

**San Juan Harbor Project, Puerto Rico: Quick Look Video Survey  
Report of the Benthic Communities of San Juan Bay Adjacent to  
Navigation Channels**

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## Introduction

A preliminary assessment utilizing underwater video was undertaken on January 30, 2016 to characterize the benthic communities adjacent to the federal designated navigation channels within San Juan Bay, Puerto Rico. This assessment will contribute to the knowledge base being compiled as part of the planning process undertaken by the Planning Division of the USACE District Office in Jacksonville, Florida for the future dredging project of San Juan Harbor. This underwater video survey concentrated in some of the areas of immediate interest compiled during the stakeholders meeting of November 4, 2015 celebrated in San Juan (see Appendix III).

## Methods

### Survey Vessel

A 19 feet long Carolina skiff with center console and an 115hp Yamaha four stroke engine was chartered from Bayside Fishing Charters located at San Juan Bay Marina. The vessel operator and two other persons made the survey crew. The survey was accomplished between 10:00 am and 12:00 noon.

### Sea State and Weather

The sky was cloudy, overcast and the wind was approximately 5-10 mph from the East and Northeast direction (see Appendix II). The seas were calm inside San Juan Harbor. Water visibility varied by location as seen in the images recorded but was not measured.

### Video

The video transects were accomplished with a GoPro Hero 3+ camera with underwater housing at an image size of 1920 x 1080 and 59.94 fps in MP4 format at ambient light levels. The camera was mounted on a 1/8" diameter by 50 ft. long nylon chord with plastic tie wraps. The chord had three 10 oz. triangle fishing weights tied at the bit end. The camera was mounted at 75 cm. from the weights. Once on station the video file was started and lowered over the side of the support vessel until reaching the bottom. The camera was then lifted slightly off the bottom to avoid impacts with the benthic community. The vessel would drift for a period

of time upon which the camera was returned to the surface and the video file was stopped. The procedure would repeat itself at each of the 16 stations sampled.

### GPS and Depth

A Garmin 76 Cx portable GPS was used to record the vessel track at all times during the video transects. A written log was maintained that provided the station number, time of video in and out and any other notes pertinent to the operation. The GPS time was used to synchronize all the written log notes. A Speedtech Instruments handheld fathometer was used to check the depth along the video transect and recorded on the log in feet.

### Video Post Processing

All video files recorded were transferred from the camera to an Asus Sonic Master laptop PC with a W8 operating system utilizing a micro USB to USB cable. The video files were viewed utilizing GoPro Studio software. The files were studied to determine benthic substrate type and identification of macro invertebrates and fish species. With files that exhibited very turbid imagery, individual frames from such files that exhibited benthic information were copied for further processing. These copied files were saved as .JPEG or .PNG format. The software program GIMP v 2.8 was utilized to change the brightness and contrast of the .JPEG or .PNG format files.

### Fish Species Identification

Humann (2002) was used to confirm fish identifications.

## Results

A total of 28.5 minutes of underwater video footage was collected at 13 stations located in San Juan and Puerto Nuevo bays. The video files size totals 6.311GB. Video station locations are depicted in Figures 1 and 2 and all position and time data is summarized in Table 1. Once the videos were reviewed, still frame composites or single images were selected which represent the benthic substrates of some of the stations sampled. Figures 3 to 12 depict these environments. A summary of the benthic substrates are presented in Table 2 and Appendix I.

The San Juan and Puerto Nuevo bays have turbid water conditions and the report photos are witness to this. At the San Juan Bay entrance by video station 211 and

navigation buoy “G3” the video audio recorded the constant buoy anchor chain noise caused by the sea wave motion. Video stations 210 and 211 exhibited the best water transparency conditions of the entire survey. The worst turbidity was at video stations 215 and 216.

Only specimens of zoanthid colonies were identified at video station 211 and no scleractinian corals could be detected at any of the stations sampled although limestone hard bottom was found. This does not mean that they are not present. It is likely that they occur at the entrance of San Juan Harbor seaward of video stations 210 and 211.

Two species of Seagrass were identified; *Halophila decipiens* and *Thalassia testudinum*. A small clump of *Thalassia* was present at video station 213 and *Halophila* was present at video station 216.

A total of 22 fishes were identified, including very small fish. The list of the species found is in Table 2. Most of the fish were found at video station 210 with a total of fourteen fish. Video station 209 followed in abundance with four fish. The most abundant species was the Lane snapper (*Lutjanus synagris*). Of particular interest was the identification of juvenile hogfish (*Lachnolaimus maximus*).

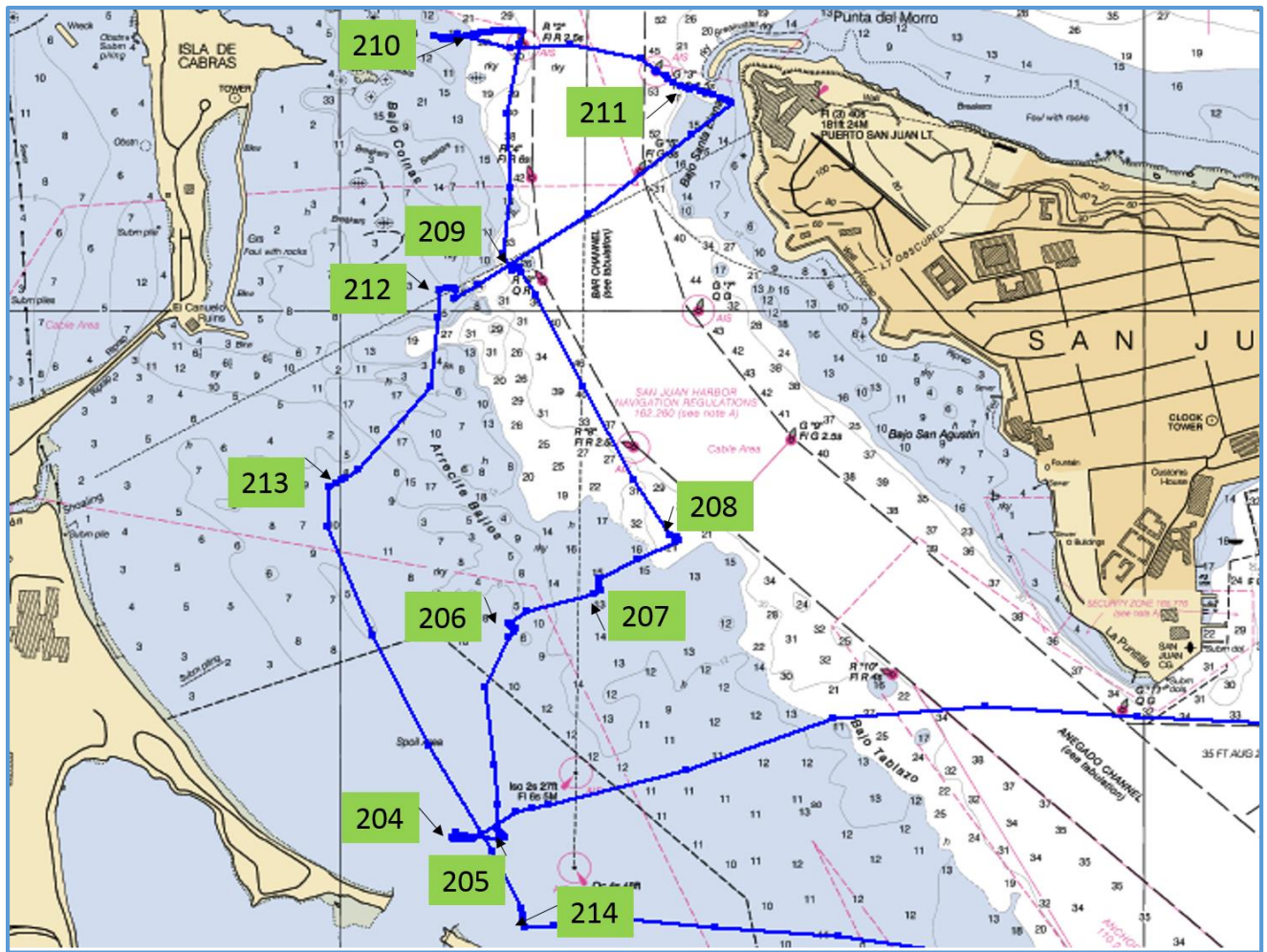


Figure 1. San Juan Bay video station location and vessel track (blue). NOAA Chart 25670\_1, 1:10,000 scale.

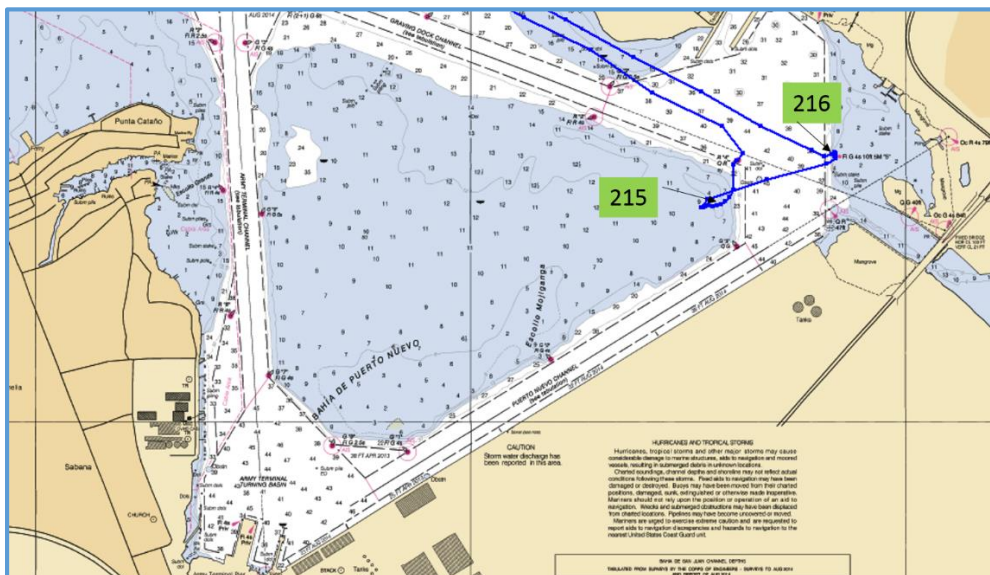


Figure 2. Puerto Nuevo Bay video station and vessel track (blue).

Table 1. San Juan Bay video transects survey position log for January 30, 2016. Latitude is north and Longitude is west and provided in degrees and decimal degrees. GPS time in hours/minutes/seconds. GoPro video time in hour/minutes/seconds/hundreds of seconds. GPS – GoPro time differential is in minutes/hundreds of minutes.

<u>Video file #</u>	<u>Depth (ft.)</u>	<u>GPS Time In</u>	<u>GPS Time Out</u>	<u>GoPro - GPS Time Diff (M.m)</u>	<u>GoPro Time Begin</u>	<u>GoPro Time End</u>	<u>GoPro Elapsed Time</u>	<u>Lat In (D.d)</u>	<u>Lon In (D.d)</u>	<u>Lat Out (D.d)</u>	<u>Lon Out (D.d)</u>
204	12	10:17:14	10:19:36	-3.54	10:20:46:31	10:23:09:08	2m 22:37s	18.4557	66.1307	18.4557	66.1310
205	17	10:21:27	10:22:23	-3.54	10:24:59:04	10:26:56:08	1m 57:04s	18.4558	66.1300	18.4558	66.1300
206	12	10:26:12	10:28:17	-3.54	10:29:45:05	10:31:50:06	2m04:55s	18.4600	66.1297	18.4602	66.1298
207	23	10:29:36	10:30:48	-3.66	10:33:15:37	10:34:28:14	1m 12:37s	18.4609	66.1279	18.4610	66.1280
208	29	10:32:40	10:34:06	-3.50	10:36:09:52	10:37:35:55	1m 26:03s	18.4619	66.1263	18.4620	66.1264
209	36	10:36:25	10:39:16	-3.62	10:40:02:24	10:42:53:42	2m 51:18s	18.4675	66.1296	18.4675	66.1298
210	30	10:42:07	10:49:43	-3.39	10:45:29:37	10:53:05:46	7m 36:09s	18.4725	66.1296	18.4724	66.1314
210	23	10:47:53						18.4723	66.1308		
210	17	10:49:00						18.4667	66.1167	18.4723	66.1312
211	54	10:53:10	11:00:07	-3.66	10:56:45:47	11:03:42:48	6m 57:01s	18.4715	66.1266	18.4710	66.1252
211	53	10:54:14						18.4714	66.1264		
211	20	10:55:04						18.4713	66.1262		
211	19	10:56:10						18.4713	66.1260		
211	22	10:57:15						18.4712	66.1258		
211	16	10:59:25						18.4667	66.1167	18.4710	66.1253
212	7	11:03:21	11:04:25	-3.55	11:06:54:12	11:07:58:34	1m 04:22s	18.4671	66.1310	18.4671	66.1311
213	13	11:06:35	11:07:54	-3.68	11:10:10:51	11:11:30:17	1m 19:26s	18.4632	66.1332	18.4631	66.1334
214	8	11:10:58	11:12:15	-3.50	11:14:28:09	11:15:44:54	1m 16:45s	18.4541	66.1295	18.4539	66.1295
215	19	11:22:54	Failed	-3.36	11:26:21:48	11:30:14:11	3m 52:23s	18.4414	66.0902		
215	8	11:24:41	Failed					18.4412	66.0907		
215	9	11:25:30	11:29:22		11:26:21:48	11:30:14:11	3m 52:23s	18.4412	66.0910	18.4431	66.0860
216	5	11:28:54	11:30:23	-3.50	11:32:27:19	11:33:56:01	1m 28:42s	18.4431	66.0860	18.4432	66.0860



Table 2. Bottom substrate type for each video transect in San Juan Bay for January 30, 2016. See Appendix I for algae list reported for these sites.

<b>Video file #</b>	<b>Substrate</b>	<b>Fish species present and number of fish</b>
204	Very turbid. Most likely muddy sand	None seen
205	Turbid. Most likely muddy sand	None seen
206	Algae clumps over limestone	<i>Chaetodon striatus</i> (1), <i>Anisotremus virginicus</i> (1)
207	Sandy	None seen
208	Sandy	None seen
209	Algae patch on limestone rock, sand	<i>Lutjanus synagris</i> (4)
210	Algae in clumps over limestone, <i>Diadema antillarum</i>	<i>Thalassoma bifasciatum</i> (3), <i>Ocyurus chrysurus</i> (3), <i>Haemulon sciurus</i> (2), <i>Acanthurus bahianus</i> (1), <i>Lachnolaimus maximus</i> (2), <i>Caranx ruber</i> (1), <i>Abudefduf saxatilis</i> (2)
211	Algae over limestone, <i>Palythoa caribbeorum</i>	<i>Sphyrna barracuda</i> (2)
212	Algae over limestone	None seen
213	Algae clumps over sand, <i>Thalassia</i>	None seen
214	Very turbid. Most likely sand	None seen
215	Very turbid. Muddy.	None seen
216	Very turbid. Mud with <i>Halophila</i>	None seen

Table 3. Video file size.

<b>Video file #</b>	<b>File size (MB)</b>
204	428
205	349
206	375
207	218
208	259
209	505
210	1,330
211	1,220
212	194
213	239
214	231
215	697
216	266
<b>Total</b>	<b>6,311</b>



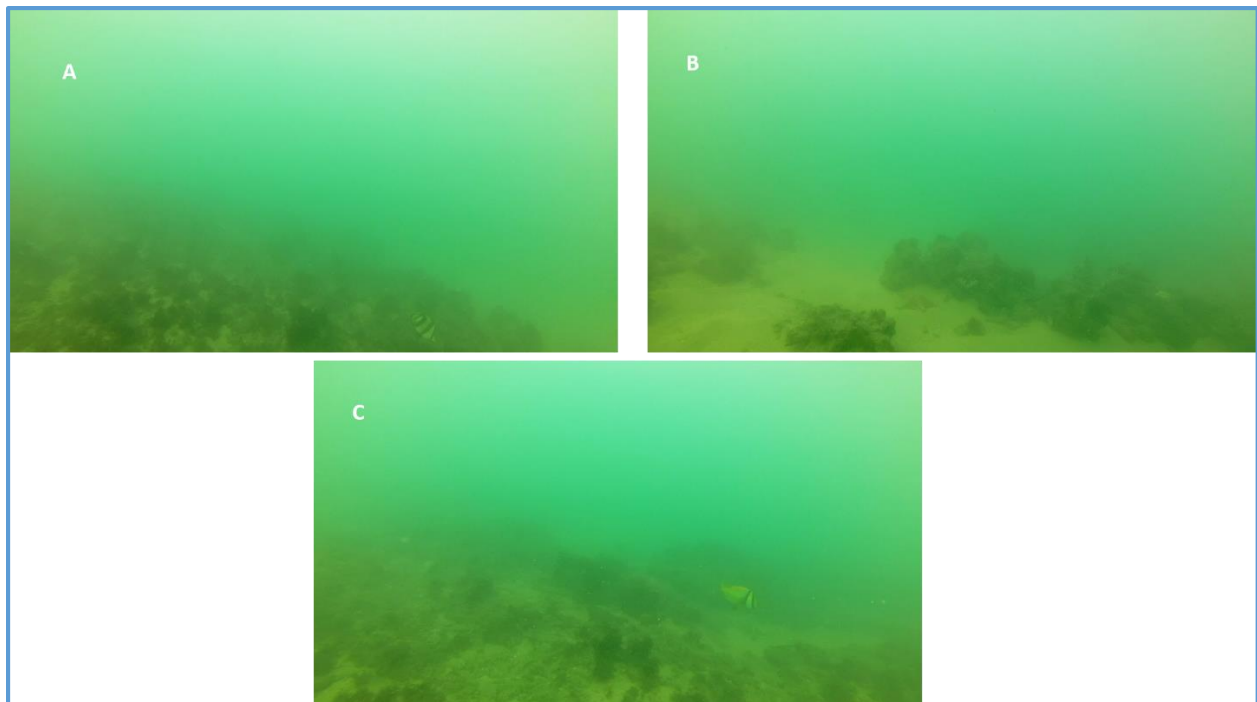


Figure 3. Photos from video transect 206 on Jan. 30, 2016. Depth is 12 ft., turbid. A and B. Algae clumps over limestone and patches of muddy sand. A. The banded butterfly fish (*Chaetodon striatus*) and C. The pork fish (*Anisotremus virginicus*).

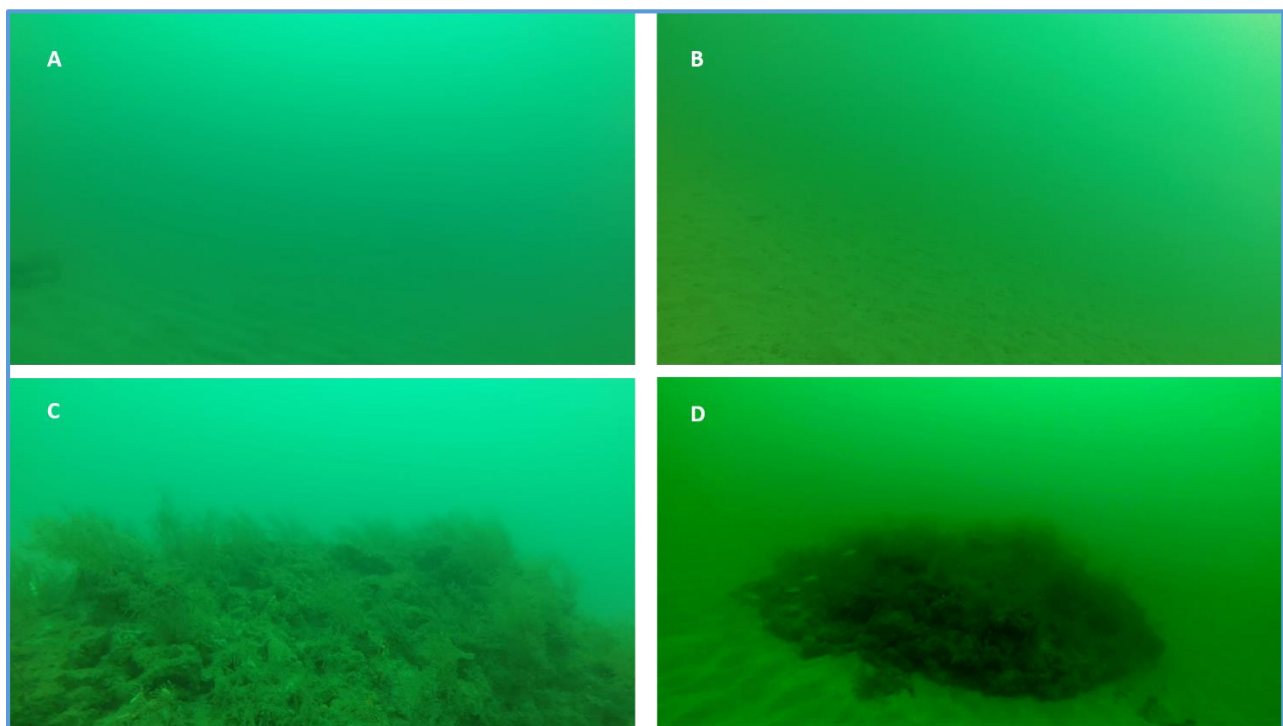


Figure 4. Photos from video transect 209 on January 30, 2016. A and B. Sand. C and D. Algae patch on limestone rock surrounded by sand. Four fish likely to be *Lutjanus synagris* (Lane snapper).

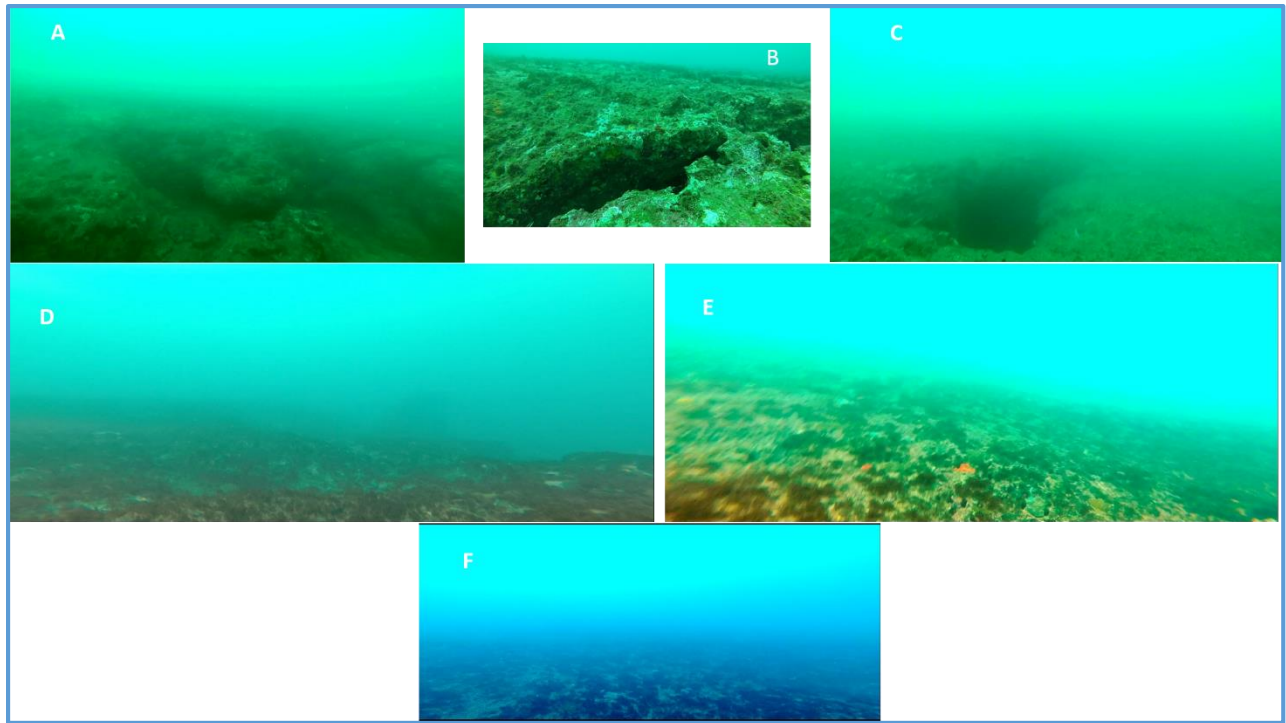


Figure 5. Photos from video transect 210 on Jan. 30, 2016. A, B and C. Limestone ledges and crevices at approximately 17 to 30 ft. depth. These crevices and ledges are inhabited by *Diadema antillarum*, *Thalassoma bifasciatum*, algae and sponges. D, E and F. Algae over limestone substrate.

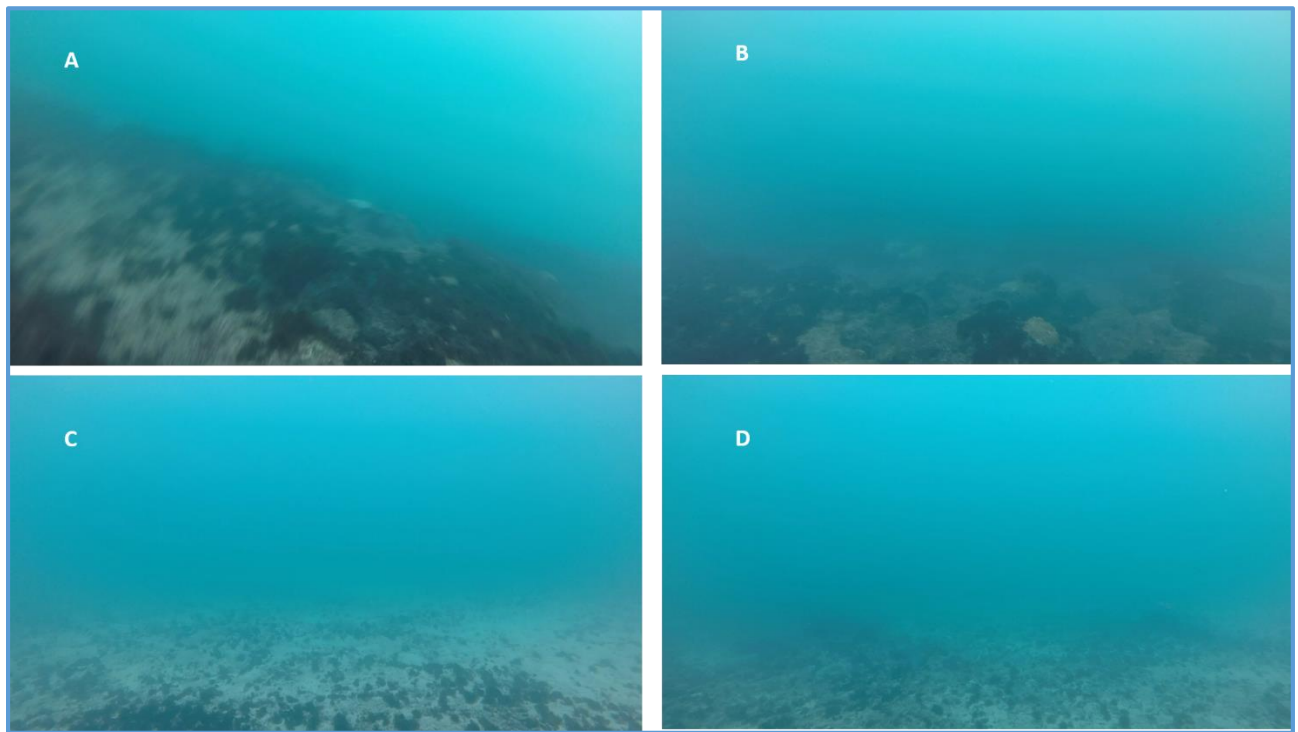


Figure 6. Photos from video transect 211 on Jan. 30, 2016. Depth of 53-54 ft. A thru D. Algae clumps over limestone and some sand. B. *Palythoa caribbearum*.



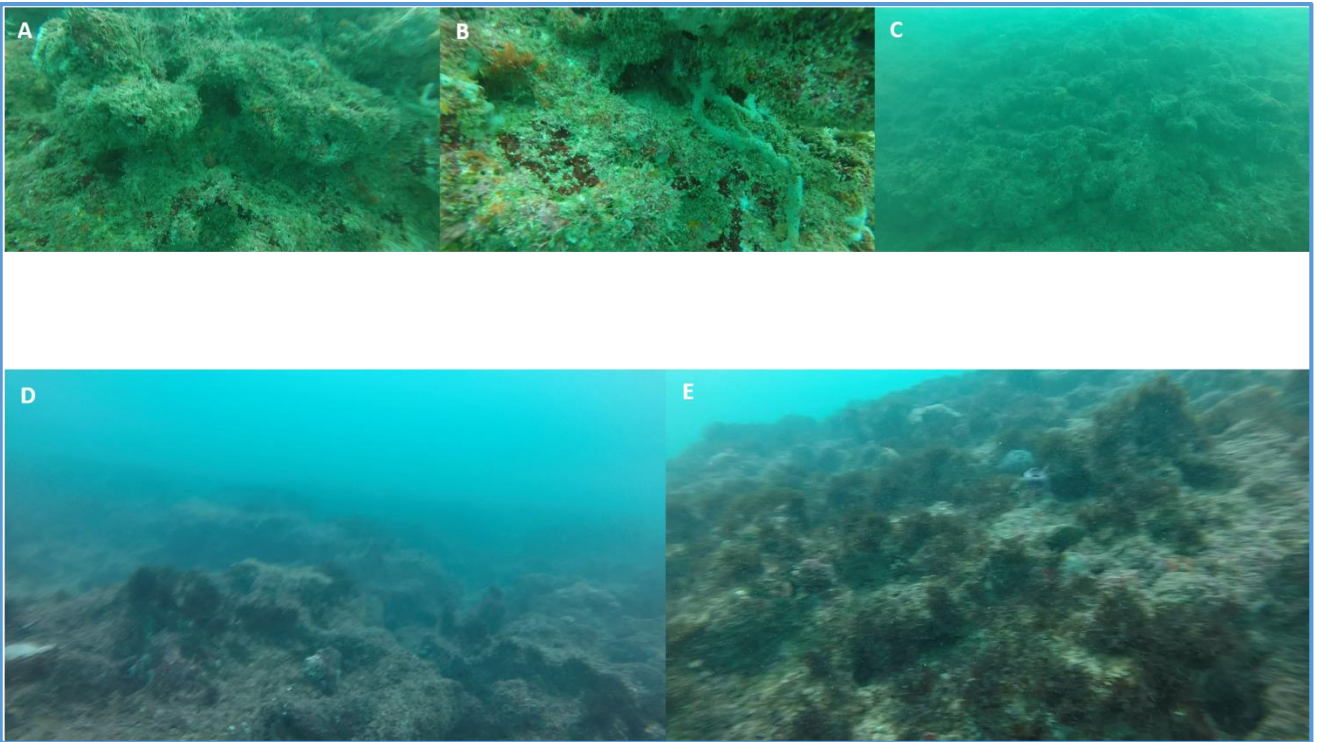


Figure 7. Photos from video transect 211 on Jan. 30, 2016. Depth 16-22 ft. A thru E. Algae and other invertebrates such as sponges over limestone.

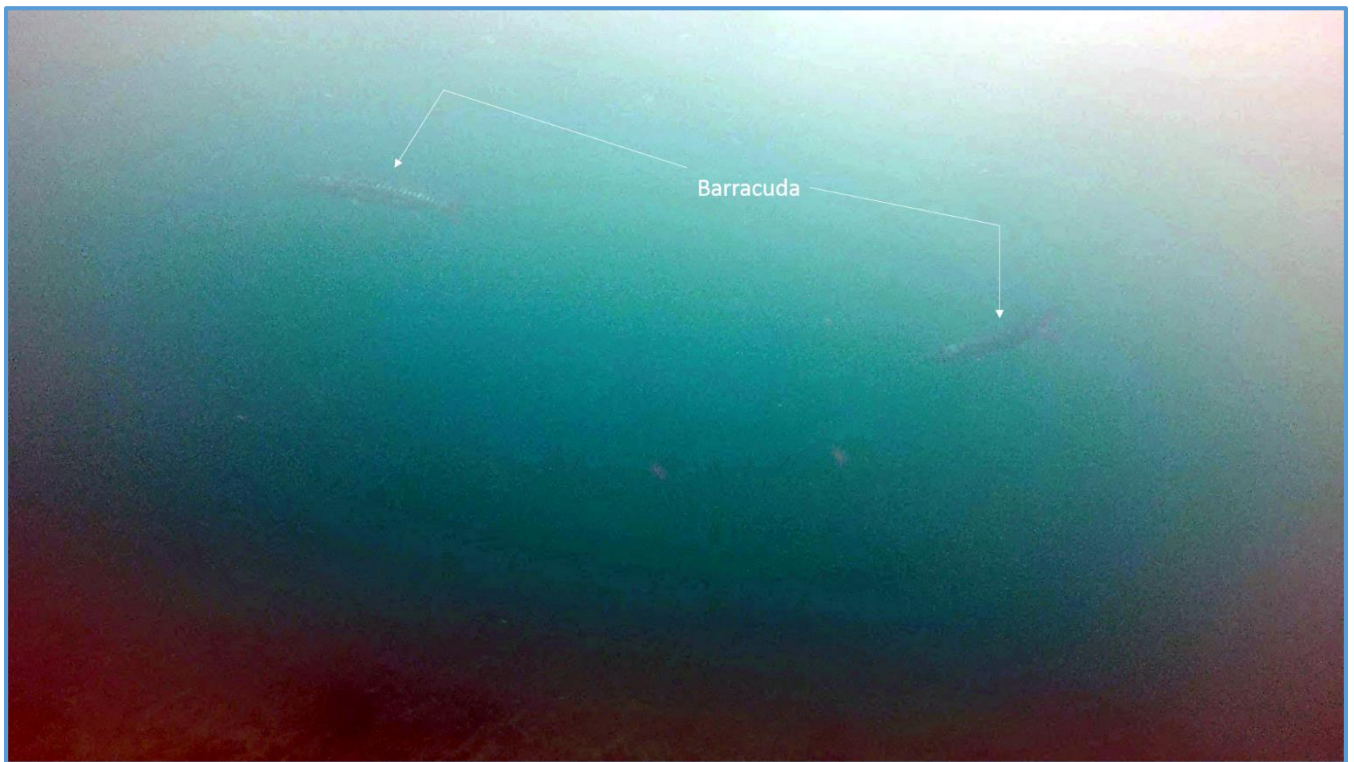


Figure 8. Photos from video transect 211 on Jan. 30, 2016. Two barracudas (*Sphyraena barracuda*) close to the bottom.

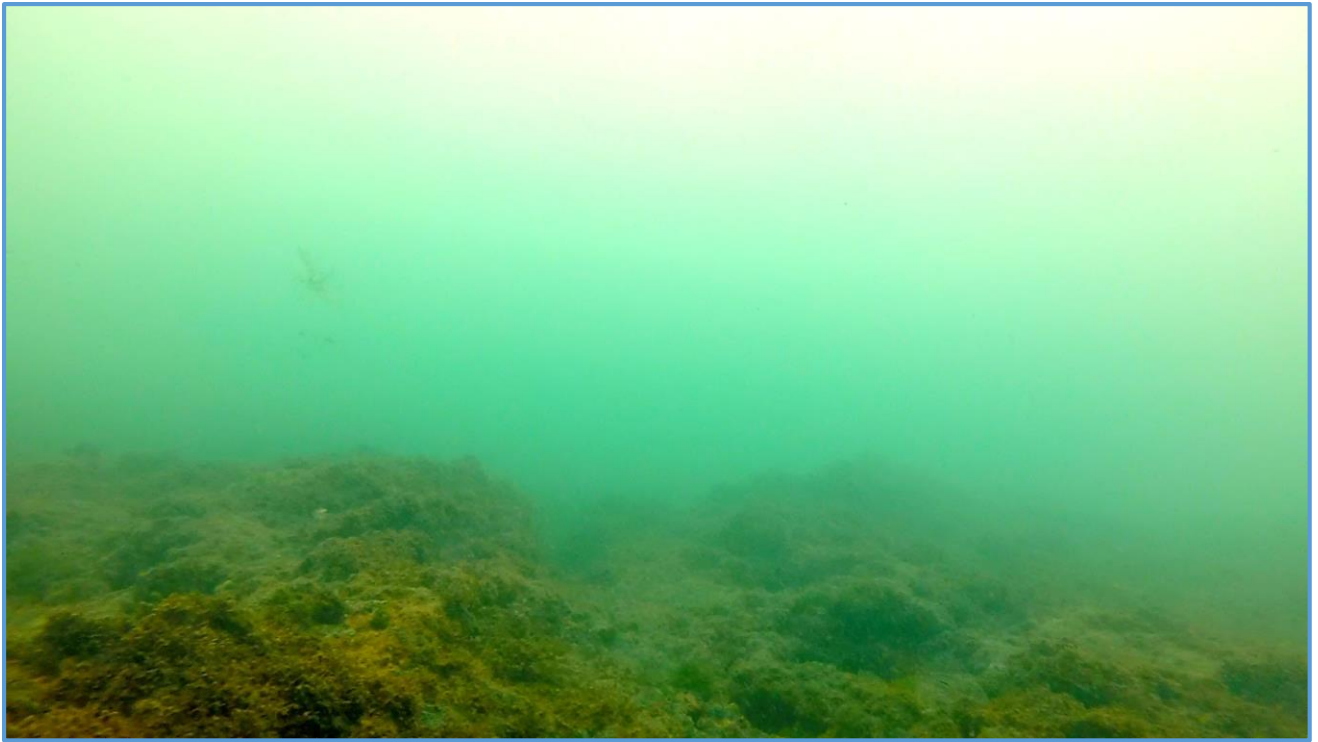


Figure 9. Photo from video transect 212 on Jan. 30, 2016. Depth is 7 ft. Brown algae over limestone.

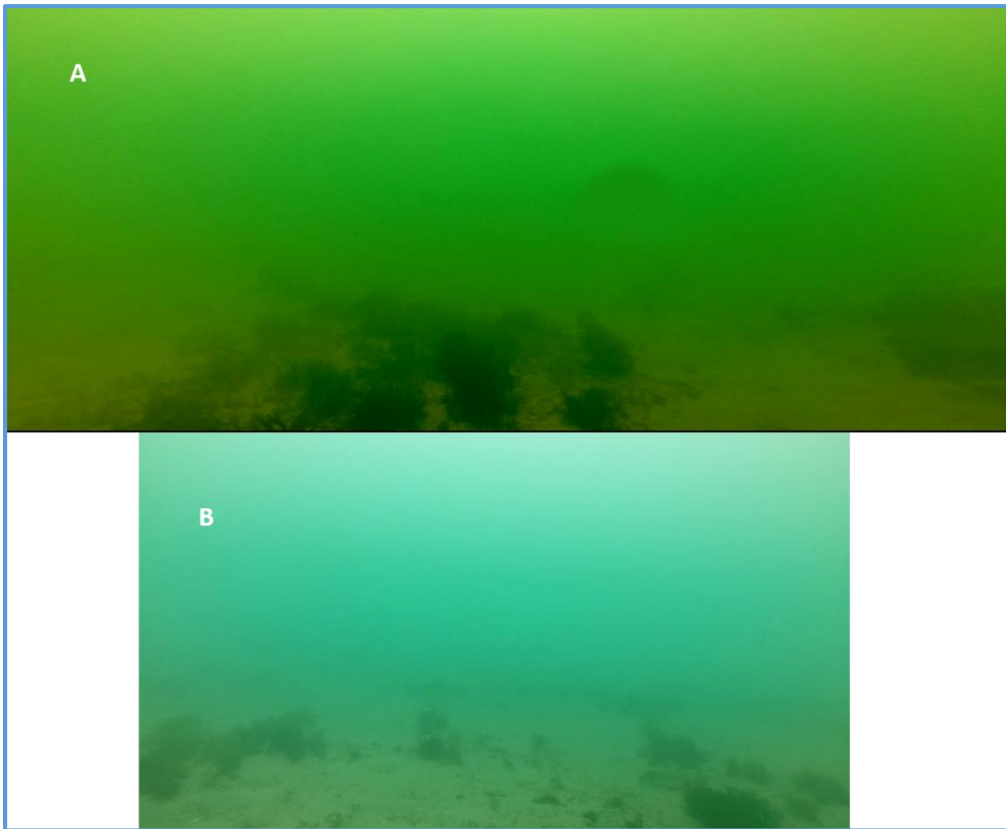


Figure 10. Photos from video transect 213 on Jan. 30, 2016. Depth is 13 ft. A and B. Algae clumps over sand. Turbid.



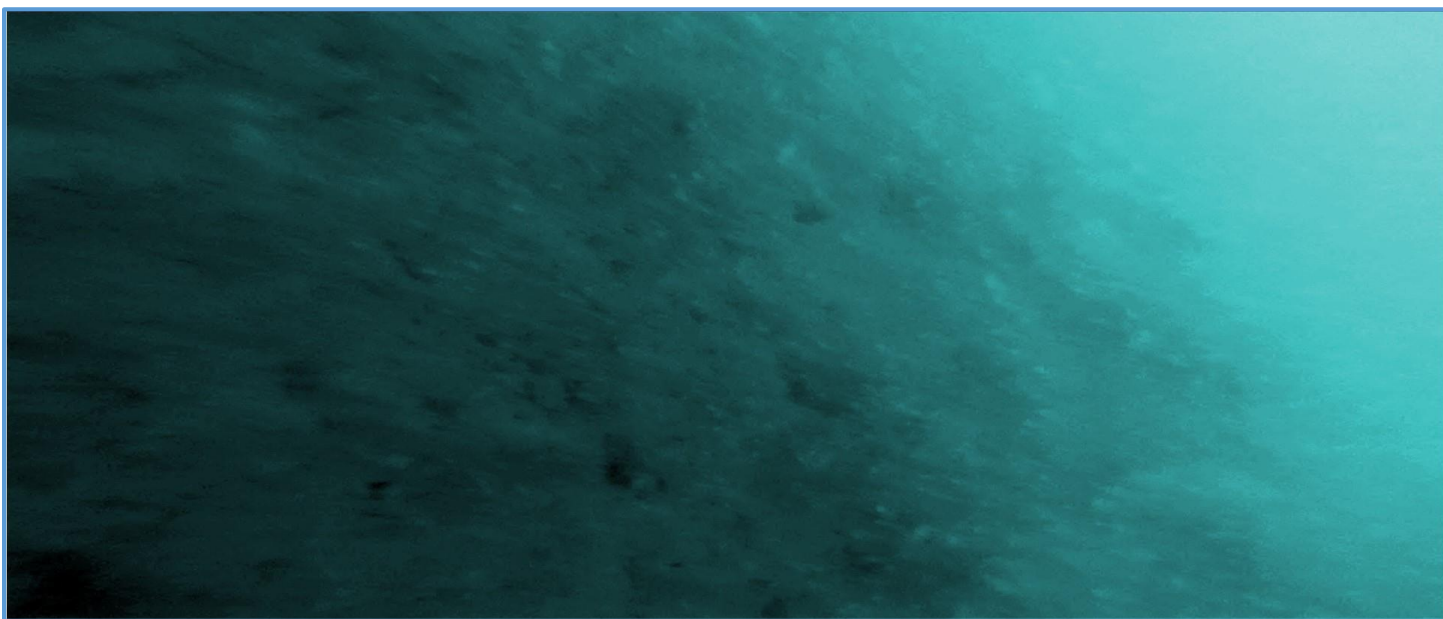


Figure 11. Photo from video transect 215 on Jan. 30, 2016. Mud substrate. Depth is 8-9 ft. Turbid.



Figure 12. Photo from video transect 216 on Jan. 30, 2016. Seagrass species *Halophila decipiens* with fruit on mud substrate. Depth is 5 ft. Very turbid.

## References

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- NOAA, 2005. Chart # 25670, San Juan Bay Harbor Chart at 1:10,000 scale, Puerto Rico. Digital raster file.
- NOAA Tides 2016. <https://tideandcurrents.noaa.gov>
- Zimmerman, R., P. M. Yoshioka, V. P. Vicente, J. G. Gonzalez and J. M. López (1980). Eutrophic Production of Benthic Algae and Power Plant Cooling-Water Intake Clogging in Boca Vieja Bay. Report to the Puerto Rico Electric Power Authority. Center for Energy and Environment Research, Marine Ecology Division, University of Puerto Rico at Mayaguez. 113 pp.

## Appendix I. Zimmerman, *et al*, 1980 substrate data.

Benthic substrate in Western San Juan Bay compiled from Fig. 12 in Zimmerman, *et al*, 1980. Geographic position in degrees and decimal degrees.

Station	Latitude N	Longitude W	Bottom substrate
1	18.460628	66.132743	Sand
2	18.461763	66.133646	Sand/Rubble
3	18.462841	66.13413	Sand/Shell
4	18.463709	66.134756	Rubble
5	18.464494	66.135359	Shell/Sand
6	18.46588	66.136226	Sand
7	18.464448	66.13793	Sand
8	18.463359	66.136526	Sand/Shell
9	18.462248	66.135205	Sand/Shell
10	18.460249	66.135308	Rock
11	18.459033	66.134089	Sand
12	18.457278	66.132628	Sand
13	18.456479	66.131293	Mud/Rock
14	18.459203	66.131582	Sand/Shell
15	18.460823	66.129756	Sand
16	18.462977	66.130828	Rubble
17	18.463736	66.131954	Rubble
18	18.465411	66.132973	Rubble
19	18.466208	66.13458	Sand/Rubble
20	18.459986	66.136703	Sand/Shell
21	18.462081	66.137397	Sand/Rock
22	18.463618	66.137682	Sand/Shell
23	18.458413	66.135811	Sand/Shell
24	18.458953	66.129464	Rubble



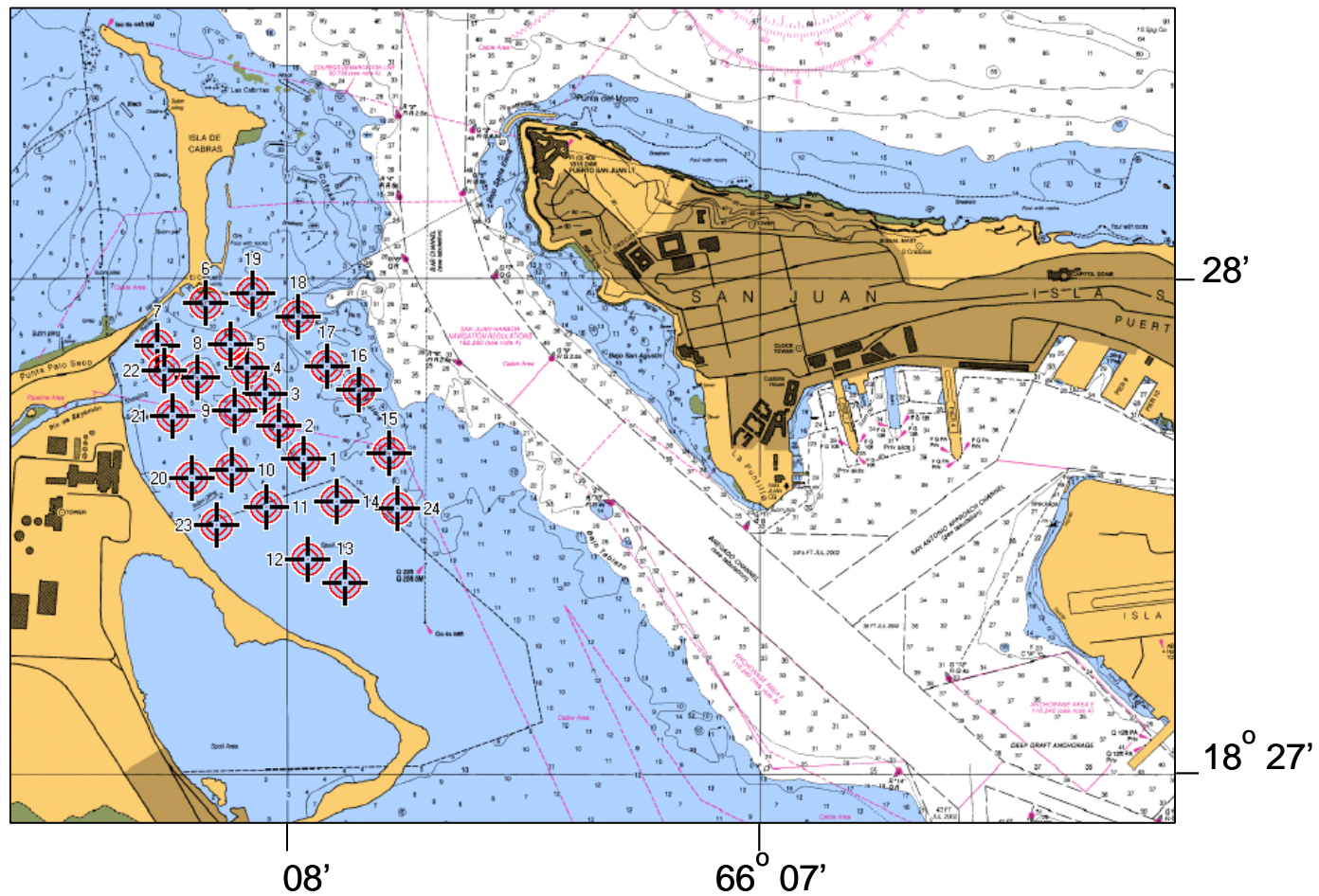


Figure 17. Substrate type station locations for Western San Juan Bay from Zimmerman, et al, 1980.

Table 12. Algae list from Zimmerman, et al, 1980:

DATA: TABLE 16

## DRIFT ALGAE BIOMASS IN WESTERN SAN JUAN BAY

STATION	DOMINANT SPECIES (90% biomass)	KILOGRAMS	AREA (m <sup>2</sup> )	Kg/m <sup>2</sup>
1	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i>	0.11	37	0.003
2	<i>Spyridia filamentosa</i> <i>Bryopsis pennata</i> <i>Caulerpa mexicana</i> <i>Gracilaria domingensis</i>	1.58	37	0.04
3	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i> <i>Spyridia filamentosa</i>	1.02	37	0.03
4	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i> <i>Ulva fasciata</i>	2.04	37	0.05
5	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i> <i>Dictyota dichotoma</i>	0.23	30	0.01
6	<i>Bryopsis pennata</i>	0.57	25	0.02
7	<i>Bryopsis pennata</i> <i>Ulva fasciata</i>	0.11	12	0.01
8	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i>	0.03	20	0.001
9	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i> <i>Ulva fasciata</i>	0.06	25	0.002
10	<i>Bryopsis pennata</i> <i>Hypnea musciformis</i> <i>Gracilaria domingensis</i>	0.40	37	0.01
11	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i>	0.03	<b>30</b>	0.001
12	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i> <i>Hypnea musciformis</i>	0.34	25	0.01
13	<i>Bryopsis pennata</i> <i>Ulva fasciata</i> <i>Gracilaria domingensis</i>	0.17	37	0.004

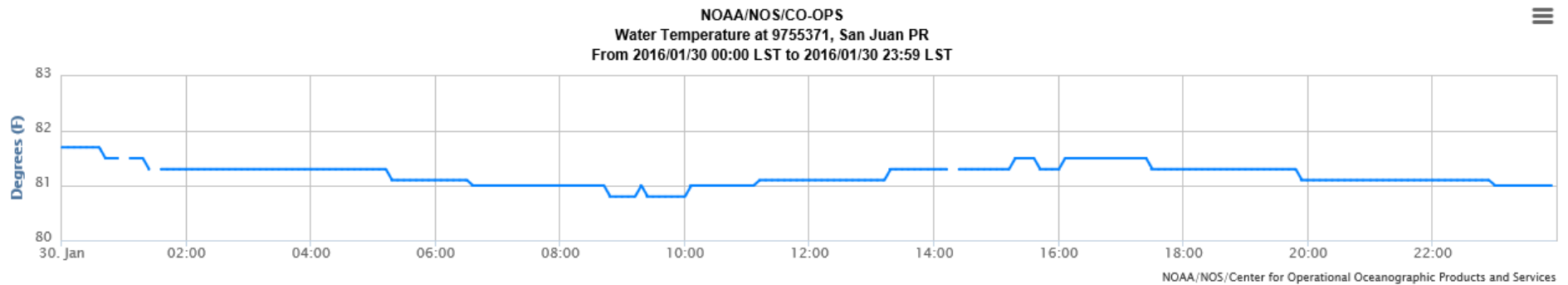
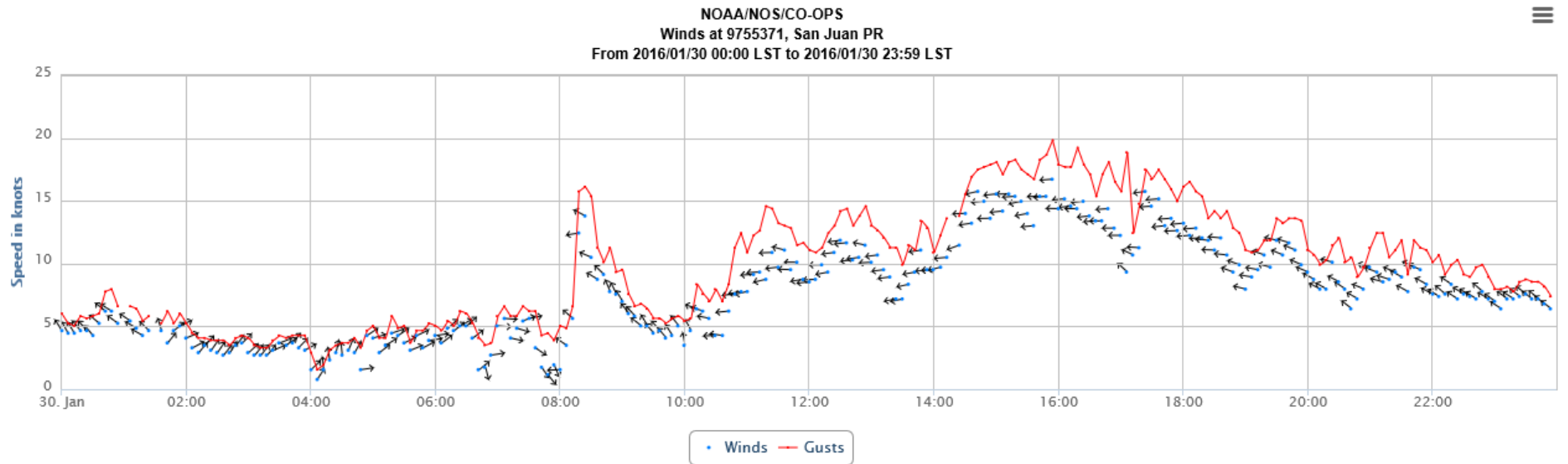
continued Data Table 16

STATION	DOMINANT SPECIES (90% biomass)	KILOGRAMS	AREA (m <sup>2</sup> )	Kg/m <sup>2</sup>
14	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i> <i>Ulva fasciata</i>	0.28	37	0.01
15	<i>Bryopsis pennata</i> <i>Hypnea cervicornis</i> <i>Caulerpa mexicana</i>	0.91	37	0.02
16	<i>Bryopsis pennata</i>	0.06	25	0.002
17	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i>	0.03	37	0.001
18	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i> <i>Caulerpa mexicana</i>	0.03	37	0.001
19	<i>Gracilaria domingensis</i> <i>Caulerpa mexicana</i> <i>Chaetomorpha crassa</i>	0.96	37	0.03
20	<i>Gracilaria domingensis</i> <i>Hypnea musciformis</i> <i>Ulva fasciata</i>	0.51	37	0.01
21	<i>Gracilaria domingensis</i> <i>Bryopsis pennata</i> <i>Ulva fasciata</i>	2.15	37	0.06
22	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i>	0.11	37	0.003
23	<i>Gracilaria domingensis</i> <i>Hypnea musciformis</i> <i>Spyridia filamentosa</i>	0.40	37	0.01
24	<i>Bryopsis pennata</i> <i>Gracilaria domingensis</i> <i>Hypnea musciformis</i>	0.34	37	0.01
TOTAL		12.47	784	0.016
xs		.52	32.66	

## FREQUENCY

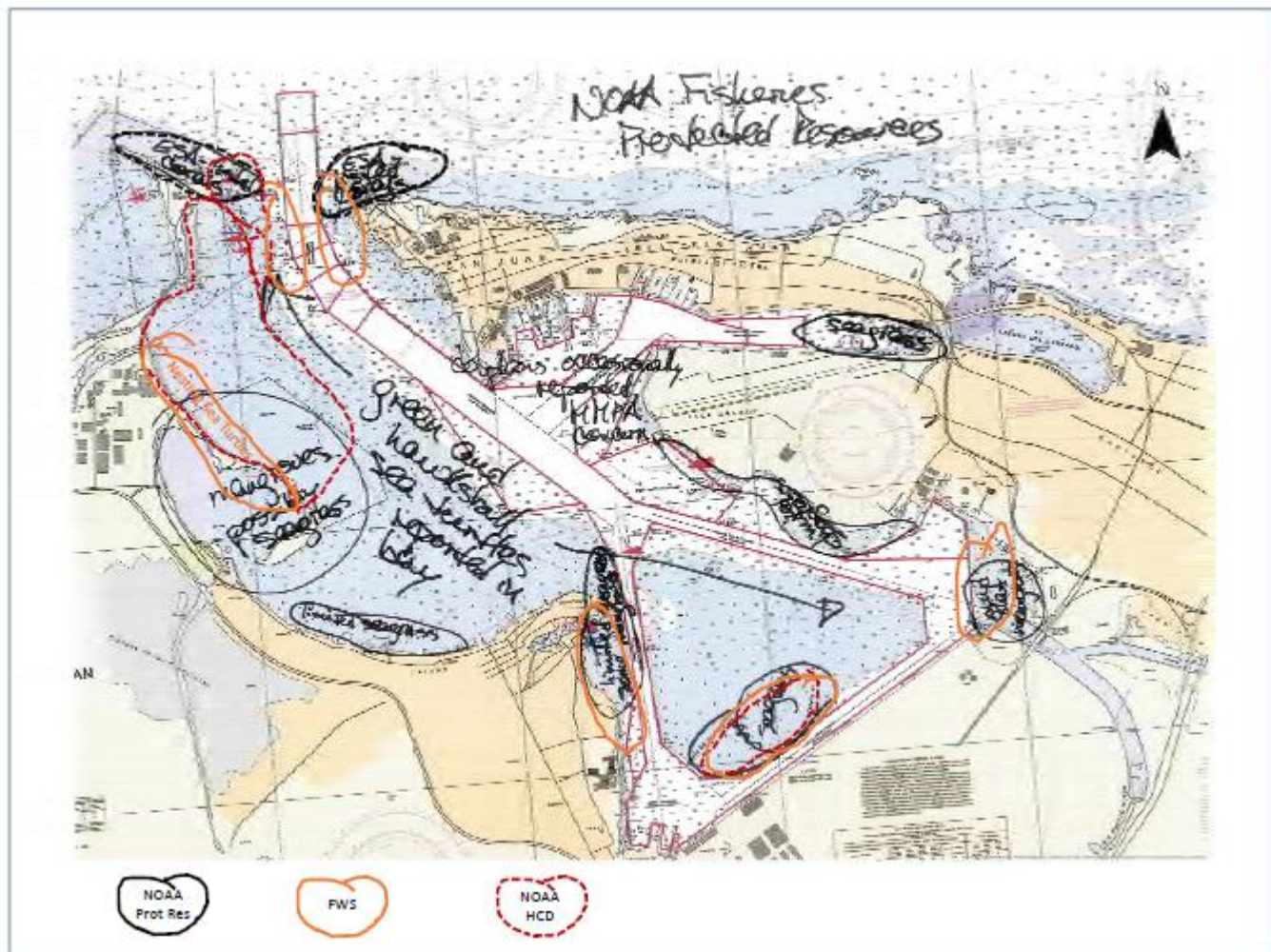
Rank 1	<i>Bryopsis pennata</i>
Rank 2	<i>Gracilaria domingensis</i>
Rank 3	<i>Ulva fasciata</i>
Rank 4	<i>Hypnea musciformis</i>
Rank 5	<i>Caulerpa mexicana</i>

## Appendix II San Juan Bay Tide Station Wind and Sea Water Temperature Data.



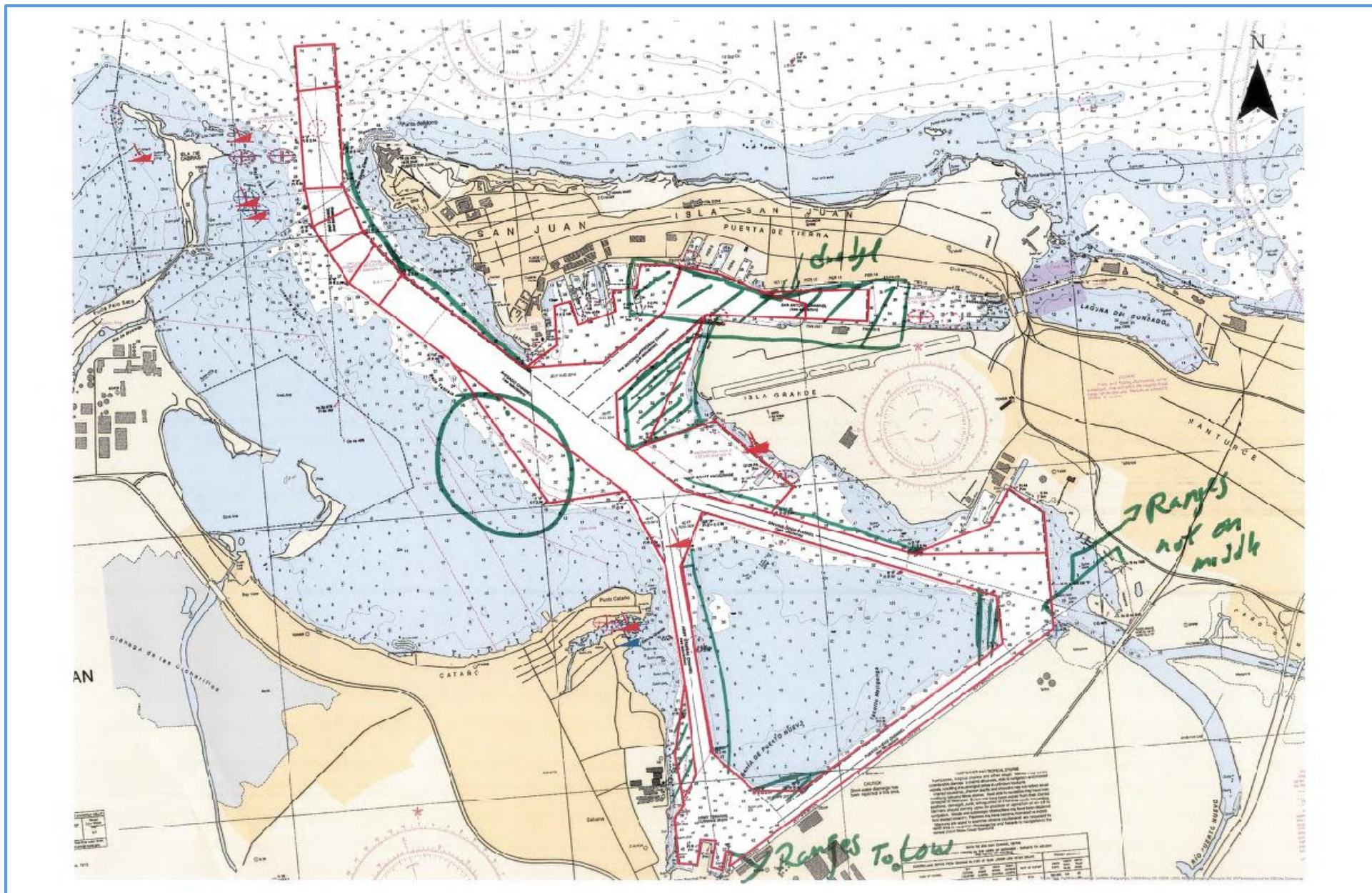
Tide Station located at Latitude 18° 27.6' N, Longitude 66° 7' W.

### Appendix III. Charette Combined Maps.



Charette Environmental Combined Map.





Charette Pilots Markup Map.