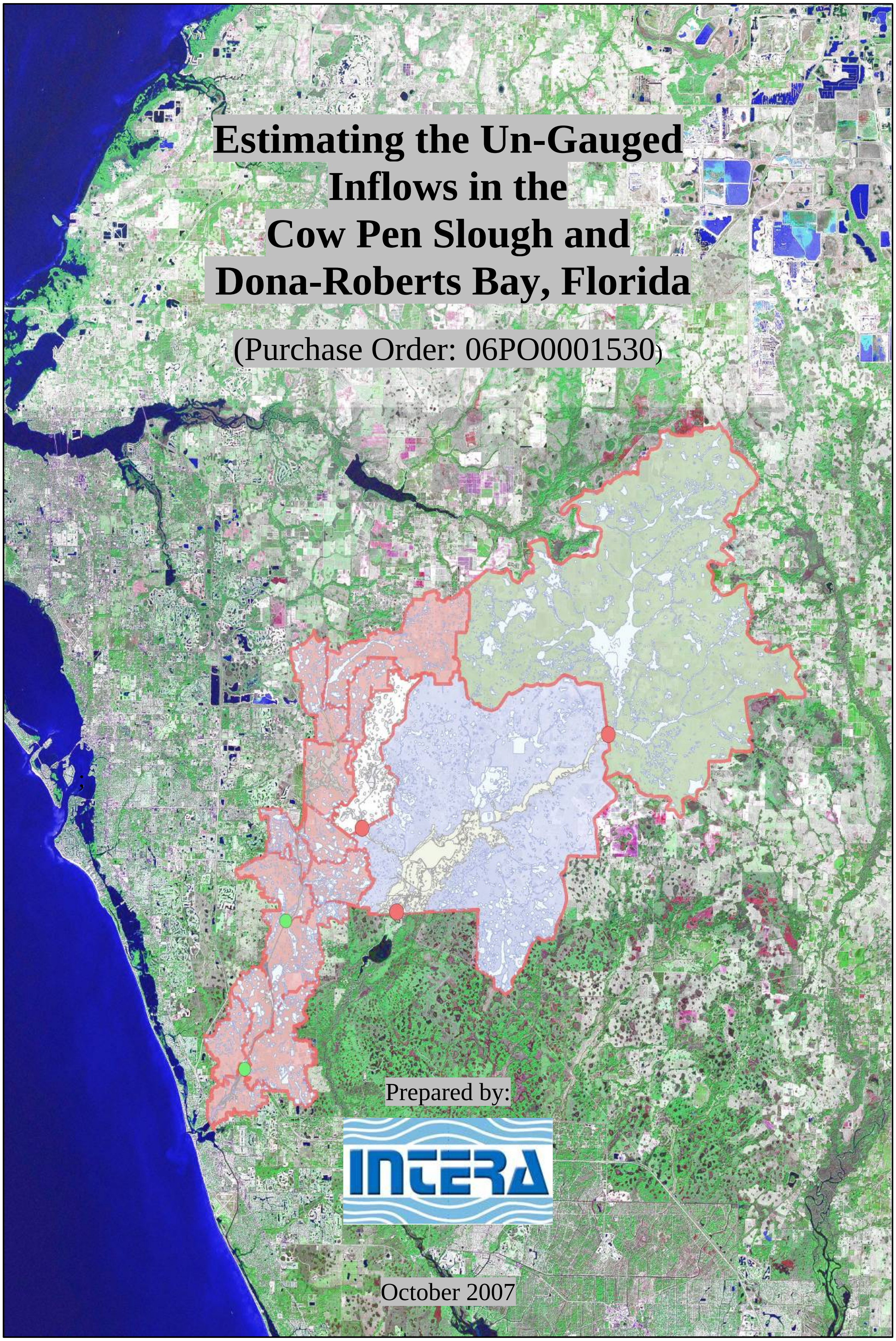
Proposed Minimum Flows and Levels for Dona Bay/Shakett Creek below Cow Pen Slough Appendices

APPENDIX 2-1

ESTIMATING THE UNGAUGED INFLOWS IN THE COW PEN SLOUGH AND DONA-ROBERTS BAY, FLORIDA



Estimating the Un-Gauged Inflows in the Cow Pen Slough and Dona-Roberts Bay, Florida

(Purchase Order: 06PO0001530)

Prepared by:

INTERA

October 2007

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Project Objectives

The objective of this project was to determine the un-gauged inflows from Cow Pen Slough and Blackburn Canal into Dona-Roberts Bay (see Figure 1). There are two main inflows into the Dona/Roberts Bay: the Cow Pen Slough and the Blackburn Canal. These freshwater flows are needed to evaluate the salinity interface in conjunction with determining Minimum Flows and Levels (MFL). The un-gauged inflows to the river can significantly affect the location and distribution of the salinity interface. The Cow Pen Slough is gauged by Sarasota County at two locations. The USGS maintains gages in the

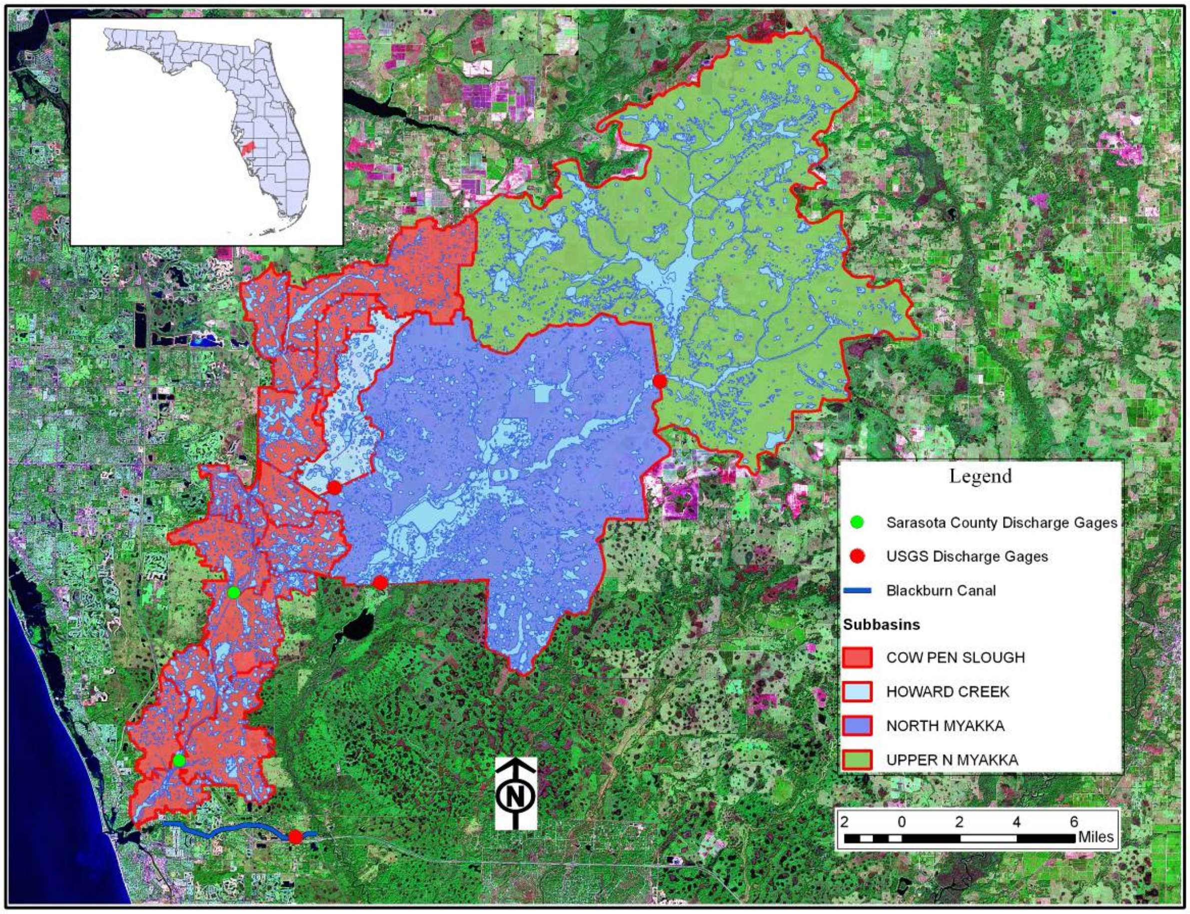


Figure 1 Site Location

adjacent Myakka basin as well as in the Blackburn Canal to the south. The Myakka basin was used as a surrogate basin for the calibration of the hydrologic model due to the short period of record for the gauges on the Cow Pen Slough. The ability to continuously gauge the tidal portion of any river basin is reduced due to the impacts of tail water conditions on the stage discharge relationship. The surface water model HSPF (Hydrological Simulation Program - FORTRAN) was used to estimate the hydrologic response of the Cow Pen Slough and Myakka River basins. The HSPF model was calibrated utilizing the rainfall response from the Myakka River and gauged portions of the Cow Pen Slough basins. The calibrated parameters were then extrapolated to the un-gauged basins utilizing the available land use distribution. The Blackburn Canal discharge into Dona/Roberts Bay was calculated using a tidal regression method, and is treated separately from the Cow Pen Slough. Thus, the hydrologic modeling and this report is divided into two parts: the Cow Pen Slough numerical modeling and the Blackburn Canal statistical modeling.

Data Collection and Analysis

Before applying the HSPF model, hydrologic data were required for boundary condition fluxes and to provide calibration targets (observed internal/external fluxes). In addition spatial data (from GIS analysis) is required to help develop model parameters. In this case many groups of external fluxes and thematic spatial data were used to drive the model. The data developed for this effort is described below.

Surface Water Basins

Several basin boundaries were collected from a number of sources including SWFWMD, USGS, and Sarasota County. The basins used in this project were derived from the delineation performed by Sarasota County and the USGS. Sarasota County's subbasin delineation was used in the Cow Pen Slough basin, whilst the USGS's delineations were used for the adjacent Myakka basin. For any basin area overlaps, the Sarasota County's basin area was assumed to be predominant. The Cow Pen Slough basin was divided into 13 subbasins and the Myakka basin was divided in to 3 subbasins (see Figure 2). The USGS quadrangles, 100,000 scale hydrography, USGS drainage basins, and even the DOQQ's were all used to aid in the aggregation/dis-aggregation process.

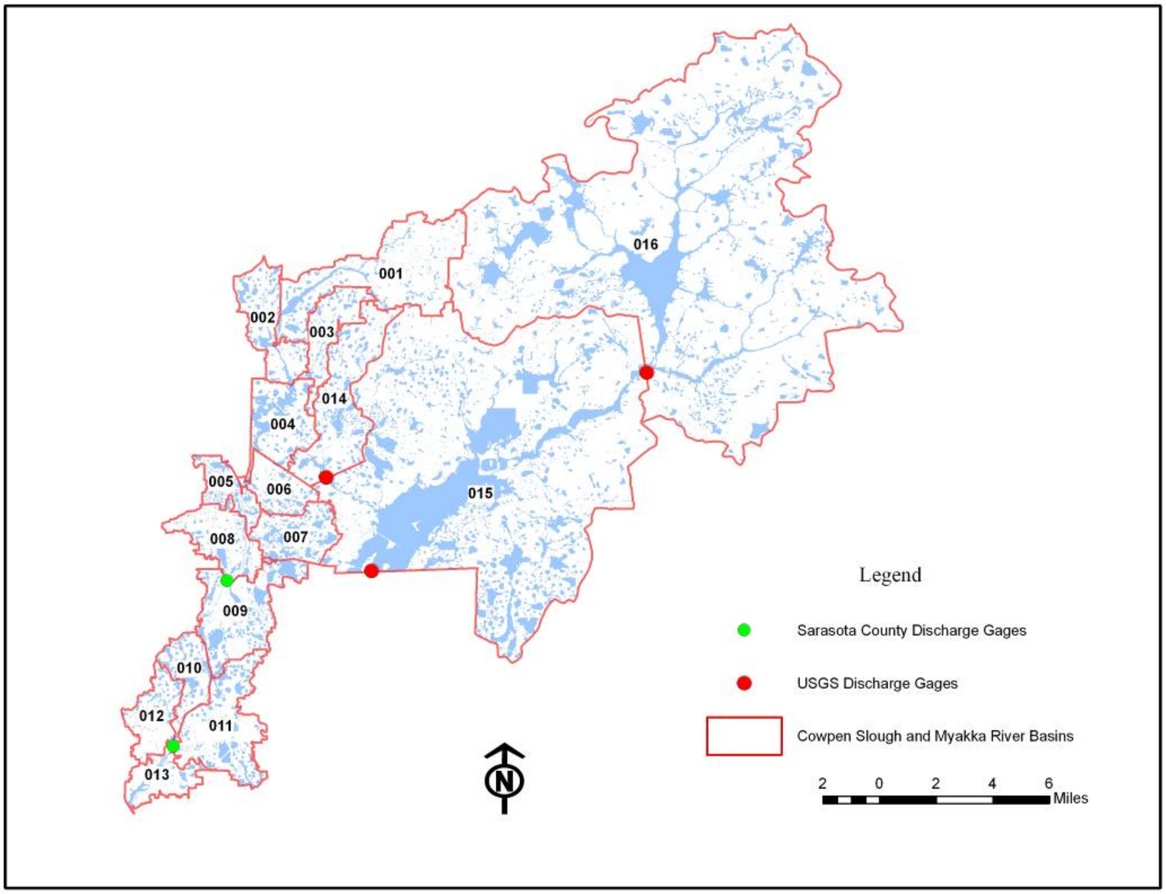


Figure 2 Cow Pen Slough and Myakka River Basins with Model Subbasins

Basin Land Use

The land use and land cover map (dated 2000) was obtained from the District's online GIS data. The land use data was used as the best estimate for the spatial coverage of wetlands and lakes which produced the hydrography area used in the model. This area was assumed to act as storage reservoirs and was simulated as such in HSPF (see Model Preparation section below). Prior efforts made an attempt at estimating the wetlands that acted like closed basins. Using a thorough review of the available data it was determined that the amount of closed or conditionally connected reaches was fairly insignificant due to the considerable ditching in the area. The land use map was also utilized to determine the irrigated agricultural areas. The irrigated portion for each basin was simulated as a separate land segment. Further separating each basin into multiple land segments allows for better definition of model parameters and boundary conditions (i.e., irrigation inflows are not averaged over the entire basin only over the irrigated agricultural lands). The generalized land use map is shown in Figure 3. See Gage/Un-Gauged Cow Pen Slough section for a table showing the FLUCCS codes and the generalized land use conditions for each code. Each generalized land use condition was represented in the model as a separate computational element to eliminate gross parameter lumping.

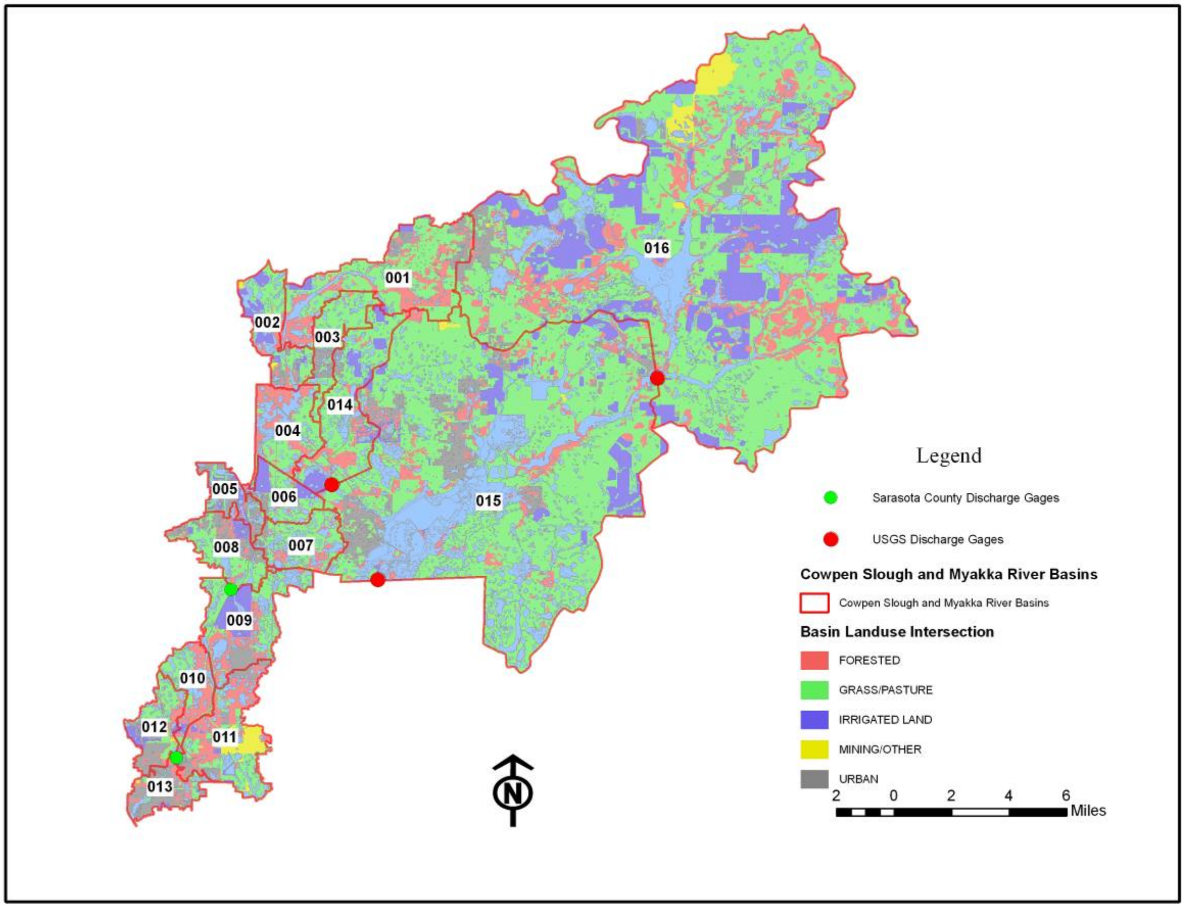


Figure 3 Cow Pen Slough and Myakka River Basins and Generalized Landuse Map

Basin Slope

The seamless DEM data was obtained for the Cow Pen Slough and Myakka basins. The DEM data was converted to a slope grid in ArcMap. The zonal statistics for each basin was computed using the slope surface. The computed average slope determined from the zonal statistics was used to develop the HSPF data set.

Rainfall

Two sets of rainfall time series was used in the numerical modeling. For the calibration phase, rainfall was obtained from the radar rain provided by the District. The radar rain was produced by OneRain Inc. in square cells with sides measuring approximately 2 kilometers. The radar rain provided 15-minute data of gauge-calibrated radar rainfall estimates (Figure 4 shows the coverage of the radar rain cells used). For each calendar day, the radar rain from several cells was area weighed for each basin to obtain a single value of rainfall for that basin. The daily average was then scaled using the temporal distribution from a similar cell. The radar rain covered only the February 1994 to September 2006 period.

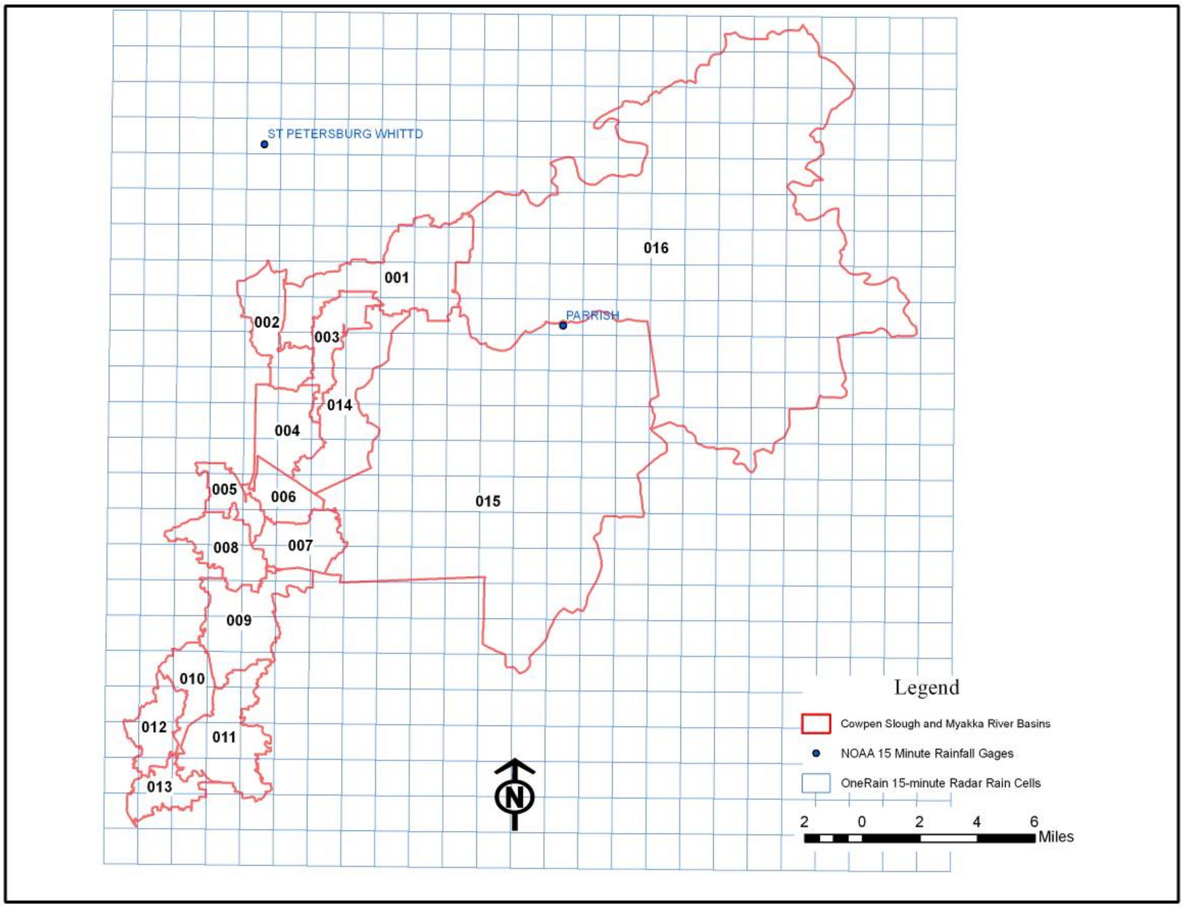


Figure 4 OneRain Radar Rain Cells and Rain Gage Locations

The predictive simulatios used NOAA 15-minute rain from 1985 to 1994 spliced to the radar rain for the latter 1995 to 2006 period. Only one NOAA 15-minute gage was used: the Parrish gage (NOAA gage ID 86880) since it was the only gauge located within the study area with the desired data resolution. The locations of the radar rain cells and the rain gage used in the model are shown in Figure 4. The developed rainfall time-series for the Cow Pen Slough Basin was stored in a model binary data format (WDM) for use by HSPF.

Evaporation

The evapotranspiration time-series (daily) was developed from the available potential evapotranspiration from Bradenton, Ona Research Station, and Bowling Green SWFWMD ET stations (see Figure 5 for stations locations). A hierarchy was setup for the data source used in the hydrologic model. The average of the Bradenton and Ona Research Station gages was preferentially used. When neither the Bradenton nor Ona Research Stations data were available a linearly regressed factored value from the Bowling Green gage was used. For the 2004 to 2005 model years, it seems that the Bowling Green gage was upgraded or recalibrated, therefore the regression factor was reset to 1.0 from 1.23. In the case that the daily data from none of the three gages were available, the gap was obtained from the average of the previous and subsequent days. This approach was necessary since the Bradenton gage only covered the period between 2/1/1981 and 7/31/1999, and the Ona Research Station gage covered the 2/10/1980 to 12/31/1995 period. Therefore, a factored value from the Bowling Green gage, which covered the period from 4/16/1996 to 7/26/2006, was used for the period after 12/31/1995. The corrected potential evapotranspiration data was stored in WDM binary file format for use by HSPF.

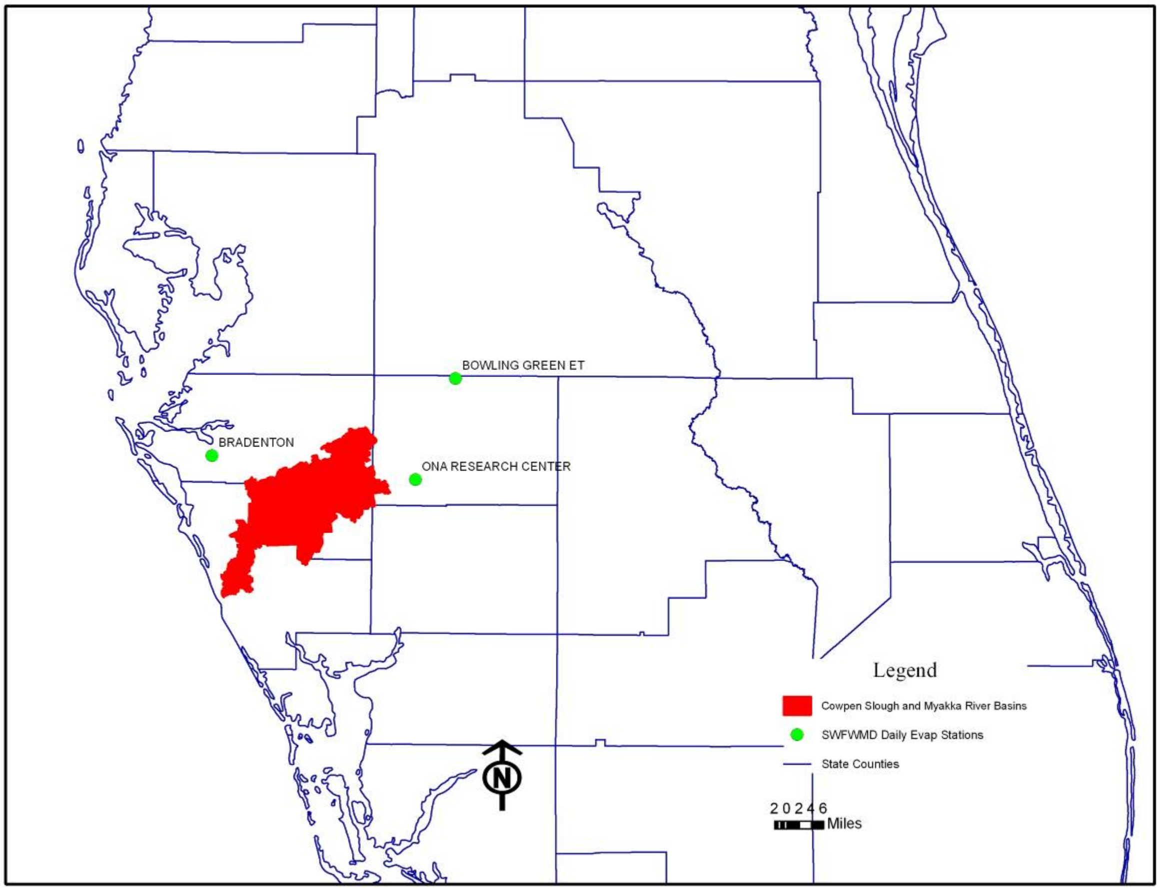


Figure 5 Potential Evapotranspiration Station Locations

Agricultural Irrigation

For detailed water budget analysis of basins heavily impacted by groundwater pumping it is necessary to return groundwater pumping used for irrigation to the surface water system. The groundwater to surface water exchange can have a significant effect on the overall water budget in agricultural areas especially the low flow conditions. The metered and estimated monthly groundwater-pumping rates were obtained from the District. Wells in the SWFWMD well permit database were used to develop the irrigation time series. Irrigated land was identified by selecting areas with a FLUCCS code between 2100 and 2600. This selection criterion included all irrigated land uses. Figure 6 shows the irrigation land use polygons with the associated water use points. The water pumped from agricultural wells was then applied to the irrigated land areas within the basins identified as agricultural land use conditions. The developed monthly time-series assumed the irrigation volume for the day is applied to the land surface and to interception storage (HSPF SURLI and CEPS variables) averaged over the day. The fraction of irrigation delivered to CEPS and SURLI was obtained from the Little Manatee model application. The fraction of drip irrigation and spray irrigation was determined from available data on crop types. The estimated irrigation data was not available for the years 2005 and 2006 for the calibration period and from 1985 to 1991, and 2005 and 2006 for the verification/predictive simulations. These missing years were estimated using representative years. The selection of the representative years were based on a simple analysis using the precipitation time series both annual rainfall totals as well as seasonal totals (using the assumption that irrigation practices would be similar for similar rainfall). The developed time series for each basin is stored in the WDM binary format for use by HSPF.

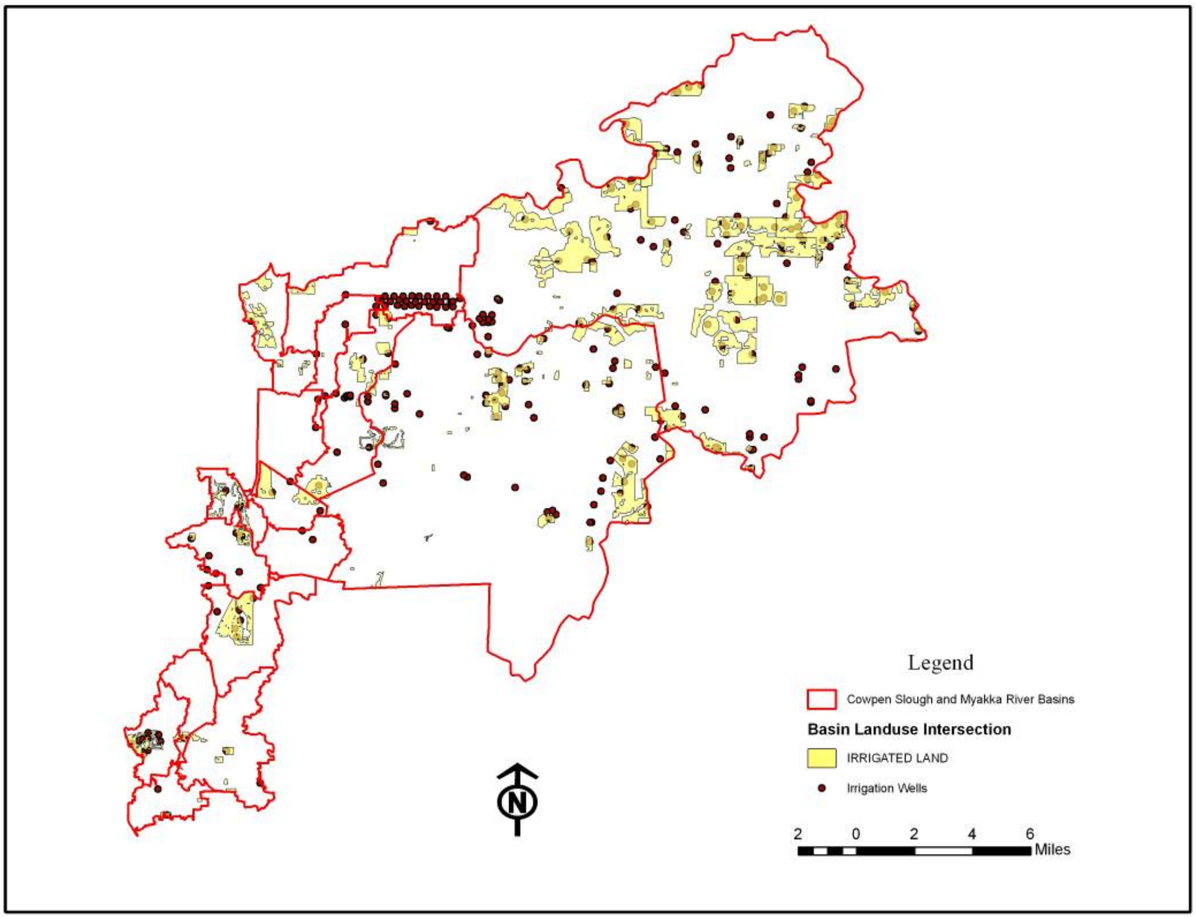


Figure 6 Agricultural Irrigation Land Segments and Water Use Points

Stream Flow

Observed stream flows were obtained from Sarasota County for two stations and from the USGS for three stations: Cow Pen Slough Dam 1 (CPS-1) and Cow Pen Slough Dam 2 (CPS-2) from Sarasota County and Howard Creek (USGS station ID 2298760), Myakka

River at Myakka City (USGS station ID 2290608) and Myakka River at Sarasota (USGS station ID 2298830). The data represents the observed average daily flow. This data was converted to estimate for runoff for calibration and verification comparisons.

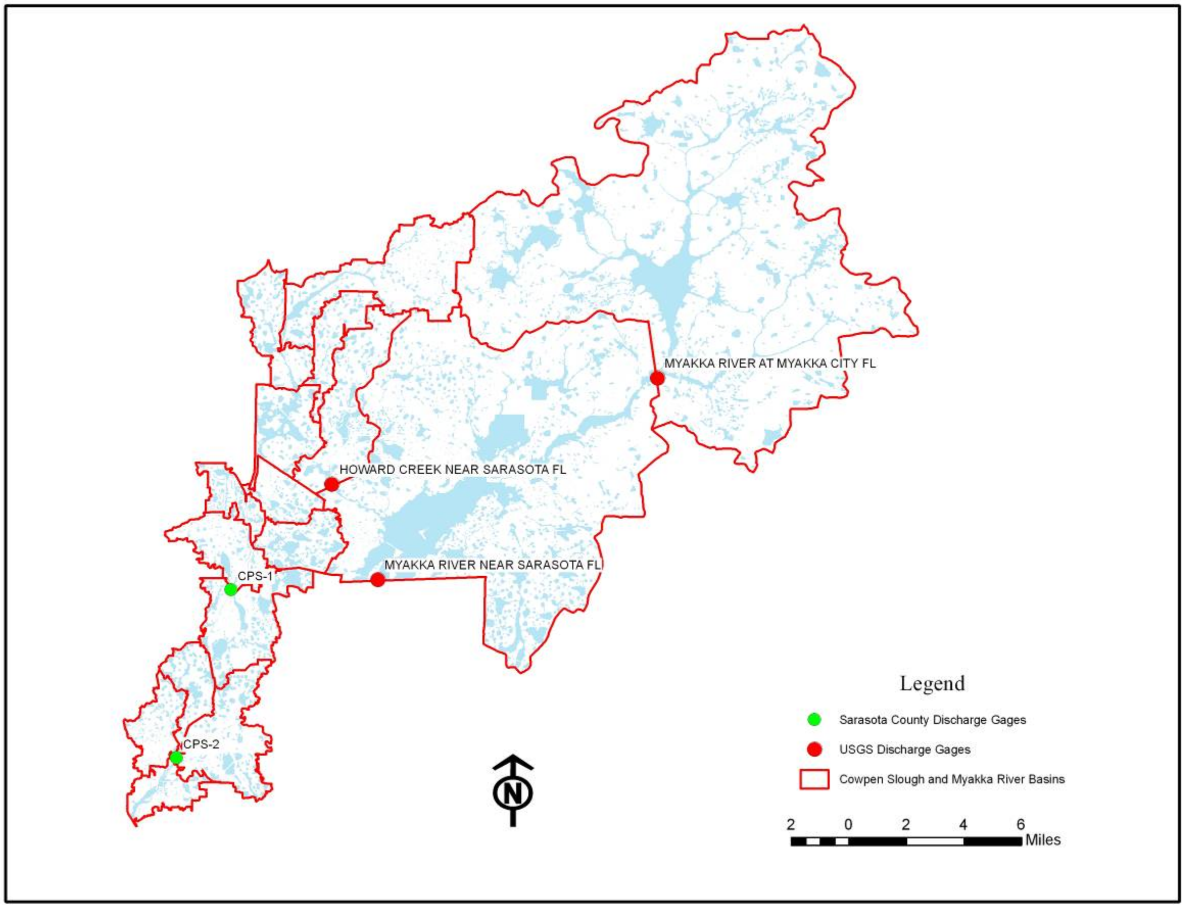


Figure 7 Calibration and Verification Streamflow Gage Locations

Cow Pen Slough Numerical Modeling

Model Preparation

The HSPF model for the Cow Pen Slough basin was developed using the spatial data and temporal data collected and processed as described above. The basins were divided into the land segments to preserve the correct parameters and avoid parameter lumping (for example averaging impervious with pervious). The reaches were developed from the land use mapping and the USGS rating tables. This allowed correct representation of the reach storage potential and therefore reach water budget. Details on the model development, calibration, and predictions and included in the sections below.

Gauged/Un-Gauged Cow Pen Slough

As stated previously, the Cow Pen Slough Basin was sub-divided into 13 subbasins for this project, and the Myakka River basin was sub-divided into 3 subbasins (see Figure 2). The 13 subbasins defined the entire Cow Pen Slough Basin. The un-gauged portion of the Cow Pen Slough is represented by three of those subbasins while the gaged portion was represented with 10 subbasins. The 16 subbasins were divided into 70 pervious land segments and 16 impervious land segments. Dividing the basins into land segments practically eliminates the parameter lumping typically found in hydrologic models. The resulting operation number in the HSPF data set was set to BasinID*10 + generalized land use code. The generalized land use codes used in the model are listed in Table 2. The land use and soils parameters for the un-gauged basins were extrapolated from the calibrated parameters from the gauged basins. This extrapolation assumes that the landforms within the basins upstream of the gages are hydraulically similar to the basins downstream of the gages. Unfortunately this is an assumption that is problematic. Moving southward towards Dona Bay, the amount of development or impervious area, mining effects, and drainage all change dramatically. Using the land map as a source of model conceptualization eliminates most of the shift in hydraulic process. The downstream basins have generally shallower depth to water table and the water budget may be affected by groundwater discharge zones. A fully integrated model is the logical next step in improving the flow estimates.

The 3 basins that represent the un-gauged portion of the Cow Pen Slough include basins 11, 12, and 13. Although, as previously stated, the two gages on the Cow Pen Slough are only recent additions (January and June 2003). Thus for practical purposed the entire Cow Pen Slough can be considered to be un-gauged.

Land Use Code	Land Use Description
1	Urban
2	Agricultural
3	Pasture
4	Forested
7	Other/Mining

Table 2 Generalized Land Use Codes

Model Basin Parameters

Appendix C tabulates model parameters and the entire HSPF model data set used in both the calibration as well as the predictive hydrologic simulations.

Model Reach Parameters

The hydrography or reaches (wetlands, lakes, and streams) play a very significant role in the hydrologic response of the basins in West-Central Florida. The reaches have considerable impact on modifying the basin runoff response to given rainfall events. The storage in these water features attenuates or even completely captures the runoff hydrograph from upland portions of the basin. The available storage capacity before a storm is a function of the antecedent moisture condition. The best way to represent this storage in HSPF is through the RCHRES module. In the Cow Pen Slough Model two types of reaches were utilized to represent the hydrography in the basin: storage attenuation reaches and routing reaches. The storage attenuation reaches were defined as an aggregate of all wetlands and lakes within each of the subbasin boundaries (one for each subbasin). The storage attenuation reaches were classified with the basin ID in which they resided therefore the RCHRES operation ID used the same number. The routing reaches were defined as the rivers and associated riparian wetlands that convey the runoff hydrographs from each basin (technically each storage attenuation reach) to the final outfall, Dona/Roberts Bay. The routing reaches RCHRES operations were number from 202 to 215 (see figure 8).

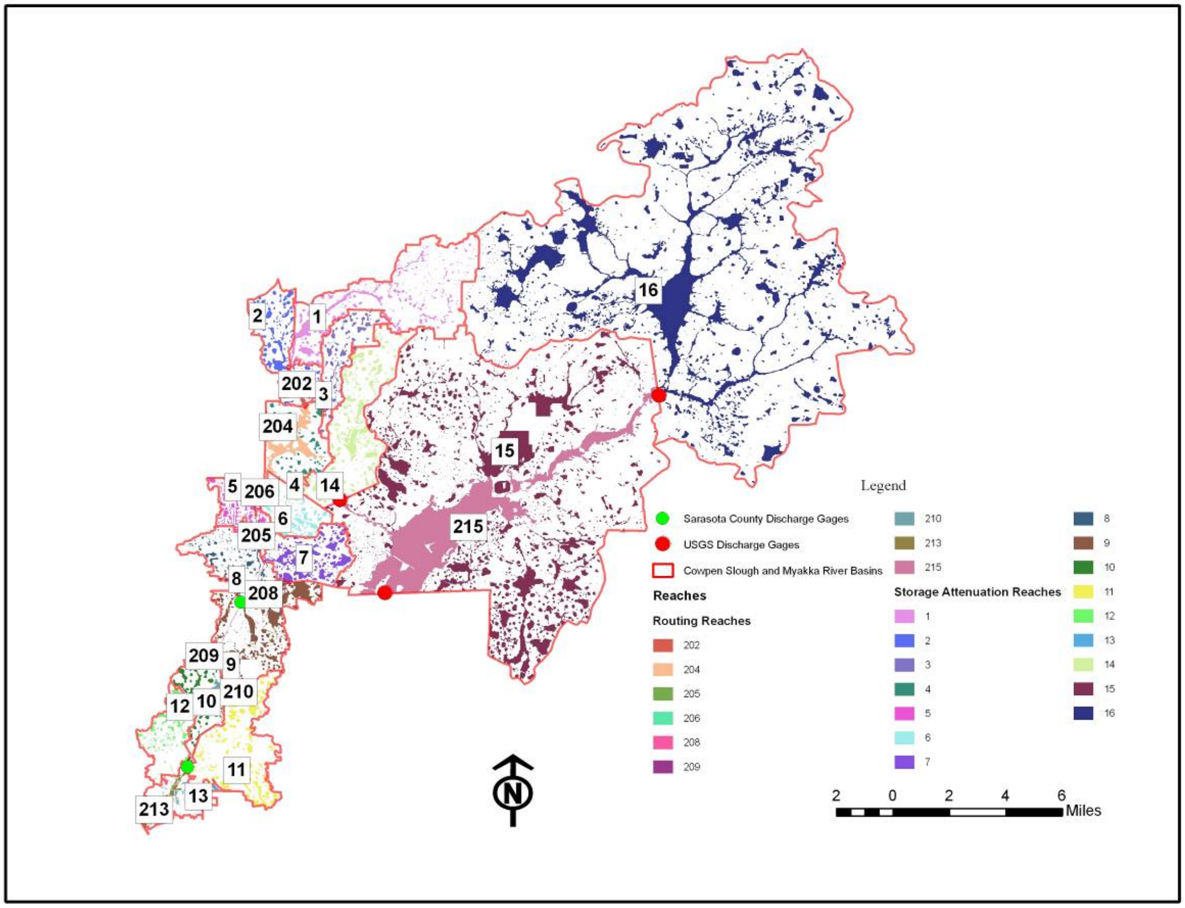


Figure 8 Storage Attenuation Reaches and Routing Reaches

In HSPF's RCHRES operations, the non-linear relationship between reach stage, storage volume, and discharge is defined with a table called an F-TABLE. The 2000 land-use map was used as the best available data for defining the spatial extent or the area of the reaches. The area for each reach was defined as a constant for all stages based on the land use mapping. This assumes the mapping represents normal pool extents. The constant area was used to eliminate the possibility of mass balance errors caused by double accounting for areas that may or may not be inundated. If the reach area were allowed to change at different stages, then the basin areas would have to change as well to conserve mass (precipitation times area and ET times area). Standard HSPF does not allow the basin areas to change with time (the reach area would not be available until after the reaches are simulated thus making it an iterative problem). Maintaining constant reach areas does introduce errors. The constant area forces the model to remove potential evaporation and add rainfall over the defined area at all times. When the reach is dry the area that should be represented with full open water potential evaporation should be something less than the defined constant area. This will over-estimate the reach evaporation rates. In turn the inflow volume will be over-estimated during these low wetland stage rain events. The high water table (even during dry periods) and the dense vegetation in wetlands will cause the actual ET to approach that of open water evaporation rates. The over-estimation of precipitation inflows will be reduced because the storage volume can include (below the invert of discharge) vadose zone soil storage. The most representative USGS rating or stage-discharge relationship of each observed gage was scaled for each reach based on the ratio between the contributing area to the reach and the contributing area of the gage. The nearest downstream rating was used to define this relationship for each reach. The volumes were then defined as the reach area times the stage (defined again by the scaling the USGS rating condition) times a volume adjustment factor. The volume adjustment factor allowed for a diminishing volume stored at lower stages while exponentially increasing at the higher stages to allow for the extreme volumes stored at high stages. The volume adjustment factors were adjusted to improve the match between observed and simulated stream discharges. This methodology dramatically simplifies the reach calibration while remaining true to the available data.

Model Simulation and Results

The simulation results include a complete water budget for all basins and reaches included in the simulation. For the gauged portion of the basin the simulation results were compared to the observed measurements. After the calibration and extrapolation of the basin and reach parameters, the un-gauged results were generated into time series inflows to the Cow Pen Slough.

Calibration and Verification Results

Model calibration and verification are necessary and critical steps in any model application. HSPF, as with any numerical model, calibration is an iterative procedure of parameter evaluation and refinement, as a result of comparing simulated and observed values of interest. It is required for parameters that cannot be deterministically, and uniquely, evaluated from topographic, climatic, edaphic, or physical/chemical characteristics of the watershed and compounds of interest. Ideally, calibration is based on several years of simulation in order to evaluate parameters under a variety of climatic, soil moisture, and water quality conditions. Calibration should result in parameter values that produce the best overall agreement between simulated and observed values throughout the calibration period while remaining within the bounds of published literature ranges.

Calibration includes the comparison of both monthly and annual values, and individual storm events, whenever sufficient data are available for these comparisons. In addition, when a continuous observed record is available, such as for stream flow, simulated and observed values should be analyzed on a frequency basis and their resulting cumulative distributions compared to assess the model behavior and agreement over the full range of observations. In addition, other calibration targets can include estimates for baseflow, ET, and reach stage or storage. Model verification is an extension of the calibration process. Its purpose is to assure that the calibrated model properly assesses all the variables and conditions which can affect model results. While there are several approaches to validating a model, perhaps the most effective procedure is to use only a portion of the available record of observed values for calibration; once the final parameter values are developed through calibration, simulation is performed for the remaining period of observed values and goodness-of-fit between recorded and simulated values is reassessed (Donigian, 2002).

The Cow Pen Slough model was calibrated for the period from June 1, 1994 to June 30, 2006. Two long term flow gages (Myakka River near Myakka City and Myakka River near Sarasota) were available for this period. The calibration comparisons were made using a variety of graphical and statistical analyses. Graphical plots included cumulative volume as well as arithmetic and logarithmic hydrographs. The cumulative graphs show the running volume comparisons over the calibration period. The arithmetic hydrographs provide an effective comparison of peak flows while the logarithmic hydrographs provide an effective comparison of low flows. Scatter plots of simulated versus observed values were also generated giving both a visual and statistical (R^2) measure of model performance. The calibration and verification results were considered reasonable estimates of total streamflow for all the gauging stations considering the scale of the application and the uncertainty of hydrologic input and hydrologic processes. The calibration comparisons for each flow gage are shown in Appendix A.

Predictive Simulation Results

A 20-year predictive simulation was performed on the whole Cow Pen Slough and Myakka River basins, using the parameter developed in the calibration phase. The time series of streamflow discharges for the 16 basins were generated for the period 1985-2005. Running hydrographs for each un-gauged basin are shown in Appendix B. The discharge from Fox and Salt Creeks are represented by the discharges from subbasins 12 and 11, respectively. They are also shown in Appendix D, as part of the un-gaged discharges.

Remarks

There were a few irregularities that became apparent late in the model simulation:

1. The simulated discharge for the Howard Creek subbasin (subbasin ID 14) always produced discharge rates approximately half of the observed discharge. Upon investigation, it was determined that its area was in fact approximately half (approximately 10 acres vs. approximately 20 acres) of the USGS estimate. The “missing” half was lumped into subbasin 16. Both subbasins 14 and 16 feed into subbasin 15, which has very good correlation between the observed and simulated discharges. No changes to the simulation were made.
2. The simulated discharge at the Cow Pen Slough 2 Dam (CPS-2) was always much higher than the observed discharge. Upon investigation, it was determined that Sarasota County’s subbasin delineation seems to be erroneous: approximately 30% of the area from subbasin 10 should discharge into subbasin 12, downstream of CPS-2. Thus, 30% of the area of subbasin 10 was reassigned to subbasin 12 as a correction.

Blackburn Canal Statistical Modeling

Estimating Blackburn Canal Flows

The development of a discharge time series for the Blackburn Canal Nr Venice gage is complex since the flows are affected by tides and well as the flows found in the Myakka River. The canal is a man made structure to short circuit the Myakka River and discharge to the bay (see Figure 1). The USGS has been gauging the flows in the canal with an ADCP. The flow record from the Blackburn gage is from March 6, 2004 to June 18, 2006. There are two flow regimes in the observed flow record, tidally influence low flow and Myakka flood stage influenced high flows. The following table shows the summary of data range for the USGS gages upstream and downstream of the BLACKBURN CANAL NR VENICE gage:

USGS Gage Number	Name	Data Range	
		Start Date	End Date
02298830	MYAKKA RIVER NEAR SARASOTA, FL	10/1/1936	4/24/2007
02299692	BLACKBURN CANAL NEAR VENICE, FL	3/6/2004	6/18/2006
02299727	SHAKETT CREEK NEAR NOKOMIS, FL	3/15/2003	2/12/2007
02299733	DONNA BAY AT NOKOMIS, FL	10/1/2003	11/20/2006
02299735	VENICE INLET AT CROW'S NEST MARINA AT VENICE, FL	4/23/2004	10/15/2006

Tidal data from NOAA was also collected with an attempt to utilize in a statistical model. The Ft. Myers tide gage had observed tide data starting in 1997 but, is too far south to be representative of the downstream stage for the Blackburn Canal. Predicted tide data were available for Ft. Myers and Venice Inlet were available but these lacked the local effects of storms. The idea was to find a local gage to use to determine the head gradient at low stages. Hydraulic gradient calculated (for low flow predictions) did not yield any significant improvement in regression results. Hence tide data was not used in the regression.

Since no reliable tide gage was discovered for significant period of record, only Myakka River near Sarasota gage was available for regression with Blackburn flows.

Data Manipulation Prior To Regression

Blackburn Canal observed flow data shows two distinct flow regimes a tidal influence at low flows (approximately below 45 cfs in the canal or 6.5 ft stage at Myakka near Sarasota) and a Myakka driven event flows for a high flow regime. To improve the regression between Blackburn Canal and Sarasota stages, a new time series of observed Blackburn Canal flow data is obtained by replacing the flows that correspond to Sarasota stages lower than 6.5 ft, by a moving average of flows from a three day period. Any observed flows above the specified threshold are left intact. The three day moving average essentially removed the tidal signature and allowed the regression to focus on the net flux.

To get a continuous predicted time series for Blackburn Canal, it was necessary to fill a few data gaps in Myakka near Sarasota stages. This is accomplished using the stage-discharge relationship at Sarasota.

Regression

A piecewise linear regression was used to regress flows at Blackburn Canal with stage data at the Myakka near Sarasota gage. Piecewise linear regression applies different regression equations on subsets of the regression data. The data subsets are obtained using a computed threshold for the Sarasota stage (6.5 ft in our case). This threshold is computed using a Quasi-Newton optimization procedure in Statistica. The following table and plots show the regression results:

Table 1 Piecewise Linear Regression Results

Model is: Piecewise linear regression with breakpoint (Regression) Dependent variable: BlackburnFlow(mov avg) Loss: Least squares Final loss: 302436.67137 **R=.96581**

Variance explained: 93.279%

	<6.5 ft		>6.5 ft	
	Const.B0	**Myakka_Stage**	**Const.B0**	**Myakka_Stage**
Estimate	-4.58861	3.981089	-846.140	129.7358

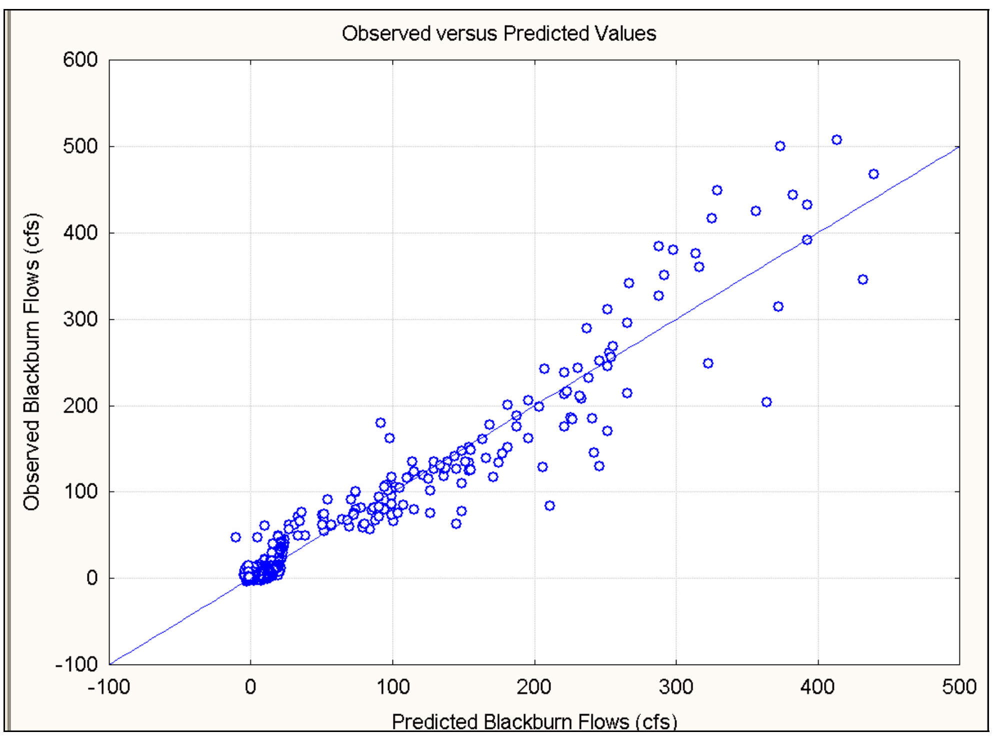


Figure 9 Observed versus Predicted Flows Scatter Plot

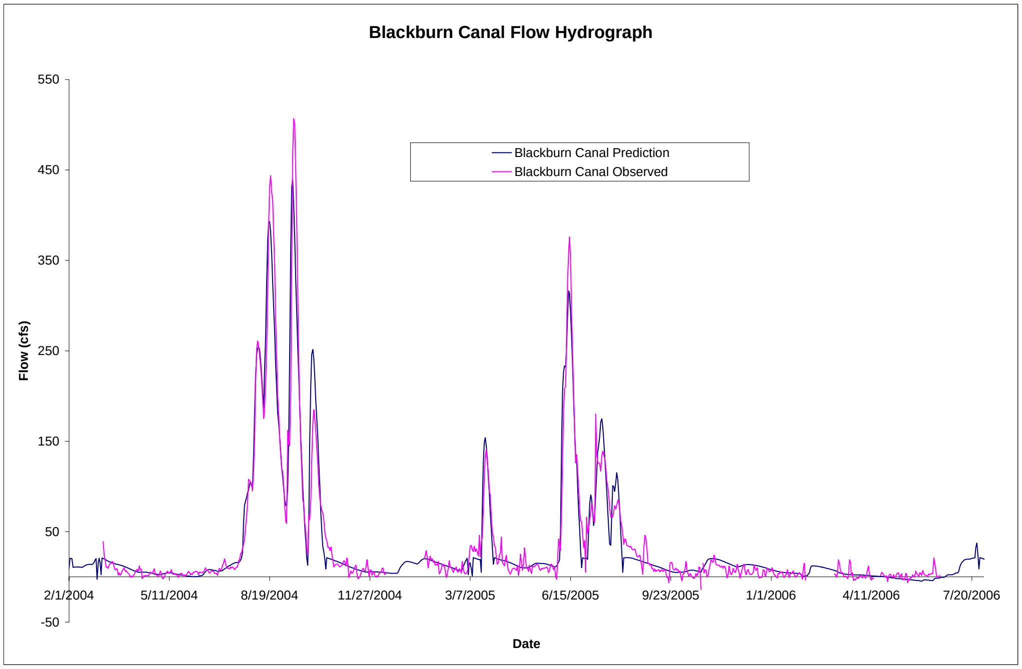


Figure 10 Observed versus Predicted Flows Comparison

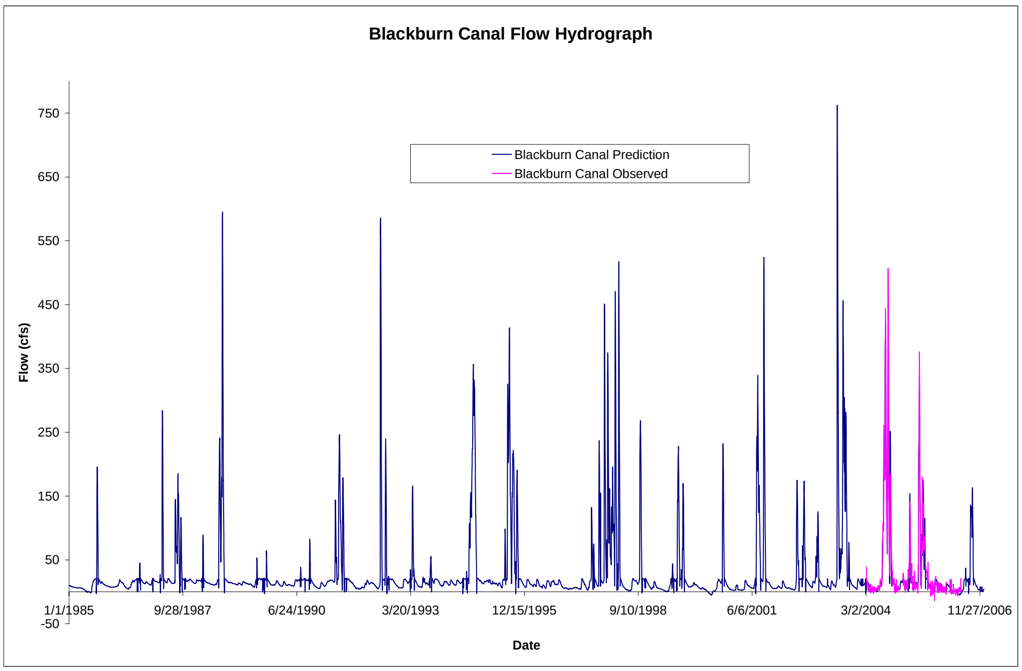


Figure 11 Complete Simulated Hydrograph for the Blackburn Canal

Curry and Hatchett Creek 20-year Discharge Simulation

Objectives

The objective of this section of the project was to simulate the discharge from Curry and Hatchett Creeks, both of which are un-gauged, into the Dona-Roberts Bay.

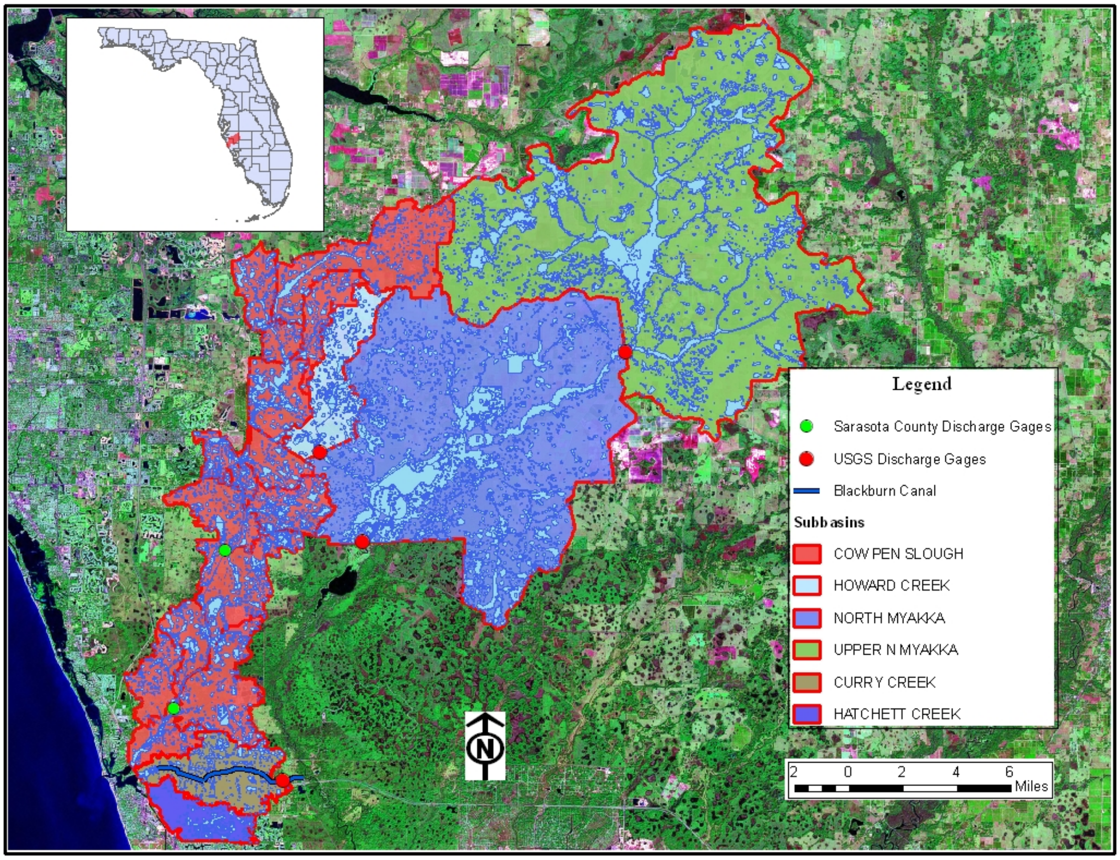


Figure 12 Locations of Curry and Hatchett Creek Basins

Model Preparation

The time-series input parameters for the HSPF model of Curry and Hatchett Creeks were copied directly from Cow Pen Slough basin 13, the basin closest to the Curry and Hatchett Creek basins. The basin slopes and various land use areas were developed for the Curry and Hatchett Creek basins just as described in the Cow Pen Slough basins.

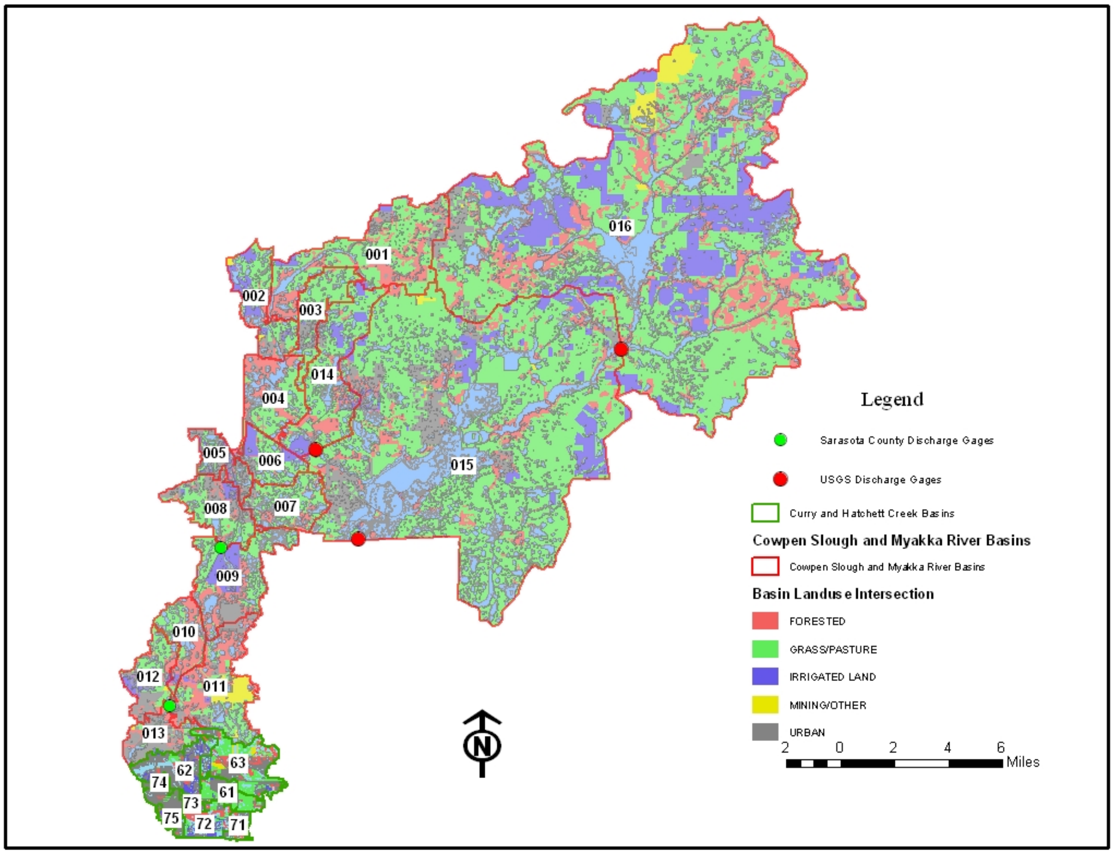


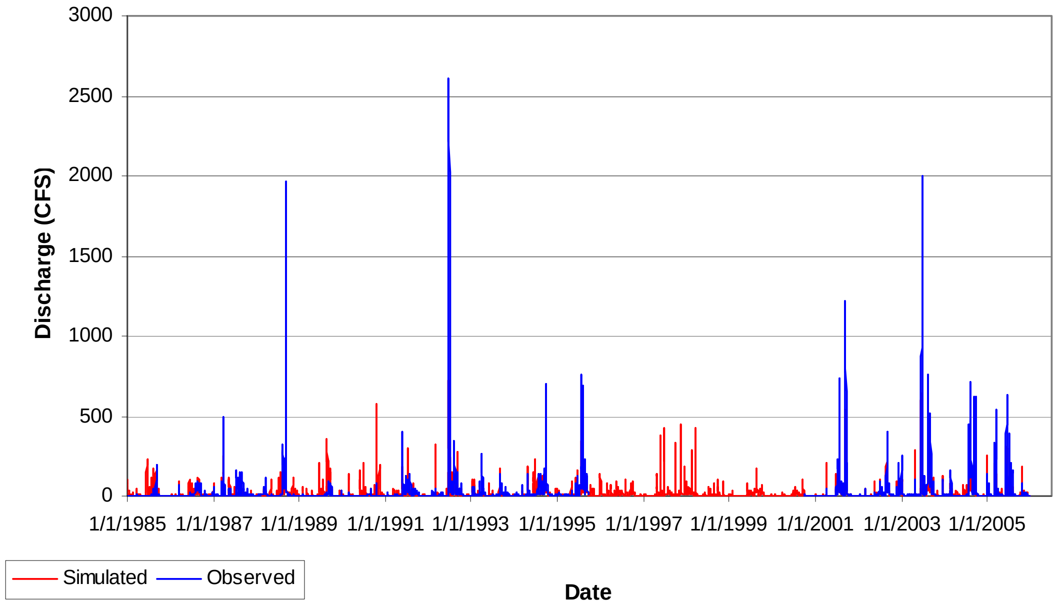
Figure 13 Cow Pen Slough, Myakka River, Curry, and Hatchett Creek Basins and Generalized Land Use Map

Predictive Simulation Results

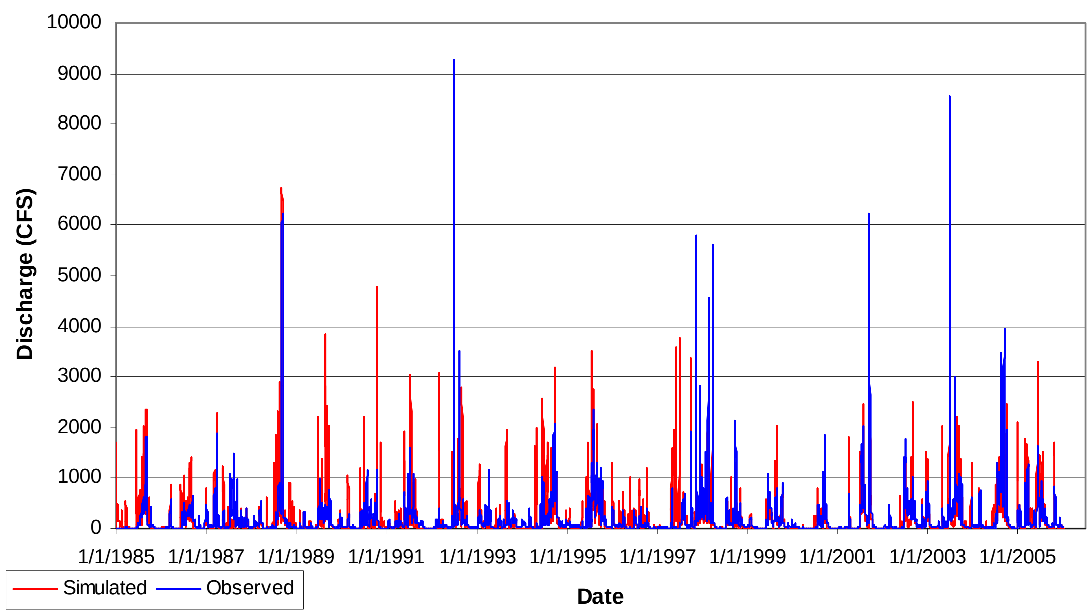
A 20-year predictive simulation was performed for the Curry and Hatchett Creek basins, using the calibrated parameters from the Cow Pen Slough and Myakka River basins. The Curry and Hatchet basin slope and land use distributions were used to develop the model data sets. The time series for the outflows from the Curry and Hatchett Creek basins for the 1985 to 2005 simulation period are shown in Appendix D.

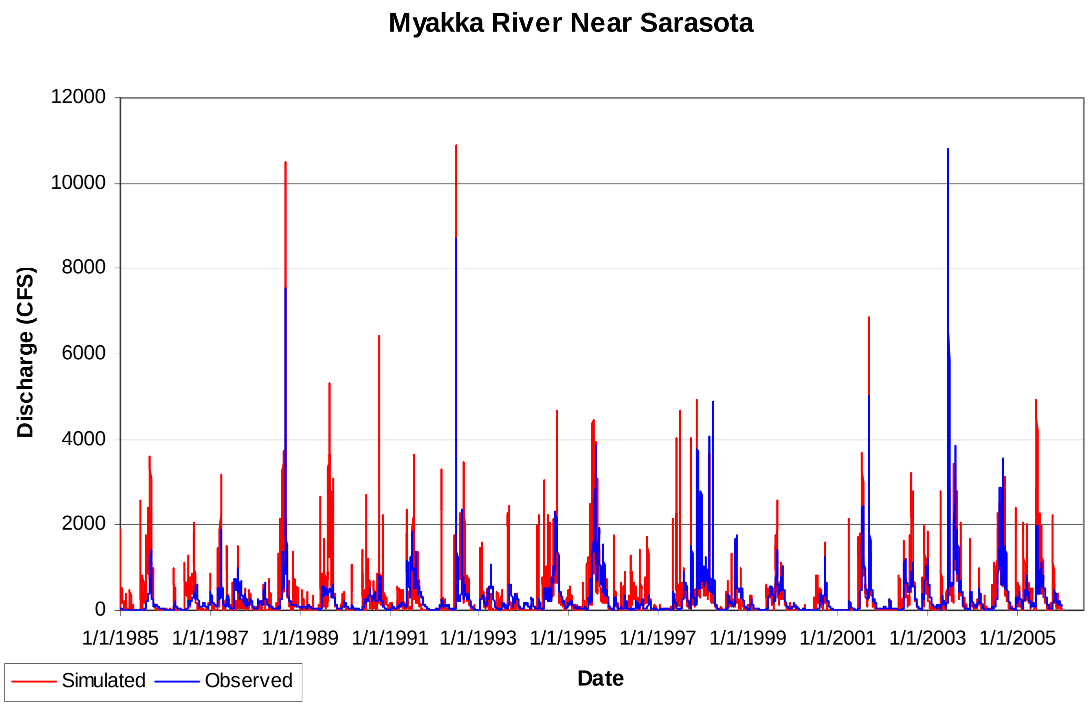
Appendix A: 20-year Observed vs Simulated Discharges

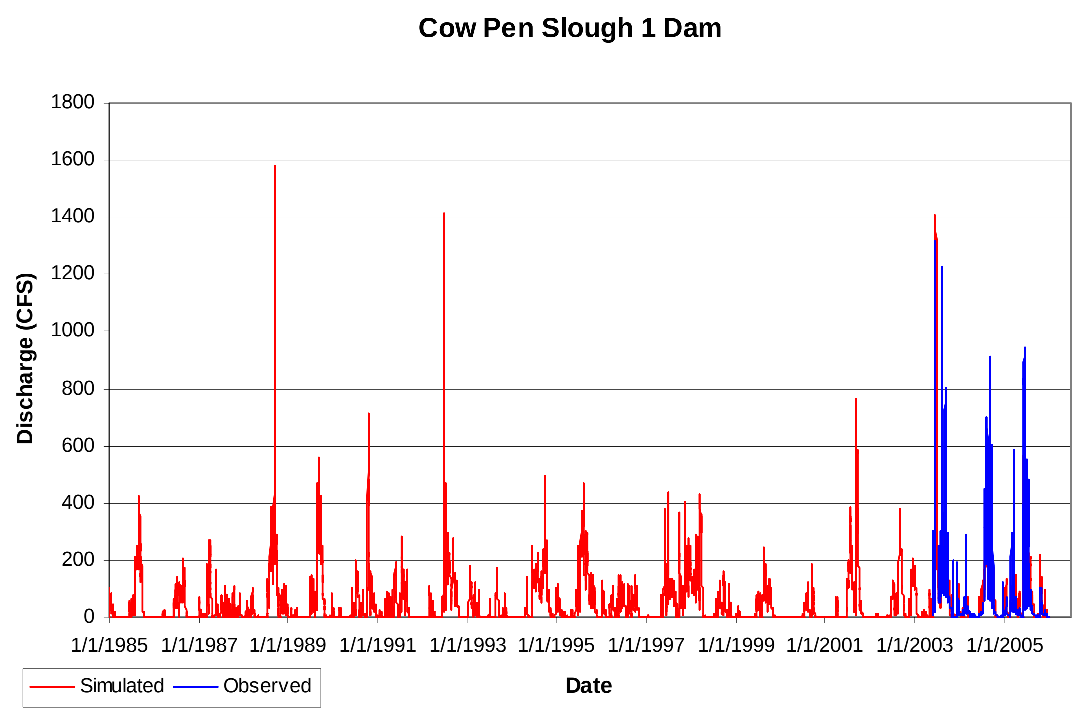
Howard Creek

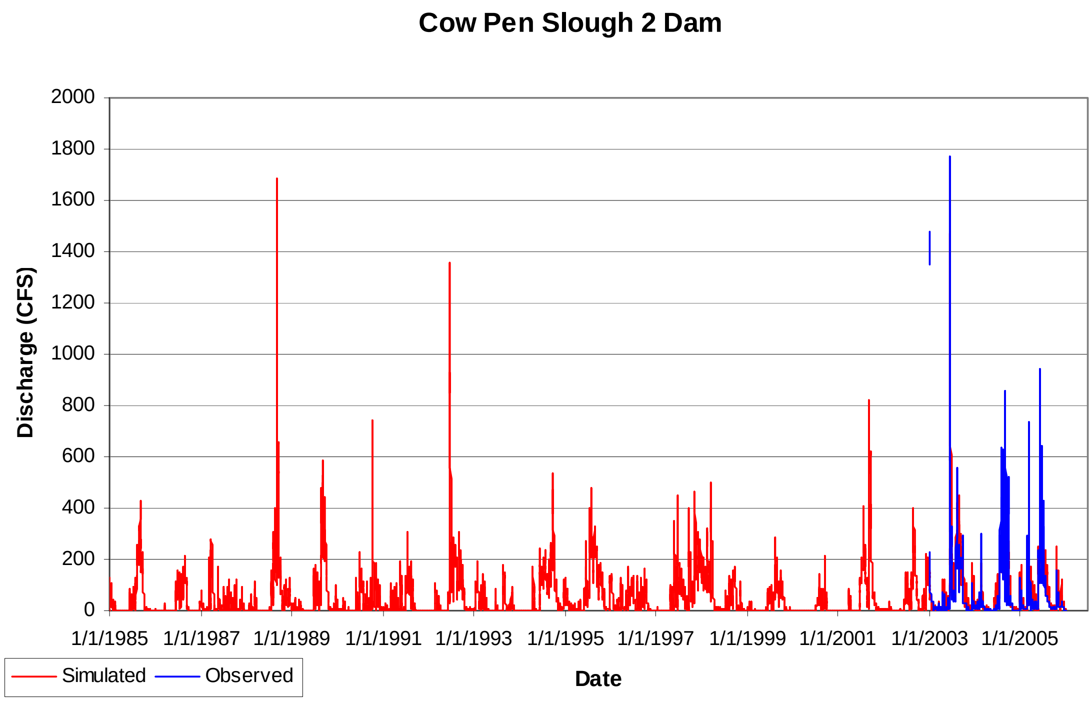


Myakka River Near Myakka City

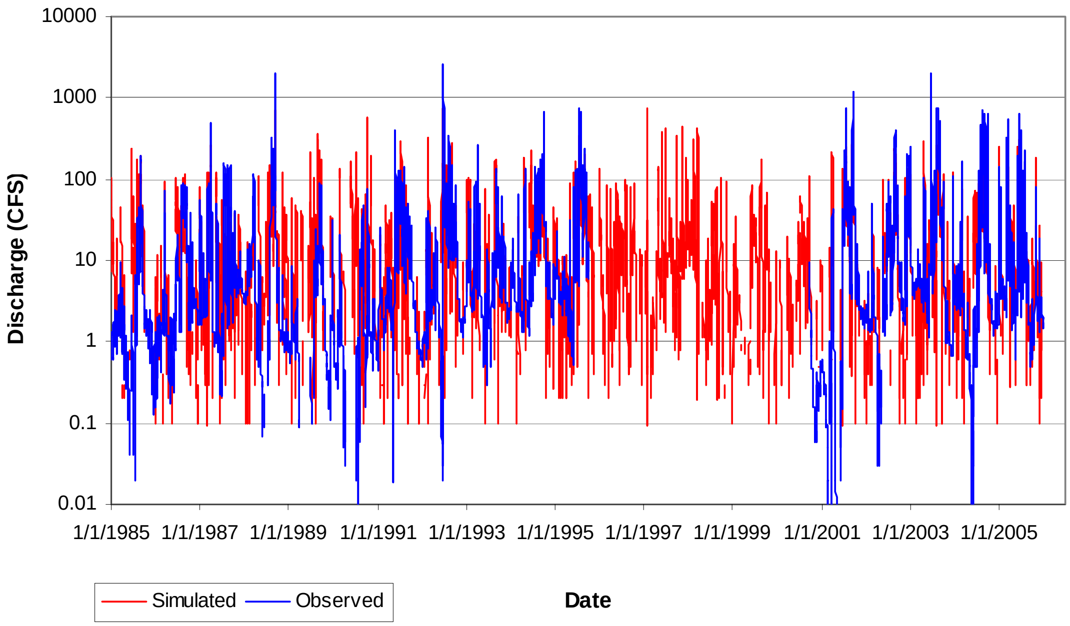



Myakka River Near Sarasota
Discharge (CFS)
12000
10000
8000
6000
4000
2000
0
1/1/1985
1/1/1987
1/1/1989
1/1/1991
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
Date
Simulated
Observed

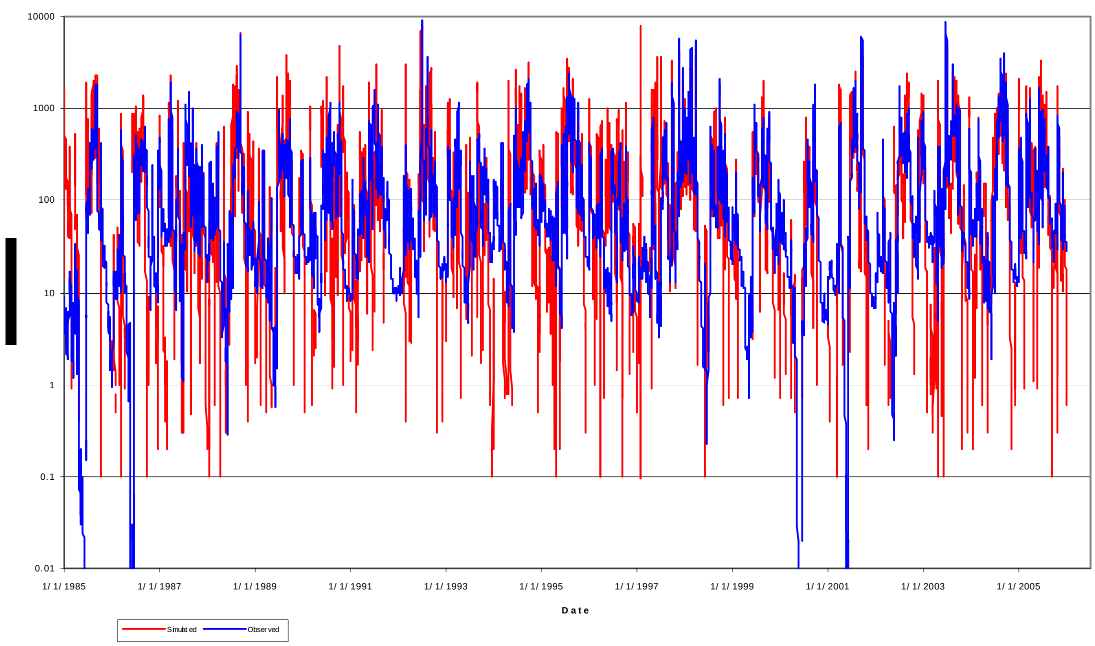

Cow Pen Slough 1 Dam
Discharge (CFS)
1800
1600
1400
1200
1000
800
600
400
200
0
1/1/1985
1/1/1987
1/1/1989
1/1/1991
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
Date
Simulated
Observed

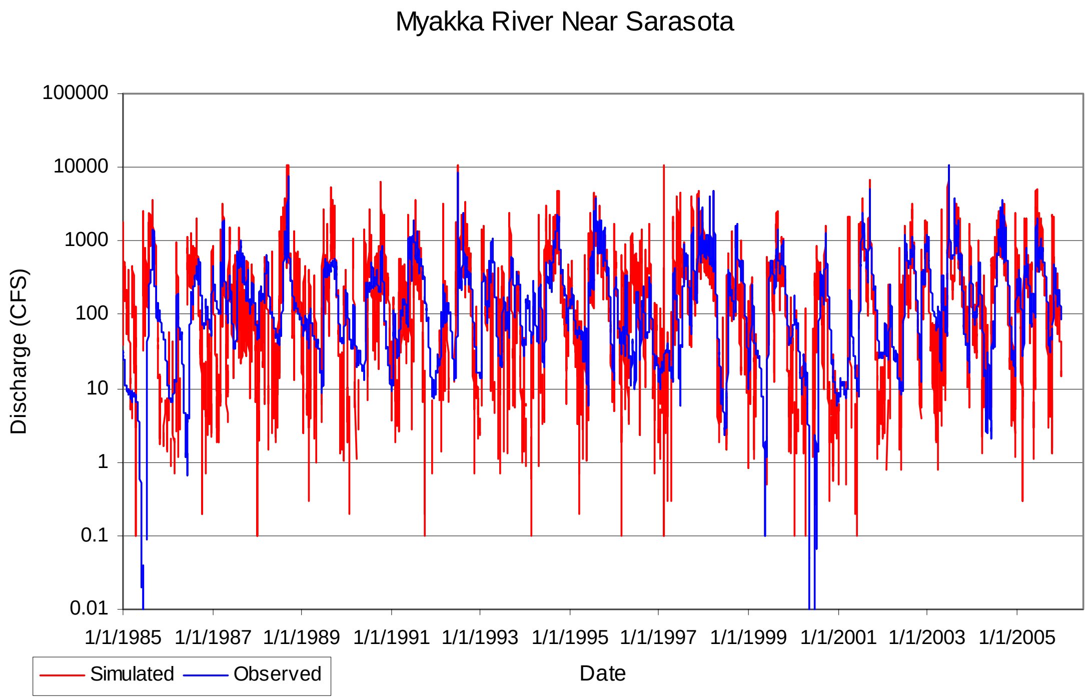

Cow Pen Slough 2 Dam
Discharge (CFS)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1/1/1985
1/1/1987
1/1/1989
1/1/1991
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
Date
Simulated
Observed

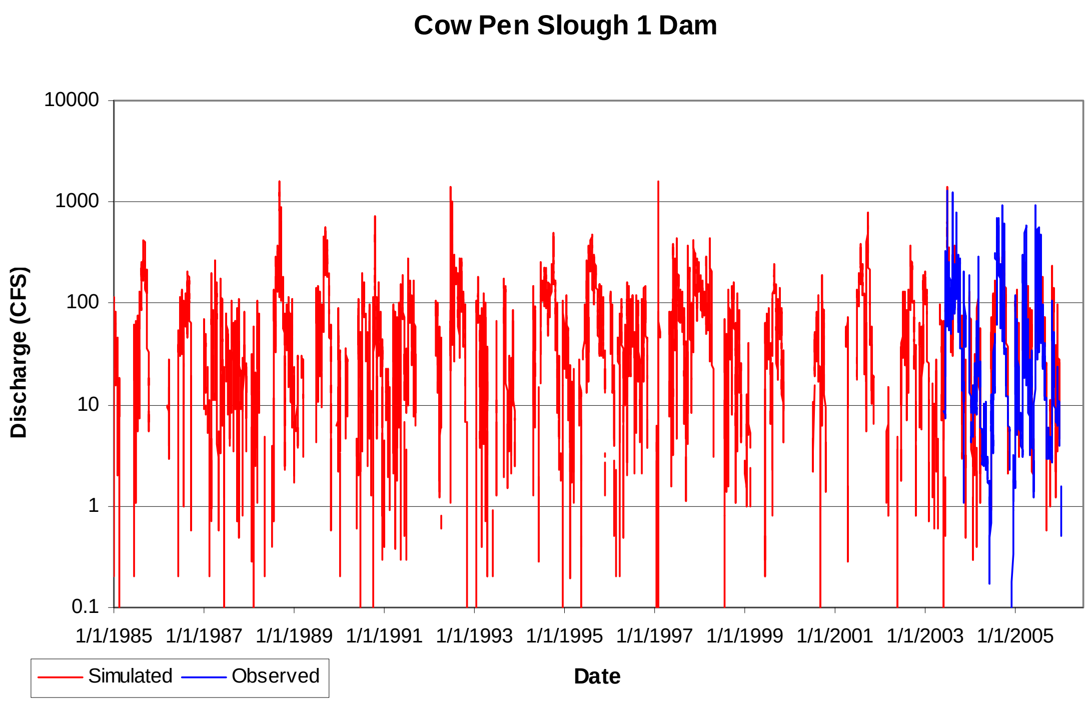
Howard Creek

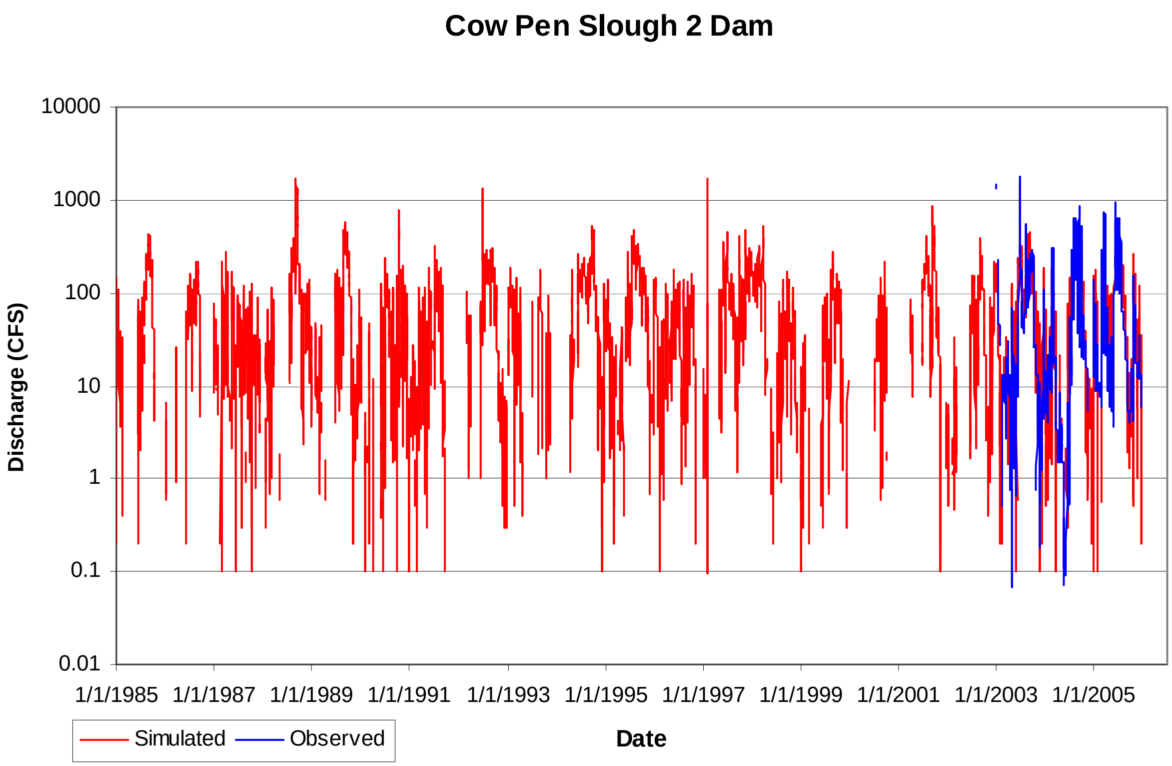


Myakka River Near Myakka City

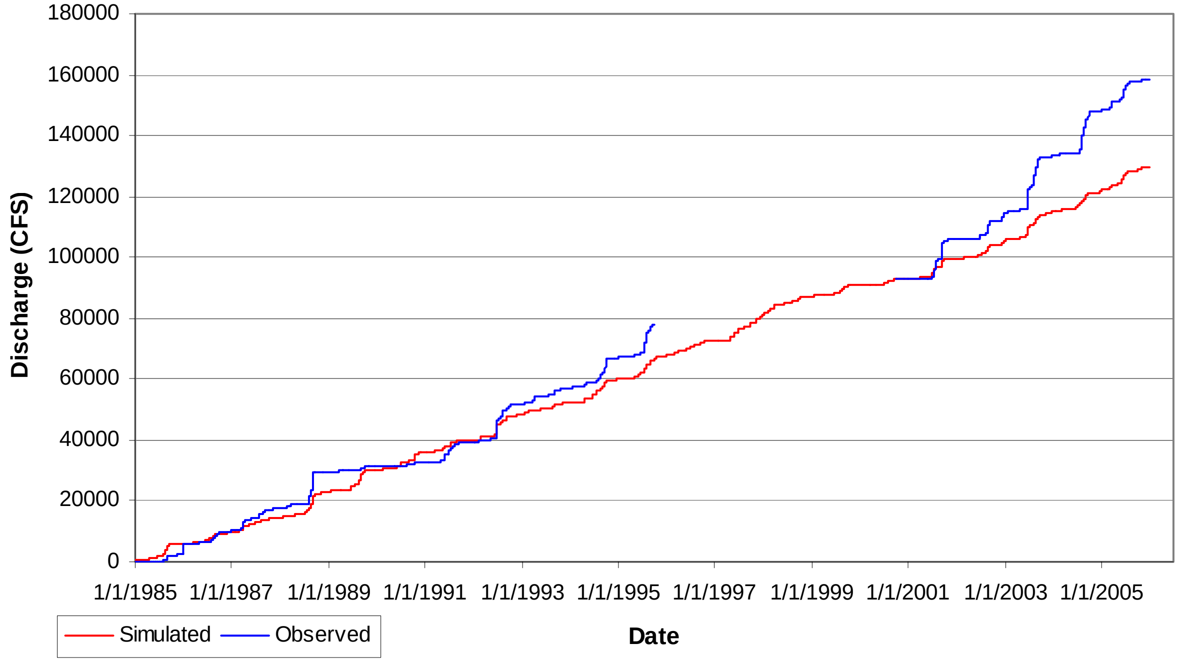



Myakka River Near Sarasota
100000
10000
1000
100
10
1
0.1
0.01
Discharge (CFS)
1/1/1985 1/1/1987 1/1/1989 1/1/1991 1/1/1993 1/1/1995 1/1/1997 1/1/1999 1/1/2001 1/1/2003 1/1/2005
Simulated
Observed
Date

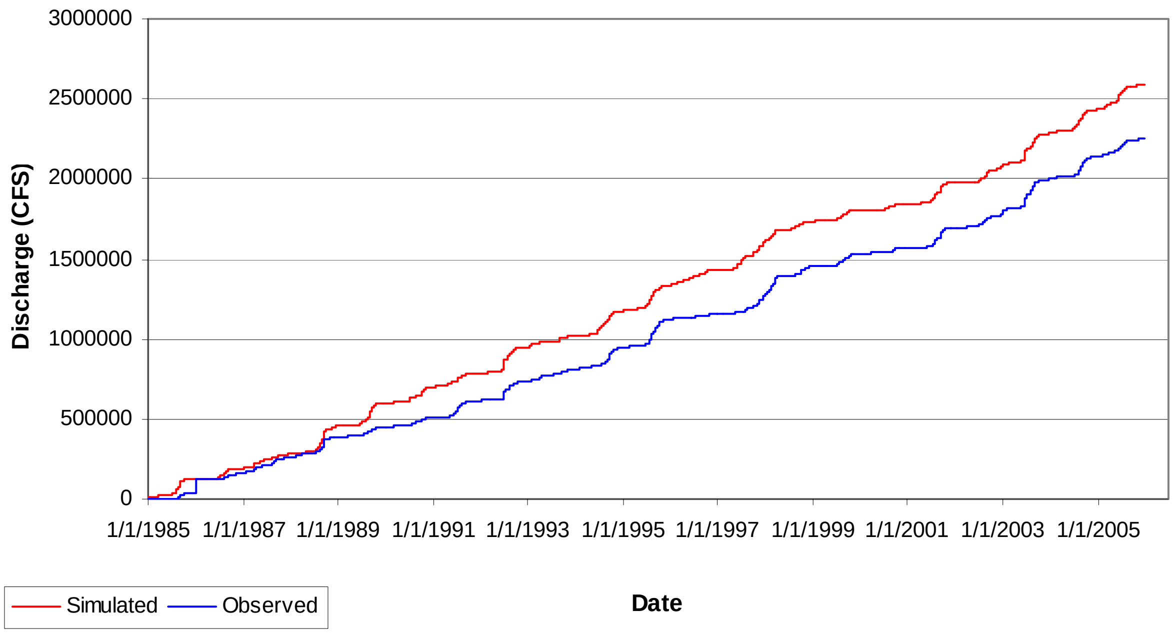

Cow Pen Slough 1 Dam
10000
1000
100
10
1
0.1
Discharge (CFS)
1/1/1985 1/1/1987 1/1/1989 1/1/1991 1/1/1993 1/1/1995 1/1/1997 1/1/1999 1/1/2001 1/1/2003 1/1/2005
Simulated
Observed
Date


Cow Pen Slough 2 Dam
Discharge (CFS)
10000
1000
100
10
1
0.1
0.01
1/1/1985
1/1/1987
1/1/1989
1/1/1991
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
Date
Simulated
Observed

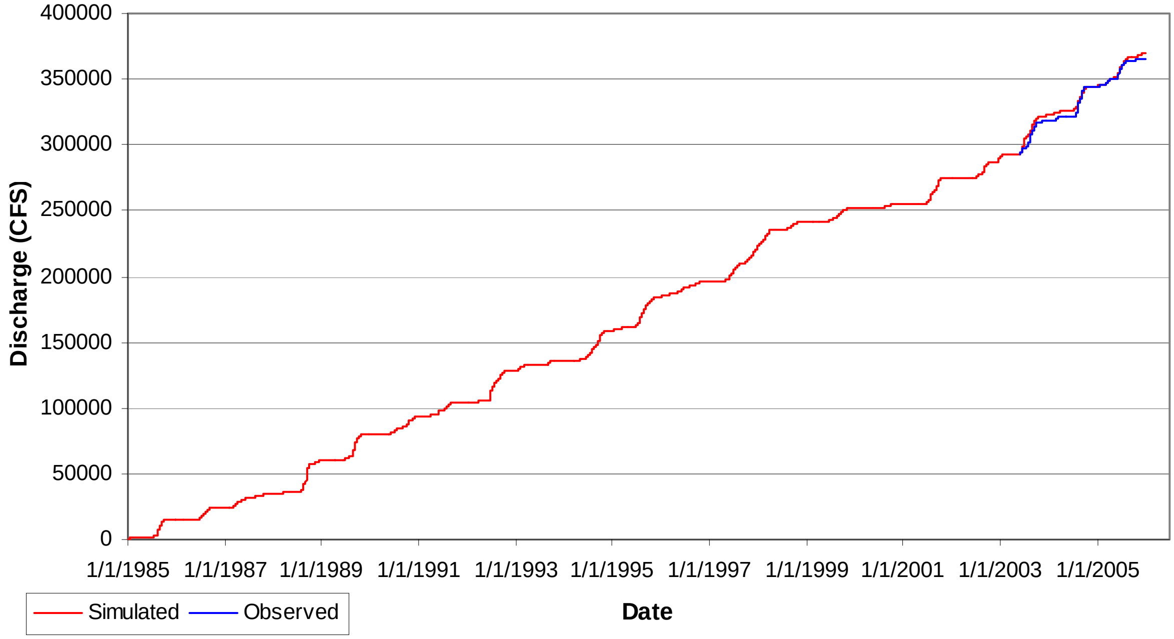
Howard Creek



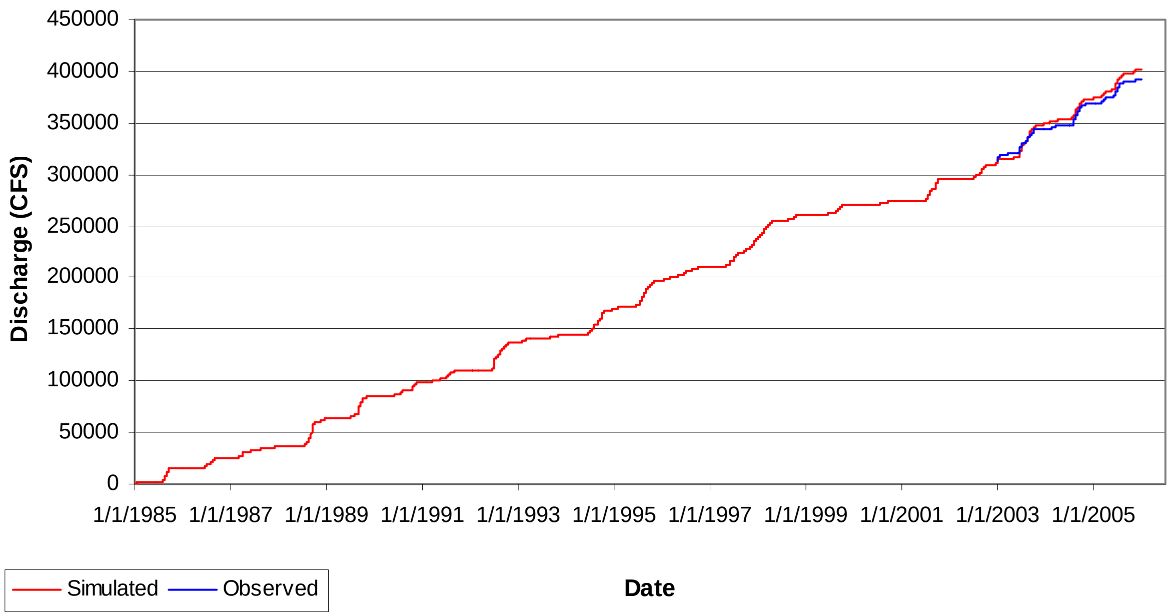
Myakka River Near Sarasota

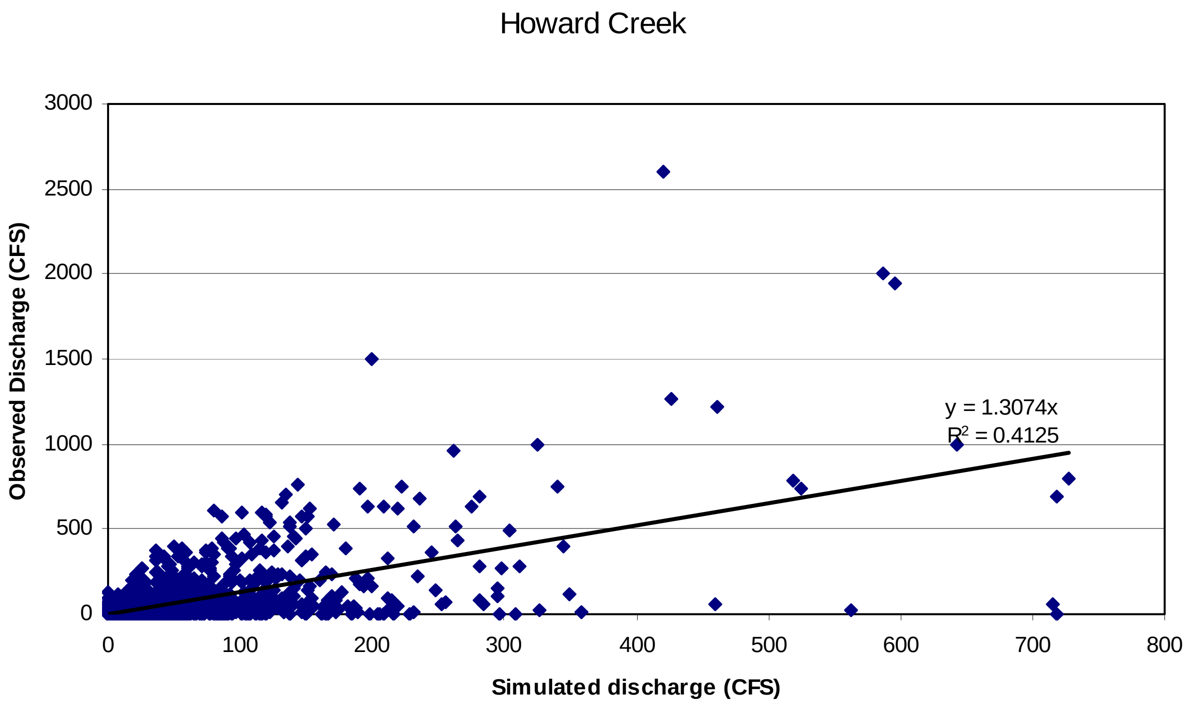


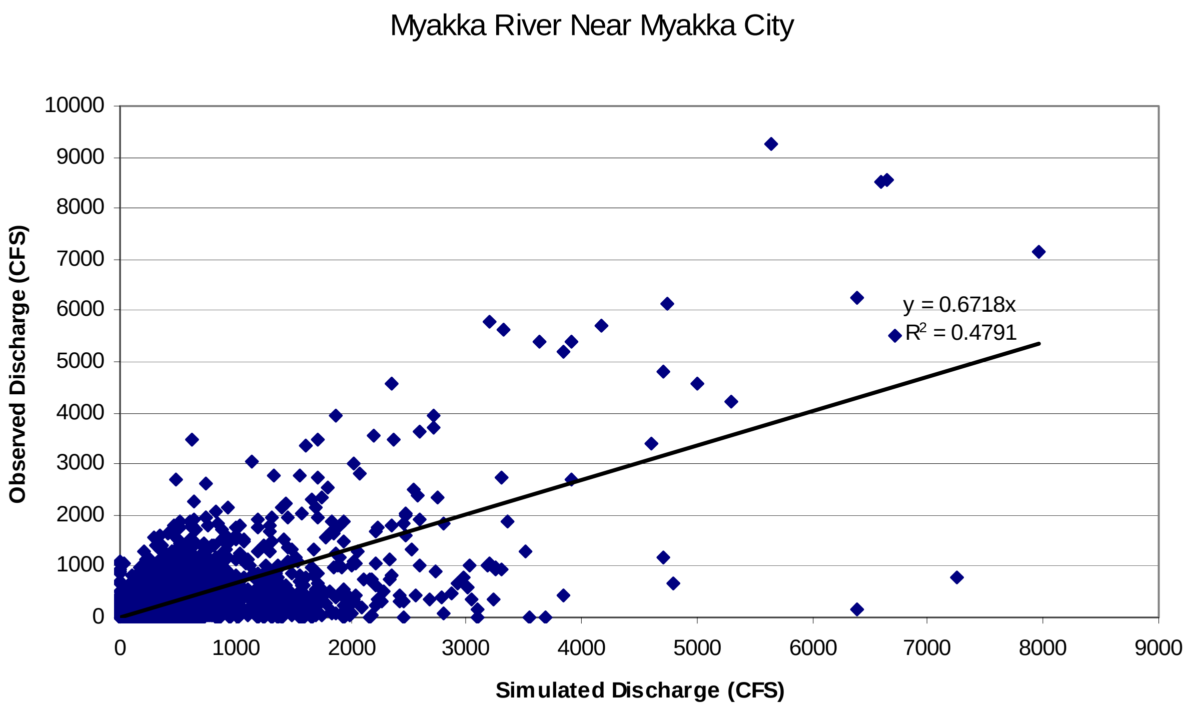
Cow Pen Slough 1 Dam

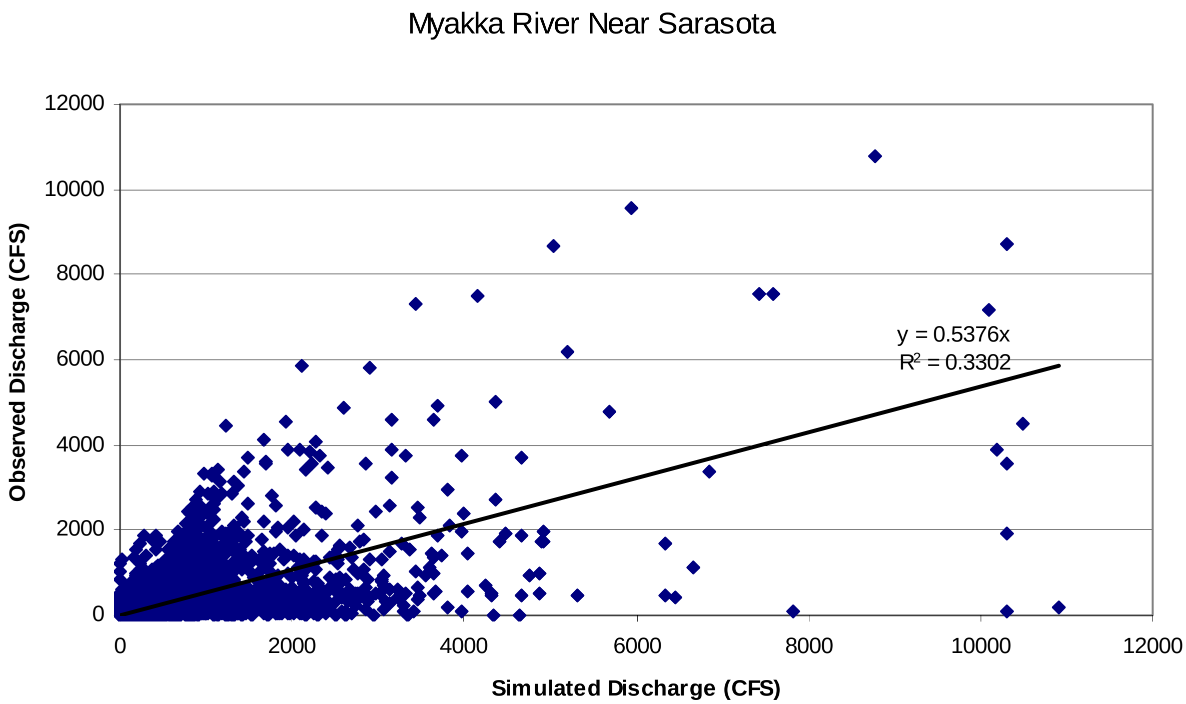


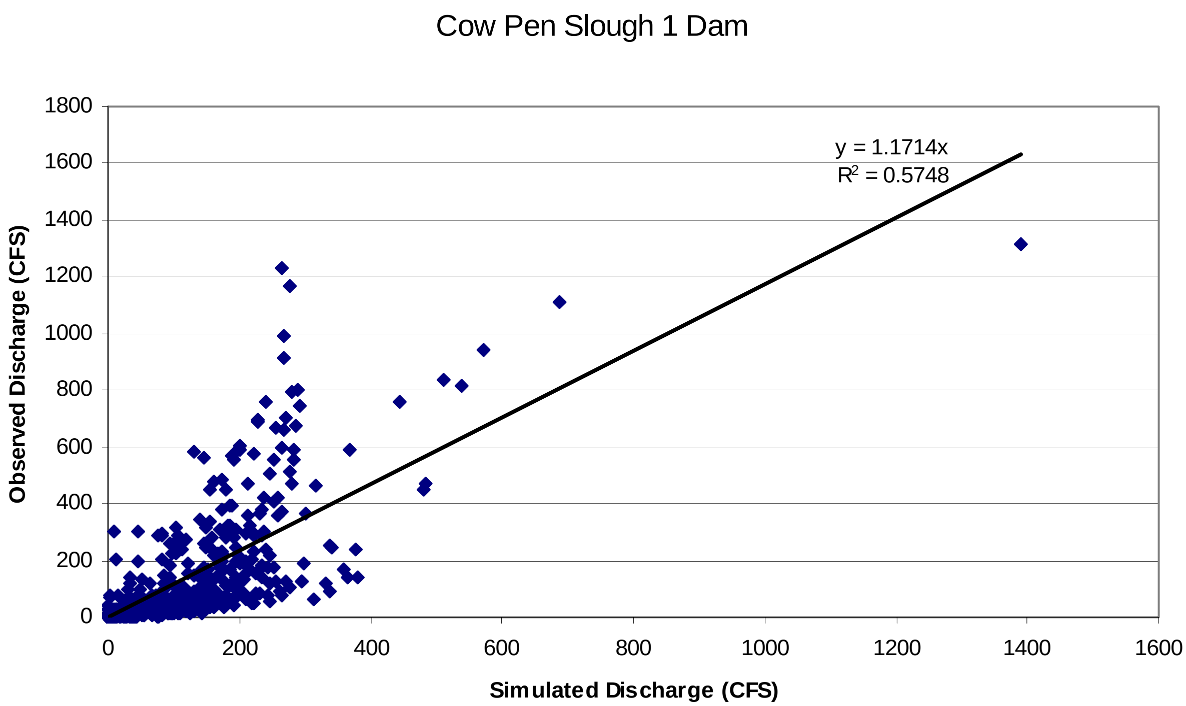
Cow Pen Slough 2 Dam

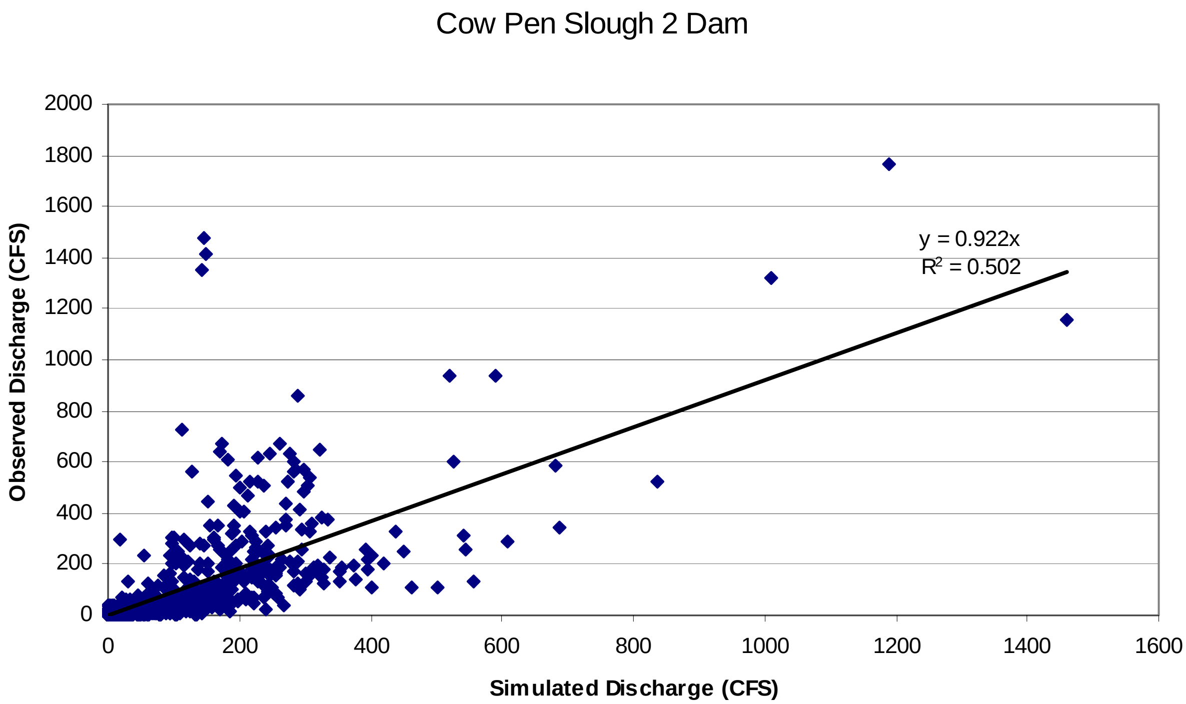



Howard Creek
Observed Discharge (CFS)
3000
2500
2000
1500
1000
500
0
0
100
200
300
400
500
600
700
800
Simulated discharge (CFS)
y = 1.3074x
R^2 = 0.4125

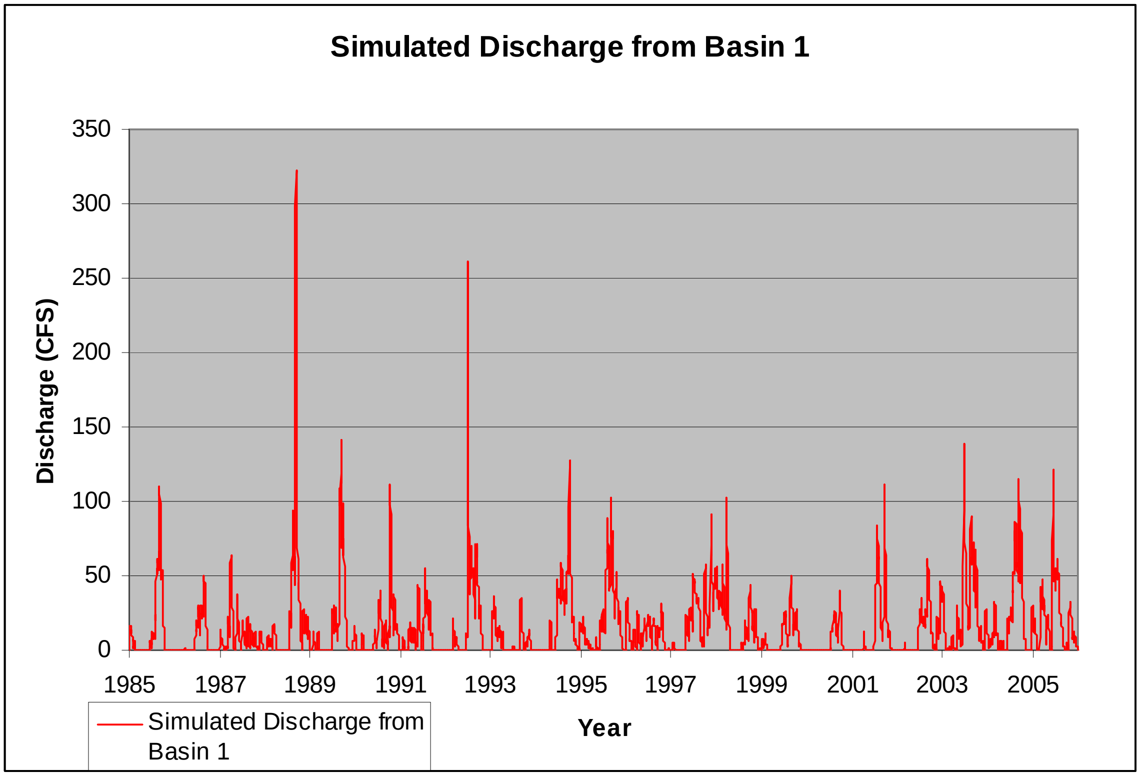

Myakka River Near Myakka City
Observed Discharge (CFS)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Simulated Discharge (CFS)
y = 0.6718x
R^2 = 0.4791

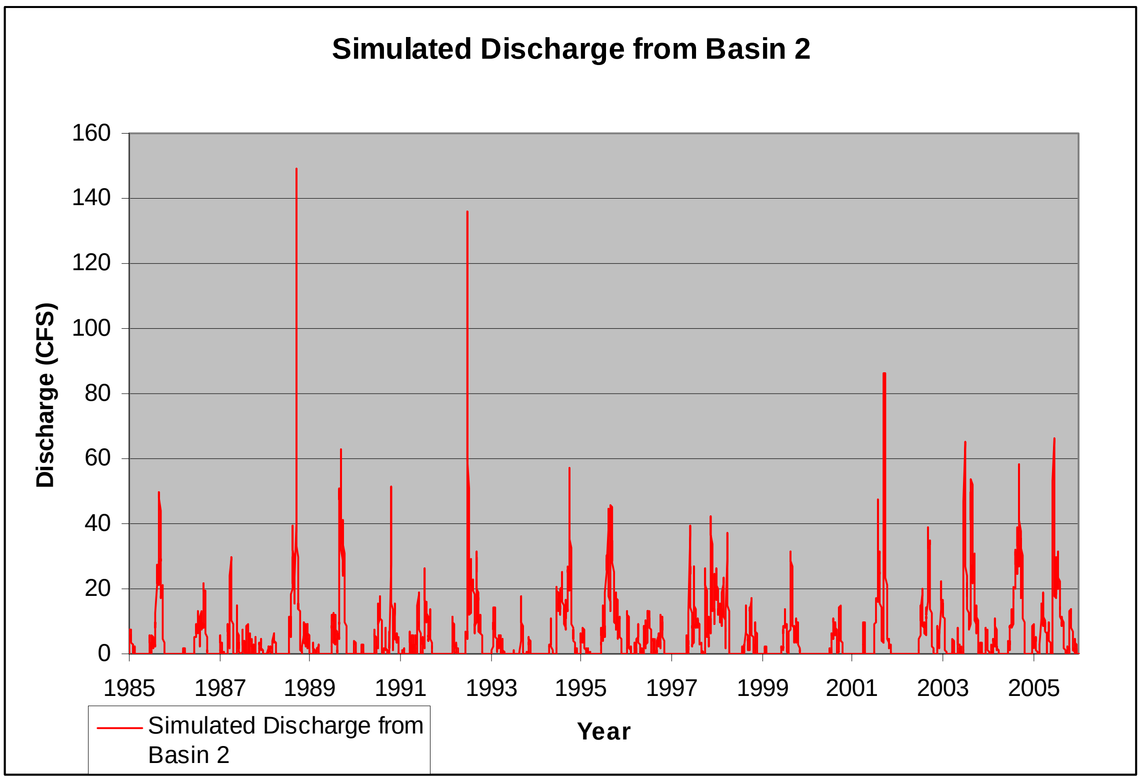

Myakka River Near Sarasota
12000
10000
8000
6000
4000
2000
0
Observed Discharge (CFS)
0
2000
4000
6000
8000
10000
12000
Simulated Discharge (CFS)
y = 0.5376x
R2 = 0.3302

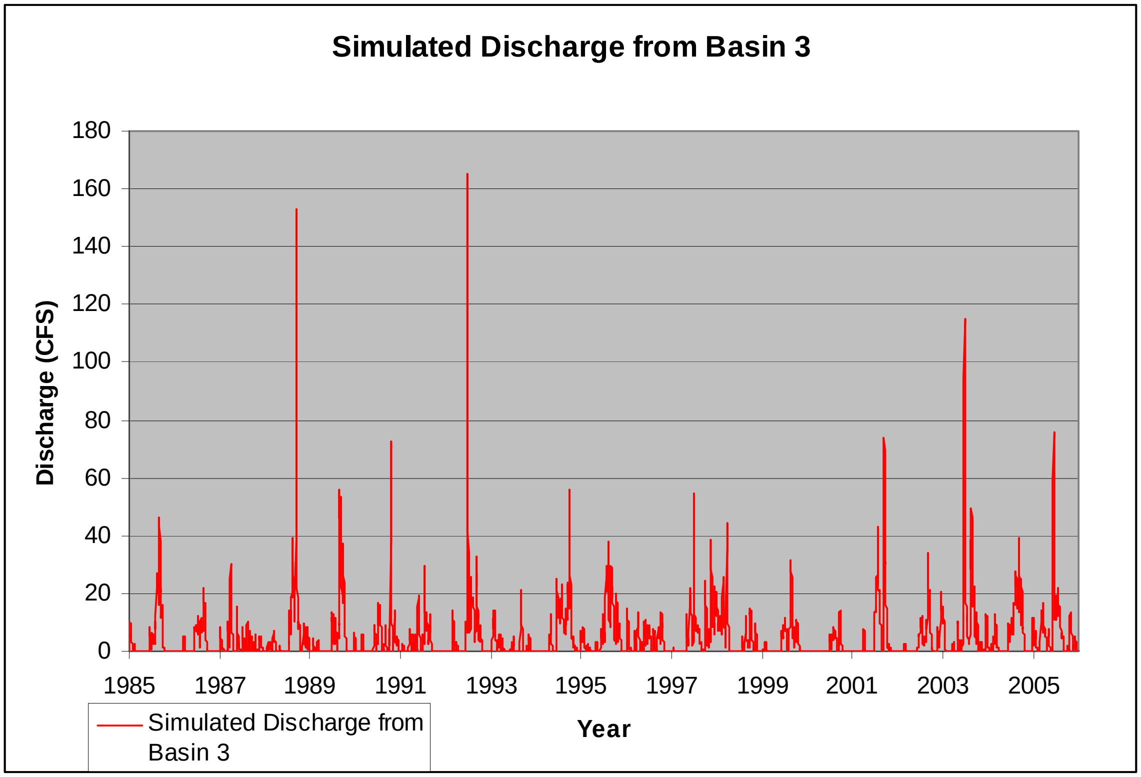

Cow Pen Slough 1 Dam
1800
1600
1400
1200
1000
800
600
400
200
0
Observed Discharge (CFS)
0
200
400
600
800
1000
1200
1400
1600
Simulated Discharge (CFS)
y = 1.1714x
R2 = 0.5748

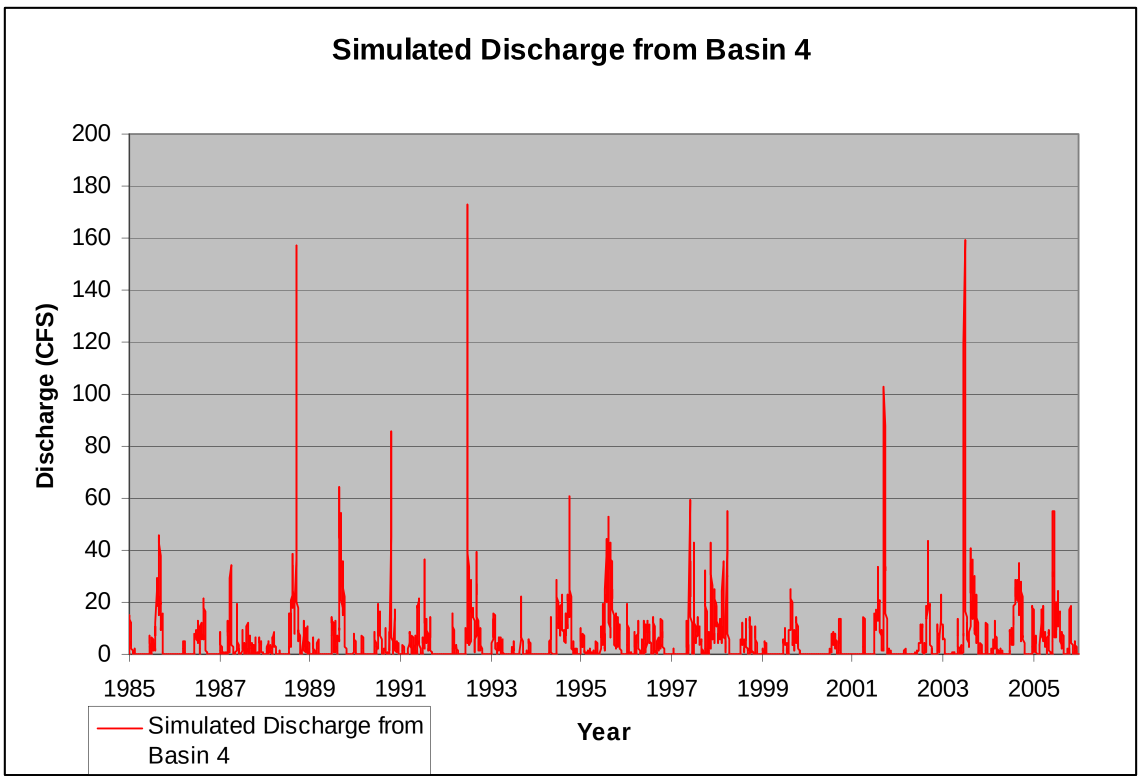

Cow Pen Slough 2 Dam
Observed Discharge (CFS)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
1400
1600
Simulated Discharge (CFS)
y = 0.922x
R^2 = 0.502

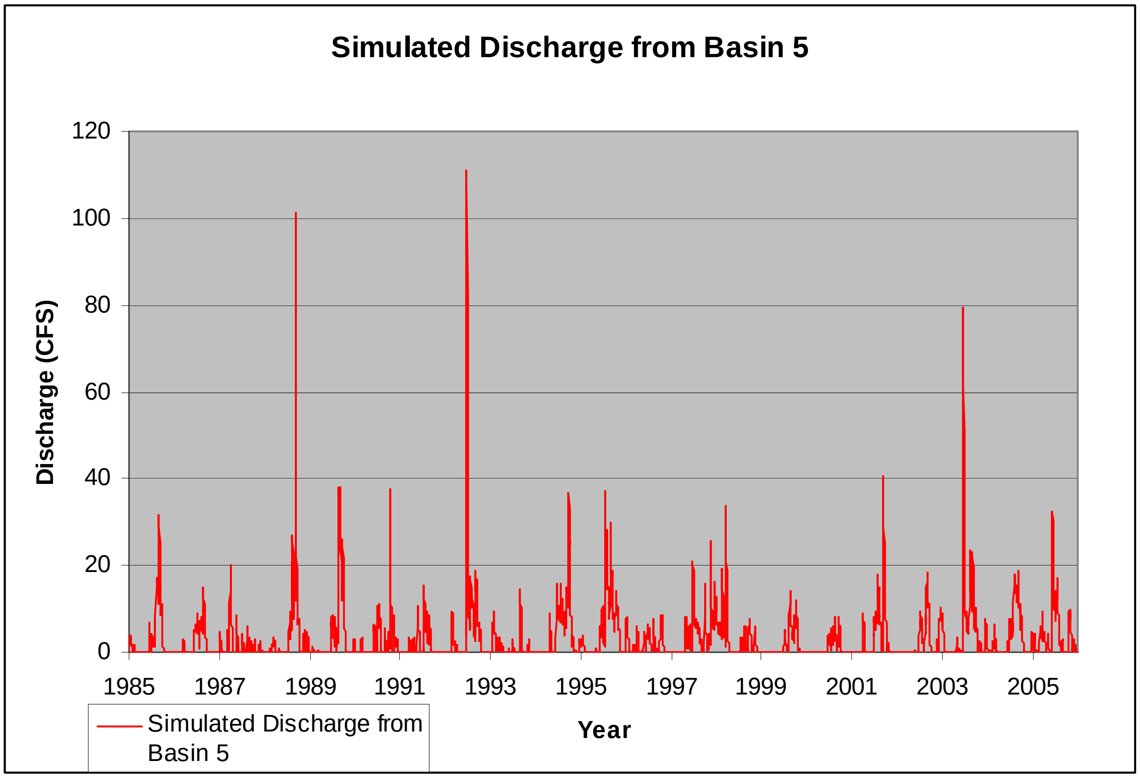
Appendix B: 20-year Simulated Sub-basin Discharges

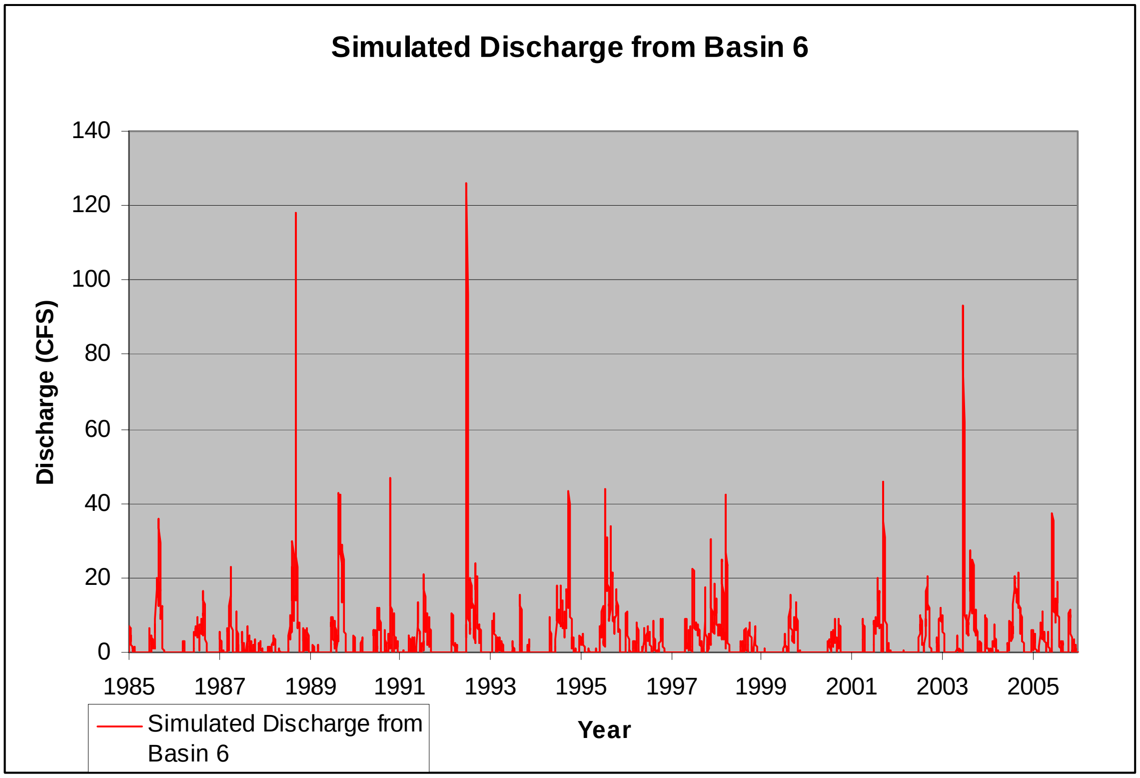


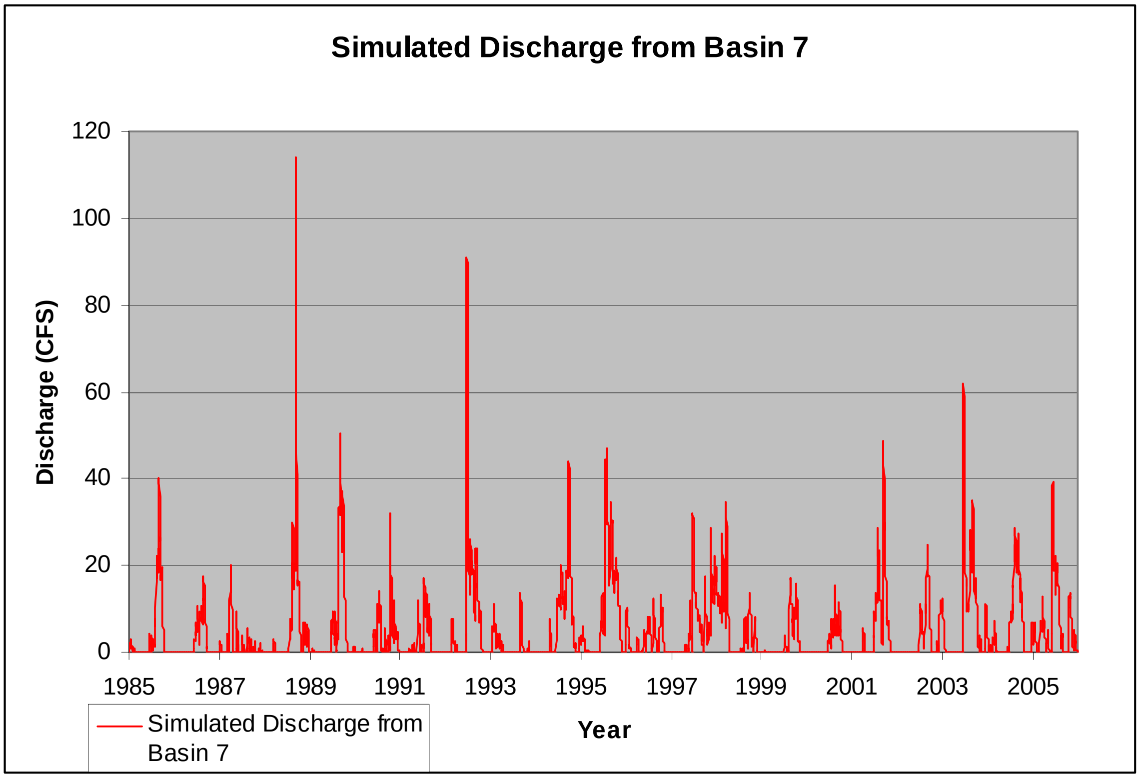


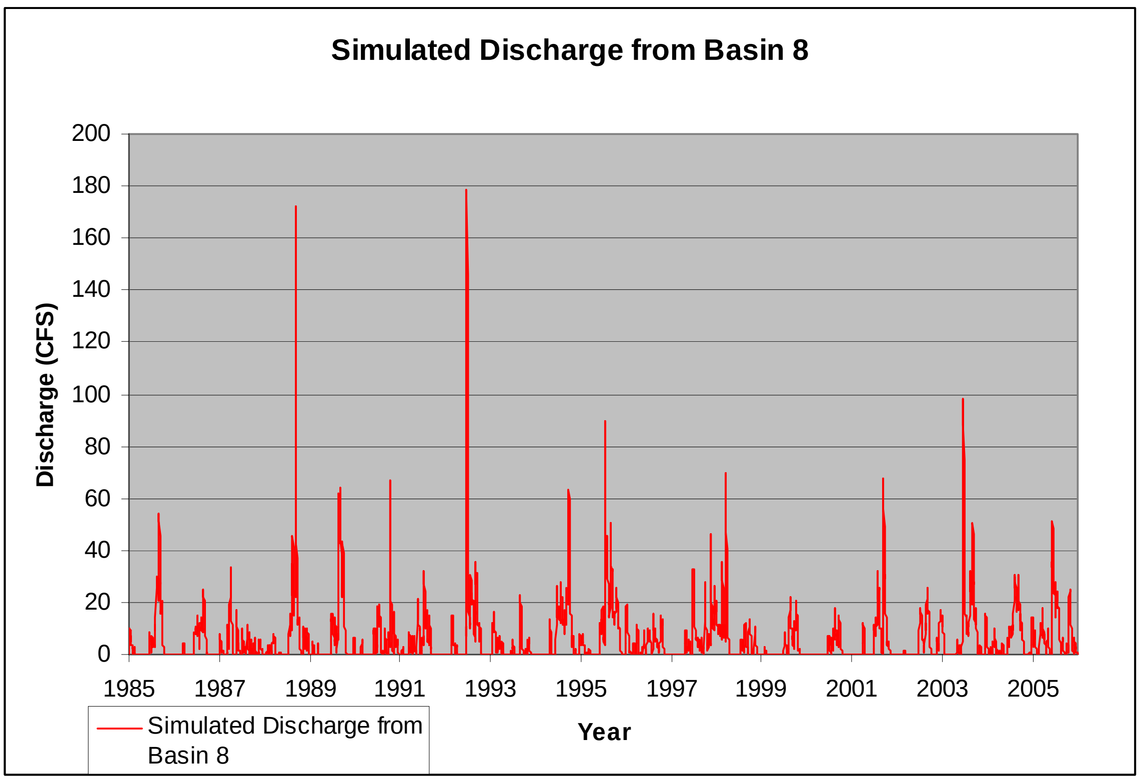

Simulated Discharge from Basin 3
Discharge (CFS)
180
160
140
120
100
80
60
40
20
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 3

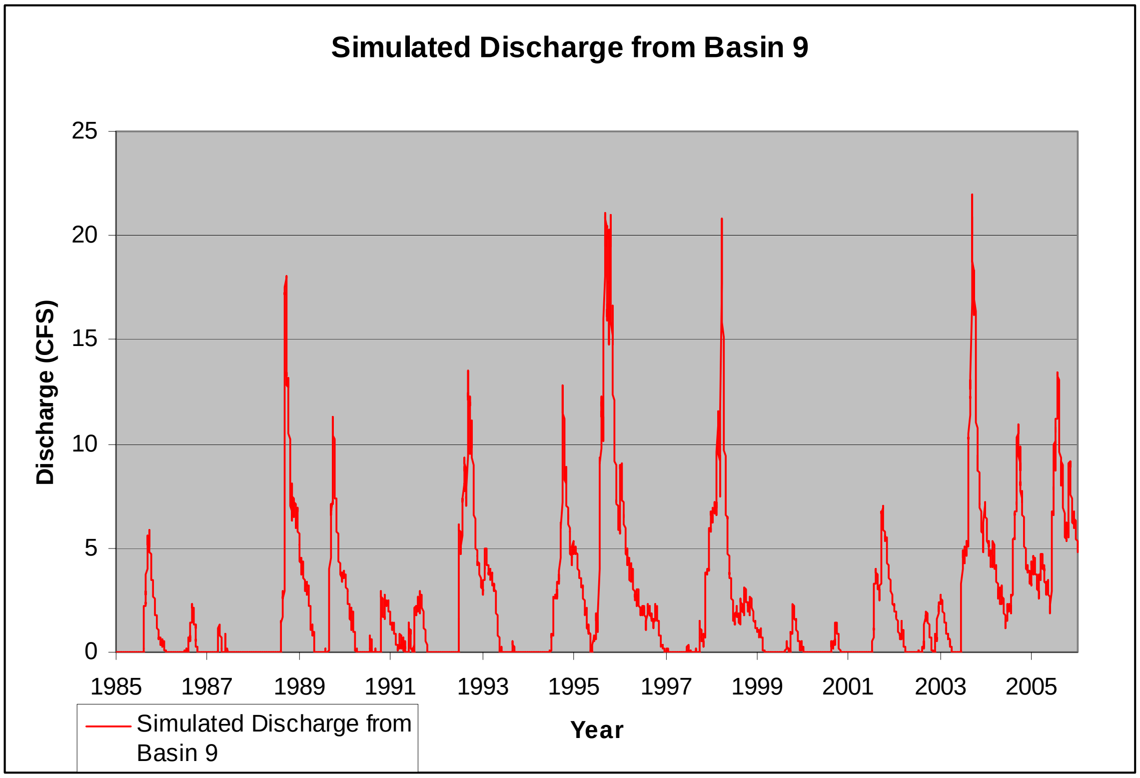

Simulated Discharge from Basin 4
Discharge (CFS)
200
180
160
140
120
100
80
60
40
20
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 4

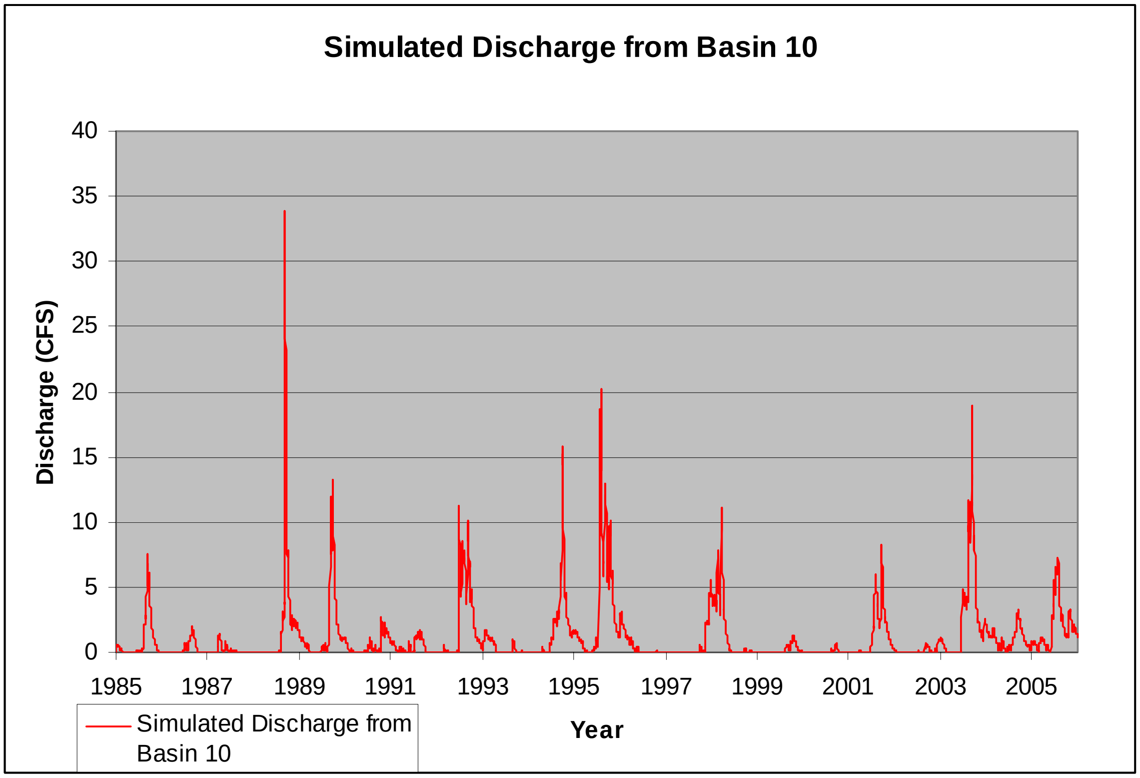

Simulated Discharge from Basin 5
Discharge (CFS)
120
100
80
60
40
20
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 5

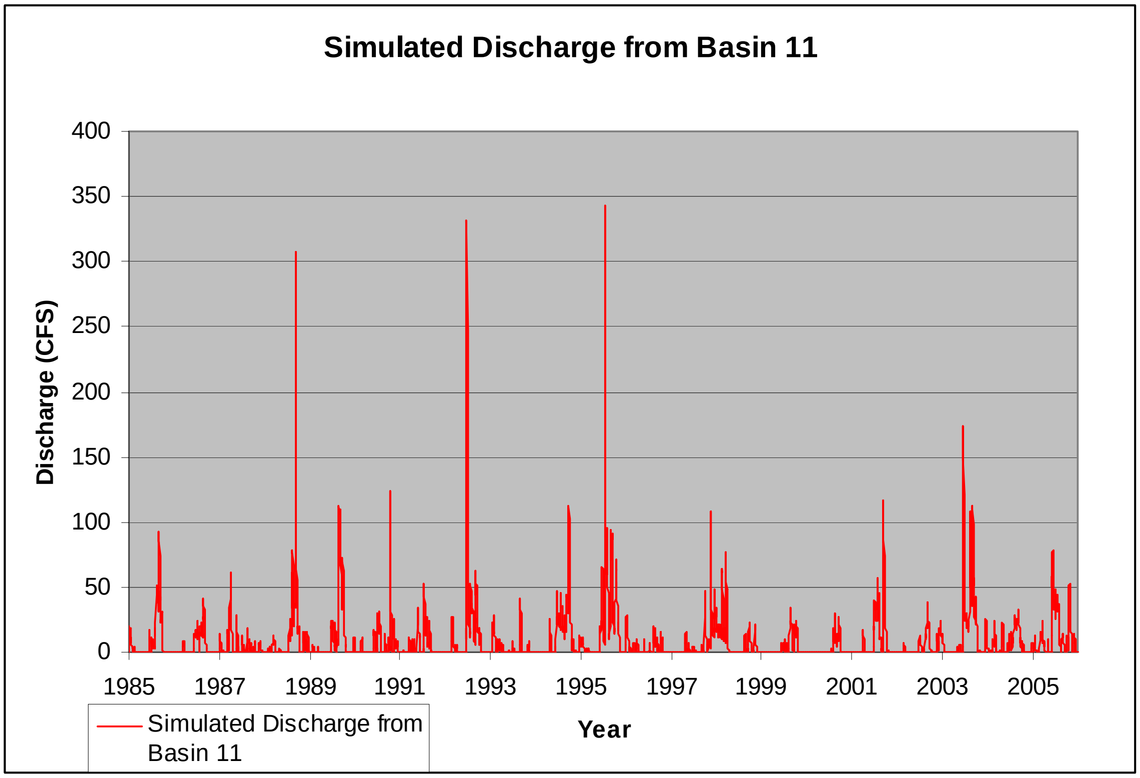

Simulated Discharge from Basin 6
Discharge (CFS)
140
120
100
80
60
40
20
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 6

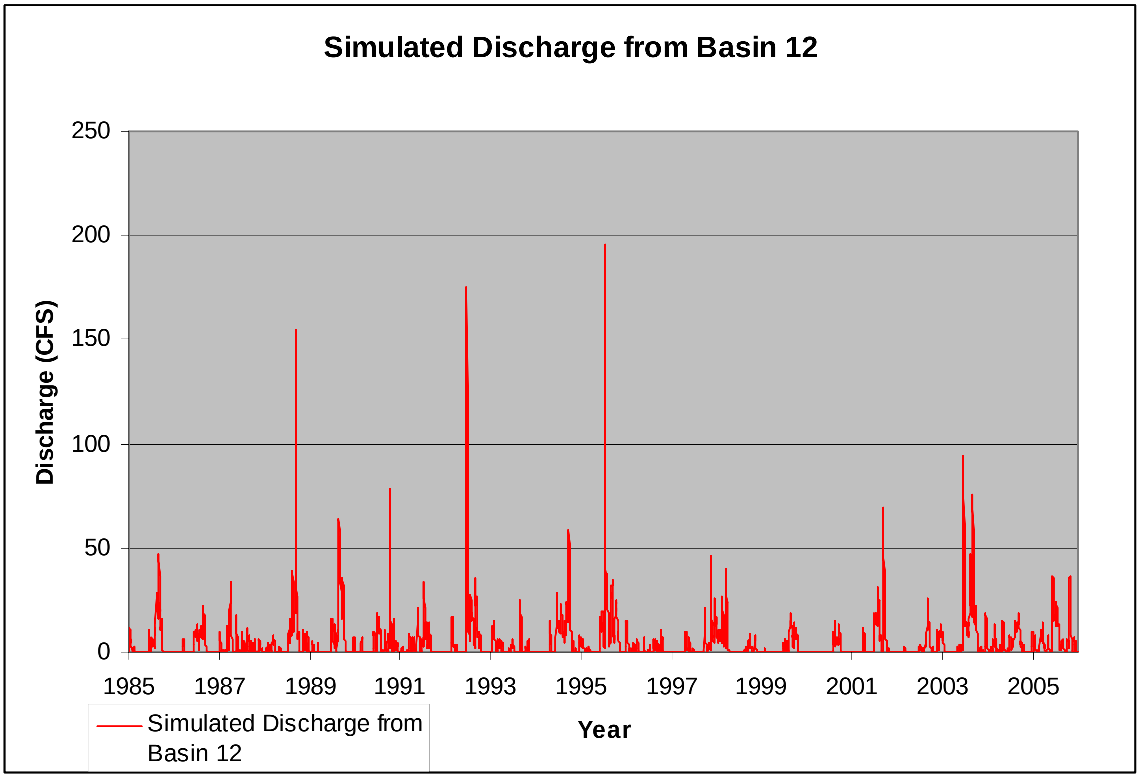

Simulated Discharge from Basin 7
Discharge (CFS)
120
100
80
60
40
20
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 7

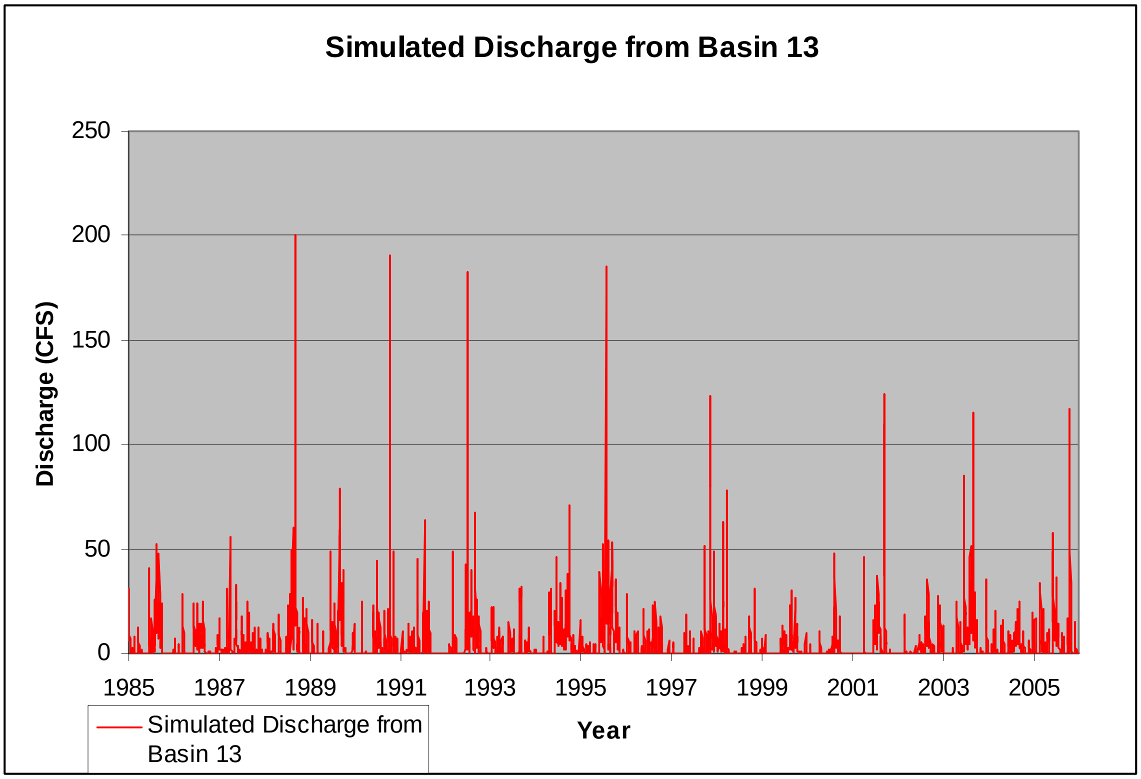

Simulated Discharge from Basin 8
Discharge (CFS)
200
180
160
140
120
100
80
60
40
20
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 8

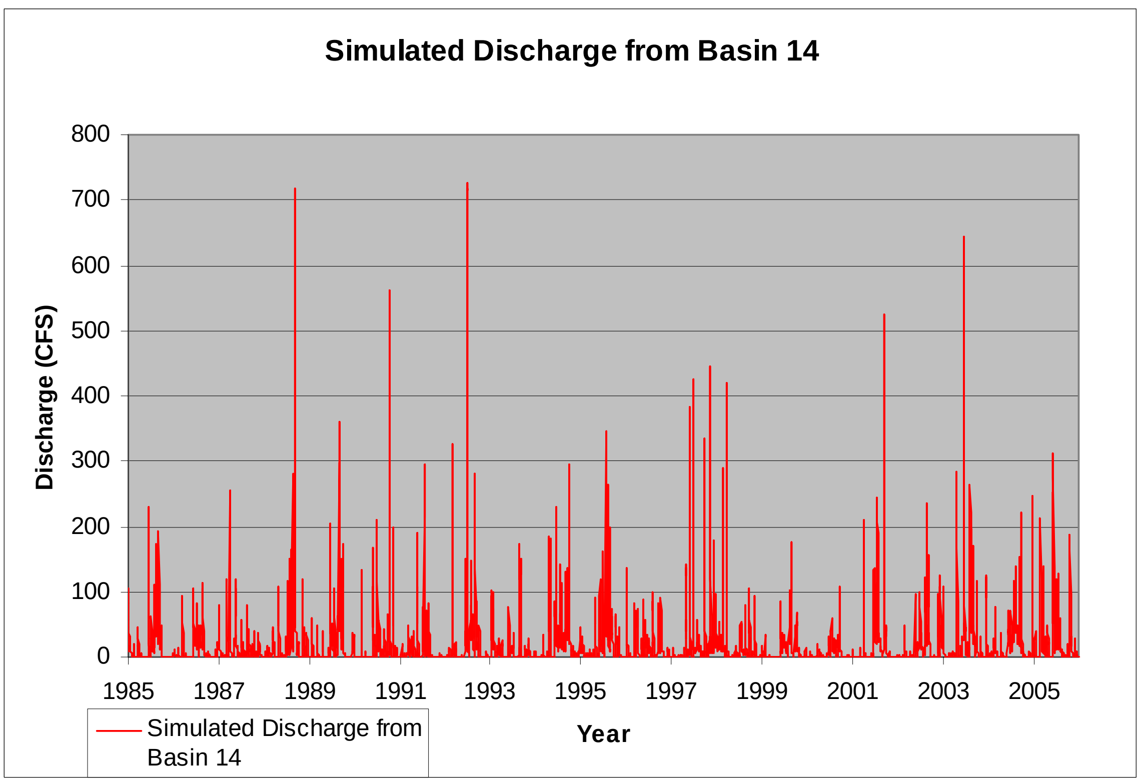

Simulated Discharge from Basin 9
Discharge (CFS)
25
20
15
10
5
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 9

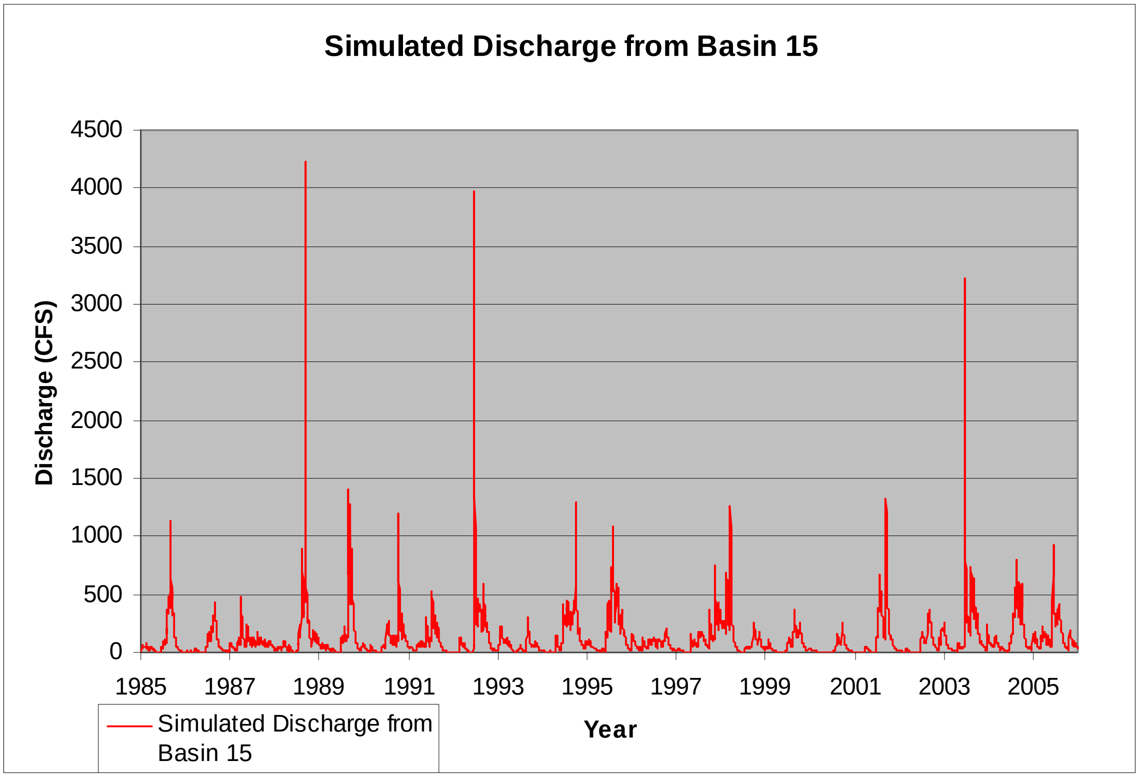

Simulated Discharge from Basin 10
Discharge (CFS)
40
35
30
25
20
15
10
5
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 10

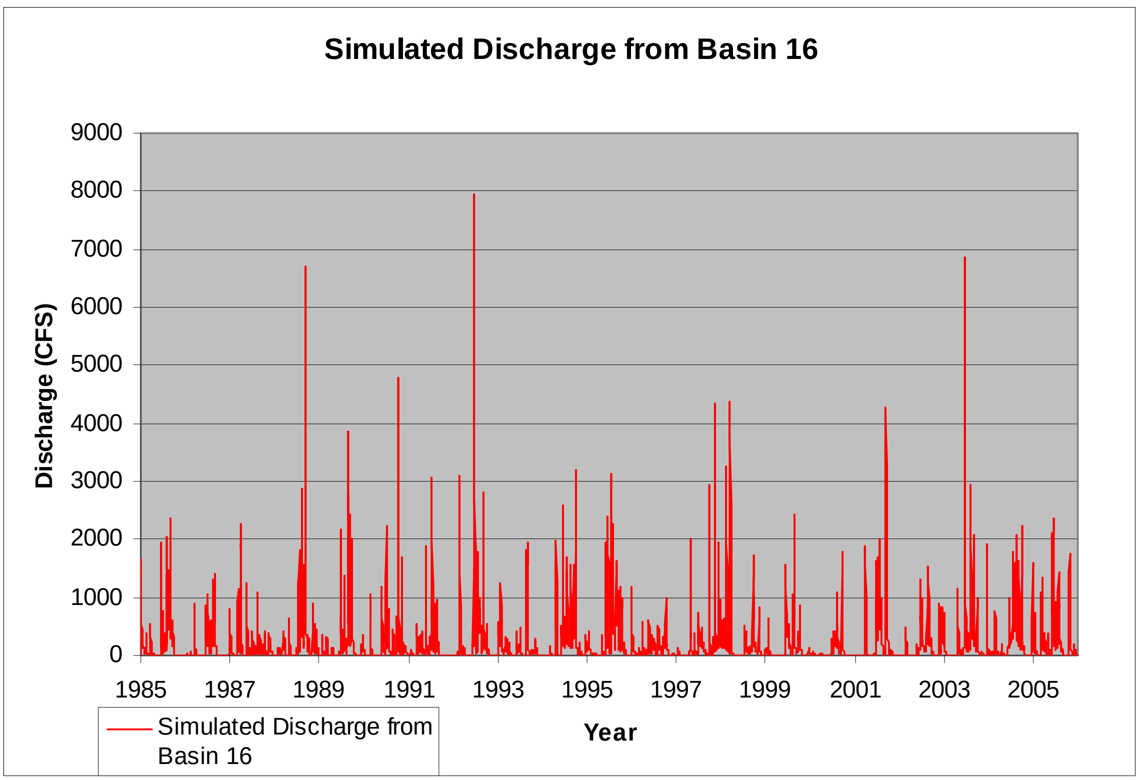

Simulated Discharge from Basin 11
Discharge (CFS)
400
350
300
250
200
150
100
50
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 11


Simulated Discharge from Basin 12
Discharge (CFS)
250
200
150
100
50
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 12


Simulated Discharge from Basin 13
Discharge (CFS)
250
200
150
100
50
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 13


Simulated Discharge from Basin 14
Discharge (CFS)
800
700
600
500
400
300
200
100
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 14


Simulated Discharge from Basin 15
Discharge (CFS)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 15


Simulated Discharge from Basin 16
Discharge (CFS)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year
Simulated Discharge from Basin 16

Appendix C: HSPF Parameter Files

Basins Parameters

```
RUN

GLOBAL
  Cow PenSlough, Base5 scen, dec. LZETP, inc. INFILT
  START       1985/01/01 00:00  END    2005/12/31 24:00
  RUN INTERP OUTPT LEVELS    5    0
  RESUME     0 RUN     1                          UNITS    1
END GLOBAL

FILES
<FILE>  <UN#>***<----FILE NAME-------------------------------------------------
>
MESSU      24   102_CPS_BASIN_out.ech
           91   102_CPS_BASIN_out.out
WDM1       25   102_CPS_BASIN_out.wdm
WDM2       26   dadada.wdm
BINO       92   102_CPS_BASIN_out.hbn
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      PERLND      12
      PERLND      13
      PERLND      14
      PERLND      17
      IMPLND      11
      PERLND      21
      PERLND      22
      PERLND      23
      PERLND      24
      PERLND      27
      IMPLND      21
      PERLND      31
      PERLND      32
      PERLND      33
```

```
PERLND    34
IMPLND    31
PERLND    41
PERLND    42
PERLND    43
PERLND    44
IMPLND    41
PERLND    51
PERLND    52
PERLND    53
PERLND    54
IMPLND    51
PERLND    61
PERLND    62
PERLND    63
PERLND    64
IMPLND    61
PERLND    71
PERLND    73
PERLND    74
IMPLND    71
PERLND    81
PERLND    82
PERLND    83
PERLND    84
IMPLND    81
PERLND    91
PERLND    92
PERLND    93
PERLND    94
IMPLND    91
PERLND   101
PERLND   102
PERLND   103
PERLND   104
IMPLND   101
PERLND   111
PERLND   112
PERLND   113
PERLND   114
```

```
      PERLND     117
      IMPLND     111
      PERLND     121
      PERLND     122
      PERLND     123
      PERLND     124
      PERLND     127
      IMPLND     121
      PERLND     131
      PERLND     132
      PERLND     133
      PERLND     134
      PERLND     137
      IMPLND     131
      PERLND     141
      PERLND     142
      PERLND     143
      PERLND     144
      IMPLND     141
      PERLND     151
      PERLND     152
      PERLND     153
      PERLND     154
      PERLND     157
      IMPLND     151
      PERLND     161
      PERLND     162
      PERLND     163
      PERLND     164
      PERLND     167
      IMPLND     161
      COPY         1
      COPY         2
    END INGRP
END OPN SEQUENCE

PERLND
  ACTIVITY
*** <PLS >               Active Sections                               ***
*** x -  x ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
```

```
   11  167    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
*** < PLS>                   Print-flags                               PIVL
PYR
*** x  - x ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC
   11  167    4    4    5    4    4    4    4    4    4    4    4    4    1
12
  END PRINT-INFO

  BINARY-INFO
*** < PLS>               Binary Output Flags                           PIVL
PYR
*** x  - x ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC
   11  167    4    4    3    4    4    4    4    4    4    4    4    4    1
12
  END BINARY-INFO

  GEN-INFO
***             Name                  Unit-systems   Printer BinaryOut
*** <PLS >                               t-series Engl Metr Engl Metr
*** x -  x                                in  out
   11      URBAN                           1    1   91    0   92    0
   12      IRRIGATED LAND                  1    1   91    0   92    0
   13      GRASS/PASTURE                   1    1   91    0   92    0
   14      FORESTED                        1    1   91    0   92    0
   17      MINING/OTHER                    1    1   91    0   92    0
   21      URBAN                           1    1   91    0   92    0
   22      IRRIGATED LAND                  1    1   91    0   92    0
   23      GRASS/PASTURE                   1    1   91    0   92    0
   24      FORESTED                        1    1   91    0   92    0
   27      MINING/OTHER                    1    1   91    0   92    0
   31      URBAN                           1    1   91    0   92    0
   32      IRRIGATED LAND                  1    1   91    0   92    0
   33      GRASS/PASTURE                   1    1   91    0   92    0
   34      FORESTED                        1    1   91    0   92    0
   41      URBAN                           1    1   91    0   92    0
   42      IRRIGATED LAND                  1    1   91    0   92    0
   43      GRASS/PASTURE                   1    1   91    0   92    0
   44      FORESTED                        1    1   91    0   92    0
```

51	URBAN	1	1	91	0	92	0
52	IRRIGATED LAND	1	1	91	0	92	0
53	GRASS/PASTURE	1	1	91	0	92	0
54	FORESTED	1	1	91	0	92	0
61	URBAN	1	1	91	0	92	0
62	IRRIGATED LAND	1	1	91	0	92	0
63	GRASS/PASTURE	1	1	91	0	92	0
64	FORESTED	1	1	91	0	92	0
71	URBAN	1	1	91	0	92	0
73	GRASS/PASTURE	1	1	91	0	92	0
74	FORESTED	1	1	91	0	92	0
81	URBAN	1	1	91	0	92	0
82	IRRIGATED LAND	1	1	91	0	92	0
83	GRASS/PASTURE	1	1	91	0	92	0
84	FORESTED	1	1	91	0	92	0
91	URBAN	1	1	91	0	92	0
92	IRRIGATED LAND	1	1	91	0	92	0
93	GRASS/PASTURE	1	1	91	0	92	0
94	FORESTED	1	1	91	0	92	0
101	URBAN	1	1	91	0	92	0
102	IRRIGATED LAND	1	1	91	0	92	0
103	GRASS/PASTURE	1	1	91	0	92	0
104	FORESTED	1	1	91	0	92	0
111	URBAN	1	1	91	0	92	0
112	IRRIGATED LAND	1	1	91	0	92	0
113	GRASS/PASTURE	1	1	91	0	92	0
114	FORESTED	1	1	91	0	92	0
117	MINING/OTHER	1	1	91	0	92	0
121	URBAN	1	1	91	0	92	0
122	IRRIGATED LAND	1	1	91	0	92	0
123	GRASS/PASTURE	1	1	91	0	92	0
124	FORESTED	1	1	91	0	92	0
127	MINING/OTHER	1	1	91	0	92	0
131	URBAN	1	1	91	0	92	0
132	IRRIGATED LAND	1	1	91	0	92	0
133	GRASS/PASTURE	1	1	91	0	92	0
134	FORESTED	1	1	91	0	92	0
137	MINING/OTHER	1	1	91	0	92	0
141	URBAN	1	1	91	0	92	0
142	IRRIGATED LAND	1	1	91	0	92	0

```
  143     GRASS/PASTURE                  1    1   91    0   92    0
  144     FORESTED                       1    1   91    0   92    0
  151     URBAN                          1    1   91    0   92    0
  152     IRRIGATED LAND                 1    1   91    0   92    0
  153     GRASS/PASTURE                  1    1   91    0   92    0
  154     FORESTED                       1    1   91    0   92    0
  157     MINING/OTHER                   1    1   91    0   92    0
  161     URBAN                          1    1   91    0   92    0
  162     IRRIGATED LAND                 1    1   91    0   92    0
  163     GRASS/PASTURE                  1    1   91    0   92    0
  164     FORESTED                       1    1   91    0   92    0
  167     MINING/OTHER                   1    1   91    0   92    0
  END GEN-INFO

  PWAT-PARM1
*** <PLS >                   Flags
*** x -  x CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE IFFC  HWT IRRG IFRD
   11         0    1    1    1    0    0    0    0    1    1    0    0    0
   12         0    1    1    1    0    0    0    0    1    1    0    1    0
   13         0    1    1    1    0    0    0    0    1    1    0    0    0
   14   17    0    1    1    1    0    0    0    0    1    1    0    0    0
   21         0    1    1    1    0    0    0    0    1    1    0    0    0
   22         0    1    1    1    0    0    0    0    1    1    0    1    0
   23         0    1    1    1    0    0    0    0    1    1    0    0    0
   24   27    0    1    1    1    0    0    0    0    1    1    0    0    0
   31         0    1    1    1    0    0    0    0    1    1    0    0    0
   32         0    1    1    1    0    0    0    0    1    1    0    1    0
   33         0    1    1    1    0    0    0    0    1    1    0    0    0
   34         0    1    1    1    0    0    0    0    1    1    0    0    0
   41         0    1    1    1    0    0    0    0    1    1    0    0    0
   42         0    1    1    1    0    0    0    0    1    1    0    1    0
   43         0    1    1    1    0    0    0    0    1    1    0    0    0
   44         0    1    1    1    0    0    0    0    1    1    0    0    0
   51         0    1    1    1    0    0    0    0    1    1    0    0    0
   52         0    1    1    1    0    0    0    0    1    1    0    1    0
   53         0    1    1    1    0    0    0    0    1    1    0    0    0
   54         0    1    1    1    0    0    0    0    1    1    0    0    0
   61         0    1    1    1    0    0    0    0    1    1    0    0    0
   62         0    1    1    1    0    0    0    0    1    1    0    1    0
   63         0    1    1    1    0    0    0    0    1    1    0    0    0
```

64		0	1	1	1	0	0	0	0	1	1	0	0	0
71		0	1	1	1	0	0	0	0	1	1	0	0	0
73		0	1	1	1	0	0	0	0	1	1	0	0	0
74		0	1	1	1	0	0	0	0	1	1	0	0	0
81		0	1	1	1	0	0	0	0	1	1	0	0	0
82		0	1	1	1	0	0	0	0	1	1	0	1	0
83		0	1	1	1	0	0	0	0	1	1	0	0	0
84		0	1	1	1	0	0	0	0	1	1	0	0	0
91		0	1	1	1	0	0	0	0	1	1	0	0	0
92		0	1	1	1	0	0	0	0	1	1	0	1	0
93		0	1	1	1	0	0	0	0	1	1	0	0	0
94		0	1	1	1	0	0	0	0	1	1	0	0	0
101		0	1	1	1	0	0	0	0	1	1	0	0	0
102		0	1	1	1	0	0	0	0	1	1	0	1	0
103		0	1	1	1	0	0	0	0	1	1	0	0	0
104		0	1	1	1	0	0	0	0	1	1	0	0	0
111		0	1	1	1	0	0	0	0	1	1	0	0	0
112		0	1	1	1	0	0	0	0	1	1	0	1	0
113		0	1	1	1	0	0	0	0	1	1	0	0	0
114	117	0	1	1	1	0	0	0	0	1	1	0	0	0
121		0	1	1	1	0	0	0	0	1	1	0	0	0
122		0	1	1	1	0	0	0	0	1	1	0	1	0
123		0	1	1	1	0	0	0	0	1	1	0	0	0
124	127	0	1	1	1	0	0	0	0	1	1	0	0	0
131		0	1	1	1	0	0	0	0	1	1	0	0	0
132		0	1	1	1	0	0	0	0	1	1	0	1	0
133		0	1	1	1	0	0	0	0	1	1	0	0	0
134	137	0	1	1	1	0	0	0	0	1	1	0	0	0
141		0	1	1	1	0	0	0	0	1	1	0	0	0
142		0	1	1	1	0	0	0	0	1	1	0	1	0
143		0	1	1	1	0	0	0	0	1	1	0	0	0
144		0	1	1	1	0	0	0	0	1	1	0	0	0
151		0	1	1	1	0	0	0	0	1	1	0	0	0
152		0	1	1	1	0	0	0	0	1	1	0	1	0
153		0	1	1	1	0	0	0	0	1	1	0	0	0
154	157	0	1	1	1	0	0	0	0	1	1	0	0	0
161		0	1	1	1	0	0	0	0	1	1	0	0	0
162		0	1	1	1	0	0	0	0	1	1	0	1	0
163		0	1	1	1	0	0	0	0	1	1	0	0	0
164	167	0	1	1	1	0	0	0	0	1	1	0	0	0

```
  END PWAT-PARM1
*** Use same assumptions as INTB model for irrigation (comments below from
INTB)

*** All spray irrigation is considered as coming from an external source
*** and all is applied as additional precip, i.e. subject to interception.
*** It is applied using the irrigation function instead of additional
*** precip so that the amounts can be tracked separately by the program.

*** Drip irrigation is handled separately as lateral inflow.  It is not
*** handled as part of the single irrigation demand timeseries so that it
*** can be given a different daily schedule (6 hrs in the morning) than
*** the spray (3 hrs in the morning).

  IRRIG-SOURCE
***  < PLS><-----External-----><---Groundwater----><-----------RCHRES-----------
>
*** x   - x     XPRIOR      XFRAC     GPRIOR      GFRAC     RPRIOR      RFRAC
IRCHNO
   12  162          1       1.0
  END IRRIG-SOURCE

  IRRIG-TARGET
*** < PLS>   Irrigation Application Target Fractions
*** x   - x  Intercep   Surface     Upper     Lower Active GW
   12  162       1.0
  END IRRIG-TARGET

*** initial LSUR values from Intera geodatabase, all others from corresponding
INTB land use
*** Adjusted INFILT values down by 75% from INTB
  PWAT-PARM2
***  < PLS>     FOREST        LZSN     INFILT        LSUR       SLSUR       KVARY
AGWRC
***  x   - x                   (in)    (in/hr)       (ft)                  (1/in)
(1/day)
   11               0.         7.2       1.31        199     0.0044            0
0.800
   12               1.         8.4       1.31        150     0.0035            0
0.800
   13               1.         8.4       1.31        339     0.0036            0
0.800
   14               1.         8.8       1.31        500     0.0048            0
0.800
```

17	1.	7.6	1.31	300	0.0084	0	0.800
21	0.	7.2	1.31	196	0.0024	0	0.800
22	1.	8.4	1.31	165	0.0018	0	0.800
23	1.	8.4	1.31	362	0.0026	0	0.800
24	1.	8.8	1.31	500	0.0033	0	0.800
27	1.	7.6	1.31	300	0.0015	0	0.800
31	0.	7.2	1.31	200	0.0014	0	0.800
32	1.	8.4	1.31	300	0.0037	0	0.800
33	1.	8.4	1.31	306	0.0029	0	0.800
34	1.	8.8	1.31	500	0.0044	0	0.800
41	0.	7.2	1.31	150	0.0039	0	0.800
42	1.	8.4	1.31	229	0.0073	0	0.800
43	1.	8.4	1.31	315	0.0051	0	0.800
44	1.	8.8	1.31	500	0.0034	0	0.800
51	0.	7.2	1.31	164	0.0066	0	0.800
52	1.	8.4	1.31	200	0.0057	0	0.800
53	1.	8.4	1.31	304	0.0097	0	0.800
54	1.	8.8	1.31	500	0.0069	0	0.800
61	0.	7.2	1.31	194	0.0046	0	0.800
62	1.	8.4	1.31	297	0.008	0	0.800
63	1.	8.4	1.31	303	0.0036	0	0.800
64	1.	8.8	1.31	500	0.0048	0	0.800
71	0.	7.2	1.31	196	0.0021	0	0.800
73	1.	8.4	1.31	312	0.0027	0	0.800

74 0.800	1.	8.8	1.31	500	0.0017	0
81 0.800	0.	7.2	1.31	196	0.0031	0
82 0.800	1.	8.4	1.31	215	0.0044	0
83 0.800	1.	8.4	1.31	301	0.0031	0
84 0.800	1.	8.8	1.31	500	0.003	0
91 0.800	0.	10.8	1.31	150	0.0018	0
92 0.800	1.	12.6	1.31	300	0.0028	0
93 0.800	1.	12.6	1.31	310	0.0033	0
94 0.800	1.	13.2	1.31	500	0.0032	0
101 0.800	0.	10.8	1.31	140	0.0063	0
102 0.800	1.	12.6	1.31	300	0.003	0
103 0.800	1.	12.6	1.31	309	0.0051	0
104 0.800	1.	13.2	1.31	500	0.0035	0
111 0.800	0.	7.2	1.31	145	0.0041	0
112 0.800	1.	8.4	1.31	245	0.0048	0
113 0.800	1.	8.4	1.31	321	0.0039	0
114 0.800	1.	8.8	1.31	500	0.0027	0
117 0.800	1.	7.6	1.31	300	0.0029	0
121 0.800	0.	7.2	1.31	162	0.0018	0
122 0.800	1.	8.4	1.31	208	0.0019	0
123 0.800	1.	8.4	1.31	332	0.0025	0
124 0.800	1.	8.8	1.31	500	0.0042	0
127 0.800	1.	7.6	1.31	300	0.0068	0
131 0.800	0.	7.2	1.31	148	0.005	0

```
  132              1.       8.4     1.31      291    0.0053       0
0.800
  133              1.       8.4     1.31      320    0.0029       0
0.800
  134              1.       8.8     1.31      500    0.0039       0
0.800
  137              1.       7.6     1.31      300    0.0024       0
0.800
  141              0.       7.2      0.1      193    0.0061       0
0.800
  142              1.       8.4      0.1      205    0.0032       0
0.800
  143              1.       8.4      0.1      304    0.0038       0
0.800
  144              1.       8.8      0.1      500    0.0045       0
0.800
  151              0.       3.6      0.1      197    0.0064       0
0.800
  152              1.       4.2      0.1      207     0.006       0
0.800
  153              1.       4.2      0.1      329    0.0058       0
0.800
  154              1.       4.4      0.1      500    0.0065       0
0.800
  157              1.       3.8      0.1      250    0.0039       0
0.800
  161              0.     2.304      0.1      198    0.0059       0
0.800
  162              1.     2.688      0.1      187    0.0055       0
0.800
  163              1.     2.688      0.1      334    0.0062       0
0.800
  164              1.     2.816      0.1      500    0.0071       0
0.800
  167              1.     2.432      0.1      290    0.0055       0
0.800
  END PWAT-PARM2

*** All initial values from INTB
*** Adjusted INFILD from 1.0 to 2.0
*** Adjusted DEEPFR values from 1.0 to 0.1
*** Adjusted AGWETP values down by 50% or more
  PWAT-PARM3
*** < PLS>    PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP
AGWETP
*** x  - x   (deg F)   (deg F)
```

11	40	35	2	2.0	0.15	0	0.10
12	40	35	2	2.0	0.15	0	0.15
13	40	35	2	2.0	0.15	0	0.11
14	40	35	2	2.0	0.15	0	0.12
17	40	35	2	2.0	0.15	0	0.14
21	40	35	2	2.0	0.15	0	0.10
22	40	35	2	2.0	0.15	0	0.15
23	40	35	2	2.0	0.15	0	0.11
24	40	35	2	2.0	0.15	0	0.12
27	40	35	2	2.0	0.15	0	0.14
31	40	35	2	2.0	0.15	0	0.10
32	40	35	2	2.0	0.15	0	0.15
33	40	35	2	2.0	0.15	0	0.11
34	40	35	2	2.0	0.15	0	0.12
41	40	35	2	2.0	0.15	0	0.10
42	40	35	2	2.0	0.15	0	0.15
43	40	35	2	2.0	0.15	0	0.11
44	40	35	2	2.0	0.15	0	0.12
51	40	35	2	2.0	0.15	0	0.10
52	40	35	2	2.0	0.15	0	0.15
53	40	35	2	2.0	0.15	0	0.11
54	40	35	2	2.0	0.15	0	0.12
61	40	35	2	2.0	0.15	0	0.10
62	40	35	2	2.0	0.15	0	0.15

63	40	35	2	2.0	0.15	0	0.11
64	40	35	2	2.0	0.15	0	0.12
71	40	35	2	2.0	0.15	0	0.10
73	40	35	2	2.0	0.15	0	0.11
74	40	35	2	2.0	0.15	0	0.12
81	40	35	2	2.0	0.15	0	0.10
82	40	35	2	2.0	0.15	0	0.15
83	40	35	2	2.0	0.15	0	0.11
84	40	35	2	2.0	0.15	0	0.12
91	40	35	2	2.0	0.5	0	0.150
92	40	35	2	2.0	0.5	0	0.225
93	40	35	2	2.0	0.5	0	0.165
94	40	35	2	2.0	0.5	0	0.180
101	40	35	2	2.0	0.5	0	0.150
102	40	35	2	2.0	0.5	0	0.225
103	40	35	2	2.0	0.5	0	0.165
104	40	35	2	2.0	0.5	0	0.180
111	40	35	2	2.0	0.15	0	0.10
112	40	35	2	2.0	0.15	0	0.15
113	40	35	2	2.0	0.15	0	0.11
114	40	35	2	2.0	0.15	0	0.12
117	40	35	2	2.0	0.15	0	0.14
121	40	35	2	2.0	0.15	0	0.10
122	40	35	2	2.0	0.15	0	0.15

```
  123                40          35           2         2.0        0.15          0
0.11
  124                40          35           2         2.0        0.15          0
0.12
  127                40          35           2         2.0        0.15          0
0.14
  131                40          35           2         2.0        0.15          0
0.10
  132                40          35           2         2.0        0.15          0
0.15
  133                40          35           2         2.0        0.15          0
0.11
  134                40          35           2         2.0        0.15          0
0.12
  137                40          35           2         2.0        0.15          0
0.14
  141                40          35           2         2.0        0.15          0
0.06
  142                40          35           2         2.0        0.15          0
0.09
  143                40          35           2         2.0        0.15          0
0.066
  144                40          35           2         2.0        0.15          0
0.072
  151                40          35           2         2.0        0.15          0
0.06
  152                40          35           2         2.0        0.15          0
0.09
  153                40          35           2         2.0        0.15          0
0.066
  154                40          35           2         2.0        0.15          0
0.072
  157                40          35           2         2.0        0.15          0
0.084
  161                40          35           2         2.0         0.1          0
0.06
  162                40          35           2         2.0         0.1          0
0.09
  163                40          35           2         2.0         0.1          0
0.066
  164                40          35           2         2.0         0.1          0
0.072
  167                40          35           2         2.0         0.1          0
0.084
  END PWAT-PARM3

*** initial UZSN and NSUR values from Intera geodatabase, all others from INTB
*** Adjusted INTFW values up by 2X
```

PWAT-PARM4

*** <PLS >	CEPSC	UZSN	NSUR	INTFW	IRC	LZETP
*** x - x	(in)	(in)			(1/day)	
11	0.050	0.149	0.298	1.20	0.2	0.22
12	0.050	0.080	0.300	1.20	0.2	0.35
13	0.068	0.074	0.298	1.15	0.2	0.20
14	0.160	0.150	0.446	1.10	0.2	0.40
17	0.030	0.051	0.200	1.10	0.2	0.44
21	0.050	0.148	0.294	1.20	0.2	0.22
22	0.053	0.084	0.290	1.20	0.2	0.35
23	0.077	0.104	0.271	1.15	0.2	0.20
24	0.160	0.150	0.448	1.10	0.2	0.40
27	0.042	0.120	0.200	1.10	0.2	0.44
31	0.050	0.150	0.300	1.20	0.2	0.22
32	0.100	0.120	0.300	1.20	0.2	0.35
33	0.062	0.083	0.297	1.15	0.2	0.20
34	0.160	0.150	0.440	1.10	0.2	0.40
41	0.050	0.100	0.200	1.20	0.2	0.22
42	0.073	0.110	0.262	1.20	0.2	0.35
43	0.064	0.086	0.293	1.15	0.2	0.20
44	0.160	0.150	0.442	1.10	0.2	0.40
51	0.050	0.129	0.255	1.20	0.2	0.22
52	0.070	0.100	0.300	1.20	0.2	0.35
53	0.053	0.030	0.341	1.15	0.2	0.20
54	0.160	0.150	0.450	1.10	0.2	0.40
61	0.050	0.145	0.290	1.20	0.2	0.22
62	0.099	0.119	0.300	1.20	0.2	0.35
63	0.061	0.081	0.299	1.15	0.2	0.20
64	0.160	0.150	0.450	1.10	0.2	0.40
71	0.050	0.146	0.293	1.20	0.2	0.22
73	0.064	0.084	0.295	1.15	0.2	0.20
74	0.160	0.150	0.449	1.10	0.2	0.40
81	0.050	0.148	0.295	1.20	0.2	0.22
82	0.072	0.103	0.286	1.20	0.2	0.35
83	0.060	0.080	0.300	1.15	0.2	0.20
84	0.160	0.150	0.450	1.10	0.2	0.40
91	0.065	0.130	0.200	1.20	0.2	0.29
92	0.130	0.156	0.300	1.20	0.2	0.46
93	0.081	0.108	0.296	1.15	0.2	0.26
94	0.208	0.195	0.450	1.10	0.2	0.52

```
  101          0.065    0.109    0.200     1.20      0.2      0.29
  102          0.130    0.156    0.300     1.20      0.2      0.46
  103          0.081    0.107    0.296     1.15      0.2      0.26
  104          0.208    0.195    0.450     1.10      0.2      0.52
  111          0.050    0.108    0.212     1.20      0.2      0.22
  112          0.083    0.108    0.300     1.20      0.2      0.35
  113          0.063    0.079    0.299     1.15      0.2      0.20
  114          0.160    0.150    0.450     1.10      0.2      0.40
  117          0.050    0.100    0.200     1.10      0.2      0.44
  121          0.050    0.124    0.257     1.20      0.2      0.22
  122          0.073    0.102    0.300     1.20      0.2      0.35
  123          0.069    0.090    0.286     1.15      0.2      0.20
  124          0.160    0.150    0.450     1.10      0.2      0.40
  127          0.030    0.150    0.200     1.10      0.2      0.44
  131          0.050    0.118    0.233     1.20      0.2      0.22
  132          0.093    0.118    0.277     1.20      0.2      0.35
  133          0.064    0.075    0.301     1.15      0.2      0.20
  134          0.160    0.150    0.450     1.10      0.2      0.40
  137          0.030    0.150    0.200     1.10      0.2      0.44
  141          0.040    0.091    0.287     1.20      0.2     0.154
  142          0.055    0.061    0.298     1.20      0.2     0.245
  143          0.048    0.052    0.299     1.15      0.2      0.14
  144          0.128    0.096    0.448     1.10      0.2      0.28
  151          0.040    0.119    0.296     1.20      0.2     0.154
  152          0.055    0.077    0.296     1.20      0.2     0.245
  153          0.049    0.073    0.286     1.15      0.2      0.14
  154          0.128    0.120    0.449     1.10      0.2      0.28
  157          0.024    0.113    0.200     1.10      0.2     0.308
  161          0.040    0.095    0.297     1.20      0.2     0.154
  162          0.050    0.058    0.298     1.20      0.2     0.245
  163          0.050    0.060    0.283     1.15      0.2      0.14
  164          0.128    0.096    0.450     1.10      0.2      0.28
  167          0.039    0.064    0.200     1.10      0.2     0.308
  END PWAT-PARM4

  PWAT-STATE1
*** < PLS>  PWATER state variables (in)
*** x   - x       CEPS       SURS        UZS       IFWS        LZS       AGWS
GWVS
   11  167       0.01       0.01        0.1       0.02        5.0       2.00
0.01
```

```
  END PWAT-STATE1

*** max CEPSC values from Intera geodatabase, used INTB for variation
  MON-INTERCEP
*** <PLS >  Interception storage capacity at start of each month (in)
*** x -  x  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
   11    11 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   12    12 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
   13    13 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
   14    14 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
   17    17 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   21    21 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   22    22 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
   23    23 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
   24    24 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
   27    27 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   31    31 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   32    32 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
   33    33 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
   34    34 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
   41    41 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   42    42 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
   43    43 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
   44    44 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
   51    51 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   52    52 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
   53    53 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
   54    54 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
   61    61 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   62    62 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
   63    63 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
   64    64 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
   71    71 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   73    73 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
   74    74 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
   81    81 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
   82    82 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
   83    83 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
   84    84 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
   91    910.015 0.030.0450.0750.0750.0750.0750.0750.0750.0750.045 0.03
```

```
  92   92 0.030.045 0.06 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.060.045
  93   930.015 0.03 0.06 0.09 0.09 0.09 0.09 0.09 0.09 0.09 0.06 0.03
  94   940.045 0.090.135 0.24 0.24 0.24 0.24 0.24 0.24 0.240.135 0.09
 101  1010.015 0.030.0450.0750.0750.0750.0750.0750.0750.0750.045 0.03
 102  102 0.030.045 0.06 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.060.045
 103  1030.015 0.03 0.06 0.09 0.09 0.09 0.09 0.09 0.09 0.09 0.06 0.03
 104  1040.045 0.090.135 0.24 0.24 0.24 0.24 0.24 0.24 0.240.135 0.09
 111  111 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 112  112 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
 113  113 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
 114  114 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
 117  117 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 121  121 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 122  122 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
 123  123 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
 124  124 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
 127  127 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 131  131 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 132  132 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
 133  133 0.01 0.02 0.04 0.06 0.06 0.06 0.06 0.06 0.06 0.06 0.04 0.02
 134  134 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
 137  137 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 141  141 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 142  142 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
 143  1430.0080.0160.0320.0480.0480.0480.0480.0480.0480.0480.0320.016
 144  144 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
 151  151 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 152  152 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
 153  1530.0080.0160.0320.0480.0480.0480.0480.0480.0480.0480.0320.016
 154  154 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
 157  157 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 161  161 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 162  162 0.02 0.03 0.04 0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.04 0.03
 163  1630.0080.0160.0320.0480.0480.0480.0480.0480.0480.0480.0320.016
 164  164 0.03 0.06 0.09 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.09 0.06
 167  167 0.01 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.03 0.02
 END MON-INTERCEP

*** INTB values lowered 25 to 50 percent
  MON-LZETPARM
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*** <PLS >  Lower zone evapotransp   parm at start of each month
*** x -  x  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
   11   11 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
   12   12 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
   13   13 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
   14   14 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
   17   17 .275 .297 .319 .341 .363 .517 .539 .539 .517 .429 .319 .297
   21   21 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
   22   22 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
   23   23 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
   24   24 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
   27   27 .275 .297 .319 .341 .363 .517 .539 .539 .517 .429 .319 .297
   31   31 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
   32   32 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
   33   33 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
   34   34 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
   41   41 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
   42   42 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
   43   43 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
   44   44 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
   51   51 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
   52   52 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
   53   53 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
   54   54 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
   61   61 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
   62   62 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
   63   63 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
   64   64 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
   71   71 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
   73   73 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
   74   74 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
   81   81 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
   82   82 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
   83   83 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
   84   84 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
   91   91 .257 .286 .315 .329 .372 .458 .486 .486 .458 .400 .343 .286
   92   92 .372 .400 .429 .458 .486 .686 .715 .715 .686 .572 .429 .400
   93   93 .286 .329 .372 .400 .429 .572 .601 .601 .572 .443 .329 .300
   94   94 .343 .372 .400 .429 .458 .658 .686 .686 .658 .543 .400 .372
  101  101 .257 .286 .315 .329 .372 .458 .486 .486 .458 .400 .343 .286
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  102  102 .372 .400 .429 .458 .486 .686 .715 .715 .686 .572 .429 .400
  103  103 .286 .329 .372 .400 .429 .572 .601 .601 .572 .443 .329 .300
  104  104 .343 .372 .400 .429 .458 .658 .686 .686 .658 .543 .400 .372
  111  111 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
  112  112 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
  113  113 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
  114  114 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
  117  117 .275 .297 .319 .341 .363 .517 .539 .539 .517 .429 .319 .297
  121  121 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
  122  122 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
  123  123 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
  124  124 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
  127  127 .275 .297 .319 .341 .363 .517 .539 .539 .517 .429 .319 .297
  131  131 .198 .220 .242 .253 .286 .352 .374 .374 .352 .308 .264 .220
  132  132 .286 .308 .330 .352 .374 .528 .550 .550 .528 .440 .330 .308
  133  133 .220 .253 .286 .308 .330 .440 .462 .462 .440 .341 .253 .231
  134  134 .264 .286 .308 .330 .352 .506 .528 .528 .506 .418 .308 .286
  137  137 .275 .297 .319 .341 .363 .517 .539 .539 .517 .429 .319 .297
  141  141 .144 .160 .176 .184 .208 .256 .272 .272 .256 .224 .192 .160
  142  142 .208 .224 .240 .256 .272 .384 .400 .400 .384 .320 .240 .224
  143  143 .160 .184 .208 .224 .240 .320 .336 .336 .320 .248 .184 .168
  144  144 .192 .208 .224 .240 .256 .368 .384 .384 .368 .304 .224 .208
  151  151 .144 .160 .176 .184 .208 .256 .272 .272 .256 .224 .192 .160
  152  152 .208 .224 .240 .256 .272 .384 .400 .400 .384 .320 .240 .224
  153  153 .160 .184 .208 .224 .240 .320 .336 .336 .320 .248 .184 .168
  154  154 .192 .208 .224 .240 .256 .368 .384 .384 .368 .304 .224 .208
  157  157 .200 .216 .232 .248 .264 .376 .392 .392 .376 .312 .232 .216
  161  161 .144 .160 .176 .184 .208 .256 .272 .272 .256 .224 .192 .160
  162  162 .208 .224 .240 .256 .272 .384 .400 .400 .384 .320 .240 .224
  163  163 .160 .184 .208 .224 .240 .320 .336 .336 .320 .248 .184 .168
  164  164 .192 .208 .224 .240 .256 .368 .384 .384 .368 .304 .224 .208
  167  167 .200 .216 .232 .248 .264 .376 .392 .392 .376 .312 .232 .216
  END MON-LZETPARM

END PERLND

IMPLND
  ACTIVITY
*** <ILS >                 Active Sections
*** x -  x ATMP SNOW IWAT  SLD  IWG IQAL
```

```
    11  161    0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
*** <ILS > ******** Print-flags ******** PIVL  PYR
*** x -  x ATMP SNOW IWAT  SLD  IWG IQAL *********
    11  161    4    4    4    4    4    4    1   12
  END PRINT-INFO

  BINARY-INFO
*** <ILS > **** Binary-Output-flags **** PIVL  PYR
*** x -  x ATMP SNOW IWAT  SLD  IWG IQAL *********
    11  161    4    4    3    4    4    4    1   12
  END BINARY-INFO

  GEN-INFO
***               Name             Unit-systems   Printer BinaryOut
*** <ILS >                             t-series Engl Metr Engl Metr
*** x -  x                              in  out
    11  161       Urban                 1    1   91    0   92    0
  END GEN-INFO

  IWAT-PARM1
*** <ILS >          Flags
*** x -  x CSNO RTOP  VRS  VNN RTLI
    11  161    0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
*** <ILS >       LSUR     SLSUR      NSUR     RETSC
*** x -  x       (ft)                          (in)
    11           100.    0.0044      0.05       0.1
    21           100.    0.0025      0.05       0.1
    31           100.    0.0015      0.05       0.1
    41           100.    0.0040      0.05       0.1
    51           100.    0.0066      0.05       0.1
    61           100.    0.0046      0.05       0.1
    71           100.    0.0022      0.05       0.1
    81           100.    0.0032      0.05       0.1
    91           100.    0.0019      0.05       0.1
```

```
  101           100.    0.0064      0.05       0.1
  111           100.    0.0041      0.05       0.1
  121           100.    0.0019      0.05       0.1
  131           100.    0.0051      0.05       0.1
  141           100.    0.0061      0.05       0.1
  151           100.    0.0064      0.05       0.1
  161           100.    0.0060      0.05       0.1
  END IWAT-PARM2

  IWAT-PARM3
*** <ILS >    PETMAX    PETMIN
*** x -  x   (deg F)   (deg F)
   11  161       40.       35.
  END IWAT-PARM3

  IWAT-STATE1
*** <ILS >  IWATER state variables (inches)
*** x -  x      RETS      SURS
   11  161      0.01      0.01
  END IWAT-STATE1

END IMPLND

COPY
  TIMESERIES
  Copy-opn***
*** x -  x  NPT  NMN
    1    2    0    7
  END TIMESERIES

END COPY

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>    x <Name> x tem strg<-factor->strg <Name>   x   x        <Name> x x ***
WDM2   666 PREC     ENGL                SAME PERLND  11  17 EXTNL  PREC
WDM2   666 PREC     ENGL                SAME PERLND  21  27 EXTNL  PREC
WDM2   666 PREC     ENGL                SAME PERLND  31  37 EXTNL  PREC
WDM2   666 PREC     ENGL                SAME PERLND  41  47 EXTNL  PREC
WDM2   666 PREC     ENGL                SAME PERLND  51  57 EXTNL  PREC
```

```
WDM2    666 PREC      ENGL                  SAME PERLND  61  67 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND  71  77 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND  81  87 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND  91  97 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND 101 107 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND 111 117 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND 121 127 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND 131 137 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND 141 147 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND 151 157 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME PERLND 161 167 EXTNL  PREC
WDM2      2 PEVT      ENGL                  DIV  PERLND  11 167 EXTNL  PETINP
WDM2    666 PREC      ENGL                  SAME IMPLND  11  17 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND  21  27 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND  31  37 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND  41  47 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND  51  57 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND  61  67 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND  71  77 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND  81  87 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND  91  97 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND 101 107 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND 111 117 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND 121 127 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND 131 137 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND 141 147 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND 151 157 EXTNL  PREC
WDM2    666 PREC      ENGL                  SAME IMPLND 161 167 EXTNL  PREC
WDM2      2 PEVT      ENGL                  DIV  IMPLND  11 161 EXTNL  PETINP
WDM2    201 PUMP      ENGL                  DIV  PERLND  12     EXTNL  IRRINP
WDM2    202 PUMP      ENGL                  DIV  PERLND  22     EXTNL  IRRINP
WDM2    203 PUMP      ENGL                  DIV  PERLND  32     EXTNL  IRRINP
WDM2    204 PUMP      ENGL                  DIV  PERLND  42     EXTNL  IRRINP
WDM2    205 PUMP      ENGL                  DIV  PERLND  52     EXTNL  IRRINP
WDM2    206 PUMP      ENGL                  DIV  PERLND  62     EXTNL  IRRINP
WDM2    207 PUMP      ENGL                  DIV  PERLND  72     EXTNL  IRRINP
WDM2    208 PUMP      ENGL                  DIV  PERLND  82     EXTNL  IRRINP
WDM2    209 PUMP      ENGL                  DIV  PERLND  92     EXTNL  IRRINP
WDM2    210 PUMP      ENGL                  DIV  PERLND 102     EXTNL  IRRINP
WDM2    211 PUMP      ENGL                  DIV  PERLND 112     EXTNL  IRRINP
```

```
WDM2   212 PUMP     ENGL              DIV  PERLND 122     EXTNL  IRRINP
WDM2   213 PUMP     ENGL              DIV  PERLND 132     EXTNL  IRRINP
WDM2   214 PUMP     ENGL              DIV  PERLND 142     EXTNL  IRRINP
WDM2   215 PUMP     ENGL              DIV  PERLND 152     EXTNL  IRRINP
WDM2   216 PUMP     ENGL              DIV  PERLND 162     EXTNL  IRRINP
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Aggr Amd
***
<Name>    x          <Name> x x<-factor->strg <Name>    x <Name>qf  tem strg
strg***
PERLND  11 PWATER PERO   1 1     48.48SUM  WDM1  2001 FLOW   1 ENGL AGGR REPL
PERLND  12 PWATER PERO   1 1     21.52SUM  WDM1  2002 FLOW   1 ENGL AGGR REPL
PERLND  13 PWATER PERO   1 1    361.63SUM  WDM1  2003 FLOW   1 ENGL AGGR REPL
PERLND  14 PWATER PERO   1 1    193.99SUM  WDM1  2004 FLOW   1 ENGL AGGR REPL
PERLND  17 PWATER PERO   1 1      0.15SUM  WDM1  2005 FLOW   1 ENGL AGGR REPL
IMPLND  11 IWATER SURO   1 1      8.56SUM  WDM1  2006 FLOW   1 ENGL AGGR REPL
PERLND  21 PWATER PERO   1 1     22.28SUM  WDM1  2007 FLOW   1 ENGL AGGR REPL
PERLND  22 PWATER PERO   1 1     58.49SUM  WDM1  2008 FLOW   1 ENGL AGGR REPL
PERLND  23 PWATER PERO   1 1    104.89SUM  WDM1  2009 FLOW   1 ENGL AGGR REPL
PERLND  24 PWATER PERO   1 1     34.75SUM  WDM1  2010 FLOW   1 ENGL AGGR REPL
PERLND  27 PWATER PERO   1 1      6.05SUM  WDM1  2011 FLOW   1 ENGL AGGR REPL
IMPLND  21 IWATER SURO   1 1      3.93SUM  WDM1  2012 FLOW   1 ENGL AGGR REPL
PERLND  31 PWATER PERO   1 1     23.84SUM  WDM1  2013 FLOW   1 ENGL AGGR REPL
PERLND  32 PWATER PERO   1 1      0.52SUM  WDM1  2014 FLOW   1 ENGL AGGR REPL
PERLND  33 PWATER PERO   1 1    152.29SUM  WDM1  2015 FLOW   1 ENGL AGGR REPL
PERLND  34 PWATER PERO   1 1      6.18SUM  WDM1  2016 FLOW   1 ENGL AGGR REPL
IMPLND  31 IWATER SURO   1 1      4.21SUM  WDM1  2017 FLOW   1 ENGL AGGR REPL
PERLND  41 PWATER PERO   1 1      7.55SUM  WDM1  2018 FLOW   1 ENGL AGGR REPL
PERLND  42 PWATER PERO   1 1      0.52SUM  WDM1  2019 FLOW   1 ENGL AGGR REPL
PERLND  43 PWATER PERO   1 1    105.58SUM  WDM1  2020 FLOW   1 ENGL AGGR REPL
PERLND  44 PWATER PERO   1 1     90.55SUM  WDM1  2021 FLOW   1 ENGL AGGR REPL
IMPLND  41 IWATER SURO   1 1      1.33SUM  WDM1  2022 FLOW   1 ENGL AGGR REPL
PERLND  51 PWATER PERO   1 1     46.00SUM  WDM1  2023 FLOW   1 ENGL AGGR REPL
PERLND  52 PWATER PERO   1 1     22.23SUM  WDM1  2024 FLOW   1 ENGL AGGR REPL
PERLND  53 PWATER PERO   1 1     22.76SUM  WDM1  2025 FLOW   1 ENGL AGGR REPL
PERLND  54 PWATER PERO   1 1      5.26SUM  WDM1  2026 FLOW   1 ENGL AGGR REPL
IMPLND  51 IWATER SURO   1 1      8.12SUM  WDM1  2027 FLOW   1 ENGL AGGR REPL
PERLND  61 PWATER PERO   1 1     12.01SUM  WDM1  2028 FLOW   1 ENGL AGGR REPL
PERLND  62 PWATER PERO   1 1     42.48SUM  WDM1  2029 FLOW   1 ENGL AGGR REPL
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PERLND  63 PWATER PERO    1 1     76.48SUM   WDM1  2030 FLOW    1 ENGL AGGR REPL
PERLND  64 PWATER PERO    1 1     10.56SUM   WDM1  2031 FLOW    1 ENGL AGGR REPL
IMPLND  61 IWATER SURO    1 1      2.12SUM   WDM1  2032 FLOW    1 ENGL AGGR REPL
PERLND  71 PWATER PERO    1 1     15.29SUM   WDM1  2033 FLOW    1 ENGL AGGR REPL
PERLND  73 PWATER PERO    1 1    121.93SUM   WDM1  2034 FLOW    1 ENGL AGGR REPL
PERLND  74 PWATER PERO    1 1     30.27SUM   WDM1  2035 FLOW    1 ENGL AGGR REPL
IMPLND  71 IWATER SURO    1 1      2.70SUM   WDM1  2036 FLOW    1 ENGL AGGR REPL
PERLND  81 PWATER PERO    1 1     56.36SUM   WDM1  2037 FLOW    1 ENGL AGGR REPL
PERLND  82 PWATER PERO    1 1     15.85SUM   WDM1  2038 FLOW    1 ENGL AGGR REPL
PERLND  83 PWATER PERO    1 1    119.41SUM   WDM1  2039 FLOW    1 ENGL AGGR REPL
PERLND  84 PWATER PERO    1 1     26.58SUM   WDM1  2040 FLOW    1 ENGL AGGR REPL
IMPLND  81 IWATER SURO    1 1      9.95SUM   WDM1  2041 FLOW    1 ENGL AGGR REPL
PERLND  91 PWATER PERO    1 1     28.14SUM   WDM1  2042 FLOW    1 ENGL AGGR REPL
PERLND  92 PWATER PERO    1 1     72.96SUM   WDM1  2043 FLOW    1 ENGL AGGR REPL
PERLND  93 PWATER PERO    1 1    137.07SUM   WDM1  2044 FLOW    1 ENGL AGGR REPL
PERLND  94 PWATER PERO    1 1     70.12SUM   WDM1  2045 FLOW    1 ENGL AGGR REPL
IMPLND  91 IWATER SURO    1 1      4.97SUM   WDM1  2046 FLOW    1 ENGL AGGR REPL
PERLND 101 PWATER PERO    1 1      1.59SUM   WDM1  2047 FLOW    1 ENGL AGGR REPL
PERLND 102 PWATER PERO    1 1      4.47SUM   WDM1  2048 FLOW    1 ENGL AGGR REPL
PERLND 103 PWATER PERO    1 1     61.57SUM   WDM1  2049 FLOW    1 ENGL AGGR REPL
PERLND 104 PWATER PERO    1 1     70.61SUM   WDM1  2050 FLOW    1 ENGL AGGR REPL
IMPLND 101 IWATER SURO    1 1      0.28SUM   WDM1  2051 FLOW    1 ENGL AGGR REPL
PERLND 111 PWATER PERO    1 1     42.51SUM   WDM1  2052 FLOW    1 ENGL AGGR REPL
PERLND 112 PWATER PERO    1 1     13.16SUM   WDM1  2053 FLOW    1 ENGL AGGR REPL
PERLND 113 PWATER PERO    1 1    105.77SUM   WDM1  2054 FLOW    1 ENGL AGGR REPL
PERLND 114 PWATER PERO    1 1    140.78SUM   WDM1  2055 FLOW    1 ENGL AGGR REPL
PERLND 117 PWATER PERO    1 1     57.55SUM   WDM1  2056 FLOW    1 ENGL AGGR REPL
IMPLND 111 IWATER SURO    1 1      7.50SUM   WDM1  2057 FLOW    1 ENGL AGGR REPL
PERLND 121 PWATER PERO    1 1     53.57SUM   WDM1  2058 FLOW    1 ENGL AGGR REPL
PERLND 122 PWATER PERO    1 1     25.07SUM   WDM1  2059 FLOW    1 ENGL AGGR REPL
PERLND 123 PWATER PERO    1 1     73.35SUM   WDM1  2060 FLOW    1 ENGL AGGR REPL
PERLND 124 PWATER PERO    1 1     24.82SUM   WDM1  2061 FLOW    1 ENGL AGGR REPL
PERLND 127 PWATER PERO    1 1      1.04SUM   WDM1  2062 FLOW    1 ENGL AGGR REPL
IMPLND 121 IWATER SURO    1 1      9.45SUM   WDM1  2063 FLOW    1 ENGL AGGR REPL
PERLND 131 PWATER PERO    1 1     83.78SUM   WDM1  2064 FLOW    1 ENGL AGGR REPL
PERLND 132 PWATER PERO    1 1      3.54SUM   WDM1  2065 FLOW    1 ENGL AGGR REPL
PERLND 133 PWATER PERO    1 1     18.81SUM   WDM1  2066 FLOW    1 ENGL AGGR REPL
PERLND 134 PWATER PERO    1 1     27.74SUM   WDM1  2067 FLOW    1 ENGL AGGR REPL
PERLND 137 PWATER PERO    1 1      0.89SUM   WDM1  2068 FLOW    1 ENGL AGGR REPL
IMPLND 131 IWATER SURO    1 1     14.79SUM   WDM1  2069 FLOW    1 ENGL AGGR REPL
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```
PERLND 141 PWATER PERO   1 1     19.58SUM  WDM1  2070 FLOW   1 ENGL AGGR REPL
PERLND 142 PWATER PERO   1 1     71.44SUM  WDM1  2071 FLOW   1 ENGL AGGR REPL
PERLND 143 PWATER PERO   1 1    262.96SUM  WDM1  2072 FLOW   1 ENGL AGGR REPL
PERLND 144 PWATER PERO   1 1     68.61SUM  WDM1  2073 FLOW   1 ENGL AGGR REPL
IMPLND 141 IWATER SURO   1 1      3.45SUM  WDM1  2074 FLOW   1 ENGL AGGR REPL
PERLND 151 PWATER PERO   1 1    322.57SUM  WDM1  2075 FLOW   1 ENGL AGGR REPL
PERLND 152 PWATER PERO   1 1    284.07SUM  WDM1  2076 FLOW   1 ENGL AGGR REPL
PERLND 153 PWATER PERO   1 1   2651.59SUM  WDM1  2077 FLOW   1 ENGL AGGR REPL
PERLND 154 PWATER PERO   1 1    344.29SUM  WDM1  2078 FLOW   1 ENGL AGGR REPL
PERLND 157 PWATER PERO   1 1     10.30SUM  WDM1  2079 FLOW   1 ENGL AGGR REPL
IMPLND 151 IWATER SURO   1 1     56.92SUM  WDM1  2080 FLOW   1 ENGL AGGR REPL
PERLND 161 PWATER PERO   1 1    132.14SUM  WDM1  2081 FLOW   1 ENGL AGGR REPL
PERLND 162 PWATER PERO   1 1   1125.57SUM  WDM1  2082 FLOW   1 ENGL AGGR REPL
PERLND 163 PWATER PERO   1 1   3105.23SUM  WDM1  2083 FLOW   1 ENGL AGGR REPL
PERLND 164 PWATER PERO   1 1    909.08SUM  WDM1  2084 FLOW   1 ENGL AGGR REPL
PERLND 167 PWATER PERO   1 1    131.34SUM  WDM1  2085 FLOW   1 ENGL AGGR REPL
IMPLND 161 IWATER SURO   1 1     23.32SUM  WDM1  2086 FLOW   1 ENGL AGGR REPL
END EXT TARGETS
END RUN
```

Storage Attenuation Reaches Parameters

```
RUN

GLOBAL
  LittleManatee, Base5 scen, dec. LZETP, inc. INFILT
  START       1985/01/01 00:00  END    2005/12/31 24:00
  RUN INTERP OUTPT LEVELS    5    0
  RESUME     0 RUN     1                      UNITS    1
END GLOBAL

FILES
<FILE>  <UN#>***<----FILE NAME-------------------------------------------------
>
MESSU       24   103_CPS_ATT_out.ech
            91   103_CPS_ATT_out.out
WDM1        25   103_CPS_ATT_out.wdm
WDM2        26   102_CPS_BASIN_out.wdm
WDM3        27   dadada.wdm
BINO        92   103_CPS_ATT_out.hbn
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      RCHRES       6
      RCHRES       7
      RCHRES       8
      RCHRES       9
      RCHRES      10
      RCHRES      11
      RCHRES      12
      RCHRES      13
      RCHRES      14
      RCHRES      15
      RCHRES      16
```

```
    END INGRP
END OPN SEQUENCE

RCHRES
  ACTIVITY
*** RCHRES  Active sections
*** x -  x HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG
    1   16    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
*** RCHRES  Printout level flags
*** x -  x HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR
    1   16    5    4    4    4    4    4    4    4    4    4    1   12
  END PRINT-INFO

  BINARY-INFO
*** RCHRES  Binary Output level flags
*** x -  x HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR
    1   16    3    4    4    4    4    4    4    4    4    4    1   12
  END BINARY-INFO

  GEN-INFO
***              Name        Nexits  Unit Systems  Printer
*** RCHRES                             t-series  Engl Metr LKFG
*** x -  x                              in  out
    1      Reach 1              1        1    1   91    0    1   92    0
    2      Reach 2              1        1    1   91    0    1   92    0
    3      Reach 3              1        1    1   91    0    1   92    0
    4      Reach 4              1        1    1   91    0    1   92    0
    5      Reach 5              1        1    1   91    0    1   92    0
    6      Reach 6              1        1    1   91    0    1   92    0
    7      Reach 7              1        1    1   91    0    1   92    0
    8      Reach 8              1        1    1   91    0    1   92    0
    9      Reach 9              1        1    1   91    0    1   92    0
   10      Reach 10             1        1    1   91    0    1   92    0
   11      Reach 11             1        1    1   91    0    1   92    0
   12      Reach 12             1        1    1   91    0    1   92    0
   13      Reach 13             1        1    1   91    0    1   92    0
   14      Reach 14             1        1    1   91    0    1   92    0
```

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   15      Reach 15                1         1    1    91    0    1    92    0
   16      Reach 16                1         1    1    91    0    1    92    0
  END GEN-INFO

  HYDR-PARM1
***          Flags for HYDR section
*** RCHRES   VC  A1  A2  A3   ODFVFG  for  each  *** ODGTFG  for  each      FUNCT   for
each
*** x    - x   FG  FG  FG  FG   possible    exit  *** possible    exit       possible
exit
    1   216   0   1   1   1    4   0   0   0   0       0   0   0   0   0       1   1   1   1
1
  END HYDR-PARM1

  HYDR-PARM2
*** RCHRES FTBW FTBU        LEN      DELTH      STCOR         KS       DB50
*** x -   x               (miles)     (ft)       (ft)                  (in)
    1        0.    1         1.         3.        3.2        0.5       0.01
    2        0.    2         1.         3.        3.2        0.5       0.01
    3        0.    3         1.         3.        3.2        0.5       0.01
    4        0.    4         1.         3.        3.2        0.5       0.01
    5        0.    5         1.         3.        3.2        0.5       0.01
    6        0.    6         1.         3.        3.2        0.5       0.01
    7        0.    7         1.         3.        3.2        0.5       0.01
    8        0.    8         1.         3.        3.2        0.5       0.01
    9        0.    9         1.         3.        3.2        0.5       0.01
   10        0.   10         1.         3.        3.2        0.5       0.01
   11        0.   11         1.         3.        3.2        0.5       0.01
   12        0.   12         1.         3.        3.2        0.5       0.01
   13        0.   13         1.         3.        3.2        0.5       0.01
   14        0.   14         1.         3.        3.2        0.5       0.01
   15        0.   15         1.         3.        3.2        0.5       0.01
   16        0.   16         1.         3.        3.2        0.5       0.01
  END HYDR-PARM2

  HYDR-INIT
***          Initial conditions for HYDR section
***RC  HRES          VOL   CAT  Initial value   of  COLIND      initial   value   of
OUTDGT
*** x   - x      ac-ft      for each possible   exit  for each possible exit,ft3
    1    13        5.00        4.2   4.5   4.5   4.5   4.2        2.1   1.2   0.5   1.2
1.8
```

```
   14    14        5.00         4.2   4.5   4.5   4.5   4.2         2.1   1.2   0.5   1.2
1.8
   16    16        5.00         4.2   4.5   4.5   4.5   4.2         2.1   1.2   0.5   1.2
1.8

  END HYDR-INIT

END RCHRES



FTABLES
  ******
  FTABLE      1
 ROWS COLS***
   13    4
***  DEPTH      AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00   1224.43      0.00      0.00
      0.85   1224.43    725.54      0.00
      1.69   1224.43   1471.81     28.29
      2.54   1224.43   2238.80     55.09
      3.39   1224.43   3016.17     98.72
      4.23   1224.43   3897.18    181.15
      5.08   1224.43   4830.01    329.15
      5.93   1224.43   5783.58    572.92
      6.77   1224.43   6757.87    947.13
      7.62   1224.43   7752.90   1491.10
      8.47   1224.43   8768.65   2246.33
      9.31   1224.43   9805.13   3099.83
     11.31   1224.43  98051.33 309983.17
  END FTABLE  1
  ******
  FTABLE      2
 ROWS COLS***
   13    4
***  DEPTH      AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00    752.50      0.00      0.00
      0.49    752.50    260.60      0.00
      0.99    752.50    528.64     11.56
      1.48    752.50    804.13     22.51
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      1.98     752.50   1083.35      40.33
      2.47     752.50   1399.79      74.01
      2.97     752.50   1734.85     134.47
      3.46     752.50   2077.35     234.06
      3.96     752.50   2427.30     386.94
      4.45     752.50   2784.69     609.17
      4.95     752.50   3149.53     917.71
      5.44     752.50   3521.81    1266.40
      7.44     752.50  35218.12 126639.64
  END FTABLE   2
  ******
  FTABLE       3
 ROWS COLS***
   13    4
***  DEPTH      AREA    VOLUME      DISCH  FLO-THRU ***
***   (FT)   (ACRES)   (AC-FT)      (CFS)     (MIN) ***
      0.00     471.01      0.00       0.00
      0.42     471.01    137.50       0.00
      0.83     471.01    278.93       8.69
      1.25     471.01    424.29      16.93
      1.67     471.01    571.61      30.34
      2.09     471.01    738.58      55.67
      2.50     471.01    915.36     101.15
      2.92     471.01   1096.08     176.06
      3.34     471.01   1280.72     291.06
      3.75     471.01   1469.30     458.23
      4.17     471.01   1661.80     690.32
      4.59     471.01   1858.23     952.61
      6.59     471.01  18582.30   95260.88
  END FTABLE   3
  ******
  FTABLE       4
 ROWS COLS***
   13    4
***  DEPTH      AREA    VOLUME      DISCH  FLO-THRU ***
***   (FT)   (ACRES)   (AC-FT)      (CFS)     (MIN) ***
      0.00     316.45      0.00       0.00
      0.51     316.45    134.98       0.00
      1.02     316.45    250.69      12.07
      1.52     316.45    369.60      23.51
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      2.03    316.45    490.12     42.12
      2.54    316.45    626.72     77.30
      3.05    316.45    771.34    140.45
      3.55    316.45    919.18    244.46
      4.06    316.45   1070.24    404.14
      4.57    316.45   1224.51    636.25
      5.08    316.45   1381.99    958.50
      5.59    316.45   1542.68   1322.69
      7.59    316.45  15426.84 132268.72
  END FTABLE   4
  ******
  FTABLE       5
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00    549.26      0.00      0.00
      0.33    549.26    126.21      0.00
      0.66    549.26    256.03      5.83
      0.98    549.26    389.46     11.36
      1.31    549.26    524.69     20.36
      1.64    549.26    677.95     37.36
      1.97    549.26    840.22     67.88
      2.30    549.26   1006.10    118.15
      2.63    549.26   1175.59    195.32
      2.95    549.26   1348.68    307.50
      3.28    549.26   1525.38    463.25
      3.61    549.26   1705.68    639.26
      5.61    549.26  17056.83  63926.21
  END FTABLE   5
  ******
  FTABLE       6
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00    470.86      0.00      0.00
      0.37    470.86    121.45      0.00
      0.74    470.86    246.37      7.07
      1.11    470.86    374.77     13.77
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      1.47    470.86    504.89     24.68
      1.84    470.86    652.37     45.29
      2.21    470.86    808.53     82.29
      2.58    470.86    968.15    143.24
      2.95    470.86   1131.24    236.80
      3.32    470.86   1297.81    372.80
      3.68    470.86   1467.84    561.63
      4.05    470.86   1641.34    775.02
      6.05    470.86  16413.42  77502.19
  END FTABLE   6
  ******
  FTABLE       7
 ROWS COLS***
   13    4
***  DEPTH      AREA    VOLUME      DISCH  FLO-THRU ***
***    (FT)  (ACRES)   (AC-FT)      (CFS)     (MIN) ***
      0.00   1032.08      0.00       0.00
      0.45   1032.08    324.58       0.00
      0.90   1032.08    658.44       9.84
      1.35   1032.08   1001.57      19.17
      1.80   1032.08   1349.34      34.35
      2.25   1032.08   1743.47      63.03
      2.70   1032.08   2160.79     114.52
      3.14   1032.08   2587.39     199.33
      3.59   1032.08   3023.25     329.52
      4.04   1032.08   3468.40     518.77
      4.49   1032.08   3922.81     781.53
      4.94   1032.08   4386.50    1078.48
      6.94   1032.08  43865.01  107847.85
  END FTABLE   7
  ******
  FTABLE       8
 ROWS COLS***
   13    4
***  DEPTH      AREA    VOLUME      DISCH  FLO-THRU ***
***    (FT)  (ACRES)   (AC-FT)      (CFS)     (MIN) ***
      0.00    619.67      0.00       0.00
      0.48    619.67    206.22       0.00
      0.95    619.67    418.32      10.81
      1.43    619.67    636.32      21.06
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        1.90    619.67    857.27     37.74
        2.38    619.67   1107.67     69.25
        2.85    619.67   1372.81    125.83
        3.33    619.67   1643.83    219.02
        3.80    619.67   1920.75    362.08
        4.28    619.67   2203.56    570.03
        4.75    619.67   2492.26    858.75
        5.23    619.67   2786.85   1185.04
        7.23    619.67  27868.54 118504.16
    END FTABLE   8
    ******
    FTABLE       9
   ROWS COLS***
     13    4
  ***  DEPTH      AREA    VOLUME      DISCH  FLO-THRU ***
  ***   (FT)  (ACRES)   (AC-FT)      (CFS)      (MIN) ***
        0.00   1540.67      0.00      0.00
        0.63   1540.67    870.68      0.00
        1.26   1540.67   1751.03      2.15
        1.88   1540.67   2641.06      4.19
        2.51   1540.67   3540.77      7.50
        3.14   1540.67   4450.14     13.76
        3.77   1540.67   5369.20     25.01
        4.40   1540.67   6297.92     43.53
        5.02   1540.67   7236.32     71.96
        5.65   1540.67   8184.40    113.30
        6.28   1540.67   9142.14    170.68
        6.91   1540.67  10109.57    235.53
        8.91   1540.67 101095.66  23552.90
    END FTABLE   9
    ******
    FTABLE      10
   ROWS COLS***
     13    4
  ***  DEPTH      AREA    VOLUME      DISCH  FLO-THRU ***
  ***   (FT)  (ACRES)   (AC-FT)      (CFS)      (MIN) ***
        0.00    566.03      0.00      0.00
        0.33    566.03    169.21      0.00
        0.66    566.03    340.30      0.74
        1.00    566.03    513.27      1.45
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```
      1.33    566.03    688.12      2.60
      1.66    566.03    864.84      4.76
      1.99    566.03   1043.45      8.65
      2.33    566.03   1223.94     15.06
      2.66    566.03   1406.31     24.90
      2.99    566.03   1590.56     39.20
      3.32    566.03   1776.69     59.05
      3.65    566.03   1964.70     81.49
      5.65    566.03  19647.00   8149.05
  END FTABLE 10
  ******
  FTABLE     11
 ROWS COLS***
   13    4
***  DEPTH     AREA   VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)  (AC-FT)     (CFS)     (MIN) ***
      0.00  1175.24     0.00      0.00
      0.35  1175.24   289.99      0.00
      0.71  1175.24   588.27     17.87
      1.06  1175.24   894.83     34.80
      1.41  1175.24  1205.54     62.37
      1.76  1175.24  1557.67    114.45
      2.12  1175.24  1930.51    207.95
      2.47  1175.24  2311.65    361.95
      2.82  1175.24  2701.06    598.37
      3.17  1175.24  3098.77    942.03
      3.53  1175.24  3504.75   1419.17
      3.88  1175.24  3919.03   1958.39
      5.88  1175.24 39190.28 195839.09
  END FTABLE 11
  ******
  FTABLE     12
 ROWS COLS***
   13    4
***  DEPTH     AREA   VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)  (AC-FT)     (CFS)     (MIN) ***
      0.00   391.86     0.00      0.00
      0.45   391.86   124.76      0.00
      0.91   391.86   253.09     10.05
      1.36   391.86   384.99     19.56
```

```
      1.82    391.86    518.66     35.06
      2.27    391.86    670.16     64.33
      2.73    391.86    830.58    116.89
      3.18    391.86    994.55    203.46
      3.64    391.86   1162.09    336.35
      4.09    391.86   1333.20    529.54
      4.55    391.86   1507.87    797.74
      5.00    391.86   1686.10   1100.85
      7.00    391.86  16861.03 110084.80
  END FTABLE 12
  ******
  FTABLE     13
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00    164.43      0.00      0.00
      0.14    164.43     16.23      0.00
      0.28    164.43     32.92      7.09
      0.42    164.43     50.08     13.80
      0.56    164.43     67.47     24.74
      0.71    164.43     87.18     45.39
      0.85    164.43    108.04     82.48
      0.99    164.43    129.37    143.56
      1.13    164.43    151.17    237.33
      1.27    164.43    173.43    373.63
      1.41    164.43    196.15    562.88
      1.55    164.43    219.33    776.74
      3.55    164.43   2193.33  77674.48
  END FTABLE 13
  ******
  FTABLE     14
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00   1401.89      0.00      0.00
      0.18   1401.89      7.41      0.00
      0.35   1401.89     19.77      3.01
      0.71   1401.89     54.36      5.66
```

```
      1.41   1401.89    133.43     10.43
      2.47   1401.89    266.85     20.31
      3.88   1401.89    464.52     49.26
      4.94   1401.89    761.02    161.17
      5.64   1401.89   1156.35    349.12
      6.35   1401.89   1749.35    549.64
      7.05   1401.89   2638.85    828.03
      7.76   1401.89   3627.19   1142.64
      9.76   1401.89  36271.89 114264.01
  END FTABLE 14
  ******
  FTABLE     15
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00   9636.71      0.00      0.00
      0.65   9636.71   4071.90      0.00
      1.30   9636.71   9083.47     13.04
      1.95   9636.71  13468.59     55.76
      2.60   9636.71  18166.94    134.51
      3.25   9636.71  23491.73    259.77
      3.90   9636.71  29129.75    433.48
      4.55   9636.71  34893.05    781.90
      5.20   9636.71  40781.65   1561.88
      5.85   9636.71  46795.53   2837.44
      6.50   9636.71  52934.71   4967.40
      7.15   9636.71  59199.17   8323.39
      9.15   9636.71 591991.68 832339.13
  END FTABLE 15
  ******
  FTABLE     16
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00  12949.39      0.00      0.00
      1.48  12949.39    574.95      0.00
      2.96  12949.39   1533.21     19.22
      4.44  12949.39   2874.76     68.92
```

```
      5.92  12949.39   4407.97    161.06
      7.40  12949.39   6132.83    361.36
      8.88  12949.39   7953.52    633.40
     10.36  12949.39   9870.03   1362.40
     11.84  12949.39  15619.56   2751.40
     13.32  12949.39  27118.62   5059.40
     14.80  12949.39  44367.21   8660.00
     16.28  12949.39  63532.31  14000.00
     18.28  12949.39 635323.061400000.00
  END FTABLE 16
END FTABLES


EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>   x <Name> x tem strg<-factor->strg <Name>   x   x        <Name> x x ***
WDM2  2001 FLOW     ENGL              SAME RCHRES   1     EXTNL  IVOL
WDM2  2002 FLOW     ENGL              SAME RCHRES   1     EXTNL  IVOL
WDM2  2003 FLOW     ENGL              SAME RCHRES   1     EXTNL  IVOL
WDM2  2004 FLOW     ENGL              SAME RCHRES   1     EXTNL  IVOL
WDM2  2005 FLOW     ENGL              SAME RCHRES   1     EXTNL  IVOL
WDM2  2006 FLOW     ENGL              SAME RCHRES   1     EXTNL  IVOL
WDM2  2007 FLOW     ENGL              SAME RCHRES   2     EXTNL  IVOL
WDM2  2008 FLOW     ENGL              SAME RCHRES   2     EXTNL  IVOL
WDM2  2009 FLOW     ENGL              SAME RCHRES   2     EXTNL  IVOL
WDM2  2010 FLOW     ENGL              SAME RCHRES   2     EXTNL  IVOL
WDM2  2011 FLOW     ENGL              SAME RCHRES   2     EXTNL  IVOL
WDM2  2012 FLOW     ENGL              SAME RCHRES   2     EXTNL  IVOL
WDM2  2013 FLOW     ENGL              SAME RCHRES   3     EXTNL  IVOL
WDM2  2014 FLOW     ENGL              SAME RCHRES   3     EXTNL  IVOL
WDM2  2015 FLOW     ENGL              SAME RCHRES   3     EXTNL  IVOL
WDM2  2016 FLOW     ENGL              SAME RCHRES   3     EXTNL  IVOL
WDM2  2017 FLOW     ENGL              SAME RCHRES   3     EXTNL  IVOL
WDM2  2018 FLOW     ENGL              SAME RCHRES   4     EXTNL  IVOL
WDM2  2019 FLOW     ENGL              SAME RCHRES   4     EXTNL  IVOL
WDM2  2020 FLOW     ENGL              SAME RCHRES   4     EXTNL  IVOL
WDM2  2021 FLOW     ENGL              SAME RCHRES   4     EXTNL  IVOL
WDM2  2022 FLOW     ENGL              SAME RCHRES   4     EXTNL  IVOL
WDM2  2023 FLOW     ENGL              SAME RCHRES   5     EXTNL  IVOL
WDM2  2024 FLOW     ENGL              SAME RCHRES   5     EXTNL  IVOL
```

```
WDM2  2025 FLOW    ENGL              SAME RCHRES   5     EXTNL  IVOL
WDM2  2026 FLOW    ENGL              SAME RCHRES   5     EXTNL  IVOL
WDM2  2027 FLOW    ENGL              SAME RCHRES   5     EXTNL  IVOL
WDM2  2028 FLOW    ENGL              SAME RCHRES   6     EXTNL  IVOL
WDM2  2029 FLOW    ENGL              SAME RCHRES   6     EXTNL  IVOL
WDM2  2030 FLOW    ENGL              SAME RCHRES   6     EXTNL  IVOL
WDM2  2031 FLOW    ENGL              SAME RCHRES   6     EXTNL  IVOL
WDM2  2032 FLOW    ENGL              SAME RCHRES   6     EXTNL  IVOL
WDM2  2033 FLOW    ENGL              SAME RCHRES   7     EXTNL  IVOL
WDM2  2034 FLOW    ENGL              SAME RCHRES   7     EXTNL  IVOL
WDM2  2035 FLOW    ENGL              SAME RCHRES   7     EXTNL  IVOL
WDM2  2036 FLOW    ENGL              SAME RCHRES   7     EXTNL  IVOL
WDM2  2037 FLOW    ENGL              SAME RCHRES   8     EXTNL  IVOL
WDM2  2038 FLOW    ENGL              SAME RCHRES   8     EXTNL  IVOL
WDM2  2039 FLOW    ENGL              SAME RCHRES   8     EXTNL  IVOL
WDM2  2040 FLOW    ENGL              SAME RCHRES   8     EXTNL  IVOL
WDM2  2041 FLOW    ENGL              SAME RCHRES   8     EXTNL  IVOL
WDM2  2042 FLOW    ENGL              SAME RCHRES   9     EXTNL  IVOL
WDM2  2043 FLOW    ENGL              SAME RCHRES   9     EXTNL  IVOL
WDM2  2044 FLOW    ENGL              SAME RCHRES   9     EXTNL  IVOL
WDM2  2045 FLOW    ENGL              SAME RCHRES   9     EXTNL  IVOL
WDM2  2046 FLOW    ENGL              SAME RCHRES   9     EXTNL  IVOL
WDM2  2047 FLOW    ENGL              SAME RCHRES  10     EXTNL  IVOL
WDM2  2048 FLOW    ENGL              SAME RCHRES  10     EXTNL  IVOL
WDM2  2049 FLOW    ENGL              SAME RCHRES  10     EXTNL  IVOL
WDM2  2050 FLOW    ENGL              SAME RCHRES  10     EXTNL  IVOL
WDM2  2051 FLOW    ENGL              SAME RCHRES  10     EXTNL  IVOL
WDM2  2052 FLOW    ENGL              SAME RCHRES  11     EXTNL  IVOL
WDM2  2053 FLOW    ENGL              SAME RCHRES  11     EXTNL  IVOL
WDM2  2054 FLOW    ENGL              SAME RCHRES  11     EXTNL  IVOL
WDM2  2055 FLOW    ENGL              SAME RCHRES  11     EXTNL  IVOL
WDM2  2056 FLOW    ENGL              SAME RCHRES  11     EXTNL  IVOL
WDM2  2057 FLOW    ENGL              SAME RCHRES  11     EXTNL  IVOL
WDM2  2058 FLOW    ENGL              SAME RCHRES  12     EXTNL  IVOL
WDM2  2059 FLOW    ENGL              SAME RCHRES  12     EXTNL  IVOL
WDM2  2060 FLOW    ENGL              SAME RCHRES  12     EXTNL  IVOL
WDM2  2061 FLOW    ENGL              SAME RCHRES  12     EXTNL  IVOL
WDM2  2062 FLOW    ENGL              SAME RCHRES  12     EXTNL  IVOL
WDM2  2063 FLOW    ENGL              SAME RCHRES  12     EXTNL  IVOL
WDM2  2064 FLOW    ENGL              SAME RCHRES  13     EXTNL  IVOL
```

```
WDM2  2065 FLOW     ENGL               SAME RCHRES  13      EXTNL   IVOL
WDM2  2066 FLOW     ENGL               SAME RCHRES  13      EXTNL   IVOL
WDM2  2067 FLOW     ENGL               SAME RCHRES  13      EXTNL   IVOL
WDM2  2068 FLOW     ENGL               SAME RCHRES  13      EXTNL   IVOL
WDM2  2069 FLOW     ENGL               SAME RCHRES  13      EXTNL   IVOL
WDM2  2070 FLOW     ENGL               SAME RCHRES  14      EXTNL   IVOL
WDM2  2071 FLOW     ENGL               SAME RCHRES  14      EXTNL   IVOL
WDM2  2072 FLOW     ENGL               SAME RCHRES  14      EXTNL   IVOL
WDM2  2073 FLOW     ENGL               SAME RCHRES  14      EXTNL   IVOL
WDM2  2074 FLOW     ENGL               SAME RCHRES  14      EXTNL   IVOL
WDM2  2075 FLOW     ENGL               SAME RCHRES  15      EXTNL   IVOL
WDM2  2076 FLOW     ENGL               SAME RCHRES  15      EXTNL   IVOL
WDM2  2077 FLOW     ENGL               SAME RCHRES  15      EXTNL   IVOL
WDM2  2078 FLOW     ENGL               SAME RCHRES  15      EXTNL   IVOL
WDM2  2079 FLOW     ENGL               SAME RCHRES  15      EXTNL   IVOL
WDM2  2080 FLOW     ENGL               SAME RCHRES  15      EXTNL   IVOL
WDM2  2081 FLOW     ENGL               SAME RCHRES  16      EXTNL   IVOL
WDM2  2082 FLOW     ENGL               SAME RCHRES  16      EXTNL   IVOL
WDM2  2083 FLOW     ENGL               SAME RCHRES  16      EXTNL   IVOL
WDM2  2084 FLOW     ENGL               SAME RCHRES  16      EXTNL   IVOL
WDM2  2085 FLOW     ENGL               SAME RCHRES  16      EXTNL   IVOL
WDM2  2086 FLOW     ENGL               SAME RCHRES  16      EXTNL   IVOL
WDM3   666 PREC     ENGL               SUM  RCHRES   1      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES   2      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES   3      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES   4      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES   5      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES   6      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES   7      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES   8      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES   9      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES  10      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES  11      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES  12      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES  13      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES  14      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES  15      EXTNL   PREC
WDM3   666 PREC     ENGL               SUM  RCHRES  16      EXTNL   PREC
WDM3     2 PEVT     ENGL               SAME RCHRES   1  16 EXTNL   POTEV
END EXT SOURCES
```

```
EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Aggr Amd
***
<Name>    x          <Name> x x<-factor->strg <Name>    x <Name>qf  tem strg
strg***
RCHRES   1 HYDR   RO     1 1          AVER WDM1  3001 FLOW   1 ENGL AGGR REPL
RCHRES   2 HYDR   RO     1 1          AVER WDM1  3002 FLOW   1 ENGL AGGR REPL
RCHRES   3 HYDR   RO     1 1          AVER WDM1  3003 FLOW   1 ENGL AGGR REPL
RCHRES   4 HYDR   RO     1 1          AVER WDM1  3004 FLOW   1 ENGL AGGR REPL
RCHRES   5 HYDR   RO     1 1          AVER WDM1  3005 FLOW   1 ENGL AGGR REPL
RCHRES   6 HYDR   RO     1 1          AVER WDM1  3006 FLOW   1 ENGL AGGR REPL
RCHRES   7 HYDR   RO     1 1          AVER WDM1  3007 FLOW   1 ENGL AGGR REPL
RCHRES   8 HYDR   RO     1 1          AVER WDM1  3008 FLOW   1 ENGL AGGR REPL
RCHRES   9 HYDR   RO     1 1          AVER WDM1  3009 FLOW   1 ENGL AGGR REPL
RCHRES  10 HYDR   RO     1 1          AVER WDM1  3010 FLOW   1 ENGL AGGR REPL
RCHRES  11 HYDR   RO     1 1          AVER WDM1  3011 FLOW   1 ENGL AGGR REPL
RCHRES  12 HYDR   RO     1 1          AVER WDM1  3012 FLOW   1 ENGL AGGR REPL
RCHRES  13 HYDR   RO     1 1          AVER WDM1  3013 FLOW   1 ENGL AGGR REPL
RCHRES  14 HYDR   RO     1 1          AVER WDM1  3014 FLOW   1 ENGL AGGR REPL
RCHRES  15 HYDR   RO     1 1          AVER WDM1  3015 FLOW   1 ENGL AGGR REPL
RCHRES  16 HYDR   RO     1 1          AVER WDM1  3016 FLOW   1 ENGL AGGR REPL
END EXT TARGETS
END RUN
```

Routing Reaches Parameters:

```
RUN

GLOBAL
  Cow Pen Slough, Flow Reaches, dec. LZETP, inc. INFILT
  START       1985/01/01 00:00  END    2005/12/31 24:00
  RUN INTERP OUTPT LEVELS    5    0
  RESUME     0 RUN     1                          UNITS    1
END GLOBAL

FILES
<FILE>  <UN#>***<----FILE  NAME-------------------------------------------------
>
MESSU      24   104_CPS_Routing_out.ech
           91   104_CPS_Routing_out.out
WDM1       25   102_CPS_BASIN_out.wdm
WDM2       26   103_CPS_ATT_out.wdm
WDM3       27   104_CPS_Routing_out.wdm
WDM4       28   dadada.wdm
BINO       92   104_CPS_Routing_out.hbn
END FILES

OPN SEQUENCE
    INGRP              INDELT 24:00
      RCHRES     202
      RCHRES     204
      RCHRES     206
      RCHRES     205
      RCHRES     208
      RCHRES     209
      RCHRES     210
      RCHRES     213
      RCHRES     215
    END INGRP
END OPN SEQUENCE

RCHRES
  ACTIVITY
*** RCHRES  Active sections
```

```
*** x -  x HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG
    1  300    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
*** RCHRES  Printout level flags
*** x -  x HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR
    1  300    5    4    4    4    4    4    4    4    4    4    1   12
  END PRINT-INFO

  BINARY-INFO
*** RCHRES  Binary Output level flags
*** x -  x HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR
    1  300    3    4    4    4    4    4    4    4    4    4    1   12
  END BINARY-INFO

  GEN-INFO
***              Name        Nexits   Unit Systems   Printer
*** RCHRES                               t-series  Engl Metr LKFG
*** x -  x                                 in  out
  202      Reach 202              1         1    1   91    0    0   92    0
  204      Reach 204              1         1    1   91    0    0   92    0
  206      Reach 206              1         1    1   91    0    0   92    0
  205      Reach 205              1         1    1   91    0    0   92    0
  208      Reach 208              1         1    1   91    0    0   92    0
  209      Reach 209              1         1    1   91    0    0   92    0
  210      Reach 210              1         1    1   91    0    0   92    0
  213      Reach 213              1         1    1   91    0    0   92    0
  215      Reach 215              1         1    1   91    0    0   92    0
  END GEN-INFO

  HYDR-PARM1
***          Flags for HYDR section
*** RCHRES   VC  A1  A2  A3   ODFVFG for each *** ODGTFG for each       FUNCT   for
each
*** x   - x   FG  FG  FG  FG   possible    exit *** possible    exit       possible
exit
    1  216   0   1   1   1    4   0   0   0   0       0   0   0   0   0       1   1   1   1
1
  END HYDR-PARM1
```

```
  HYDR-PARM2
*** RCHRES FTBW FTBU        LEN     DELTH     STCOR        KS       DB50
*** x -  x               (miles)     (ft)      (ft)                 (in)
    1         0.   1.        1.        3.       3.2       0.5       0.01
    2         0.   2.        1.        3.       3.2       0.5       0.01
    3         0.   3.        1.        3.       3.2       0.5       0.01
    4         0.   4.        1.        3.       3.2       0.5       0.01
    5         0.   5.        1.        3.       3.2       0.5       0.01
    6         0.   6.        1.        3.       3.2       0.5       0.01
    7         0.   7.        1.        3.       3.2       0.5       0.01
    8         0.   8.        1.        3.       3.2       0.5       0.01
    9         0.   9.        1.        3.       3.2       0.5       0.01
   10         0.  10.        1.        3.       3.2       0.5       0.01
   11         0.  11.        1.        3.       3.2       0.5       0.01
   12         0.  12.        1.        3.       3.2       0.5       0.01
   13         0.  13.        1.        3.       3.2       0.5       0.01
   14         0.  14.        1.        3.       3.2       0.5       0.01
   15         0.  15.        1.        3.       3.2       0.5       0.01
   16         0.  16.        1.        3.       3.2       0.5       0.01
  202         0. 202.        1.        3.       3.2       0.5       0.01
  204         0. 204.        1.        3.       3.2       0.5       0.01
  206         0. 206.        1.        3.       3.2       0.5       0.01
  205         0. 205.        1.        3.       3.2       0.5       0.01
  208         0. 208.        1.        3.       3.2       0.5       0.01
  209         0. 209.        1.        3.       3.2       0.5       0.01
  210         0. 210.        1.        3.       3.2       0.5       0.01
  213         0. 213.        1.        3.       3.2       0.5       0.01
  215         0. 215.        1.        3.       3.2       0.5       0.01
  END HYDR-PARM2

  HYDR-INIT
***          Initial conditions for HYDR section
***RC HRES         VOL   CAT Initial value  of COLIND      initial   value   of
OUTDGT
*** x   - x      ac-ft      for each possible   exit  for each possible exit,ft3
    1  207        5.00        4.2  4.5  4.5  4.5  4.2        2.1  1.2  0.5  1.2
1.8
  208  208        5.00        4.2  4.5  4.5  4.5  4.2        2.1  1.2  0.5  1.2
1.8
  209  216        5.00        4.2  4.5  4.5  4.5  4.2        2.1  1.2  0.5  1.2
1.8
```

```
  END HYDR-INIT
END RCHRES

FTABLES
  ******
  FTABLE    202
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00    92.75      0.00      0.00
      1.04    92.75      2.89      0.00
      2.08    92.75      7.71     77.60
      3.12    92.75     14.46    139.05
      4.16    92.75     22.18    255.16
      5.20    92.75     30.86    463.62
      6.24    92.75     40.02    806.97
      7.28    92.75     49.66   1334.06
      8.32    92.75     78.59   2100.26
      9.36    92.75    136.44   3164.04
     10.40    92.75    223.23   4366.23
     11.44    92.75    319.66   5568.42
     13.44    92.75   3196.55 556841.62
  END FTABLE202
  ******
  FTABLE    204
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00   987.70      0.00      0.00
      1.34   987.70     39.62     60.60
      2.67   987.70    105.66    118.03
      4.01   987.70    198.11    211.51
      5.35   987.70    303.77    388.12
      6.69   987.70    422.63    705.21
      8.02   987.70    548.10   1227.50
      9.36   987.70    680.17   2029.26
     10.70   987.70   1076.38   3194.74
     12.03   987.70   1868.82   4812.86
```

```
     13.37     987.70    3057.46    6641.52
     14.71     987.70    4378.18    8470.19
     16.71     987.70   43781.79  847018.73
  END FTABLE204
  ******
  FTABLE    206
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00     14.63      0.00      0.00
      1.43     14.63      0.63     67.68
      2.86     14.63      1.67    131.80
      4.29     14.63      3.14    236.19
      5.71     14.63      4.81    433.41
      7.14     14.63      6.69    787.51
      8.57     14.63      8.67   1370.74
     10.00     14.63     10.76   2266.06
     11.43     14.63     17.04   3567.54
     12.86     14.63     29.58   5374.49
     14.29     14.63     48.39   7416.55
     15.72     14.63     69.29   9458.60
     17.72     14.63    692.93 945860.21
  END FTABLE206
  ******
  FTABLE    205
 ROWS COLS***
   13    4
***  DEPTH     AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00     20.63      0.00      0.00
      1.34     20.63      0.83     60.60
      2.67     20.63      2.21    118.03
      4.01     20.63      4.14    211.51
      5.35     20.63      6.34    388.12
      6.69     20.63      8.83    705.21
      8.02     20.63     11.45   1227.50
      9.36     20.63     14.20   2029.26
     10.70     20.63     22.48   3194.74
     12.03     20.63     39.03   4812.86
```

```
     13.37      20.63      63.85   6641.52
     14.71      20.63      91.43   8470.19
     16.71      20.63     914.31 847018.73
  END FTABLE205
  ******
  FTABLE    208
 ROWS COLS***
   13    4
***  DEPTH      AREA     VOLUME      DISCH  FLO-THRU ***
***   (FT)   (ACRES)    (AC-FT)      (CFS)     (MIN) ***
      0.00      20.66       0.00      0.00
      1.74      20.66       1.08     94.17
      3.48      20.66       2.88    183.39
      5.23      20.66       5.40    328.64
      6.97      20.66       8.28    603.05
      8.71      20.66      11.51   1095.73
     10.45      20.66      14.93   1907.23
     12.19      20.66      18.53   3152.98
     13.93      20.66      29.32   4963.85
     15.68      20.66      50.91   7478.03
     17.42      20.66      83.29  10319.33
     19.16      20.66     119.27  13160.63
     21.16      20.66    1192.741316063.02
  END FTABLE208
  ******
  FTABLE    209
 ROWS COLS***
   13    4
***  DEPTH      AREA     VOLUME      DISCH  FLO-THRU ***
***   (FT)   (ACRES)    (AC-FT)      (CFS)     (MIN) ***
      0.00      71.37       0.00      0.00
      1.93      71.37       4.12    111.36
      3.85      71.37      11.00    216.88
      5.78      71.37      20.62    388.64
      7.71      71.37      31.62    713.16
      9.63      71.37      43.99   1295.81
     11.56      71.37      57.06   2255.48
     13.48      71.37      70.80   3728.70
     15.41      71.37     112.05   5870.22
     17.34      71.37     194.54   8843.46
```

```
     19.26      71.37     318.27  12203.56
     21.19      71.37     455.76  15563.66
     23.19      71.37   4557.551556366.23
  END FTABLE209
  ******
  FTABLE    210
 ROWS COLS***
   13    4
***  DEPTH      AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00    128.76      0.00      0.00
      1.99    128.76      2.56    117.31
      3.97    128.76      7.68    228.46
      5.96    128.76     15.35    409.40
      7.95    128.76     25.59    751.26
      9.94    128.76     40.94   1365.03
     11.92    128.76     61.42   2375.97
     13.91    128.76     87.01   3927.89
     15.90    128.76    163.77   6183.81
     17.89    128.76    317.31   9315.88
     19.87    128.76    547.62  12855.48
     21.86    128.76    803.52  16395.09
     23.86    128.76   8035.201639508.52
  END FTABLE210
  ******
  FTABLE    213
 ROWS COLS***
   13    4
***  DEPTH      AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00    255.13      0.00      0.00
      2.32    255.13     17.79    152.31
      4.65    255.13     47.44    296.64
      6.97    255.13     88.96    531.57
      9.30    255.13    136.40    975.43
     11.62    255.13    189.78   1772.34
     13.95    255.13    246.11   3084.94
     16.27    255.13    305.42   5099.94
     18.60    255.13    483.33   8029.01
     20.92    255.13    839.16  12095.67
```

```
     23.24    255.13   1372.90  16691.47
     25.57    255.13   1965.95  21287.26
     27.57    255.13  19659.512128726.06
  END FTABLE213
  ******
  FTABLE    215
 ROWS COLS***
   13    4
***  DEPTH      AREA    VOLUME     DISCH  FLO-THRU ***
***   (FT)  (ACRES)   (AC-FT)     (CFS)     (MIN) ***
      0.00   6620.06      0.00      0.00
      1.10   6620.06     72.82     15.67
      2.20   6620.06    218.46     66.99
      3.30   6620.06    436.92    161.60
      4.40   6620.06    728.21    312.10
      5.50   6620.06   1165.13    520.80
      6.60   6620.06   1747.70    939.40
      7.70   6620.06   2475.90   1876.50
      8.80   6620.06   4660.52   3409.00
      9.90   6620.06   9029.76   5968.00
     11.00   6620.06  15583.62  10000.00
     12.10   6620.06  22865.68  11000.00
     14.10   6620.06 228656.831100000.00
  END FTABLE215
END FTABLES

***COPY
***  TIMESERIES
***  Copy-opn***
*** x -  x  NPT  NMN
    1    2    0    7
***  END TIMESERIES

***END COPY

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name>    x <Name> x tem strg<-factor->strg <Name>   x   x        <Name> x x ***
WDM2  3001 FLOW     ENGL          1.98SAME RCHRES 202     EXTNL  IVOL
WDM2  3002 FLOW     ENGL          1.98SAME RCHRES 202     EXTNL  IVOL
```

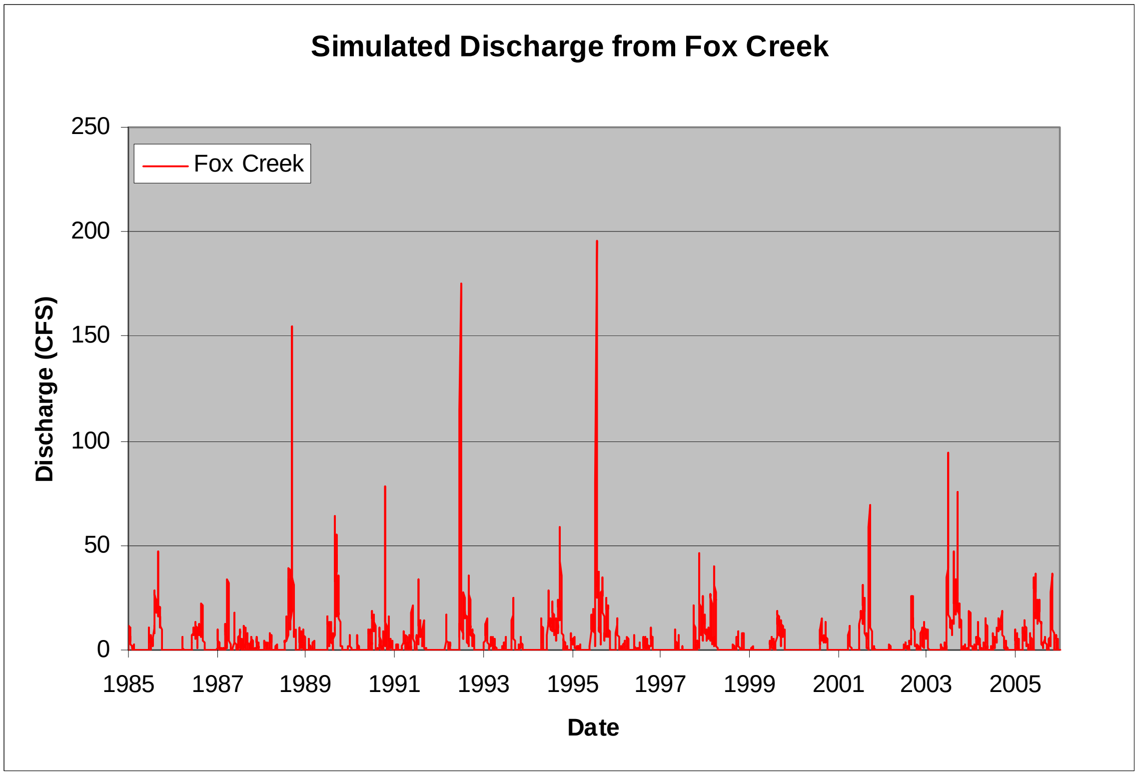
```
WDM2  3003 FLOW     ENGL           1.98SAME RCHRES 204     EXTNL  IVOL
WDM2  3004 FLOW     ENGL           1.98SAME RCHRES 204     EXTNL  IVOL
WDM2  3005 FLOW     ENGL           1.98SAME RCHRES 205     EXTNL  IVOL
WDM2  3006 FLOW     ENGL           1.98SAME RCHRES 206     EXTNL  IVOL
WDM2  3007 FLOW     ENGL           1.98SAME RCHRES 205     EXTNL  IVOL
WDM2  3008 FLOW     ENGL           1.98SAME RCHRES 208     EXTNL  IVOL
WDM2  3009 FLOW     ENGL           1.98SAME RCHRES 209     EXTNL  IVOL
WDM2  3010 FLOW     ENGL           1.98SAME RCHRES 210     EXTNL  IVOL
WDM2  3011 FLOW     ENGL           1.98SAME RCHRES 213     EXTNL  IVOL
WDM2  3012 FLOW     ENGL           1.98SAME RCHRES 213     EXTNL  IVOL
WDM2  3013 FLOW     ENGL           1.98SAME RCHRES 213     EXTNL  IVOL
WDM2  3014 FLOW     ENGL           1.98SAME RCHRES 215     EXTNL  IVOL
WDM2  3015 FLOW     ENGL           1.98SAME RCHRES 215     EXTNL  IVOL
WDM2  3016 FLOW     ENGL           1.98SAME RCHRES 215     EXTNL  IVOL
WDM4   666 PREC     ENGL               SUM  RCHRES 202     EXTNL  PREC
WDM4   666 PREC     ENGL               SUM  RCHRES 204     EXTNL  PREC
WDM4   666 PREC     ENGL               SUM  RCHRES 205     EXTNL  PREC
WDM4   666 PREC     ENGL               SUM  RCHRES 206     EXTNL  PREC
WDM4   666 PREC     ENGL               SUM  RCHRES 208     EXTNL  PREC
WDM4   666 PREC     ENGL               SUM  RCHRES 209     EXTNL  PREC
WDM4   666 PREC     ENGL               SUM  RCHRES 210     EXTNL  PREC
WDM4   666 PREC     ENGL               SUM  RCHRES 213     EXTNL  PREC
WDM4   666 PREC     ENGL               SUM  RCHRES 215     EXTNL  PREC
WDM4     2 PEVT     ENGL               SUM  RCHRES 201 215 EXTNL  POTEV
END EXT SOURCES

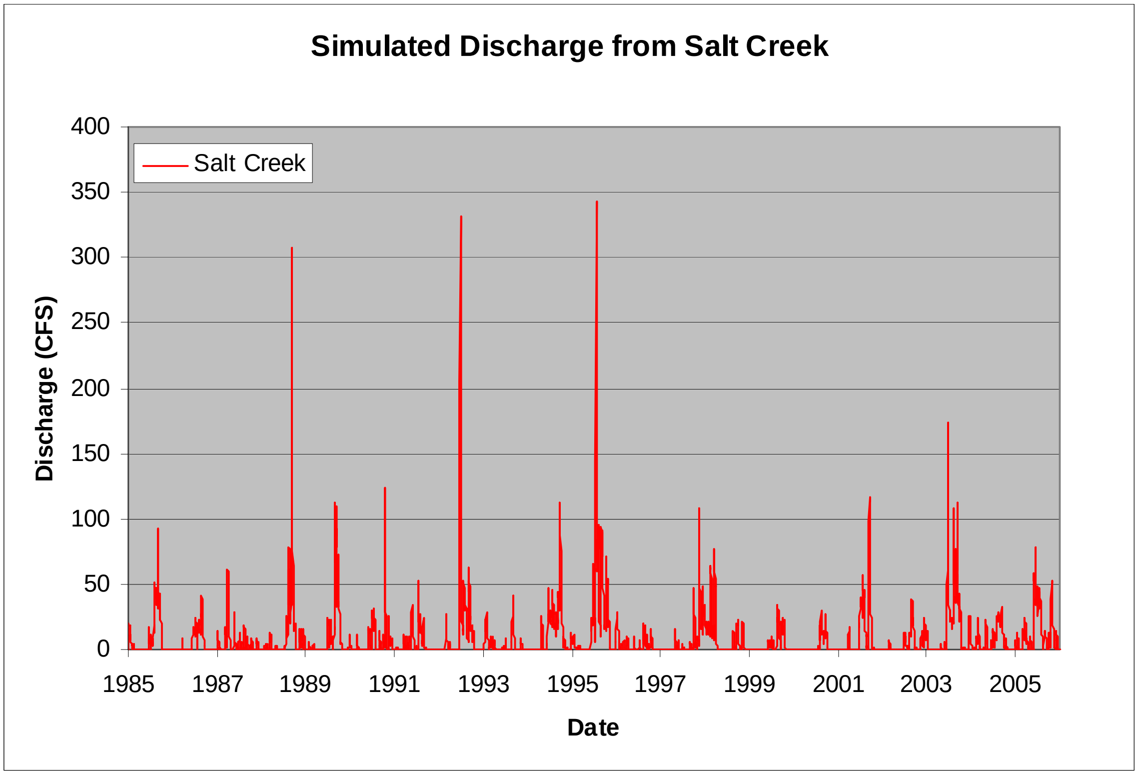
NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-grp> <-Member-> ***
<Name>   x        <Name> x x<-factor->strg <Name>   x   x        <Name> x x ***
RCHRES 202 HYDR   ROVOL              1SAME RCHRES 204     EXTNL  IVOL
RCHRES 204 HYDR   ROVOL              1SAME RCHRES 206     EXTNL  IVOL
RCHRES 206 HYDR   ROVOL              1SAME RCHRES 205     EXTNL  IVOL
RCHRES 205 HYDR   ROVOL              1SAME RCHRES 208     EXTNL  IVOL
RCHRES 208 HYDR   ROVOL              1SAME RCHRES 209     EXTNL  IVOL
RCHRES 209 HYDR   ROVOL              1SAME RCHRES 210     EXTNL  IVOL
RCHRES 210 HYDR   ROVOL              1SAME RCHRES 213     EXTNL  IVOL
END NETWORK

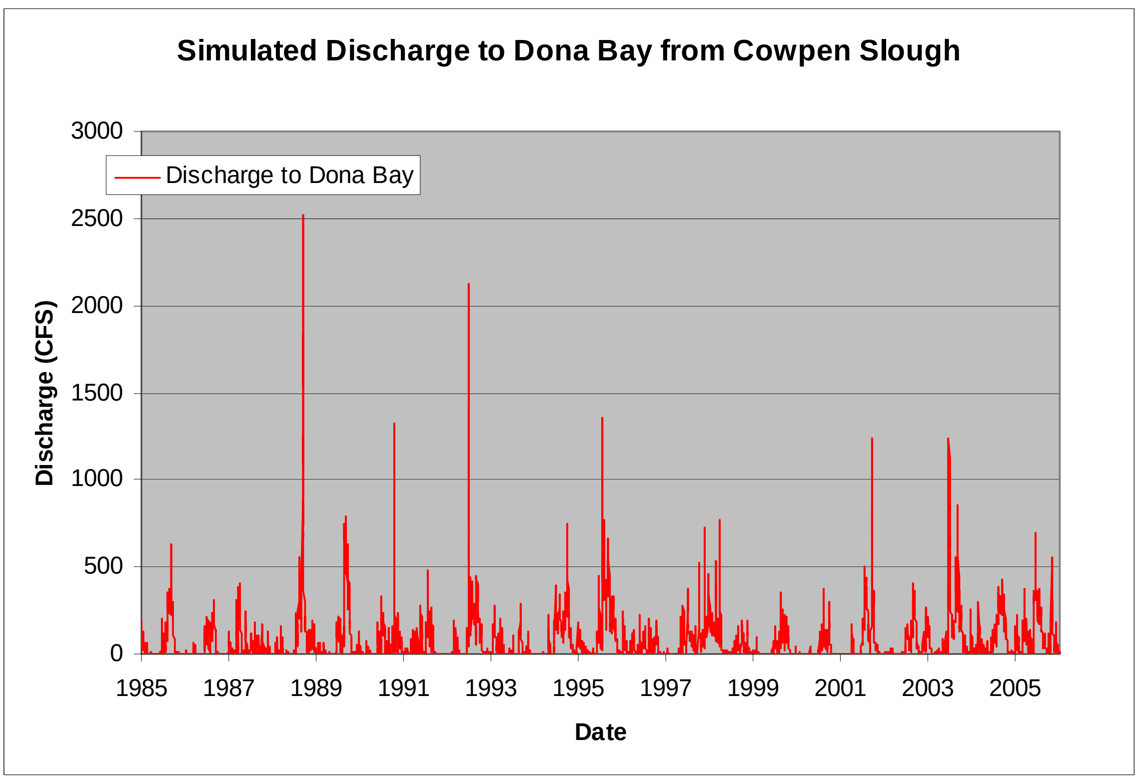
EXT TARGETS
```

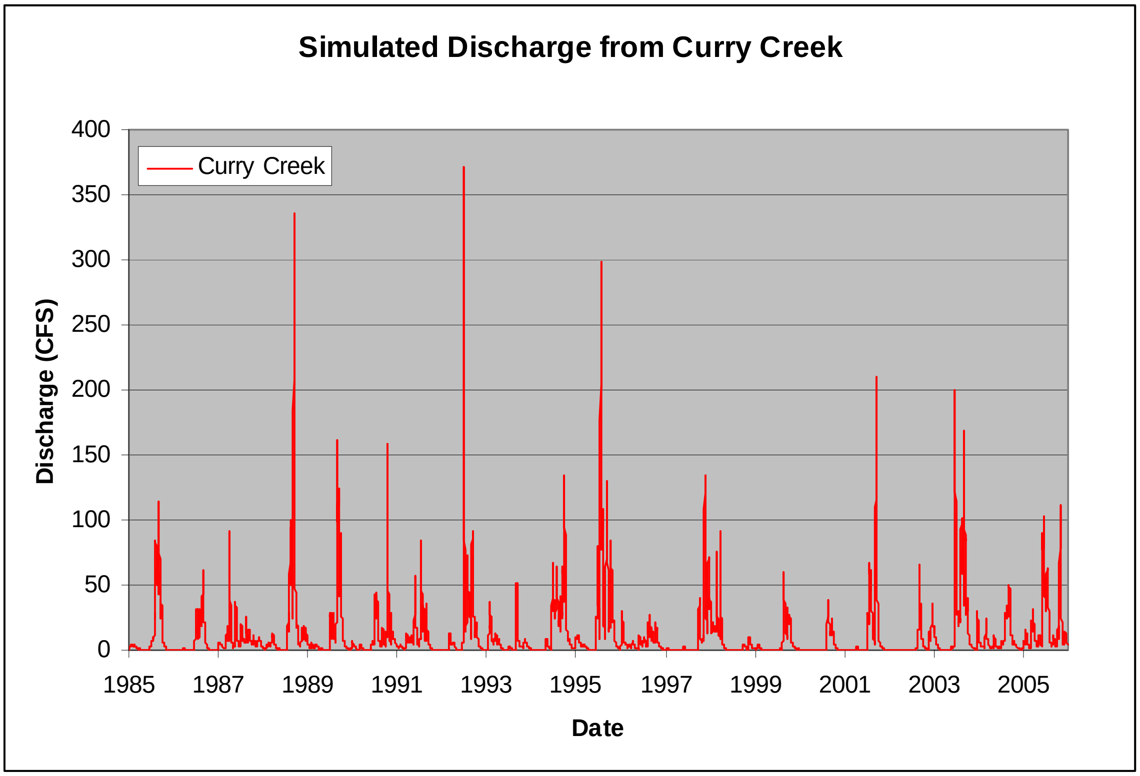
```
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Aggr Amd
***
<Name>    x          <Name> x x<-factor->strg <Name>    x <Name>qf  tem strg
strg***
RCHRES 202 HYDR   RO     1 1          AVER WDM3  4001 FLOW   1 ENGL AGGR REPL
RCHRES 204 HYDR   RO     1 1          AVER WDM3  4002 FLOW   1 ENGL AGGR REPL
RCHRES 206 HYDR   RO     1 1          AVER WDM3  4003 FLOW   1 ENGL AGGR REPL
RCHRES 205 HYDR   RO     1 1          AVER WDM3  4004 FLOW   1 ENGL AGGR REPL
RCHRES 208 HYDR   RO     1 1          AVER WDM3  4005 FLOW   1 ENGL AGGR REPL
RCHRES 209 HYDR   RO     1 1          AVER WDM3  4006 FLOW   1 ENGL AGGR REPL
RCHRES 210 HYDR   RO     1 1          AVER WDM3  4007 FLOW   1 ENGL AGGR REPL
RCHRES 213 HYDR   RO     1 1          AVER WDM3  4008 FLOW   1 ENGL AGGR REPL
RCHRES 215 HYDR   RO     1 1          AVER WDM3  4009 FLOW   1 ENGL AGGR REPL
END EXT TARGETS
END RUN
```

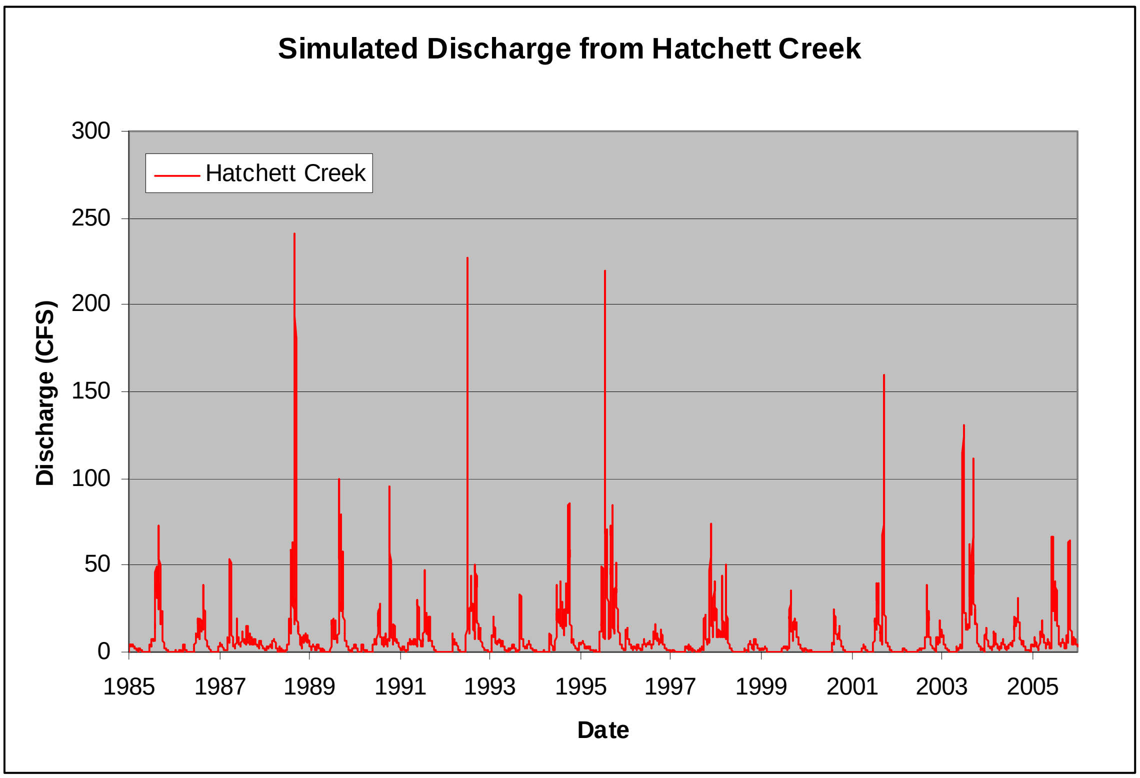
Appendix D: 20-year Discharge from Un-gauged Reaches




Simulated Discharge from Salt Creek
Salt Creek
Discharge (CFS)
400
350
300
250
200
150
100
50
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Date


Simulated Discharge to Dona Bay from Cowpen Slough
Discharge to Dona Bay
Discharge (CFS)
3000
2500
2000
1500
1000
500
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Date


Simulated Discharge from Curry Creek
Curry Creek
Discharge (CFS)
400
350
300
250
200
150
100
50
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Date


Simulated Discharge from Hatchett Creek
Hatchett Creek
Discharge (CFS)
300
250
200
150
100
50
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Date

Appendix E: District Review Comments

The District review comment are shown in red. INTERA reply shown in black.

First the trivial and the editorial.

Please add the Purchase Order number to the cover page

PO number was added.

Please add page numbers and insert a blank line between each paragraph.

Page numbers and blank lines were added.

Can the ArcView figures be improved by either increasing the resolution, or by increasing the size ?

Graphics were modified.

Technical comments.

1)The model domain does not match the RFQ or the scope of work in that the ungauged contribution of Robert's bay is missing. I think we discussed this when you were here in the context of deciding how to deal with the Blackburn Canal interchange with the Myakka. Both the RFQ and the scope included the following text (emphasis added):

> *The present project involves estimation of the daily flow from the gaged and ungaged areas of the Dona and Roberts watersheds. The District expects to develop an MFL rule during 2007 for Cow Pen Slough/Dona Bay (hereinafter referred to as the CPS MFL) <u>downstream of the last control structure on Cow Pen Slough Canal. Salt Creek, Fox Creek and an unnamed tributary flow directly into this reach and it is likely that the ungaged flow from Roberts Bay (including inflows from Curry Creek and Hatchett Creek)</u> and Lyons Bay contribute freshwater that will affect the salinity with Dona Bay.*

The simulated domain was extended. The report was appended with an additional section and appendix. The data was already made available for use in the ecological modeling of Donna and Roberts Bays.

2) I'm curious why you didn't identify the wetlands as a land use? I see that ultimately you created storage reaches out of them, but wouldn't it have been easier to identify them as a land use from the FLUCCS codes.

Wetlands were simulated as reaches. HSPF can represent wetlands as a separate pervious land segment. However it is difficult to represent the storage available in a wetland with the parameters within the HSPF PERLND module. Wetland ET is also difficult to represent with the HSPF PERLND definitions. We have found that it is easier to simulate a wetland as a reach or RCHRES. The HSPF RCHRES module allows the modeler to better represent the stage storage relationship. The RCHRES module also better represents the ET rates from wetlands.

3) The application of the irrigation was based on FLUCCS code assignments between 2100 and 2600. First of all, 2600 represents something described as "other open lands – rural". Not sure that should be considered as irrigated land. But the bigger issue is that we discussed comparing the FLUCCS land use with some form of aerial photography in order to refine the actual acreage under irrigation. The two areas can be quite different and there is no mention in the report of completing this QA step. RESPEC ran into this problem when doing the Manatee River HSPF – by applying the pumped quantities to gross overestimates of the actual acreage they predicted no appreciable runoff from row crops and that is patently wrong. One estimate I read indicated that only about 30% of the farm land in Manatee County is actually irrigated and I suspect that same number is probably applicable to Sarasota County.

Unfortunately performing detailed irrigated acreage estimates from the available aerial photography was outside the scope of this work. We agree the area to which the irrigation is applied can be quite different than the land use mapping. The irrigated areas can also change significantly from year to year. It is also the primary crop type can also change and therefore any estimates for irrigate areas will be erroneous. Best available data was used in developing the irrigation rates and irrigated areas.

4) Continuing with the discussion about irrigation, I think we need to include a table which identifies how much acreage (and type of crop) is irrigated with drip and with spray because the Florida estimates that I have seen don't seem to agree with actual use. Also, I note that ridge/furrow is not listed in the report. This is probably the most common irrigation practice for row crops that I have observed in Manatee County and it is grossly inefficient – about 40-50% or the applied water is converted directly to runoff. If the HSPF treatment of the row crop land use does not show significant runoff, then it needs to be adjusted.

Knowing that most of the irrigation is applied through ridge furrow irrigation we decided to simply apply the irrigation to the interception storage. This method would produce more runoff. We performed some unit testing on the irrigation impacts. The runoff rates were directly impacted by the application of groundwater pumping to the land surface. Unfortunately there is no hard observed data to determine the impacts therefore no comparison is possible.

5) Paragraph titled **Gauged/Un-Gauged Cow Pen Slough** second to last sentence describing shallower water table in the lower reaches etc. This statement has been used

frequently in both USF and INTERA reports. It would seem that the opposite would be true when you have a large concentration of wetlands in the upper watershed. Please provide a literature citation or some evidence to support this statement.

The opposite can be true. Obviously location of the water table well can significantly impact the depth to the water table. For example a well can be placed directly next to a wetland and record the water table close to land surface. The statement is however, in very general terms. Generally speaking the coastal area is flat with very shallow slopes as opposed to regions further inland. An extreme case of this is the Withlacoochee River basin. It has a vast coastal plains area with relatively high ridge areas as you follow the river up into the head waters.

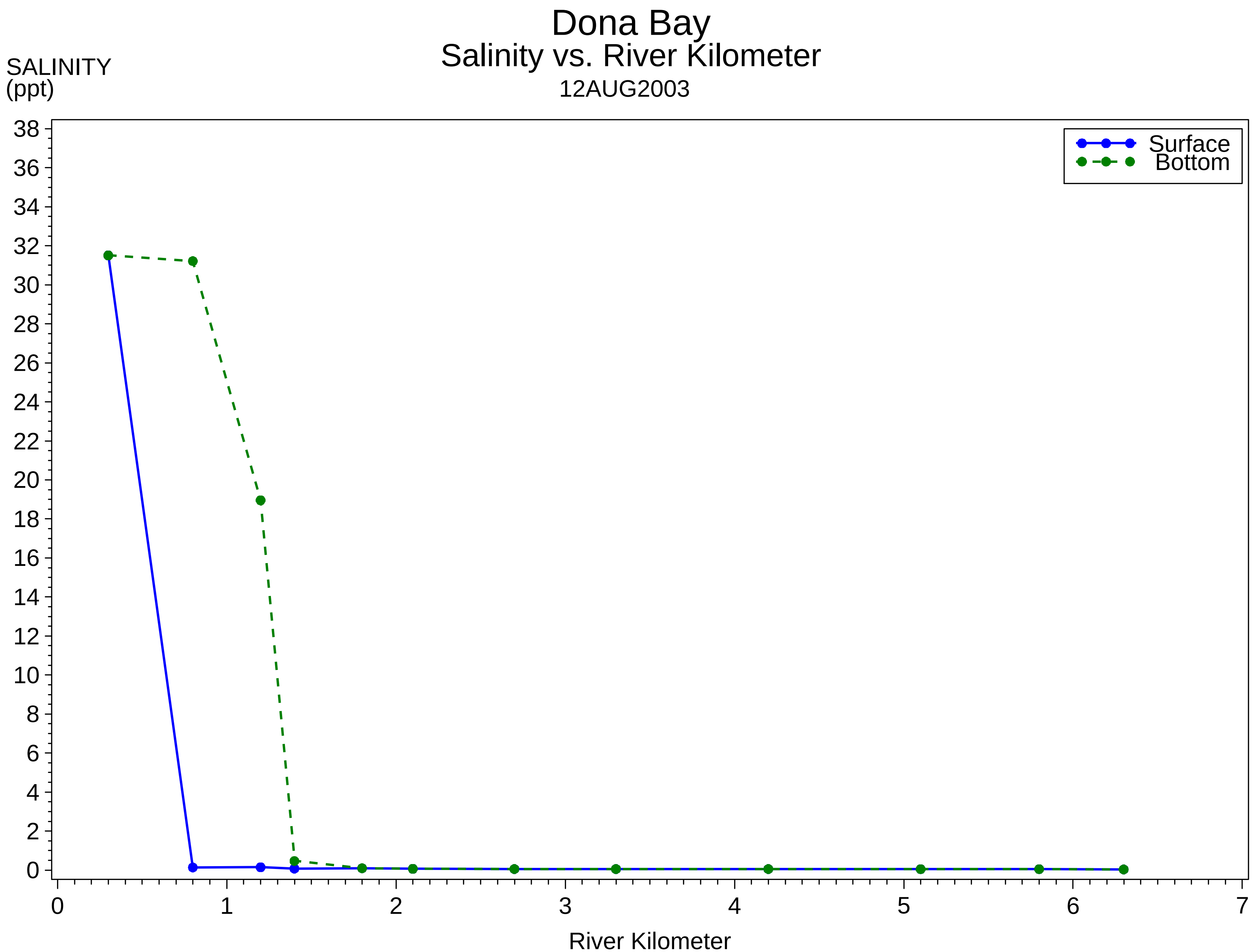
6) **Predictive Simulation Results**

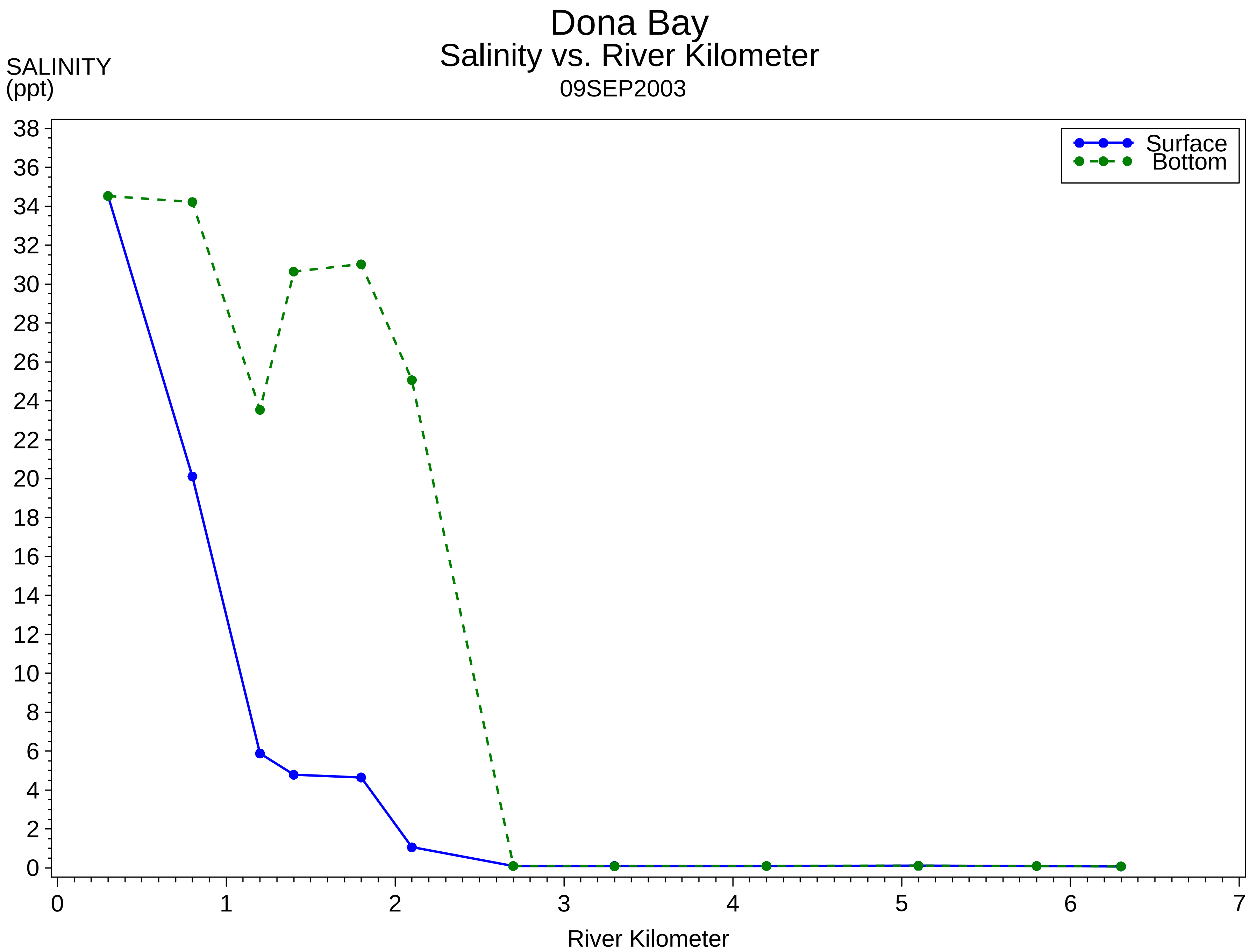
Remarks

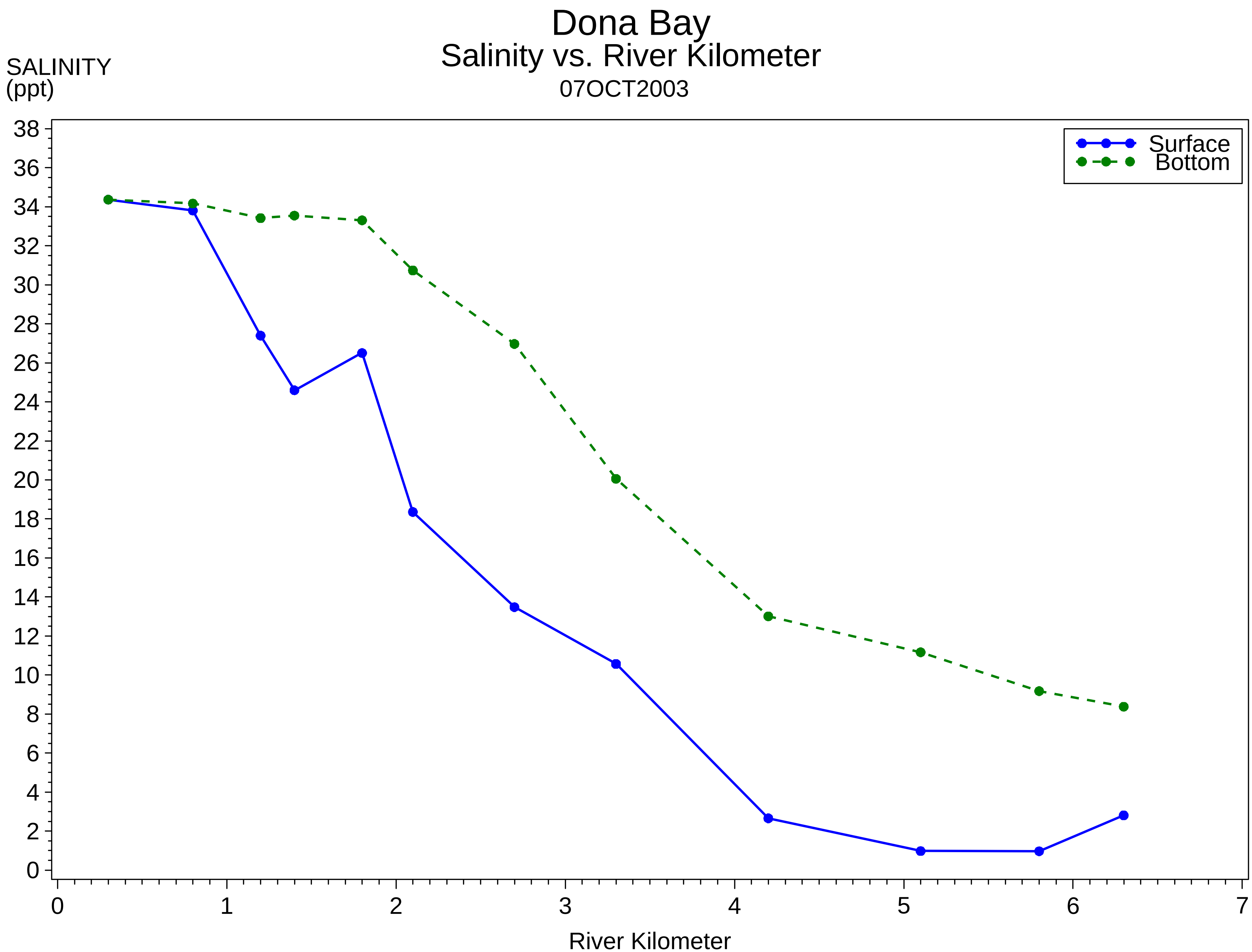
1. I think the areas should be mi^2 not acres.

APPENDIX 4-1

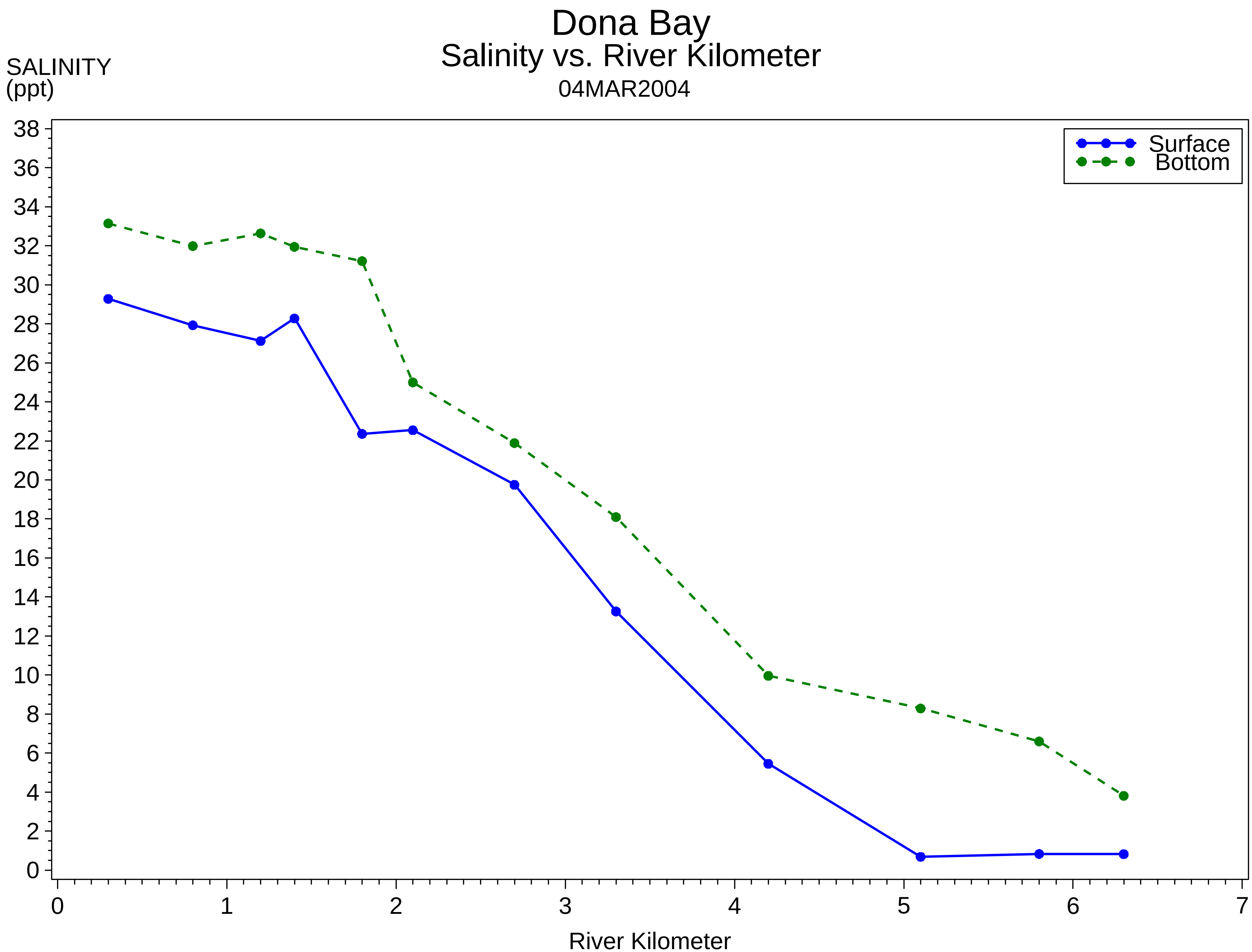
PLOTS OF SALINTIY VS RIVER KM
IN DONA BAY BY DATE

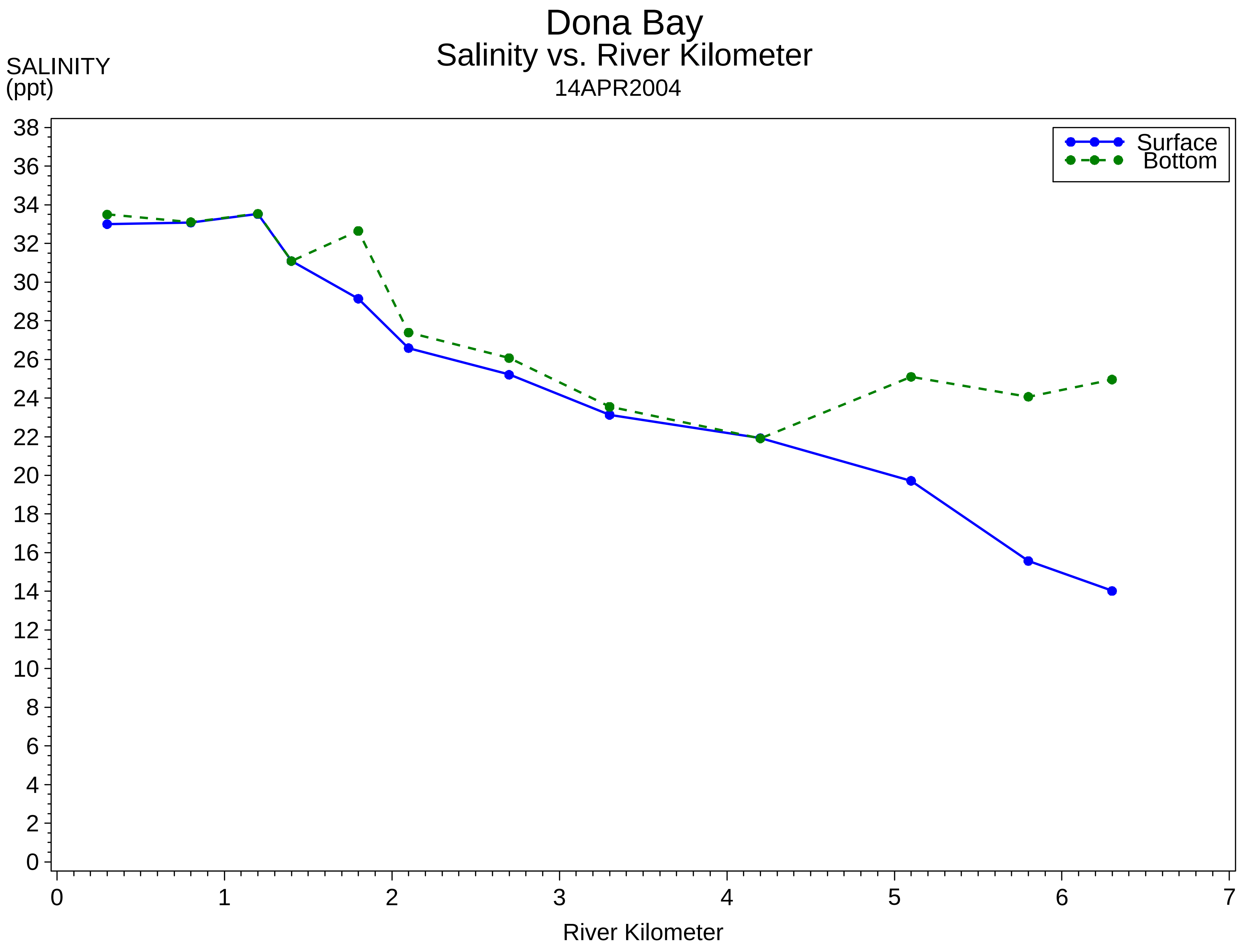

Dona Bay
Salinity vs. River Kilometer
12AUG2003
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Surface
Bottom
0
1
2
3
4
5
6
7
River Kilometer

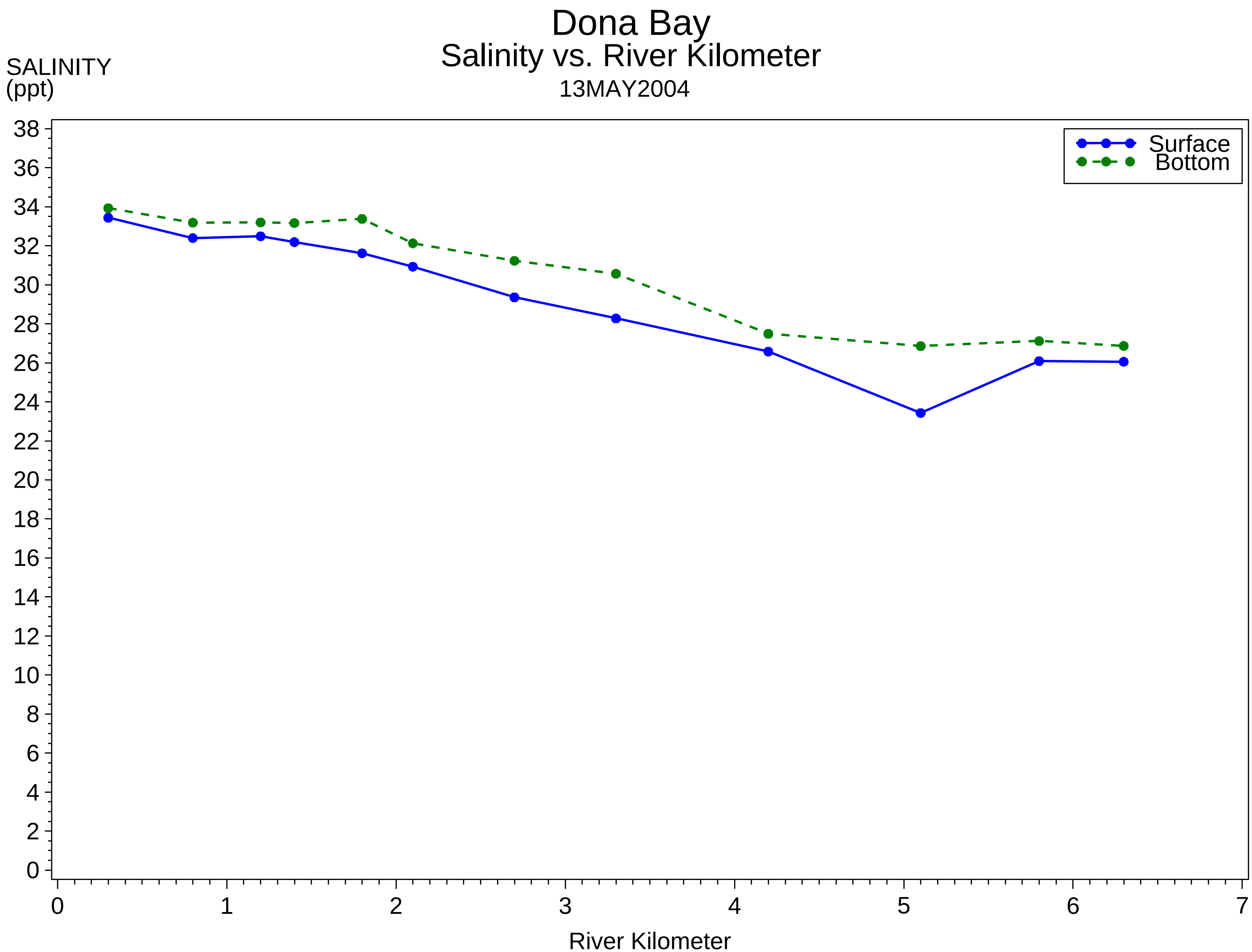

Dona Bay
Salinity vs. River Kilometer
09SEP2003
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

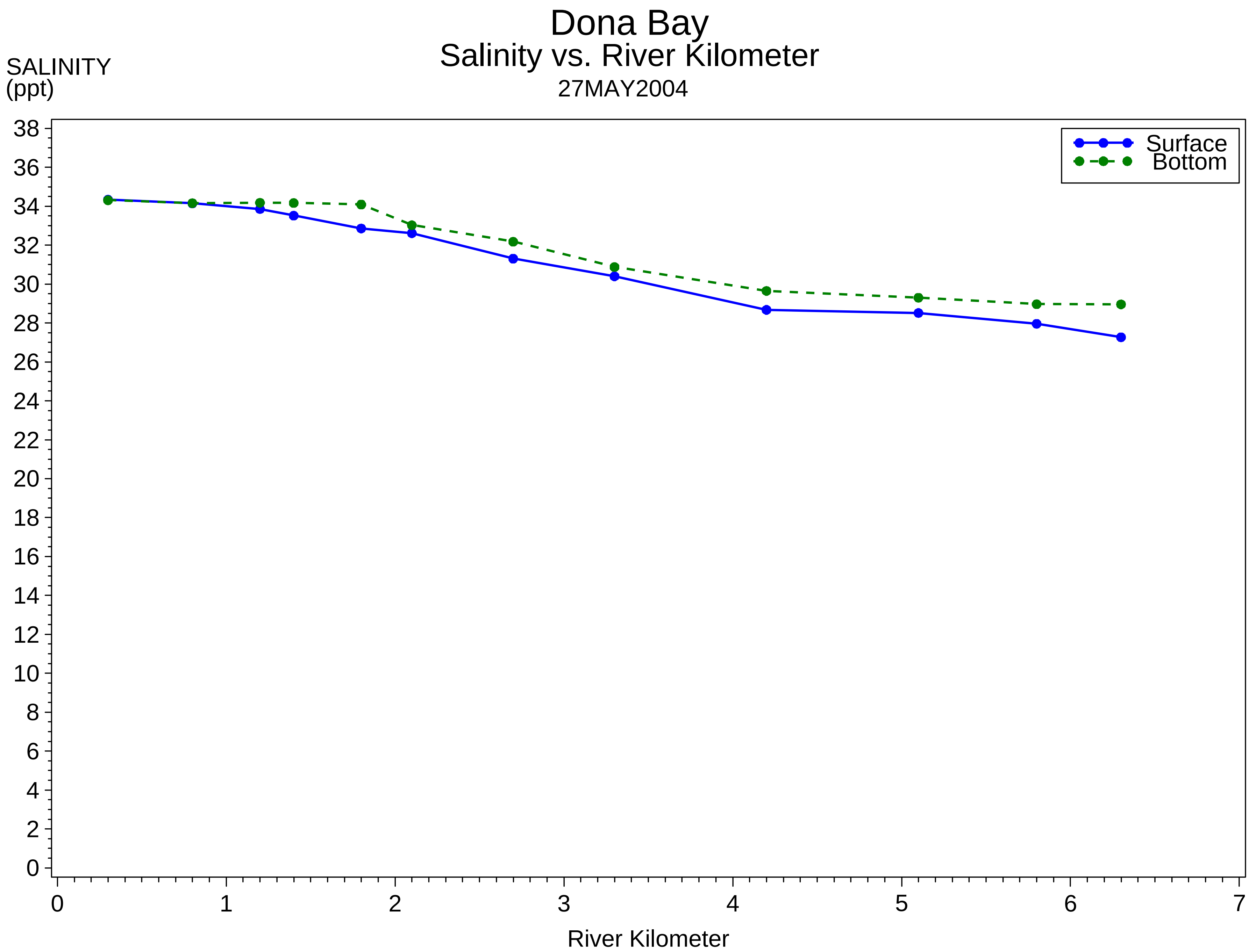

Dona Bay
Salinity vs. River Kilometer
07OCT2003
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Surface
Bottom
0
1
2
3
4
5
6
7
River Kilometer

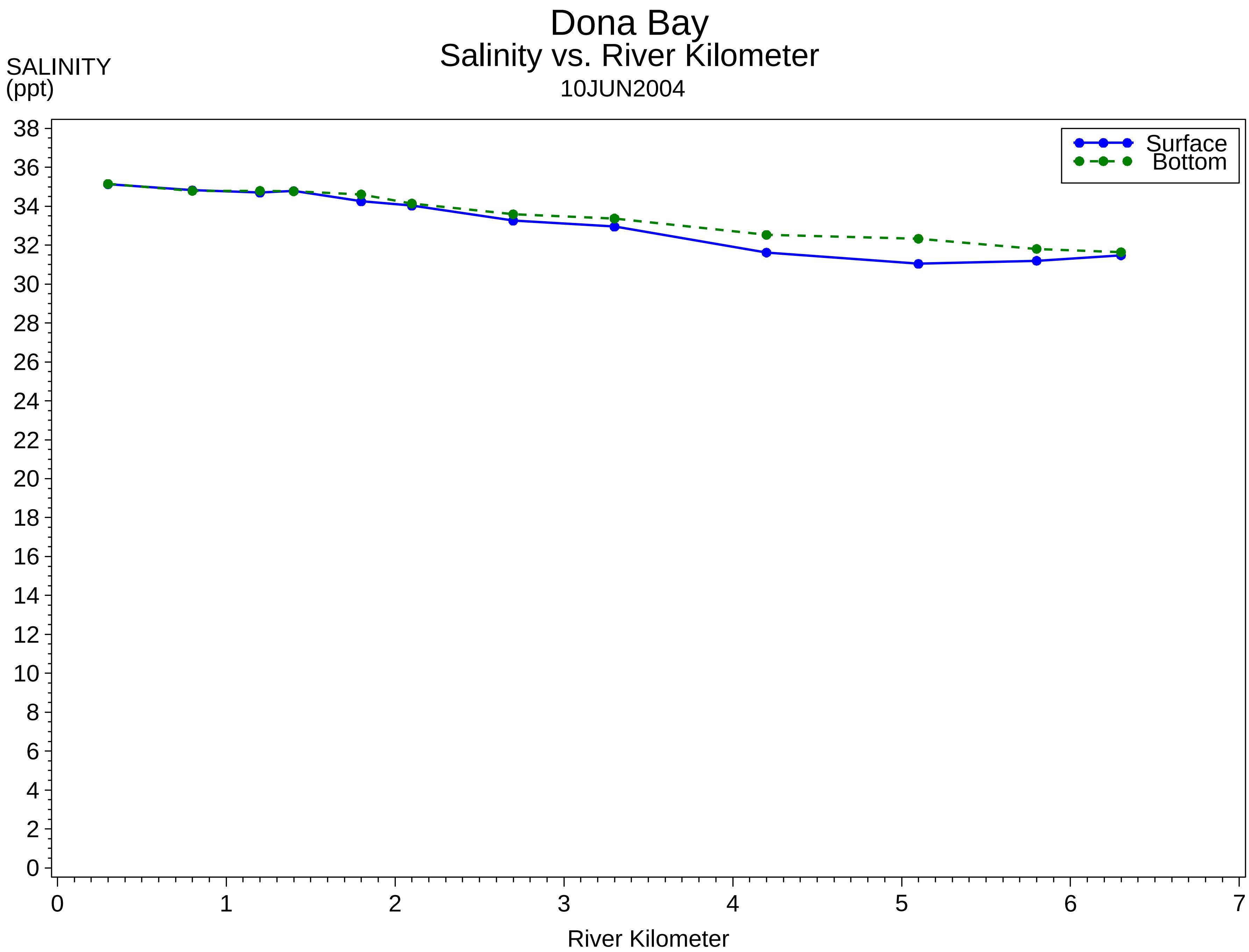

Dona Bay
Salinity vs. River Kilometer
12NOV2003
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Surface
Bottom
0
1
2
3
4
5
6
7
River Kilometer

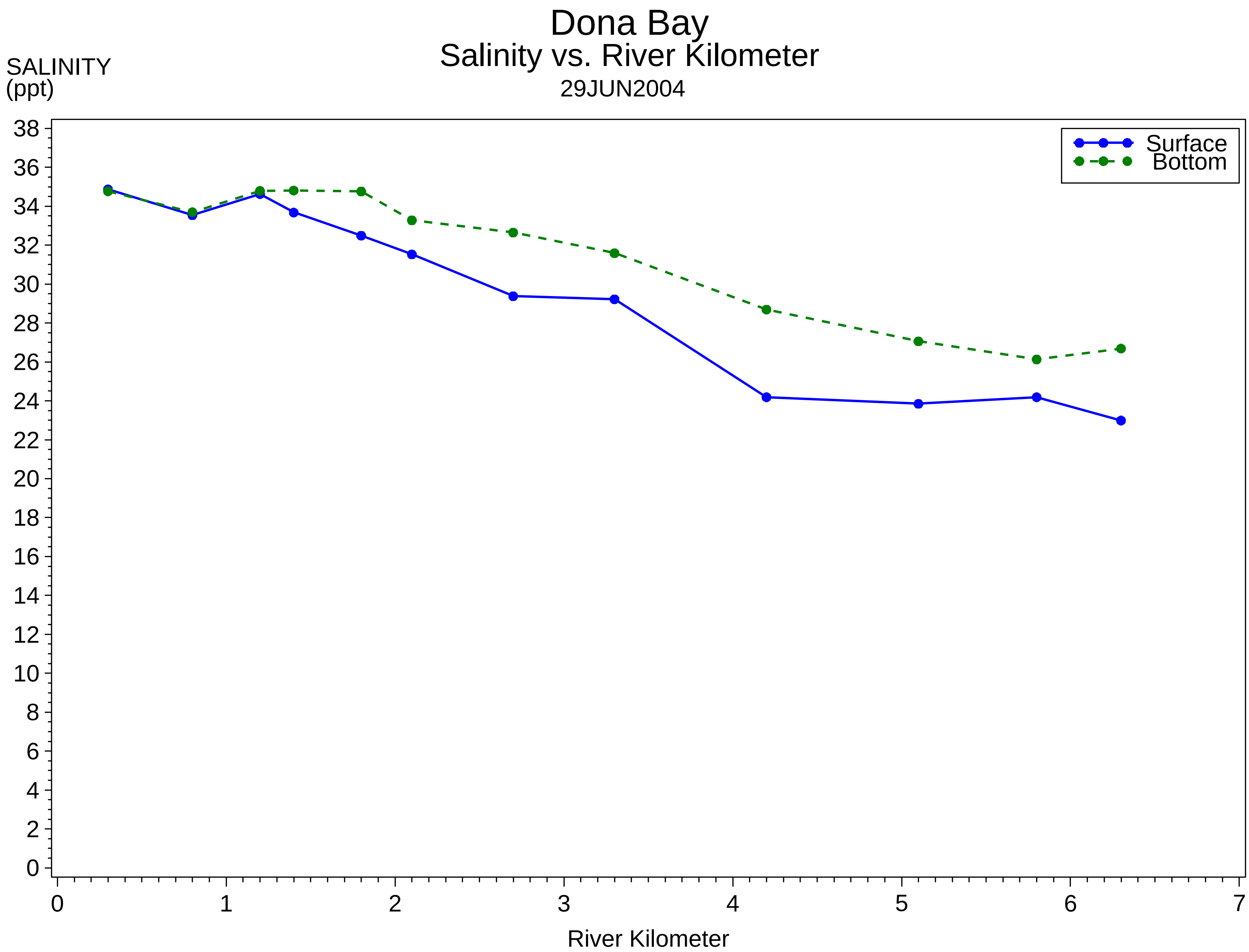

Dona Bay
Salinity vs. River Kilometer
04MAR2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

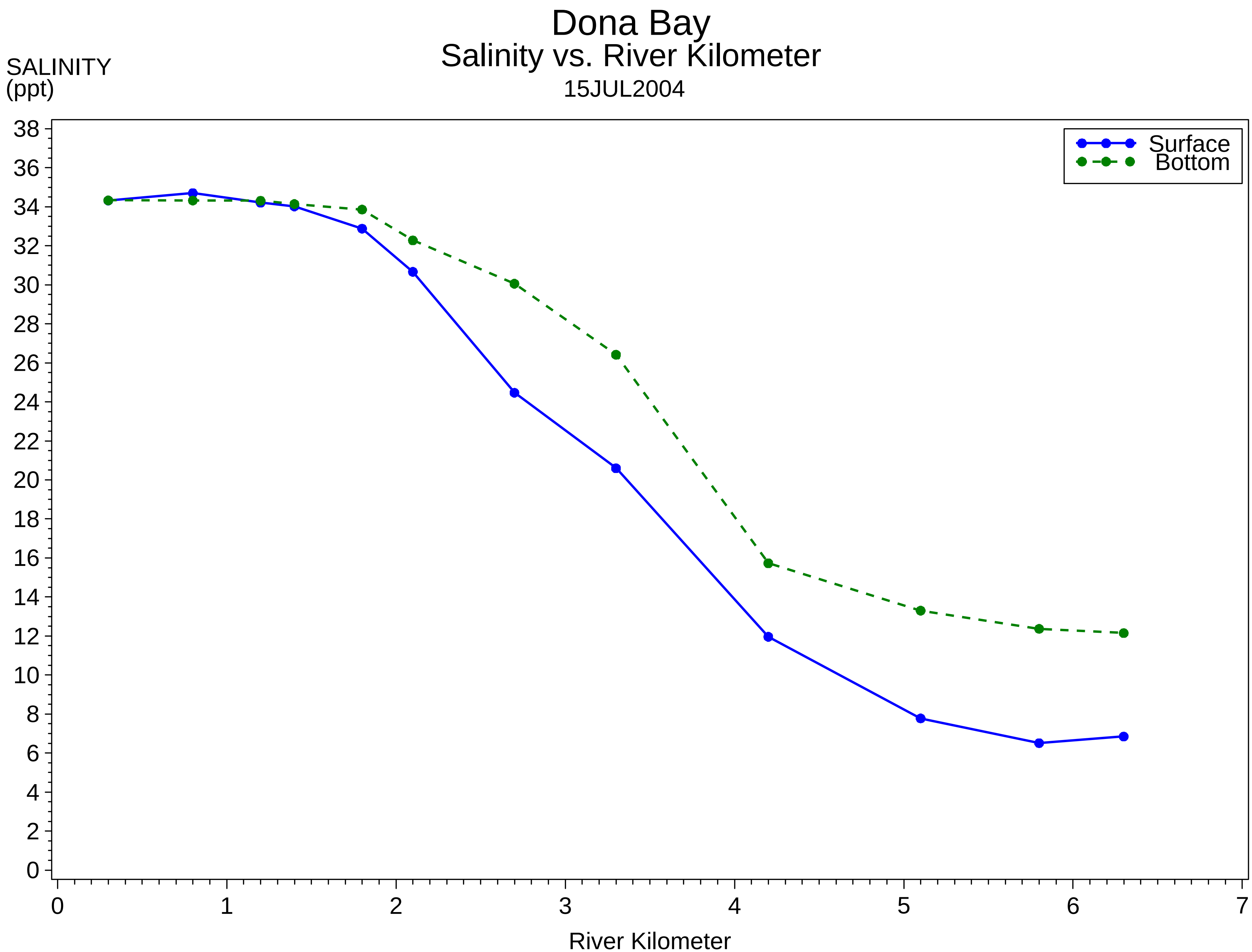

Dona Bay
Salinity vs. River Kilometer
14APR2004
SALINITY
(ppt)
Surface
Bottom
River Kilometer
0
1
2
3
4
5
6
7
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38

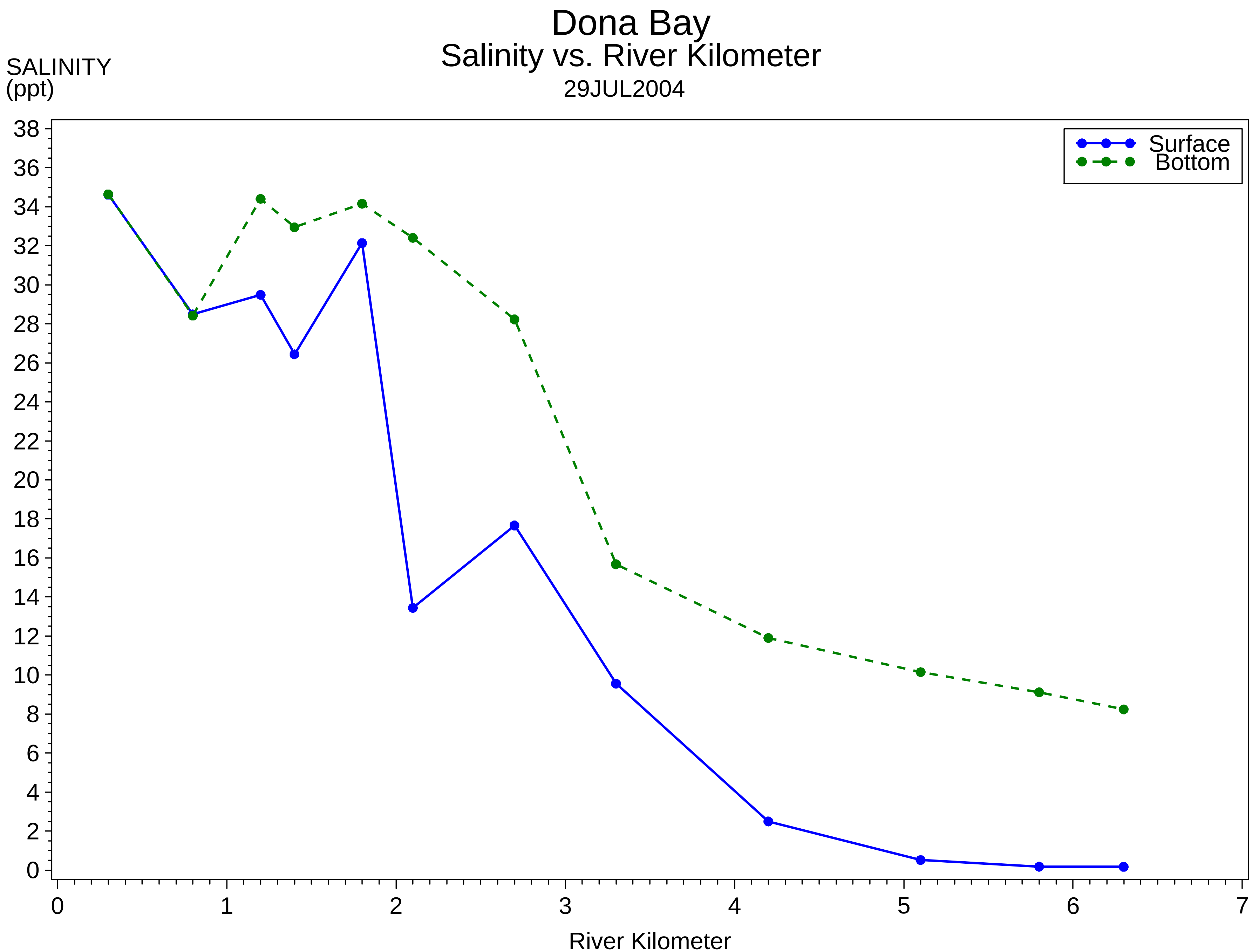

Dona Bay
Salinity vs. River Kilometer
13MAY2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

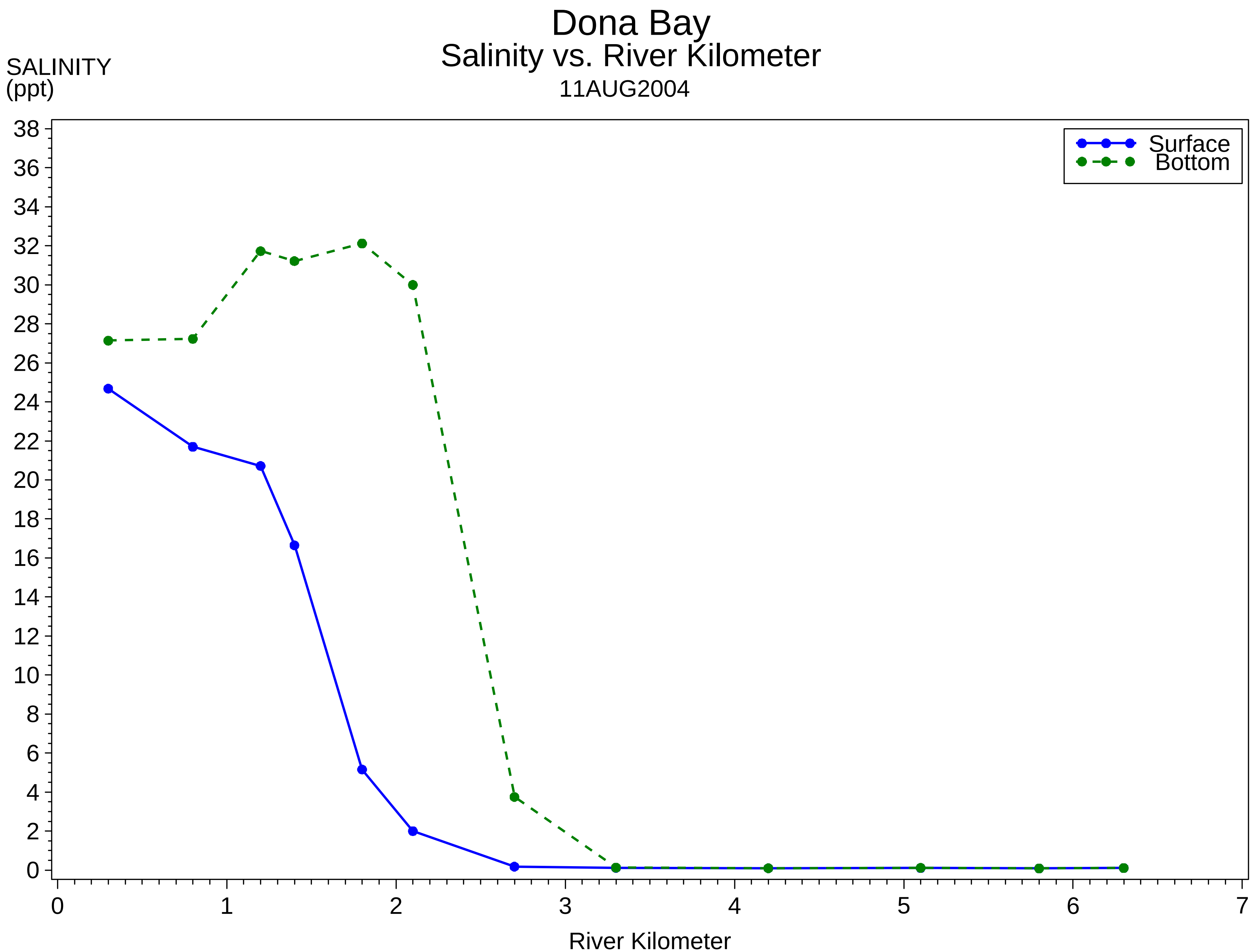

Dona Bay
Salinity vs. River Kilometer
27MAY2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

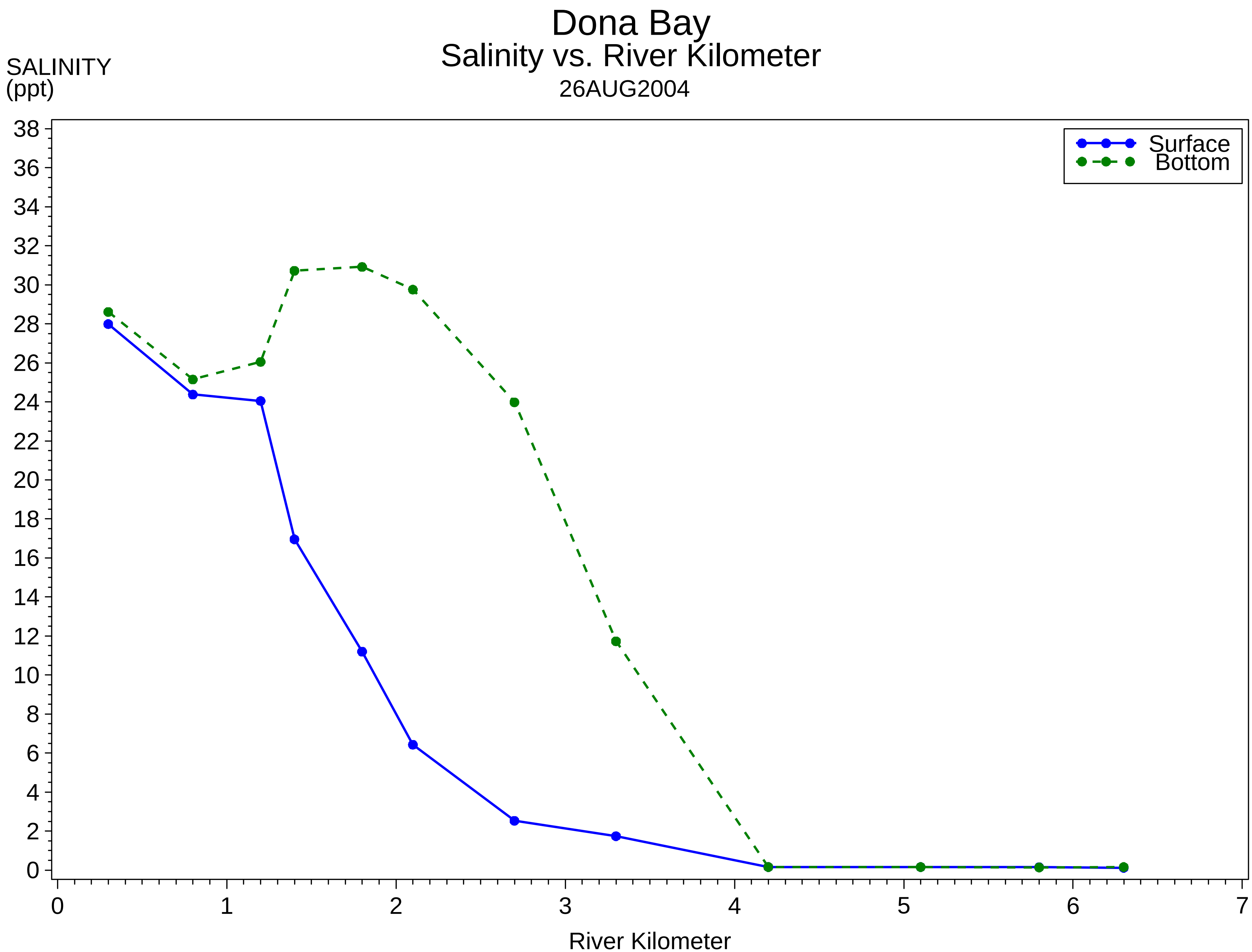

Dona Bay
Salinity vs. River Kilometer
10JUN2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom


Dona Bay
Salinity vs. River Kilometer
29JUN2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Surface
Bottom
0
1
2
3
4
5
6
7
River Kilometer


Dona Bay
Salinity vs. River Kilometer
15JUL2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom


Dona Bay
Salinity vs. River Kilometer
29JUL2004
SALINITY
(ppt)
Surface
Bottom
River Kilometer
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
0
1
2
3
4
5
6
7


Dona Bay
Salinity vs. River Kilometer
11AUG2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom


Dona Bay
Salinity vs. River Kilometer
26AUG2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
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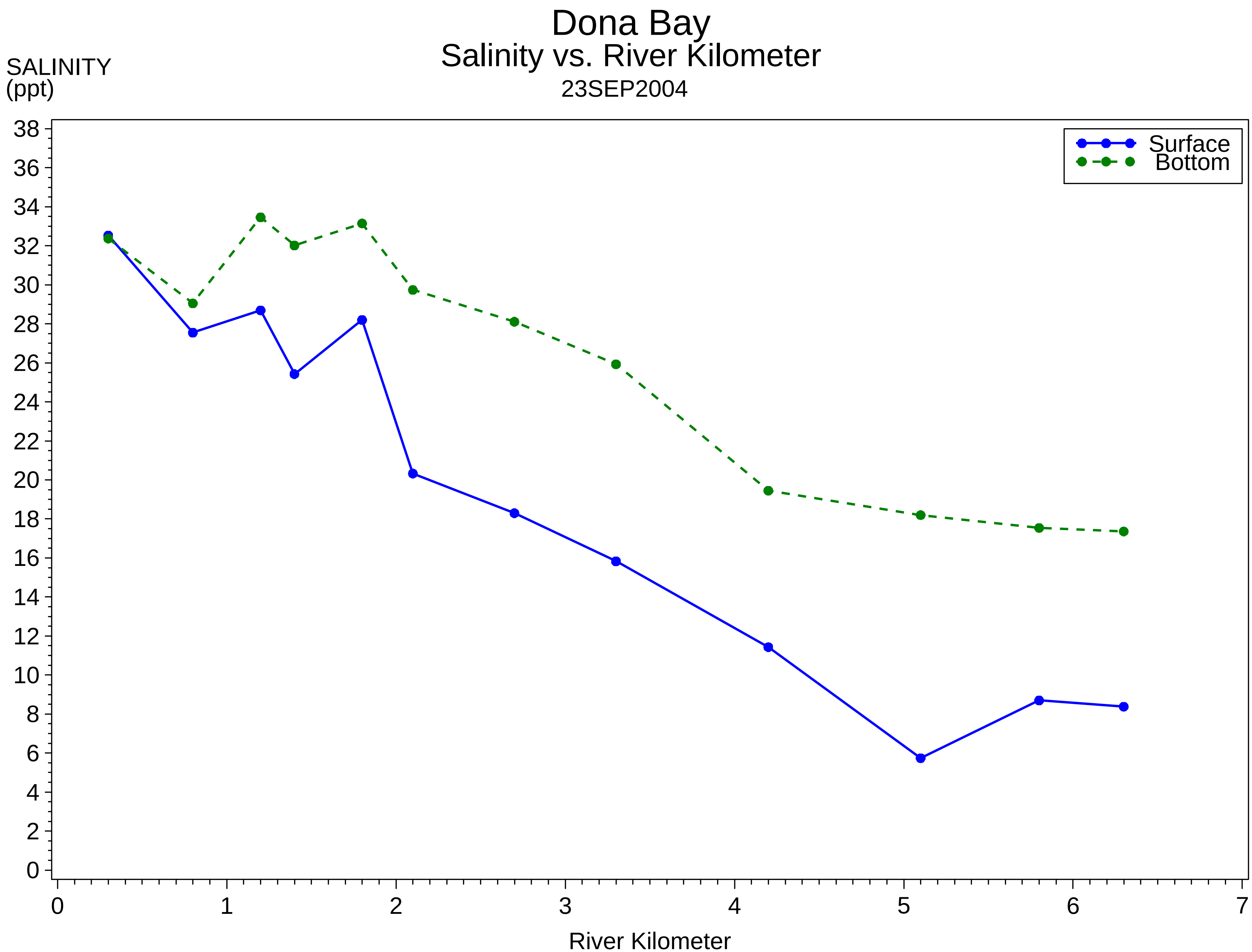
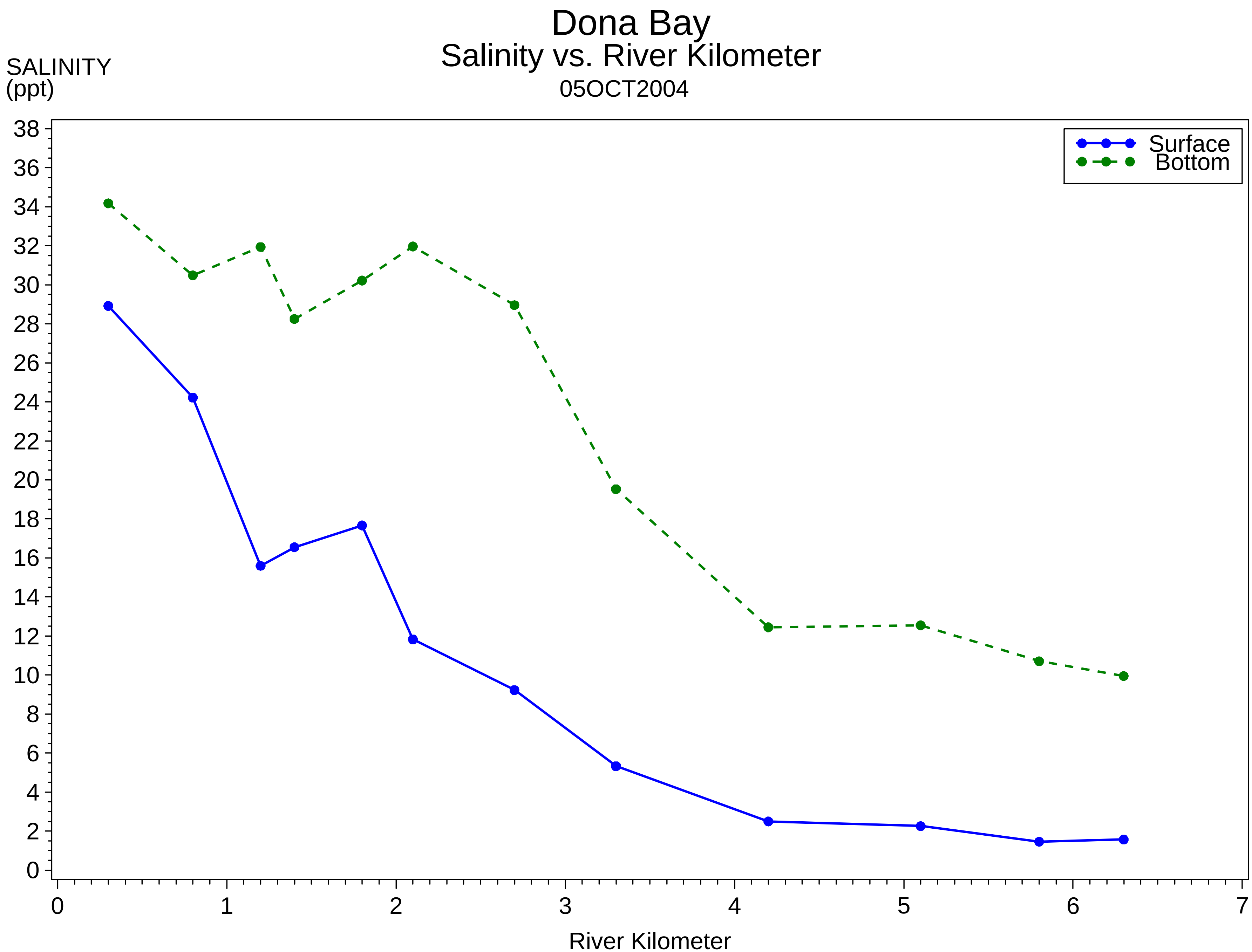
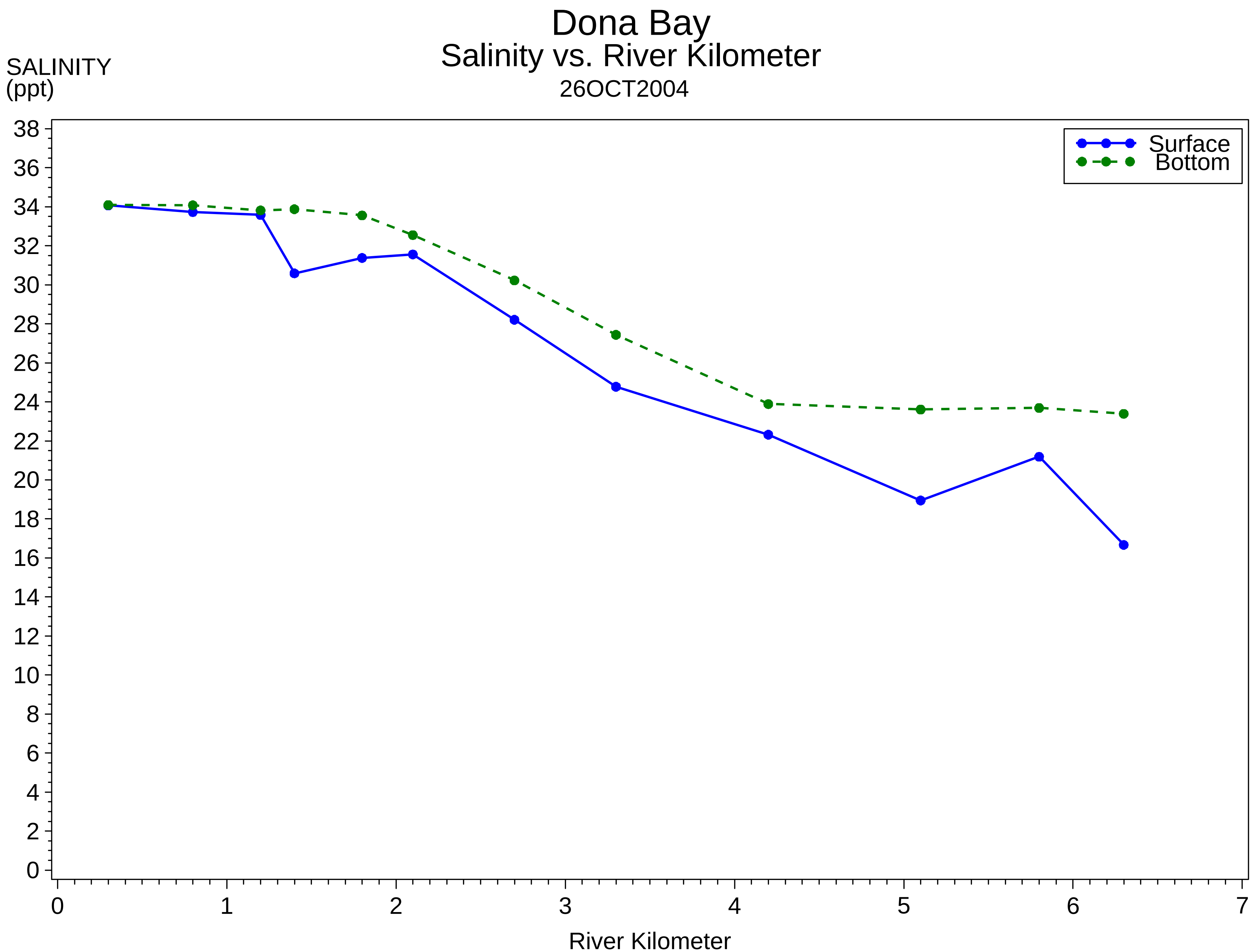
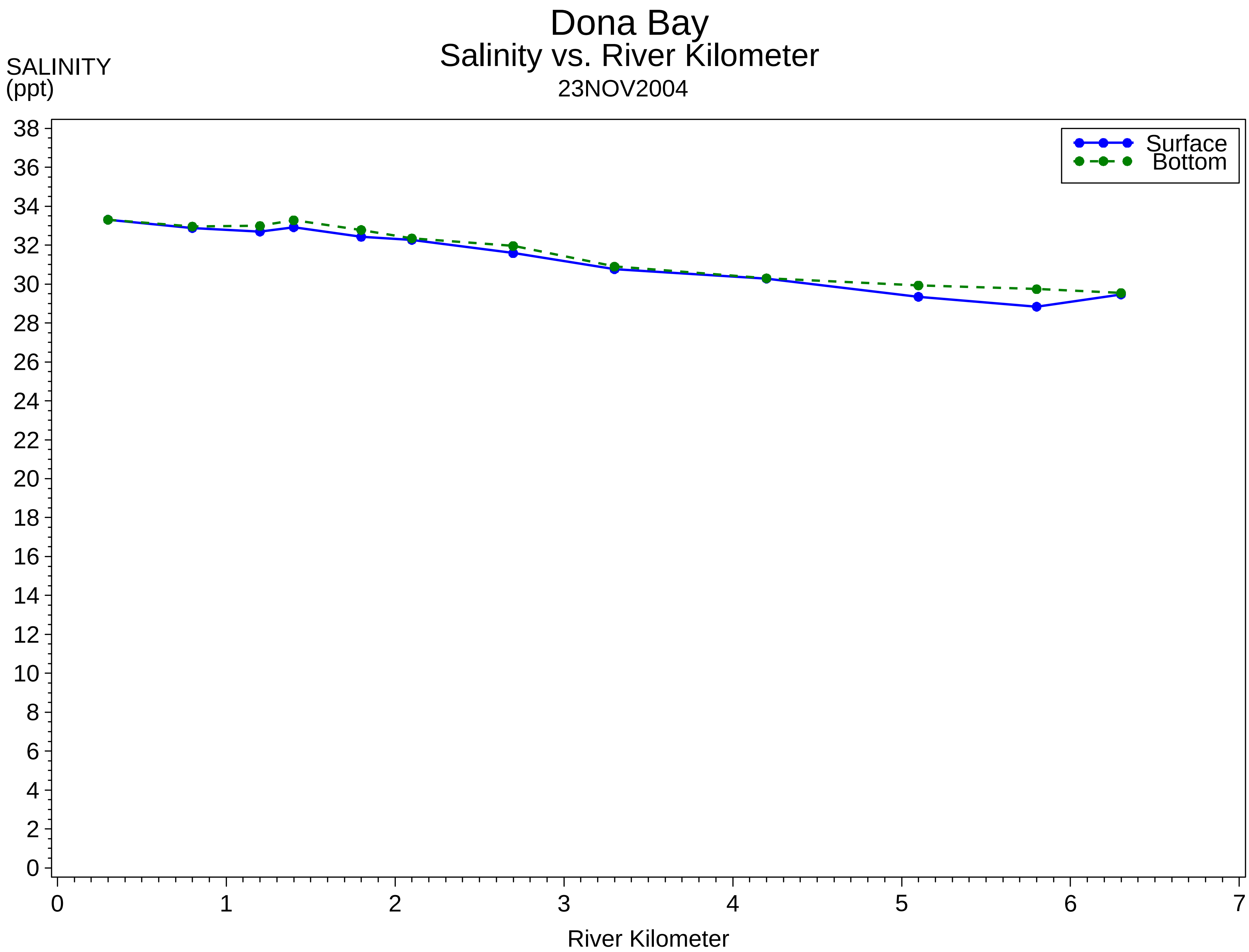
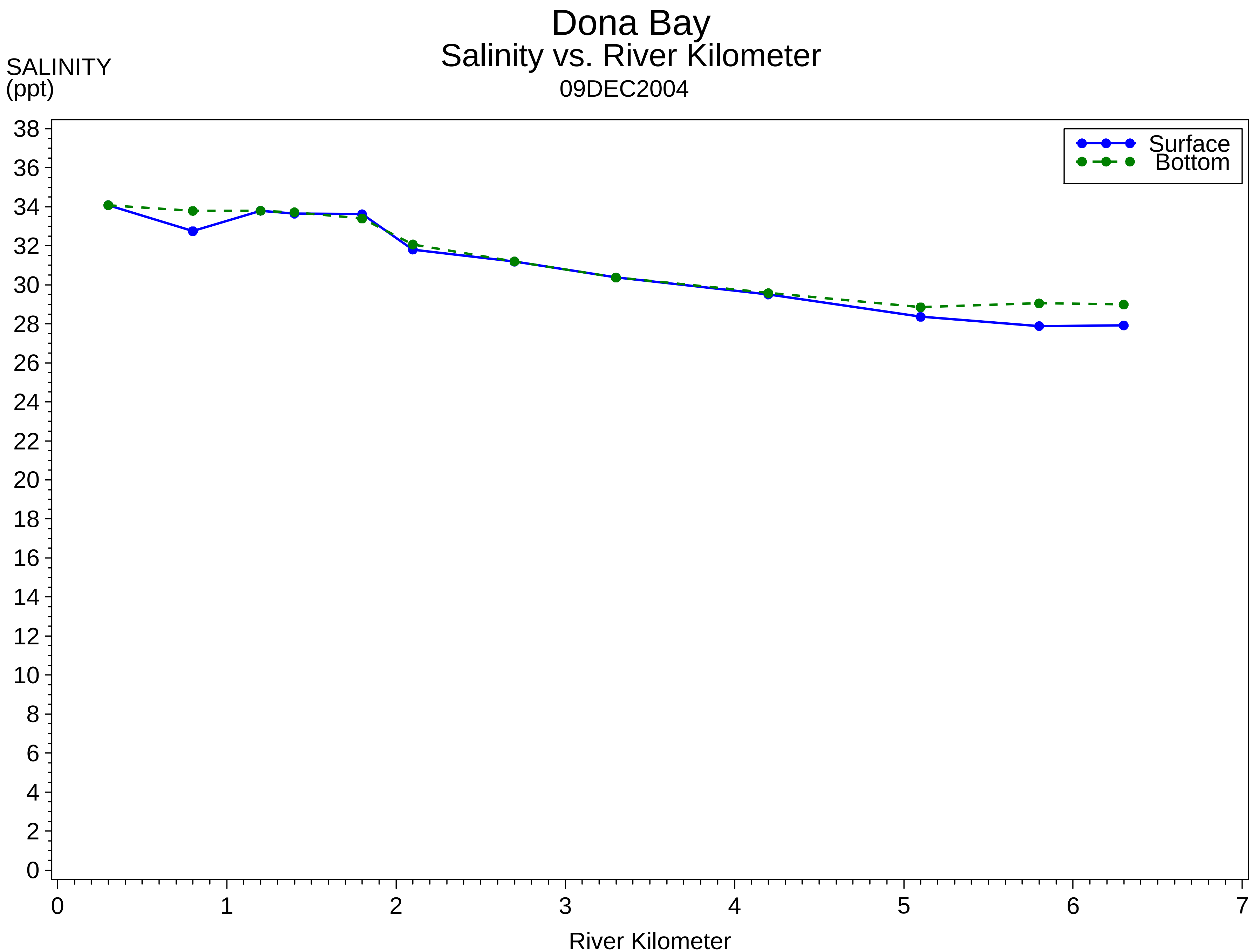
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

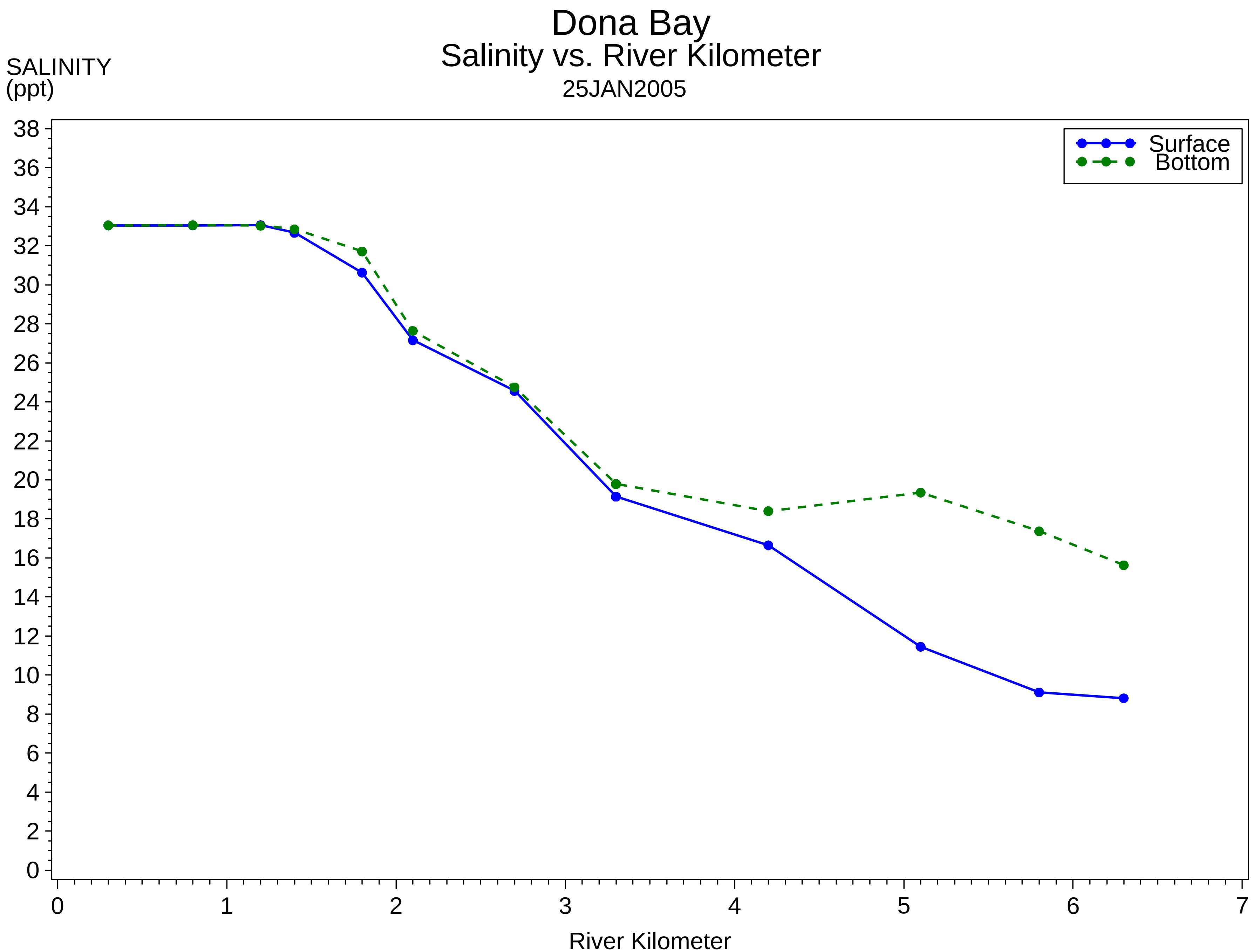

Dona Bay
Salinity vs. River Kilometer
23SEP2004
SALINITY (ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

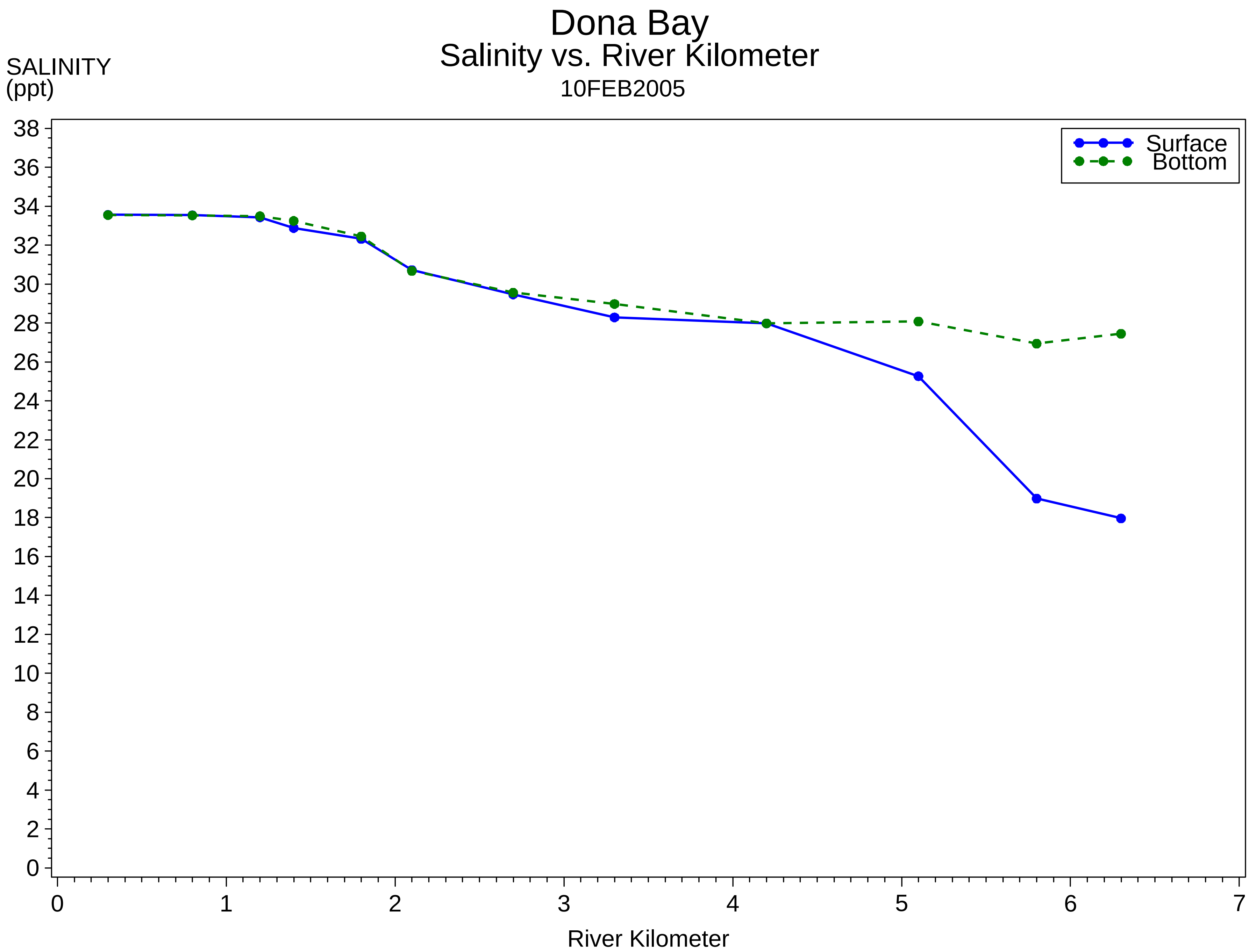

Dona Bay
Salinity vs. River Kilometer
05OCT2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

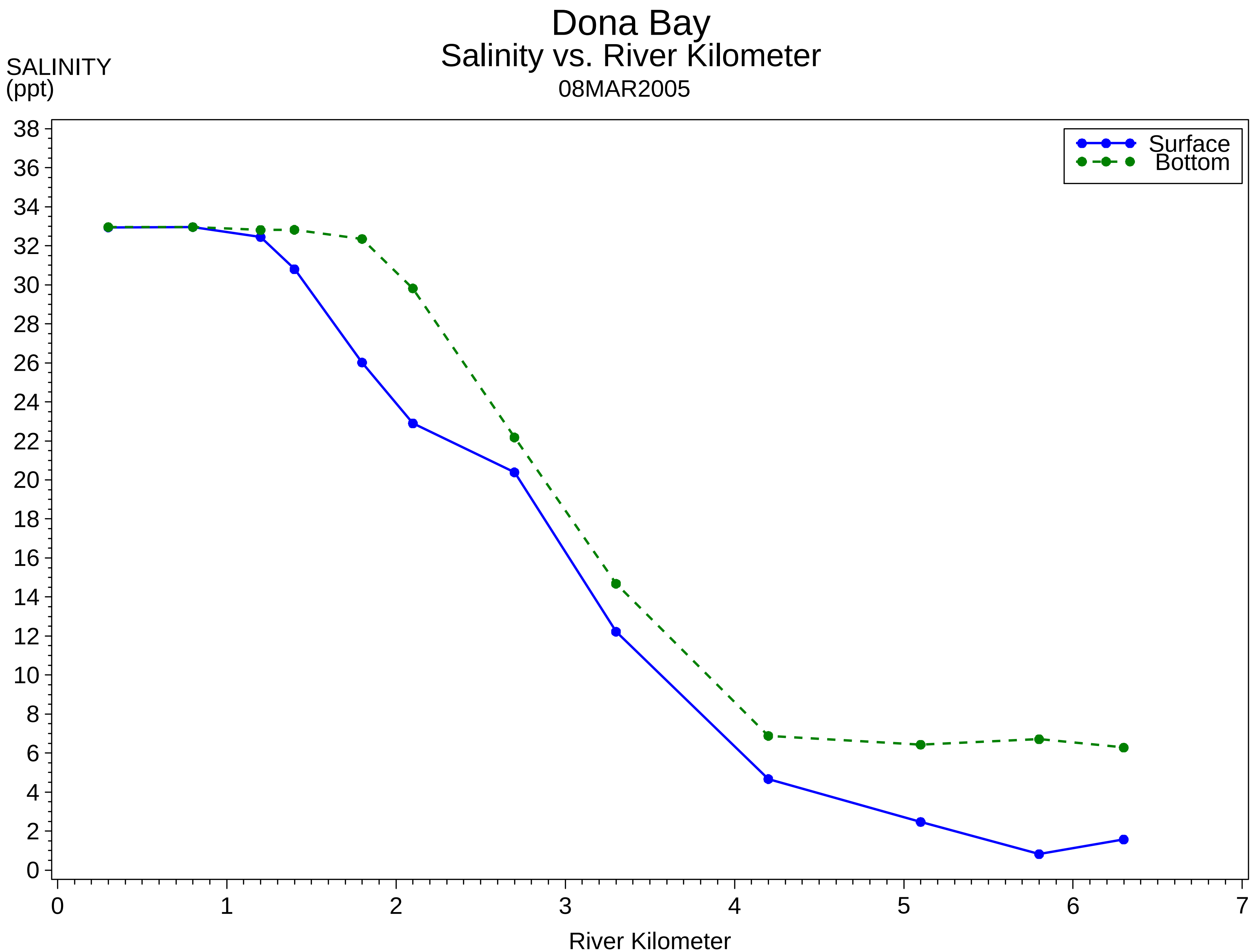

Dona Bay
Salinity vs. River Kilometer
26OCT2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

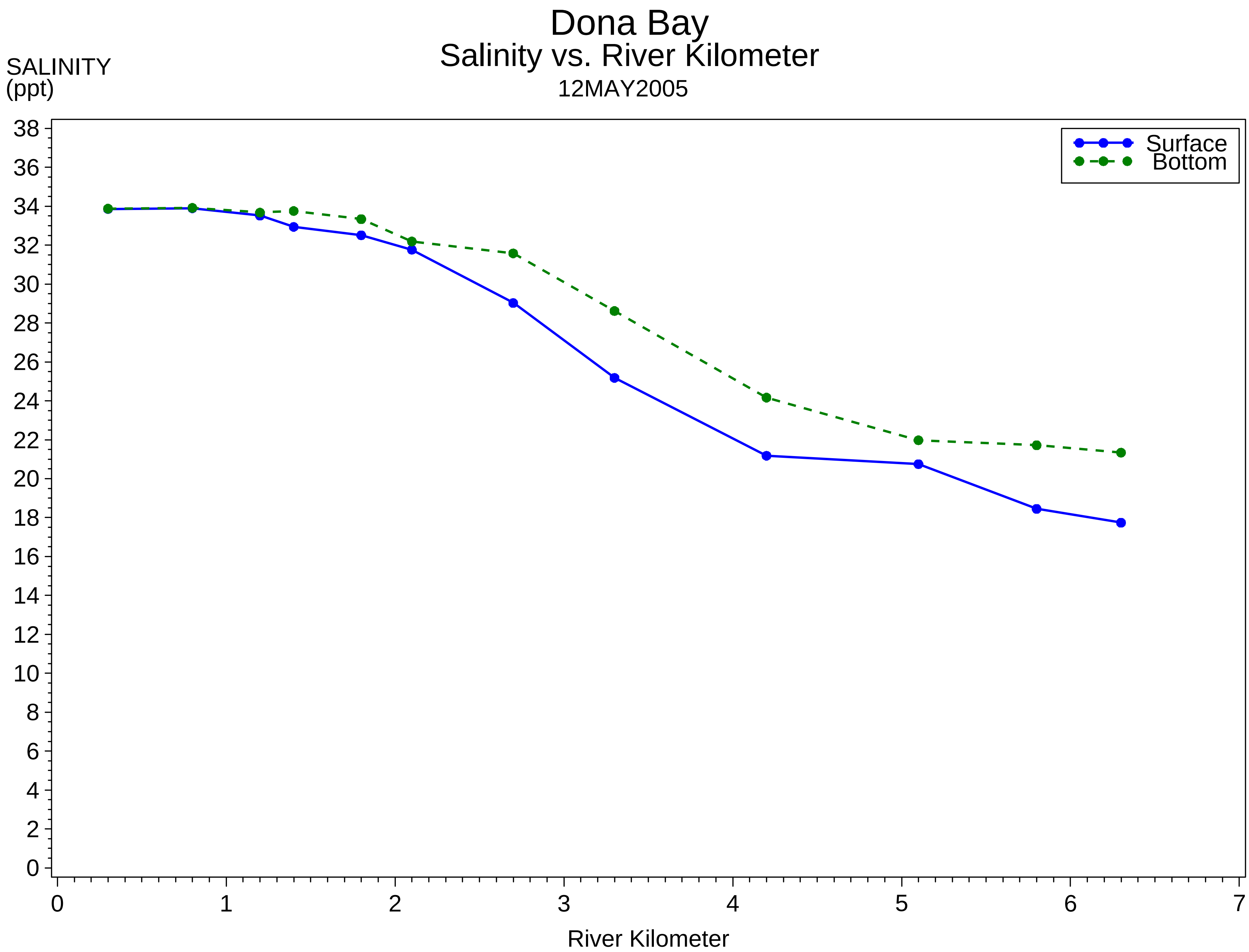

Dona Bay
Salinity vs. River Kilometer
23NOV2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

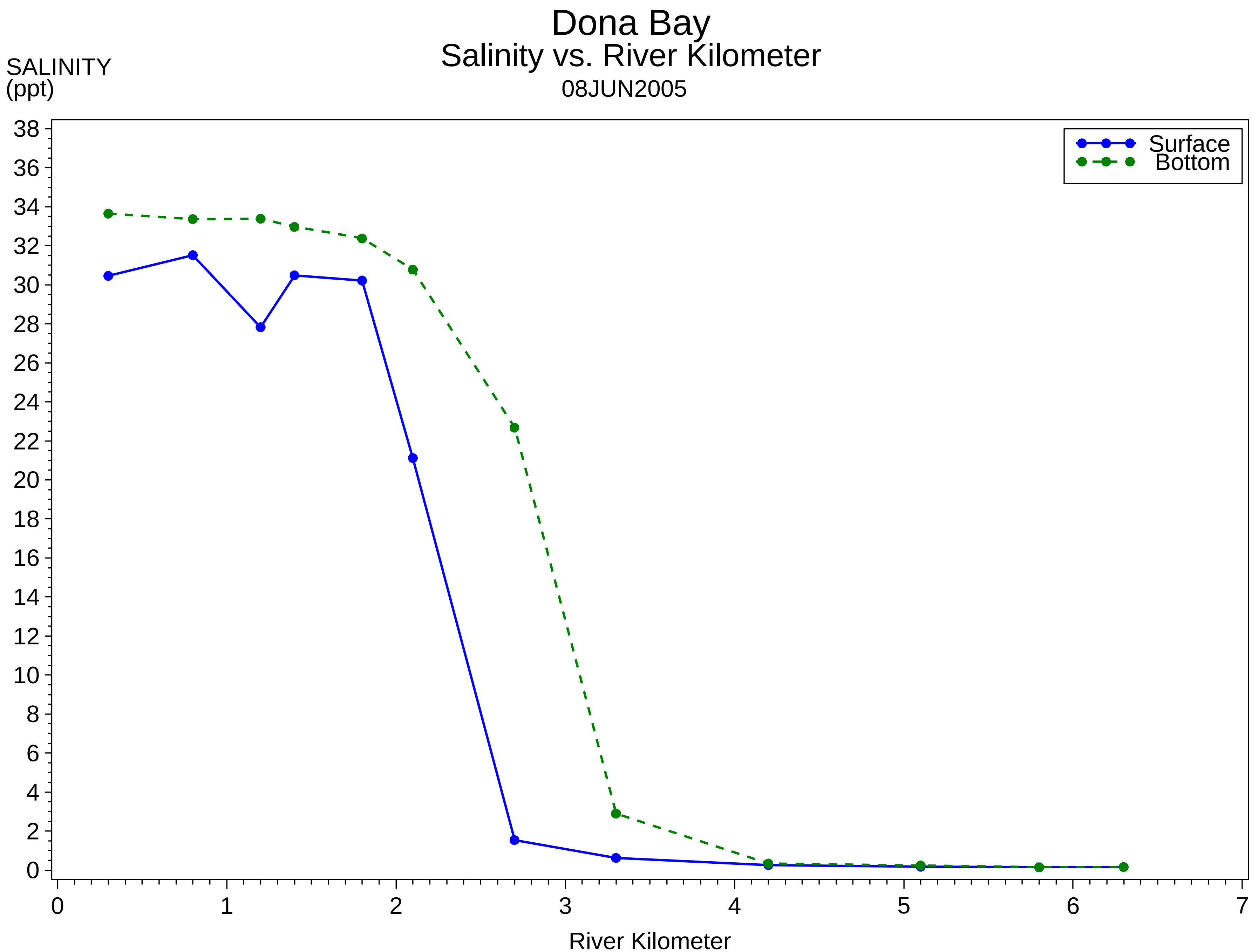

Dona Bay
Salinity vs. River Kilometer
09DEC2004
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom


Dona Bay
Salinity vs. River Kilometer
25JAN2005
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

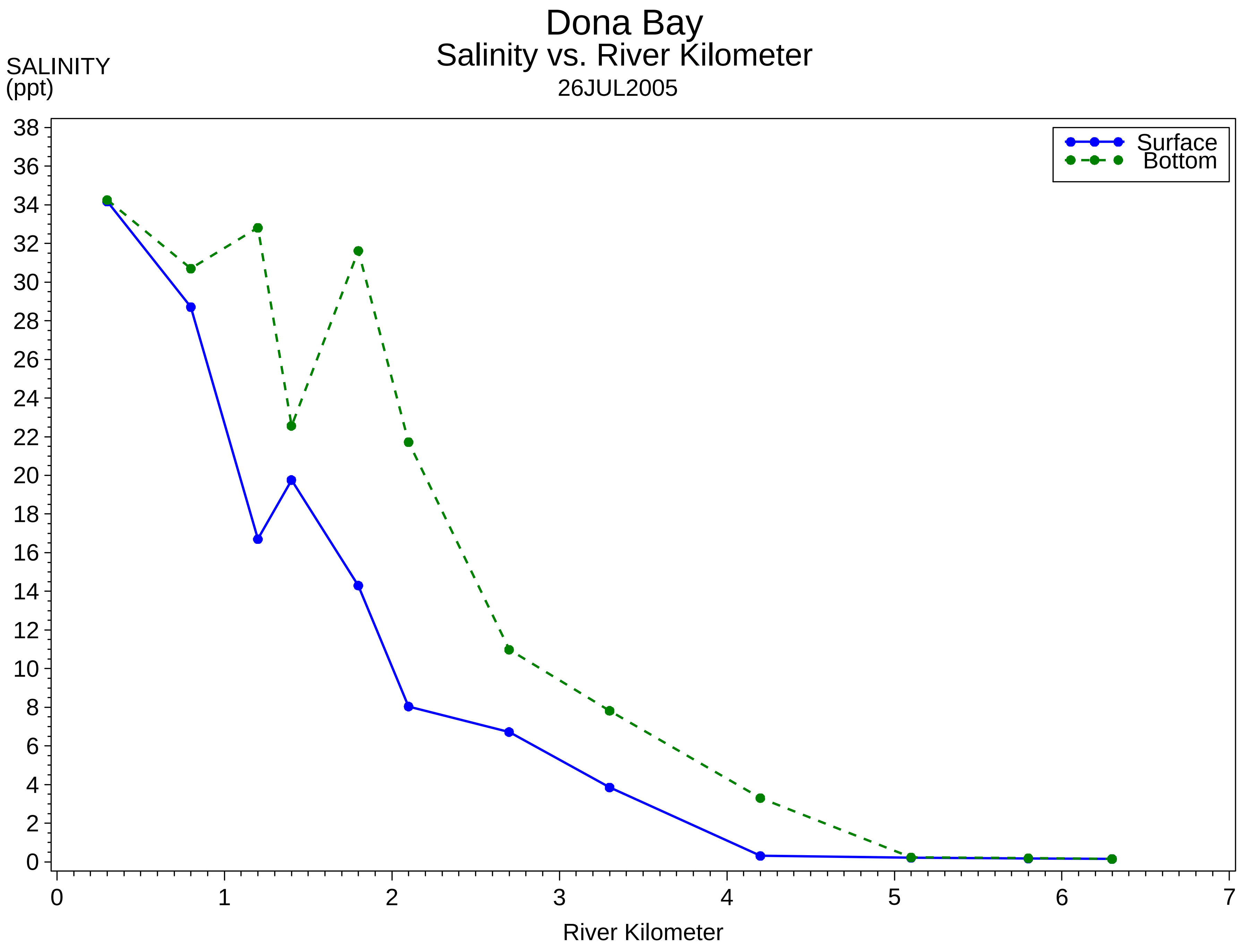

Dona Bay
Salinity vs. River Kilometer
10FEB2005
SALINITY (ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom


Dona Bay
Salinity vs. River Kilometer
08MAR2005
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

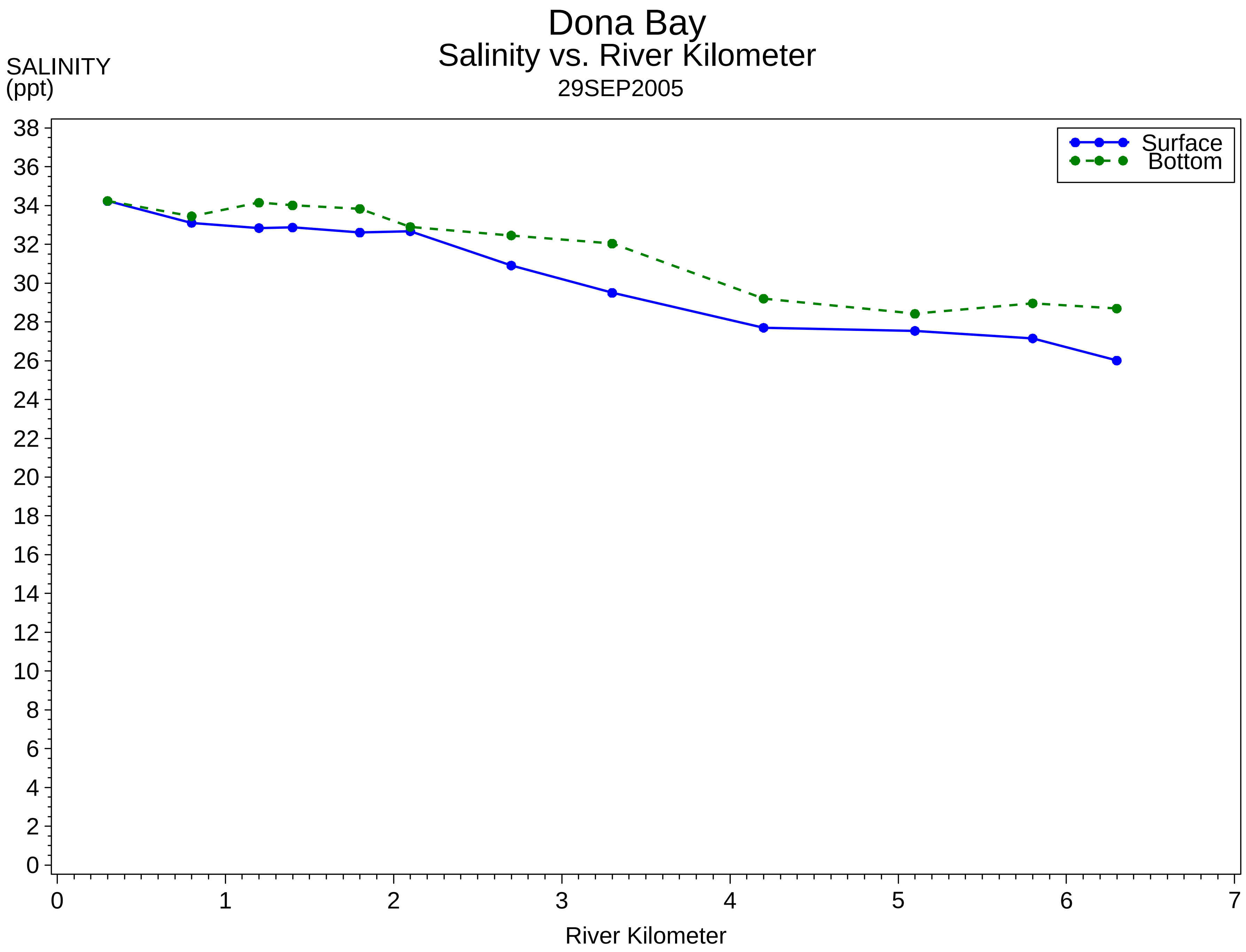

Dona Bay
Salinity vs. River Kilometer
12MAY2005
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

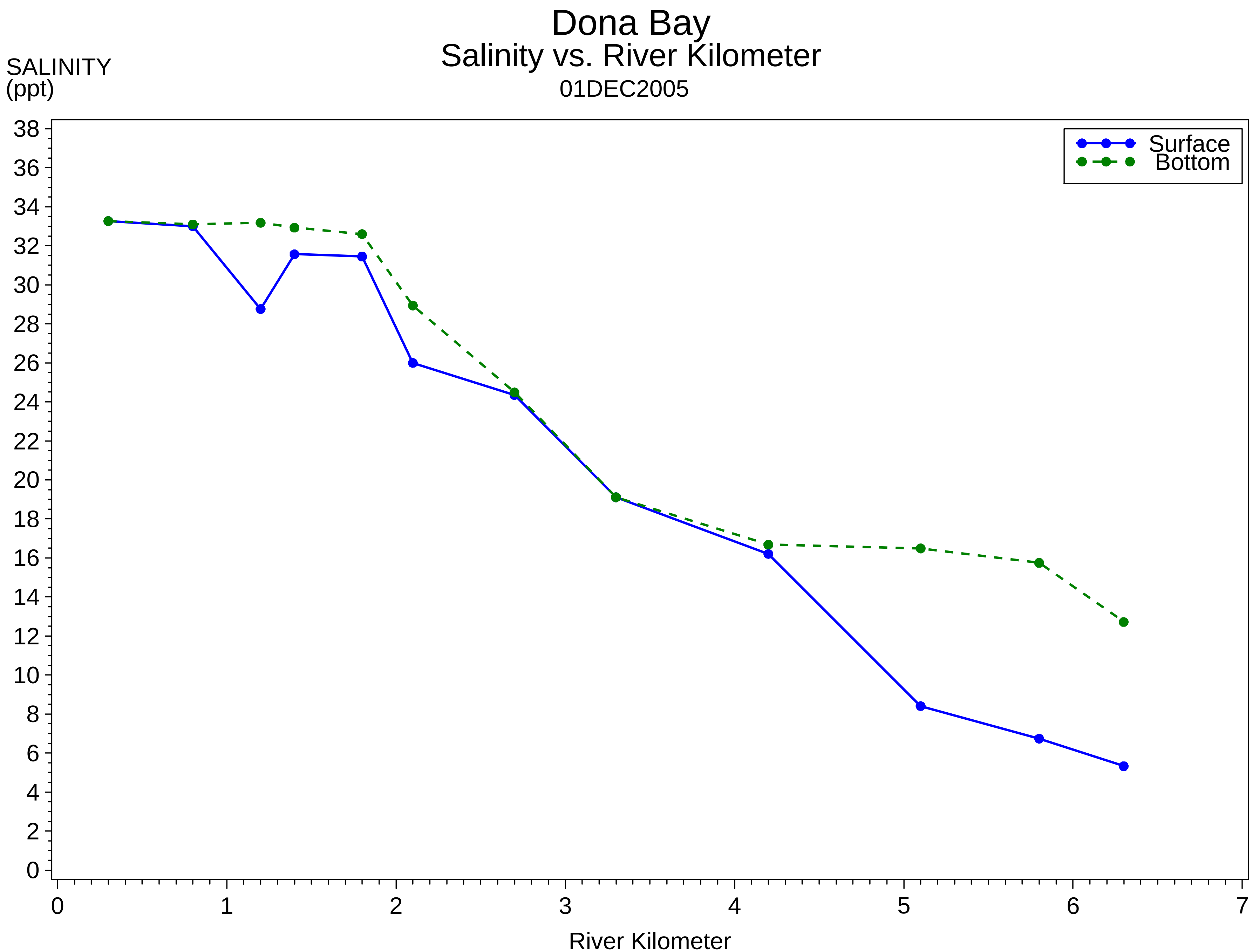


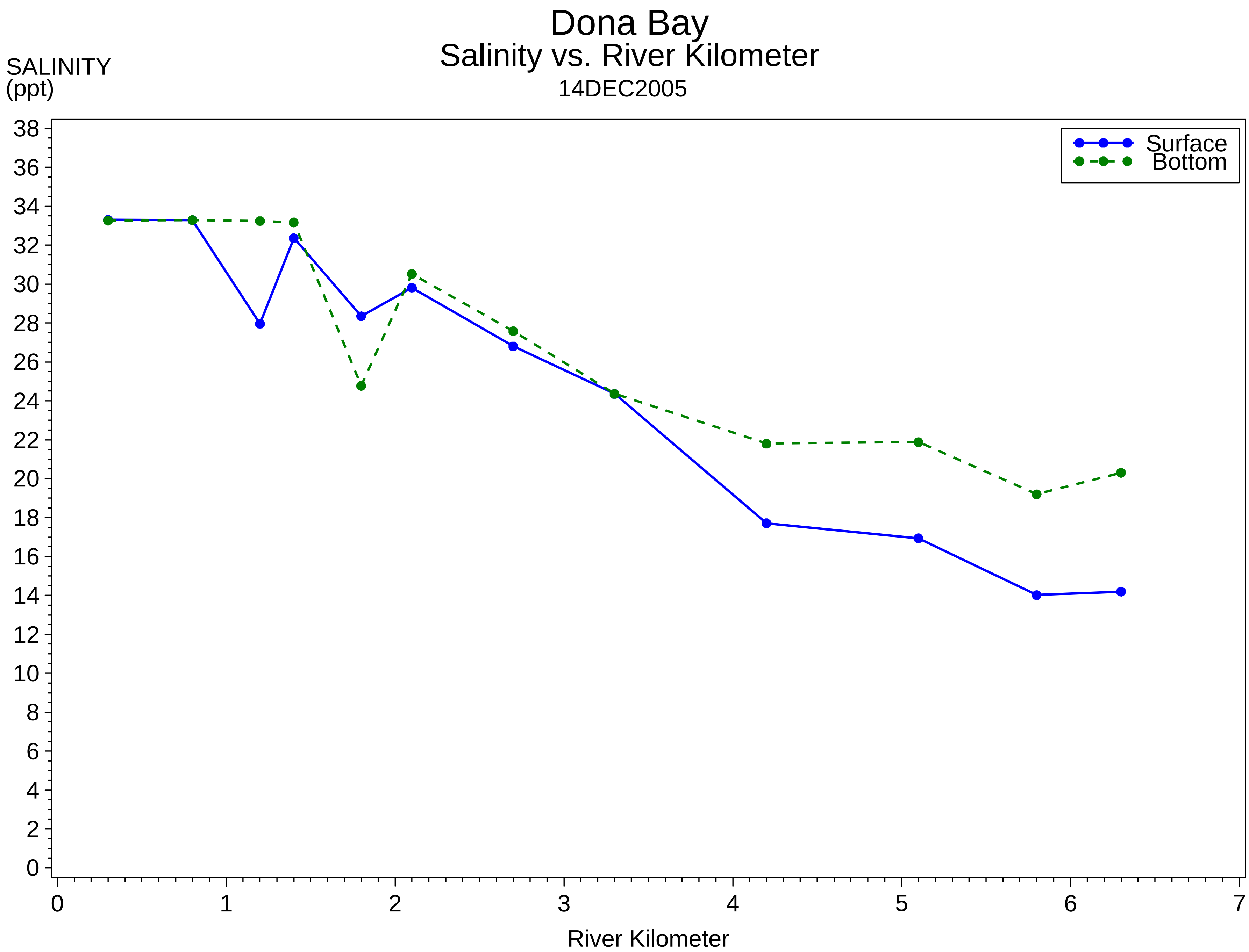
Dona Bay
Salinity vs. River Kilometer
08JUN2005
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom


Dona Bay
Salinity vs. River Kilometer
26JUL2005
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

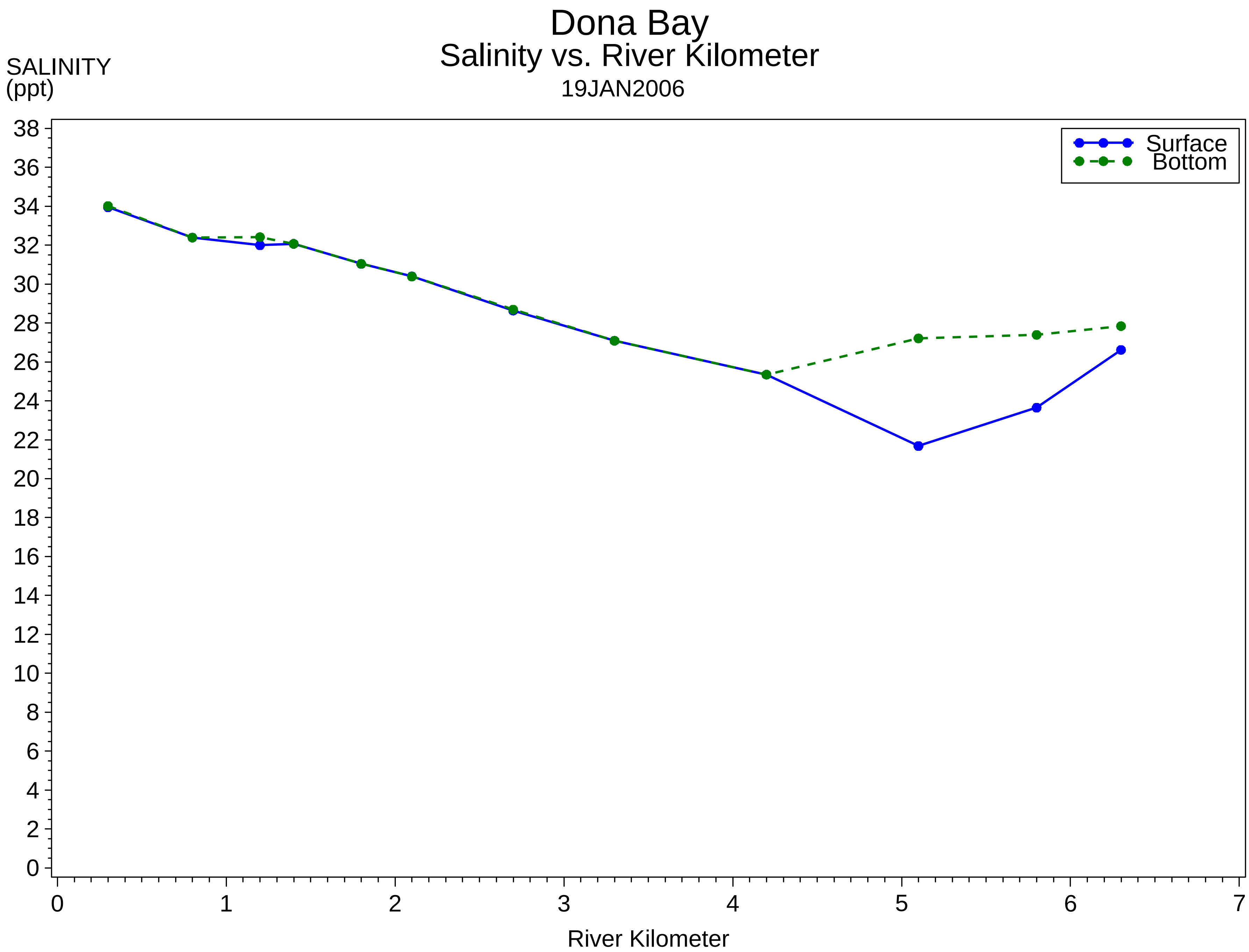

Dona Bay
Salinity vs. River Kilometer
25AUG2005
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom


Dona Bay
Salinity vs. River Kilometer
29SEP2005
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom


Dona Bay
Salinity vs. River Kilometer
01DEC2005
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

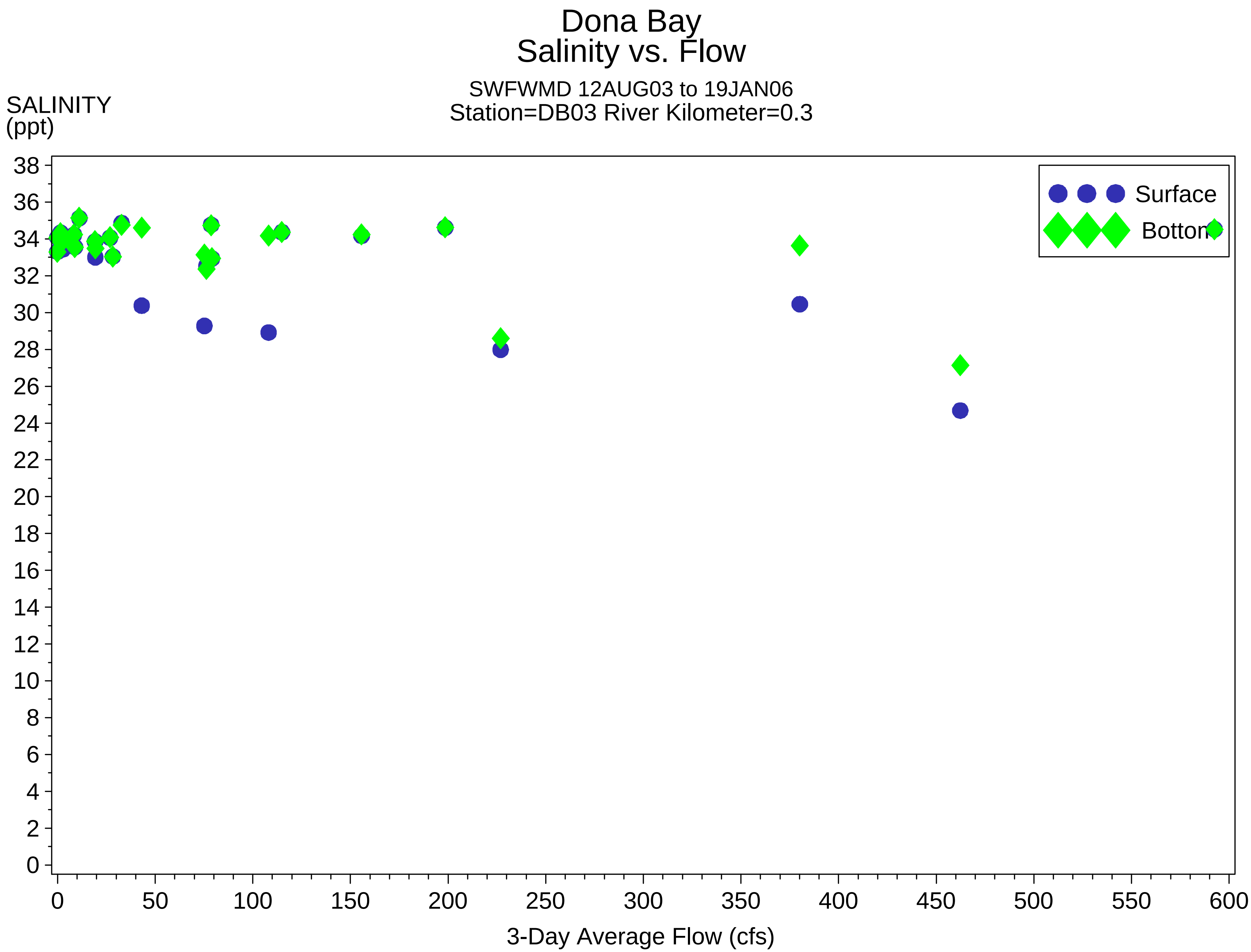


Dona Bay
Salinity vs. River Kilometer
14DEC2005
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Surface
Bottom
0
1
2
3
4
5
6
7
River Kilometer


Dona Bay
Salinity vs. River Kilometer
19JAN2006
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
River Kilometer
Surface
Bottom

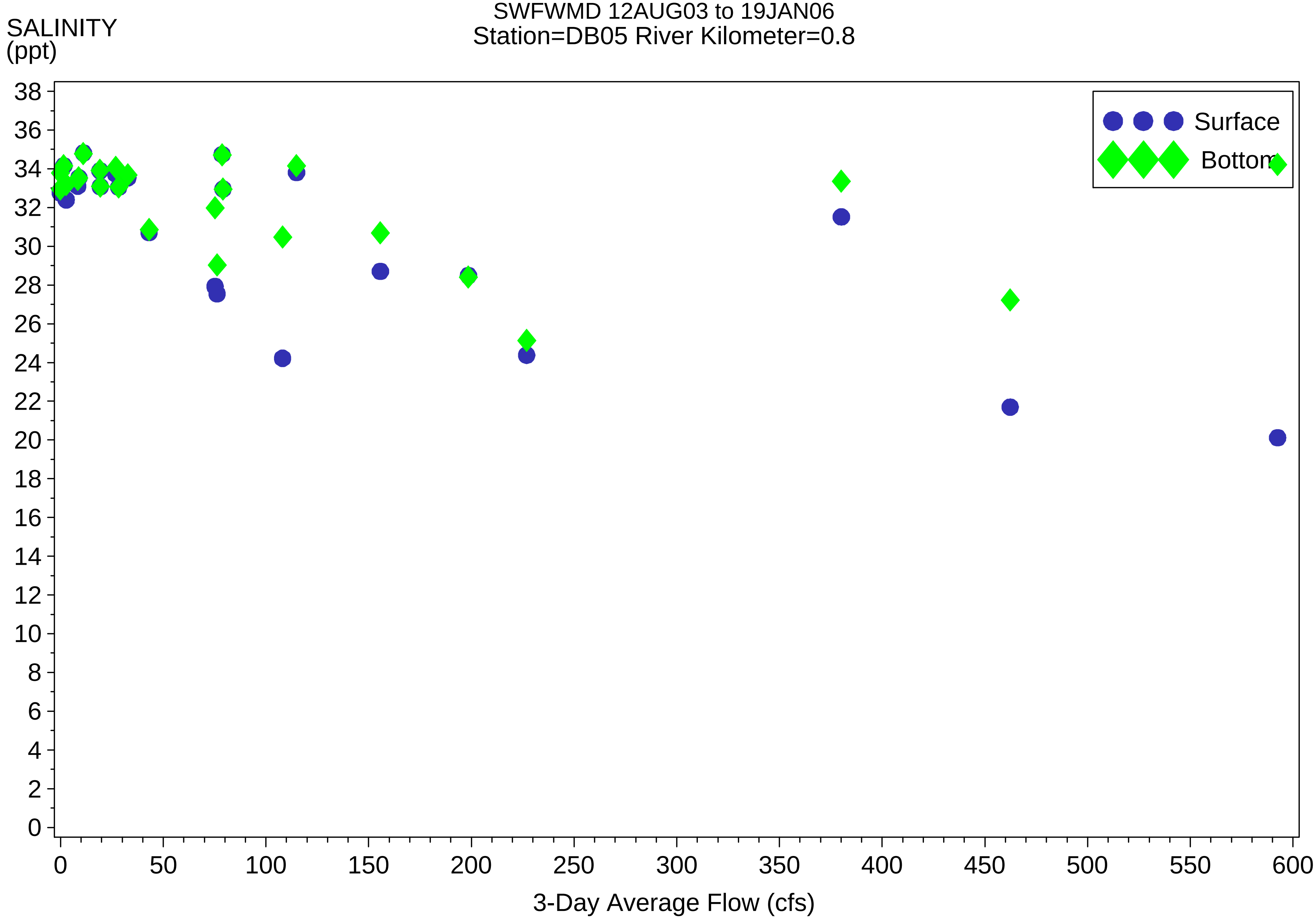
APPENDIX 4-2

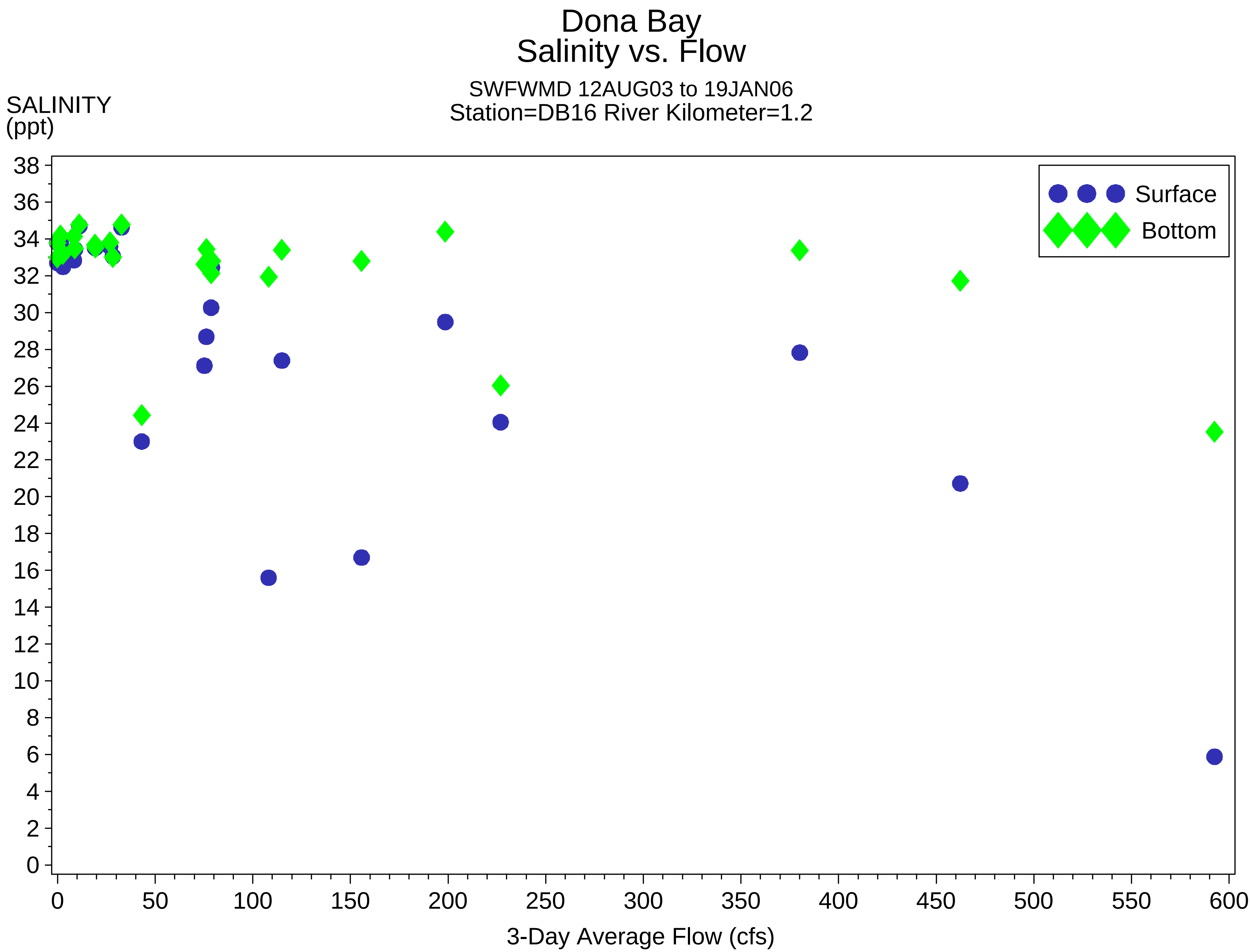
PLOTS OF SALINTIY VS 3-DAY AVERAGE FLOW IN DONA BAY BY RIVER KM

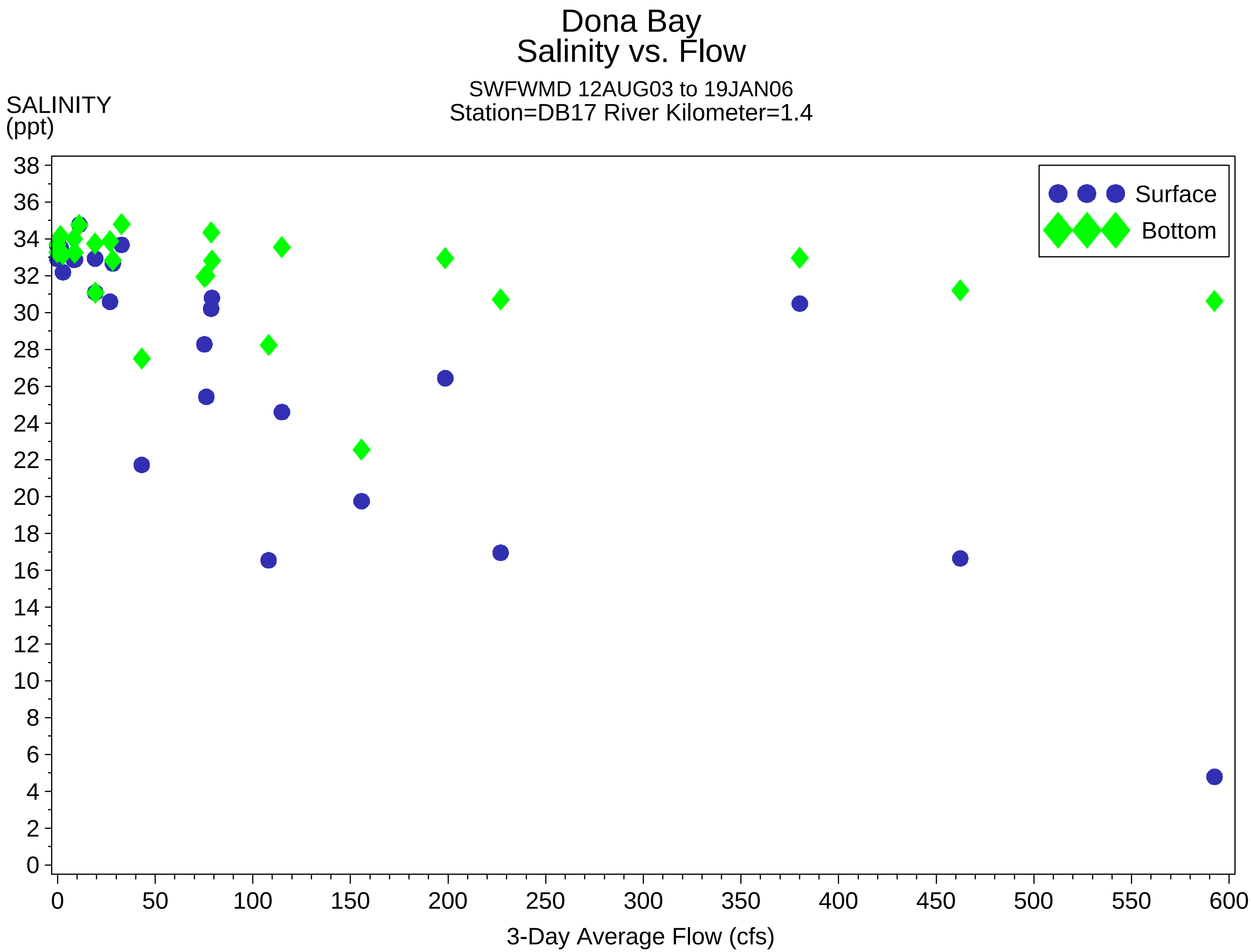

Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB03 River Kilometer=0.3
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)
Surface
Bottom

Dona Bay
Salinity vs. Flow

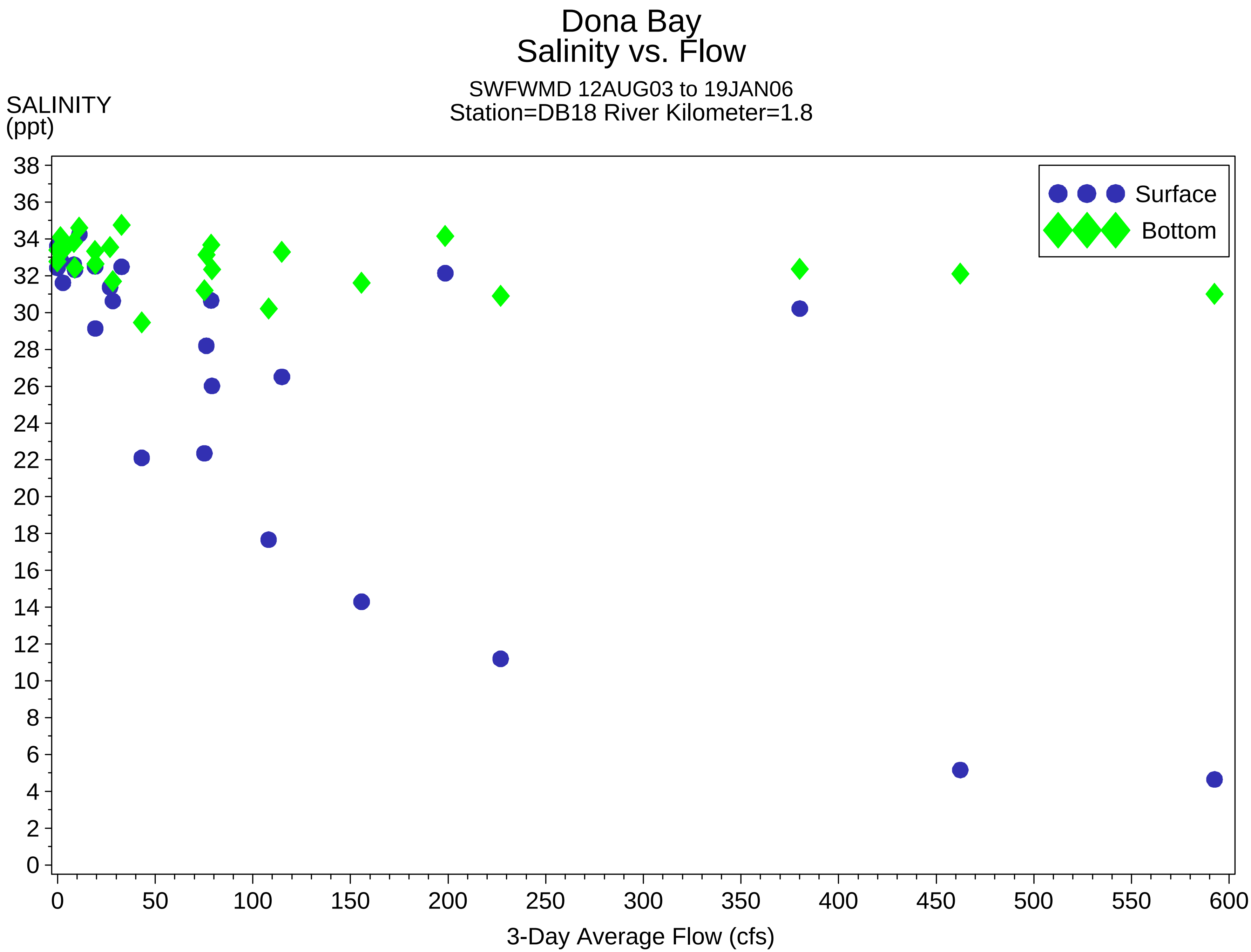
SWFWMD 12AUG03 to 19JAN06
Station=DB05 River Kilometer=0.8

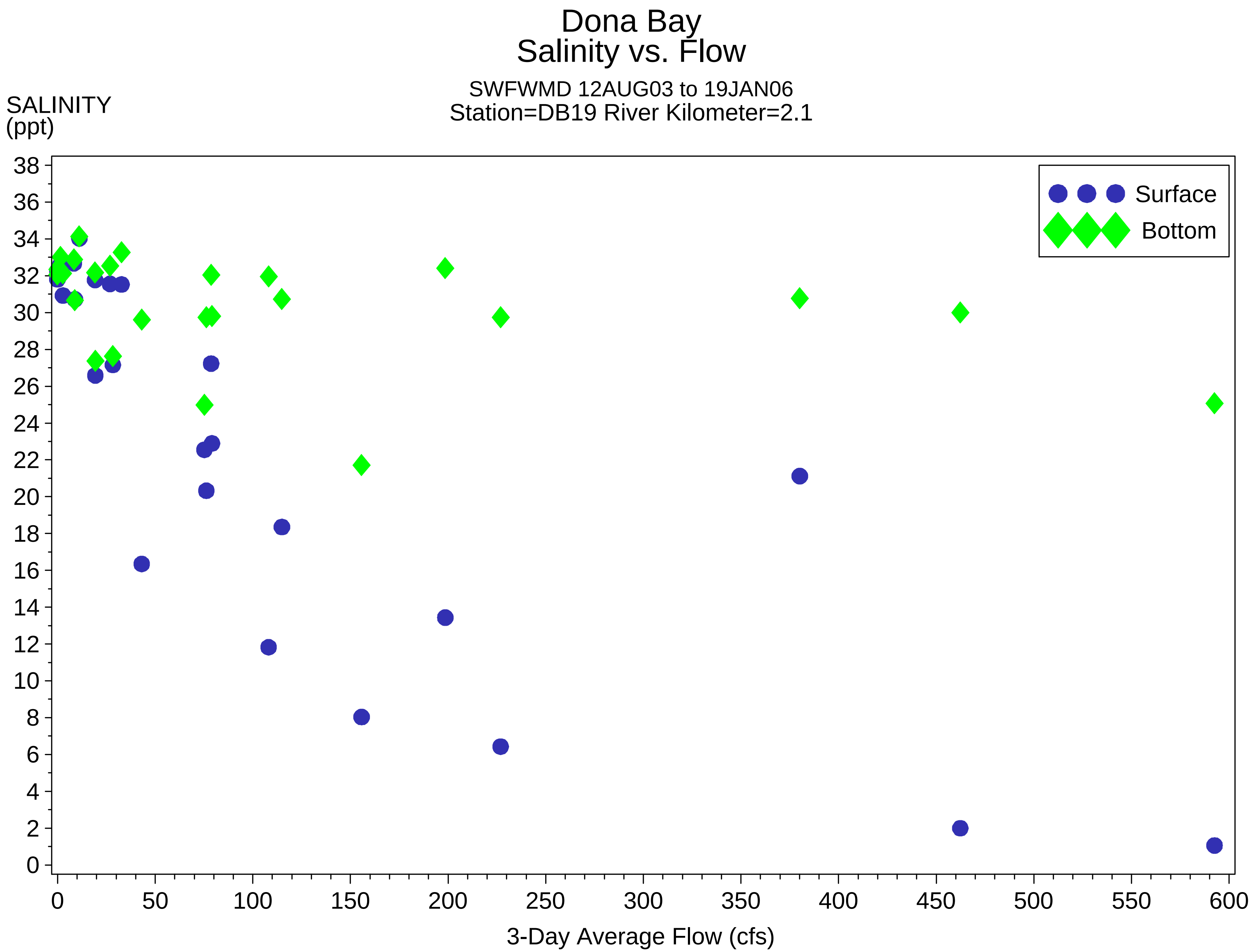


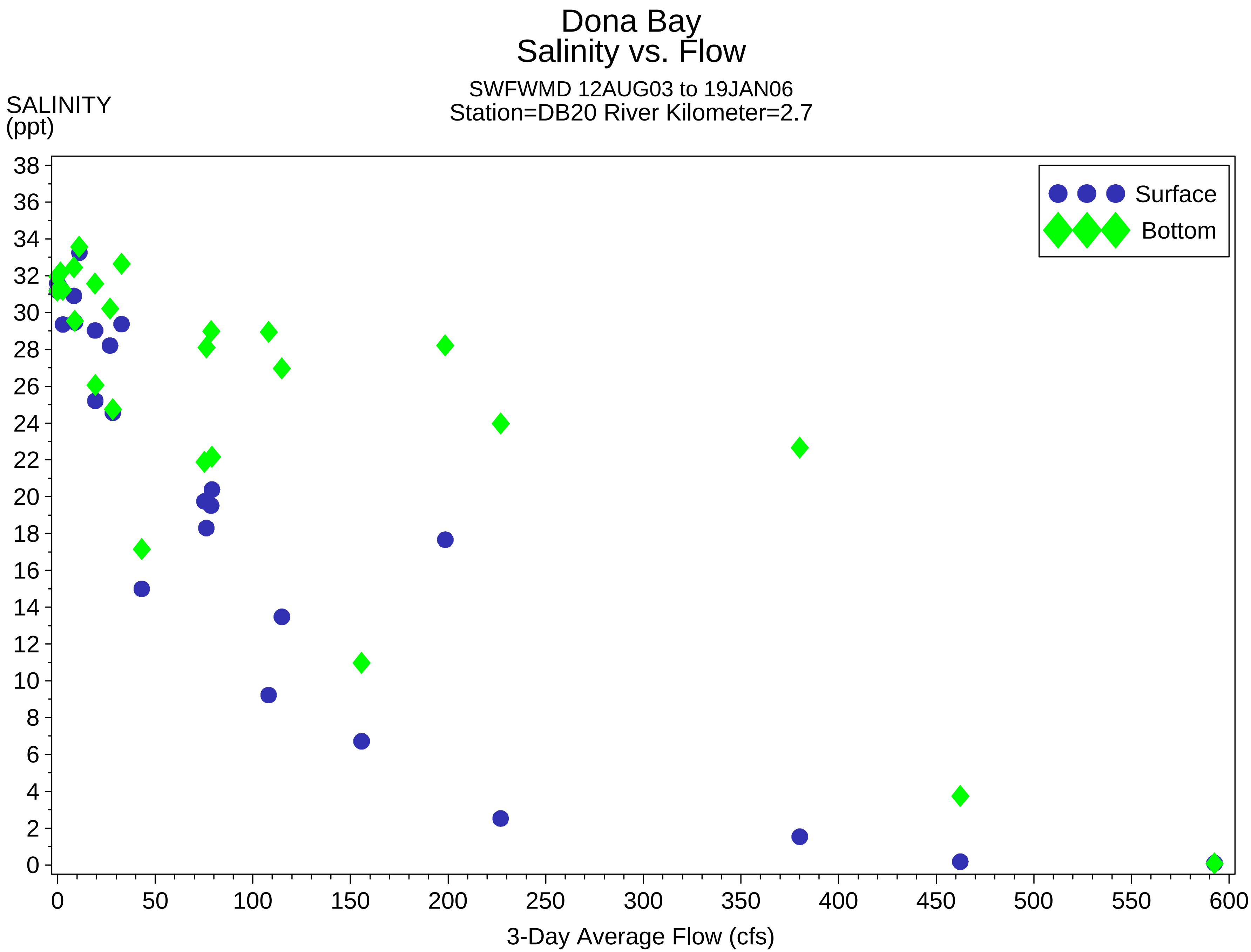

Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB16 River Kilometer=1.2
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)
Surface
Bottom

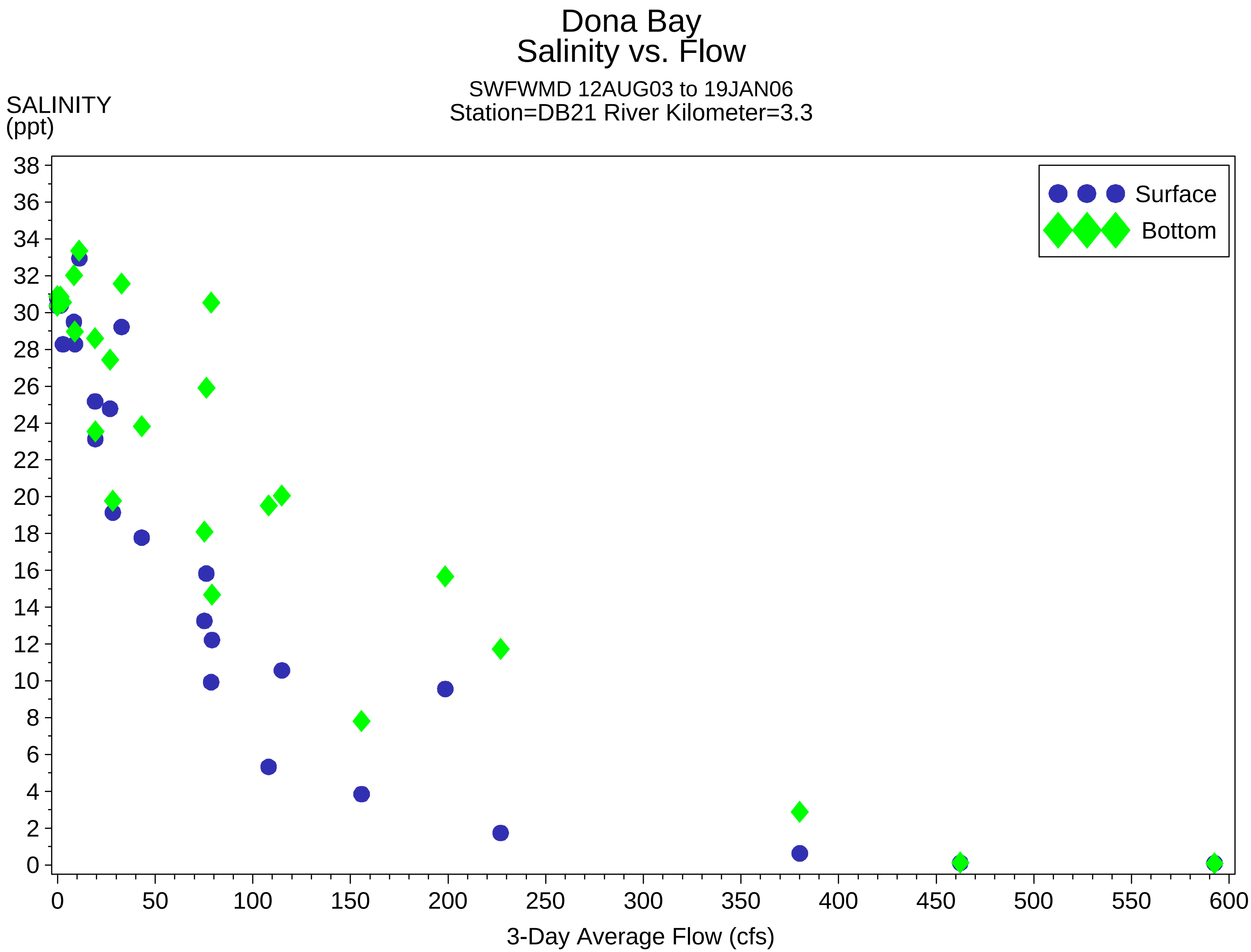


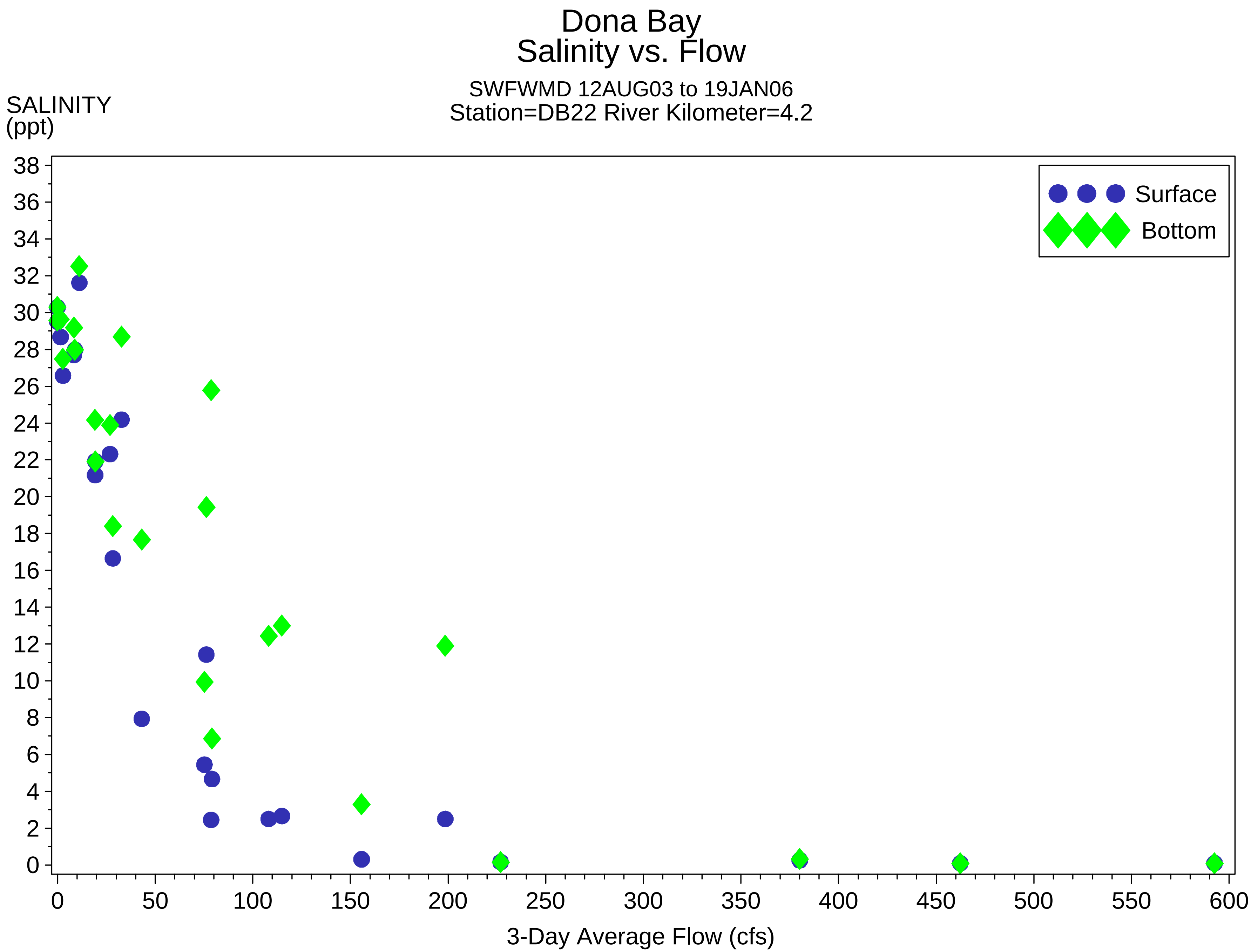
Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB17 River Kilometer=1.4
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Surface
Bottom
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)


Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB18 River Kilometer=1.8
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)
Surface
Bottom

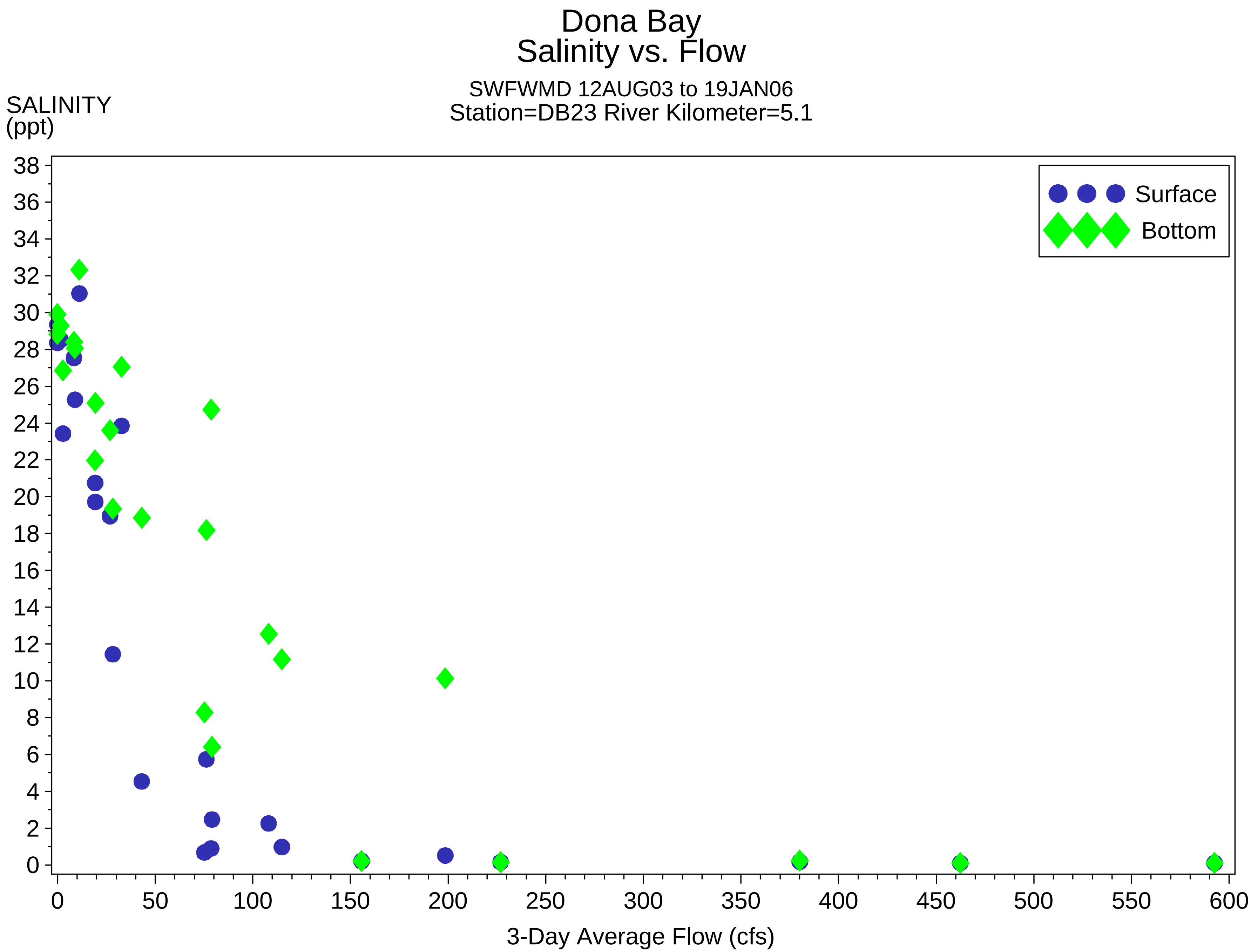

Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB19 River Kilometer=2.1
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)
Surface
Bottom

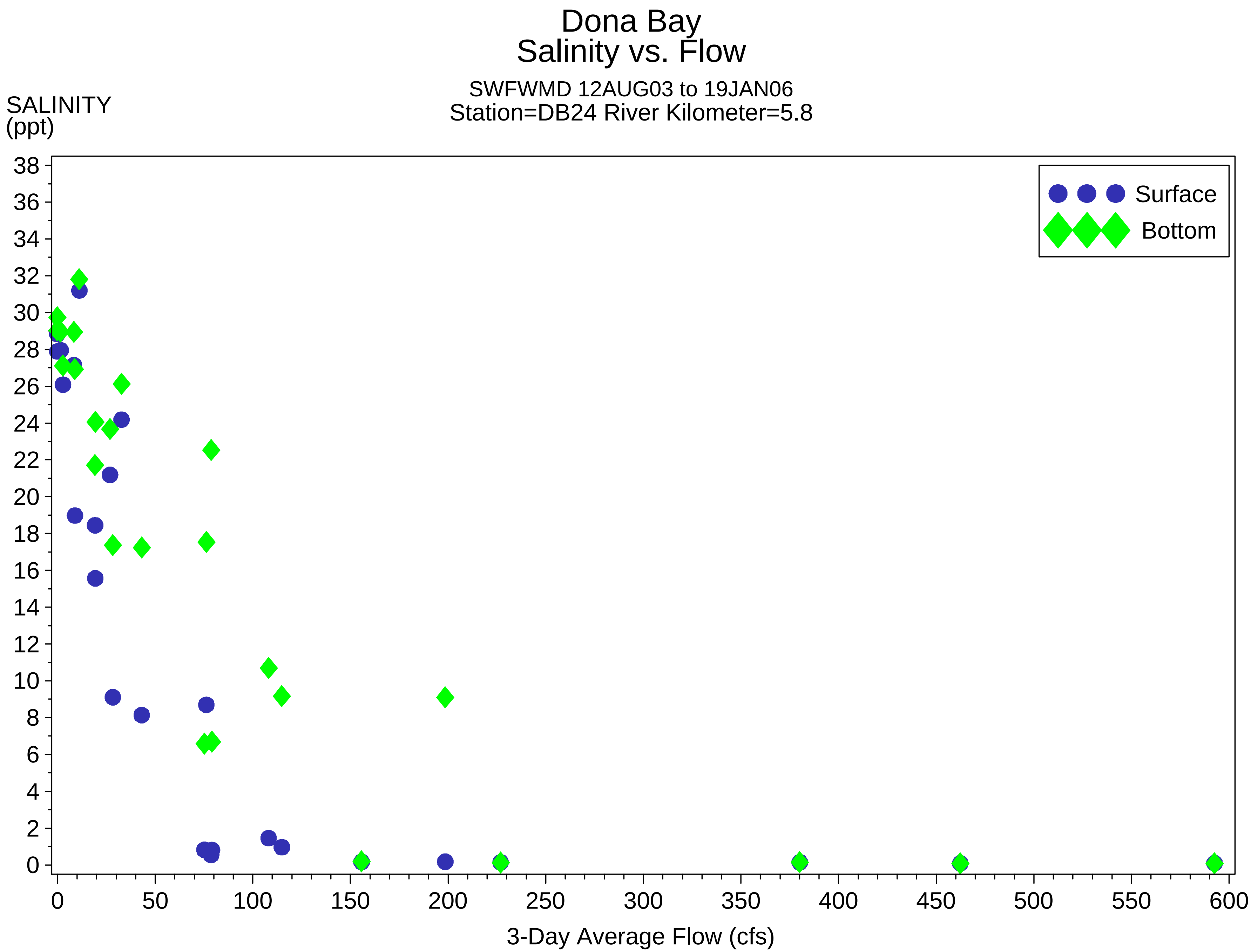

Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB20 River Kilometer=2.7
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)
Surface
Bottom

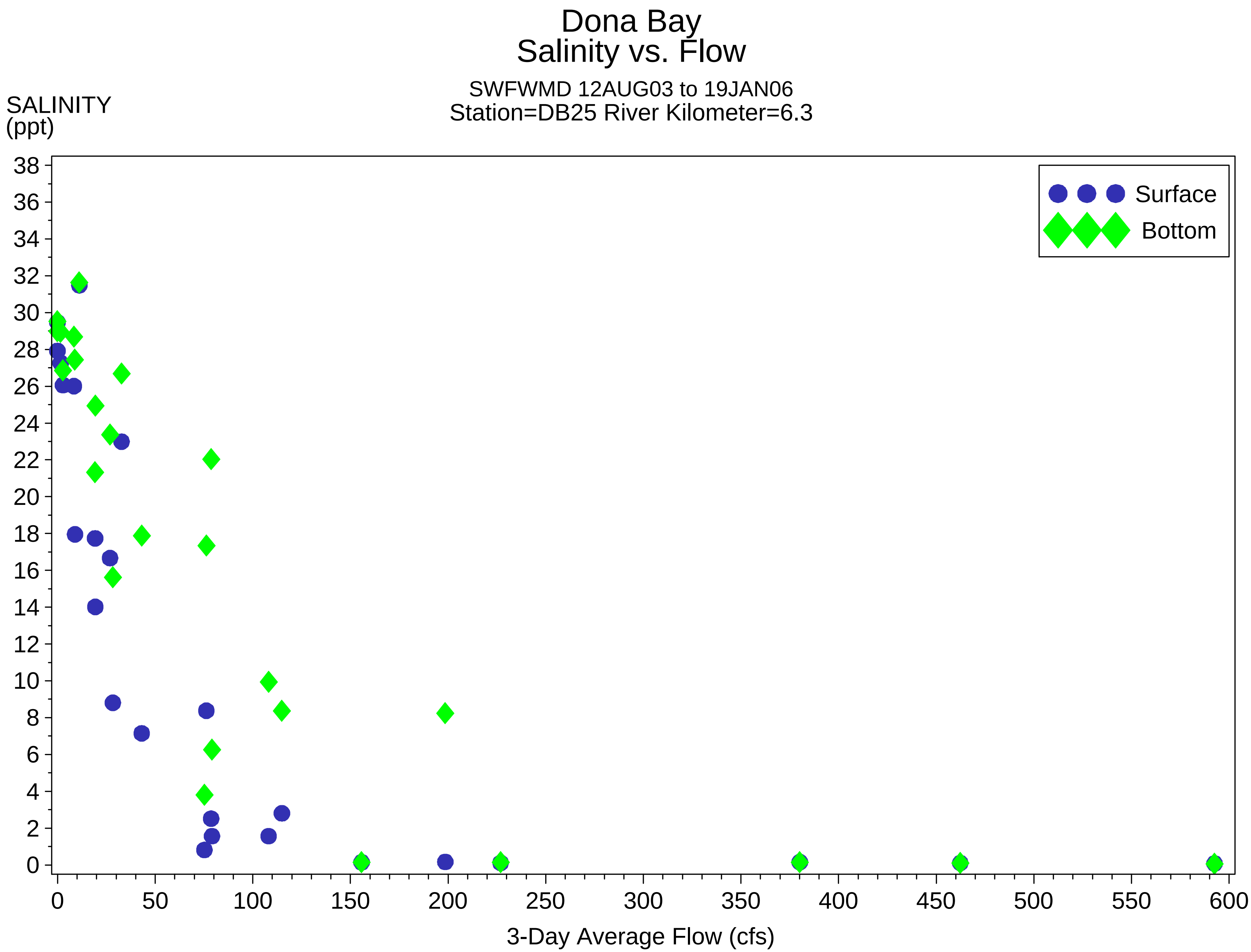

Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB21 River Kilometer=3.3
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Surface
Bottom
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)



Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB22 River Kilometer=4.2
SALINITY
(ppt)
Surface
Bottom
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)


Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB23 River Kilometer=5.1
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Surface
Bottom
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)


Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB24 River Kilometer=5.8
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)
Surface
Bottom


Dona Bay
Salinity vs. Flow
SWFWMD 12AUG03 to 19JAN06
Station=DB25 River Kilometer=6.3
SALINITY
(ppt)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350
400
450
500
550
600
3-Day Average Flow (cfs)
Surface
Bottom

APPENDIX 5-1

METHODS USED FOR MOTE MARINE LABORATORY INVESTIGATIONS OF BENTHOS IN DONA AND ROBERTS BAY

METHODS

Laboratory procedures were similar for each study. Organisms were first sorted from each sample, identified to the lowest practical identification level (LPIL), and counted. Changes in nomenclature and the increased availability of keys and taxonomic descriptions need to be recognized as a source of “error” when comparing the results of each study. We have updated the nomenclature when the evidence for change is clear. For example, *Ampelisca verilli* and *Ampelisca holmesi* are morphologically similar, and easily confused, yet only the latter is now known to occur in the Gulf of Mexico (LeCroy, 2002). The different sampling characteristics of the dredge and core samplers is another source of error to be considered in comparing the two surveys. The dredge sampler integrates a larger sampling area than the core and the dredge samples only the shallower stratum where most organisms typically occur; the core sampler penetrates to about twice the depth of the dredge.

To help offset these two potential sources of error, where data from both studies are compared, analyses were done at both the lowest taxonomic level and at the Family level.

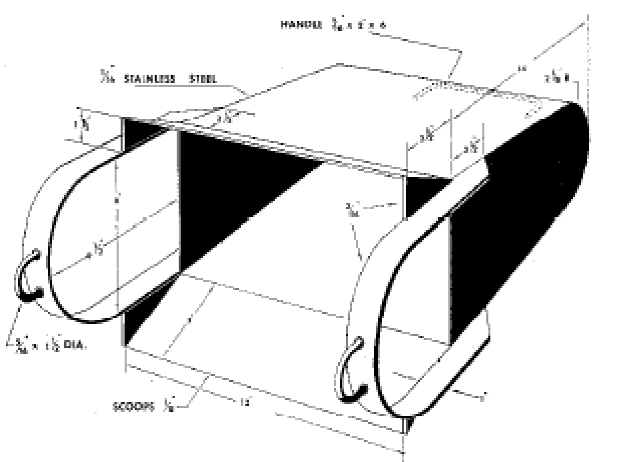


Figure A. Taylor bucket dredge (From: Taylor, 1965).

Table A. Numbers of samples collected for benthic infauna from Shackett Creek, Dona and Roberts bays, 1974, 1975, and 2004 (Adapted from: Lincer, 1975; Culter, 2006).

Sample Perod	Shackett Creek	Dona Bay	Roberts Bay
May 1974	3	2	3
July 1974	3	2	3
December 1974	3	2	3
April 1975	3	2	3
May-June 2004	16	4	12
Total	28	12	24

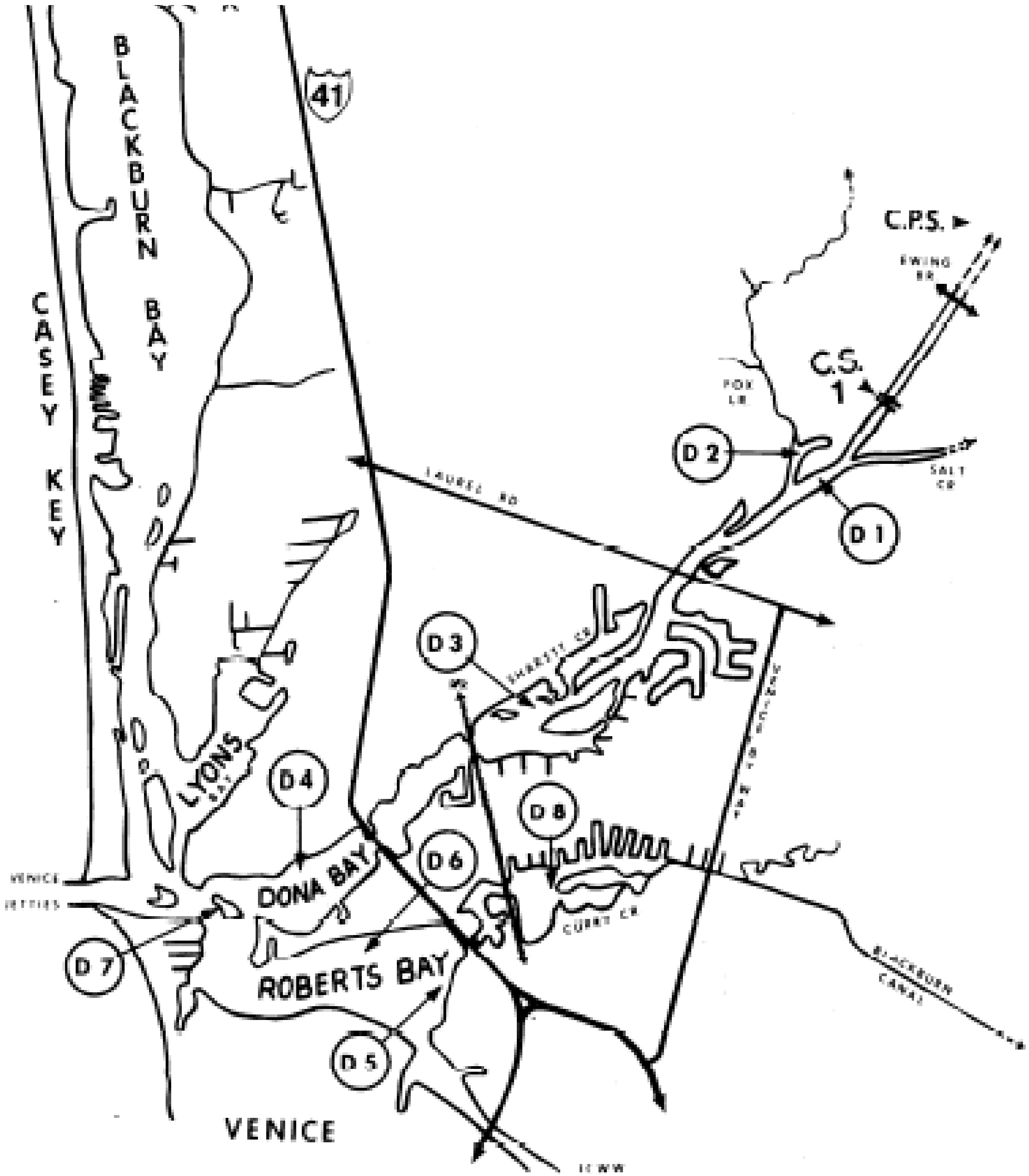


Figure B. Location of benthic sampling stations in Shackett Creek and Dona and Roberts bays, 1974-1975 (From Lincer, 1975)

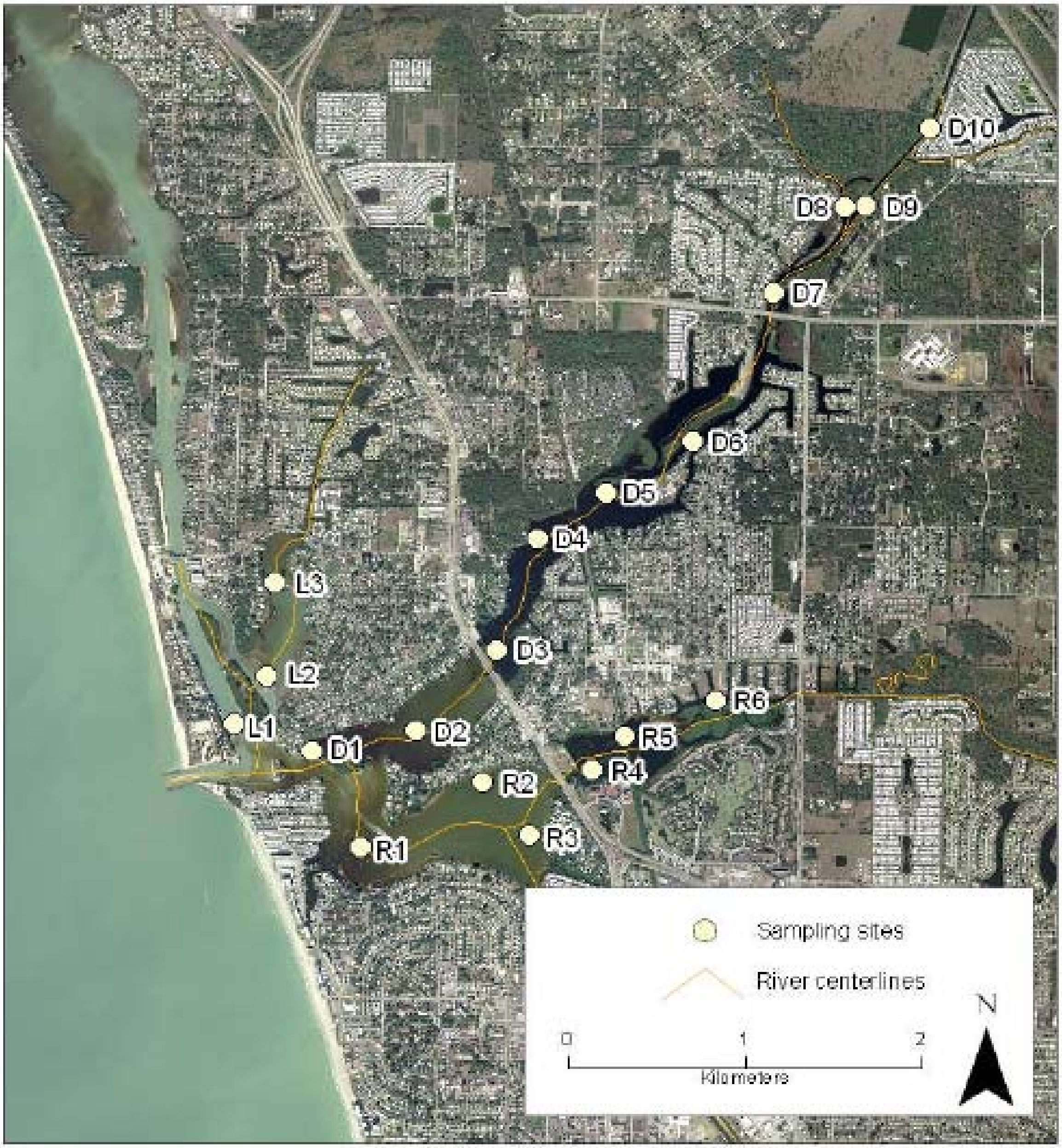


Figure C. Location of benthic sampling stations in Shackett Creek and Dona and Roberts bays, 2004 (From Culter, 2006). D1-D10= Shackett Creek and Dona Bay; R1-R6= Roberts Bay.

APPENDIX 5-2

SUMMARY OF SALINITY DATA COLLECTED DURING MOTE BENTHIC STUDIES

SALINITY

Salinity did not appear to have been measured at either the time or place benthic samples were collected in both surveys (Lincer, 1975; Culter, 2006). Three of the 1974-1975 water quality sampling locations were near to benthic stations. Mean salinity data were presented as “pre-rainy season”, “rainy season” and “post-rainy season”. Dry season salinity values were typically >30 ppt at all stations. Rainy season salinities were as much as 30 ppt lower than dry season values. In June 1974 there was a release of water from the slough that caused this salinity reduction (Lincer, 1975). The salinities measured during May-June 2004 were, again, typically >30 ppt.

Janicki Environmental, Inc. (2007) used a principal components analysis to identify salinity classes based upon the distribution of the benthos in 12 southwest Florida tidal rivers”

- Oligohaline ≤7 ppt
- Mesohaline: >7≤18 ppt
- Polyhaline: >18≤29 ppt
- Euhaline: >29 ppt

The 1974-1975 DARB salinities correspond to the Euhaline salinity class under this classification. Mean salinity values during May-June 2004 were in the Euhaline and Polyhaline salinity classes, although the range over a tidal cycle could be >10 ppt.

TABLE A. SUMMARY OF SHACKETT CREEK, DON BAY, AND ROBERTS BAY SALINITY MEASUREMENTS, 1974-1975 AND 2005 (FROM: LINCER, 1975; CULTER, 2006)

Station	Pre-rainy Season 1974-1975	Rainy Season 1974-1975	Post-rainy Season 1974-1975	2004 Median (range)
2004 Station SKC3 (located above confluence with Salt Creek, upstream of benthic stations D1 and D-2)				29.5 (27.2-30.8)
1974 Station 3 (upstream of benthic station D-3 in Shackett Creek)	33.6	3.3	22.2	
2004 Station SKC 2 (upstream of benthic station D3 and downstream of 1974 station 3)				31.5 (30.3-32.7)
1974 Station 5 & 2004 Station SKC 1 (located at/upstream US 41 bridge)	36.9	7.5	30.4	32.9 (31.8-34.1)
1974 Station 6 (located in Venice Pass)	37.1	20.0	30.8	
2004 Station DB1 (located near benthic station D7)				34.8 (33.2-35.2)
2004 Station RB1 (located nearby to benthic station D-6 in Roberts Bay)				35.5 (35.1-36.0)

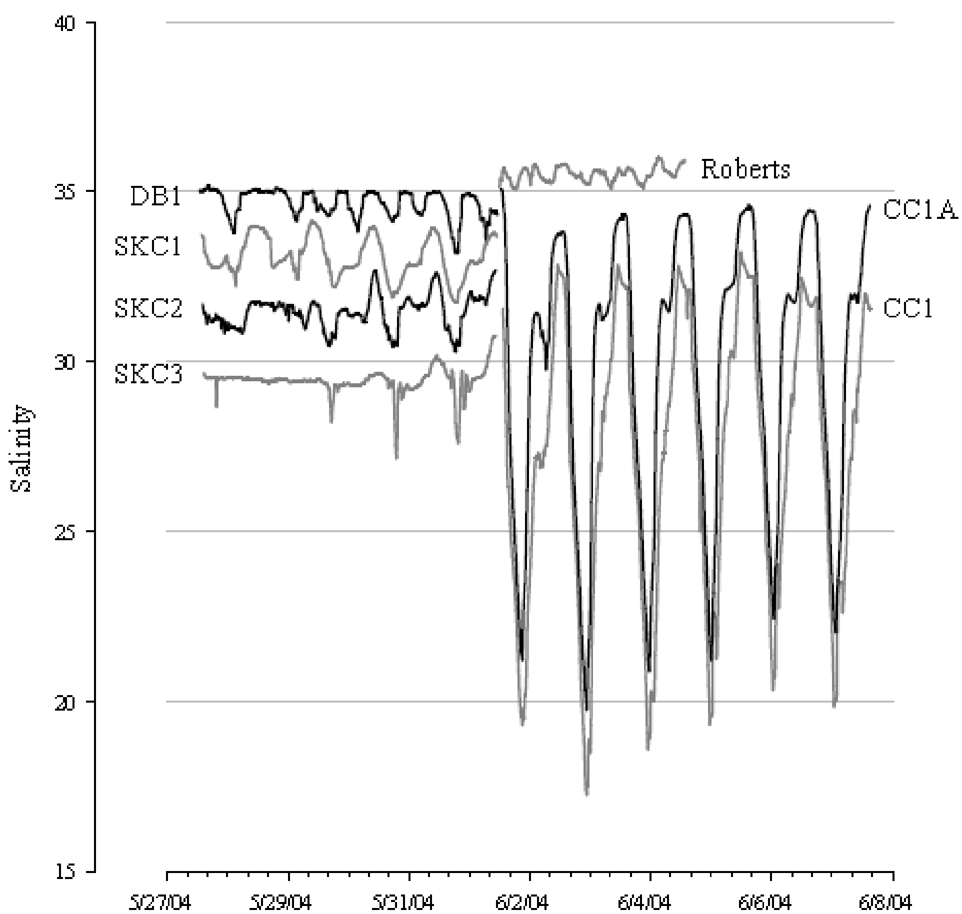


Figure A. Salinity x Time, 27 May-8 June 2004: Shackett Creek, Dona Bay, & Roberts Bay (Culter, 2006)

APPENDIX 5-3

SUMMARY OF DISSOLVED OXYGEN DATA COLLECTED DURING MOTE BENTHIC STUDIES

DISSOLVED OXYGEN

The mean dissolved oxygen concentrations during the 1974-1975 survey exceeded 4 ppm. The “post-rainy season” means at stations 5 and 6 were supersaturated (>8 ppm at salinities >30 ppt) (Table 6-4). Subnominal (<4 ppm) conditions were observed at three of the four sites inn 2004. Hypoxia (<2 ppm) was prevalent at the most upstream station in Shakett Creek (Table 6-C). Appendix 6-2 shows the diel variations in dissolved oxygen at the 2004 continuous monitoring locations.

Table A. Summary of Shakett Creek, Don Bay, and Roberts Bay dissolved oxygen measurements, 1974-1975 and 2005 (From: Lincer, 1975; Culter, 2006).

Station	Pre-rainy Season 1974-1975	Rainy Season 1974-1975	Post-rainy Season 1974-1975	2004 Median (range)
2004 Station SKC3 (located above confluence with Salt Creek, upstream of benthic stations D1 and D-2)				1.2 0.6-6.6)
1974 Station 3 (upstream of benthic station D-3 in Shakett Creek)	6.2	6.2	7.8	
2004 Station SKC 2 (upstream of benthic station D3 and downstream of 1974 station 3)				
1974 Station 5 & 2004 Station SKC 1 (located at/upstream US 41 bridge)	6.0	5.7	8.3	5.4 (4.1-7.0)
1974 Station 6 (located in Venice Pass)	7.4	6.8	8.4	
2004 Station DB1 (located near benthic station D7)				3.4 (0.7-7.6)
2004 Station RB1 (located nearby to benthic station D-6 in Roberts Bay)				4.3 (1.9-7.9)

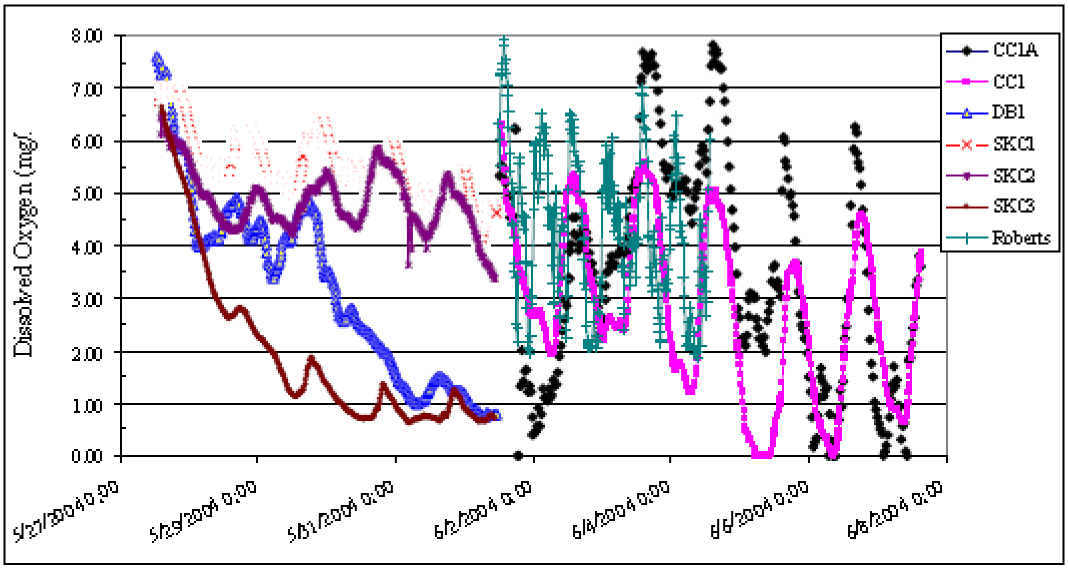


Figure A. Dissolved Oxygen Concentrations x Time, 27 May-8 June 2004: Shakett Creek, Dona Bay, & Roberts Bay (Culter, 2006)

APPENDIX 5-4

SUMMARY OF SEDIMENT DATA COLLECTED DURING MOTE BENTHIC STUDIES

SEDIMENTS

Samples for analysis of sediment characteristics were collected in September and November 1974—months in which benthos was not sampled (Lincer, 1975). The 2004 samples were collected with the benthos (Culter, 2006). These data showed that sediments were generally similar between the two sampling events and:

- The percentage of organic matter was generally high (>2%); and
- medium sand-sized sediments predominated.

Table A. PERCENT ORGANIC MATTER, BY STATION, SHAKETT CREEK, DONA BAY, AND ROBERTS BAY DECEMBER 1974 (FROM LINCER, 1975)

Station	D.I.	% O.M.
S1	1.27	5.00
S2	3.30	11.00
D1	1.40	2.40
D3	.18	2.00
D4	2.79	2.00
D5	4.04	8.50
D7	4.72	8.50
D8	1.51	4.30

r = 0.7392; df = 6 (p <0.05)

* Invertebrates collected in December 1974.
† Sediment cores collected within approximately two months before invertebrates were sampled and near, but notnecessarily at, invertebrate collection sites.

Table B. SEDIMENT CHARACTERISTICS, SHAKETT CREEK, DONA BAY, AND ROBERTS BAY, MAY-JUNE 2004 (FROM CULTER, 2006)

Station	Deep (D) Shallow	Percent Solids	Percent Moisture	Percent Organic	Percent Sand	Percent Silt	Percent Clay	Grain Size Statistics: Mean (µm)	Median (µm)	Mode (µm)	St.Dev	Skewness	Kurtosis
Dona Bay1	S	76.8	23.2	1.0	88.1	9.2	2.7	157.60	170.40	153.80	3.89	-1.28	2.98
Dona Bay1	D	72.4	27.6	1.5	87.9	9.6	2.5	174.30	176.40	153.80	4.01	-1.08	2.18
Dona Bay2	S	78.0	22.0	1.5	84.4	12.6	3.0	182.70	248.00	203.50	4.30	-1.52	1.96
Dona Bay2	D	64.1	35.9	4.4	67.4	28.1	4.6	85.91	136.70	168.80	4.90	-0.76	-0.01
Dona Bay3	S	57.0	43.0	2.3	59.3	36.8	3.8	64.19	102.00	153.80	4.23	-0.68	-0.13
Dona Bay3	D	74.2	25.8	2.0	79.0	16.2	4.8	123.80	176.30	168.80	4.95	-1.12	0.93
Dona Bay4	S	75.2	24.8	1.3	73.6	23.4	3.0	124.30	180.30	185.30	4.74	-0.86	0.30
Dona Bay4	D	59.8	40.2	4.3	69.3	26.9	3.8	82.74	122.30	140.10	4.33	-0.78	0.45
Dona Bay5	S	75.7	24.3	0.9	92.1	6.7	1.3	206.40	223.00	203.50	3.02	-1.57	4.56
Dona Bay5	D	68.6	31.4	3.0	70.7	23.9	5.4	82.81	144.70	168.80	4.77	-1.00	0.23
Dona Bay6	S	70.8	29.2	1.8	88.4	9.7	2.0	158.40	170.00	153.80	3.47	-1.19	2.95
Dona Bay6	D	68.5	31.5	2.4	88.7	9.6	1.7	183.80	200.50	168.80	3.53	-1.22	2.69
Dona Bay7	S	71.7	28.3	1.6	85.0	12.8	2.2	121.40	139.10	127.60	3.29	-1.39	3.00
Dona Bay7	D	77.1	22.9	1.9	92.8	6.1	1.1	320.20	377.20	471.10	3.33	-1.59	3.75
Dona Bay8	S	68.9	31.1	2.2	82.6	15.1	2.4	120.40	157.90	168.80	3.46	-1.41	2.42
Dona Bay8	D	74.7	25.3	1.0	92.6	6.5	1.0	243.40	305.60	324.30	2.69	-2.48	7.28
Dona Bay9	S	69.2	30.8	1.8	85.1	12.7	2.3	109.00	130.50	140.10	3.08	-1.49	4.02
Dona Bay9	D	64.0	36.0	3.5	66.2	29.8	4.0	76.13	134.50	168.80	4.17	-0.94	0.33
Dona Bay10	S	75.0	25.0	2.4	88.9	9.1	2.0	204.30	208.30	153.80	3.79	-1.20	2.63
Dona Bay10	D	58.7	41.3	3.4	70.1	27.5	2.4	85.19	131.80	153.80	3.58	-1.02	0.89
Roberts Bay1	S	67.3	32.7	2.3	74.3	23.0	2.7	167.00	208.30	185.30	5.72	-0.67	-0.19
Roberts Bay1	D	65.2	34.8	7.2	62.6	32.2	5.2	72.62	122.10	153.80	5.04	-0.67	-0.29
Roberts Bay2	S	66.1	33.9	5.2	58.0	35.5	6.5	74.25	121.30	185.30	6.47	-0.37	-0.78
Roberts Bay2	D	69.5	30.5	2.9	70.8	24.0	5.2	100.40	161.90	185.30	5.44	-0.84	-0.01
Roberts Bay3	S	77.5	22.5	1.1	94.3	4.9	0.8	409.20	500.30	1198.0	3.43	-1.40	2.89
Roberts Bay3	D	68.9	31.1	3.2	66.0	27.9	6.1	80.20	148.80	185.30	5.39	-0.84	-0.21
Roberts Bay4	S	73.1	26.9	2.5	77.5	19.5	3.1	138.60	214.60	223.40	4.58	-1.16	0.70
Roberts Bay4	D	66.5	33.5	3.0	74.7	22.0	3.3	101.90	159.00	168.80	4.14	-1.17	0.79
Roberts Bay5	S	73.8	26.2	1.8	80.4	16.4	3.2	116.80	170.90	168.80	3.96	-1.39	1.55
Roberts Bay5	D	74.4	25.6	1.3	84.1	13.0	2.9	124.40	172.70	168.80	3.53	-1.73	2.75
Roberts Bay6	S	74.7	25.3	0.5	98.4	1.3	0.3	358.50	338.60	295.50	2.08	-1.62	10.10
Roberts Bay6	D	74.8	25.2	0.4	97.6	1.9	0.5	260.50	269.50	269.20	1.99	-2.78	16.60
Lyons Bay1	S	75.1	24.9	1.3	82.6	13.5	3.9	87.57	130.80	140.10	3.30	-2.13	4.02
Lyons Bay1	D	77.3	22.7	0.6	92.8	5.4	1.9	190.30	167.40	153.80	3.37	-1.14	3.53
Lyons Bay2	S	65.1	34.9	2.7	84.9	11.9	3.3	116.50	149.30	153.80	3.65	-1.41	2.86
Lyons Bay2	D	73.2	26.8	1.1	86.6	11.0	2.4	119.70	149.10	153.80	3.16	-1.87	4.81
Lyons Bay3	S	69.9	30.1	2.2	49.0	45.1	5.9	47.42	57.55	153.80	4.90	-0.33	-0.56
Lyons Bay3	D	79.0	21.0	1.1	88.9	8.8	2.4	213.50	248.80	203.50	3.91	-1.53	2.90

APPENDIX 5-5

ABUNDANCE OF BENTHIC ORGANISMS
IN DARB SYSTEM
LINCER ET AL. 1975

ABUNDANCE OF BENTHIC ORGANISMS IN SHAKETT CREEK-DONA BAY, LYONS BAY, AND ROBERTS BAY, 1974-1975
(FROM LINCER, 1975)

A. MAY 1974

	Station Number										
	South Creek			Dona-Robert's Bays							
TAXA	S1	2	3	D1	2	3	4	5	6	7	8
I. POLYCHAETES											
Cirriformia grandis	67	4	120								
Chaetopterus variopedatus		3					1				
Cistenides gouldi	2		1		1		1				
Diopatra cuprea	6	47									
Eteone heteropoda		9									
Goniada teres	30	7				1	1				
Namalycastis abiuma				1	3						
Nereis sp.	18		6								
Nereis pelagica occidentalis		3									
Notomastus sp.				4							5
Onuphis sp.			1							1	
Terebellides stroemi			47						148	21	2
Spiochaetopterus costarum oculatus	2										
II. AMPHINEURANS											
Ischnochiton sp.		1									
III. SCAPHOPODS											
Dentalium eboreum		5					1		2		
Dentalium texasianum		4									
IV. GASTROPODS											
Batillaria minima										1	
Bulla occidentalis	7	2								15	
Cerithium muscarum										21	
Haminoea succinea	10	15	1							8	
Neritina reclivata	4										
Prunum apicinum		2									
Tectonatica pusilla										2	
V. BIVALVES											
Abra aequalis		16	1			2	14		11	56	
Amygdalum papyria			1		3						
Anadara sp.	1										
Anodontia sp.	3	28								4	
Anomalocardia cuneimeris	2		1								
Chione grus										2	
Chione cancellata	1									5	

	South Creek			Dona-Robert's Bays							
V. BIVALVES (cont.)	S1	2	3	D1	2	3	4	5	6	7	8
Corbula barrattiana		8								2	
Laevicardium mortoni	1		4			2					
Lyonsia floridana			1								
Macoma tenta	9	27	59			1	86		3		
Mercenaria campechiensis		1					2	3	12		
Mulinia lateralis			8	1	9	4					
Solemya occidentalis		19									
Tagelus divisus		1	7	87	47	1			1		18
Tellidora cristata		3									
Tellina lineata											
Tellina tampaensis			1			1					
Tellina texana	5	33	21	4	8	1				1	
Tellina versicolor		8	3				21				
Trachycardium muricatum					1						
Transenella conradiana		1									
VI. CRUSTACEANS											
Ampelisca sp.			27	1	1	3					
Cronius sp.										9	
Crustacean sp. A		41									
Gammarus sp.	12	14							13	46	
Lysianopsis sp. (?)		1									
Pagurus longicarpus										1	
Portunus gibbessii								1			
VII. ECHINODERMS											
Hemipholis elongata											
Ophiolepis sp. (?)											
Ophionema sp.											
Ophiophragmus sp.									3		
Thyone sp.											
VIII. TUNICATES											
Bostrichobranchus sp.	8	34							12		
IX. CEPHALOCHORDATES											
Amphioxus sp.		4									

B. JULY 1974

	Station Number										
	South Creek			Dona-Robert's Bays							
TAXA	S1	2	3	D1	2	3	4	5	6	7	8
I. POLYCHAETES											
Cistenides gouldi										3	
Diopatra cuprea											
Namalycastis abiuma											4
Nereis sp.											2
Nereis pelagica			2								
Onuphis sp.		6			6			58			100
Spiochaetopterus sp.	1										
Terebellides stroemi									2		
II. GASTROPODS											
Cerithium muscarum											
III. BIVALVES											
	1		1				6	2	6	4	
Anodontia sp.								1			
Anomalocardia cuneimeris								1			
Chione cancellata						1	1				
Chione grus		1						2			
Corbula barattiana							9	1	2		
Macoma tenta								2	2		
Mytilus edulis								1			
Tellina texana							2				
IV. CRUSTACEANS											
Callinectes sapidus		2									2
Gammarus sp.						3				3	2
V. ECHINODERMS											
Hemipholis elongata							2				
Ophionema sp.							2				

C. DECEMBER 1974

	South Creek			Dona-Robert's Bays								Buck Creek	
	S1	2	3	D1	2	3	4	5	6	7	8	M1	2
I. POLYCHAETES													
Chaetopterus variopedatus										1			
Cirriformia grandis	38												53
Cistenides gouldi	1	3											
Diopatra cuprea	9	18								6			
Goniada teres													4
Maldane sarsi								1		2			
Namalycastis abiuma		3									1		2
Nereis pelagica occidentalis				3									
Nereis sp.	140	19	26			1	4	3		1	19	52	5
Notomastus sp.				1	3		1						
Onuphis magna									43				
Onuphis sp.	8										16		1
Pista palmata											5		
Spiochaetopterus sp.	1												
Terebellides stroemi	21	4					1			2			7
II. GASTROPODS													
Batillaria minima										2			
Cerithium muscarum								1					
Prunum apicinum										1			
III. BIVALVES													
Abra aequalis								7	6	18	2		
Amygdalum papyria				4			1		1				
Anodontia sp.	3	8		2			2			11		1	
Anomalocardia cuneimeris											2	9	20
Arca transversa													3
Chione cancellata							1	6	1	24			1
Chione grus												1	
Corbula barattiana	1	2					1	6	1				
Laevicardium mortoni		1											
Littorina irrorata								1					
Lucina multilineata										1			
Macoma tenta								5	1	3			
Mercenaria campechiensis		4					1	3		8			
Mulinia lateralis	1	3				2		1	2			1	7
Mytilus exustus												1	
Tagelus divisus						146		3	1	2	25	31	
Tellina tampaensis						2							2
Tellina texana					3		14		4				
Tellina versicolor		1								3			

	South Creek			Dona-Robert's Bays								Buck Creek	
IV. AMPHIPODS	S1	2	3	D1	2	3	4	5	6	7	8	B1	2
Ampelisca sp.													12
Gammarus sp.													12
Leptochelia	1			8									
V. ECHINODERMS													
Hemipholis elongata										1			
Ophionema sp.							2	18					
VI. CEPHALOCHORDATES													
Amphioxus sp.	1												

D. APRIL 1975

	Station Number												
	South Creek			Dona-Robert's Bays								Buck Creek	
TAXA	S1	2	3	D1	2	3	4	5	6	7	8	B1	2
I. POLYCHAETES													
Arenicola cristata												1	
Cirriformia grandis	30	1											
Cistenides gouldi	1						1		7	1	1		
Diopatra cuprea		12										1	
Eteone heteropoda												3	
Goniada teres	3			1							15	8	
Namalycastis abiuma								10		4			
Nereis pelagica occidentalis		1									2	2	
Nereis sp.					16							5	
Notomastus sp.											1		
Onuphis sp.	2	2											
Polydora sp.								9					
Spiochaetopterus							2						
Terebellides stroemi						18			11		3		
II. SCAPHOPODS													
Dentalium eboreum							1		4				
Dentalium texasianum									1				
III. GASTROPODS													
Bulla occidentalis		1								2		1	
Haminoea succinea	5	4					1		2		1		
Nassarius vibex	1	1											
Neritina reclivata												2	
IV. BIVALVES													
Abra aequalis		4				1	1	2	5				
Aequipecten gibbus												1	
Amygdalum papyria		2							3				
Anadara sp.												2	
Anodontia sp.		3			7				3	17			
Anomalocardia cuneimeris	3	1						1	3			8	
Arca transversa		4											
Brachiodontes exustus					76								
Chione grus										2			
Corbula barrattiana	1						1	8	5	1			
Laevicardium mortoni		10							10	2			
Lyonsia floridana		4											
Macoma tenta	18	8				2		1	3				

	Station Number												
	South Creek			Dona-Robert's Bays								Buck Creek	
IV. BIVALVES (cont.)	S1	2	3	D1	2	3	4	5	6	7	8	B1	2
Mercenaria campechiensis		7							2	6			
Mulinia lateralis				2					5		8		
Tagelus divisus	19	5											
Tagelus sp.				172	6	38				1	20	11	
Tellina tampaensis	4												
Tellina texana		12		10	8	4		16	21		5	7	
Tellina versicolor									15				
V. CRUSTACEANS													
Ampelisca sp.		4			12						(	21	
Leptochelia sp.		2									(		
Lysianopsis sp.	23	24										28	
VI. ECHINODERMS													
Hemipholis elongata							6						
Ophiolepis elegans		2											
Ophiophragmus sp.		(					4						
VII. TUNICATES													
Bostrichobranchus		2								1	1		
VIII. CEPHALOCHORDATES													
Amphioxus sp.									2	1			

APPENDIX 5-6

ABUNDANCE OF BENTHIC ORGANISMS IN DARB SYSTEM MOTE 2006

ABUNDANCE OF BENTHIC ORGANISMS IN SHAKETT CREEK-DONA BAY, LYONS BAY, AND ROBERTS BAY, MAY-JUNE 2004
(FROM CULTER, 2006)

Taxonomic Group/Identified Taxa	Dona	% of Total	Lyons	% of Total	Roberts	% of Total
PHYLUM CNIDARIA						
CLASS ANTHOZOA						
ORDER ACTINIARIA						
Actiniaria	0		2	0.25	0	
PHYLUM PLATYHELMINTHES						
Platyhelminthes	3	0.28	1	0.12	4	0.21
PHYLUM NEMERTEA						
Nemertea	14	1.33	7	0.87	16	0.86
PHYLUM ANNELIDA						
CLASS POLYCHAETA						
FAMILY SIGALIONIDAE						
Sthenelais sp. A	0		0		6	0.32
FAMILY AMPHINOMIDAE						
Amphinomidae	0		2	0.25	0	
FAMILY PHYLLODOCIDAE						
Eteone heteropoda	0		1	0.12	5	0.27
Genetyllis castanea	0		1	0.12	0	
Paranaitis polynoides	1	0.09	0		0	
Eumida sanguinea	0		0		1	0.05
Phyllodoce arenae	0		2	0.25	0	
FAMILY HESIONIDAE						
Parahesione luteola	0		0		1	0.05
Podarke obscura	0		1	0.12	0	
Podarkeopsis levifuscina	0		0		1	0.05
FAMILY PILARGIDAE						
Sigambra tentaculata	2	0.19	0		1	0.05
Cabira incerta	0		0		1	0.05
Ancistrosyllis sp. C	0		0		1	0.05
FAMILY SYLLIDAE						
Ehlersia cornuta	0		1	0.12	0	
Typosyllis	0		3	0.37	0	
Exogone	0		6	0.75	1	0.05
Sphaerosyllis	0		1	0.12	0	
Sphaerosyllis taylori	1	0.09	1	0.12	0	
Sphaerosyllis longicauda	0		1	0.12	0	
Brania	0		1	0.12	0	
Streptosyllis pettiboneae	2	0.19	0		0	
FAMILY NEREIDAE						
Ceratonereis irritabilis	3	0.28	0		0	
Neanthes acuminata	0		9	1.12	0	
Nereis	1	0.09	0		0	
Laeonereis culveri	13	1.23	34	4.23	59	3.17

Taxonomic Group/Identified Taxa	Dona	% of Total	Lyons	% of Total	Roberts	% of Total
FAMILY NEPHTYIDAE						
Aglaophamus verrilli	0		0		1	0.05
FAMILY GLYCERIDAE						
Glycera americana	4	0.38	1	0.12	2	0.11
FAMILY GONIADIDAE						
Glycinde solitaria	4	0.38	8	1.00	21	1.13
FAMILY ONUPHIDAE						
Onuphidae	1	0.09	1	0.12	2	0.11
Diopatra cuprea	0		1	0.12	0	
FAMILY EUNICIDAE						
Eunicidae	0		1	0.12	0	
FAMILY LUMBRINERIDAE						
Lumbrineris	3	0.28	1	0.12	1	0.05
Lumbrineris ernesti	0		1	0.12	0	
FAMILY DORVILLEIDAE						
Ophryotrocha	0		1	0.12	1	0.05
FAMILY ORBINIIDAE						
Leitoscoloplos robustus	2	0.19	11	1.37	7	0.38
Scoloplos rubra	2	0.19	0		0	
FAMILY PARAONIDAE						
Aricidea philbinae	7	0.66	46	5.73	104	5.58
Aricidea taylori	1	0.09	0		6	0.32
FAMILY SPIONIDAE						
Polydora	2	0.19	0		0	
Polydora socialis	0		1	0.12	9	0.48
Polydora ligni	0		0		1	0.05
Prionospio heterobranchia	8	0.76	9	1.12	14	0.75
Prionospio steenstrupi	18	1.71	10	1.25	3	0.16
Prionospio pygmaea	2	0.19	6	0.75	1	0.05
Prionospio perkinsi	8	0.76	5	0.62	0	
Spio pettiboneae	1	0.09	7	0.87	0	
Spiophanes bombyx	0		1	0.12	1	0.05
Paraprionospio pinnata	0		1	0.12	0	
Streblospio benedicti	65	6.17	0		0	
Scolelepis texana	1	0.09	0		1	0.05
Carazziella hobsonae	0		0		4	0.21
FAMILY CIRRATULIDAE						
Caulleriella	6	0.57	19	2.37	42	2.25
Tharyx	0		4	0.50	0	
Monticellina dorsobranchialis	28	2.66	52	6.48	207	11.11
Chaetozone	1	0.09	2	0.25	2	0.11
Cirriformia sp. A	1	0.09	0		0	

Taxonomic Group/Identified Taxa	Dona	% of Total	Lyons	% of Total	Roberts	% of Total
FAMILY FLABELLIGERIDAE						
Piromis roberti	0		0		1	0.05
FAMILY OPHELIIDAE						
Armandia maculata	23	2.18	14	1.74	3	0.16
Travisia hobsonae	0		1	0.12	0	
FAMILY CAPITELLIDAE						
Capitellidae	0		0		1	0.05
Capitella capitata	15	1.42	4	0.50	84	4.51
Heteromastus filiformis	13	1.23	0		19	1.02
Notomastus	0		0		1	0.05
Mediomastus ambiseta	24	2.28	21	2.62	36	1.93
FAMILY MALDANIDAE						
Asychis elongata	0		2	0.25	5	0.27
Axiothella	0		1	0.12	0	
FAMILY OWENIIDAE						
Owenia fusiformis	2	0.19	2	0.25	0	
Myriochele oculata	2	0.19	2	0.25	8	0.43
FAMILY SABELLARIIDAE						
Sabellaria vulgaris	1	0.09	0		3	0.16
FAMILY PECTINARIIDAE						
Pectinaria gouldii	0		0		3	0.16
FAMILY AMPHARETIDAE						
Amphicteis gunneri	0		0		19	1.02
Isolda pulchella	4	0.38	0		6	0.32
FAMILY TEREBELLIDAE						
Terebellidae	0		2	0.25	0	
Eupolymnia nebulosa	0		0		2	0.11
Pista	1	0.09	0		0	
Pista palmata	0		0		1	0.05
Polycirrus	0		0		1	0.05
Streblosoma hartmanae	0		1	0.12	0	
FAMILY TRICHOBRANCHIDAE						
Terebellides stroemi	0		0		5	0.27
FAMILY SABELLIDAE						
Chone	1	0.09	0		0	
Fabriciola	165	15.65	17	2.12	15	0.81
Branchiomma	0		0		5	0.27
CLASS OLIGOCHAETA						
Oligochaeta	25	2.37	83	10.34	45	2.42
CLASS HIRUDINEA						
Hirudinea	1	0.09	0		0	

Taxonomic Group/Identified Taxa	Dona	% of Total	Lyons	% of Total	Roberts	% of Total
PHYLUM MOLLUSCA						
CLASS GASTROPODA						
Gastropoda	1	0.09	0		1	0.05
ORDER MESOGASTROPODA						
FAMILY HYDROBIIDAE						
Hydrobiidae	0		0		1	0.05
FAMILY RISSOIDAE						
Assiminea succinea	15	1.42	0		2	0.11
FAMILY VITRINELLIDAE						
Cyclostremiscus pentagonus	0		0		1	0.05
FAMILY CERITHIIDAE						
Bittiolum varium	2	0.19	68	8.47	5	0.27
Cerithium muscarum	0		4	0.50	0	
FAMILY MELANELLIDAE						
Melanella	0		0		1	0.05
FAMILY NATICIDAE						
Tectonatica pusilla	0		2	0.25	0	
ORDER NEOGASTROPODA						
FAMILY PYRENIDAE						
Astyris lunata	0		0		4	0.21
Mitrella lunata	0		1	0.12	1	0.05
Parvanachis obesa	0		1	0.12	2	0.11
FAMILY NASSARIIDAE						
Nassarius vibex	0		4	0.50	3	0.16
ORDER PYRAMIDELLOIDA						
FAMILY PYRAMIDELLIDAE						
Turbonilla	0		0		1	0.05
Turbonilla interrupta	0		0		1	0.05
ORDER CEPHALASPIDEA						
FAMILY ACTEONIDAE						
Rictaxis punctostriatus	3	0.28	0		0	
FAMILY CYLICHNIDAE						
Acteocina canaliculata	2	0.19	18	2.24	11	0.59
Acteocina bidentata	0		0		2	0.11
FAMILY BULLIDAE						
Bulla striata	0		1	0.12	0	
FAMILY HAMINOEIDAE						
Haminoea succinea	2	0.19	0		2	0.11
Haminoea antillarum	3	0.28	2	0.25	1	0.05
(SUBCLASS OPISTHOBRANCHIA)						
Opisthobranchia	1	0.09	0		3	0.16
CLASS BIVALVIA						
Bivalvia	4	0.38	1	0.12	6	0.32

Taxonomic Group/Identified Taxa	Dona	% of Total	Lyons	% of Total	Roberts	% of Total
ORDER ARCOIDA						
FAMILY ARCIDAE						
Anadara transversa	5	0.47	4	0.50	11	0.59
ORDER MYTILOIDA						
FAMILY MYTILIDAE						
Musculus lateralis	1	0.09	1	0.12	1	0.05
Amygdalum papyrium	1	0.09	0		1	0.05
ORDER PTERIOIDA						
FAMILY ANOMIIDAE						
Anomia simplex	1	0.09	0		0	
ORDER VENEROIDA						
FAMILY LUCINIDAE						
Lucinidae	0		2	0.25	0	
Parvilucina multilineata	0		27	3.36	5	0.27
Lucina nassula	0		2	0.25	0	
FAMILY MONTACUTIDAE						
Mysella planulata	3	0.28	1	0.12	11	0.59
FAMILY CRASSATELLIDAE						
Crassinella lunulata	0		2	0.25	6	0.32
FAMILY CARDIIDAE						
Laevicardium mortoni	0		1	0.12	1	0.05
FAMILY MACTRIDAE						
Mulinia lateralis	0		0		1	0.05
Rangia cuneata	0		0		1	0.05
FAMILY TELLINIDAE						
Macoma tenta	5	0.47	6	0.75	18	0.97
Tellina	1	0.09	1	0.12	1	0.05
Tellina versicolor	24	2.28	65	8.09	76	4.08
Tellina alternata	19	1.80	2	0.25	52	2.79
Tellidora cristata	0		1	0.12	0	
FAMILY PSAMMOBIIDAE						
Tagelus	1	0.09	0		1	0.05
Tagelus plebeius	37	3.51	0		6	0.32
Tagelus divisus	0		1	0.12	6	0.32
FAMILY SEMELIDAE						
Abra aequalis	7	0.66	5	0.62	14	0.75
FAMILY DREISSENIDAE						
Mytilopsis leucophaeata	9	0.85	0		7	0.38
FAMILY VENERIDAE						
Mercenaria	0		5	0.62	2	0.11
Chione cancellata	6	0.57	4	0.50	6	0.32
Macrocallista nimbosa	0		1	0.12	0	
Anomalocardia auberiana	0		0		2	0.11

Taxonomic Group/Identified Taxa	Dona	% of Total	Lyons	% of Total	Roberts	% of Total
ORDER MYINA						
FAMILY MYIDAE						
Sphenia antillensis	1	0.09	0		0	
FAMILY CORBULIDAE						
Corbula contracta	0		0		1	0.05
FAMILY LYONSIIDAE						
Lyonsia floridana	0		0		2	0.11
PHYLUM CRUSTACEA						
CLASS MALACOSTRACA						
ORDER MYSIDACEA						
FAMILY MYSIDAE						
Heteromysis formosa	56	5.31	1	0.12	73	3.92
Mysidopsis almyra	22	2.09	0		18	0.97
Bowmaniella floridana	0		0		1	0.05
ORDER CUMACEA						
FAMILY LEUCONIDAE						
Leucon americanus	0		1	0.12	0	
FAMILY DIASTYLIDAE						
Oxyurostylis smithi	0		1	0.12	1	0.05
FAMILY NANNASTACIDAE						
Almyracuma sp. proximoculae	0		0		2	0.11
FAMILY BODOTRIIDAE						
Cyclaspis pustulata	0		0		7	0.38
Cyclaspis varians	0		0		4	0.21
ORDER TANAIDACEA						
FAMILY PARAPSEUDIDAE						
Halmyrapseudes bahamensis	0		1	0.12	2	0.11
FAMILY PSEUDOZEUXIDAE						
Hargeria rapax	11	1.04	22	2.74	125	6.71
ORDER ISOPODA						
FAMILY ANTHURIDAE						
Xenanthura brevitelson	0		12	1.49	6	0.32
Mesanthura floridensis	1	0.09	0		2	0.11
Amakusanthura magnifica	0		0		5	0.27
FAMILY SPHAEROMATIDAE						
Cassidinidea ovalis	0		0		1	0.05
Harrieta faxoni	0		1	0.12	0	
FAMILY IDOTHEIDAE						
Erichsonella attenuata	0		0		1	0.05
Erichsonella filiformis	0		4	0.50	1	0.05
Edotea montosa	26	2.47	1	0.12	14	0.75

Taxonomic Group/Identified Taxa	Dona	% of Total	Lyons	% of Total	Roberts	% of Total
ORDER AMPHIPODA						
Amphipoda	5	0.47	6	0.75	0	
FAMILY AMPELISCIDAE						
Ampelisca	0		0		1	0.05
Ampelisca verrilli	5	0.47	0		1	0.05
Ampelisca agassizi	6	0.57	1	0.12	0	
Ampelisca holmesi	2	0.19	9	1.12	11	0.59
Ampelisca burkei	4	0.38	13	1.62	13	0.70
FAMILY AMPHILOCHIDAE						
Gitanopsis laguna	1	0.09	0		1	0.05
FAMILY AMPITHOIDAE						
Cymadusa filosa	3	0.28	0		0	
FAMILY AORIDAE						
Rudilemboides naglei	0		4	0.50	2	0.11
FAMILY COROPHIIDAE						
Corophiidae	0		0		1	0.05
Corophium	125	11.86	3	0.37	226	12.13
Erichthonius rubricornis	0		0		20	1.07
Unciola	0		15	1.87	20	1.07
Grandidierella bonnieroides	124	11.76	26	3.24	193	10.36
Bemlos	9	0.85	0		0	
FAMILY MELITIDAE						
Elasmopus	2	0.19	0		4	0.21
Elasmopus laevis	0		4	0.50	0	
Gammarus	0		0		2	0.11
Gammarus palustris	0		0		1	0.05
Melita	0		3	0.37	0	
Dulichiella sp. A	1	0.09	0		0	
FAMILY ISCHYROCERIDAE						
Jassa falcata	0		0		2	0.11
FAMILY LYSIANASSIDAE						
Lysianopsis alba	1	0.09	0		0	
FAMILY CAPRELLIDAE						
Caprellidae	0		1	0.12	2	0.11
ORDER DECAPODA						
Decapoda (unid. shrimp)	0		1	0.12	0	
FAMILY PENAEIDAE						
Penaeus	8	0.76	2	0.25	3	0.16
(INFRAORDER CARIDEA)						
Caridea	0		15	1.87	0	

Taxonomic Group/Identified Taxa	Dona	% of Total	Lyons	% of Total	Roberts	% of Total
Caridea	0		15	1.87	0	
FAMILY PASIPHAEIDAE						
Leptochela	0		2	0.25	0	
FAMILY PALAEMONIDAE						
Palaemonidae	2	0.19	0		0	
Palaemonetes	0		0		3	0.16
ORDER DECAPODA						
FAMILY DIOGENIDAE						
Paguristes	0		0		1	0.05
FAMILY PORTUNIDAE						
Callinectes sapidus	1	0.09	1	0.12	0	
Portunus	0		0		1	0.05
FAMILY XANTHIDAE						
Xanthidae	1	0.09	0		6	0.32
Rhithropanopeus harrisii	0		0		1	0.05
PHYLUM UNIRAMIA						
SUBPHYLUM HEXAPODA						
ORDER DIPTERA						
FAMILY CHIRONOMIDAE						
Chironomidae	1	0.09	0		0	
PHYLUM SIPUNCULA						
Sipuncula	0		0		5	0.27
FAMILY GOLFINGIIDAE						
Phascolion strombi	1	0.09	7	0.87	5	0.27
PHYLUM ECHIURA						
Echiura	0		0		1	0.05
PHYLUM ECHINODERMATA						
CLASS STELLEROIDEA						
(SUBCLASS OPHIUROIDEA)						
Ophiuroidea	0		0		1	0.05
ORDER OPHIURIDA						
FAMILY OPHIODERMATIDAE						
Amphiuroidea	0		0		1	0.05
FAMILY AMPHIURIDAE						
Amphioplus	0		0		1	0.05
PHYLUM CHORDATA						
SUBPHYLUM VERTEBRATA						
CLASS OSTEICHTHYES						
Osteichthyes	0		0		1	0.05
Total Individuals:	1,054	100	803	100	1,863	100
Mean Number of Individuals/taxa	5	1	4	1	19	1
Standard Deviation:	18.6	2.5	11.0		29.7	
Minimum	0.0	0.1	0.0		0.0	
Maximum	165	16	83		226	

APPENDIX 5-7

FRESHWATER INFLOW EFFECTS ON FISHES AND INVERTEBRATES IN THE DONA AND ROBERTS BAY ESTUARY

FRESHWATER INFLOW EFFECTS ON FISHES AND INVERTEBRATES IN THE DONA AND ROBERTS BAY ESTUARY

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SUMMARY

Quantitative ecological criteria are needed to establish minimum flows and levels for rivers and streams within the Southwest Florida Water Management District (SWFWMD), as well as for the more general purpose of improving overall management of aquatic ecosystems. As part of the approach to obtaining these criteria, the impacts of managed freshwater inflows on downstream estuaries are being assessed. A 16-month study of freshwater inflow effects on habitat use by estuarine organisms in the Dona and Roberts Bay (DARB) estuary was undertaken from March 2004 to June 2005. Although the DARB estuary is influenced by freshwater inflows from both Cow Pen Slough and the Blackburn Canal, the analyses presented here emphasize estuarine relationships with Cow Pen Slough.

The general objective of the present data analysis was to identify patterns of estuarine habitat use and organism abundance under variable freshwater inflow conditions and to evaluate responses. Systematic monitoring was performed to develop a predictive capability for evaluating potential impacts of proposed freshwater withdrawals and, in the process, to contribute to baseline data. The predictive aspect involves development of regressions that describe variation in organism distribution and abundance as a function of natural variation in inflows. These regressions can be applied to any proposed alterations of freshwater inflows that fall within the range of natural inflow variation documented during the data collection period.

For sampling purposes, the DARB estuary was divided into five zones from which plankton net, seine net and trawl samples were taken on a monthly basis. Salinity, water temperature, dissolved oxygen and pH measurements were taken in association with each net deployment. Daily freshwater inflow estimates were derived from gauged streamflow records from Cow Pen Slough. A large body of descriptive habitat-use information was generated and is presented in accompanying appendices.

Larval gobies and anchovies dominated the larval fish catch. Gobies of the genus *Gobiosoma* were dominant over those of the genus *Microgobius*, and the anchovies were dominated by bay anchovy (*Anchoa mitchilli*). Other common fishes included scaled sardine (*Harengula jaguana*), eucinostomus mojarras (*Eucinostomus* spp.), freshwater

shads (*Dorosoma* spp.) and sand seatrout (*Cynoscion arenarius*). If fish eggs are excluded, then gobies, anchovies and the latter taxa comprised over 95% of the plankton-net fish catch. The plankton-net invertebrate catch was dominated by larval crabs (decapod zoeae), the mysid *Americamysis almyra*, gammaridean amphipods, the planktonic copepods *Acartia tonsa* and *Labidocera aestiva*, the planktonic shrimp *Lucifer faxoni*, chaetognaths and the larvacean *Oikopleura dioica*. Together, these taxa comprised 80% of the invertebrate plankton catch.

The seine catch of fishes was dominated (94% of total catch) by bay anchovy (*Anchoa mitchilli*), eucinostomus mojarras (*Eucinostomus* spp.), scaled sardine (*Harengula jaguana*), spanish sardine (*Sardinella aurita*), silversides (*Menidia* spp.), Cuban anchovy (*A. cubana*), pinfish (*Lagodon rhomboides*), silver jenny (*Eucinostomus gula*), and tidewater mojarra (*Eucinostomus harengulus*). The trawl catch of fishes was dominated (nearly 80% of total catch) by eucinostomus mojarras, pinfish, silver jenny, and Cuban anchovy. The seine catch of invertebrates was dominated (over 94% of total catch) by daggerblade grass shrimp (*Palaemonetes pugio*), pink shrimp (*Farfantepenaeus duorarum*), and blue crab (*Callinectes sapidus*). The trawl catch of invertebrates was dominated (over 85% of total catch) by pink shrimp, longtail grass shrimp (*Periclimenes longicaudatus*), and blue crab.

Use of the area as spawning habitat was indicated by the presence of fish eggs or newly hatched larvae. The eggs of unidentified herrings (clupeids), the scaled sardine (*Harengula jaguana*), the Atlantic thread herring (*Opisthonema oglinum*), the bay anchovy (*Anchoa mitchilli*), the striped anchovy (*A. hepsetus*) and unidentified sciaenid fishes were collected from the DARB survey area. All of these eggs were relatively abundant in Roberts Bay and Venice Inlet. If the abundance of early larvae is proportionate to the abundance of eggs, then silver perch (*Bairdiella chrysoura*), seatrouts (*Cynoscion arenarius* and *C. nebulosus*) and kingfishes (*Menticirrhus* spp.) are the sciaenid fishes that are most likely to have spawned in this area; the earliest larval stages of these species were most abundant in Roberts Bay and near Venice Inlet. Blennies (blenniids) and the hogchoker (*Trinectes maculatus*) spawned near Venice Inlet and possibly other seaward parts of the DARB survey area. Skilletfish (*Gobiesox strumosus*) and gobies (*Bathygobius soporator*, *Gobiosoma* spp. and *Microgobius* spp.) spawned toward the landward side of the DARB survey area within upper Dona Bay and Shackett Creek. The repeated collection of small juveniles of live-bearing gulf pipefish (*Syngnathus scovelli*), chain pipefish (*S. louisianae*) and lined seahorse (*Hippocampus erectus*) is an indication that these species reproduced near or within the study area. Estuary-dependent nearshore or offshore-spawning taxa using the study area as a nursery comprised the majority of the most common nekton taxa: overall, six of the ten most abundant taxa in deeper (trawled) habitats and seven of the ten most abundant taxa in nearshore (seined) habitats could be considered estuary-dependent. The remaining abundant taxa were estuarine spawners or tidal-river residents. The dependents included taxa of commercial importance (i.e., blue crab and pink shrimp) and taxa of ecological importance due to high abundance (i.e., pinfish, eucinostomus mojarras, tidewater mojarra, and silver jenny).

Based on plankton-net data, alteration of flows would appear to have the lowest potential for impacting many taxa during the period from November through February, which is the period when the fewest taxa were present. The highest potential to impact many species would appear to be from June through October. Some species were present throughout the year (bay anchovy), whereas others had more seasonal spawning and recruitment patterns.

Based on seine or trawl collections, few clear seasonal patterns of taxon richness were evident in the DARB estuary, which may be attributed to both the relatively short duration of sampling and the unusual hydrological conditions encountered during the study. Monthly taxon richness in seined areas was highly variable, with no consistently high periods during the study period; in deeper (trawled) habitats, the November–February period had greatest taxon richness. Overall abundances and abundances of new recruits of nekton taxa indicate extensive use of the study area during all months. Overall abundance peaks for tidal-river residents occurred in late spring/early summer. Estuarine and nearshore spawners tended to have peak periods of abundance in summer, whereas offshore spawners had most peaks in abundance in winter and late spring. Among new recruits, peak recruitment periods varied somewhat between life-history categories: offshore spawners tended to recruit in winter and late summer, nearshore spawners' peaks of recruitment were in summer and winter, estuarine spawners recruitment peaks were in spring and summer, and peaks in residents' recruitment were in late spring and winter.

Twenty-eight (49%) of the 57 plankton-net taxa evaluated for distribution responses to Cow Pen Slough inflows exhibited significant responses. All were negative responses, wherein animals moved upstream as inflows decreased. Upstream movement is the typical low-inflow response seen in estuaries on Florida's west coast. Time lags associated with these responses were variable, but most taxa responded to inflow within days or weeks. Detection of distribution responses to Cow Pen Slough inflows was complicated by concurrent inflows from the Blackburn Canal into Roberts Bay. Nevertheless, approximately half of the observed responses had r^2 values >50%, and these strong responders were dominated by estuarine, rather than freshwater, taxa.

For seine and trawl data, nearly 60% of the 19 pseudo-species evaluated for distributional responses to freshwater inflow exhibited a significant response for at least one lagged flow period. The best models tended to involve long lag periods. Less than half (45%) of the significant responses were negative (i.e., animals moved upstream with decreasing freshwater inflow), in marked contrast to previous studies where the great majority of responses were negative. Typically, pseudo-species' centers of abundance shift downstream during periods of higher inflow because individuals occupy areas with suitable salinities or food sources. In the present study, 11 of the 14 seine and trawl sampling events occurred when there was considerably less than average inflow. It is possible that inflows (short, medium, and long term) were so low during the sampling period that the relatively small quantities of freshwater entering the system had the effect of attracting many animals upstream (towards the fresh water source) rather than downstream into the higher-salinity portion of the system.

Sixteen (28%) of the 57 plankton-net taxa evaluated for abundance relationships with freshwater inflow exhibited significant responses. Six were positive responses and ten were negative. Nine of the ten negative responses involved taxa that exhibited significant downstream movement in response to increased inflow, suggesting that the reductions in abundance were caused by movement into the Gulf or adjacent bays.

Four of the six taxa with positive inflow responses were insect larvae (*Chaoborus punctipennis*, trichopteran larvae, chironomid larvae, dipteran pupae), which are primarily freshwater, but may contain estuarine species. These taxa had positive responses to freshwater inflow because they were introduced into the study area by freshwater inflows.

Two estuarine taxa had positive responses: preflexion anchovy larvae and the tanaid *Hargeria rapax*. The larval anchovy lags were most highly significant at 4 d, but remained highly significant for lags of up to several weeks duration, which places this response within the same time frame as a positive population (spawning) response to inflow. Lags associated with *Hargeria rapax*'s abundance response (67 d) were also within a time frame that could represent population responses to inflow.

For seine and trawl data, 70.4% of the 27 pseudo-species considered demonstrated significant relationships between abundance and average inflow. The greatest proportion of variance in abundance was explained by linear models for three pseudo-species and by quadratic models for 16 pseudo-species. Of the three linear models, all were negative relationships, indicating increasing abundance with decreasing inflow. One-quarter of significant quadratic models were negative relationships. The most common quadratic relationship (nearly 47% of significant quadratic relationships) suggested lowest abundance at intermediate inflows ('intermediate-minimum'). Of the remaining quadratic models, four suggested greatest abundance at intermediate inflow ('intermediate-maximum') and one suggested greatest abundance at higher flow levels. The percentage of significant abundance responses to inflow ranged from 57% of tested pseudo-species in estuarine spawners to 82% in offshore spawners. Nearshore spawners most commonly exhibited negative relationships to flow, whereas there were no clearly evident trends discernible for the other life-history categories. Best-fitting regression models incorporated medium or longer lags for all life-history categories. The ten strongest abundance-inflow relationships included pseudo-species from all life-history categories. Of these ten strongest relationships, nine were analyses conducted on data collected by trawl in the channel habitat. Relationships of abundance to flow in these ten pseudo-species were positive, negative, intermediate-minimum, or intermediate-maximum. An increase in abundance with increased flow may suggest beneficial aspects of increased nutrient input, for example, or perhaps better detection of the tidal-river nursery area. Intermediate-minimum relationships are difficult to explain in ecological terms. Intermediate-maximum relationships, which are opposite in nature to intermediate-minimum relationships, perhaps indicate differing forces operating at opposite ends of the inflow spectrum. At low flows, opportunities for either chemical detection of tidal nursery habitats or selective tidal-stream transport may be reduced, and at high flows, physical displacement may occur, or perhaps undesirable properties of fresher water (e.g., low pH) become more prominent.

Salinity variability within the study area increased as freshwater inflow increased, becoming most variable at inflows >100 cfs. Zooplankton community structure throughout the DARB estuary was most spatially uniform when inflows were reduced and was most spatially variable when inflows were elevated. High levels of spatial heterogeneity in community structure appeared to be maintained at inflow levels >100 cfs. There was a gradient in community structure along the axis from Venice Inlet through Dona Bay and into Shakett Creek, with the structure in the two upstream zones (3.0-5.0 and 5.0-6.4 km) being significantly different from those of the downstream zone (1.0-3.0 km) and the two lateral bays (Roberts Bay and Lyons Bay). These differences were stronger for invertebrate zooplankton than for ichthyoplankton. The two upstream zones had higher abundances of mysids and amphipods, which are important prey for juvenile estuary-dependent fishes, and the downstream zones had higher abundances of copepods, which are important prey for fish larvae and adult zooplanktivorous fishes such as anchovies, sardines and herring. From the perspective of the entire survey period, community differences between the downstream zone and the two lateral bays were minor. The Intracoastal Waterway is likely to have unified the faunal compositions of these two bays to some extent, and reproductive seasonalities and other biological factors are likely to have masked some of the variability caused by inflow. However, when the confounding effects of seasonality were removed by comparing June data from a dry (2004) and wet (2005) year, there was a significant difference in invertebrate community structure between Lyons and Roberts Bays. The difference was caused by increased abundances of fish prey organisms (amphipods, copepods and mysids) and decreased abundances of gelatinous predators (ctenophores, hydromedusae and chaetognaths) during the wetter year. Important prey taxa such as mysids, gammaridean amphipods and bay anchovy juveniles were more abundant in Roberts Bay than Lyons Bay and also favored the landward end of the principal estuarine axis.

As inflow from the Blackburn Canal increased, there was a significant decrease in the similarity of the shoreline (seined) nekton community between Lyons and Roberts Bays; no trend in community similarity was apparent for the deeper (trawled) areas as inflow increased. There were obvious spatial differences in nekton community structure of the shoreline and deeper portions of the DARB estuary. In both habitats, the greatest differences in community structure were between the 5.0–6.4 km section of Shakett Creek/Cow Pen Slough and Lyons and Roberts Bays. These differences were attributable to higher abundances of typical low-salinity taxa in the 5.0–6.4 km segment (e.g., *Menidia* spp., *P. pugio*) versus higher abundances of estuary-dependent offshore-spawning species such as *L. rhomboides* and *E. gula* in the bays. In general, the differences in nekton community structure along the axis of Dona Bay-Shakett Creek-Cow Pen Slough were as expected given their relative positions along the estuarine gradient. Nekton community structure tended to differ between the low-inflow June of 2004 and the high-inflow June of 2005, with low-salinity species being more abundant during high inflows and vice versa.

In summary, the estuarine fauna demonstrated a distributional affinity for the two point sources of freshwater inflow (Cow Pen Slough and the Blackburn Canal). This was evident in community structure and in the distributions of individual species. When the effects of reproductive seasonality were controlled, increased freshwater inflows were associated with changes in the community structure of Roberts Bay relative to Lyons Bay, affecting shoreline fish community structure, increasing fish prey abundance and decreasing gelatinous predator abundance within Roberts Bay. However, fewer successful models of abundance response to inflow were developed relative to similar studies conducted elsewhere. This could be the result of (1) the short duration of the study period, (2) inflow levels that were atypically low, or (3) a high degree of temporal and spatial irregularity in inflow’s effects. If erratic inflows cause areas of increased prey productivity to be short-lived and geographically inconsistent, then the transfer of biomass to young fish and crustaceans will be inefficient. Erratic inflows also cause irregularity in the delivery of chemical habitat cues to coastal waters, thereby reducing the utility of these cues to migrating organisms seeking productive nursery habitat. Distributional responses to inflow into the DARB estuary were somewhat anomalous. Typical distribution responses were observed, wherein organisms moved upstream with decreasing inflow, yet the opposite was equally common - a large proportion of seine and trawl taxa moved upstream during elevated flows. None of the taxa in the plankton survey exhibited this response, which suggests that the mechanism involves active behavior rather than passive advection. Freshwater inflows appear to be serving as an attractant to estuarine fish and crustaceans in the DARB estuary, but perhaps without providing the usual trophic benefits. A less erratic inflow regime may therefore result in more efficient production of estuarine fish and crustaceans.

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1.0 INTRODUCTION

Rivers export nutrients, detritus, and other productivity promoting materials to the estuary and sea. Freshwater inflows also strongly influence the stratification and circulation of coastal waters, which in itself may have profound effects on coastal ecosystems (Mann and Lazier 1996). Estuary-related fisheries constitute a very large portion of the total weight of the U.S. fisheries yield (66% of finfish and shellfish harvest, Day et al. 1989; 82% of finfish harvest, Imperial et al. 1992). The contribution of estuary-related fisheries is consistently high among U.S. states that border the Gulf of Mexico, where the estimates typically exceed 80% of the total weight of the catch (Day et al. 1989). Examples from around the world indicate that these high fisheries productivities are not guaranteed, however. In many locations, large amounts of fresh water have been diverted from estuaries to generate hydroelectric power or to provide water for agricultural and municipal use. Mann and Lazier (1996) reviewed cases where freshwater diversions were followed by the collapse of downstream fisheries in San Francisco Bay, the Nile River delta, James Bay, Canada, and at several inland seas in the former U.S.S.R. Sinha et al. (1996) documented a reversal of this trend where an increase in fisheries landings followed an increase in freshwater delivery to the coast.

Fishery yields around the world are often positively correlated with freshwater discharge at the coast (Drinkwater 1986). These correlations are often strongest when they are lagged by the age of the harvested animal. In south Florida, Browder (1985) correlated 14 years of pink shrimp landings with lagged water levels in the Everglades. Associations between river discharge and fisheries harvests have also been identified for various locations in the northern and western Gulf of Mexico (Day et al. 1989, Grimes 2001). Surprisingly, discharge-harvest correlations sometimes extend to non-estuarine species. Sutcliffe (1972, 1973) reported lagged correlations between discharge of the St. Lawrence River and the harvest of non-estuarine species such as American lobster and haddock. In recognition of the potential complexities behind these correlations, Drinkwater (1986) advised that the effect of freshwater inflows be considered on a species-by-species basis.

Freshwater influence on coastal ecosystems extends beyond its immediate effects on fisheries. Because of the intricate nature of many food web interactions, changes in the abundance of even a single species may be propagated along numerous pathways, some anticipated and some not, eventually causing potentially large changes in the abundance of birds, marine mammals and other groups of special concern (Christensen 1998, Okey and Pauly 1999). Mann and Lazier (1996) concluded “one lesson is clear: a major change in the circulation pattern of an estuary brought about by damming the freshwater flows, a tidal dam, or other engineering projects may well have far reaching effects on the primary and secondary productivity of the system.”

This project was conducted to support the establishment of minimum flows for Cow Pen Slough by the Southwest Florida Water Management District (SWFWMD). Minimum flows are defined in Florida Statutes (373.042) as the “limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area.” In the process of establishing minimum flows for an estuarine system, the SWFWMD evaluates the effects of the freshwater inflows on ecological resources and processes in the receiving estuary. The findings of this project will be used by the SWFWMD to evaluate the fish nursery function of Cow Pen Slough’s receiving estuary in relation to freshwater inflows. It is not the purpose of this project to determine the level of effect that constitutes significant harm, as that determination will be made by the Governing Board of the SWFWMD.

1.1 Objectives

This project uses plankton-net, seine and trawl surveys to document the abundance and distribution of fishes and invertebrates that use Cow Pen Slough's receiving estuary as habitat. There were several objectives for this project. One was to produce a descriptive database that could serve as a baseline for comparison with future ecological change. These baseline data also provide seasonality records that identify the times of year when the risk of adverse impacts would be greatest for specific organisms.

Another principal objective was to develop regressions to model the responses of estuarine organisms to variations in freshwater inflows. The resulting models would then be available for evaluating proposed minimum flows or the potential impacts of proposed freshwater management plans. These models were developed for both estuarine fishes and the invertebrate prey groups that sustain young fishes while they occupy estuarine nursery habitats. A third objective was to evaluate changes in community structure that are associated with variations in freshwater inflow.

2.0 METHODS

2.1 Study Area

Cow Pen Slough is a 14-mile canal that was connected to a coastal bay system in the late 1960s for the purpose of flood control. The 97-mi^2 Cow Pen Slough watershed lies largely within Sarasota County, with a small portion extending into Manatee County to the north. Discharge from Cow Pen Slough is partially regulated by a control structure located near km 6.4 in the estuarine portion of Shakett Creek (Fig. 2.1.1). Although the gates of the structure are opened on June 1 and closed on November 1, a considerable amount of flow may overtop the closed structure during rainy periods. During low discharge periods, salinity increases immediately below this control structure. In its natural conformation, Shakett Creek was a tidal stream with a small, slowly draining watershed of approximately 5 mi^2 (Lincer 1975). Shakett Creek now links the faster-draining, expanded Cow Pen Slough watershed directly to Dona Bay and indirectly to Roberts Bay to the south. Roberts Bay also receives freshwater diversions from the Myakka River via the Blackburn Canal and Curry Creek. To the north, Lyons Bay remains largely unaffected by these engineered freshwater discharges. Lincer (1975) and Jones (2003) refer to this complex of bays and creeks as the “DARB” system (acronym for Dona And Roberts Bay), which is a term that we will also use in collective reference to Shakett Creek, Dona Bay, Roberts Bay, Lyons Bay and Venice Inlet.

The DARB estuary is a bar-built estuary with a tidal range of <0.9 m at Venice Inlet and primarily semidiurnal tides. Bottom substrates in the DARB area tend to be dominated by very coarse sand and shell near the Gulf of Mexico. The substrate becomes increasingly fine-grained and organic in poorly circulating areas and in the parts of bays that are most influenced by the two canals (Lincer 1975). Large areas of marsh and shallow bay bottom have been dredged and filled, and most natural shoreline has been replaced by seawall. Brackish marshes are limited to areas adjacent to Shakett and Curry Creeks. The dredged channel of the Intracoastal Waterway runs through western

Roberts Bay, through the junction between Dona Bay and Venice Inlet, and continues north along the western margin of Lyons Bay.

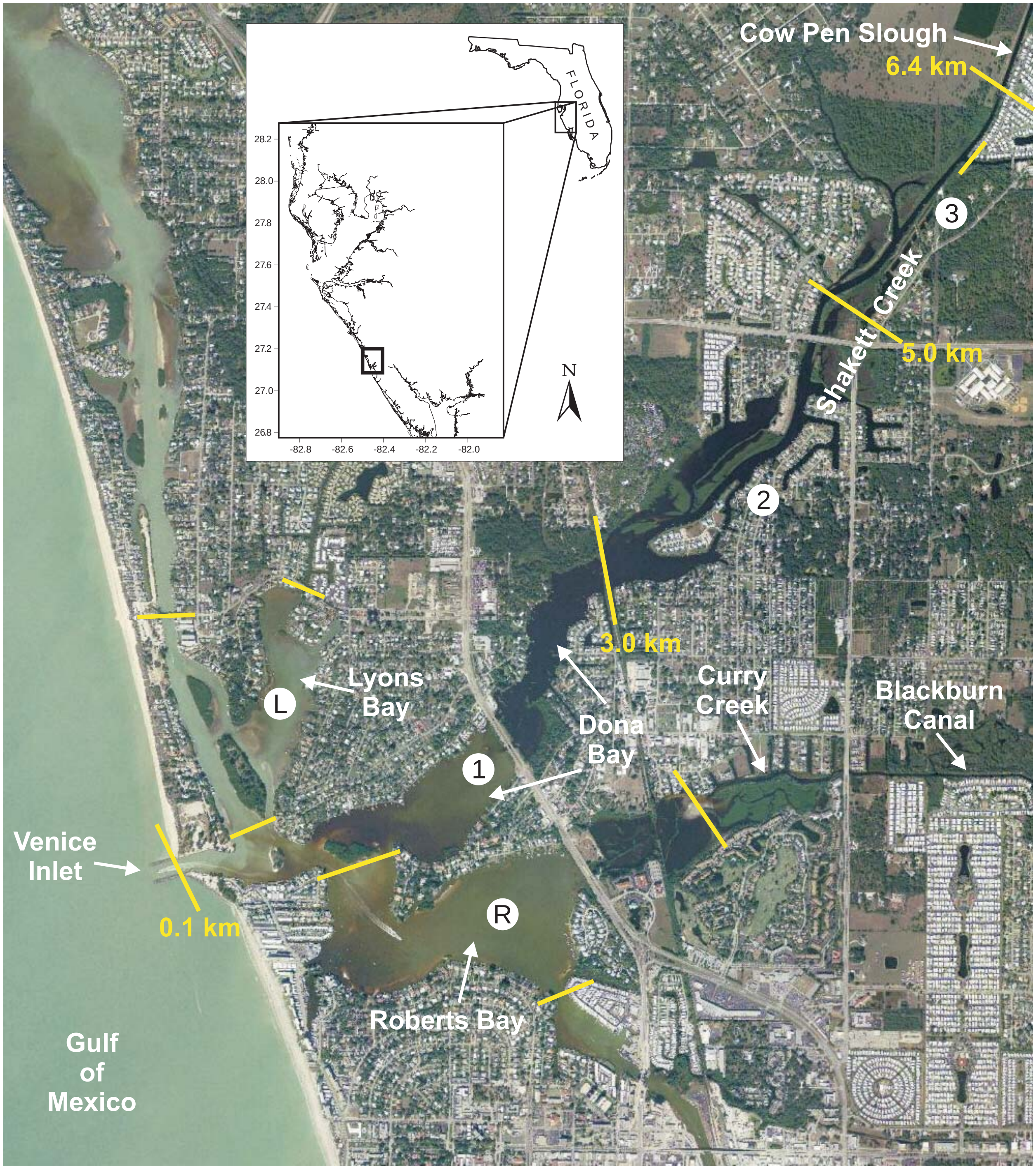


Fig. 2.1.1. Map of survey area.

2.2 Survey Design

Three gear types were used to monitor organism distributions: a plankton net deployed during nighttime flood tides and a bag seine and otter trawl deployed during the day under variable tide stages. The plankton net surveys were conducted by the University of South Florida College of Marine Science, and the seine and trawl surveys were conducted by the Fisheries-Independent Monitoring (FIM) program of the Fish and Wildlife Research Institute (Florida Fish and Wildlife Conservation Commission).

The small organisms collected at night by the plankton net represent a combination of the zooplankton and hyperbenthos communities. The term *zooplankton* includes all weakly swimming animals that suspend in the water column during one or more life stages. The distribution of such animals is largely subject to the motion of the waters in which they live. The term *hyperbenthos* applies to animals that are associated with the bottom but tend to suspend above it, rising higher into the water column at night or during certain times of year (vertical migrators). The permanent hyperbenthos of estuaries (non-transient hyperbenthos) tends to be dominated by peracarid crustaceans, especially mysids and amphipods (Mees et al. 1993). Many types of hyperbenthos are capable of actively positioning themselves at different places along the estuarine gradient by selectively occupying opposing tidal flows.

The faunal mixture that forms in the nighttime water column includes the planktonic eggs and larvae of fishes (ichthyoplankton). One of the most common reasons for using plankton nets to survey estuarine waters is to study ichthyoplankton. Although fish eggs and larvae are the intended focus of such studies, invertebrate plankton and hyperbenthos almost always dominate the samples numerically. The invertebrate catch largely consists of organisms that serve as important food for juvenile estuary-dependent and estuary-resident fishes. In an effort to characterize the invertebrate catch more completely, all water-column animals collected by the plankton net were enumerated at a practical taxonomic level. For convenience, the plankton net catch will be collectively referred to as “zooplankton” while maintaining a distinction between its fish (ichthyoplankton) and invertebrate (zooplankton and hyperbenthos) components.

Seines and trawls were used to survey larger organisms that typically evade plankton nets. Generally speaking, the data from seine hauls document habitat use by shallow-water organisms whereas the data from trawls document habitat use in deeper areas. The dominant catch for both gear types is juvenile fishes, although the adults of smaller species are also commonly caught. The seines and trawls also regularly collect a few of the larger macroinvertebrate species from coastal embayments, notably juvenile and adult blue crabs (*Callinectes sapidus*) and juvenile pink shrimp (*Farfantepenaeus duorarum*).

Monthly sampling in the DARB area began in March 2004 and ended in June 2005. The study area was divided into five collection zones (Fig. 2.1.1, Table 2.2.1). Two seine hauls and two trawl deployments were made each month in each zone. Two plankton-net tows were made each month in each zone except for Lyons Bay, which had one tow per month, and the 0.1-3.0 km zone, which had three tows per month. The locations for seine and trawl deployment were randomly selected within each zone during each survey, whereas the plankton-net collections were made at fixed stations. The longitudinal position of each station was measured as the distance from the entrance to Venice Inlet, using the Sarasota County centerline for Venice Inlet, Dona Bay and Shakett Creek.

Table 2.2.1. Distribution of sampling effort within the DARB area (March 2004–June 2005). Zone position is measured relative to the river mouth.

Location (river km)	Plankton	Seine	Trawl
Lyons Bay	16	32	16
Roberts Bay	32	32	16
0.1-3.0	48	32	16
3.0-5.0	32	32	16
5.0-6.4	32	32	16
Totals	160	160	80

2.3 Plankton Net Specifications and Deployment

The plankton gear consisted of a 0.5-m-mouth-diameter 500-µm-mesh conical (3:1) plankton net equipped with a 3-pt nylon bridle, a calibrated flow meter (General Oceanics model 2030R or SeaGear model MF315), a 1-liter plastic cod-end jar, and a 9-kg (20-lb.) weight. The net was deployed between low slack and high slack tide, with sampling beginning within two hours after sunset and typically ending less than four hours later. Tow duration was 5 min, with tow time being divided equally among bottom, mid-water and surface depths. The fishing depth of the weighted net was controlled by adjusting the length of the tow line while using tachometer readings to maintain a constant line angle. The tow line was attached to a winch located on the gunnel near the transom. Placement of the winch in this location caused asymmetry in the steering of the boat, which caused propeller turbulence to be directed away from the towed net. Tow speed was approximately 1.3 m s^{-1}, resulting in a tow length of >400 m over water and a and a typical filtration of 70-80 m^3. Upon retrieval of the net, the flowmeter reading was recorded and the contents of the net were rinsed into the cod-end jar using an electric wash-down pump and hose with an adjustable nozzle. The samples were preserved in 6-10% formalin in ambient saline.

The net was cleaned between surveys using an enzyme solution that dissolves organic deposits. Salinity, temperature, pH and dissolved oxygen were measured at one-meter intervals from surface to bottom after each plankton-net deployment.

2.4 Seine and Trawl Specifications and Deployment

The gear used in all seine collections was a 21.3-m center-bag seine with 3.2-mm mesh and leads spaced every 150 mm. To deploy the seine in riverine environments (i.e., shorelines with water depth ≤1.8 m in the study area), the boat dropped off a member of the seine crew near the shoreline with one end of the seine, and the boat then paid out the net in a semicircle until the boat reached a second drop-off point near the shoreline. The lead line was retrieved simultaneously from both ends, with effort made to keep the lead line in contact with the bottom. This process forced the catch into the bag portion of the seine. The area sampled by each boat-deployed seine collection was approximately 68 m^2.

The 6.1-m otter trawl had 38-mm stretched mesh, a 3.2-mm mesh liner, and a tickler chain. It was towed in deeper areas (≥ 1.8 m, < 7.6 m) for five minutes in a straight line; when a suitably deep site could not be found and depths were between 1.0 and 1.8 m, the trawl was towed in an arc. Tow speed averaged 0.6 m s^{-1}, resulting in a typical tow length of about 180 m. Trawl width averaged 4 m, giving an approximate area sampled by a typical tow of 720 m^2. Salinity, temperature, pH, and dissolved oxygen were measured at the surface and at 1-m intervals to the bottom in association with each gear deployment.

2.5 Plankton Sample Processing

All aquatic taxa collected by the plankton net were identified and counted, except for invertebrate eggs and organisms that were attached to debris (sessile stages of barnacles, bryozoans, sponges, tunicates and sessile coelenterates). During sorting, the data were entered directly into an electronic database via programmable keyboards that interfaced with a macro-driven spreadsheet. Photomicrographs of representative specimens were compiled into a reference atlas that was used for quality-control purposes.

Most organisms collected by the plankton net fell within the size range of 0.5-50 mm. This size range spans three orders of magnitude, and includes mesozooplankton (0.2-20 mm) macrozooplankton/micronekton (>20 mm) and analogous sizes of hyperbenthos. To prevent larger objects from visually obscuring smaller ones during sample processing, all samples were separated into two size fractions using stacked sieves with mesh openings of 4 mm and 250 µm. The >4 mm fraction primarily consisted of juvenile and adult fishes, large macroinvertebrates and large particulate organic matter. In most cases, the fishes and macroinvertebrates in the >4 mm fraction could be identified and enumerated without the aid of microscopes.

A microscope magnification of 7-12X was used to enumerate organisms in the >250 µm fraction, with zoom magnifications as high as 90X being available for identifying individual specimens. The >250 µm fraction was usually sorted in two stages. In the first sorting stage, the entire sample was processed as 10-15 ml aliquots that were scanned in succession using a gridded petri dish. Only relatively uncommon taxa (n<50) were enumerated during this first stage. After the entire sample had been processed in this manner, the collective volume of the aliquots was recorded within a graduated mixing cylinder, the sample was inverted repeatedly, and then a single 30-60 ml aliquot was poured. The aliquot volume typically represented about 12-50% of the entire sample volume. The second sorting stage consisted of enumerating the relatively abundant taxa within this single aliquot. The second sorting stage was not required for all samples. The second stage was, however, sometimes extended to less abundant taxa (n<50) that were exceptionally small or were otherwise difficult to enumerate.

2.5.1 Staging Conventions.

All fishes were classified according to developmental stage (Fig. 2.5.1.1), where

> **preflexion** larval stage = the period between hatching and notochord flexion; the tip of the straight notochord is the most distal osteological feature.
>
> **flexion** larval stage = the period during notochord flexion; the upturned notochord or urostyle is the most distal osteological feature.
>
> **postflexion** larval stage = the period between completion of flexion and the juvenile stage; the hypural bones are the most distal osteological feature.
>
> **metamorphic** stage (clupeid fishes) = the stage after postflexion stage during which body depth increases to adult proportions (ends at juvenile stage).
>
> **juvenile** stage = the period beginning with attainment of meristic characters and body shape comparable to adult fish and ending with sexual maturity.

Decapod larvae were classified as zoea, megalopa or mysis stage. These terms are used as terms of convenience and should not be interpreted as technical definitions. Planktonic larvae belonging to Anomura and Brachyura (crabs) were called zoea. Individuals from these groups displaying the planktonic to benthic transitional morphologies were classified as megalopae. All other decapod larvae (shrimps) were classified as mysis stages until the uropods differentiated into exopods and endopods (5 total elements in the telsonic fan), after which they were classified as postlarvae until they reached the juvenile stage. The juvenile stage was characterized by resemblance to small (immature) adults. Under this system, the juvenile shrimp stage (e.g., for *Palaemonetes*) is equivalent to the postlarval designation used by some authors.

In many fish species, the juvenile stage is difficult to distinguish from other stages. At its lower limit, the juvenile stage may lack a clear developmental juncture that distinguishes it from the postflexion or metamorphic stage. Likewise, at its upper limit, more than one length at maturity may be reported for a single species or the reported length at maturity may differ between males and females. To avoid inconsistency in the staging process, length-based staging conventions were applied to the more common taxa. These staging conventions agree with stage designations used by the U.S. Fish and Wildlife Service (e.g., Jones et al. 1978). The list in Table 2.5.1.1 is comprehensive, representing the conventions that have been required to date by various surveys. Some of the species or stages in the list were not encountered during the surveys covered by this report.

Table 2.5.1.1. Length-based staging conventions used to define developmental stage limits. Fish lengths are standard length (SL) and shrimp length is total length.

Postflexion-juvenile transition (mm):	
Lucania parva	10
Menidia spp.	10
Eucinostomus spp.	10
Lagodon rhomboides	10
Bairdiella chrysoura	10
Cynoscion arenarius	10
Cynoscion nebulosus	10
Sciaenops ocellatus	10
Menticirrhus spp.	10
Leiostomus xanthurus	15
Orthopristis chrysoptera	15
Achirus lineatus	5
Trinectes maculatus	5
Gobiesox strumosus	5
Eugerres plumieri	10
Prionotus spp.	10
Symphurus plagiusa	10
Anchoa mitchilli	15
Sphoeroides spp.	10
Chilomycterus schoepfii	10
Lepomis spp.	10
Micropterus salmoides	10
Membras martinica	10
Chloroscombrus chrysurus	10
Hemicaranx amblyrhynchus	10
Micropogonias undulatus	15
Chaetodipterus faber	5

Juvenile-adult transition (mm):	
Anchoa mitchilli	30
Lucania parva	15
Gambusia holbrooki	15
Heterandria formosa	10
Menidia spp.	35
Eucinostomus spp.	50
Gobiosoma bosc	20
Gobiosoma robustum	20
Microgobius gulosus	20
Microgobius thalassinus	20
Gobiesox strumosus	35
Trinectes maculatus	35
Palaemonetes pugio	20
Membras martinica	50
Syngnathus spp.	80
Poecilia latipinna	30
Anchoa hepsetus	75

Metamorph-juvenile transition (mm):	
Brevoortia spp.	30
Dorosoma petenense	30

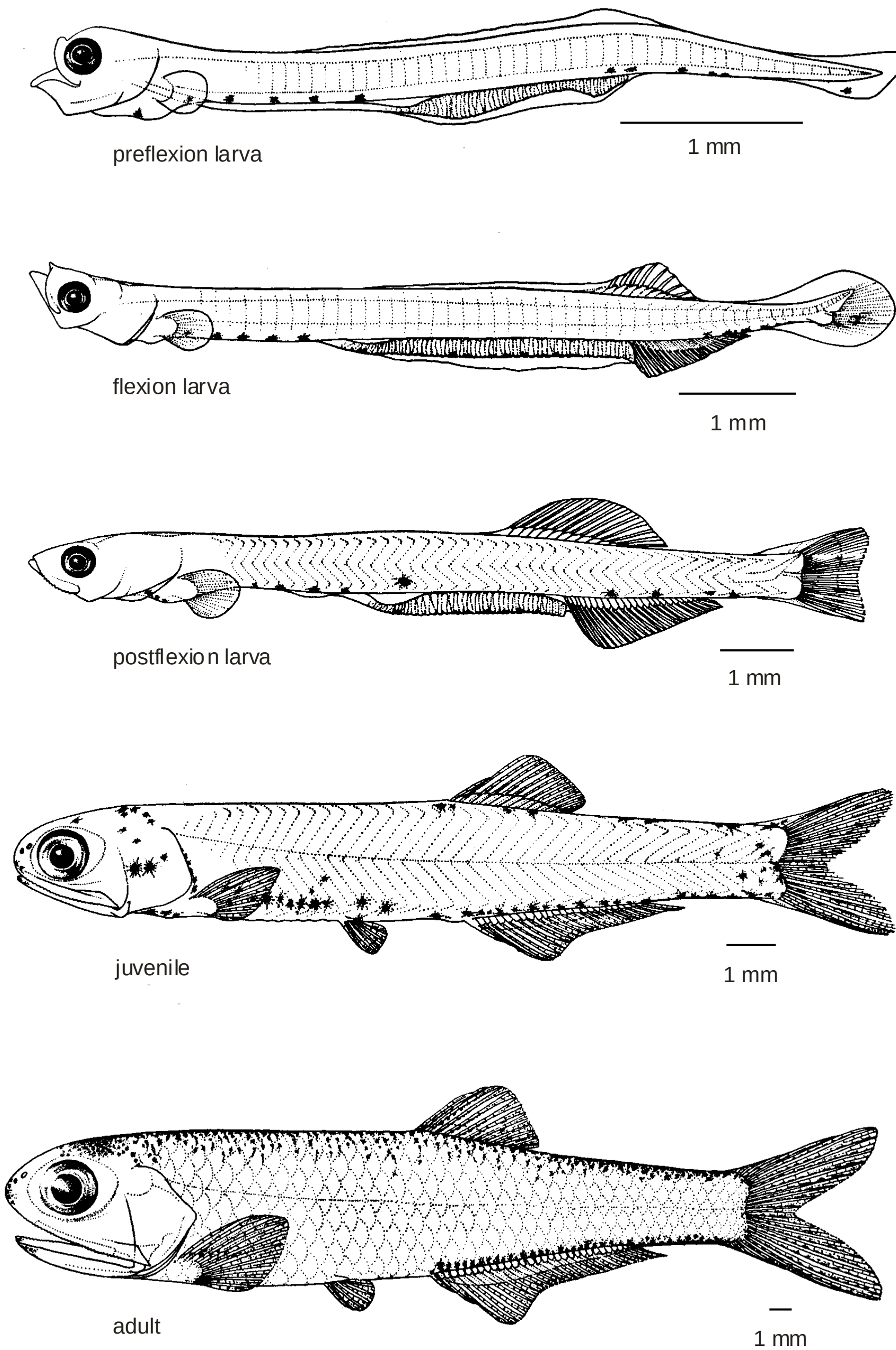


Fig. 2.5.1.1. Fish-stage designations, using the bay anchovy as an example. Specimens measured 4.6, 7.0, 10.5, 16, and 33 mm standard length.

2.6 Seine and Trawl Sample Processing

Fish and selected crustaceans collected in seine and trawl samples were removed from the net into a bucket and processed onboard. Animals were identified to the lowest practical taxonomic category, generally species. Representative samples (three individuals of each species from each gear on each sampling trip) were brought back to the FWC/FWRI laboratory to confirm field identification. Species for which field identification was uncertain were also brought back to the laboratory. A maximum of 10 measurements (mm) were made per taxon, unless distinct cohorts were identifiable, in which case a maximum of 10 measurements were taken from each cohort; for certain economically valuable fish species, twenty individuals were measured. Standard length (SL) was used for fish (total length [TL] for seahorses and disk width [DW] for rays), post-orbital head length (POHL) for pink shrimp, and carapace width (CW) for crabs. Animals that were not measured were identified and counted. When large numbers of individuals (>> 1,000) were captured, the total number was estimated by fractional expansion of sub-sampled portions of the total catch split with a modified Motoda box splitter (Winner and McMichael, 1997). Animals not chosen for further laboratory examination were returned to the river.

Due to frequent hybridization and/or extreme difficulty in the identification of smaller individuals, members of several abundant species complexes were not identified to species. We did not separate menhaden, *Brevoortia*, species. *Brevoortia patronus* and *B. smithi* frequently hybridize, and juveniles of the hybrids and the parent species are difficult to identify (Dahlberg, 1970). *Brevoortia smithi* and hybrids may be the most abundant forms on the Gulf coast of the Florida peninsula, especially in coastal embayments (Dahlberg, 1970), and we treated them as one functional group. The two abundant silverside species (genus *Menidia*) tend to hybridize, form all-female clones, and occur in great abundance that renders identification to species impractical due to the nature of the diagnostic characters (Duggins et al., 1986; Echelle and Echelle, 1997; Chernoff, personal communication). Species-level identification of mojarras (genus *Eucinostomus*) was limited to individuals ≥ 40 mm SL due to great difficulty in separating *E. gula* and *E. harengulus* below this size (Matheson, personal observation). The term "eucinostomus mojarras" is used for these small specimens. Species-level identification of gobies of the genus *Gobiosoma* (i.e., *G. robustum* and *G. bosc*) used in analyses was limited to individuals ≥ 20 mm SL for the same reason; smaller individuals are hereafter referred to as "gobiosoma gobies". Similarly, needlefishes (*Strongylura* spp.) other than *S. notata* were only identified to species at lengths ≥ 100 mm SL.

2.7 Data Analysis

2.7.1 Freshwater Inflow (*F*).

Sarasota County operates two gauging stations on Cow Pen Slough. Data from the downstream-most gauge were used. All flow rates are expressed as average daily flows in cubic feet per second (cfs).

2.7.2 Organism-Weighted Salinity (S_U).

The central salinity tendency for catch-per-unit-effort (CPUE) was calculated as

$$S_U = \frac{\sum (S \cdot U)}{\sum U}$$

where U is CPUE (No. m^{-3} for plankton data and No. 100 m^{-2} for seine and trawl data) and S is water-column average salinity during deployment.

2.7.3 Center of CPUE (km_U).

The central geographic tendency for CPUE was calculated as

$$km_U = \frac{\sum (km \cdot U)}{\sum U}$$

where *km* is distance from the river mouth.

2.7.4 Organism Number (N) and Relative Abundance ($\overline{N}$).

Using plankton-net data, the total number of organisms in the DARB survey area was estimated by summing the products of mean organism density ($\overline{U}$, as No. m^{-3}) and tide-corrected water volume (V) from the five collection zones as

$$N = \sum (\overline{U} \cdot V)$$

Volumes corresponding to NGVD were contoured (Surfer 7, Golden Software, Kriging method, linear semivariogram model) using bathymetric transects provided by SWFWMD (relative to UTM Zone 17 meters), and these volumes were then adjusted to the actual water level at the time of collection using data from the water-level recorder in Dona Bay.

For seine and trawl data, relative abundance (mean number per 100 m^2 sampled area) was calculated for each month as

$$\overline{N} = 100 \times \frac{N_{total}}{A_{total}}$$

where N_{total} = total number of animals captured in that month and A_{total} is the total area sampled in that month. $\overline{N}$ is also occasionally referred to as CPUE in some instances.

2.7.5 Inflow Response Regressions.

Regressions were run for km_U on F, N on F, and $\overline{N}$ on F. N, $\overline{N}$, km_U (seine/trawl data only) and F were Ln-transformed prior to regression to improve normality. To avoid censoring zero values in seine and trawl regressions, a constant of 1 was added to $\overline{N}$ and F.

Regressions using plankton-net data were limited to taxa that were encountered during a minimum of 10 of the monthly surveys. The fits of the following regression models were compared to determine if an alternative model produced consistently better fit than the linear model ($Y = a + b*F$):

Square root-Y: $Y = (a + b*F)^2$
Exponential: $Y = \exp(a + b*F)$
Reciprocal-Y: $Y = 1/(a + b*F)$
Square root-*F*: $Y = a + b*\mathrm{sqrt}(F)$
Reciprocal-*F*: $Y = a + b/F$
Double reciprocal: $Y = 1/(a + b/F)$
Logarithmic-*F*: $Y = a + b*\mathrm{Ln}(F)$
Multiplicative: $Y = a*F^b$
S-curve: $Y = \exp(a + b/F)$

where Y is km_U or *N*. In these regressions, *F* was represented by same-day inflow and by mean inflows extending as far back as 120 days prior to the sampling date. The combination of consecutive dates that produced the maximum regression fit was used to model the *N* and km_U responses to *F* for each taxon. This approach provided an indication of the temporal responsiveness of the various taxa to inflow variations. An organism was considered to be responsive if the regression slope was significantly different from zero at $p<0.05$.

Seine and trawl regressions were limited to taxa that were reasonably abundant (total abundance>100 in seines, >50 in trawls) and frequently collected (present in at least 3% of collections for each gear). Monthly length-frequency plots (Appendix C) were examined in order to assign appropriate size classes ('pseudo-species') and seasonal recruitment windows for each of these taxa. For distribution regressions (km_U), all months were considered when a pseudo-species was collected in at least one sample from that month. For abundance regressions ($\bar{N}$), all samples collected within a determined recruitment period from monthly length-frequency plots (Appendix C) were considered. Mean flows from the date of sampling, as well as continuously lagged weekly averages from the day of sampling to 365 d before sampling (i.e., average flow of sampling day and preceding 6 days, average flow of sampling day and preceding 13 days, etc.), were considered and linear and quadratic regressions were evaluated.

2.7.6 Community-level Analyses

To investigate the effects of varying freshwater inflow on the plankton and nekton communities, various multivariate analyses were undertaken using PRIMER v6 software (PRIMER-E Ltd. [UK]; Clarke & Gorley 2006). Taxa were divided into the same pseudo-species used for regression analyses. Inflow data were the same as used for regression analyses.

Given the increase in salinity variability with increasing inflow (see Fig. 3.9.2.1), it was hypothesized that variability in nekton community structure would also increase with increasing inflow. This hypothesis was examined using the Index of Multivariate Dispersion (MVDISP routine in PRIMER; Warwick & Clarke 1993; Travers & Potter 2002), an index that increases with increasing community variability. Data were square-root transformed (plankton net catch) or fourth-root-transformed (seine and trawl catch) to reduce the influence of patchy, abundant species. Abundances were averaged by zone (Lyons, Roberts, 0.1–3.0 km, 3.0–5.0 km, and 5.0–6.4 km) and month. Bray-Curtis similarities (Bray & Curtis 1957) were calculated between each pair of averaged samples, followed by calculation of monthly Indices of Multivariate Dispersion (IMDs). For seine and trawl data, the Spearman Rank Correlation Coefficient (r_S) was calculated between the ranks of IMDs and river inflows over the 16-month study period. Statistical significance of the correlation was determined by comparing the actual r_S with values generated from 10,000 random permutations of the ranked data.

Particular attention was placed on comparing differences in the community structure of Lyons and Roberts Bays. The former had relatively constant, near-marine salinities over the course of the study period, while salinity in the latter responded variably to freshwater inflow, principally from the Blackburn Canal. Monthly Bray-Curtis similarities between the two bays were calculated and these were regressed against freshwater inflow. It was hypothesized that community similarity would decrease as freshwater inflow increased. For this analysis, inflow data were taken from USGS gauge 02299692 (Blackburn Canal near Venice).

Differences in community structure among all five spatial zones within the DARB estuary were also examined. Bray-Curtis similarities were calculated as described above, and the relationships between the samples were examined in Nonmetric Multidimensional Scaling (MDS) ordination plots (Clarke 1993). Analysis of Similarities (ANOSIM; Clarke 1993) was used to test for significant differences in community structure between pairs of spatial zones. The taxa contributing to substantial differences in community structure (i.e., ANOSIM *R* values > 0.5 from pairwise comparisons) were identified using Similarity Percentages Analysis (SIMPER; Clarke 1993).

Differences in nekton community structure between two months of contrasting freshwater inflow level (June 2004 and June 2005), were investigated in a similar manner to the spatial analysis described above. MDS allowed visualization of patterns of zone-averaged community structure in the two months and SIMPER was used to identify the taxa responsible for the major differences between years.

2.7.7 Data Limitations and Gear Biases.

All nets used to sample aquatic organisms are size selective. Small organisms pass through the meshes and large organisms evade the gear altogether. Intermediate-sized organisms are either fully retained or partially retained. When retention is partial, abundance becomes relative. However, temporal or spatial comparisons can still be made because, for a given deployment method and size of organism, the selection process can usually be assumed to have constant characteristics over space and time. The 500-µm plankton gear retains a wide range of organism sizes completely, yet it should be kept in mind that many estimates of organism density and total number are relative rather than absolute. Organism measurements from Little Manatee River and Tampa Bay plankton samples (Peebles 1996) indicate that the following taxa will be collected selectively by 500-µm mesh: marine-derived cyclopoid copepods, some cladocerans, some ostracods, harpacticoid copepods, cirriped nauplii and cypris larvae, the larvacean *Oikopleura dioica*, some decapod zoeae, and some adult calanoid copepods. Taxa that are more completely retained include cumaceans, chaetognaths, insect larvae, fish eggs, most fish larvae and postlarvae, some juvenile fishes, gammaridean amphipods, decapod mysis larvae, most decapod megalopae, mysids, isopods, and the juveniles and adults of most shrimps. This partitioning represents a very general guide to the relative selectivities of commonly caught organisms.

The plankton nets were deployed during nighttime flood tides because larval fishes and invertebrates are generally more abundant in the water column at night (Colton et al. 1961, Temple and Fisher 1965, Williams and Bynum 1972, Wilkins and Lewis 1971, Fore and Baxter 1972, Hobson and Chess 1976, Alldredge and King 1985, Peebles 1987, Haney 1988, Lyczkowski-Shultz and Steen 1991, Olmi 1994) and during specific tide stages (Wilkins and Lewis 1971, King 1971, Peebles 1987, Olmi 1994, Morgan 1995a, 1995b). Organisms that selectively occupy the water column during flood tides tend to move upstream, and organisms that occupy the water column during all tidal stages tend to have little net horizontal movement other than that caused by net estuarine outflow (Cronin 1982, McCleave and Kleckner 1982, Olmi 1994). The plankton catch was therefore biased toward organisms that were either invading the coastal embayments or were attempting to maintain position within the coastal embayments. This bias would tend to exclude the youngest larvae of some estuarine crabs, which are released at high tide to facilitate export downstream with the ebb tide (Morgan 1995a). However, as the young crabs undergo their return migrations at later larval stages, they become most available for collection during nighttime flood tides (Olmi 1994, Morgan 1995b).

Seines and trawls tend to primarily collect small fish, either adults of small-bodied species or juveniles of larger taxa. Trawls tend to capture larger fish than seines (Nelson and Leffler, 2001), and whether this is due to gear characteristics or preferred use of channel habitat by larger fish is uncertain. Sampling efficiency inevitably varies by species and size class (Rozas and Minello, 1997), but we assume reasonable consistency between samples collected with a given gear type. We acknowledge that movement of various taxa (e.g. killifishes, Fundulidae and Cyprinodontidae) into emergent vegetation at high water levels occurs (Rozas and Minello, 1997) and could complicate interpretation of some results.

3.0 RESULTS AND DISCUSSION

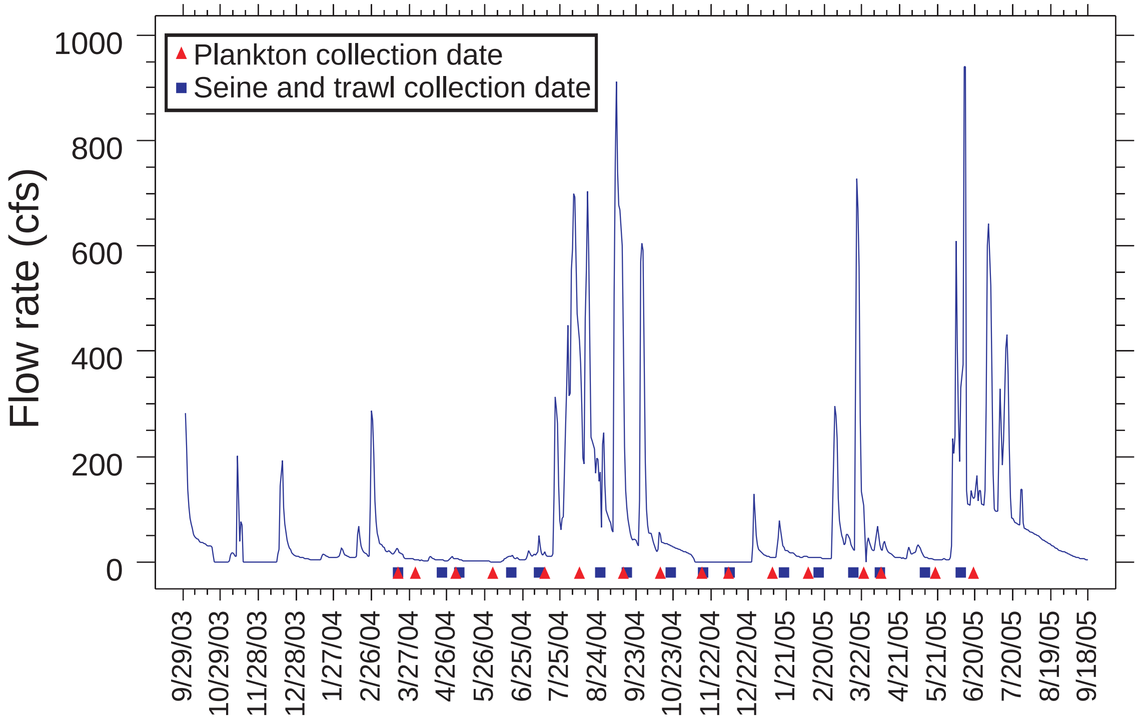
3.1 Streamflow Status During Survey Years

During the 16-month survey period (March 2004 through June 2005), Cow Pen Slough flows had an average of 85 cfs and a median of 15 cfs, with zero flows occurring on 47 days or 10% of the time (Fig. 3.1.1). Biological collections started during a period with relatively low Cow Pen Slough discharges (spring and early summer 2004) and continued through the summer rainy season. Late winter and spring of 2005 were comparably wet with no prolonged dry periods. Collections stopped soon after the onset of the 2005 summer rainy season. Inflows from the Blackburn Canal into Roberts Bay were of comparable magnitude to those from Cow Pen Slough, but were generally lower, with an average of 54 cfs and a median of 12 cfs (streamflow records from December 14, 2004 to January 19, 2005 were missing). Ln-transformed inflows from the two sources were strongly correlated ($r=0.80$, $p<0.0001$) and had a linear regression slope of 0.91. The Blackburn Canal often contributed inflows to the DARB estuary on days when Cow Pen Slough inflows were zero.

3.2 Physico-chemical Conditions

Summary statistics from the electronic meter data collected during plankton sampling are presented in Table 3.2.1. Temperatures underwent seasonal variation within a typical range (Fig. 3.2.1). The two summer rainy seasons and the high inflows that occurred during spring 2005 (Fig. 3.1.1) created complete salinity spectra within the DARB area. A moderately broad range of salinities was also observed during the low Cow Pen Slough discharge period of April and May 2004, which suggests that the Blackburn Canal or non-point sources of fresh water were reducing salinities at these times. The DARB area appears to recover quickly from the salinity effects of freshwater inflow; salinities during November were consistently elevated throughout the area, despite the recent cumulative effects of the summer rainy season.

Dissolved oxygen (DO) and pH tended to track each other over time. This tendency has been observed in a number of riverine estuaries in the region. It is notable that the lowest DO levels were observed at a time when discharge from Cow Pen Slough was also low, and that these low DO values (<3 mg/l) did not occur during summer. However, low pH was associated with the 2004 rainy season, presumably due to elevated ecosystem metabolism (high CO_2 production) during months that experienced high nutrient and organic loads coupled with high temperatures. Hypoxia often accompanies this pattern in other estuaries, but local circulation appears to have mitigated this association in the DARB area. In general, hypoxia was not a chronic problem in the DARB area during the surveys. DO (and pH) levels were lowest in Shakett Creek immediately below the Cow Pen Slough control structure, but were not generally hypoxic even at this location. Supersaturation of DO in Lyons Bay during May 2005 is indicative of a primary producer bloom that occurred there. Large quantities of chain-forming diatoms (*Skeletonema*) were collected by the plankton nets during this bloom. The bloom was not accompanied by elevated pH values, which indicates that circulation and atmospheric diffusion in the Lyons Bay area sufficiently kept the bloom supplied with CO_2. In small estuarine embayments that have poor exchange with adjoining water bodies, CO_2 supplies can become exhausted during primary producer blooms, driving pH higher than the typical ranges observed in coastal waters (Riley and Chester 1971).



Plankton collection dates:	Seine and trawl collection dates:
3-18-2004	3-18-2004
4-1-2004	4-22-2004
5-3-2004	5-6-2004
6-2-2004	6-16-2004
7-13-2004	7-8-2004
8-9-2004	8-26-2004
9-13-2004	9-16-2004
10-13-2004	10-21-2004
11-15-2004	11-16-2004
12-6-2005	12-7-2005
1-10-2005	1-19-2005
2-7-2005	2-16-2005
3-23-2005	3-15-2005
4-6-2005	4-5-2005
5-19-2005	5-11-2005
6-19-2005	6-9-2005

Fig. 3.1.1. Cow Pen Slough gauged streamflow and collection dates.

Table 3.2.1. Electronic meter summary statistics associated with plankton net deployment. Mean depth is mean depth at deployment. Sample sizes (n) reflect the combination of survey frequency (16 monthly surveys) and depth of measurement. Measurements were made at surface, bottom and at one-meter intervals between surface and bottom.

Location (km from mouth)	Mean Depth (m)	Salinity (psu)					Water Temperature (°C)					Dissolved Oxygen (mg/l)					pH				
		n	mean	std. dev.	min.	max.	n	mean	std. dev.	min.	max.	n	mean	std. dev.	min.	max.	n	mean	std. dev.	min.	max.
Lyons	1.4	42	32.1	2.7	22.0	35.4	42	25.6	4.5	17.8	32.7	42	7.7	1.4	4.4	11.5	42	7.9	0.3	7.0	8.3
Roberts 1	2.9	68	31.3	5.5	6.0	35.6	68	24.9	4.6	16.7	32.1	68	6.7	0.9	4.1	8.3	68	8.0	0.3	7.1	8.3
Roberts 2	1.4	45	27.5	7.4	4.8	34.0	45	25.5	4.5	17.3	32.6	45	6.0	1.6	2.4	9.2	45	7.9	0.2	7.4	8.3
0.3	3.4	77	32.0	4.3	2.9	36.1	77	25.2	4.6	16.8	32.1	77	6.8	0.7	5.1	8.6	77	8.0	0.2	7.5	8.3
1.2	1.4	43	25.5	10.2	0.6	33.8	43	25.9	4.5	17.6	33.1	43	6.1	1.6	1.9	8.7	43	7.9	0.3	7.1	8.3
2.4	1.5	45	20.0	12.0	0.2	32.4	45	26.2	4.0	18.5	33.0	45	6.3	0.9	4.8	8.7	45	7.8	0.3	7.1	8.3
3.5	1.5	46	16.4	11.9	0.2	30.5	46	25.7	4.0	17.8	33.1	46	6.3	1.2	3.7	8.7	46	7.7	0.3	6.8	8.2
4.4	1.6	47	15.7	11.2	0.1	30.9	47	25.9	4.0	18.8	33.5	47	6.5	1.2	3.5	8.7	47	7.6	0.4	6.7	8.2
5.1	1.7	48	13.8	11.2	0.1	30.0	48	26.2	3.8	18.2	33.6	48	5.9	1.5	1.6	8.3	48	7.5	0.4	6.6	8.1
6.0	2.4	59	13.9	11.1	0.1	30.4	59	25.9	3.8	18.1	33.8	59	5.8	1.5	1.4	8.9	59	7.4	0.4	6.5	7.9

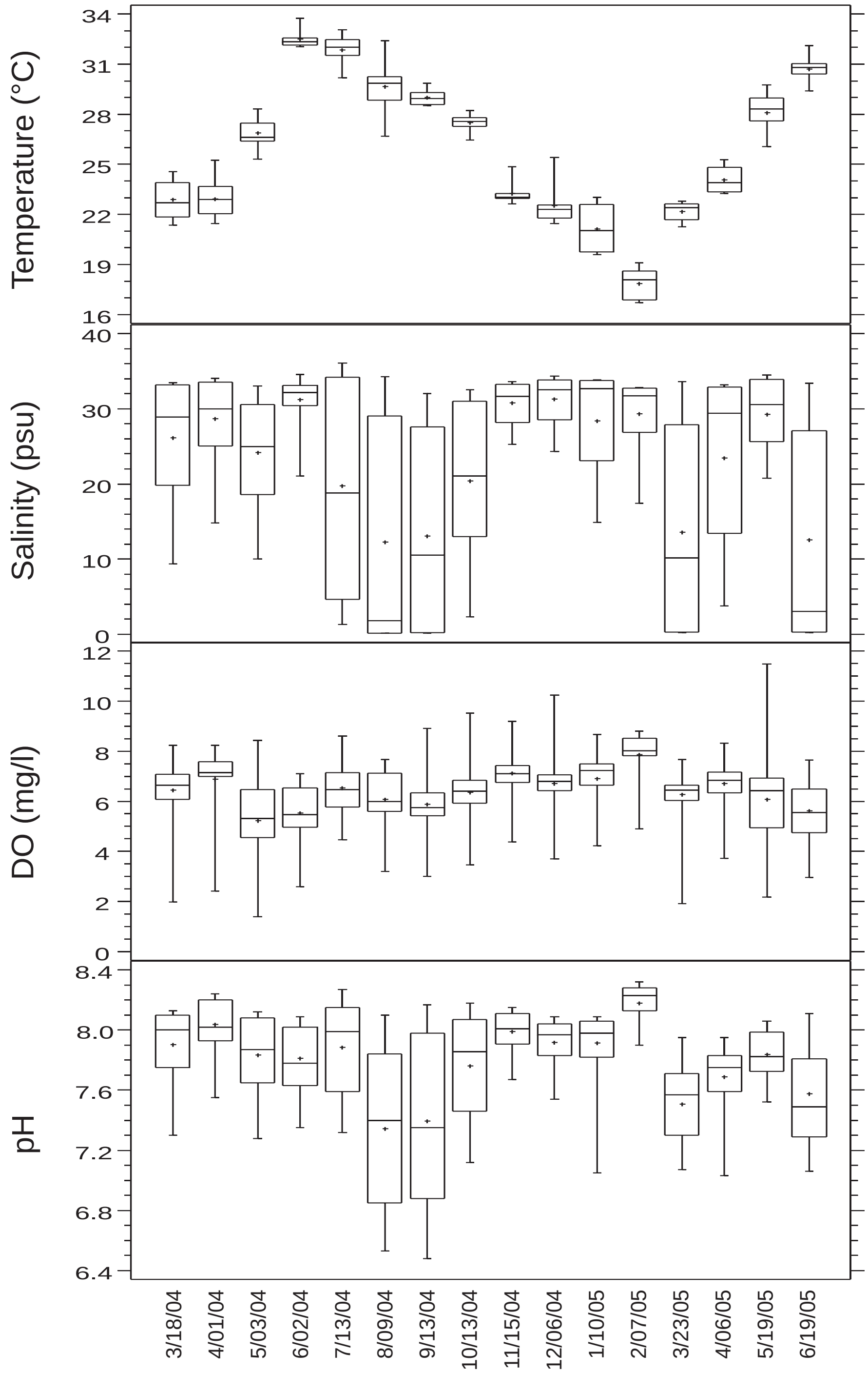


Fig. 3.2.1. Electronic meter data associated with plankton net deployment, where the cross identifies the mean, the horizontal line identifies the median, the box delimits the interquartile range, and the whiskers delimit the total range.

3.3 Catch Composition

3.3.1 Fishes.

3.3.1.1 **Plankton net.** Larval gobies and anchovies dominated the ichthyoplankton catch (Table A1). Gobies of the genus *Gobiosoma* were dominant over those of the genus *Microgobius*, and the anchovies were dominated by bay anchovy (*Anchoa mitchilli*). Other common fishes included scaled sardine (*Harengula jaguana*), eucinostomus mojarras (*Eucinostomus* spp.), freshwater shads (*Dorosoma* spp.) and sand seatrout (*Cynoscion arenarius*). If fish eggs are excluded, then gobies, anchovies and the latter taxa comprised over 95% of the plankton-net fish catch.

3.3.1.2 **Seine.** The seine catch (Table B1) was dominated by bay anchovy (*Anchoa mitchilli*), eucinostomus mojarras (*Eucinostomus* spp.), scaled sardine (*Harengula jaguana*), spanish sardine (*Sardinella aurita*), silversides (*Menidia* spp.), Cuban anchovy (*A. cubana*), pinfish (*Lagodon rhomboides*), silver jenny (*E. gula*), and tidewater mojarra (*E. harengulus*). These taxa comprised over 94% of total seine fish catch.

3.3.1.3 **Trawl.** The trawl catch (Table B2) was dominated by eucinostomus mojarras, pinfish, silver jenny, and Cuban anchovy. These taxa comprised nearly 80% of total trawl catch of fishes.

3.3.2. Invertebrates.

3.3.2.1. **Plankton net.** The plankton-net invertebrate catch (Table A1) was dominated by larval crabs (decapod zoeae), the mysid *Americamysis almyra*, gammaridean amphipods, the planktonic copepods *Acartia tonsa* and *Labidocera aestiva*, the planktonic shrimp *Lucifer faxoni*, chaetognaths and the larvacean *Oikopleura dioica*. Together, these taxa comprised 80% of the catch.

3.3.2.2 **Seine.** The seine catch (Table B1) was dominated by daggerblade grass shrimp (*Palaemonetes pugio*), pink shrimp (*Farfantepenaeus duorarum*), and blue crab (*Callinectes sapidus*), which together comprised over 94% of the invertebrate catch.

3.3.2.3 **Trawl.** The trawl catch (Table B2) was dominated by pink shrimp, longtail grass shrimp (*Periclimenes longicaudatus*), and blue crab. These taxa comprised over 85% of total trawl catch of invertebrates.

3.4 Use of Area as Spawning Habitat

The eggs of unidentified herrings (clupeids), scaled sardine (*Harengula jaguana*), Atlantic thread herring (*Opisthonema oglinum*), bay anchovy (*Anchoa mitchilli*), striped anchovy (*A. hepsetus*) and unidentified sciaenid fishes were collected from the DARB survey area (Table A1). All of these eggs were relatively abundant in Roberts Bay and Venice Inlet (Table A3). If the abundance of early larvae is proportionate to the abundance of eggs, then silver perch (*Bairdiella chrysoura*), seatrouts (*Cynoscion arenarius* and *C. nebulosus*) and kingfishes (*Menticirrhus* spp.) are the sciaenids that are most likely to have spawned in this area; the earliest larval stages of these species were most abundant in Roberts Bay and near Venice Inlet, in agreement with the sciaenid egg distribution (Tables A3 and 3.4.1). The data in Tables A3 and 3.4.1 also indicate that blennies and hogchoker (*Trinectes maculatus*) spawned near Venice Inlet and possibly other seaward parts of the DARB survey area. Table A3 suggests that skilletfish (*Gobiesox strumosus*) and gobies (*Bathygobius soporator*, *Gobiosoma* spp. and *Microgobius* spp.) spawned toward the landward side of the DARB survey area within upper Dona Bay and Shackett Creek. The repeated collection of small juveniles of live-bearing gulf pipefish (*Syngnathus scovelli*), chain pipefish (*S. louisianae*) and lined seahorse (*Hippocampus erectus*) is an indication that these species reproduced near or within the area. A review of trends in spawning habitat among coastal fishes is presented by Peebles and Flannery (1992).

Table 3.4.1. Relative abundance of larval stages for non-freshwater fishes with a collection frequency >10 for the larval-stage aggregate, where *Pre* = preflexion (youngest larval stage), *Flex* = flexion stage (intermediate larval stage) and *Post* = postflexion (oldest larval stage). **X** identifies the most abundant stage and x indicates that the stage was present.

Taxon	**Common Name**	**Pre**	**Flex**	**Post**
clupeids	herrings	**X**	x	x
Anchoa spp.	anchovies	**X**	x	x
Gobiesox strumosus	skilletfish	**X**	x	x
Menidia spp.	silversides	**X**	x	x
Bairdiella chrysoura	silver perch	**X**	x	x
Cynoscion arenarius	sand seatrout	**X**	x	x
Cynoscion nebulosus	spotted seatrout	**X**	x	x
Menticirrhus spp.	kingfishes	**X**	x	x
blenniids	blennies	**X**	x	x
Trinectes maculatus	hogchoker	**X**	x	x
gerreids	mojarras	x	x	**X**
Gobiids	gobies	x	x	**X**
Achirus lineatus	lined sole	x	x	**X**

3.5 Use of Area as Nursery Habitat

Estuary-dependent nearshore or offshore-spawning taxa using the study area as a nursery comprised the majority of the most common nekton taxa; overall, six of the ten most abundant taxa in deeper (trawled) habitats and seven of the ten most abundant taxa in nearshore (seined) habitats could be considered estuary-dependent (Tables B1–B2). The remaining abundant taxa were estuarine spawners or tidal river residents. The dependents included taxa of commercial importance (i.e., blue crab and pink shrimp) and taxa of ecological importance due to high abundance (i.e., pinfish, eucinostomus mojarras, tidewater mojarra, and silver jenny).

3.6 Seasonality

3.6.1. Plankton Net.

The number of taxa collected during an individual survey is not a true measure of species richness because many taxa could not be identified to species level. Nevertheless, this index produces a clear seasonal pattern. Specifically, more taxa tend to be collected during the warmer months than during winter (Fig. 3.6.1.1).

Species diversity tends to be highest near the seaward ends of coastal embayments due to an increased presence of marine-derived species and at the landward ends due to the presence of freshwater species. This creates a low-diversity zone in the middle reaches (Merriner et al. 1976). Changes in streamflow can shift this pattern downstream or upstream. However, in the case of the DARB estuary, many monthly collections extended across a very large part of the salinity spectrum (Fig. 3.2.1), resulting in the collection of >120 taxa per month (excluding stage-based taxa).

For a given species of fish, the length of the spawning season tends to become shorter at the more northerly locations within a species' geographic range, but the time of year when spawning takes place is otherwise consistent for a given species. Among species with long or year-round spawning seasons, local conditions have been observed to have a strong influence on egg production within the spawning season (Peebles 2002a). Local influences include seasonally anomalous water temperature, seasonal variation in the abundance of prey, and seasonal variation in retention or transport of eggs and larvae after spawning. The latter processes (prey availability and retention and transport) are influenced by freshwater inflows at the coast.

Alteration of flows would appear to have the lowest potential for impacting many taxa during the period from November through February, which is the period when the fewest taxa were present. The highest potential to impact many species would appear to be from June through October. Some species were present throughout the year (bay anchovy, Fig. 3.6.1.2), whereas others had more seasonal spawning and recruitment patterns (spotted seatrout and red drum, Fig. 3.6.1.2).

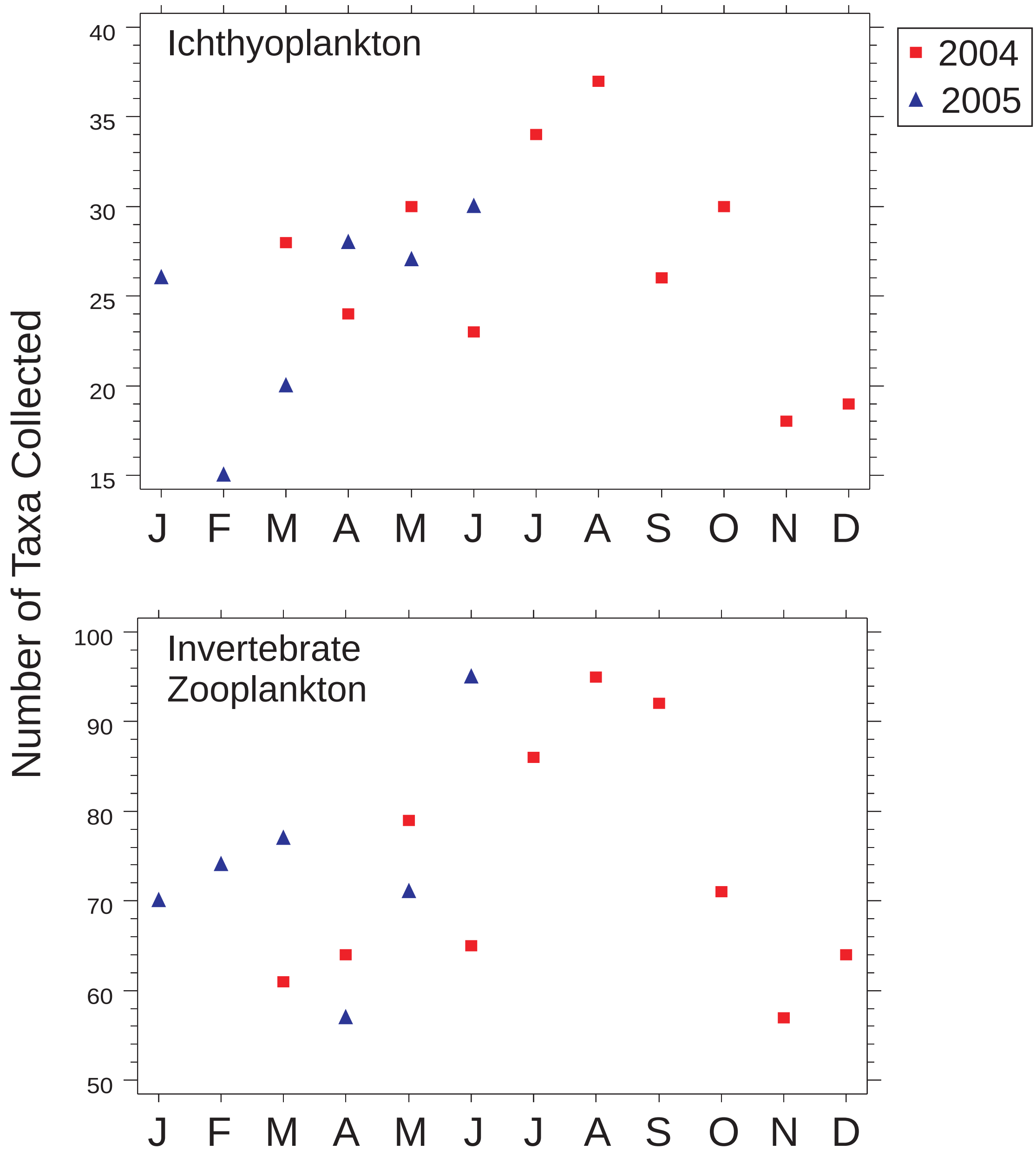


Fig. 3.6.1.1. Number of taxa collected per month by plankton net.

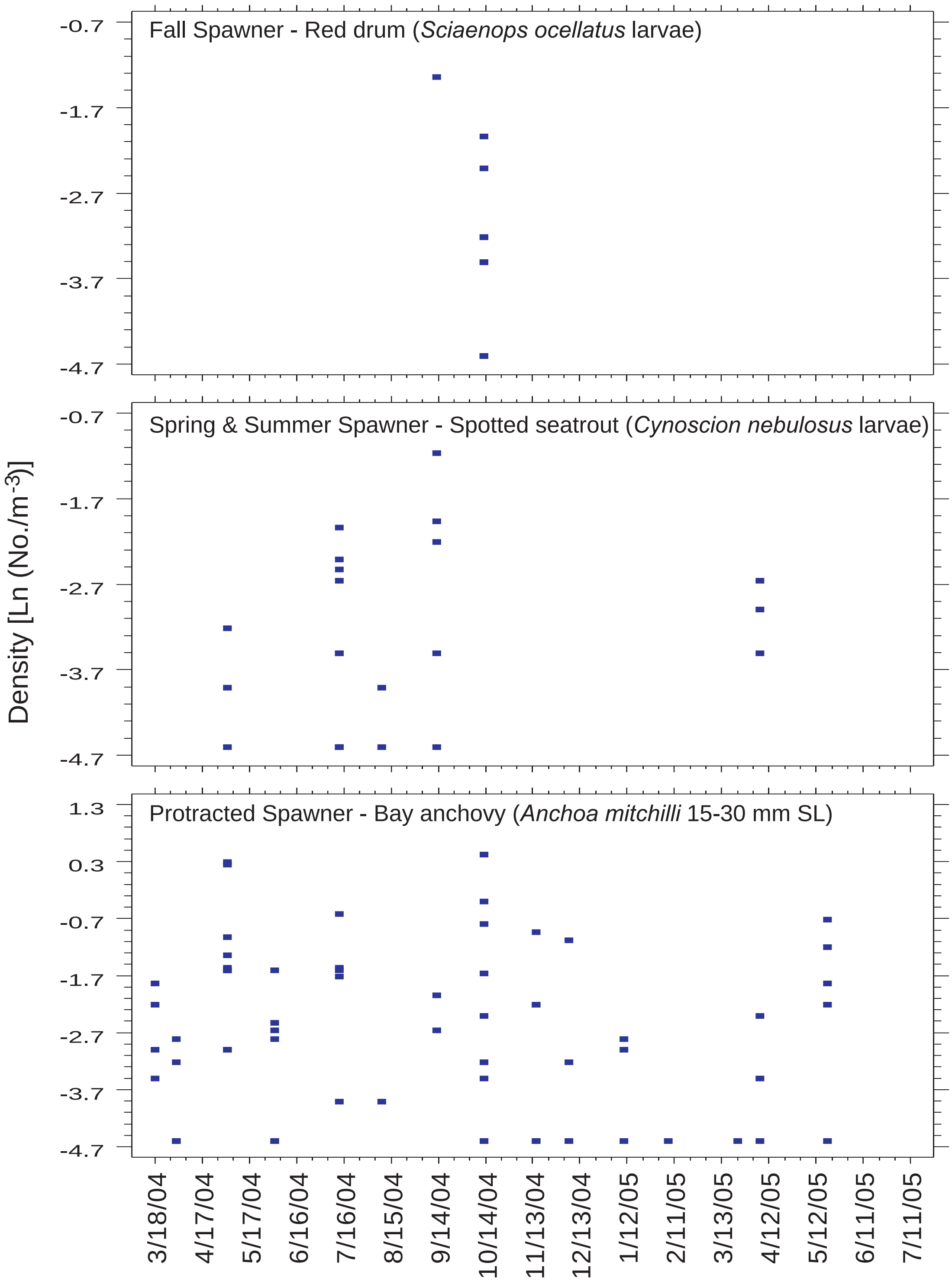


Fig. 3.6.1.2. Examples of species-specific seasonality from plankton net data.

3.6.2. Seine and Trawl.

Few clear seasonal patterns of taxon richness were evident in the DARB estuary (Fig. 3.6.2.1), which may be attributed to both the relatively short duration of sampling and the unusual hydrological conditions encountered during the study. Monthly taxon richness in seined areas was highly variable, with no consistently high periods during the study period; in deeper (trawled) habitats, the November–February period had greatest taxon richness. Overall abundances and abundances of new recruits of nekton taxa indicate extensive use of the study area during all months (see Appendix C), but temporal resource partitioning among species is evident, i.e., there is a seasonal succession of species that may allow estuaries to annually support a greater abundance of animals than if all species were present simultaneously. Twenty-one taxa were deemed abundant enough to determine seasonality in either the deeper, trawled habitats or in shallow, seined habitats (i.e., total catch of at least 100 individuals in seined habitats or 50 individuals in trawled habitats and occurrence in ≥ 5% of samples). If we consider the months in which each of these taxa was most abundant (Fig. 3.6.2.2), then peaks for tidal-river residents occurred in late spring/early summer. Estuarine and nearshore spawners tended to have peak periods of abundance in summer, whereas offshore spawners had most peaks in abundance in winter and late spring. Among new recruits (i.e., the smallest two or three 5-mm size classes captured by our gears), peak recruitment periods varied somewhat between life-history categories (Fig. 3.6.2.3): of the 17 taxa for which these trends could be judged, peak recruitment tended to occur in winter and summer for offshore spawners, spring and summer for estuarine spawners, and late spring and winter for residents. Note that in most cases these determinations were based on the trends of relatively few taxa.

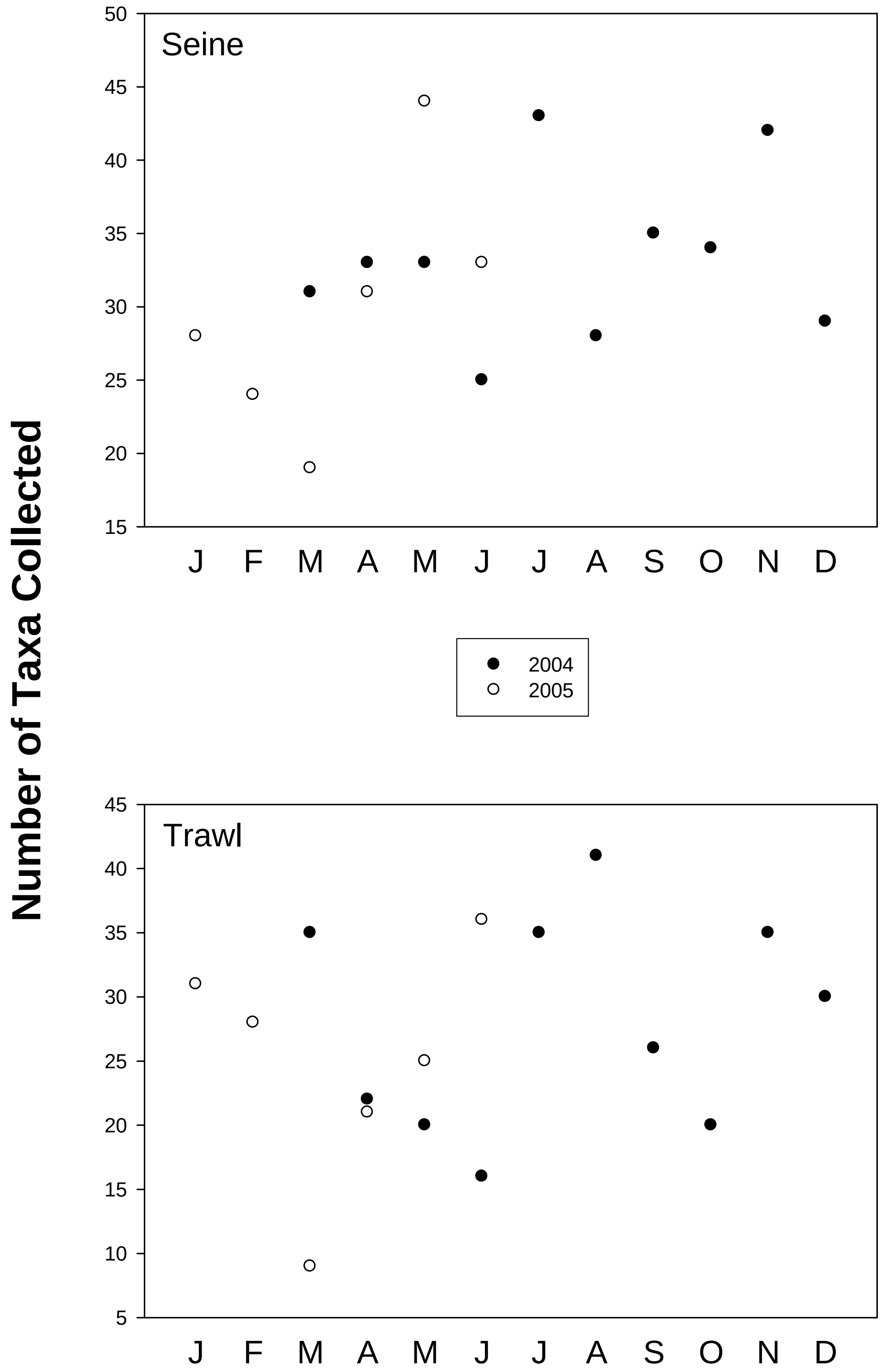


Fig. 3.6.2.1 Number of taxa collected per month by seine and trawl.

	January	February	March	April	May	June	July	August	September	October	November	December
Offshore Spawners												
F. duorarum		T					ST				S	ST
S. foetens				T	ST				T	S	S	
L. synagris									ST	S	T	ST
L. rhomboides	ST	T		S	S							T
L. xanthurus	S		S	S								
M. cephalus	S		S		S							
Total Peaks	**4**	**2**	**2**	**3**	**4**	**0**	**2**	**0**	**3**	**2**	**3**	**4**
Nearshore Spawners												
C. sapidus		T				S	T	T			S	S
H. jaguana							S	S	S			
E. gula		S					ST	T	T			S
E. harengulus				S	S		T		T		T	S
C. undecimalis									S	S	S	
Total Peaks	**0**	**2**	**0**	**1**	**1**	**1**	**5**	**3**	**4**	**1**	**3**	**3**
Estuarine Spawners												
P. americanus				T			T	T				
P. longicaudatus				T		T					T	
A. mitchilli	S		T		S			T	S	T		
A. felis	T		T				T					
E. plumieri	T	T					ST	S	S			
T. maculatus								ST	T	S		ST
Total Peaks	**3**	**1**	**2**	**2**	**1**	**1**	**4**	**5**	**3**	**2**	**1**	**2**
Tidal-River Residents												
P. pugio	S		S	S								
F. grandis					S	S					S	
Menidia spp.					S	S		S				
M. gulosus					S	S		ST	T			T
Total Peaks	**1**	**0**	**1**	**1**	**3**	**3**	**0**	**3**	**1**	**0**	**1**	**1**

Fig. 3.6.2.2. Top months of relative abundance for all individuals collected in seines (S) and trawls (T). Note that spawning location is uncertain for some species, and may shift between nearshore and estuarine areas depending on local conditions. Brackets indicate months of peak abundance.

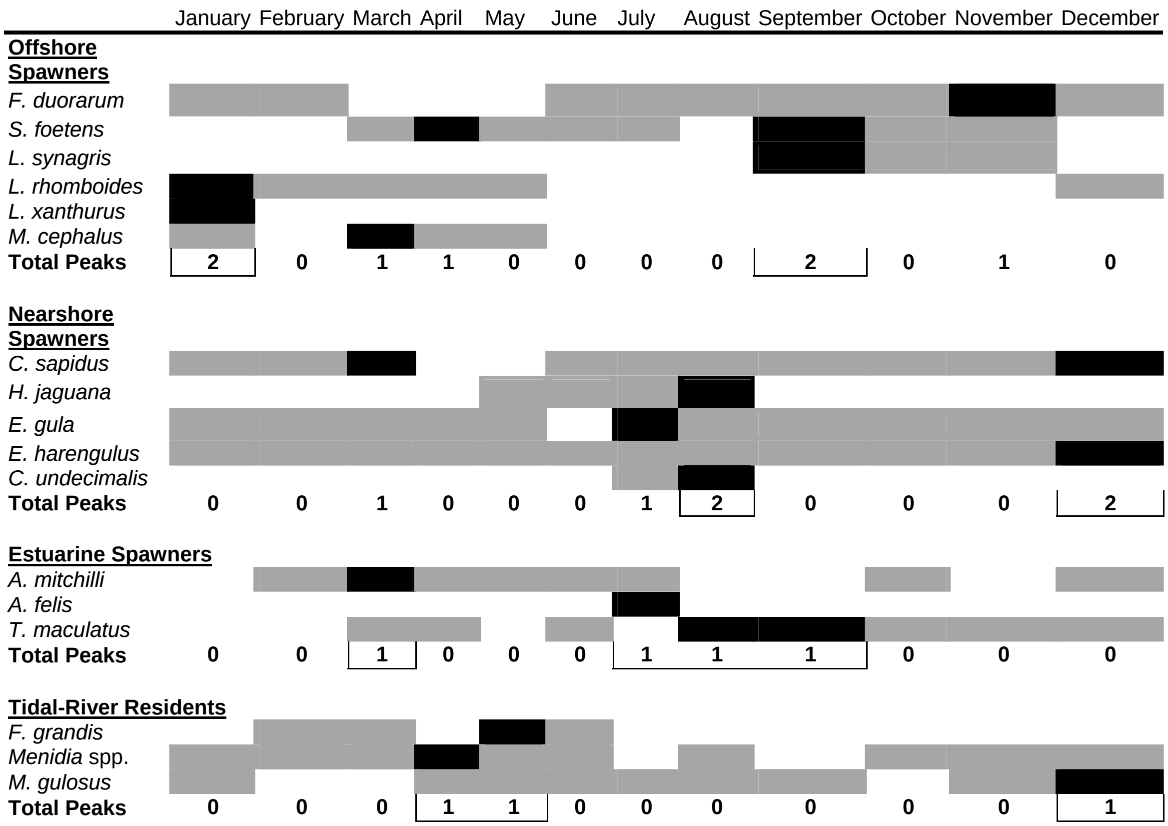


Fig. 3.6.2.3. Months of occurrence (■) and peak abundance (■) for new recruits collected by seine and trawl. Note that spawning location is uncertain for some species, and may shift between nearshore and estuarine areas depending on local conditions. Brackets indicate months of peak abundance.

3.7 Distribution (km_u) Responses to Freshwater Inflow

3.7.1 Plankton Net.

Twenty-eight (49%) of the 57 plankton-net taxa evaluated for distribution responses to freshwater inflow exhibited significant responses. All were negative responses, wherein animals moved upstream as inflows decreased (Table 3.7.1.1). Upstream movement is the typical response to reduced inflows seen in riverine estuaries on Florida's west coast (Peebles 2002b, MacDonald et al. 2005, Greenwood et al. 2006). Time lags associated with these responses were variable, but most taxa responded to inflow within days or weeks.

It is possible that organisms moved laterally into Roberts or Lyons Bays as inflows increased, rather than moving toward Venice Inlet and the Gulf of Mexico. This would have been difficult to detect with the present analysis, which was designed to detect responses along the principal conveying channel. Detection of distribution responses is further complicated by inflows from the Blackburn Canal into Roberts Bay. Nevertheless, approximately half of the observed responses had r^2 values >50%, and these strong responders were dominated by estuarine, rather than freshwater, taxa.

Table 3.7.1.1. Plankton-net organism distribution (km_U) responses to mean freshwater inflow (Ln *F*+1), ranked by linear regression slope. Other regression statistics are sample size (*n*), intercept (*Int.*), slope probability (*P*) and fit (adjusted r^2, as %). *DW* identifies where serial correlation is possible (x indicates p<0.05 for Durbin-Watson statistic). *D* is the number of daily inflow values used to calculate mean freshwater inflow.

Description	***Common Name***	***n***	***Int.***	***Slope***	***P***	r^2	***DW***	***D***
Lucifer faxoni juveniles and adults	shrimp	16	0.392	-0.049	0.030	24		1
Hippolyte zostericola postlarvae	zostera shrimp	16	0.535	-0.075	0.032	24		99
chaetognaths, sagittid	arrow worms	16	0.921	-0.159	0.000	67		1
Sarsiella zostericola	ostracod, seed shrimp	11	1.484	-0.233	0.040	32		6
Cassidinidea ovalis	isopod	15	4.660	-0.300	0.005	43		1
decapod mysis	shrimp larvae	16	3.224	-0.398	0.034	23	x	6
amphipods, gammaridean	amphipods	16	4.375	-0.403	0.000	61		8
alphaeid postlarvae	snapping shrimps	13	2.090	-0.423	0.042	26		28
cumaceans	cumaceans	16	2.586	-0.430	0.019	29		120
blenniid preflexion larvae	blennies	11	2.816	-0.440	0.019	41		1
branchiurans, Argulus spp.	fish lice	15	3.373	-0.464	0.013	35		63
Microgobius spp. postflexion larvae	gobies	13	5.833	-0.524	0.023	33		5
decapod zoeae	crab larvae	16	3.766	-0.530	0.004	42		5
dipteran, Chaoborus punctipennis	phanton midge	13	6.843	-0.537	0.000	89		9
Taphromysis bowmani	mysid, opossum shrimp	12	5.625	-0.539	0.017	39		3
Anchoa mitchilli juveniles	bay anchovy	15	5.776	-0.548	0.013	34		21
Edotea triloba	isopod	16	5.814	-0.559	0.000	72		9
unidentified Americamysis juveniles	mysid, opossum shrimp	16	5.687	-0.564	0.000	73		10
Americamysis almyra	mysid, opossum shrimp	16	6.061	-0.590	0.000	63		11
gobiid preflexion larvae	gobies	16	5.054	-0.600	0.002	49		9
Microgobius spp. flexion larvae	gobies	14	5.555	-0.608	0.002	52		7
Bowmaniella dissimilis	mysid, opossum shrimp	15	4.156	-0.642	0.000	61		11
Palaemonetes spp. postlarvae	grass shrimps	16	5.359	-0.659	0.000	61		9
Sphaeroma terebrans	isopod	16	6.361	-0.685	0.001	56		84
Gobiosoma spp. postflexion larvae	gobies	15	5.967	-0.708	0.002	51		8
Palaemonetes pugio juveniles	daggerblade grass shrimp	13	5.855	-0.722	0.005	49		56
cymothoid sp. a (Lironeca) juveniles	isopod	12	4.064	-0.723	0.005	53		56
gobiid flexion larvae	gobies	16	5.779	-0.740	0.000	64		8

3.7.2 Seine and Trawl.

Nearly 60% of the 19 pseudo-species/gear combinations (hereafter simply referred to as ‘pseudo-species’) evaluated for distributional responses to freshwater inflow exhibited a significant response for at least one lagged flow period. For the purposes of this discussion, we refer only to the best models for each of the 11 pseudo-species (i.e., statistically significant [$p<0.05$] models with normally distributed residuals that explain the greatest proportion of the variance [highest r^2 value] for each pseudo-species) (Table 3.7.2.1). Best models are plotted in Appendix G.

The best models tended to involve long lag periods (Fig. 3.7.2.1). Less than half (45%) of the significant responses were negative (i.e., animals moved upstream with decreasing freshwater inflow), in marked contrast to previous studies where the great majority of responses were negative (e.g., Peebles 2002b, MacDonald et al. 2005, Greenwood et al. 2006). Typically, pseudo-species’ centers of abundance shift downstream during periods of higher inflow because individuals occupy areas with suitable salinities or food sources, although some displacement during periods of extremely high flows cannot be discounted for smaller individuals. In the present study, 11 of the seine and trawl sampling events occurred when there was considerably less than average inflow. The average inflow during the flow record for the DARB estuary was 85 cfs. Only three of the sampling events had daily inflows greater than the average inflow and over half of the sampling events had an inflow less than one-third of the average (>25 cfs). It is possible that inflows (short, medium, and long term) were so low during the sampling period that the relatively small quantities of freshwater entering the system had the effect of attracting many animals upstream (towards the freshwater sources) rather than downstream into the higher-salinity portion of the system.

Table 3.7.2.1. Best-fit seine and trawl-based pseudo-species distributional response to continuously-lagged mean freshwater inflow (Ln(km_U) vs. Ln(inflow)) for the DARB estuary. Degrees of freedom (*df*), intercept, slope, probability that the slope is significant (*P*), and fit (Adj-r^2) are provided. The number of days in the continuously-lagged mean inflow is represented by *D*. An “x” in *DW* indicates that the Durbin-Watson statistic was significant ($p<0.05$), a possible indication that serial correlation was present.

Species	***Common name***	***Gear***	***Size***	***Period***	***df***	***Intercept***	***Linear coef.***	***Linear P***	***Adj-r^2***	***DW***	***D***
Farfantepenaeus duorarum	Pink shrimp	seine	<=10	Jan. to Dec.	9	1.8358	-0.1834	0.0048	60.59		1
Farfantepenaeus duorarum	Pink shrimp	seine	>=11	Jan. to Dec.	5	-13.1008	3.3796	0.0019	87.69	x	350
Callinectes sapidus	Blue crab	seine	<=30	Jan. to Dec.	12	0.1816	0.3371	0.0119	42.21		147
Callinectes sapidus	Blue crab	trawl	<=30	Jan. to Dec.	8	0.8851	0.1221	0.0019	71.92		7
Anchoa mitchilli	Bay anchovy	seine	<=25	Jan. to Dec.	4	2.7528	-0.2865	0.0486	66.29		238
Anchoa mitchilli	Bay anchovy	seine	26 to 35	Jan. to Dec.	4	3.694	-0.486	0.0311	72.63		266
Anchoa mitchilli	Bay anchovy	seine	>=36	Jan. to Dec.	5	0.4147	0.29	0.0009	90.73		84
Eucinostomus harengulus	Tidewater mojarra	seine	>=40	Jan. to Dec.	14	2.1615	-0.1442	0.0357	27.85		203
Eucinostomus harengulus	Tidewater mojarra	trawl	>=40	Jan. to Dec.	6	2.8232	-0.3476	0.0042	77.05		161
Microgobius gulosus	Clown goby	seine	All sizes	Jan. to Dec.	14	1.3693	0.102	0.0031	47.58		189
Microgobius gulosus	Clown goby	trawl	All sizes	Jan. to Dec.	6	-2.8947	1.0427	0.0013	84.3	x	308

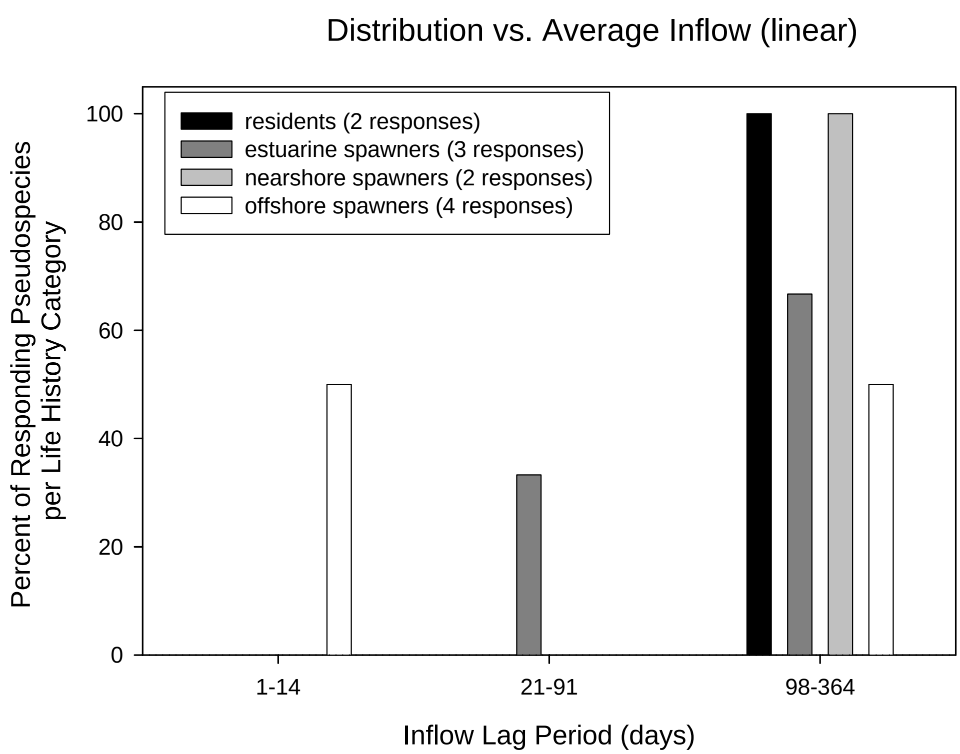


Fig. 3.7.2.1. Summary of linear regression results assessing distribution (km_U) in relation to inflow and lag period.

3.8 Abundance (N, $\bar{N}$) Responses to Freshwater Inflow

3.8.1 Plankton Net.

Sixteen (28%) of the 57 plankton-net taxa evaluated for abundance relationships with freshwater inflow exhibited significant responses (Table 3.8.1.1). Six were positive responses and ten were negative. Nine of the ten negative responses involved taxa that exhibited significant downstream movement in response to inflow (Table 3.7.1.1), suggesting that the reductions in abundance were caused by movement into the Gulf or lateral bays. The tenth negatively responding taxon, *Temora turbinata*, is an estuarine plume animal that is usually restricted to the lower parts of embayments during dry conditions and is also likely to move seaward during periods of elevated inflow.

Four of the six taxa with positive inflow responses were insect larvae (*Chaoborus punctipennis*, trichopteran larvae, chironomid larvae, dipteran pupae), which are primarily freshwater, but may contain estuarine species. These taxa had positive responses to freshwater inflow because they were introduced into the study area by freshwater inflows.

Two estuarine taxa had positive responses: preflexion anchovy larvae and the tanaid *Hargeria rapax*. The larval anchovy lags were most highly significant at 4 d, but remained highly significant for lags of up to several weeks duration, which places this response within the same time frame as a positive population (spawning) response to inflows. Lags associated with the abundance response for *Hargeria rapax* (67 d) were also within a time frame that could represent population responses to inflow. Other plankton-net surveys conducted by USF for SWFWMD have not identified positive responses by egg or larval anchovies to freshwater inflows (e.g., Peebles 2002b, MacDonald et al. 2005, Greenwood et al. 2006). This is probably because these other survey areas did not encompass local spawning activity. Instead, within the typical riverine transects surveyed in other studies, spawning is only detected at the seaward ends of transects during dry periods, and the eggs and larvae move seaward as soon as inflows increase, reducing their apparent number. In contrast, it is likely that the local spawning population was largely contained within the boundaries of the DARB survey area (Table A3).

Table 3.8.1.1. Plankton-net organism abundance responses to mean freshwater inflow from Cow Pen Slough (Ln *F*+1), ranked by linear regression slope. Other regression statistics are sample size (*n*), intercept (*Int.*), slope probability (*P*) and fit (adjusted r^2, as %). *DW* identifies where serial correlation is possible (x indicates p<0.05 for Durbin-Watson statistic). *D* is the number of daily inflow values used to calculate mean freshwater inflow.

Description	***Common Name***	***n***	***Int.***	***Slope***	***P***	r^2	***DW***	***D***
dipterans, pupae	flies, mosquitos	12	6.930	1.112	0.0080	47		6
Hargeria rapax	tanaid	15	6.782	1.001	0.0333	25	x	67
Anchoa spp. preflexion larvae	anchovies	12	9.688	0.886	0.0049	52		4
dipteran, Chaoborus punctipennis	phantom midge	13	9.984	0.799	0.0067	46		6
trichopteran larvae	caddisflies	10	7.115	0.669	0.0058	59		9
dipterans, chironomid larvae	midges	14	8.427	0.649	0.0006	61		8
blenniid preflexion larvae	blennies	11	11.109	-0.275	0.0377	33		16
branchiurans, Argulus spp.	fish lice	15	11.707	-0.296	0.0384	24		2
decapod mysis	shrimp larvae	16	17.044	-0.641	0.0344	23		120
chaetognaths, sagittid	arrow worms	16	17.043	-0.673	0.0005	56	x	11
cymothoid sp. a (Lironeca) juveniles	isopod	12	13.290	-0.719	0.0028	57		49
Bowmaniella dissimilis	mysid, opossum shrimp	15	15.131	-0.786	0.0055	42		51
Temora turbinata	copepod	10	13.774	-0.908	0.0039	63	x	106
alphaeid postlarvae	snapping shrimp	13	15.166	-0.976	0.0173	36		120
Microgobius spp. flexion larvae	gobies	14	16.005	-1.280	0.0130	37		120
cumaceans	cumaceans	16	19.535	-1.602	0.0001	64	x	120

3.8.2 Seine and Trawl.

Among the 27 pseudo-species considered in these analyses, abundances of 70.4% were significantly related to average inflow (Table 3.8.2.1). The greatest proportion of variance in abundance was explained by linear models for three pseudo-species and by quadratic models for 16 pseudo-species. Of the three linear models, all were negative relationships, indicating increasing abundance with decreasing inflow. One-quarter of significant quadratic models were negative relationships. The most common quadratic relationship (nearly 47% of significant quadratic relationships) suggested lowest abundance at intermediate inflows (‘intermediate-minimum’). Of the remaining quadratic models, four suggested greatest abundance at intermediate inflow (‘intermediate-maximum’) and one suggested greatest abundance at higher flow levels. The percentage of significant abundance responses to inflow ranged from 57% of tested pseudo-species in estuarine spawners to 82% in offshore spawners. Nearshore spawners most commonly exhibited negative relationships to flow, whereas there were no clearly evident trends discernible for the other life-history categories (Fig. 3.8.2.1). All best models are plotted in Appendix I.

Best-fitting regression models incorporated medium or longer lags for all life-history categories; longer lags were especially pronounced in nearshore and offshore spawners (Fig. 3.8.2.2). Best models incorporated lagged inflows ranging from 28 to 259 days for residents, 1 to 238 days for estuarine spawners, and 1 to 364 days for nearshore and offshore spawners.

The ten strongest abundance-inflow relationships—those where inflow explained a sizeable portion of variance (r^2>~50%) in at least six data points—included pseudo-species from all life-history categories, with life-history categories being represented in proportion to the total number of significant regressions that each possessed. Of these ten strongest relationships, nine were analyses conducted on data collected by trawl in the channel habitat. Relationships of abundance to flow in these ten pseudo-species were positive (Fig. I6), negative (Figs. I3, I4, I12, and I14), intermediate-minimum (Figs. I5, I7, and I9), or intermediate-maximum (Fig. I17). An increase in abundance with increased flow may suggest beneficial aspects of increased nutrient input, for example, or perhaps better detection of the tidal-river nursery area. Intermediate-minimum relationships, where abundance is greatest at either low or high flows and least at intermediate flows, are difficult to explain in ecological terms. Intermediate-maximum relationships, which are opposite in nature to intermediate-minimum relationships, perhaps indicate differing forces operating at opposite ends of the inflow spectrum. At low flows, opportunities for either chemical detection of tidal nursery habitats or selective tidal-stream transport may be reduced, and at high flows, physical displacement may occur, or perhaps undesirable properties of fresher water (e.g., low pH) become more prominent. Caution should be applied when assessing regression results as some relationships may have been spurious and could have arisen from outlying points unduly influencing results (e.g., Fig. I16) or because of relatively few data points (e.g., Fig. I17).

Table 3.8.2.1, Page 1 of 2

Table 3.8.2.1. Best-fit seine and trawl-based pseudo-species abundance ($\bar{N}$) response to continuously-lagged mean freshwater inflow (Ln(cpue) vs. Ln(inflow)) for the DARB estuary. The type of response is either quadratic (Q) or linear (L). Degrees of freedom (*df*), intercept, slope (*Linear coef.*), probability that the slope is significant (*Linear P*), quadratic coefficient (*Quad. coef.*), probability that the quadratic coefficient is significant (*Quad. P*), and fit (r^2) are provided. The number of days in the continuously-lagged mean inflow is represented by *D*. An "x" in *DW* indicates that the Durbin-Watson statistic was significant (p<0.05), a possible indication that serial correlation was present.

Species	***Common name***	***Gear***	***Size***	***Period***	***Response***	***df***	***Intercept***	***Linear coef.***	***Linear P***	***Quad. Coef.***	***Quad. P***	***Adj-r^2***	***DW***	***D***
Farfantepenaeus duorarum	Pink shrimp	seine	<=10	Jun. to Mar.	Q	9	24.9745	-12.8432	0.0025	1.6525	0.0022	67.15		168
Farfantepenaeus duorarum	Pink shrimp	seine	>=11	Jun. to Mar.	L	10	1.3805	-0.2701	0.0017	.	.	64.4	x	1
Farfantepenaeus duorarum	Pink shrimp	trawl	<=10	Jun. to Mar.	Q	8	16.5038	-7.6512	0.0319	0.9001	0.0476	81.16		280
Farfantepenaeus duorarum	Pink shrimp	trawl	>=11	Jun. to Mar.	Q	7	574.5863	-258.3373	0.0012	29.0284	0.0013	89.88		364
Periclimenes americanus	American grass shrimp	trawl	All sizes	Dec. to Aug.	Q	10	2.0008	-1.0893	0	0.1457	0	84.9		119
Callinectes sapidus	Blue crab	seine	<=30	Jan. to Dec.	Q	13	1.8106	-0.8446	0.0161	0.1466	0.015	38.02		1
Callinectes sapidus	Blue crab	trawl	<=30	Jan. to Dec.	Q	9	139.9573	-63.2239	0.0018	7.1422	0.002	80.49		357
Anchoa mitchilli	Bay anchovy	seine	<=25	Dec. to Oct.	Q	12	-46.8116	26.7227	0.0006	-3.5889	0.0005	68.47	x	238
Anchoa mitchilli	Bay anchovy	seine	26 to 35	Dec. to Oct.	Q	12	5.5183	-2.7702	0.0019	0.3652	0.0065	60.15	x	1
Anchoa mitchilli	Bay anchovy	seine	>=36	Dec. to Oct.	L	13	3.5541	-0.5985	0.1947	.	.	12.57		84
Eucinostomus gula	Silver jenny	seine	40 to 70	Jan. to Dec.	Q	13	21.0857	-10.2962	0.0188	1.2636	0.0231	41.39		189
Eucinostomus gula	Silver jenny	trawl	40 to 70	Jan. to Dec.	Q	9	201.2805	-89.8794	0.0184	10.032	0.0215	80.14		350
Eucinostomus harengulus	Tidewater mojarra	seine	>=40	Jan. to Dec.	L	14	3.3141	-0.3331	0.0116	.	.	37.53	x	1
Eucinostomus harengulus	Tidewater mojarra	trawl	>=40	Jan. to Dec.	Q	9	206.648	-92.9807	0.0242	10.4577	0.0261	68.18		364
Lagodon rhomboides	Pinfish	seine	>=31	Jan. to Aug.	Q	9	-26.4046	15.7406	0.015	-2.1195	0.0132	53.61		245
Lagodon rhomboides	Pinfish	trawl	<=30	Dec. to Jun.	Q	8	1.5461	-0.9122	0.0008	0.1337	0.0003	91.28	x	126
Leiostomus xanthurus	Spot	trawl	All sizes	Jan. to Apr.	Q	3	-23.0567	10.6294	0.0177	-1.2188	0.0177	88.29		245
Microgobius gulosus	Clown goby	seine	All sizes	Jan. to Dec.	Q	12	-30.0672	17.4733	0.0016	-2.3064	0.0015	58.12		259
Microgobius gulosus	Clown goby	trawl	All sizes	Jan. to Dec.	Q	13	0.9441	-0.5856	0.0001	0.0875	0.0001	68.95		28

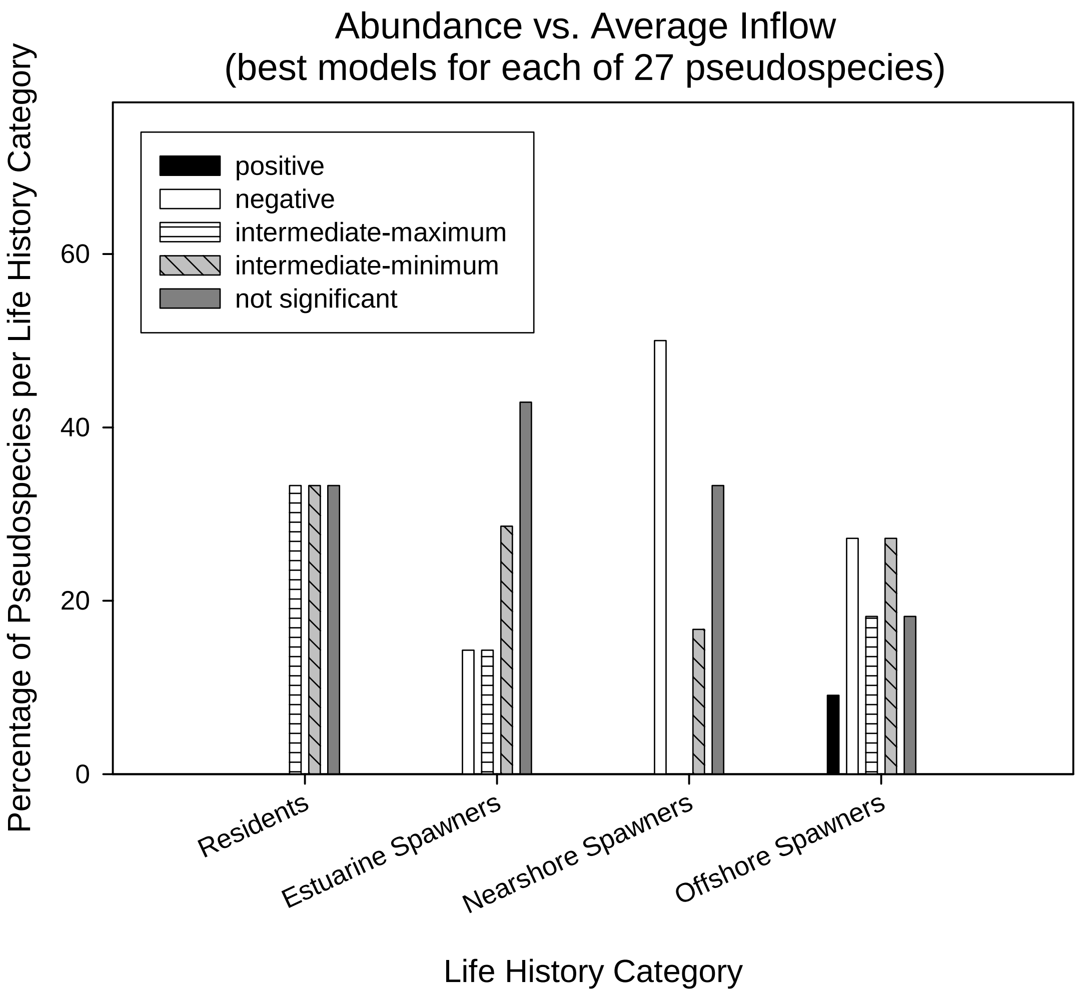


Fig. 3.8.2.1. Summary of regression results assessing abundance ($\overline{N}$) in relation to inflow. Positive and negative indicate increase and decrease in abundance with increasing inflow, respectively, while intermediate indicates maximum or minimum abundance at intermediate inflows.

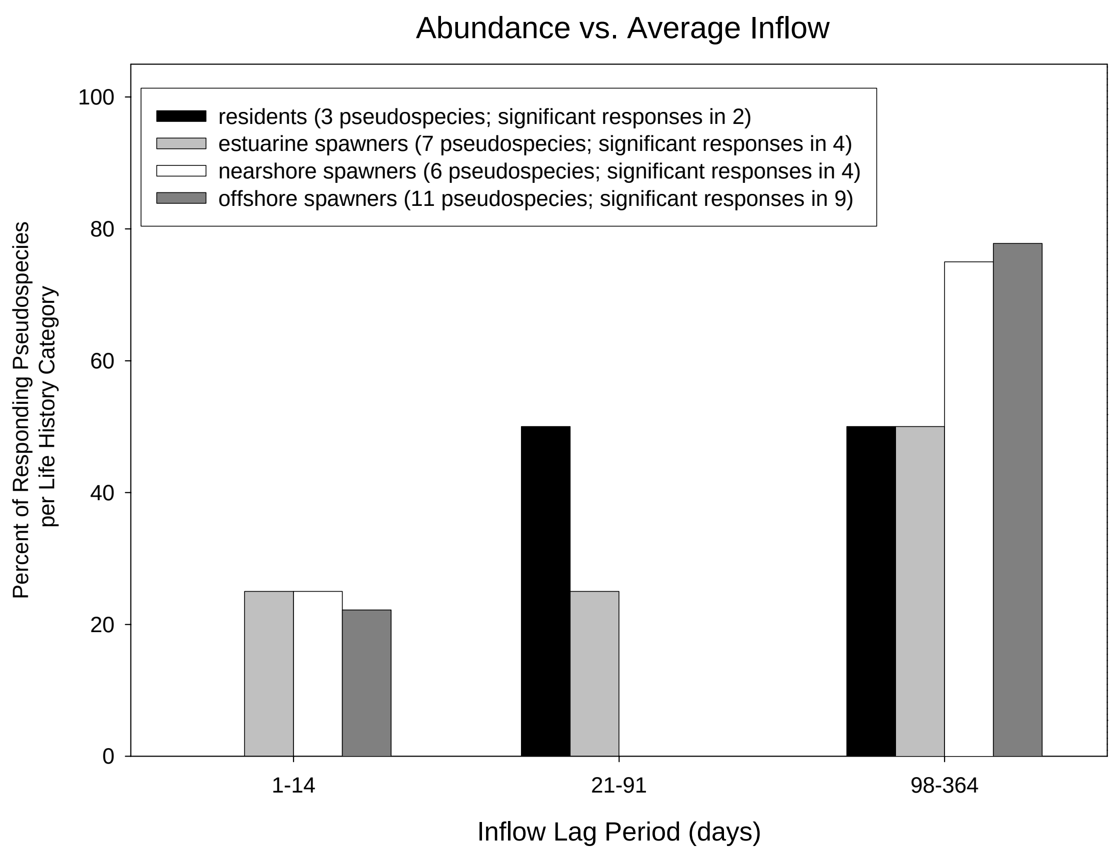


Fig. 3.8.2.2. Summary of regression results assessing abundance ($\overline{N}$) in relation to inflow and lag period.

3.9 Community Structure

Additional insight into the effects of inflow on variation in community structure can be obtained by first looking at inflow effects on variation in salinity. The pattern of spatial variability in the salinity of the DARB estuary appears to respond to inflows from Cow Pen Slough (Fig. 3.9.1). Salinity is actually responding to inflows from both Cow Pen Slough and the Blackburn Canal; salinity variation appears to respond to Cow Pen Slough inflows because inflows from Cow Pen Slough and the Blackburn Canal were strongly correlated (see Section 3.1). The response appears to be asymptotic, wherein salinity variation has a strong linear response at Cow Pen Slough inflows <100 cfs, but becomes less responsive at inflows above 100 cfs. Comparable patterns of community structure response to inflow are examined in Sections 3.9.1 and 3.9.2.

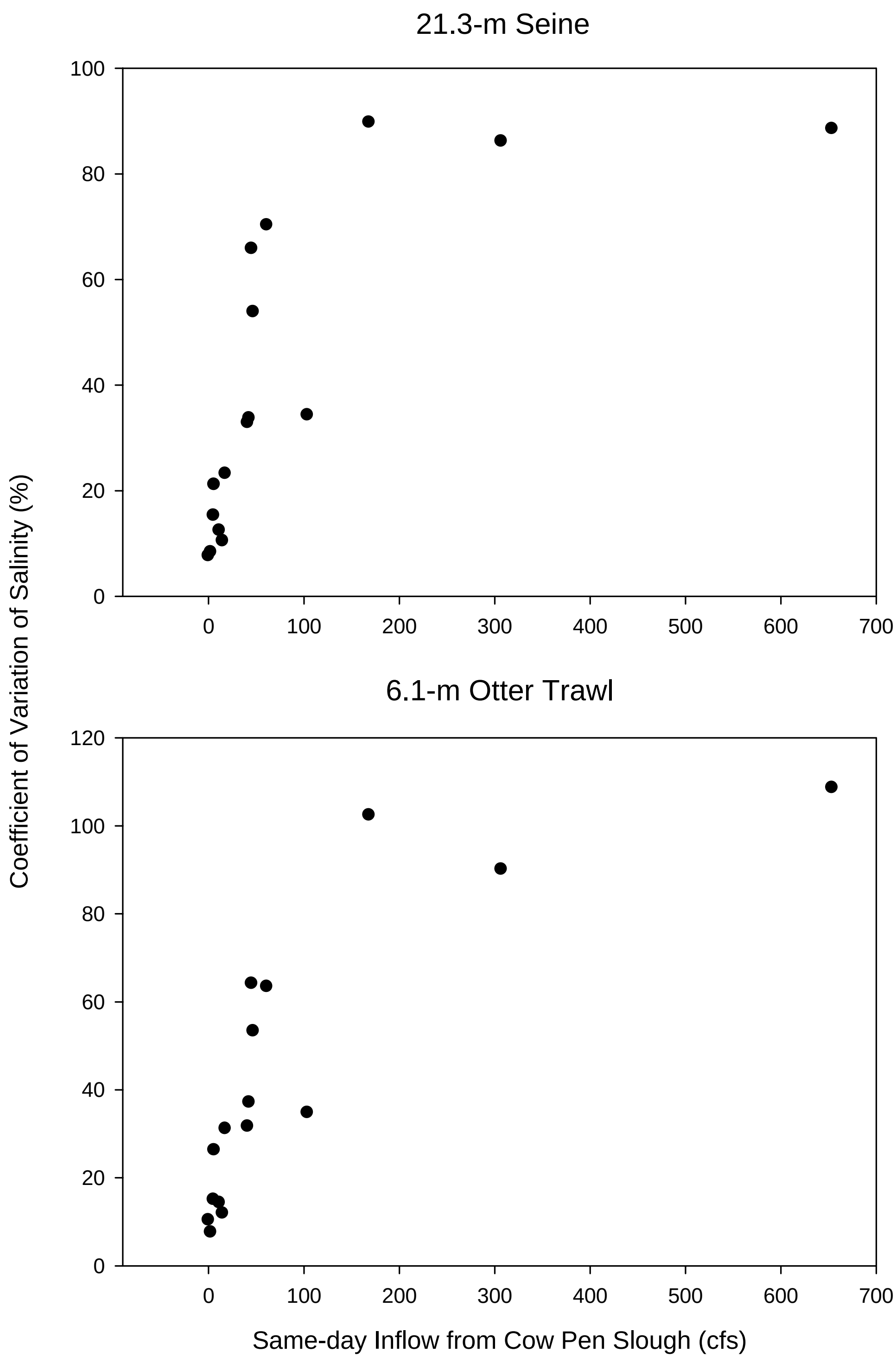


Fig. 3.9.1. Relationship between Cow Pen Slough inflows and spatial salinity variability (measured as coefficient of variability, %) in the DARB estuary. Figure titles indicate whether the salinity data were associated with shallow (seine) or deep (trawl) gear deployments. Each data point represents a monthly collection effort.

3.9.1. Plankton net

Zooplankton community structure throughout the DARB estuary was most spatially uniform when inflows were reduced and was most spatially variable when inflows were elevated above 100 cfs (Fig. 3.9.1.1). This pattern was similar to that observed for salinity (Fig. 3.9.1), although reproductive seasonality, predator-prey interactions and other biological influences are likely to have caused considerable variation in community structure at all inflow levels. Fig. 3.9.1.1 depicts a response to same-day inflows, but inflows averaged over longer periods were also examined (not shown). Using inflow averages over 10-120 d caused increased scatter in the relationship while otherwise maintaining a positive trend. Inflow averages based on 2-9 d caused individual data points to become redistributed in a manner that supports the pattern in Fig. 3.9.1. If inflows had ever been large enough to cause the entire DARB estuary to become fresh, then the universal presence of a freshwater zooplankton community would have reduced spatial variation in community structure. The entire response is therefore arch-shaped, but we only observed the left-hand part of this arch because freshwater inflows never dominated the entirety of the DARB estuary.

Fig. 3.9.1.2 indicates that low inflows from the Blackburn Canal did not result in strong zooplankton community differences between the open waters of Roberts and Lyons Bays. This suggests that under most inflow conditions, biological factors are likely to dominate differences between these two lateral bays. It is also likely that tidal movement in the Intracoastal Waterway encourages similarity in the zooplankton fauna between the two bays.

Zooplankton community structure along the axis from Venice Inlet through Dona Bay and into Shakett Creek varied as expected, given the relative positions of these areas along the estuarine gradient (Fig. 3.9.1.3, Table 3.9.1.1). Zooplankton community structure in the two upstream zones (3.0-5.0 and 5.0-6.4 km) was different from that of the downstream zone (1.0-3.0 km) and the two lateral bays. These differences were stronger for invertebrates than for ichthyoplankton. The two upstream zones had higher abundances of mysids and amphipods, which are important prey for juvenile estuary-dependent fishes, and the downstream zones had higher abundances of copepods, which are important prey for fish larvae and adult zooplanktivorous fishes such as anchovies, sardines and herrings (Table 3.9.1.2). From the perspective of the entire survey period, differences between the downstream zone and the two lateral bays were minor (Table 3.9.1.2). To eliminate variation caused by reproductive seasonality, Lyons and Roberts Bays were compared during June of two different years. The hydrograph in Fig. 3.1.1 illustrates the relatively late onset of the summer rainy season in 2004, which makes comparison of the two June observations more directly relevant to differences in inflow. There was a significant difference in the invertebrate community structure of the two lateral bays during June of these two years (Fig. 3.9.1.4, ANOSIM $R=0.42$, $p=0.03$), and the difference was not caused by the presence of more freshwater organisms during the wetter year. It was instead caused by increased abundances of fish prey organisms (amphipods, copepods and mysids) and decreased abundances of gelatinous predators (ctenophores, hydromedusae and chaetognaths) during the wetter year (Table 3.9.1.3). The two similar observations in the lower panel of Fig. 3.9.1.4 were from seaward locations. Important prey taxa such as mysids, gammaridean amphipods and bay anchovy juveniles were more abundant in Roberts Bay than Lyons Bay and also favored the landward end of the principal estuarine axis (Table A3).

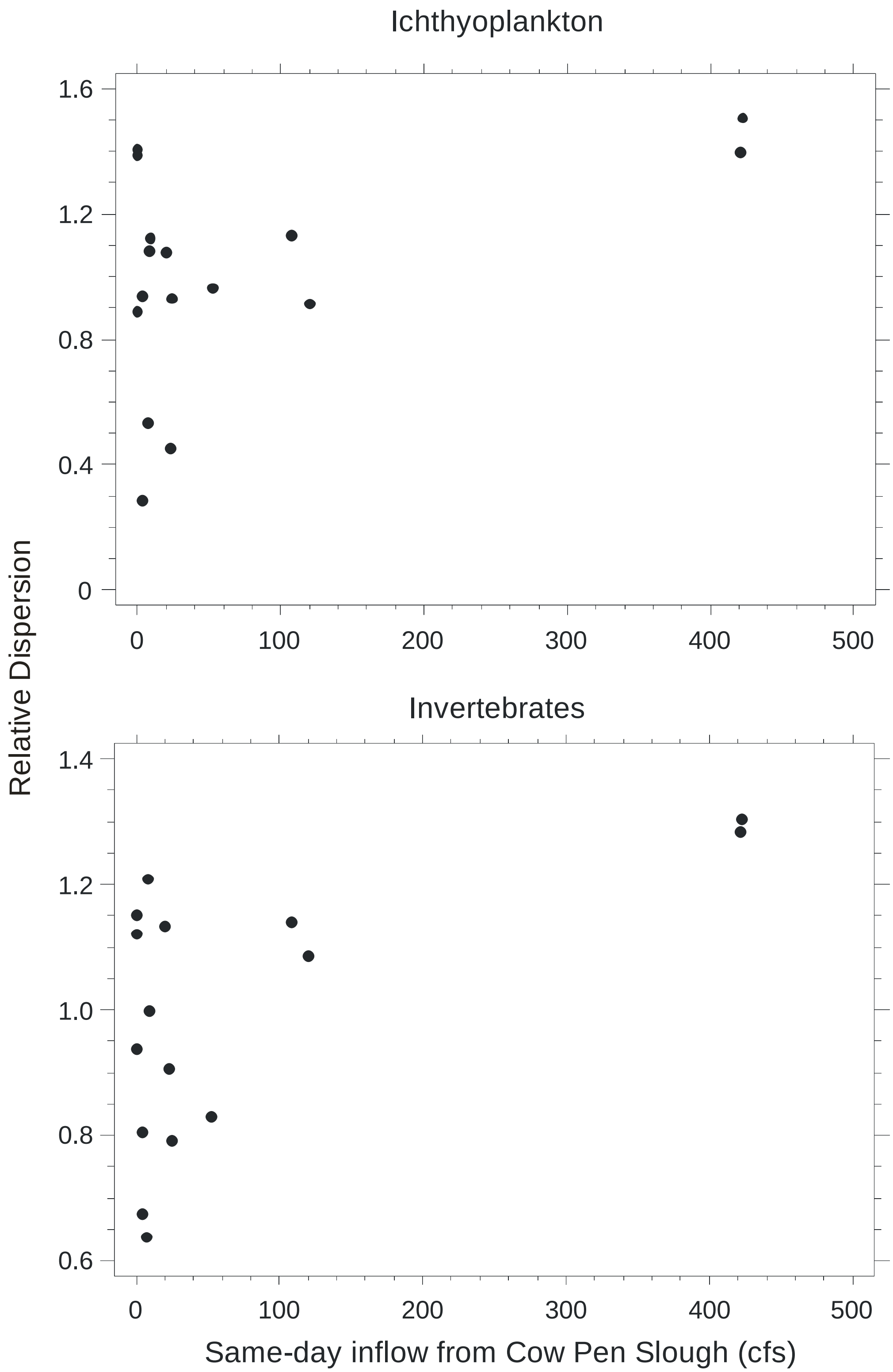


Fig. 3.9.1.1. Relationship between Cow Pen Slough inflows and zooplankton community variability throughout the DARB estuary (measured as Index of Multivariate Dispersion).

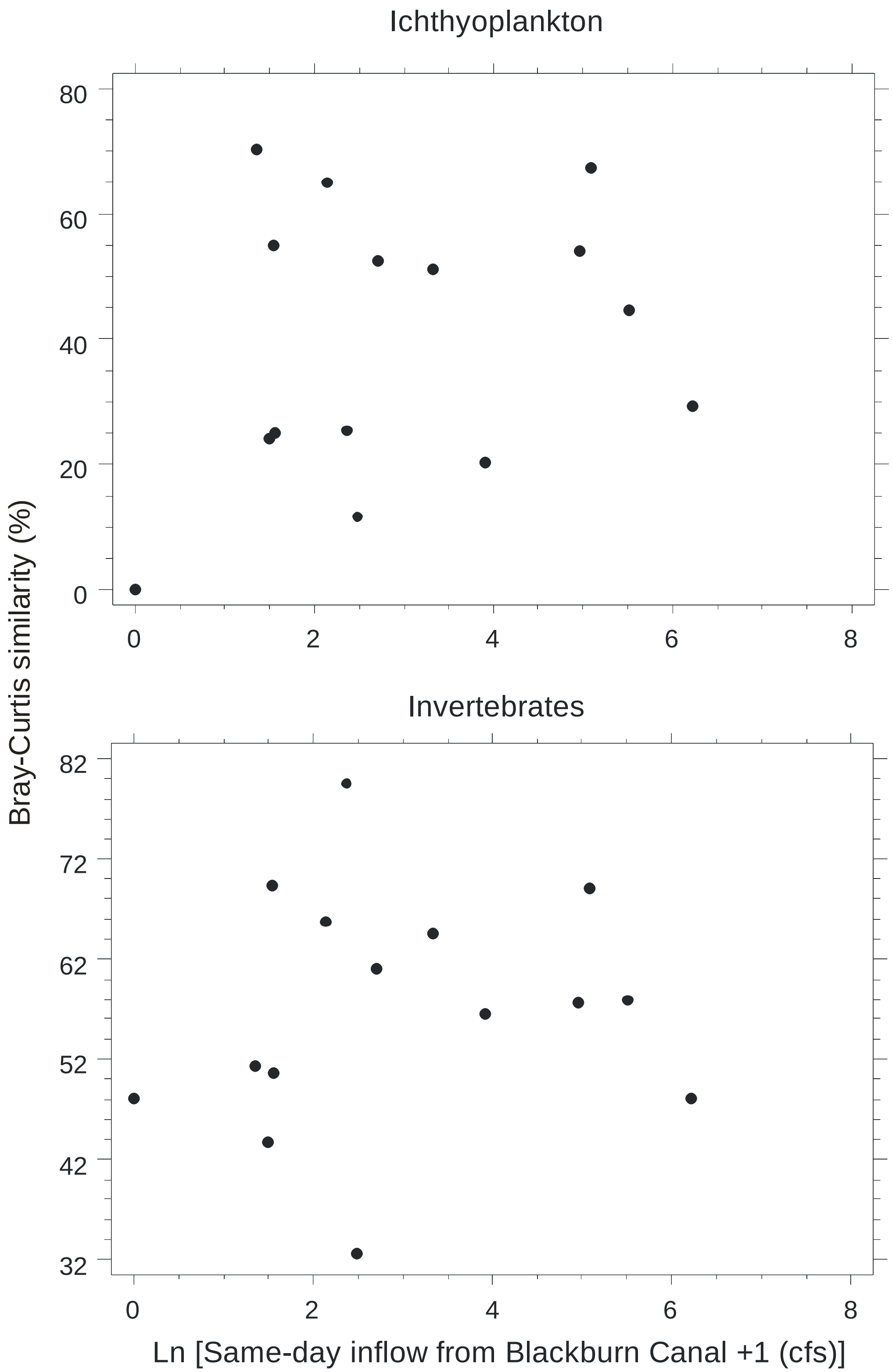
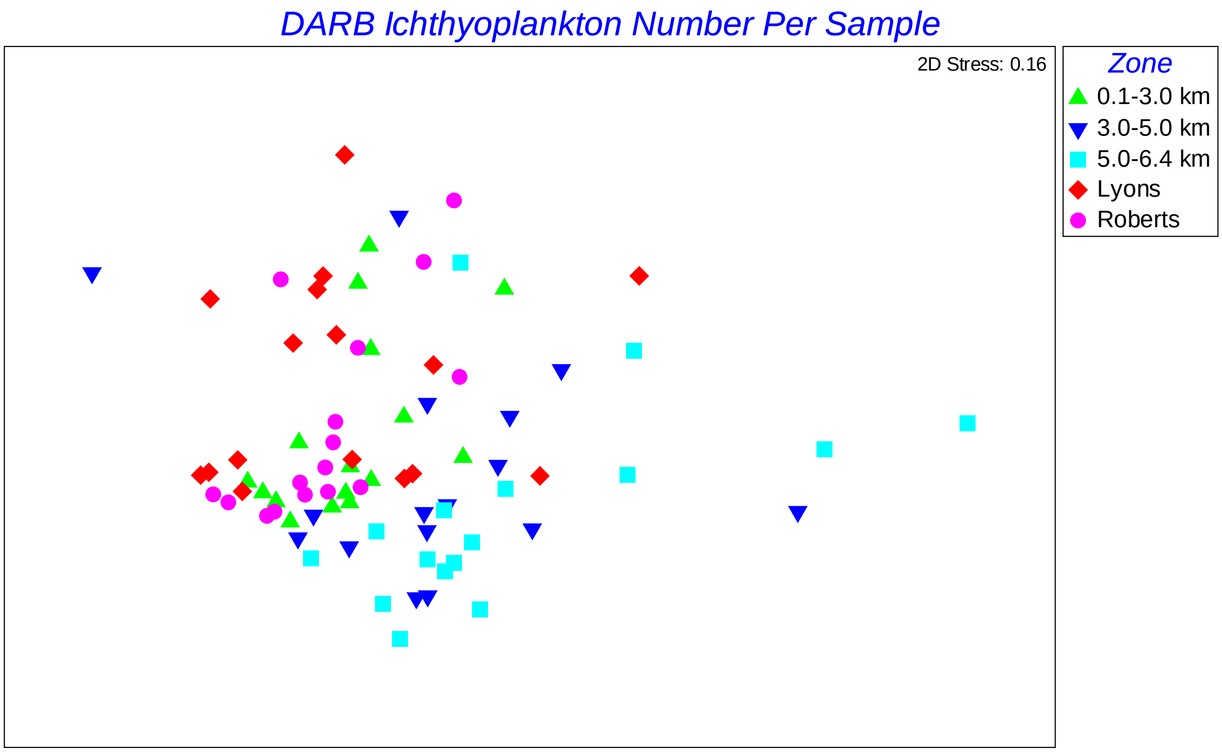


Fig. 3.9.1.2. Relationship between Blackburn Canal inflows and zooplankton community similarity (Bray-Curtis similarity) of Lyons and Roberts Bays. Each data point represents a monthly collection effort.



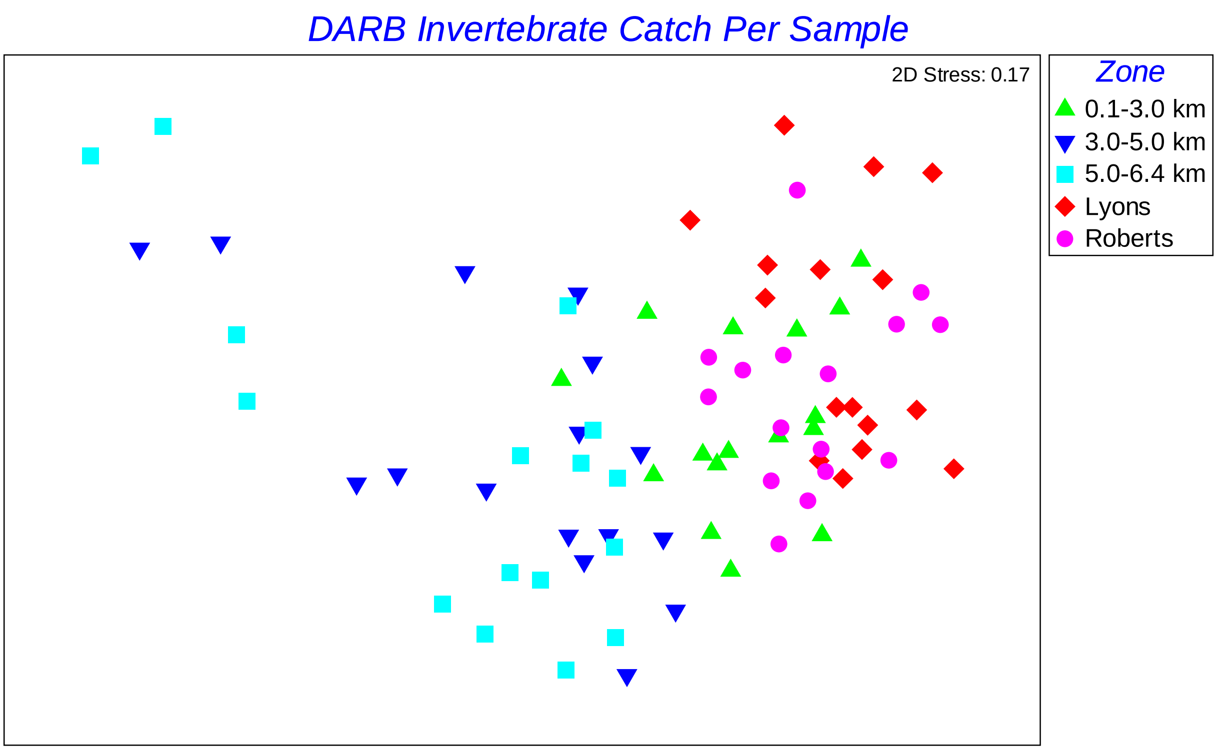


Fig. 3.9.1.3. Nonmetric Multidimensional Scaling (MDS) ordination plot of plankton community structure in the DARB estuary (data averaged by month and year).

Table 3.9.1.1. Analysis of similarities (ANOSIM) of DARB estuary zooplankton community structure. Pairwise ANOSIM *R* values are shown (greater *R* indicates greater difference between the named zones).

Fish		Invertebrates	
Groups	ANOSIM *R*	Groups	ANOSIM *R*
5.0-6.4 km, Roberts	0.297	3.0-5.0 km, Lyons	0.691
0.1-3.0 km, 5.0-6.4 km	0.259	5.0-6.4 km, Lyons	0.663
3.0-5.0 km, Roberts	0.213	3.0-5.0 km, Roberts	0.612
3.0-5.0 km, Lyons	0.197	5.0-6.4 km, Roberts	0.607
0.1-3.0 km, 3.0-5.0 km	0.144	0.1-3.0 km, 5.0-6.4 km	0.415
0.1-3.0 km, Lyons	0.044	0.1-3.0 km, 3.0-5.0 km	0.393
Lyons, Roberts	0.019	0.1-3.0 km, Lyons	0.292
5.0-6.4 km, Lyons	0.290	Lyons, Roberts	0.161
0.1-3.0 km, Roberts	-0.041	0.1-3.0 km, Roberts	0.023
3.0-5.0 km, 5.0-6.4 km	-0.025	3.0-5.0 km, 5.0-6.4 km	-0.023

Table 3.9.1.2. Zooplankton taxa distinguishing spatial zones of the DARB estuary. Only pairwise comparisons with ANOSIM *R* > 0.5 are shown. Top ten taxa contributing to dissimilarity are given for each comparison. Abundance is represented as the square root of catch per sample.

Groups 3.0-5.0 km & Lyons
Average dissimilarity = 76.05

	Group 3.0-5.0 km	Group Lyons				
Taxon	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
decapod zoeae	28.96	31.66	6.81	1.42	8.96	8.96
amphipods, gammaridean	29.89	2.60	6.66	1.62	8.76	17.72
Americamysis almyra	23.74	0.37	5.40	1.25	7.10	24.82
unidentified Americamysis juveniles	23.11	0.80	5.17	1.07	6.80	31.62
Acartia tonsa	6.86	19.90	4.62	1.31	6.08	37.70
chaetognaths, sagittid	3.19	17.30	3.91	1.28	5.14	42.84
Lucifer faxoni juveniles and adults	1.79	16.39	3.84	1.03	5.04	47.88
appendicularian, Oikopleura dioica	0.28	9.92	2.36	0.69	3.11	50.99
Labidocera aestiva	1.77	10.33	2.34	0.91	3.08	54.07
Penilia avirostris	0.00	8.38	1.95	0.54	2.56	56.63

Groups 5.0-6.4 km & Lyons
Average dissimilarity = 79.03

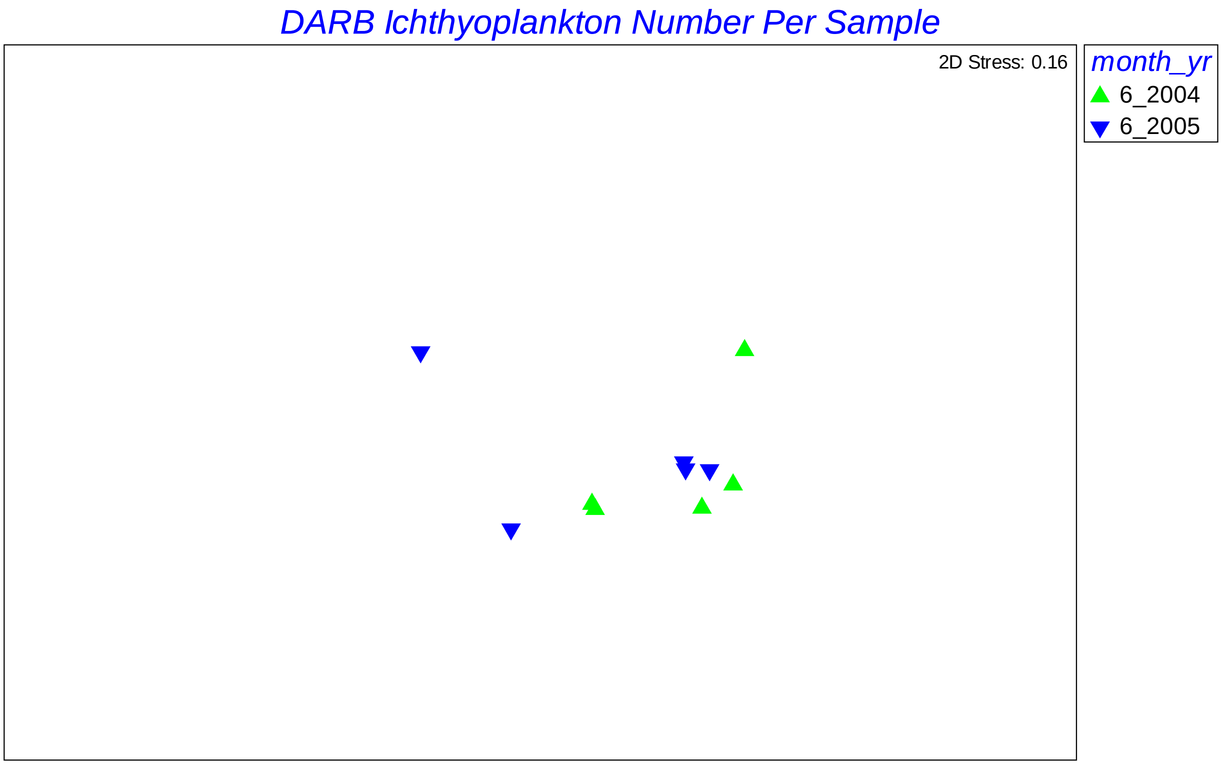
	Group 5.0-6.4 km	Group Lyons				
Taxon	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Americamysis almyra	32.45	0.37	7.36	1.01	9.32	9.32
decapod zoeae	29.08	31.66	6.75	1.27	8.54	17.86
unidentified Americamysis juveniles	21.66	0.80	4.79	0.99	6.07	23.93
Acartia tonsa	10.19	19.90	4.74	1.32	5.99	29.92
amphipods, gammaridean	20.62	2.60	4.49	1.42	5.68	35.60
chaetognaths, sagittid	1.84	17.30	4.19	1.32	5.30	40.90
Lucifer faxoni juveniles and adults	0.74	16.39	4.04	1.05	5.11	46.01
Labidocera aestiva	0.62	10.33	2.42	0.92	3.06	49.06
appendicularian, Oikopleura dioica	0.21	9.92	2.34	0.68	2.96	52.02
dipteran, Chaoborus punctipennis larvae	10.27	0.06	2.24	0.74	2.84	54.86

Groups 3.0-5.0 km & Roberts
Average dissimilarity = 72.02

	Group 3.0-5.0 km	Group Roberts				
Taxon	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
decapod zoeae	28.96	31.62	5.65	1.35	7.85	7.85
amphipods, gammaridean	29.89	11.98	4.45	1.37	6.18	14.03
Labidocera aestiva	1.77	22.10	4.40	1.37	6.11	20.14
Americamysis almyra	23.74	2.08	4.14	1.12	5.75	25.90
Acartia tonsa	6.86	22.22	4.11	1.33	5.71	31.60
unidentified Americamysis juveniles	23.11	2.44	4.07	1.02	5.66	37.26
Lucifer faxoni juveniles and adults	1.79	19.73	3.91	1.07	5.43	42.69
chaetognaths, sagittid	3.19	18.10	3.29	1.20	4.57	47.26
Penilia avirostris	0.00	9.51	2.20	0.72	3.05	50.32
appendicularian, Oikopleura dioica	0.28	9.87	2.09	0.79	2.90	53.22

Groups 5.0-6.4 km & Roberts
Average dissimilarity = 75.87

Taxon	Group 5.0-6.4 km Av.Abund	Group Roberts Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Americamysis almyra	32.45	2.08	5.91	0.98	7.79	7.79
decapod zoeae	29.08	31.62	5.58	1.24	7.36	15.14
Labidocera aestiva	0.62	22.10	4.56	1.43	6.01	21.15
Acartia tonsa	10.19	22.22	4.15	1.36	5.47	26.62
Lucifer faxoni juveniles and adults	0.74	19.73	4.10	1.12	5.40	32.02
unidentified Americamysis juveniles	21.66	2.44	3.78	0.96	4.99	37.01
chaetognaths, sagittid	1.84	18.10	3.50	1.26	4.62	41.62
amphipods, gammaridean	20.62	11.98	3.18	1.34	4.19	45.81
Penilia avirostris	0.04	9.51	2.16	0.71	2.85	48.66
dipteran, Chaoborus punctipennis larvae	10.27	3.60	2.13	0.74	2.81	51.48



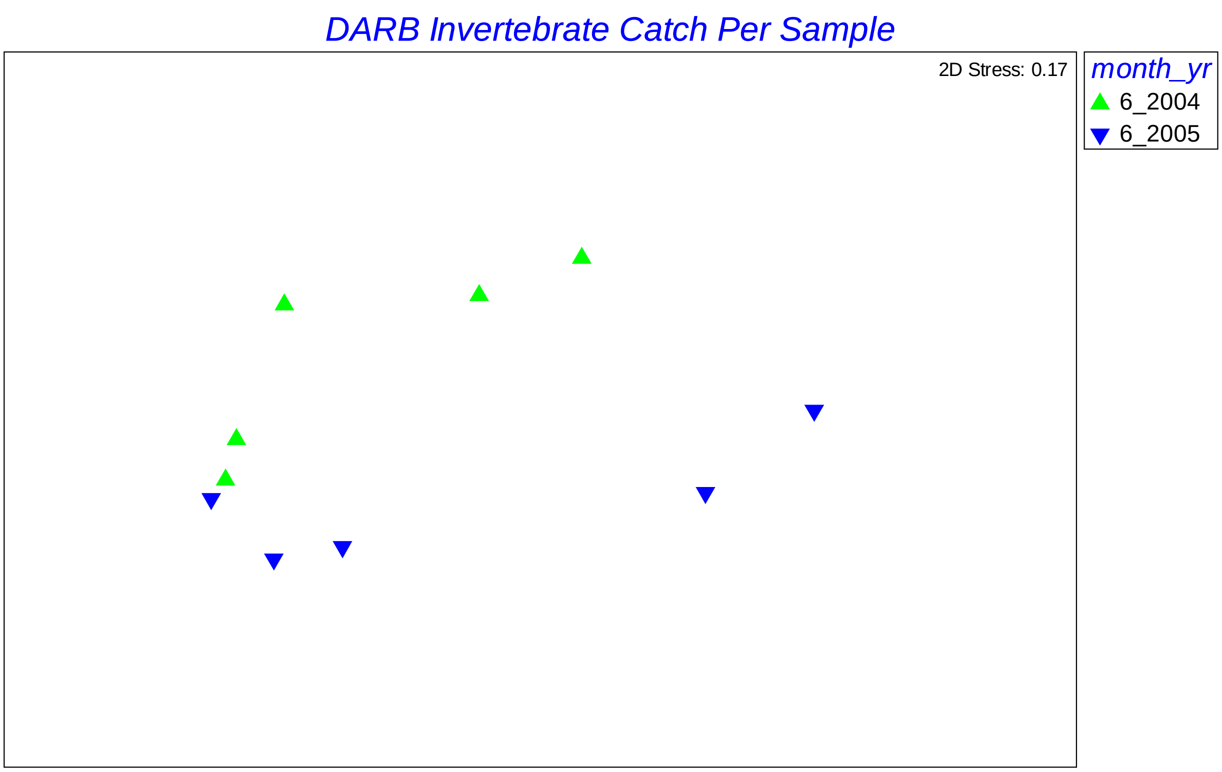


Fig. 3.9.1.4. Nonmetric Multidimensional Scaling (MDS) ordination plot of zooplankton community structure in the DARB estuary on June 2, 2004 (mean CPS inflow: 0.5 cfs) and June 19, 2005 (mean CPS inflow: 120 cfs).

Table 3.9.1.3. Zooplankton taxa that distinguish low- and high-inflow months (June 2004 [6_2004] and June 2005 [6_2005], respectively) in the DARB estuary. Top ten taxa contributing to dissimilarity are given for each comparison.

Ichthyoplankton

Groups 6_2004 & 6_2005
Average dissimilarity = 67.60

	Group 6_2004	Group 6_2005				
Taxon	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
fish eggs, percomorph	15.64	11.67	18.75	1.67	27.73	27.73
Gobiosoma spp. postflexion larvae	7.13	4.27	7.86	1.13	11.63	39.37
gobiid flexion larvae	5.29	2.72	4.98	1.39	7.36	46.73
gobiid preflexion larvae	3.64	1.98	3.12	1.36	4.62	51.35
Anchoa spp. preflexion larvae	0.43	2.23	2.69	1.15	3.97	55.33
clupeid preflexion larvae	1.75	0.20	1.89	1.11	2.80	58.13
Anchoa mitchilli juveniles	1.22	0.00	1.77	0.86	2.62	60.75
Microgobius spp. postflexion larvae	1.35	0.52	1.74	1.15	2.57	63.32
Gobiosoma robustum juveniles	0.00	0.95	1.51	1.01	2.24	65.56
Gobiosoma bosc juveniles	0.00	0.91	1.40	0.86	2.07	67.63

Invertebrates

Groups 6_2004 & 6_2005
Average dissimilarity = 73.20

	Group 6_2004	Group 6_2005				
Taxon	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
decapod zoeae	37.23	15.51	6.53	1.32	8.92	8.92
amphipods, gammaridean	8.01	33.36	6.15	1.75	8.40	17.32
Labidocera aestiva	4.54	29.21	5.99	1.40	8.18	25.50
Lucifer faxoni juveniles and adults	7.21	27.11	5.69	1.27	7.78	33.28
Acartia tonsa	5.14	21.57	4.29	1.49	5.86	39.14
Mnemiopsis mccradyi	8.52	0.00	2.30	0.54	3.14	42.28
cumaceans	12.77	4.06	2.30	1.63	3.14	45.42
medusa sp. a	8.52	0.00	2.13	0.52	2.92	48.33
Americamysis almyra	3.15	8.23	1.78	1.21	2.43	50.76
chaetognaths, sagittid	8.65	1.90	1.74	1.57	2.38	53.14

3.9.2. Seine and trawl

The hypothesized relationship of increased variability in nekton community structure with increasing inflow was rejected in shoreline (seine) habitats (r_S = 0.22, P = 0.414) and also in channel/deeper (trawl) habitats (r_S = -0.061, P = 0.816) (Fig. 3.9.2.2). The similarity of the shoreline nekton communities in Lyons and Roberts Bays significantly decreased as freshwater inflow increased (linear regression, P = 0.032), but this was not true of the deeper areas sampled by trawling (Fig. 3.9.2.2).

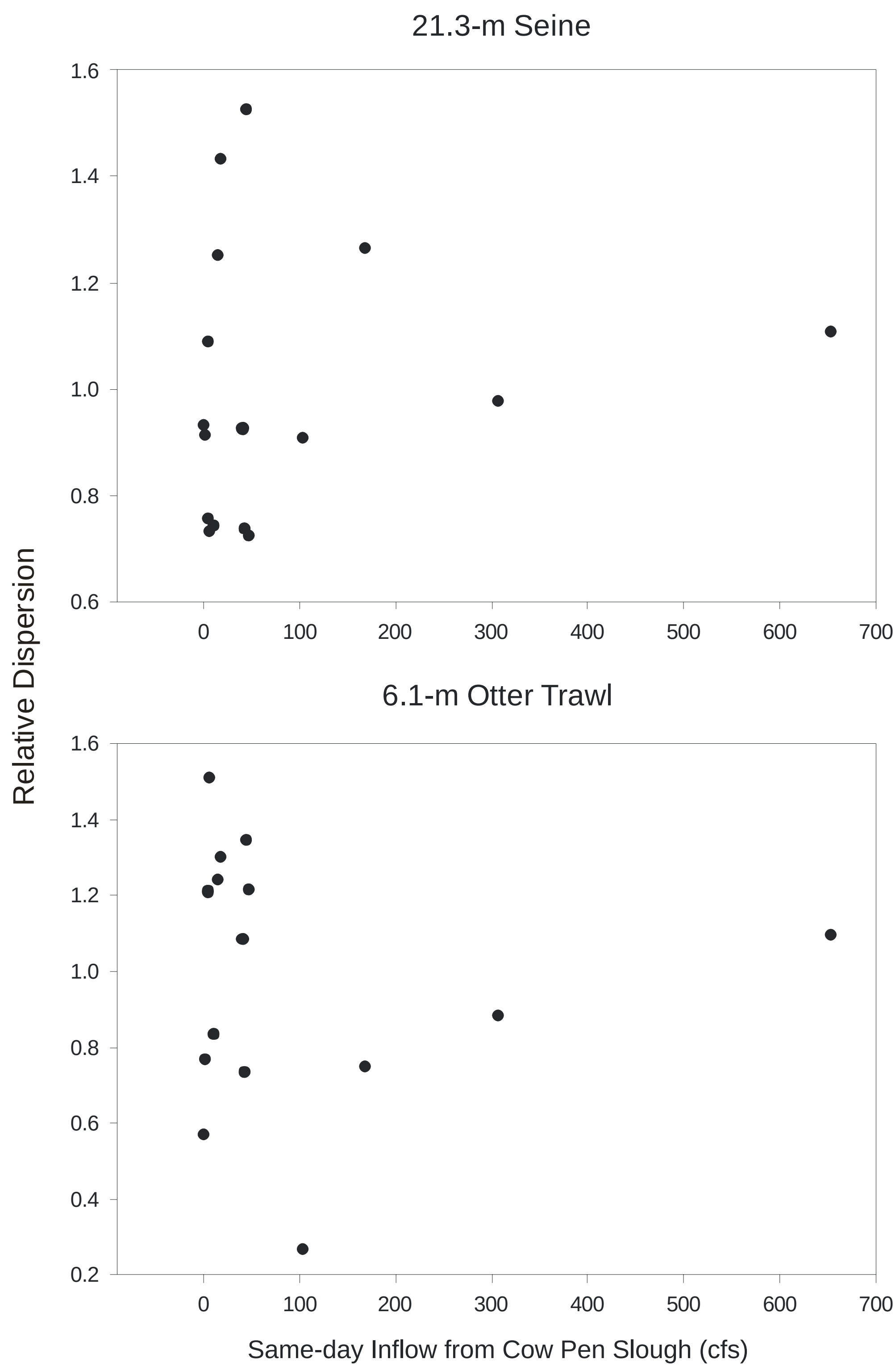


Fig. 3.9.2.1. Relationship between Cow Pen Slough inflows and nekton community variability throughout the DARB estuary (measured as Index of Multivariate Dispersion).

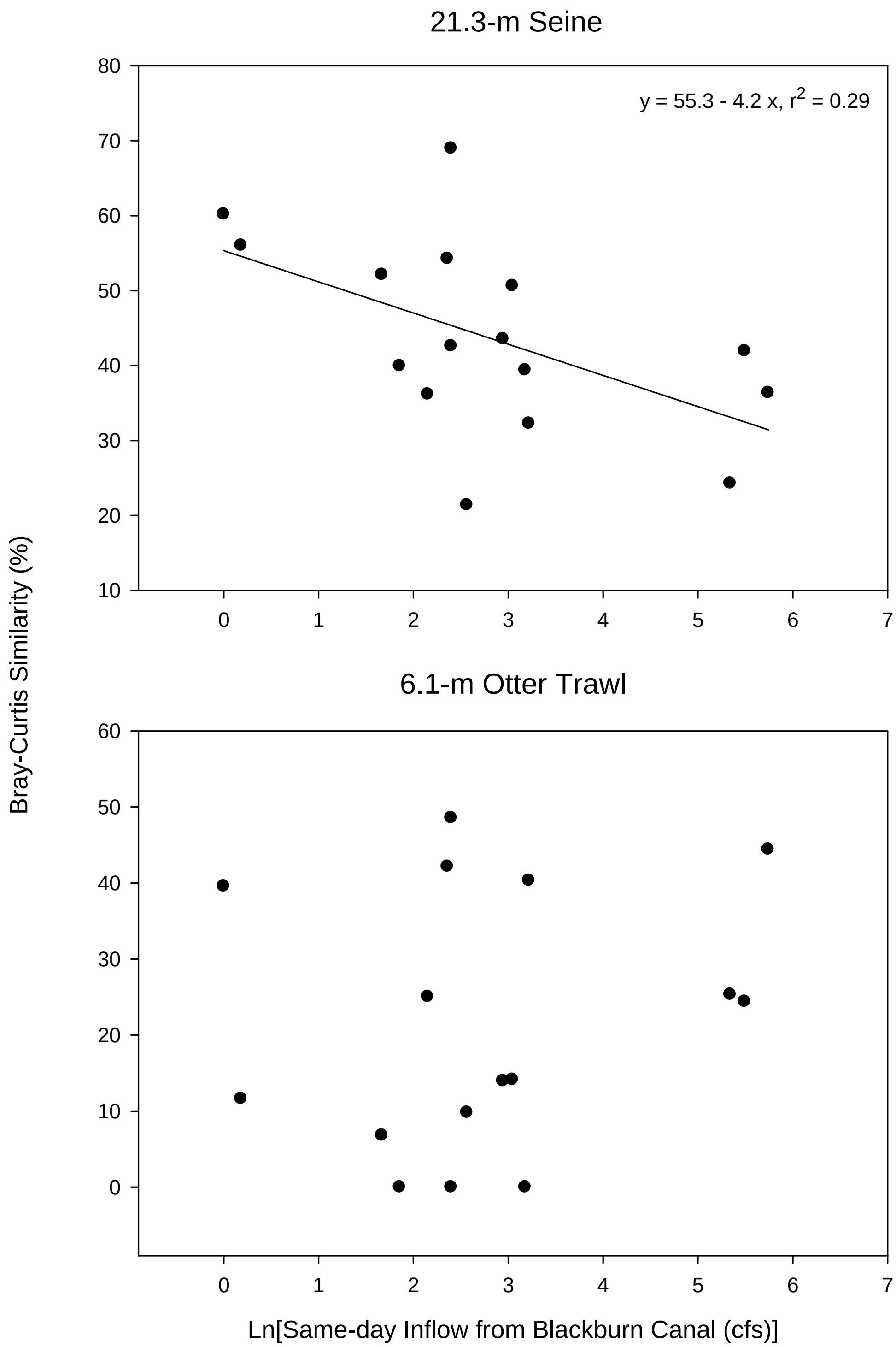
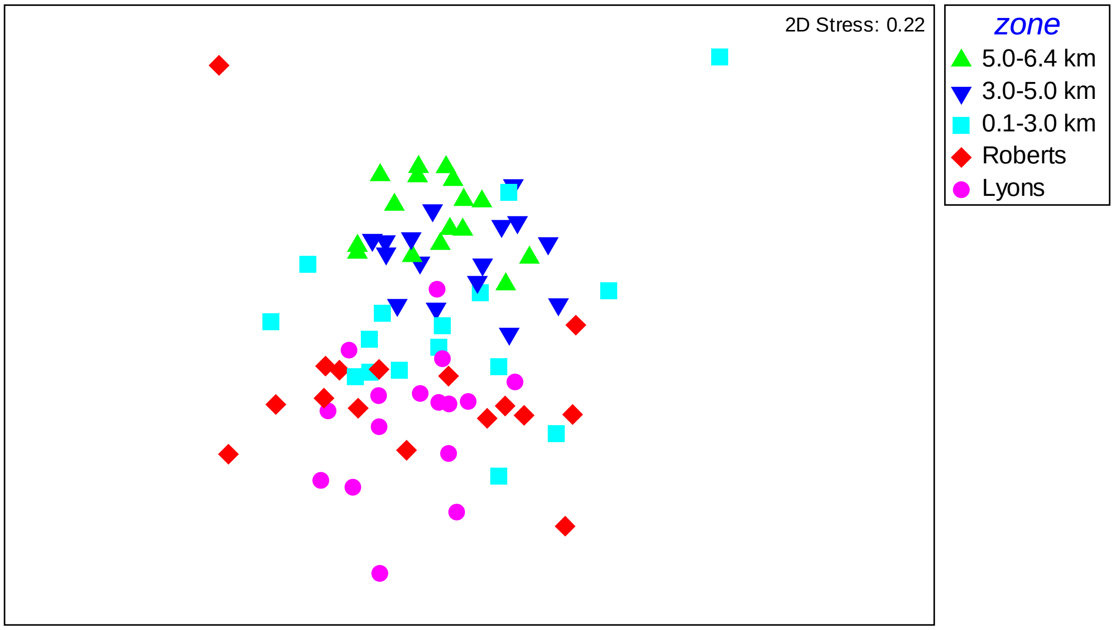


Fig. 3.9.2.2. Relationship between Blackburn Canal inflows and nekton community similarity (Bray-Curtis similarity) of Lyons and Roberts Bays. Each data point represents a monthly collection effort.

There were obvious spatial differences in nekton community structure of the shoreline and deeper portions of the DARB estuary (Fig. 3.9.2.3). In both habitats, the greatest differences in community structure were between the 5.0–6.4 km section of Shakett Creek/Cow Pen Slough and Lyons and Roberts Bays (Fig. 3.9.2.3, Table 3.9.2.1). These differences were attributable to higher abundances of typical low-salinity taxa in the 5.0–6.4 km segment (e.g., *Menidia* spp., *P. pugio*) contrasting with low abundance of these taxa in the bays, but high abundance of estuary-dependent offshore-spawning species such as *L. rhomboides* and *E. gula* in the bays (Table 3.9.2.2). There were minor differences in nekton community structure between Lyons and Roberts Bays, and between these Bays and the 0.1–3.0 km portion of the DARB estuary. Differences in nekton community structure along the axis of Dona Bay-Shakett Creek-Cow Pen Slough were as expected given their relative positions along the estuarine gradient (Fig. 3.9.2.3, Table 3.9.2.1).

21.3-m Seine



6.1-m Otter Trawl

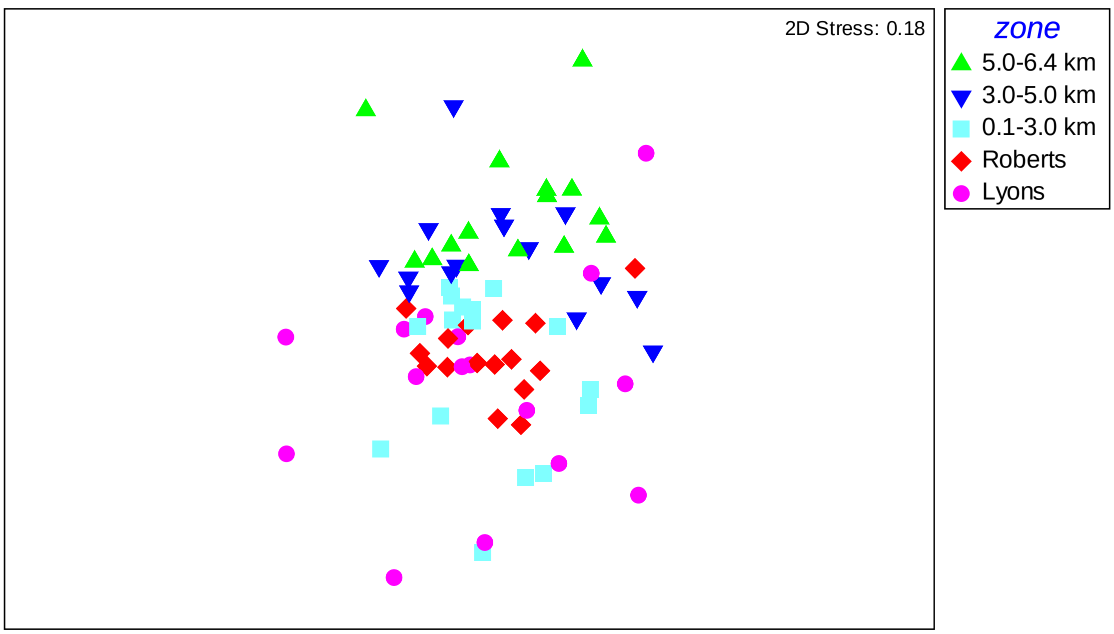


Fig. 3.9.2.3. Nonmetric Multidimensional Scaling (MDS) ordination plot of nekton community structure in the DARB estuary (data averaged by month and year).

Table 3.9.2.1. Analysis of similarities (ANOSIM) of DARB estuary nekton community structure. Pairwise ANOSIM *R* values are shown (greater *R* indicates greater difference between the named zones).

21.3-m Seines

Groups	ANOSIM *R*
5.0-6.4 km, Lyons	0.764
5.0-6.4 km, Roberts	0.636
3.0-5.0 km, Lyons	0.561
5.0-6.4 km, 0.1-3.0 km	0.441
3.0-5.0 km, Roberts	0.440
3.0-5.0 km, 0.1-3.0 km	0.193
0.1-3.0 km, Lyons	0.124
5.0-6.4 km, 3.0-5.0 km	0.072
Roberts, Lyons	0.069
0.1-3.0 km, Roberts	0.061

6.1-m Otter Trawls

Groups	ANOSIM *R*
5.0-6.4 km, Roberts	0.506
3.0-5.0 km, Roberts	0.347
5.0-6.4 km, Lyons	0.335
5.0-6.4 km, 0.1-3.0 km	0.315
3.0-5.0 km, 0.1-3.0 km	0.182
3.0-5.0 km, Lyons	0.133
Lyons, Roberts	0.085
0.1-3.0 km, Roberts	0.084
3.0-5.0 km, 5.0-6.4 km	0.044
Lyons, 0.1-3.0 km	0.010

Table 3.9.2.2. Seine and trawl pseudo-species that distinguish spatial zones of the DARB estuary. Only pairwise comparisons with ANOSIM *R* > 0.5 are shown. Top ten pseudo-species contributing to dissimilarity are given for each comparison. Abundance is represented as the fourth root of catch per sample.

21.3-m Seines

Groups 5.0-6.4 km & Lyons
Average dissimilarity = 74.43%

	Group 5.0-6.4 km	Group Lyons				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
E. gula 40-70 mm	0	1.74	5.37	2.01	7.22	7.22
Menidia spp.	1.87	0.61	4.49	1.7	6.03	13.25
L. rhomboides >30 mm	0.18	1.41	3.95	1.65	5.31	18.56
M. gulosus	1.36	0.13	3.9	1.84	5.24	23.79
Eucinostomus spp.	2.55	2.16	3.36	1.18	4.51	28.31
P. pugio	0.99	0	2.88	0.87	3.88	32.18
H. jaguana	0	1.03	2.88	0.65	3.87	36.05
E. gula >70 mm	0	0.75	2.46	0.98	3.3	39.36
E. harengulus	1.24	0.83	2.3	1.27	3.09	42.45
A. mitchilli >35 mm	0.29	0.65	2.24	0.56	3.01	45.46

Groups 5.0-6.4 km & Roberts
Average dissimilarity = 76.53%

	Group 5.0-6.4 km	Group Roberts				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Menidia spp.	1.87	0.15	6.03	2.09	7.88	7.88
M. gulosus	1.36	0.04	4.76	1.81	6.22	14.1
E. gula 40-70 mm	0	1.32	4.59	1.57	5.99	20.09
Eucinostomus spp.	2.55	1.76	4.45	1.12	5.81	25.9
P. pugio	0.99	0.07	3.26	0.87	4.26	30.16
A. mitchilli 26-35 mm	0.17	0.99	2.81	0.69	3.67	33.82
A. mitchilli >35 mm	0.29	0.87	2.79	0.81	3.65	37.47
E. harengulus	1.24	1.04	2.57	1.08	3.36	40.83
L. rhomboides <31 mm	0.36	0.64	2.22	1.05	2.9	43.73
T. maculatus	0.62	0.03	2.22	0.9	2.9	46.63

Groups 3.0-5.0 km & Lyons
Average dissimilarity = 70.78%

	Group 3.0-5.0 km	Group Lyons				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
E. gula 40-70 mm	0.12	1.74	5.26	1.8	7.44	7.44
Menidia spp.	1.17	0.61	3.47	1.12	4.91	12.34
L. rhomboides >30 mm	0.68	1.41	3.18	1.27	4.5	16.84
Eucinostomus spp.	2.3	2.16	3.08	1.23	4.35	21.19
E. harengulus	1.45	0.83	3.02	1.44	4.27	25.47
H. jaguana	0.04	1.03	2.99	0.66	4.22	29.69
M. gulosus	1.03	0.13	2.96	1.36	4.18	33.86
E. gula >70 mm	0	0.75	2.53	0.97	3.58	37.44

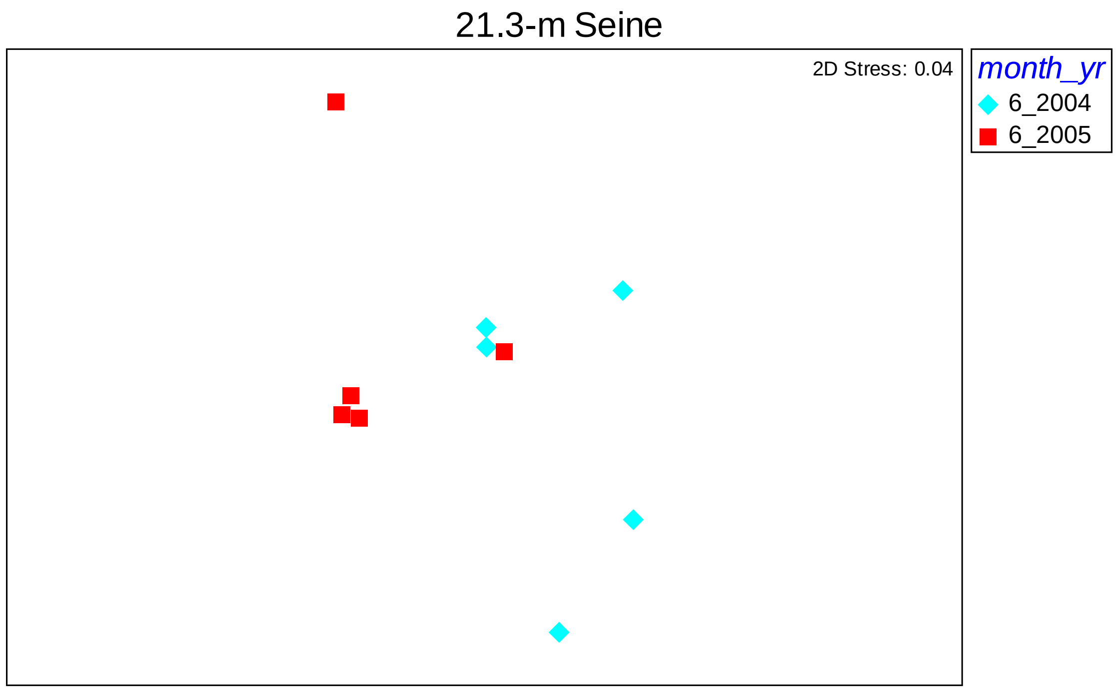
L. rhomboides <31 mm	0.55	0.62	2.45	1.12	3.46	40.9
A. mitchilli >35 mm	0.34	0.65	2.37	0.58	3.35	44.24

6.1-m Otter Trawls

Groups 5.0-6.4 km & Roberts
Average dissimilarity = 87.00%

	Group 5.0-6.4 km	Group Roberts				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Eucinostomus spp.	0.77	0.89	6.15	1.22	7.07	7.07
T. maculatus	0.5	0.08	3.37	0.75	3.88	10.95
C. sapidus >30 mm	0.39	0.68	3.31	1.03	3.8	14.75
E. plumieri	0.43	0.08	3.02	0.86	3.47	18.22
F. duorarum <11 mm	0.19	0.5	2.99	0.99	3.43	21.65
L. rhomboides <31 mm	0.04	0.54	2.98	0.9	3.43	25.08
S. foetens	0	0.49	2.94	1.11	3.38	28.46
F. duorarum >10 mm	0.29	0.38	2.8	0.9	3.22	31.68
C. undecimalis	0.42	0	2.78	0.85	3.2	34.88
P. albigutta	0	0.37	2.42	0.93	2.78	37.66

Although somewhat overlapping, the nekton community structure tended to differ between the low-inflow June of 2004 and the high-inflow June of 2005 (Fig. 3.9.2.4). Low-salinity species (e.g., *Menidia* spp., *M. gulosus*, *P. longicaudatus*, and *A. probatocephalus*) were more abundant during high inflows, while species that tend to occur in higher in salinities (e.g., *F. duorarum* and *L. rhomboides*) were more abundant during lower inflows (Table 3.9.2.3).



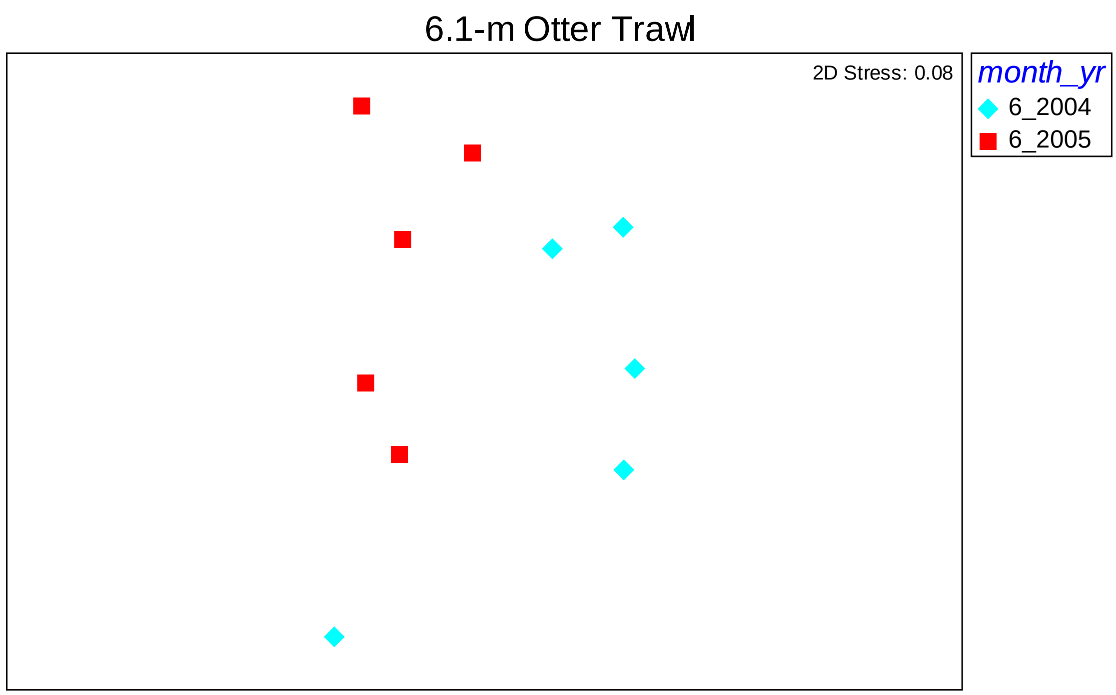


Fig. 3.9.2.4. Nonmetric Multidimensional Scaling (MDS) ordination plot of nekton community structure in the DARB estuary on June 16, 2004 (mean CPS inflow: 11 cfs) and June 9, 2005 (mean CPS inflow: 331 cfs).

Table 3.9.2.3. Seine and trawl pseudo-species distinguishing low- and high-inflow months (June 2004 [6_2004] and June 2005 [6_2005], respectively) in the DARB estuary. Top ten pseudo-species contributing to dissimilarity are given for each comparison.

21.3-m Seines

Groups 6_2004 & 6_2005
Average dissimilarity = 73.25%

	Group 6_2004	Group 6_2005				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Menidia spp.	1.03	2.17	6.15	1.58	8.4	8.4
Eucinostomus spp.	1.85	1.76	5.63	0.84	7.69	16.08
H. jaguana	1.16	0	4.36	0.66	5.96	22.04
M. gulosus	0.6	0.97	3.47	1.24	4.73	26.77
C. sapidus <31 mm	0	1	3.33	1.46	4.55	31.32
L. rhomboides >30 mm	0.9	0.79	3.29	1.22	4.49	35.81
E. harengulus	0.65	0.52	2.94	0.87	4.02	39.83
Gobiosoma spp.	0	0.83	2.76	1.16	3.77	43.6
F. duorarum <11 mm	0.64	0.2	2.49	1.54	3.4	47
A. probatocephalus	0.1	0.72	2.41	1.23	3.29	50.29

6.1-m Otter Trawls

Groups 6_2004 & 6_2005
Average dissimilarity = 92.36%

	Group 6_2004	Group 6_2005				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Eucinostomus spp.	1.13	0.12	8.22	0.98	8.9	8.9
P. longicaudatus	0	0.78	7.5	0.95	8.12	17.02
C. sapidus >30 mm	0.35	0.52	4.4	1.02	4.76	21.79
G. robustum	0	0.44	4.25	0.92	4.6	26.39
F. duorarum <11 mm	0.53	0.27	4.21	1.04	4.56	30.95
A. probatocephalus	0.12	0.39	3.69	0.83	3.99	34.94
C. sapidus <31 mm	0	0.41	3.48	0.93	3.77	38.71
S. laevigata	0	0.36	3.23	0.56	3.5	42.21
T. maculatus	0.12	0.16	2.84	0.63	3.07	45.28
Gobiosoma spp.	0	0.3	2.77	0.62	3	48.28

4.0 CONCLUSIONS

4.1 Descriptive Observations

1.) **Dominant Catch.** The plankton-net catch was dominated by larval gobies and anchovies. Gobies of the genus *Gobiosoma* were more abundant than gobies of the genus *Microgobius*, and the anchovies were dominated by the bay anchovy (*Anchoa mitchilli*). Other common fishes included the scaled sardine (*Harengula jaguana*), Eucinostomus mojarras (*Eucinostomus* spp.), freshwater shads (*Dorosoma* spp.) and sand seatrout (*Cynoscion arenarius*).

The plankton-net invertebrate catch was dominated by larval crabs (decapod zoeae), the mysid *Americamysis almyra*, gammaridean amphipods, the planktonic copepods *Acartia tonsa* and *Labidocera aestiva*, the planktonic shrimp *Lucifer faxoni*, chaetognaths and the larvacean *Oikopleura dioica*. Together, these taxa comprised 80% of the plankton-net invertebrate catch.

Seine fish collections were dominated by bay anchovy, eucinostomus mojarras, scaled sardine, spanish sardine, silversides, Cuban anchovy, pinfish, silver jenny, and tidewater mojarra; trawl catches were dominated by eucinostomus mojarras, pinfish, silver jenny, and Cuban anchovy. Invertebrates collected by seines were dominated by daggerblade grass shrimp, pink shrimp, and blue crab; invertebrate trawl catches primarily consisted of pink shrimp, longtail grass shrimp, and blue crab.

2.) **Use of Area as Spawning Habitat.** The eggs of unidentified herrings (clupeids), the scaled sardine (*Harengula jaguana*), the Atlantic thread herring (*Opisthonema oglinum*), the bay anchovy (*Anchoa mitchilli*), the striped anchovy (*A. hepsetus*) and unidentified sciaenid fishes were collected from the DARB survey area. All of these eggs were relatively abundant in Roberts Bay and Venice Inlet. If the abundance of early larvae is proportionate to the abundance of eggs, then silver perch (*Bairdiella chrysoura*), seatrouts (*Cynoscion arenarius* and *C. nebulosus*) and kingfishes (*Menticirrhus* spp.) are the sciaenid fishes that are most likely to have spawned in this area; the earliest larval stages of these species were most abundant in Roberts Bay and near Venice Inlet. Blennies (blenniids) and the hogchoker (*Trinectes maculatus*) spawned near Venice Inlet and possibly other seaward parts of the DARB survey area. Skilletfish (*Gobiesox strumosus*) and gobies (*Bathygobius soporator*, *Gobiosoma* spp. and *Microgobius* spp.) spawned toward the landward side of the DARB survey area within upper Dona Bay and Shackett Creek. The repeated collection of small juveniles of live-bearing gulf pipefish (*Syngnathus scovelli*), chain pipefish (*S. louisianae*) and lined seahorse (*Hippocampus erectus*) is an indication that these species reproduced near or within the study area.

3.) **Use of Area as Nursery Habitat.** Estuary-dependent nearshore or offshore-spawning taxa using the study area as a nursery comprised the majority of the common nekton taxa: overall, six of the ten most abundant taxa in deeper (trawled) habitats and seven of the ten most abundant taxa in nearshore (seined) habitats could be considered estuary-dependent. The remaining abundant taxa were estuarine spawners or tidal-river residents. The dependents included taxa of commercial importance (i.e., blue crab and pink shrimp) and taxa of ecological importance due to high abundance (i.e., pinfish, eucinostomus mojarras, tidewater mojarra, and silver jenny). The juvenile nursery habitats for selected species were characterized from seine and trawl data in terms of preference for shallower or deeper areas, zone of the study area, type of shoreline, and salinity (Appendices D and E).

4.) **Plankton Catch Seasonality.** Alteration of flows would appear to have the lowest potential for impacting many taxa during the period from November through February, which is the period when the fewest estuarine taxa were present. The highest potential to impact many species would appear to be from June through October. Some species were present throughout the year (bay anchovy), whereas others had more seasonal spawning and recruitment patterns.

5.) **Seine and Trawl Catch Seasonality.** Based on seine or trawl collections, few clear seasonal patterns of taxon richness were evident in the DARB estuary, which may be attributed to both the relatively short duration of sampling and the unusual hydrological conditions encountered during the study. Nevertheless, some trends could be detected. Monthly taxon richness in seined areas was highly variable, with no consistently high periods during the study period; in deeper (trawled) habitats, the November–February period had greatest taxon richness. Overall abundances and abundances of new recruits of nekton taxa indicate extensive use of the study area during all months. The seasonal succession of species may allow the DARB estuary to annually support a greater abundance of animals than if all species were present simultaneously. Peaks for tidal-river residents occurred in late spring/early summer. Estuarine and nearshore spawners tended to have peak periods of abundance in summer, whereas offshore spawners had most peaks in abundance in winter and late spring. Among new recruits, peak recruitment periods varied somewhat between life-history categories: offshore spawners tended to recruit in winter and late summer, nearshore spawners' peaks of recruitment were in summer and winter, estuarine spawners recruitment peaks were in spring and summer, and peaks in residents' recruitment were in late spring and winter. Therefore we conclude that alteration of flows at any time of the year will inevitably have the potential to affect some species.

4.2 Responses to Freshwater Inflow

1.) **Plankton Catch Distribution Responses.** Twenty-eight (49%) of the 57 plankton-net taxa evaluated for distribution responses to freshwater inflow exhibited significant responses. All were negative responses, wherein animals moved upstream as inflows decreased. Upstream movement is the typical response to reduced inflows observed in estuaries on Florida's west coast. Time lags associated with these responses were variable, but most taxa responded to inflow within days or weeks.

Detection of distribution responses to Cow Pen Slough inflows was complicated by concurrent inflows from the Blackburn Canal into Roberts Bay. Nevertheless, approximately half of the observed responses had r^2 values >50%, and these strong responders were dominated by estuarine, rather than freshwater, taxa.

2.) **Seine and Trawl Catch Distribution Responses.** For seine and trawl data, nearly 60% of the 19 pseudo-species evaluated for distributional responses to freshwater inflow exhibited a significant response for at least one lagged flow period. The best models tended to involve long lag periods. Less than half (45%) of the significant responses were negative (i.e., animals moved upstream with decreasing freshwater inflow), in marked contrast to previous studies where the great majority of responses were negative. Typically, pseudo-species' centers of abundance shift downstream during periods of higher inflow because individuals occupy areas with suitable salinities or food sources. In the present study, the majority of sampling events occurred when inflows were considerably less than average. It is possible that inflows were so low during the sampling period that the relatively small quantities of freshwater entering the system had the effect of attracting many animals upstream (towards the nutrient sources) rather than downstream into the higher-salinity portion of the system.

3.) **Plankton Catch Abundance Responses.** Sixteen (28%) of the 57 plankton-net taxa evaluated for abundance relationships with freshwater inflow exhibited significant responses. Six were positive responses and ten were negative. Nine of the ten negative responses involved taxa that exhibited significant downstream movement in response to inflow, suggesting that the reductions in abundance were caused by movement into either the Gulf or adjacent bays.

Four of the six taxa with positive inflow responses were insect larvae

(*Chaoborus punctipennis*, trichopteran larvae, chironomid larvae, dipteran pupae), which are primarily freshwater, but may contain estuarine species. These taxa had positive responses to freshwater inflow because they were introduced into the study area by freshwater inflows.

Two estuarine taxa had positive responses: preflexion anchovy larvae and the tanaid *Hargeria rapax*. The larval anchovy lags were most highly significant at 4 d, but remained highly significant for lags of up to several weeks duration, which places this response within the same time frame as a positive population (spawning) response to inflows. Lags associated with *Hargeria rapax*'s abundance response (67 d) were also within a time frame that could represent population responses to inflow.

4.) **Seine and Trawl Catch Abundance Responses.** For seine and trawl data, 70.4% of the 27 pseudo-species considered demonstrated significant relationships between abundance and average inflow. The majority of these responses were non-linear. All linear models were negative relationships, indicating increasing abundance with decreasing inflow. The most common quadratic relationship (nearly 47% of significant quadratic relationships) suggested lowest abundance at intermediate inflows ('intermediate-minimum'). The percentage of significant abundance responses to inflow ranged from 57% of tested pseudo-species in estuarine spawners to 82% in offshore spawners. Nearshore spawners most commonly exhibited negative relationships to flow, whereas there were no clearly evident trends discernible for the other life-history categories. Best-fitting regression models incorporated medium or longer lags for all life-history categories. The ten strongest abundance-inflow relationships included pseudo-species from all life-history categories and 90% of these were analyses conducted on data collected by trawl in the channel habitat. Relationships of abundance to flow in these ten pseudo-species were positive, negative, intermediate-minimum, or intermediate-maximum. An increase in abundance with increased flow may suggest beneficial aspects of increased nutrient input, for example, or perhaps better detection of the tidal-river nursery area. Intermediate-minimum relationships are difficult to explain in ecological terms. Intermediate-maximum relationships may indicate that opportunities for either chemical detection of tidal nursery habitats or selective tidal-stream transport may be reduced at low flows, and at high flows, physical displacement may occur, or perhaps undesirable properties of fresher water (e.g., low pH) become more prominent.

4.3 Community Structure

Salinity variability within the study area increased as freshwater inflow increased, reaching an asymptote at about 100 cfs. This observation is relevant to some of the community structure responses to inflow.

1.) **Plankton Catch Community Analyses.** Zooplankton community structure throughout the DARB estuary was most spatially uniform when inflows were reduced and was most spatially variable when inflows were elevated. High levels of spatial heterogeneity in community structure appeared to be maintained at inflow levels >100 cfs. A gradient in community structure existed along the axis from Venice Inlet through Dona Bay and into Shakett Creek, with the structure in the two upstream zones (3.0-5.0 and 5.0-6.4 km) being significantly different from those of the downstream zone (1.0-3.0 km) and the two lateral bays (Roberts Bay and Lyons Bay). These differences were stronger for invertebrate zooplankton than for ichthyoplankton. The two upstream zones had higher abundances of mysids and amphipods, which are important prey for juvenile estuary-dependent fishes, and the downstream zones had higher abundances of copepods, which are important prey for fish larvae and adult zooplanktivorous fishes such as anchovies, sardines and herring. From the perspective of the entire survey period, community differences between the downstream zone and the two lateral bays were minor. The Intracoastal Waterway is likely to have unified the faunal compositions of these two bays to some extent, and reproductive seasonalities and other biological factors are likely to have masked some of the variability caused by inflow. However, when the confounding effects of seasonality were removed by comparing June data from dry (2004) and wet (2005) years, there was a significant difference in invertebrate community structure between Lyons and Roberts Bays. The difference was caused by increased abundances of fish prey organisms (amphipods, copepods and mysids) and decreased abundances of gelatinous predators (ctenophores, hydromedusae and chaetognaths) during the wetter year. Important prey taxa such as the mysids, gammaridean amphipods and bay anchovy juveniles were more abundant in Roberts Bay than Lyons Bay and also favored the landward end of the principal estuarine axis.

2.) **Seine and Trawl Catch Community Analyses.** Although an increase in inflow to the DARB estuary increased salinity variability within the study area, there was not an accompanying increase in variability of nekton community structure in either seined or trawled areas. This may have been because the range of inflows was rather limited (see above). Comparison of nekton-community similarity between Lyons and Roberts Bays revealed that, at least in the case of the shoreline (seined) species, similarity declined as inflow (from the Blackburn Canal) increased. This reflects the relative stability of physicochemical conditions in Lyons Bay, which has no major freshwater inflow, in contrast to Roberts Bay, which undergoes substantial alteration of ambient conditions when receiving freshwater inflow from the Blackburn Canal. Comparison of nekton community structure in June 2004 (a low-inflow period) and June 2005 (a high-inflow period) showed that the overall nekton community responded to inflows by increased abundance of low-salinity species as the quantity of inflow increased. Comparing the same period of the year over several years with different inflows is desirable because the suite of species occupying the estuary would be expected to be similar between years, based on predictable seasonal species turnover. The spatial differences in nekton community structure were as expected given the relative positions of the different sampling zones and their respective physicochemical conditions, especially salinity. Thus, the upper portion (5.0–6.4 km) of Shakett Creek/Cowpen Slough was most different from Lyons and Roberts Bays, due to its high abundance of low-salinity species and low abundance of high-salinity species. There was little difference in the community structure between Lyons Bay, Roberts Bay, and the 0.1–3.0-km portion of Dona Bay/Shakett Creek.

4.4 Synthesis

The estuarine fauna demonstrated a distributional affinity for the two point sources of freshwater inflow (Cow Pen Slough and the Blackburn Canal). This was evident in community structure and in the distributions of individual species. When the effects of reproductive seasonality were controlled, increased freshwater inflows were associated with changes in the community structure of Roberts Bay relative to Lyons Bay, affecting shoreline fish community structure, increasing fish prey abundance and decreasing gelatinous predator abundance within Roberts Bay. However, fewer successful models of abundance response to inflow were developed relative to similar studies conducted elsewhere. This could be the result of (1) the short duration of the study period, (2) inflow levels that were atypically low, or (3) a high degree of temporal and spatial irregularity in inflow's effects. If erratic inflows cause areas of increased prey productivity to be short-lived and geographically inconsistent, then the transfer of biomass to young fish and crustaceans will be inefficient. Erratic inflows also cause irregularity in the delivery of chemical habitat cues to coastal waters, thereby reducing the utility of these cues to migrating organisms seeking productive nursery habitat. Distributional responses to inflow into the DARB estuary were somewhat anomalous. Typical distribution responses were observed, wherein organisms moved upstream with decreasing inflow, yet the opposite was equally common - a large proportion of seine and trawl taxa moved upstream during elevated flows. None of the taxa in the plankton survey exhibited this response, which suggests that the mechanism involves active behavior rather than passive advection. Freshwater inflows appear to be serving as an attractant to estuarine fish and crustaceans in the DARB estuary, but perhaps without providing the usual trophic benefits. A less erratic inflow regime may therefore result in more efficient production of estuarine fish and crustaceans.

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Appendix A:

Plankton data summary tables

Table A1, page 1 of 7.

Plankton-net catch statistics (March 2004 through June 2005, n=160 samples).

Organisms are listed in phylogenetic order.

Roberts and Lyons Bays were excluded from Kmu calculations.

Taxon	Common Name	Number Collected	Collection Frequency	*Kmu* (km)	*Su* (psu)	Mean CPUE (No./10^3 m^3)	Max CPUE (No./10^3 m^3)
foraminiferans	foraminiferans	231	16	0.2	32.4	19.39	1795.68
Liriope tetraphylla	hydromedusa	1418	23	2.4	26.5	117.62	9285.07
Clytia sp.	hydromedusa	5264	56	4.3	16.4	440.60	15020.74
medusa sp. a	hydromedusa	3326	25	4.7	27.0	304.71	44855.53
medusa sp. b	hydromedusa	5033	39	4.6	20.8	423.77	38265.94
medusa sp. c	hydromedusa	1495	15	0.6	32.0	120.82	7033.31
medusa sp. d	hydromedusa	153	8	3.8	14.8	12.45	696.65
medusa sp. e	hydromedusa	12891	8	5.2	24.6	1118.87	96918.35
medusa, Bougainvillia sp.	hydromedusa	237	9	0.5	32.1	21.02	682.74
medusa, Eutima sp.	hydromedusa	4	2	0.0	22.9	0.35	42.76
medusa, Hydrocodon forbesi	hydromedusa	34	1	0.3	34.3	3.22	515.85
medusa, Obelia sp.	hydromedusa	25	5	2.5	28.7	2.16	140.69
siphonophores	siphonophores	99	10	0.4	33.0	8.55	899.38
scyphozoan ephyrae	jellyfish larvae	76	9	3.6	26.9	6.53	392.24
Chrysaora quinquecirrha	sea nettle	5	3	0.1	29.4	0.42	40.02
Aurelia aurita	moon jellyfish	12	3	3.4	25.0	0.98	83.91
Mnemiopsis mccradyi	comb jelly, ctenophore	3657	25	3.1	28.1	326.49	37559.96
Beroe ovata	sea walnut, ctenophore	2	1	3.5	29.9	0.18	28.19
turbellarians	flatworms	1	1	0.0	34.4	0.08	12.24
nematodes	roundworms, threadworms	22	8	0.8	30.5	1.83	108.83
polychaetes	sand worms, tube worms	5261	138	0.7	25.7	468.81	33484.08
oligochaetes	freshwater worms	102	13	4.7	1.2	8.53	349.82
hirudinoideans	leeches	35	16	4.6	16.2	3.00	103.15
cladocerans, Daphnia spp.	water fleas	3761	12	5.7	17.4	312.43	30058.86
Simocephalus vetulus	water flea	2332	25	4.8	0.4	195.47	10870.15
Ceridodaphnia sp.	water flea	17	5	4.7	11.8	1.45	106.94
Bunops sp.	water flea	3	1	5.1	0.1	0.25	39.95
Grimaldina brazzai	water flea	41	5	4.2	0.2	3.46	226.48
Ilyocryptus sp.	water flea	197	15	3.8	0.6	16.65	571.08
Sida crystallina	water flea	4446	10	4.3	0.7	371.13	18535.29
Penilia avirostris	water flea	29641	51	0.3	33.4	2584.12	72323.81
Pseudosida bidentata	water flea	5	1	5.1	0.1	0.42	66.58
Latonopsis fasciculata	water flea	358	9	4.7	0.1	30.49	1824.30
Kurzia longirostris	water flea	97	5	4.9	0.3	8.10	588.69
Leydigia sp.	water flea	11	3	3.8	0.3	0.88	100.29
Evadne tergestina	water flea	47	10	0.2	28.3	4.73	370.43
decapod zoeae	crab larvae	245417	155	2.2	25.6	20704.06	232623.75
decapod mysis	shrimp larvae	21744	153	1.3	25.9	1789.89	16502.95
decapod megalopae	post-zoea crab larvae	15060	127	2.5	20.3	1266.09	15933.60
shrimps, unidentified postlarvae	shrimps	13	4	0.2	29.0	1.27	83.19
shrimps, unidentified juveniles	shrimps	3	2	1.1	26.7	0.27	29.45
penaeid postlarvae	penaeid shrimps	1	1	0.0	32.6	0.08	13.54
penaeid metamorphs	penaeid shrimps	1728	56	0.6	24.9	151.79	5950.30
Farfantepenaeus duorarum juveniles	pink shrimp	93	23	1.3	13.9	7.85	351.87
sicyoniid postlarvae	rock shrimps	70	8	0.3	27.7	6.42	386.87
sicyoniid juveniles	rock shrimps	7	2	0.3	31.5	0.58	65.44
Sicyonia laevigata juveniles	rock shrimp	4	2	0.5	34.1	0.34	41.86
Lucifer faxoni mysis	shrimp	5064	8	0.3	33.8	390.03	62015.56
Lucifer faxoni juveniles and adults	shrimp	43553	111	0.2	30.9	3545.86	75932.71
Leptochela serratorbita postlarvae	combclaw shrimp	32	3	0.0	25.5	4.00	514.49
Leptochela serratorbita juveniles	combclaw shrimp	19	5	0.1	27.2	2.11	226.38
Palaemonetes spp. postlarvae	grass shrimp	3226	93	3.8	16.8	270.80	3834.85
Palaemonetes pugio juveniles	daggerblade grass shrimp	145	48	3.3	13.3	12.26	272.05
Palaemonetes pugio adults	daggerblade grass shrimp	21	10	4.1	6.8	1.75	87.75
Palaemonetes vulgaris juveniles	grass shrimp	13	4	1.0	16.2	1.06	76.46
Palaemonetes vulgaris adults	grass shrimp	2	2	0.8	15.0	0.16	13.53
Periclimenes spp. postlarvae	shrimps	6	3	0.6	25.7	0.51	39.26
Periclimenes spp. juveniles	shrimps	124	4	0.6	26.9	10.30	693.71
Periclimenes americanus adults	American grass shrimp	3	1	0.0	24.4	0.24	37.88

Table A1, page 2 of 7.

Plankton-net catch statistics (March 2004 through June 2005, n=160 samples).

Organisms are listed in phylogenetic order.

Roberts and Lyons Bays were excluded from Kmu calculations.

Taxon	Common Name	Number Collected	Collection Frequency	*Kmu* (km)	*Su* (psu)	Mean CPUE (No./10^3 m^3)	Max CPUE (No./10^3 m^3)
Periclimenes longicaudatus juveniles	longtail grass shrimp	91	20	1.3	32.0	7.65	238.81
alphaeid mysis larvae	snapping shrimps	1	1	0.0	30.0	0.08	13.20
alphaeid postlarvae	snapping shrimps	1096	54	0.3	31.6	93.21	2838.48
alphaeid juveniles	snapping shrimps	7	2	1.4	5.5	0.64	88.72
Alpheus viridari juveniles	snapping shrimp	1	1	2.4	0.2	0.08	12.41
Hippolyte zostericola postlarvae	zostera shrimp	3430	77	0.2	30.9	288.83	8519.87
Hippolyte zostericola juveniles	zostera shrimp	182	23	0.1	31.0	15.32	660.00
Hippolyte zostericola adults	zostera shrimp	32	7	0.1	28.8	2.67	168.44
Tozeuma carolinense mysis larvae	arrow shrimp	3	1	0.3	33.1	0.28	45.27
Tozeuma carolinense postlarvae	arrow shrimp	34	17	0.2	28.7	2.87	106.72
Tozeuma carolinense juveniles	arrow shrimp	22	10	1.1	29.0	1.96	54.96
Tozeuma carolinense adults	arrow shrimp	1	1	0.3	34.2	0.08	13.60
processid postlarvae	night shrimps	131	15	0.3	31.4	11.19	785.25
Ambidexter symmetricus postlarvae	shrimp	570	27	0.2	30.9	49.99	2838.48
Ambidexter symmetricus juveniles	shrimp	50	8	0.5	29.9	4.89	362.16
callianassid postlarvae	ghost shrimps	2	1	0.0	25.8	0.16	25.49
Callianassa spp. postlarvae	ghost shrimps	2	1	0.0	30.5	0.17	27.40
Upogebia spp. postlarvae	mud shrimps	213	28	0.5	30.5	17.83	484.37
Upogebia spp. juveniles	mud shrimps	40	10	0.2	30.1	3.19	223.55
Upogebia affinis juveniles	coastal mud shrimp	1	1	1.2	1.2	0.08	13.53
Euceramus praelongus megalops larvae	olivepit porcelain crab	1	1	0.3	34.2	0.08	13.60
Euceramus praelongus juveniles	olivepit porcelain crab	22	4	0.2	29.5	2.04	161.33
Petrolisthes armatus juveniles	porcelain crab	13	7	0.2	28.0	1.08	39.26
paguroid megalops larvae	hermit crabs	13	7	0.2	31.3	1.09	37.88
paguroid juveniles	hermit crabs	6	2	0.2	31.4	0.49	65.44
Callinectes sapidus megalops larvae	blue crab	1	1	2.4	26.7	0.09	14.17
Callinectes sapidus juveniles	blue crab	88	31	2.5	19.7	7.33	134.25
Portunus sp. juveniles	swimming crab	20	10	2.5	18.1	1.69	68.85
xanthid juveniles	mud crabs	1	1	0.0	14.2	0.09	13.72
Rhithropanopeus harrisii adults	Harris mud crab	1	1	0.0	26.5	0.08	12.96
Aratus pisonii juveniles	mangrove tree crab	1	1	3.5	17.5	0.07	10.50
pinnotherid juveniles	pea crabs	1	1	0.0	32.7	0.09	13.66
Squilla empusa larvae	mantis shrimp	112	18	0.5	31.5	9.13	256.86
unidentified Americamysis juveniles	opossum shrimps, mysids	84051	127	4.3	15.8	6888.90	224363.60
Americamysis almyra	opossum shrimp, mysid	127819	115	4.7	14.0	10280.66	202700.48
Americamysis bahia	opossum shrimp, mysid	103	28	0.4	30.1	8.80	171.79
Americamysis stucki	opossum shrimp, mysid	431	26	0.4	30.1	37.67	1292.83
Bowmaniella dissimilis	opossum shrimp, mysid	1995	82	3.1	24.7	167.68	7141.67
Bowmaniella sp.	opossum shrimp, mysid	12	5	0.4	29.9	0.92	73.39
Metamysidopsis swifti	opossum shrimp, mysid	20	2	0.4	32.6	1.86	271.62
Mysidopsis furca	opossum shrimp, mysid	17	1	0.0	34.0	1.35	215.67
Taphromysis bowmani	opossum shrimp, mysid	1335	37	4.0	11.9	102.91	4806.50
cumaceans	cumaceans	7515	114	1.2	29.3	634.05	12204.58
Sinelobus stanfordi	tanaid	14	7	3.1	23.5	1.18	70.22
Apseudes sp.	tanaid	146	31	2.1	23.6	11.83	408.49
Hargeria rapax	tanaid	646	56	1.0	25.2	52.42	2185.86
Cyathura polita	isopod	38	13	2.9	19.1	3.16	123.79
Xenanthura brevitelson	isopod	14	7	0.8	20.0	1.26	71.26
Munna reynoldsi	isopod	227	29	2.4	23.3	19.70	723.30
Anopsilana jonesi	isopod	2	1	6.0	0.2	0.17	27.40
cymothoid sp. a (Lironeca) juveniles	isopod	474	76	2.4	26.3	40.45	873.20
Cassidinidea ovalis	isopod	248	46	3.7	14.8	20.51	338.48
Harrieta faxoni	isopod	18	9	1.0	25.7	1.52	65.44
Sphaeroma quadridentata	isopod	55	21	0.9	24.9	4.83	146.78
Sphaeroma terebrans	isopod	296	58	3.9	16.5	24.95	741.80
Edotea triloba	isopod	3893	87	3.7	13.4	323.76	7957.91
Erichsonella attenuata	isopod	29	8	0.5	25.5	2.35	110.08
Erichsonella filiforme	isopod	10	4	0.1	31.1	0.81	38.39
amphipods, gammaridean	amphipods	110370	154	3.1	18.2	9195.45	164153.23

Table A1, page 3 of 7.

Plankton-net catch statistics (March 2004 through June 2005, n=160 samples).

Organisms are listed in phylogenetic order.

Roberts and Lyons Bays were excluded from Kmu calculations.

Taxon	Common Name	Number Collected	Collection Frequency	*Kmu* (km)	*Su* (psu)	Mean CPUE (No./10^3 m^3)	Max CPUE (No./10^3 m^3)
amphipods, caprellid	skeleton shrimps	288	43	0.4	30.0	24.03	831.75
cirriped nauplius stage	barnacles	2127	31	0.4	32.6	177.78	10271.56
cirriped cypris stage	barnacles	4	1	0.0	19.3	0.37	59.67
branchiurans, Argulus spp.	fish lice	347	101	1.8	27.6	28.84	157.78
Alteutha sp.	copepod	3	2	1.4	28.8	0.26	27.40
unidentified harpacticoids	copepods	135	28	1.0	27.9	11.03	518.29
Sapphirina spp.	copepods	2	1	1.2	32.2	0.15	24.13
Corycaeus spp.	copepods	58	13	0.2	29.9	5.35	288.11
siphonostomatids	parasitic copepods	19	6	0.3	30.7	1.68	123.24
Monstrilla sp.	copepod	322	43	2.2	30.7	26.29	687.74
unidentified freshwater cyclopoids	copepods	7	2	5.1	0.2	0.59	66.58
Cyclops spp.	copepods	4	2	1.2	15.2	0.31	25.62
Eucyclops speratus	copepod	8	5	0.3	33.5	0.65	37.12
Macrocyclops albidus	copepods	563	18	4.6	0.3	47.19	1358.24
Mesocyclops edax	copepod	7163	28	5.4	1.7	585.47	38844.63
Oithona spp.	copepods	189	22	0.5	30.9	16.42	808.38
Orthocyclops modestus	copepod	255	9	4.4	0.6	20.99	1057.35
Saphirella spp.	copepods	2	2	0.0	33.4	0.17	14.72
paracalanids	copepods	67	16	0.5	27.0	6.66	514.49
Acartia tonsa	copepod	81410	142	1.1	28.4	6799.45	71196.76
Calanopia americana	copepod	4004	59	0.3	32.6	345.50	21541.56
Centropages hamatus	copepod	7	4	0.3	33.2	0.58	54.56
Centropages velificatus	copepod	586	50	0.3	30.5	49.17	988.89
Diaptomus spp.	copepods	45	11	5.0	5.1	3.70	145.34
Eucalanus sp.	copepod	544	50	1.0	30.6	45.03	869.37
Eurytemora affinis	copepod	4	2	5.6	27.6	0.34	41.20
Labidocera aestiva	copepod	51414	110	0.3	30.6	4314.70	87581.32
Osphranticum labronectum	copepod	21	7	4.3	0.2	1.78	105.74
Pseudodiaptomus coronatus	copepod	575	79	2.8	21.6	47.43	744.35
Temora turbinata	copepod	100	26	0.9	31.2	8.44	218.65
myodocopod sp. a	ostracod, seed shrimp	1	1	0.0	32.6	0.08	13.54
Euconchoecia chierchiae	ostracod, seed shrimp	1	1	0.3	33.6	0.08	12.37
Sarsiella zostericola	ostracod, seed shrimp	148	33	0.3	29.6	12.98	219.34
Parasterope pollex	ostracod, seed shrimp	82	25	0.3	29.6	7.24	421.67
ostracods, podocopid	ostracods, seed shrimps	100	26	2.4	17.6	8.34	284.10
collembolas, podurid	springtails	6	3	2.0	16.6	0.49	39.65
ephemeropteran larvae	mayflies	1996	25	5.0	0.9	166.02	4202.77
odonates, anisopteran larvae	dragonflies	73	10	5.5	1.4	5.91	723.17
odonates, zygopteran larvae	damselflies	153	17	4.9	0.8	12.67	335.76
hemipterans, belostomatid adults	giant water bugs	16	5	5.5	0.8	1.39	91.38
hemipterans, corixid juveniles	water boatmen	6	2	3.3	5.0	0.50	66.08
hemipterans, corixid adults	water boatmen	24	11	4.4	4.9	2.05	65.44
hemipterans, gerrid adults	water striders	65	13	4.3	2.6	5.54	191.56
hemipterans, naucorid adults	creeoing water bugs	2	1	2.4	0.2	0.16	24.83
hemipterans, pleid adults	pygmy backswimmers	15	7	4.7	2.1	1.28	45.25
neuropterans, Climacia spp. larvae	spongillaflies	2	1	2.4	0.2	0.16	24.83
coleopterans, curculionid adults	beetles	6	3	3.2	0.3	0.49	40.71
coleopterans, dytiscid larvae	predaceous diving beetles	5	2	4.9	0.1	0.44	45.69
coleopterans, noterid adults	burrowing water beetles	78	19	4.2	2.1	6.69	176.42
coleopterans, elmid larvae	riffle beetles	15	6	4.6	1.2	1.26	68.50
coleopterans, elmid adults	riffle beetles	9	6	3.9	0.8	0.74	39.26
coleopterans, gyrinid larvae	whirligig beetles	9	3	4.5	0.2	0.74	62.47
coleopterans, haliplid larvae	crawling water beetles	1	1	6.0	0.2	0.08	12.94
coleopterans, noterid larvae	burrowing water beetles	4	3	5.0	0.2	0.33	24.99
coleopterans, dytiscid adults	predaceous diving beetles	9	5	4.2	3.7	0.79	45.25
coleopterans, scirtid larvae	marsh beetles	11	4	5.2	0.2	0.91	64.70
dipterans, pupae	flies, mosquitoes	7066	44	5.7	1.9	573.07	77676.35
dipterans, ceratopogonid larvae	biting midges	8	3	3.2	0.2	0.68	44.21
dipteran, Chaoborus punctipennis larvae	phantom midge	21894	64	4.4	9.0	1764.46	166458.54

Table A1, page 4 of 7.

Plankton-net catch statistics (March 2004 through June 2005, n=160 samples).

Organisms are listed in phylogenetic order.

Roberts and Lyons Bays were excluded from Kmu calculations.

Taxon	Common Name	Number Collected	Collection Frequency	*Kmu* (km)	*Su* (psu)	Mean CPUE (No./10^3 m^3)	Max CPUE (No./10^3 m^3)
dipterans, chironomid larvae	midges	803	49	4.9	4.5	66.87	3131.48
dipterans, stratiomyid larvae	soldier flies	43	5	5.4	7.2	3.47	387.41
dipterans, sciomyzid larvae	marsh flies	6	1	6.0	17.9	0.50	79.28
dipterans, tabanid larvae	deer flies	2	2	5.2	12.6	0.17	13.70
trichopteran larvae	caddisflies	247	21	5.2	1.5	20.89	1013.84
lepidopterans, pyralid larvae	aquatic caterpillars	17	8	4.2	8.6	1.41	45.25
pycnogonids	sea spiders	9	3	0.0	30.3	0.77	57.71
Limulus polyphemus larvae	horsehoe crab	4	2	0.2	29.6	0.37	45.27
acari	water mites	87	16	4.3	2.8	7.17	167.88
gastropods, prosobranch	snails	1193	83	3.0	12.7	100.77	3793.25
gastropods, opisthobranch	sea slugs	97	21	1.0	31.3	7.82	503.66
pelecypods	clams, mussels, oysters	1066	56	0.3	31.4	89.83	4322.06
ophiopluteus larvae	brittlestars	8	1	0.3	31.8	0.65	104.70
ophiuroidean juveniles	brittlestars	14	6	0.5	32.1	1.12	66.27
Lolliguncula brevis juveniles	bay squid	1	1	0.3	33.8	0.08	12.32
brachiopod, Glottidia pyramidata larvae	lamp shell	132	25	0.4	30.0	11.35	524.31
chaetognaths, sagittid	arrow worms	38168	124	0.4	31.8	3103.66	54326.60
ascidiacean larvae	tunicate larvae	7	4	0.8	23.8	0.57	38.82
appendicularian, Oikopleura dioica	larvacean	30462	82	0.3	32.4	2735.11	63404.04
Branchiostoma floridae	lancelet	29	9	0.2	25.6	2.41	165.67
Lepisosteus platyrhincus flexion larvae	Florida gar	1	1	4.4	0.3	0.09	13.60
Elops saurus postflexion larvae	ladyfish	8	5	5.4	21.9	0.65	40.10
Elops saurus juveniles	ladyfish	1	1	2.4	26.7	0.09	14.17
Myrophis punctatus postflexion larvae	speckled worm eel	2	2	0.0	33.9	0.15	12.69
Myrophis punctatus juveniles	speckled worm eel	12	5	0.9	31.6	1.03	87.74
clupeid eggs	herrings	38	9	0.1	32.1	3.06	112.41
clupeid preflexion larvae	herrings	283	27	0.3	32.8	23.36	1076.52
clupeid postflexion larvae	herrings	1	1	1.2	31.3	0.08	12.98
Brevoortia spp. postflexion larvae	menhaden	6	4	1.3	30.9	0.52	45.27
Brevoortia spp. metamorphs	menhaden	2	2	5.6	17.5	0.16	13.04
Brevoortia smithi juveniles	yellowfin menhaden	1	1	4.4	18.4	0.09	13.83
Dorosoma spp. postflexion larvae	shads	15	6	3.8	21.2	1.25	92.88
Dorosoma spp. metamorphs	shads	144	5	5.3	12.9	11.88	1353.37
Dorosoma petenense juveniles	threadfin shad	4	3	6.0	8.1	0.34	25.83
Harengula jaguana eggs	scaled sardine	518	8	0.2	33.7	42.23	2702.24
Harengula jaguana flexion larvae	scaled sardine	30	10	0.2	30.2	2.39	63.13
Harengula jaguana postflexion larvae	scaled sardine	28	8	0.3	32.0	2.38	95.47
Harengula jaguana metamorphs	scaled sardine	41	10	0.2	20.6	3.49	329.38
Harengula jaguana juveniles	scaled sardine	3	1	0.0	25.8	0.24	38.23
Opisthonema oglinum eggs	Atlantic thread herring	77	2	0.0	34.0	6.10	938.81
Opisthonema oglinum flexion larvae	Atlantic thread herring	8	3	0.1	34.4	0.70	42.16
Opisthonema oglinum postflexion larvae	Atlantic thread herring	9	4	0.3	34.2	0.77	83.72
Opisthonema oglinum juveniles	Atlantic thread herring	3	2	3.0	10.8	0.25	27.22
Sardinella aurita flexion larvae	Spanish sardine	7	4	0.2	33.0	0.60	39.26
Sardinella aurita postflexion larvae	Spanish sardine	2	2	0.0	33.5	0.18	14.72
Sardinella aurita metamorphs	Spanish sardine	1	1	0.0	33.1	0.09	14.05
Anchoa spp. preflexion larvae	anchovies	4291	66	0.5	28.3	391.51	15572.60
Anchoa spp. flexion larvae	anchovies	416	40	0.6	28.2	35.49	1341.32
Anchoa hepsetus eggs	striped anchovy	121	8	0.1	29.5	9.73	871.58
Anchoa hepsetus postflexion larvae	striped anchovy	37	9	0.4	31.9	3.00	260.81
Anchoa hepsetus juveniles	striped anchovy	5	4	0.0	27.0	0.43	25.49
Anchoa mitchilli eggs	bay anchovy	7026	29	0.8	26.3	564.58	47103.98
Anchoa mitchilli postflexion larvae	bay anchovy	169	40	2.0	23.1	14.40	362.16
Anchoa mitchilli juveniles	bay anchovy	885	62	4.5	16.6	72.92	1517.74
Anchoa mitchilli adults	bay anchovy	113	29	1.1	18.9	9.73	466.62
Misgurnus anguillicaudatus postflexion larvae	oriental weatherfish	1	1	5.1	0.4	0.08	13.56
Ameiurus catus juveniles	white catfish	2	1	2.4	0.2	0.16	24.83
Ameiurus natalis juveniles	yellow bullhead	1	1	6.0	0.1	0.09	15.08
Noturus gyrinus postflexion larvae	tadpole madtom	1	1	6.0	0.2	0.09	13.70

Table A1, page 5 of 7.

Plankton-net catch statistics (March 2004 through June 2005, n=160 samples).

Organisms are listed in phylogenetic order.

Roberts and Lyons Bays were excluded from Kmu calculations.

Taxon	Common Name	Number Collected	Collection Frequency	*Kmu* (km)	*Su* (psu)	Mean CPUE (No./10^3 m^3)	Max CPUE (No./10^3 m^3)
Ictalurus punctatus juveniles	channel catfish	1	1	5.1	0.4	0.08	13.56
Ariopsis felis juveniles	hardhead catfish	5	1	0.0	33.1	0.44	70.26
Hoplosternum littorale juveniles	brown hoplo catfish	2	2	6.0	0.1	0.19	15.08
Synodus foetens postflexion larvae	inshore lizardfish	2	2	2.3	8.8	0.18	14.79
Synodus foetens juveniles	inshore lizardfish	4	3	0.0	27.1	0.33	26.68
Gobiesox strumosus preflexion larvae	skilletfish	32	16	1.9	26.9	2.61	140.77
Gobiesox strumosus flexion larvae	skilletfish	15	7	5.2	24.5	1.28	68.45
Gobiesox strumosus postflexion larvae	skilletfish	28	8	4.2	27.4	2.38	177.96
Gobiesox strumosus juveniles	skilletfish	15	9	4.1	20.3	1.26	29.34
Hyporhamphus unifasciatus flexion larvae	silverstripe halfbeak	1	1	3.5	0.3	0.08	13.22
Jordanella floridae juveniles	flagfish	1	1	6.0	0.2	0.09	13.70
Fundulus grandis postflexion larvae	gulf killifish	5	2	4.5	20.1	0.44	55.34
Fundulus grandis juveniles	gulf killifish	1	1	4.4	25.2	0.08	13.48
Lucania parva postflexion larvae	rainwater killifish	3	2	5.1	24.0	0.25	27.17
Lucania parva juveniles	rainwater killifish	7	2	5.9	15.3	0.58	79.28
Gambusia holbrooki juveniles	eastern mosquitofish	27	8	4.8	0.4	2.26	82.20
Gambusia holbrooki adults	eastern mosquitofish	5	5	3.8	0.3	0.42	15.23
Heterandria formosa juveniles	least killifish	7	2	4.1	0.4	0.59	81.42
Heterandria formosa adults	least killifish	13	6	4.0	0.2	1.10	62.07
Menidia spp. preflexion larvae	silversides	8	6	3.4	5.5	0.68	28.55
Menidia spp. flexion larvae	silversides	3	2	4.1	12.8	0.25	27.67
Menidia spp. postflexion larvae	silversides	3	3	3.3	15.7	0.25	14.17
Menidia spp. juveniles	silversides	29	11	4.7	7.8	2.34	104.71
Menidia spp. adults	silversides	1	1	3.5	0.3	0.08	12.54
Membras martinica preflexion larvae	rough silverside	3	1	6.0	22.8	0.24	38.68
Membras martinica flexion larvae	rough silverside	3	1	0.0	31.7	0.24	38.39
Membras martinica postflexion larvae	rough silverside	1	1	0.0	33.0	0.08	12.94
Labidesthes sicculus postflexion larvae	brook silverside	2	1	6.0	1.5	0.16	25.83
Labidesthes sicculus juveniles	brook silverside	55	2	5.9	1.5	4.44	697.34
fish eggs, percomorph	sciaenid eggs (primarily)	107768	91	0.9	30.4	9077.96	141024.64
Hippocampus erectus juveniles	lined seahorse	11	8	1.7	28.9	0.89	38.85
Hippocampus erectus adults	lined seahorse	1	1	4.4	21.1	0.08	13.29
Hippocampus zosterae juveniles	dwarf seahorse	1	1	0.3	30.8	0.08	13.44
Syngnathus louisianae juveniles	chain pipefish	10	9	2.6	26.2	0.86	28.19
Syngnathus scovelli juveniles	gulf pipefish	28	17	1.0	27.7	2.28	76.78
Prionotus spp. preflexion larvae	searobins	7	2	0.1	33.2	0.59	51.76
Prionotus spp. flexion larvae	searobins	4	2	0.0	31.0	0.33	37.26
Prionotus spp. postflexion larvae	searobins	9	2	0.3	28.0	0.73	90.70
Prionotus tribulus preflexion larvae	bighead searobin	1	1	0.0	30.0	0.08	13.20
Prionotus tribulus postflexion larvae	bighead searobin	4	2	1.0	29.6	0.34	41.86
Prionotus tribulus juveniles	bighead searobin	1	1	0.0	23.6	0.08	13.24
Centropomus undecimalis postflexion larvae	snook	1	1	1.2	1.2	0.08	13.53
Epinephelus itajara juveniles	goliath grouper	1	1	0.0	30.9	0.08	13.34
Elassoma okefenoke juveniles	Okefenokee pygmy sunfish	2	1	6.0	0.2	0.16	25.88
Lepomis spp. preflexion larvae	sunfishes	11	2	5.8	18.4	0.93	122.57
Lepomis spp. flexion larvae	sunfishes	5	1	5.1	1.9	0.41	65.44
Lepomis spp. postflexion larvae	sunfishes	37	7	5.6	1.4	3.01	335.76
Lepomis auritus juveniles	redbreast sunfish	2	2	4.7	0.3	0.17	13.60
Lepomis macrochirus juveniles	bluegill	27	4	5.6	1.9	2.19	219.53
Lepomis macrochirus adults	bluegill	1	1	6.0	1.5	0.08	12.91
Lepomis punctatus juveniles	spotted sunfish	1	1	6.0	0.2	0.09	13.70
Micropterus salmoides juveniles	largemouth bass	6	4	4.3	0.2	0.49	26.94
Pomoxis nigromaculatus preflexion larvae	black crappie	2	2	5.2	9.0	0.17	13.91
Etheostoma fusiforme preflexion larvae	swamp darter	10	4	4.3	0.5	0.83	67.35
Chloroscombrus chrysurus preflexion larvae	Atlantic bumper	3	1	0.3	26.5	0.34	54.96
Chloroscombrus chrysurus flexion larvae	Atlantic bumper	1	1	0.0	27.8	0.10	15.62
Chloroscombrus chrysurus postflexion larvae	Atlantic bumper	4	2	0.2	29.3	0.37	33.28
Chloroscombrus chrysurus juveniles	Atlantic bumper	5	3	0.1	29.4	0.42	40.02
Oligoplites saurus juveniles	leatherjack	3	3	3.4	26.6	0.25	14.74

Table A1, page 6 of 7.

Plankton-net catch statistics (March 2004 through June 2005, n=160 samples).

Organisms are listed in phylogenetic order.

Roberts and Lyons Bays were excluded from Kmu calculations.

Taxon	Common Name	Number Collected	Collection Frequency	*Kmu* (km)	*Su* (psu)	Mean CPUE (No./10^3 m^3)	Max CPUE (No./10^3 m^3)
Lutjanus griseus juveniles	gray snapper	1	1	0.3	30.8	0.08	13.44
gerreid preflexion larvae	mojjaras	45	10	0.2	30.6	4.21	178.12
gerreid flexion larvae	mojjaras	1	1	0.3	33.5	0.09	14.28
Eucinostomus spp. postflexion larvae	mojarras	283	32	0.7	18.2	24.18	850.90
Eucinostomus spp. juveniles	mojarras	29	15	2.5	27.1	2.46	67.22
Eucinostomus gula juveniles	silver jenny	2	2	1.7	19.0	0.16	13.72
Eucinostomus harengulus juveniles	tidewater mojarra	8	5	4.1	17.8	0.69	54.48
Orthopristis chrysoptera juveniles	pigfish	1	1	0.0	30.0	0.08	13.20
Archosargus probatocephalus flexion larvae	sheepshead	1	1	0.0	32.5	0.09	13.94
Archosargus probatocephalus postflexion larva	sheepshead	22	7	1.8	23.6	1.83	71.09
Archosargus probatocephalus juveniles	sheepshead	1	1	2.4	26.7	0.09	14.17
Lagodon rhomboides flexion larvae	pinfish	1	1	0.0	33.8	0.07	11.04
Lagodon rhomboides postflexion larvae	pinfish	8	4	0.9	32.3	0.63	40.80
Lagodon rhomboides juveniles	pinfish	29	10	1.6	25.5	2.41	136.16
Lagodon rhomboides adults	pinfish	1	1	0.3	31.8	0.08	13.09
Bairdiella chrysoura preflexion larvae	silver perch	28	7	0.2	32.0	2.31	166.37
Bairdiella chrysoura flexion larvae	silver perch	12	6	0.2	30.9	0.97	38.39
Bairdiella chrysoura postflexion larvae	silver perch	9	5	2.6	25.1	0.77	42.03
Bairdiella chrysoura juveniles	silver perch	3	2	3.0	20.8	0.26	28.02
Cynoscion arenarius preflexion larvae	sand seatrout	105	16	0.3	27.4	10.84	677.87
Cynoscion arenarius flexion larvae	sand seatrout	10	4	0.5	26.6	1.05	109.92
Cynoscion arenarius postflexion larvae	sand seatrout	3	3	2.6	18.0	0.24	13.28
Cynoscion nebulosus preflexion larvae	spotted seatrout	67	15	0.5	27.5	6.46	311.45
Cynoscion nebulosus flexion larvae	spotted seatrout	16	4	0.9	24.7	1.46	109.92
Cynoscion nebulosus postflexion larvae	spotted seatrout	4	3	2.6	7.9	0.32	25.50
Cynoscion nebulosus juveniles	spotted seatrout	1	1	5.1	1.9	0.08	13.09
Leiostomus xanthurus postflexion larvae	spot	1	1	2.4	28.4	0.07	10.62
Leiostomus xanthurus juveniles	spot	10	3	5.0	24.0	0.83	108.95
Menticirrhus spp. preflexion larvae	kingfishes	60	19	0.3	29.9	5.48	201.53
Menticirrhus spp. flexion larvae	kingfishes	9	4	0.1	30.1	0.75	50.98
Menticirrhus spp. postflexion larvae	kingfishes	1	1	3.5	11.4	0.09	13.77
Sciaenops ocellatus flexion larvae	red drum	15	2	0.3	26.4	1.69	256.49
Sciaenops ocellatus postflexion larvae	red drum	28	8	3.2	17.5	2.34	125.17
Mugil cephalus juveniles	striped mullet	9	5	5.4	12.1	0.73	64.16
Mugil curema juveniles	white mullet	15	7	1.9	28.5	1.22	51.30
blenniid preflexion larvae	blennies	84	37	1.7	29.8	6.98	110.08
Chasmodes saburrae flexion larvae	Florida blenny	1	1	0.0	30.0	0.08	13.20
Chasmodes saburrae postflexion larvae	Florida blenny	4	3	1.1	29.8	0.39	30.81
Hypsoblennius spp. flexion larvae	blennies	1	1	2.4	26.7	0.09	14.17
Lupinoblennius nicholsi flexion larvae	highfin blenny	1	1	1.2	18.9	0.08	12.10
gobiid eggs	gobies	51	1	4.4	0.3	4.36	698.21
gobiid preflexion larvae	gobies	10423	116	3.9	16.3	844.82	21301.79
gobiid flexion larvae	gobies	6549	104	4.3	21.5	547.63	13693.84
Bathygobius soporator preflexion larvae	frillfin goby	21	8	2.5	20.1	1.78	71.09
Bathygobius soporator flexion larvae	frillfin goby	3	1	1.2	31.4	0.26	41.19
Bathygobius soporator postflexion larvae	frillfin goby	50	2	5.1	2.0	4.10	628.23
Gobionellus spp. postflexion larvae	gobies	50	2	4.4	22.4	4.37	671.29
Gobionellus boleosoma juveniles	darter goby	1	1	0.3	33.5	0.09	14.28
Gobionellus oceanicus postflexion larvae	highfin goby	1	1	2.4	17.6	0.08	13.08
Gobiosoma spp. postflexion larvae	gobies	31882	97	5.1	20.0	2660.29	160395.73
Gobiosoma bosc juveniles	naked goby	39	16	3.9	6.9	3.24	125.36
Gobiosoma robustum juveniles	code goby	23	12	3.6	10.8	1.95	42.82
Microgobius spp. flexion larvae	gobies	790	36	4.2	16.1	65.60	2804.80
Microgobius spp. postflexion larvae	gobies	2568	56	4.9	13.4	210.11	5732.64
Microgobius gulosus juveniles	clown goby	167	11	5.5	2.5	13.59	1627.14
Paralichthys spp. preflexion larvae	flounders	1	1	0.0	33.1	0.08	12.75
Paralichthys spp. flexion larvae	flounders	1	1	2.4	28.4	0.07	10.62
Achirus lineatus preflexion larvae	lined sole	26	9	0.4	28.1	2.54	201.53
Achirus lineatus flexion larvae	lined sole	28	11	1.3	26.0	2.31	66.39

Table A1, page 7 of 7.

Plankton-net catch statistics (March 2004 through June 2005, n=160 samples).

Organisms are listed in phylogenetic order.

Roberts and Lyons Bays were excluded from Kmu calculations.

Taxon	Common Name	Number Collected	Collection Frequency	*Kmu* (km)	*Su* (psu)	Mean CPUE (No./10^3 m^3)	Max CPUE (No./10^3 m^3)
Achirus lineatus postflexion larvae	lined sole	47	15	1.6	18.7	3.90	130.83
Achirus lineatus juveniles	lined sole	4	2	3.6	9.8	0.36	39.26
Trinectes maculatus preflexion larvae	hogchoker	33	11	0.7	29.8	2.92	109.84
Trinectes maculatus flexion larvae	hogchoker	18	11	1.0	25.7	1.54	57.71
Trinectes maculatus postflexion larvae	hogchoker	14	7	3.5	13.2	1.19	41.72
Trinectes maculatus juveniles	hogchoker	6	5	2.2	13.2	0.52	27.07
Symphurus plagiusa postflexion larvae	blackcheek tonguefish	22	4	0.2	27.1	2.48	256.49
Symphurus plagiusa juveniles	blackcheek tonguefish	16	4	2.1	18.1	1.33	104.66
Stephanolepis hispidus juveniles	planehead filefish	2	2	3.5	22.6	0.17	14.22
Stephanolepis setifer juveniles	pygmy filefish	1	1	0.3	30.8	0.08	13.44
tetraodontid preflexion larvae	puffers	2	1	0.0	34.1	0.19	30.81
Sphoeroides spp. juveniles	puffers	1	1	0.3	30.3	0.08	12.23
Chilomycterus schoepfii juveniles	striped burrfish	1	1	0.3	36.1	0.09	13.95
unidentified preflexion larvae	fish	7	2	5.5	4.4	0.54	47.06
unidentified flexion larvae	fish	3	1	6.0	19.2	0.25	40.10
unidentified postflexion larvae	fish	5	3	4.6	19.2	0.40	39.64
anuran larvae	tadpoles	1	1	3.5	0.2	0.09	14.74

Table A2. Page 1 of 8.

Plankton net catch by month (March 2004 to June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
foraminiferans	foraminiferans	19	1	3		9	8	188	2				1
Liriope tetraphylla	hydromedusa		3	5	1041	46						25	298
Clytia sp.	hydromedusa	13	154	32	36	136	57	49		8	3481	407	891
medusa sp. a	hydromedusa		157	28	12	33	3063			14	3	10	6
medusa sp. b	hydromedusa			129	611	3539	746	5	1		2		
medusa sp. c	hydromedusa	4	1465	8		5				11		2	
medusa sp. d	hydromedusa		16		137								
medusa sp. e	hydromedusa					12867	24						
medusa, Bougainvillia sp.	hydromedusa					197	40						
medusa, Eutima sp.	hydromedusa						4						
medusa, Hydrocodon forbesi	hydromedusa					34							
medusa, Obelia sp.	hydromedusa					20	5						
siphonophores	siphonophores		9	85		3					2		
scyphozoan ephyrae	jellyfish larvae				2	67	7						
Chrysaora quinquecirrha	sea nettle										5		
Aurelia aurita	moon jellyfish				12								
Mnemiopsis mccradyi	comb jelly, ctenophore			95	204	581	2777						
Beroe ovata	sea walnut, ctenophore						2						
turbellarians	flatworms						1						
nematodes	roundworms, threadworms			3		2	3	12			2		
polychaetes	sand worms, tube worms	127	201	552	379	306	120	499	2584	166	167	57	103
oligochaetes	freshwater worms	1		7			6	9	2	76	1		
hirudinoideans	leeches			6	7	3	11		3	4			1
cladocerans, Daphnia spp.	water fleas	450	684	333	5	2286	2			1			
Simocephalus vetulus	water flea	5		2171			9	59	25	60	3		
Ceridodaphnia sp.	water flea	8							6	3			
Bunops sp.	water flea									3			
Grimaldina brazzai	water flea									41			
Ilyocryptus sp.	water flea							7	95	88	7		
Sida crystallina	water flea			4435				3	6	2			
Penilia avirostris	water flea	36		10	1	19224	1481	2155	197	122	645	3938	1832
Pseudosida bidentata	water flea									5			
Latonopsis fasciculata	water flea						1		19	338			
Kurzia longirostris	water flea			97									
Leydigia sp.	water flea						11						
Evadne tergestina	water flea			1	2	4	13	9		18			
decapod zoeae	crab larvae	1352	928	18169	56658	84932	23960	24151	5800	4575	16963	5260	2669
decapod mysis	shrimp larvae	335	189	2370	3113	6782	2013	4063	1313	272	612	363	319
decapod megalopae	post-zoea crab larvae	85	4	48	1535	751	1260	2863	794	571	5681	1365	103
shrimps, unidentified postlarvae	shrimps					3	2		5	3			
shrimps, unidentified juveniles	shrimps										1		2
penaeid postlarvae	penaeid shrimps		1										
penaeid metamorphs	penaeid shrimps	13	2		10	16	47	149	593	202	689	4	3
Farfantepenaeus duorarum juveniles	pink shrimp		5				3	21	43	12	9		
sicyoniid postlarvae	rock shrimps					3	6		8	17	36		
sicyoniid juveniles	rock shrimps						5				2		
Sicyonia laevigata juveniles	rock shrimp							4					
Lucifer faxoni mysis	shrimp	5034	1	1								23	5

Table A2. Page 2 of 8.

Plankton net catch by month (March 2004 to June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
Lucifer faxoni juveniles and adults	shrimp	7914	2518	511	4861	2339	11736	2036	320	154	6442	1939	2783
Leptochela serratorbita postlarvae	combclaw shrimp									32			
Leptochela serratorbita juveniles	combclaw shrimp							3	2	14			
Palaemonetes spp. postlarvae	grass shrimp	10	4	33	658	484	119	514	220	68	670	220	226
Palaemonetes pugio juveniles	daggerblade grass shrimp	6	5	19		7	57	14	11	12	6	3	5
Palaemonetes pugio adults	daggerblade grass shrimp	2		2			12		2	1			2
Palaemonetes vulgaris juveniles	grass shrimp							1	11				1
Palaemonetes vulgaris adults	grass shrimp					1			1				
Periclimenes spp. postlarvae	shrimps						5						1
Periclimenes spp. juveniles	shrimps										124		
Periclimenes americanus adults	American grass shrimp						3						
Periclimenes longicaudatus juveniles	longtail grass shrimp	13	1									34	43
alphaeid mysis larvae	snapping shrimps				1								
alphaeid postlarvae	snapping shrimps	4		18	81	341	418	143	31	13	41		6
alphaeid juveniles	snapping shrimps									7			
Alpheus viridari juveniles	snapping shrimp								1				
Hippolyte zostericola postlarvae	zostera shrimp	59	26	292	1357	410	512	300	271	97	76	7	23
Hippolyte zostericola juveniles	zostera shrimp	5	13	53	25	13	14	49	3	4	1		2
Hippolyte zostericola adults	zostera shrimp		5			1	4	16	6				
Tozeuma carolinense mysis larvae	arrow shrimp				3								
Tozeuma carolinense postlarvae	arrow shrimp		1	4		6			5	3	12	2	1
Tozeuma carolinense juveniles	arrow shrimp				3	8	3	4		3			1
Tozeuma carolinense adults	arrow shrimp												1
processid postlarvae	night shrimps			2	15	38	76						
Ambidexter symmetricus postlarvae	shrimp	1			3	117	268	45	67	43	11	15	
Ambidexter symmetricus juveniles	shrimp		2		28	2				15	2	1	
callianassid postlarvae	ghost shrimps								2				
Callianassa spp. postlarvae	ghost shrimps					2							
Upogebia spp. postlarvae	mud shrimps	1		2	112	56	26	5	4	3	2	2	
Upogebia spp. juveniles	mud shrimps				28	2	3		2		5		
Upogebia affinis juveniles	coastal mud shrimp								1				
Euceramus praelongus megalops larvae	olivepit porcelain crab												1
Euceramus praelongus juveniles	olivepit porcelain crab									6	15		1
Petrolisthes armatus juveniles	porcelain crab						8			1	4		
paguroid megalops larvae	hermit crabs		4				3						6
paguroid juveniles	hermit crabs						6						
Callinectes sapidus megalops larvae	blue crab			1									
Callinectes sapidus juveniles	blue crab	16	16	8		3	8	6		15	11		5
Portunus sp. juveniles	swimming crab		1						1	1	17		
xanthid juveniles	mud crabs								1				
Rhithropanopeus harrisii adults	Harris mud crab							1					
Aratus pisonii juveniles	mangrove tree crab					1							
pinnotherid juveniles	pea crabs		1										
Squilla empusa larvae	mantis shrimp			2	33	74			2			1	
unidentified Americamysis juveniles	opossum shrimps, mysids	728	7700	12673	51873	561	1066	3038	26	31	4735	1389	231
Americamysis almyra	opossum shrimp, mysid	2530	8967	23057	70971	1152	1776	5757	81	103	8704	2831	1890
Americamysis bahia	opossum shrimp, mysid	8	12	4	20	19	8	8	22				2
Americamysis stucki	opossum shrimp, mysid	1	109	88	35		39	1	2	29	112	5	10

Table A2. Page 3 of 8.

Plankton net catch by month (March 2004 to June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
Bowmaniella dissimilis	opossum shrimp, mysid	92	57	74	160	386	200	456	6	13	10	17	524
Bowmaniella sp.	opossum shrimp, mysid				1	11							
Metamysidopsis swifti	opossum shrimp, mysid				20								
Mysidopsis furca	opossum shrimp, mysid				17								
Taphromysis bowmani	opossum shrimp, mysid	1	91	110	809	43	150	114	8	8	1		
cumaceans	cumaceans	68	293	602	1720	1615	2730	368	67	16	12	9	15
Sinelobus stanfordi	tanaid	1				1	3		2				7
Apseudes sp.	tanaid	17	14		38	28	13	5			28		3
Hargeria rapax	tanaid	1	4	156	308	82	70	11	7	1	2	1	3
Cyathura polita	isopod		1	6	11		13	6		1			
Xenanthura brevitelson	isopod			3	1	1	6		3				
Munna reynoldsi	isopod	4		119	77	11	14			1			1
Anopsilana jonesi	isopod						2						
cymothoid sp. a (Lironeca) juveniles	isopod	16	9	13	19	150	191	19	15	8	10	14	10
Cassidinidea ovalis	isopod	34	2	22	35	40	66	13	10		3	14	9
Harrieta faxoni	isopod	1	1				7	4	4		1		
Sphaeroma quadridentata	isopod	1		4		15	16	4	10	4		1	
Sphaeroma terebrans	isopod	8	1	13	37	23	89	22	1	12	5	30	55
Edotea triloba	isopod	50	146	122	1490	252	1193	359	73	7	88	91	22
Erichsonella attenuata	isopod					14	7		4	4			
Erichsonella filiforme	isopod				3	3	2	2					
amphipods, gammaridean	amphipods	1493	4268	14894	41196	16535	18105	3154	969	268	8433	707	348
amphipods, caprellid	skeleton shrimps	5	7	54	31	118	36	11		5	17		4
cirriped nauplius stage	barnacles	1	1628		13	53	159	224		36	4	8	1
cirriped cypris stage	barnacles									4			
branchiurans, Argulus spp.	fish lice	53	27	21	23	34	35	19	10	6	40	57	22
Alteutha sp.	copepod		1			2							
unidentified harpacticoids	copepods	14	17	19	3	11		55	3			10	3
Sapphirina spp.	copepods				2								
Corycaeus spp.	copepods			17		5		14	4	14	4		
siphonostomatids	parasitic copepods					9	10						
Monstrilla sp.	copepod	38		5	5	15	11	6	2		1	155	84
unidentified freshwater cyclopoids	copepods						2			5			
Cyclops spp.	copepods			4									
Eucyclops speratus	copepod	1	1			2						3	1
Macrocyclops albidus	copepods			326			14		28	195			
Mesocyclops edax	copepod	2		524			247	5845	85	457	3		
Oithona spp.	copepods	13	4	1	4	153		4		9		1	
Orthocyclops modestus	copepod			249			4		2				
Saphirella spp.	copepods											1	1
paracalanids	copepods		1	1	9	15	4			29	6	2	
Acartia tonsa	copepod	1289	15913	13315	22781	7926	8540	4914	820	642	103	559	4608
Calanopia americana	copepod	328	7		7	91	87	67	4	80	523	80	2730
Centropages hamatus	copepod				1		6						
Centropages velificatus	copepod	5	1	2	23	125	132	113	13	40	63	64	5
Diaptomus spp.	copepods			10		11	1	9	3	11			
Eucalanus sp.	copepod	14	251	6	129	21	24			14	33	49	3
Eurytemora affinis	copepod											4	

Table A2. Page 4 of 8.

Plankton net catch by month (March 2004 to June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
Labidocera aestiva	copepod	5304	3703	2500	15021	3494	15526	1402	96	1908	409	53	1998
Osphranticum labronectum	copepod			11			3		5	2			
Pseudodiaptomus coronatus	copepod	37	51	102	233	19	2	13	23	9	23	52	11
Temora turbinata	copepod	6	32	1	8	11	1	22	3	3		1	12
myodocopod sp. a	ostracod, seed shrimp		1										
Euconchoecia chierchiae	ostracod, seed shrimp											1	
Sarsiella zostericola	ostracod, seed shrimp	4	28	1	8	33	23	15	10	20	1	4	1
Parasterope pollex	ostracod, seed shrimp	2	15	1	1	13	7	5	31	1	5		1
ostracods, podocopid	ostracods, seed shrimps	9	4	3		17	4	46	9	5	1		2
collembolas, podurid	springtails			5									1
ephemeropteran larvae	mayflies			916	4		306	351	114	305			
odonates, anisopteran larvae	dragonflies			3			5	60	4	1			
odonates, zygopteran larvae	damselflies			43			34	50	23	3			
hemipterans, belostomatid adults	giant water bugs			2			1	7	6				
hemipterans, corixid juveniles	water boatmen			6									
hemipterans, corixid adults	water boatmen			8		3	2	5	3	3			
hemipterans, gerrid adults	water striders						17	10	30		5	1	2
hemipterans, naucorid adults	creeoing water bugs								2				
hemipterans, pleid adults	pygmy backswimmers			6					8				1
neuropterans, Climacia spp. larvae	spongillaflies								2				
coleopterans, curculionid adults	beetles								6				
coleopterans, dytiscid larvae	predaceous diving beetles								3	2			
coleopterans, noterid adults	burrowing water beetles			8		3	12	4	44	7			
coleopterans, elmid larvae	riffle beetles			1			13		1				
coleopterans, elmid adults	riffle beetles			1			2	3	2	1			
coleopterans, gyrinid larvae	whirligig beetles						2			7			
coleopterans, haliplid larvae	crawling water beetles			1									
coleopterans, noterid larvae	burrowing water beetles						2			2			
coleopterans, dytiscid adults	predaceous diving beetles		1						4	4			
coleopterans, scirtid larvae	marsh beetles			6			5						
dipterans, pupae	flies, mosquitoes	1	2	350	48	4	147	6105	219	179	11		
dipterans, ceratopogonid larvae	biting midges			3					5				
dipteran, Chaoborus punctipennis larvae	phantom midge	134	129	1382	383	72	422	18530	319	439	84		
dipterans, chironomid larvae	midges	11	15	387	2	20	104	32	55	76	96		5
dipterans, stratiomyid larvae	soldier flies				3	3		37					
dipterans, sciomyzid larvae	marsh flies					6							
dipterans, tabanid larvae	deer flies		1				1						
trichopteran larvae	caddisflies	1	1	39	3		136	7	3	39	18		
lepidopterans, pyralid larvae	aquatic caterpillars			4	1	3			8		1		
pycnogonids	sea spiders					2	7						
Limulus polyphemus larvae	horsehoe crab			1	3								
acari	water mites		2	33			16	25	9	2			
gastropods, prosobranch	snails	13	9	675	110	33	23	201	41	44	26	10	8
gastropods, opisthobranch	sea slugs	12	55		2	18		7				3	
pelecypods	clams, mussels, oysters	24	96	119	216	483	56	12		52		1	7
ophiopluteus larvae	brittlestars						8						
ophiuroidean juveniles	brittlestars	1	5	1	1	6							
Lolliguncula brevis juveniles	bay squid	1											

Table A2. Page 5 of 8.

Plankton net catch by month (March 2004 to June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
brachiopod, Glottidia pyramidata larvae	lamp shell				17	20	11	9		8	60	7	
chaetognaths, sagittid	arrow worms	6444	570	1159	3630	7487	1210	8584	306	2123	2906	1022	2727
ascidiacean larvae	tunicate larvae	1				3	2					1	
appendicularian, Oikopleura dioica	larvacean	860	1721	4137	904	18479	273	1873	12	2117	5	60	21
Branchiostoma floridae	lancelet		5	4				1	16	3			
Lepisosteus platyrhincus flexion larvae	Florida gar						1						
Elops saurus postflexion larvae	ladyfish	6											2
Elops saurus juveniles	ladyfish			1									
Myrophis punctatus postflexion larvae	speckled worm eel	1			1								
Myrophis punctatus juveniles	speckled worm eel	1	11										
clupeid eggs	herrings	5		7	5	7	14						
clupeid preflexion larvae	herrings	6			17	49	76	134					1
clupeid postflexion larvae	herrings			1									
Brevoortia spp. postflexion larvae	menhaden	3			3								
Brevoortia spp. metamorphs	menhaden	1		1									
Brevoortia smithi juveniles	yellowfin menhaden			1									
Dorosoma spp. postflexion larvae	shads				5	10							
Dorosoma spp. metamorphs	shads					107	3	34					
Dorosoma petenense juveniles	threadfin shad						2	2					
Harengula jaguana eggs	scaled sardine			5	513								
Harengula jaguana flexion larvae	scaled sardine				4	12	9	5					
Harengula jaguana postflexion larvae	scaled sardine					9	17	2					
Harengula jaguana metamorphs	scaled sardine						4	5	32				
Harengula jaguana juveniles	scaled sardine								3				
Opisthonema oglinum eggs	Atlantic thread herring				77								
Opisthonema oglinum flexion larvae	Atlantic thread herring					2	3	3					
Opisthonema oglinum postflexion larvae	Atlantic thread herring			1			1	6	1				
Opisthonema oglinum juveniles	Atlantic thread herring							2	1				
Sardinella aurita flexion larvae	Spanish sardine	1					3						3
Sardinella aurita postflexion larvae	Spanish sardine						1						1
Sardinella aurita metamorphs	Spanish sardine						1						
Anchoa spp. preflexion larvae	anchovies		4	206	2550	73	94	197	21	1129	13	4	
Anchoa spp. flexion larvae	anchovies			64	257	18	12	8	6	30	18	2	1
Anchoa hepsetus eggs	striped anchovy	1	3	109	8								
Anchoa hepsetus postflexion larvae	striped anchovy	1			26		1	8			1		
Anchoa hepsetus juveniles	striped anchovy				1	1			2	1			
Anchoa mitchilli eggs	bay anchovy	79		5316	1590	17	13	10					1
Anchoa mitchilli postflexion larvae	bay anchovy	1		4	46	46	5	7	7	13	37	2	1
Anchoa mitchilli juveniles	bay anchovy	10	1	28	20	375	31	87	2	14	241	49	27
Anchoa mitchilli adults	bay anchovy	10	12	3	2	11	6		46	17	3	2	1
Misgurnus anguillicaudatus postflexion larvae	oriental weatherfish						1						
Ameiurus catus juveniles	white catfish								2				
Ameiurus natalis juveniles	yellow bullhead								1				
Noturus gyrinus postflexion larvae	tadpole madtom						1						
Ictalurus punctatus juveniles	channel catfish						1						
Ariopsis felis juveniles	hardhead catfish						5						
Hoplosternum littorale juveniles	brown hoplo catfish								1	1			
Synodus foetens postflexion larvae	inshore lizardfish									1	1		

Table A2. Page 6 of 8.

Plankton net catch by month (March 2004 to June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
Synodus foetens juveniles	inshore lizardfish	1							1		2		
Gobiesox strumosus preflexion larvae	skilletfish	8		1	3	14					2	2	2
Gobiesox strumosus flexion larvae	skilletfish	3			3		2				1		6
Gobiesox strumosus postflexion larvae	skilletfish					2	4				1	5	16
Gobiesox strumosus juveniles	skilletfish				5	2			1	2	1		4
Hyporhamphus unifasciatus flexion larvae	silverstripe halfbeak			1									
Jordanella floridae juveniles	flagfish						1						
Fundulus grandis postflexion larvae	gulf killifish			4			1						
Fundulus grandis juveniles	gulf killifish		1										
Lucania parva postflexion larvae	rainwater killifish		1			2							
Lucania parva juveniles	rainwater killifish			1		6							
Gambusia holbrooki juveniles	eastern mosquitofish						14	4	6	3			
Gambusia holbrooki adults	eastern mosquitofish			1			2		2				
Heterandria formosa juveniles	least killifish						1		6				
Heterandria formosa adults	least killifish			2			2		8	1			
Menidia spp. preflexion larvae	silversides					2	2		2	1	1		
Menidia spp. flexion larvae	silversides			2			1						
Menidia spp. postflexion larvae	silversides			1				1			1		
Menidia spp. juveniles	silversides				14		2	9	2		1		1
Menidia spp. adults	silversides						1						
Membras martinica preflexion larvae	rough silverside				3								
Membras martinica flexion larvae	rough silverside					3							
Membras martinica postflexion larvae	rough silverside			1									
Labidesthes sicculus postflexion larvae	brook silverside							2					
Labidesthes sicculus juveniles	brook silverside							54	1				
fish eggs, percomorph	sciaenid eggs (primarily)	196	124	35671	54384	3539	7977	4009	737	1102	5	2	22
Hippocampus erectus juveniles	lined seahorse	1			6	1						2	1
Hippocampus erectus adults	lined seahorse	1											
Hippocampus zosterae juveniles	dwarf seahorse										1		
Syngnathus louisianae juveniles	chain pipefish				2		3	1	1			1	2
Syngnathus scovelli juveniles	gulf pipefish	3	1	4	2	7	5			1	3	2	
Prionotus spp. preflexion larvae	searobins			7									
Prionotus spp. flexion larvae	searobins				3				1				
Prionotus spp. postflexion larvae	searobins							7					2
Prionotus tribulus preflexion larvae	bighead searobin				1								
Prionotus tribulus postflexion larvae	bighead searobin							4					
Prionotus tribulus juveniles	bighead searobin										1		
Centropomus undecimalis postflexion larvae	snook								1				
Epinephelus itajara juveniles	goliath grouper										1		
Elassoma okefenoke juveniles	Okefenokee pygmy sunfish			2									
Lepomis spp. preflexion larvae	sunfishes		9					2					
Lepomis spp. flexion larvae	sunfishes							5					
Lepomis spp. postflexion larvae	sunfishes						6	31					
Lepomis auritus juveniles	redbreast sunfish						2						
Lepomis macrochirus juveniles	bluegill						1	26					
Lepomis macrochirus adults	bluegill							1					
Lepomis punctatus juveniles	spotted sunfish						1						
Micropterus salmoides juveniles	largemouth bass			4					2				

Table A2. Page 7 of 8.

Plankton net catch by month (March 2004 to June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
Pomoxis nigromaculatus preflexion larvae	black crappie										2		
Etheostoma fusiforme preflexion larvae	swamp darter			10									
Chloroscombrus chrysurus preflexion larvae	Atlantic bumper									3			
Chloroscombrus chrysurus flexion larvae	Atlantic bumper								1				
Chloroscombrus chrysurus postflexion larvae	Atlantic bumper								2		2		
Chloroscombrus chrysurus juveniles	Atlantic bumper										5		
Oligoplites saurus juveniles	leatherjack					1	1	1					
Lutjanus griseus juveniles	gray snapper										1		
gerreid preflexion larvae	mojjaras	1		15		14		3		10			2
gerreid flexion larvae	mojjaras			1									
Eucinostomus spp. postflexion larvae	mojarras					13	21	8	150	40	40		11
Eucinostomus spp. juveniles	mojarras	1				5	4	1			10	6	2
Eucinostomus gula juveniles	silver jenny	1							1				
Eucinostomus harengulus juveniles	tidewater mojarra	1	4							2	1		
Orthopristis chrysoptera juveniles	pigfish				1								
Archosargus probatocephalus flexion larvae	sheepshead			1									
Archosargus probatocephalus postflexion larv	sheepshead			6	13	3							
Archosargus probatocephalus juveniles	sheepshead			1									
Lagodon rhomboides flexion larvae	pinfish	1											
Lagodon rhomboides postflexion larvae	pinfish	2			3								3
Lagodon rhomboides juveniles	pinfish		6	4	18	1							
Lagodon rhomboides adults	pinfish						1						
Bairdiella chrysoura preflexion larvae	silver perch			6	9	13							
Bairdiella chrysoura flexion larvae	silver perch			1	3	6	1			1			
Bairdiella chrysoura postflexion larvae	silver perch				1	3	2	1	2				
Bairdiella chrysoura juveniles	silver perch					2		1					
Cynoscion arenarius preflexion larvae	sand seatrout			1	32	3		7		60	2		
Cynoscion arenarius flexion larvae	sand seatrout			2					1	6	1		
Cynoscion arenarius postflexion larvae	sand seatrout										3		
Cynoscion nebulosus preflexion larvae	spotted seatrout				11	5		23	1	27			
Cynoscion nebulosus flexion larvae	spotted seatrout							10		6			
Cynoscion nebulosus postflexion larvae	spotted seatrout							3	1				
Cynoscion nebulosus juveniles	spotted seatrout							1					
Leiostomus xanthurus postflexion larvae	spot	1											
Leiostomus xanthurus juveniles	spot	2	8										
Menticirrhus spp. preflexion larvae	kingfishes	3			7	5		10	6	16	6	7	
Menticirrhus spp. flexion larvae	kingfishes				3				4			2	
Menticirrhus spp. postflexion larvae	kingfishes										1		
Sciaenops ocellatus flexion larvae	red drum									14	1		
Sciaenops ocellatus postflexion larvae	red drum										28		
Mugil cephalus juveniles	striped mullet			1	8								
Mugil curema juveniles	white mullet				1						6	8	
blenniid preflexion larvae	blennies	1	5	5	23	17	7	4	3		2	8	9
Chasmodes saburrae flexion larvae	Florida blenny				1								
Chasmodes saburrae postflexion larvae	Florida blenny					3						1	
Hypsoblennius spp. flexion larvae	blennies			1									
Lupinoblennius nicholsi flexion larvae	highfin blenny			1									
gobiid eggs	gobies			51									

Table A2. Page 8 of 8.

Plankton net catch by month (March 2004 to June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
gobiid preflexion larvae	gobies	10	1	2374	4657	2217	233	576	44	90	203	7	11
gobiid flexion larvae	gobies	9	9	558	2138	1789	607	394	59	16	112	834	24
Bathygobius soporator preflexion larvae	frillfin goby				11	6		2	2				
Bathygobius soporator flexion larvae	frillfin goby					3							
Bathygobius soporator postflexion larvae	frillfin goby							50					
Gobionellus spp. postflexion larvae	gobies				50								
Gobionellus boleosoma juveniles	darter goby			1									
Gobionellus oceanicus postflexion larvae	highfin goby										1		
Gobiosoma spp. postflexion larvae	gobies	28		280	7503	18924	1026	3052	130	3	219	198	519
Gobiosoma bosc juveniles	naked goby	1				9	19	7	2			1	
Gobiosoma robustum juveniles	code goby			2	3	3	11	2	2				
Microgobius spp. flexion larvae	gobies	2		114	284	59	16	255	1	3	30	25	1
Microgobius spp. postflexion larvae	gobies	4		27	598	559	42	1083	14		130	48	63
Microgobius gulosus juveniles	clown goby		3				3	156	5				
Paralichthys spp. preflexion larvae	flounders	1											
Paralichthys spp. flexion larvae	flounders	1											
Achirus lineatus preflexion larvae	lined sole					4			6	13		3	
Achirus lineatus flexion larvae	lined sole					5	3	4	2		14		
Achirus lineatus postflexion larvae	lined sole						1	18	12		16		
Achirus lineatus juveniles	lined sole							3		1			
Trinectes maculatus preflexion larvae	hogchoker					22	3	1		3	4		
Trinectes maculatus flexion larvae	hogchoker					4	6	1	3		4		
Trinectes maculatus postflexion larvae	hogchoker						1	3	2		8		
Trinectes maculatus juveniles	hogchoker			1					2		1		2
Symphurus plagiusa postflexion larvae	blackcheek tonguefish					3				18	1		
Symphurus plagiusa juveniles	blackcheek tonguefish								1		15		
Stephanolepis hispidus juveniles	planehead filefish				1							1	
Stephanolepis setifer juveniles	pygmy filefish										1		
tetraodontid preflexion larvae	puffers					2							
Sphoeroides spp. juveniles	puffers					1							
Chilomycterus schoepfii juveniles	striped burrfish							1					
unidentified preflexion larvae	fish			3							4		
unidentified flexion larvae	fish	3											
unidentified postflexion larvae	fish				1	3					1		
anuran larvae	tadpoles								1				

Table A3, page 1 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

		Location									
Description	Common Name	Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
foraminiferans	foraminiferans	131.64	0.00	43.09	3.41	10.87	1.49	3.40	0.00	0.00	0.00
Liriope tetraphylla	hydromedusa	11.46	62.12	54.58	4.07	583.58	113.83	51.60	6.13	64.53	224.29
Clytia sp.	hydromedusa	30.48	56.92	37.85	20.00	37.66	498.47	953.91	984.76	476.09	1309.86
medusa sp. a	hydromedusa	8.86	171.22	1.80	42.79	7.18	11.73	0.00	0.00	2803.47	0.00
medusa sp. b	hydromedusa	26.12	93.71	166.12	29.93	29.38	270.06	158.41	182.40	2688.22	593.31
medusa sp. c	hydromedusa	121.80	248.06	133.76	441.90	138.34	30.78	89.34	4.21	0.00	0.00
medusa sp. d	hydromedusa	0.85	0.00	0.00	0.00	10.77	7.74	44.86	35.10	18.73	6.42
medusa sp. e	hydromedusa	0.83	0.00	9.42	18.81	0.00	209.25	1663.13	1733.51	1496.32	6057.40
medusa, Bougainvillia sp.	hydromedusa	34.03	46.40	19.76	65.57	11.16	33.27	0.00	0.00	0.00	0.00
medusa, Eutima sp.	hydromedusa	0.83	0.00	2.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
medusa, Hydrocodon forbesi	hydromedusa	0.00	0.00	0.00	32.24	0.00	0.00	0.00	0.00	0.00	0.00
medusa, Obelia sp.	hydromedusa	1.70	1.93	5.14	4.09	0.00	0.00	0.00	0.00	0.00	8.79
siphonophores	siphonophores	6.57	2.43	0.00	63.77	11.38	0.00	1.32	0.00	0.00	0.00
scyphozoan ephyrae	jellyfish larvae	0.00	2.40	0.00	0.00	0.00	27.86	8.34	2.64	19.49	4.61
Chrysaora quinquecirrha	sea nettle	0.00	2.50	0.83	0.84	0.00	0.00	0.00	0.00	0.00	0.00
Aurelia aurita	moon jellyfish	1.53	0.00	0.00	0.00	0.00	0.00	3.00	5.24	0.00	0.00
Mnemiopsis mccradyi	comb jelly, ctenophore	91.56	29.52	49.56	14.17	382.42	124.38	2406.01	66.91	42.01	58.31
Beroe ovata	sea walnut, ctenophore	0.00	0.00	0.00	0.00	0.00	0.00	1.76	0.00	0.00	0.00
turbellarians	flatworms	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
nematodes	roundworms, threadworms	10.15	0.00	0.00	2.62	3.95	0.00	0.00	0.00	0.00	1.62
polychaetes	sand worms, tube worms	2649.23	395.41	410.94	210.57	239.46	183.35	312.70	157.64	86.96	41.86
oligochaetes	freshwater worms	0.00	0.00	1.66	0.00	1.81	2.22	15.04	22.65	14.16	27.72
hirudinoideans	leeches	0.00	0.00	0.00	0.00	0.00	0.80	3.18	10.26	14.81	0.92
cladocerans, Daphnia spp.	water fleas	6.47	2.40	0.00	1.70	0.00	98.48	172.70	1.71	0.75	2840.06
Simocephalus vetulus	water flea	0.00	1.60	6.24	0.00	6.08	27.98	190.52	694.56	613.00	414.74
Ceridodaphnia sp.	water flea	0.00	1.59	0.00	0.00	0.85	0.00	0.00	0.00	5.35	6.68
Bunops sp.	water flea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.00
Grimaldina brazzai	water flea	0.00	0.00	0.00	0.00	0.00	0.88	14.16	8.59	9.15	1.85
Ilyocryptus sp.	water flea	0.00	0.00	0.00	0.00	13.53	52.35	27.90	9.71	38.60	24.37
Sida crystallina	water flea	0.00	0.00	0.00	0.00	0.85	518.78	658.37	1124.15	1160.91	248.29
Penilia avirostris	water flea	5316.30	6343.25	539.59	9514.11	4102.74	24.39	0.00	0.00	0.00	0.86
Pseudosida bidentata	water flea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.16	0.00
Latonopsis fasciculata	water flea	0.00	0.00	0.00	0.00	0.85	12.89	57.50	54.66	128.30	50.69
Kurzia longirostris	water flea	0.00	0.00	0.00	0.00	0.00	1.60	6.61	36.79	10.10	25.88
Leydigia sp.	water flea	0.00	0.00	0.00	0.00	0.00	0.00	6.27	1.70	0.85	0.00
Evadne tergestina	water flea	6.55	27.10	0.00	12.74	0.00	0.00	0.00	0.87	0.00	0.00
decapod zoeae	crab larvae	17966.58	21095.73	16761.44	29018.73	23884.38	19787.37	21585.84	16872.67	11903.88	28163.94
decapod mysis	shrimp larvae	2133.22	3657.44	2557.87	1999.07	2710.88	1410.37	868.15	894.60	752.11	915.14
decapod megalopae	post-zoea crab larvae	400.25	1620.72	1237.51	1598.93	891.00	844.97	1363.63	1822.66	1790.70	1090.54
shrimps, unidentified postlarvae	shrimps	0.00	2.40	0.00	10.34	0.00	0.00	0.00	0.00	0.00	0.00
shrimps, unidentified juveniles	shrimps	0.00	1.84	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00

Table A3, page 2 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

Description	Common Name	Location									
		Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
penaeid postlarvae	penaeid shrimps	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
penaeid metamorphs	penaeid shrimps	391.29	278.56	171.43	142.53	463.78	33.23	17.27	5.10	9.04	5.65
Farfantepenaeus duorarum juveniles	pink shrimp	0.85	9.21	23.43	2.46	28.16	3.79	0.80	0.85	4.66	4.28
sicyoniid postlarvae	rock shrimps	0.00	28.96	5.34	21.55	7.55	0.82	0.00	0.00	0.00	0.00
sicyoniid juveniles	rock shrimps	0.00	0.00	0.00	5.77	0.00	0.00	0.00	0.00	0.00	0.00
Sicyonia laevigata juveniles	rock shrimp	0.00	0.00	0.00	2.62	0.76	0.00	0.00	0.00	0.00	0.00
Lucifer faxoni mysis	shrimp	1.71	2.24	0.00	3894.84	0.00	0.66	0.00	0.84	0.00	0.00
Lucifer faxoni juveniles and adults	shrimp	6771.40	14799.25	1344.52	9801.38	1853.05	643.35	112.30	69.26	40.62	23.46
Leptochela serratorbita postlarvae	combclaw shrimp	0.00	32.16	0.93	6.87	0.00	0.00	0.00	0.00	0.00	0.00
Leptochela serratorbita juveniles	combclaw shrimp	1.61	15.74	0.00	3.76	0.00	0.00	0.00	0.00	0.00	0.00
Palaemonetes spp. postlarvae	grass shrimp	89.79	77.67	51.13	205.25	60.33	217.23	476.32	474.85	573.42	482.01
Palaemonetes pugio juveniles	daggerblade grass shrimp	0.00	5.55	18.75	2.57	5.56	3.98	18.95	38.25	19.49	9.53
Palaemonetes pugio adults	daggerblade grass shrimp	0.00	0.00	0.00	0.00	0.00	0.00	8.18	5.08	4.26	0.00
Palaemonetes vulgaris juveniles	grass shrimp	0.00	4.78	0.00	0.00	4.99	0.00	0.00	0.00	0.86	0.00
Palaemonetes vulgaris adults	grass shrimp	0.00	0.00	0.00	0.76	0.85	0.00	0.00	0.00	0.00	0.00
Periclimenes spp. postlarvae	shrimps	0.00	0.00	0.00	3.30	1.81	0.00	0.00	0.00	0.00	0.00
Periclimenes spp. juveniles	shrimps	0.00	43.36	15.72	0.00	38.18	5.72	0.00	0.00	0.00	0.00
Periclimenes americanus adults	American grass shrimp	0.00	2.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Periclimenes longicaudatus juveniles	longtail grass shrimp	0.00	3.68	34.40	6.41	5.55	7.51	13.90	1.61	2.55	0.86
alphaeid mysis larvae	snapping shrimps	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
alphaeid postlarvae	snapping shrimps	56.67	362.33	170.15	234.22	82.62	13.05	8.50	0.00	0.00	4.58
alphaeid juveniles	snapping shrimps	0.00	0.00	0.00	0.00	5.54	0.88	0.00	0.00	0.00	0.00
Alpheus viridari juveniles	snapping shrimp	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.00
Hippolyte zostericola postlarvae	zostera shrimp	353.62	1106.04	157.22	1083.40	172.64	15.35	0.00	0.00	0.00	0.00
Hippolyte zostericola juveniles	zostera shrimp	2.54	54.27	51.96	36.78	6.86	0.82	0.00	0.00	0.00	0.00
Hippolyte zostericola adults	zostera shrimp	0.00	4.78	15.99	5.07	0.86	0.00	0.00	0.00	0.00	0.00
Tozeuma carolinense mysis larvae	arrow shrimp	0.00	0.00	0.00	2.83	0.00	0.00	0.00	0.00	0.00	0.00
Tozeuma carolinense postlarvae	arrow shrimp	1.78	13.81	8.61	0.89	2.47	1.10	0.00	0.00	0.00	0.00
Tozeuma carolinense juveniles	arrow shrimp	0.00	0.78	4.97	8.73	1.62	0.88	0.00	0.00	0.00	2.64
Tozeuma carolinense adults	arrow shrimp	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00
processid postlarvae	night shrimps	5.89	19.15	4.25	76.55	3.42	2.63	0.00	0.00	0.00	0.00
Ambidexter symmetricus postlarvae	shrimp	15.08	295.00	29.42	134.97	16.66	8.12	0.66	0.00	0.00	0.00
Ambidexter symmetricus juveniles	shrimp	0.00	0.00	0.82	45.47	0.92	0.00	0.00	0.00	1.66	0.00
callianassid postlarvae	ghost shrimps	0.00	1.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Callianassa spp. postlarvae	ghost shrimps	0.00	0.00	1.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upogebia spp. postlarvae	mud shrimps	29.98	44.29	17.13	33.42	46.86	6.66	0.00	0.00	0.00	0.00
Upogebia spp. juveniles	mud shrimps	4.82	19.73	3.43	0.00	1.62	2.32	0.00	0.00	0.00	0.00
Upogebia affinis juveniles	coastal mud shrimp	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00
Euceramus praelongus megalops larvae	olivepit porcelain crab	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00
Euceramus praelongus juveniles	olivepit porcelain crab	0.00	3.42	0.00	16.95	0.00	0.00	0.00	0.00	0.00	0.00
Petrolisthes armatus juveniles	porcelain crab	1.53	0.00	4.37	4.13	0.81	0.00	0.00	0.00	0.00	0.00

Table A3, page 3 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

		Location									
Description	Common Name	Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
paguroid megalops larvae	hermit crabs	0.00	5.06	1.76	3.22	0.83	0.00	0.00	0.00	0.00	0.00
paguroid juveniles	hermit crabs	0.83	0.00	0.00	4.09	0.00	0.00	0.00	0.00	0.00	0.00
Callinectes sapidus megalops larvae	blue crab	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00
Callinectes sapidus juveniles	blue crab	0.85	4.12	10.90	0.00	5.96	19.57	18.44	7.48	0.77	5.22
Portunus sp. juveniles	swimming crab	0.80	0.83	1.65	1.80	2.49	0.82	4.30	1.58	0.00	2.61
xanthid juveniles	mud crabs	0.00	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rhithropanopeus harrisii adults	Harris mud crab	0.00	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aratus pisonii juveniles	mangrove tree crab	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00
pinnotherid juveniles	pea crabs	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Squilla empusa larvae	mantis shrimp	20.52	24.30	4.19	16.83	19.47	5.98	0.00	0.00	0.00	0.00
unidentified Americamysis juveniles	opossum shrimps, mysids	26.88	129.30	77.42	234.71	515.71	8069.33	19433.80	15717.13	12751.53	11933.26
Americamysis almyra	opossum shrimp, mysid	7.80	43.88	114.12	18.70	456.03	10203.60	16536.50	17983.93	23151.97	34290.09
Americamysis bahia	opossum shrimp, mysid	15.81	19.77	16.68	24.35	1.59	6.50	3.28	0.00	0.00	0.00
Americamysis stucki	opossum shrimp, mysid	5.71	98.03	9.34	201.48	61.37	0.74	0.00	0.00	0.00	0.00
Bowmaniella dissimilis	opossum shrimp, mysid	8.86	21.28	136.90	85.55	36.44	263.61	718.68	184.04	197.74	23.70
Bowmaniella sp.	opossum shrimp, mysid	0.00	3.19	0.80	4.59	0.00	0.00	0.66	0.00	0.00	0.00
Metamysidopsis swifti	opossum shrimp, mysid	0.00	0.00	0.00	16.98	1.62	0.00	0.00	0.00	0.00	0.00
Mysidopsis furca	opossum shrimp, mysid	0.00	13.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taphromysis bowmani	opossum shrimp, mysid	0.00	1.60	10.53	5.49	8.90	293.11	124.71	54.36	518.17	12.26
cumaceans	cumaceans	74.57	848.84	1529.41	1430.35	180.60	1390.33	286.77	400.28	161.93	37.43
Sinelobus stanfordi	tanaid	0.00	0.00	0.00	0.00	0.00	7.68	2.47	0.00	0.00	1.69
Apseudes sp.	tanaid	0.85	11.57	8.63	14.15	6.43	48.62	10.36	7.33	5.15	5.22
Hargeria rapax	tanaid	21.71	164.88	49.60	45.28	114.27	106.86	13.40	0.86	4.14	3.23
Cyathura polita	isopod	0.00	3.13	1.76	0.00	0.83	9.51	6.75	6.13	3.46	0.00
Xenanthura brevitelson	isopod	0.00	0.00	8.72	0.00	1.18	0.84	1.81	0.00	0.00	0.00
Munna reynoldsi	isopod	1.66	15.64	0.80	65.43	0.00	2.53	57.59	45.51	7.01	0.84
Anopsilana jonesi	isopod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.71
cymothoid sp. a (Lironeca) juveniles	isopod	41.67	28.66	42.48	3.09	57.59	50.70	48.39	83.33	35.66	12.95
Cassidinidea ovalis	isopod	1.62	0.00	4.29	2.08	0.00	39.31	72.67	42.32	32.24	10.61
Harrieta faxoni	isopod	0.00	1.59	1.62	6.17	4.15	0.00	0.00	0.79	0.00	0.84
Sphaeroma quadridentata	isopod	0.00	8.33	4.99	23.79	1.94	2.54	2.35	2.62	0.85	0.86
Sphaeroma terebrans	isopod	0.00	0.00	2.54	3.44	5.11	24.88	113.56	44.62	26.69	28.61
Edotea triloba	isopod	4.15	31.62	62.62	32.57	523.04	438.62	467.47	417.96	715.89	543.64
Erichsonella attenuata	isopod	3.22	4.77	6.10	6.88	0.00	1.62	0.00	0.00	0.92	0.00
Erichsonella filiforme	isopod	0.00	4.73	1.62	1.70	0.00	0.00	0.00	0.00	0.00	0.00
amphipods, gammaridean	amphipods	140.20	1710.87	5038.60	3698.32	7410.22	21536.19	22128.80	14413.59	10548.00	5329.72
amphipods, caprellid	skeleton shrimps	2.38	36.87	32.01	134.26	19.00	14.19	0.00	0.00	1.59	0.00
cirriped nauplius stage	barnacles	26.79	828.54	12.43	532.52	345.25	24.13	7.28	0.84	0.00	0.00
cirriped cypris stage	barnacles	0.00	0.00	3.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00
branchiurans, Argulus spp.	fish lice	33.61	32.06	38.04	42.75	24.23	31.43	30.53	21.17	12.30	22.33
Alteutha sp.	copepod	0.00	0.00	1.71	0.00	0.00	0.00	0.00	0.84	0.00	0.00

Table A3, page 4 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

Description	Common Name	Location: Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
unidentified harpacticoids	copepods	14.23	8.24	35.02	11.36	14.76	9.99	9.04	6.80	0.84	0.00
Sapphirina spp.	copepods	0.00	0.00	0.00	0.00	1.51	0.00	0.00	0.00	0.00	0.00
Corycaeus spp.	copepods	2.44	38.67	1.62	4.30	6.49	0.00	0.00	0.00	0.00	0.00
siphonostomatids	parasitic copepods	0.83	10.07	0.89	4.09	0.00	0.00	0.00	0.88	0.00	0.00
Monstrilla sp.	copepod	4.81	12.67	23.00	30.17	34.94	83.35	33.76	18.71	10.17	11.37
unidentified freshwater cyclopoids	copepods	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.86	0.00
Cyclops spp.	copepods	1.50	0.00	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.00
Eucyclops speratus	copepod	2.66	0.69	0.00	2.32	0.83	0.00	0.00	0.00	0.00	0.00
Macrocyclops albidus	copepods	0.00	0.00	0.00	0.00	0.00	47.59	91.26	72.14	146.70	114.21
Mesocyclops edax	copepod	0.00	42.25	4.90	0.00	1.69	69.79	148.48	301.80	2618.86	2666.95
Oithona spp.	copepods	14.45	27.52	54.12	17.08	39.23	11.84	0.00	0.00	0.00	0.00
Orthocyclops modestus	copepod	0.00	0.00	0.00	0.00	0.00	27.97	67.65	23.10	33.68	57.47
Saphirella spp.	copepods	0.00	0.92	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
paracalanids	copepods	13.96	34.93	4.95	0.00	8.63	0.82	0.00	0.00	0.74	2.61
Acartia tonsa	copepod	6992.04	11581.68	6697.41	21944.11	6153.95	3466.73	841.41	2750.87	5170.54	2395.74
Calanopia americana	copepod	89.76	1683.68	338.65	888.92	221.09	163.00	57.02	5.89	4.54	2.42
Centropages hamatus	copepod	0.77	0.79	0.00	3.41	0.81	0.00	0.00	0.00	0.00	0.00
Centropages velificatus	copepod	41.34	203.46	43.42	161.20	16.19	15.18	9.15	0.00	1.72	0.00
Diaptomus spp.	copepods	0.00	0.00	0.00	0.00	0.92	1.60	4.09	7.30	6.69	16.35
Eucalanus sp.	copepod	62.24	129.64	24.14	72.65	38.03	58.61	57.52	3.32	1.54	2.55
Eurytemora affinis	copepod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00	2.58
Labidocera aestiva	copepod	3104.18	15063.15	3535.30	16569.27	3037.31	1621.38	136.43	57.45	17.31	5.24
Osphranticum labronectum	copepod	0.00	0.00	0.00	0.00	0.00	1.55	9.37	0.86	0.00	6.03
Pseudodiaptomus coronatus	copepod	9.26	25.69	32.39	68.35	47.89	54.23	57.35	67.90	60.16	51.03
Temora turbinata	copepod	3.43	12.85	0.93	46.09	8.14	5.13	0.00	0.82	5.13	1.83
myodocopod sp. a	ostracod, seed shrimp	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Euconchoecia chierchiae	ostracod, seed shrimp	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	0.00
Sarsiella zostericola	ostracod, seed shrimp	13.64	31.79	31.74	35.24	10.21	4.85	2.36	0.00	0.00	0.00
Parasterope pollex	ostracod, seed shrimp	32.22	7.58	3.42	21.02	4.48	2.84	0.00	0.87	0.00	0.00
ostracods, podocopid	ostracods, seed shrimps	5.83	5.06	20.99	0.00	14.17	1.62	11.61	1.56	3.20	19.37
collembolas, podurid	springtails	1.63	0.00	0.00	0.00	0.82	0.00	2.48	0.00	0.00	0.00
ephemeropteran larvae	mayflies	0.00	19.56	0.00	0.00	4.23	38.58	185.77	359.35	381.05	671.69
odonates, anisopteran larvae	dragonflies	0.00	0.00	0.00	0.00	0.00	3.10	4.90	1.70	3.30	46.05
odonates, zygopteran larvae	damselflies	0.00	0.00	0.00	0.00	0.85	7.05	19.66	24.50	29.00	45.63
hemipterans, belostomatid adults	giant water bugs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.17	5.70
hemipterans, corixid juveniles	water boatmen	0.00	0.00	0.00	0.00	0.00	0.89	4.13	0.00	0.00	0.00
hemipterans, corixid adults	water boatmen	0.80	0.00	0.00	0.00	0.00	0.80	5.20	4.27	4.93	4.48
hemipterans, gerrid adults	water striders	0.00	0.00	0.00	0.00	2.54	0.74	19.02	14.31	6.25	12.56
hemipterans, naucorid adults	creeoing water bugs	0.00	0.00	0.00	0.00	0.00	1.55	0.00	0.00	0.00	0.00
hemipterans, pleid adults	pygmy backswimmers	0.00	0.00	0.00	0.00	0.00	1.55	1.65	4.26	0.00	5.36
neuropterans, Climacia spp. larvae	spongillaflies	0.00	0.00	0.00	0.00	0.00	1.55	0.00	0.00	0.00	0.00

Table A3, page 5 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

		Location									
Description	Common Name	Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
coleopterans, curculionid adults	beetles	0.00	0.00	0.00	0.00	0.85	1.55	0.00	2.54	0.00	0.00
coleopterans, dytiscid larvae	predaceous diving beetles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.56	2.86	0.00
coleopterans, noterid adults	burrowing water beetles	0.00	1.59	0.00	0.00	4.14	4.76	18.32	13.58	8.71	15.80
coleopterans, elmid larvae	riffle beetles	0.00	0.00	0.86	0.00	0.00	0.00	2.35	2.56	2.54	4.28
coleopterans, elmid adults	riffle beetles	0.00	0.00	0.00	0.00	0.00	1.55	2.49	0.85	2.45	0.00
coleopterans, gyrinid larvae	whirligig beetles	0.00	0.00	0.00	0.00	0.00	0.00	1.77	3.90	0.00	1.71
coleopterans, haliplid larvae	crawling water beetles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81
coleopterans, noterid larvae	burrowing water beetles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.56	0.85	0.86
coleopterans, dytiscid adults	predaceous diving beetles	0.85	0.00	0.00	0.00	0.85	0.88	0.00	0.00	2.50	2.83
coleopterans, scirtid larvae	marsh beetles	0.00	0.00	0.00	0.00	0.00	0.00	0.83	3.40	0.00	4.90
dipterans, pupae	flies, mosquitoes	0.00	70.41	2.71	0.00	12.37	61.49	183.92	201.97	113.60	5084.23
dipterans, ceratopogonid larvae	biting midges	0.00	0.00	0.00	0.00	0.00	1.55	5.24	0.00	0.00	0.00
dipteran, Chaoborus punctipennis larvae	phantom midge	0.75	3516.43	248.51	0.00	73.41	459.19	896.12	344.56	946.68	11158.95
dipterans, chironomid larvae	midges	28.30	2.37	4.34	2.45	4.34	22.98	94.51	82.79	67.65	359.00
dipterans, stratiomyid larvae	soldier flies	0.00	3.13	0.00	0.00	0.00	0.00	0.00	0.00	2.45	29.11
dipterans, sciomyzid larvae	marsh flies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.95
dipterans, tabanid larvae	deer flies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.86
trichopteran larvae	caddisflies	0.00	0.00	0.00	0.00	0.00	1.90	20.26	45.70	42.05	98.98
lepidopterans, pyralid larvae	aquatic caterpillars	0.00	2.40	0.00	0.00	0.00	1.55	0.00	2.54	0.74	6.92
pycnogonids	sea spiders	1.70	2.37	3.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limulus polyphemus larvae	horsehoe crab	0.00	0.00	0.83	2.83	0.00	0.00	0.00	0.00	0.00	0.00
acari	water mites	0.00	3.13	0.00	0.00	1.69	7.03	10.77	12.79	20.91	15.39
gastropods, prosobranch	snails	47.95	11.53	130.62	44.21	18.58	19.29	407.90	211.77	90.06	25.74
gastropods, opisthobranch	sea slugs	1.64	5.54	9.09	14.31	37.90	3.66	6.04	0.00	0.00	0.00
pelecypods	clams, mussels, oysters	288.28	222.20	8.41	285.20	59.04	4.94	7.94	13.96	2.45	5.89
ophiopluteus larvae	brittlestars	0.00	0.00	0.00	6.54	0.00	0.00	0.00	0.00	0.00	0.00
ophiuroidean juveniles	brittlestars	0.81	5.48	0.00	0.00	4.95	0.00	0.00	0.00	0.00	0.00
Lolliguncula brevis juveniles	bay squid	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	0.00
brachiopod, Glottidia pyramidata larvae	lamp shell	3.16	40.49	6.76	49.52	4.62	7.31	0.86	0.79	0.00	0.00
chaetognaths, sagittid	arrow worms	5579.94	10481.76	2313.03	6942.81	3643.66	1287.56	386.08	121.59	64.37	215.78
ascidiacean larvae	tunicate larvae	2.43	0.00	0.00	1.54	0.00	1.69	0.00	0.00	0.00	0.00
appendicularian, Oikopleura dioica	larvacean	4833.84	5782.56	1926.10	11676.69	3075.79	39.28	6.47	3.41	4.30	2.67
Branchiostoma floridae	lancelet	0.98	12.06	2.65	5.85	2.61	0.00	0.00	0.00	0.00	0.00
Lepisosteus platyrhincus flexion larvae	Florida gar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00
Elops saurus postflexion larvae	ladyfish	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	2.35	3.42
Elops saurus juveniles	ladyfish	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00
Myrophis punctatus postflexion larvae	speckled worm eel	0.00	1.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Myrophis punctatus juveniles	speckled worm eel	0.00	0.00	5.48	0.77	1.66	1.10	1.32	0.00	0.00	0.00
clupeid eggs	herrings	1.70	25.70	0.00	2.45	0.76	0.00	0.00	0.00	0.00	0.00
clupeid preflexion larvae	herrings	17.75	107.46	30.14	60.12	5.61	9.26	0.00	0.00	0.00	3.23
clupeid postflexion larvae	herrings	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.00	0.00

Table A3, page 6 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

		Location									
Description	Common Name	Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
Brevoortia spp. postflexion larvae	menhaden	0.00	0.00	0.00	3.60	0.76	0.00	0.00	0.00	0.00	0.84
Brevoortia spp. metamorphs	menhaden	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.81
Brevoortia smithi juveniles	yellowfin menhaden	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00	0.00
Dorosoma spp. postflexion larvae	shads	0.00	0.00	2.48	0.00	0.00	0.00	0.75	3.51	5.80	0.00
Dorosoma spp. metamorphs	shads	0.00	0.00	0.00	0.00	0.00	0.00	0.66	3.57	84.59	30.01
Dorosoma petenense juveniles	threadfin shad	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.39
Harengula jaguana eggs	scaled sardine	64.93	172.13	22.98	132.66	25.64	4.00	0.00	0.00	0.00	0.00
Harengula jaguana flexion larvae	scaled sardine	2.43	13.38	0.80	5.70	0.00	1.62	0.00	0.00	0.00	0.00
Harengula jaguana postflexion larvae	scaled sardine	0.00	4.93	5.41	9.02	4.43	0.00	0.00	0.00	0.00	0.00
Harengula jaguana metamorphs	scaled sardine	1.95	7.99	21.49	1.04	1.57	0.00	0.88	0.00	0.00	0.00
Harengula jaguana juveniles	scaled sardine	0.00	2.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Opisthonema oglinum eggs	Atlantic thread herring	0.00	58.68	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Opisthonema oglinum flexion larvae	Atlantic thread herring	1.70	2.63	0.00	2.62	0.00	0.00	0.00	0.00	0.00	0.00
Opisthonema oglinum postflexion larvae	Atlantic thread herring	0.00	1.67	0.00	5.23	0.81	0.00	0.00	0.00	0.00	0.00
Opisthonema oglinum juveniles	Atlantic thread herring	0.00	0.80	0.00	0.00	0.00	0.00	0.00	1.70	0.00	0.00
Sardinella aurita flexion larvae	Spanish sardine	0.83	1.84	0.00	3.30	0.00	0.00	0.00	0.00	0.00	0.00
Sardinella aurita postflexion larvae	Spanish sardine	0.00	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sardinella aurita metamorphs	Spanish sardine	0.00	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Anchoa spp. preflexion larvae	anchovies	117.19	994.28	191.63	1598.14	803.66	114.09	75.96	9.28	5.23	5.65
Anchoa spp. flexion larvae	anchovies	33.58	114.00	41.44	95.96	20.06	15.05	26.74	3.41	2.94	1.72
Anchoa hepsetus eggs	striped anchovy	0.75	92.23	0.00	0.00	2.41	1.10	0.78	0.00	0.00	0.00
Anchoa hepsetus postflexion larvae	striped anchovy	1.59	16.30	1.65	8.06	0.76	0.00	0.80	0.00	0.00	0.84
Anchoa hepsetus juveniles	striped anchovy	0.00	2.56	1.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Anchoa mitchilli eggs	bay anchovy	39.87	3822.32	627.52	42.93	10.59	232.65	301.64	310.68	252.61	5.01
Anchoa mitchilli postflexion larvae	bay anchovy	18.32	13.48	5.75	37.76	3.88	12.05	15.10	9.28	21.72	6.63
Anchoa mitchilli juveniles	bay anchovy	4.90	4.95	29.18	8.96	18.69	40.28	52.60	130.11	234.17	205.30
Anchoa mitchilli adults	bay anchovy	1.82	8.67	49.10	0.00	15.42	7.63	2.33	4.31	2.98	5.04
Misgurnus anguillicaudatus postflexion larvae	oriental weatherfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00
Ameiurus catus juveniles	white catfish	0.00	0.00	0.00	0.00	0.00	1.55	0.00	0.00	0.00	0.00
Ameiurus natalis juveniles	yellow bullhead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94
Noturus gyrinus postflexion larvae	tadpole madtom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86
Ictalurus punctatus juveniles	channel catfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00
Ariopsis felis juveniles	hardhead catfish	0.00	4.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hoplosternum littorale juveniles	brown hoplo catfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.87
Synodus foetens postflexion larvae	inshore lizardfish	0.00	0.00	0.00	0.00	0.92	0.00	0.86	0.00	0.00	0.00
Synodus foetens juveniles	inshore lizardfish	0.00	1.67	1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gobiesox strumosus preflexion larvae	skilletfish	0.76	9.59	0.87	0.00	2.00	3.73	3.46	4.99	0.75	0.00
Gobiesox strumosus flexion larvae	skilletfish	0.00	0.00	0.00	0.00	0.00	0.82	0.91	0.83	4.28	5.93
Gobiesox strumosus postflexion larvae	skilletfish	0.00	0.00	0.00	0.00	1.18	4.30	0.66	4.82	12.80	0.00
Gobiesox strumosus juveniles	skilletfish	0.00	0.00	0.00	0.00	0.00	1.59	4.99	2.44	1.72	1.83
Hyporhamphus unifasciatus flexion larvae	silverstripe halfbeak	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00

Table A3, page 7 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

		Location									
Description	Common Name	Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
Jordanella floridae juveniles	flagfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86
Fundulus grandis postflexion larvae	gulf killifish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.46	0.92	0.00
Fundulus grandis juveniles	gulf killifish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00
Lucania parva postflexion larvae	rainwater killifish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.47	0.00
Lucania parva juveniles	rainwater killifish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	4.95
Gambusia holbrooki juveniles	eastern mosquitofish	0.00	0.00	0.00	0.00	0.00	2.33	4.33	2.55	5.04	8.37
Gambusia holbrooki adults	eastern mosquitofish	0.00	0.00	0.00	0.00	0.00	0.78	1.61	0.85	0.95	0.00
Heterandria formosa juveniles	least killifish	0.00	0.00	0.00	0.00	0.00	0.84	0.00	5.09	0.00	0.00
Heterandria formosa adults	least killifish	0.00	0.00	0.00	0.00	0.00	3.88	0.92	1.70	3.59	0.92
Menidia spp. preflexion larvae	silversides	0.00	0.00	0.00	0.00	1.69	0.00	1.67	3.42	0.00	0.00
Menidia spp. flexion larvae	silversides	0.00	0.00	0.00	0.00	0.00	0.00	0.78	1.73	0.00	0.00
Menidia spp. postflexion larvae	silversides	0.00	0.00	0.00	0.00	0.00	1.70	0.00	0.00	0.82	0.00
Menidia spp. juveniles	silversides	0.00	0.00	0.00	0.00	0.00	1.55	5.24	1.67	10.91	4.06
Menidia spp. adults	silversides	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00
Membras martinica preflexion larvae	rough silverside	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.42
Membras martinica flexion larvae	rough silverside	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Membras martinica postflexion larvae	rough silverside	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labidesthes sicculus postflexion larvae	brook silverside	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.61
Labidesthes sicculus juveniles	brook silverside	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	43.58
fish eggs, percomorph	sciaenid eggs (primarily)	11214.40	25860.02	1314.28	30231.88	8360.13	557.14	2891.40	3588.89	3234.69	3526.74
Hippocampus erectus juveniles	lined seahorse	1.58	1.58	0.00	0.00	3.24	0.00	0.00	1.62	0.84	0.00
Hippocampus erectus adults	lined seahorse	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00
Hippocampus zosterae juveniles	dwarf seahorse	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00
Syngnathus louisianae juveniles	chain pipefish	0.77	0.00	0.86	1.72	0.00	0.00	3.47	0.00	0.86	0.92
Syngnathus scovelli juveniles	gulf pipefish	3.29	4.80	5.79	0.00	3.14	3.23	0.00	2.51	0.00	0.00
Prionotus spp. preflexion larvae	searobins	0.00	3.24	0.00	2.68	0.00	0.00	0.00	0.00	0.00	0.00
Prionotus spp. flexion larvae	searobins	0.98	2.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prionotus spp. postflexion larvae	searobins	0.00	0.00	5.67	0.00	1.63	0.00	0.00	0.00	0.00	0.00
Prionotus tribulus preflexion larvae	bighead searobin	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prionotus tribulus postflexion larvae	bighead searobin	0.00	0.00	0.00	2.62	0.00	0.00	0.80	0.00	0.00	0.00
Prionotus tribulus juveniles	bighead searobin	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Centropomus undecimalis postflexion larvae	snook	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00
Epinephelus itajara juveniles	goliath grouper	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Elassoma okefenoke juveniles	Okefenokee pygmy sunfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62
Lepomis spp. preflexion larvae	sunfishes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.64	7.66
Lepomis spp. flexion larvae	sunfishes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.09	0.00
Lepomis spp. postflexion larvae	sunfishes	0.00	0.00	0.00	0.00	0.00	0.84	0.78	0.85	5.79	21.84
Lepomis auritus juveniles	redbreast sunfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.85	0.00
Lepomis macrochirus juveniles	bluegill	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	6.54	14.58
Lepomis macrochirus adults	bluegill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81
Lepomis punctatus juveniles	spotted sunfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86

Table A3, page 8 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

		Location									
Description	Common Name	Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
Micropterus salmoides juveniles	largemouth bass	0.00	0.00	0.00	0.00	0.00	1.55	0.00	0.86	1.68	0.81
Pomoxis nigromaculatus preflexion larvae	black crappie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.87
Etheostoma fusiforme preflexion larvae	swamp darter	0.00	0.00	0.00	0.00	0.00	0.80	2.48	0.86	4.21	0.00
Chloroscombrus chrysurus preflexion larvae	Atlantic bumper	0.00	0.00	0.00	3.44	0.00	0.00	0.00	0.00	0.00	0.00
Chloroscombrus chrysurus flexion larvae	Atlantic bumper	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloroscombrus chrysurus postflexion larvae	Atlantic bumper	0.00	1.67	0.00	2.08	0.00	0.00	0.00	0.00	0.00	0.00
Chloroscombrus chrysurus juveniles	Atlantic bumper	0.00	2.50	0.83	0.84	0.00	0.00	0.00	0.00	0.00	0.00
Oligoplites saurus juveniles	leatherjack	0.00	0.00	0.00	0.00	0.76	0.00	0.83	0.00	0.92	0.00
Lutjanus griseus juveniles	gray snapper	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00
gerreid preflexion larvae	mojjaras	0.00	7.57	11.93	21.77	0.81	0.00	0.00	0.00	0.00	0.00
gerreid flexion larvae	mojjaras	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00
Eucinostomus spp. postflexion larvae	mojarras	1.95	62.11	77.97	19.52	55.74	11.17	3.46	0.79	0.86	8.21
Eucinostomus spp. juveniles	mojarras	0.00	0.00	4.10	4.97	0.86	5.08	3.48	0.00	2.59	3.54
Eucinostomus gula juveniles	silver jenny	0.00	0.00	0.86	0.00	0.00	0.00	0.78	0.00	0.00	0.00
Eucinostomus harengulus juveniles	tidewater mojarra	0.00	0.00	0.93	0.00	0.92	0.00	0.86	0.00	0.75	3.40
Orthopristis chrysoptera juveniles	pigfish	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Archosargus probatocephalus flexion larvae	sheepshead	0.00	0.00	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Archosargus probatocephalus postflexion larva	sheepshead	0.00	7.15	0.87	1.78	0.00	0.00	4.44	4.08	0.00	0.00
Archosargus probatocephalus juveniles	sheepshead	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00
Lagodon rhomboides flexion larvae	pinfish	0.00	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lagodon rhomboides postflexion larvae	pinfish	0.00	1.59	0.00	2.55	0.00	2.13	0.00	0.00	0.00	0.00
Lagodon rhomboides juveniles	pinfish	1.58	1.55	6.28	0.94	0.00	10.28	1.81	0.82	0.00	0.80
Lagodon rhomboides adults	pinfish	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.00	0.00
Bairdiella chrysoura preflexion larvae	silver perch	0.00	11.21	5.14	3.72	3.02	0.00	0.00	0.00	0.00	0.00
Bairdiella chrysoura flexion larvae	silver perch	0.00	4.78	1.80	2.29	0.81	0.00	0.00	0.00	0.00	0.00
Bairdiella chrysoura postflexion larvae	silver perch	0.00	1.59	0.00	0.00	0.00	2.63	1.76	1.72	0.00	0.00
Bairdiella chrysoura juveniles	silver perch	0.00	0.00	0.00	0.00	0.00	1.75	0.00	0.85	0.00	0.00
Cynoscion arenarius preflexion larvae	sand seatrout	2.51	37.14	2.58	53.21	9.71	3.20	0.00	0.00	0.00	0.00
Cynoscion arenarius flexion larvae	sand seatrout	0.98	0.00	0.00	8.65	0.00	0.00	0.86	0.00	0.00	0.00
Cynoscion arenarius postflexion larvae	sand seatrout	0.00	0.00	0.00	0.00	0.83	0.82	0.00	0.79	0.00	0.00
Cynoscion nebulosus preflexion larvae	spotted seatrout	4.94	16.88	4.86	28.08	5.41	0.00	4.44	0.00	0.00	0.00
Cynoscion nebulosus flexion larvae	spotted seatrout	0.00	0.00	1.62	6.87	4.55	0.00	1.59	0.00	0.00	0.00
Cynoscion nebulosus postflexion larvae	spotted seatrout	0.00	0.00	0.00	0.00	0.85	0.74	1.59	0.00	0.00	0.00
Cynoscion nebulosus juveniles	spotted seatrout	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00
Leiostomus xanthurus postflexion larvae	spot	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00
Leiostomus xanthurus juveniles	spot	0.00	0.69	0.00	0.77	0.00	0.00	0.00	0.00	0.00	6.81
Menticirrhus spp. preflexion larvae	kingfishes	4.34	21.28	1.65	21.91	5.01	0.66	0.00	0.00	0.00	0.00
Menticirrhus spp. flexion larvae	kingfishes	0.00	3.93	0.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00
Menticirrhus spp. postflexion larvae	kingfishes	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00
Sciaenops ocellatus flexion larvae	red drum	0.00	0.00	0.83	16.03	0.00	0.00	0.00	0.00	0.00	0.00
Sciaenops ocellatus postflexion larvae	red drum	0.00	2.50	0.00	5.88	0.83	1.64	1.72	0.79	2.21	7.82

Table A3, page 9 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

Description	Common Name	Location									
		Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
Mugil cephalus juveniles	striped mullet	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.82	0.79	4.82
Mugil curema juveniles	white mullet	0.00	1.67	0.83	1.68	0.83	3.13	4.10	0.00	0.00	0.00
blenniid preflexion larvae	blennies	3.05	7.35	7.76	16.03	5.65	12.97	8.57	3.35	1.69	3.33
Chasmodes saburrae flexion larvae	Florida blenny	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chasmodes saburrae postflexion larvae	Florida blenny	0.00	1.93	0.00	0.00	1.18	0.00	0.80	0.00	0.00	0.00
Hypsoblennius spp. flexion larvae	blennies	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00
Lupinoblennius nicholsi flexion larvae	highfin blenny	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.00	0.00
gobiid eggs	gobies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.64	0.00	0.00
gobiid preflexion larvae	gobies	86.40	220.42	258.20	176.14	175.25	1290.98	756.51	2342.28	2353.05	788.92
gobiid flexion larvae	gobies	101.40	127.43	181.74	113.05	58.70	782.94	355.03	879.33	625.95	2250.72
Bathygobius soporator preflexion larvae	frillfin goby	0.76	0.00	0.80	4.37	1.52	0.00	4.44	5.87	0.00	0.00
Bathygobius soporator flexion larvae	frillfin goby	0.00	0.00	0.00	0.00	2.57	0.00	0.00	0.00	0.00	0.00
Bathygobius soporator postflexion larvae	frillfin goby	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.70	39.26	0.00
Gobionellus spp. postflexion larvae	gobies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.96	1.72	0.00
Gobionellus boleosoma juveniles	darter goby	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00
Gobionellus oceanicus postflexion larvae	highfin goby	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.00
Gobiosoma spp. postflexion larvae	gobies	124.84	231.43	181.73	92.65	54.37	275.09	1906.46	4104.16	7882.03	11750.10
Gobiosoma bosc juveniles	naked goby	0.00	0.00	0.00	0.00	0.00	5.85	11.16	8.63	4.30	2.48
Gobiosoma robustum juveniles	code goby	2.49	0.80	0.86	0.00	0.00	0.84	3.37	4.40	2.54	4.19
Microgobius spp. flexion larvae	gobies	0.00	1.59	4.17	3.44	2.41	65.40	215.48	190.21	61.84	111.48
Microgobius spp. postflexion larvae	gobies	6.69	5.56	17.85	0.00	3.29	114.82	255.68	215.97	742.56	738.70
Microgobius gulosus juveniles	clown goby	0.00	0.00	0.00	0.00	4.05	0.84	5.02	11.06	10.63	104.25
Paralichthys spp. preflexion larvae	flounders	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paralichthys spp. flexion larvae	flounders	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00
Achirus lineatus preflexion larvae	lined sole	4.37	3.19	0.80	15.44	0.00	0.78	0.00	0.79	0.00	0.00
Achirus lineatus flexion larvae	lined sole	3.25	7.22	2.69	0.00	4.15	0.00	1.72	2.37	1.70	0.00
Achirus lineatus postflexion larvae	lined sole	1.81	3.19	9.07	2.08	6.31	8.92	3.44	1.70	2.45	0.00
Achirus lineatus juveniles	lined sole	0.00	0.00	0.00	1.15	0.00	0.00	0.00	0.00	2.45	0.00
Trinectes maculatus preflexion larvae	hogchoker	1.70	2.50	5.97	7.98	7.62	2.63	0.78	0.00	0.00	0.00
Trinectes maculatus flexion larvae	hogchoker	3.65	0.00	6.18	0.00	1.62	1.56	0.86	0.79	0.74	0.00
Trinectes maculatus postflexion larvae	hogchoker	0.00	0.00	0.00	2.08	0.76	0.00	4.10	2.37	0.00	2.61
Trinectes maculatus juveniles	hogchoker	0.00	0.92	0.88	0.00	1.69	0.00	0.00	0.00	0.84	0.87
Symphurus plagiusa postflexion larvae	blackcheek tonguefish	0.00	5.14	0.83	18.88	0.00	0.00	0.00	0.00	0.00	0.00
Symphurus plagiusa juveniles	blackcheek tonguefish	0.00	0.00	0.00	0.00	5.00	6.54	1.72	0.00	0.00	0.00
Stephanolepis hispidus juveniles	planehead filefish	0.00	0.00	0.00	0.00	0.00	0.00	1.69	0.00	0.00	0.00
Stephanolepis setifer juveniles	pygmy filefish	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00
tetraodontid preflexion larvae	puffers	0.00	1.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphoeroides spp. juveniles	puffers	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00
Chilomycterus schoepfii juveniles	striped burrfish	0.00	0.00	0.00	0.87	0.00	0.00	0.00	0.00	0.00	0.00
unidentified preflexion larvae	fish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.94	2.43
unidentified flexion larvae	fish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.51

Table A3, page 10 of 10. Location specific plankton-net catch.

Data are presented as mean number per 1,000 cubic meters.

Organisms are listed in phylogenetic order.

		Location									
Description	Common Name	Lyons	Roberts 1	Roberts 2	0.3 km	1.2 km	2.4 km	3.5 km	4.4 km	5.1 km	6.0 km
unidentified postflexion larvae	fish	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.74	2.48
anuran larvae	tadpoles	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00	0.00	0.00

Appendix B:

Seine and trawl summary tables

Table B1, page 1 of 3.

Seine catch statistics (October 2004 through September 2005, n=144).

Organisms are listed in phylogenetic order.

Taxon	Common Name	Number Collected	Collection Frequency	km_U (km)	S_U (psu)	Mean CPUE (No./100m^2)	Max CPUE (No./100m^2)
Farfantepenaeus duorarum	Pink shrimp	426	61	3.86	29.22	3.92	80.88
Sicyonia spp.	Rock shrimps	2	1	-	34.80	0.02	2.94
Sicyonia brevirostris	Brown rock shrimp	1	1	-	36.05	0.01	1.47
Sicyonia parri	Rock shrimp	1	1	-	34.30	0.01	1.47
Palaemonetes spp.	Grass shrimps	7	6	3.36	20.54	0.06	2.94
Palaemonetes intermedius	Brackish grass shrimp	46	5	2.90	31.86	0.42	29.41
Palaemonetes paludosus	Riverine grass shrimp	2	2	4.80	17.20	0.02	1.47
Palaemonetes pugio	Daggerblade grass shrimp	1358	38	5.10	15.34	12.48	686.76
Periclimenes americanus	American grass shrimp	21	6	1.39	33.01	0.19	13.24
Periclimenes longicaudatus	Longtail grass shrimp	11	5	3.80	34.77	0.10	8.82
Palaemon floridanus	Florida grass shrimp	3	2	-	34.17	0.03	2.94
Hippolyte zostericola	Zostera shrimp	1	1	-	33.63	0.01	1.47
Tozeuma spp.	Arrow shrimps	1	1	-	36.05	0.01	1.47
Tozeuma carolinense	Arrow shrimp	17	2	-	34.18	0.16	20.59
Callinectes sapidus	Blue crab	192	50	4.59	16.37	1.76	22.06
Callinectes similis	Lesser blue crab	1	1	0.60	33.10	0.01	1.47
Portunus spp.	Portunus crabs	1	1	1.10	32.75	0.01	1.47
Menippe spp.	Stone crabs	1	1	-	33.10	0.01	1.47
Brevoortia spp.	Menhadens	9	4	5.20	24.23	0.08	5.88
Dorosoma cepedianum	Gizzard shad	7	1	5.70	0.20	0.06	10.29
Opisthonema oglinum	Atlantic thread herring	157	5	-	34.29	1.44	117.65
Harengula jaguana	Scaled sardine	7528	15	1.04	34.31	69.19	4470.59
Sardinella aurita	Spanish sardine	4191	4	-	35.28	38.52	5576.47
Anchoa hepsetus	Striped anchovy	214	2	-	34.46	1.97	220.59
Anchoa mitchilli	Bay anchovy	32450	36	3.43	32.75	298.25	21035.29
Anchoa cubana	Cuban anchovy	2522	6	6.00	28.53	23.18	3435.29
Anchoa nasuta	Longnose anchovy	4	1	-	32.67	0.04	5.88
Synodus foetens	Inshore lizardfish	66	33	2.48	30.40	0.61	13.24
Opsanus beta	Gulf toadfish	1	1	-	33.10	0.01	1.47
Hyporhamphus meeki	False silverstripe halfbeak	1	1	1.20	34.70	0.01	1.47
Strongylura spp.	Needlefishes	22	12	2.77	32.09	0.20	5.88
Strongylura marina	Atlantic needlefish	11	7	2.38	29.42	0.10	4.41
Strongylura notata	Redfin needlefish	15	9	3.10	26.41	0.14	4.41
Strongylura timucu	Timucu	17	8	1.74	30.29	0.16	10.29
Fundulus grandis	Gulf killifish	169	15	3.43	26.95	1.55	155.88
Lucania parva	Rainwater killifish	1	1	-	33.10	0.01	1.47
Floridichthys carpio	Goldspotted killifish	14	1	-	31.95	0.13	20.59
Gambusia holbrooki	Eastern mosquitofish	35	8	5.67	7.03	0.32	23.53
Poecilia latipinna	Sailfin molly	13	5	4.99	19.81	0.12	7.35
Membras martinica	Rough silverside	33	1	-	33.20	0.30	48.53
Menidia spp.	Silversides	3264	69	4.88	24.07	30.00	1585.29
Labidesthes sicculus	Brook silverside	2	2	5.60	0.20	0.02	1.47
Syngnathus louisianae	Chain pipefish	8	5	3.75	32.65	0.07	4.41
Syngnathus scovelli	Gulf pipefish	17	13	3.52	31.29	0.16	4.41
Hippocampus spp.	Seahorses	1	1	1.20	33.35	0.01	1.47
Hippocampus erectus	Lined seahorse	2	2	-	34.10	0.02	1.47
Prionotus scitulus	Leopard searobin	1	1	-	31.75	0.01	1.47
Prionotus tribulus	Bighead searobin	4	4	4.68	22.52	0.04	1.47
Centropomus undecimalis	Common snook	180	45	3.90	19.67	1.65	61.76
Centropristis striata	Black sea bass	2	1	-	34.40	0.02	2.94
Epinephelus itajara	Jewfish	1	1	-	32.87	0.01	1.47
Epinephelus morio	Red grouper	1	1	-	34.55	0.01	1.47

Table B1, page 2 of 3.

Seine catch statistics (October 2004 through September 2005, n=144).

Organisms are listed in phylogenetic order.

Taxon	Common Name	Number Collected	Collection Frequency	km_U (km)	S_U (psu)	Mean CPUE (No./100m^2)	Max CPUE (No./100m^2)
Mycteroperca microlepis	Gag	5	2	4.40	29.04	0.05	5.88
Diplectrum formosum	Sand perch	1	1	-	33.93	0.01	1.47
Serraniculus pumilio	Pygmy sea bass	6	4	1.20	33.75	0.06	4.41
Serranus subligarius	Belted sandfish	1	1	-	34.10	0.01	1.47
Lepomis spp.	Sunfishes	28	5	5.20	1.24	0.26	17.65
Lepomis macrochirus	Bluegill	15	5	4.36	1.69	0.14	11.76
Lepomis microlophus	Redear sunfish	1	1	5.40	1.00	0.01	1.47
Micropterus salmoides	Largemouth bass	9	5	4.80	1.78	0.08	5.88
Etheostoma fusiforme	Swamp darter	4	2	3.53	16.18	0.04	4.41
Caranx hippos	Crevalle jack	9	3	5.91	18.83	0.08	8.82
Chloroscombrus chrysurus	Atlantic bumper	1	1	4.20	14.25	0.01	1.47
Oligoplites saurus	Leatherjack	18	7	4.26	26.15	0.17	11.76
Trachinotus falcatus	Permit	5	1	-	31.53	0.05	7.35
Lutjanus griseus	Gray snapper	76	40	3.06	28.47	0.70	17.65
Lutjanus synagris	Lane snapper	79	16	2.30	34.18	0.73	60.29
Eucinostomus spp.	Eucinostomus mojarras	9608	137	3.93	26.29	88.31	1114.71
Eucinostomus argenteus	Spotfin mojarra	11	2	-	33.11	0.10	11.76
Eucinostomus gula	Silver jenny	1782	68	1.42	33.42	16.38	308.82
Eucinostomus harengulus	Tidewater mojarra	1457	110	3.98	25.63	13.39	297.06
Eugerres plumieri	Striped mojarra	93	21	5.38	6.29	0.85	32.35
Haemulon plumieri	White grunt	3	2	-	28.77	0.03	2.94
Orthopristis chrysoptera	Pigfish	131	8	1.40	34.04	1.20	110.29
Lagodon rhomboides	Pinfish	2453	94	2.01	30.52	22.55	416.18
Archosargus probatocephalus	Sheepshead	73	23	4.04	11.08	0.67	35.29
Diplodus holbrooki	Spottail pinfish	1	1	-	35.20	0.01	1.47
Cynoscion nebulosus	Spotted seatrout	2	2	2.70	17.52	0.02	1.47
Bairdiella chrysoura	Silver perch	195	4	4.93	33.36	1.79	279.41
Leiostomus xanthurus	Spot	253	20	2.69	31.29	2.33	202.94
Menticirrhus saxatilis	Northern kingfish	6	4	0.80	30.54	0.06	2.94
Pogonias cromis	Black drum	1	1	3.70	28.35	0.01	1.47
Sciaenops ocellatus	Red drum	13	6	5.49	24.14	0.12	10.29
Chaetodipterus faber	Atlantic spadefish	1	1	4.20	14.25	0.01	1.47
Mugil spp.	Mullets	3	1	2.90	25.40	0.03	4.41
Mugil cephalus	Striped mullet	570	19	6.03	15.67	5.24	654.41
Mugil curema	White mullet	78	5	2.96	29.27	0.72	57.35
Mugil gyrans	Fantail mullet	38	7	2.56	29.55	0.35	16.18
Sphyraena borealis	Northern sennet	7	2	-	32.88	0.06	8.82
Sphyraena barracuda	Great barracuda	4	4	-	27.37	0.04	1.47
Chasmodes saburrae	Florida blenny	1	1	2.90	30.30	0.01	1.47
Gobionellus spp.	Gobionellus gobies	1	1	-	33.60	0.01	1.47
Gobionellus boleosoma	Darter goby	8	6	-	33.97	0.07	4.41
Gobionellus oceanicus	Highfin goby	3	1	4.90	15.80	0.03	4.41
Gobiosoma spp.	Gobiosoma gobies	119	35	4.05	9.95	1.09	57.35
Gobiosoma bosc	Naked goby	51	23	4.66	17.39	0.47	11.76
Gobiosoma robustum	Code goby	6	4	1.37	29.65	0.06	2.94
Microgobius gulosus	Clown goby	552	57	4.84	15.97	5.07	101.47
Bathygobius soporator	Frillfin goby	1	1	2.90	30.30	0.01	1.47
Lophogobius cyprinoides	Crested goby	20	12	3.61	19.16	0.18	7.35
Citharichthys macrops	Spotted whiff	1	1	-	34.20	0.01	1.47
Paralichthys albigutta	Gulf flounder	1	1	-	34.30	0.01	1.47
Trinectes maculatus	Hogchoker	74	22	5.08	13.43	0.68	16.18
Achirus lineatus	Lined sole	29	20	3.51	26.52	0.27	5.88

Table B1, page 3 of 3.

Seine catch statistics (October 2004 through September 2005, n=144).

Organisms are listed in phylogenetic order.

Taxon	Common Name	Number Collected	Collection Frequency	km_U (km)	S_U (psu)	Mean CPUE (No./100m^2)	Max CPUE (No./100m^2)
Symphurus plagiusa	Blackcheek tonguefish	10	6	4.06	30.74	0.09	5.88
Stephanolepis hispidus	Planehead filefish	9	7	-	34.01	0.08	4.41
Sphoeroides nephelus	Southern puffer	8	6	2.06	32.70	0.07	4.41
Chilomycterus schoepfii	Striped burrfish	4	4	1.70	32.39	0.04	1.47

Table B2, page 1 of 2.

Trawl catch statistics (October 2004 through September 2005, n=72).

Organisms are listed in phylogenetic order.

Taxon	Common Name	Number Collected	Collection Frequency	km_U (km)	S_U (psu)	Mean CPUE (No./100m^2)	Max CPUE (No./100m^2)
Farfantepenaeus duorarum	Pink shrimp	571	36	3.01	28.08	1.00	11.69
Rimapenaeus constrictus	Roughneck shrimp	6	3	-	32.53	0.01	0.60
Sicyonia brevirostris	Brown rock shrimp	2	1	-	32.63	0.00	0.30
Sicyonia laevigata	Hardback	15	2	0.50	35.49	0.03	1.89
Palaemonetes spp.	Grass shrimps	1	1	-	34.70	0.00	0.13
Palaemonetes paludosus	Riverine grass shrimp	1	1	4.90	0.20	0.00	0.15
Palaemonetes pugio	Daggerblade grass shrimp	1	1	6.20	0.10	0.00	0.13
Periclimenes americanus	American grass shrimp	69	14	1.46	32.84	0.12	2.10
Periclimenes longicaudatus	Longtail grass shrimp	216	11	2.41	31.64	0.39	14.54
Palaemon floridanus	Florida grass shrimp	10	1	-	28.40	0.02	1.35
Brachycarpus biunguiculatus	Twoclaw shrimp	9	1	-	34.07	0.01	1.10
Alpheus spp.	Snapping shrimp	2	2	3.40	18.29	0.00	0.17
Hippolyte zostericola	Zostera shrimp	21	1	-	32.70	0.04	3.15
Callinectes spp.	Blue crabs	11	3	-	33.57	0.02	0.86
Callinectes sapidus	Blue crab	190	47	3.06	26.47	0.34	3.37
Callinectes similis	Lesser blue crab	8	2	-	31.38	0.01	0.81
Callinectes ornatus	Shelligs	4	2	1.80	30.61	0.01	0.40
Menippe spp.	Stone crabs	7	3	0.40	34.43	0.01	0.67
Dasyatis sabina	Atlantic stingray	1	1	1.30	23.37	0.00	0.13
Dasyatis say	Bluntnose stingray	1	1	-	34.20	0.00	0.15
Elopiformes spp.	Tarpons	1	1	6.20	27.93	0.00	0.15
Elops saurus	Ladyfish	2	2	4.15	27.32	0.00	0.13
Opisthonema oglinum	Atlantic thread herring	1	1	1.70	31.10	0.00	0.15
Harengula jaguana	Scaled sardine	13	1	-	28.40	0.02	1.75
Sardinella aurita	Spanish sardine	1	1	-	31.93	0.00	0.13
Anchoa hepsetus	Striped anchovy	2	2	-	33.82	0.00	0.15
Anchoa mitchilli	Bay anchovy	111	10	3.86	26.16	0.20	6.88
Anchoa cubana	Cuban anchovy	329	6	4.04	30.09	0.56	17.94
Synodus foetens	Inshore lizardfish	86	26	1.04	32.56	0.16	2.10
Ameiurus nebulosus	Brown bullhead	1	1	6.30	3.38	0.00	0.15
Ariopsis felis	Hardhead catfish	79	19	3.27	25.04	0.14	4.05
Hoplosternum littorale	Brown hoplo	1	1	4.90	0.20	0.00	0.15
Opsanus beta	Gulf toadfish	12	6	1.50	31.99	0.02	0.40
Gobiesox strumosus	Skilletfish	1	1	3.90	25.03	0.00	0.12
Ogcocephalus radiatus	Polka-dot batfish	1	1	-	34.20	0.00	0.13
Menidia spp.	Silversides	1	1	3.40	1.65	0.00	0.13
Syngnathus louisianae	Chain pipefish	7	6	1.50	33.49	0.01	0.27
Syngnathus springeri	Bull pipefish	1	1	-	34.20	0.00	0.15
Syngnathus scovelli	Gulf pipefish	10	7	1.50	33.51	0.02	0.54
Hippocampus erectus	Lined seahorse	18	11	0.78	34.17	0.03	0.67
Hippocampus zosterae	Dwarf seahorse	4	3	3.10	29.59	0.01	0.25
Scorpaena brasiliensis	Barbfish	7	6	0.82	32.74	0.01	0.27
Prionotus scitulus	Leopard searobin	19	13	0.88	33.59	0.03	0.40
Prionotus tribulus	Bighead searobin	11	9	3.59	27.93	0.02	0.30
Centropomus undecimalis	Common snook	45	12	5.55	7.43	0.08	2.43
Centropristis striata	Black sea bass	4	3	1.50	32.76	0.01	0.30
Epinephelus itajara	Jewfish	1	1	6.10	28.97	0.00	0.13
Mycteroperca microlepis	Gag	3	3	0.40	33.53	0.01	0.22
Mycteroperca bonaci	Black grouper	1	1	-	33.00	0.00	0.13
Diplectrum formosum	Sand perch	5	5	0.90	33.48	0.01	0.15
Serraniculus pumilio	Pygmy sea bass	1	1	0.90	34.50	0.00	0.13
Serranus subligarius	Belted sandfish	1	1	-	33.90	0.00	0.15

Table B2, page 2 of 2.

Trawl catch statistics (October 2004 through September 2005, n=72).

Organisms are listed in phylogenetic order.

Taxon	Common Name	Number Collected	Collection Frequency	km_U (km)	S_U (psu)	Mean CPUE (No./100m^2)	Max CPUE (No./100m^2)
Lepomis microlophus	Redear sunfish	1	1	-	28.40	0.00	0.13
Pomoxis nigromaculatus	Black crappie	1	1	4.90	0.20	0.00	0.15
Etheostoma fusiforme	Swamp darter	2	2	5.52	0.15	0.00	0.15
Chloroscombrus chrysurus	Atlantic bumper	4	2	0.60	33.45	0.01	0.30
Selene vomer	Lookdown	1	1	-	34.33	0.00	0.13
Lutjanus griseus	Gray snapper	30	9	5.37	27.93	0.05	1.62
Lutjanus synagris	Lane snapper	72	15	2.31	31.46	0.13	2.10
Eucinostomus spp.	Eucinostomus mojarras	4468	42	4.12	28.42	7.87	90.84
Eucinostomus argenteus	Spotfin mojarra	18	3	1.70	32.37	0.03	1.35
Eucinostomus gula	Silver jenny	472	26	1.50	30.45	0.80	18.48
Eucinostomus harengulus	Tidewater mojarra	87	23	3.54	25.64	0.15	2.56
Eugerres plumieri	Striped mojarra	60	13	5.77	9.63	0.10	2.97
Orthopristis chrysoptera	Pigfish	74	8	-	33.70	0.12	7.60
Lagodon rhomboides	Pinfish	607	24	2.00	33.92	1.00	36.43
Archosargus probatocephalus	Sheepshead	47	28	3.45	27.31	0.08	0.60
Calamus arctifrons	Grass porgy	1	1	-	33.90	0.00	0.22
Cynoscion nebulosus	Spotted seatrout	22	5	5.43	18.38	0.04	1.75
Cynoscion arenarius	Sand seatrout	26	8	4.60	17.89	0.04	1.08
Bairdiella chrysoura	Silver perch	35	3	3.90	33.46	0.06	3.64
Leiostomus xanthurus	Spot	72	5	4.83	32.85	0.11	7.97
Menticirrhus americanus	Southern kingfish	4	2	1.67	21.10	0.01	0.37
Micropogonias undulatus	Atlantic croaker	1	1	-	34.70	0.00	0.13
Pogonias cromis	Black drum	5	2	4.76	21.34	0.01	0.54
Sciaenops ocellatus	Red drum	68	4	6.14	14.00	0.12	8.63
Chaetodipterus faber	Atlantic spadefish	5	5	3.57	27.14	0.01	0.17
Mugil cephalus	Striped mullet	4	2	4.63	26.79	0.01	0.40
Sphyraena borealis	Northern sennet	1	1	-	31.60	0.00	0.17
Nicholsina usta	Emerald parrotfish	1	1	-	33.90	0.00	0.15
Astroscopus y-graecum	Southern stargazer	1	1	0.60	34.70	0.00	0.15
Gobionellus boleosoma	Darter goby	1	1	-	28.40	0.00	0.13
Gobionellus oceanicus	Highfin goby	1	1	3.40	1.65	0.00	0.13
Gobiosoma spp.	Gobiosoma gobies	17	10	5.48	25.54	0.03	0.75
Gobiosoma bosc	Naked goby	5	4	4.25	30.68	0.01	0.27
Gobiosoma robustum	Code goby	18	9	1.19	32.00	0.03	0.81
Gobiosoma longipala	Twoscale goby	1	1	0.40	34.50	0.00	0.13
Microgobius gulosus	Clown goby	97	18	4.72	18.73	0.17	5.40
Lophogobius cyprinoides	Crested goby	1	1	3.20	2.60	0.00	0.13
Peprilus alepidotus	Harvestfish	6	1	-	34.70	0.01	0.90
Citharichthys macrops	Spotted whiff	2	2	-	33.98	0.00	0.15
Etropus crossotus	Fringed flounder	9	7	1.37	31.19	0.02	0.30
Paralichthys albigutta	Gulf flounder	29	16	1.39	31.71	0.05	0.81
Trinectes maculatus	Hogchoker	148	16	5.85	3.26	0.25	10.79
Achirus lineatus	Lined sole	27	13	2.59	16.38	0.05	1.35
Symphurus plagiusa	Blackcheek tonguefish	18	7	1.60	28.03	0.03	0.60
Stephanolepis hispidus	Planehead filefish	14	10	1.00	33.27	0.02	0.40
Acanthostracion quadricornis	Scrawled cowfish	1	1	-	32.20	0.00	0.15
Sphoeroides nephelus	Southern puffer	12	10	1.50	34.00	0.02	0.27
Sphoeroides parvus	Least puffer	1	1	1.50	33.45	0.00	0.15
Sphoeroides spengleri	Bandtail puffer	1	1	-	34.20	0.00	0.13
Chilomycterus schoepfii	Striped burrfish	20	9	-	33.11	0.04	0.81
	Unidentified species	1	1	0.40	34.50	0.00	0.13

Table B3. Page 1 of 4.

Seine catch by month (March 2004 through June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
Farfantepenaeus duorarum	Pink shrimp	12	6	7	2	6	22	56	45	71	20	140	39
Sicyonia spp.	Rock shrimps	2	0	0	0	0	0	0	0	0	0	0	0
Sicyonia brevirostris	Brown rock shrimp	0	0	1	0	0	0	0	0	0	0	0	0
Sicyonia parri	Rock shrimp	0	0	0	1	0	0	0	0	0	0	0	0
Palaemonetes spp.	Grass shrimps	2	1	0	0	2	0	1	0	1	0	0	0
Palaemonetes intermedius	Brackish grass shrimp	0	0	16	0	9	0	0	0	0	0	21	0
Palaemonetes paludosus	Riverine grass shrimp	0	0	0	0	2	0	0	0	0	0	0	0
Palaemonetes pugio	Daggerblade grass shrimp	351	21	781	9	150	5	2	0	0	0	39	0
Periclimenes americanus	American grass shrimp	0	0	0	13	0	0	6	0	0	0	1	1
Periclimenes longicaudatus	Longtail grass shrimp	0	0	6	0	3	0	1	0	0	0	1	0
Palaemon floridanus	Florida grass shrimp	0	1	0	0	2	0	0	0	0	0	0	0
Hippolyte zostericola	Zostera shrimp	0	0	0	0	1	0	0	0	0	0	0	0
Tozeuma spp.	Arrow shrimps	0	0	1	0	0	0	0	0	0	0	0	0
Tozeuma carolinense	Arrow shrimp	0	0	0	14	3	0	0	0	0	0	0	0
Callinectes sapidus	Blue crab	9	5	29	9	17	54	4	2	6	10	24	23
Callinectes similis	Lesser blue crab	0	0	0	0	0	1	0	0	0	0	0	0
Portunus spp.	Portunus crabs	0	0	0	0	0	0	1	0	0	0	0	0
Menippe spp.	Stone crabs	0	0	0	0	0	0	0	0	0	1	0	0
Brevoortia spp.	Menhadens	0	0	0	4	4	1	0	0	0	0	0	0
Dorosoma cepedianum	Gizzard shad	0	0	0	0	0	7	0	0	0	0	0	0
Opisthonema oglinum	Atlantic thread herring	0	0	0	0	0	80	45	5	0	0	0	27
Harengula jaguana	Scaled sardine	0	0	0	1	2	3338	3087	340	653	2	0	105
Sardinella aurita	Spanish sardine	0	0	0	0	0	0	3801	237	153	0	0	0
Anchoa hepsetus	Striped anchovy	0	0	0	0	64	150	0	0	0	0	0	0
Anchoa mitchilli	Bay anchovy	959	3	7195	2137	20872	172	33	58	604	170	0	247
Anchoa cubana	Cuban anchovy	0	0	3	0	96	38	0	48	0	0	2337	0
Anchoa nasuta	Longnose anchovy	0	0	4	0	0	0	0	0	0	0	0	0
Synodus foetens	Inshore lizardfish	1	0	0	11	15	6	1	1	10	8	8	5
Opsanus beta	Gulf toadfish	0	0	0	1	0	0	0	0	0	0	0	0
Hyporhamphus meeki	False silverstripe halfbeak	0	0	0	0	1	0	0	0	0	0	0	0

Table B3. Page 2 of 4.

Seine catch by month (March 2004 through June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
Strongylura spp.	Needlefishes	0	0	0	7	11	1	1	1	0	1	0	0
Strongylura marina	Atlantic needlefish	0	0	0	0	1	6	1	3	0	0	0	0
Strongylura notata	Redfin needlefish	0	0	0	0	0	2	2	0	5	4	2	0
Strongylura timucu	Timucu	0	0	2	0	0	2	2	0	1	10	0	0
Fundulus grandis	Gulf killifish	0	1	1	1	32	106	7	0	0	2	19	0
Lucania parva	Rainwater killifish	0	0	0	1	0	0	0	0	0	0	0	0
Floridichthys carpio	Goldspotted killifish	0	0	0	0	0	0	0	0	0	14	0	0
Gambusia holbrooki	Eastern mosquitofish	7	0	4	18	3	1	0	0	0	0	2	0
Poecilia latipinna	Sailfin molly	2	0	0	0	0	0	5	0	0	0	6	0
Membras martinica	Rough silverside	0	0	0	0	0	0	33	0	0	0	0	0
Menidia spp.	Silversides	17	3	105	446	234	1684	369	47	99	5	54	201
Labidesthes sicculus	Brook silverside	0	0	0	0	0	1	0	0	1	0	0	0
Syngnathus louisianae	Chain pipefish	0	0	0	2	1	0	0	0	0	0	5	0
Syngnathus scovelli	Gulf pipefish	0	1	0	3	3	3	1	1	3	0	1	1
Hippocampus spp.	Seahorses	0	0	0	0	1	0	0	0	0	0	0	0
Hippocampus erectus	Lined seahorse	0	0	1	0	0	0	0	0	0	1	0	0
Prionotus scitulus	Leopard searobin	0	0	1	0	0	0	0	0	0	0	0	0
Prionotus tribulus	Bighead searobin	1	0	0	0	0	0	0	0	0	1	1	1
Centropomus undecimalis	Common snook	0	3	10	5	9	15	7	17	28	30	53	3
Centropristis striata	Black sea bass	0	0	0	0	0	0	2	0	0	0	0	0
Epinephelus itajara	Jewfish	0	0	0	0	0	0	0	0	0	1	0	0
Epinephelus morio	Red grouper	0	1	0	0	0	0	0	0	0	0	0	0
Mycteroperca microlepis	Gag	1	0	0	0	4	0	0	0	0	0	0	0
Diplectrum formosum	Sand perch	0	0	0	1	0	0	0	0	0	0	0	0
Serraniculus pumilio	Pygmy sea bass	0	0	1	0	0	0	0	0	3	2	0	0
Serranus subligarius	Belted sandfish	0	0	0	0	0	0	0	0	0	0	0	1
Lepomis spp.	Sunfishes	0	0	0	0	0	28	0	0	0	0	0	0
Lepomis macrochirus	Bluegill	0	0	0	0	0	3	0	3	9	0	0	0
Lepomis microlophus	Redear sunfish	0	0	0	1	0	0	0	0	0	0	0	0
Micropterus salmoides	Largemouth bass	0	0	0	5	0	4	0	0	0	0	0	0

Table B3. Page 3 of 4.

Seine catch by month (March 2004 through June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
Etheostoma fusiforme	Swamp darter	0	0	3	0	0	1	0	0	0	0	0	0
Caranx hippos	Crevalle jack	0	0	0	0	0	2	7	0	0	0	0	0
Chloroscombrus chrysurus	Atlantic bumper	0	0	0	0	0	0	1	0	0	0	0	0
Oligoplites saurus	Leatherjack	0	0	0	0	0	2	16	0	0	0	0	0
Trachinotus falcatus	Permit	0	0	0	0	0	0	0	0	0	5	0	0
Lutjanus griseus	Gray snapper	5	2	0	1	4	6	20	8	9	10	8	3
Lutjanus synagris	Lane snapper	0	0	0	0	0	0	0	1	44	11	9	14
Eucinostomus spp.	Eucinostomus mojarras	476	906	1097	1062	324	1446	877	311	90	820	1265	934
Eucinostomus argenteus	Spotfin mojarra	0	0	0	0	0	0	0	0	0	0	11	0
Eucinostomus gula	Silver jenny	96	388	111	351	152	25	56	44	32	153	179	195
Eucinostomus harengulus	Tidewater mojarra	30	71	93	431	410	52	45	54	32	56	105	78
Eugerres plumieri	Striped mojarra	5	0	0	3	8	5	12	43	10	3	2	2
Haemulon plumieri	White grunt	0	0	0	0	0	0	0	2	0	0	1	0
Orthopristis chrysoptera	Pigfish	3	0	0	1	84	19	2	0	22	0	0	0
Lagodon rhomboides	Pinfish	384	59	327	770	541	178	82	44	5	48	3	12
Archosargus probatocephalus	Sheepshead	1	0	1	1	23	36	3	1	4	0	0	3
Diplodus holbrooki	Spottail pinfish	0	0	0	0	0	1	0	0	0	0	0	0
Cynoscion nebulosus	Spotted seatrout	0	0	0	0	1	1	0	0	0	0	0	0
Bairdiella chrysoura	Silver perch	0	0	0	0	193	0	2	0	0	0	0	0
Leiostomus xanthurus	Spot	172	2	24	52	2	0	1	0	0	0	0	0
Menticirrhus saxatilis	Northern kingfish	0	0	1	2	1	2	0	0	0	0	0	0
Pogonias cromis	Black drum	0	0	0	0	0	0	0	0	0	0	1	0
Sciaenops ocellatus	Red drum	0	0	0	0	0	0	0	0	0	2	8	3
Chaetodipterus faber	Atlantic spadefish	0	0	0	0	0	0	1	0	0	0	0	0
Mugil spp.	Mullets	0	0	0	0	3	0	0	0	0	0	0	0
Mugil cephalus	Striped mullet	14	2	456	3	70	1	2	0	0	22	0	0
Mugil curema	White mullet	0	0	0	1	76	0	1	0	0	0	0	0
Mugil gyrans	Fantail mullet	22	0	0	0	2	0	5	0	1	0	8	0
Sphyraena borealis	Northern sennet	0	0	0	6	1	0	0	0	0	0	0	0
Sphyraena barracuda	Great barracuda	0	0	0	0	0	0	0	0	2	1	0	1

Table B3. Page 4 of 4.

Seine catch by month (March 2004 through June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (10)	Feb (10)	Mar (20)	Apr (20)	May (20)	Jun (20)	Jul (10)	Aug (10)	Sep (10)	Oct (10)	Nov (10)	Dec (10)
Chasmodes saburrae	Florida blenny	0	0	0	0	0	0	0	0	0	0	1	0
Gobionellus spp.	Gobionellus gobies	0	0	0	1	0	0	0	0	0	0	0	0
Gobionellus boleosoma	Darter goby	0	0	0	3	2	1	0	1	0	0	1	0
Gobionellus oceanicus	Highfin goby	0	0	0	0	0	0	0	0	0	3	0	0
Gobiosoma spp.	Gobiosoma gobies	7	3	6	6	18	60	2	1	3	0	4	9
Gobiosoma bosc	Naked goby	1	2	11	16	2	2	0	0	1	0	11	5
Gobiosoma robustum	Code goby	0	0	4	0	0	1	0	0	1	0	0	0
Microgobius gulosus	Clown goby	16	19	26	18	193	98	9	37	19	6	46	65
Bathygobius soporator	Frillfin goby	0	0	0	0	0	0	0	0	0	0	1	0
Lophogobius cyprinoides	Crested goby	0	0	8	3	1	1	2	0	3	0	1	1
Citharichthys macrops	Spotted whiff	0	0	0	0	0	0	0	0	0	0	1	0
Paralichthys albigutta	Gulf flounder	0	0	0	1	0	0	0	0	0	0	0	0
Trinectes maculatus	Hogchoker	0	1	8	6	0	1	0	18	7	8	7	18
Achirus lineatus	Lined sole	1	3	2	3	6	2	0	3	5	1	3	0
Symphurus plagiusa	Blackcheek tonguefish	0	0	0	0	0	0	0	0	1	0	4	5
Stephanolepis hispidus	Planehead filefish	0	0	0	4	1	0	0	0	1	1	1	1
Sphoeroides nephelus	Southern puffer	1	0	0	1	5	0	0	0	0	0	1	0
Chilomycterus schoepfii	Striped burrfish	0	1	1	0	0	0	0	0	0	2	0	0

Table B4. Page 1 of 4.

Trawl catch by month (March 2004 through June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (5)	Feb (5)	Mar (10)	Apr (10)	May (10)	Jun (10)	Jul (5)	Aug (5)	Sep (5)	Oct (5)	Nov (5)	Dec (5)
Farfantepenaeus duorarum	Pink shrimp	11	37	9	3	6	61	287	41	30	22	28	36
Rimapenaeus constrictus	Roughneck shrimp	0	0	0	1	0	0	4	0	0	1	0	0
Sicyonia brevirostris	Brown rock shrimp	0	0	2	0	0	0	0	0	0	0	0	0
Sicyonia laevigata	Hardback	0	0	0	0	0	15	0	0	0	0	0	0
Palaemonetes spp.	Grass shrimps	0	0	1	0	0	0	0	0	0	0	0	0
Palaemonetes paludosus	Riverine grass shrimp	0	0	0	0	0	1	0	0	0	0	0	0
Palaemonetes pugio	Daggerblade grass shrimp	0	0	0	0	0	0	0	1	0	0	0	0
Periclimenes americanus	American grass shrimp	1	2	7	19	9	4	15	6	0	0	2	4
Periclimenes longicaudatus	Longtail grass shrimp	0	3	2	102	15	81	0	0	0	2	7	4
Palaemon floridanus	Florida grass shrimp	0	0	0	0	0	10	0	0	0	0	0	0
Brachycarpus biunguiculatus	Twoclaw shrimp	9	0	0	0	0	0	0	0	0	0	0	0
Alpheus spp.	Snapping shrimp	0	0	0	1	0	1	0	0	0	0	0	0
Hippolyte zostericola	Zostera shrimp	0	0	0	21	0	0	0	0	0	0	0	0
Callinectes spp.	Blue crabs	7	0	0	0	1	0	3	0	0	0	0	0
Callinectes sapidus	Blue crab	4	21	10	13	37	29	27	19	15	7	4	4
Callinectes similis	Lesser blue crab	0	0	0	0	6	0	0	2	0	0	0	0
Callinectes ornatus	Shelligs	0	0	0	0	0	3	0	0	1	0	0	0
Menippe spp.	Stone crabs	0	0	1	5	0	0	0	0	0	0	0	1
Dasyatis sabina	Atlantic stingray	0	0	0	0	0	0	0	1	0	0	0	0
Dasyatis say	Bluntnose stingray	0	0	0	0	0	0	0	0	0	0	1	0
Elopiformes spp.	Tarpons	0	0	0	0	0	0	0	0	0	0	0	1
Elops saurus	Ladyfish	0	2	0	0	0	0	0	0	0	0	0	0
Opisthonema oglinum	Atlantic thread herring	0	0	0	0	0	0	0	0	0	0	1	0
Harengula jaguana	Scaled sardine	0	0	0	0	0	13	0	0	0	0	0	0
Sardinella aurita	Spanish sardine	0	0	0	0	0	0	0	1	0	0	0	0
Anchoa hepsetus	Striped anchovy	0	0	1	0	0	0	1	0	0	0	0	0
Anchoa mitchilli	Bay anchovy	1	6	24	0	0	0	3	52	3	22	0	0
Anchoa cubana	Cuban anchovy	0	0	0	0	0	133	0	115	0	0	81	0
Synodus foetens	Inshore lizardfish	1	1	6	14	27	4	6	5	15	0	4	3
Ameiurus nebulosus	Brown bullhead	0	0	0	1	0	0	0	0	0	0	0	0
Ariopsis felis	Hardhead catfish	9	2	8	4	4	0	44	3	1	2	2	0
Hoplosternum littorale	Brown hoplo	0	0	0	0	0	1	0	0	0	0	0	0

Table B4. Page 2 of 4.

Trawl catch by month (March 2004 through June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (5)	Feb (5)	Mar (10)	Apr (10)	May (10)	Jun (10)	Jul (5)	Aug (5)	Sep (5)	Oct (5)	Nov (5)	Dec (5)
Opsanus beta	Gulf toadfish	0	3	0	1	3	3	2	0	0	0	0	0
Gobiesox strumosus	Skilletfish	0	0	0	0	1	0	0	0	0	0	0	0
Ogcocephalus radiatus	Polka-dot batfish	0	0	0	0	0	0	0	0	0	0	0	1
Menidia spp.	Silversides	0	0	0	0	0	1	0	0	0	0	0	0
Syngnathus louisianae	Chain pipefish	1	0	2	0	3	1	0	0	0	0	0	0
Syngnathus springeri	Bull pipefish	0	0	0	0	0	0	0	0	0	0	1	0
Syngnathus scovelli	Gulf pipefish	0	2	1	1	0	1	5	0	0	0	0	0
Hippocampus erectus	Lined seahorse	1	2	6	4	2	1	1	0	0	0	1	0
Hippocampus zosterae	Dwarf seahorse	4	0	0	0	0	0	0	0	0	0	0	0
Scorpaena brasiliensis	Barbfish	0	0	1	2	0	0	1	1	1	0	1	0
Prionotus scitulus	Leopard searobin	3	0	5	3	2	1	0	1	0	3	0	1
Prionotus tribulus	Bighead searobin	2	1	0	0	1	2	0	1	0	2	0	2
Centropomus undecimalis	Common snook	18	4	12	1	0	2	0	4	3	1	0	0
Centropristis striata	Black sea bass	0	0	0	0	1	0	3	0	0	0	0	0
Epinephelus itajara	Jewfish	0	0	0	0	0	0	0	0	0	0	1	0
Mycteroperca microlepis	Gag	0	0	0	0	2	0	0	1	0	0	0	0
Mycteroperca bonaci	Black grouper	0	0	0	0	0	0	0	0	0	0	1	0
Diplectrum formosum	Sand perch	0	0	2	1	0	1	0	1	0	0	0	0
Serraniculus pumilio	Pygmy sea bass	0	0	1	0	0	0	0	0	0	0	0	0
Serranus subligarius	Belted sandfish	0	0	0	0	0	0	0	0	0	0	0	1
Lepomis microlophus	Redear sunfish	0	0	0	0	0	1	0	0	0	0	0	0
Pomoxis nigromaculatus	Black crappie	0	0	0	0	0	1	0	0	0	0	0	0
Etheostoma fusiforme	Swamp darter	0	0	0	0	0	1	0	1	0	0	0	0
Chloroscombrus chrysurus	Atlantic bumper	2	0	0	0	0	0	0	0	2	0	0	0
Selene vomer	Lookdown	0	0	0	0	0	0	1	0	0	0	0	0
Lutjanus griseus	Gray snapper	0	0	1	0	1	0	0	13	5	2	6	2
Lutjanus synagris	Lane snapper	4	0	0	0	0	2	0	10	17	8	12	19
Eucinostomus spp.	Eucinostomus mojarras	31	25	75	4	1	656	690	535	645	673	133	1000
Eucinostomus argenteus	Spotfin mojarra	0	0	0	0	0	0	0	0	0	0	18	0
Eucinostomus gula	Silver jenny	17	10	7	5	14	66	58	214	49	9	18	5
Eucinostomus harengulus	Tidewater mojarra	3	2	15	2	0	1	30	3	13	3	9	6
Eugerres plumieri	Striped mojarra	9	0	16	6	0	2	22	2	3	0	0	0

Table B4. Page 3 of 4.

Trawl catch by month (March 2004 through June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (5)	Feb (5)	Mar (10)	Apr (10)	May (10)	Jun (10)	Jul (5)	Aug (5)	Sep (5)	Oct (5)	Nov (5)	Dec (5)
Orthopristis chrysoptera	Pigfish	62	0	0	0	3	0	2	1	1	0	4	1
Lagodon rhomboides	Pinfish	298	68	133	39	15	7	10	4	0	0	5	28
Archosargus probatocephalus	Sheepshead	5	1	6	10	0	5	4	3	1	3	4	5
Calamus arctifrons	Grass porgy	0	0	0	0	1	0	0	0	0	0	0	0
Cynoscion nebulosus	Spotted seatrout	0	0	0	0	1	0	20	1	0	0	0	0
Cynoscion arenarius	Sand seatrout	0	0	0	0	3	0	3	1	8	10	1	0
Bairdiella chrysoura	Silver perch	0	0	0	0	7	0	27	0	0	1	0	0
Leiostomus xanthurus	Spot	66	3	2	0	0	0	0	0	1	0	0	0
Menticirrhus americanus	Southern kingfish	0	0	0	0	0	0	0	1	3	0	0	0
Micropogonias undulatus	Atlantic croaker	0	0	1	0	0	0	0	0	0	0	0	0
Pogonias cromis	Black drum	0	4	0	0	0	1	0	0	0	0	0	0
Sciaenops ocellatus	Red drum	0	0	0	0	0	0	0	0	0	65	2	1
Chaetodipterus faber	Atlantic spadefish	0	0	2	0	0	0	1	1	0	1	0	0
Mugil cephalus	Striped mullet	0	4	0	0	0	0	0	0	0	0	0	0
Sphyraena borealis	Northern sennet	0	0	0	1	0	0	0	0	0	0	0	0
Nicholsina usta	Emerald parrotfish	0	0	0	0	0	0	0	0	0	0	0	1
Astroscopus y-graecum	Southern stargazer	1	0	0	0	0	0	0	0	0	0	0	0
Gobionellus boleosoma	Darter goby	0	0	0	0	0	1	0	0	0	0	0	0
Gobionellus oceanicus	Highfin goby	0	0	0	0	0	1	0	0	0	0	0	0
Gobiosoma spp.	Gobiosoma gobies	0	1	1	0	6	5	1	2	0	0	1	0
Gobiosoma bosc	Naked goby	0	0	2	1	0	0	1	0	0	0	1	0
Gobiosoma robustum	Code goby	3	1	1	2	0	8	2	1	0	0	0	0
Gobiosoma longipala	Twoscale goby	0	0	0	0	1	0	0	0	0	0	0	0
Microgobius gulosus	Clown goby	0	0	1	1	12	5	1	32	6	0	2	37
Lophogobius cyprinoides	Crested goby	0	0	0	0	0	0	0	1	0	0	0	0
Peprilus alepidotus	Harvestfish	6	0	0	0	0	0	0	0	0	0	0	0
Citharichthys macrops	Spotted whiff	1	0	0	0	0	0	0	0	0	0	0	1
Etropus crossotus	Fringed flounder	0	0	2	1	0	0	0	3	0	0	1	2
Paralichthys albigutta	Gulf flounder	1	2	3	1	3	2	1	8	0	0	7	1
Trinectes maculatus	Hogchoker	0	0	0	0	2	4	1	49	83	2	2	5
Achirus lineatus	Lined sole	0	1	0	1	2	2	1	14	4	0	2	0
Symphurus plagiusa	Blackcheek tonguefish	0	1	0	0	1	2	2	4	4	0	4	0

Table B4. Page 4 of 4.

Trawl catch by month (March 2004 through June 2005).

Number of monthly samples is indicated in parentheses.

Taxon	Common Name	Jan (5)	Feb (5)	Mar (10)	Apr (10)	May (10)	Jun (10)	Jul (5)	Aug (5)	Sep (5)	Oct (5)	Nov (5)	Dec (5)
Stephanolepis hispidus	Planehead filefish	0	0	3	4	3	1	0	1	0	0	2	0
Acanthostracion quadricornis	Scrawled cowfish	0	0	0	0	0	0	0	0	1	0	0	0
Sphoeroides nephelus	Southern puffer	2	1	2	2	3	0	0	0	0	0	0	2
Sphoeroides parvus	Least puffer	0	0	0	0	0	0	0	0	0	0	0	1
Sphoeroides spengleri	Bandtail puffer	0	0	0	0	0	0	0	0	0	0	0	1
Chilomycterus schoepfii	Striped burrfish	2	8	0	3	0	0	2	0	1	0	3	1
	Unidentified species	0	0	0	0	1	0	0	0	0	0	0	0

Table B5, page 1 of 2. Location-specific seine catch.

Data are presented as mean number per 100m^2.

Organisms are listed in phylogenetic order.

		Location (km from mouth)				
Taxon	Common Name	Lyons	Roberts	0.1-3.0	3.0-5.0	5.0-6.4
Farfantepenaeus duorarum	Pink shrimp	6.158	1.654	4.550	2.068	5.147
Sicyonia spp.	Rock shrimps	0.092	0.000	0.000	0.000	0.000
Sicyonia brevirostris	Brown rock shrimp	0.046	0.000	0.000	0.000	0.000
Sicyonia parri	Rock shrimp	0.046	0.000	0.000	0.000	0.000
Palaemonetes spp.	Grass shrimps	0.000	0.000	0.138	0.138	0.046
Palaemonetes intermedius	Brackish grass shrimp	0.965	0.781	0.368	0.000	0.000
Palaemonetes paludosus	Riverine grass shrimp	0.000	0.000	0.000	0.046	0.046
Palaemonetes pugio	Daggerblade grass shrimp	0.000	0.138	8.502	12.270	41.498
Periclimenes americanus	American grass shrimp	0.230	0.414	0.322	0.000	0.000
Periclimenes longicaudatus	Longtail grass shrimp	0.322	0.138	0.000	0.046	0.000
Palaemon floridanus	Florida grass shrimp	0.046	0.092	0.000	0.000	0.000
Hippolyte zostericola	Zostera shrimp	0.000	0.046	0.000	0.000	0.000
Tozeuma spp.	Arrow shrimps	0.046	0.000	0.000	0.000	0.000
Tozeuma carolinense	Arrow shrimp	0.643	0.138	0.000	0.000	0.000
Callinectes sapidus	Blue crab	0.414	0.276	1.517	2.574	4.044
Callinectes similis	Lesser blue crab	0.000	0.000	0.046	0.000	0.000
Portunus spp.	Portunus crabs	0.000	0.000	0.046	0.000	0.000
Menippe spp.	Stone crabs	0.046	0.000	0.000	0.000	0.000
Brevoortia spp.	Menhadens	0.000	0.046	0.000	0.092	0.276
Dorosoma cepedianum	Gizzard shad	0.000	0.000	0.000	0.000	0.322
Opisthonema oglinum	Atlantic thread herring	2.895	4.320	0.000	0.000	0.000
Harengula jaguana	Scaled sardine	290.303	47.105	8.456	0.092	0.000
Sardinella aurita	Spanish sardine	192.188	0.414	0.000	0.000	0.000
Anchoa hepsetus	Striped anchovy	0.000	9.835	0.000	0.000	0.000
Anchoa mitchilli	Bay anchovy	687.776	629.366	40.165	91.774	42.188
Anchoa cubana	Cuban anchovy	8.364	0.138	0.000	0.046	107.353
Anchoa nasuta	Longnose anchovy	0.000	0.184	0.000	0.000	0.000
Synodus foetens	Inshore lizardfish	0.781	1.425	0.551	0.276	0.000
Opsanus beta	Gulf toadfish	0.046	0.000	0.000	0.000	0.000
Hyporhamphus meeki	False silverstripe halfbeak	0.000	0.000	0.046	0.000	0.000
Strongylura spp.	Needlefishes	0.551	0.322	0.046	0.092	0.000
Strongylura marina	Atlantic needlefish	0.138	0.184	0.138	0.046	0.000
Strongylura notata	Redfin needlefish	0.460	0.138	0.046	0.046	0.000
Strongylura timucu	Timucu	0.414	0.046	0.276	0.046	0.000
Fundulus grandis	Gulf killifish	0.965	4.871	1.379	0.276	0.276
Lucania parva	Rainwater killifish	0.046	0.000	0.000	0.000	0.000
Floridichthys carpio	Goldspotted killifish	0.643	0.000	0.000	0.000	0.000
Gambusia holbrooki	Eastern mosquitofish	0.000	0.000	0.000	0.092	1.517
Poecilia latipinna	Sailfin molly	0.000	0.000	0.000	0.276	0.322
Membras martinica	Rough silverside	0.000	1.517	0.000	0.000	0.000
Menidia spp.	Silversides	63.649	2.665	7.721	26.241	49.724
Labidesthes sicculus	Brook silverside	0.000	0.000	0.000	0.000	0.092
Syngnathus louisianae	Chain pipefish	0.230	0.046	0.000	0.092	0.000
Syngnathus scovelli	Gulf pipefish	0.184	0.368	0.046	0.184	0.000
Hippocampus spp.	Seahorses	0.000	0.000	0.046	0.000	0.000
Hippocampus erectus	Lined seahorse	0.092	0.000	0.000	0.000	0.000
Prionotus scitulus	Leopard searobin	0.046	0.000	0.000	0.000	0.000
Prionotus tribulus	Bighead searobin	0.000	0.000	0.000	0.092	0.092
Centropomus undecimalis	Common snook	0.597	0.735	1.057	4.320	1.563
Centropristis striata	Black sea bass	0.092	0.000	0.000	0.000	0.000
Epinephelus itajara	Jewfish	0.000	0.046	0.000	0.000	0.000
Epinephelus morio	Red grouper	0.000	0.046	0.000	0.000	0.000
Mycteroperca microlepis	Gag	0.000	0.184	0.000	0.046	0.000
Diplectrum formosum	Sand perch	0.046	0.000	0.000	0.000	0.000

Table B5, page 2 of 2. Location-specific seine catch.

Data are presented as mean number per $100m^2$.

Organisms are listed in phylogenetic order.

Taxon	Common Name	Location (km from mouth) Lyons	Roberts	0.1-3.0	3.0-5.0	5.0-6.4
Serraniculus pumilio	Pygmy sea bass	0.230	0.000	0.046	0.000	0.000
Serranus subligarius	Belted sandfish	0.046	0.000	0.000	0.000	0.000
Lepomis spp.	Sunfishes	0.046	0.000	0.000	0.643	0.597
Lepomis macrochirus	Bluegill	0.000	0.000	0.000	0.551	0.138
Lepomis microlophus	Redear sunfish	0.000	0.000	0.000	0.000	0.046
Micropterus salmoides	Largemouth bass	0.000	0.000	0.046	0.138	0.230
Etheostoma fusiforme	Swamp darter	0.000	0.000	0.138	0.000	0.046
Caranx hippos	Crevalle jack	0.092	0.000	0.000	0.046	0.276
Chloroscombrus chrysurus	Atlantic bumper	0.000	0.000	0.000	0.046	0.000
Oligoplites saurus	Leatherjack	0.000	0.368	0.046	0.276	0.138
Trachinotus falcatus	Permit	0.000	0.230	0.000	0.000	0.000
Lutjanus griseus	Gray snapper	1.011	0.781	0.919	0.506	0.276
Lutjanus synagris	Lane snapper	3.125	0.322	0.138	0.046	0.000
Eucinostomus spp.	Eucinostomus mojarras	103.263	44.669	92.877	82.169	118.566
Eucinostomus argenteus	Spotfin mojarra	0.138	0.368	0.000	0.000	0.000
Eucinostomus gula	Silver jenny	51.976	21.415	8.180	0.322	0.000
Eucinostomus harengulus	Tidewater mojarra	5.744	16.085	9.881	19.761	15.487
Eugerres plumieri	Striped mojarra	0.000	0.046	0.046	0.827	3.355
Haemulon plumieri	White grunt	0.138	0.000	0.000	0.000	0.000
Orthopristis chrysoptera	Pigfish	1.287	4.596	0.138	0.000	0.000
Lagodon rhomboides	Pinfish	34.375	27.436	42.371	6.710	1.838
Archosargus probatocephalus	Sheepshead	0.138	0.322	1.241	0.460	1.195
Diplodus holbrooki	Spottail pinfish	0.046	0.000	0.000	0.000	0.000
Cynoscion nebulosus	Spotted seatrout	0.000	0.046	0.046	0.000	0.000
Bairdiella chrysoura	Silver perch	0.046	8.732	0.000	0.046	0.138
Leiostomus xanthurus	Spot	6.572	2.436	1.700	0.689	0.230
Menticirrhus saxatilis	Northern kingfish	0.000	0.138	0.138	0.000	0.000
Pogonias cromis	Black drum	0.000	0.000	0.000	0.046	0.000
Sciaenops ocellatus	Red drum	0.000	0.000	0.000	0.000	0.597
Chaetodipterus faber	Atlantic spadefish	0.000	0.000	0.000	0.046	0.000
Mugil spp.	Mullets	0.000	0.000	0.138	0.000	0.000
Mugil cephalus	Striped mullet	0.276	0.184	0.276	1.195	24.265
Mugil curema	White mullet	0.000	1.700	1.792	0.092	0.000
Mugil gyrans	Fantail mullet	0.046	0.689	0.781	0.000	0.230
Sphyraena borealis	Northern sennet	0.276	0.046	0.000	0.000	0.000
Sphyraena barracuda	Great barracuda	0.092	0.092	0.000	0.000	0.000
Chasmodes saburrae	Florida blenny	0.000	0.000	0.046	0.000	0.000
Gobionellus spp.	Gobionellus gobies	0.000	0.046	0.000	0.000	0.000
Gobionellus boleosoma	Darter goby	0.276	0.092	0.000	0.000	0.000
Gobionellus oceanicus	Highfin goby	0.000	0.000	0.000	0.138	0.000
Gobiosoma spp.	Gobiosoma gobies	0.046	0.000	2.160	1.517	1.746
Gobiosoma bosc	Naked goby	0.000	0.046	0.414	0.643	1.241
Gobiosoma robustum	Code goby	0.138	0.000	0.138	0.000	0.000
Microgobius gulosus	Clown goby	0.230	0.092	1.103	10.983	12.960
Bathygobius soporator	Frillfin goby	0.000	0.000	0.046	0.000	0.000
Lophogobius cyprinoides	Crested goby	0.000	0.000	0.138	0.735	0.046
Citharichthys macrops	Spotted whiff	0.046	0.000	0.000	0.000	0.000
Paralichthys albigutta	Gulf flounder	0.046	0.000	0.000	0.000	0.000
Trinectes maculatus	Hogchoker	0.000	0.046	0.506	0.368	2.482
Achirus lineatus	Lined sole	0.460	0.138	0.368	0.230	0.138
Symphurus plagiusa	Blackcheek tonguefish	0.092	0.046	0.000	0.276	0.046
Stephanolepis hispidus	Planehead filefish	0.368	0.046	0.000	0.000	0.000
Sphoeroides nephelus	Southern puffer	0.000	0.138	0.184	0.046	0.000
Chilomycterus schoepfii	Striped burrfish	0.092	0.000	0.092	0.000	0.000

Table B6, page 1 of 2. Location-specific trawl catch.

Data are presented as mean number per 100m^2.

Organisms are listed in phylogenetic order.

		Location (km from mouth)				
Taxon	Common Name	Lyons	Roberts	0.1-3.0	3.0-5.0	5.0-6.4
Farfantepenaeus duorarum	Pink shrimp	0.766	0.894	2.175	0.313	0.841
Rimapenaeus constrictus	Roughneck shrimp	0.011	0.048	0.000	0.000	0.000
Sicyonia brevirostris	Brown rock shrimp	0.000	0.019	0.000	0.000	0.000
Sicyonia laevigata	Hardback	0.000	0.008	0.118	0.000	0.000
Palaemonetes spp.	Grass shrimps	0.008	0.000	0.000	0.000	0.000
Palaemonetes paludosus	Riverine grass shrimp	0.000	0.000	0.000	0.000	0.009
Palaemonetes pugio	Daggerblade grass shrimp	0.000	0.000	0.000	0.000	0.008
Periclimenes americanus	American grass shrimp	0.275	0.147	0.201	0.000	0.000
Periclimenes longicaudatus	Longtail grass shrimp	1.007	0.660	0.152	0.076	0.037
Palaemon floridanus	Florida grass shrimp	0.000	0.084	0.000	0.000	0.000
Brachycarpus biunguiculatus	Twoclaw shrimp	0.000	0.069	0.000	0.000	0.000
Alpheus spp.	Snapping shrimp	0.000	0.011	0.000	0.008	0.000
Hippolyte zostericola	Zostera shrimp	0.197	0.000	0.000	0.000	0.000
Callinectes spp.	Blue crabs	0.000	0.090	0.000	0.000	0.000
Callinectes sapidus	Blue crab	0.111	0.704	0.450	0.245	0.193
Callinectes similis	Lesser blue crab	0.000	0.067	0.000	0.000	0.000
Callinectes ornatus	Shelligs	0.000	0.008	0.025	0.000	0.000
Menippe spp.	Stone crabs	0.008	0.009	0.042	0.000	0.000
Dasyatis sabina	Atlantic stingray	0.000	0.000	0.008	0.000	0.000
Dasyatis say	Bluntnose stingray	0.009	0.000	0.000	0.000	0.000
Elopiformes spp.	Tarpons	0.000	0.000	0.000	0.000	0.009
Elops saurus	Ladyfish	0.000	0.000	0.000	0.008	0.008
Opisthonema oglinum	Atlantic thread herring	0.000	0.000	0.009	0.000	0.000
Harengula jaguana	Scaled sardine	0.000	0.110	0.000	0.000	0.000
Sardinella aurita	Spanish sardine	0.008	0.000	0.000	0.000	0.000
Anchoa hepsetus	Striped anchovy	0.008	0.009	0.000	0.000	0.000
Anchoa mitchilli	Bay anchovy	0.493	0.000	0.059	0.308	0.119
Anchoa cubana	Cuban anchovy	0.970	1.189	0.300	0.008	0.337
Synodus foetens	Inshore lizardfish	0.290	0.290	0.203	0.000	0.000
Ameiurus nebulosus	Brown bullhead	0.000	0.000	0.000	0.000	0.009
Ariopsis felis	Hardhead catfish	0.034	0.049	0.286	0.179	0.148
Hoplosternum littorale	Brown hoplo	0.000	0.000	0.000	0.000	0.009
Opsanus beta	Gulf toadfish	0.017	0.070	0.019	0.000	0.000
Gobiesox strumosus	Skilletfish	0.000	0.000	0.000	0.008	0.000
Ogcocephalus radiatus	Polka-dot batfish	0.008	0.000	0.000	0.000	0.000
Menidia spp.	Silversides	0.000	0.000	0.000	0.008	0.000
Syngnathus louisianae	Chain pipefish	0.008	0.040	0.017	0.000	0.000
Syngnathus springeri	Bull pipefish	0.009	0.000	0.000	0.000	0.000
Syngnathus scovelli	Gulf pipefish	0.042	0.037	0.009	0.000	0.000
Hippocampus erectus	Lined seahorse	0.017	0.054	0.085	0.000	0.000
Hippocampus zosterae	Dwarf seahorse	0.009	0.015	0.000	0.009	0.000
Scorpaena brasiliensis	Barbfish	0.009	0.017	0.035	0.000	0.000
Prionotus scitulus	Leopard searobin	0.055	0.061	0.052	0.000	0.000
Prionotus tribulus	Bighead searobin	0.000	0.018	0.035	0.008	0.036
Centropomus undecimalis	Common snook	0.000	0.000	0.000	0.067	0.315
Centropristis striata	Black sea bass	0.000	0.009	0.027	0.000	0.000
Epinephelus itajara	Jewfish	0.000	0.000	0.000	0.000	0.008
Mycteroperca microlepis	Gag	0.008	0.014	0.008	0.000	0.000
Mycteroperca bonaci	Black grouper	0.000	0.008	0.000	0.000	0.000
Diplectrum formosum	Sand perch	0.008	0.026	0.008	0.000	0.000
Serraniculus pumilio	Pygmy sea bass	0.000	0.000	0.008	0.000	0.000
Serranus subligarius	Belted sandfish	0.000	0.009	0.000	0.000	0.000

Table B6, page 2 of 2. Location-specific trawl catch.

Data are presented as mean number per 100m^2.

Organisms are listed in phylogenetic order.

Taxon	Common Name	Location (km from mouth) Lyons	Roberts	0.1-3.0	3.0-5.0	5.0-6.4
Lepomis microlophus	Redear sunfish	0.000	0.008	0.000	0.000	0.000
Pomoxis nigromaculatus	Black crappie	0.000	0.000	0.000	0.000	0.009
Etheostoma fusiforme	Swamp darter	0.000	0.000	0.000	0.000	0.018
Chloroscombrus chrysurus	Atlantic bumper	0.019	0.000	0.019	0.000	0.000
Selene vomer	Lookdown	0.008	0.000	0.000	0.000	0.000
Lutjanus griseus	Gray snapper	0.129	0.067	0.000	0.017	0.044
Lutjanus synagris	Lane snapper	0.173	0.338	0.088	0.034	0.000
Eucinostomus spp.	Eucinostomus mojarras	12.151	3.389	7.560	6.112	10.123
Eucinostomus argenteus	Spotfin mojarra	0.047	0.034	0.084	0.000	0.000
Eucinostomus gula	Silver jenny	1.768	0.282	1.968	0.000	0.000
Eucinostomus harengulus	Tidewater mojarra	0.167	0.103	0.191	0.169	0.127
Eugerres plumieri	Striped mojarra	0.000	0.020	0.000	0.067	0.430
Orthopristis chrysoptera	Pigfish	0.008	0.576	0.000	0.000	0.000
Lagodon rhomboides	Pinfish	2.047	2.794	0.119	0.025	0.009
Archosargus probatocephalus	Sheepshead	0.124	0.057	0.078	0.099	0.062
Calamus arctifrons	Grass porgy	0.000	0.014	0.000	0.000	0.000
Cynoscion nebulosus	Spotted seatrout	0.017	0.008	0.008	0.042	0.110
Cynoscion arenarius	Sand seatrout	0.000	0.008	0.070	0.008	0.129
Bairdiella chrysoura	Silver perch	0.228	0.059	0.000	0.008	0.000
Leiostomus xanthurus	Spot	0.025	0.498	0.008	0.000	0.027
Menticirrhus americanus	Southern kingfish	0.000	0.000	0.031	0.000	0.000
Micropogonias undulatus	Atlantic croaker	0.008	0.000	0.000	0.000	0.000
Pogonias cromis	Black drum	0.000	0.000	0.000	0.008	0.034
Sciaenops ocellatus	Red drum	0.000	0.000	0.009	0.000	0.566
Chaetodipterus faber	Atlantic spadefish	0.017	0.008	0.000	0.019	0.000
Mugil cephalus	Striped mullet	0.000	0.000	0.000	0.008	0.025
Sphyraena borealis	Northern sennet	0.000	0.011	0.000	0.000	0.000
Nicholsina usta	Emerald parrotfish	0.000	0.009	0.000	0.000	0.000
Astroscopus y-graecum	Southern stargazer	0.000	0.000	0.009	0.000	0.000
Gobionellus boleosoma	Darter goby	0.000	0.008	0.000	0.000	0.000
Gobionellus oceanicus	Highfin goby	0.000	0.000	0.000	0.008	0.000
Gobiosoma spp.	Gobiosoma gobies	0.035	0.051	0.008	0.000	0.055
Gobiosoma bosc	Naked goby	0.026	0.000	0.000	0.017	0.000
Gobiosoma robustum	Code goby	0.045	0.083	0.027	0.000	0.000
Gobiosoma longipala	Twoscale goby	0.000	0.000	0.008	0.000	0.000
Microgobius gulosus	Clown goby	0.017	0.000	0.094	0.287	0.467
Lophogobius cyprinoides	Crested goby	0.000	0.000	0.000	0.008	0.000
Peprilus alepidotus	Harvestfish	0.056	0.000	0.000	0.000	0.000
Citharichthys macrops	Spotted whiff	0.000	0.017	0.000	0.000	0.000
Etropus crossotus	Fringed flounder	0.000	0.053	0.026	0.000	0.000
Paralichthys albigutta	Gulf flounder	0.080	0.105	0.077	0.000	0.000
Trinectes maculatus	Hogchoker	0.000	0.017	0.059	0.017	1.162
Achirus lineatus	Lined sole	0.036	0.008	0.077	0.110	0.000
Symphurus plagiusa	Blackcheek tonguefish	0.008	0.000	0.146	0.000	0.000
Stephanolepis hispidus	Planehead filefish	0.026	0.053	0.042	0.000	0.000
Acanthostracion quadricornis	Scrawled cowfish	0.009	0.000	0.000	0.000	0.000
Sphoeroides nephelus	Southern puffer	0.043	0.057	0.008	0.000	0.000
Sphoeroides parvus	Least puffer	0.000	0.000	0.009	0.000	0.000
Sphoeroides spengleri	Bandtail puffer	0.008	0.000	0.000	0.000	0.000
Chilomycterus schoepfii	Striped burrfish	0.059	0.118	0.000	0.000	0.000
	Unidentified species	0.000	0.000	0.008	0.000	0.000

Appendix C:

Length-frequency plots for selected taxa

Farfantepenaeus duorarum **(Pink shrimp)**

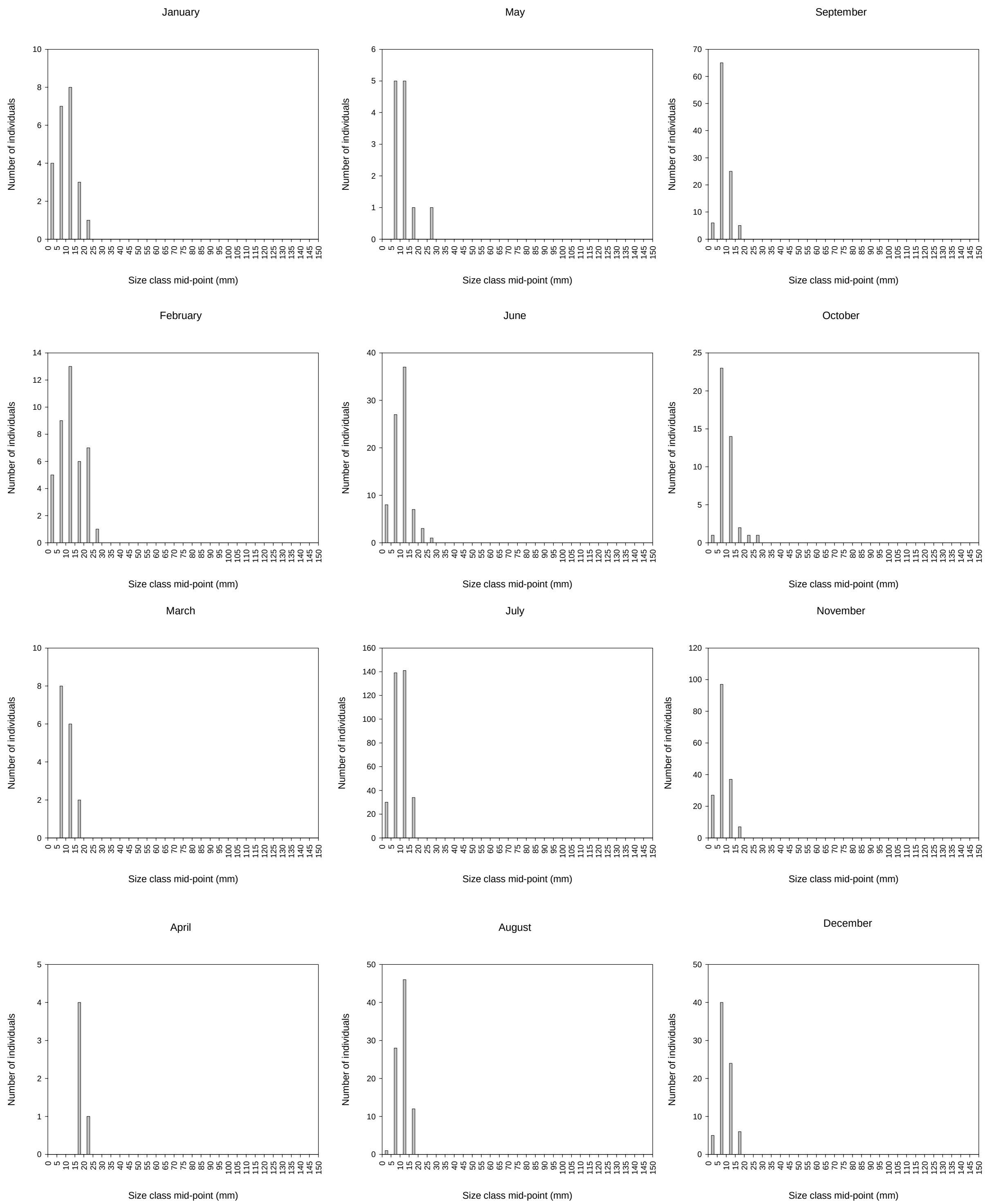


Fig. C1. Monthly length frequencies of Pink shrimp collected in seines and trawls.

Callinectes sapidus (Blue crab)

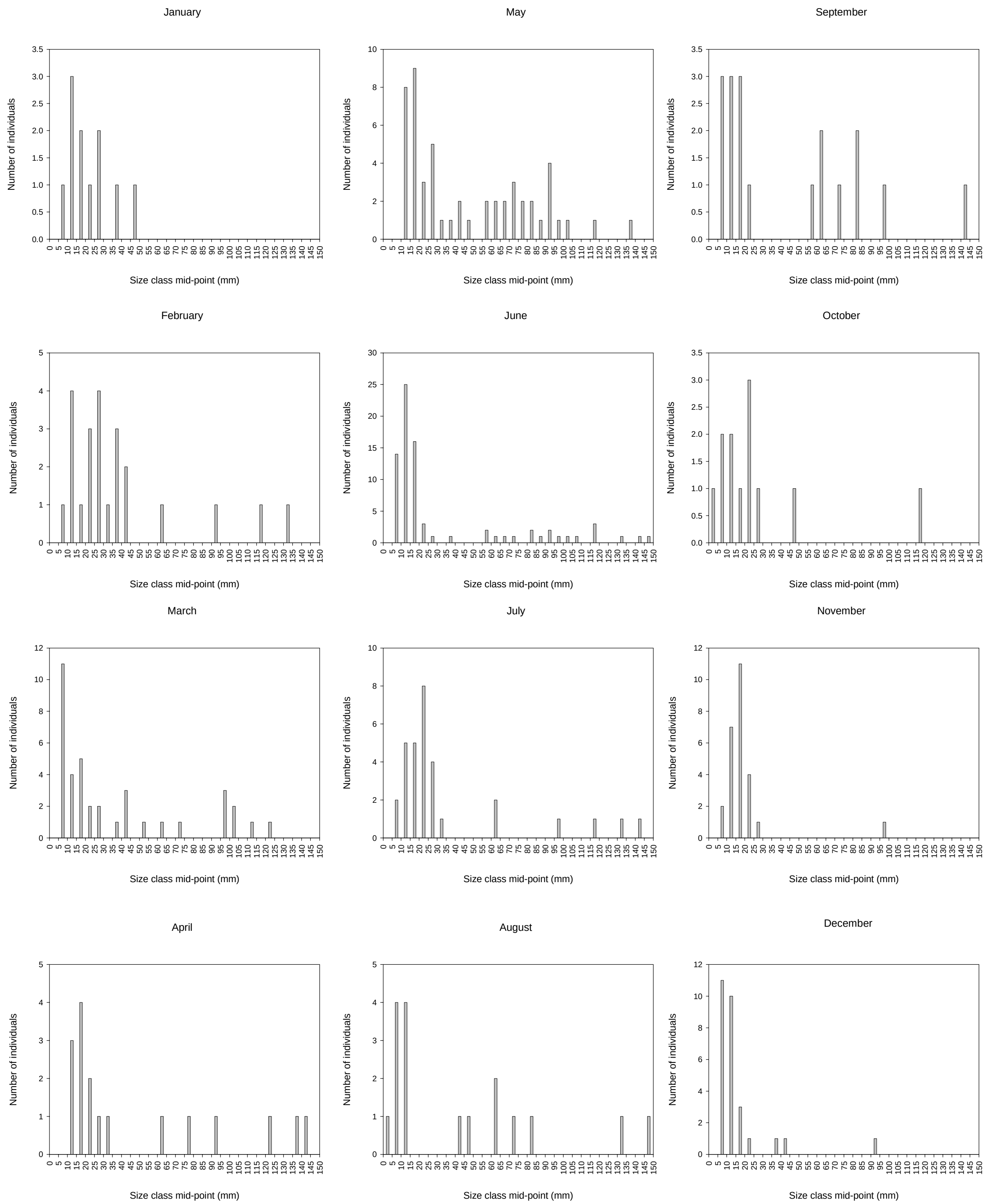


Fig. C2. Monthly length frequencies of Blue crab collected in seines and trawls.

Opisthonema oglinum (Atlantic thread herring)

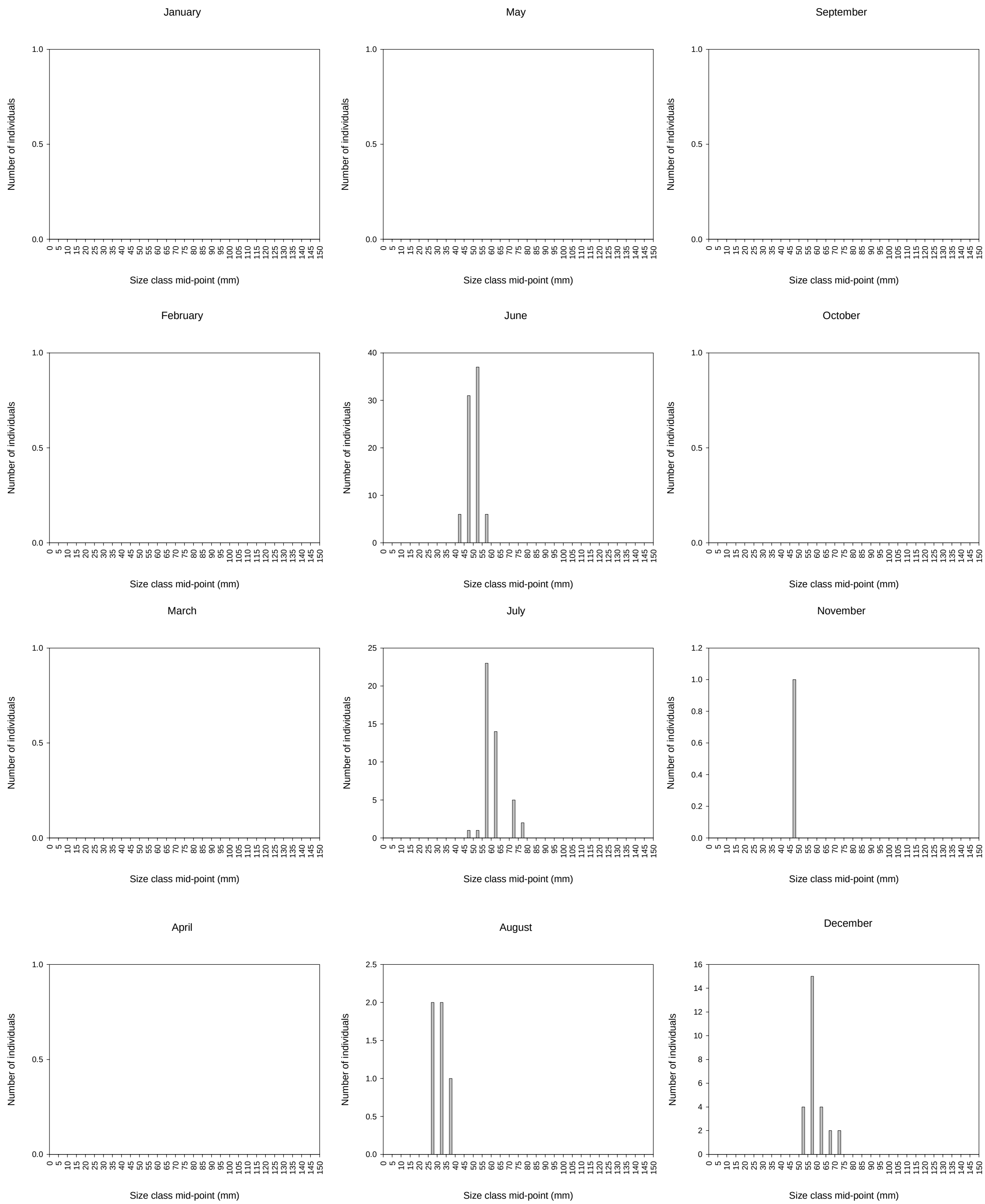


Fig. C3. Monthly length frequencies of Atlantic thread herring collected in seines and trawls.

Harengula jaguana (Scaled sardine)

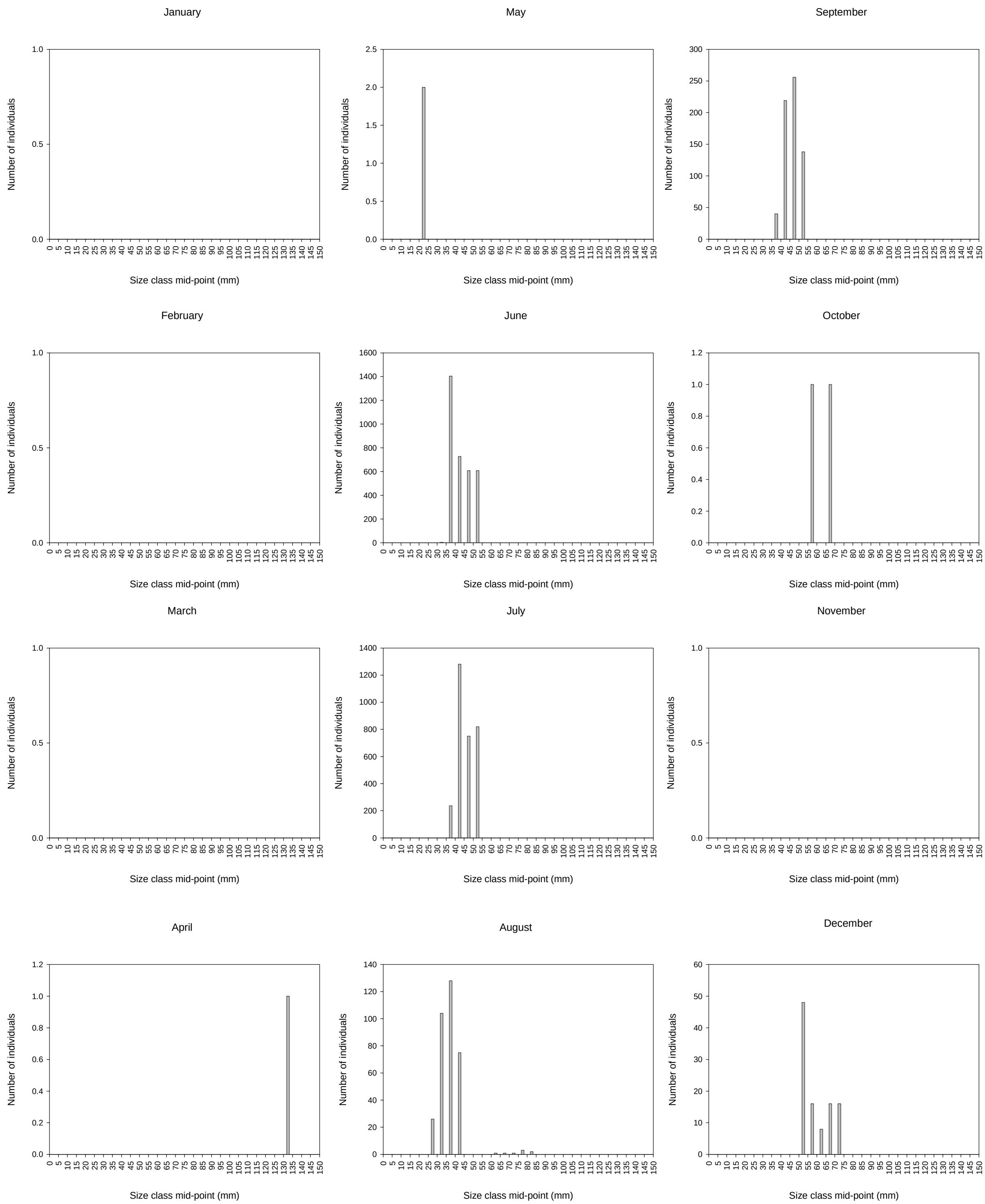


Fig. C4. Monthly length frequencies of Scaled sardine collected in seines and trawls.

Anchoa mitchilli (Bay anchovy)

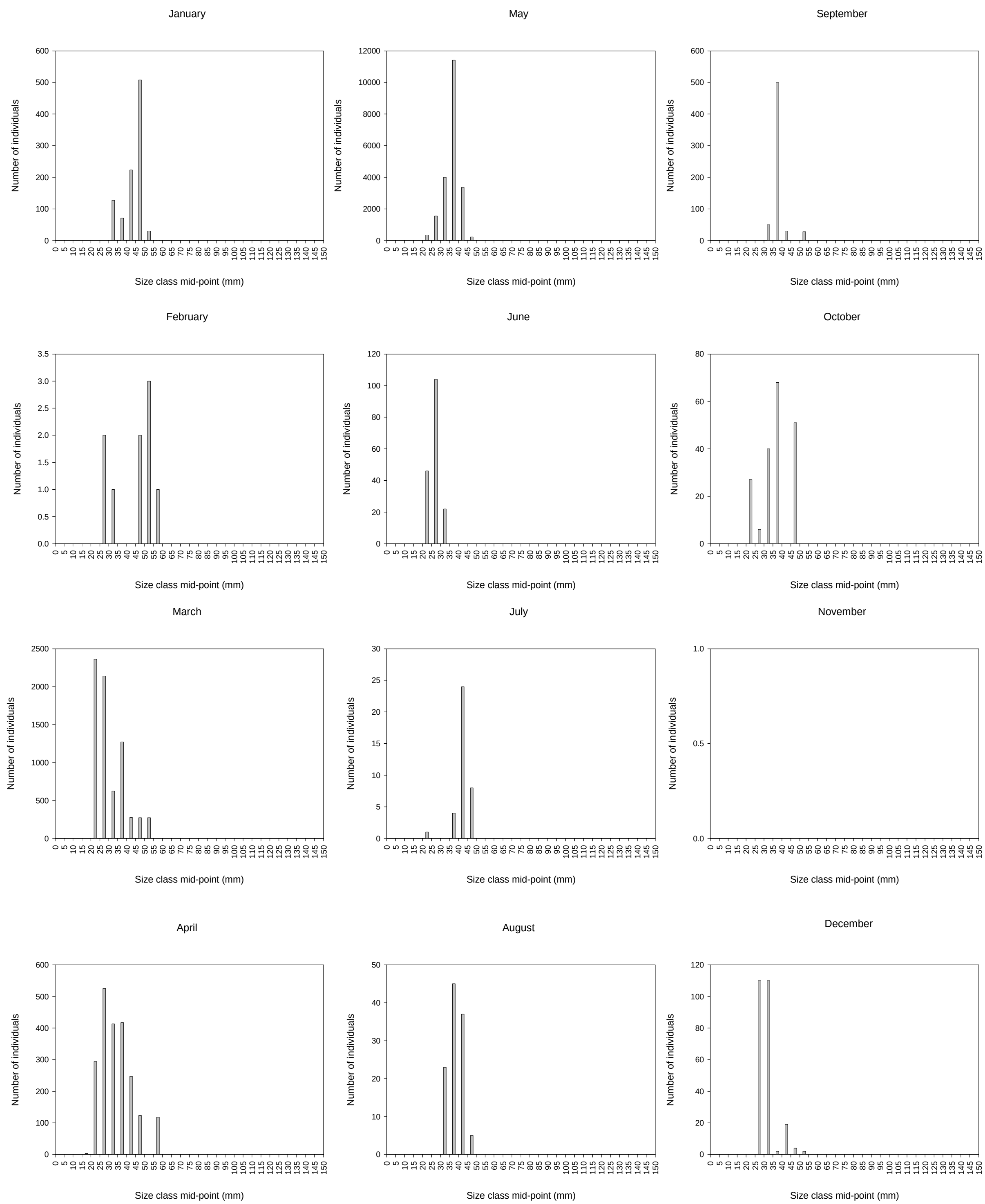


Fig. C5. Monthly length frequencies of Bay anchovy collected in seines and trawls.

Anchoa cubana (Cuban anchovy)

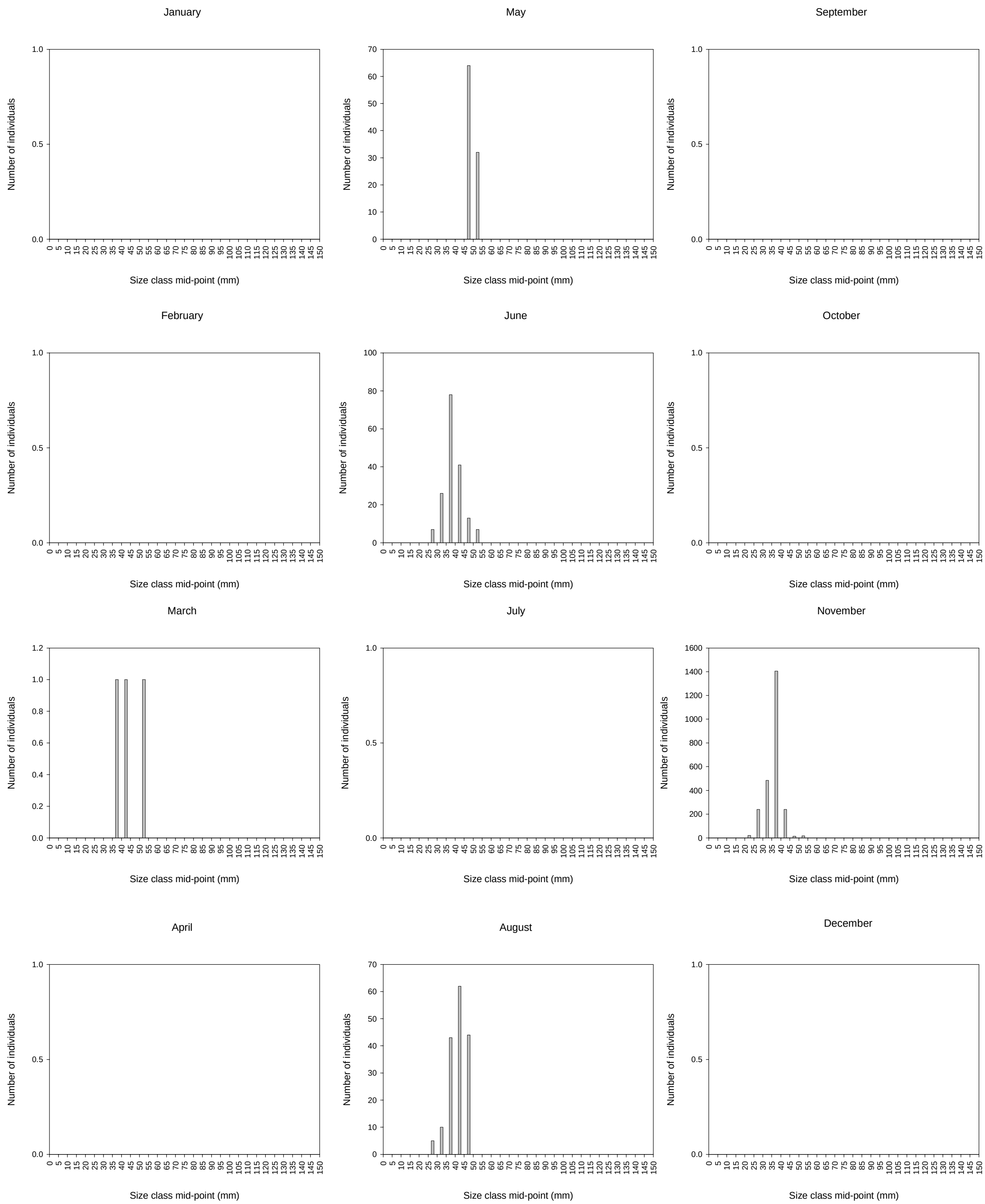


Fig. C6. Monthly length frequencies of Cuban anchovy collected in seines and trawls.

Synodus foetens (Inshore lizardfish)

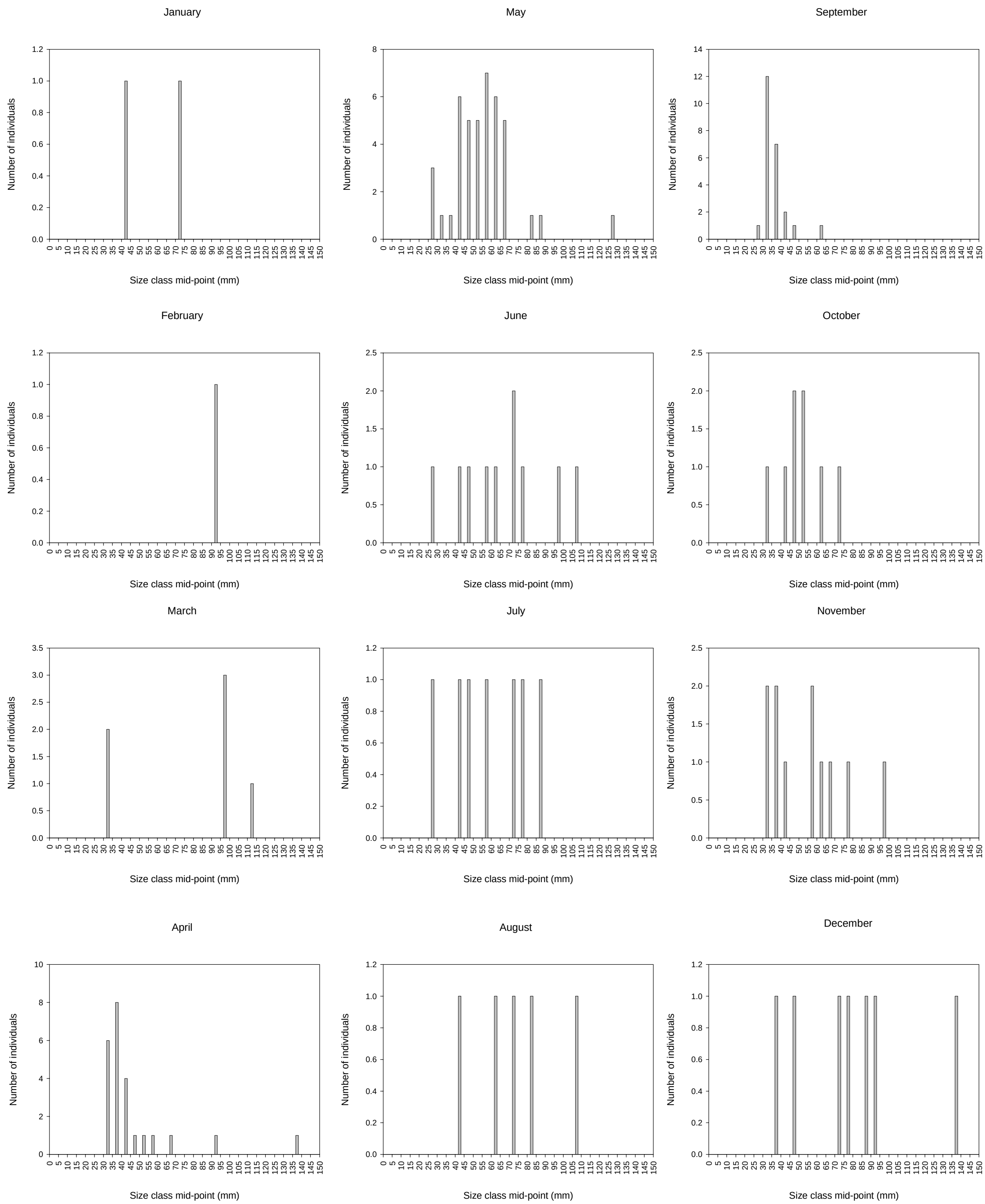


Fig. C7. Monthly length frequencies of Inshore lizardfish collected in seines and trawls.

Ariopsis felis (Hardhead catfish)

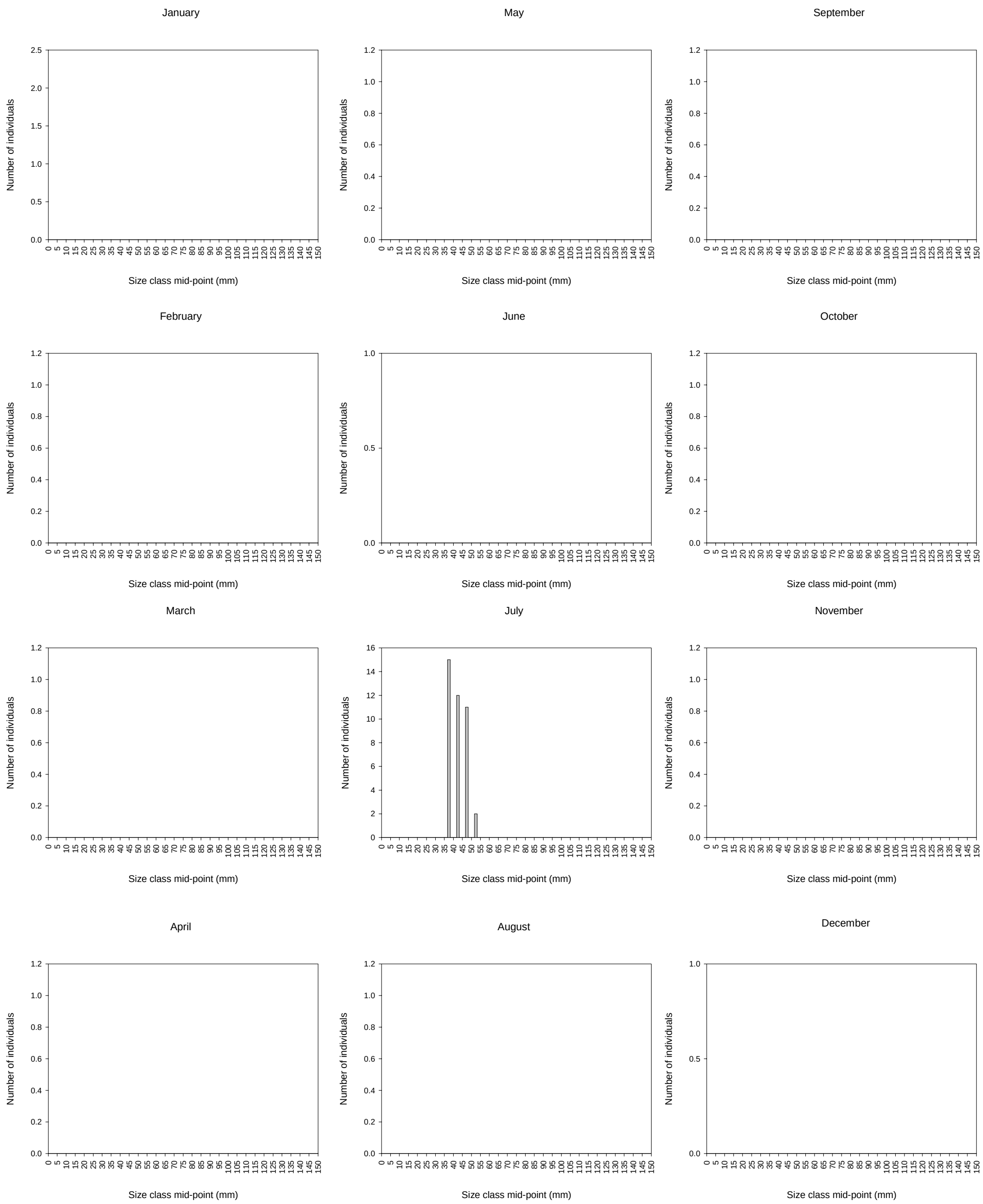


Fig. C8. Monthly length frequencies of Hardhead catfish collected in seines and trawls.

Fundulus grandis (Gulf killifish)

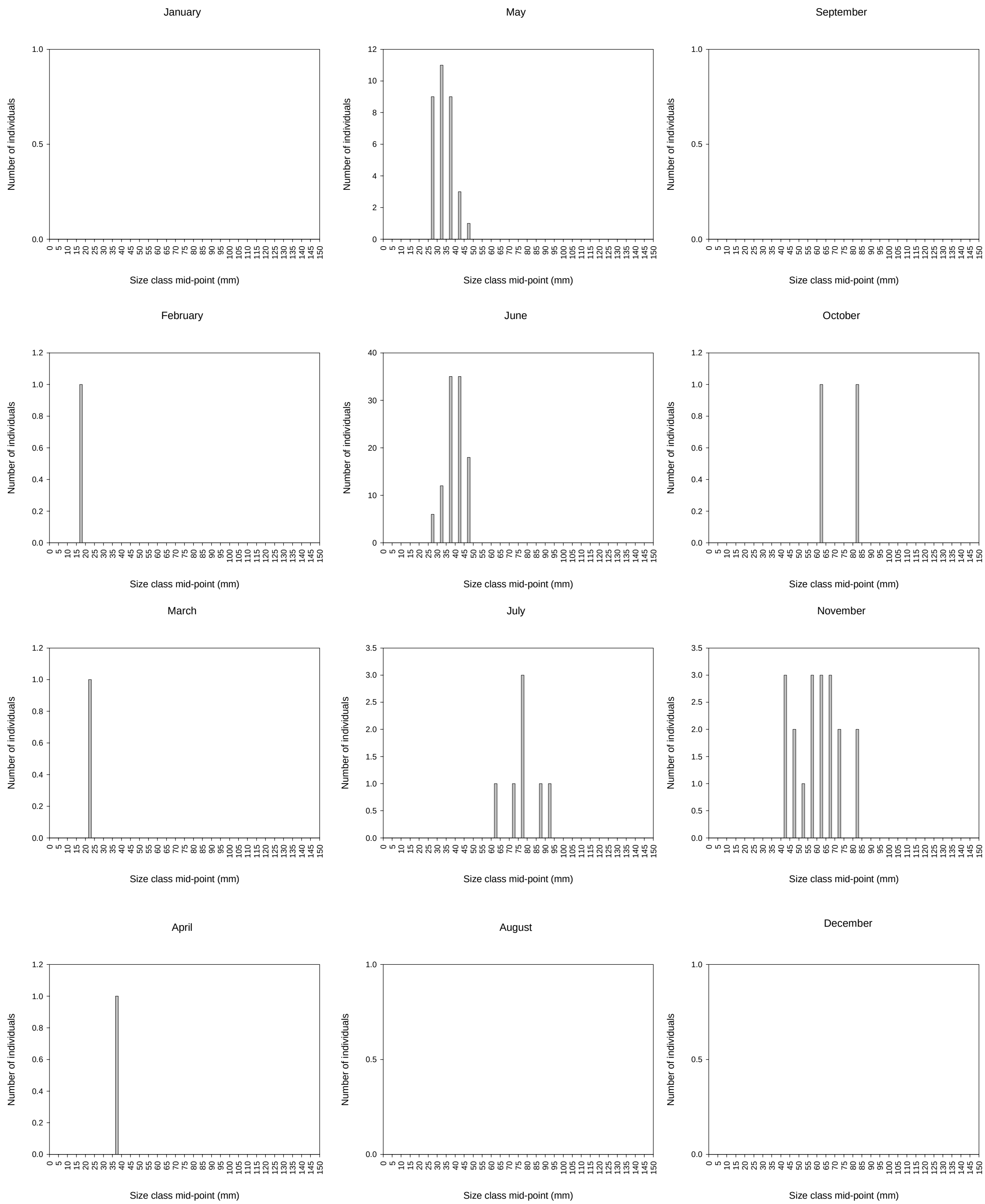


Fig. C9. Monthly length frequencies of Gulf killifish collected in seines and trawls.

Menidia spp. (Silversides)

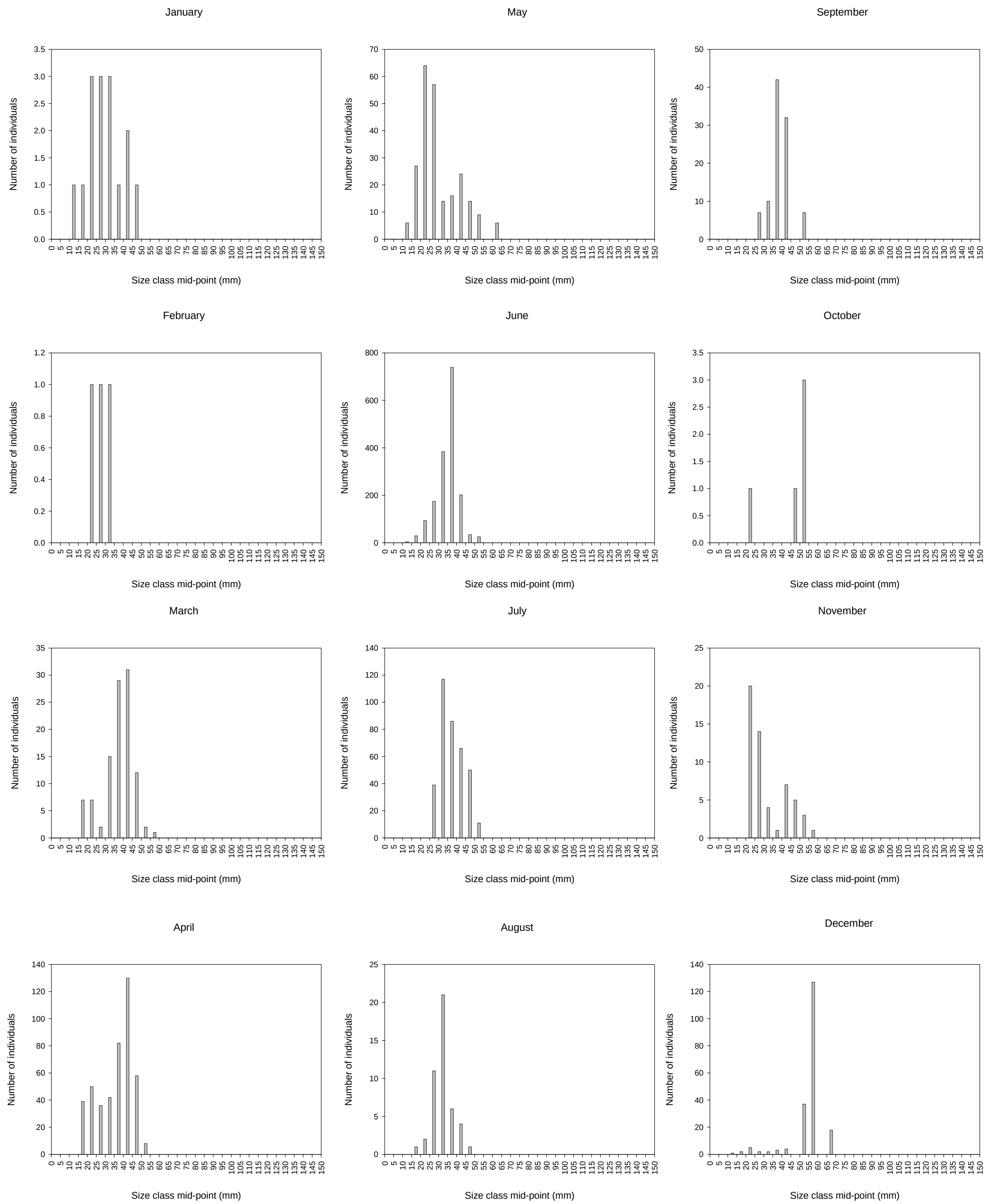


Fig. C10. Monthly length frequencies of Silversides collected in seines and trawls.

Centropomus undecimalis (Common snook)

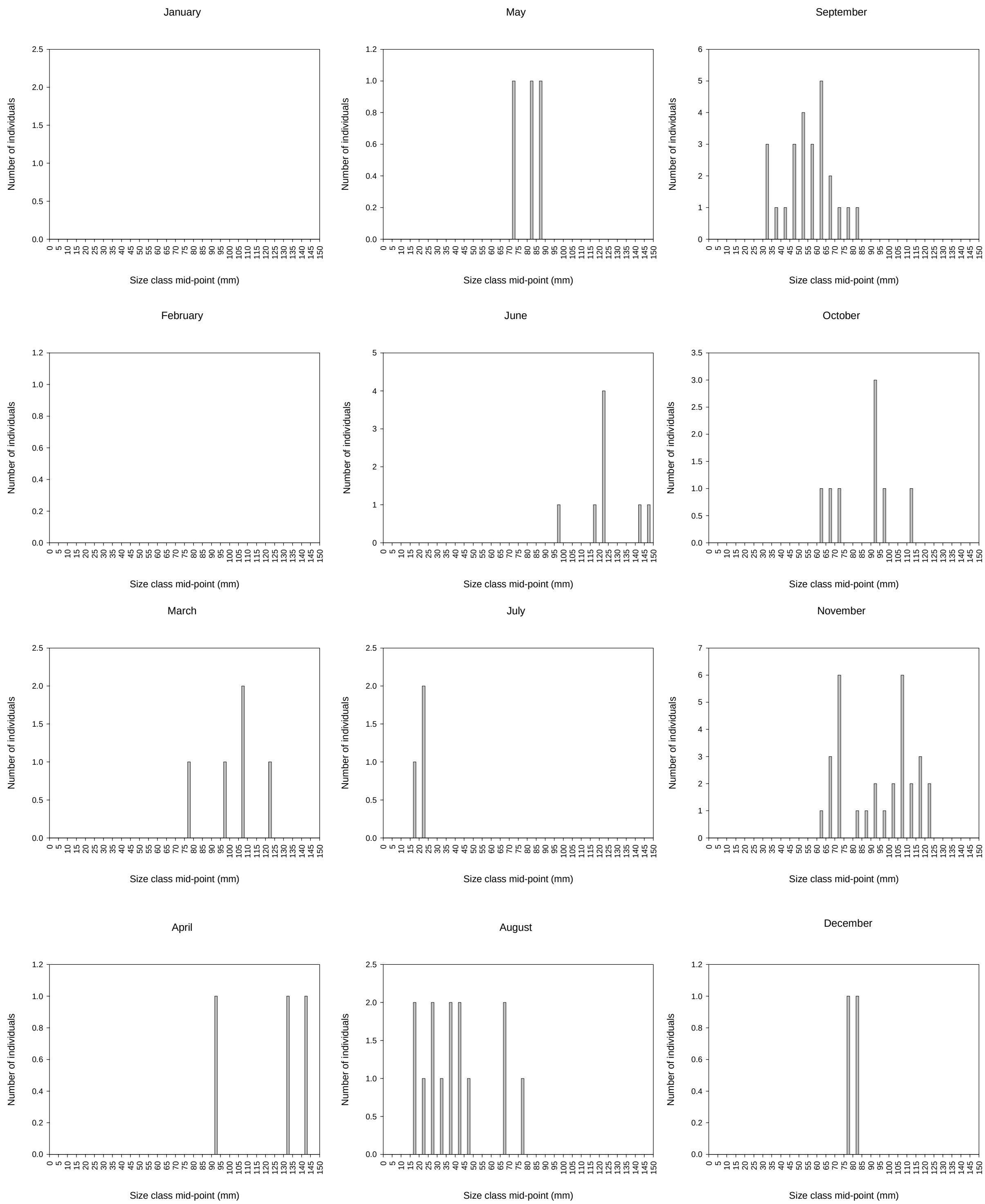


Fig. C11. Monthly length frequencies of Common snook collected in seines and trawls.

Lutjanus synagris (Lane snapper)

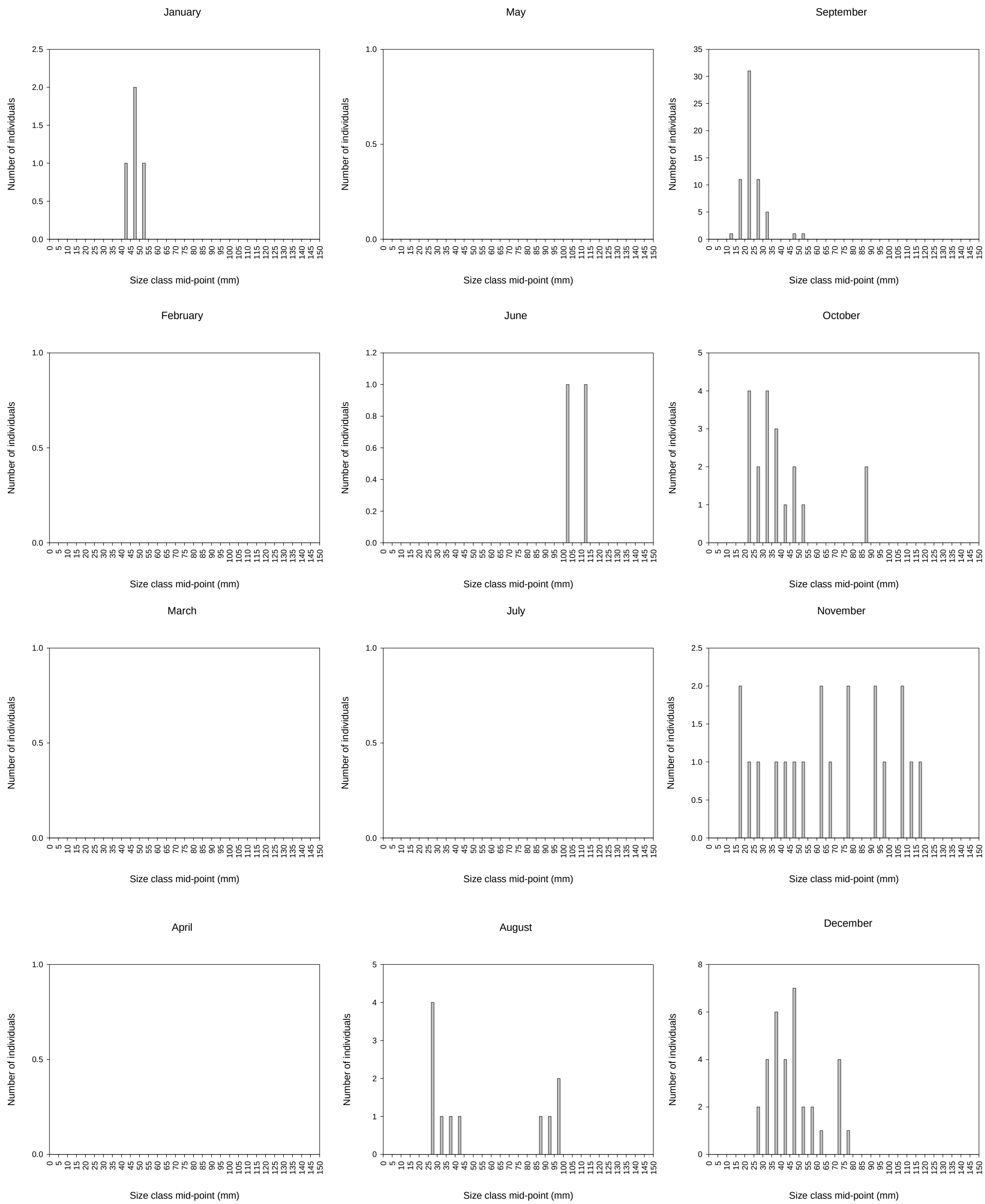


Fig. C12. Monthly length frequencies of Lane snapper collected in seines and trawls.

Eucinostomus spp. (Eucinostomus mojarras)

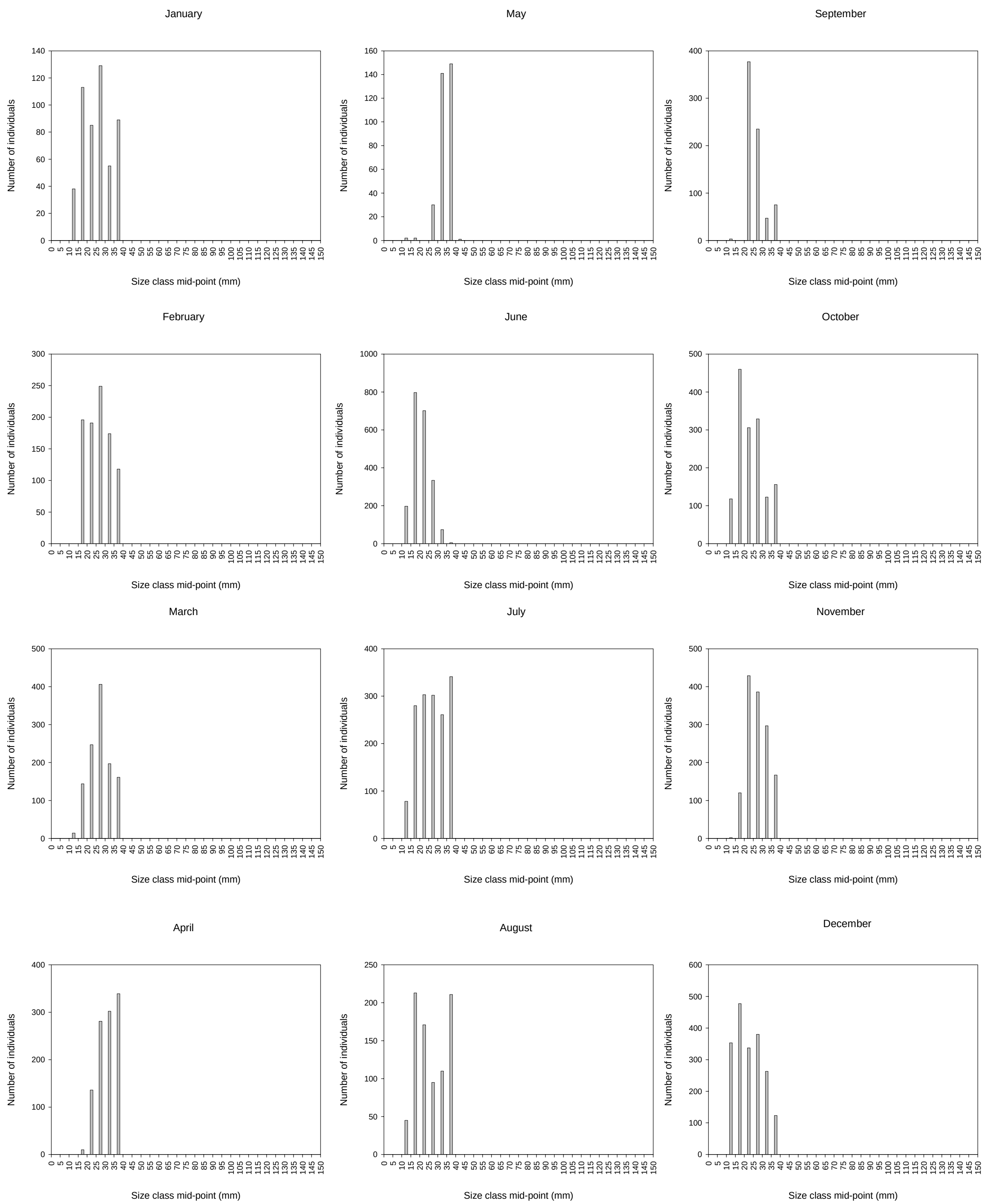


Fig. C13. Monthly length frequencies of Eucinostomus mojarras collected in seines and trawls.

Eucinostomus gula (Silver jenny)

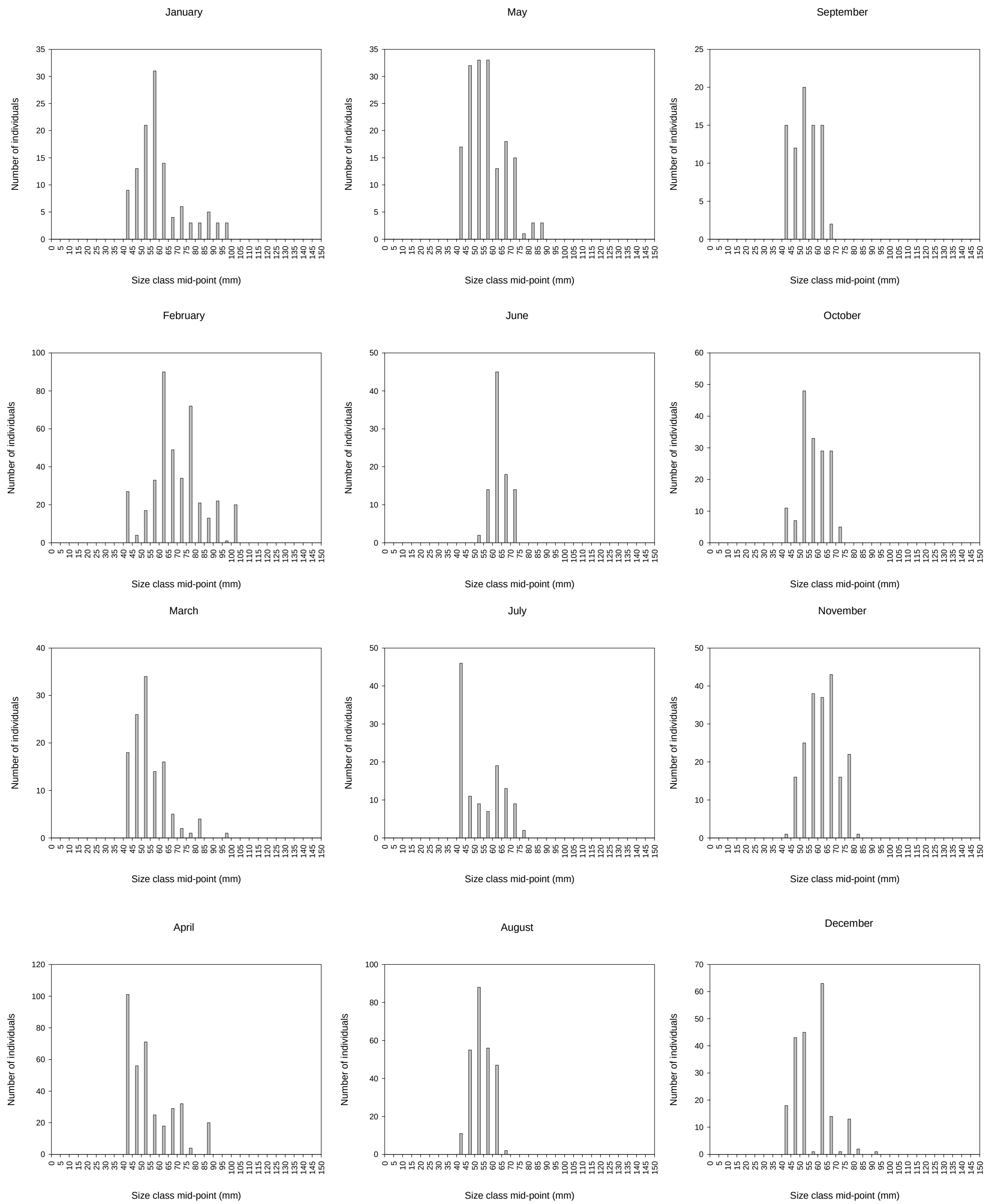


Fig. C14. Monthly length frequencies of Silver jenny collected in seines and trawls.

Eucinostomus harengulus (Tidewater mojarra)

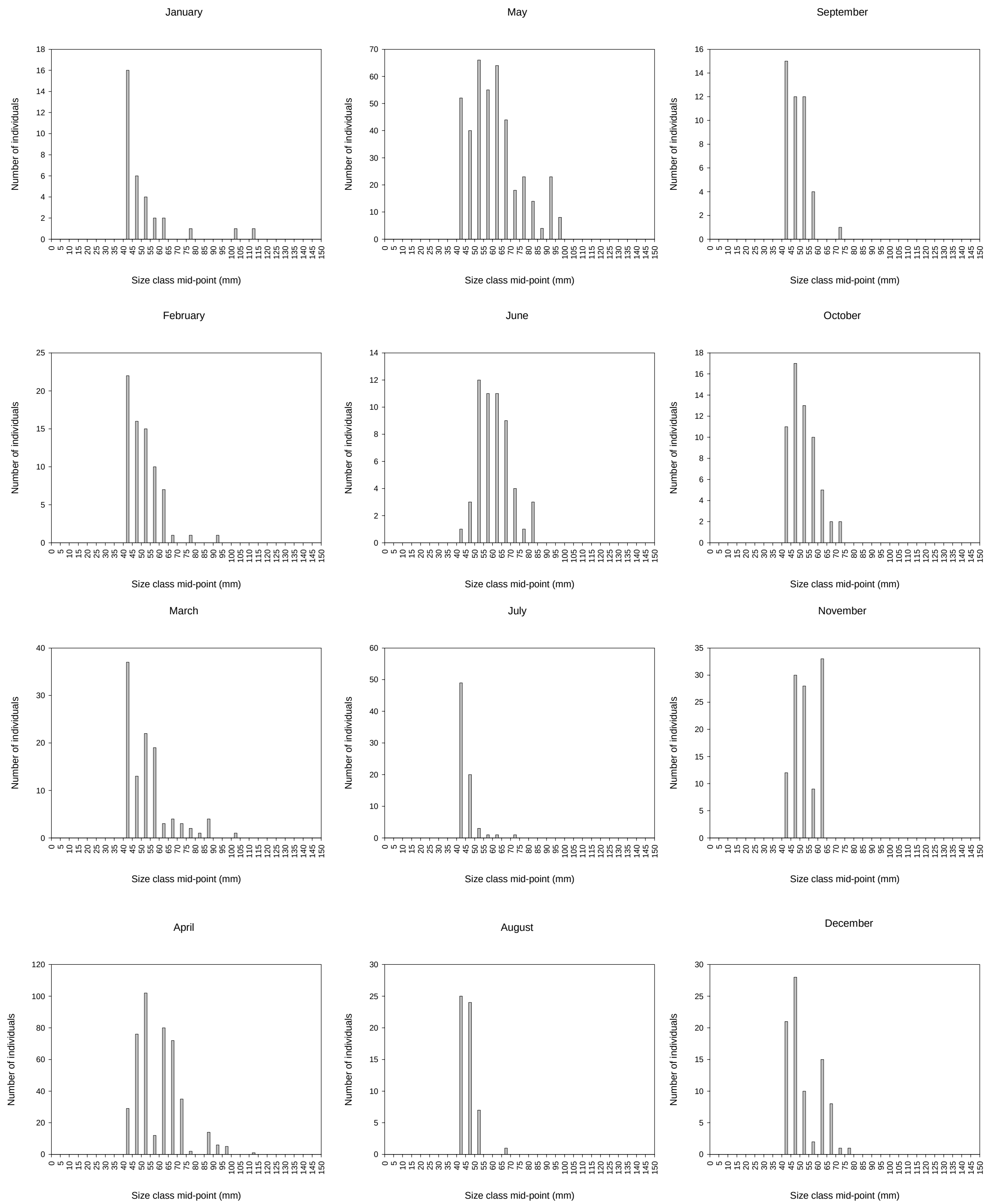


Fig. C15. Monthly length frequencies of Tidewater mojarra collected in seines and trawls.

Eugerres plumieri (Striped mojarra)

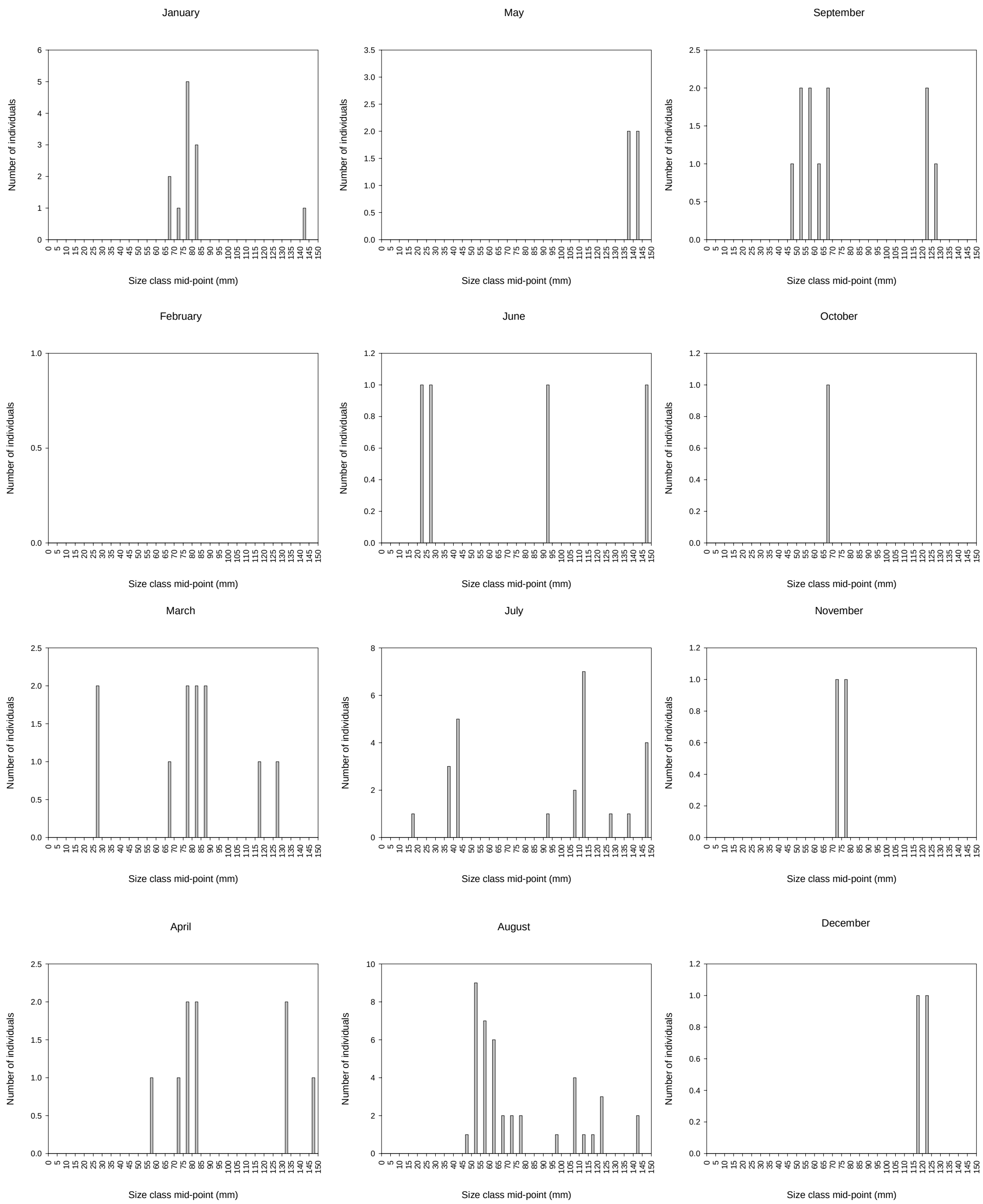


Fig. C16. Monthly length frequencies of Striped mojarra collected in seines and trawls.

Orthopristis chrysoptera (Pigfish)

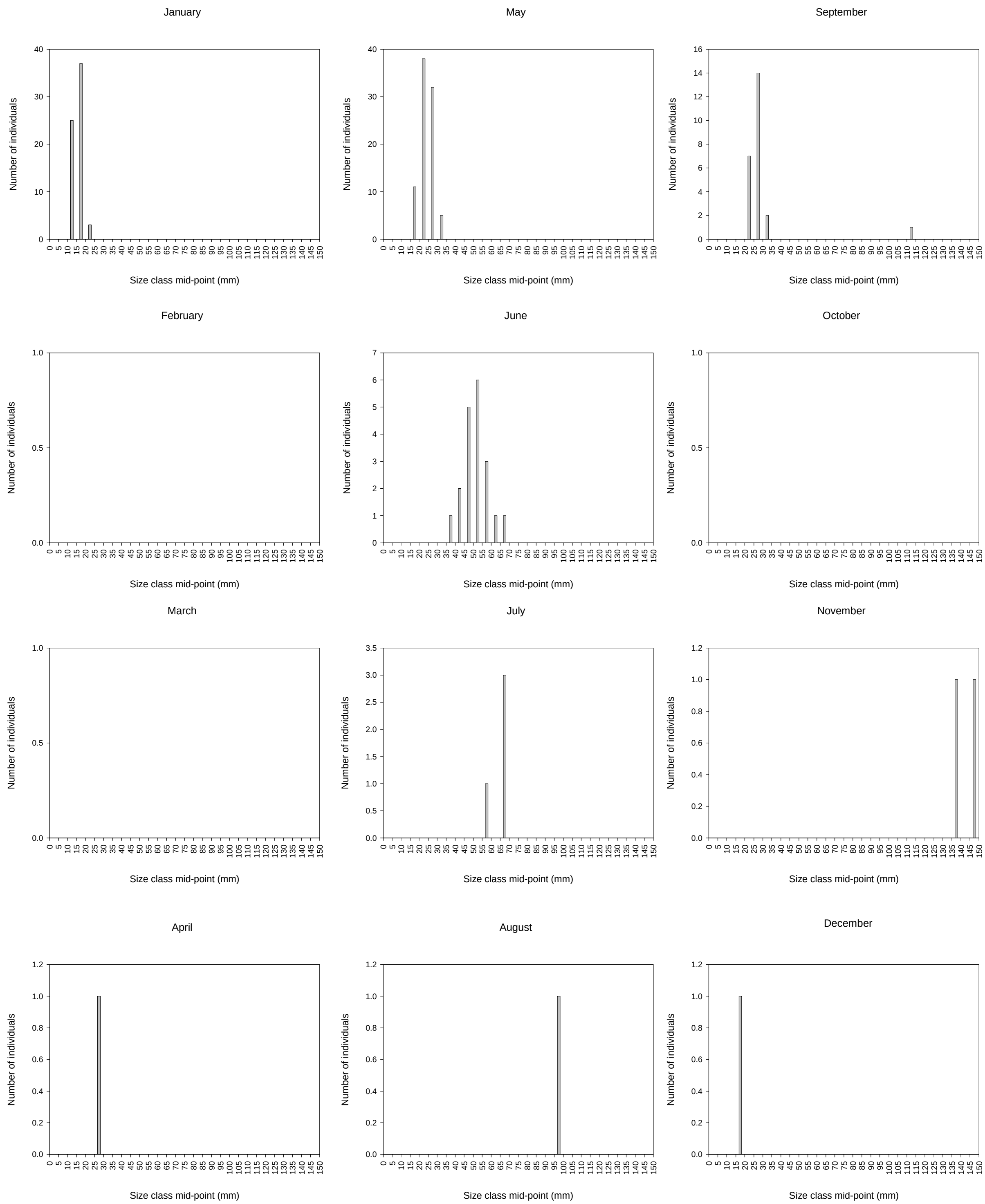


Fig. C17. Monthly length frequencies of Pigfish collected in seines and trawls.

Lagodon rhomboides (Pinfish)

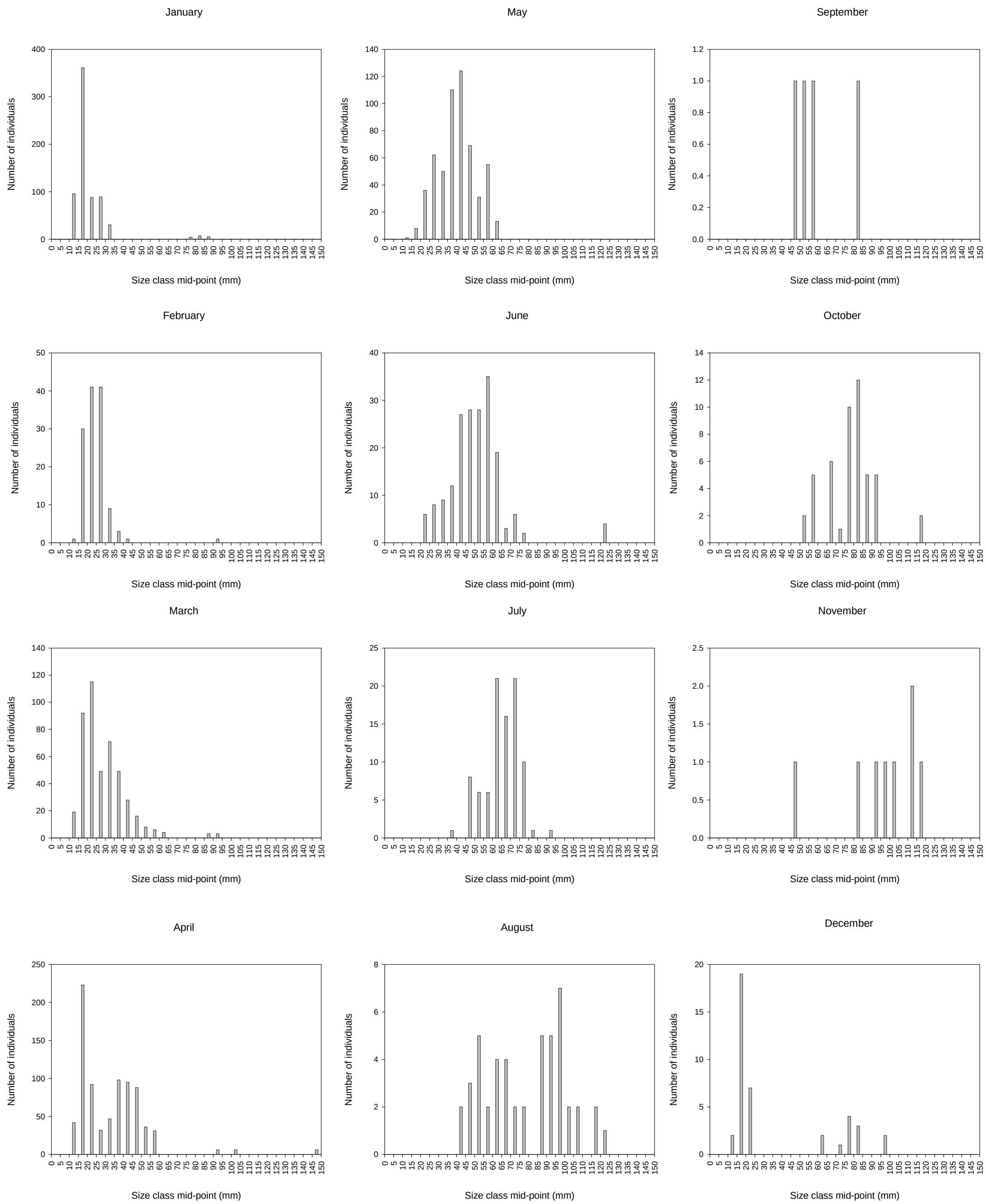


Fig. C18. Monthly length frequencies of Pinfish collected in seines and trawls.

Leiostomus xanthurus (Spot)

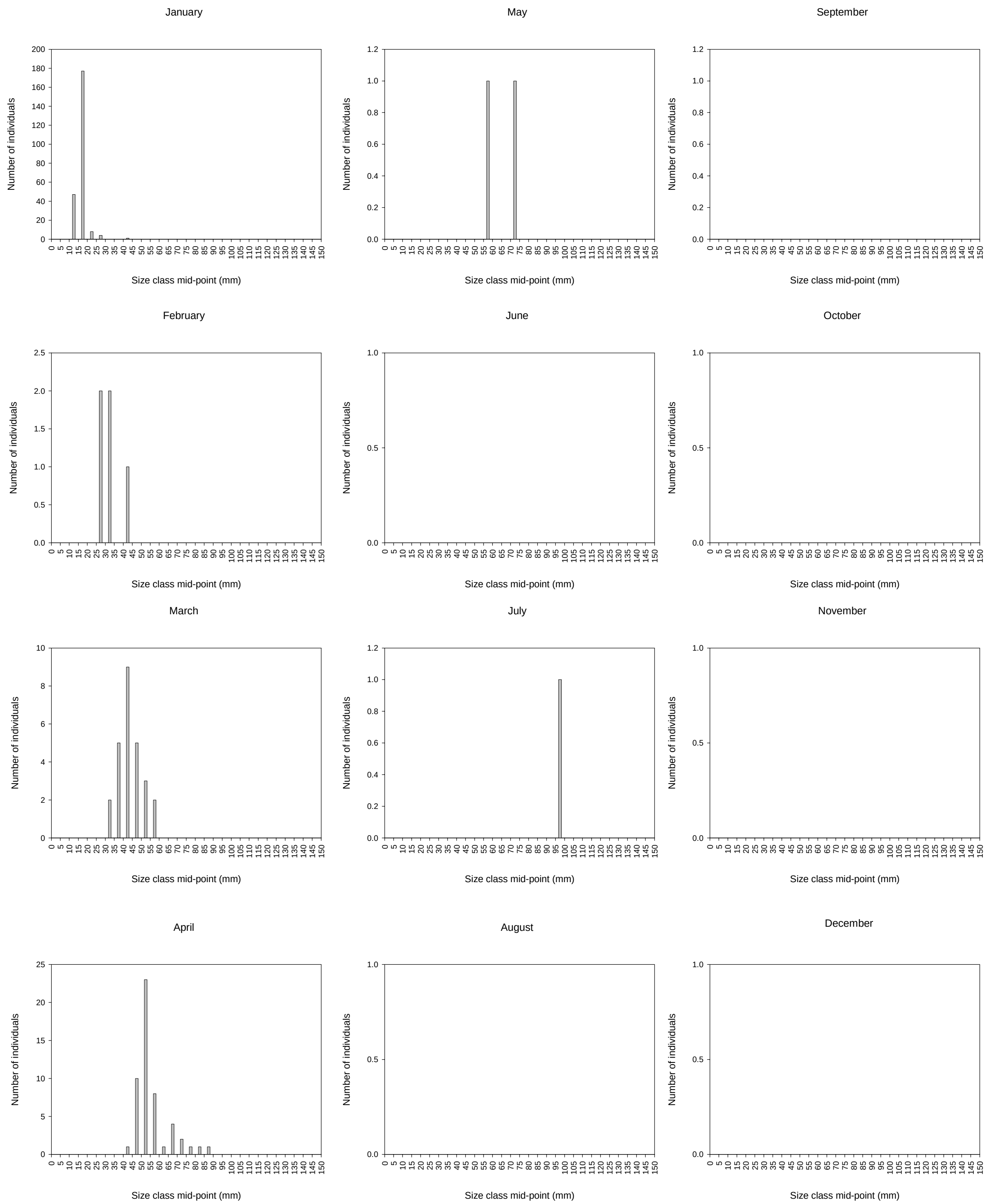


Fig. C19. Monthly length frequencies of Spot collected in seines and trawls.

Sciaenops ocellatus (Red drum)

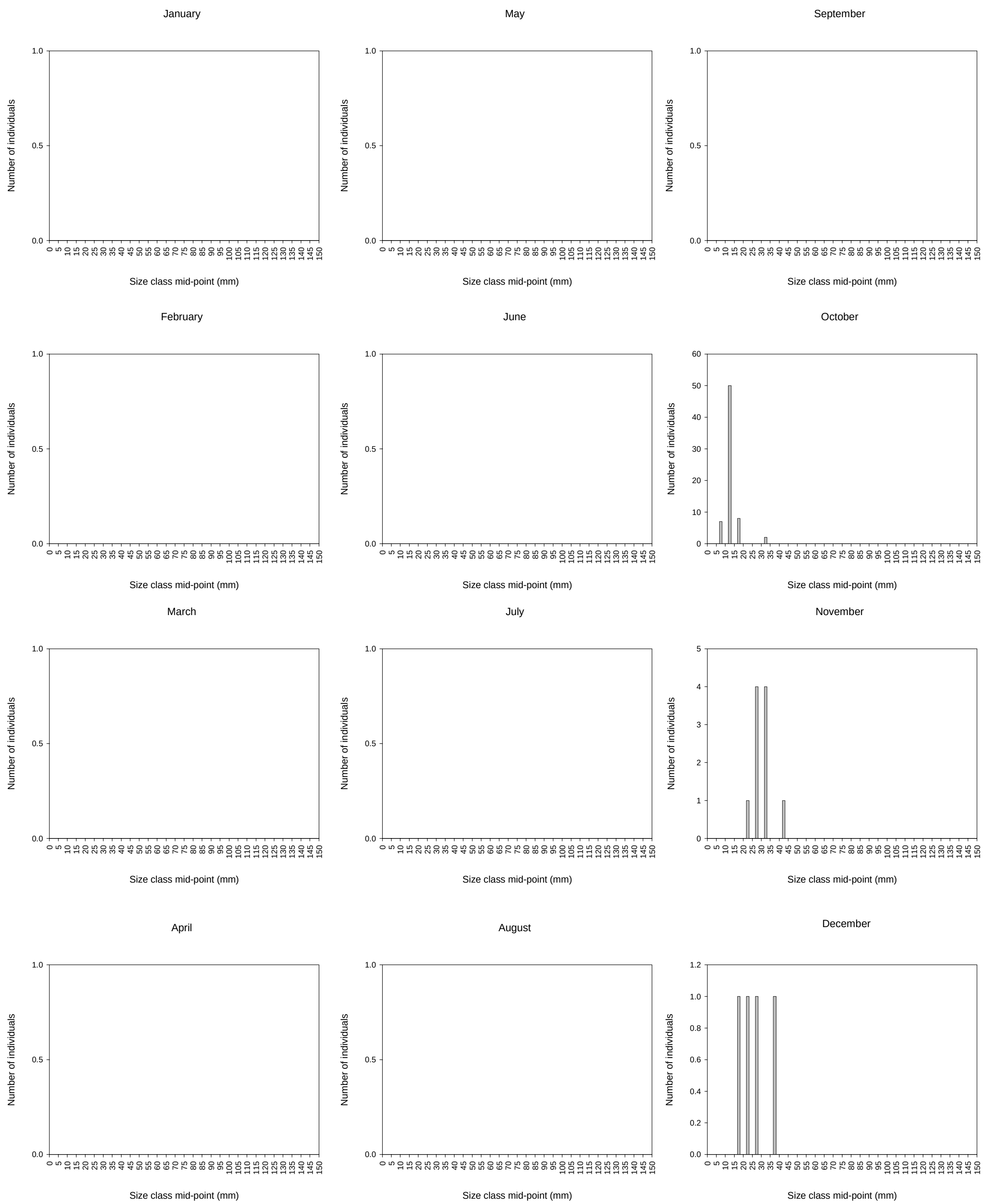


Fig. C20. Monthly length frequencies of Red drum collected in seines and trawls.

Mugil cephalus (Striped mullet)

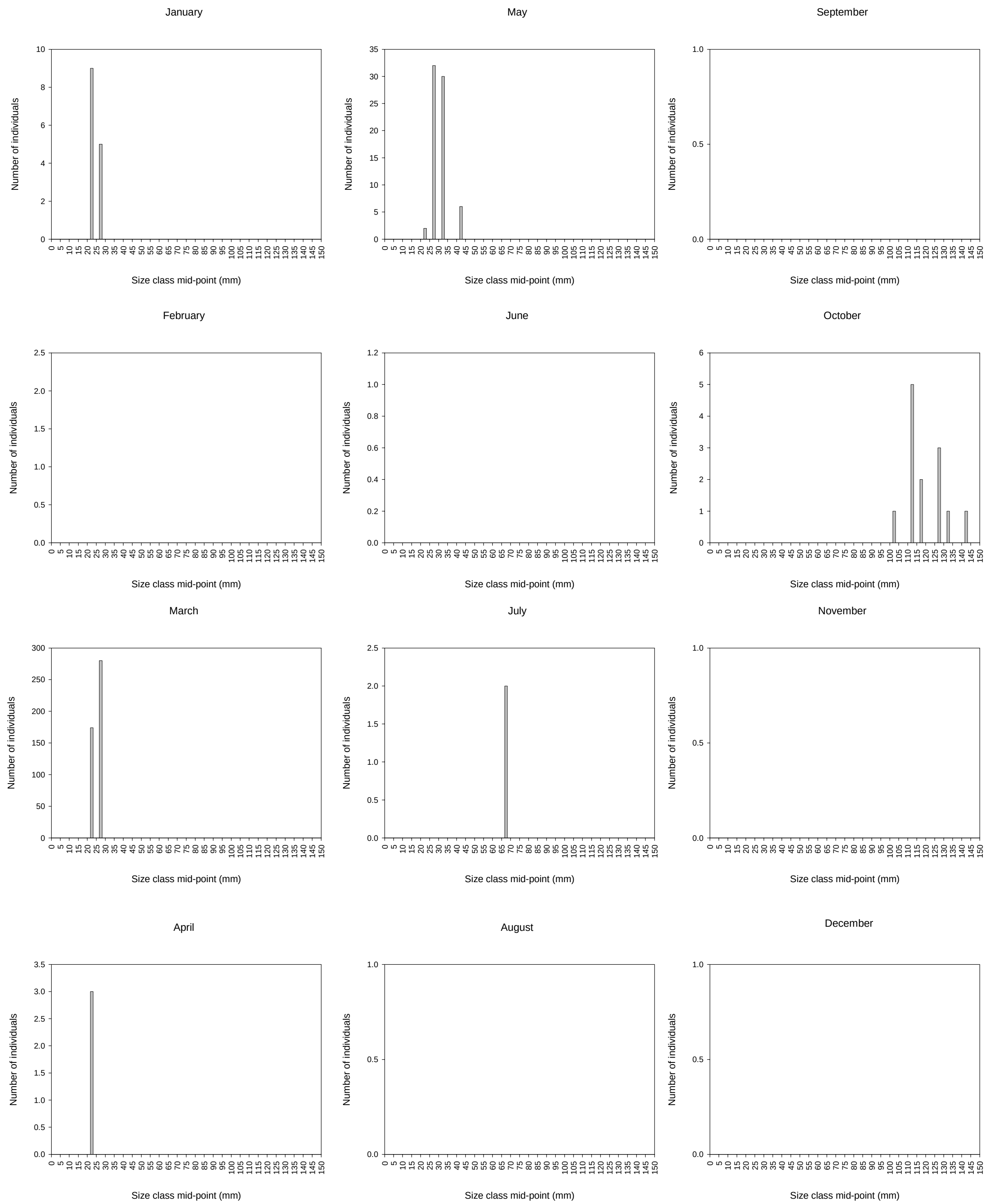


Fig. C21. Monthly length frequencies of Striped mullet collected in seines and trawls.

Gobiosoma spp. (Gobiosoma gobies)

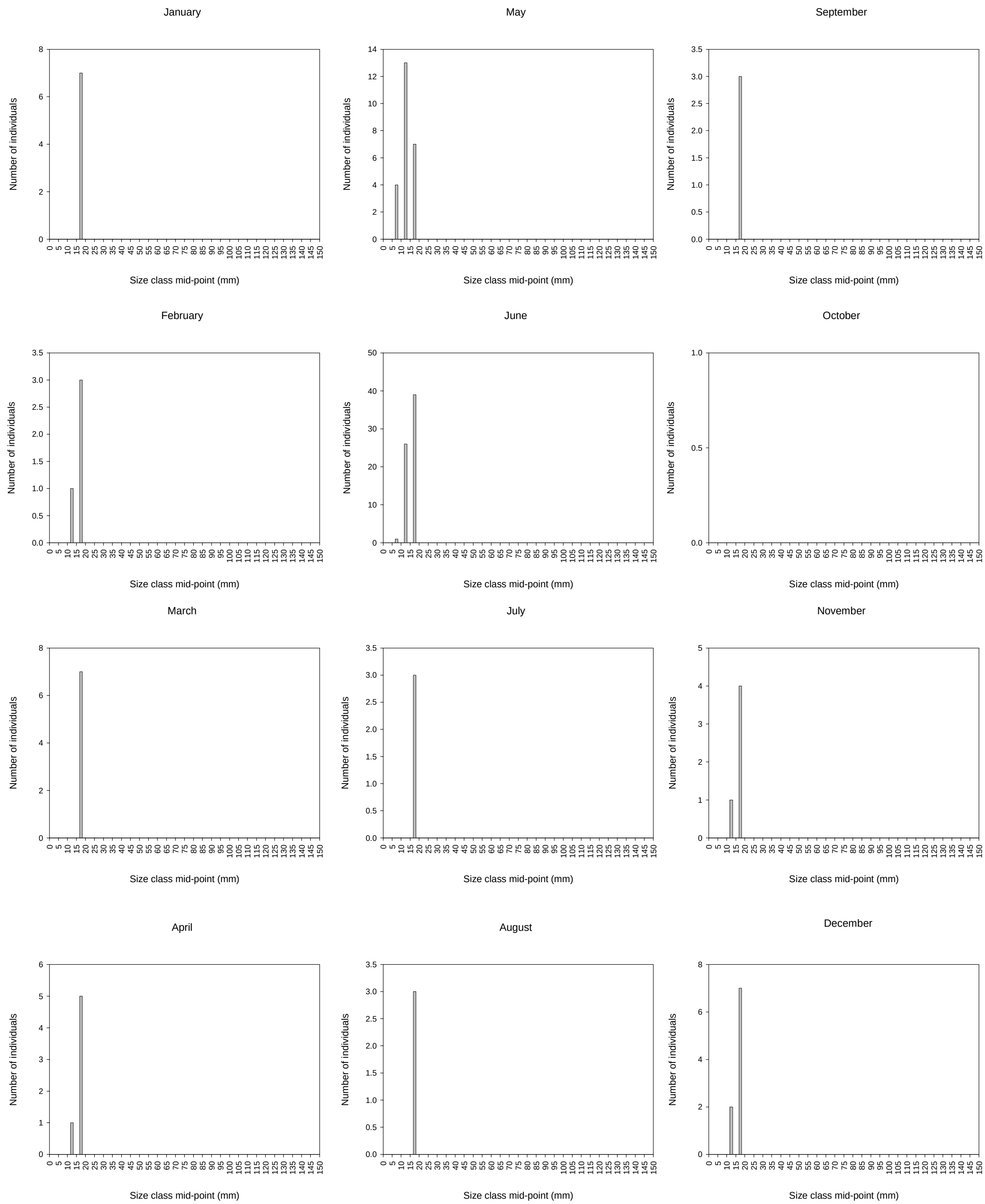


Fig. C22. Monthly length frequencies of Gobiosoma gobies collected in seines and trawls.

Microgobius gulosus (Clown goby)

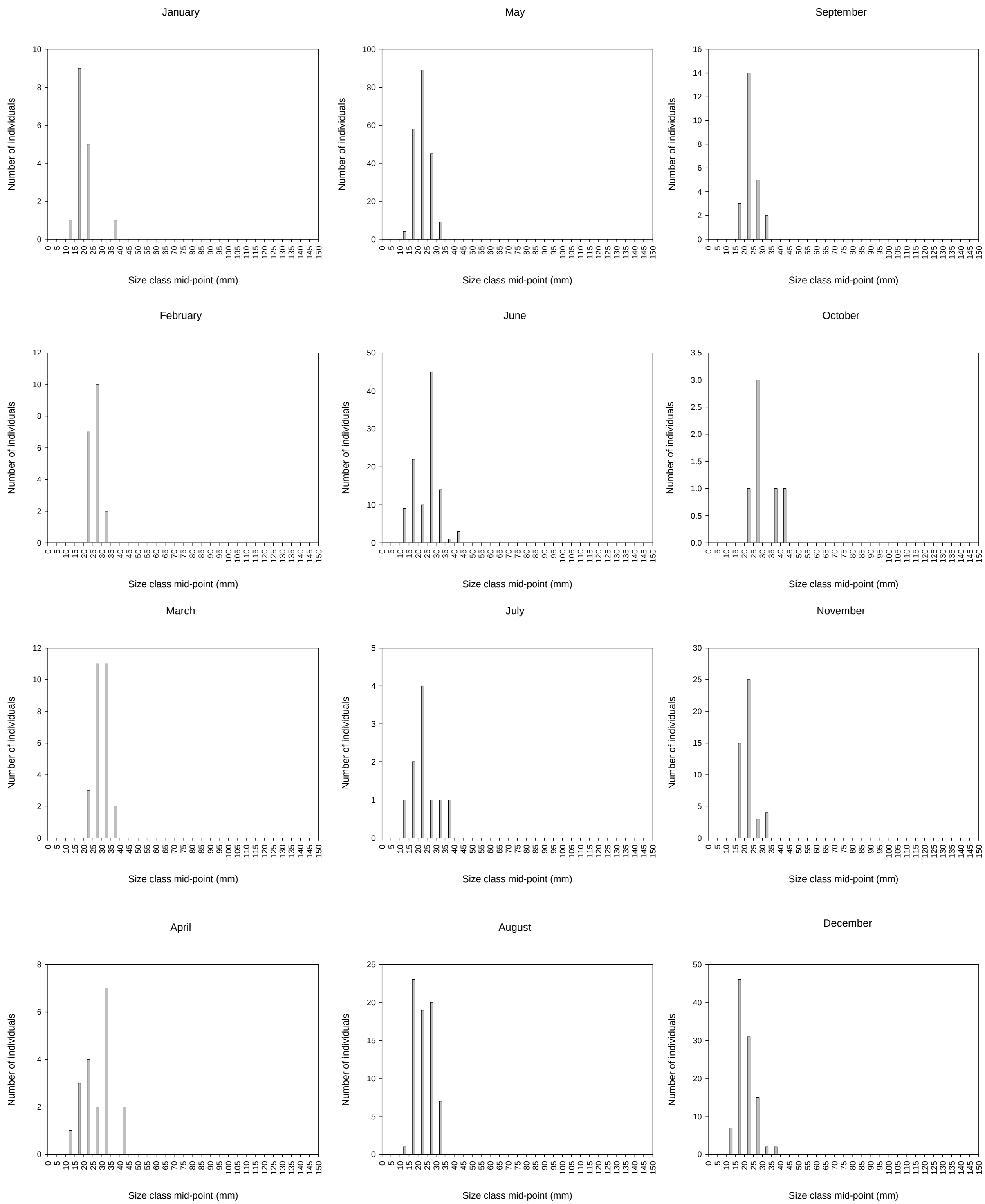


Fig. C23. Monthly length frequencies of Clown goby collected in seines and trawls.

Trinectes maculatus (Hogchoker)

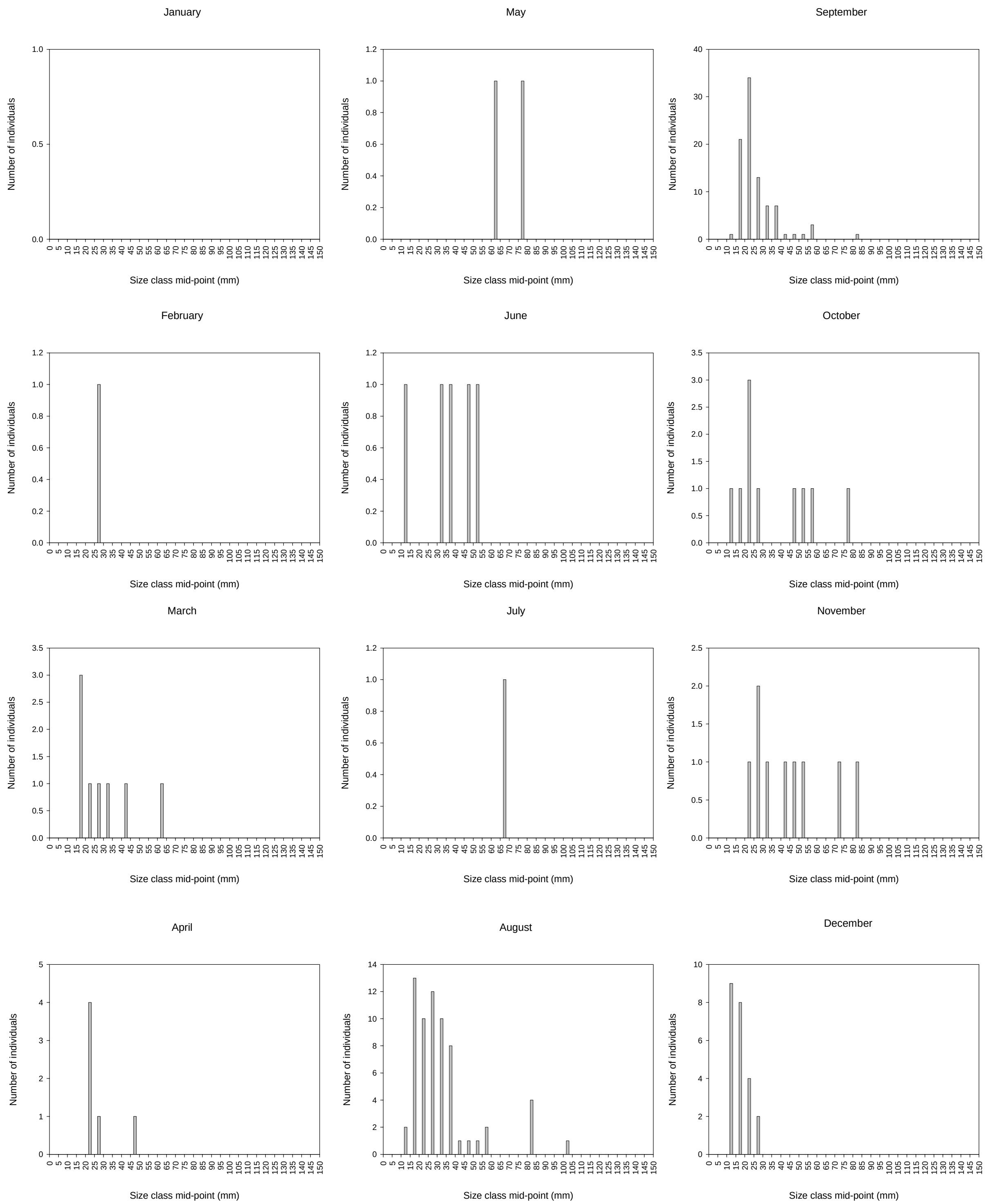


Fig. C24. Monthly length frequencies of Hogchoker collected in seines and trawls.

Appendix D:

Seine catch overview plots

Note: The Modified Venice salinity classification used in the plots is as follows: limnetic (0-0.49), oligohaline (0.5-4.99), low mesohaline (5-11.99), high mesohaline (12-17.99), polyhaline (18-29.99) and euhaline (>=30 psu).

Farfantepenaeus duorarum (Pink shrimp), Seines

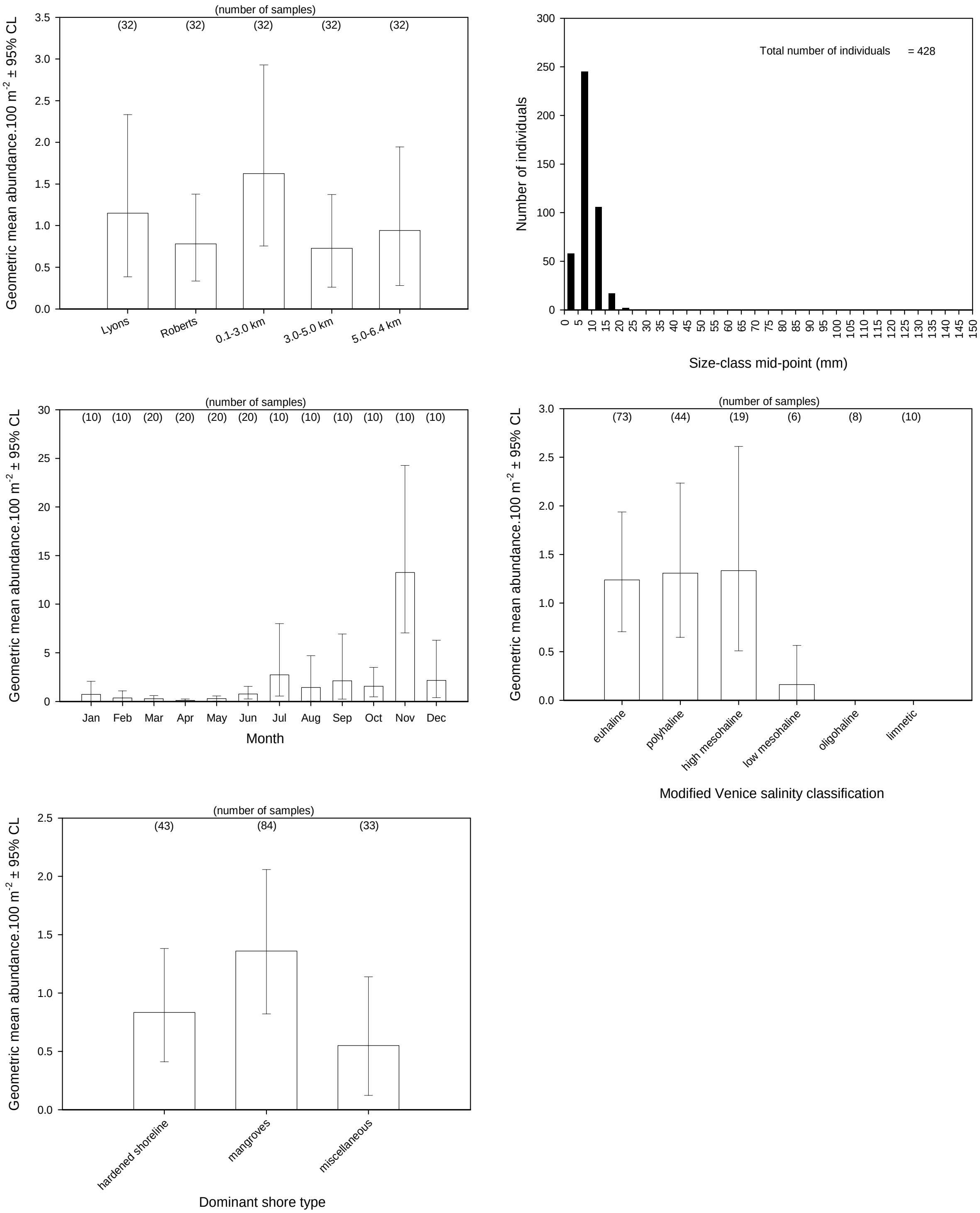


Fig. D1. Relative abundance of Pink shrimp in shoreline (seined) habitats.

Palaemonetes pugio (Daggerblade grass shrimp), Seines

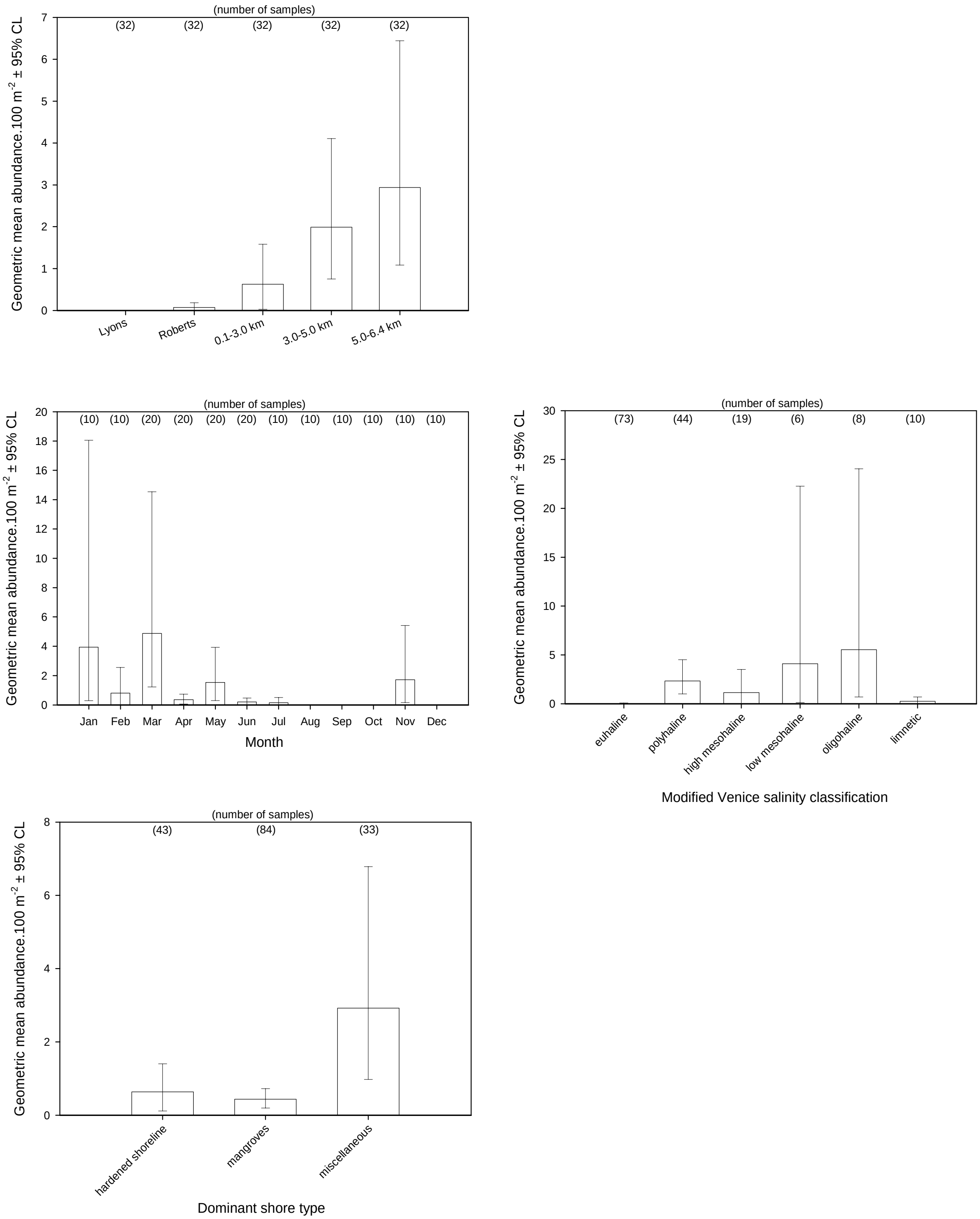


Fig. D2. Relative abundance of Daggerblade grass shrimp in shoreline (seined) habitats.

Callinectes sapidus **(Blue crab), Seines**

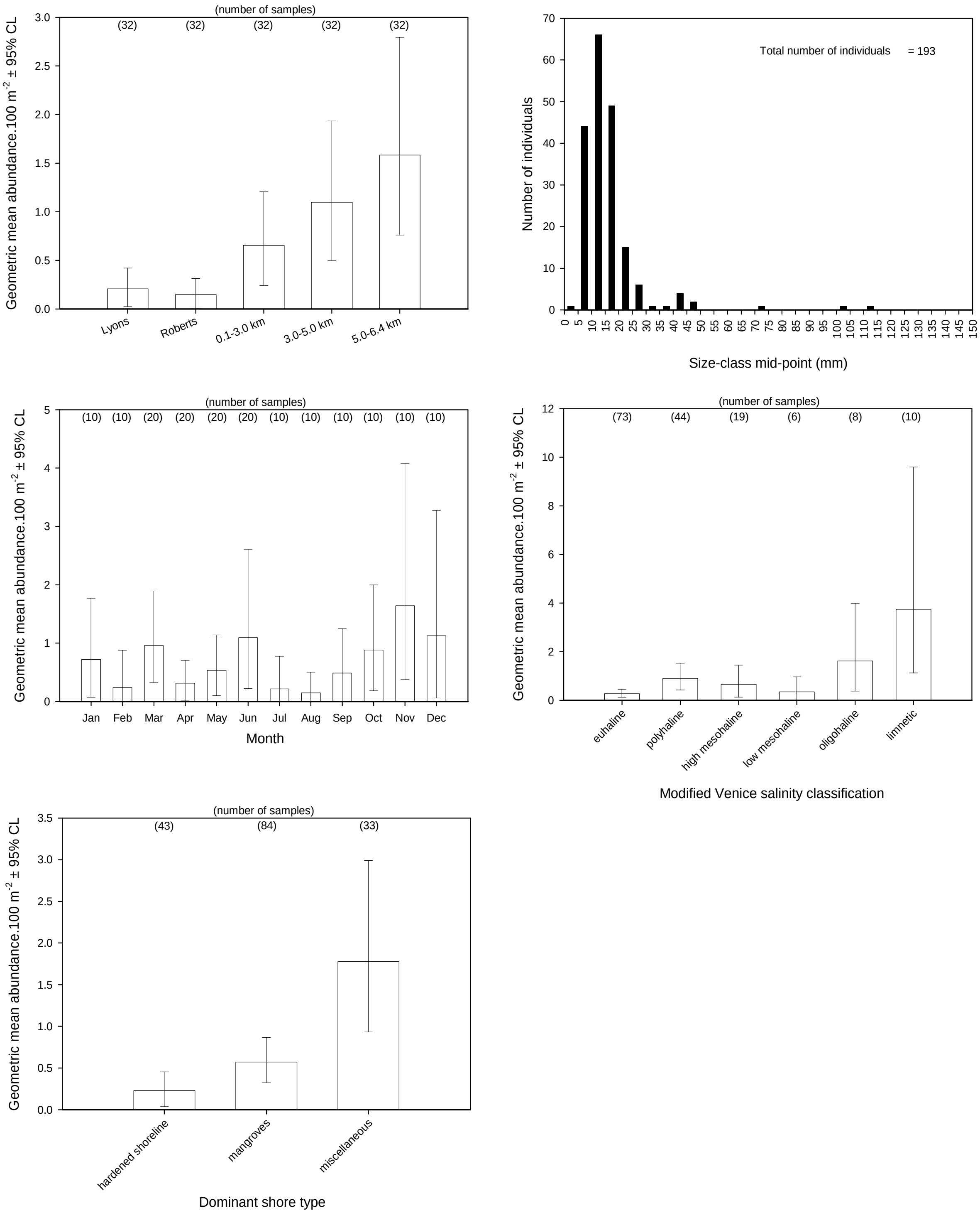


Fig. D3. Relative abundance of Blue crab in shoreline (seined) habitats.

Harengula jaguana (Scaled sardine), Seines

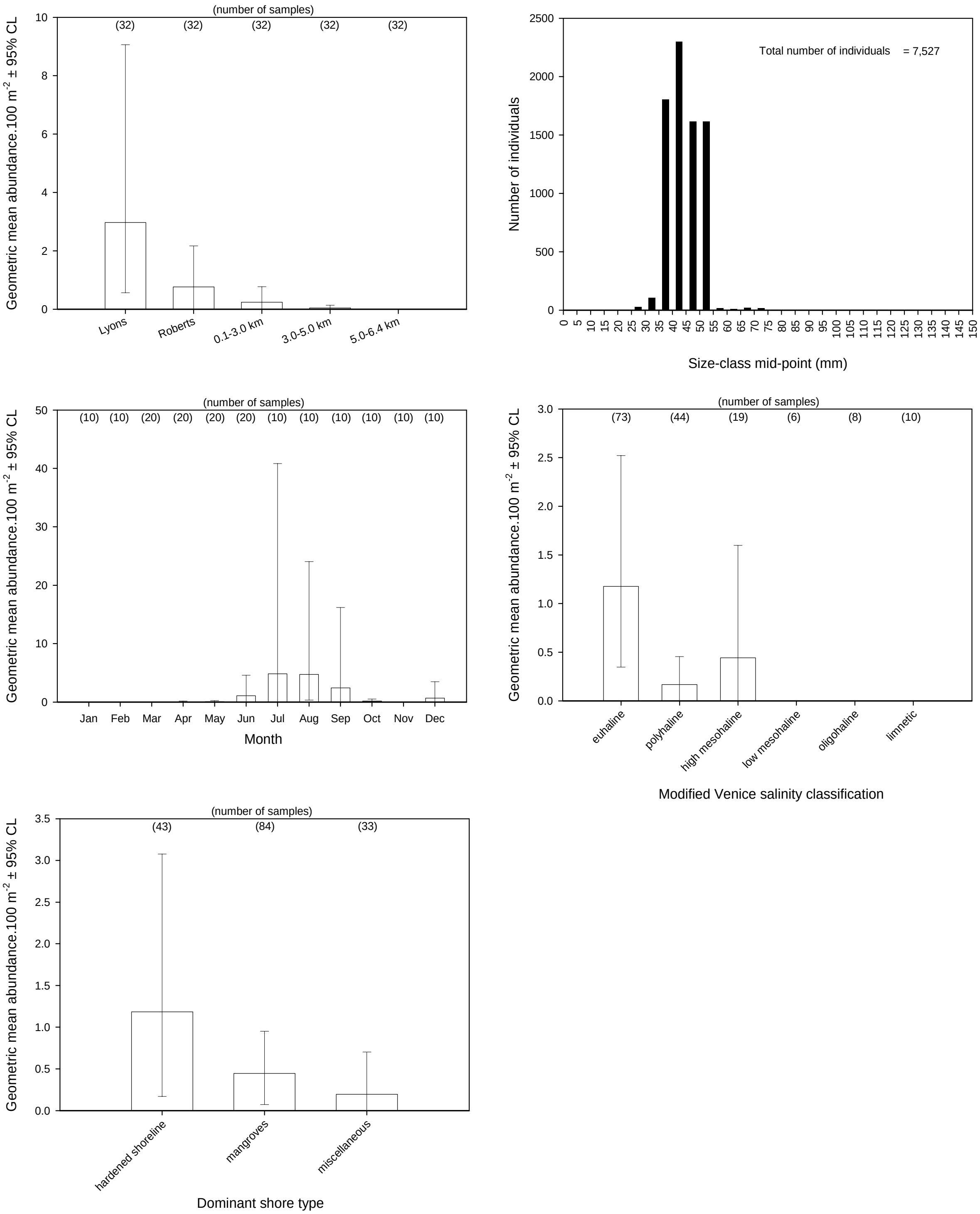


Fig. D4. Relative abundance of Scaled sardine in shoreline (seined) habitats.

Anchoa mitchilli (Bay anchovy), Seines

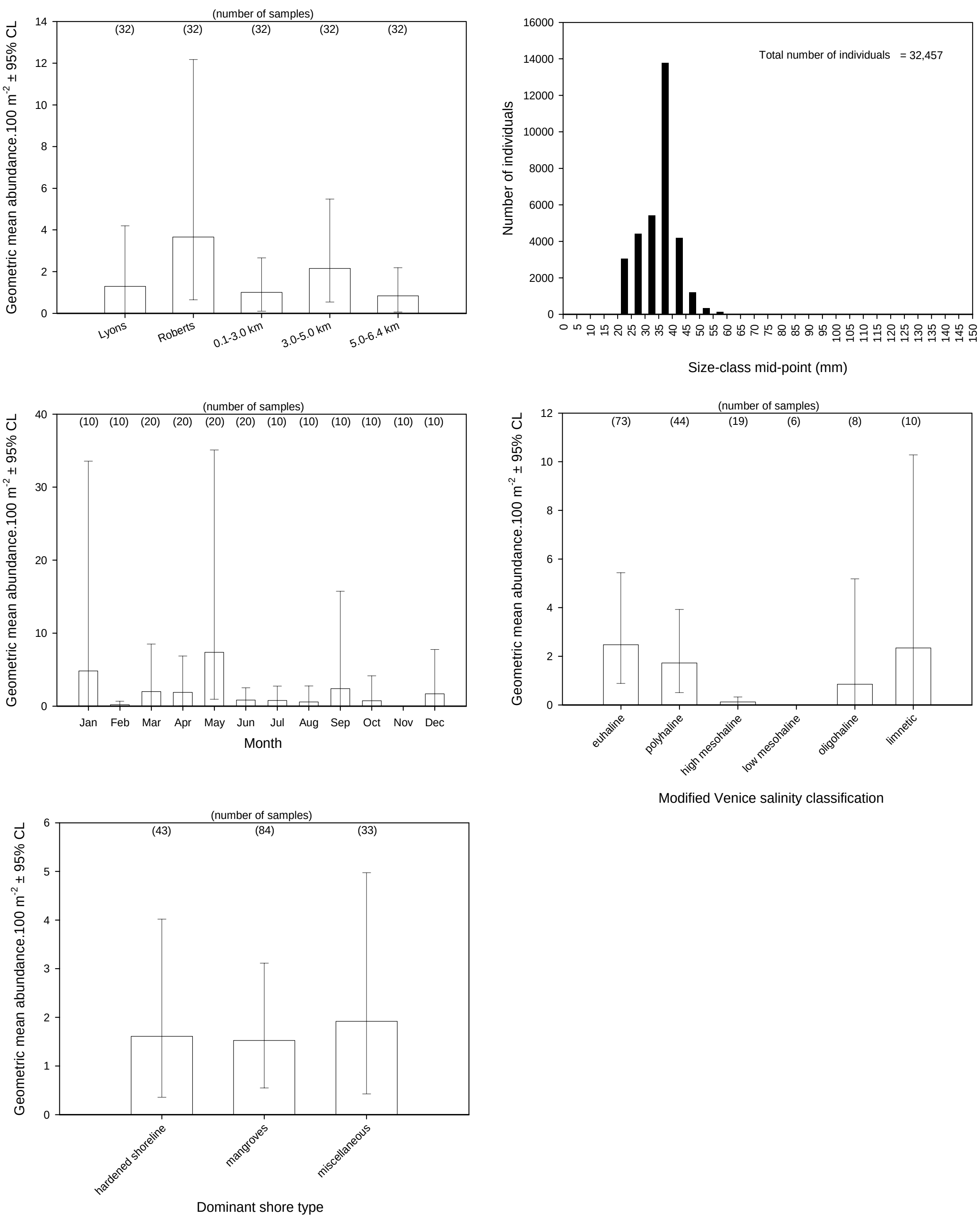


Fig. D5. Relative abundance of Bay anchovy in shoreline (seined) habitats.

Synodus foetens (Inshore lizardfish), Seines

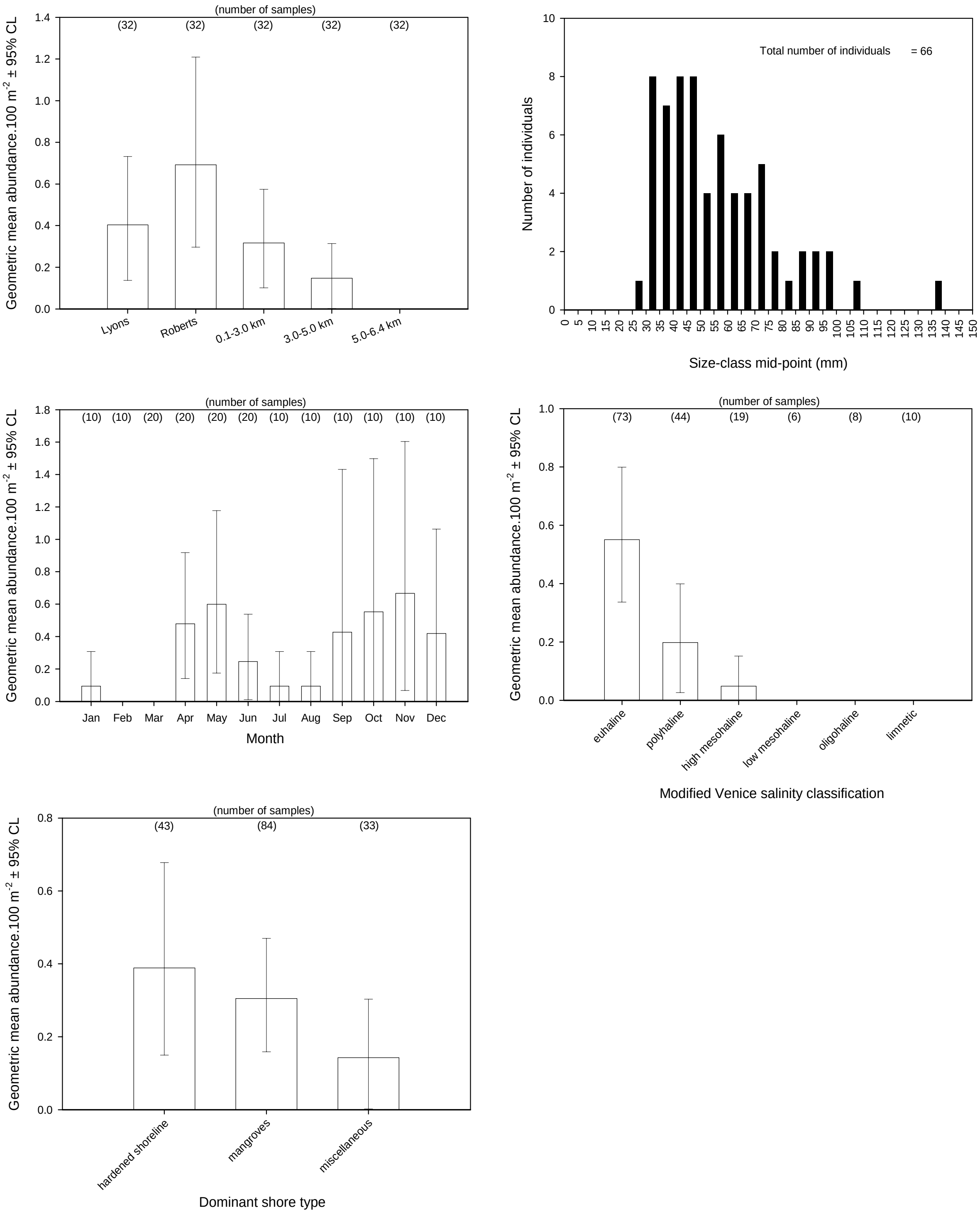


Fig. D6. Relative abundance of Inshore lizardfish in shoreline (seined) habitats.

Fundulus grandis **(Gulf killifish), Seines**

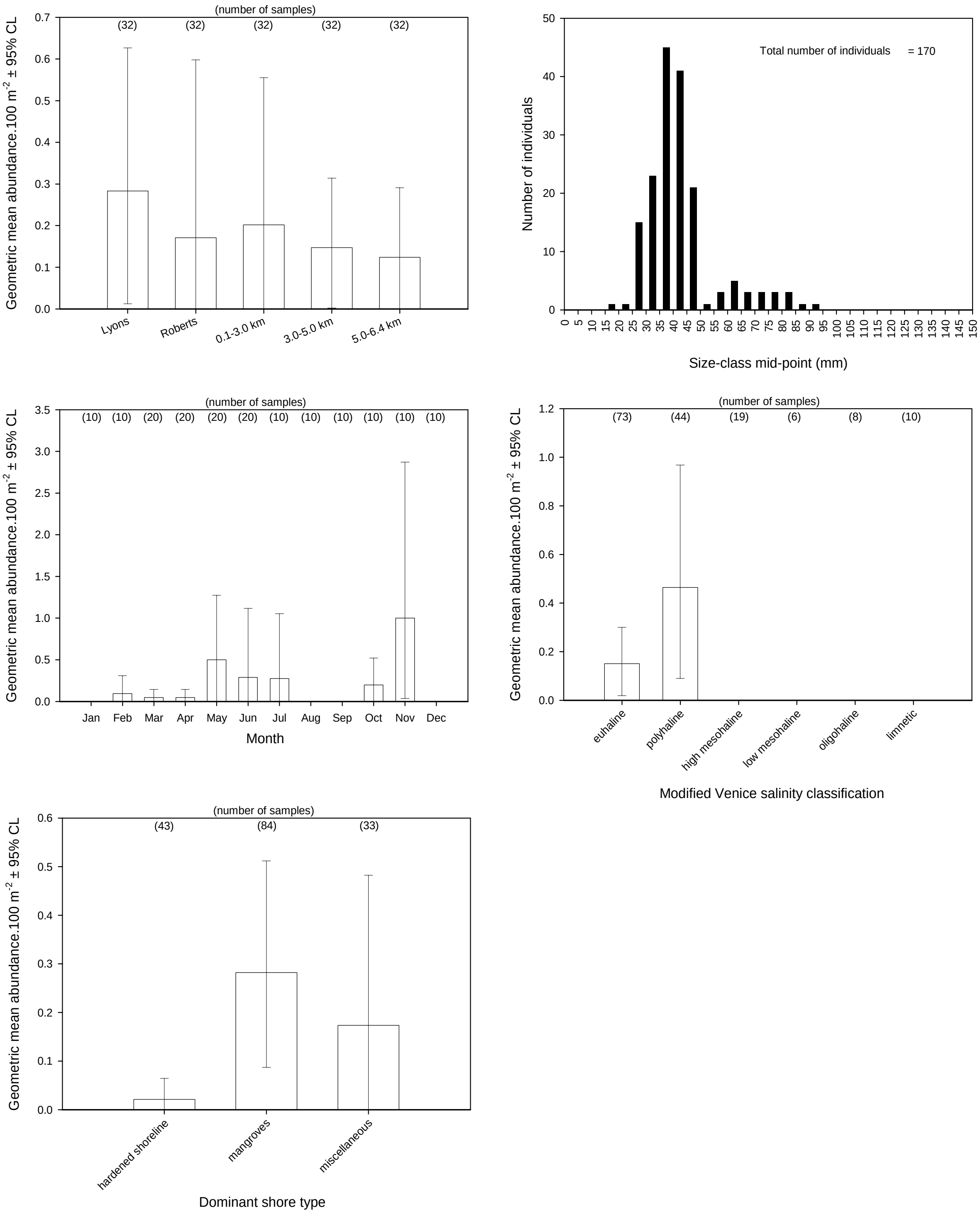


Fig. D7. Relative abundance of Gulf killifish in shoreline (seined) habitats.

Menidia spp. (Silversides), Seines

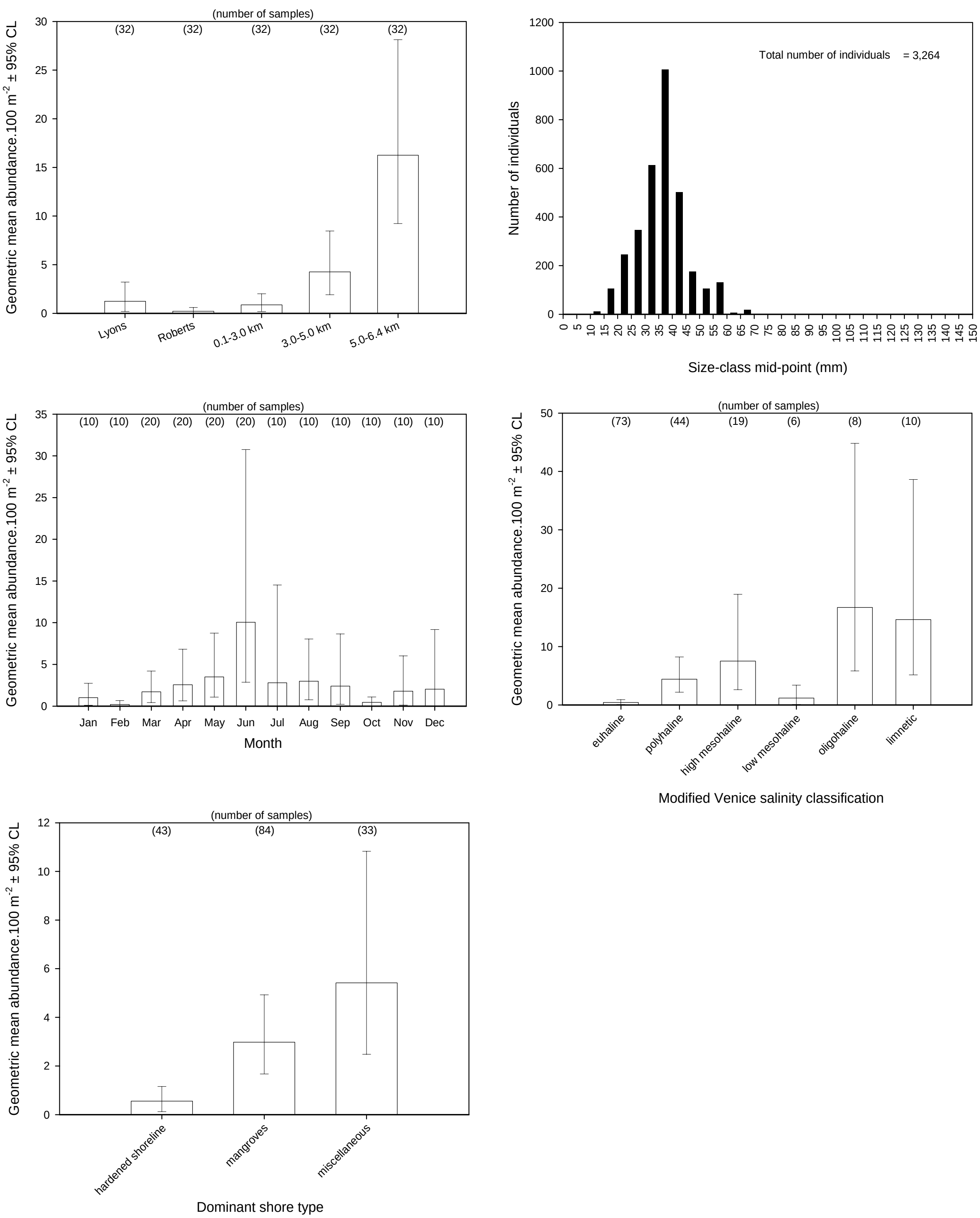


Fig. D8. Relative abundance of Silversides in shoreline (seined) habitats.

Centropomus undecimalis (Common snook), Seines

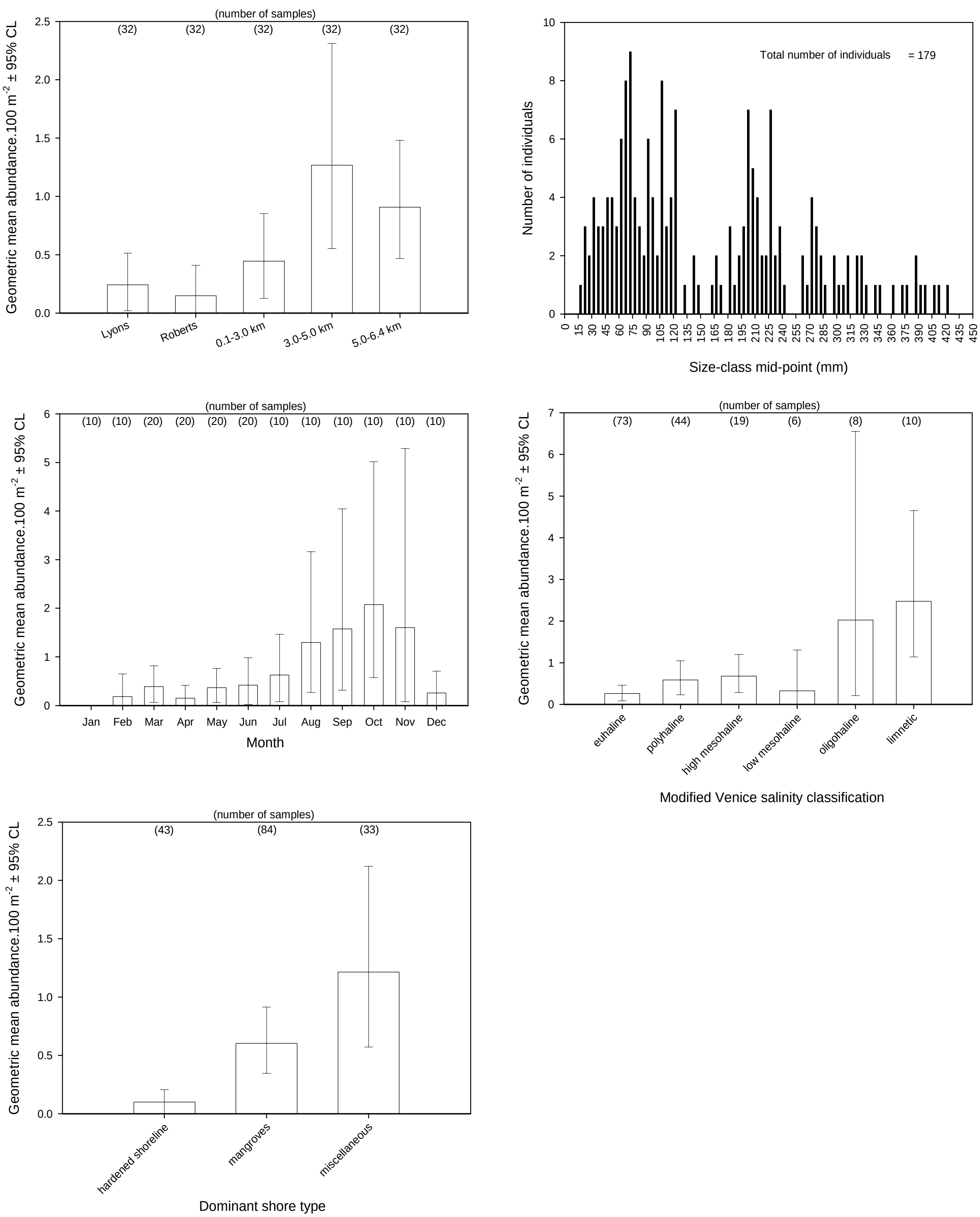


Fig. D9. Relative abundance of Common snook in shoreline (seined) habitats.

Lutjanus synagris (Lane snapper), Seines

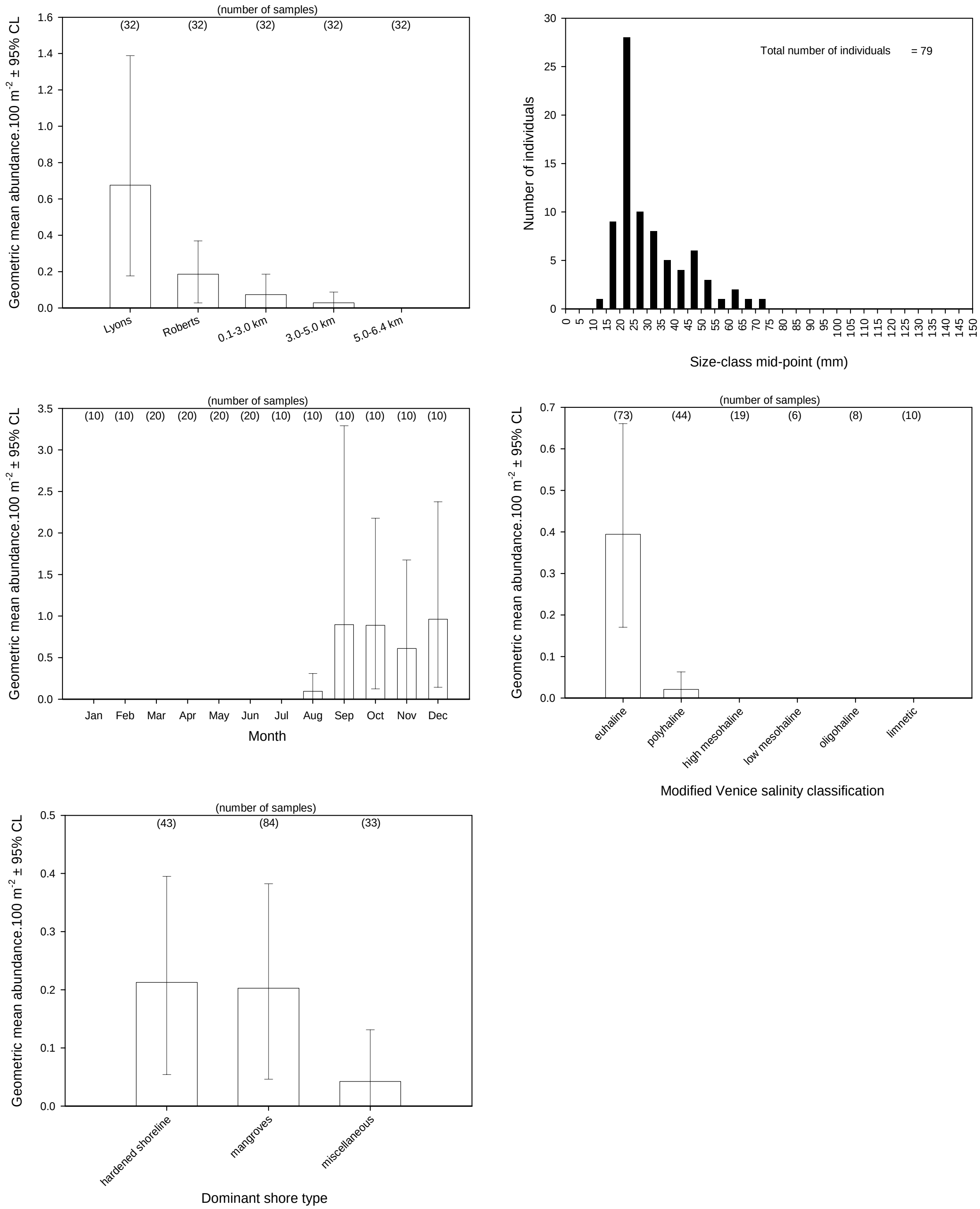


Fig. D10. Relative abundance of Lane snapper in shoreline (seined) habitats.

Eucinostomus spp. (Eucinostomus mojarras), Seines

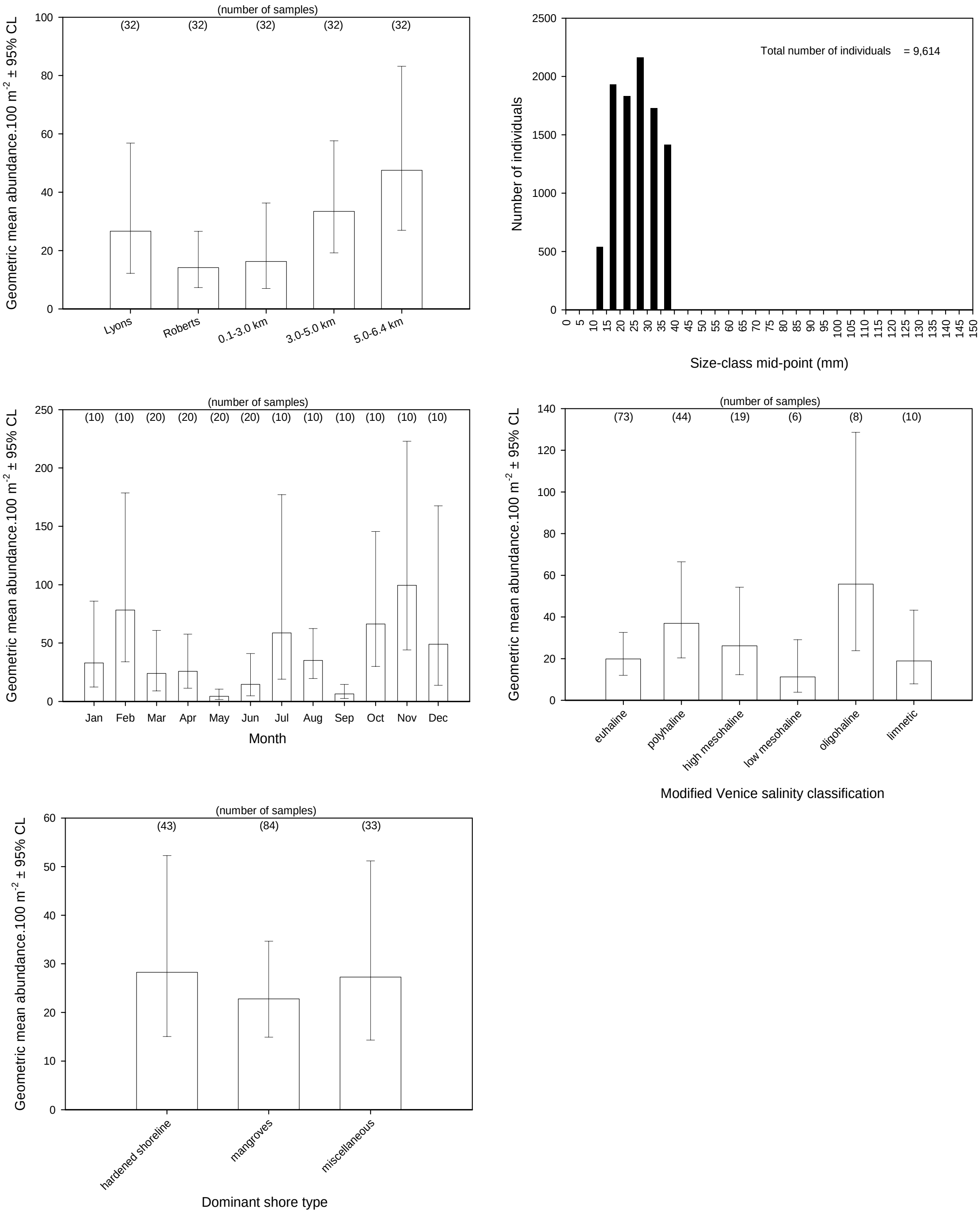


Fig. D11. Relative abundance of Eucinostomus mojarras in shoreline (seined) habitats.

Eucinostomus gula **(Silver jenny), Seines**

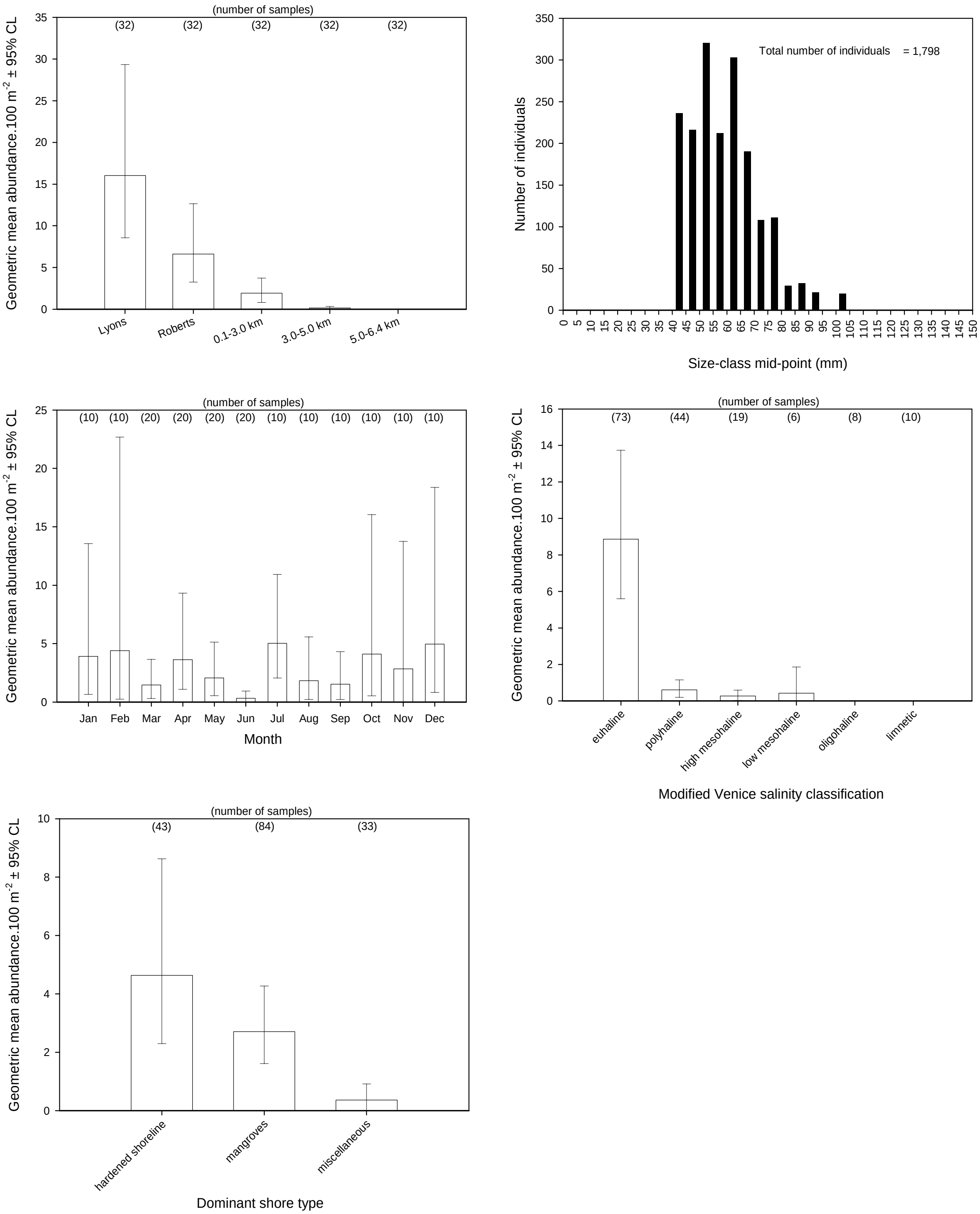


Fig. D12. Relative abundance of Silver jenny in shoreline (seined) habitats.

Eucinostomus harengulus (Tidewater mojarra), Seines

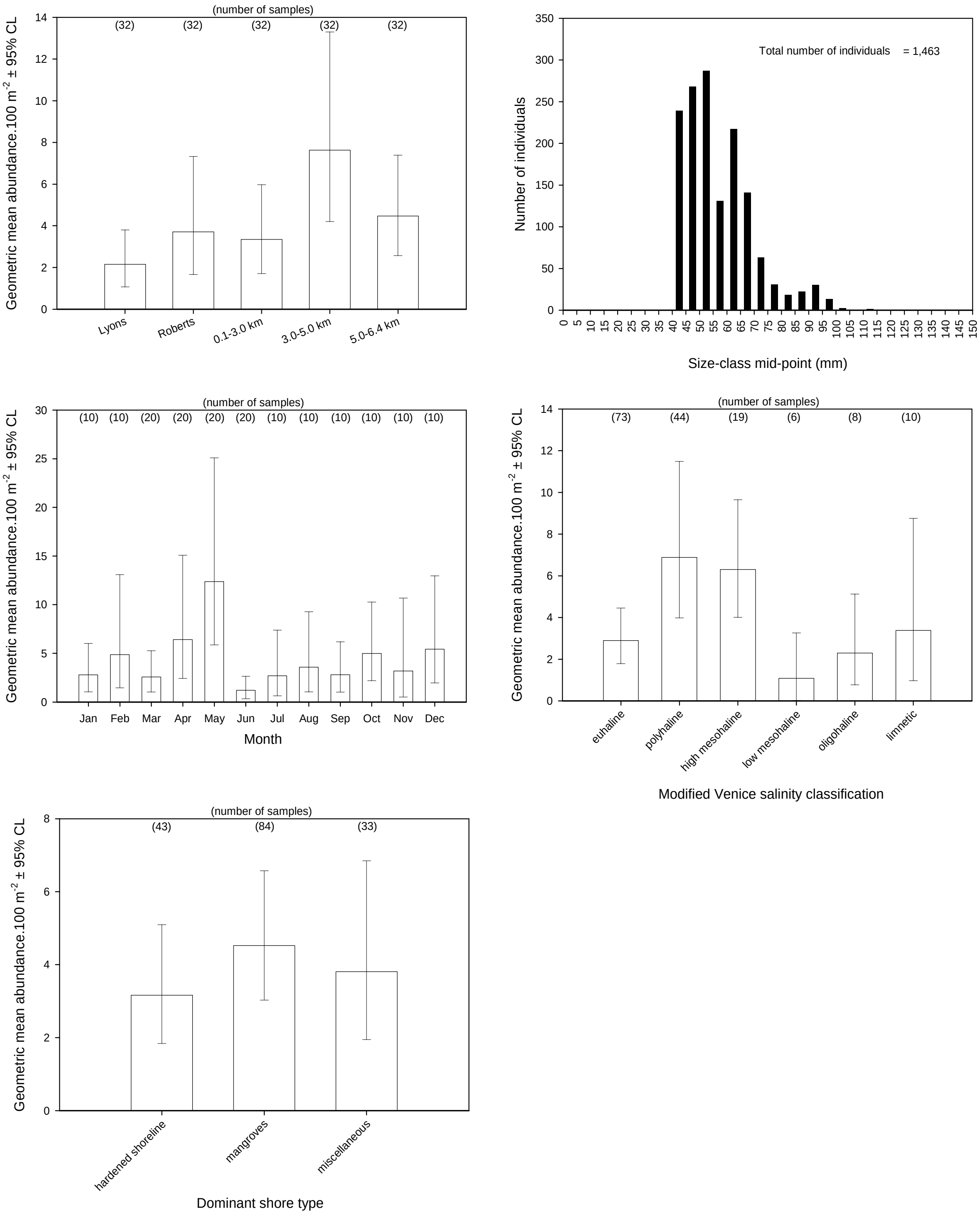


Fig. D13. Relative abundance of Tidewater mojarra in shoreline (seined) habitats.

Eugerres plumieri **(Striped mojarra), Seines**

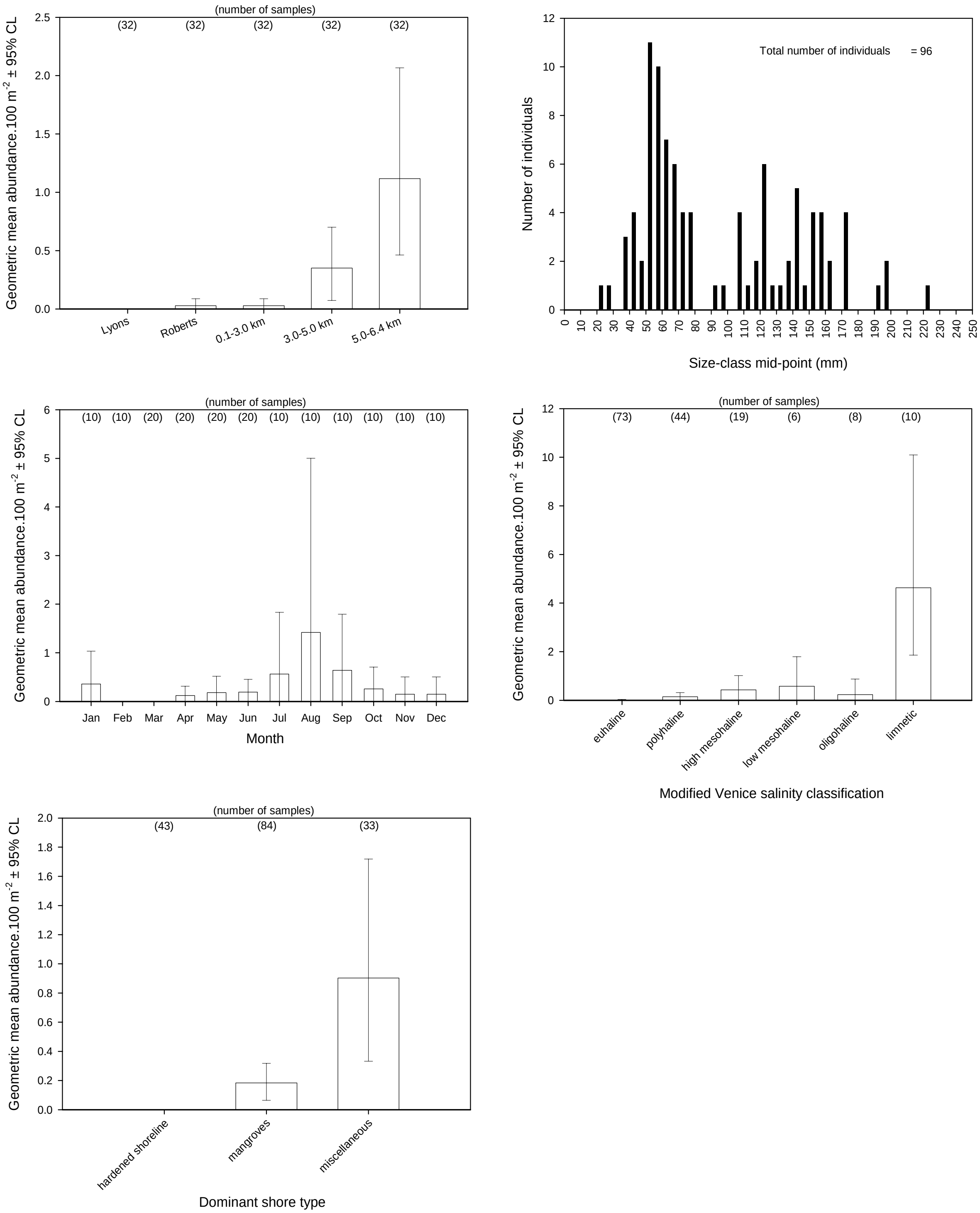


Fig. D14. Relative abundance of Striped mojarra in shoreline (seined) habitats.

Lagodon rhomboides (Pinfish), Seines

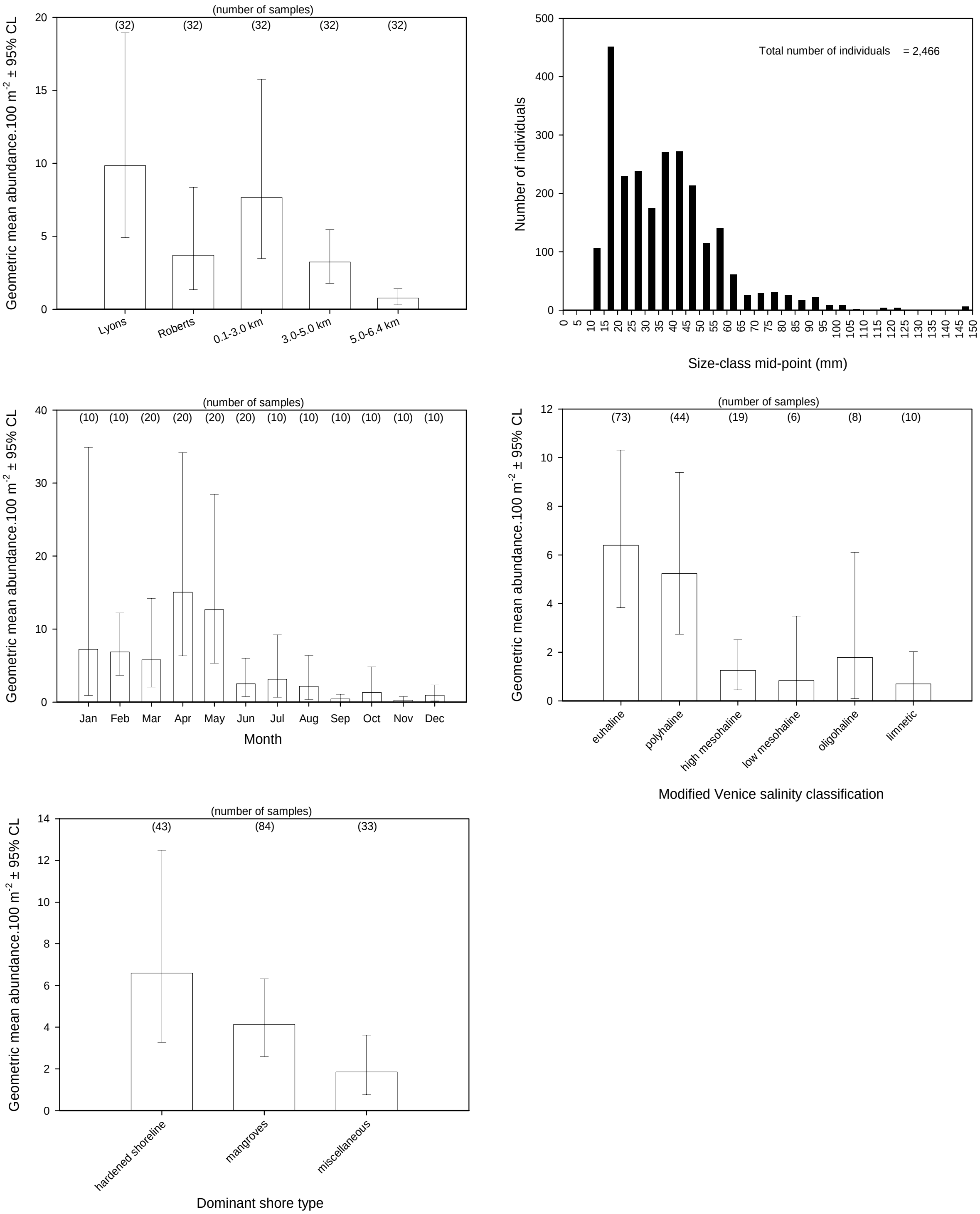


Fig. D15. Relative abundance of Pinfish in shoreline (seined) habitats.

Leiostomus xanthurus (Spot), Seines

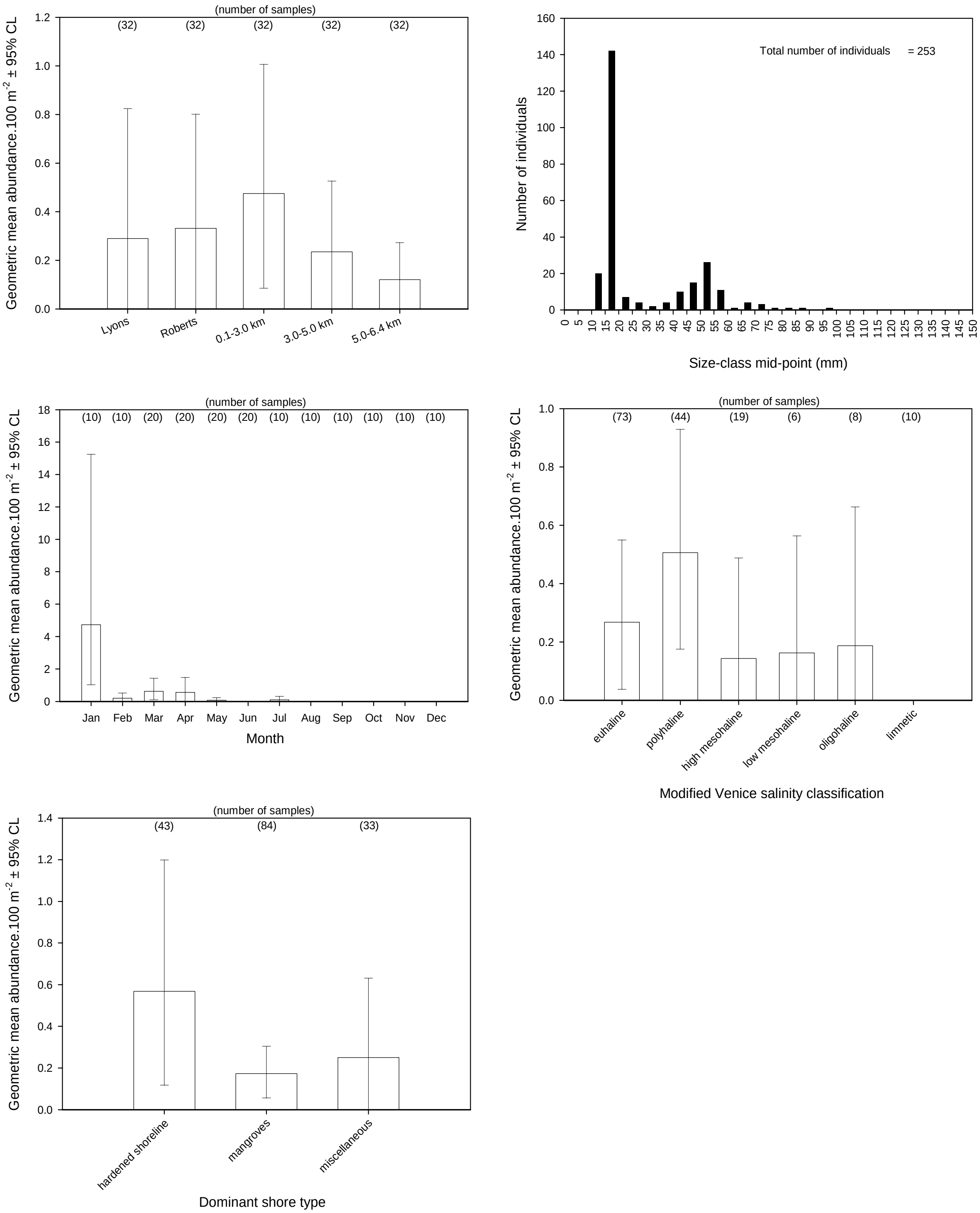
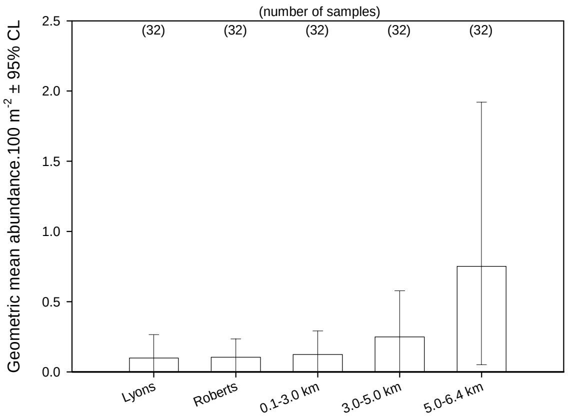
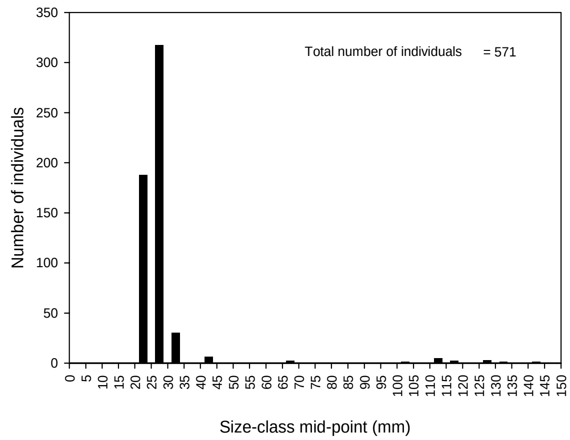
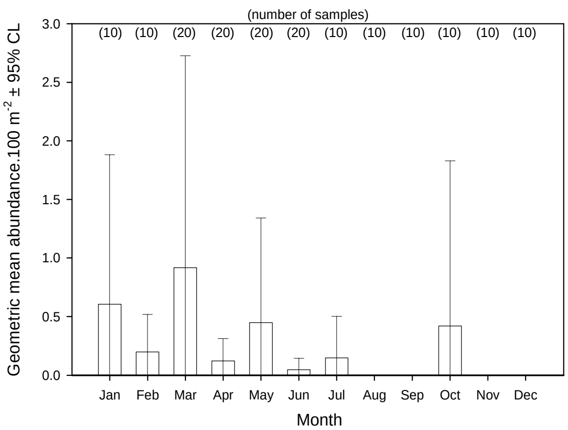


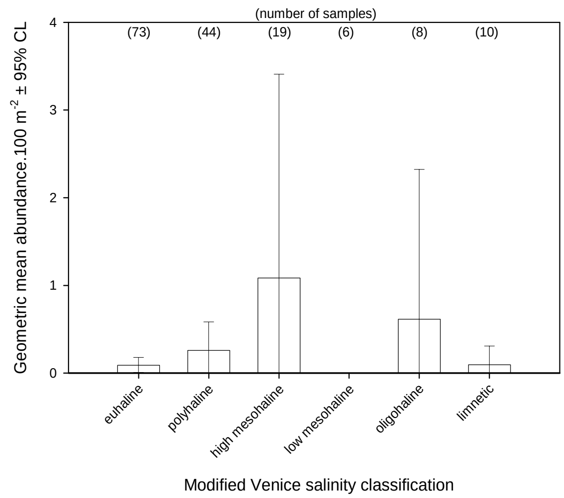
Fig. D16. Relative abundance of Spot in shoreline (seined) habitats.

Mugil cephalus (Striped mullet), Seines









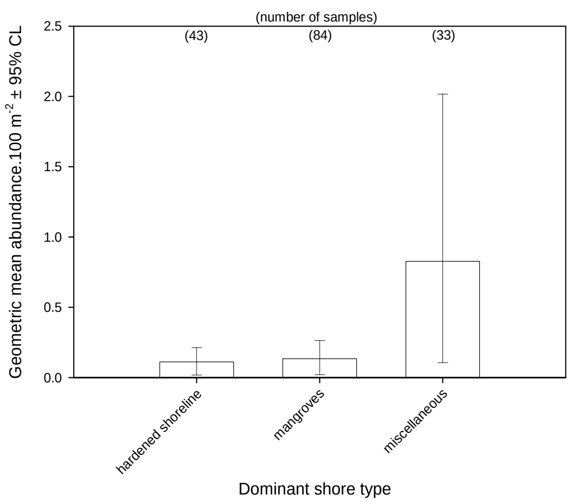


Fig. D17. Relative abundance of Striped mullet in shoreline (seined) habitats.

Gobiosoma spp. (Gobiosoma gobies), Seines

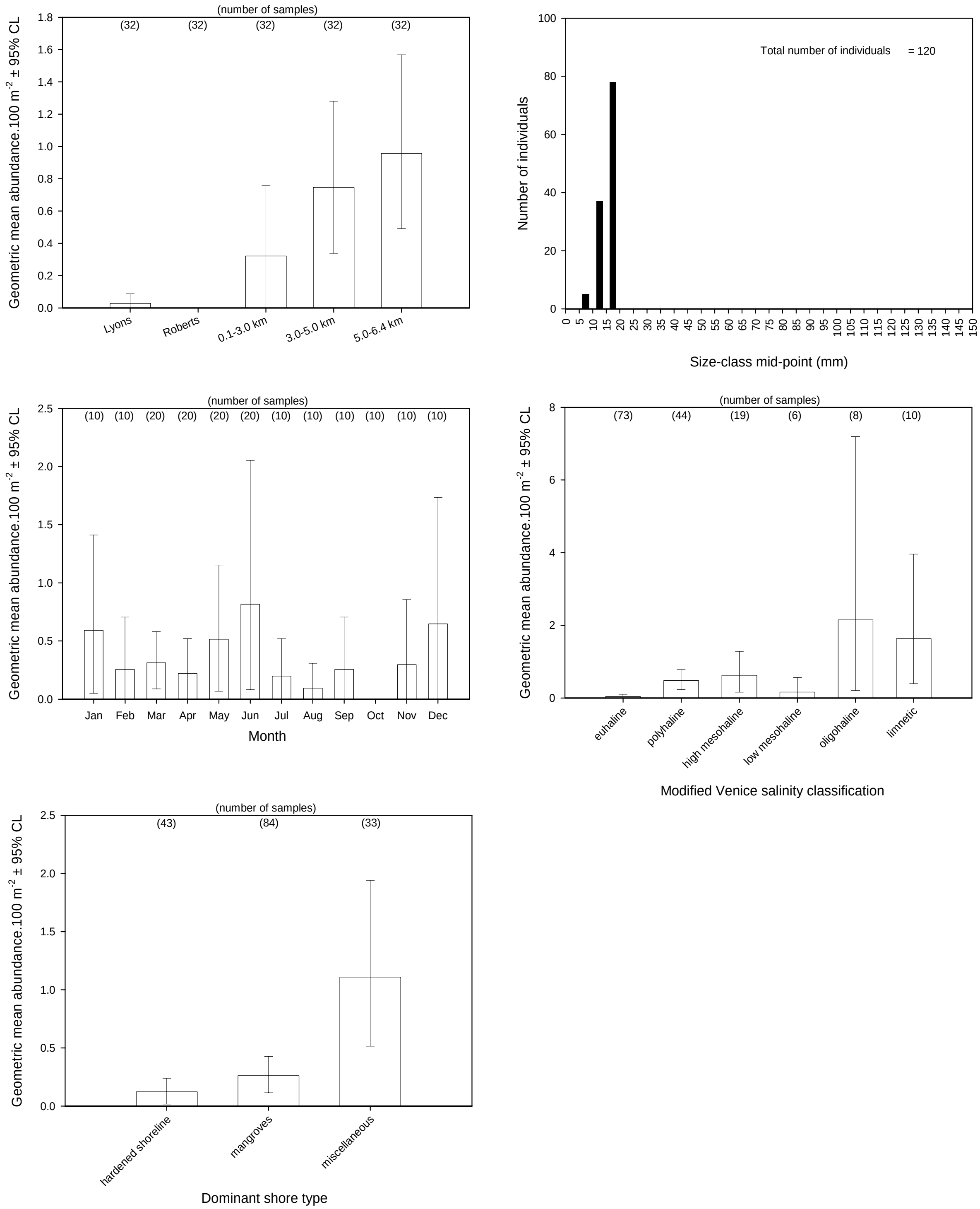


Fig. D18. Relative abundance of Gobiosoma gobies in shoreline (seined) habitats.

Microgobius gulosus (Clown goby), Seines

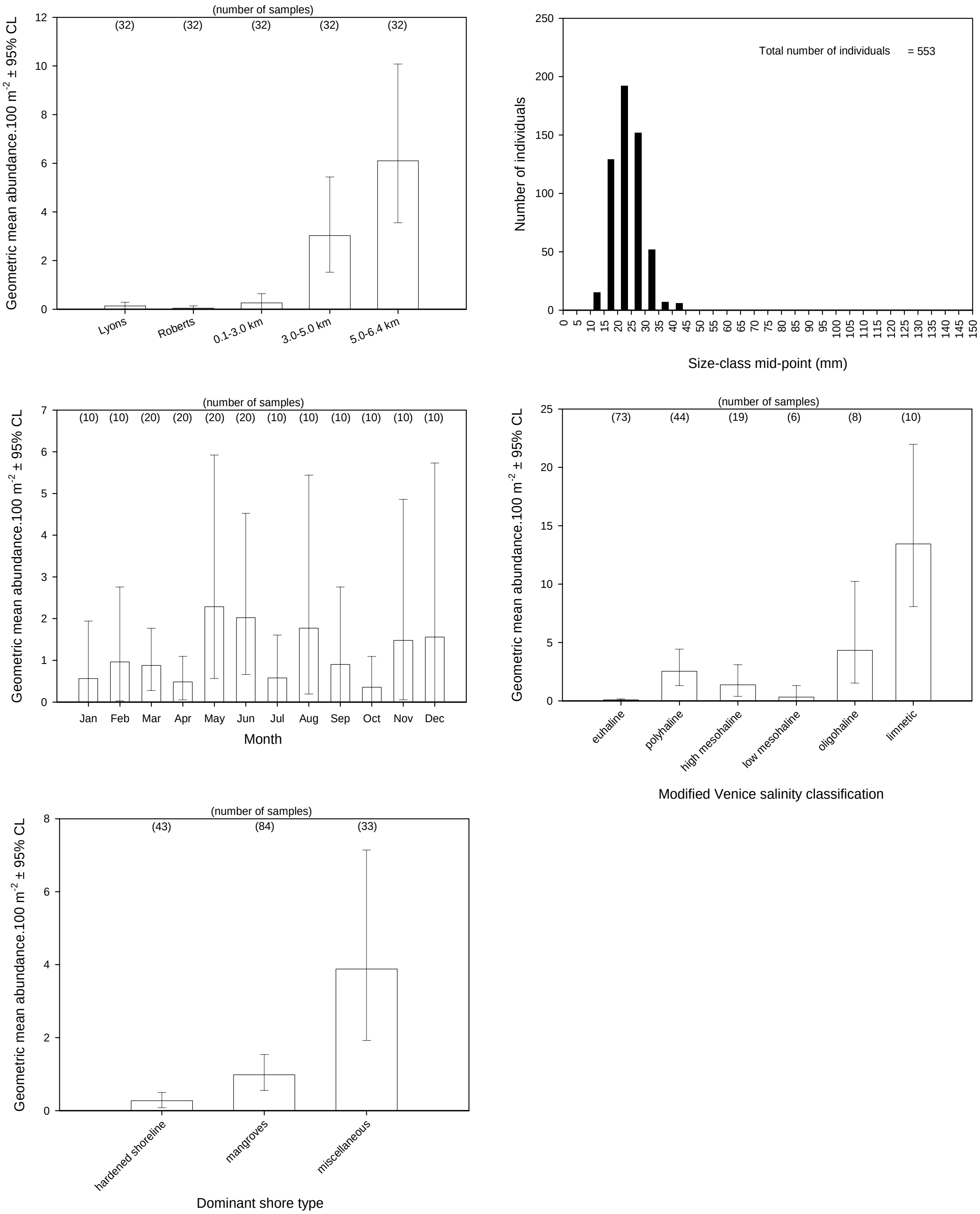


Fig. D19. Relative abundance of Clown goby in shoreline (seined) habitats.

Trinectes maculatus (Hogchoker), Seines

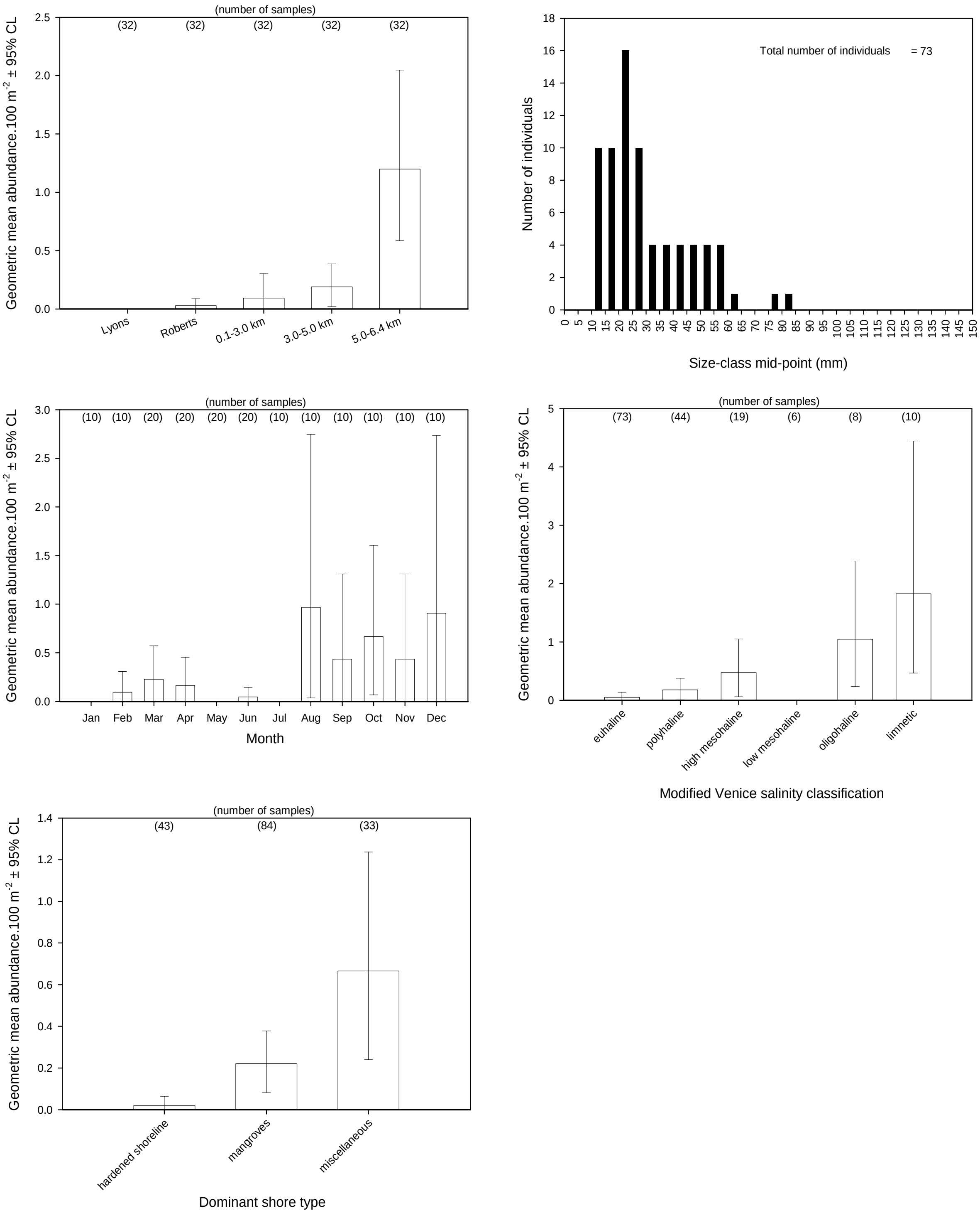


Fig. D20. Relative abundance of Hogchoker in shoreline (seined) habitats.

Appendix E:

Trawl catch overview plots

Farfantepenaeus duorarum (Pink shrimp), Trawls

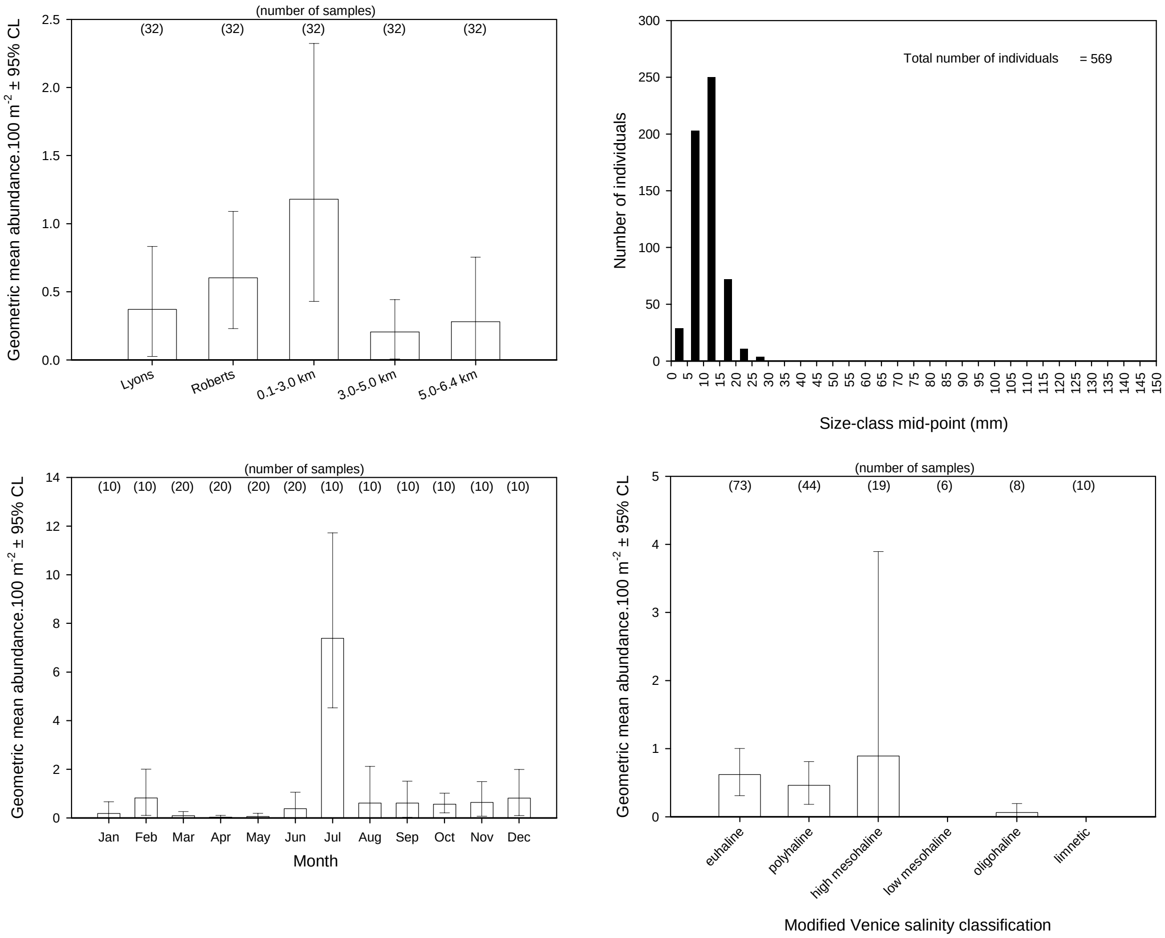


Fig. E1. Relative abundance of Pink shrimp in channel (trawled) habitats.

Periclimenes americanus (American grass shrimp), Trawls

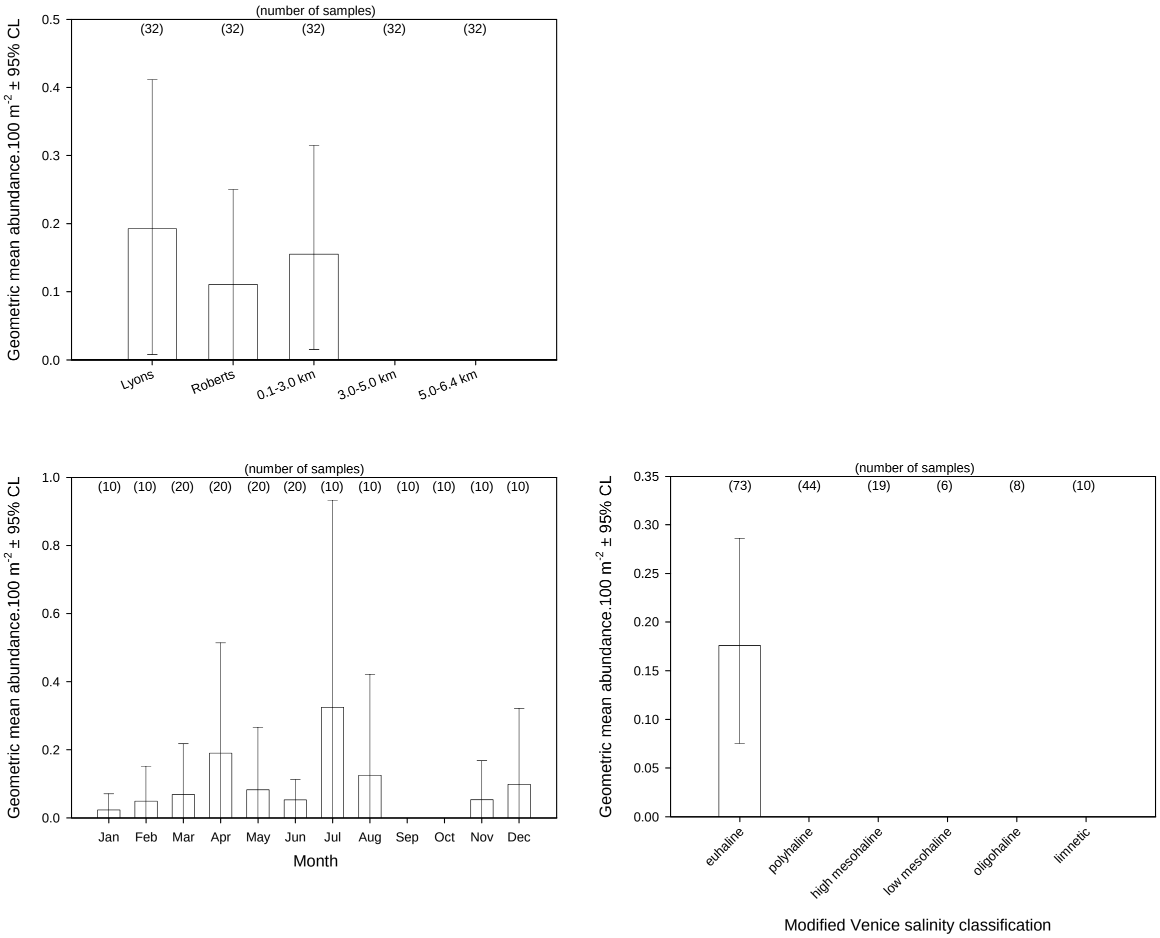


Fig. E2. Relative abundance of American grass shrimp in channel (trawled) habitats.

Periclimenes longicaudatus (Longtail grass shrimp), Trawls

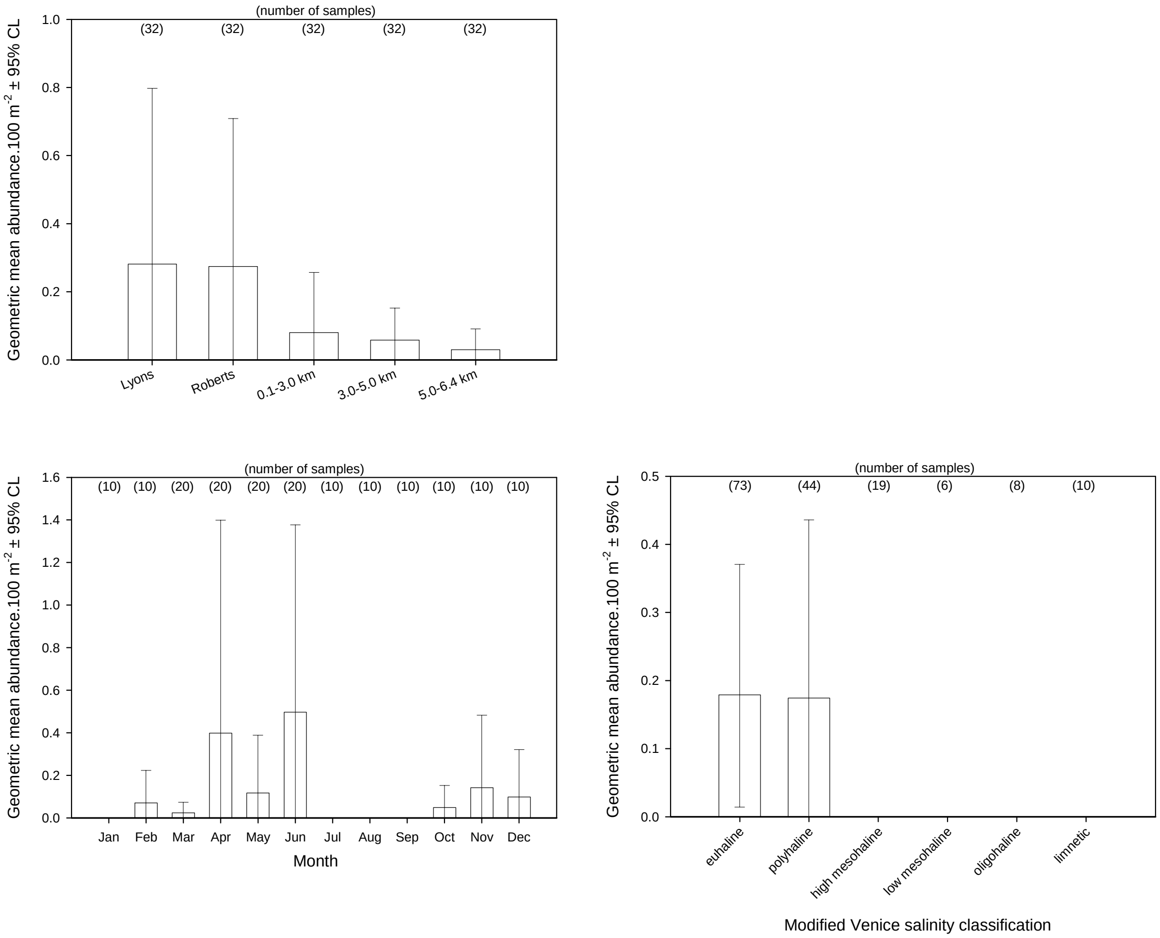


Fig. E3. Relative abundance of Longtail grass shrimp in channel (trawled) habitats.

***Callinectes sapidus* (Blue crab), Trawls**

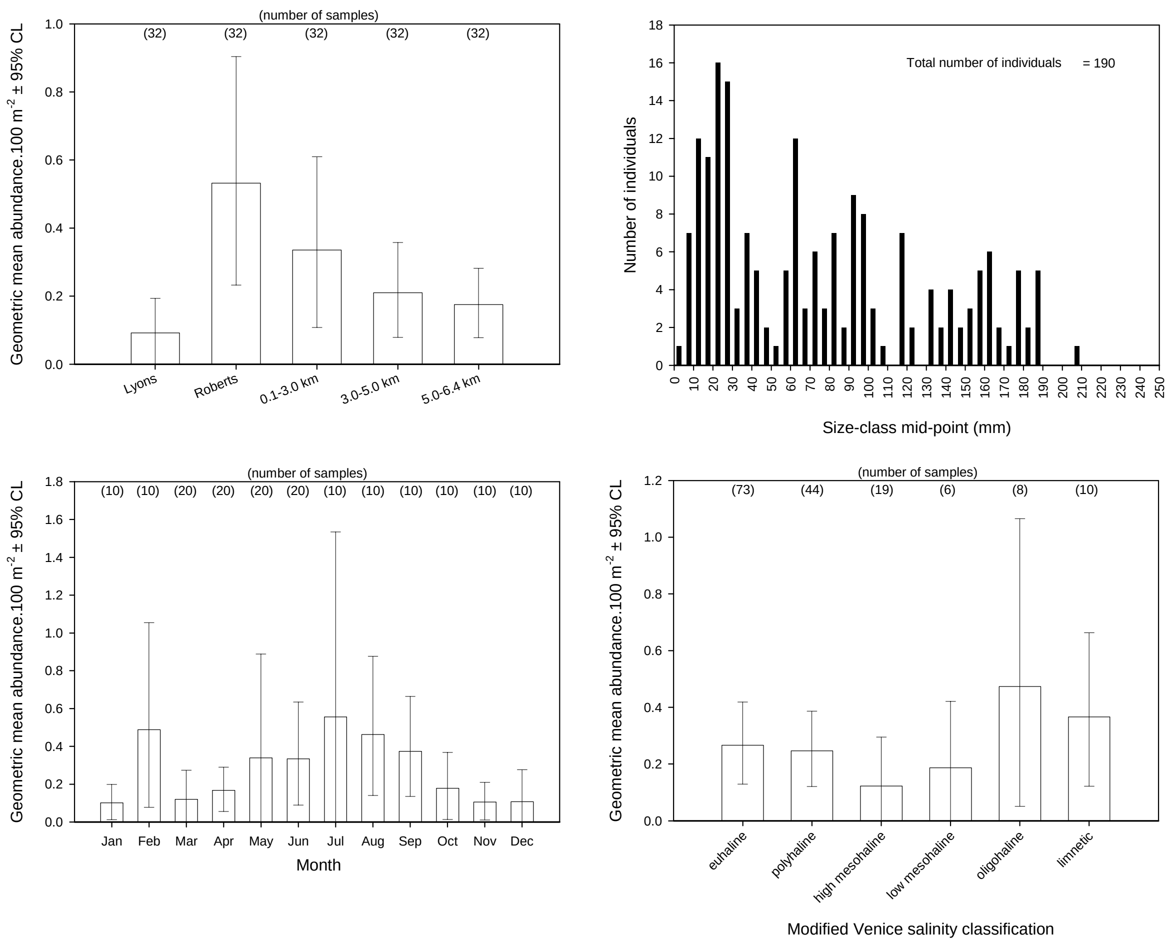


Fig. E4. Relative abundance of Blue crab in channel (trawled) habitats.

Anchoa mitchilli (Bay anchovy), Trawls

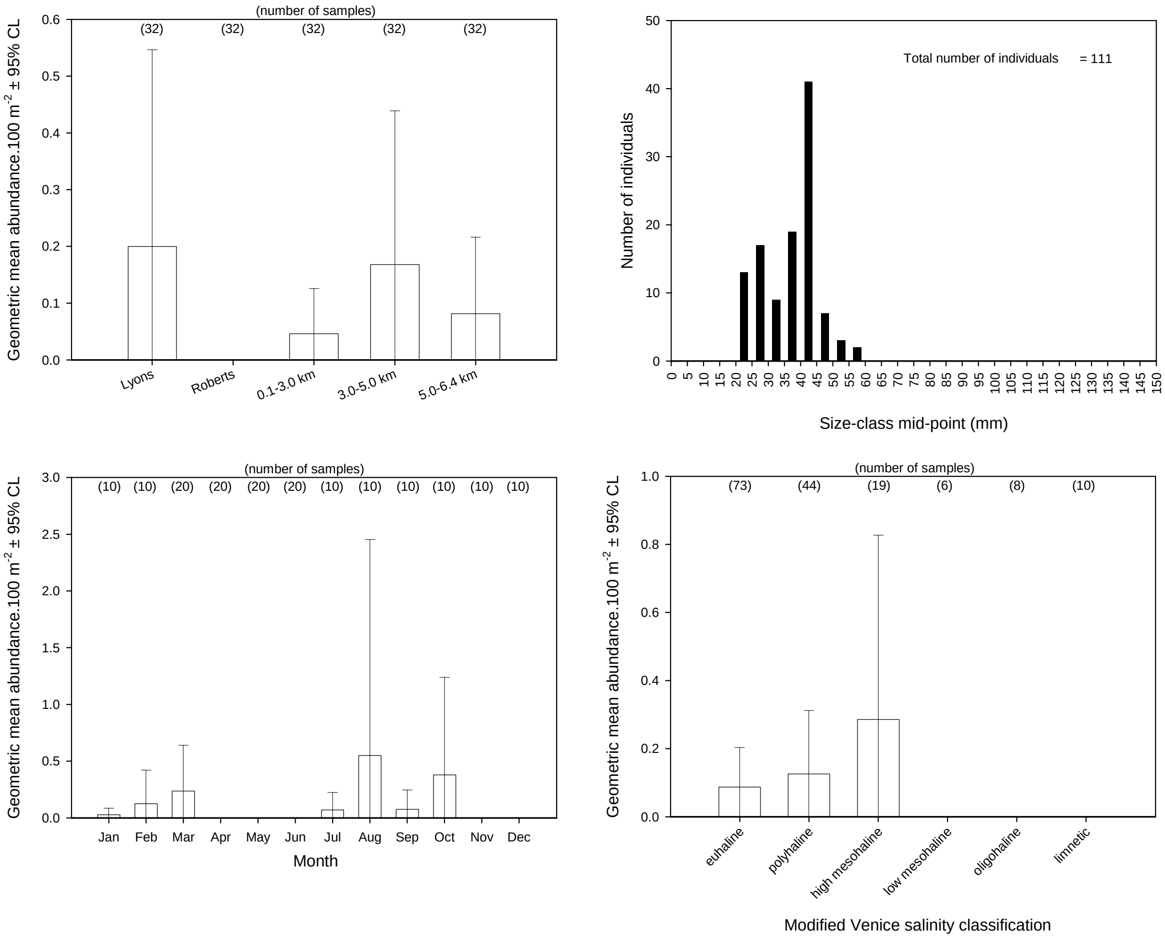


Fig. E5. Relative abundance of Bay anchovy in channel (trawled) habitats.

Synodus foetens (Inshore lizardfish), Trawls

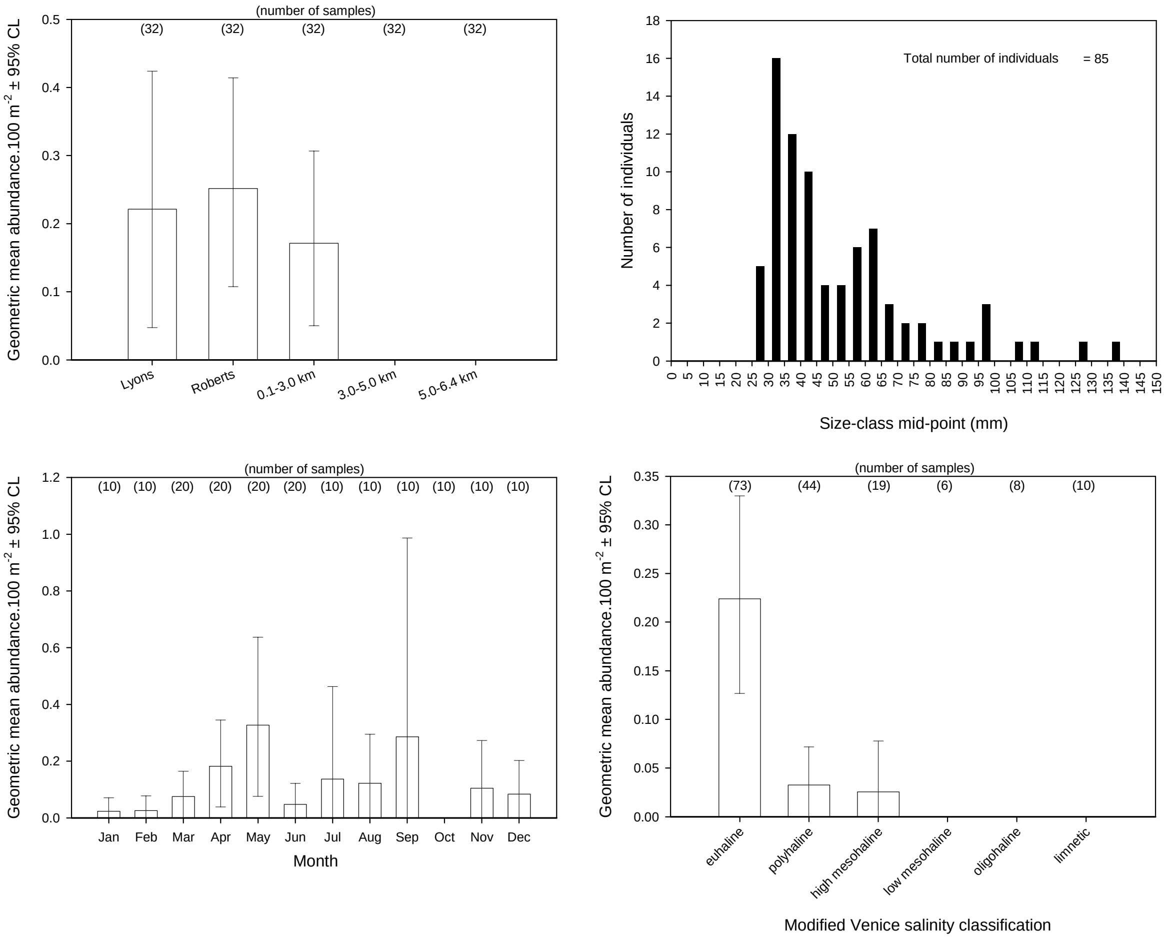


Fig. E6. Relative abundance of Inshore lizardfish in channel (trawled) habitats.

Ariopsis felis (Hardhead catfish), Trawls

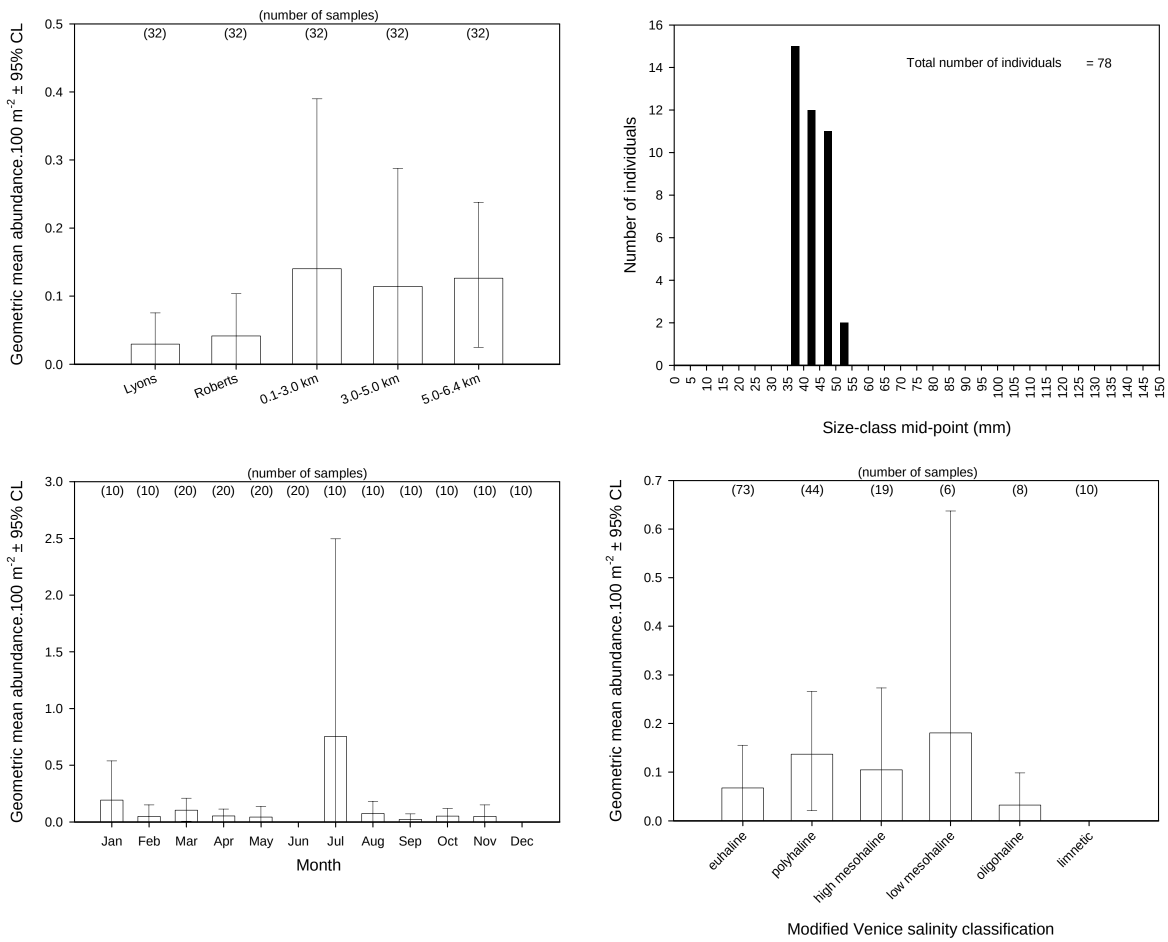


Fig. E7. Relative abundance of Hardhead catfish in channel (trawled) habitats.

Lutjanus synagris (Lane snapper), Trawls

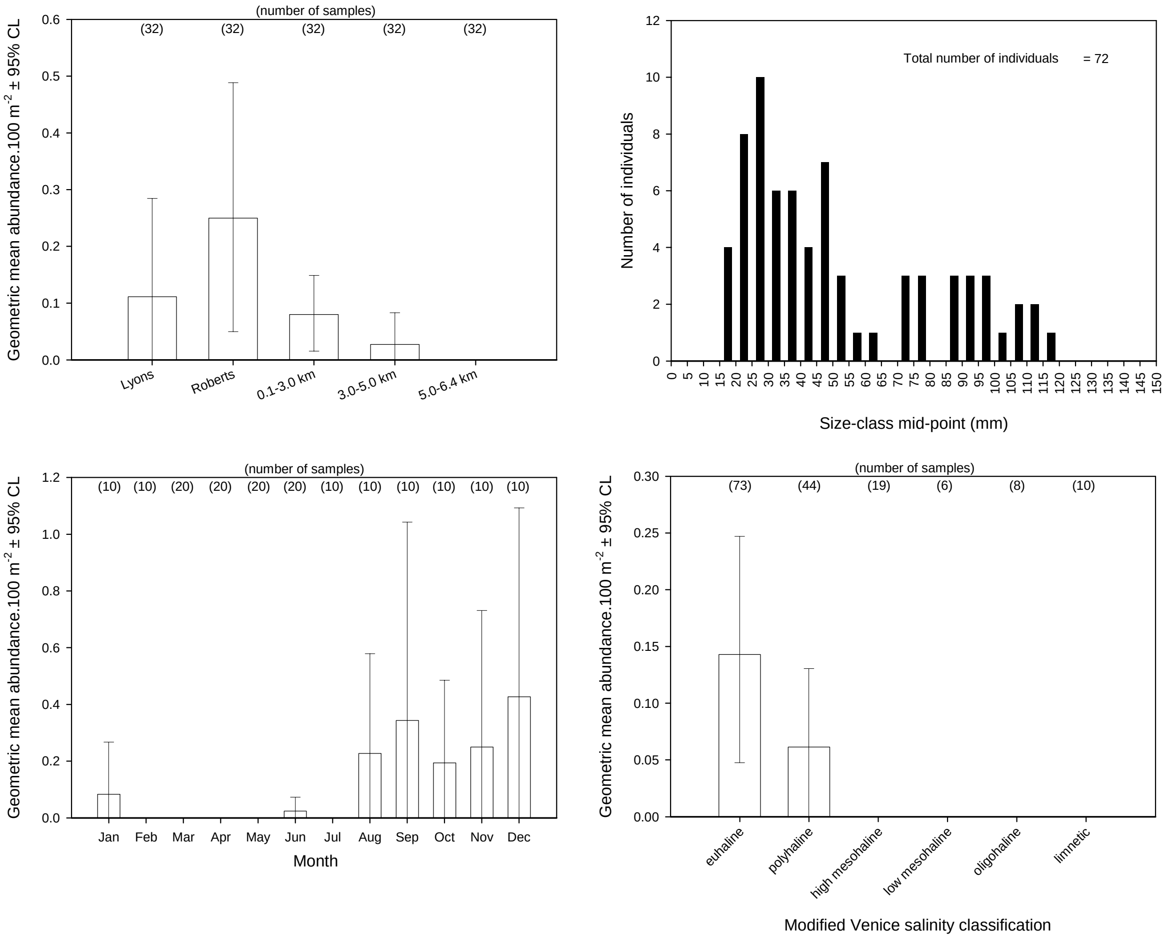


Fig. E8. Relative abundance of Lane snapper in channel (trawled) habitats.

Eucinostomus spp. (Eucinostomus mojarras), Trawls

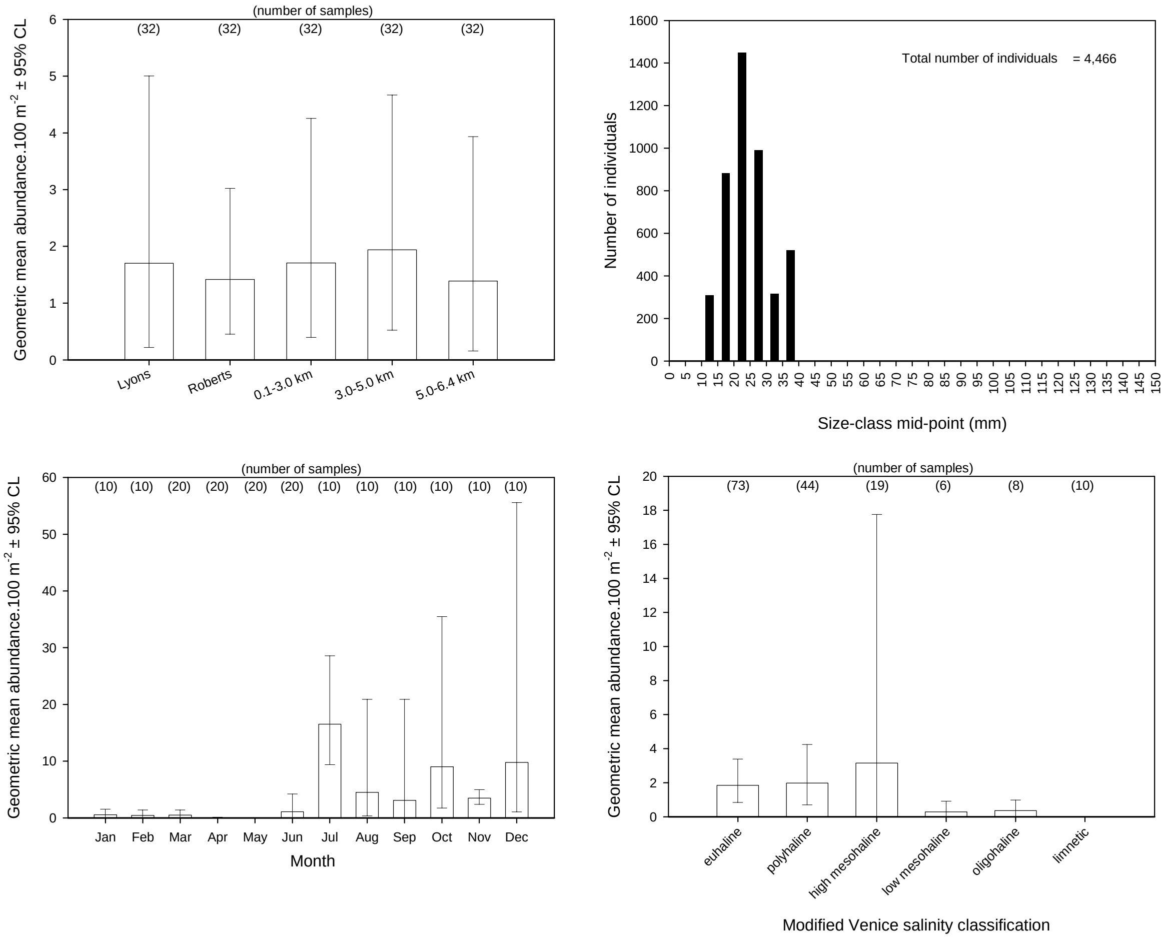


Fig. E9. Relative abundance of Eucinostomus mojarras in channel (trawled) habitats.

Eucinostomus gula **(Silver jenny), Trawls**

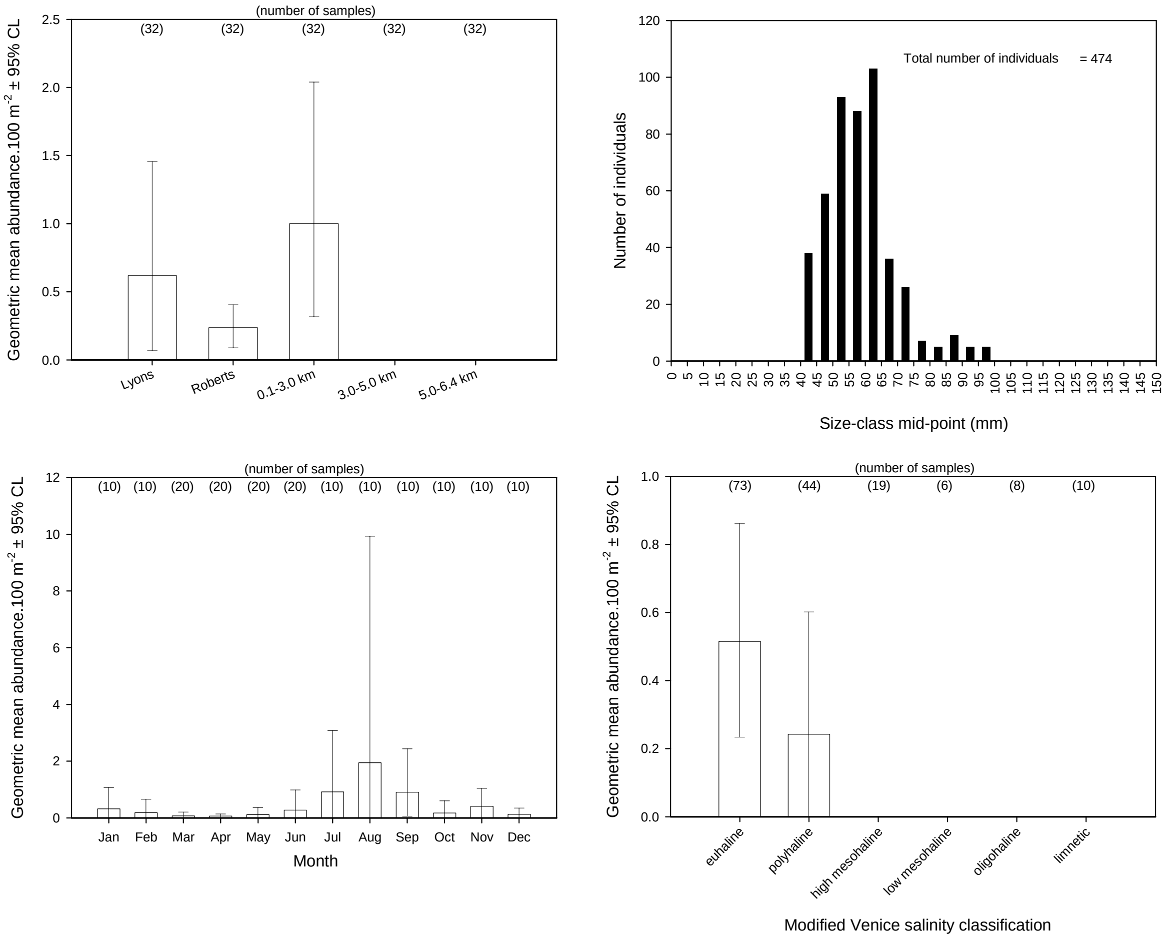


Fig. E10. Relative abundance of Silver jenny in channel (trawled) habitats.

Eucinostomus harengulus (Tidewater mojarra), Trawls

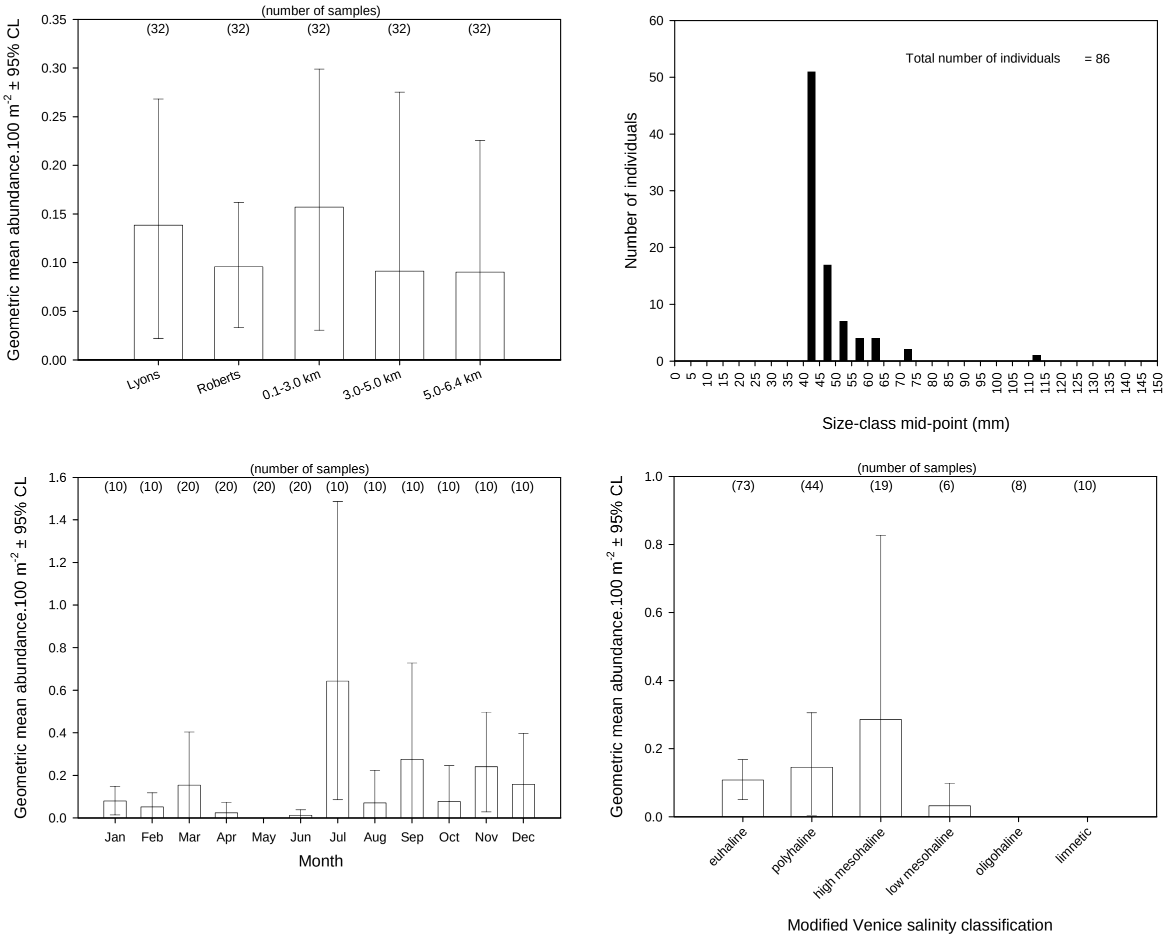


Fig. E11. Relative abundance of Tidewater mojarra in channel (trawled) habitats.

Eugerres plumieri (Striped mojarra), Trawls

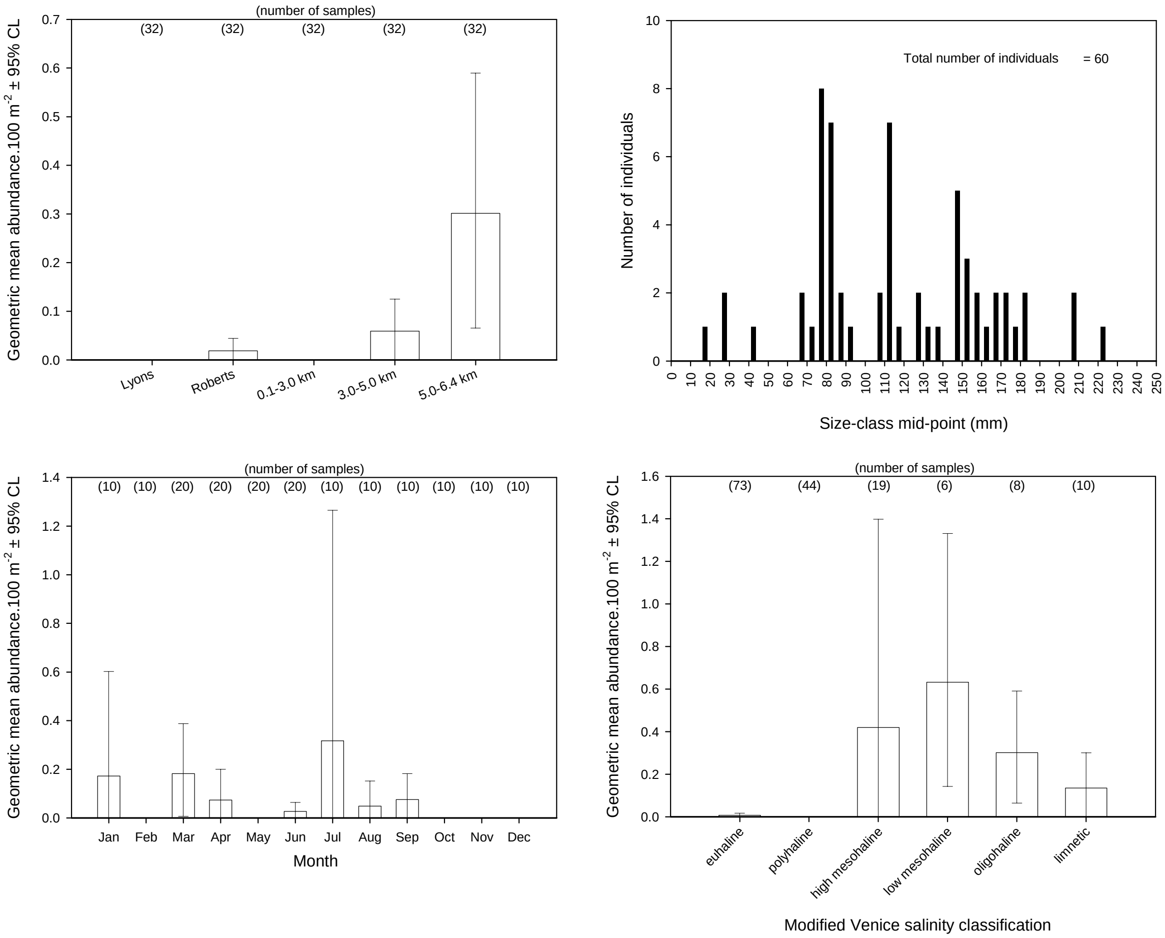


Fig. E12. Relative abundance of Striped mojarra in channel (trawled) habitats.

Lagodon rhomboides (Pinfish), Trawls

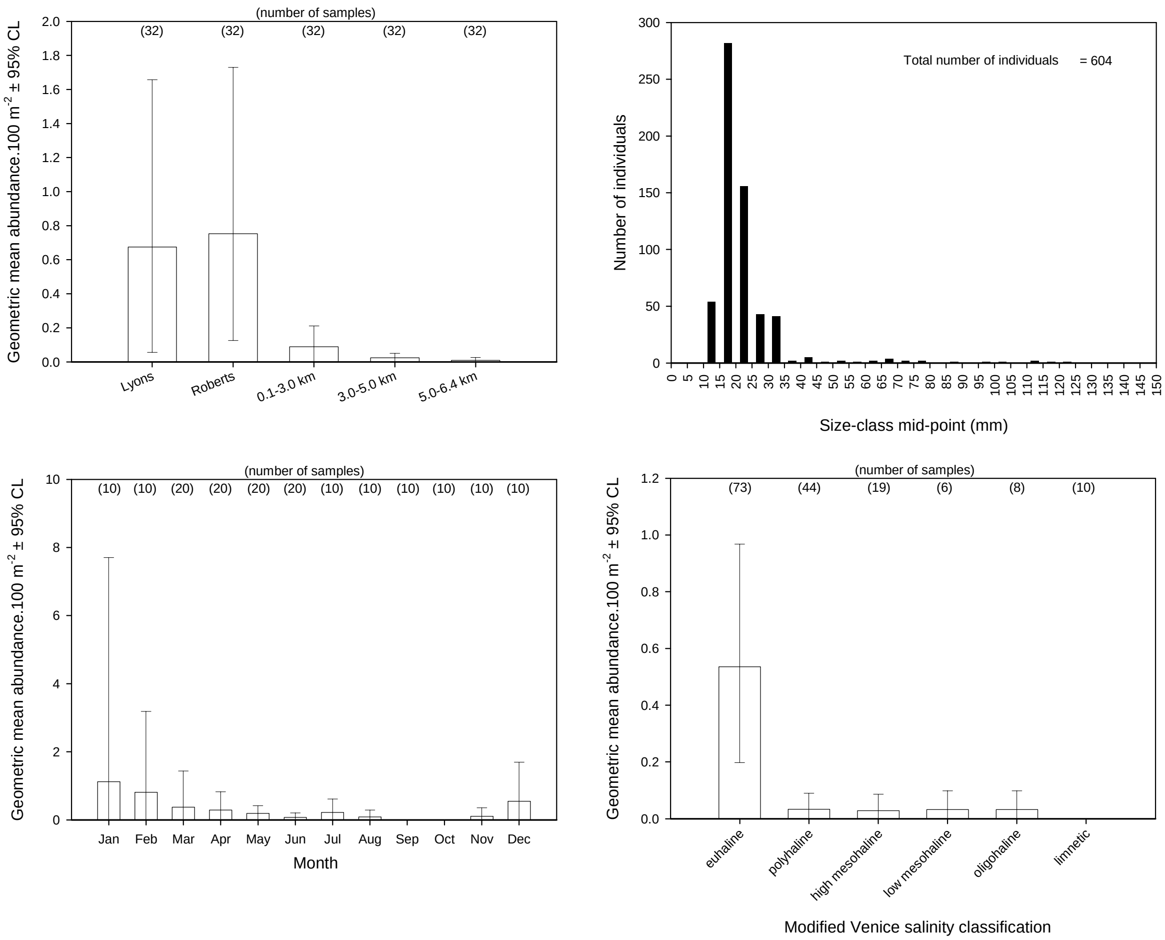


Fig. E13. Relative abundance of Pinfish in channel (trawled) habitats.

Microgobius gulosus (Clown goby), Trawls

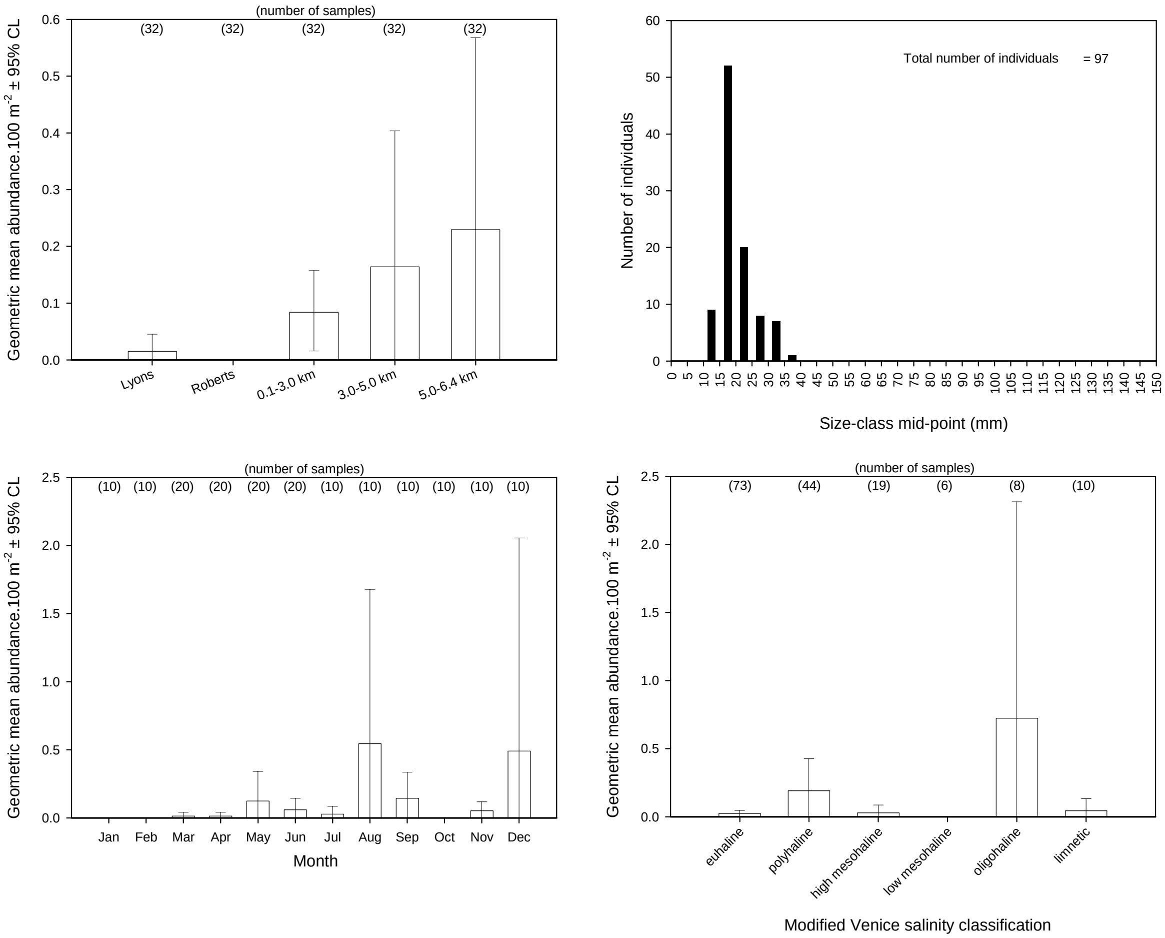


Fig. E14. Relative abundance of Clown goby in channel (trawled) habitats.

Trinectes maculatus (Hogchoker), Trawls

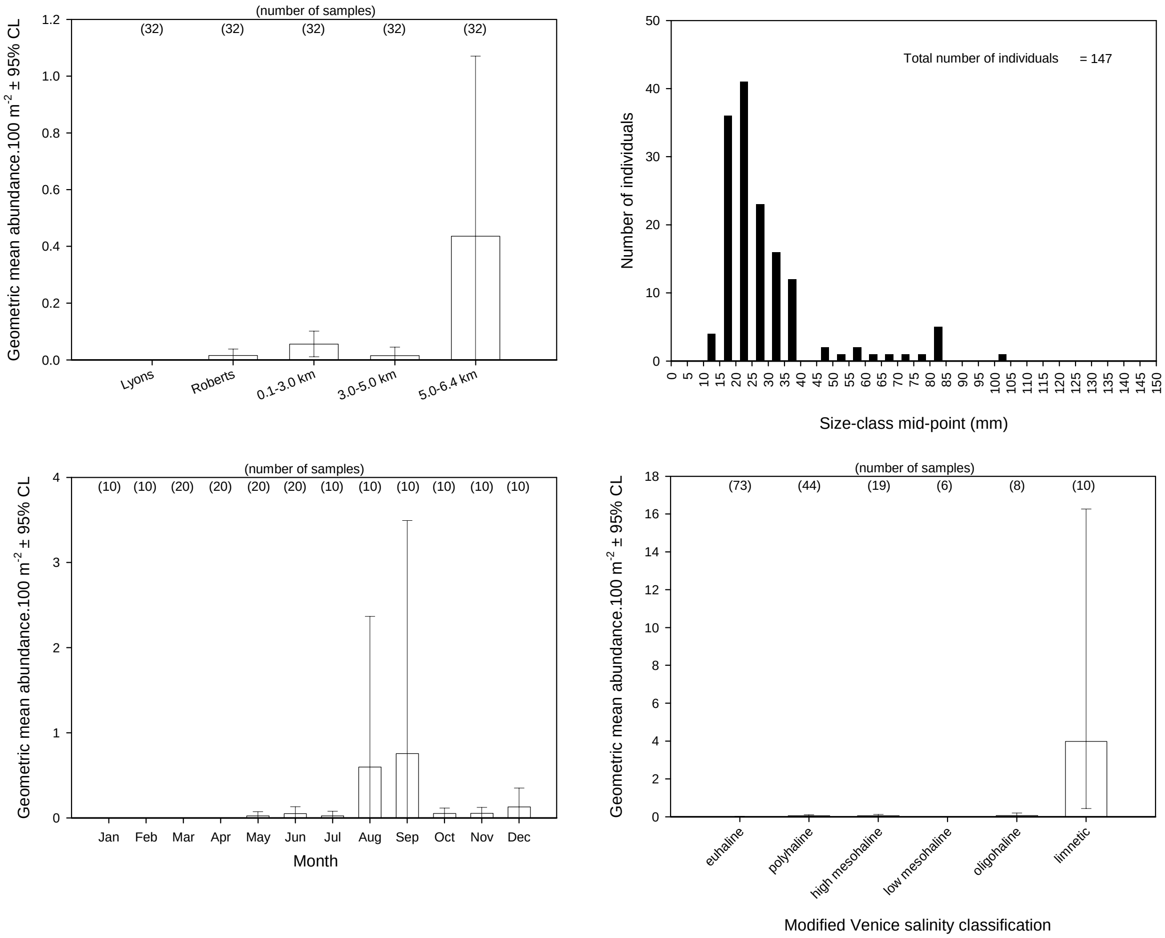
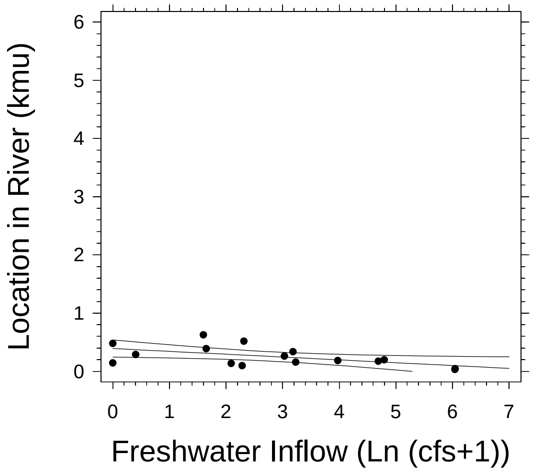


Fig. E15. Relative abundance of Hogchoker in channel (trawled) habitats.

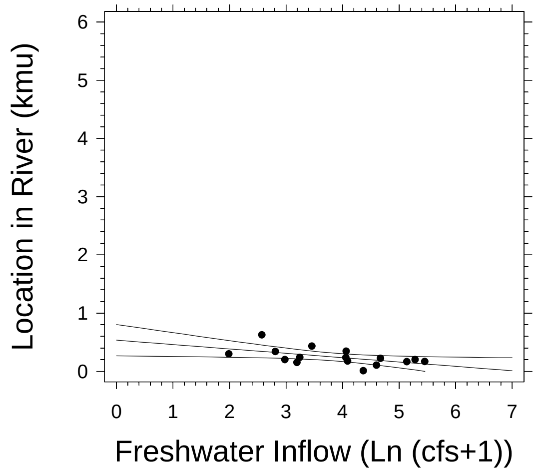
Appendix F:

Plots of the plankton-net distribution responses in Table 3.7.1.1
with 95% confidence limits for predicted means

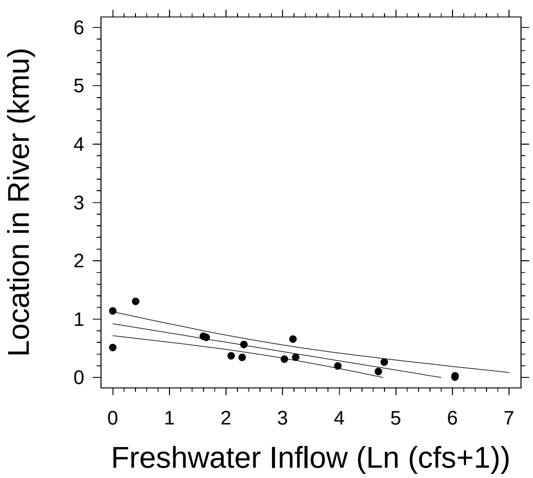
Lucifer faxoni juveniles and adults



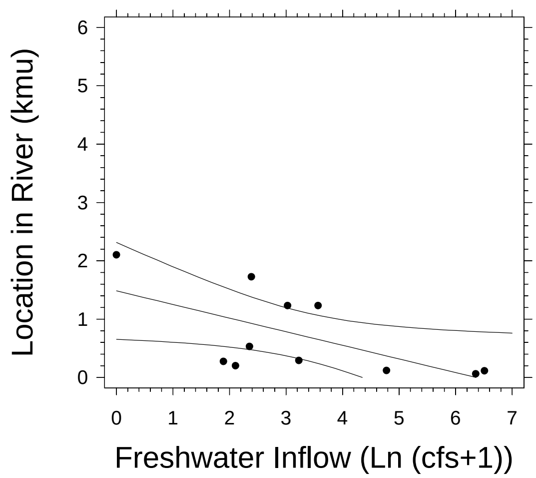
Hippolyte zostericola postlarvae



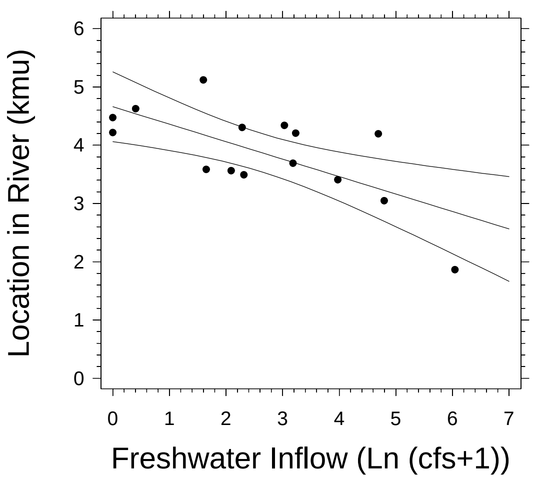
chaetognaths, sagittid



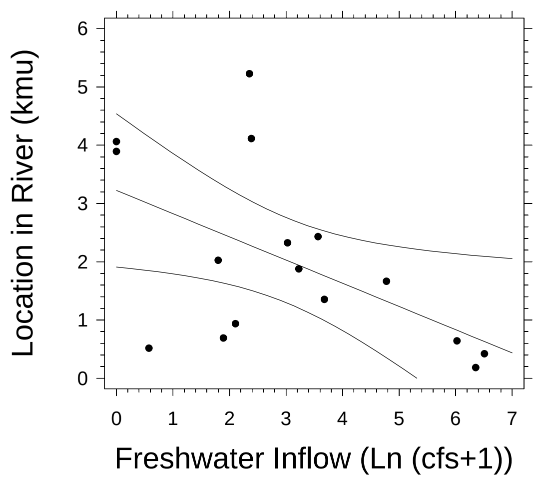
Sarsiella zostericola



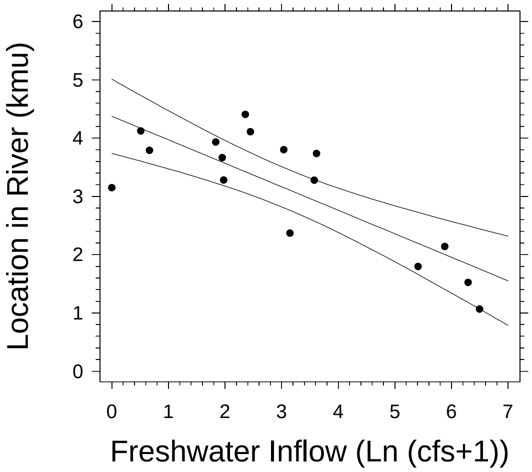
Cassidinidea ovalis



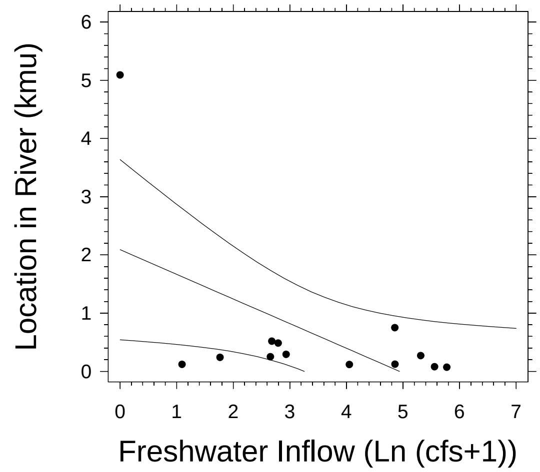
decapod mysis



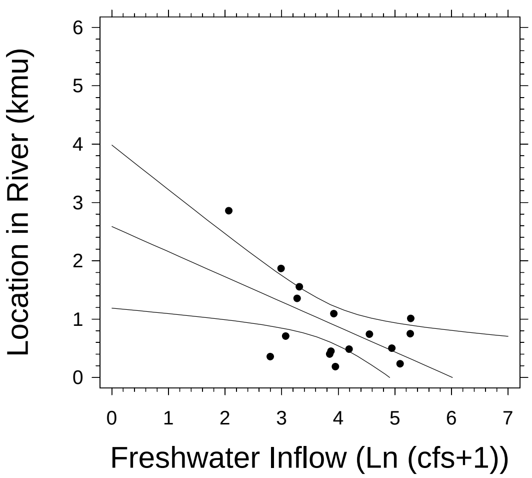
amphipods, gammaridean



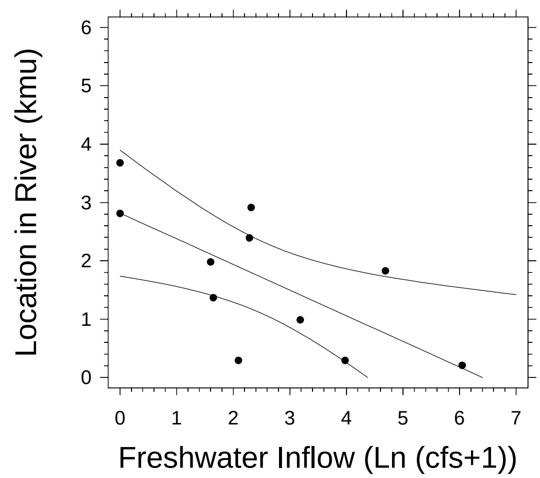
alphaeid postlarvae



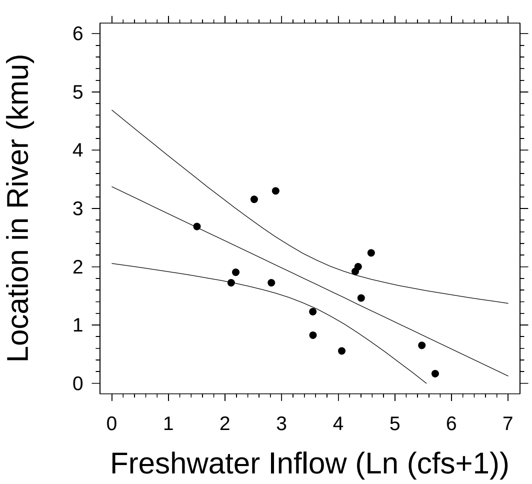
cumaceans



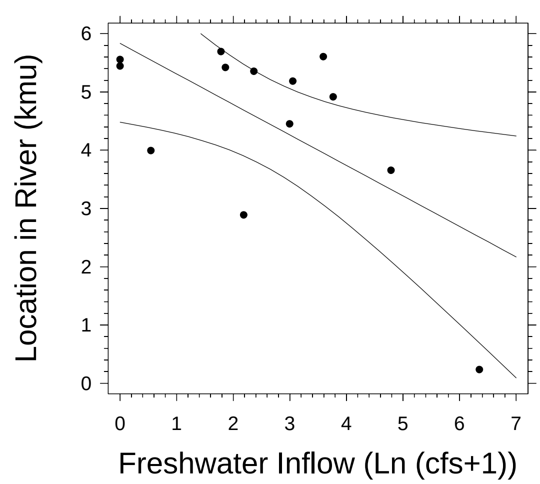
blenniid preflexion larvae



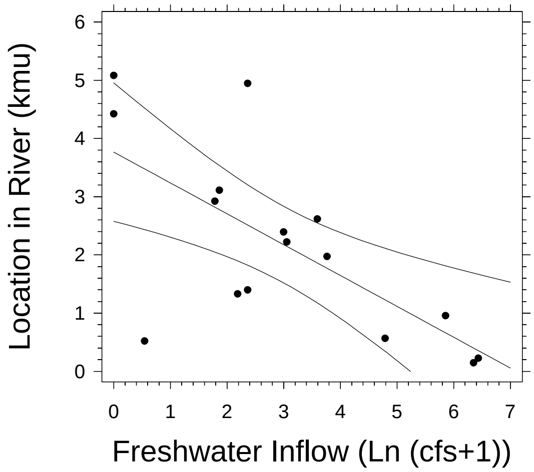
branchiurans, Argulus spp.



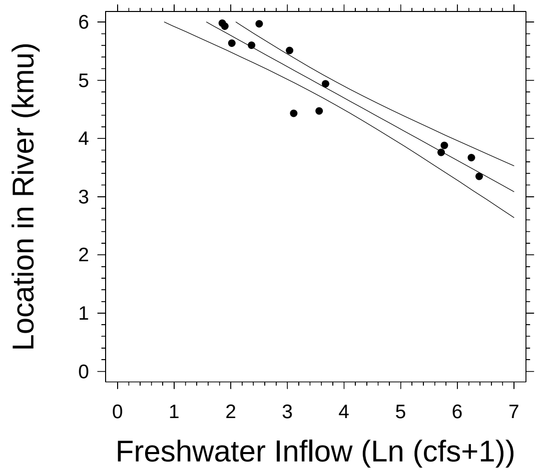
Microgobius spp. postflexion larvae



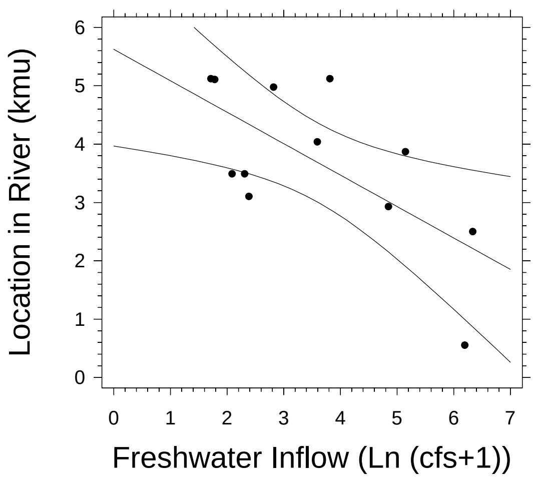
decapod zoeae



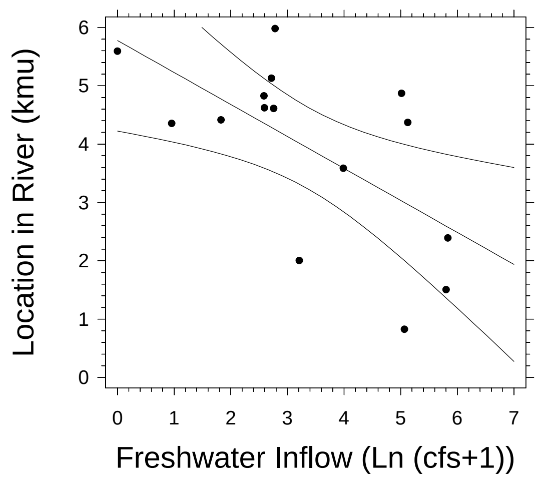
dipteran, Chaoborus punctipennis



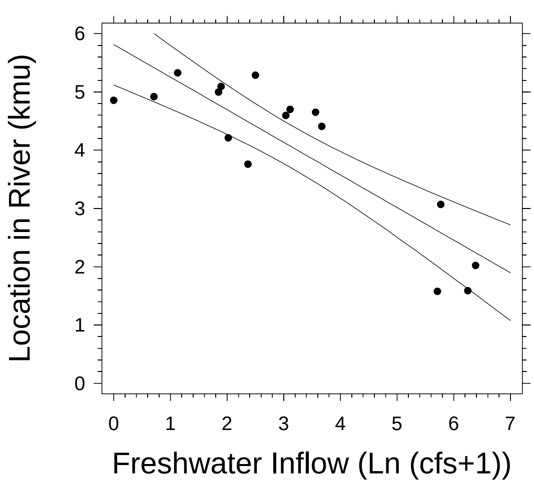
Taphromysis bowmani



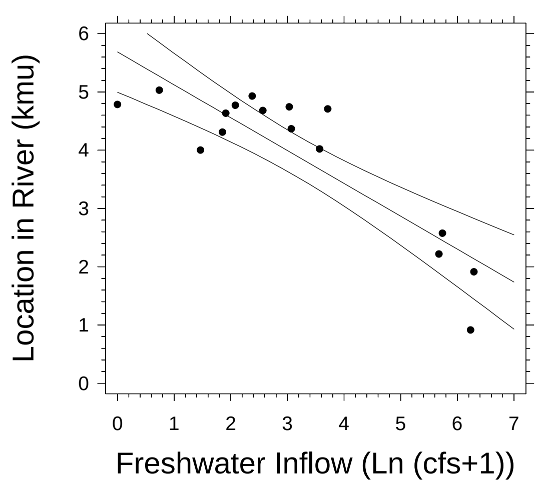
Anchoa mitchilli juveniles



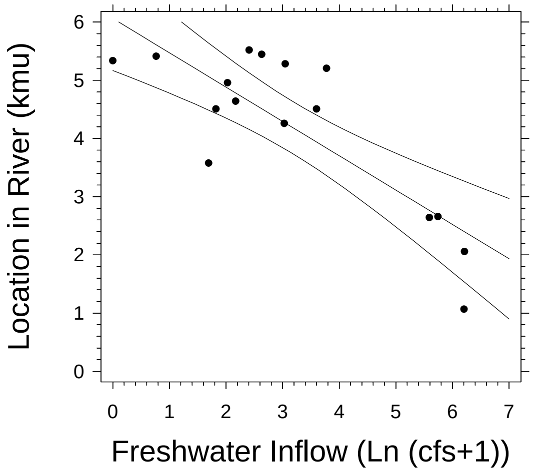
Edotea triloba



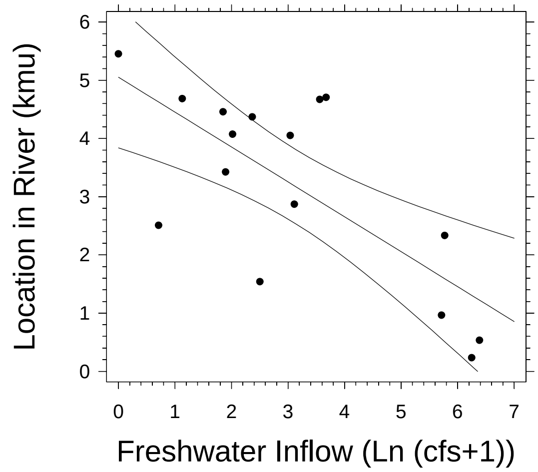
unidentified Americamysis juveniles



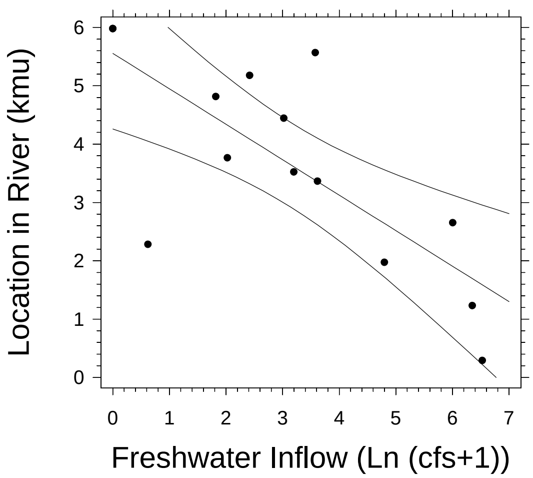
Americamysis almyra



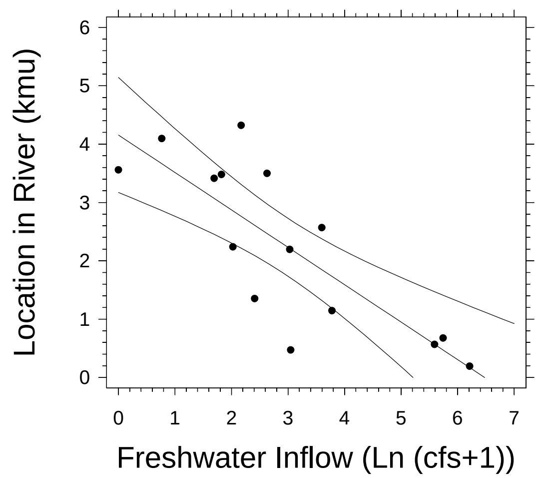
gobiid preflexion larvae



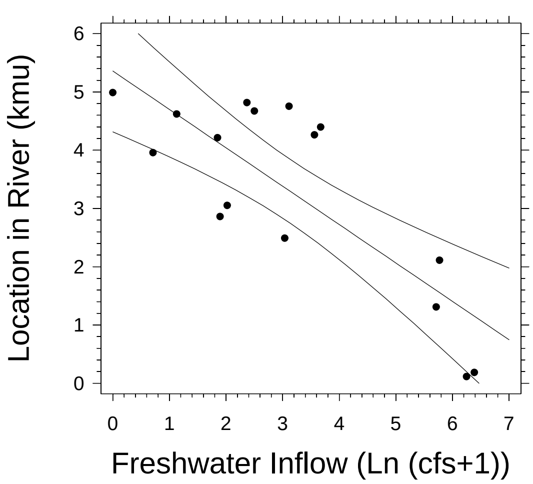
Microgobius spp. flexion larvae



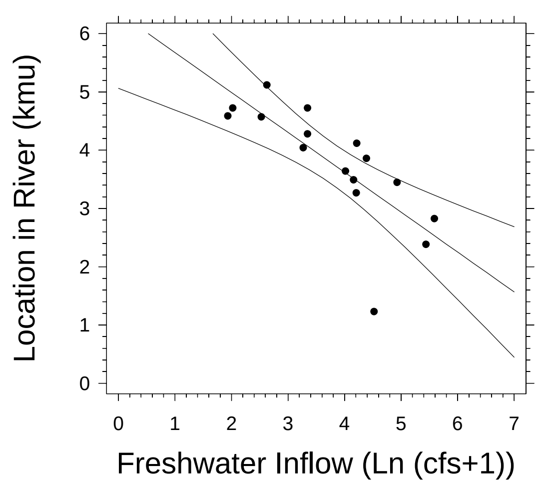
Bowmaniella dissimilis



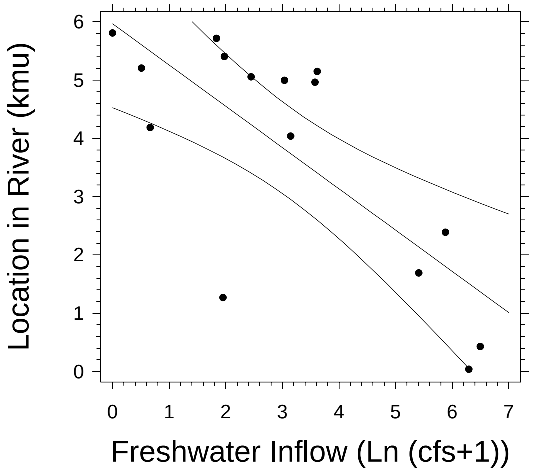
Palaemonetes spp. postlarvae



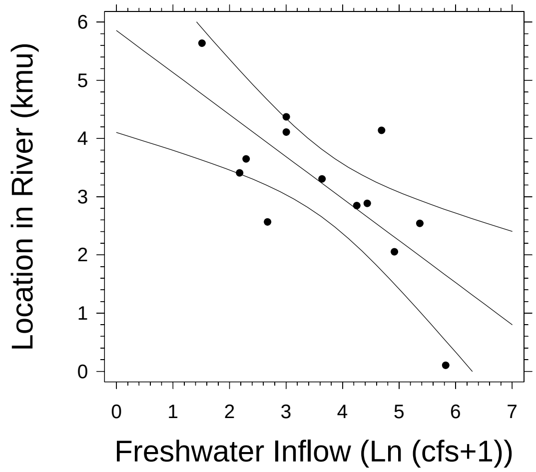
Sphaeroma terebrans



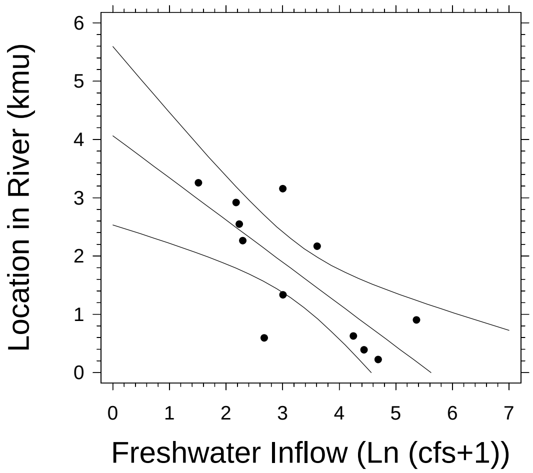
Gobiosoma spp. postflexion larvae



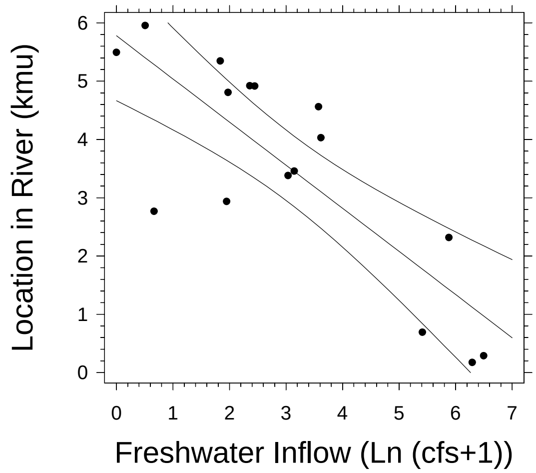
Palaemonetes pugio juveniles



cymothoid sp. a (Lironeca) juveniles



gobiid flexion larvae



Appendix G:

Plots of the seine and trawl distribution responses in Table 3.7.2.1

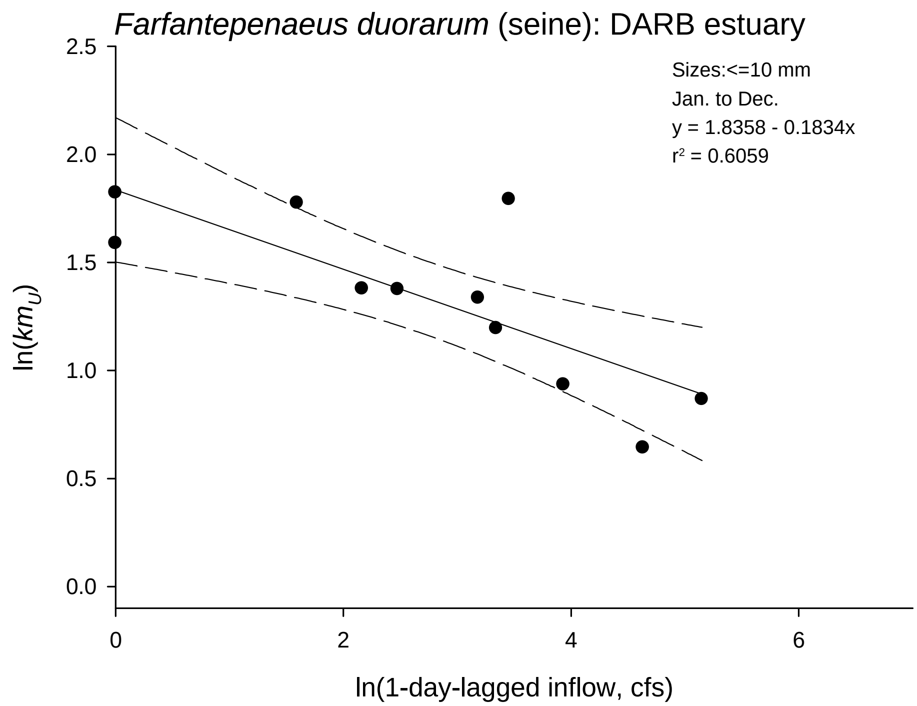


Fig. G1. Distribution response of Pink shrimp (<=10 mm) in the DARB estuary estuary to 1-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

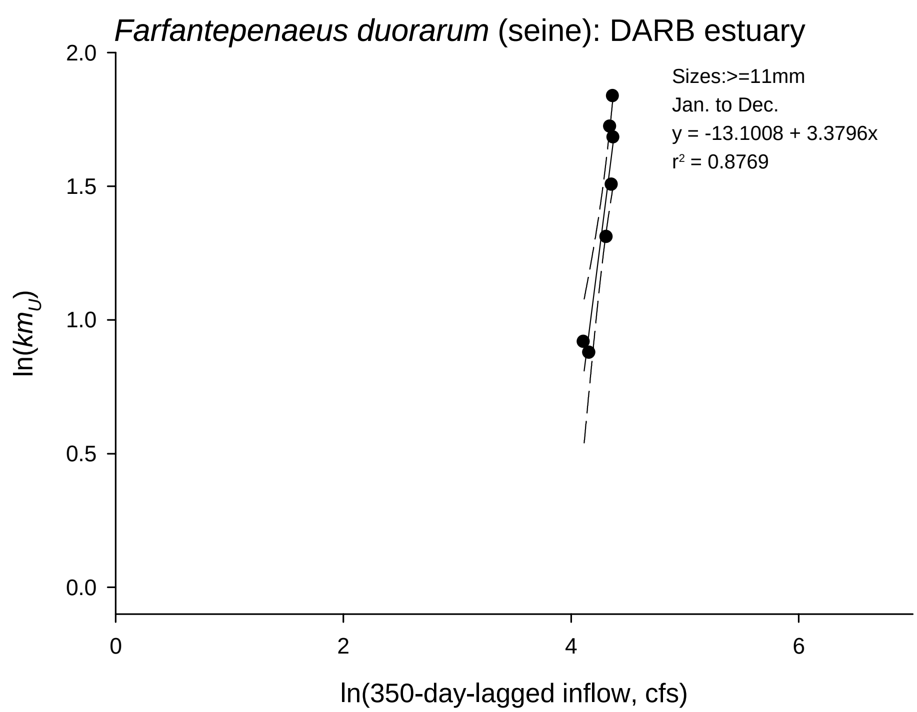


Fig. G2. Distribution response of Pink shrimp (>=11 mm) in the DARB estuary estuary to 350-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

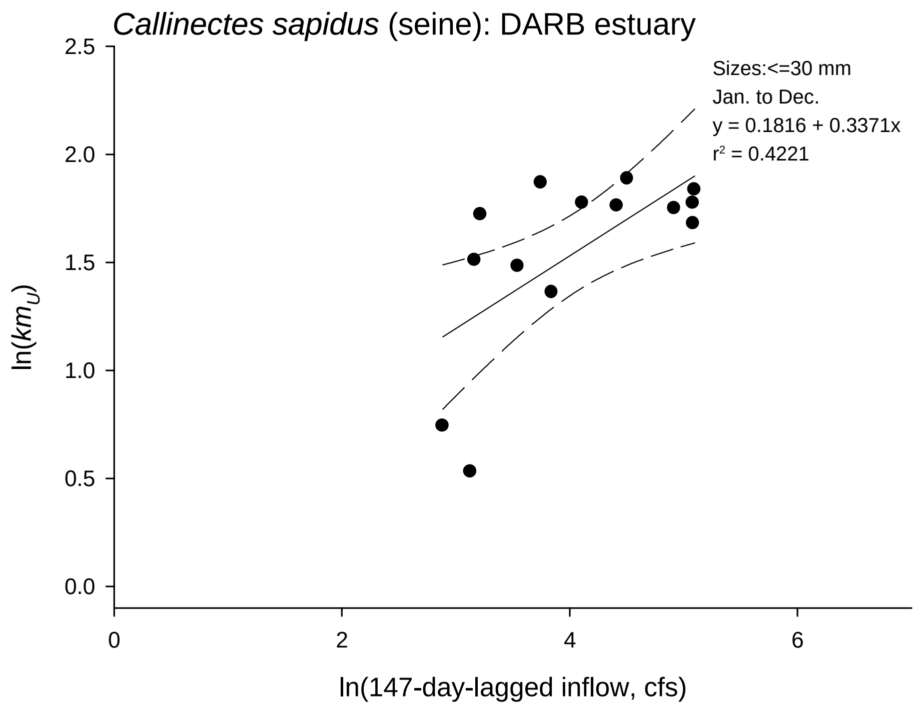


Fig. G3. Distribution response of Blue crab (<=30 mm) in the DARB estuary estuary to 147-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

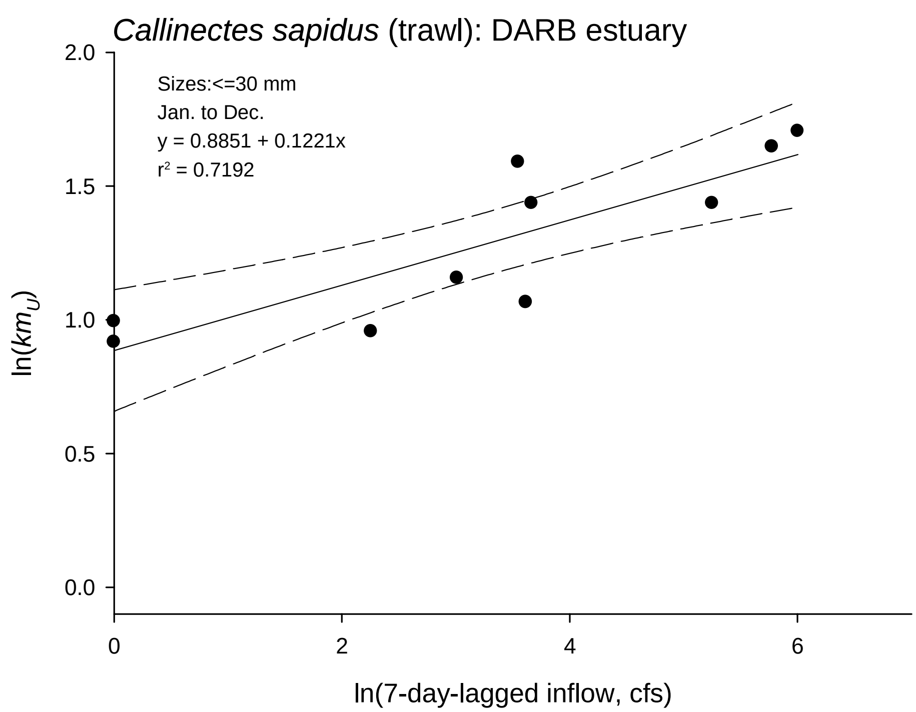


Fig. G4. Distribution response of Blue crab (<=30 mm) in the DARB estuary estuary to 7-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

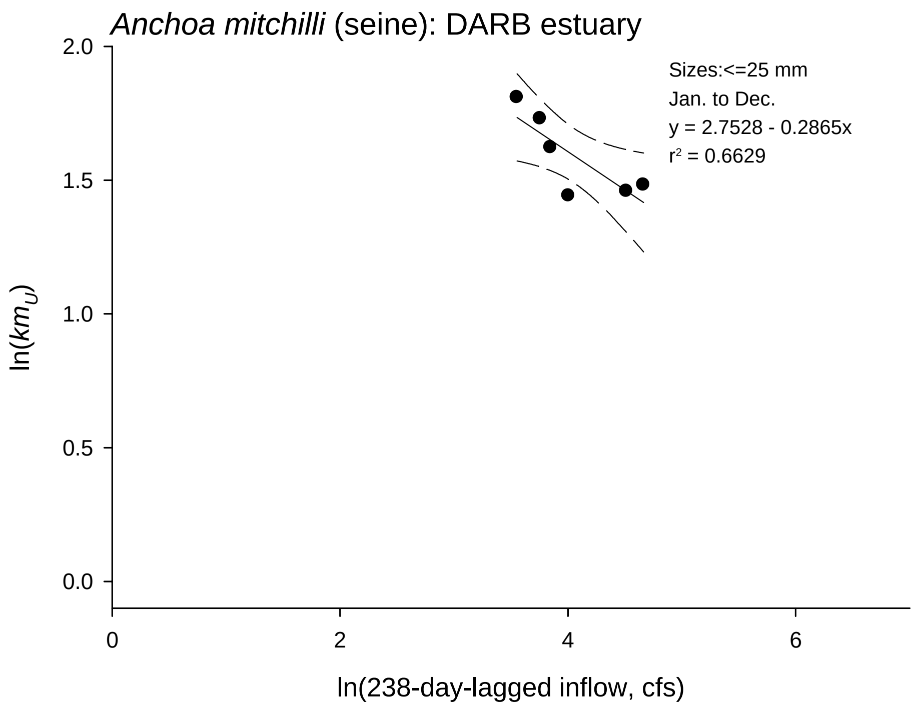


Fig. G5. Distribution response of Bay anchovy (<=25 mm) in the DARB estuary estuary to 238-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

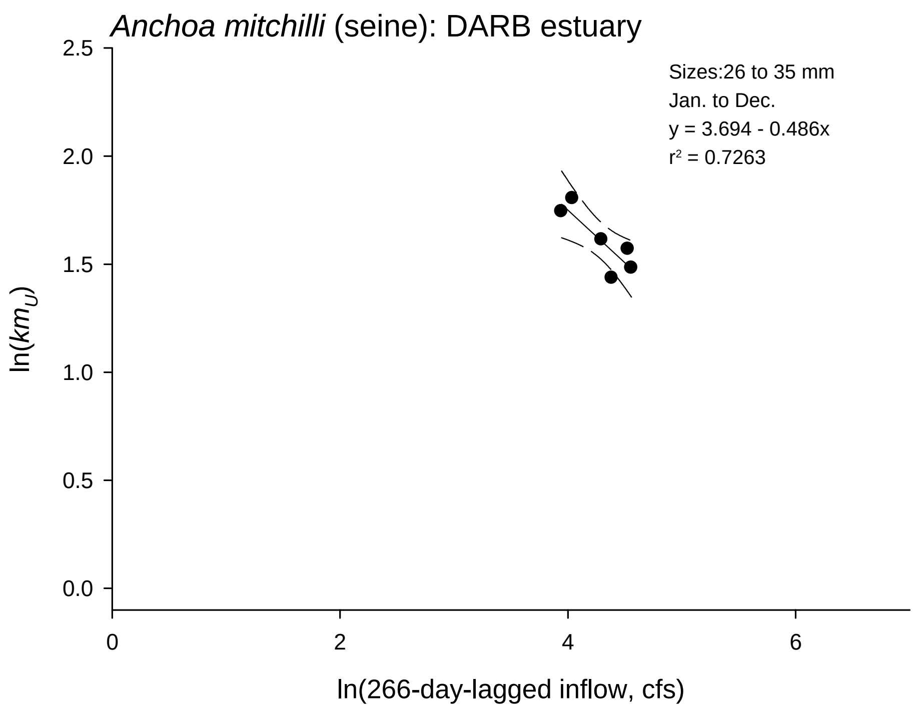


Fig. G6. Distribution response of Bay anchovy (26 to 35 mm) in the DARB estuary estuary to 266-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

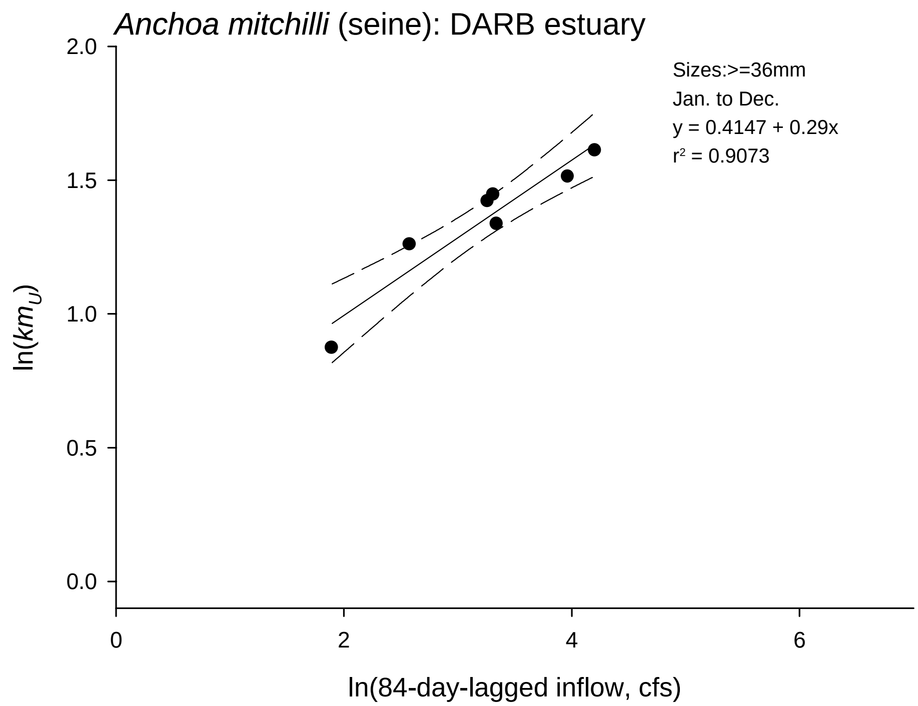


Fig. G7. Distribution response of Bay anchovy (>=36 mm) in the DARB estuary estuary to 84-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

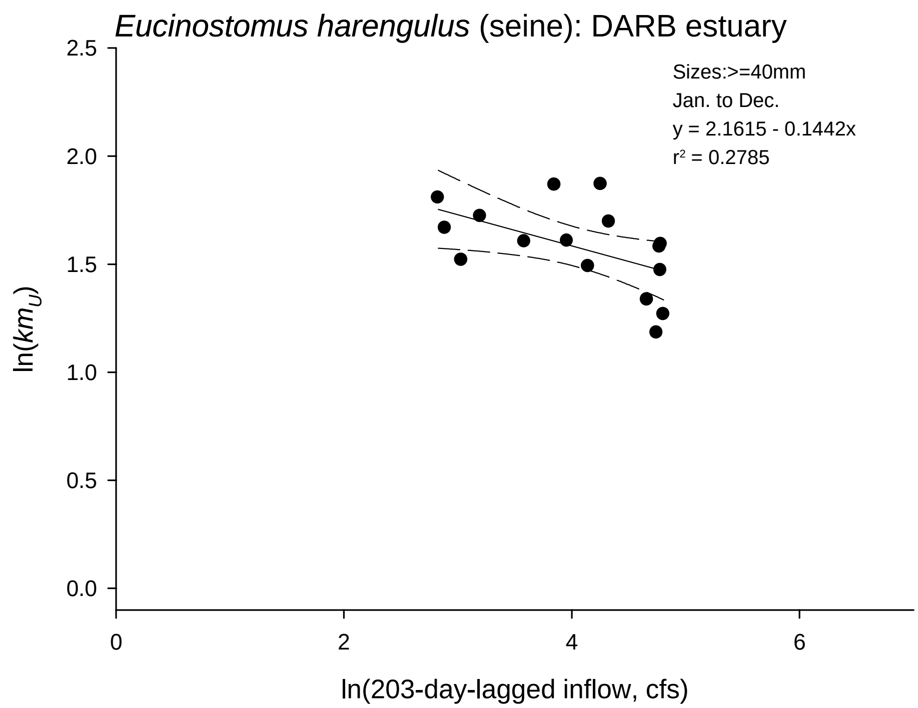


Fig. G8. Distribution response of Tidewater mojarra (>=40 mm) in the DARB estuary estuary to 203-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

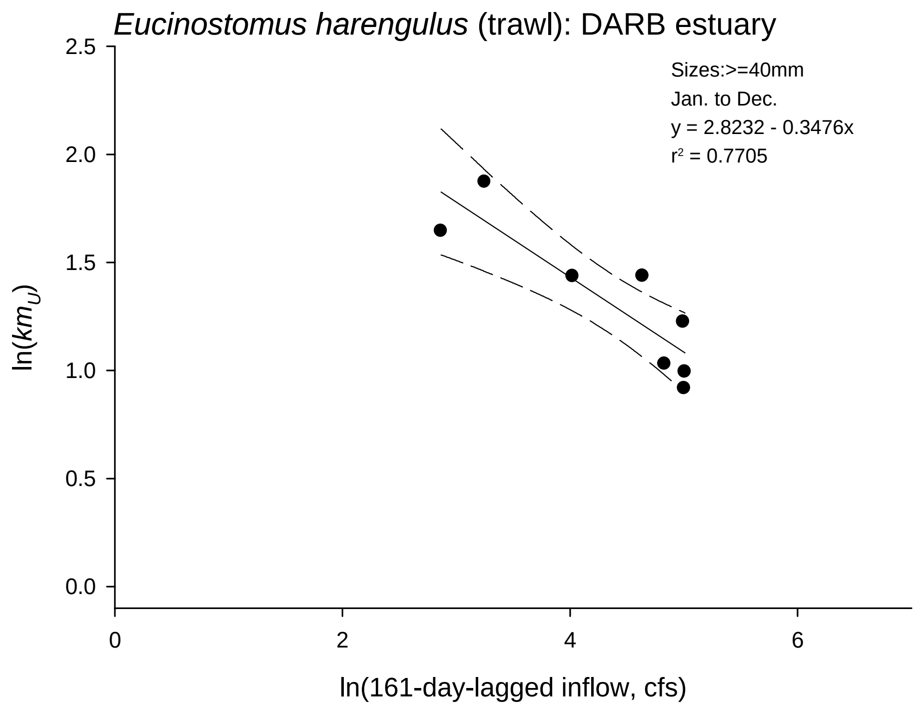


Fig. G9. Distribution response of Tidewater mojarra (>=40 mm) in the DARB estuary estuary to 161-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

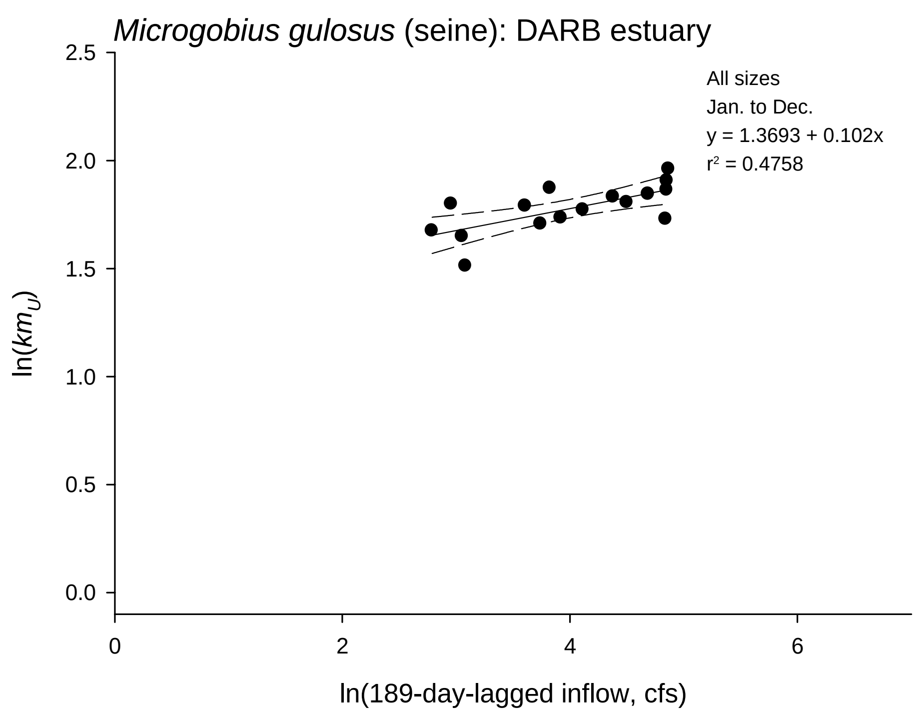


Fig. G10. Distribution response of Clown goby (All sizes) in the DARB estuary estuary to 189-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

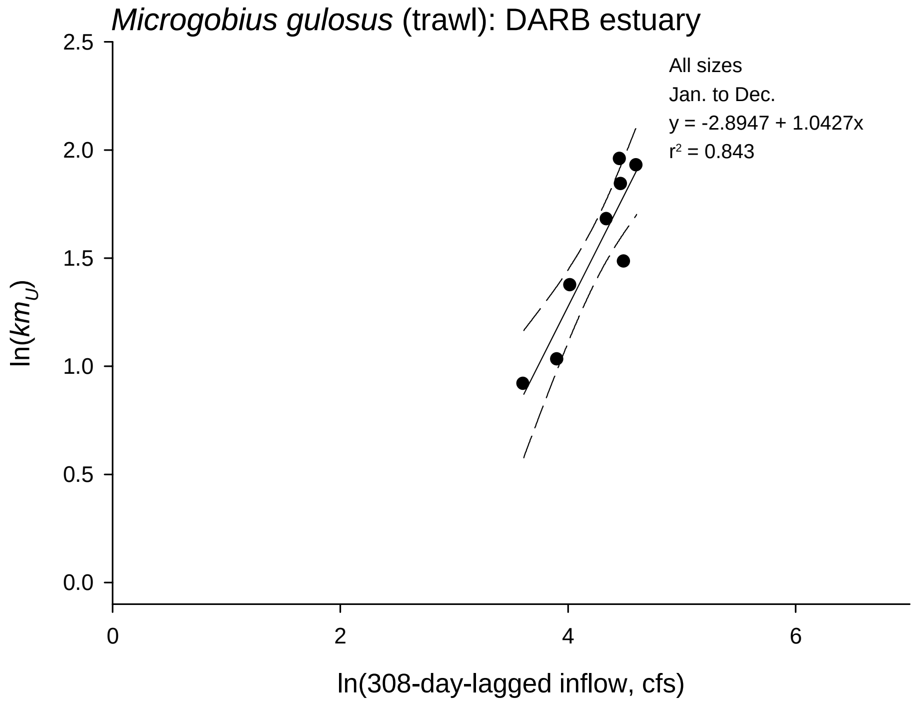
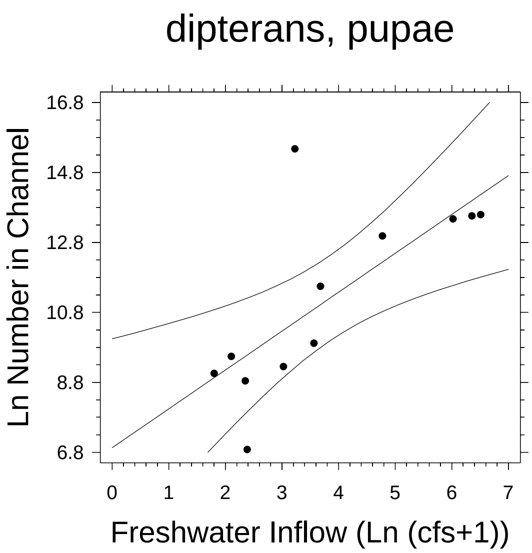
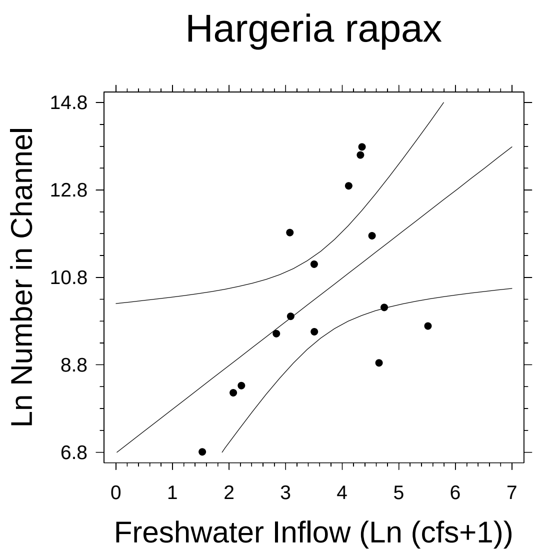


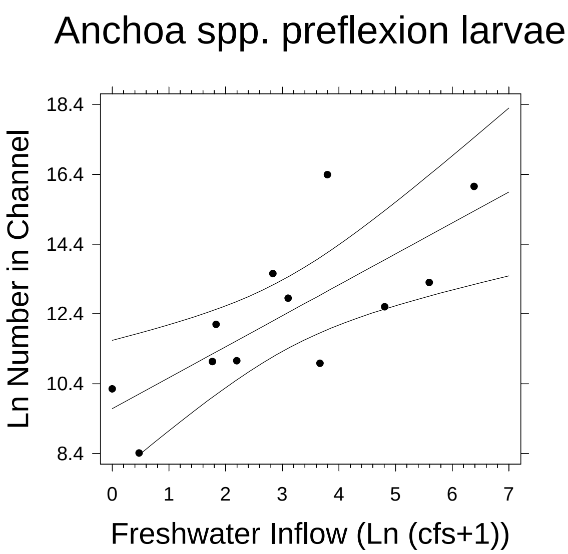
Fig. G11. Distribution response of Clown goby (All sizes) in the DARB estuary estuary to 308-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

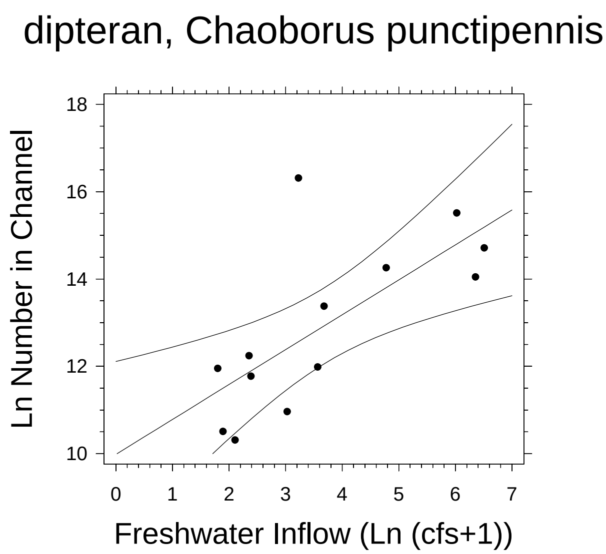
Appendix H:

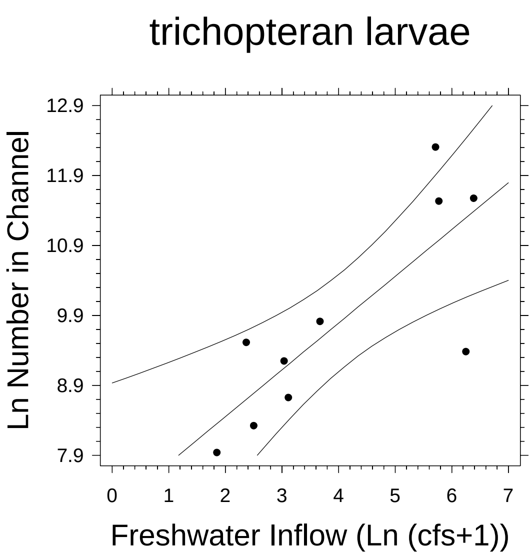
Plots of the plankton-net abundance responses in Table 3.8.1.1
with 95% confidence limits for predicted means

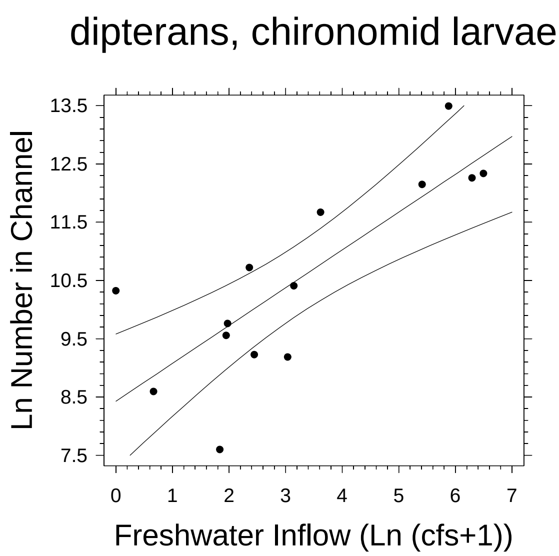

dipterans, pupae
16.8
14.8
12.8
10.8
8.8
6.8
Ln Number in Channel
0
1
2
3
4
5
6
7
Freshwater Inflow (Ln (cfs+1))


Hargeria rapax
14.8
12.8
10.8
8.8
6.8
Ln Number in Channel
0
1
2
3
4
5
6
7
Freshwater Inflow (Ln (cfs+1))

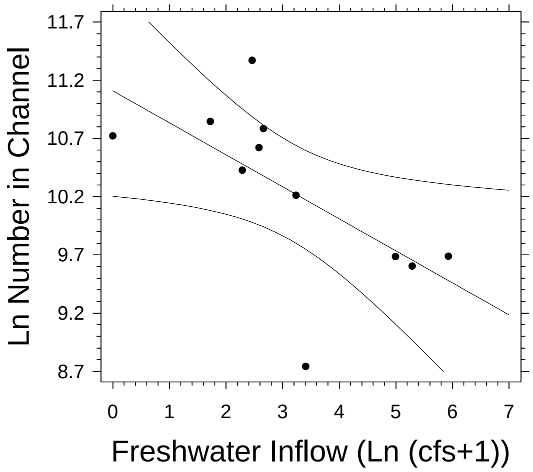

Anchoa spp. preflexion larvae
18.4
16.4
14.4
12.4
10.4
8.4
Ln Number in Channel
0
1
2
3
4
5
6
7
Freshwater Inflow (Ln (cfs+1))


dipteran, Chaoborus punctipennis
18
16
14
12
10
Ln Number in Channel
0
1
2
3
4
5
6
7
Freshwater Inflow (Ln (cfs+1))

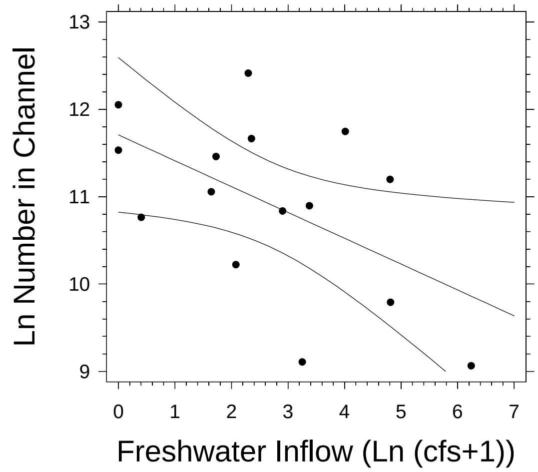

trichopteran larvae
12.9
11.9
10.9
9.9
8.9
7.9
Ln Number in Channel
0
1
2
3
4
5
6
7
Freshwater Inflow (Ln (cfs+1))


dipterans, chironomid larvae
13.5
12.5
11.5
10.5
9.5
8.5
7.5
Ln Number in Channel
0
1
2
3
4
5
6
7
Freshwater Inflow (Ln (cfs+1))

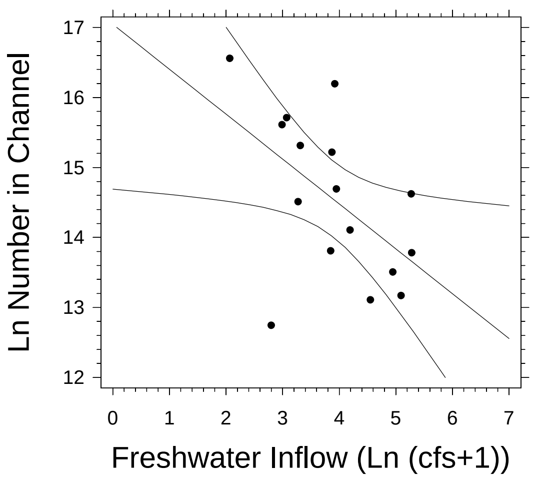
blenniid preflexion larvae



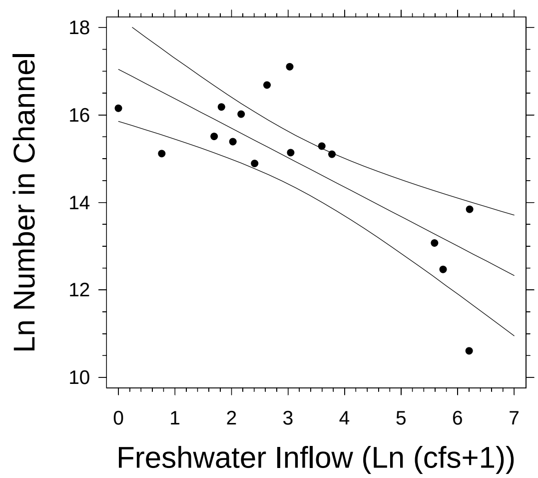
branchiurans, Argulus spp.



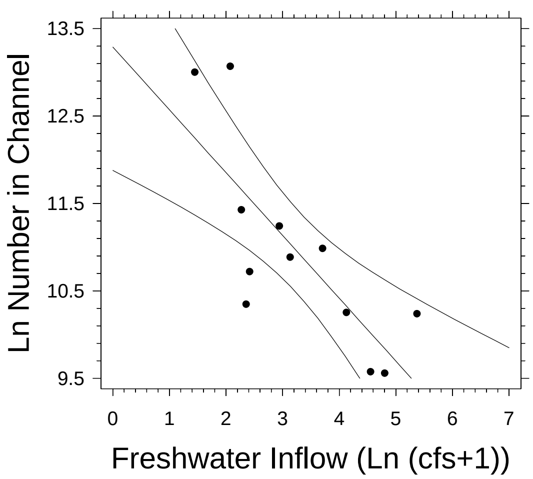
decapod mysis



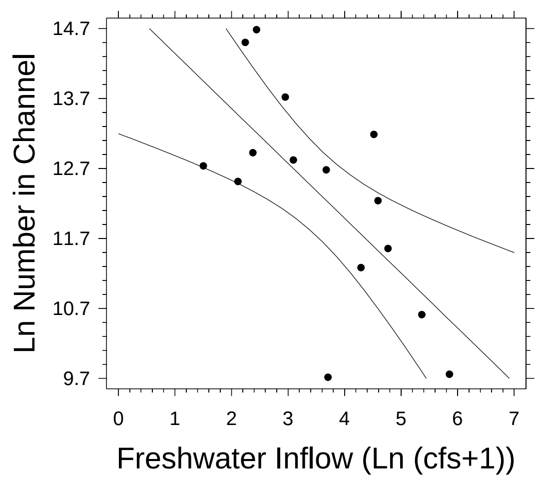
chaetognaths, sagittid

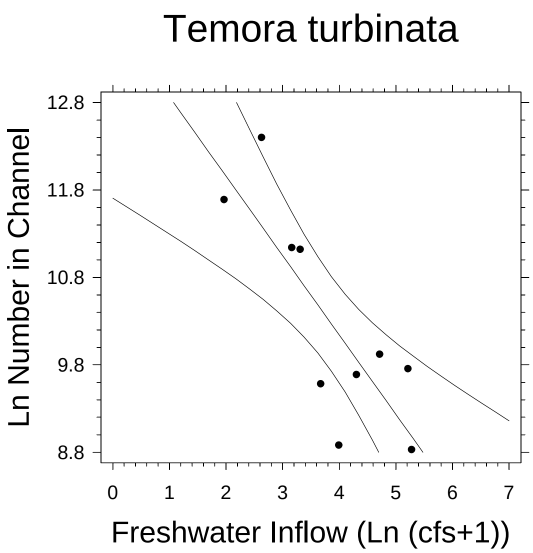


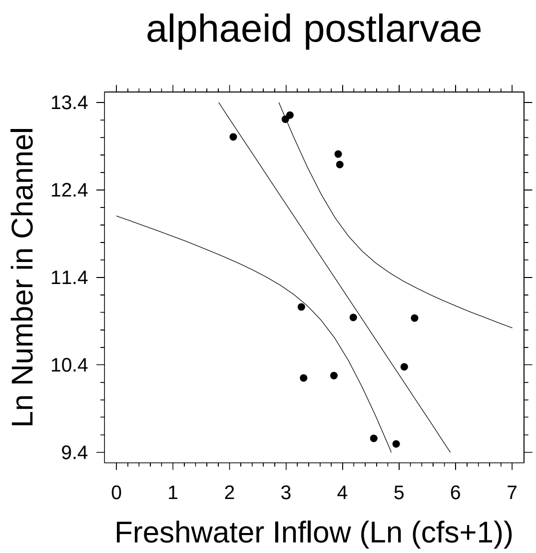
cymothoid sp. a (Lironeca) juveniles

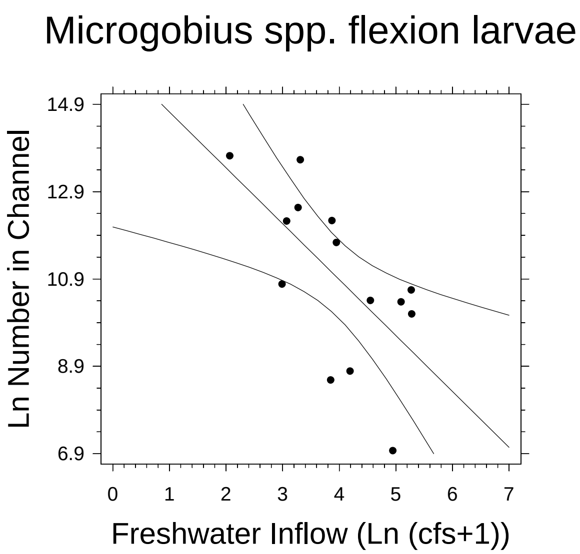


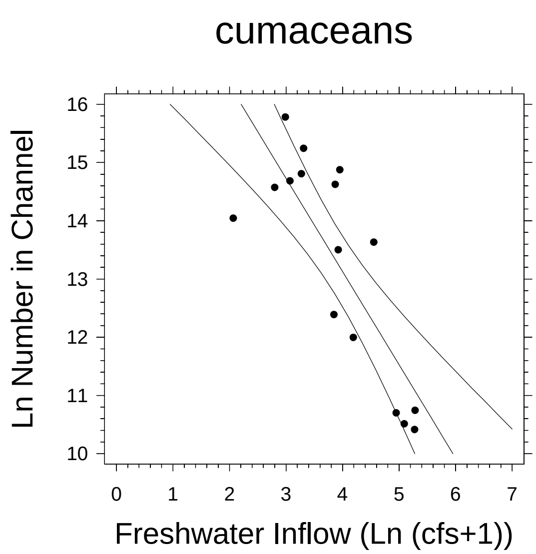
Bowmaniella dissimilis




Temora turbinata
Ln Number in Channel
12.8
11.8
10.8
9.8
8.8
0 1 2 3 4 5 6 7
Freshwater Inflow (Ln (cfs+1))


alphaeid postlarvae
Ln Number in Channel
13.4
12.4
11.4
10.4
9.4
0 1 2 3 4 5 6 7
Freshwater Inflow (Ln (cfs+1))


Microgobius spp. flexion larvae
Ln Number in Channel
14.9
12.9
10.9
8.9
6.9
0 1 2 3 4 5 6 7
Freshwater Inflow (Ln (cfs+1))


cumaceans
Ln Number in Channel
16
15
14
13
12
11
10
0 1 2 3 4 5 6 7
Freshwater Inflow (Ln (cfs+1))

Appendix I:

Plots of the seine and trawl abundance responses in Table 3.8.2.1

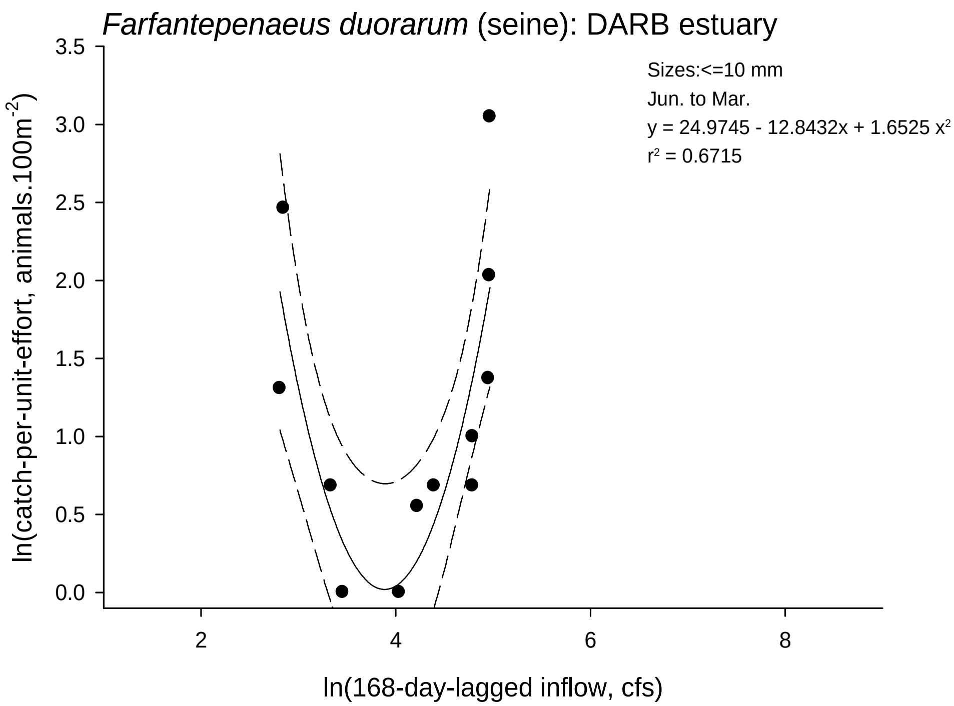


Fig. I1. Abundance response of Pink shrimp (<=10 mm) in the DARB estuary estuary to 168-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

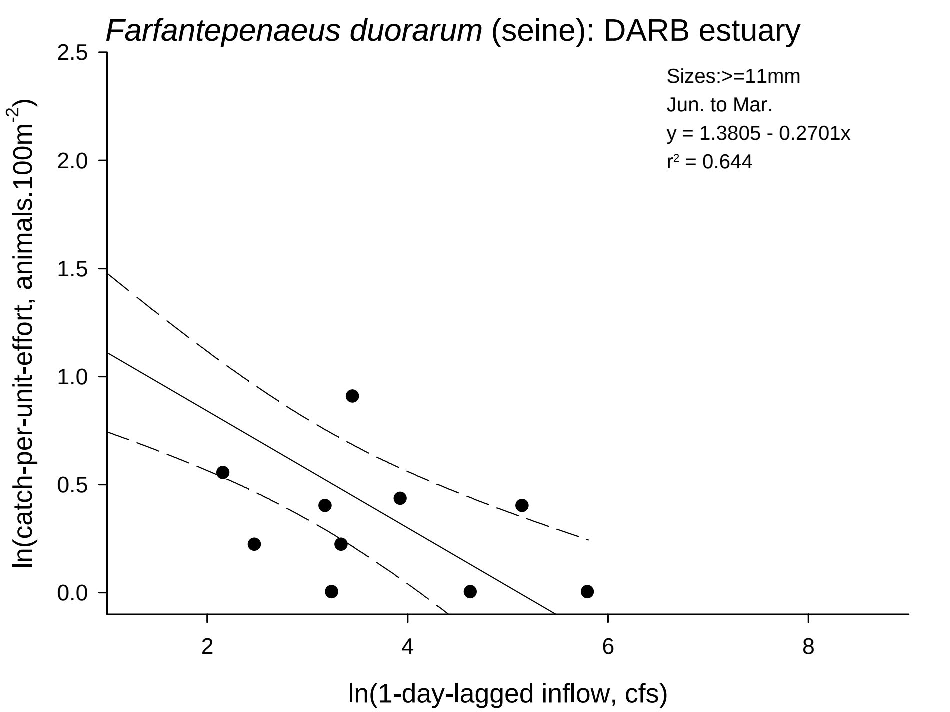


Fig. I2. Abundance response of Pink shrimp (>=11mm) in the DARB estuary estuary to 1-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

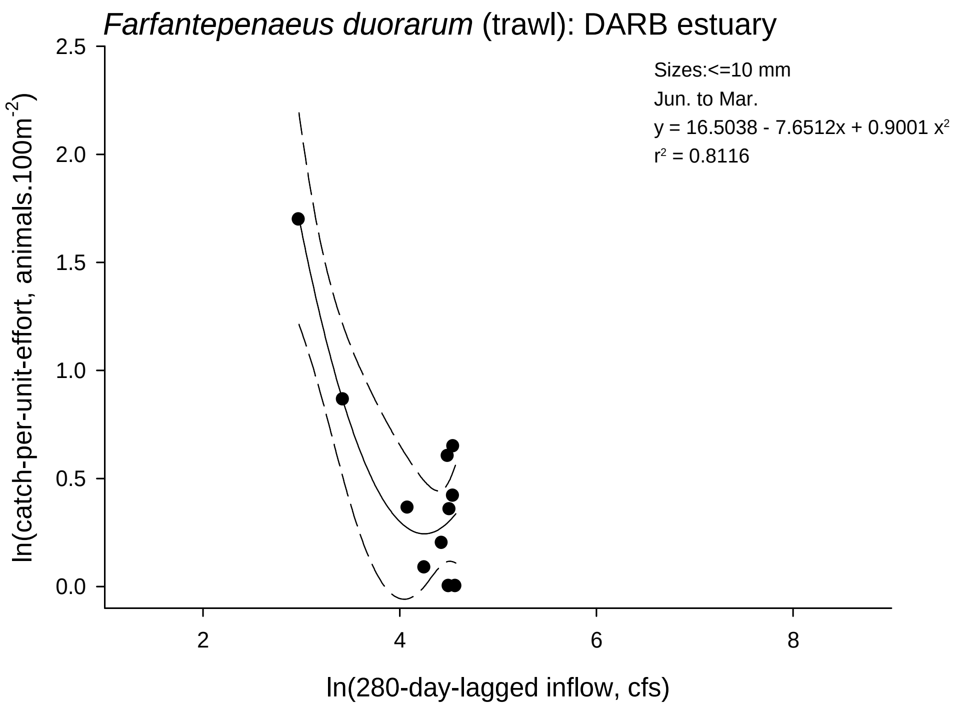


Fig. I3. Abundance response of Pink shrimp (<=10 mm) in the DARB estuary estuary to 280-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

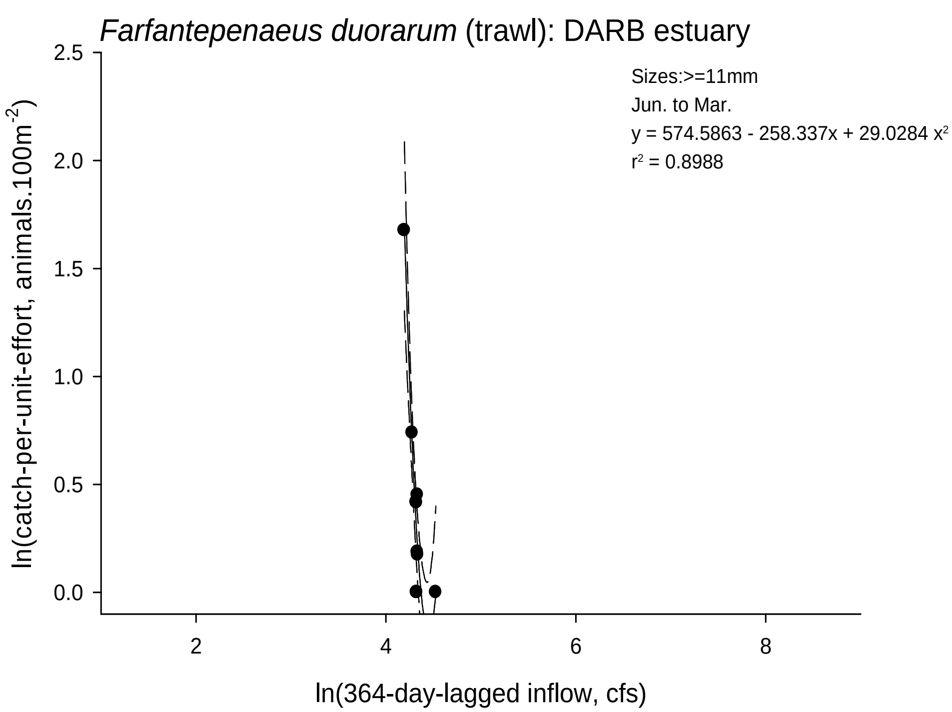


Fig. I4. Abundance response of Pink shrimp (>=11mm) in the DARB estuary estuary to 364-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

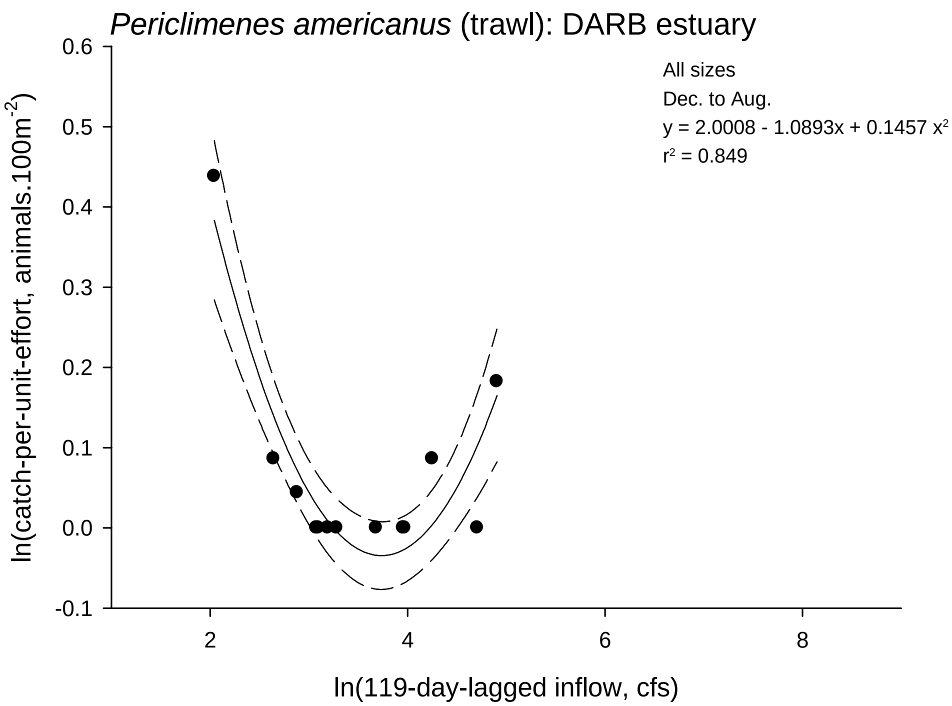


Fig. I5. Abundance response of American grass shrimp (All sizes) in the DARB estuary estuary to 119-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

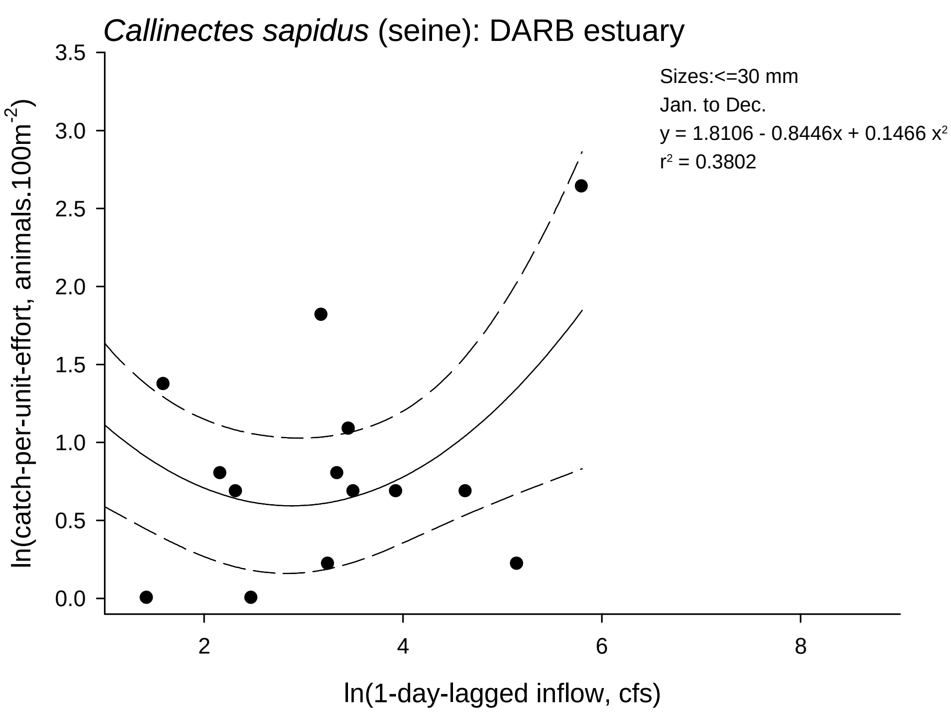


Fig. I6. Abundance response of Blue crab (<=30 mm) in the DARB estuary estuary to 1-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

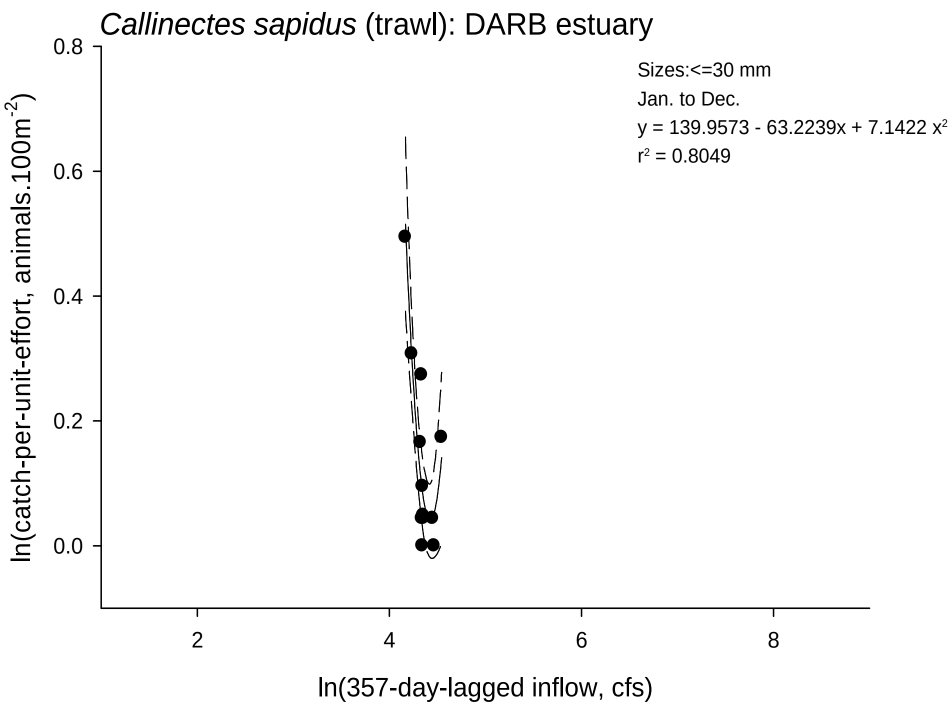


Fig. I7. Abundance response of Blue crab (<=30 mm) in the DARB estuary estuary to 357-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

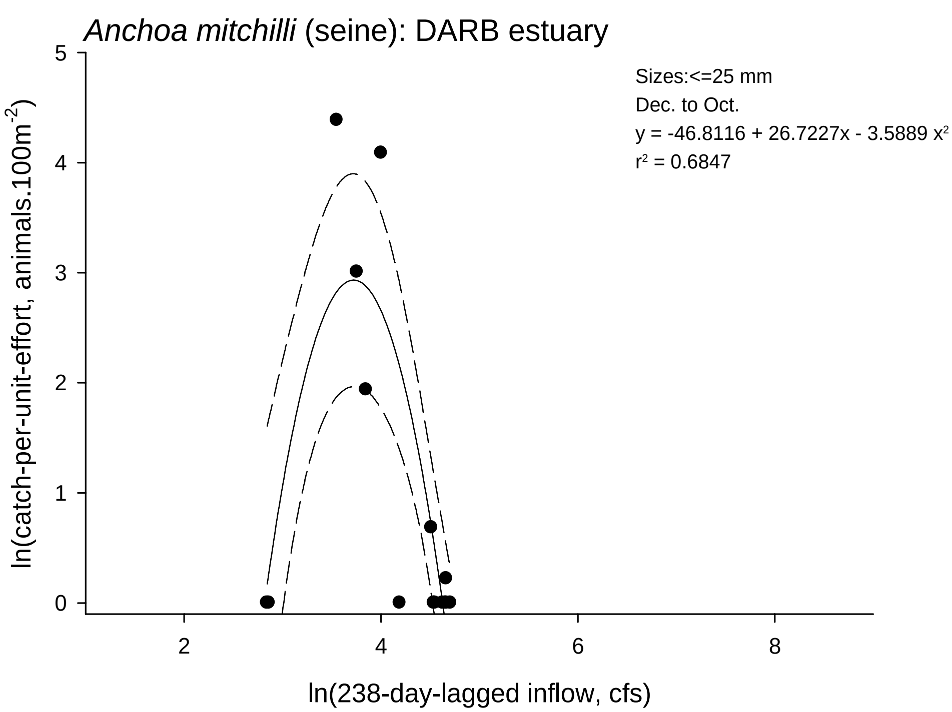


Fig. I8. Abundance response of Bay anchovy (<=25 mm) in the DARB estuary estuary to 238-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

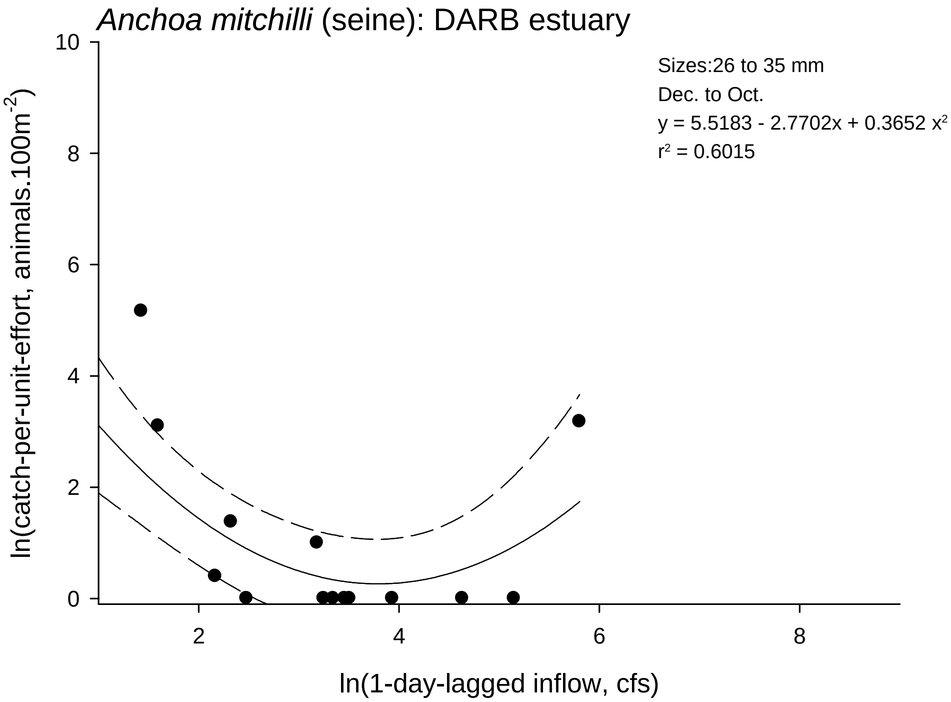


Fig. I9. Abundance response of Bay anchovy (26 to 35 mm) in the DARB estuary estuary to 1-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

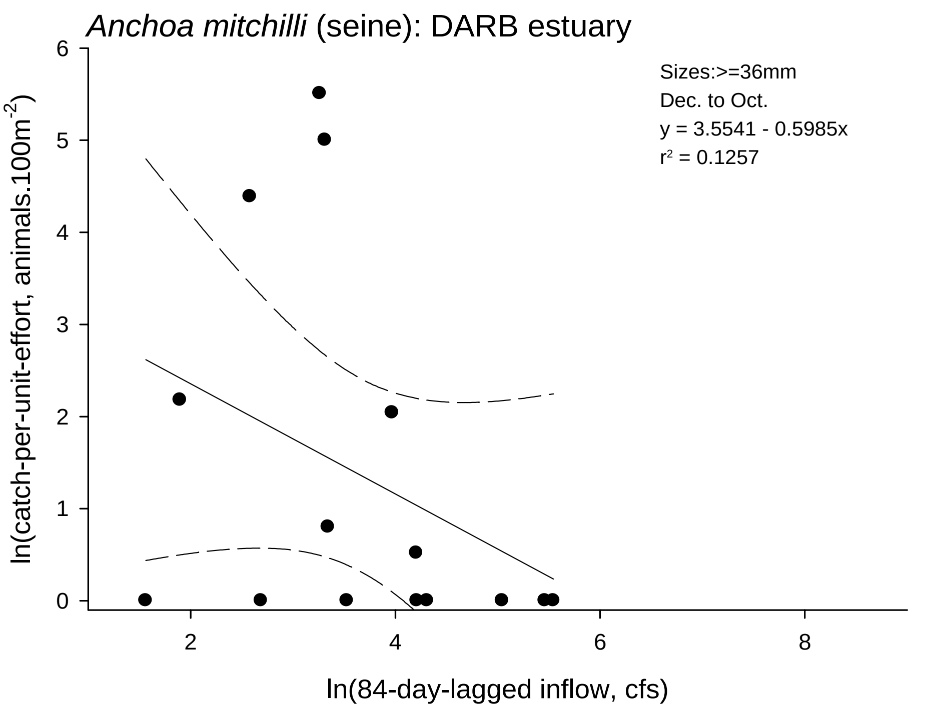


Fig. I10. Abundance response of Bay anchovy (>=36mm) in the DARB estuary estuary to 84-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

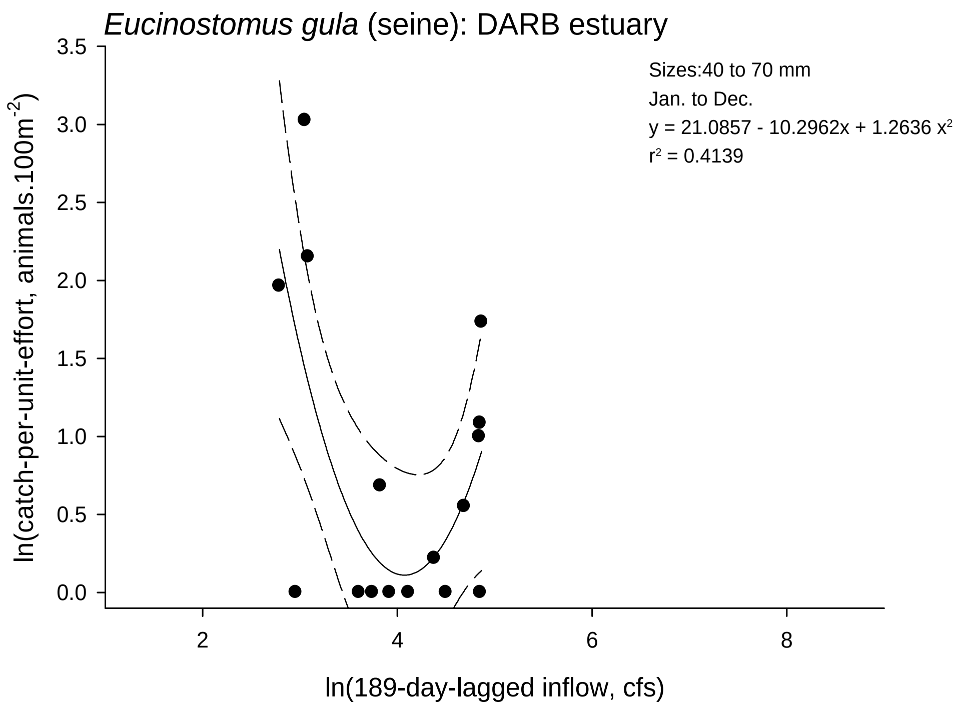


Fig. I11. Abundance response of Silver jenny (40 to 70 mm) in the DARB estuary estuary to 189-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

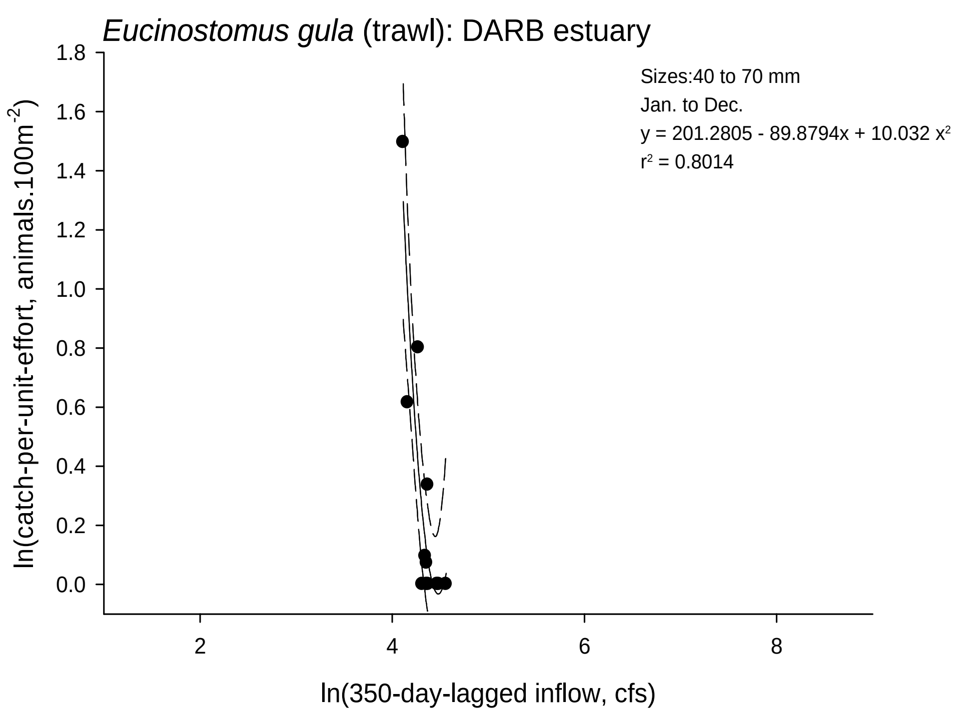


Fig. I12. Abundance response of Silver jenny (40 to 70 mm) in the DARB estuary estuary to 350-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

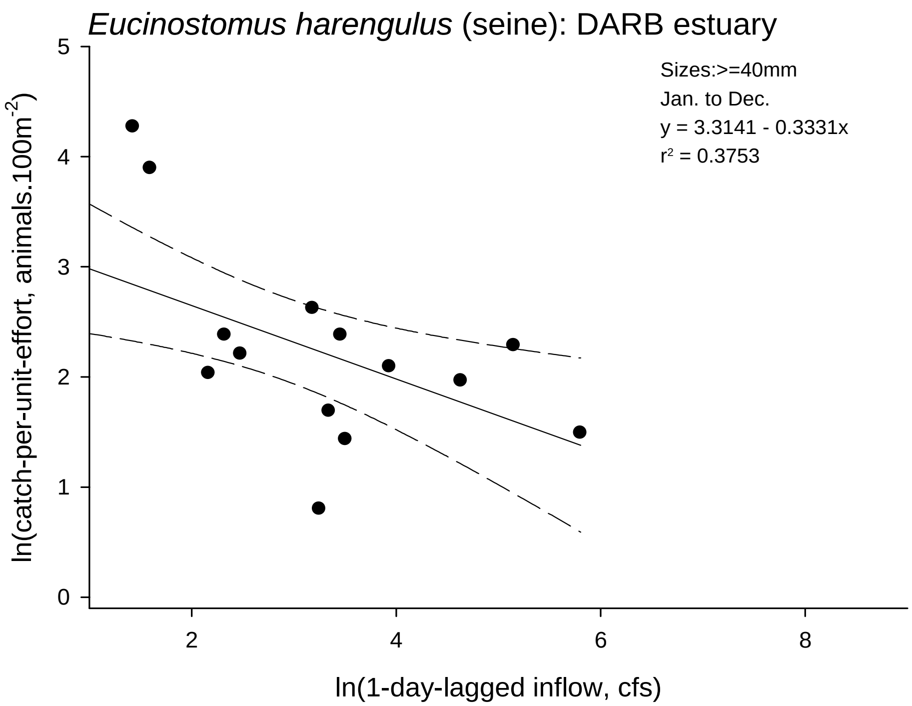


Fig. I13. Abundance response of Tidewater mojarra (>=40mm) in the DARB estuary estuary to 1-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

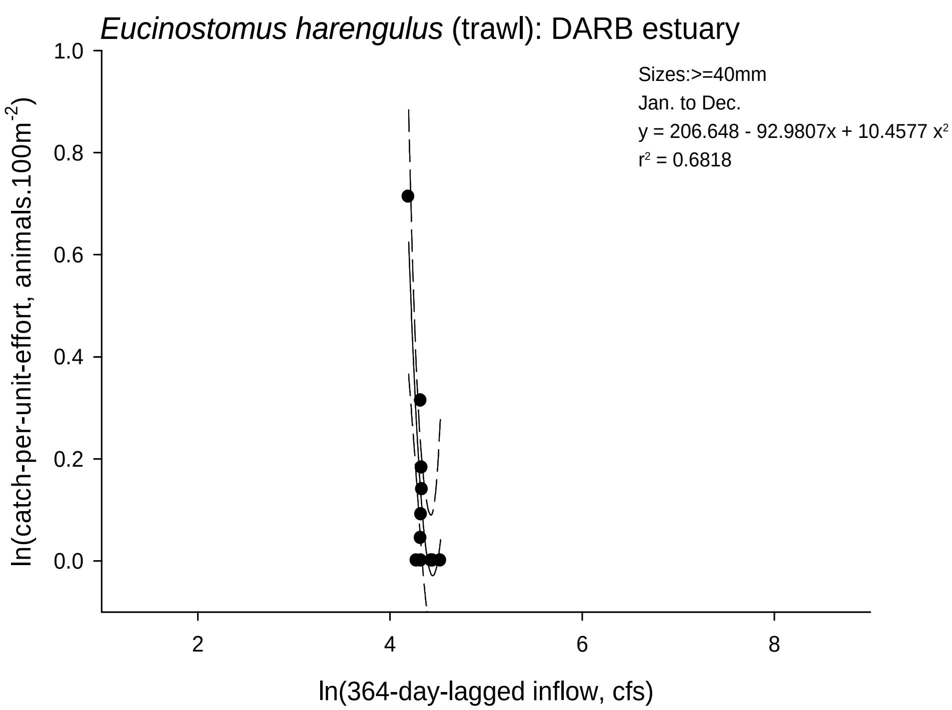


Fig. I14. Abundance response of Tidewater mojarra (>=40mm) in the DARB estuary estuary to 364-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

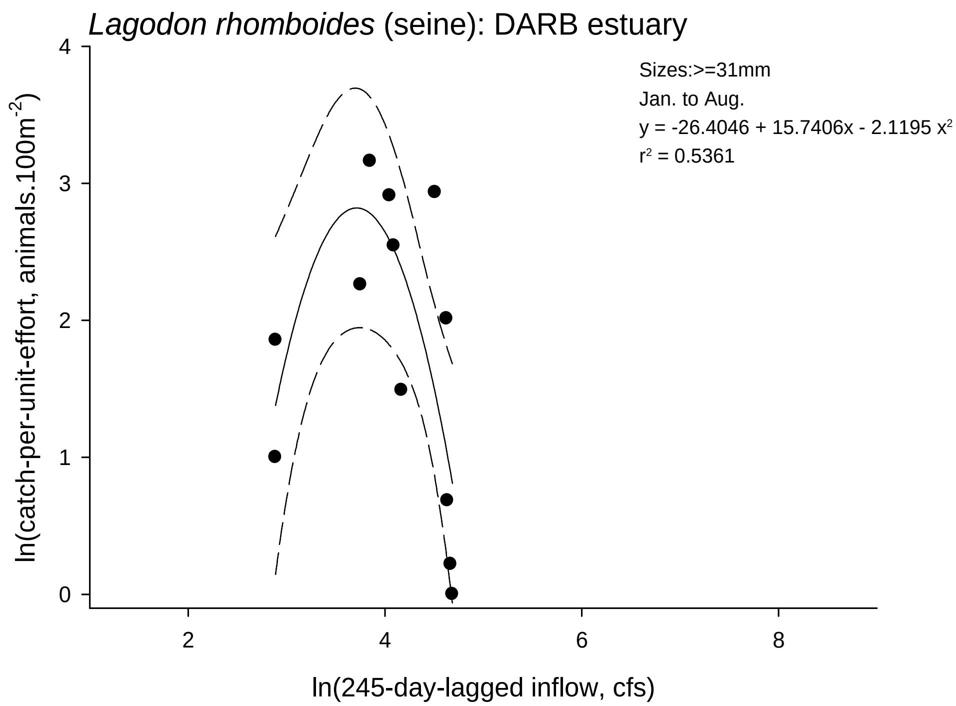


Fig. I15. Abundance response of Pinfish (>=31mm) in the DARB estuary estuary to 245-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

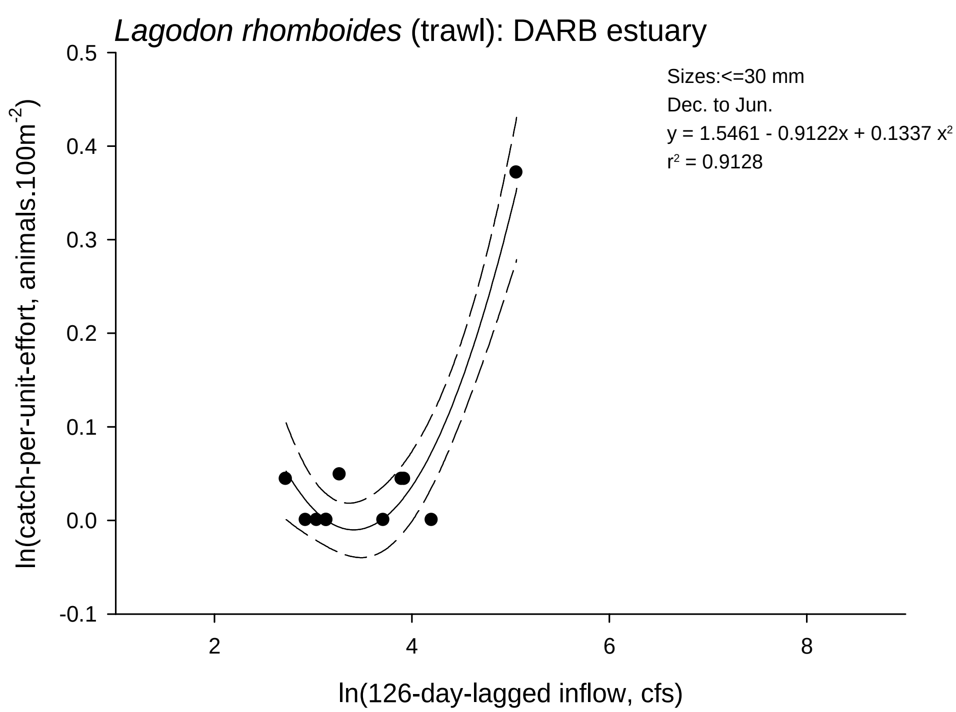


Fig. I16. Abundance response of Pinfish (<=30 mm) in the DARB estuary estuary to 126-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

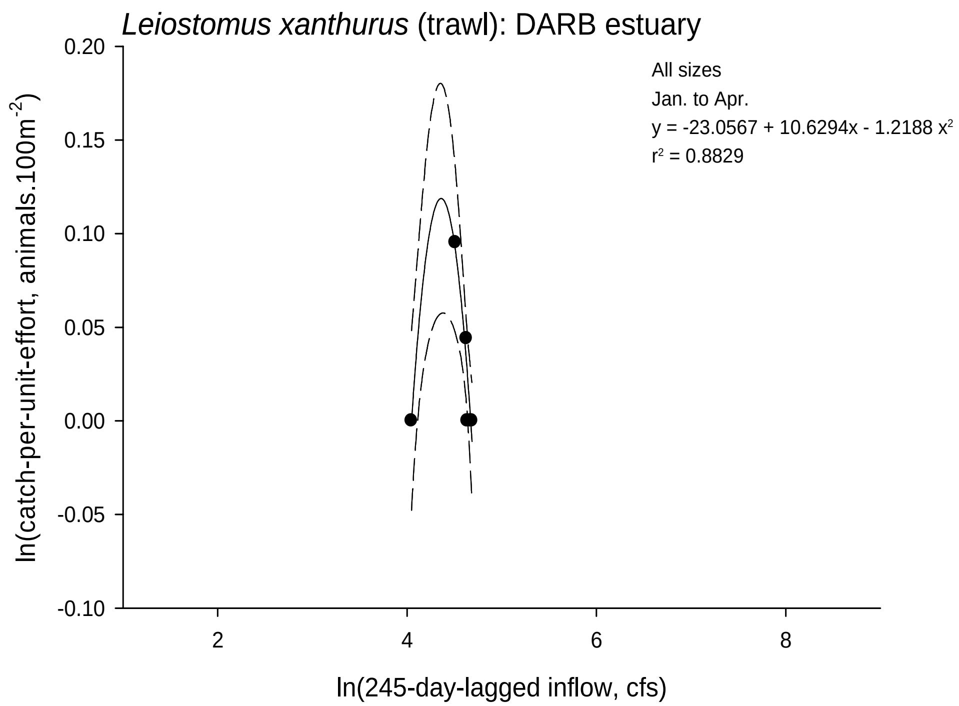


Fig. I17. Abundance response of Spot (All sizes) in the DARB estuary estuary to 245-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

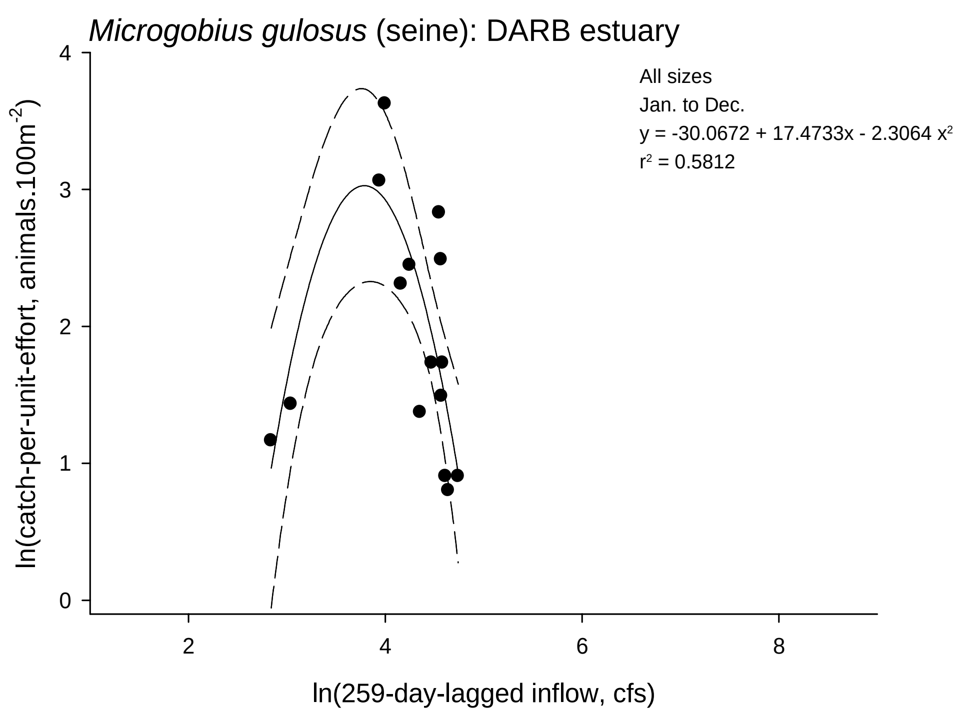


Fig. I18. Abundance response of Clown goby (All sizes) in the DARB estuary estuary to 259-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

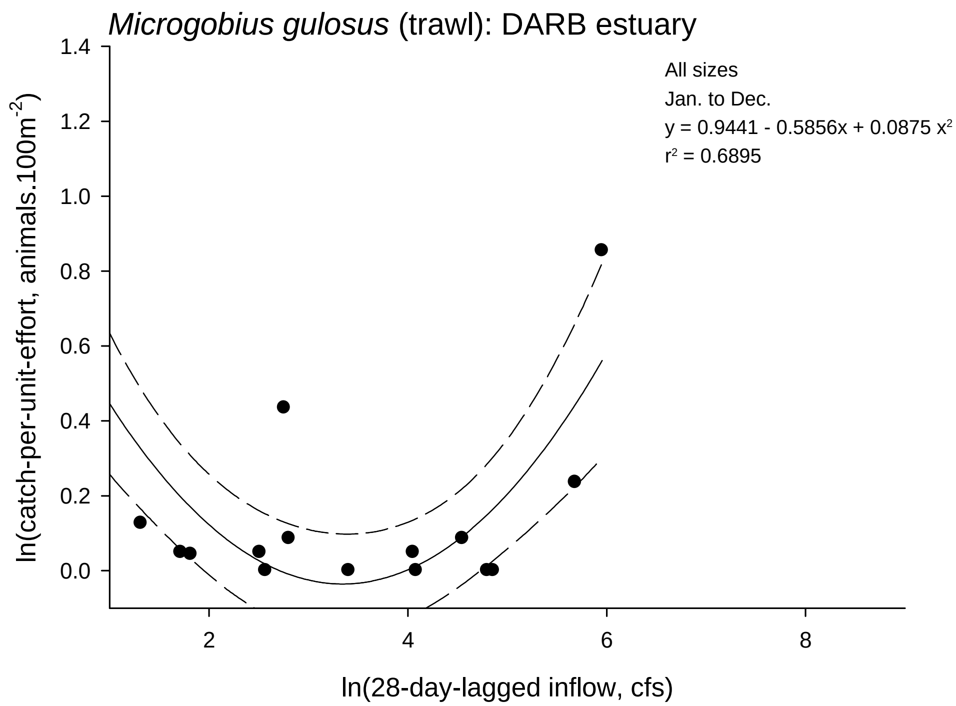


Fig. I19. Abundance response of Clown goby (All sizes) in the DARB estuary estuary to 28-day-lagged inflow. Solid lines: predicted values; dashed lines: 95% CI.

APPENDIX 6-1

COW PEN SLOUGH MFL
HYDRODYNAMIC MODEL DEVELOPMENT
DONA AND ROBERTS BAY

Cow Pen Slough MFL
Hydrodynamic Model Development

Dona and Roberts Bay

Southwest Florida Water Management District
7601 US Hwy. 301
Tampa, FL 33637-6759

July 2007

Applied Technology and Management, Inc.
PO Box 357610
Gainesville, FL 32635-7610
352-375-8700

Janicki Environmental, Inc.
1155 Eden Isle Drive, N.E.
St. Petersburg, FL 33704
727-895-7722

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1.0 INTRODUCTION AND PURPOSE

The Southwest Florida Water Management District (SWFWMD) is in the process of developing methods and rules for the establishment and implementation of minimum flows and levels (MFL) for priority water bodies within its jurisdiction as directed under Sections 373.042 and 373.0421 of the Florida Statutes. Under Section 373, an MFL is defined as:

> “The minimum flow for a given watercourse shall be the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. “

Based upon these regulatory requirements, the District is working to establish minimum flows and levels for Cow Pen Slough. Cow Pen Slough is a freshwater tributary to Dona and Roberts Bay, an estuarine system located on the southern end of Blackburn Bay in Sarasota County. As a key aspect of an estuarine system is the balance between freshwater inflows and saline water from the Gulf of Mexico, determination of the MFL for Cow Pen Slough required that the salinity response within Dona and Roberts Bay be evaluated under varying freshwater inflow conditions. Based upon this need, a multi-dimensional model, with the capability to simulate salinity response under varying freshwater inflow was required.

For this project a model developed by Applied Technology and Management (ATM) that extended from near Longboat Key down to Venice Inlet was utilized. This model was developed to simulate conditions within Little Sarasota Bay near the former Midnight Pass. For the Cow Pen Slough MFL, the existing model grid was modified by ATM to provide greater resolution in the vicinity of Dona and Roberts Bay, the model was also extended south into portions of Lemon Bay. With assistance from Janicki Environmental, the model was calibrated and validated using observed tides and salinity concentrations in Dona and Roberts Bay.

1.1 MODEL DESCRIPTION

The Environmental Fluid Dynamics Code (EFDC) model was used for this project. EFDC is a general purpose modeling package for simulating three-dimensional flow, transport and biogeochemical process in surface water systems including: rivers, lakes, estuaries, reservoirs, wetlands and near shore to shelf scale coastal regions. The EFDC model was originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications and is considered public domain software.

The following description is from the introduction to the EFDC User Manual (Hamrick, 1996):

"The physics of the EFDC model, and many aspects of the computational scheme, are equivalent to the widely used Blumberg-Mellor model (Blumberg and Mellor, 1987) and the U.S. Army Corps of Engineers' CH3D or Chesapeake Bay model (Johnson, et al, 1993). The EFDC model solves the three-dimensional, vertically hydrostatic, free surface, turbulent averaged equations of motions for a variable density fluid. Dynamically coupled transport equations for turbulent kinetic energy, turbulent length scale, salinity and temperature are also solved. The two turbulence parameter transport equations implement the Mellor-Yamda level 2.5 turbulence closure scheme (Mellor and Yamada, 1982; Galperin et al, 1988). The EFDC model uses a stretched or sigma vertical coordinate and Cartesian or curvilinear, orthogonal horizontal coordinates.

The numerical scheme employed in EFDC to solve the equations of motion uses second order accurate spatial finite differencing on a staggered or C grid. The model's time integration employs a second order accurate three-time level, finite difference scheme with an internal-external mode splitting procedure to separate the internal shear or baroclinic mode from the external free surface gravity wave or barotropic mode. The external mode solution is semi-implicit, and simultaneously computes the two-dimensional surface elevation field by a preconditioned conjugate gradient procedure. The external solution is completed by the calculation of the depth average barotropic velocities using the new surface elevation field. The model's semi-implicit external solution allows large time steps that are constrained only by the stability criteria of the explicit central difference or high order upwind advection scheme (Smolarkiewicz and Margolin, 1993) used for the nonlinear accelerations. Horizontal boundary conditions for the external mode solution include portions for simultaneously specifying the surface elevation only, the characteristic of an incoming wave (Bennett and McIntosh, 1982), free radiation of an outgoing wave (Bennett, 1976) or the normal volumetric flux on arbitrary portions of the boundary. The EFDC model's internal momentum equation solution, at the same time step as the external, is implicit with respect to vertical diffusion. The internal solution of the momentum equations is in terms of the vertical profile of shear stress and velocity shear, which results in the simplest and most accurate form of the baroclinic pressure gradients and eliminates the over-determined character of alternate internal mode formulations. Time splitting inherent in the three time level scheme is controlled by periodic insertion of a second order accurate two time level trapezoidal step. The EFDC model is also readily configured as a two-dimensional model in either the horizontal or vertical planes.

The EFDC model implements a second order accurate in space and time, mass conservation fractional step solution scheme for the Eulerian transport equations for salinity, temperature, suspended sediment, water quality constituents and toxic contaminants. The transport equations are temporally integrated at the same time step or twice the time step of the momentum equation solution (Smolarkiewicz and Margolin, 1993). The advective step of the transport solution uses either the central difference scheme used in the Blumberg-Mellor model or a hierarchy of positive definite upwind difference schemes. The highest accuracy upwind scheme, second order accurate in space and time, is base on a flux corrected transport version of Smolarkiewicz's multidimensional positive definite advection transport algorithm numerical diffusion. The horizontal diffusion step, if required, is explicit in time, while the vertical diffusion step is implicit. Horizontal boundary conditions include time variable material inflow concentrations, upwinded outflow, and a damping relation specification of climatological boundary concentration. For the temperature transport equation, the NOAA Geophysical Fluid Dynamics Laboratory's atmospheric heat exchange model (Rosati and Miyakoda, 1988) is implemented."

2.0 MODEL INPUTS AND DATA FOR CALIBRATION AND VALIDATION

This section provides descriptions of the data utilized as input to the model, and for calibration and verification of the model. Descriptions include data sources, locations, periods of record, and frequency.

2.1 MODEL GRID AND BATHYMETRY

Figure 2-1 presents the overall model grid extending from Big Sarasota Bay down to Venice Inlet and Lemon Bay to the south. The increased grid resolution in the area of Dona and Roberts Bay can be seen in relation to the more coarse grid to the north. The reason for keeping the grid in the upper portions was to assure accurate simulation of flow distribution between the various interacting bay systems, Little Sarasota Bay, Blackburn Bay, and the area around Venice Inlet. The offshore boundary at Venice Inlet was extended a sufficient distance to assure that all freshwater influence was sufficiently diffused and the offshore constant salinity condition was reasonable.

Figures 2-2 and 2-3 provide the grid in the vicinity of Dona and Roberts Bay along with the bathymetric conditions utilized in the model simulations near Dona and Roberts Bay. The average grid cell in this region is on the order of 40 meters wide in the cross-channel direction with good resolution in the complex embayment and working up the tributaries and canals.

2.2 BOUNDARY CONDITIONS

The model described in Section 1 required boundary conditions for elevation and salinity, freshwater and point source inflows, wind forcing, and rainfall to the water surface. Each of these is described below.

Elevations boundary conditions were necessary for the western offshore boundary and for the southern ICW boundary. For the model calibration, measured water surface elevations from the USGS gage at Venice Inlet was used for the offshore model boundary. To adjust for some loss of tidal amplitude between the offshore boundary and the Venice Inlet gage, a 0.025 m increase in the tidal M2 harmonic was added to the time series. This value was determined iteratively by comparing the simulated and measured tides at the Venice Inlet gage. The southern boundary in the ICW is not located near a tide gage or predicted tide station that can be used to estimate the phase lag and tidal damping that occurs at the location. The USGS gage at Shakett Creek exhibits some phase lag and tidal damping. The time series from this gage was used for the southern boundary. This boundary does not have a large influence on the salinity in Donna and Roberts Bay, other than allowing some wind-driven net flow through the boundary to the south. Therefore, it was determined that the use of the Shakett Creek gage data for this boundary was reasonable.

For the model validation, longer periods of boundary forcing data were needed. Unfortunately, the USGS gage data are not available for the entire validation period. Therefore, predicted tides were used for the boundary. The predicted tides for the Bradenton Beach station were used for the offshore boundary. Tidal harmonic analysis was used to determine the tidal damping that occurs between the offshore boundary and the ICW boundary for the calibration simulation. This damping was applied to predicted offshore tides to generate the ICW boundary condition for the validation simulation.

Salinity boundary conditions were required for the western offshore boundary and for the southern ICW boundary. Offshore salinity was set to a constant 34 ppt. The southern boundary in the ICW was set using monthly data collected in the northern portion of Lemon Bay.

Inflows to the Dona and Roberts Bay system are from sources both gauged and ungaged, and from one point source discharge (Figure 2-4). Additional freshwater inflows occur to the remainder of the model domain to the north of the Dona and Roberts Bay system (Figure 2-5), as previously identified for an EFDC modeling effort for Midnight Pass (Applied Technology and Management and Erickson Consulting Engineers, 2004).

The inflows to the Dona and Roberts Bay system include (Figure 2-1):

- Cow Pen Slough (gaged),
- Blackburn Canal (gaged and estimated by the District),
- Shakett Creek (ungaged estimated for the District by Intera),
- Fox Creek (ungaged estimated for the District by Intera),
- Salt Creek (ungaged estimated for the District by Intera),
- Hatchett Creek (ungaged estimated, as described below),
- Curry Creek (ungaged estimated, as described below),
- Lyons Bay inflow (ungaged estimated, as described below), and
- Venice Reverse Osmosis Water Treatment Facility.

Cow Pen Slough discharges to Dona Bay at the head of Shakett Creek, over a structure at Kings Gate MHP. Daily flows, obtained from the District, are gaged by Sarasota Co., with the flow record beginning 06/01/03.

Blackburn Canal discharges, near the eastern end of the canal, were measured by USGS (site 02299692, Blackburn Canal near Venice, FL) since 03/06/04. The District developed a regression relationship between Blackburn flows and stage data for the USGS gage at 02298830, Myakka River near Sarasota, FL. This relationship was used to estimate flows for 06/01/03-03/05/04.

Daily flows from the Shakett Creek, Fox Creek, and Salt Creek ungaged watersheds were estimated using an HSPF model developed for the District by Intera (2007). Intera provided ungaged flows from these watersheds for 1985-2005. For modeling purposes, the Shakett Creek ungaged flows were divided into two ungaged flows, one entering Shakett Creek from the west, and one from the east. This division was based on the proportion of the area of the Shakett Creek watershed within each subarea, with 32.7 percent of the flow assigned to the western subarea and 67.3 percent of the flow assigned to the eastern subarea.

Other ungaged inflows to the Dona and Roberts Bay system were also accounted for. Runoff from the ungaged Hatchett Creek, Lyons Bay, and Curry Creek watersheds were also estimated, utilizing estimated watershed boundaries and daily unit areal runoff from similar watersheds for which estimates existed from the HSPF model. Estimates for Hatchett Creek runoff were developed using daily unit areal runoff from Fox Creek, and estimates for both Lyons Bay and Curry Creek runoff were developed using daily unit areal runoff from Shakett Creek.

Additional inflows to the Dona and Roberts Bay system are from the Venice Reverse Osmosis Water Treatment Plant, which discharges south of Roberts Bay to the ICW, near the mouth of Hatchett Creek. Associated with this discharge are relatively low salinity concentrations, <4 ppt. These discharges and salinity concentrations were obtained from EPA for the June 2003 – September 2005 period.

For the model domain north of the Dona and Roberts Bay system, ungaged flow estimates were developed using daily unit areal runoff from Shakett Creek for the following inflows (Figure 2-2):

- Phillippi Creek,
- Whitaker Bayou,
- Bowlees Creek,
- Matheny Creek,
- Phillippi Canal,
- Catfish Creek,
- South Creek, and
- the northern tribuaries.

Wind speed and direction were obtained for Sarasota Bradenton International Airport at hourly frequency from NOAA NCDC. Daily rainfall was obtained for Venice from NOAA NWS.

2.3 CALIBRATION AND VERIFICATION DATA

Data from two sources were utilized as the comparison data for calibration and verification. For calibration, three USGS continuous recorders provided water surface elevation and surface and bottom salinity recorded every 15 minutes, for the period May 2004 – September 2004. These recorders were at Dona Bay (July 2003 – September 2004), Venice Inlet (May 2004 – September 2004), and Shakett Creek (June 2003 – September 2004) (Figure 2-6). Additional monitoring was performed by the District along the longitudinal axes of Dona, Roberts, and Lyons bays, and within the ICW to the north and south of the Dona and Roberts Bay system (Figure 2-6). Salinity data were collected at these 25 sites monthly at various depths, including surface and bottom, for August 2003 – September 2006. When available, both the continuous recorder elevation and salinity data and the District salinity data were used for both calibration and verification comparisons.

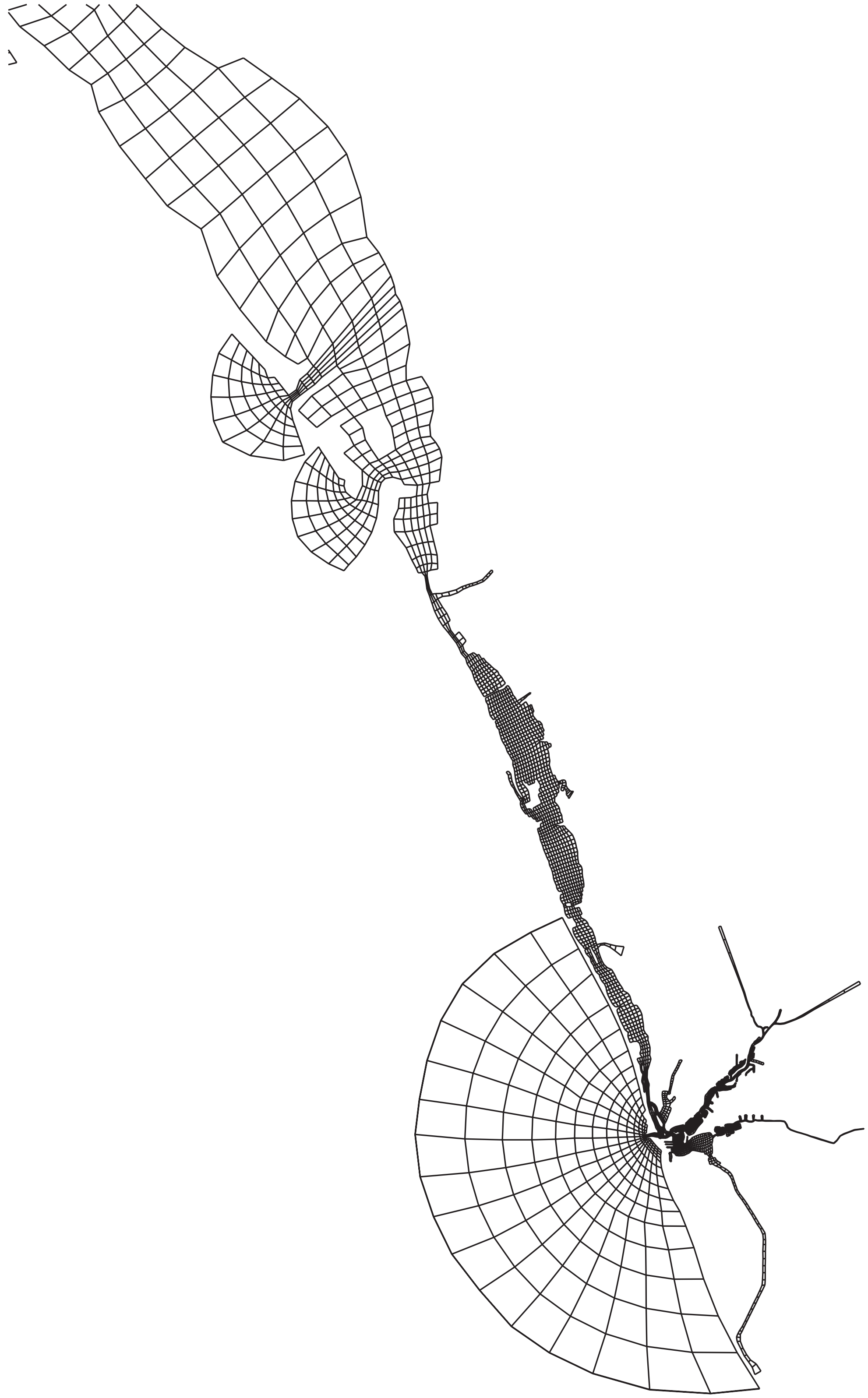

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Figure 2-1
Model Grid for Entire Solution Domain

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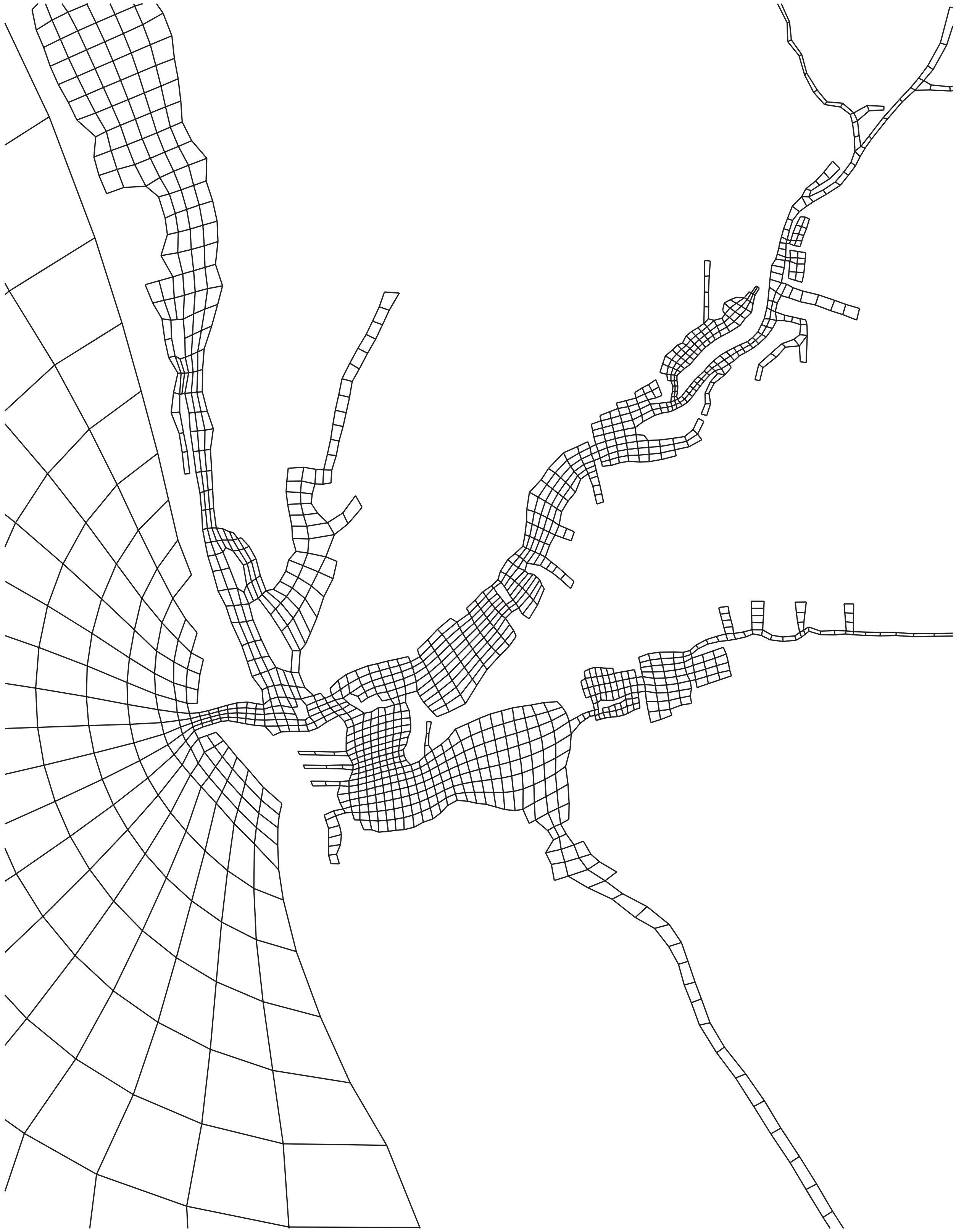

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Figure 2-2
Model Grid for Dona and Roberts Bay Region

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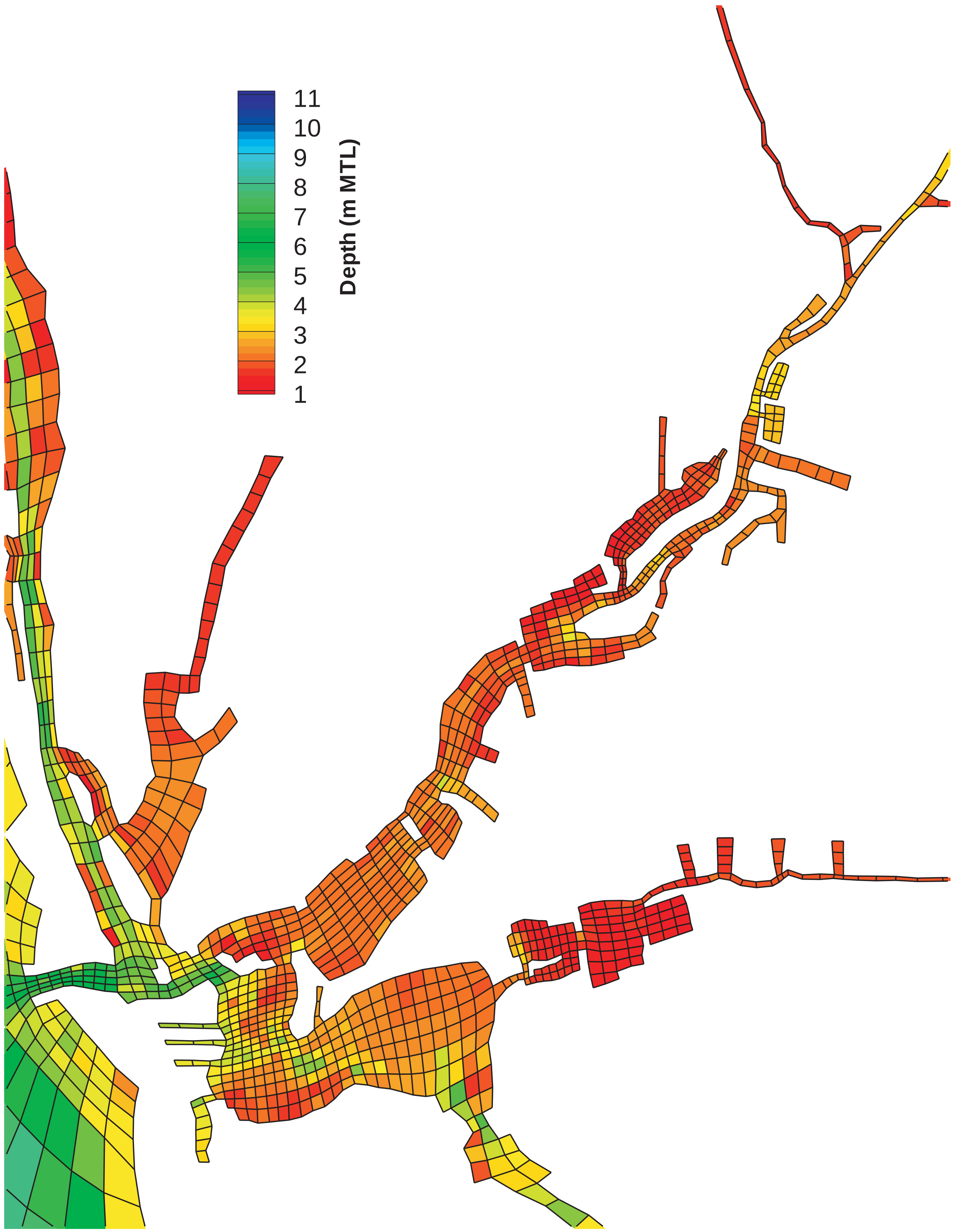

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Figure 2-3
Model Bathymetry for Dona and Roberts Bay Region

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07-1517 Fig 2-4.CDR 07/17/07

Figure 2-4
Inflow Locations for DARB Region of Model Domain

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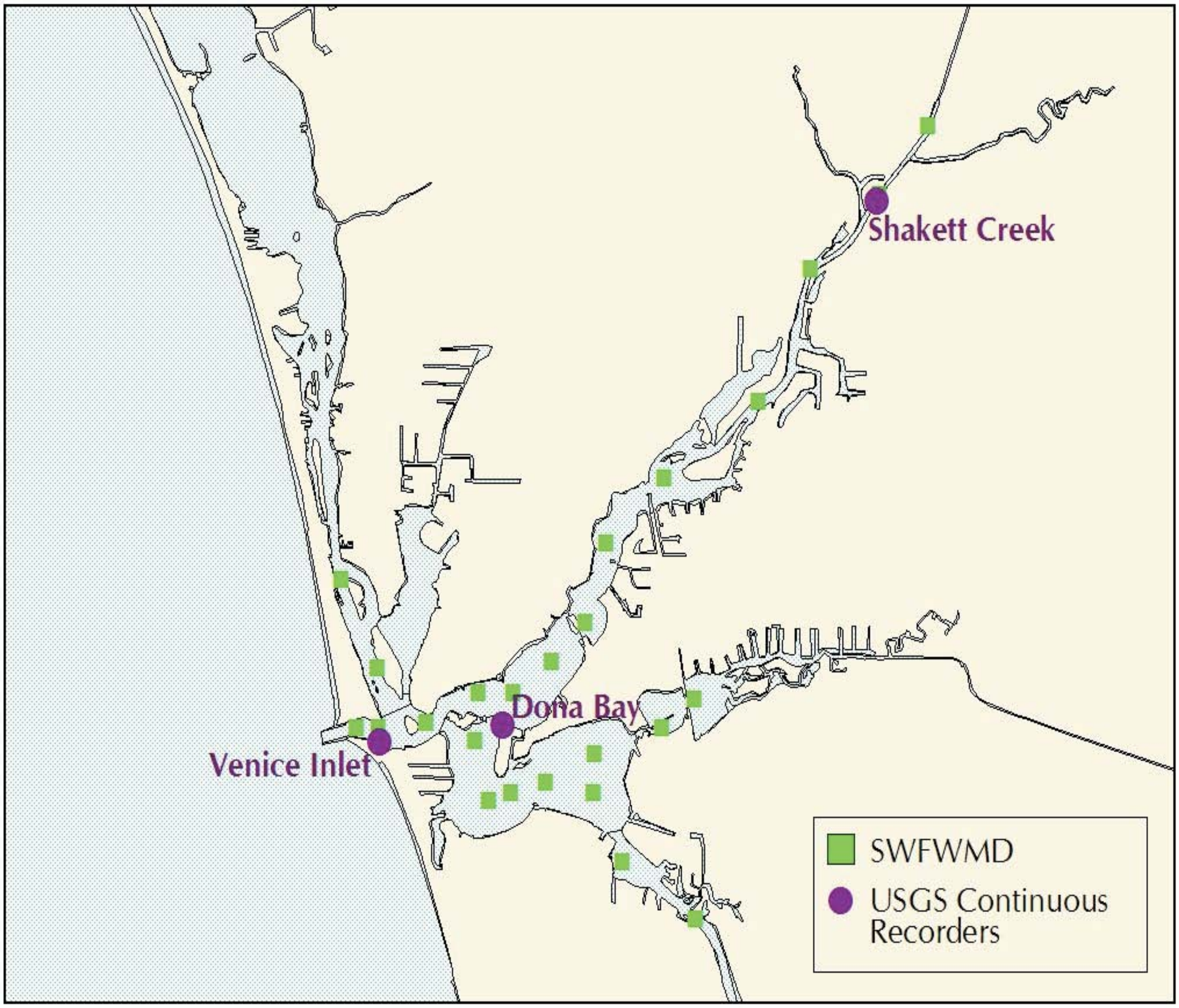
Figure 2-5
Inflow Locations for Northern Region of Model Domain

ATM APPLIED TECHNOLOGY & MANAGEMENT



07-1517 Fig 2-6.CDR 07/17/07

Figure 2-6
Locations and Names of Continuous Recorders (Purple) and Locations of SWFWMD Monitoring Sites (Green)

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3.0 MODEL CALIBRATION AND VALIDATION

This section presents a summary of the results of the model calibration and validation. The results focus on simulation of the time variant water levels and the time variant salinities.

3.1 SIMULATION PERIODS

As described in Section 2.2, data for the model calibration period were from May 2004 through September 2004. During this time frame freshwater inflow conditions were such that significant salinity variations were recorded at both the Dona Bay and Roberts Bay stations. Figure 3-1 provides the freshwater inflow during the model calibration period. The input flows for the calibration period ranged between 0 and 913 cfs. As shown in Figure 3-1, there was little freshwater inflow up until July 19. Blackburn Canal and Cow Pen Slough provided the largest flows during the wetter period between July 19 and September 16. The data for this period show fluctuations in salinity levels at the Dona Bay and Shakett Creek stations ranging from 30 ppt down to 0 ppt.

For the model validation, the calibration period was extended to cover from May 2003 through September 2004. As with the calibration period in 2004, the freshwater inflow during the period for 2003 was such that significant salinity variations occurred with ranges at the Dona Bay and Shakett Creek stations once again ranging from 0 to 30 ppt.

3.2 MODEL CALIBRATION

For the model calibration, model parameters were adjusted until the simulated and measured salinities and water levels were reasonable. Figures 3-2 through 3-4 present the simulated versus measured water surface elevation at the Venice Inlet station, the Dona Bay station, and the Shakett Creek station. The data show that the model simulates the changes in water surface elevation moving upstream with slight over predictions of the magnitude of the tidal fluctuations at the Shakett Creek station.

Figures 3-5 through 3-7 present the simulated versus measured salinities at the 3 continuous monitoring stations. Both the data and the model show similar variations in salinity under the varying freshwater inflow with both ranging from near zero to over 30 ppt. The magnitude of the variations and the time frame of the significant changes are nearly identical between the model and the data showing that the model is reasonably simulating the exchange processes.

The errors between the daily-averaged simulated salinity and measured salinity at the USGS gages are summarized in Table 3-1. Overall, the model errors are reasonable and are within 2 ppt more than 70 percent of the time, except at the Donna Bay bottom gage. At this location, the model tends to under-predict salinity at this location by an average of 1.91 ppt.

Table 3-1. Summary of Errors Between the Daily-Averaged Simulated Salinity and Measured Salinity at the USGS Gages

USGS Gage	Mean Error	Mean of Absolute Error	RMSE	RMSE%	% Comparisons Absolute Error <2 ppt
Dona Bay Surface	0.7	1.4	1.8	5%	78%
Dona Bay Bottom	1.9	2.3	3.5	10%	62%
Shakett Cr Surface	0.5	1.3	2.2	6%	77%
Shakett Cr Bottom	-1.0	1.5	2.3	7%	70%
Venice Inlet Surface	-1.1	1.5	2.0	6%	74%
Venice Inlet Bottom	0.1	1.2	1.5	4%	78%

3.3 MODEL VALIDATION

Utilizing the same parameters as those set for the calibration period, the model was run from May 2003 to September 2004. Figures 3-8 and 3-9 present the simulated versus measured salinity for this period at the Dona Bay and Shakett Creek stations. As with the calibration, the model represents the salinity variations both in time frame and magnitude with the same level of accuracy.

Appendix A also presents the comparisons between the model simulations and the discrete salinity monitoring conducted by the District. A total of 21 stations are presented. While not as indicative of the overall performance as the continuous monitoring comparisons, the data do show similar levels of variation with that simulated.

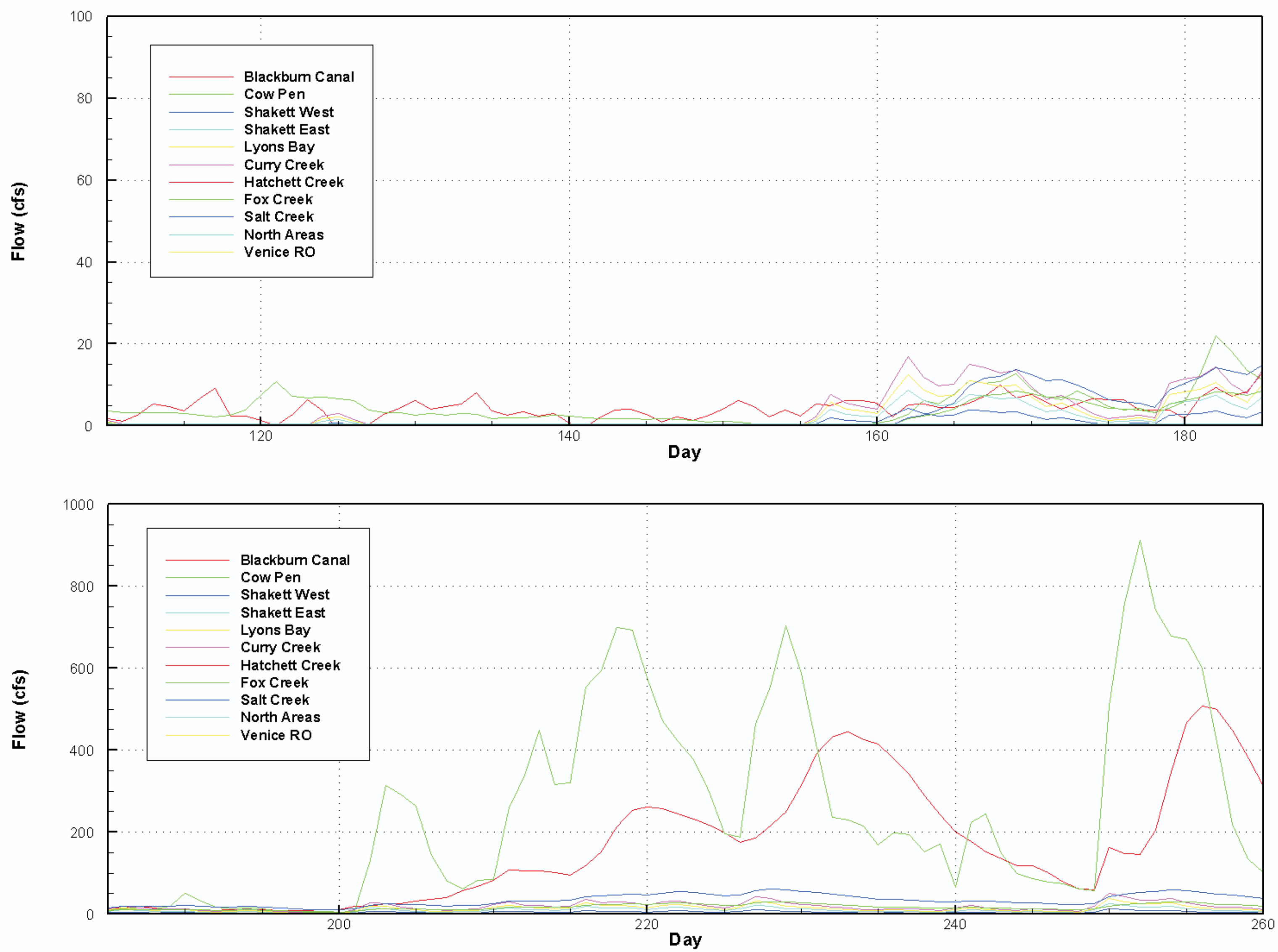

Figure 3-1
Input Freshwater Flows for Calibration Period Simulation

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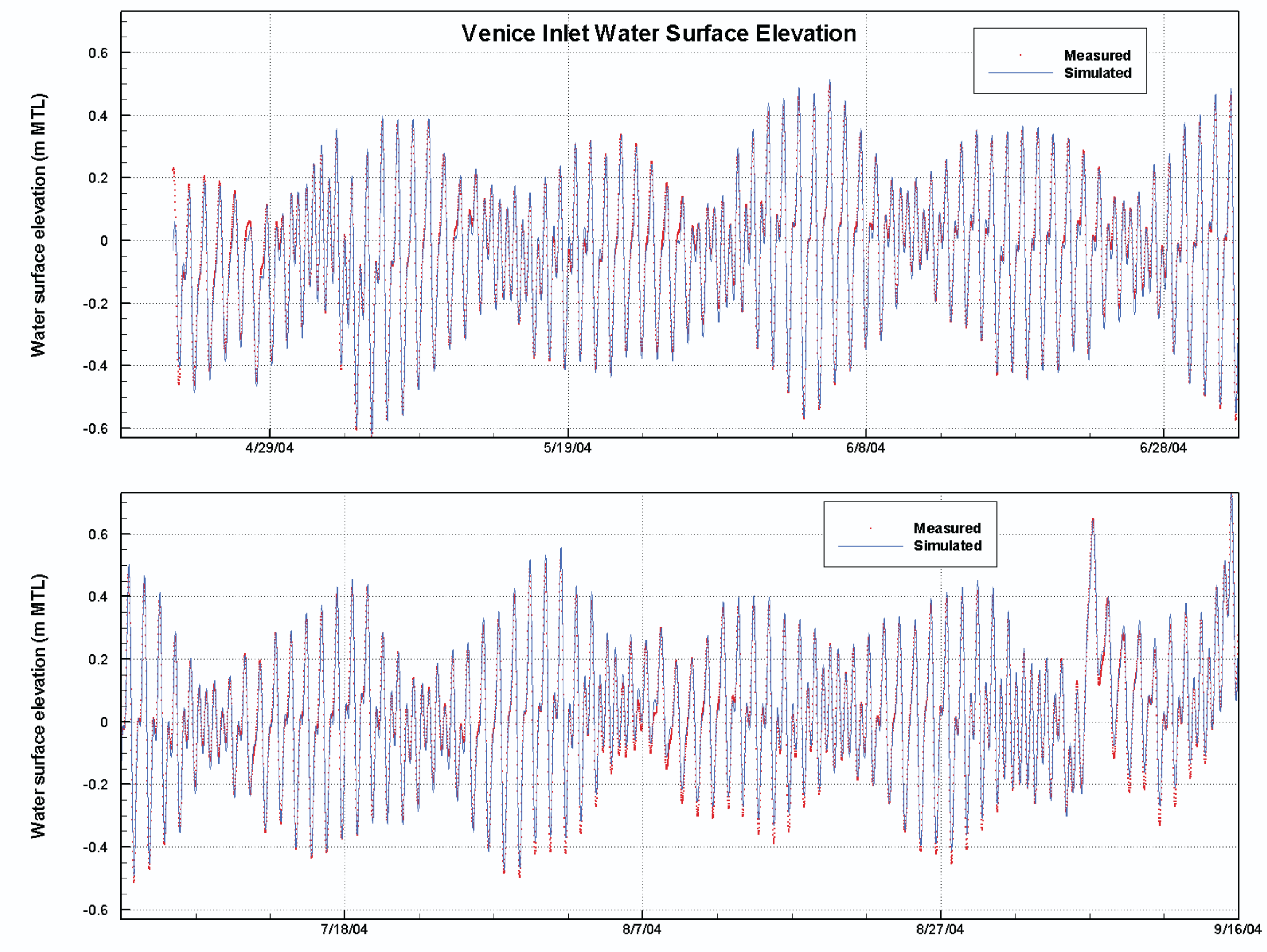

Figure 3-2

Simulated versus Measured Water Surface Elevation at Venice Inlet for Calibration Period (May 2004 to September 2004)

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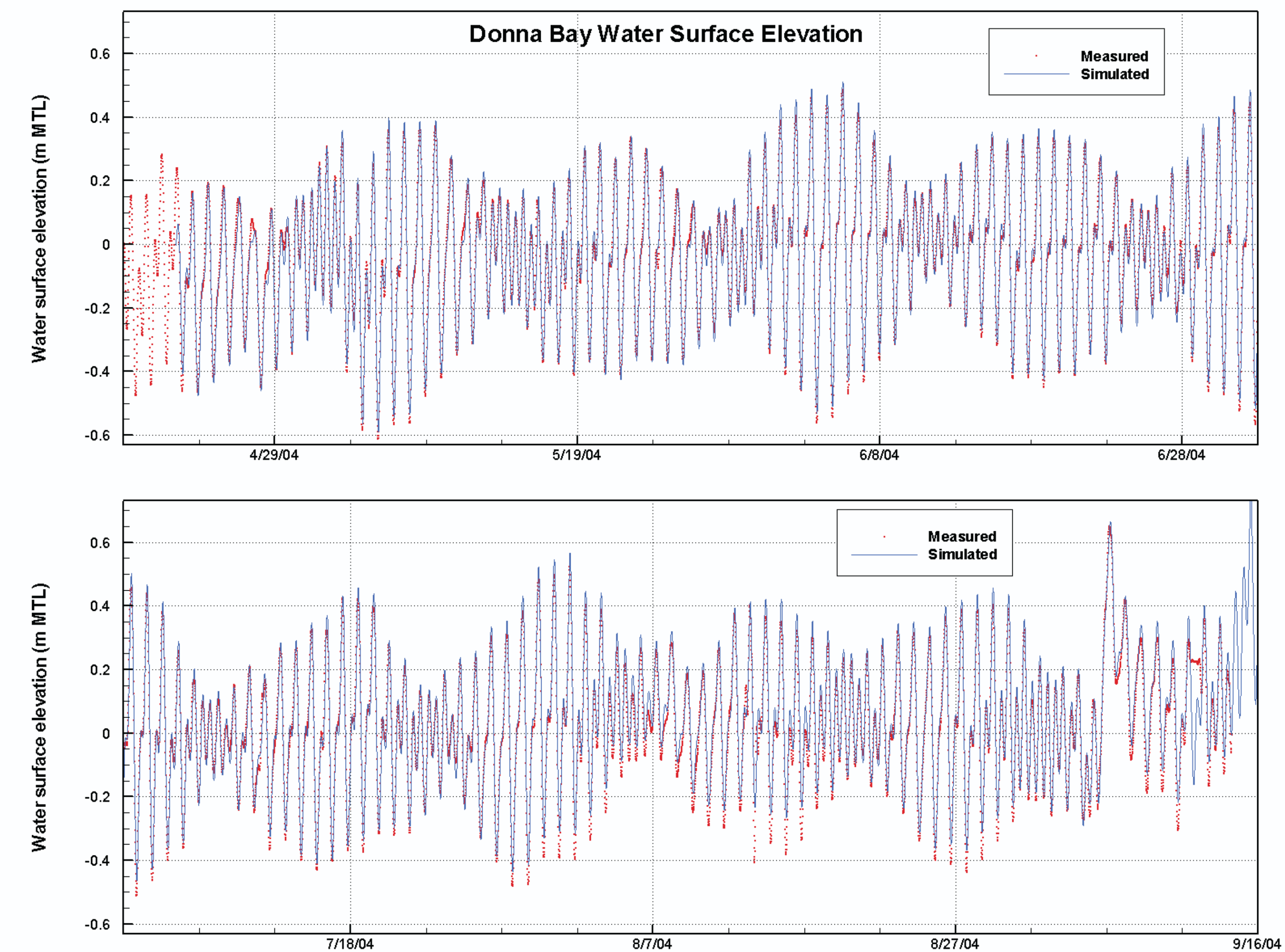

Figure 3-3

Simulated versus Measured Water Surface Elevation at Dona Bay for Calibration Period (May 2004 to September 2004)

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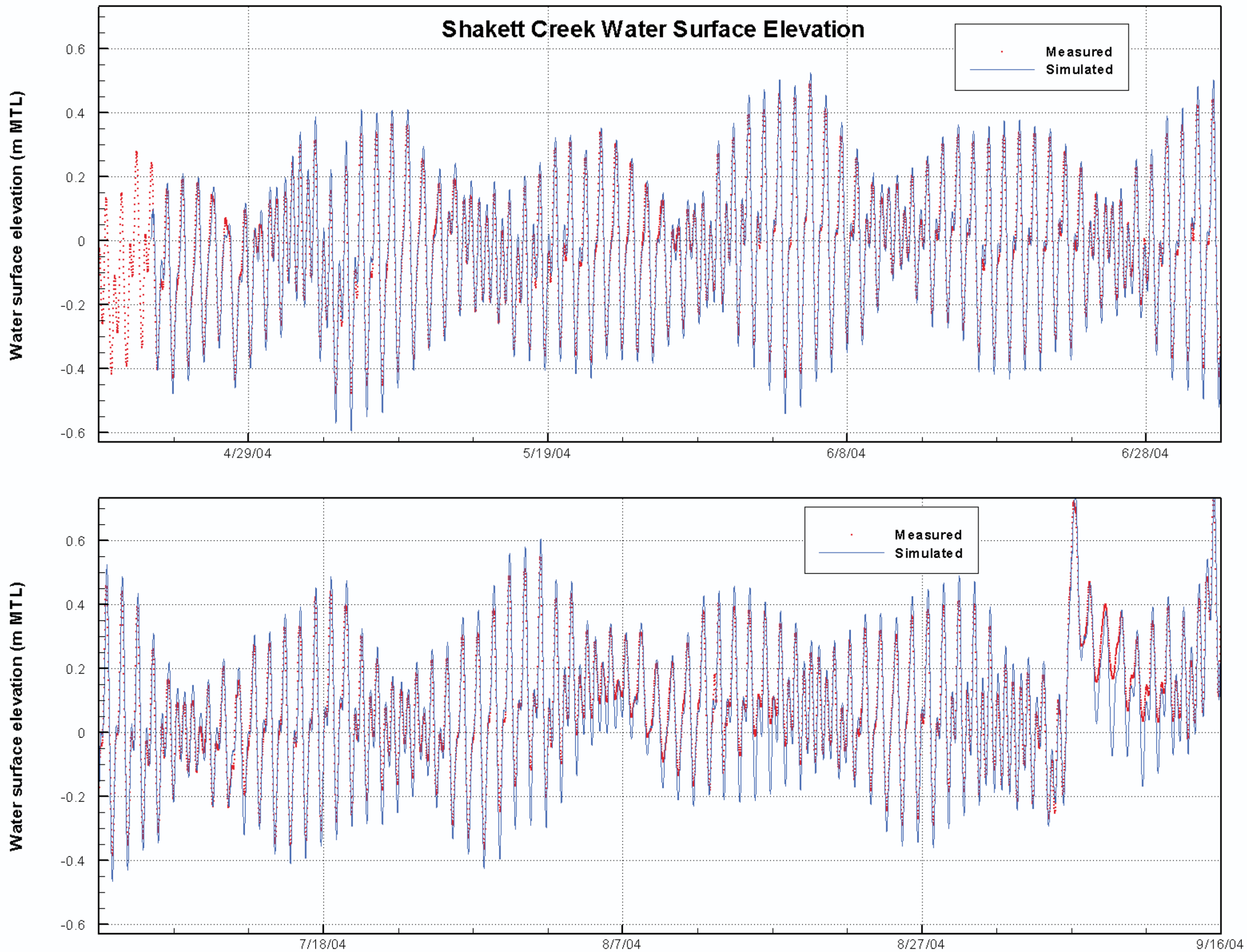

Figure 3-4
Simulated versus Measured Water Surface Elevation at Shakett Creek for Calibration Period (May 2004 to September 2004)

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07-1517 Fig 3-5.CDR 07/17/07

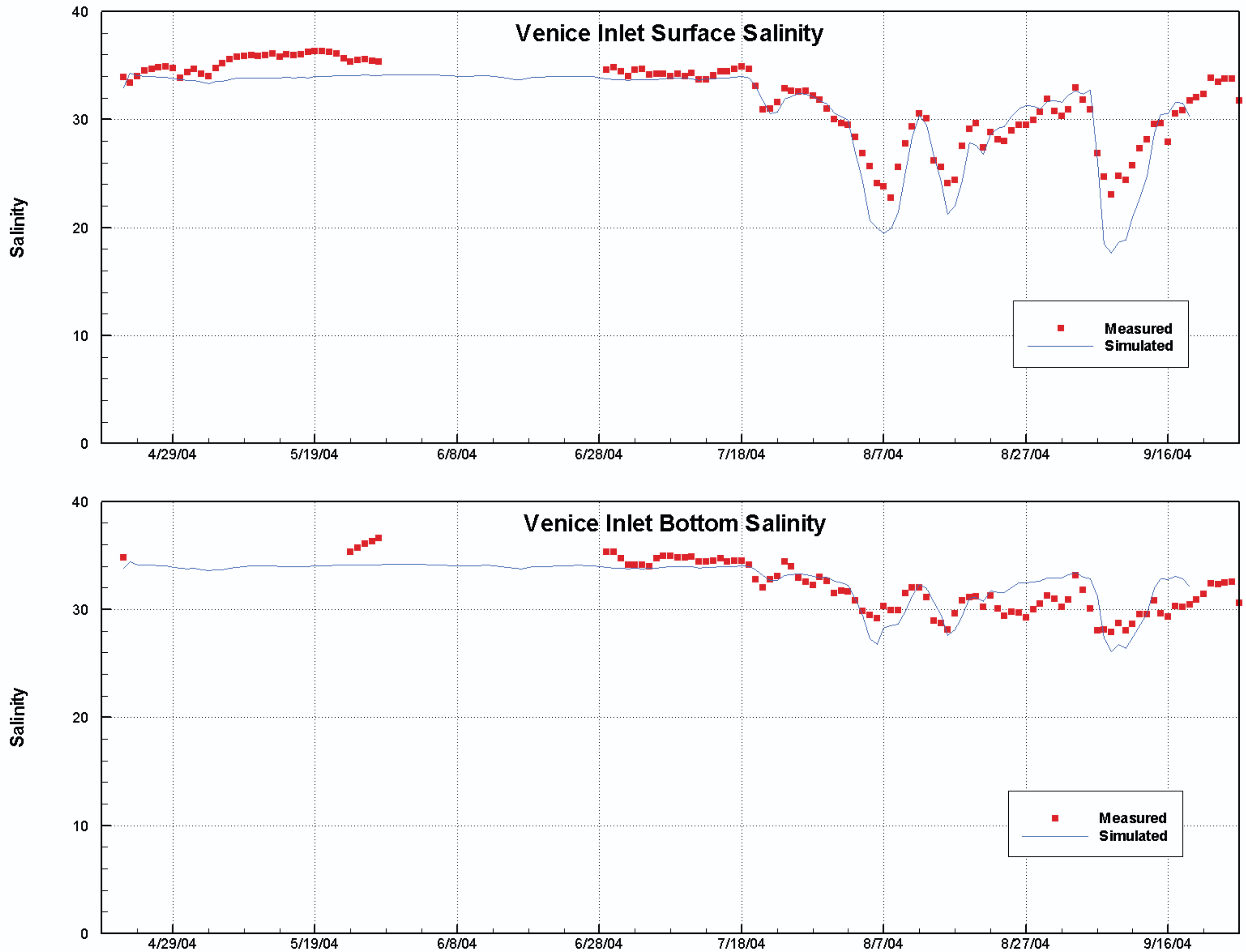

Figure 3-5
Simulated versus Measured Salinity at Venice Inlet for Calibration Period
(May 2004 to September 2004)

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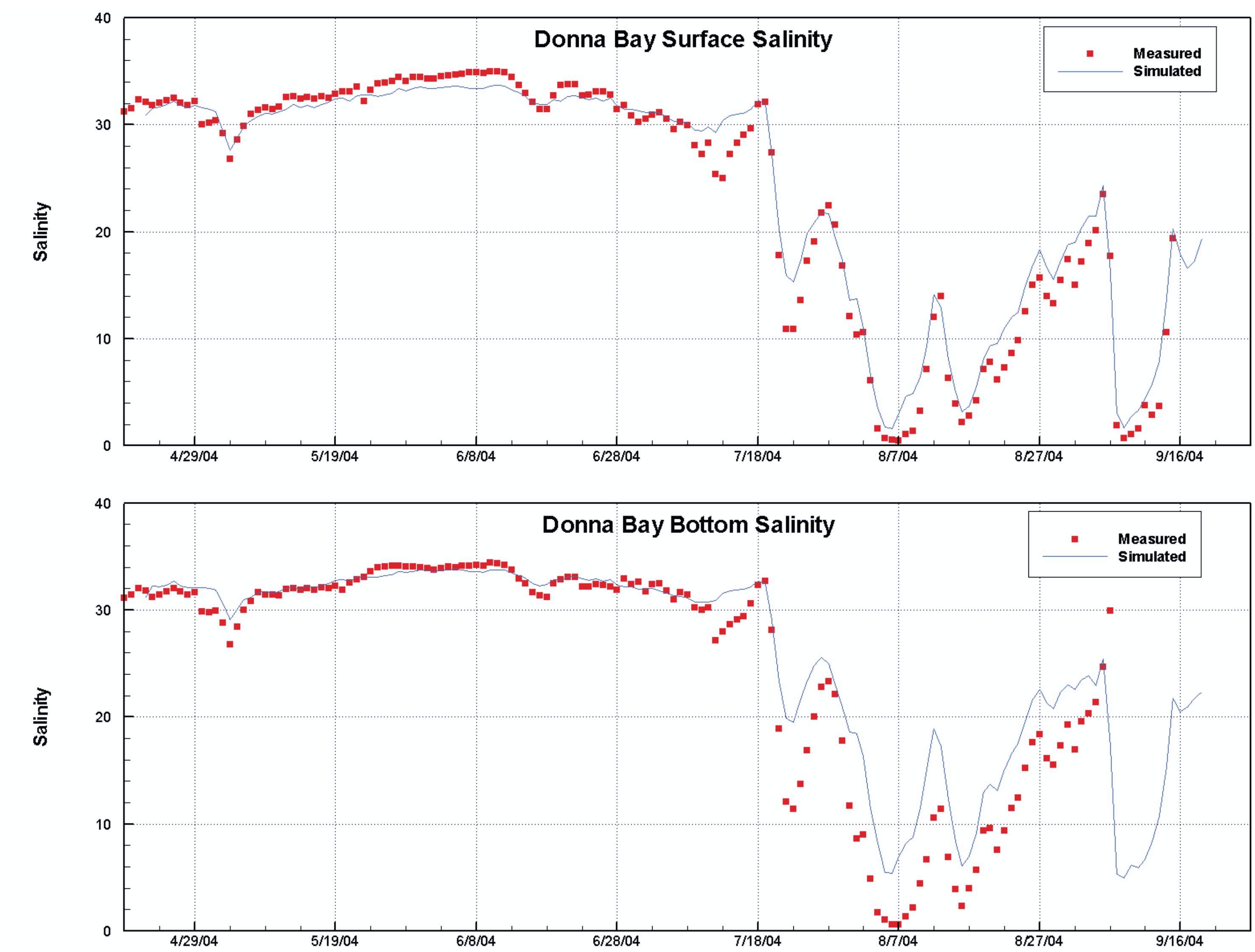

Figure 3-6
Simulated versus Measured Salinity at Dona Bay for Calibration Period
(May 2004 to September 2004)

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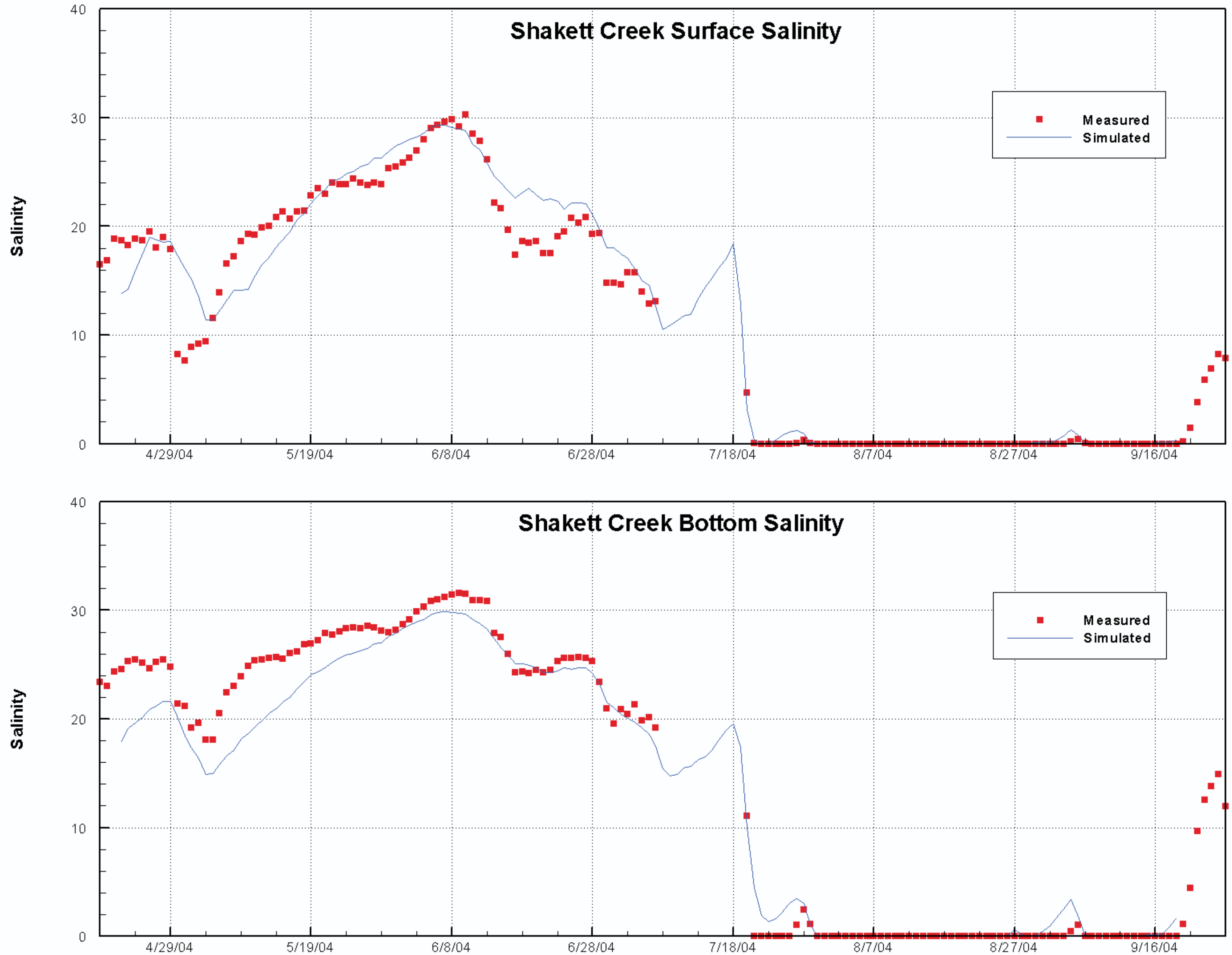

Figure 3-7
Simulated versus Measured Salinity at Shakett Creek for Calibration Period
(May 2004 to September 2004)

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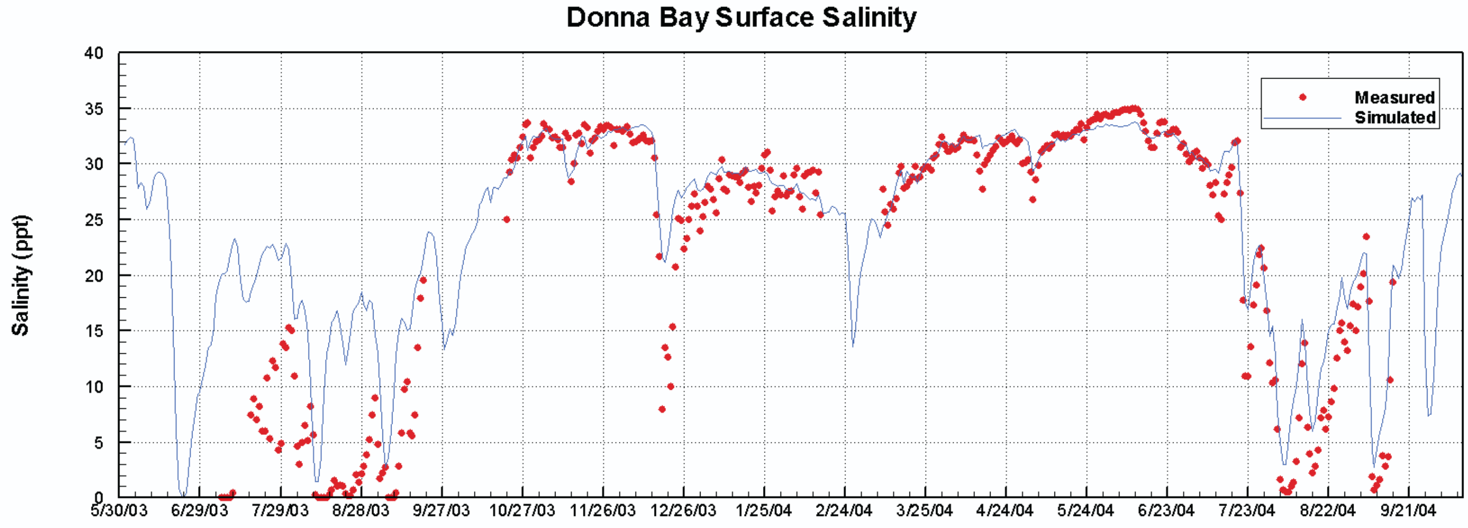

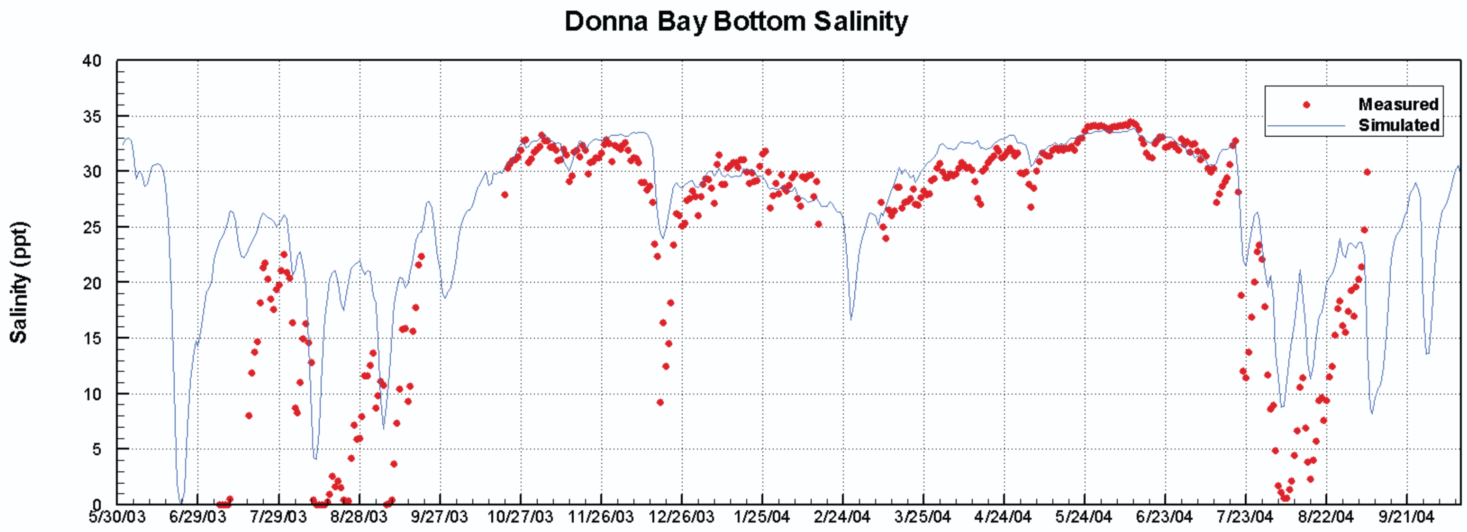

Figure 3-8
Simulated versus Measured Salinity at Dona Bay for Validation Period
(June 2003 to September 2004)

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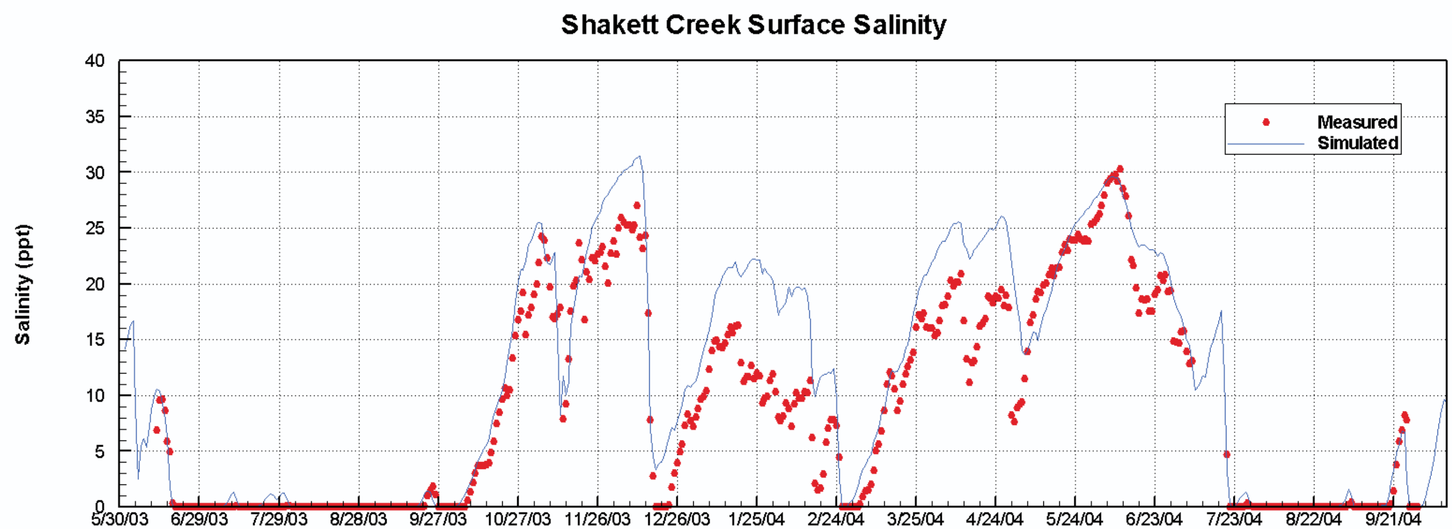

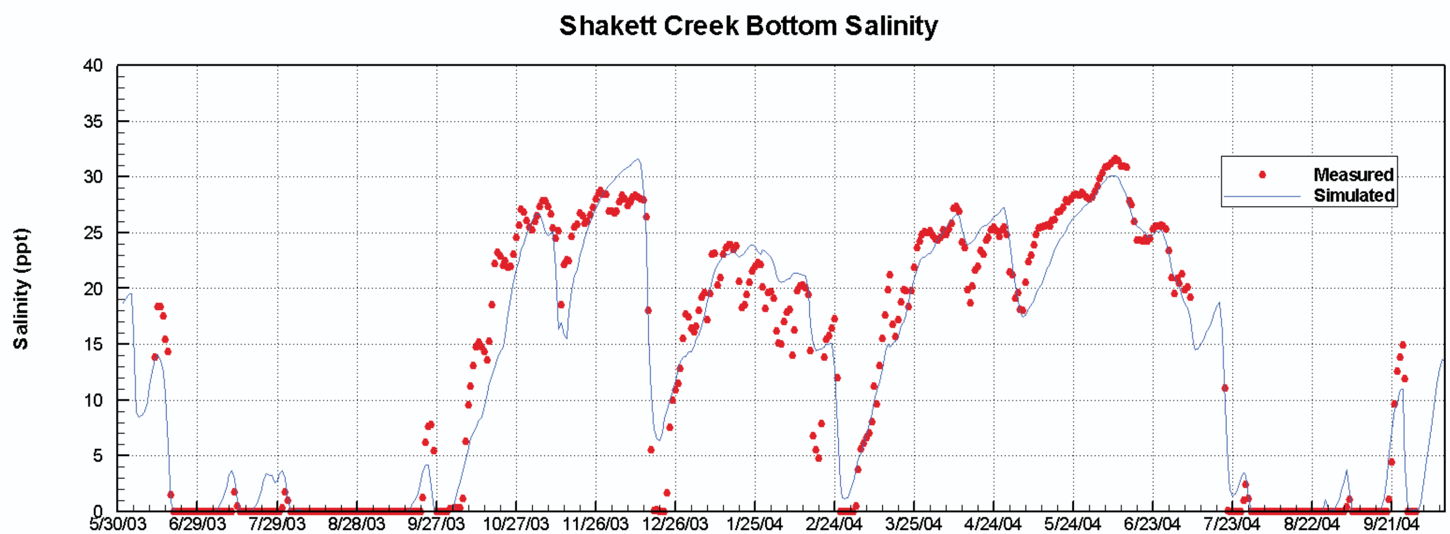

Figure 3-9

Simulated versus Measured Salinity at Shakett Creek for Validation Period (June 2003 to September 2004)

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4.0 REFERENCES

Applied Technology and Management, Inc., and Erickson Consulting Engineers, Inc. 2004. Midnight Pass Reopening Hydrodynamic Modeling Report. Appendix A to the Midnight Pass Reopening Project Design Report. Prepared by Erickson Consulting Engineers for the Sarasota County Board of County Commissioners.

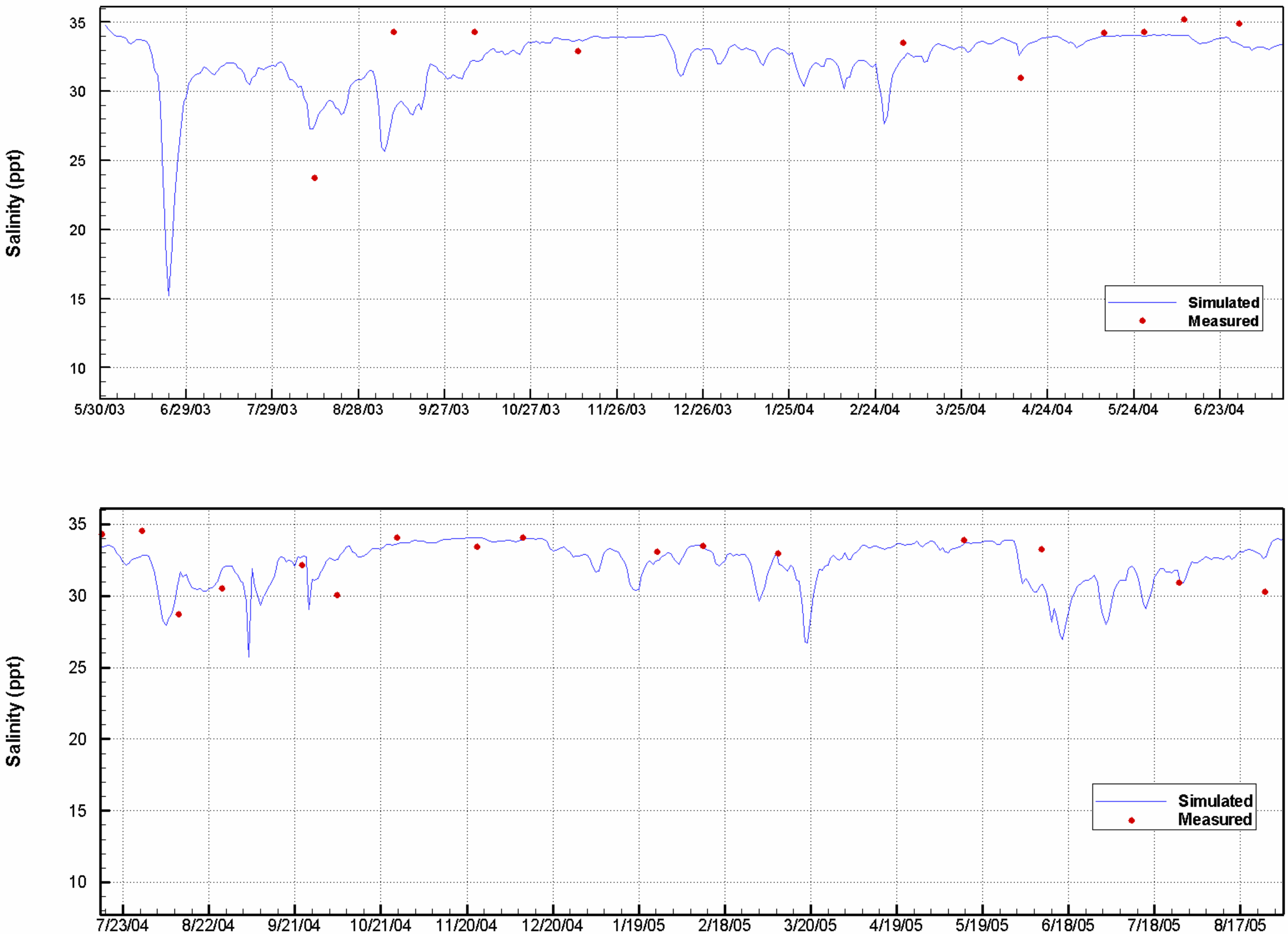
Hamrick, J.M. (1996). User's manual for the environmental fluid dynamics computer code. Special Report No. 331 in Applied Marine Science and Ocean Engineering. Department of Physical Sciences, School of Marine Science, Virginia Institute of Marine Science, The College of William and Mary. Gloucester Point, VA.

Intera, 2007. Estimating the un-gauged inflows in the Cow Pen Slough and Dona-Roberts Bay, Florida. Draft. Prepared for Southwest Florida Water Management District.

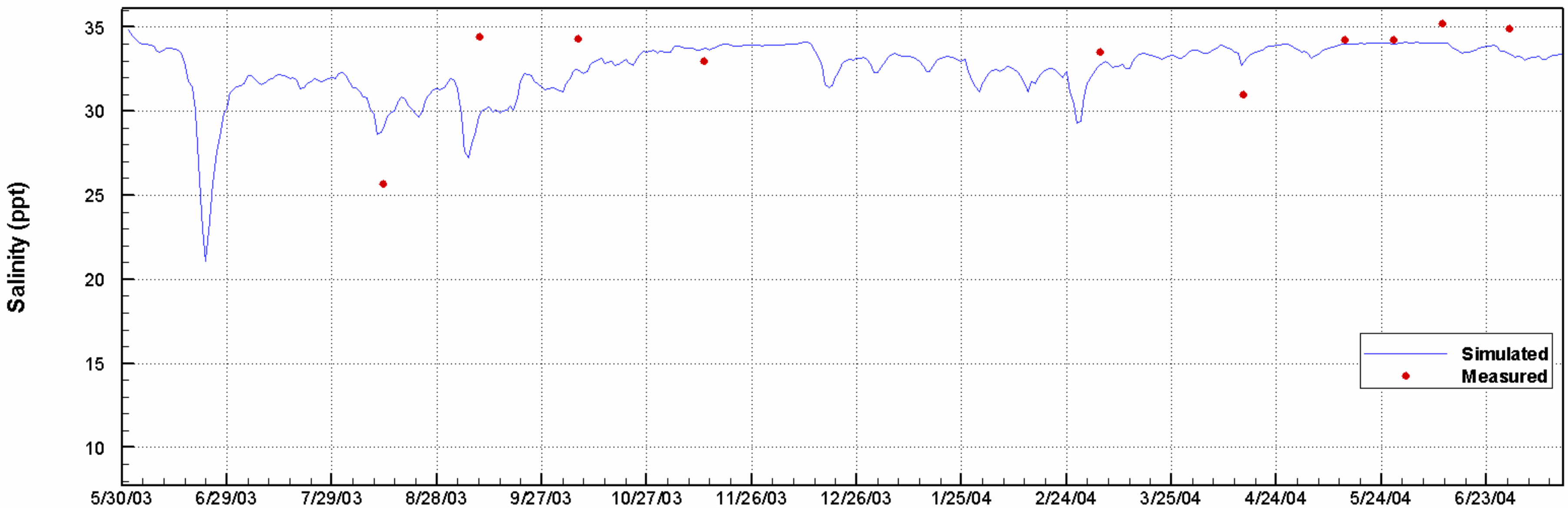
Appendix A

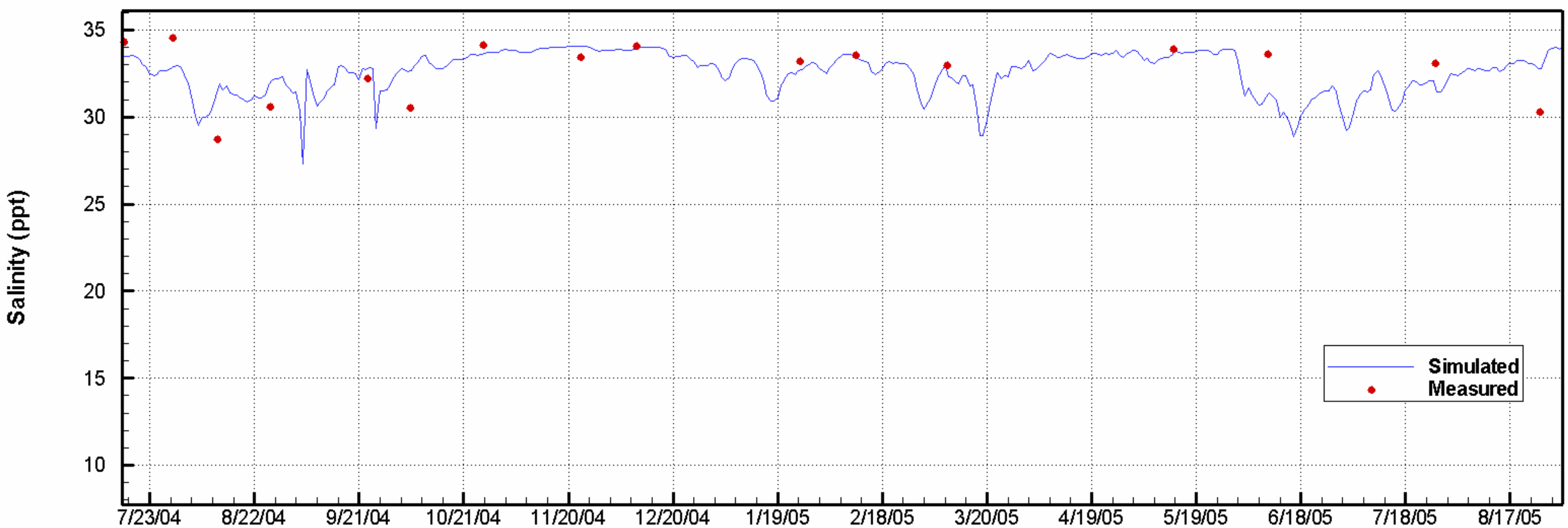
Comparisons between the Model Simulations and the Discrete Salinity Monitoring Conducted by the District

CP1 Surface Salinity

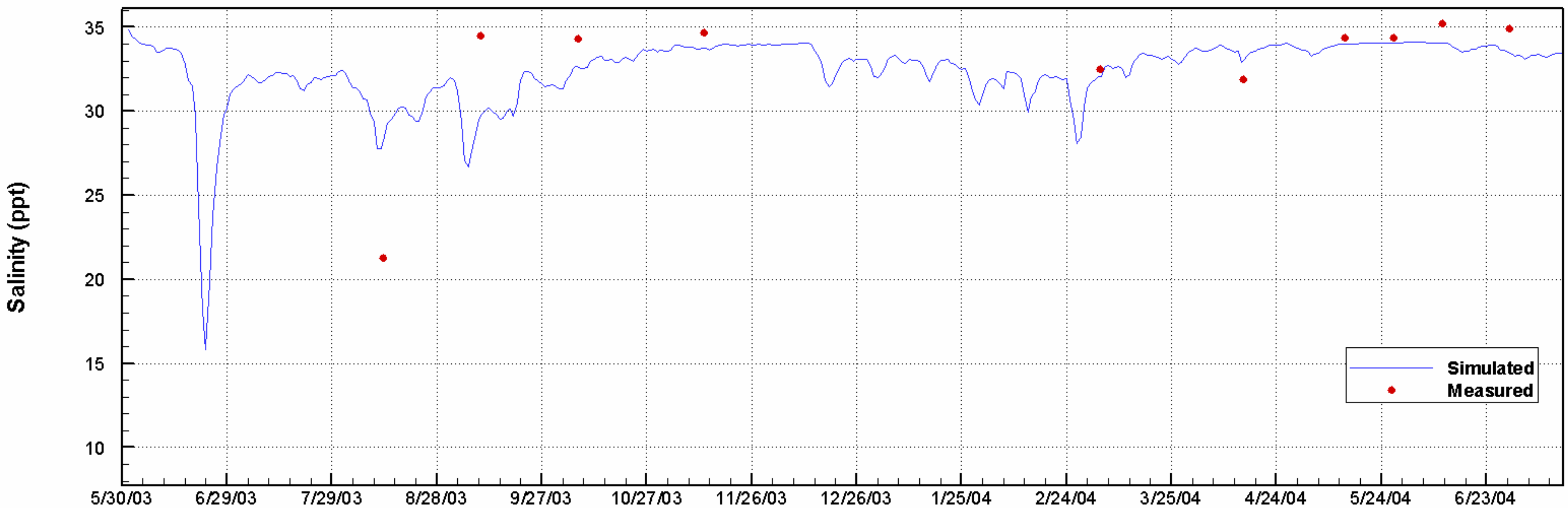


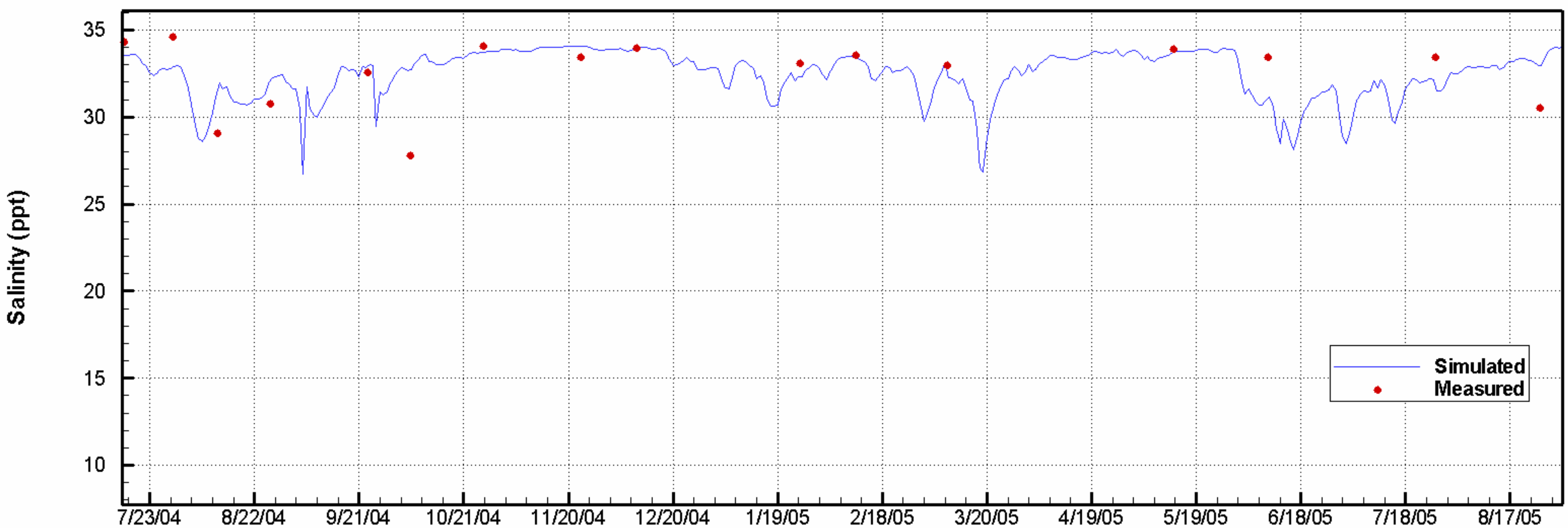
CP1 Bottom Salinity



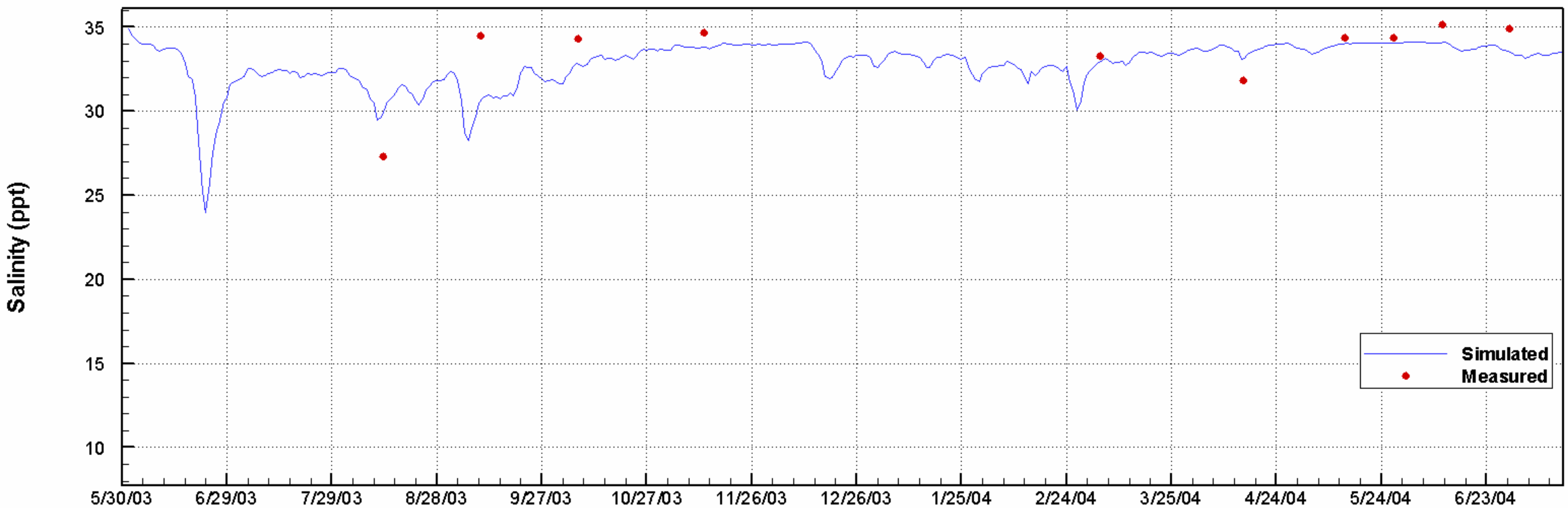


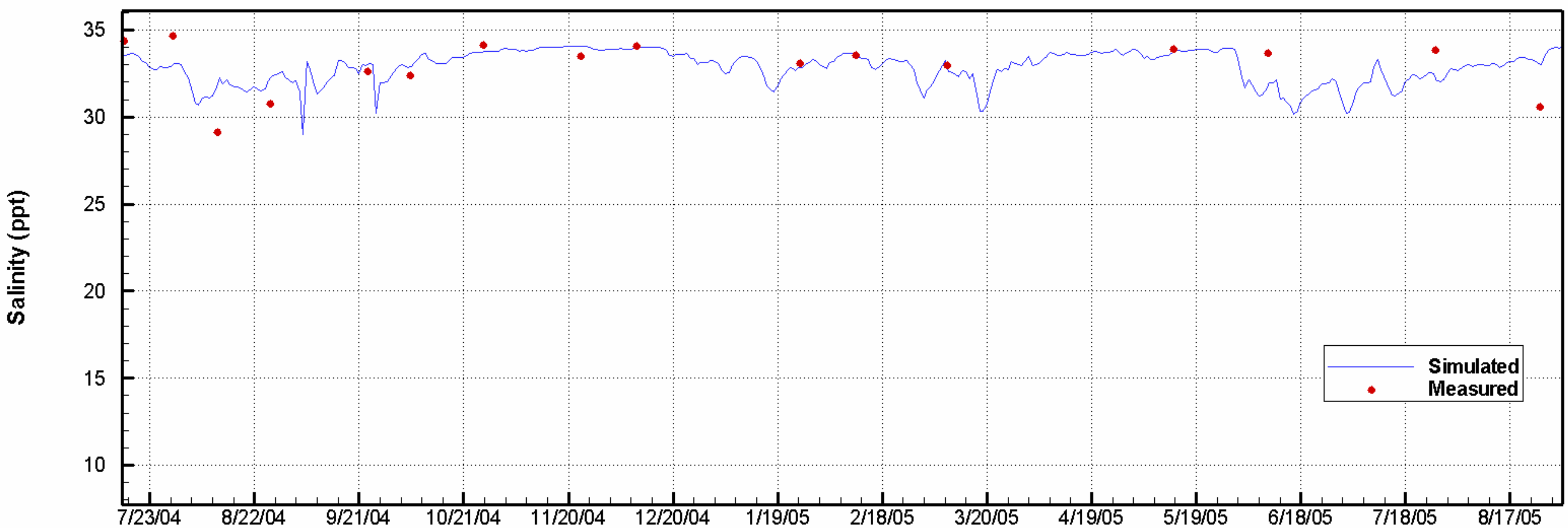
CP2 Surface Salinity



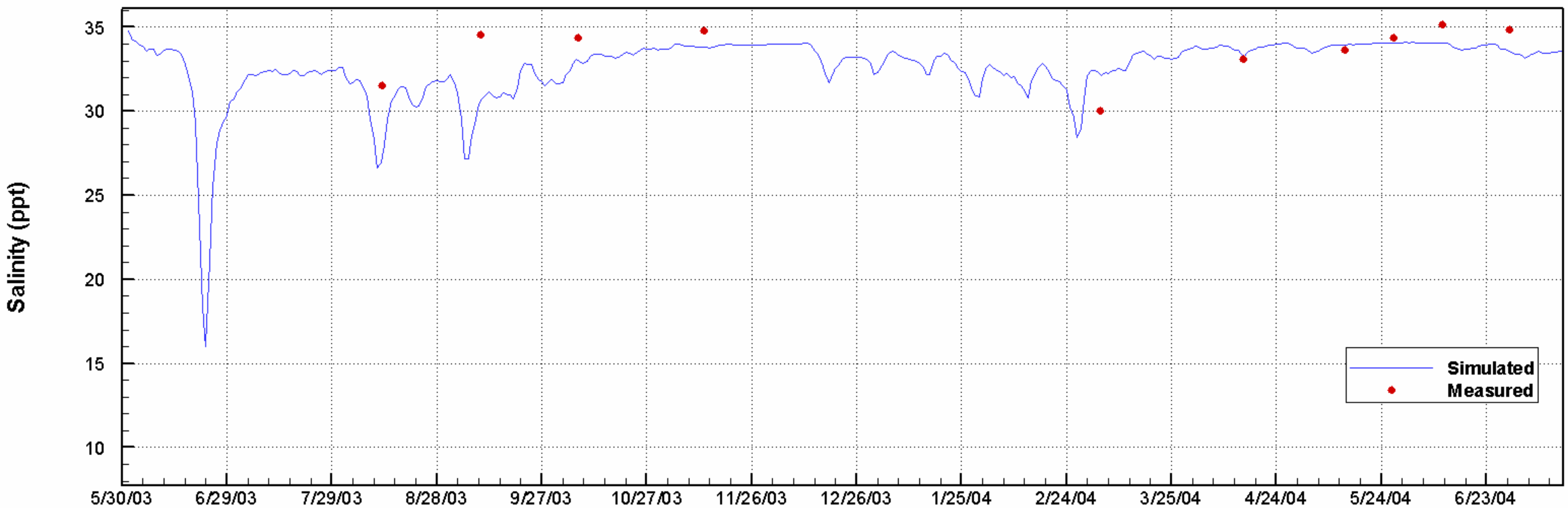


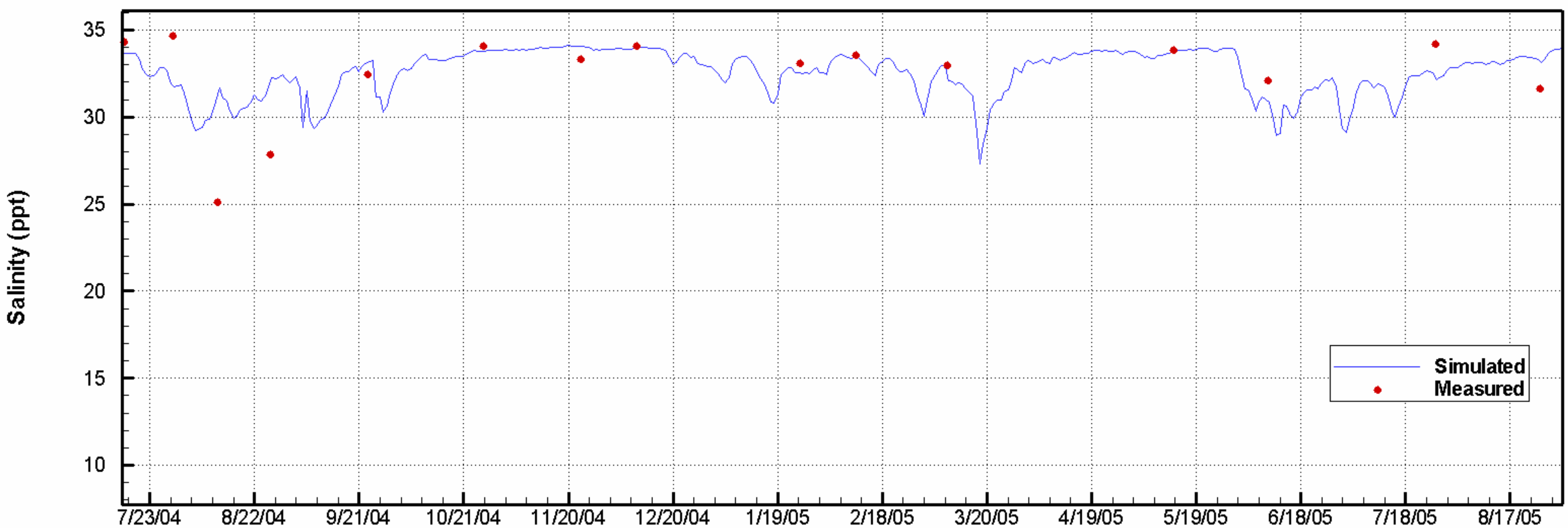
CP2 Bottom Salinity



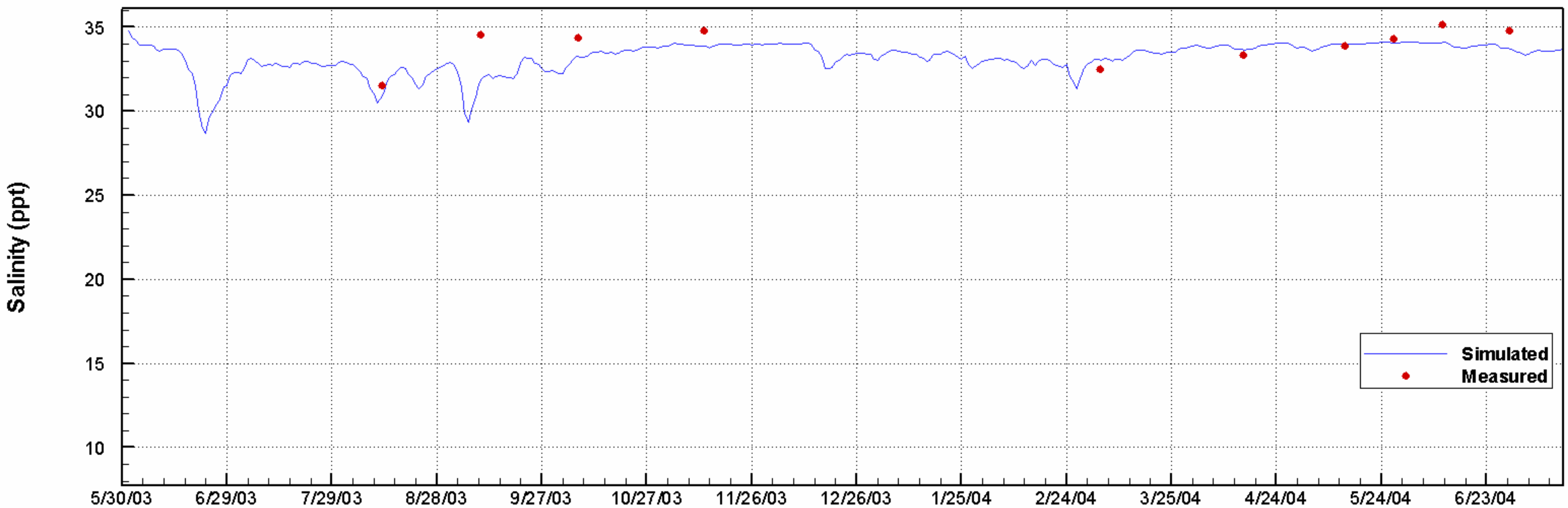


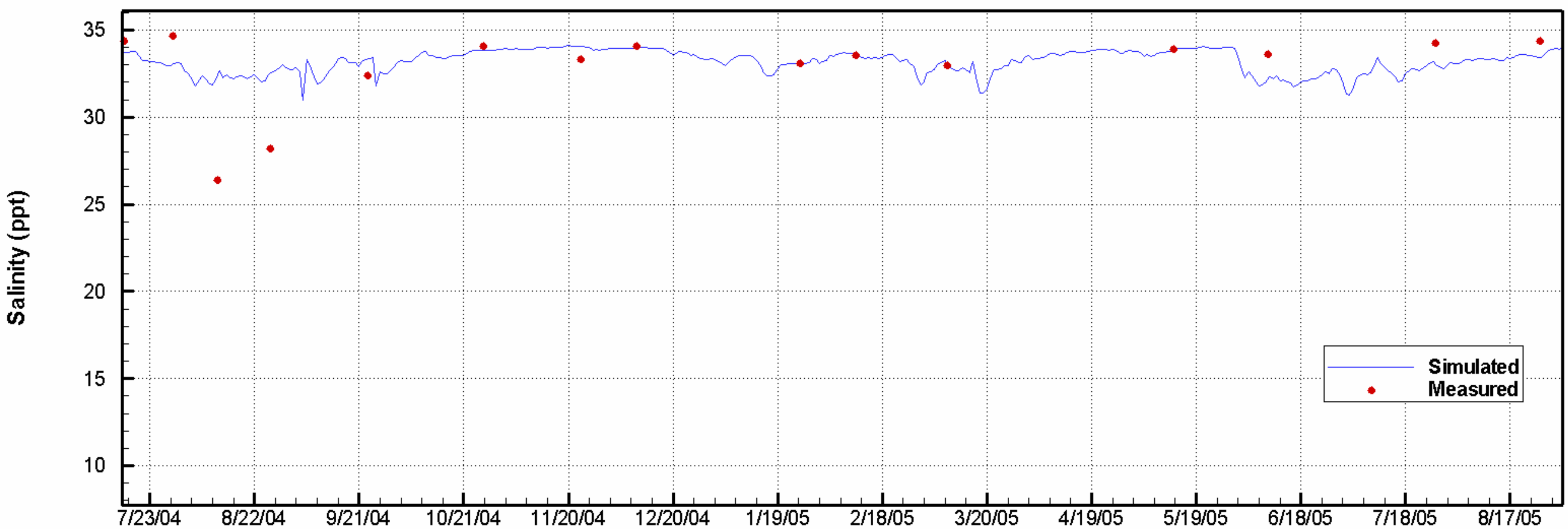
CP3 Surface Salinity



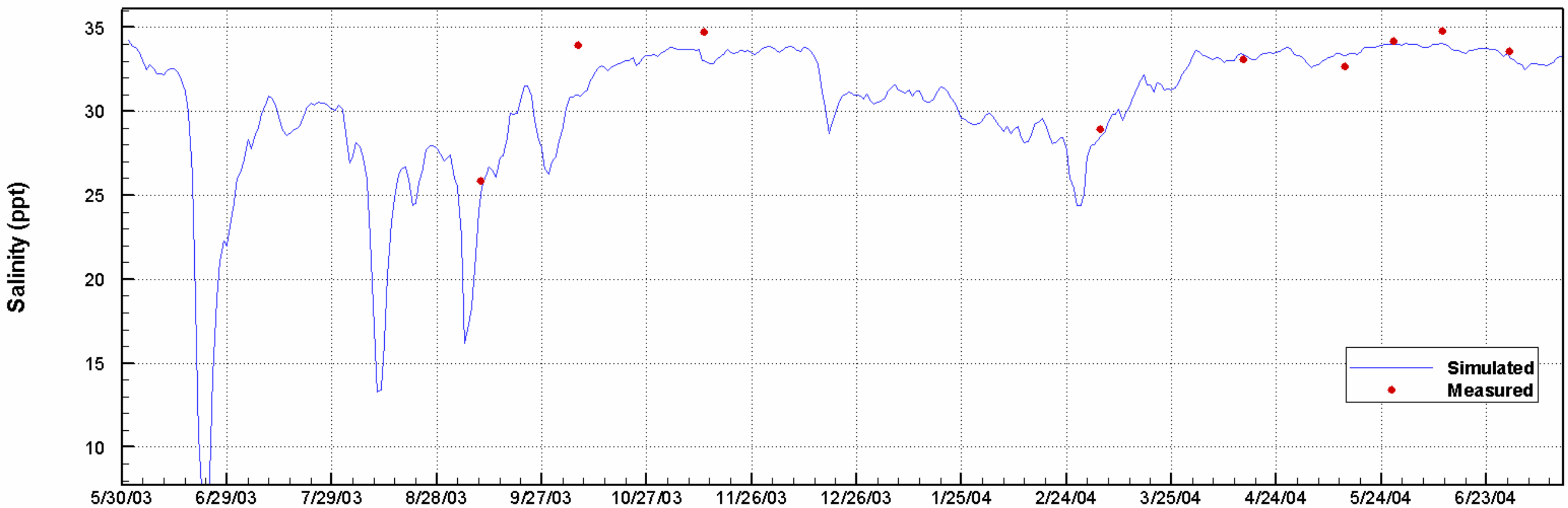


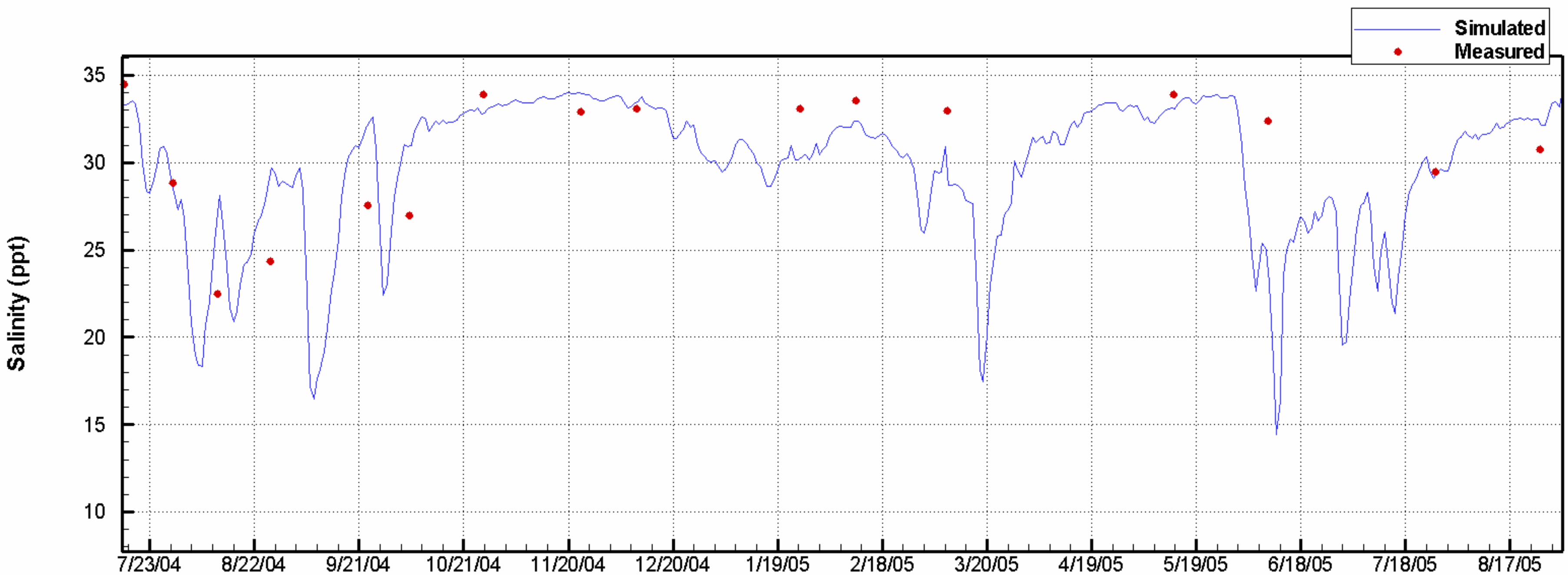
CP3 Bottom Salinity



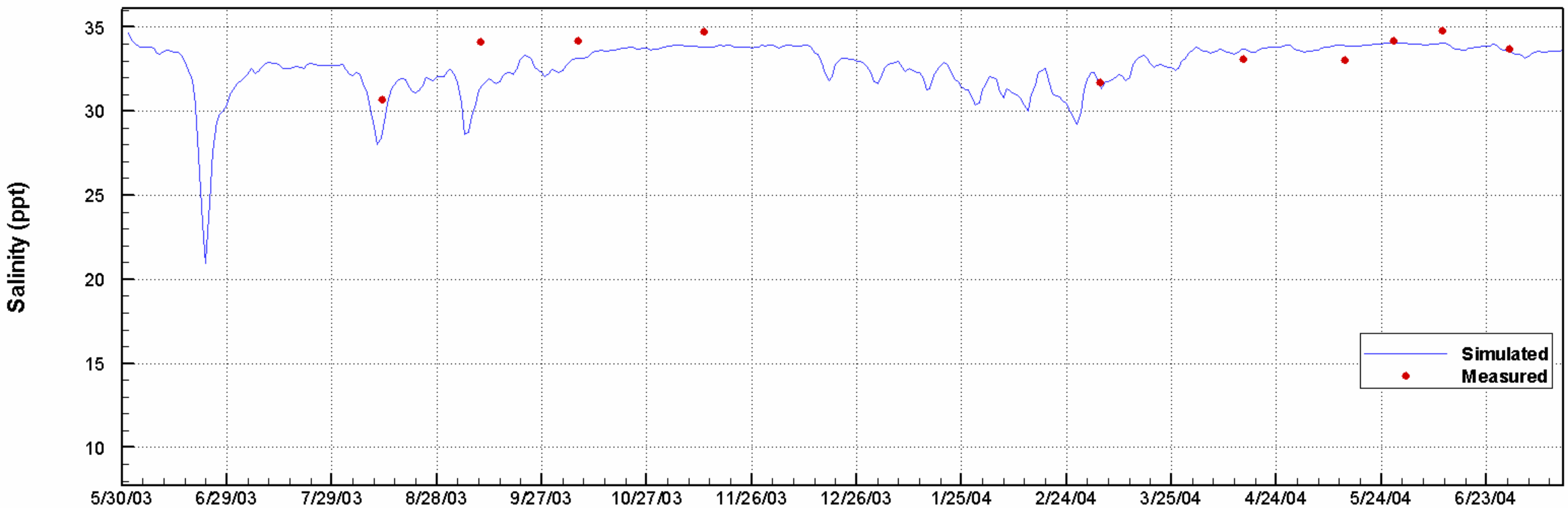


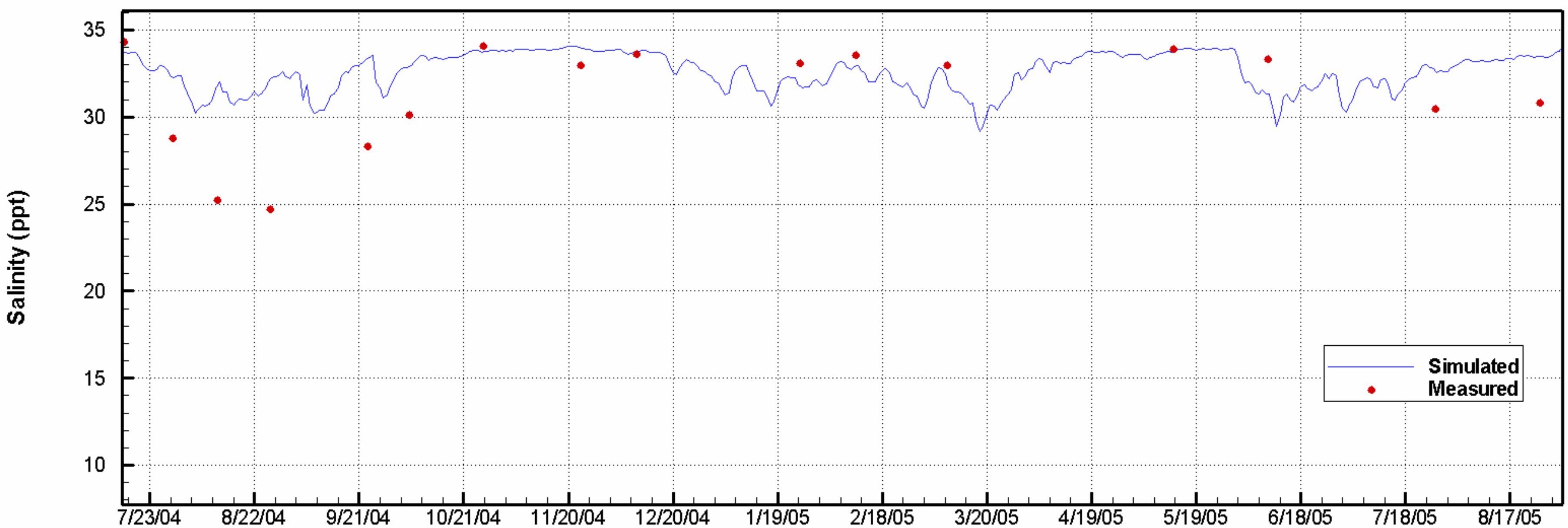
CP5 Surface Salinity

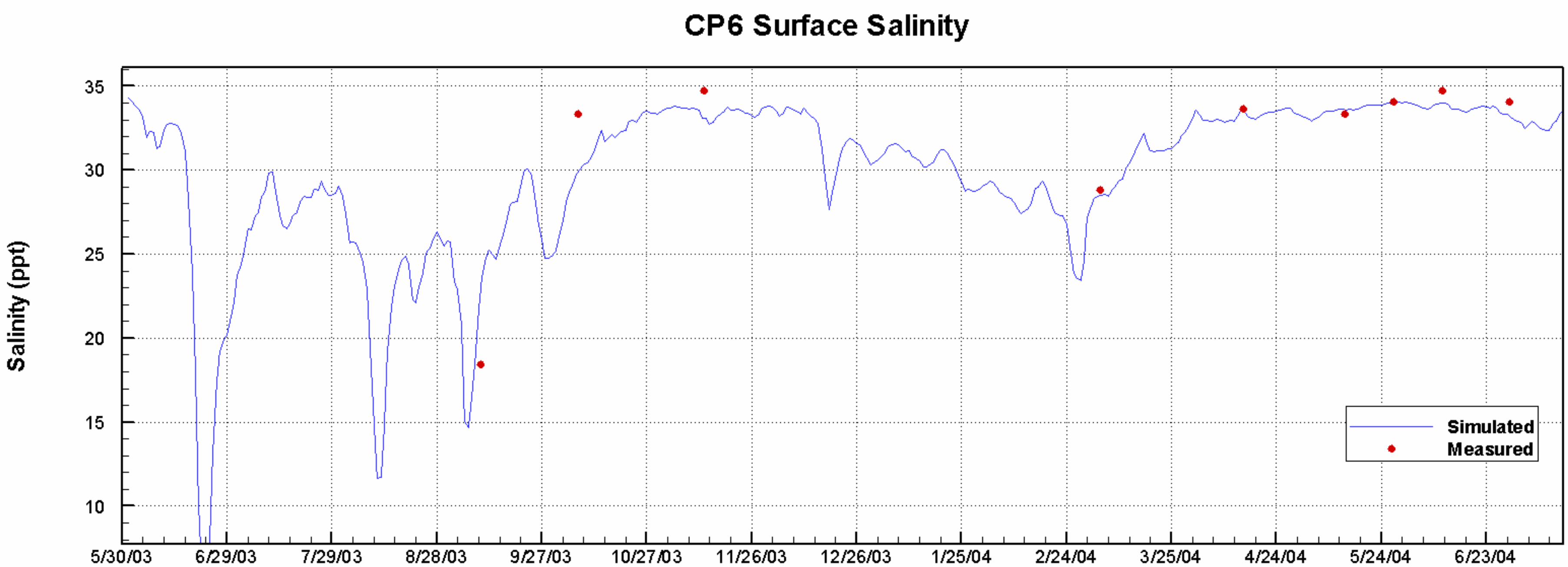


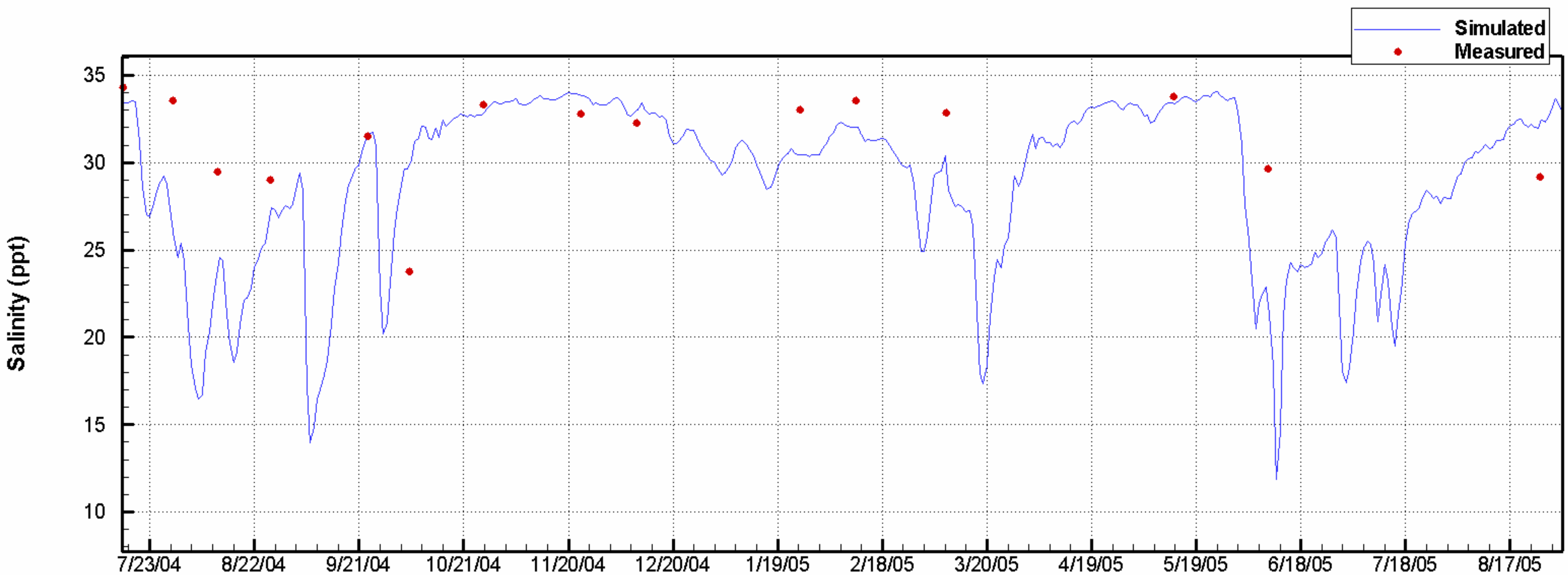


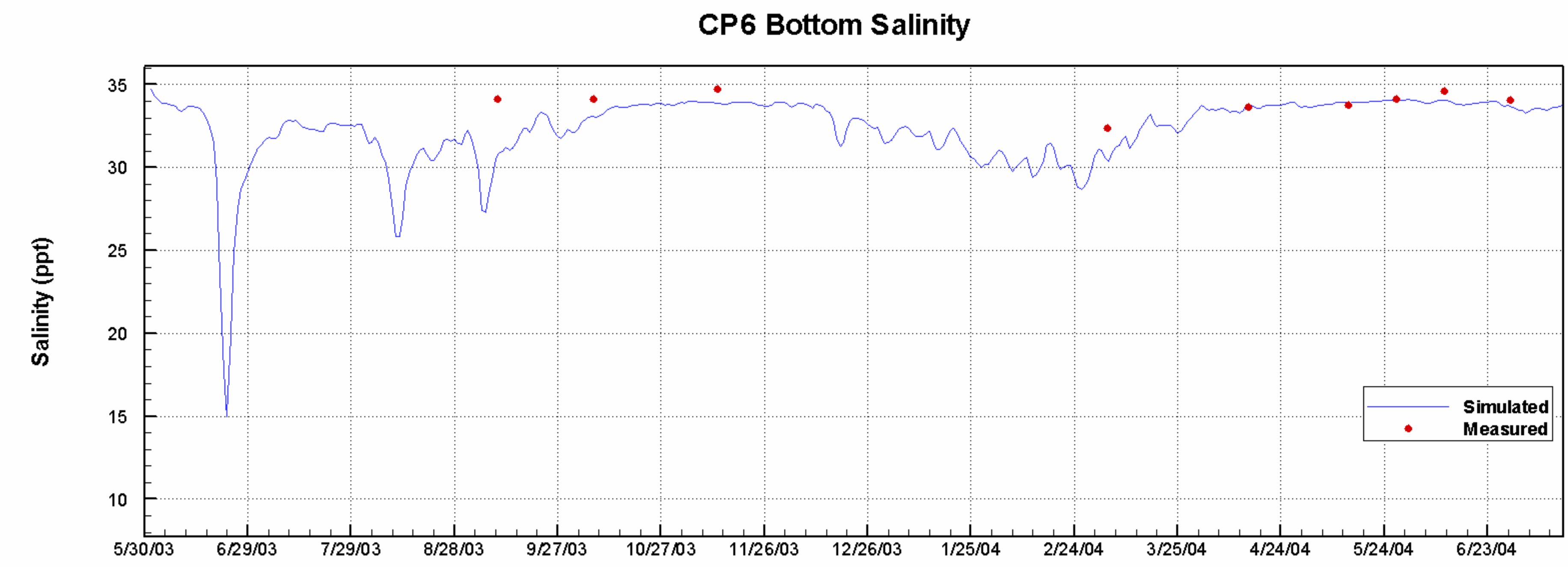
CP5 Bottom Salinity

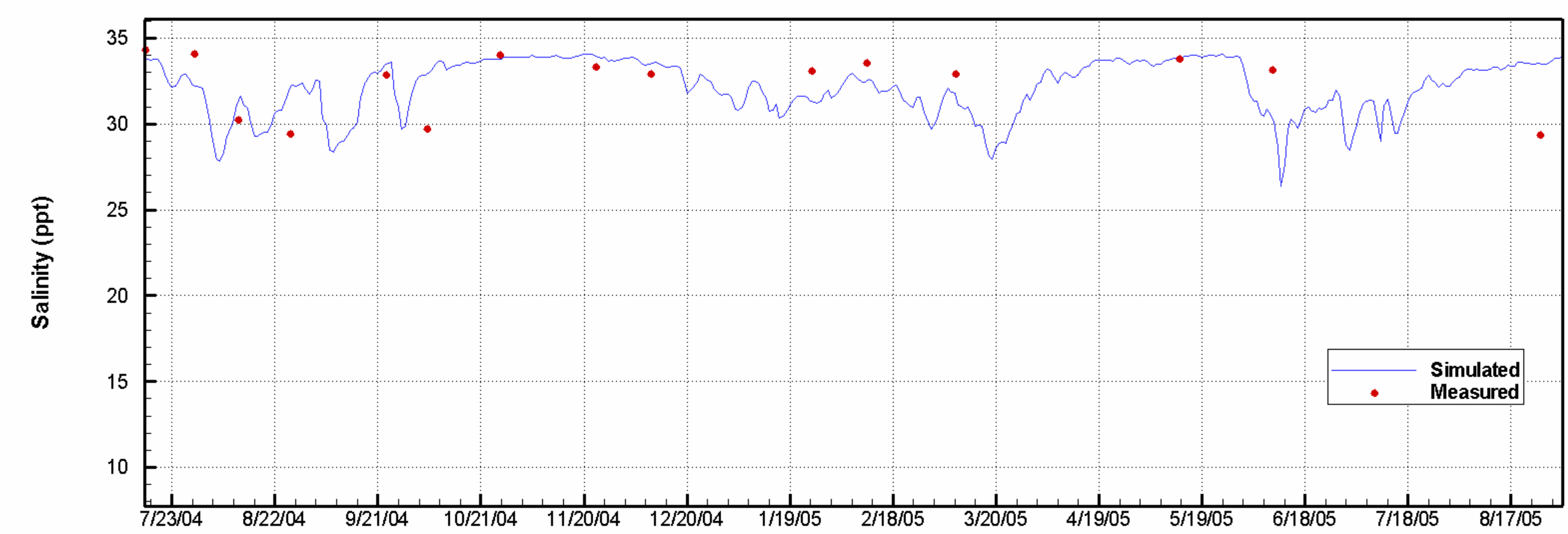




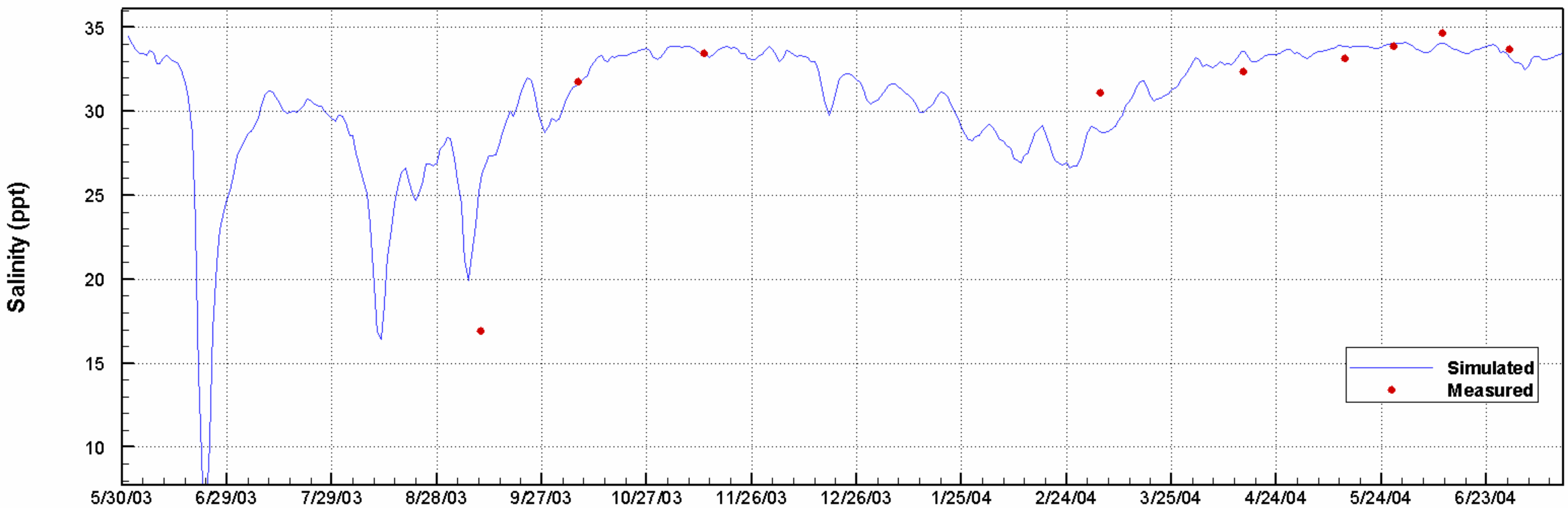

CP6 Surface Salinity
Salinity (ppt)
35
30
25
20
15
10
5/30/03
6/29/03
7/29/03
8/28/03
9/27/03
10/27/03
11/26/03
12/26/03
1/25/04
2/24/04
3/25/04
4/24/04
5/24/04
6/23/04
Simulated
Measured

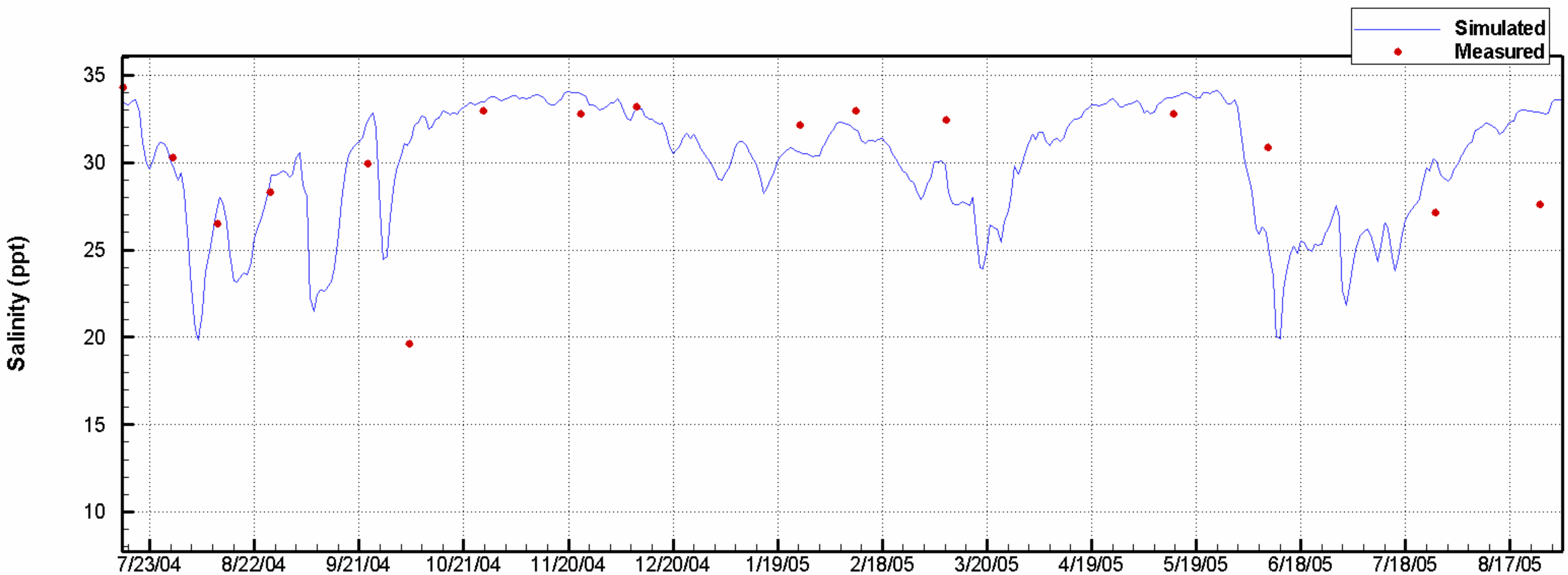

Salinity (ppt)
35
30
25
20
15
10
7/23/04
8/22/04
9/21/04
10/21/04
11/20/04
12/20/04
1/19/05
2/18/05
3/20/05
4/19/05
5/19/05
6/18/05
7/18/05
8/17/05
Simulated
Measured


CP6 Bottom Salinity
Salinity (ppt)
35
30
25
20
15
10
5/30/03
6/29/03
7/29/03
8/28/03
9/27/03
10/27/03
11/26/03
12/26/03
1/25/04
2/24/04
3/25/04
4/24/04
5/24/04
6/23/04
Simulated
Measured

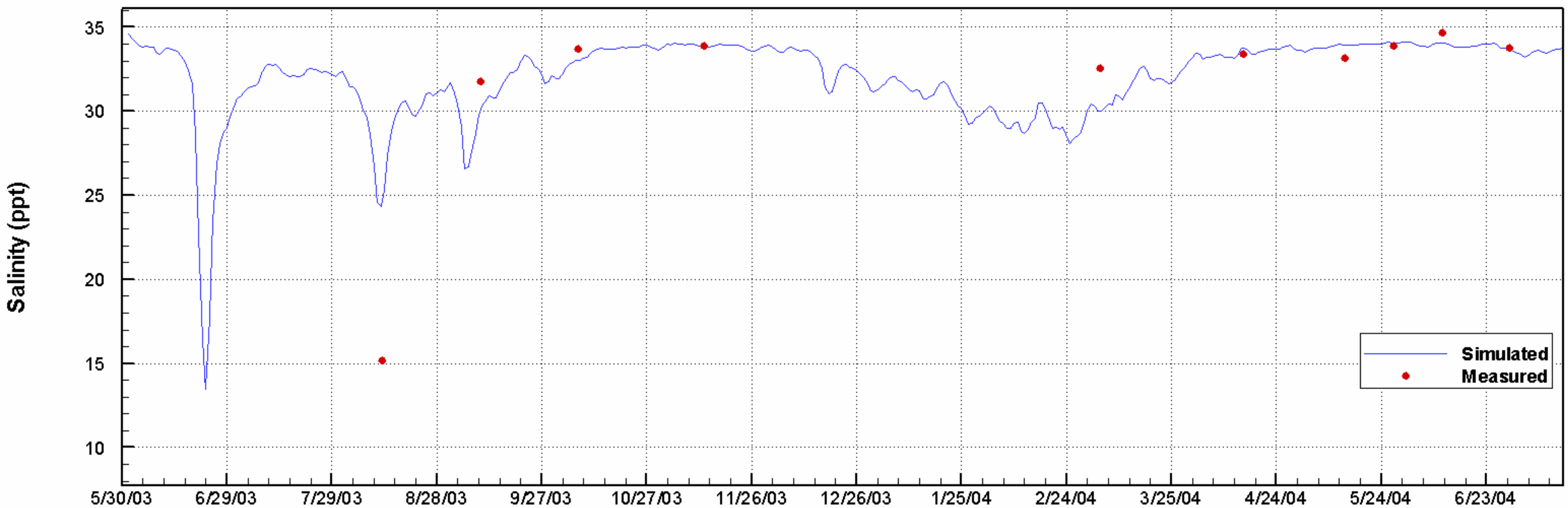

Salinity (ppt)
35
30
25
20
15
10
7/23/04
8/22/04
9/21/04
10/21/04
11/20/04
12/20/04
1/19/05
2/18/05
3/20/05
4/19/05
5/19/05
6/18/05
7/18/05
8/17/05
Simulated
Measured

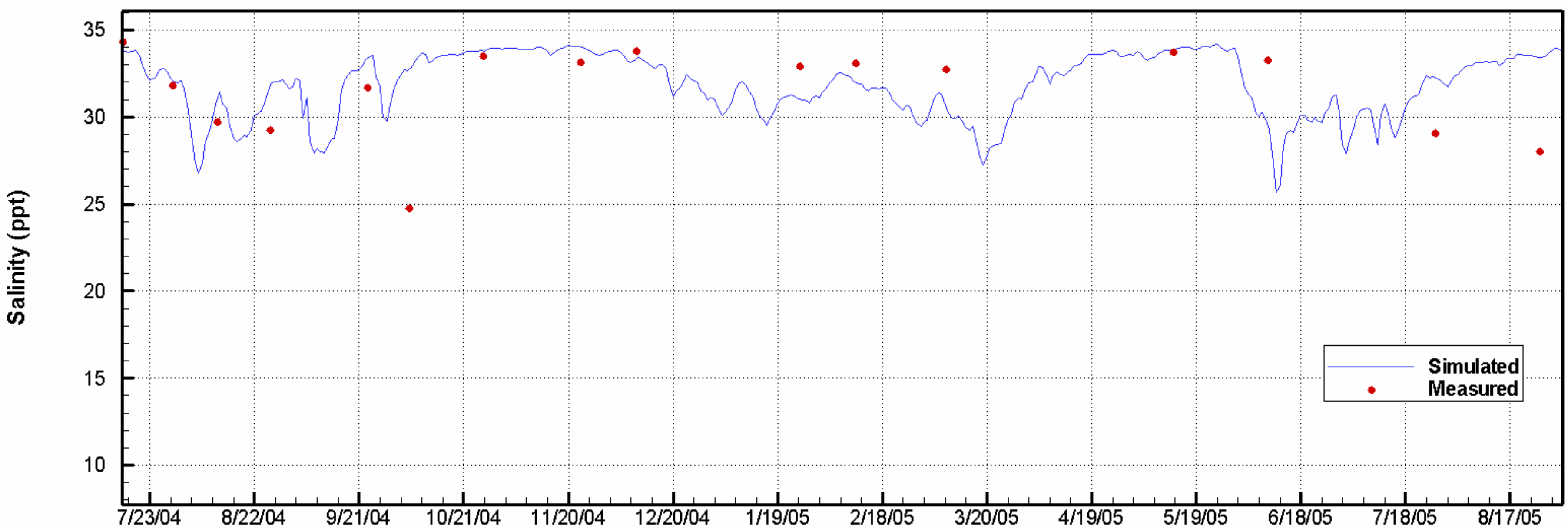
CP7 Surface Salinity



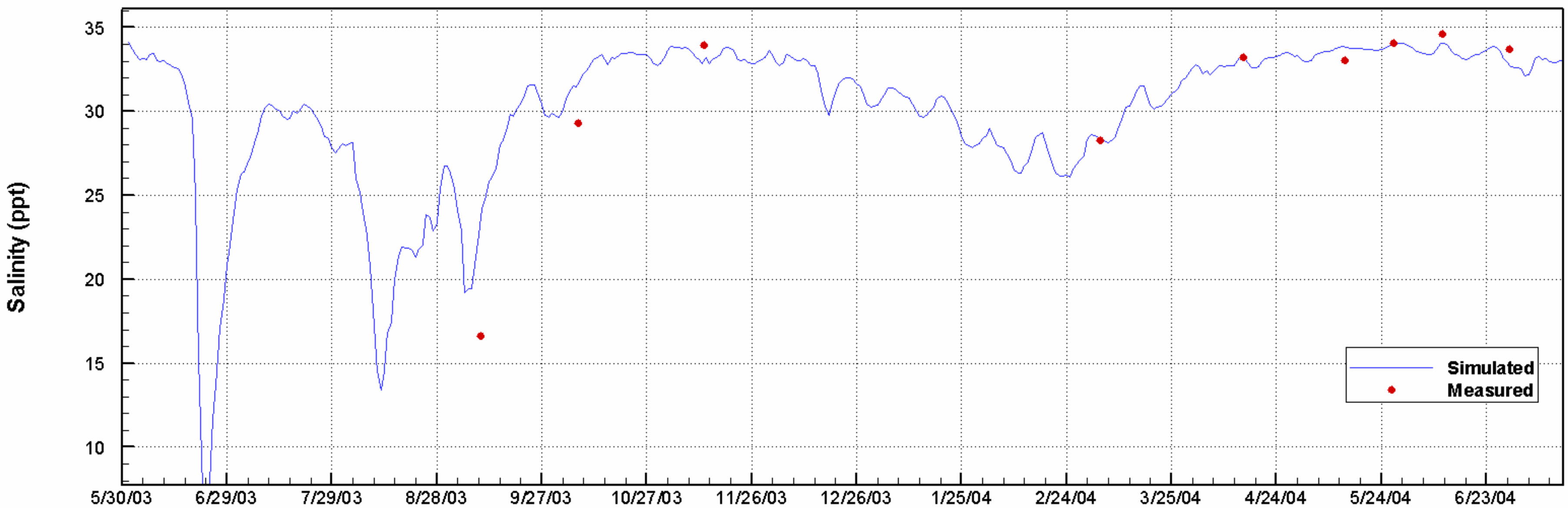


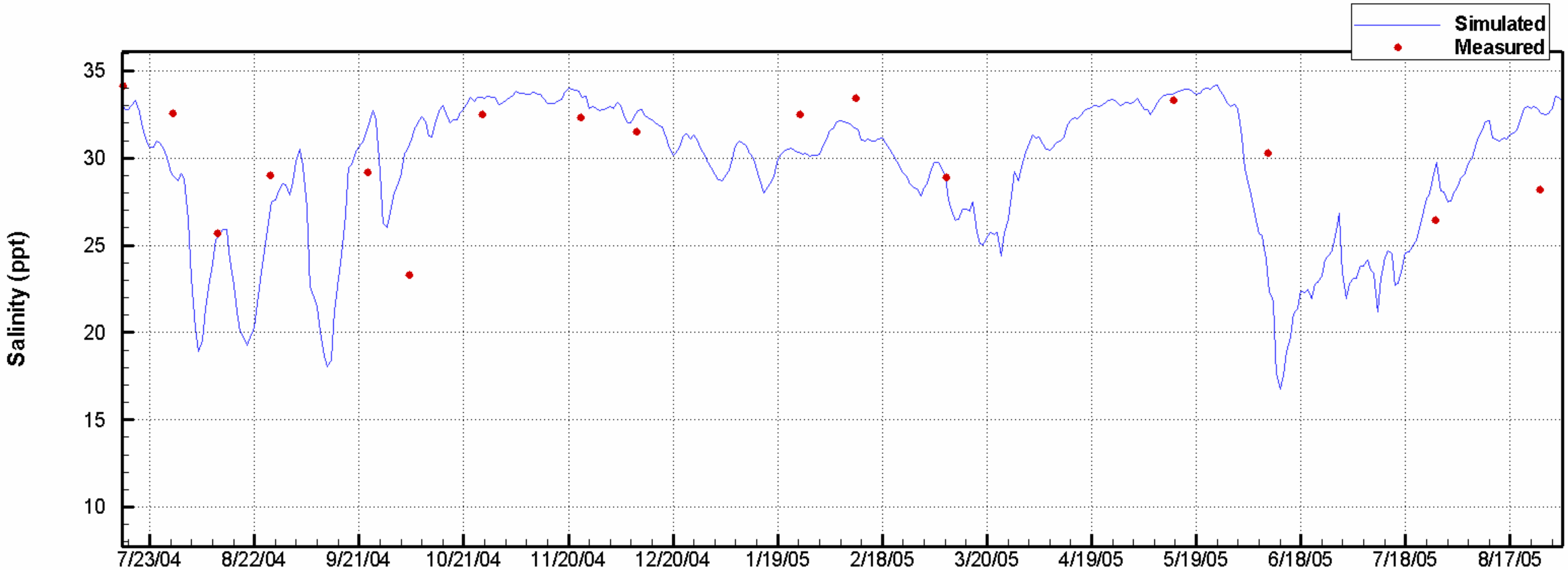
CP7 Bottom Salinity



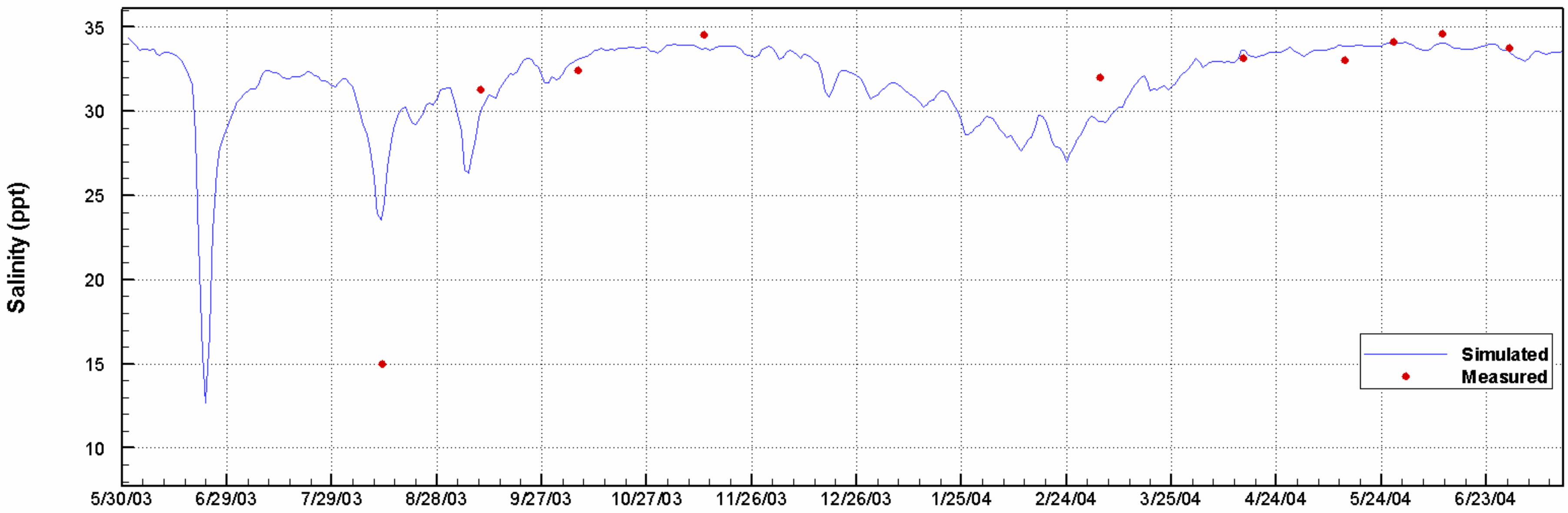


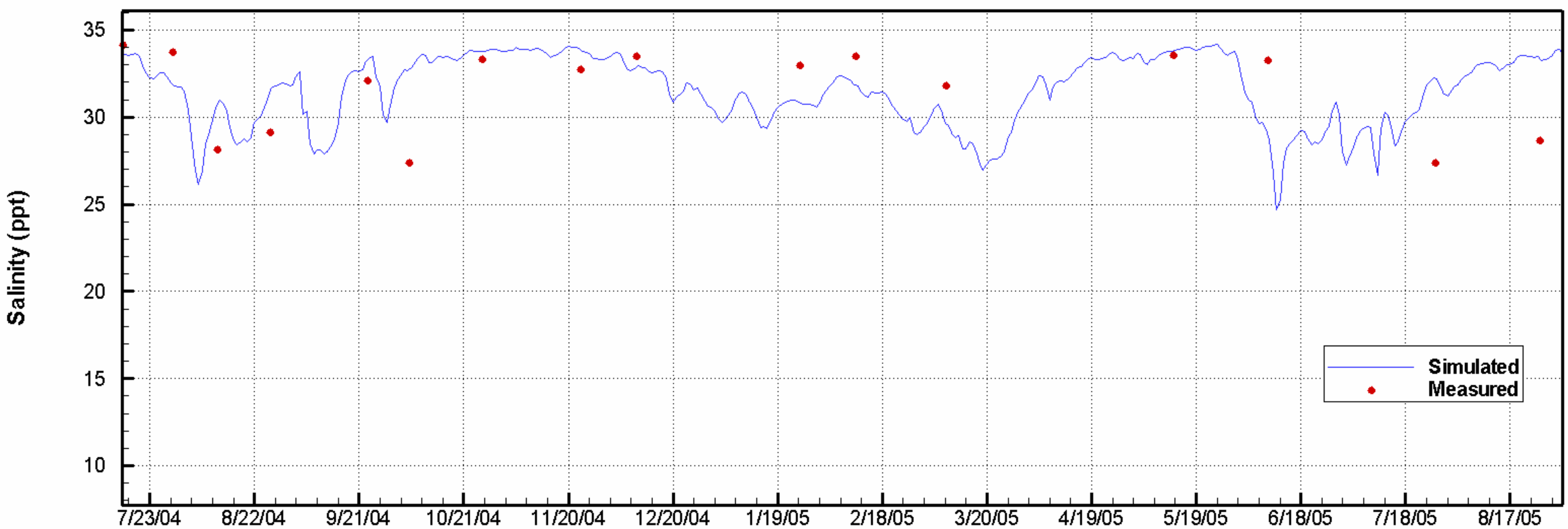
CP9 Surface Salinity

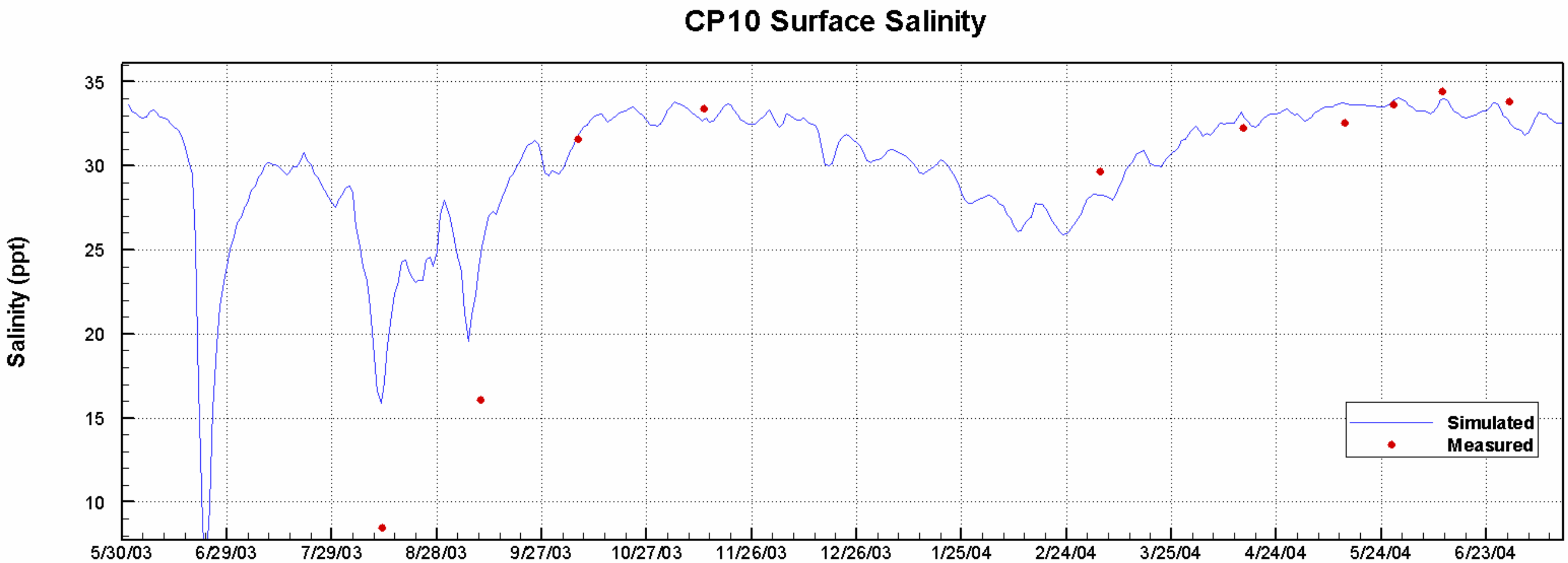


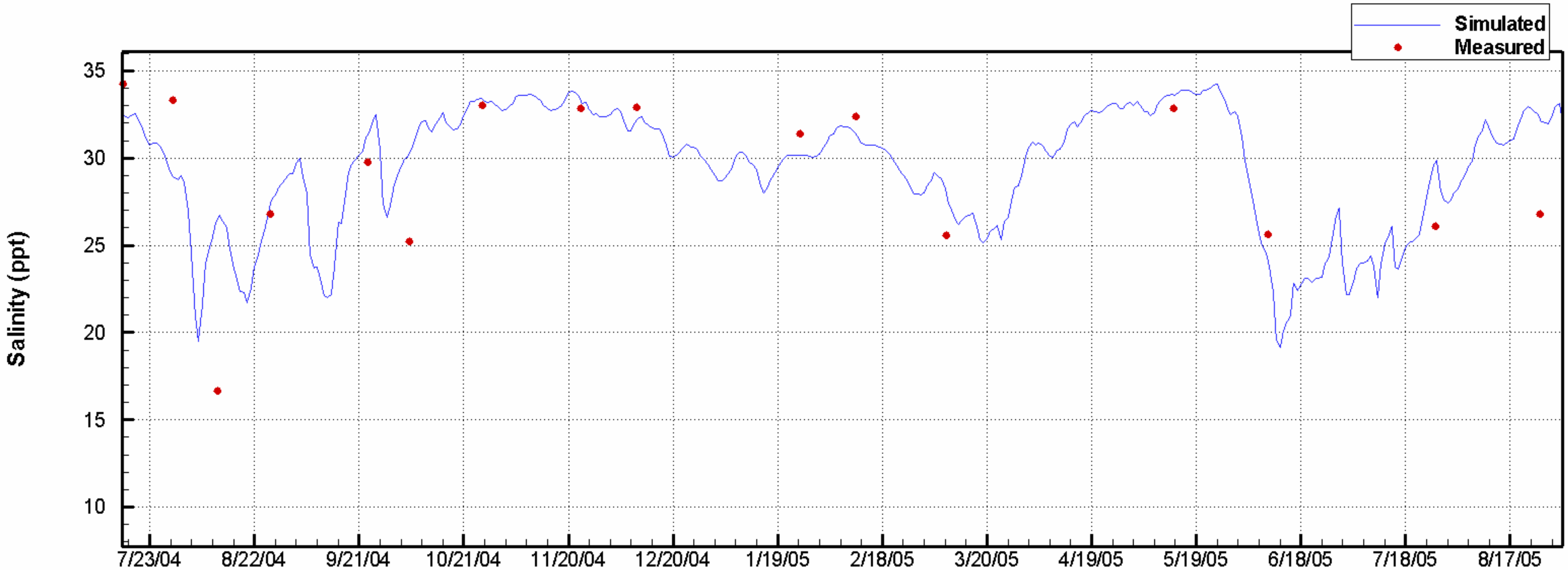


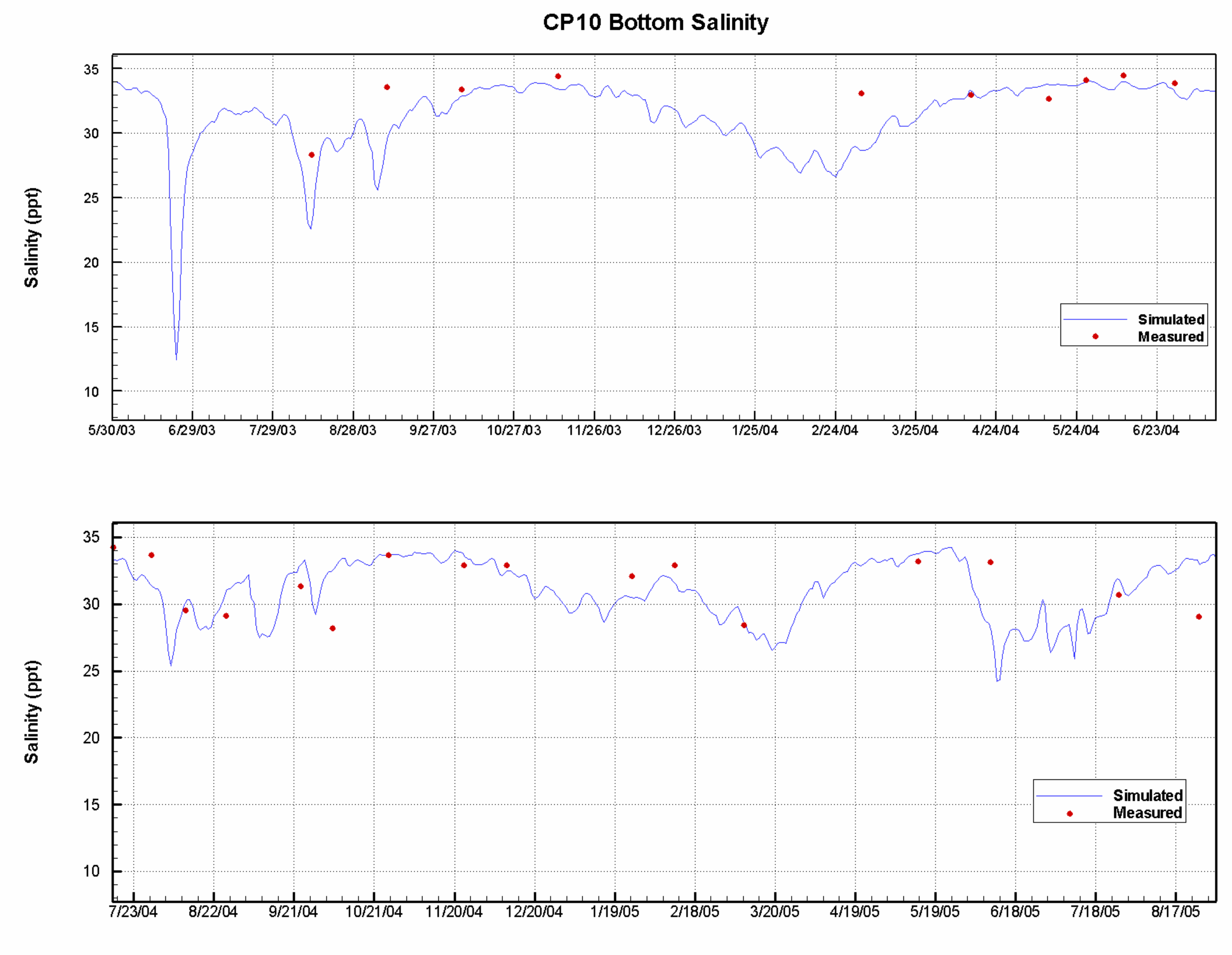
CP9 Bottom Salinity

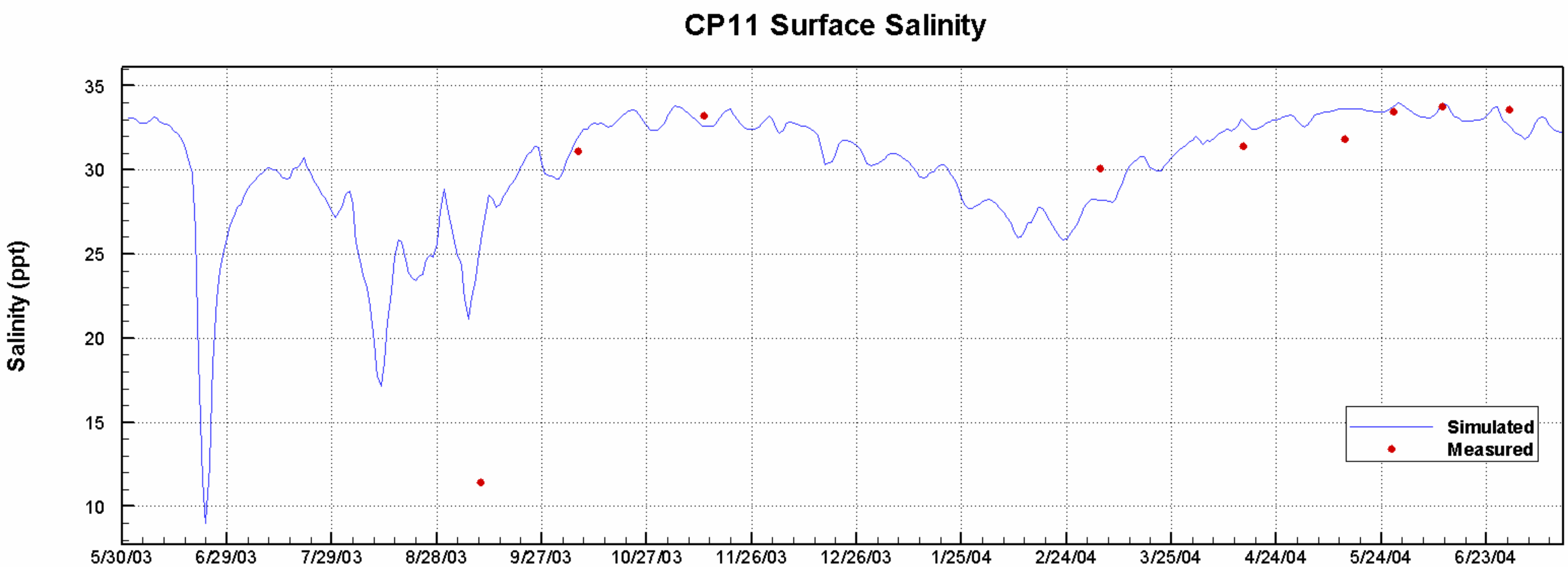


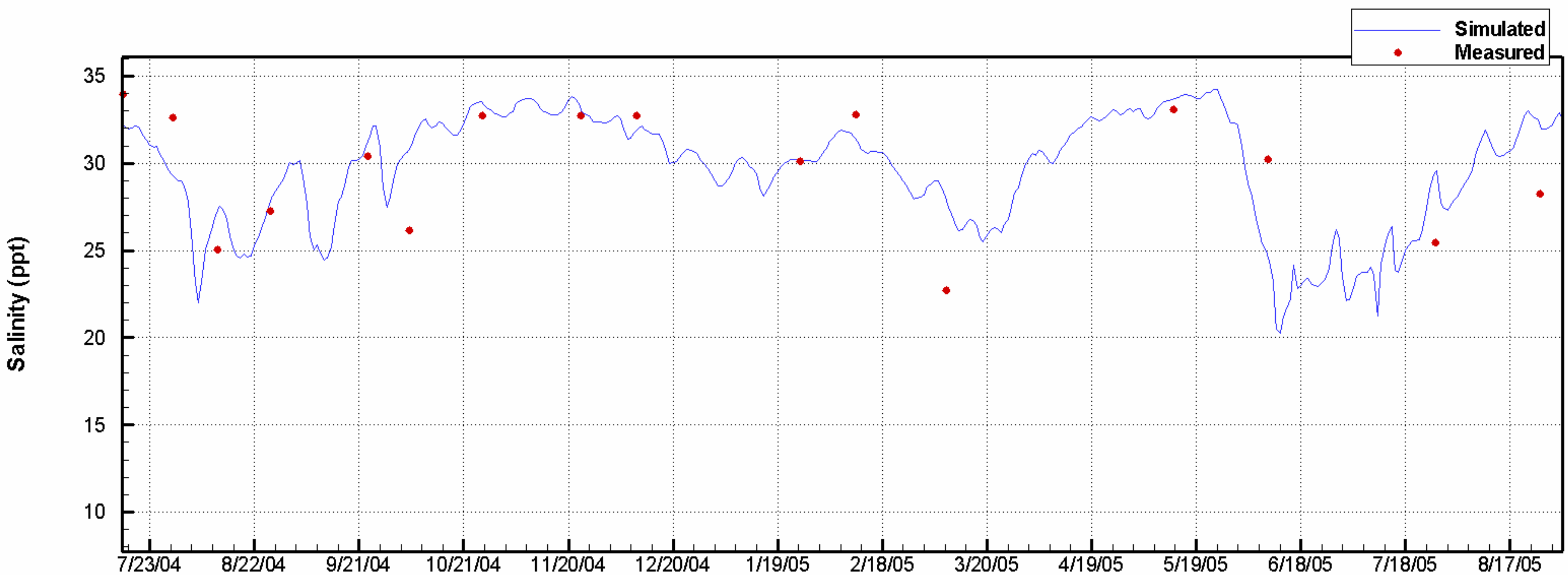



CP10 Surface Salinity
Salinity (ppt)
35
30
25
20
15
10
5/30/03
6/29/03
7/29/03
8/28/03
9/27/03
10/27/03
11/26/03
12/26/03
1/25/04
2/24/04
3/25/04
4/24/04
5/24/04
6/23/04
Simulated
Measured


Salinity (ppt)
35
30
25
20
15
10
7/23/04
8/22/04
9/21/04
10/21/04
11/20/04
12/20/04
1/19/05
2/18/05
3/20/05
4/19/05
5/19/05
6/18/05
7/18/05
8/17/05
Simulated
Measured


CP10 Bottom Salinity
Salinity (ppt)
35
30
25
20
15
10
5/30/03
6/29/03
7/29/03
8/28/03
9/27/03
10/27/03
11/26/03
12/26/03
1/25/04
2/24/04
3/25/04
4/24/04
5/24/04
6/23/04
Simulated
Measured
Salinity (ppt)
35
30
25
20
15
10
7/23/04
8/22/04
9/21/04
10/21/04
11/20/04
12/20/04
1/19/05
2/18/05
3/20/05
4/19/05
5/19/05
6/18/05
7/18/05
8/17/05
Simulated
Measured


CP11 Surface Salinity
Salinity (ppt)
35
30
25
20
15
10
5/30/03
6/29/03
7/29/03
8/28/03
9/27/03
10/27/03
11/26/03
12/26/03
1/25/04
2/24/04
3/25/04
4/24/04
5/24/04
6/23/04
Simulated
Measured


Simulated
Measured
Salinity (ppt)
35
30
25
20
15
10
7/23/04
8/22/04
9/21/04
10/21/04
11/20/04
12/20/04
1/19/05
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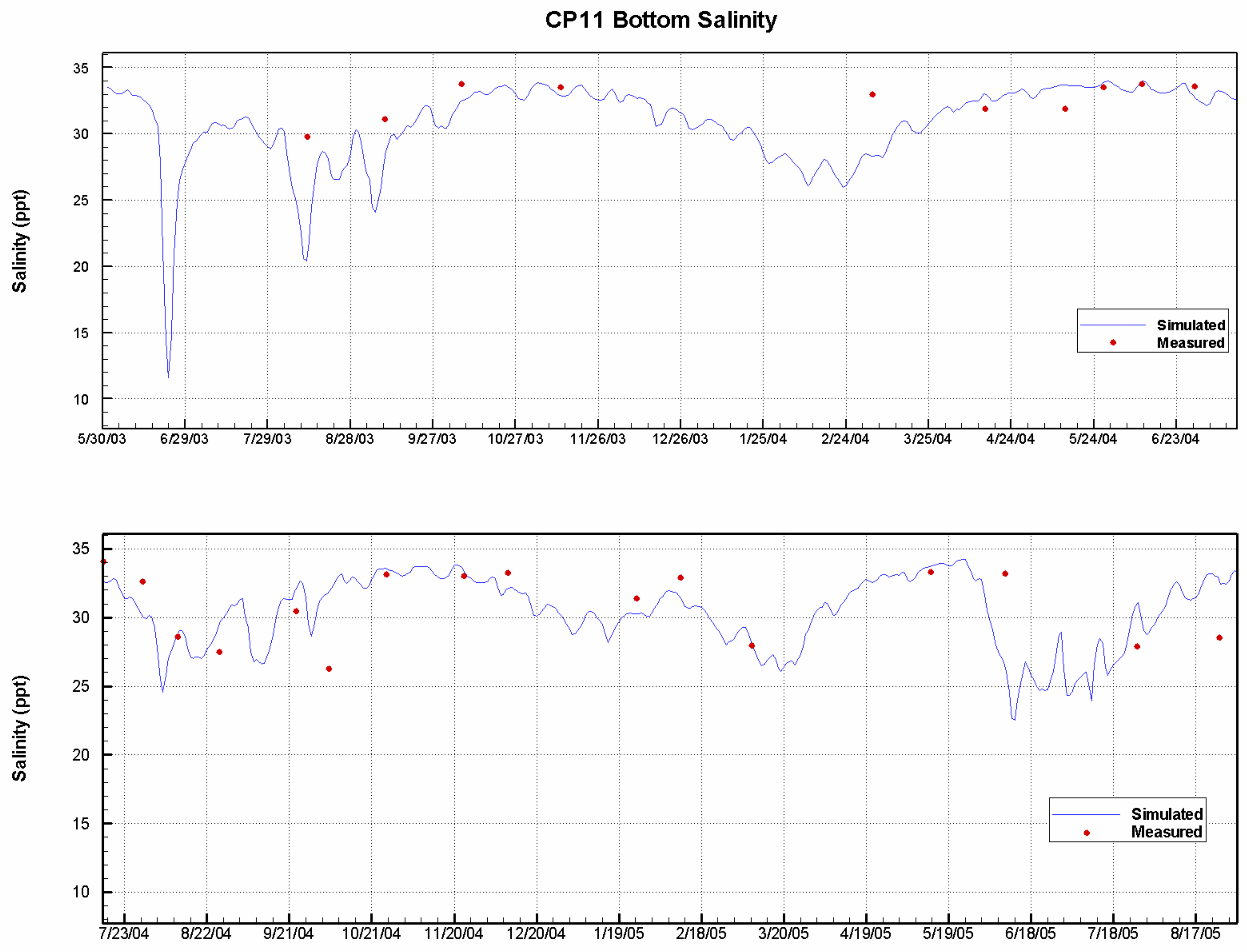
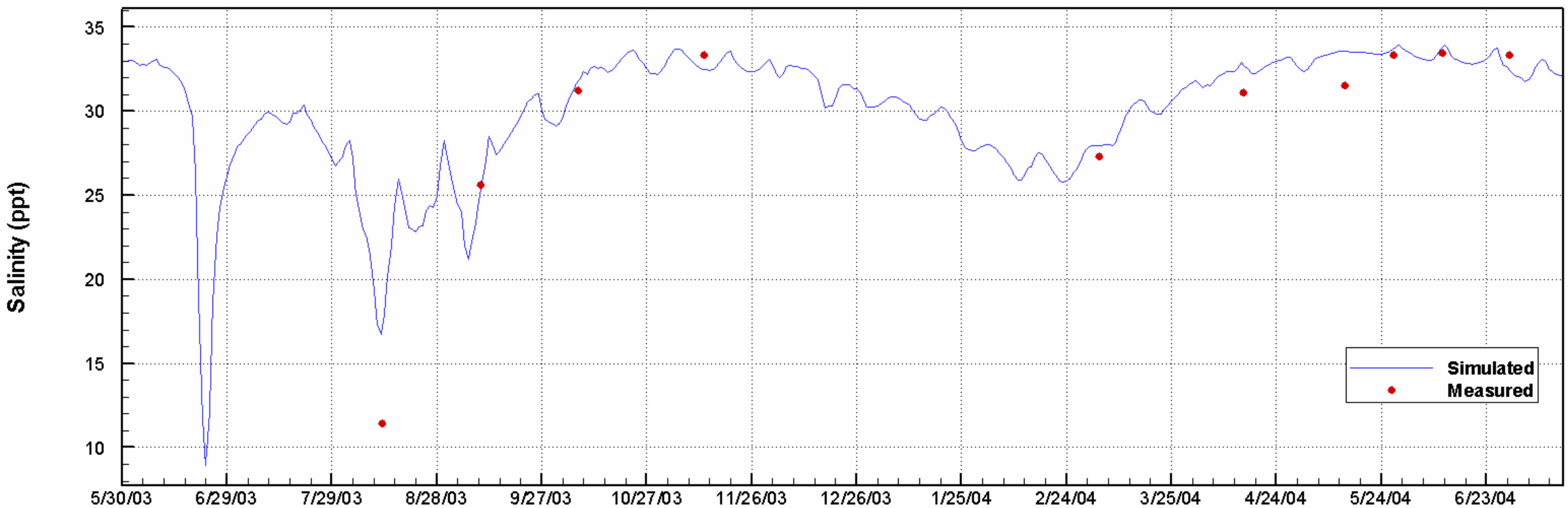
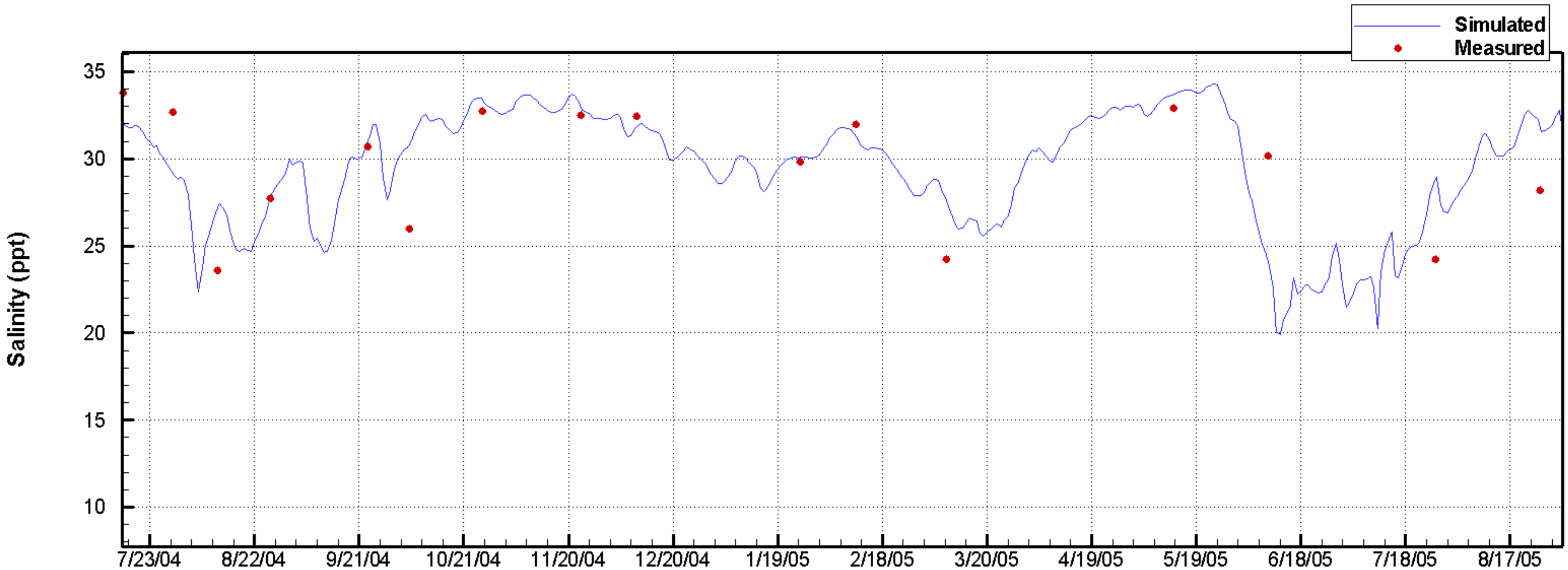
7/18/05
8/17/05

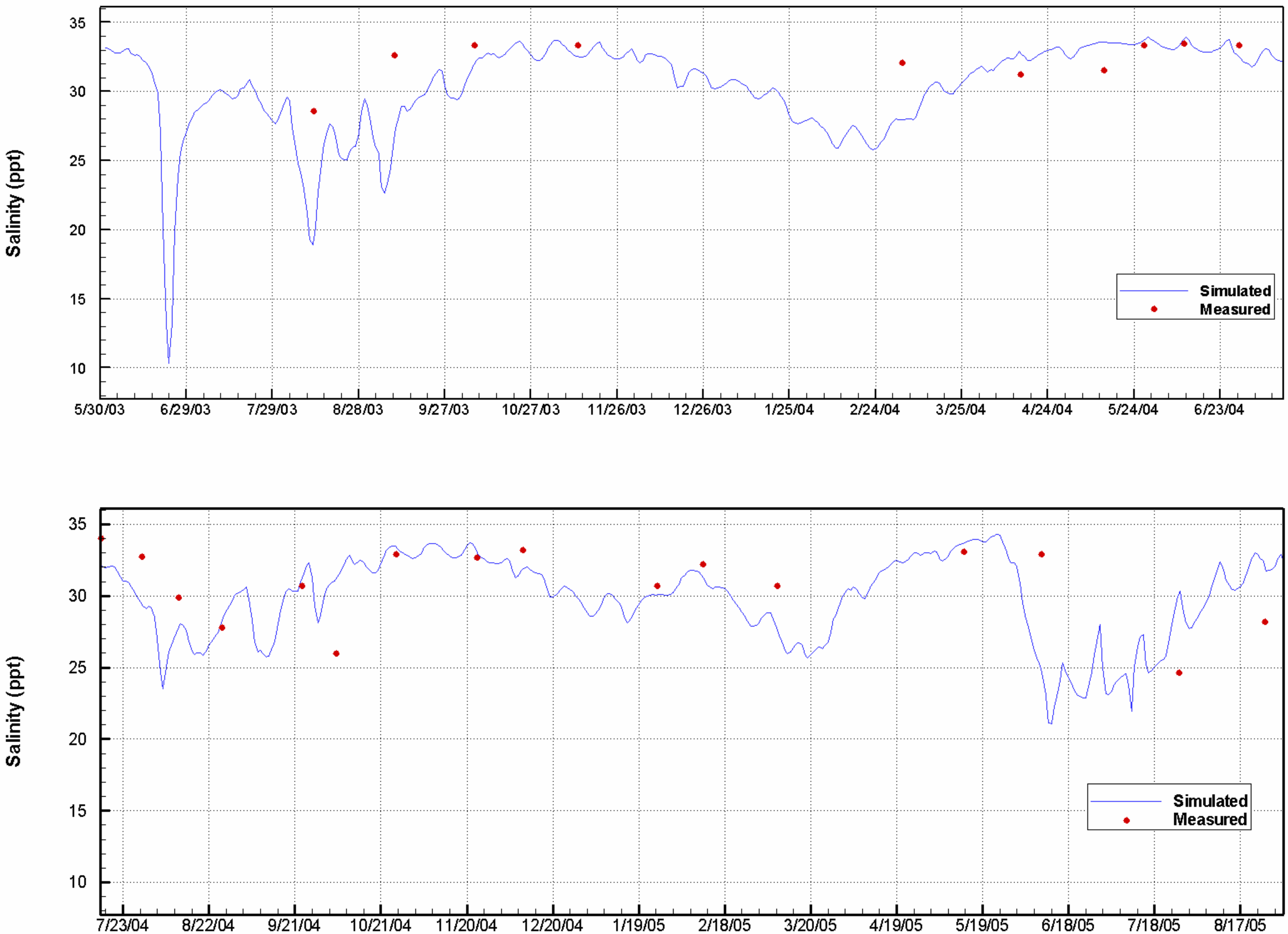

CP11 Bottom Salinity
Salinity (ppt)
35
30
25
20
15
10
5/30/03
6/29/03
7/29/03
8/28/03
9/27/03
10/27/03
11/26/03
12/26/03
1/25/04
2/24/04
3/25/04
4/24/04
5/24/04
6/23/04
Simulated
Measured
Salinity (ppt)
35
30
25
20
15
10
7/23/04
8/22/04
9/21/04
10/21/04
11/20/04
12/20/04
1/19/05
2/18/05
3/20/05
4/19/05
5/19/05
6/18/05
7/18/05
8/17/05
Simulated
Measured

CP12 Surface Salinity

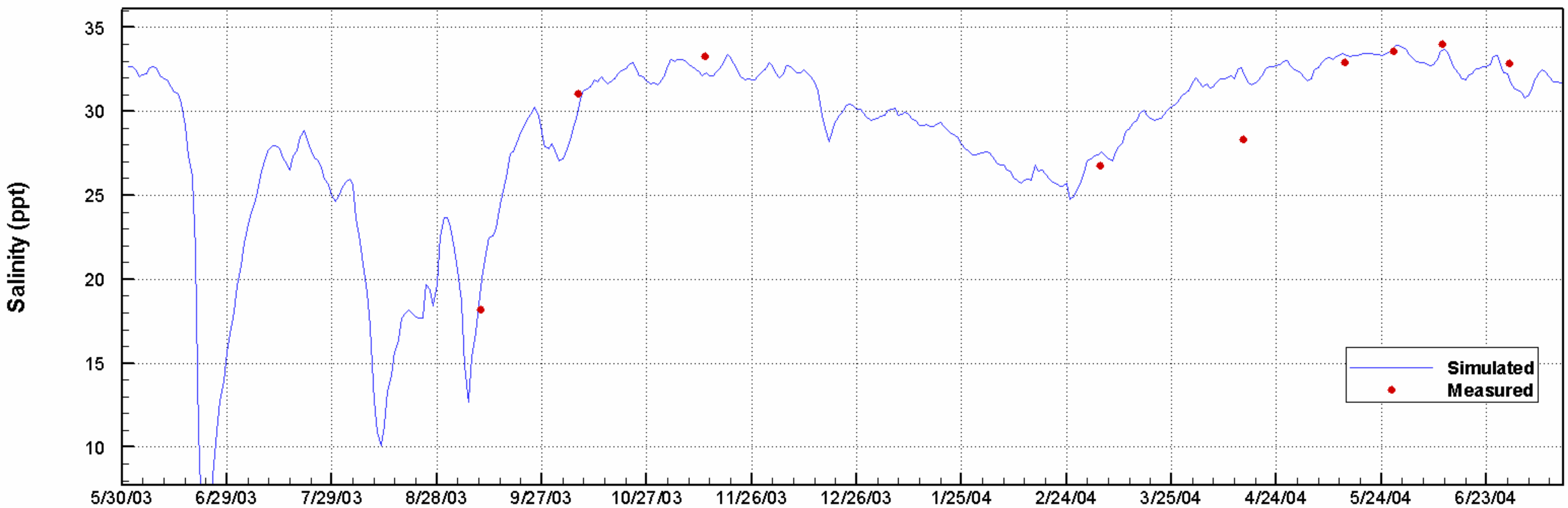


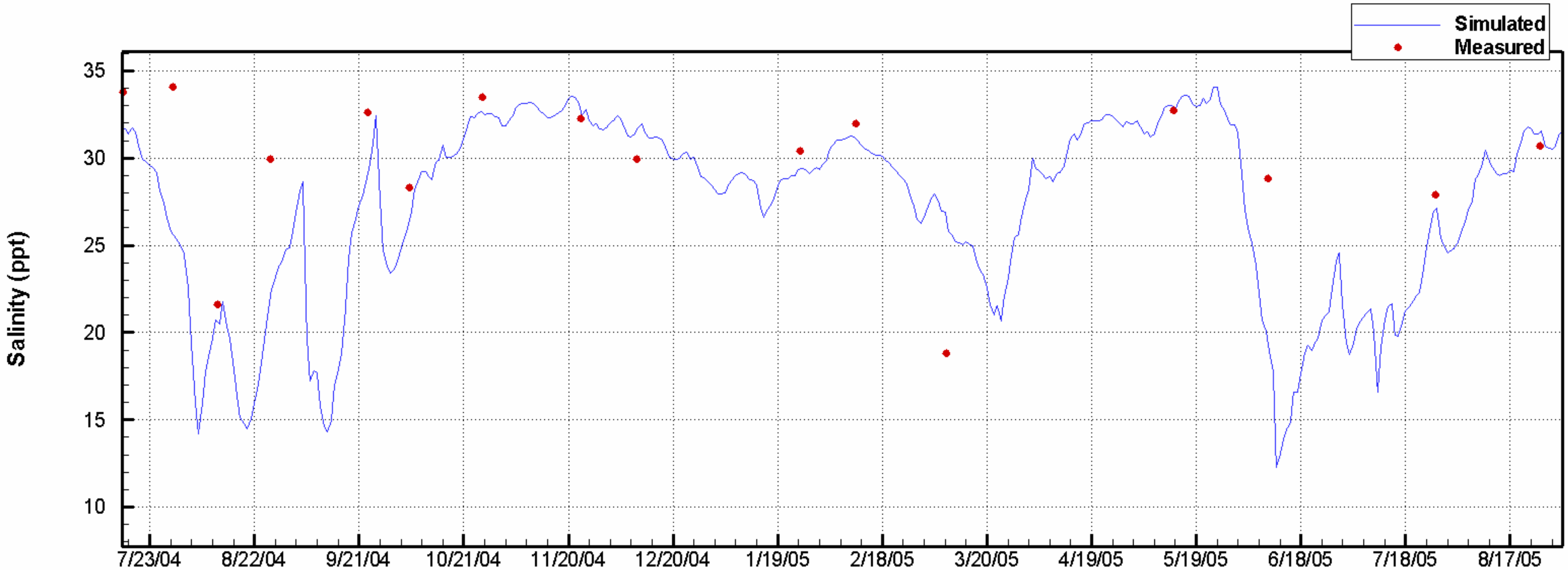


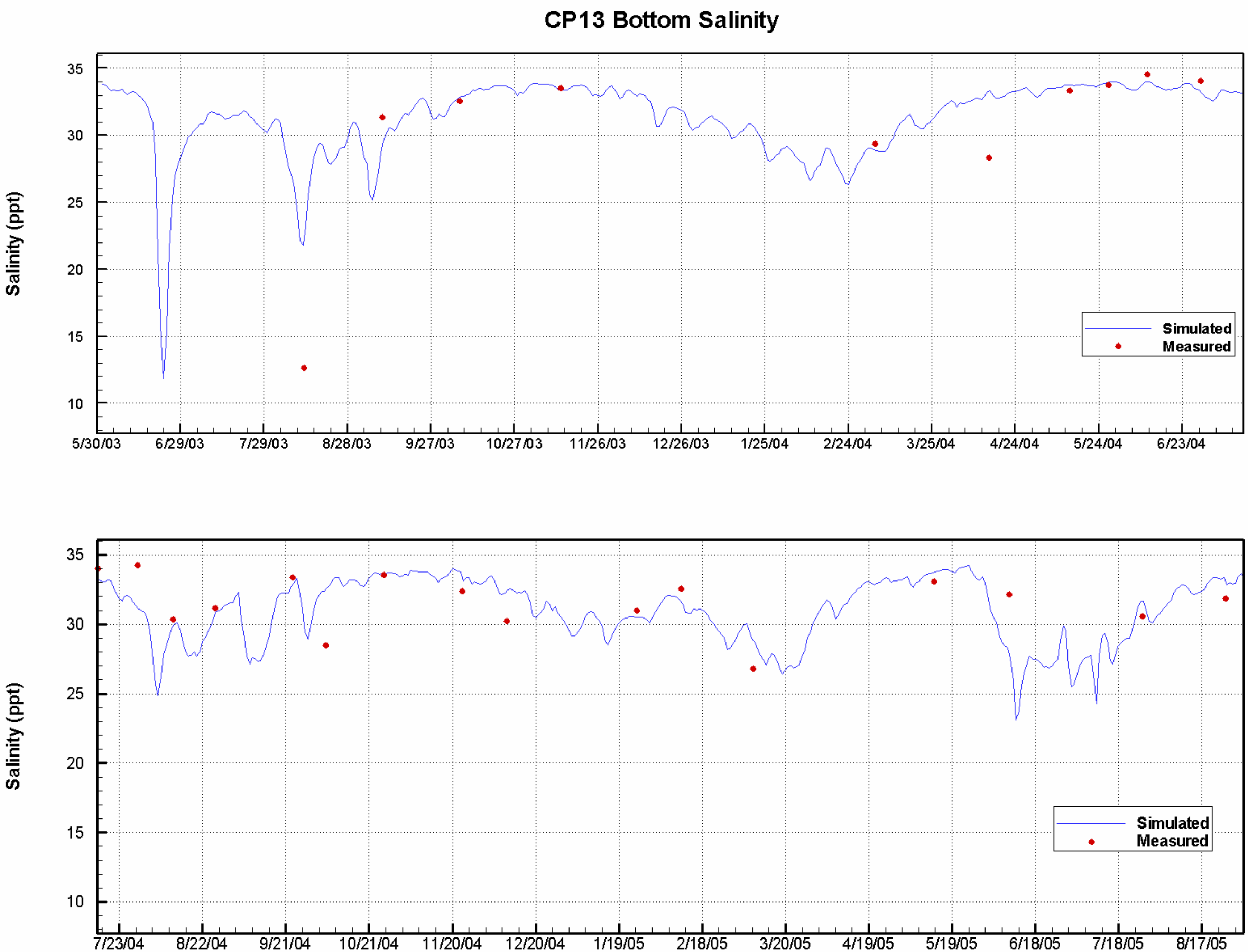
CP12 Bottom Salinity



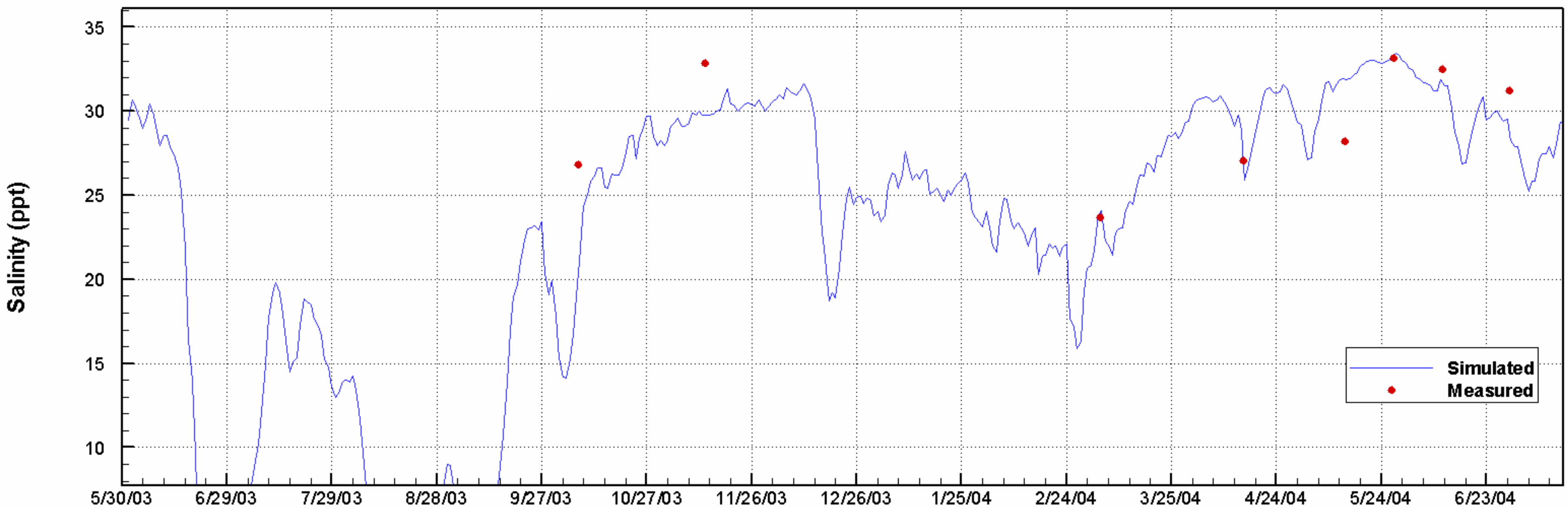
CP13 Surface Salinity

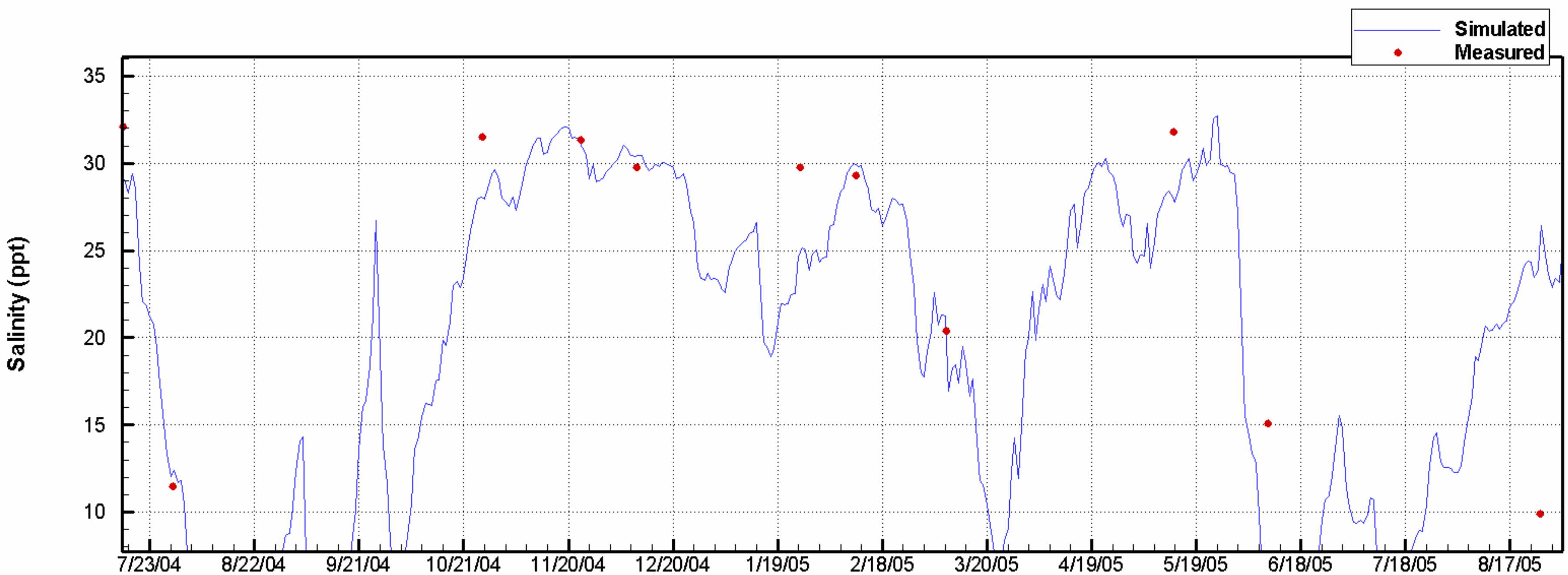




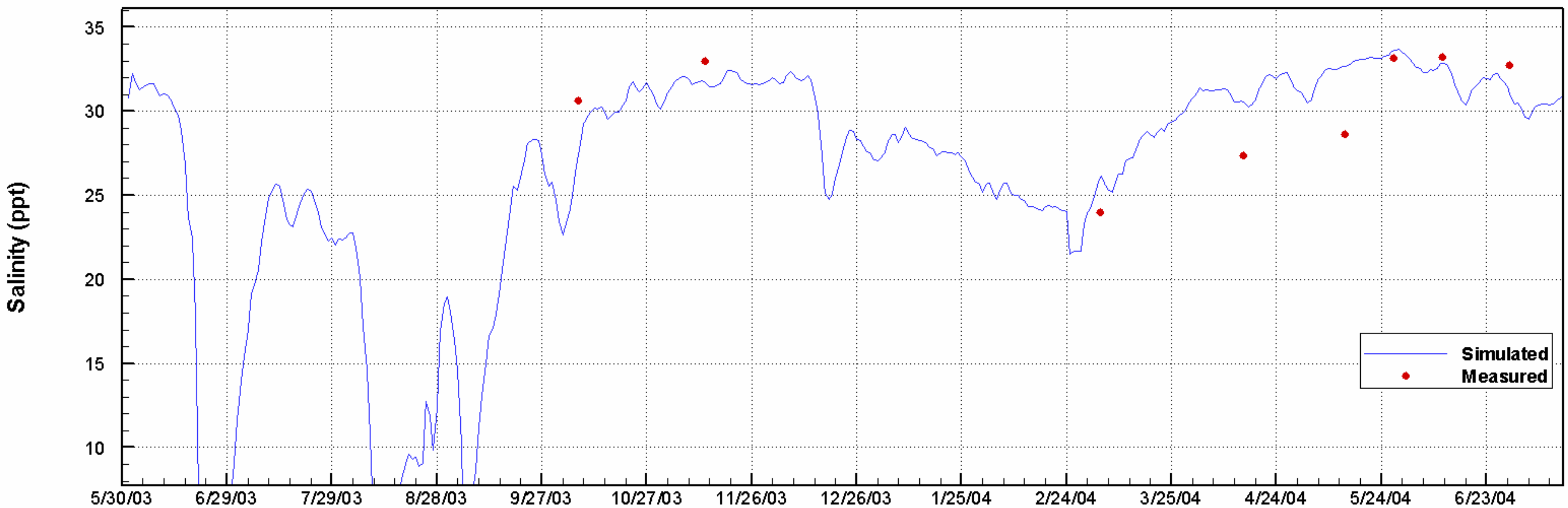

CP13 Bottom Salinity
Salinity (ppt)
35
30
25
20
15
10
5/30/03
6/29/03
7/29/03
8/28/03
9/27/03
10/27/03
11/26/03
12/26/03
1/25/04
2/24/04
3/25/04
4/24/04
5/24/04
6/23/04
Simulated
Measured
Salinity (ppt)
35
30
25
20
15
10
7/23/04
8/22/04
9/21/04
10/21/04
11/20/04
12/20/04
1/19/05
2/18/05
3/20/05
4/19/05
5/19/05
6/18/05
7/18/05
8/17/05
Simulated
Measured

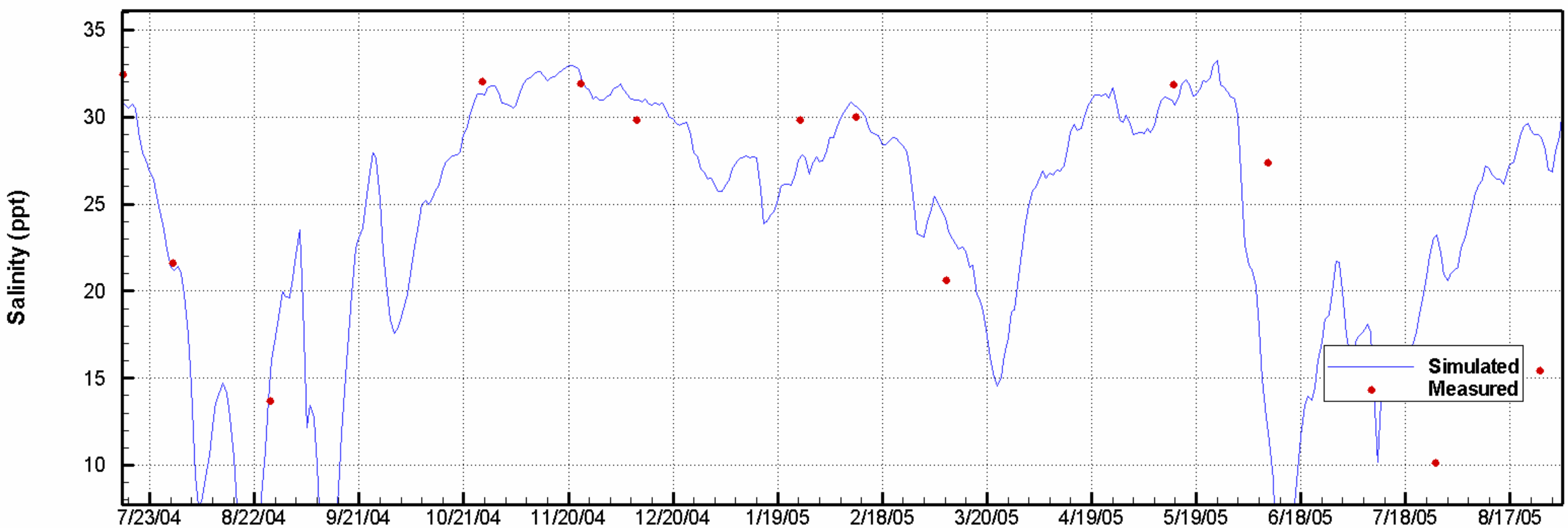
CP14 Surface Salinity



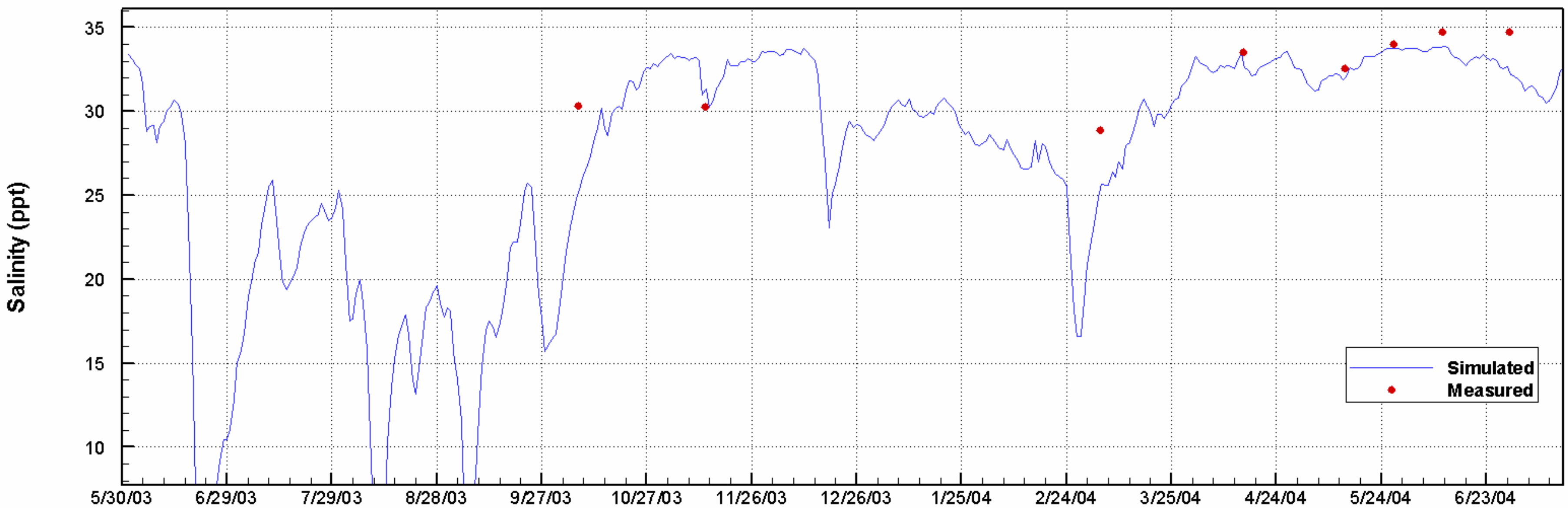


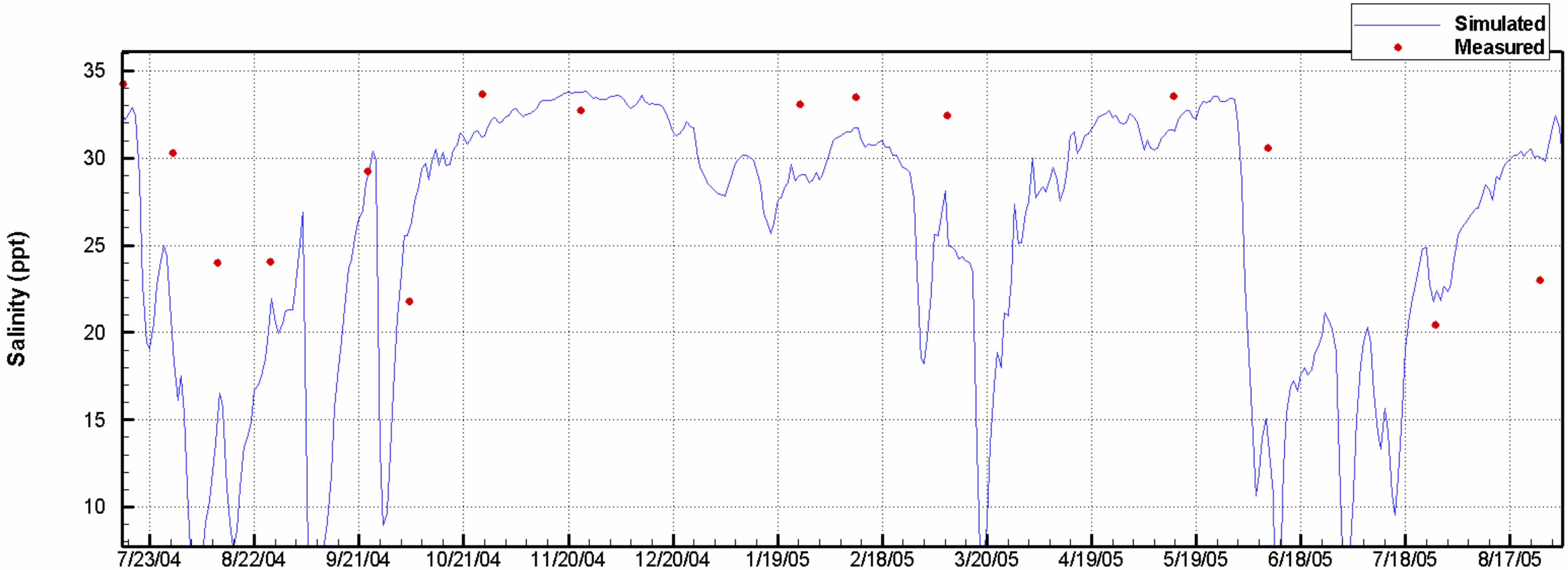
CP14 Bottom Salinity



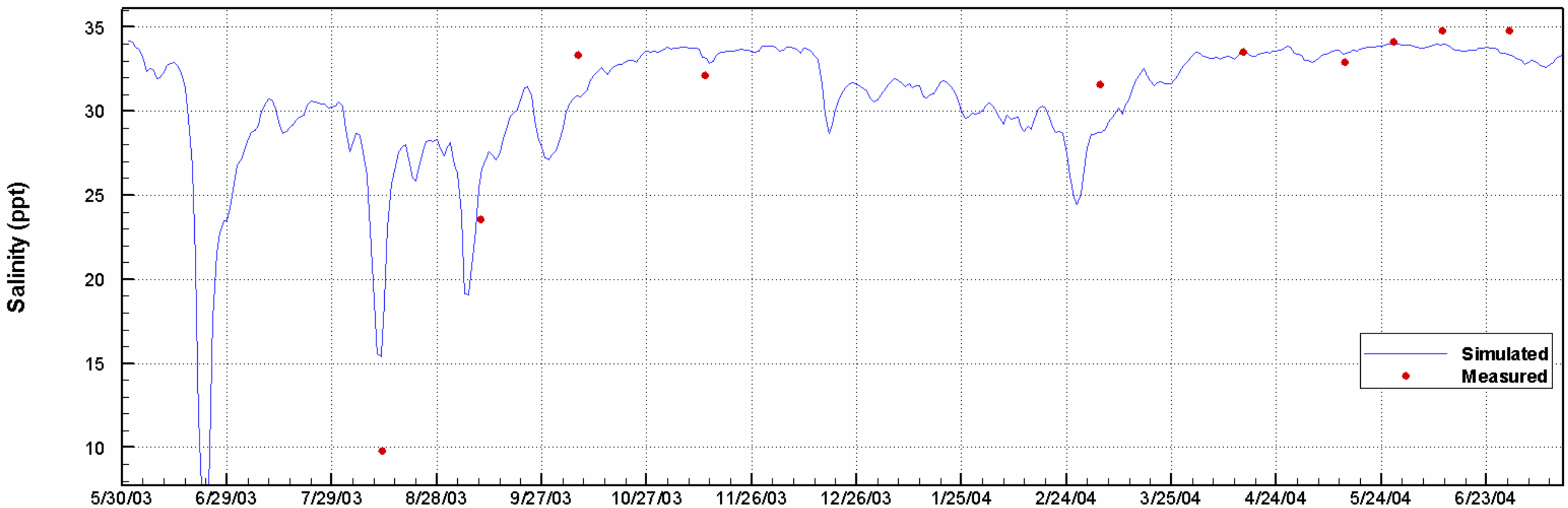


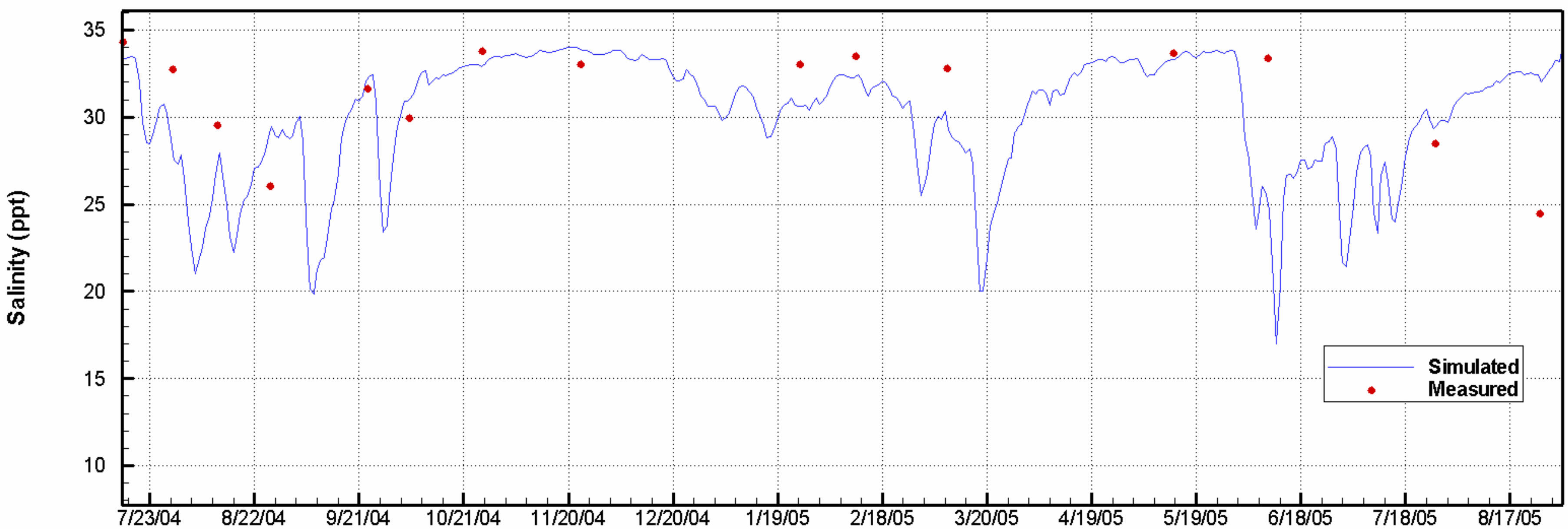
CP16 Surface Salinity



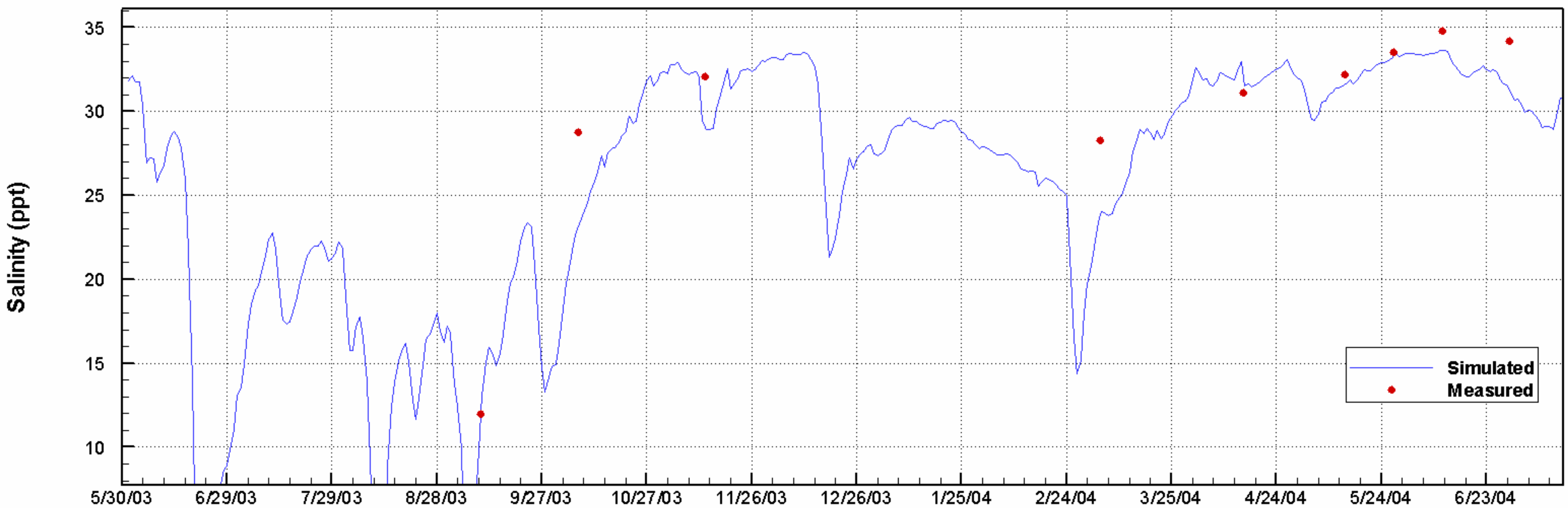


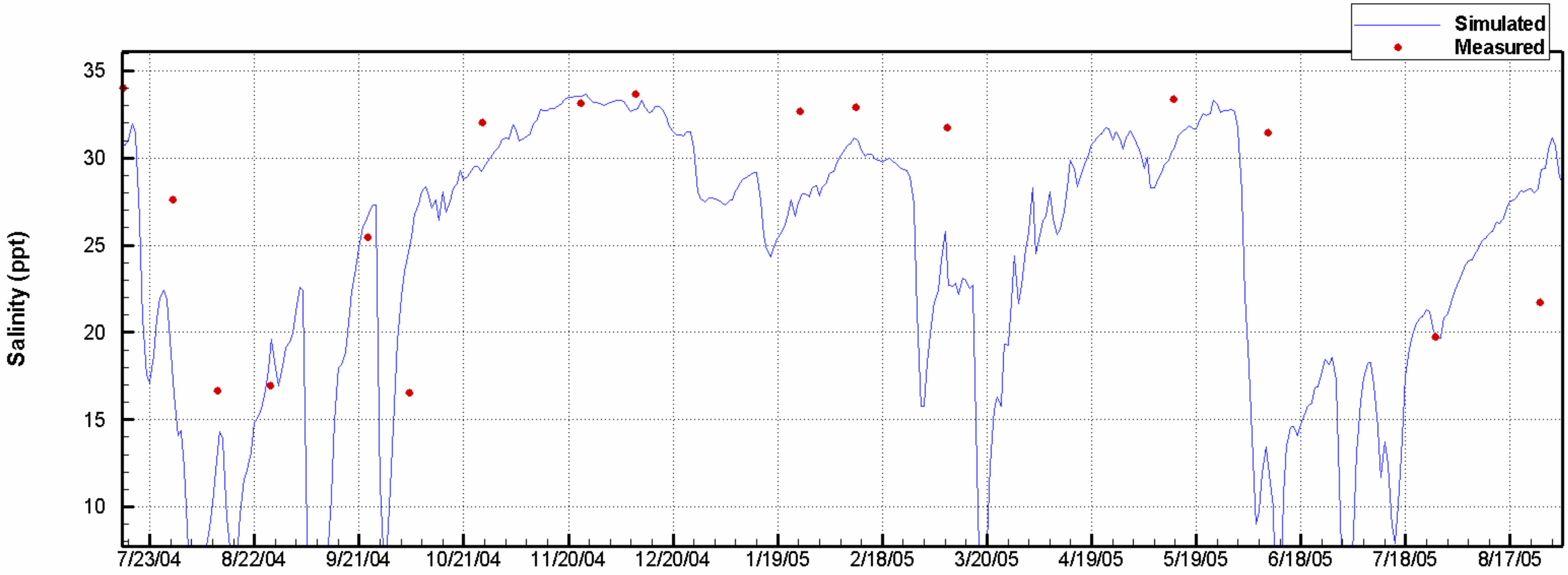
CP16 Bottom Salinity

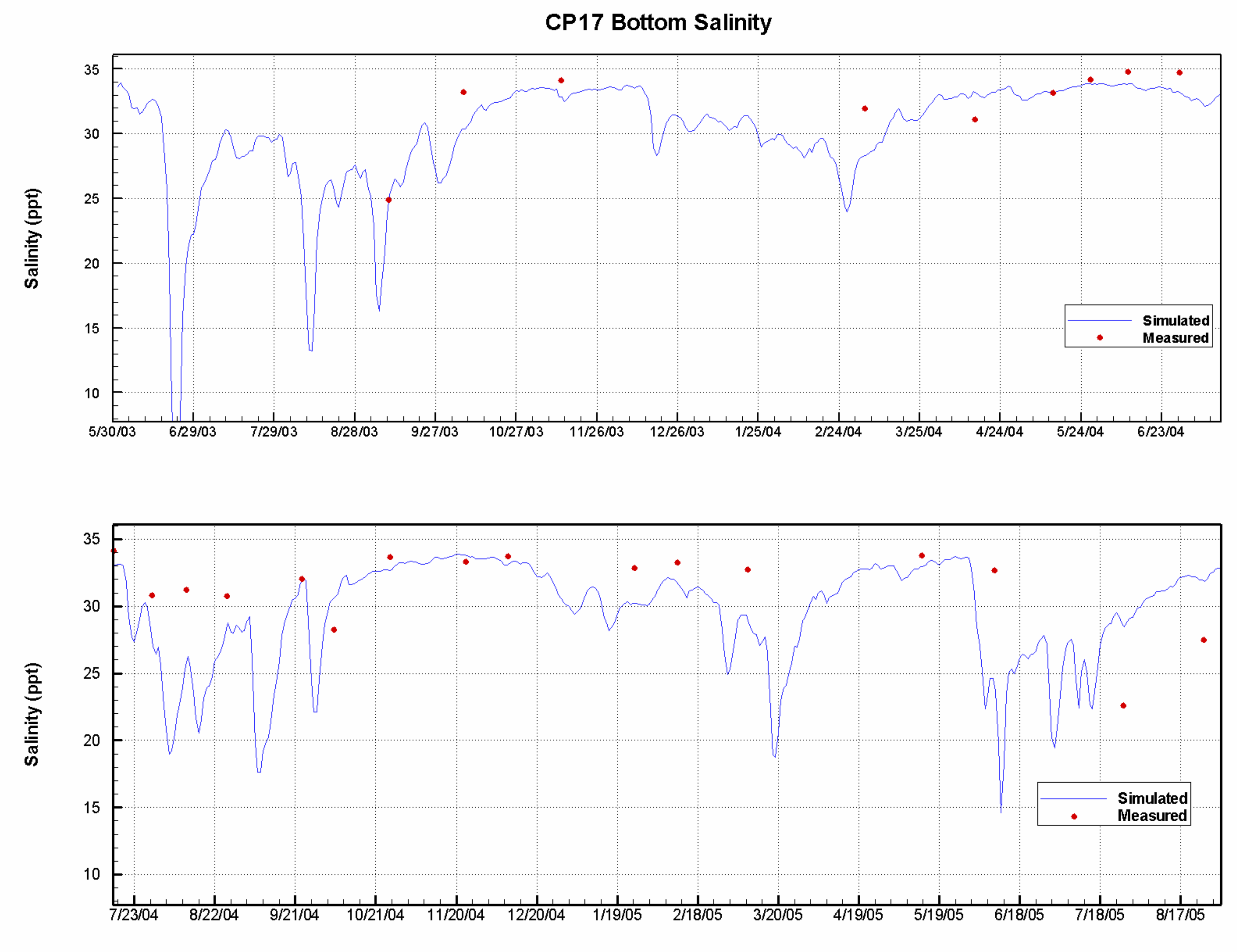


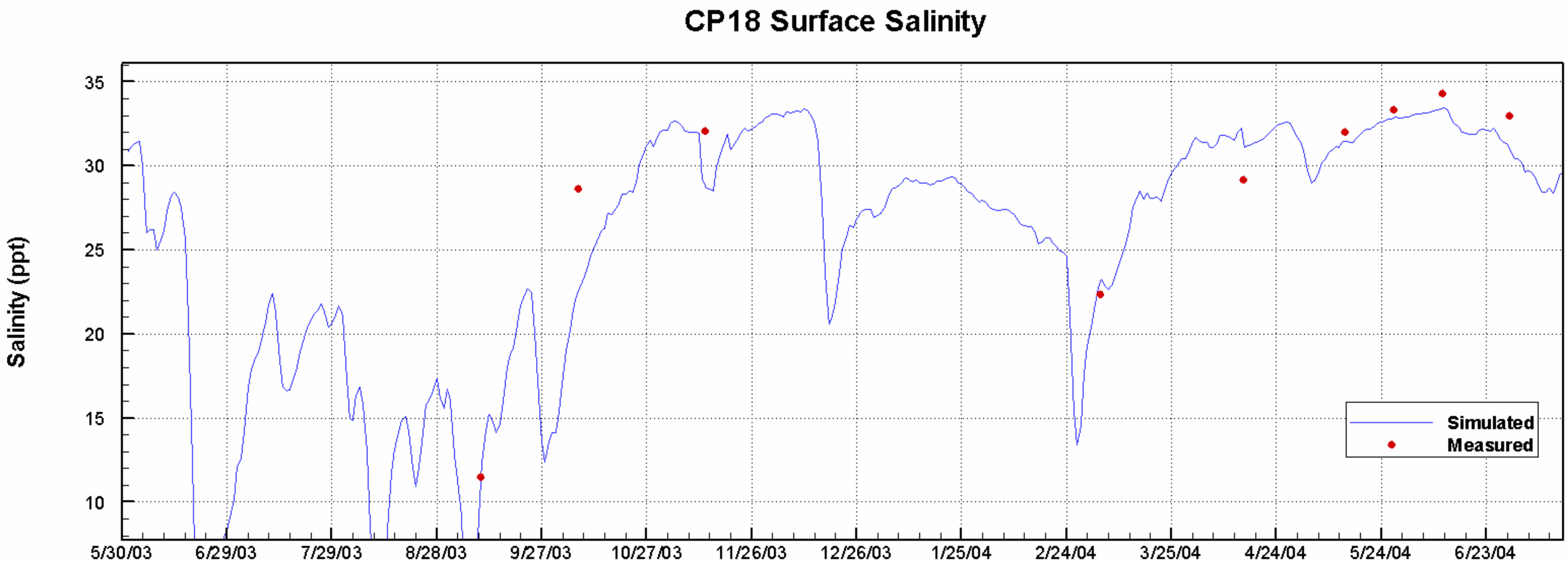


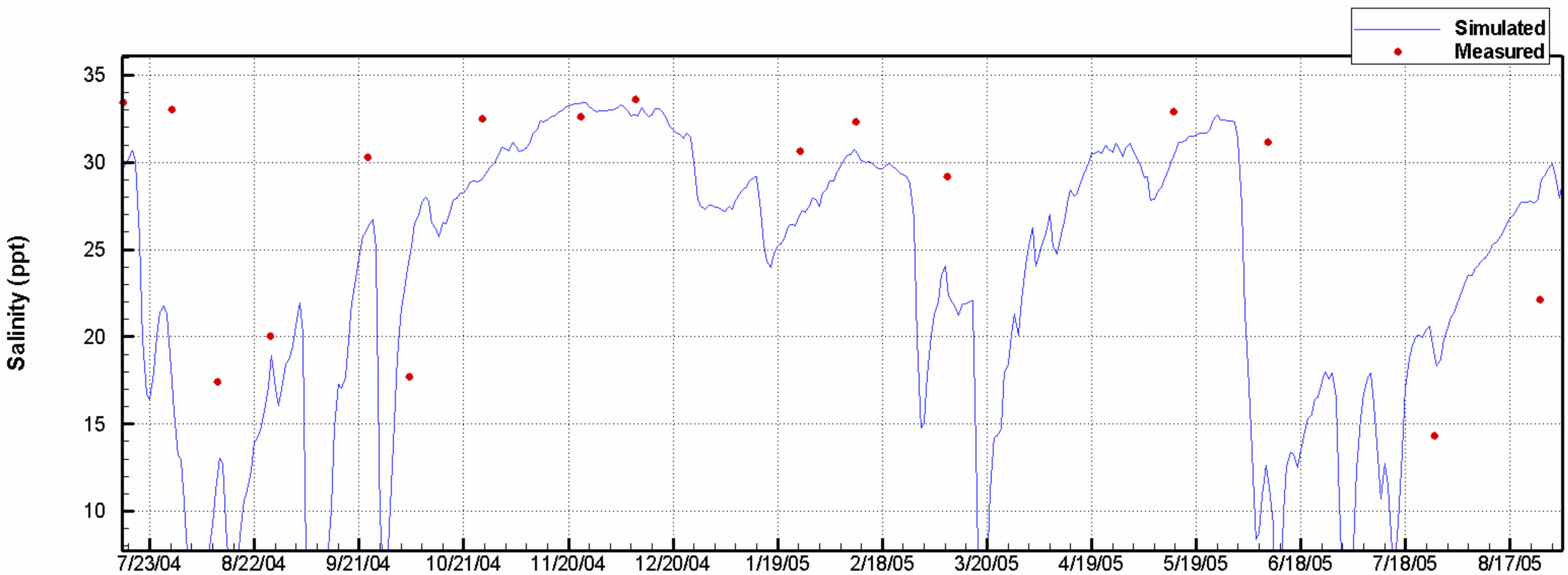
CP17 Surface Salinity



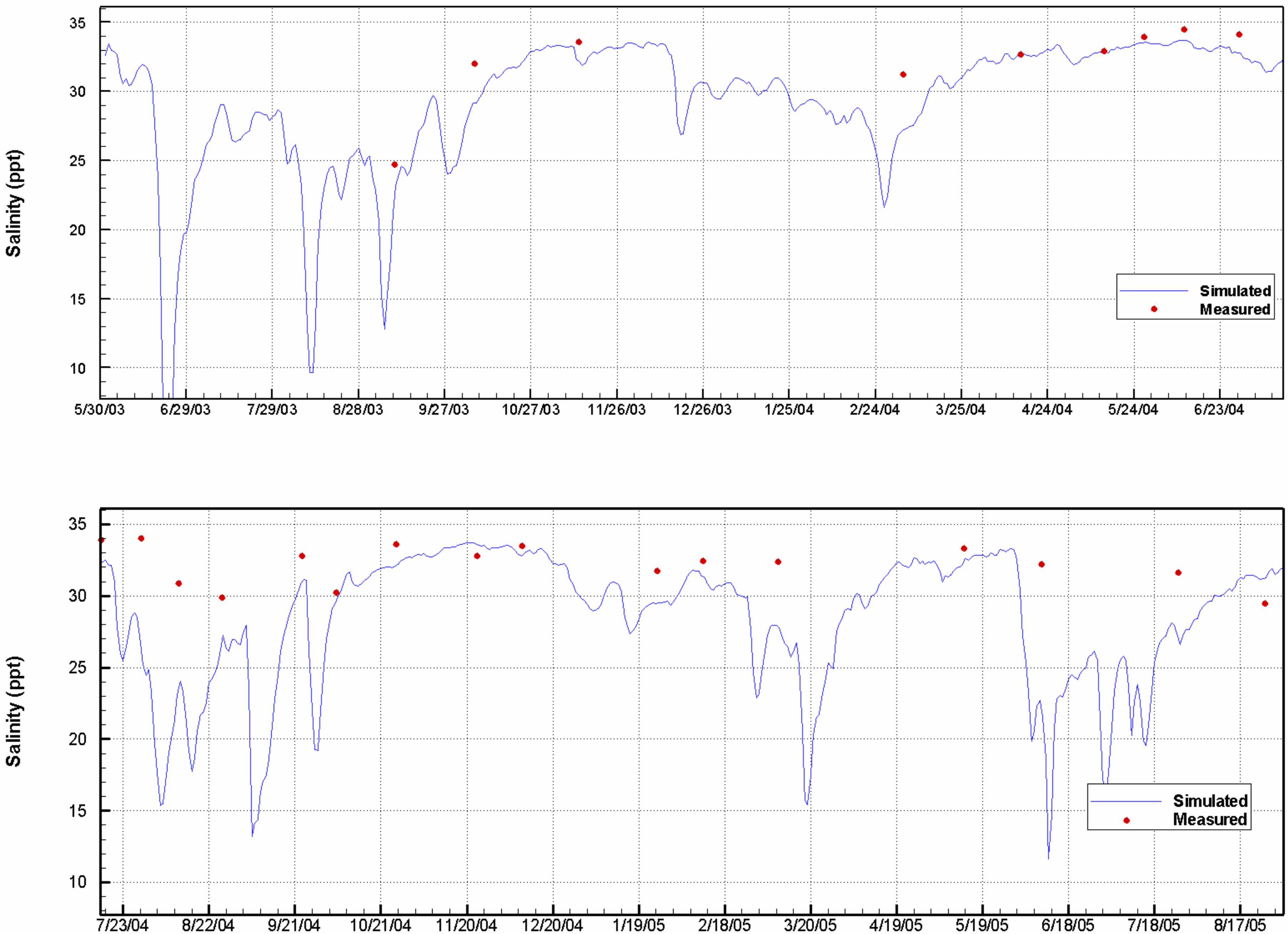



CP17 Bottom Salinity
Salinity (ppt)
35
30
25
20
15
10
5/30/03
6/29/03
7/29/03
8/28/03
9/27/03
10/27/03
11/26/03
12/26/03
1/25/04
2/24/04
3/25/04
4/24/04
5/24/04
6/23/04
Simulated
Measured
Salinity (ppt)
35
30
25
20
15
10
7/23/04
8/22/04
9/21/04
10/21/04
11/20/04
12/20/04
1/19/05
2/18/05
3/20/05
4/19/05
5/19/05
6/18/05
7/18/05
8/17/05
Simulated
Measured

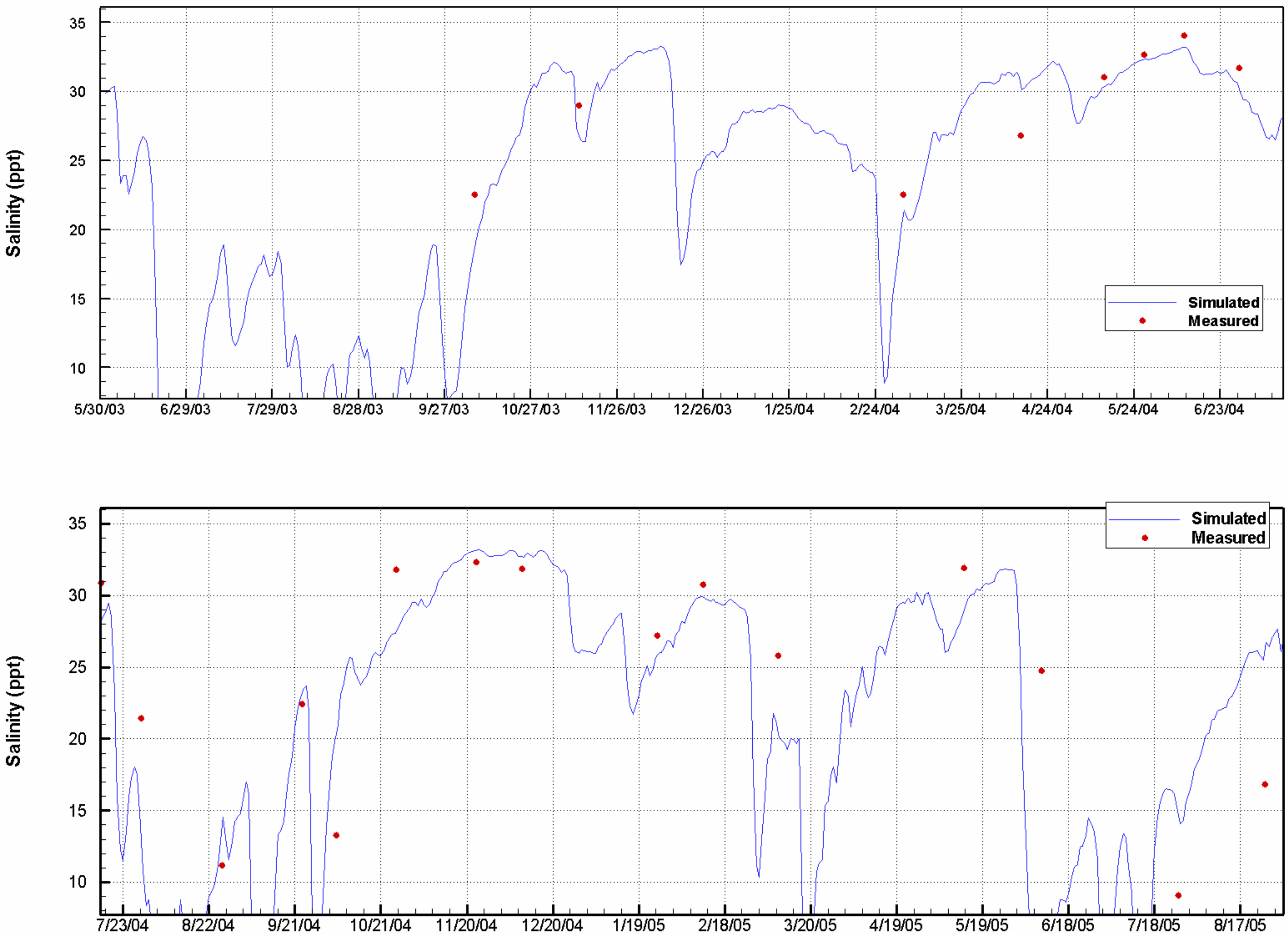

CP18 Surface Salinity
Salinity (ppt)
35
30
25
20
15
10
5/30/03
6/29/03
7/29/03
8/28/03
9/27/03
10/27/03
11/26/03
12/26/03
1/25/04
2/24/04
3/25/04
4/24/04
5/24/04
6/23/04
Simulated
Measured


Salinity (ppt)
35
30
25
20
15
10
7/23/04
8/22/04
9/21/04
10/21/04
11/20/04
12/20/04
1/19/05
2/18/05
3/20/05
4/19/05
5/19/05
6/18/05
7/18/05
8/17/05
Simulated
Measured

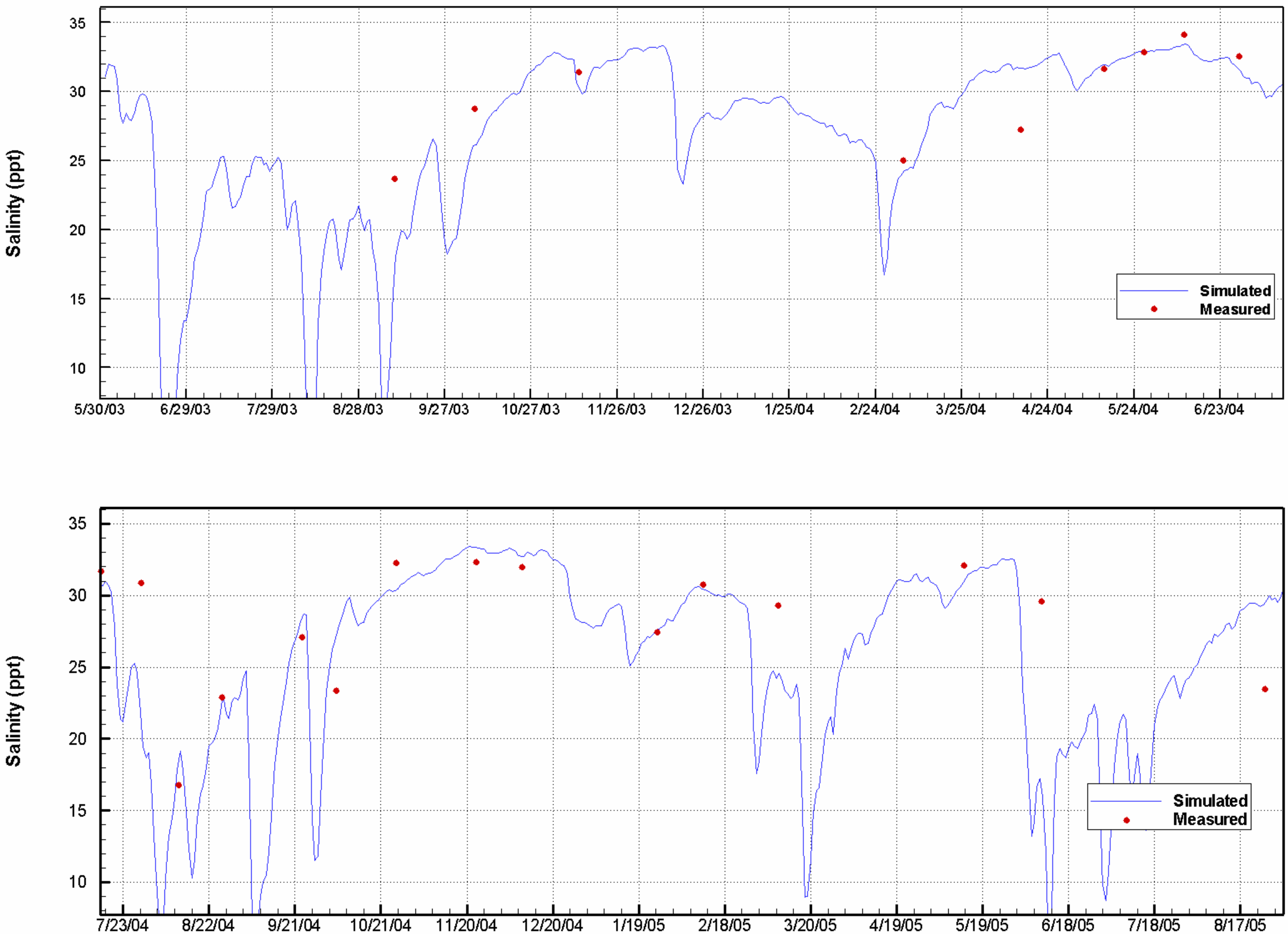
CP18 Bottom Salinity



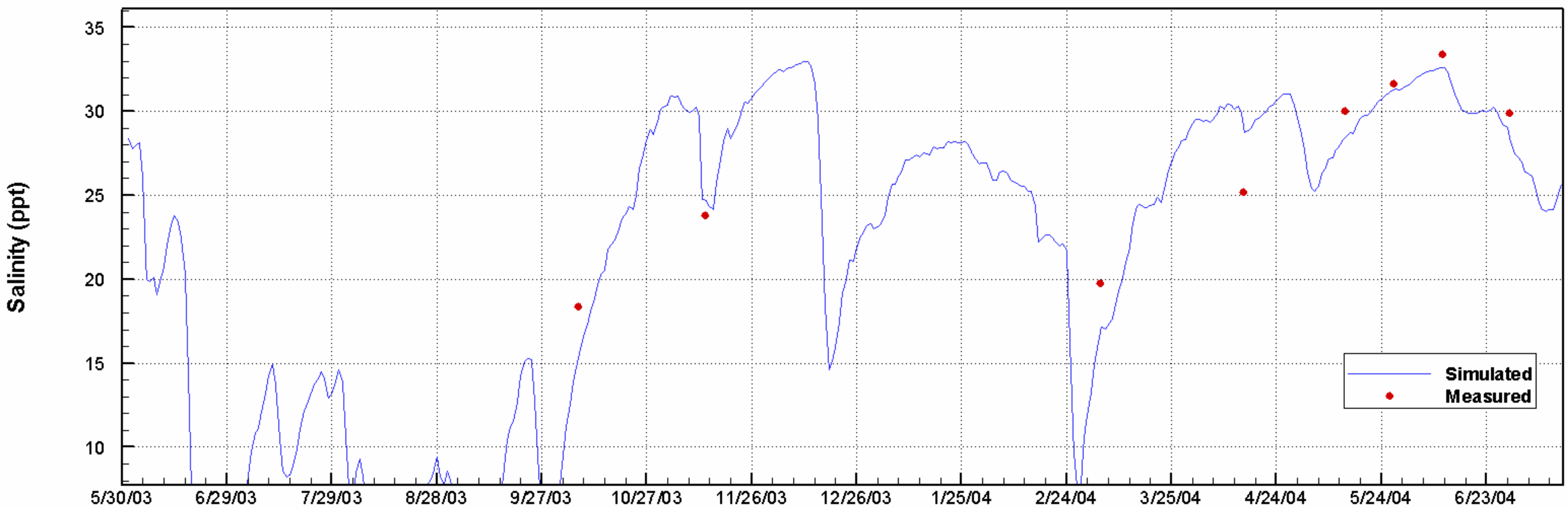
CP19 Surface Salinity

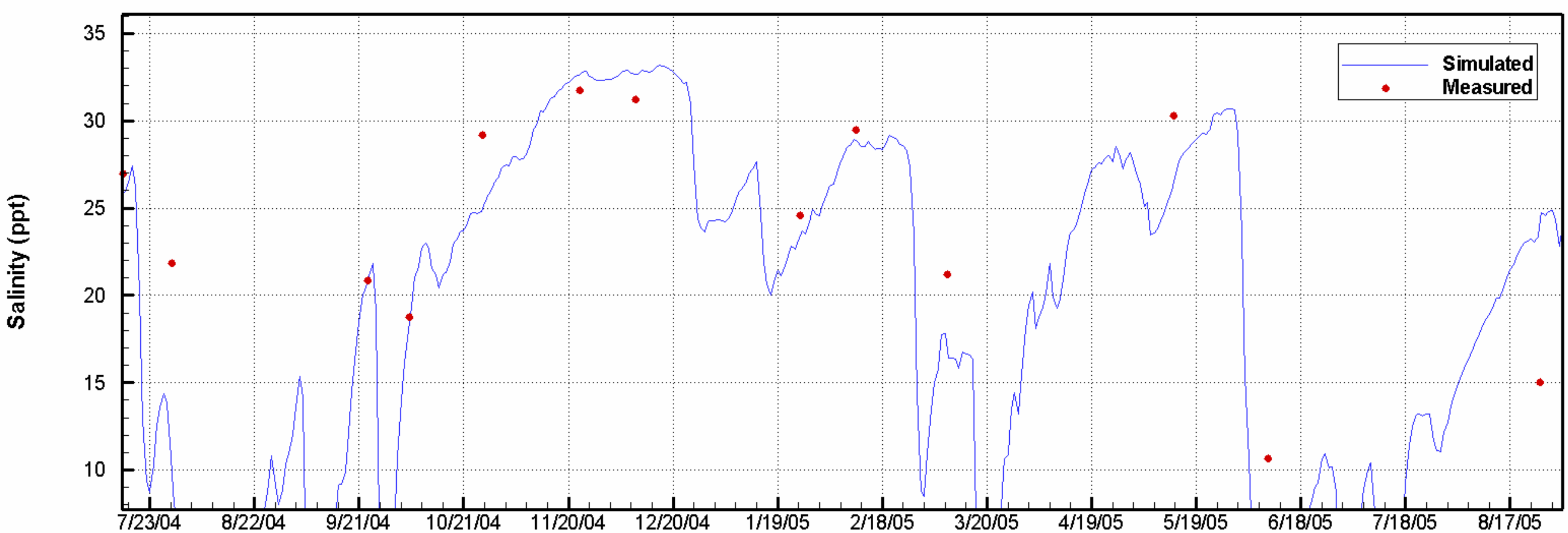


CP19 Bottom Salinity

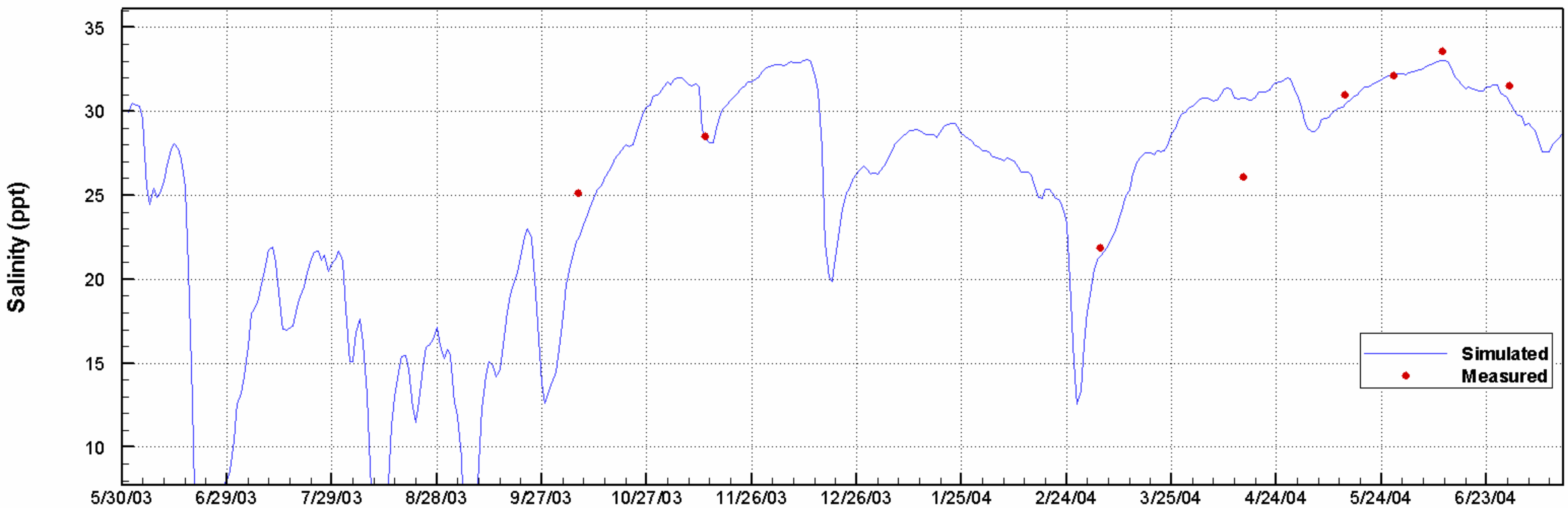


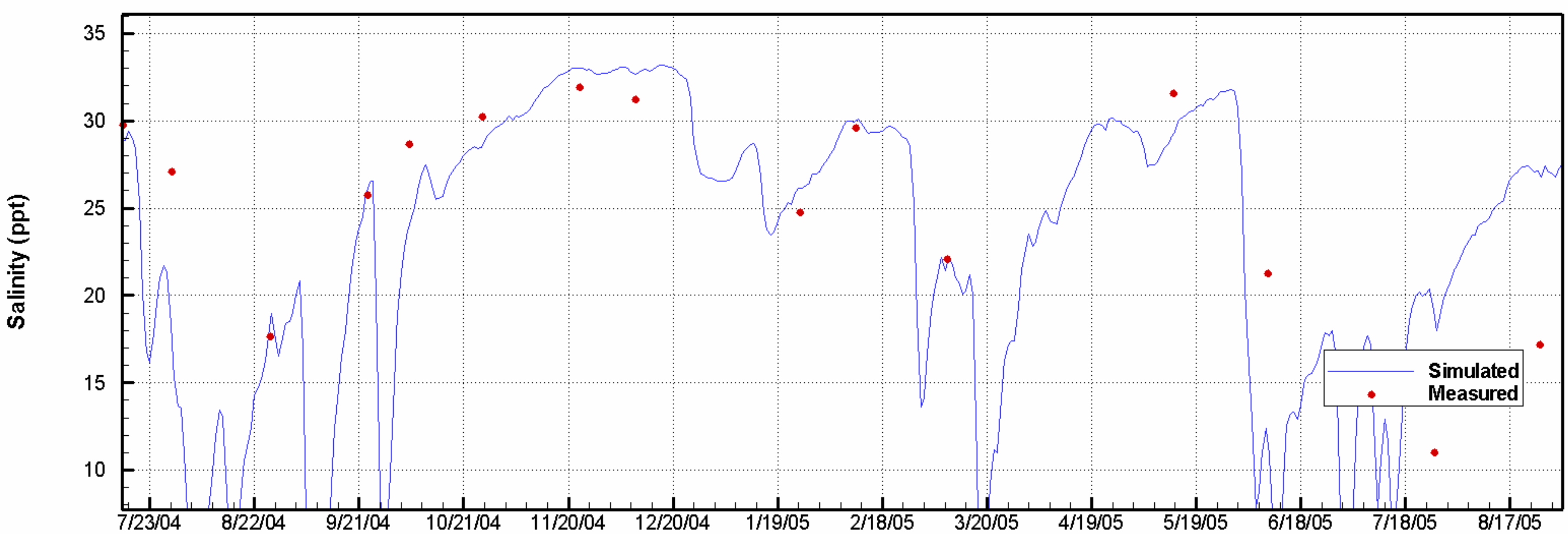
CP20 Surface Salinity



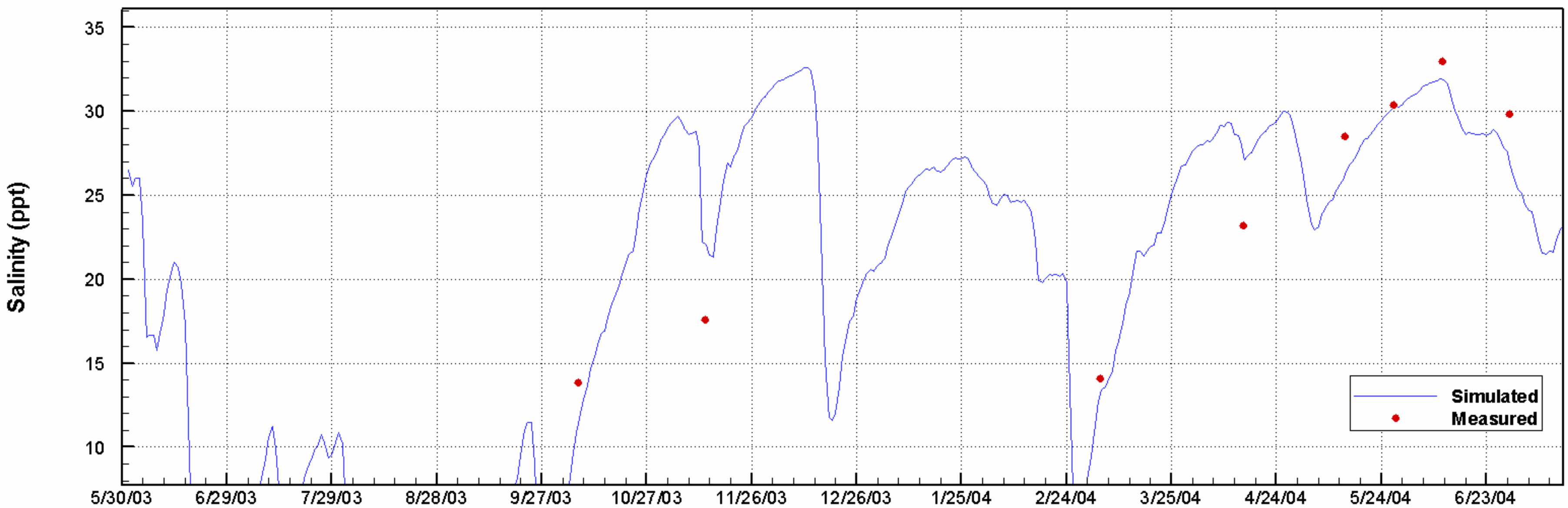


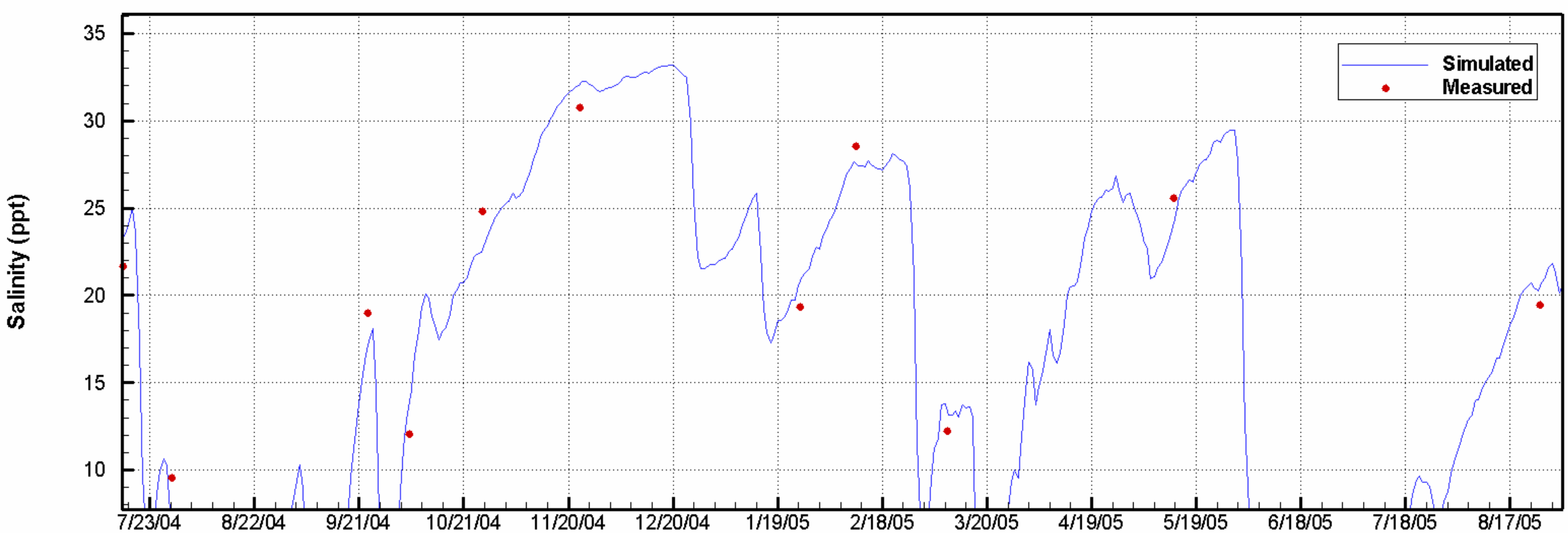
CP20 Bottom Salinity



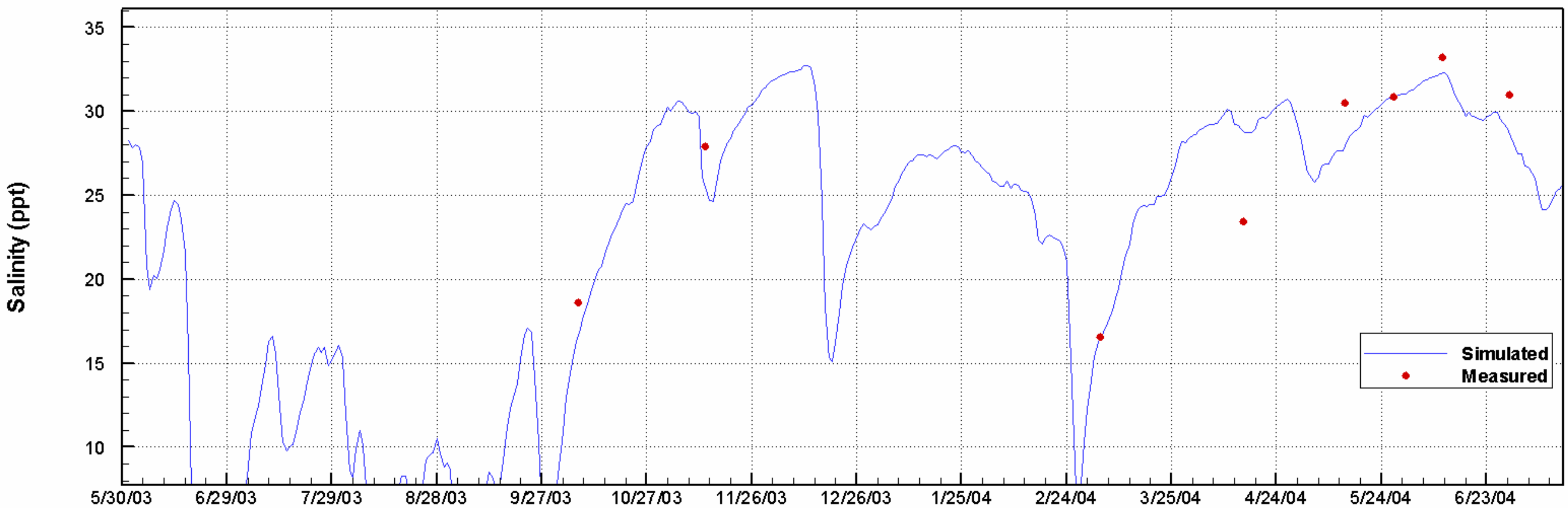


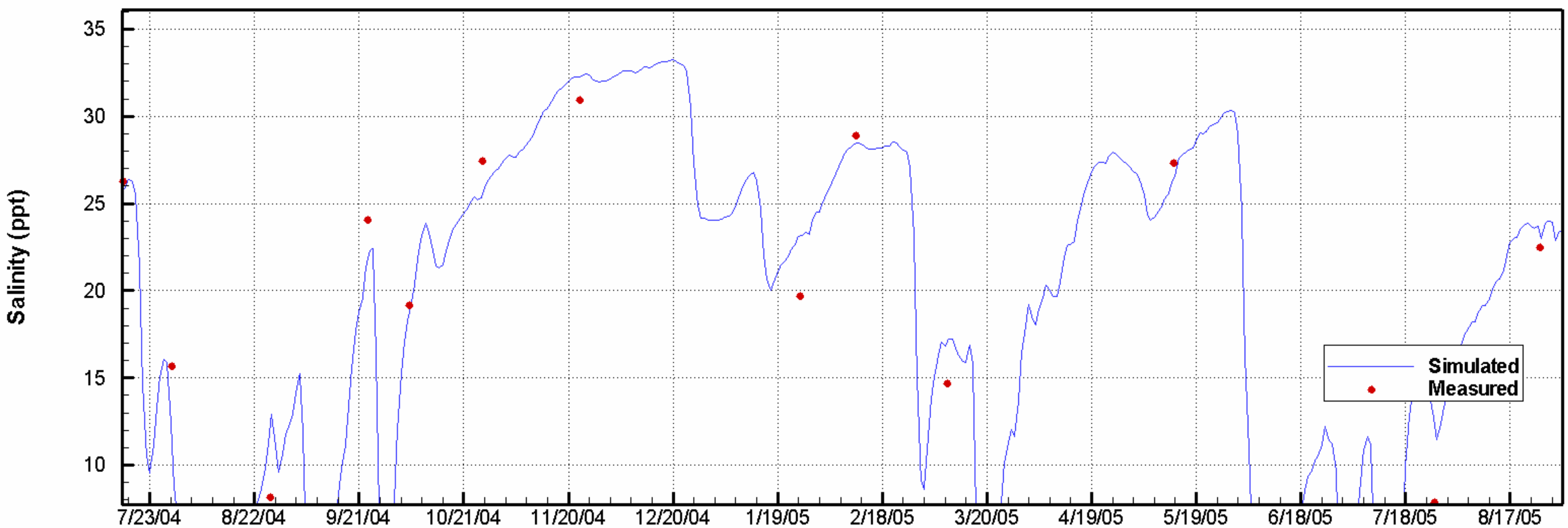
CP21 Surface Salinity



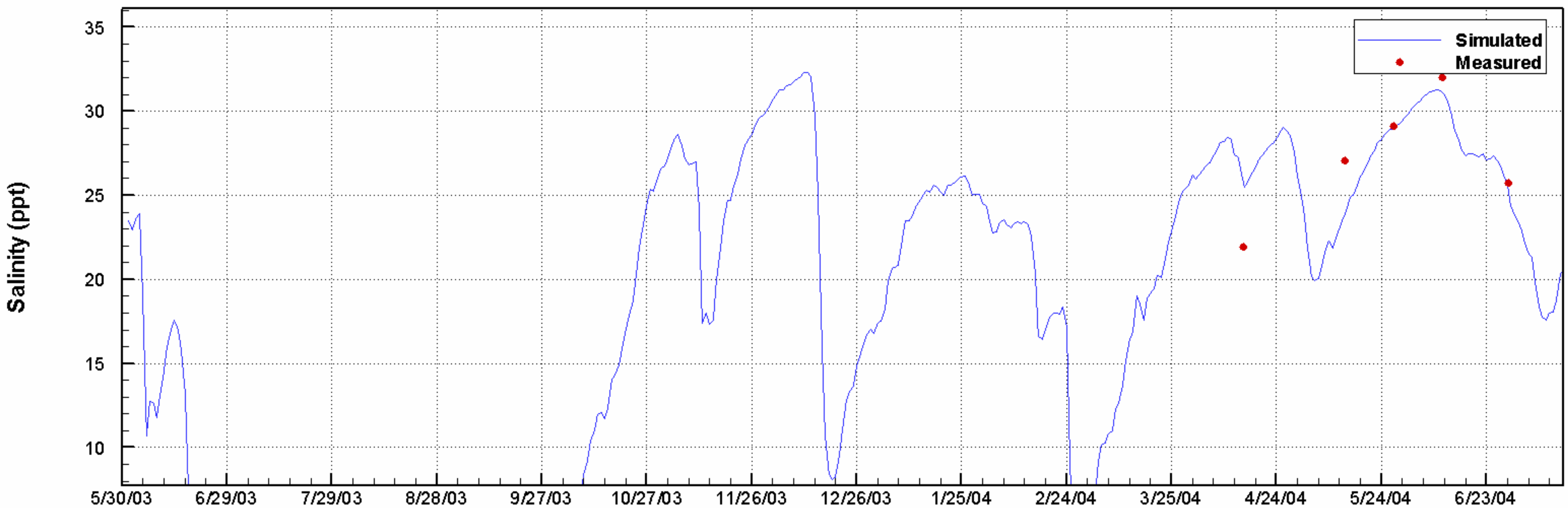


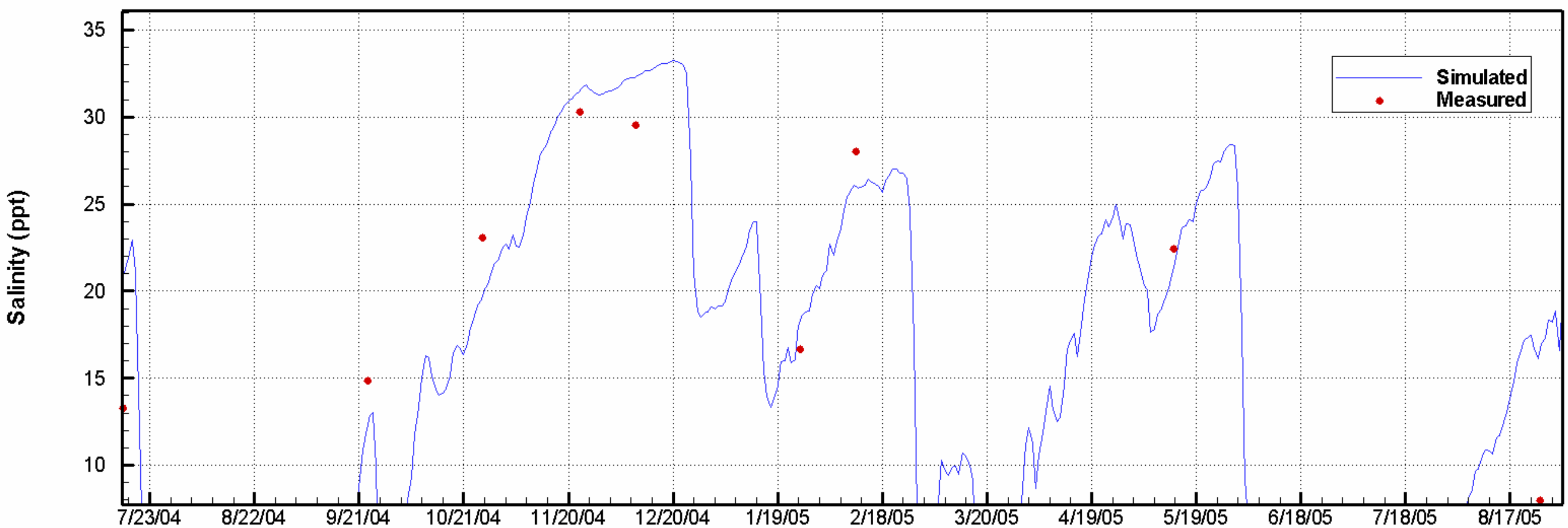
CP21 Bottom Salinity



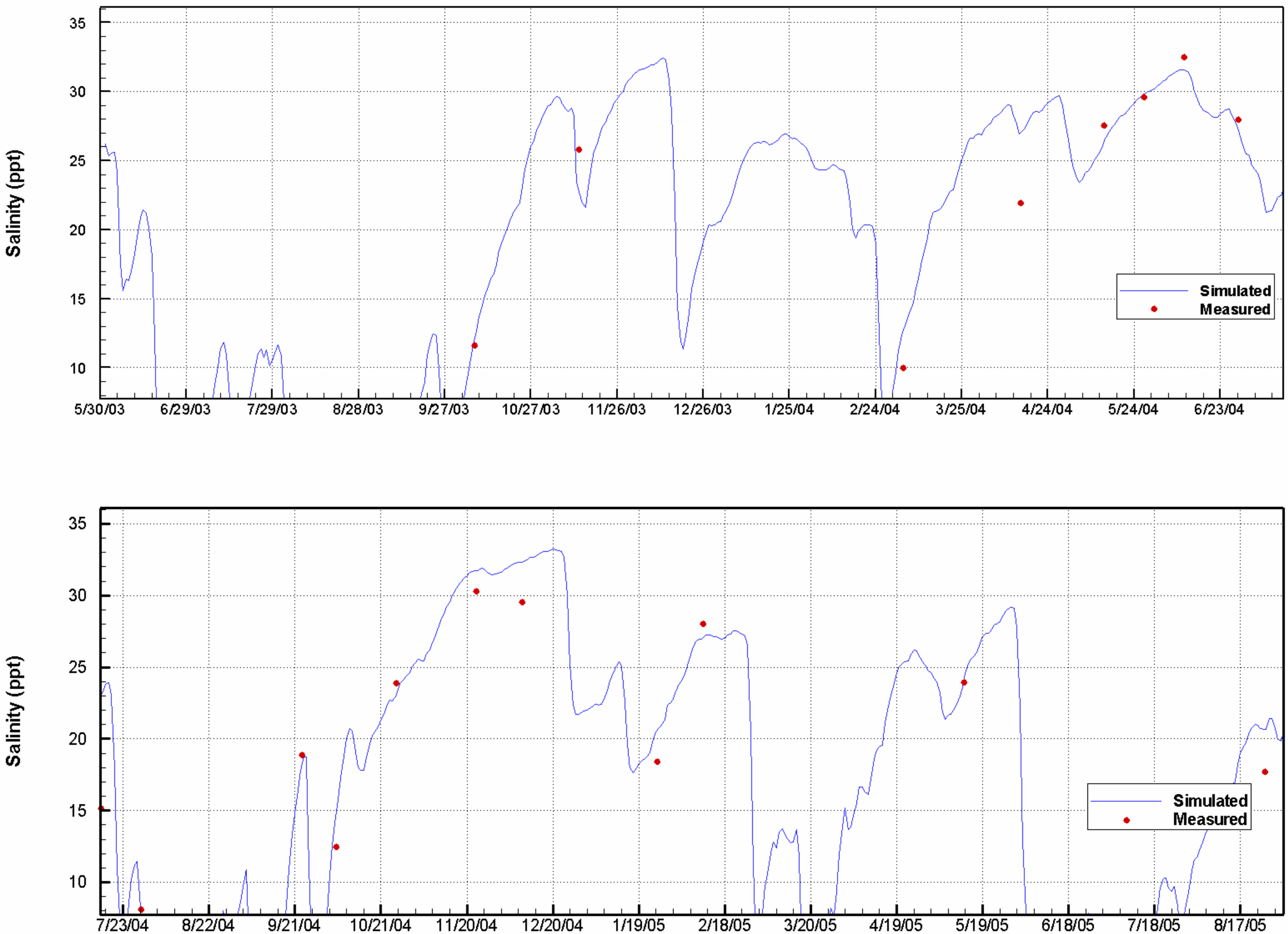


CP22 Surface Salinity

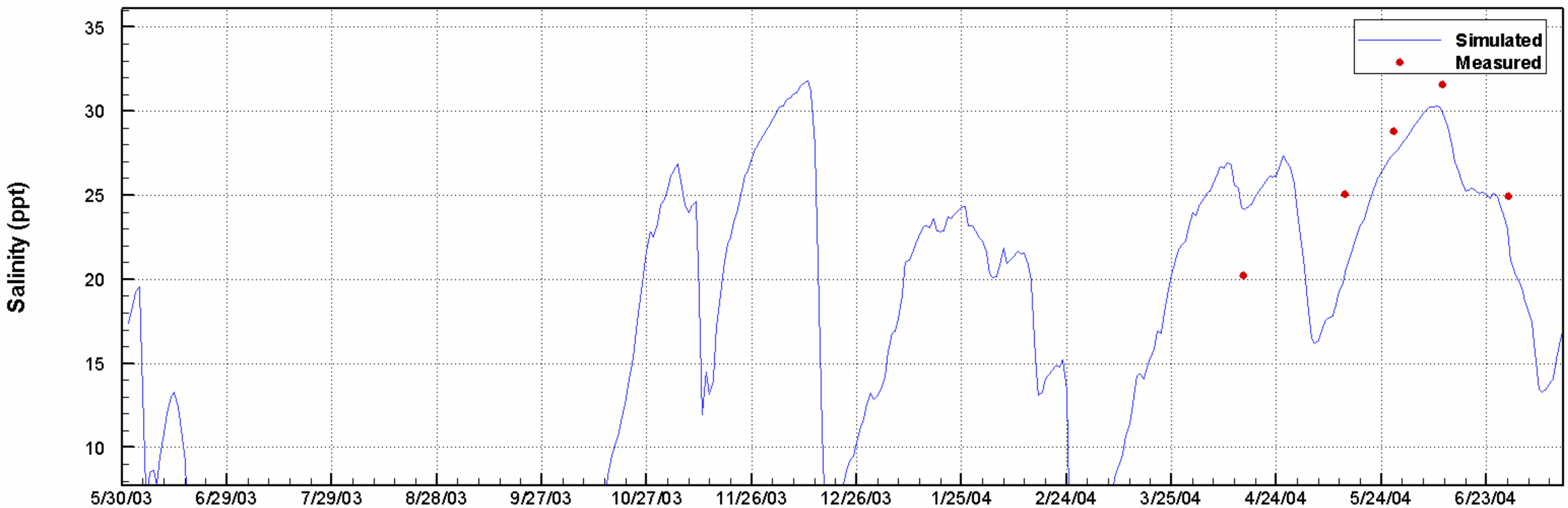


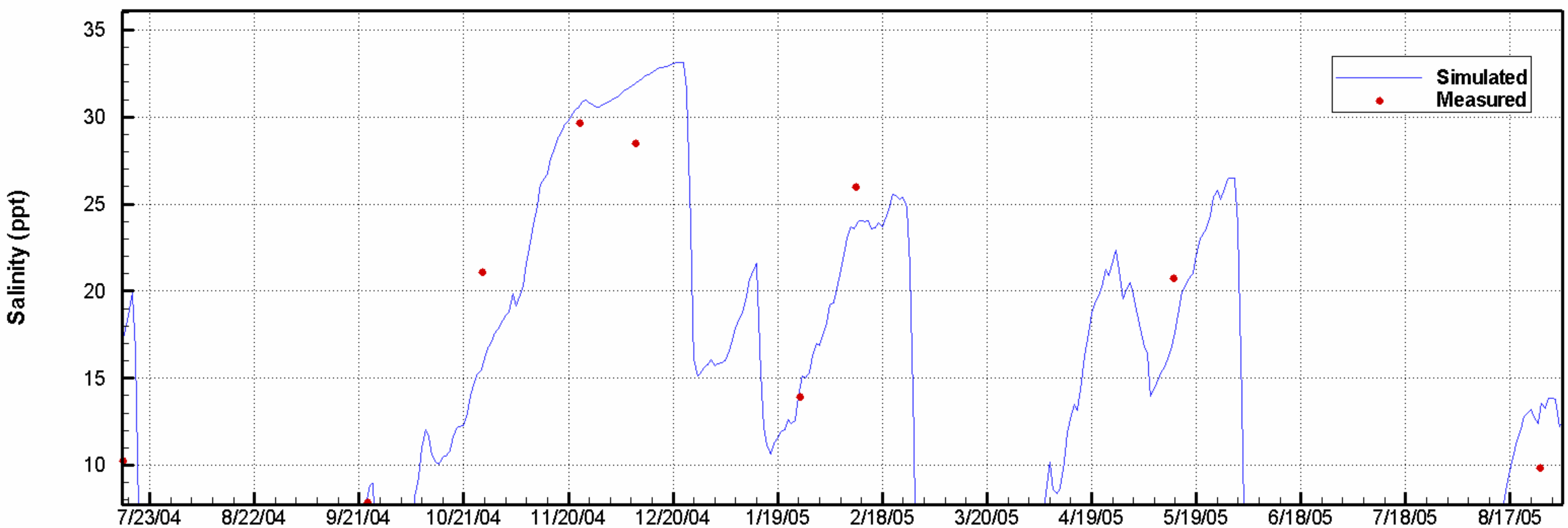


CP22 Bottom Salinity

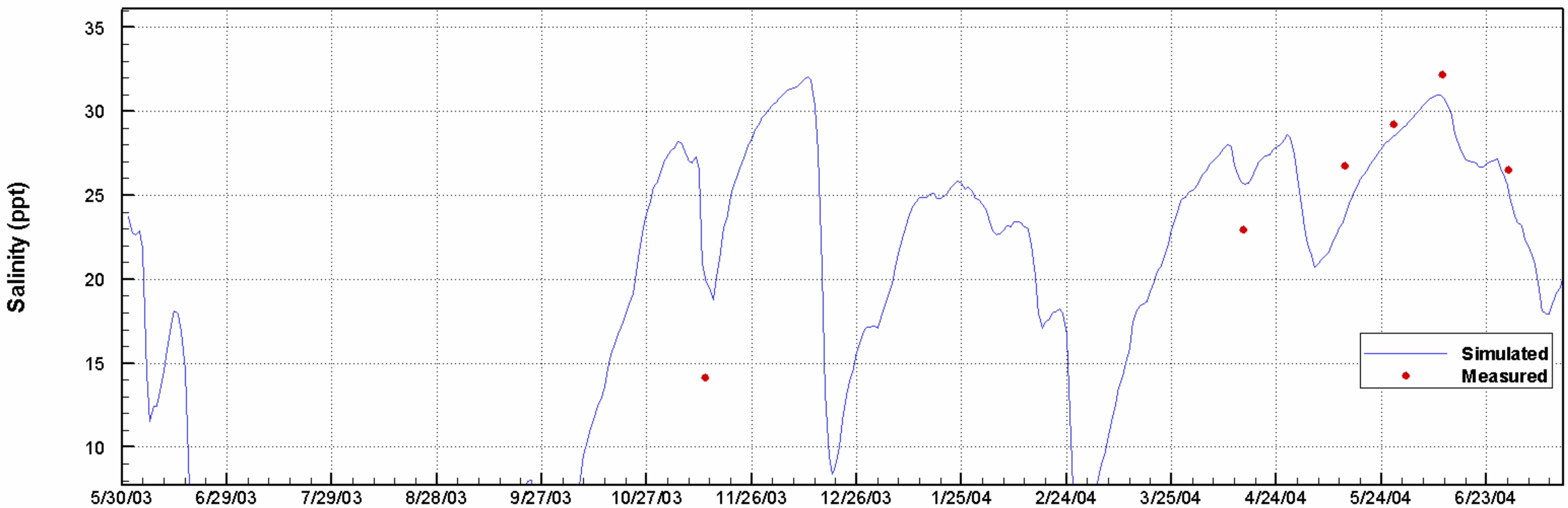


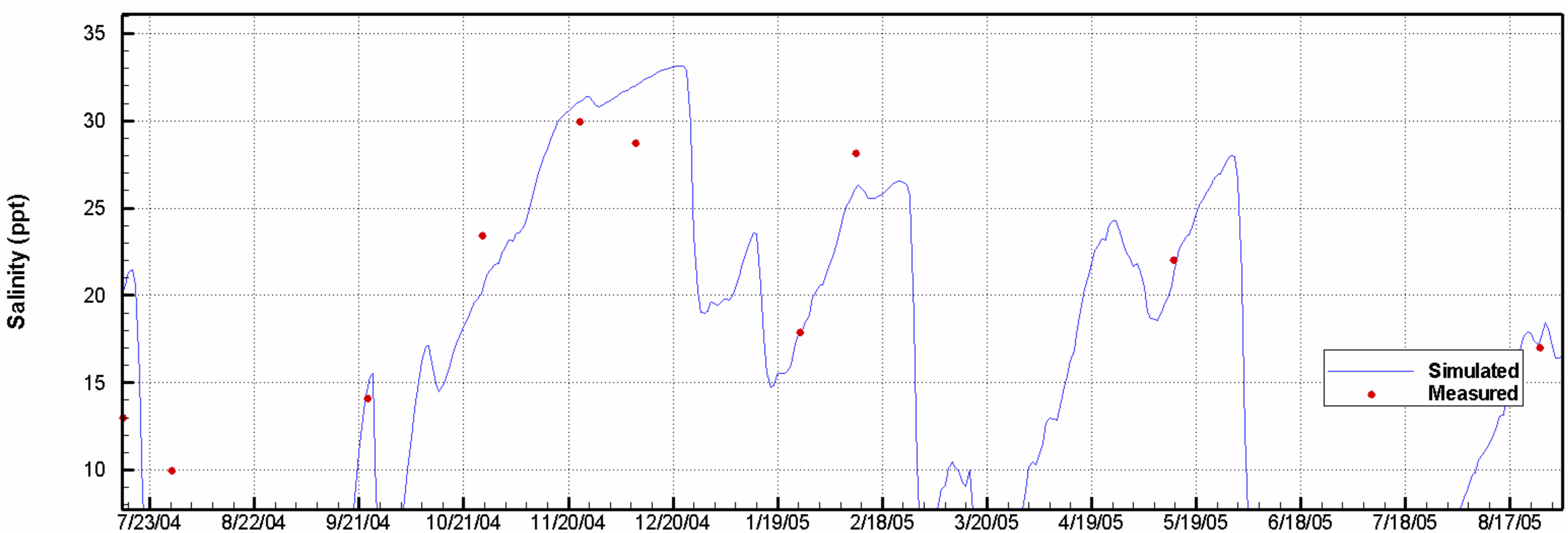
CP23 Surface Salinity



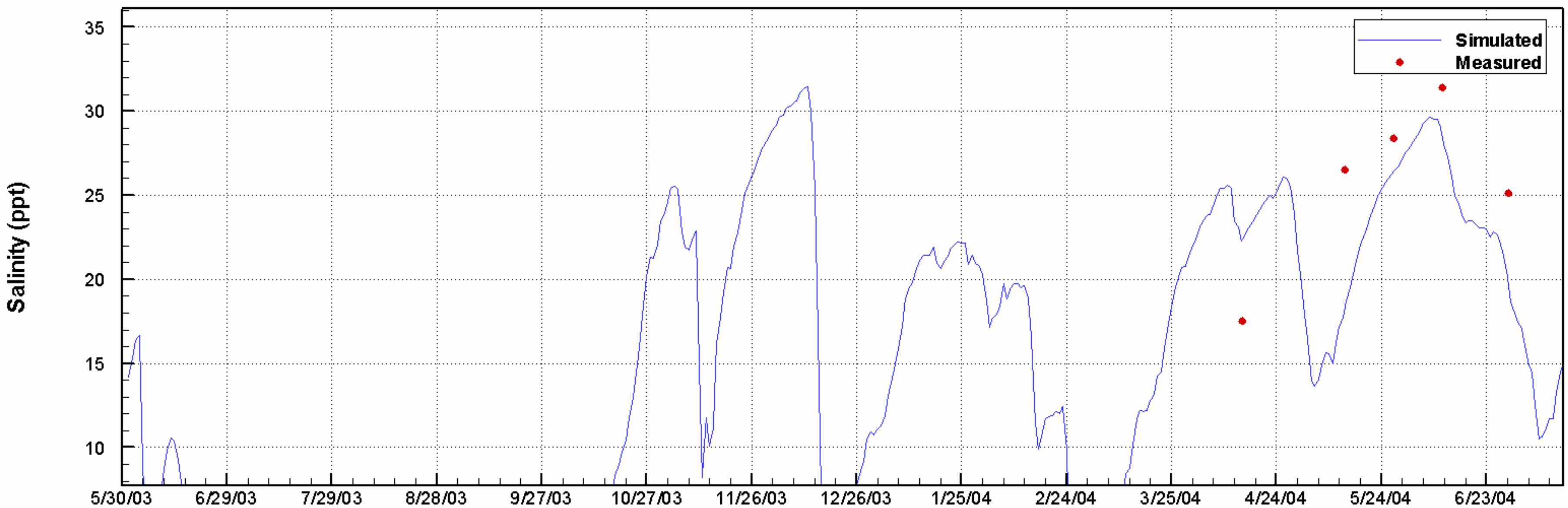


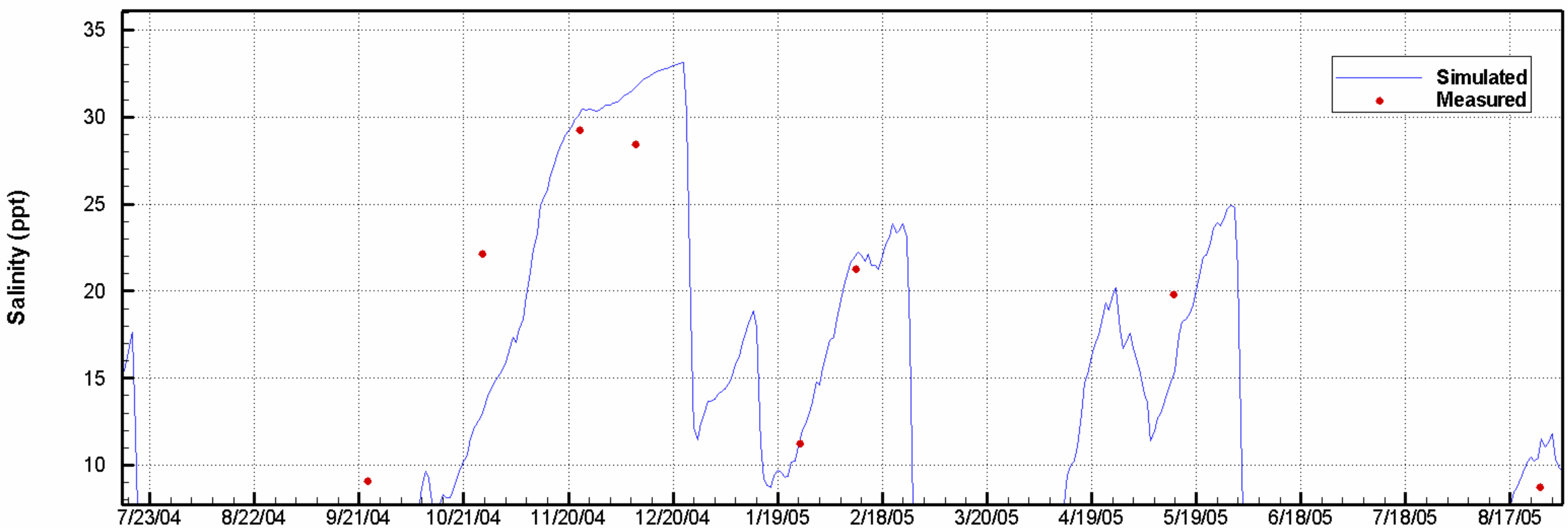
CP23 Bottom Salinity



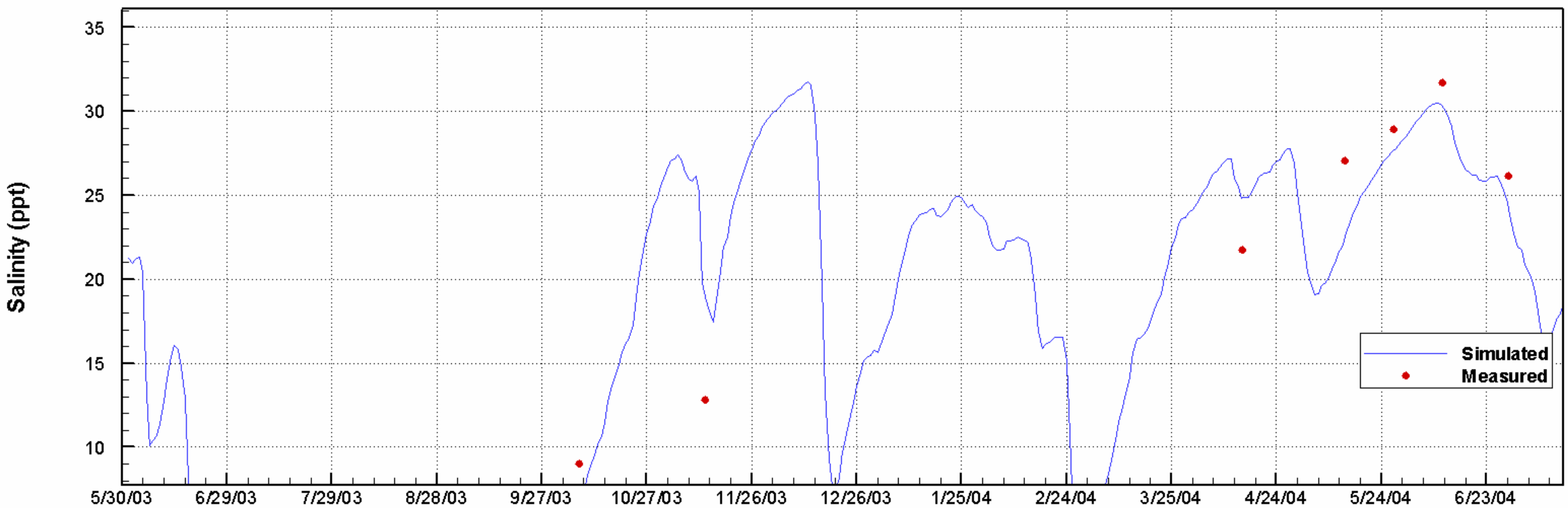


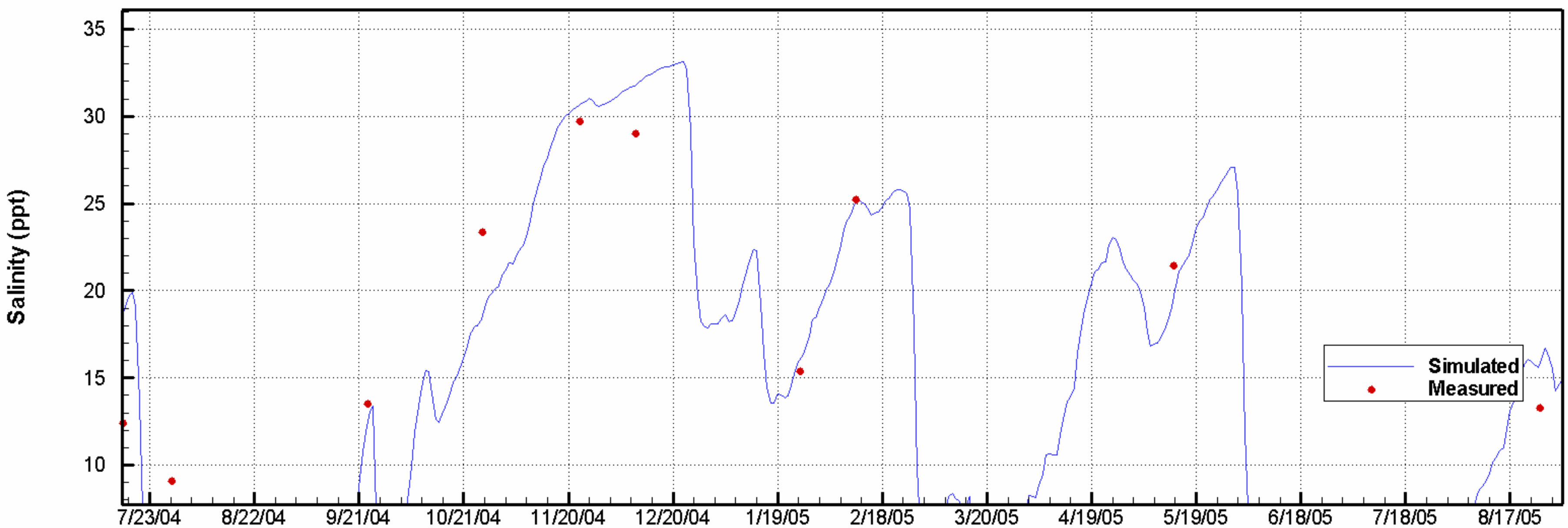
CP24 Surface Salinity





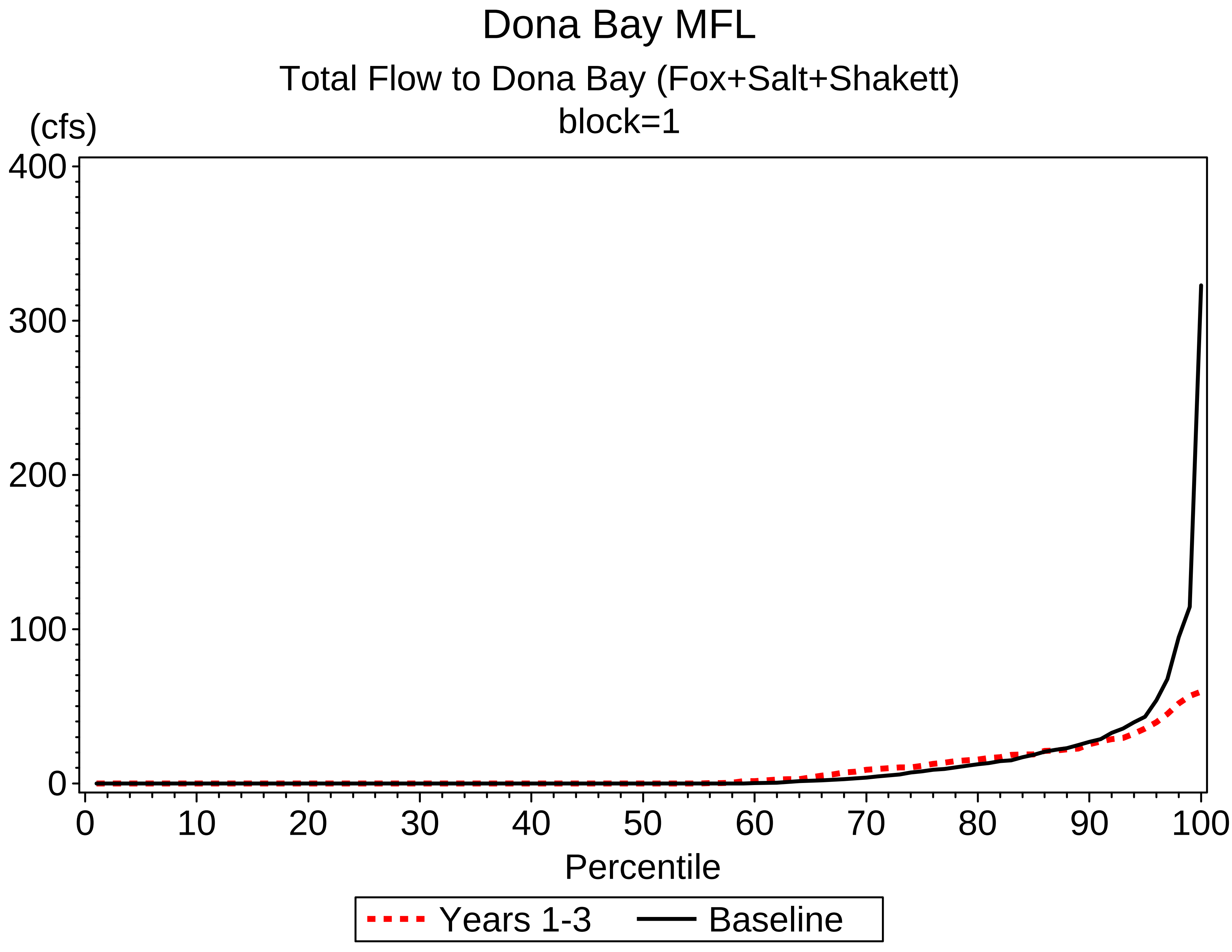
CP24 Bottom Salinity

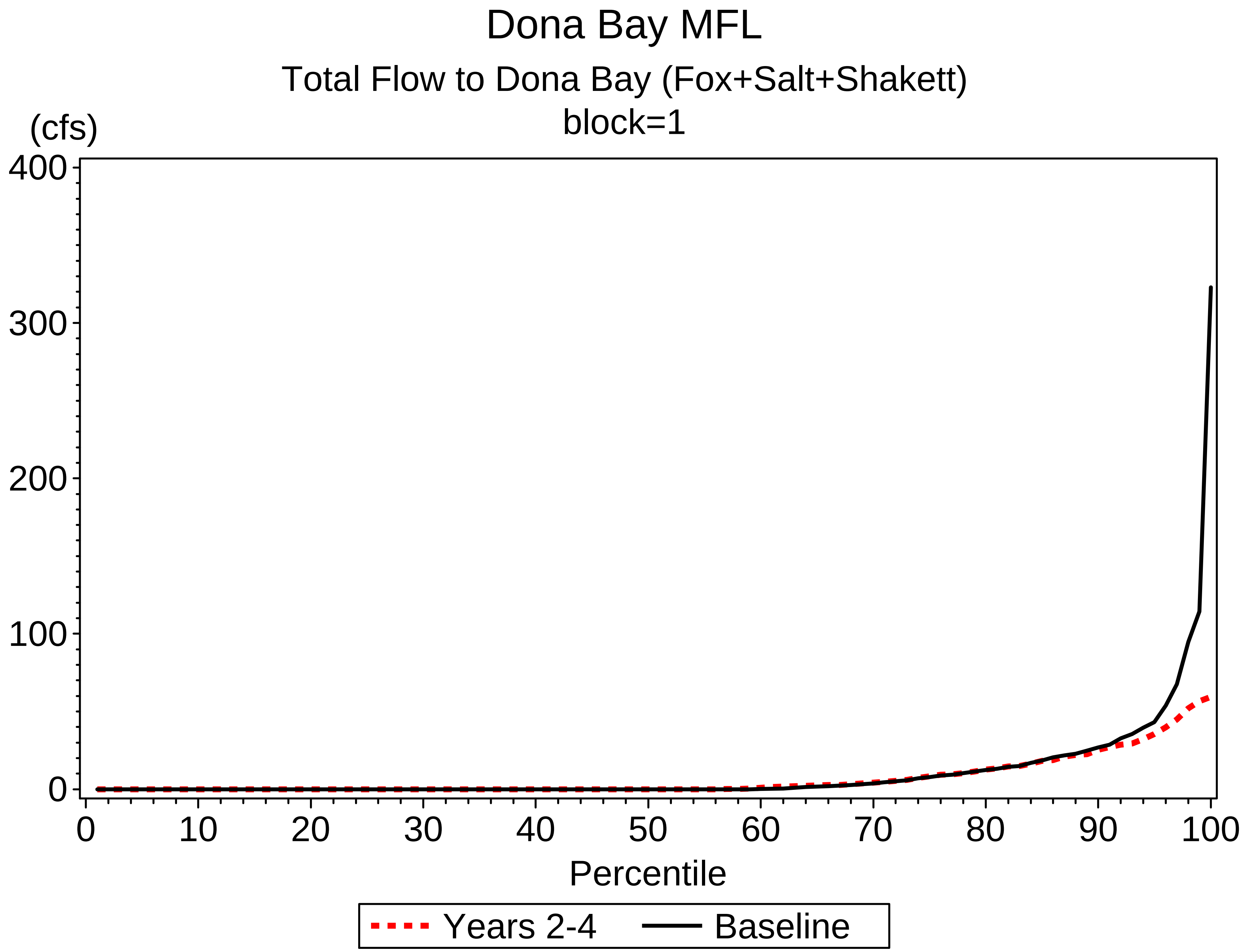


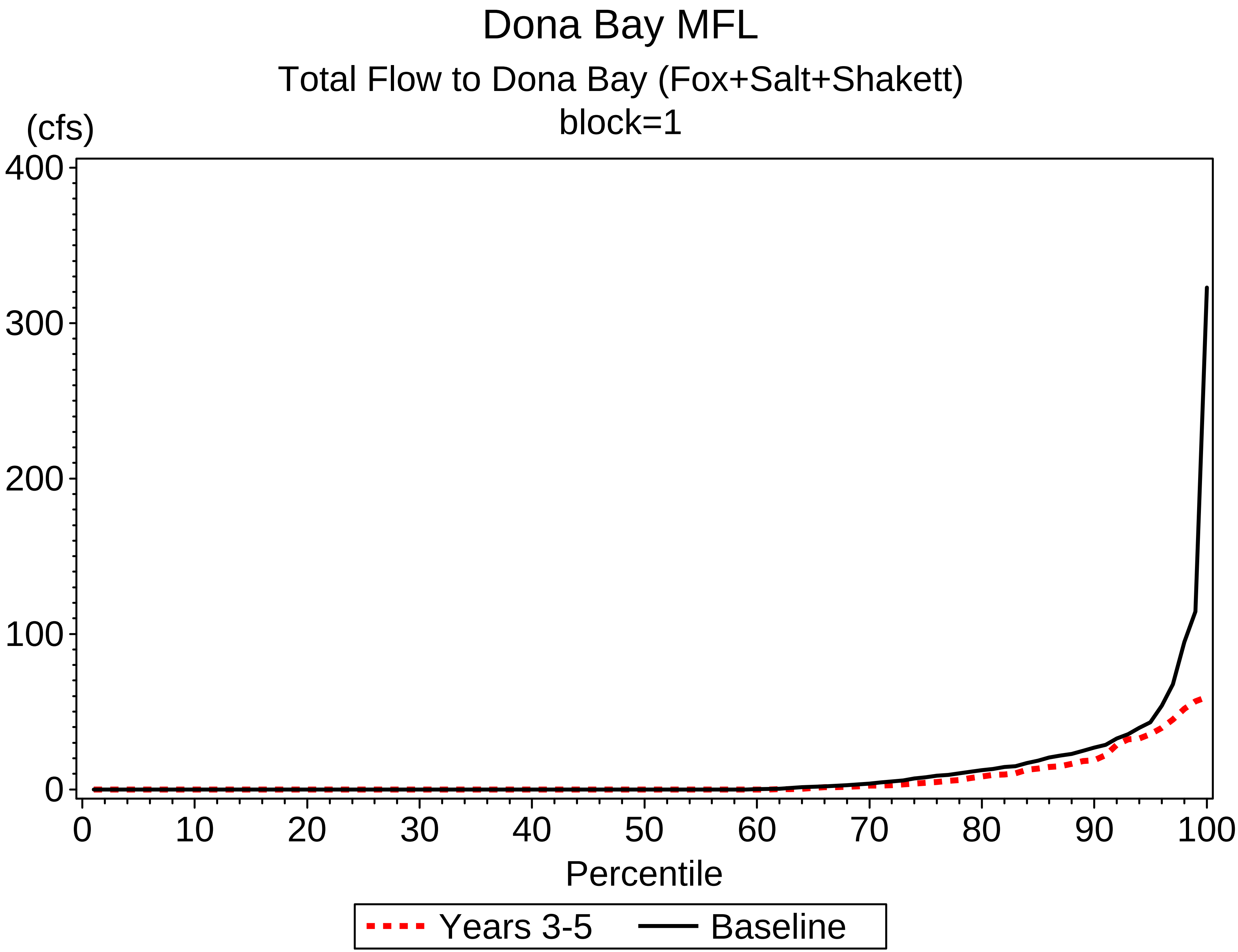


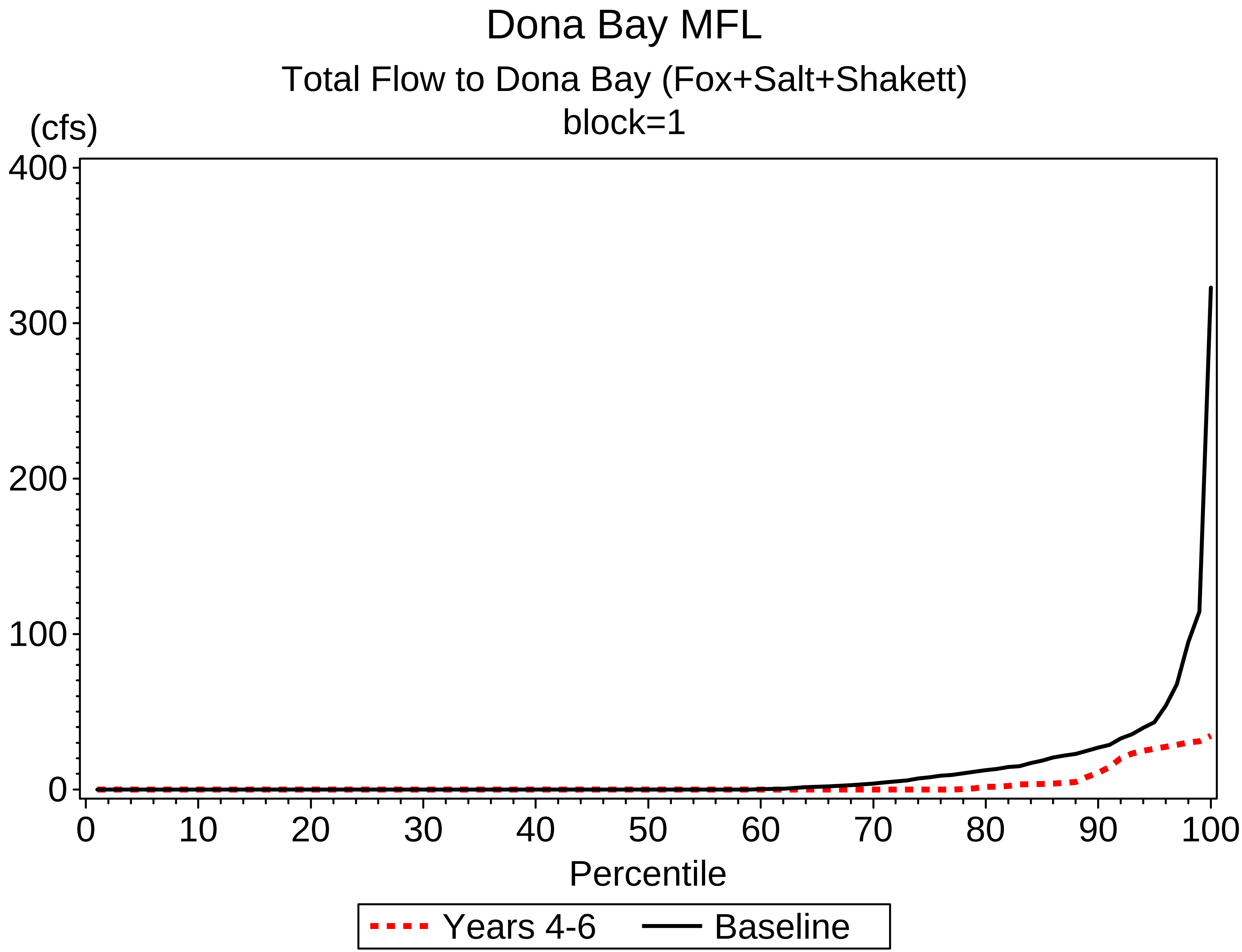
APPENDIX 6-2

FLOW DURATION CURVES COMPARING ENTIRE BASELINE PERIOD TO 3-YEAR INTERVALS

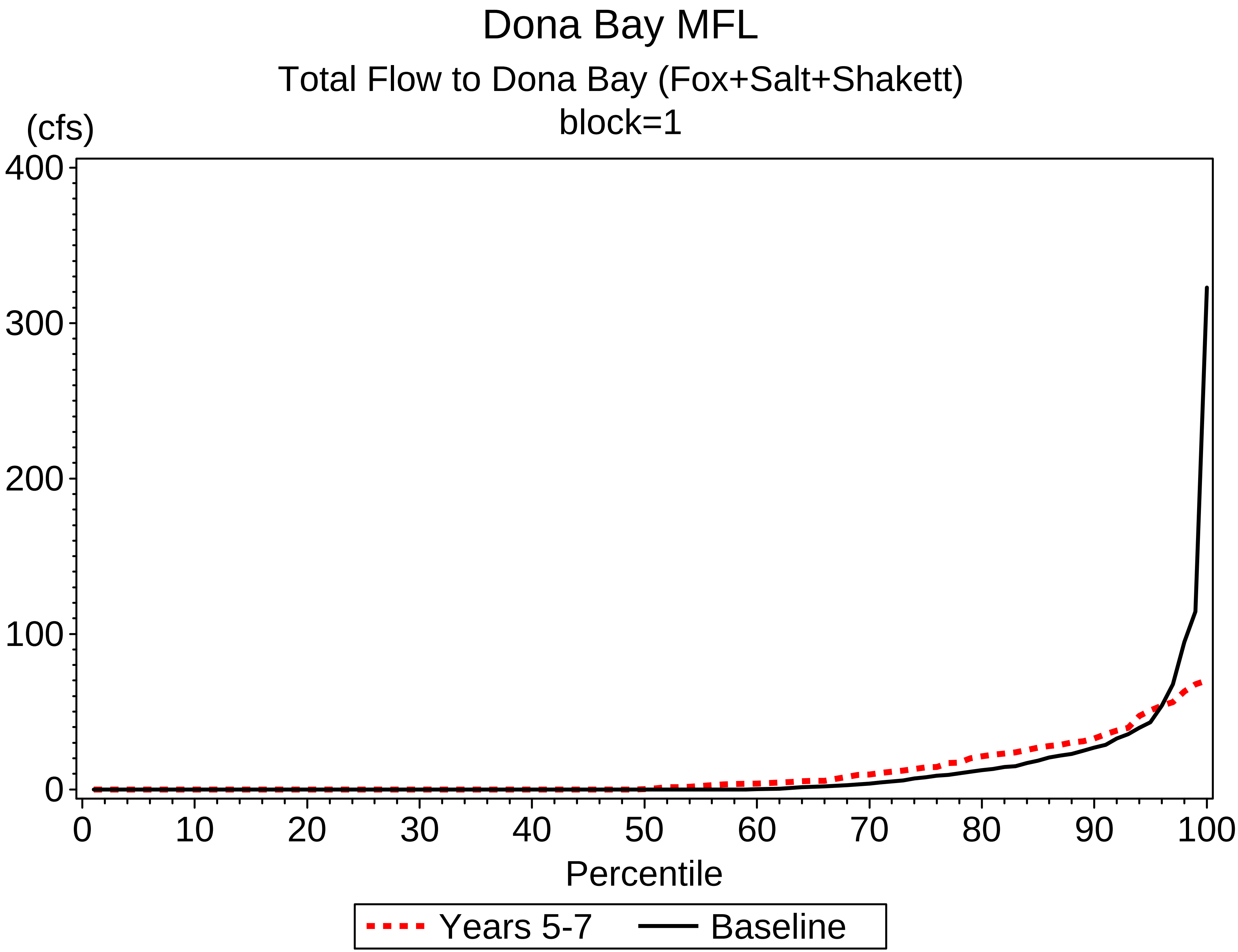

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 1-3
Baseline

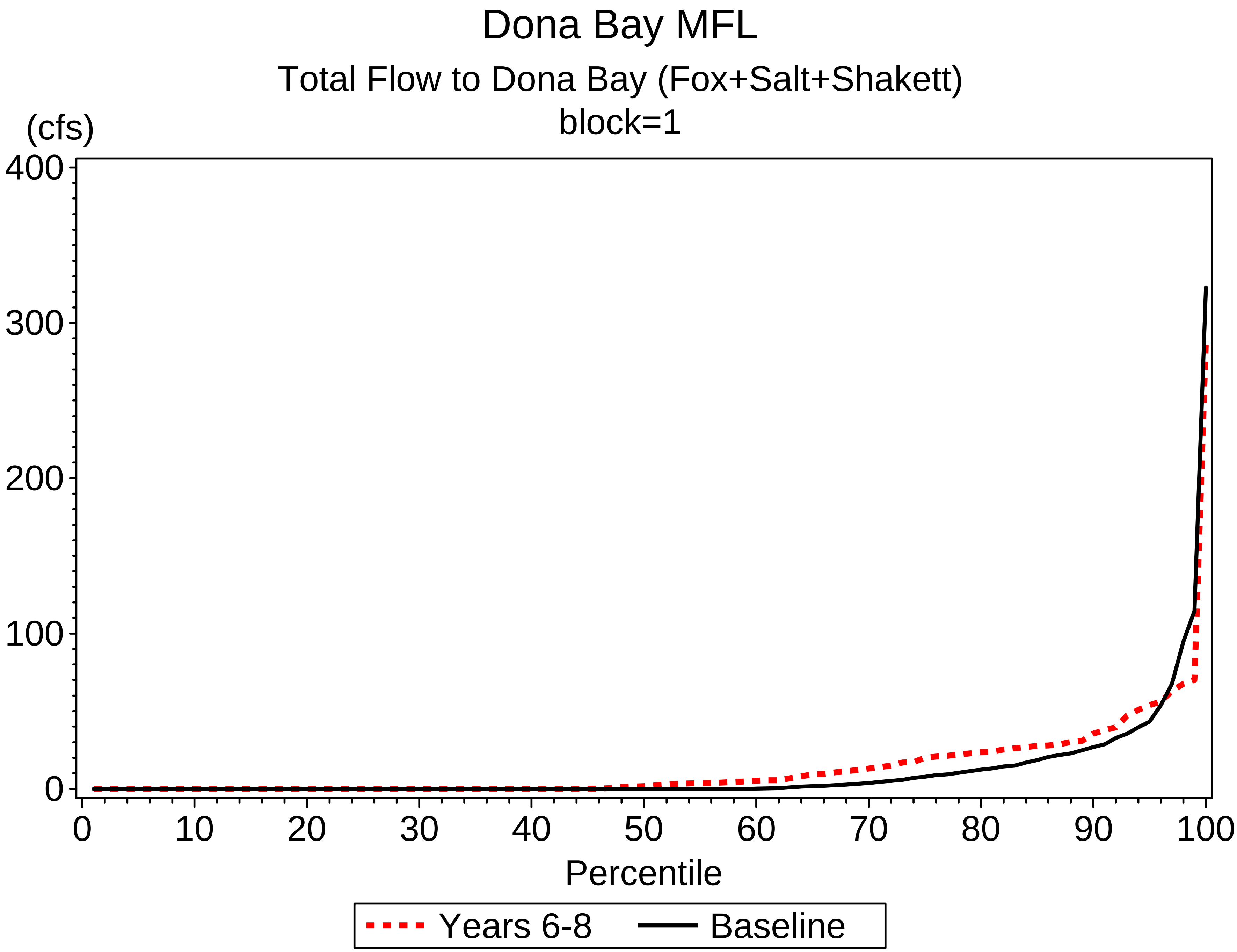

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 2-4
Baseline

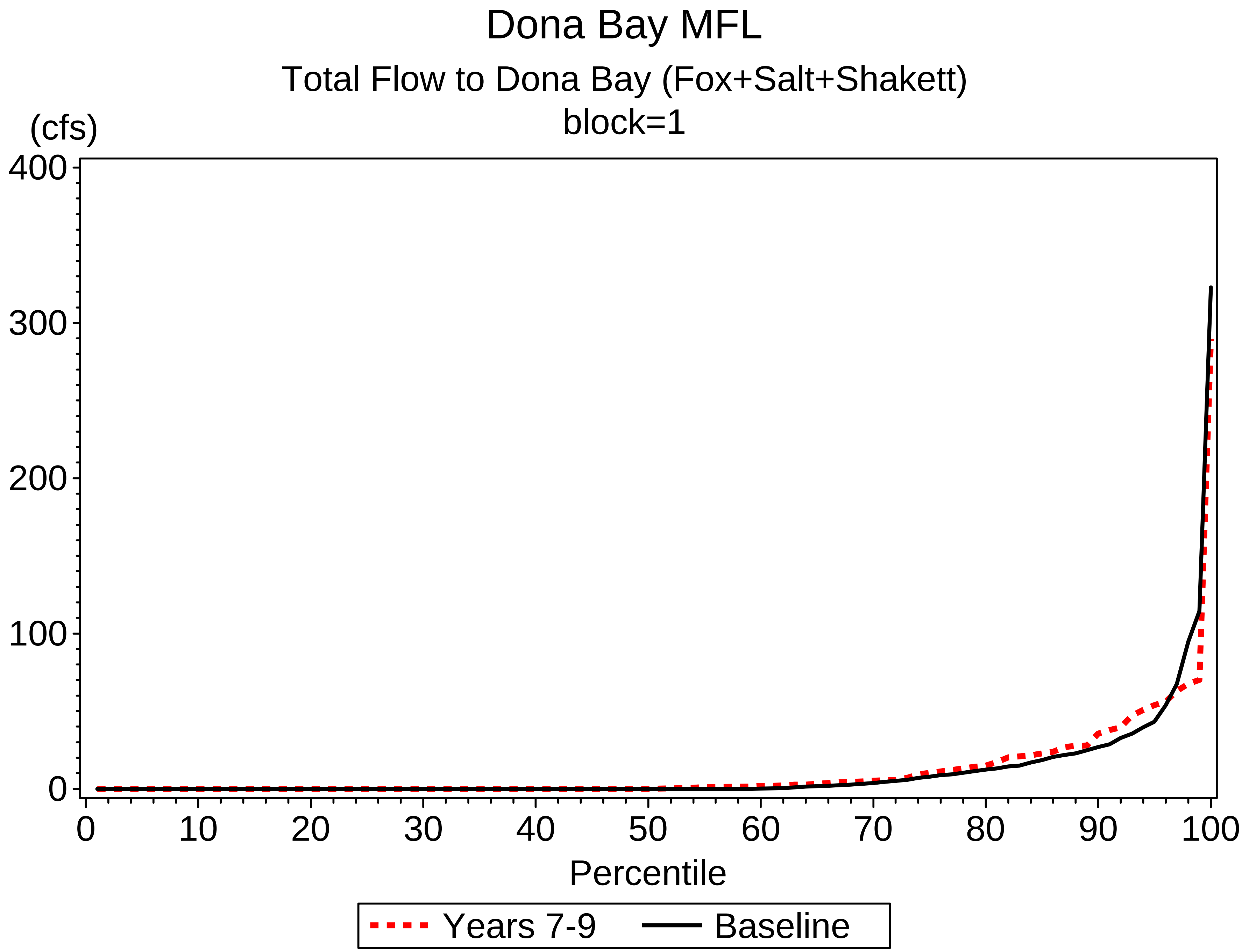

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 3-5
Baseline

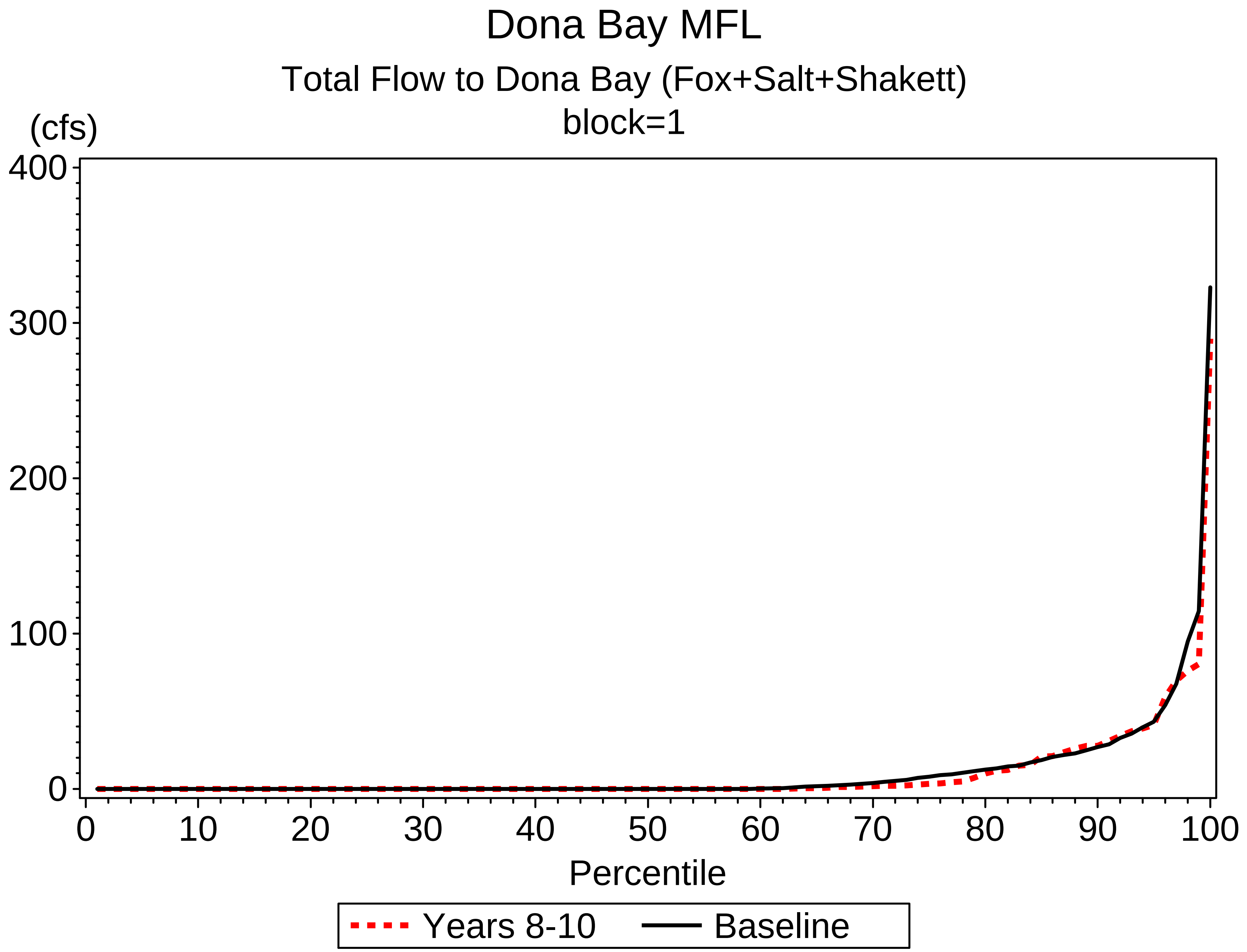


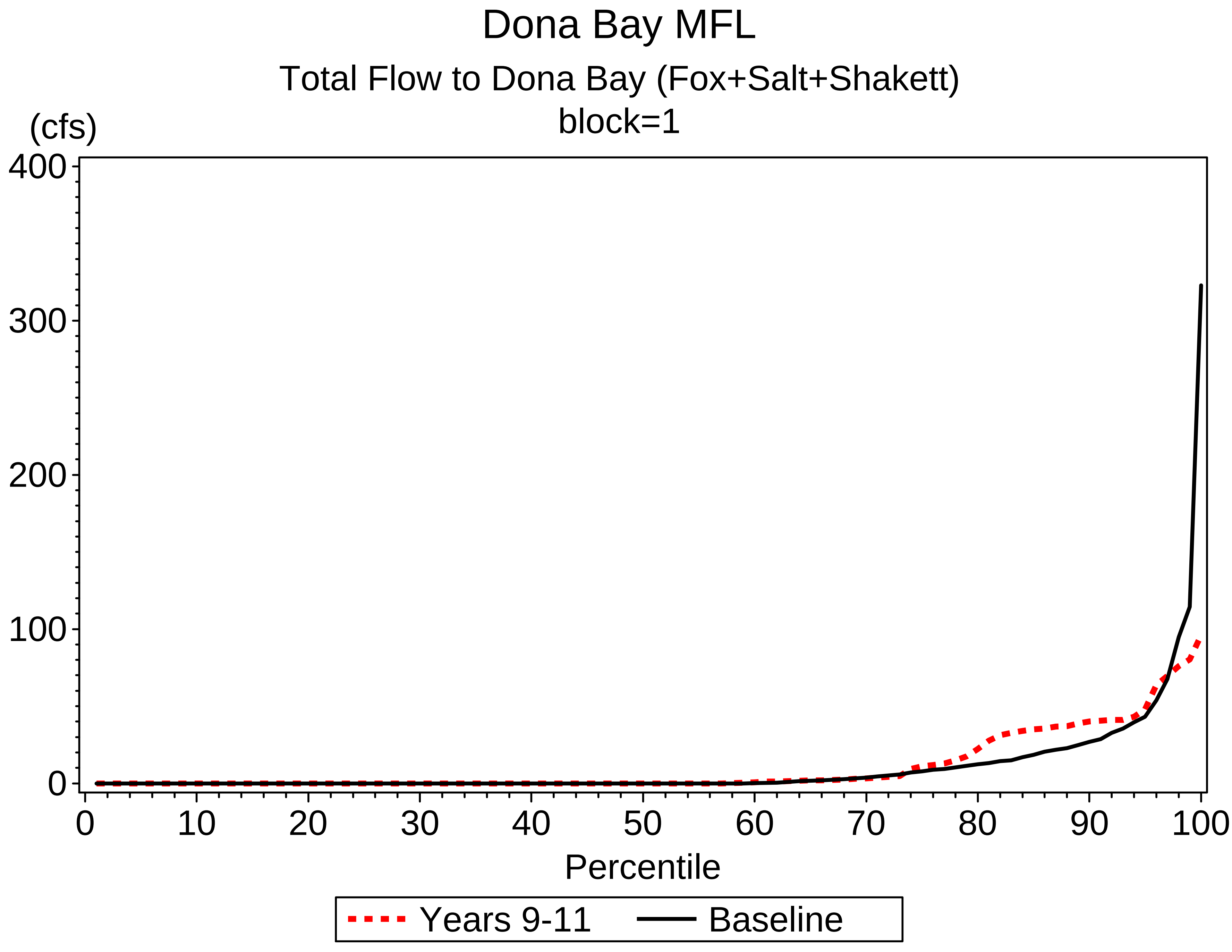
Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 4-6
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 5-7
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 6-8
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 7-9
Baseline

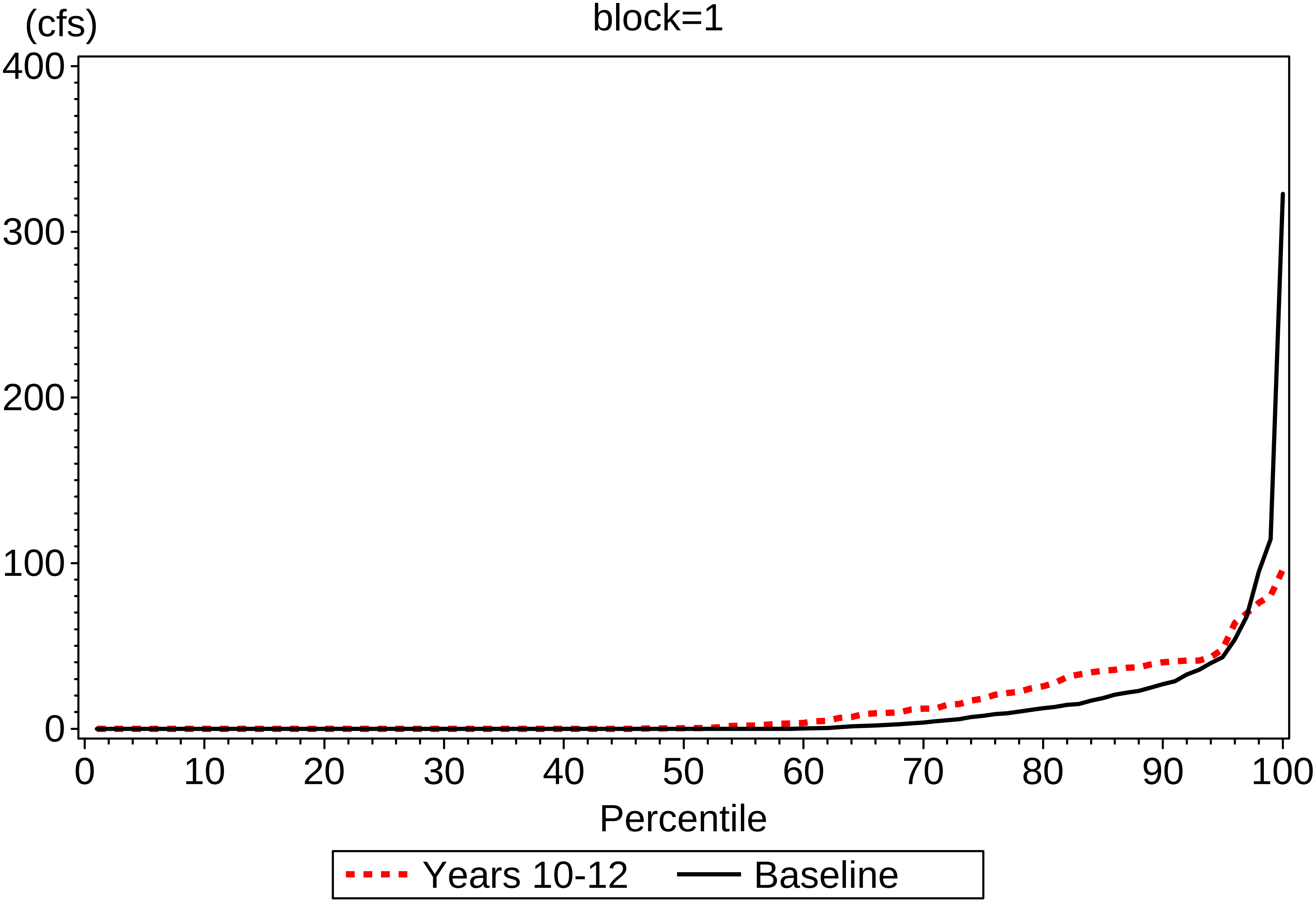

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 8-10
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 9-11
Baseline

Dona Bay MFL

Total Flow to Dona Bay (Fox+Salt+Shakett)

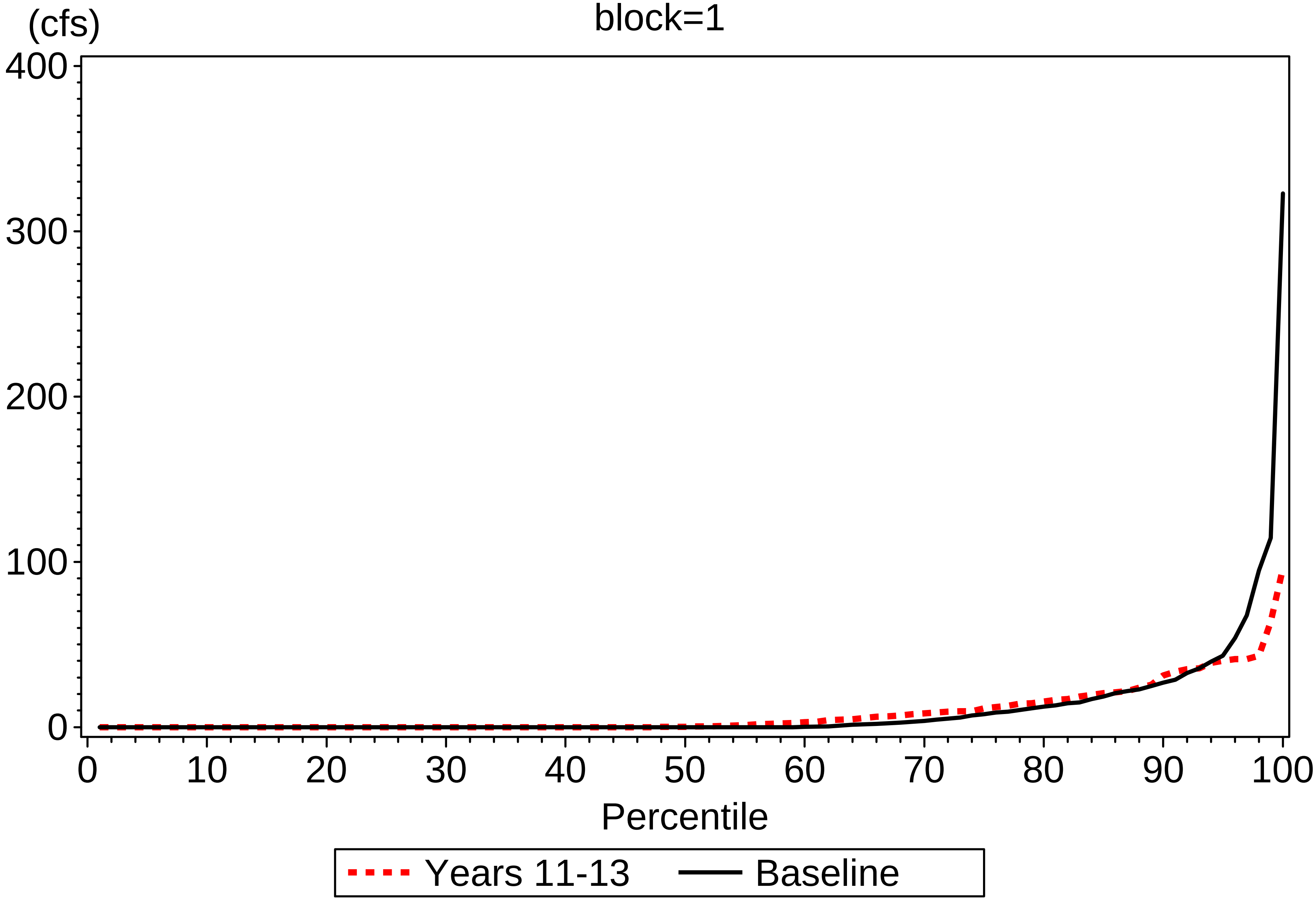
block=1

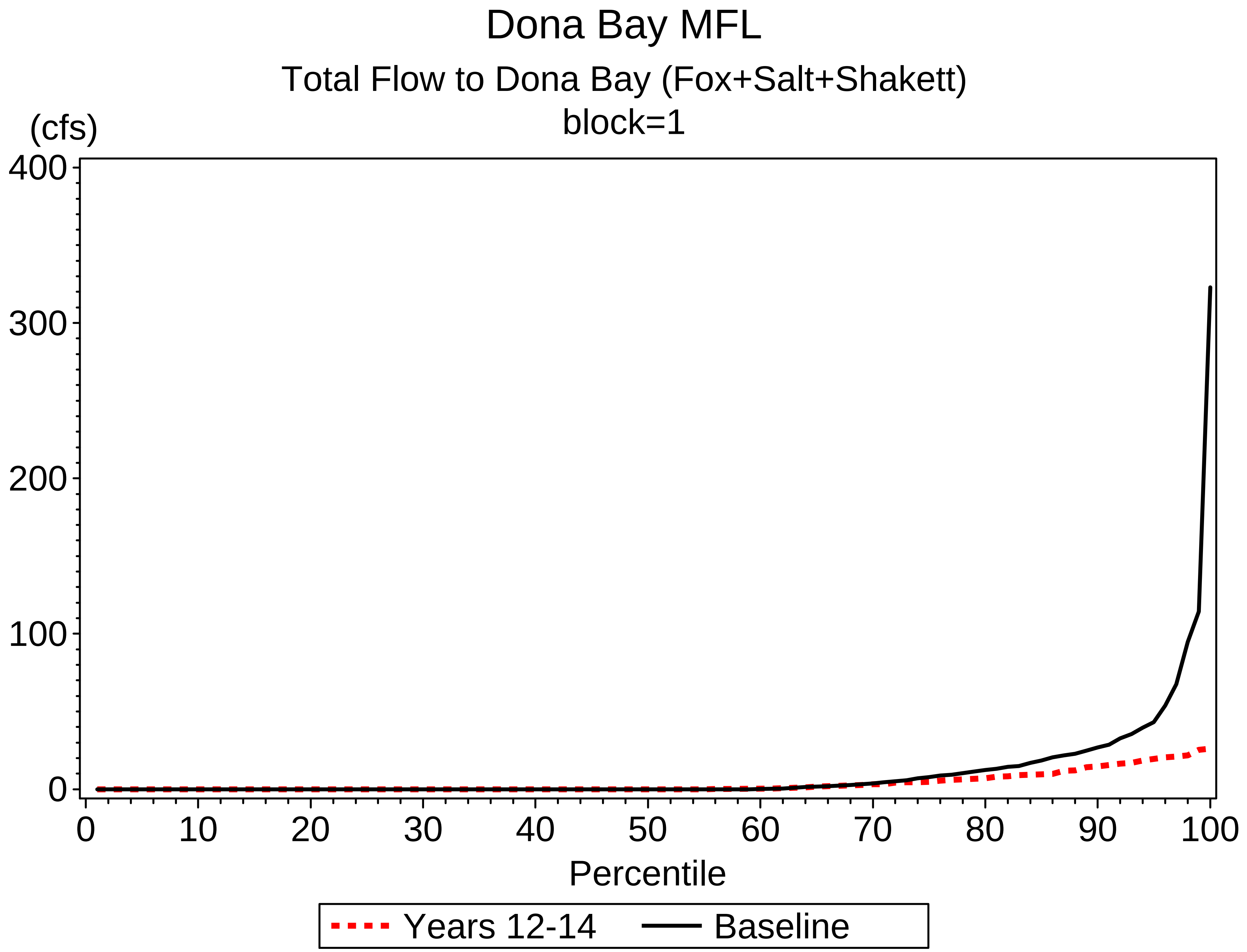


Dona Bay MFL

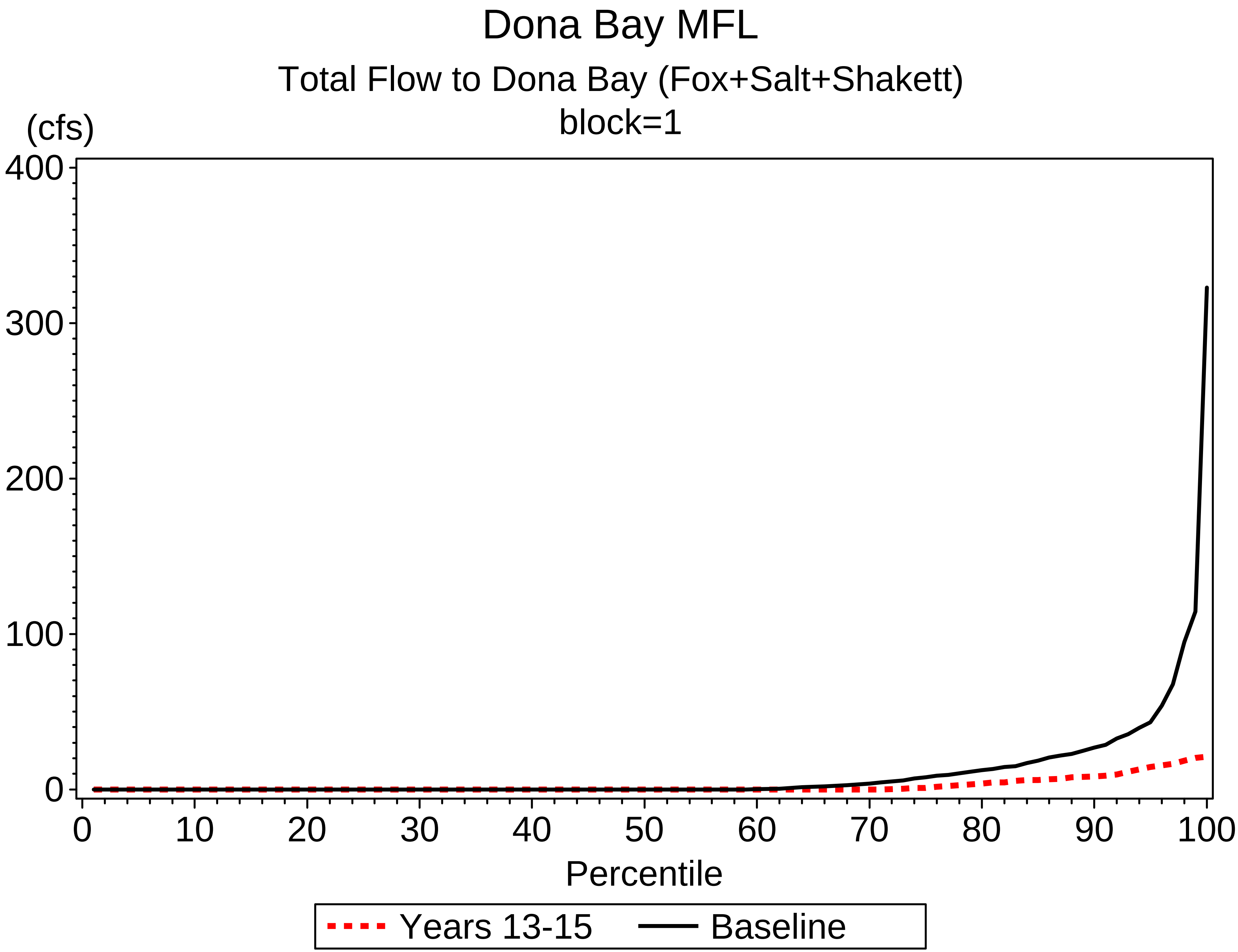
Total Flow to Dona Bay (Fox+Salt+Shakett)

block=1





Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 12-14
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
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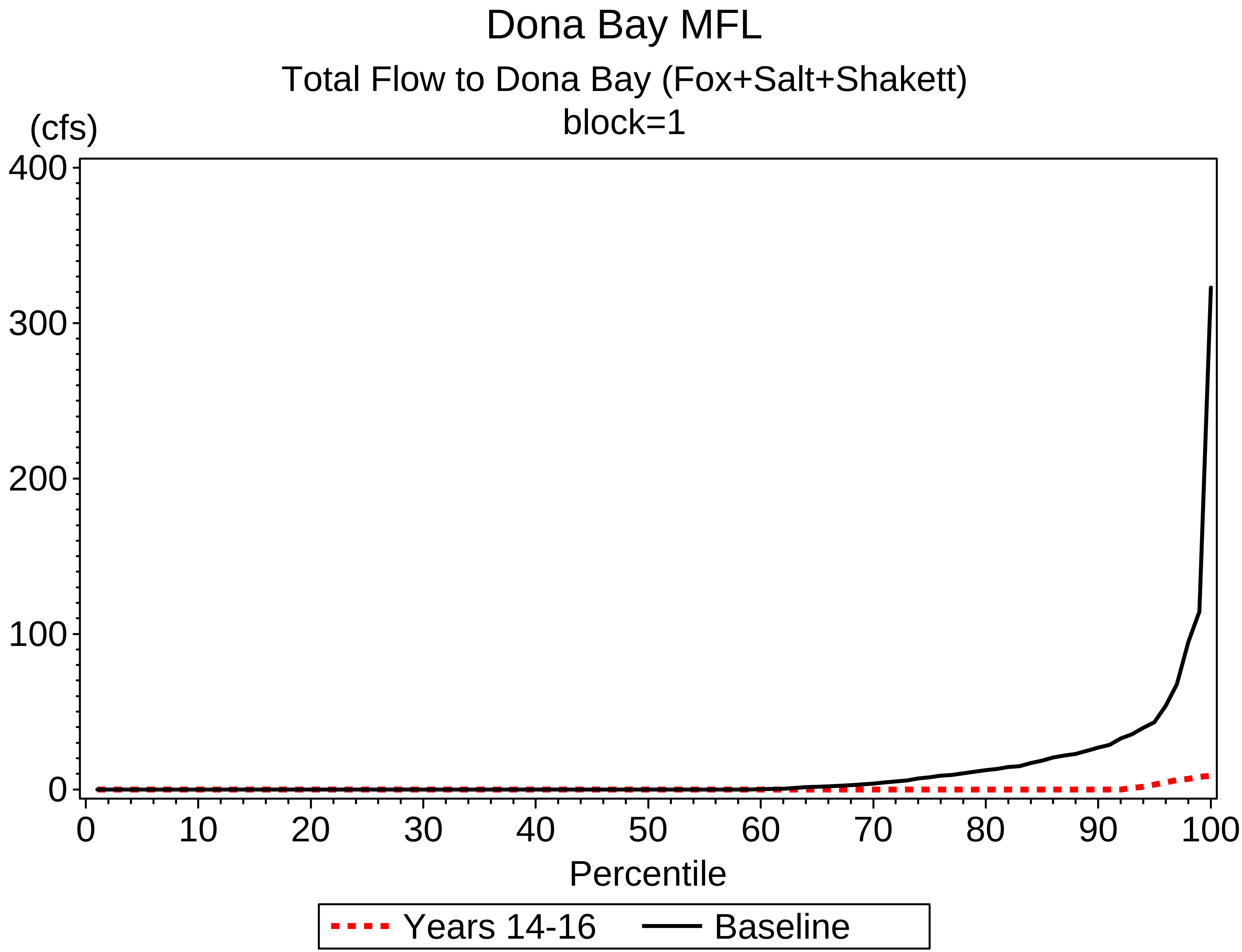
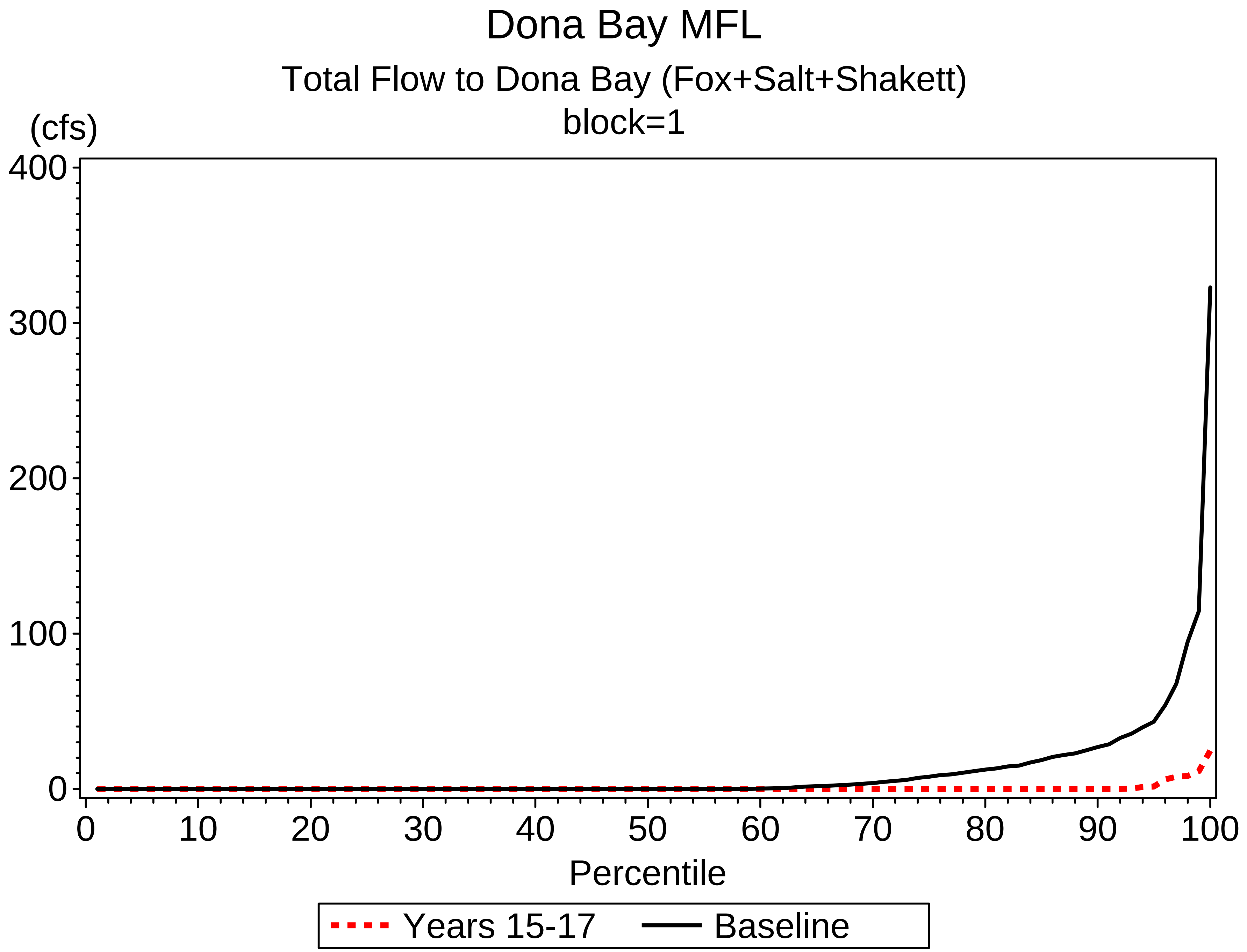
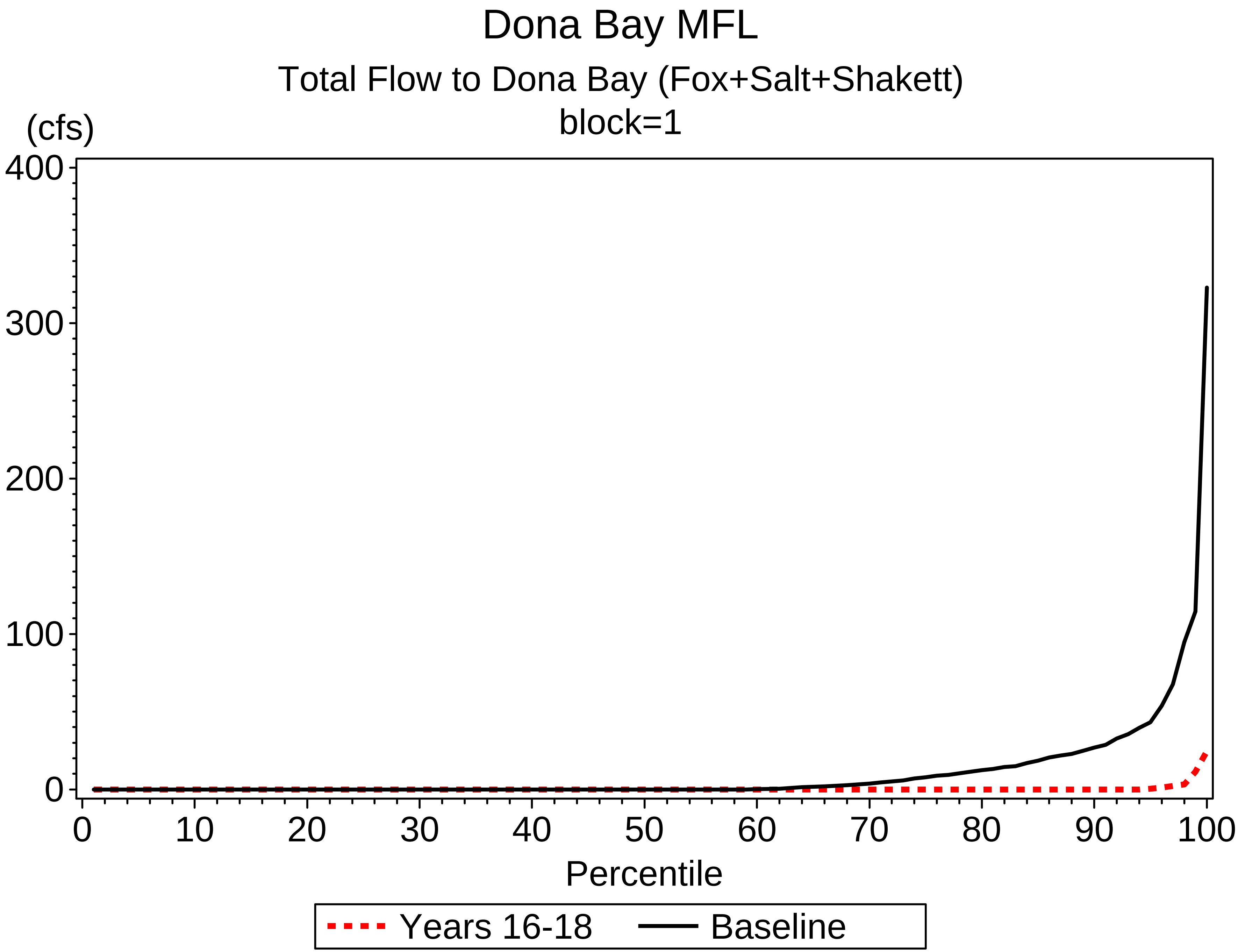
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 13-15
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 14-16
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 15-17
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
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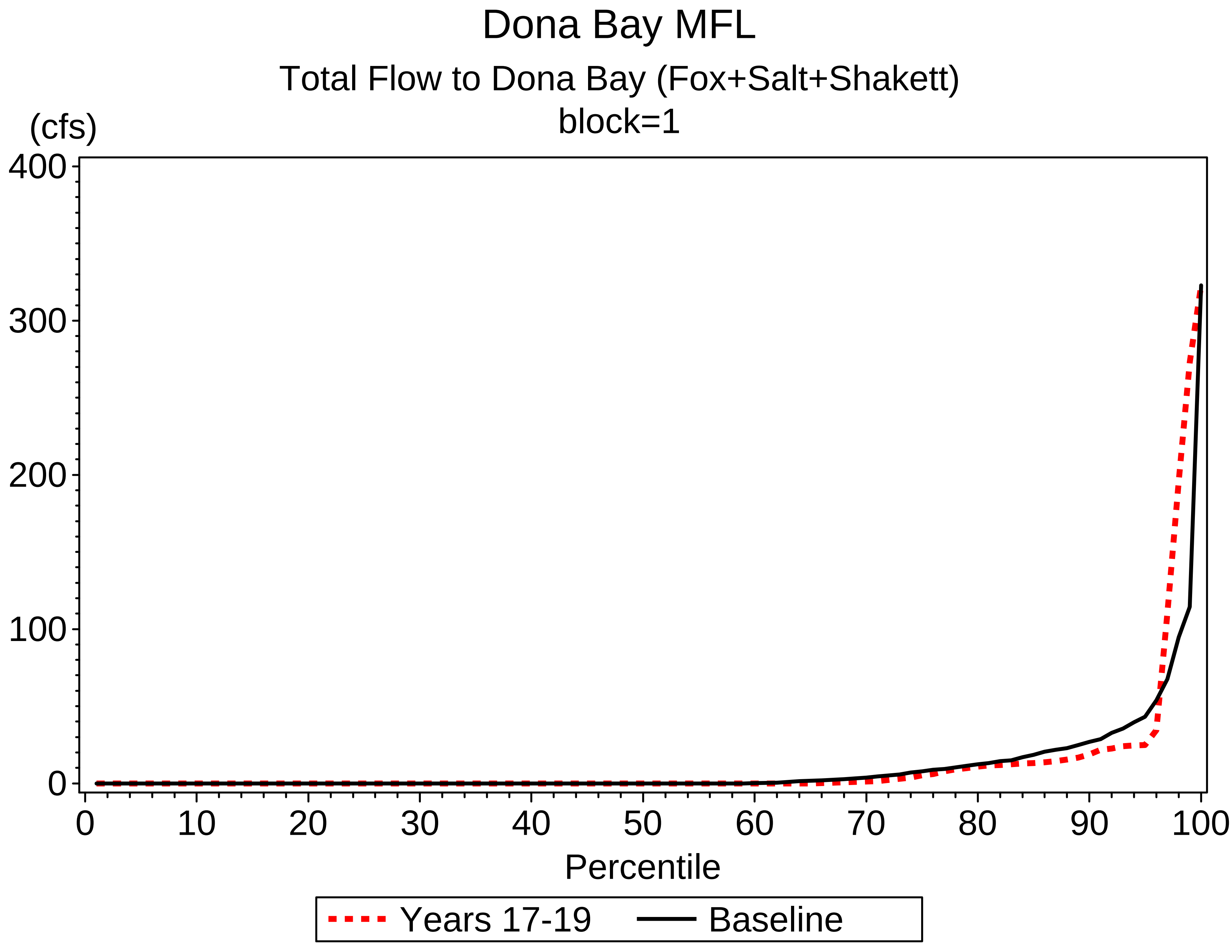
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 16-18
Baseline



Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
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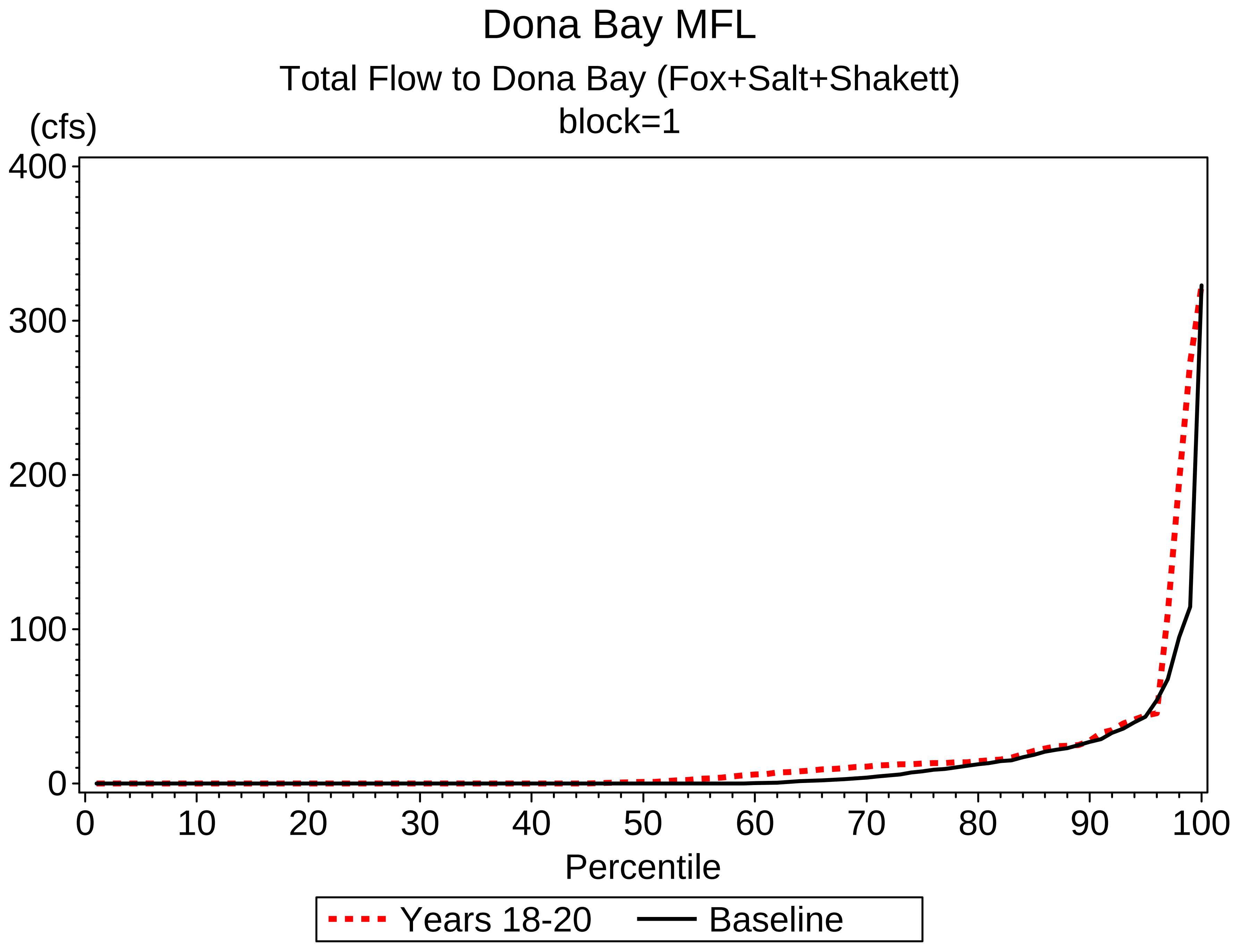
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 17-19
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
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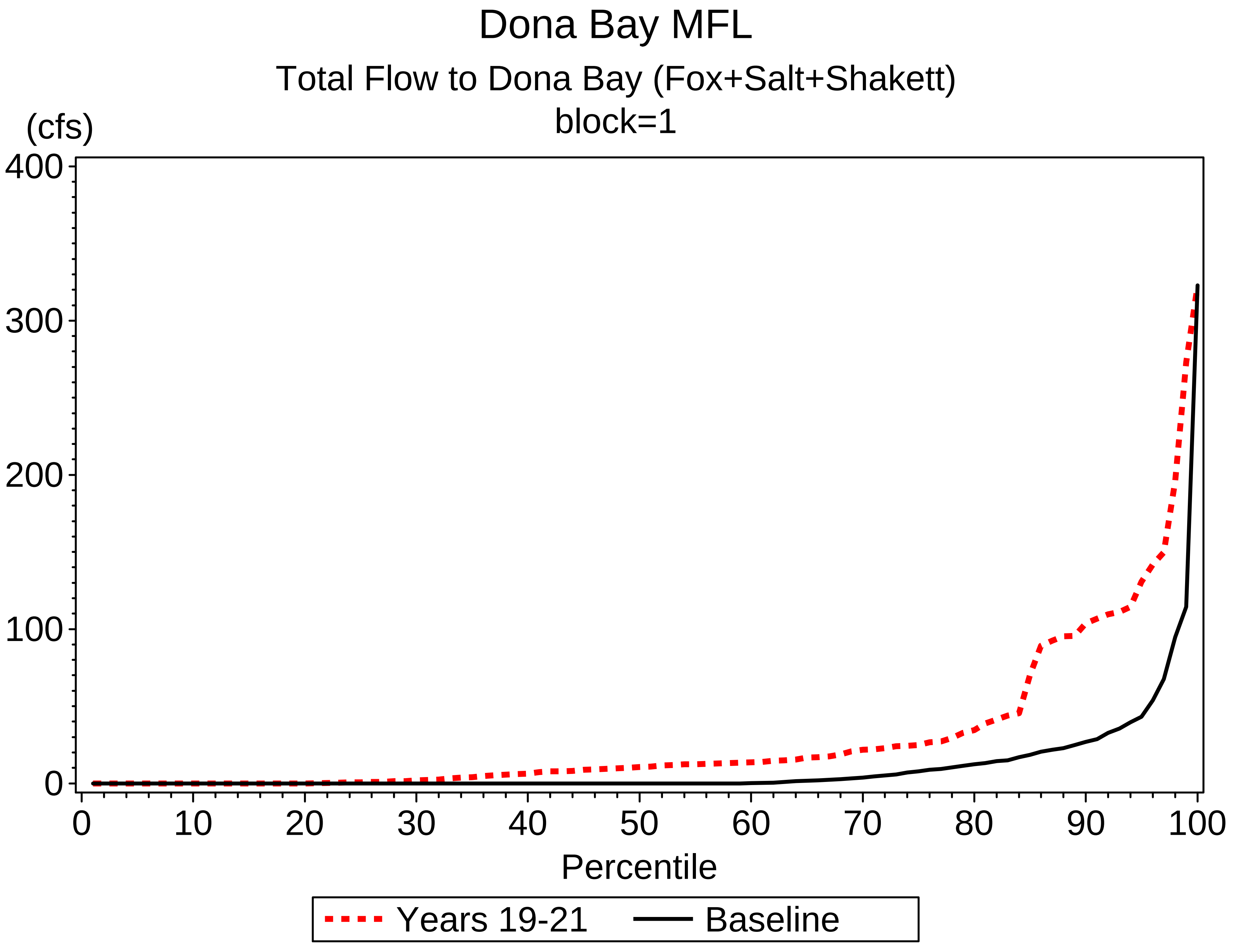
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 18-20
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=1
(cfs)
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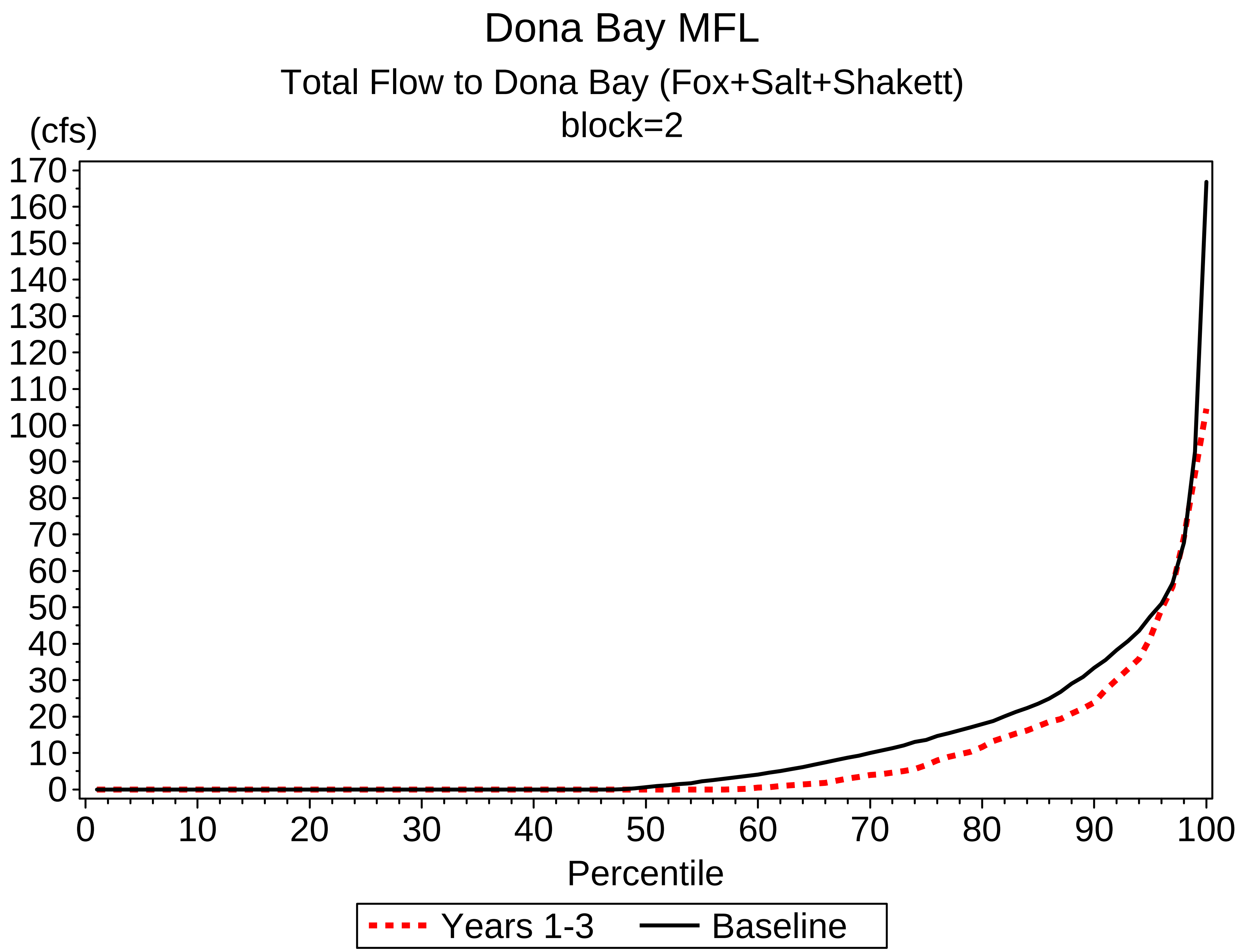
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 19-21
Baseline



Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
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160
150
140
130
120
110
100
90
80
70
60
50
40
30
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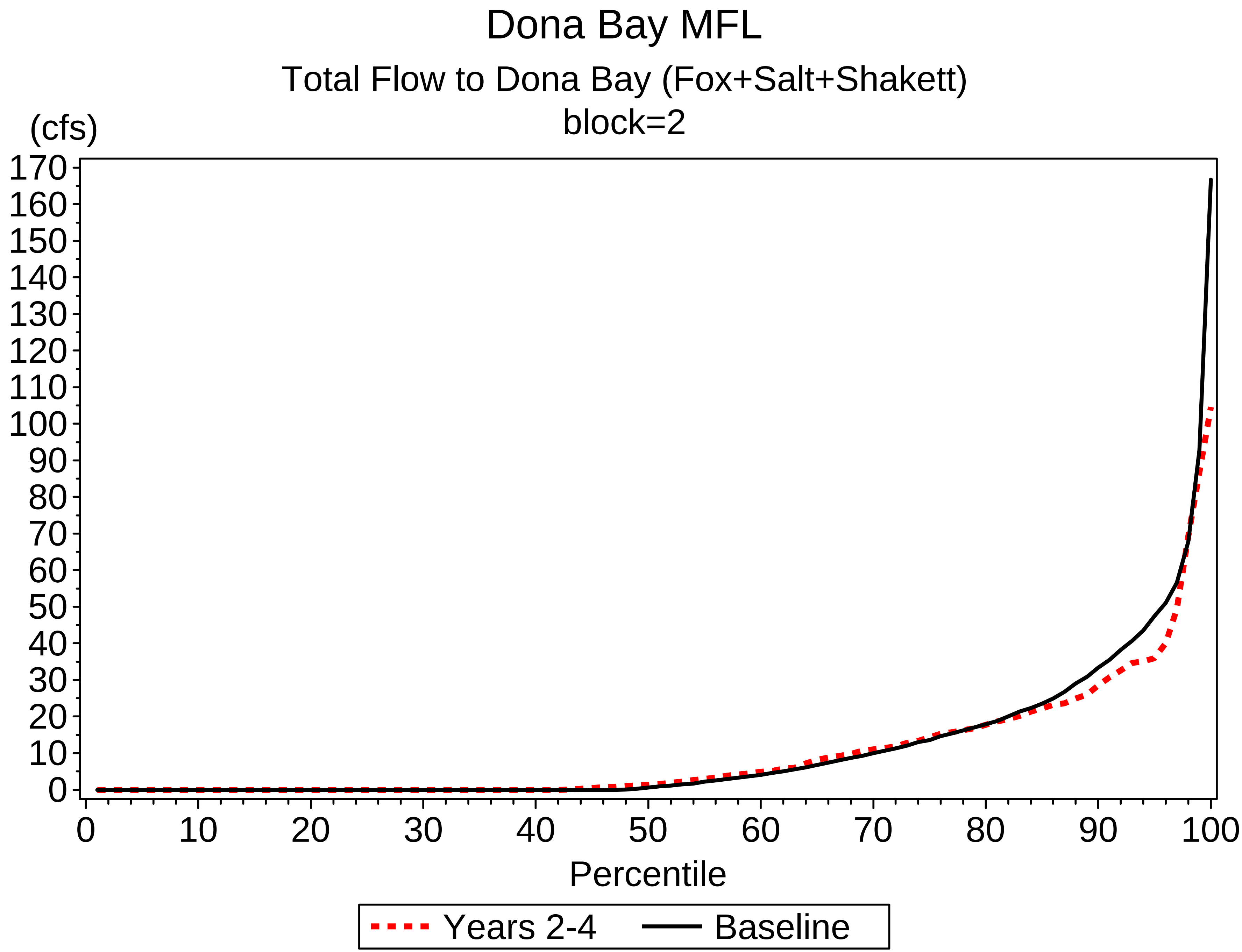
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 1-3
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
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20
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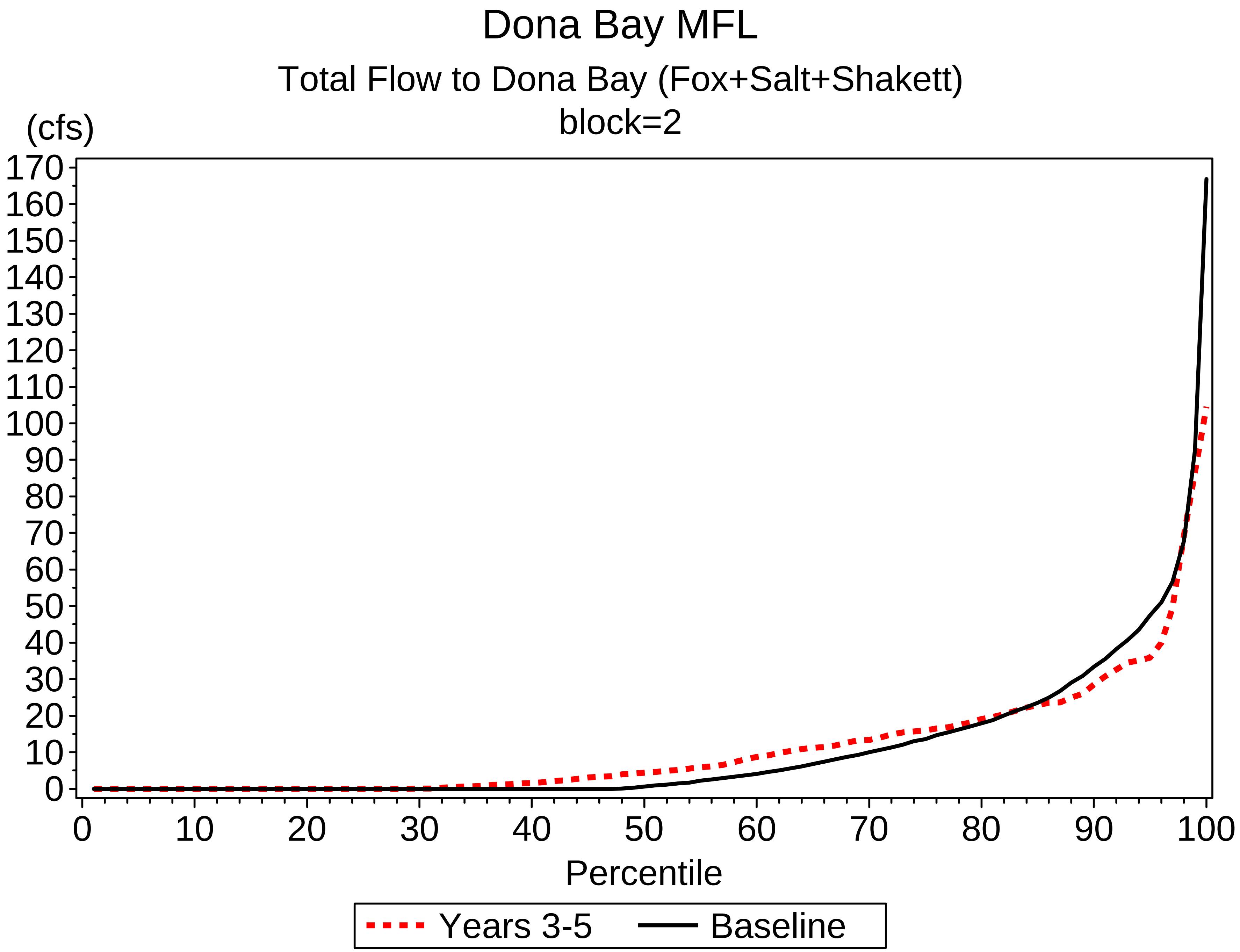
10
20
30
40
50
60
70
80
90
100
Percentile
Years 2-4
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
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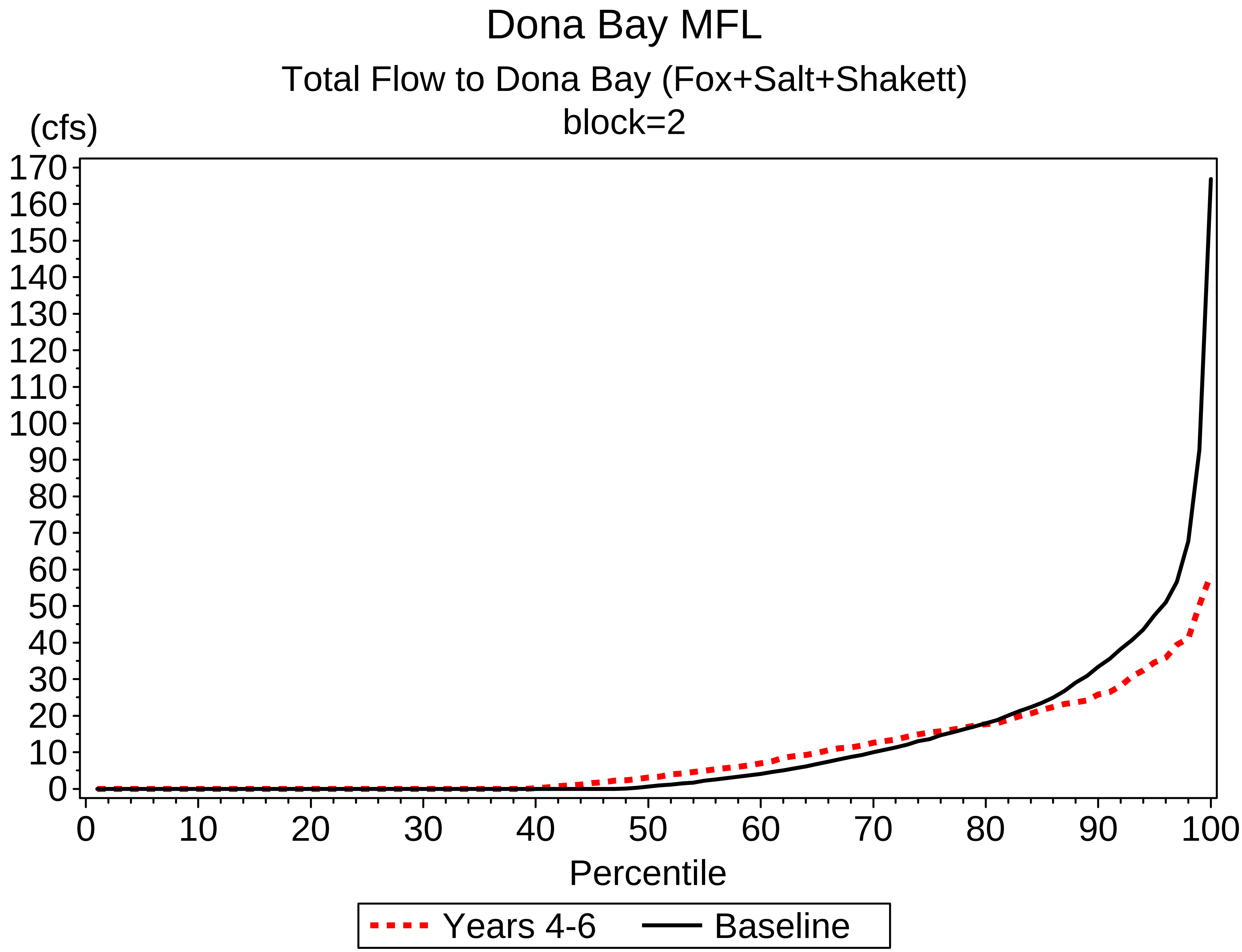
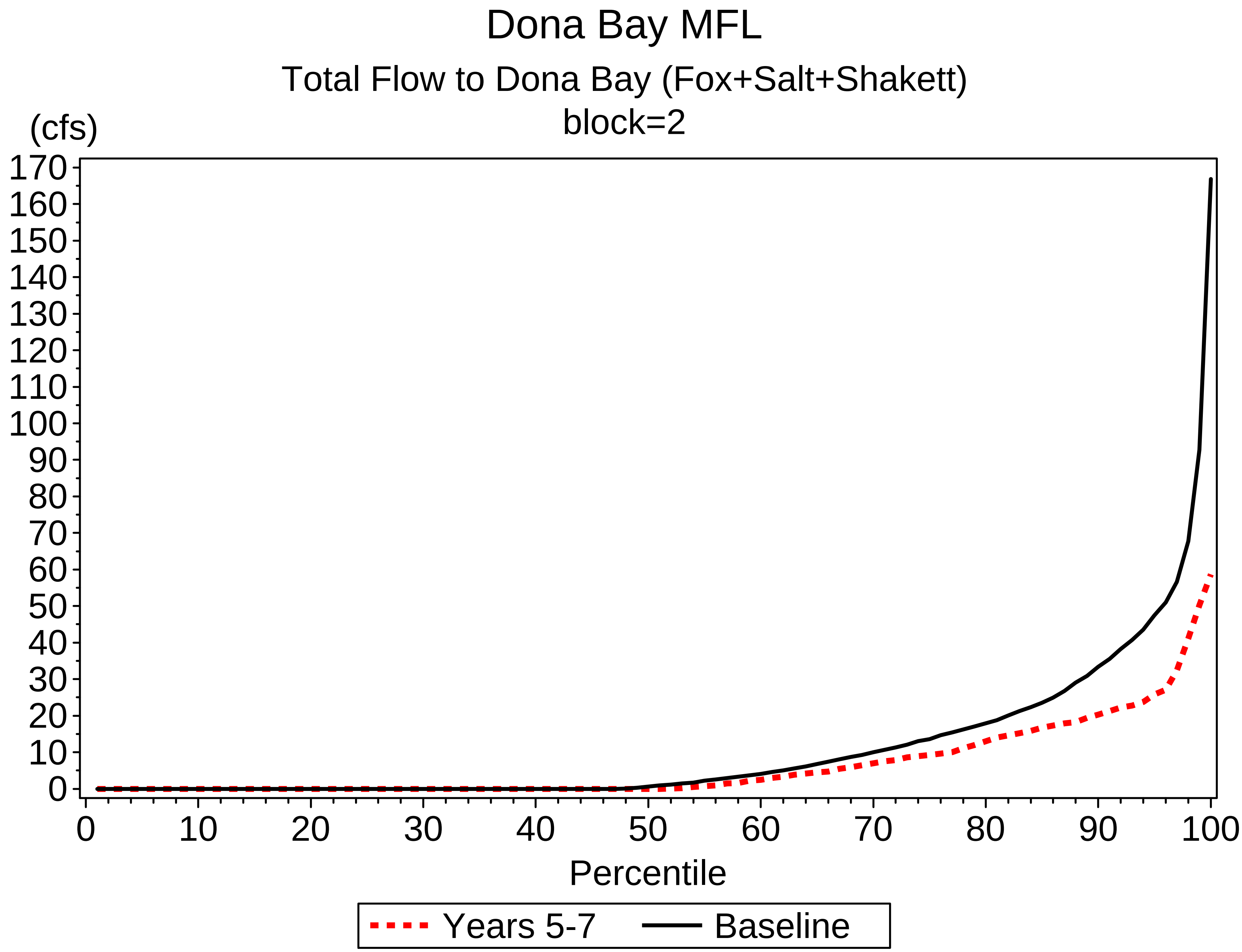
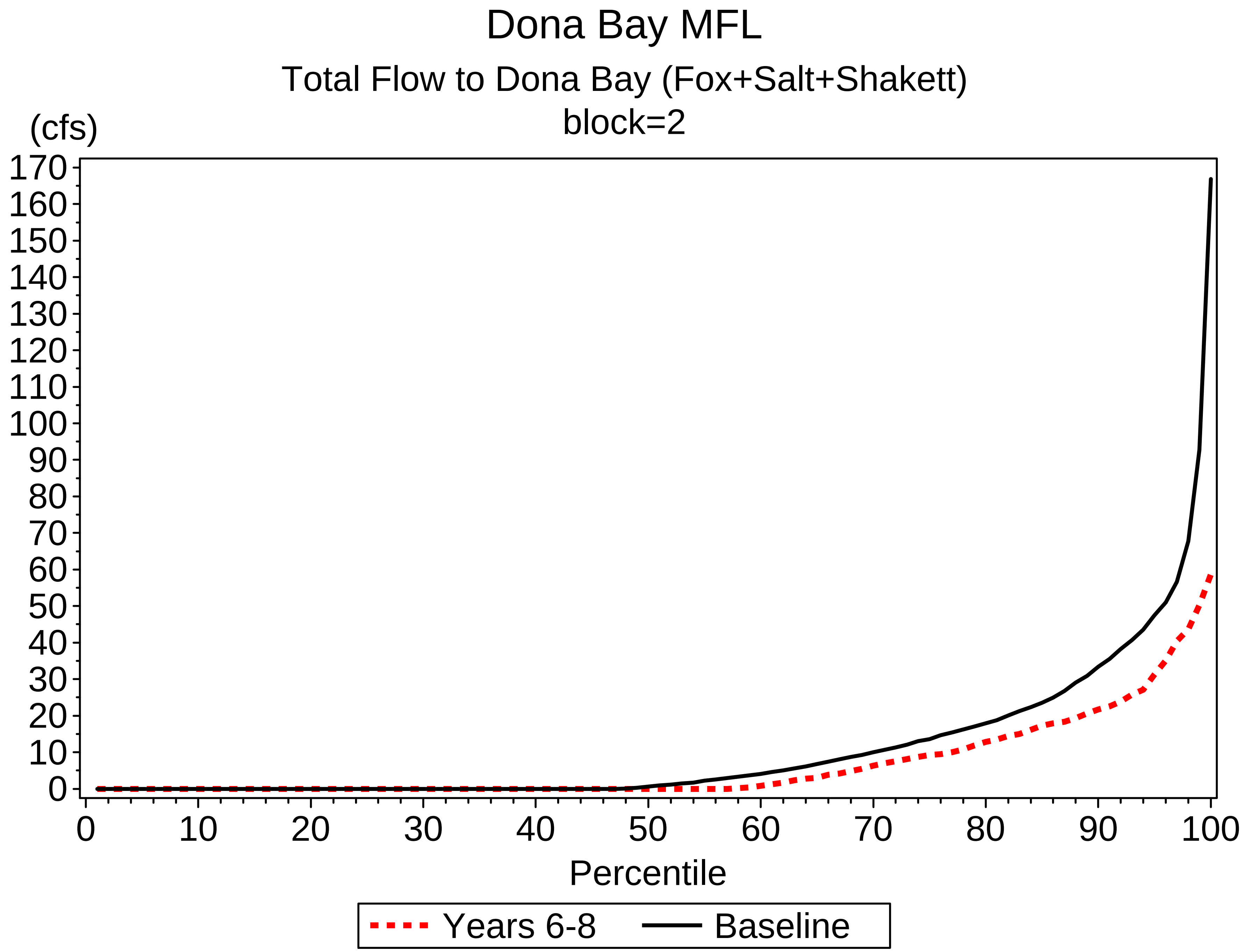
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 3-5
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 4-6
Baseline



Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 5-7
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
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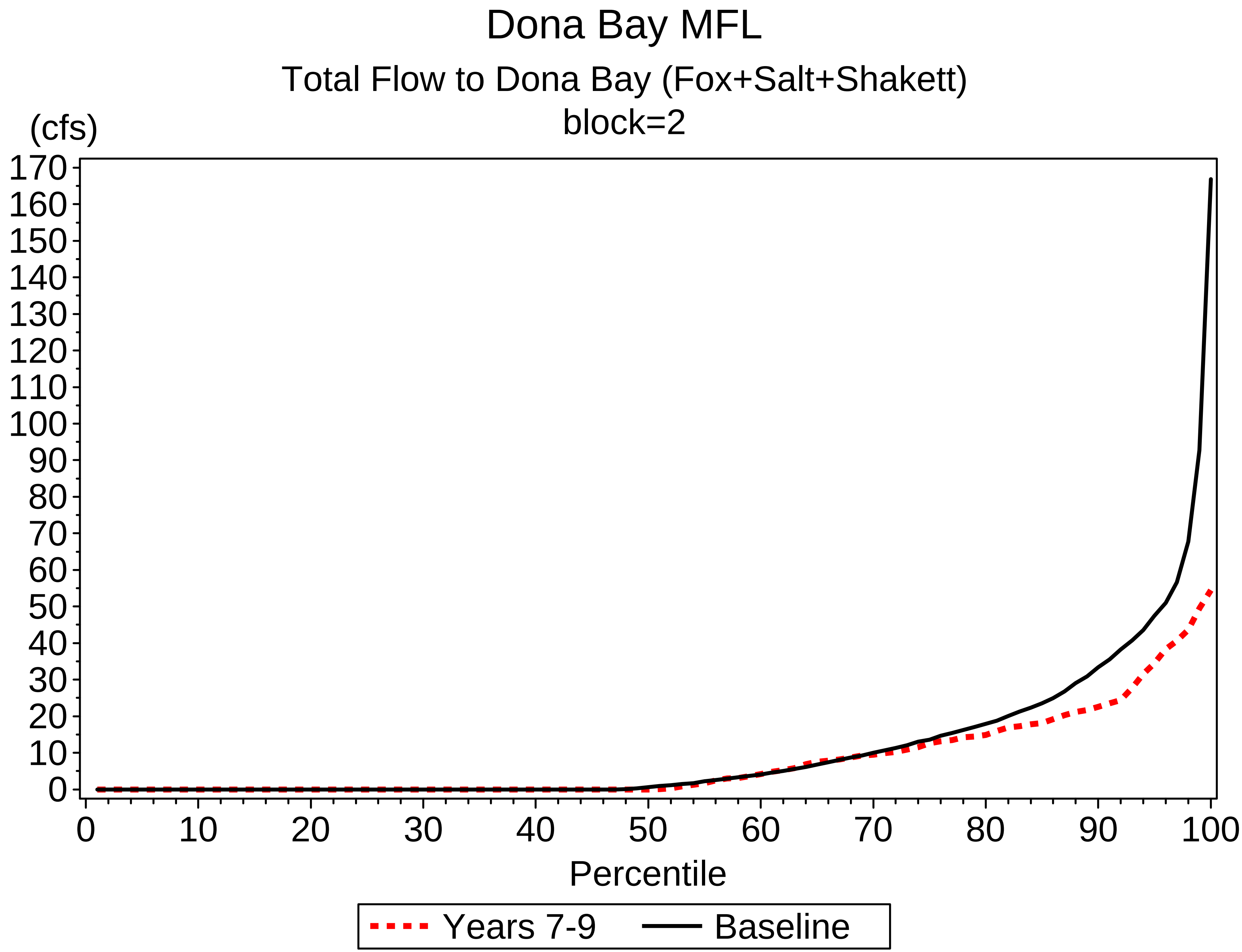
20
30
40
50
60
70
80
90
100
Percentile
Years 6-8
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
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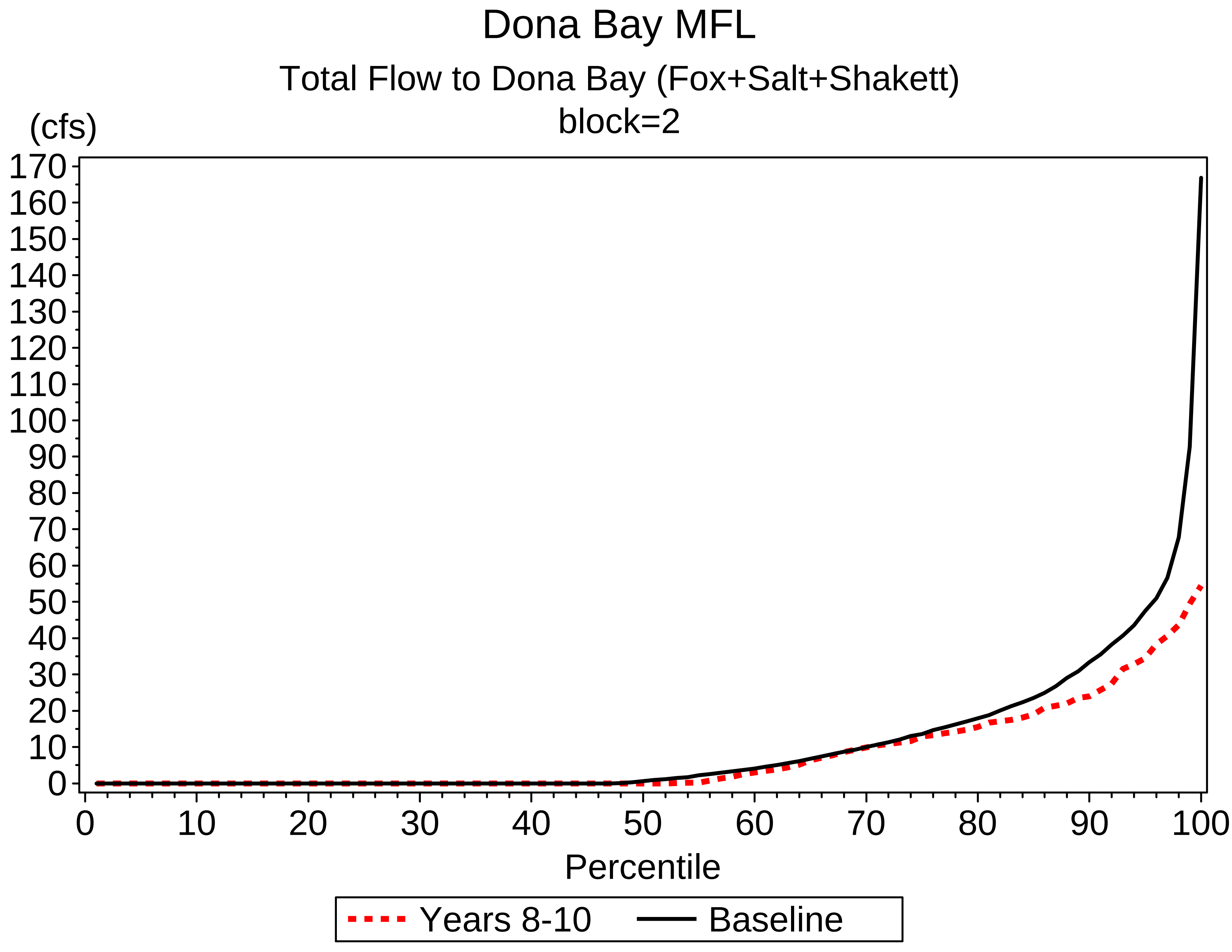
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 7-9
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
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90
80
70
60
50
40
30
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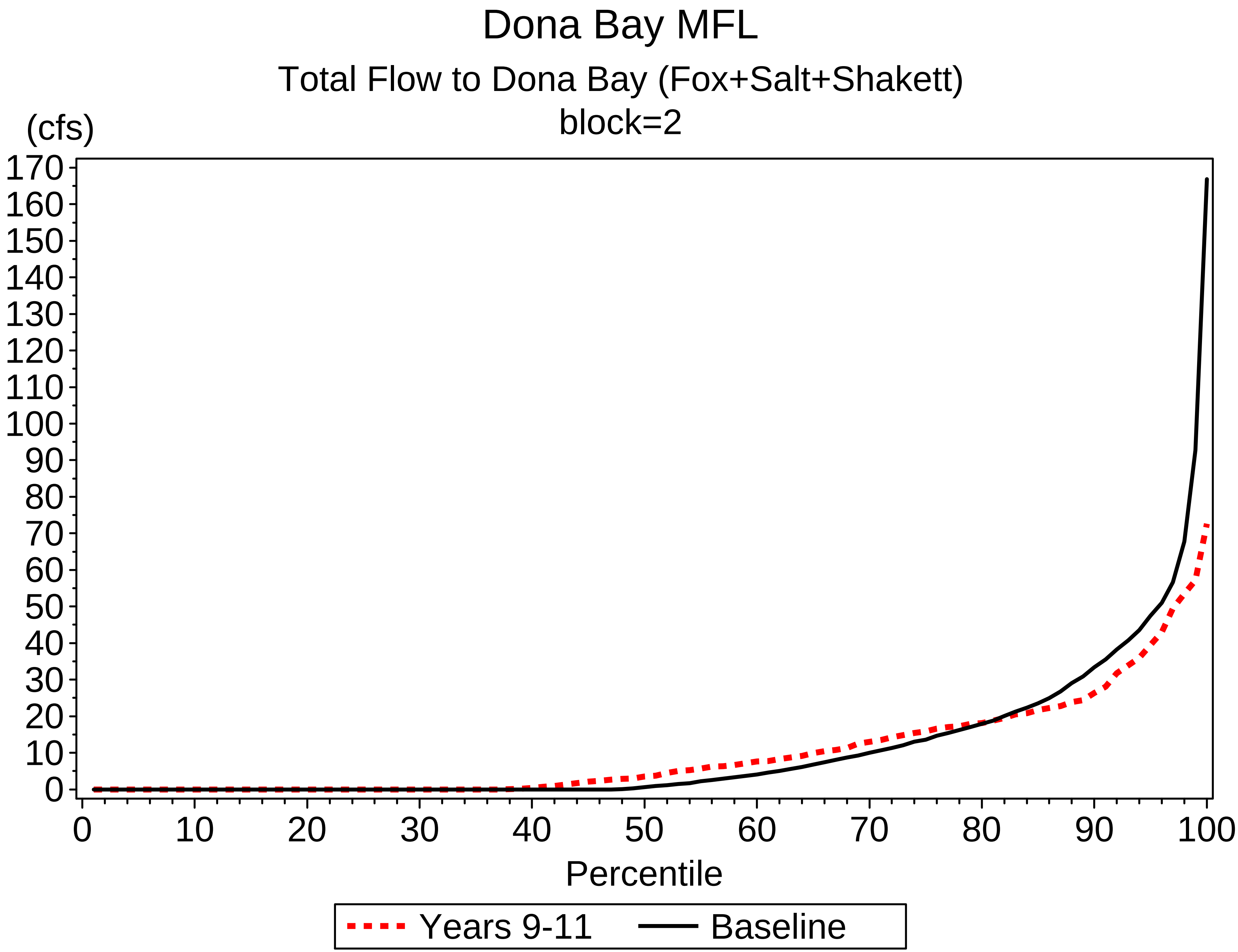
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 8-10
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
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80
70
60
50
40
30
20
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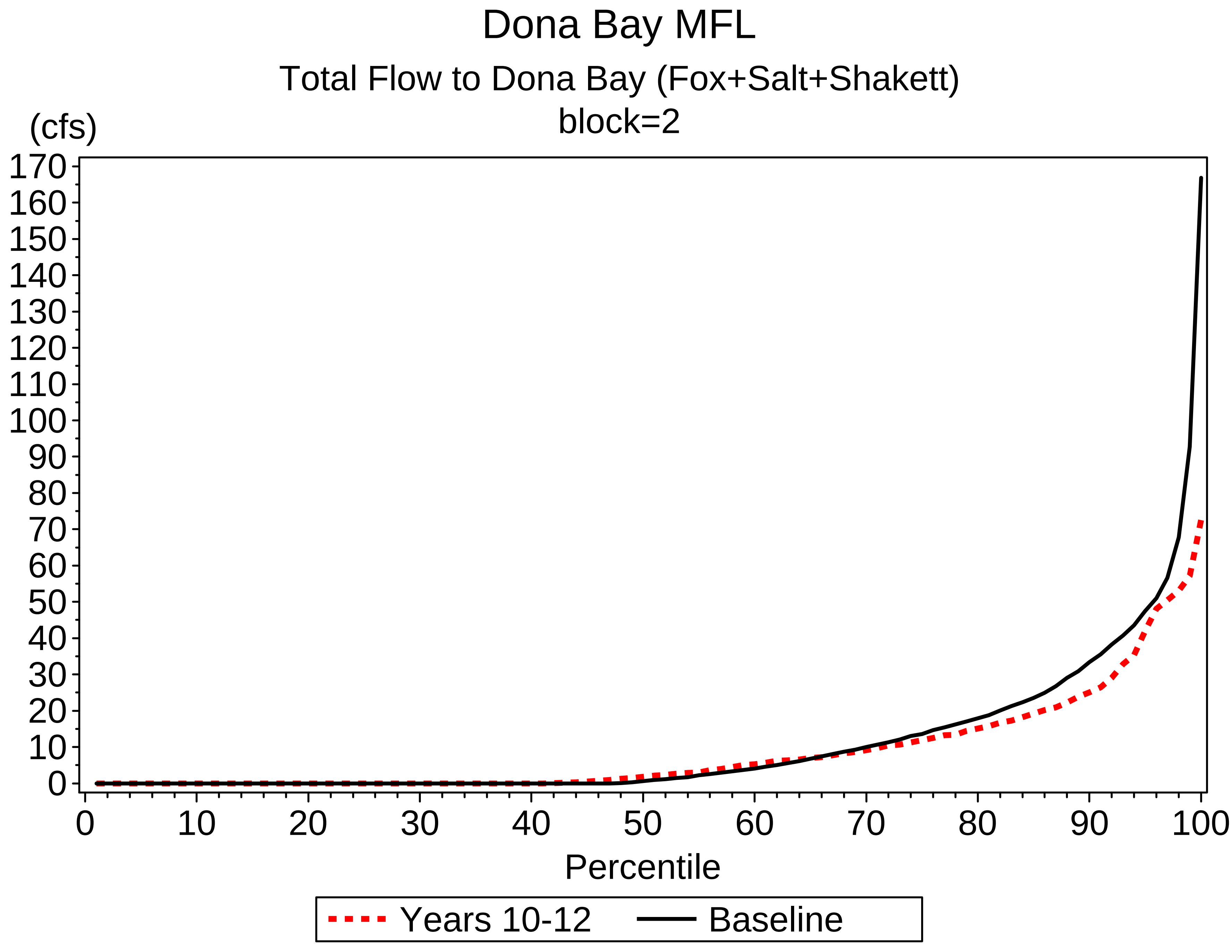
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 9-11
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
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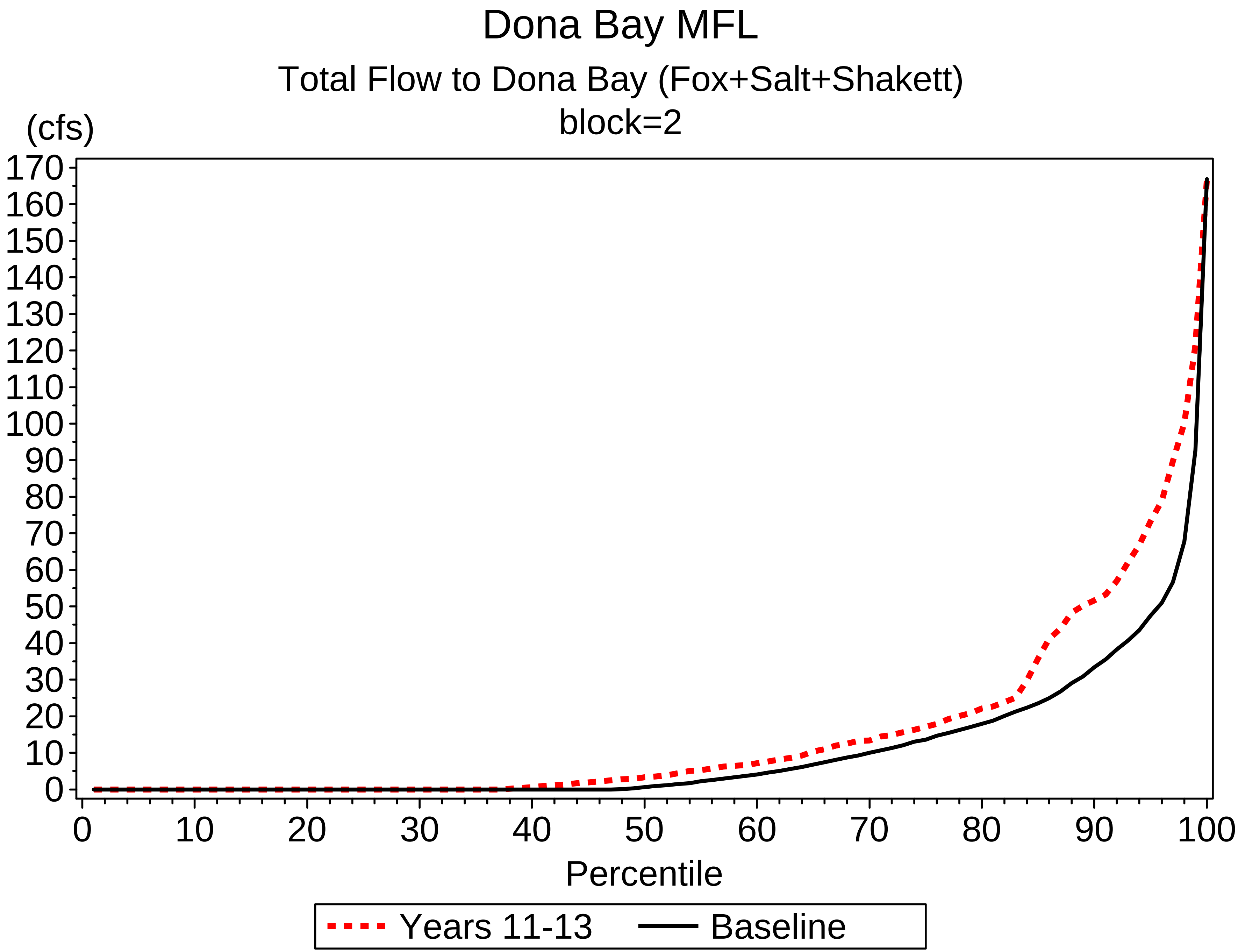
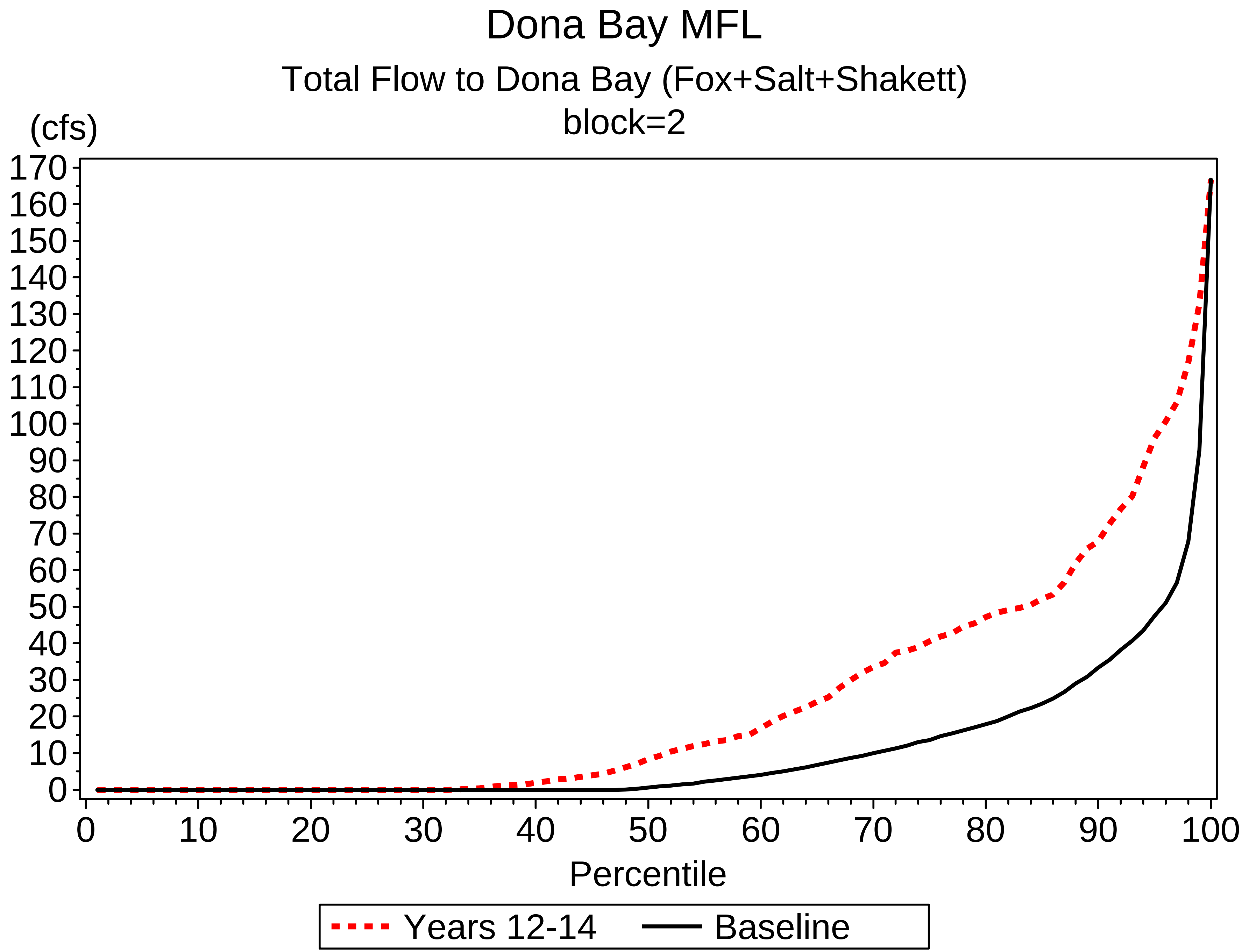
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 10-12
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 11-13
Baseline



Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
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80
70
60
50
40
30
20
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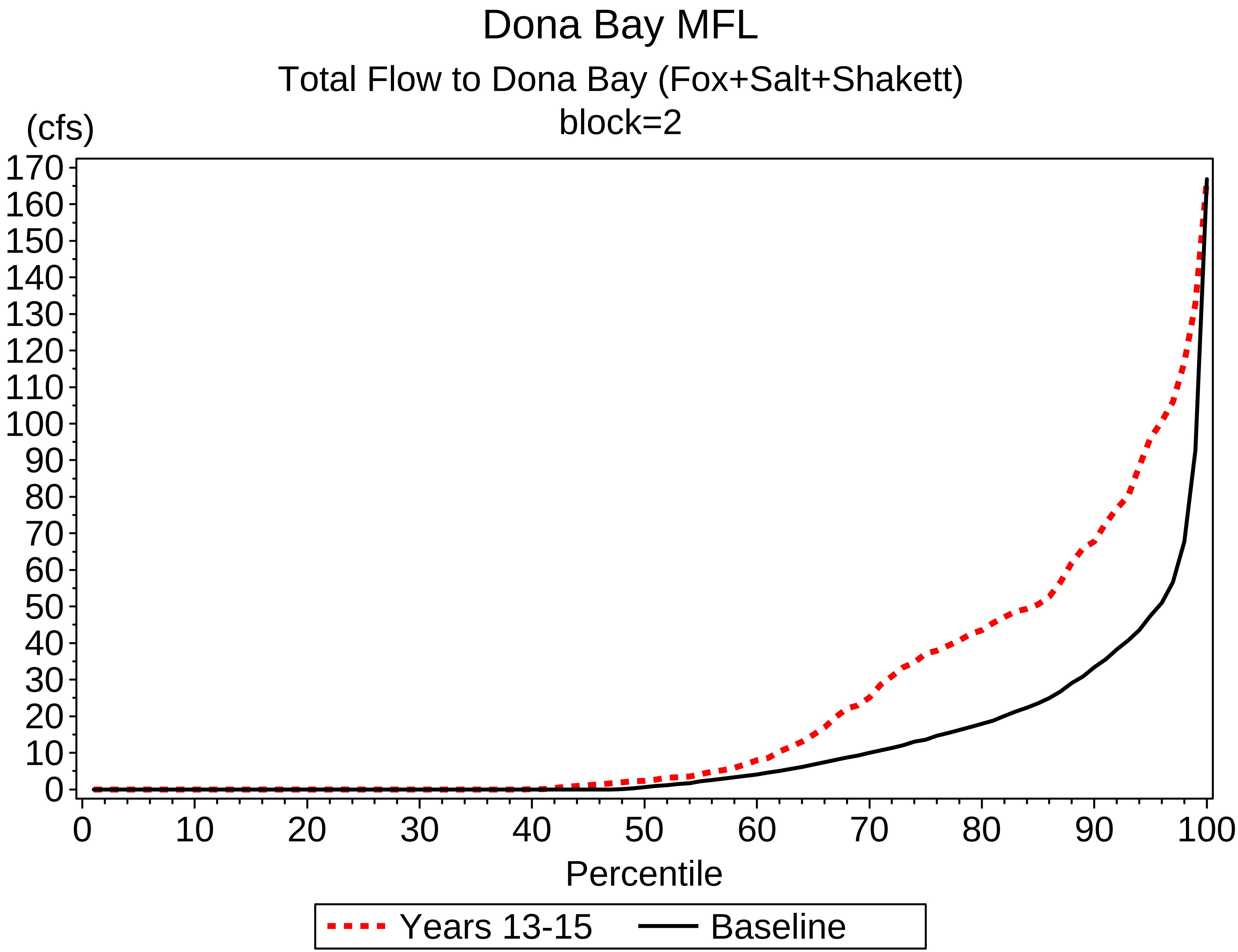
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 12-14
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
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90
80
70
60
50
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20
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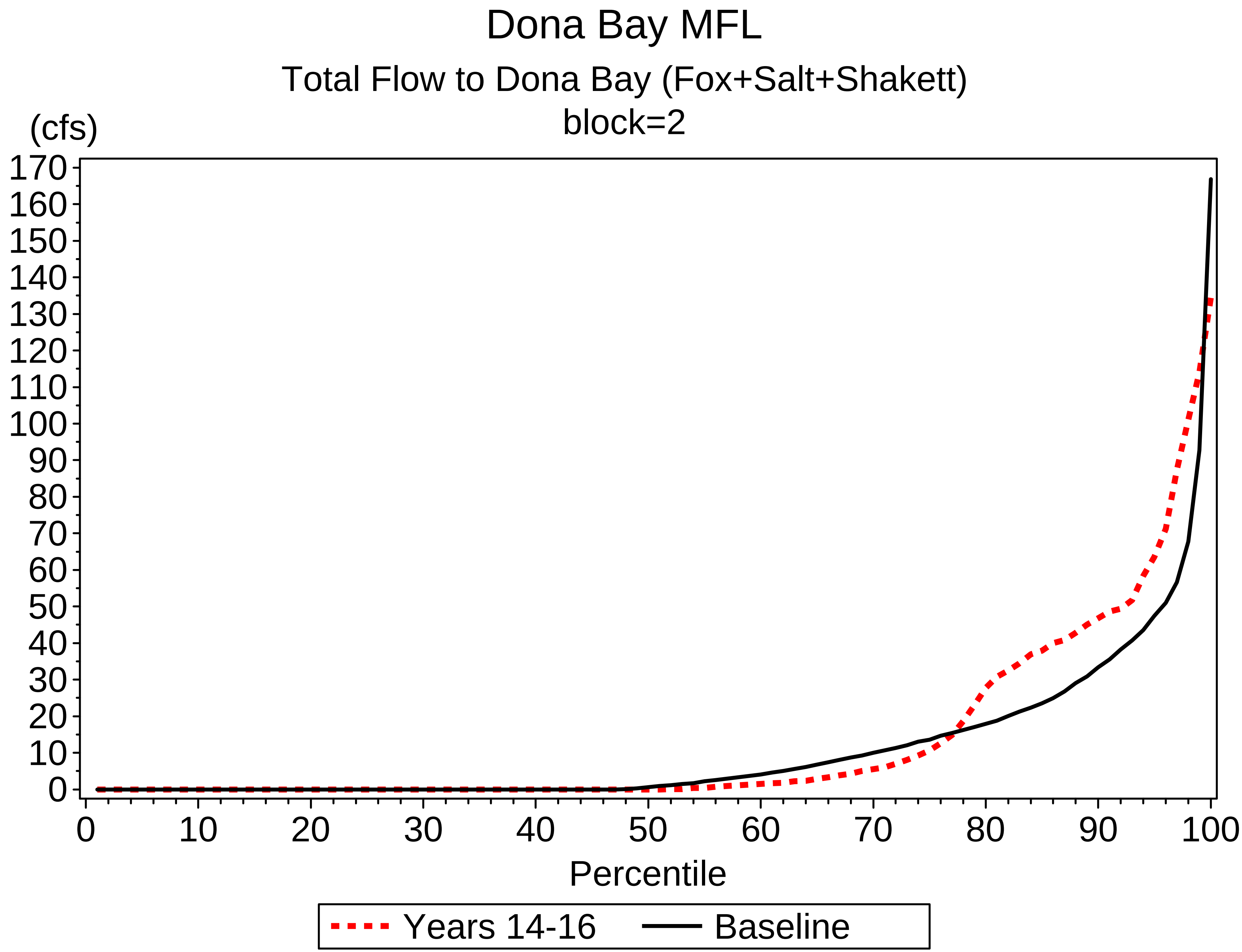
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 13-15
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
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90
80
70
60
50
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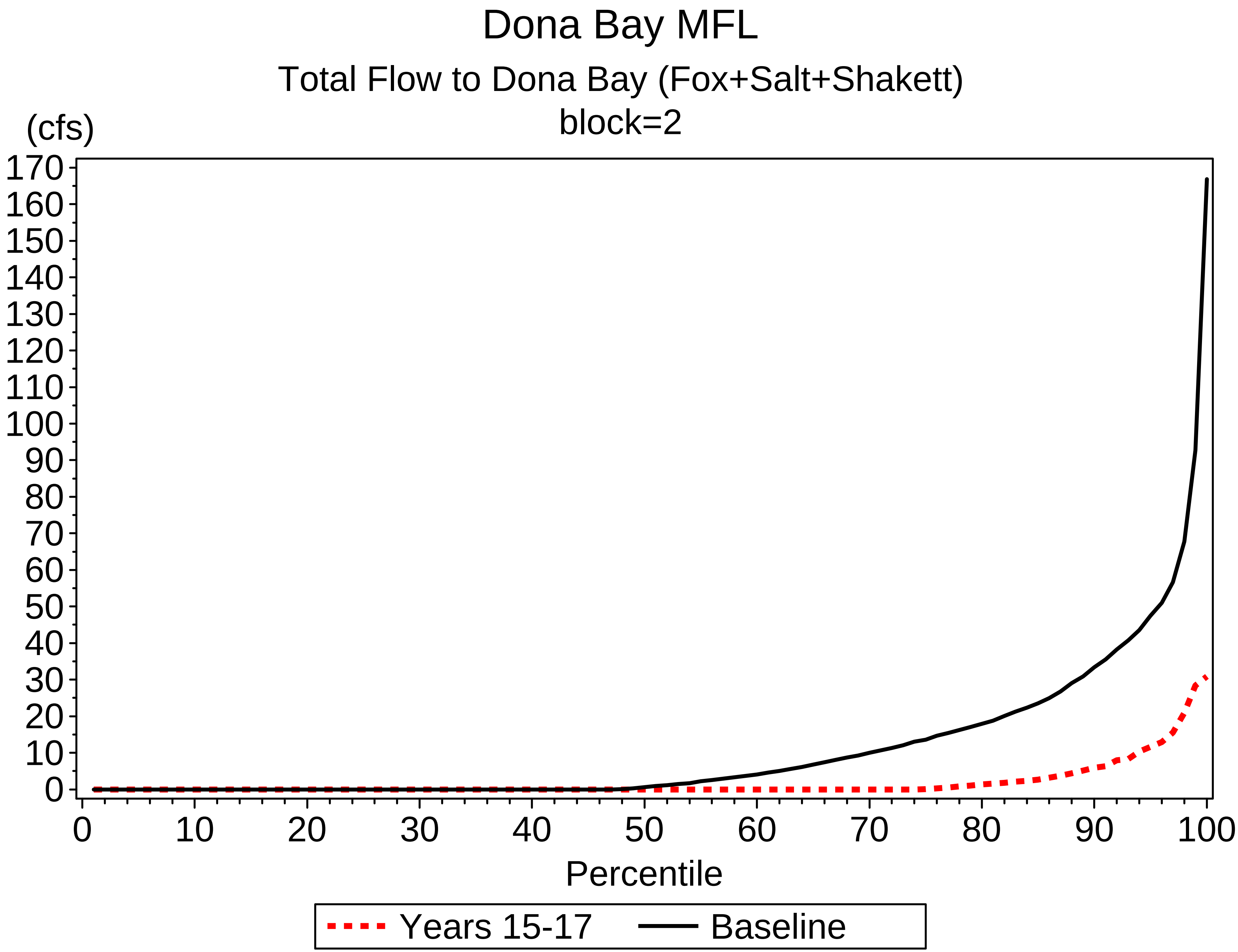
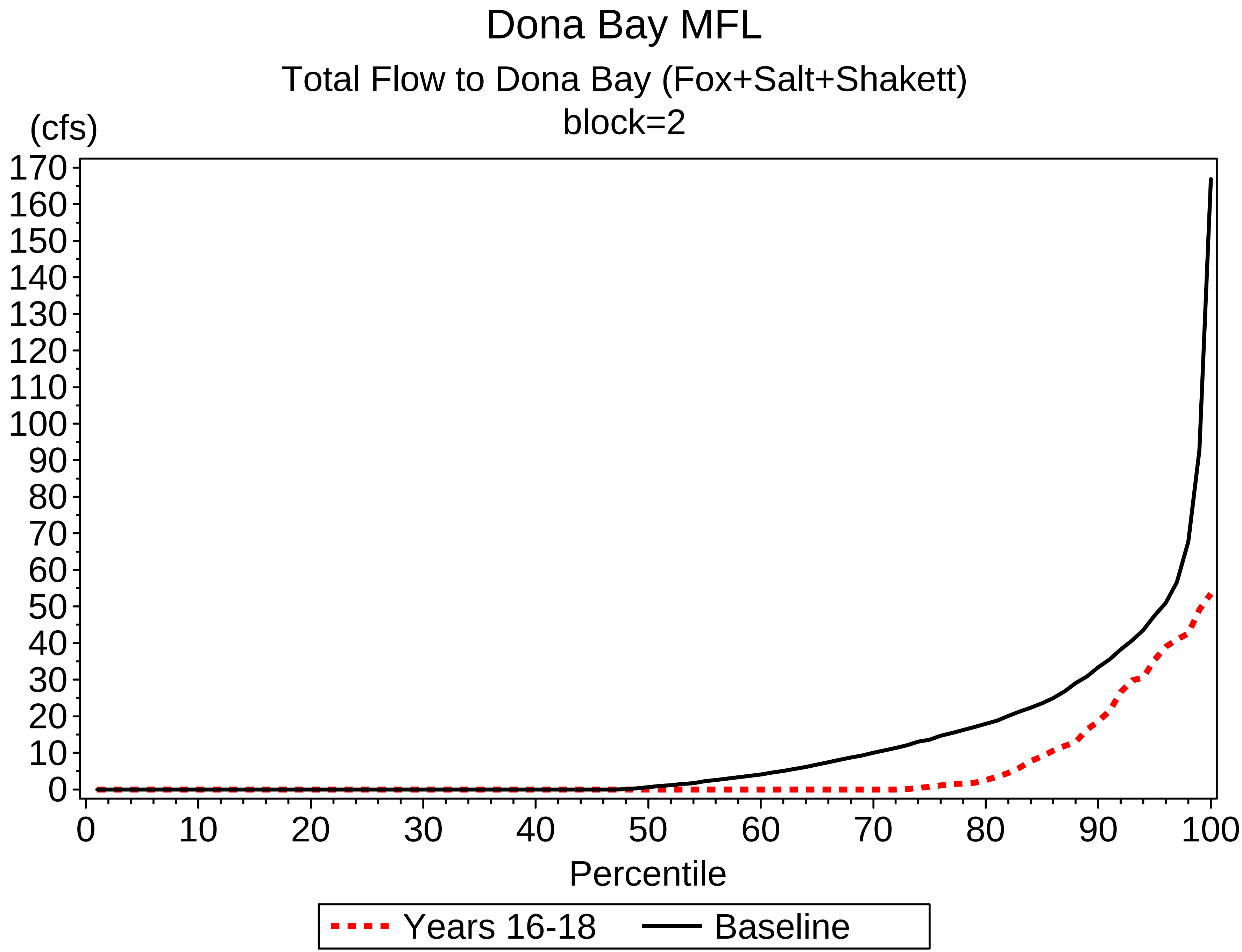
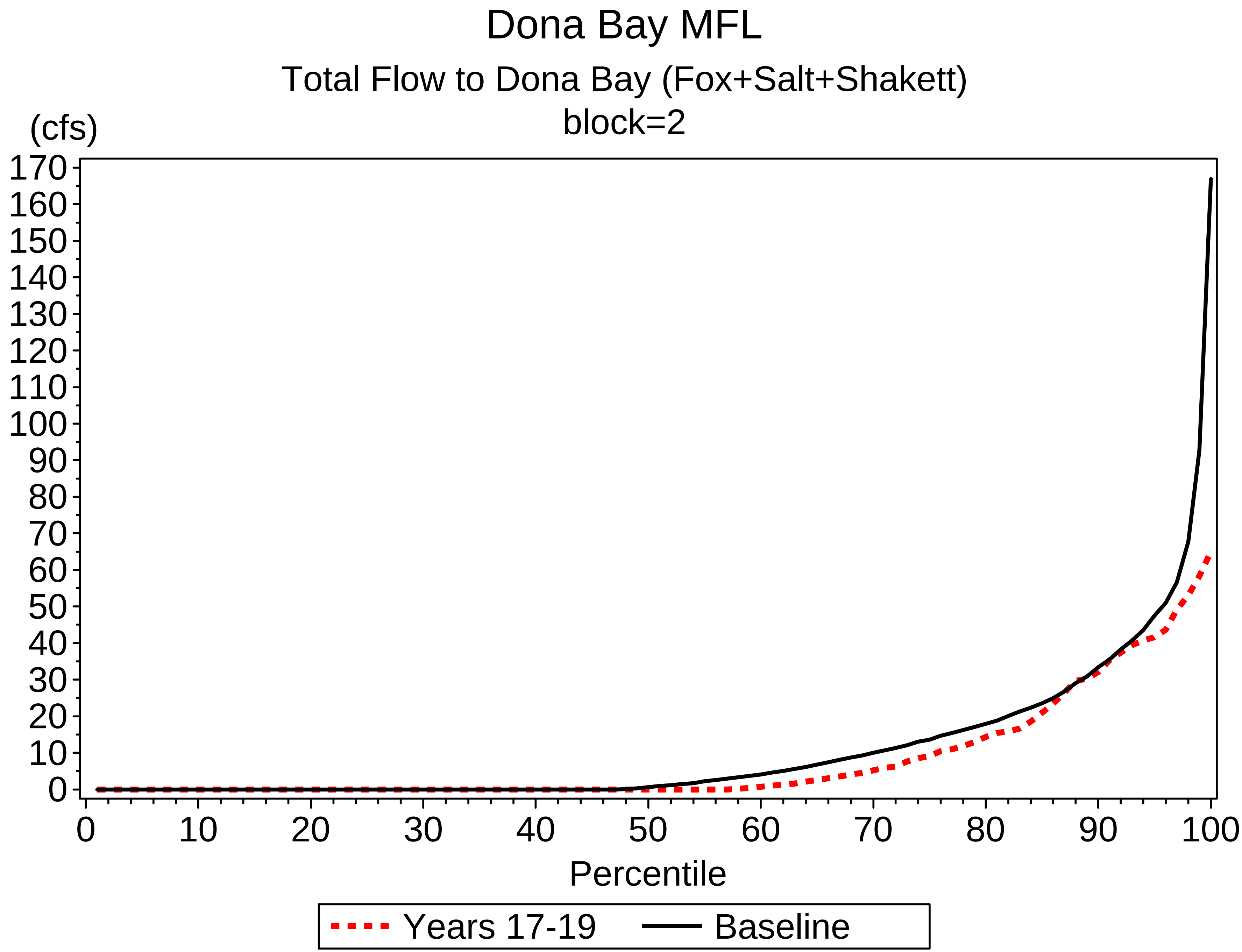
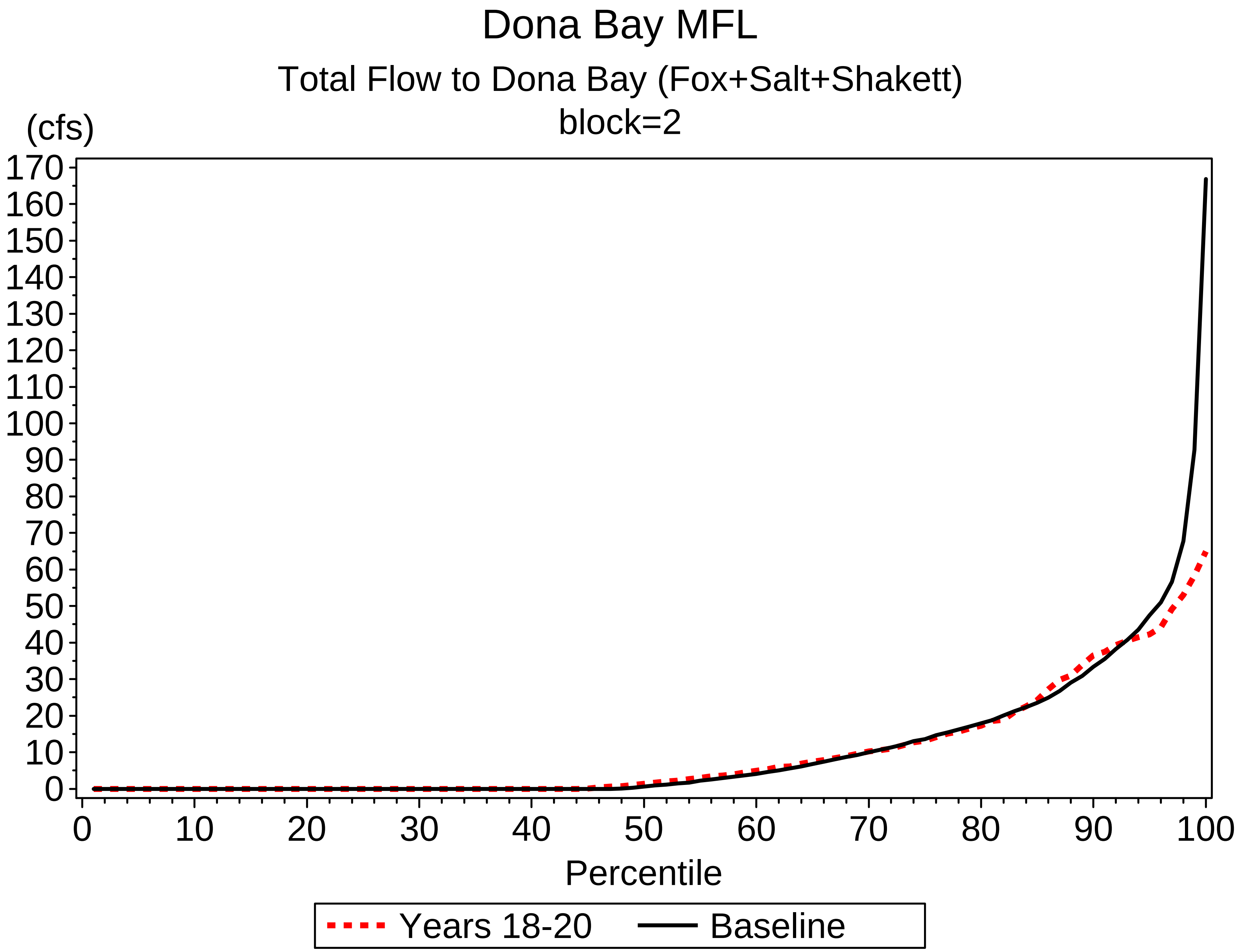
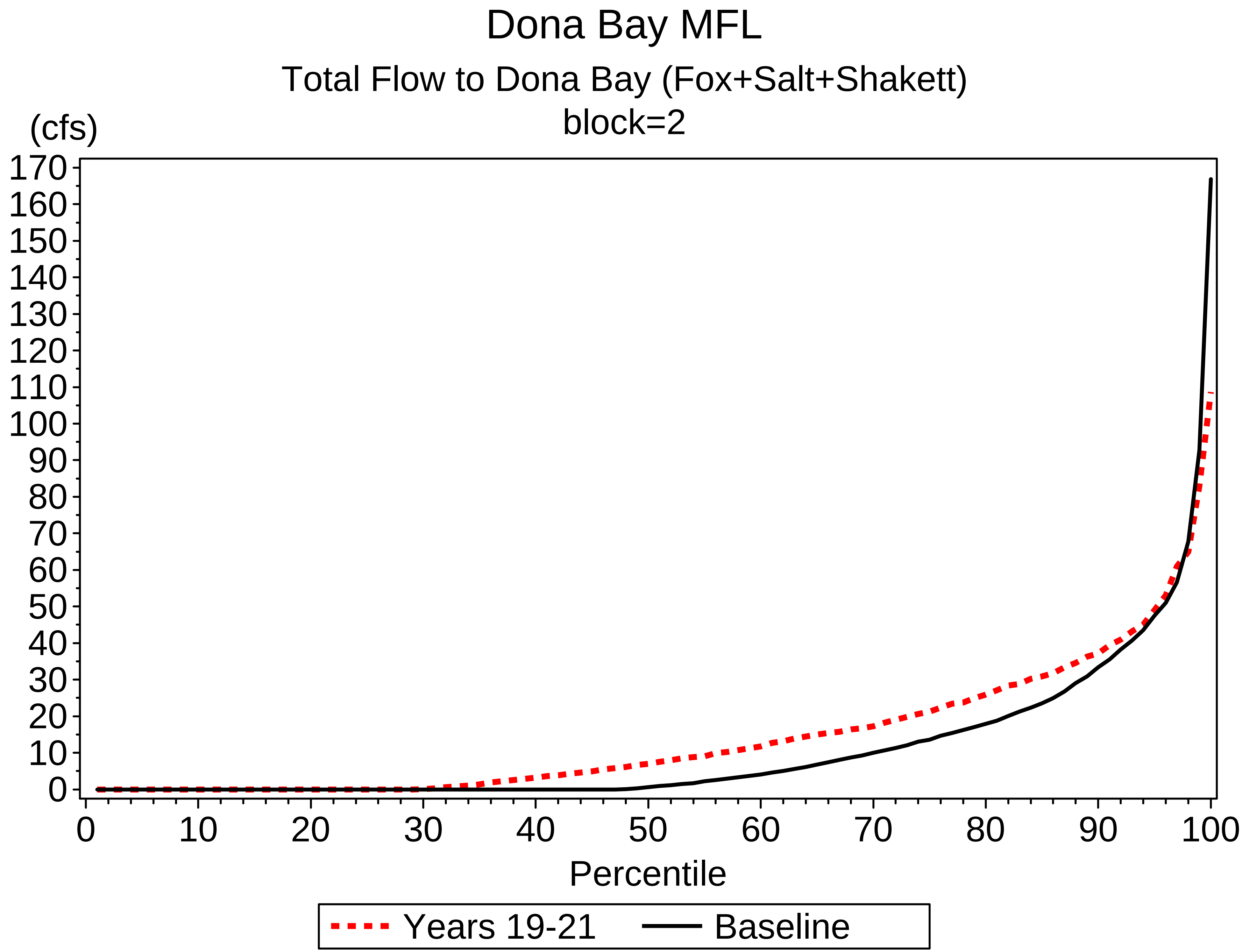
10
20
30
40
50
60
70
80
90
100
Percentile
Years 14-16
Baseline

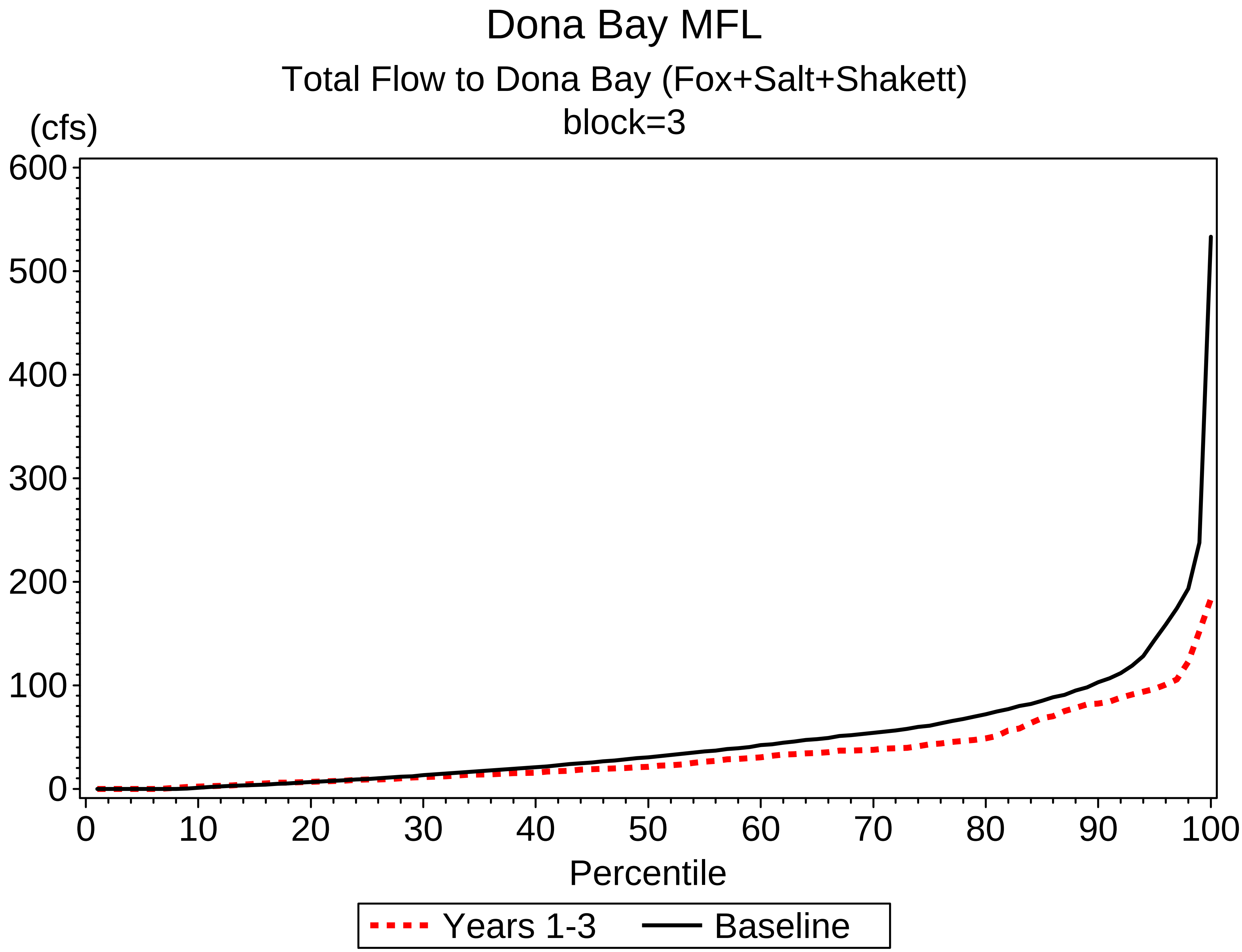

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 15-17
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 16-18
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 17-19
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 18-20
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=2
(cfs)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 19-21
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
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200
100
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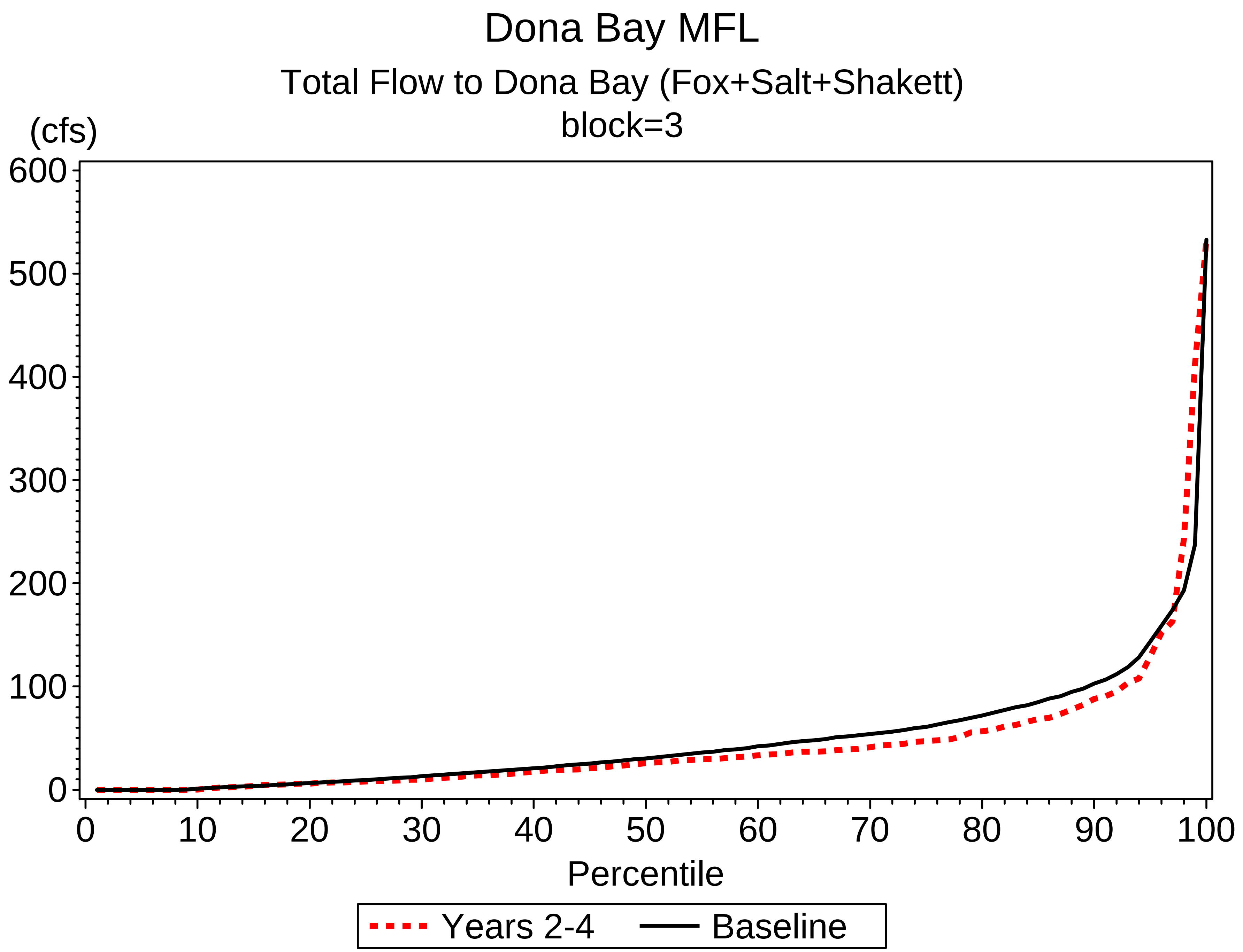
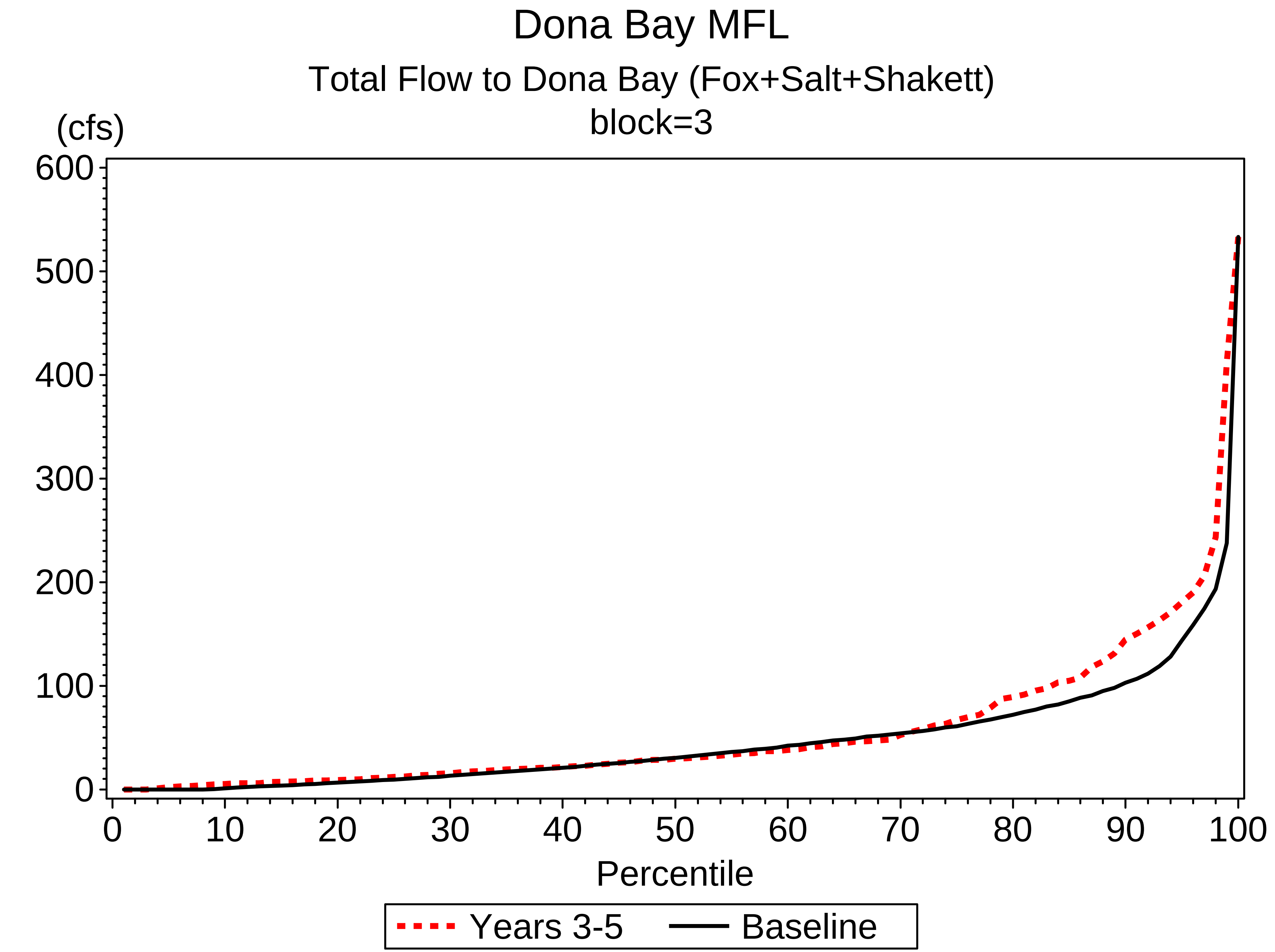
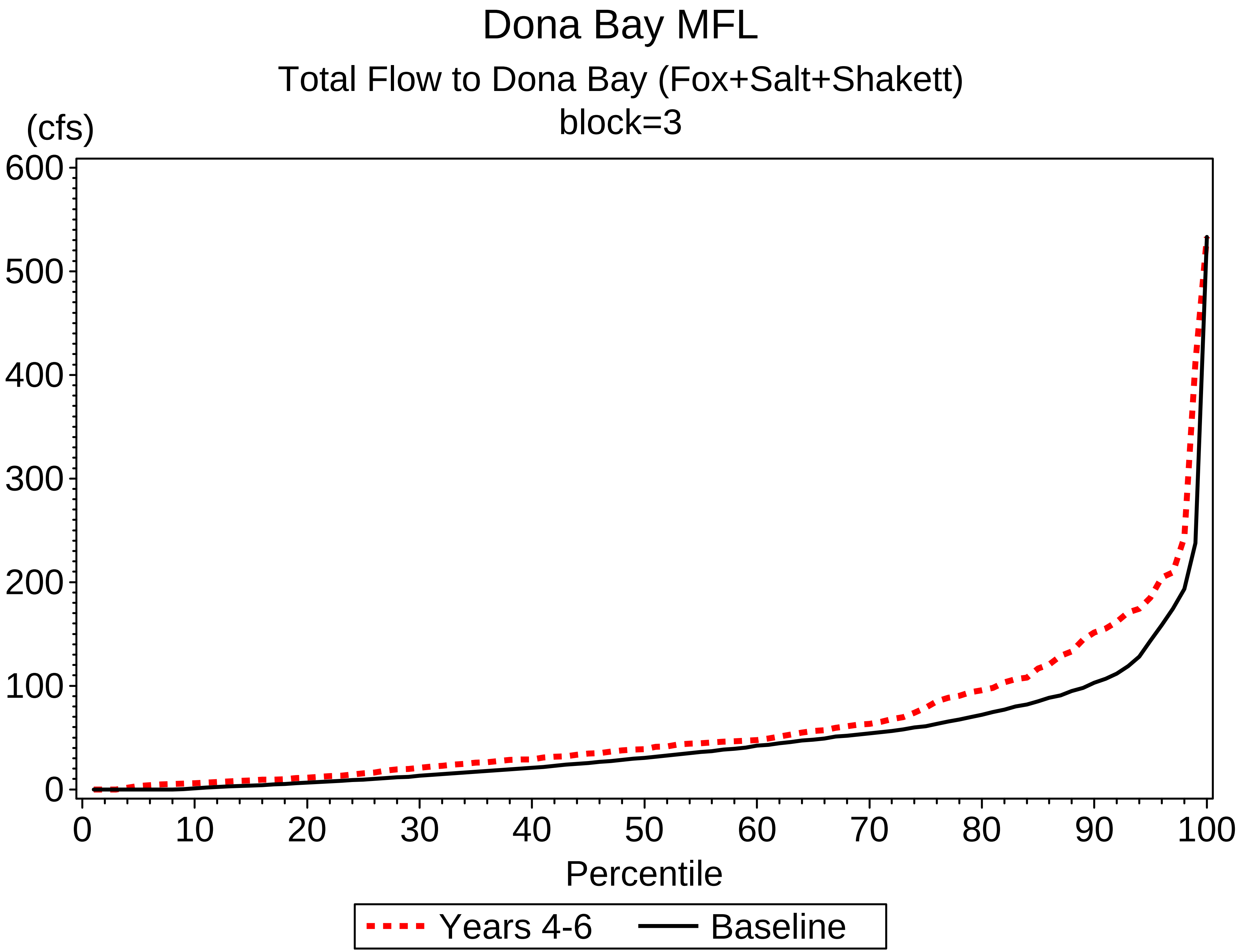
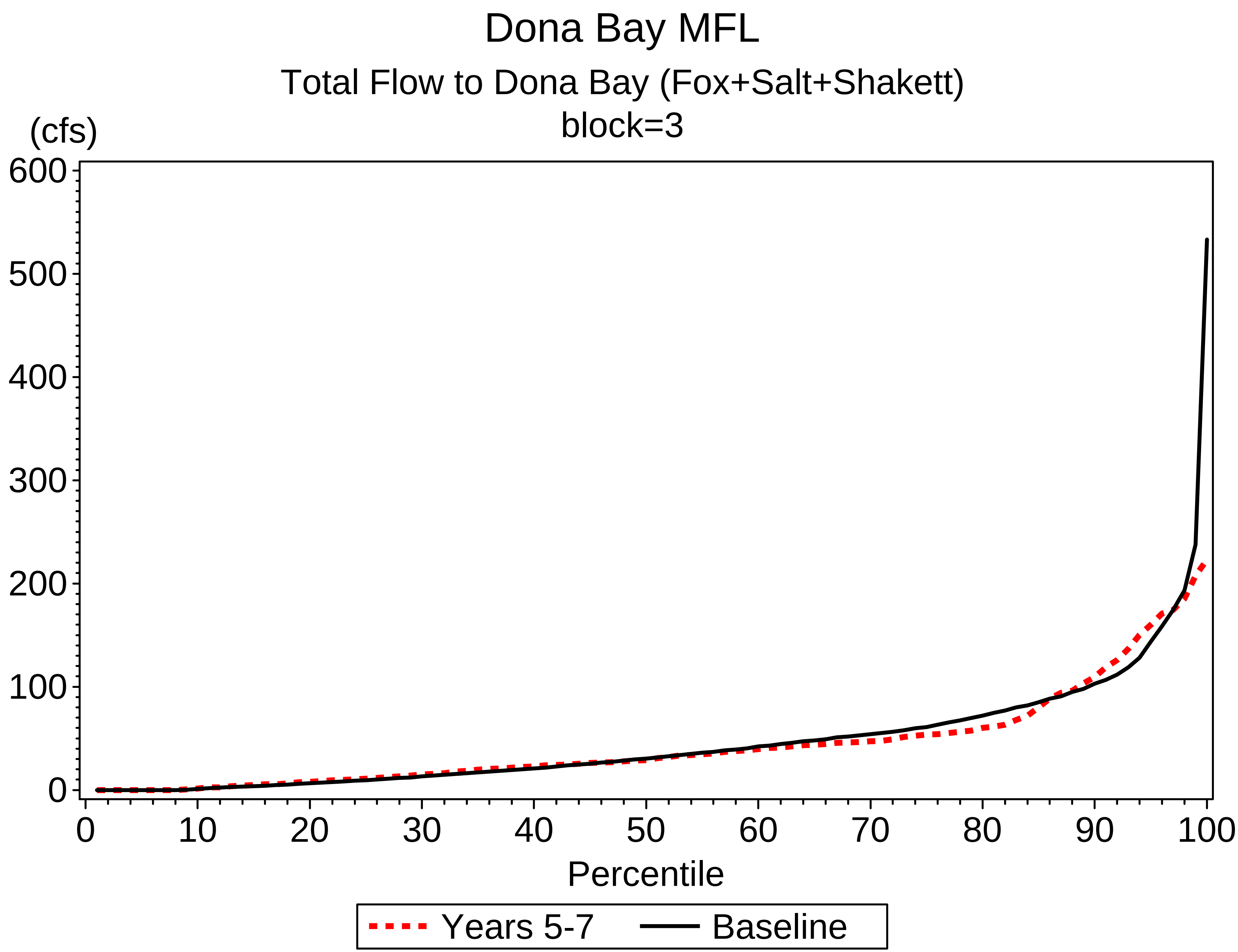
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 1-3
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 2-4
Baseline

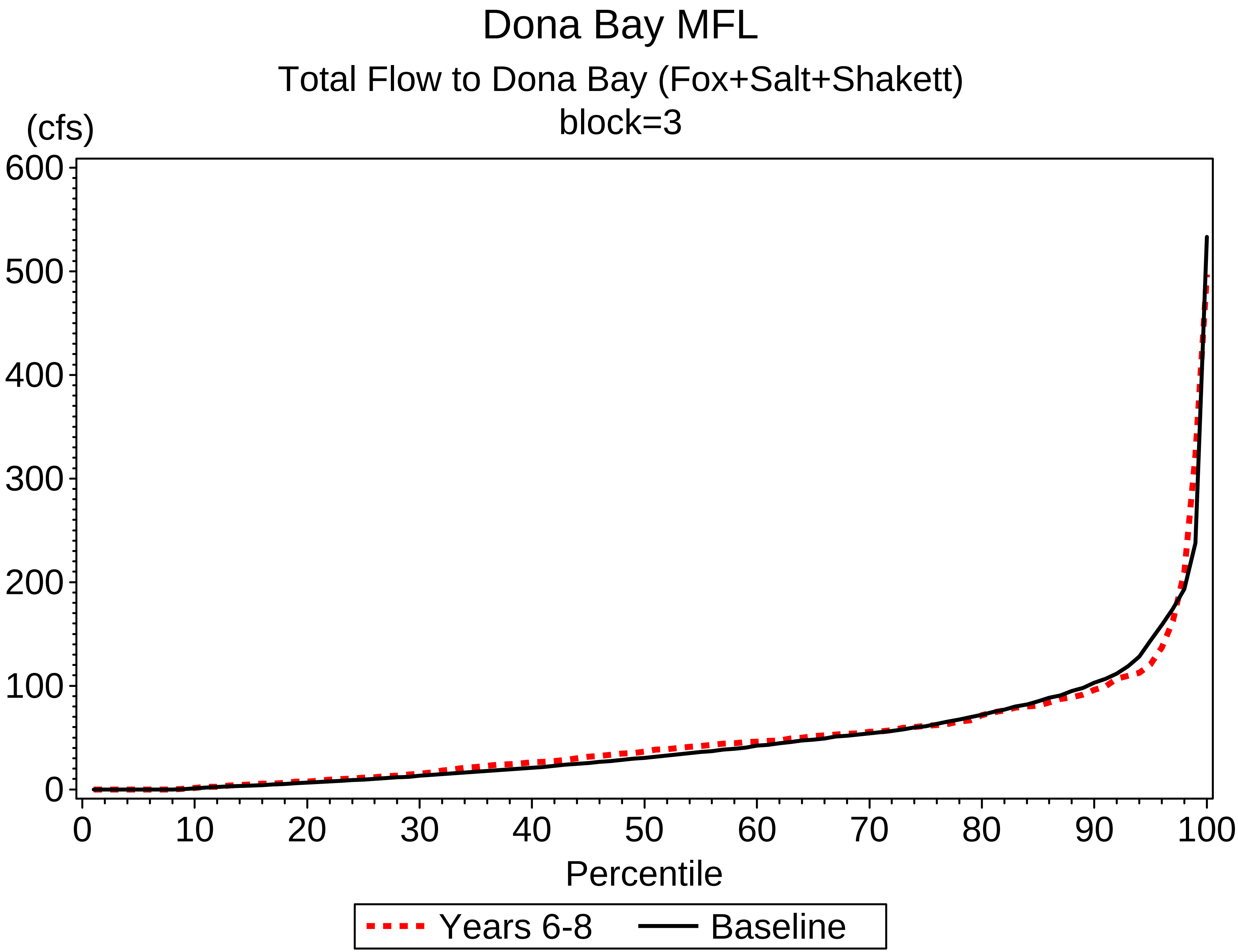

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 3-5
Baseline



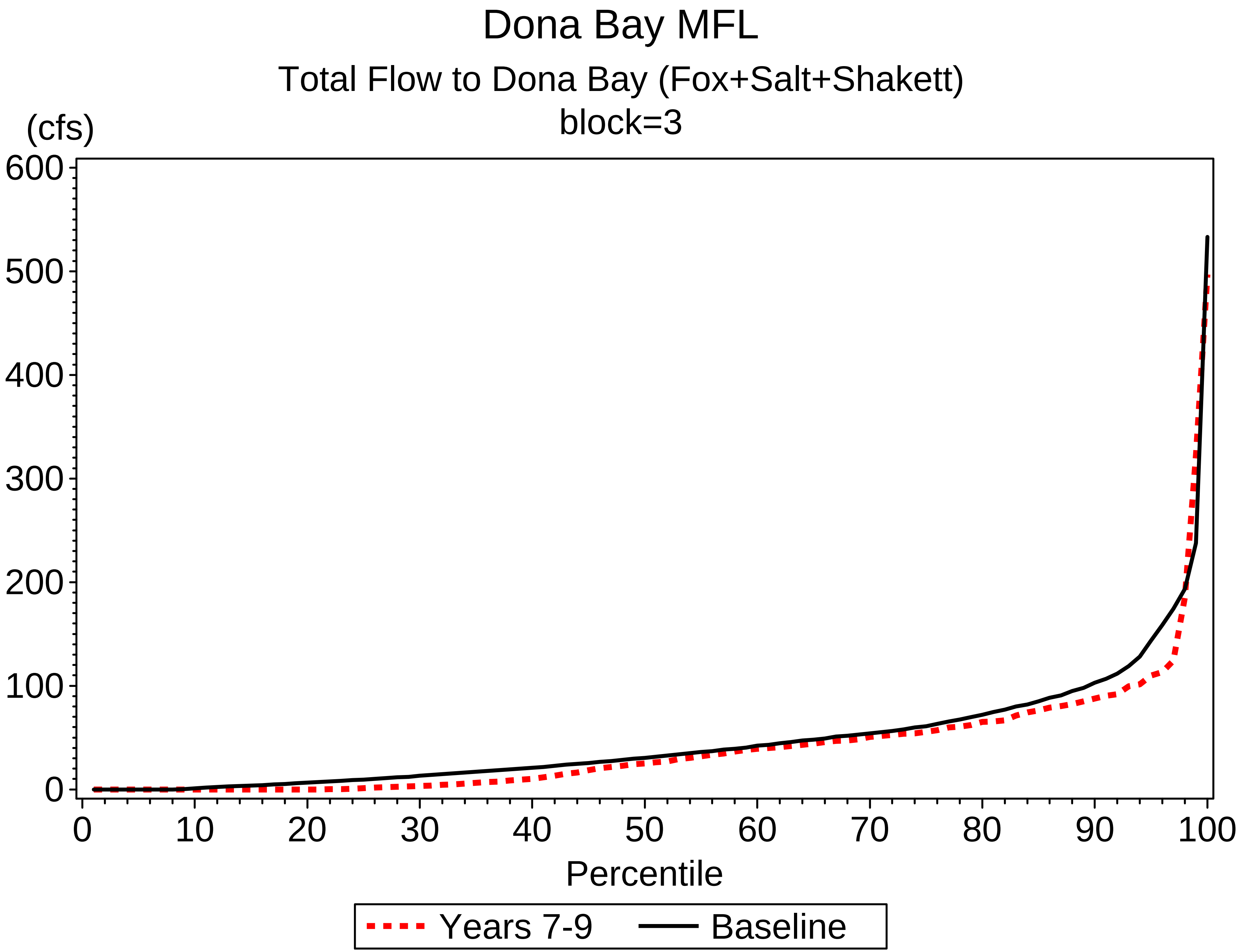
Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 4-6
Baseline



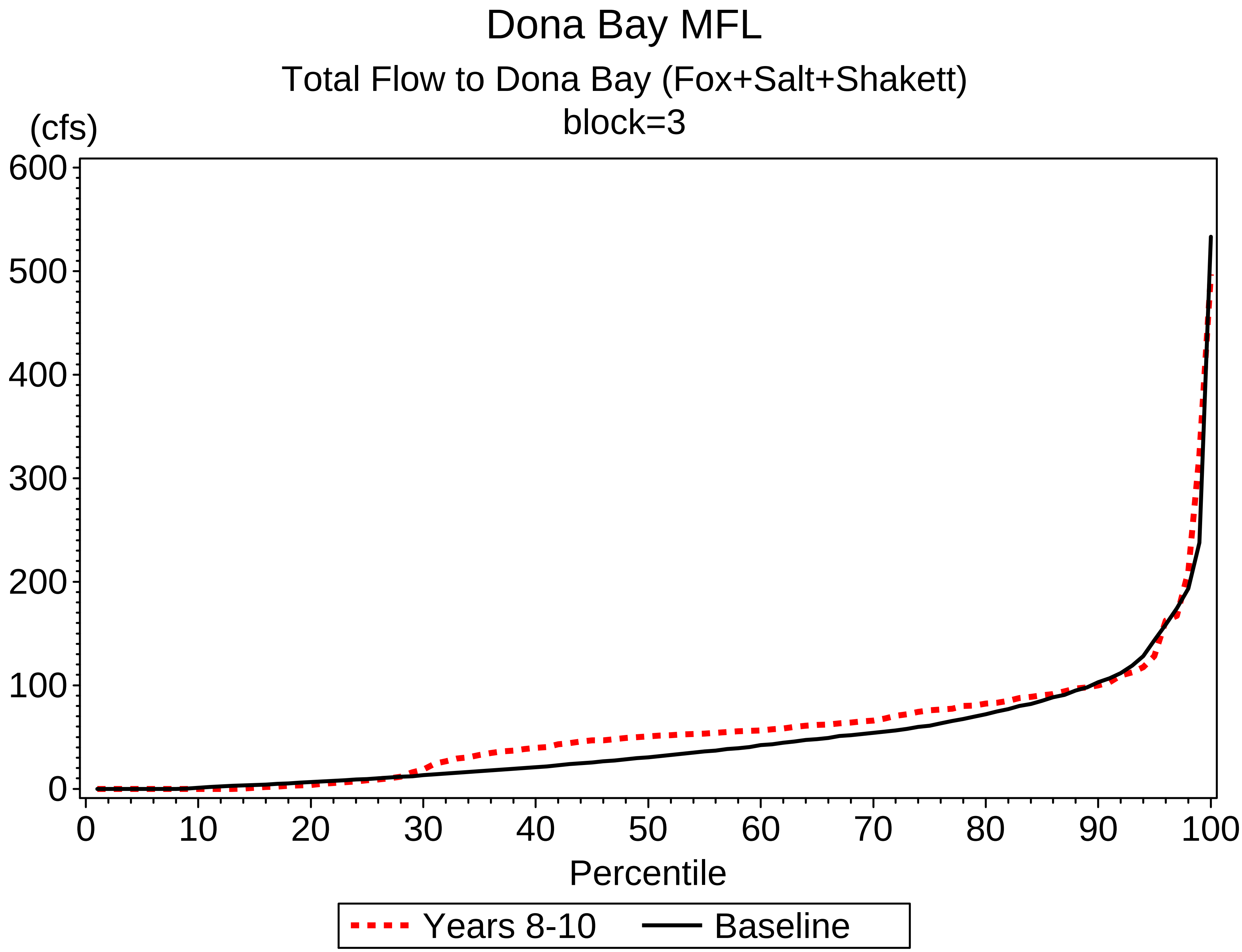
Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 5-7
Baseline



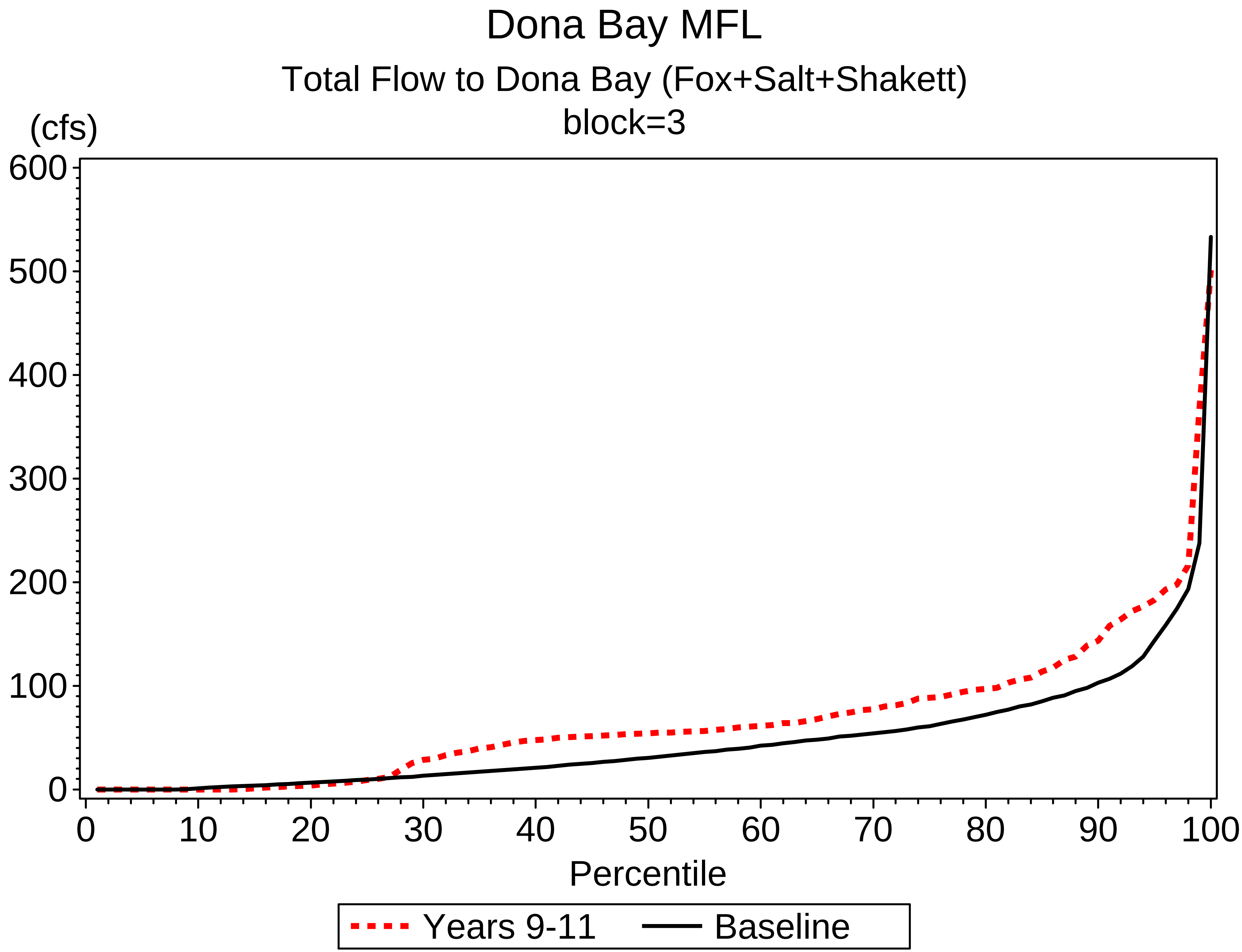
Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 6-8
Baseline

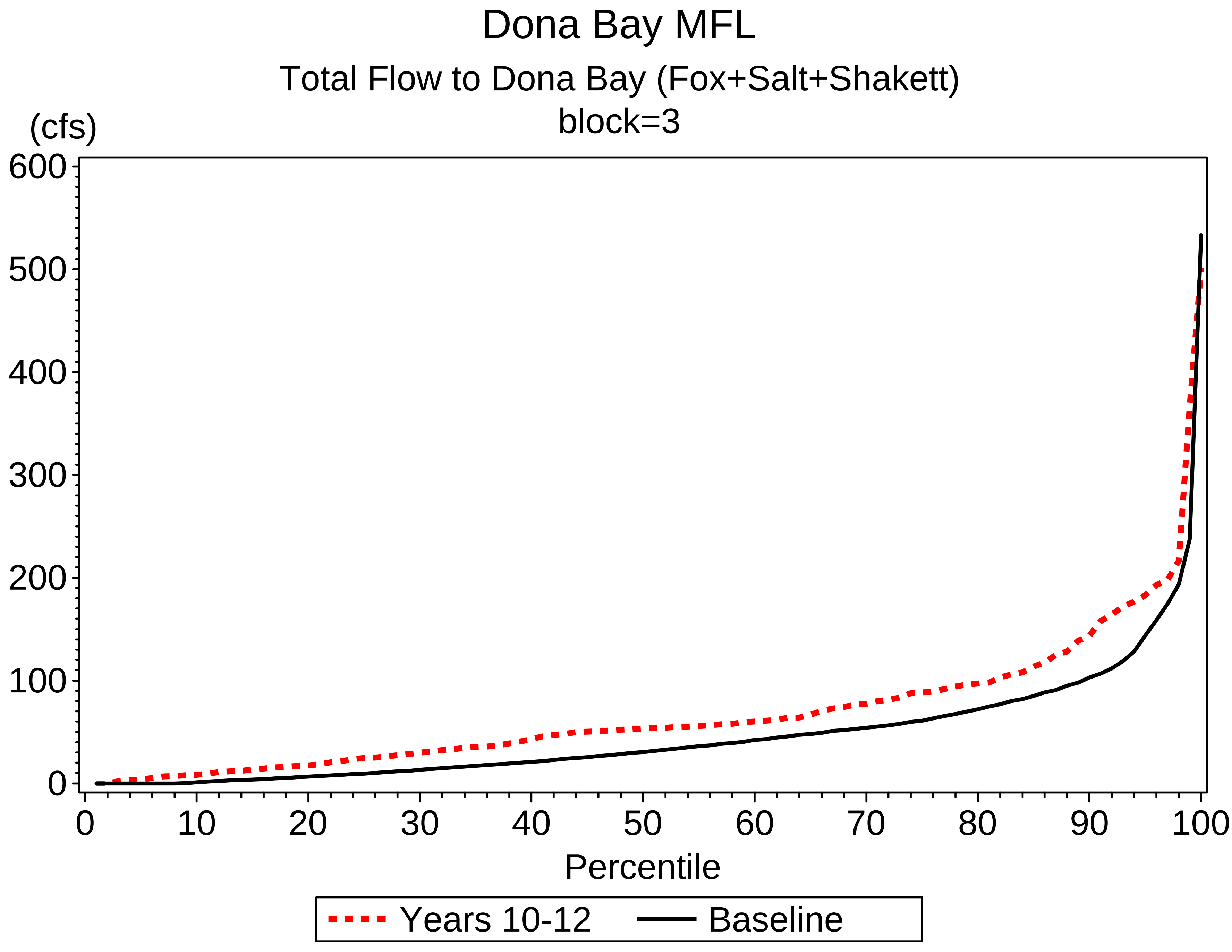


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 7-9
Baseline

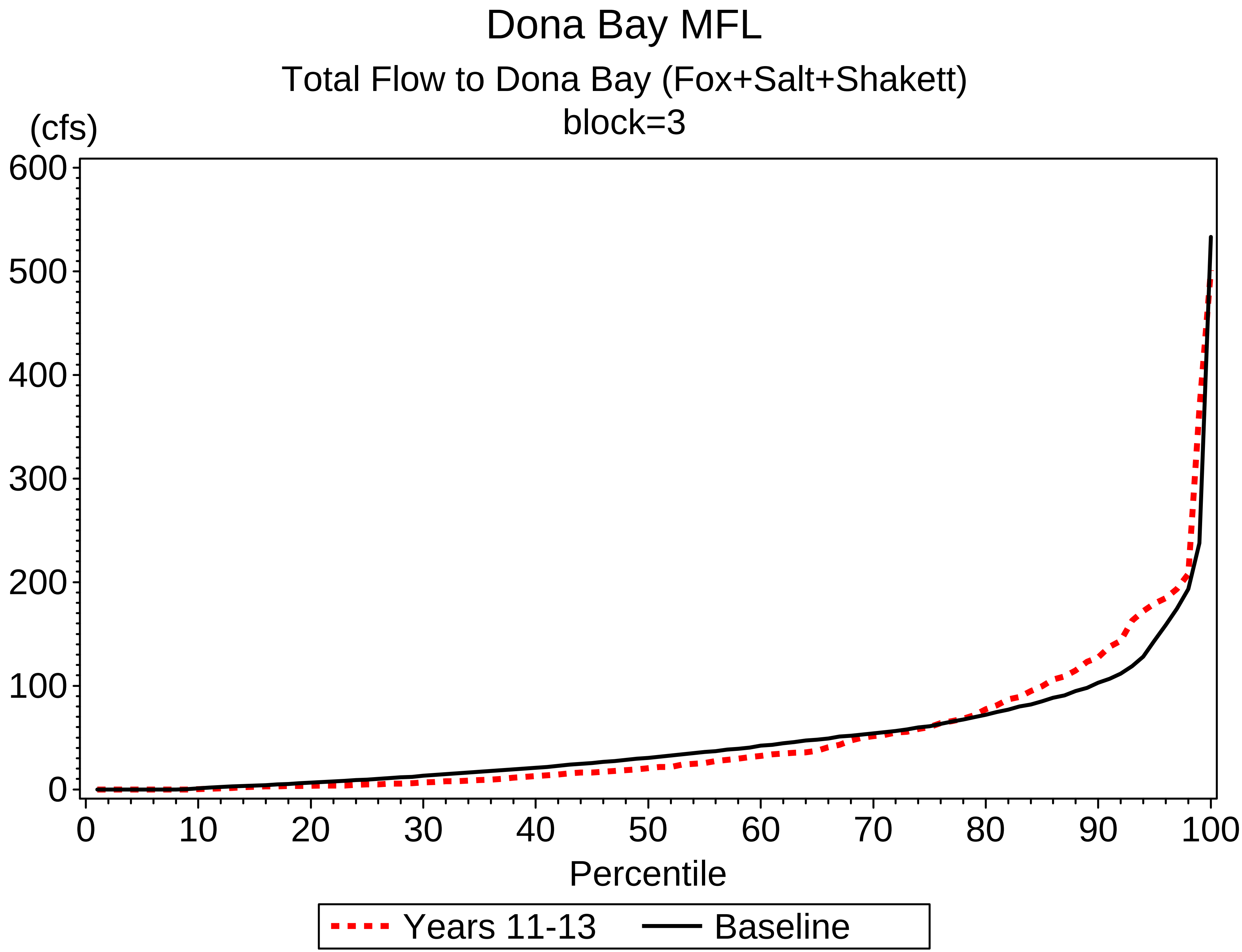


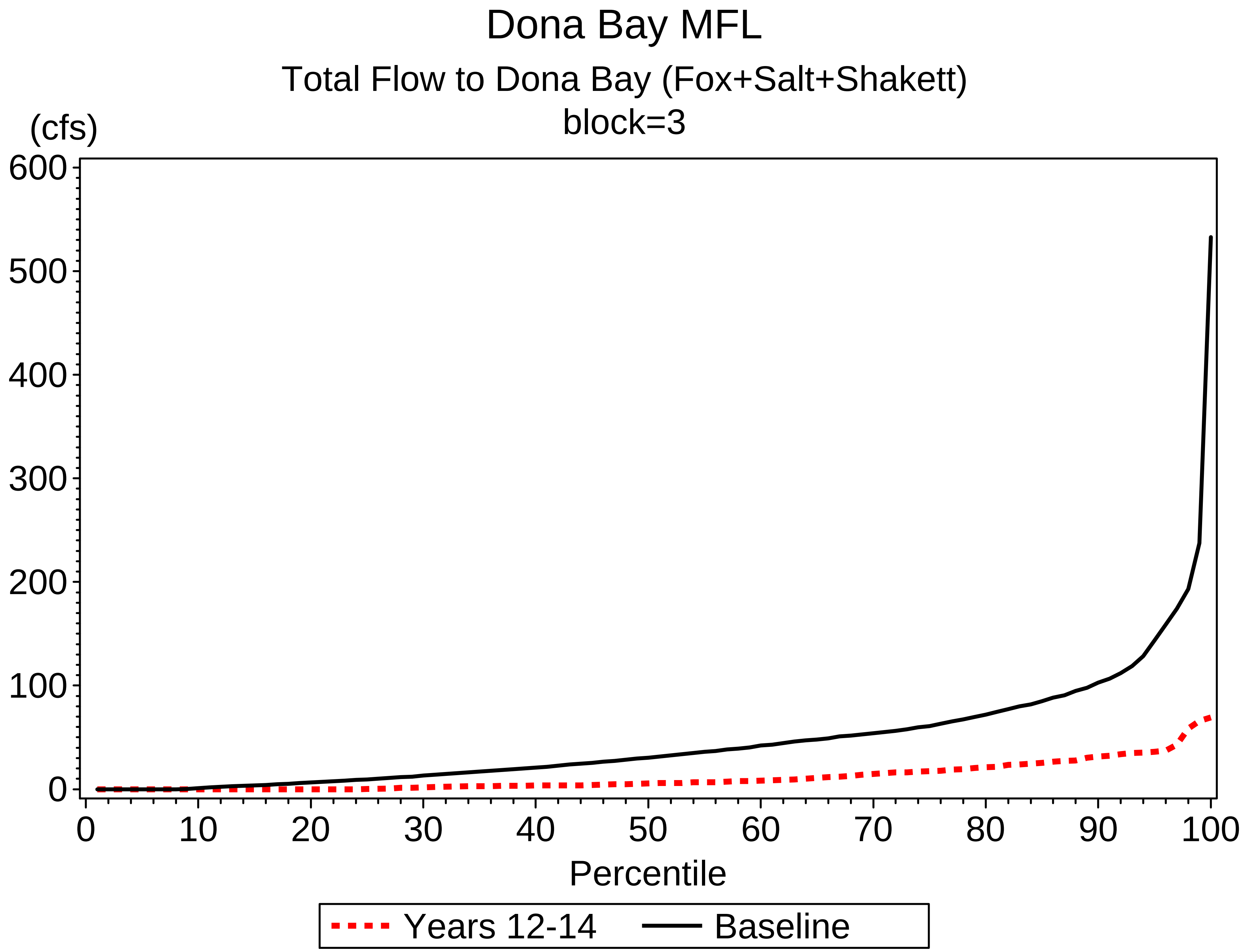
Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 8-10
Baseline

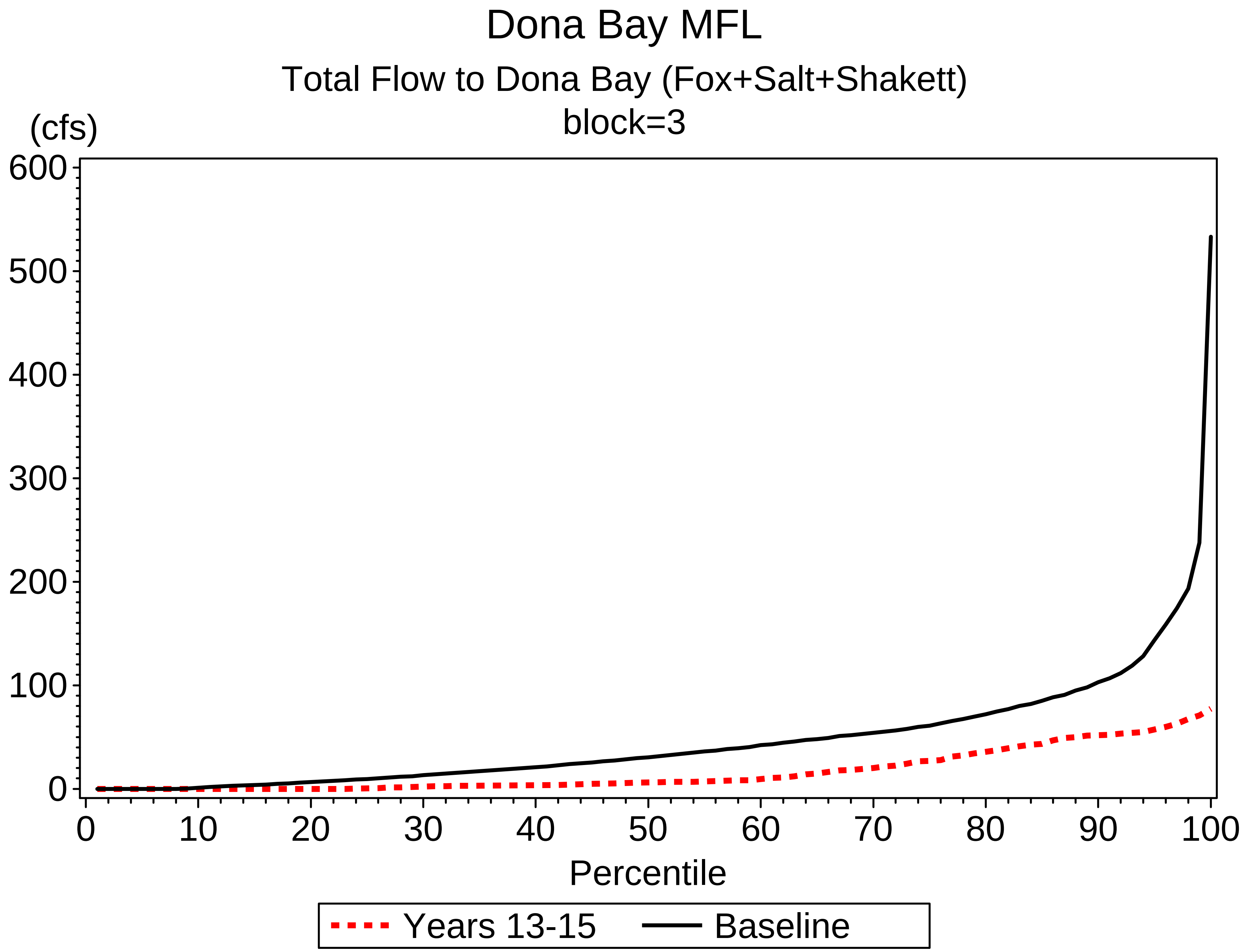

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 9-11
Baseline

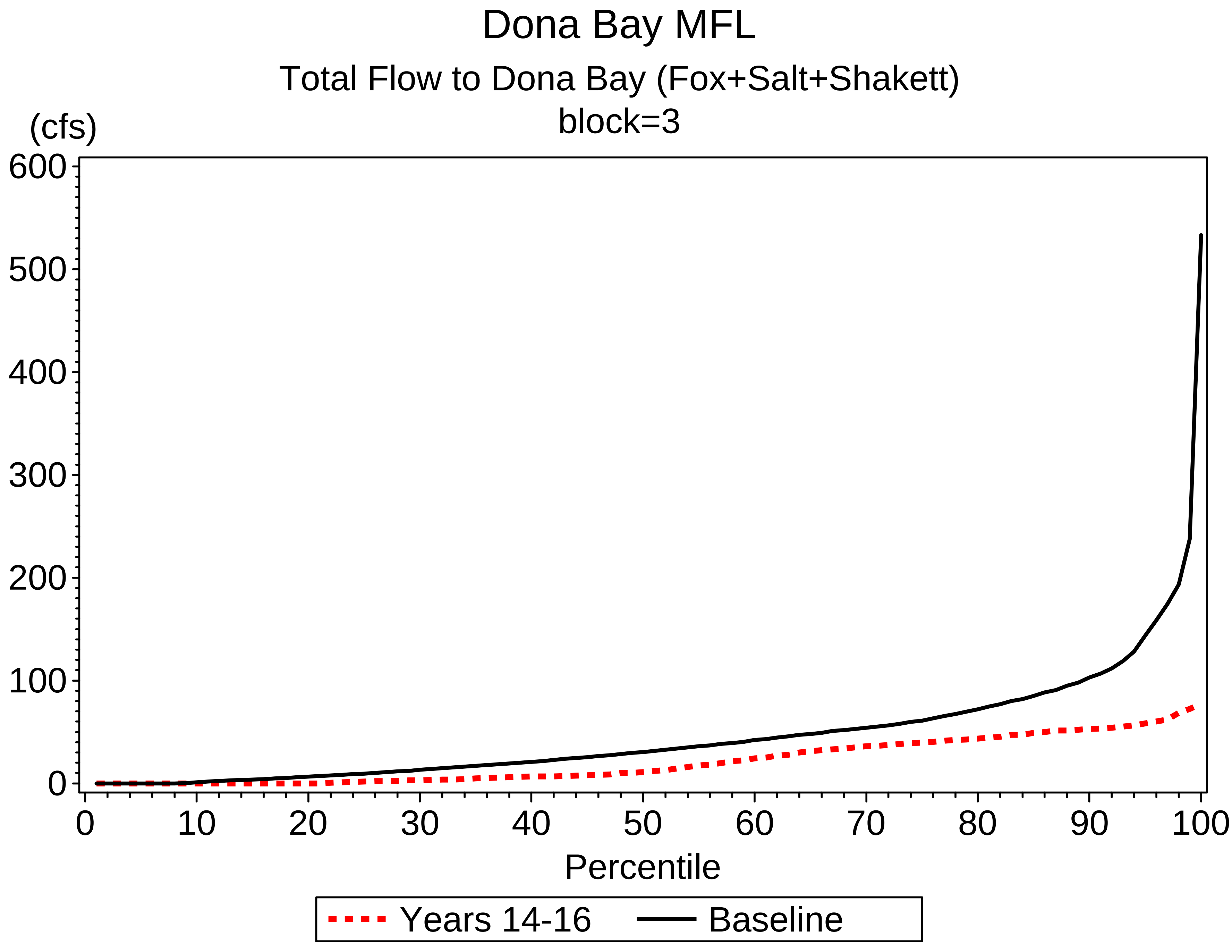


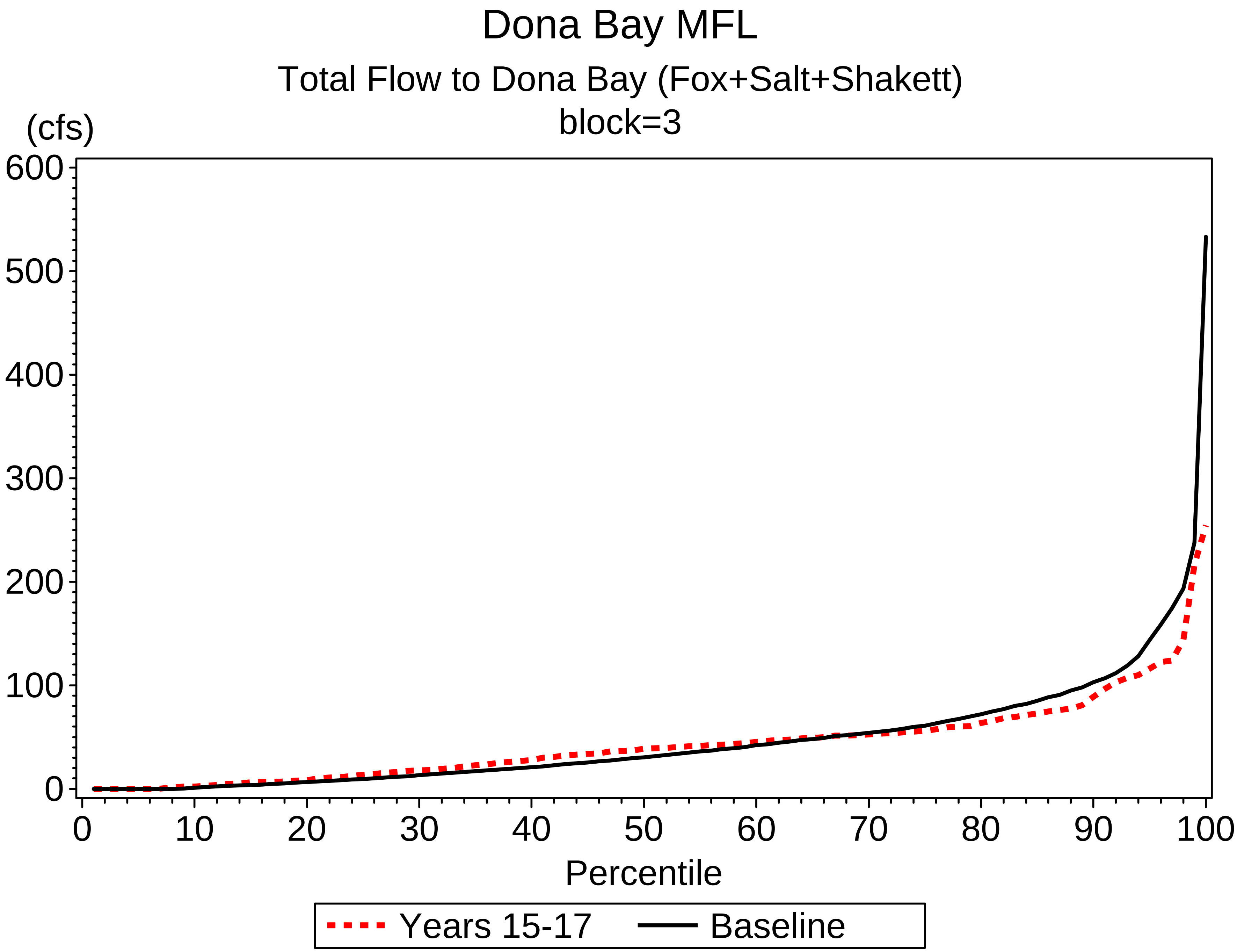
Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 10-12
Baseline

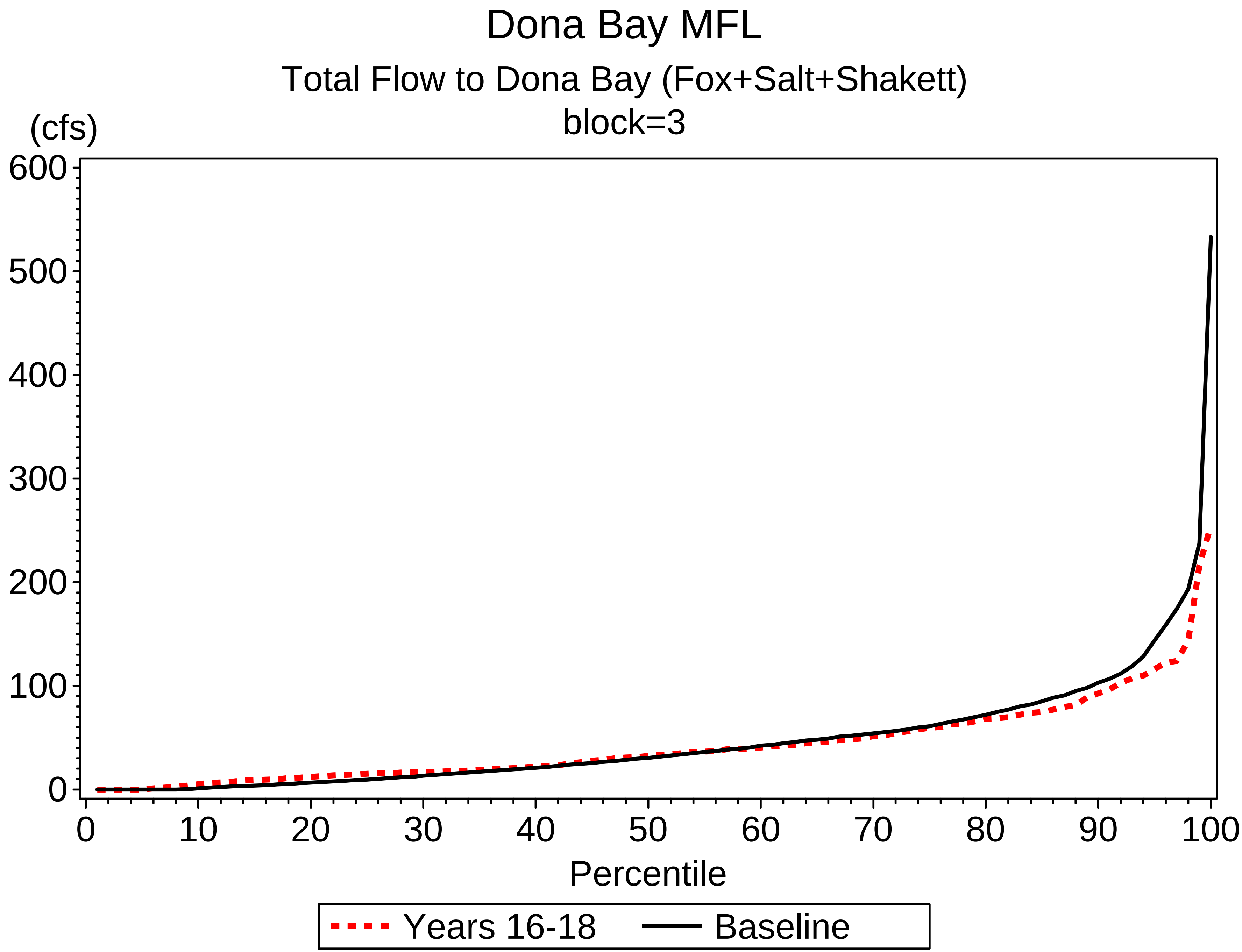

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 11-13
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 12-14
Baseline

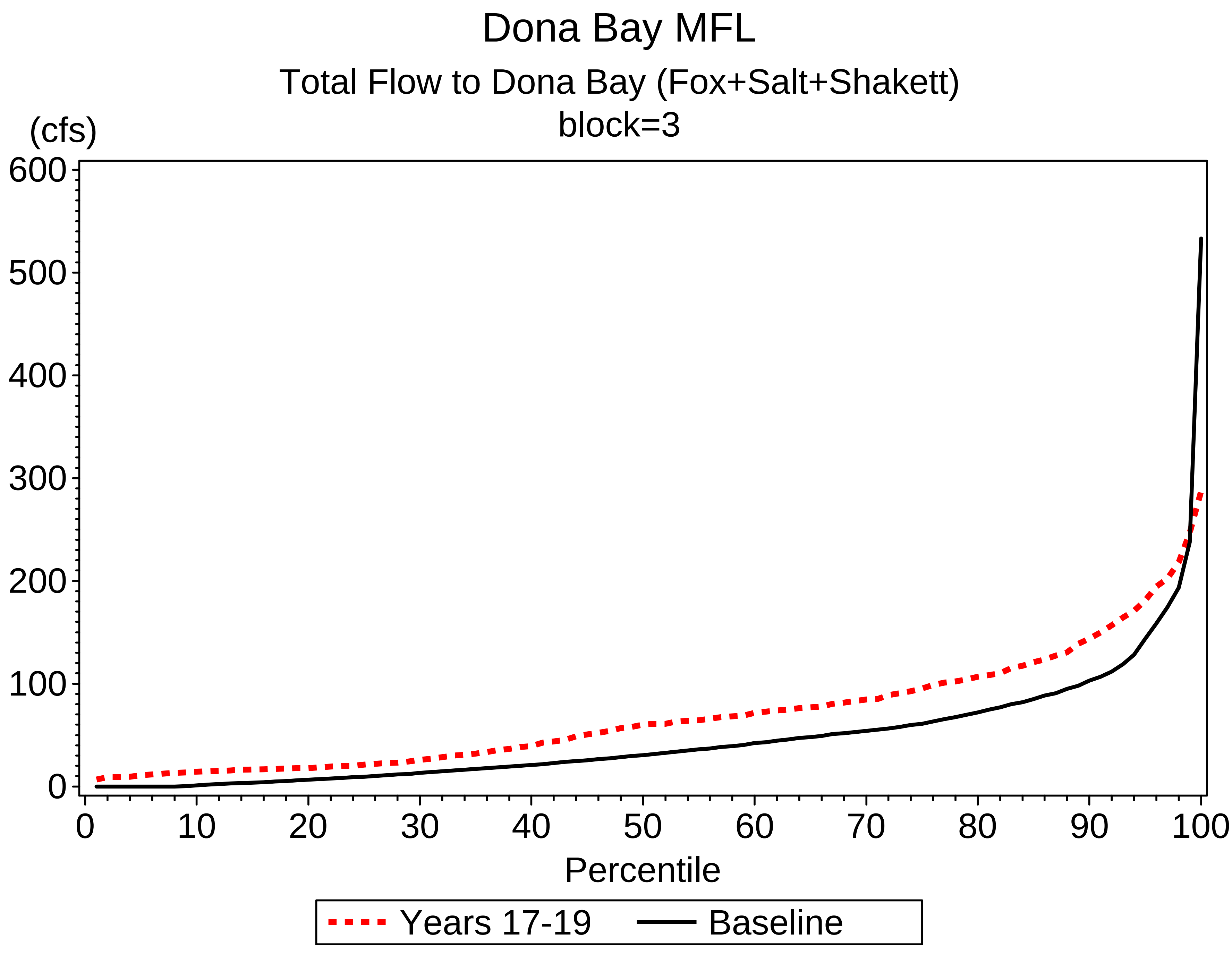

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 13-15
Baseline

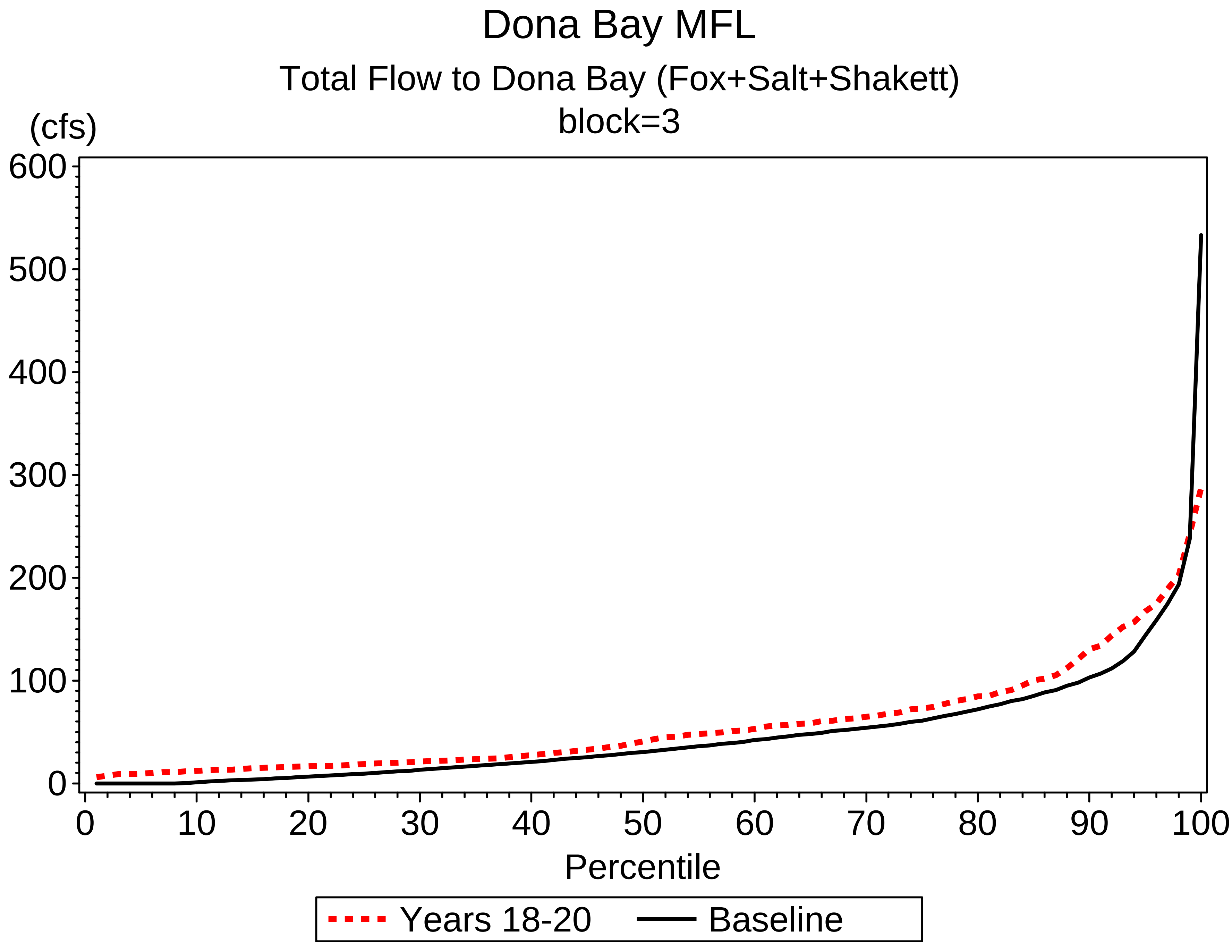

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 14-16
Baseline


Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 15-17
Baseline



Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 16-18
Baseline

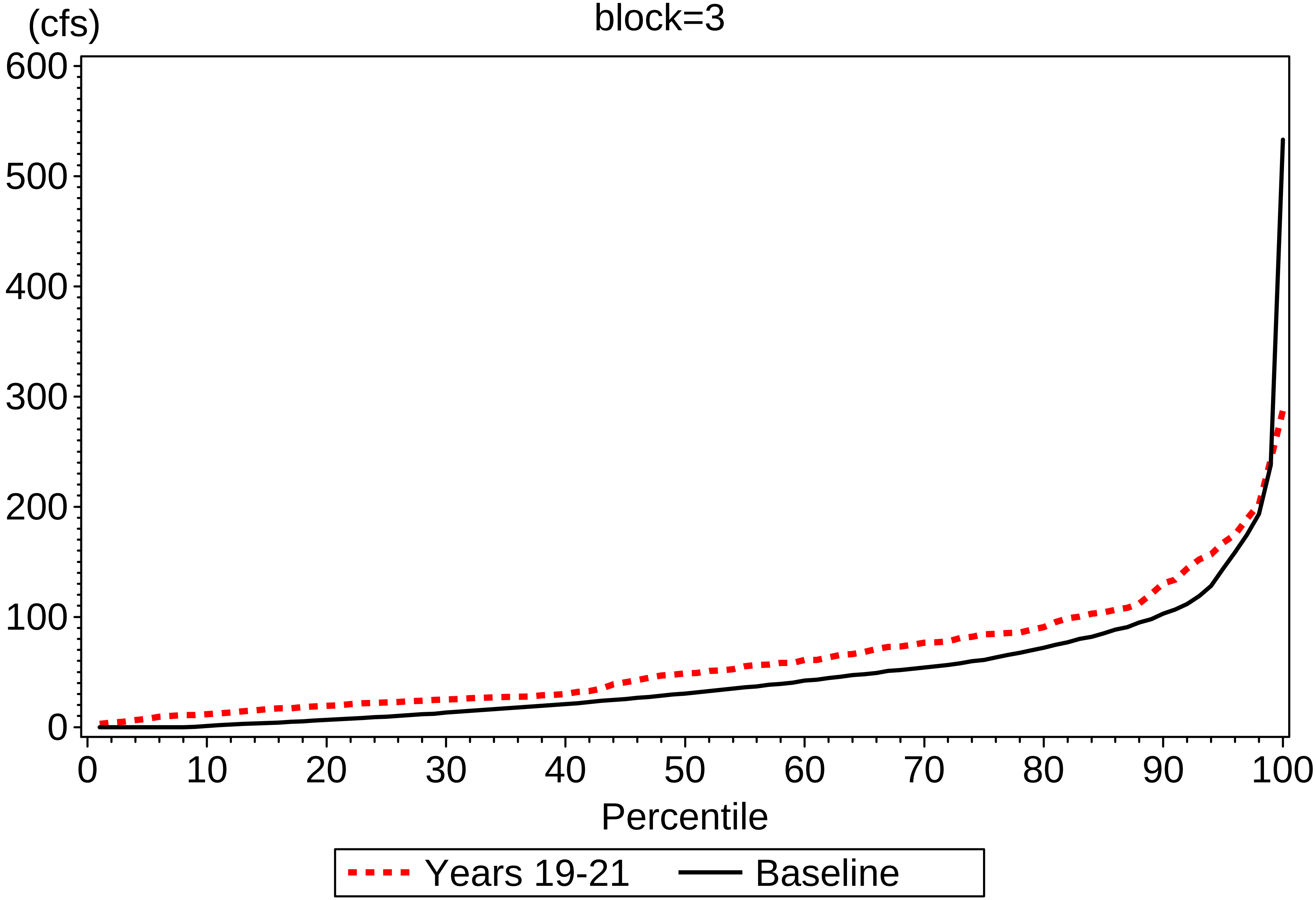

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 17-19
Baseline

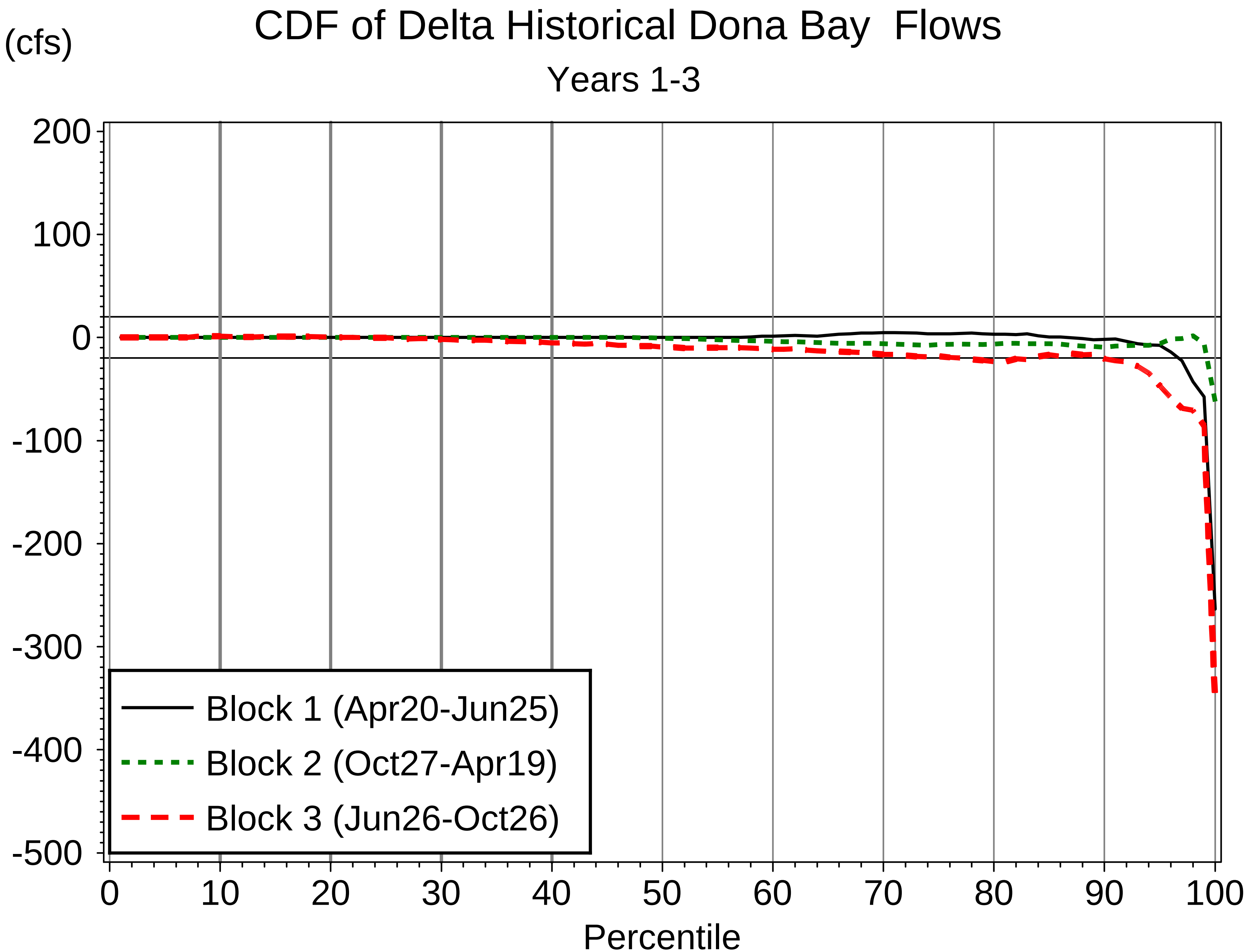

Dona Bay MFL
Total Flow to Dona Bay (Fox+Salt+Shakett)
block=3
(cfs)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percentile
Years 18-20
Baseline

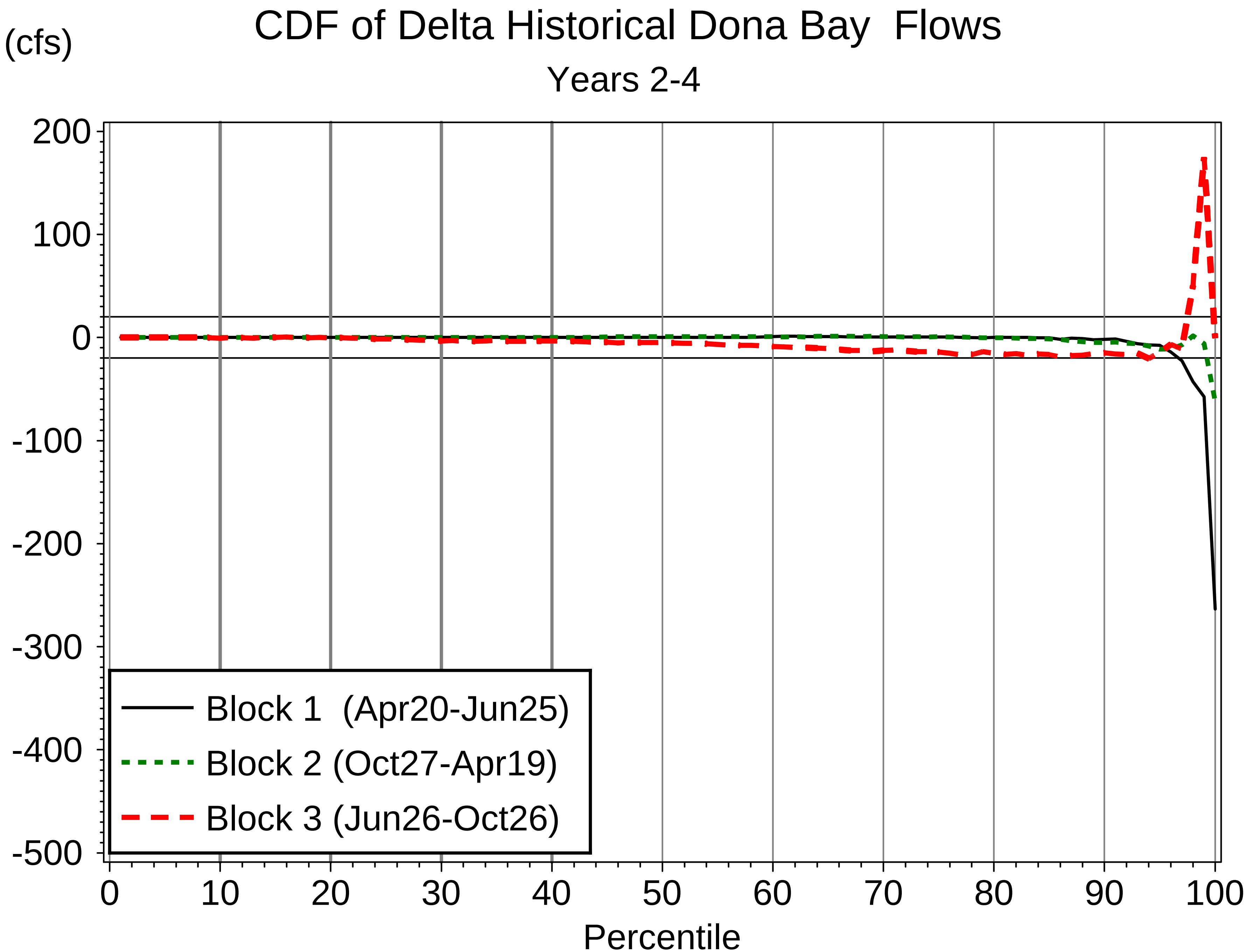
Dona Bay MFL

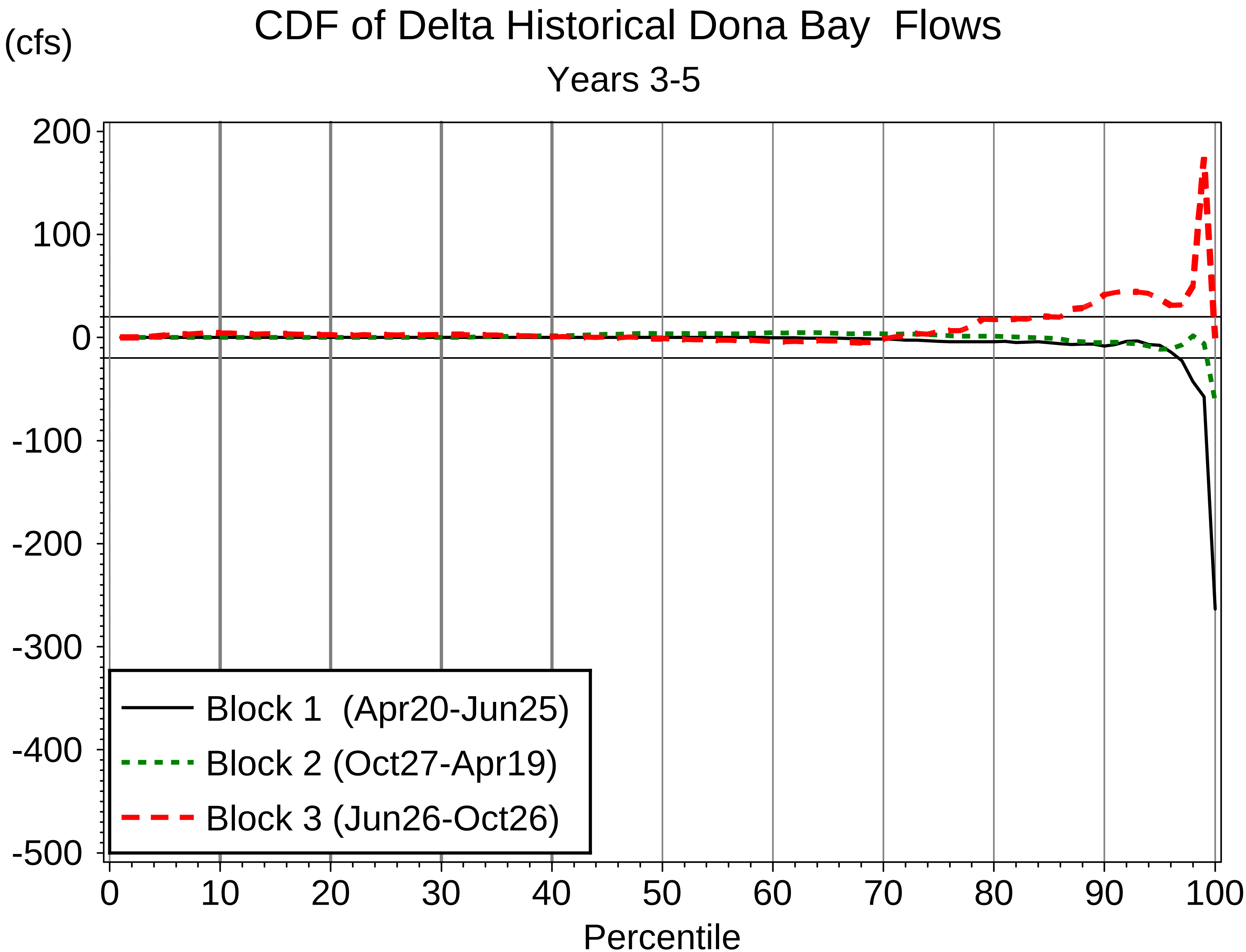
Total Flow to Dona Bay (Fox+Salt+Shakett)

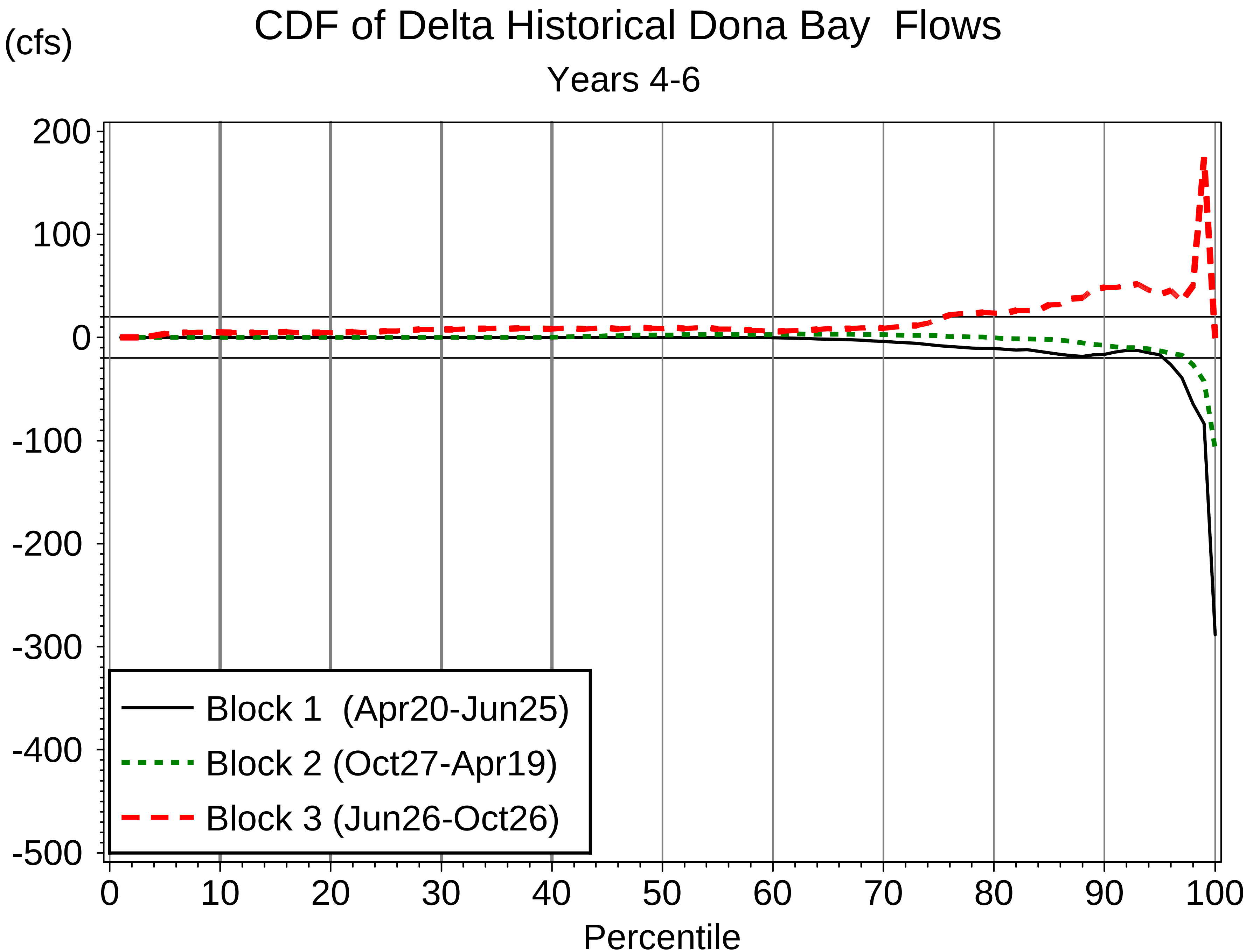
block=3

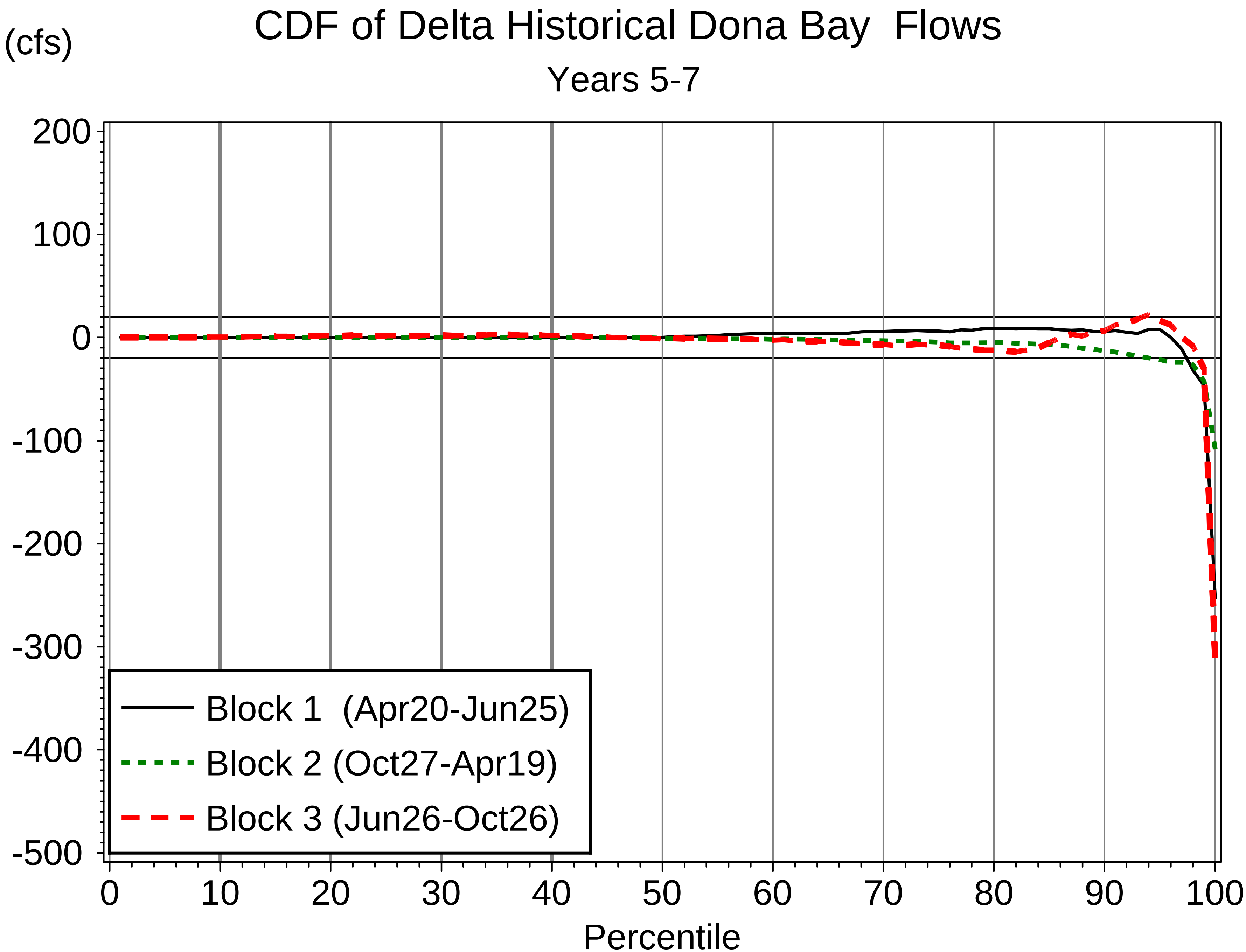



CDF of Delta Historical Dona Bay Flows
Years 1-3
(cfs)
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)

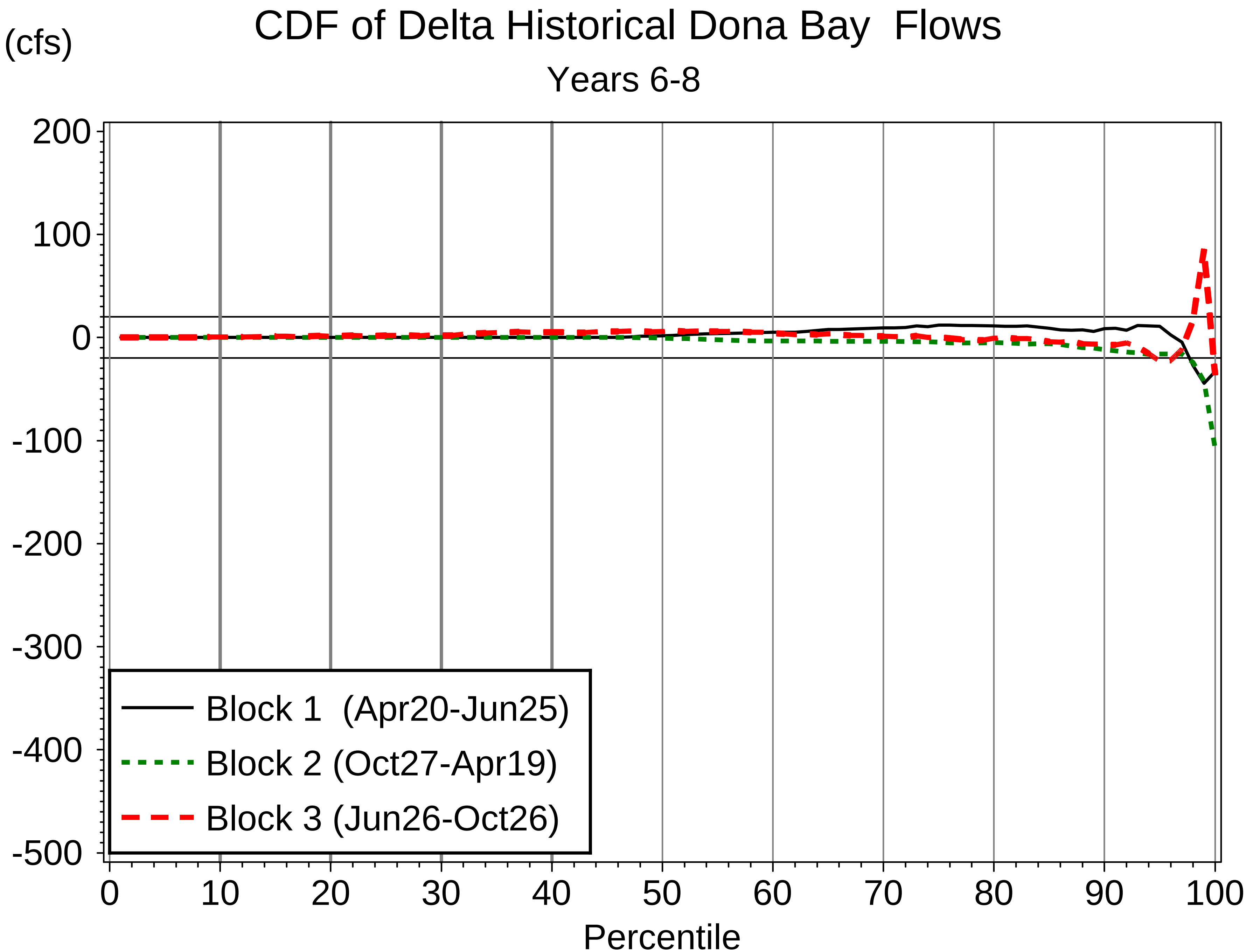

(cfs)
CDF of Delta Historical Dona Bay Flows
Years 2-4
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)


(cfs)
CDF of Delta Historical Dona Bay Flows
Years 3-5
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)

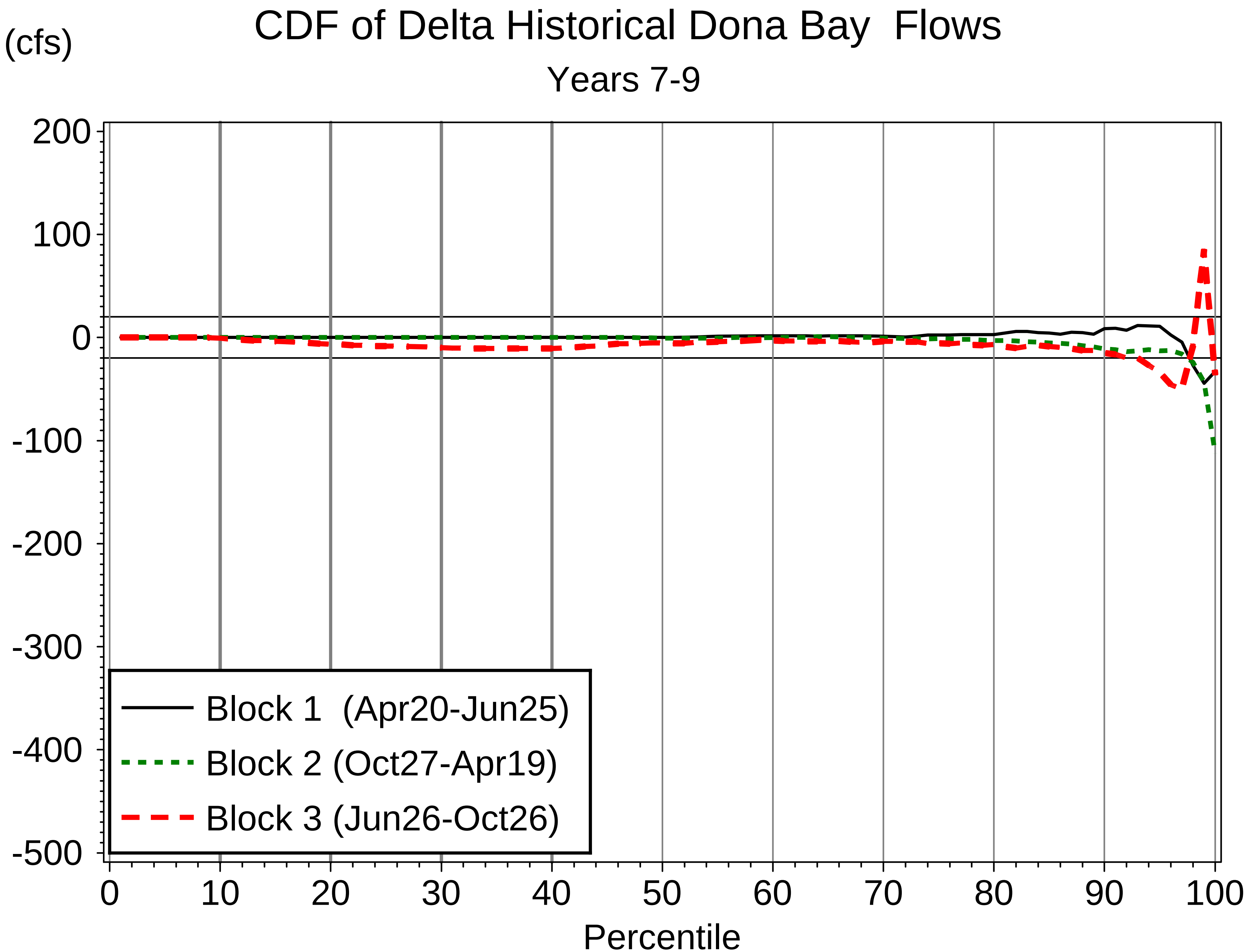

(cfs)
CDF of Delta Historical Dona Bay Flows
Years 4-6
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)



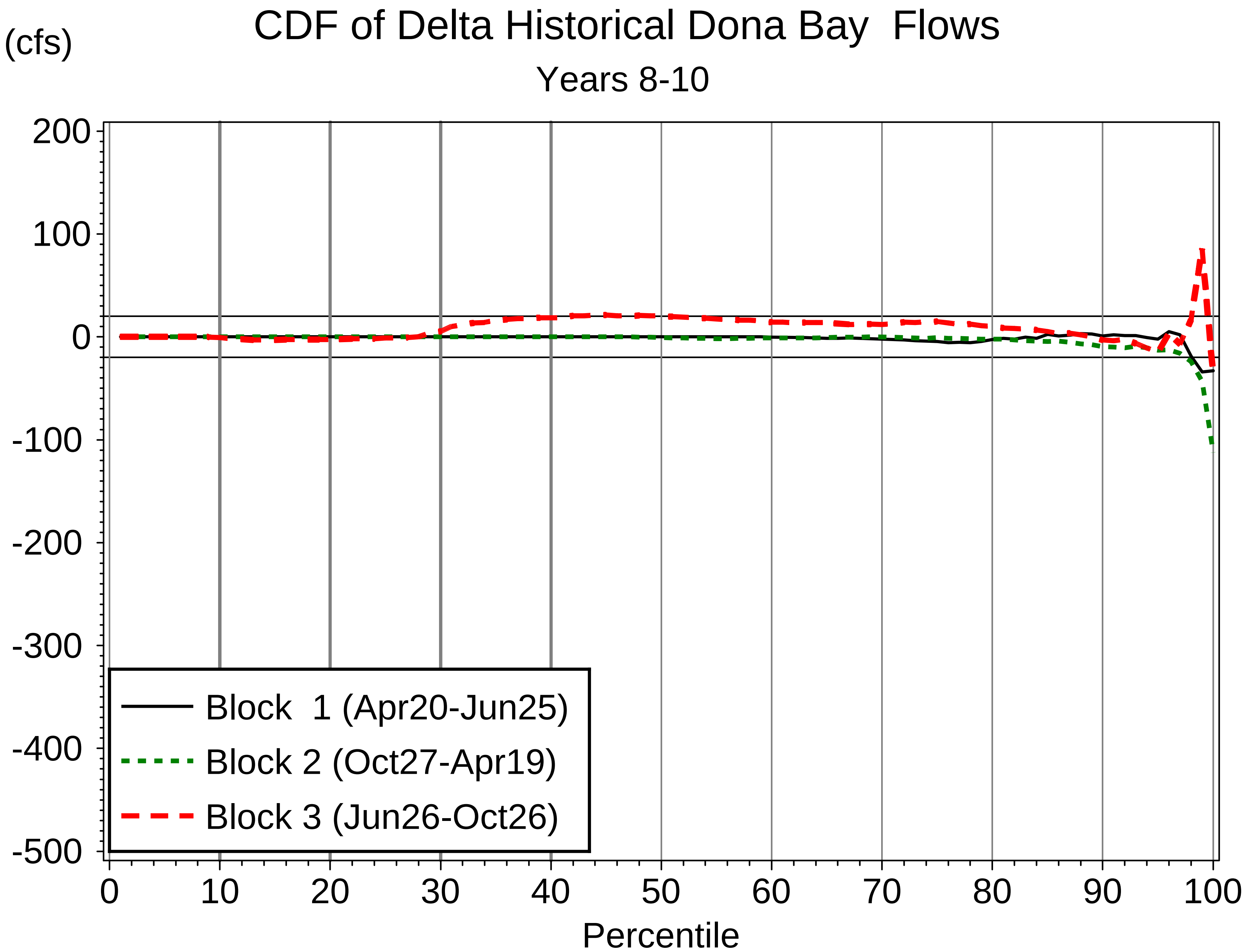
(cfs)
CDF of Delta Historical Dona Bay Flows
Years 5-7
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)



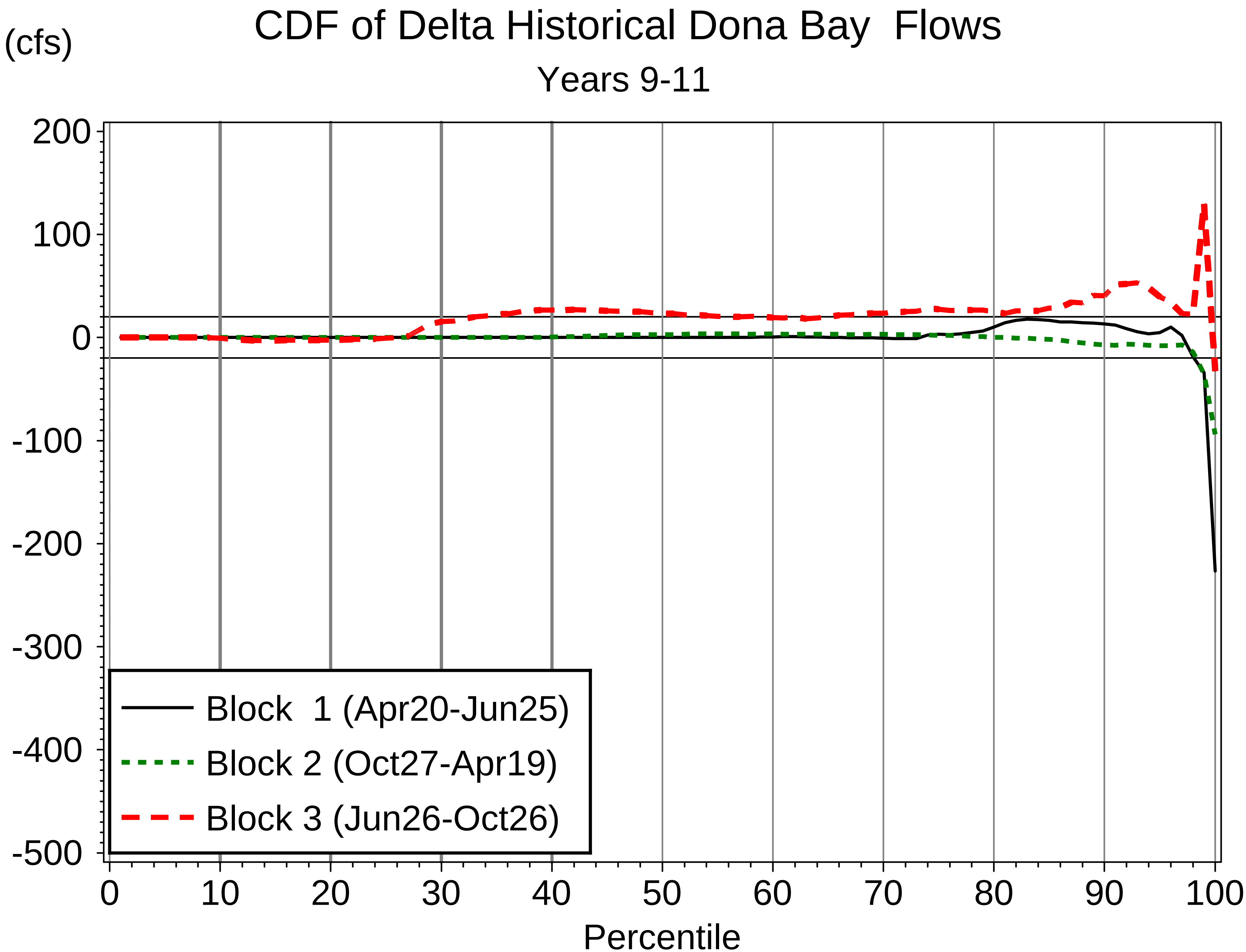
CDF of Delta Historical Dona Bay Flows
Years 6-8
(cfs)
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)

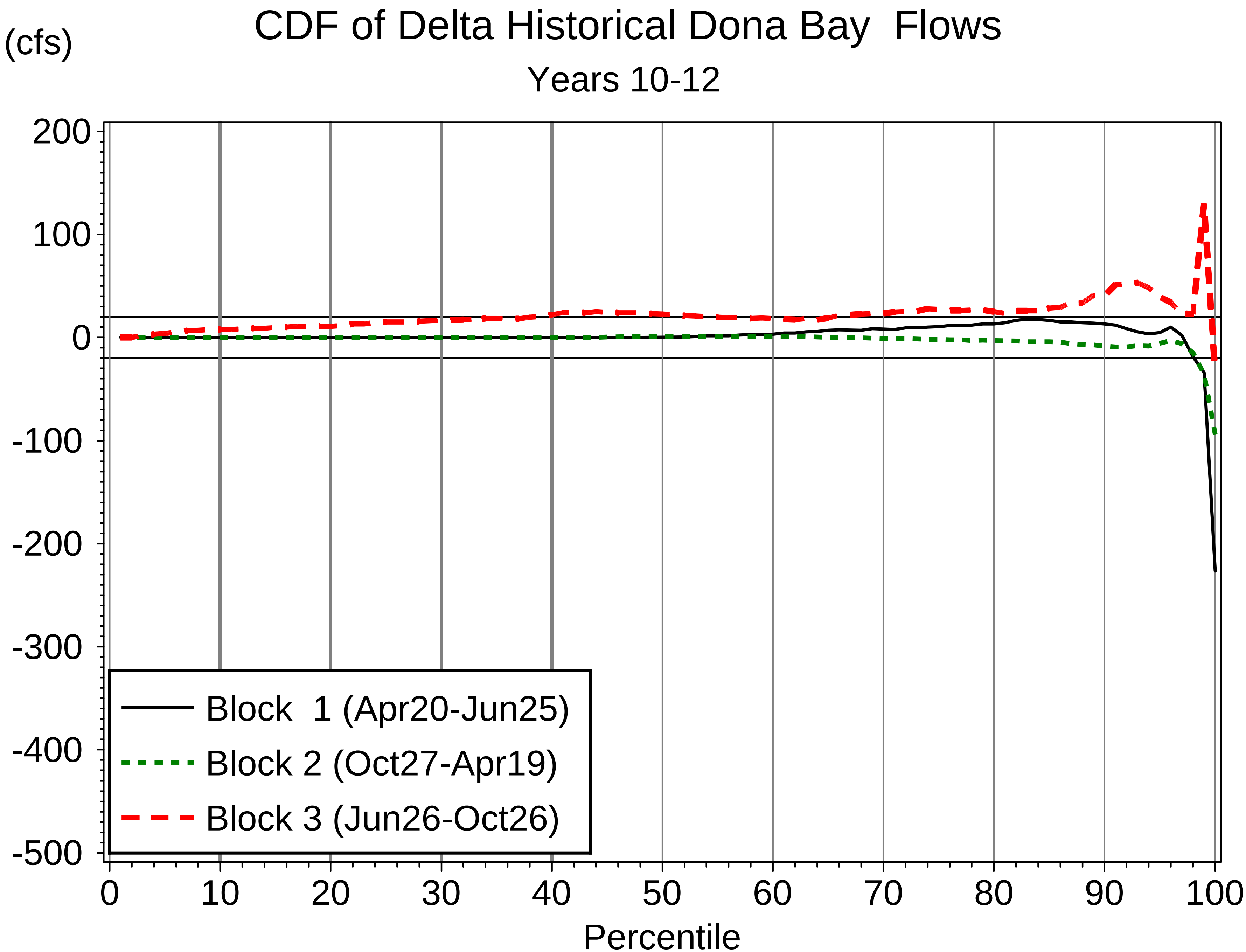


(cfs)
CDF of Delta Historical Dona Bay Flows
Years 7-9
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)

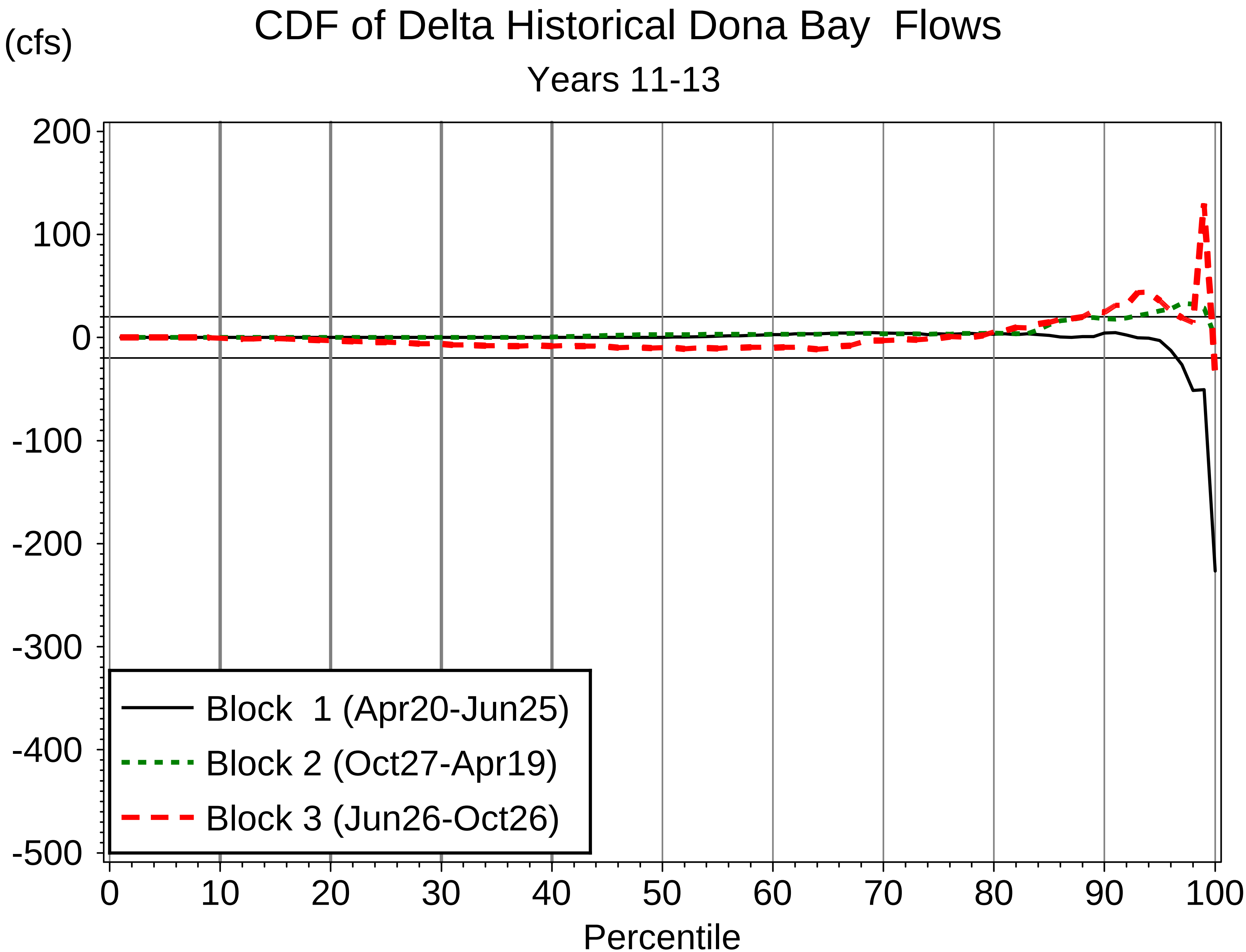


(cfs)
CDF of Delta Historical Dona Bay Flows
Years 8-10
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)

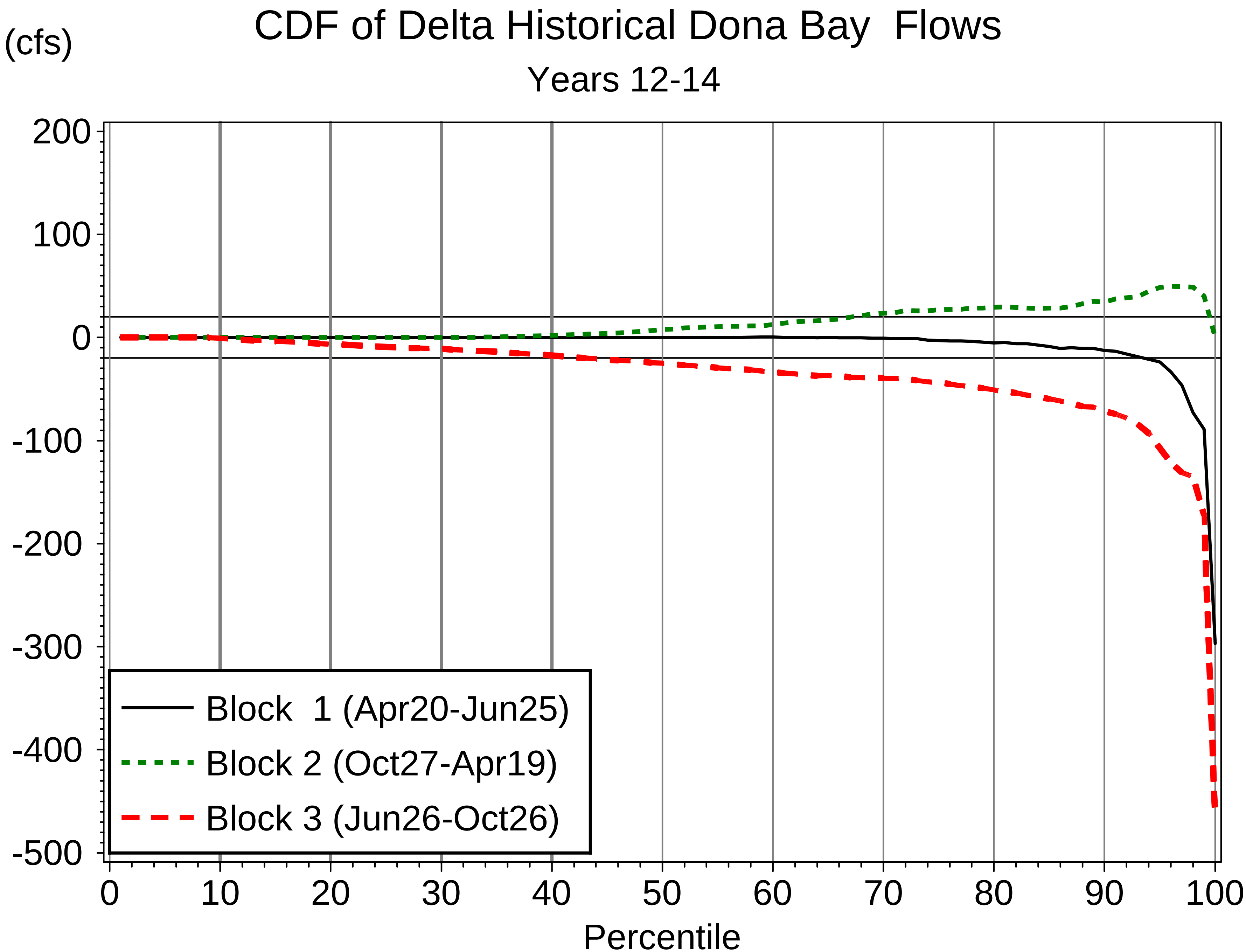

(cfs)
CDF of Delta Historical Dona Bay Flows
Years 9-11
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)



(cfs)
CDF of Delta Historical Dona Bay Flows
Years 10-12
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)

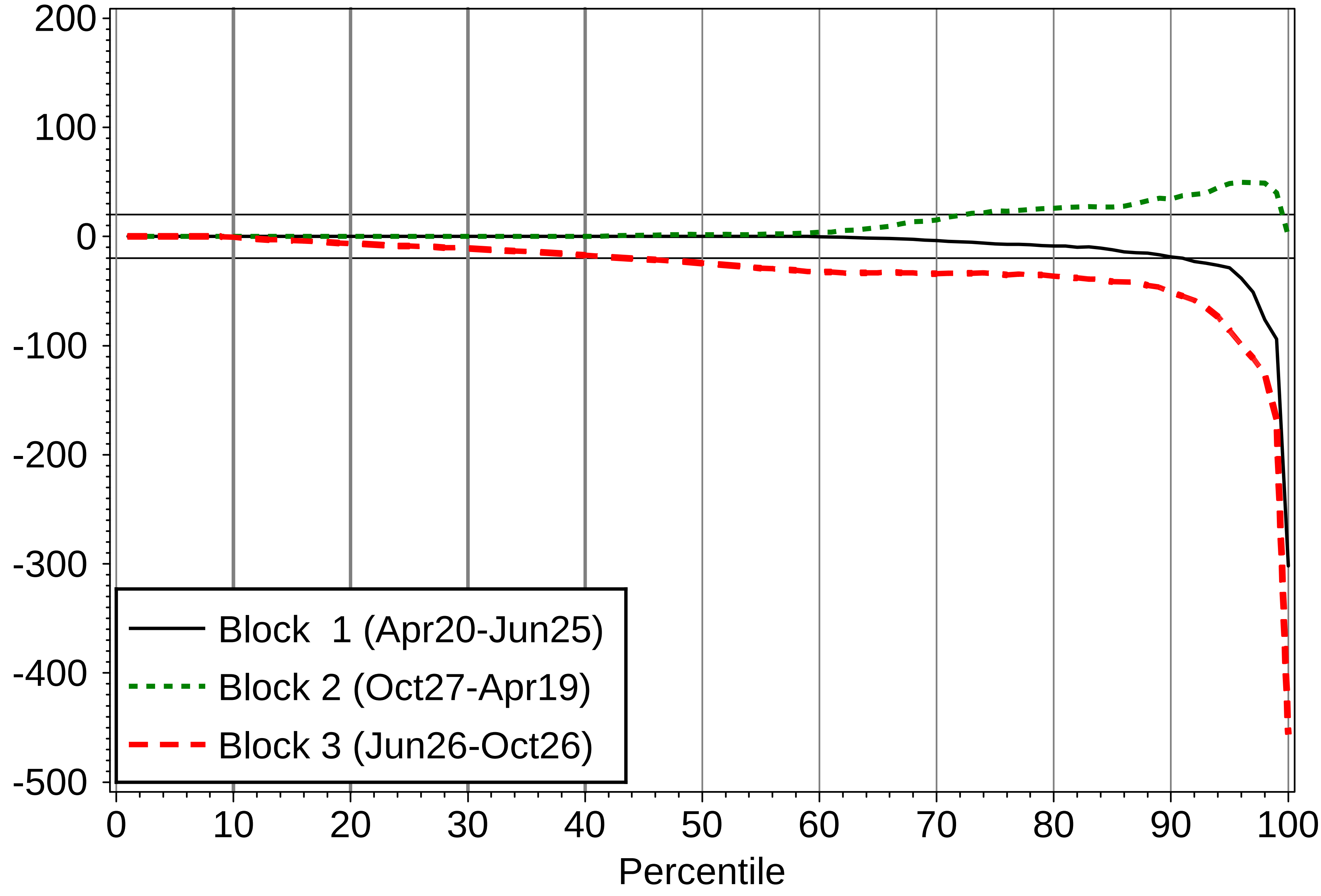


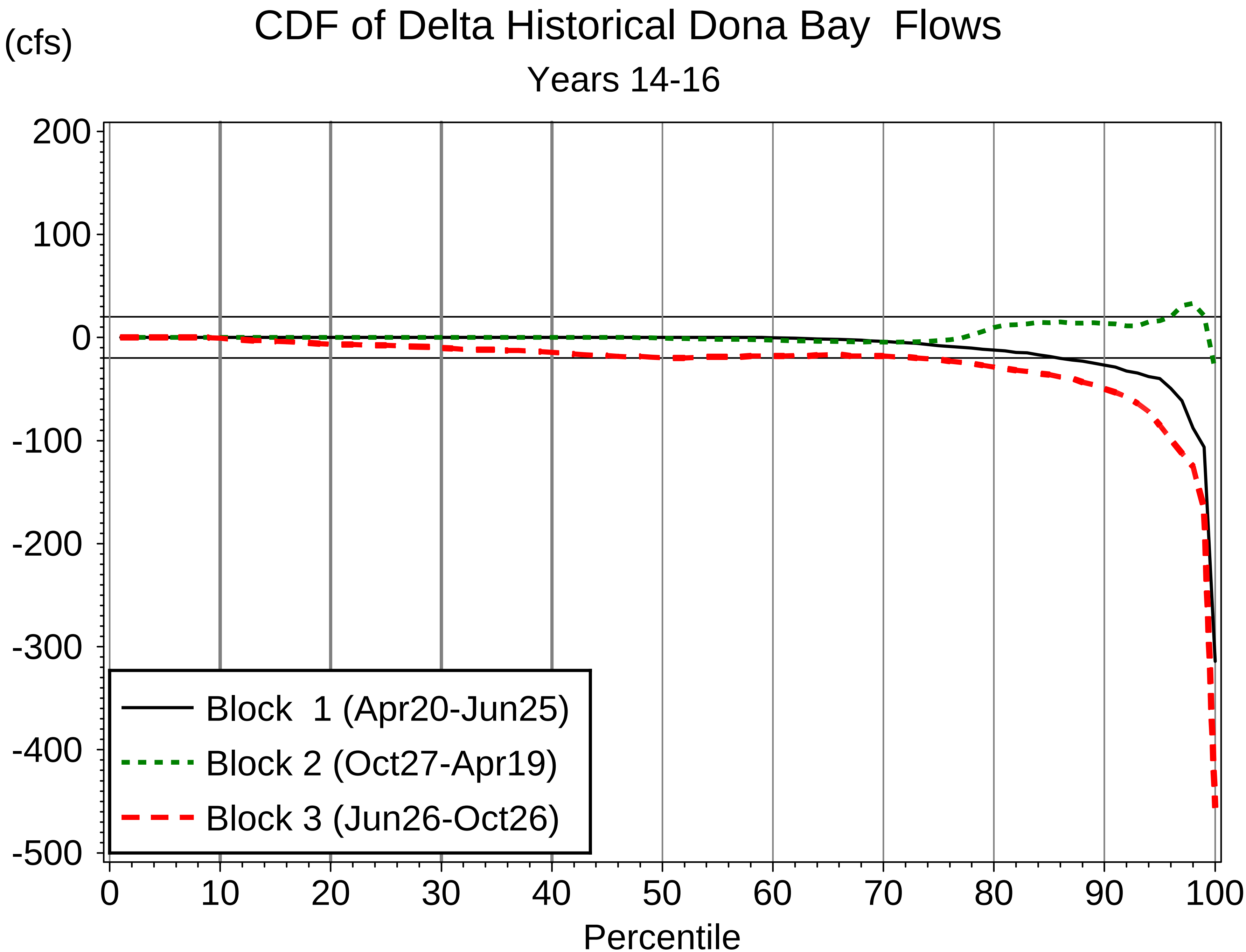
(cfs)
CDF of Delta Historical Dona Bay Flows
Years 11-13
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)


(cfs)
CDF of Delta Historical Dona Bay Flows
Years 12-14
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)

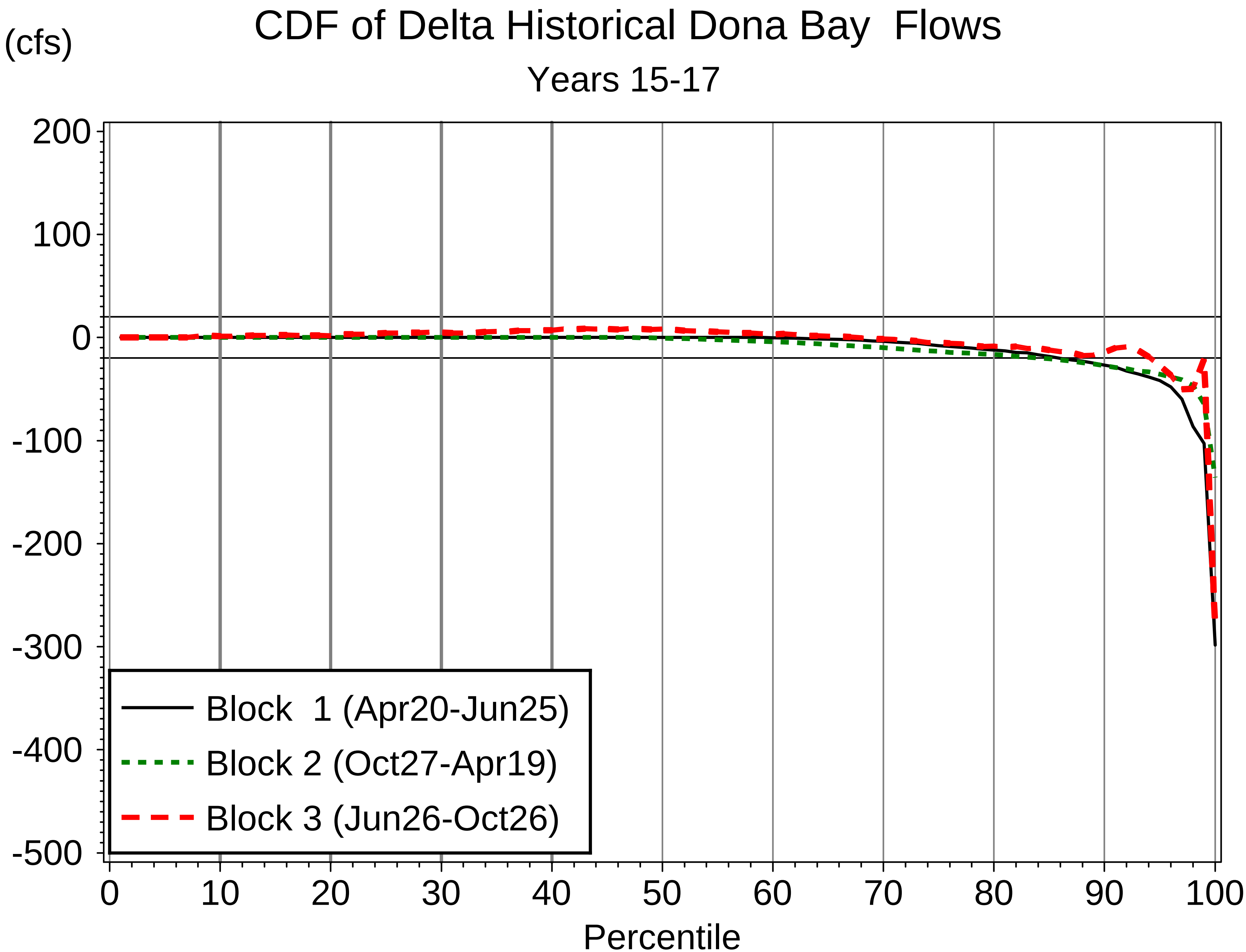
CDF of Delta Historical Dona Bay Flows

Years 13-15

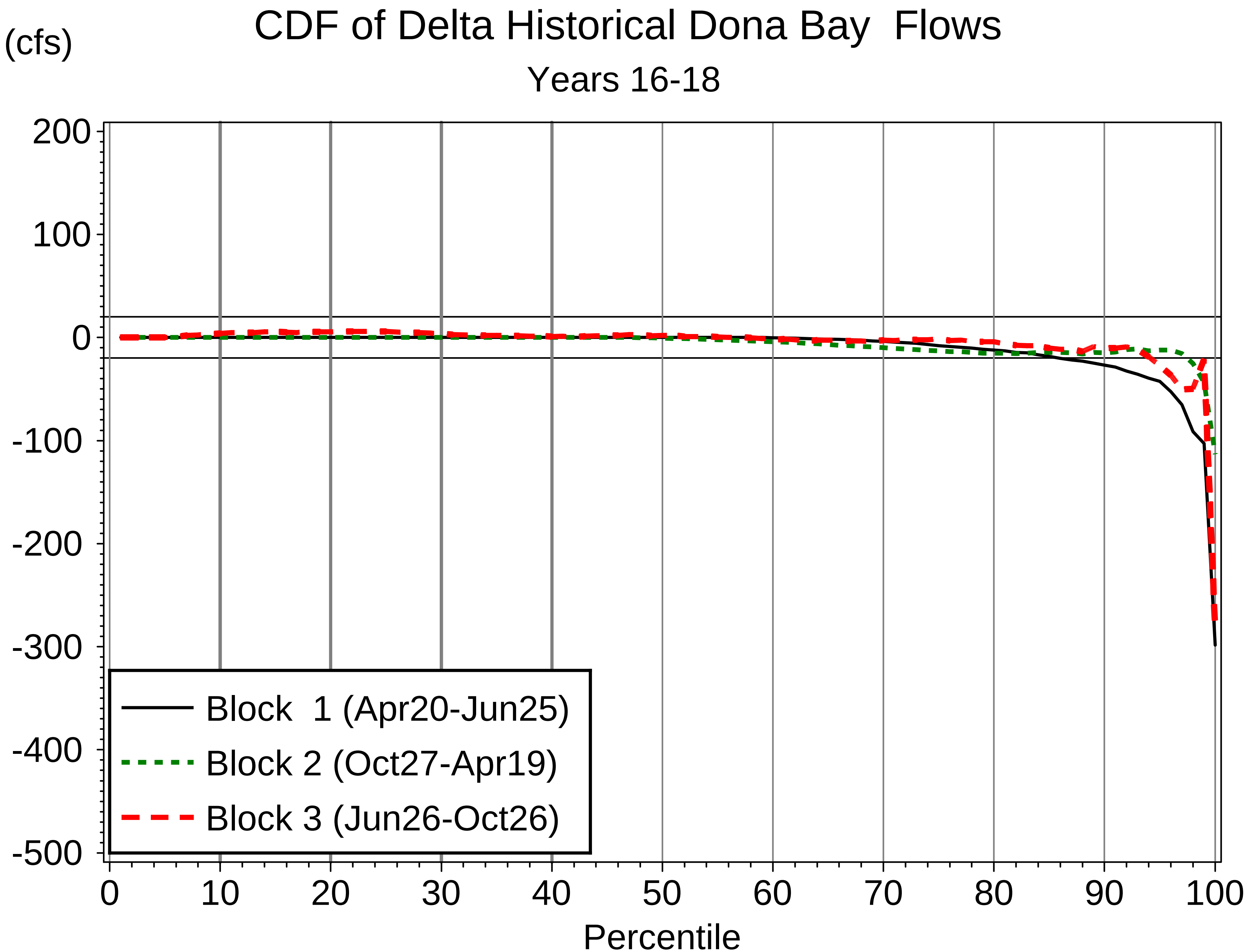




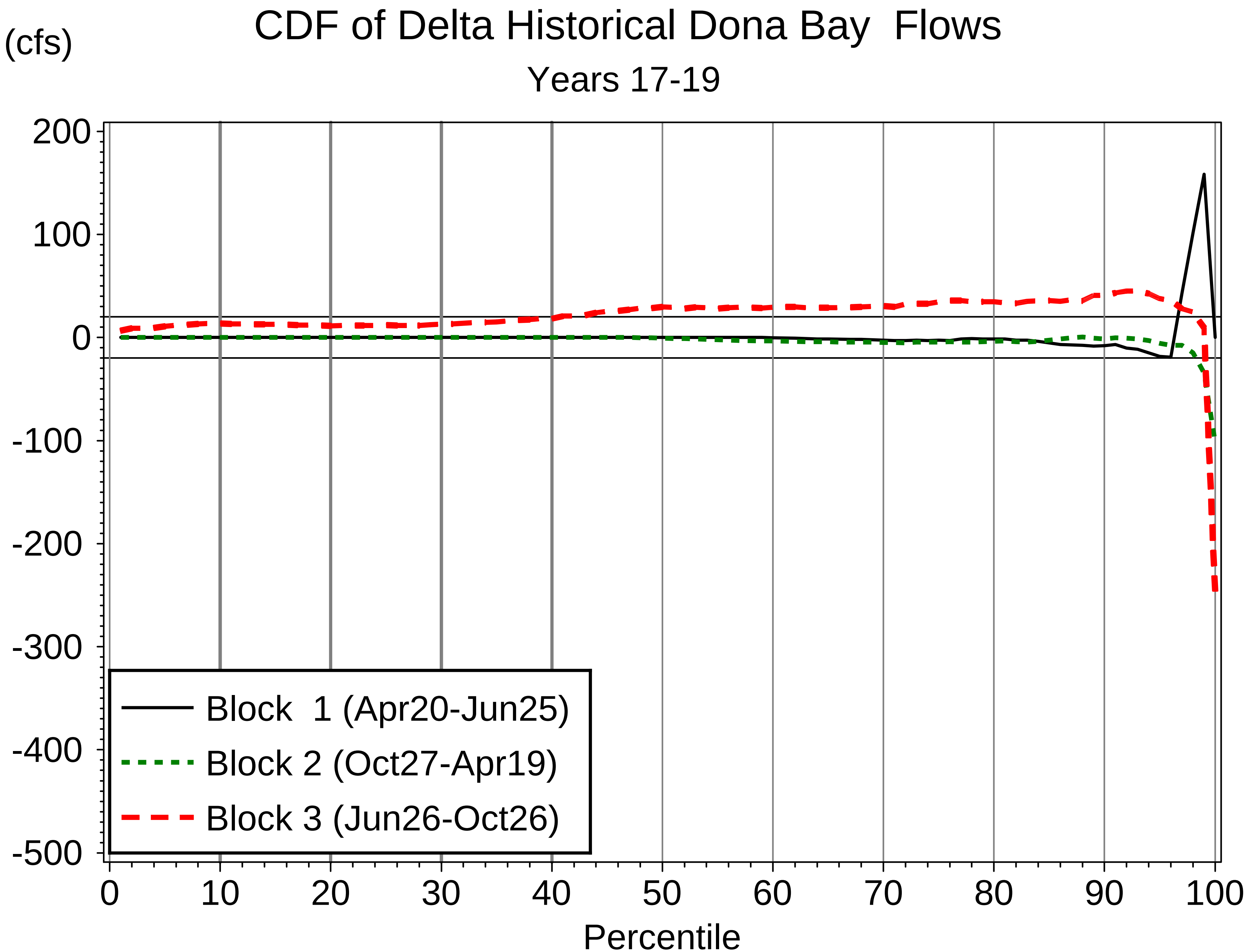
CDF of Delta Historical Dona Bay Flows
Years 14-16
(cfs)
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)

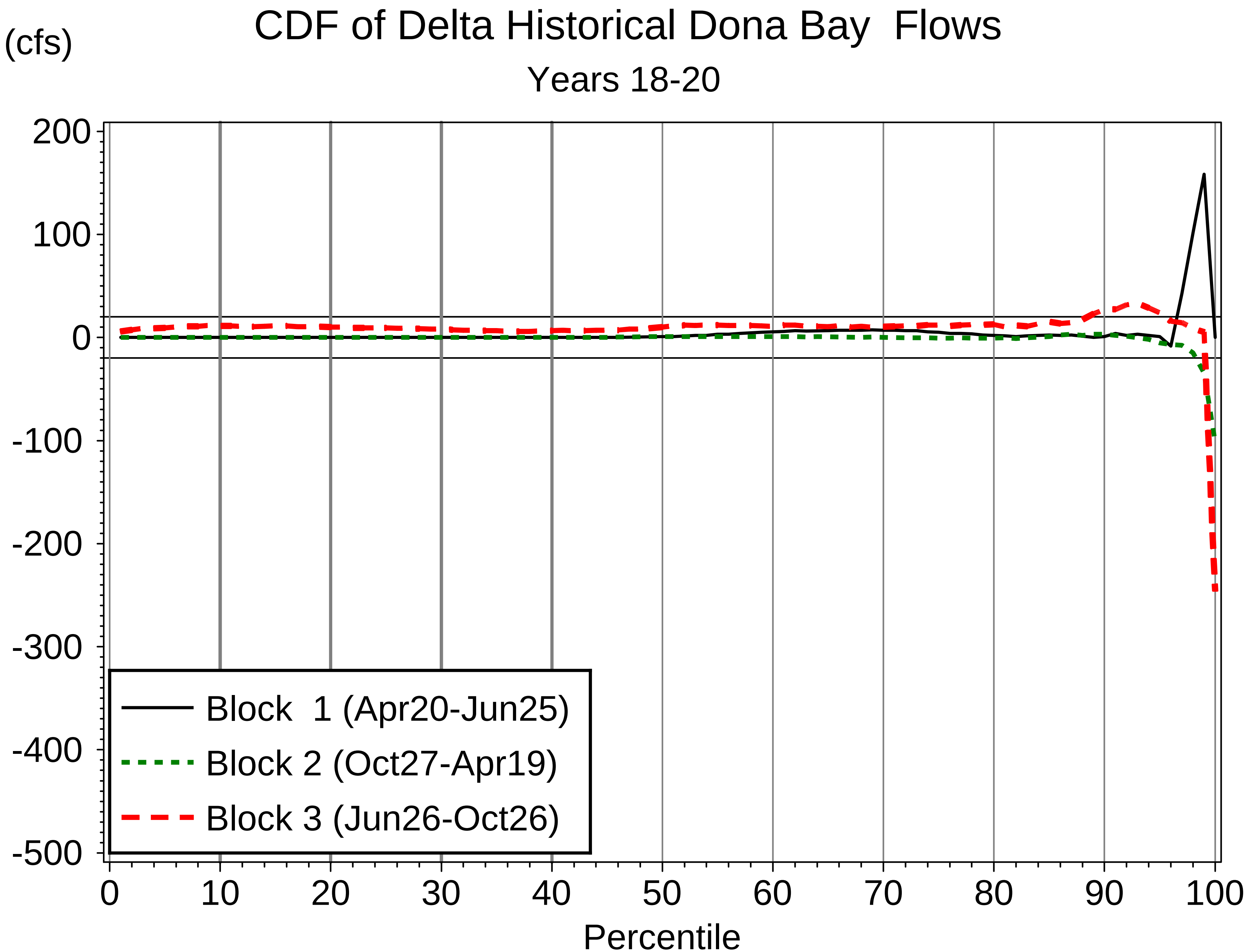


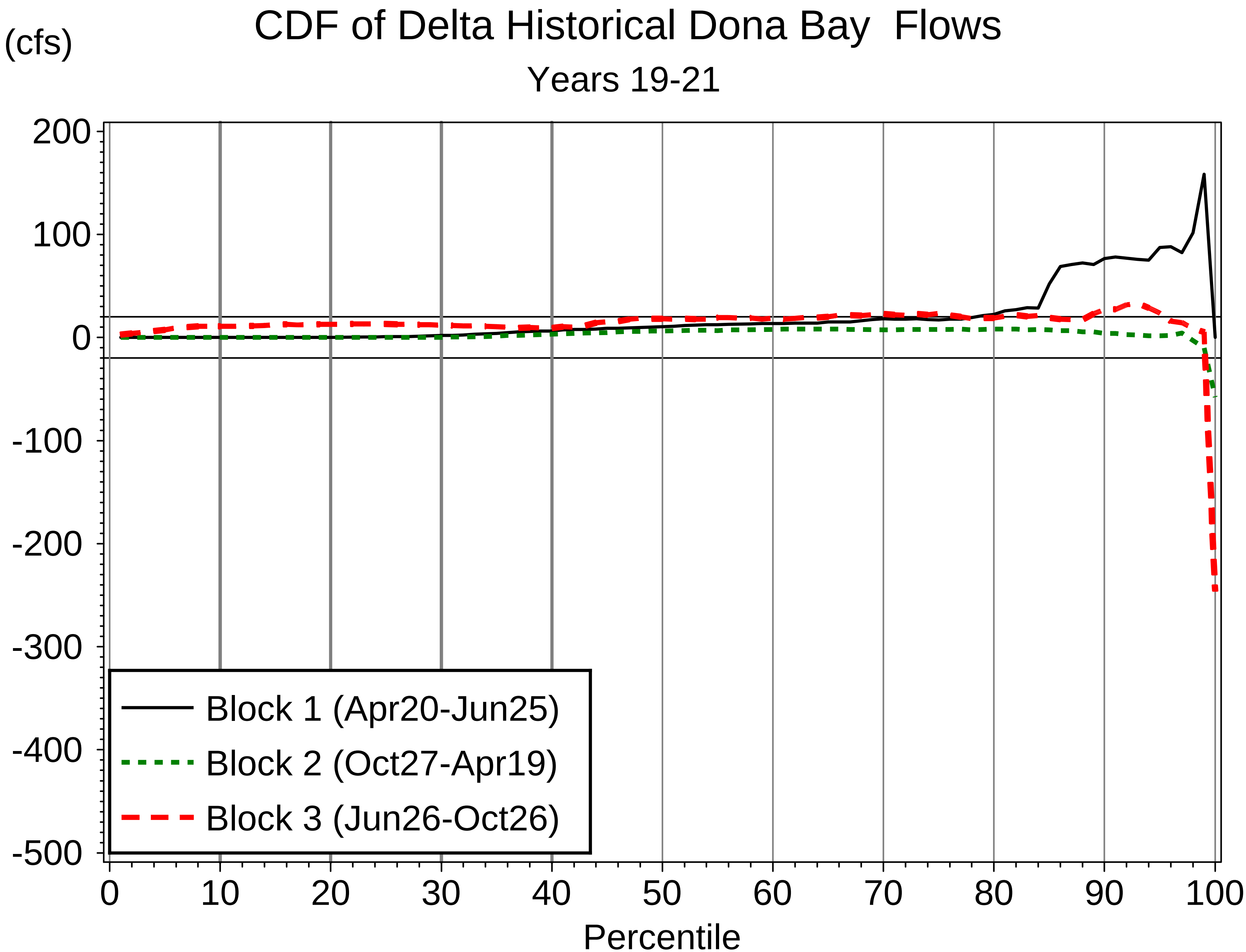
(cfs)
CDF of Delta Historical Dona Bay Flows
Years 15-17
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)



(cfs)
CDF of Delta Historical Dona Bay Flows
Years 16-18
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)


CDF of Delta Historical Dona Bay Flows
Years 17-19
(cfs)
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)


(cfs)
CDF of Delta Historical Dona Bay Flows
Years 18-20
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)


CDF of Delta Historical Dona Bay Flows
Years 19-21
(cfs)
200
100
0
-100
-200
-300
-400
-500
0
10
20
30
40
50
60
70
80
90
100
Percentile
Block 1 (Apr20-Jun25)
Block 2 (Oct27-Apr19)
Block 3 (Jun26-Oct26)