2018 Upper Perdido Bay Ecological Survey Report

Friends of Perdido Bay

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Cover Photo: View of Entrance to Wicker Lake from Ponar Sample Station WL-1 on August 13, 2018

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1 Overview

Routine sampling of Upper Perdido Bay by International Paper and previous owners of the Cantonment paper mill was conducted under the guidance of Dr. Skip Livingston, from October 1988 until September 2007, when much of the active field sampling in Upper Perdido Bay ceased.

Between 2008 and 2014 data collection by the mill included a significant amount of benthic macroinvertebrate sampling within the wetlands upstream of the Tee and Wicker Lake complex and within Eleven Mile Creek. Most of this work was performed by Water and Air Research, and represents the nascent development of the baseline data by International Paper to seek a Site Specific Alternative Criteria from the FDEP.

In 2014, International Paper contacted the FDEP to seek a Site Specific Alternative Criteria for Dissolved Oxygen (DO SSAC) based on their wetland treatment and land management data collection. The DO SSAC included an intensive biomonitoring program which was approved in August of 2014. The data collection portion of the plan, implemented by Nutter and Associates in April 2014, included macroinvertebrate collections in the Tee and Wicker lakes complex in March and May of 2015. The consent order authorizing the DO SSAC was approved in 2018. The DO SSAC requires a robust chemical, floral, and faunal biological monitoring program to demonstrate compliance with the SSAC. This monitoring includes chemical analysis in the Upper Perdido Bay, Tee, and Wicker Lake complex and Eleven Mile creek. Additionally biomonitoring in the form of Stream Condition Index sampling is to be performed in Eleven Mile Creek.

In an effort to provide additional information on the current condition of Upper Perdido Bay and Tee and Wicker Lakes, the Friends of Perdido Bay (FOPB) requested the completion of an ecological assessment of several established stations within the Bay. This assessment includes a benthic macroinvertebrate assessment collected via petite ponar, an epibenthic vertebrates, and macroinvertebrate assessment via otter trawl, as well as the general physicochemical measurements associated with the sample locations

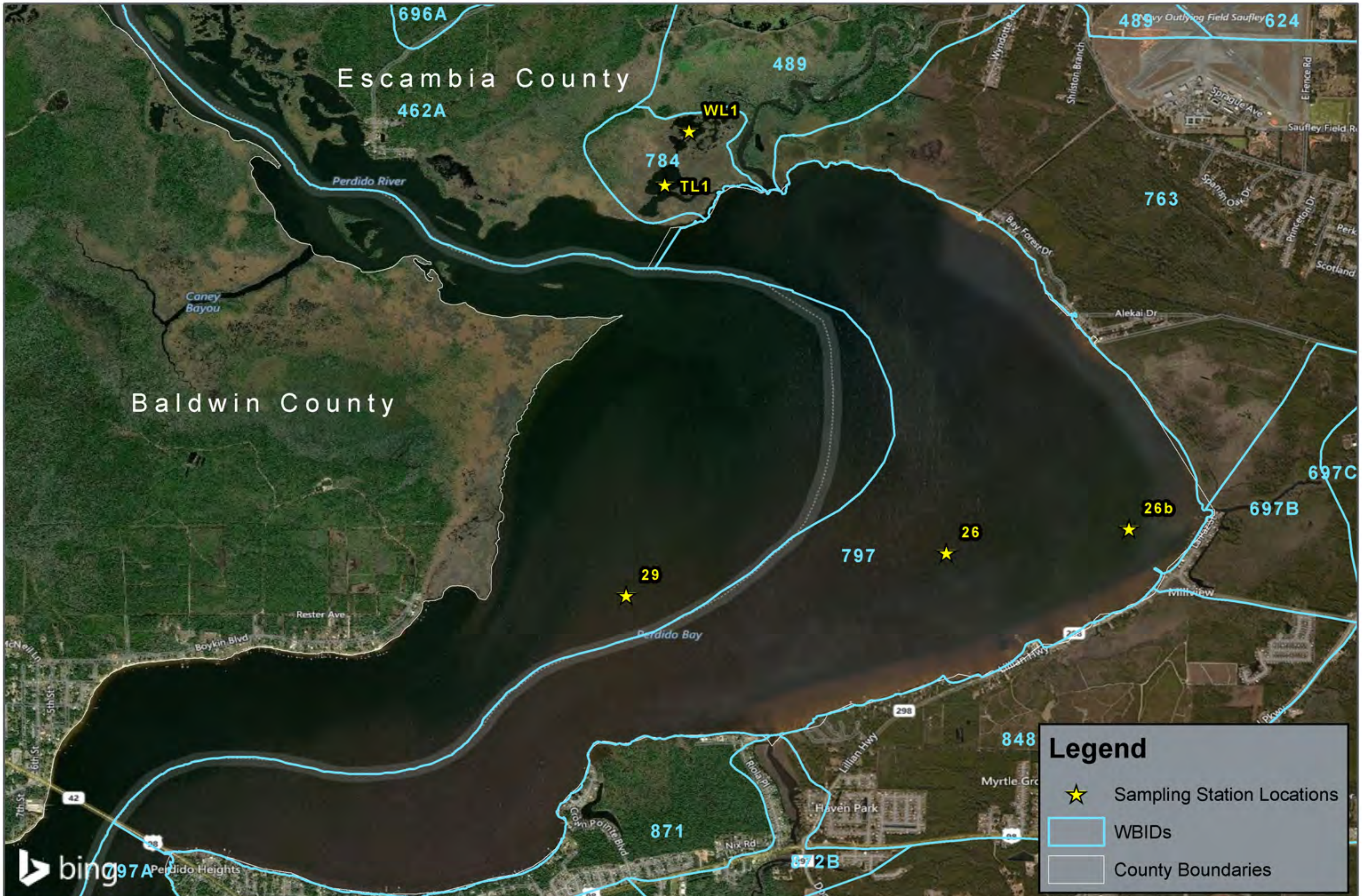
This report serves as a summary of the Upper Perdido Bay Ecological Survey, completed on August 13-14, 2018.

2 Sampling Locations

All sample collections were performed across or between five established stations. The three sampling locations within Upper Perdido Bay were previously established for monitoring conducted by Dr. Livingston. The two stations located within the Tee and Wicker Lake complex were established for the purposes of this project, but closely correspond to historical sampling locations within the FDEP network, see **Table 1**. Stations 26 and 26b are located in the eastern portion of the Upper Bay. Station 26 is located approximately halfway between the centerline of the Upper Bay and the eastern shore and 26b is located approximately 500 meters from the eastern shoreline. Station 26b was used exclusively as the trawl station endpoint. Station 29 is located in Alabama state waters in the western portion of Upper Perdido Bay approximately halfway between the centerline of the Upper Bay and the western shore. Station TL-1 is located in Tee Lake on the far northern portion of Perdido Bay. This station is located in the approximate center of the largest open water portion of Tee Lake just northwest of the mouth of the entrance to Tee Lake. Station WL-1 is located in the approximate center of the largest open water portion of Wicker Lake just north of a smaller lobe of the lake. See station map in **Figure 1**.

Table 1 Sample Station locations within Upper Perdido Bay.

Station	Latitude	Longitude	Location
26	30.42700	-87.36233	Upper Perdido Bay – East Portion
29	30.42350	-87.38867	Upper Perdido Bay – West Portion
26b	30.428962	-87.347308	Upper Perdido Bay – Far East Portion
TL-1	30.45730	-87.3855	Tee Lake – Near Lake Center
WL-1	30.461711	-87.3835	Wicker Lake – Near Lake Center



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Sampling Station Locations

Upper Perdido Bay
Escambia County, Florida

0 — 4,000 — 8,000 Feet
0 — 1,219 — 2,438 Meters

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GIS Analyst: Lauren Federsel

3 Methods

Sampling for this project consisted of four major tasks. Task 1. Collection of physicochemical measurements prior to the completion of biological sampling. Task 2. Collection of benthic macroinvertebrate samples using a petite ponar sampler at selected stations. Task 3. Collection by otter trawl of epibenthic vertebrate and macroinvertebrate samples along a selected transect. Task 4. Processing, taxonomic identification, and statistical analysis of all samples at the Cardno wet lab. Physicochemical and biological parameters are detailed in **Table 2**.

Table 2 List of physiochemical and analytical parameters measured by station in Upper Perdido Bay.

Sample Analysis	Sample Stations				
	26	26b	29	TL-1	WL-1
Temperature	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution
Dissolved Oxygen	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution
pH	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution
Salinity	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution
Specific Conductance	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution	Depth Profile: 0.5m resolution
Secchi Depth	Max Secchi	Max Secchi	Max Secchi	Max Secchi	Max Secchi
Turbidity	Grab @ 0.5m	Grab @ 0.5m	Grab @ 0.5m	Grab @ 0.5m	Grab @ 0.5m
Petite Ponar (Macroinvert)	3 ponar composite	N/A	3 ponar composite	3 ponar composite	3 ponar composite
Otter Trawl (Epibenthic)	N/A	7 Trawl Tows	N/A	N/A	N/A

3.1 Physicochemical Sampling

Physicochemical data was collected at all stations in accordance with FDEP SOP FS1000 and FS2000 series. Physicochemical measurements, including Temperature, Dissolved Oxygen, Salinity, and Specific Conductance were collected at each station prior to the start of the prescribed biological sampling protocol. Physicochemical measurements were collected using an YSI 6920 V2 multi-parameter sonde with appropriate calibration brackets. At stations with a depth of greater than 1 meter, profile samples were collected at 0.5 meter increments starting at a depth of 0.5 meters and continuing until reaching near bottom. In stations with a depth of less than 1 meter, profile samples were collected at near surface (approx. 0.25 meters) and near bottom (0.75 meters). In addition to sonde measurements, turbidity was measured using a Hach 2100P Turbidimeter with appropriate calibration brackets. Turbidity samples were collected within the top 0.5 meters of water following a triple rinse of the sampling cuvette. The turbidimeter was set to average a series of multiple turbidity measurements from the same sample cuvette to obtain an accurate result. Finally, at each station, a secchi measurement to assess light penetration was performed using a standard 30 cm Secchi disk with a white/black color bias in compliance with standard methodology as described in FDEP SOP FT1700.

3.2 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate sampling was completed at stations 26, 29, TL-1 and WL-1 in general accordance with FDEP SOP FS7000 series. Samples were collected at each station using a Wildco 6X6 inch stainless steel petite ponar. Three replicate 6 inch ponar grabs were collected and composited at each station sampled. Each individual ponar replicate was brought aboard the boat and inspected to insure proper sampler performance. Once a successful replicate was completed, the material was systematically transferred from the ponar into an 18-inch brass sieve with a US standard #35 stainless steel mesh. The replicate was then sieved such that all small sediment components were removed from the matrix leaving only the larger sediment components and the targeted benthic macroinvertebrates. The remaining components were methodically transferred from the sieve to a container and preserved with 10% buffered formalin with a Rose Bengal stain. After three replicates were composited and a complete sample was transferred to the sample container, the container was labelled with an external and internal label and placed under Chain of Custody to be transferred to the Cardno wet lab for analysis. Ponar samples were performed as the first biological analysis to avoid sampling in an area that may become disturbed by trawling.

3.3 Epibenthic Vertebrate and Macroinvertebrate Sampling

Epibenthic sampling was completed along a transect extending between stations 26 and 26b in the eastern portion of Upper Perdido Bay. Sampling was completed in accordance with FDEP SOP FS7000 series. Trawl sampling was performed using a standard 5 meter otter trawl with a mesh size of 1.9 cm for the wing and a mesh size of 0.6 cm for the liner. Each of the trawl replicates were towed at a speed of 3.5-4 km/hr. for a 2 minute period as consistent with Livingston, 2007. Each of the seven replicate otter trawl tows were performed between stations 26 and 26b with general consideration to not cover a previously trawled alignment. Upon completion of each replicate otter trawl tow, the catch was brought aboard and removed from the otter trawl netting. The original sample plan provided for all specimens to be collected, measured, and weighed on station to minimize specimen mortality. Due to the large number of individuals caught in replicate trawls 1 and 7, all samples were collected, placed in labelled containers, preserved with 10% buffered formalin and returned to the Cardno wet lab for taxonomic identification, enumeration, and weighing.

3.4 Laboratory Analysis

Following the completion of the field event, all samples were transferred under Chain of Custody to the Cardno wet lab for analysis. Ponar samples were allowed to rest under preservation for an additional 24 hours to allow for an increased uptake of Rose Bengal stain into the lipids of the macroinvertebrates. Trawl samples remained sealed in containers with a 10% buffered formalin solution until they were processed.

Ponar samples were processed using a US standard #35 sieve and irrigated to remove any additional formalin and Rose Bengal in the matrix. Samples were then transferred to a pick pan to allow for aliquot selection. Aliquots of sample matrix were transferred to a petri dish and macroinvertebrates were sorted from the matrix using a Wild M5A stereo microscope. For each aliquot, macroinvertebrate sampling was performed using a systematic grid search pattern until no more macroinvertebrates were found. As quality control, each of the aliquots were then disturbed in the petri dish and searched again using the systematic grid search procedure until no macroinvertebrates were discovered in three successive searches. Collected macroinvertebrates were identified per aliquot to the Lowest Practical Taxonomic Level (LPIL), enumerated, and archived per station in borosilicate vials in 70% ethanol. This procedure was repeated until all ponar samples were sorted in their entirety. Taxonomic identification of marine organisms was performed by Robert Howell, and taxonomic identification of freshwater organisms was performed by Dr. John Epler.

All seven trawl samples were collected and brought to the Cardno Wet lab in 10% buffered formalin. For each sample, all fishes and invertebrates were identified to LPIL by Robert Howell with species verification from Hoese and Moore's Fishes of the Gulf of Mexico and naming convention verification using the World Register of Marine Species. Due to the large numbers of fishes of same species caught in some trawls, Cardno employed a size classification methodology. Within a single species and within a single trawl, size classes were created at ten millimeter increments. In any instance where the number of individuals within a given size class exceeded ten individuals, all individuals were grouped and weighed as one class. Any 10 mm size class containing less than 10 individuals, individuals were weighed and measured separately. All individuals were assessed for external physical abnormalities.

4 Results and Discussion

All sampling was completed between the morning of August 13, 2018 and the afternoon of August 14, 2018. All samples were collected on an incoming tide and outside any precipitation event.

4.1 Antecedent Weather and Tidal Conditions

Air temperatures on August 13 and 14, 2018 were warm and near average for summer in the western Florida Panhandle with highs in the mid-90s and lows in the mid-70s. According to the National Weather Service (NWS) Station in Pensacola, FL. 0.68 inches of precipitation fell in the late afternoon of August 13. In the preceding 72 hours, a total of 0.18 inches of precipitation fell within the area. Ponar samples were collected on August 13 and trawl samples were collected on August 14. The Nix Point tide gauge located at Perdido Bay indicated that low tide occurred at 2:23 AM (0.0 ft.) and high tide at 15:56 PM (0.8 ft.). On August 14, low tide occurred at 2:38 AM (0.1 ft.) and high tide at 16:57 PM (0.7 ft.). All samples were collected on an incoming tide. General weather conditions on both days were clear to partly cloudy in the morning progressing to mostly cloudy in the afternoon with a light to moderate north wind.

4.2 Physicochemical Data Collection

Physicochemical data was recorded as a profile of 0.5m increments at all stations where depth permitted and as top and bottom readings when the depth was too shallow for a true profile, see **Table 3**. All samples were recorded using equipment that was maintained with appropriate calibration brackets.

Four of the five sample stations are located within two distinct FDEP Watershed Boundary IDs (WBIDs). Stations WL-1 and TL-1 are located in WBID 784, the Tee and Wicker Lakes. Station 26 and 26b are located in WBID 797 Perdido bay (Upper Segment). Station 29 is located in the Alabama portion of Upper Perdido Bay approximately 400-500 meters west of the state boundary. For purposes of this assessment, station 29 will be assessed as if it were in WBID 797 to provide a comparable metric. All stations exist in watersheds that are categorized as Class III M waters. All waters are considered to be estuarine in nature.

The rules that guide the physicochemical portion of the assessment include the following:

For Florida waters, Rule 62-303.200 F.A.C. defines predominantly marine waters as any body of water whose average conductivity exceed 4580 umohs/com in the bottom half of the water column. As expected, all conductivity measurements in Perdido Bay and the Tee/Wicker Lake complex meet the threshold for a predominantly marine waterbody.

Rule 62-302.530 F.A.C. establishes regulatory criterion regarding physicochemical and analytical chemistry measurements within Florida waters.

Rule 62-302.533 F.A.C. establishes a regulatory DO criteria based on diel measurements, so single measurement values are not an indication of an exceedance. However, single measurements can be an indicator of a need for further study.

Table 3 Physicochemical Measurements at selected stations within Upper Perdido Bay.

Station	Depth (M)	Temperature (C)	Ph (SU)	Specific Conductance (umohs/cm)	DO (mg/L)	DO (%sat)	Salinity (ppt)	Turbidity (NTU)	Secchi (M)
WL-1	0.30	29.12	7.06	11463	4.78	64.4	6.48	6.52	VOB
	0.75	29.11	7.01	11670	4.27	57.4	6.62		
TL-1	0.25	29.72	7.17	12982	5.35	73.3	7.41	7.18	VOB
	0.75	30.07	7.09	15009	4.94	68.6	8.67		
29	0.5	29.76	7.52	14314	7.60	105.2	8.25	2.57	0.90
	1.0	29.45	7.52	15812	7.53	103.6	9.18		
	1.5	30.09	7.50	18525	6.72	95.0	11.6		
	2.0	30.95	7.20	33785	2.57	38.7	21.04		
	2.5	30.95	7.17	33861	2.07	31.2	21.09		
26	0.5	29.78	7.52	15027	7.42	103.2	8.66	4.85	0.75
	1	29.56	7.51	15115	7.52	103.2	8.75		
	1.5	29.39	7.47	16194	7.12	98.1	9.42		
	2.0	30.34	7.21	27507	2.81	40.1	16.88		
26b	0.5	29.55	7.99	14902	7.10	97.7	8.61	4.26	0.90
	1	29.49	7.99	15022	7.15	98.4	8.68		
	1.5	30.35	7.77	22731	4.69	67.3	13.66		
	2.0	30.33	7.46	26118	1.56	22.1	15.88		

VOB – Secchi Disk is visible on the bottom.

According to administrative code, in class III marine waters, pH must not be lowered to less than 6.5 units or raised above 8.5 units. If natural background is demonstrated to be outside of these limits, pH must not vary more than one unit from natural background. Considering all stations and depths in the profiles, pH measurements ranged between 7.01 and 7.99 SU, thus all measurements meet the FDEP pH standard. As expected, the highest pH values are exhibited at the stations in the main part of the bay while the lowest pH measurements are exhibited in the Tee and Wicker lakes. The difference in pH values is primarily due to the influence of lower salinity and a higher quantity of organic materials on water chemistry.

In class III marine waters, administrative code requires that turbidity levels shall be maintained at less than 29 NTU above background conditions. All turbidity measurements collected at all stations ranged between 2.57 and 7.18 SU. There were no visible contributions for ongoing construction in the area. All stations meet the turbidity standard. The Tee and Wicker lake complex exhibited a slightly higher turbidity measurement than the main bay stations. This could be due to a number of factors, but is most likely due to a combination of water movement within the complex coupled with a higher algal content in the lake waters compared to the Bay. Further testing would need to be performed to confirm this assumption.

The Florida administrative rule established minimum DO saturation levels is based on a trio of conditions as follows: First, the daily average percent DO saturation shall not be reduced below 42% saturation in more than 10% of all diel values collected. Second, the seven-day average DO percent saturation shall not be reduced below 51% saturation more than once in any twelve week period. Third, the 30-day average DO percent saturation shall not be reduced below 56% more than once per year. Diel measurements were not collected during this sample event. However, it can be useful to compare single measurements to the standard as a means of demonstrating potential compliance. In Upper Perdido Bay and in the Tee and Wicker lakes complex, all measurements collected within the top 1.5 meters of water at all stations meet the conditions of the DO standard. The deeper measurements in Upper Perdido Bay begin to exhibit a rapid decline in oxygen levels below 1.5 meter. It is important to reiterate, that single measurements of Dissolved Oxygen do not indicate compliance or non-compliance to administrative rule, that only diel measurements are considered valid assessments of the rule.

Without further chemical (nutrient and chlorophyll) or planktonic analysis, it is difficult to prescribe a trophic condition such as oligotrophic or eutrophic to the bay or lakes. However, surface DO levels at or above 100% saturation coupled with low DO levels at the bottom are a potential indicator of phytoplankton bloom conditions. Additional analysis would be required to provide a more detailed assessment of trophic condition.

4.3 Benthic Macroinvertebrate Data Collection

Benthic sampling was completed at four stations within Upper Perdido Bay. Stations 26 and 29 represent the eastern and western portions of Upper Perdido Bay respectively. Stations TL-1 and WL-1 represent the Tee and Wicker lakes respectively. Each sample consisted of a three ponar composite. FDEP considers the use of a three ponar composite for the size petite ponar being used in this assessment to be adequate if a count of 300 individuals or more is collected. Upon analysis, none of the samples achieved the 300 individual goal. The closest individual count in this group of stations was 261 individuals at station TL-1. The fewest number of individuals were collected at WL-1 with only 69 individuals being collected. Stations 26 and 29 resulted in counts of 71 and 135 individuals respectively.

4.3.1 Station 26 – Eastern Upper Perdido Bay

Station 26, on the east side of Upper Perdido Bay exhibited a total collection of 71 individuals from four species. Of those individuals, there were two species of polychaete worms and two species of bivalves, all four of which are generally considered euryhaline generalist estuarine species, see **Table 4**.

Table 4 Species List and Count from Station 26 – East Upper Perdido Bay

Class	Order	Family	Genus	Species	Abundance	Fresh/Marine
Polychaeta	Canalipalpata	Spionidae	*Streblospio*	*benedicti*	50	Marine
Polychaeta	Sedentaria	Capitellidae	*Mediomastus*	*ambiseta*	15	Marine
Bivalvia	Veneroida	Mactridae	*Rangia*	*cuneata*	5	Marine
Bivalvia	Cardiida	Tellinidae	*Ameritella*	*mitchelli*	1	Marine

4.3.2 Station 29 – Western Upper Perdido Bay

Station 29 on the western side of Upper Perdido Bay received a total collection of 135 individuals from four species. These four species are the same taxa found at station 26. The species are comprised of two polychaete worms and two bivalves, all of which are considered to be euryhaline generalist estuarine species, see **Table 5**.

Table 5 Species List and Count from Station 29 – West Upper Perdido Bay

Class	Order	Family	Genus	Species	Abundance	Fresh/Marine
Polychaeta	Canalipalpata	Spionidae	*Streblospio*	*benedicti*	93	Marine
Polychaeta	Sedentaria	Capitellidae	*Mediomastus*	*ambiseta*	35	Marine
Bivalvia	Veneroida	Mactridae	*Rangia*	*cuneata*	6	Marine
Bivalvia	Cardiida	Tellinidae	*Ameritella*	*mitchelli*	1	Marine

4.3.3 Station TL-1 – Tee Lake

Station TL-1 is located at the approximate center of Tee Lake in the northern portion of Upper Perdido Bay. This station exhibited a total collection of 261 individuals from sixteen species. This station contained both estuarine (marine) and freshwater species. The collected taxa consists of four polychaete species, three dipteran species, two bivalve species, two shrimp species, one isopod species, one amphipod species, one oligochaete worm species, one ribbon worm species, and one copepod species. All marine species are euryhaline generalists. While the majority of the species found in Tee Lake were estuarine (marine) (13 of 16), the majority of the individual invertebrates collected were freshwater species (66.3%). All of the freshwater species are particularly tolerant of low oxygen conditions, see **Table 6**.

Specific conductance at the time of sampling was 15,009 umohs/cm, indicating estuarine conditions. Nutter and Associates during April 2014 - April 2015 sampling of Tee and Wicker lakes reported an average specific conductivity of 11,095 umohs/cm from bottom samples in Tee Lake, with a range of 102 – 32,363 umohs/cm and a standard deviation of 8,657 umohs/cm. Median specific conductance was 10,611 umohs/cm, with 25th and 75th percentiles of 1,583 and 18,336 umohs/cm respectively. This indicates that while Tee Lake is correctly identified as a marine water, it spends considerable time in a freshwater condition.

In March 2015, Nutter and Associates collected 4 ponar samples from near TL-1 but the data available does not provide the specific conductivity on the sample date. From the Nutter sample, 36 taxa and 929 individuals were recovered, with the majority of both taxa and individuals being estuarine (marine) organisms. It is likely that saltier conditions prevailed during this sample collection than during our August sampling.

It is important to understand that the benthic community within Tee Lake must change in response to changing salinities and that this change can be both frequent and sudden. By their very nature, estuaries are areas of natural environmental flux for basic parameters that influence biological communities. It would not be unusual for the species list from the same station to change dramatically in number of taxa, composition of taxa and in abundance season to season or year to year with only a few taxa in–common between sampling events.

Table 6 Species List and Count from Station TL-1 – Tee Lake

Class	Order	Family	Genus	Species	Abundance	Fresh/Marine
Polychaeta	Canalipalpata	Spionidae	*Streblospio*	*benedicti*	35	Marine
Polychaeta	Sedentaria	Capitellidae	*Mediomastus*	*ambiseta*	29	Marine
Bivalvia	Veneroida	Mactridae	*Rangia*	*cuneata*	4	Marine
Bivalvia	Cardiida	Tellinidae	*Ameritella*	*mitchelli*	1	Marine
Polychaeta	Phyllodocida	Nereididae	*Laeonereis*	*culveri*	1	Marine
Polychaeta	Terebellida	Ampharetidae	*Hobsonia*	*florida*	8	Marine
Nemertea (phylum)				sp.	1	Marine
Hexanauplia	Copepoda (subclass)			sp.	2	Marine
Malacostraca	Mysidia	Mysidae	*Americamysis*	*bigelowi*	2	Marine
Malacostraca	Mysidia	Mysidae	*Americamysis*	*bahia*	1	Marine
Malacostraca	Isopoda	Idoteidae	*Edotia*	*montosa*	1	Marine
Malacostraca	Amphipoda	Aoridae	*Grandidierella*	*bonnieroides*	1	Marine
Clitellata	Oligochaeta	Naididae	*Tubificoides*	*heterochaetus*	2	Marine
Insecta	Diptera	Ceratopogonidae		sp.	1	Freshwater
Insecta	Diptera	Chironomidae	*Chironomus*	sp.	169	Freshwater
Insecta	Diptera	Chironomidae	*Tanypus*	*clavatus*	3	Freshwater

4.3.4 Station WL-1 – Wicker Lake – Upper Perdido Bay

Station WL-1 is located in the approximate center of the main lobe of Wicker Lake. This station exhibited a total collection of 69 individuals from 8 species. This station contained both estuarine (marine) and freshwater species. The collected taxa consists of two polychaete species, two shrimp species, one amphipod species, and three freshwater dipteran species. All marine species are euryhaline generalists. While the majority of the species were estuarine (marine) (5 of 8), the majority of the individuals (70%) were freshwater species. All of the freshwater species are particularly tolerant of low oxygen conditions, see **Table 7**.

Specific conductivity at the time of sampling was 11,670 umohs/cm, indicating estuarine conditions. Nutter and Associates during April 2014 - April 2015 sampling of Tee and Wicker lakes reported an average specific conductivity of 10,346 umohs/cm from bottom samples in Wicker Lake, with a range of 93 – 31,733 umohs/cm and a standard deviation of 8,430 umohs/cm. Median specific conductance was 9,235 umohs/cm, with 25th and 75th percentiles of 1,438 and 17,386 umohs/cm respectively. This indicates that while Wicker Lake is correctly identified as a marine water, it spends considerable time in a freshwater condition and likely more so than Tee Lake.

In March 2015, Nutter and Associates collected 4 ponar samples from near WL-1 but the data available does not provide the specific conductivity on the sample date. From that sample, 22 taxa and 589 individuals were recovered, with the majority of both taxa and individuals being estuarine (marine) organisms. Once again, it is likely that saltier conditions prevailed during this sample event. The most abundant species collect on March 2015 by Nutter and Associates, the amphipod *Grandidierella bonnieroides*, was represented by a single individual in our August 2018 sample.

Table 7 Species List and Count from WL-1 – Wicker Lake

Class	Order	Family	Genus	Species	Abundance	Fresh/Marine
Polychaeta	Canalipalpata	Spionidae	*Streblospio*	*benedicti*	4	Marine
Polychaeta	Terebellida	Ampharetidae	*Hobsonia*	*florida*	9	Marine
Malacostraca	Mysidia	Mysidae	*Americamysis*	*bigelowi*	3	Marine
Malacostraca	Mysidia	Mysidae	*Americamysis*	*bahia*	4	Marine
Malacostraca	Amphipoda	Aoridae	*Grandidierella*	*bonnieroides*	1	Marine
Insecta	Diptera	Chironomidae	*Chironomus*	sp.	43	Freshwater
Insecta	Diptera	Chironomidae	*Tanypus*	*clavatus*	2	Freshwater
Insecta	Diptera	Chironomidae	*Tanypus*	*neopunctipennis*	3	Freshwater

4.3.5 Diversity and Evenness Comparisons for Benthic Macroinvertebrates

It is not possible to draw conclusions from single date biological collections. At all stations, the abundance of organisms is less than adequate for good statistical analysis. Using the data collected, several concepts and indices were evaluated to view the benthic community. Species or taxa richness refers to the number of species and species evenness refers to homogeneity of individuals among the species. The more equal the proportions for each of the groups, the more homogeneous, or even, the groups are. Diversity is a concept that evaluates the species richness and the evenness together.

The Shannon index and the Simson index measure species diversity within a community while Hills measures species evenness. Statistical comparisons (low confidence because of too few individuals) for these stations are found in **Table 8**.

Table 8 Statistical Analysis of Ponar Samples Collected in Upper Perdido Bay-August 2018

Stations	Abundance	Taxa Richness	Shannon	Simpsons	Hills
26	71	4	1.19	0.54	0.38
29	135	4	1.13	0.54	0.41
TL-1	261	16	1.84	0.45	0.23
WL-1	69	8	1.91	0.41	0.25
Bay Only	206	4	1.15	0.54	0.39
Lakes Only	330	17	1.98	0.44	0.21
All Stations	536	17	2.20	0.29	0.30

Albeit a low confidence evaluation, there is little difference between stations, especially when comparing the two lake stations and the two bay stations.

The Shannon diversity index as applied to aquatic biological communities measures the relation of the number of taxa and evenness of abundance within those taxa. Most diverse aquatic biological systems are associated with stable, environmental conditions. Coral reefs for example are highly diverse communities. Historically, the Shannon diversity index has been used as a regulatory tool to evaluate stable ecosystems including freshwater streams, and other systems with little flux in basic parameters that influence the biological community present. In freshwater streams, for example, the flux in parameters is more likely to be induced by pollution, resulting in a lowering of the macroinvertebrate community diversity. Thus, higher Shannon values in freshwater systems are regarded as good and lower values as impaired. Due to the constant flux in basic parameters such as salinity and temperature in coastal estuaries, use of the Shannon index is a less reliable predictor of impact within the ecosystem.

It is our opinion that absolute Shannon values have little meaning as applied to a “health” evaluation of estuarine benthic communities or as baseline standards. Comparative Shannon values between un-impacted (reference) and impacted sites can have value when other conditions can be held similar. Even then, both the reference and impacted site can change as discussed previously with natural environmental fluxes in the estuary.

4.4 Epibenthic Vertebrate and Macroinvertebrate Data Collection

Epibenthic sampling was conducted as a series of otter trawls. Stations 26b and 26 represent the beginning and ending point boundaries of the trawl area. The event was composed of seven trawls tows between these stations with the species composition being recorded on a per trawl basis. All individuals collected were brought back to the Cardno wet lab for measurement, weight, and taxonomic ID and anomaly analysis. Due to the numbers of individuals, some species were aggregated and size classed where appropriate, results are found in **Table 9.**

Table 9 Species List and Critical Measurements from Epibenthic Trawls

Trawl #	Species ID	Count	Length (mm)	Weight (g)	Anomalies
1	*Micropogonias undulatus*	1	159	45	N/A
1	*Leiostomus xanthurus*	1146	size class: 50-60	1881	N/A
1	*Leiostomus xanthurus*	28	size class: 40-49	36	N/A
1	*Leiostomus xanthurus*	19	size class: 61-70	57	N/A
1	*Leiostomus xanthurus*	1	77	6	N/A
1	*Leiostomus xanthurus*	1	73	5	N/A
1	*Leiostomus xanthurus*	1	71	5	N/A
1	*Leiostomus xanthurus*	1	80	7	N/A
1	*Leiostomus xanthurus*	1	87	9	N/A
1	*Anchoa mitchilli*	1	59	3	N/A
1	*Anchoa mitchilli*	1	66	3	N/A
1	*Anchoa mitchilli*	1	69	3	N/A
1	*Brevoortia patronus*	1	81	6	N/A
1	*Brevoortia patronus*	1	88	7	N/A
2	*Micropogonias undulatus*	1	117	4	N/A
2	*Micropogonias undulatus*	1	119	4	N/A
2	*Bagre marinus*	1	131	11	N/A
2	*Lagodon rhomboides*	1	87	9	N/A
2	*Leiostomus xanthurus*	1	111	4	N/A
2	*Leiostomus xanthurus*	1	51	1	N/A
2	*Leiostomus xanthurus*	1	54	1	N/A
2	*Leiostomus xanthurus*	1	53	1	N/A
2	*Leiostomus xanthurus*	1	52	1	N/A
2	*Leiostomus xanthurus*	1	56	1	N/A
2	*Leiostomus xanthurus*	1	63	1.5	N/A

Trawl #	Species ID	Count	Length (mm)	Weight (g)	Anomalies
2	*Leiostomus xanthurus*	1	69	1.5	N/A
2	*Leiostomus xanthurus*	1	68	1.5	N/A
2	*Leiostomus xanthurus*	22	size class:70-79	52	N/A
2	*Leiostomus xanthurus*	12	size class:80-87	38	N/A
3	*Farfantepenaeus aztecus* (female)	1	73	2	N/A
4	**EMPTY TRAWL NO CATCH**	**0**	**0**	**0**	**0**
5	*Leiostomus xanthurus*	1	93	4	N/A
5	*Leiostomus xanthurus*	1	52	1	N/A
5	*Leiostomus xanthurus*	1	52	1	N/A
5	*Leiostomus xanthurus*	1	53	1	N/A
5	*Leiostomus xanthurus*	1	53	1	N/A
5	*Leiostomus xanthurus*	1	54	1	N/A
5	*Leiostomus xanthurus*	1	55	1	N/A
5	*Leiostomus xanthurus*	1	53	1	N/A
5	*Leiostomus xanthurus*	1	52	1	N/A
5	*Leiostomus xanthurus*	10	size class: 60-69	21	N/A
5	*Leiostomus xanthurus*	14	size class: 70-79	38	N/A
5	*Penaeidae species*	1	34	< 1	N/A
6	*Penaeidae species*	1	31	< 1	N/A
6	*Farfantepenaeus aztecus* (male)	1	84	2	N/A
7	*Leiostomus xanthurus*	2806	size class: 50-59	5175	N/A
7	*Leiostomus xanthurus*	89	size class: 60-69	231	N/A
7	*Leiostomus xanthurus*	53	size class: 40-49	44	N/A
7	*Leiostomus xanthurus*	18	size class:70-76	55	N/A

4.4.1 Diversity and Evenness Comparisons for Epibenthic Vertebrates and Macroinvertebrates

The seven otter trawls exhibited large variation in the yield of each trawl, as well as the contents of each trawl. Diversity and evenness indices will primarily be affected by the few numbers and species caught in some of the trawls, and by the massive dominance of single species catches in other trawls. All indices are summarized in **Table 10 and Table 11**.

Table 10 Statistical Analysis of Otter Trawl Samples by Number

Trawl #	Abundance	Taxa Richness	Shannon	Simpsons	Hills
1	1204	4	0.05	0.99	0.19
2	47	4	0.55	0.84	0.27
3	1	1	NA	NA	NA
4	0	0	NA	NA	NA
5	34	2	0.19	0.94	0.30
6	2	2	1.00	0	NA
7	2966	1	0	1.00	NA
All Trawls	4254	9	0.04	0.99	0.16

Table 11 Statistical Analysis of Otter Trawl Samples by Weight

Trawl #	Weight (g)	Taxa Richness	Shannon	Simpsons	Hills
1	2073	4	0.25	0.94	0.24
2	131.5	4	1.08	0.63	0.30
3	2	1	0	1.00	NA
4	0	0	NA	NA	NA
5	71.5	2	0.06	0.99	0.23
6	2.5	2	0.72	0.47	1.08
7	5505	1	0	1.00	NA
All Trawls	7785.5	9	0.13	0.97	0.19

As expected, the diversity and evenness statistics indicate low diversity with a high dominance of the species *Leiostomus xanthurus* (spot). Again, when evaluating estuaries, productivity rather than diversity is usually a better approach. Using diversity indices in samples such as this should be treated with great caution. Trawls 2 through 6 did not yield enough individuals to provide a statistical basis upon which to individually analyze the trawls. Regarding trawls 1 and 7, while they did yield numbers that are amenable to analysis, the trawls clearly passed through an area containing common schooling baitfish. The catch of trawls 1 and 7 contain a large number of the primary species within that school. That is more of a commentary on the population dynamic of the school rather than the bay as a whole. Conspicuous by their near absence in this survey are several key groups used for trophic and tissue analysis. These include groups such as predator/top feeders and larger bottom feeders, both of which are in the bay, but typically not collected using this sampling technique. Perhaps the most important results from the series of trawls is the presence of the brown shrimp *Farfantepenaeus aztecus*, and other penaeid shrimp as well as gulf menhaden *Brevoortia patronus*, all of which are common commercially fished species.

5 Conclusion

The benthic biological communities and population dynamic of estuarine waters in North Florida vary greatly on a seasonal basis. Marshes and estuarine systems are the breeding grounds for many species of vertebrates and invertebrates alike. Many of the species that inhabit estuarine systems, particularly benthic macroinvertebrates and finfish, rely on a boom and bust reproductive strategy to propagate the species. For example, many species of shrimp, and fish such as menhaden, both of which were species caught in the trawls, spend their adult lives in marine waters, but their larval development stages are spent in estuarine and marsh zones. As they develop, larval forms begin consuming zooplankton, but will eventually switch to larger prey as they transition through life stages. As seasons progress, into late winter and spring, benthic macroinvertebrate species reach their peak abundance in Upper Perdido Bay. This sample event was completed in late summer, during a period when predation and environmental stressors are near their peak. As a result, the expected outcome would be a reduced benthic macroinvertebrate abundance.

Seasonal warming of estuarine waters and variable amounts of freshwater inflow can lead to nutrient spikes, phytoplankton blooms and low dissolved oxygen concentrations near the bottom due to stratification based on differences in densities between fresher surface waters and more salty bottom waters.

Physicochemical measurements within the Upper Bay reveal low diurnal DO concentration in near bottom waters. Measurements suggest higher levels of photosynthetic productivity in the surface layers as DO values are over 100% saturation. Below 1.5 meters, DO decreases rapidly and salinity increases rapidly, indicating a halocline is present. Ponar grab samples, when brought to the surface, expressed a strong hydrogen sulfide (H_2S) odor. Collectively, this information strongly suggests that bottom sediments within the Upper Bay were in a near anoxic state during the period of sampling. Since H_2S is toxic to virtually all macroinvertebrates, this is another possible explanation for the low taxa richness and low abundance observed in the samples.

While the Tee and Wicker Lake stations were not stratified and near bottom DO concentrations were not extremely low, comparison to the conductivity data reported by Nutter and Associates show that the lakes can exhibit extreme fluctuations in salinity. Even though both are classed as predominately marine waters, the data shows they can spend a substantial period of time in freshwater conditions. Such extremes in environmental conditions can decrease both species abundance and taxa richness.

The benthic macroinvertebrate ponar sampling results indicated for both the bay and the lakes stations, a low abundance of macroinvertebrates. Of the species that are present, the marine taxa are particularly tolerant of euryhaline conditions while the freshwater taxa are noted to be very tolerant of low DO conditions. Low DO is not uncommon in estuarine systems, particularly in the late summer and early fall of the year. Seasonal sampling would provide a more holistic view of the condition of the benthos rather than a single sample event. All macroinvertebrates collected in stations 29 and 26 are marine/estuarine in nature. At the Tee Lake, the same species collected in the bay were also present, but in reduced abundance. Tee lake samples also contained multiple freshwater chironomid species with the individuals comprising the freshwater species being numerically dominant over the marine species. In Wicker Lake, all but one of species found in the bay had dropped out (although other marine taxa are present) and chironomids are again numerically dominant.

The epibenthic trawling produced data with less certainty and high variability. In order to produce data with a statistically valid trend for analysis, more replicates across a more diverse set of conditions and times would need to be collected. Trawls 1 and 7 produced an abundance of juvenile spot (*Leiostomus xanthurus*) which is a short lived, schooling, estuarine baitfish species native to the entire Gulf of Mexico and Eastern Seaboard. The most salient species collected were those primarily collected in trawls 1-6. Though their numbers were not dominant when compared to the spot, collection of brown shrimp (*Farfantepenaeus aztecus*), the gulf menhaden (*Brevoortia patronus*) and the bay anchovy (*Anchoa mitchilli*) are important as they are all commercially harvested species. Gulf Menhaden currently support the second largest fishery by weight in the United States and are commonly used in the production of fish oil and fish meal products. With that being said, all fish species caught are considered generalist species, and in most cases, either feed upon ubiquitous zooplankton, or the commonly available estuarine benthic macroinvertebrate species found in Upper Perdido Bay.

APPENDIX

A

FIELD DOCUMENTATION

Surface Water Physical/Chemical Field Datasheet

Cardno
Shaping the Future

Study Name: Upper Perdido
Sample Team: BMW / RLH
Field ID: WL-1
Sample ID: WL-1
Sample Date: 08/13/18 (MM/DD/YYYY)
Sample Time: 1010 (HH:MM)

Physical (n/a if not applicable)

Air Temperature °F: 81
Wind Speed/Direction: 2-4 mph NE
Tidal Cycle: incoming
% Overcast: 90
Antecedent Rainfall (within past 48 hrs): —
Gauge Ht: — (reference USGS gauge number if applicable)
Canopy Cover: —
Photograph Description: 4 photos

Associated Sampling (Check all that apply)

Water Chemistry ☐ Sediment Chemistry ☐ Groundwater ☐ Grain Size ☐ Diel Sonde ☐ Habitat Assessment ☐

Phytoplankton ☐ Fish/Mussel ☐ SCI ☐ BioRecon ☐ RPS ☐ LVS ☐ LVI ☐ Other: Ponar

Field Measurements

Instrument ID#: AF3 Sample Depth (m): — Secchi Depth(m): VOB Total Depth (m): 0.83 Recorder Initial: BW

Depth (m)	Temp (°C)	PH	Cond (µmhos/cm)	Sp. Cond (µmhos/cm)	DO (mg/L)	DO (% Sat)	Turbidity (NTU)	Salinity (PPT)
0.30	29.12	7.06	12368	11463	4.78	64.4	6.52	6.48
0.75	29.11	7.01	12503	11670	4.27	57.4		6.62

Water Sample Collection Method: Direct Grab with Sample Bottle ☐ Intermediate Sampling Device ______

Were all appropriate samples (including QA/QC) properly preserved within 15 minutes? YES ☐ NO ☐
Were all acidified samples verified that the pH was less than 2 SU? YES ☐ NO ☐
Were all samples preserved on ice within 15 minutes of collection? YES ☐ NO ☐
Were all filtered samples properly filtered? YES ☐ NO ☐

QA/QC

Field Blank ID: ______ - FB Collection Time: ______

Field Dup ID: ______ - FD Collection Time: ______

Sampler Names (Print) and Signatures: Brandon Wenner

General Comments:

Include information such as: estimated level of impact to the system (ex. obvious pollution, none visible, etc.), any variations from normal preservation protocols (ex. adding more than 1 ml acid, etc.), any problems experienced with collecting samples (ex. grab 1 lost due to fall-out, etc.). Noteable changes in site appearance from previous visits (ex. Significant water level rise/drop, alge blooms, new obstructions, etc.), any qualifiers needed (ex. "F" for failed calibration verification, etc.), the use of fuel-powered equipment, etc.

Fine Colloidal mud, very little plant material 3 Ponars Collected
few large macros observed

Surface Water Physical/Chemical Field Datasheet

Cardno
Shaping the Future

Study Name: Upper Perdido
Sample Team: BMW/RLH
Field ID: TL-1
Sample ID: TL-1
Sample Date: 08/13/18 (MM/DD/YYYY)
Sample Time: 11:00 (HH:MM)

Physical (n/a if not applicable)

Air Temperature °F: 82
Wind Speed/Direction: 2-4mph NE
Tidal Cycle: incoming
% Overcast: 90
Antecedent Rainfall (within past 48 hrs): —
Gauge Ht: (reference USGS gauge number if applicable)
Canopy Cover: —
Photograph Description: multiple

Associated Sampling (Check all that apply)

Water Chemistry ☐ Sediment Chemistry ☐ Groundwater ☐ Grain Size ☐ Diel Sonde ☐ Habitat Assessment ☐

Phytoplankton ☐ Fish/Mussel ☐ SCI ☐ BioRecon ☐ RPS ☐ LVS ☐ LVI ☐ Other: Ponar

Field Measurements

Instrument ID#: AF3 Sample Depth (m): Secchi Depth(m): VOB Total Depth (m): 0.79 Recorder Initials: BW

Depth (m)	Temp (°C)	PH	Cond (µmhos/cm)	Sp. Cond (µmhos/cm)	DO (mg/L)	DO (% Sat)	Turbidity (NTU)	Salinity (PPT)
0.25	29.74	7.17	14187	12982	5.35	73.3	7.18	7.41
0.75	30.07	7.09	16461	15009	4.94	68.6		8.67

Water Sample Collection Method: Direct Grab with Sample Bottle ☐ Intermediate Sampling Device

Were all appropriate samples (including QA/QC) properly preserved within 15 minutes? YES ☐ NO ☐
Were all acidified samples verified that the pH was less than 2 SU? YES ☐ NO ☐
Were all samples preserved on ice within 15 minutes of collection? YES ☐ NO ☐
Were all filtered samples properly filtered? YES ☐ NO ☐

QA/QC

Field Blank ID: - FB Collection Time:

Field Dup ID: - FD Collection Time:

Sampler Names (Print) and Signatures: Brandon Wanner

General Comments:

Include information such as: estimated level of impact to the system (ex. obvious pollution, none visible, etc.), any variations from normal preservation protocols (ex. adding more than 1 ml acid, etc.), any problems experienced with collecting samples (ex. grab 1 lost due to fall-out, etc.). Noteable changes in site appearance from previouse visits (ex. Significant water level rise/drop, alge blooms, new obstructions, etc.), any qualifiers needed (ex. "F" for failed calibration verfication, etc.), the use of fuel-powered equipment, etc.

SL tannic w/ green tint, calm, fine colloidal mud 3 Ponars taken
Few moving macros observed

Extra Ponar Sample @ Edge for Comparison TL-2 30°27'25.1", -87°23'04.7"

Surface Water Physical/Chemical Field Datasheet

Cardno
Shaping the Future

Study Name: UPPer Perdido
Sample Team: BMW / ALH
Field ID: 29
Sample ID: 29
Sample Date: ~~0810~~ 08/13/18 (MM/DD/YYYY)
Sample Time: 1240 (HH:MM)

Physical (n/a if not applicable)

Air Temperature °F: 84
Wind Speed/Direction: 02 mph NE
Tidal Cycle: incoming
% Overcast: 100
Antecedent Rainfall (within past 48 hrs): —
Gauge Ht: (reference USGS gauge number if applicable)
Canopy Cover: —
Photograph Description: mulxdb

Associated Sampling (Check all that apply)

Water Chemistry ☐ Sediment Chemistry ☐ Groundwater ☐ Grain Size ☐ Diel Sonde ☐ Habitat Assessment ☐

Phytoplankton ☐ Fish/Mussel ☐ SCI ☐ BioRecon ☐ RPS ☐ LVS ☐ LVI ☐ Other: Ponar

Field Measurements

Instrument ID#: AFE Sample Depth (m): — Secchi Depth(m): 0.9 Total Depth (m): 2.57 Recorder Initial: BW

Depth (m)	Temp (°C)	PH	Cond (µmhos/cm)	Sp. Cond (µmhos/cm)	DO (mg/L)	DO (% Sat)	Turbidity (NTU)	Salinity (PPT)
0.5	29.76	7.52	15622	14314	7.60	105.2		8.25
1.0	29.45	7.52	17166	15812	7.53	103.6		9.18
1.5	30.09	7.50	20012	18525	6.72	95.0		11.16
2.0	30.95	7.20	37629	33785	2.57	38.7		21.04
2.5	30.95	7.17	37704	33861	2.07	31.2		21.09

Water Sample Collection Method: Direct Grab with Sample Bottle ☐ Intermediate Sampling Device

Were all appropriate samples (including QA/QC) properly preserved within 15 minutes? YES ☐ NO ☐
Were all acidified samples verified that the pH was less than 2 SU? YES ☐ NO ☐
Were all samples preserved on ice within 15 minutes of collection? YES ☐ NO ☐
Were all filtered samples properly filtered? YES ☐ NO ☐

QA/QC

Field Blank ID: - FB Collection Time:

Field Dup ID: - FD Collection Time:

Sampler Names (Print) and Signatures: Brandon Wagner

General Comments:

Include information such as: estimated level of impact to the system (ex. obvious pollution, none visible, etc.), any variations from normal preservation protocols (ex. adding more than 1 ml acid, etc.), any problems experienced with collecting samples (ex. grab 1 lost due to fall-out, etc.). Noteable changes in site appearance from previouse visits (ex. Significant water level rise/drop, alge blooms, new obstructions, etc.), any qualifiers needed (ex. "F" for failed calibration verification, etc.), the use of fuel-powered equipment, etc.

Fine Colloidal, black silt, 3 Ponars Collected

Surface Water Physical/Chemical Field Datasheet

Cardno
Shaping the Future

Study Name: Upper Perdido
Field ID: 26
Sample Date: 08/13/18 (MM/DD/YYYY)
Sample Team: BMW/RLH
Sample ID: 26
Sample Time: 1355 (HH.MM)

Physical (n/a if not applicable)

Air Temperature °F: 87
% Overcast: 100
Canopy Cover: –
Wind Speed/Direction: 0-2 mph NE
Antecedent Rainfall (within past 48 hrs): –
Photograph Description: multiple photos
Tidal Cycle: incoming
Gauge Ht: (reference USGS gauge number if applicable)

Associated Sampling (Check all that apply)

Water Chemistry ☐ Sediment Chemistry ☐ Groundwater ☐ Grain Size ☐ Diel Sonde ☐ Habitat Assessment ☐
Phytoplankton ☐ Fish/Mussel ☐ SCI ☐ BioRecon ☐ RPS ☐ LVS ☐ LVI ☐ Other: Ponar

Field Measurements

Instrument ID#: AF3 Sample Depth (m): – Secchi Depth(m): 0.75 Total Depth (m): 2.41 Recorder Initial: BW

Depth (m)	Temp (°C)	PH	Cond (μmhos/cm)	Sp. Cond (μmhos/cm)	DO (mg/L)	DO (% Sat)	Turbidity (NTU)	Salinity (PPT)
0.5	29.78	7.52	16413	15027	7.42	103.2	4.85	8.66
1.0	29.56	7.51	16380	15115	7.52	103.2		8.75
1.5	29.39	7.47	17551	16194	7.12	98.1		9.42
2.0	30.34	7.21	30226	27507	2.81	40.1		16.88

Water Sample Collection Method: Direct Grab with Sample Bottle ☐ Intermediate Sampling Device ______

Were all appropriate samples (including QA/QC) properly preserved within 15 minutes? YES ☐ NO ☐
Were all acidified samples verified that the pH was less than 2 SU? YES ☐ NO ☐
Were all samples preserved on ice within 15 minutes of collection? YES ☐ NO ☐
Were all filtered samples properly filtered? YES ☐ NO ☐

QA/QC

Field Blank ID: ______ - FB Collection Time: ______
Field Dup ID: ______ - FD Collection Time: ______

Sampler Names (Print) and Signatures: Brendan Warner
[signature]

General Comments:

Include information such as: estimated level of impact to the system (ex. obvious pollution, none visible, etc.), any variations from normal preservation protocols (ex. adding more than 1 ml acid, etc.), any problems experienced with collecting samples (ex. grab 1 lost due to fail-out, etc.). Noteable changes in site appearance from previous visits (ex. Significant water level rise/drop, alge blooms, new obstructions, etc.), any qualifiers needed (ex. "F" for failed calibration verification, etc.), the use of fuel-powered equipment, etc.

Increasingly overcast, fine black anoxic mud, green tint H_2O
3 Ponars Collected

Surface Water Physical/Chemical Field Datasheet

Cardno
Shaping the Future

Study Name:	Upper Perdido	Sample Team:	BMW/RLH
Field ID:	26B	Sample ID:	26B
Sample Date: (MM/DD/YYYY)	08/14/2018	Sample Time: (HH.MM)	0800

Physical (n/a if not applicable)

Air Temperature °F	79	Wind Speed/Direction	0-2 NE	Tidal Cycle	Incoming
% Overcast	30	Antecedent Rainfall (within past 48 hrs)	—	Gauge Ht: (reference USGS gauge number if applicable)	
Canopy Cover	—	Photograph Description	Multiple		

Associated Sampling (Check all that apply)

Water Chemistry ☐ Sediment Chemistry ☐ Groundwater ☐ Grain Size ☐ Diel Sonde ☐ Habitat Assessment ☐

Phytoplankton ☐ Fish/Mussel ☐ SCI ☐ BioRecon ☐ RPS ☐ LVS ☐ LVI ☐ Other Trawling

Field Measurements

Instrument ID# AF3 Sample Depth (m) — Secchi Depth(m): 0.8 Total Depth (m): 2.09 Recorder Initial: BW

Depth (m)	Temp (°C)	PH	Cond (μmhos/cm)	Sp. Cond (μmhos/cm)	DO (mg/L)	DO (% Sat)	Turbidity (NTU)	Salinity (PPT)
0.5	29.55	7.99	16195	14902	7.10	97.7	4.26	8.61
1.0	29.49	7.99	16293	15022	7.15	98.4		8.68
1.5	30.35	7.77	24938	22731	4.69	67.3		13.66
2.0	30.33	7.46	28752	26118	1.56	22.1		15.88

Water Sample Collection Method: Direct Grab with Sample Bottle ☐ Intermediate Sampling Device

Were all appropriate samples (including QA/QC) properly preserved within 15 minutes? YES ☐ NO ☐

Were all acidified samples verified that the pH was less than 2 SU? YES ☐ NO ☐

Were all samples preserved on ice within 15 minutes of collection? YES ☐ NO ☐

Were all filtered samples properly filtered? YES ☐ NO ☐

QA/QC

Field Blank ID: ______ -FB Collection Time:

Field Dup ID: ______ - FD Collection Time:

Sampler Names (Print) and Signatures

Brandon Warner

Brandon Warner

General Comments:

Include information such as: estimated level of impact to the system (ex. obvious pollution, none visible, etc.), any variations from normal preservation protocols (ex. adding more than 1 ml acid, etc.), any problems experienced with collecting samples (ex. grab 1 lost due to fall-out, etc.). Noteable changes in site appearance from previous visits (ex. Significant water level rise/drop, alge blooms, new obstructions, etc.), any qualifiers needed (ex. "F" for failed calibration verification, etc.), the use of fuel-powered equipment, etc.

Calm, Sl. turbid, green tint,

Taken Just Prior to Trawl #1

Cardno
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YSI Sonde Calibration/Verification Log
Dissolved Oxygen

Calibration procedures followed in accordance with FDEP SOP FT1000

YSI Sonde ID: 9F3	Date (mm/dd/yy): 08/13/18
Project: Perdido	Type (circle): Calibration Verification
Calibration/Verification Location	
Field ID: WL-1	Sample ID: WL-1
Barometric Pressure: 760 mm/Hg	
Method (cricle): One Point Saturated Air | One Point Saturated Water | Two Point Air/Water | Other	

	Time (hh:mm)	DO (mg/L)	Temp (°C)	DO Saturation (%)	Theoretical Saturation (mg/L)	Acceptance Criteria (DO +/- 0.3mg/L)
Calibration Reading (C)	947	7.34	31.64	100.0	7.34	Pass Fail
Verification Reading (R)	948	7.22	32.16	99.2	~~99.2~~ 7.21	Pass Fail
	DO Charge: —			DO Gain: 1.02		

DO Calibration/Verification Performed By: [signature]

Comments:

Data Recorder Signature: [signature]

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Phone: 850 681 9700 Fax 850 681 9741
www.cardnoentrix.com

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YSI Sonde Calibration/Verification Log
Dissolved Oxygen

Calibration procedures followed in accordance with FDEP SOP FT1000

YSI Sonde ID: AP3			Date (mm/dd/yy): 08/14/18			
Project: Upper Peridido			Type (circle): Calibration Verification			
Calibration/Verification Location						
Field ID: 26A			Sample ID: 26A			
Barometric Pressure: 760 mm/Hg						
Method (cricle): One Point Saturated Air | One Point Saturated Water | Two Point Air/Water | Other						
	Time (hh:mm)	DO (mg/L)	Temp (°C)	DO Saturation (%)	Theoretical Saturation (mg/L)	Acceptance Criteria (DO +/- 0.3mg/L)
~~Calibration Reading (C)~~						Pass Fail
Verification Reading (R)	1410	7.35	30.83	99.1	7.46	Pass Fail
	DO Charge: —			DO Gain: 1.02		

DO Calibration/Verification Performed By: Brun

Comments:

Data Recorder Signature:

Cardno inc.
2420 Lakeshore Drive
Tallahassee, FL 32312
Phone (850)-681-9700 Fax (850)-681-9741

Chain of Custody Record

Cardno
Shaping the Future

Client Contact	Project Manager: Brandon Wanner	Site Contact: Brandon Wanner	Date: 08/22/18	COC No:
Friends of Perdido Bay	Tel/Fax:(850) 681-9700	Lab Contact: John Epler	Carrier No:	Job No.
10738 Lillian Hwy	Analysis Turnaround Time	Picked Ponar Samples		
Pensacola, FL, 32506	[X] Standard			
	Rush Charges Authorized for ____			
	[ ] 2 weeks			
Project Name: Perdido Bay - Benthic Sampling	[ ] 1 week			
Site: Tee and Wicker Lakes	[ ] 2 days			
PO #: Purchase Order not required	[ ] 1 day			
WO #:	[X] Non-Hazardous			

STATION ID	FIELD ID	Sample Date	Sample Time	Sample Type	Matrix	Total Number of Containers	Special Instructions/Note:
Tee Lake	TL-1	8/13/18	9:00	C	Bio	1	30.45730, -87.3855 For ID purposes
Wicker Lake	WL-1	8/13/18	9:30	C	Bio	1	30.461711, -87.3835 For ID purposes

All Samples Preserved on Ice [ ] Preservative: 1 = H_2SO_4 2 = HNO_3 3 = Field Filtered; 4 = HCL

Tracking Number: *Distilled Water* *see lab* *H2SO4* *see lab* *HNO3* *see lab*

Special Instructions/QC Requirements:

Relinquished by: Brandon Wanner	Company: Cardno Inc.	Date/Time: 8/22/18 15:00	Received by:	Company:	Date/Time:
Received by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

Comments:

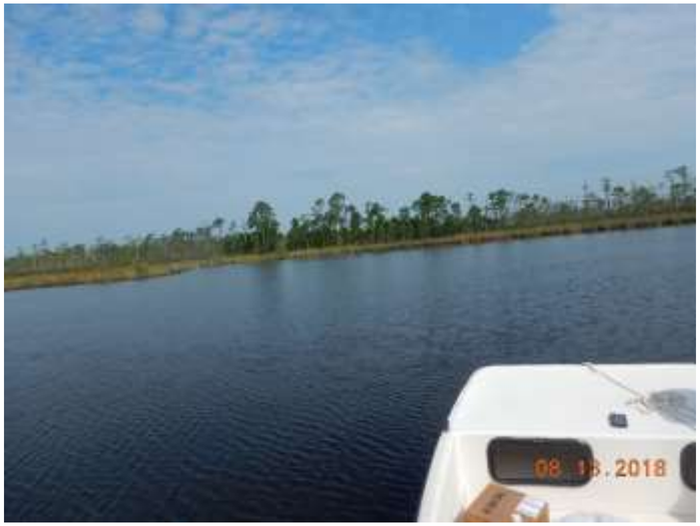
APPENDIX B

PHOTO LOG

Photograph 1 – Tee Lake Directional Photo from Station

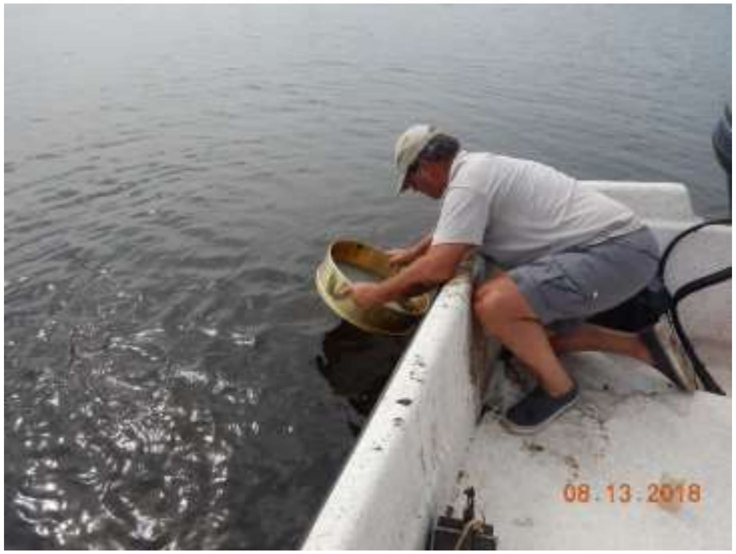
Photograph 2 – Tee Lake Directional Photo from Station

Photograph 3 – Tee Lake Directional Photo from Station

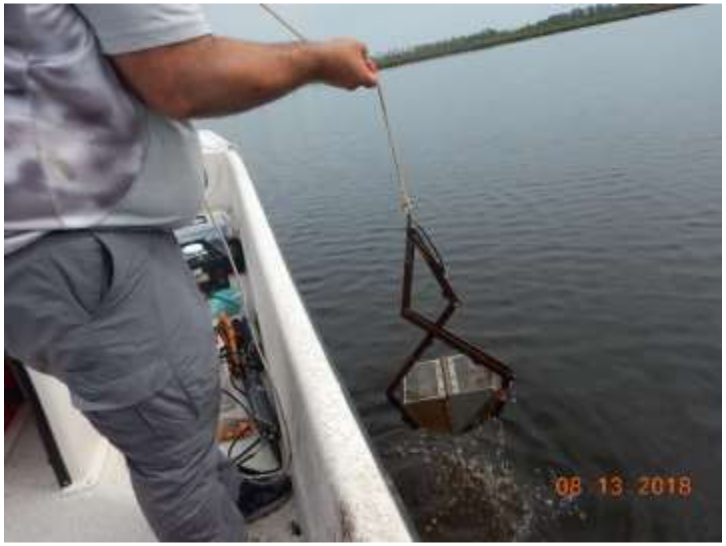


Photograph 4 – Tee Lake Directional Photo from Station

Photograph 5 – Sieved Ponar #1 from Tee Lake



Photograph 6 – Sieving of Ponar #2 from Tee Lake

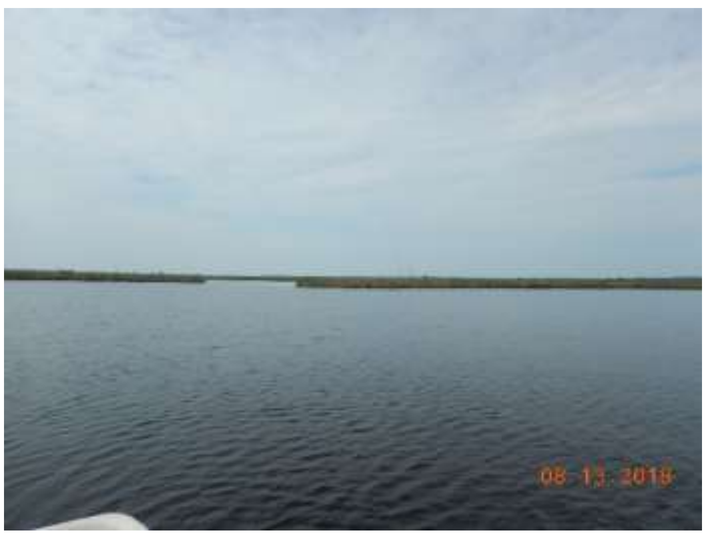


Photograph 7 – Wicker Lake - Ponar Sample Collected

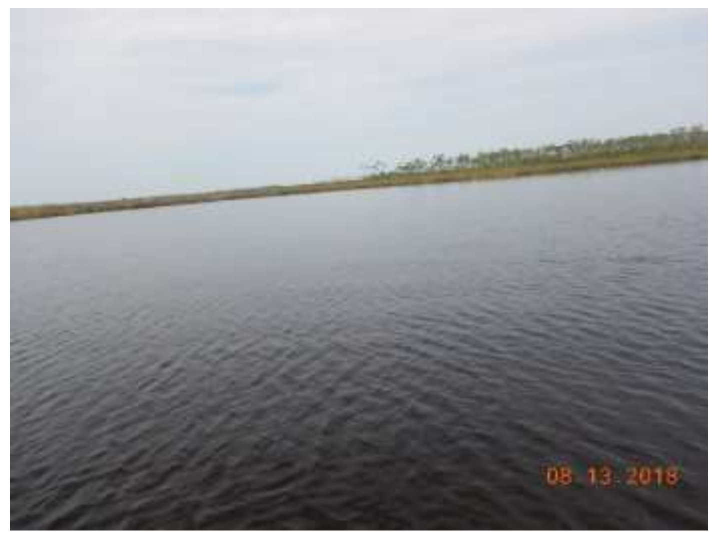
Photograph 8 – Wicker Lake Ponar Sample Prior to Sieving.

Photograph 9 – Wicker Lake Directional Photo from Station

Photograph 10 – Wicker Lake Directional Photo from Station



Photograph 11 – Wicker Lake Directional Photo from Station



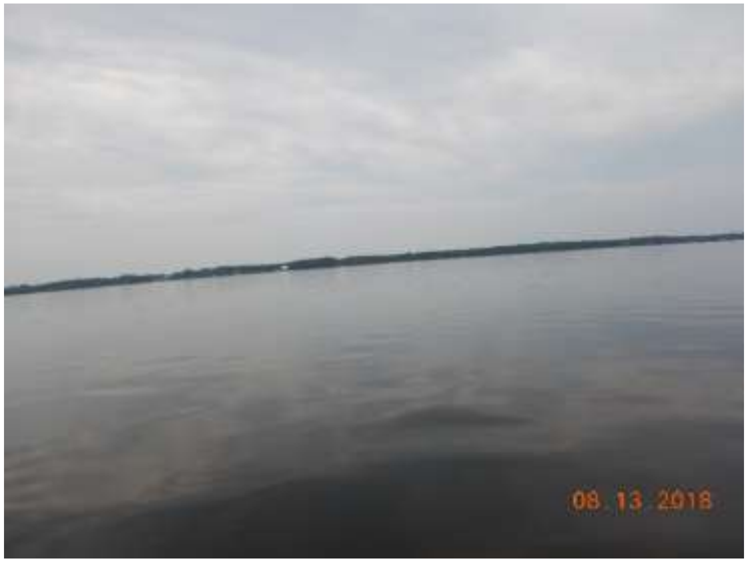
Photograph 12 – Wicker Lake Directional Photo from Station.

Photograph 13 – Station 29 Sample Sieving

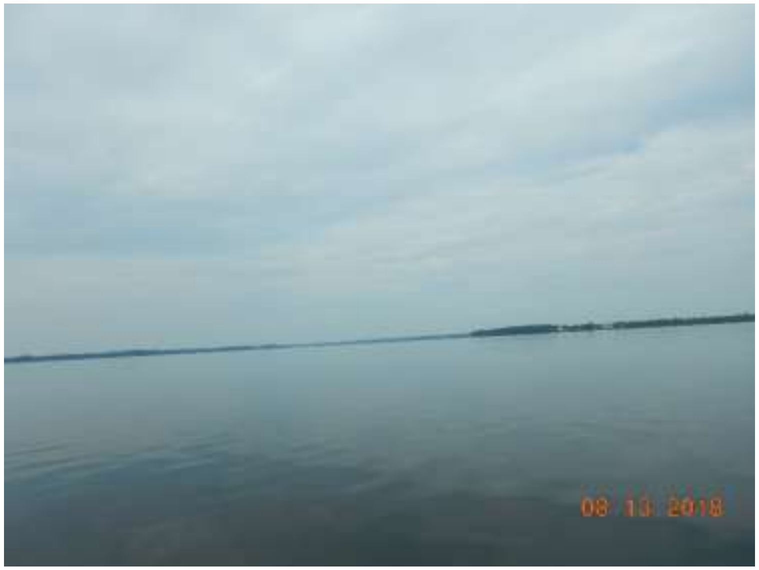
Photograph 14 – Station 29 Sieved and Preserved Sample

Photograph 15 – Station 26 Ponar Sample Collection and Removal

Photograph 16 – Station 26 Ponar Sample Collection and Removal

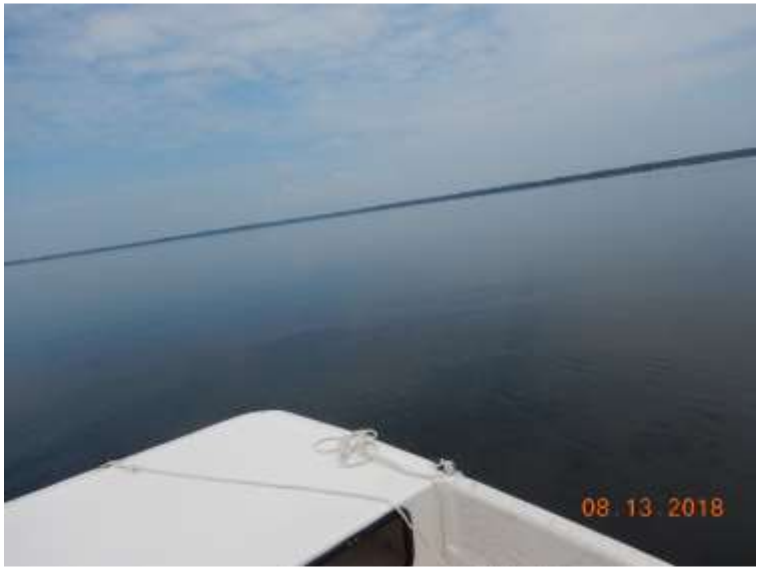


Photograph 17 – Station 29 – On Station Photo

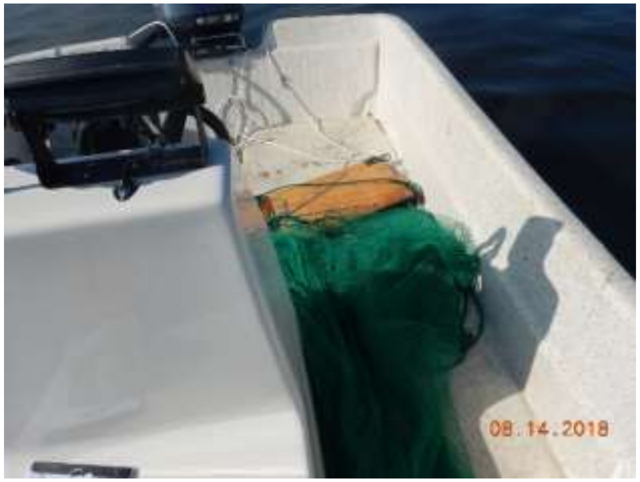


Photograph 18 – Station 29 On Station Photo

Photograph 19 – Station 26 – On Station Photo



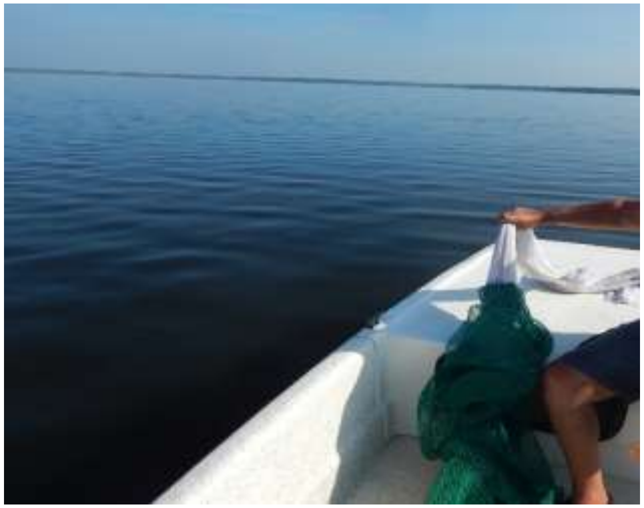
Photograph 20 – Station 26 – On Station Photo



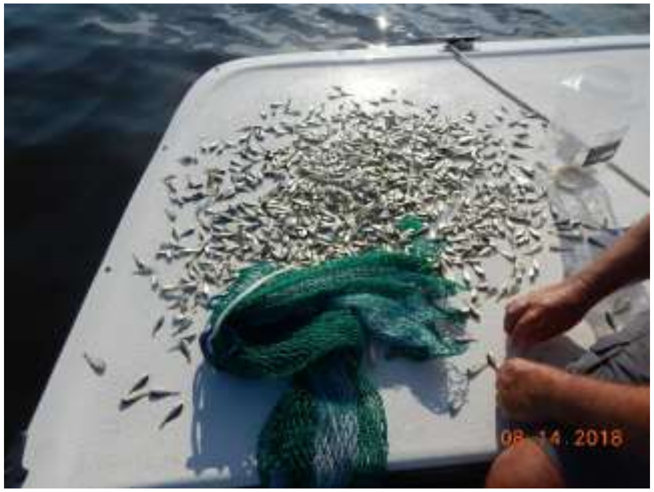
Photograph 21 – Upper Perdido Bay - Trawl Prep for First Trawl Tow

Photograph 22 – Upper Perdido Bay - Beginning of Trawl deployment

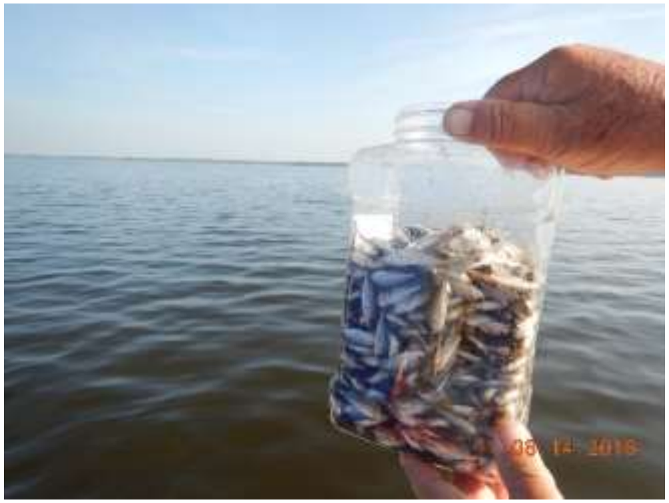
Photograph 23 – Upper Perdido Bay - Active Trawling



Photograph 24 – Upper Perdido Bay – Exposing Inner Net – Trawl #3



Photograph 25 – Upper Perdido Bay – Starting to Measure Trawl #1



Photograph 26 – Upper Perdido Bay – Trawl #1 Going to the Lab

Photograph 15 – Upper Perdido Bay – Trawl #7 Collected for the Lab

Photograph 16 – Upper Perdido Bay – Trawl #7 Formalin Preserved