Elkhorn Slough (ELK) NERR Nutrient Metadata
(January - December 2014)
Latest Update: August 26, 2016

I). Data Set and Research Descriptors

1) Principal investigator(s) and contact persons –

a) Reserve Contact

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b) **Laboratory Contact**

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c) **Other Contacts and Programs**

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2) Research objectives – Elkhorn Slough (ESNERR) is a unique estuary along the central Californian coast. ESNERR has fresh water inputs during the wet season (October through May) causing a brackish environment, while during the dry season (June through September) there is very little freshwater input resulting in a much more saline environment. The surrounding area is mostly farmlands, which causes concern, as farms may be a considerable source of large amounts of nutrients entering the slough possibly causing eutrophication. With the monthly monitoring program we are able to quantify the variability of nutrients in different areas of the slough and possibly correlate any changes in land use with changes in nutrient concentrations.

a) **Monthly Grab Sampling Program**

To quantify the spatial variability of nutrient concentrations in Elkhorn Slough we collect monthly grab samples in the water column. The sampled sites represent the estuarine endpoints from the head to the mouth of Elkhorn Slough estuary and sites throughout the estuary.

b) **Diel Sampling Program**

To quantify the temporal variability of important nutrients in the water column as a function of tidal forcing we collect 13 water samples through a 24-hour tidal cycle once per month, at a permanent water quality station, South Marsh.

3) Research methods

a) **Monthly Grab Sampling Program**
Monthly grab samples were taken at four stations within the Elkhorn Slough estuary. Samples were taken at the four principle ESNERR data sonde stations (Azevedo Pond, North Marsh, South Marsh and Vierra Mouth). All grab samples were taken on the same day in the time window of -3 to 0 hours before low tide. At each station either replicate samples were taken (n = 2) or at one of the four stations, a triplicate samples was taken (n = 3) and then only a single sample was taken at one of the other four stations. Each month, we grabbed a total of n = 8 samples at the four stations collectively. If we arrived at a station after low tide, no sample was grabbed. No distinction was made between neap and spring tide conditions. Grab samples were collected by hand at an approximate depth of 10 cm. At the time of sample collection, water temperature, salinity, specific conductivity, pH, chlorophyll, and dissolved oxygen was measured with a YSI V2 6600 sonde and a hand held YSI 650 unit. These field data are not included in this dataset, but are available directly through the Reserve if you contact John Haskins or Rikke Jeppesen. All samples were collected in amber, narrow-mouth, 250 mL nalgene sample bottles that were previously acid washed (10% HCL), rinsed (3x) with distilled-deionized water, dried, and followed by rinsing (3x) with ambient water prior to collection of the sample. Samples were immediately placed on ice in the dark and returned to the laboratory. Once in the laboratory, samples were shaken, filtered and processed for nutrient and Chl-a analysis.

b) **Diel Sampling Program**
Within the same 24-hour period of grab sample collection, we deploy an ISCO water sampler from the bank of the marsh at South Marsh. This device automatically samples 500 ml of water every 2 hrs 4 min (Jan.-Dec). All samples are pumped into polyethylene sample bottles that were previously acid washed (10% HCL), rinsed (3x) with distilled-deionized water and dried. Samples are kept cold with ice until the end of the 24 hr period; the 13 samples are kept in the dark and returned to the laboratory for immediate processing. From January to December, samples were collected every other hour through a 24-hour tidal cycle.

4) Site location and character

Elkhorn Slough is located on the West Coast of the United States in Central California. The estuarine water of Elkhorn Slough enters the Pacific Ocean in central Monterey Bay near Moss Landing, California. There are four NERR sampling sites in Elkhorn Slough:

Azevedo Pond (AP)(36°50’44.64”N, 121°45’13.24”W) is in a pond that receives fertilizer and pesticide run-off from a strawberry field in year-round production. The sample station is located about 10m from a tidal control structure in front of a culvert connecting the pond to the slough. The tide ranged from 1.16 to 2.49 meters and salinity ranged from 16.9 ppt during heavy run-off to 44.8 ppt during strong evaporation during the summer. Depth at mean low tide is approximately 1.5 meters. The YSI sonde associated with this site (collecting readings for the water quality dataset) is located approximately 30 cm off the bottom, which is composed of silty mud.

North Marsh (NM)(36°50’04.75”N, 121°44’18. 33”W) is located in-between South Marsh and Azevedo Pond. This site is impacted by both agricultural and urban run-off. The tide ranged from approximately 0.62 to 1.22 meters. Salinity ranged between 17.7 and 40.7 ppt and is affected by freshwater run-off from agriculture and upland run-off. Depth at mean low tide is approximately 1 meter. The YSI sonde associated with this site (WQ dataset) is approximately 30 cm off the bottom, which is composed of silty mud.

South Marsh (SM)(36°49’05.00”N, 121°44’21.83”W) which is located approximately 3 km south of NM and is surrounded by mostly reserve land, is in a side channel of the slough and is relatively free from impact by anthropogenic influence. This site receives run-off mostly from uplands with some run-off coming from cattle ranches. This site receives the least amount of pollution. The tidal range was from -0.34 to 2.32 meters and the salinity range was from 25.0 to 35.8 ppt. Depth at mean low tide is approximately 3 meters. The YSI sonde associated with this site (collecting readings for the water quality dataset) is approximately 30 cm off the bottom, which is composed of compacted silty mud.

The fourth site Vierra Mouth (VM) (36°48’39.95”N, 121°46’45.22”W) is located at the mouth of the slough and is used to identify oceanic influence. . The tidal range was from -0.32 to 2.30 meters and salinity ranged from 24.8 to 35.0 ppt. Depth at mean low water is approximately 4 meters. The YSI sonde associated with this site (collecting readings for the water quality dataset) is located approximately 30 cm off the bottom which is composed of compacted mud and sand due to strong tidal currents. This site receives drainage from the entire watershed due to its location at the mouth. There are several auto wreaking yards located approximately 2 km east of this site.

5) Code variable definitions

elkapnut = Elkhorn Slough Reserve Azevedo Pond Site nutrient data
elknmnut = Elkhorn Slough Reserve North Marsh Site nutrient data
elksmnut = Elkhorn Slough Reserve South Marsh Site nutrient data
elkvmnut = Elkhorn Slough Reserve Vierra Mouth Site nutrient data

Monthly grab sample program= 1
Diel grab sample program= 2

Replicates = 1, 2, or 3

6) Data Collection Period

SWMP nutrient montoring first began in April 2002 for elkap, elknm, elkvm, and in August 2002 for elksm.

Sampling in 2014 occurred between 06:00 January 7, 2014 and 06:48 December 3, 2014.

Diel Sampling

Site	Start Date	Start Time	End Date	End Time
Elksm	01/07/2014	06:00	01/08/2014	06:48
Elksm	02/11/2014	06:00	02/12/2014	06:48
Elksm	03/11/2014	06:00	03/12/2014	06:48

Elksm	04/08/2014	06:00	04/09/2014	06:48
Elksm	05/06/2014	06:00	05/07/2014	06:48
Elksm	06/03/2014	06:00	06/04/2014	06:48
Elksm	07/08/2014	06:00	07/09/2014	06:48
Elksm	08/05/2014	06:00	08/06/2014	06:48
Elksm	09/02/2014	06:00	09/03/2014	06:48
Elksm	10/07/2014	06:00	10/08/2014	06:48
Elksm	11/04/2014	06:00	11/05/2014	06:48
Elksm	12/02/2014	06:00	12/03/2014	06:48

Grab Sampling

Site	Start Date	Start Time	End Date	End Time
Elkap	01/07/2014	08:53	01/07/2014	08:54
Elkap	02/11/2014	13:46	02/11/2014	13:47
Elkap	03/11/2014	12:50	03/11/2014	12:51
Elkap	04/08/2014	11:03	04/09/2014	11:05
Elkap	05/06/2014	09:15	05/06/2014	09:16
Elkap	06/03/2014	07:17	06/03/2014	07:19
Elkap	07/08/2014	11:20	07/08/2014	11:21
Elkap	08/05/2014	09:09	08/05/2014	09:11
Elkap	09/02/2014	08:04	09/02/2014	08:05
Elkap	10/07/2014	13:50	10/07/2014	13:51
Elkap	11/04/2014	13:21	11/04/2014	13:22
Elkap	12/02/2014	11:38	12/02/2014	11:40

Site	Start Date	Start Time	End Date	End Time
Elknm	01/07/2014	08:06	01/07/2014	08:06
Elknm	02/11/2014	12:54	02/11/2014	12:55
Elknm	03/11/2014	11:50	03/11/2014	11:52
Elknm	04/08/2014	09:59	04/08/2014	09:59
Elknm	05/06/2014	08:10	05/06/2014	08:10 (1 rep)
Elknm	06/03/2014	06:15	06/03/2014	06:16
Elknm	07/08/2014	10:24	07/08/2014	10:25
Elknm	08/05/2014	08:16	08/05/2014	08:16 (1 rep)
Elknm	09/02/2014	07:05	09/02/2014	07:05 (1 rep)
Elknm	10/07/2014	12:50	10/07/2014	12:51
Elknm	11/04/2014	12:17	11/04/2014	12:19
Elknm	12/02/2014	11:38	12/02/2014	11:38 (1 rep)

Site	Start Date	Start Time	End Date	End Time
Elksm	01/07/2014	07:21	01/07/2014	07:22
Elksm	02/11/2014	12:15	02/11/2014	12:17
Elksm	03/11/2014	10:58	03/11/2014	10:59
Elksm	04/08/2014	09:06	04/08/2014	09:07
Elksm	05/06/2014	07:23	05/06/2014	07:24
Elksm	06/03/2014	05:29	06/03/2014	05:30
Elksm	07/08/2014	09:30	07/08/2014	09:31
Elksm	08/05/2014	07:39	08/05/2014	07:40
Elksm	09/02/2014	06:30	09/02/2014	06:31
Elksm	10/07/2014	12:14	10/07/2014	12:15
Elksm	11/04/2014	11:37	11/04/2014	11:38

Elksm	12/02/2014	10:53	12/02/2014	10:54

Site	Start Date	Start Time	End Date	End Time
Elkvm	01/07/2014	08:32	01/07/2014	08:34
Elkvm	02/11/2014	14:23	02/11/2014	14:23 (1 rep)
Elkvm	03/11/2014	12:20	03/11/2014	12:20 (1 rep)
Elkvm	04/08/2014	11:08	04/08/2014	11:09
Elkvm	05/06/2014	09:41	05/06/2014	09:43
Elkvm	06/03/2014	07:44	06/02/2014	07:44 (1 rep)
Elkvm	07/08/2014	11:41	07/08/2014	11:41 (1 rep)
Elkvm	08/05/2014	09:48	08/05/2014	09:49
Elkvm	09/02/2014	08:32	09/02/2014	08:34
Elkvm	10/07/2014	14:44	10/07/2014	14:44 (1 rep)
Elkvm	11/04/2014	14:02	11/04/2014	14:02 (1 rep)
Elkvm	12/02/2014	12:43	12/02/2014	12:44

7) Associated researchers and projects

As part of the SWMP long-term monitoring program, ELK NERR also monitors Meteorological and Water Quality data which may be correlated with this Nutrient dataset. These data are available from the Research Coordinator or online at http://cdmo.baruch.sc.edu/.

The following researchers are working directly with us here at the Elkhorn Slough NERR

Susie Fork conducts field survey monitoring of shorebirds; egret and heron rookery, bird nest boxes, raptors, and invertebrate populations.

Rikke Jeppesen and Susie Fork conduct annual crab trapping in order to track crab populations, particularly invasions by non-native European crabs. Additionally, Susie Fork conducts annual invertebrate surveys on mudflats, in permant transects. The surveys include varies clam and shrimp species, in addition to fat innkeeper worms.

Charlie Endris works on remote-sensing using GIS to analyze habitat change and NERR bio-monitoring pilot studies for Tier 1, emergent vegetation.

Kerstin Wasson monitors oyster recruitment and conducts experiments to determine the status and trajectory of native oyster populations.

John Haskins and Rikke Jeppesen conduct water quality research currently focusing on eutrophication in the slough and are managing the SWMP weather monitoring and the SWMP water quality programs that are used in conjunction with eutrophication research.

The following researchers are affiliated with other institutions.

Aiello, Ivano, Moss Landing Marine Laboratories: examines sediment characteristics relevant to Minhoto restoration by collecting sediment cores using a Vibrocore.

Anderson, Brian, Siegler, Katie; UC Davis, seine for topsmelt - study pesticide levels in indicator fish.

Baguley, Jeff; University of Nevada: collects mud cores to characterize meifauna esp. harpacticoid copepods

Behesti, Kat; University of California, Santa Cruz: monitors marsh, crabs, and otters with fencing experiments to examine the effects of oteerss and crabs on salt marsh health.

Carlisle, Aron; Dale, Jonathan, Chapple, Taylor: catch small leopard sharks in the Parsons complex, using a gill net, in order to examine physiological response in sharks to different habitat conditions.

Dwywer, Nicole, University of California, Santa Cruz: observes sea otters and kayakers to determine the effects of kayakers on sea otters

Espinosa, Sara, Staedler, Michelle, et al. observe otters from land-based sites in orde to track sea otter movement and survival (radio-tagged animals) and patterns of distribution, abundance, and behavior (entire Slough population)

Fabian, Rachael, UC Santa Cruz: collects Batillaria snails to assess effects of ocean acidification on Batillaria. Batillaria is used as proxy for other snails.

Francis, Chris, Stanford University: collects water samples and sediment cores to study the diversity and activity of (de)-nitrifying microbial communities

Gibble, Corinne; Kudela, Raphe, UC Santa Cruz: collect small numbers of invertebrates to determine whether toxic algal blooms are posing a threat to common sea otter prey

Hammerstrom, Kamille; Oliver, John; Moss Landing Marine Laboratories, deploy eelgrass seeds and transplants by diving; coffee-can cores and sieving of mud; from shore and boat (for subtidal)- eelgrass restoration science project

Hughes, Brent; Nash, Paul; UC Santa Cruz, conducts surveys and experiments with algal biomass and seagrass populations and additionally quantifies eutrophication indicators.

Johnson, Andrew; Monterey Bay Aquarium: tracks sea otter movements; assesses rehabilitated animals; studies otters

Kvitek, Rikk; Spear, Brian; California State University Monterey Bay, use small boat in Parson's complex - map Slough bathymetry to monitor changes resulting from tidal scour

Lidgard, Scott collects bryozoans at Whislestop lagoon to understand gene expression and development in Bugula.

McCann, Linda, Smithsonian Environmental Research Center: sets and retrieves crab traps to examine long term trends in non-native green crab populations.

Pien, Cataraina, Moss Landing Marine Laboratories: catch elasmobranchs with gillnets, seines to determine how elasmobranch assemblages have changed over time.

Tomoleoni, Joseph collects 10-15 invertebrates (jack knife clams, mussels) to compare ease of opening of different types of sea otter prey.

Wade, Pamela, Moss Landing Marine Laboratories: maintain experiments on tiles in Whistlestop area to examine effects of competition on oysters; examine oyster recruitment.

Wyckoff, Christy, Santa Lucia Conservancy: traps and observes blackbirds to understand movement and habitat use of tri-colored blackbirds.

Frequent docent researchers: Shirley Murphy (various bird monitoring programs). Ron Eby (marsh, bird, otter monitoring)

Frequent interns: Miguel Rodriguez (water quality intern), Ken Pollak, Celeste Stanik, Margie Kay (volunteer water quality research assistants), Brady Latham, Laura Mercado (water quality interns).

8) Distribution

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and process the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:
National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: www.nerrsdata.org; *accessed* 12 October 2012.

NERR nutrient data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma separated version format.

II. Physical Structure Descriptors

9) Entry verification –

Nutrient data are entered into a Microsoft Excel worksheet and processed using the NutrientQAQC Excel macro. The NutrientQAQC macro sets up the data worksheet, metadata worksheets, and MDL worksheet; adds chosen parameters and facilitates data entry; allows the user to set the number of significant figures to be reported for each parameter and

rounds using banker's rounding rules; allows the user to input MDL values and then automatically flags/codes measured values below MDL and inserts the MDL; calculates parameters chosen by the user and automatically flags/codes for component values below MDL, negative calculated values, and missing data; allows the user to apply QAQC flags and codes to the data; produces summary statistics; graphs selected parameters for review; and exports the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database

Monthly nutrient data are obtained by filtering grab and diel samples at Moss Landing Marine Laboratory, Moss Landing, CA. John Haskins and Rikke Preisler are responsible for measuring nitrite, ammonia, and chlorophyll concentrations. Sara Tanner is responsible for measuring nitrite+nitrate, and phosphate concentrations. All data are entered in an Excel spread sheet while processing the samples of nitrite, ammonia, and chlorophyll. Sara Tanner e-mails the remaining results monthly, and Tanner's results are then entered into the same monthly nutrient Excel sheet by Rikke Preisler. The Excel file contains information of sampling station ID, date and time, and parameter values expressed in unit concentrations. Rikke Preisler verify all parameter values in the excel file by cross comparison with laboratory data sheets and by graphing the data and identifying anomalous data points or other problems. Monthly excel files were compiled into a yearly excel file. Missing data are verified through inspection of fields.

All parameter values at Moss Landing Marine Laboratories (MLML) are calculated and reported in µM. For purposes of consistency in the NERR System, Elkhorn Slough NERR calculates the concentrations as mg/ l-1 based on atomic weights of 14.01, 30.97 for N and P respectively. Therefore, Elkhorn Slough NERR staff multiplies the concentrations reported by MLML by 0.01401, 0.03097 to yield concentrations in mg/L as N and P respectively. Chlorophyll a is measured in RFU and ESNERR staff converts RFU to µg/L by using the following conversion:
$(1.45*10^{-4}$ µg Chla/mL/RFU)*$RFU_{measured}$*dilution factor* (extraction volume/filtered volume)*1000mL/L

10) Parameter Titles and Variable Names by Data Category

Required NOAA/NERRS System-wide Monitoring Program nutrient parameters are denoted by an asterisks "*".

Data Category	Parameter	Variable Name	Units of Measure
Phosphorus and Nitrogen:			
	*Orthophosphate	PO4F	mg/L as P
	*Ammonium, Filtered	NH4F	mg/L as N
	*Nitrite, Filtered	NO2F	mg/L as N
	*Nitrate, Filtered	NO3F	mg/L as N
	*Nitrite + Nitrate, Filtered	NO23F	mg/L as N
	Dissolved Inorganic Nitrogen	DIN	mg/L as N
Plant Pigments:			
	*Chlorophyll a	CHLA_N	µg/L

Notes:

1. Time is coded based on a 2400 clock and is referenced to Standard Time.
2. Reserves have the option of measuring either NO2 and NO3 or they may substitute NO23 for individual analyses if they can show that NO2 is a minor component relative to NO3.

11) Measured and Calculated Laboratory Parameters –

a)Parameters measured directly

Nitrogen species:	NH4F, NO2F, NO23F
Phosphorus species:	PO4F
Other:	CHLA_N

b)Calculated parameters

NO3F	NO23F-NO2F
DIN	NO23F+NH4F

12) Limits of Detection -

The Moss Landing Marine Lab (MLML) Nutrient Analytical Laboratory has established Method Detection Limits (MDL), the lowest concentration of a parameter that an analytical procedure can reliably detect. The MDL is determined as 3 times the standard deviation of a minimum of five replicates of a single low concentration sample. The overall annual MDL is calculated as the average of the monthly MDLs. The following chart presents the current average MDL's; these values are reviewed and revised periodically. The MDL for each individual month are listed in the submitted raw metadata spreadsheet.

MDL TABLE

Parameter	Start date	End date	MDL
NO23F	1/1/2014	1/31/2014	0.00027
NO23F	2/1/2014	2/28/2014	0.00034
NO23F	3/1/2014	3/31/2014	0.00037
NO23F	4/1/2014	4/30/2014	0.00023
NO23F	5/1/2014	5/31/2014	0.00012
NO23F	6/1/2014	6/30/2014	0.00036
NO23F	7/1/2014	7/31/2014	0.00053
NO23F	8/1/2014	8/31/2014	0.00039
NO23F	9/1/2014	9/30/2014	GDM
NO23F	10/1/2014	10/31/2014	0.00031
NO23F	11/1/2014	11/30/2014	0.00021
NO23F	12/1/2014	12/31/2014	0.00035
NO3F	1/1/2014	1/31/2014	0.00783
NO3F	2/1/2014	2/28/2014	0.00389
NO3F	3/1/2014	3/31/2014	0.00000
NO3F	4/1/2014	4/30/2014	0.00424
NO3F	5/1/2014	5/31/2014	0.00300
NO3F	6/1/2014	6/30/2014	0.00267
NO3F	7/1/2014	7/31/2014	0.00526

NO3F	8/1/2014	8/31/2014	0.00214
NO3F	9/1/2014	9/30/2014	GDM
NO3F	10/1/2014	10/31/2014	0.00514
NO3F	11/1/2014	11/30/2014	0.00491
NO3F	12/1/2014	12/31/2014	0.00242
PO4F	1/1/2014	1/31/2014	0.00170
PO4F	2/1/2014	2/28/2014	0.00168
PO4F	3/1/2014	3/31/2014	0.00173
PO4F	4/1/2014	4/30/2014	0.00250
PO4F	5/1/2014	5/31/2014	0.00183
PO4F	6/1/2014	6/30/2014	0.00094
PO4F	7/1/2014	7/31/2014	0.00173
PO4F	8/1/2014	8/31/2014	0.00047
PO4F	9/1/2014	9/30/2014	GDM
PO4F	10/1/2014	10/31/2014	0.00142
PO4F	11/1/2014	11/30/2014	0.00138
PO4F	12/1/2014	12/31/2014	0.00271
NH4F	1/1/2014	1/31/2014	0.00449
NH4F	2/1/2014	2/28/2014	0.00239
NH4F	3/1/2014	3/31/2014	0.00231
NH4F	4/1/2014	4/30/2014	0.00164
NH4F	5/1/2014	5/31/2014	0.00135
NH4F	6/1/2014	6/30/2014	0.00142
NH4F	7/1/2014	7/31/2014	0.00421
NH4F	8/1/2014	8/31/2014	0.00225
NH4F	9/1/2014	9/30/2014	GDM
NH4F	10/1/2014	10/31/2014	0.00543
NH4F	11/1/2014	11/30/2014	0.00377
NH4F	12/1/2014	12/31/2014	0.00405
CHLA_N	1/1/2014	12/31/2014	0.04500

13) Laboratory Methods –

a) **Parameter: NH4F**

i) Method Reference: Stricklin and Parsons Determination of Ammonia.

ii) Method Descriptor: Samples collected and stored on ice in amber bottles prior to being filtered with a 0.45 μm GFF filter and subsequently subjected to hypochlorite-phenol in the presence of NH3. Sodium nitroprusside is then used as a catalyst in the reaction. An oxidizing solution is then added (a mixture of sodium hypochlorite and alkaline reagent). The sample is then allowed to stand at a temperature between 20 and 27 C for at least 1 hour and then placed in a 1 cm cuvette and absorbance is measured at 640 nm.

iii) Preservation Method: Samples filtered and stored at 4 °C up to 24 hours.

b) **Parameter: NO23F, NO3F, and NO2F**

i) Method Reference: Stricklin and Parsons Determination of Nitrite.

ii) Method Descriptor: The water sample is first filtered then is passed through a cadmium column where the nitrate is reduced to nitrite. When only analyzing for nitrite the sample is not exposed to cadmium and thus the nitrite in the water is quantified. The nitrite is then exposed to sulfanilamide solution and allowed to react for 2 minutes then is exposed to N-(1-naphthyl)-ethylenediamine dihydrochloride solution and allowed to react for at least 10 minutes. The sample is then placed in a 10 cm cuvette where the absorbance is measured at 543 nm. Nitrate concentration equals the NO23F (nitrate + nitrite) concentration minus the nitrite concentration. Thus NO3 is calculated by subtracting NO23F - N02F.

iii) Preservation Method: Sample is filtered through a 0.45 um filter and analyzed the same day.

c) **Parameter: PO4F**

i. Method Reference. Same as Nitrite with Alpkem analyzer.

ii. Method Descriptor: Ammonium molybdate is added to a water sample to produce phosphomolybdic acid, which is then reduced to phosphomolybdous acid (a blue compound) following the addition of dihydrazine (or hydrazine) sulfate. The sample is passed through a 50 mm flow cell and absorbance is measured at 820 nm.

iii. Preservation Method: Sample is filtered through a 0.45 um filter and analyzed the same day.

d) **Parameter: ChlA**

i) Method Reference. EPA method 445.0*UNESCO* (1994) Protocols for the joint global ocean flux study (JGOFS) core measurements. pp. 97-100.

ii) Method Descriptor: CHLA is extracted in 8 ml 90% acetone for 24 hrs and then fluorescence is measured and recorded (Fo).

iii) Preservation Method: A known volume of sample is filtered onto a 25 mm GF/F filter, folded in half and placed in a know volume of 90% acetone and then stored at -4^{o}C until analysis 24 hrs later.

14) Field and Laboratory QA/QC Programs –

a. Precision

i. **Field Variability** –ELKNERR collects two or three successive grab samples for the determination of water mass variability within each site. Each collection date, there are three true field replicates, which are successive grab samples.

ii. **Laboratory Variability** – In determining laboratory variability, replicates are split from a single diel sample. Three laboratory replicates are done for ammonium, nitrite, nitrate and phosphate standards on a regular basis. Variability was found to be no more than 74 % for nitrite, 59% for nitrite+nitrate, 25% for phosphate, and 21% for ammonia.

Average percent difference

Nitrite	40.2%
Ammonia	8.2%
Nitrate	5.0%
Phosphate	4.2%

iii. **Inter-organizational splits** – None

b. Accuracy

i. **Sample Spikes** – Sample spikes were split from a single diel sample. Sample spikes were always from the sample diel sample as lab replicate 3. Sample spikes are done for nitrite and ammonium on a monthly basis. Average percent recovery was found to be 33% for nitrite and 94% for ammonia.

ii. **Standard Reference Material Analysis –** Standard reference materials are diluted from a single concentrated stock sample. Standard reference analysis is conducted for nitrite and ammonium on a regular basis. Average percent difference was found to be 26.3% for nitrite and 7.8% for ammonia.

iii. **Cross Calibration Exercises** – An inter-comparison study is conducted in some years of a known concentration of nutrients in seawater as part of the NOAA National Estuarine Research Reserve System-Wide Monitoring Program. Our analyses of all the nutrients have been within one standard deviation of all nutrients analyzed among all labs in the program.

15) QAQC flag definitions –

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). QAQC flags are applied to the nutrient data during secondary QAQC to indicate data that are out of sensor range low (-4), rejected due to QAQC checks (-3), missing (-2), optional and were not collected (-1), suspect (1), and that have been corrected (5). All remaining data are flagged as having passed initial QAQC checks (0) when the data are uploaded and assimilated into the CDMO ODIS as provisional plus data. The historical data flag (4) is used to indicate data that were submitted to the CDMO prior to the initiation of secondary QAQC flags and codes (and the use of the automated primary QAQC system for WQ and MET data). This flag is only present in historical data that are exported from the CDMO ODIS.

-4 Outside Low Sensor Range
-3 Data Rejected due to QAQC
-2 Missing Data
-1 Optional SWMP Supported Parameter
0 Data Passed Initial QAQC Checks
1 Suspect Data
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

16) QAQC code definitions –

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the sample or sample collection, sensor errors document common sensor or parameter specific

problems, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point. However, a record flag column (F_Record) in the nutrient data allows multiple comment codes to be applied to the entire data record.

General errors

GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GDM	Data missing or sample never collected
GQD	Data rejected due to QA/QC checks
GQS	Data suspect due to QA/QC checks
GSM	See metadata

Sensor errors

SBL	Value below minimum limit of method detection
SCB	Calculated value could not be determined due to a below MDL component
SCC	Calculation with this component resulted in a negative value
SNV	Calculated value is negative
SRD	Replicate values differ substantially
SUL	Value above upper limit of method detection

Parameter Comments

CAB	Algal bloom
CDR	Sample diluted and rerun
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Record comments

CAB	Algal bloom
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Cloud cover

CCL	clear (0-10%)
CSP	scattered to partly cloudy (10-50%)

CPB	partly to broken (50-90%)
COC	overcast (>90%)
CFY	foggy
CHY	hazy
CCC	cloud (no percentage)

Precipitation

PNP	none
PDR	drizzle
PLR	light rain
PHR	heavy rain
PSQ	squally
PFQ	frozen precipitation (sleet/snow/freezing rain)
PSR	mixed rain and snow

Tide stage

TSE	ebb tide
TSF	flood tide
TSH	high tide
TSL	low tide

Wave height

WH0	0 to <0.1 meters
WH1	0.1 to 0.3 meters
WH2	0.3 to 0.6 meters
WH3	0.6 to > 1.0 meters
WH4	1.0 to 1.3 meters
WH5	1.3 or greater meters

Wind direction

N	from the north
NNE	from the north northeast
NE	from the northeast
ENE	from the east northeast
E	from the east
ESE	from the east southeast
SE	from the southeast
SSE	from the south southeast
S	from the south
SSW	from the south southwest
SW	from the southwest
WSW	from the west southwest
W	from the west
WNW	from the west northwest
NW	from the northwest
NNW	from the north northwest

Wind speed

WS0	0 to 1 knot
WS1	> 1 to 10 knots

WS2	> 10 to 20 knots
WS3	> 20 to 30 knots
WS4	> 30 to 40 knots
WS5	> 40 knots

17) Other remarks/notes

Data may be missing due to problems with sample collection or processing. Laboratories in the NERRS System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. MDLs for specific parameters are listed in the Laboratory Methods and Detection Limits Section (Section II, Part 12) of this document. Concentrations that are less than this limit are censored with the use of a QAQC flag and code, and the reported value is the method detection limit itself rather than a measured value. For example, if the measured concentration of NO23F was 0.0005 mg/l as N (MDL=0.0008), the reported value would be 0.0008 and would be flagged as out of sensor range low (-4) and coded SBL. In addition, if any of the components used to calculate a variable are below the MDL, the calculated variable is removed and flagged/coded -4 SCB. If a calculated value is negative, it is rejected and all measured components are marked suspect. If additional information on MDL's or missing, suspect, or rejected data is needed, contact the Research Coordinator at the Reserve submitting the data.

Note: The way below MDL values are handled in the NERRS SWMP dataset was changed in November of 2011. Previously, below MDL data from 2007-2010 were also flagged/coded, but either reported as the measured value or a blank cell. Any 2007-2011 nutrient/pigment data downloaded from the CDMO prior to November of 2011 will reflect this difference.

In February 2014, the ISCO sampler ran out of battery and samples ISCO8 to ISCO13 were not collected. The battery has now been replaced.

In September 2014, the filtered samples accidentally were discarded before analyzed for phosphate and nitrite+nitrate.