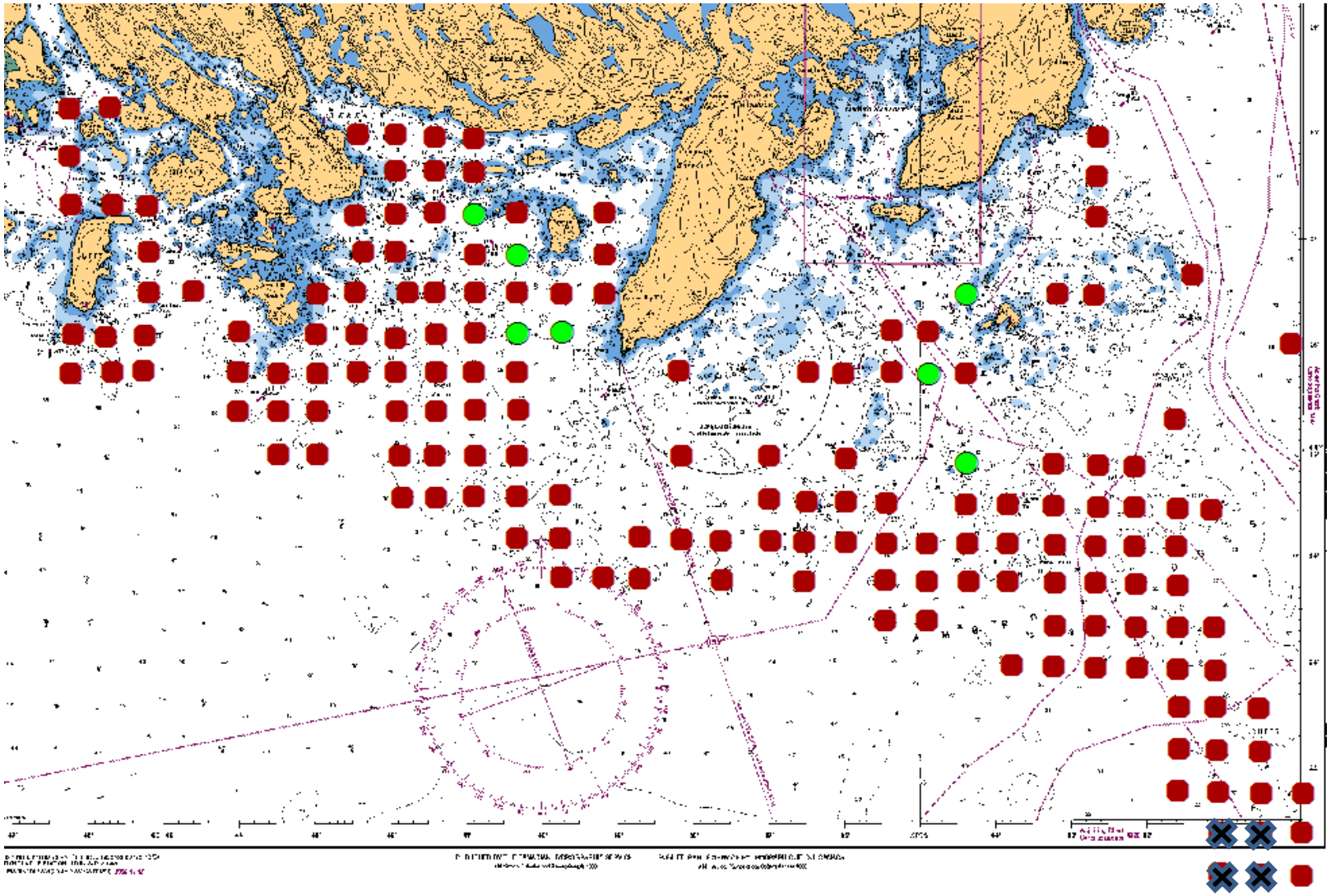

Figure 43: Drop camera locations with sand dollars seen in video (green circles; red squares=absent; X=no video).

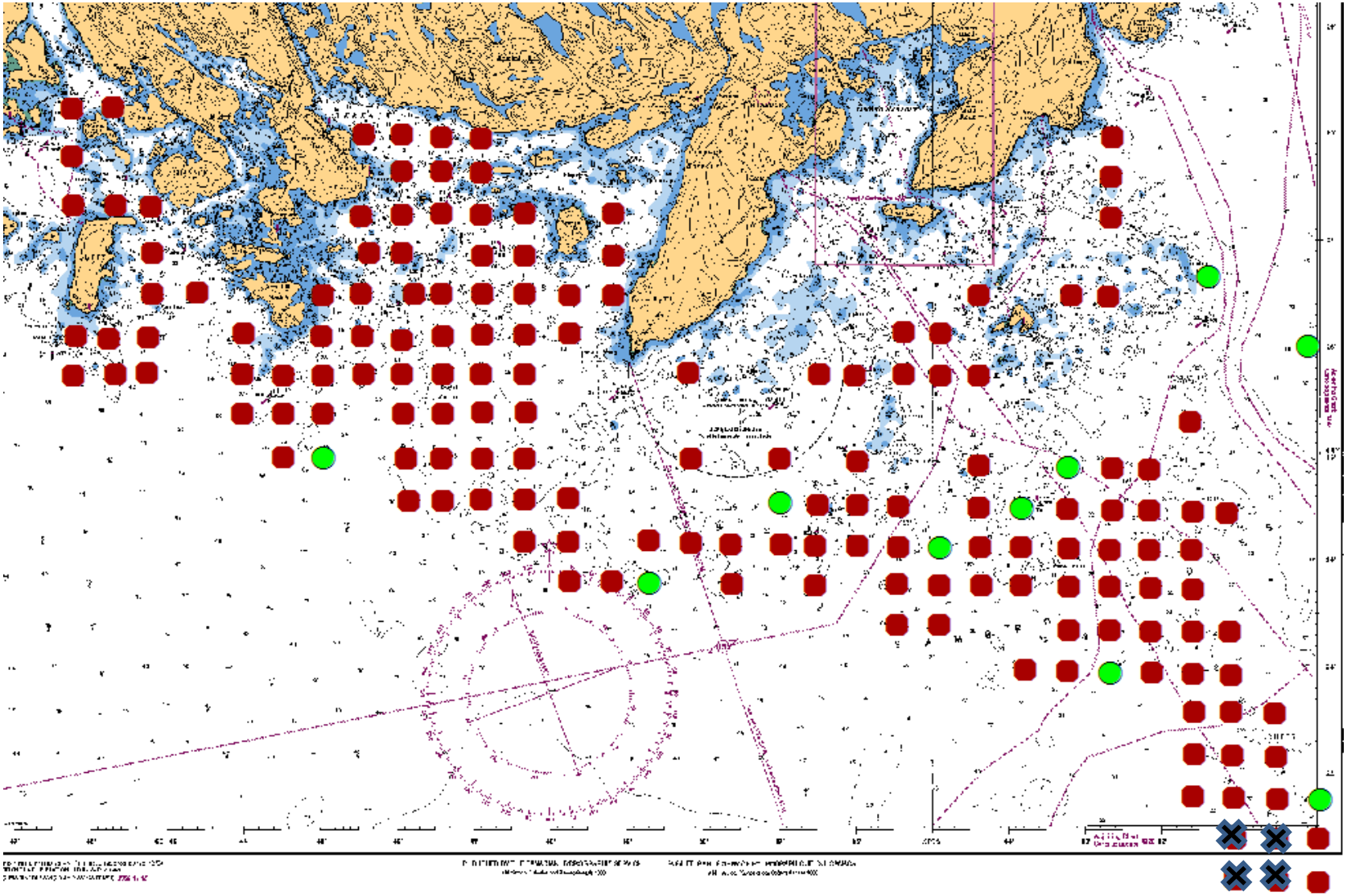

Figure 44: Drop camera locations with brittle stars seen in video (green circles; red squares=absent; X=no video).