Final Report

Minimum Flow and Level Analysis of Benthic Macrofauna in the Caloosahatchee Estuary

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INTRODUCTION

The Caloosahatchee Estuary is a small (62 km^2) but significant part of the Charlotte Harbor estuarine complex, which is located in the southwest coast of Florida (Figure 1; Moretzsohn *et al.* 2013). Inflow to the Caloosahatchee Estuary comes mainly from the Caloosahatchee River, a highly modified tributary that was connected to Lake Okeechobee, the largest lake in Florida, in 1884 (Doering and Chamberlain 1999). Runoff and groundwater seepage from the 344,000 ha watershed, and releases from Lake Okeechobee combine to deliver an annual median of 870 x 10^6 m^3 of freshwater to the estuary annually (Flaig and Capece 1998, Doering and Chamberlain 1999). This annual inflow volume is roughly eight times the volume of the estuary (105 x 10^6 m^3, Doering and Chamberlain 1999).

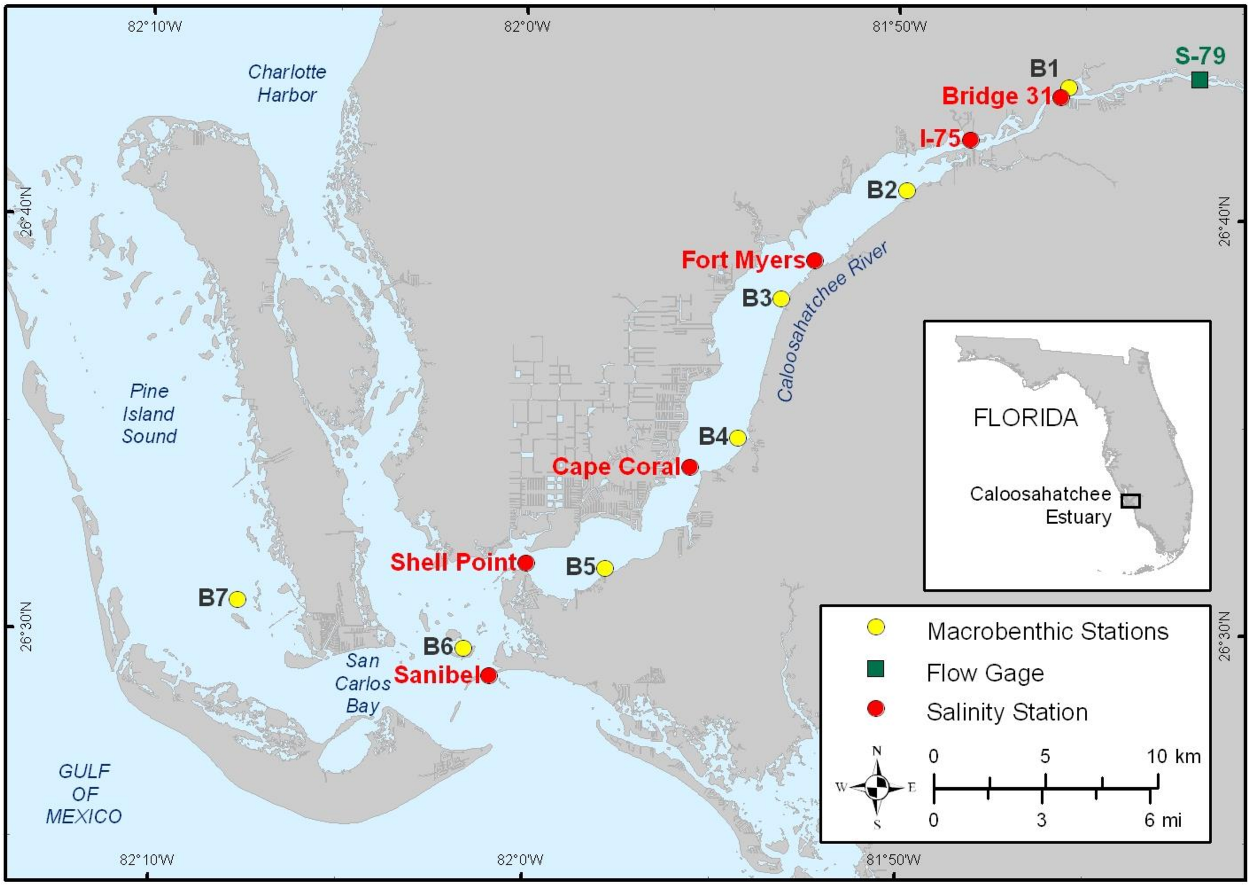

Figure 1. The Caloosahatchee Estuary sampling stations.
Stations with prefix B (yellow dots) are macrobenthic stations and with names (red dots) are salinity data logger stations.

Natural habitats, drainage patterns, land uses, and managed freshwater flows within the Caloosahatchee River Watershed have been altered significantly over time (Balci et al. 2012).

Observations that the Caloosahatchee River Estuary has been adversely affected by changes in water quality and hydrology have prompted the development of the Caloosahatchee River Watershed Protection Plan (CRWPP; SFWMD et al., 2009, Liu et al. 2009). Two of the aims of the plan are to improve water quality delivered to the estuary and minimize undesirable flows to the estuary (largely from Lake Okeechobee). Alterations of the quality, quantity, timing and distribution of inflows are extremely important to the health and function of an estuary (Montagna et al. 2013). Within the Caloosahatchee Estuary, alterations in inflow dynamics have altered salinity regimes which in turn have altered the ecological integrity of the estuary (Doering and Chamberlain 1999, Barnes 2005). Changes in freshwater inflows and salinity have been shown to change the distribution and dynamics of many taxa and communities in the Caloosahatchee Estuary, including submerged aquatic vegetation (Kraemer et al. 1999, Doering et al. 2002, Lauer et al. 2011), oysters and dermo disease (La Peyre et al. 2003, Volety 2008), fauna inhabiting oyster reefs (Tolley et al. 2005, 2006), fishes (Stevens et al. 2010), and cownose rays (Collins et al. 2008).

The purpose of this current project is to determine how changes in freshwater inflows and salinities affect benthic macrofauna within the Caloosahatchee Estuary. The characteristics of benthic communities specifically assessed are their distribution, abundance and community structure. Benthic organisms are ideal biological indicators of changes in water quality because they are relatively immobile, have long lifespans relative to plankton, and many species are sensitive to changes in water and sediment quality (Montagna et al. 2013). Hydrographic factors influence macrofaunal communities more than sediment characteristics in the adjacent Charlotte Harbor (Estevez 1986) and this is expected in the Caloosahatchee Estuary also. Many studies have linked benthic communities to changes and freshwater inflow and have used these indicator communities to predict freshwater inflow needs and estuarine health (for a summary see Montagna et al. 2013). Methods, including some of those employed by Montagna et al. (2002) in Rincon Bayou, Texas, Montagna et al. (2008) in Southwest Florida, Palmer et al. (2011) in several Texas estuaries, and Mattson et al. (2012) in St. Johns Estuary, Florida, will be applied to the data collected in the Caloosahatchee Estuary.

METHODOLOGY

Data Collection

Sampling Design

The study was designed by Robert Chamberlin, South Florida Water Management District (SFWMD), to investigate benthic macrofauna distributions as related to the salinity gradient within the estuary, and to compare temporal variability. Samples were collected by the SFWMD at seven stations (B1 – B7) (Figure 1) during two periods; from February 1986 to April 1989 (Period 1) and from October 1994 to December 1995 (Period 2) (Table 1, Figure 1). During the first sampling period, sampling occurred every two months at stations 1 – 6 and every four months at station 7. Four stations (2, 4, 5, and 6) were sampled in the second period for 12 months of the 15-month period. The environmental conditions were different between the two sampling periods. Relatively low inflow rates occurred during the first period, and extremely high inflow rates occurred during the second period (Figure 2). The peak monthly inflow during the second period was the highest of any month from 1980 to 2001.

To identify if seasonal variation is important to organisms, the data set was also parsed into wet seasons and dry seasons based on Liu et al. (2009). The wet season is defined as the months of June to September, and the dry season is defined as the months of October to May.

Macrofauna

Benthic samples were collected using a Wildco® petite ponar grab (0.02323 m^2) (Chamberlain 1987). Five replicates were collected at each station within a 30-50 m diameter. The sediment at each station consisted of predominantly sand and shell hash, away from vegetation. Samples were sieved in the field on a 500 µm screen, preserved in formalin buffered by Epsom salt, and stained with Rose Bengal. The concentration of formalin used in the first sampling period was 5-10%, whereas in the second period the concentration of formalin was 10-15%. An increase in storage time combined with the increase in formalin concentration may have led to the increased dissolution of mollusk shells in the samples taken in the second period. Invertebrates were separated from the sieved substrate by either SFWMD (Period 1) or Mote Marine Laboratory (MML; Period 2) and stored in ethanol. Staff from MML identified the dominant taxa (95% of organisms) to the species level and the remaining taxa to genera or higher taxa groups. Only four of the five replicates were processed in the second sampling period.

Water Quality

Salinity was calculated by the SFWMD using a time-series modeling technique that accounts for the temporal and spatial distribution of salinity in the estuary and driving factors such as freshwater inflows, rainfall, and tide (Qiu and Wan, 2013.). This model has been calibrated to local salinities measured at seven stations in the estuary (Figure 1). The modeled salinity was provided in Microsoft Excel format along with actual daily gauged flow at the S-79 lock-anddam structure, and simulated tidal basin flow (from Y. Wan, SFWMD) (CAL_Benthic_approx_sta_loc_SalinityData1980to2000.xlsx).

A comprehensive suite of water quality sample data, including nutrients, chlorophyll and physical data, were provided to the authors (CAL_Project_full_rpt_woFlags.xlsx). This data was collected at each station during the sample periods. Different variables had different sampling frequencies. However, many variables were sampled approximately every one or two months.

Table 1. Benthic macrofauna sampling frequency.

	Benthic Sampling Station						
Date	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Period 1							
Feb 1986	X	X	X	X	X	X	.
Apr 1986	X	X	X	X	X	X	X
Jul 1986	X	X	X	X	X	X	.
Sep 1986	X	X	X	X	X	X	X
Dec 1986	X	X	X	X	X	X	X
Mar 1987	X	X	X	X	X	X	.
Apr 1987	X	X	X	X	X	X	X
Jun 1987	X	X	X	X	X	X	.
Aug 1987	X	X	X	X	X	X	X
Nov 1987	X	X	X	.	X	X	X
Mar 1988	X	X	X	X	X	X	X
Apr 1988	X	X	X	X	X	X	X
Jun 1988	X	X	X	X	X	X	X
Aug 1988	X	X	X	X	X	X	.
Dec 1988	X	X	X	X	X	X	X
Mar 1989	X	X	X	X	X	X	.
Apr 1989	X	X	X	X	X	X	X
Period 2							
Oct 1994	.	X	.	X	X	X	.
Nov 1994	.	X	.	X	X	X	.
Dec 1994	.	X	.	X	X	X	.
Jan 1995	.	X	.	X	X	X	.
Mar 1995	.	X	.	X	X	X	.
May 1995	.	X	.	X	X	X	.
Jun 1995	.	X	.	X	X	X	.
Aug 1995	.	X	.	X	X	X	.
Sep 1995	.	X	.	X	X	X	.
Oct 1995	.	X	.	X	X	X	.
Nov 1995	.	X	.	X	X	X	.
Dec 1995	.	X	.	X	X	X	.

X = sample taken, . =no sample taken.

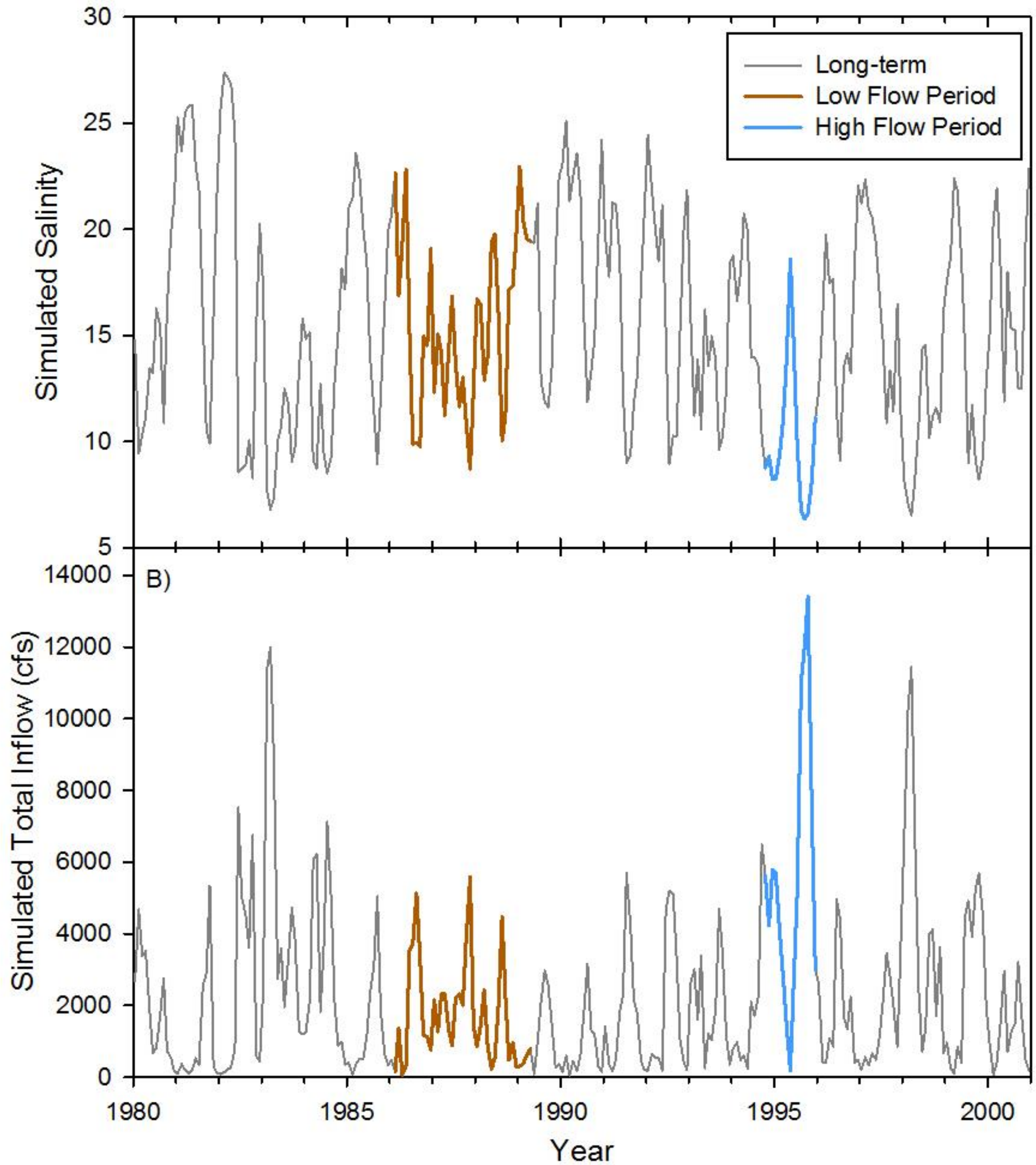

Figure 2. Mean monthly modeled salinity of benthic stations (A) and total estuarine inflow (B) over time including high and low inflowbenthic sampling periods.

Macrofauna Database Processing

Macrofauna abundance data were provided by the SFWMD in Microsoft Excel files (CRE_Benthic_86-89.xlsx and CRE_Benthic_94_95.xlsx). A taxa list was provided, which included a 12-digit classification code and a National Oceanographic Data Center (NODC)[1]

[1] http://www.nodc.noaa.gov/

taxonomic code for some species and a Taxonomic Serial Number (TSN) from the Integrated Taxonomic Information System (ITIS)[2] for most species.

Taxa nomenclature of the supplied species list (CRE_Benthic_Species_List.xlsx) was verified by the authors using the Catalogue of Life internet-based checklist (Roskov et al. 2013). The macrofauna abundance files were merged and updated using the updated species list (HRI_CRE_Benthic_Species_List.xls) to form a single data file (HRI_CRE_Benthic_Species_Abundances.xls).

Data Analysis

Univariate Macrofauna Indices

Mean macrofauna abundance and diversity were calculated for the stations within the estuary. Macrofaunal diversity was calculated using Hill's N1 diversity index (Hill, 1973). Hill's N1 was used because it has units of number of dominant species, and is more interpretable than most other diversity indices (Ludwig and Reynolds, 1988). Differences in macrofauna characteristics among stations were tested on two subsets of the data because the sampling regime was uneven (Table 1). The first subset included all seven stations for ten months in period 1 (dry). The second subset included four stations (2, 4, 5, and 6) across all months (except November 1987) and encompasses both sampling periods.

Differences in macrofauna characteristics among stations were determined using two-way ANOVAs with station and month-year as treatments. A linear contrast was added to the ANOVA that was undertaken on the second subset (four stations, all dates) to test for differences among sampling periods. Post-hoc Tukey tests were run to test for differences among stations and station-period interactions. ANOVA and Tukey statistical tests were performed using SAS 9.3 software on $\log_e(x+1)$-transformed data using the PROC GLM procedure (SAS Institute Inc. 2011).

Macrofauna Community Structure

Macrofaunal community structure was analyzed using non-metric multi-dimensional scaling (MDS) using a Bray-Curtis similarity matrix among stations to create a MDS plot (Clarke 1993; Clarke and Warwick 2001). Relationships within each MDS were highlighted using a Cluster Analysis using the group average method. Significant differences between each cluster were tested using the SIMPROF permutation procedure using a significance level of 5 % (0.05). Where stations were sampled in both time periods, differences in community structure and species assemblages between periods and among zones were tested using ANOSIM, and SIMPER in Primer (Clarke 1993). Data were $\log_e(x + 1)$ transformed prior to multivariate

[2] http://www.itis.gov/

analysis in Primer software to decrease the effect of numerically dominant species on the interpretation of the community composition (Clarke and Gorley, 2006).

Water Quality

Water quality along the Caloosahatchee Estuary was characterized using Principal Components Analysis (PCA) using supplied water quality data. PCA is a multivariate variable reduction method that allows many different continuous variables at many sample points to be compared simultaneously. PCA was performed in SAS (SAS Institute Inc. 2011) on $\log_e(x + 1)$ transformed data (except for pH, which is already log-transformed). Water quality variables were included if they were sampled in the same months and stations as macrofauna samples were taken. PCA was performed using water quality measurements taken only when all seven stations were sampled (which was all in the low inflow period). Some station-months could not be used in the PCA because of missing data. Actual salinity values were used in PCA rather than modeled values.

Linking Macrofauna to Salinity, and Salinity to Inflow

Conceptual Model

A conceptual model has emerged the helps us identify inflow effects on estuary resources. The relationship between biology and hydrology is complex and embedded in the food web and material flow dynamics of estuaries. For example, one cannot grow fish by simply adding water to a fish tank; organic matter is required to grow fish. Ultimately, biological resources in estuaries are affected by salinity more than inflow by itself, but salinity however, is affected by inflow (Figure 2). Because of the links between flow, salinity, and biology; determining the relationship between inflow and resources is a multi-step approach. First, the resource to be protected is identified. Second, the salinity range or requirements of that resource are identified in both space and time. Third, the flow regime needed to support the required distribution of salinity is identified, usually using hydrodynamic and salinity transport models. These experiences led to a generic framework that inflow hydrology drives estuarine condition and estuarine condition drives biological resources (Figure 3). Benthic macrofauna has been identified as a resourceof interest in this current investigation, because it is an indicator of estuarine condition, and indirectly of inflow hydrology. Therefore, the next step is to link macrofauna to salinity, the most obvious component of estuarine condition.

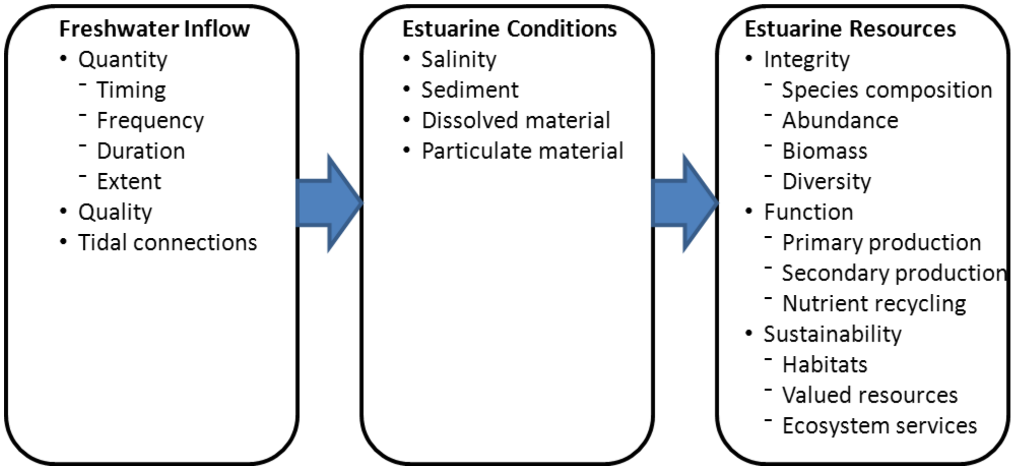

Figure 3. Conceptual model of inflow effects on estuary biological resources (Montagna et al. 2013).

Salinity-Macrofauna Relationships

Relationships between previously modeled salinity (Qiu and Wan, 2013) and macrofauna abundance and diversity were examined with a non-linear model. The model was used successfully in Texas and Florida estuaries in the Gulf of Mexico (Montagna et al., 2002; Montagna et al., 2008). The assumption behind the model is that there is an optimal range for salinity and values decline prior to and after meeting this maximum value. That is, the relationship resembles a bell-shaped curve. The shape of this curve can be predicted with a three-parameter, log normal model:

$$Y = ae^{\left[-0.5\left(\frac{ln\left(\frac{X}{X_c}\right)}{b}\right)^2\right]}$$

This model was used to characterize the nonlinear relationship between a biological characteristic (Y) and salinity (X) or inflow (X). The three parameters characterize different attributes of the curve, where *a* is the maximum value, *b* is the skewness or rate of change of the response as a function of salinity, and *c* the location of the peak response value on the salinity axis. For this project, the log-normal model was used only with raw abundances above zero (i.e., samples with zero abundances were not used). The nonlinear statistical models were developed using SAS 9.3 software using the PROC NLIN procedure (SAS Institute Inc. 2011).

Macrofauna community structure was linked with environmental variables using the BIO-ENV procedure. The BIO-ENV procedure calculates weighted Spearman rank correlations (ρw) between sample ordinations from all of the environmental variables and an ordination of biotic variables (Clarke and Ainsworth 1993). Correlations are then compared to determine the best match. BIO-ENV was calculated with Primer software (Clarke and Warwick 2001; Clarke and Gorley 2006).

Salinity-Inflow Relationships

The analyses above linked macrofauna characteristics with salinity, optimal relationships with salinity and tipping points where rapid changes in macrofauna characteristics occur with small changes in salinity. Optimal relationships were determined by using the non-linear model between univariate macrofauna variables and salinity mentioned above (e.g., Montagna et al. 2002). Tipping points can be identified by using this same method, but also when comparing multivariate community structure (e.g., Palmer et al. 2011). Essentially, the optimal relationships and breaking points are salinity thresholds. For example, during the Nueces Bay studies, the threshold value of 18 ppt was identified, and above this value a wide variety of estuarine resources were degraded (NBBEST 2011). Similarly, in the Nueces Marsh, the optimal threshold value of 10 ppt was identified for macrofauna biomass (Montagna et al. 2002).

The final step was to simply identify inflow regimes that will yield the desired salinity thresholds. The two benthic sampling periods had different inflows and salinities and thus provided the basis for a low flow (period 1) and high flow (period 2) regimes (Figure 2). Based on macrofauna community structure and diversity groupings, the Caloosahatchee Estuary was divided into four zones. The lower quartile, median and upper quartile of salinity were determined for each zone and sampling period combination using salinities from all dates and stations within each zone and period. The summary statistics of salinities were then converted to inflow at each salinity station within each zone (Figure 1).

The conversion from salinity to flow was enabled using non-linear models. A two-parameter exponential decrease model was used to estimate the natural logarithm of flow (Q) from salinity (S):

$$\log(Q + 1) = ae^{-bS}$$

Flow at the S-79 gaging station was estimated for the lower, middle (median), and upper quartiles of previously modeled salinity (Qiu and Wan, 2013) in each period (1 and 2) at four salinity stations within or adjacent to the four macrofauna community zones (Figure 1). The salinity stations used were Bridge 31 (zone 1), Fort Myers (zone 2), Shell Point (zone 3), and Sanibel (zone 4). Each salinity-flow conversion, along with ninety-percent confidence intervals was calculated using the PROC NLIN procedure in SAS 9.3 software (SAS Institute Inc. 2011). These analyses allowed us to determine a minimum flow that supports the salinity threshold. One must always be mindful however, that a minimum flow could maintain an ecosystem at a sub-optimal level.

RESULTS

Macrofauna Communities

Univariate Macrofauna Indices

Macrofauna community analyses that included both the high inflow (1994-1995) and low inflow periods (1986-1989) among all seven benthic sampling stations could not be completed because of an uneven sampling design (Table 1). Spatial analyses of all seven stations were compared using only the 10 months that all stations were sampled. These 10 months were all within the dry sampling period. Spatial comparisons of macrofauna communities that incorporated all months (except November 1987) were enabled when only data from stations 2, 4, 5 and 6 were used. Comparisons of macrofauna communities in the high and low inflow periods could also only be made using the same four stations (2, 4, 5 and 6).

Macrofauna abundance did not follow a linear trend moving horizontally up or down the Caloosahatchee Estuary (Figure 4A and Figure 7). Mean abundance peaked at stations 3 and 6 and was lowest at stations 5 and 7. N1 diversity followed a general pattern of low to high from upstream to downstream (Figure 4B and Figure 7). N1 diversity at the downstream stations 6 and 7 were significantly greater than at station 5, which in turn was significantly greater than at the upstream four stations. N1 diversity at station 1 was significantly higher than at stations 2 and 4 but not than at station 3.

N1 diversity and especially abundance were variable over the study period (Figure 5 and Figure 6). Mean abundance and N1 diversity were higher in the low inflow period (mean abundance 8203 n m^{-2}, N1 8.1 $grab^{-1}$) than the high inflow period (mean abundance 5891 n m^{-2}, N1 5.9 $grab^{-1}$). However these differences between periods were only significant at one station for each variable. Abundance was significantly higher in period 1 than period 2 at station 4 only (Figure 7, Table 2). N1 diversity was significantly higher in period one than period two at station 6 only (Figure 8, Table 3).

The results of all ANOVAs to test the differences among months and stations for abundance and diversity are found in Appendix 1.

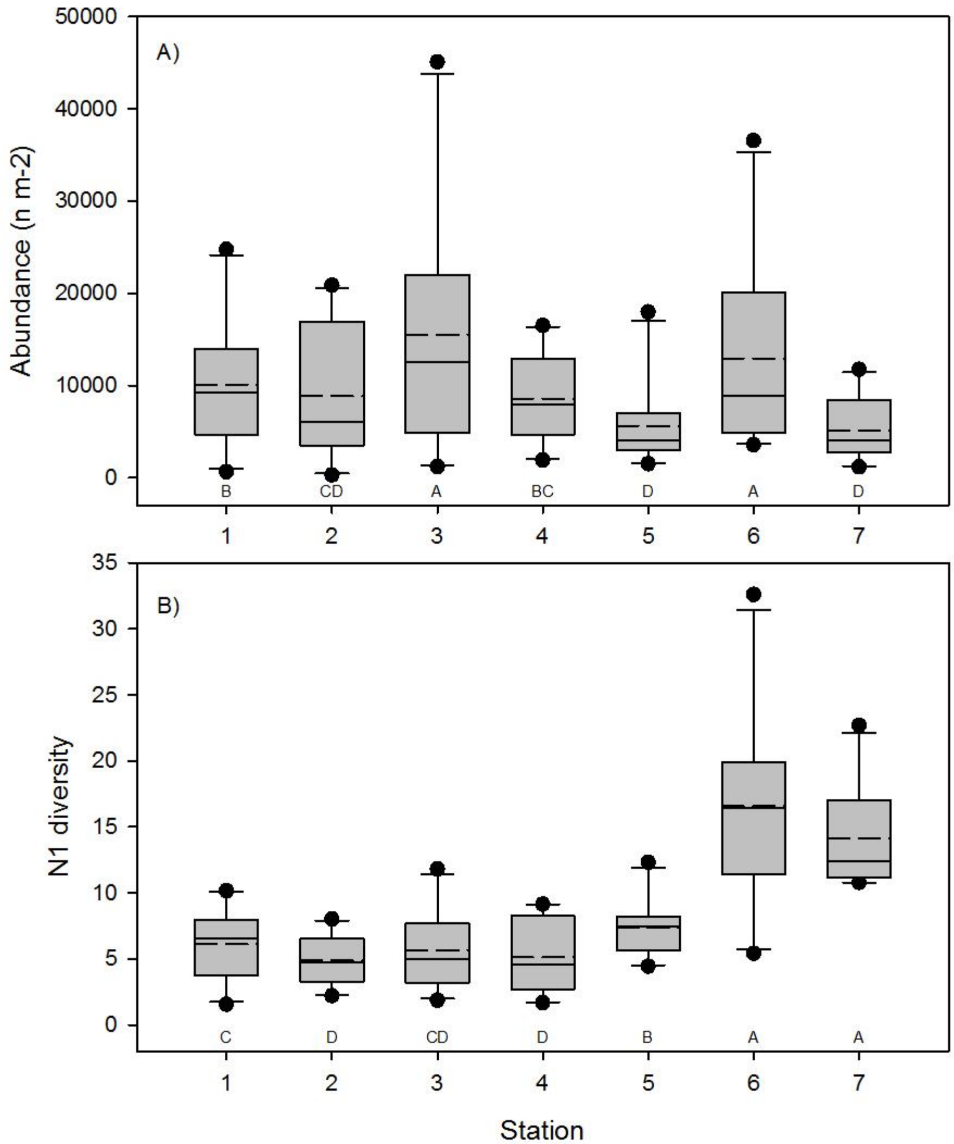

Figure 4. Boxplot of A) abundance and B) N1 diversity at each sampling station during simultaneous sampling in period 1 (10 months).
Dashed line indicates mean, letters represent Tukey groupings on log-transformed data.

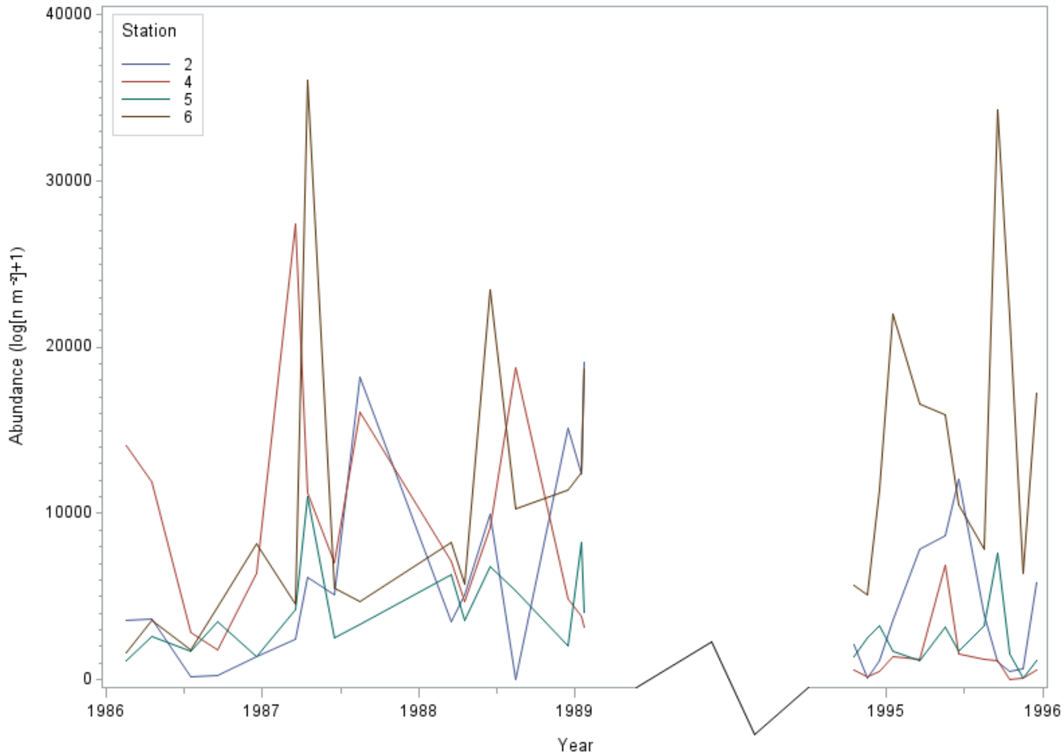

Figure 5. Time series of detransformed abundance at four simultaneously sampled stations.

Figure 6. Time series of detransformed N1 diversity at four simultaneously sampled stations.

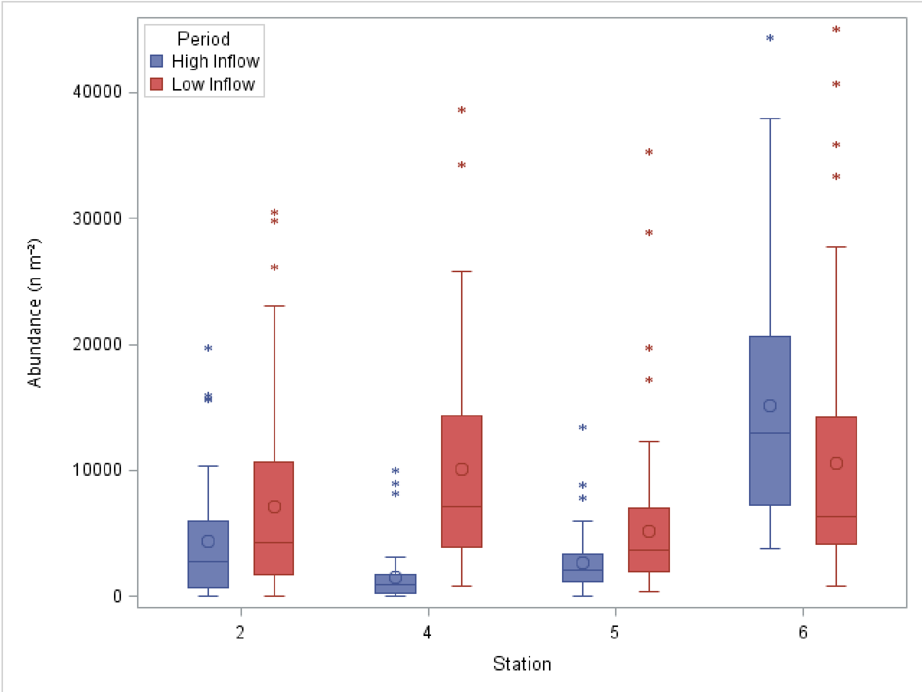

Figure 7. Boxplot of abundance at four simultaneously sampled stations in each period. Periods 1 and 2 were only significantly different from each other at station 4. Circles indicate means, whiskers indicate 1.5 x interquartile range, asterisks indicate outliers beyond this range.

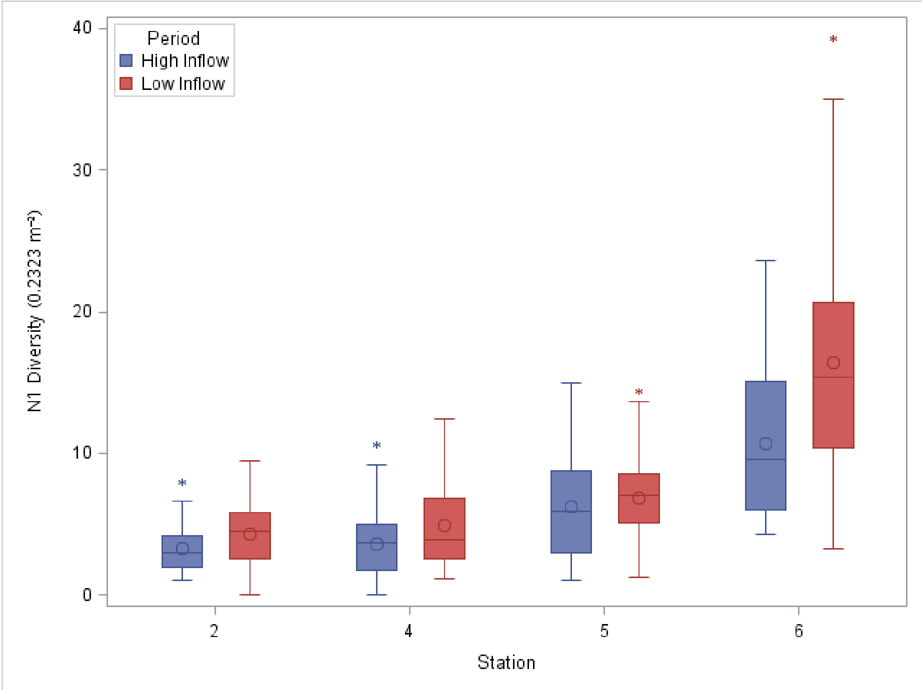

Figure 8. Boxplot of N1 diversity at four simultaneously sampled stations in each period. Periods 1 and 2 were only significantly different from each other at station 6. Circles indicate means, whiskers indicate 1.5 x interquartile range, asterisks indicate outliers beyond this range.

Table 2. Post hoc Tukey groupings of macrofauna abundance at each station between periods 1 (dry) and 2 (wet).

Tukey Grouping		Station-Period	Mean ($\log_e [x+1]$)	Detransformed Mean	N
	A	Sta6-P2	9.42	12375	48
	A				
B	A	Sta4-P1	8.88	7202	79
B	A				
B	A	Sta6-P1	8.88	7156	80
B					
B	C	Sta5-P1	8.16	3504	80
	C				
	C	Sta2-P1	7.76	2338	80
	C				
	C	Sta2-P2	7.61	2025	48
	C				
	C	Sta5-P2	7.41	1650	48
	D	Sta4-P2	6.32	555	48

Table 3. Post hoc Tukey groupings of macrofauna N1 diversity at each station between periods 1 (low inflow) and 2 (high inflow).

Tukey Grouping		Station-Period	Mean ($\log_e [x+1]$)	Detransformed Mean	N
	A	Sta6-P1	2.75	14.71	80
	B	Sta6-P2	2.36	9.62	48
	C	Sta5-P1	1.98	6.26	80
	C				
D	C	Sta5-P2	1.84	5.27	48
D					
D	E	Sta4-P1	1.65	4.23	79
	E				
F	E	Sta2-P1	1.55	3.70	80
F	E				
F	E	Sta4-P2	1.39	3.03	48
F					
F		Sta2-P2	1.37	2.94	48

Macrofauna Community Structure

Mean macrofauna community structure was grouped by location, with the upstream stations being different - from the downstream stations (Figure 9 and Figure 10). When comparing all stations only (but only period 1), stations 1 - 4 were different from downstream station 5 – 7. Each of these two clusters was at least 43% similar to each other. These clusters were each subdivided into two further communities. The communities at stations 2 to 4 were significantly similar to each other (> 57% similar) but not to station 1. Similarly, communities at stations 6 and 7 were significantly similar to each other (> 53% similar) but not to station 5. From this clustering, the stations were divided into four spatial zones. Zone 1 (upstream) consists of station 1, zone 2 consists of stations 2 to 4, zone 3 consists of station 5, and zone 4 (downstream) consists of stations 6 and 7 (Figure 11).

The most abundant species within zone 1 were the amphipod *Grandidierella bonnieroides*, Conrad's false mussel *Mytilopsis leucophaeata*, and the Atlantic rangia clam *Rangia cuneata* (Table 4, Appendix 2). In zone 2, the most abundant organisms were the cumacean *Cyclaspis varians*, the amphipod *Grandidierella bonnieroides*, and Conrad's false mussel *Mytilopsis leucophaeata*. The most abundant species in zone 3 was the amphipod *Ampelisca vadorum*, while the most abundant species in zone 4 were the spionid polychate *Carazziella hobsonae*, and the myodocopid ostracod *Parasterope pollex*.

When comparing the four stations that were sampled in both periods, the upstream stations were again divided into upstream (stations 2 and 4) and downstream (stations 5 and 6) stations. Stations 2 and 4 were 58% similar but stations 5 and 6 were only 47% similar. Macrofauna communities in each of the three zones that were sampled in both periods were all significantly different from each other (ANOSIM: R statistic = 0.62, significance value ≤ 0.1%). The communities in zones 2 and 4 were more similar to those in zone 3 (R statistic = 0.5 and 0.63) than to each other (R statistic = 0.79). Polychaetes *Paraprionospio pinnata*, *Glycinde solitaria*, and *Mediomastus ambiseta* were more abundant in zones 3 and 4 than zone 2 (Table 5). The polychaetes *Aricidea philbinae*, *Tharyx dorsobranchialis*, *Prionospio perkinsi*, *Sigambra tentaculata*, and bivalve *Tellina versicolor* were all more abundant in zone 4 than zones 2 or 3. The amphipod *Grandidierella bonnieroides* was more abundant in zone 2 than in zones 3 or 4.

The cumacean *Cyclaspis varians* and polychaete *Streblospio benedicti* both decreased in abundance in period 2 (high inflow) relative to period 1 (low inflow) in zones 2 and 3 (Table 6). Unidentified Tubificidae without capillary setae (Oligochaeta) increased in abundance in all zones from period 1 to period 3. The isopod *Cyathura polita* and amphipod *Grandidierella bonnieroides* both decreased in abundance between dry and wet period, however unidentified Tanypodinae (Chironomidae) increased during the same time. Unidentified Tubificidae without capillary setae also decreased in abundance in the high inflow period relative to the low inflow period in zone 3, while several taxa, including *Ampelisca vadorum* decreased in abundance. Many species increased in abundance from low inflow to high inflow period in zone 4, including amphipod *Cerapus tubularis*, isopod *Edotia montosa*, and bivalves *Mulinia lateralis* and *Mysella planulata*.

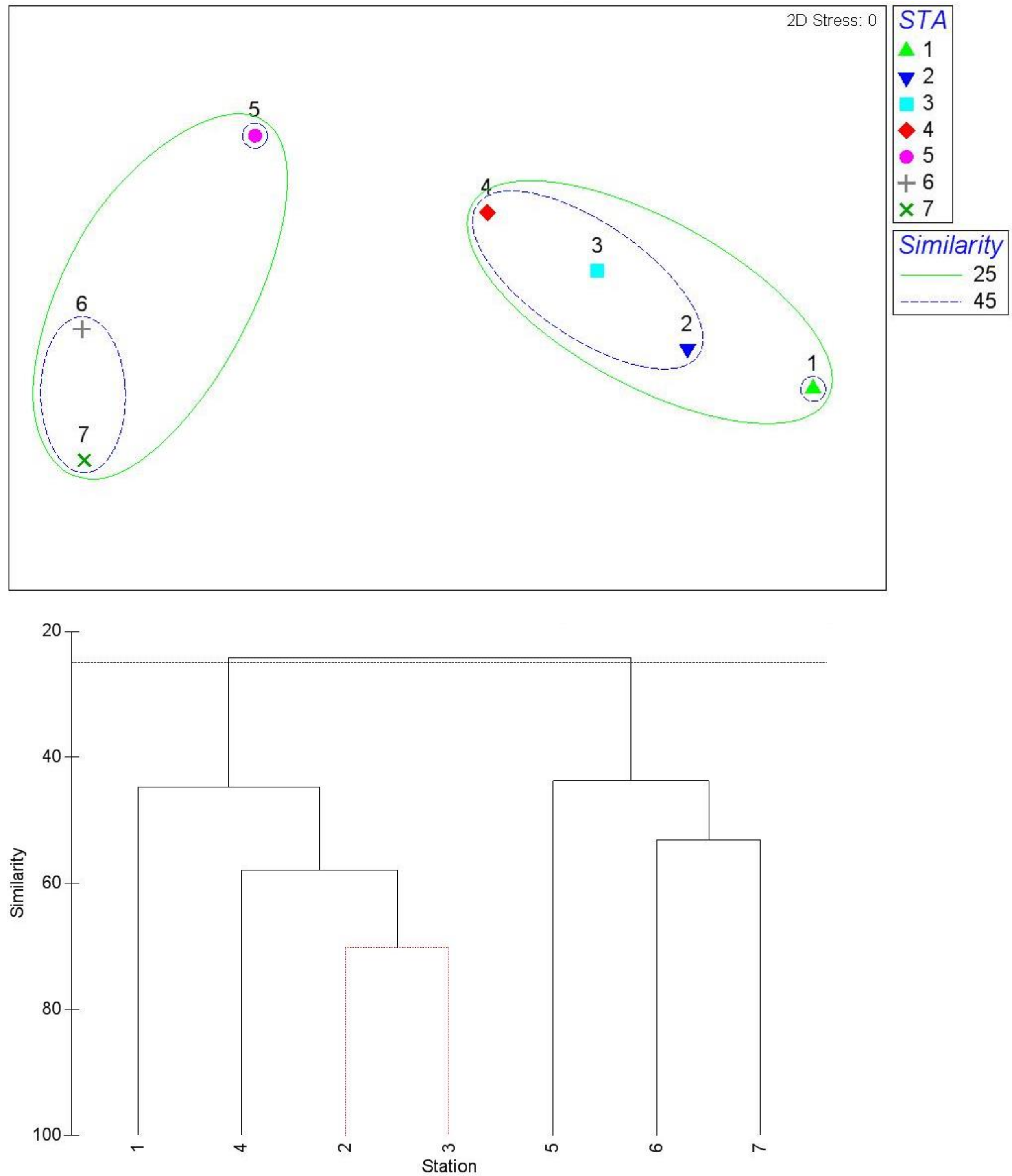

Figure 9. Multi-dimensional scaling plot of mean community structure at each station from Feb 1986 to Apr 1989 (A). Plot is overlaid with contours from cluster analysis (B).

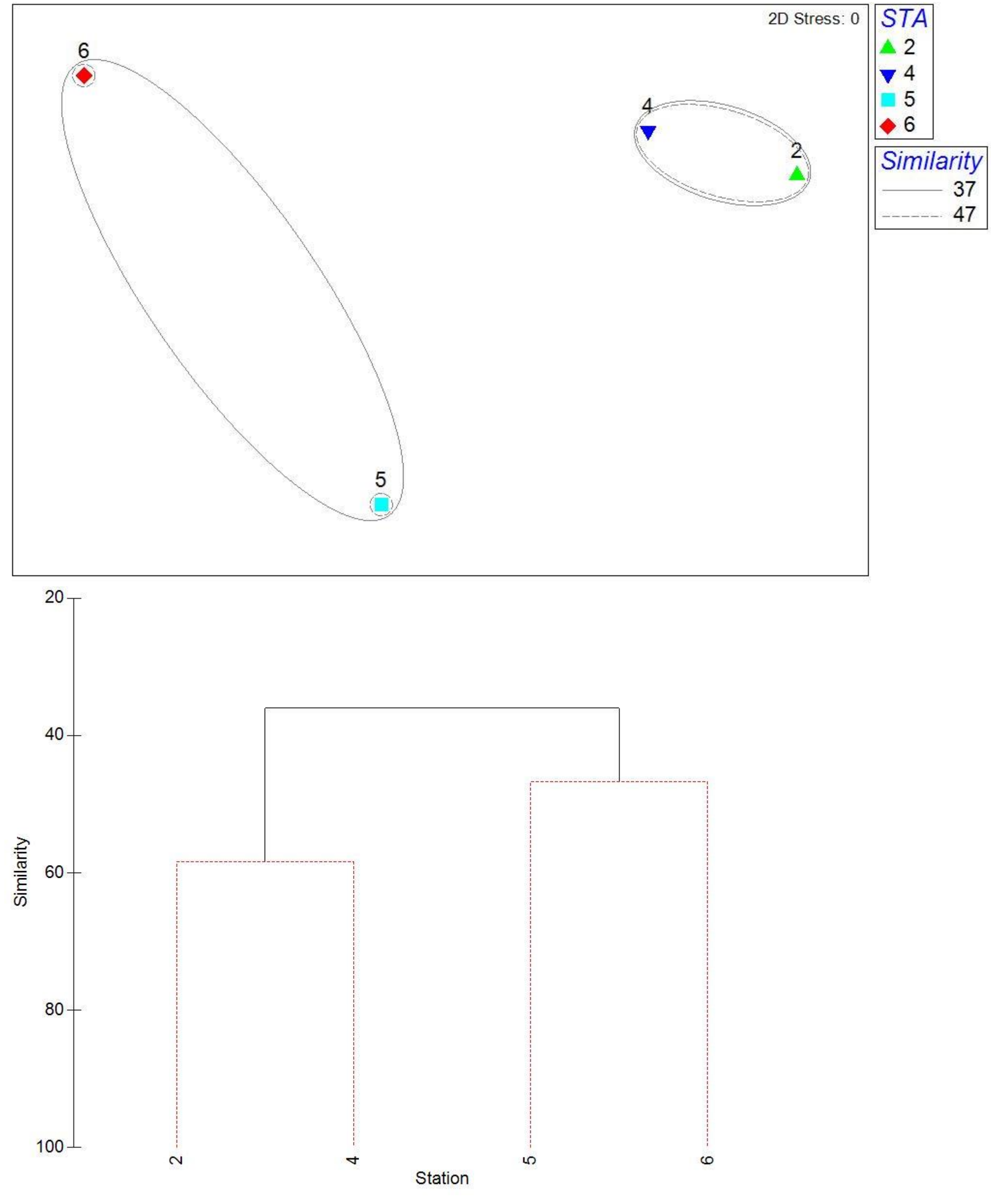

Figure 10. Multi-dimensional scaling plot of mean macrofaunal communities over both sampling periods. Plot is overlaid with contours from cluster analysis (B).

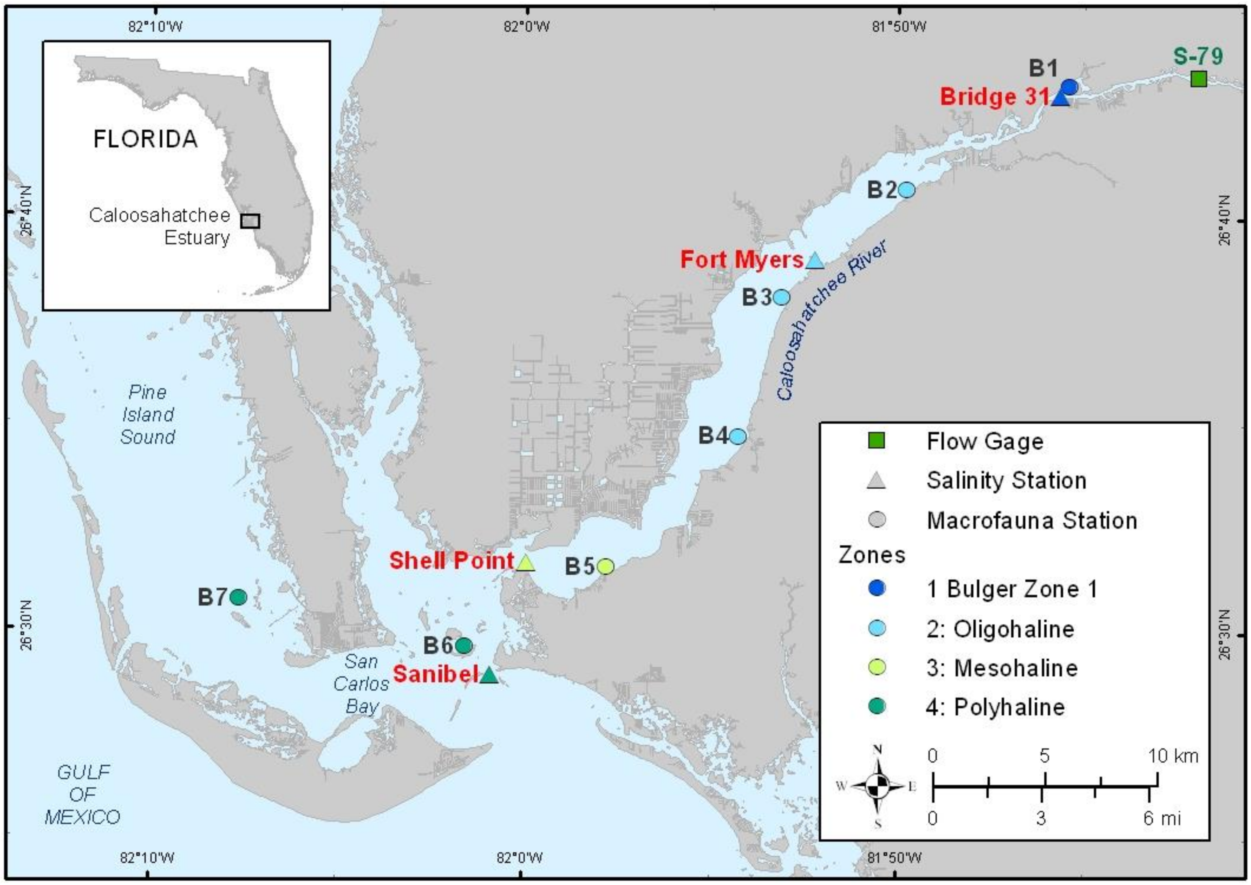

Figure 11. Map of macrofauna and salinity sampling stations showing macrofauna communtiy zones (as in Figure 9).

Table 4. Mean abundance of the most abundant species at all stations in Period 1.

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Cyclaspis varians	2	1579	4280	900	403	311	22	1071	11.24	11.24
Grandidierella bonnieroides	2332	1095	2071	354	6	25	0	840	8.82	20.07
Mytilopsis leucophaeata	1350	1714	1796	204	1	0	0	724	7.60	27.66
Ampelisca vadorum	1	9	115	2035	2065	807	11	720	7.56	35.23
Ampelisca abdita	0	1	1244	1365	205	42	0	408	4.29	39.51
Tellina versicolor	2	158	554	1527	80	181	82	369	3.87	43.39
Carazziella hobsonae	0	0	0	0	8	2372	31	344	3.62	47.00
Parasterope pollex	3	2	3	115	206	1283	770	340	3.57	50.57
Assiminea succinea	383	153	1776	39	0	4	2	337	3.53	54.11
Streblospio benedicti	369	622	503	301	139	35	0	281	2.95	57.06
Mulinia lateralis	36	1358	69	60	6	4	1	219	2.30	59.36
Rangia cuneata	1295	161	52	0	0	0	0	215	2.26	61.62
Mediomastus ambiseta	0	1	0	21	375	425	677	214	2.25	63.87
Cyprideis sp.	221	0	0	1	0	540	650	202	2.12	65.99
Ampelisca sp.	0	5	73	545	327	276	25	179	1.88	67.87
Cyathura polita	382	223	543	96	0	0	0	178	1.86	69.73
Tellina texana	121	316	512	79	47	117	3	171	1.79	71.53
Peloscolex heterochaetus	2	556	355	95	0	1	0	144	1.51	73.04
Tanytarsus sp.	891	2	0	0	0	0	0	128	1.34	74.38
Bivalvia (unidentified)	77	4	32	67	184	281	196	120	1.26	75.64
451 other species	2626	872	1543	778	1541	6244	2637	2320	24.36	100.00
Total	10091	8831	15520	8582	5593	12948	5108	9525	100.00	

Abbreviation: Cum. = cumulative abundance

Table 5. Discriminating species among spatial zones from SIMPER analysis.

	Species	Av. Abundance*		Av.Diss	Diss/SD	Contrib%
Zones 2 & 3	Av. Diss. = 80.20	Zone 2	Zone 3			
	Paraprionospio pinnata	0.68	4.39	2.27	1.5	2.83
	Glycinde solitaria	0.64	3.25	1.62	1.32	2.03
	Grandidierella bonnieroides	3.51	1.39	1.84	1.25	2.29
	Cyclaspis varians	2.35	3.75	1.96	1.22	2.44
	Mediomastus ambiseta	0.33	3.16	1.74	1.2	2.16
	Bivalvia (unidentified)	1.25	3.02	1.58	1.14	1.97
	Cyathura polita	2.52	0.08	1.39	1.1	1.73
	Streblospio benedicti	3.33	3.94	2.3	1.08	2.87
	Nemertea (unidentified)	3.41	2.34	1.41	1.03	1.76
	Mulinia lateralis	1.63	1.61	1.4	1.02	1.75
Zones 2 & 4	Av. Diss.= 88.44	Zone 2	Zone 4			
	Aricidea philbinae	0.14	4.62	1.42	2.87	1.6
	Prionospio perkinsi	0	4.63	1.5	2.5	1.7
	Tharyx dorsobranchialis	0	5.17	1.68	1.99	1.9
	Mediomastus ambiseta	0.33	4.93	1.47	1.98	1.67
	Paraprionospio pinnata	0.68	4.99	1.46	1.89	1.65
	Glycinde solitaria	0.64	3.78	1.08	1.84	1.22
	Bivalvia (unidentified)	1.25	4.45	1.14	1.74	1.28
	Sigambra tentaculata	0	3.02	0.94	1.6	1.07
	Tellina versicolor	2.31	3.74	0.97	1.4	1.1
	Acteocina canaliculata	0.62	3.59	1.14	1.35	1.28
Zones 3 & 4	Av. Diss.= = 74.66	Zone 3	Zone 4			
	Aricidea philbinae	0.41	4.62	1.2	2.4	1.61
	Tharyx dorsobranchialis	0.24	5.17	1.44	1.83	1.92
	Prionospio perkinsi	1.48	4.63	1	1.56	1.34
	Tellina versicolor	1.41	3.74	0.92	1.48	1.23
	Sigambra tentaculata	0.62	3.02	0.75	1.4	1
	Acteocina canaliculata	1.83	3.59	0.87	1.27	1.17
	Cyclaspis varians	3.75	4.68	0.99	1.26	1.32
	Bivalvia (unidentified)	3.02	4.45	0.71	1.23	0.96
	Streblospio benedicti	3.94	2.19	0.79	1.22	1.05
	Diplodonta semiaspera	0.08	2.6	0.74	1.21	0.99

*$Log_e(n+1)$ transformed

Abbreviations: Av. = average, Diss. = dissimilarity, SD = standard deviation, Contrib. = contribution

Table 6. Discriminating species between periods within spatial zones from SIMPER analysis.

Zone	Species	Av. Abundance*		Av.Diss	Diss/SD	Contrib%
Zone 2	Av. Diss. = 85.45	Low Inflow	High Inflow			
	Cyathura polita	4.19	0.12	3.32	1.58	3.88
	Grandidierella bonnieroides	4.74	1.76	3.17	1.27	3.71
	Streblospio benedicti	3.93	2.35	2.84	1.2	3.33
	Cyclaspis varians	3.3	0.94	2.35	1.08	2.75
	Tubificidae w/o cap setae	0.51	3.66	3.14	1.07	3.67
	Tanypodinae (unidentified)	0	2.56	2.36	0.99	2.77
	Nemertea (unidentified)	3.85	2.65	2.04	0.99	2.38
	Tellina versicolor	3.01	1.44	2.6	0.94	3.04
	Peloscolex heterochaetus	2.58	0	1.78	0.94	2.08
	Mulinia lateralis	2.52	0.33	1.76	0.92	2.06
	Mesanthura fasciata	0	2.27	1.75	0.92	2.05
	Mytilopsis leucophaeata	2.36	0.95	1.99	0.89	2.33
	Rhithropanopeus harrisii	1.76	1.19	1.59	0.86	1.86
	Hydrobiidae (unidentified)	0.07	2.93	2.54	0.85	2.97
	Rangia cuneata	1.41	2.46	2.39	0.83	2.8
Zone 3	Av. Diss. = 80.58					
	Tubificidae w/o cap setae	0.49	3.96	1.85	1.49	2.3
	Streblospio benedicti	3.53	4.19	1.37	1.32	1.7
	Cyclaspis varians	4.51	2.36	1.7	1.3	2.11
	Bivalvia (unidentified)	3.76	2.02	1.38	1.24	1.71
	Ampelisca sp.	3.46	0.5	1.63	1.2	2.02
	Ampelisca vadorum	4.2	0	2.08	1.17	2.59
	Cirrophorus sp.	2.48	0	1.25	1.16	1.55
	Mediomastus sp.	2.83	0.8	1.38	1.13	1.72
	Nemertea (unidentified)	2.74	2.34	0.95	1.13	1.18
	Mulinia lateralis	1.18	2.09	0.98	1.11	1.21
	Mediomastus ambiseta	3.65	2.45	1.47	1.06	1.82
	Parasterope pollex	2.64	0.58	1.22	1.06	1.51
	Acteocina canaliculata	1.95	1.15	0.97	1.06	1.2
	Glycinde solitaria	3.91	2.24	1.23	1.05	1.53
	Paraprionospio pinnata	5.1	3.01	1.53	1	1.9
Zone 4	Av. Diss. = 69.39					
	Cerapus tubularis	0.93	7.18	1.32	2.43	1.91
	Nemertea sp. f	0.24	3.8	0.75	2.04	1.08
	Tubificidae w o cap setae	1.98	6.83	1.02	1.92	1.47
	Edotia montosa	0.37	3.47	0.65	1.86	0.94
	Mysella sp. a	0.47	4.89	0.95	1.8	1.37

Zone	Species	Av. Abundance*		Av.Diss	Diss/SD	Contrib%
	Mulinia lateralis	1.02	5.62	0.99	1.74	1.43
	Mysella planulata	1.1	3.54	0.62	1.61	0.9
	Nemertea sp. b	0.43	3.38	0.66	1.58	0.95
	Gastropoda	2.9	0.69	0.52	1.56	0.76
	Tellina sp.	1.84	3.58	0.58	1.55	0.84
	Ampelisca sp c	0.59	4.08	0.77	1.52	1.11
	Cyclaspis varians	4.75	5.57	0.73	1.46	1.05
	Podarkeopsis levifuscina	1.45	3.6	0.55	1.38	0.79
	Aricidea taylori	1.49	3.34	0.54	1.38	0.78
	Micropholis atra	1.8	3.11	0.52	1.33	0.75
	Streblospio benedicti	1.73	3.55	0.63	1.31	0.91

An analysis was performed to compare community structure during wet and dry seasons (Figure 12 and Figure 13). The wet and dry season MDS analyses used only dates in the low inflow period (Period 1) because this is when all stations were simultaneously sampled. Overall, the dominant pattern where there is a a large difference between stations 4 and 5 remain. There was also no difference between zones 1 and 2 in wet and dry seasons. While stations 5, 6, and 7 were similar above the 40% level, there was a downstream shift during dry seasons, because station 6 was more similar to station 7 in dry seasons, where it was more similar to station 5 in wet seaons.

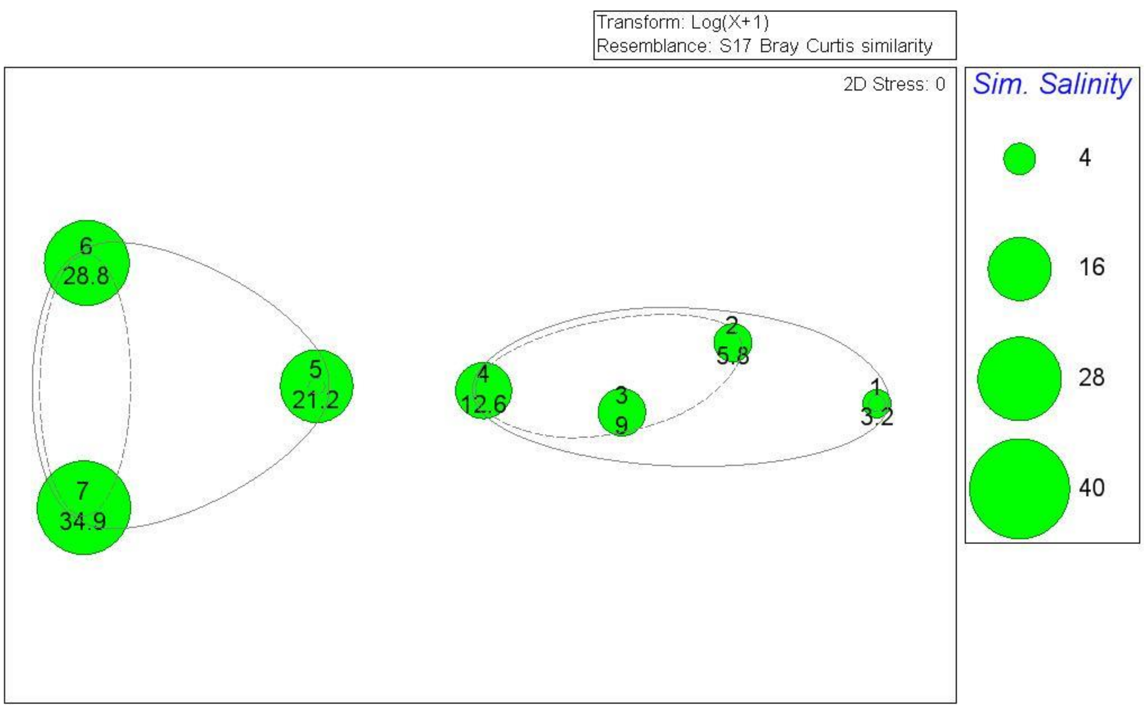

Figure 12. Community structure analysis by MDS for the dry season (October - May) during Period 1.

Plot is overlaid with contours from cluster analysis where similaries are 25% for dotted lines, and 44% for solid lines. Salinities are mean modeled salinities (Qiu and Wan, 2013).

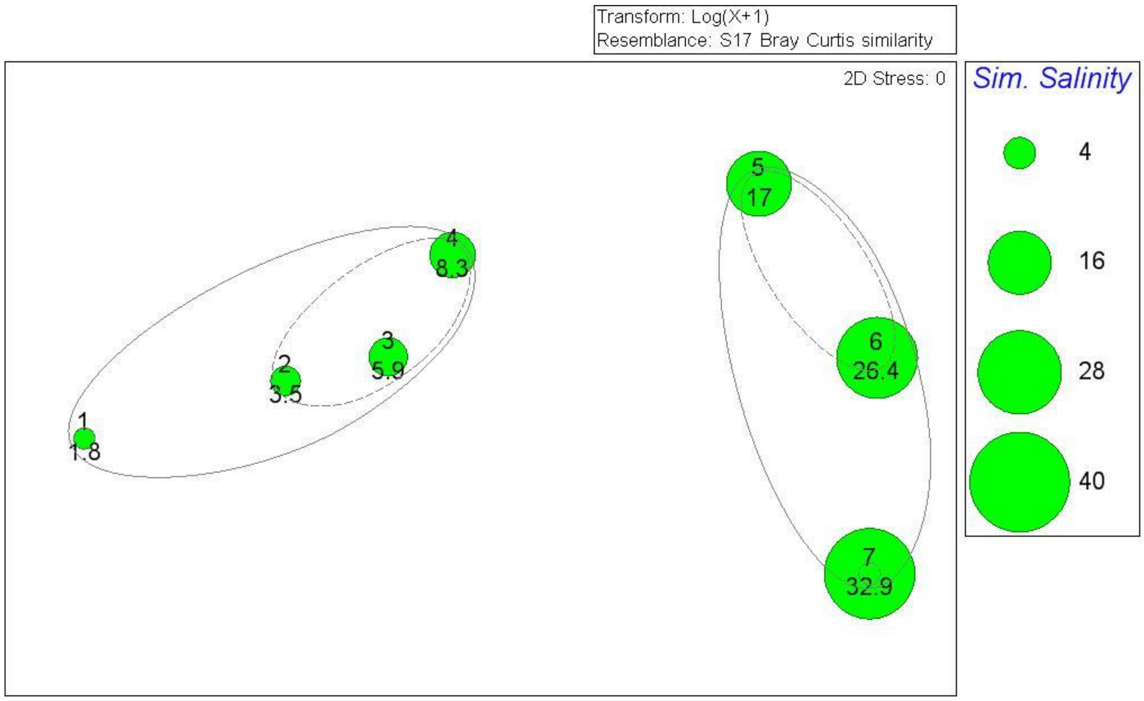

Figure 13. Community structure analysis by MDS for the wet season (June - September) during Period 1.

Plot is overlaid with contours from cluster analysis where similarities are 20% for dotted lines and 39% for solid lines. Salinities are mean modeled salinities (Qiu and Wan, 2013).

Water Quality

Principal components (PC) one and two accounted for 56.7 and 15.0% of the variation (total 71.7%) in water quality variables among station-dates (Figure 14). The seven stations are ordered consecutively along the PC1 axis, with upstream stations having negative values and downstream values having positive values (Figure 14A). PC1 is a rough approximation of inflow effects with positive values having high salinity (measured, not modeled), conductivity, hardness values, high concentrations of sulfate, potassium, calcium, and low color values (Figure 14B). PC2 is a rough approximation of seasonal effects on water quality, with positive PC2 values having high temperatures and low dissolved oxygen concentrations. The factor scores of the first principal component (PC1) were significantly correlated with total inflow to the estuary at all stations except station 6 ($r < -0.78$, $p < 0.05$ Table 7, Figure 14). The correlation between total inflow and PC1 for all stations combined ($r = -0.43$, $p \leq 0.001$) was lower than those of the individual stations ($r < 0.61$), however it was still significant. Inflow was not significantly correlated with PC2.

As expected, salinities increase as you travel from upstream to downstream from macrofauna community zones 1 to 4 (Table 12, Figure 15). Salinities are also significantly higher during period 1 (dry) than period 2 (wet) in each zone (Appendix 3). All period-zone combinations are significantly different from each other except for zone 1 in period 1 (low inflow) has salinities not significantly different to those in zone 2, period 2 (high inflow).

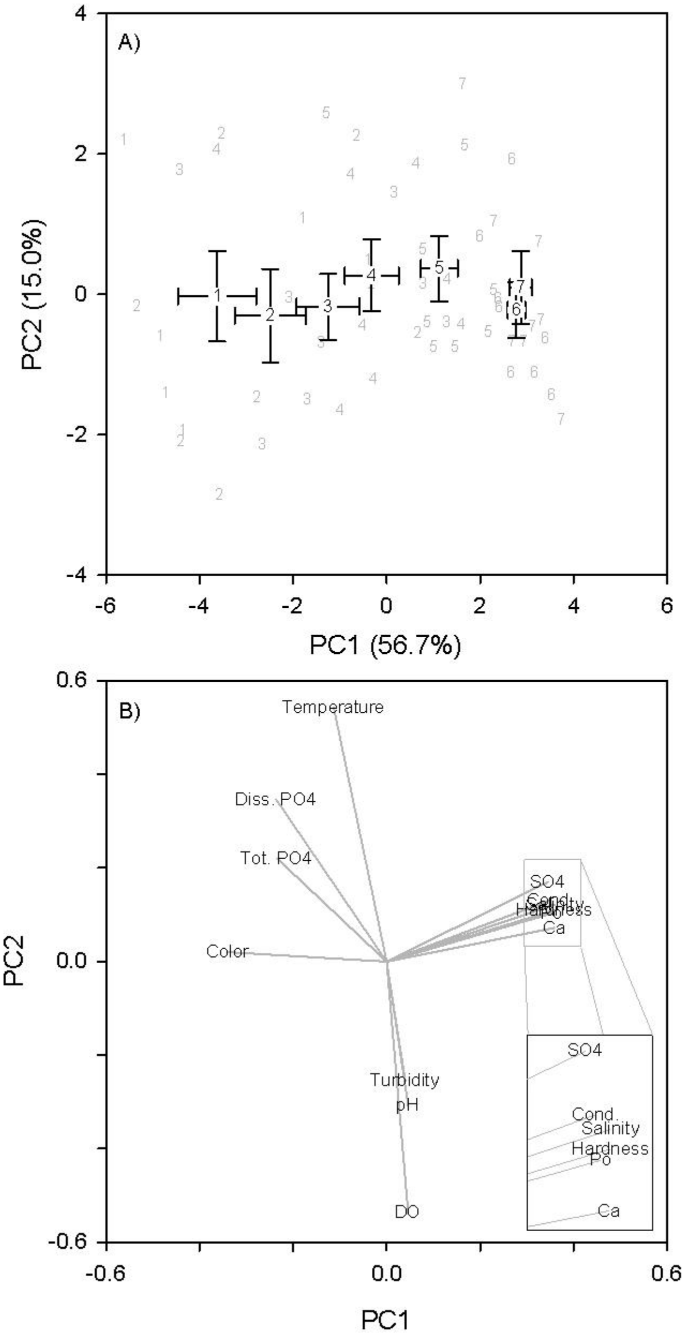

Figure 14. Principal Components Analysis scores (A) and loading vectors (B) of water quality variables sampled in the same months as the macrobenthos during the low inflow period. Numbers in (A) indicate station number. Black numbers and error bars indicate station means and standard errors of individual PCA values (grey). Cond = conductivity, DO = dissolved oxygen, Diss = dissolved, Tot = total.

Table 7. Pearson Correlations between the first two Principal Component (PC) factor scores from Prinicpal Components Analysis of water quality (Figure 14) and monthly freshwater inflow.

		Total Inflow		S-79 gage flow	
Station	n	r	p	r	p
PC 1					
1	6	**-0.83**	**0.0426**	**-0.82**	**0.0440**
2	8	**-0.94**	**0.0005**	**-0.91**	**0.0016**
3	8	**-0.90**	**0.0020**	**-0.83**	**0.0103**
4	8	**-0.88**	**0.0044**	**-0.79**	**0.0201**
5	8	**-0.79**	**0.0200**	-0.68	0.0614
6	8	-0.62	0.1036	-0.46	0.2511
7	8	**-0.92**	**0.0012**	**-0.79**	**0.0194**
All	54	**-0.43**	**0.0011**	**-0.42**	**0.0017**
PC 2					
1	6	-0.01	0.9884	-0.19	0.7157
2	8	-0.21	0.6092	-0.47	0.2438
3	8	0.08	0.8587	-0.06	0.8843
4	8	0.12	0.7758	-0.12	0.7741
5	8	0.24	0.5726	0.07	0.8762
6	8	0.04	0.9200	-0.08	0.8440
7	8	0.63	0.0948	0.45	0.2595
All	54	0.11	0.4121	-0.07	0.6100

Flow is modeled flow to the entire estuary (total inflow, from Y. Wan, SFWMD) and actual flow at the S-79 gage. **Bold** indicates a significant correlation ($p < 0.05$).

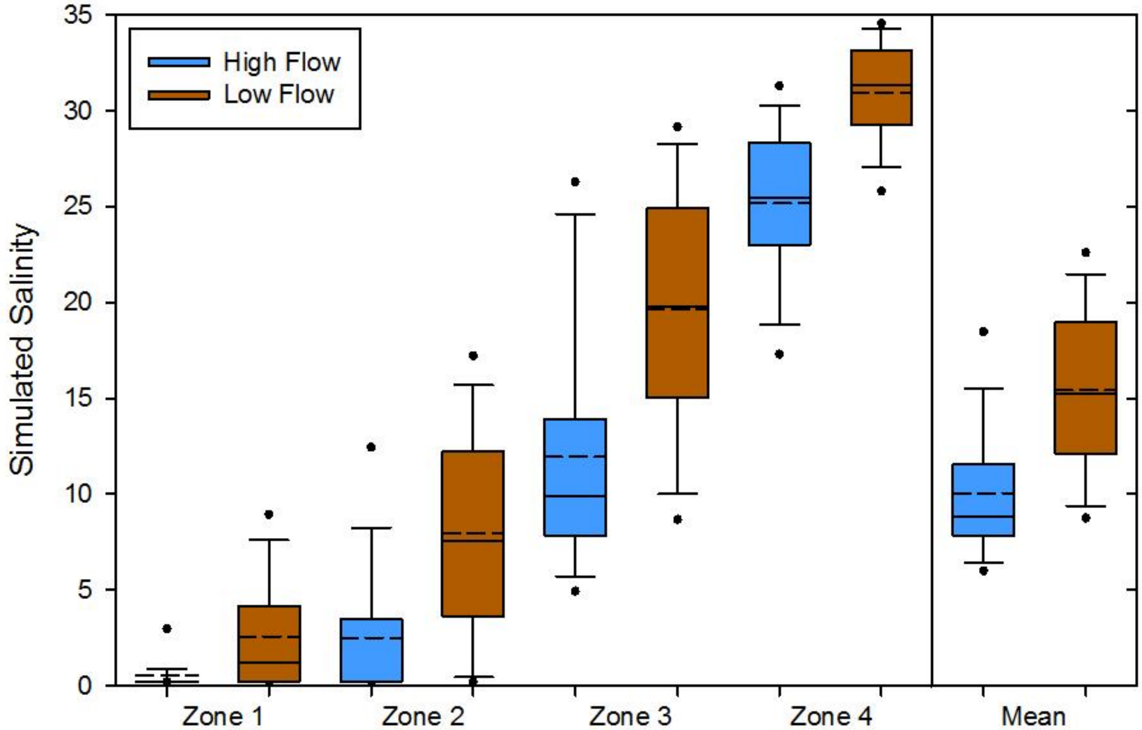

Figure 15. Boxplot of daily salinities within each salinity zone during each sampling period. Dashed line indicates mean, dot represents 5th/95th percentiles.

Table 8. Summary statistics of salinities within each zone during low and high inflow periods.

Statistic	Low Inflow				High Inflow			
	1	2	3	4	1	2	3	4
Number of Observations	1185	3555	1185	2370	457	1371	457	914
Mean	2.6	8.0	19.6	30.9	0.6	2.5	12.0	25.2
Standard Deviation	3.0	6.1	6.3	4.4	1.2	4.2	6.3	6.0
Maximum	11.8	23.2	30.2	35.5	7.4	19.8	28.9	33.0
Upper Quartile	4.2	12.5	24.9	34.7	0.2	3.1	13.9	30.5
Median	1.2	7.1	19.8	32.5	0.2	0.2	9.9	26.2
Lower Quartile	0.2	2.6	15.1	28.0	0.2	0.2	7.9	21.0
Minimum	0.2	0.2	6.6	15.0	0.2	0.2	3.9	2.6

Linking Macrofauna to Salinity, and Salinity to Inflow

Salinity-Univariate Macrofauna Relationships

The number of species and N1 diversity both had linear increases with salinity (Figure 16). Macrofauna abundance had no significant linear or log-normal relationship with salinity. There were significant log-normal relationships between salinity and N1 diversity within each zone, and between salinity and abundance within zone 2 (Table 9, Figure 17 and Figure 18). Peak diversities occurred when salinities were less than 6 at the two upstream zones (1 and 2) and when salinities were above 28 at the two downstream zones (3 and 4). The relationship between abundance and salinity in zone two was not a good fit, even though it was significant.

The abundances of 34 taxa had significant log-normal relationships with salinity (Table 10, Appendix 4).

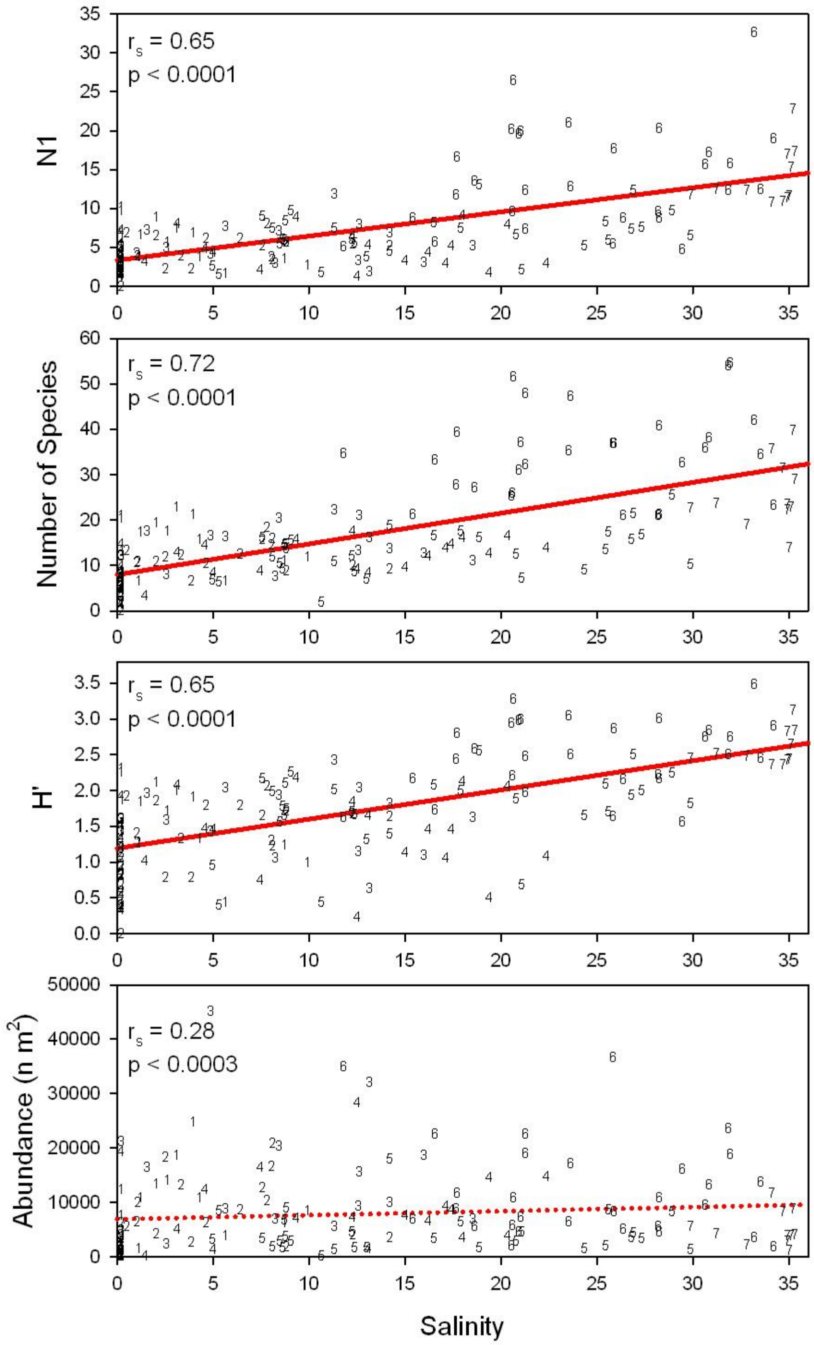

Figure 16. Linear regressions of salinity with N1 diversity, number of species, Shannon diversity (H') and abundance.
r_s = Spearman's rank correlation.

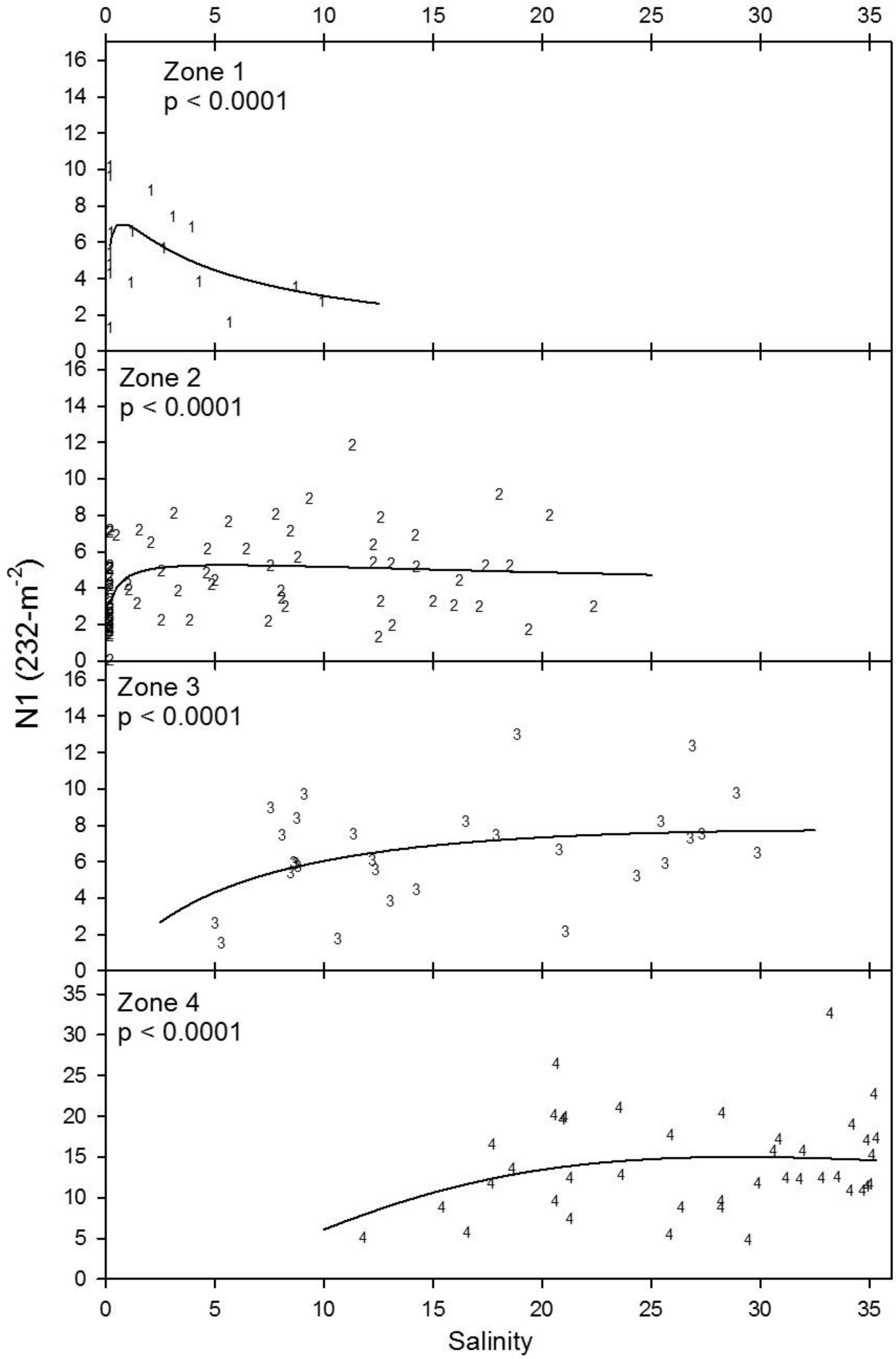

Figure 17. Log-normal relationships between N1 diversity and modeled salinity within each zone.

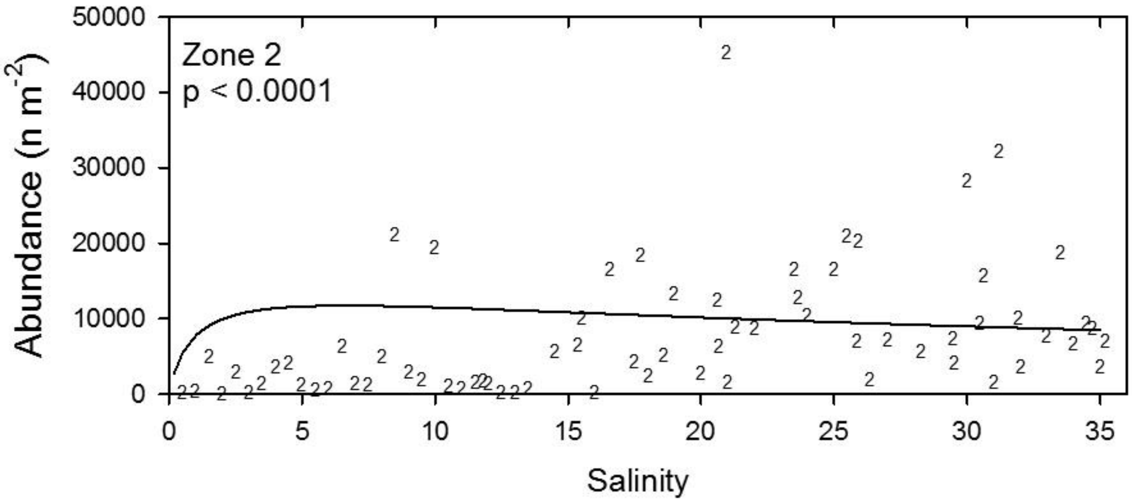

Figure 18. Log-normal relationships between macrofauna abundance and modeled salinity within each zone.

Table 9. Log normal model relationships of N1 diversity and abundance with modeled salinity

Metric	Zone	N	Parameters					p value
			a (peak abund.)	b (skewness)	c (salinity)			
					Estimate	90% low	90% high	
N1 Diversity	1	17	7.1	2.0	0.7	0.2	1.2	<.0001
	2	74	5.3	3.3	5.5	-2.0	12.9	<.0001
	3	29	7.7	1.8	36.2	-99.5	171.8	<.0001
	4	40	15.0	0.8	29.1	15.3	42.9	<.0001
Abundance	1	17	11726	-164700000	2475026			-
(n m^2)	2	74	11744	-2	6.6	-0.3	13.5	<.0001
	3	29	10	462	0.0			-
	4	40	10	209	0.1			-

Table 10. Taxa with significant log-normal relationships between abundances and salinity.

Taxa name	Higher taxa group[1]	Lower taxa group[2]	Parameters					p-value
			a (peak)	b (skewness)	c (salinity)			
					Estimate	90% low	90% high	
Ceratopogonidae sp.	Insecta	Diptera	29	3.93	0.0	-1.7	1.8	0.0364
Amphicteis floridus	Polychaeta	Ampharetidae	137	2.10	0.4	-0.3	1.0	< 0.0001
Edotia sp. 1	Crustacea	Isopoda	546	1.16	0.8	0.5	1.2	0.0008
Edotia spp.	Crustacea	Isopoda	253	1.53	1.0	0.2	1.7	0.0016
Tellina texana	Bivalvia	Veneroida	1139	-1.38	1.6	0.5	2.7	0.0002
Tubificidae w/o cap. setae	Clitellata	Oligochaeta	1034	1.94	1.9	0.6	3.2	< 0.0001
Neanthes succinea	Polychaeta	Nereididae	109	1.26	2.2	0.0	4.3	0.0131
Streblospio benedicti	Polychaeta	Spionidae	970	1.48	2.7	1.0	4.4	< 0.0001
Eteone heteropoda	Polychaeta	Phyllodocidae	128	0.68	5.2	3.2	7.2	0.0022
Assiminea succinea	Gastropoda	Neotaenioglossa	6.2×10^{10}	-0.04	5.9	5.1	6.8	< 0.0001
Mulinia lateralis	Bivalvia	Veneroida	1347	-0.65	6.8	0.6	13.0	0.0772
Tellina versicolor	Bivalvia	Veneroida	16711	-0.09	7.0	6.7	7.2	< 0.0001
Stylochus sp.	Platyhelminthes	Polycladida	51	0.77	8.8	5.7	11.8	< 0.0001
Tagelus plebeius	Bivalvia	Veneroida	57497727	-0.04	10.1	9.9	10.2	< 0.0001
Ischadium recurvum	Bivalvia	Mytiloida	1016692	0.05	10.1	9.7	10.5	< 0.0001
Lucina nassula	Bivalvia	Veneroida	36	-0.63	13.0	-3.1	29.1	0.0075
Ampelisca spp.	Crustacea	Amphipoda	3469	0.36	15.0	12.1	17.9	0.0003
Paraprionospio pinnata	Polychaeta	Spionidae	290	0.95	15.8	9.5	22.1	< 0.0001
Mysella sp. A	Bivalvia	Veneroida	1828	-0.04	17.0	16.7	17.4	0.0063
Odostomia sp.	Gastropoda	Heterostropha	220	0.11	20.4	19.9	21.0	0.0032
Mysella planulata	Bivalvia	Veneroida	115	0.35	21.5	14.2	28.7	0.0302
Caecum pulchellum	Gastropoda	Neotaenioglossa	124	0.10	21.7	20.2	23.1	0.0067
Aglaophamus verrilli	Polychaeta	Nephtyidae	22	0.58	23.5	8.7	38.4	0.001
Phascolion strombus strombus	Sipuncula	Golfingiiformes	119	0.15	24.8	22.7	26.9	0.0211

Taxa name	Higher taxa group[1]	Lower taxa group[2]	Parameters					p-value
			a (peak)	b (skewness)	c (salinity)			
					Estimate	90% low	90% high	
Listriella barnardi	Crustacea	Amphipoda	864	-0.04	26.0	24.1	27.2	0.0005
Parvilucina multilineata	Bivalvia	Veneroida	51	0.24	26.1	23.8	28.4	< 0.0001
Ampelisca sp. 3	Crustacea	Amphipoda	153	0.15	26.5	23.7	29.3	0.004
Sthenelais sp. A (or spp.)	Polychaeta	Sigalionidae	72	0.23	26.9	22.4	31.3	0.0015
Kalliapseudes sp. 1	Crustacea	Tanaidacea	188	0.12	27.6	26.4	28.9	0.0012
Schistomeringos rudolphi	Polychaeta	Dorvilleidae	103	0.03	30.1	29.7	30.4	0.0041
Spiochaetopterus oculatus	Polychaeta	Chaetopteridae	425	0.01	30.7	30.3	31.1	0.001
Molgula occidentalis	Ascidiacea	Pleurogona	519	-0.03	31.4	31.1	31.8	0.0006
Eusarsiella texana	Crustacea	Ostracoda	310	-0.03	31.6	31.2	32.1	< 0.0001
Grubeulepis mexicana	Polychaeta	Eulepethidae	110	0.04	32.1	31.8	32.5	0.027

[1]Mostly Subphyla or Class. [2]Mostly Order or Family. Peak abundance is in n m^{-2}.

Water Quality-Community Structure Relationships

Salinity, calcium concentrations, total phosphate concentrations, color and hardness in several different combinations were correlated highest with macrobenthic community structure during period 1 (low inflow), when all stations were simultaneously sampled (Table 11A). The combination of salinity, calcium, color and total phosphate had the highest correlation with macrobenthic community structure (ρ_w = 0.70, significance ≤ 0.1%), while calcium concentrations and salinity were the single variables with the highest concentrations with macrobenthic community structure. Dissolved oxygen concentrations, temperature, turbidity, pH, potassium concentrations, and sulfate concentrations were not important in explaining the multivariate community structure in period 1.

Fewer water quality variables could be compared with macrobenthic communities from both periods in this study because sampling of water quality variables was inconsistent among dates and stations. Combinations of conductivity, salinity, and total or dissolved phosphate had the highest correlations with macrobenthic community structure among all dates (ρ_w = 0.59, significance ≤ 0.1%;Table 11B). Salinity and/or conductivity made up the highest one- or two-variable combinations with macrofauna community structure (ρ_w = 0.57 to 0.58, significance ≤ 0.1%). Dissolved oxygen concentrations, temperature, turbidity, and pH were not important in explaining the multivariate community structure over both periods.

Table 11. Correlations between macrobenthic communities and water quality variables resulting from the BIO-ENV procedure using data from (A) months that all seven macrofauna stations were sampled, and (B) all samples.

Number of	Correlation with	Variables						
		Salinity	Calcium	Color	Tot.	Hardness	Diss.	Cond.
A) Simultaneously sampled communities								
4	0.700	X	X	X	X			
4	0.698		X	X	X	X		
4	0.696	X		X	X	X		
5	0.695	X	X	X	X	X		
3	0.694	X		X	X			
3	0.693			X	X	X		
4	0.692	X	X	X			X	
5	0.690	X	X	X	X		X	
4	0.690		X	X		X	X	
5	0.689	X	X	X		X	X	
…								
2	0.664	X			X			
2	0.655				X	X		
2	0.655		X	X				
2	0.652	X		X				
…								
1	0.635		X					
1	0.630	X						
1	0.609					X		
1	0.591			X				
B) All communities sampled								
3	0.590	X			X			X
3	0.585	X					X	X
2	0.577	X						X
1	0.573							X
1	0.569	X						
2	0.558	X			X			
2	0.555	X					X	
2	0.554				X			X

X indicates that variable was used in correlation.

Grey box indicates variables were not used in this analysis because of lack of data.

Abbreviations: Cond. = conductivity, Tot. = total, Diss. = dissolved.

Other variables included in the analysis were dissolved oxygen, temperature, turbidity and pH for (A) and (B), and potassium, sulfate for (A).

Salinity-Inflow Relationships

Modeled salinity at each of the four salinity stations were correlated successfully with flow at gage S-79 using the exponential decrease model (Figure 19 to Figure 22, Table 12, Appendix 5). Flow estimates for median salinities associated with each spatial zone range from 11 to 48 m^3s^{-1} during period 1 (low inflow) to 34 to 126 m^3s^{-1} during period 2 (high inflow). The corresponding flows estimated from the lower quartile of salinity in period 1 is similar to the corresponding flows estimated from the upper quartile of salinity in period 2 (16 to 78 m^3s^{-1} and 16 to 76 m^3s^{-1} respectively).

At low salinites (< 3), the prediction equation appears to over-predict the flow as most data points were below the lower 90% limit. This true for the gages at Bridge 31 and the Fort Meyers station.

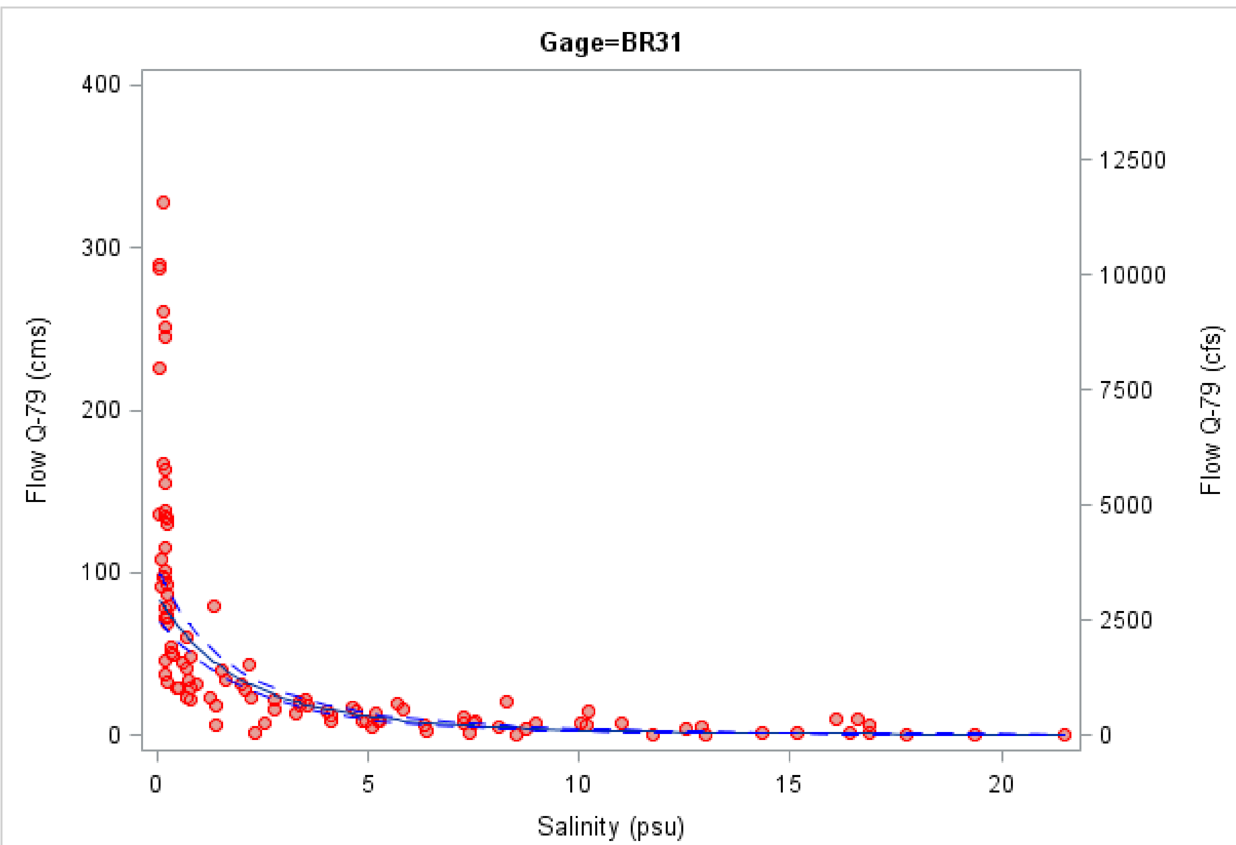

Figure 19. Actual and modeled flow-salinity relationship at Bridge 31.
Upper and lower bounds are at 90% confidence interval.

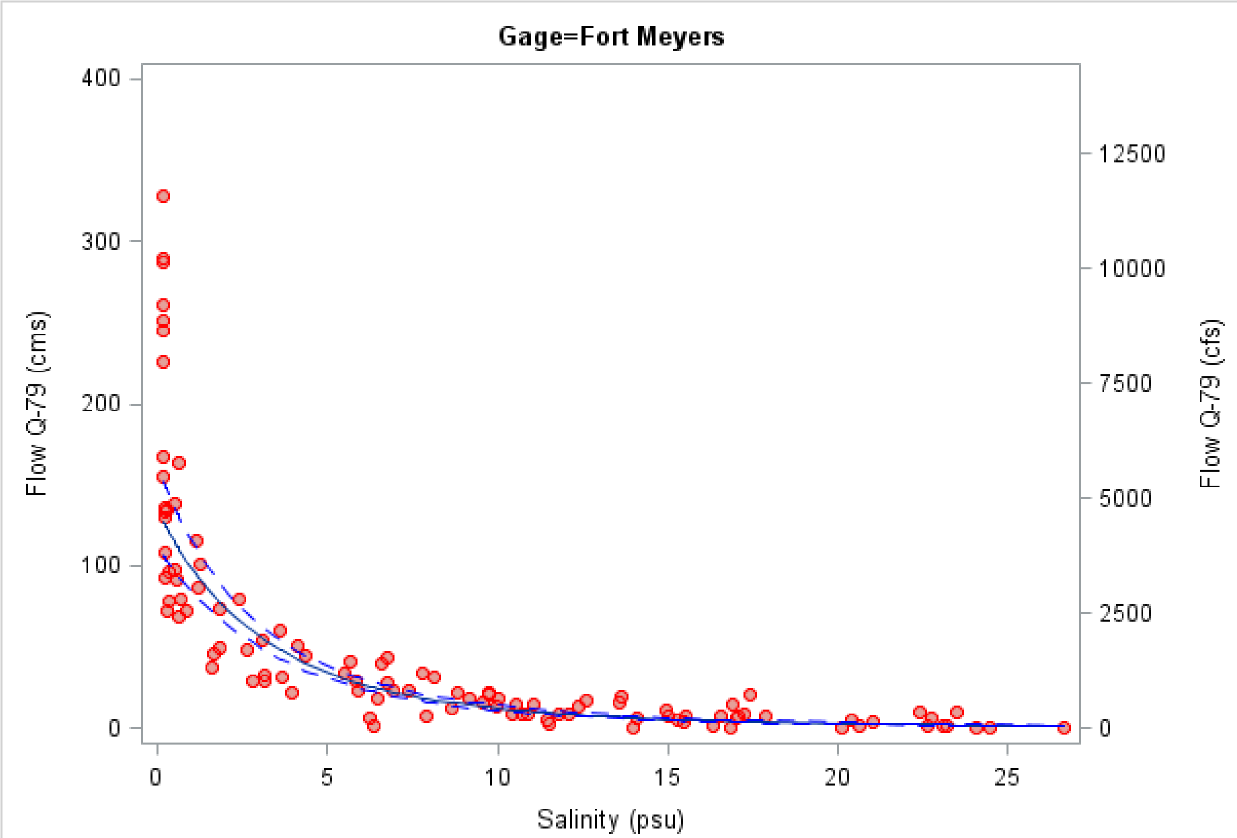

Figure 20. Actual and modeled flow-salinity relationship at Fort Myers.
Upper and lower bounds are at 90% confidence interval.

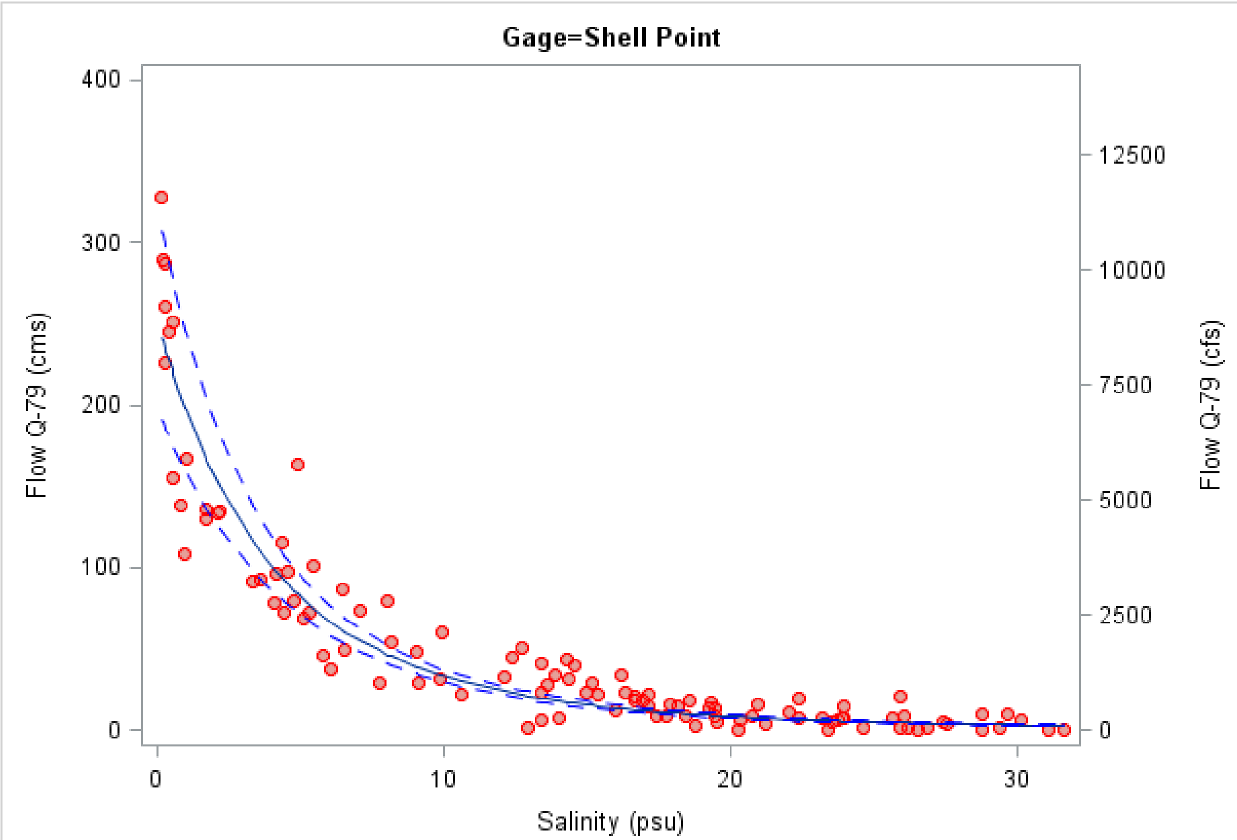

Figure 21. Actual and modeled flow-salinity relationship at Shell Point. Upper and lower bounds are at 90% confidence interval.

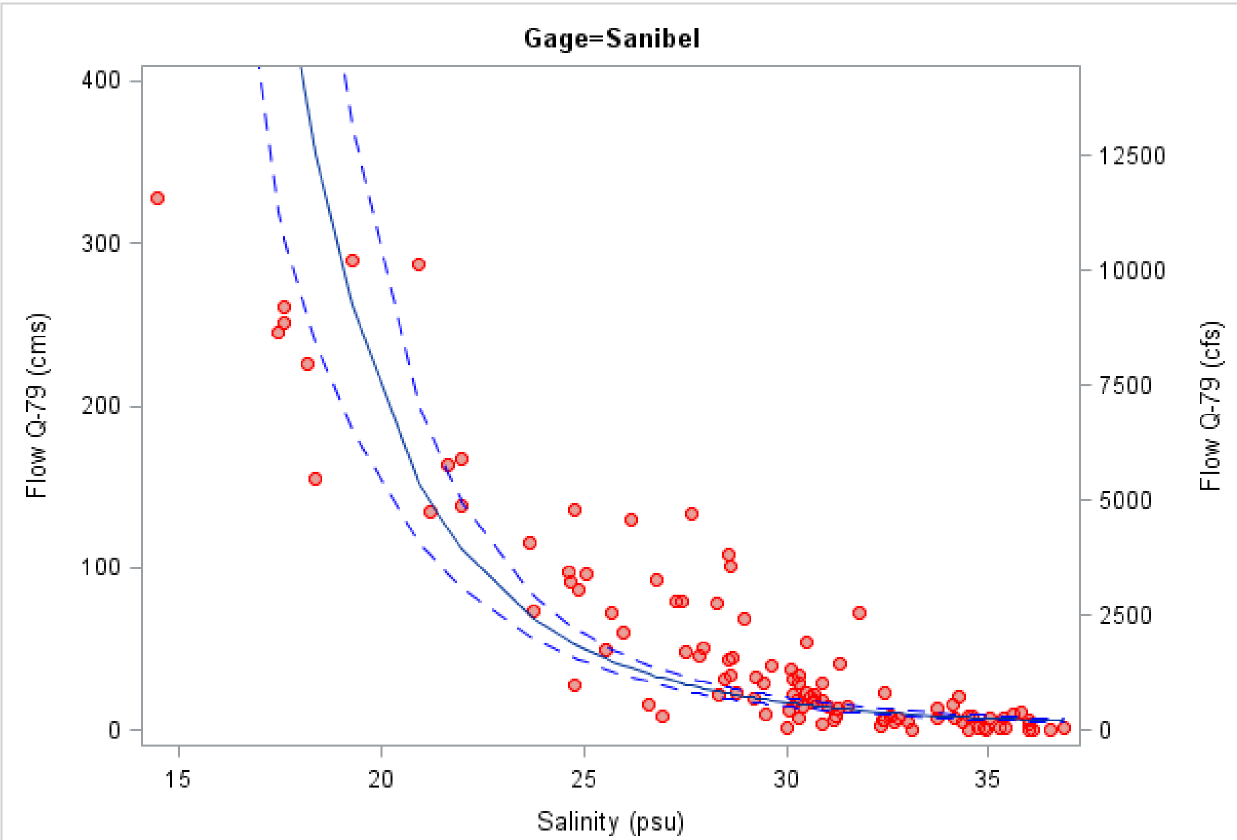

Figure 22. Actual and modeled flow-salinity relationship at Sanibel.
Upper and lower bounds are at 90% confidence interval.

Table 12. Salinities of each zone and corresponding flow estimates and 90% confidence intervals.

Period	Salinity Statistic	Zone	Salinity	Corresponding Flow (m^3s^{-1})			Corresponding Flow (cfs)		
				Estimate	90% high Conf. Interval	90% low Conf. Interval	Estimate	90% high Conf. Interval	90% low Conf. Interval
Low Inflow	Lower Quartile	1	0.2	77.9	66.1	91.6	2749	2333	3236
		2	2.6	63.8	58.1	69.8	2253	2052	2464
		3	15.1	15.7	16.4	14.9	554	581	526
		4	28.0	25.6	24.7	23.4	905	874	825
	Median	1	1.2	47.8	43.8	52.0	1690	1548	1836
		2	7.1	21.7	22.1	21.2	767	781	749
		3	19.8	8.7	9.5	8.0	307	336	281
		4	32.5	11.3	11.9	9.6	398	422	340
	Upper Quartile	1	4.2	15.2	16.2	14.1	536	573	500
		2	12.5	8.1	8.9	7.3	286	316	259
		3	24.9	5.1	5.8	4.5	180	204	160
		4	34.7	7.9	8.7	6.6	279	307	233
High Inflow	Lower Quartile	1	0.2	77.9	66.1	91.6	2749	2333	3236
		2	0.2	126.4	106.0	150.7	4465	3743	5322
		3	7.9	47.8	45.4	50.1	1688	1603	1768
		4	21.0	152.0	113.0	170.9	5367	3992	6034
	Median	1	0.2	77.9	66.1	91.6	2749	2333	3236
		2	0.2	126.4	106.0	150.7	4465	3743	5322
		3	9.9	33.7	33.1	34.1	1190	1169	1205
		4	26.2	38.1	34.9	36.1	1345	1233	1274
	Upper Quartile	1	0.2	76.4	65.0	89.7	2699	2297	3167
		2	3.1	55.3	51.2	59.5	1955	1809	2102
		3	13.9	18.4	19.1	17.7	651	674	626
		4	30.5	15.8	16.2	13.8	558	570	488

DISCUSSION

The purpose of this study is to determine how changes in salinities and freshwater inflows affect benthic macrofauna within the Caloosahatchee Estuary. Specifically, the study assessed how the distribution, abundance, and community structure change with varying freshwater flows to define salinity thresholds that drive these changes. By comparing macrofauna communities along a spatial salinity gradient, useful information about the effects of temporal changes in salinity can be inferred. Freshwater inflows can be approximated by salinity because salinity is positively correlated with seawater indicators sulfate, calcium, potassium, hardness, and in the Caloosahatchee Estuary, negatively correlated with the freshwater indicator, color among spatio-temporal water quality samples (Figure 14). The fact that salinity, color, calcium concentrations and phosphate concentrations are correlated highest with spatio-temporal differences among macrobenthic communities (Table 10), suggests that not only is salinity a suitable proxy for freshwater inflow, but salinity and freshwater inflows are a dominant driver of macrofauna communities in the Caloosahatchee Estuary.

The linking of freshwater inflows to salinity and benthic community characteristics is simplified in the Caloosahatchee Estuary because the Estuary is a conceptually simple estuary. The Caloosahatchee is a classic ‘drowned river valley’ or ‘coastal plains’ estuary (Pritchard 1967) with a single large inflow source (the Caloosahatchee River) and a well defined unidirectional salinity gradient along the narrow length of the estuary. As with other ‘gradient estuaries’, minor changes in the salinity gradient are caused by tidal fluctuations, but much larger changes in the salinity gradient are caused by variation in river flow (Hodgkin 1994). Determining the effects of changes in freshwater inflows on macrofauna communities are made more difficult in complex estuaries, such as those with more than one major inflow source (e.g. Palmer et al. 2011) or temporary closed mouths (e.g. Teske and Wooldridge 2001).

There is a distinct zonation of benthic communities along the salinity gradient in the Caloosahatchee Estuary. This zonation is evident when comparing N1 diversity (Figure 4B) and multivariate community structure (Figure 9, Figure 11) of the communities along the length of the Caloosahatchee Estuary. The positive relationship between salinity and diversity on a spatial salinity gradient is common in many estuaries including those in Texas (Montagna and Kalke 1992, Palmer et al. 2002, Palmer et al. 2011), South Africa (Schlacher and Wooldridge 1996), Portugal (Sousa et al. 2006, Teixeira et al. 2008), northwest Europe (Ysebaert et al. 1998, 2003), and Baltic Sea (Zettler et al., 2007).

Diversity increased during the dry period in all four stations that were sampled for the duration of this study, although the increase was only significant at station 6. This increase in diversity from high inflow to low inflow periods has been observed in some, but not all Texas estuaries, including the Guadalupe and Lavaca-Colorado Estuaries (Montagna and Palmer 2012). One sub-estuary that does not follow this positive salinity-diversity gradient is Rincon Bayou, Nueces estuary, Texas. In Rincon Bayou, a reverse estuary has developed and subsequent hypersalinity is correlated with decreased diversity over time (Montagna et al. 2002, Montagna and Palmer 2012).

As has long been recognized elsewhere, species diversity increases with increasing salinity because of the invasion by marine species (Remane 1934, Remane and Schlieper 1971). So, univariate metrics of species diversity itself cannot be used to set inflow criteria. This is why it is important to identify the salinities associated with community zones using multivariate analyses.

In this current study, 34 taxa have been identified as being indicators of salinity (Table 10). Two taxa are calculated as being indicators of limnetic conditions (salinity < 0.5), 6 as being indicators of oligohaline conditions (salinity 0.5 to 5), 11 as being indicators of mesohaline conditions (salinity 5 to 18), 10 as being indicators of polyhaline conditions (salinity 18 to 30), and 5 as being indicators of euhaline conditions (salinity 30 to 40) according to the Venice salinity classification system (Anon. 1958, Cowardin et al. 1979).

But, although the Venice system is widely used to divide an estuary into zones, it is not biologically relevant to many local estuaries (Bulger et al. 1993). Studies by authors such as Bulger et al. (1993) divide an estuary into several overlapping zones that are based on the abundances of organisms along a salinity gradient. In the present study, we use a combination of these two classification schemes to name the macrofauna community zones.

Table 13. Classification of salinity zones from the Venice system, Bulger et al. study and the current study.

Venice System*		Bulger Study*		This Study		
					Salinity Quartiles	
Name	Salinities	Name	Salinities	Name	Low Inflow Period	High Inflow Period
Fresh	<0.5					
Mixohaline (Brackish)	0.5-30.0	1	Fresh-4	Bulger Zone 1	0.2-4.2	0.2-0.2
Oligohaline	0.5-5.0	2	2-14	Oligohaline	2.6-12.5	0.2-3.1
Mesohaline	5.0-18.0	3	11-18	Mesohaline	15.1-24.9	7.9-13.9
Polyhaline	18.0-30.0	4	16-27	Polyhaline	28.0-34.7	21.0-30.5
Euhaline	30.0-40.0	5	24-Marine			
Hyperhaline	>40.0					

*Data modified from Anon 1958, Bulger et al. 1993.

As reported in this study, insects and the polychaete *Amphicteis floridus* (synonym *Hobsonia florida*) are good low salinity indicators (Tanypodinae in Table 6 and Ceratopogonidae and *A. floridus* in Table 10). Insects, including those from the Ceratopogonidae and Chironomidae families are common in lower salinities or after flooding events (Kalke and Montagna 1991, Schlacher and Wooldridge 1996, Montagna et al. 2002). Chironomidae larvae are considered to be a species that is vulnerable to drought in three Texas estuaries (Montagna and Palmer 2012).

A. floridus has been found to be abundant in environments that have frequent low salinities (Zajac and Whitlatch 1982, Kalke and Montagna 1991, Poirrier et al. 2008).

Several polyhaline and euhaline species have been identified by this study. *Molgula* spp. (Ascidacea) is reported to have an optimal salinity range from 18 to 36 in Tampa Bay (Dragovich and Kelly 1964), which in consistent with the optimal salinity modeled in this study, which is 31 (Table 10). The bivalve *Mysella planulata* was modeled to have peak abundances at salinities of 22 (Table 10). The success of this model is reinforced by *M. planulata* increasing in abundance (Table 6) when mean salinities decreased from 31 in period 1 to 25 in period 2 in zone 4 (Table 8). Unidentified Tubificidae without capillary setae is a low salinity indicator (peak at salinity of 2) that increased in abundance when flows increased between period 1 and 2. The amphipod *Listriella barnardi* is more abundant at high salinity (> 20) regions of several Texas estuaries and increased in abundance during drought periods in Lavaca and San Antonio Bays, Texas (Montagna and Palmer 2012), which is in agreement with the optimal salinity of 26 found in this study (Van Diggelen 2014).

Despite the loss of several macrobenthic species in high-flow relative to low-flow periods, the abundance of several mobile invertebrates and fish have been documented to decrease during low-flow periods in southwest Florida estuaries (Flannery et al. 2002). Mobile species with decreases during low-flow periods include bay anchovy and sand seatrout juveniles, mysids, and grass shrimp. A study on fish and mobile aquatic invertebrates (blue crab *Callinectes sapidus* and pink shrimp *Farfantepenaeus duorarum*) separated Caloosahatchee into three zones, with the lower, middle and upper zones incorporating the reach of the benthic stations in the current study of stations 4 and 5, 2 and 3, and 1 respectively (Stevens et al. 2008, 2010). In this study, significant differences in community structure of fish and mobile invertebrates were found among the estuarine zones, and associated species with each zone were identified. Of the 25 species with an estuarine zone preference, 9 preferred the upper zone, 6 preferred the middle zone, 5 preferred the lower zone, and 5 preferred two zones.

One interesting outcome when wet and dry seasons are comared is that the tipping points among the zones do not change among the freshest three zones in the upper reaches (Figure 12 and Figure 13). However, in dry seasons, stations 6 and 7 are grouped together; whereas in wet seasons, stations 5 and 6 are grouped together. This indicates that there is a downstream shift in the communities during the dry seasons.

If not extreme enough to cause hypersalinity, decreases in freshwater inflows to the Caloosahatchee Estuary will result in an increase in diversity of macrobenthic fauna throughout the estuary. However, potential decreases in freshwater inflows can cause important freshwater and low-salinity species and habitats to be lost or reduced in size as these habitats are destroyed or relocated upstream (Chamberlain and Doering 1998a, b). Maintaining low salinity habitat is integral for at least part of the life cycle of mobile species such as *Callinectes sapidus* (blue crab), *Carcharhinus leucas* (bull shark) and *Pristis pectinata* (smalltooth sawfish; Hunt and

Doering 2013) and many other species in the Caloosahatchee Estuary (Stevens et al. 2008, 2010).

Providing sufficient inflows to the Caloosahatchee Estuary allows a spatial salinity gradient which is host to a range of organisms, including benthic communities. Benthic communities are not only indicators of a salinity gradient, but are part of the food chain for many mobile aquatic species. By maintaining the benthic communities defined in this study (Table 4, Table 5, and Figure 9), a healthy ecosystem is ensured. Macrofauna abundances in the Caloosahatchee (mean abundances 4,000 - 12,500 n m^{-2} at four stations sampled over both periods, Appendix 2) are comparable to those in five Texas estuaries with mean salinities of 4 to 23 (mean abundances 4,000 to 10,300 n m^{-2}, Palmer et al. 2011), and higher than those in St. Johns Estuary, Florida over similar salinities (250 – 2,600 n m^{-2}, Mattson et al. 2012). Although abundance is not always the best indicator of ecosystem health, the fact that the abundances in Calooshatchee are comparable or higher than those of other estuaries with similar climates and salinities, suggests that the macrofauna communities in the Caloosahatchee are close to ‘normal’. Freshwater inflow rates that provide suitable conditions for these benthic communities, and indirectly other organisms, were developed in this study (Table 12). Providing such inflows during low and high inflow periods will allow the ecosystem health of the Caloosahatchee to be maintained.

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APPENDIX 1: MACROFAUNA ANOVAS

All Stations, Ten months

Class Level Information

Class	Levels	Values
STA	7	1 2 3 4 5 6 7
yearmon	10	1986APR 1986DEC 1986SEP 1987APR 1987AUG 1988APR 1988DEC 1988JUN 1988MAR 1989APR

Number of Observations Read	348
Number of Observations Used	348

Dependent Variable: log (N1 diversity+1)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	69	108.2641987	1.5690464	29.13	<.0001
Error	278	14.9754081	0.0538684		
Corrected Total	347	123.2396068			

R-Square	Coeff Var	Root MSE	logn1 Mean
0.878485	11.13465	0.232096	2.084445

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Station	6	62.00814062	10.33469010	191.85	<.0001
Year-month	9	13.41441889	1.49049099	27.67	<.0001
Station * Year-month	54	33.62566651	0.62269753	11.56	<.0001

Dependent Variable: log (abundance [n m^{-2}] +1)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	69	108.2641987	1.5690464	29.13	<.0001
Error	278	14.9754081	0.0538684		
Corrected Total	347	123.2396068			

R-Square	Coeff Var	Root MSE	logn1 Mean
0.878485	11.13465	0.232096	2.084445

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Station	6	62.00814062	10.33469010	191.85	<.0001
Year-month	9	13.41441889	1.49049099	27.67	<.0001
Station * Year-month	54	33.62566651	0.62269753	11.56	<.0001

Four Stations, All Months (Except Nov 1987)

Class Level Information		
Class	**Levels**	**Values**
Station	4	2 4 5 6
Year-month	28	1986APR 1986DEC 1986FEB 1986JUL 1986SEP 1987APR 1987AUG 1987JUN 1987MAR 1988APR 1988AUG 1988DEC 1988JUN 1988MAR 1989APR 1989MAR 1994DEC 1994NOV 1994OCT 1995AUG 1995DEC 1995JAN 1995JUN 1995MAR 1995MAY 1995NOV 1995OCT 1995SEP

Number of Observations Used	511

Dependent Variable: log (N1 diversity+1)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	111	204.0506817	1.8382944	28.44	<.0001
Error	399	25.7911497	0.0646395		
Corrected Total	510	229.8418314			

R-Square	Coeff Var	Root MSE	logn1 Mean
0.887787	13.42675	0.254243	1.893555

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Station	3	98.99424171	32.99808057	510.49	<.0001
Year-month	27	44.87877020	1.66217667	25.71	<.0001
Year-month*Station	81	57.61171045	0.71125568	11.00	<.0001

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
Period1 vs Period2	1	7.03156363	7.03156363	108.78	<.0001

Dependent Variable: log (abundance [n m^{-2}] +1)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	111	1224.262575	11.029393	28.45	<.0001
Error	399	154.706841	0.387736		
Corrected Total	510	1378.969416			

R-Square	Coeff Var	Root MSE	lognm2 Mean
0.887810	7.644994	0.622685	8.145002

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Station	3	170.4112470	56.8037490	146.50	<.0001
Year-month	27	378.8494501	14.0314611	36.19	<.0001
Year-month*Station	81	693.8562357	8.5661264	22.09	<.0001

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
Period1 vs Period2	1	63.91136704	63.91136704	164.83	<.0001

Four Stations, One-Way ANOVA

Class Level Information		
Class	**Levels**	**Values**
Station-Period	8	Sta2-P1 Sta2-P2 Sta4-P1 Sta4-P2 Sta5-P1 Sta5-P2 Sta6-P1 Sta6-P2

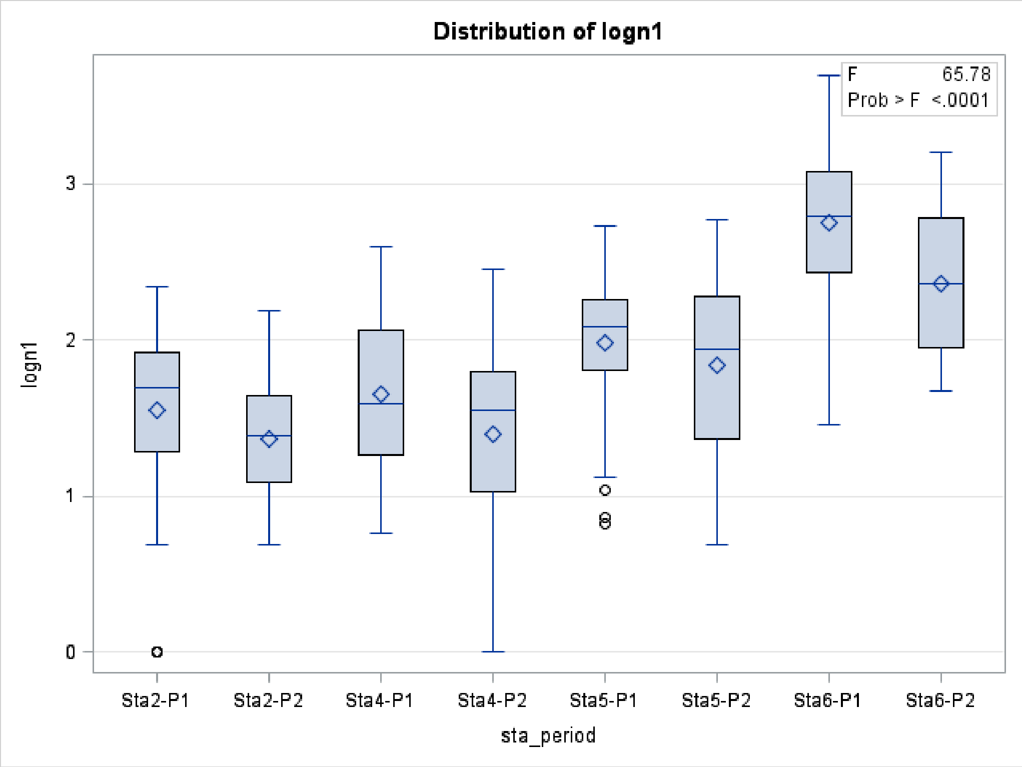
Number of Observations Used	511

Dependent Variable: log (N1 diversity+1)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	109.8456741	15.6922392	65.78	<.0001
Error	503	119.9961573	0.2385609		
Corrected Total	510	229.8418314			

R-Square	Coeff Var	Root MSE	logn1 Mean
0.477919	25.79418	0.488427	1.893555

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Station-Period	7	109.8456741	15.6922392	65.78	<.0001

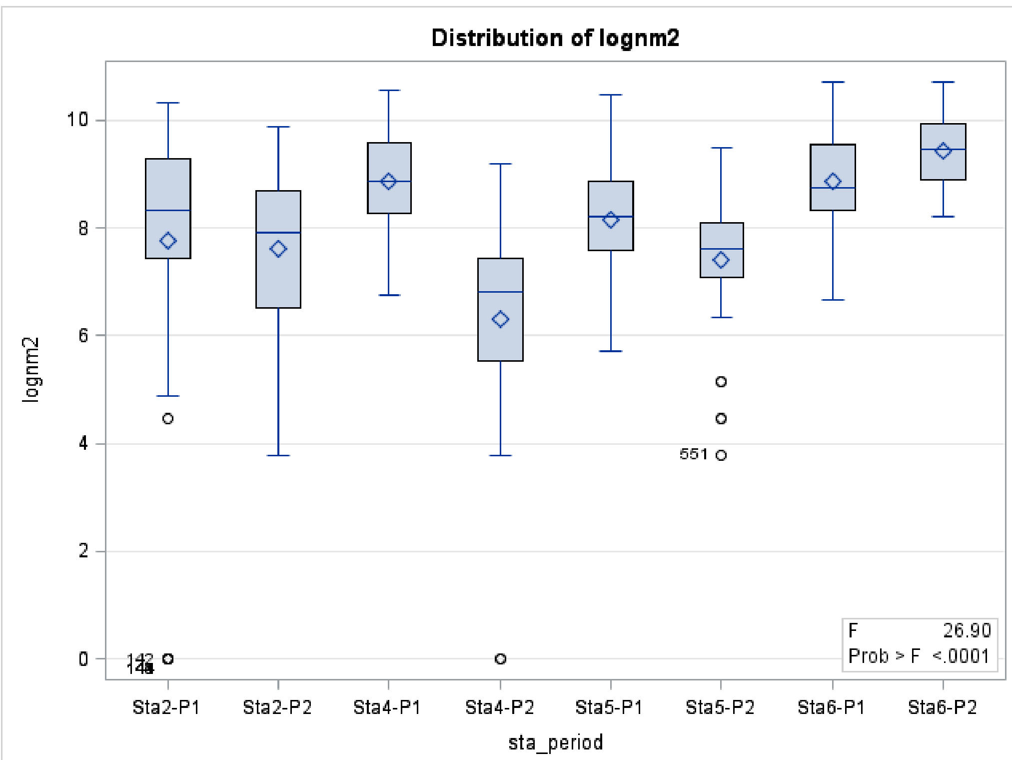


Dependent Variable: log (abundance [n m^{-2}] +1)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	375.600734	53.657248	26.90	<.0001
Error	503	1003.368682	1.994769		
Corrected Total	510	1378.969416			

R-Square	Coeff Var	Root MSE	lognm2 Mean
0.272378	17.34024	1.412363	8.145002

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Station-Period	7	375.6007341	53.6572477	26.90	<.0001



APPENDIX 2: SPECIES LISTS

All Stations, Ten Months (Period 1)

Mean abundance of all species for all months that all seven stations were sampled (Apr, Sep, Dec 1986; Apr, Aug 1987; Mar, Apr, Jun, Dec 1988; Apr 1989).

Species	Zone / Station							Mean ($n\ m^{-2}$)	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Cyclaspis varians	2	1579	4280	900	403	311	22	1071	11.24	11.24
Grandidierella bonnieroides	2332	1095	2071	354	6	25	0	840	8.82	20.07
Mytilopsis leucophaeata	1350	1714	1796	204	1	0	0	724	7.60	27.66
Ampelisca vadorum	1	9	115	2035	2065	807	11	720	7.56	35.23
Ampelisca abdita	0	1	1244	1365	205	42	0	408	4.29	39.51
Tellina versicolor	2	158	554	1527	80	181	82	369	3.87	43.39
Carazziella hobsonae	0	0	0	0	8	2372	31	344	3.62	47.00
Parasterope pollex	3	2	3	115	206	1283	770	340	3.57	50.57
Assiminea succinea	383	153	1776	39	0	4	2	337	3.53	54.11
Streblospio benedicti	369	622	503	301	139	35	0	281	2.95	57.06
Mulinia lateralis	36	1358	69	60	6	4	1	219	2.30	59.36
Rangia cuneata	1295	161	52	0	0	0	0	215	2.26	61.62
Mediomastus ambiseta	0	1	0	21	375	425	677	214	2.25	63.87
Cyprideis	221	0	0	1	0	540	650	202	2.12	65.99
Ampelisca	0	5	73	545	327	276	25	179	1.88	67.87
Cyathura polita	382	223	543	96	0	0	0	178	1.86	69.73
Tellina texana	121	316	512	79	47	117	3	171	1.79	71.53
Peloscolex heterochaetus	2	556	355	95	0	1	0	144	1.51	73.04
Tanytarsus	891	2	0	0	0	0	0	128	1.34	74.38
Bivalvia	77	4	32	67	184	281	196	120	1.26	75.64
Paraprionospio pinnata	2	0	3	65	351	189	224	119	1.25	76.89
Polymesoda caroliniana	153	128	546	0	0	0	0	118	1.24	78.13
Laeonereis culveri	744	13	9	0	0	3	0	110	1.15	79.29
Nemertea	26	166	142	115	38	155	62	101	1.06	80.34
Ampelisca holmesi	0	0	0	0	3	453	48	72	0.76	81.10
Prionospio perkinsi	1	0	0	0	64	375	56	71	0.74	81.84
Tharyx dorsobranchialis	0	0	0	0	2	404	1	58	0.61	82.45
Almyracuma sp. 1	327	1	2	0	0	0	0	47	0.49	82.95
Mediomastus	2	0	0	3	90	196	38	47	0.49	83.44
Tectidrilus bori	0	0	0	0	0	307	0	44	0.46	83.90
Coelotanypus	57	208	8	1	0	0	0	39	0.41	84.31
Edotia sp. 1	108	82	65	7	0	9	1	39	0.41	84.72
Tubificoides brownae	0	0	0	0	83	35	152	39	0.40	85.12
Glycinde solitaria	0	4	14	29	65	46	105	38	0.40	85.52
Tellina	2	10	34	114	1	75	24	37	0.39	85.91

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Acteocina canaliculata	0	1	14	33	26	89	96	37	0.39	86.29
Capitella capitata	0	3	36	2	0	206	8	36	0.38	86.68
Tubificoides wasselli	0	0	0	0	0	149	90	34	0.36	87.03
Listriella barnardi	0	0	0	0	1	195	38	33	0.35	87.38
Aricidea philbinae	0	0	0	1	2	213	3	31	0.33	87.71
Leucon sp. 1	0	0	0	1	7	202	4	31	0.32	88.03
Apoprionospio pygmaea	1	1	0	0	0	38	168	30	0.31	88.34
Polydora cornuta	166	8	26	1	0	0	5	29	0.31	88.65
Haminoea succinea	0	0	9	74	35	71	9	29	0.30	88.95
Amygdalum papyrium	12	15	129	34	0	0	0	27	0.28	89.23
Gastropoda	47	1	2	2	14	43	71	25	0.27	89.50
Oxyurostylis smithi	0	0	13	12	20	84	47	25	0.26	89.77
Limnodriloides barnardi	0	0	0	0	7	162	6	25	0.26	90.03
Spiochaetopterus costarum	0	0	0	6	6	23	138	25	0.26	90.29
Tectidrilus squalidus	0	0	0	0	0	170	0	24	0.25	90.54
Macoma tenta	0	0	0	0	42	102	21	24	0.25	90.79
Cerapus benthophilus	0	0	0	0	131	28	0	23	0.24	91.03
Eteone heteropoda	6	46	74	30	1	0	0	22	0.23	91.26
Ablabesmyia	154	1	1	0	0	0	0	22	0.23	91.50
Nucula proxima	0	0	0	0	4	23	121	21	0.22	91.72
Amphicteis floridus	8	44	48	24	1	5	0	19	0.19	91.91
Abra aequalis	0	0	0	0	4	120	0	18	0.19	92.10
Acuminodeutopus	0	0	2	2	6	111	2	17	0.18	92.28
Cyclaspis sp.1	0	0	51	40	11	3	10	17	0.17	92.46
Acteocina	0	0	0	1	68	23	18	16	0.17	92.62
Eusarsiella texana	0	0	0	0	0	100	10	16	0.17	92.79
Chironomus	103	1	0	0	0	0	0	15	0.16	92.94
Tubificoides motei	0	0	0	0	0	100	0	14	0.15	93.09
Leitoscoloplos foliosus	0	0	0	0	86	3	3	13	0.14	93.23
Molgula occidentalis	0	0	0	0	10	79	2	13	0.14	93.37
Asthenothaerus hemphilli	0	0	0	0	3	85	2	13	0.13	93.50
Solemya occidentalis	0	0	0	0	0	0	86	12	0.13	93.63
Parastarte triquetra	0	0	0	0	0	0	85	12	0.13	93.76
Stylochus	2	21	29	2	10	11	10	12	0.13	93.89
Prionospio pinnata	0	0	0	0	0	84	0	12	0.13	94.02
Pectinaria gouldii	0	4	41	12	1	7	19	12	0.13	94.14
Einfeldia	81	1	0	0	0	0	0	12	0.12	94.26
Polypedilum	71	5	3	0	0	0	0	11	0.12	94.38
Cladotanytarsus	77	0	0	0	0	0	1	11	0.12	94.50

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Neanthes succinea	2	32	19	20	1	0	4	11	0.12	94.62
Almyracuma sp. A	71	0	1	0	0	0	0	10	0.11	94.72
Hydra	5	0	65	0	0	1	0	10	0.11	94.83
Phascolion strombus strombus	0	0	0	0	0	45	27	10	0.11	94.94
Olivella	0	1	0	0	0	7	63	10	0.11	95.04
Tellinidae	0	4	0	0	13	18	30	9	0.10	95.14
Chironomidae	60	0	0	0	3	0	0	9	0.09	95.24
Nuculana acuta	0	0	0	0	6	14	43	9	0.09	95.33
Spiochaetopterus oculatus	0	0	0	1	0	45	17	9	0.09	95.43
Sthenelais sp. A	0	0	0	0	10	24	26	9	0.09	95.52
Cryptochironomus	31	8	17	1	0	0	0	8	0.09	95.60
Scolelepis texana	0	0	33	3	18	2	0	8	0.08	95.68
Rhithropanopeus harrisii	11	18	16	6	1	0	0	8	0.08	95.76
Ampelisca sp. 3	0	0	0	0	0	28	22	7	0.08	95.84
Mysella planulata	0	0	0	0	0	44	6	7	0.07	95.91
Cerapus sp. 1	0	0	0	0	0	48	0	7	0.07	95.99
Halmyrapseudes bahamensis	0	1	0	0	5	22	20	7	0.07	96.06
Onuphidae	0	0	0	0	0	3	44	7	0.07	96.13
Phyllodoce arenae	0	0	0	2	3	12	29	7	0.07	96.19
Parvilucina multilineata	0	0	0	0	0	30	15	6	0.07	96.26
Amakusanthura magnifica	0	0	0	0	0	41	0	6	0.06	96.32
Cirrophorus	0	0	0	0	34	7	0	6	0.06	96.39
Podocopa	0	0	0	0	1	4	35	6	0.06	96.45
Haminoea	0	0	0	0	0	34	5	6	0.06	96.50
Sigambra tentaculata	0	0	0	0	4	31	2	5	0.06	96.56
Americamysis almyra	18	2	11	4	1	0	0	5	0.05	96.61
Monoculodes nyei	0	0	0	8	5	20	3	5	0.05	96.67
Acteocina bidentata	0	0	0	0	3	26	6	5	0.05	96.72
Dicrotendipes	32	0	1	0	0	0	0	5	0.05	96.77
Diplodonta semiaspera	0	0	0	0	1	30	2	5	0.05	96.82
Malmgreniella sp. B	0	0	0	0	2	27	2	4	0.05	96.86
Leucon	0	0	0	0	0	29	0	4	0.04	96.91
Chironomini	24	3	2	0	0	0	0	4	0.04	96.95
Amphilochus	0	0	0	3	26	0	0	4	0.04	96.99
Ericthonius brasiliensis	0	0	0	0	0	28	0	4	0.04	97.04
Eulimastoma weberi	0	0	0	1	6	16	6	4	0.04	97.08
Kalliapseudes sp. 1	0	0	0	0	0	28	0	4	0.04	97.12
Paracaprella tenuis	0	2	4	0	6	16	1	4	0.04	97.16
Glycera americana	0	0	0	1	3	16	8	4	0.04	97.21

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Eusarsiella zostericola	0	0	0	1	4	22	0	4	0.04	97.25
Fabriciola sp. A	0	0	0	0	9	18	0	4	0.04	97.29
Tubificidae w o cap setae	0	2	0	2	2	8	13	4	0.04	97.32
Chaoborus punctipennis	21	4	0	0	0	0	0	4	0.04	97.36
Corophium	1	0	3	1	1	13	7	4	0.04	97.40
Corophium acherusicum	0	0	1	0	0	17	7	4	0.04	97.44
Tagelus plebeius	11	7	5	0	0	0	0	3	0.03	97.47
Pinnixa	0	0	0	1	3	18	1	3	0.03	97.50
Haplosyllis spongicola	0	0	0	0	0	0	22	3	0.03	97.54
Leptosynapta crassipatina	0	0	0	0	0	14	8	3	0.03	97.57
Malmgreniella sp. A	0	0	0	0	0	18	3	3	0.03	97.60
Gammarus	20	0	0	0	0	0	0	3	0.03	97.63
Cerapus	0	0	0	0	12	8	0	3	0.03	97.66
Euplana	7	1	3	2	6	1	0	3	0.03	97.69
Podarkeopsis levifuscina	0	0	0	1	2	16	0	3	0.03	97.72
Prunum apicinum	0	0	0	0	0	5	14	3	0.03	97.74
Rictaxis punctostriatus	0	3	10	0	3	3	0	3	0.03	97.77
Aglaophamus verrilli	0	0	0	0	1	4	13	3	0.03	97.80
Turbonilla	0	0	0	0	2	3	13	3	0.03	97.83
Semelidae	0	0	0	0	3	13	1	2	0.03	97.85
Ericthonius sp. 2	0	0	0	0	2	9	7	2	0.03	97.88
Lumbrineris verrilli	0	0	0	0	0	17	0	2	0.03	97.90
Ceratopogonidae	17	0	0	0	0	0	0	2	0.03	97.93
Cymadusa compta	0	1	1	1	0	1	13	2	0.02	97.95
Balanus	14	0	2	1	0	0	0	2	0.02	97.98
Polycirrus	0	0	0	0	0	16	0	2	0.02	98.00
Ischadium recurvum	0	1	12	1	2	0	0	2	0.02	98.03
Armandia maculata	0	0	0	0	0	0	16	2	0.02	98.05
Lophogastrida	0	0	0	10	5	0	0	2	0.02	98.07
Micropholis atra	0	0	0	0	0	16	0	2	0.02	98.10
Scoloplos texana	0	0	0	0	13	3	0	2	0.02	98.12
Aricidea taylori	0	0	0	0	5	10	0	2	0.02	98.14
Armandia agilis	0	0	0	0	0	2	14	2	0.02	98.17
Microdeutopus myersi	0	0	0	0	0	10	5	2	0.02	98.19
Uromunna reynoldsi	8	0	0	1	3	3	0	2	0.02	98.21
Photis sp. 1	0	0	0	0	0	14	0	2	0.02	98.23
Terebridae	0	0	0	0	0	0	14	2	0.02	98.25
Batea catharinensis	0	0	0	0	2	11	1	2	0.02	98.27
Edotia sp. A	0	0	4	9	0	0	0	2	0.02	98.29

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Polydora socialis	6	0	2	0	0	0	6	2	0.02	98.31
Schistomeringos rudolphi	0	0	1	0	0	13	0	2	0.02	98.34
Cirolana polita	13	0	0	0	0	0	0	2	0.02	98.35
Exogone dispar	0	0	0	0	0	13	0	2	0.02	98.37
Gammarus tigrinus	13	0	0	0	0	0	0	2	0.02	98.39
Melita longisetosa	0	0	0	13	0	0	0	2	0.02	98.41
Scolelepis squamata	0	0	0	0	1	12	0	2	0.02	98.43
Amphilochus sp. 1	0	0	0	2	11	0	0	2	0.02	98.45
Eusarsiella disparalis	0	0	0	0	0	9	4	2	0.02	98.47
Olividae sp.	0	0	0	0	0	0	13	2	0.02	98.49
Melita	0	0	0	3	9	0	0	2	0.02	98.51
Asteropterygion oculitristris	0	0	0	0	0	5	7	2	0.02	98.53
Corophium lacustre	2	0	2	6	3	0	0	2	0.02	98.54
Microprotopus raneyi	0	0	0	0	0	9	3	2	0.02	98.56
Acuminodeutopus naglei	0	0	0	2	0	9	0	2	0.02	98.58
Lembos	0	0	0	0	0	5	6	2	0.02	98.60
Caenis	11	0	0	0	0	0	0	2	0.02	98.61
Corbula contracta	0	0	0	0	7	3	1	2	0.02	98.63
Grubeulepis mexicana	0	0	0	0	0	0	11	2	0.02	98.65
Nassarius vibex	0	0	0	0	0	1	9	1	0.02	98.66
Limnodriloides	0	0	0	0	0	9	1	1	0.02	98.68
Nereididae sp. juv	8	0	1	0	0	0	2	1	0.02	98.69
Fabriciola sp. 1	0	0	0	0	0	9	0	1	0.01	98.71
Gitanopsis	0	1	0	9	0	0	0	1	0.01	98.72
Lucifer faxoni	0	0	0	1	0	3	6	1	0.01	98.74
Mitrella lunata	0	0	0	2	3	3	2	1	0.01	98.75
Ophiurida	0	0	0	0	0	7	3	1	0.01	98.76
Ophiuroidea	0	0	0	0	0	9	0	1	0.01	98.78
Strombiformis hemphilli	0	0	0	0	0	9	0	1	0.01	98.79
Asychis elongata	0	0	0	0	0	0	9	1	0.01	98.81
Balanus improvisus	7	1	0	0	0	1	0	1	0.01	98.82
Caecum pulchellum	0	0	0	0	0	6	3	1	0.01	98.83
Lucinidae	0	0	0	0	0	4	4	1	0.01	98.85
Mysidacea sp. 1	0	0	0	4	4	0	0	1	0.01	98.86
Periclimenes americanus	0	0	0	4	4	0	0	1	0.01	98.87
Phoronis psammophila	0	0	0	0	0	8	1	1	0.01	98.88
Scoloplos robustus	0	0	0	0	3	3	3	1	0.01	98.90
Heteromastus filiformis	0	0	0	5	0	3	0	1	0.01	98.91
Actiniaria	0	0	1	0	1	4	2	1	0.01	98.92

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Cryptotendipes	8	0	0	0	0	0	0	1	0.01	98.93
Dyspanopeus texana	3	3	1	1	0	0	1	1	0.01	98.94
Lyonsia hyalina floridana	0	0	0	0	0	8	0	1	0.01	98.96
Podocopa sp.1	4	0	0	0	0	2	2	1	0.01	98.97
Sipuncula	4	0	0	0	0	0	3	1	0.01	98.98
Upogebia affinis	0	0	0	4	0	3	1	1	0.01	98.99
Notomastus latericeus	0	0	0	0	0	1	7	1	0.01	99.00
Prionospio heterobranchia	0	0	0	0	0	1	7	1	0.01	99.01
Xanthidae	2	2	2	1	1	0	1	1	0.01	99.03
Amphioplus thrombodes	0	0	0	0	0	4	3	1	0.01	99.04
Crepidula	0	0	0	0	0	3	4	1	0.01	99.05
Ampelisca sp. C	0	0	0	0	0	7	0	1	0.01	99.06
Amphipoda	1	2	0	0	0	1	3	1	0.01	99.07
Amphiuridae	0	0	0	0	0	7	0	1	0.01	99.08
Apoprionospio pinnata	0	0	0	0	0	7	0	1	0.01	99.09
Brachyura	0	1	1	2	3	1	0	1	0.01	99.10
Eusarsiella cresseyi	0	0	0	0	0	7	0	1	0.01	99.11
Fabriciola trilobata	0	0	0	0	0	7	0	1	0.01	99.12
Glyptotendipes	7	0	0	0	0	0	0	1	0.01	99.13
Mysidopsis	0	0	1	2	1	3	1	1	0.01	99.14
Aulodrilus pigueti	6	0	0	0	0	0	0	1	0.01	99.15
Caulleriella	0	0	0	0	0	6	0	1	0.01	99.16
Ericthonius sp. 1	0	0	0	0	0	6	0	1	0.01	99.17
Eumida sanguinea	0	0	0	0	1	0	5	1	0.01	99.17
Piromis roberti	0	0	0	0	6	0	0	1	0.01	99.18
Americamysis bahia	1	0	0	0	1	4	0	1	0.01	99.19
Genetyllis castanea	0	0	2	0	1	3	1	1	0.01	99.20
Marginella	0	0	0	0	0	2	4	1	0.01	99.21
Oxyurostylis sp.1	0	0	0	0	0	4	2	1	0.01	99.22
Parahesione luteola	0	0	0	2	4	0	0	1	0.01	99.23
Spiophanes bombyx	0	0	0	0	0	2	4	1	0.01	99.24
Dero digitata	5	0	0	0	0	0	0	1	0.01	99.25
Micropholis gracillima	0	0	0	0	0	5	0	1	0.01	99.25
Phascolion	0	0	0	0	0	5	0	1	0.01	99.26
Pinnixa sayana	0	0	0	0	2	3	0	1	0.01	99.27
Polycladida	0	0	3	3	0	0	0	1	0.01	99.28
Sigalionidae	0	0	0	0	0	4	1	1	0.01	99.28
Strombiformis	0	0	0	0	0	4	1	1	0.01	99.29
Stylochus sp.3	0	0	4	1	0	0	0	1	0.01	99.30

Species	Zone 1	Zone 2			Zone 3	Zone 4		Mean (n m^{-2})	Mean (%)	Cum. (%)
	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7			
Tubificoides fraseri	0	0	0	1	4	0	0	1	0.01	99.31
Vitrinellidae sp.	0	0	0	0	5	0	0	1	0.01	99.31
Xenanthura brevitelson	0	0	0	2	3	0	0	1	0.01	99.32
Ampithoidae	1	2	0	0	0	3	0	1	0.01	99.33
Cyclaspis pustulata	0	0	0	0	0	5	0	1	0.01	99.34
Eudevenopus honduranus	0	0	0	0	0	5	0	1	0.01	99.35
Eusarsiella spinosa	0	0	0	0	0	5	0	1	0.01	99.35
Acuminodeutopus sp. 1	0	0	0	1	0	3	0	1	0.01	99.36
Amphiodia	0	0	0	0	0	4	0	1	0.01	99.37
Aoridae	0	0	0	0	0	4	0	1	0.01	99.37
Ascidiacea	0	0	0	0	2	3	0	1	0.01	99.38
Bowmaniella	0	0	3	1	0	0	0	1	0.01	99.39
Corophium sp	0	0	0	0	0	4	0	1	0.01	99.39
Diopatra cuprea	0	0	0	0	0	3	1	1	0.01	99.40
Dulichiella appendiculata	0	0	0	0	0	3	2	1	0.01	99.40
Elasmopus levis	0	0	0	0	0	2	3	1	0.01	99.41
Ericthonius	0	0	0	0	1	3	1	1	0.01	99.42
Holothuroidea	0	0	0	0	0	2	3	1	0.01	99.42
Leitoscoloplos	0	0	0	0	1	2	2	1	0.01	99.43
Leptocheliidae	0	0	0	1	0	2	2	1	0.01	99.44
Limnodrilus	0	0	0	0	4	0	0	1	0.01	99.44
Lucina nassula	0	0	0	0	0	3	1	1	0.01	99.45
Megalomma pigmentum	0	0	0	0	0	1	3	1	0.01	99.46
Musculus lateralis	0	0	0	0	0	2	3	1	0.01	99.46
Nais pardalis	2	3	0	0	0	0	0	1	0.01	99.47
Opisthobranchia	0	0	0	0	3	2	0	1	0.01	99.48
Parametopella cypris	0	0	0	2	1	2	0	1	0.01	99.48
Podarkeopsis brevipalpa	0	0	0	0	2	3	0	1	0.01	99.49
Polymasoda caroliniana	4	0	0	0	0	0	0	1	0.01	99.50
Scoloplos rubra	0	0	0	0	1	3	1	1	0.01	99.50
Spionidae	0	0	0	0	1	3	1	1	0.01	99.51
Sthenelais sp. 1	0	0	0	0	0	3	2	1	0.01	99.52
Turbonilla interrupta	0	0	0	0	0	1	3	1	0.01	99.52
Brachyura sp.	0	3	1	0	0	0	0	0	0.01	99.53
Mytilidae	3	1	0	0	0	0	0	0	0.01	99.53
Platyhelminthes	0	0	0	0	0	1	3	0	0.01	99.54
Americamysis bigelowi	0	0	1	0	0	2	1	0	0.01	99.54
Amphiodia trychna	0	0	0	0	0	3	0	0	0.01	99.55
Ampithoe	0	0	0	0	0	1	3	0	0.01	99.55

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Anachis obesa	0	0	0	0	2	1	1	0	0.01	99.56
Asthenothaerus	0	0	0	0	0	3	0	0	0.01	99.56
Dexiospira spirillum	0	0	0	0	0	3	0	0	0.01	99.57
Elasmopus	0	0	0	0	1	1	2	0	0.01	99.57
Gitanopsis sp. 1	0	0	0	0	3	0	0	0	0.01	99.58
Mediomastus californiensis	0	0	2	0	0	1	1	0	0.01	99.58
Melita cf elongata	0	0	0	0	3	0	0	0	0.01	99.59
Mooreonuphis	0	0	0	0	0	0	3	0	0.01	99.59
Photis	0	0	0	0	0	3	0	0	0.01	99.60
Sipuncula sp.	0	0	0	0	0	3	0	0	0.01	99.61
Smithsonidrilus marinus	0	0	0	0	0	3	0	0	0.01	99.61
Synchelidium americanum	0	0	0	0	0	0	3	0	0.01	99.62
Ampelisca parapacifica	0	0	0	0	0	2	1	0	0.00	99.62
Boonea impressa	0	0	1	2	0	0	0	0	0.00	99.62
Brania clavata	0	0	0	0	0	3	0	0	0.00	99.63
Corophium louisianum	0	0	2	1	0	0	0	0	0.00	99.63
Cyclaspis	0	0	0	0	0	3	0	0	0.00	99.63
Deutella incerta	0	0	0	0	0	2	1	0	0.00	99.64
Edotia triloba	0	0	0	2	0	1	0	0	0.00	99.64
Erichsonella	0	0	0	0	0	1	2	0	0.00	99.65
Leptosynapta sp. 1	0	0	0	0	1	0	2	0	0.00	99.65
Listriella	0	0	0	0	0	1	2	0	0.00	99.65
Magelona	0	0	0	0	0	1	2	0	0.00	99.66
Maldanidae	0	0	0	0	0	2	1	0	0.00	99.66
Mercenaria	0	0	0	0	0	3	0	0	0.00	99.67
Mercenaria campechiensis	0	0	0	0	0	2	1	0	0.00	99.67
Microgobius gulosus	0	0	0	0	2	1	0	0	0.00	99.67
Molgulidae sp.1	0	0	0	3	0	0	0	0	0.00	99.68
Paramphinome sp. B	0	0	0	0	0	2	1	0	0.00	99.68
Polydora websteri	1	0	0	0	1	1	0	0	0.00	99.69
Sabellidae	0	0	0	0	0	1	2	0	0.00	99.69
Stylochus sp.2	0	0	2	1	0	0	0	0	0.00	99.69
Tagelus	0	0	1	0	0	2	0	0	0.00	99.70
Tagelus divisus	0	0	0	0	0	1	2	0	0.00	99.70
Tellidora cristata	0	0	0	0	0	1	2	0	0.00	99.71
Tubificoides w o cap setae	0	0	0	0	1	2	0	0	0.00	99.71
Vitrinellidae	0	0	0	2	0	1	0	0	0.00	99.71
Branchiostoma floridae	0	0	0	0	0	0	3	0	0.00	99.72
Cyclostremiscus	0	0	0	0	3	0	0	0	0.00	99.72

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Enteropneusta	0	0	0	0	0	3	0	0	0.00	99.72
Pinnotheridae	0	0	0	0	0	0	3	0	0.00	99.73
Taphromysis bowmani	3	0	0	0	0	0	0	0	0.00	99.73
Terebra dislocata	0	0	0	0	0	0	3	0	0.00	99.74
Alpheus estuariensis	0	0	0	0	2	0	0	0	0.00	99.74
Americardia	0	0	0	0	0	0	2	0	0.00	99.74
Amphiura	0	0	0	0	0	2	0	0	0.00	99.74
Anachis sp.	0	0	0	0	0	2	0	0	0.00	99.75
Bemlos unicornis	0	0	0	0	0	1	1	0	0.00	99.75
Calanoida	0	0	0	2	0	0	0	0	0.00	99.75
Caprellidae	0	0	0	0	0	0	2	0	0.00	99.75
Chaetozone	0	0	0	0	0	2	0	0	0.00	99.76
Cirriformia	0	0	0	0	0	0	2	0	0.00	99.76
Cirriformia sp. 1	0	0	0	0	0	0	2	0	0.00	99.76
Clymenella torquata	0	0	0	0	0	1	1	0	0.00	99.76
Crustipellis tribranchiata	1	1	0	0	0	0	0	0	0.00	99.77
Cymadusa sp.1	0	0	0	0	0	0	2	0	0.00	99.77
Dinocardium robustum	0	0	0	0	0	1	1	0	0.00	99.77
Eobrolgus spinosus	0	0	0	0	2	0	0	0	0.00	99.78
Eulepethidae	0	0	0	0	0	0	2	0	0.00	99.78
Gibberosus myersi	0	0	0	0	0	2	0	0	0.00	99.78
Gobiidae	1	1	0	0	0	0	0	0	0.00	99.78
Kinbergonuphis simoni	0	0	0	0	0	0	2	0	0.00	99.79
Leitoscoloplos fragilis	0	0	0	0	0	1	1	0	0.00	99.79
Lightiella floridana	0	0	0	0	0	2	0	0	0.00	99.79
Lyonsia hyalina	0	0	0	0	0	2	0	0	0.00	99.79
Magelona pettiboneae	0	0	0	0	0	1	1	0	0.00	99.80
Melita sp. 1	0	0	0	0	2	0	0	0	0.00	99.80
Natica pusilla	0	0	0	0	0	2	0	0	0.00	99.80
Nephtys bucera	0	0	0	0	0	2	0	0	0.00	99.80
Nereis riisei	0	0	0	0	0	2	0	0	0.00	99.81
Nuculana	0	0	0	0	0	2	0	0	0.00	99.81
Nudibranchia sp. 2	0	0	0	2	0	0	0	0	0.00	99.81
Odostomia	0	0	0	0	0	0	2	0	0.00	99.81
Oecetis	2	0	0	0	0	0	0	0	0.00	99.82
Orbinia riseri	0	0	0	0	0	2	0	0	0.00	99.82
Owenia sp.1	0	0	0	0	0	2	0	0	0.00	99.82
Oxyurostylis	0	0	0	0	0	0	2	0	0.00	99.82
Pagurus spp	0	0	0	0	0	1	1	0	0.00	99.83

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Parametopella	0	0	0	0	0	1	1	0	0.00	99.83
Phoronida	0	0	0	0	0	2	0	0	0.00	99.83
Pista cristata	0	0	0	0	0	2	0	0	0.00	99.84
Poecilochaetus johnsoni	0	0	0	0	0	0	2	0	0.00	99.84
Polydora	0	0	0	0	0	0	2	0	0.00	99.84
Procladius	2	0	0	0	0	0	0	0	0.00	99.84
Spio pettiboneae	0	0	0	0	0	2	0	0	0.00	99.85
Stenothoe gallensis	0	0	0	0	0	1	1	0	0.00	99.85
Terebellidae	0	0	0	0	0	2	0	0	0.00	99.85
Turridae	0	0	0	0	0	0	2	0	0.00	99.85
Acari	0	0	0	0	0	0	1	0	0.00	99.85
Ambidexter symmetricus	0	0	0	0	0	1	0	0	0.00	99.86
Ampelisca agassizi	0	0	0	0	0	1	0	0	0.00	99.86
Ampharete	0	0	0	0	0	1	0	0	0.00	99.86
Ampharetidae	0	0	0	0	0	1	0	0	0.00	99.86
Amphictene sp. A	0	0	0	0	0	1	0	0	0.00	99.86
Amphioplus abditus abdita	0	0	0	0	0	1	0	0	0.00	99.86
Amygdalum	0	1	0	0	0	0	0	0	0.00	99.86
Argissa hamatipes	0	0	0	0	0	1	0	0	0.00	99.87
Aricidea	0	0	0	0	0	1	0	0	0.00	99.87
Athenaria	0	0	0	0	0	1	0	0	0.00	99.87
Axiothella	0	0	0	0	0	1	0	0	0.00	99.87
Axiothella mucosa	0	0	0	0	0	1	0	0	0.00	99.87
Barbatia candida	0	0	0	0	0	1	0	0	0.00	99.87
Bowmaniella brasiliensis	0	0	1	0	0	0	0	0	0.00	99.87
Cabira incerta	0	0	0	0	0	0	1	0	0.00	99.87
Caecum	0	0	0	0	0	0	1	0	0.00	99.88
Capitellidae	0	0	0	0	0	1	0	0	0.00	99.88
Cardiomya costellata	0	0	0	0	0	1	0	0	0.00	99.88
Cerapus tubularis	0	0	0	0	0	1	0	0	0.00	99.88
Chione cancellata	0	0	0	0	0	1	0	0	0.00	99.88
Collembola	0	0	0	0	0	0	1	0	0.00	99.88
Corbula	0	0	0	0	0	1	0	0	0.00	99.88
Corbula sp	0	0	0	0	0	0	1	0	0.00	99.88
Corbula swiftiana	0	0	0	0	0	1	0	0	0.00	99.89
Cossura sp. juv	0	0	0	0	0	1	0	0	0.00	99.89
Crassinella lunulata	0	0	0	0	0	1	0	0	0.00	99.89
Crepidula sp.1	0	0	0	1	0	0	0	0	0.00	99.89
Dentalium	0	0	0	0	0	0	1	0	0.00	99.89

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Dosinia discus	0	0	0	0	0	1	0	0	0.00	99.89
Edotia	0	0	0	0	0	0	1	0	0.00	99.89
Erichsonella attenuata	1	0	0	0	0	0	0	0	0.00	99.89
Euceramus praelongus	0	0	0	0	0	1	0	0	0.00	99.90
Eulalia sanguinea	0	0	0	0	0	0	1	0	0.00	99.90
Eulimidae	0	0	0	0	0	1	0	0	0.00	99.90
Fabricia sp. 1	0	0	0	0	0	1	0	0	0.00	99.90
Galathowenia oculata	0	0	0	0	0	1	0	0	0.00	99.90
Gammarus daiberi	1	0	0	0	0	0	0	0	0.00	99.90
Gammarus mucronatus	0	0	0	1	0	0	0	0	0.00	99.90
Glottidia	0	0	0	0	0	0	1	0	0.00	99.91
Glottidia pyramidata	0	0	0	0	0	1	0	0	0.00	99.91
Glyceridae	0	0	0	0	1	0	0	0	0.00	99.91
Hargeria rapax	0	0	0	0	0	1	0	0	0.00	99.91
Harpacticoida	0	0	0	0	0	0	1	0	0.00	99.91
Hemichordata	0	0	0	0	0	1	0	0	0.00	99.91
Hippolyte zostericola	1	0	0	0	0	0	0	0	0.00	99.91
Hirudinea	0	0	1	0	0	0	0	0	0.00	99.91
Hydroidolina	0	0	0	0	0	0	1	0	0.00	99.92
Kinbergonuphis	0	0	0	0	0	0	1	0	0.00	99.92
Leptochelia dubia	0	0	0	0	0	0	1	0	0.00	99.92
Leucon sp. A	0	0	0	0	0	1	0	0	0.00	99.92
Limnodriloides appendiculatus	0	0	0	0	1	0	0	0	0.00	99.92
Limnodriloides baculatus	0	0	0	0	0	0	1	0	0.00	99.92
Limnodriloides monothecus	0	0	0	0	0	0	1	0	0.00	99.92
Limnodriloides vespertinus	0	0	0	0	0	0	1	0	0.00	99.92
Lucinoma filosa	0	0	0	0	0	1	0	0	0.00	99.93
Luconacia incerta	0	0	0	0	0	0	1	0	0.00	99.93
Lumbrineris	0	0	0	0	0	1	0	0	0.00	99.93
Lumbrineris sp. d	0	0	0	0	0	0	1	0	0.00	99.93
Lysianassa	0	0	0	0	1	0	0	0	0.00	99.93
Lysianopsis alba	0	0	0	0	0	1	0	0	0.00	99.93
Macoma constricta	0	0	0	0	0	0	1	0	0.00	99.93
Melanella	0	0	0	0	0	1	0	0	0.00	99.94
Melita cf intermedia	0	0	0	1	0	0	0	0	0.00	99.94
Melita intermedia	0	0	0	1	0	0	0	0	0.00	99.94
Micropholis	0	0	0	0	0	1	0	0	0.00	99.94
Monoculodes	0	0	0	0	1	0	0	0	0.00	99.94
Monoculodes sp. A	0	0	0	1	0	0	0	0	0.00	99.94

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Myodocopa sp.1	0	0	0	1	0	0	0	0	0.00	99.94
Myrophis punctatus	0	1	0	0	0	0	0	0	0.00	99.94
Mysidopsis furca	0	0	0	0	0	0	1	0	0.00	99.95
Nemertea sp.1	1	0	0	0	0	0	0	0	0.00	99.95
Nephtys	0	0	0	0	0	0	1	0	0.00	99.95
Nephtys cryptomma	0	0	0	0	0	0	1	0	0.00	99.95
Nephtys picta	0	0	0	0	0	1	0	0	0.00	99.95
Neritina reclivata	0	0	1	0	0	0	0	0	0.00	99.95
Nudibranchia	0	0	0	0	0	1	0	0	0.00	99.95
Nudibranchia sp. 1	0	0	1	0	0	0	0	0	0.00	99.95
Ogyrides alphaerostris	0	0	0	0	1	0	0	0	0.00	99.96
Ophiophragmus filograneus	0	0	0	0	0	0	1	0	0.00	99.96
Owenia fusiformis	0	0	0	0	0	0	1	0	0.00	99.96
Owenia sp.a	0	0	0	0	0	1	0	0	0.00	99.96
Pagurus cf maclaughlinae	0	0	0	0	0	1	0	0	0.00	99.96
Palpomyia bezzia sp.	0	1	0	0	0	0	0	0	0.00	99.96
Paracaprella	0	0	0	0	0	1	0	0	0.00	99.96
Periclimenes iridescens	0	0	0	0	0	0	1	0	0.00	99.97
Pettiboneia duofurca	0	0	0	0	0	1	0	0	0.00	99.97
Photis pugnator	0	0	0	0	0	1	0	0	0.00	99.97
Pinnixa retinens	0	0	0	0	0	0	1	0	0.00	99.97
Piscicolidae	1	0	0	0	0	0	0	0	0.00	99.97
Polinices duplicatus	0	0	0	0	0	0	1	0	0.00	99.97
Pomatoceros americanus	0	0	0	0	0	0	1	0	0.00	99.97
Porifera	0	0	0	0	0	0	1	0	0.00	99.97
Prionospio	0	0	0	0	0	0	1	0	0.00	99.98
Pycnogonida	0	0	0	0	0	1	0	0	0.00	99.98
Scoloplos	0	0	0	0	1	0	0	0	0.00	99.98
Semelina nuculoides	0	0	0	0	0	0	1	0	0.00	99.98
Sigambra wassi	0	0	0	0	0	1	0	0	0.00	99.98
Solenidae	0	0	0	0	0	1	0	0	0.00	99.98
Sphaeromatidae	0	0	0	0	0	0	1	0	0.00	99.98
Sphaerosyllis	0	0	0	0	0	1	0	0	0.00	99.98
Sphaerosyllis aciculata	0	0	0	0	0	1	0	0	0.00	99.99
Sphaerosyllis longicauda	0	0	0	0	0	1	0	0	0.00	99.99
Sphaerosyllis taylori	0	0	0	0	0	1	0	0	0.00	99.99
Stenothoidae	0	0	0	0	0	1	0	0	0.00	99.99
Streptosyllis pettiboneae	0	0	0	0	0	1	0	0	0.00	99.99
Stylochus sp.1	1	0	0	0	0	0	0	0	0.00	99.99

Species	Zone / Station							Mean (n m^{-2})	Mean (%)	Cum. (%)
	1	2			3	4				
	1	2	3	4	5	6	7			
Tanytarsini	1	0	0	0	0	0	0	0	0.00	99.99
Terebellides stroemi	0	0	0	0	0	0	1	0	0.00	100.00
Thalassinidea	0	1	0	0	0	0	0	0	0.00	100.00
Thenaria	0	0	0	0	0	1	0	0	0.00	100.00
Turbonilla conradi	0	0	0	0	0	0	1	0	0.00	100.00
Turbonilla sp.b 2	0	0	0	0	0	0	1	0	0.00	100.00
Veneridae	0	0	0	0	0	0	1	0	0.00	100.00
Total	10091	8831	15520	8582	5593	12948	5108	9525	100.0	

Four Stations, All Months (Except Nov 1987)

Mean abundance of all species at stations 2, 4, 5 and 6 over the entire study period.

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Cyclaspis varians	656.4	370.2	381.8	1321.9	682.6	9.45	9.45
Ampelisca abdita	0.6	1899.4	235.6	64.6	550.1	7.61	17.06
Ampelisca vadorum	4.3	1008.5	857.7	291.0	540.4	7.48	24.53
Cerapus tubularis	0.0	6.5	30.0	1596.2	408.2	5.65	30.18
Streblospio benedicti	461.4	492.1	363.5	92.6	352.4	4.88	35.06
Mulinia lateralis	689.6	91.1	16.5	592.8	347.5	4.81	39.87
Grandidierella bonnieroides	582.6	483.8	15.3	16.3	274.5	3.80	43.66
Tubificidae w o cap setae	488.9	21.0	92.0	481.6	270.9	3.75	47.41
Tellina versicolor	97.6	645.0	51.4	129.6	230.9	3.20	50.61
Carazziella hobsonae	0.0	0.0	3.9	902.9	226.7	3.14	53.74
Mytilopsis leucophaeata	649.7	91.1	0.6	0.0	185.4	2.56	56.31
Hydrobiidae	284.1	88.8	340.3	0.4	178.4	2.47	58.78
Parasterope pollex	0.6	50.1	100.3	540.1	172.8	2.39	61.17
Tharyx dorsobranchialis	0.0	0.0	0.9	613.0	153.5	2.12	63.29
Rangia cuneata	579.6	12.2	0.0	0.0	148.0	2.05	65.34
Mediomastus ambiseta	0.3	8.4	166.1	409.2	146.0	2.02	67.36
Ampelisca	1.8	269.4	143.7	121.3	134.1	1.86	69.22
Paraprionospio pinnata	0.4	37.2	225.9	255.9	129.9	1.80	71.01
Bivalvia (unidentified)	9.9	67.3	110.6	201.0	97.2	1.34	72.36
Nemertea (unidentified)	97.0	81.1	25.8	95.6	74.9	1.04	73.39
Tellina texana	156.9	43.4	28.9	51.4	70.1	0.97	74.36
Cyprideis	0.0	0.6	0.3	250.1	62.7	0.87	75.23
Prionospio perkinsi	0.0	0.0	26.6	218.0	61.1	0.85	76.08
Peloscolex heterochaetus	206.1	36.6	0.0	0.3	60.7	0.84	76.92
Aricidea philbinae	0.0	1.3	1.6	224.9	57.0	0.79	77.71
Ampelisca holmesi	0.0	0.0	1.2	212.2	53.4	0.74	78.45
Acteocina canaliculata	0.9	22.5	25.4	152.4	50.3	0.70	79.14
Tanytarsus	195.2	0.0	0.0	0.0	48.8	0.68	79.82
Amygdalum papyrium	8.0	17.2	3.1	158.4	46.7	0.65	80.46
Tectidrilus bori	0.0	0.0	0.0	177.2	44.3	0.61	81.07
Cyathura polita	124.3	47.4	0.3	0.0	43.0	0.60	81.67
Mediomastus	0.0	7.1	69.2	89.0	41.3	0.57	82.24
Tellina	4.0	63.3	20.7	72.3	40.1	0.55	82.80
Ampelisca sp. C	0.0	23.8	27.7	106.7	39.5	0.55	83.34
Mysella sp. A	0.0	0.0	1.2	156.5	39.4	0.55	83.89
Leucon sp. 1	0.0	0.3	3.1	138.1	35.4	0.49	84.38
Haminoea succinea	0.0	29.8	32.7	74.0	34.1	0.47	84.85

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Glycinde solitaria	1.8	14.2	50.8	68.8	33.9	0.47	85.32
Limnodriloides barnardi	0.0	0.0	2.5	111.0	28.4	0.39	85.71
Abra aequalis	0.0	0.0	6.4	96.9	25.8	0.36	86.07
Capitella capitata	1.2	3.1	0.0	93.7	24.5	0.34	86.41
Listriella barnardi	0.0	0.0	0.3	92.7	23.2	0.32	86.73
Cyclaspis sp.1	4.0	71.7	14.5	2.2	23.1	0.32	87.05
Assiminea succinea	55.1	31.0	0.0	3.5	22.4	0.31	87.36
Macoma tenta	0.0	0.9	23.7	63.9	22.1	0.31	87.66
Coelotanypus	85.2	0.6	0.0	0.0	21.5	0.30	87.96
Tubificoides wasselli	0.0	0.0	0.0	79.7	19.9	0.28	88.24
Edotia sp. 1	31.7	37.7	0.0	3.4	18.2	0.25	88.49
Amphicteis gunneri	3.8	29.5	19.2	20.0	18.1	0.25	88.74
Spiochaetopterus costarum	0.0	2.2	12.1	58.3	18.1	0.25	88.99
Tectidrilus squalidus	0.0	0.0	0.0	72.0	18.0	0.25	89.24
Cerapus benthophilus	0.0	0.0	57.2	12.3	17.4	0.24	89.48
Polymesoda caroliniana	59.0	1.5	0.0	0.0	15.1	0.21	89.69
Mesanthura fasciata	39.2	10.0	2.3	6.5	14.5	0.20	89.89
Edotia montosa	6.2	2.3	5.8	40.8	13.7	0.19	90.08
Tubificoides brownae	0.0	0.0	33.8	20.6	13.6	0.19	90.27
Leitoscoloplos foliosus	0.0	0.0	52.0	2.2	13.5	0.19	90.46
Aricidea taylori	0.0	0.4	7.5	46.1	13.5	0.19	90.64
Oxyurostylis smithi	0.0	4.3	8.3	38.8	12.8	0.18	90.82
Tubificoides motei	0.0	0.0	0.0	51.1	12.8	0.18	91.00
Asthenothaerus hemphilli	0.0	0.0	0.9	49.5	12.6	0.17	91.17
Sigambra tentaculata	0.0	0.0	4.2	44.6	12.2	0.17	91.34
Procladius	46.9	1.5	0.0	0.0	12.1	0.17	91.51
Diplodonta semiaspera	0.0	0.0	0.3	47.0	11.8	0.16	91.67
Acuminodeutopus	0.0	0.9	2.2	42.8	11.5	0.16	91.83
Eusarsiella texana	0.0	0.0	0.0	42.8	10.7	0.15	91.98
Mysella planulata	0.0	0.0	0.0	42.3	10.6	0.15	92.12
Sthenelais sp. A	0.0	0.0	11.7	30.2	10.5	0.14	92.27
Amphicteis floridus	23.1	16.0	0.3	1.9	10.3	0.14	92.41
Decapoda	22.3	0.4	5.8	8.5	9.2	0.13	92.54
Scoloplos texana	0.0	0.0	31.8	3.2	8.7	0.12	92.66
Eteone heteropoda	23.1	11.2	0.6	0.0	8.7	0.12	92.78
Platyhelminthes	0.8	0.6	1.9	31.5	8.7	0.12	92.90
Nemertea sp. f	0.0	0.0	1.9	32.7	8.7	0.12	93.02
Micropholis atra	0.0	0.0	0.0	34.2	8.6	0.12	93.14
Acteocina	0.0	0.6	24.3	8.6	8.4	0.12	93.26

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Oxyurostylis cf smithi	0.4	0.4	1.5	30.8	8.3	0.11	93.37
Amakusanthura magnifica	4.6	0.4	0.6	27.4	8.2	0.11	93.48
Molgula occidentalis	0.0	0.6	3.7	28.3	8.2	0.11	93.60
Nemertea sp. B	1.2	0.0	0.0	31.1	8.1	0.11	93.71
Neanthes succinea	21.2	10.6	0.3	0.0	8.0	0.11	93.82
Gastropoda	0.3	0.6	7.1	23.8	8.0	0.11	93.93
Podarkeopsis levifuscina	0.0	0.6	1.6	29.6	8.0	0.11	94.04
Photis pugnator	8.1	11.2	3.8	7.6	7.7	0.11	94.15
Prionospio pinnata	0.0	0.0	0.0	30.1	7.5	0.10	94.25
Rhithropanopeus harrisii	13.4	14.9	0.7	1.2	7.5	0.10	94.35
Phyllodoce arenae	0.0	1.2	2.8	25.3	7.3	0.10	94.46
Cirrophorus	0.0	0.0	19.4	9.8	7.3	0.10	94.56
Tanypodinae	21.1	6.2	0.4	0.0	6.9	0.10	94.65
Lophogastrida	4.2	7.4	9.0	5.8	6.6	0.09	94.74
Pectinaria gouldii	3.7	9.0	2.5	11.2	6.6	0.09	94.84
Paracaprella tenuis	0.6	0.3	4.9	17.9	5.9	0.08	94.92
Scolelepis texana	0.6	0.9	20.6	1.3	5.9	0.08	95.00
Diptera	22.7	0.4	0.0	0.0	5.8	0.08	95.08
Fabriciola trilobata	0.0	0.0	14.8	7.7	5.6	0.08	95.16
Caecum pulchellum	0.0	0.0	0.0	22.2	5.5	0.08	95.23
Parvilucina multilineata	0.0	0.0	0.0	22.2	5.5	0.08	95.31
Gammarus mucronatus	15.4	1.0	5.4	0.0	5.4	0.08	95.38
Chironomus	18.6	1.2	1.9	0.0	5.4	0.08	95.46
Nucula crenulata	0.0	0.0	0.0	20.8	5.2	0.07	95.53
Spiochaetopterus oculatus	0.0	0.6	0.3	19.7	5.2	0.07	95.60
Rictaxis punctostriatus	6.5	0.4	1.9	10.6	4.8	0.07	95.67
Polypedilum	14.7	0.4	1.9	2.3	4.8	0.07	95.74
Apoprionospio pygmaea	0.3	0.0	0.0	18.8	4.8	0.07	95.80
Cyclostremiscus suppressus	0.0	0.0	0.0	18.8	4.7	0.07	95.87
Monoculodes nyei	0.0	4.0	4.6	10.2	4.7	0.06	95.93
Cerapus sp. 1	0.0	0.0	0.0	18.8	4.7	0.06	96.00
Ampelisca sp. 3	0.0	0.0	0.0	18.5	4.6	0.06	96.06
Kalliapseudes sp. 1	0.0	0.0	0.3	17.8	4.5	0.06	96.12
Leucon	0.0	0.0	0.0	17.5	4.4	0.06	96.18
Stylochus	7.4	1.5	3.7	4.9	4.4	0.06	96.25
Tellinidae	1.8	0.6	4.9	10.2	4.4	0.06	96.31
Ophiuroidea	0.0	0.0	0.0	17.2	4.3	0.06	96.37
Hargeria rapax	1.8	0.7	1.1	13.4	4.2	0.06	96.42
Phascolion strombus	0.0	0.0	0.0	16.9	4.2	0.06	96.48

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
strombus							
Sipuncula	0.0	0.0	0.0	16.8	4.2	0.06	96.54
Prunum apicinum	0.0	0.0	0.0	15.8	4.0	0.05	96.60
Batea catharinensis	0.0	2.2	1.4	11.8	3.8	0.05	96.65
Acteocina bidentata	0.0	0.0	4.0	10.6	3.7	0.05	96.70
Odostomia	0.0	0.0	0.8	13.8	3.7	0.05	96.75
Nucula proxima	0.0	0.0	1.5	12.3	3.5	0.05	96.80
Parahesione luteola	0.0	0.6	3.8	9.2	3.4	0.05	96.84
Eusarsiella zostericola	0.0	1.2	2.5	9.8	3.4	0.05	96.89
Lyonsia hyalina floridana	0.0	0.3	0.6	12.5	3.3	0.05	96.94
Anthuridae	0.0	1.9	1.5	9.8	3.3	0.05	96.98
Fabriciola sp. A	0.0	0.0	3.1	10.2	3.3	0.05	97.03
Chironominae	7.7	2.7	1.2	1.5	3.3	0.05	97.08
Eulimastoma weberi	0.0	0.3	7.1	5.5	3.2	0.04	97.12
Corbula contracta	0.0	0.0	3.6	8.7	3.1	0.04	97.16
Malmgreniella sp. B	0.0	0.0	0.6	11.7	3.1	0.04	97.20
Lumbrineris verrilli	0.0	0.0	0.0	12.2	3.0	0.04	97.25
Amphilochus	0.0	1.2	10.8	0.0	3.0	0.04	97.29
Haminoea	0.0	0.0	0.0	12.0	3.0	0.04	97.33
Olivella	0.3	0.0	0.0	11.3	2.9	0.04	97.37
Pinnixa	0.0	0.3	0.9	10.2	2.9	0.04	97.41
Amphilochus sp. 1	0.0	2.2	8.9	0.0	2.8	0.04	97.45
Glycera americana	0.0	0.3	2.5	7.9	2.7	0.04	97.48
Micropholis gracillima	0.0	0.0	0.0	10.6	2.7	0.04	97.52
Lucina nassula	0.0	0.0	0.0	10.4	2.6	0.04	97.56
Eulimastoma	0.0	0.0	0.0	10.4	2.6	0.04	97.59
Laeonereis culveri	7.2	0.4	0.0	2.8	2.6	0.04	97.63
Microprotopus raneyi	0.0	0.0	5.0	5.2	2.6	0.04	97.66
Ericthonius brasiliensis	0.0	0.0	0.0	10.2	2.5	0.04	97.70
Nuculana acuta	0.0	0.0	2.2	8.0	2.5	0.04	97.73
Halmyrapseudes bahamensis	0.3	0.0	1.8	8.0	2.5	0.04	97.77
Exogone dispar	0.0	0.0	0.0	9.5	2.4	0.03	97.80
Malmgreniella sp. A	0.0	0.0	0.0	9.5	2.4	0.03	97.84
Schistomeringos rudolphi	0.0	0.0	0.0	9.5	2.4	0.03	97.87
Ericthonius sp. 2	0.0	0.0	0.9	8.0	2.2	0.03	97.90
Melita	0.0	2.8	6.2	0.0	2.2	0.03	97.93
Scoloplos rubra	0.0	0.0	0.3	8.5	2.2	0.03	97.96
Mitrella lunata	0.0	1.0	1.8	5.8	2.2	0.03	97.99
Semelidae	0.0	0.0	1.2	6.8	2.0	0.03	98.02

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Corophium acherusicum	0.0	0.0	0.0	7.1	1.8	0.02	98.04
Cerapus	0.0	0.0	4.3	2.8	1.8	0.02	98.07
Malmgreniella maccraryae	0.0	0.0	0.0	6.9	1.7	0.02	98.09
Molgulidae sp.1	0.0	6.8	0.0	0.0	1.7	0.02	98.11
Aglaophamus verrilli	0.0	0.0	0.3	6.2	1.6	0.02	98.14
Spionidae	1.9	0.3	1.5	2.5	1.6	0.02	98.16
Ampelisca parapacifica	0.0	0.0	0.0	6.2	1.6	0.02	98.18
Sigalionidae	0.0	0.0	0.0	6.2	1.6	0.02	98.20
Genetyllis castanea	0.0	0.3	0.3	5.5	1.5	0.02	98.22
Mesanthura	1.9	0.8	0.8	2.7	1.5	0.02	98.24
Cryptochironomus	3.7	2.2	0.0	0.0	1.5	0.02	98.26
Polycirrus	0.0	0.0	0.0	5.8	1.5	0.02	98.29
Scoloplos robustus	0.0	0.0	2.2	3.5	1.4	0.02	98.30
Mysidacea sp. 1	0.0	1.5	4.0	0.0	1.4	0.02	98.32
Tubificoides w o cap setae	0.0	0.0	4.9	0.6	1.4	0.02	98.34
Podarke obscura	0.0	0.0	0.0	5.4	1.3	0.02	98.36
Tagelus plebeius	2.5	2.8	0.0	0.0	1.3	0.02	98.38
Corophium	0.0	0.3	0.3	4.6	1.3	0.02	98.40
Leptosynapta crassipatina	0.0	0.0	0.0	5.2	1.3	0.02	98.42
Melita longisetosa	0.0	5.2	0.0	0.0	1.3	0.02	98.43
Amphipoda	1.0	0.8	3.1	0.3	1.3	0.02	98.45
Acmira lopezi	0.0	0.0	5.0	0.0	1.3	0.02	98.47
Photis sp. 1	0.0	0.0	0.0	4.9	1.2	0.02	98.49
Microdeutopus myersi	0.0	0.0	0.0	4.9	1.2	0.02	98.50
Phoronis psammophila	0.0	0.0	0.0	4.9	1.2	0.02	98.52
Amphiuridae	0.0	0.4	0.4	4.1	1.2	0.02	98.54
Sphaerosyllis longicauda	0.0	0.0	0.0	4.8	1.2	0.02	98.55
Edotia sp. A	1.2	3.4	0.0	0.0	1.2	0.02	98.57
Periclimenes americanus	0.0	1.9	2.5	0.3	1.2	0.02	98.59
Phascolion	0.0	0.0	0.0	4.6	1.2	0.02	98.60
Scolelepis squamata	0.0	0.0	0.3	4.3	1.2	0.02	98.62
Strombiformis hemphilli	0.0	0.0	0.0	4.5	1.1	0.02	98.63
Heteromastus filiformis	0.0	3.5	0.0	0.9	1.1	0.02	98.65
Euplana	0.3	1.5	2.2	0.3	1.1	0.01	98.66
Leucon americanus	0.0	0.0	1.5	2.7	1.1	0.01	98.68
Xenanthura brevitelson	0.0	1.2	2.9	0.0	1.0	0.01	98.69
Acuminodeutopus naglei	0.0	0.6	0.0	3.4	1.0	0.01	98.71
Americamysis almyra	1.5	2.2	0.3	0.0	1.0	0.01	98.72
Podocopa	0.0	0.0	0.3	3.7	1.0	0.01	98.73

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Tagelus divisus	0.0	0.0	0.4	3.6	1.0	0.01	98.75
Podarkeopsis brevipalpa	0.0	0.0	3.1	0.9	1.0	0.01	98.76
Lucifer faxoni	0.0	0.7	0.0	3.2	1.0	0.01	98.78
Hypereteone heteropoda	0.0	0.8	1.5	1.5	1.0	0.01	98.79
Sphenia antillensis	0.0	0.0	0.0	3.8	1.0	0.01	98.80
Polydora cornuta	2.8	0.6	0.0	0.3	0.9	0.01	98.81
Amphioplus thrombodes	0.0	0.0	0.0	3.7	0.9	0.01	98.83
Gitanopsis	0.3	3.4	0.0	0.0	0.9	0.01	98.84
Maldanidae	0.0	0.0	0.0	3.7	0.9	0.01	98.85
Leitoscoloplos	0.0	0.0	0.3	3.2	0.9	0.01	98.86
Mysidopsis	0.9	0.6	0.3	1.7	0.9	0.01	98.88
Piromis roberti	0.0	0.0	2.8	0.7	0.9	0.01	98.89
Leitoscoloplos fragilis	0.0	0.0	2.8	0.6	0.8	0.01	98.90
Turbonilla	0.0	0.0	0.6	2.8	0.8	0.01	98.91
Actiniaria	0.0	0.0	0.3	3.1	0.8	0.01	98.92
Fabriciola sp. 1	0.0	0.0	0.0	3.4	0.8	0.01	98.94
Gitanopsis sp. 1	0.3	1.5	1.2	0.3	0.8	0.01	98.95
Limnodriloides	0.0	0.0	0.0	3.4	0.8	0.01	98.96
Anachis obesa	0.0	0.0	2.2	1.2	0.8	0.01	98.97
Brachyura	0.3	1.2	1.2	0.6	0.8	0.01	98.98
Ampelisca agassizi	0.0	0.0	1.2	2.2	0.8	0.01	98.99
Onuphidae	0.0	0.0	0.0	3.2	0.8	0.01	99.01
Monoculodes edwardsi	0.0	0.0	0.0	3.1	0.8	0.01	99.02
Ascidiacea	0.0	0.3	1.2	1.5	0.8	0.01	99.03
Corophium lacustre	0.0	2.2	0.9	0.0	0.8	0.01	99.04
Caulleriella	0.0	0.0	0.0	3.1	0.8	0.01	99.05
Eusarsiella disparalis	0.0	0.0	0.0	3.1	0.8	0.01	99.06
Americamysis bigelowi	0.0	0.0	0.4	2.5	0.7	0.01	99.07
Ophiurida	0.0	0.0	0.0	2.8	0.7	0.01	99.08
Smithsonidrilus marinus	0.0	0.0	0.0	2.8	0.7	0.01	99.09
Ampharetidae	0.0	0.4	0.8	1.6	0.7	0.01	99.10
Upogebia affinis	0.0	1.9	0.0	0.9	0.7	0.01	99.11
Galathowenia oculata	0.0	0.0	0.0	2.8	0.7	0.01	99.12
Cyclostremiscus pentagonus	0.0	0.0	1.9	0.8	0.7	0.01	99.13
Malmgreniella taylori	0.0	0.0	0.0	2.7	0.7	0.01	99.14
Nephtys cf hombergi	0.0	0.0	0.0	2.7	0.7	0.01	99.14
Owenia	0.0	0.0	0.0	2.7	0.7	0.01	99.15
Enteropneusta	0.0	0.0	0.4	2.2	0.7	0.01	99.16
Ampithoidae	0.6	0.0	0.7	1.2	0.6	0.01	99.17

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Apoprionospio pinnata	0.0	0.0	0.0	2.5	0.6	0.01	99.18
Asteropterygion oculitristris	0.0	0.0	0.0	2.5	0.6	0.01	99.19
Crepidula	0.0	0.0	0.0	2.5	0.6	0.01	99.20
Dyspanopeus texana	0.9	0.3	0.0	1.2	0.6	0.01	99.21
Eusarsiella cresseyi	0.0	0.0	0.0	2.5	0.6	0.01	99.21
Lembos	0.0	0.0	0.0	2.5	0.6	0.01	99.22
Lucinidae	0.0	0.0	0.0	2.5	0.6	0.01	99.23
Oxyurostylis sp.1	0.0	0.0	0.0	2.5	0.6	0.01	99.24
Uromunna reynoldsi	0.0	0.3	0.9	1.2	0.6	0.01	99.25
Opisthobranchia	0.0	0.3	0.9	1.0	0.6	0.01	99.26
Cyclaspis pustulata	0.0	0.0	0.0	2.2	0.5	0.01	99.26
Cymadusa compta	0.3	0.3	0.0	1.5	0.5	0.01	99.27
Ericthonius	0.0	0.0	0.3	1.9	0.5	0.01	99.28
Ericthonius sp. 1	0.0	0.0	0.0	2.2	0.5	0.01	99.29
Micropholis	0.0	0.0	0.0	2.2	0.5	0.01	99.29
Parametopella cypris	0.0	0.6	0.9	0.6	0.5	0.01	99.30
Terebellidae	0.0	0.0	0.0	2.2	0.5	0.01	99.31
Xanthidae	1.5	0.3	0.3	0.0	0.5	0.01	99.32
Ampharete parvidentata	0.0	0.0	0.0	1.9	0.5	0.01	99.32
Amphiodia	0.0	0.0	0.0	1.9	0.5	0.01	99.33
Magelona riojai	0.0	0.0	0.0	1.9	0.5	0.01	99.34
Melita nitida	0.0	0.0	1.9	0.0	0.5	0.01	99.34
Parvanachis obesa	0.0	0.0	0.4	1.5	0.5	0.01	99.35
Schistomeringos cf rudolphi	0.0	0.0	0.0	1.9	0.5	0.01	99.36
Americamysis bahia	0.0	0.0	0.3	1.5	0.5	0.01	99.36
Corophium sp	0.0	0.0	0.0	1.9	0.5	0.01	99.37
Gobiosoma	0.0	0.0	0.3	1.5	0.5	0.01	99.37
Magelona pettiboneae	0.0	0.0	0.0	1.9	0.5	0.01	99.38
Strombiformis	0.0	0.0	0.0	1.9	0.5	0.01	99.39
Tubificoides fraseri	0.0	0.3	1.5	0.0	0.5	0.01	99.39
Vitrinellidae sp.	0.0	0.0	1.8	0.0	0.5	0.01	99.40
Diopatra cuprea	0.0	0.0	0.0	1.9	0.5	0.01	99.41
Eudevenopus honduranus	0.0	0.0	0.0	1.9	0.5	0.01	99.41
Eusarsiella spinosa	0.0	0.0	0.0	1.9	0.5	0.01	99.42
Pinnixa sayana	0.0	0.0	0.6	1.2	0.5	0.01	99.43
Nassarius vibex	0.0	0.0	0.0	1.8	0.4	0.01	99.43
Nuculana	0.0	0.0	0.0	1.8	0.4	0.01	99.44
Spio pettiboneae	0.0	0.0	0.0	1.7	0.4	0.01	99.44
Vitrinellidae	0.0	0.6	0.4	0.7	0.4	0.01	99.45

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Amphioplus	0.0	0.0	0.0	1.5	0.4	0.01	99.45
Ancistrosyllis jonesi	0.0	0.0	0.0	1.5	0.4	0.01	99.46
Aoridae	0.0	0.0	0.0	1.5	0.4	0.01	99.47
Brania clavata	0.0	0.0	0.0	1.5	0.4	0.01	99.47
Chaoborus punctipennis	1.5	0.0	0.0	0.0	0.4	0.01	99.48
Limnodrilus	0.0	0.0	1.5	0.0	0.4	0.01	99.48
Macoma constricta	0.0	0.0	0.0	1.5	0.4	0.01	99.49
Marginella	0.0	0.0	0.0	1.5	0.4	0.01	99.49
Ophiophragmus wurdemani	0.0	0.0	0.0	1.5	0.4	0.01	99.50
Orbiniidae	0.0	0.0	1.5	0.0	0.4	0.01	99.50
Podocopa sp. p	0.0	0.0	0.0	1.5	0.4	0.01	99.51
Sipuncula sp.	0.0	0.0	0.0	1.5	0.4	0.01	99.51
Turbellaria	0.0	0.0	0.0	1.5	0.4	0.01	99.52
Acuminodeutopus sp. 1	0.0	0.3	0.0	1.2	0.4	0.01	99.52
Alpheus estuariensis	0.0	0.3	1.2	0.0	0.4	0.01	99.53
Balanus	0.0	0.3	0.0	1.2	0.4	0.01	99.53
Cyclostremiscus	0.0	0.0	0.9	0.6	0.4	0.01	99.54
Nudibranchia	0.0	0.0	0.6	0.9	0.4	0.01	99.55
Glottidia pyramidata	0.0	0.0	0.0	1.5	0.4	0.01	99.55
Sthenelais	0.0	0.0	0.0	1.5	0.4	0.01	99.56
Chironomidae	0.4	0.0	0.9	0.0	0.3	0.00	99.56
Megalomma pigmentum	0.0	0.0	0.0	1.3	0.3	0.00	99.56
Melita intermedia	0.0	0.3	0.9	0.0	0.3	0.00	99.57
Amphiodia trychna	0.0	0.0	0.0	1.2	0.3	0.00	99.57
Asthenothaerus	0.0	0.0	0.0	1.2	0.3	0.00	99.58
Dexiospira spirillum	0.0	0.0	0.0	1.2	0.3	0.00	99.58
Edotia triloba	0.0	0.9	0.0	0.3	0.3	0.00	99.59
Ischadium recurvum	0.3	0.3	0.6	0.0	0.3	0.00	99.59
Leptocheliidae	0.0	0.3	0.0	0.9	0.3	0.00	99.59
Lyonsia hyalina	0.0	0.0	0.0	1.2	0.3	0.00	99.60
Melita cf elongata	0.0	0.0	1.2	0.0	0.3	0.00	99.60
Melita sp. 1	0.0	0.0	1.2	0.0	0.3	0.00	99.61
Myodocopa sp.1	0.0	0.9	0.3	0.0	0.3	0.00	99.61
Photis	0.0	0.0	0.0	1.2	0.3	0.00	99.62
Polydora socialis	0.0	0.0	0.0	1.2	0.3	0.00	99.62
Prionospio heterobranchia	0.0	0.0	0.0	1.2	0.3	0.00	99.62
Spiophanes bombyx	0.0	0.0	0.0	1.2	0.3	0.00	99.63
Stylochus sp.2	0.3	0.9	0.0	0.0	0.3	0.00	99.63
Aeolidiidae	0.0	0.0	0.0	1.2	0.3	0.00	99.64

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Melinna maculata	0.0	0.0	0.0	1.2	0.3	0.00	99.64
Prionospio pygmaea	0.0	0.0	0.0	1.2	0.3	0.00	99.64
Stenoninereis martini	0.0	0.0	1.2	0.0	0.3	0.00	99.65
Asychis elongata	0.0	0.0	0.0	1.1	0.3	0.00	99.65
Chione cancellata	0.0	0.0	0.0	1.1	0.3	0.00	99.66
Sabellidae	0.0	0.0	0.0	1.1	0.3	0.00	99.66
Cirratulidae	0.0	0.0	0.0	1.0	0.3	0.00	99.66
Gobiidae	0.3	0.3	0.0	0.4	0.3	0.00	99.67
Natica pusilla	0.0	0.0	0.0	1.0	0.3	0.00	99.67
Thenaria	0.0	0.0	0.0	1.0	0.3	0.00	99.67
Ampelisca sp. 1	0.0	0.0	0.0	0.9	0.2	0.00	99.68
Brachyura sp.	0.9	0.0	0.0	0.0	0.2	0.00	99.68
Cyclaspis	0.0	0.0	0.0	0.9	0.2	0.00	99.68
Dulichiella appendiculata	0.0	0.0	0.0	0.9	0.2	0.00	99.69
Luconacia incerta	0.0	0.0	0.0	0.9	0.2	0.00	99.69
Megalomma bioculatum	0.0	0.0	0.0	0.9	0.2	0.00	99.69
Mercenaria	0.0	0.0	0.0	0.9	0.2	0.00	99.70
Nais pardalis	0.9	0.0	0.0	0.0	0.2	0.00	99.70
Polycladida	0.0	0.9	0.0	0.0	0.2	0.00	99.70
Sthenelais sp. 1	0.0	0.0	0.0	0.9	0.2	0.00	99.71
Anachis sp.	0.0	0.0	0.0	0.9	0.2	0.00	99.71
Chironomini	0.9	0.0	0.0	0.0	0.2	0.00	99.71
Elasmopus levis	0.0	0.0	0.0	0.9	0.2	0.00	99.72
Eulimidae	0.0	0.0	0.0	0.9	0.2	0.00	99.72
Gibberosus myersi	0.0	0.0	0.0	0.9	0.2	0.00	99.72
Lightiella floridana	0.0	0.0	0.0	0.9	0.2	0.00	99.72
Streptosyllis pettiboneae	0.0	0.0	0.0	0.9	0.2	0.00	99.73
Stylochus sp.3	0.0	0.9	0.0	0.0	0.2	0.00	99.73
Turbonilla interrupta	0.0	0.0	0.0	0.9	0.2	0.00	99.73
Axiothella mucosa	0.0	0.0	0.3	0.6	0.2	0.00	99.74
Boonea impressa	0.3	0.6	0.0	0.0	0.2	0.00	99.74
Bowmaniella brasiliensis	0.0	0.3	0.0	0.6	0.2	0.00	99.74
Eobrolgus spinosus	0.0	0.0	0.6	0.3	0.2	0.00	99.75
Microgobius gulosus	0.0	0.0	0.6	0.3	0.2	0.00	99.75
Anachis floridana	0.0	0.0	0.8	0.0	0.2	0.00	99.75
Anomalocardia auberiana	0.0	0.0	0.0	0.8	0.2	0.00	99.76
Aricidea fragilis	0.0	0.0	0.0	0.8	0.2	0.00	99.76
Caecum bipartitum	0.0	0.0	0.0	0.8	0.2	0.00	99.76
Ceratopogonidae	0.8	0.0	0.0	0.0	0.2	0.00	99.76

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Eolidoidea	0.0	0.0	0.0	0.8	0.2	0.00	99.77
Isolda pulchella	0.0	0.0	0.0	0.8	0.2	0.00	99.77
Microchironomus	0.8	0.0	0.0	0.0	0.2	0.00	99.77
Nemertea sp. A	0.0	0.4	0.0	0.4	0.2	0.00	99.77
Pinnixa chaetopterana	0.0	0.0	0.4	0.4	0.2	0.00	99.78
Polydora	0.0	0.0	0.0	0.8	0.2	0.00	99.78
Amphioplus abditus abdita	0.0	0.0	0.0	0.7	0.2	0.00	99.78
Portunus gibbesii	0.0	0.0	0.0	0.7	0.2	0.00	99.78
Sphaerosyllis aciculata	0.0	0.0	0.0	0.7	0.2	0.00	99.79
Bowmaniella	0.0	0.3	0.4	0.0	0.2	0.00	99.79
Ogyrides alphaerostris	0.0	0.0	0.3	0.4	0.2	0.00	99.79
Ablabesmyia	0.6	0.0	0.0	0.0	0.2	0.00	99.79
Amphilochidae	0.0	0.0	0.6	0.0	0.2	0.00	99.80
Amphiura	0.0	0.0	0.0	0.6	0.2	0.00	99.80
Ampithoe	0.0	0.0	0.0	0.6	0.2	0.00	99.80
Aricidea	0.0	0.0	0.0	0.6	0.2	0.00	99.80
Armandia agilis	0.0	0.0	0.0	0.6	0.2	0.00	99.80
Athenaria	0.0	0.0	0.0	0.6	0.2	0.00	99.81
Balanus improvisus	0.3	0.0	0.0	0.3	0.2	0.00	99.81
Calanoida	0.0	0.6	0.0	0.0	0.2	0.00	99.81
Chaetozone	0.0	0.0	0.0	0.6	0.2	0.00	99.81
Deutella incerta	0.0	0.0	0.0	0.6	0.2	0.00	99.81
Dosinia discus	0.0	0.0	0.0	0.6	0.2	0.00	99.82
Elasmopus	0.0	0.0	0.3	0.3	0.2	0.00	99.82
Gammaridae	0.0	0.0	0.3	0.3	0.2	0.00	99.82
Holothuroidea	0.0	0.0	0.0	0.6	0.2	0.00	99.82
Listriella	0.0	0.0	0.0	0.6	0.2	0.00	99.83
Lysianassa	0.0	0.0	0.3	0.3	0.2	0.00	99.83
Mercenaria campechiensis	0.0	0.0	0.0	0.6	0.2	0.00	99.83
Musculus lateralis	0.0	0.0	0.0	0.6	0.2	0.00	99.83
Nephtys bucera	0.0	0.0	0.0	0.6	0.2	0.00	99.83
Nereis riisei	0.0	0.0	0.0	0.6	0.2	0.00	99.84
Notomastus latericeus	0.0	0.0	0.0	0.6	0.2	0.00	99.84
Nudibranchia sp. 2	0.0	0.6	0.0	0.0	0.2	0.00	99.84
Orbinia riseri	0.0	0.0	0.0	0.6	0.2	0.00	99.84
Owenia sp.1	0.0	0.0	0.0	0.6	0.2	0.00	99.84
Paracaprella	0.0	0.0	0.0	0.6	0.2	0.00	99.85
Paramphinome sp. B	0.0	0.0	0.0	0.6	0.2	0.00	99.85
Phoronida	0.0	0.0	0.0	0.6	0.2	0.00	99.85

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Pinnixa pearsei	0.0	0.0	0.0	0.6	0.2	0.00	99.85
Pista cristata	0.0	0.0	0.0	0.6	0.2	0.00	99.86
Podocopa sp.1	0.0	0.0	0.0	0.6	0.2	0.00	99.86
Poecilochaetus johnsoni	0.0	0.0	0.0	0.6	0.2	0.00	99.86
Polydora websteri	0.0	0.0	0.3	0.3	0.2	0.00	99.86
Pycnogonida	0.0	0.0	0.0	0.6	0.2	0.00	99.86
Tagelus	0.0	0.0	0.0	0.6	0.2	0.00	99.87
Tellidora cristata	0.0	0.0	0.0	0.6	0.2	0.00	99.87
Alpheus heterochaelis	0.0	0.0	0.4	0.0	0.1	0.00	99.87
Ampelisca sp. A	0.0	0.0	0.4	0.0	0.1	0.00	99.87
Anadara transversa	0.0	0.0	0.0	0.4	0.1	0.00	99.87
Anomia simplex	0.0	0.0	0.0	0.4	0.1	0.00	99.87
Balanomorpha	0.0	0.0	0.0	0.4	0.1	0.00	99.87
Brachidontes exustus	0.0	0.0	0.0	0.4	0.1	0.00	99.88
Cirripedia	0.4	0.0	0.0	0.0	0.1	0.00	99.88
Corbicula fluminea	0.4	0.0	0.0	0.0	0.1	0.00	99.88
Culicidae	0.4	0.0	0.0	0.0	0.1	0.00	99.88
Cyclinella tenuis	0.0	0.0	0.0	0.4	0.1	0.00	99.88
Edotia	0.0	0.0	0.4	0.0	0.1	0.00	99.88
Euclymene sp. B	0.0	0.0	0.0	0.4	0.1	0.00	99.88
Exogone lourei	0.0	0.0	0.0	0.4	0.1	0.00	99.89
Hirudinea	0.0	0.0	0.0	0.4	0.1	0.00	99.89
Kinbergonuphis simoni	0.0	0.0	0.0	0.4	0.1	0.00	99.89
Mooreonuphis nebulosa	0.0	0.0	0.0	0.4	0.1	0.00	99.89
Nephtys	0.0	0.0	0.0	0.4	0.1	0.00	99.89
Ogyrides	0.0	0.0	0.0	0.4	0.1	0.00	99.89
Olividae	0.0	0.0	0.0	0.4	0.1	0.00	99.89
Ophiophragmus filograneus	0.0	0.0	0.0	0.4	0.1	0.00	99.89
Pista	0.0	0.0	0.0	0.4	0.1	0.00	99.90
Pleuronectidae	0.0	0.0	0.4	0.0	0.1	0.00	99.90
Portunidae	0.0	0.0	0.0	0.4	0.1	0.00	99.90
Prionospio cristata	0.0	0.0	0.4	0.0	0.1	0.00	99.90
Pyrgocythara plicosa	0.0	0.0	0.0	0.4	0.1	0.00	99.90
Solariorbis infracarinata	0.0	0.0	0.0	0.4	0.1	0.00	99.90
Squilla empusa	0.0	0.0	0.0	0.4	0.1	0.00	99.90
Syllis ehlersia cornuta	0.0	0.0	0.0	0.4	0.1	0.00	99.91
Almyracuma sp. 1	0.3	0.0	0.0	0.0	0.1	0.00	99.91
Ambidexter symmetricus	0.0	0.0	0.0	0.3	0.1	0.00	99.91
Ampharete	0.0	0.0	0.0	0.3	0.1	0.00	99.91

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Amphictene sp. A	0.0	0.0	0.0	0.3	0.1	0.00	99.91
Amygdalum	0.3	0.0	0.0	0.0	0.1	0.00	99.91
Anadara	0.0	0.0	0.0	0.3	0.1	0.00	99.91
Arcidae	0.0	0.0	0.0	0.3	0.1	0.00	99.91
Argissa hamatipes	0.0	0.0	0.0	0.3	0.1	0.00	99.91
Axiothella	0.0	0.0	0.0	0.3	0.1	0.00	99.91
Barbatia candida	0.0	0.0	0.0	0.3	0.1	0.00	99.92
Bemlos unicornis	0.0	0.0	0.0	0.3	0.1	0.00	99.92
Bowmaniella sp.1	0.0	0.3	0.0	0.0	0.1	0.00	99.92
Branchiostoma	0.0	0.0	0.0	0.3	0.1	0.00	99.92
Callianassidae sp. juv	0.0	0.3	0.0	0.0	0.1	0.00	99.92
Capitellidae	0.0	0.0	0.0	0.3	0.1	0.00	99.92
Caprellidae	0.0	0.0	0.0	0.3	0.1	0.00	99.92
Cardiomya costellata	0.0	0.0	0.0	0.3	0.1	0.00	99.92
Cerithiopsis greenii	0.0	0.0	0.3	0.0	0.1	0.00	99.92
Chone sp.1	0.0	0.0	0.0	0.3	0.1	0.00	99.93
Clymenella torquata	0.0	0.0	0.0	0.3	0.1	0.00	99.93
Collembola	0.0	0.3	0.0	0.0	0.1	0.00	99.93
Corbula	0.0	0.0	0.0	0.3	0.1	0.00	99.93
Corbula swiftiana	0.0	0.0	0.0	0.3	0.1	0.00	99.93
Corophium louisianum	0.0	0.3	0.0	0.0	0.1	0.00	99.93
Cossura sp. juv	0.0	0.0	0.0	0.3	0.1	0.00	99.93
Crassinella lunulata	0.0	0.0	0.0	0.3	0.1	0.00	99.93
Crepidula sp.1	0.0	0.3	0.0	0.0	0.1	0.00	99.93
Crustipellis tribranchiata	0.3	0.0	0.0	0.0	0.1	0.00	99.93
Cumacea	0.3	0.0	0.0	0.0	0.1	0.00	99.94
Dinocardium robustum	0.0	0.0	0.0	0.3	0.1	0.00	99.94
Einfeldia	0.3	0.0	0.0	0.0	0.1	0.00	99.94
Erichsonella	0.0	0.0	0.0	0.3	0.1	0.00	99.94
Euceramus praelongus	0.0	0.0	0.0	0.3	0.1	0.00	99.94
Eumida sanguinea	0.0	0.0	0.3	0.0	0.1	0.00	99.94
Fabricia	0.0	0.0	0.0	0.3	0.1	0.00	99.94
Fabricia sp. 1	0.0	0.0	0.0	0.3	0.1	0.00	99.94
Glyceridae	0.0	0.0	0.3	0.0	0.1	0.00	99.94
Harrieta faxoni	0.0	0.0	0.0	0.3	0.1	0.00	99.95
Hemichordata	0.0	0.0	0.0	0.3	0.1	0.00	99.95
Hydra	0.0	0.0	0.0	0.3	0.1	0.00	99.95
Kalliapseudes sp. A	0.0	0.0	0.0	0.3	0.1	0.00	99.95
Leptosynapta sp. 1	0.0	0.0	0.3	0.0	0.1	0.00	99.95

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Leucon sp. A	0.0	0.0	0.0	0.3	0.1	0.00	99.95
Limnodriloides appendiculatus	0.0	0.0	0.3	0.0	0.1	0.00	99.95
Lucina pectinata	0.0	0.0	0.0	0.3	0.1	0.00	99.95
Lucinoma filosa	0.0	0.0	0.0	0.3	0.1	0.00	99.95
Luidia senegalensis	0.0	0.0	0.0	0.3	0.1	0.00	99.96
Lumbrineris	0.0	0.0	0.0	0.3	0.1	0.00	99.96
Lumbrineris sp. d	0.0	0.0	0.0	0.3	0.1	0.00	99.96
Lysianopsis alba	0.0	0.0	0.0	0.3	0.1	0.00	99.96
Macoma mitchelli	0.0	0.0	0.3	0.0	0.1	0.00	99.96
Magelona	0.0	0.0	0.0	0.3	0.1	0.00	99.96
Mediomastus californiensis	0.0	0.0	0.0	0.3	0.1	0.00	99.96
Melanella	0.0	0.0	0.0	0.3	0.1	0.00	99.96
Melita cf intermedia	0.0	0.3	0.0	0.0	0.1	0.00	99.96
Melita nitida complex	0.0	0.3	0.0	0.0	0.1	0.00	99.96
Monoculodes	0.0	0.0	0.3	0.0	0.1	0.00	99.97
Monoculodes sp. A	0.0	0.3	0.0	0.0	0.1	0.00	99.97
Myrophis punctatus	0.3	0.0	0.0	0.0	0.1	0.00	99.97
Mytilidae	0.3	0.0	0.0	0.0	0.1	0.00	99.97
Nephtys picta	0.0	0.0	0.0	0.3	0.1	0.00	99.97
Nereididae sp. juv	0.0	0.0	0.0	0.3	0.1	0.00	99.97
Nuculanidae	0.0	0.0	0.0	0.3	0.1	0.00	99.97
Olividae sp.	0.0	0.0	0.0	0.3	0.1	0.00	99.97
Ophichthidae	0.0	0.0	0.3	0.0	0.1	0.00	99.97
Owenia fusiformis	0.0	0.0	0.0	0.3	0.1	0.00	99.98
Owenia sp.a	0.0	0.0	0.0	0.3	0.1	0.00	99.98
Pagurus cf maclaughlinae	0.0	0.0	0.0	0.3	0.1	0.00	99.98
Pagurus spp	0.0	0.0	0.0	0.3	0.1	0.00	99.98
Palaemonetes sp	0.0	0.0	0.3	0.0	0.1	0.00	99.98
Palpomyia bezzia sp.	0.3	0.0	0.0	0.0	0.1	0.00	99.98
Parametopella	0.0	0.0	0.0	0.3	0.1	0.00	99.98
Pettiboneia duofurca	0.0	0.0	0.0	0.3	0.1	0.00	99.98
Pinnixa retinens	0.0	0.0	0.0	0.3	0.1	0.00	99.98
Poromya	0.0	0.0	0.0	0.3	0.1	0.00	99.98
Processa hemphilli	0.0	0.0	0.0	0.3	0.1	0.00	99.99
Rhepoxynius epistomus	0.0	0.0	0.0	0.3	0.1	0.00	99.99
Rocinela cf signata	0.3	0.0	0.0	0.0	0.1	0.00	99.99
Scoloplos	0.0	0.0	0.3	0.0	0.1	0.00	99.99
Sigambra wassi	0.0	0.0	0.0	0.3	0.1	0.00	99.99

Species	Zone / Station				Mean		
	2	3		4			
	2	4	5	6	(n m^{-2})	(%)	(Cum. %)
Solenidae	0.0	0.0	0.0	0.3	0.1	0.00	99.99
Sphaeromatidae	0.0	0.0	0.0	0.3	0.1	0.00	99.99
Sphaerosyllis	0.0	0.0	0.0	0.3	0.1	0.00	99.99
Sphaerosyllis taylori	0.0	0.0	0.0	0.3	0.1	0.00	99.99
Stenothoe gallensis	0.0	0.0	0.0	0.3	0.1	0.00	100.00
Stenothoidae	0.0	0.0	0.0	0.3	0.1	0.00	100.00
Thalassinidea	0.3	0.0	0.0	0.0	0.1	0.00	100.00
Typosyllis sp. C	0.0	0.0	0.0	0.3	0.1	0.00	100.00
Veneridae	0.0	0.0	0.0	0.3	0.1	0.00	100.00
Stenothoidae	0.0	0.0	0.0	0.3	0.1	0.00	100.00
Thalassinidea	0.3	0.0	0.0	0.0	0.1	0.00	100.00
Typosyllis sp. C	0.0	0.0	0.0	0.3	0.1	0.00	100.00
Total	5922.5	6414.2	4074.4	12497.4	7215.4	100.00	

APPENDIX 3: SALINITY ANOVAS

Two-way ANOVA: Zone and Period

Class Level Information		
Class	**Levels**	**Values**
Zone	4	1 2 3 4
Period	2	Dry Wet

Number of Observations Used	11494

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	1381523.906	197360.558	7302.12	<.0001
Error	11486	310441.848	27.028		
Corrected Total	11493	1691965.755			

R-Square	Coeff Var	Root MSE	Sal Mean
0.816520	37.33034	5.198831	13.92656

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Zone	3	1019068.320	339689.440	12568.1	<.0001
Period	1	50877.292	50877.292	1882.40	<.0001
Zone*Period	3	5601.547	1867.182	69.08	<.0001

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	Zone
A	29.3285	3284	4
B	17.5041	1642	3
C	6.4372	4926	2
D	2.0131	1642	1

Tukey Grouping	Mean	N	Period
A	15.4206	8295	Low Inlow
B	10.0526	3199	High Inflow

One-way ANOVA: Zone-Period

Class Level Information		
Class	**Levels**	**Values**
Zone-Inflow	8	1-Dry 1-Wet 2-Dry 2-Wet 3-Dry 3-Wet 4-Dry 4-Wet

Number of Observations Used	11494

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	1381523.906	197360.558	7302.12	<.0001
Error	11486	310441.848	27.028		
Corrected Total	11493	1691965.755			

R-Square	Coeff Var	Root MSE	Sal Mean
0.816520	37.33034	5.198831	13.92656

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Zone-Inflow	7	1381523.906	197360.558	7302.12	<.0001

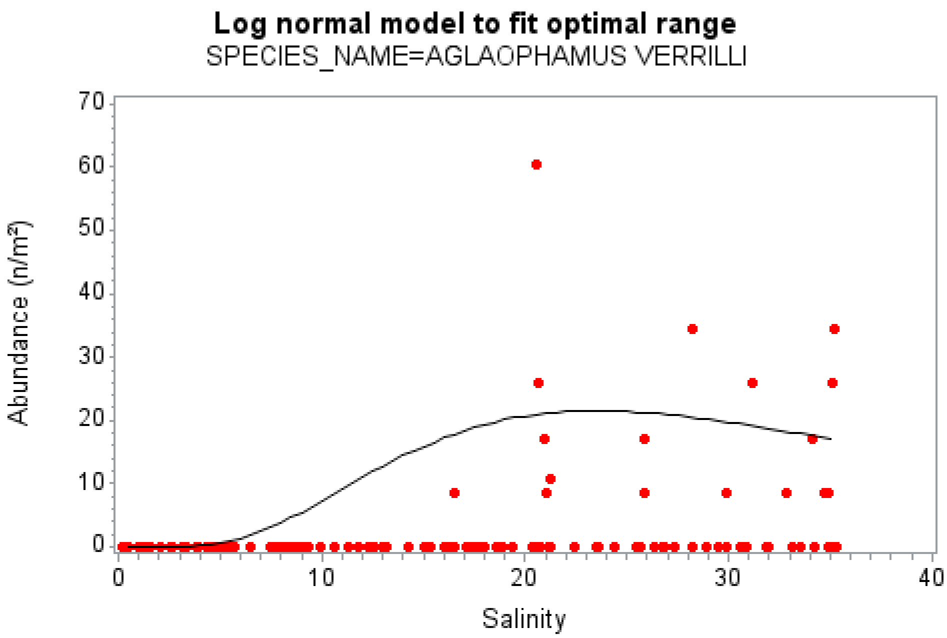
Means with the same letter are not significantly different.

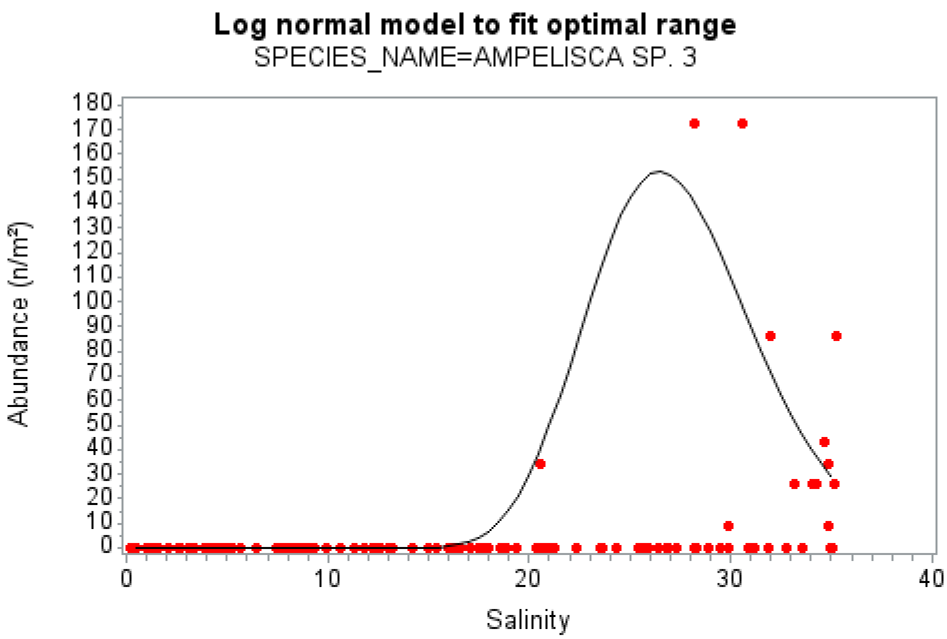
Tukey Grouping	Mean	N	ZonePd
A	30.9300	2370	4-Low
B	25.1758	914	4-High
C	19.6433	1185	3-Low
D	11.9571	457	3-High
E	7.9562	3555	2-Low
F	2.5720	1185	1-Low
F			
F	2.4986	1371	2-High
G	0.5637	457	1-High

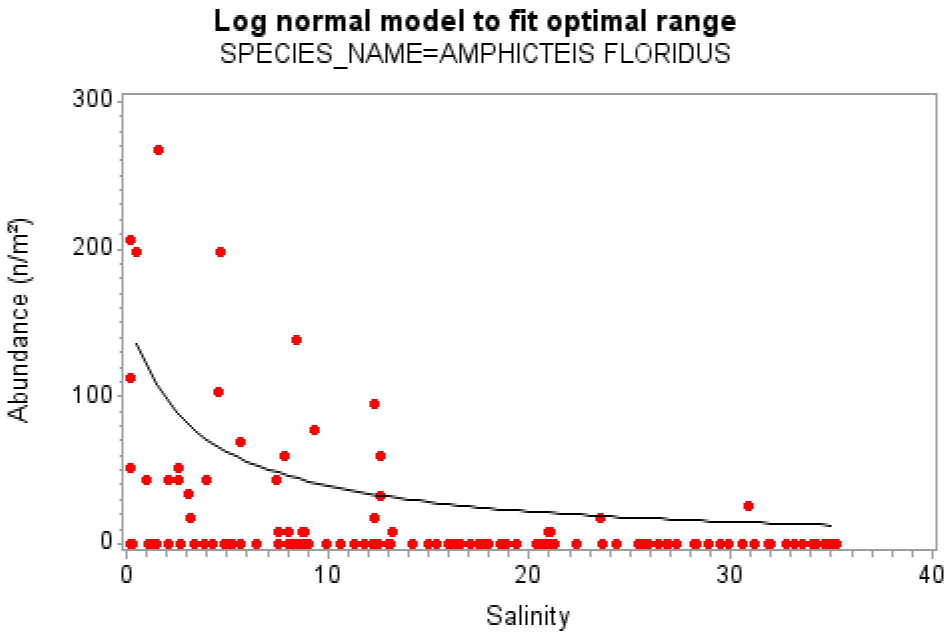
APPENDIX 4: REGRESSIONS OF SPECIES' ABUNDANCES WITH SALINITY

Species

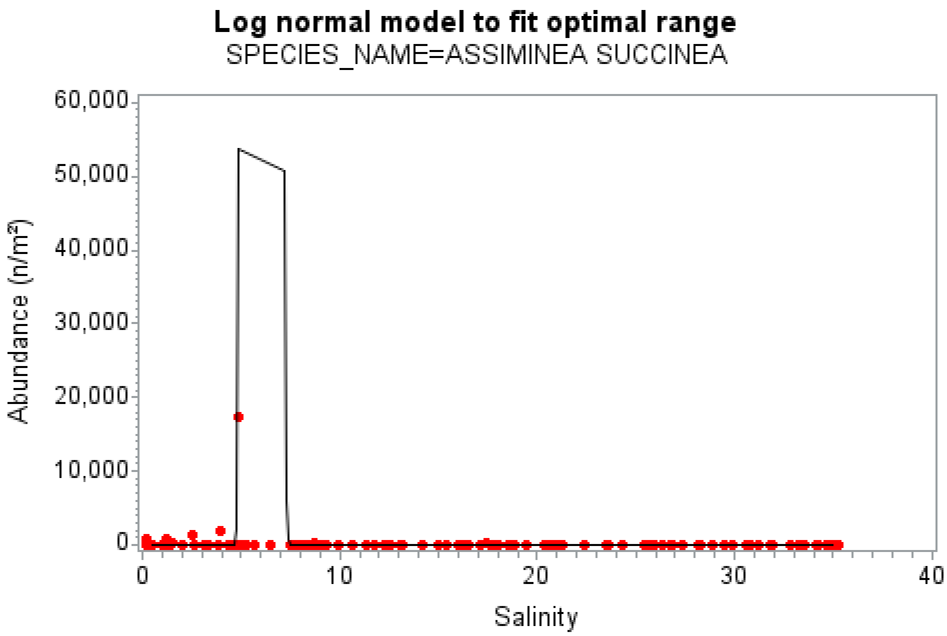
In alphabetical order.



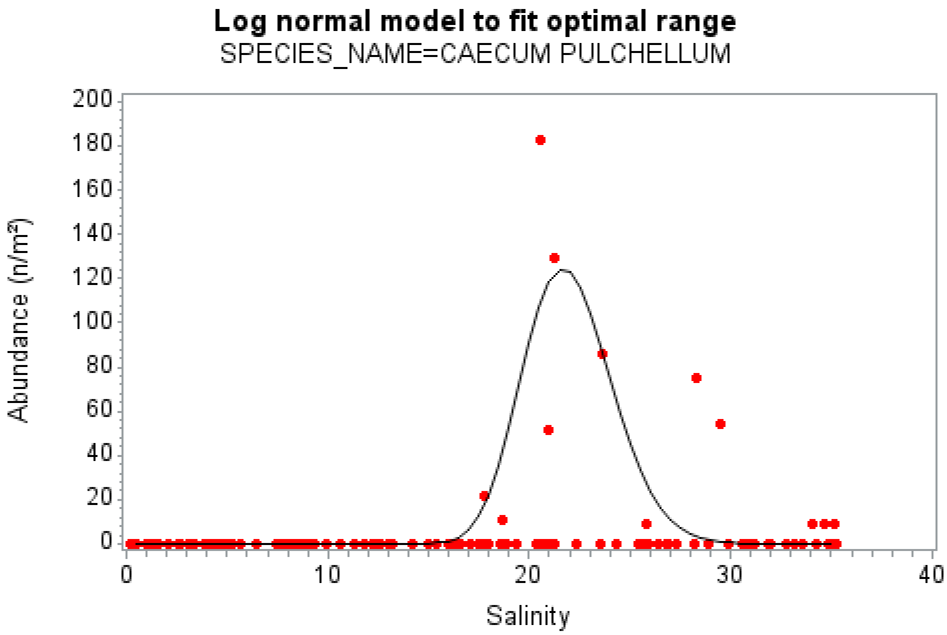


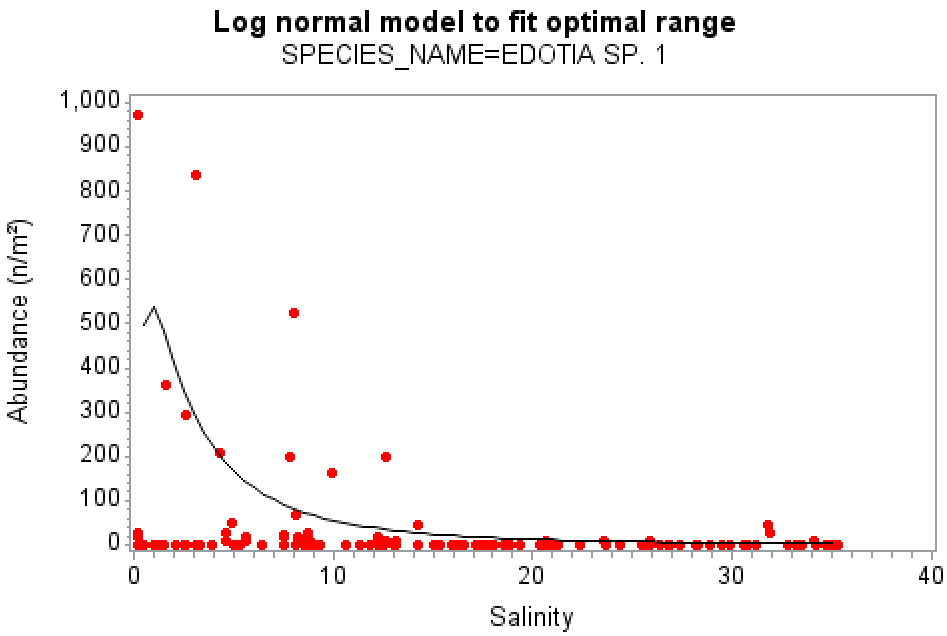


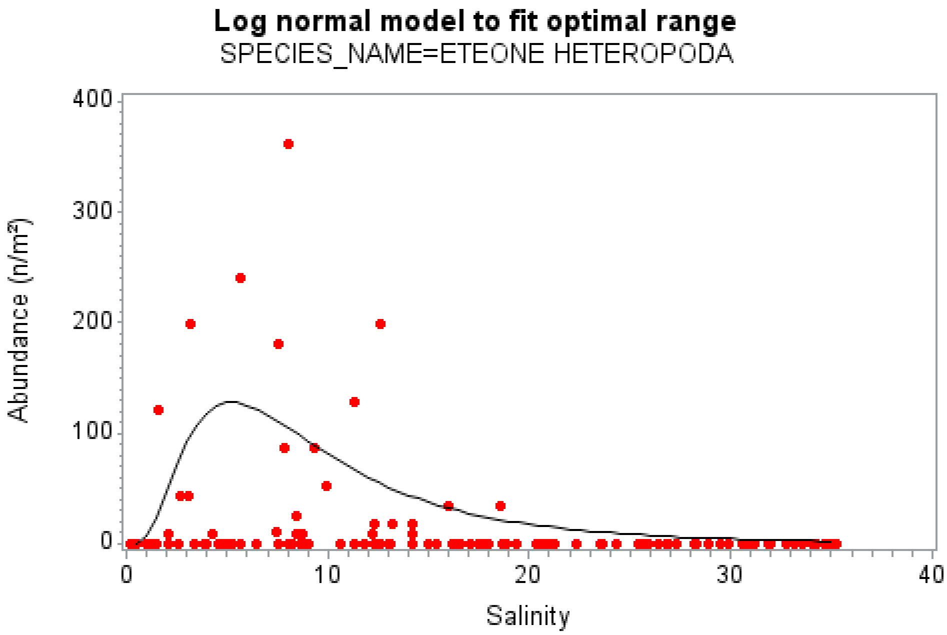
Log normal model to fit optimal range
SPECIES_NAME=AMPHICTEIS FLORIDUS
Abundance (n/m²)
300
200
100
0
0
10
20
30
40
Salinity

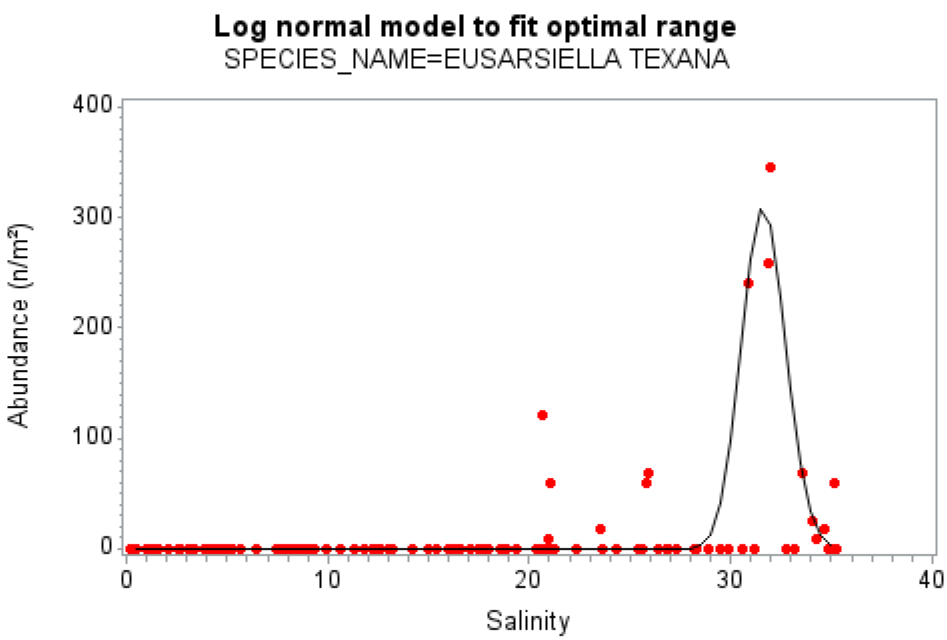


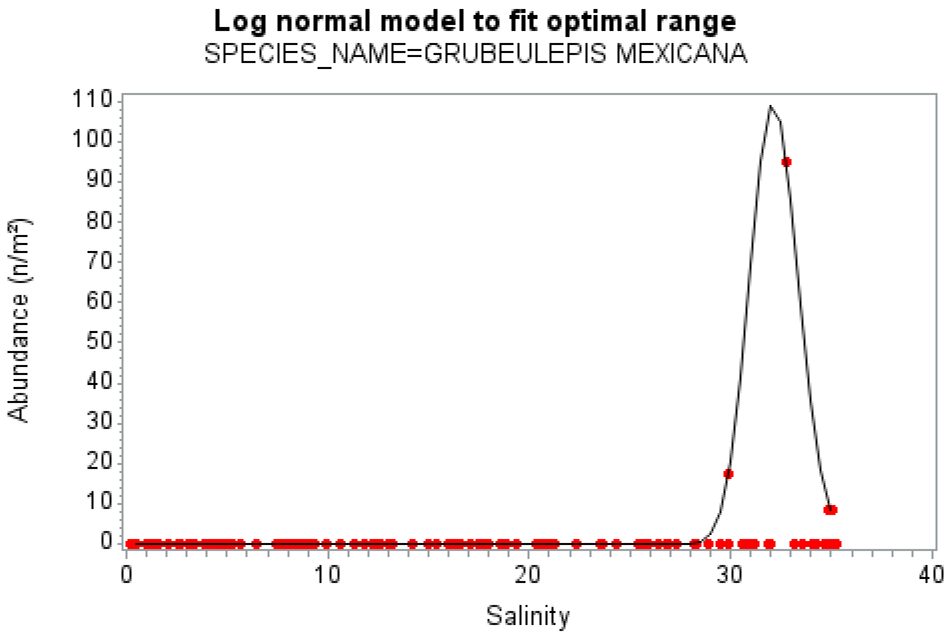
Log normal model to fit optimal range
SPECIES_NAME=ASSIMINEA SUCCINEA
Abundance (n/m²)
60,000
50,000
40,000
30,000
20,000
10,000
0
0
10
20
30
40
Salinity

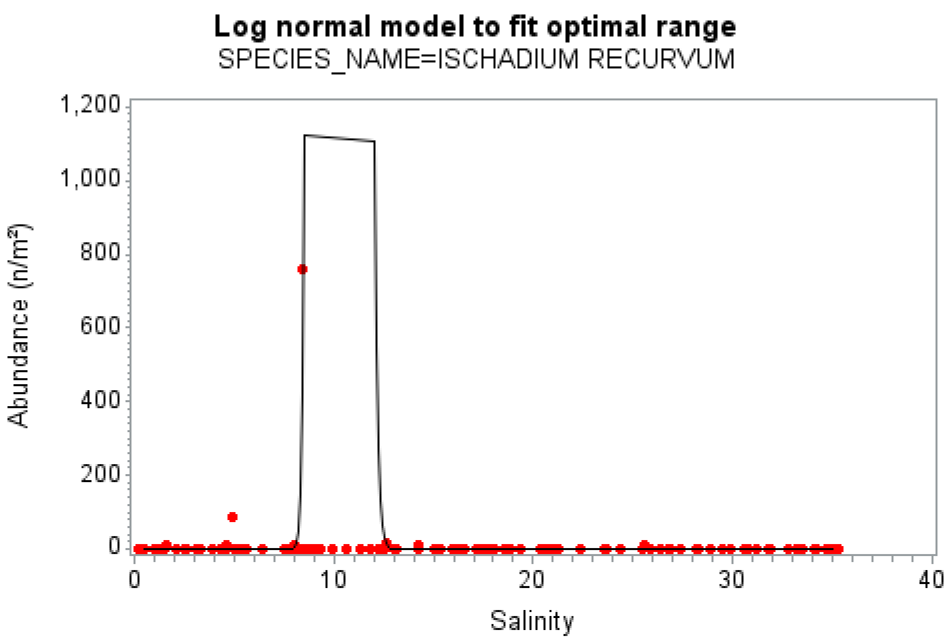

Log normal model to fit optimal range
SPECIES_NAME=CAECUM PULCHELLUM
Abundance (n/m²)
Salinity

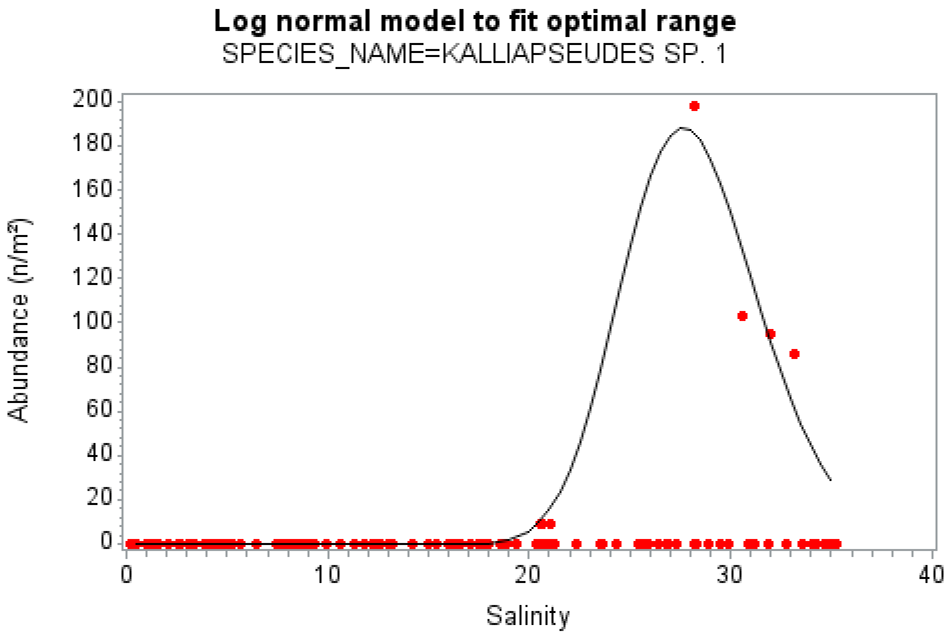

Log normal model to fit optimal range
SPECIES_NAME=EDOTIA SP. 1
Abundance (n/m²)
Salinity

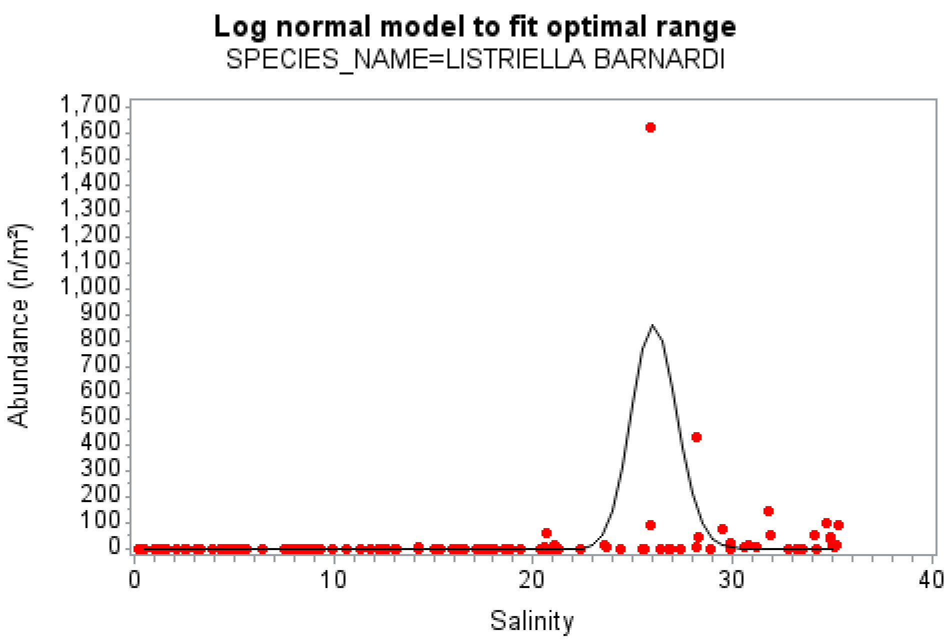

Log normal model to fit optimal range
SPECIES_NAME=ETEONE HETEROPODA
Abundance (n/m²)
400
300
200
100
0
0
10
20
30
40
Salinity

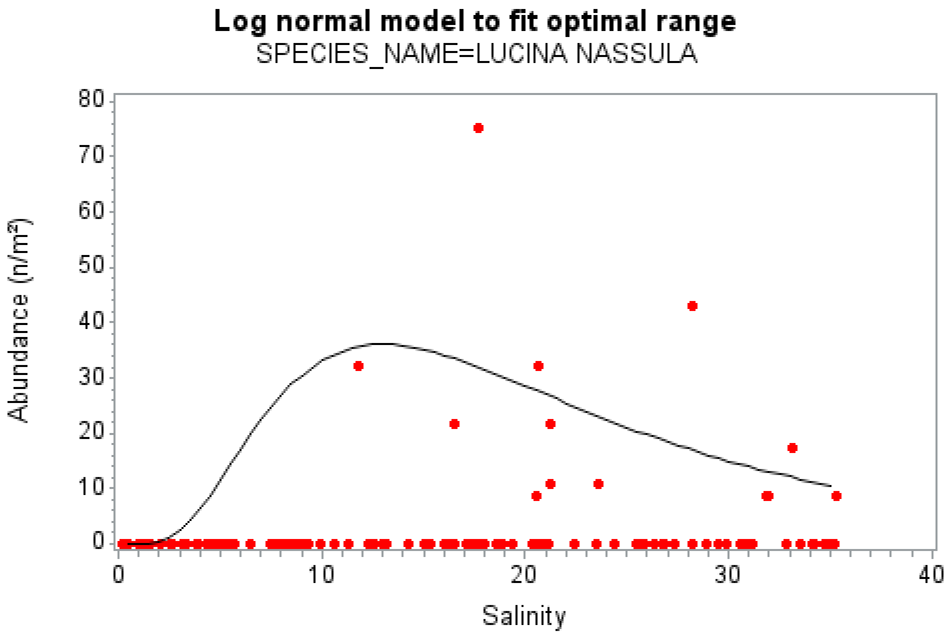

Log normal model to fit optimal range
SPECIES_NAME=EUSARSIELLA TEXANA
Abundance (n/m²)
400
300
200
100
0
0
10
20
30
40
Salinity

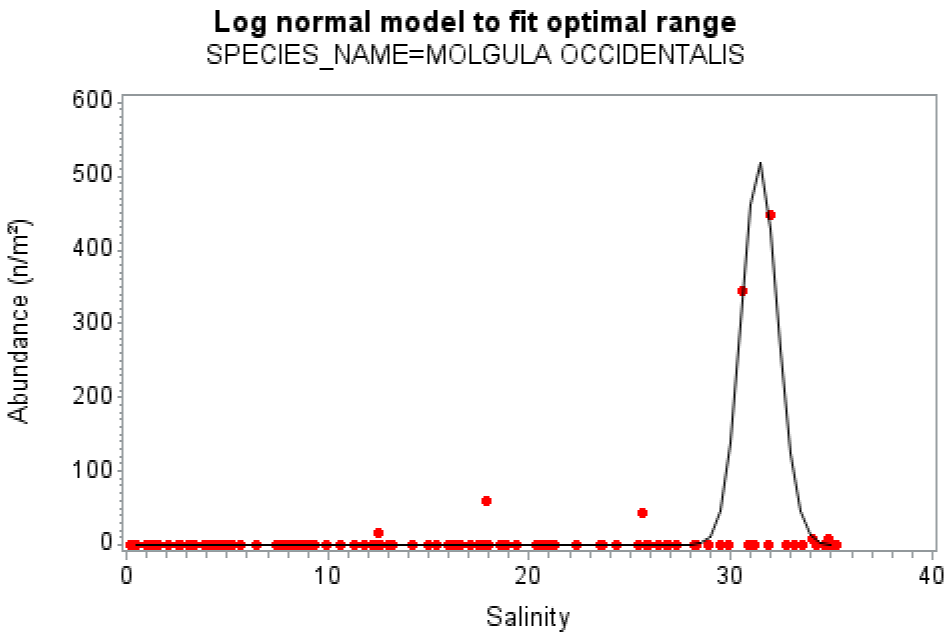

Log normal model to fit optimal range
SPECIES_NAME=GRUBEULEPIS MEXICANA
Abundance (n/m²)
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
Salinity

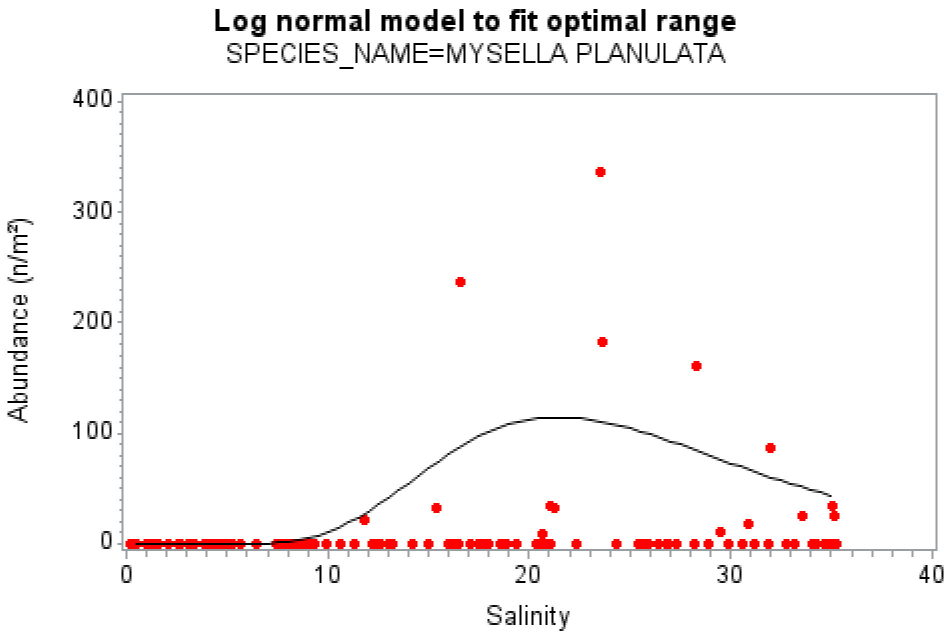

Log normal model to fit optimal range
SPECIES_NAME=ISCHADIUM RECURVUM
Abundance (n/m²)
1,200
1,000
800
600
400
200
0
0
10
20
30
40
Salinity


Log normal model to fit optimal range
SPECIES_NAME=KALLIAPSEUDES SP. 1
Abundance (n/m²)
0
20
40
60
80
100
120
140
160
180
200
0
10
20
30
40
Salinity

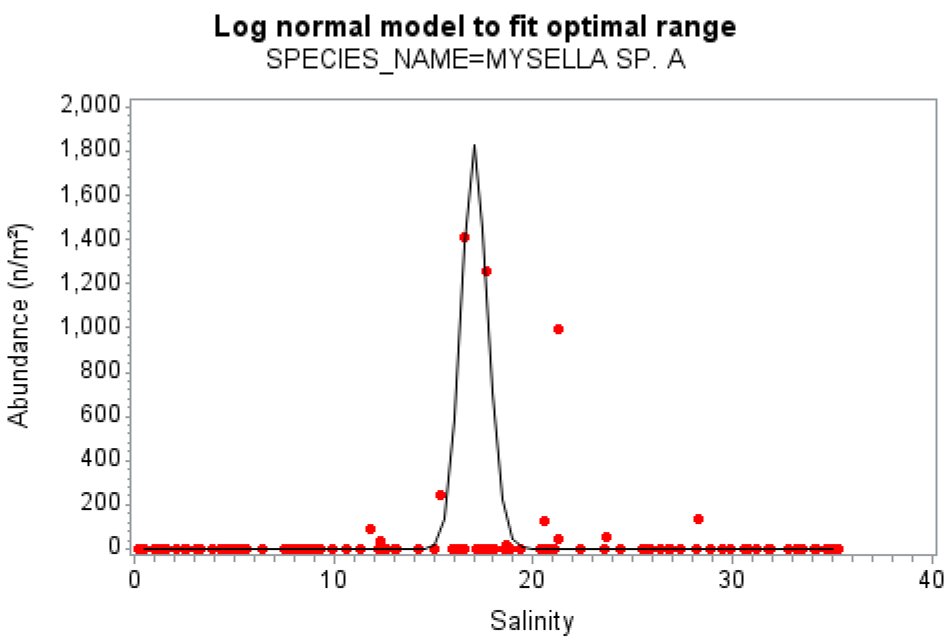

Log normal model to fit optimal range
SPECIES_NAME=LISTRIELLA BARNARDI
Abundance (n/m²)
0
100
200
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300
1,400
1,500
1,600
1,700
0
10
20
30
40
Salinity


Log normal model to fit optimal range
SPECIES_NAME=LUCINA NASSULA
Abundance (n/m²)
Salinity

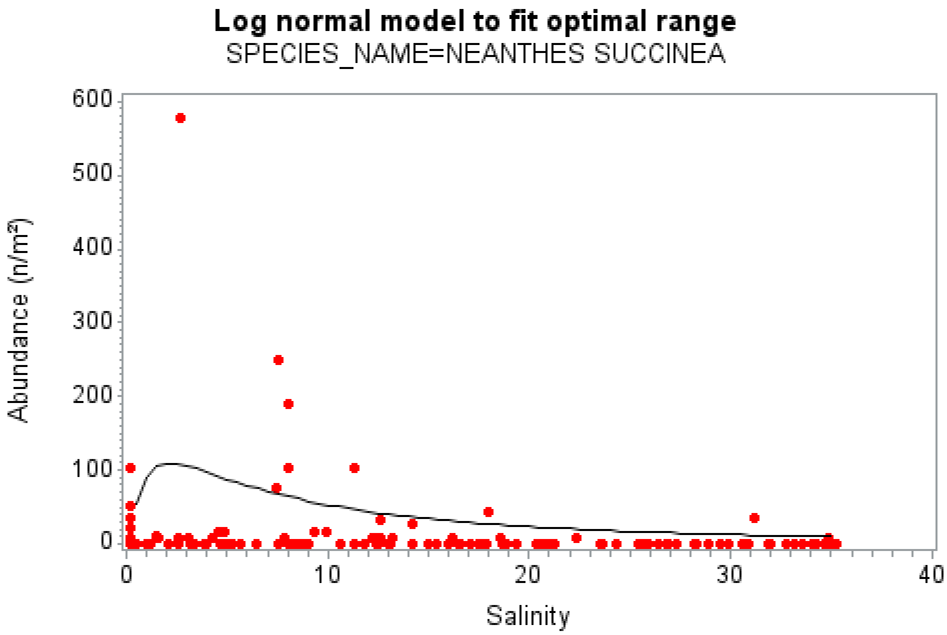

Log normal model to fit optimal range
SPECIES_NAME=MOLGULA OCCIDENTALIS
Abundance (n/m²)
Salinity

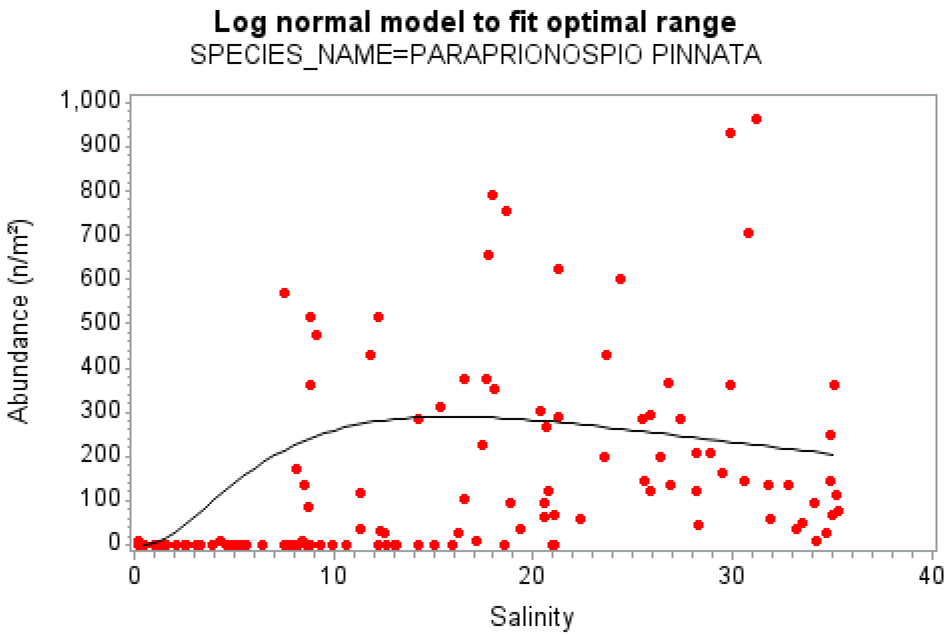


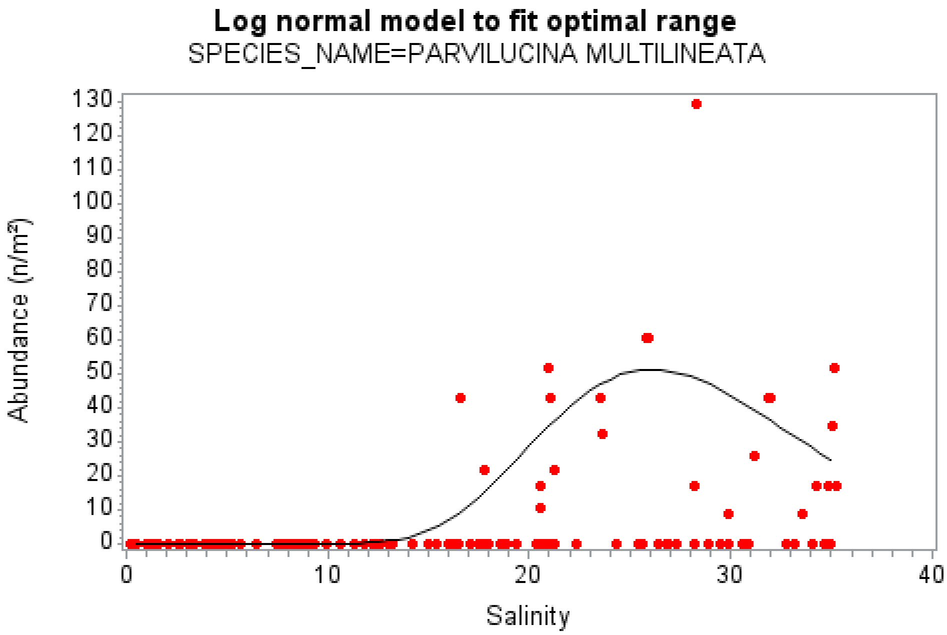
Log normal model to fit optimal range
SPECIES_NAME=MYSELLA PLANULATA
Abundance (n/m²)
400
300
200
100
0
0
10
20
30
40
Salinity

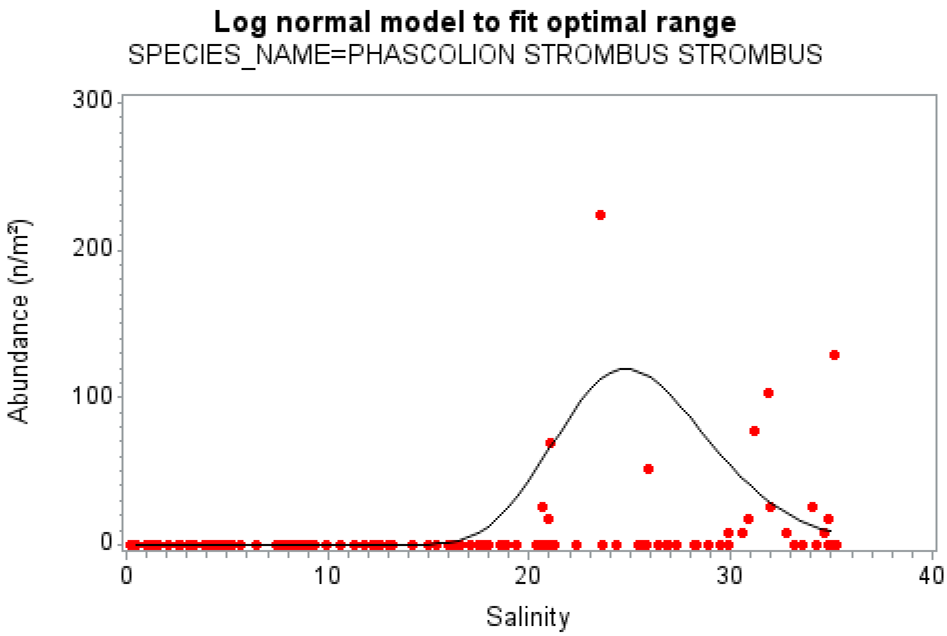


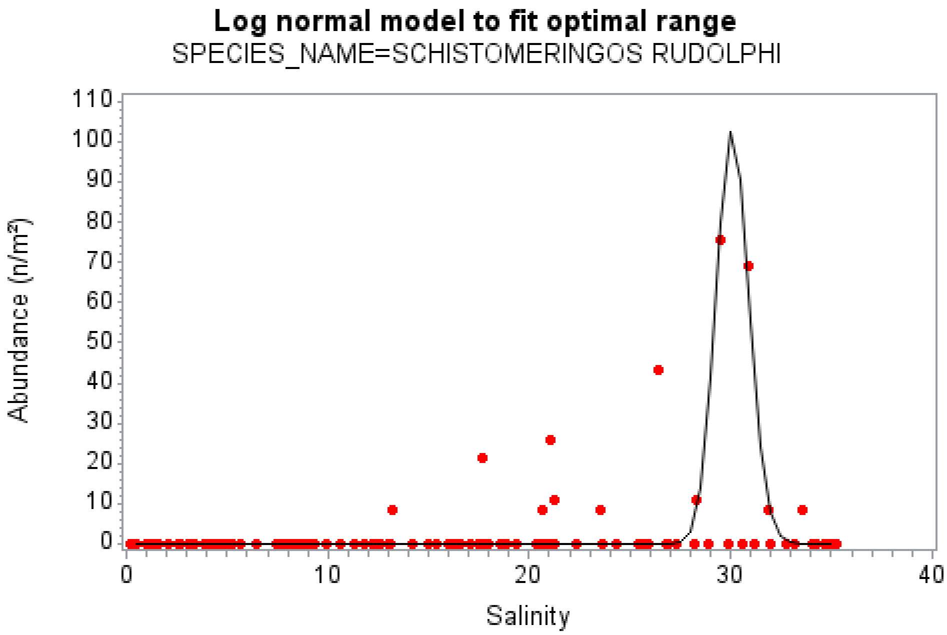
Log normal model to fit optimal range
SPECIES_NAME=MYSELLA SP. A
Abundance (n/m²)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
10
20
30
40
Salinity

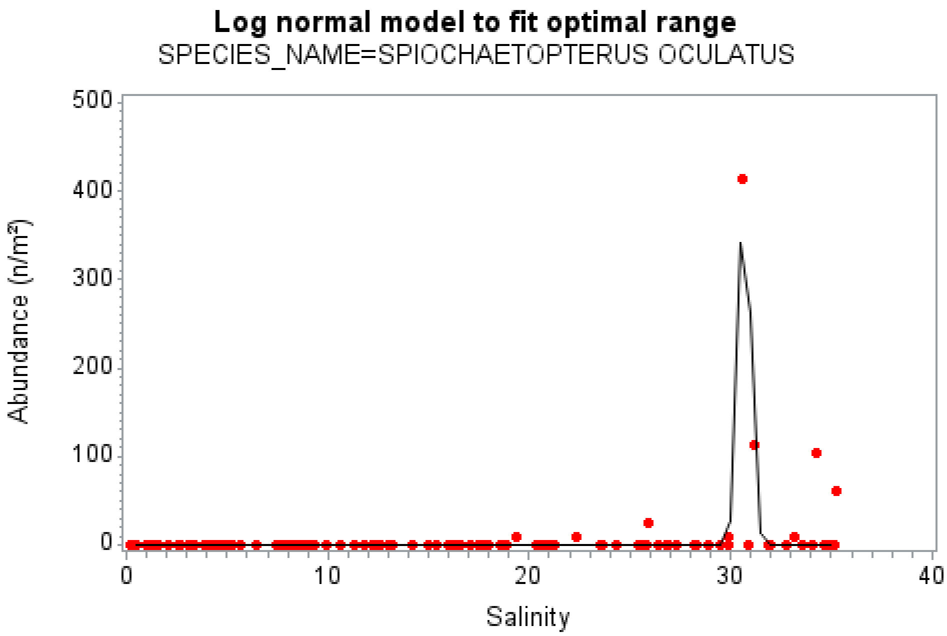

Log normal model to fit optimal range
SPECIES_NAME=NEANTHES SUCCINEA
Abundance (n/m²)
Salinity
0
100
200
300
400
500
600
10
20
30
40


Log normal model to fit optimal range
SPECIES_NAME=PARAPRIONOSPIO PINNATA
Abundance (n/m²)
Salinity
0
100
200
300
400
500
600
700
800
900
1,000
10
20
30
40


Log normal model to fit optimal range
SPECIES_NAME=PARVILUCINA MULTILINEATA
Abundance (n/m²)
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
Salinity

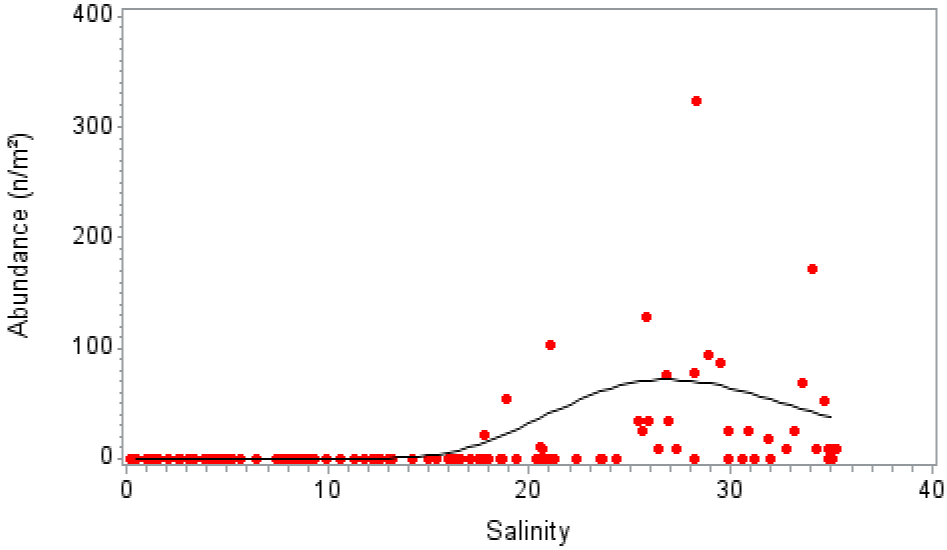

Log normal model to fit optimal range
SPECIES_NAME=PHASCOLION STROMBUS STROMBUS
Abundance (n/m²)
300
200
100
0
0
10
20
30
40
Salinity


Log normal model to fit optimal range
SPECIES_NAME=SCHISTOMERINGOS RUDOLPHI
Abundance (n/m²)
0
10
20
30
40
50
60
70
80
90
100
110
0
10
20
30
40
Salinity


Log normal model to fit optimal range
SPECIES_NAME=SPIOCHAETOPTERUS OCULATUS
Abundance (n/m²)
0
100
200
300
400
500
0
10
20
30
40
Salinity

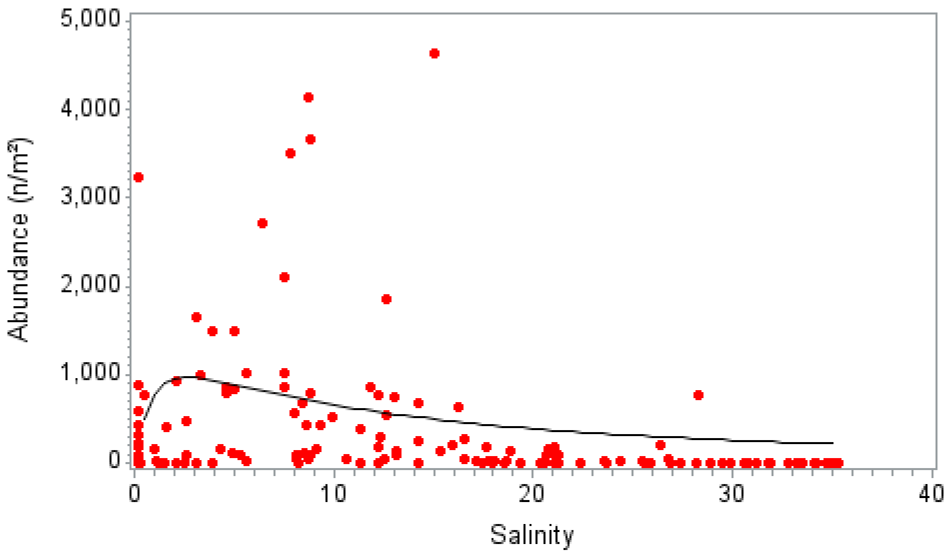
Log normal model to fit optimal range

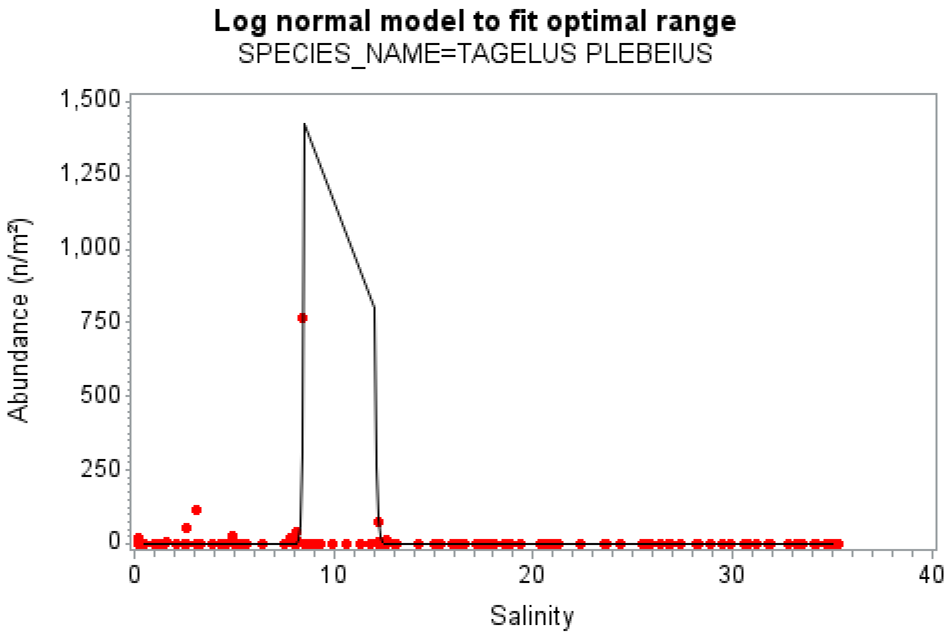
SPECIES_NAME=STHENELAIS SP. A

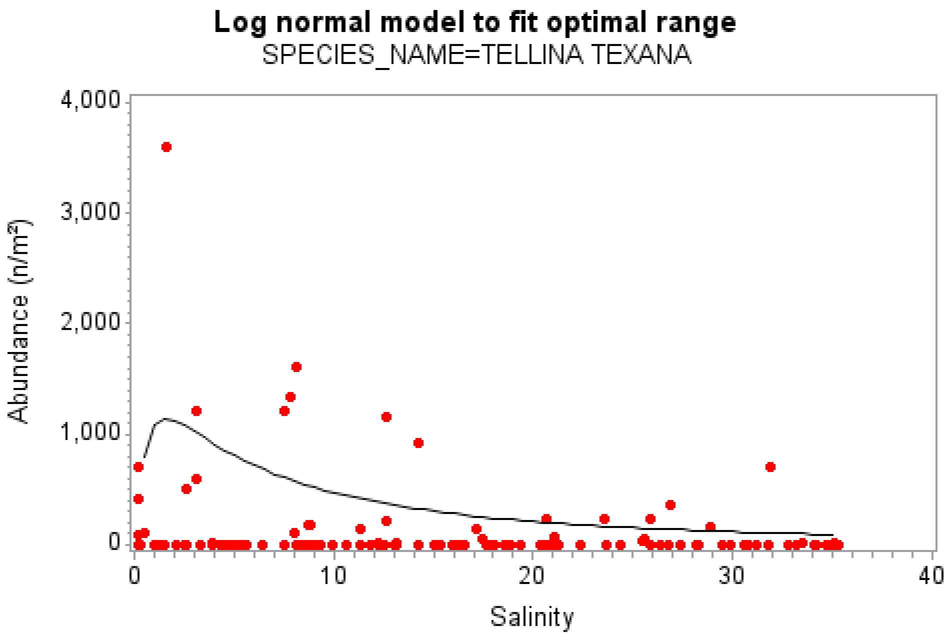


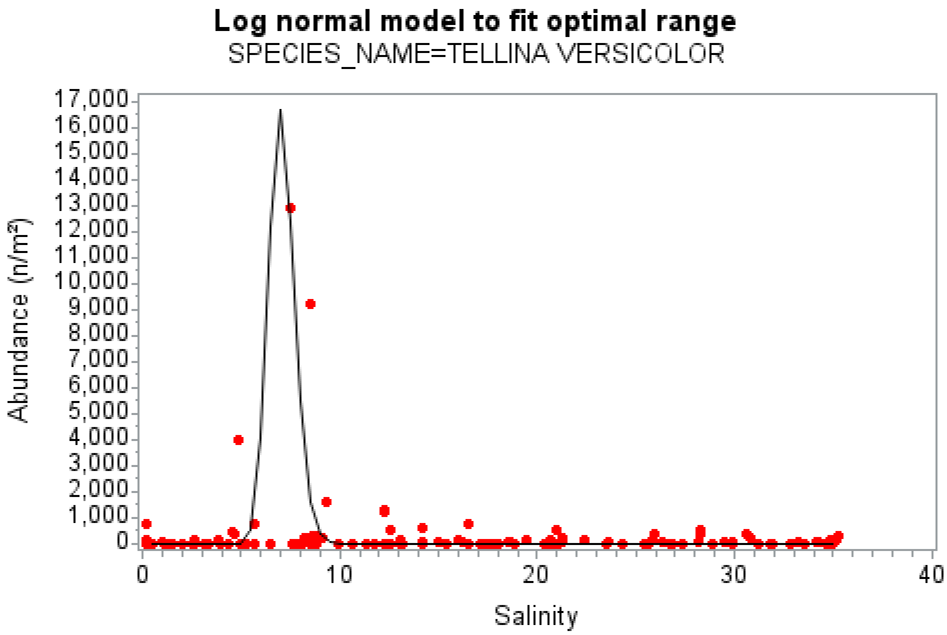
Log normal model to fit optimal range

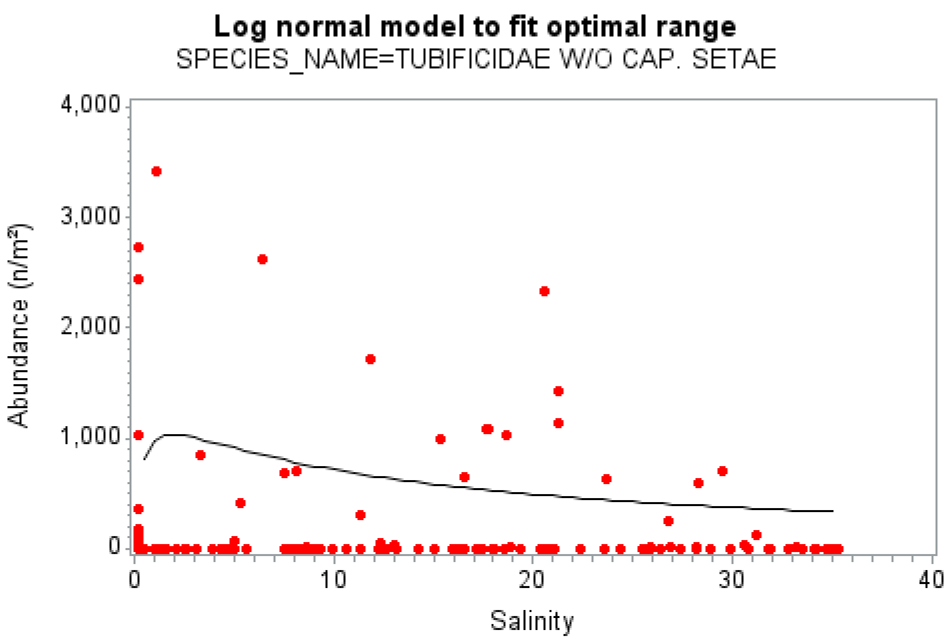
SPECIES_NAME=STREBLOSPIO BENEDICTI



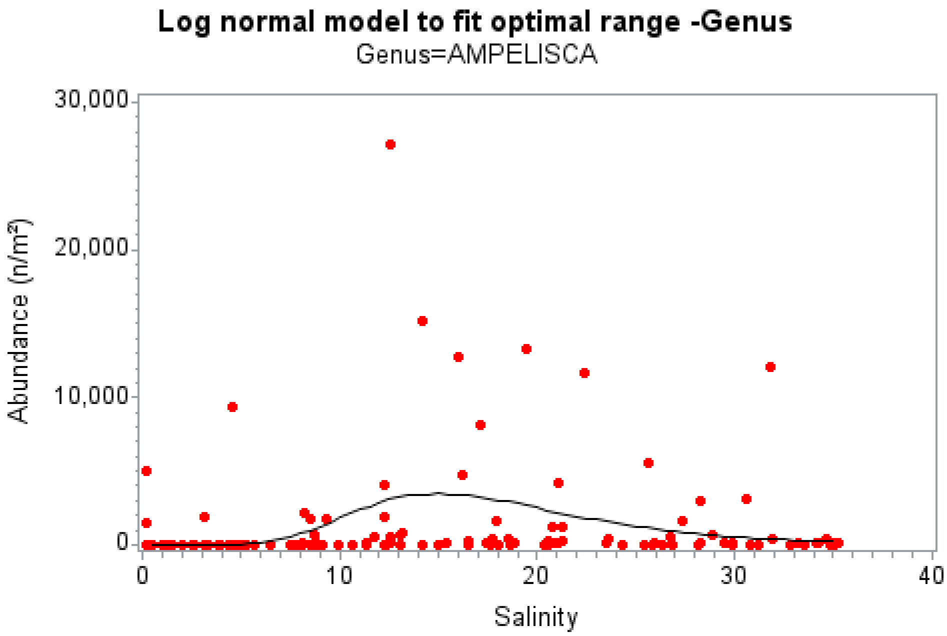

Log normal model to fit optimal range
SPECIES_NAME=TAGELUS PLEBEIUS
Abundance (n/m²)
1,500
1,250
1,000
750
500
250
0
0
10
20
30
40
Salinity

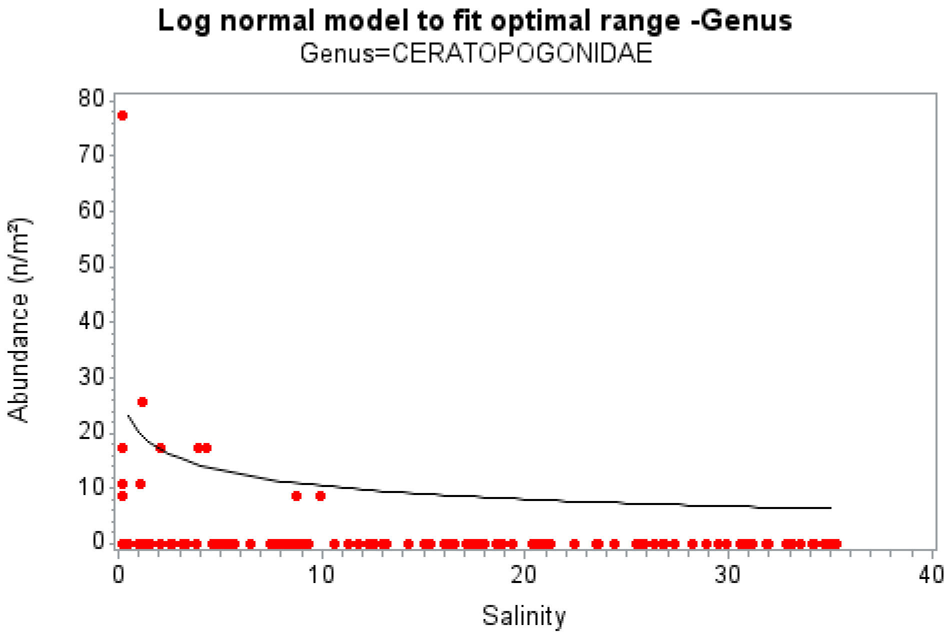

Log normal model to fit optimal range
SPECIES_NAME=TELLINA TEXANA
Abundance (n/m²)
4,000
3,000
2,000
1,000
0
0
10
20
30
40
Salinity

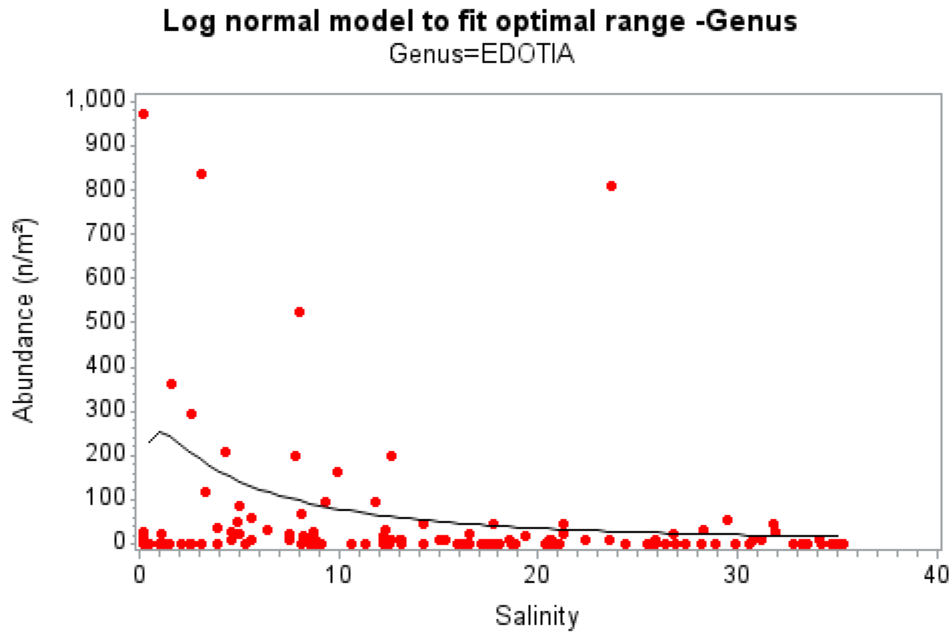

Log normal model to fit optimal range
SPECIES_NAME=TELLINA VERSICOLOR
Abundance (n/m²)
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0
10
20
30
40
Salinity

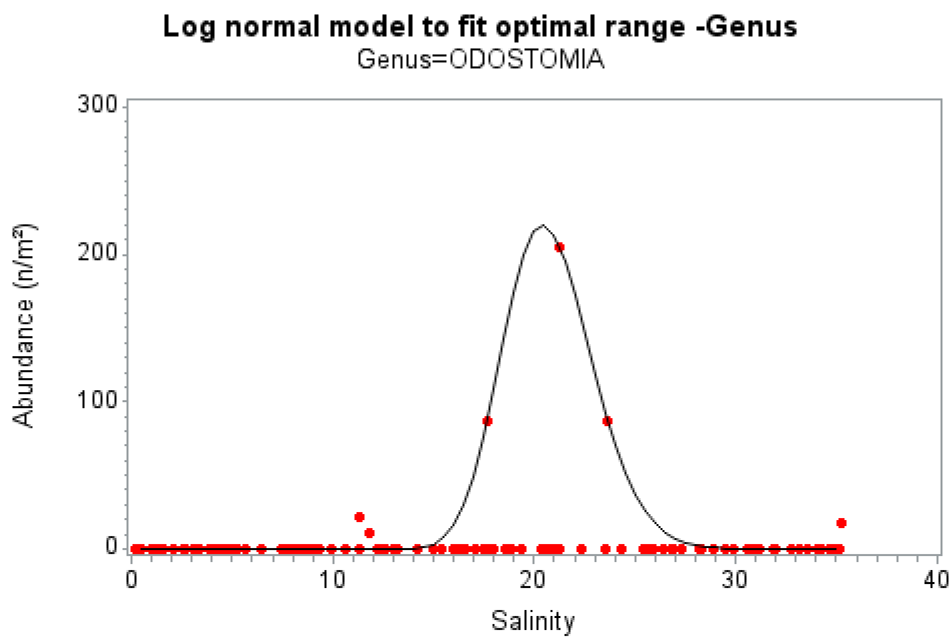

Log normal model to fit optimal range
SPECIES_NAME=TUBIFICIDAE W/O CAP. SETAE
Abundance (n/m²)
4,000
3,000
2,000
1,000
0
0
10
20
30
40
Salinity

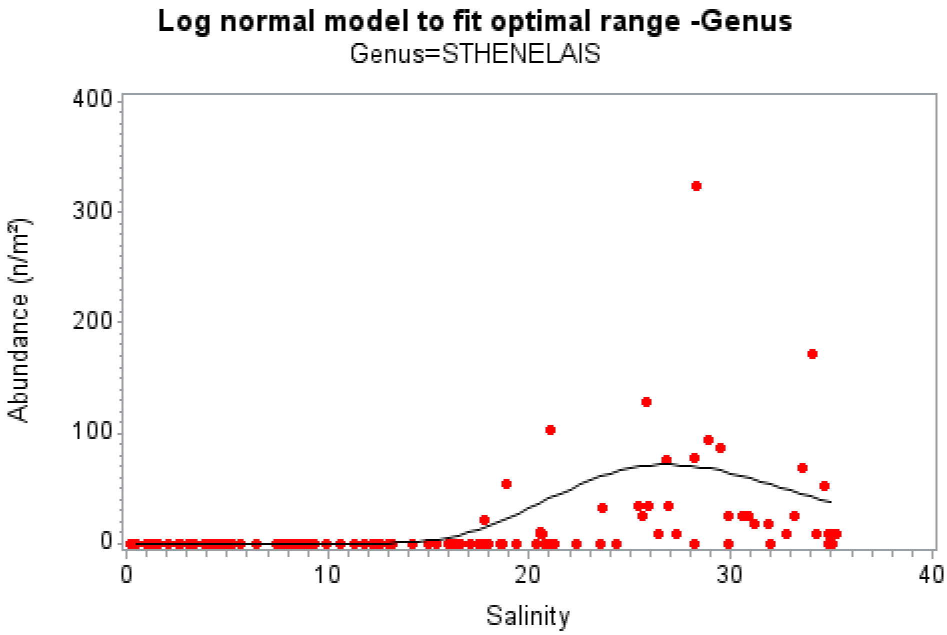
Genera and higher taxonomic resolution
In alphabetical order.

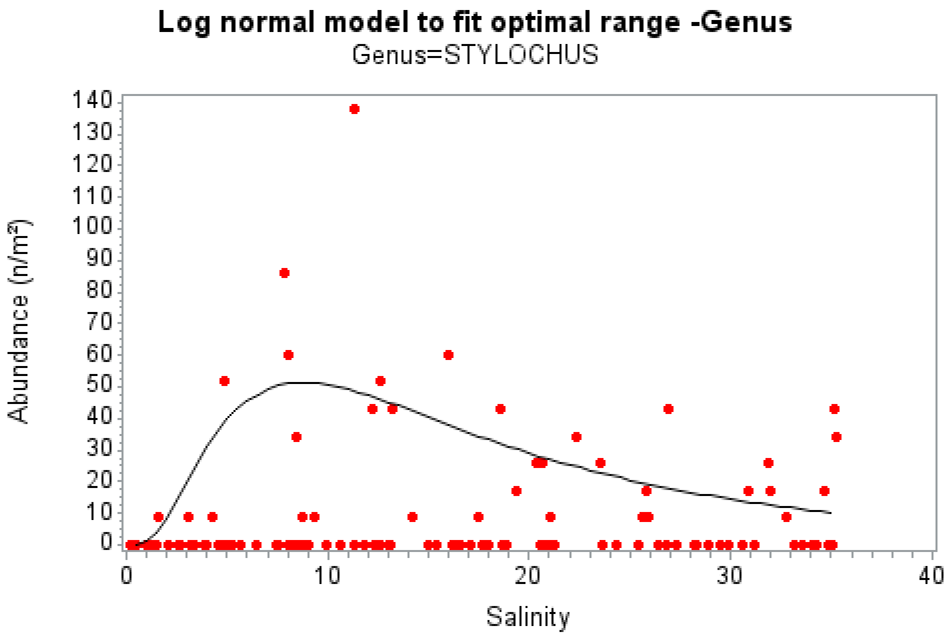





Log normal model to fit optimal range -Genus
Genus=EDOTIA
Abundance (n/m²)
1,000
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
Salinity


Log normal model to fit optimal range -Genus
Genus=ODOSTOMIA
Abundance (n/m²)
300
200
100
0
0
10
20
30
40
Salinity

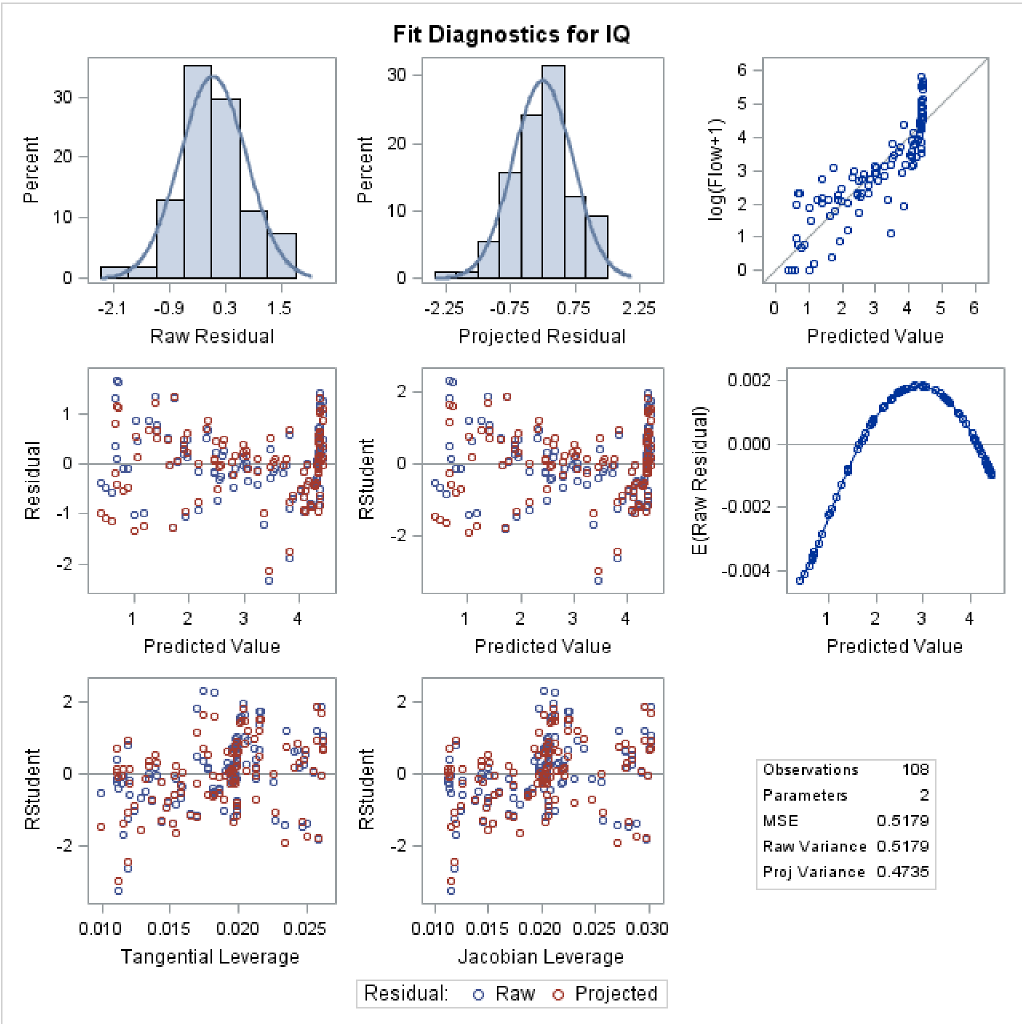

Log normal model to fit optimal range -Genus
Genus=STHENELAIS
Abundance (n/m²)
Salinity
0
100
200
300
400
0
10
20
30
40

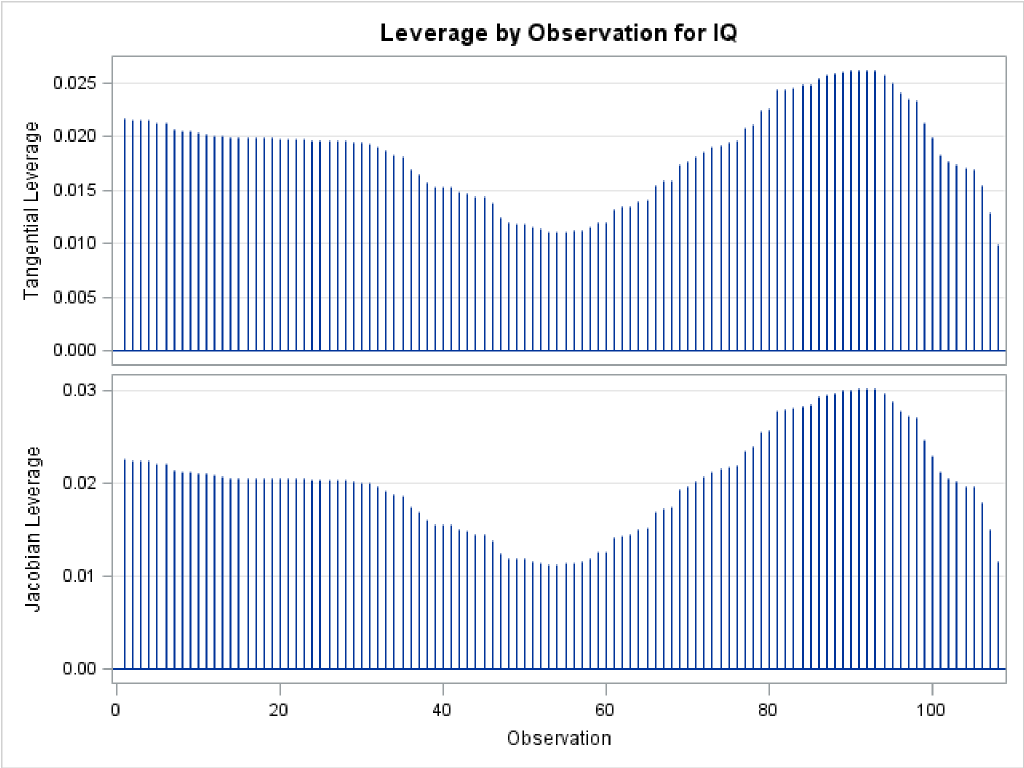

Log normal model to fit optimal range -Genus
Genus=STYLOCHUS
Abundance (n/m²)
Salinity
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
10
20
30
40

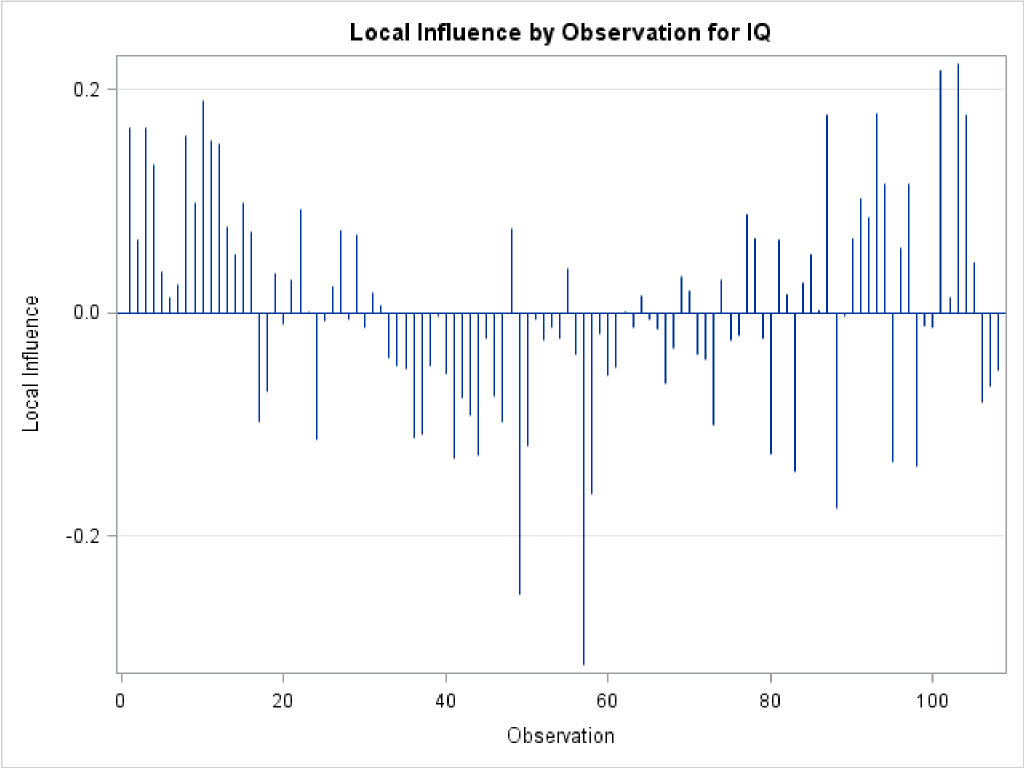
APPENDIX 5: SALINITY-FLOW REGRESSION

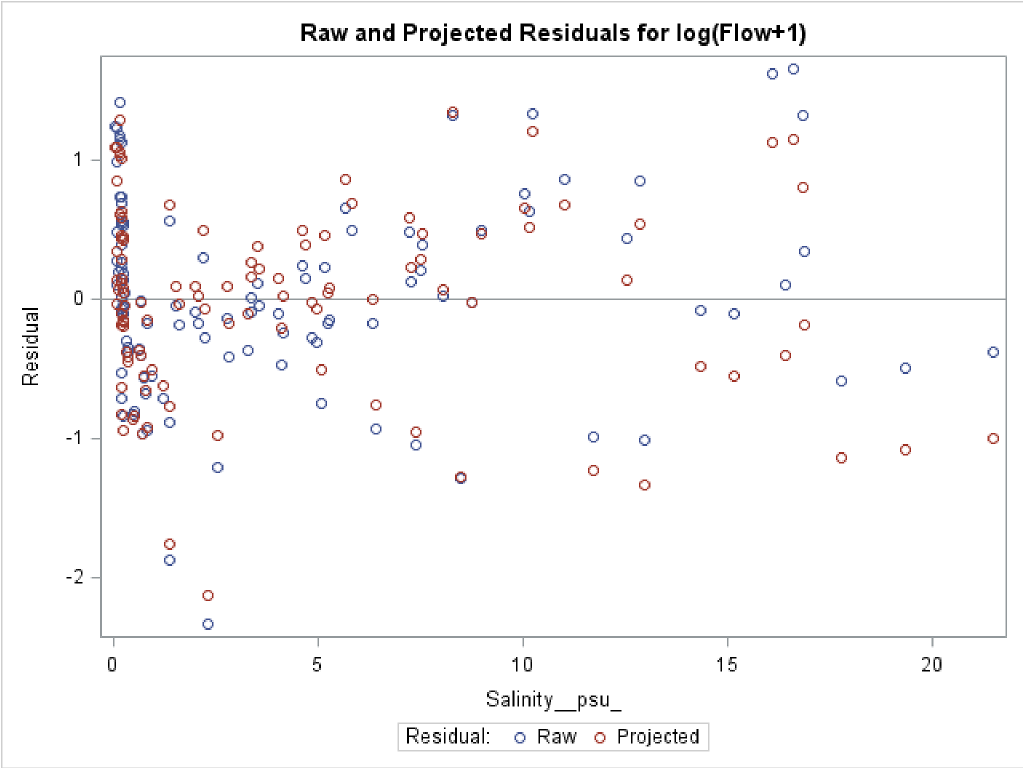
Bridge 31

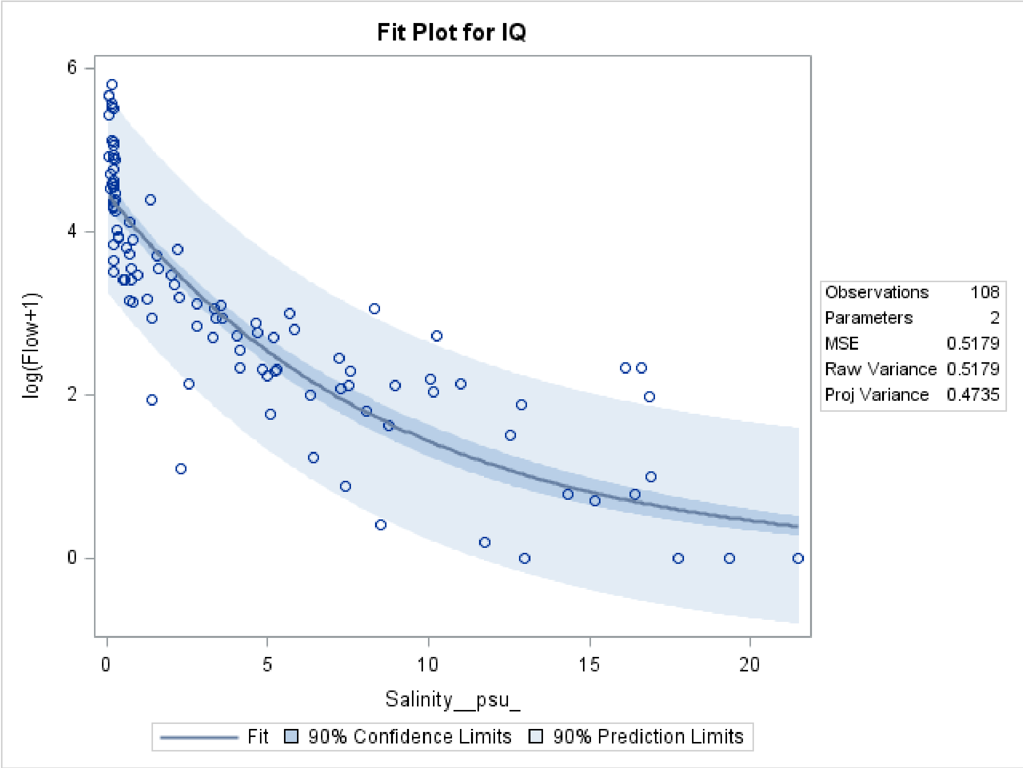
Model: $\log(Q+1) = ae^{-bS} = 4.4681\, e^{-0.1138S}$




Leverage by Observation for IQ
Tangential Leverage
0.025
0.020
0.015
0.010
0.005
0.000
Jacobian Leverage
0.03
0.02
0.01
0.00
0
20
40
60
80
100
Observation


Local Influence by Observation for IQ
Local Influence
0.2
0.0
-0.2
0
20
40
60
80
100
Observation


Raw and Projected Residuals for log(Flow+1)
Residual
Salinity__psu_
Residual: Raw Projected
1
0
-1
-2
0
5
10
15
20


Fit Plot for IQ
log(Flow+1)
Salinity__psu_
6
4
2
0
0
5
10
15
20
Observations 108
Parameters 2
MSE 0.5179
Raw Variance 0.5179
Proj Variance 0.4735
Fit 90% Confidence Limits 90% Prediction Limits

Estimation Summary	
Method	Gauss-Newton
Iterations	5
R	4.616E-6
PPC(b)	3.818E-6
RPC(b)	0.000027
Object	1.239E-9
Objective	54.89338
Observations Read	108
Observations Used	108
Observations Missing	0

Note: An intercept was not specified for this model.

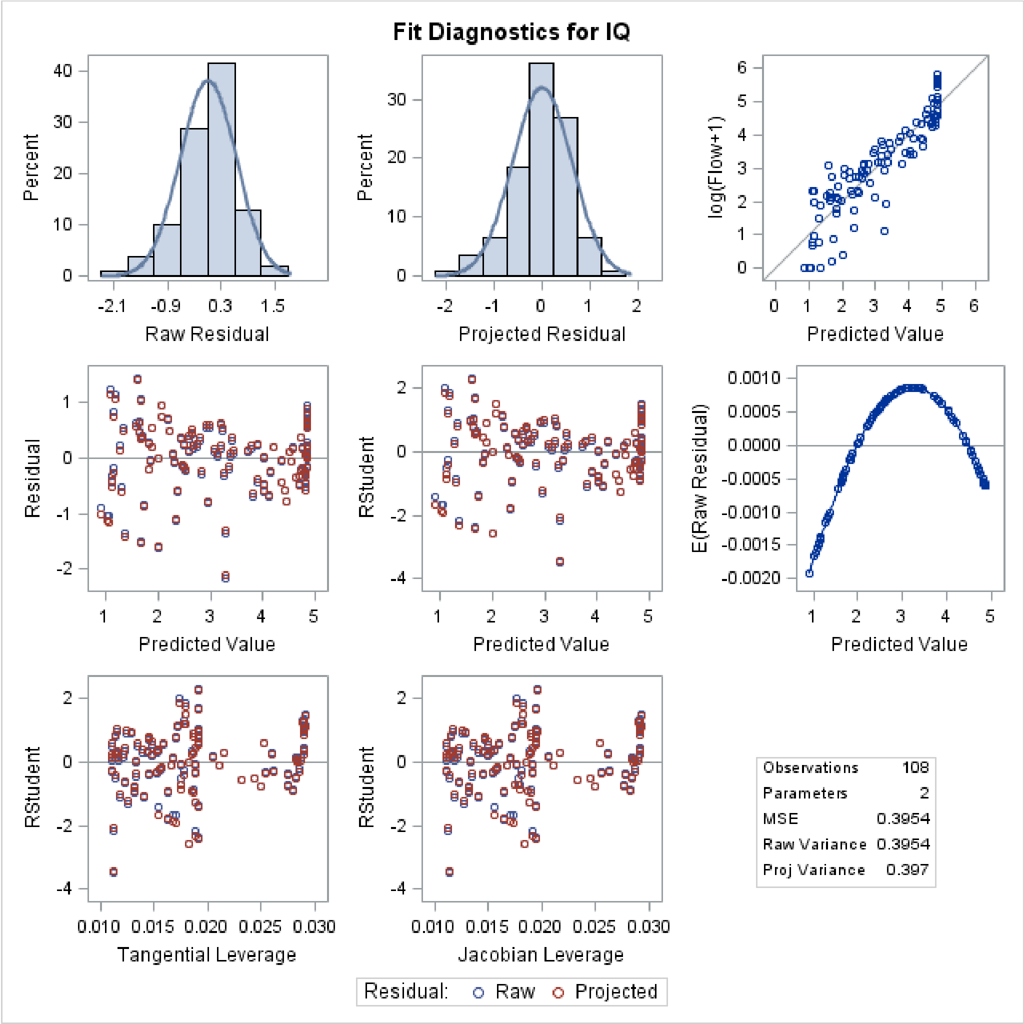
Source	DF	Sum of Squares	Mean Square	F Value	Approx Pr > F
Model	2	1226.9	613.4	1184.55	<.0001
Error	106	54.8934	0.5179		
Uncorrected Total	108	1281.8			

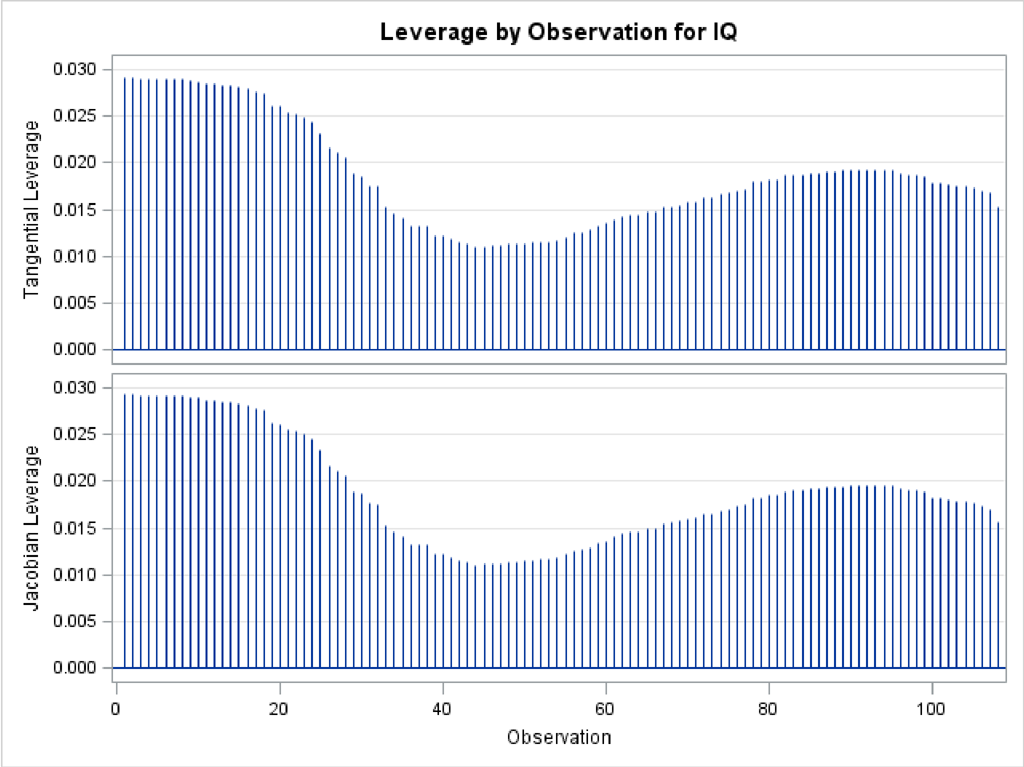
Parameter	Estimate	Approx Std Error	Approximate 90% Confidence Limits		Skewness	Bias	Percent Bias
a	4.4681	0.1078	4.2892	4.6471	0.0171	0.00112	0.025
b	0.1138	0.00914	0.0986	0.1290	0.1804	0.000275	0.24

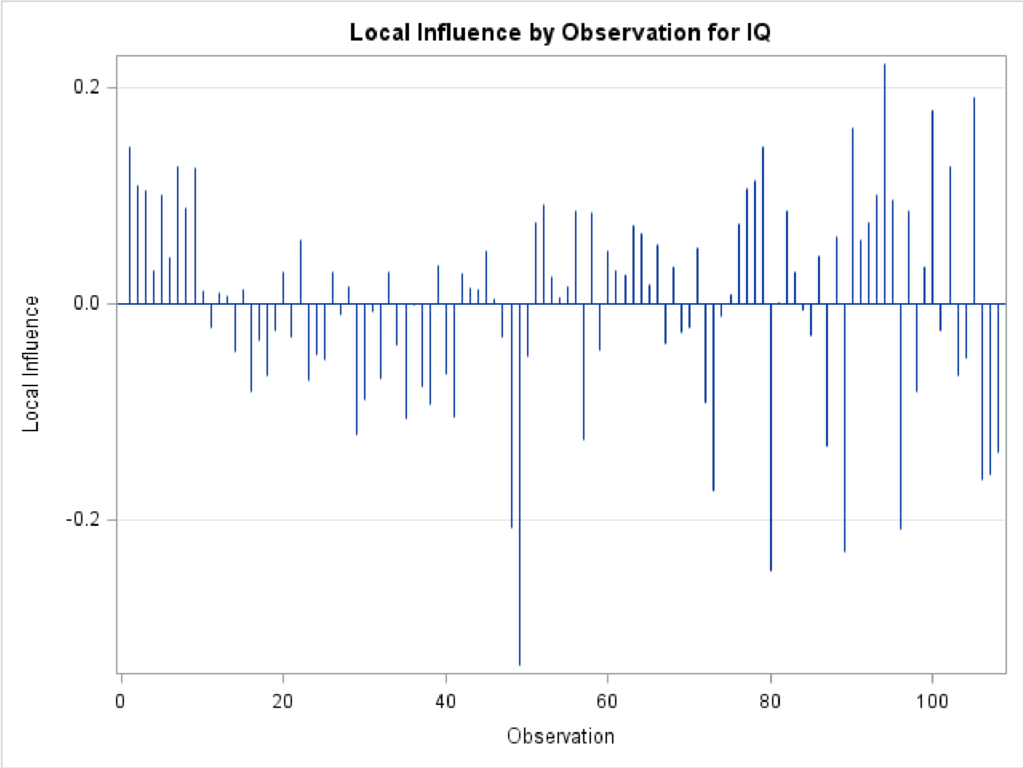
Approximate Correlation Matrix		
	a	**b**
a	1.0000000	0.5248941
b	0.5248941	1.0000000

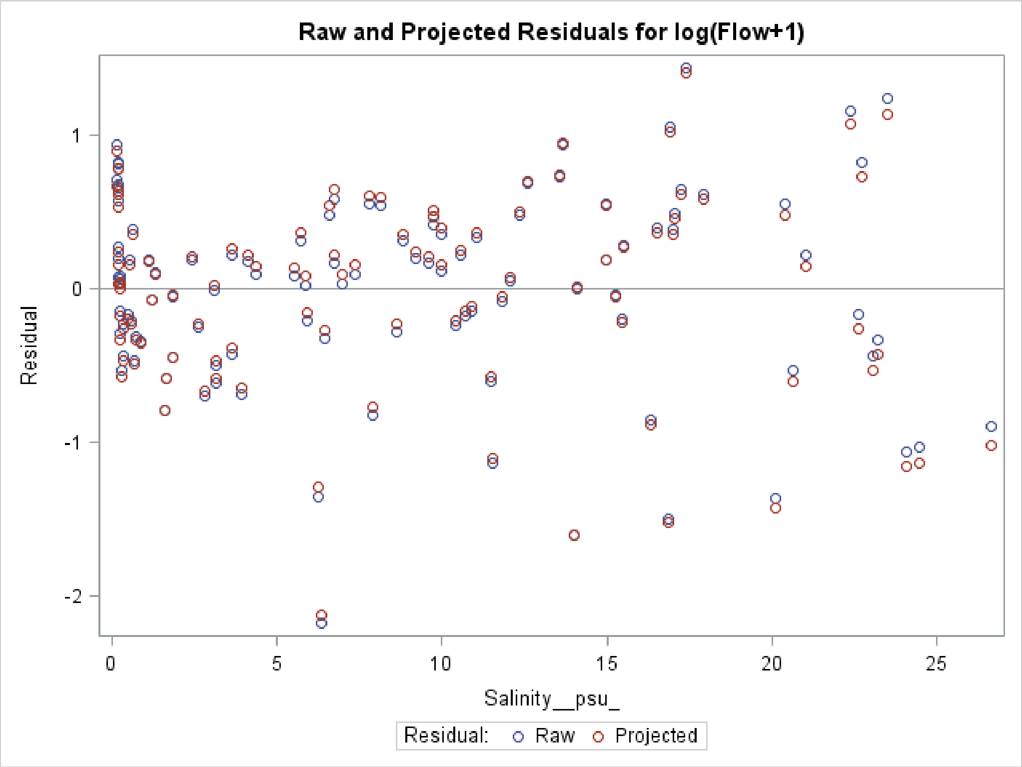
Fort Myers

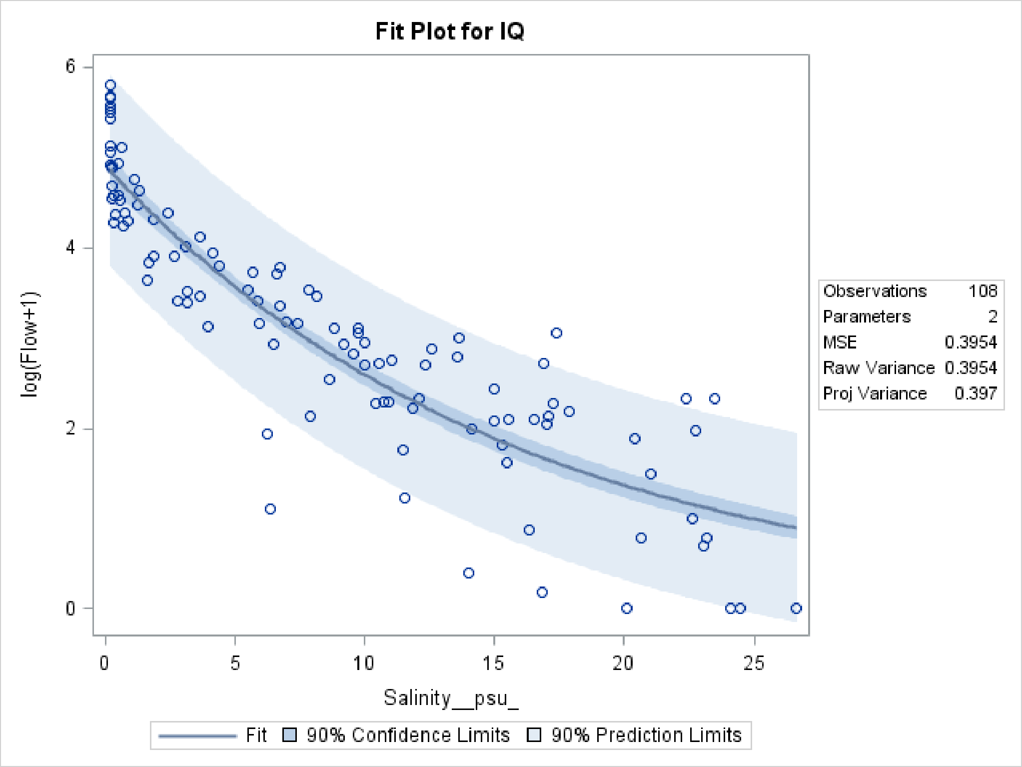
Model: $\log(Q+1) = ae^{-bS} = 4.9098\, e^{-0.0639S}$




Leverage by Observation for IQ
Tangential Leverage
Jacobian Leverage
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
20
40
60
80
100
Observation


Local Influence by Observation for IQ
Local Influence
0.2
0.0
-0.2
0
20
40
60
80
100
Observation


Raw and Projected Residuals for log(Flow+1)
Residual
Salinity__psu_
Residual: Raw Projected
1
0
-1
-2
0
5
10
15
20
25


Fit Plot for lQ
log(Flow+1)
Salinity__psu_
Observations 108
Parameters 2
MSE 0.3954
Raw Variance 0.3954
Proj Variance 0.397
Fit
90% Confidence Limits
90% Prediction Limits
6
4
2
0
0
5
10
15
20
25

Estimation Summary	
Method	Gauss-Newton
Iterations	4
R	5.725E-6
PPC(b)	3.419E-6
RPC(b)	0.000188
Object	1.017E-7
Objective	41.90914
Observations Read	108
Observations Used	108
Observations Missing	0

Note: An intercept was not specified for this model.

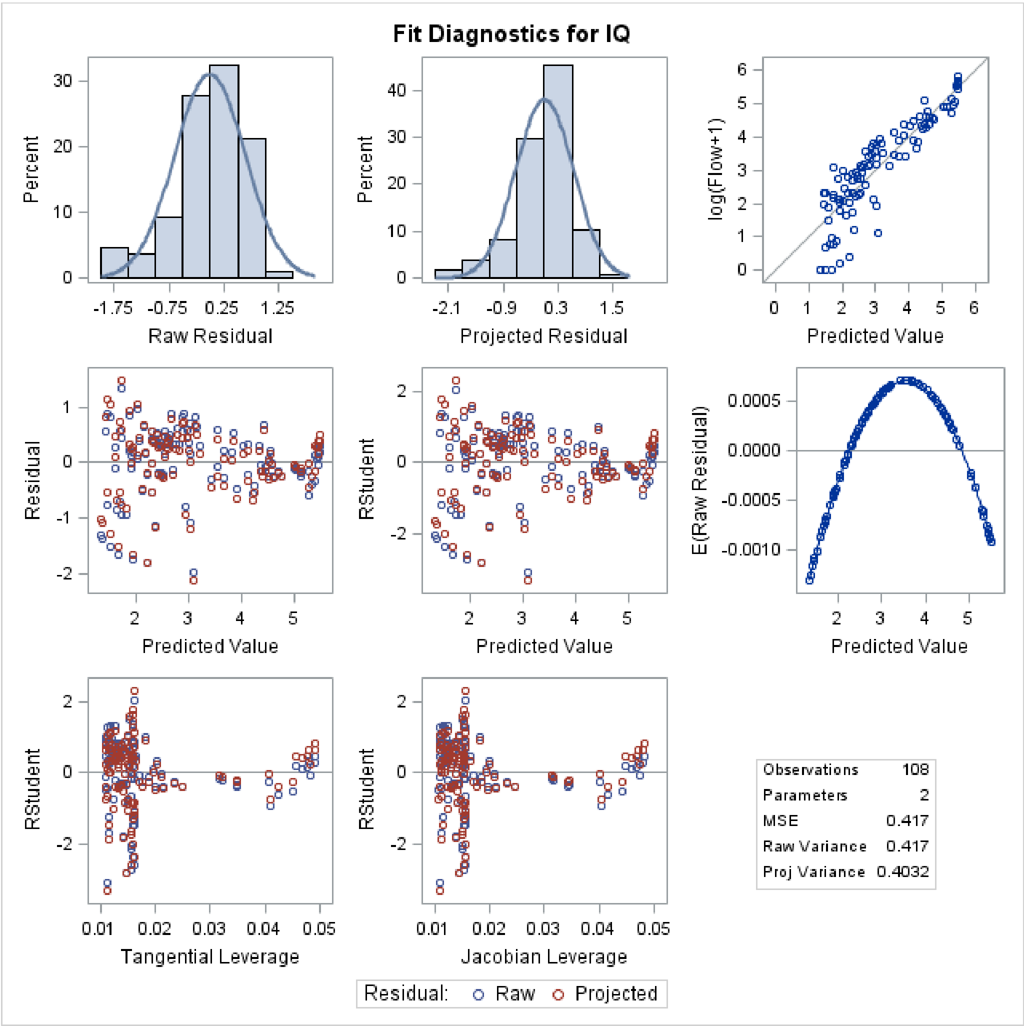
Source	DF	Sum of Squares	Mean Square	F Value	Approx Pr > F
Model	2	1239.9	619.9	1567.97	<.0001
Error	106	41.9091	0.3954		
Uncorrected Total	108	1281.8			

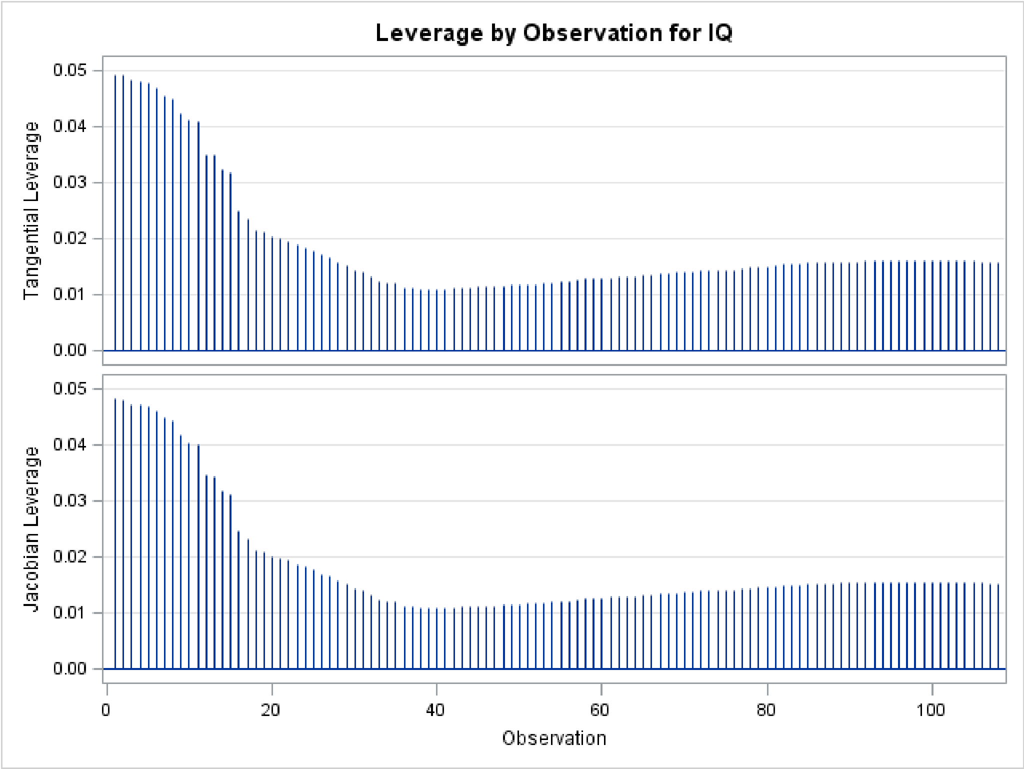
Parameter	Estimate	Approx Std Error	Approximate 90% Confidence Limits		Skewness	Bias	Percent Bias
a	4.9098	0.1102	4.7269	5.0927	0.0142	0.000708	0.014
b	0.0639	0.00370	0.0577	0.0700	0.0931	0.000057	0.090

Approximate Correlation Matrix		
	a	**b**
a	1.0000000	0.6060985
b	0.6060985	1.0000000

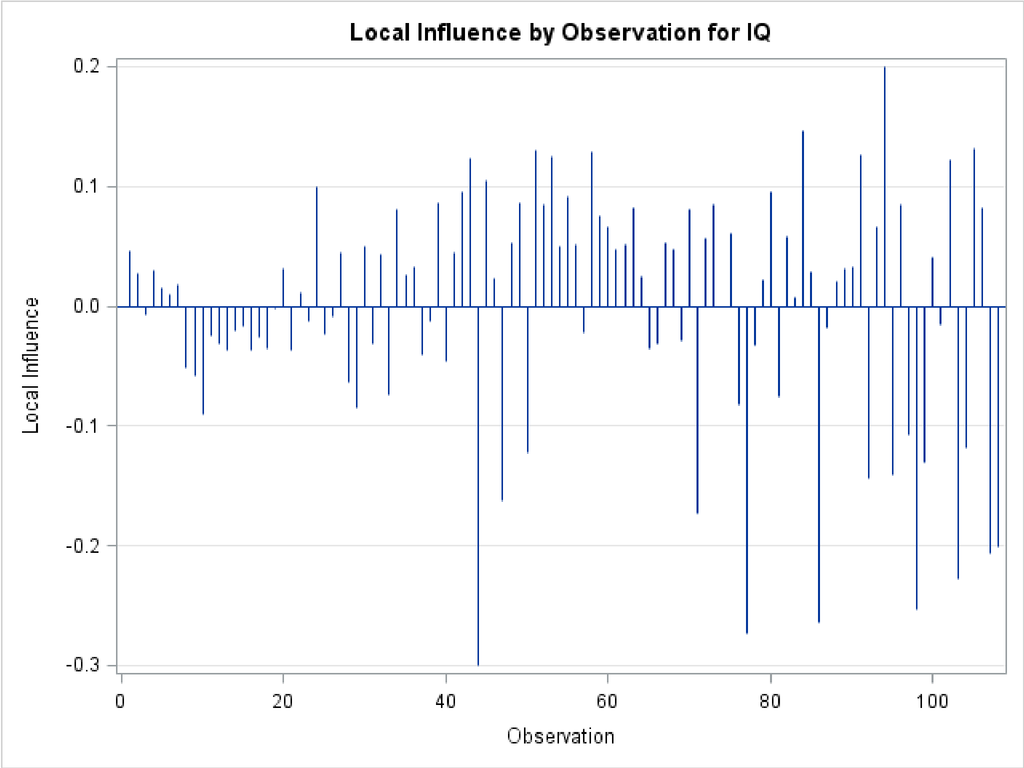
Shell Point

Model: $\log(Q+1) = ae^{-bS} = 5.5347\, e^{-0.0449S}$

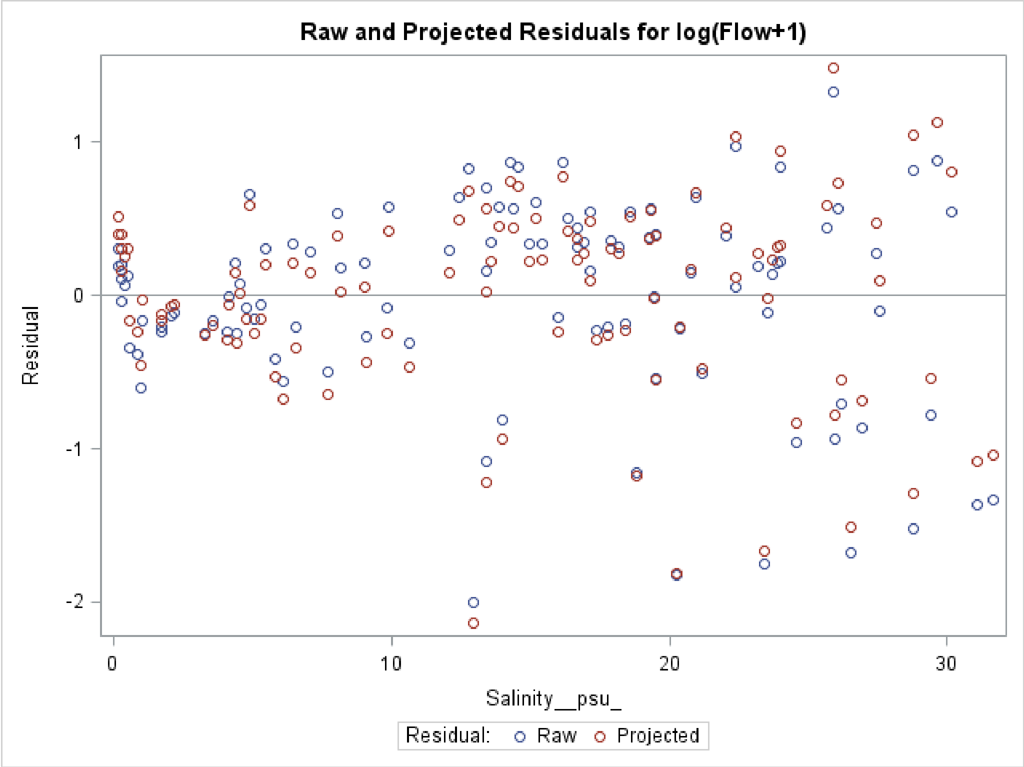


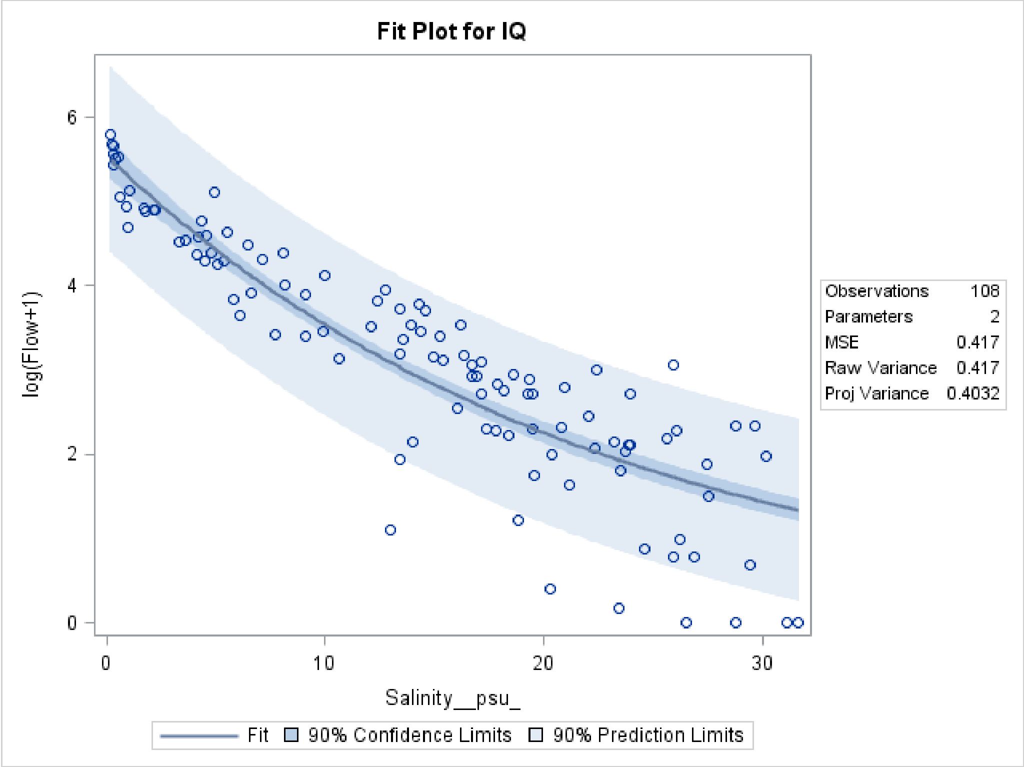


Leverage by Observation for IQ
Tangential Leverage
Jacobian Leverage
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
100
Observation



Local Influence by Observation for IQ
Local Influence
0.2
0.1
0.0
-0.1
-0.2
-0.3
0
20
40
60
80
100
Observation


Raw and Projected Residuals for log(Flow+1)
Residual
Salinity__psu_
Residual: Raw Projected


Fit Plot for IQ
log(Flow+1)
Salinity__psu_
Observations 108
Parameters 2
MSE 0.417
Raw Variance 0.417
Proj Variance 0.4032
Fit 90% Confidence Limits 90% Prediction Limits

Estimation Summary	
Method	Gauss-Newton
Iterations	4
R	7.58E-6
PPC(b)	4.195E-6
RPC(b)	0.000107
Object	3.564E-8
Objective	44.20078
Observations Read	108
Observations Used	108
Observations Missing	0

Note: An intercept was not specified for this model.

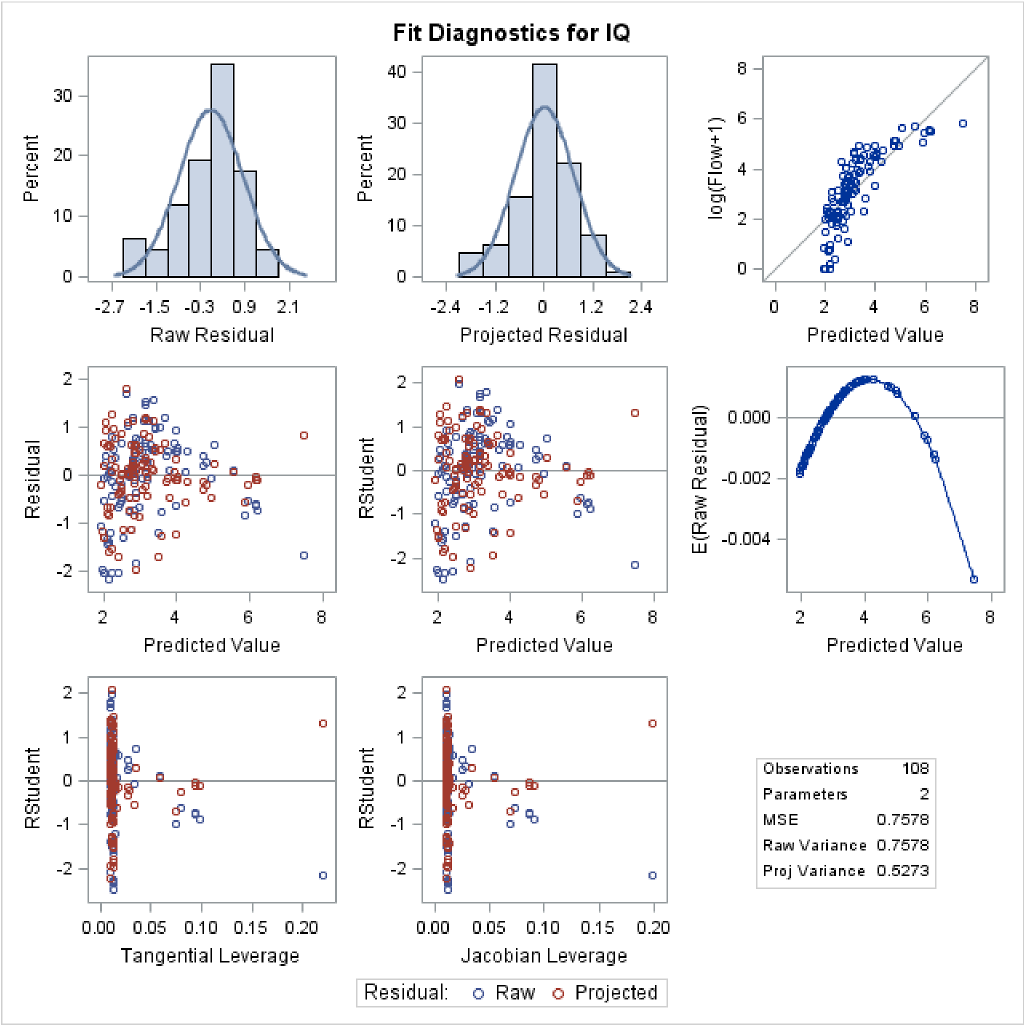
Source	DF	Sum of Squares	Mean Square	F Value	Approx Pr > F
Model	2	1237.6	618.8	1483.93	<.0001
Error	106	44.2008	0.4170		
Uncorrected Total	108	1281.8			

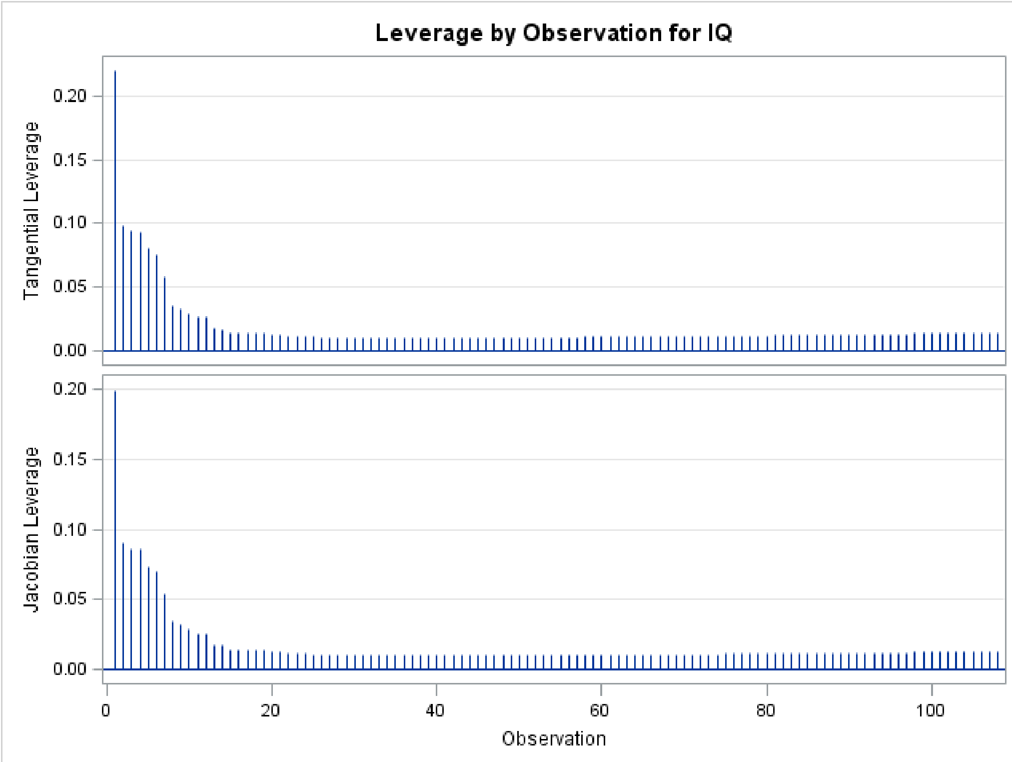
Parameter	Estimate	Approx Std Error	Approximate 90% Confidence Limits		Skewness	Bias	Percent Bias
a	5.5347	0.1460	5.2924	5.7770	0.0209	0.000987	0.018
b	0.0449	0.00242	0.0409	0.0489	0.0530	0.000021	0.047

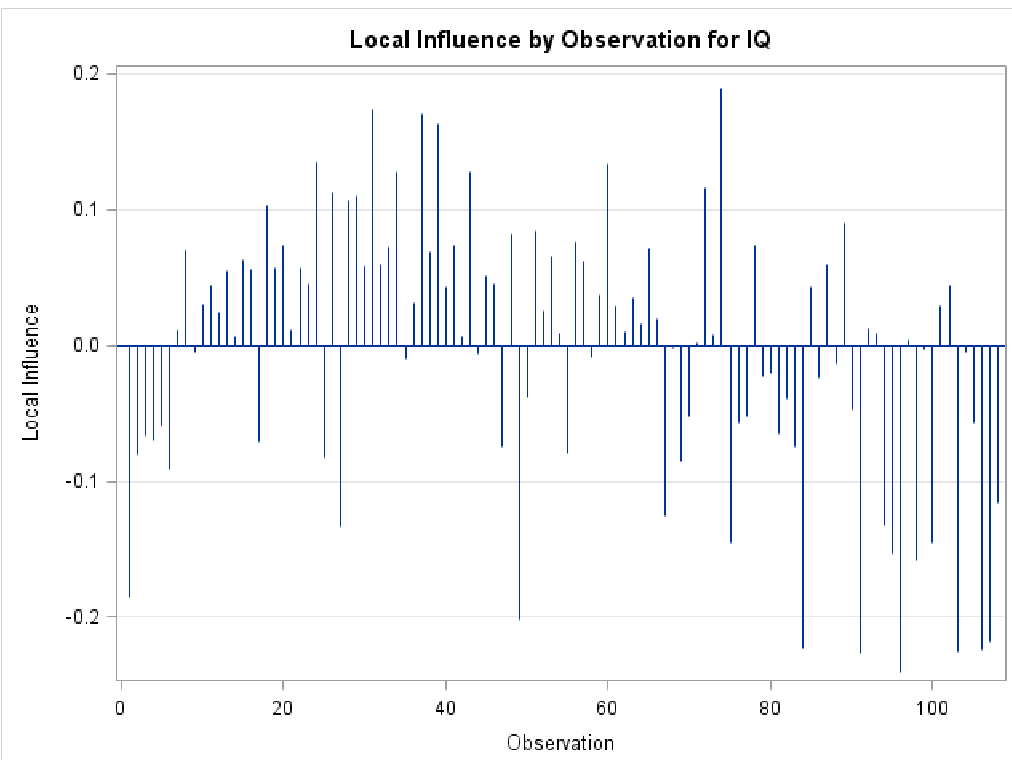
Approximate Correlation Matrix		
	a	**b**
a	1.0000000	0.7181492
b	0.7181492	1.0000000

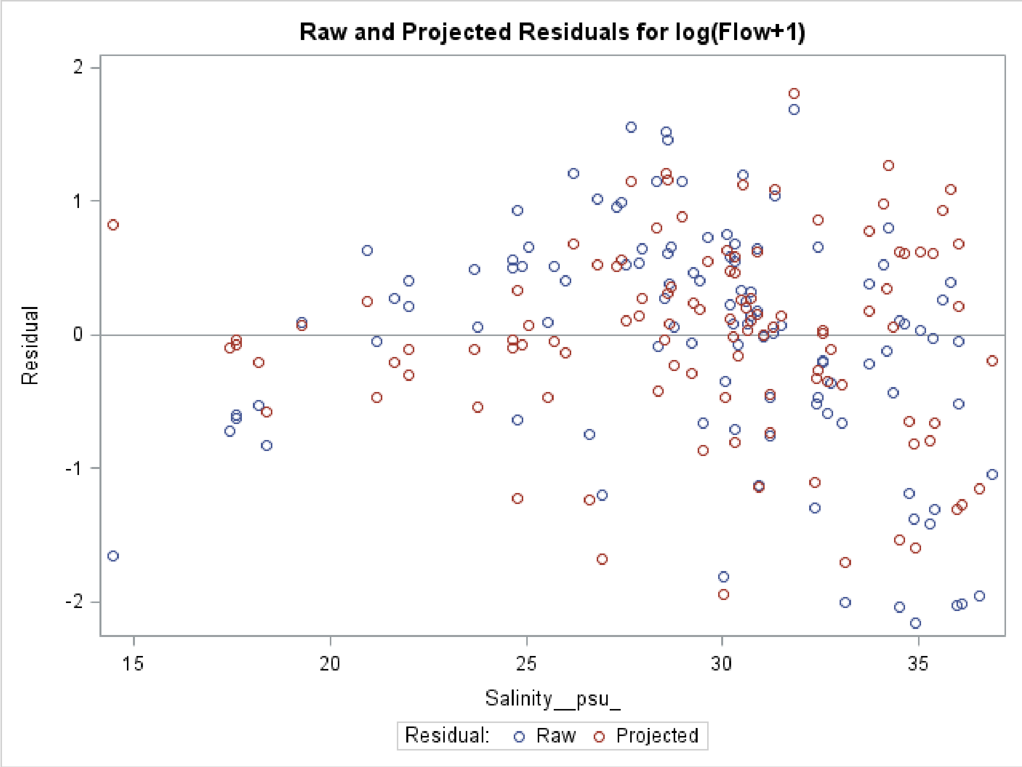
Sanibel

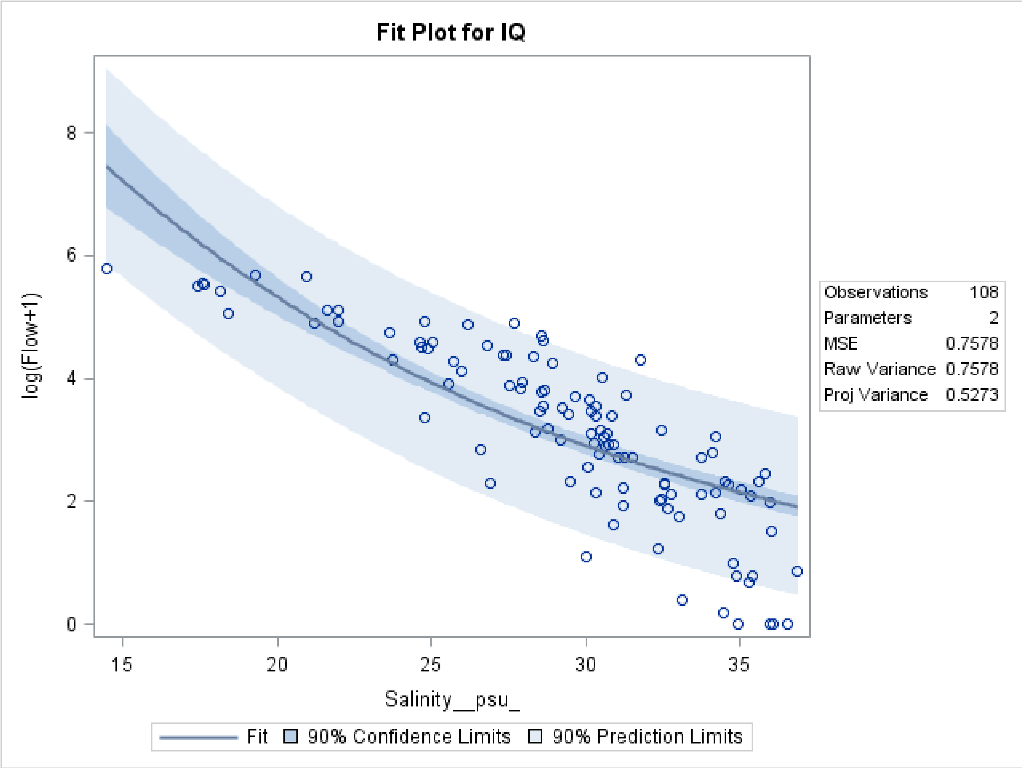
Model: $\log(Q+1) = ae^{-bS} = 17.8959\, e^{-0.0606S}$




Leverage by Observation for IQ
Tangential Leverage
0.00
0.05
0.10
0.15
0.20
Jacobian Leverage
0.00
0.05
0.10
0.15
0.20
0
20
40
60
80
100
Observation


Local Influence by Observation for IQ
Local Influence
0.2
0.1
0.0
-0.1
-0.2
0
20
40
60
80
100
Observation


Raw and Projected Residuals for log(Flow+1)
Residual
Salinity__psu_
Residual: Raw Projected


Fit Plot for IQ
log(Flow+1)
Salinity__psu_
Observations 108
Parameters 2
MSE 0.7578
Raw Variance 0.7578
Proj Variance 0.5273
Fit 90% Confidence Limits 90% Prediction Limits

Estimation Summary	
Method	Gauss-Newton
Iterations	8
Subiterations	3
Average Subiterations	0.375
R	3.6E-6
PPC(a)	4.096E-6
RPC(a)	0.000029
Object	5.61E-10
Objective	80.32357
Observations Read	108
Observations Used	108
Observations Missing	0

Note: An intercept was not specified for this model.

Source	DF	Sum of Squares	Mean Square	F Value	Approx Pr > F
Model	2	1201.4	600.7	792.75	<.0001
Error	106	80.3236	0.7578		
Uncorrected Total	108	1281.8			

Parameter	Estimate	Approx Std Error	Approximate 90% Confidence Limits		Skewness	Bias	Percent Bias
a	17.8959	2.0279	14.5309	21.2610	0.2738	0.0973	0.54
b	0.0606	0.00428	0.0535	0.0677	-0.0191	-0.00001	-0.02

Approximate Correlation Matrix		
	a	**b**
a	1.0000000	0.9751313
b	0.9751313	1.0000000

APPENDIX 6: SCHEDULE AND DOCUMENTATION FORMATS

Task	Deliverable	Expected Completion Date	File Format	File Name (if complete)
1. Project management and communication	1.1 Power Point presentation kickoff meeting	5 April 2013	Microsoft PowerPoint 2010	Montagna_Caloosahatchee_work_plan_April2013.pptx
	1.2.1 Draft project work plan	30 April 2013	Microsoft Word 2003	Montagna_Caloos_workplan_draft.doc
	1.2.2 Final project work plan	14 May 2013	Microsoft Word 2007	Montagna_Caloos_workplan_final.docx
2. Master data file	2.1 Draft master data file	3 May 2013	Microsoft Excel 2003	HRI_CRE_Benthic_Species_Abundances.xls HRI_CRE_Benthic_Species_List.xls
	2.2 Final master data file	May 2013	Microsoft Excel 2003	
3. Analyses of freshwater inflow	3. Progress update presentation 1	6 Dec 2013	Microsoft PowerPoint 2010	Montagna_Caloosahatchee_Prelim_Results_Jan2014.pptx
4. Analyses of macrofauna community structure and the estuarine salinity gradient	4. Progress update presentation 2	7 March 2014	Microsoft PowerPoint 2010	Montagna_Caloosahatchee_Draft_Report_Mar2014.pptx
5. Final report and project close-out	5.1 Draft final report	2 May 2014	Microsoft Word 2007	Montagna_Caloosahatchee_Draft_Final_Report_May2014.docx
	5.2 Final project meeting presentation	13 May 2014	PowerPoint 2010	
	5.3 Final report	13 June 2014	Microsoft Word 2007	