QUARTERLY PROGRESS REPORT
As of March 31, 2016

Date: April 18, 2016 Dates Covered by this Report: January 1 – March 31, 2016

Agreement No.: P1496011 00 Grant Term: March 1, 2020

Project Title: Initiation of Thin-Layer Sediment Augmentation on the Pacific Coast

Grantee: U.S. Fish and Wildlife Service, San Diego NWRC

FISCAL REPORT

Fund Source	Amount Awarded	Amount Invoiced as of March 31, 2016	Total Amount Remaining
CDFW GGRF Grant Funds	$1,055,827	$32,390.61	$1,023,436.39
Cost Share	$1,306,048	$94,027.96*	$1,212,020.04
Agreement Totals	$2,361,875	$126,418.57	$2,235,456.43

*Includes in-kind labor by USFWS

Invoice Submitted this Quarter: ☒ Yes ☐ No

PROGRAM/TECHNICAL REPORT

Activities Performed from January 1 to March 31, 2016:

- The majority of the work conducted during this quarter related to the sediment augmentation process. During this time, Kirk Gilligan (Refuge Manager) and Rick Nye (Refuge Biologist) from the Refuge and various County staff members worked with and monitored the activities of the dredging contractor.
    - Weekly meetings involving the contractor, Orange County Parks staff, and Refuge staff were initiated on January 5, 2016.
    - On January 4, 2016, a final dredge plan was submitted by the contractor to the USACOE for approval and a Sediment Placement Plan for the augmentation site was submitted to the Service and Orange County Parks.
    - Installation of the sediment barrier around the augmentation site by the contractor was initiated the week of January 4, 2016. Placement was coordinated with Refuge staff.

- Hay bales were installed as the sediment barrier using wooden stakes; they were displaced with the first higher high tide.
- Hay bales were then successfully secured using rebar.
- UCLA and contractor installed grade stakes on 10m x 10m grid to assist in determining the height of the sediment during placement.
- Testing in the trial area began the week of January 18, 2016.
- Areas were identified where the sediment slurry was scouring underneath the hay bales (this was occurring primarily where tidal creeks on the site emptied into adjacent tidal channels). Straw waddles, sand bags, and geotextile fabric were used to minimize loss of sediment from the site.

January 21, 2016

- During the initial process, a number of problems were encountered with the 8-inch dredge.
- The first significant day of sediment application was January 22, 2016.
- By the week of February 16, the contractor determined that significantly more than 13,500 CY of dredge material would be required to achieve 10 inches of sediment across the 10-acre site. The slurry material was deeper in the “ponds” and tidal creeks present within the site, and because of the nature of the material slurry that filled the site like water in a bathtub.
- By the week of March 14, the 8” dredge was demobilized and replaced with a 12” dredge and a new 12” pipeline was built and extended from the new dredge to the project site. The new dredge has been much more efficient.
- Also during the week of March 14, the three test plots were created with hay bales and the side walls were lined with geotextile sheets.

Deeper Test Plots Prior to Augmentation

- By mid-March, it became clear that there would not be adequate sediment to cover the entire 10-acre site for the reasons described above. As a result, the site boundaries were revised to eliminate portions of the site that did not include research plots. The revised site boundaries are presented in Figure 1.
- By March 31, application of sediment to the site was nearing completion.

A more complete description of the augmentation process along with the challenges and lessons learned will be provided as part of our annual report. Photos and time lapse videos will also be provided at that time.

- A project calendar was created for the contractor, monitors, and researchers to use to track when and where sediment application would be occurring, when biological and turbidity monitoring was being conducted, and times when the Safety Danger Zone for the Navy’s small arms range would be cold.

- Refuge staff continued to work with the Navy to identify days when the small arms range would be cold to accommodate activity within the northern portion of the project site. Despite the need to extend the construction period into March, the Navy was very accommodating.

- To minimize the potential for impacts to eelgrass beds located adjacent to the project site, Standard Operating Procedures for measuring and monitoring turbidity in adjacent tidal channels were prepared and followed. Measurements were routinely taken by Rick Nye, the Service's on-site monitor during sediment augmentation.

- Scheduling delays associated with initiating the dredging project were apparent by early January; as a result, on January 15, 2016, the Service submitted notifications of the potential need to extend the construction period into April to the USACE (which issued a revised Nationwide Permit (NWP) verification letter on February 3, 2016), Santa Ana Regional Water Quality Control Board, the California Coastal Conservancy, and NOAA.

- SWIA continues to work on contracts for carbon-related analysis, pre- and post-sediment augmentation monitoring, and aerial photography and photogrammetric mapping services, actions which will be funded with CDFW and/or California Coastal Conservancy grant funds.

- Sediment Augmentation Team Conference Calls continue to be conducted regularly to ensure that all required activities are being conducted as proposed and on time. We also use this time to discuss any problems and catch up on new information. This quarter, these calls were held on January 26, February 22, and March 23, 2016.

- On February 23, members of the project team participated in a conference call to discuss the benefits and constraints of using LiDAR versus photogrammetry to establish site elevations immediately following the completion of sediment argumentation on the site. It was determined that aerial photography and photogrammetric mapping services would provide the best benefits for the project. GPSi will conduct post-augmentation elevation surveys using Coastal Conservancy grant funds.

- USGS (Sediment Flux) – During this quarter, USGS continued to analyze sediment flux and turbidity patterns in the tidal channel adjacent to the project site. The results of this analysis are provided in the attached report titled: Thin-Layer Sediment Application Pilot Project at Seal Beach National Wildlife Refuge: sediment flux patterns in deep channel site and turbidity patterns in eelgrass site (March 22, 2016).

- UCLA (Sediment Thickness, Bulk Density, Tidal Creek Geomorphology) – No field work was conducted by UCLA during this period. Dr. Ambrose did present a talk on the sediment augmentation project, titled "Managing sea level rise in coastal wetlands: testing thin layer sediment augmentation as an adaptation strategy" at the US-Iran Wetland Symposium sponsored by the US National Academy of Sciences.
- Chapman College (Gas Flux) – Dr. Keller developed and refined a gas chromatography method to analyze N_2O in samples collected from flux chambers in the field. Samples previously collected from the augmentation site (7 November, 2015), control site (30 November, 2015), and augmentation site (6 December, 2015) were analyzed. The net

flux of N_2O was below detection limits at both the augmentation site and the control site for samples measured at the end of 2015. Additionally, a Dionex ion chromatograph was successfully installed at Chapman University that will be used for post augmentation analysis of porewater samples from the augmentation and control sites. No gas samples were collected during this period.

- CSULB (Biomass, Plant Physiology) – No sampling of plants or invertebrates has occurred this quarter. With funding from the Conservancy, Dr. Whitcraft and her team have conducted sediment grain size analysis of the dredge material for the Service. Analysis was conducted on dredge sediments both pre- and post-application. This work is being conducted because sediment being applied to the site appears to have a higher percent of sand than was expected based on pre-project grain size analysis. Analysis results for this quarter indicated that the majority of the samples had between 85 – 95 percent sand with low silt and clay content.

  With respect to laboratory analysis, invertebrate sorting has been ongoing throughout this quarter. All spring 2015 (pre-augmentation) invertebrate samples have been sorted. Dr. Whitcraft and her team are in the process of identifying the invertebrates to species. The preliminary data is presented in Figure 1.

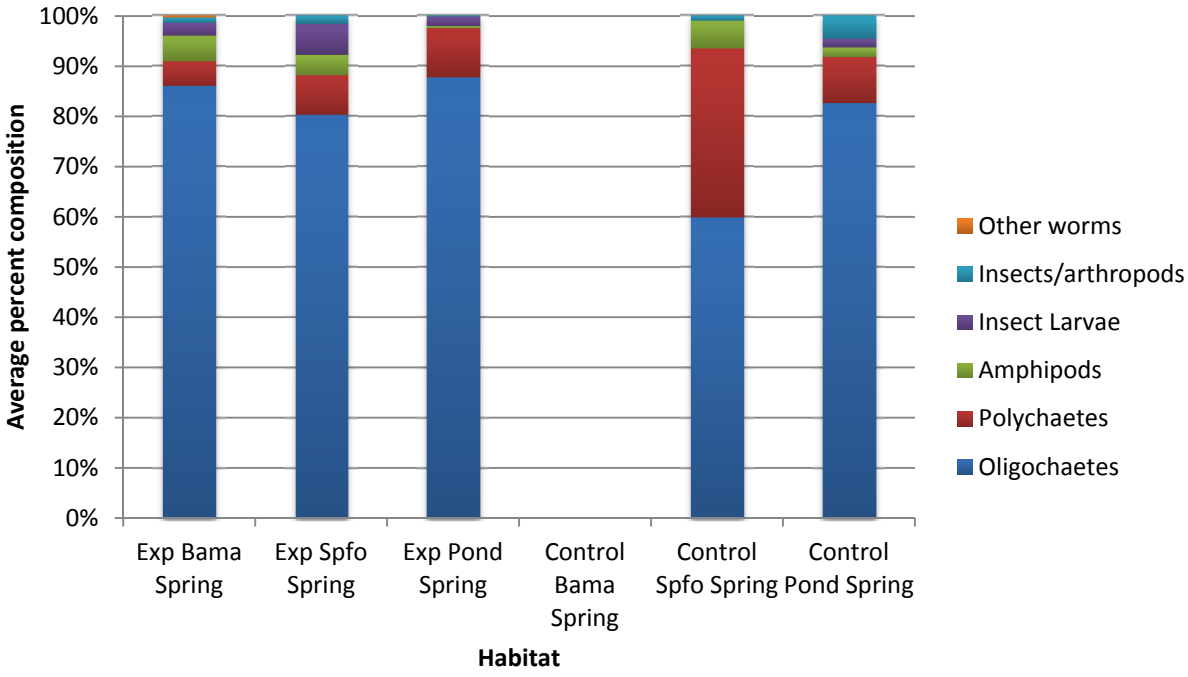

Figure 1. Preliminary data of the average percent composition of infauna in each sediment core for spring 2015. (Note that while samples from Control Bama have been sorted, identification is not yet complete.)

Photosynthetic rates (pre-augmentation) from fall 2015 have been analyzed. The preliminary data is provided in Figure 2.

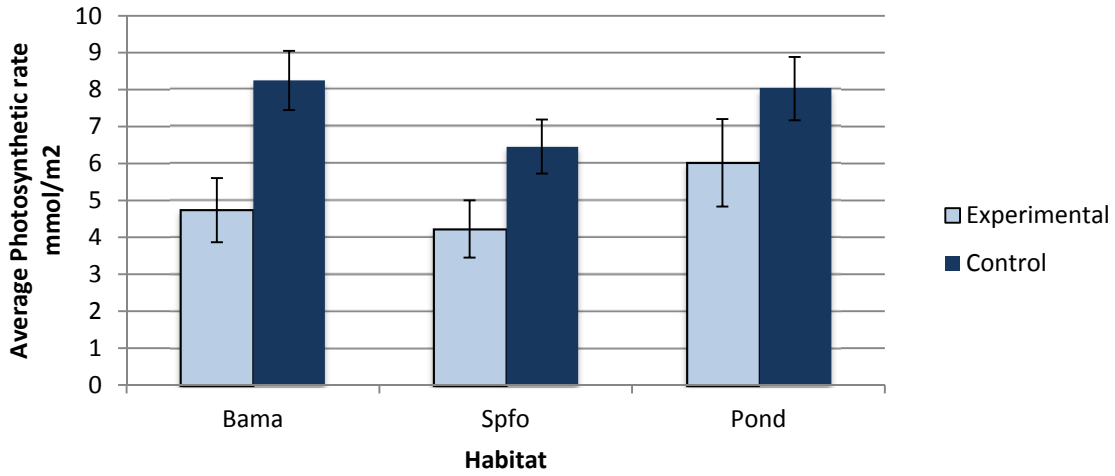

Figure 2. Preliminary data for the average photosynthetic rate of *Spartina foliosa* in the augmentation and control sites for fall 2015.

Preliminary results indicate that plant and invertebrate community parameters are similar in spring 2015 between the augmentation and control sites, indicating that for the most part the control site is an appropriate control for the project. Researchers did notice significantly different photosynthetic rates between the augmentation and control sites. Because the researchers control for light, this is most likely a result of muddier plants in the control area, which can lead to lowered photosynthetic rates. These differences will be corrected in the Before-After-Control-Impact design. In addition, plants will be cleaned more thoroughly in subsequent sampling.

- UCLA (Sediment Coring) – Analyses of the samples taken last quarter continues. The results will be provided in our 2016 annual report.

- Five shorebird surveys were conducted at the project site during the January through March 2016 quarter. Shorebird surveys were typically conducted during a high tide and a low tide. The annual monitoring of light-footed Ridgway's rail will began in mid-March; none of the rail platforms in the general area of the project site were occupied by the end of March. Rick Nye, the Service's site monitor, did observe rails on the project site on several occasions and encouraged them to move off the site prior to sediment application. Other birds were also moved off the site with the use of an air horn. Once the spray of sediment was initiated, the birds returned and foraged on invertebrates that had been carried to the site in the slurry. No birds were adversely affected.

- Three field cameras, purchased with USFWS station funds, continue to capture changes at the augmentation site as the augmentation process proceeds. The annual report will include time lapse videos.

- Outreach – Kirk gave a project presentation on March 3, 2016 in San Francisco at the USACE office. The webinar/presentation was attended or watched by a wide range of interests, from consultants and land managers, to regulatory staff, and interested members of the public. Kirk also presented on the project to the Carlsbad Ecological Services office of the USFWS on April 4, 2016. The Service issued a press release on February 19, 2016 inviting the press to observe the augmentation process and learn more about the project. Unfortunately, no one from the press responded, so the event was not held.

- The project webpage is periodically updated with information and photos. (http://www.fws.gov/refuge/seal_beach/what_we_do/resource_management/Sediment_Pilot_Project.html)

Percentage of Task Completed as of March 31, 2016:

Task 1 – Project Management and Administration	15%
Task 2 – Sediment Augmentation	90%
Task 3 – Project Monitoring (overall)	15.7**%**
1) Carbon Storage/Sequestration Benefits	15%
2) Percent Total Plant Coverage	10%
3) Pacific Cordgrass Analysis	10%
4) Site Elevations	10%
5) Sediment Analysis (compaction, movement, bulk density)	15%
6) Turbidity Levels	25%
7) Eelgrass	25%
Task 4 – Engineering Design/Environmental Documentation (overall)	100%
1) Engineering Plans for Sediment Augmentation Site	100%
2) Environmental Documentation*	100%
*CEQA/NEPA has been completed by SCC/USFWS	
Task 5 – Public Participation/Presentations (overall)	37.5%
1) Oral/Poster Presentations	50%
2) Workshops and/or Webinars	25%
Overall Project	**51.6%**

Deliverables Completed for Each Task:

Task 1 – Project Management and Administration

1) Quarterly Progress Report	3 to date
2) Monthly Invoices	5 to date
3) Subcontractor Selection	Orange County Parks & SWIA selected
4) Data Management	preliminary data for monitoring locations
5) Acknowledgement of Credit	ongoing (i.e., March 2016 presentation)

Task 2 – Sediment Augmentation

1) Sediment Application	almost complete
2) Adaptive Management	not yet completed
3) Reporting Results/Lessons Learned	not yet completed

Task 3 – Project Monitoring

1) Carbon Storage/Sequestration Benefits	pre-augmentation site monitoring completed/data processing underway
2) Percent Total Plant Coverage	pre-augmentation work completed
3) Pacific Cordgrass Analysis	pre-augmentation work completed
4) Site Elevations	pre-augmentation RTK survey completed
5) Sediment Analysis	initial core samples retrieved/data processing underway
6) Turbidity Levels	monitoring ongoing; prel. data available
7) Eelgrass	pre-augmentation survey completed; post augmentation survey scheduled

Task 4 – Engineering Design/Environmental Documentation

1) Engineering Plans for Augmentation Site	100% engineering plans completed
2) Environmental Documentation* *for USFWS and Coastal Conservancy	CEQA/NEPA documents final; ND recorded

Task 5 – Public Participation/Presentations

1) Oral/Poster Presentations	Presentations in November/December 2015; March 2016
2) Workshops and/or Webinars	not yet initiated

Problems/Delays Proposed Resolution:
Initiation of sediment augmentation was originally expected to occur in November and be completed in February. Augmentation actually started in late January and will be completed by the first week in April. Concurrence from the regulatory agencies for the extended construction schedule was received.

Due to issues summarized above, it was not possible to achieve an even 10 inches of sediment over the 10 acre site. A map of the area we expect to have covered at the end of the augmentation process is provided as Figure 3. Although all ten acres of the site will not be covered, more than 13,500 cubic yards of sediment are expected to be needed to cover the revised project boundary. The final volumes and acres of area covered will be provided when augmentation is completed. The reasons for this problem will be detailed and possible solutions for dealing with this issue addressed in the “lessons learned” document that will be prepare following completion of the augmentation process. This document will be included in our first annual report for the project.

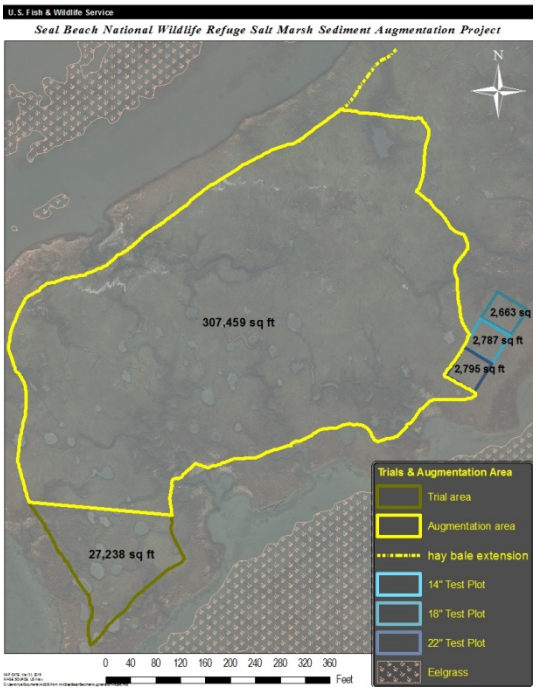

Figure 3. Estimated Augmentation Area

Figure 3 indicates the anticipated area of sediment coverage on the augmentation site at the end of the augmentation process. Coverage includes the 27,238 square foot trial area; the text plots, shown in blue; and the main portion of the site where the depth of sediment was to be 10 inches (a 307,459 square foot area). More sediment was needed than planned just to complete this area. Additional information about the process and final results will be included in the lessons learned document to be completed at the end of the augmentation process.

Project Benefits and Results:

It is too early in the project to address project benefits and results, but we have learned quite a bit about the sediment augmentation process. Our "lessons learned" document will benefit those land managers contemplating the initiation of this process elsewhere on the Pacific Coast. As we begin the post-sediment augmentation data collection effort, we will have a clearer understanding of the benefits to salt marsh habitat of sediment augmentation.

Summarize Benefits to Disadvantaged Communities (if applicable):

Not applicable to this project.

List of Proposed Activities and Tasks for the Next Quarter:

Task 1 – Project Management and Administration

Continue to monitor the performance of subcontractors, monitor the sediment augmentation process (e.g., record effectiveness of application methods and sediment retention, prepare a narrative of the process as it proceeds), assist researchers in the field following sediment application, process invoices, prepare for the next quarterly report, and implement all other responsibilities that may be necessary to successfully complete the project.

Task 2 – Sediment Augmentation

Continue to coordinate with OC Parks, their dredging contractor, and the Navy to ensure that sediment augmentation is completed in compliance with all permitting requirements, safety requirements, and biological monitoring requirements. Provide biological monitoring at the site during augmentation.

Task 3 – Project Monitoring

Sediment Augmentation – USFWS staff working with USGS and the sediment augmentation contractor will continue to monitor turbidity levels in adjacent tidal channels during the augmentation process, routine examine the slurry pipe line for potential leaks, monitor for the potential presence of rails and shorebirds on the project site, and monitoring for the potential presence of sea turtles and marine mammals in adjacent subtidal areas.

Post Augmentation – The post augmentation eelgrass survey has been scheduled, as has the flight to conduct aerial photography and photogrammetry to determine the post augmentation elevations on the site.

The Service, working with the contractor, will document the sediment augmentation process to record methods used, problems encountered, and lessons learned.

Monthly shorebird surveys will continue and Refuge-wide monitoring of light-footed Ridgway's rail will continue through September.

UCLA will begin the first post-augmentation sampling about two months after sediment augmentation is completed. The following activities will be conducted:

1. Sampling the 24 feldspar plots in the sediment augmentation area (SAA). The thickness of the sediment over the feldspar will be measured and sediment samples will be taken for bulk density and carbon analyses. The distance from the top of the stakes marking the plots to the sediment will be measured.
2. Sampling the 14 feldspar plots in the control area (CA). The thickness of the sediment over the feldspar will be measured and sediment samples will be taken for bulk density and carbon analyses. The distance from the top of the stakes marking the plots to the sediment will be measured.
3. Conducting tidal creek cross-section surveys in the SAA. The distance from the top of the stakes marking the cross-section transect to the sediment will be measured.
4. Conducting tidal creek cross-section surveys in the CA. The distance from the top of the stakes marking the cross-section transect to the sediment will be measured.
5. Measuring distance to sediment from the top of the sediment stakes.
6. Laboratory analyses of bulk density, grain size, and carbon content (loss on ignition [LOI]).
7. Data entry and analysis.

UCLA researchers working on core dating will be coordinating with researchers at CSULB to process cores for belowground biomass. Analysis of samples taken in January for ^{14}C, ^{137}Cs, and ^{210}Pb will be conducted. The results of radiocarbon samples processed at UC Irvine and cesium and lead samples sent to USC will be compiled.

- Dr. Keller will resume gas flux measurements at both the augmentation site and control site once the site is stable enough to allow access. Work will continue on refining the analytical method for N_2O analysis on the gas chromatograph and a method will be developed for the analysis of porewater ions (e.g., chloride, sulfate) using a Dionex ion chromatograph. Dr. Keller has gained experience with this instrument in the current quarter on a different project and is now prepared to develop a method to support the Seal Beach project and analyze frozen samples.

- CSULB will coordinate splitting of carbon sequestration cores with UCLA and process the cores for belowground biomass. Spring data collection will begin in April/May. This will involve plant and invertebrate sampling as well as frequent photosynthetic sampling (starting at 1 month post-augmentation).

- USGS will collect data from the YSIs and ADCP and conduct regular maintenance immediately following augmentation. Water samples will be collected to calibrate the instruments during data downloads. Reading of the SETs will be done immediately following augmentation.

- The team will begin to compile interim project results for incorporation into our first annual report.

Task 4 – Engineering Design/Environmental Documentation
This task has been completed.

Task 5 – Public Participation/Presentations
A webpage for the project has been developed. Information about the sediment augmentation project will be posted and progress on the project will be updated as necessary. Acknowledgement of our funding partners is also provided at that site.

We will continue to present information about the project at conferences as opportunities arise.

Description of Amendments and Modifications to Grant:
We do not currently have any proposals to amend or modify the existing grant.

Thin-Layer Sediment Application Pilot Project at Seal Beach National Wildlife Refuge: sediment flux patterns in deep channel site and turbidity patterns in eelgrass site

March 22, 2016

Principle Contact: Dr. Karen M. Thorne[1], 916 -502-2996, kthorne@usgs.gov

Team: Dr. Neil K. Ganju[2], Arianna C. Goodman[1], Chase Freeman[1], and Jordan A. Rosencranz[1,3]

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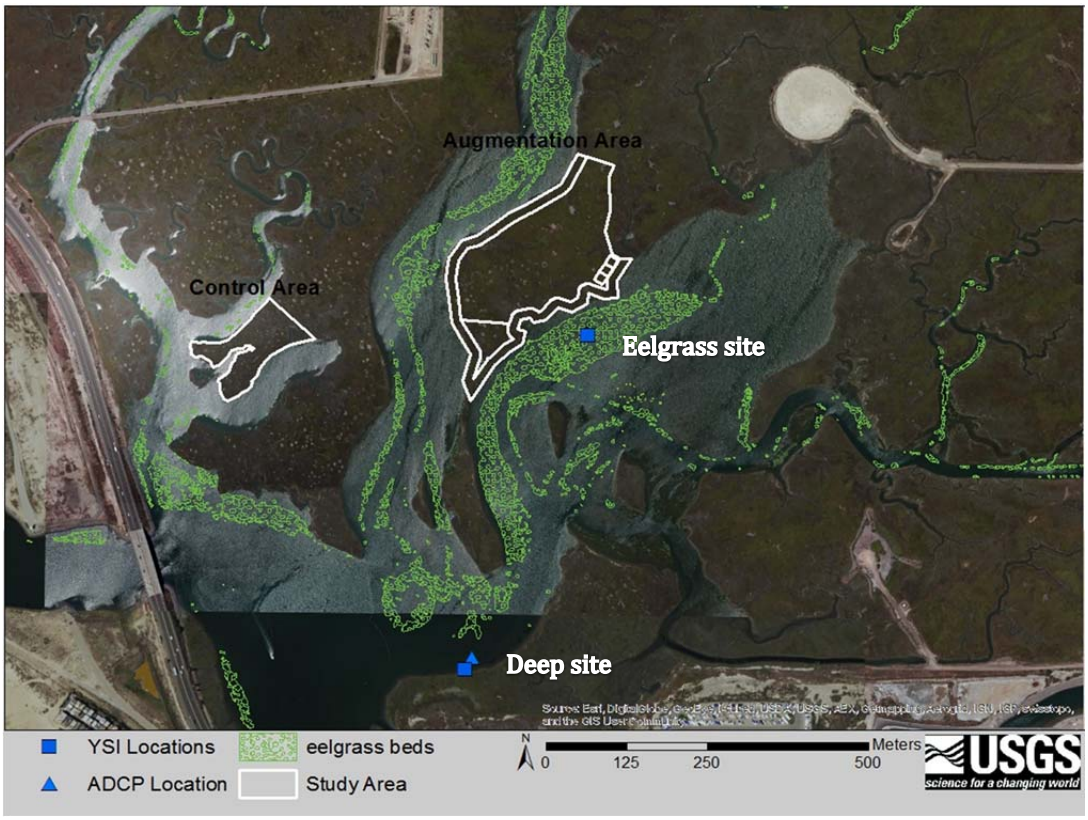

Seal Beach National Wildlife Refuge – locations of YSIs and ADCP

Summary

- Mean suspended sediment concentration (SSC) and sediment flux calculations were consistent across five deployments between November 2014 and March 2016, showing net export of SSC out of Seal Beach NWR (Figure 1 and Table 1). We didn't observe an increase in net export of SSC with the initiation of sediment application compared to other sampling periods (Table 1).
- Across the December 2015-March 2016 monitoring periods, turbidity patterns and magnitudes were relatively consistent between six deployments for each site (Figure 2).
- The highest mean turbidity values of 4.6 NTU and 3.5 NTU were observed in the eelgrass bed and the deep channel site during the January 2016-March 2016 monitoring period (Table 2). When peak or high turbidities occurred measurements returned to the mean with 24-48 hours.
- Next steps include relating high turbidities with boat traffic and storm events.

To estimate sediment fluxes, turbidity, which is measured in nephelometric turbidity units (NTU), was calibrated to SSC using a regional calibration from Mugu (Rosencranz et al. 2015). The calibration from Mugu was used in place of the calibration from Seal Beach, because of the greater range of turbidity levels sampled at Mugu. Water samples were collected at Seal Beach in mid-October 2015 to

calibrate the instruments. Once those samples are returned from the lab we will incorporate those measurements into the NTU to SSC calibration.

No long-term sediment flux signal was detected from augmentation. Sediment budget was consistent across deployment periods. In the deep channel site, time-series of water level, depth-averaged water speed, suspended sediment concentration (SSC), and flux per unit area of the creek cross-section were calculated for the five deployments between November 2014 and March 2016 (augmentation; Table 1 and Figure 1). Turbidity patterns and magnitudes were similar between eelgrass and deep channel site (Figure 2). Across six deployments from November 2014-March 2016, mean turbidity at the deep channel site, averaged across all deployments was 3.1 NTU, while mean turbidity at the eelgrass site was 2.6 NTU (Table 2). Due to biofouling (Figure 3), presumably from warmer water temperatures, some data were omitted between June and August 2015 (Figure 2).

Elevated peaks in turbidity may be a result of boat traffic both from construction and researchers. The next step would be to relate elevated turbidities with logs of boat traffic in the area. Also, any rain events from El Nino could increase local turbidity and sediment flux export. The next step would be to relate storm events with elevated turbidities.

Table 1. Mean suspended sediment concentration (SSC), mean flux per unit area of the creek cross-section, and flood-ebb SSC differential at deep channel site over the five November 2014-March 2016 monitoring periods. No data were collected between December 2015 and January 2016 from the ADCP deployment period.

	Mean flux ($g/m^2/s$)*	Mean SSC (mg/L)	Flood-ebb SSC differential (mg/L)**
Deployment 1 (November 2014-January 2015)	-0.21	7.6	-1.5
Deployment 2 (January 2015 – May 2015)	-0.17	8.8	-1.5
Deployment 3 (May 2015-August 2015)	-0.19	8.6	-1.2
Deployment 4 (October 2015-December 2015)	-0.19	8.1	-1.2
Deployment 5 (January 2016-March 2016)	-0.17	8.8	-1.1

*negative values indicate export
**negative values indicate larger SSC

Table 2. Mean suspended sediment concentration (SSC), mean flux per unit area of the creek cross-section, and flood-ebb SSC differential at Deep Channel and Eelgrass bed sites over the six November 2014-March 2016 monitoring periods.

	Eelgrass Bed		**Deep Channel**	
	Maximum Turbidity (NTU)	Mean Turbidity (NTU)	Maximum Turbidity (NTU)	Mean Turbidity (NTU)
Deployment 1 (November 2014-January 2015)	30	1.9	33	2.5
Deployment 2 (January 2015 – May 2015)	33	1.6	60	3.4
Deployment 3 (May 2015-August 2015)	No Data	No Data	30	3.2
Deployment 4 (October 2015-December 2015)	60	3.6	60	3.1
Deployment 5 (December 2015-January 2016)	31	3.0	63	3.1
Deployment 6 (January 2016-March 2016)	52	4.6	98	3.5

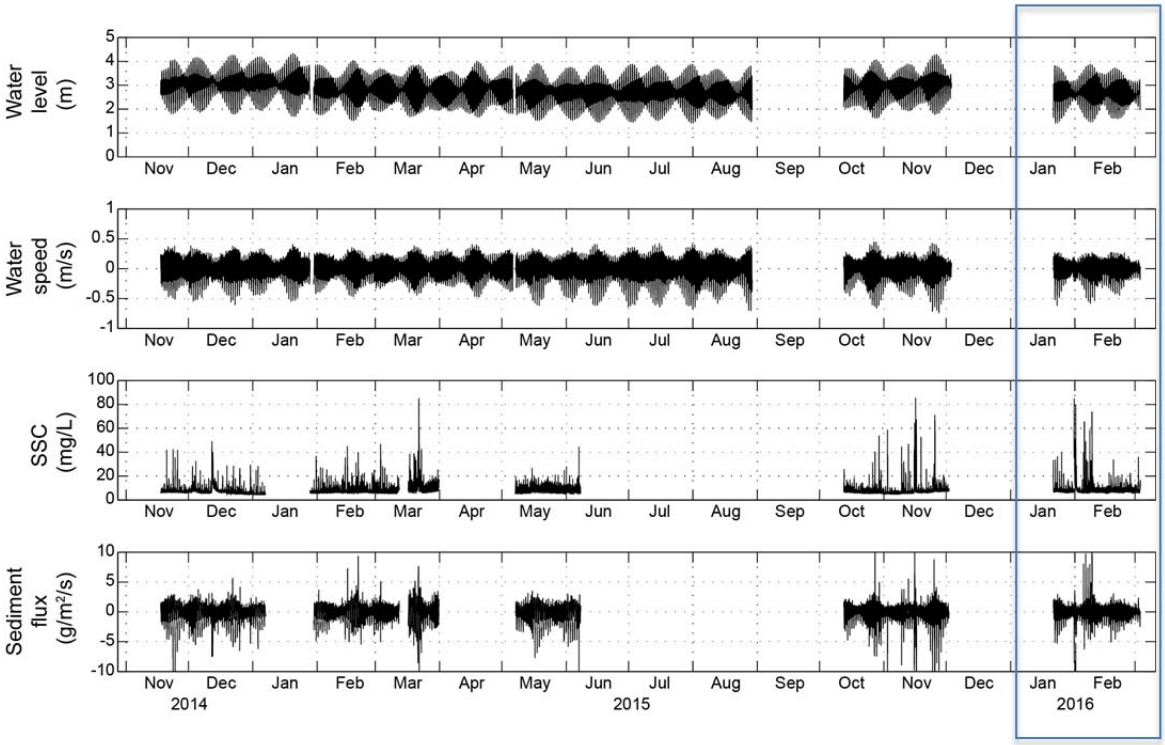

Figure 1. Time-series of water level, depth-averaged water speed, suspended sediment concentration (SSC), and flux per unit area of the creek cross-section at deep channel site over the November 2014-March 2016 monitoring period. Blue box indicates the new data for this quarterly report.

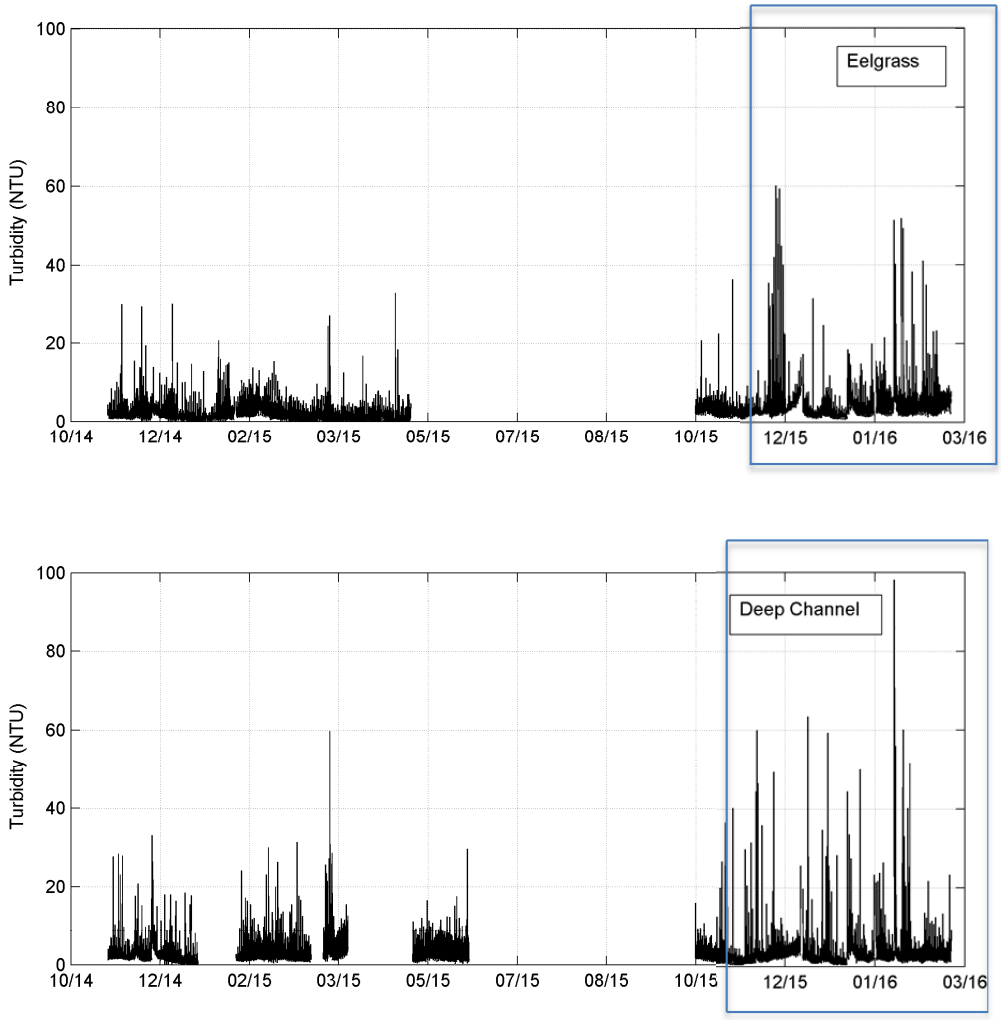

Figure 2. Time-series of turbidity at eelgrass bed site (top) and deep channel site (bottom) over six monitoring periods during November 2014-March 2016. Due to biofouling, presumably from warmer water temperatures, data were omitted between June and October 2015. YSI instruments were pulled out of the water and sent in for servicing in August 2015. Blue boxes indicate new data for this quarterly report.

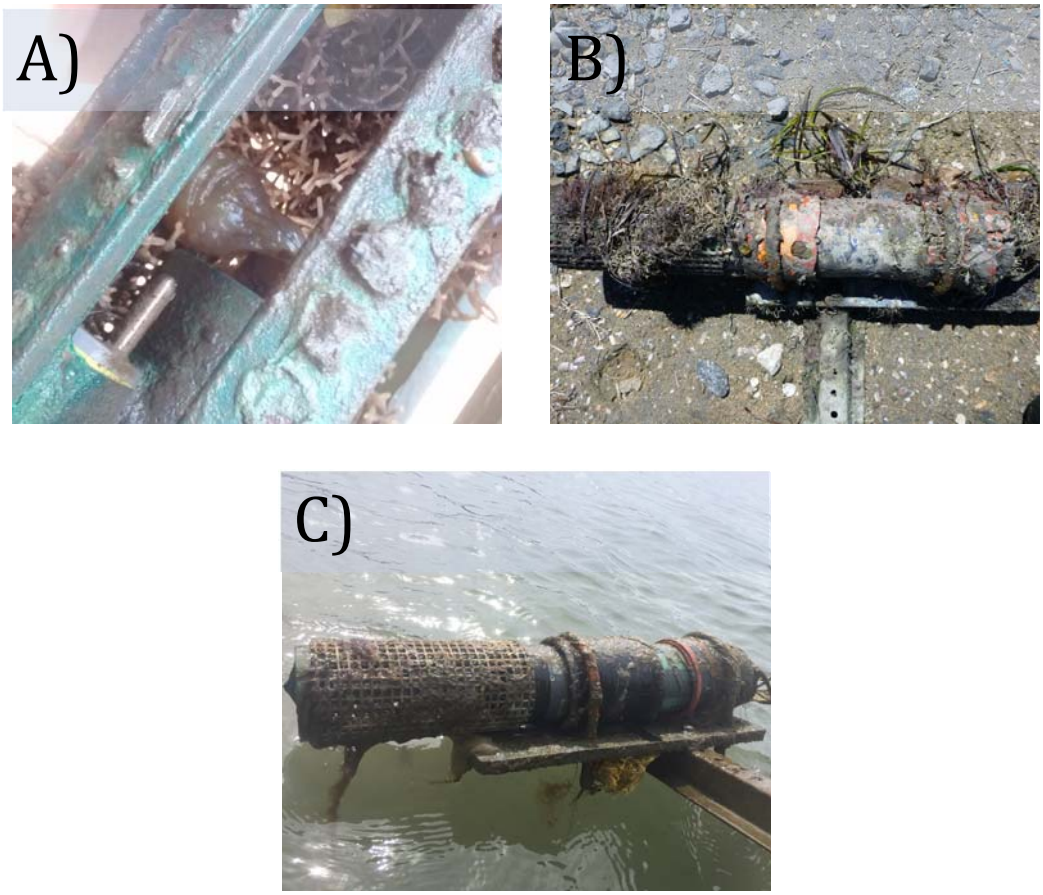

Figure 3. Photos detailing fouling of sensors. A) Soft-bodied organisms growing inside deep channel probe guard after 90 day interval B) Fouling on deep channel YSI after 90 day interval C) Fouling on deep channel YSI after 45 day interval.

References

Rosencranz JA, NK Ganju, RFAmbrose, SM Brosnahan., PJ Dickhudt, GR Guntenspergen, GM MacDonald, JY Takekawa. KM Thorne. 2015. Balanced Sediment Fluxes in Southern California's Mediterranean-Climate Zone Salt Marshes. Estuaries and Coasts:1-15