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APPLICATION OF A COUPLED HYDRODYNAMIC/ WATER COLUMN/SEDIMENT MODEL FOR THE TAR-PAMLICO RIVER, NORTH CAROLINA

TPBA0010

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CONTENTS

CONTENTS (cont.)

FIGURES

FIGURE (cont.)

Figure Page

TABLES

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1. REPORT SUMMARY

A coupled hydrodynamic/water quality model of the Tar-Pamlico River was developed for the North Carolina Department of Environmental Management (NCDEM) to assist in developing nutrient trading strategies within the basin. The calibrated water quality model will eventually be used by NCDEM to develop an effective basinwide point and non-point source nutrient reduction program that will improve water quality within the Tar-Pamlico River basin.

The stratification and destratification processes observed in the Tar-Pamlico River required the use of a time-variable coupled hydrodynamic/water quality model which is capable of representing these processes. Because the water column/sediment nutrient exchanges and sediment oxygen demand were considered important in the Tar-Pamlico River, a sediment submodel was included in the water quality modeling framework to represent these interactions. The coupled hydrodynamic/water quality model was calibrated against tidal stage and water quality data collected during 1991 and resulted in a calibrated model that represented the hydrodynamic, water column and sediment quality in the Tar-Pamlico River reasonably well. Even though the water quality models were calibrated reasonably well, certain areas of the coupled model need further refinement and should be validated against another year of data.

Preliminary water quality projections were completed as part of the Tar-Pamlico River project as an example of point and non-point source nutrient control effects on water quality. In general, the non-point source nutrient controls had a greater impact on calculated dissolved oxygen concentrations than the point source controls. These preliminary projections were based upon the currently calibrated coupled model and should be revised after further validation of the coupled model.

In general, the development of the coupled hydrodynamic/water quality model of the Tar-Pamlico River should provide the NCDEM with a reliable tool for developing preliminary basinwide nutrient control targets. The predictive capability of the water quality model to project water quality improvements is only as good as the calibration and any further validation of the water quality model would improve the reliability of nutrient reduction projections.

2. CONCLUSIONS AND RECOMMENDATIONS

A laterally averaged two-dimensional hydrodynamic/water quality model has been developed for the Tar-Pamlico River/Estuary. The water quality model was derived from the Long Island Sound and Chesapeake Bay eutrophication and sediment models and was calibrated against water quality data in the Tar-Pamlico River for 1991. The sediment model was primarily based upon the Chesapeake Bay Study calibration and refined for the Tar-Pamlico River based upon historical sediment data (early 1980's) and from calibration of the eutrophication component of the water quality model. The hydrodynamic modeling was completed using the coastal and ocean circulation model ECOM3D (Blumberg and Mellor, 1987) which was calibrated against surface elevation and salinity data in the Tar-Pamlico River for 1991.

In general, the annual interactions between the hydrodynamic circulation, nutrient loadings, phytoplankton populations, sediment fluxes and dissolved oxygen concentrations in the Tar-Pamlico River during 1991 are reasonably represented by the calibrated hydrodynamic, eutrophication and sediment models. However, certain discrepancies between the observed data and the model calculations are apparent in the hydrodynamic and water quality models which indicate a need for further refinements to the models.

2.1 CONCLUSIONS

The following conclusions were drawn from the analysis of historical data in the Tar-Pamlico River, the model calibration to the 1991 data and the preliminary projections completed as part of this study:

1. Chlorophyll levels at the mouth of the estuary, near Pamlico Point, are typically the lowest in the estuary. Upstream from Pamlico Point, chlorophyll levels increase and typically reach a maximum between Blounts Bay and Washington. In 1991, the winter median chlorophyll levels ranged from 5 to 20 μg/l and the summer levels ranged from 10 to 50 μg/l.

2. Typically, the limiting nutrient for algal growth in the estuary is nitrogen. Phosphorus may limit algal growth upstream near Washington during periods of high freshwater flow, when nitrogen concentrations are high. Median total inorganic nitrogen (TIN) concentrations in 1991 ranged from 20 to 400 μg/l during the winter and from 20 to 200 μg/l during the summer. The maximum TIN concentrations typically occur upstream where freshwater flow dominates the system. Total inorganic phosphorus (TIP) median concentrations in 1991 ranged from 50 to 100 μg/l during the winter and from 100 to 400 μg/l during the summer. Maximum TIP concentrations typically occur in the middle of the estuary primarily due to the Texasgulf industrial discharge of phosphorus mining wastes.

3. Nitrogen loads to the Tar-Pamlico River were estimated in 1991 for both point and non-point sources. The total point source nitrogen loading was approximately 1.2 million pounds which was approximately 17% of the total nitrogen load to the system. Non-point source nitrogen loads contributed approximately 83% of the total nitrogen load and were approximately 5.8 million pounds.

4. Bottom layer dissolved oxygen concentrations are less than 5 mg/l approximately 30 to 60% of the time throughout the estuary, where the larger percentages typically occur upstream. Surface layer dissolved oxygen concentrations are typically above 5 mg/l below Blounts Bay and at station 12 (near Washington) are above 5 mg/l approximately 90% of the time.

5. The low bottom layer dissolved oxygen concentrations are primarily due to salinity stratification coupled with the oxygen demand from the sediment (SOD) and algal respiration.

6. Salinity stratification is a periodic event which is highly influenced by wind conditions and to a lesser extent, freshwater flow. The duration of these stratification events is typically on a time scale of days to a week.

7. The SOD observed in the Tar-Pamlico River is primarily derived from the settling of algae and the subsequent decay of algal carbon in the sediments.

8. The preliminary nutrient reduction projections for the Tar-Pamlico River, indicate that a 50% point source nitrogen reduction will increase the bottom layer dissolved oxygen concentrations by less than 0.5 mg/l. Non-point source nutrient reductions of 25 and 50% resulted in approximately a 1.0 and 1.5 mg/l increase in bottom layer dissolved oxygen concentrations. The full impact of these reductions on dissolved oxygen concentrations appears to take approximately five years due to the storage capacity of the sediments.

2.2 RECOMMENDATIONS

In light of the conclusions drawn from this study, a number of recommendations for further investigation are presented:

1. The importance of the Tar-Pamlico River model to accurately predict the impact of nutrient loadings and future control strategies rests in the level of model calibration. Since, the models have only been calibrated against the 1991 data set, and questions concerning model geometry, stratification levels, non-point source loadings, sediment fluxes and organic carbon input are still present, additional data sets that include the annual cycle should be used to validate the model.

2. The existing data collection program, as maintained by Dr. Donald Stanley for Texasgulf Inc., should be continued or adopted by another agency to monitor the effects of nutrient loading reductions and subsequent improvement in dissolved oxygen levels.

3. In addition to the routine monitoring program currently in effect, additional data should be collected to help address the questions remaining after this study. The following additional data should be collected:

a. water column long term BOD (LTBOD),

b. non-point source loadings,

c. lateral water quality measurements,

d. measurement of the sediment fluxes of oxygen (SOD), nitrogen and phosphorus,

e. measurement of phytoplankton primary productivity and respiration,

f. measurement of zooplankton populations.

3. INTRODUCTION

Historical water quality studies of the Tar-Pamlico River system have highlighted the periodic salinity stratification and destratification events and the associated effects on bottom water dissolved oxygen levels. The causes of these phenomena are mainly related to freshwater inflow and wind conditions but the inputs of nutrients required for algal growth and oxygen demanding materials also contribute to the deoxygenation of the bottom waters. The salinity and dissolved oxygen concentrations for station 7, are presented in Figure 3-1 for the years 1987 through 1991. This station is in the middle of the estuary, Figure 4-1, and the data displays the typical patterns of salinity and dissolved oxygen stratification and destratification present in the Tar-Pamlico River. Typically, surface water dissolved oxygen levels are above 5 mg/l and are near the surface dissolved oxygen saturation concentrations. Bottom water dissolved oxygen levels, depending upon the degree of salinity stratification present, are quite often less than 5 mg/l and typically during the warmer summer months approach hypoxic conditions.

The water quality modeling of the Tar-Pamlico River system was precipitated by the requirements of the Nutrient Sensitive Waters (NSW) strategy. To quantify the cause and control of the periodic hypoxic events observed within the system, the NSW strategy required the development of a water quality model to investigate and assess the relative effects of point and non-point source nutrient loadings upon algal growth and dissolved oxygen hypoxia in the Tar-Pamlico River basin. The final goal in developing the water quality model was to provide the North Carolina Division of Environmental Management (NCDEM) with a tool to develop nutrient loading reduction targets and point and non-point source nutrient control strategies.

The water quality modeling effort consists of two components: hydrodynamic and water quality modeling. The hydrodynamic model calculates the advective and diffusive transport processes within the estuarine system which are then used to drive the water quality model calculation for a number of water quality constituents. The water quality model employed allows the calculation of important water column/sediment exchanges through the use of coupled eutrophication and sediment model.

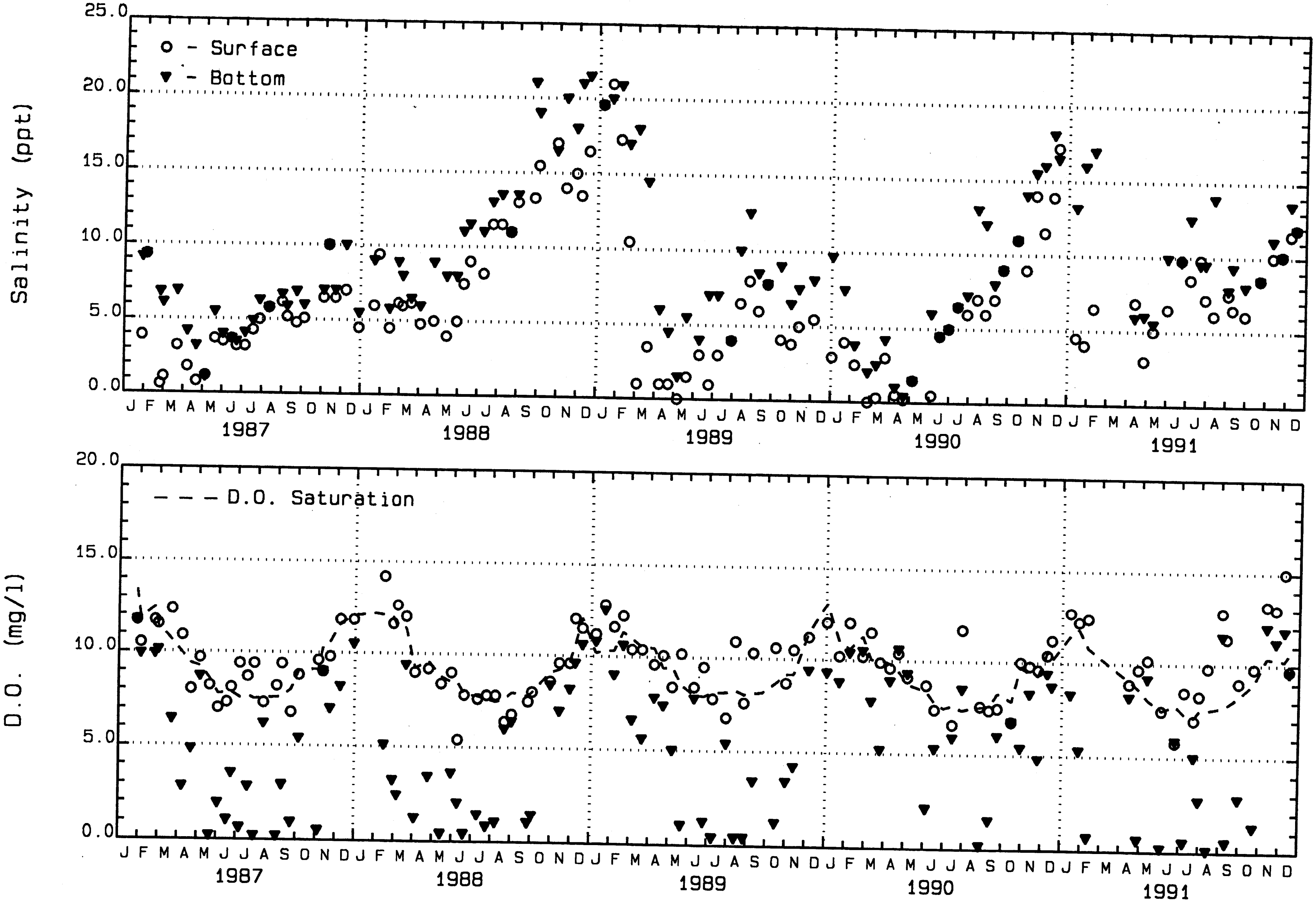

Figure 3-1. Temporal Distribution of Salinity and D.O. in the Tar-Pamlico River for Station 7 (1987-1991)

4. STUDY AREA

The Tar-Pamlico River is located in eastern North Carolina and is connected to Pamlico Sound near Pamlico Point, see Figure 4-1. The Tar River, which is upstream from Washington, has depths ranging from 8 to 20 feet (ft) and is about 300 ft wide. The Pamlico River, which is downstream from Washington, increases in width from 1000 ft at Washington to about 4 miles at the mouth near Pamlico Point. Average water depths in the Pamlico River also increase in the downstream direction from about 5 ft at Washington to 20 ft near Pamlico Point. A navigation channel is maintained in the Tar-Pamlico River by the U.S. Army Corps of Engineers from the mouth of the Tar-Pamlico River upstream to Greenville. The channel is maintained at 200 feet wide and 12 feet deep from the mouth of the Tar-Pamlico to Washington, 100 feet wide and 12 feet deep from Washington to Hardee Creek (a tributary on the Tar River) and 75 feet wide and 5 feet deep from Hardee Creek to Greenville.

The drainage area of the Tar-Pamlico River at Washington is approximately 3,100 square miles (mi^2) and increases to a total of approximately 4,300 mi^2 at the mouth near Pamlico Point. The surface area of the Tar-Pamlico River including the Pungo River is approximately 150 mi^2 and the total volume is approximately 344 billion gallons.

The mean freshwater inflow to the estuary at Washington is approximately 3,200 cubic feet per second (cfs). The main freshwater inputs to the estuary are from the Tar River upstream and several tributaries which include Chicod, Grindle, Tranters, Bath, Durham, South and Goose Creeks. Water levels in the estuary fluctuate primarily in response to wind driven currents due to the dampening of ocean tides by the Pamlico Sound. The daily water level fluctuation in the Pamlico River is only about 0.7 ft and salinities range between 0 and 20 parts per thousand (ppt) within the estuary. Despite the shallowness of the system, significant vertical density gradients, up to 10 ppt difference between surface and bottom salinities, occur during periods of high freshwater inflow or low wind conditions. These stratification events can significantly affect dissolved oxygen levels in the lower layers of the water column causing intermittent hypoxia, especially during the warmer periods of the year.

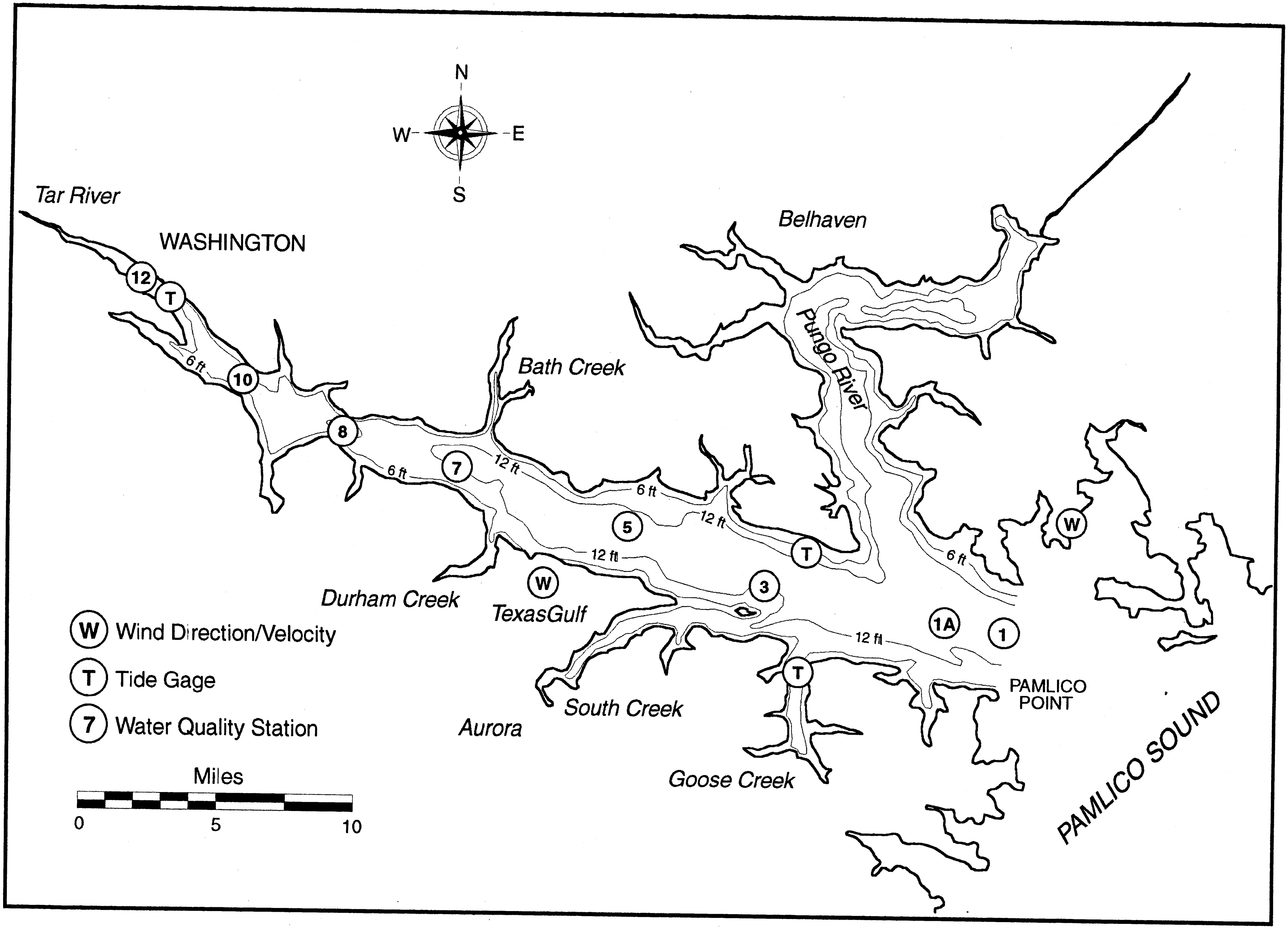

Figure 4-1. Tar Pamlico River Study Area

The Tar-Pamlico River receives loadings of nutrients, nitrogen and phosphorus, primarily from point and non-point sources. Most of the point source loadings (municipal and industrial) discharge to the Tar River above Greenville, with a few municipal and industrial loadings discharging to the Tar-Pamlico River below Greenville. The largest point source in the system is the Texasgulf Inc. industrial discharge of phosphorus from its mining operations which are located in the middle of the estuary between Durham Creek and South Creek. The non-point source loadings within the Tar-Pamlico River are more difficult to locate and primarily originate from a number of sources: forested land, harvested agricultural cropland, nonforested farmland, pastureland, farm animals, urban land and all other land areas (Stanley, 1993).

The nitrogen and phosphorus loadings from these sources are available for algal growth and therefore affect the eutrophication of the Tar-Pamlico River. Observations of nitrogen and phosphorus concentrations within the estuary and results of previous estuarine studies indicate that for a large area of the estuary during most of the year, algal growth is limited by nitrogen. The magnitude of these point and non-point source loadings of nitrogen depend upon the time of year. Typically during the winter and spring when freshwater flows and point source dilution are the greatest, non-point sources loadings are the dominant source. During summer and fall, when freshwater flows are low and runoff is minimal, the significance of the point source loadings increases.

5. MODELING FRAMEWORK

5.1 HYDRODYNAMIC MODEL

The movement and mixing of waste materials introduced to the marine environment are controlled by the circulation characteristics of the particular body of water. To predict the circulation characteristics, one must define the hydrodynamic transport processes as forced by various hydrographical (runoff), meteorological (surface wind, heating/cooling), adjacent open ocean (large scale ocean circulation offshore), and astronomical mechanisms. In recent years, hydrodynamic models have come to be relied upon to provide the necessary ingredients, namely the currents and dispersions, for use in water quality analyses.

The hydrodynamic modeling framework is based upon the time-dependent, three-dimensional estuarine, coastal and ocean circulation model (ECOM-3D) developed by Blumberg and Mellor (1980, 1987) and Blumberg and Herring (1987). ECOM-3D solves prognostic equations for free surface elevation, velocity components, temperature, salinity, turbulence energy and turbulence macroscale. The vertical turbulent mixing processes are parameterized using the turbulent closure submodel of Mellor and Yamada (1982). This submodel contains non-dimensional empirical constants that are fixed by reference to laboratory data and are independent of particular hydrodynamic model applications. ECOM-3D also incorporates an σ-coordinate system such that the number of grid points in the vertical is independent of depth so that the dynamically important surface and bottom boundary layers across a sloping region can be adequately resolved. The last model feature to note is the use of a curvilinear coordinate system, greatly increasing model efficiency in treating irrregularly shaped coastlines and meeting requirements for high resolution in specific local regions. The model incorporates detailed features of the bathymetry and shoreline and includes: freshwater run-off, surface wind stress, surface heat flux, temperature and salinity profiles at the edges of the modeled region as time-dependent forcing boundary conditions, and, therefore, includes the entire spectrum of factors determining the three-dimensional estuarine circulation. A complete description of the governing equations and numerical techniques can be found in Blumberg and Mellor (1987). The model has been used in over 30 studies, the results of which have appeared in the referred literature and is being exercised in an operational forecasting mode for the Great Lakes and the Norwegian coastal waters. A detailed presentation of the model equations can be found in the ECOM-3D users manual (HydroQual, 1992).

The presence of lateral salinity gradients have been observed in the Pamlico River, with the higher salinities found on the northern side of the estuary. However, longitudinal and vertical salinity gradients in the estuary are much more important in driving the two-layer estuarine circulation pattern, with denser, saltier water flowing upstream in the lower layer and fresher water flowing toward the estuary mouth in the upper portion of the water column. A valid approximation to the full three-dimensional equations of motion in this case is the two-dimensional, laterally-averaged equations, which neglect lateral velocities and gradients. This type of model approximates the geometry of the estuary as a rectangular channel with the water column divided into a number of layers in the vertical. Examination of Tar Pamlico River bathymetry indicates that a typical cross-section can be approximated by a rectangular channel reasonably well, see Figure 4-1.

5.2 WATER QUALITY MODEL

The eutrophication modeling framework employed for the Tar-Pamlico River system was developed during the Long Island Sound (HydroQual, Inc. 1991) and Chesapeake Bay (HydroQual, Inc. 1987, 1989) modeling studies. Modeling the exchanges of nutrients and oxygen between the water column and the sediment was accomplished through the use of the sediment model developed during the Chesapeake Bay modeling study (HydroQual, Inc. 1993). The estuarine transport processes for the system are obtained from the hydrodynamic model (ECOM3D) which is briefly described in Section 5.1. A detailed description of the eutrophication model is included in Appendix 9.1, which was derived from the theory section developed during the Long Island Sound Study. Sediment model development and calibration are presented in the HydroQual, Inc. 1993 report for the United States Corps of Engineers entitled "Chesapeake Bay Sediment Flux Model". The remainder of this section contains a general description of the eutrophication and sediment model frameworks employed in this study.

The eutrophication model includes the modeling of two phytoplankton groups (winter and summer assemblages), salinity, dissolved oxygen, and the various organic and inorganic forms of nitrogen, phosphorus, silica and carbon. The diagram presented in Figure 5-1, presents the various kinetic pathways involved in the modeling framework. A brief description of the 25 state variables and their various kinetic pathways is described below. The calibration constants developed during the Tar-Pamlico modeling study are tabulated along with the detailed kinetic discussion in Appendix 9.1.

5.2.1 Phytoplankton - Winter and Summer Functional Groups

The eutrophication model includes two algal groups, a winter and summer population. The basic kinetics affecting phytoplankton growth and death are identical for the two groups, with the distinction in the growth kinetic constants assigned for each group. Phytoplankton growth is dependent upon temperature, ambient light and nutrient levels which modify the maximum growth rate to ambient conditions. The growth rates of the two algal groups are controlled through the use of temperature optimums that maximize growth at a certain temperature and decrease growth above and below this temperature. In this manner, the winter and summer algal groups were allowed to peak in growth at different times of the year or within different temperature regimes. Ambient surface light conditions are input externally and are reduced with depth as a function of measured light extinction coefficients. The surface light conditions are either based upon ambient measurements or calculated from percent cloud cover data. Algal growth is further decreased when the ambient nutrients (phosphorus, nitrogen and silica) approach a limiting concentration. A nutrient limitation factor, defined in Appendix 9.1, is calculated for phosphorus, nitrogen and silica with the minimum factor chosen to adjust the growth rate. The ambient growth rate, which is adjusted for temperature, light and nutrient limitations, is then used to determine the oxygen produced through photosynthesis during growth.

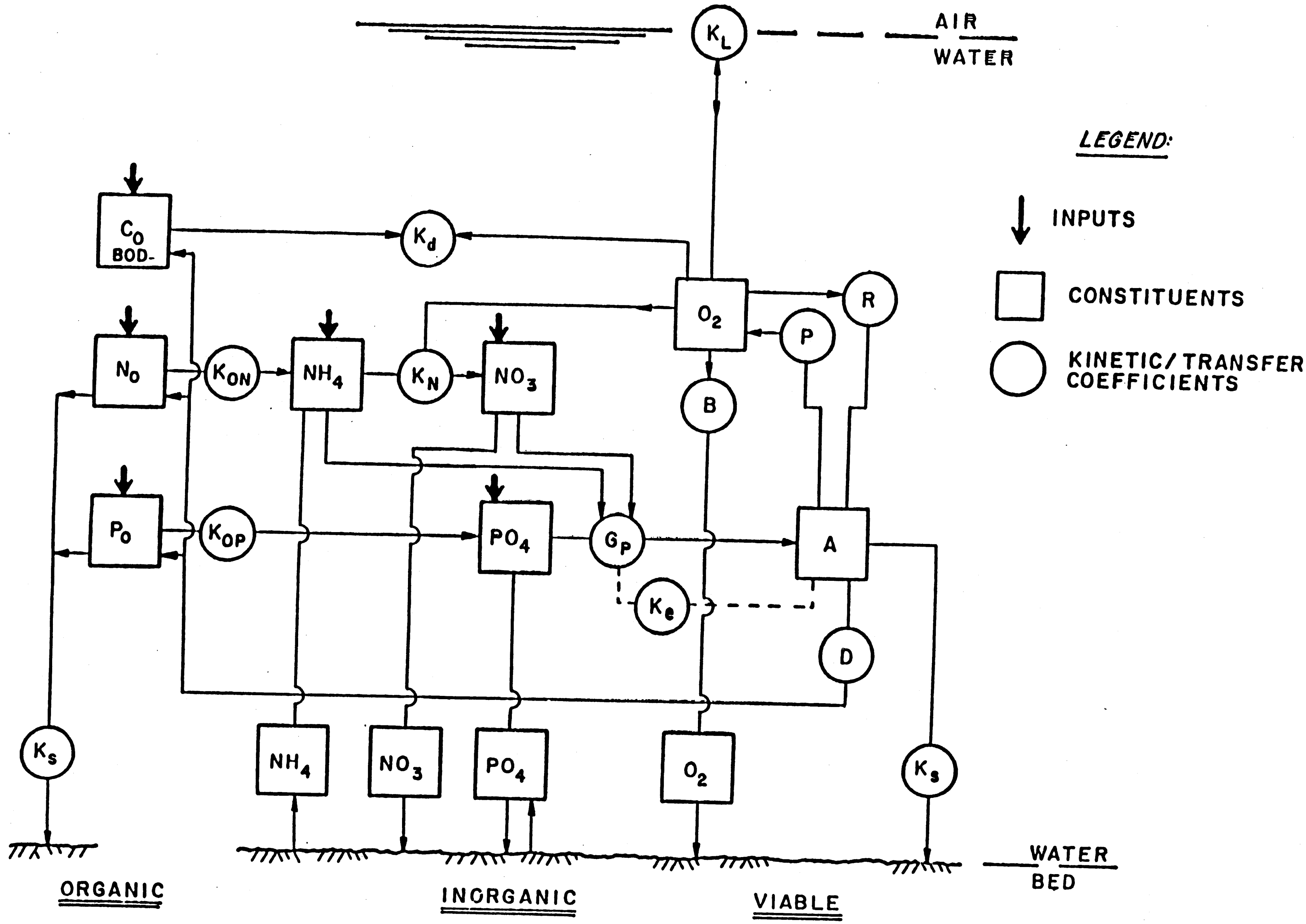

Figure 5-1. Water Quality Model Phytoplankton Kinetics

The loss of biomass from the water column through respiration, zooplankton grazing and settling are identical for the two algal groups. The respiration formulation for each algal group allows the respiration to vary as a fraction of the temperature corrected growth rate above a minimum basal respiration rate. During respiration, dissolved oxygen is consumed and nutrients are recycled to the phosphorus, nitrogen and silica systems. Zooplankton grazing is accounted for through a temperature dependent decay rate and recycles nutrients and carbon. Algal settling to the sediment is a temperature dependent process and is increased as the nutrient limitation factor decreases (nutrient stressed settling).

5.2.2 Phosphorus

Particulate and dissolved organic phosphorus forms are included in the model with further distinctions based upon reactivity. The reactivity distinctions are based upon the relative decay rates for the organics. A labile fraction accounts for organic material that decays on a time scale of several weeks to a month or two, while the refractory fraction accounts for decay processes on a time scale of months to a year. The labile fractions decay primarily in the water column or else rapidly in the sediments while the refractory components are mainly decomposed in the sediments. The inorganic form of phosphorus, orthophosphate (PO_4), is also modeled for a total of five state variables for phosphorus, as tabulated in Table 5-1.

Table 5-1. Phosphorus State Variables

Refractory Particulate Organic Phosphorus	(RPOP)
Labile Particulate Organic Phosphorus	(LPOP)
Refractory Dissolved Organic Phosphorus	(RDOP)
Labile Dissolved Organic Phosphorus	(LDOP)
Orthophosphate	(PO_4)

Particulate organic phosphorus, whether refractory or labile, decomposes to dissolved organic phosphorus through hydrolysis which is a temperature and bacterial biomass mediated reaction. The size of the bacterial population involved in decomposing organic compounds in the water column affects the rate at which this process occurs. Because, bacterial biomass is not directly modeled, algal biomass is used as a surrogate tracking variable for computational purposes. The particulate fraction of organic phosphorus settles at a temperature dependent rate within the water column and is deposited to the sediment where it is further decomposed through anaerobic processes. The dissolved form of organic phosphorus further decomposes through mineralization into the inorganic form of phosphorus (PO_4) which is affected by the same factors controlling hydrolysis. Inorganic phosphorus (PO_4) is lost through the utilization by algae as a nutrient essential for growth and is supplied from or lost to the sediment. All forms of phosphorus, organic and inorganic, are supplied as a consequence of algal respiration and zooplankton grazing which is termed algal nutrient recycle. Inputs of organic and inorganic phosphorus from the atmosphere, boundaries, tributaries, non-point and point sources are also accounted for in the modeling framework.

5.2.3 Nitrogen

The organic nitrogen state variables are divided into the same four components as organic phosphorus with the addition of the two inorganic forms of nitrogen: ammonia (NH_3) and nitrite plus nitrate (NO_3). A total of six state variables are include for nitrogen as tabulated in Table 5-2.

Table 5-2. Nitrogen State Variables	
Refractory Particulate Organic Nitrogen	(RPON)
Labile Particulate Organic Nitrogen	(LPON)
Refractory Dissolved Organic Nitrogen	(RDON)
Labile Dissolved Organic Nitrogen	(LDON)
Ammonia	(NH_3)
Nitrite plus Nitrate	(NO_3)

The particulate and dissolved forms of nitrogen decompose through the same reaction pathways as phosphorus with the particulate fractions settling to the sediment. The dissolved organic forms mineralize to ammonia which is subsequently nitrified to nitrite and nitrate in which dissolved oxygen is consumed. Nitrification is an aerobic reaction and therefore the reaction decreases as dissolved oxygen concentrations decrease below a certain value. The nitrification reaction is therefore dependent upon water column dissolved oxygen concentrations and also upon temperature. The denitrification of nitrate to nitrogen gas is an anaerobic reaction and is also dependent upon water column dissolved oxygen concentrations and temperature. Ammonia and nitrite plus nitrate are utilized by algae as nutrients for growth with ammonia being the preferred nutrient. An ammonia preference scheme for determining ammonia or nitrite plus nitrate preference at varying concentrations is presented in Appendix 9.1. Algal nutrient recycle replenishes the four organic forms and ammonia during algal respiration and zooplankton grazing. Sediment fluxes of ammonia and nitrate are either a source or sink of these nutrients in the water column. External inputs of all forms of nitrogen are also accounted for within the model.

5.2.4 Carbon

Organic carbon is divided into the same groups as organic nitrogen and phosphorus with two additional state variables. The inputs of highly reactive dissolved organic material, such as carbonaceous inputs associated with sewage treatment plants or combined sewer outfalls which decay on a time scale of days to a week or two, is classified as reactive dissolved organic carbon. Excretion of dissolved organic carbon by phytoplankton during photosynthesis is included as the state variable algal exudate, and decays on a time scale similar to reactive dissolved organic carbon. The six state variables described for carbon are tabulated in Table 5-3.

Table 5-3. Carbon State Variables	
Refractory Particulate Organic Carbon	(RPOC)
Labile Particulate Organic Carbon	(LPOC)
Refractory Dissolved Organic Carbon	(RDOC)
Labile Dissolved Organic Carbon	(LDOC)
Reactive Dissolved Organic Carbon	(REDOC)
Algal Exudate Dissolved Organic Carbon	(EXDOC)

The particulate and dissolved forms of carbon decompose through the same reaction pathways as phosphorus and nitrogen with the particulate fractions settling to the sediment. The dissolved forms of carbon oxidize to carbon dioxide and utilize dissolved oxygen during the process. Oxidation of dissolved organic carbon is aerobic and is therefore reduced at low water column dissolved oxygen concentrations. The oxidation process is also modified for temperature and bacterial biomass levels, which are indirectly represented by algal biomass. Algal recycle due to zooplankton grazing is a source for refractory particulate and dissolved organic carbon and for labile particulate and dissolved organic carbon. External inputs of organic carbon are also included in the modeling framework.

5.2.5 Silica

Two silica forms are included in the model: particulate biogenic silica, which is unavailable for algal growth and silica which is available for algal growth. Particulate biogenic silica is mineralized to available silica at a temperature and bacterial biomass dependent rate and can also settle to the sediment. Available silica is utilized as a nutrient during algal growth and interacts with the sediment through silica fluxes. Algal recycle supplies the particulate biogenic silica system through algal respiration and zooplankton grazing. The two state variables for silica are tabulated in Table 5-4.

Table 5-4. Silica State Variables	
Biogenic Silica - Unavailable	(BSI)
Silica - Available	(SI)

5.2.6 Dissolved Oxygen

Dissolved oxygen is affected through the nitrification of ammonia, denitrification of nitrate, oxidation of dissolved organic carbon, algal oxygen production and respiration, sediment oxygen demand (SOD) and atmospheric reaeration. The sediment oxygen demand is calculated within the sediment model as an end product of carbon diagenesis and supplied to the water quality model. Aqueous SOD or the oxygen demanding equivalents associated with sediment sulfide production, is included as an additional state variable (O2EQ). It is coupled with the sediment oxygen demand and is produced at low water column dissolved oxygen levels when the sediment oxidation of sulfide (SOD) is reduced. The aqueous SOD produced is fluxed into the water column and oxidized when water column dissolved oxygen levels increase. Dissolved oxygen saturation is computed from water column temperature, an external input, and from salinity, which is modeled as a separate state variable. The dissolved oxygen effects due to algal photosynthesis and respiration are briefly described in Section 5.2.1.

5.2.7 Sediment Model

The sediment model framework described in this section is a brief description of the processes that affect sediment nutrient fluxes and sediment oxygen demand (SOD). A more detailed discussion is found in the report documenting the development and calibration of the Chesapeake Bay Sediment Flux Model (HydroQual, Inc. 1993). A sediment diagram is presented in Figure 5-2 which highlights the general interactions occurring in the sediment. The sediment model is formulated with two compartments, an aerobic and anaerobic sediment layer, and uses the settling fluxes from the eutrophication model as inputs. Particulate organic matter (POM), detrital or algal nitrogen, phosphorus, silica and carbon, settles through the water column and is deposited to the sediment. This settling of POM is the driving force behind the various decay mechanisms occurring in the sediment. The POM that settles into the sediment is classified into three reactivity classes referenced G1, G2 and G3. The G1 component is the most reactive with a half-life of about 20 days. The G2 component has a half-life of about one year and the G3

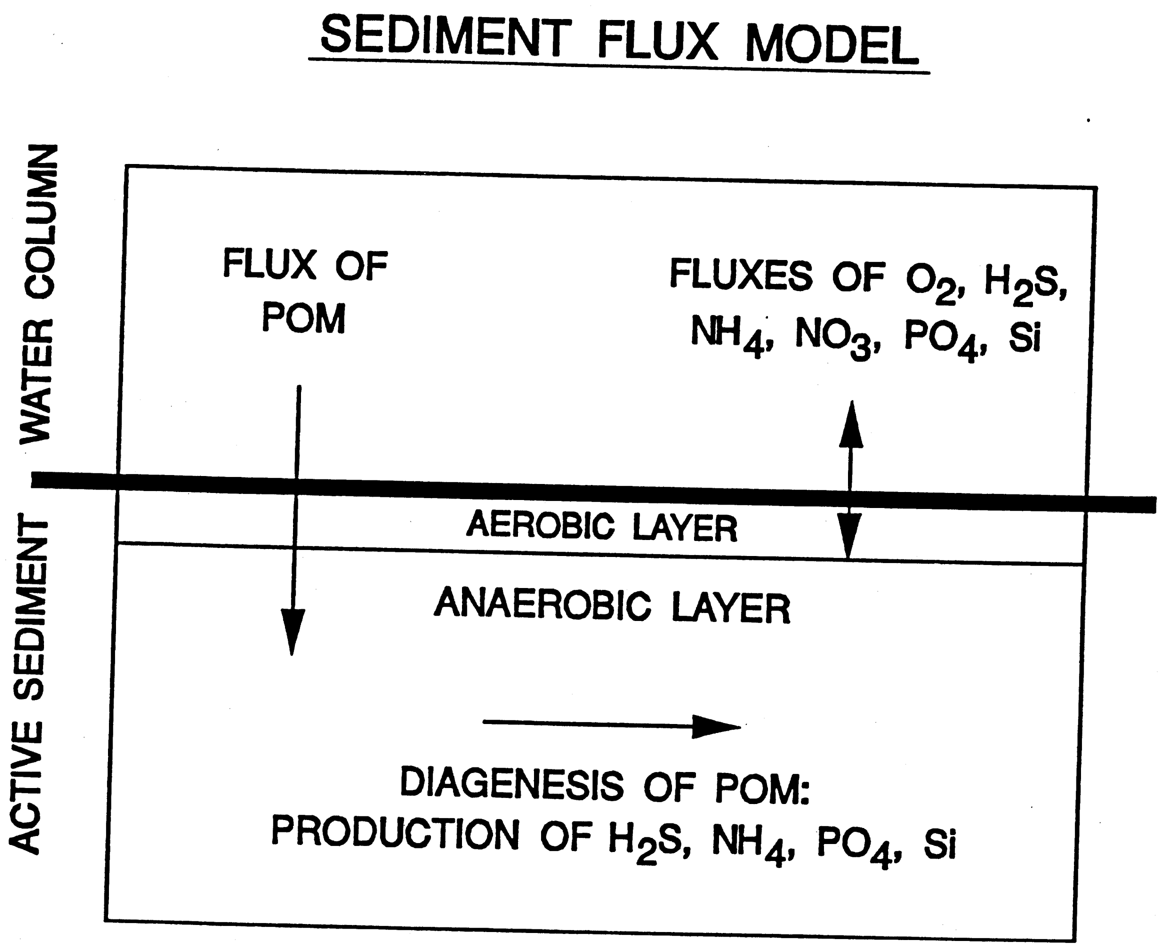

Figure 5-2. Water Quality Model Sediment Kinetics

component is basically non-reactive in the current model calibration. Once POM settles to the sediment, it can either decompose through diagenesis to the various end products of nitrogen, phosphorus, carbon and silica or become buried in the sediments. The particulate organic nitrogen, phosphorus and silica that settle to the sediment eventually decompose following various temperature dependent kinetic pathways into their associated inorganic forms: ammonia, orthophosphate, and available silica. Depending upon overlying water dissolved oxygen concentrations and the water column/sediment dissolved concentration gradients, ammonia, orthophosphate and available silica can either flux out of or into the sediments. The temperature dependent decomposition of particulate organic carbon in the sediment results in the formation of sulfide. Depending upon the overlying water column dissolved oxygen concentration, the sulfide is either oxidized in the sediment (SOD) or fluxed into the water column at low dissolved oxygen levels as oxygen demanding equivalents or aqueous SOD (O2EQ). In addition to the carbon component of the SOD, the nitrification of ammonia to nitrate consumes oxygen and therefore is also included in the calculation of the total SOD.

This simplified description of the sediment model should not detract from the importance of sediment processes in the context of an estuarine system like the Tar-Pamlico River. The nutrient fluxes into the water column can be a significant source of nutrients needed for algal growth and for the sediment oxygen demand, a significant source of deoxygenation potential. Also, the storage capacity of POM in the sediments during the cooler fall and winter seasons, plays a vital role in the cycling of nutrients back into the water column during the warmer spring and summer months. In general, the inclusion of the sediment in the modeling framework greatly improves the ability to predict the dynamics of the estuary over the course of a year.

6. HYDRODYNAMIC MODEL CALIBRATION

6.1 GRID SELECTION

The laterally-averaged hydrodynamic model was developed for a 55 mile reach of the Tar Pamlico River, extending from Greenville to Pamlico Point including the Pungo River. A total of 56 numerical grid elements were used to discretize the study area in the horizontal plane, with a grid spacing of about 1.25 miles, depending upon local bathymetry and geometry, see Figures 6-1 and 6-2. Eight sigma layers were used in the vertical. The depth assigned to each grid element was the laterally-averaged depth at that particular cross-section. The variation of laterally-averaged depth throughout the estuary is shown on Figure 6-3.

6.2 MODEL FORCING DATA

The hydrodynamic model requires five types of boundary condition data: freshwater inflow, water surface elevation, salinity, temperature and wind direction/velocity. The nearest U.S. Geological Survey (USGS) stream gauging station on the Tar River is located at Tarboro, which has a drainage area of 2,200 mi^2. Daily average flow rates are measured by USGS at the Tarboro station. To specify the flow rate at Greenville, the upstream limit of the model domain, drainage area proration of flows measured at Tarboro was used. The drainage area increases by 20 percent between Tarboro and Greenville, so measured flow rates at Tarboro were multiplied by 1.20 to estimate the flow rate at Greenville. Seven ungauged tributaries flow into the Tar Pamlico estuary downstream of Greenville. The assumption has been made in this study that the same drainage area proration applied at Greenville can be used for these tributaries. Therefore, all tributary inflows are proportional to the flow at Tarboro. These proportionality constants are presented in Table 6-1.

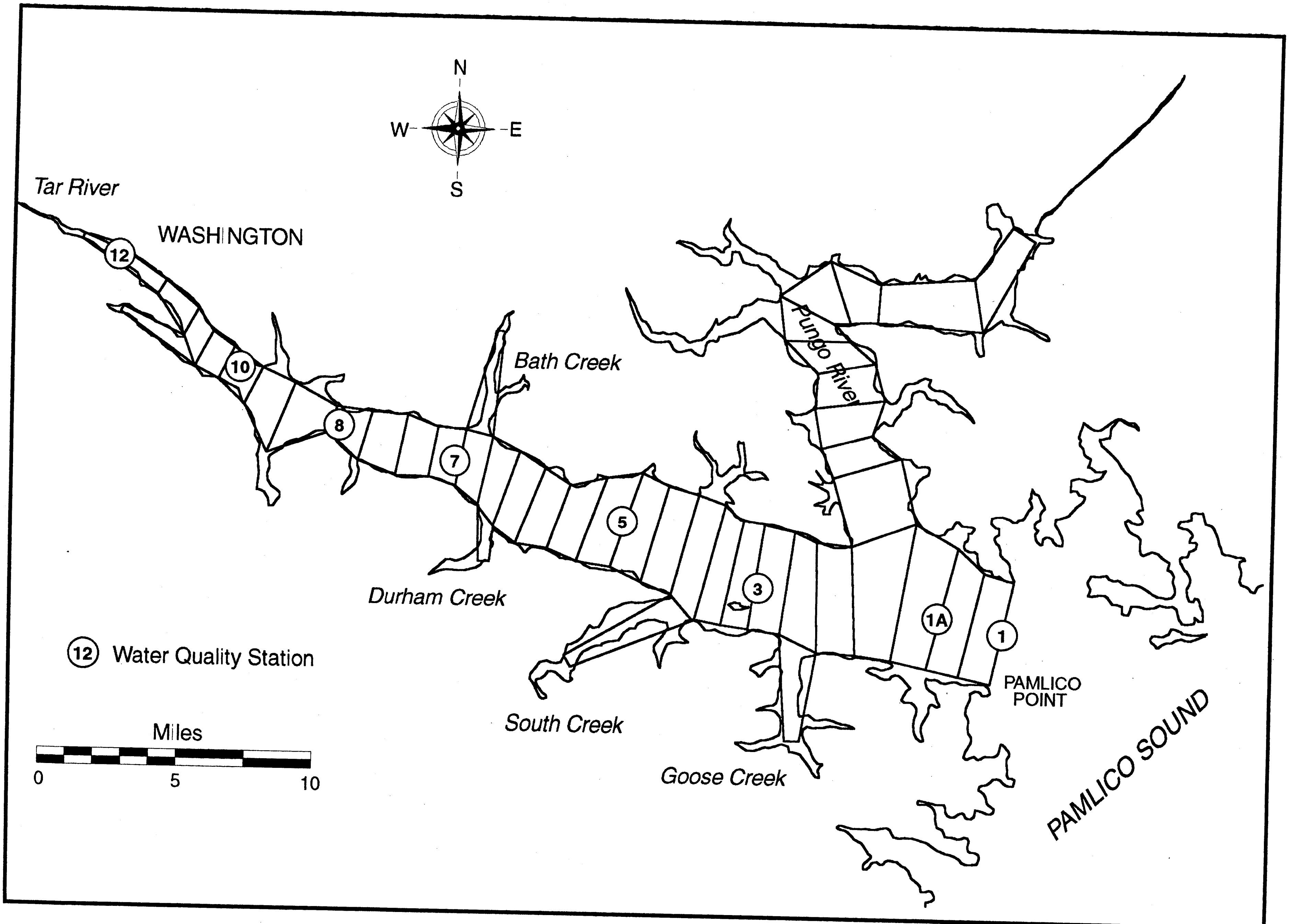

Figure 6-1. Pamlico River Model Segmentation

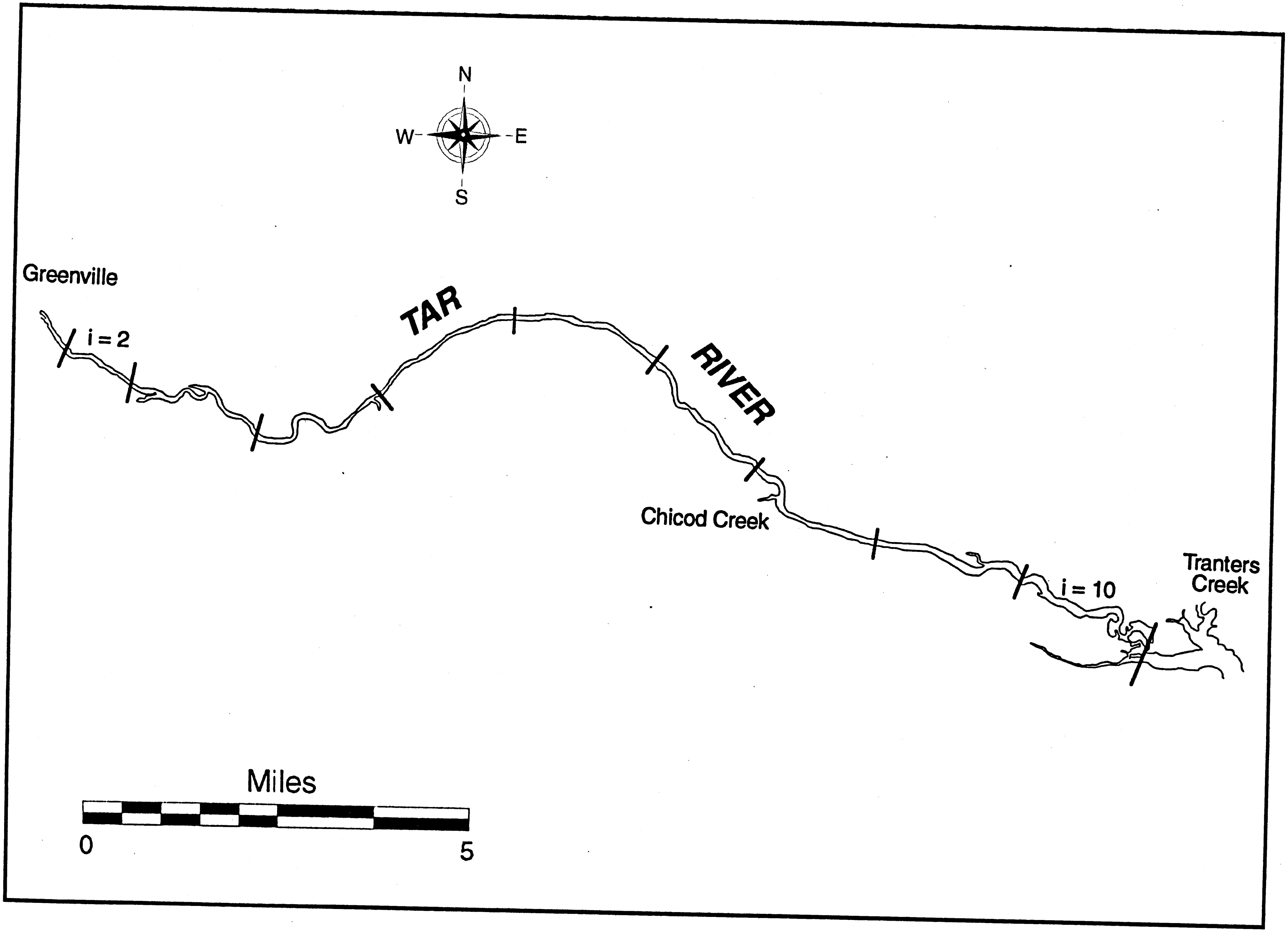

Figure 6-2. Tar River Model Segmentation

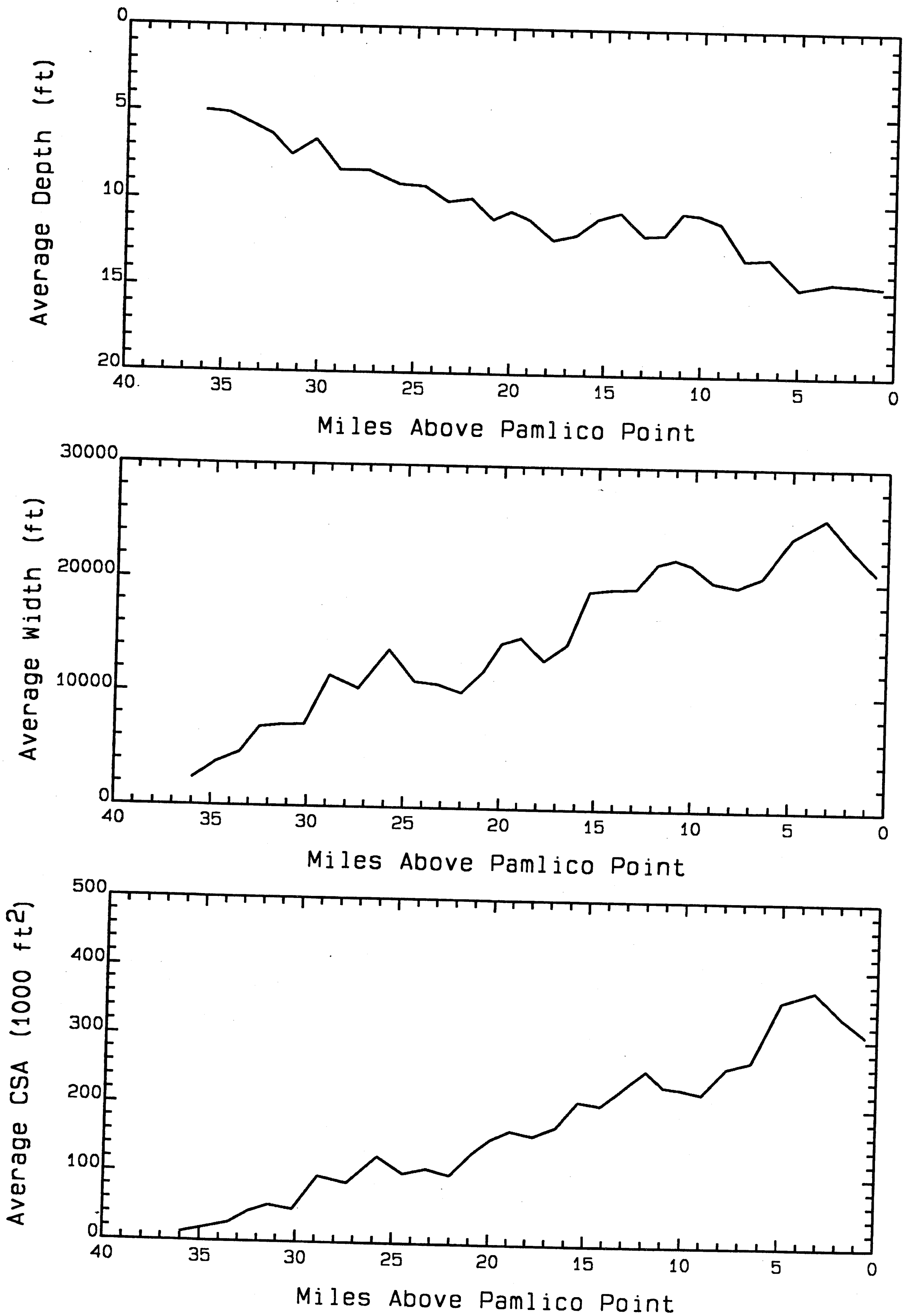

Figure 6-3. Tar Pamlico River Model Geometry

TABLE 6-1. TRIBUTARY FLOW RATE MULTIPLIERS	
Tributary	Multiplier of Tarboro Flow Rate
Grindle Creek	0.06
Chicod Creek	0.05
Tranters Creek	0.10
Bath Creek	0.14
Durham Creek	0.14
South Creek	0.14
Goose Creek	0.14

Water surface elevation must be specified at the downstream limit of the numerical grid, which is located at Pamlico Point. The nearest tidal gauges are located on the north (Pamlico Beach) and south (Goose Creek) sides of the estuary, see Figure 4-1. The USGS operates these tide gauges and measurements are made every 15 minutes. The assumption has been made that the effective water surface elevation at this cross-section is the average of the Pamlico Beach and Goose Creek observations. Once the observed elevations have been averaged, a phase shift must be used to account for the distance between the tide gauge locations and Pamlico Point, which is approximately 7.5 miles. Modeling analyses indicated that a 40 minute phase shift produced the best results; elevations at Pamlico Point are specified 40 minutes earlier than the measured elevations.

Surface and bottom salinity measurements obtained at either water quality station 1 or 1A (Figure 6-1) were used to specify the vertical salinity distribution at the Pamlico Point open boundary. The observations at these stations have been collected infrequently, with only ten measurements being made in 1991. Thus, linear interpolation between observations was used to temporally vary the salinity boundary conditions at Pamlico Point. Salinity was set to zero at all freshwater inflows. Since vertical stratification due to temperature variations is negligible in this estuary, temperature was specified as vertically constant at all boundaries. Temperature was allowed to vary temporally using the interpolation procedure applied to salinity but the same temperature was applied to all boundaries at a particular time.

Wind speed and direction were specified using hourly wind data collected at the Texasgulf plant, see Figure 4-1. Wind direction had to be converted for proper grid orientation using the following formula:

$$\theta_M = \begin{cases} 340^o + \theta_W \quad , & 0^o \leq \theta_W < 20^o \\ \theta_W - 20^o, \quad , & 20^o \leq \theta_W < 360^o \end{cases} \qquad (1)$$

where θ_M is the converted model wind direction and θ_W is the measured wind direction with respect to North.

6.3 DESCRIPTION OF CALIBRATION PERIOD

A one-year period, 1991, was used to calibrate and validate the hydrodynamic model. Surface elevation and salinity data collected within the Tar Pamlico estuary during that period were used to assess the performance of the model. The daily average flow rates measured at Tarboro during 1991 are illustrated on Figure 6-4. The average flow rate at Tarboro during this year was 1,240 cfs which corresponds to an annual average freshwater inflow to the Tar Pamlico estuary of 2,440 cfs. Six relatively high flow events, with maximum flow rates greater than 3000 cfs at Tarboro, occurred during 1991. Variations in the wind stress, determined from measured wind velocities, during 1991 are also shown on Figure 6-4. Significant wind events, i.e., greater than 1 dyne/cm^2 which corresponds to a velocity of approximately 18 knots, occur about once every two weeks. Observed tidal elevations, representing the average of the Pamlico Beach and Goose Creek tide gauge measurements, during the calibration period are shown on Figure 6-5.

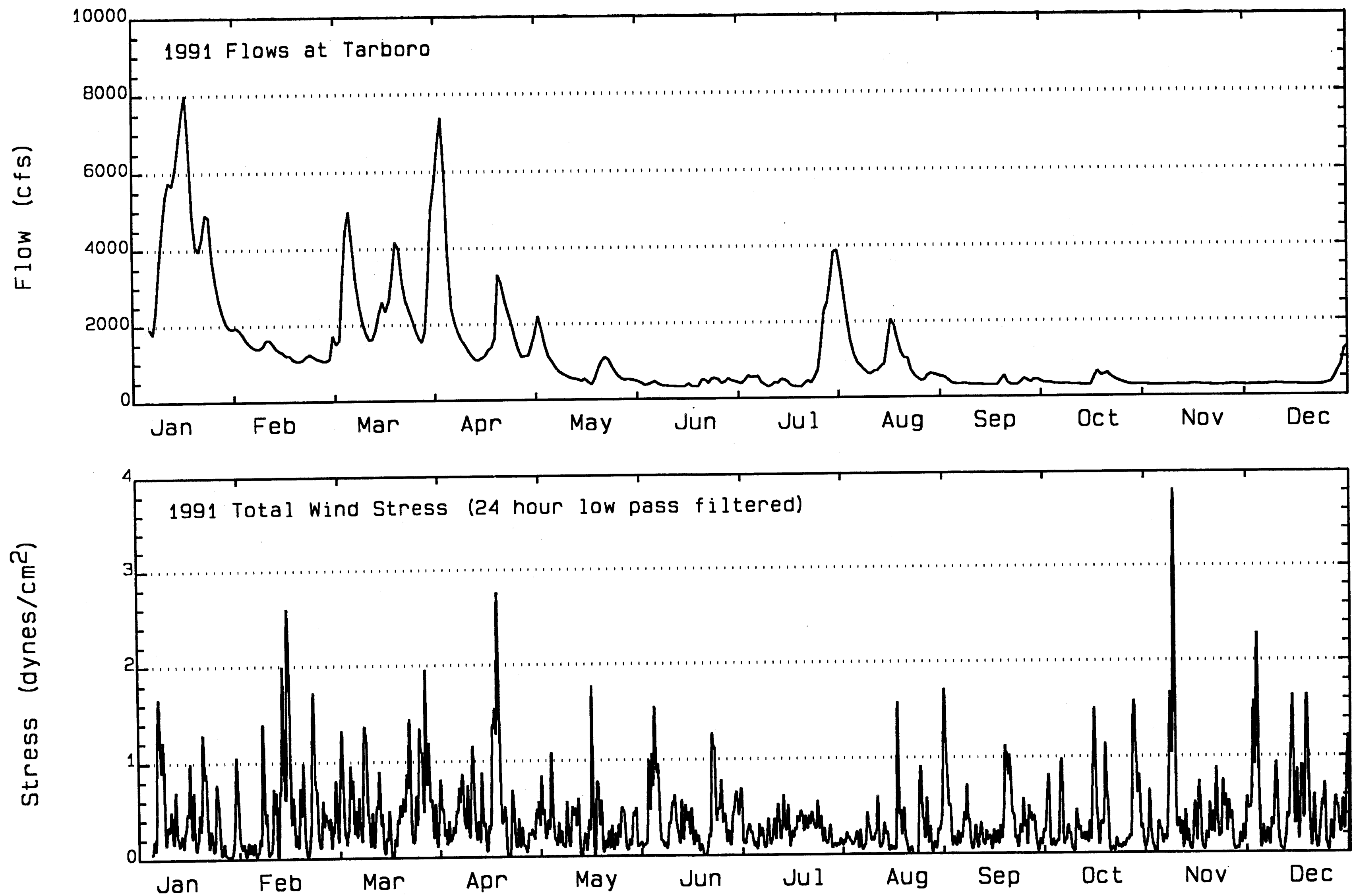

Figure 6-4. 1991 Tar River Flows and Wind Stresses

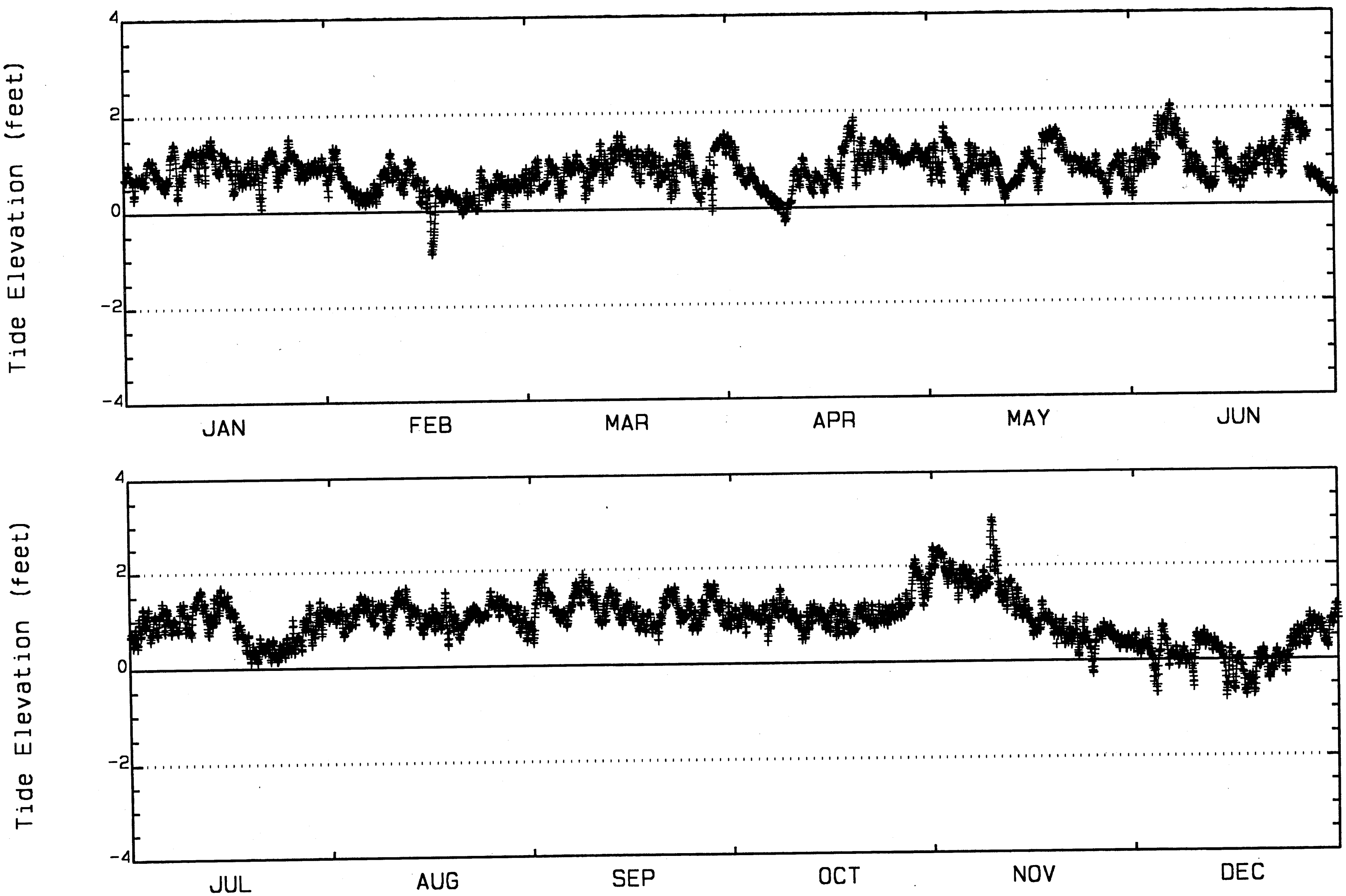

Figure 6-5. 1991 Tide Elevations at the Mouth of Pamlico River

6.4 MODEL PARAMETERS AND COEFFICIENTS

A 10 minute timestep was used for the internal mode calculations and a 1 minute timestep was utilized for the external mode (free surface waves). The vertical turbulence closure sub-model used a background mixing value of 5 X 10^{-6} m^2/s. The two coefficients that were adjusted to achieve the best calibration results were the bottom roughness coefficient and the horizontal eddy viscosity. The optimum values of the bottom roughness and horizontal viscosity were 0.1 cm and 15 m^2/s, respectively. The eddy diffusion coefficients were set equal to the eddy viscosity coefficients in all calculations.

6.5 CALIBRATION RESULTS

Surface elevation and salinity distribution were the two quantities used to assess the accuracy of the hydrodynamic model during the one year calibration period. A comparison between predicted and observed tidal elevations at Washington is presented on Figure 6-6. The agreement between simulation results and measurements is seen to be excellent. The average error was 3.3 percent for the entire year. These results indicate that the model geometry and bottom friction coefficient are realistic and accurate.

Due to a sparsity of salinity boundary condition data, calibration of the hydrodynamic model using observed salinity distributions required interpolation between measurements. Surface and bottom salinity observations were made at the downstream boundary only 10 times during 1991, so very little information on the temporal and vertical variation at this important location was available. Adjustment of the downstream salinity boundary condition, with respect to the few available measurements, was necessary to improve the model results. The temporal variation of surface and bottom salinity values specified at the downstream boundary are shown in the top panel on Figure 6-7.

Predicted surface and bottom salinities were compared with measured salinity values at the seven water quality stations shown on Figure 6-1. Time-histories of predicted salinities and measured values at stations 1A, 3, 5, 7, 8, 10 and 12 are

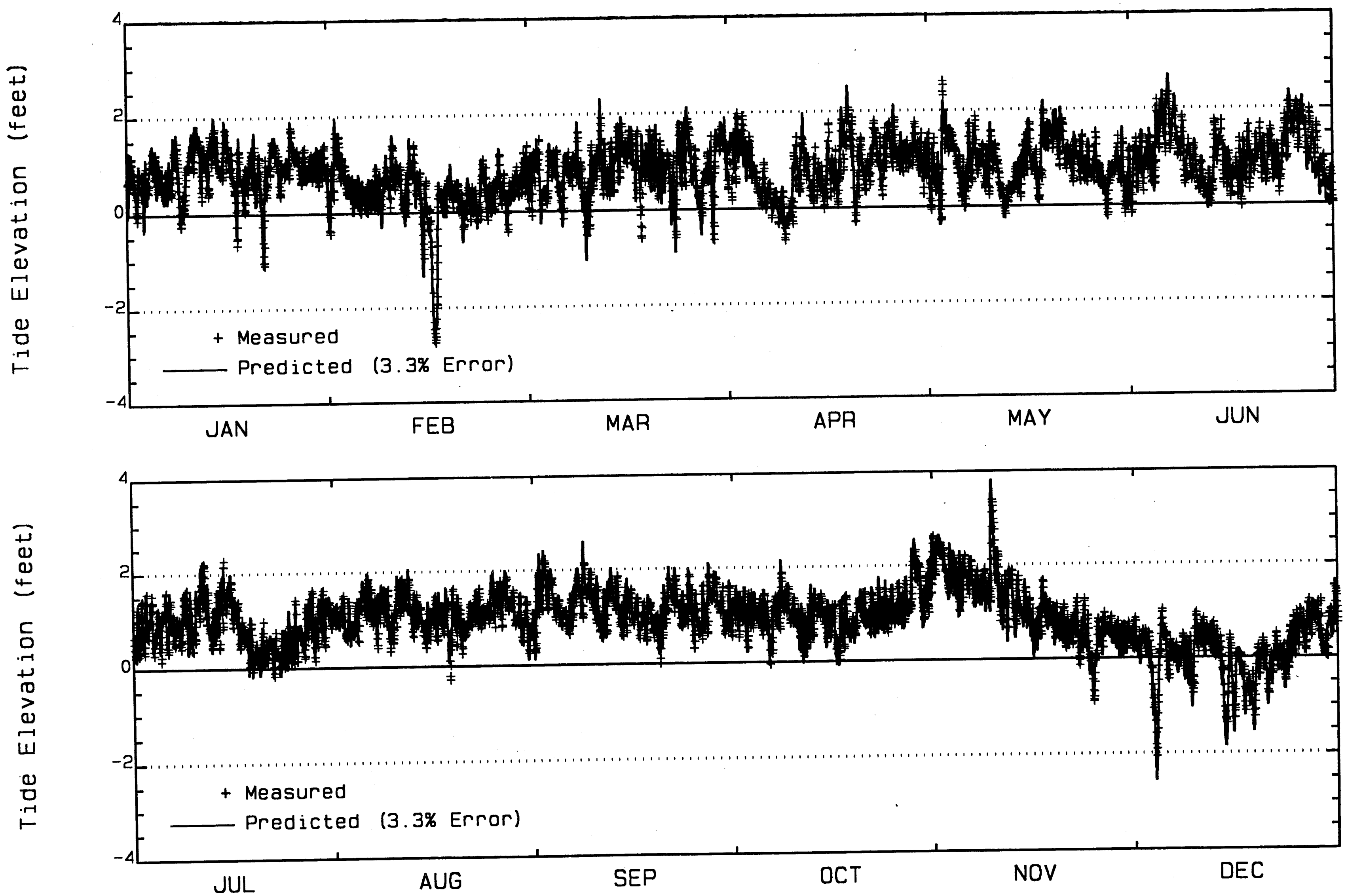

Figure 6-6. 1991 Tide Elevations at Washington, NC

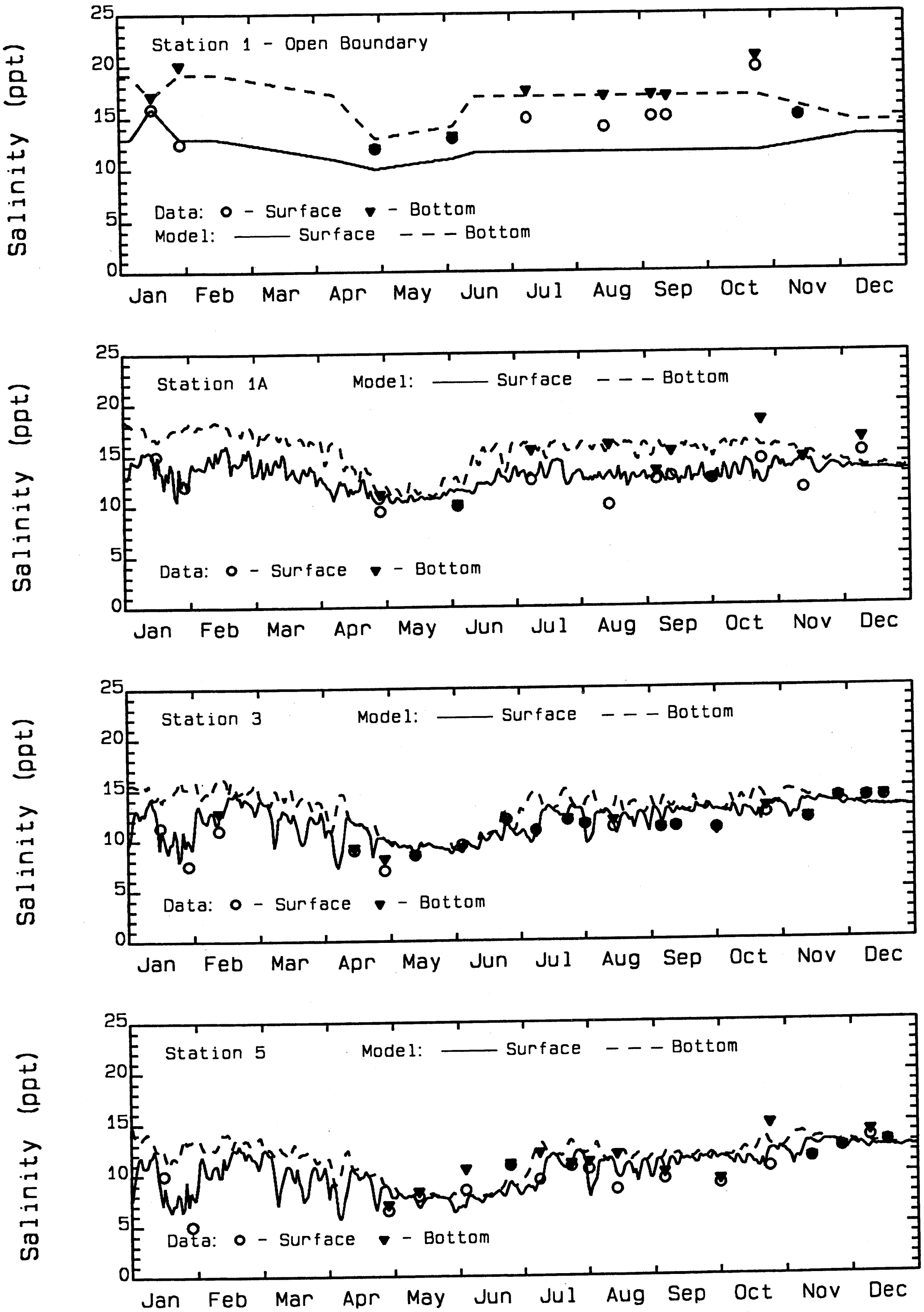

Figure 6-7. 1991 Salinity Calibration for Stations 1, 1A, 3 and 5

presented on Figures 6-7 and 6-8, respectively. Measured bottom salinities shown on these graphs are laterally-averaged values. This lateral-averaging was necessary because the salinity measurements were typically made in the deeper, central portion of the estuary channel. Differences between the lateral-average depth used in the hydrodynamic model and the depth at the measurement site could be significant. The bottom salinity data was collected deeper in the water column than the lateral-average depth, causing the data to be incompatible with the hydrodynamic model results. By laterally-averaging the bottom salinity data, model predictions and observed values could be fairly compared.

Review of Figures 6-7 and 6-8 indicates that the model adequately reproduces the salt distribution in the Tar Pamlico estuary over a wide range of conditions. The longitudinal distribution of salt, which indicates the limit of salt intrusion, followed the observed pattern fairly well, with the salt intrusion usually extending up to the vicinity of Washington. While the model did not always match the level of stratification indicated by the data, the model was successfully able to reproduce the periodic stratification events, at about the correct frequency, that are typical of this estuary.

The ability of the model to realistically simulate the two-layer circulation pattern in the Tar Pamlico estuary is demonstrated by examining the vertical distributions of salinity and velocity at station 7 during two days in July 1991. Low river flow conditions existed on both days, July 9 and 17, with freshwater input from the Tar River averaging about 530 cfs. The estuary was vertically stratified on the first day, July 9, due to low winds. Increased wind velocity during the second day mixed the water column and generated unstratified conditions in the mid-section of the estuary. As mentioned previously, intermittent stratified/unstratified periods due to varying winds during the summer and early fall are typical in the Pamlico River.

The vertical variations in daily-average salinity and longitudinal velocity on July 9 are shown in the top panels on Figure 6-9. The difference between the lateral-average depth and the depth at station 7 is clearly seen on this figure. The hydrodynamic model predicts a surface to bottom stratification of nearly 4 ppt which compares favorably with

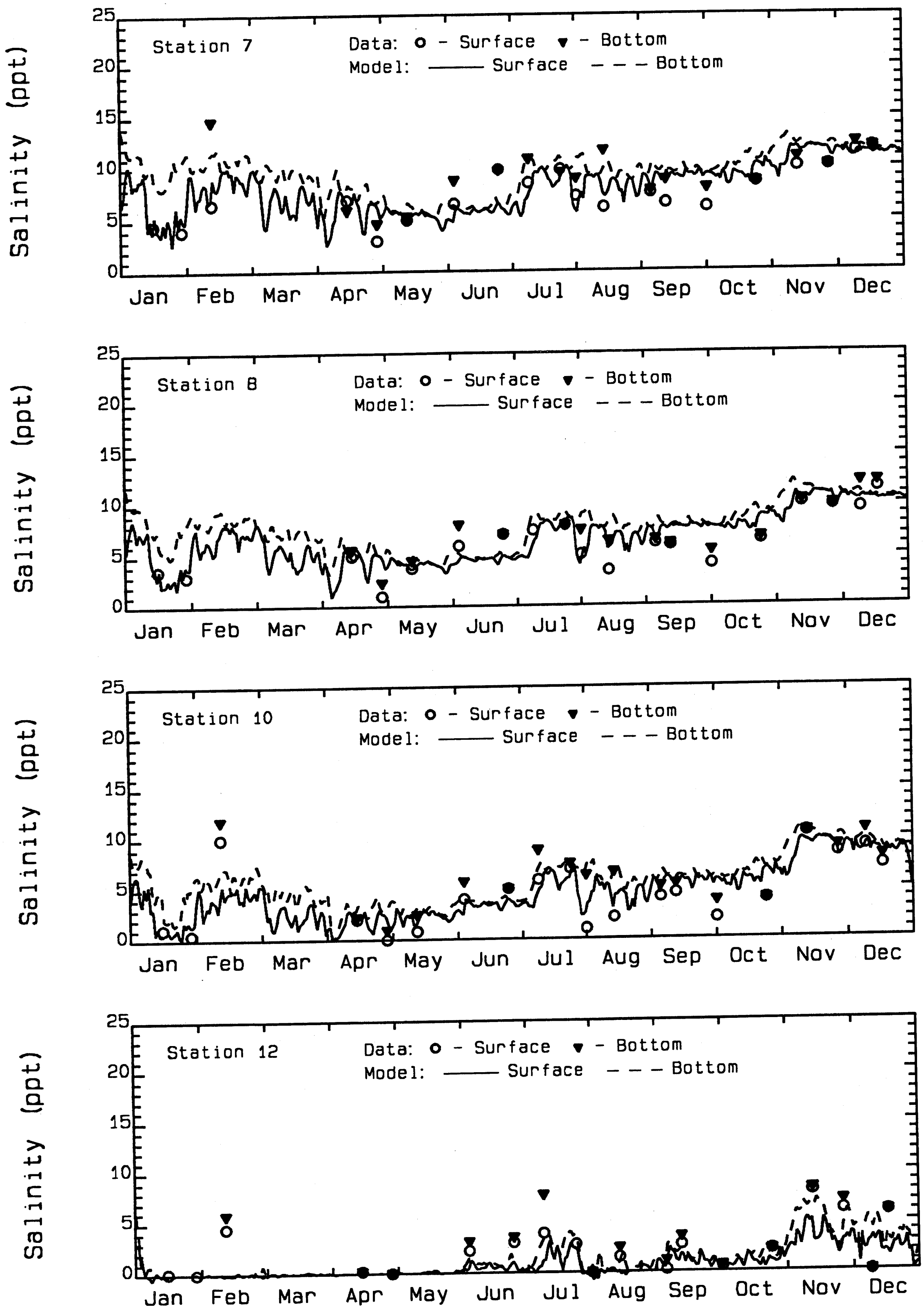

Figure 6-8. 1991 Salinity Calibration for Stations 7, 8, 10 and 12

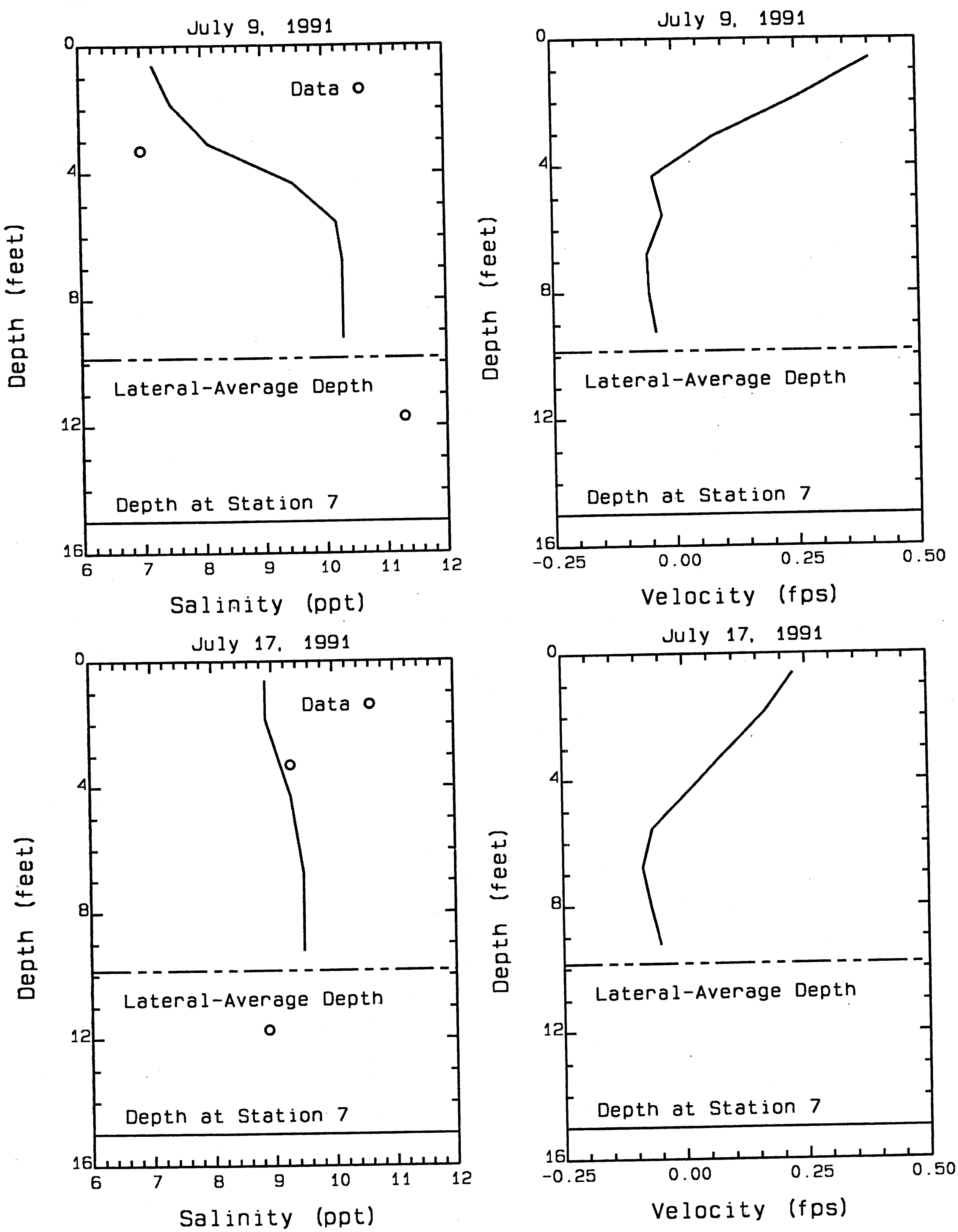

Figure 6-9. 1991 Vertical Salinity and Velocity Profiles

observed values. The halocline is predicted to be located at about mid-depth. Two-layer estuarine circulation is clearly evident in the vertical velocity profile. Dense water flows upstream in the lower layer, at about -0.05 ft/s, while fresher water flows toward the estuary mouth in the upper portion of the water column. The vertically-averaged velocity on July 9 was 0.065 ft/s.

The hydrodynamic model produces a very weakly stratified water column on July 17, see bottom panels on Figure 6-9, with a difference of 0.6 ppt from top to bottom. The measured surface salinity was actually 0.4 ppt greater than the observed bottom value on this day. Even with this weak stratification, the model generates a significant two-layer flow with the shear layer occurring near mid-depth. The driving force of this two-layer circulation pattern is the horizontal density gradient caused by longitudinal variations in salinity. This phenomenon has been observed in previous estuarine studies (Galperin et al., 1992) and emphasizes the need for properly accounting for salinity gradients, even in an estuary that can be classified as well-mixed. Bottom layer velocities are slightly greater than on July 9, about -0.065 ft/s, while surface layer flow has decreased significantly. The vertically-averaged velocity on this day was 0.03 ft/s.

The circulation pattern and salinity distribution in the estuary on a day with an approximately average freshwater inflow, 2,800 cfs, are illustrated on Figure 6-10. The model results presented on this figure are daily average values on August 3. Vertical stratification in the estuary, except in the upstream portion near Washington, is between 2 and 3 ppt. The fresher surface flow is clearly evident in the top meter of the water column. Upstream flow in the lower layer extends almost to Washington. Interestingly, some upwelling in the lower layer occurs at several intermediate points between the upstream limit of the salinity intrusion near Washington and Pamlico Point. This phenomenon is due to geometric variations in the estuary, i.e., bathymetry and cross-sectional area.

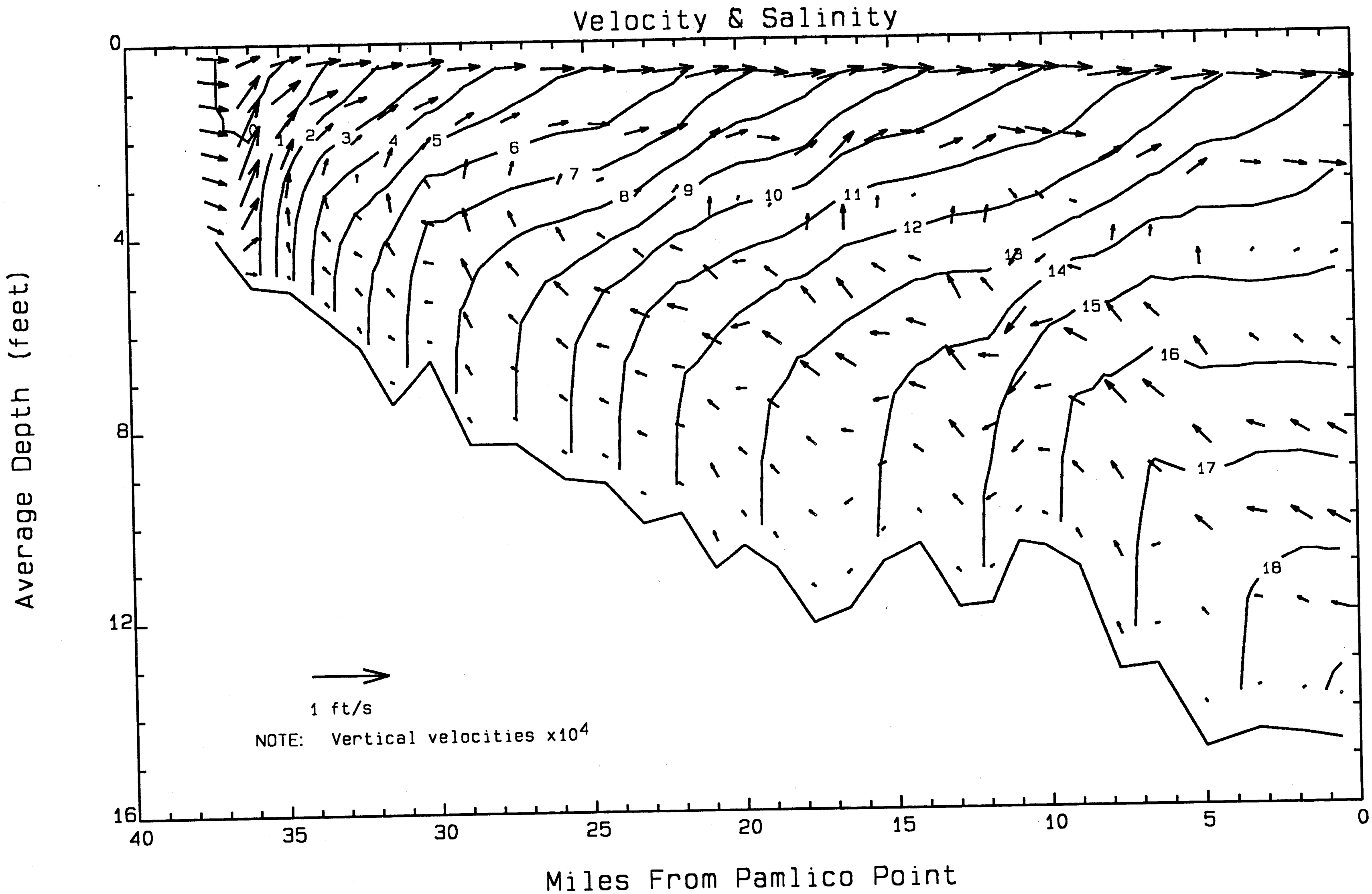

Figure 6-10. Salinity and Circulation Pattern for August 3, 1991

7. WATER QUALITY MODEL CALIBRATION

The segmentation and geometry used for water quality modeling is identical to that developed for the hydrodynamic modeling (Section 6). There are a total of nine boundary conditions in the model which include the upstream freshwater inflow from the Tar River at Greenville, the tidally influenced downstream boundary near Pamlico Point and seven freshwater tributaries, which are tabulated in Table 6-1. Five main point sources are included within the model domain, see Figure 7-1, of which three are municipal waste water treatment plants (WWTP) for the cities of Washington, Aurora and Belhaven. The two industrial point sources are the National Spinning Company in Washington and Texasgulf, Inc. which discharges its phosphorus mining wastes between Durham Creek and South Creek. There are also a number of point source loadings upstream from the boundary at Greenville that are not directly included in the model but are reflected in the measured upstream boundary inputs. A table of the point source loadings and flows entering the Tar-Pamlico River system upstream and downstream from Greenville for 1991 are presented in Appendix 9.2. Monthly loadings of total nitrogen and total phosphorus were compiled from four sources: NCDEM (1987, 1989), Research Triangle Institute (1992), personal correspondence from Paul Blount (Tar-Pamlico Basin Association, 1993) and Dr. Donald Stanley (East Carolina University, 1993).

The data collected as part of the Tar-Pamlico River sampling program funded by Texasgulf, Inc., was used to develop inputs and to calibrate the water quality model for the 1991 study period. The 1991 data is part of an extensive database collected by Dr. Donald Stanley and East Carolina University (Institute for Coastal and Marine Resources, 1991). A compilation of the data for 1981 through 1990 is presented in a report completed by HydroQual in 1992. Data collected as part of the sampling program included: particulate phosphorus, total dissolved phosphorus, orthophosphate phosphorus, ammonia nitrogen, nitrate nitrogen, particulate nitrogen, dissolved kjeldahl nitrogen, total fluoride, chlorophyll, salinity, temperature, dissolved oxygen and pH. Surface and bottom samples were collected bi-monthly for all of the constituents and beginning in 1990, vertical sampling with respect to depth for salinity, temperature and dissolved oxygen. A

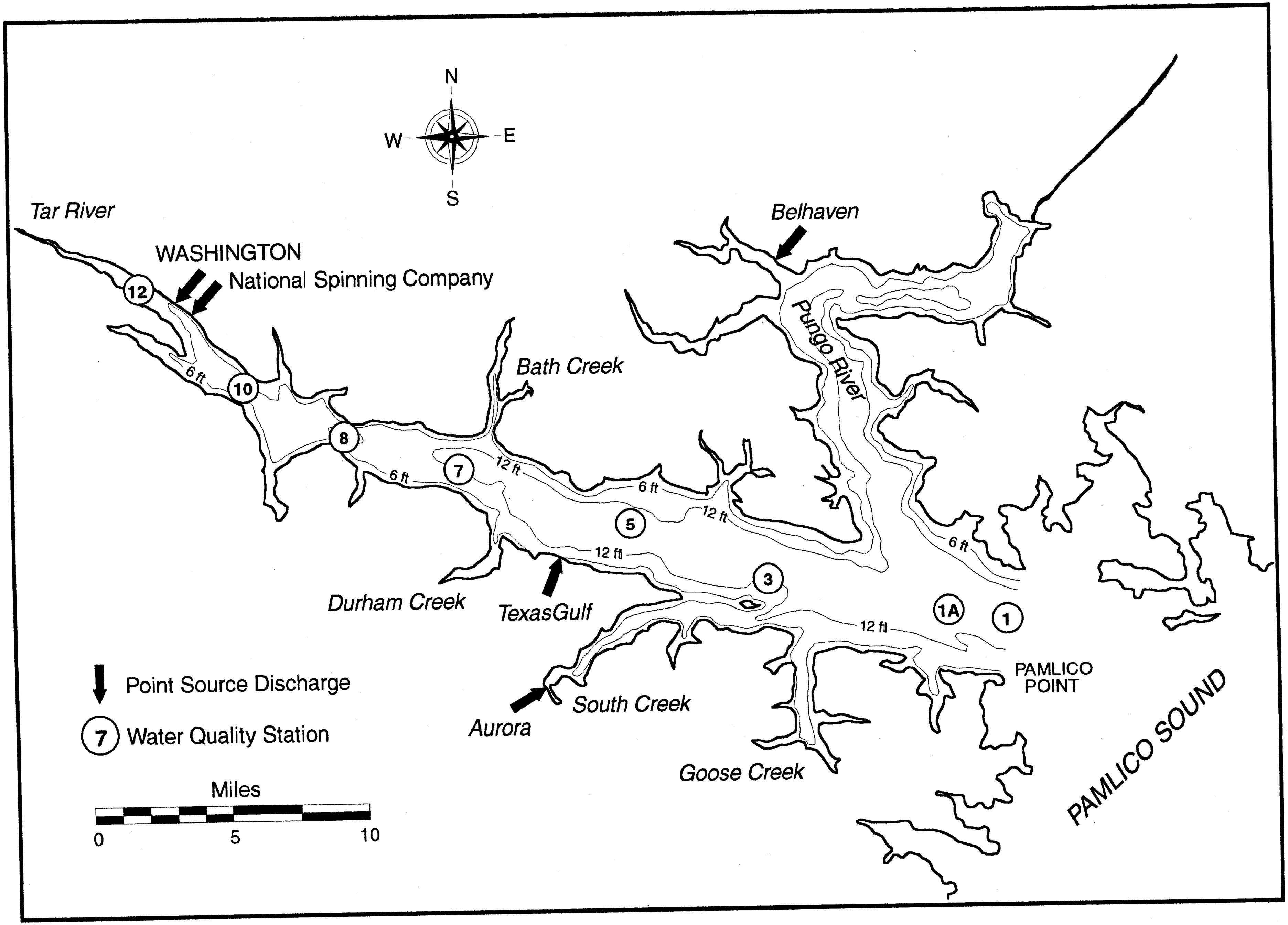

Figure 7-1. Point Source Locations in the Pamlico River Basin

total of 21 stations were sampled of which eight main stem stations, see Figure 4-1, were used for model inputs and calibration. Since silica is not considered to limit algal growth in this system and is abundantly available in the Tar-Pamlico River, the two silica state variables were not modeled in this calibration analysis.

7.1 MODEL INPUTS AND FORCINGS

7.1.1 Boundary Conditions

A total of nine boundary conditions are included in the model, eight of which are freshwater tributaries. The upstream boundary on the Tar River at Greenville was based on the data collected at a station near Grimesland (Seine Beach, SB) during 1991. This station is approximately nine miles downstream from the Greenville model boundary and is upstream from Grindle and Chicod Creeks. Data was collected at this station twenty times throughout 1991 and was linearly interpolated in between sampling dates for model input. The downstream boundary near Pamlico Point was based upon data collected during 1991 at stations 1 and 1A, see Figure 4-1. The use of both stations in defining the boundary condition was based on the model calibration analysis and also upon the need to further define the temporal variation at this boundary. Vertical stratification of salinity and dissolved oxygen occurs at these stations and therefore the boundary condition data was interpolated vertically and then temporally for input into the model.

Unfortunately, water quality data for the seven tributaries was sparse or not available for 1991 and therefore the available databases were used to develop concentration versus flow relationships for defining the tributary model inputs. Water quality data collected at Chicod Creek, Tranters Creek, Durham Creek and Campbell Creek by the NCDEM and the United States Geological Survey (USGS) from 1986 through 1991 was used to establish the relationships. Since flow data was not available for these creeks and model flow inputs were based upon the Tar River flow at Tarboro, the relationships were developed relative to the flow at Tarboro. Seasonal relationships, winter and summer, were developed for Tranters Creek, Durham Creek and Campbell Creek but not for Chicod Creek due to the sparsity of data. The results of these analyses are presented in a log-log format in Appendix 9.3 and for the Tranters Creek summer data in Figure 7-2. Adjustments in the relationships developed for Chicod Creek total kjeldahl nitrogen and nitrite plus nitrate, presented in Appendix 9.3 were necessary based upon the calibration analysis. The adjusted relationships are represented in the figure as dashed lines. Certain assumptions were made regarding the ammonia and orthophosphate relationships, as noted in Appendix 9.3 which were based upon available data and the model calibration. Also, the particulate and dissolved fractions of the measured organics for the tributary inputs was based upon the available data.

Organic carbon and biochemical oxygen demand (BOD) measurements were either extremely limited or non-existent during 1991 and therefore historical values were used to define the boundary condition inputs. Measurements made between August, 1975 and July, 1977 within the Tar-Pamlico River were used to define the boundary inputs (Davis, et. al. 1978). The organic carbon boundary inputs used for the 1991 calibration are presented in Table 7-1.

Table 7-1. 1991 Calibration Boundary Inputs of Organic Carbon

Boundary	POC (mg/l)		DOC (mg/l)	
	Surface	Bottom	Surface	Bottom
Pamlico Point	1.5	1.6	5.7	6.2
Tar River at Greenville	1.8	1.8	6.8	6.8
Tributaries	1.0	1.0	21.0	21.0

The reactivities of organic material, as described in Section 5.2, for the boundary condition inputs is also necessary. Because no data were available on the relative reactivity of boundary organic nitrogen, phosphorus and carbon, reactivity fractions were assigned from other estuarine studies. The upstream and tributary boundary inputs of organic material were assigned 75% labile and 25% refractory. The downstream boundary near Pamlico Point is influenced by the Pamlico Sound where it is assumed that the labile

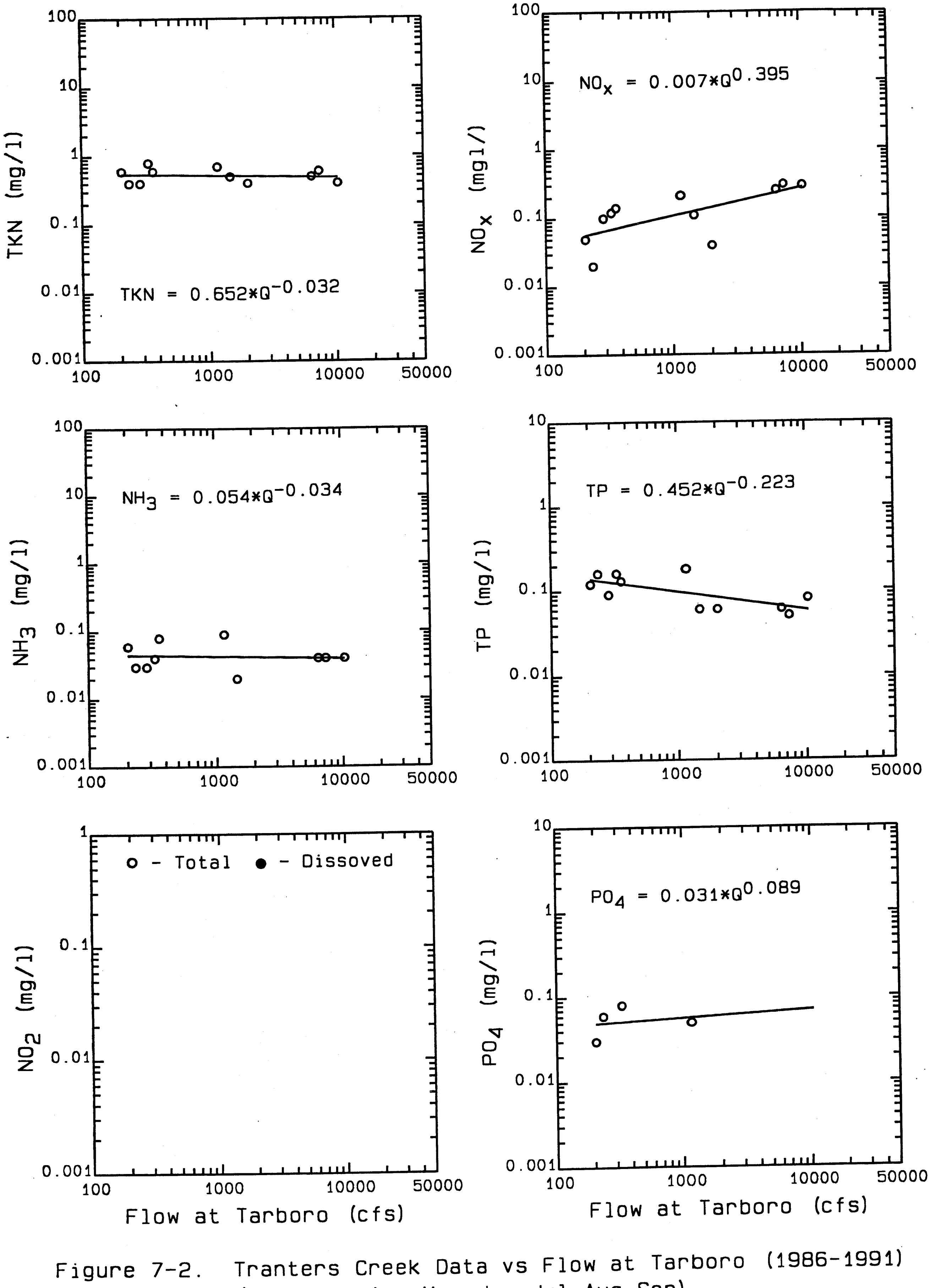

Figure 7-2. Tranters Creek Data vs Flow at Tarboro (1986-1991)
(Summer = Apr, May, Jun, Jul, Aug, Sep)

fraction of organic material has had sufficient time to decompose. Therefore, organic material entering the Tar-Pamlico River from the Pamlico Sound was assumed to be more refractory (stable) in nature than the upstream sources. The percentage of organic material in the labile and refractory forms for the calibration was assigned as 50% labile and 50% refractory.

7.1.2 Solar Radiation, Fraction Daylight and Saturating Algal Light Intensity

The input of these three parameters is necessary for the algal growth formulation described in Section 5.2. Solar radiation controls the amount of energy available for algal growth and was estimated on a daily basis. Daily cloud cover data for 1991 was obtained from the National Oceanic and Atmospheric Administration (NOAA) weather station at Cape Hatteras, North Carolina and converted to total daily solar radiation. The conversion of cloud cover data to solar radiation values in langleys was based upon an empirical equation developed by Hamon, Weiss and Wilson (1954) and the latitude of the modeled system.

The duration of sunlight within a day, fraction daylight, is also required for the algal growth formulation, since algal growth only occurs during the day. An estimate of the fraction daylight was based upon the latitude of the system and the equations developed by Duffie and Beckman (1974).

The optimum light condition at which algal growth is maximized is referred to as the saturating algal light intensity. In previous algal growth formulations this value was assigned as a constant in time, but for this analysis the saturating algal light intensity was assigned as a fraction of the daylight solar radiation. The daily saturating algal light intensity was calculated as 40% of the five day moving average of the daylight solar radiation. The total solar radiation, fraction daylight, daylight solar radiation and saturating algal light intensity for 1991 are presented in Figure 7-3. The calculation results in saturating algal light intensities that range from 250 to 500 langleys per day.

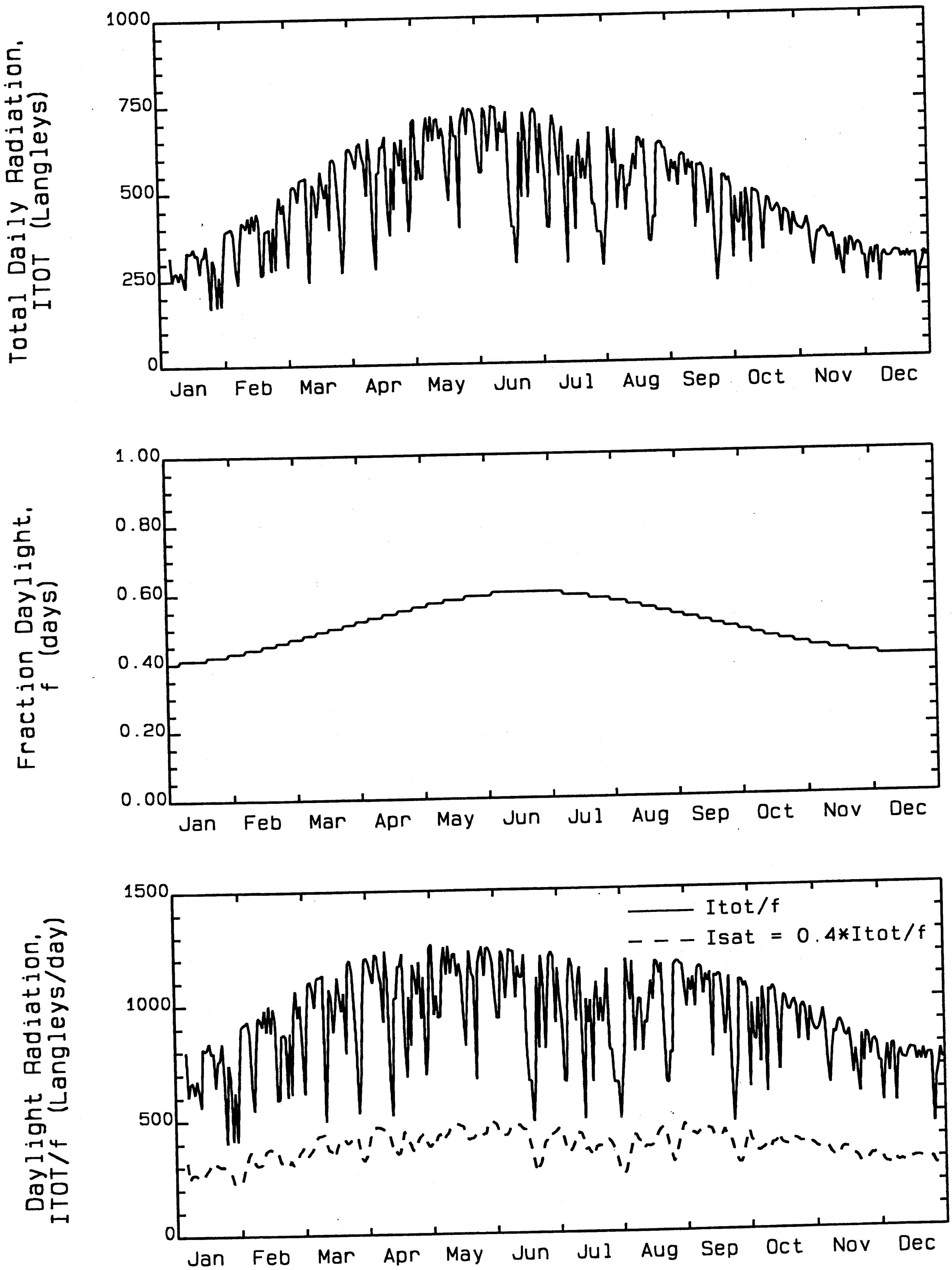

Figure 7-3. Solar Radiation Based on Percent Cloud Cover at Cape Hatteras, NC (1991)

7.1.3 Light Extinction Coefficients

The solar radiation that is available for algal growth is a maximum at the surface and decreases with depth in the water column. This decrease of solar radiation with depth is estimated by an exponential decay function and light extinction coefficients. In the Tar-Pamlico River, direct measurements of the light extinction coefficients for 1991 were available in the database collected by Dr. Donald Stanley and East Carolina University (ECU). These measured light extinction coefficients were input spatially and temporally and are presented for seven main stem water quality stations in Figure 7-4.

The light extinction coefficient measures the light absorbance of detrital (non-algal) material and also of the ambient algal cells. The light formulation used in this study, utilizes the non-algal (base) light extinction and therefore the measured light extinction coefficients (total) must be corrected for algal interference or algal self shading. The algal self shading effect is computed internally based upon an algal related light extinction coefficient and the computed algal biomass (chlorophyll). The algal related light extinction coefficient per unit of chlorophyll was determined from an analysis of the measured total light extinction coefficients and the associated chlorophyll at the time of measurement. The details of the complete algal light formulation are presented in Appendix 9.1.

7.1.4 Algal Stoichiometry

The phytoplankton systems in the water quality model are based in carbon units and therefore the ratios of carbon, nitrogen and phosphorus to chlorophyll are necessary. Organic carbon data was not collected in 1991 and therefore the carbon to chlorophyll ratio (C/Chl) could not be developed. A C/Chl ratio of 83 was used based upon the organic carbon and chlorophyll data collected from 1976 through 1977 (Davis, et. al. 1978). Nitrogen to chlorophyll (N/Chl) and phosphorus to chlorophyll (P/Chl) ratios were developed based upon the ECU database for 1991. A N/Chl ratio of 6.6 and a P/Chl ratio of 1.0 were calculated from the 1991 data and used for calibration. The calibration C/Chl, N/Chl and P/Chl ratios and data are presented in Figure 7-5. Nutrient ratios reported for the

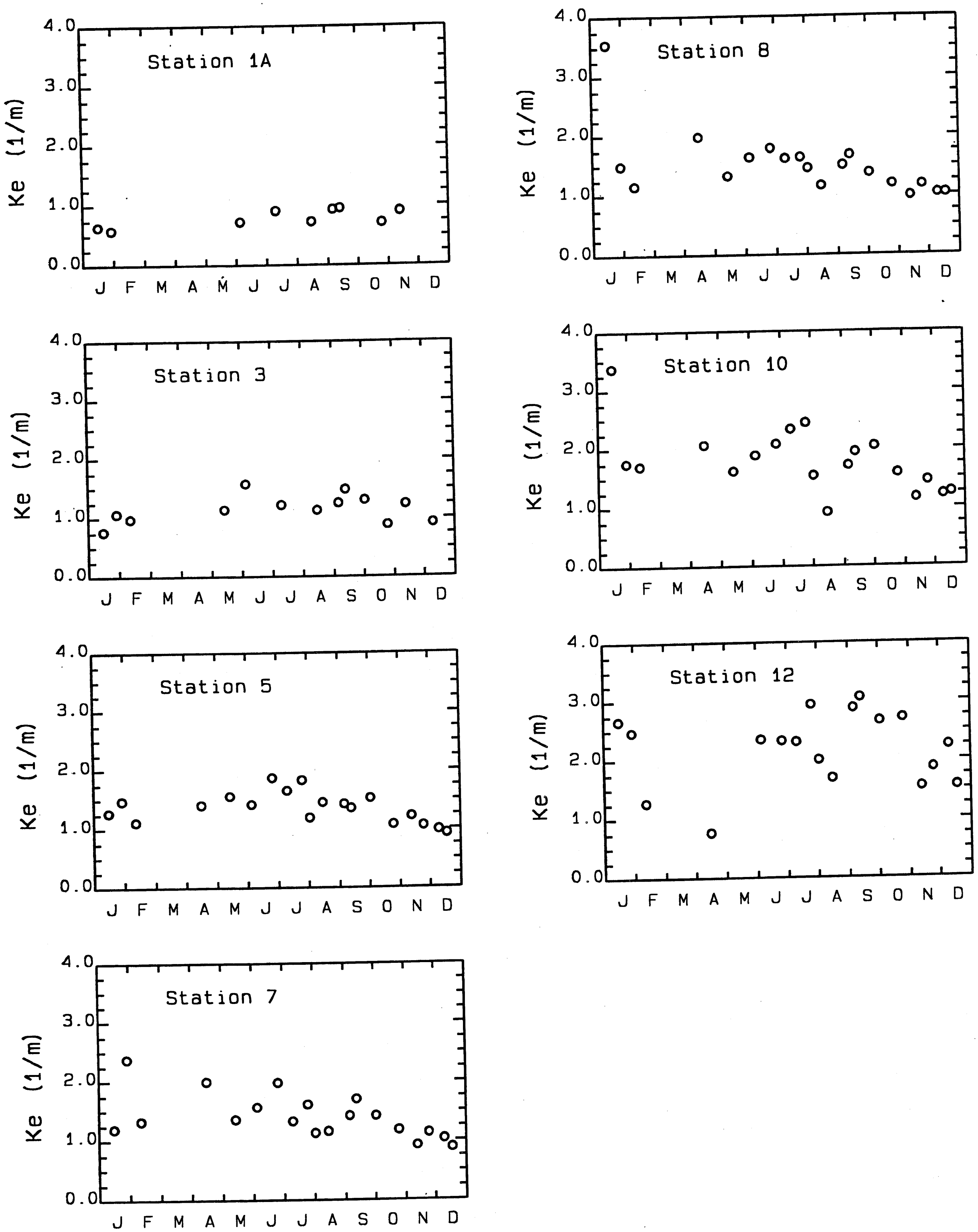

Figure 7-4. Tar-Pamlico River Light Extinction Coefficients for 1991

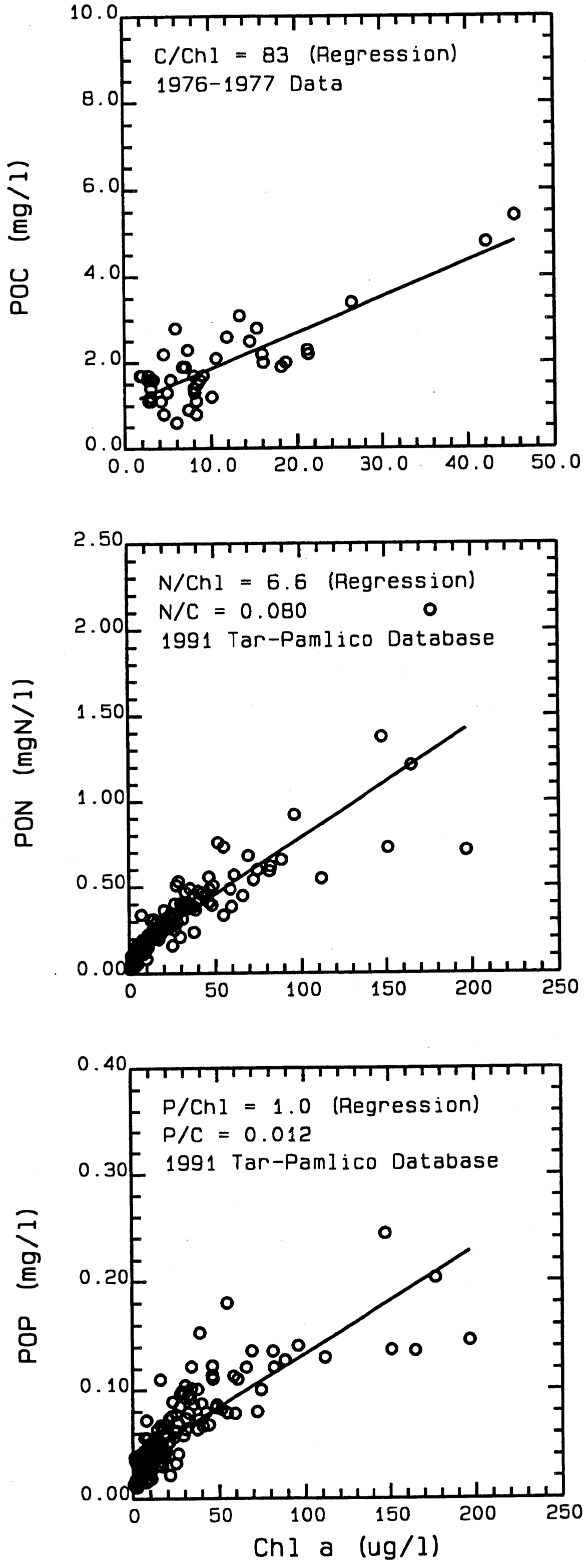

Figure 7-5. Tar-Pamlico Estuary C/Chl, N/Chl and P/Chl Ratios for the 1991 Calibration

Tar-Pamlico River (USGS, 1990) are in general agreement with those calculated from the 1991 data, see Table 7-2. The Redfield ratios are also presented in Table 7-2 for reference.

Table 7-2. Nutrient Ratio Comparisons

Source	Carbon: Nitrogen	Carbon: Phosphorus	Nitrogen: Phosphorus
Calibration	12.6	83.0	6.6
USGS, 1990	17.0	85.9	5.3
Redfield	5.7	41.0	7.2

7.1.5 Oxygen Transfer Coefficient

Atmospheric reaeration is calculated from an oxygen transfer coefficient and water depth, see Appendix 9.1. Typical ranges of the oxygen transfer coefficient in estuarine systems are from 2 to 7 feet per day (ft/d). Since the stratification/destratification and hypoxia events in this system are mainly coupled to wind conditions, the oxygen transfer coefficient was calculated as a function of the daily wind speed. Oxygen transfer coefficients were calculated from the daily wind speed measurements at the Texasgulf facility and the equations developed by O'Connor (1983). Figure 7-6 present the daily wind speeds and the calculated oxygen transfer coefficients for 1991 based upon O'Connor's equations for an intermediate system.

7.1.6 Water Temperature

Water temperatures in the Tar-Pamlico River on average range from about 5 degrees celsius (°C) in the winter months to about 30°C during the summer. In 1991, minimum water temperatures were about 8°C in January and December and increased to maximum of about 30°C in June, July and August. Water column temperatures were input spatially, temporally and constant in depth for 1991.

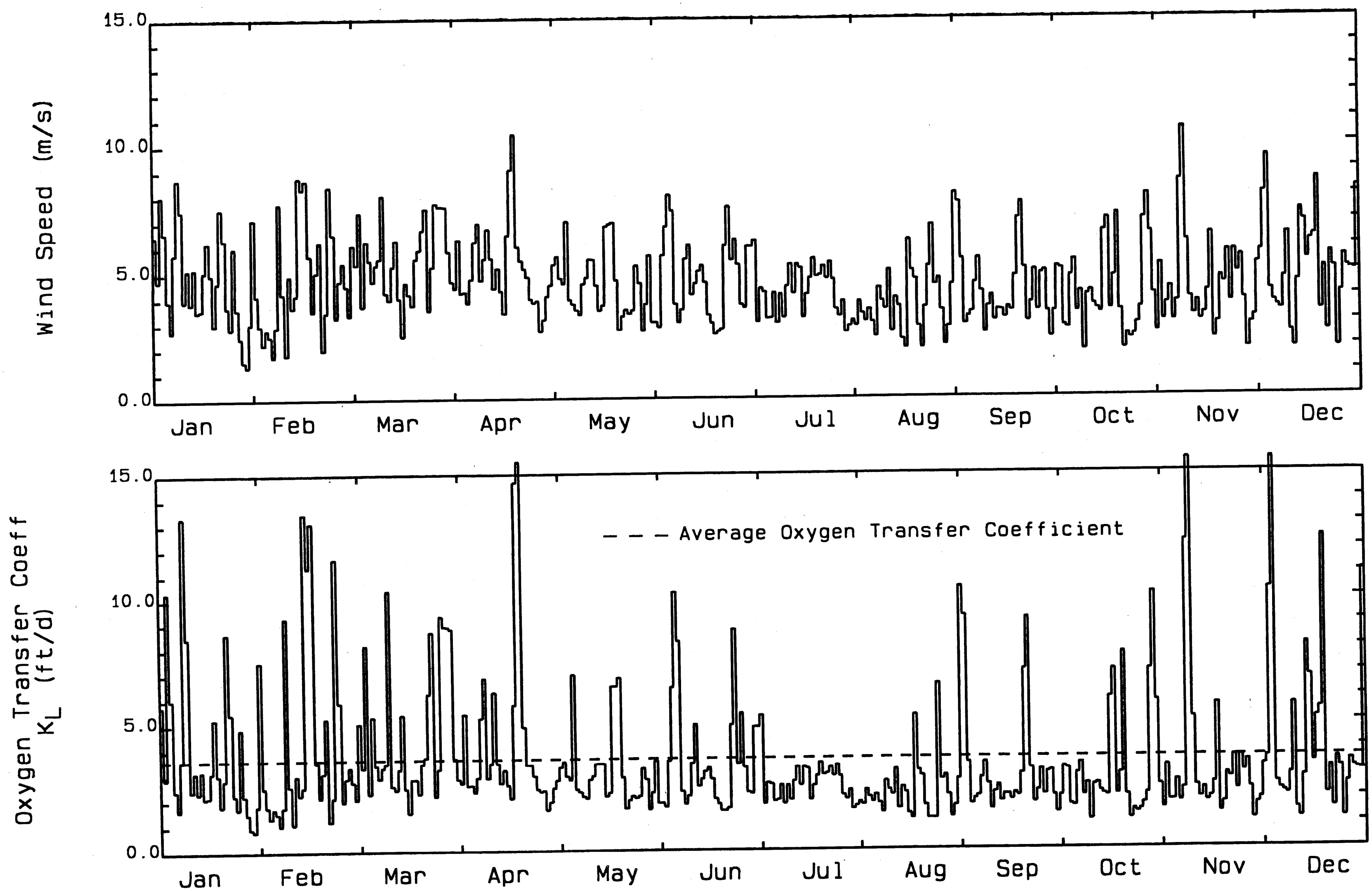

Figure 7-6. Daily Wind Speed at TexasGulf, NC and Calculated K_L for 1991

7.2 CALIBRATION ANALYSIS

The data used for calibration was from the 1991 ECU database and at times also included NCDEM and USGS water quality data. Sediment data was not available for 1991 and therefore historical sediment data from the early 1980's was used to guide the calibration (Water Resources Research Institute of the University of North Carolina, 1983, 1984). The only recent sediment data was SOD measurements collected in 1992 by the NCDEM. Typical sediment data magnitudes and ranges from other estuarine studies on Long Island Sound and Chesapeake Bay, were used for additional guidance during the calibration. The water quality model calibration examined the model behavior over the year at nine water quality stations. Sediment model output was also examined at these stations plus at stations where historical data was available for comparison. The final calibration was the result of over 100 model runs calculated on a daily basis which included model sensitivities for various model coefficients.

The calibration analysis that follows is presented in three graphical formats to highlight the insights gained throughout the course of this study.

1. Seasonally averaged spatial figures of water quality data and model output to address the general dynamics of the system.

2. Temporal figures of water quality data and model output for specific stations to address system dynamics within the year.

3. Temporal enlargements of salinity and dissolved oxygen data and model output to address the dynamics of the stratification/destratification and hypoxia events within the system.

Salinity and dissolved oxygen samples were collected vertically in the water column and at times the maximum sampling depth exceeded the model segment depth. This discrepancy typically occurred at the upstream stations due to sampling in the dredged center channel or in a deeper center channel. The laterally averaged model can not represent these geometries adequately because model depths must represent the entire width of the river. It was therefore necessary to weight the vertical samples of salinity and dissolved oxygen with respect to the cross sectional area at each sampling station. In the remaining calibration figures salinity and dissolved oxygen concentrations are presented as a weighted average above and below the halocline with the ranges representing the minimum and maximum values for each case. Surface and bottom samples are presented for the remaining data, e.g. chlorophyll and ammonia concentrations, and model output is presented for layers 1 and 8.

In addition to the averaging procedure outlined above, bottom layer model and data comparisons for stations 3 and 12 were omitted for the following reasons. Data samples at station 12 were often collected in the dredged center channel near Washington. The dimensions of this channel are maintained at approximately 12 feet in depth and 200 feet in width. The actual dimensions of the river at this location are approximately 3,500 feet wide and 4 to 5 feet deep. The laterally averaged model geometry represents the average depths and therefore can not include the dredged channel. Data samples collected within the dredged channel were excluded when averaging the data and the remaining samples were considered as surface layer measurements.

Station 3 is located downstream near Indian Island where samples were typically collected at shallower depths than the main channel. Maximum sample depths ranged between 10 and 12 feet while the main channel depth was approximately 16 feet. Therefore, actual bottom layer samples may not have been collected. All measurements obtained at station 3 were assumed to represent the surface layer and were averaged for model and data comparisons.

During a few sampling dates in September, November and December measured dissolved oxygen concentrations from the ECU database seemed to contradict measurements obtained by the NCDEM during the same periods. Dissolved oxygen concentrations from the ECU database were significantly higher than those measured by the NCDEM during the same periods. In Figure 7-7, the comparison of dissolved oxygen concentrations from the two databases for 1991 highlight the discrepancies during these periods. Probability distributions of the dissolved oxygen concentrations from the two databases are presented in Figures 7-8 and 7-9 with and without the questionable ECU dissolved oxygen data. The dissolved oxygen probability distributions from the two databases compare more favorably without the questionable ECU data. Therefore, in some of the subsequent calibration figures, the questionable ECU dissolved oxygen data have been excluded where noted.

7.2.1 Summer Averaged Spatial Comparisons

The summer averaged model output and data are presented in Figures 7-10 through 7-12 as spatial profiles beginning near Grimesland, station SB, and ending near Pamlico Point, station 1. The summer average includes the months of May through September and is calculated from daily model output. The plotted data represent the median and range of the values within these periods above and below the halocline. Similarly, the model output represents the average within these periods with the surface layer composed of the top 5 model layers and the bottom composed of the bottom 3 model layers.

In general, the overall computed spatial profiles and magnitudes of dissolved oxygen, salinity and chlorophyll levels reproduce the observed trends and are within the associated ranges for this period, Figure 7-10. Computed surface layer dissolved oxygen concentrations generally reproduce the observed median concentrations which are relatively constant within the estuary. The computed increase in dissolved oxygen concentrations at station 12 is due the increase in chlorophyll levels and the associated increase in oxygen production. The computed bottom layer dissolved oxygen concentrations at stations 8 and 10 are slightly higher than the observed median values. Computed chlorophyll levels reproduce the observed increase in chlorophyll levels from the mouth of the estuary to a maximum near station 12 at Washington and then decrease upstream from Washington.

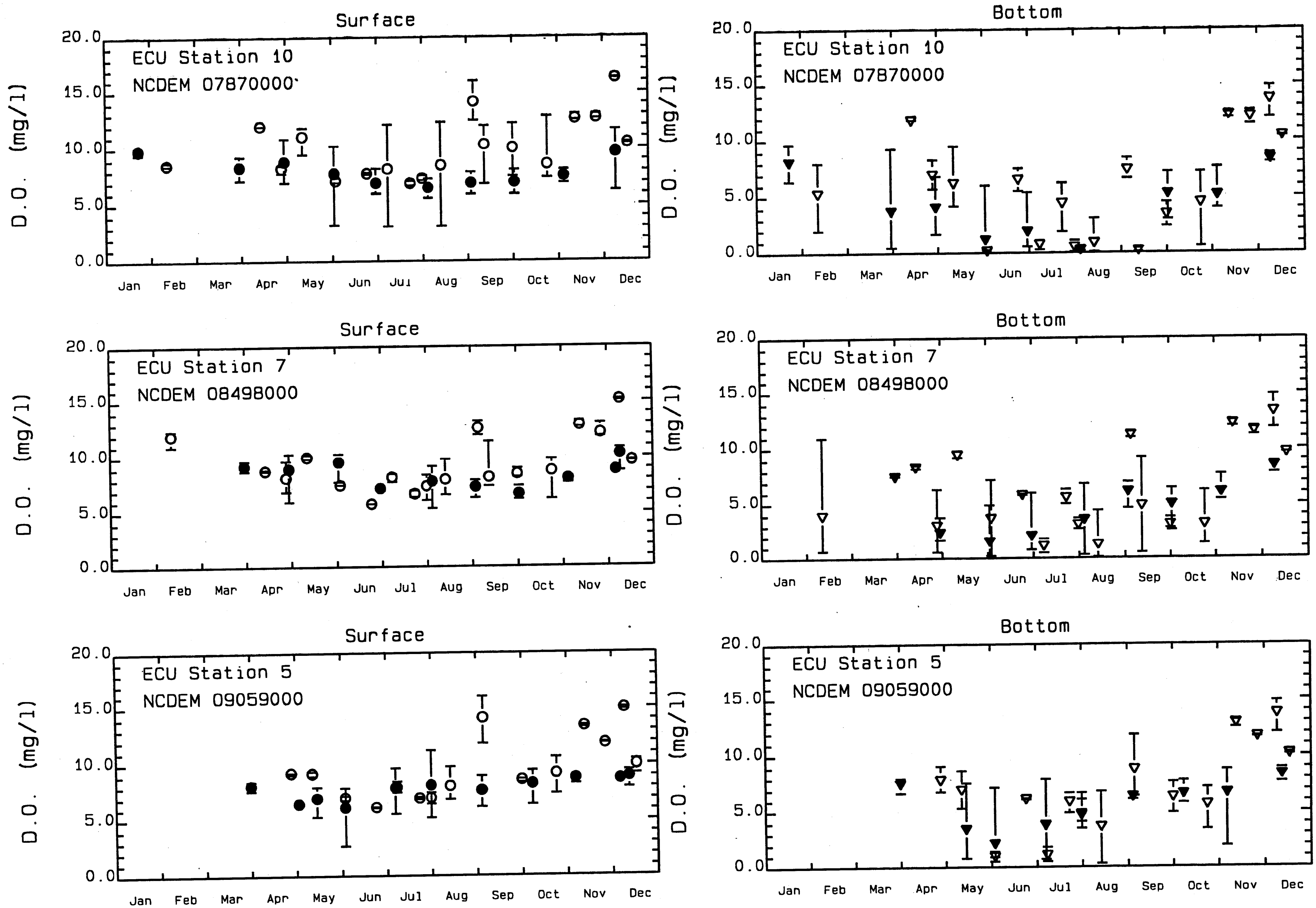

Figure 7-7. Tar-Pamlico River 1991 D.O. Data Comparisons

- o Surface (ECU) ● Surface (NCDEM)
- ▽ Bottom (ECU) ▼ Bottom (NCDEM)

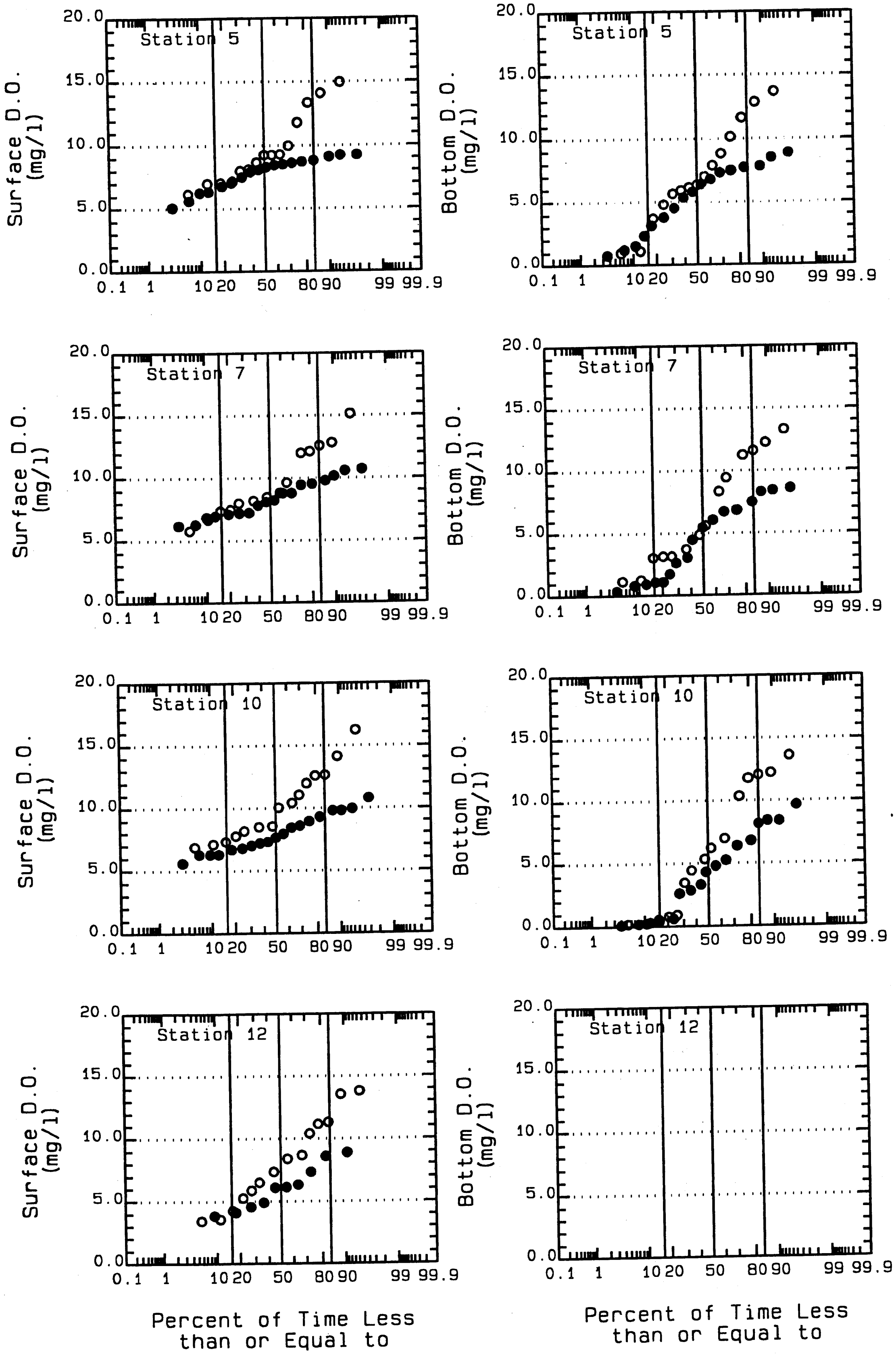

Figure 7-8. Tar-Pamlico River D.O. Probability Distributions - 1991

- Data averaged above and below the halocline
- Open Symbols = ECU, Filled Symbols = NCDEM

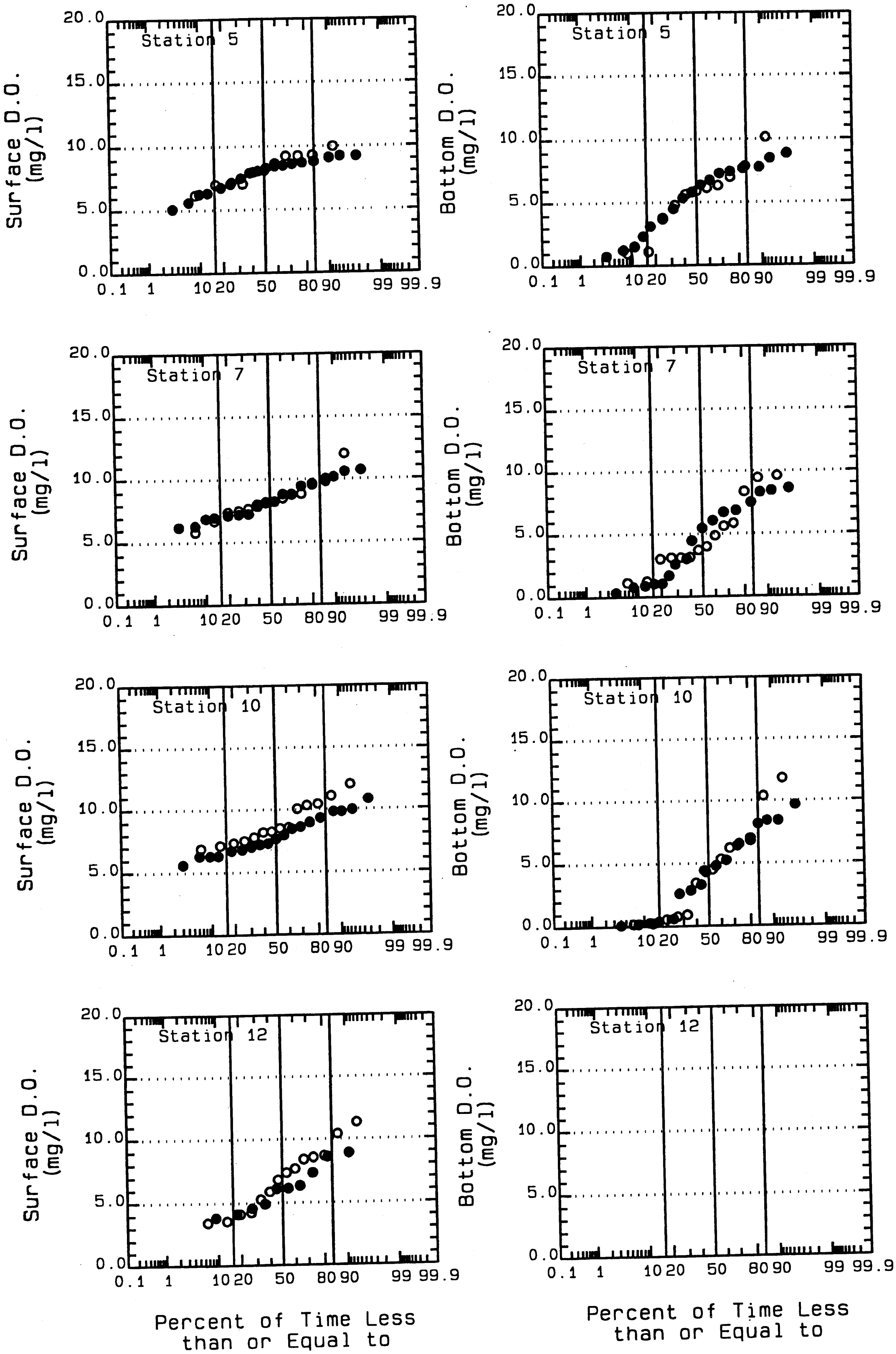

Figure 7-9. Tar-Pamlico River D.O. Probability Distributions - 1991

- Data averaged above and below the halocline
- Open Symbols = ECU, Filled Symbols = NCDEM
- Excludes 9/5, 11/12, 11/26 and 12/9 ECU data

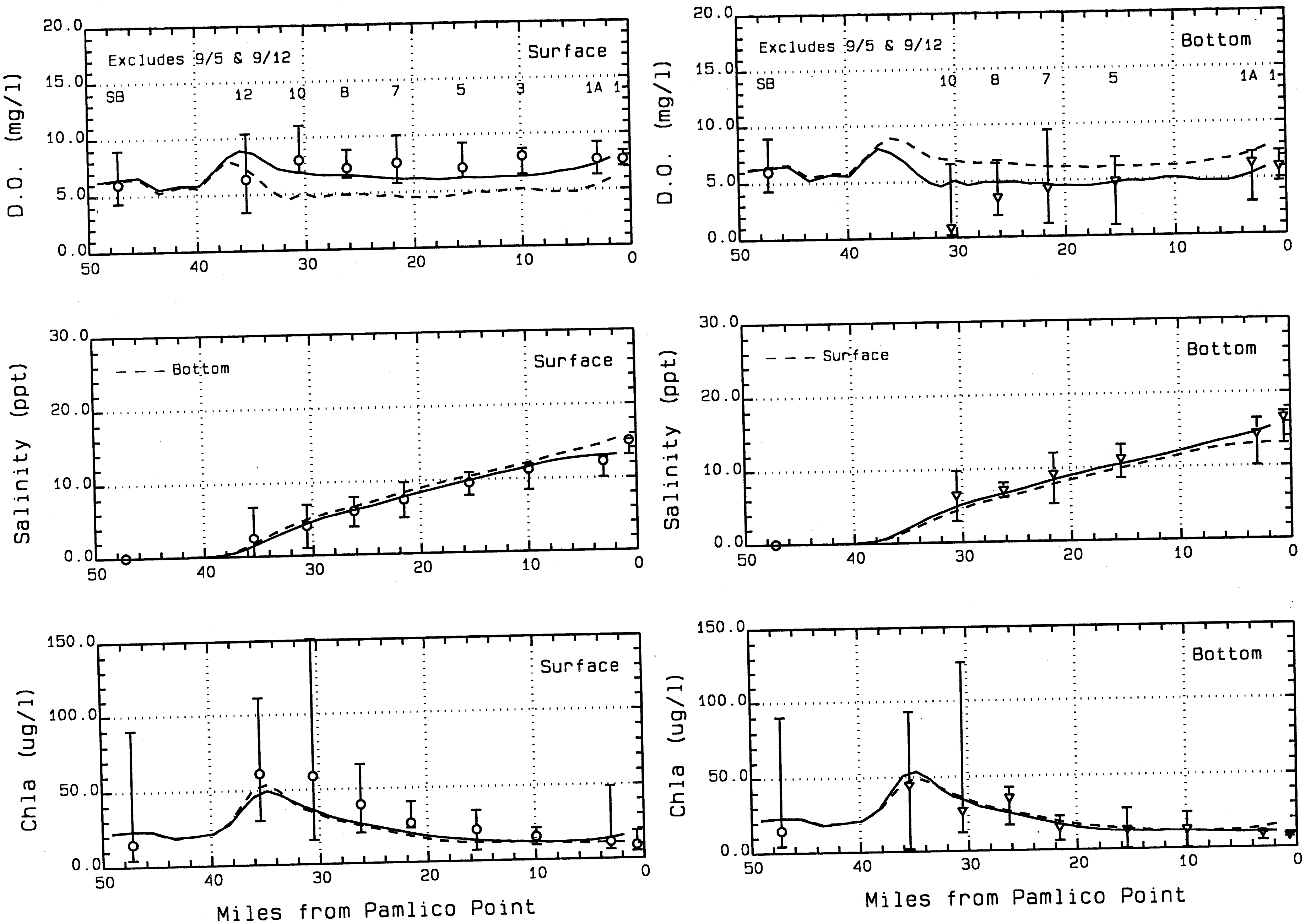

Figure 7-10. Tar-Pamlico River - 1991 Summer Averages

- Data Plotted represents Median and Range, ——— Model Average

The model computes that saltwater intrudes into the estuary a couple of miles beyond station 12, near Washington, where freshwater from the Tar River meets the Pamlico River, as shown in the middle panels of Figure 7-10. The salinity levels near the mouth of the estuary, Pamlico Point, are approximately 13 ppt in the downstream flowing surface layer and 15 ppt in the upstream flowing bottom layer. The average difference between surface and bottom layer salinities during this period is less than 1 ppt. The model captures the observed decrease in salinity levels from Pamlico Point to Washington and also the approximate level of salinity stratification.

This computed level of salinity stratification along with the oxygen demands within the system cause an associated stratification in computed dissolved oxygen concentrations of approximately 1 to 2 mg/l between Washington and Pamlico Point, as shown in the top panels of Figure 7-10. The computed dissolved oxygen stratification upstream from Washington gradually decreases as salinity stratification decreases and as the system becomes dominated by the completely mixed freshwater reaches of the Tar River. Computed surface layer dissolved oxygen concentrations range between 6 and 9 mg/l and are slightly lower than the observed median concentrations which are generally near the dissolved oxygen saturation values. The computed bottom layer dissolved oxygen concentrations range between 5 and 8 mg/l and are higher than the observed median concentrations near stations 8 and 10. The differences in computed and observed dissolved oxygen concentrations at stations 8 and 10 may be due to the collection of samples within a center channel which is not represented by the laterally averaged model. Also, the slightly greater observed salinity stratification than computed results in increased computed vertical mixing which effects the level of dissolved oxygen stratification.

The oxygen demands within the system also have an impact upon dissolved oxygen concentrations and the level of dissolved oxygen stratification. One of the sources of oxygen demanding material in the estuary originates from phytoplankton growth and death. The oxygen demands associated with the phytoplankton are due to algal respiration and indirectly due to the decomposition of dead algae in the sediments and the associated SOD. The average phytoplankton levels, measured in chlorophyll units, are presented in the bottom panels of Figure 7-10 and range from 10 to 50 μg/l. Computed upstream surface layer chlorophyll concentrations are lower than the observed median concentrations which may explain the lower surface layer dissolved oxygen concentrations, since algal oxygen production may be slightly greater. The difference in computed and observed bottom layer dissolved oxygen concentrations may also result from the lower computed chlorophyll levels along with the level of salinity stratification since algal respiration and SOD are main factors in the bottom layer oxygen balance.

The spatial profiles of chlorophyll, ammonia plus nitrate and orthophosphate concentrations for the summer period are presented in Figure 7-11. Ammonia plus nitrate, total inorganic nitrogen (TIN), entering the system near Grimesland (station SB) is approximately 0.8 mg/l and decreases to less 0.1 mg/l downstream from station 10. This decrease of TIN, which is captured by the model, is mainly due to saltwater dilution at this location with additional losses due to uptake by algae for growth and flux into the sediments. The ammonia concentrations constitute approximately 10% of the TIN at station SB and the nitrate concentrations constitute approximately 90%. At station 12, the percentages change to approximately 40% ammonia and 60% nitrate and then ammonia tends to dominate farther downstream with the percentages of 80% ammonia and 20% nitrate. The impact of freshwater sources is reflected by the larger percentage of observed nitrate in the upstream reaches of the estuary. The peak in chlorophyll levels near station 12 is primarily due to the available nutrients. Since ambient phosphorus levels downstream from station 12 are above the phosphorus half saturation constant of 0.001 mg/l, the system is nitrogen limited. Therefore, the nutrient limitations that occur downstream from station 12 are the primary cause for the decrease in chlorophyll levels. The lower chlorophyll levels upstream from station 12 is mainly controlled by the short residence time since ambient nutrients are above the half saturation constants for nitrogen and phosphorus.

The model computation of orthophosphate concentrations are less than the observed median values in the central sections of the estuary. This discrepancy may result from under computed sediment phosphorus fluxes. Since the concentrations are well

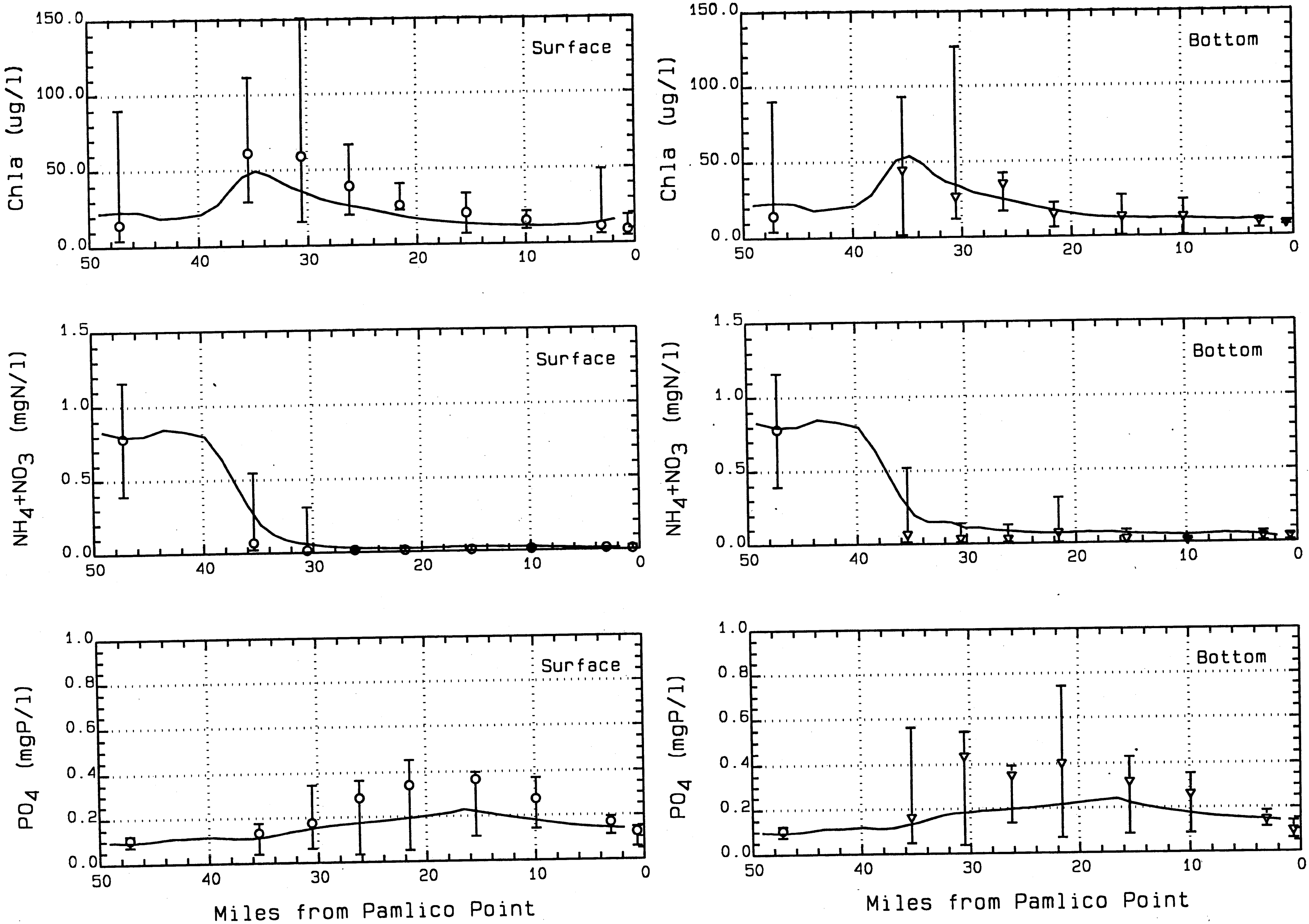

Figure 7-11. Tar-Pamlico River - 1991 Summer Averages
- Data Plotted represents Median and Range, ——— Model Average

above the phosphorus half saturation constant of 0.001 mg/l, the discrepancy does not effect algal growth. Sediment phosphorus fluxes are dependent upon water column dissolved oxygen concentrations and therefore discrepancies between computed and observed dissolved oxygen concentrations may also effect sediment phosphorus fluxes. The uncertainty in phosphorus loadings to the system, specifically non-point sources, may also contribute to the under computed water column orthophosphate concentrations. Generally, the computed nutrient concentrations reproduce the observed trends and fall within the measured ranges. The Texasgulf phosphorus loading is apparent between stations 5 and 7 near mile 16. Algal levels and spatial profiles are reasonably computed and the algal-nutrient interactions are properly modeled.

The averaged sediment output, at ambient temperature, for the summer period is presented in Figure 7-12 along with the bottom layer dissolved oxygen and chlorophyll concentrations. The computed spatial trends for the SOD and phosphorus, ammonia and nitrate fluxes respond to the algal peak near station 12. The computed SOD and fluxes increase to a maximum slightly downstream from station 12 between stations 10 and 12 (mile 32) which may result from increased settling due to changes in geometry. Computed SOD is approximately 1 $g/m^2/d$ upstream and downstream from the maximum of approximately 2.2 $g/m^2/d$. The computed phosphorus fluxes range from 6 $mg/m^2/d$ to 26 $mg/m^2/d$ at the peak. The computed ammonia and nitrate fluxes upstream from station 12 are generally into the sediments due to the large concentration gradient between the water column and the sediment pore water. The ammonia fluxes decrease downstream of station 12 from approximately 70 to 5 $mg/m^2/d$ and the nitrate fluxes decrease from approximately 25 to 10 $mg/m^2/d$.

7.2.2 Winter Averaged Spatial Comparisons

The winter period is presented in Figures 7-13 through 7-15 and the data and model are averaged for the months of October through April as described for the summer average comparisons. Generally, the same trends and factors that affect the water quality data and model output for the summer average period are true for the winter.

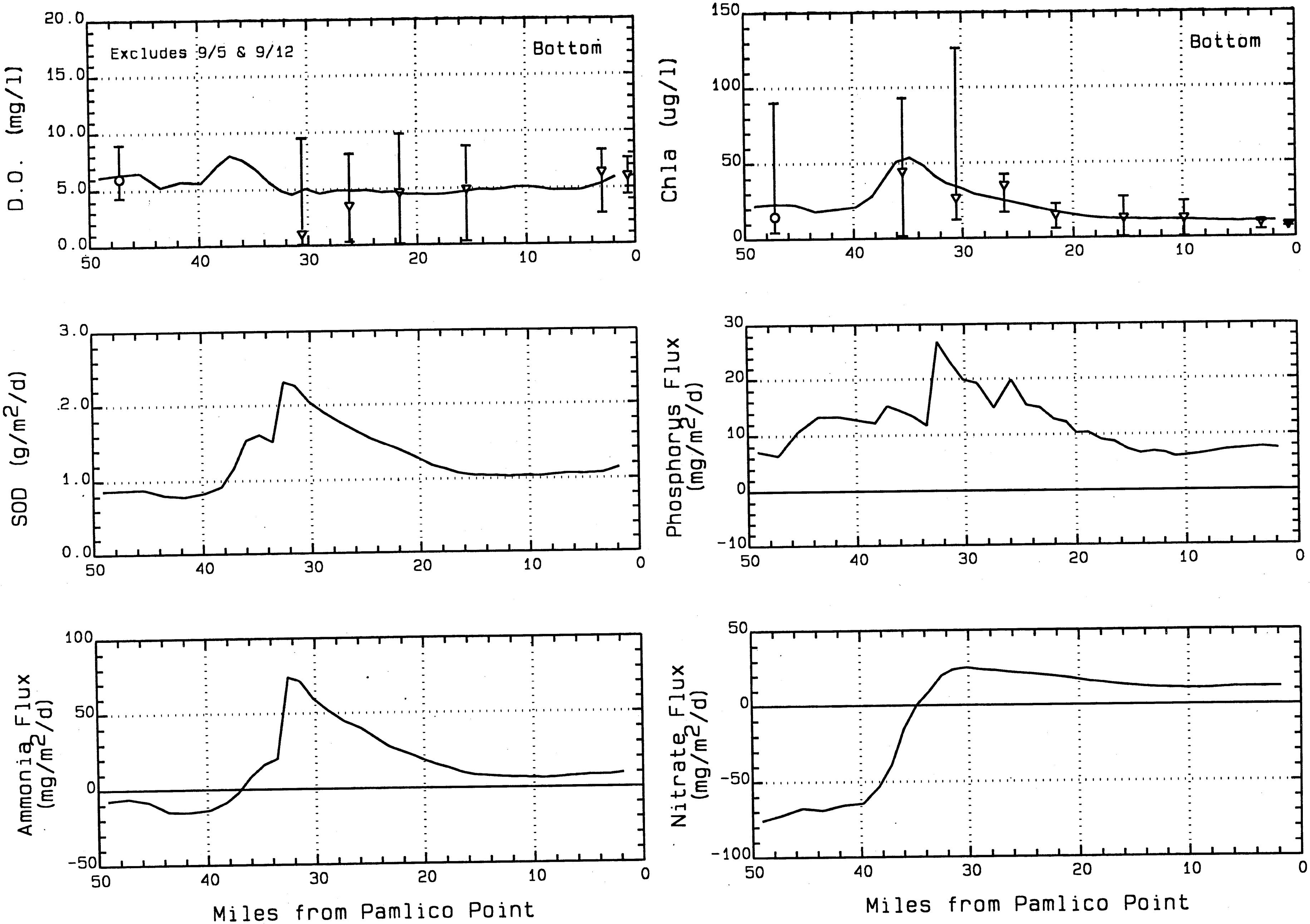

Figure 7-12. Tar-Pamlico River - 1991 Summer Averages

- Data Plotted represents Median and Range, ——— Model Average

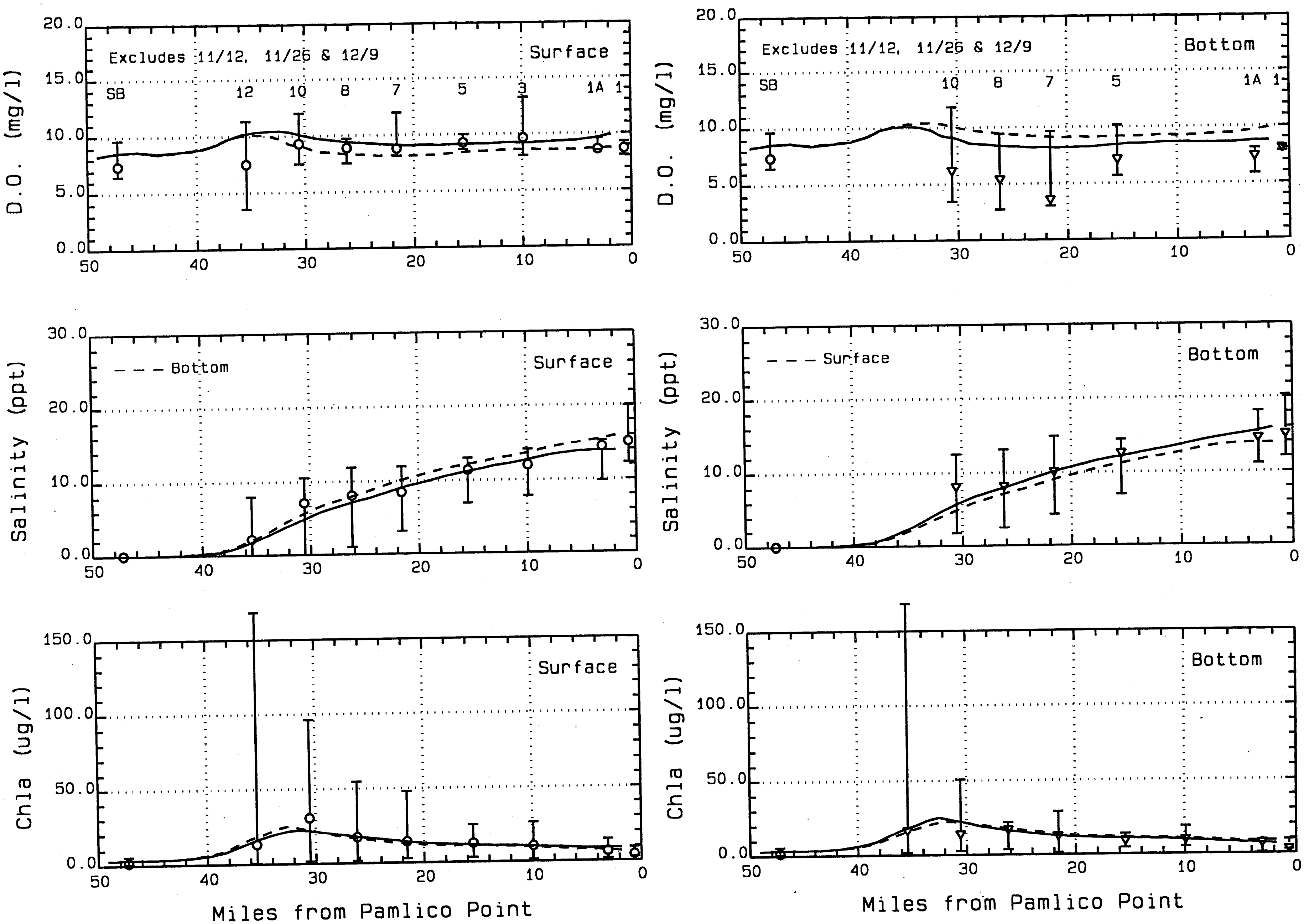

Figure 7-13. Tar-Pamlico River - 1991 Winter Averages

- Data Plotted represents Median and Range, ——— Model Average

The observed and modeled dissolved oxygen, salinity and chlorophyll concentrations are presented in Figure 7-13. The model reasonably captures the magnitudes and trends of the observed data except for the bottom layer dissolved oxygen concentrations which are greater than observed median values for station 7, 8 and 10 but are still within the observed ranges for this period. Surface layer observed and modeled dissolved oxygen concentrations are near the surface dissolved oxygen saturation value and are approximately 9 mg/l. Bottom layer median dissolved oxygen concentrations are approximately 7 mg/l at station SB and downstream from station 5 and for stations 7, 8 and 10 are approximately 5 mg/l. The increase in dissolved oxygen levels during the winter period is due to the lower water temperatures and algal levels and the subsequent decrease in the SOD.

The observed and computed chlorophyll levels are approximately one half the summer values and peak between stations 10 and 12, see Figure 7-14. Chlorophyll levels upstream and downstream from the peak are approximately 5 μg/l and increase to a maximum of 25 μg/l. The TIN concentrations exhibit the same decreasing spatial trend as the summer values. Higher TIN concentrations from station 12 downstream are due to the high freshwater loadings of ammonia and nitrate in the beginning of the year. Upstream TIN concentrations are composed of approximately 13% ammonia and 87% nitrate and at station 12 are approximately 20% ammonia and 80% nitrate. Downstream from station 12 to station 1 the percentage of ammonia increases from approximately 50% to 80%. The lower percentage of ammonia during the winter than the summer reflects the higher loading of nitrate from the high flows in the beginning of the year and the higher ammonia fluxes during the summer. Modeled orthophosphate concentrations are slightly higher than the observed medians in the middle of the estuary but are still within the observed ranges. Winter observed orthophosphate concentrations are lower than the summer values due to the increased phosphorus fluxes during the summer.

The average sediment response to the lower water temperatures and algal levels during the winter is evident from Figure 7-15. The computed SOD and phosphorus,

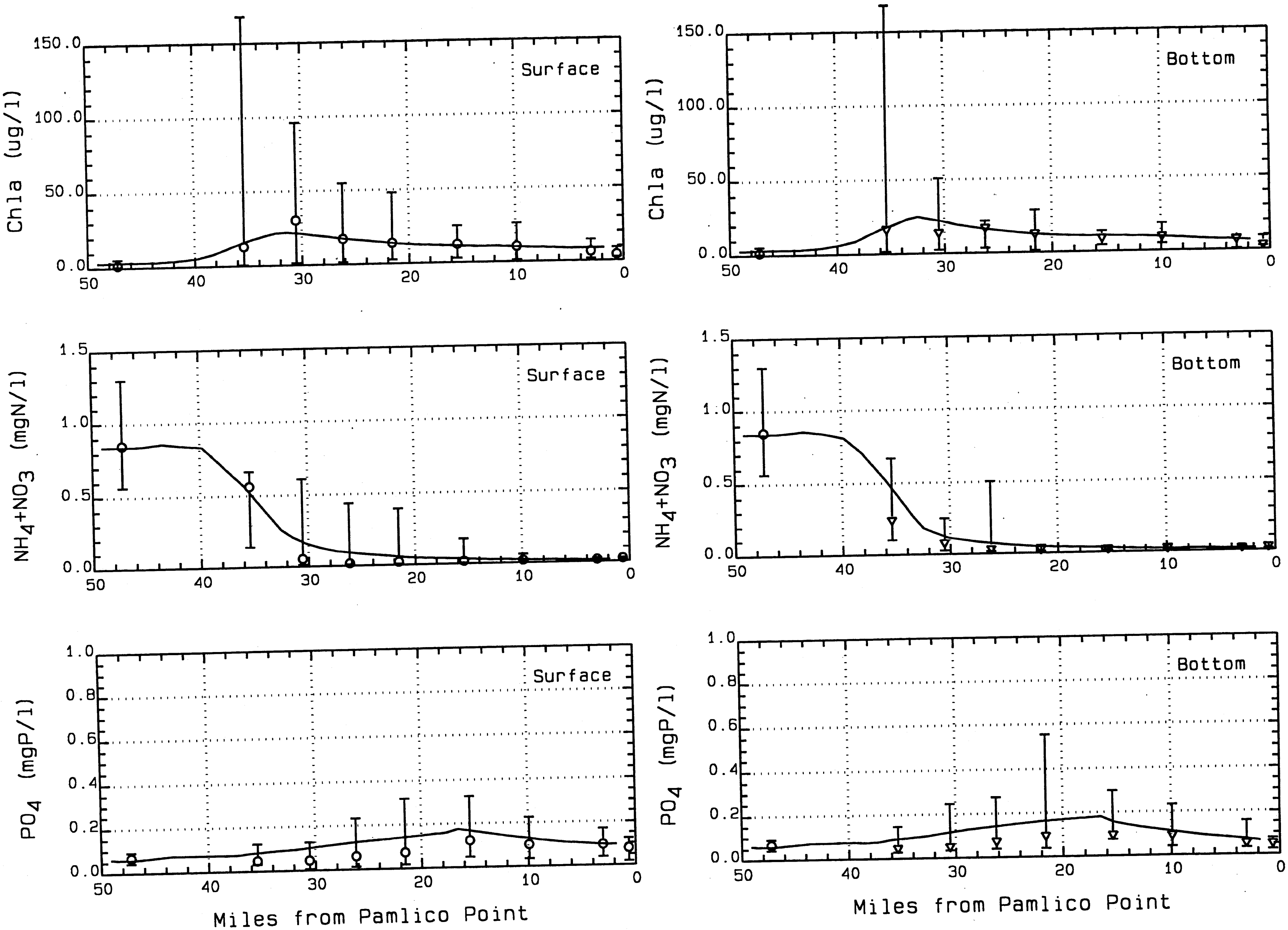

Figure 7-14. Tar-Pamlico River - 1991 Winter Averages

- Data Plotted represents Median and Range, ——— Model Average

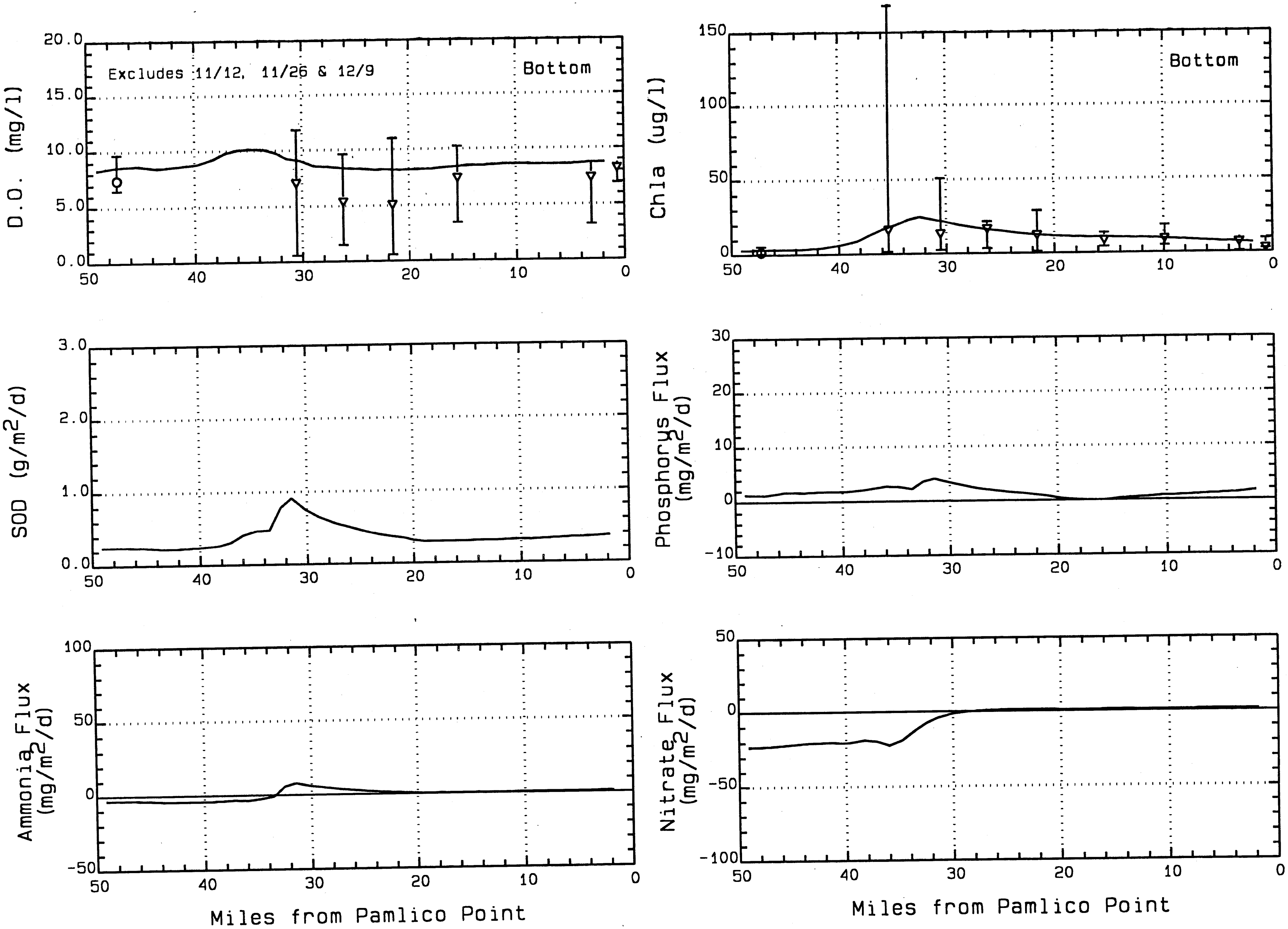

Figure 7-15. Tar-Pamlico River - 1991 Winter Averages

- Data Plotted represents Median and Range, ——— Model Average

ammonia and nitrate fluxes are all significantly lower than the values computed during the summer. Water temperature is the primary cause for these decreased values. The peak in the SOD and fluxes still responds to the algal peak between stations 10 and 12. The maximum SOD during the winter period is approximately 1.0 $g/m^2/d$ as compared to the summer maximum of approximately 2.2 $g/m^2/d$. Upstream and downstream from the peak, the SOD decreases to approximately 0.2 to 0.4 $g/m^2/d$. The phosphorus fluxes range between 0 and 4 $mg/m^2/d$. The ammonia and nitrate fluxes upstream from station 12 are into the sediments, similar to the summer fluxes, due to the large concentration gradient between the water column and sediment pore water concentrations. Ammonia fluxes downstream from station 12 range from 0 to 10 $mg/m^2/d$ and the nitrate fluxes are near zero.

7.2.3 Temporal Comparisons

The next series of figures presents the temporal trends in water quality data and daily model output for four stations in the estuary. Dissolved oxygen, salinity, chlorophyll, orthophosphate, ammonia and nitrate concentrations for stations 5, 7, 8 and 10 are presented on Figures 7-16 through 7-19. The dissolved oxygen and salinity data and model output are also presented on expanded scales in Figures 7-20 through 7-23. The dissolved oxygen and salinity data and model output are averaged above and below the halocline as outlined in Section 7.2, with the solid line representing the surface layer and the dashed line representing the bottom layer. Chlorophyll, orthophosphate, ammonia and nitrate concentrations are presented as surface and bottom samples for the observed data and as layers 1 and 8 for the model output. For these constituents, the solid line represents layer 1 model output and the dashed line represents layer 8.

The observed salinity concentrations for 1991 generally increase throughout the year reflecting the overall decrease in freshwater flow entering the system, Figures 7-16 through 7-19. The decrease in salinity concentrations during January, March, April and August reflect the high freshwater flows entering the system in the beginning of the year and in late July and August. The model generally captures the increasing salinity

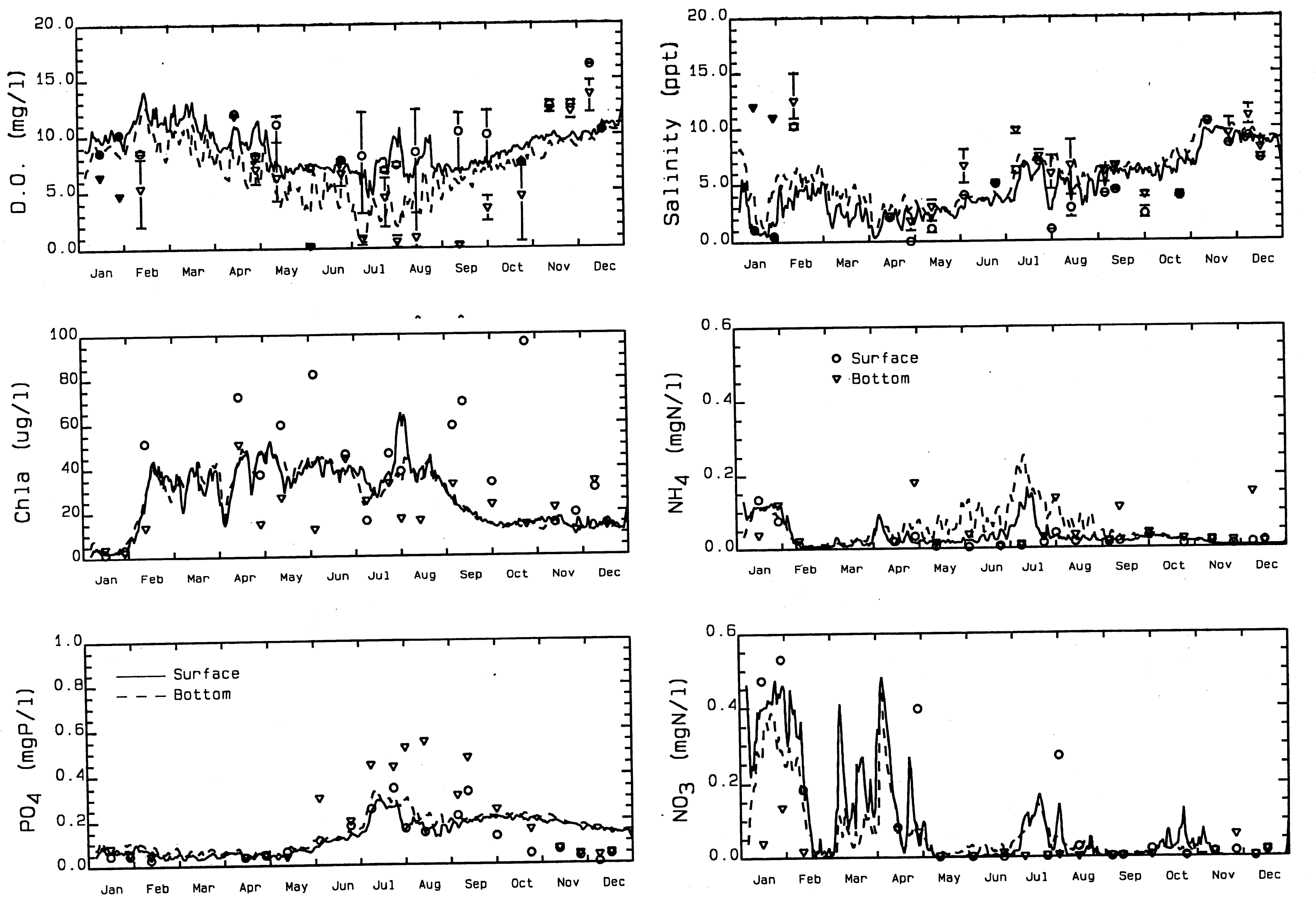

Figure 7-16. Tar-Pamlico River - Station 10, 1991
Model Segment 18, 3

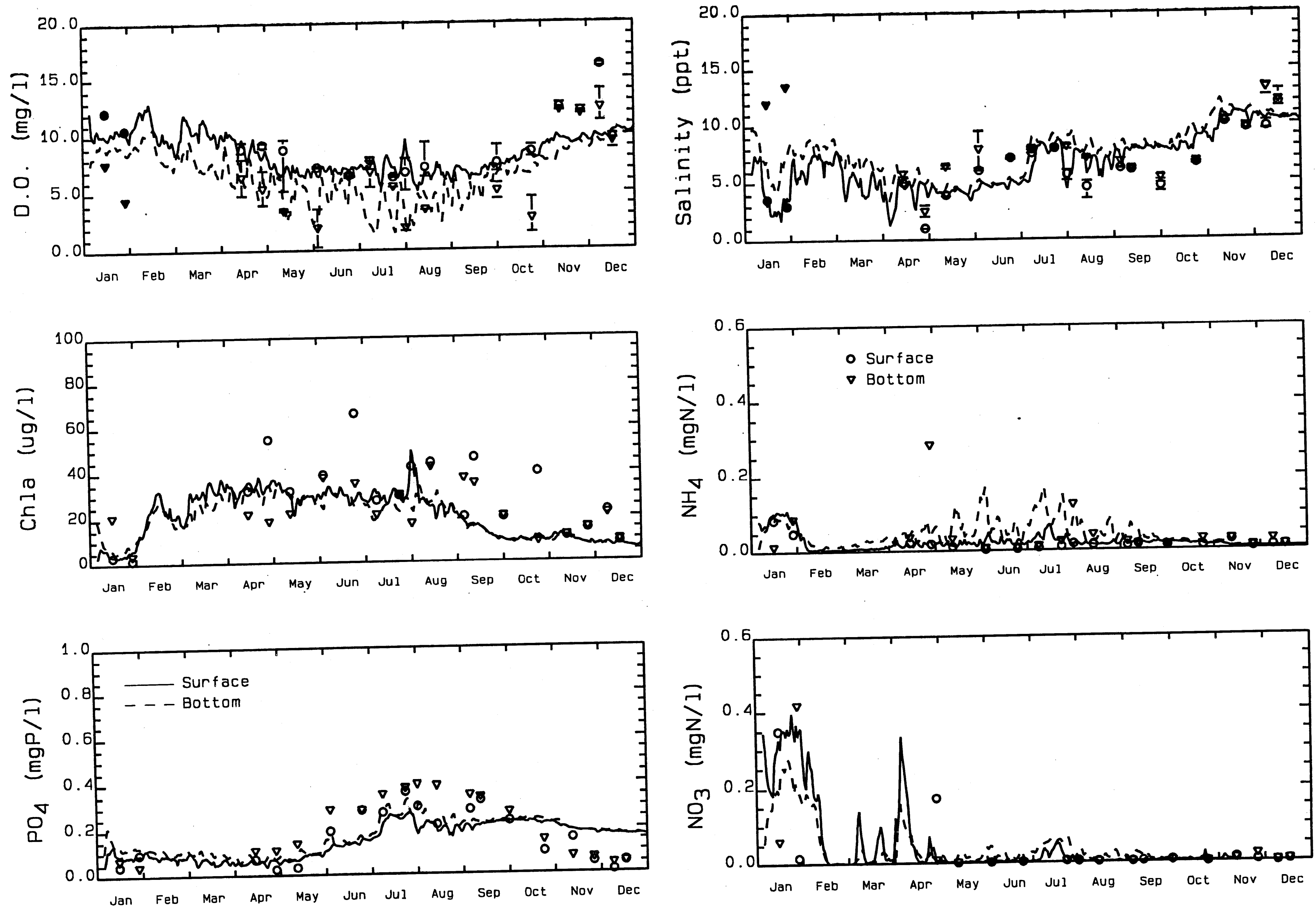

Figure 7-17. Tar-Pamlico River - Station 8, 1991
Model Segment 21, 3

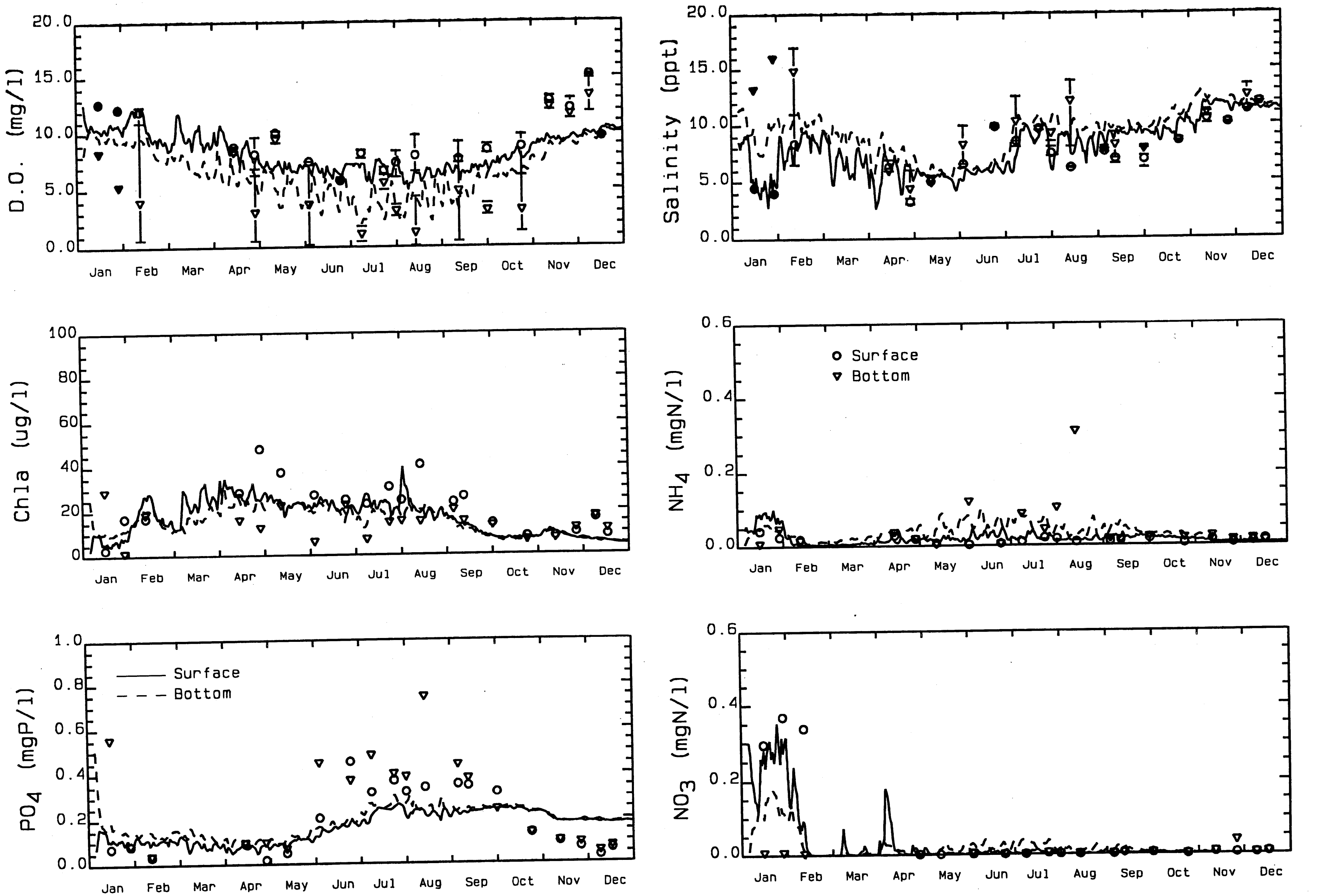

Figure 7-18. Tar-Pamlico River - Station 7, 1991
Model Segment 24, 3

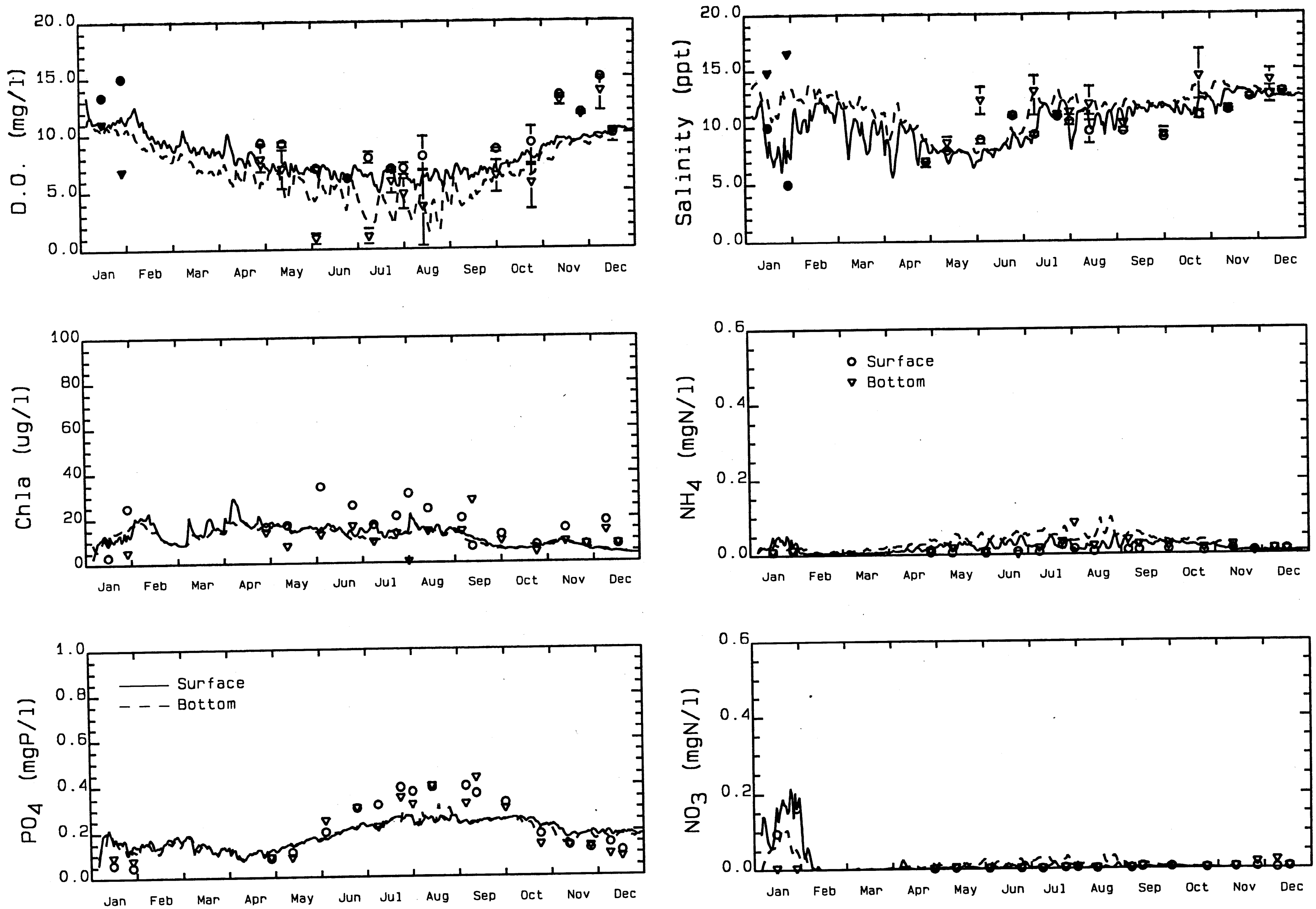

Figure 7-19. Tar-Pamlico River - Station 5, 1991
Model Segment 30, 3

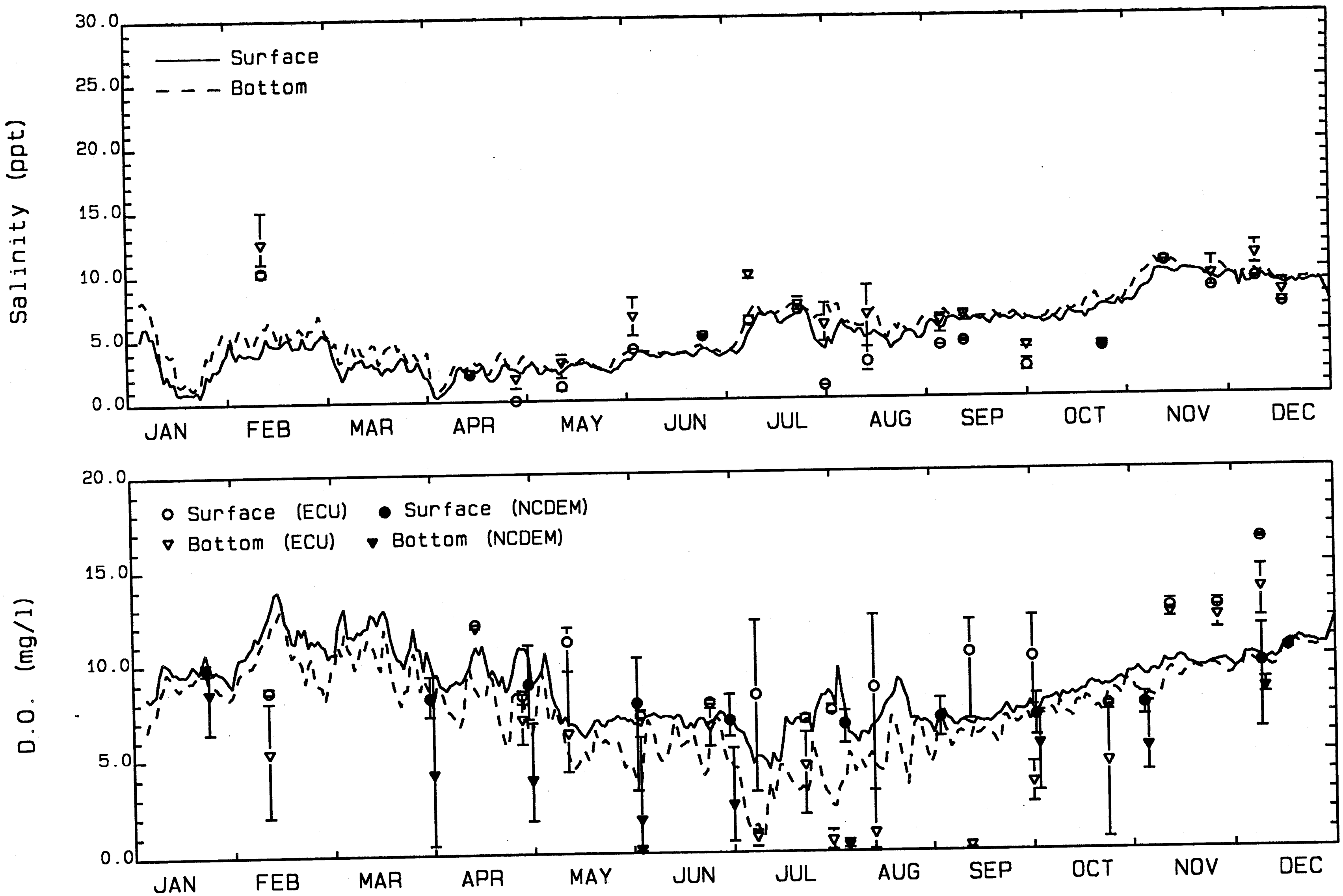

Figure 7-20. Tar-Pamlico River Salinity and D.O. - Station 10
Model Segment 18, 3

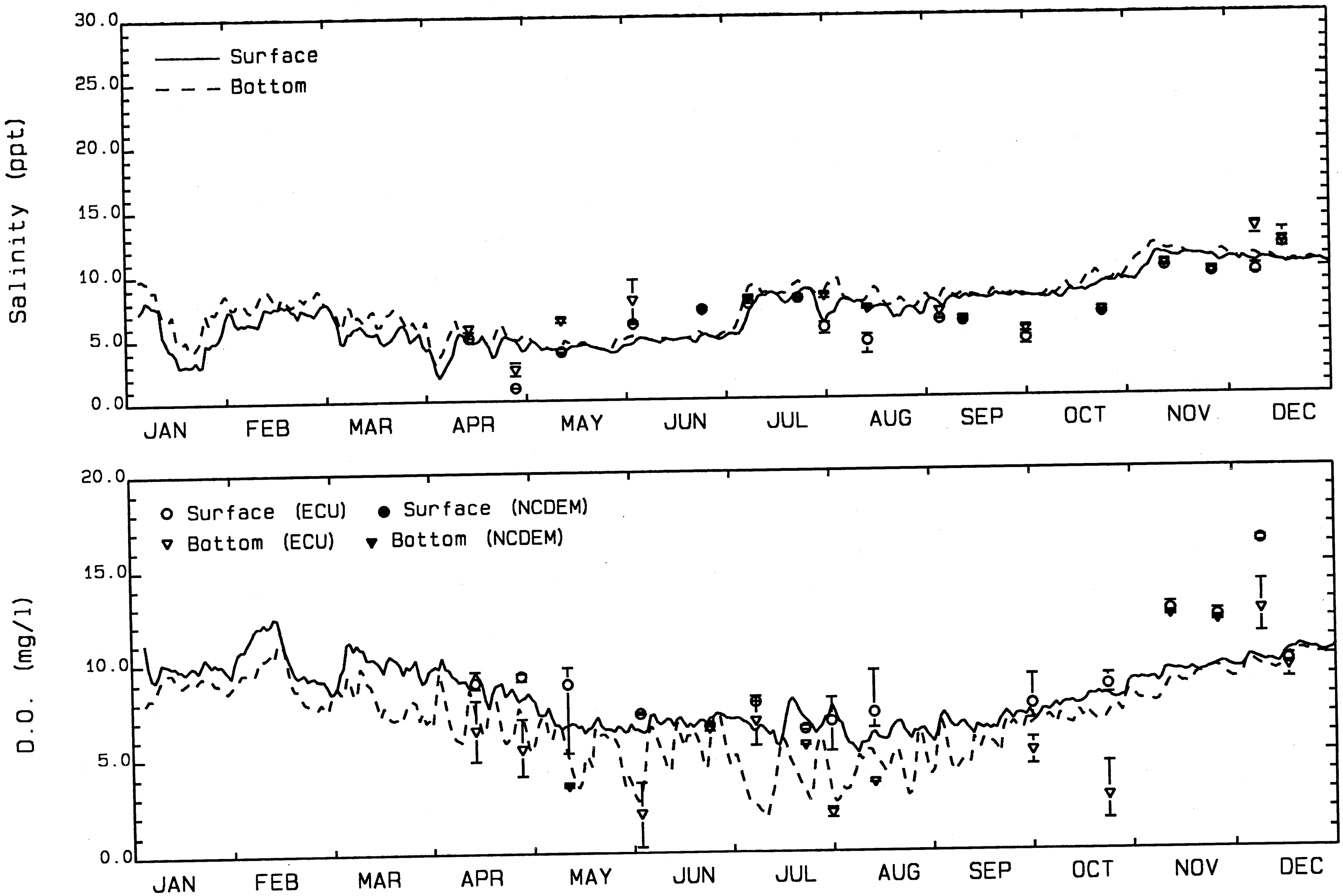

Figure 7-21. Tar-Pamlico River Salinity and D.O. - Station 8
Model Segment 21.3

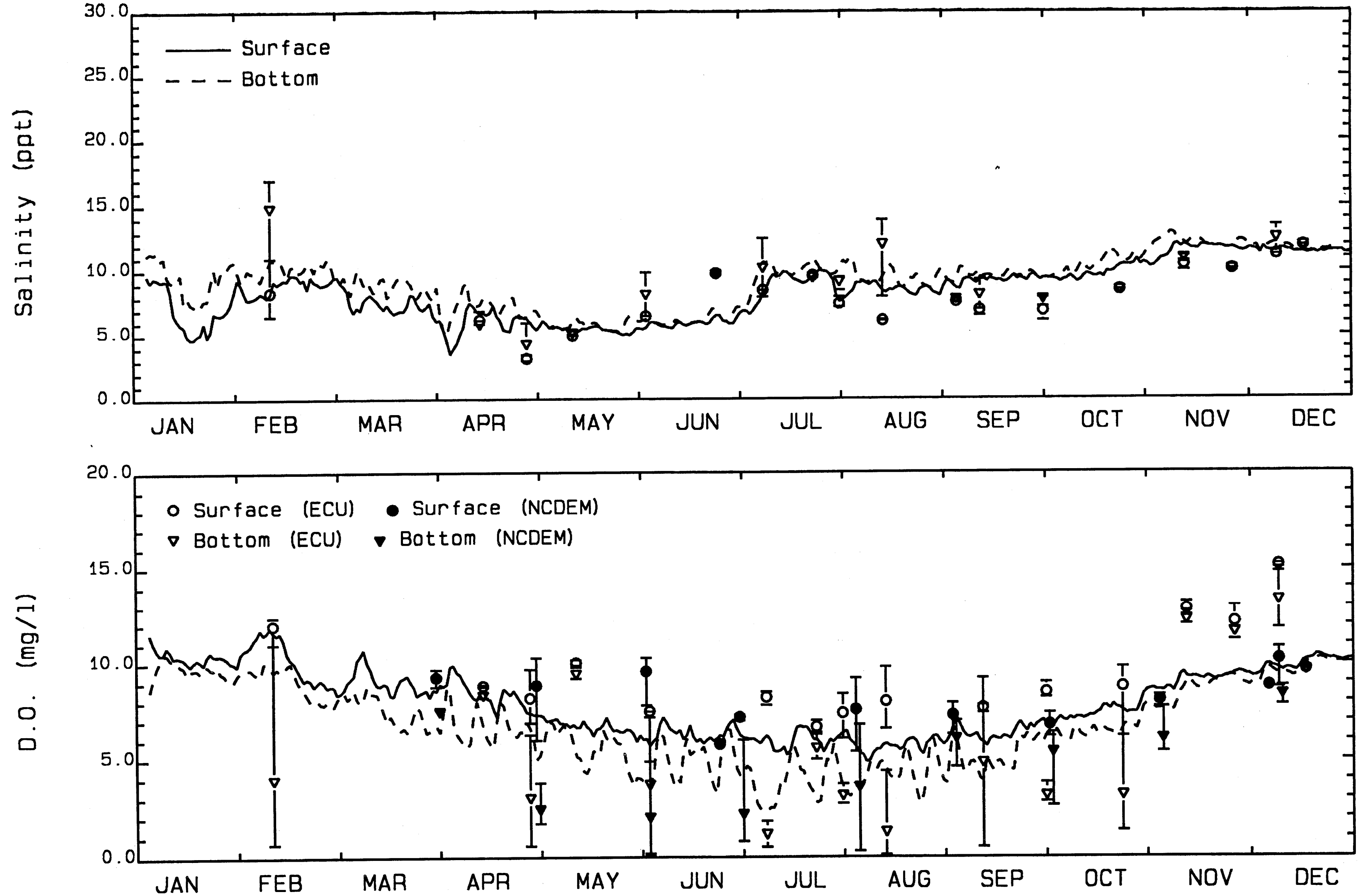

Figure 7-22. Tar-Pamlico River Salinity and D.O. - Station 7
Model Segment 24, 3

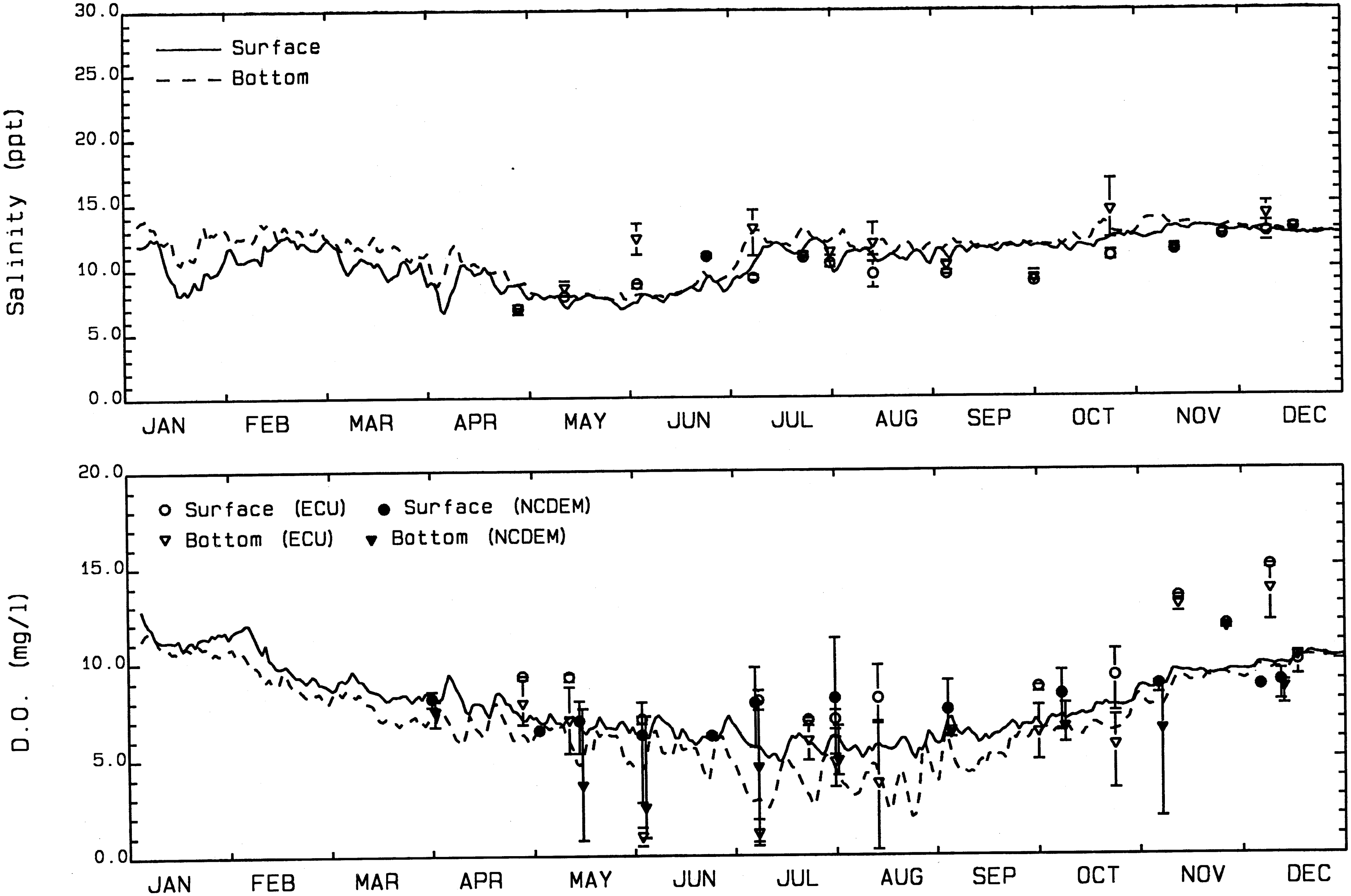

Figure 7-23. Tar-Pamlico River Salinity and D.O. - Station 5
Model Segment 30, 3

concentrations throughout the year for these stations and also the downstream increase in salinity concentrations from station 10 to 5. The short term salinity stratification and destratification events that occur within days in the estuary are calculated by the model yet are not obvious from the data, which is sampled approximately every two weeks. This behavior is exhibited in the USGS salinity and dissolved oxygen continuous monitoring data in Figure 7-24. The relatively short time scale of the mixing events is evident from the USGS surface and bottom data collected at the four stations in the estuary. The discontinuous behavior of the USGS data is due to malfunctions of the sampling device during the sampling period.

The observed surface layer dissolved oxygen concentrations are typically near the dissolved oxygen saturation values which are approximately 9.5 mg/l during the winter and 7.5 mg/l in the summer. Surface layer dissolved oxygen concentrations occasionally are supersaturated primarily due to algal dissolved oxygen production. The modeled surface layer dissolved oxygen concentrations for stations 5, 7, 8 and 10 generally reproduce the observed winter and summer trends and magnitudes and are typically within the measured ranges for these stations during the year. The observed dissolved oxygen concentrations during November and December were included in these figures to highlight the discrepancies in their magnitude, as described in section 7.2.

Bottom layer dissolved oxygen concentrations are significantly less than the surface layer concentrations due the salinity stratification present and the ambient oxygen demands. These low dissolved oxygen levels typically occur during the summer when water temperatures are near the maximum of approximately 30°C. Also at this time of the year, SOD and the sediment fluxes are at their maximums, again due to the high water temperatures. The observed and modeled dissolved oxygen stratification typically coincides with salinity stratification and the frequency of events is of the same time scale as that for salinity stratification. The modeled bottom layer dissolved oxygen concentrations are slightly higher than the observed concentrations (station 10), as mentioned in Section 7.2.1, which is possibly due to the lateral averaging of water depths for model geometry. Differences between the laterally averaged modeled depth and the

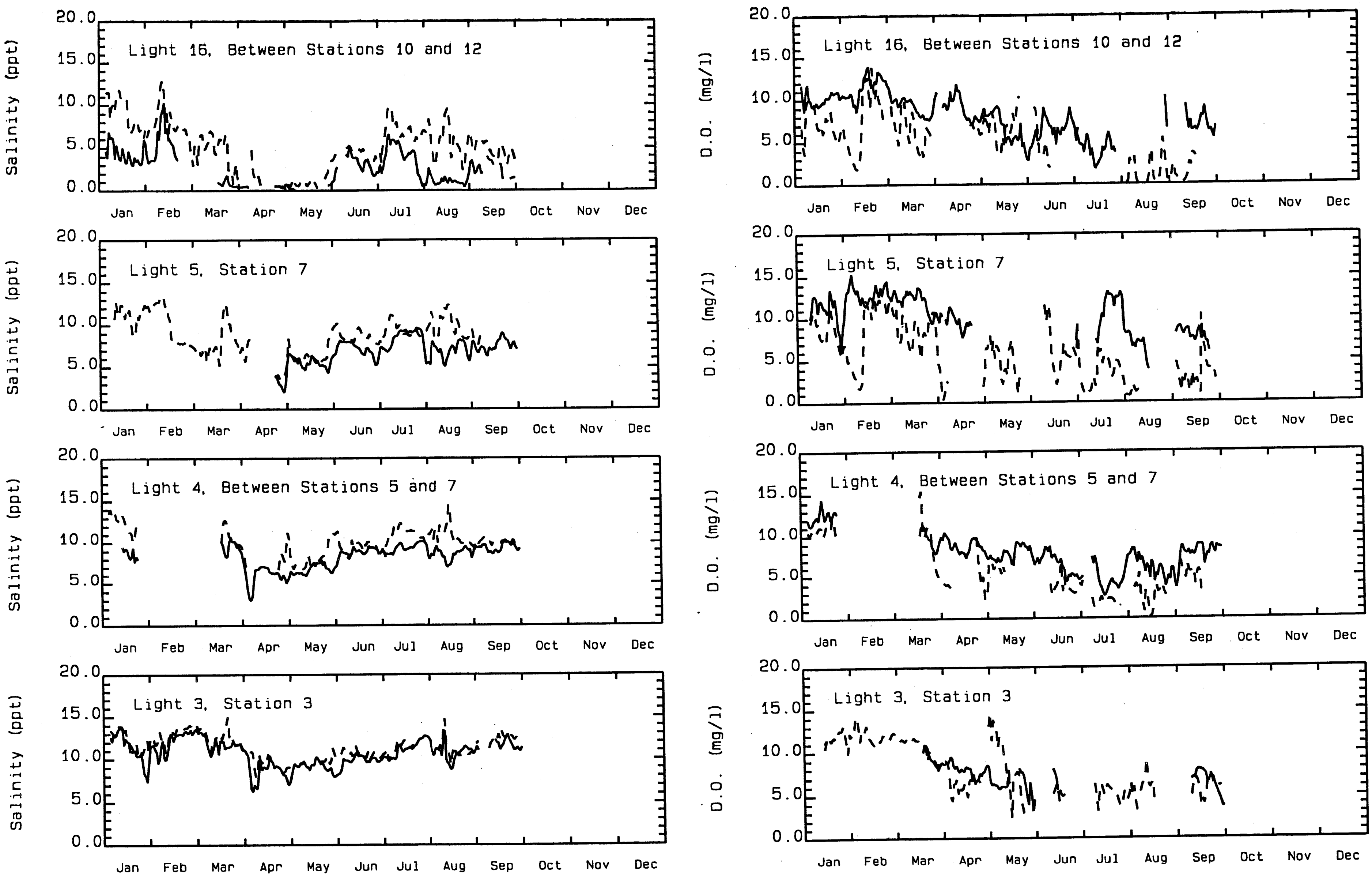

Figure 7-24. USGS Salinity and D.O. Continuous Monitoring Data for 1991

observed maximum depth are a maximum upstream and decrease in the downstream direction. The improvement between observed and modeled bottom layer dissolved oxygen concentrations at station 5, 7 and 8, may reflect better agreement between model and actual water depths at these stations.

The computed chlorophyll, orthophosphate, ammonia and nitrate concentrations reasonably reproduce the observed patterns and magnitudes of the observed data for stations 5, 7, 8 and 10. The computed algal biomass reproduces the observed average level throughout the year. Chlorophyll concentrations in 1991 typically start at low levels and grow to maximums during the spring and summer and then decrease again near the end of the year. The periodic algal peaks or blooms that occur throughout the year are not computed in the model since most of these peaks are probably of small areal extent and are locally influenced. The decreasing chlorophyll levels from September through December at these stations are caused by the decreasing available nitrogen, specifically ammonia, and decreasing water temperatures.

The computed and observed ammonia and nitrate concentrations are typically the greatest in the beginning of the year when the freshwater inflows were the highest and decrease throughout the year to low levels during the winter. The effect of the freshwater inflow and the associated elevated ammonia and nitrate concentrations are reproduced by the model. Summer increases in the ammonia and nitrate concentrations, especially in the bottom layer, reflect the increased fluxes of ammonia and nitrate. In general, the ammonia and nitrate concentrations are near the nitrogen half saturation constant for algal growth of 0.01 mg/l and are the limiting nutrients for the year.

Orthophosphate concentrations are at the highest levels during the summer due to the increased phosphorus fluxes during this time. The summer increase of phosphorus fluxes is due to high water temperatures and low bottom layer dissolved oxygen levels. This observed behavior is generally computed by the model but the summer magnitudes are under computed. Even though the observed summer orthophosphate concentrations are under computed, there is no effect upon algal growth since nitrogen is the limiting nutrient. Also, the orthophosphate concentrations near the end of the year are slightly over computed. The difficulty in reproducing the observed orthophosphate concentrations may result from the absence of sediment data for 1991 which is needed to calibrate the sediment model for this system. Other difficulties may stem from the limited data used to develop the tributary loadings for 1991 and also not knowing the capacity of the sediment to store phosphorus from previous years.

The primary factors influencing salinity stratification and destratification (mixing) for this system are the ambient wind and flow conditions. In Figure 7-25, the daily average freshwater flow, wind stress and station 7 salinity and dissolved oxygen data are presented to highlight the physical mixing factors. The high freshwater flows in the beginning of the year and in July and August cause salinity stratification in April and at the end of July as bottom salinities remain constant while the surface salinities decrease. The importance of low wind conditions and therefore low surface wind stress, is more important during steady flow conditions such as those observed during June and July and from September through December. The low wind stress near the end of May causes significant vertical salinity stratification as observed during the first sampling date in June. The second sampling date in June is completely mixed in the vertical in response to the increased wind stress prior to the sampling date. The importance of wind or flow induced stratification and destratification is also observed in the dissolved oxygen data in Figure 7-25. Typically, when surface and bottom salinities are stratified, a concurrent stratification of surface and bottom dissolved oxygen concentrations is observed.

Figures 7-20 through 7-23 highlight the importance of these mixing processes on dissolved oxygen levels and also the frequency of these events in the Tar-Pamlico River. These wind induced mixing events occur on a time scale of days to weeks and result in the mixing of the surface and bottom layers in the estuary. The effect of these mixing processes on dissolved oxygen levels is apparent from these figures. At the onset of salinity stratification, surface and bottom layer dissolved oxygen concentrations are either completely or partially mixed. As the duration of the stratification event increases, the bottom layer dissolved oxygen concentrations decrease and if water temperatures and

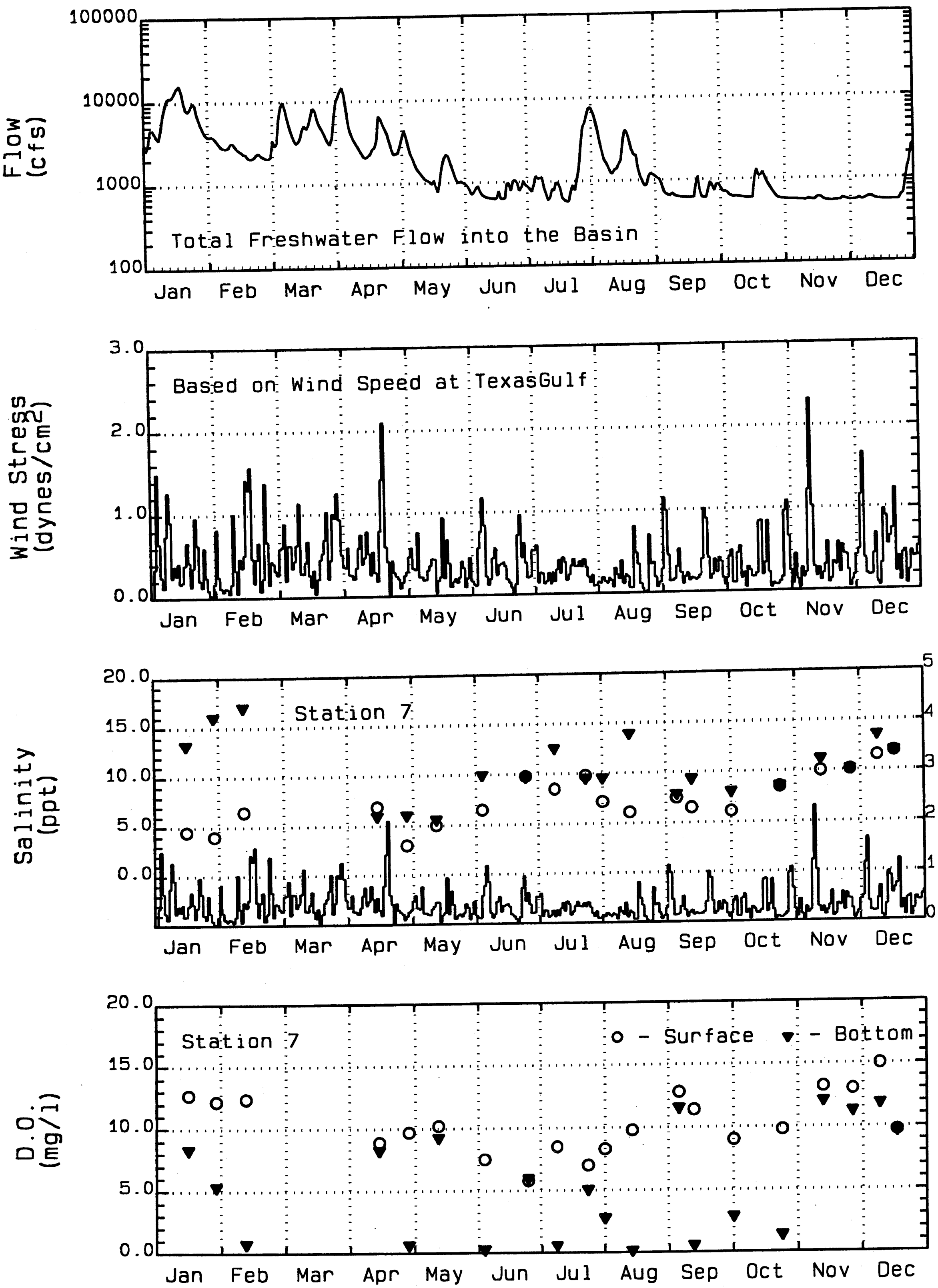

Figure 7-25. Physical Factors Affecting Salinity and Dissolved Oxygen Stratification in the Tar-Pamlico River for 1991

oxygen demands are high they may approach hypoxic conditions. The physical process that controls the deoxygenation of the bottom waters is the decrease in mixing between the surface and bottom layers. As this physical mixing decreases, the transfer of dissolved oxygen from the surface layer to the bottom layer is reduced and the dissolved oxygen supplied through atmospheric reaeration is prevented from offsetting the oxygen demands in the bottom layer. As the wind speeds increase and therefore mixing, surface and bottom layer salinities and dissolved oxygen concentrations become mixed until the winds subside and the stratification processes begin again. These events occur throughout the year as displayed in the Figures for stations 5 through 10 but dissolved oxygen hypoxia typically occurs during the summer when water temperatures and oxygen demands are the highest.

7.2.4 Sediment Model Calibration

The computed SOD and nutrient fluxes for 1991 are presented in Figures 7-26 through 7-31 along with SOD measurements from 1992 and ammonia and orthophosphate fluxes from 1981 through 1983. None of the sediment data available coincided with the calibration year of 1991 and therefore the yearly trends and relative magnitudes of the data were considered during the calibration of the sediment model. Pore water data was also available from a few studies during 1980 through 1983 and are included with the sediment calibration figures in Appendix 9.4.

The computed SOD and nutrient fluxes all reach maximum values during the summer when water temperatures are high and dissolved oxygen levels are low. Also, the algal biomass is an important factor controlling nutrient fluxes and SOD since the settling algae are the main source of organic material in the sediments and their decomposition is important in sediment nutrient recycling. The sediments also act as a reservoir for settling organic material during the cooler months when sediment decomposition is slow. As water temperatures increase, the decay of organic material (carbon, nitrogen and phosphorus) in the sediments increases and therefore the production of their end products (sulfide, ammonia and nitrate, and orthophosphate) also increases. The oxidation of sulfide

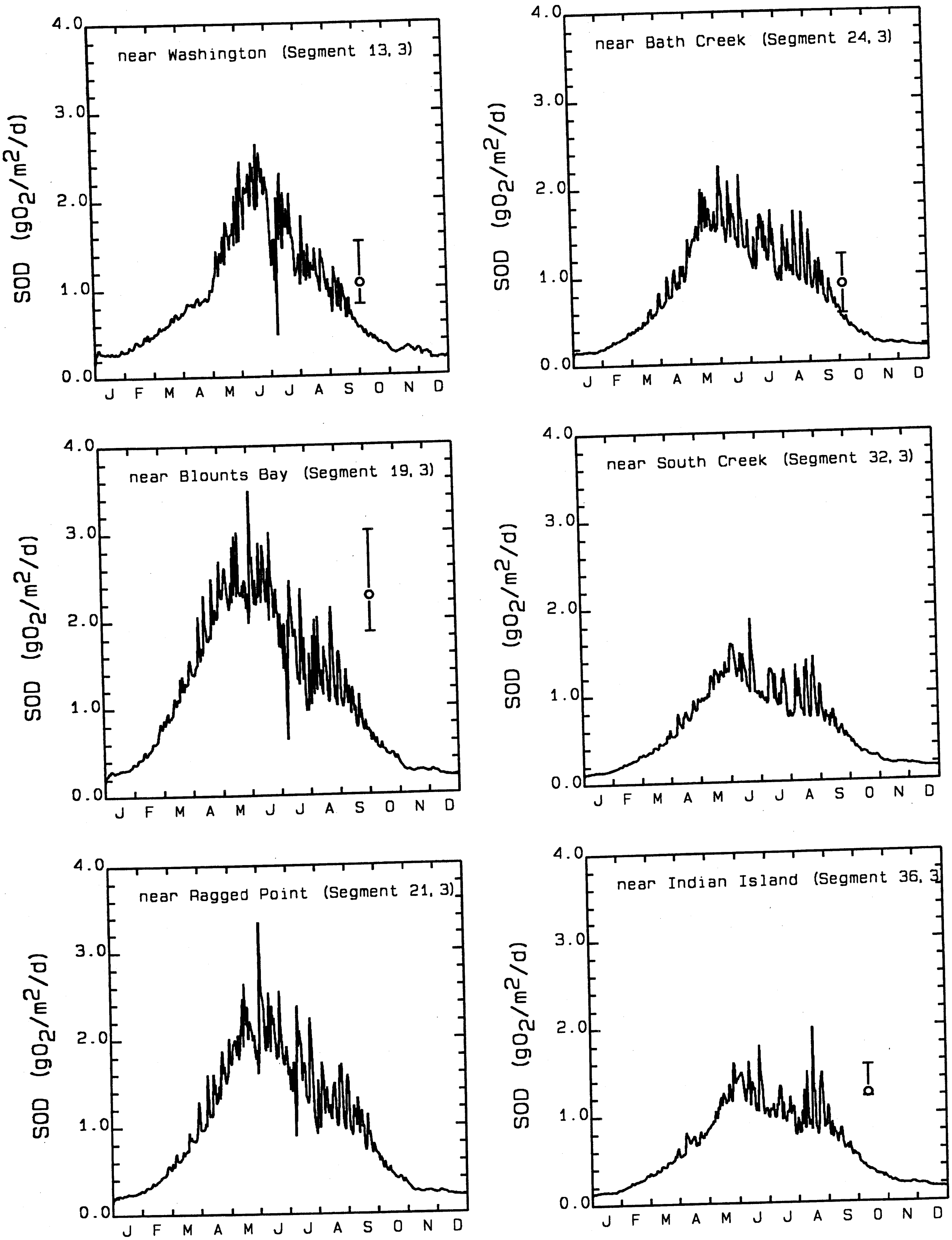

Figure 7-26. Tar-Pamlico Sediment Model SOD and 1992 Data

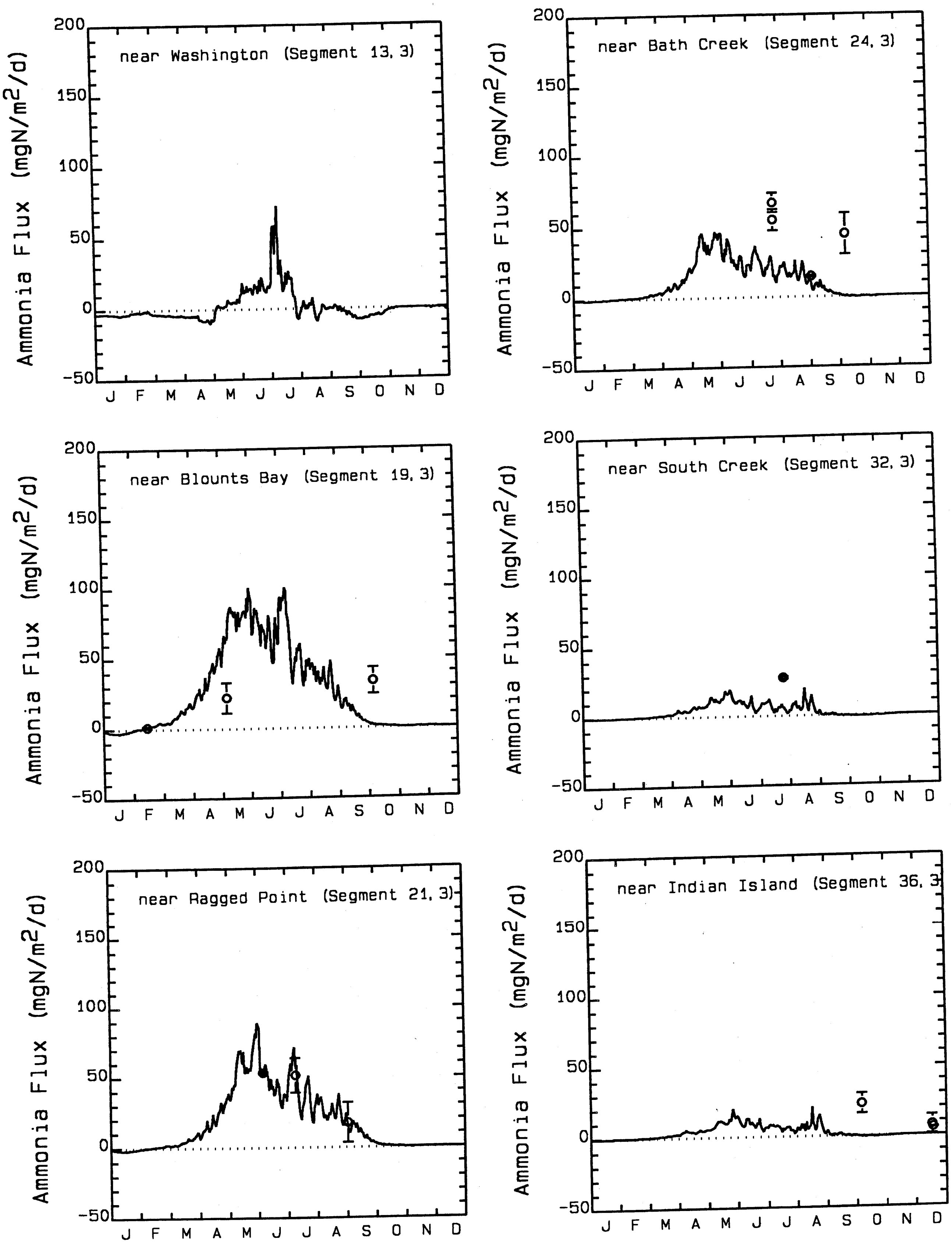

Figure 7-27. Tar-Pamlico Sediment Model Ammonia Flux and 1981-1982 Data

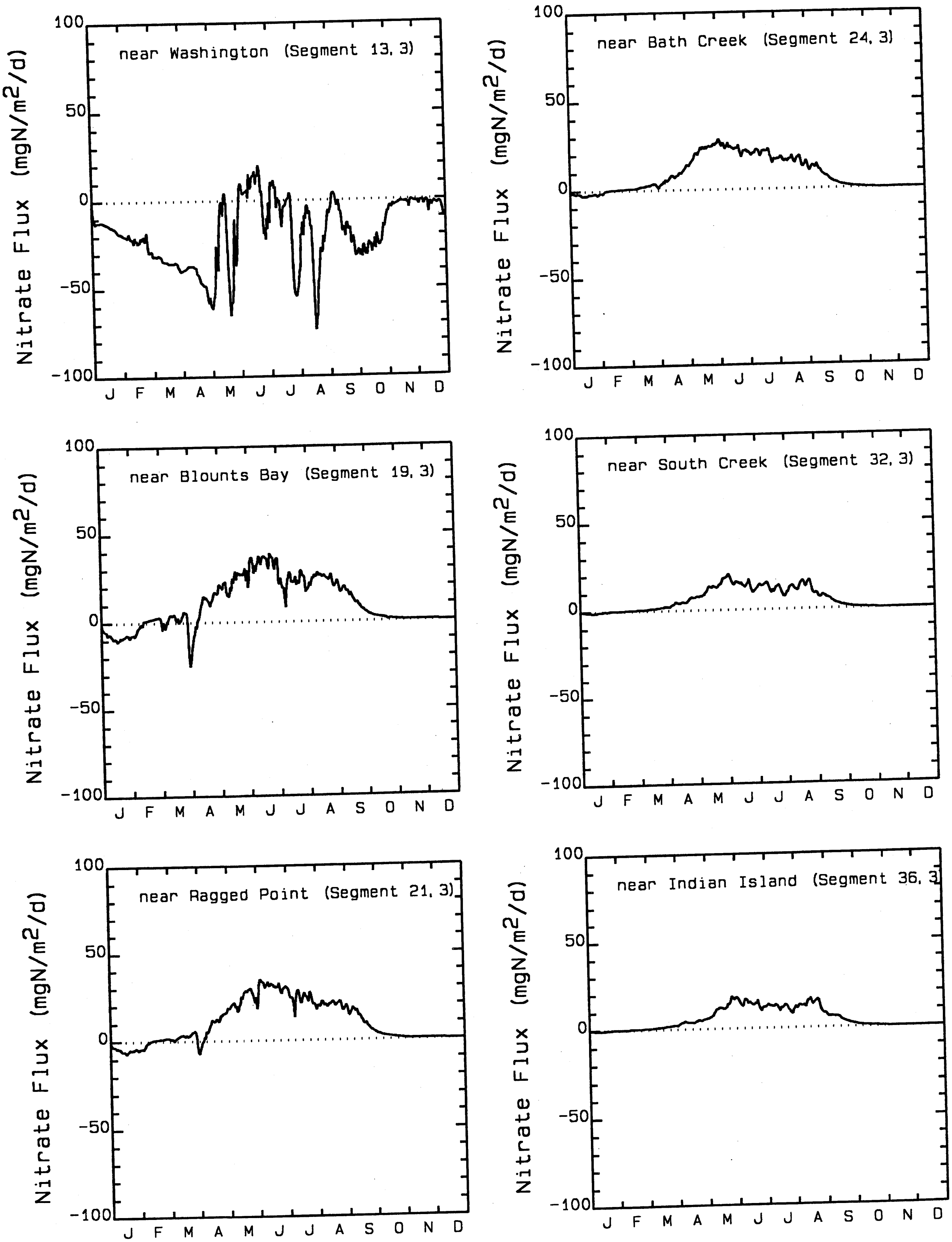

Figure 7-28. Tar-Pamlico Sediment Model Nitrate Flux

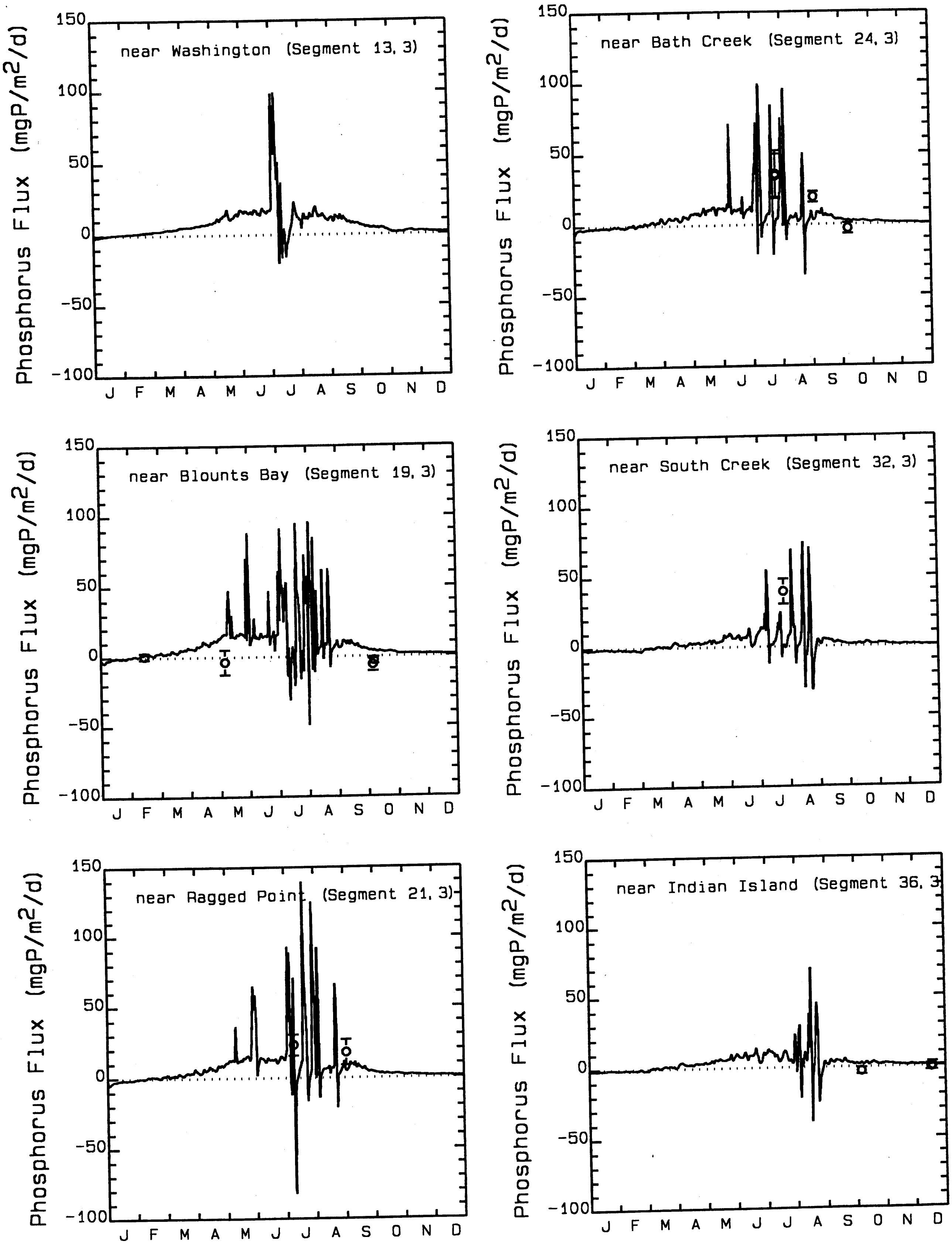

Figure 7-29. Tar-Pamlico Sediment Model Phosphorus Flux and 1981-1982 Data

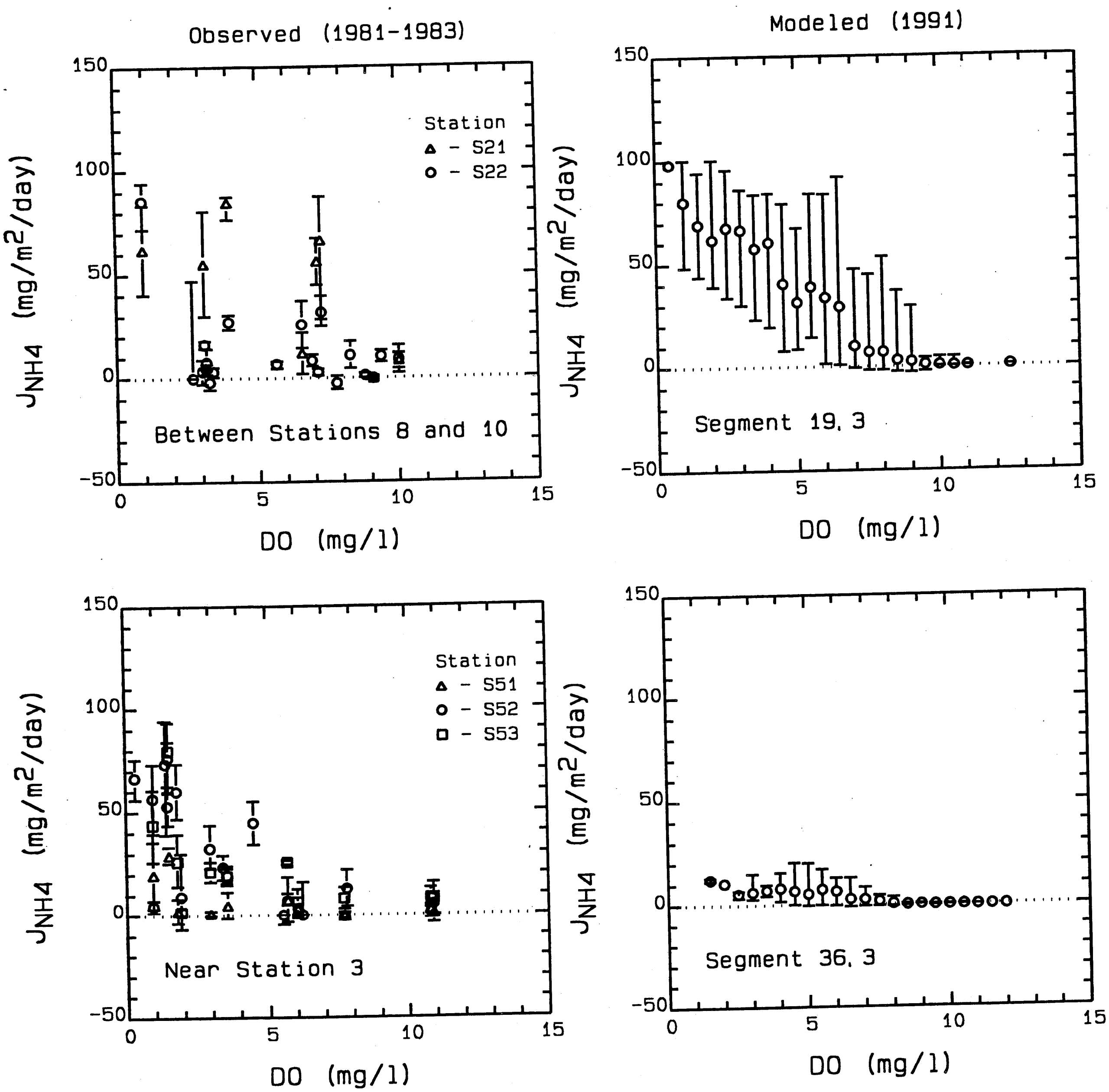

Figure 7-30. Tar-Pamlico Ammonia Fluxes

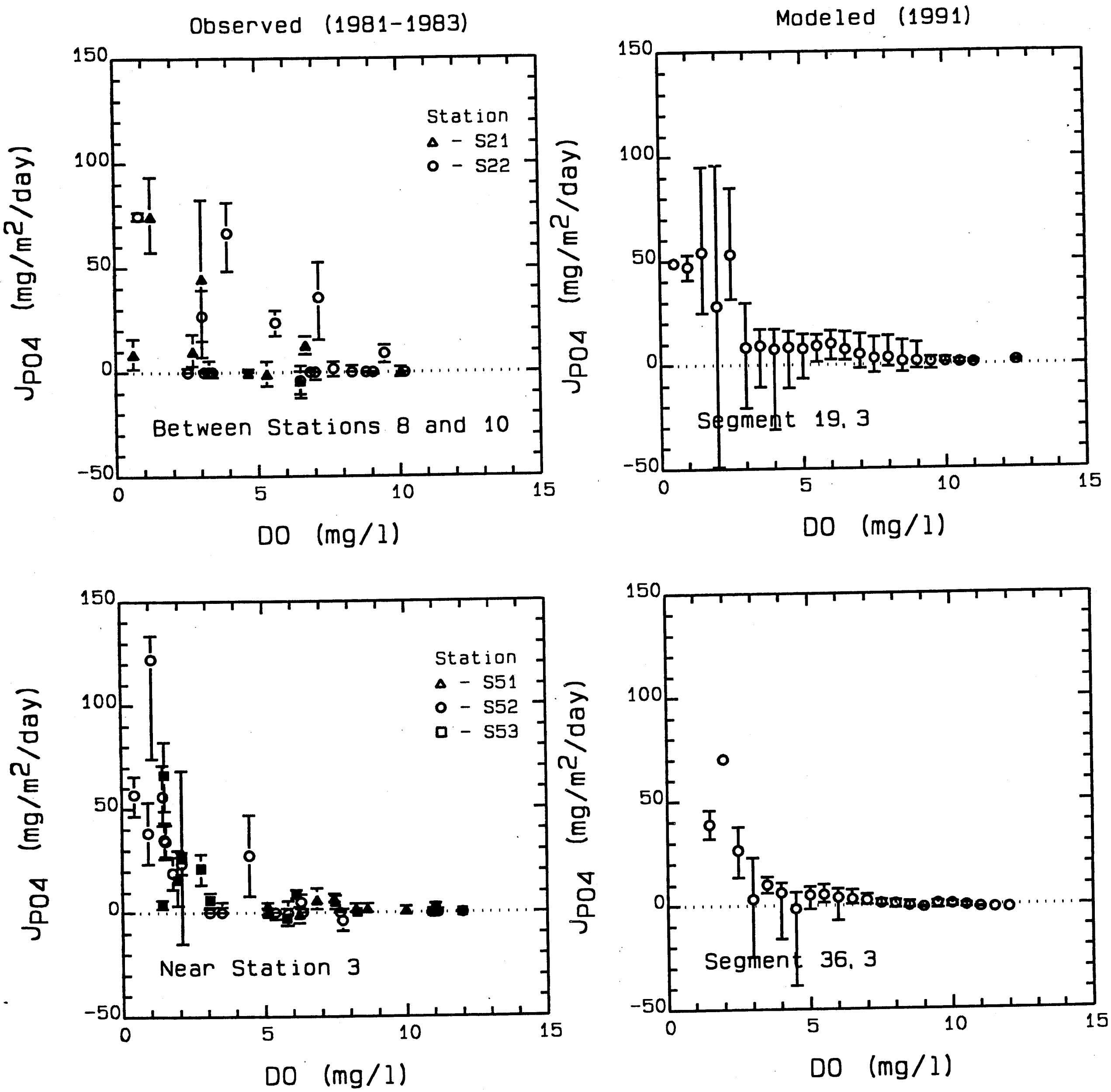

Figure 7-31. Tar-Pamlico Phosphorus Fluxes

and the nitrification of ammonia to nitrate determine the SOD and occur in the presence of oxygen, aerobic conditions. Therefore, as dissolved oxygen levels decrease, the SOD decreases due to the decrease of sulfide oxidation and nitrification. The production of sulfide is not affected by low dissolved oxygen levels and therefore fluxes into the water column where it eventually oxidizes. Another consequence of low dissolved oxygen levels is that the nitrification of ammonia to nitrate decreases and ammonia is fluxed into the water column. This increase in ammonia flux is observed in the data and model output during the summer when the dissolved oxygen levels are low and the water temperatures are high. Orthophosphate fluxes are also increased as dissolved oxygen levels decrease which is due to increases in the dissolved fraction of orthophosphate in the sediments. In general, the computed SOD and sediment fluxes behave in established patterns, low fluxes during the cooler winter months and high fluxes during the warmer summer months. Their relative magnitudes are similar to those measured in the Tar-Pamlico estuary and to those observed in similar systems.

The relationship between ammonia and orthophosphate fluxes and dissolved oxygen levels is presented in Figures 7-30 and 7-31. Observed and modeled fluxes are compared to the dissolved oxygen concentrations at the time of measurement or calculation. Additional ammonia and orthophosphate flux data from a few long term studies from 1981 to 1983 was included in these figures along with the data presented in Figures 7-26 to 7-29. These figures highlight the strong correlation between decreasing dissolved oxygen concentrations and increasing ammonia and orthophosphate fluxes. In both cases, the model reasonably reproduces the observed flux increase with decreasing dissolved oxygen concentrations.

7.3 VERTICAL DISPERSION SENSITIVITY

A model sensitivity was performed to address the question regarding the lateral averaging of model depths and its effect upon salinity and dissolved oxygen stratification. As discussed earlier, the laterally averaged model depths are less than the actual depths in certain areas of the estuary where a center channel may exist. The inability of a two-dimensional, laterally averaged model to represent these geometries may result in calculated vertical stratification, vertical mixing, that is less than observed. To address this question, the calculated vertical dispersion from ECOM3D was reduced by 75% for the entire year and the model calibration re-executed.

In order to compare the sensitivity results to the calibration for the entire year, the difference between computed surface and bottom layer salinities, termed delta salinity, are compared as frequency distributions in Figure 7-32. The calibration delta salinities are presented as a solid line in Figure 7-32 and the sensitivity results as a dashed line. The observed delta salinities for stations 5, 7, 8 and 10 are also presented in Figure 7-32. The calibration delta salinities are less than those observed and may suggest that the proper level of vertical salinity stratification is not attained. Comparison of observed and computed delta salinities for the sensitivity is improved and begins to approach the observed level of vertical salinity stratification. The effect of the increased salinity stratification on dissolved oxygen levels is presented in the next series of figures.

Observed and modeled surface layer and bottom layer dissolved oxygen concentrations are presented as frequency distributions for stations 5, 7, 8, and 10. Also included in the figures are the model computed minimum and maximum dissolved oxygen concentrations. The comparisons for the calibration are presented in Figure 7-33 and compare reasonably well but bottom layer dissolved oxygen concentrations are slightly higher than observed, especially at station 10. The comparison between observed and modeled dissolved oxygen concentrations for the sensitivity is presented in Figure 7-34 and shows the improved comparison of the bottom layer dissolved oxygen concentrations. Since vertical dispersions were reduced at all times during the year, some of the bottom layer dissolved oxygen concentrations which are above 7 or 8 mg/l were under computed, which compared favorably during the calibration.

There are also changes in the computed chlorophyll, orthophosphate, ammonia and nitrate concentrations due to the vertical dispersion sensitivity. In general, the orthophosphate, ammonia and nitrate concentrations are greater than those computed in

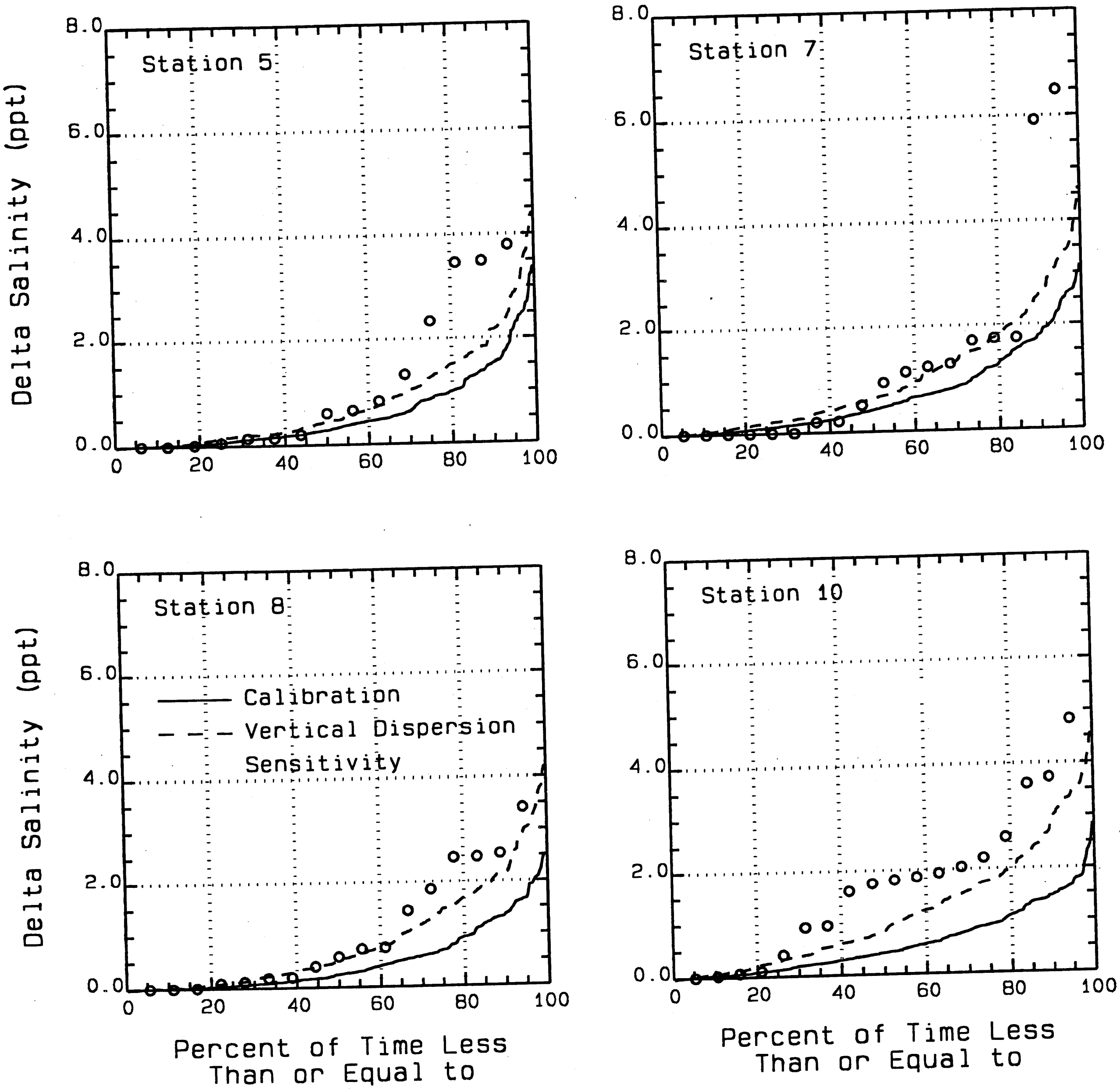

Figure 7-32. Tar-Pamlico River Delta Salinity Frequency Distributions

- Data averaged above and below the halocline
- Model surface = layers 1-5 Model bottom = layers 6-8

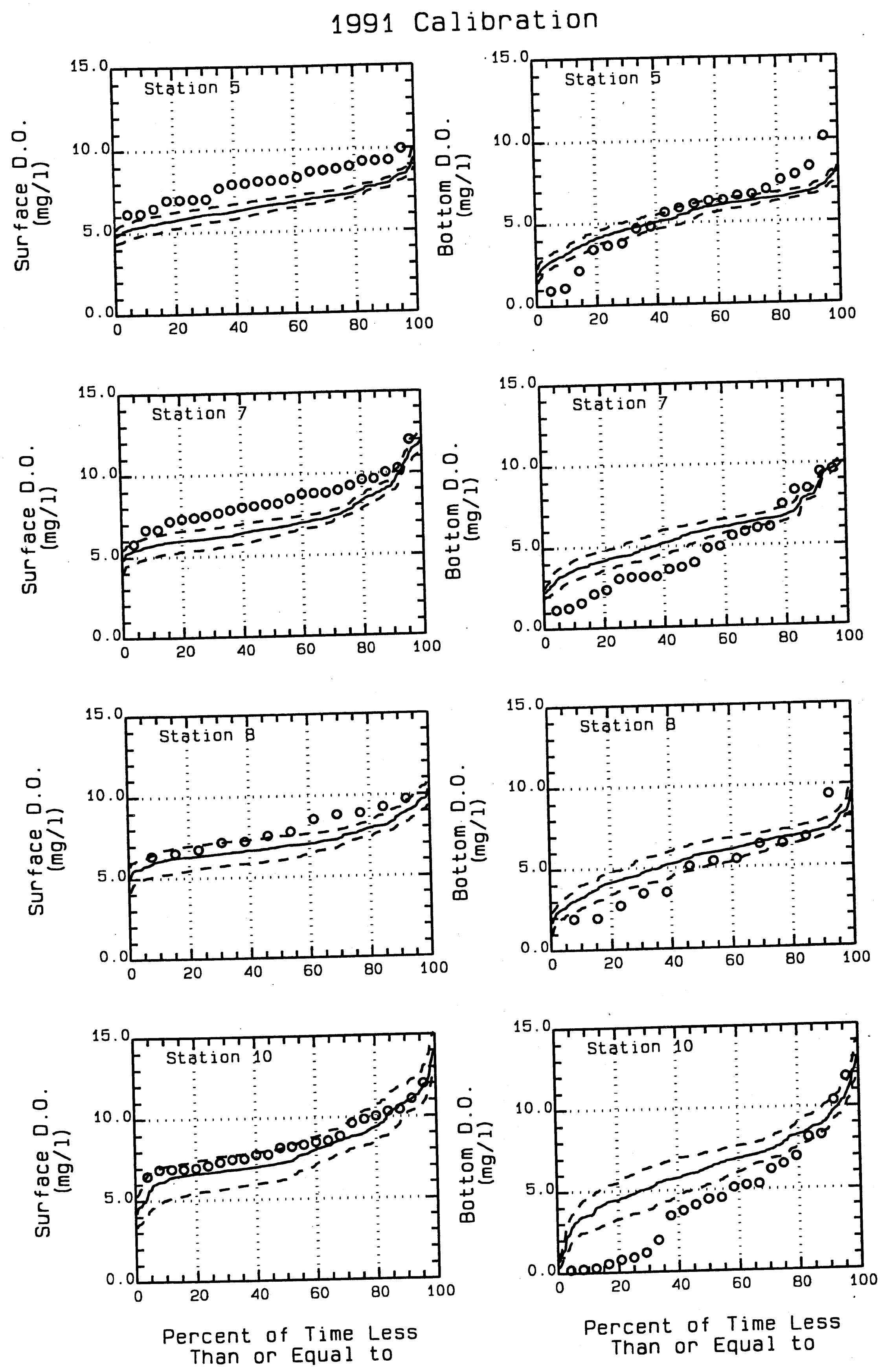

Figure 7-33. Tar-Pamlico River D.O. Frequency Distributions

- Data averaged above and below the halocline
- Model surface = layers 1-5 Model bottom = layers 6-8
- Excludes 9/5, 11/12, 11/26 and 12/9 Don Stanley Data

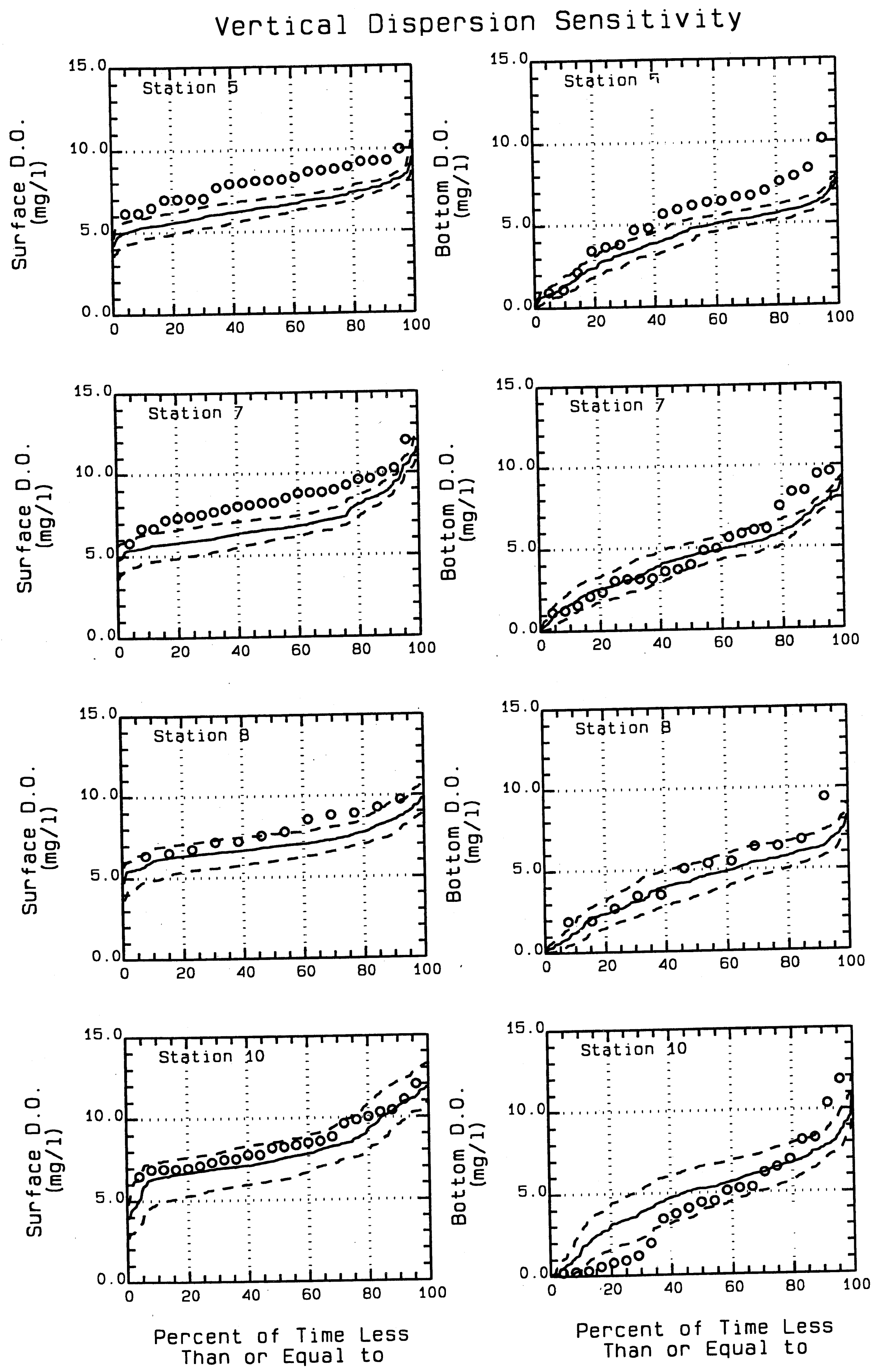

Figure 7-34. Tar-Pamlico River D.O. Frequency Distributions

- Data averaged above and below the halocline
- Model surface = layers 1-5 Model bottom = layers 6-8
- Excludes 9/5, 11/12, 11/26 and 12/9 Don Stanley Data

the calibration. This is due to the lower bottom layer dissolved oxygen concentrations and the associated increase of the sediment fluxes. Since the system is nitrogen limited, the increased ammonia and nitrate concentrations also cause the algal levels to increase slightly. The increases in the ammonia and nitrate concentrations for the sensitivity may require further calibration analyses if this sensitivity is ever used as a final calibration.

The vertical dispersion sensitivity highlights the importance of vertical mixing on salinity and dissolved oxygen stratification. The reduction of the vertical dispersion significantly increases the vertical salinity stratification which in turn increases the level of dissolved oxygen stratification. Even though this simple sensitivity highlights the importance of vertical mixing, further testing is necessary. A more formal and rigorous testing of this hypothesis should be completed in the future if the model is validated against another data set or if the model is applied to a different system. Such testing might include reduction of the vertical dispersion term within the hydrodynamic model and laterally segmenting the model in order to more realistically represent the actual bathymetry.

7.4 EXAMPLE MODEL PROJECTION

The ultimate purpose in developing and calibrating the water quality model for the Tar-Pamlico River was to develop a nutrient control strategy for the basin. Model projections were completed with the calibrated model that present examples of point and non-point source nutrient controls and their associated impacts on water quality. The first projection involved the reduction of point source inputs based upon effluent nutrient targets. The second set of projections presents a 25% and 50% reduction of non-point source loadings to the system. The water quality improvement for these projections was based upon the computed dissolved oxygen concentrations. Dissolved oxygen concentrations from the projections were compared to the calibration concentrations and judgements were made based upon the relative improvements in each case. The dissolved oxygen concentrations are presented as frequency distributions at each station for the summer and winter periods described in Section 7.2.

The point source nutrient reduction projection was based on effluent nutrient targets for total nitrogen of 6 mg/l and for total phosphorus of 2 mg/l. Current effluent concentrations of total nitrogen (TN) and total phosphorus (TP) were determined from the point source loadings tabulated in Appendix 9.2 and resulted in concentrations of approximately 13.3 mg/l TN and 1.8 mg/l TP. Since current TP concentrations were less than the target value, only TN point source reductions were considered. The point source loadings downstream from Greenville are input directly into the model and therefore their loadings were directly reduced for each month. Point sources entering the system upstream from Greenville were indirectly reduced by adjusting the measured upstream boundary loadings. The monthly averaged TN and TP loadings at Greenville, based on station SB data, are presented in Figure 7-35 along with the estimated point and non-point source loadings. The point source loadings upstream from Greenville were estimated from the data tabulated in Appendix 9.2. Non-point source loadings were estimated as the difference between the measured loadings at the boundary and the estimated point source loadings. This method implies that all of the point source nutrients entering the system upstream from Greenville reach the boundary and are reflected in the measured concentrations. Any losses, such as denitrification or sedimentation, are not considered which might result in optimistic improvements in water quality for the point source projection. The problems associated with this method are obvious in the TP loadings for September through November, when estimated point source loadings were greater than the measured loadings at the boundary. The Texasgulf loadings were not reduced for the point source reduction projection.

The non-point source projections were based upon a 25% and 50% reduction of TN and TP monthly loadings to the system. The estimated upstream TP non-point source loadings from September through November were not adjusted since the estimated point source loadings were greater than the measured loadings. Therefore, the measured loadings were input and were assumed to entirely reflect point source loadings. The tributary and downstream, Pamlico Point, boundary TN and TP loadings were also reduced to reflect the 25% and 50% non-point source nutrient reduction.

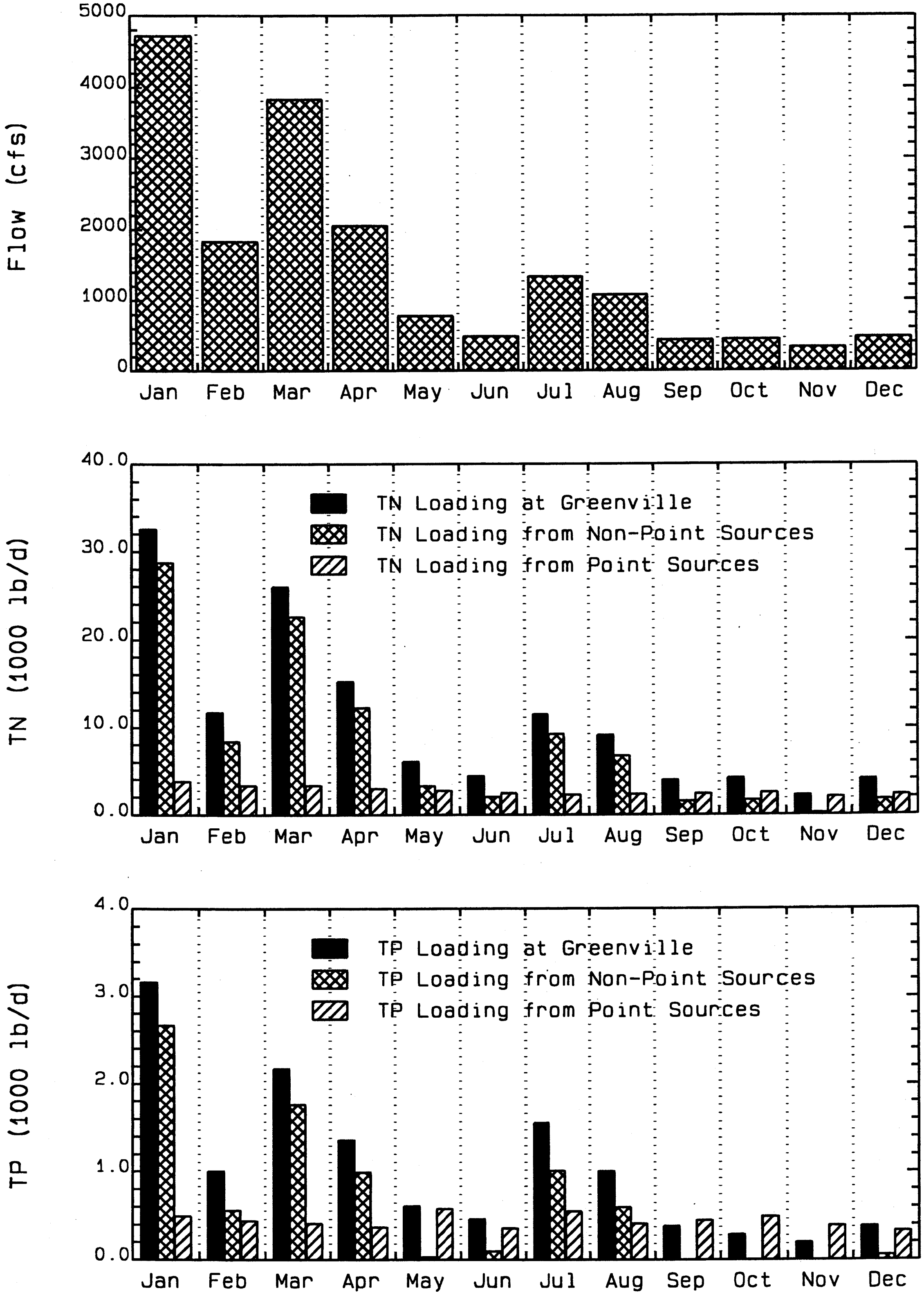

Figure 7-35. Tar River Flow at Greenville and TN & TP Loadings

The point and non-point source projection cases were run for five years to allow the sediment particulate organic concentrations to reach steady state in response to the decrease of nutrient inputs and their effects on algal populations. Results from the fifth year are presented for the point source nutrient reductions in Figures 7-36 and 7-37 and for the non-point source nutrient reductions in Figures 7-38 and 7-41 for stations 5, 7, 8 and 10. The differences between the calibration dissolved oxygen concentrations and the projection concentrations are considered to assess the benefit in each case.

The point source TN reduction of approximately 50%, results in small changes in bottom layer dissolved oxygen concentrations for the winter months of October through April, see Figure 7-36. Maximum bottom layer increases for the four stations range from 0.07 to 0.31 mg/l. Surface layer dissolved oxygen concentrations are slightly lower than the calibration concentrations due to decreased algal levels and the associated decrease in oxygen production. The maximum decrease of surface layer dissolved oxygen concentrations range from 0.14 to 0.40 mg/l. The projection for the summer months of May through September, Figure 7-37, results in larger increases in bottom layer dissolved oxygen concentrations than the winter months with the maximum increases ranging from 0.16 to 0.40 mg/l. Surface layer dissolved oxygen concentrations are again greater during the summer than the winter with the maximums differences ranging from 0.04 to 0.52 mg/l.

The results from the 25% non-point nutrient reductions are presented in Figures 7-38 and 7-39 for the winter and summer periods, and for the 50% reduction in Figures 7-40 and 7-41. Again, the results from the summer period indicate a greater improvement in bottom layer dissolved oxygen concentrations than during the winter period. The maximum differences during the winter for the 25% non-point source reductions range from 0.42 to 0.56 mg/l in the surface layer and from 0.27 to 0.78 mg/l in the bottom layer. The summer maximum differences, for the 25% reduction, range from 0.13 to 0.97 mg/l in the surface layer and from 0.66 to 1.1 mg/l in the bottom layer. The greater bottom layer dissolved oxygen improvements for the non-point source nutrient reductions than from the point reductions reflects the larger percentage of nutrient inputs to the system from non-point sources.

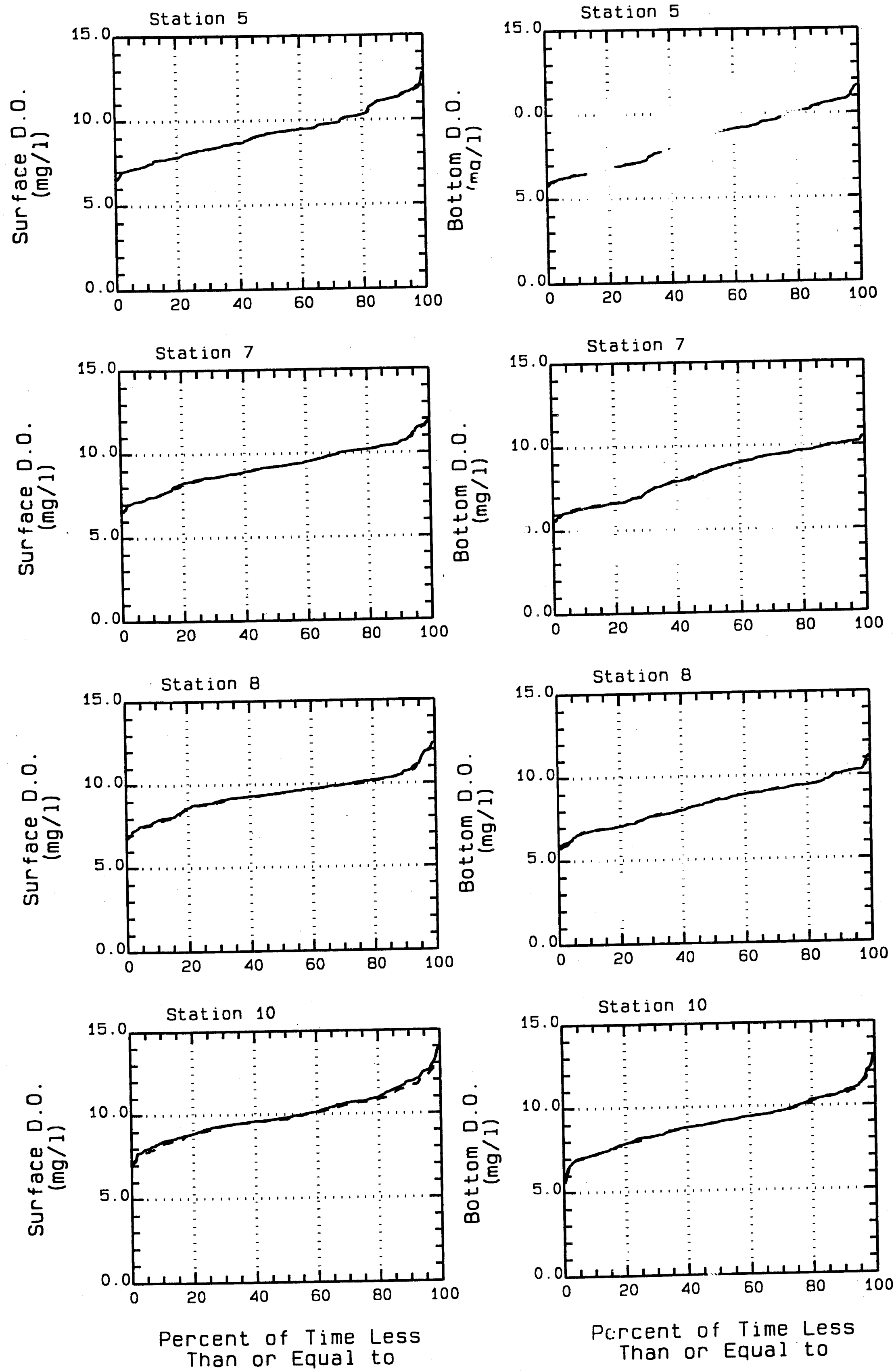

Figure 7-36. Tar-Pamlico River Winter D.O. Projections for Point Source Nitrogen Reductions
(——— 1991 Calibration – – – Point Source Control)

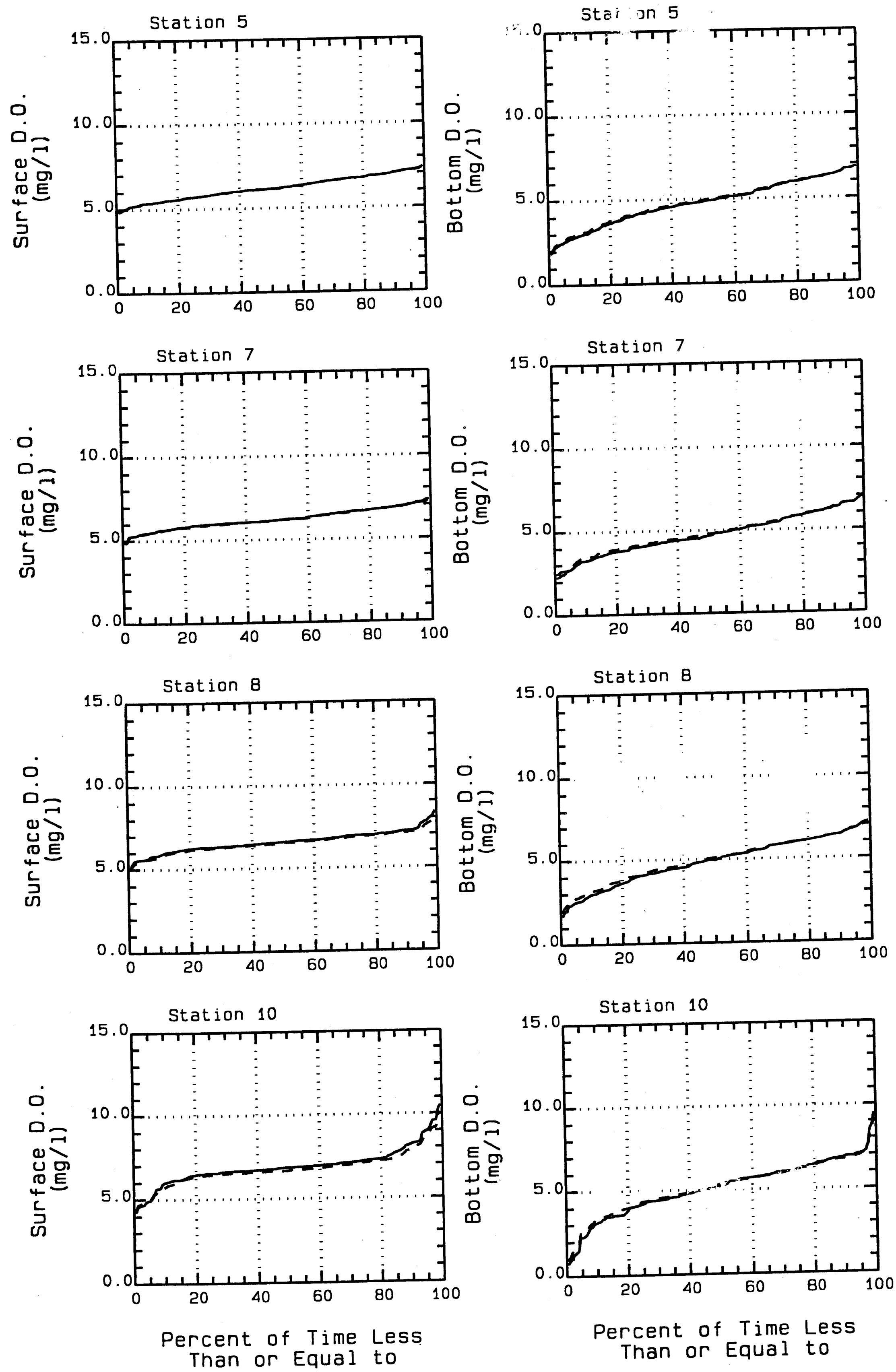

Figure 7-37. Tar-Pamlico River Summer D.O. Projections for Point Source Nitrogen Reductions

(——— 1991 Calibration — — — Point Source Control)

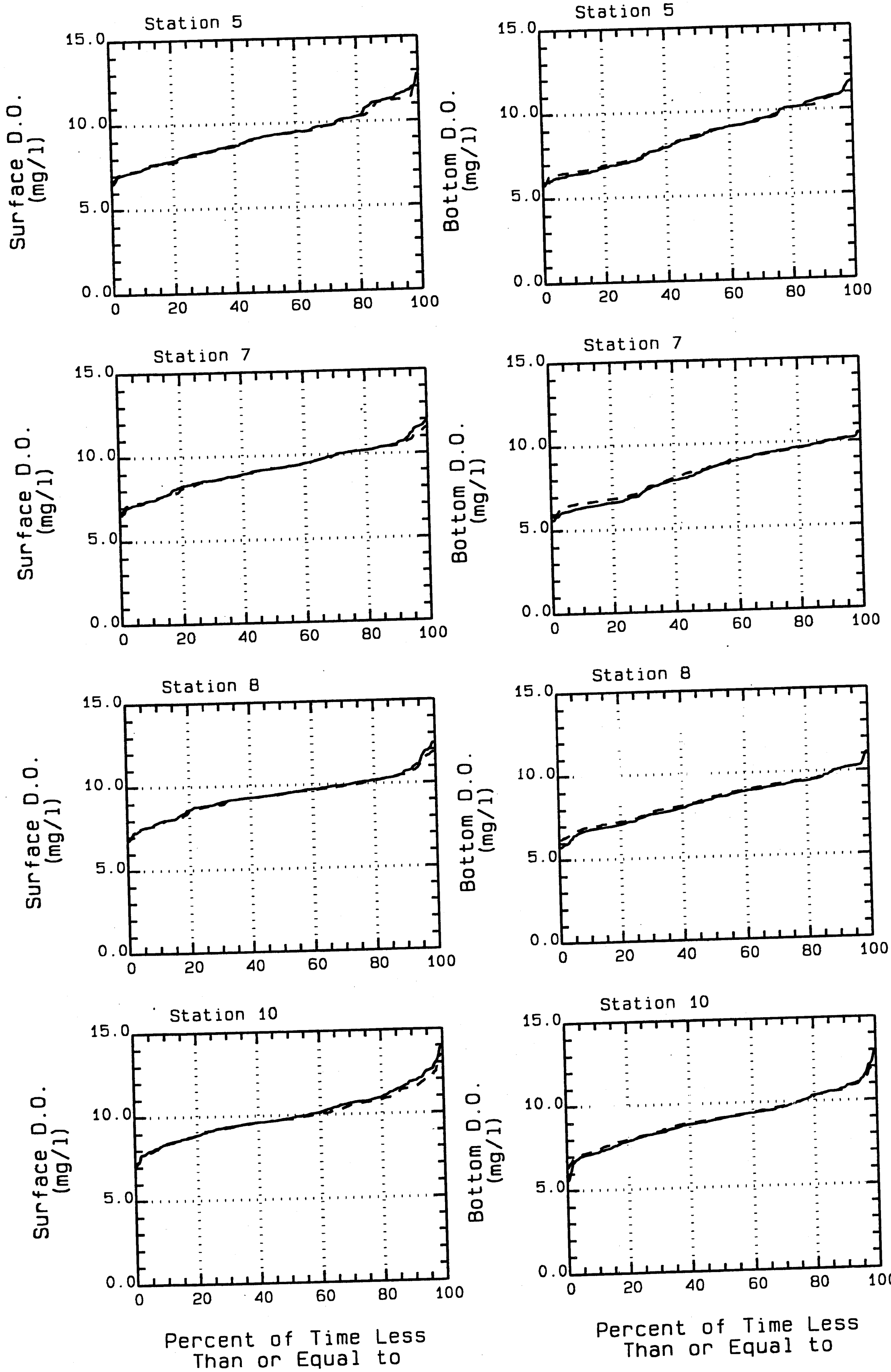

Figure 7-38. Tar-Pamlico River Winter D.O. Projections for Non-Point Source 25% Nutrient Reductions
(——— 1991 Calibration – – – Non-Point Source Control)

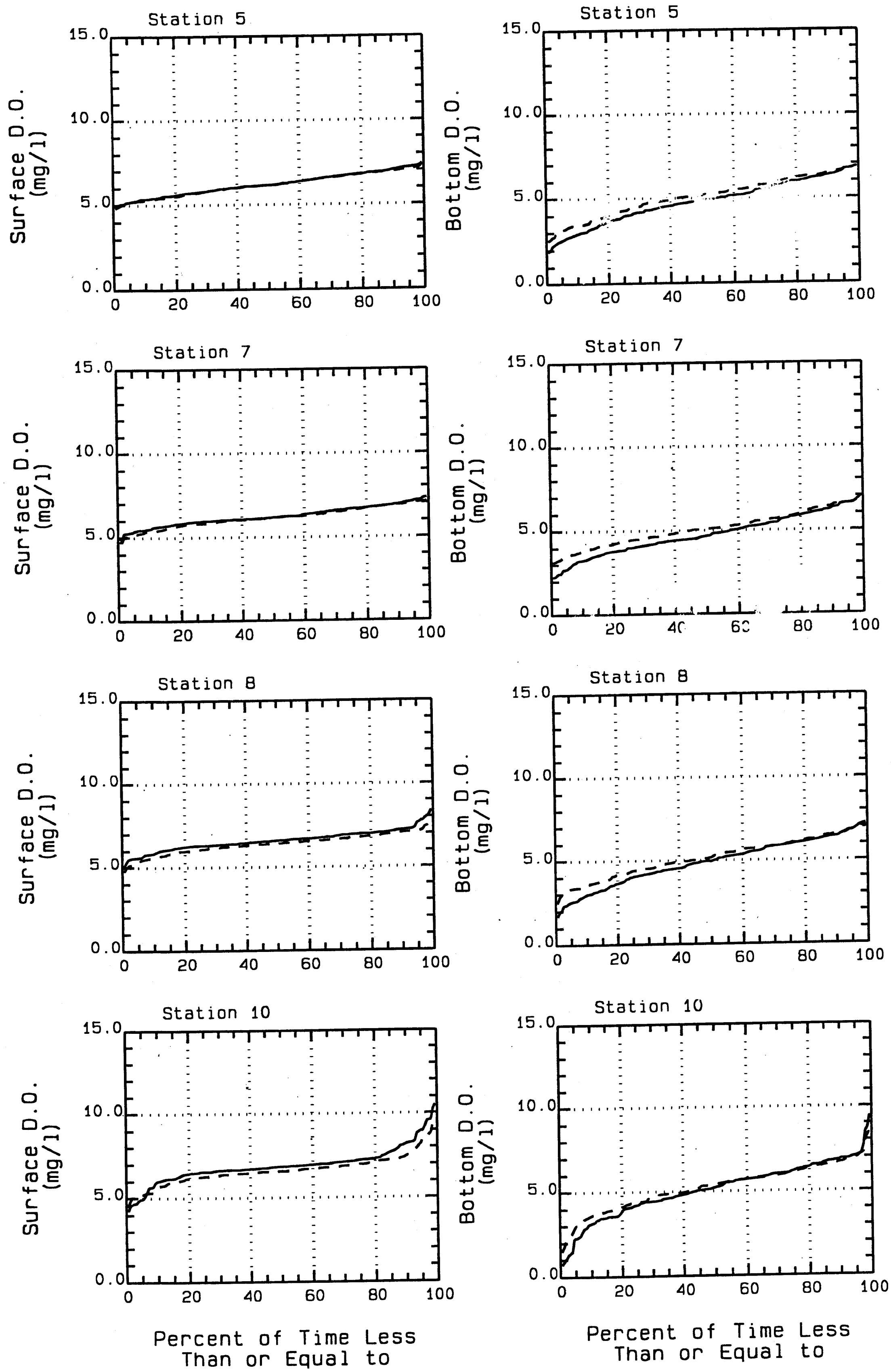

Figure 7-39. Tar-Pamlico River Summer D.O. Projections for Non-Point Source 25% Nutrient Reductions

(——— 1991 Calibration – – – Non-Point Source Control)

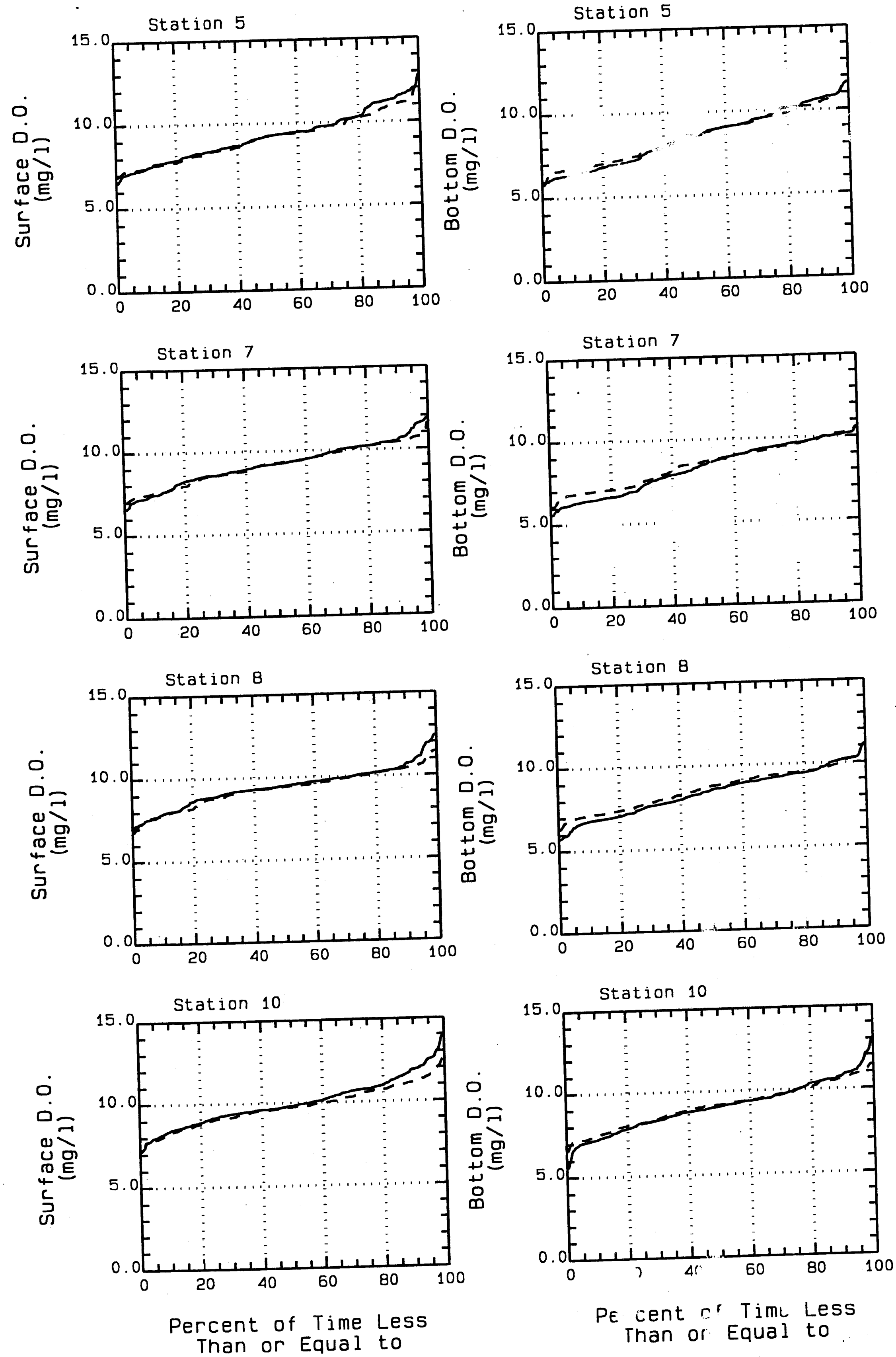

Figure 7-40. Tar-Pamlico River Winter D.O. Projections for Non-Point Source 50% Nutrient Reductions
(——— 1991 Calibration – – – Non-Point Source Control)

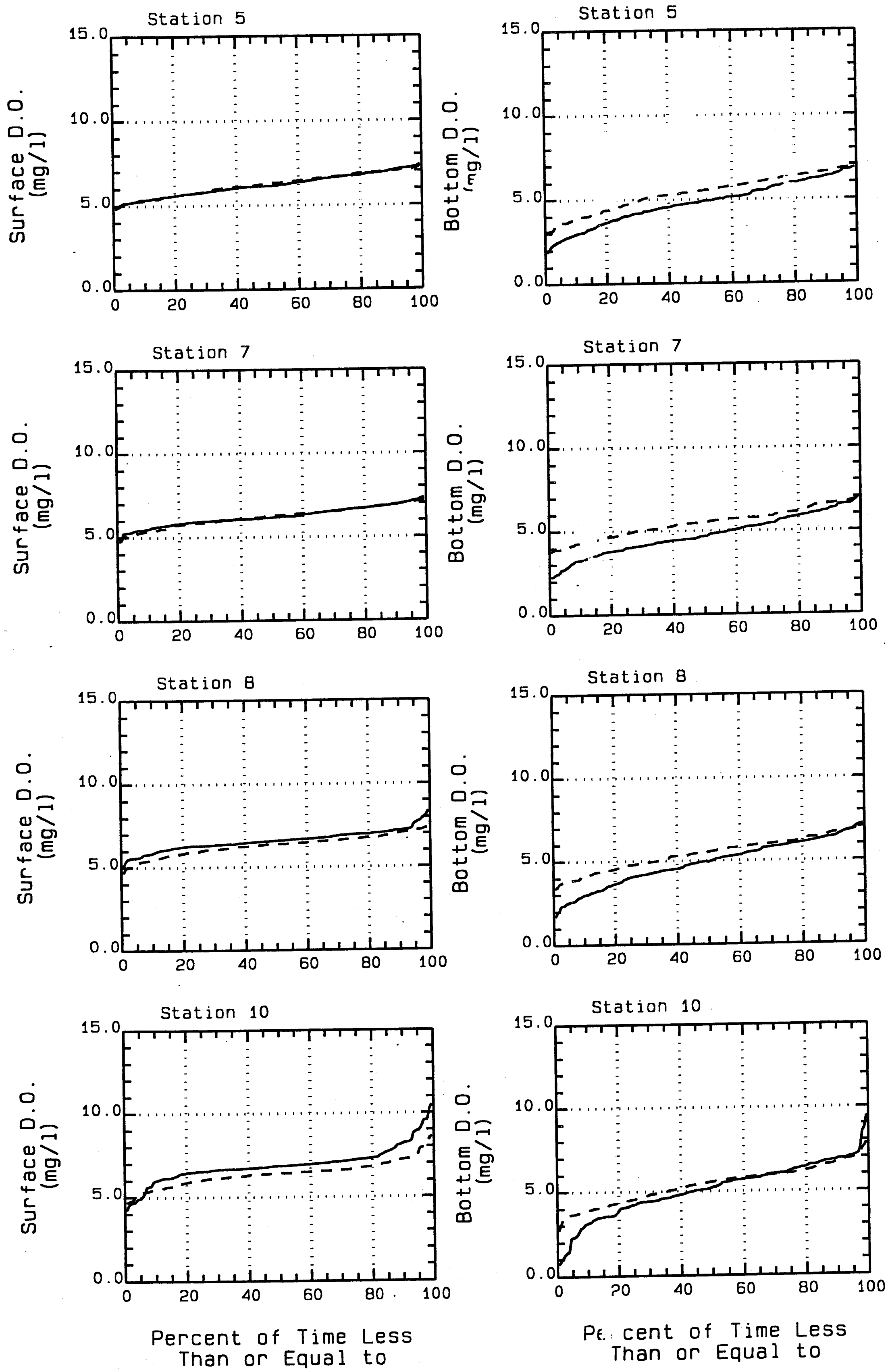

Figure 7-41. Tar-Pamlico River Summer D.O. Projections for Non-Point Source 50% Nutrient Reductions
(—— 1991 Calibration – – – Non-Point Source Control)

Similarly, for the 50% non-point source nutrient reduction summer dissolved oxygen differences are greater than the winter differences. The maximum differences in the surface layer during the winter range from 0.62 to 1.39 mg/l and in the bottom layer range from 0.50 to 1.0 mg/l. Summer maximum differences in the surface layer range from 0.13 to 1.9 mg/l and in the bottom layer range from 1.2 to 2.3 mg/l. The bottom layer dissolved oxygen differences for the 50% non-point source nutrient reduction are approximately twice the differences calculated for the 25% reduction. This suggests that there is an approximate linear relationship between the non-point source nutrient input to the Tar-Pamlico River and the calculated bottom water dissolved oxygen concentrations.

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9. APPENDICES

APPENDIX 9.1 - WATER QUALITY MODEL THEORY (LISS) AND CALIBRATION CONSTANTS

APPENDIX 9.2 - TAR-PAMLICO RIVER POINT SOURCE LOADINGS AND FLOWS

APPENDIX 9.3 - TRIBUTARY CONCENTRATION VS FLOW RELATIONSHIPS

APPENDIX 9.4 - WATER COLUMN AND SEDIMENT MODEL CALIBRATION FIGURES

APPENDIX 9.5 - 1991 TAR-PAMLICO RIVER WATER QUALITY DATA

APPENDIX 9.1

WATER QUALITY MODEL THEORY (LISS) AND CALIBRATION CONSTANTS

APPENDIX 9.1

WATER QUALITY MODEL

1.1 INTRODUCTION

1.1.1 Conservation of Mass

The modeling framework used in this study and detailed in this report is based upon the principle of conservation of mass. The conservation of mass accounts for all of a material entering or leaving a body of water, transport of the material within the water body, and physical, chemical and biological transformations of the material. For an infinitesimal volume oriented along the axis of a three-dimensional coordinate system, a mathematical formulation of the conservation of mass may be written:

$$\frac{\partial c}{\partial t} = \underbrace{\frac{\partial}{\partial x}\left(E_x\frac{\partial c}{\partial x}\right) + \frac{\partial}{\partial y}\left(E_y\frac{\partial c}{\partial y}\right) + \frac{\partial}{\partial z}\left(E_z\frac{\partial c}{\partial z}\right)}_{\text{dispersive transport}} \underbrace{- U_x\frac{\partial c}{\partial x} - U_y\frac{\partial c}{\partial y} - U_z\frac{\partial c}{\partial z}}_{\text{advective transport}} \qquad (1\text{-}1)$$

$$\underbrace{\pm\, S(x,y,z,t)}_{\text{sources or sinks}} \quad + \quad \underbrace{W(x,y,z,t)}_{\text{external inputs}}$$

While Equation 1-1 is often taken as the "instantaneous" water quality mass balance equation, it may be interpreted as the "time-averaged over the tidal period" mass balance equation when the coefficients of the equation are chosen as follows:

c = concentration of the water quality variable $[M/L^3]$,

t = time [T],

E = dispersion (mixing) coefficient due to tides and density and velocity gradients (L^2/T),

U = tidally-averaged net advective velocity (L/T),

S = sources and sinks of the water quality variable, representing kinetic interactions (M/L^3-T),

W = external inputs of the variable C (M/L^3-T),

x,y,z = longitudinal, lateral and vertical coordinates,

M,L,T = units of mass, length and time, respectively.

The modeling framework employed in this study is made up of three components: the transport due to density-driven currents and dispersion, the kinetic interaction between variables and the external inputs. Density-driven currents and tidally induced mixing are responsible for the movement of the water quality constituents within the waterbody.

External inputs of nutrients and oxygen-demanding material are derived from municipal and industrial discharges, CSO's, natural surface runoff and atmospheric deposition to the water surface of the waterbody.

The kinetics control the rates of interactions among the water quality constituents. Ideally, in a modeling effort, they should be independent of location per se, although they may be functions of exogenous variables, such as temperature and light, which may vary with location.

Analytical solutions are not available for partial differential equations of the form of Equation 1-1 except for the simplest cases. Instead, numerical methods are utilized to solve these mass balance equations. A specific method of solution, employed in a majority of water quality modeling frameworks, is known as the finite difference technique. First, the estuary is divided into finite volumes. Then a finite difference approximation of Equation 1-1 is applied to the i^{th} finite volume or segment, resulting in an equation of the form (see Thomann, 1972):

$$V_i \frac{dc_i}{dt} = \sum_j R_{ij}(c_j - c_i) + \sum_k Q_{ki}c_k - \sum_m Q_{im}c_i \pm S_i + W_i \qquad (1\text{-}2)$$

$$i = 1, 2, \ldots, m$$

where

V_i = volume of segment i (L^3),

c_i = concentration of the water quality variable in the i^{th} segment (M/L^3),

R_{ij} = exchange between segment i and j resulting from dispersive mixing (L^3/T),

Q_{ki} = net advective flow entering segment i from segment k (L^3/T),

Q_{im} = net advective flow leaving segment i and going to segment m (L^3/T),

S_i = sources and sinks, in segment i representing kinetic interactions (M/T),

W_i = external inputs to segment i (M/T).

The exchange coefficients and advective flows are computed from

$$R_{ij} = \frac{E_{ij}\,A_{ij}}{L_{ij}} \qquad (1\text{-}3a)$$

$$Q_{ij} = A_{ij}\,U_{ij} \qquad (1\text{-}3b)$$

respectively, where E_{ij} is the dispersion coefficient, representing the overall phenomenon of mixing due to temporal variation in the tidal velocity, lateral and vertical gradients in velocity, and density differences within the water body; A_{ij} is the cross-sectional area of the ij interface; L_{ij} is the characteristic length defined as $(L_i + L_j)/2$; and U_{ij} is the net advective velocity from segment i to j. The term S_i, the sources and sinks of material in segment i, represents the kinetic interactions (physical, chemical and biological) occurring within the segment. These interactions may be functions only of the variable under consideration, for example, the first order decay of organic material. Alternately they may involve the interactions between other variables, for example, the first order feed-forward interaction between organic carbon BOD and dissolved oxygen, or the more complex interactions between phytoplankton biomass and nutrients which involve non-linear feed-forward and feedback interactions. The term W_i, the external inputs of material into segment i, includes point and nonpoint source loads, CSO loads, atmospheric loads and inputs from the sediment bed.

Mass balance equations in the form of Equation 1-2 are formulated for each segment in the estuary and for each state variable included in the modeling framework. This results in n x m simultaneous finite difference equations to be solved, where n is the number of segments and m is the number of state variables.

1.1.2 Choice of State Variables

An important criterion for the inclusion of variables in a modeling framework is the existence of adequate field data for calibration/verification of the variable, as well as the importance of the variable in the processes being considered. The kinetic framework employed is based on the LISS eutrophication model (HydroQual, Inc. 1991) and the modeling effort of the Chesapeake Bay system (HydroQual, Inc. 1989) and utilizes the following 25 state variables:

1. - salinity (S)
2. - phytoplankton carbon - winter assemblage (P_{c1})
3. - phytoplankton carbon - summer assemblage (P_{c2})
4. - refractory particulate organic phosphorus (RPOP)
5. - labile particulate organic phosphorus (LPOP)
6. - refractory dissolved organic phosphorus (RDOP)
7. - labile dissolved organic phosphorus (LDOP)

8. - dissolved inorganic phosphorus (DIP)
9. - refractory particulate organic nitrogen (RPON)
10. - labile particulate organic nitrogen (LPON)
11. - refractory dissolved organic nitrogen (RDON)
12. - labile dissolved organic nitrogen (LDON)
13. - ammonia nitrogen (NH_3)
14. - nitrite + nitrate nitrogen (NO_2 + NO_3)
15. - biogenic silica - unavailable (SiU)
16. - silica - available (Si)
17. - refractory particulate organic carbon (RPOC)
18. - labile particulate organic carbon (LPOC)
19. - refractory dissolved organic carbon (RDOC)
20. - labile dissolved organic carbon (LDOC)
21. - reactive dissolved organic carbon (ReDOC)
22. - algal exudate dissolved organic carbon (ExDOC)
23. - dissolved oxygen equivalents (O_2^*)
24. - dissolved oxygen (DO)
25. - total active metal (TAM)

The kinetic equations discussed below incorporate these state variables and are designed to simulate the annual cycle of phytoplankton production, its relation to the supply of nutrients and its effect on dissolved oxygen. The calculation is based on formulating the kinetics which govern the interactions of the biota and the various nutrient forms, and the application of these kinetics to the waterbody within the context of mass conservation equations.

1.2 MODEL KINETICS

1.2.1 General Structure

Salinity is included in the modeling framework to enable verification of the transport structure transferred from the hydrodynamic model ECOM3D (Blumberg and Mellor, 1987).

For salinity there are no reaction kinetics involved, i.e., they are conservative. There are no direct sources or sinks of salinity, other than via exchange with the model boundaries or via freshwater dilution resulting from wastewater treatment facilities and from freshwater rivers draining into the waterbody.

Figure 1-1 presents the principal kinetic interactions for the nutrient cycles and dissolved oxygen. In the phosphorus system kinetics, DIP is utilized by phytoplankton for growth. Phosphorus is returned from the phytoplankton biomass pool to the various dissolved and particulate organic phosphorus pools and to DIP through endogenous respiration and predatory grazing. The various forms of organic phosphorus are converted to DIP at a temperature-dependent rate.

The kinetics of the nitrogen species are fundamentally the same as the kinetics of the phosphorus system. Ammonia and nitrate are used by phytoplankton for growth. Ammonia is the preferred form of inorganic nitrogen for algal growth, but phytoplankton will utilize nitrate nitrogen as ammonia concentrations become depleted. Nitrogen is returned from the algal biomass and follows pathways that are similar to those of phosphorus. Organic nitrogen is converted to ammonia at a temperature-dependent rate, and ammonia is then converted to nitrate (nitrification) at a temperature- and oxygen-dependent rate. Nitrate may be converted to nitrogen gas (denitrification) in the absence of oxygen at a temperature-dependent rate.

Available silica is utilized by diatom phytoplankton during growth. Silica is returned to the unavailable silica pool during respiration and predation and must undergo mineralization processes before becoming available for phytoplankton growth.

Dissolved oxygen is coupled to the other state variables. The sources of oxygen considered are reaeration and algal photosynthesis. The sinks of oxygen are algal respiration, oxidation of detrital carbon and carbonaceous material from wastewater treatment plant effluents and nonpoint discharges, nitrification and SOD.

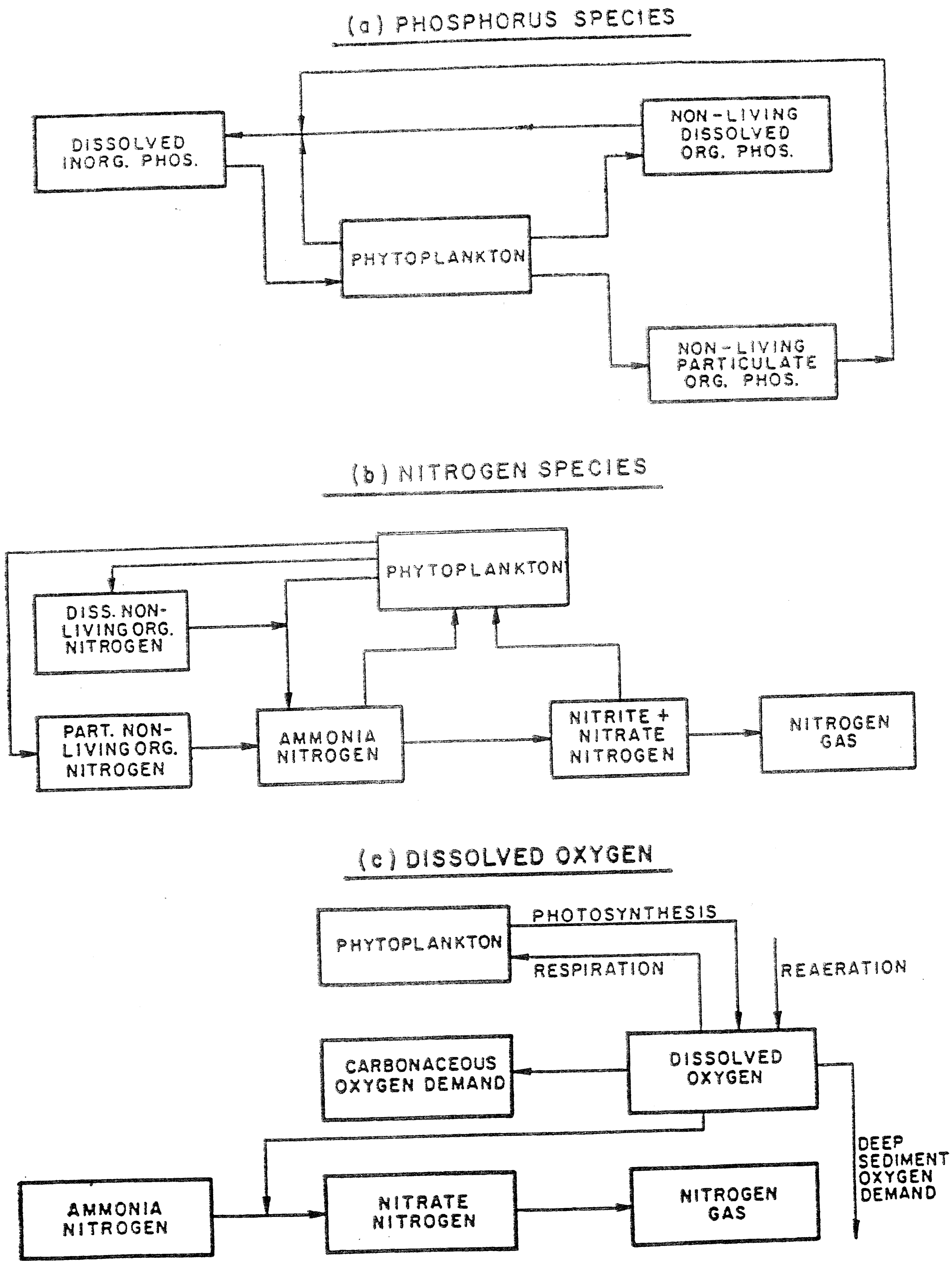

Figure 1-1. Principal Kinetic Interactions for Nutrient Cycles and Dissolved Oxygen

Organic carbon sources include anthropogenic inputs and the by-products of primary production and zooplankton grazing. The sink of organic carbon is via bacterial decomposition or oxidation. Specific details for the above reactions are presented below.

1.2.2 Phytoplankton Growth and Death

The kinetic framework employed for both functional algal groups is the same, only the choice of model coefficients is different. It is convenient to express the kinetic source term for phytoplankton, S_P, as the difference between the phytoplankton growth rate, G_P, and the death rate, D_P. That is:

$$S_P = (G_P - D_P)P \tag{1-4}$$

where P is the phytoplankton population, and where G_P and D_P have units (day^{-1}). The balance between the magnitude of the growth rate and the death rate (together with the transport and mixing) determines the rate at which phytoplankton mass is created in each volume element.

The growth rate of a population of phytoplankton in a natural environment is a complicated function of the species of phytoplankton present and their differing reactions to solar radiation, temperature, and the balance between nutrient availability and nutrient requirements. The complex and often conflicting data pertinent to this problem have been reviewed by many researchers (Rhee, 1973; Hutchinson, 1967; Strickland, 1965; Lund, 1965, and Raymont, 1963). The available information is not sufficiently detailed to specify the growth kinetics for individual algal species in a natural environment. Hence, in order to construct a growth function, a simplified approach is followed. Rather than consider the problem of different species and their associated environmental and nutrient requirements, the population is characterized as a whole by a measurement of the biomass of the phytoplankton present.

For single species, the direct measure of the population size is the number of cells per unit volume. Cell counts of a single species may be obtained fairly readily in a well-controlled laboratory environment. However, in naturally occurring populations, this measure may be somewhat ambiguous. It is difficult to distinguish between viable and non-viable cells, and colonizing species tend to pose a problem because counts usually do not distinguish individual cells, and the sizes of the colonies are quite variable.

The sum of the numbers of each species, the total count, could be used to characterize biomass, but since cell size varies substantially, the pico-phytoplankton would dominate such an aggregation. To account for this, the total bio-volume, or wet weight of phytoplankton, assuming unit density, can be calculated using characteristic volumes for each identified species. Unfortunately, volumes can vary appreciably as a function of nutrient availability. Conversion to phytoplankton dry weight and carbon involves further species-dependent constants, which are also nutrient dependent, and therefore, are subject to variation and uncertainty. Thus, although the use of phytoplankton dry weight or carbon concentration is an appealing solution to the issue of aggregation, it suffers from some practical difficulties.

An alternative approach to this problem is to measure a parameter which is characteristic of all phytoplankton, namely, chl-a, and to use this as the aggregated variable. The principal advantages are that the measurement is direct, it integrates cell types and age, and it accounts for cell viability. The principal disadvantages are that it is a community measurement with no differentiation between functional groups (for example, diatoms or blue-green algae), and it is not necessarily a good measurement of standing crop in dry weight or carbon units, since the chlorophyll to dry weight and carbon ratios are variable, and non-active chlorophyll (phaeo-pigments) must be measured to determine viable chlorophyll concentrations.

As can be seen from the above discussion, no simple aggregate measurement is entirely satisfactory. From a historical and practical point of view, the availability of extensive chlorophyll data for many waterbodies essentially dictates its use as the aggregate measure of the phytoplankton population, or biomass, for calibration and verification purposes. However, for internal computations, the eutrophication model uses phytoplankton carbon as a measure of algal biomass. The reasons for choosing phytoplankton carbon, rather than chl-a as the internal state variable, are twofold. The first is a desire to maintain compatibility with the modeling framework developed by HydroQual, Inc. for the Chesapeake Bay study, from which the basic kinetic framework is drawn. The second reason is that the use of phytoplankton carbon greatly facilitates the model computation of oxygen-demanding material deposited to the sediment bed via settling.

With the choice of biomass units established, a growth rate which expresses the rate of production of biomass as a function of the important environmental variables, temperature, light and nutrients, may be developed. The specific growth rate, G_P, is related to G_{Pmax}, the maximum growth rate at optimum light, temperature and nutrients, via the following equation:

$$G_P = G_{Pmax} \bullet \underset{\text{temperature}}{G_T(T)} \bullet \underset{\text{light}}{G_I(I)} \bullet \underset{\text{nutrients}}{G_N(N)} \tag{1-5}$$

where

$G_T(T)$ is the effect of temperature,

$G_I(I)$ is the light attenuation given by

$$G_I(I) = g(I,f,H,k_e) \tag{1-6}$$

and $G_N(N)$ is the nutrient limitation given by

$$G_N(N) = g(DIP,DIN,Si) \tag{1-7}$$

where T is the ambient water temperature; I is the incident solar radiation; f is the fraction of daylight; H is the depth of the water column; k_e is the extinction or light attenuation coefficient; and DIP, DIN and Si are the available nutrients required for growth: dissolved inorganic phosphorus (orthophosphate), dissolved inorganic nitrogen (ammonia plus nitrite/nitrate) and available silica, respectively.

Initial estimates of G_{Pmax} were based upon previous estuarine modeling studies and were subsequently refined during the calibration process. The selected maximum growth rates are then temperature-corrected using spatially dependent, ambient water column temperature values. The temperature-corrected growth rate is computed using the following equation, which relates $G_{Pmax}(T)$, the growth rate at ambient temperature, T, to $G_{Pmax}(T_{opt})$, the growth rate at the optimal temperature, T_{opt}:

$$G_{Pmax}(T) = G_{Pmax}(T_{opt})\,\theta_P^{(T-T_{opt})} \qquad T \leq T_{opt} \tag{1-8a}$$

or

$$G_{Pmax}(T) = G_{Pmax}(T_{opt})\,\theta_P^{(T_{opt}-T)} \qquad T > T_{opt} \tag{1-8b}$$

The temperature-corrected growth rate is then adjusted to reflect attenuation due to ambient light and nutrient levels.

In the natural environment, the light intensity to which the phytoplankton are exposed is not uniformly at the optimum value. At the surface and near-surface of the air-water interface, photo-inhibition can occur due to high light intensities, while at depths below the euphotic zone, light is not available for photosynthesis due to natural and algal related turbidity. The modeling framework used in this study extends from a light curve analysis formulated by Steele (1962), and accounts for both the effects of supersaturating light intensities and light attenuation through the water column. The depth-averaged light attenuated growth rate factor, $G_I(I)$, is presented in Equation 1-9 and is obtained by integrating the specific growth rate over depth:

$$G_I(I) = \frac{ef}{k_e H} [\exp(\frac{-I_o}{I_s} e^{-K_e H}) - \exp(\frac{-I_o}{I_s})] \tag{1-9}$$

where:

e = 2.718,

f = the photoperiod or fraction of daylight,

H = the total water column depth (m),

k_e = the total extinction coefficient, computed from the sum of the base, non-algal related, light attenuation, k_{ebase}, and the self-shading attenuation due to the ambient phytoplankton population $k_c P_{chl\text{-}a}$ (m^{-1}),

k_c = the algal related extinction coefficient per unit of chlorophyll (m^2/mg chl-a),

$P_{chl\text{-}a}$ = the ambient phytoplankton population as chlorophyll (mg chl-a/L), where $P_{chl\text{-}a} = P_c/a_{cchl}$,

P_c = the ambient phytoplankton population as carbon (mgC/L),

a_{cchl} = the ratio of algal carbon to algal chlorophyll (mgC/mg chl-a),

I_o = the total daily incident light intensity at the surface (ly/day), and

I_s = the saturating light intensity (ly/day).

In the Tar-Pamlico River model, the saturating light intensity has been modified from a constant throughout the year to a time dependent variable. The saturating light intensity is formulated as a fraction (0.4) of the total daily incident light intensity at the surface. Since the saturating light intensity response to the total daily incident light intensity is not instantaneous, a five day moving average of the total daily incident light intensity was used to calculate the saturating light intensity.

The effects of various nutrient concentrations on the growth of phytoplankton have been investigated, and the results are quite complex. As a first approximation to the effect of nutrient concentration on the growth rate, it is assumed that the phytoplankton population in question follows Monod growth kinetics with respect to the important nutrients. That is, at an adequate level of substrate concentration, the growth rate proceeds at the saturated rate for the ambient temperature and light conditions. However, at low substrate concentration, the growth rate becomes linearly proportional to substrate concentration. Thus, for a nutrient with concentration N_j in the j^{th} segment, the factor by which the saturated growth rate is reduced in the j^{th} segment is $N_j/(K_m + N_j)$. The constant, K_m, which is called the Michaelis, or half-saturation constant, is the nutrient concentration at which the growth rate is half the saturated growth rate. Since there are three nutrients, nitrogen, phosphorus and silica, considered in this framework, the Michaelis-Menton expression is evaluated for each nutrient and the minimum value is chosen to reduce the saturated growth rate,

$$G_N(N) = \text{Min}\left(\frac{DIN}{K_{mN} + DIN}, \frac{DIP}{K_{mP} + DIP}, \frac{Si}{K_{mSi} + Si}\right). \qquad (1\text{-}10)$$

Numerous mechanisms have been proposed which contribute to the death rate of phytoplankton: endogenous respiration, grazing by herbivorous zooplankton, sinking or settling from the water column and parasitization (Fogg, 1965). The first three mechanisms have been included in previous models for phytoplankton dynamics, and they have been shown to be of general importance. For this study, only endogenous respiration and settling have been explicitly included in the modeling framework. The effect of zooplankton grazing is included indirectly using a first-order temperature corrected algal loss rate.

The endogenous respiration rate of phytoplankton is the rate at which the phytoplankton oxidize their organic carbon to carbon dioxide per unit weight of phytoplankton organic carbon. Respiration is the reverse of the photosynthesis process, and as such, contributes to the death rate of the phytoplankton population. If the respiration rate of the phytoplankton as a whole is greater than the growth rate, there is a net loss of phytoplankton carbon or biomass. The endogenous respiration rate has been shown to be temperature dependent (Riley et al., 1949) and is determined via Equation 1-11,

$$k_{PR}(T) = k_{PR}(20°C) \cdot \theta_{PR}^{(T-20)} \qquad (1\text{-}11)$$

where k_{PR} (20°C) is the endogenous respiration rate at 20°C, and $k_{PR}(T)$ is the temperature corrected rate. The units of k_{PR} are day^{-1}.

The respiration rate presented in Equation 1-11 has been modified in the Tar-Pamlico River model and is determined from Equation 1-11a.

$$k_{PR}(T) = k_{PRbasal} + f_r \; G_{Pmax}(T) \qquad (1\text{-}11a)$$

where:

$k_{PRbasal}$ = the minimum basal respiration rate (day^{-1}),
f_r = the fraction of the temperature corrected growth rate, and
$G_{Pmax}(T)$ = the temperature corrected growth rate (day^{-1}).

The current formulation of the respiration rate is calculated as a fraction of the temperature corrected growth rate above a minimum basal respiration rate.

The sinking of phytoplankton is an important contribution to the overall mortality of the phytoplankton population, particularly in lakes and coastal oceanic waters. Published values of the sinking velocity of phytoplankton, mostly in quiescent laboratory conditions, range from 0.1 to 18.0 m/day. In some instances, however, the settling velocity is zero or negative. Actual settling rates in natural waters are a complex phenomenon, affected by vertical turbulence, density gradients and the physiological state of the different species of phytoplankton. An important factor determining the physiological state of algae is nutrient availability. Bienfang et al. (1982) measured sinking rate response of four marine diatoms to depletion of nitrate, phosphate and silicate. All four species showed significant increase in sinking rate under conditions of silica depletion; one species showed increased settling rate under nitrate limitation. An analysis of field experiments by Culver and Smith (1989) indicated that low concentrations of nitrate, as well as light availability, affected diatom settling rates. Although the effective settling rate of phytoplankton is greatly reduced in a relatively shallow, well-mixed river or estuary due to vertical turbulence, it still can contribute to the overall mortality of the algal population. In addition, the settling phytoplankton can be a significant source of nutrients to the sediments and can play an important role in the generation of SOD. For these reasons, a temperature dependent term representing phytoplankton settling has been included in the algal mortality expression, and is determined by:

$$k_{sP} = \left[\frac{v_{sPb}}{H} + \frac{v_{sPn}}{H} \bullet (1 - G_N(N)) \right] \bullet \theta_{base}^{(T-20)} \quad (1\text{-}12)$$

where k_sP is the net effective algal loss rate due to settling (day^{-1}), v_{sPb} is the base settling velocity of phytoplankton (m/day), v_{sPn} is the nutrient dependent settling rate, (m/day), $G_N(N)$ is defined by Equation 1-10, and H is the depth of the segment, (m).

Zooplankton grazing may, depending upon time of the year and zooplankton biomass levels, be an important loss rate for phytoplankton. The loss term used to represent zooplankton grazing is as follows:

$$k_{grz}(T) = k_{grz}(20°C) \bullet \theta_{grz}^{(T-20)} \quad (1\text{-}13)$$

where $k_{grz}(T)$ is the temperature corrected loss rate due to zooplankton grazing and $k_{grz}(20°C)$ is the predation rate at 20°C. The units of k_{grz} are day^{-1}.

The total loss rate for phytoplankton is the sum of the three loss rates described below:

$$D_P = k_{PR}(T) + k_sP + k_{grz}(T) \quad (1\text{-}14)$$

This completes the specification of the growth and death rates for phytoplankton in terms of the physical variables: light, temperature and available nutrients. Table 1-1 summarizes the equations and model coefficients used in this study. With these variables known as a function of time, it would be possible to calculate the annual cycle of phytoplankton chlorophyll. However, the nutrient concentrations are not known a priori since they depend upon the phytoplankton population which develops. That is, these systems are interdependent and cannot be analyzed separately. It is necessary to formulate a mass balance for the nutrients as well as the phytoplankton in order to calculate the chlorophyll which would develop for a given set of environmental conditions.

1.2.2.1 Stoichiometry and Uptake Kinetics

A principal component in the mass balance equations for the nutrient systems included in the eutrophication framework is the nutrient uptake kinetics associated with algal growth. In order to quantify the nutrient uptake it is necessary to specify the population stoichiometry in units of nutrient uptake per mass of population synthesized. For carbon as the unit of population biomass, the relevant ratios are the mass of nitrogen, phosphorus and silica per unit mass of carbon. Table 1-2 lists the phosphorus to carbon and nitrogen to carbon ratios used in this study.

TABLE 1-2. PHOSPHORUS TO CARBON, NITROGEN TO CARBON AND SILICA TO CARBON RATIOS

	Winter Assemblage	Summer Assemblage
Nitrogen/Carbon (mgN/mgC)	0.080	0.080
Phosphorus/Carbon (mgP/mgC)	0.012	0.012
Silica/Carbon (mgSi/mgC)	0.27	0.27

Once the stoichiometric ratios have been determined, the mass balance equations may be written for the nutrients in much the same way as for the phytoplankton biomass. The principal processes determining the distribution of nutrients among the various pools are: the uptake of inorganic nutrients by phytoplankton for cell growth, the release of

TABLE 1-1. PHYTOPLANKTON NET GROWTH EQUATIONS

$$S_p = \left(G_{Pmax} \cdot G_T(T) \cdot G_I(I) \cdot G_N(N) - \left[k_{PR_{basal}} + f_r \cdot G_{Pmax}(T)\right] - k_{sP} - k_{grz}\theta_{grz}^{T-20}\right) \cdot P_c$$

Temperature Correction

$$G_{Pmax}(T) = G_{Pmax}(T_{opt}) \cdot \theta_P^{T-T_{opt}} \qquad T \leq T_{opt}$$

$$G_{Pmax}(T) = G_{Pmax}(T_{opt}) \cdot \theta_P^{T_{opt}-T} \qquad T > T_{opt}$$

Light Reduction

$$G_I(I) = \frac{ef}{K_e H} \cdot \left(e^{-\alpha_1} - e^{-\alpha_0}\right)$$

$$\alpha_1 = \frac{I_o}{I_s} e^{-k_e H} \qquad \alpha_0 = \frac{I_o}{I_s}$$

$$k_e = K_{e_{base}} + k_c \cdot a_{cchl} \cdot P_c$$

Nutrient Uptake

$$G_N(N) = \mathrm{Min}\left\{\frac{DIN}{K_{mN} + DIN}, \frac{DIP}{K_{mP} + DIP}, \frac{Si}{K_{mSi} + Si}\right\}$$

DIN = dissolved inorganic nitrogen = $NH_3 + NO_2 + NO_3$
DIP = dissolved inorganic phosphorus
Si = available silica

Algal Settling

$$k_{sP} = \left[\frac{v_{sPb}}{H} + \frac{v_{sPn}}{H} \cdot (1 - G_N(N))\right] \cdot \theta_{base}^{T-20}$$

TABLE 1-1. PHYTOPLANKTON NET GROWTH EQUATIONS
(Continued)

Exogenous Variables

Description	Notation
Total Extinction Coefficient	k_e
Base Extinction Coefficient	$k_{e_{base}}$
Total Daily Surface Solar Radiation	I_o
Temperature	T
Segment Depth	H
Fraction of Daylight	f

Rate Constants

Description	Notation	Winter Diatoms	Summer Assemblage	Units
Maximum Specific Growth Rate at T_{opt}	G_{Pmax}	2.0	3.0	day^{-1}
Temperature Coefficient	θ_P	1.068	1.068	
Temperature Optimum	T_{opt}	12.	25.	°C
Phytoplankton Self-Light Attenuation	k_c	0.016	0.016	m^2/mg chl-a
Half-Saturation Constant for Nitrogen	K_{mN}	10.	10.	μgN/L
Half-Saturation Constant for Phosphorus	K_{mP}	1.	1.	μgP/L
Half-Saturation Constant for Silica	K_{mSi}	1.	1.	μgsi/L*
Minimum Basal Respiration Rate	$k_{PRbasal}$	0.03	0.03	day^{-1}
Fraction of Temperature Corrected Growth Rate	f_r	0.05	0.12	
Base Algal Settling Rate	V_{sPb}	0.25	0.25	m/day
Nutrient Dependent Algal Settling Rate	v_{sPn}	0.005	0.005	m/day
Temperature Coefficient	θ_{base}	1.029	1.029	
Loss Due to Zooplankton Grazing	k_{grz}	0.025	0.025	day
Temperature Coefficient	θ_{grz}	1.08	1.08	
Carbon/Chlorophyll Ratio	a_{cchl}	83.	83.	mgC/mg chl-a

inorganic and organic nutrients by algal respiration and predation processes, and the recycling of organic nutrients to inorganic forms via bacterial hydrolysis and mineralization.

In their work on Lake Huron and Saginaw Bay, Di Toro and Matystick (1980) proposed a nutrient recycle formulation that was a function of the localized phytoplankton population. Drawing from an analysis of available field data and citing the work of others (Hendry, 1977; Lowe, 1976; Henrici, 1938; Menon et al., 1972; and Rao, 1976) that indicated bacterial biomass increased as phytoplankton biomass increased, the mechanism chosen, saturating recycle, was a compromise. This compromise was between the conventional first-order temperature corrected mechanism and a second-order recycle mechanism, in which the recycle rate is directly proportional to the phytoplankton biomass present, as indicated in pure culture, bacteria seeded laboratory studies (Jewell and McCarty 1971). The various relationships may be written:

First-order recycle: $$k(T) = k'(20°C)\theta^{T-20} \tag{1-15a}$$

Second-order recycle: $$k(T) = k''(20°C)\theta^{T-20} \bullet P_c \tag{1-15b}$$

Saturating recycle: $$k(T) = k'(20°C)\theta^{T-20} \bullet \frac{P_c}{K_{mP_c} + P_c} \tag{1-15c}$$

Saturating recycle permits second-order dependency at low phytoplankton concentrations, when $P_c << K_{mPc}$, where K_{mPc} is the half saturation constant for recycle. It also permits first-order recycle when the phytoplankton concentrations greatly exceed the half saturation constant. Basically, this mechanism employs a second order recycle that slows the recycle rate if the algal population is small, but does not permit the rate to increase continuously as phytoplankton concentrations increase. The assumption is that at higher population levels, other factors are limiting the recycle kinetics so that it proceeds at its maximum first-order rate.

1.2.2.2 Organic Carbon

Six organic carbon state variables are considered: reactive dissolved organic (ReDOC), labile dissolved (LDOC), refractory dissolved (RDOC), labile particulate (LPOC), refractory particulate (RPOC) and dissolved algal exudate (ExDOC). Reactive, labile and refractory distinctions are based upon the time scale of oxidation or decomposition. Reactive organic carbon decomposes on a time scale of days to a week or two; labile organic carbon decomposes on the time scale of several weeks to a month or two; refractory organic carbon decomposes on the order of months to a year. Reactive and labile organic carbon decompose primarily in the water column or else rapidly in the sediments. Refractory organic carbon decomposes much more slowly, almost entirely in the sediments.

The principal sources of organic carbon are anthropogenic inputs and natural runoff, and detrital algal carbon, which is produced as a result of predation. Zooplankton take up and redistribute algal carbon to the organic carbon pools via grazing, assimilation, respiration and excretion. Since zooplankton are not directly included in the model, the redistribution of algal carbon by zooplankton is simulated by empirical distribution coefficients.

An additional term, representing the excretion of DOC by phytoplankton during photosynthesis, is included in the model. This algal exudate is very reactive and has a time constant similar to the reactive DOC.

The decomposition of organic carbon is assumed to be temperature and bacterial biomass mediated. Since bacterial biomass is not directly included within the model framework, phytoplankton biomass is used as a surrogate variable. Table 1-3 presents the reaction rate terms for each of the organic carbon pools considered in the model framework.

TABLE 1-3. ORGANIC CARBON REACTION EQUATIONS
(Numbering scheme refers to the variable list in Section 1.1.2)

Refractory Particulate Organic Carbon (RPOC)

$$S_{17} = f_{RPOC} \cdot k_{grz}(T) \cdot P_c - k_{17,19}\, \theta_{17,19}^{T-20} \cdot RPOC \cdot \frac{P_c}{K_{mP_c} + P_c}$$

$$- \frac{v_{s17}}{H} \cdot RPOC$$

Labile Particulate Organic Carbon (LPOC)

$$S_{18} = f_{LPOC} \cdot k_{grz}\,(T) \cdot P_c - k_{18,20}\, \theta_{18,20}^{T-20} \cdot LPOC\, \frac{P_c}{K_{mP_c} + P_c} - \frac{v_{s18}}{H} \cdot LPOC$$

Refractory Dissolve Organic Carbon (RDOC)

$$S_{19} = f_{RDOC} \cdot k_{grz}(T) \cdot P_C + k_{17,19}\theta_{17,19}^{T-20} \cdot RPOC \cdot \frac{P_c}{K_{mP_c} + P_c}$$

$$- k_{19,0}\theta_{19,0}^{T-20} \cdot RDOC \cdot \frac{P_c}{K_{mP_c} + P_c} \cdot \frac{DO}{K_{DO} + DO}$$

TABLE 1-3. ORGANIC CARBON REACTION EQUATIONS
(Numbering scheme refers to the variable list in Section 1.1.2)
(Continued)

Labile Dissolved Organic Carbon (LDOC)

$$S_{20} = f_{LDOC} \cdot k_{grz}(T) \cdot P_C + k_{18,20}\theta_{18,20}^{T-20} \cdot LPOC \cdot \frac{P_c}{K_{mP_c} + P_c}$$

$$-k_{20,0}\theta_{20,0}^{T-20} \cdot LDOC \cdot \frac{P_c}{K_{mP_c} + P_c} \cdot \frac{DO}{K_{DO} + DO} \cdot \frac{LDOC}{K_{mLDOC} + LDOC}$$

$$-\frac{5}{4} \cdot \frac{12}{14} \cdot k_{14,0}\theta_{14,0}^{T-20} \cdot NO_2 + NO_3 \cdot \frac{K_{NO_3}}{K_{NO_3} + DO}$$

Reactive Dissolved Organic carbon (ReDOC)

$$S_{21} = -k_{21,0}\theta_{21,0}^{T-20} \cdot ReDOC \cdot \frac{P_c}{k_{mp_c} + P_c} \cdot \frac{DO}{K_{DO} + DO} \cdot \frac{ReDOC}{K_{mLDOC} + ReDOC}$$

Algal Exudate Dissolved Organic Carbon (ExDOC)

$$S_{22} = f_{ExPP} \cdot G_P \cdot P_c$$

$$-k_{22,0}\theta_{22,0}^{T-20} \cdot ExDOC \cdot \frac{P_c}{K_{mP_c} + P_c} \cdot \frac{DO}{K_{DO} + DO} \cdot \frac{ExDOC}{K_{mLDOC} + ExDOC}$$

TABLE 1-3. ORGANIC CARBON REACTION EQUATIONS
(Numbering scheme refers to the variable list in Section 1.1.2)
(Continued)

Description	Notation	Value	Units
Phytoplankton Biomasss	P_c	-	mgC/L
Specific Phytoplankton Growth Rate	G_P	Eq. 1-5	day^{-1}
Half Saturation Constant for Phytoplankton Limitation	K_{mP_C}	0.375	mgC/L
Fraction of Grazed Organic Carbon Recycle to:			
the LPOC pool	f_{LPOC}	0.45	
the RPOC pool	f_{RPOC}	0.05	
the LDOC pool	f_{LDOC}	0.45	
the RDOC pool	f_{RDOC}	0.05	
Fraction of Primary Productivity Going to the Algal Exudate DOC pool	f_{ExPP}	0.10	
Hydrolysis Rate for RPOC	$k_{17,19}$	0.005	day^{-1}
Temperature Coefficient	$\theta_{17,19}$	1.08	
Settling Rate of RPOC	v_{s17}	0.25	m/day
Hydrolysis Rate for LPOC	$k_{18,20}$	0.075	day^{-1}
Temperature Coefficient	$\theta_{18,20}$	1.08	
Settling Rate of LPOC	v_{s18}	0.25	m/day
Segment depth	H	-	m
Oxidation Rate of RDOC	$k_{19,0}$	0.005	
Temperature Coefficient	$\theta_{19,0}$	1.047	
Oxidation Rate LDOC	$k_{20,0}$	0.05	day^{-1}
Temperature Coefficient	$\theta_{20,0}$	1.047	
Oxidation Rate of ReDOC	$k_{21,0}$	0.25	day^{-1}
Temperature Coefficient	$\theta_{21,0}$	1.047	
Oxidation Rate of ExDOC	$K_{22,0}$	0.5	day^{-1}
Temperature Coefficient	$\theta_{22,0}$	1.047	
Half Saturation for Oxygen Limitation	k_{DO}	0.2	mgO_2/L
Michaelis Constant for LDOC	K_{mLDOC}	0.5	mg/L
Dissolved Oxygen	DO	-	mgO_2/L

1.2.2.3 Phosphorus

The eutrophication model includes five principal phosphorus forms: labile and refractory dissolved organic (LDOP and RDOP, respectively), labile and refractory particulate organic (LPOP and RPOP, respectively), and DIP. Inorganic phosphorus is utilized by phytoplankton for growth and phosphorus is returned to the various organic and inorganic forms via respiration and predation. A fraction of the phosphorus released during phytoplankton respiration and predation is in the inorganic form and readily available for uptake by other viable algal cells. The remaining fraction released is in the dissolved and particulate organic forms. The organic phosphorus must undergo a mineralization or bacterial decomposition into inorganic phosphorus before it can be used by phytoplankton. Table 1-4 presents the reaction rate terms for each of the five phosphorus forms.

1.2.2.4 Nitrogen

The kinetic structure for nitrogen is similar to that for the phosphorus system. Table 1-5 summarizes the terms used in the nitrogen system kinetics. During algal respiration and death, a fraction of the cellular nitrogen is returned to the inorganic pool in the form of NH_3. The remaining fraction is recycled to the dissolved and particulate organic nitrogen pools. Organic nitrogen undergoes a bacterial decomposition, the end-product of which is NH_3. Ammonia nitrogen, in the presence of nitrifying bacteria and oxygen, is converted to nitrite nitrogen and subsequently nitrate nitrogen (nitrification). Both ammonia and nitrate are available for uptake and are used in cell growth by phytoplankton; however, for physiological reasons, the preferred form is NH_3. The ammonia preference term takes the following form:

$$\alpha_{NH_3} = NH_3 \bullet \frac{NO_2+NO_3}{(K_{mN}+NH_3) \cdot (K_{mN}+NO_2+NO_3)} \qquad (1\text{-}16)$$

TABLE 1-4. PHOSPHORUS REACTION RATES
(Numbering scheme refers to the variable list in Section 1.1.2)

Refractory Particulate Organic Phosphorus (RPOP)

$$S_4 = a_{PC} \cdot f_{RPOP} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c - k_{4,6}\theta_{4,6}^{T-20} \cdot RPOP \cdot \frac{P_c}{K_{mP_c} + P_c}$$

$$- \frac{v_{s4}}{H} \cdot RPOP$$

Labile Particulate Organic Phosphorus (LPOP)

$$S_5 = a_{PC} \cdot f_{LPOP} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c$$

$$- k_{5,7}\theta_{5,7}^{T-20} \cdot LPOP \cdot \frac{P_c}{K_{mP_c} + P_c} - \frac{v_{s5}}{H} \cdot LPOP$$

Refractory Dissolved Organic Phosphorus (RDOP)

$$S_6 = a_{PC} \cdot f_{RDOP} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c$$

$$+ k_{4,6}\theta_{4,6}^{T-20} \cdot RPOP \cdot \frac{P_c}{K_{mP_c} + P_c}$$

$$- k_{6,8}\theta_{6,8}^{T-20} \cdot RDOP \cdot \frac{P_c}{K_{mP_c} + P_c}$$

Labile Dissolved Organic Phosphorus (LDOP)

$$S_7 = a_{PC} \cdot f_{LDOP} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c$$

$$+ k_{5,7}\theta_{5,7}^{T-20} \cdot LPOP \cdot \frac{P_c}{K_{mP_c} + P_c}$$

TABLE 1-4. PHOSPHORUS REACTION RATES
(Continued)

$$- k_{7,8}\theta_{7,8}{}^{T-20} \cdot LDOP \cdot \frac{P_c}{K_{mP_c} + P_c}$$

Dissolved Inorganic Phosphorus (DIP)

$$S_8 = a_{PC} \cdot f_{DIP} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c$$

$$+ (k_{6,8}\theta_{6,8}{}^{T-20} \cdot RDOP + k_{7,8}\theta_{7,8}{}^{T-20} \cdot LDOP) \cdot \frac{P_c}{K_{mP_c} + P_c}$$

$$- a_{PC} \cdot (1 - f_{ExPP}) \cdot G_P \cdot P_c$$

TABLE 1-4. PHOSPHORUS REACTION RATES
(Continued)

Description	Notation	Value	Units
Phytoplankton Biomass	P_c	-	mgC/L
Temperature Corrected Algal Respiration Rate	$k_{PR}(T)$	Eq. 1-11a	day^{-1}
Temperature Corrected Grazing Rate	$k_{grz}(T)$	Eq. 1-13	day^{-1}
Specific Phytoplankton Growth Rate	G_P	Eq. 1-5	day^{-1}
Phosphorus to Carbon Ratio	a_{PC}	Table 1-2	mgP/mgC
Fraction of Primary Productivity Going to the Algal Exudate DOC pool	f_{ExPP}	0.1	
Fraction of Respired and Grazed Algal Phosphorus Recycled to			
the LPOP pool	f_{LPOP}	0.35	
the RPOP pool	f_{RPOP}	0.05	
the LDOP pool	f_{LDOP}	0.10	
the RDOP pool	f_{RDOP}	0.05	
the DIP pool	f_{DIP}	0.45	
RPOP Hydrolysis Rate at 20°C	$k_{4,6}$	0.005	day^{-1}
Temperature Coefficient	$\theta_{4,6}$	1.08	
RPOP Settling Rate	v_{s4}	0.25	m/day
LPOP Hydrolysis Rate at 20°C	$k_{5,7}$	0.075	day^{-1}
Temperature Coefficient	$\theta_{5,7}$	1.08	
LPOP Settling Rate	v_{s5}	0.25	m/day
RDOP Mineralization Rate at 20°C	$k_{6,8}$	0.005	day^{-1}
Temperature Coefficient	$\theta_{6,8}$	1.08	
LDOP Mineralization Rate at 20°C	$k_{7,8}$	0.075	day^{-1}
Temperature Coefficient	$\theta_{7,8}$	1.08	

TABLE 1-5. NITROGEN REACTION RATES

(Numbering scheme refers to the variable list in Section 1.1.2)

Refractory Particulate Organic Nitrogen (RPON)

$$S_9 = a_{NC} \cdot f_{RPON} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c - k_{9,11}, \theta_{9,11}{}^{T-20} \cdot RPON \frac{P_c}{K_{mP_c} + P_c}$$

$$- \frac{v_{s9}}{H} \cdot RPON$$

Labile Particulate Organic Nitrogen (LPON)

$$S_{10} = a_{NC} \cdot f_{LPON} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c$$

$$- k_{10,12} \theta_{10,12}{}^{T-20} \cdot LPON \cdot \frac{P_c}{K_{mP_c} + P_c} - \frac{v_{s10}}{H} \cdot LPON$$

Refractory Dissolved Organic Nitrogen (RDON)

$$S_{11} = a_{NC} \cdot f_{RDON} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c$$

$$+ k_{9,11} \theta_{9,11}{}^{T-20} \cdot RPON \cdot \frac{P_c}{K_{mP_c} + P_c}$$

$$- k_{11,13} \theta_{11,13}{}^{T-20} \cdot RDON \cdot \frac{P_c}{K_{mP_c} + P_c}$$

Labile Dissolved Organic Nitrogen (LDON)

$$S_{12} = a_{NC} \cdot f_{LDON} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c$$

$$+ k_{10,12} \theta_{10,12}{}^{T-20} \cdot LPON \cdot \frac{P_c}{K_{mP_c} + P_c}$$

TABLE 1-5. NITROGEN REACTION RATES
(Continued)

$$k_{12,13}\theta_{12,13}^{T-20} \cdot LDON \cdot \frac{P_c}{K_{mP_c} + P_c}$$

Ammonia Nitrogen (NH_3)

$$S_{13} = a_{NC} \cdot f_{NH3} \cdot (k_{PR}(T) + k_{grz}(T)) \cdot P_c$$

$$+ (k_{11,13}\theta_{11,13}^{T-20} \cdot RDON + k_{12,13}\theta_{12,13}^{T-20} \cdot LDON) \cdot \frac{P_c}{K_{mP_c} + P_c}$$

$$-a_{NC} \cdot \alpha_{NH_3} \cdot (1 - f_{ExPP}) \cdot G_P \cdot P_c - k_{13,14}\theta_{13,14}^{T-20} \cdot NH_3 \cdot \frac{DO}{K_{nitr} + DO}$$

Nitrite + Nitrate Nitrogen ($NO_2 + NO_3$)

$$S_{14} = k_{13,14}\theta_{13,14}^{T-20} \cdot NH_3 \cdot \frac{DO}{K_{nitr} + DO} - a_{NC} \cdot (1 - \alpha_{NH_3}) \cdot (1 - f_{ExPP}) \cdot G_P \cdot P_c$$

$$- k_{14,0}\theta_{14,0}^{T-20} \cdot NO_2 + NO_3 \cdot \frac{K_{NO_3}}{K_{NO_3} + DO}$$

TABLE 1-5. NITROGEN REACTION RATES
(Continued)

Description	Notation	Value	Units
Phytoplankton Biomass	P_c	-	mgC/L
Temperature Corrected Algal Respiration Rate	$k_{PR}(T)$	cf Eq. 1-11a	day^{-1}
Temperature Corrected Grazing Rate	$k_{grz}(T)$	cf Eq. 1-13	day^{-1}
Specific Phytoplankton Growth Rate	G_P	cf Eq. 1-5	day^{-1}
Nitrogen to Carbon Ration	a_{NC}	cf Table 1-2	mgN/mgC
Fraction of Primary Productivity Going to the Algal Exudate DOC pool	f_{ExPP}	0.1	
Fraction of Respired and Grazed Algal Nitrogen Recycled to			
The LPON pool	f_{LPON}	0.35	
the RPON pool	f_{RPON}	0.05	
the LDON pool	f_{LDON}	0.30	
the RDON pool	f_{RDON}	0.05	
the NH_3 pool	f_{NH3}	0.25	
RPON Hydrolysis Rate at 20°C	$k_{9,11}$	0.005	day^{-1}
Temperature Coefficient	$\theta_{9,11}$	1.08	
RPON Settling Rate	v_{s9}	0.25	m/day
LPON Hydrolysis Rate at 20°C	$k_{10,12}$	0.075	day^{-1}
Temperature Coefficient	$\theta_{10,12}$	1.08	
LPON Settling Rate	v_{s10}	0.25	m/day
RDON Mineralization Rate at 20°C	$k_{11,13}$	0.005	day^{-1}
Temperature Coefficient	$\theta_{11,13}$	1.08	
LDON Mineralization Rate at 20°C	$k_{12,13}$	0.075	day^{-1}
Temperature Coefficient	$\theta_{12,13}$	1.08	
Nitrification Rate at 20°C	$k_{13,14}$	0.05	day^{-1}
Temperature Coefficient	$\theta_{13,14}$	1.08	
Half Saturation Constant for Oxygen Limitation	K_{nitr}	2.0	mgO_2/L
Denitrification Rate at 20°C	$K_{14,0}$	0.05	day^{-1}
Temperature Coefficient	$\theta_{14,0}$	1.045	
Michaelis Constant for Denitrification	K_{NO_3}	0.01	$mgO_{2/L}$

$$+ NH_3 \bullet \frac{K_{mN}}{(NH_3+NO_2+NO_3) \cdot (K_{mN}+NO_2+NO_3)}$$

The behavior of this equation, for a Michaelis value, K_{mN}, of 10 μgN/L, is illustrated on Figure 1-2. The behavior of Equation 1-16 is most sensitive at low values of ammonia or nitrate. For a given concentration of ammonia, as the available nitrate increases above approximately the Michaelis limitation, the preference for ammonia reaches a plateau. Also, as the concentration of available ammonia increases, the plateau occurs at values closer to unity, that is, total preference for ammonia. The process of nitrification in natural waters is carried out by aerobic autotrophs, *Nitrosomonas* and *Nitrobacter,* in particular. It is a two-step process with *Nitrosomonas* bacteria responsible for the conversion of ammonia to nitrite (NO_2) and *Nitrobacter* responsible for the subsequent conversion of nitrite to nitrate (NO_3). Essential to this reaction process are aerobic conditions. In order to reduce the number of state variables required in the modeling framework, it was decided to incorporate nitrite and nitrate together as a single state variable. Therefore, the process of nitrification is assumed to be approximated by a first-order reaction rate that is a function of the water column dissolved oxygen concentration and ambient temperature.

Denitrification refers to the reduction of NO_3 (or NO_2) to N_2 and other gaseous products such as N_2O and NO. This process is carried out by a large number of heterotrophic, facultative anaerobes. Under normal aerobic conditions found in the water column, these organisms utilize oxygen to oxidize organic material. However, under the anaerobic conditions found in the sediment bed or during extremely low oxygen conditions in the water column, these organisms are able to use NO_3 as the electron acceptor. The process of denitrification is included in the modeling framework simply as a sink of nitrate. This can always occur in the anaerobic sediment layer. In the water column, however, denitrification should only occur under extremely low dissolved oxygen conditions. This is accomplished computationally by modifying the linear first-order denitrification rate by the expression $K_{NO3}/(K_{NO3} + DO)$. This expression is similar to the Michaelis-Menton expression; for concentrations of dissolved oxygen greater than 1 mg/L, the expression

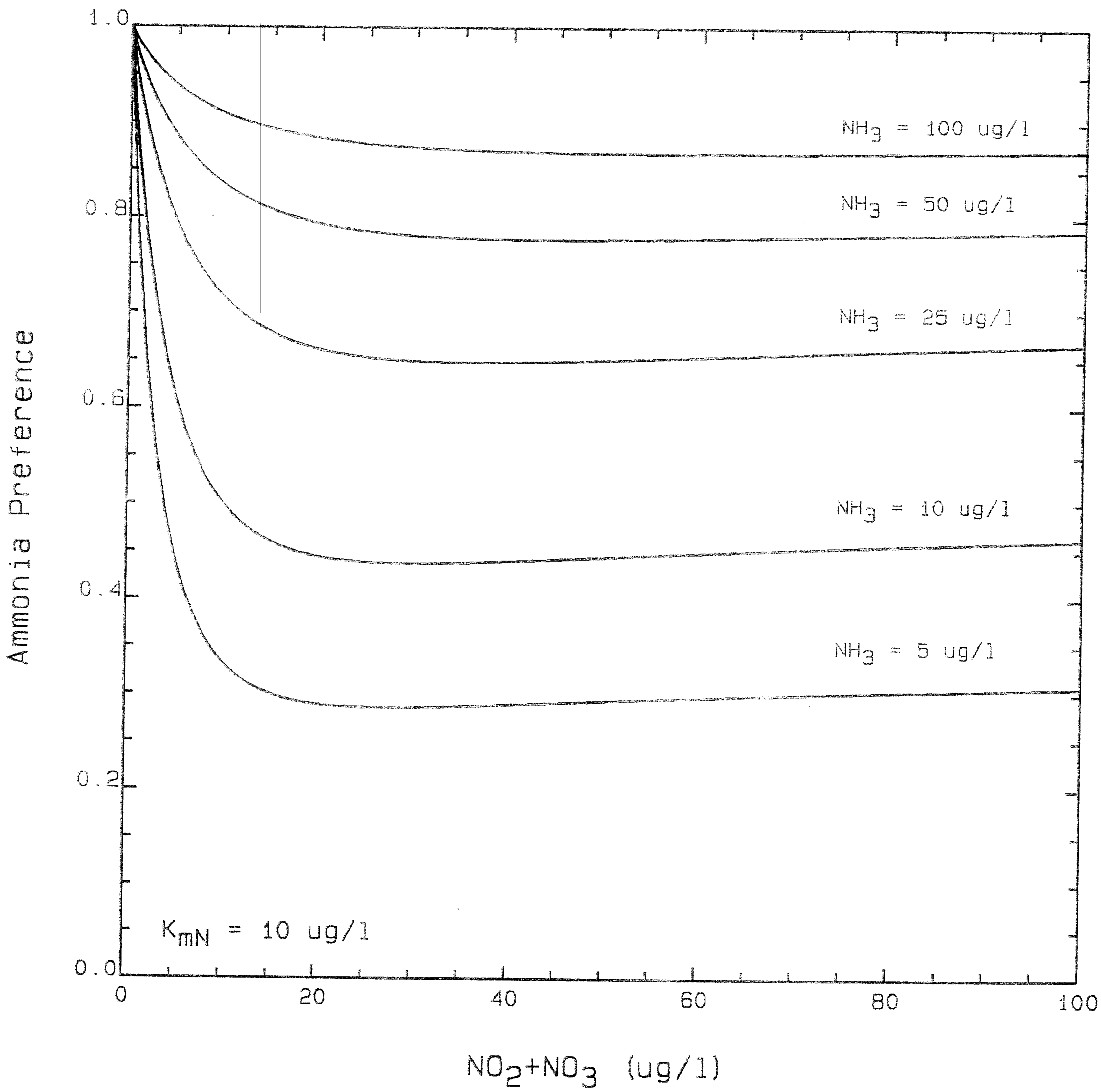

Figure 1-2. Behavior of the Ammonia Preference Structure for Various Concentrations of NH_3 and NO_2+NO_3

reduces denitrification to near zero, whereas for dissolved oxygen levels less than 0.1mg/L, this expression permits denitrification to occur.

1.2.2.5 Silica

Two silica state-variables are considered: available (Si) and unavailable or particulate biogenic (SiU). Available silica is dissolved and is utilized by diatoms during growth for their cell structure. Unavailable or particulate biogenic silica is produced from diatom respiration and diatom grazing by zooplankton. Particulate biogenic silica undergoes mineralization to available silica or settles to the sediment from the water column. Table 1-6 presents the state-variable equations for the two silica forms utilized in the model framework.

1.2.2.6 Dissolved Oxygen

A by-product of photosynthetic carbon fixation is the production of dissolved oxygen. The rate of oxygen production and nutrient uptake is proportional to the growth rate of the phytoplankton, since its stoichiometry is fixed. An additional source of oxygen from algal growth occurs when the available ammonia nutrient source is exhausted and the phytoplankton begin to utilize the available nitrate. This additional oxygen source can be seen by comparing equations 1-17a and 1-17b (Morel, 1983).

$$106\ CO_2 + 16\ NH_4^+ + H_2PO_4^- + 106\ H_2O \Rightarrow \text{Protoplasm} + 106\ O_2 + 15H^+ \tag{1-17a}$$

$$106\ CO_2\ 16\ NO_3^- + H_2PO_4^- + 122\ H_2O + 17\ H^+ \Rightarrow \text{Protoplasm} + 138\ O_2 \tag{1-17b}$$

TABLE 1-6. SILICA REACTION EQUATIONS

Unavailable or Biogenic (SiU)

$$S_{15} = (k_{PR}(T) + k_{grz}(T)) \cdot P_c - k_{15,16}\theta_{15,16}^{T-20} \cdot SiU \cdot \frac{P_c}{K_{mP_c} + P_c} - \frac{V_{s15}}{H} \cdot SiU$$

Available Silica (Si)

$$S_{16} = k_{15,16}\theta_{15,16}^{T-20} \cdot SiU \cdot \frac{P_c}{K_{mP_c} + Pc} - (1 - f_{ExPP}) \cdot a_{sc} \cdot G_P \cdot P_c$$

Description	Notation	Value	Units
Phytoplankton Biomass	P_c	-	mgC/L
Temperature Corrected Algal Respiration Rate	$k_{PR}(T)$	Eq. 1-11a	day^{-1}
Temperature Corrected Grazing Rate	$k_{grz}(T)$	Eq. 1-13	day^{-1}
Specific Phytoplankton Growth Rate	G_p	Eq. 1-5	day^{-1}
Silica to Carbon Ration	a_{sc}	Table 1-2	mgSi/mgC
Fraction of Primary Productivity Going to the Algal Exudate pool	f_{ExPP}	0.1	
Mineralization Rate of Biogenic Silica	$k_{15,16}$	0.05	day^{-1}
Temperature Coefficient	$\theta_{15,16}$	1.08	
Silica Settling Rate	V_{s15}	0.25	m/day

The above equations present the stoichiometric description of the photosynthetic process assuming ammonium (Equation 1-17a) or nitrate (Equation 1-17b) as the nitrogen source and assuming algal biomass to have Redfield stoichiometry:

$$\text{Biomass} = C_{106}\, H_{263}\, O_{110}\, N_{16}\, P_1 \qquad (1\text{-}18)$$

Oxygen-deficient or under-saturated waters are replenished via atmospheric reaeration. The reaeration coefficient is a function of the average tidal velocity, wind and temperature, and is computed using Equations 1-19a and 1-19b:

$$k_a\ (20°C) = K_L/H \qquad (1\text{-}19a)$$

wind

$$k_a(T) = k_a(20°C)\theta_a^{T-20} \qquad (1\text{-}19b)$$

temperature

where

ka = the surface mass transfer coefficient (m/day),
H = depth (m),
θ_a = temperature coefficient.

In the Tar-Pamlico River model, the oxygen transfer coefficient (K_L) has been modified from a constant in time to a time varying coefficient. The oxygen transfer coefficient is calculated as a function of the daily wind speeds based upon the equations developed by O'Connor (1983).

Dissolved oxygen saturation is a function of both temperature and salinity and is determined via Equation 1-20 (Hyer et al., 1971):

$$DO_{sat} = 14.6244 - 0.367134T + 0.0044972T^2 - 0.0966S \qquad (1\text{-}20)$$

where S is salinity in ppt.

$$+ 0.00205ST + 0.0002739S^2$$

Dissolved oxygen is diminished in the water column as a result of algal respiration, which is the reverse process of photosynthesis; as a result of nitrification:

$$NH_4^+ + 2O_2 \rightarrow NO_3^- + H_2O + 2H^+ \qquad (1\text{-}21)$$

as a result of the oxidation of carbonaceous material (including detrital phytoplankton):

$$CH_2O + O_2 \rightarrow CO_2 + H_2O \qquad (1\text{-}22)$$

and, if dissolved oxygen concentrations are sufficiently low, as a result of denitrification:

$$5CH_2O + 4NO_3^- + 4H^+ \rightarrow 5CO_2 + 2N_2 + 7H_2O \qquad (1\text{-}23)$$

Table 1-7 presents a summary of the dissolved oxygen mass balance equation and associated coefficients used in this study.

TABLE 1-7. DISSOLVED OXYGEN AND O_2^* REACTION RATES

Sulfide Oxygen Equivalents (O_2^*)

$$S_{23} = K_{O_2^*} \, \theta_{O_2^*}^{\,T-20} \cdot O_2^* \cdot \frac{P_c}{K_{mP_c} + P_c} \cdot \frac{DO}{K_{DO_{O_2^*}} + DO}$$

Dissolved Oxygen (DO)

$$S_{24} = a_{OC} \cdot \alpha_{NH3} \cdot G_P \cdot P_c + (a_{NO_3}c) \cdot (1 - \alpha_{NH_3}) \cdot G_P \cdot P_c$$

$$+ k_a \theta_a^{\,T-20} \cdot (DO_{sat} - DO) - a_{OC} \cdot k_{PR}(T) \cdot P_C$$

$$-2 \cdot a_{ON} \cdot k_{13,14} \theta_{13,14}^{\,T-20} \cdot NH_3 \cdot \frac{DO}{K_{nitr} + DO}$$

$$- a_{oc} \cdot \Bigg[k_{19,0} \, \theta_{19,0}^{T-20} \cdot RDOC + k_{20,0} \, \theta_{20,0}^{T-20} \cdot LDOC \cdot \frac{LDOC}{K_{m_{LDOC}} + LDOC}$$

$$+ k_{21,0} \, \theta_{21,0}^{T-20} \cdot ReDOC \cdot \frac{ReDOC}{K_{mLDOC} + ReDOC}$$

$$+ k_{22,0} \, \theta_{22,0}^{T-20} \cdot ExDOC \cdot \frac{ExDOC}{K_{mLDOC} + ExDOC} \Bigg] \cdot \frac{P_c}{K_{mPc} + P_c} \cdot \frac{DO}{K_{DO} + DO}$$

$$- K_{o_2^*} \, \theta_{o_2^*}^{\,T-20} \cdot O_2^* \cdot \frac{P_c}{K_{mPc} + P_c} \cdot \frac{DO}{K_{DO_{O_2^*}} + DO}$$

TABLE 1-7. DISSOLVED OXYGEN AND O_2^* REACTION RATES (Continued)

Rate Constants

Description	Notation	Value	Units
Oxygen to Carbon Ratio	a_{OC}	32/12	mgO_2/mg C
Oxygen to Nitrogen Ratio	a_{ON}	32/14	mgO_2/mg N
Oxygen to Carbon Ratio for Nitrate Uptake	a_{NO_3C}	$\frac{48}{14} a_{NC}$	mgO_2/mg C
Reaeration Rate at 20°C	k_a	Eq. 1.19a	day^{-1}
Temperature Coefficient	θ_a	1.024	none
Oxygen Transfer Coefficient	k_L	function of wind	m^{-1}
Dissolved Oxygen Saturation	DO_{sat}	Eq. 1.20	mgO_2/L
Oxidation Rates and Temperature Coefficients			
for RDOC	$k_{19,0}$ $\theta_{19,0}$	0.005 1.047	day^{-1}
for LDOC	$k_{20,0}$ $\theta_{20,0}$	0.05 1.047	day^{-1}
for ReDOC	$k_{21,0}$ $\theta_{21,0}$	0.25 1.047	day^{-1}
for ExDOC	$k_{22,0}$ $\theta_{22,0}$	0.5 1.047	day^{-1}
Oxidation Rate of Dissolved Sulfide	$k_{O_2^*}$	0.25	day^{-1}
Temperature Coefficient	$\theta_{O_2^*}$	1.047	
Half Saturation for Oxygen Limitation	$k_{DO_{O_2^*}}$	0.2	mgO_2/l

SECTION 7.
REFERENCES

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APPENDIX 9.2

TAR-PAMLICO RIVER POINT SOURCE LOADINGS AND FLOWS

Tar-Pamlico River Point Source Loadings

Point Source		NPDES Permit Flow (MGD)	1991 Avg Flow (MGD)	Pct of Permit Flow	Calc Avg Flow (MGD)	Avg TN (mg/l)	Total Nitrogen Loadings (lb/d) January	February	March	April	May	June	July	August	September	October	November	December
Above Greenville																		
Rocky Mount WWTP	1	14.000	11.730			10.17	1182.0	1343.0	1414.0	1415.0	1235.0	832.0	715.0	757.0	795.0	792.0	707.0	751.0
Greenville WWTP	1	10.500	8.010			12.34	1663.0	1156.0	989.0	731.0	635.0	780.0	606.0	632.0	661.0	848.0	521.0	679.0
Tarboro WWTP	2	3.000		0.66	1.980	13.75 *	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1
Oxford WWTP	1	2.170	1.220			11.63	144.0	110.0	149.0	105.0	176.0	80.0	212.0	108.0	67.0	93.0	82.0	94.0
Warren County WWTP	2	2.000		0.20	0.400	9.20 *	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7
Robersonville WWTP	2	1.800		0.48	0.864	11.65 *	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9
Scotland Neck WWTP	2	0.900		0.50	0.450	12.00 **	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
Louisburg WWTP	1	0.800	0.510			18.12	94.0	74.0	78.0	61.0	63.0	45.0	61.0	136.0	123.0	51.0	68.0	73.0
Bethel WWTP	2	0.750		0.41	0.308	6.62 *	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Enfield WWTP	1	0.500	0.350			18.69	65.0	42.0	86.0	52.0	52.0	46.0	56.0	62.0	42.0	45.0	35.0	62.0
Franklin W&SA	1	0.500	0.220			17.49	44.0	11.0	31.0	24.0	14.0	25.0	23.0	44.0	66.0	41.0	33.0	25.0
Franklinton WWTP	2	0.500		0.34	0.170	12.00 **	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Spring Hope WWTP	1	0.400	0.170			18.42	43.0	23.0	24.0	24.0	20.0	21.0	24.0	26.0	28.0	24.0	23.0	24.0
Pinetops WWTP	1	0.300	0.230			17.67	37.0	33.0	39.0	36.0	34.0	28.0	28.0	36.0	34.0	32.0	29.0	32.0
Littleton WWTP	2	0.280		0.67	0.188	12.79 *	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Nashville WWTP	2	0.250		0.95	0.238	12.00 **	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8
Macclesfield WWTP	2	0.175		0.72	0.126	12.54 *	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
Seaboard RR	2	0.100		0.68	0.068	9.65 *	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Warrenton WWTP	1		0.340			14.52	51.0	21.0	32.0	24.0	32.0	59.0	39.0	49.0	66.0	44.0	34.0	38.0
Bunn WWTP	1		0.090			18.84	6.0	14.0	15.0	14.0	12.0	10.0	11.0	14.0	16.0	18.0	18.0	19.0
						TOTAL =	3812	3310	3340	2969	2756	2409	2258	2347	2381	2471	2033	2280
Below Greenville																		
Washington WWTP	1	2.250	1.560			7.94	192.0	126.0	117.0	80.0	78.0	75.0	72.0	148.0	101.0	105.0	89.0	57.0
Nat'l Spinning Co.	2	1.750		0.62	1.085	9.64 *	87.2	87.2	87.2	87.2	87.2	87.2	87.2	87.2	87.2	87.2	87.2	87.2
Belhaven WWTP	1	0.500	0.470			14.32	77.0	46.0	68.0	64.0	51.0	53.0	57.0	67.0	46.0	43.0	61.0	43.0
Aurora WWTP	2	0.120		0.76	0.091	12.00 **	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
TexasGulf	2						430.6	430.6	430.6	430.6	430.6	430.6	430.6	430.6	430.6	430.6	430.6	430.6
						TOTAL =	796	699	712	671	656	655	656	742	674	675	677	627

1 - Data from Personal Correspondence with Paul Blount

2 - Data Compiled from "Surface Water Quality Concerns in the Tar-Pamlico River Basin", NCDEM, December, 1987
"Tar-Pamlico River Basin Nutrient Sensitive Waters Designation & Nutrient Management Strategy", NCDEM, April, 1989
"Watershed Planning in the Albemarle-Pamlico Estuarine System, Report 1", RTI, August, 1992

3 - Data from Personal Correspondence with Don Stanley

* - From 1989-1990 Data Presented in the RTI Report

** - Averaged from 1989-1990 Data Presented in the RTI Report

Point Source		NPDES Permit Flow (MGD)	1991 Avg Flow (MGD)	Pct of Permit Flow	Calc Avg Flow (MGD)	Avg TP (mg/l)	January	February	March	April	May	June	July	August	September	October	November	December
							Total Phosphorus Loadings (lb/d)											
Above Greenville																		
Rocky Mount WWTP	1	14.000	11.730			2.05	239.0	234.0	162.0	195.0	239.0	135.0	186.0	180.0	198.0	216.0	241.0	187.0
Greenville WWTP	1	10.500	8.010			1.67	112.0	87.0	112.0	50.0	205.0	99.0	219.0	81.0	137.0	166.0	36.0	32.0
Tarboro WWTP	2	3.000		0.66	1.980	1.18 *	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5
Oxford WWTP	1	2.170	1.220			1.36	23.0	11.0	13.0	17.0	22.0	16.0	33.0	2.0	6.0	7.0	7.0	8.0
Warren County WWTP	2	2.000		0.20	0.400	7.50 *	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Robersonville WWTP	2	1.800		0.48	0.864	2.15 *	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
Scotland Neck WWTP	2	0.900		0.50	0.450	2.00 **	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Louisburg WWTP	1	0.800	0.510			2.76	16.0	13.0	14.0	11.0	11.0	8.0	6.0	50.0	4.0	1.0	3.0	5.0
Bethel WWTP	2	0.750		0.41	0.308	0.76 *	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Enfield WWTP	1	0.500	0.350			2.40	8.0	4.0	10.0	7.0	7.0	6.0	7.0	9.0	6.0	6.0	6.0	6.0
Franklin W&SA	1	0.500	0.220			2.03	5.0	3.0	4.0	3.0	3.0	3.0	3.0	4.0	5.0	5.0	4.0	3.0
Franklinton WWTP	2	0.500		0.34	0.170	2.00 **	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Spring Hope WWTP	1	0.400	0.170			1.46	2.0	3.0	3.0	3.0	2.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0
Pinetops WWTP	1	0.300	0.230			0.14	4.0	0.0	4.0	3.0	7.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0
Littleton WWTP	2	0.280		0.67	0.188	0.95 *	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Nashville WWTP	2	0.250		0.95	0.238	2.00 **	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Macclesfield WWTP	2	0.175		0.72	0.126	1.46 *	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Seaboard RR	2	0.100		0.68	0.068	0.14 *	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Warrenton WWTP	1		0.340			0.89	3.0	4.0	5.0	1.0	1.0	4.0	4.0	2.0	2.0	1.0	3.0	1.0
Bunn WWTP	1		0.090			2.12	1.0	2.0	2.0	2.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0
						TOTAL =	492	440	408	371	577	356	544	413	445	489	387	329
Below Greenville																		
Washington WWTP	1	2.250	1.560			1.44	17.0	23.0	22.0	19.0	24.0	21.0	13.0	15.0	16.0	19.0	17.0	19.0
Nat'l Spinning Co.	2	1.750		0.62	1.085	0.78 *	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Belhaven WWTP	1	0.500	0.470			1.01	5.0	3.0	5.0	5.0	2.0	4.0	4.0	5.0	3.0	3.0	6.0	3.0
Aurora WWTP	1	0.120		0.76	0.091	2.00 **	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
TexasGulf	3						8540	5865	4681	3346	3741	3156	2807	2801	1690	1926	2012	2156
						TOTAL =	8571	5900	4717	3379	3776	3190	2833	2830	1718	1957	2044	2187

1 - Data from Personal Correspondence with Paul Blount

2 - Data Compiled from "Surface Water Quality Concerns in the Tar-Pamlico River Basin", NCDEM, December, 1987
"Tar-Pamlico River Basin Nutrient Sensitive Waters Designation & Nutrient Management Strategy", NCDEM, April, 1989
"Watershed Planning in the Albemarle-Pamlico Estuarine System, Report 1", RTI, August, 1992

3 - Data from Personal Correspondence with Don Stanley

* - From 1989-1990 Data Presented in the RTI Report

** - Averaged from 1989-1990 Data Presented in the RTI Report

Tar-Pamlico River Point Source Flows

Point Source		NPDES Permit Flow (MGD)	1991 Avg Flow (MGD)	Pct of Permit Flow	Calc Avg Flow (MGD)	Effluent Flows (MGD) January	February	March	April	May	June	July	August	September	October	November	December
Above Greenville																	
Rocky Mount WWTP	1	14.000	11.730			15.40	12.20	13.20	12.70	11.50	10.80	10.50	12.20	10.90	10.70	10.33	10.35
Greenville WWTP	1	10.500	8.010			8.98	8.72	8.98	8.51	8.46	7.42	7.73	8.06	7.48	8.27	7.10	6.46
Tarboro WWTP	2	3.000		0.66	1.980	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98
Oxford WWTP	1	2.170	1.220			1.44	1.23	1.32	1.24	1.17	0.78	2.49	1.21	0.94	0.98	0.86	0.97
Warren County WWTP	2	2.000		0.20	0.400	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Robersonville WWTP	2	1.800		0.48	0.864	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Scotland Neck WWTP	2	0.900		0.50	0.450	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Louisburg WWTP	1	0.800	0.510			0.72	0.56	0.60	0.47	0.48	0.35	0.43	0.42	0.60	0.43	0.52	0.57
Bethel WWTP	2	0.750		0.41	0.308	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Enfield WWTP	1	0.500	0.350			0.42	0.27	0.47	0.33	0.33	0.29	0.36	0.45	0.32	0.31	0.27	0.31
Franklin W&SA	1	0.500	0.220			0.30	0.19	0.21	0.16	0.18	0.17	0.19	0.27	0.26	0.26	0.22	0.19
Franklinton WWTP	2	0.500		0.34	0.170	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Spring Hope WWTP	1	0.400	0.170			0.28	0.15	0.16	0.16	0.13	0.14	0.16	0.16	0.16	0.16	0.16	0.16
Pinetops WWTP	1	0.300	0.230			0.25	0.22	0.27	0.25	0.23	0.19	0.19	0.24	0.23	0.22	0.20	0.22
Littleton WWTP	2	0.280		0.67	0.188	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Nashville WWTP	2	0.250		0.95	0.238	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Macclesfield WWTP	2	0.175		0.72	0.126	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Seaboard RR	2	0.100		0.68	0.068	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Warrenton WWTP	1		0.340			0.43	0.36	0.43	0.34	0.35	0.30	0.31	0.30	0.33	0.31	0.28	0.31
Bunn WWTP	1		0.090			0.04	0.09	0.09	0.09	0.08	0.07	0.07	0.09	0.08	0.12	0.12	0.12
					TOTAL =	33.05	28.78	30.52	29.04	27.70	25.30	27.22	28.19	26.09	26.55	24.85	24.45
Below Greenville																	
Washington WWTP	1	2.250	1.560			1.53	1.56	1.70	1.66	1.56	1.60	1.57	1.61	1.50	1.46	1.46	1.51
Nat'l Spinning Co.	2	1.750		0.62	1.085	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Belhaven WWTP	1	0.500	0.470			0.65	0.43	0.57	0.54	0.40	0.45	0.48	0.58	0.38	0.36	0.45	0.36
Aurora WWTP	2	0.120		0.76	0.091	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
TexasGulf	2																
					TOTAL =	3.36	3.17	3.45	3.38	3.14	3.23	3.23	3.37	3.06	3.00	3.09	3.05

1 - Data from Personal Correspondence with Paul Blount

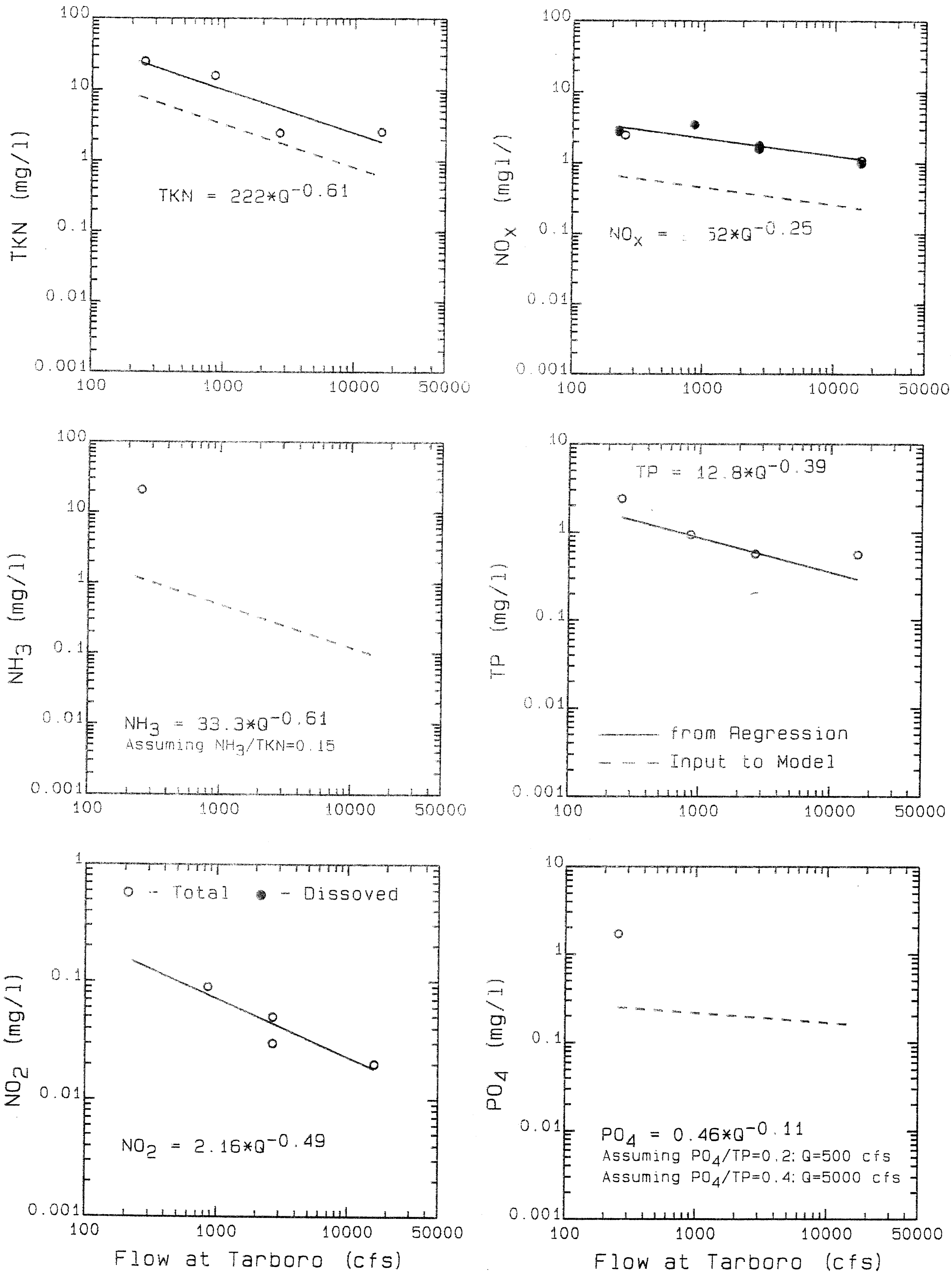
2 - Data Compiled from "Surface Water Quality Concerns in the Tar-Pamlico River Basin", NCDEM, December, 1987
"Tar-Pamlico River Basin Nutrient Sensitive Waters Designation & Nutrient Management Strategy", NCDEM, April, 1989
"Watershed Planning in the Albemarle-Pamlico Estuarine System, Report 1", RTI, August, 1992

3 - Data from Personal Correspondence with Don Stanley

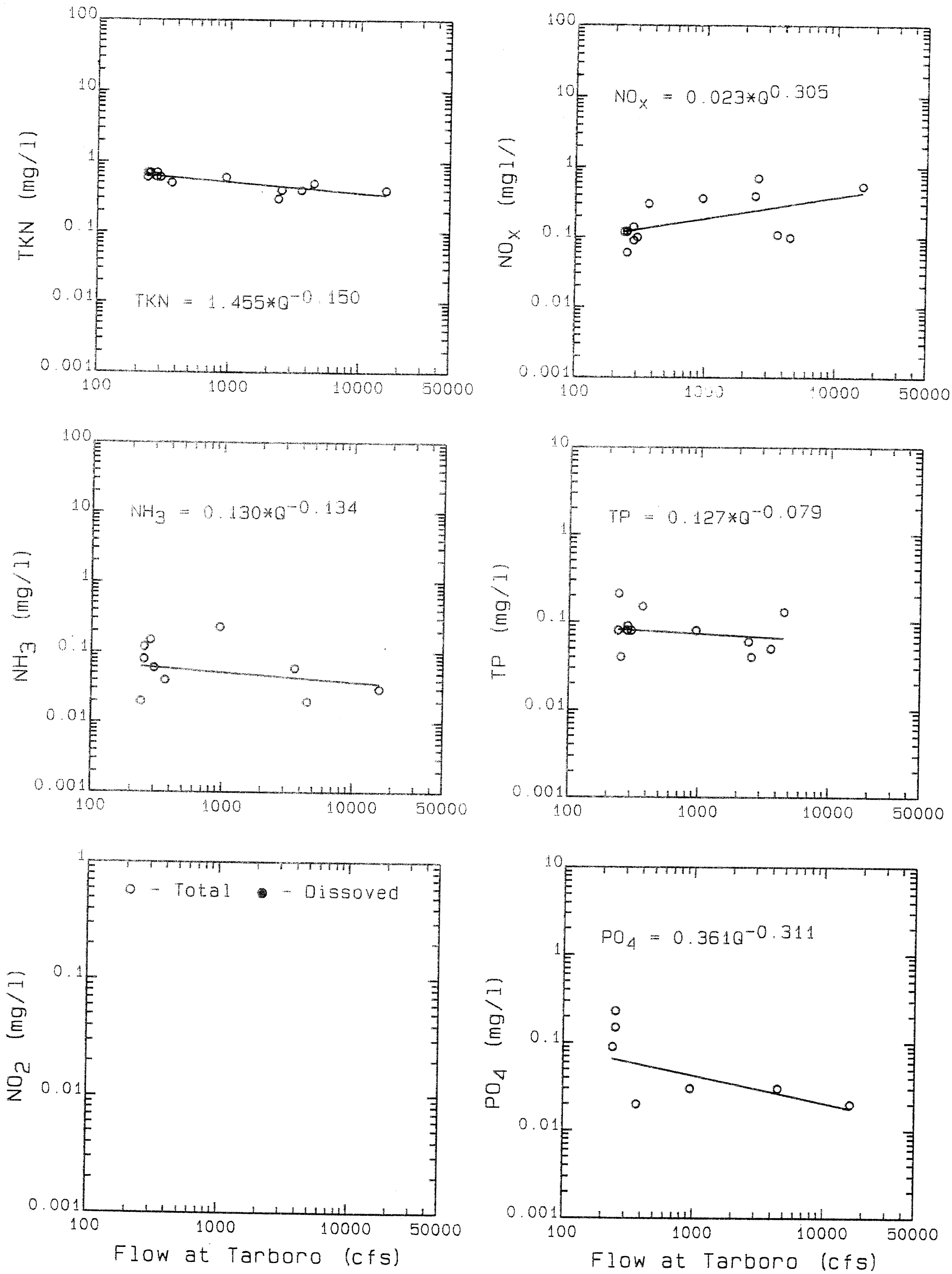
* - Averaged from Data Presented in the RTI Report

APPENDIX 9.3

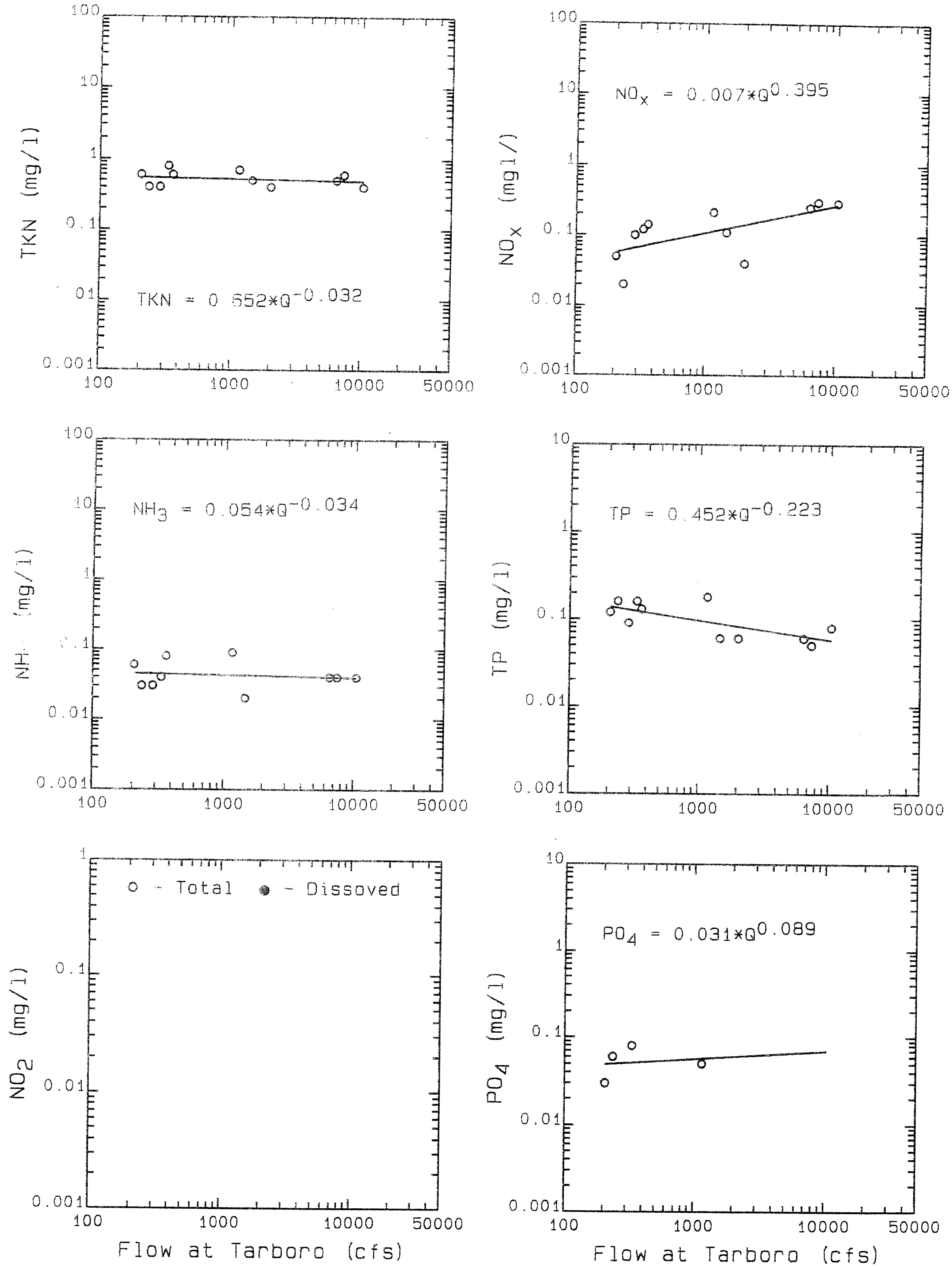
TRIBUTARY CONCENTRATION VS FLOW RELATIONSHIPS



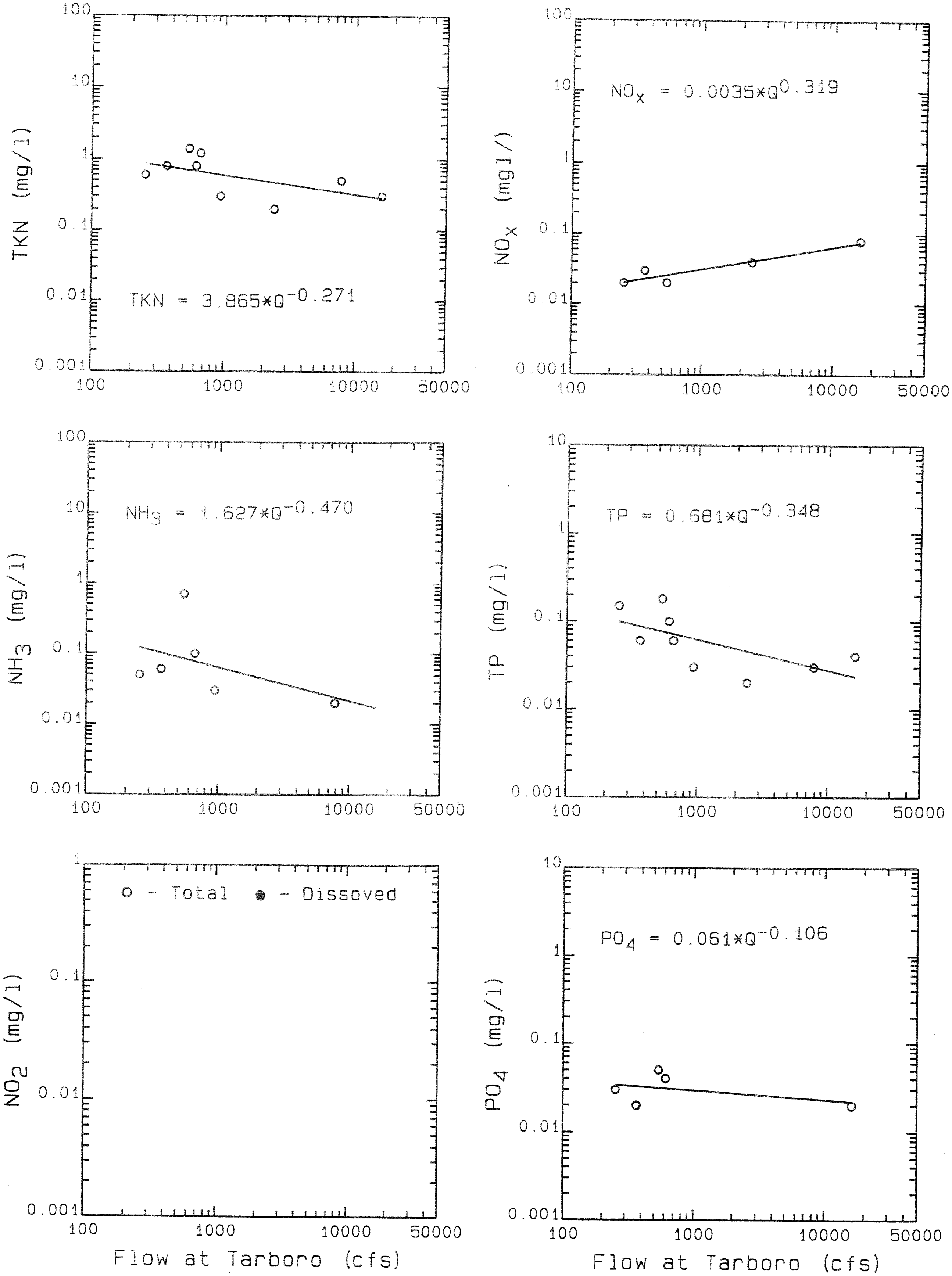
Chicod Creek Data vs Flow at Tarboro - 1986-1991



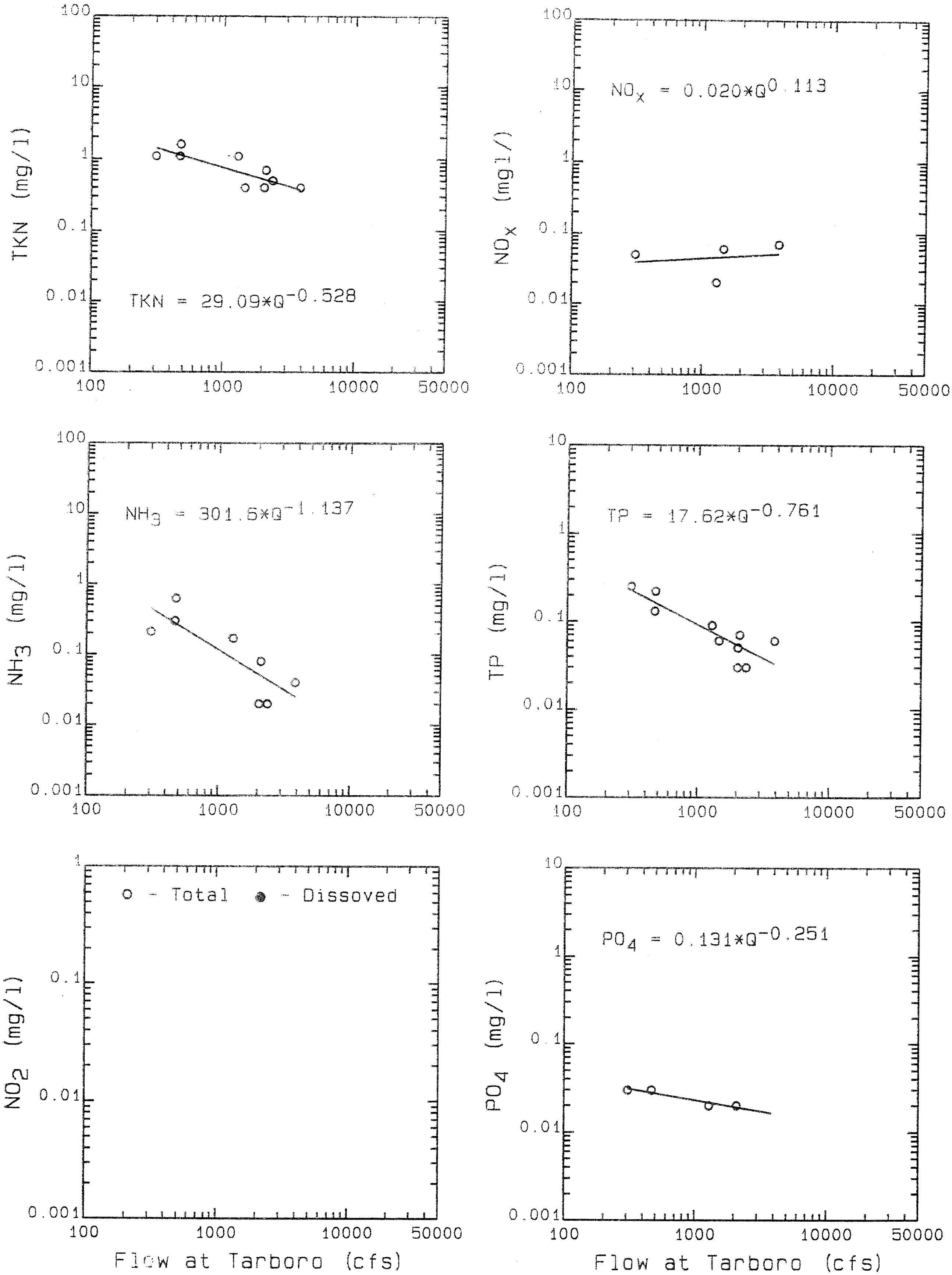
Tranters Creek Data vs Flow at Tarboro - 1986-1991
(Winter = Jan, Feb, Mar, Oct, Nov, Dec)



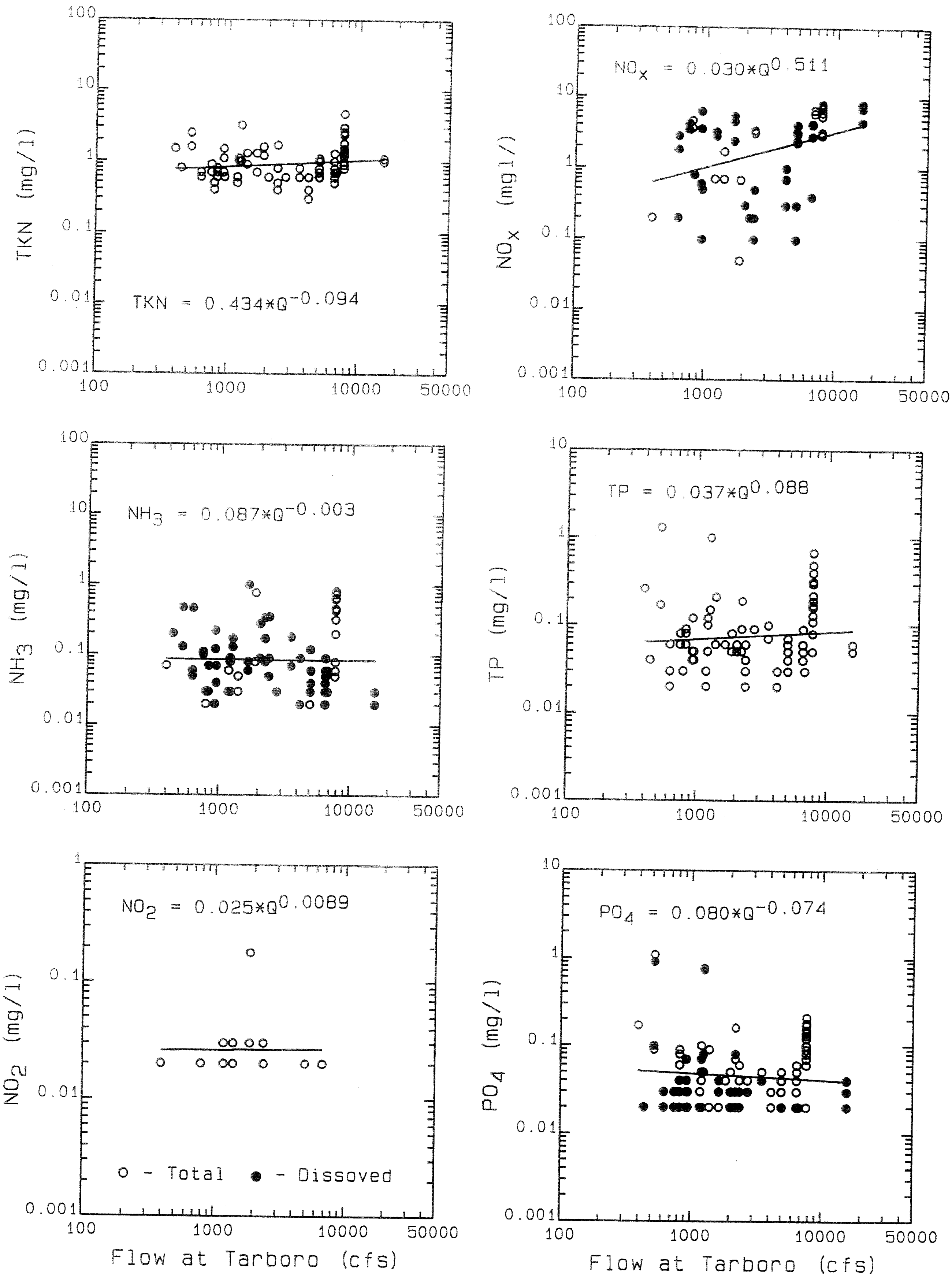
Tranters Creek Data vs Flow at Tarboro - 1986-1991
(Summer = Apr, May, Jun, Jul, Aug, Sep)



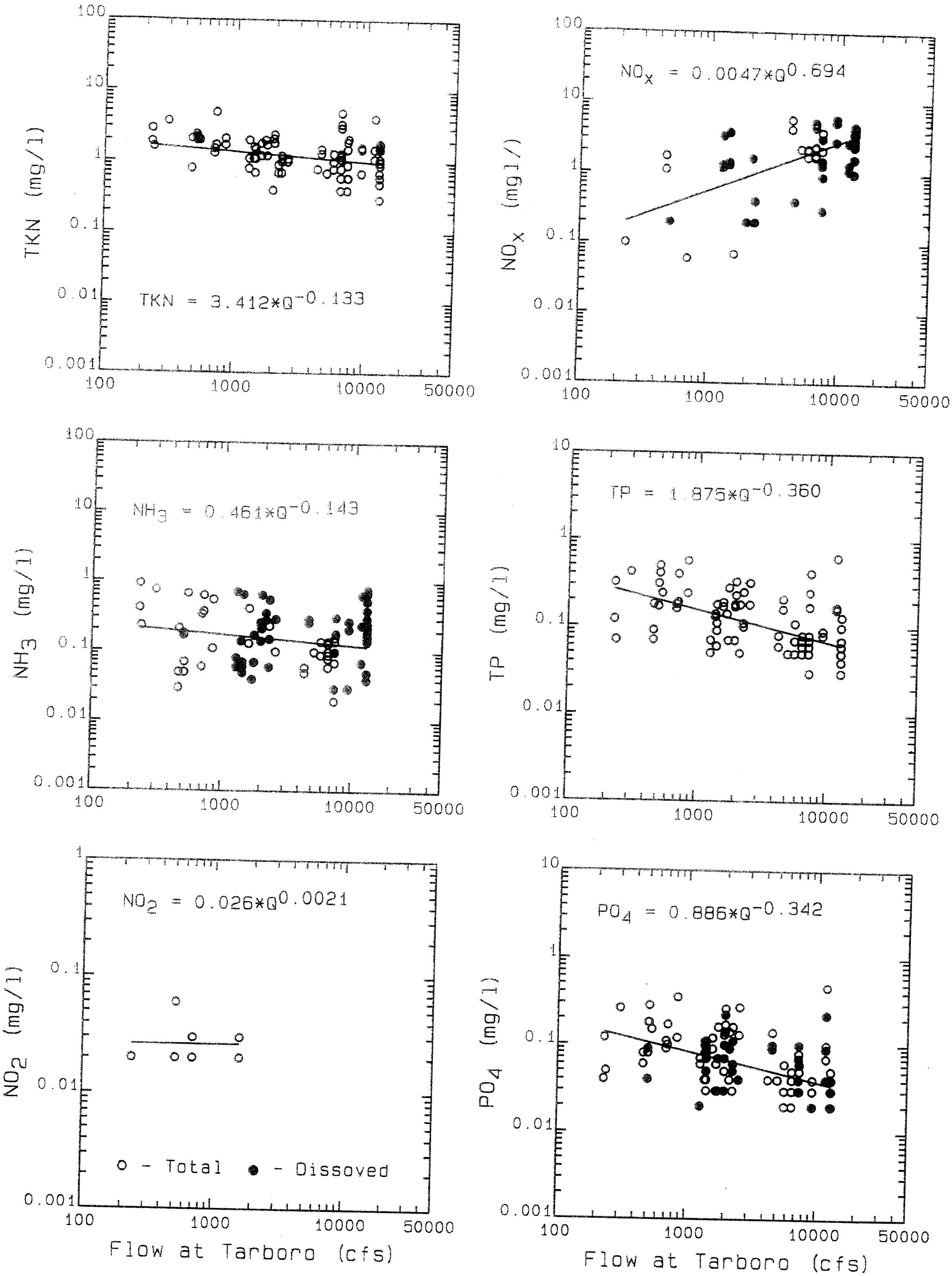
Durham Creek Data vs Flow at Tarboro - 1986-1991
(Winter = Jan, Feb, Mar, Oct, Nov, Dec)



Durham Creek Data vs Flow at Tarboro - 1986-1991
(Summer = Apr, May, Jun, Jul, Aug, Sep)



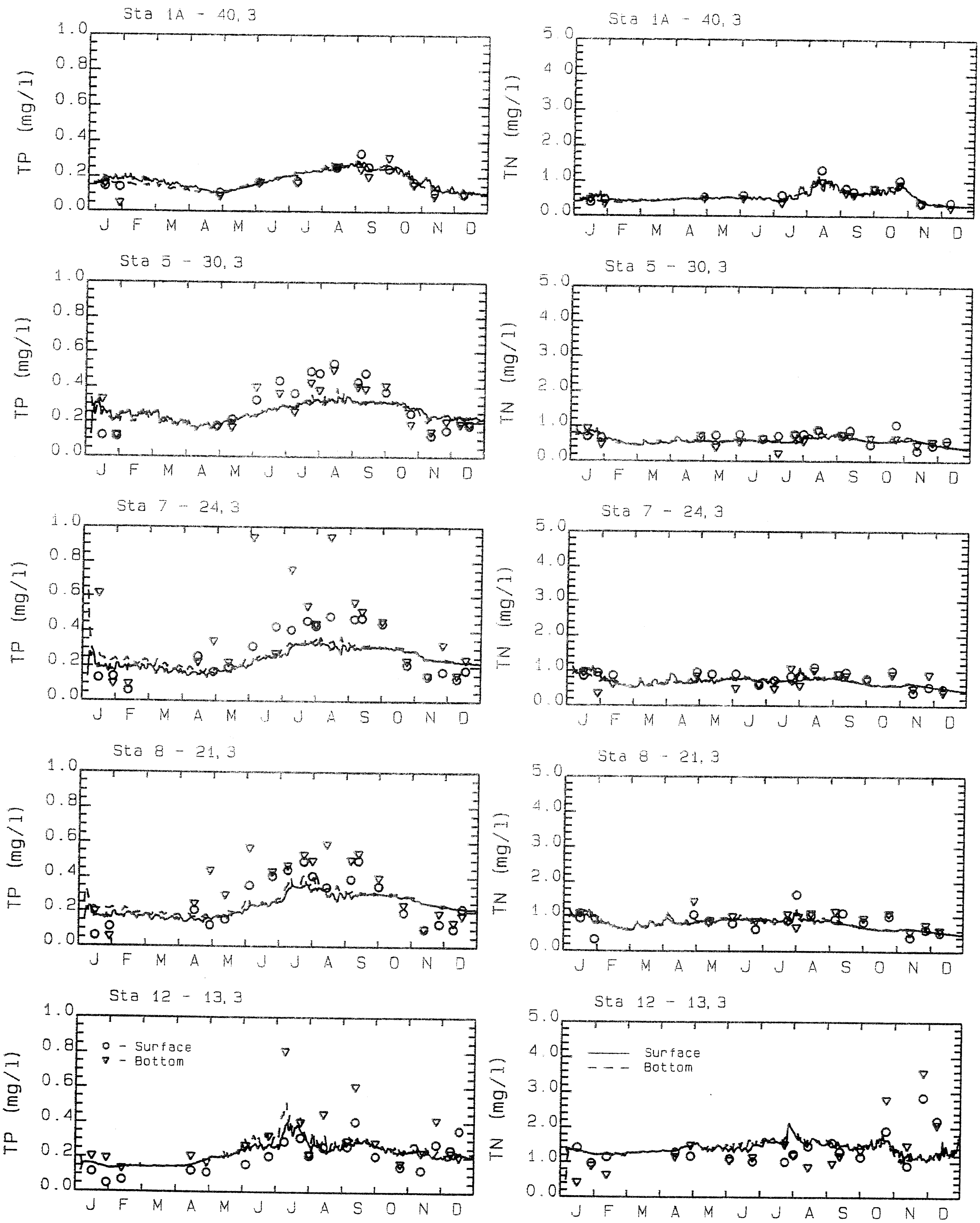
Campbell Creek Data vs Flow at Tarboro - 1986-1991
(Winter = Jan, Feb, Mar, Oct, Nov, Dec)



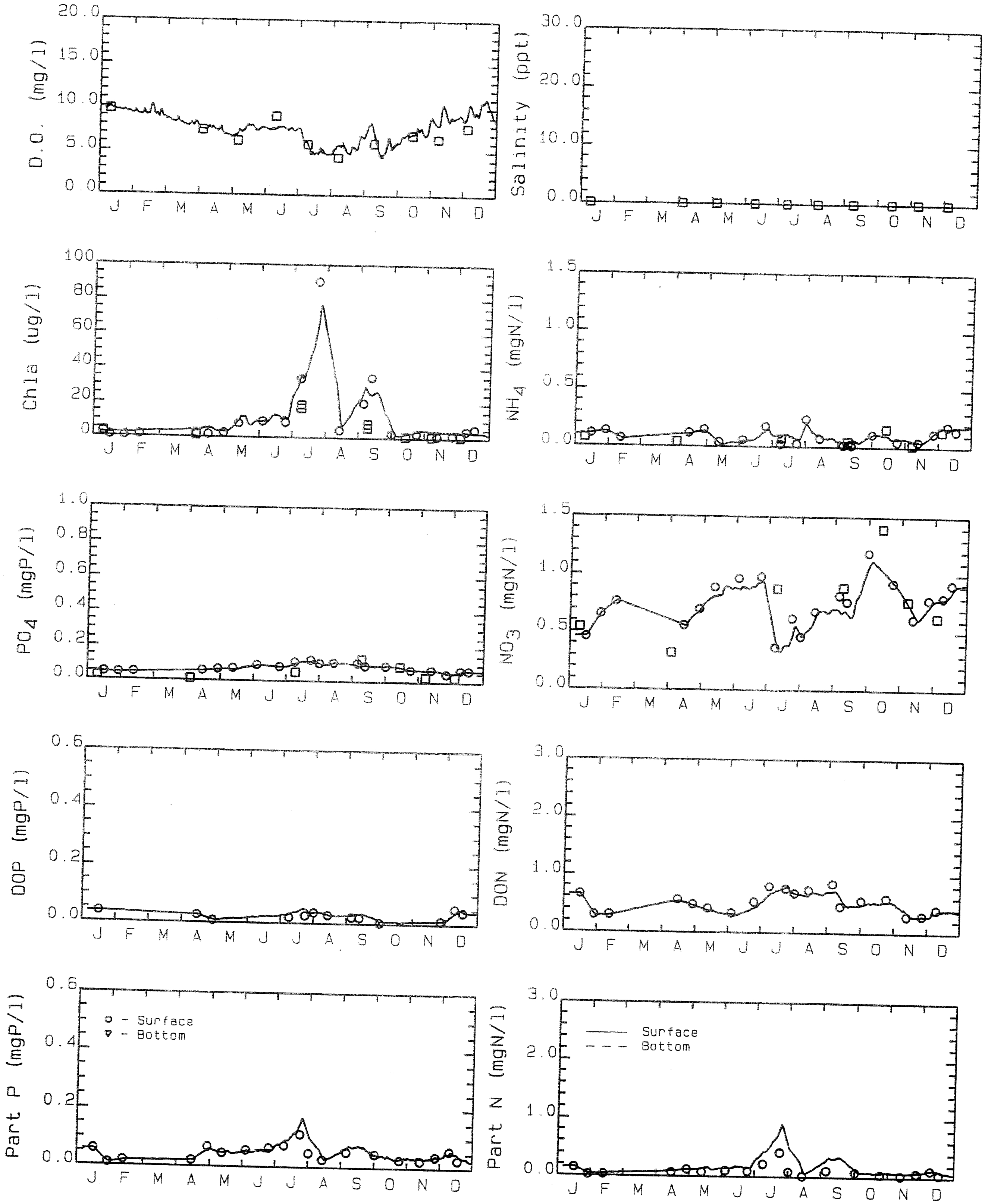
Campbell Creek Data vs Flow at Tarboro - 1986-1991
(Summer = Apr, May, Jun, Jul, Aug, Sep)

APPENDIX 9.4

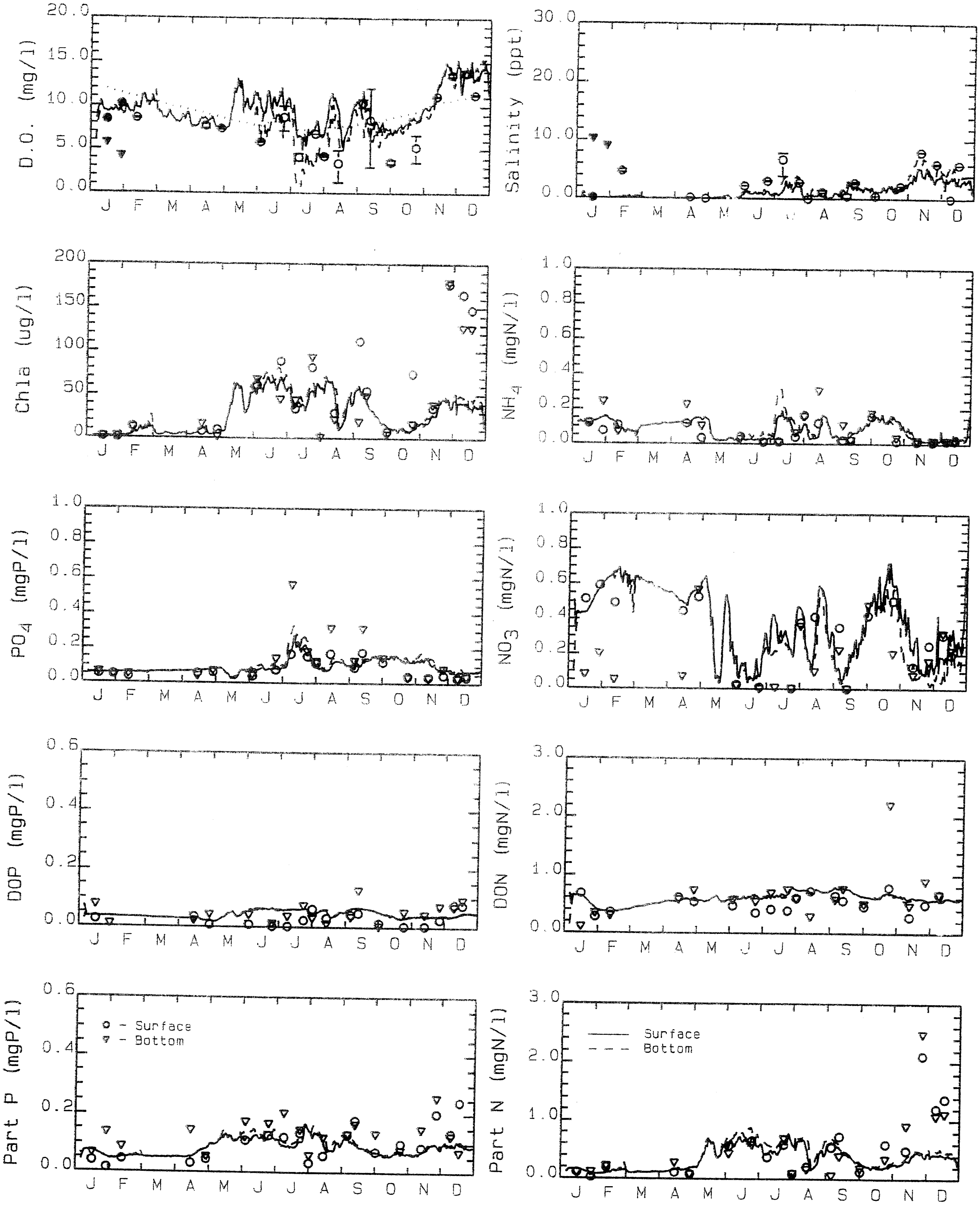
WATER COLUMN AND SEDIMENT MODEL CALIBRATION FIGURES



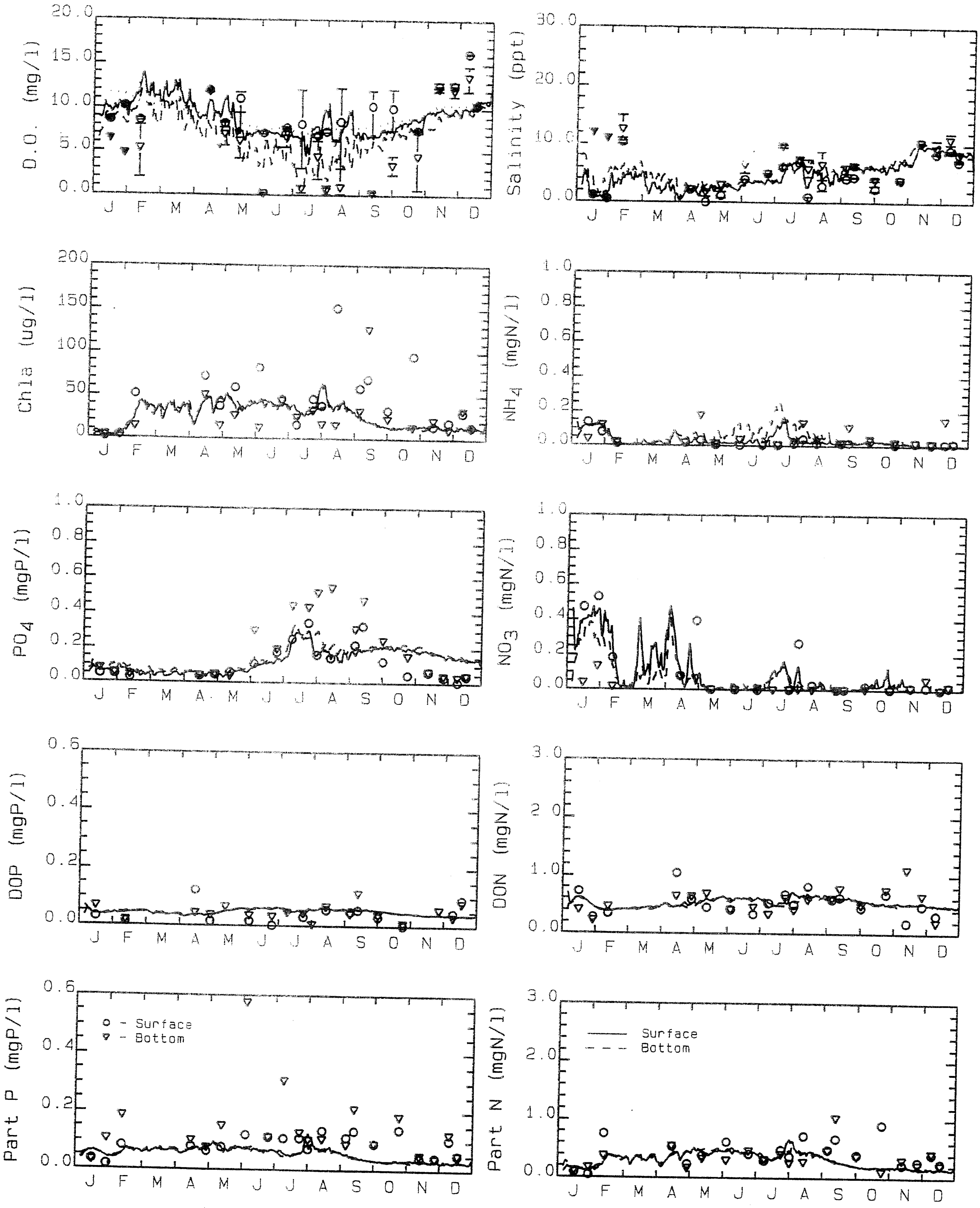
Tar-Pamlico Estuary - TP and TN, 1991



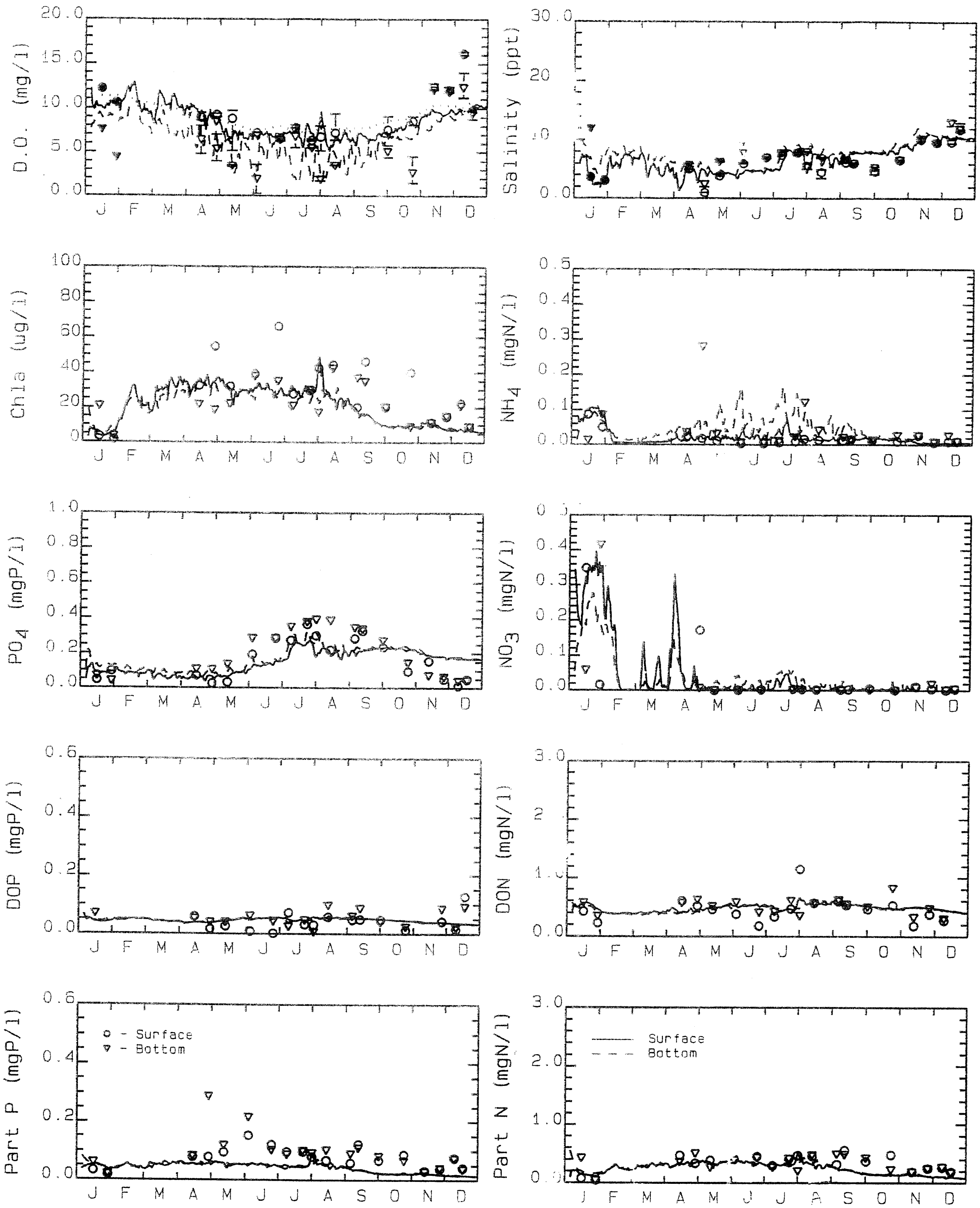
Tar-Pamlico Estuary - Station SB, 1991
Model Segment 6, 3



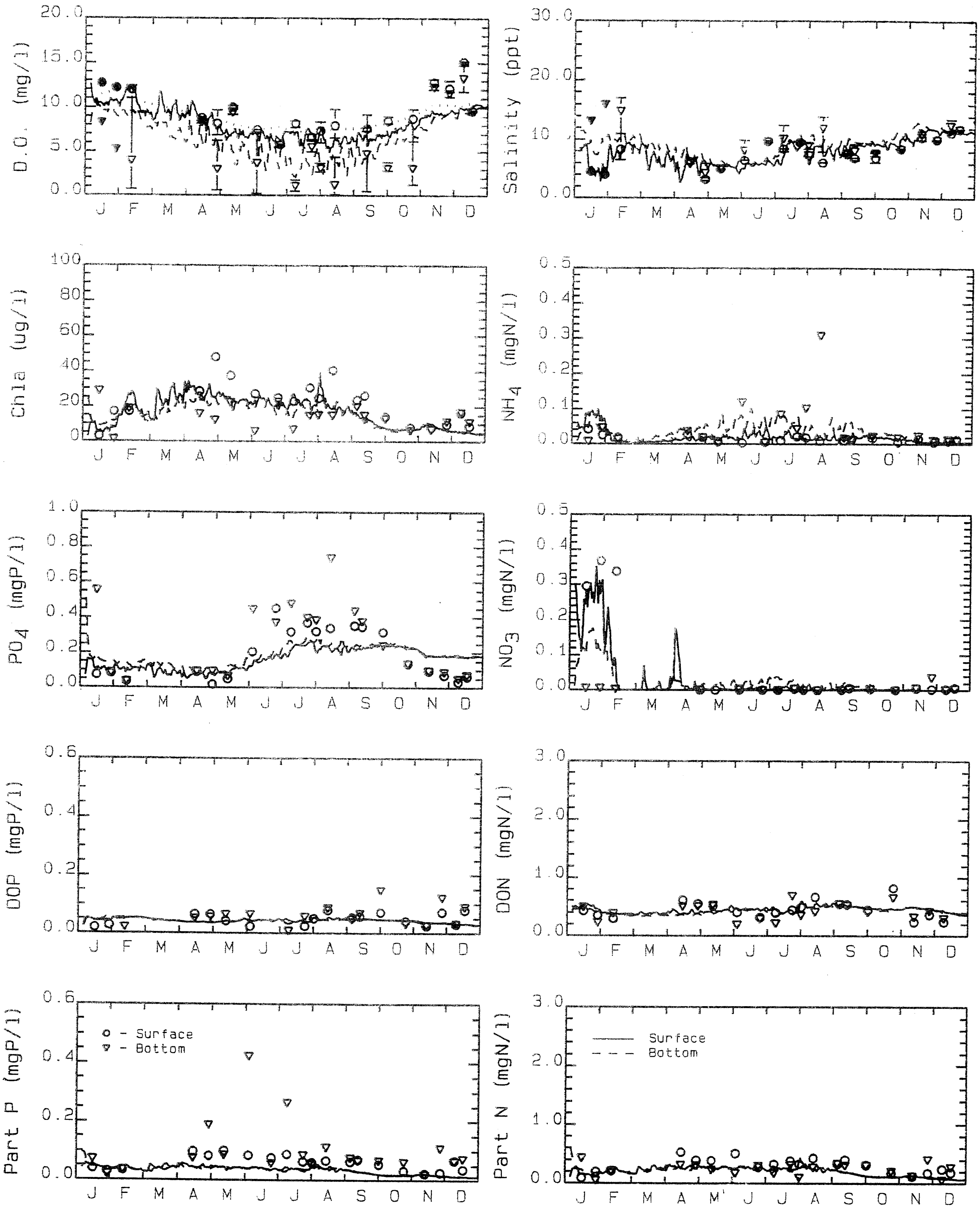
Tar-Pamlico River - Station 12, 1991
Model Segment 13, 3



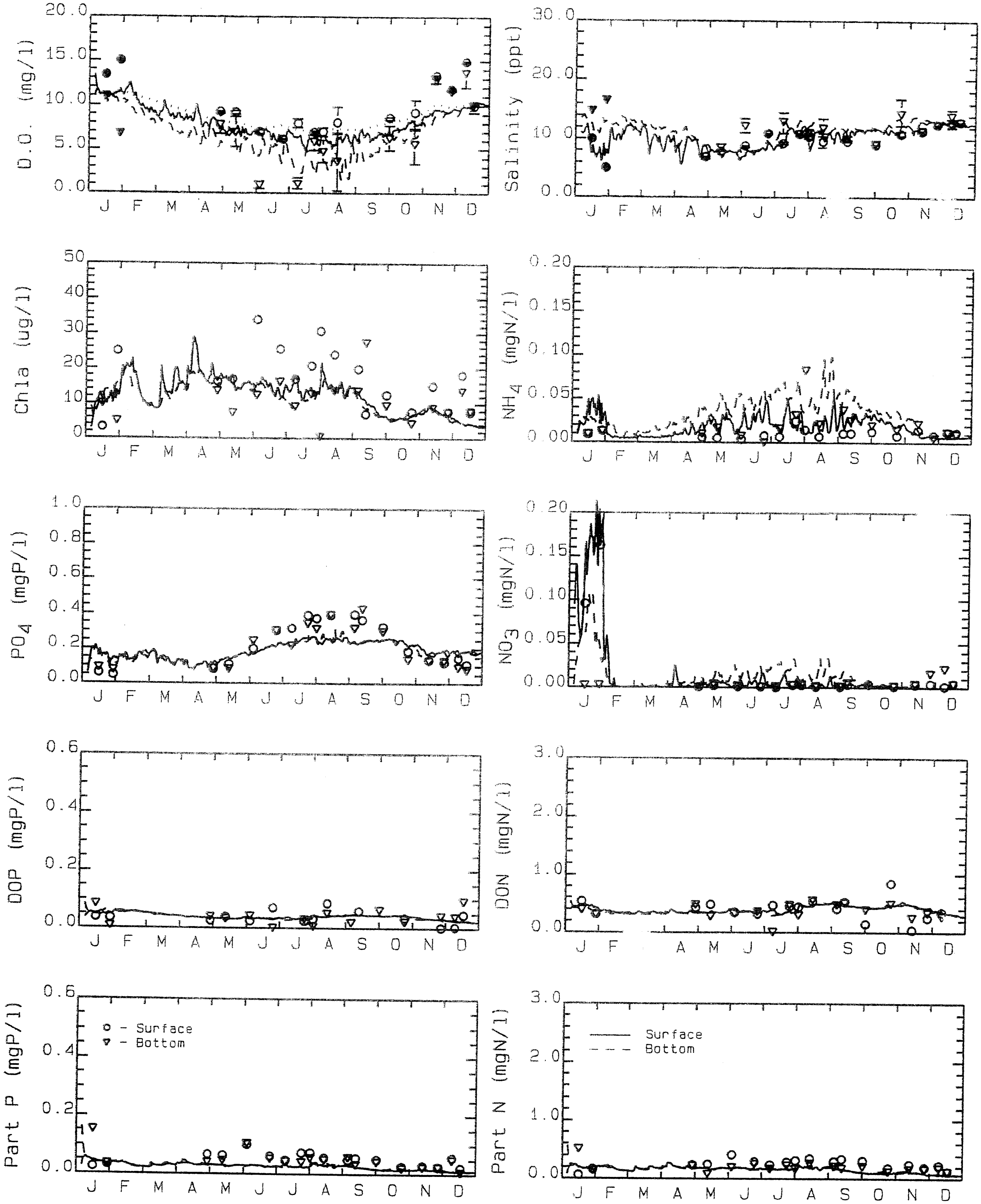
Tar-Pamlico River - Station 10, 1991
Model Segment 18, 3



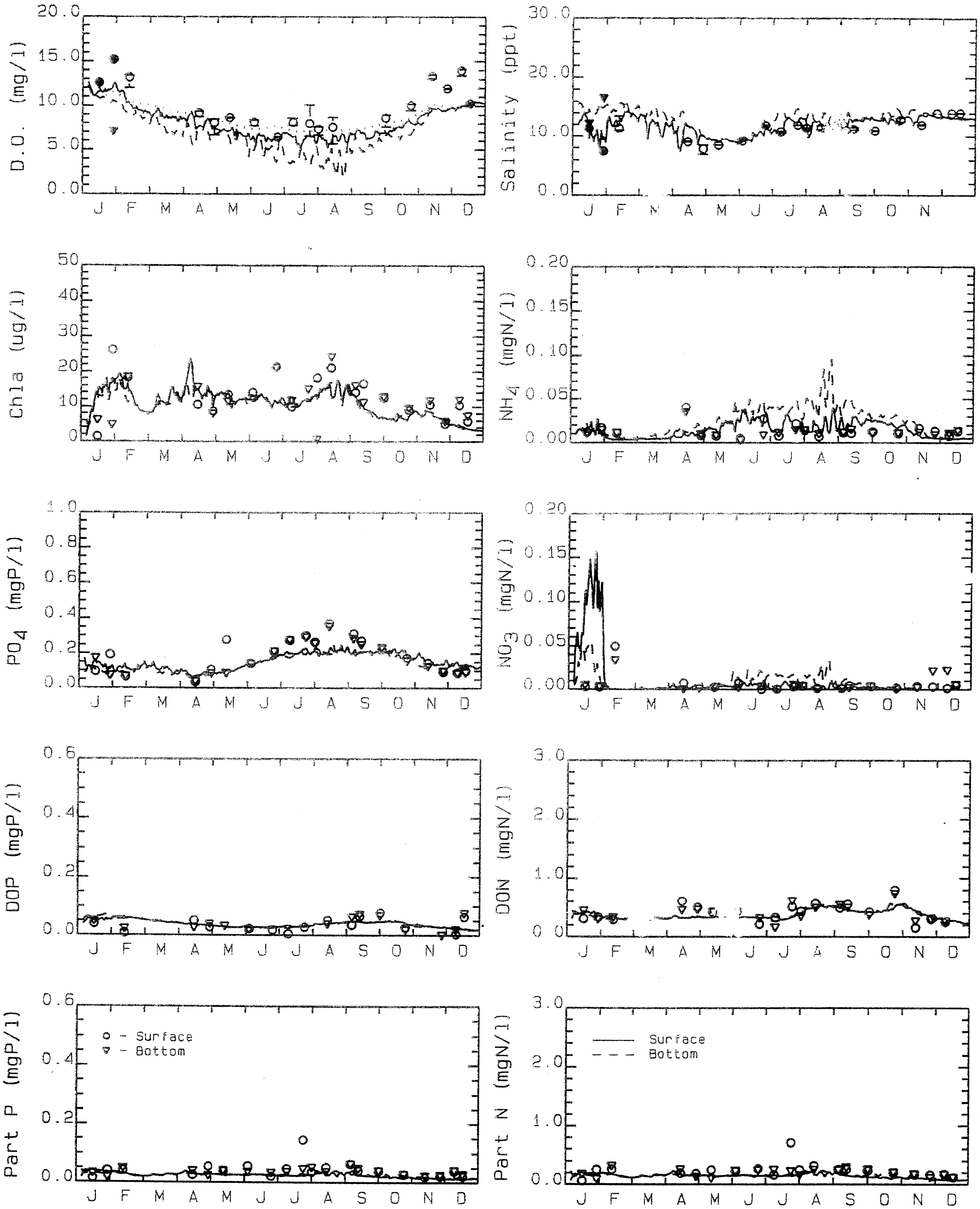
Tar-Pamlico River - Station 8, 1991
Model Segment 21, 3



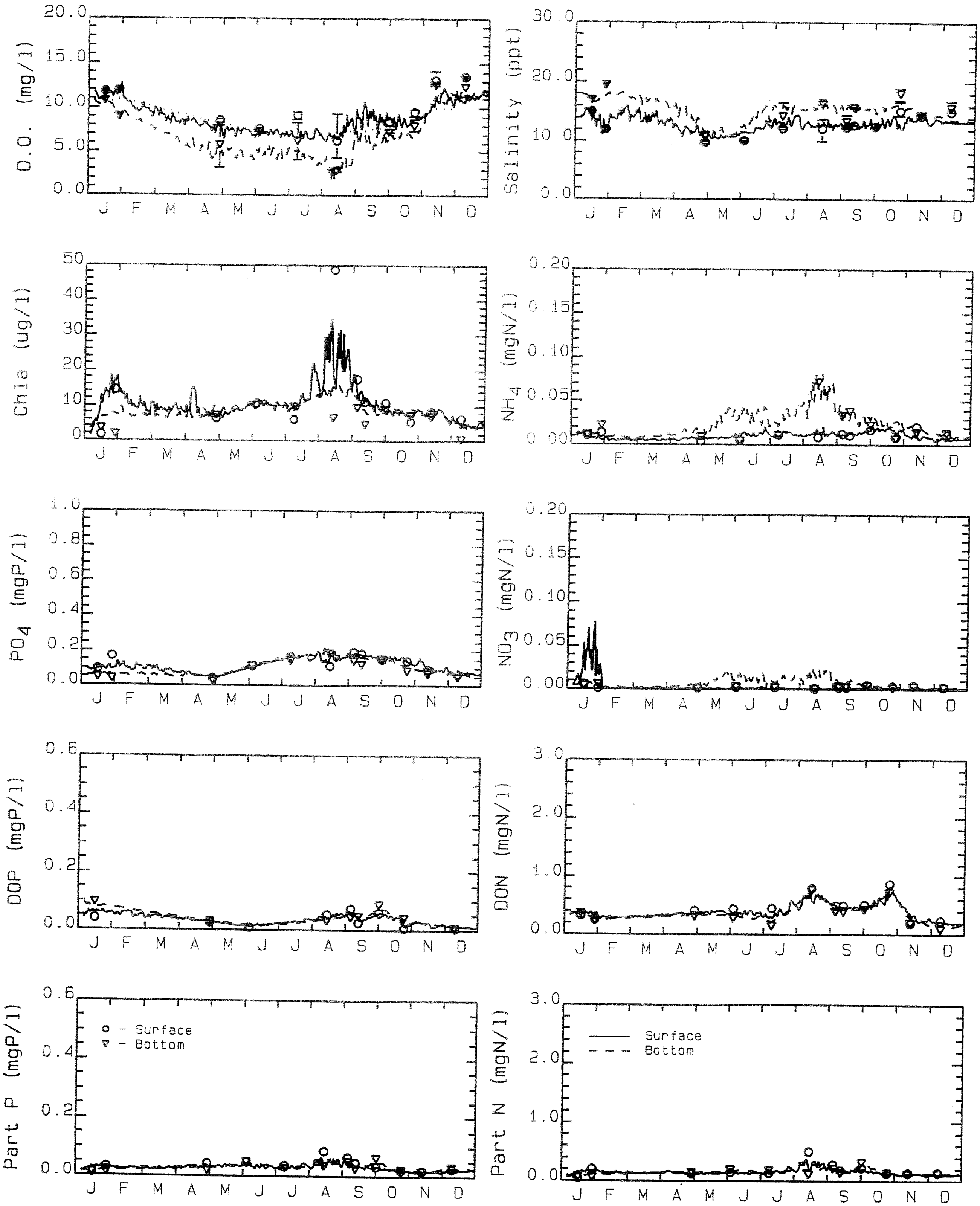
Tar-Pamlico River - Station 7, 1991
Model Segment 24, 3



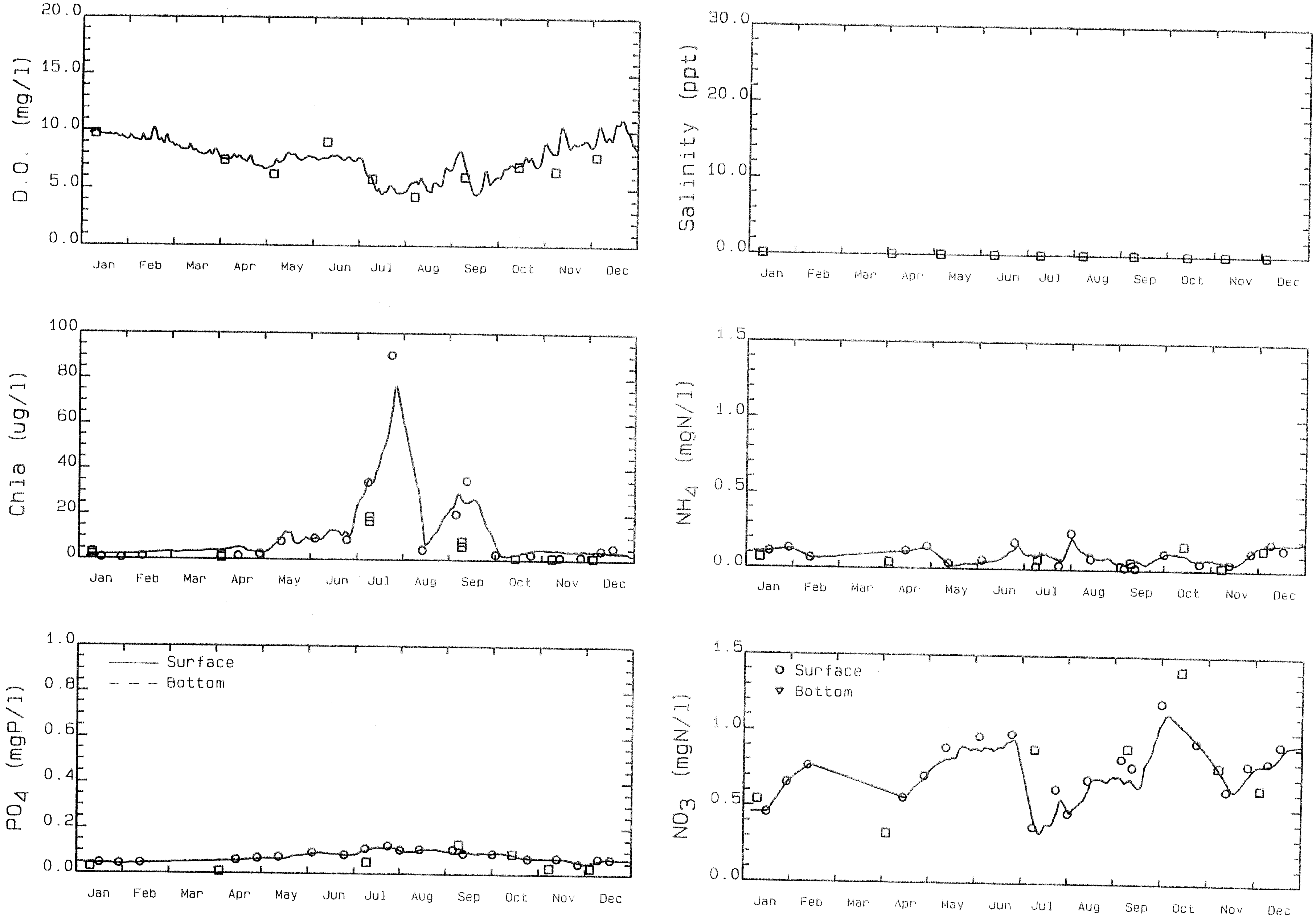
Tar-Pamlico River - Station 5, 1991
Model Segment 30, 3



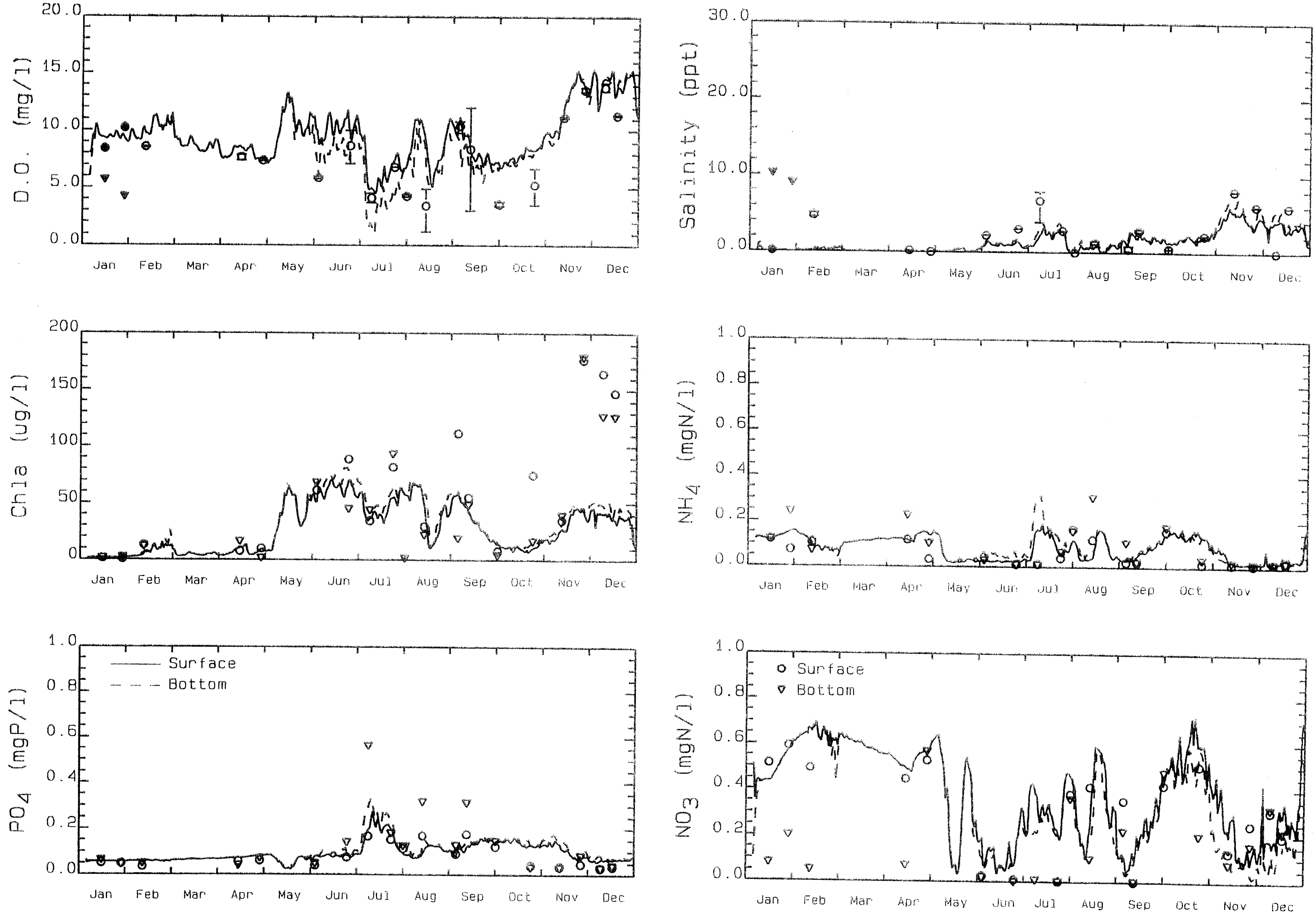
Tar-Pamlico River - Station 3, 1991
Model Segment 35, 3



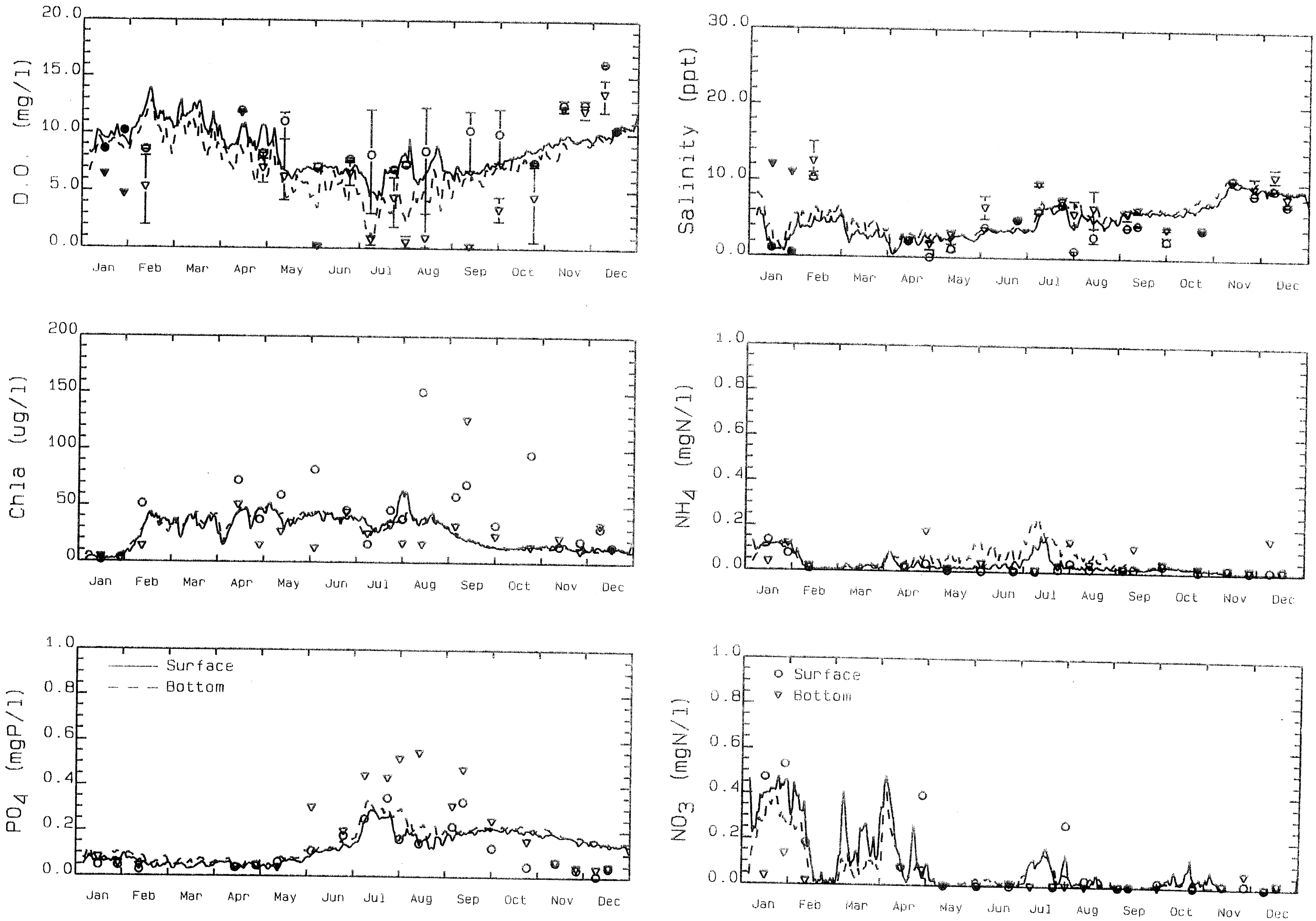
Tar-Pamlico River - Station 1A, 1991
Model Segment 40, 3



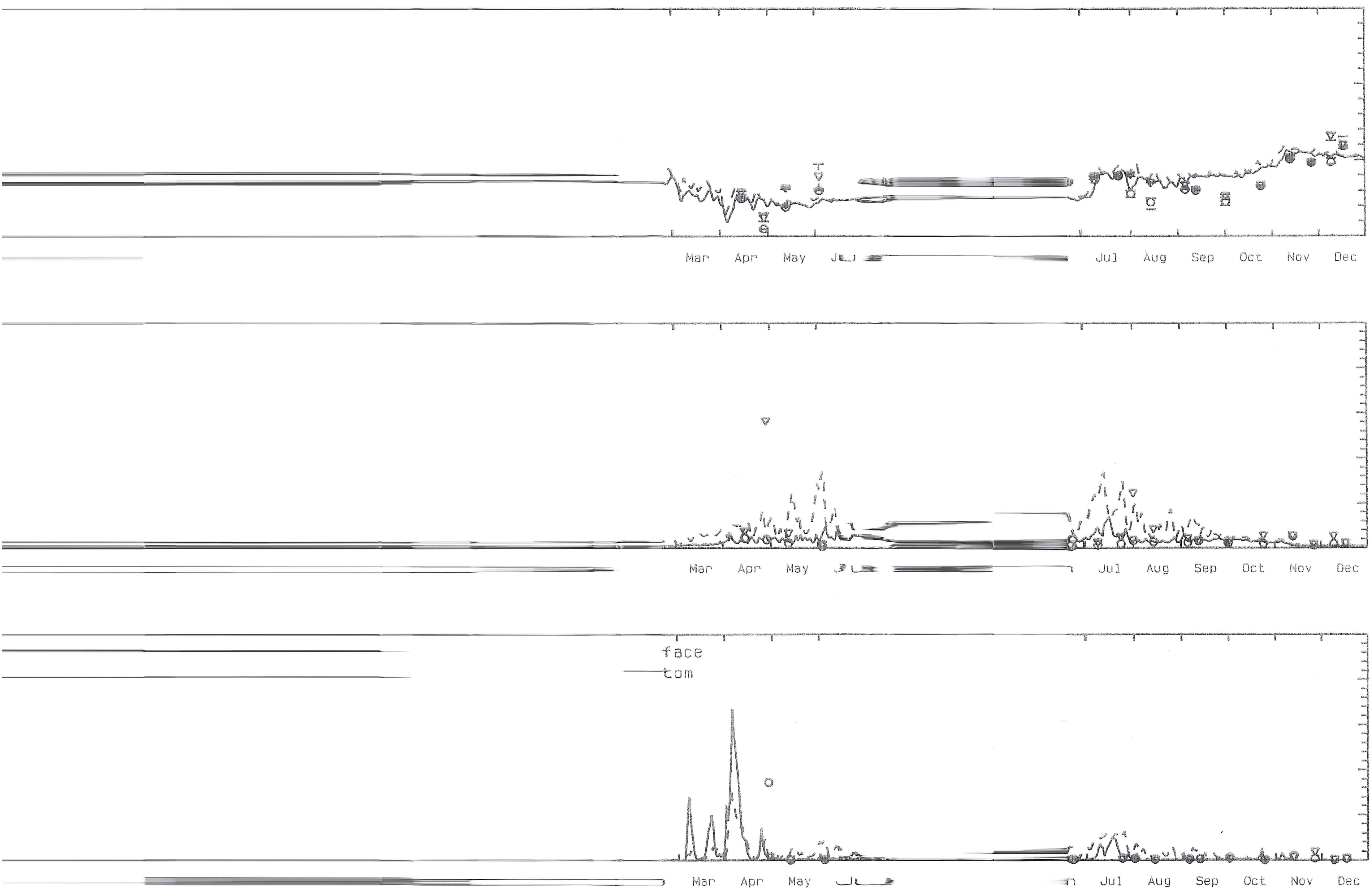
Tar-Pamlico River - Station SB, 1991
Model Segment 6, 3

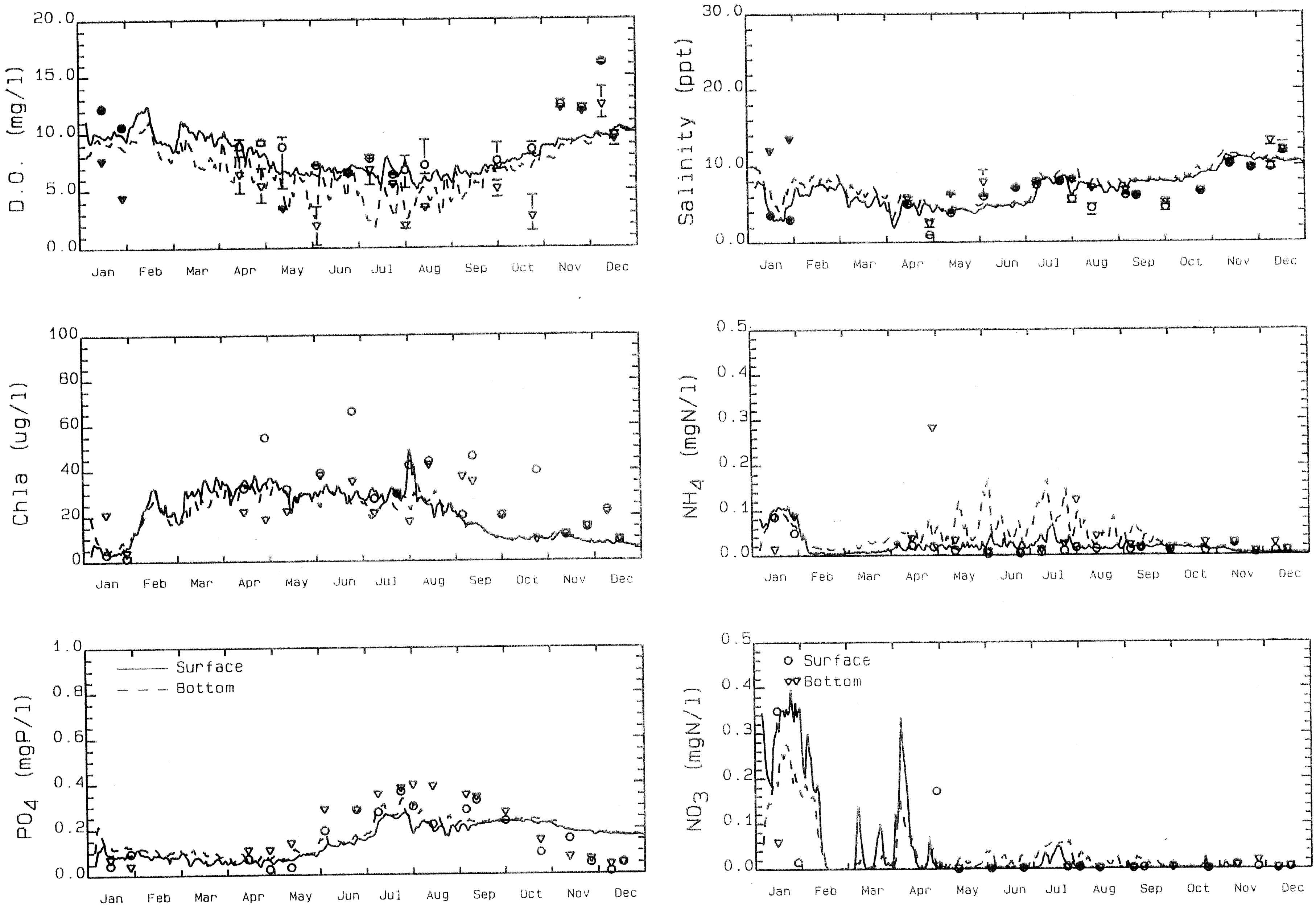


Tar-Pamlico River - Station 12, 1991
Model Segment 13, 3

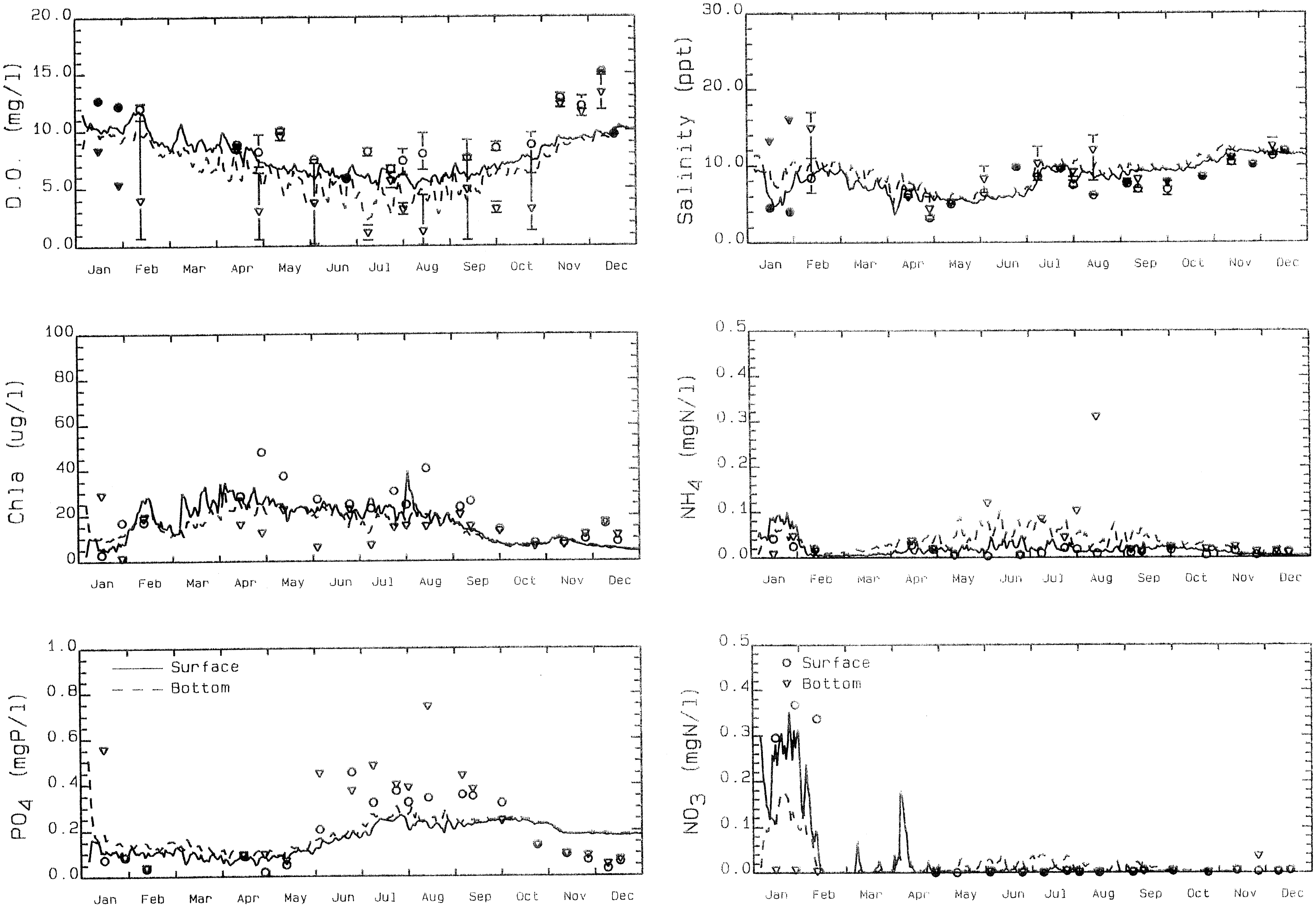


Tar-Pamlico River - Station 10, 1991
Model Segment 18, 3

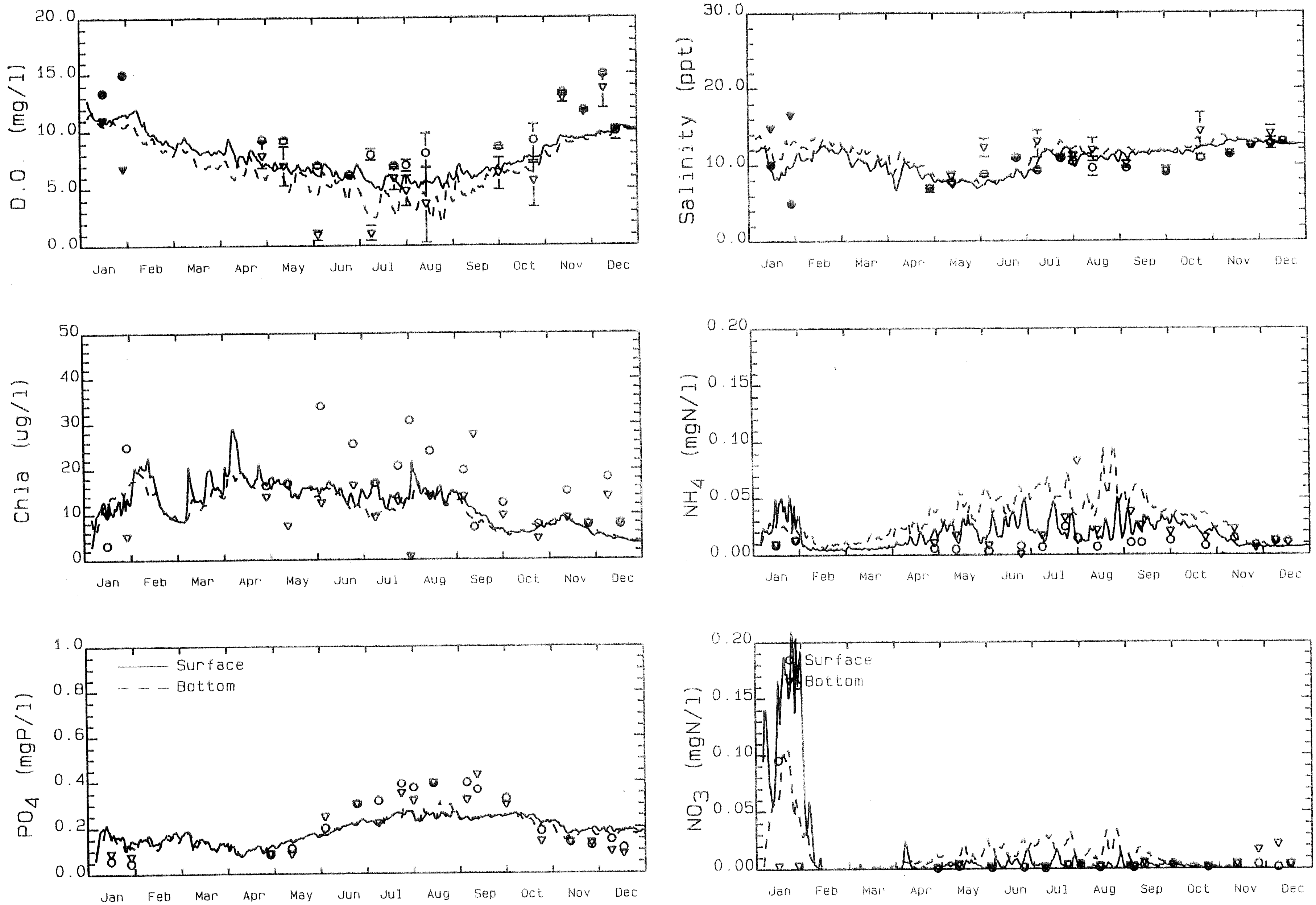

Mar
Apr
May
Jul
Aug
Sep
Oct
Nov
Dec
face
tom



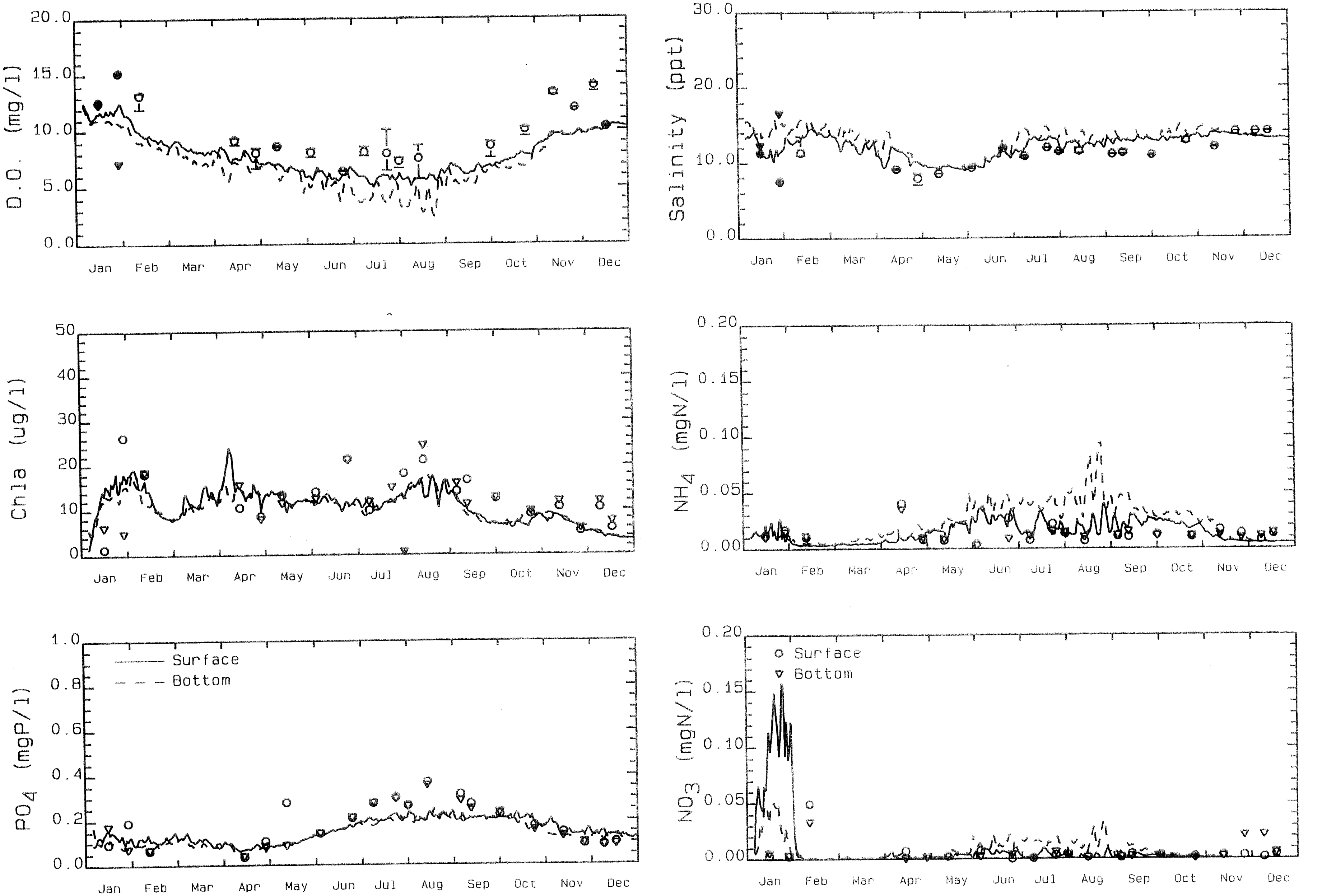
Tar-Pamlico River - Station 8, 1991
Model Segment 21, 3



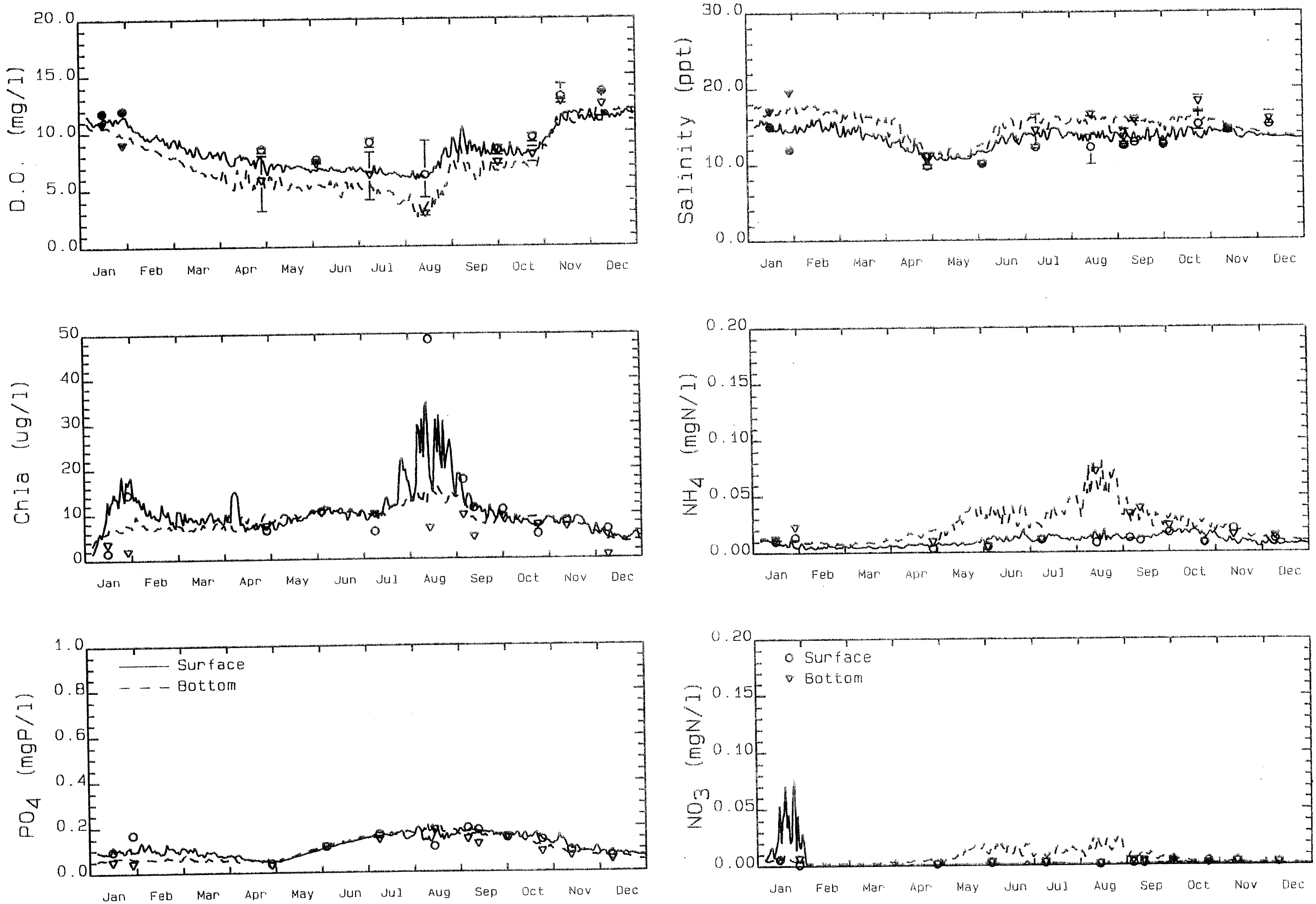
Tar-Pamlico River - Station 7, 1991
Model Segment 24, 3



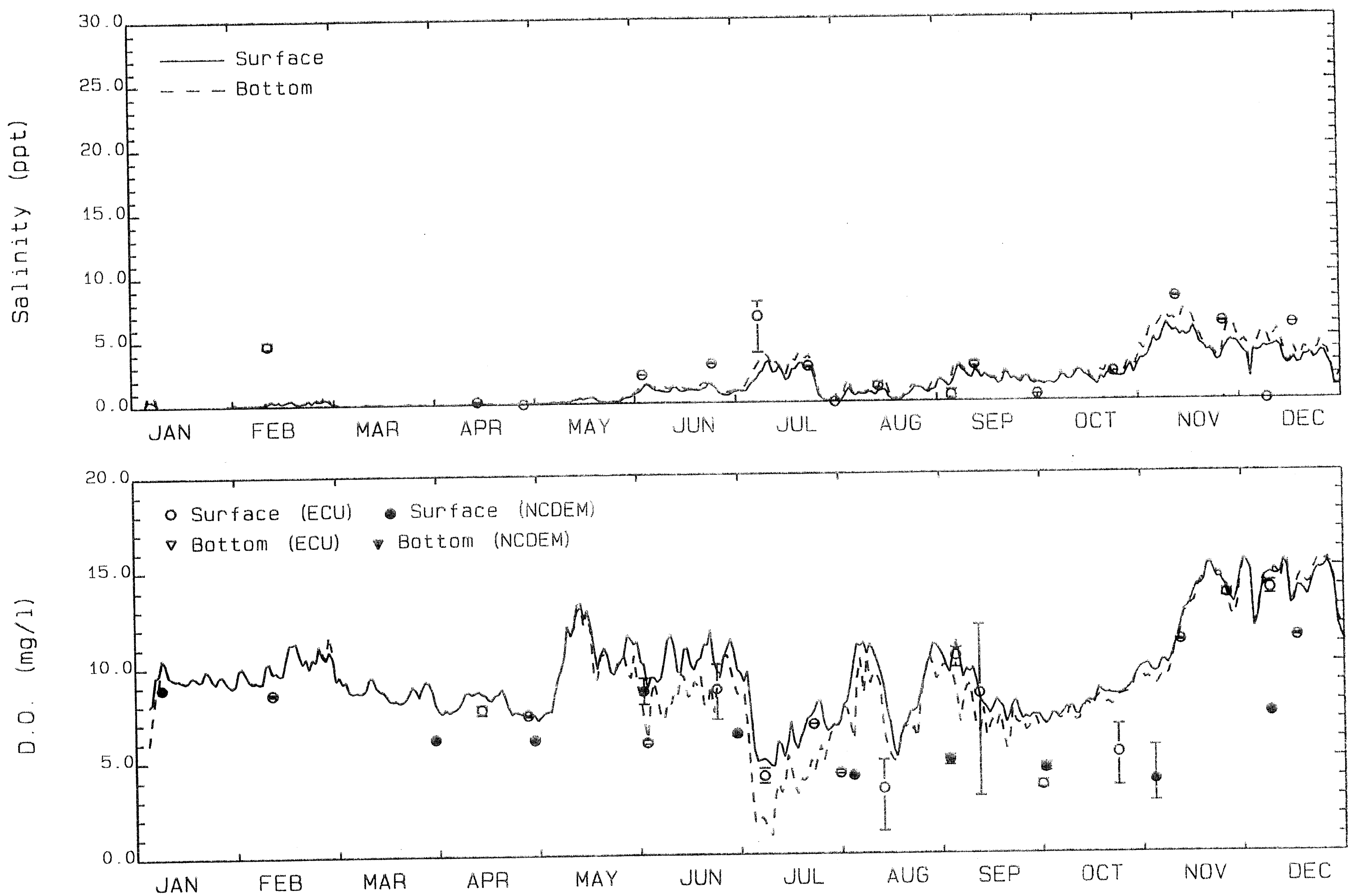
Tar-Pamlico River - Station 5, 1991
Model Segment 30, 3



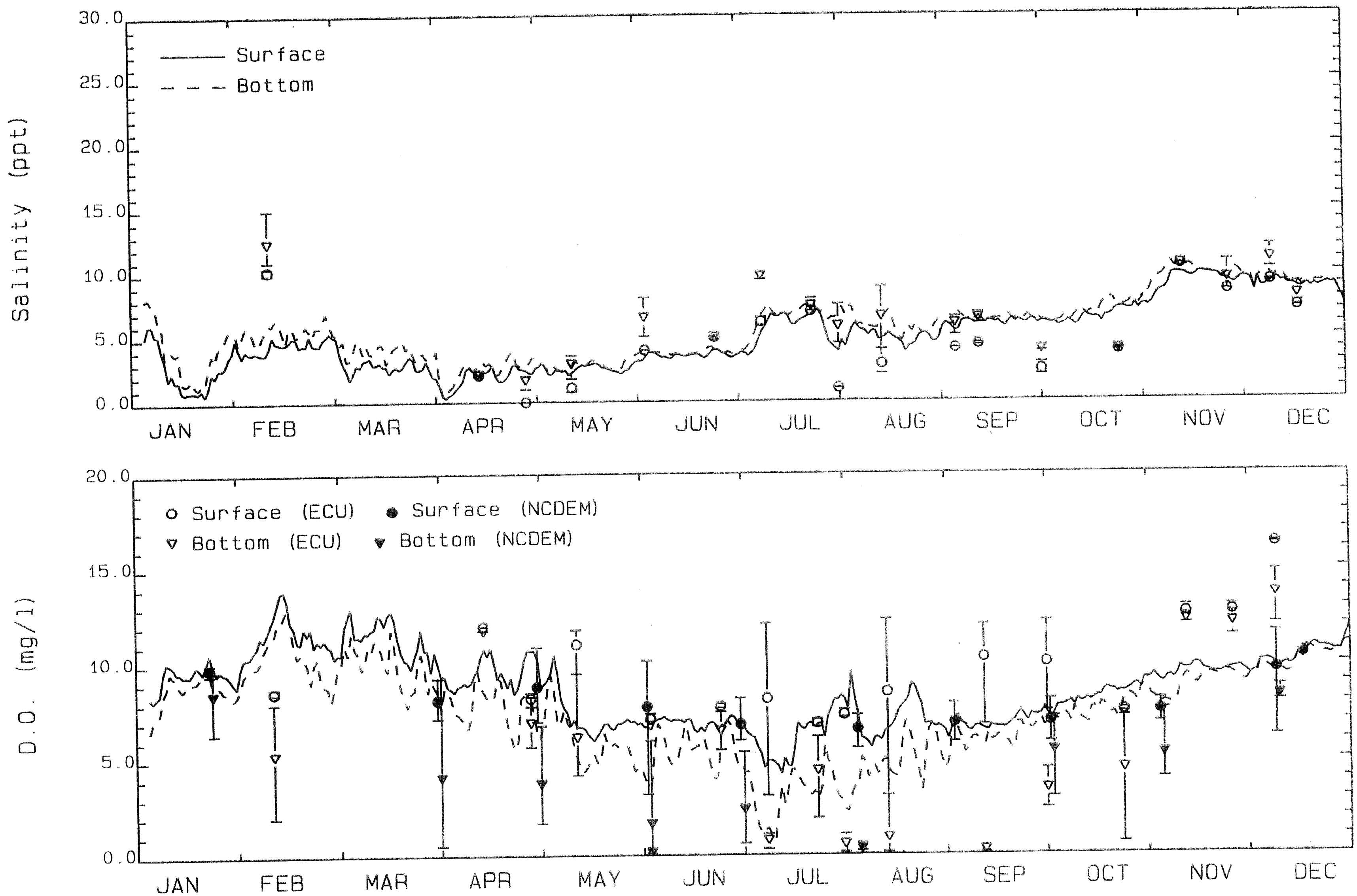
Tar-Pamlico River - Station 3, 1991
Model Segment 35, 3



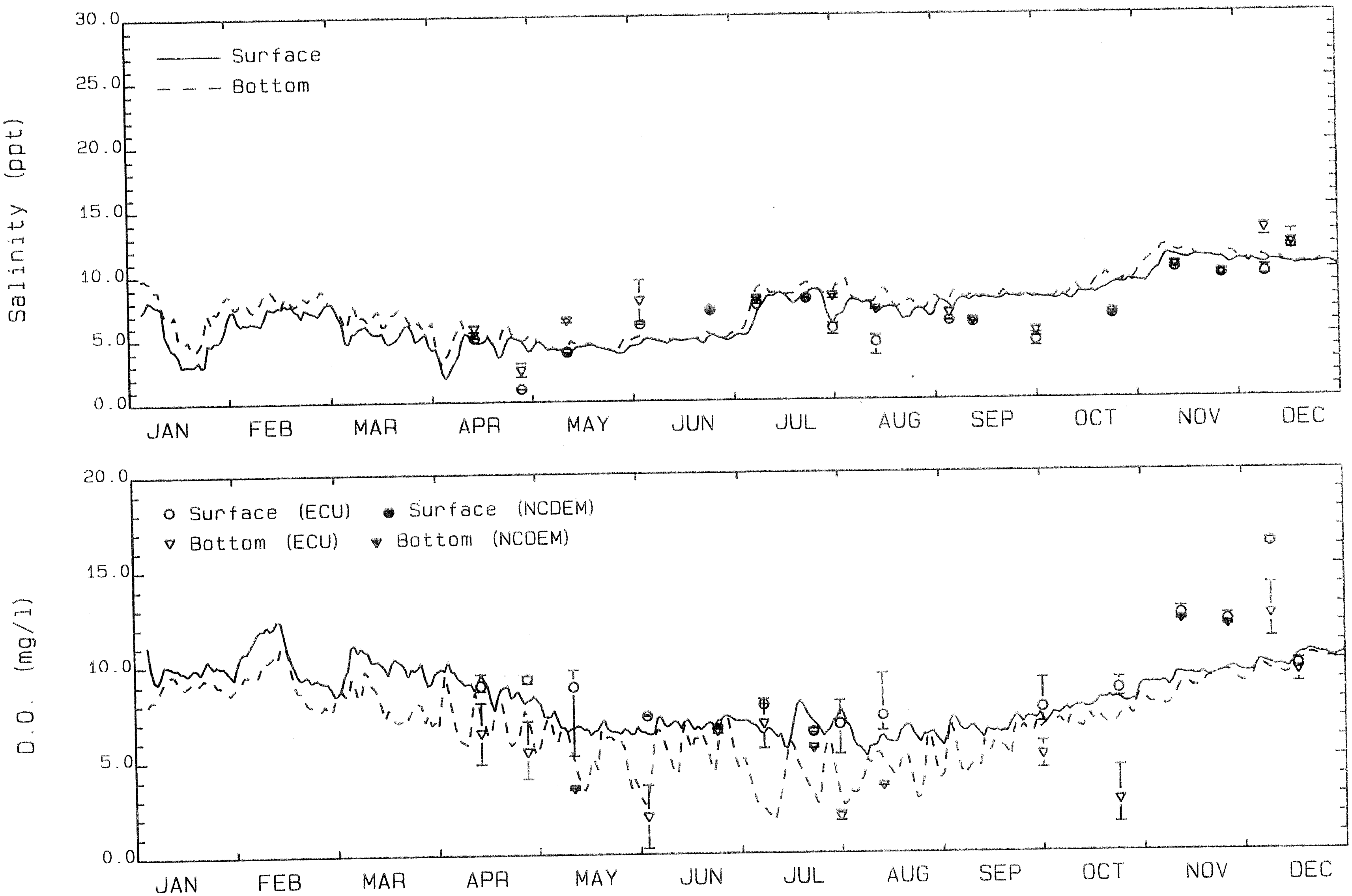
Tar-Pamlico River - Station 1A, 1991
Model Segment 40, 3



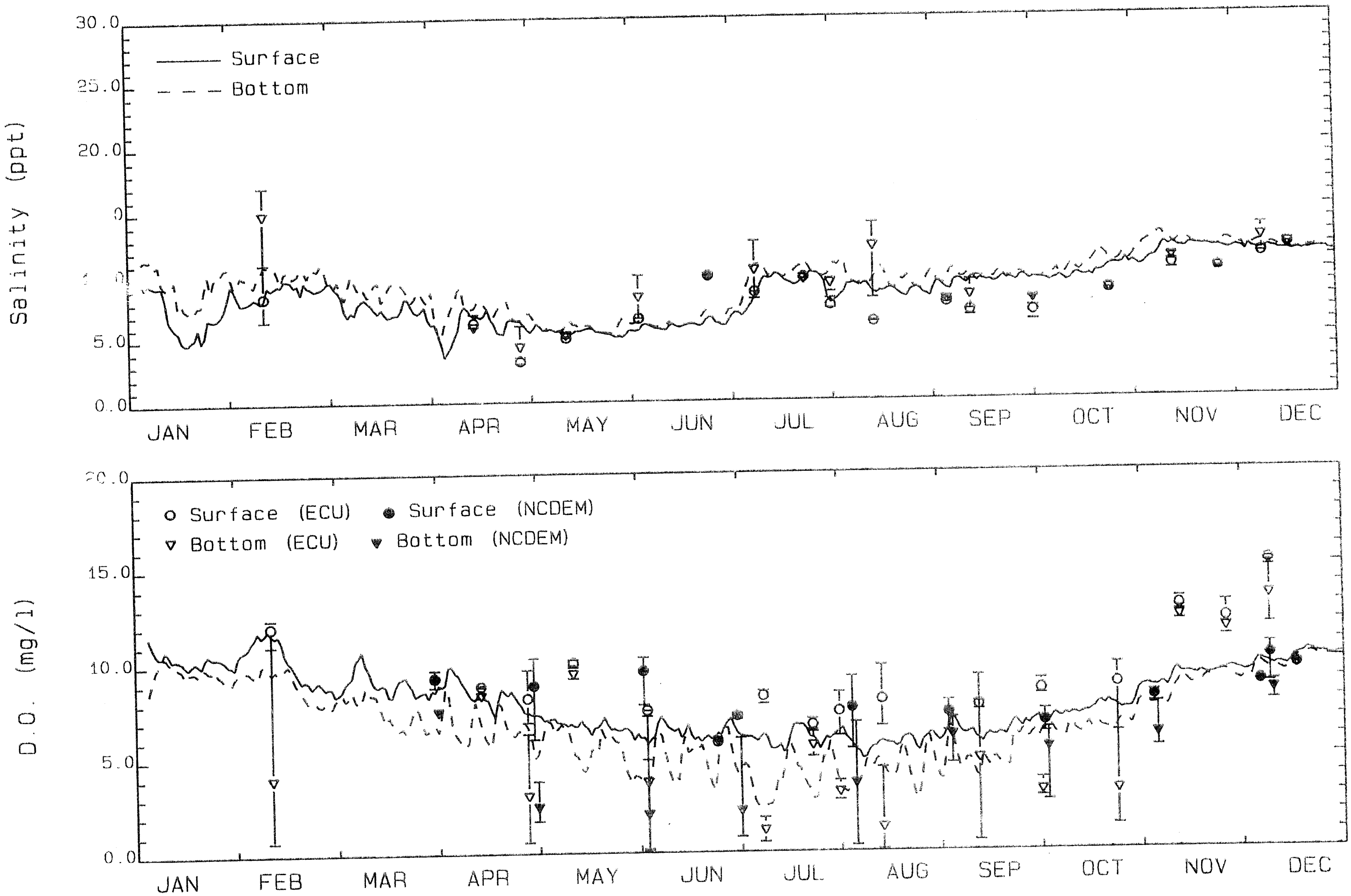
Tar-Pamlico River Salinity and D.O. - Station 12
Model Segment 13.3



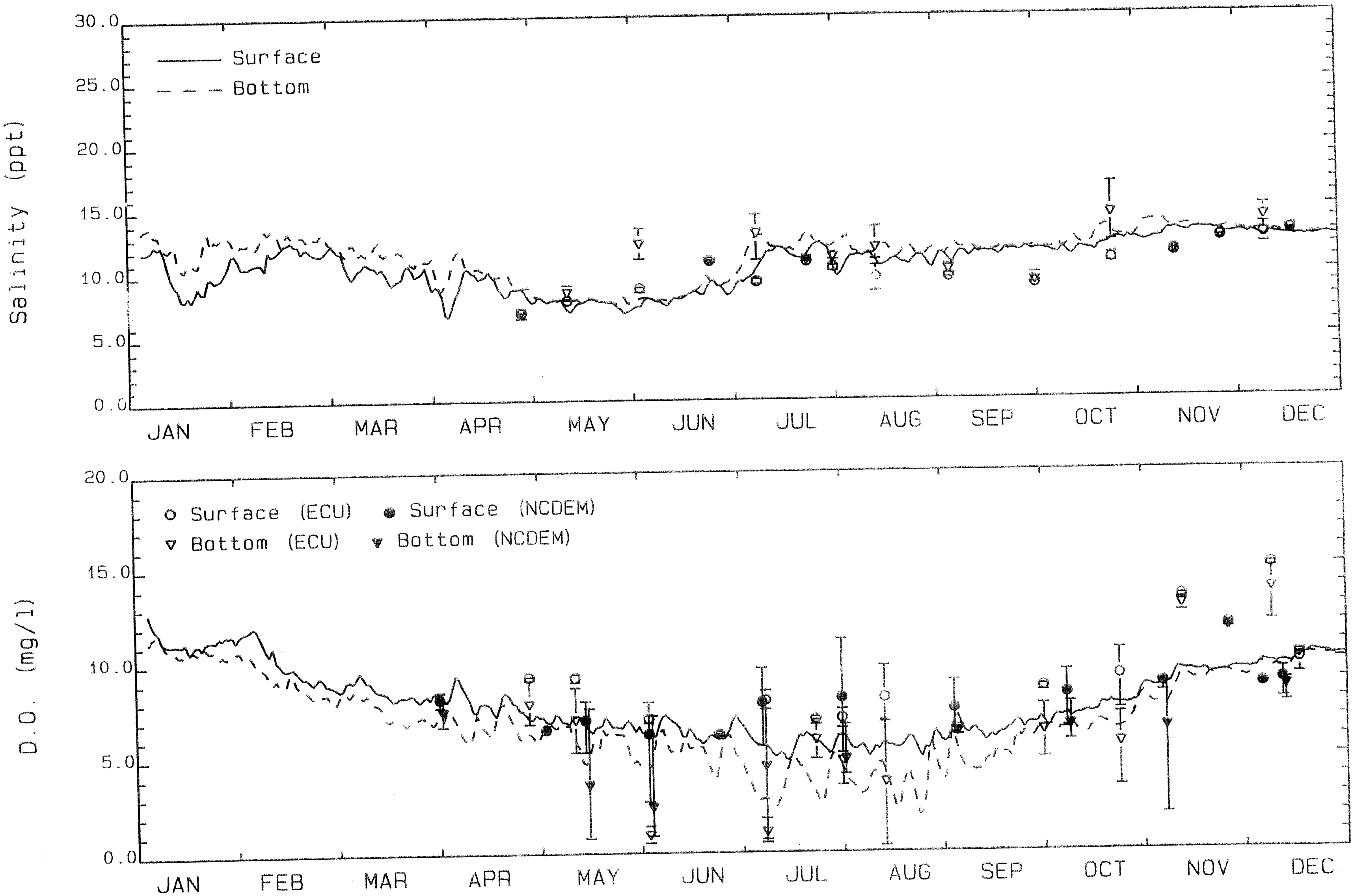
Tar-Pamlico River Salinity and D.O. - Station 10
Model Segment 18, 3



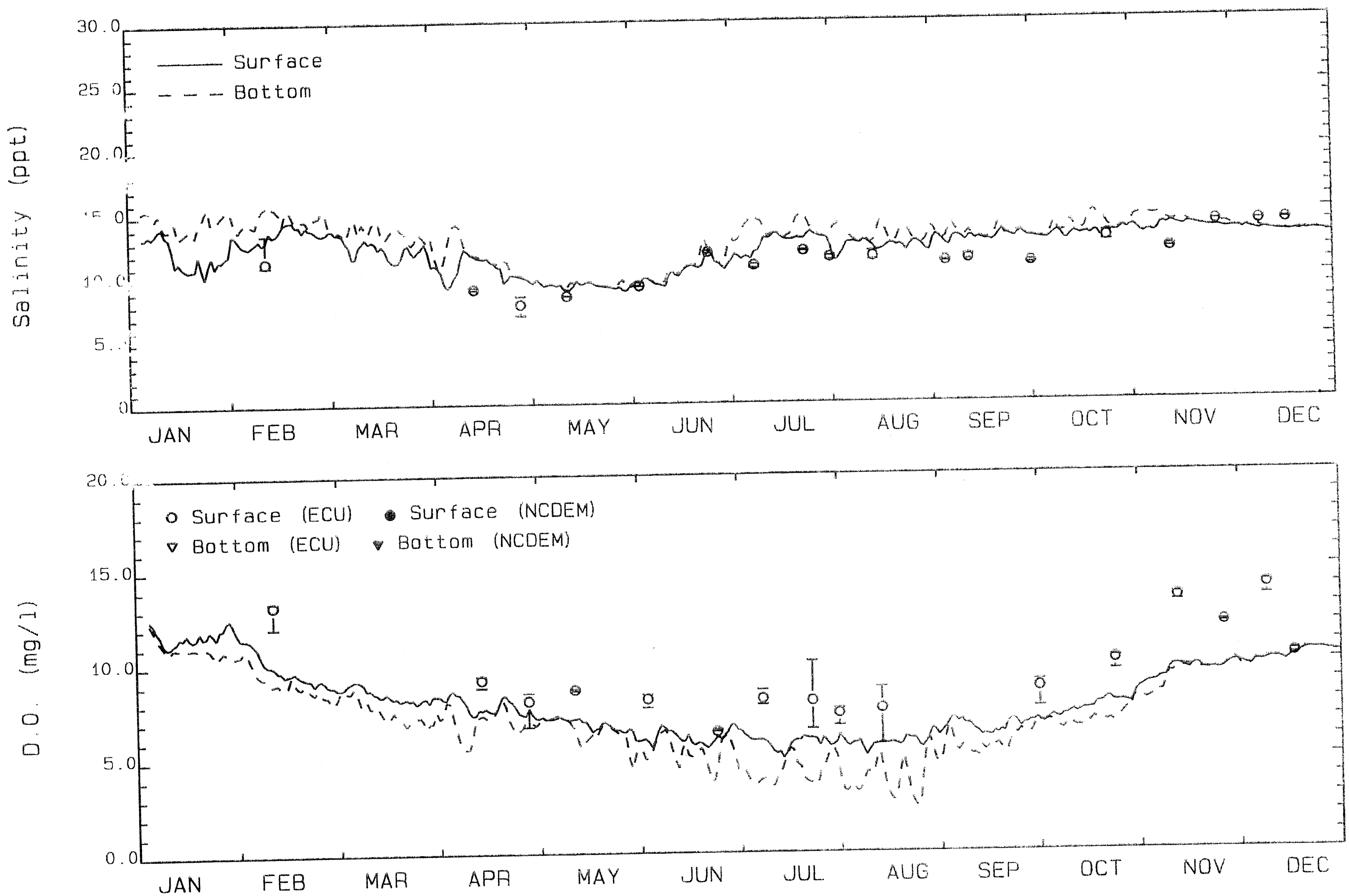
Tar-Pamlico River Salinity and D.O. - Station 8
Model Segment 21.3



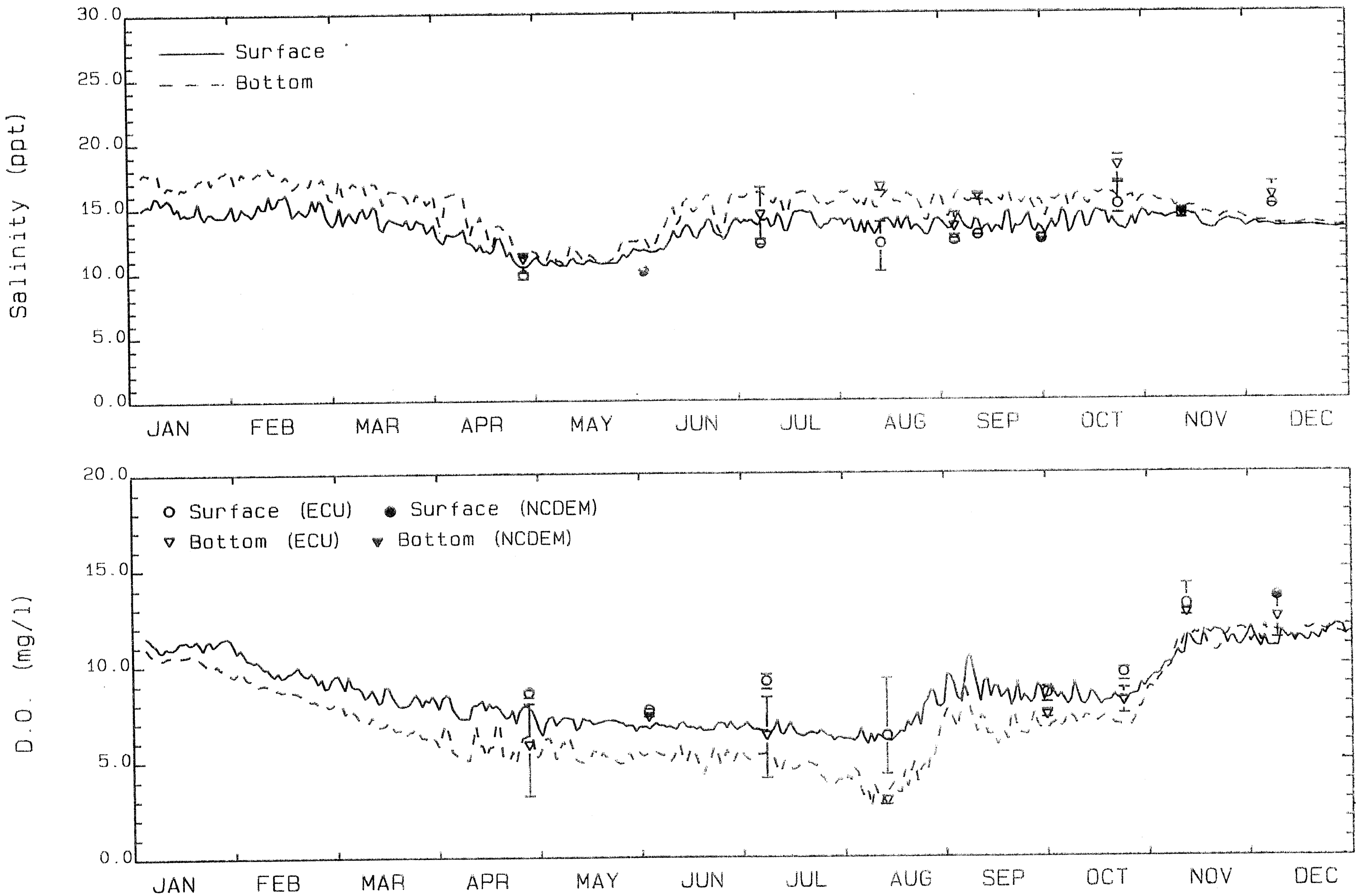
Tar-Pamlico River Salinity and D.O. - Station 7
Model Segment 24.3



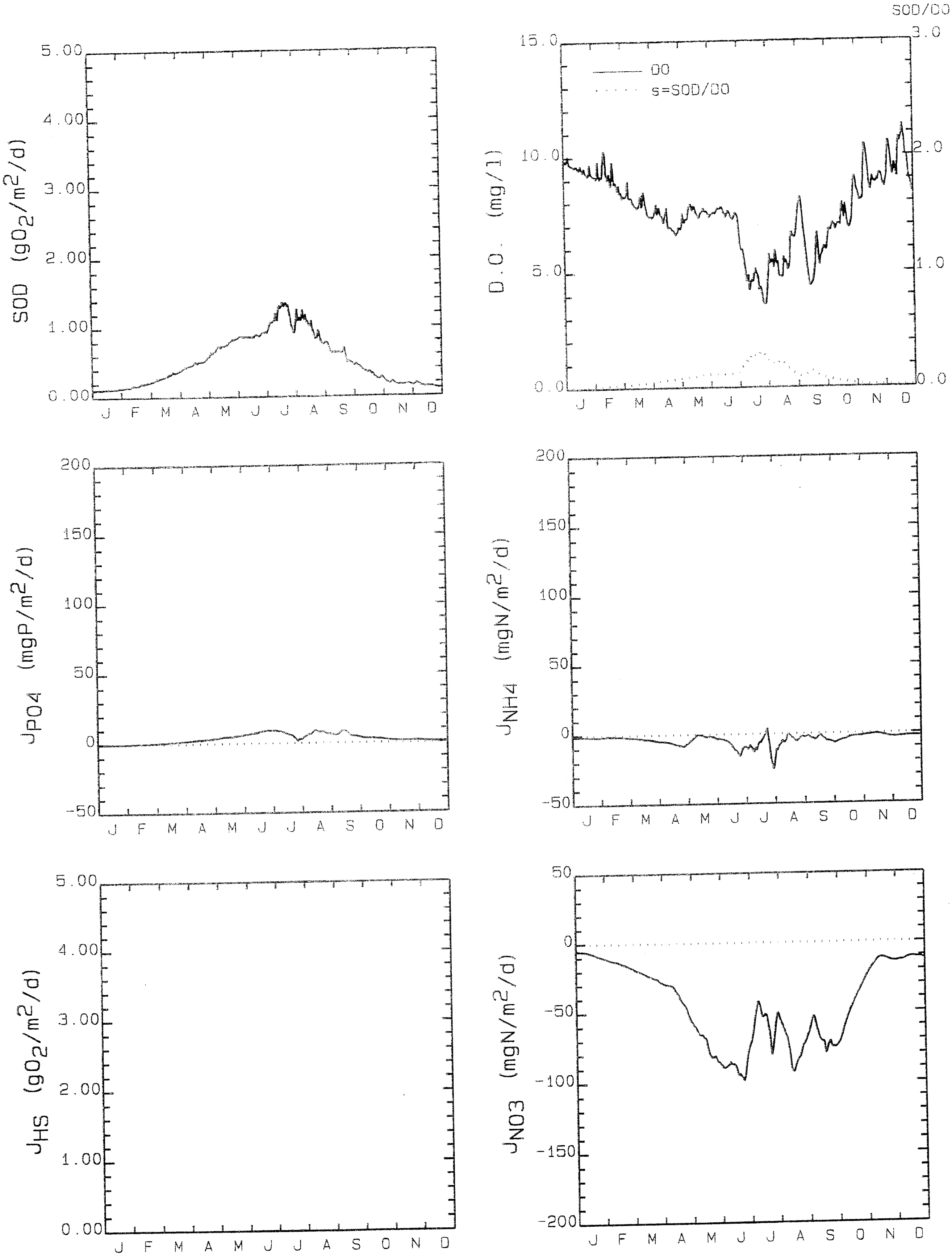
Tar-Pamlico River Salinity and D.O. - Station 5
Model Segment 30, 3



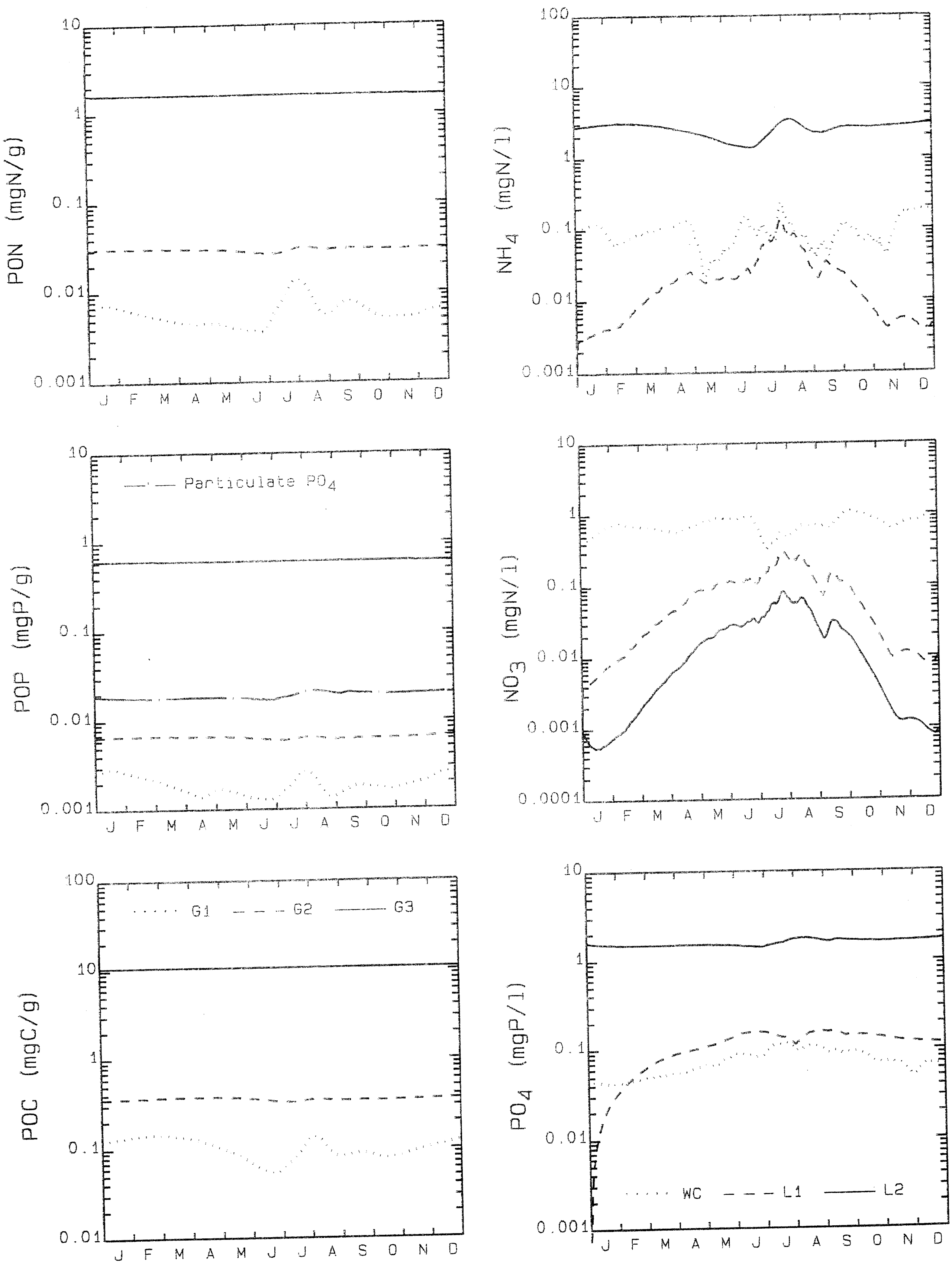
Tar-Pamlico River Salinity and D.O. - Station 3
Model Segment 35, 3



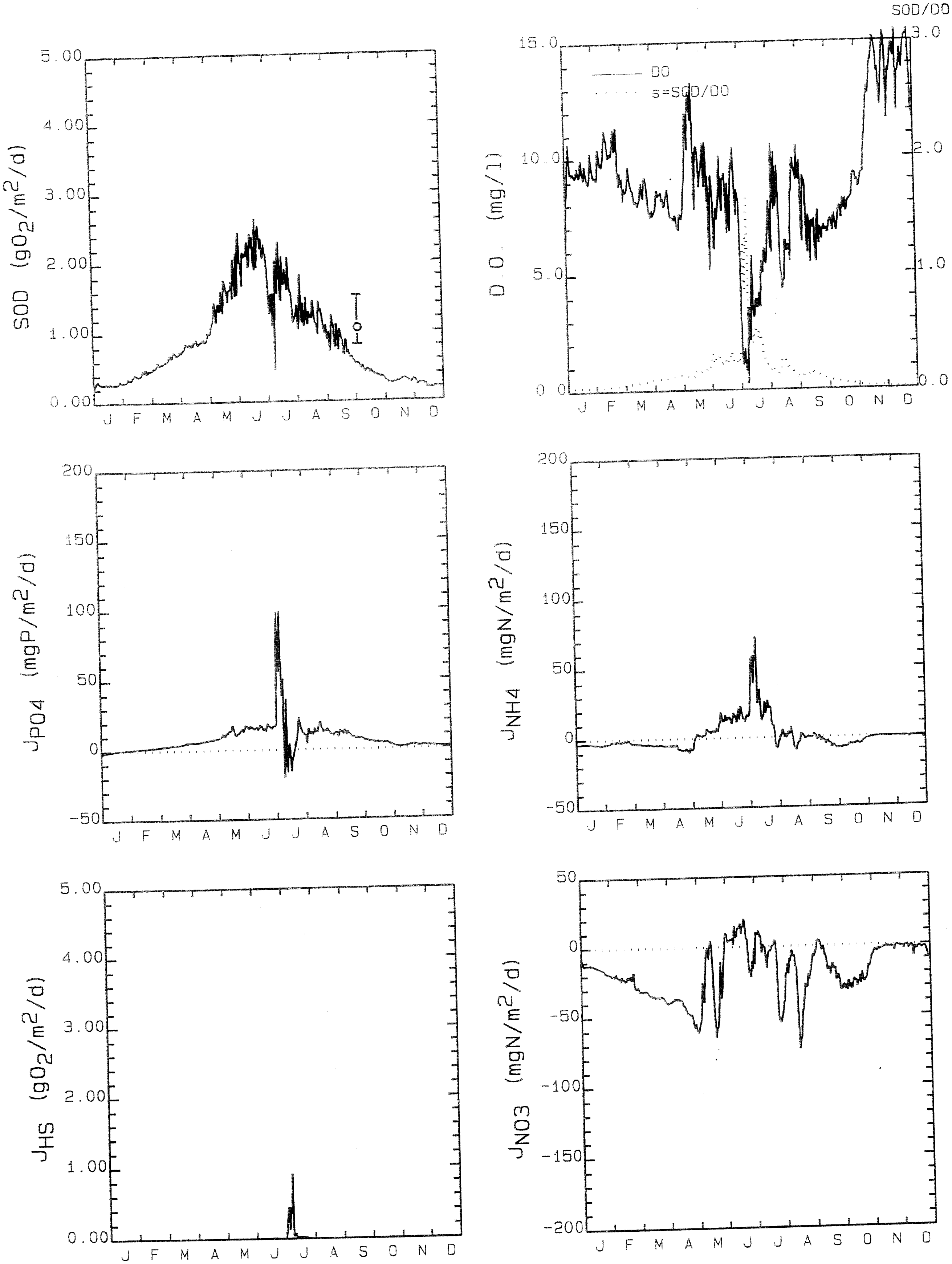
Tar-Pamlico River Salinity and D.O. - Station 1A
Model Segment 40,3



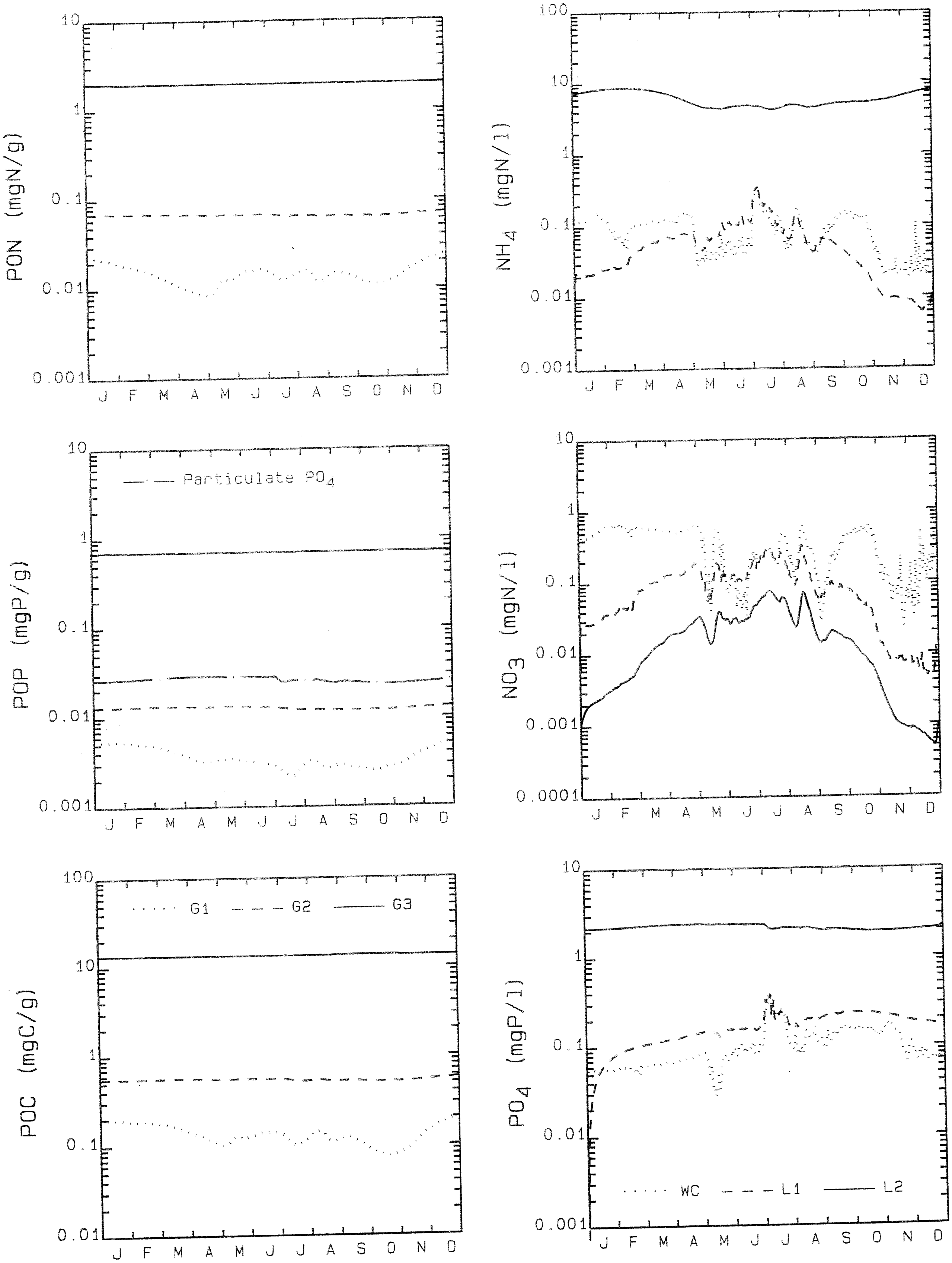
Tar-Pamlico Sediment Model Output for 6, 3



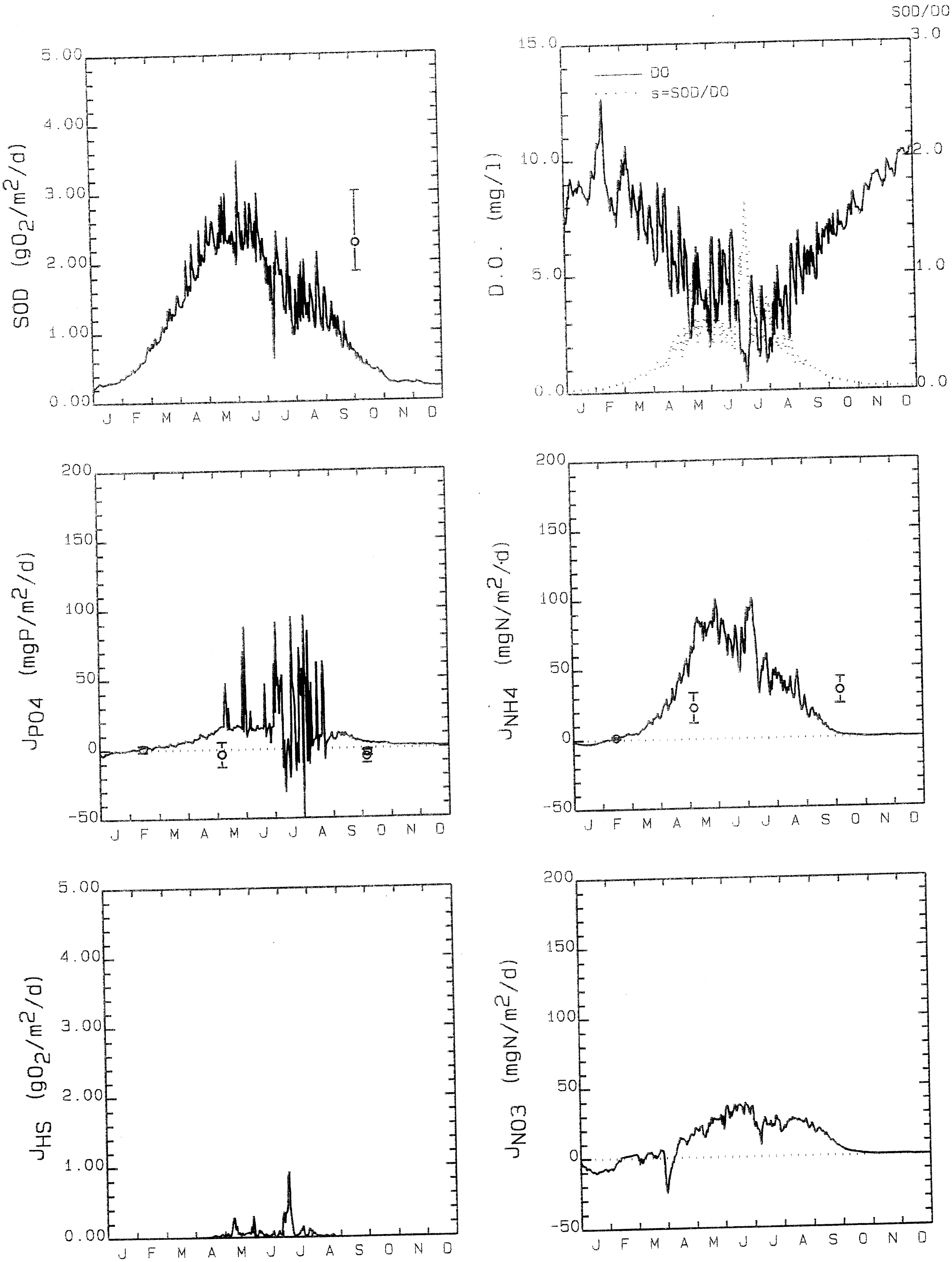
Tar-Pamlico Sediment Model Output for 6.3



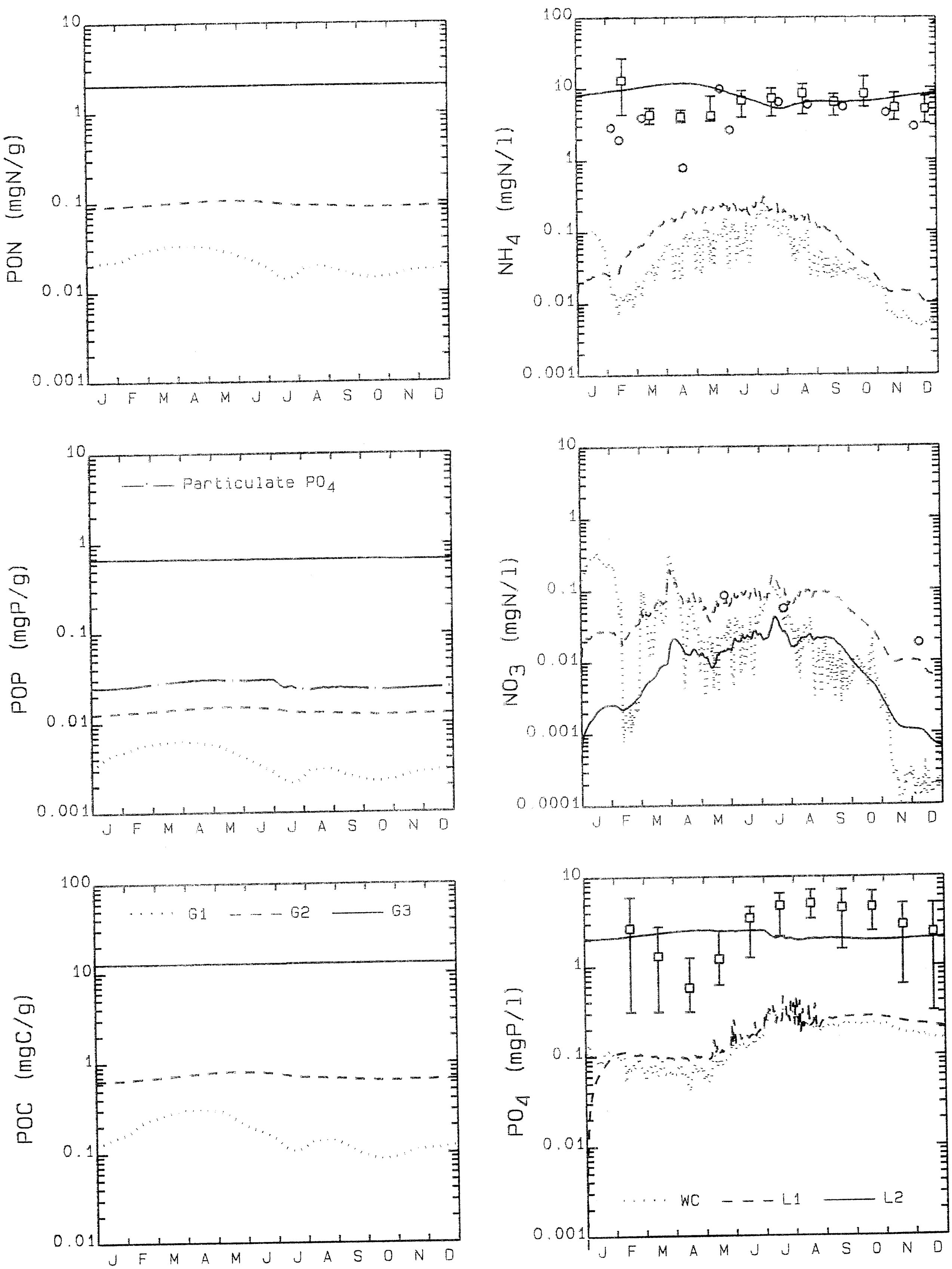
Tar-Pamlico Sediment Model Output for 13, 3



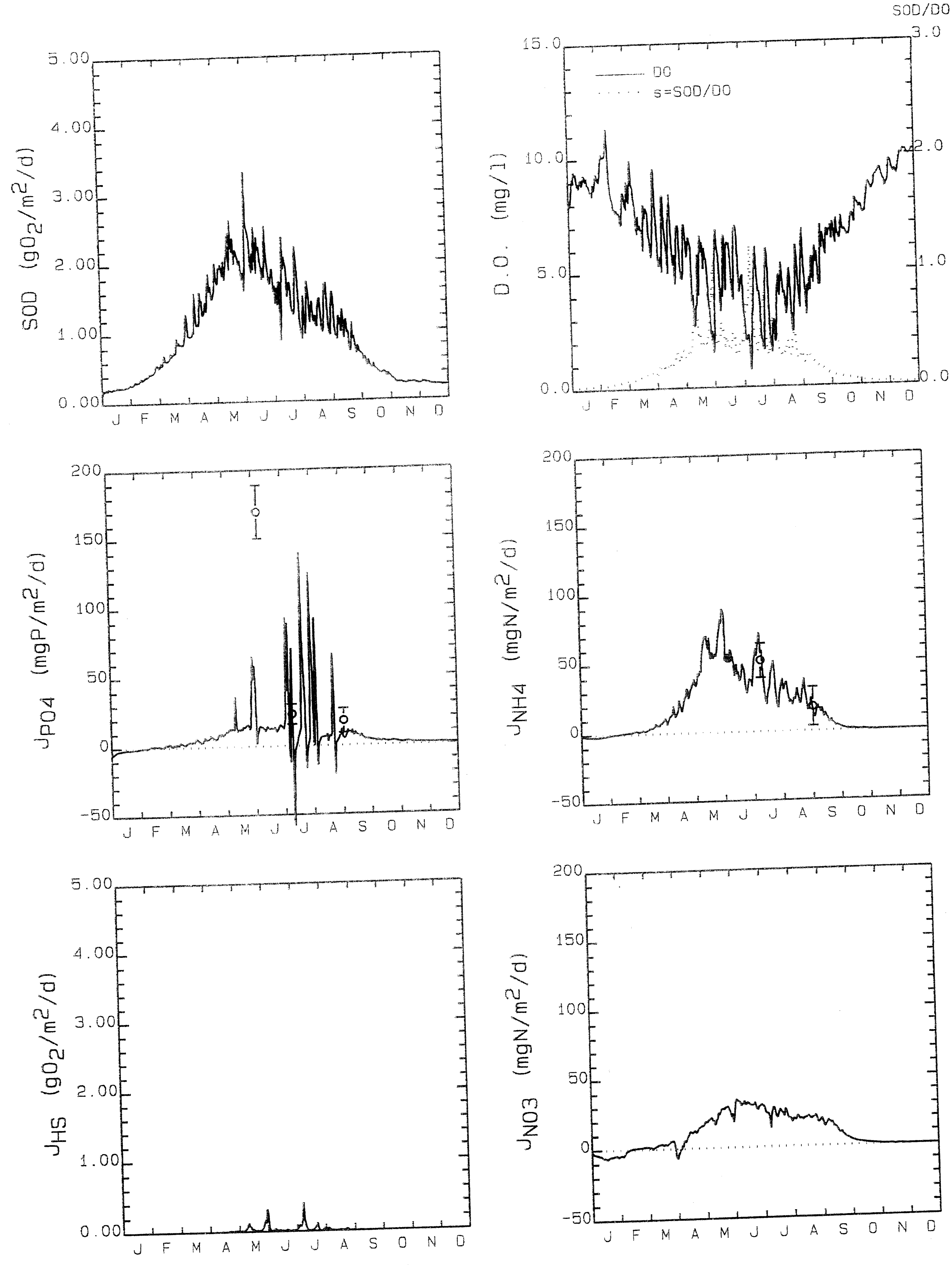
Tar-Pamlico Sediment Model Output for 13.3



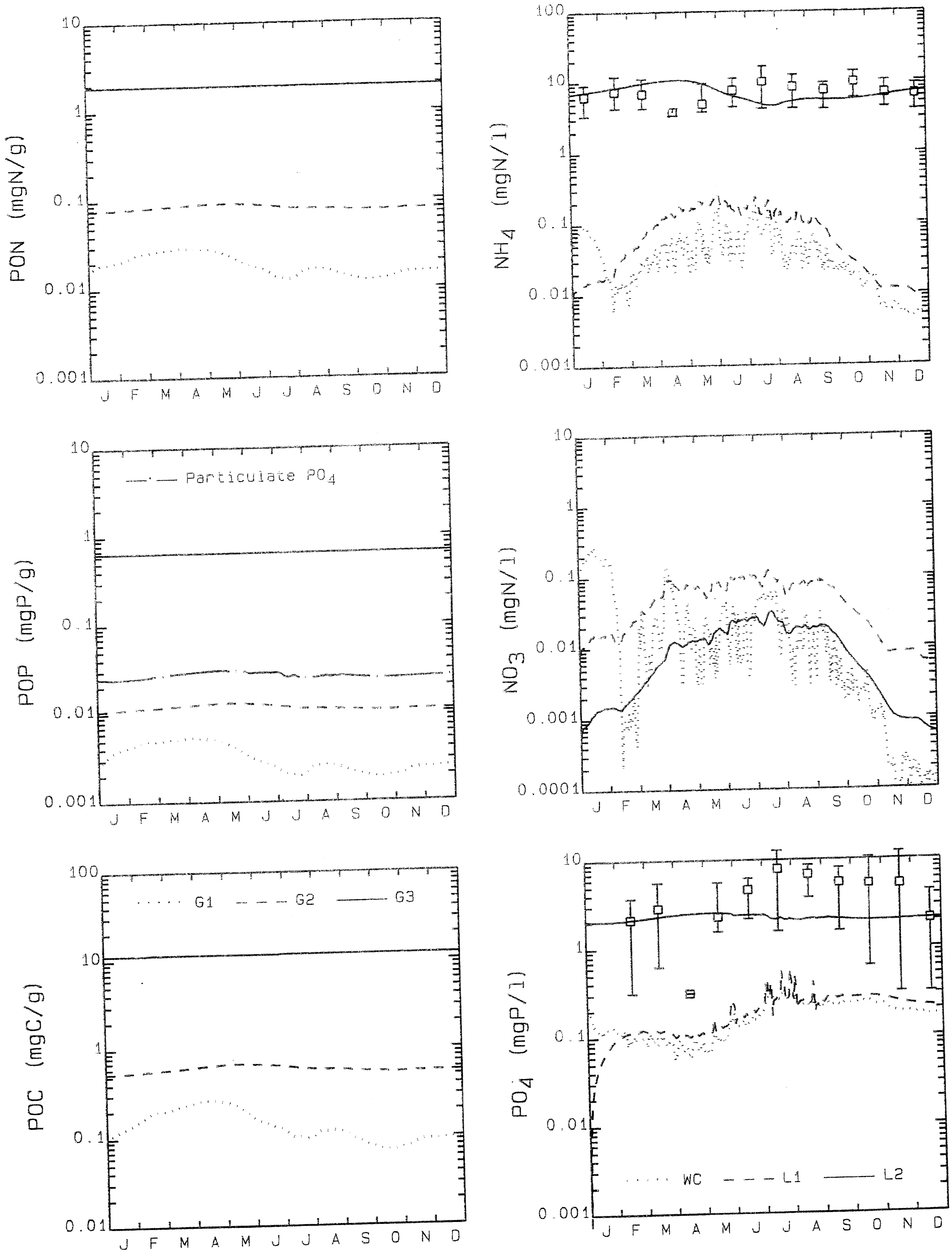
Tar-Pamlico Sediment Model Output for 19, 3



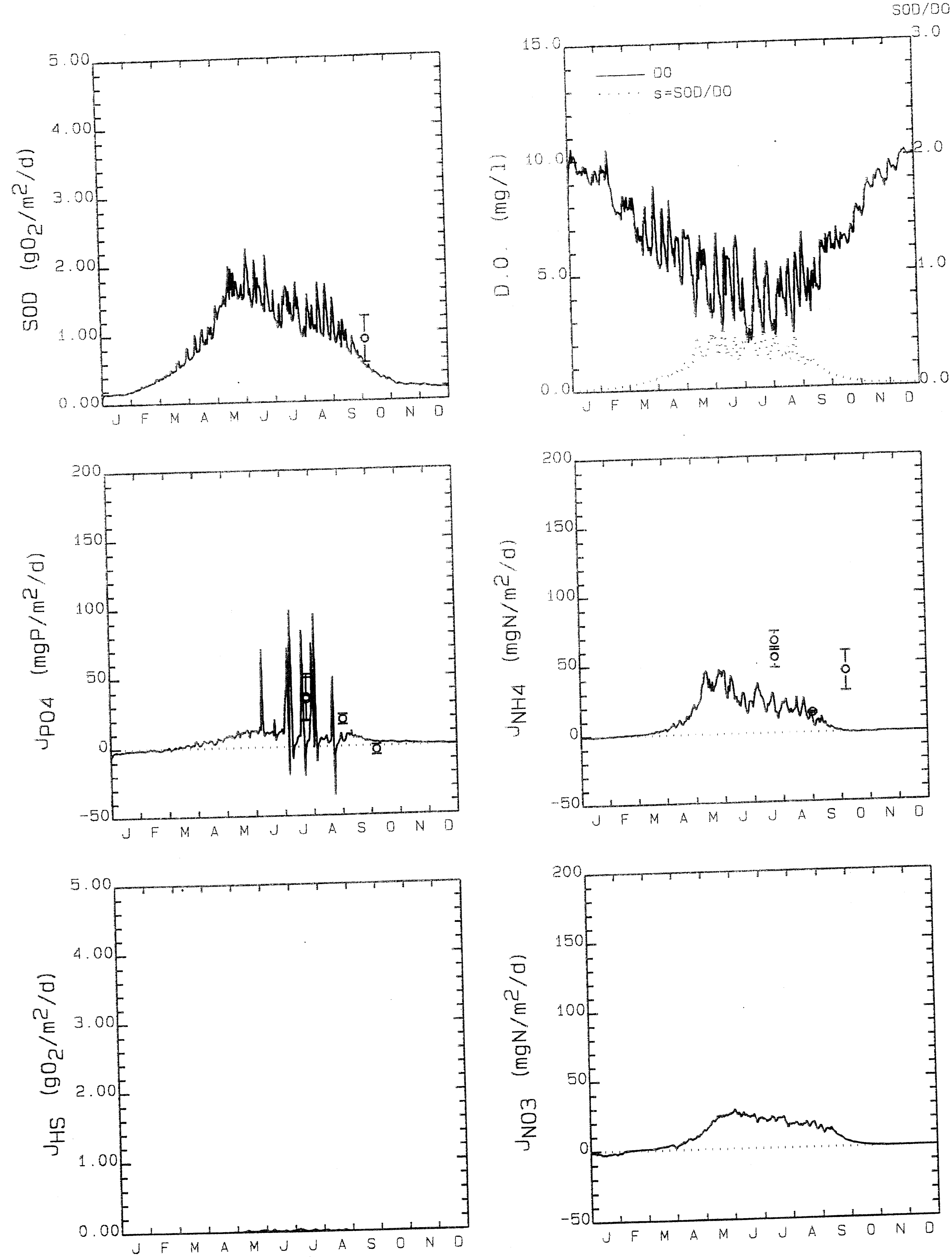
Tar-Pamlico Sediment Model Output for 19.3



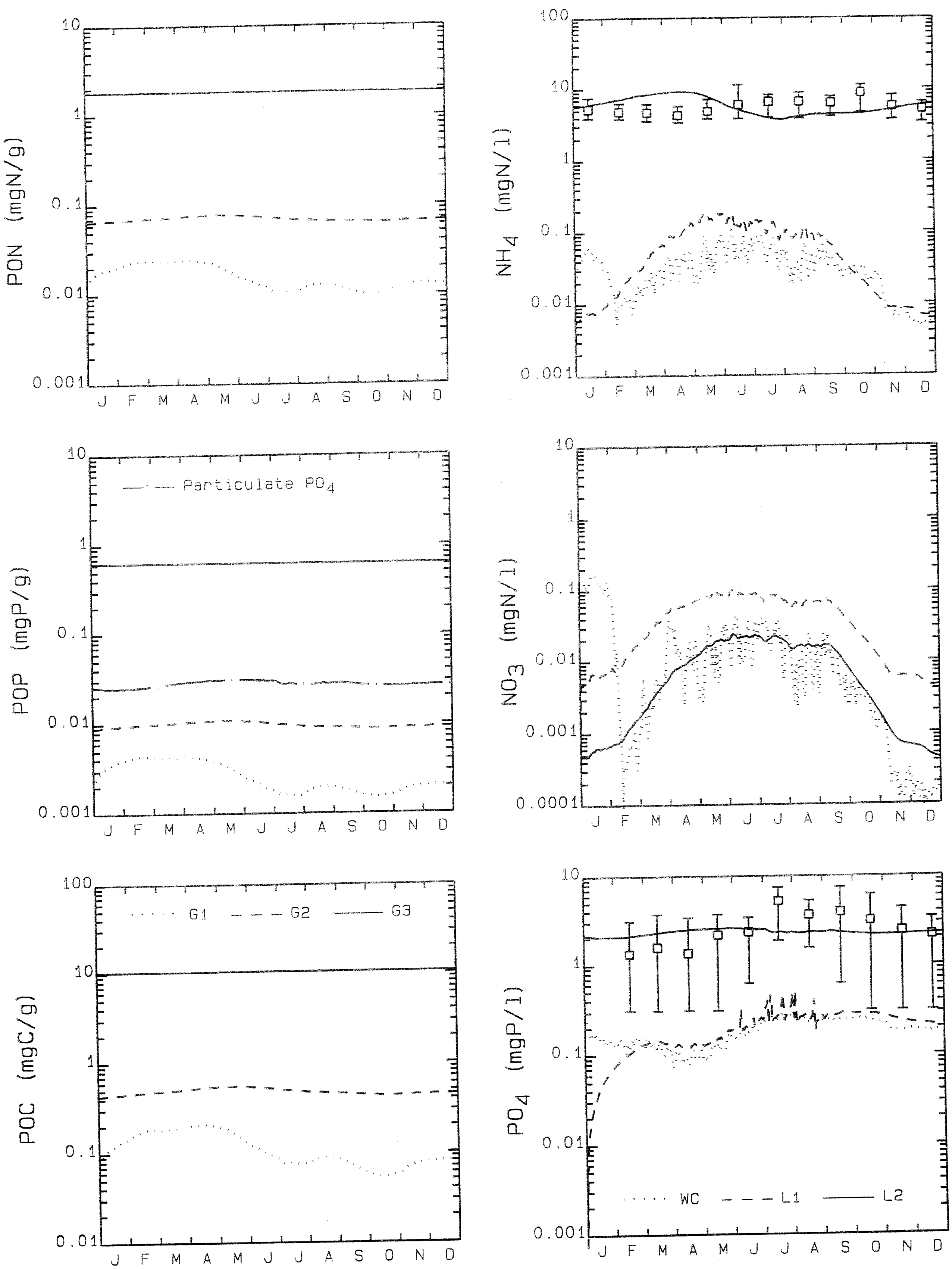
Tar-Pamlico Sediment Model Output for 21,3



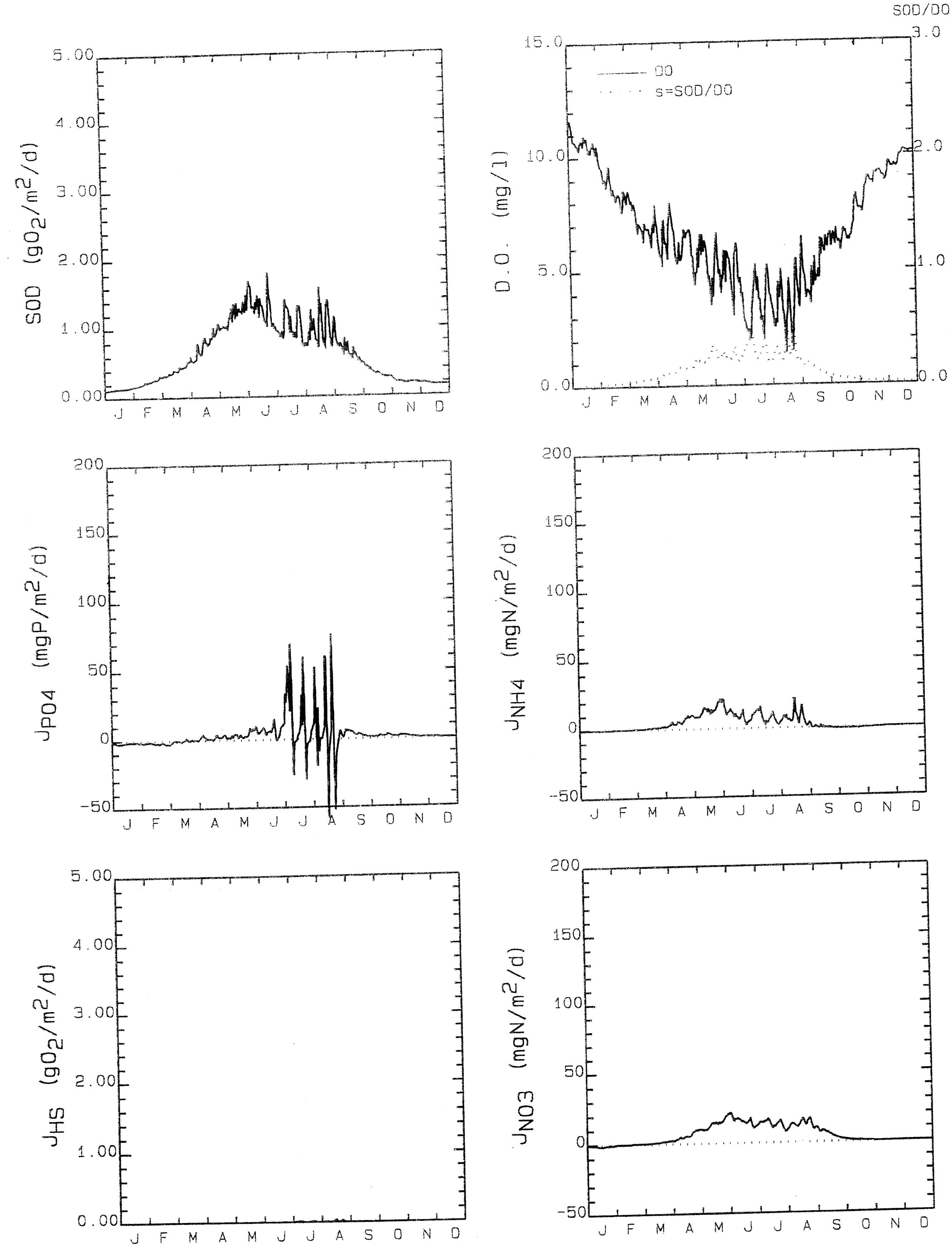
Tar-Pamlico Sediment Model Output for 21.3



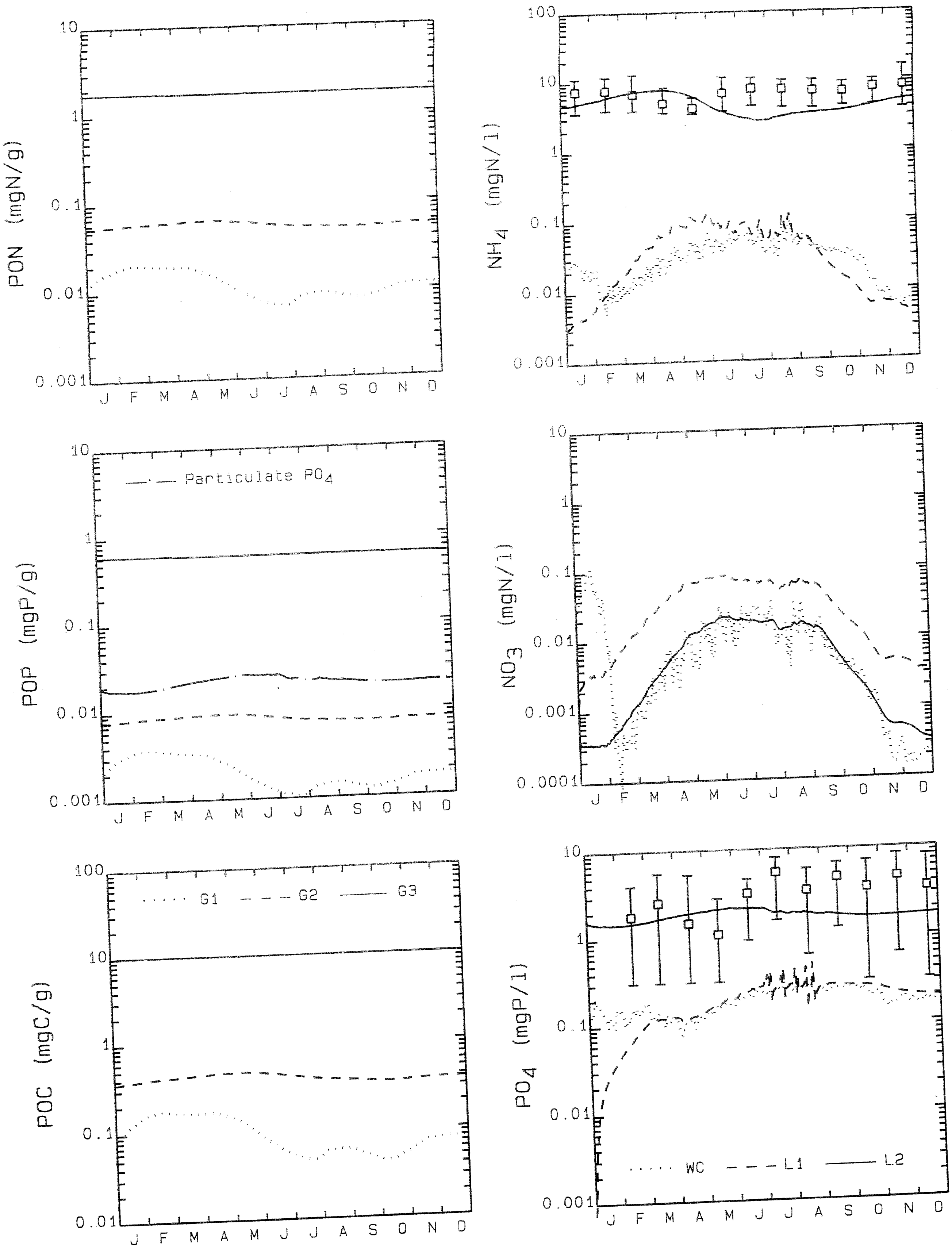
Tar-Pamlico Sediment Model Output for 24.3



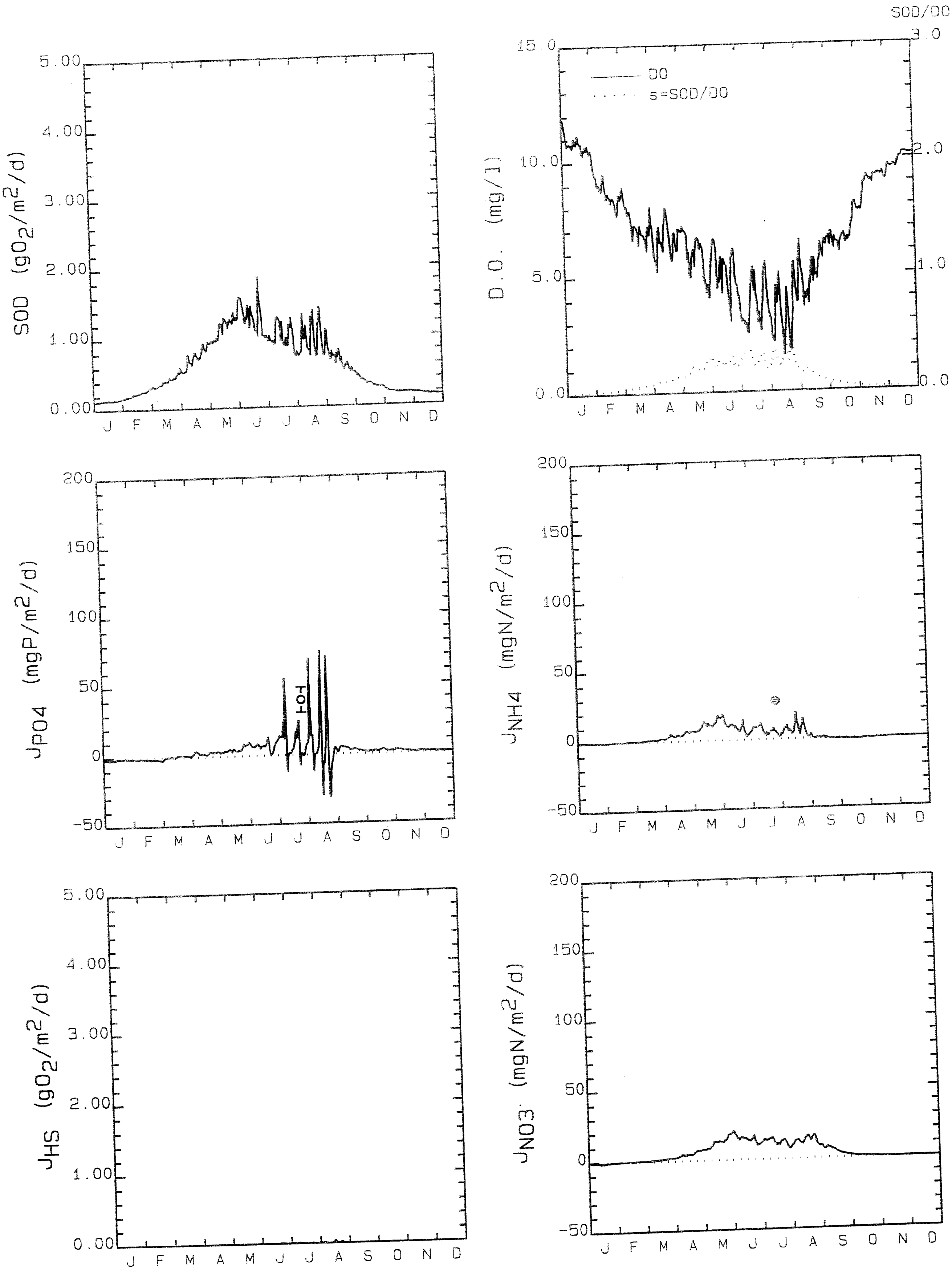
Tar-Pamlico Sediment Model Output for 24.3



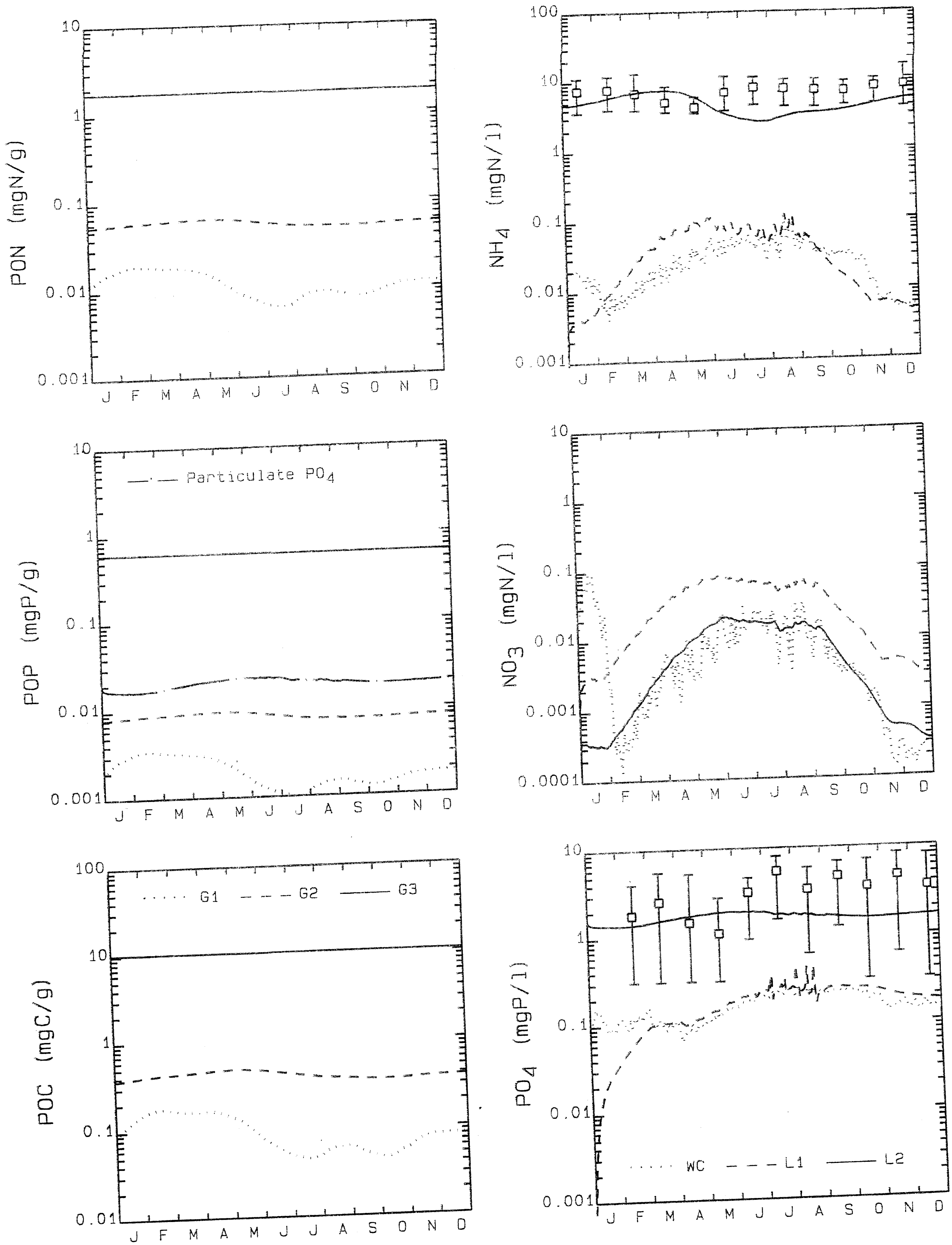
Tar-Pamlico Sediment Model Output for 30.3



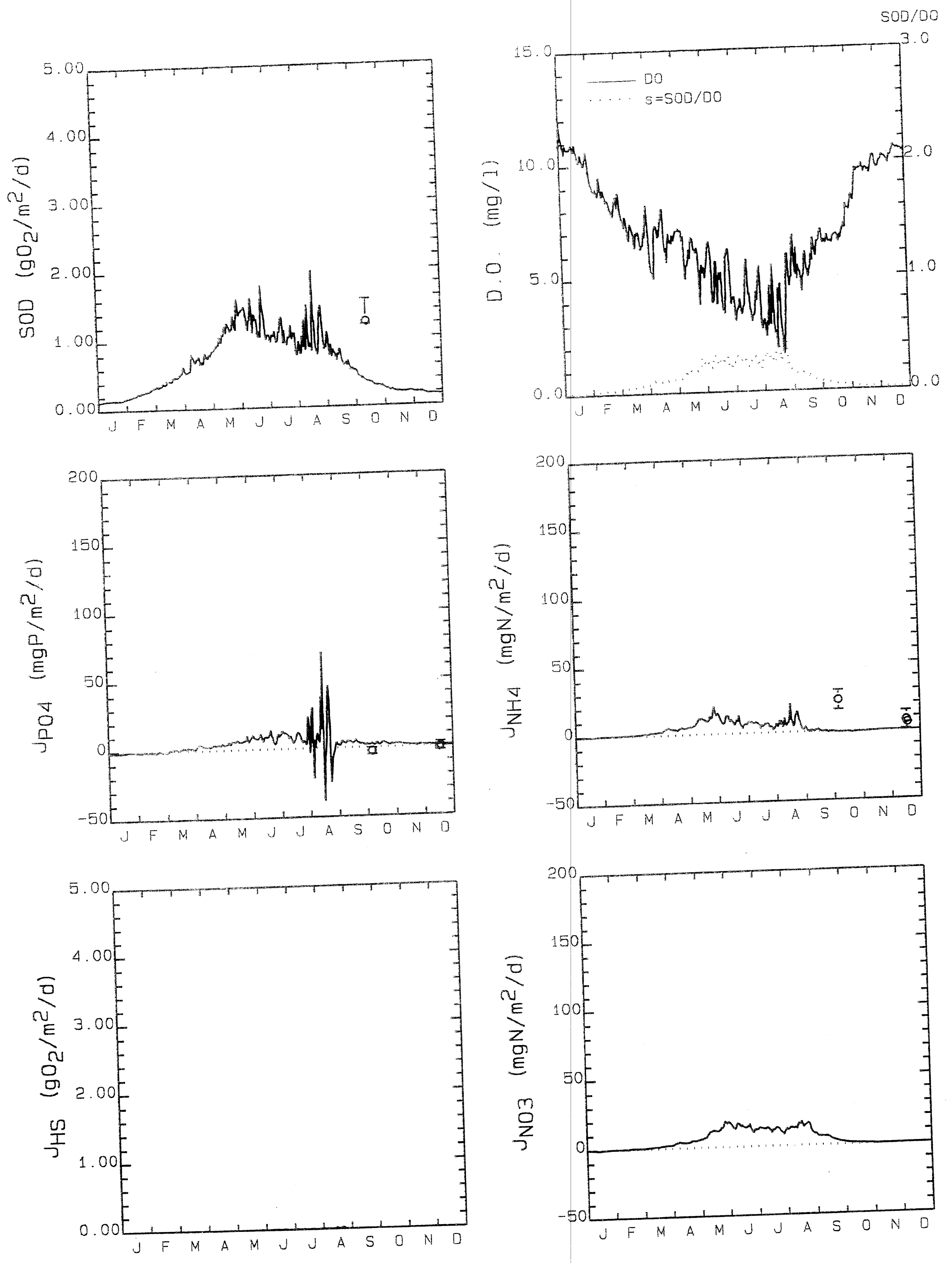
Tar-Pamlico Sediment Model Output for 30, 3



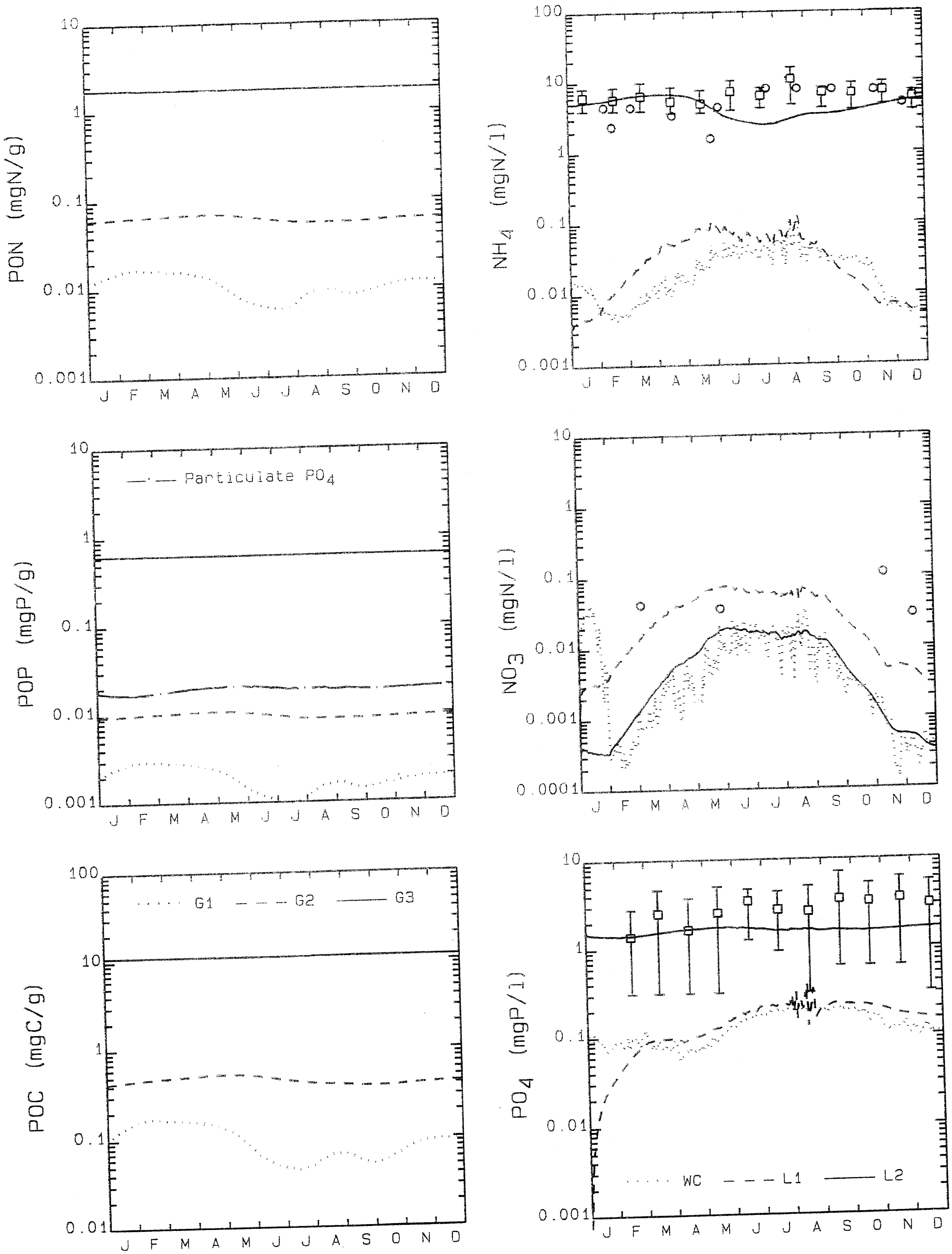
Tar-Pamlico Sediment Model Output for 32, 3



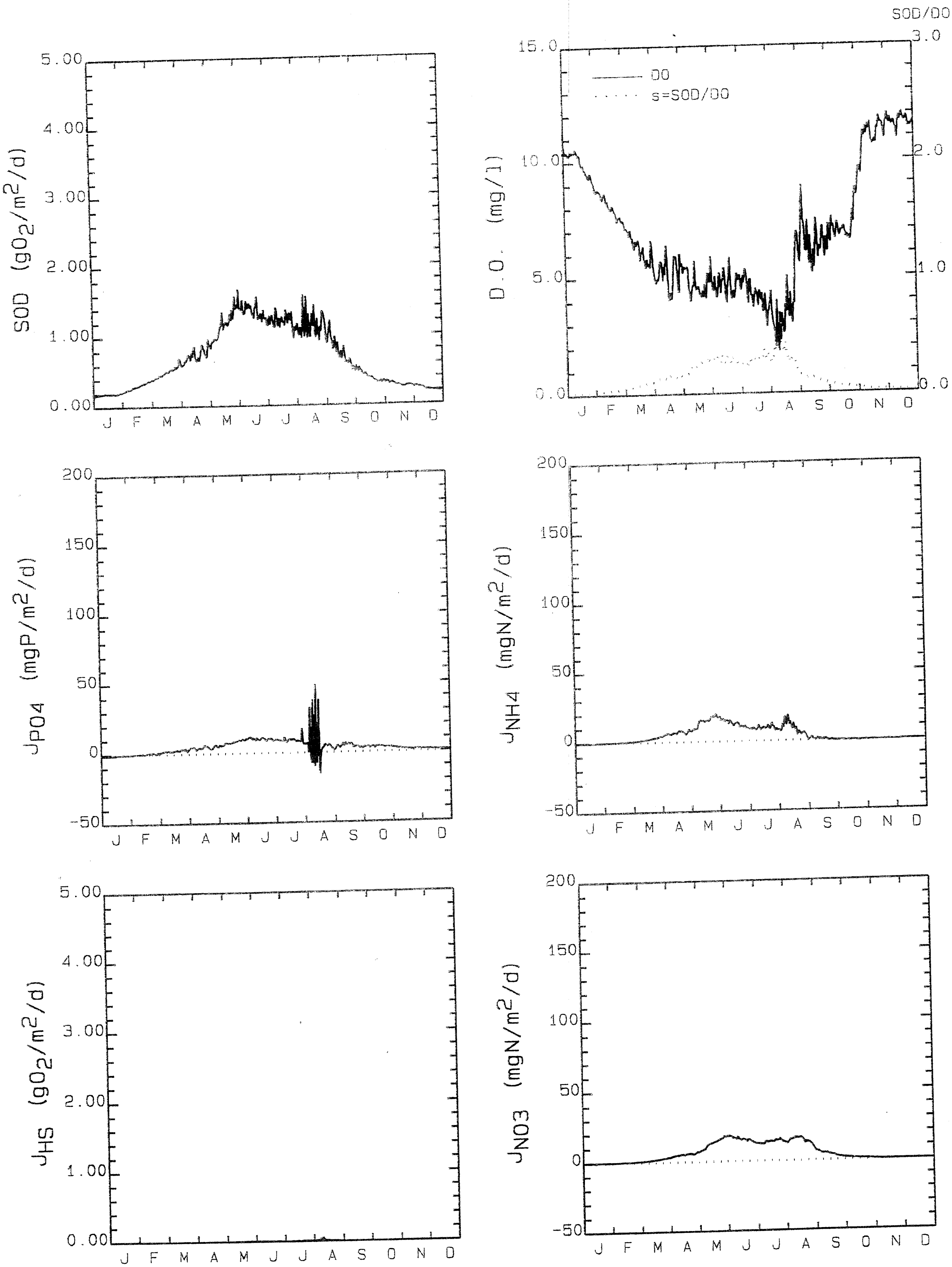
Tar-Pamlico Sediment Model Output for 32, 3



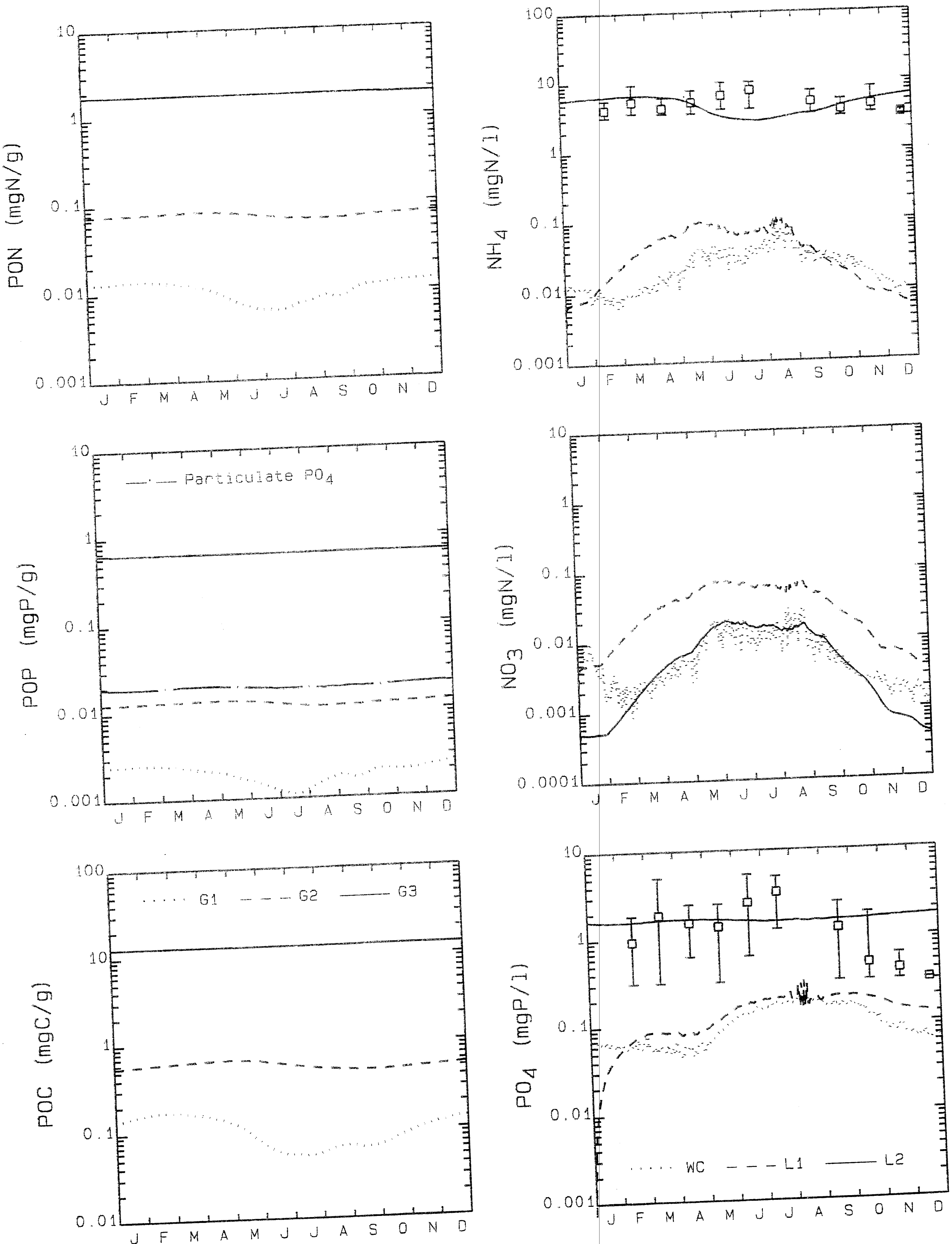
Tar-Pamlico Sediment Model Output for 36.3



Tar-Pamlico Sediment Model Output for 36.3



Tar-Pamlico Sediment Model Output for 40,3



Tar-Pamlico Sediment Model Output for 40, 3

APPENDIX 9.5

1991 TAR-PAMLICO RIVER WATER QUALITY DATA

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
15-Jan-91	1	S	15	1	91	9.0	15.9	11.4	8.0	12.271
15-Jan-91	1	B	15	1	91	9.2	17.1	10.4	7.9	13.187
15-Jan-91	1A	S	15	1	91	9.2	15.0	11.8	8.0	11.548
15-Jan-91	1A	B	15	1	91	9.1	17.0	10.8	8.0	13.120
15-Jan-91	2S	S	15	1	91	9.0	13.0	11.8	8.1	10.006
15-Jan-91	2S	B	15	1	91	8.9	13.9	11.5	8.0	10.719
15-Jan-91	3	S	15	1	91	8.9	11.3	12.6	8.3	8.688
15-Jan-91	3	B	15	1	91	8.9	12.2	12.4	8.2	9.391
15-Jan-91	4N	S	15	1	91	9.2	12.1	11.4	8.0	9.284
15-Jan-91	4N	B	15	1	91	9.2	15.0	10.5	7.9	11.548
15-Jan-91	4S	S	15	1	91	8.9	11.2	12.0	8.2	8.609
15-Jan-91	4S	B	15	1	91	9.8	14.9	10.8	7.9	11.406
15-Jan-91	4P	S	15	1	91	8.9	10.0	12.1	8.0	7.672
15-Jan-91	4P	B	15	1	91	9.6	14.0	10.4	7.9	10.726
15-Jan-91	5	S	15	1	91	9.0	10.0	13.4	8.2	7.663
15-Jan-91	5	B	15	1	91	9.2	14.8	11.0	7.9	11.392
15-Jan-91	5N	S	15	1	91	9.2	10.5	12.2	8.2	8.035
15-Jan-91	5N	B	15	1	91	9.8	14.8	10.2	7.9	11.328
15-Jan-91	5S	S	15	1	91	8.0	7.9	13.2	8.2	6.103
15-Jan-91	5S	B	15	1	91	9.8	15.9	8.4	7.8	12.185
15-Jan-91	6	S	15	1	91	7.2	7.5	12.9	8.4	5.844
15-Jan-91	6	B	15	1	91	9.8	15.8	8.3	7.2	12.107
15-Jan-91	7	S	15	1	91	8.1	4.5	12.7	7.4	3.434
15-Jan-91	7	B	15	1	91	9.9	13.2	8.3	7.1	10.070
15-Jan-91	7N	S	15	1	91	9.8	8.0	12.8	8.5	6.028
15-Jan-91	7N	B	15	1	91	9.8	13.0	10.5	8.3	9.925
15-Jan-91	7S	S	15	1	91	8.1	7.0	13.8	7.4	5.391
15-Jan-91	7S	B	15	1	91	10.0	12.5	8.5	7.1	9.514
15-Jan-91	8	S	15	1	91	8.9	3.6	12.2	8.1	2.672
15-Jan-91	8	B	15	1	91	10.0	12.0	7.6	7.6	9.124
15-Jan-91	9N	S	15	1	91	10.8	1.2	10.0	8.0	0.639
15-Jan-91	9N	B	15	1	91	10.0	12.0	6.7	7.4	9.124
15-Jan-91	9S	S	15	1	91	9.1	2.0	10.2	7.9	1.408
15-Jan-91	9S	B	15	1	91	10.1	12.5	5.7	7.3	9.503
15-Jan-91	10	S	15	1	91	8.1	1.1	8.6	8.3	0.772
15-Jan-91	10	B	15	1	91	10.0	12.0	6.4	7.7	9.124
15-Jan-91	11	S	15	1	91	7.9	0.9	8.7	8.0	0.628
15-Jan-91	11	B	15	1	91	10.0	7.1	2.3	7.4	5.307
15-Jan-91	12	S	15	1	91	8.0	0.1	8.4	8.3	-0.005
15-Jan-91	12	B	15	1	91	9.8	10.2	5.7	7.2	7.743
28-Jan-91	1	S	28	1	91	7.5	12.5	11.4	8.6	9.744
28-Jan-91	1	B	28	1	91	8.0	20.0	9.3	8.1	15.577
28-Jan-91	1A	S	28	1	91	8.0	12.0	12.0	8.7	9.313
28-Jan-91	1A	B	28	1	91	8.0	19.5	9.0	8.1	15.186
28-Jan-91	2S	S	28	1	91	7.5	8.0	13.2	8.9	6.216
28-Jan-91	2S	B	28	1	91	8.0	18.0	8.5	7.9	14.011
28-Jan-91	3	S	28	1	91	7.0	7.5	15.2	9.1	5.856
28-Jan-91	3	B	28	1	91	8.0	16.5	7.1	7.8	12.837
28-Jan-91	4N	S	28	1	91	9.0	11.5	12.2	8.6	8.835
28-Jan-91	4N	B	28	1	91	8.5	16.0	6.4	7.7	12.399

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
28-Jan-91	4S	S	28	1	91	8.0	7.0	16.0	9.3	5.398
28-Jan-91	4S	B	28	1	91	8.0	16.0	6.6	7.7	12.445
28-Jan-91	4P	S	28	1	91	8.0	7.0	14.0	8.9	5.398
28-Jan-91	4P	B	28	1	91	7.5	12.0	9.4	8.1	9.352
28-Jan-91	5	S	28	1	91	8.0	5.0	15.0	9.0	3.832
28-Jan-91	5	B	28	1	91	8.5	16.5	6.8	7.8	12.790
28-Jan-91	5N	S	28	1	91	9.0	6.5	18.0	9.5	4.930
28-Jan-91	5N	B	28	1	91	9.0	15.0	5.5	7.7	11.568
28-Jan-91	5S	S	28	1	91	7.0	4.5	12.3	8.1	3.501
28-Jan-91	5S	B	28	1	91	9.0	17.0	5.1	7.6	13.130
28-Jan-91	6	S	28	1	91	8.0	3.5	12.0	7.8	2.658
28-Jan-91	6	B	28	1	91	8.5	16.0	5.1	7.5	12.399
28-Jan-91	7	S	28	1	91	7.0	4.0	12.2	8.3	3.108
28-Jan-91	7	B	28	1	91	9.0	16.0	5.3	7.6	12.349
28-Jan-91	7N	S	28	1	91	7.0	10.0	17.0	9.3	7.818
28-Jan-91	7N	B	28	1	91	9.0	14.0	5.1	7.6	10.787
28-Jan-91	7S	S	28	1	91	7.0	3.5	11.0	8.1	2.716
28-Jan-91	7S	B	28	1	91	8.5	13.5	5.0	7.6	10.444
28-Jan-91	8	S	28	1	91	9.0	3.0	10.6	7.8	2.196
28-Jan-91	8	B	28	1	91	9.5	13.5	4.4	7.4	10.346
28-Jan-91	9N	S	28	1	91	9.5	3.0	10.6	7.7	2.156
28-Jan-91	9N	B	28	1	91	9.5	10.0	4.1	7.2	7.616
28-Jan-91	9S	S	28	1	91	9.0	2.0	10.2	8.0	1.415
28-Jan-91	9S	B	28	1	91	9.5	12.0	4.3	7.4	9.176
28-Jan-91	10	S	28	1	91	9.0	0.5	10.2	8.3	0.244
28-Jan-91	10	B	28	1	91	9.0	11.0	4.7	7.5	8.444
28-Jan-91	11	S	28	1	91	8.5	0.5	10.0	7.9	0.278
28-Jan-91	11	B	28	1	91	8.5	4.0	2.6	7.3	3.015
28-Jan-91	12	S	28	1	91	8.5	0.0	10.2	7.7	-0.113
28-Jan-91	12	B	28	1	91	9.5	9.0	4.2	7.0	6.836
11-Feb-91	2S	0.0	11	2	91	10.0	11.0	12.6	8.6	8.345
11-Feb-91	2S	0.5	11	2	91	10.0	11.0	12.6		8.345
11-Feb-91	2S	1.0	11	2	91	10.0	11.0	12.8		8.345
11-Feb-91	2S	1.5	11	2	91	10.0	11.0	12.8		8.345
11-Feb-91	2S	2.0	11	2	91	10.0	11.0	13.0		8.345
11-Feb-91	2S	2.5	11	2	91	10.0	11.0	13.0		8.345
11-Feb-91	2S	3.0	11	2	91	9.5	11.5	11.8		8.786
11-Feb-91	2S	3.5	11	2	91	9.5	13.0	11.0		9.956
11-Feb-91	2S	4.0	11	2	91	9.5	13.5	10.4		10.346
11-Feb-91	2S	4.5	11	2	91	9.5	14.0	9.8	8.0	10.736
11-Feb-91	3	0.0	11	2	91	10.0	11.0	13.2	8.6	8.345
11-Feb-91	3	0.5	11	2	91	10.0	11.0	13.4		8.345
11-Feb-91	3	1.0	11	2	91	10.0	11.0	13.4		8.345
11-Feb-91	3	1.5	11	2	91	10.0	11.0	13.4		8.345
11-Feb-91	3	2.0	11	2	91	10.0	11.0	13.4		8.345
11-Feb-91	3	2.5	11	2	91	10.0	11.0	13.4		8.345
11-Feb-91	3	3.0	11	2	91	10.0	13.5	12.0	8.5	10.293
11-Feb-91	4N	0.0	11	2	91	10.0	15.5	10.4	8.1	11.851
11-Feb-91	4N	0.5	11	2	91	10.0	15.5	10.4		11.851
11-Feb-91	4N	1.0	11	2	91	10.0	15.5	10.4		11.851

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
11-Feb-91	4N	1.5	11	2	91	10.0	16.0	10.2		12.240
11-Feb-91	4N	2.0	11	2	91	10.0	16.0	10.2		12.240
11-Feb-91	4N	2.5	11	2	91	10.0	16.0	10.2	7.8	12.240
11-Feb-91	4S	0.0	11	2	91	10.0	8.5	13.2	8.6	6.398
11-Feb-91	4S	0.5	11	2	91	10.0	8.5	13.6		6.398
11-Feb-91	4S	1.0	11	2	91	10.0	8.5	13.6		6.398
11-Feb-91	4S	1.5	11	2	91	10.0	9.5	13.0		7.177
11-Feb-91	4S	2.0	11	2	91	10.0	13.0	10.4		9.903
11-Feb-91	4S	2.5	11	2	91	10.0	13.5	10.0		10.293
11-Feb-91	4S	3.0	11	2	91	9.5	14.0	7.0	7.8	10.736
11-Feb-91	4P	0.0	11	2	91	10.0	11.0	12.6	8.5	8.345
11-Feb-91	4P	0.5	11	2	91	10.0	11.0	12.6		8.345
11-Feb-91	4P	1.0	11	2	91	10.0	11.5	12.6		8.735
11-Feb-91	4P	1.5	11	2	91	10.0	11.5	12.6		8.735
11-Feb-91	4P	2.0	11	2	91	10.0	11.5	12.6		8.735
11-Feb-91	4P	2.5	11	2	91	10.0	12.5	7.6		9.514
11-Feb-91	4P	3.0	11	2	91	10.0	13.0	7.0	7.7	9.903
11-Feb-91	5N	0.0	11	2	91	10.0	17.0	10.4	8.0	13.019
11-Feb-91	5N	0.5	11	2	91	10.0	17.0	10.4		13.019
11-Feb-91	5N	1.0	11	2	91	10.0	17.0	10.4		13.019
11-Feb-91	5N	1.5	11	2	91	10.0	17.0	10.4		13.019
11-Feb-91	5N	2.0	11	2	91	10.0	17.0	10.4		13.019
11-Feb-91	5N	2.5	11	2	91	10.0	17.0	8.4	7.8	13.019
11-Feb-91	5S	0.0	11	2	91	10.0	8.5	13.8	8.7	6.398
11-Feb-91	5S	0.5	11	2	91	10.0	8.5	14.0		6.398
11-Feb-91	5S	1.0	11	2	91	10.0	9.0	13.8		6.787
11-Feb-91	5S	1.5	11	2	91	10.0	9.5	13.8		7.177
11-Feb-91	5S	2.0	11	2	91	10.0	11.0	13.0		8.345
11-Feb-91	5S	2.5	11	2	91	10.0	11.5	12.8		8.735
11-Feb-91	5S	3.0	11	2	91	10.0	12.5	8.4		9.514
11-Feb-91	5S	3.5	11	2	91	9.5	17.0	5.4	7.6	13.076
11-Feb-91	6	0.0	11	2	91	10.0	8.0	14.0	8.8	6.008
11-Feb-91	6	0.5	11	2	91	10.0	8.0	14.0		6.008
11-Feb-91	6	1.0	11	2	91	10.0	8.0	14.2		6.008
11-Feb-91	6	1.5	11	2	91	10.0	8.0	14.2		6.008
11-Feb-91	6	2.0	11	2	91	10.0	9.5	11.6		7.177
11-Feb-91	6	2.5	11	2	91	10.0	12.0	8.4		9.124
11-Feb-91	6	3.0	11	2	91	10.0	13.0	6.0		9.903
11-Feb-91	6	3.5	11	2	91	10.0	17.0	5.0		13.019
11-Feb-91	6	4.0	11	2	91	9.5	17.0	4.6	7.5	13.076
11-Feb-91	7	0.0	11	2	91	10.0	6.5	12.4	8.3	4.840
11-Feb-91	7	0.5	11	2	91	10.0	6.5	12.4		4.840
11-Feb-91	7	1.0	11	2	91	10.0	8.5	12.4		6.398
11-Feb-91	7	1.5	11	2	91	10.0	11.0	11.0		8.345
11-Feb-91	7	2.0	11	2	91	10.0	15.5	1.5		11.851
11-Feb-91	7	2.5	11	2	91	9.5	17.0	0.7		13.076
11-Feb-91	7	3.0	11	2	91	9.5	17.0	0.7	7.4	13.076
11-Feb-91	7N	0.0	11	2	91	10.5	13.0	13.0	8.4	9.847
11-Feb-91	7N	0.5	11	2	91	10.5	13.0	13.0		9.847
11-Feb-91	7N	1.0	11	2	91	10.5	13.0	13.0		9.847

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
11-Feb-91	7N	1.5	11	2	91	10.0	15.0	12.2		11.461
11-Feb-91	7N	2.0	11	2	91	10.0	16.0	11.0		12.240
11-Feb-91	7N	2.5	11	2	91	10.0	16.5	6.2		12.630
11-Feb-91	7N	3.0	11	2	91	9.5	16.5	6.2	7.5	12.686
11-Feb-91	7S	0.0	11	2	91	10.0	7.5	13.4	8.6	5.619
11-Feb-91	7S	0.5	11	2	91	10.0	7.5	13.4		5.619
11-Feb-91	7S	1.0	11	2	91	10.0	7.5	13.4		5.619
11-Feb-91	7S	1.5	11	2	91	10.0	7.5	13.4		5.619
11-Feb-91	7S	2.0	11	2	91	10.0	16.5	1.0		12.630
11-Feb-91	7S	2.5	11	2	91	9.5	17.0	0.7	7.4	13.076
11-Feb-91	9N	0.0	11	2	91	11.0	11.0	14.4	8.4	8.234
11-Feb-91	9N	0.5	11	2	91	11.0	11.0	14.4		8.234
11-Feb-91	9N	1.0	11	2	91	11.0	11.5	13.0		8.622
11-Feb-91	9N	1.5	11	2	91	10.5	13.0	10.4		9.847
11-Feb-91	9N	2.0	11	2	91	10.0	13.5	5.2	7.9	10.293
11-Feb-91	9S	0.0	11	2	91	10.0	6.5	11.6	8.0	4.840
11-Feb-91	9S	0.5	11	2	91	10.0	6.5	11.6		4.840
11-Feb-91	9S	1.0	11	2	91	10.0	6.5	11.6		4.840
11-Feb-91	9S	1.5	11	2	91	10.0	6.5	11.6		4.840
11-Feb-91	9S	2.0	11	2	91	10.0	6.5	7.4	7.6	4.840
11-Feb-91	10	0.0	11	2	91	10.0	10.0	8.8	7.5	7.566
11-Feb-91	10	0.5	11	2	91	10.0	10.0	8.6		7.566
11-Feb-91	10	1.0	11	2	91	10.0	10.5	8.5		7.956
11-Feb-91	10	1.5	11	2	91	10.0	10.5	8.5		7.956
11-Feb-91	10	2.0	11	2	91	10.0	11.0	8.0		8.345
11-Feb-91	10	2.5	11	2	91	10.0	11.5	6.0		8.735
11-Feb-91	10	3.0	11	2	91	10.0	15.0	2.0	7.3	11.461
11-Feb-91	11	0.0	11	2	91	11.0	7.0	9.4	7.6	5.126
11-Feb-91	11	0.5	11	2	91	11.0	7.0	9.2		5.126
11-Feb-91	11	1.0	11	2	91	11.0	8.0	7.2		5.903
11-Feb-91	11	1.5	11	2	91	10.0	14.0	1.8	7.2	10.682
11-Feb-91	12	0.0	11	2	91	10.0	4.5	8.6	7.6	3.282
11-Feb-91	12	0.5	11	2	91	10.0	4.5	8.6		3.282
11-Feb-91	12	1.0	11	2	91	10.0	5.0	8.5		3.671
11-Feb-91	12	1.5	11	2	91	10.0	5.0	8.0		3.671
11-Feb-91	12	2.0	11	2	91	9.0	10.0	3.0		7.663
11-Feb-91	12	2.5	11	2	91	10.0	13.0	2.3		9.903
11-Feb-91	12	3.0	11	2	91	10.0	14.0	2.0	7.1	10.682
15-Apr-91	1	S	15	4	91					
15-Apr-91	1	B	15	4	91					
15-Apr-91	1A	S	15	4	91					
15-Apr-91	1A	B	15	4	91					
15-Apr-91	2S	S	15	4	91					
15-Apr-91	2S	B	15	4	91					
15-Apr-91	3	0.0	15	4	91	19.0	9.0	9.4	7.4	5.361
15-Apr-91	3	0.5	15	4	91					
15-Apr-91	3	1.0	15	4	91	18.5	9.0	9.4		5.467
15-Apr-91	3	1.5	15	4	91					
15-Apr-91	3	2.0	15	4	91	18.2	9.2	8.8	7.5	5.682
15-Apr-91	4N	S	15	4	91					

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
15-Apr-91	4N	B	15	4	91					
15-Apr-91	4S	0.0	15	4	91	19.5	9.0	9.4	7.3	5.252
15-Apr-91	4S	0.5	15	4	91					
15-Apr-91	4S	1.0	15	4	91	19.2	9.0	9.4		5.318
15-Apr-91	4S	1.5	15	4	91					
15-Apr-91	4S	2.0	15	4	91	19.0	9.0	9.4	7.5	5.361
15-Apr-91	4P	0.0	15	4	91	19.0	9.2	8.0	7.3	5.513
15-Apr-91	4P	0.5	15	4	91					
15-Apr-91	4P	1.0	15	4	91	18.5	9.0	8.4		5.467
15-Apr-91	4P	1.5	15	4	91					
15-Apr-91	4P	2.0	15	4	91	18.5	9.0	8.6		5.467
15-Apr-91	4P	2.5	15	4	91					
15-Apr-91	4P	3.0	15	4	91	17.5	9.0	8.6	7.4	5.671
15-Apr-91	5	S	15	4	91					
15-Apr-91	5	B	15	4	91					
15-Apr-91	5N	S	15	4	91					
15-Apr-91	5N	B	15	4	91					
15-Apr-91	5S	0.0	15	4	91	18.0	7.5	8.8	7.6	4.426
15-Apr-91	5S	0.5	15	4	91					
15-Apr-91	5S	1.0	15	4	91	18.0	7.6	8.8		4.502
15-Apr-91	5S	1.5	15	4	91					
15-Apr-91	5S	2.0	15	4	91	18.0	7.8	5.6		4.655
15-Apr-91	5S	2.5	15	4	91					
15-Apr-91	5S	3.0	15	4	91	17.8	7.8	8.3		4.695
15-Apr-91	5S	3.5	15	4	91					
15-Apr-91	5S	4.0	15	4	91	17.5	8.5	0.3	7.1	5.289
15-Apr-91	6	0.0	15	4	91	18.0	7.5	9.0	7.6	4.426
15-Apr-91	6	0.5	15	4	91					
15-Apr-91	6	1.0	15	4	91	18.0	7.5	8.8		4.426
15-Apr-91	6	1.5	15	4	91					
15-Apr-91	6	2.0	15	4	91	17.8	7.5	7.6		4.466
15-Apr-91	6	2.5	15	4	91					
15-Apr-91	6	3.0	15	4	91	17.8	7.8	5.4	7.4	4.695
15-Apr-91	7	0.0	15	4	91	18.0	6.9	8.9	7.8	3.968
15-Apr-91	7	0.5	15	4	91					
15-Apr-91	7	1.0	15	4	91	18.0	5.9	8.8		3.205
15-Apr-91	7	1.5	15	4	91					
15-Apr-91	7	2.0	15	4	91	17.8	5.9	8.5		3.244
15-Apr-91	7	2.5	15	4	91					
15-Apr-91	7	3.0	15	4	91	17.5	5.9	8.2	7.7	3.302
15-Apr-91	7N	S	15	4	91					
15-Apr-91	7N	B	15	4	91					
15-Apr-91	7S	0.0	15	4	91	18.0	7.0	8.5	7.6	4.045
15-Apr-91	7S	0.5	15	4	91					
15-Apr-91	7S	1.0	15	4	91	17.8	6.9	8.5		4.008
15-Apr-91	7S	1.5	15	4	91					
15-Apr-91	7S	2.0	15	4	91	17.5	7.0	7.3	7.4	4.143
15-Apr-91	8	0.0	15	4	91	17.9	5.0	9.5	8.0	2.538
15-Apr-91	8	0.5	15	4	91					
15-Apr-91	8	1.0	15	4	91	17.5	5.0	8.6		2.615

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
15-Apr-91	8	1.5	15	4	91					
15-Apr-91	8	2.0	15	4	91	17.2	5.5	8.0		3.053
15-Apr-91	8	2.5	15	4	91					
15-Apr-91	8	3.0	15	4	91	17.5	6.0	4.8	7.4	3.379
15-Apr-91	9N	0.0	15	4	91	17.9	4.5	10.2	6.9	2.156
15-Apr-91	9N	0.5	15	4	91					
15-Apr-91	9N	1.0	15	4	91	17.5	5.2	7.4		2.767
15-Apr-91	9N	1.5	15	4	91	17.5	5.2	6.3		2.767
15-Apr-91	9S	0.0	15	4	91	18.0	3.2	11.5	8.2	1.145
15-Apr-91	9S	0.5	15	4	91					
15-Apr-91	9S	1.0	15	4	91	17.5	4.3	9.2		2.080
15-Apr-91	9S	1.5	15	4	91					
15-Apr-91	9S	2.0	15	4	91	17.5	5.0	8.6	7.8	2.615
15-Apr-91	10	0.0	15	4	91	19.0	2.0	12.0	8.0	0.034
15-Apr-91	10	0.5	15	4	91					
15-Apr-91	10	1.0	15	4	91	19.0	2.2	12.0		0.186
15-Apr-91	10	1.5	15	4	91					
15-Apr-91	10	2.0	15	4	91	19.0	2.2	11.8	7.8	0.186
15-Apr-91	11	0.0	15	4	91	19.5	1.5	9.2	7.9	-0.448
15-Apr-91	11	0.5	15	4	91					
15-Apr-91	11	1.0	15	4	91	19.2	1.5	9.1	7.8	-0.387
15-Apr-91	12	0.0	15	4	91	20.0	0.2	7.8	7.9	-1.540
15-Apr-91	12	0.5	15	4	91	20.0	0.2	7.9		-1.540
15-Apr-91	12	1.0	15	4	91	19.0	0.2	7.4	7.1	-1.336
29-Apr-91	1	0.0	29	4	91	22.0	12.0	8.1	7.6	6.921
29-Apr-91	1	0.2	29	4	91	22.0	12.5	8.0		7.299
29-Apr-91	1	1.0	29	4	91	22.0	12.5	8.0		7.299
29-Apr-91	1	1.5	29	4	91	21.5	12.0	8.2		7.050
29-Apr-91	1	2.0	29	4	91	21.0	12.0	8.2		7.175
29-Apr-91	1	2.5	29	4	91	20.5	12.0	8.2		7.297
29-Apr-91	1	3.0	29	4	91	20.5	12.0	8.3	7.6	7.297
29-Apr-91	1A	0.0	29	4	91	22.0	9.5	8.6	7.1	5.034
29-Apr-91	1A	0.5	29	4	91	21.5	10.0	8.7		5.538
29-Apr-91	1A	1.0	29	4	91	21.5	10.0	8.7		5.538
29-Apr-91	1A	1.5	29	4	91	21.0	10.0	8.7		5.661
29-Apr-91	1A	2.0	29	4	91	20.5	9.5	8.6		5.402
29-Apr-91	1A	2.5	29	4	91	20.5	9.5	8.5		5.402
29-Apr-91	1A	3.0	29	4	91	20.0	10.0	8.3		5.898
29-Apr-91	1A	3.5	29	4	91	19.5	10.0	8.0		6.012
29-Apr-91	1A	4.0	29	4	91	19.5	11.0	7.4		6.772
29-Apr-91	1A	4.5	29	4	91	18.5	11.5	6.6		7.372
29-Apr-91	1A	5.0	29	4	91	17.5	11.5	3.8		7.581
29-Apr-91	1A	5.5	29	4	91	17.0	11.5	3.2	7.4	7.680
29-Apr-91	2S	0.0	29	4	91	21.5	8.5	8.3	7.5	4.404
29-Apr-91	2S	0.5	29	4	91	21.0	8.5	8.4		4.526
29-Apr-91	2S	1.0	29	4	91	21.0	8.5	8.3		4.526
29-Apr-91	2S	1.5	29	4	91	21.0	8.5	8.2		4.526
29-Apr-91	2S	2.0	29	4	91	20.5	8.5	8.0		4.644
29-Apr-91	2S	2.5	29	4	91	20.5	8.5	7.7		4.644
29-Apr-91	2S	3.0	29	4	91	20.0	9.0	7.2		5.139

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
29-Apr-91	2S	3.5	29	4	91	20.5	9.5	7.2	7.2	5.402
29-Apr-91	3	0.0	29	4	91	21.5	7.0	8.5	7.6	3.270
29-Apr-91	3	0.5	29	4	91	21.0	8.5	8.5		4.526
29-Apr-91	3	1.0	29	4	91	21.0	8.5	8.5		4.526
29-Apr-91	3	1.5	29	4	91	20.5	7.5	8.4		3.886
29-Apr-91	3	2.0	29	4	91	20.0	7.5	8.2		4.001
29-Apr-91	3	2.5	29	4	91	19.5	7.5	7.6		4.112
29-Apr-91	3	3.0	29	4	91	19.0	8.0	6.7	7.5	4.600
29-Apr-91	4N	0.0	29	4	91	22.5	7.0	8.5	7.7	3.020
29-Apr-91	4N	0.5	29	4	91	22.5	7.5	8.5		3.397
29-Apr-91	4N	1.0	29	4	91	22.5	7.5	8.5		3.397
29-Apr-91	4N	1.5	29	4	91	22.5	7.5	8.5		3.397
29-Apr-91	4N	2.0	29	4	91	22.5	7.5	8.4		3.397
29-Apr-91	4N	2.5	29	4	91	22.0	7.5	8.3	7.6	3.524
29-Apr-91	4S	0.0	29	4	91	22.0	8.0	8.0	7.5	3.901
29-Apr-91	4S	0.5	29	4	91	21.5	8.0	8.0		4.026
29-Apr-91	4S	1.0	29	4	91	21.0	8.0	8.0		4.147
29-Apr-91	4S	1.5	29	4	91	20.5	8.0	7.9		4.265
29-Apr-91	4S	2.0	29	4	91	20.0	8.0	7.1		4.380
29-Apr-91	4S	2.5	29	4	91	19.5	8.0	6.2		4.492
29-Apr-91	4S	3.0	29	4	91	18.5	8.0	3.3	7.2	4.705
29-Apr-91	4P	0.0	29	4	91	23.0	7.0	9.1	8.0	2.890
29-Apr-91	4P	0.5	29	4	91	22.5	7.0	9.0		3.020
29-Apr-91	4P	1.0	29	4	91	22.5	7.0	9.1		3.020
29-Apr-91	4P	1.5	29	4	91	21.0	7.0	7.9		3.390
29-Apr-91	4P	2.0	29	4	91	20.5	7.5	7.0		3.886
29-Apr-91	4P	2.5	29	4	91	19.5	7.5	5.3	7.2	4.112
29-Apr-91	5	0.0	29	4	91	23.5	6.5	9.1	7.8	2.381
29-Apr-91	5	0.5	29	4	91	22.5	7.0	9.3		3.020
29-Apr-91	5	1.0	29	4	91	22.5	7.0	9.3		3.020
29-Apr-91	5	1.5	29	4	91	22.5	7.0	9.3		3.020
29-Apr-91	5	2.0	29	4	91	22.0	7.0	9.3		3.146
29-Apr-91	5	2.5	29	4	91	22.0	7.0	9.1		3.146
29-Apr-91	5	3.0	29	4	91	21.5	7.0	7.7		3.270
29-Apr-91	5	3.5	29	4	91	20.0	7.0	6.8	7.7	3.621
29-Apr-91	5N	0.0	29	4	91	23.0	6.5	9.0	7.8	2.514
29-Apr-91	5N	0.5	29	4	91	23.0	6.5	9.0		2.514
29-Apr-91	5N	1.0	29	4	91	23.5	7.0	9.1		2.757
29-Apr-91	5N	1.5	29	4	91	23.0	7.0	9.1		2.890
29-Apr-91	5N	2.0	29	4	91	23.0	7.0	8.9		2.890
29-Apr-91	5N	2.5	29	4	91	23.0	7.0	8.5		2.890
29-Apr-91	5N	3.0	29	4	91	21.0	7.0	5.7	7.1	3.390
29-Apr-91	5S	0.0	29	4	91	21.0	5.5	8.3	7.5	2.255
29-Apr-91	5S	0.5	29	4	91	20.5	5.5	8.5		2.370
29-Apr-91	5S	1.0	29	4	91	20.0	5.5	8.5		2.483
29-Apr-91	5S	1.5	29	4	91	19.5	5.5	8.2		2.592
29-Apr-91	5S	2.0	29	4	91	19.5	5.5	7.4		2.592
29-Apr-91	5S	2.5	29	4	91	19.0	6.0	6.1		3.078
29-Apr-91	5S	3.0	29	4	91	18.5	6.5	5.0	7.3	3.562
29-Apr-91	6	0.0	29	4	91	22.0	4.0	7.9	7.3	0.881

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
29-Apr-91	6	0.5	29	4	91	22.0	4.0	7.8		0.881
29-Apr-91	6	1.0	29	4	91	20.5	5.0	8.3		1.991
29-Apr-91	6	1.5	29	4	91	19.5	5.0	6.6		2.212
29-Apr-91	6	2.0	29	4	91	19.5	5.5	7.6		2.592
29-Apr-91	6	2.5	29	4	91	20.0	6.0	7.5		2.862
29-Apr-91	6	3.0	29	4	91	19.0	5.5	5.2		2.698
29-Apr-91	6	3.5	29	4	91	18.0	6.0	3.2	7.2	3.282
29-Apr-91	7	0.0	29	4	91	21.5	3.0	9.7	8.1	0.246
29-Apr-91	7	0.5	29	4	91	21.5	3.0	9.7		0.246
29-Apr-91	7	1.0	29	4	91	20.0	3.0	8.1		0.585
29-Apr-91	7	1.5	29	4	91	20.0	3.5	6.9		0.965
29-Apr-91	7	2.0	29	4	91	19.5	3.5	7.0		1.072
29-Apr-91	7	2.5	29	4	91	19.5	3.5	6.3		1.072
29-Apr-91	7	3.0	29	4	91	18.5	4.0	3.2		1.657
29-Apr-91	7	3.5	29	4	91	18.0	4.5	1.1		2.137
29-Apr-91	7	4.0	29	4	91	17.5	6.0	0.6	7.4	3.379
29-Apr-91	7N	0.0	29	4	91	25.0	5.0	10.0	8.1	0.841
29-Apr-91	7N	0.5	29	4	91	24.5	5.0	10.0		0.982
29-Apr-91	7N	1.0	29	4	91	24.5	5.0	9.9		0.982
29-Apr-91	7N	1.5	29	4	91	24.5	5.0	9.9		0.982
29-Apr-91	7N	2.0	29	4	91	24.0	5.0	9.6		1.119
29-Apr-91	7N	2.5	29	4	91	22.0	5.5	8.9		2.014
29-Apr-91	7N	3.0	29	4	91	21.0	5.5	6.6		2.255
29-Apr-91	7N	3.5	29	4	91	19.5	6.0	2.9		2.972
29-Apr-91	7N	4.0	29	4	91	19.0	6.0	2.2		3.078
29-Apr-91	7N	4.5	29	4	91	18.5	6.0	0.8		3.181
29-Apr-91	7N	5.0	29	4	91	18.5	6.0	0.6	7.1	3.181
29-Apr-91	7S	0.0	29	4	91	21.5	4.0	9.1	7.7	1.002
29-Apr-91	7S	0.5	29	4	91	21.5	4.0	9.1		1.002
29-Apr-91	7S	1.0	29	4	91	21.0	4.0	9.0		1.119
29-Apr-91	7S	1.5	29	4	91	21.0	4.0	8.9		1.119
29-Apr-91	7S	2.0	29	4	91	21.0	4.0	8.9		1.119
29-Apr-91	7S	2.5	29	4	91	21.0	4.0	8.6	7.4	1.119
29-Apr-91	8	0.0	29	4	91	22.0	1.0	9.4	7.6	-1.384
29-Apr-91	8	0.5	29	4	91	21.5	1.0	9.4		-1.266
29-Apr-91	8	1.0	29	4	91	21.0	1.0	9.0		-1.152
29-Apr-91	8	1.5	29	4	91	20.0	2.0	7.0		-0.174
29-Apr-91	8	2.0	29	4	91	19.5	2.5	5.1		0.312
29-Apr-91	8	2.5	29	4	91	19.0	2.5	4.8		0.415
29-Apr-91	8	3.0	29	4	91	19.0	3.0	4.0	7.2	0.795
29-Apr-91	9N	0.0	29	4	91	23.0	1.5	10.0	7.9	-1.251
29-Apr-91	9N	0.5	29	4	91	23.0	1.5	9.9		-1.251
29-Apr-91	9N	1.0	29	4	91	22.6	1.5	9.0		-1.152
29-Apr-91	9N	1.5	29	4	91	22.0	1.8	7.6	7.6	-0.780
29-Apr-91	10	0.0	29	4	91	23.0	0.0	8.5	7.4	-2.381
29-Apr-91	10	0.5	29	4	91	22.5	0.0	8.5		-2.258
29-Apr-91	10	1.0	29	4	91	22.5	0.0	8.3		-2.258
29-Apr-91	10	1.5	29	4	91	22.5	0.0	7.8		-2.258
29-Apr-91	10	2.0	29	4	91	21.0	1.0	7.4		-1.152
29-Apr-91	10	2.5	29	4	91	21.0	2.0	8.3		-0.395

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
29-Apr-91	10	3.0	29	4	91	20.5	2.0	6.5		-0.283
29-Apr-91	10	3.5	29	4	91	20.0	2.0	5.7	7.0	-0.174
29-Apr-91	11	0.0	29	4	91	23.5	0.0	8.8	7.4	-2.507
29-Apr-91	11	0.5	29	4	91	23.5	0.0	8.8		-2.507
29-Apr-91	11	1.0	29	4	91	23.5	0.0	8.7		-2.507
29-Apr-91	11	1.5	29	4	91	23.0	0.0	8.4		-2.381
29-Apr-91	11	2.0	29	4	91	22.5	0.0	7.4	7.3	-2.258
29-Apr-91	12	0.0	29	4	91	23.0	0.0	7.4	7.2	-2.381
29-Apr-91	12	0.5	29	4	91	23.0	0.0	7.4		-2.381
29-Apr-91	12	1.0	29	4	91	22.5	0.0	7.3		-2.258
29-Apr-91	12	1.5	29	4	91	21.5	0.0	6.8		-2.022
29-Apr-91	12	2.0	29	4	91	20.0	0.0	6.1		-1.692
29-Apr-91	12	2.5	29	4	91	19.5	0.0	5.9		-1.588
29-Apr-91	12	3.0	29	4	91	19.5	0.0	6.0		-1.588
29-Apr-91	12	3.5	29	4	91	19.0	0.0	5.9	7.1	-1.488
13-May-91	1	S	13	5	91					
13-May-91	1	B	13	5	91					
13-May-91	1A	S	13	5	91					
13-May-91	1A	B	13	5	91					
13-May-91	2S	0.0	13	5	91	24.2	10.9	8.3	7.4	5.493
13-May-91	2S	0.5	13	5	91	23.8	10.9	8.3		5.606
13-May-91	2S	1.0	13	5	91	23.5	10.9	8.3		5.690
13-May-91	2S	1.5	13	5	91	23.5	10.9	8.3		5.690
13-May-91	2S	2.0	13	5	91	23.2	10.9	8.3		5.772
13-May-91	2S	2.5	13	5	91	23.2	10.8	8.3		5.697
13-May-91	2S	3.0	13	5	91	23.0	10.9	8.3		5.827
13-May-91	2S	3.5	13	5	91	23.0	10.9	8.3	7.4	5.827
13-May-91	3	0.0	13	5	91	24.5	8.5	8.7	7.4	3.607
13-May-91	3	0.5	13	5	91	23.5	8.5	8.7		3.885
13-May-91	3	1.0	13	5	91	23.5	8.5	8.6		3.885
13-May-91	3	1.5	13	5	91	23.2	8.5	8.7		3.966
13-May-91	3	2.0	13	5	91	23.2	8.5	8.6		3.966
13-May-91	3	2.5	13	5	91	23.2	8.5	8.6		3.966
13-May-91	3	3.0	13	5	91	23.2	8.5	8.7		3.966
13-May-91	3	3.5	13	5	91	23.0	8.5	8.7	7.3	4.020
13-May-91	4N	0.0	13	5	91	25.0	8.0	8.7	7.4	3.088
13-May-91	4N	0.5	13	5	91	23.9	8.0	8.7		3.400
13-May-91	4N	1.0	13	5	91	23.9	8.0	8.5		3.400
13-May-91	4N	1.5	13	5	91	23.8	8.0	8.5		3.427
13-May-91	4N	2.0	13	5	91	23.8	8.0	8.5		3.427
13-May-91	4N	2.5	13	5	91	23.6	8.0	8.3		3.482
13-May-91	4N	3.0	13	5	91	23.6	8.0	8.2		3.482
13-May-91	4N	3.5	13	5	91	23.5	8.0	8.0		3.509
13-May-91	4N	4.0	13	5	91	23.5	8.0	7.9		3.509
13-May-91	4N	4.5	13	5	91	23.5	8.0	7.7	7.3	3.509
13-May-91	4S	0.0	13	5	91	24.5	8.8	8.8	7.4	3.832
13-May-91	4S	0.5	13	5	91	23.5	8.8	8.8		4.111
13-May-91	4S	1.0	13	5	91	23.5	8.8	8.7		4.111
13-May-91	4S	1.5	13	5	91	23.2	8.8	8.8		4.192
13-May-91	4S	2.0	13	5	91	23.2	8.8	8.7		4.192

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
13-May-91	4S	2.5	13	5	91	23.0	8.8	8.6	7.5	4.245
13-May-91	4P	0.0	13	5	91	24.5	9.0	8.8	7.5	3.982
13-May-91	4P	0.5	13	5	91	24.2	8.9	8.8		3.992
13-May-91	4P	1.0	13	5	91	24.0	8.9	8.8		4.048
13-May-91	4P	1.5	13	5	91	24.0	8.9	8.8		4.048
13-May-91	4P	2.0	13	5	91	24.0	9.0	8.6		4.123
13-May-91	4P	2.5	13	5	91	23.9	9.0	8.4		4.151
13-May-91	4P	3.0	13	5	91	23.0	9.8	5.2	7.4	4.998
13-May-91	5	0.0	13	5	91	24.0	7.9	9.4	7.1	3.297
13-May-91	5	0.5	13	5	91	23.8	7.9	9.4		3.352
13-May-91	5	1.0	13	5	91	23.5	7.9	9.4		3.434
13-May-91	5	1.5	13	5	91	23.5	7.9	9.3		3.434
13-May-91	5	2.0	13	5	91	23.2	7.9	9.2		3.515
13-May-91	5	2.5	13	5	91	23.2	7.9	9.2		3.515
13-May-91	5	3.0	13	5	91	23.0	7.9	9.0		3.568
13-May-91	5	3.5	13	5	91	23.0	7.9	9.0		3.568
13-May-91	5	4.0	13	5	91	22.9	8.0	8.7		3.670
13-May-91	5	4.5	13	5	91	23.0	9.1	5.3	7.0	4.471
13-May-91	5N	0.0	13	5	91	25.0	7.0	8.5	7.3	2.339
13-May-91	5N	0.5	13	5	91	23.5	6.8	8.7		2.607
13-May-91	5N	1.0	13	5	91	23.2	6.8	8.7		2.687
13-May-91	5N	1.5	13	5	91	23.0	6.8	8.5		2.739
13-May-91	5N	2.0	13	5	91	23.0	6.8	8.5		2.739
13-May-91	5N	2.5	13	5	91	23.0	6.9	8.6		2.815
13-May-91	5N	3.0	13	5	91	23.0	6.9	8.5		2.815
13-May-91	5N	3.5	13	5	91	23.0	6.9	8.3	7.3	2.815
13-May-91	5S	0.0	13	5	91	24.0	7.0	8.8	7.4	2.621
13-May-91	5S	0.5	13	5	91	23.8	7.5	9.0		3.052
13-May-91	5S	1.0	13	5	91	23.5	7.5	8.8		3.133
13-May-91	5S	1.5	13	5	91	23.5	7.5	8.5		3.133
13-May-91	5S	2.0	13	5	91	23.2	7.5	8.3		3.214
13-May-91	5S	2.5	13	5	91	23.0	7.5	8.3		3.267
13-May-91	5S	3.0	13	5	91	23.0	8.0	8.0		3.643
13-May-91	5S	3.5	13	5	91	22.9	8.1	4.7	7.2	3.745
13-May-91	6	0.0	13	5	91	24.1	7.0	9.0	7.4	2.593
13-May-91	6	0.5	13	5	91	24.0	7.1	9.1		2.696
13-May-91	6	1.0	13	5	91	24.0	7.2	9.2		2.771
13-May-91	6	1.5	13	5	91	23.9	7.1	9.1		2.724
13-May-91	6	2.0	13	5	91	23.9	7.2	8.9		2.799
13-May-91	6	2.5	13	5	91	23.5	7.2	8.8		2.908
13-May-91	6	3.0	13	5	91	23.5	7.3	8.7		2.983
13-May-91	6	3.5	13	5	91	23.2	7.5	7.5		3.214
13-May-91	6	4.0	13	5	91	22.9	7.6	4.7	7.1	3.368
13-May-91	7	0.0	13	5	91	24.5	5.0	10.2	7.7	0.982
13-May-91	7	0.5	13	5	91	24.2	5.0	10.0		1.064
13-May-91	7	1.0	13	5	91	24.2	5.0	10.1		1.064
13-May-91	7	1.5	13	5	91	24.1	5.0	9.9		1.092
13-May-91	7	2.0	13	5	91	24.0	5.0	9.8		1.119
13-May-91	7	2.5	13	5	91	24.0	5.1	9.4		1.194
13-May-91	7	3.0	13	5	91	24.0	5.2	9.4		1.269

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
13-May-91	7	3.5	13	5	91	23.9	5.5	9.2	7.5	1.522
13-May-91	7N	0.0	13	5	91	25.0	5.1	8.4	7.3	0.916
13-May-91	7N	0.5	13	5	91	24.0	5.1	8.4		1.194
13-May-91	7N	1.0	13	5	91	24.0	5.1	8.4		1.194
13-May-91	7N	1.5	13	5	91	24.0	5.1	8.4		1.194
13-May-91	7N	2.0	13	5	91	24.0	5.1	8.3		1.194
13-May-91	7N	2.5	13	5	91	24.0	5.1	8.3		1.194
13-May-91	7N	3.0	13	5	91	23.9	5.5	7.2		1.522
13-May-91	7N	3.5	13	5	91	23.9	5.9	6.5	7.2	1.822
13-May-91	7S	0.0	13	5	91	25.0	7.1	8.8	7.4	2.414
13-May-91	7S	0.5	13	5	91	25.0	7.1	8.8		2.414
13-May-91	7S	1.0	13	5	91	24.9	7.0	8.7		2.368
13-May-91	7S	1.5	13	5	91	23.5	7.0	7.0		2.757
13-May-91	7S	2.0	13	5	91	23.0	7.0	6.3		2.890
13-May-91	7S	2.5	13	5	91	22.9	7.0	5.0		2.916
13-May-91	7S	3.0	13	5	91	22.8	7.1	3.8	7.2	3.018
13-May-91	8	0.0	13	5	91	24.5	3.8	9.7	7.6	0.082
13-May-91	8	0.5	13	5	91	24.5	3.8	9.7		0.082
13-May-91	8	1.0	13	5	91	24.2	3.8	9.7		0.164
13-May-91	8	1.5	13	5	91	24.2	3.8	9.5		0.164
13-May-91	8	2.0	13	5	91	24.1	3.8	8.8		0.191
13-May-91	8	2.5	13	5	91	23.9	4.0	8.3		0.395
13-May-91	8	3.0	13	5	91	23.0	4.1	5.2		0.706
13-May-91	8	3.5	13	5	91	23.0	6.2	3.5		2.288
13-May-91	8	4.0	13	5	91	23.0	6.5	3.4		2.514
13-May-91	8	4.5	13	5	91	23.0	6.5	3.4		2.514
13-May-91	8	5.0	13	5	91	23.0	6.5	3.4	7.1	2.514
13-May-91	9N	0.0	13	5	91	24.1	1.0	10.0	7.8	-1.911
13-May-91	9N	0.5	13	5	91	24.1	1.0	9.9		-1.911
13-May-91	9N	1.0	13	5	91	24.1	1.0	9.9		-1.911
13-May-91	9N	1.5	13	5	91	24.0	1.5	9.7		-1.510
13-May-91	9N	2.0	13	5	91	23.9	0.0	6.5		-2.610
13-May-91	9N	2.5	13	5	91	24.0	1.5	8.7	7.1	-1.510
13-May-91	9S	0.0	13	5	91	25.1	3.0	10.3	7.6	-0.685
13-May-91	9S	0.5	13	5	91	25.1	3.0	10.0		-0.685
13-May-91	9S	1.0	13	5	91	25.0	3.0	10.0		-0.657
13-May-91	9S	1.5	13	5	91	25.0	3.0	10.0		-0.657
13-May-91	9S	2.0	13	5	91	23.9	4.8	2.5		0.996
13-May-91	9S	2.5	13	5	91	23.0	5.0	1.6	7.1	1.384
13-May-91	10	0.0	13	5	91	25.0	0.8	11.8	8.4	-2.305
13-May-91	10	0.5	13	5	91	25.0	0.8	11.8		-2.305
13-May-91	10	1.0	13	5	91	24.9	0.9	11.5		-2.202
13-May-91	10	1.5	13	5	91	24.2	1.8	9.5		-1.338
13-May-91	10	2.0	13	5	91	23.9	3.5	5.2		0.019
13-May-91	10	2.5	13	5	91	23.5	3.5	4.5		0.125
13-May-91	10	3.0	13	5	91	23.5	3.6	4.2	7.2	0.200
13-May-91	11	S	13	5	91					
13-May-91	11	B	13	5	91					
13-May-91	12	S	13	5	91					
13-May-91	12	B	13	5	91					

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
04-Jun-91	1	0.0	4	6	91	28.8	13.0	7.7	7.9	5.600
04-Jun-91	1	0.5	4	6	91					
04-Jun-91	1	1.0	4	6	91	29.0	13.1	7.6		5.604
04-Jun-91	1	1.5	4	6	91					
04-Jun-91	1	2.0	4	6	91	29.0	13.1	7.6		5.604
04-Jun-91	1	2.5	4	6	91					
04-Jun-91	1	3.0	4	6	91	29.0	13.0	7.6		5.530
04-Jun-91	1	3.5	4	6	91					
04-Jun-91	1	4.0	4	6	91	29.0	13.0	7.5		5.530
04-Jun-91	1	4.5	4	6	91					
04-Jun-91	1	5.0	4	6	91	28.9	13.1	7.0	7.9	5.639
04-Jun-91	1A	0.0	4	6	91	28.8	10.0	7.7	7.8	3.376
04-Jun-91	1A	0.5	4	6	91					
04-Jun-91	1A	1.0	4	6	91	29.0	10.1	7.7		3.381
04-Jun-91	1A	1.5	4	6	91					
04-Jun-91	1A	2.0	4	6	91	29.0	10.1	7.7		3.381
04-Jun-91	1A	2.5	4	6	91					
04-Jun-91	1A	3.0	4	6	91	29.0	10.1	7.5		3.381
04-Jun-91	1A	3.5	4	6	91					
04-Jun-91	1A	4.0	4	6	91	29.0	10.1	7.3	7.7	3.381
04-Jun-91	2S	0.0	4	6	91	29.0	9.0	7.7	7.6	2.566
04-Jun-91	2S	0.5	4	6	91					
04-Jun-91	2S	1.0	4	6	91	29.0	9.5	7.7		2.937
04-Jun-91	2S	1.5	4	6	91					
04-Jun-91	2S	2.0	4	6	91	29.0	9.5	7.3		2.937
04-Jun-91	2S	2.5	4	6	91					
04-Jun-91	2S	3.0	4	6	91	29.0	9.5	6.8	7.7	2.937
04-Jun-91	3	0.0	4	6	91	29.1	9.5	8.2	8.0	2.902
04-Jun-91	3	0.5	4	6	91					
04-Jun-91	3	1.0	4	6	91	28.8	9.2	8.4		2.783
04-Jun-91	3	1.5	4	6	91					
04-Jun-91	3	2.0	4	6	91	28.8	9.2	8.2		2.783
04-Jun-91	3	2.5	4	6	91					
04-Jun-91	3	3.0	4	6	91	28.5	9.2	7.7	8.1	2.885
04-Jun-91	4N	0.0	4	6	91	28.8	10.0	7.4	7.9	3.376
04-Jun-91	4N	0.5	4	6	91					
04-Jun-91	4N	1.0	4	6	91	28.9	10.1	7.0		3.416
04-Jun-91	4N	1.5	4	6	91					
04-Jun-91	4N	2.0	4	6	91	28.0	11.0	4.2		4.389
04-Jun-91	4N	2.5	4	6	91					
04-Jun-91	4N	3.0	4	6	91	28.5	11.5	2.0	7.7	4.591
04-Jun-91	4S	0.0	4	6	91	29.0	8.5	7.8	8.1	2.196
04-Jun-91	4S	0.5	4	6	91					
04-Jun-91	4S	1.0	4	6	91	29.0	8.5	7.6		2.196
04-Jun-91	4S	1.5	4	6	91					
04-Jun-91	4S	2.0	4	6	91	28.9	8.5	7.2		2.230
04-Jun-91	4S	2.5	4	6	91	28.5	8.9	5.4	7.9	2.662
04-Jun-91	4P	0.0	4	6	91	29.0	9.0	7.7	8.0	2.566
04-Jun-91	4P	0.5	4	6	91					
04-Jun-91	4P	1.0	4	6	91	29.2	9.1	7.6		2.571

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
04-Jun-91	4P	1.5	4	6	91					
04-Jun-91	4P	2.0	4	6	91	29.0	9.0	6.5	7.0	2.566
04-Jun-91	5	0.0	4	6	91	29.0	8.5	7.2	7.9	2.196
04-Jun-91	5	0.5	4	6	91					
04-Jun-91	5	1.0	4	6	91	29.0	8.9	7.2		2.492
04-Jun-91	5	1.5	4	6	91					
04-Jun-91	5	2.0	4	6	91	29.0	8.9	7.0		2.492
04-Jun-91	5	2.5	4	6	91					
04-Jun-91	5	3.0	4	6	91	29.0	8.9	6.8		2.492
04-Jun-91	5	3.5	4	6	91					
04-Jun-91	5	4.0	4	6	91	28.0	11.1	1.4		4.463
04-Jun-91	5	4.5	4	6	91					
04-Jun-91	5	5.0	4	6	91	27.9	13.5	0.5	7.6	6.280
04-Jun-91	5N	0.0	4	6	91	28.9	9.9	6.8	7.8	3.268
04-Jun-91	5N	0.5	4	6	91					
04-Jun-91	5N	1.0	4	6	91	29.1	9.9	6.6		3.199
04-Jun-91	5N	1.5	4	6	91					
04-Jun-91	5N	2.0	4	6	91	28.9	10.1	4.0		3.416
04-Jun-91	5N	2.5	4	6	91					
04-Jun-91	5N	3.0	4	6	91	28.0	11.5	1.2	7.6	4.761
04-Jun-91	5S	0.0	4	6	91	29.0	7.5	8.5	8.0	1.455
04-Jun-91	5S	0.5	4	6	91					
04-Jun-91	5S	1.0	4	6	91	29.5	7.5	8.3		1.283
04-Jun-91	5S	1.5	4	6	91					
04-Jun-91	5S	2.0	4	6	91	29.0	7.5	8.5		1.455
04-Jun-91	5S	2.5	4	6	91					
04-Jun-91	5S	3.0	4	6	91	28.0	7.8	7.2	7.9	2.012
04-Jun-91	6	0.0	4	6	91	29.0	7.2	8.0	8.0	1.232
04-Jun-91	6	0.5	4	6	91					
04-Jun-91	6	1.0	4	6	91	28.5	7.5	8.2		1.623
04-Jun-91	6	1.5	4	6	91					
04-Jun-91	6	2.0	4	6	91	29.0	7.5	7.6		1.455
04-Jun-91	6	2.5	4	6	91					
04-Jun-91	6	3.0	4	6	91	28.9	7.5	6.5		1.489
04-Jun-91	6	3.5	4	6	91					
04-Jun-91	6	4.0	4	6	91	28.0	8.5	2.2		2.532
04-Jun-91	6	4.5	4	6	91	25.8	8.5	0.5	7.6	3.226
04-Jun-91	7	0.0	4	6	91	28.2	6.5	7.5	7.5	0.980
04-Jun-91	7	0.5	4	6	91					
04-Jun-91	7	1.0	4	6	91	28.9	6.5	7.5		0.748
04-Jun-91	7	1.5	4	6	91					
04-Jun-91	7	2.0	4	6	91	28.9	6.5	7.2		0.748
04-Jun-91	7	2.5	4	6	91					
04-Jun-91	7	3.0	4	6	91	26.9	9.9	0.2	7.4	3.930
04-Jun-91	7N	0.0	4	6	91	29.9	8.5	6.2	7.9	1.883
04-Jun-91	7N	0.5	4	6	91					
04-Jun-91	7N	1.0	4	6	91	29.0	9.5	4.0		2.937
04-Jun-91	7N	1.5	4	6	91					
04-Jun-91	7N	2.0	4	6	91	28.0	10.9	0.5		4.315
04-Jun-91	7N	2.5	4	6	91					

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
04-Jun-91	7N	3.0	4	6	91	27.8	11.1	0.1		4.530
04-Jun-91	7N	3.5	4	6	91					
04-Jun-91	7N	4.0	4	6	91	27.2	11.1	0.1	7.6	4.727
04-Jun-91	7S	0.0	4	6	91	28.8	7.0	7.5	7.7	1.152
04-Jun-91	7S	0.5	4	6	91					
04-Jun-91	7S	1.0	4	6	91	29.0	7.0	7.4		1.084
04-Jun-91	7S	1.5	4	6	91					
04-Jun-91	7S	2.0	4	6	91	28.9	7.0	6.5		1.118
04-Jun-91	7S	2.5	4	6	91					
04-Jun-91	7S	3.0	4	6	91	26.5	8.0	2.0	7.4	2.638
04-Jun-91	8	0.0	4	6	91	28.9	6.0	7.3	7.6	0.377
04-Jun-91	8	0.5	4	6	91					
04-Jun-91	8	1.0	4	6	91	28.9	6.0	7.2		0.377
04-Jun-91	8	1.5	4	6	91					
04-Jun-91	8	2.0	4	6	91	28.5	6.2	3.6		0.659
04-Jun-91	8	2.5	4	6	91					
04-Jun-91	8	3.0	4	6	91	26.8	9.5	0.3	7.5	3.663
04-Jun-91	9N	0.0	4	6	91	29.8	6.5	7.0	7.7	0.439
04-Jun-91	9N	0.5	4	6	91					
04-Jun-91	9N	1.0	4	6	91	28.8	6.5	6.8		0.781
04-Jun-91	9N	1.5	4	6	91					
04-Jun-91	9N	2.0	4	6	91	28.0	8.8	0.3	7.5	2.755
04-Jun-91	9S	0.0	4	6	91	27.3	4.5	7.8	7.6	-0.219
04-Jun-91	9S	0.5	4	6	91					
04-Jun-91	9S	1.0	4	6	91	27.9	4.8	7.4		-0.185
04-Jun-91	9S	1.5	4	6	91					
04-Jun-91	9S	2.0	4	6	91	27.1	6.5	0.7		1.333
04-Jun-91	9S	2.5	4	6	91					
04-Jun-91	9S	3.0	4	6	91	26.1	8.5	0.1	7.3	3.135
04-Jun-91	10	0.0	4	6	91	28.0	4.0	7.4	7.4	-0.812
04-Jun-91	10	0.5	4	6	91					
04-Jun-91	10	1.0	4	6	91	28.2	4.0	7.0		-0.876
04-Jun-91	10	1.5	4	6	91					
04-Jun-91	10	2.0	4	6	91	27.5	5.1	0.3		0.165
04-Jun-91	10	2.5	4	6	91					
04-Jun-91	10	3.0	4	6	91	26.5	8.1	0.1	7.2	2.713
04-Jun-91	11	0.0	4	6	91	28.5	3.1	7.2	7.2	-1.642
04-Jun-91	11	0.5	4	6	91					
04-Jun-91	11	1.0	4	6	91	28.5	3.2	6.7		-1.567
04-Jun-91	11	1.5	4	6	91					
04-Jun-91	11	2.0	4	6	91	27.0	6.2	0.3	7.1	1.141
04-Jun-91	12	0.0	4	6	91	28.8	2.2	6.0	7.3	-2.407
04-Jun-91	12	0.5	4	6	91					
04-Jun-91	12	1.0	4	6	91	27.6	2.2	5.8		-2.024
04-Jun-91	12	1.5	4	6	91					
04-Jun-91	12	2.0	4	6	91	27.1	5.0	0.3	7.1	0.216
25-Jun-91	1	S	25	6	91					
25-Jun-91	1	B	25	6	91					
25-Jun-91	1A	S	25	6	91					
25-Jun-91	1A	B	25	6	91					

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
25-Jun-91	2S	S	25	6	91					
25-Jun-91	2S	B	25	6	91					
25-Jun-91	3	0.0	25	6	91	25.0	12.0	6.5	7.8	6.084
25-Jun-91	3	0.5	25	6	91	25.5	12.0	6.4		5.933
25-Jun-91	3	1.0	25	6	91	25.5	11.8	6.4		5.784
25-Jun-91	3	1.5	25	6	91	25.1	11.8	6.4		5.904
25-Jun-91	3	2.0	25	6	91	25.1	11.8	6.4	7.7	5.904
25-Jun-91	4N	0.0	25	6	91	25.5	12.0	6.0	7.5	5.933
25-Jun-91	4N	0.5	25	6	91	25.5	12.0	5.9		5.933
25-Jun-91	4N	1.0	25	6	91	25.5	12.0	5.8		5.933
25-Jun-91	4N	1.5	25	6	91	25.1	12.0	5.4		6.054
25-Jun-91	4N	2.0	25	6	91	25.1	12.0	4.2	7.5	6.054
25-Jun-91	4S	0.0	25	6	91	25.0	10.5	6.5	7.8	4.961
25-Jun-91	4S	0.5	25	6	91	25.1	10.1	6.5		4.632
25-Jun-91	4S	1.0	25	6	91	25.0	10.5	6.5		4.961
25-Jun-91	4S	1.5	25	6	91	25.0	10.0	6.5		4.586
25-Jun-91	4S	2.0	25	6	91	25.1	10.5	6.5		4.931
25-Jun-91	4S	2.5	25	6	91	25.0	10.0	6.4		4.586
25-Jun-91	4S	3.0	25	6	91	25.0	10.0	6.1	7.7	4.586
25-Jun-91	4P	0.0	25	6	91	25.5	9.8	6.7	7.8	4.288
25-Jun-91	4P	0.5	25	6	91	25.1	9.5	6.7		4.182
25-Jun-91	4P	1.0	25	6	91	25.5	9.5	6.6		4.063
25-Jun-91	4P	1.5	25	6	91	26.0	9.8	6.7		4.136
25-Jun-91	4P	2.0	25	6	91	26.0	9.5	6.5	7.7	3.912
25-Jun-91	5	0.0	25	6	91	25.0	10.9	6.2	7.8	5.260
25-Jun-91	5	0.5	25	6	91	25.0	11.0	6.2		5.335
25-Jun-91	5	1.0	25	6	91	25.5	11.0	6.1		5.185
25-Jun-91	5	1.5	25	6	91	25.5	10.9	6.2		5.111
25-Jun-91	5	2.0	25	6	91	25.1	10.9	6.2		5.231
25-Jun-91	5	2.5	25	6	91	25.5	11.0	6.1		5.185
25-Jun-91	5	3.0	25	6	91	25.5	10.9	6.1		5.111
25-Jun-91	5	3.5	25	6	91	25.0	10.8	6.2		5.185
25-Jun-91	5	4.0	25	6	91	25.1	11.0	6.2	7.7	5.305
25-Jun-91	5N	0.0	25	6	91	25.5	11.0	5.8	7.5	5.185
25-Jun-91	5N	0.5	25	6	91	26.0	11.0	5.8		5.033
25-Jun-91	5N	1.0	25	6	91	26.0	11.0	5.8		5.033
25-Jun-91	5N	1.5	25	6	91	26.5	11.0	5.6		4.876
25-Jun-91	5N	2.0	25	6	91	26.0	11.0	5.5		5.033
25-Jun-91	5N	2.5	25	6	91	25.5	11.0	4.6	7.4	5.185
25-Jun-91	5S	0.0	25	6	91	25.0	10.0	6.4	7.9	4.586
25-Jun-91	5S	0.5	25	6	91	25.0	10.0	6.3		4.586
25-Jun-91	5S	1.0	25	6	91	25.1	10.0	6.4		4.557
25-Jun-91	5S	1.5	25	6	91	25.1	9.8	6.4		4.407
25-Jun-91	5S	2.0	25	6	91	26.0	10.0	6.2	7.8	4.286
25-Jun-91	6	0.0	25	6	91	24.0	8.8	7.3	8.0	3.973
25-Jun-91	6	0.5	25	6	91	25.1	9.0	7.0		3.808
25-Jun-91	6	1.0	25	6	91	25.5	8.9	6.8		3.615
25-Jun-91	6	1.5	25	6	91	25.5	9.0	6.6		3.689
25-Jun-91	6	2.0	25	6	91	25.0	9.1	6.3		3.912
25-Jun-91	6	2.5	25	6	91	25.1	9.0	6.1	7.9	3.808

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
25-Jun-91	7	0.0	25	6	91	25.1	9.8	5.8	7.6	4.407
25-Jun-91	7	0.5	25	6	91	25.1	9.7	5.8		4.332
25-Jun-91	7	1.0	25	6	91	25.1	9.8	5.8		4.407
25-Jun-91	7	1.5	25	6	91	25.1	9.9	5.8		4.482
25-Jun-91	7	2.0	25	6	91	25.0	9.8	5.8		4.436
25-Jun-91	7	2.5	25	6	91	25.0	9.8	5.8		4.436
25-Jun-91	7	3.0	25	6	91	25.1	9.7	5.9	7.6	4.332
25-Jun-91	7N	0.0	25	6	91	27.0	9.9	6.7	7.5	3.898
25-Jun-91	7N	0.5	25	6	91	27.0	10.0	6.6		3.972
25-Jun-91	7N	1.0	25	6	91	26.5	10.0	6.4		4.130
25-Jun-91	7N	1.5	25	6	91	26.5	10.0	5.7		4.130
25-Jun-91	7N	2.0	25	6	91	26.0	10.0	5.5		4.286
25-Jun-91	7N	2.5	25	6	91	25.5	10.0	4.8		4.437
25-Jun-91	7N	3.0	25	6	91	25.1	10.1	2.4	7.7	4.632
25-Jun-91	7S	0.0	25	6	91	25.0	7.8	7.6	7.8	2.938
25-Jun-91	7S	0.5	25	6	91	25.1	7.5	7.6		2.685
25-Jun-91	7S	1.0	25	6	91	25.0	8.8	6.5		3.687
25-Jun-91	7S	1.5	25	6	91	25.0	8.8	6.6		3.687
25-Jun-91	7S	2.0	25	6	91	25.1	8.8	6.6		3.658
25-Jun-91	7S	2.5	25	6	91	25.5	8.8	6.6		3.540
25-Jun-91	7S	3.0	25	6	91	25.1	8.8	6.9	7.6	3.658
25-Jun-91	8	0.0	25	6	91	25.0	7.1	6.7	7.7	2.414
25-Jun-91	8	0.5	25	6	91	25.1	7.2	6.5		2.460
25-Jun-91	8	1.0	25	6	91	25.1	7.0	6.5		2.310
25-Jun-91	8	1.5	25	6	91	26.0	7.0	6.5		2.045
25-Jun-91	8	2.0	25	6	91	26.0	7.1	6.3	7.7	2.119
25-Jun-91	9N	0.0	25	6	91	25.5	6.0	4.9	7.4	1.445
25-Jun-91	9N	0.5	25	6	91					
25-Jun-91	9N	1.0	25	6	91	26.0	5.0	4.9		0.551
25-Jun-91	9N	1.5	25	6	91	25.8	5.3	4.8		0.834
25-Jun-91	9N	2.0	25	6	91	25.8	5.3	4.7		0.834
25-Jun-91	9N	2.5	25	6	91	25.8	5.3	4.7	7.5	0.834
25-Jun-91	9S	0.0	25	6	91	25.0	5.8	7.0	7.8	1.440
25-Jun-91	9S	0.5	25	6	91	25.0	5.8	6.9		1.440
25-Jun-91	9S	1.0	25	6	91	25.0	5.8	6.9		1.440
25-Jun-91	9S	1.5	25	6	91	25.0	5.8	6.9		1.440
25-Jun-91	9S	2.0	25	6	91	25.0	5.8	6.9	7.6	1.440
25-Jun-91	10	0.0	25	6	91	27.5	5.0	7.9	7.7	0.091
25-Jun-91	10	0.5	25	6	91	27.5	5.0	7.8		0.091
25-Jun-91	10	1.0	25	6	91	27.0	5.0	7.7		0.247
25-Jun-91	10	1.5	25	6	91	27.0	5.0	7.5		0.247
25-Jun-91	10	2.0	25	6	91	27.0	5.0	6.2		0.247
25-Jun-91	10	2.5	25	6	91	27.0	5.1	5.5	7.9	0.322
25-Jun-91	11	0.0	25	6	91	26.0	3.0	8.0	7.8	-0.943
25-Jun-91	11	0.5	25	6	91	26.8	3.0	8.0		-1.182
25-Jun-91	11	1.0	25	6	91	27.0	3.1	7.1		-1.168
25-Jun-91	11	1.5	25	6	91	26.5	3.5	5.3	7.8	-0.719
25-Jun-91	12	0.0	25	6	91	20.0	3.0	10.0	7.7	0.585
25-Jun-91	12	0.5	25	6	91	16.0	3.0	9.6		1.349
25-Jun-91	12	1.0	25	6	91	16.0	3.1	7.1		1.426

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
25-Jun-91	12	1.5	25	6	91	20.9	3.8	6.0		0.991
25-Jun-91	12	2.0	25	6	91	20.9	4.0	4.6		1.142
25-Jun-91	12	2.5	25	6	91	21.0	4.0	4.4	8.3	1.119
09-Jul-91	1	0.0	9	7	91	30.0	14.9	8.5	8.0	6.577
09-Jul-91	1	0.5	9	7	91	29.5	14.5	8.8		6.463
09-Jul-91	1	1.0	9	7	91	29.2	14.1	8.6		6.274
09-Jul-91	1	1.5	9	7	91	29.1	14.2	8.6		6.384
09-Jul-91	1	2.0	9	7	91	29.1	14.5	8.5		6.606
09-Jul-91	1	2.5	9	7	91	29.0	14.9	8.2		6.938
09-Jul-91	1	3.0	9	7	91	29.0	15.0	7.7		7.012
09-Jul-91	1	3.5	9	7	91	28.5	17.1	6.3		8.746
09-Jul-91	1	4.0	9	7	91	28.1	17.5	5.9		9.184
09-Jul-91	1	4.5	9	7	91	28.1	17.5	5.8		9.184
09-Jul-91	1	5.0	9	7	91	27.1	17.5	5.8	7.7	9.526
09-Jul-91	1A	0.0	9	7	91	30.0	12.5	9.1	8.0	4.803
09-Jul-91	1A	0.5	9	7	91	30.0	12.5	9.5		4.803
09-Jul-91	1A	1.0	9	7	91	29.8	12.1	9.4		4.580
09-Jul-91	1A	1.5	9	7	91	29.5	12.1	9.2		4.687
09-Jul-91	1A	2.0	9	7	91	29.2	12.1	9.0		4.793
09-Jul-91	1A	2.5	9	7	91	29.0	12.1	9.0		4.863
09-Jul-91	1A	3.0	9	7	91	29.0	12.1	8.7		4.863
09-Jul-91	1A	3.5	9	7	91	29.0	12.5	8.3		5.160
09-Jul-91	1A	4.0	9	7	91	28.0	16.5	4.1	7.9	8.476
09-Jul-91	2S	0.0	9	7	91	31.0	11.1	9.9	8.2	3.402
09-Jul-91	2S	0.5	9	7	91	31.0	11.0	10.0		3.328
09-Jul-91	2S	1.0	9	7	91	30.5	11.0	10.0		3.513
09-Jul-91	2S	1.5	9	7	91	30.0	11.0	10.0		3.695
09-Jul-91	2S	2.0	9	7	91	30.0	11.0	9.5		3.695
09-Jul-91	2S	2.5	9	7	91	30.0	11.0	9.2	8.1	3.695
09-Jul-91	3	0.0	9	7	91	30.0	10.9	8.6	7.9	3.621
09-Jul-91	3	0.5	9	7	91	30.0	10.9	8.4		3.621
09-Jul-91	3	1.0	9	7	91	29.8	10.9	8.0		3.693
09-Jul-91	3	1.5	9	7	91	29.8	10.8	8.0		3.619
09-Jul-91	3	2.0	9	7	91	29.5	10.6	7.8	7.8	3.577
09-Jul-91	4N	0.0	9	7	91	31.0	11.1	8.2	7.5	3.402
09-Jul-91	4N	0.5	9	7	91	30.0	11.1	7.0		3.769
09-Jul-91	4N	1.0	9	7	91	29.0	11.5	6.5		4.419
09-Jul-91	4N	1.5	9	7	91	29.0	12.0	6.1		4.789
09-Jul-91	4N	2.0	9	7	91	29.0	12.1	5.1	7.4	4.863
09-Jul-91	4S	0.0	9	7	91	30.0	11.0	9.1	7.9	3.695
09-Jul-91	4S	0.5	9	7	91	30.0	11.0	9.1		3.695
09-Jul-91	4S	1.0	9	7	91	30.0	11.0	8.1		3.695
09-Jul-91	4S	1.5	9	7	91	29.8	11.1	6.5		3.840
09-Jul-91	4S	2.0	9	7	91	29.0	12.0	1.5		4.789
09-Jul-91	4S	2.5	9	7	91	29.0	12.2	0.4	7.4	4.937
09-Jul-91	4P	0.0	9	7	91	30.0	10.0	8.5	7.6	2.956
09-Jul-91	4P	0.5	9	7	91	30.0	10.0	8.1		2.956
09-Jul-91	4P	1.0	9	7	91	29.0	10.0	7.5		3.307
09-Jul-91	4P	1.5	9	7	91	30.0	10.0	7.0		2.956
09-Jul-91	4P	2.0	9	7	91	30.0	10.0	6.0	7.5	2.956

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
09-Jul-91	5	0.0	9	7	91	29.8	9.5	8.5	7.8	2.657
09-Jul-91	5	0.5	9	7	91	30.0	9.1	8.5		2.291
09-Jul-91	5	1.0	9	7	91	29.2	9.1	8.1		2.571
09-Jul-91	5	1.5	9	7	91	29.0	9.1	7.9		2.640
09-Jul-91	5	2.0	9	7	91	29.0	9.5	7.5		2.937
09-Jul-91	5	2.5	9	7	91	29.0	9.5	7.5		2.937
09-Jul-91	5	3.0	9	7	91	29.0	11.0	1.8		4.048
09-Jul-91	5	3.5	9	7	91	28.0	14.5	0.8		6.990
09-Jul-91	5	4.0	9	7	91	28.0	14.0	0.5	7.4	6.618
09-Jul-91	5N	0.0	9	7	91	30.5	10.0	8.5	7.8	2.775
09-Jul-91	5N	0.5	9	7	91	30.0	10.1	8.5		3.030
09-Jul-91	5N	1.0	9	7	91	29.5	10.1	8.2		3.207
09-Jul-91	5N	1.5	9	7	91	29.1	10.2	7.3		3.421
09-Jul-91	5N	2.0	9	7	91	29.0	10.9	5.2	7.5	3.974
09-Jul-91	5S	0.0	9	7	91	29.8	9.1	9.1	8.0	2.362
09-Jul-91	5S	0.5	9	7	91	30.0	9.1	9.1		2.291
09-Jul-91	5S	1.0	9	7	91	30.0	9.1	9.0		2.291
09-Jul-91	5S	1.5	9	7	91	30.0	9.1	9.0		2.291
09-Jul-91	5S	2.0	9	7	91	30.0	9.1	9.0		2.291
09-Jul-91	5S	2.5	9	7	91	30.0	9.5	8.0	8.0	2.586
09-Jul-91	6	0.0	9	7	91	30.0	9.1	9.0	8.1	2.291
09-Jul-91	6	0.5	9	7	91	30.1	9.1	9.2		2.255
09-Jul-91	6	1.0	9	7	91	30.0	9.0	8.4		2.217
09-Jul-91	6	1.5	9	7	91	30.0	9.0	8.0		2.217
09-Jul-91	6	2.0	9	7	91	30.0	9.0	8.0		2.217
09-Jul-91	6	2.5	9	7	91	30.0	9.0	8.0	7.9	2.217
09-Jul-91	7	0.0	9	7	91	29.0	8.5	8.5	7.8	2.196
09-Jul-91	7	0.5	9	7	91	30.0	8.5	8.2		1.847
09-Jul-91	7	1.0	9	7	91	30.0	8.5	8.3		1.847
09-Jul-91	7	1.5	9	7	91	30.0	8.5	8.3		1.847
09-Jul-91	7	2.0	9	7	91	30.0	8.5	7.8		1.847
09-Jul-91	7	2.5	9	7	91	28.9	8.0	1.8		1.859
09-Jul-91	7	3.0	9	7	91	28.0	12.5	0.5	7.5	5.504
09-Jul-91	7N	0.0	9	7	91	31.0	9.1	9.0	7.9	1.928
09-Jul-91	7N	0.5	9	7	91	31.0	9.1	8.3		1.928
09-Jul-91	7N	1.0	9	7	91	29.1	9.8	5.8		3.125
09-Jul-91	7N	1.5	9	7	91	29.0	10.0	4.8		3.307
09-Jul-91	7N	2.0	9	7	91	29.0	10.9	2.6		3.974
09-Jul-91	7N	2.5	9	7	91	28.5	11.0	2.2		4.220
09-Jul-91	7N	3.0	9	7	91	28.5	11.5	1.4	7.4	4.591
09-Jul-91	7S	0.0	9	7	91	30.0	8.2	8.9	7.9	1.626
09-Jul-91	7S	0.5	9	7	91	30.0	8.1	8.9		1.552
09-Jul-91	7S	1.0	9	7	91	30.0	8.1	8.8		1.552
09-Jul-91	7S	1.5	9	7	91	30.0	8.2	8.6		1.626
09-Jul-91	7S	2.0	9	7	91	30.0	8.2	8.4		1.626
09-Jul-91	7S	2.5	9	7	91	28.0	10.0	0.6	7.9	3.646
09-Jul-91	8	0.0	9	7	91	29.0	7.5	7.8	7.7	1.455
09-Jul-91	8	0.5	9	7	91	30.0	7.5	7.8		1.108
09-Jul-91	8	1.0	9	7	91	29.8	7.8	8.1		1.400
09-Jul-91	8	1.5	9	7	91	29.8	8.0	5.5	7.6	1.548

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
09-Jul-91	9N	0.0	9	7	91	29.8	5.9	7.9	7.5	-0.004
09-Jul-91	9N	0.5	9	7	91	28.3	7.0	3.4		1.319
09-Jul-91	9N	1.0	9	7	91	26.5	10.9	0.6		4.802
09-Jul-91	9N	1.5	9	7	91	28.1	10.8	0.5		4.207
09-Jul-91	9N	2.0	9	7	91	28.0	10.8	0.5	7.3	4.241
09-Jul-91	9S	0.0	9	7	91	29.9	6.3	8.5	7.7	0.256
09-Jul-91	9S	0.5	9	7	91	29.5	6.5	8.3		0.543
09-Jul-91	9S	1.0	9	7	91	29.0	7.5	5.2		1.455
09-Jul-91	9S	1.5	9	7	91	28.0	9.5	0.5		3.275
09-Jul-91	9S	2.0	9	7	91	28.0	11.0	0.2	7.4	4.389
09-Jul-91	10	0.0	9	7	91	32.0	5.9	10.5	8.1	-0.799
09-Jul-91	10	0.5	9	7	91	30.0	6.0	12.1		-0.000
09-Jul-91	10	1.0	9	7	91	29.0	6.5	3.1		0.714
09-Jul-91	10	1.5	9	7	91	28.5	9.5	1.1		3.107
09-Jul-91	10	2.0	9	7	91	28.2	10.0	0.8		3.579
09-Jul-91	10	2.5	9	7	91	28.1	10.0	0.3	7.4	3.613
09-Jul-91	11	0.0	9	7	91	32.0	5.0	11.0	8.3	-1.461
09-Jul-91	11	0.5	9	7	91	31.0	6.0	8.6		-0.357
09-Jul-91	11	1.0	9	7	91	28.5	9.0	0.7	7.4	2.736
09-Jul-91	12	0.0	9	7	91	32.0	3.9	16.1	8.3	-2.269
09-Jul-91	12	0.5	9	7	91	29.0	7.0	4.5		1.084
09-Jul-91	12	1.0	9	7	91	28.8	7.9	3.7		1.819
09-Jul-91	12	1.5	9	7	91	28.1	7.9	2.1	7.4	2.053
24-Jul-91	1	S	24	7	91					
24-Jul-91	1	B	24	7	91					
24-Jul-91	1A	S	24	7	91					
24-Jul-91	1A	B	24	7	91					
24-Jul-91	2S	S	24	7	91					
24-Jul-91	2S	B	24	7	91					
24-Jul-91	3	0.0	24	7	91	30.0	11.9	10.1	8.0	4.360
24-Jul-91	3	0.5	24	7	91	30.0	11.9	9.0		4.360
24-Jul-91	3	1.0	24	7	91	29.5	11.9	8.1		4.539
24-Jul-91	3	1.5	24	7	91	29.1	12.0	7.0		4.754
24-Jul-91	3	2.0	24	7	91	29.1	12.0	6.5	7.8	4.754
24-Jul-91	4N	0.0	24	7	91	30.0	10.8	7.0	7.6	3.547
24-Jul-91	4N	0.5	24	7	91	30.0	10.8	7.0		3.547
24-Jul-91	4N	1.0	24	7	91	29.5	10.5	6.6		3.503
24-Jul-91	4N	1.5	24	7	91	29.0	10.5	6.2		3.678
24-Jul-91	4N	2.0	24	7	91	29.0	10.2	5.7	7.6	3.455
24-Jul-91	4S	0.0	24	7	91	29.9	11.5	7.0	7.9	4.100
24-Jul-91	4S	0.5	24	7	91	29.5	11.5	7.0		4.243
24-Jul-91	4S	1.0	24	7	91	29.1	11.2	6.4		4.162
24-Jul-91	4S	1.5	24	7	91	29.5	11.8	6.3		4.465
24-Jul-91	4S	2.0	24	7	91	29.0	11.9	4.4	7.8	4.715
24-Jul-91	4P	0.0	24	7	91	30.0	11.5	7.0	7.8	4.064
24-Jul-91	4P	0.5	24	7	91	30.0	11.5	7.0		4.064
24-Jul-91	4P	1.0	24	7	91	30.0	11.5	6.7		4.064
24-Jul-91	4P	1.5	24	7	91	29.1	11.5	4.1		4.384
24-Jul-91	4P	2.0	24	7	91	29.0	12.0	2.4	7.7	4.789
24-Jul-91	5	0.0	24	7	91	30.0	10.8	6.9	7.8	3.547

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
24-Jul-91	5	0.5	24	7	91	30.0	10.8	7.0		3.547
24-Jul-91	5	1.0	24	7	91	30.0	10.8	7.1		3.547
24-Jul-91	5	1.5	24	7	91	30.0	10.9	7.0		3.621
24-Jul-91	5	2.0	24	7	91	29.8	11.0	6.9		3.766
24-Jul-91	5	2.5	24	7	91	29.5	11.0	6.7		3.873
24-Jul-91	5	3.0	24	7	91	29.1	11.0	5.9		4.014
24-Jul-91	5	3.5	24	7	91	29.0	11.0	5.8		4.048
24-Jul-91	5	4.0	24	7	91	29.0	11.0	4.9	7.7	4.048
24-Jul-91	5N	0.0	24	7	91	30.0	10.0	6.6	7.7	2.956
24-Jul-91	5N	0.5	24	7	91	30.0	10.2	6.4		3.104
24-Jul-91	5N	1.0	24	7	91	30.0	10.2	6.4		3.104
24-Jul-91	5N	1.5	24	7	91	30.0	10.2	6.4		3.104
24-Jul-91	5N	2.0	24	7	91	30.0	10.2	6.2	7.7	3.104
24-Jul-91	5S	0.0	24	7	91	29.8	10.8	6.9	7.8	3.619
24-Jul-91	5S	0.5	24	7	91	29.5	10.8	7.0		3.725
24-Jul-91	5S	1.0	24	7	91	29.2	10.5	6.8		3.608
24-Jul-91	5S	1.5	24	7	91	29.0	10.5	6.4		3.678
24-Jul-91	5S	2.0	24	7	91	29.0	10.5	6.2		3.678
24-Jul-91	5S	2.5	24	7	91	29.0	10.5	5.8		3.678
24-Jul-91	5S	3.0	24	7	91	29.0	11.0	2.8	7.7	4.048
24-Jul-91	6	0.0	24	7	91	29.5	10.0	6.7	7.8	3.133
24-Jul-91	6	0.5	24	7	91	29.2	10.0	6.6		3.238
24-Jul-91	6	1.0	24	7	91	29.0	10.0	6.4		3.307
24-Jul-91	6	1.5	24	7	91	29.0	10.0	6.0		3.307
24-Jul-91	6	2.0	24	7	91	29.0	10.0	5.6		3.307
24-Jul-91	6	2.5	24	7	91	28.8	10.1	3.8		3.450
24-Jul-91	6	3.0	24	7	91	28.5	10.5	2.3		3.849
24-Jul-91	6	3.5	24	7	91	28.2	11.0	1.5	7.5	4.322
24-Jul-91	7	0.0	24	7	91	30.0	9.8	7.0	8.0	2.808
24-Jul-91	7	0.5	24	7	91	30.0	9.8	7.0		2.808
24-Jul-91	7	1.0	24	7	91	30.0	9.5	6.5		2.586
24-Jul-91	7	1.5	24	7	91	29.5	9.5	6.4		2.763
24-Jul-91	7	2.0	24	7	91	29.5	9.5	6.3		2.763
24-Jul-91	7	2.5	24	7	91	29.5	9.5	5.5		2.763
24-Jul-91	7	3.0	24	7	91	29.2	9.5	5.0	7.8	2.868
24-Jul-91	7N	0.0	24	7	91	31.0	9.0	6.6	7.7	1.854
24-Jul-91	7N	0.5	24	7	91	31.0	9.0	6.7		1.854
24-Jul-91	7N	1.0	24	7	91	31.0	9.0	6.7		1.854
24-Jul-91	7N	1.5	24	7	91	31.0	9.0	6.7		1.854
24-Jul-91	7N	2.0	24	7	91	31.0	9.0	6.6	7.6	1.854
24-Jul-91	7S	0.0	24	7	91	29.0	10.0	5.2	7.7	3.307
24-Jul-91	7S	0.5	24	7	91	29.0	10.0	4.6		3.307
24-Jul-91	7S	1.0	24	7	91	28.5	10.0	2.6		3.478
24-Jul-91	7S	1.5	24	7	91	28.5	10.1	1.8		3.552
24-Jul-91	7S	2.0	24	7	91	28.2	10.1	1.5	7.4	3.654
24-Jul-91	8	0.0	24	7	91	30.0	8.0	6.5	7.9	1.478
24-Jul-91	8	0.5	24	7	91	30.0	7.9	6.3		1.404
24-Jul-91	8	1.0	24	7	91	29.9	7.9	5.5	7.8	1.439
24-Jul-91	9N	0.0	24	7	91	30.0	6.5	6.3	7.9	0.369
24-Jul-91	9N	0.5	24	7	91	31.0	6.5	6.0	7.8	0.012

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
24-Jul-91	9S	0.0	24	7	91	29.8	7.8	5.8	7.7	1.400
24-Jul-91	9S	0.5	24	7	91	29.8	7.8	5.6		1.400
24-Jul-91	9S	1.0	24	7	91	29.0	8.0	3.7		1.825
24-Jul-91	9S	1.5	24	7	91	27.5	8.0	3.0	7.5	2.323
24-Jul-91	10	0.0	24	7	91	30.0	7.0	7.1	8.0	0.739
24-Jul-91	10	0.5	24	7	91	29.9	7.0	7.0		0.774
24-Jul-91	10	1.0	24	7	91	29.5	7.0	6.7		0.913
24-Jul-91	10	1.5	24	7	91	29.5	7.0	6.2		0.913
24-Jul-91	10	2.0	24	7	91	29.0	8.0	1.9	7.5	1.825
24-Jul-91	11	0.0	24	7	91	29.8	7.0	5.9	7.6	0.809
24-Jul-91	11	0.5	24	7	91	30.0	7.0	5.5		0.739
24-Jul-91	11	1.0	24	7	91	29.0	7.1	1.5	7.4	1.158
24-Jul-91	12	0.0	24	7	91	30.0	2.8	6.8	7.5	-2.365
24-Jul-91	12	0.5	24	7	91	30.2	2.8	6.8	7.5	-2.434
01-Aug-91	1	S	1	8	91					
01-Aug-91	1	B	1	8	91					
01-Aug-91	1A	S	1	8	91					
01-Aug-91	1A	B	1	8	91					
01-Aug-91	2S	S	1	8	91					
01-Aug-91	2S	B	1	8	91					
01-Aug-91	3	0.0	1	8	91	28.0	11.5	7.6	7.8	4.761
01-Aug-91	3	0.5	1	8	91	28.0	11.2	7.6		4.538
01-Aug-91	3	1.0	1	8	91	28.0	11.5	7.5		4.761
01-Aug-91	3	1.5	1	8	91	28.0	11.5	7.3		4.761
01-Aug-91	3	2.0	1	8	91	27.9	11.5	6.7	7.8	4.794
01-Aug-91	4N	0.0	1	8	91	28.0	10.0	8.2	7.8	3.646
01-Aug-91	4N	0.5	1	8	91	28.0	10.5	7.8		4.018
01-Aug-91	4N	1.0	1	8	91	28.0	10.5	7.2		4.018
01-Aug-91	4N	1.5	1	8	91	28.0	10.2	6.5		3.795
01-Aug-91	4N	2.0	1	8	91	28.0	10.8	3.0	7.7	4.241
01-Aug-91	4S	0.0	1	8	91	28.0	11.0	11.6	8.0	4.389
01-Aug-91	4S	0.5	1	8	91	27.5	11.0	9.1		4.555
01-Aug-91	4S	1.0	1	8	91	27.5	11.0	9.2		4.555
01-Aug-91	4S	1.5	1	8	91	27.5	11.2	6.4		4.704
01-Aug-91	4S	2.0	1	8	91	27.2	11.5	4.2		5.025
01-Aug-91	4S	2.5	1	8	91	27.2	12.0	3.2	7.7	5.397
01-Aug-91	4P	0.0	1	8	91	28.0	9.8	8.0	7.7	3.498
01-Aug-91	4P	0.5	1	8	91	28.0	9.9	7.8		3.572
01-Aug-91	4P	1.0	1	8	91	27.5	10.1	7.2		3.885
01-Aug-91	4P	1.5	1	8	91	27.5	11.0	5.8		4.555
01-Aug-91	4P	2.0	1	8	91	27.5	11.5	4.6		4.927
01-Aug-91	4P	2.5	1	8	91	27.5	11.5	4.2	7.6	4.927
01-Aug-91	5	0.0	1	8	91	28.0	10.5	7.5	7.7	4.018
01-Aug-91	5	0.5	1	8	91	28.0	10.5	7.5		4.018
01-Aug-91	5	1.0	1	8	91	28.0	10.1	7.2		3.720
01-Aug-91	5	1.5	1	8	91	28.0	10.5	6.6		4.018
01-Aug-91	5	2.0	1	8	91	28.0	10.5	6.5		4.018
01-Aug-91	5	2.5	1	8	91	28.0	11.0	6.1		4.389
01-Aug-91	5	3.0	1	8	91	28.0	11.0	5.2		4.389
01-Aug-91	5	3.5	1	8	91	28.0	11.5	3.9		4.761

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
01-Aug-91	5	4.0	1	8	91	28.0	11.5	3.5	7.6	4.761
01-Aug-91	5N	0.0	1	8	91	28.0	10.0	7.0	7.7	3.646
01-Aug-91	5N	0.5	1	8	91	28.0	10.0	7.0		3.646
01-Aug-91	5N	1.0	1	8	91	28.0	10.0	7.0		3.646
01-Aug-91	5N	1.5	1	8	91	28.0	10.0	6.7		3.646
01-Aug-91	5N	2.0	1	8	91	28.0	10.0	6.0	7.7	3.646
01-Aug-91	5S	0.0	1	8	91	28.0	10.0	7.3	7.6	3.646
01-Aug-91	5S	0.5	1	8	91	28.0	10.1	7.0		3.720
01-Aug-91	5S	1.0	1	8	91	27.5	10.1	6.6		3.885
01-Aug-91	5S	1.5	1	8	91	27.5	10.1	6.5		3.885
01-Aug-91	5S	2.0	1	8	91	27.5	10.5	5.8		4.183
01-Aug-91	5S	2.5	1	8	91	27.1	10.5	4.9		4.313
01-Aug-91	5S	3.0	1	8	91	27.5	10.5	4.0	7.5	4.183
01-Aug-91	6	0.0	1	8	91	27.1	10.0	5.3	7.5	3.940
01-Aug-91	6	0.5	1	8	91	27.2	10.0	5.1		3.908
01-Aug-91	6	1.0	1	8	91	27.2	10.0	4.9		3.908
01-Aug-91	6	1.5	1	8	91	27.2	10.0	4.8		3.908
01-Aug-91	6	2.0	1	8	91	27.5	10.0	4.7		3.811
01-Aug-91	6	2.5	1	8	91	27.2	10.0	4.3		3.908
01-Aug-91	6	3.0	1	8	91	27.0	10.0	4.1	7.5	3.972
01-Aug-91	7	0.0	1	8	91	27.9	7.2	8.3	7.7	1.598
01-Aug-91	7	0.5	1	8	91	27.8	7.2	8.4		1.631
01-Aug-91	7	1.0	1	8	91	27.2	7.2	7.2		1.823
01-Aug-91	7	1.5	1	8	91	27.2	8.0	6.1		2.419
01-Aug-91	7	2.0	1	8	91	27.5	8.5	3.7		2.695
01-Aug-91	7	2.5	1	8	91	28.0	9.5	3.0		3.275
01-Aug-91	7	3.0	1	8	91	28.0	9.5	2.7	7.5	3.275
01-Aug-91	7N	0.0	1	8	91	28.5	8.5	9.6	7.9	2.365
01-Aug-91	7N	0.5	1	8	91	28.5	8.5	9.6		2.365
01-Aug-91	7N	1.0	1	8	91	28.5	8.5	9.5		2.365
01-Aug-91	7N	1.5	1	8	91	28.5	8.5	8.4		2.365
01-Aug-91	7N	2.0	1	8	91	28.0	9.1	3.2		2.977
01-Aug-91	7N	2.5	1	8	91	28.0	9.8	2.1		3.498
01-Aug-91	7N	3.0	1	8	91	28.0	9.8	2.0		3.498
01-Aug-91	7N	3.5	1	8	91	28.0	9.9	2.0		3.572
01-Aug-91	7N	4.0	1	8	91	28.0	9.8	2.0	7.7	3.498
01-Aug-91	7S	0.0	1	8	91	27.5	8.5	7.5	7.7	2.695
01-Aug-91	7S	0.5	1	8	91	27.8	8.9	7.4		2.895
01-Aug-91	7S	1.0	1	8	91	27.2	9.0	6.3		3.163
01-Aug-91	7S	1.5	1	8	91	27.0	9.0	5.9		3.227
01-Aug-91	7S	2.0	1	8	91	27.0	9.0	5.2		3.227
01-Aug-91	7S	2.5	1	8	91	27.0	9.0	4.5	7.6	3.227
01-Aug-91	8	0.0	1	8	91	27.0	5.1	8.0	7.7	0.322
01-Aug-91	8	0.5	1	8	91	27.5	5.5	7.7		0.463
01-Aug-91	8	1.0	1	8	91	27.5	6.0	5.2		0.835
01-Aug-91	8	1.5	1	8	91	27.9	7.9	2.2		2.119
01-Aug-91	8	2.0	1	8	91	27.9	8.0	2.0		2.193
01-Aug-91	8	2.5	1	8	91	28.0	8.2	1.7		2.309
01-Aug-91	8	3.0	1	8	91	28.0	8.2	1.8		2.309
01-Aug-91	8	3.5	1	8	91	28.0	8.2	1.8	7.5	2.309

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
01-Aug-91	9N	0.0	1	8	91	27.8	4.0	9.4	8.0	-0.748
01-Aug-91	9N	0.5	1	8	91	28.0	4.5	5.2		-0.440
01-Aug-91	9N	1.0	1	8	91	28.0	7.0	0.3		1.417
01-Aug-91	9N	1.5	1	8	91	28.0	7.0	0.2	7.5	1.417
01-Aug-91	9S	0.0	1	8	91	27.0	2.0	7.7	7.5	-1.988
01-Aug-91	9S	0.5	1	8	91	27.1	3.0	7.0		-1.273
01-Aug-91	9S	1.0	1	8	91	27.8	5.0	2.6		-0.005
01-Aug-91	9S	1.5	1	8	91	28.0	6.0	0.6		0.674
01-Aug-91	9S	2.0	1	8	91	28.0	7.1	0.4	7.2	1.491
01-Aug-91	10	0.0	1	8	91	27.1	1.0	7.6	7.7	-2.763
01-Aug-91	10	0.5	1	8	91	27.5	1.0	7.2		-2.885
01-Aug-91	10	1.0	1	8	91	28.0	4.5	1.1		-0.440
01-Aug-91	10	1.5	1	8	91	28.1	6.0	0.3		0.642
01-Aug-91	10	2.0	1	8	91	28.0	7.5	0.1	7.1	1.789
01-Aug-91	11	0.0	1	8	91	27.0	1.0	6.0	7.6	-2.733
01-Aug-91	11	0.5	1	8	91	27.2	1.2	7.0		-2.644
01-Aug-91	11	1.0	1	8	91	27.8	2.0	8.3	7.3	-2.235
01-Aug-91	12	0.0	1	8	91	25.9	0.0	4.4	7.7	-3.156
01-Aug-91	12	0.5	1	8	91	25.5	0.0	4.2		-3.043
01-Aug-91	12	1.0	1	8	91	25.2	0.0	4.2	7.5	-2.959
14-Aug-91	1	0.0	14	8	91	28.5	14.0	7.9	8.2	6.446
14-Aug-91	1	0.5	14	8	91	28.8	14.0	8.2		6.342
14-Aug-91	1	1.0	14	8	91	28.0	14.9	7.4		7.287
14-Aug-91	1	1.5	14	8	91	27.0	15.0	6.9		7.697
14-Aug-91	1	2.0	14	8	91	27.9	16.0	6.1		8.138
14-Aug-91	1	2.5	14	8	91	27.5	16.0	6.2		8.275
14-Aug-91	1	3.0	14	8	91	27.5	17.0	4.8		9.019
14-Aug-91	1	3.5	14	8	91	27.5	17.0	5.0		9.019
14-Aug-91	1	4.0	14	8	91	27.5	17.0	4.5		9.019
14-Aug-91	1	4.5	14	8	91	27.5	17.0	4.4	7.8	9.019
14-Aug-91	1A	0.0	14	8	91	28.8	10.0	9.3	8.4	3.376
14-Aug-91	1A	0.5	14	8	91	28.0	11.0	7.1		4.389
14-Aug-91	1A	1.0	14	8	91	28.0	12.0	6.5		5.132
14-Aug-91	1A	1.5	14	8	91	28.0	12.5	6.3		5.504
14-Aug-91	1A	2.0	14	8	91	27.5	13.1	5.3		6.117
14-Aug-91	1A	2.5	14	8	91	27.5	13.8	4.3		6.638
14-Aug-91	1A	3.0	14	8	91	27.8	16.2	3.1		8.321
14-Aug-91	1A	3.5	14	8	91	27.8	16.5	3.0		8.544
14-Aug-91	1A	4.0	14	8	91	27.8	16.5	2.8		8.544
14-Aug-91	1A	4.5	14	8	91	27.8	16.8	2.7	7.6	8.767
14-Aug-91	2S	0.0	14	8	91	28.5	12.2	8.6	8.2	5.111
14-Aug-91	2S	0.5	14	8	91	28.8	12.1	8.6		4.933
14-Aug-91	2S	1.0	14	8	91	28.5	12.0	8.0		4.962
14-Aug-91	2S	1.5	14	8	91	28.1	12.1	7.3		5.173
14-Aug-91	2S	2.0	14	8	91	28.1	12.1	6.6		5.173
14-Aug-91	2S	2.5	14	8	91	28.0	12.5	5.5		5.504
14-Aug-91	2S	3.0	14	8	91	28.0	13.0	3.5	7.9	5.875
14-Aug-91	3	0.0	14	8	91	29.0	11.2	8.7	8.3	4.196
14-Aug-91	3	0.5	14	8	91	28.5	11.2	8.7		4.369
14-Aug-91	3	1.0	14	8	91	28.1	11.5	8.0		4.727

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
14-Aug-91	3	1.5	14	8	91	28.0	11.5	7.6		4.761
14-Aug-91	3	2.0	14	8	91	28.0	11.5	6.7		4.761
14-Aug-91	3	2.5	14	8	91	28.0	11.9	5.7	8.2	5.058
14-Aug-91	4N	0.0	14	8	91	27.2	11.9	6.7	7.9	5.323
14-Aug-91	4N	0.5	14	8	91	27.2	11.9	6.7		5.323
14-Aug-91	4N	1.0	14	8	91	28.0	11.9	5.9		5.058
14-Aug-91	4N	1.5	14	8	91	28.0	11.0	3.4		4.389
14-Aug-91	4N	2.0	14	8	91	28.0	13.0	1.8		5.875
14-Aug-91	4N	2.5	14	8	91	28.0	13.1	1.4	7.5	5.949
14-Aug-91	4S	0.0	14	8	91	29.0	11.5	9.0	8.3	4.419
14-Aug-91	4S	0.5	14	8	91	29.0	11.1	9.1		4.122
14-Aug-91	4S	1.0	14	8	91	29.0	11.5	8.5		4.419
14-Aug-91	4S	1.5	14	8	91	28.9	11.1	7.9		4.157
14-Aug-91	4S	2.0	14	8	91	28.1	11.5	5.9		4.727
14-Aug-91	4S	2.5	14	8	91	28.0	11.9	4.4	8.0	5.058
14-Aug-91	4P	0.0	14	8	91	29.0	10.5	9.3	8.1	3.678
14-Aug-91	4P	0.5	14	8	91	29.0	10.5	9.1		3.678
14-Aug-91	4P	1.0	14	8	91	28.5	10.5	8.9		3.849
14-Aug-91	4P	1.5	14	8	91	28.0	10.5	8.3		4.018
14-Aug-91	4P	2.0	14	8	91	28.0	11.1	3.4	7.8	4.463
14-Aug-91	5	0.0	14	8	91	29.0	8.5	9.8	8.5	2.196
14-Aug-91	5	0.5	14	8	91	28.8	9.0	9.2		2.635
14-Aug-91	5	1.0	14	8	91	28.0	9.1	8.3		2.977
14-Aug-91	5	1.5	14	8	91	28.0	10.0	7.8		3.646
14-Aug-91	5	2.0	14	8	91	28.0	10.0	7.2		3.646
14-Aug-91	5	2.5	14	8	91	28.0	10.5	6.9		4.018
14-Aug-91	5	3.0	14	8	91	28.0	11.0	6.8		4.389
14-Aug-91	5	3.5	14	8	91	28.0	11.1	4.0		4.463
14-Aug-91	5	4.0	14	8	91	27.9	13.0	1.7		5.909
14-Aug-91	5	4.5	14	8	91	27.9	13.5	0.3	7.8	6.280
14-Aug-91	5N	0.0	14	8	91	27.5	10.2	7.0	8.0	3.960
14-Aug-91	5N	0.5	14	8	91	27.9	10.2	5.5		3.828
14-Aug-91	5N	1.0	14	8	91	27.9	10.5	4.5		4.051
14-Aug-91	5N	1.5	14	8	91	27.8	11.1	1.5		4.530
14-Aug-91	5N	2.0	14	8	91	27.9	11.5	1.4		4.794
14-Aug-91	5N	2.5	14	8	91	27.9	11.8	1.4	7.6	5.017
14-Aug-91	5S	0.0	14	8	91	29.0	10.1	10.1	8.5	3.381
14-Aug-91	5S	0.5	14	8	91	29.0	10.1	10.2		3.381
14-Aug-91	5S	1.0	14	8	91	29.0	10.8	9.4		3.900
14-Aug-91	5S	1.5	14	8	91	28.1	11.0	8.6		4.356
14-Aug-91	5S	2.0	14	8	91	28.0	11.5	7.8		4.761
14-Aug-91	5S	2.5	14	8	91	28.0	11.8	5.9		4.984
14-Aug-91	5S	3.0	14	8	91	27.5	15.5	0.4		7.903
14-Aug-91	5S	3.5	14	8	91	27.2	19.0	0.1	7.7	10.609
14-Aug-91	6	0.0	14	8	91	29.0	10.0	9.9	8.4	3.307
14-Aug-91	6	0.5	14	8	91	29.0	10.0	9.5		3.307
14-Aug-91	6	1.0	14	8	91	28.0	10.0	8.5		3.646
14-Aug-91	6	1.5	14	8	91	28.0	10.8	7.5		4.241
14-Aug-91	6	2.0	14	8	91	28.0	11.0	6.8		4.389
14-Aug-91	6	2.5	14	8	91	27.9	11.0	0.8		4.422

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
14-Aug-91	6	3.0	14	8	91	27.5	15.5	0.2	7.8	7.903
14-Aug-91	7	0.0	14	8	91	28.1	6.1	9.8	8.4	0.716
14-Aug-91	7	0.5	14	8	91	28.0	6.1	8.7		0.748
14-Aug-91	7	1.0	14	8	91	27.8	6.1	7.8		0.813
14-Aug-91	7	1.5	14	8	91	27.9	6.2	6.6		0.855
14-Aug-91	7	2.0	14	8	91	27.9	8.0	4.4		2.193
14-Aug-91	7	2.5	14	8	91	27.9	12.5	0.4		5.537
14-Aug-91	7	3.0	14	8	91	27.9	13.8	0.1		6.503
14-Aug-91	7	3.5	14	8	91	27.9	13.9	0.1	7.4	6.578
14-Aug-91	7N	0.0	14	8	91	28.0	8.0	7.1	8.0	2.160
14-Aug-91	7N	0.5	14	8	91	28.0	8.0	6.7		2.160
14-Aug-91	7N	1.0	14	8	91	28.0	8.0	0.5		2.160
14-Aug-91	7N	1.5	14	8	91	28.0	10.0	0.2		3.646
14-Aug-91	7N	2.0	14	8	91	28.0	11.0	0.1		4.389
14-Aug-91	7N	2.5	14	8	91	28.0	11.5	0.1		4.761
14-Aug-91	7N	3.0	14	8	91	28.0	11.8	0.1	7.3	4.984
14-Aug-91	7S	0.0	14	8	91	29.0	11.4	9.4	8.5	4.345
14-Aug-91	7S	0.5	14	8	91	28.5	11.8	8.7		4.814
14-Aug-91	7S	1.0	14	8	91	28.0	12.0	8.1		5.132
14-Aug-91	7S	1.5	14	8	91	28.0	12.0	7.5		5.132
14-Aug-91	7S	2.0	14	8	91	27.9	13.0	4.4		5.909
14-Aug-91	7S	2.5	14	8	91	27.5	13.0	2.5	7.8	6.043
14-Aug-91	8	0.0	14	8	91	27.9	3.5	9.4	8.2	-1.152
14-Aug-91	8	0.5	14	8	91	27.5	4.5	6.9		-0.281
14-Aug-91	8	1.0	14	8	91	27.8	5.0	6.4		-0.005
14-Aug-91	8	1.5	14	8	91	27.8	7.0	3.5		1.482
14-Aug-91	8	2.0	14	8	91	27.5	7.1	3.5	7.5	1.653
14-Aug-91	9N	0.0	14	8	91	28.0	3.0	7.9	6.7	-1.555
14-Aug-91	9N	0.5	14	8	91	27.9	4.9	1.9		-0.111
14-Aug-91	9N	1.0	14	8	91	27.9	6.2	0.4		0.855
14-Aug-91	9N	1.5	14	8	91	27.9	6.5	0.2		1.078
14-Aug-91	9N	2.0	14	8	91	27.9	6.6	0.1	6.6	1.152
14-Aug-91	9S	0.0	14	8	91	29.2	3.5	10.4	8.7	-1.576
14-Aug-91	9S	0.5	14	8	91	29.0	3.1	10.2		-1.806
14-Aug-91	9S	1.0	14	8	91	28.0	3.8	8.1		-0.960
14-Aug-91	9S	1.5	14	8	91	28.0	9.0	0.5		2.903
14-Aug-91	9S	2.0	14	8	91	28.0	11.5	0.2		4.761
14-Aug-91	9S	2.5	14	8	91	28.0	11.5	0.1	7.3	4.761
14-Aug-91	10	0.0	14	8	91	29.1	2.1	12.3	8.7	-2.580
14-Aug-91	10	0.5	14	8	91	29.0	2.1	12.0		-2.547
14-Aug-91	10	1.0	14	8	91	28.0	4.0	3.1		-0.812
14-Aug-91	10	1.5	14	8	91	27.5	5.9	0.4		0.760
14-Aug-91	10	2.0	14	8	91	27.5	7.5	0.1		1.951
14-Aug-91	10	2.5	14	8	91	27.8	8.1	0.1		2.300
14-Aug-91	10	3.0	14	8	91	27.5	8.9	0.1	7.5	2.992
14-Aug-91	11	0.0	14	8	91	29.5	2.0	11.8	8.7	-2.787
14-Aug-91	11	0.5	14	8	91	28.5	2.0	10.7		-2.458
14-Aug-91	11	1.0	14	8	91	28.0	3.0	2.8		-1.555
14-Aug-91	11	1.5	14	8	91	27.8	5.0	1.1	7.6	-0.005
14-Aug-91	12	0.0	14	8	91	29.0	1.5	4.9	7.0	-2.991

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
14-Aug-91	12	0.5	14	8	91	29.0	1.1	4.9		-3.288
14-Aug-91	12	1.0	14	8	91	28.5	1.2	1.2		-3.051
14-Aug-91	12	1.5	14	8	91	28.0	3.5	0.5	6.8	-1.183
05-Sep-91	1	0.0	5	9	91	28.0	15.0	14.4	7.6	7.361
05-Sep-91	1	0.5	5	9	91	27.8	15.0	14.8		7.429
05-Sep-91	1	1.0	5	9	91	27.0	15.0	15.2		7.697
05-Sep-91	1	1.5	5	9	91	26.8	15.0	14.0		7.763
05-Sep-91	1	2.0	5	9	91	26.2	15.1	12.8		8.032
05-Sep-91	1	2.5	5	9	91	26.1	15.5	12.0		8.362
05-Sep-91	1	3.0	5	9	91	26.0	16.0	11.6		8.768
05-Sep-91	1	3.5	5	9	91	25.9	16.5	11.4		9.173
05-Sep-91	1	4.0	5	9	91	26.0	15.9	11.0		8.693
05-Sep-91	1	4.5	5	9	91	26.0	17.0	10.0		9.515
05-Sep-91	1	5.0	5	9	91	26.0	17.1	9.2		9.589
05-Sep-91	1	5.5	5	9	91	26.0	17.1	8.8	7.7	9.589
05-Sep-91	1A	0.0	5	9	91	27.5	12.5	13.4	7.8	5.671
05-Sep-91	1A	0.5	5	9	91	27.2	12.5	13.2		5.769
05-Sep-91	1A	1.0	5	9	91	26.5	12.5	13.2		5.995
05-Sep-91	1A	1.5	5	9	91	26.1	12.3	12.4		5.972
05-Sep-91	1A	2.0	5	9	91	26.0	12.2	11.6		5.929
05-Sep-91	1A	2.5	5	9	91	25.9	12.8	10.5		6.408
05-Sep-91	1A	3.0	5	9	91	25.9	13.0	10.2		6.558
05-Sep-91	1A	3.5	5	9	91	25.9	13.5	9.6		6.931
05-Sep-91	1A	4.0	5	9	91	25.9	14.5	7.4		7.679
05-Sep-91	1A	4.5	5	9	91	25.9	13.5	6.7	7.5	6.931
05-Sep-91	2S	0.0	5	9	91	27.1	11.8	12.8	7.8	5.281
05-Sep-91	2S	0.5	5	9	91	26.9	11.5	13.0		5.122
05-Sep-91	2S	1.0	5	9	91	26.5	11.5	13.2		5.249
05-Sep-91	2S	1.5	5	9	91	26.1	11.5	13.2		5.375
05-Sep-91	2S	2.0	5	9	91	26.0	11.5	13.0		5.406
05-Sep-91	2S	2.5	5	9	91	25.9	11.8	12.5		5.661
05-Sep-91	2S	3.0	5	9	91	25.9	12.0	12.5		5.811
05-Sep-91	2S	3.5	5	9	91	25.9	12.1	11.4	7.9	5.885
05-Sep-91	3	0.0	5	9	91	27.9	11.1	13.2	7.8	4.497
05-Sep-91	3	0.5	5	9	91	27.0	11.1	13.2		4.792
05-Sep-91	3	1.0	5	9	91	26.2	11.0	13.2		4.970
05-Sep-91	3	1.5	5	9	91	26.0	11.0	13.2		5.033
05-Sep-91	3	2.0	5	9	91	26.0	11.1	13.2		5.107
05-Sep-91	3	2.5	5	9	91	25.9	11.1	12.5	7.9	5.138
05-Sep-91	4N	0.0	5	9	91	28.1	11.0	13.8	7.9	4.356
05-Sep-91	4N	0.5	5	9	91	28.0	10.8	13.0		4.241
05-Sep-91	4N	1.0	5	9	91	27.1	10.8	10.8		4.536
05-Sep-91	4N	1.5	5	9	91	26.9	10.8	8.8		4.600
05-Sep-91	4N	2.0	5	9	91	26.5	10.8	7.0		4.727
05-Sep-91	4N	2.5	5	9	91	26.5	11.0	6.2	7.6	4.876
05-Sep-91	4S	0.0	5	9	91	27.9	11.1	13.5	7.8	4.497
05-Sep-91	4S	0.5	5	9	91	26.9	11.1	14.6		4.824
05-Sep-91	4S	1.0	5	9	91	26.1	11.5	13.2		5.375
05-Sep-91	4S	1.5	5	9	91	26.0	11.5	12.5		5.406
05-Sep-91	4S	2.0	5	9	91	25.9	11.9	10.5		5.736

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
05-Sep-91	4S	2.5	5	9	91	25.9	12.0	9.6		5.811
05-Sep-91	4S	3.0	5	9	91	25.8	12.0	8.7	7.6	5.841
05-Sep-91	4P	0.0	5	9	91	26.9	10.0	14.5	7.8	4.004
05-Sep-91	4P	0.5	5	9	91	26.9	10.0	14.2		4.004
05-Sep-91	4P	1.0	5	9	91	26.2	10.0	14.0		4.224
05-Sep-91	4P	1.5	5	9	91	26.1	10.0	12.5		4.255
05-Sep-91	4P	2.0	5	9	91	25.9	10.8	10.5		4.914
05-Sep-91	4P	2.5	5	9	91	25.9	11.2	8.5	7.7	5.213
05-Sep-91	5	0.0	5	9	91	28.9	9.5	15.8	8.0	2.971
05-Sep-91	5	0.5	5	9	91	28.0	9.5	16.0		3.275
05-Sep-91	5	1.0	5	9	91	27.0	9.5	15.0		3.600
05-Sep-91	5	1.5	5	9	91	26.1	9.5	14.0		3.881
05-Sep-91	5	2.0	5	9	91	26.0	9.5	12.4		3.912
05-Sep-91	5	2.5	5	9	91	26.0	9.8	11.8		4.136
05-Sep-91	5	3.0	5	9	91	26.0	9.8	11.8		4.136
05-Sep-91	5	3.5	5	9	91	26.0	10.0	9.8		4.286
05-Sep-91	5	4.0	5	9	91	25.9	10.2	7.4		4.466
05-Sep-91	5	4.5	5	9	91	25.9	10.5	6.5		4.690
05-Sep-91	5	5.0	5	9	91	25.9	10.5	6.4	7.6	4.690
05-Sep-91	5N	0.0	5	9	91	28.0	9.8	14.2	8.0	3.498
05-Sep-91	5N	0.5	5	9	91	27.2	9.8	13.6		3.759
05-Sep-91	5N	1.0	5	9	91	26.5	9.8	12.4		3.981
05-Sep-91	5N	1.5	5	9	91	26.5	9.5	11.6		3.757
05-Sep-91	5N	2.0	5	9	91	26.3	9.5	10.4	7.7	3.820
05-Sep-91	5S	0.0	5	9	91	26.9	9.5	13.6	7.8	3.631
05-Sep-91	5S	0.5	5	9	91	26.8	9.5	14.0		3.663
05-Sep-91	5S	1.0	5	9	91	26.5	9.5	14.0		3.757
05-Sep-91	5S	1.5	5	9	91	26.1	9.5	14.0		3.881
05-Sep-91	5S	2.0	5	9	91	26.1	9.5	13.6		3.881
05-Sep-91	5S	2.5	5	9	91	26.1	10.0	12.2		4.255
05-Sep-91	5S	3.0	5	9	91	26.1	10.0	11.8		4.255
05-Sep-91	5S	3.5	5	9	91	26.1	10.1	10.0	7.7	4.329
05-Sep-91	6	0.0	5	9	91	26.8	9.0	13.2	7.8	3.290
05-Sep-91	6	0.5	5	9	91	26.8	9.0	13.2		3.290
05-Sep-91	6	1.0	5	9	91	26.2	9.0	13.8		3.477
05-Sep-91	6	1.5	5	9	91	25.9	8.9	13.4		3.494
05-Sep-91	6	2.0	5	9	91	25.9	9.0	12.2		3.569
05-Sep-91	6	2.5	5	9	91	25.9	9.1	11.8		3.644
05-Sep-91	6	3.0	5	9	91	25.8	9.1	11.0		3.674
05-Sep-91	6	3.5	5	9	91	25.8	9.1	10.4	7.8	3.674
05-Sep-91	7	0.0	5	9	91	26.5	7.5	12.8	7.7	2.265
05-Sep-91	7	0.5	5	9	91	26.1	7.5	13.2		2.388
05-Sep-91	7	1.0	5	9	91	26.0	7.5	12.5		2.418
05-Sep-91	7	1.5	5	9	91	26.0	7.8	12.0		2.642
05-Sep-91	7	2.0	5	9	91	26.0	7.8	11.0		2.642
05-Sep-91	7	2.5	5	9	91	26.0	7.8	11.5	7.7	2.642
05-Sep-91	7N	0.0	5	9	91	28.0	8.1	14.2	7.8	2.234
05-Sep-91	7N	0.5	5	9	91	28.1	8.1	14.4		2.201
05-Sep-91	7N	1.0	5	9	91	27.5	8.0	12.2		2.323
05-Sep-91	7N	1.5	5	9	91	27.0	8.1	10.2		2.557

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
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DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
05-Sep-91	7N	2.0	5	9	91	26.9	8.1	6.0		2.588
05-Sep-91	7N	2.5	5	9	91	26.5	8.5	5.2		3.011
05-Sep-91	7N	3.0	5	9	91	26.5	8.5	4.5		3.011
05-Sep-91	7N	3.5	5	9	91	26.5	8.5	3.8		3.011
05-Sep-91	7N	4.0	5	9	91	26.5	8.5	3.7		3.011
05-Sep-91	7N	4.5	5	9	91	26.3	8.5	3.6	7.5	3.073
05-Sep-91	7S	0.0	5	9	91	27.0	7.5	11.6	7.8	2.110
05-Sep-91	7S	0.5	5	9	91	27.0	7.5	11.6		2.110
05-Sep-91	7S	1.0	5	9	91	26.5	7.9	11.0		2.564
05-Sep-91	7S	1.5	5	9	91	26.1	8.0	11.5		2.761
05-Sep-91	7S	2.0	5	9	91	26.0	8.1	8.4		2.866
05-Sep-91	7S	2.5	5	9	91	25.9	8.1	7.6		2.896
05-Sep-91	7S	3.0	5	9	91	25.9	8.2	7.2	7.7	2.971
05-Sep-91	8	0.0	5	9	91	26.5	6.2	14.5	7.8	1.296
05-Sep-91	8	0.5	5	9	91	26.5	6.2	14.5		1.296
05-Sep-91	8	1.0	5	9	91	26.1	6.1	14.2		1.342
05-Sep-91	8	1.5	5	9	91	25.9	6.1	13.0		1.402
05-Sep-91	8	2.0	5	9	91	25.9	6.2	12.2		1.477
05-Sep-91	8	2.5	5	9	91	25.8	6.2	7.8		1.507
05-Sep-91	8	3.0	5	9	91	25.8	7.0	6.0		2.104
05-Sep-91	8	3.5	5	9	91	25.8	7.0	4.5	7.5	2.104
05-Sep-91	9N	0.0	5	9	91	28.1	5.1	16.8	8.3	-0.027
05-Sep-91	9N	0.5	5	9	91	28.2	5.1	17.2		-0.059
05-Sep-91	9N	1.0	5	9	91	28.0	5.1	16.2		0.005
05-Sep-91	9N	1.5	5	9	91	26.6	5.5	14.2		0.743
05-Sep-91	9N	2.0	5	9	91	26.9	6.0	12.0	7.8	1.023
05-Sep-91	9S	0.0	5	9	91	26.1	5.0	14.5	7.9	0.521
05-Sep-91	9S	0.5	5	9	91	26.1	5.0	14.8		0.521
05-Sep-91	9S	1.0	5	9	91	26.1	5.1	13.0		0.595
05-Sep-91	9S	1.5	5	9	91	25.8	6.0	9.3		1.357
05-Sep-91	9S	2.0	5	9	91	25.5	6.1	8.2		1.520
05-Sep-91	9S	2.5	5	9	91	25.5	6.5	7.0	7.5	1.819
05-Sep-91	10	0.0	5	9	91	26.5	4.1	16.0	7.8	-0.271
05-Sep-91	10	0.5	5	9	91	26.1	4.1	15.6		-0.151
05-Sep-91	10	1.0	5	9	91	25.9	4.1	13.4		-0.092
05-Sep-91	10	1.5	5	9	91	25.9	4.1	12.5		-0.092
05-Sep-91	10	2.0	5	9	91	26.0	5.1	8.4		0.625
05-Sep-91	10	2.5	5	9	91	26.0	6.5	7.2		1.671
05-Sep-91	10	3.0	5	9	91	26.0	6.5	6.6	7.5	1.671
05-Sep-91	11	0.0	5	9	91	26.7	2.9	15.5	7.6	-1.226
05-Sep-91	11	0.5	5	9	91	26.5	2.9	15.5		-1.166
05-Sep-91	11	1.0	5	9	91	26.0	2.9	14.2		-1.018
05-Sep-91	11	1.5	5	9	91	25.9	3.0	6.3	7.5	-0.914
05-Sep-91	12	0.0	5	9	91	26.1	0.2	10.8	7.4	-3.064
05-Sep-91	12	0.5	5	9	91	26.1	0.2	10.8		-3.064
05-Sep-91	12	1.0	5	9	91	26.2	0.9	9.8		-2.570
05-Sep-91	12	1.5	5	9	91	26.4	1.5	7.8	7.4	-2.181
12-Sep-91	1	0.0	12	9	91	26.5	15.0	11.6	8.2	7.860
12-Sep-91	1	0.5	12	9	91	26.5	15.0	11.6		7.860
12-Sep-91	1	1.0	12	9	91	26.5	15.0	11.6		7.860

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
12-Sep-91	1	1.5	12	9	91	26.5	15.0	11.6		7.860
12-Sep-91	1	2.0	12	9	91	26.5	15.0	11.6		7.860
12-Sep-91	1	2.5	12	9	91	26.0	14.9	10.8		7.946
12-Sep-91	1	3.0	12	9	91	26.0	15.5	9.0		8.394
12-Sep-91	1	3.5	12	9	91	25.5	16.5	8.3		9.299
12-Sep-91	1	4.0	12	9	91	25.5	16.9	8.0		9.599
12-Sep-91	1	4.5	12	9	91	25.5	16.9	7.3	8.0	9.599
12-Sep-91	1A	0.0	12	9	91	26.8	12.8	12.6	8.3	6.123
12-Sep-91	1A	0.5	12	9	91	26.5	12.8	12.4		6.219
12-Sep-91	1A	1.0	12	9	91	26.5	12.8	12.4		6.219
12-Sep-91	1A	1.5	12	9	91	26.5	12.8	12.2		6.219
12-Sep-91	1A	2.0	12	9	91	26.2	12.8	12.0		6.314
12-Sep-91	1A	2.5	12	9	91	26.1	12.8	12.0		6.346
12-Sep-91	1A	3.0	12	9	91	26.1	12.8	11.8		6.346
12-Sep-91	1A	3.5	12	9	91	26.0	15.5	7.4		8.394
12-Sep-91	1A	4.0	12	9	91	25.8	15.9	6.7		8.756
12-Sep-91	1A	4.5	12	9	91	25.8	15.9	6.5	8.0	8.756
12-Sep-91	2S	0.0	12	9	91	27.0	12.0	11.9	8.1	5.462
12-Sep-91	2S	0.5	12	9	91	27.0	12.0	11.6		5.462
12-Sep-91	2S	1.0	12	9	91	27.0	12.0	11.0		5.462
12-Sep-91	2S	1.5	12	9	91	27.0	12.0	10.8		5.462
12-Sep-91	2S	2.0	12	9	91	26.5	12.0	9.4		5.622
12-Sep-91	2S	2.5	12	9	91	26.5	12.0	9.0		5.622
12-Sep-91	2S	3.0	12	9	91	26.5	12.1	8.2		5.697
12-Sep-91	2S	3.5	12	9	91	26.5	12.1	7.9	8.0	5.697
12-Sep-91	3	0.0	12	9	91	27.0	11.2	12.2	8.2	4.866
12-Sep-91	3	0.5	12	9	91	27.0	11.5	12.1		5.090
12-Sep-91	3	1.0	12	9	91	26.9	11.2	11.8		4.898
12-Sep-91	3	1.5	12	9	91	26.5	11.1	11.0		4.951
12-Sep-91	3	2.0	12	9	91	26.2	11.2	10.2		5.120
12-Sep-91	3	2.5	12	9	91	26.1	11.2	9.7	8.0	5.151
12-Sep-91	4N	0.0	12	9	91	26.5	12.0	8.8	8.0	5.622
12-Sep-91	4N	0.5	12	9	91	26.9	12.0	8.6		5.494
12-Sep-91	4N	1.0	12	9	91	26.9	12.0	8.5		5.494
12-Sep-91	4N	1.5	12	9	91	26.8	11.9	8.3		5.452
12-Sep-91	4N	2.0	12	9	91	26.0	12.1	5.3		5.854
12-Sep-91	4N	2.5	12	9	91	26.0	12.1	4.7	7.9	5.854
12-Sep-91	4S	0.0	12	9	91	27.0	10.9	12.0	8.3	4.643
12-Sep-91	4S	0.5	12	9	91	27.0	10.9	12.0		4.643
12-Sep-91	4S	1.0	12	9	91	27.0	11.0	11.8		4.717
12-Sep-91	4S	1.5	12	9	91	27.0	11.0	11.2		4.717
12-Sep-91	4S	2.0	12	9	91	26.5	11.0	10.4		4.876
12-Sep-91	4S	2.5	12	9	91	26.1	11.1	7.5		5.076
12-Sep-91	4S	3.0	12	9	91	26.1	11.5	6.9	8.1	5.375
12-Sep-91	4P	0.0	12	9	91	27.0	11.0	11.8	8.1	4.717
12-Sep-91	4P	0.5	12	9	91	27.0	11.0	11.8		4.717
12-Sep-91	4P	1.0	12	9	91	27.0	11.0	11.4		4.717
12-Sep-91	4P	1.5	12	9	91	26.9	11.0	10.4		4.749
12-Sep-91	4P	2.0	12	9	91	26.5	11.0	8.3		4.876
12-Sep-91	4P	2.5	12	9	91	26.0	11.0	5.4	8.1	5.033

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
12-Sep-91	5	S	12	9	91					
12-Sep-91	5	B	12	9	91					
12-Sep-91	5N	0.0	12	9	91	26.5	10.0	11.2	8.3	4.130
12-Sep-91	5N	0.5	12	9	91	26.5	10.0	11.0		4.130
12-Sep-91	5N	1.0	12	9	91	26.5	10.0	10.8		4.130
12-Sep-91	5N	1.5	12	9	91	26.5	10.0	10.4		4.130
12-Sep-91	5N	2.0	12	9	91	26.1	10.0	8.5		4.255
12-Sep-91	5N	2.5	12	9	91	26.0	10.0	5.6	8.2	4.286
12-Sep-91	5S	0.0	12	9	91	26.9	9.0	12.2	8.2	3.259
12-Sep-91	5S	0.5	12	9	91	27.0	9.0	12.4		3.227
12-Sep-91	5S	1.0	12	9	91	27.0	9.0	12.3		3.227
12-Sep-91	5S	1.5	12	9	91	27.0	9.0	12.2		3.227
12-Sep-91	5S	2.0	12	9	91	27.0	9.0	11.5		3.227
12-Sep-91	5S	2.5	12	9	91	26.5	9.0	5.5		3.384
12-Sep-91	5S	3.0	12	9	91	26.0	10.0	4.7	8.2	4.286
12-Sep-91	6	0.0	12	9	91	27.1	8.0	12.0	8.4	2.451
12-Sep-91	6	0.5	12	9	91	27.0	8.0	12.2		2.482
12-Sep-91	6	1.0	12	9	91	27.0	8.0	11.6		2.482
12-Sep-91	6	1.5	12	9	91	27.0	8.0	10.0		2.482
12-Sep-91	6	2.0	12	9	91	26.8	8.1	9.2		2.620
12-Sep-91	6	2.5	12	9	91	26.2	8.5	6.0		3.104
12-Sep-91	6	3.0	12	9	91	26.0	9.1	3.2	8.1	3.613
12-Sep-91	7	0.0	12	9	91	26.0	6.5	11.4	8.4	1.671
12-Sep-91	7	0.5	12	9	91	26.9	7.0	7.8		1.768
12-Sep-91	7	1.0	12	9	91	26.9	7.0	7.8		1.768
12-Sep-91	7	1.5	12	9	91	26.9	7.0	7.4		1.768
12-Sep-91	7	2.0	12	9	91	26.5	7.0	9.2		1.892
12-Sep-91	7	2.5	12	9	91	26.0	9.3	0.5	8.1	3.763
12-Sep-91	7N	S	12	9	91					
12-Sep-91	7N	B	12	9	91					
12-Sep-91	7S	0.0	12	9	91	27.0	7.1	12.4	8.3	1.812
12-Sep-91	7S	0.5	12	9	91	27.0	7.2	12.4		1.886
12-Sep-91	7S	1.0	12	9	91	27.0	7.2	12.2		1.886
12-Sep-91	7S	1.5	12	9	91	27.0	7.2	11.8		1.886
12-Sep-91	7S	2.0	12	9	91	27.0	7.2	11.2		1.886
12-Sep-91	7S	2.5	12	9	91	26.5	7.5	4.0		2.265
12-Sep-91	7S	3.0	12	9	91	26.0	8.5	1.0	8.2	3.165
12-Sep-91	8	0.0	12	9	91	26.5	6.0	11.1	8.2	1.146
12-Sep-91	8	0.5	12	9	91	26.9	6.0	11.2		1.023
12-Sep-91	8	1.0	12	9	91	27.8	6.0	10.6		0.739
12-Sep-91	8	1.5	12	9	91	26.2	6.2	3.6	8.2	1.387
12-Sep-91	9N	0.0	12	9	91	26.0	5.0	8.9	7.6	0.551
12-Sep-91	9N	0.5	12	9	91	26.0	5.0	8.3		0.551
12-Sep-91	9N	1.0	12	9	91	26.1	5.9	6.0		1.193
12-Sep-91	9N	1.5	12	9	91	26.1	6.1	3.4		1.342
12-Sep-91	9N	2.0	12	9	91	26.0	6.5	2.5	7.2	1.671
12-Sep-91	10	0.0	12	9	91	26.5	4.5	12.0	8.3	0.027
12-Sep-91	10	0.5	12	9	91	26.8	4.5	11.9		-0.064
12-Sep-91	10	1.0	12	9	91	26.9	4.3	11.4		-0.244
12-Sep-91	10	1.5	12	9	91	26.8	4.3	6.8		-0.213

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
12-Sep-91	10	2.0	12	9	91	26.1	6.0	0.4		1.268
12-Sep-91	10	2.5	12	9	91	26.0	6.5	0.2		1.671
12-Sep-91	10	3.0	12	9	91	26.0	6.8	0.1	7.1	1.895
12-Sep-91	11	0.0	12	9	91	26.9	3.9	12.9	8.3	-0.542
12-Sep-91	11	0.5	12	9	91	27.0	3.8	12.6		-0.647
12-Sep-91	11	1.0	12	9	91	27.0	3.8	12.0		-0.647
12-Sep-91	11	1.5	12	9	91	26.2	4.5	0.5	8.1	0.118
12-Sep-91	12	0.0	12	9	91	26.5	2.7	12.0	7.6	-1.315
12-Sep-91	12	0.5	12	9	91	27.0	2.7	12.0		-1.466
12-Sep-91	12	1.0	12	9	91	27.0	3.0	3.0		-1.243
12-Sep-91	12	1.5	12	9	91	26.9	4.0	3.7		-0.467
12-Sep-91	12	2.0	12	9	91	26.5	4.0	1.2		-0.346
12-Sep-91	12	2.5	12	9	91	26.5	4.2	0.9		-0.196
12-Sep-91	12	3.0	12	9	91	26.1	4.5	0.2		0.147
12-Sep-91	12	3.5	12	9	91	26.0	5.0	0.1	7.2	0.551
01-Oct-91	1	S	1	10	91					
01-Oct-91	1	B	1	10	91					
01-Oct-91	1A	0.0	1	10	91	22.5	12.5	8.8	8.1	7.167
01-Oct-91	1A	0.5	1	10	91	22.5	12.5	8.8		7.167
01-Oct-91	1A	1.0	1	10	91	22.5	12.5	8.6		7.167
01-Oct-91	1A	1.5	1	10	91	22.0	12.5	8.3		7.299
01-Oct-91	1A	2.0	1	10	91	22.0	12.5	8.0		7.299
01-Oct-91	1A	2.5	1	10	91	22.0	12.5	7.6		7.299
01-Oct-91	1A	3.0	1	10	91	22.0	12.5	7.2		7.299
01-Oct-91	1A	3.5	1	10	91	22.0	12.5	7.2	8.0	7.299
01-Oct-91	2S	0.0	1	10	91	23.0	13.9	8.4	8.0	8.086
01-Oct-91	2S	0.5	1	10	91	22.9	14.0	8.4		8.189
01-Oct-91	2S	1.0	1	10	91	22.5	13.9	8.5		8.222
01-Oct-91	2S	1.5	1	10	91	22.5	12.5	8.3		7.167
01-Oct-91	2S	2.0	1	10	91	22.0	12.5	7.6		7.299
01-Oct-91	2S	2.5	1	10	91	22.0	12.5	7.3	7.8	7.299
01-Oct-91	3	0.0	1	10	91	23.0	11.0	8.8	8.1	5.902
01-Oct-91	3	0.5	1	10	91	22.9	11.0	9.0		5.929
01-Oct-91	3	1.0	1	10	91	22.5	11.0	9.0		6.036
01-Oct-91	3	1.5	1	10	91	22.0	10.9	8.7		6.091
01-Oct-91	3	2.0	1	10	91	22.0	10.8	7.6	8.2	6.015
01-Oct-91	4N	0.0	1	10	91	23.0	10.5	7.8	8.0	5.526
01-Oct-91	4N	0.5	1	10	91	23.0	10.5	7.6		5.526
01-Oct-91	4N	1.0	1	10	91	23.0	10.5	7.6		5.526
01-Oct-91	4N	1.5	1	10	91	23.0	10.5	7.6	8.0	5.526
01-Oct-91	4S	0.0	1	10	91	23.0	11.0	9.5	8.1	5.902
01-Oct-91	4S	0.5	1	10	91	23.0	11.0	9.0		5.902
01-Oct-91	4S	1.0	1	10	91	23.0	11.0	9.0		5.902
01-Oct-91	4S	1.5	1	10	91	22.5	11.0	9.0		6.036
01-Oct-91	4S	2.0	1	10	91	22.5	10.9	8.7	8.1	5.960
01-Oct-91	4P	0.0	1	10	91	23.0	10.1	9.0	8.1	5.224
01-Oct-91	4P	0.5	1	10	91	23.0	10.1	9.0		5.224
01-Oct-91	4P	1.0	1	10	91	22.0	10.1	8.7		5.487
01-Oct-91	4P	1.5	1	10	91	22.0	10.1	8.5		5.487
01-Oct-91	4P	2.0	1	10	91	22.0	10.1	8.0	8.0	5.487

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
01-Oct-91	5	0.0	1	10	91	23.0	9.0	8.7	8.2	4.396
01-Oct-91	5	0.5	1	10	91	23.0	9.0	8.7		4.396
01-Oct-91	5	1.0	1	10	91	23.0	9.0	8.7		4.396
01-Oct-91	5	1.5	1	10	91	23.0	9.0	8.7		4.396
01-Oct-91	5	2.0	1	10	91	22.5	9.0	8.4		4.528
01-Oct-91	5	2.5	1	10	91	22.0	9.0	7.7		4.656
01-Oct-91	5	3.0	1	10	91	22.0	9.0	6.7		4.656
01-Oct-91	5	3.5	1	10	91	22.0	9.2	5.5		4.807
01-Oct-91	5	4.0	1	10	91	22.0	9.8	4.9	7.9	5.260
01-Oct-91	5N	0.0	1	10	91	23.0	9.0	8.5	8.2	4.396
01-Oct-91	5N	0.5	1	10	91	23.0	9.0	8.6		4.396
01-Oct-91	5N	1.0	1	10	91	23.0	9.0	8.6		4.396
01-Oct-91	5N	1.5	1	10	91	23.2	9.0	8.5		4.342
01-Oct-91	5N	2.0	1	10	91	23.2	9.1	8.0	8.1	4.418
01-Oct-91	5S	0.0	1	10	91	22.5	9.0	8.1	8.0	4.528
01-Oct-91	5S	0.5	1	10	91	22.1	9.0	8.0		4.631
01-Oct-91	5S	1.0	1	10	91	22.0	9.0	7.0		4.656
01-Oct-91	5S	1.5	1	10	91	22.0	9.0	6.9		4.656
01-Oct-91	5S	2.0	1	10	91	22.0	9.0	7.0		4.656
01-Oct-91	5S	2.5	1	10	91	22.0	9.0	6.3		4.656
01-Oct-91	5S	3.0	1	10	91	22.0	9.0	6.0	7.8	4.656
01-Oct-91	6	0.0	1	10	91	23.0	8.0	8.0	7.8	3.643
01-Oct-91	6	0.5	1	10	91	23.0	8.0	8.0		3.643
01-Oct-91	6	1.0	1	10	91	22.5	8.0	7.8		3.774
01-Oct-91	6	1.5	1	10	91	22.0	8.0	7.8		3.901
01-Oct-91	6	2.0	1	10	91	21.9	8.0	7.7		3.927
01-Oct-91	6	2.5	1	10	91	21.9	8.0	5.8	7.7	3.927
01-Oct-91	7	0.0	1	10	91	23.0	6.1	9.0	8.1	2.212
01-Oct-91	7	0.5	1	10	91	22.0	6.1	8.5		2.467
01-Oct-91	7	1.0	1	10	91	22.0	7.9	8.5		3.826
01-Oct-91	7	1.5	1	10	91	22.0	7.0	8.2		3.146
01-Oct-91	7	2.0	1	10	91	22.0	7.2	3.8		3.297
01-Oct-91	7	2.5	1	10	91	22.1	8.0	3.1		3.876
01-Oct-91	7	3.0	1	10	91	22.5	8.0	2.8		3.774
01-Oct-91	7	3.5	1	10	91	22.5	8.0	2.8	7.7	3.774
01-Oct-91	7N	0.0	1	10	91	23.0	8.0	8.5	8.2	3.643
01-Oct-91	7N	0.5	1	10	91	23.0	8.0	8.6		3.643
01-Oct-91	7N	1.0	1	10	91	23.0	8.0	8.6		3.643
01-Oct-91	7N	1.5	1	10	91	23.0	8.0	8.5		3.643
01-Oct-91	7N	2.0	1	10	91	23.0	8.0	8.5		3.643
01-Oct-91	7N	2.5	1	10	91	23.0	8.0	5.4		3.643
01-Oct-91	7N	3.0	1	10	91	22.8	8.2	4.7		3.846
01-Oct-91	7N	3.5	1	10	91	22.8	8.5	4.4		4.072
01-Oct-91	7N	4.0	1	10	91	22.8	8.5	4.3	7.8	4.072
01-Oct-91	7S	0.0	1	10	91	23.0	7.0	8.7	7.8	2.890
01-Oct-91	7S	0.5	1	10	91	23.0	7.1	8.6		2.965
01-Oct-91	7S	1.0	1	10	91	22.5	7.0	8.6		3.020
01-Oct-91	7S	1.5	1	10	91	22.0	7.0	8.1		3.146
01-Oct-91	7S	2.0	1	10	91	22.0	7.1	6.8		3.222
01-Oct-91	7S	2.5	1	10	91	22.0	7.5	6.2	7.9	3.524

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
01-Oct-91	8	0.0	1	10	91	22.0	4.1	9.1	8.2	0.957
01-Oct-91	8	0.5	1	10	91	22.0	4.8	6.8		1.485
01-Oct-91	8	1.0	1	10	91	22.0	5.1	5.8		1.712
01-Oct-91	8	1.5	1	10	91	22.0	5.5	4.4	8.0	2.014
01-Oct-91	9N	0.0	1	10	91	22.0	3.0	9.8	7.1	0.126
01-Oct-91	9N	0.5	1	10	91	22.5	4.0	9.8		0.758
01-Oct-91	9N	1.0	1	10	91	22.8	4.0	8.7		0.682
01-Oct-91	9N	1.5	1	10	91	23.0	4.5	6.1	7.4	1.008
01-Oct-91	9S	0.0	1	10	91	21.8	2.8	11.4	8.4	0.024
01-Oct-91	9S	0.5	1	10	91	21.9	3.0	10.0		0.151
01-Oct-91	9S	1.0	1	10	91	21.9	3.1	9.3		0.226
01-Oct-91	9S	1.5	1	10	91	21.9	3.9	4.3	8.3	0.830
01-Oct-91	10	0.0	1	10	91	22.0	2.0	12.2		-0.629
01-Oct-91	10	0.5	1	10	91	22.0	2.0	11.5		-0.629
01-Oct-91	10	1.0	1	10	91	22.0	2.9	7.5		0.051
01-Oct-91	10	1.5	1	10	91	22.5	3.8	4.5		0.607
01-Oct-91	10	2.0	1	10	91	22.5	4.0	3.0		0.758
01-Oct-91	10	2.5	1	10	91	22.0	4.2	2.4	7.7	1.032
01-Oct-91	11	0.0	1	10	91	22.5	1.0	8.9	8.2	-1.504
01-Oct-91	11	0.5	1	10	91	22.5	1.0	8.7		-1.504
01-Oct-91	11	1.0	1	10	91	22.5	1.1	6.8		-1.429
01-Oct-91	11	1.5	1	10	91	22.5	1.5	4.2	7.8	-1.127
01-Oct-91	12	0.0	1	10	91	22.0	0.5	3.8	7.5	-1.761
01-Oct-91	12	0.5	1	10	91	22.0	0.5	3.6		-1.761
01-Oct-91	12	1.0	1	10	91	22.0	0.5	3.4		-1.761
01-Oct-91	12	1.5	1	10	91	22.0	0.5	2.9		-1.761
01-Oct-91	12	2.0	1	10	91	22.0	1.0	2.0	7.0	-1.384
24-Oct-91	1	0.0	24	10	91	20.0	19.7	9.0	8.2	13.260
24-Oct-91	1	0.5	24	10	91	19.5	19.7	9.4		13.384
24-Oct-91	1	1.0	24	10	91	19.0	19.9	9.3		13.656
24-Oct-91	1	1.5	24	10	91	18.5	19.9	9.3		13.773
24-Oct-91	1	2.0	24	10	91	18.1	20.1	9.2		14.017
24-Oct-91	1	2.5	24	10	91	18.0	20.1	8.5		14.040
24-Oct-91	1	3.0	24	10	91	18.0	20.2	8.0		14.116
24-Oct-91	1	3.5	24	10	91	17.8	20.2	6.9		14.161
24-Oct-91	1	4.0	24	10	91	17.8	20.2			14.161
24-Oct-91	1	4.5	24	10	91	17.5	20.7		8.0	14.609
24-Oct-91	1A	0.0	24	10	91	19.0	14.4	9.5	8.3	9.471
24-Oct-91	1A	0.5	24	10	91	18.0	14.4	9.7		9.691
24-Oct-91	1A	1.0	24	10	91	17.5	14.6	9.8		9.949
24-Oct-91	1A	1.5	24	10	91	17.2	15.5	9.6		10.699
24-Oct-91	1A	2.0	24	10	91	17.2	16.7	9.1		11.616
24-Oct-91	1A	2.5	24	10	91	17.5	16.9	8.7		11.706
24-Oct-91	1A	3.0	24	10	91	17.5	18.0	8.5		12.547
24-Oct-91	1A	3.5	24	10	91	17.2	18.8	7.5		13.222
24-Oct-91	1A	4.0	24	10	91	17.2	18.9	7.4	8.1	13.298
24-Oct-91	2S	0.0	24	10	91	18.8	14.1	9.4	8.3	9.287
24-Oct-91	2S	0.5	24	10	91	18.0	14.1	9.6		9.462
24-Oct-91	2S	1.0	24	10	91	17.5	14.7	9.7		10.025
24-Oct-91	2S	1.5	24	10	91	17.5	14.7	9.7		10.025

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
24-Oct-91	2S	2.0	24	10	91	17.5	14.7	9.7		10.025
24-Oct-91	2S	2.5	24	10	91	17.5	14.8	8.4	8.2	10.102
24-Oct-91	3	0.0	24	10	91	19.0	12.5	9.5	8.5	8.025
24-Oct-91	3	0.5	24	10	91	18.0	12.8	10.2		8.470
24-Oct-91	3	1.0	24	10	91	17.5	12.8	10.2		8.574
24-Oct-91	3	1.5	24	10	91	17.9	12.8	10.2		8.491
24-Oct-91	3	2.0	24	10	91	17.8	13.2	10.0	8.4	8.817
24-Oct-91	4N	0.0	24	10	91	19.8	12.6	10.6	8.4	7.918
24-Oct-91	4N	0.5	24	10	91	19.1	12.7	10.4		8.154
24-Oct-91	4N	1.0	24	10	91	19.0	12.9	10.4		8.329
24-Oct-91	4N	1.5	24	10	91	18.0	13.9	6.4		9.309
24-Oct-91	4N	2.0	24	10	91	17.9	15.1	3.2	7.9	10.246
24-Oct-91	4S	0.0	24	10	91	18.0	12.0	8.5	8.0	7.860
24-Oct-91	4S	0.5	24	10	91	17.5	12.0	8.5		7.963
24-Oct-91	4S	1.0	24	10	91	17.5	12.2	9.0		8.115
24-Oct-91	4S	1.5	24	10	91	17.5	13.5	6.3		9.109
24-Oct-91	4S	2.0	24	10	91	17.2	14.1	6.0	7.8	9.628
24-Oct-91	4P	0.0	24	10	91	19.0	11.7	9.0	8.3	7.416
24-Oct-91	4P	0.5	24	10	91	18.0	11.7	9.3		7.631
24-Oct-91	4P	1.0	24	10	91	17.5	11.7	9.3		7.733
24-Oct-91	4P	1.5	24	10	91	17.5	11.7	9.0		7.733
24-Oct-91	4P	2.0	24	10	91	17.5	11.9	7.0	8.0	7.886
24-Oct-91	5	0.0	24	10	91	18.8	10.6	10.6	8.2	6.622
24-Oct-91	5	0.5	24	10	91	18.0	10.6	10.6		6.791
24-Oct-91	5	1.0	24	10	91	17.5	10.6	10.0		6.893
24-Oct-91	5	1.5	24	10	91	17.0	11.3	8.0		7.527
24-Oct-91	5	2.0	24	10	91	17.0	11.3	7.4		7.527
24-Oct-91	5	2.5	24	10	91	17.0	12.3	7.2		8.292
24-Oct-91	5	3.0	24	10	91	17.0	14.1	6.5		9.669
24-Oct-91	5	3.5	24	10	91	17.5	15.2	4.7		10.407
24-Oct-91	5	4.0	24	10	91	18.0	16.8	3.4	7.7	11.522
24-Oct-91	5N	0.0	24	10	91	20.5	10.8	10.8	8.5	6.388
24-Oct-91	5N	0.5	24	10	91	19.2	10.7	11.0		6.611
24-Oct-91	5N	1.0	24	10	91	19.0	10.7	9.8		6.655
24-Oct-91	5N	1.5	24	10	91	19.0	10.7	7.7		6.655
24-Oct-91	5N	2.0	24	10	91	19.8	13.5	5.6	8.1	8.602
24-Oct-91	5S	0.0	24	10	91	18.0	10.3	9.7	8.2	6.562
24-Oct-91	5S	0.5	24	10	91	17.2	10.5	9.8		6.876
24-Oct-91	5S	1.0	24	10	91	17.1	10.8	6.7		7.125
24-Oct-91	5S	1.5	24	10	91	17.1	11.9	5.7		7.966
24-Oct-91	5S	2.0	24	10	91	17.1	13.0	5.5		8.807
24-Oct-91	5S	2.5	24	10	91	17.5	13.4	4.3		9.032
24-Oct-91	5S	3.0	24	10	91	17.8	13.9	3.4	7.7	9.352
24-Oct-91	6	0.0	24	10	91	18.5	10.5	10.3	8.2	6.610
24-Oct-91	6	0.5	24	10	91	18.0	10.5	10.1		6.715
24-Oct-91	6	1.0	24	10	91	17.5	10.5	9.8		6.817
24-Oct-91	6	1.5	24	10	91	17.5	10.4	4.7		6.740
24-Oct-91	6	2.0	24	10	91	18.0	11.3	3.1	7.7	7.325
24-Oct-91	7	0.0	24	10	91	18.0	8.5	9.8	8.1	5.189
24-Oct-91	7	0.5	24	10	91	17.2	8.5	9.8		5.347

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
24-Oct-91	7	1.0	24	10	91	17.2	8.5	9.8		5.347
24-Oct-91	7	1.5	24	10	91	17.0	8.5	6.2		5.385
24-Oct-91	7	2.0	24	10	91	17.2	8.5	2.5		5.347
24-Oct-91	7	2.5	24	10	91	17.0	8.5	1.7		5.385
24-Oct-91	7	3.0	24	10	91	17.0	8.5	1.3	7.7	5.385
24-Oct-91	7N	0.0	24	10	91	22.0	9.5	10.8	8.5	5.034
24-Oct-91	7N	0.5	24	10	91	20.1	9.8	10.4		5.723
24-Oct-91	7N	1.0	24	10	91	19.1	9.8	10.4		5.948
24-Oct-91	7N	1.5	24	10	91	19.0	9.7	10.4		5.894
24-Oct-91	7N	2.0	24	10	91	18.5	9.9	4.9		6.153
24-Oct-91	7N	2.5	24	10	91	18.0	12.4	3.2		8.165
24-Oct-91	7N	3.0	24	10	91	18.0	14.0	3.0		9.386
24-Oct-91	7N	3.5	24	10	91	17.9	14.0	3.1	8.0	9.407
24-Oct-91	7S	0.0	24	10	91	17.5	8.9	9.0	8.1	5.594
24-Oct-91	7S	0.5	24	10	91	17.0	9.1	9.5		5.844
24-Oct-91	7S	1.0	24	10	91	17.0	9.1	9.5		5.844
24-Oct-91	7S	1.5	24	10	91	17.0	9.1	6.1		5.844
24-Oct-91	7S	2.0	24	10	91	17.2	9.1	4.6	7.9	5.805
24-Oct-91	8	0.0	24	10	91	18.2	6.5	9.1	8.1	3.623
24-Oct-91	8	0.5	24	10	91	17.9	6.5	8.7		3.683
24-Oct-91	8	1.0	24	10	91	17.2	6.7	8.1		3.970
24-Oct-91	8	1.5	24	10	91	17.1	6.7	4.5		3.989
24-Oct-91	8	2.0	24	10	91	17.5	6.7	2.9		3.913
24-Oct-91	8	2.5	24	10	91	17.9	6.7	2.1		3.835
24-Oct-91	8	3.0	24	10	91	18.0	6.7	1.8		3.816
24-Oct-91	8	3.5	24	10	91	18.0	6.7	1.5	7.8	3.816
24-Oct-91	9N	0.0	24	10	91	18.9	5.2	12.6	9.0	2.490
24-Oct-91	9N	0.5	24	10	91	18.8	5.2	12.0		2.511
24-Oct-91	9N	1.0	24	10	91	18.6	5.2	10.4		2.552
24-Oct-91	9N	1.5	24	10	91	17.4	5.2	3.2		2.786
24-Oct-91	9N	2.0	24	10	91	18.5	5.2			2.572
24-Oct-91	9N	2.5	24	10	91	18.3	5.2		8.6	2.612
24-Oct-91	9S	0.0	24	10	91	18.5	4.6	12.5	8.9	2.115
24-Oct-91	9S	0.5	24	10	91	18.1	4.6	12.5		2.194
24-Oct-91	9S	1.0	24	10	91	18.1	4.6	11.2		2.194
24-Oct-91	9S	1.5	24	10	91	18.0	4.6	2.6	8.1	2.213
24-Oct-91	10	0.0	24	10	91	19.5	3.9	12.8	8.8	1.376
24-Oct-91	10	0.5	24	10	91	19.4	3.9	7.4		1.397
24-Oct-91	10	1.0	24	10	91	18.3	3.8	7.6		1.545
24-Oct-91	10	1.5	24	10	91	18.2	3.9	7.2		1.640
24-Oct-91	10	2.0	24	10	91	18.0	4.0	0.6		1.756
24-Oct-91	10	2.5	24	10	91	17.7	4.0			1.813
24-Oct-91	10	3.0	24	10	91	17.9	4.0		7.9	1.775
24-Oct-91	11	0.0	24	10	91	19.4	3.2	12.6	8.9	0.865
24-Oct-91	11	0.5	24	10	91	18.5	3.1	12.0		0.972
24-Oct-91	11	1.0	24	10	91	17.9	3.1	3.0		1.088
24-Oct-91	11	1.5	24	10	91	17.7	3.1	3.0		1.126
24-Oct-91	11	2.0	24	10	91	17.6	3.0		8.9	1.068
24-Oct-91	12	0.0	24	10	91	18.0	2.2	6.7	8.2	0.382
24-Oct-91	12	0.5	24	10	91	18.0	2.2	6.3		0.382

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
24-Oct-91	12	1.0	24	10	91	18.0	2.2	3.5	7.8	0.382
12-Nov-91	1	0.0	12	11	91	11.9	15.0	13.2	8.1	11.223
12-Nov-91	1	0.5	12	11	91	11.9	15.0	13.1		11.223
12-Nov-91	1	1.0	12	11	91	12.0	15.0	13.0		11.210
12-Nov-91	1	1.5	12	11	91	11.9	15.0	13.0		11.223
12-Nov-91	1	2.0	12	11	91	11.9	15.0	13.0		11.223
12-Nov-91	1	2.5	12	11	91	11.8	15.0	12.9		11.237
12-Nov-91	1	3.0	12	11	91	11.5	15.0	12.9		11.277
12-Nov-91	1	3.5	12	11	91	11.5	15.0	12.8		11.277
12-Nov-91	1	4.0	12	11	91	11.5	15.0	12.8		11.277
12-Nov-91	1	4.5	12	11	91	11.5	15.0	12.7		11.277
12-Nov-91	1	5.0	12	11	91	11.5	15.0	12.6		11.277
12-Nov-91	1	5.5	12	11	91	11.5	15.0	12.4	8.1	11.277
12-Nov-91	1A	0.0	12	11	91	11.5	14.0	14.2	8.0	10.501
12-Nov-91	1A	0.5	12	11	91	11.7	14.2	13.0		10.630
12-Nov-91	1A	1.0	12	11	91	11.8	14.5	13.0		10.849
12-Nov-91	1A	1.5	12	11	91	11.5	14.5	13.0		10.889
12-Nov-91	1A	2.0	12	11	91	11.6	14.5	12.9		10.876
12-Nov-91	1A	2.5	12	11	91	11.5	14.5	12.8		10.889
12-Nov-91	1A	3.0	12	11	91	11.5	14.5	12.8		10.889
12-Nov-91	1A	3.5	12	11	91	11.5	14.5	12.7		10.889
12-Nov-91	1A	4.0	12	11	91	11.5	14.5	12.6		10.889
12-Nov-91	1A	4.5	12	11	91	11.5	14.5	12.6		10.889
12-Nov-91	1A	5.0	12	11	91	11.5	14.5	12.5		10.889
12-Nov-91	1A	5.5	12	11	91	11.5	14.6	12.5	8.0	10.967
12-Nov-91	2S	0.0	12	11	91	10.9	11.2	13.2		8.401
12-Nov-91	2S	0.5	12	11	91	11.0	11.5	13.0		8.622
12-Nov-91	2S	1.0	12	11	91	11.0	11.5	13.0		8.622
12-Nov-91	2S	1.5	12	11	91	11.0	11.5	13.1		8.622
12-Nov-91	2S	2.0	12	11	91	11.1	11.5	13.0		8.610
12-Nov-91	2S	2.5	12	11	91	11.1	11.5	13.1		8.610
12-Nov-91	2S	3.0	12	11	91	11.0	11.5	13.0		8.622
12-Nov-91	2S	3.5	12	11	91	10.9	11.5	12.8	8.1	8.634
12-Nov-91	3	0.0	12	11	91	10.9	11.9	13.5	7.7	8.945
12-Nov-91	3	0.5	12	11	91	11.1	11.9	13.5		8.921
12-Nov-91	3	1.0	12	11	91	11.1	11.9	13.4		8.921
12-Nov-91	3	1.5	12	11	91	11.1	11.9	13.4		8.921
12-Nov-91	3	2.0	12	11	91	11.1	12.0	13.3		8.999
12-Nov-91	3	2.5	12	11	91	11.0	12.0	13.2		9.011
12-Nov-91	3	3.0	12	11	91	11.0	12.1	13.1	7.8	9.088
12-Nov-91	4N	0.0	12	11	91	11.1	12.6	13.6	8.0	9.465
12-Nov-91	4N	0.5	12	11	91	11.8	12.6	13.5		9.376
12-Nov-91	4N	1.0	12	11	91	11.8	12.5	13.6		9.299
12-Nov-91	4N	1.5	12	11	91	11.9	12.5	13.5		9.285
12-Nov-91	4N	2.0	12	11	91	11.5	12.5	13.5		9.337
12-Nov-91	4N	2.5	12	11	91	11.2	12.5	13.0		9.375
12-Nov-91	4N	3.0	12	11	91	11.2	12.9	12.5	8.0	9.685
12-Nov-91	4S	0.0	12	11	91	11.0	11.1	13.2	7.7	8.311
12-Nov-91	4S	0.5	12	11	91	11.1	11.1	13.2		8.300
12-Nov-91	4S	1.0	12	11	91	11.1	11.1	13.2		8.300

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
12-Nov-91	4S	1.5	12	11	91	11.1	11.1	13.2		8.300
12-Nov-91	4S	2.0	12	11	91	11.1	11.1	13.1		8.300
12-Nov-91	4S	2.5	12	11	91	11.1	11.1	13.0		8.300
12-Nov-91	4S	3.0	12	11	91	11.0	11.1	13.0	7.4	8.311
12-Nov-91	4P	0.0	12	11	91	10.9	10.0	13.5	7.6	7.468
12-Nov-91	4P	0.5	12	11	91	10.9	10.0	13.5		7.468
12-Nov-91	4P	1.0	12	11	91	10.9	10.0	13.5		7.468
12-Nov-91	4P	1.5	12	11	91	10.8	10.1	13.4		7.557
12-Nov-91	4P	2.0	12	11	91	10.8	10.1	13.4		7.557
12-Nov-91	4P	2.5	12	11	91	10.9	10.9	12.8		8.168
12-Nov-91	4P	3.0	12	11	91	11.2	12.0	11.0	7.8	8.987
12-Nov-91	5	0.0	12	11	91	11.5	11.5	13.4	7.4	8.561
12-Nov-91	5	0.5	12	11	91	11.1	11.5	13.4		8.610
12-Nov-91	5	1.0	12	11	91	11.1	11.2	13.4		8.377
12-Nov-91	5	1.5	12	11	91	11.1	11.2	13.4		8.377
12-Nov-91	5	2.0	12	11	91	11.1	11.5	13.2		8.610
12-Nov-91	5	2.5	12	11	91	11.1	11.5	13.1		8.610
12-Nov-91	5	3.0	12	11	91	11.1	11.5	13.0		8.610
12-Nov-91	5	3.5	12	11	91	11.1	11.5	12.9		8.610
12-Nov-91	5	4.0	12	11	91	11.1	11.5	12.8		8.610
12-Nov-91	5	4.5	12	11	91	11.1	11.5	12.7		8.610
12-Nov-91	5	5.0	12	11	91	11.1	11.5	12.5	7.6	8.610
12-Nov-91	5N	0.0	12	11	91	11.3	11.0	12.9	8.0	8.198
12-Nov-91	5N	0.5	12	11	91	11.3	11.0	12.8		8.198
12-Nov-91	5N	1.0	12	11	91	11.2	11.0	12.8		8.210
12-Nov-91	5N	1.5	12	11	91	11.2	11.0	12.8		8.210
12-Nov-91	5N	2.0	12	11	91	11.2	11.2	12.7		8.365
12-Nov-91	5N	2.5	12	11	91	11.5	11.5	12.5		8.561
12-Nov-91	5N	3.0	12	11	91	11.9	11.9	12.1	7.9	8.820
12-Nov-91	5S	0.0	12	11	91	11.0	10.5	13.2	7.6	7.845
12-Nov-91	5S	0.5	12	11	91	11.1	10.5	12.8		7.834
12-Nov-91	5S	1.0	12	11	91	11.1	10.5	12.8		7.834
12-Nov-91	5S	1.5	12	11	91	11.1	10.5	12.8		7.834
12-Nov-91	5S	2.0	12	11	91	11.0	10.5	12.8		7.845
12-Nov-91	5S	2.5	12	11	91	11.0	10.9	12.7		8.156
12-Nov-91	5S	3.0	12	11	91	11.1	11.0	12.5		8.222
12-Nov-91	5S	3.5	12	11	91	11.1	11.0	12.4		8.222
12-Nov-91	5S	4.0	12	11	91	11.1	11.0	12.3	7.7	8.222
12-Nov-91	6	0.0	12	11	91	10.5	9.8	13.0	7.5	7.358
12-Nov-91	6	0.5	12	11	91	10.5	10.0	12.9		7.513
12-Nov-91	6	1.0	12	11	91	10.8	10.1	12.8		7.557
12-Nov-91	6	1.5	12	11	91	11.0	10.5	12.6		7.845
12-Nov-91	6	2.0	12	11	91	11.0	10.5	12.5		7.845
12-Nov-91	6	2.5	12	11	91	11.0	10.8	12.5		8.078
12-Nov-91	6	3.0	12	11	91	11.1	10.9	12.5		8.144
12-Nov-91	6	3.5	12	11	91	11.0	10.9	12.5		8.156
12-Nov-91	6	4.0	12	11	91	11.1	10.8	12.4		8.067
12-Nov-91	6	4.5	12	11	91	11.1	10.8	12.4	7.7	8.067
12-Nov-91	7	0.0	12	11	91	10.9	10.0	13.2	7.7	7.468
12-Nov-91	7	0.5	12	11	91	10.1	10.5	12.8		7.945

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
12-Nov-91	7	1.0	12	11	91	11.1	10.5	12.8		7.834
12-Nov-91	7	1.5	12	11	91	11.0	10.6	12.7		7.923
12-Nov-91	7	2.0	12	11	91	11.0	10.7	12.5		8.001
12-Nov-91	7	2.5	12	11	91	11.1	10.9	12.4		8.144
12-Nov-91	7	3.0	12	11	91	11.2	11.1	12.2		8.288
12-Nov-91	7	3.5	12	11	91	11.2	11.1	12.0		8.288
12-Nov-91	7	4.0	12	11	91	11.2	11.1	12.0	7.7	8.288
12-Nov-91	7N	0.0	12	11	91	11.1	10.8	13.6	7.9	8.067
12-Nov-91	7N	0.5	12	11	91	10.8	11.0	13.5		8.257
12-Nov-91	7N	1.0	12	11	91	11.8	10.9	13.5		8.058
12-Nov-91	7N	1.5	12	11	91	11.8	10.9	13.5		8.058
12-Nov-91	7N	2.0	12	11	91	11.8	10.9	13.5		8.058
12-Nov-91	7N	2.5	12	11	91	11.2	10.9	13.4		8.132
12-Nov-91	7N	3.0	12	11	91	11.1	11.1	12.8		8.300
12-Nov-91	7N	3.5	12	11	91	11.5	11.9	12.4		8.872
12-Nov-91	7N	4.0	12	11	91	12.0	12.1	11.8		8.962
12-Nov-91	7N	4.5	12	11	91	12.1	12.5	11.2		9.259
12-Nov-91	7N	5.0	12	11	91	11.2	12.5	11.0		9.375
12-Nov-91	7N	5.5	12	11	91	11.2	12.5	10.8	7.9	9.375
12-Nov-91	7S	0.0	12	11	91	10.9	10.5	12.6	7.6	7.857
12-Nov-91	7S	0.5	12	11	91	11.0	10.5	12.6		7.845
12-Nov-91	7S	1.0	12	11	91	11.0	10.5	12.6		7.845
12-Nov-91	7S	1.5	12	11	91	11.0	10.5	12.5		7.845
12-Nov-91	7S	2.0	12	11	91	11.1	10.8	12.3		8.067
12-Nov-91	7S	2.5	12	11	91	11.1	10.9	11.8		8.144
12-Nov-91	7S	3.0	12	11	91	11.2	11.0	11.7	7.7	8.210
12-Nov-91	8	0.0	12	11	91	10.8	10.1	12.8	7.7	7.557
12-Nov-91	8	0.5	12	11	91	10.8	10.1	12.5		7.557
12-Nov-91	8	1.0	12	11	91	10.9	10.2	12.2		7.624
12-Nov-91	8	1.5	12	11	91	10.8	10.2	12.2		7.635
12-Nov-91	8	2.0	12	11	91	11.0	10.2	12.1		7.612
12-Nov-91	8	2.5	12	11	91	11.0	10.2	12.1		7.612
12-Nov-91	8	3.0	12	11	91	11.1	10.5	12.1		7.834
12-Nov-91	8	3.5	12	11	91	11.1	10.5	12.1		7.834
12-Nov-91	8	4.0	12	11	91	11.1	10.5	12.2		7.834
12-Nov-91	8	4.5	12	11	91	11.2	10.5	12.2	7.7	7.822
12-Nov-91	9N	0.0	12	11	91	11.5	10.1	13.2	7.8	7.475
12-Nov-91	9N	0.5	12	11	91	11.3	10.2	13.0		7.577
12-Nov-91	9N	1.0	12	11	91	11.2	10.1	13.0		7.511
12-Nov-91	9N	1.5	12	11	91	11.1	10.1	12.9		7.523
12-Nov-91	9N	2.0	12	11	91	11.0	10.1	12.8	7.7	7.534
12-Nov-91	9S	0.0	12	11	91	11.0	10.5	12.8	7.7	7.845
12-Nov-91	9S	0.5	12	11	91	11.0	10.5	12.5		7.845
12-Nov-91	9S	1.0	12	11	91	11.0	10.5	12.5		7.845
12-Nov-91	9S	1.5	12	11	91	11.0	10.5	12.5		7.845
12-Nov-91	9S	2.0	12	11	91	11.0	10.5	12.4		7.845
12-Nov-91	9S	2.5	12	11	91	11.0	10.5	12.2	7.7	7.845
12-Nov-91	10	0.0	12	11	91	10.8	10.5	13.0	7.5	7.868
12-Nov-91	10	0.5	12	11	91	11.0	10.5	12.5		7.845
12-Nov-91	10	1.0	12	11	91	11.0	10.5	12.5		7.845

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
12-Nov-91	10	1.5	12	11	91	11.0	10.5	12.4		7.845
12-Nov-91	10	2.0	12	11	91	11.0	10.5	12.3		7.845
12-Nov-91	10	2.5	12	11	91	10.9	10.5	12.2		7.857
12-Nov-91	10	3.0	12	11	91	10.9	10.5	12.0	7.6	7.857
12-Nov-91	11	0.0	12	11	91	10.8	9.9	13.2	7.5	7.402
12-Nov-91	11	0.5	12	11	91	10.8	9.9	13.2		7.402
12-Nov-91	11	1.0	12	11	91	10.8	9.9	13.2		7.402
12-Nov-91	11	1.5	12	11	91	10.7	9.9	13.4		7.413
12-Nov-91	11	2.0	12	11	91	10.5	9.9	13.3	7.4	7.435
12-Nov-91	12	0.0	12	11	91	11.0	8.0	11.2	7.3	5.903
12-Nov-91	12	0.5	12	11	91	11.0	8.0	11.2		5.903
12-Nov-91	12	1.0	12	11	91	11.0	8.1	11.1		5.980
12-Nov-91	12	1.5	12	11	91	11.0	8.1	11.1		5.980
12-Nov-91	12	2.0	12	11	91	11.1	9.2	10.5	7.2	6.824
26-Nov-91	1	S	26	11	91					
26-Nov-91	1	B	26	11	91					
26-Nov-91	1A	S	26	11	91					
26-Nov-91	1A	B	26	11	91					
26-Nov-91	2S	S	26	11	91					
26-Nov-91	2S	B	26	11	91					
26-Nov-91	3	0.0	26	11	91	12.0	14.0	12.0	7.6	10.435
26-Nov-91	3	0.5	26	11	91	12.1	14.0	12.0		10.421
26-Nov-91	3	1.0	26	11	91	12.1	14.0	12.0		10.421
26-Nov-91	3	1.5	26	11	91	12.1	14.0	12.0		10.421
26-Nov-91	3	2.0	26	11	91	12.1	14.0	12.0		10.421
26-Nov-91	3	2.5	26	11	91	12.1	14.0	11.9	7.6	10.421
26-Nov-91	4N	0.0	26	11	91	12.0	14.0	12.5	7.3	10.435
26-Nov-91	4N	0.5	26	11	91	12.1	14.0	12.0		10.421
26-Nov-91	4N	1.0	26	11	91	12.2	14.0	11.8		10.407
26-Nov-91	4N	1.5	26	11	91	12.2	14.0	11.7		10.407
26-Nov-91	4N	2.0	26	11	91	12.5	14.1	11.7		10.442
26-Nov-91	4N	2.5	26	11	91	12.5	14.1	11.6	7.5	10.442
26-Nov-91	4S	0.0	26	11	91	11.0	12.5	12.2	7.5	9.399
26-Nov-91	4S	0.5	26	11	91	12.0	12.5	12.0		9.272
26-Nov-91	4S	1.0	26	11	91	12.0	12.5	12.0		9.272
26-Nov-91	4S	1.5	26	11	91	12.0	12.5	12.0		9.272
26-Nov-91	4S	2.0	26	11	91	12.0	12.5	12.0		9.272
26-Nov-91	4S	2.5	26	11	91	12.0	12.5	12.0	7.5	9.272
26-Nov-91	4P	0.0	26	11	91	12.0	12.0	12.2	7.4	8.885
26-Nov-91	4P	0.5	26	11	91	12.0	12.0	11.8		8.885
26-Nov-91	4P	1.0	26	11	91	12.0	12.1	11.7		8.962
26-Nov-91	4P	1.5	26	11	91	12.0	12.1	11.4		8.962
26-Nov-91	4P	2.0	26	11	91	12.0	12.1	11.4		8.962
26-Nov-91	4P	2.5	26	11	91	12.0	12.1	11.4	7.4	8.962
26-Nov-91	5	0.0	26	11	91	12.5	12.5	11.8	7.4	9.204
26-Nov-91	5	0.5	26	11	91	12.5	12.5	11.8		9.204
26-Nov-91	5	1.0	26	11	91	12.5	12.5	11.9		9.204
26-Nov-91	5	1.5	26	11	91	12.5	12.5	11.8		9.204
26-Nov-91	5	2.0	26	11	91	12.5	12.5	11.8		9.204
26-Nov-91	5	2.5	26	11	91	12.5	12.5	11.7		9.204

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
26-Nov-91	5	3.0	26	11	91	12.5	12.5	11.7		9.204
26-Nov-91	5	3.5	26	11	91	12.5	12.5	11.6		9.204
26-Nov-91	5	4.0	26	11	91	12.5	12.5	11.6		9.204
26-Nov-91	5	4.5	26	11	91	12.5	12.5	11.6	7.5	9.204
26-Nov-91	5N	0.0	26	11	91	12.0	14.5	12.0	7.6	10.822
26-Nov-91	5N	0.5	26	11	91	12.2	15.0	11.6		11.182
26-Nov-91	5N	1.0	26	11	91	12.5	15.0	11.5		11.139
26-Nov-91	5N	1.5	26	11	91	12.5	15.0	11.5		11.139
26-Nov-91	5N	2.0	26	11	91	12.5	15.0	11.5		11.139
26-Nov-91	5N	2.5	26	11	91	12.5	15.0	11.5	7.6	11.139
26-Nov-91	5S	0.0	26	11	91	12.0	13.5	12.2	7.3	10.047
26-Nov-91	5S	0.5	26	11	91	12.0	13.5	12.1		10.047
26-Nov-91	5S	1.0	26	11	91	12.0	13.5	12.0		10.047
26-Nov-91	5S	1.5	26	11	91	12.0	13.5	12.0		10.047
26-Nov-91	5S	2.0	26	11	91	12.0	13.5	12.0		10.047
26-Nov-91	5S	2.5	26	11	91	12.0	13.5	12.1	7.3	10.047
26-Nov-91	5S	3.0	26	11	91	12.0	13.5	12.0	7.4	10.047
26-Nov-91	6	0.0	26	11	91	11.5	11.5	12.1	7.4	8.561
26-Nov-91	6	0.5	26	11	91	11.5	11.5	12.0		8.561
26-Nov-91	6	1.0	26	11	91	11.5	11.5	11.9		8.561
26-Nov-91	6	1.5	26	11	91	11.5	11.5	11.8		8.561
26-Nov-91	6	2.0	26	11	91	11.5	11.5	11.8		8.561
26-Nov-91	6	2.5	26	11	91	11.5	11.5	11.8		8.561
26-Nov-91	6	3.0	26	11	91	11.5	11.5	11.8		8.561
26-Nov-91	6	3.5	26	11	91	11.5	11.5	11.8		8.561
26-Nov-91	6	4.0	26	11	91	11.5	11.5	11.4		8.561
26-Nov-91	6	4.5	26	11	91	11.0	11.5	11.2	7.3	8.622
26-Nov-91	7	0.0	26	11	91	11.0	10.1	13.0	7.1	7.534
26-Nov-91	7	0.5	26	11	91	12.0	10.1	12.2		7.412
26-Nov-91	7	1.0	26	11	91	12.0	10.1	12.0		7.412
26-Nov-91	7	1.5	26	11	91	12.0	10.1	11.8		7.412
26-Nov-91	7	2.0	26	11	91	12.0	10.0	11.8		7.335
26-Nov-91	7	2.5	26	11	91	12.0	10.1	11.8		7.412
26-Nov-91	7	3.0	26	11	91	12.0	10.1	11.6		7.412
26-Nov-91	7	3.5	26	11	91	12.0	10.1	11.2	7.2	7.412
26-Nov-91	7N	0.0	26	11	91	12.0	13.0	12.6	7.6	9.660
26-Nov-91	7N	0.5	26	11	91	13.0	13.0	12.0		9.519
26-Nov-91	7N	1.0	26	11	91	13.0	13.0	11.8		9.519
26-Nov-91	7N	1.5	26	11	91	13.0	13.0	11.8		9.519
26-Nov-91	7N	2.0	26	11	91	12.8	13.0	11.6		9.548
26-Nov-91	7N	2.5	26	11	91	12.8	13.0	11.6		9.548
26-Nov-91	7N	3.0	26	11	91	12.8	13.0	11.6		9.548
26-Nov-91	7N	3.5	26	11	91	12.8	13.0	11.4		9.548
26-Nov-91	7N	4.0	26	11	91	12.8	13.0	11.4	7.6	9.548
26-Nov-91	7S	0.0	26	11	91	10.0	10.0	12.2	7.3	7.566
26-Nov-91	7S	0.5	26	11	91	10.1	10.1	11.9		7.634
26-Nov-91	7S	1.0	26	11	91	10.1	10.1	11.8		7.634
26-Nov-91	7S	1.5	26	11	91	10.9	10.9	11.6		8.168
26-Nov-91	7S	2.0	26	11	91	11.0	11.0	11.0		8.234
26-Nov-91	7S	2.5	26	11	91	12.0	11.5	10.6		8.497

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
26-Nov-91	7S	3.0	26	11	91	12.0	11.5	10.4	7.2	8.497
26-Nov-91	8	0.0	26	11	91	11.0	9.8	12.4	7.2	7.301
26-Nov-91	8	0.5	26	11	91	12.1	9.7	12.0		7.089
26-Nov-91	8	1.0	26	11	91	12.1	9.5	12.0		6.934
26-Nov-91	8	1.5	26	11	91	12.1	9.5	11.9		6.934
26-Nov-91	8	2.0	26	11	91	12.1	9.5	11.8		6.934
26-Nov-91	8	2.5	26	11	91	12.1	10.0	11.8	7.1	7.322
26-Nov-91	9N	0.0	26	11	91	12.0	10.5	11.2	6.9	7.722
26-Nov-91	9N	0.5	26	11	91	12.1	10.5	11.1		7.709
26-Nov-91	9N	1.0	26	11	91	12.2	10.1	11.1		7.386
26-Nov-91	9N	1.5	26	11	91	12.5	10.2	11.6		7.423
26-Nov-91	9N	2.0	26	11	91	12.5	10.2	11.0	6.9	7.423
26-Nov-91	9S	0.0	26	11	91	11.0	12.1	13.2	7.1	9.088
26-Nov-91	9S	0.5	26	11	91	11.1	12.0	12.1		8.999
26-Nov-91	9S	1.0	26	11	91	11.6	11.1	12.1		8.238
26-Nov-91	9S	1.5	26	11	91	12.4	11.2	12.1		8.211
26-Nov-91	9S	2.0	26	11	91	12.2	11.1	12.1		8.161
26-Nov-91	9S	2.5	26	11	91	12.2	11.5	12.5	7.1	8.470
26-Nov-91	10	0.0	26	11	91	11.0	8.5	13.0	7.1	6.291
26-Nov-91	10	0.5	26	11	91	12.0	8.5	12.6		6.172
26-Nov-91	10	1.0	26	11	91	12.0	8.5	12.6		6.172
26-Nov-91	10	1.5	26	11	91	12.0	8.5	12.6		6.172
26-Nov-91	10	2.0	26	11	91	12.0	8.5	12.6		6.172
26-Nov-91	10	2.5	26	11	91	12.0	9.0	12.2		6.560
26-Nov-91	10	3.0	26	11	91	13.0	10.8	11.4	7.0	7.818
26-Nov-91	11	0.0	26	11	91	11.0	8.0	13.4	7.3	5.903
26-Nov-91	11	0.5	26	11	91	11.1	8.1	12.9		5.969
26-Nov-91	11	1.0	26	11	91	11.1	8.1	12.6		5.969
26-Nov-91	11	1.5	26	11	91	11.1	8.0	12.6	7.3	5.892
26-Nov-91	12	0.0	26	11	91	11.0	6.1	13.8	7.2	4.426
26-Nov-91	12	0.5	26	11	91	11.0	6.1	13.6		4.426
26-Nov-91	12	1.0	26	11	91	11.0	6.0	13.4		4.349
26-Nov-91	12	1.5	26	11	91	11.0	6.5	13.2		4.737
26-Nov-91	12	2.0	26	11	91	11.5	8.1	13.0		5.923
26-Nov-91	12	2.5	26	11	91	13.0	13.2	8.0		9.673
26-Nov-91	12	3.0	26	11	91	14.0	14.1	7.6		10.213
26-Nov-91	12	3.5	26	11	91	14.0	14.1	7.6		10.213
26-Nov-91	12	4.0	26	11	91	14.0	14.5	7.6	7.3	10.521
09-Dec-91	1	S	9	12	91					
09-Dec-91	1	B	9	12	91					
09-Dec-91	1A	0.0	9	12	91	11.5	15.1	13.5	7.3	11.355
09-Dec-91	1A	0.5	9	12	91	11.5	15.1	13.5		11.355
09-Dec-91	1A	1.0	9	12	91	11.5	15.1	13.6		11.355
09-Dec-91	1A	1.5	9	12	91	11.5	15.1	13.5		11.355
09-Dec-91	1A	2.0	9	12	91	11.2	15.1	13.5		11.394
09-Dec-91	1A	2.5	9	12	91	11.1	15.1	13.5		11.407
09-Dec-91	1A	3.0	9	12	91	11.0	15.1	13.5		11.419
09-Dec-91	1A	3.5	9	12	91	10.9	15.1	13.4		11.432
09-Dec-91	1A	4.0	9	12	91	11.0	15.6	12.4		11.808
09-Dec-91	1A	4.5	9	12	91	11.1	16.8	11.3	7.3	12.727

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
09-Dec-91	2S	0.0	9	12	91	11.2	14.5	13.8	7.6	10.928
09-Dec-91	2S	0.5	9	12	91	11.1	14.5	13.8		10.941
09-Dec-91	2S	1.0	9	12	91	11.1	14.5	13.8		10.941
09-Dec-91	2S	1.5	9	12	91	11.1	14.5	13.8		10.941
09-Dec-91	2S	2.0	9	12	91	11.1	14.5	13.8		10.941
09-Dec-91	2S	2.5	9	12	91	11.0	14.5	13.8		10.953
09-Dec-91	2S	3.0	9	12	91	11.0	14.5	13.6		10.953
09-Dec-91	2S	3.5	9	12	91	11.0	14.5	13.6	7.5	10.953
09-Dec-91	3	0.0	9	12	91	12.0	14.0	13.4	7.6	10.435
09-Dec-91	3	0.5	9	12	91	11.5	14.0	14.0		10.501
09-Dec-91	3	1.0	9	12	91	11.5	14.0	14.0		10.501
09-Dec-91	3	1.5	9	12	91	11.5	14.0	14.0		10.501
09-Dec-91	3	2.0	9	12	91	11.5	14.0	14.0		10.501
09-Dec-91	3	2.5	9	12	91	11.2	14.0	14.1	7.5	10.540
09-Dec-91	4N	0.0	9	12	91	12.5	14.5	12.4	7.4	10.752
09-Dec-91	4N	0.5	9	12	91	12.2	14.5	12.5		10.794
09-Dec-91	4N	1.0	9	12	91	12.1	14.5	12.6		10.808
09-Dec-91	4N	1.5	9	12	91	12.0	14.5	12.6		10.822
09-Dec-91	4N	2.0	9	12	91	12.0	14.3	12.6		10.667
09-Dec-91	4N	2.5	9	12	91	11.8	14.5	12.5	7.3	10.849
09-Dec-91	4S	0.0	9	12	91	12.0	14.1	14.4	7.6	10.512
09-Dec-91	4S	0.5	9	12	91	12.0	14.1	14.4		10.512
09-Dec-91	4S	1.0	9	12	91	12.0	14.1	14.4		10.512
09-Dec-91	4S	1.5	9	12	91	12.0	14.1	14.3		10.512
09-Dec-91	4S	2.0	9	12	91	11.9	14.1	14.4		10.526
09-Dec-91	4S	2.5	9	12	91	11.9	14.1	14.2	7.6	10.526
09-Dec-91	4P	0.0	9	12	91	10.8	13.9	13.4	7.3	10.512
09-Dec-91	4P	0.5	9	12	91	10.8	13.9	13.4		10.512
09-Dec-91	4P	1.0	9	12	91	10.8	13.9	13.4		10.512
09-Dec-91	4P	1.5	9	12	91	10.8	13.9	13.4		10.512
09-Dec-91	4P	2.0	9	12	91	10.8	13.9	13.5		10.512
09-Dec-91	4P	2.5	9	12	91	10.8	13.9	13.5	7.5	10.512
09-Dec-91	5	0.0	9	12	91	11.2	13.5	15.0	7.6	10.151
09-Dec-91	5	0.5	9	12	91	11.2	12.0	15.0		8.987
09-Dec-91	5	1.0	9	12	91	11.2	12.8	14.8		9.608
09-Dec-91	5	1.5	9	12	91	11.2	12.8	15.0		9.608
09-Dec-91	5	2.0	9	12	91	11.2	12.8	15.0		9.608
09-Dec-91	5	2.5	9	12	91	11.2	12.8	15.0		9.608
09-Dec-91	5	3.0	9	12	91	11.0	13.0	14.8		9.788
09-Dec-91	5	3.5	9	12	91	11.1	13.8	14.2		10.397
09-Dec-91	5	4.0	9	12	91	11.5	15.0	13.0		11.277
09-Dec-91	5	4.5	9	12	91	11.5	15.0	12.0	7.5	11.277
09-Dec-91	5N	0.0	9	12	91	11.9	13.5	13.5	7.4	10.061
09-Dec-91	5N	0.5	9	12	91	11.9	13.5	13.5		10.061
09-Dec-91	5N	1.0	9	12	91	11.9	13.5	13.5		10.061
09-Dec-91	5N	1.5	9	12	91	11.9	13.5	13.5		10.061
09-Dec-91	5N	2.0	9	12	91	11.8	13.5	13.4		10.074
09-Dec-91	5N	2.5	9	12	91	11.5	13.8	13.0	7.3	10.346
09-Dec-91	5S	0.0	9	12	91	11.1	12.8	14.6	7.6	9.620
09-Dec-91	5S	0.5	9	12	91	11.1	12.8	14.6		9.620

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
09-Dec-91	5S	1.0	9	12	91	11.0	12.9	14.8		9.710
09-Dec-91	5S	1.5	9	12	91	11.0	12.9	14.8		9.710
09-Dec-91	5S	2.0	9	12	91	11.0	12.9	14.8		9.710
09-Dec-91	5S	2.5	9	12	91	11.0	13.0	14.6		9.788
09-Dec-91	5S	3.0	9	12	91	11.5	14.0	13.5		10.501
09-Dec-91	5S	3.5	9	12	91	11.6	14.8	12.0	7.5	11.109
09-Dec-91	6	0.0	9	12	91	11.2	12.0	15.1	7.6	8.987
09-Dec-91	6	0.5	9	12	91	11.0	11.9	10.1		8.933
09-Dec-91	6	1.0	9	12	91	11.2	11.9	15.2		8.909
09-Dec-91	6	1.5	9	12	91	11.2	12.2	14.8		9.142
09-Dec-91	6	2.0	9	12	91	11.5	13.5	14.0		10.113
09-Dec-91	6	2.5	9	12	91	11.8	13.8	12.6		10.307
09-Dec-91	6	3.0	9	12	91	11.8	14.1	12.0		10.539
09-Dec-91	6	3.5	9	12	91	11.8	14.5	11.5	7.4	10.849
09-Dec-91	7	0.0	9	12	91	11.1	11.5	15.0	7.6	8.610
09-Dec-91	7	0.5	9	12	91	11.0	11.2	15.1		8.389
09-Dec-91	7	1.0	9	12	91	11.0	11.2	15.1		8.389
09-Dec-91	7	1.5	9	12	91	11.0	11.2	15.2		8.389
09-Dec-91	7	2.0	9	12	91	11.0	11.2	15.2		8.389
09-Dec-91	7	2.5	9	12	91	10.9	11.2	15.2		8.401
09-Dec-91	7	3.0	9	12	91	10.9	11.5	14.8		8.634
09-Dec-91	7	3.5	9	12	91	11.1	13.5	11.8	7.5	10.164
09-Dec-91	7N	0.0	9	12	91	12.1	12.2	14.8	7.5	9.026
09-Dec-91	7N	0.5	9	12	91	12.1	12.2	14.9		9.026
09-Dec-91	7N	1.0	9	12	91	12.1	12.1	14.0		8.949
09-Dec-91	7N	1.5	9	12	91	12.0	12.1	14.0		8.962
09-Dec-91	7N	2.0	9	12	91	12.2	12.2	13.7		9.013
09-Dec-91	7N	2.5	9	12	91	12.1	12.8	13.2		9.491
09-Dec-91	7N	3.0	9	12	91	12.0	12.9	13.0		9.582
09-Dec-91	7N	3.5	9	12	91	12.0	13.0	12.3	7.3	9.660
09-Dec-91	7S	0.0	9	12	91	11.8	13.9	12.3	7.4	10.384
09-Dec-91	7S	0.5	9	12	91	11.8	13.9	12.4		10.384
09-Dec-91	7S	1.0	9	12	91	11.9	13.9	12.3		10.371
09-Dec-91	7S	1.5	9	12	91	11.9	14.0	12.0		10.448
09-Dec-91	7S	2.0	9	12	91	11.9	14.1	11.7		10.526
09-Dec-91	7S	2.5	9	12	91	11.8	14.0	11.5	7.4	10.462
09-Dec-91	8	0.0	9	12	91	11.8	9.5	16.0	7.7	6.972
09-Dec-91	8	0.5	9	12	91	11.5	9.5	16.2		7.009
09-Dec-91	8	1.0	9	12	91	11.5	9.5	16.3		7.009
09-Dec-91	8	1.5	9	12	91	11.0	10.2	16.0		7.612
09-Dec-91	8	2.0	9	12	91	11.1	12.5	14.0		9.387
09-Dec-91	8	2.5	9	12	91	11.5	13.1	12.5		9.803
09-Dec-91	8	3.0	9	12	91	11.5	13.2	11.9		9.880
09-Dec-91	8	3.5	9	12	91	11.8	13.5	11.5		10.074
09-Dec-91	8	4.0	9	12	91	11.8	13.5	11.2	7.5	10.074
09-Dec-91	9N	0.0	9	12	91	13.0	9.0	15.6	7.6	6.427
09-Dec-91	9N	0.5	9	12	91	13.0	9.0	15.6		6.427
09-Dec-91	9N	1.0	9	12	91	12.9	9.0	15.6		6.440
09-Dec-91	9N	1.5	9	12	91	12.9	9.0	15.5	7.6	6.440
09-Dec-91	9S	0.0	9	12	91	12.0	12.9	13.0	7.7	9.582

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
09-Dec-91	9S	0.5	9	12	91	12.0	12.9	13.0		9.582
09-Dec-91	9S	1.0	9	12	91	12.0	12.9	13.0		9.582
09-Dec-91	9S	1.5	9	12	91	12.0	12.9	12.8		9.582
09-Dec-91	9S	2.0	9	12	91	11.9	12.9	12.7		9.595
09-Dec-91	9S	2.5	9	12	91	11.9	13.1	12.3	7.4	9.750
09-Dec-91	10	0.0	9	12	91	11.1	9.1	16.2	7.7	6.746
09-Dec-91	10	0.5	9	12	91	11.1	9.2	16.2		6.824
09-Dec-91	10	1.0	9	12	91	11.0	9.2	16.3		6.835
09-Dec-91	10	1.5	9	12	91	11.2	10.2	14.8		7.589
09-Dec-91	10	2.0	9	12	91	11.8	11.1	13.5		8.213
09-Dec-91	10	2.5	9	12	91	12.0	12.0	12.0	7.4	8.885
09-Dec-91	11	0.0	9	12	91	10.8	0.0	16.8	7.6	-0.294
09-Dec-91	11	0.5	9	12	91	10.8	0.0	16.5		-0.294
09-Dec-91	11	1.0	9	12	91	10.8	0.0	16.5		-0.294
09-Dec-91	11	1.5	9	12	91	12.1	0.0	9.5	7.5	-0.426
09-Dec-91	12	0.0	9	12	91	11.3	0.0	13.5	7.1	-0.343
09-Dec-91	12	0.5	9	12	91	11.5	0.0	13.6		-0.363
09-Dec-91	12	1.0	9	12	91	11.2	0.0	14.2	7.3	-0.333
17-Dec-91	1	S	17	12	91					
17-Dec-91	1	B	17	12	91					
17-Dec-91	1A	S	17	12	91					
17-Dec-91	1A	B	17	12	91					
17-Dec-91	2S	S	17	12	91					
17-Dec-91	2S	B	17	12	91					
17-Dec-91	3	0.0	17	12	91	9.0	14.0	10.4	7.5	10.787
17-Dec-91	3	0.5	17	12	91	9.0	14.0	10.4		10.787
17-Dec-91	3	1.0	17	12	91	9.2	14.0	10.2		10.767
17-Dec-91	3	1.5	17	12	91	9.5	14.1	10.2	7.5	10.814
17-Dec-91	4S	0.0	17	12	91	9.0	13.9	10.2	7.4	10.709
17-Dec-91	4S	0.5	17	12	91	9.0	13.8	10.2		10.631
17-Dec-91	4S	1.0	17	12	91	9.0	13.9	10.1	7.5	10.709
17-Dec-91	4P	0.0	17	12	91	8.5	13.5	9.2	7.4	10.444
17-Dec-91	4P	0.5	17	12	91	8.5	13.5	10.2		10.444
17-Dec-91	4P	1.0	17	12	91	8.9	13.5	10.0		10.406
17-Dec-91	4P	1.5	17	12	91	8.5	13.5	10.0		10.444
17-Dec-91	4P	2.0	17	12	91	8.5	13.5	10.0		10.444
17-Dec-91	4P	2.5	17	12	91	8.5	13.5	10.0	7.4	10.444
17-Dec-91	5	0.0	17	12	91	9.2	13.0	10.4	7.4	9.986
17-Dec-91	5	0.5	17	12	91	9.5	12.9	9.2		9.878
17-Dec-91	5	1.0	17	12	91	9.8	13.0	10.2		9.925
17-Dec-91	5	1.5	17	12	91	9.5	13.0	10.1		9.956
17-Dec-91	5	2.0	17	12	91	9.8	13.0	10.2		9.925
17-Dec-91	5	2.5	17	12	91	9.8	13.0	10.2		9.925
17-Dec-91	5	3.0	17	12	91	9.5	13.0	10.1		9.956
17-Dec-91	5	3.5	17	12	91	9.8	13.0	10.2		9.925
17-Dec-91	5	4.0	17	12	91	10.0	13.0	10.1	7.5	9.903
17-Dec-91	5N	S	17	12	91					
17-Dec-91	5N	B	17	12	91					
17-Dec-91	5S	0.0	17	12	91	10.0	13.5	10.3	7.4	10.293
17-Dec-91	5S	0.5	17	12	91	10.1	13.5	10.0		10.282

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
17-Dec-91	5S	1.0	17	12	91	10.1	13.5	9.9		10.282
17-Dec-91	5S	1.5	17	12	91	10.1	13.5	9.8		10.282
17-Dec-91	5S	2.0	17	12	91	10.1	13.5	9.8		10.282
17-Dec-91	5S	2.5	17	12	91	10.1	13.5	9.8		10.282
17-Dec-91	5S	3.0	17	12	91	10.5	14.0	9.7	7.4	10.625
17-Dec-91	6	0.0	17	12	91	10.2	13.8	9.5	7.4	10.504
17-Dec-91	6	0.5	17	12	91	10.2	13.0	9.5		9.881
17-Dec-91	6	1.0	17	12	91	10.2	12.9	9.5		9.803
17-Dec-91	6	1.5	17	12	91	10.5	12.9	9.6		9.769
17-Dec-91	6	2.0	17	12	91	10.5	12.9	9.7		9.769
17-Dec-91	6	2.5	17	12	91	10.5	12.9	9.7		9.769
17-Dec-91	6	3.0	17	12	91	10.5	13.0	9.7	7.4	9.847
17-Dec-91	7	0.0	17	12	91	9.2	11.9	9.7	7.4	9.128
17-Dec-91	7	0.5	17	12	91	9.5	11.9	9.7		9.098
17-Dec-91	7	1.0	17	12	91	9.5	11.9	9.6		9.098
17-Dec-91	7	1.5	17	12	91	9.5	11.9	9.6		9.098
17-Dec-91	7	2.0	17	12	91	9.5	11.9	9.6		9.098
17-Dec-91	7	2.5	17	12	91	9.5	11.9	9.6		9.098
17-Dec-91	7	3.0	17	12	91	9.5	11.9	9.6		9.098
17-Dec-91	7	3.5	17	12	91	9.5	11.9	9.6	7.4	9.098
17-Dec-91	7N	0.0	17	12	91	9.5	11.5	10.0	7.5	8.786
17-Dec-91	7N	0.5	17	12	91	9.5	11.5	9.8		8.786
17-Dec-91	7N	1.0	17	12	91	9.5	11.2	9.8		8.552
17-Dec-91	7N	1.5	17	12	91	9.5	11.2	9.7		8.552
17-Dec-91	7N	2.0	17	12	91	9.5	11.2	9.7		8.552
17-Dec-91	7N	2.5	17	12	91	9.5	11.2	9.7		8.552
17-Dec-91	7N	3.0	17	12	91	9.5	11.2	10.0		8.552
17-Dec-91	7N	3.5	17	12	91	9.5	11.2	10.0		8.552
17-Dec-91	7N	4.0	17	12	91	9.5	11.2	10.0		8.552
17-Dec-91	7N	4.5	17	12	91	9.2	11.1	10.0	7.5	8.503
17-Dec-91	7S	0.0	17	12	91	8.5	12.0	9.8	7.4	9.271
17-Dec-91	7S	0.5	17	12	91	8.8	12.0	9.7		9.244
17-Dec-91	7S	1.0	17	12	91	8.8	12.0	9.0		9.244
17-Dec-91	7S	1.5	17	12	91	8.8	12.0	9.7		9.244
17-Dec-91	7S	2.0	17	12	91	8.8	11.9	9.7	7.4	9.166
17-Dec-91	8	0.0	17	12	91	8.9	11.5	10.0		8.844
17-Dec-91	8	0.5	17	12	91	9.1	11.9	9.7		9.137
17-Dec-91	8	1.0	17	12	91	9.1	11.9	9.6		9.137
17-Dec-91	8	1.5	17	12	91	9.1	11.9	9.6		9.137
17-Dec-91	8	2.0	17	12	91	9.1	11.9	9.6		9.137
17-Dec-91	8	2.5	17	12	91	9.1	11.9	9.5		9.137
17-Dec-91	8	3.0	17	12	91	9.1	11.9	9.5		9.137
17-Dec-91	8	3.5	17	12	91	9.1	12.0	9.0		9.216
17-Dec-91	8	4.0	17	12	91	10.0	12.8	8.9		9.747
17-Dec-91	8	4.5	17	12	91	10.1	13.0	8.8	7.4	9.892
17-Dec-91	9N	0.0	17	12	91	8.0	8.0	10.2	7.3	6.181
17-Dec-91	9N	0.5	17	12	91	8.0	8.0	9.9		6.181
17-Dec-91	9N	1.0	17	12	91	8.0	8.0	9.8	7.3	6.181
17-Dec-91	9S	0.0	17	12	91	8.8	11.5	10.0	7.4	8.853
17-Dec-91	9S	0.5	17	12	91	8.8	10.5	9.5		8.072

TAR-PAMLICO RIVER VERTICAL FIELD DATA FOR 1991

Note that only S and B depths sampled on some occasions
(S = 0.5m below surface; B = 0.5 m above bottom)

DATE	STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH	Sigma-t
17-Dec-91	9S	1.0	17	12	91	8.8	11.5	9.5		8.853
17-Dec-91	9S	1.5	17	12	91	8.9	11.5	9.6		8.844
17-Dec-91	9S	2.0	17	12	91	8.9	11.5	9.5	7.4	8.844
17-Dec-91	10	0.0	17	12	91	7.8	7.2	10.5	7.4	5.569
17-Dec-91	10	0.5	17	12	91	7.8	7.2	10.4		5.569
17-Dec-91	10	1.0	17	12	91	7.5	7.1	10.4		5.511
17-Dec-91	10	1.5	17	12	91	7.5	7.5	10.4		5.824
17-Dec-91	10	2.0	17	12	91	7.9	9.0	10.3	7.4	6.972
17-Dec-91	11	0.0	17	12	91	7.3	8.9	10.6	7.4	6.935
17-Dec-91	11	0.5	17	12	91	7.5	7.5	10.5		5.824
17-Dec-91	11	1.0	17	12	91	7.5	8.9	10.4	7.4	6.922
17-Dec-91	12	0.0	17	12	91	8.0	5.9	11.4	7.5	4.537
17-Dec-91	12	0.5	17	12	91	8.5	5.9	11.3		4.500
17-Dec-91	12	1.0	17	12	91	8.8	5.9	11.3	7.5	4.477

TAR-PAMLICO RIVER FIELD DATA FOR 1991

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
1	S	15	1	91	9.0	15.9	11.4	8.0
1	B	15	1	91	9.2	17.1	10.4	7.9
1A	S	15	1	91	9.2	15.0	11.8	8.0
1A	B	15	1	91	9.1	17.0	10.8	8.0
2S	S	15	1	91	9.0	13.0	11.8	8.1
2S	B	15	1	91	8.9	13.9	11.5	8.0
3	S	15	1	91	8.9	11.3	12.6	8.3
3	B	15	1	91	8.9	12.2	12.4	8.2
4N	S	15	1	91	9.2	12.1	11.4	8.0
4N	B	15	1	91	9.2	15.0	10.5	7.9
4S	S	15	1	91	8.9	11.2	12.0	8.2
4S	B	15	1	91	9.8	14.9	10.8	7.9
4P	S	15	1	91	8.9	10.0	12.1	8.0
4P	B	15	1	91	9.6	14.0	10.4	7.9
5	S	15	1	91	9.0	10.0	13.4	8.2
5	B	15	1	91	9.2	14.8	11.0	7.9
5N	S	15	1	91	9.2	10.5	12.2	8.2
5N	B	15	1	91	9.8	14.8	10.2	7.9
5S	S	15	1	91	8.0	7.9	13.2	8.2
5S	B	15	1	91	9.8	15.9	8.4	7.8
6	S	15	1	91	7.2	7.5	12.9	8.4
6	B	15	1	91	9.8	15.8	8.3	7.2
7	S	15	1	91	8.1	4.5	12.7	7.4
7	B	15	1	91	9.9	13.2	8.3	7.1
7N	S	15	1	91	9.8	8.0	12.8	8.5
7N	B	15	1	91	9.8	13.0	10.5	8.3
7S	S	15	1	91	8.1	7.0	13.8	7.4
7S	B	15	1	91	10.0	12.5	8.5	7.1
8	S	15	1	91	8.9	3.6	12.2	8.1
8	B	15	1	91	10.0	12.0	7.6	7.6
9N	S	15	1	91	10.8	1.2	10.0	8.0
9N	B	15	1	91	10.0	12.0	6.7	7.4
9S	S	15	1	91	9.1	2.0	10.2	7.9
9S	B	15	1	91	10.1	12.5	5.7	7.3
10	S	15	1	91	8.1	1.1	8.6	8.3
10	B	15	1	91	10.0	12.0	6.4	7.7
11	S	15	1	91	7.9	0.9	8.7	8.0
11	B	15	1	91	10.0	7.1	2.3	7.4
12	S	15	1	91	8.0	0.1	8.4	8.3
12	B	15	1	91	9.8	10.2	5.7	7.2
1	S	28	1	91	7.5	12.5	11.4	8.6
1	B	28	1	91	8.0	20.0	9.3	8.1
1A	S	28	1	91	8.0	12.0	12.0	8.7
1A	B	28	1	91	8.0	19.5	9.0	8.1
2S	S	28	1	91	7.5	8.0	13.2	8.9
2S	B	28	1	91	8.0	18.0	8.5	7.9
3	S	28	1	91	7.0	7.5	15.2	9.1
3	B	28	1	91	8.0	16.5	7.1	7.8
4N	S	28	1	91	9.0	11.5	12.2	8.6
4N	B	28	1	91	8.5	16.0	6.4	7.7
4S	S	28	1	91	8.0	7.0	16.0	9.3
4S	B	28	1	91	8.0	16.0	6.6	7.7

TAR-PAMLICO RIVER FIELD DATA FOR 1991

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
4P	S	28	1	91	8.0	7.0	14.0	8.9
4P	B	28	1	91	7.5	12.0	9.4	8.1
5	S	28	1	91	8.0	5.0	15.0	9.0
5	B	28	1	91	8.5	16.5	6.8	7.8
5N	S	28	1	91	9.0	6.5	18.0	9.5
5N	B	28	1	91	9.0	15.0	5.5	7.7
5S	S	28	1	91	7.0	4.5	12.3	8.1
5S	B	28	1	91	9.0	17.0	5.1	7.6
6	S	28	1	91	8.0	3.5	12.0	7.8
6	B	28	1	91	8.5	16.0	5.1	7.5
7	S	28	1	91	7.0	4.0	12.2	8.3
7	B	28	1	91	9.0	16.0	5.3	7.6
7N	S	28	1	91	7.0	10.0	17.0	9.3
7N	B	28	1	91	9.0	14.0	5.1	7.6
7S	S	28	1	91	7.0	3.5	11.0	8.1
7S	B	28	1	91	8.5	13.5	5.0	7.6
8	S	28	1	91	9.0	3.0	10.6	7.8
8	B	28	1	91	9.5	13.5	4.4	7.4
9N	S	28	1	91	9.5	3.0	10.6	7.7
9N	B	28	1	91	9.5	10.0	4.1	7.2
9S	S	28	1	91	9.0	2.0	10.2	8.0
9S	B	28	1	91	9.5	12.0	4.3	7.4
10	S	28	1	91	9.0	0.5	10.2	8.3
10	B	28	1	91	9.0	11.0	4.7	7.5
11	S	28	1	91	8.5	0.5	10.0	7.9
11	B	28	1	91	8.5	4.0	2.6	7.3
12	S	28	1	91	8.5	0.0	10.2	7.7
12	B	28	1	91	9.5	9.0	4.2	7.0
2S	S	11	2	91	10.0	11.0	12.6	8.6
2S	B	11	2	91	9.5	14.0	9.8	8.0
3	S	11	2	91	10.0	11.0	13.2	8.6
3	B	11	2	91	10.0	13.5	12.0	8.5
4N	S	11	2	91	10.0	15.5	10.4	8.1
4N	B	11	2	91	10.0	16.0	10.2	7.8
4S	S	11	2	91	10.0	8.5	13.2	8.6
4S	B	11	2	91	9.5	14.0	7.0	7.8
4P	S	11	2	91	10.0	11.0	12.6	8.5
4P	B	11	2	91	10.0	13.0	7.0	7.7
5N	S	11	2	91	10.0	17.0	10.4	8.0
5N	B	11	2	91	10.0	17.0	8.4	7.8
5S	S	11	2	91	10.0	8.5	13.8	8.7
5S	B	11	2	91	9.5	17.0	5.4	7.6
6	S	11	2	91	10.0	8.0	14.0	8.8
6	B	11	2	91	9.5	17.0	4.6	7.5
7	S	11	2	91	10.0	6.5	12.4	8.3
7	B	11	2	91	9.5	17.0	0.7	7.4
7N	S	11	2	91	10.5	13.0	13.0	8.4
7N	B	11	2	91	9.5	16.5	6.2	7.5
7S	S	11	2	91	10.0	7.5	13.4	8.6
7S	B	11	2	91	9.5	17.0	0.7	7.4
9N	S	11	2	91	11.0	11.0	14.4	8.4
9N	B	11	2	91	10.0	13.5	5.2	7.9

TAR-PAMLICO RIVER FIELD DATA FOR 1991

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
9S	S	11	2	91	10.0	6.5	11.6	8.0
9S	B	11	2	91	10.0	6.5	7.4	7.6
10	S	11	2	91	10.0	10.0	8.8	7.5
10	B	11	2	91	10.0	15.0	2.0	7.3
11	S	11	2	91	11.0	7.0	9.4	7.6
11	B	11	2	91	10.0	14.0	1.8	7.2
12	S	11	2	91	10.0	4.5	8.6	7.6
12	B	11	2	91	10.0	14.0	2.0	7.1
1	S	15	4	91				
1	B	15	4	91				
1A	S	15	4	91				
1A	B	15	4	91				
2S	S	15	4	91				
2S	B	15	4	91				
3	S	15	4	91	19.0	9.0	9.4	7.4
3	B	15	4	91	18.2	9.2	8.8	7.5
4N	S	15	4	91				
4N	B	15	4	91				
4S	S	15	4	91	19.5	9.0	9.4	7.3
4S	B	15	4	91	19.0	9.0	9.4	7.5
4P	S	15	4	91	19.0	9.2	8.0	7.3
4P	B	15	4	91	17.5	9.0	8.6	7.4
5	S	15	4	91				
5	B	15	4	91				
5N	S	15	4	91				
5N	B	15	4	91				
5S	S	15	4	91	18.0	7.5	8.8	7.6
5S	B	15	4	91	17.5	8.5	0.3	7.1
6	S	15	4	91	18.0	7.5	9.0	7.6
6	B	15	4	91	17.8	7.8	5.4	7.4
7	S	15	4	91	18.0	6.9	8.9	7.8
7	B	15	4	91	17.5	5.9	8.2	7.7
7N	S	15	4	91				
7N	B	15	4	91				
7S	S	15	4	91	18.0	7.0	8.5	7.6
7S	B	15	4	91	17.5	7.0	7.3	7.4
8	S	15	4	91	17.9	5.0	9.5	8.0
8	B	15	4	91	17.5	6.0	4.8	7.4
9N	S	15	4	91	17.9	4.5	10.2	6.9
9N	B	15	4	91	17.5	5.2	6.3	
9S	S	15	4	91	18.0	3.2	11.5	8.2
9S	B	15	4	91	17.5	5.0	8.6	7.8
10	S	15	4	91	19.0	2.0	12.0	8.0
10	B	15	4	91	19.0	2.2	11.8	7.8
11	S	15	4	91	19.5	1.5	9.2	7.9
11	B	15	4	91	19.2	1.5	9.1	7.8
12	S	15	4	91	20.0	0.2	7.8	7.9
12	B	15	4	91	19.0	0.2	7.4	7.1
1	S	29	4	91	22.0	12.0	8.1	7.6
1	B	29	4	91	20.5	12.0	8.3	7.6
1A	S	29	4	91	22.0	9.5	8.6	7.1
1A	B	29	4	91	17.0	11.5	3.2	7.4

TAR-PAMLICO RIVER FIELD DATA FOR 1991

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
2S	S	29	4	91	21.5	8.5	8.3	7.5
2S	B	29	4	91	20.5	9.5	7.2	7.2
3	S	29	4	91	21.5	7.0	8.5	7.6
3	B	29	4	91	19.0	8.0	6.7	7.5
4N	S	29	4	91	22.5	7.0	8.5	7.7
4N	B	29	4	91	22.0	7.5	8.3	7.6
4S	S	29	4	91	22.0	8.0	8.0	7.5
4S	B	29	4	91	18.5	8.0	3.3	7.2
4P	S	29	4	91	23.0	7.0	9.1	8.0
4P	B	29	4	91	19.5	7.5	5.3	7.2
5	S	29	4	91	23.5	6.5	9.1	7.8
5	B	29	4	91	20.0	7.0	6.8	7.7
5N	S	29	4	91	23.0	6.5	9.0	7.8
5N	B	29	4	91	21.0	7.0	5.7	7.1
5S	S	29	4	91	21.0	5.5	8.3	7.5
5S	B	29	4	91	18.5	6.5	5.0	7.3
6	S	29	4	91	22.0	4.0	7.9	7.3
6	B	29	4	91	18.0	6.0	3.2	7.2
7	S	29	4	91	21.5	3.0	9.7	8.1
7	B	29	4	91	17.5	6.0	0.6	7.4
7N	S	29	4	91	25.0	5.0	10.0	8.1
7N	B	29	4	91	18.5	6.0	0.6	7.1
7S	S	29	4	91	21.5	4.0	9.1	7.7
7S	B	29	4	91	21.0	4.0	8.6	7.4
8	S	29	4	91	22.0	1.0	9.4	7.6
8	B	29	4	91	19.0	3.0	4.0	7.2
9N	S	29	4	91	23.0	1.5	10.0	7.9
9N	B	29	4	91	22.0	1.8	7.6	7.6
10	S	29	4	91	23.0	0.0	8.5	7.4
10	B	29	4	91	20.0	2.0	5.7	7.0
11	S	29	4	91	23.5	0.0	8.8	7.4
11	B	29	4	91	22.5	0.0	7.4	7.3
12	S	29	4	91	23.0	0.0	7.4	7.2
12	B	29	4	91	19.0	0.0	5.9	7.1
1	S	13	5	91				
1	B	13	5	91				
1A	S	13	5	91				
1A	B	13	5	91				
2S	S	13	5	91	24.2	10.9	8.3	7.4
2S	B	13	5	91	23.0	10.9	8.3	7.4
3	S	13	5	91	24.5	8.5	8.7	7.4
3	B	13	5	91	23.0	8.5	8.7	7.3
4N	S	13	5	91	25.0	8.0	8.7	7.4
4N	B	13	5	91	23.5	8.0	7.7	7.3
4S	S	13	5	91	24.5	8.8	8.8	7.4
4S	B	13	5	91	23.0	8.8	8.6	7.5
4P	S	13	5	91	24.5	9.0	8.8	7.5
4P	B	13	5	91	23.0	9.8	5.2	7.4
5	S	13	5	91	24.0	7.9	9.4	7.1
5	B	13	5	91	23.0	9.1	5.3	7.0
5N	S	13	5	91	25.0	7.0	8.5	7.3
5N	B	13	5	91	23.0	6.9	8.3	7.3

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
5S	S	13	5	91	24.0	7.0	8.8	7.4
5S	B	13	5	91	22.9	8.1	4.7	7.2
6	S	13	5	91	24.1	7.0	9.0	7.4
6	B	13	5	91	22.9	7.6	4.7	7.1
7	S	13	5	91	24.5	5.0	10.2	7.7
7	B	13	5	91	23.9	5.5	9.2	7.5
7N	S	13	5	91	25.0	5.1	8.4	7.3
7N	B	13	5	91	23.9	5.9	6.5	7.2
7S	S	13	5	91	25.0	7.1	8.8	7.4
7S	B	13	5	91	22.8	7.1	3.8	7.2
8	S	13	5	91	24.5	3.8	9.7	7.6
8	B	13	5	91	23.0	6.5	3.4	7.1
9N	S	13	5	91	24.1	1.0	10.0	7.8
9N	B	13	5	91	24.0	1.5	8.7	7.1
9S	S	13	5	91	25.1	3.0	10.3	7.6
9S	B	13	5	91	23.0	5.0	1.6	7.1
10	S	13	5	91	25.0	0.8	11.8	8.4
10	B	13	5	91	23.5	3.6	4.2	7.2
11	S	13	5	91				
11	B	13	5	91				
12	S	13	5	91				
12	B	13	5	91				
1	S	4	6	91	28.8	13.0	7.7	7.9
1	B	4	6	91	28.9	13.1	7.0	7.9
1A	S	4	6	91	28.8	10.0	7.7	7.8
1A	B	4	6	91	29.0	10.1	7.3	7.7
2S	S	4	6	91	29.0	9.0	7.7	7.6
2S	B	4	6	91	29.0	9.5	6.8	7.7
3	S	4	6	91	29.1	9.5	8.2	8.0
3	B	4	6	91	28.5	9.2	7.7	8.1
4N	S	4	6	91	28.8	10.0	7.4	7.9
4N	B	4	6	91	28.5	11.5	2.0	7.7
4S	S	4	6	91	29.0	8.5	7.8	8.1
4S	B	4	6	91	28.5	8.9	5.4	7.9
4P	S	4	6	91	29.0	9.0	7.7	8.0
4P	B	4	6	91	29.0	9.0	6.5	7.0
5	S	4	6	91	29.0	8.5	7.2	7.9
5	B	4	6	91	27.9	13.5	0.5	7.6
5N	S	4	6	91	28.9	9.9	6.8	7.8
5N	B	4	6	91	28.0	11.5	1.2	7.6
5S	S	4	6	91	29.0	7.5	8.5	8.0
5S	B	4	6	91	28.0	7.8	7.2	7.9
6	S	4	6	91	29.0	7.2	8.0	8.0
6	B	4	6	91	25.8	8.5	0.5	7.6
7	S	4	6	91	28.2	6.5	7.5	7.5
7	B	4	6	91	26.9	9.9	0.2	7.4
7N	S	4	6	91	29.9	8.5	6.2	7.9
7N	B	4	6	91	27.2	11.1	0.1	7.6
7S	S	4	6	91	28.8	7.0	7.5	7.7
7S	B	4	6	91	26.5	8.0	2.0	7.4
8	S	4	6	91	28.9	6.0	7.3	7.6
8	B	4	6	91	26.8	9.5	0.3	7.5

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
9N	S	4	6	91	29.8	6.5	7.0	7.7
9N	B	4	6	91	28.0	8.8	0.3	7.5
9S	S	4	6	91	27.3	4.5	7.8	7.6
9S	B	4	6	91	26.1	8.5	0.1	7.3
10	S	4	6	91	28.0	4.0	7.4	7.4
10	B	4	6	91	26.5	8.1	0.1	7.2
11	S	4	6	91	28.5	3.1	7.2	7.2
11	B	4	6	91	27.0	6.2	0.3	7.1
12	S	4	6	91	28.8	2.2	6.0	7.3
12	B	4	6	91	27.1	5.0	0.3	7.1
1	S	25	6	91				
1	B	25	6	91				
1A	S	25	6	91				
1A	B	25	6	91				
2S	S	25	6	91				
2S	B	25	6	91				
3	S	25	6	91	25.0	12.0	6.5	7.8
3	B	25	6	91	25.1	11.8	6.4	7.7
4N	S	25	6	91	25.5	12.0	6.0	7.5
4N	B	25	6	91	25.1	12.0	4.2	7.5
4S	S	25	6	91	25.0	10.5	6.5	7.8
4S	B	25	6	91	25.0	10.0	6.1	7.7
4P	S	25	6	91	25.5	9.8	6.7	7.8
4P	B	25	6	91	26.0	9.5	6.5	7.7
5	S	25	6	91	25.0	10.9	6.2	7.8
5	B	25	6	91	25.1	11.0	6.2	7.7
5N	S	25	6	91	25.5	11.0	5.8	7.5
5N	B	25	6	91	25.5	11.0	4.6	7.4
5S	S	25	6	91	25.0	10.0	6.4	7.9
5S	B	25	6	91	26.0	10.0	6.2	7.8
6	S	25	6	91	24.0	8.8	7.3	8.0
6	B	25	6	91	25.1	9.0	6.1	7.9
7	S	25	6	91	25.1	9.8	5.8	7.6
7	B	25	6	91	25.1	9.7	5.9	7.6
7N	S	25	6	91	27.0	9.9	6.7	7.5
7N	B	25	6	91	25.1	10.1	2.4	7.7
7S	S	25	6	91	25.0	7.8	7.6	7.8
7S	B	25	6	91	25.1	8.8	6.9	7.6
8	S	25	6	91	25.0	7.1	6.7	7.7
8	B	25	6	91	26.0	7.1	6.3	7.7
9N	S	25	6	91	25.5	6.0	4.9	7.4
9N	B	25	6	91	25.8	5.3	4.7	7.5
9S	S	25	6	91	25.0	5.8	7.0	7.8
9S	B	25	6	91	25.0	5.8	6.9	7.6
10	S	25	6	91	27.5	5.0	7.9	7.7
10	B	25	6	91	27.0	5.1	5.5	7.9
11	S	25	6	91	26.0	3.0	8.0	7.8
11	B	25	6	91	26.5	3.5	5.3	7.8
12	S	25	6	91	20.0	3.0	10.0	7.7
12	B	25	6	91	21.0	4.0	4.4	8.3
1	S	9	7	91	30.0	14.9	8.5	8.0
1	B	9	7	91	27.1	17.5	5.8	7.7

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
1A	S	9	7	91	30.0	12.5	9.1	8.0
1A	B	9	7	91	28.0	16.5	4.1	7.9
2S	S	9	7	91	31.0	11.1	9.9	8.2
2S	B	9	7	91	30.0	11.0	9.2	8.1
3	S	9	7	91	30.0	10.9	8.6	7.9
3	B	9	7	91	29.5	10.6	7.8	7.8
4N	S	9	7	91	31.0	11.1	8.2	7.5
4N	B	9	7	91	29.0	12.1	5.1	7.4
4S	S	9	7	91	30.0	11.0	9.1	7.9
4S	B	9	7	91	29.0	12.2	0.4	7.4
4P	S	9	7	91	30.0	10.0	8.5	7.6
4P	B	9	7	91	30.0	10.0	6.0	7.5
5	S	9	7	91	29.8	9.5	8.5	7.8
5	B	9	7	91	28.0	14.0	0.5	7.4
5N	S	9	7	91	30.5	10.0	8.5	7.8
5N	B	9	7	91	29.0	10.9	5.2	7.5
5S	S	9	7	91	29.8	9.1	9.1	8.0
5S	B	9	7	91	30.0	9.5	8.0	8.0
6	S	9	7	91	30.0	9.1	9.0	8.1
6	B	9	7	91	30.0	9.0	8.0	7.9
7	S	9	7	91	29.0	8.5	8.5	7.8
7	B	9	7	91	28.0	12.5	0.5	7.5
7N	S	9	7	91	31.0	9.1	9.0	7.9
7N	B	9	7	91	28.5	11.5	1.4	7.4
7S	S	9	7	91	30.0	8.2	8.9	7.9
7S	B	9	7	91	28.0	10.0	0.6	7.9
8	S	9	7	91	29.0	7.5	7.8	7.7
8	B	9	7	91	29.8	8.0	5.5	7.6
9N	S	9	7	91	29.8	5.9	7.9	7.5
9N	B	9	7	91	28.0	10.8	0.5	7.3
9S	S	9	7	91	29.9	6.3	8.5	7.7
9S	B	9	7	91	28.0	11.0	0.2	7.4
10	S	9	7	91	32.0	5.9	10.5	8.1
10	B	9	7	91	28.1	10.0	0.3	7.4
11	S	9	7	91	32.0	5.0	11.0	8.3
11	B	9	7	91	28.5	9.0	0.7	7.4
12	S	9	7	91	32.0	3.9	16.1	8.3
12	B	9	7	91	28.1	7.9	2.1	7.4
1	S	24	7	91				
1	B	24	7	91				
1A	S	24	7	91				
1A	B	24	7	91				
2S	S	24	7	91				
2S	B	24	7	91				
3	S	24	7	91	30.0	11.9	10.1	8.0
3	B	24	7	91	29.1	12.0	6.5	7.8
4N	S	24	7	91	30.0	10.8	7.0	7.6
4N	B	24	7	91	29.0	10.2	5.7	7.6
4S	S	24	7	91	29.9	11.5	7.0	7.9
4S	B	24	7	91	29.0	11.9	4.4	7.8
4P	S	24	7	91	30.0	11.5	7.0	7.8
4P	B	24	7	91	29.0	12.0	2.4	7.7

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
5	S	24	7	91	30.0	10.8	6.9	7.8
5	B	24	7	91	29.0	11.0	4.9	7.7
5N	S	24	7	91	30.0	10.0	6.6	7.7
5N	B	24	7	91	30.0	10.2	6.2	7.7
5S	S	24	7	91	29.8	10.8	6.9	7.8
5S	B	24	7	91	29.0	11.0	2.8	7.7
6	S	24	7	91	29.5	10.0	6.7	7.8
6	B	24	7	91	28.2	11.0	1.5	7.5
7	S	24	7	91	30.0	9.8	7.0	8.0
7	B	24	7	91	29.2	9.5	5.0	7.8
7N	S	24	7	91	31.0	9.0	6.6	7.7
7N	B	24	7	91	31.0	9.0	6.6	7.6
7S	S	24	7	91	29.0	10.0	5.2	7.7
7S	B	24	7	91	28.2	10.1	1.5	7.4
8	S	24	7	91	30.0	8.0	6.5	7.9
8	B	24	7	91	29.9	7.9	5.5	7.8
9N	S	24	7	91	30.0	6.5	6.3	7.9
9N	B	24	7	91	31.0	6.5	6.0	7.8
9S	S	24	7	91	29.8	7.8	5.8	7.7
9S	B	24	7	91	27.5	8.0	3.0	7.5
10	S	24	7	91	30.0	7.0	7.1	8.0
10	B	24	7	91	29.0	8.0	1.9	7.5
11	S	24	7	91	29.8	7.0	5.9	7.6
11	B	24	7	91	29.0	7.1	1.5	7.4
12	S	24	7	91	30.0	2.8	6.8	7.5
12	B	24	7	91	30.2	2.8	6.8	7.5
1	S	1	8	91				
1	B	1	8	91				
1A	S	1	8	91				
1A	B	1	8	91				
2S	S	1	8	91				
2S	B	1	8	91				
3	S	1	8	91	28.0	11.5	7.6	7.8
3	B	1	8	91	27.9	11.5	6.7	7.8
4N	S	1	8	91	28.0	10.0	8.2	7.8
4N	B	1	8	91	28.0	10.8	3.0	7.7
4S	S	1	8	91	28.0	11.0	11.6	8.0
4S	B	1	8	91	27.2	12.0	3.2	7.7
4P	S	1	8	91	28.0	9.8	8.0	7.7
4P	B	1	8	91	27.5	11.5	4.2	7.6
5	S	1	8	91	28.0	10.5	7.5	7.7
5	B	1	8	91	28.0	11.5	3.5	7.6
5N	S	1	8	91	28.0	10.0	7.0	7.7
5N	B	1	8	91	28.0	10.0	6.0	7.7
5S	S	1	8	91	28.0	10.0	7.3	7.6
5S	B	1	8	91	27.5	10.5	4.0	7.5
6	S	1	8	91	27.1	10.0	5.3	7.5
6	B	1	8	91	27.0	10.0	4.1	7.5
7	S	1	8	91	27.9	7.2	8.3	7.7
7	B	1	8	91	28.0	9.5	2.7	7.5
7N	S	1	8	91	28.5	8.5	9.6	7.9
7N	B	1	8	91	28.0	9.8	2.0	7.7

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
7S	S	1	8	91	27.5	8.5	7.5	7.7
7S	B	1	8	91	27.0	9.0	4.5	7.6
8	S	1	8	91	27.0	5.1	8.0	7.7
8	B	1	8	91	28.0	8.2	1.8	7.5
9N	S	1	8	91	27.8	4.0	9.4	8.0
9N	B	1	8	91	28.0	7.0	0.2	7.5
9S	S	1	8	91	27.0	2.0	7.7	7.5
9S	B	1	8	91	28.0	7.1	0.4	7.2
10	S	1	8	91	27.1	1.0	7.6	7.7
10	B	1	8	91	28.0	7.5	0.1	7.1
11	S	1	8	91	27.0	1.0	6.0	7.6
11	B	1	8	91	27.8	2.0	8.3	7.3
12	S	1	8	91	25.9	0.0	4.4	7.7
12	B	1	8	91	25.2	0.0	4.2	7.5
1	S	14	8	91	28.5	14.0	7.9	8.2
1	B	14	8	91	27.5	17.0	4.4	7.8
1A	S	14	8	91	28.8	10.0	9.3	8.4
1A	B	14	8	91	27.8	16.8	2.7	7.6
2S	S	14	8	91	28.5	12.2	8.6	8.2
2S	B	14	8	91	28.0	13.0	3.5	7.9
3	S	14	8	91	29.0	11.2	8.7	8.3
3	B	14	8	91	28.0	11.9	5.7	8.2
4N	S	14	8	91	27.2	11.9	6.7	7.9
4N	B	14	8	91	28.0	13.1	1.4	7.5
4S	S	14	8	91	29.0	11.5	9.0	8.3
4S	B	14	8	91	28.0	11.9	4.4	8.0
4P	S	14	8	91	29.0	10.5	9.3	8.1
4P	B	14	8	91	28.0	11.1	3.4	7.8
5	S	14	8	91	29.0	8.5	9.8	8.5
5	B	14	8	91	27.9	13.5	0.3	7.8
5N	S	14	8	91	27.5	10.2	7.0	8.0
5N	B	14	8	91	27.9	11.8	1.4	7.6
5S	S	14	8	91	29.0	10.1	10.1	8.5
5S	B	14	8	91	27.2	19.0	0.1	7.7
6	S	14	8	91	29.0	10.0	9.9	8.4
6	B	14	8	91	27.5	15.5	0.2	7.8
7	S	14	8	91	28.1	6.1	9.8	8.4
7	B	14	8	91	27.9	13.9	0.1	7.4
7N	S	14	8	91	28.0	8.0	7.1	8.0
7N	B	14	8	91	28.0	11.8	0.1	7.3
7S	S	14	8	91	29.0	11.4	9.4	8.5
7S	B	14	8	91	27.5	13.0	2.5	7.8
8	S	14	8	91	27.9	3.5	9.4	8.2
8	B	14	8	91	27.5	7.1	3.5	7.5
9N	S	14	8	91	28.0	3.0	7.9	6.7
9N	B	14	8	91	27.9	6.6	0.1	6.6
9S	S	14	8	91	29.2	3.5	10.4	8.7
9S	B	14	8	91	28.0	11.5	0.1	7.3
10	S	14	8	91	29.1	2.1	12.3	8.7
10	B	14	8	91	27.5	8.9	0.1	7.5
11	S	14	8	91	29.5	2.0	11.8	8.7
11	B	14	8	91	27.8	5.0	1.1	7.6

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
12	S	14	8	91	29.0	1.5	4.9	7.0
12	B	14	8	91	28.0	3.5	0.5	6.8
1	S	5	9	91	28.0	15.0	14.4	7.6
1	B	5	9	91	26.0	17.1	8.8	7.7
1A	S	5	9	91	27.5	12.5	13.4	7.8
1A	B	5	9	91	25.9	13.5	6.7	7.5
2S	S	5	9	91	27.1	11.8	12.8	7.8
2S	B	5	9	91	25.9	12.1	11.4	7.9
3	S	5	9	91	27.9	11.1	13.2	7.8
3	B	5	9	91	25.9	11.1	12.5	7.9
4N	S	5	9	91	28.1	11.0	13.8	7.9
4N	B	5	9	91	26.5	11.0	6.2	7.6
4S	S	5	9	91	27.9	11.1	13.5	7.8
4S	B	5	9	91	25.8	12.0	8.7	7.6
4P	S	5	9	91	26.9	10.0	14.5	7.8
4P	B	5	9	91	25.9	11.2	8.5	7.7
5	S	5	9	91	28.9	9.5	15.8	8.0
5	B	5	9	91	25.9	10.5	6.4	7.6
5N	S	5	9	91	28.0	9.8	14.2	8.0
5N	B	5	9	91	26.3	9.5	10.4	7.7
5S	S	5	9	91	26.9	9.5	13.6	7.8
5S	B	5	9	91	26.1	10.1	10.0	7.7
6	S	5	9	91	26.8	9.0	13.2	7.8
6	B	5	9	91	25.8	9.1	10.4	7.8
7	S	5	9	91	26.5	7.5	12.8	7.7
7	B	5	9	91	26.0	7.8	11.5	7.7
7N	S	5	9	91	28.0	8.1	14.2	7.8
7N	B	5	9	91	26.3	8.5	3.6	7.5
7S	S	5	9	91	27.0	7.5	11.6	7.8
7S	B	5	9	91	25.9	8.2	7.2	7.7
8	S	5	9	91	26.5	6.2	14.5	7.8
8	B	5	9	91	25.8	7.0	4.5	7.5
9N	S	5	9	91	28.1	5.1	16.8	8.3
9N	B	5	9	91	26.9	6.0	12.0	7.8
9S	S	5	9	91	26.1	5.0	14.5	7.9
9S	B	5	9	91	25.5	6.5	7.0	7.5
10	S	5	9	91	26.5	4.1	16.0	7.8
10	B	5	9	91	26.0	6.5	6.6	7.5
11	S	5	9	91	26.7	2.9	15.5	7.6
11	B	5	9	91	25.9	3.0	6.3	7.5
12	S	5	9	91	26.1	0.2	10.8	7.4
12	B	5	9	91	26.4	1.5	7.8	7.4
1	S	12	9	91	26.5	15.0	11.6	8.2
1	B	12	9	91	25.5	16.9	7.3	8.0
1A	S	12	9	91	26.8	12.8	12.6	8.3
1A	B	12	9	91	25.8	15.9	6.5	8.0
2S	S	12	9	91	27.0	12.0	11.9	8.1
2S	B	12	9	91	26.5	12.1	7.9	8.0
3	S	12	9	91	27.0	11.2	12.2	8.2
3	B	12	9	91	26.1	11.2	9.7	8.0
4N	S	12	9	91	26.5	12.0	8.8	8.0
4N	B	12	9	91	26.0	12.1	4.7	7.9

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
4S	S	12	9	91	27.0	10.9	12.0	8.3
4S	B	12	9	91	26.1	11.5	6.9	8.1
4P	S	12	9	91	27.0	11.0	11.8	8.1
4P	B	12	9	91	26.0	11.0	5.4	8.1
5	S	12	9	91				
5	B	12	9	91				
5N	S	12	9	91	26.5	10.0	11.2	8.3
5N	B	12	9	91	26.0	10.0	5.6	8.2
5S	S	12	9	91	26.9	9.0	12.2	8.2
5S	B	12	9	91	26.0	10.0	4.7	8.2
6	S	12	9	91	27.1	8.0	12.0	8.4
6	B	12	9	91	26.0	9.1	3.2	8.1
7	S	12	9	91	26.0	6.5	11.4	8.4
7	B	12	9	91	26.0	9.3	0.5	8.1
7N	S	12	9	91				
7N	B	12	9	91				
7S	S	12	9	91	27.0	7.1	12.4	8.3
7S	B	12	9	91	26.0	8.5	1.0	8.2
8	S	12	9	91	26.5	6.0	11.1	8.2
8	B	12	9	91	26.2	6.2	3.6	8.2
9N	S	12	9	91	26.0	5.0	8.9	7.6
9N	B	12	9	91	26.0	6.5	2.5	7.2
10	S	12	9	91	26.5	4.5	12.0	8.3
10	B	12	9	91	26.0	6.8	0.1	7.1
11	S	12	9	91	26.9	3.9	12.9	8.3
11	B	12	9	91	26.2	4.5	0.5	8.1
12	S	12	9	91	26.5	2.7	12.0	7.6
12	B	12	9	91	26.0	5.0	0.1	7.2
1	S	1	10	91				
1	B	1	10	91				
1A	S	1	10	91	22.5	12.5	8.8	8.1
1A	B	1	10	91	22.0	12.5	7.2	8.0
2S	S	1	10	91	23.0	13.9	8.4	8.0
2S	B	1	10	91	22.0	12.5	7.3	7.8
3	S	1	10	91	23.0	11.0	8.8	8.1
3	B	1	10	91	22.0	10.8	7.6	8.2
4N	S	1	10	91	23.0	10.5	7.8	8.0
4N	B	1	10	91	23.0	10.5	7.6	8.0
4S	S	1	10	91	23.0	11.0	9.5	8.1
4S	B	1	10	91	22.5	10.9	8.7	8.1
4P	S	1	10	91	23.0	10.1	9.0	8.1
4P	B	1	10	91	22.0	10.1	8.0	8.0
5	S	1	10	91	23.0	9.0	8.7	8.2
5	B	1	10	91	22.0	9.8	4.9	7.9
5N	S	1	10	91	23.0	9.0	8.5	8.2
5N	B	1	10	91	23.2	9.1	8.0	8.1
5S	S	1	10	91	22.5	9.0	8.1	8.0
5S	B	1	10	91	22.0	9.0	6.0	7.8
6	S	1	10	91	23.0	8.0	8.0	7.8
6	B	1	10	91	21.9	8.0	5.8	7.7
7	S	1	10	91	23.0	6.1	9.0	8.1
7	B	1	10	91	22.5	8.0	2.8	7.7

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
7N	S	1	10	91	23.0	8.0	8.5	8.2
7N	B	1	10	91	22.8	8.5	4.3	7.8
7S	S	1	10	91	23.0	7.0	8.7	7.8
7S	B	1	10	91	22.0	7.5	6.2	7.9
8	S	1	10	91	22.0	4.1	9.1	8.2
8	B	1	10	91	22.0	5.5	4.4	8.0
9N	S	1	10	91	22.0	3.0	9.8	7.1
9N	B	1	10	91	23.0	4.5	6.1	7.4
9S	S	1	10	91	21.8	2.8	11.4	8.4
9S	B	1	10	91	21.9	3.9	4.3	8.3
10	S	1	10	91	22.0	2.0	12.2	
10	B	1	10	91	22.0	4.2	2.4	7.7
11	S	1	10	91	22.5	1.0	8.9	8.2
11	B	1	10	91	22.5	1.5	4.2	7.8
12	S	1	10	91	22.0	0.5	3.8	7.5
12		1	10	91	22.0	0.5	2.9	
12	B	1	10	91	22.0	1.0	2.0	7.0
1	S	24	10	91	20.0	19.7	9.0	8.2
1	B	24	10	91	17.5	20.7		8.0
1A	S	24	10	91	19.0	14.4	9.5	8.3
1A	B	24	10	91	17.2	18.9	7.4	8.1
2S	S	24	10	91	18.8	14.1	9.4	8.3
2S	B	24	10	91	17.5	14.8	8.4	8.2
3	S	24	10	91	19.0	12.5	9.5	8.5
3	B	24	10	91	17.8	13.2	10.0	8.4
4N	S	24	10	91	19.8	12.6	10.6	8.4
4N	B	24	10	91	17.9	15.1	3.2	7.9
4S	S	24	10	91	18.0	12.0	8.5	8.0
4S	B	24	10	91	17.2	14.1	6.0	7.8
4P	S	24	10	91	19.0	11.7	9.0	8.3
4P	B	24	10	91	17.5	11.9	7.0	8.0
5	S	24	10	91	18.8	10.6	10.6	8.2
5	B	24	10	91	18.0	16.8	3.4	7.7
5N	S	24	10	91	20.5	10.8	10.8	8.5
5N	B	24	10	91	19.8	13.5	5.6	8.1
5S	S	24	10	91	18.0	10.3	9.7	8.2
5S	B	24	10	91	17.8	13.9	3.4	7.7
6	S	24	10	91	18.5	10.5	10.3	8.2
6	B	24	10	91	18.0	11.3	3.1	7.7
7	S	24	10	91	18.0	8.5	9.8	8.1
7	B	24	10	91	17.0	8.5	1.3	7.7
7N	S	24	10	91	22.0	9.5	10.8	8.5
7N	B	24	10	91	17.9	14.0	3.1	8.0
7S	S	24	10	91	17.5	8.9	9.0	8.1
7S	B	24	10	91	17.2	9.1	4.6	7.9
8	S	24	10	91	18.2	6.5	9.1	8.1
8	B	24	10	91	18.0	6.7	1.5	7.8
9N	S	24	10	91	18.9	5.2	12.6	9.0
9N	B	24	10	91	18.3	5.2		8.6
9S	S	24	10	91	18.5	4.6	12.5	8.9
9S	B	24	10	91	18.0	4.6	2.6	8.1
10	S	24	10	91	19.5	3.9	12.8	8.8

TAR-PAMLICO RIVER FIELD DATA FOR 1991

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
10	B	24	10	91	17.9	4.0		7.9
11	S	24	10	91	19.4	3.2	12.6	8.9
11	B	24	10	91	17.6	3.0		8.9
12	S	24	10	91	18.0	2.2	6.7	8.2
12	B	24	10	91	18.0	2.2	3.5	7.8
1	S	12	11	91	11.9	15.0	13.2	8.1
1	B	12	11	91	11.5	15.0	12.4	8.1
1A	S	12	11	91	11.5	14.0	14.2	8.0
1A	B	12	11	91	11.5	14.6	12.5	8.0
2S	S	12	11	91	10.9	11.2	13.2	
2S	B	12	11	91	10.9	11.5	12.8	8.1
3	S	12	11	91	10.9	11.9	13.5	7.7
3	B	12	11	91	11.0	12.1	13.1	7.8
4N	S	12	11	91	11.1	12.6	13.6	8.0
4N	B	12	11	91	11.2	12.9	12.5	8.0
4S	S	12	11	91	11.0	11.1	13.2	7.7
4S	B	12	11	91	11.0	11.1	13.0	7.4
4P	S	12	11	91	10.9	10.0	13.5	7.6
4P	B	12	11	91	11.2	12.0	11.0	7.8
5	S	12	11	91	11.5	11.5	13.4	7.4
5	B	12	11	91	11.1	11.5	12.5	7.6
5N	S	12	11	91	11.3	11.0	12.9	8.0
5N	B	12	11	91	11.9	11.9	12.1	7.9
5S	S	12	11	91	11.0	10.5	13.2	7.6
5S	B	12	11	91	11.1	11.0	12.3	7.7
6	S	12	11	91	10.5	9.8	13.0	7.5
6	B	12	11	91	11.1	10.8	12.4	7.7
7	S	12	11	91	10.9	10.0	13.2	7.7
7	B	12	11	91	11.2	11.1	12.0	7.7
7N	S	12	11	91	11.1	10.8	13.6	7.9
7N	B	12	11	91	11.2	12.5	10.8	7.9
7S	S	12	11	91	10.9	10.5	12.6	7.6
7S	B	12	11	91	11.2	11.0	11.7	7.7
8	S	12	11	91	10.8	10.1	12.8	7.7
8	B	12	11	91	11.2	10.5	12.2	7.7
9N	S	12	11	91	11.5	10.1	13.2	7.8
9N	B	12	11	91	11.0	10.1	12.8	7.7
9S	S	12	11	91	11.0	10.5	12.8	7.7
9S	B	12	11	91	11.0	10.5	12.2	7.7
10	S	12	11	91	10.8	10.5	13.0	7.5
10	B	12	11	91	10.9	10.5	12.0	7.6
11	S	12	11	91	10.8	9.9	13.2	7.5
11	B	12	11	91	10.5	9.9	13.3	7.4
12	S	12	11	91	11.0	8.0	11.2	7.3
12	B	12	11	91	11.1	9.2	10.5	7.2
1	S	26	11	91				
1	B	26	11	91				
1A	S	26	11	91				
1A	B	26	11	91				
2S	S	26	11	91				
2S	B	26	11	91				
3	S	26	11	91	12.0	14.0	12.0	7.6

TAR-PAMLICO RIVER FIELD DATA FOR 1991

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
3	B	26	11	91	12.1	14.0	11.9	7.6
4N	S	26	11	91	12.0	14.0	12.5	7.3
4N	B	26	11	91	12.5	14.1	11.6	7.5
4S	S	26	11	91	11.0	12.5	12.2	7.5
4S	B	26	11	91	12.0	12.5	12.0	7.5
4P	S	26	11	91	12.0	12.0	12.2	7.4
4P	B	26	11	91	12.0	12.1	11.4	7.4
5	S	26	11	91	12.5	12.5	11.8	7.4
5	B	26	11	91	12.5	12.5	11.6	7.5
5N	S	26	11	91	12.0	14.5	12.0	7.6
5N	B	26	11	91	12.5	15.0	11.5	7.6
5S	S	26	11	91	12.0	13.5	12.2	7.3
5S	B	26	11	91	12.0	13.5	12.0	7.4
6	S	26	11	91	11.5	11.5	12.1	7.4
6	B	26	11	91	11.0	11.5	11.2	7.3
7	S	26	11	91	11.0	10.1	13.0	7.1
7	B	26	11	91	12.0	10.1	11.2	7.2
7N	S	26	11	91	12.0	13.0	12.6	7.6
7N	B	26	11	91	12.8	13.0	11.4	7.6
7S	S	26	11	91	10.0	10.0	12.2	7.3
7S	B	26	11	91	12.0	11.5	10.4	7.2
8	S	26	11	91	11.0	9.8	12.4	7.2
8	B	26	11	91	12.1	10.0	11.8	7.1
9N	S	26	11	91	12.0	10.5	11.2	6.9
9N	B	26	11	91	12.5	10.2	11.0	6.9
9S	S	26	11	91	11.0	12.1	13.2	7.1
9S	B	26	11	91	12.2	11.5	12.5	7.1
10	S	26	11	91	11.0	8.5	13.0	7.1
10	B	26	11	91	13.0	10.8	11.4	7.0
11	S	26	11	91	11.0	8.0	13.4	7.3
11	B	26	11	91	11.1	8.0	12.6	7.3
12	S	26	11	91	11.0	6.1	13.8	7.2
12	B	26	11	91	14.0	14.5	7.6	7.3
1	S	9	12	91				
1	B	9	12	91				
1A	S	9	12	91	11.5	15.1	13.5	7.3
1A	B	9	12	91	11.1	16.8	11.3	7.3
2S	S	9	12	91	11.2	14.5	13.8	7.6
2S	B	9	12	91	11.0	14.5	13.6	7.5
3	S	9	12	91	12.0	14.0	13.4	7.6
3	B	9	12	91	11.2	14.0	14.1	7.5
4N	S	9	12	91	12.5	14.5	12.4	7.4
4N	B	9	12	91	11.8	14.5	12.5	7.3
4S	S	9	12	91	12.0	14.1	14.4	7.6
4S	B	9	12	91	11.9	14.1	14.2	7.6
4P	S	9	12	91	10.8	13.9	13.4	7.3
4P	B	9	12	91	10.8	13.9	13.5	7.5
5	S	9	12	91	11.2	13.5	15.0	7.6
5	B	9	12	91	11.5	15.0	12.0	7.5
5N	S	9	12	91	11.9	13.5	13.5	7.4
5N	B	9	12	91	11.5	13.8	13.0	7.3
5S	S	9	12	91	11.1	12.8	14.6	7.6

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
5S	B	9	12	91	11.6	14.8	12.0	7.5
6	S	9	12	91	11.2	12.0	15.1	7.6
6	B	9	12	91	11.8	14.5	11.5	7.4
7	S	9	12	91	11.1	11.5	15.0	7.6
7	B	9	12	91	11.1	13.5	11.8	7.5
7N	S	9	12	91	12.1	12.2	14.8	7.5
7N	B	9	12	91	12.0	13.0	12.3	7.3
7S	S	9	12	91	11.8	13.9	12.3	7.4
7S	B	9	12	91	11.8	14.0	11.5	7.4
8	S	9	12	91	11.8	9.5	16.0	7.7
8	B	9	12	91	11.8	13.5	11.2	7.5
9N	S	9	12	91	13.0	9.0	15.6	7.6
9N	B	9	12	91	12.9	9.0	15.5	7.6
9S	S	9	12	91	12.0	12.9	13.0	7.7
9S	B	9	12	91	11.9	13.1	12.3	7.4
10	S	9	12	91	11.1	9.1	16.2	7.7
10	B	9	12	91	12.0	12.0	12.0	7.4
11	S	9	12	91	10.8	0.0	16.8	7.6
11	B	9	12	91	12.1	0.0	9.5	7.5
12	S	9	12	91	11.3	0.0	13.5	7.1
12	B	9	12	91	11.2	0.0	14.2	7.3
1	S	17	12	91				
1	B	17	12	91				
1A	S	17	12	91				
1A	B	17	12	91				
2S	S	17	12	91				
2S	B	17	12	91				
3	S	17	12	91	9.0	14.0	10.4	7.5
3	B	17	12	91	9.5	14.1	10.2	7.5
4S	S	17	12	91	9.0	13.9	10.2	7.4
4S	B	17	12	91	9.0	13.9	10.1	7.5
4P	S	17	12	91	8.5	13.5	9.2	7.4
4P	B	17	12	91	8.5	13.5	10.0	7.4
5	S	17	12	91	9.2	13.0	10.4	7.4
5	B	17	12	91	10.0	13.0	10.1	7.5
5N	S	17	12	91				
5N	B	17	12	91				
5S	S	17	12	91	10.0	13.5	10.3	7.4
5S	B	17	12	91	10.5	14.0	9.7	7.4
6	S	17	12	91	10.2	13.8	9.5	7.4
6	B	17	12	91	10.5	13.0	9.7	7.4
7	S	17	12	91	9.2	11.9	9.7	7.4
7	B	17	12	91	9.5	11.9	9.6	7.4
7N	S	17	12	91	9.5	11.5	10.0	7.5
7N	B	17	12	91	9.2	11.1	10.0	7.5
7S	S	17	12	91	8.5	12.0	9.8	7.4
7S	B	17	12	91	8.8	11.9	9.7	7.4
8	S	17	12	91	8.9	11.5	10.0	
8	B	17	12	91	10.1	13.0	8.8	7.4
9N	S	17	12	91	8.0	8.0	10.2	7.3
9N	B	17	12	91	8.0	8.0	9.8	7.3
9S	S	17	12	91	8.8	11.5	10.0	7.4

STA	DEPTH (m)	DA	MO	YR	TEMP (C)	SAL (ppt)	DO (mg/l)	PH
9S	B	17	12	91	8.9	11.5	9.5	7.4
10	S	17	12	91	7.8	7.2	10.5	7.4
10	B	17	12	91	7.9	9.0	10.3	7.4
11	S	17	12	91	7.3	8.9	10.6	7.4
11	B	17	12	91	7.5	8.9	10.4	7.4
12	S	17	12	91	8.0	5.9	11.4	7.5
12	B	17	12	91				

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
1	S	15	1	91	1.08	0.50	33.33	4.66	2.51	3.51	0.34	2.40	25.10
1	B	15	1	91	2.54	0.54	30.41	5.53	1.57	4.55	0.47	2.56	24.80
1A	S	15	1	91	0.75	0.40	23.98	3.35	3.08	4.34	0.35	1.60	25.50
1A	B	15	1	91	0.86	0.36	26.90	5.53	1.57	4.65	0.46	3.52	26.10
2S	S	15	1	91	1.02	0.29	25.73	4.87	7.61	9.44	0.53	3.20	26.40
2S	B	15	1	91	0.75	0.24	28.65	9.01	4.20	6.73	0.74	6.41	26.20
3	S	15	1	91	0.86	0.21	22.81	4.33	3.06	4.34	0.48	1.39	23.30
3	B	15	1	91	0.75	0.38	32.75	12.72	5.57	7.15	1.03	6.09	26.00
4N	S	15	1	91	0.86	0.21	20.47	3.57	3.38	4.76	0.46	1.92	23.60
4N	B	15	1	91	0.86	0.45	36.26	12.50	2.73	5.59	0.97	8.33	26.10
4S	S	15	1	91	0.69	0.92	23.98	5.31	6.61	7.67	0.63	2.56	24.50
4S	B	15	1	91	0.91	0.29	32.16	12.72	3.55	6.21	1.04	9.83	25.90
4P	S	15	1	91	0.86	10.96	42.11	5.20	5.72	7.25	0.75		23.10
4P	B	15	1	91	1.14	0.31	29.82	23.40	4.87	6.42	3.42	9.83	27.00
5	S	15	1	91	0.63	6.81	38.60	4.44	1.91	3.10	0.78	3.20	19.20
5	B	15	1	91	0.69	0.19	28.65	36.80	2.91	5.59	4.93	10.01	27.00
5N	S	15	1	91	0.63	0.38	45.61	7.05	2.53	3.30	0.69	4.17	22.80
5N	B	15	1	91	0.63	0.21	32.75	19.69	2.98	5.80	1.77	21.79	26.30
5S	S	15	1	91	0.63	5.14	22.22	2.91	2.61	3.72	0.50	1.60	19.20
5S	B	15	1	91	0.91	0.36	34.50	13.37	2.81	5.07	1.11	7.69	27.00
6	S	15	1	91	0.75	3.73	38.60	7.27	7.51	8.81	1.74	6.73	21.50
6	B	15	1	91	0.97	0.33	32.16	9.89	5.02	7.15	1.36	7.05	27.20
7	S	15	1	91	2.99	21.09	33.33	6.40	2.36	2.99	1.28	2.88	12.90
7	B	15	1	91	0.52	0.50	35.67	30.92	17.90	17.54	2.33	28.84	26.40
7N	S	15	1	91	0.75	5.10	25.73	4.66	1.69	2.26	0.71	2.43	19.30
7N	B	15	1	91	0.91	0.24	23.98	11.41	4.57	7.05	1.13	7.69	27.00
7S	S	15	1	91	0.63	4.02	31.58	22.85	1.39	1.85	1.75	25.63	18.40
7S	B	15	1	91	1.19	0.40	27.49	26.67	7.51	9.44	1.67	11.21	25.90
8	S	15	1	91	6.14	24.95	36.26	5.31	1.44	0.91	1.03	3.20	10.70
8	B	15	1	91	0.97	4.20	42.11	30.15	2.21	4.45	1.96	20.83	23.50
9N	S	15	1	91	8.04	27.90	52.05	11.08	1.49	1.43	1.37	8.33	7.65
9N	B	15	1	91	1.36	0.85	29.82	8.59	2.68	4.45	0.77	8.01	24.80
9S	S	15	1	91	7.76	31.87	54.97	6.62	1.52	1.75	1.15	4.17	7.70
9S	B	15	1	91	0.80	1.48	34.50	35.17	2.44	4.76	2.82	22.75	25.00
10	S	15	1	91	9.62	33.75	61.40	6.40	1.54	2.47	1.11	1.60	6.70
10	B	15	1	91	2.65	2.68	31.58	8.14	2.53	4.65	0.97	3.84	24.00
11	S	15	1	91	9.00	33.75	75.44	6.07	1.64	2.68	1.02	0.64	6.55
11	B	15	1	91	4.17	20.21	43.27	17.73	1.17	2.68	1.51	7.05	15.40
12	S	15	1	91	8.44	36.67	56.73	7.49	1.66	2.47	1.22	1.28	5.18
12	B	15	1	91	8.49	5.73	15.79	7.49	2.04	4.45	2.06	1.60	22.50
SB	S	15	1	91	7.88	32.58	54.39	10.10	1.49	2.68	1.84	0.69	4.51
SB	B	15	1	91									
1	S	28	1	91	1.38	0.11	19.69	8.64	3.96	3.17	0.60	8.97	28.70
1	B	28	1	91	1.67	0.41	19.69	5.72	1.19	1.04	0.46	2.56	28.30
1A	S	28	1	91	0.99	0.08	19.16	14.50	5.44	3.54	0.99	14.42	28.70
1A	B	28	1	91	1.61	0.46	18.62	4.90	1.29	1.04	0.46	1.92	27.40
2S	S	28	1	91	0.93	0.54	20.22	10.17	5.46	2.99	0.76	11.21	24.40
2S	B	28	1	91	1.89	0.57	23.42	3.49	2.14	2.06	0.43	1.92	26.80
3	S	28	1	91	1.21	0.19	25.02	18.01	6.17	4.65	1.33	26.27	24.50
3	B	28	1	91	1.04	0.24	22.89	6.65	2.33	2.25	0.58	4.81	26.60
4N	S	28	1	91	0.99	-0.03	22.35	29.83	2.50	2.62	2.24	17.62	29.00
4N	B	28	1	91	1.04	0.21	25.02	15.43	2.57	2.43	1.03	19.54	26.00

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
4S	S	28	1	91	1.04	0.11	22.89	57.19	1.85	1.78	3.12	47.10	20.50
4S	B	28	1	91	1.27	0.30	25.55	9.11	2.87	3.17	0.96	4.81	25.40
4P	S	28	1	91	0.93	1.01	20.22	11.57	14.93	13.73	1.47	18.90	30.10
4P	B	28	1	91	1.50	0.30	25.02	5.13	4.01	3.73	0.60	2.88	24.10
5	S	28	1	91	0.93	11.60	23.42	11.57	1.51	2.62	1.05	24.99	18.10
5	B	28	1	91	0.93	0.21	22.89	10.52	2.45	2.71	1.15	5.13	26.00
5N	S	28	1	91	0.93	0.32	23.42	35.45	2.53	3.45	2.80	66.64	31.10
5N	B	28	1	91	1.10	-0.00	17.56	145.06	0.97	-0.07	9.37	116.63	17.10
5S	S	28	1	91	2.29	21.70	22.89	9.93	8.91	7.80	1.36	13.14	22.80
5S	B	28	1	91	3.43	0.52	21.82	16.96	3.52	2.71	3.89	7.12	25.80
6	S	28	1	91	7.85	19.87	30.35	27.84	174.07	114.52	6.53	67.28	130.00
6	B	28	1	91	4.05	0.41	18.62	4.78	3.25	2.71	0.96	2.24	26.10
7	S	28	1	91	1.78	26.29	26.62	14.15	2.67	3.54	0.96	16.98	15.00
7	B	28	1	91	3.37	0.49	19.69	3.85	2.72	2.52	0.65	1.28	24.90
7N	S	28	1	91	1.50	6.38	57.01	124.03	2.11	6.41	5.68	127.63	21.30
7N	B	28	1	91	1.44	0.41	27.69	37.79	2.43	2.99	3.80	28.48	24.30
7S	S	28	1	91	4.33	26.52	33.02	6.30	1.73	2.71	0.65	8.97	14.50
7S	B	28	1	91	8.08	2.67	31.95	8.88	2.87	2.99	1.54	4.17	23.40
8	S	28	1	91	3.54	1.14	19.69	3.14	3.08	3.08	0.55	1.60	29.70
8	B	28	1	91	6.21	29.73	30.89	3.14	1.29	1.04	0.69	3.52	10.90
9N	S	28	1	91	6.04	32.82	29.29	6.42	1.56	1.88	0.73	6.41	11.30
9N	B	28	1	91	12.96	9.09	31.95	3.96	1.60	1.32	0.85	1.28	19.00
9S	S	28	1	91	6.04	32.25	27.15	3.14	2.72	0.76	0.55	1.60	10.90
9S	B	28	1	91	9.10	2.48	20.22	3.03	2.26	1.50	0.53	0.00	21.40
10	S	28	1	91	5.47	37.87	25.02	3.26	1.51	0.58	0.52	3.52	8.51
10	B	28	1	91	8.48	9.58	23.95	12.39	1.75	1.04	3.39	2.56	18.70
11	S	28	1	91	5.75	37.75	20.76	3.61	1.19	1.13	0.56	5.13	8.50
11	B	28	1	91	19.40	17.23	38.88	12.51	1.51	0.76	2.78	2.88	15.70
12	S	28	1	91	5.24	42.23	25.02	1.97	1.58	1.13	0.43	0.64	7.26
12	B	28	1	91	17.20	14.25	41.02	8.29	1.46	1.78	4.43	2.24	16.80
SB	S	28	1	91	9.44	46.81	30.35	1.50	1.41	1.13	0.30	0.64	9.15
SB	B	28	1	91									
1	S	11	2	91									
1	B	11	2	91									
1A	S	11	2	91									
1A	B	11	2	91									
2S	S	11	2	91	1.13	1.00	24.02	19.55	4.82	4.99	1.32	15.70	20.90
2S	B	11	2	91	1.57	0.43	28.47	9.02	3.43	4.09	0.79	5.45	23.40
3	S	11	2	91	0.75	3.53	21.80	18.57	2.12	2.39	1.34	18.26	20.10
3	B	11	2	91	0.80	2.37	24.58	22.48	2.20	2.93	1.58	18.58	22.80
4N	S	11	2	91	0.97	0.87	22.91	21.50	1.88	1.85	1.58	16.73	23.70
4N	B	11	2	91	1.57	0.32	54.01	9.64	1.52	2.39	0.91	8.01	25.50
4S	S	11	2	91	0.69	9.68	14.03	16.12	4.93	4.00	1.27	20.19	17.70
4S	B	11	2	91	1.13	0.27	29.02	22.97	2.83	3.82	1.54	19.54	25.00
4P	S	11	2	91	0.80	0.48	24.02	22.48	1.69	1.76	1.49	14.74	19.50
4P	B	11	2	91	1.62	0.27	32.91	19.55	3.27	4.63	2.56	10.25	24.40
5	S	11	2	91									
5	B	11	2	91									
5N	S	11	2	91	0.86	0.22	57.34	26.03	1.55	2.03	1.84	21.51	21.10
5N	B	11	2	91	1.18	0.27	36.24	23.34	1.52	2.57	1.84	22.43	25.50
5S	S	11	2	91	0.91	11.48	50.68	23.83	1.99	1.85	1.61	29.16	23.70
5S	B	11	2	91	1.18	0.74	30.69	37.29	2.23	3.46	3.19	40.37	25.40

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
6	S	11	2	91	0.69	12.68	26.80	33.00	1.14	1.22	2.18	48.38	17.70
6	B	11	2	91	1.35	0.43	39.57	32.27	1.90	3.10	2.37	38.45	26.50
7	S	11	2	91	1.35	24.10	22.36	15.26	1.09	0.87	1.10	16.98	15.20
7	B	11	2	91	1.07	0.27	28.47	15.26	1.25	1.94	1.15	18.58	26.30
7N	S	11	2	91	1.02	0.37	25.14	38.88	0.76	1.22	2.70	45.21	21.00
7N	B	11	2	91	1.13	0.25	37.35	43.25	1.39	2.66	3.22	52.47	25.80
7S	S	11	2	91	0.69	15.39	19.58	11.23	0.90	0.95	1.09	18.58	16.40
7S	B	11	2	91	1.02	0.35	26.80	45.45	1.63	2.66	4.17	55.51	25.30
8	S	11	2	91									
8	B	11	2	91									
9N	S	11	2	91	0.75	3.59	25.69	57.14	0.92	1.31	3.46	71.69	20.30
9N	B	11	2	91	1.02	3.22	35.13	96.29	1.28	3.02	5.43	101.99	23.40
9S	S	11	2	91	0.75	24.40	29.02	24.44	0.79	0.69	1.65	26.91	15.00
9S	B	11	2	91	0.97	15.99	33.46	49.80	0.87	1.85	4.65	46.40	23.90
10	S	11	2	91	0.75	13.13	25.14	54.20	0.90	1.31	2.66	51.58	19.00
10	B	11	2	91	1.46	1.10	34.02	26.76	1.39	1.94	5.98	13.47	23.60
11	S	11	2	91	5.28	22.00	29.58	9.02	0.54	0.33	0.99	8.33	15.10
11	B	11	2	91	8.45	3.33	36.79	21.50	1.30	1.85	4.23	11.90	22.70
12	S	11	2	91	7.52	35.21	32.91	14.04	1.14	0.78	1.44	13.14	12.80
12	B	11	2	91	5.06	3.61	26.25	15.63	1.60	1.58	2.79	11.85	22.70
SB	S	11	2	91	4.90	54.59	26.25	2.17	1.52	1.04	0.63	1.28	7.13
SB	B	11	2	91									
1	S	15	4	91									
1	B	15	4	91									
1A	S	15	4	91									
1A	B	15	4	91									
2S	S	15	4	91									
2S	B	15	4	91									
3	S	15	4	91	2.90	0.53	46.59	13.83	1.16	2.79	0.84	10.57	17.7
3	B	15	4	91	2.52	0.03	35.60	18.64	1.32	2.19	1.33	15.70	17.5
4N	S	15	4	91									
4N	B	15	4	91									
4S	S	15	4	91	1.28	0.63	36.52	17.46	1.61	3.13	1.10	8.01	17.9
4S	B	15	4	91	2.25	0.20	30.11	22.04	1.63	2.62	1.88	18.93	17.9
4P	S	15	4	91	1.11	0.46	42.93	22.51	1.32	3.22	1.68	14.74	18.6
4P	B	15	4	91	3.17	0.20	38.35	30.02	1.52	2.79	3.75	13.09	18.3
5	S	15	4	91									
5	B	15	4	91									
5N	S	15	4	91									
5N	B	15	4	91									
5S	S	15	4	91	1.11	0.28	33.77	22.75	2.33	3.47	1.93	17.62	17.20
5S	B	15	4	91	2.58	0.11	42.01	40.07	2.60	4.84	3.39	35.54	17.50
6	S	15	4	91	1.44	0.02	36.52	34.48	8.75	9.87	3.37	28.20	22.10
6	B	15	4	91	2.68	0.13	48.42	23.68	2.75	4.41	2.90	10.57	17.00
7	S	15	4	91	1.98	-0.12	45.68	38.00	2.91	5.01	3.19	28.52	15.80
7	B	15	4	91	2.63	-0.11	38.81	22.75	3.05	4.67	2.49	16.02	15.80
7N	S	15	4	91									
7N	B	15	4	91									
7S	S	15	4	91	1.76	0.63	40.18	27.56	2.69	4.41	2.12	8.97	16.70
7S	B	15	4	91	2.47	0.03	44.30	23.92	3.00	4.67	2.53	13.62	17.10
8	S	15	4	91	1.55	-0.08	44.76	33.66	2.26	4.15	2.55	32.36	13.60
8	B	15	4	91	2.63	-0.08	43.84	26.03	3.50	5.18	2.71	21.79	14.60

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
9N	S	15	4	91	1.66	0.49	25.53	17.11	6.68	7.23	1.60	13.46	12.40
9N	B	15	4	91	2.52	0.01	53.00	21.57	2.40	3.90	2.82	15.70	14.00
9S	S	15	4	91	1.66	0.23	50.25	34.95	1.83	3.64	2.53	46.46	11.50
9S	B	15	4	91	1.49	-0.16	47.05	18.99	2.28	3.64	1.72	14.74	13.60
10	S	15	4	91	1.38	5.76	76.58	38.59	1.21	5.18	2.58	72.36	9.62
10	B	15	4	91	1.33	5.42	47.51	39.18	1.27	2.70	3.31	50.76	10.10
11	S	15	4	91	1.06	11.97	45.68	25.56	0.87	2.70	2.05	43.25	8.50
11	B	15	4	91	1.22	12.28	44.76	24.51	0.98	1.76	2.67	32.04	8.42
12	S	15	4	91	8.42	31.88	52.09	7.96	1.83	2.96	1.00	7.69	8.51
12	B	15	4	91	16.22	5.11	57.12	20.16	1.29	2.02	4.65	16.42	13.00
SB	S	15	4	91	8.48	39.89	48.88	4.91	1.92	2.79	0.68	1.60	12.40
SB	B	15	4	91									
1	S	29	4	91	0.63	0.13	26.52	5.28	0.59	1.22	0.45	2.56	24.30
1	B	29	4	91	1.08	0.25	24.65	4.73	0.79	1.63	0.26	2.88	23.40
1A	S	29	4	91	0.30	0.10	29.33	8.89	1.28	2.13	1.41	6.41	24.80
1A	B	29	4	91	0.69	0.10	23.24	10.98	1.06	2.05	0.68	7.37	25.90
2S	S	29	4	91	0.24	0.08	39.17	12.62	2.58	3.45	1.57	7.05	25.10
2S	B	29	4	91	0.86	0.18	28.39	18.00	1.47	2.62	1.70	7.61	24.90
3	S	29	4	91	0.58	-0.02	36.82	13.28	3.46	4.36	1.79	8.65	24.60
3	B	29	4	91	0.69	0.10	34.01	9.77	2.75	4.03	0.78	8.01	23.30
4N	S	29	4	91	0.52	0.10	29.80	12.84	3.59	3.95	1.76	8.65	23.80
4N	B	29	4	91	0.80	0.03	37.76	13.72	2.80	4.36	1.10	8.97	23.80
4S	S	29	4	91	0.63	0.08	37.29	10.76	2.95	3.86	1.61	6.41	25.00
4S	B	29	4	91	1.08	0.13	28.39	14.60	2.70	3.95	1.57	9.93	26.50
4P	S	29	4	91	0.69	0.05	33.08	15.37	1.08	2.29	1.93	21.47	24.20
4P	B	29	4	91	2.42	0.13	31.20	12.40	2.65	3.86	1.20	7.37	25.40
5	S	29	4	91	0.41	0.05	31.20	17.01	2.68	3.53	2.18	16.34	23.70
5	B	29	4	91	0.74	0.08	35.42	16.57	2.80	4.11	1.33	13.78	23.10
5N	S	29	4	91	0.41	0.05	43.85	16.13	2.14	3.20	2.15	16.02	24.30
5N	B	29	4	91	1.30	0.05	31.20	23.37	2.38	3.62	1.92	18.90	25.20
5S	S	29	4	91	0.52	0.05	32.14	18.44	1.84	2.71	2.19	19.22	21.10
5S	B	29	4	91	1.30	0.13	36.82	16.57	4.03	5.51	1.69	18.58	25.10
6	S	29	4	91	1.02	0.80	33.55	27.76	21.86	23.18	3.33	31.40	42.40
6	B	29	4	91	6.21	0.98	38.23	33.54	8.40	14.10	8.79	17.30	30.60
7	S	29	4	91	1.30	0.03	40.57	28.20	0.61	2.71	2.70	48.06	17.10
7	B	29	4	91	1.36	0.18	37.76	22.06	3.07	4.85	6.13	12.42	23.50
7N	S	29	4	91	0.69	0.05	38.70	24.80	1.18	2.29	2.73	23.71	21.40
7N	B	29	4	91	1.75	0.08	42.45	35.22	3.49	5.18	5.45	17.62	23.60
7S	S	29	4	91	0.86	-0.05	34.48	19.42	0.49	1.47	2.37	23.39	18.70
7S	B	29	4	91	1.47	0.10	39.64	18.44	2.09	3.45	3.30	20.60	21.60
8	S	29	4	91	1.30	12.29	38.23	24.03	0.84	1.39	2.56	54.79	12.40
8	B	29	4	91	20.16	0.58	64.93	36.21	3.46	4.77	9.33	18.69	17.80
9N	S	29	4	91	2.36	0.28	47.60	41.04	1.47	1.47	3.40	109.68	12.80
9N	B	29	4	91	5.10	1.40	50.41	24.69	0.74	2.05	3.20	35.64	13.40
9S	S	29	4	91	1.52	13.39	37.76	23.59	0.61	1.06	2.63	53.51	11.60
9S	B	29	4	91	8.67	3.31	50.88	16.57	1.30	2.54	3.11	17.30	15.00
10	S	29	4	91	2.36	28.27	44.32	17.01	1.47	1.96	2.06	37.49	8.24
10	B	29	4	91	12.74	4.76	58.37	11.97	1.60	2.79	2.50	14.74	14.50
11	S	29	4	91	1.30	30.93	40.10	17.12	1.55	1.88	2.09	34.60	7.02
11	B	29	4	91	3.64	28.58	96.13	16.68	1.69	3.45	2.25	28.84	9.56
12	S	29	4	91	2.42	37.67	40.57	6.04	1.97	2.21	1.45	9.93	8.31
12	B	29	4	91	7.38	40.49	59.78	5.38	2.31	3.70	1.76	1.60	13.00

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
SB	S	29	4	91	10.68	50.05	45.26	8.79	2.19	2.46	2.19	2.46	11.00
SB	B	29	4	91									
1	S	13	5	91									
1	B	13	5	91									
1A	S	13	5	91									
1A	B	13	5	91									
2S	S	13	5	91	0.53	0.16	31.96	11.46	1.52	2.79	0.77	7.70	21.40
2S	B	13	5	91	0.64	0.27	32.45	7.29	1.52	3.14	1.14	6.41	22.40
3	S	13	5	91	0.53	0.18	30.48	17.79	8.99	3.85	1.25	13.46	21.00
3	B	13	5	91	0.64	0.14	31.46	7.40	2.81	3.85	1.34	11.53	22.10
4N	S	13	5	91	0.48	0.12	29.99	18.51	2.26	3.41	2.20	16.02	20.30
4N	B	13	5	91	0.75	0.21	29.50	13.97	3.33	3.67	1.99	16.96	21.70
4S	S	13	5	91	0.53	0.30	43.27	13.26	8.13	4.03	1.63	9.29	21.10
4S	B	13	5	91	0.48	0.48	33.43	10.75	2.86	4.29	1.58	8.01	22.30
4P	S	13	5	91	0.58	0.12	33.43	20.30	2.13	3.41	2.10	20.35	22.20
4P	B	13	5	91	0.58	0.30	29.00	9.43	2.45	4.11	1.62	9.97	23.30
5	S	13	5	91	0.37	0.16	34.94	17.79	3.54	4.82	2.08	16.98	20.90
5	B	13	5	91	1.23	0.32	21.62	6.45	2.75	3.85	1.55	7.48	23.20
5N	S	13	5	91	0.64	0.09	32.94	23.05	2.47	3.76	2.50	23.85	18.90
5N	B	13	5	91	0.75	0.09	31.96	16.24	2.91	4.20	2.30	20.83	20.70
5S	S	13	5	91	0.42	0.07	28.51	19.94	8.97	9.85	2.58	19.58	24.70
5S	B	13	5	91	1.34	0.18	37.86	10.87	4.58	5.97	2.21	11.53	22.90
6	S	13	5	91	0.32	0.09	46.72	16.24	7.53	8.53	2.54	21.47	23.70
6	B	13	5	91	2.36	0.30	23.59	13.38	5.66	7.73	2.78	10.93	23.00
7	S	13	5	91	0.48	0.03	36.88	27.71	1.62	2.97	3.26	37.53	16.70
7	B	13	5	91	0.32	-0.02	38.35	17.20	2.17	4.29	2.82	22.43	17.80
7N	S	13	5	91	0.53	0.05	35.89	27.23	1.80	2.61	3.42	30.07	16.60
7N	B	13	5	91	1.18	0.05	46.69	28.18	2.86	5.35	3.75	26.01	18.40
7S	S	13	5	91	0.42	0.07	35.40	19.82	6.29	6.76	3.20	18.58	22.20
7S	B	13	5	91	2.84	0.12	38.35	21.61	6.79	8.62	4.45	16.02	23.50
8	S	13	5	91	0.80	0.03	33.43	27.82	1.06	1.91	3.08	32.04	15.00
8	B	13	5	91	2.30	0.09	39.34	18.99	4.41	5.70	3.87	22.07	20.20
9N	S	13	5	91	0.53	0.00	34.91	28.78	0.23	0.85	3.54	56.07	13.00
9N	B	13	5	91	1.34	1.25	43.77	41.32	1.48	3.32	5.70	39.73	14.20
9S	S	13	5	91	0.53	0.05	34.91	34.87	0.69	1.38	3.15	39.25	14.10
9S	B	13	5	91	0.80	0.21	29.00	32.24	2.03	3.23	7.06	39.73	15.90
10	S	13	5	91	0.42	0.05	32.45	27.59	1.96	0.67	2.53	59.64	12.50
10	B	13	5	91	1.01	0.16	50.16	23.29	1.20	3.32	4.92	26.70	15.00
11	S	13	5	91									
11	B	13	5	91									
12	S	13	5	91									
12	B	13	5	91									
SB	S	13	5	91	2.79	63.49	32.45	5.49	2.38	2.35	1.52	8.01	10.30
SB	B	13	5	91									
1	S	4	6	91	0.33	0.03	17.12	10.03	1.86	1.47	1.20	8.97	21.70
1	B	4	6	91	0.48	0.31	18.61	11.95	1.91	1.92	1.43	8.33	23.10
1A	S	4	6	91	0.38	0.16	31.35	10.67	3.65	3.93	1.54	10.57	21.60
1A	B	4	6	91	0.38	0.24	20.49	14.39	3.67	3.56	1.65	10.25	23.50
2S	S	4	6	91	0.33	0.13	28.34	22.34	5.59	5.75	2.31	23.71	20.90
2S	B	4	6	91	0.27	0.21	21.24	17.08	4.92	4.75	1.48	13.46	23.60
3	S	4	6	91	0.33	0.52	30.60	15.93	4.57	5.29	1.83	14.10	21.60
3	B	4	6	91	0.22	0.16	31.35	16.70	4.52	5.20	1.23	12.50	22.70

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
4N	S	4	6	91	0.22	0.13	26.85	24.01	4.82	5.02	2.46	21.11	21.70
4N	B	4	6	91	1.52	0.08	27.60	21.96	6.07	6.57	2.03	10.95	23.40
4S	S	4	6	91	0.22	0.18	24.98	16.83	5.54	5.57	2.08	15.70	22.70
4S	B	4	6	91	0.53	0.16	28.35	17.85	6.71	7.57	1.70	13.46	23.10
4P	S	4	6	91	0.17	0.08	30.97	24.91	6.38	7.20	3.32	26.27	21.40
4P	B	4	6	91	0.74	0.03	32.10	21.57	13.70	17.31	4.71	15.34	24.40
5	S	4	6	91	0.27	0.08	25.36	29.53	6.40	7.20	3.28	33.96	21.60
5	B	4	6	91	0.59	0.18	24.23	14.77	7.96	9.39	3.47	12.50	24.50
5N	S	4	6	91	0.27	0.13	29.85	27.09	6.20	7.11	3.54	33.32	21.30
5N	B	4	6	91	0.59	0.18	26.48	18.11	7.96	8.75	3.94	16.98	24.20
5S	S	4	6	91	0.12	0.18	24.23	20.55	6.73	7.30	1.83	19.54	22.80
5S	B	4	6	91	0.64	0.13	20.11	22.09	11.43	12.12	4.42	18.26	23.10
6	S	4	6	91	0.48	0.16	23.11	34.53	9.41	9.57	3.04	44.22	20.10
6	B	4	6	91	4.73	0.26	33.22	19.78	13.93	15.49	11.66	8.81	25.20
7	S	4	6	91	0.22	0.08	28.73	36.46	6.63	7.39	2.74	27.23	20.20
7	B	4	6	91	8.52	0.31	22.36	12.72	14.46	16.58	13.69	6.09	23.90
7N	S	4	6	91	0.22	0.03	27.98	30.55	7.91	8.84	4.96	52.12	20.20
7N	B	4	6	91	1.93	0.21	32.47	16.06	11.45	13.67	5.03	10.57	24.10
7S	S	4	6	91	0.27	0.05	24.61	30.43	7.55	8.39	4.19	34.28	20.00
7S	B	4	6	91	11.47	0.21	27.23	23.50	17.60	20.68	20.22	15.22	23.20
8	S	4	6	91	0.22	0.08	27.23	29.27	6.20	6.48	4.94	39.09	19.00
8	B	4	6	91	0.53	0.11	42.21	27.99	9.21	11.21	7.03	37.81	21.90
9N	S	4	6	91	0.17	0.08	29.10	38.64	6.73	7.39	5.48	53.09	19.00
9N	B	4	6	91	0.33	0.13	23.48	84.72	9.72	11.76	34.31	155.07	22.20
9S	S	4	6	91	0.53	0.05	30.97	43.77	5.10	6.02	3.88	76.89	17.80
9S	B	4	6	91	0.38	0.13	26.10	30.68	10.53	11.94	15.89	44.86	22.60
10	S	4	6	91	0.22	0.03	29.48	44.28	3.57	4.11	3.91	82.24	17.20
10	B	4	6	91	2.61	0.13	31.72	21.57	9.69	10.85	18.56	12.28	22.40
11	S	4	6	91	0.33	0.08	27.60	39.28	3.16	3.47	5.18	55.11	16.30
11	B	4	6	91	0.74	0.11	22.73	37.74	6.38	7.84	15.35	39.52	20.70
12	S	4	6	91	3.18	1.77	36.59	40.69	1.28	1.56	3.56	61.12	15.40
12	B	4	6	91	2.14	1.51	42.58	30.81	1.56	2.93	5.64	67.74	16.70
SB	S	4	6	91	4.32	68.92	28.35	7.33	3.01	2.65	1.84	9.29	11.20
SB	B	4	6	91									
1	S	25	6	91									
1	B	25	6	91									
1A	S	25	6	91									
1A	B	25	6	91									
2S	S	25	6	91									
2S	B	25	6	91									
3	S	25	6	91	1.94	0.01	17.31	19.16	6.76	7.36	0.70	21.47	21.20
3	B	25	6	91	0.63	0.27	23.50	17.64	6.80	4.41	1.11	21.15	21.30
4N	S	25	6	91	0.34	0.16	25.67	18.78	7.72	9.37	0.94	18.58	21.50
4N	B	25	6	91	0.91	0.21	22.42	18.02	6.99	5.88	1.45	13.53	21.10
4S	S	25	6	91	0.45	0.12	30.00	26.39	9.85	11.52	1.97	24.64	23.20
4S	B	25	6	91	0.34	0.08	23.50	20.93	9.92	5.48	1.56	19.22	22.90
4P	S	25	6	91	0.34	0.10	28.92	24.99	9.34	11.38	1.70	32.04	22.20
4P	B	25	6	91	0.17	0.08	37.58	23.09	9.71	8.57	2.00	25.63	22.10
5	S	25	6	91	0.57	0.08	23.50	21.06	9.78	12.05	2.01	25.63	21.80
5	B	25	6	91	0.05	0.12	26.21	18.91	9.80	9.91	1.77	16.34	21.40
5N	S	25	6	91	0.40	0.10	25.67	22.71	9.60	11.52	2.20	27.46	22.50
5N	B	25	6	91	0.45	0.12	22.96	21.06	9.73	9.77	1.94	22.43	21.60

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
5S	S	25	6	91	0.28	0.08	23.50	22.46	10.30	13.39	2.01	24.88	23.50
5S	B	25	6	91	0.28	0.12	45.16	23.98	10.39	11.38	2.19	25.31	23.60
6	S	25	6	91	0.45	0.01	24.59	33.23	23.49	26.94	3.09	43.03	35.00
6	B	25	6	91	0.22	0.05	21.34	26.77	20.51	16.08	2.38	32.68	27.90
7	S	25	6	91	0.40	0.05	22.96	19.67	14.64	11.25	2.50	25.03	20.70
7	B	25	6	91	0.34	0.08	21.34	21.82	12.03	6.82	1.91	22.75	21.30
7N	S	25	6	91	0.11	0.14	25.13	20.55	12.03	11.92	2.38	20.83	20.60
7N	B	25	6	91	1.37	0.10	24.59	18.02	15.01	11.11	2.56	14.74	21.40
7S	S	25	6	91	0.40	0.05	26.75	28.92	12.03	12.59	3.14	32.50	19.70
7S	B	25	6	91	0.28	0.05	31.08	28.80	11.70	10.85	2.68	29.16	19.80
8	S	25	6	91	0.28	0.16	13.22	32.09	9.18	9.24	3.91	66.22	18.50
8	B	25	6	91	0.57	0.08	30.00	30.95	9.18	10.58	3.34	35.24	18.90
9N	S	25	6	91	0.28	0.01	28.92	38.56	6.53	7.63	4.67	64.08	16.40
9N	B	25	6	91	0.28	0.03	31.08	29.81	6.76	8.16	3.96	24.03	17.40
9S	S	25	6	91	0.22	-0.01	27.83	25.12	6.64	7.09	3.65	33.64	16.40
9S	B	25	6	91	0.28	0.03	30.00	31.33	6.87	7.49	3.90	34.60	17.30
10	S	25	6	91	0.40	0.01	24.04	29.43	5.68	5.75	3.67	46.23	15.40
10	B	25	6	91	0.28	0.75	32.71	33.36	6.30	7.36	3.65	44.16	16.70
11	S	25	6	91	0.40	-0.03	27.83	28.16	3.14	3.74	3.31	48.52	14.20
11	B	25	6	91	0.51	0.25	36.50	32.22	3.30	6.55	3.94	46.99	15.10
12	S	25	6	91	0.80	0.73	25.67	46.94	2.43	2.53	4.12	88.64	16.00
12	B	25	6	91	0.74	0.12	39.20	41.85	4.56	4.95	5.43	44.86	16.00
SB	S	25	6	91	12.70	70.11	50.57	6.73	2.68	2.00	2.11	8.77	11.10
SB	B	25	6	91									
1	S	9	7	91	0.17	0.11	31.51	3.90	2.51	2.73	0.88	4.81	23.60
1	B	9	7	91	1.75	0.35	23.64	8.45	2.11	2.39	1.23	7.05	25.70
1A	S	9	7	91	0.82	0.16	32.82	10.24	5.41	4.42	1.20	6.09	23.80
1A	B	9	7	91	0.82	0.22	11.84	13.82	4.66	4.34	0.94	9.93	24.30
2S	S	9	7	91	0.39	0.05	30.20	7.90	8.47	8.33	1.29	15.06	24.20
2S	B	9	7	91	1.69	0.05	17.74	15.75	8.52	7.99	1.15	11.53	24.40
3	S	9	7	91	0.55	0.05	24.30	11.76	8.84	9.01	1.53	9.93	23.70
3	B	9	7	91	0.82	0.03	12.50	17.82	8.96	8.75	1.23	11.85	24.00
4N	S	9	7	91	0.66	0.24	27.57	12.45	9.13	9.60	1.72	11.21	23.90
4N	B	9	7	91	0.82	0.03	5.95	17.41	7.86	7.31	1.28	12.82	24.00
4S	S	9	7	91	0.82	0.03	23.64	17.13	9.62	10.37	2.13	14.74	24.30
4S	B	9	7	91	0.98	0.08	10.53	24.30	12.94	12.49	4.22	13.22	24.70
4P	S	9	7	91	0.98	0.03	24.95	21.55	10.42	11.05	2.51	32.47	23.50
4P	B	9	7	91	0.60	0.05	13.16	22.37	11.61	11.73	2.94	29.58	24.10
5	S	9	7	91	0.49	0.03	34.13	17.13	10.22	10.20	1.55	16.98	23.10
5	B	9	7	91	1.20	0.13	2.67	12.58	7.05	6.80	1.45	9.29	25.40
5N	S	9	7	91	0.39	0.05	17.09	9.69	10.41	9.86	1.91	13.14	23.40
5N	B	9	7	91	0.88	0.13	15.12	21.13	10.78	10.54	2.17	18.00	24.50
5S	S	9	7	91	0.77	0.03	17.09	13.82	11.17	11.05	2.12	17.62	25.50
5S	B	9	7	91	0.49	0.03	14.47	19.20	12.50	12.41	2.54	15.82	25.00
6	S	9	7	91	0.49	0.00	22.33	14.93	12.14	11.64	2.06	14.10	25.00
6	B	9	7	91	1.20	0.00	41.34	20.17	16.48	15.29	2.09	16.92	28.60
7	S	9	7	91	0.71	0.03	28.89	23.48	10.32	10.28	2.88	23.07	22.10
7	B	9	7	91	6.10	0.03	21.68	12.72	15.51	15.80	8.55	7.04	24.60
7N	S	9	7	91	0.88	0.03	13.16	17.68	11.70	10.62	2.31	16.66	22.40
7N	B	9	7	91	1.09	0.08	45.93	10.24	10.60	12.07	2.59	13.35	24.20
7S	S	9	7	91	0.22	-0.03	14.47	23.61	11.16	10.71	2.86	27.41	23.10
7S	B	9	7	91	0.60	0.00	33.47	8.03	10.50	12.15	2.39	22.11	22.70

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
8	S	9	7	91	0.49	-0.08	24.30	21.13	8.82	11.13	3.14	27.63	20.50
8	B	9	7	91	0.88	-0.03	31.51	19.34	11.39	12.24	2.87	21.15	21.50
9N	S	9	7	91	0.39	-0.05	28.87	26.23	8.87	9.18	3.58	30.44	19.20
9N	B	9	7	91	0.71	0.05	22.99	23.48	11.39	15.72	6.47	22.43	23.60
9S	S	9	7	91	0.55	-0.05	30.85	31.47	7.35	8.58	4.22	35.78	20.30
9S	B	9	7	91	1.09	0.08	28.89	20.17	15.28	15.63		31.72	23.00
10	S	9	7	91	0.39	-0.05	38.06	21.41	8.12	7.31	3.55	16.02	19.60
10	B	9	7	91	0.66	0.03	24.30	23.06	14.27	15.80	9.96	24.99	24.00
11	S	9	7	91	0.28	-0.08	18.40	23.61	8.47	7.65	3.77	24.35	18.70
11	B	9	7	91	0.66	0.03	24.95	34.50	15.24	19.11	22.91	67.64	23.60
12	S	9	7	91	0.93	-0.16	30.20	26.92	5.36	5.44	3.93	34.18	17.50
12	B	9	7	91	0.77	0.64	49.86	-1.75	18.16	19.37	6.62	43.79	22.90
SB	S	9	7	91	1.64	26.44	59.04	15.89	3.59	4.25	2.39	34.18	11.60
SB	B	9	7	91									
1	S	24	7	91									
1	B	24	7	91									
1A	S	24	7	91									
1A	B	24	7	91									
2S	S	24	7	91									
2S	B	24	7	91									
3	S	24	7	91	1.57	0.23	38.44	50.76	9.73	10.64	4.71	196.90	30.70
3	B	24	7	91	1.07	0.43	45.39	16.64	9.50	8.33	1.54	15.06	28.30
4N	S	24	7	91	1.00	0.26	34.96	25.22	11.94	12.12	2.94	26.70	31.20
4N	B	24	7	91	1.69	0.18	36.70	21.33	11.76	12.12	2.05	22.83	29.80
4S	S	24	7	91	1.07	0.21	30.61	27.97	10.37	11.30	2.97	48.70	31.40
4S	B	24	7	91	1.44	0.16	40.17	20.52	9.45	10.47	1.82	17.30	28.90
4P	S	24	7	91	0.94	0.21	35.83	24.09	9.73	10.47	2.98	33.96	29.20
4P	B	24	7	91	0.94	0.16	39.30	19.55	9.73	11.30	1.97	18.58	29.00
5	S	24	7	91	1.76	0.21	34.09	20.36	12.63	13.44	2.36	20.83	31.20
5	B	24	7	91	2.32	0.26	36.70	16.96	11.20	12.28	1.39	12.82	29.60
5N	S	24	7	91	1.07	0.18	43.65	25.87	12.22	13.11	2.74	24.03	29.80
5N	B	24	7	91	1.00	0.31	40.17	23.60	12.50	13.27	2.85	16.02	30.20
5S	S	24	7	91	1.07	0.41	33.22	24.41	13.14	13.44	2.77	28.52	33.70
5S	B	24	7	91	1.13	0.16	39.30	18.42	11.43	12.78	2.31	14.74	31.30
6	S	24	7	91	1.76	0.26	36.70	30.07	13.79	15.25	3.41	36.53	32.70
6	B	24	7	91	2.38	0.31	41.91	21.82	13.74	15.09	2.51	19.60	32.80
7	S	24	7	91	1.50	0.26	33.22	27.32	11.99	12.78	2.06	30.76	28.70
7	B	24	7	91	3.14	0.36	52.34	23.11	12.91	14.76	2.80	14.74	29.10
7N	S	24	7	91	0.94	0.31	41.91	23.76	12.27	13.60	2.82	24.99	27.00
7N	B	24	7	91	1.32	0.16	49.74	26.03	12.27	14.10	3.02	21.79	27.10
7S	S	24	7	91	1.50	0.41	28.87	29.75	13.70	15.09	3.42	39.09	31.50
7S	B	24	7	91	3.57	0.36	41.91	19.23	13.93	15.25	3.01	18.26	31.20
8	S	24	7	91	0.69	0.31	34.09	28.94	11.76	12.78	3.13	29.80	27.00
8	B	24	7	91	1.69	0.21	45.39	29.91	12.22	13.77	3.29	30.12	26.60
9N	S	24	7	91	1.57	0.06	64.51	32.18	10.19	11.96	3.59	31.40	25.00
9N	B	24	7	91	1.32	0.11	47.13	28.94	11.02	13.27	3.54	30.76	24.90
9S	S	24	7	91	1.00	0.16	38.44	30.88	12.03	12.78	3.66	37.81	26.00
9S	B	24	7	91	3.51	0.26	46.26	25.38	13.51	14.92	3.45	25.31	27.40
10	S	24	7	91	1.00	0.11	49.74	34.77	11.11	12.12	3.57	46.46	24.90
10	B	24	7	91	2.07	0.21	46.26	29.10	14.01	15.42	4.17	32.84	26.80
11	S	24	7	91	0.88	0.13	61.04	46.55	11.90	13.77	4.69	95.20	24.50
11	B	24	7	91	1.57	0.13	55.82	100.35	17.67	20.36	9.15	169.81	25.40

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
12	S	24	7	91	2.88	0.21	30.61	42.21	4.92	5.69	4.39	81.70	19.10
12	B	24	7	91	4.76	0.26	58.43	49.50	5.80	8.17	4.74	93.16	18.60
SB	S	24	7	91	2.13	44.54	56.69	29.91	4.00	4.87	3.65	90.25	16.30
SB	B	24	7	91									
1	S	1	8	91									
1	B	1	8	91									
1A	S	1	8	91									
1A	B	1	8	91									
2S	S	1	8	91									
2S	B	1	8	91									
3	S	1	8	91	0.98	0.29	32.15	17.83	8.54	7.99	1.19	18.26	27.00
3	B	1	8	91	1.04	0.29	26.16	11.78	8.36	7.99	1.69	0.64	25.50
4N	S	1	8	91	1.11	0.29	35.75	36.95	10.02	10.15	3.45	66.22	27.70
4N	B	1	8	91	1.10	0.33	27.96	30.03	10.47	10.61	3.75	1.97	25.20
4S	S	1	8	91	1.43	0.29	47.73	83.46	10.66	13.84	7.68	585.69	28.10
4S	B	1	8	91	1.50	0.29	27.36	22.11	10.02	10.46	2.77	0.64	24.80
4P	S	1	8	91	1.11	0.16	45.93	29.15	8.64	10.30	3.26	37.99	25.10
4P	B	1	8	91	3.26	0.29	28.56	22.00	9.74	9.84	3.00	-0.53	23.60
5	S	1	8	91	1.04	0.21	32.75	22.55	12.04	13.07	2.39	30.76	29.00
5	B	1	8	91	5.93	0.29	27.96	12.55	10.20	10.46	1.84	0.64	24.70
5N	S	1	8	91	0.98	0.29	39.34	26.62	12.50	13.84	2.41	36.04	29.80
5N	B	1	8	91	1.30	0.21	29.76	20.90	12.50	12.77	2.86	0.49	28.70
5S	S	1	8	91	1.17	0.29	36.35	22.00	20.77	21.69	2.38	36.45	42.70
5S	B	1	8	91	17.15	0.63	35.15	13.65	16.45	15.38	2.88	16.02	20.50
6	S	1	8	91	8.02	1.52	35.75	19.59	17.83	12.92	2.92	20.93	37.70
6	B	1	8	91	17.02	1.30	42.34	19.04	19.02	19.69	4.23	14.19	31.30
7	S	1	8	91	1.30	0.08	36.35	23.76	10.38	12.00	1.97	24.67	25.70
7	B	1	8	91	7.30	0.12	32.75	7.72	12.50	12.46	1.79	15.38	22.60
7N	S	1	8	91	1.24	0.25	30.96	34.56	11.12	13.23	3.90	80.63	24.30
7N	B	1	8	91	5.02	0.29	32.15	15.19	12.50	12.92	2.38	13.15	23.30
7S	S	1	8	91	0.78	0.46	43.53	23.32	11.67	10.92	2.11	25.31	24.40
7S	B	1	8	91	1.17	0.25	29.16	25.41	12.22	12.61	3.55	22.43	22.00
8	S	1	8	91	1.17	0.25	83.66	33.43	9.65	10.61	2.57	42.45	21.80
8	B	1	8	91	8.74	0.21	33.95	14.75	12.68	12.92	3.01	17.30	20.70
9N	S	1	8	91	7.76	0.12	44.73	127.82	6.52	7.99	5.96	271.54	19.80
9N	B	1	8	91	1.96	0.21	30.36	22.77	15.71	15.23	7.23	30.63	19.30
9S	S	1	8	91	1.89	15.33	36.35	26.42	4.50	5.22	3.44	77.96	14.20
9S	B	1	8	91	3.98	1.05	31.56	20.68	12.68	12.92	3.22	20.19	19.10
10	S	1	8	91	2.87	19.23	38.74	26.29	5.24	5.22	2.36	38.45	11.90
10	B	1	8	91	9.59	0.29	38.74	18.82	16.72	16.92	3.40	16.66	19.80
11	S	1	8	91	8.48	19.96	43.53	22.22	8.73	4.61	2.38	1.07	12.10
11	B	1	8	91	21.59	6.31	70.49	20.46	14.52	15.38	3.62	27.23	14.20
12	S	1	8	91	11.87	27.27	54.91	6.18	3.67	5.69	1.08	-0.10	9.12
12	B	1	8	91	11.28	25.81	53.72	6.62	4.04	5.07	1.92	1.60	7.77
SB	S	1	8	91	17.35	33.10	66.29	6.51	3.40	4.61	1.58	-0.80	8.21
SB	B	1	8	91									
1	S	14	8	91	0.44	0.12	56.83	20.18	4.67	5.77	1.83	18.58	20.80
1	B	14	8	91	3.50	0.22	30.84	2.30	4.50	5.47	0.61	7.37	24.40
1A	S	14	8	91	0.61	0.07	57.62	36.18	3.62	5.37	2.79	48.70	18.10
1A	B	14	8	91	5.16	0.12	61.16	8.53	5.99	7.08	1.23	6.72	25.00
2S	S	14	8	91	0.50	0.12	56.04	26.77	10.20	11.20	1.98	31.08	21.40
2S	B	14	8	91	1.61	0.12	40.68	19.94	8.62	10.40	1.45	16.98	25.40

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
3	S	14	8	91	0.50	0.12	41.47	22.89	11.95	13.62	1.69	21.14	21.50
3	B	14	8	91	0.72	0.07	36.74	17.94	11.43	12.71	1.23	24.35	26.10
4N	S	14	8	91	0.61	0.12	40.68	23.00	13.62	15.73	1.91	26.27	20.90
4N	B	14	8	91	4.99	0.17	39.89	24.77	14.06	15.63	2.31	14.02	25.40
4S	S	14	8	91	0.55	0.12	42.65	28.30	12.57	15.02	2.09	24.67	21.60
4S	B	14	8	91	1.28	0.12	37.92	22.30	12.39	14.22	1.76	18.26	25.70
4P	S	14	8	91	0.44	0.12	39.89	26.18	12.22	14.92	2.27	26.91	20.30
4P	B	14	8	91	3.99	0.12	37.14	18.89	13.27	14.92	1.71	14.42	25.90
5	S	14	8	91	0.50	0.07	39.11	24.89	12.65	15.43	1.83	24.03	19.40
5	B	14	8	91	1.55	0.17	42.26	19.24	12.74	14.42	1.62	13.77	26.40
5N	S	14	8	91	0.55	0.03	36.74	27.71	13.79	16.43	2.75	27.55	19.90
5N	B	14	8	91	2.33	0.12	35.96	25.83	15.20	16.83	2.28	22.75	26.70
5S	S	14	8	91	0.44	0.03	37.92	28.77	13.27	15.12	2.64	33.00	19.90
5S	B	14	8	91	2.39	0.12	41.47	27.00	19.14	20.96	2.71	25.95	26.20
6	S	14	8	91	0.50	0.07	47.77	32.89	15.55	18.44	3.46	35.96	23.30
6	B	14	8	91	3.66	0.55	56.43	22.77	23.90	26.89	3.32	28.03	36.30
7	S	14	8	91	0.67	0.03	48.16	30.89	10.99	13.52	2.16	40.69	15.70
7	B	14	8	91	22.08	0.12	51.71	20.06	23.90	26.69	3.68	15.06	26.00
7N	S	14	8	91	0.50	0.03	41.08	24.42	13.44	15.02	1.81	26.91	18.40
7N	B	14	8	91	1.50	0.12	43.04	32.65	19.93	22.87	3.02	35.03	26.80
7S	S	14	8	91	0.50	0.03	41.47	33.00	11.95	14.02	2.36	40.37	18.30
7S	B	14	8	91	1.11	0.03	40.68	20.89	14.93	17.44	2.55	20.83	25.60
8	S	14	8	91	0.94	0.17	41.47	32.30	7.04	8.89	2.20	44.21	12.10
8	B	14	8	91	3.00	0.07	43.44	34.18	12.48	15.63	3.34	42.29	20.00
9N	S	14	8	91	2.44	3.45	46.98	24.42	7.30	8.79	2.99	35.88	11.10
9N	B	14	8	91	3.72	0.17	50.13	31.24	20.02	21.76	3.51	38.05	19.40
9S	S	14	8	91	0.72	0.07	45.80	26.77	5.29	6.58	2.90	41.97	10.80
9S	B	14	8	91	14.98	0.07	54.86	15.59	22.15	25.48	2.94	12.17	24.70
10	S	14	8	91	1.16	1.98	59.98	51.89	4.67	6.48	4.43	151.12	10.00
10	B	14	8	91	2.39	0.07	44.23	20.06	17.57	19.75	3.48	16.02	20.70
11	S	14	8	91	0.55	0.03	47.38	27.24	4.58	5.97	3.50	86.26	9.69
11	B	14	8	91	11.93	4.40	49.74	16.53	11.86	13.42	2.54	23.71	15.60
12	S	14	8	91	8.66	29.61	60.37	15.00	5.46	6.48	1.88	29.48	8.93
12	B	14	8	91	21.97	7.16	42.26	11.94	10.20	10.60	3.87	22.12	14.30
SB	S	14	8	91	5.33	48.87	58.10	1.24	3.53	4.47	0.87	4.49	7.45
SB	B	14	8	91									
1	S	5	9	91	1.01	0.45	35.93	13.67	4.43	5.84	1.61	8.97	22.80
1	B	5	9	91	2.38	0.30	28.88	12.39	3.56	5.37	1.50	8.97	23.80
1A	S	5	9	91	0.90	0.15	36.35	20.06	6.22	8.60	2.11	17.62	23.00
1A	B	5	9	91	2.43	0.30	30.95	15.74	4.66	6.13	1.67	9.61	24.00
2S	S	5	9	91	0.96	0.09	31.78	16.54	8.37	9.84	1.95	14.09	23.60
2S	B	5	9	91	0.85	0.15	37.59	19.74	7.44	9.27	1.36	14.74	23.90
3	S	5	9	91	0.80	0.09	35.93	18.14	10.12	11.27	2.05	14.09	23.50
3	B	5	9	91	0.85	0.11	40.08	17.66	9.23	11.27	2.06	16.02	23.40
4N	S	5	9	91	0.80	0.07	33.86	21.33	10.26	12.31	2.32	13.14	23.30
4N	B	5	9	91	1.59	0.24	41.33	22.45	10.40	10.79	1.79	18.42	23.40
4S	S	5	9	91	0.85	0.15	31.78	21.97	8.70	10.60	1.81	18.26	23.20
4S	B	5	9	91	1.17	0.19	37.18	19.42	7.27	8.89	1.57	14.32	23.50
4P	S	5	9	91	0.90	0.11	39.25	25.48	10.91	11.74	2.06	26.01	23.10
4P	B	5	9	91	2.33	0.17	37.59	25.80	7.48	8.79	2.46	16.58	23.30
5	S	5	9	91	0.75	0.07	30.12	21.33	12.77	12.22	1.61	19.86	23.90
5	B	5	9	91	2.70	0.13	37.59	15.59	10.28	10.98	1.92	13.78	23.50

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
5N	S	5	9	91	0.75	0.05	36.35	22.61	12.66	15.07	1.72	18.26	23.30
5N	B	5	9	91	1.06	0.13	39.25	25.48	12.37	14.79	2.64	25.95	23.30
5S	S	5	9	91	0.85	0.15	30.54	29.64	12.77	14.22	6.90	21.47	24.00
5S	B	5	9	91	1.22	0.11	37.59	31.71	11.73	14.50	2.49	30.50	24.00
6	S	5	9	91	0.80	0.11	38.42	22.61	13.24	14.03	2.18	21.15	23.90
6	B	5	9	91	1.38	0.13	35.93	21.33	14.11	14.98	1.48	26.27	25.40
7	S	5	9	91	0.75	0.07	39.67	23.73	11.44	13.17	2.04	23.71	20.90
7	B	5	9	91	1.22	0.11	40.50	24.53	14.16	15.74	2.49	20.18	21.80
7N	S	5	9	91	0.80	0.11	42.57	27.56	12.37	14.31	2.36	26.59	22.10
7N	B	5	9	91	1.38	0.11	41.33	24.69	14.86	16.59	2.45	18.58	22.50
7S	S	5	9	91	0.85	0.07	33.44	21.49	12.31	13.74	2.01	18.58	23.40
7S	B	5	9	91	2.17	0.13	32.20	21.05	13.18	14.03	2.74	21.47	25.20
8	S	5	9	91	0.85	0.13	43.40	22.45	9.16	10.70	1.89	20.18	19.30
8	B	5	9	91	1.54	0.05	46.31	35.38	11.21	13.17	2.93	37.25	20.70
9N	S	5	9	91	0.96	0.05	47.55	24.37	8.81	11.36	2.97	30.16	17.00
9N	B	5	9	91	1.11	0.05	42.57	33.95	10.02	11.08	3.07	38.07	17.70
9S	S	5	9	91	0.90	0.05	40.08	24.05	7.90	8.70	2.94	33.93	16.70
9S	B	5	9	91	1.32	0.03	40.91	36.02	9.46	10.70	3.00	44.50	18.60
10	S	5	9	91	1.06	0.03	42.99	34.90	7.09	8.70	3.65	58.87	15.40
10	B	5	9	91	1.32	0.11	45.06	33.79	9.98	11.36	2.87	32.42	18.50
11	S	5	9	91	0.90	0.07	43.72	43.53	5.08	6.89	4.92	68.89	13.30
11	B	5	9	91	1.54	0.34	42.99	44.32	5.99	6.99	4.24	54.47	14.30
12	S	5	9	91	1.59	25.19	47.55	39.06	2.94	4.32	4.20	111.60	10.40
12	B	5	9	91	7.76	15.82	48.80	4.41	4.12	5.27	4.24	19.22	11.90
SB	S	5	9	91	1.17	58.73	62.07	8.24	3.49	4.23	1.72	20.18	11.10
SB	B	5	9	91									
1	S	12	9	91	1.63	0.31	33.16	12.27	4.00	5.06	1.44	7.69	23.30
1	B	12	9	91	3.15	0.58	30.37	14.79	3.06	5.77	1.61	7.61	23.80
1A	S	12	9	91	0.76	0.14	36.34	13.06	5.94	6.77	1.50	11.21	23.50
1A	B	12	9	91	2.77	0.27	30.77	10.70	3.98	5.57	0.90	4.81	24.00
2S	S	12	9	91	0.81	0.29	37.93	22.18	7.22	8.67	1.57	18.90	23.70
2S	B	12	9	91	1.19	0.15	36.74	25.01	7.04	8.87	1.83	14.50	23.30
3	S	12	9	91	0.76	0.31	41.11	18.56	8.77	10.88	1.32	16.66	24.10
3	B	12	9	91	1.08	0.15	37.13	20.76	8.03	10.37	1.57	11.21	23.60
4N	S	12	9	91	0.81	0.17	37.53	18.41	8.13	10.27	1.40	13.46	23.40
4N	B	12	9	91	1.74	0.17	38.33	16.83	9.87	9.97	1.39	8.62	23.20
4S	S	12	9	91	0.87	0.13	41.11	20.61	9.76	11.98	1.52	15.70	24.40
4S	B	12	9	91	1.03	0.15	38.33	17.93	10.83	11.28	1.37	10.89	23.50
4P	S	12	9	91	0.87	0.31	39.92	25.64	9.38	11.68	2.44	19.54	24.80
4P	B	12	9	91	1.03	0.37	38.33	19.19	9.51	11.48	1.60	14.10	23.30
5	S	12	9	91	0.76	0.26	38.33	24.22	11.75	13.68	1.80	7.05	25.90
5	B	12	9	91	1.84	0.42	38.72	13.06	13.85	11.38	1.16	27.55	24.30
5N	S	12	9	91	0.92	0.36	35.94	23.28	13.38	13.38	1.60	48.06	25.40
5N	B	12	9	91	0.98	0.23	36.34	18.72	13.91	13.48	1.42	11.21	24.00
5S	S	12	9	91	1.03	0.18	39.52	31.45	13.38	15.68	2.21	3.52	25.30
5S	B	12	9	91	1.25	0.53	39.12	29.73	13.32	15.08	2.07	24.99	25.20
6	S	12	9	91	0.87	0.83	39.12	28.62	11.40	14.98	2.27	22.07	23.00
6	B	12	9	91	3.26	0.06	37.93	23.12	16.40	18.89	2.43	15.06	28.90
7	S	12	9	91	0.92	0.41	39.52	28.78	11.22	13.08	2.27	26.28	21.30
7	B	12	9	91	1.03	0.23	38.72	22.02	12.25	14.48	2.14	15.06	21.60
7N	S	12	9	91	0.92	0.13	35.94	29.57	12.08	14.88	2.34	28.12	23.60
7N	B	12	9	91	1.36	0.00	37.93	21.39	12.67	15.08	1.76	16.66	25.60

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
7S	S	12	9	91	0.92	0.04	38.33	30.51	11.06	13.28	2.47	29.55	22.10
7S	B	12	9	91	1.14	0.11	40.32	28.47	11.04	13.68	2.30	21.78	22.50
8	S	12	9	91	1.08	0.21	38.72	39.79	10.50	12.08	3.96	46.23	19.60
8	B	12	9	91	1.14	-0.02	40.32	34.60	10.89	13.68	3.58	34.92	19.80
9N	S	12	9	91	1.14	0.36	42.70	31.77	14.27	15.68	2.97	32.44	17.30
9N	B	12	9	91	1.30	0.22	38.72	28.47	14.51	16.59	3.59	23.06	19.50
9S	S	12	9	91	1.19	0.22	44.29	36.01	9.53	11.58	3.21	32.84	16.90
9S	B	12	9	91	1.19	0.10	45.09	37.74	9.38	11.68	3.98	42.29	20.00
10	S	12	9	91	1.25	0.13	45.89	48.59	10.58	12.38	4.40	69.50	16.50
10	B	12	9	91	7.77	0.15	63.39	74.25	15.22	18.89	6.86	126.32	17.10
11	S	12	9	91	1.03	0.04	45.89	49.06	10.50	12.18	4.69	76.89	15.10
11	B	12	9	91	1.41	0.11	49.07		10.50	12.78		55.10	16.20
12	S	12	9	91	1.52	0.07	41.51	52.36	5.69	7.27	5.82	55.02	13.50
12	B	12	9	91	1.68	0.18	56.23	28.00	10.12	14.18	5.34	48.52	19.50
SB	S	12	9	91	0.98	54.90	33.55		2.96	3.66		35.06	10.80
SB	B	12	9	91									
1	S	1	10	91									
1	B	1	10	91									
1A	S	1	10	91	1.23	0.36	37.53	16.08	4.87	6.79	1.09	10.89	21.50
1A	B	1	10	91	1.66	0.32	32.71	23.47	5.01	7.84	2.03	9.21	21.40
2S	S	1	10	91	1.01	0.34	34.15	18.77	5.41	7.49	1.40	11.53	21.90
2S	B	1	10	91	1.01	0.36	19.20	15.68	5.73	6.62	1.26	10.25	22.10
3	S	1	10	91	0.90	0.24	31.26	16.75	7.22	9.72	1.25	12.50	22.80
3	B	1	10	91	0.80	0.24	27.88	18.50	7.50	9.68	1.29	12.83	23.10
4N	S	1	10	91	0.96	0.32	28.85	18.50	7.45	9.07	1.45	11.86	22.40
4N	B	1	10	91	0.80	0.22	25.47	17.56	7.66	9.51	1.42	12.50	23.30
4S	S	1	10	91	0.85	0.29	26.44	18.23	7.17	8.63	1.41	9.61	22.50
4S	B	1	10	91	0.80	0.24	20.17	16.49	7.50	9.07	1.40	16.72	22.70
4P	S	1	10	91	0.96	0.29	18.24	18.10	7.78	8.89	1.47	11.21	22.10
4P	B	1	10	91	1.17	0.14	15.83	22.80	7.99	9.42	2.39	6.72	22.40
5	S	1	10	91	0.90	0.29	11.48	22.26	10.48	10.38	1.64	12.50	23.20
5	B	1	10	91	1.44	0.22	30.30	15.55	9.62	11.69	1.42	9.61	24.20
5N	S	1	10	91	0.85	0.29	24.99	23.47	10.76	11.87	1.63	11.21	23.50
5N	B	1	10	91	0.90	0.22	33.19	20.65	10.55	12.83	1.70	10.25	24.20
5S	S	1	10	91	0.85	0.24	15.83	23.60	11.19	11.60	1.87	14.95	23.80
5S	B	1	10	91	1.12	0.14	32.23	19.58	10.69	12.65	1.90	10.41	24.40
6	S	1	10	91	1.01	0.34	25.47	23.34	24.88	22.10	2.47	14.02	36.60
6	B	1	10	91	1.28	0.29	31.26	21.99	16.08	14.40	3.00	12.59	25.80
7	S	1	10	91	1.23	0.27	33.19	22.40	10.27	12.57	1.75	14.09	19.50
7	B	1	10	91	1.66	0.36	30.78	22.13	7.79	12.57	2.17	13.14	22.30
7N	S	1	10	91	0.85	0.34	31.26	26.29	10.50	12.48	2.03	15.06	21.80
7N	B	1	10	91	1.93	0.24	32.23	25.49	9.66	11.43	2.33	17.62	21.80
7S	S	1	10	91	0.80	0.27	32.23	25.19	10.76	12.48	1.98	14.42	20.70
7S	B	1	10	91	0.90	0.14	36.08	23.74	10.36	12.30	2.34	12.82	22.20
8	S	1	10	91	0.80	0.39	33.67	26.16	7.52	9.07	2.18	20.03	17.00
8	B	1	10	91	0.96	0.19	37.05	30.59	8.78	10.12	2.65	20.51	18.40
9N	S	1	10	91	0.80	0.29	35.60	30.59	6.03	7.84	2.89	28.12	15.30
9N	B	1	10	91	1.23	0.12	41.87	34.62	8.38	9.86	3.31	24.99	17.20
9S	S	1	10	91	1.07	0.19	27.40	30.46	3.83	5.40	2.72	31.24	14.40
9S	B	1	10	91	2.74	0.10	42.35	28.98	7.55	8.89	2.67	24.79	17.00
10	S	1	10	91	2.26	1.49	34.15	28.71	4.10	5.13	2.97	33.24	13.30
10	B	1	10	91	2.85	0.29	38.01	27.10	7.92	9.16	2.96	23.07	17.10

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
11	S	1	10	91	1.39	4.28	36.57	28.44	3.43	4.35	3.49	46.69	11.10
11	B	1	10	91	1.66	2.30	38.01	37.58	4.92	5.40	4.59	44.43	13.30
12	S	1	10	91	11.28	30.07	43.80	9.10	3.96	4.43	2.33	7.92	9.06
12	B	1	10	91	12.53	34.23	48.14	13.13	4.73	4.87	4.29	4.46	9.97
SB	S	1	10	91	7.99	85.09	48.14	6.28	2.96	3.12	1.54	2.56	8.80
SB	B	1	10	91									
1	S	24	10	91	0.91	0.00		11.14	2.72	2.89	0.62	4.17	27.30
1	B	24	10	91	0.74	0.17	35.42	12.49	2.45	5.21	0.93	9.29	27.70
1A	S	24	10	91	0.63	0.28	63.23	9.55	4.58	4.81	0.66	5.45	26.70
1A	B	24	10	91	0.57	0.14	52.80	10.65	2.83	4.20	0.76	7.37	28.90
2S	S	24	10	91	0.52	0.28	56.28	9.80	4.71	5.31	0.74	6.41	27.30
2S	B	24	10	91	0.52	0.28	39.47	7.59	4.42	5.01	0.58	7.69	28.80
3	S	24	10	91	0.74	0.14	58.02	13.96	5.59	6.42	0.89	8.97	27.40
3	B	24	10	91	0.80	0.05	53.38	14.95	5.01	5.61	0.91	9.61	28.70
4N	S	24	10	91	0.74	0.28	58.02	12.00	5.54	6.12	0.83	7.37	27.30
4N	B	24	10	91	0.63	0.11	39.47	14.58	4.13	4.91	1.09	9.61	28.10
4S	S	24	10	91	0.63	0.08	56.28	15.56	5.91	6.62	1.08	8.65	27.70
4S	B	24	10	91	1.02	0.08	41.79	21.57	4.74	5.41	2.30	9.61	28.90
4P	S	24	10	91	0.57	0.11	71.35	11.63	6.44	7.32	0.84	9.93	28.80
4P	B	24	10	91	0.91	0.05	41.79	16.91	5.86	5.81	1.56	8.01	29.10
5	S	24	10	91	0.57	0.11	61.49	13.23	5.96	7.12	0.89	7.69	27.00
5	B	24	10	91	1.08	0.17	37.16	9.18	4.45	5.21	0.72	4.49	29.70
5N	S	24	10	91	0.46	0.25	60.34	17.40	5.33	6.42	1.15	9.93	26.20
5N	B	24	10	91	0.74	0.17	42.95	17.15	5.06	5.61	1.05	10.89	28.50
5S	S	24	10	91	0.80	0.22	61.49	17.64	6.12	6.82	1.08	10.25	27.00
5S	B	24	10	91	2.31	0.17	53.96	13.96	5.40	5.81	1.27	5.45	29.00
6	S	24	10	91	0.63	0.05	57.44	17.15	6.04	8.73	1.26	9.29	27.20
6	B	24	10	91	5.12	0.17	37.16	19.36	4.37	6.82	4.39	5.45	28.20
7	S	24	10	91	0.40	0.05	59.18	12.49	4.37	5.71	1.04	8.01	23.80
7	B	24	10	91	1.36	0.08	48.17	15.19	4.37	5.41	1.99	6.41	26.90
7N	S	24	10	91	0.40	-0.05	48.17	20.59	4.66	5.81	1.36	13.46	24.60
7N	B	24	10	91	1.08	0.08	56.86	14.70	4.42	5.41	1.65	8.97	27.90
7S	S	24	10	91	0.46	0.06	63.81	10.78	4.39	5.41	0.92	6.08	24.30
7S	B	24	10	91	1.47	0.14	53.38	14.70	4.71	5.71	1.38	7.05	27.00
8	S	24	10	91	0.74	0.03	38.31	33.95	3.07	3.50	2.83	39.88	21.30
8	B	24	10	91	1.97	0.05	60.91	16.29	4.71	5.51	2.15	8.97	26.70
9N	S	24	10	91	0.63	-0.02	47.59	36.53	2.03	2.29	3.37	56.19	19.00
9N	B	24	10	91	0.57	0.03	57.44	28.56	2.61	3.09	3.02	36.53	21.40
9S	S	24	10	91	0.63	-0.05	36.00	24.51	1.34	1.48	2.68	43.25	17.60
9S	B	24	10	91	1.02	0.06	52.22	25.37	4.31	4.60	3.84	25.31	22.80
10	S	24	10	91	0.68	0.22	49.32	65.72	1.52	1.58	4.55	96.12	17.80
10	B	24	10	91	1.64	0.05	55.70	7.83	5.03	5.31	6.02	13.78	23.40
11	S	24	10	91	0.57	0.17	42.37	77.68	0.70	0.88	5.49	92.56	16.00
11	B	24	10	91	0.96	0.06	44.11	36.65	1.18	1.58	3.84	57.67	18.30
12	S	24	10	91	1.13	36.12	57.44	42.66	1.34	1.48	3.24	74.76	15.00
12	B	24	10	91	2.42	14.51	160.14	24.51	1.12	2.79	2.49	16.66	18.50
SB	S	24	10	91	3.55	66.51	46.43	3.66	2.27	1.99	0.92	2.56	12.30
SB	B	24	10	91									
1	S	12	11	91	1.51	0.26	16.61	10.13	2.46	1.77	0.48	7.69	22.30
1	B	12	11	91	1.19	0.29	14.69	8.29	1.88	1.42	0.75	6.73	30.10
1A	S	12	11	91	1.48	0.31	15.65	10.02	3.02	2.92	0.58	8.33	23.60
1A	B	12	11	91	1.08	0.26	15.65	8.51	2.25	2.22	0.64	7.05	30.60

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
2S	S	12	11	91	1.29	0.36	5.59	14.15	4.55	3.28	0.83	13.46	23.40
2S	B	12	11	91	1.29	0.38	20.92	9.27	3.88	3.72	0.75	7.69	30.60
3	S	12	11	91	1.19	0.26	12.30	12.08	4.68	2.66	0.60	10.57	22.80
3	B	12	11	91	0.87	0.17	20.44	12.74	4.09	3.98	0.79	11.85	31.00
4N	S	12	11	91	1.67	0.36	7.98	16.21	4.06	2.30	0.89	12.82	22.40
4N	B	12	11	91	1.19	0.31	19.48	10.57	3.48	3.63	0.71	8.65	30.40
4S	S	12	11	91	1.67	0.50	3.19	12.84	5.60	3.28	0.83	8.97	22.00
4S	B	12	11	91	1.51	0.38	20.44	11.65	5.54	5.04	0.96	9.93	31.10
4P	S	12	11	91	2.09	0.45	20.92	12.30	5.23	4.51	0.81	10.89	22.60
4P	B	12	11	91	3.15	0.60	25.23	10.89	6.03	5.22	0.77	8.65	32.20
5	S	12	11	91	1.03	0.24	4.15	17.62	4.34	2.92	0.98	15.06	22.80
5	B	12	11	91	1.61	0.33	20.44	12.30	4.28	3.72	0.83	8.97	31.60
5N	S	12	11	91	2.83	0.69	14.69	9.70	7.72	3.72	0.73	6.73	21.70
5N	B	12	11	91	2.14	0.50	22.36	10.57	3.91	3.36	0.72	6.41	31.90
5S	S	12	11	91	1.98	0.41	12.78	9.05	4.80	4.43	0.79	7.05	21.30
5S	B	12	11	91	2.20	0.26	22.36	9.70	4.25	3.72	0.71	5.45	31.10
6	S	12	11	91	2.67	0.50	16.61	10.13	4.43	6.54	0.98	6.73	21.00
6	B	12	11	91	2.04	0.26	30.02	3.41	3.94	6.19	0.58	6.41	30.50
7	S	12	11	91	1.08	0.38	18.05	8.83	3.08	3.89	0.74	8.01	20.90
7	B	12	11	91	1.72	0.45	25.23	9.27	3.17	4.07	0.66	7.05	30.30
7N	S	12	11	91	0.87	0.21	10.38	14.80	3.08	3.36	1.01	13.78	21.60
7N	B	12	11	91	2.83	0.50	24.27	7.86	2.77	3.36	0.59	8.33	30.40
7S	S	12	11	91	1.77	0.36	9.90	7.75	3.91	3.19	0.61	6.41	22.00
7S	B	12	11	91	2.83	0.50	25.71	10.78	3.88	3.54	0.93	7.05	30.90
8	S	12	11	91	1.82	0.74	14.69	13.39	4.99	2.22	1.03	11.21	20.50
8	B	12	11	91	1.98	0.60	25.23	13.39	2.37	2.30	0.97	11.53	29.70
9N	S	12	11	91	0.92	0.93	16.61	19.24	3.02	2.04	1.54	17.62	20.70
9N	B	12	11	91	1.29	0.64	23.80	14.15	2.12	1.69	1.21	10.25	28.10
9S	S	12	11	91	1.29	0.57	11.34	10.35	2.22	1.60	0.95	10.25	20.70
9S	B	12	11	91	1.77	0.55	90.50	14.47	2.09	1.77	1.24	9.93	28.10
10	S	12	11	91	1.24	0.96	14.69	16.42	2.09	1.77	1.37	14.74	21.10
10	B	12	11	91	1.45	0.98	80.91	22.06	2.15	1.60	1.68	21.47	28.00
11	S	12	11	91	0.92	0.41	20.44	20.65	1.94	1.69	1.73	22.75	20.30
11	B	12	11	91	1.45	0.60	28.11	38.55	1.54	1.33	2.68	42.61	27.20
12	S	12	11	91	0.98	9.17	20.92	35.08	1.17	1.33	2.81	35.24	18.40
12	B	12	11	91	1.56	5.70	35.29	65.21	1.05	2.48	4.85	39.09	25.80
SB	S	12	11	91	3.42	44.27	24.27	2.33	2.34	1.77	0.82	1.28	15.60
SB	B	12	11	91									
1	S	26	11	91									
1	B	26	11	91									
1A	S	26	11	91									
1A	B	26	11	91									
2S	S	26	11	91									
2S	B	26	11	91									
3	S	26	11	91	0.96	0.23	22.89	11.81	2.98	2.60	0.68	5.13	22.80
3	B	26	11	91	0.66	1.53	21.80	8.75	3.19	3.20	0.84	5.77	22.50
4N	S	26	11	91	0.49	0.18	20.71	12.83	2.88	2.80	0.59	9.61	23.00
4N	B	26	11	91	0.49	1.21	27.25	12.06	3.59	3.81	0.70	9.29	22.60
4S	S	26	11	91	0.43	0.18	19.62	11.30	3.54	3.81	0.57	7.69	23.10
4S	B	26	11	91	0.72	0.33	26.16	16.14	4.01	4.61	1.26	7.37	22.50
4P	S	26	11	91	0.43	0.26	26.16	13.08	3.06	4.61	0.79	6.09	22.20
4P	B	26	11	91	0.43	1.46	25.07	13.59	3.46	4.82	0.86	7.37	22.30

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
5	S	26	11	91	0.60	0.31	18.52	13.85	3.93	4.01	0.86	7.69	22.80
5	B	26	11	91	0.43	1.18	25.07	12.32	4.22	5.62	0.84	7.69	22.70
5N	S	26	11	91	0.49	0.33	25.07	12.57	3.83	3.81	0.55	7.37	22.70
5N	B	26	11	91	0.43	0.46	21.80	13.08	4.73	4.21	0.79	7.37	22.50
5S	S	26	11	91	0.43	0.16	21.80	11.30	2.43	3.00	0.50	6.25	22.70
5S	B	26	11	91	0.49	2.63	21.80	11.55	4.07	4.01	0.84	6.41	22.20
6	S	26	11	91	0.49	0.16	13.07	12.06	2.90	2.60	0.77	7.37	22.20
6	B	26	11	91	1.55	0.63	26.16	13.08	3.80	4.82	1.30	6.73	22.40
7	S	26	11	91	0.43	0.21	26.16	12.83	2.29	4.61	0.86	9.72	20.60
7	B	26	11	91	0.90	2.58	31.61	29.14	2.90	6.83	3.56	11.53	20.90
7N	S	26	11	91	0.43	0.23	22.89	14.61	2.98	3.81	0.77	9.61	21.90
7N	B	26	11	91	0.66	3.05	29.43	12.83	3.46	5.62	1.24	8.97	21.80
7S	S	26	11	91	0.96	0.21	15.25	12.32	2.37	3.40	1.01	6.41	21.00
7S	B	26	11	91	0.55	4.97	29.43	14.86	5.02	7.44	1.39	7.69	21.70
8	S	26	11	91	0.43	0.31	27.25	17.41	1.63	3.00	1.24	14.74	20.00
8	B	26	11	91	0.66	1.36	34.89	17.41	2.06	4.82	1.32	15.06	20.70
9N	S	26	11	91	0.49	0.31	26.16	27.22	2.56	2.60	2.22	30.20	19.30
9N	B	26	11	91	0.60	0.73	34.89	28.63	1.63	3.60	1.97	27.87	19.50
9S	S	26	11	91	0.55	1.21	23.98	13.08	1.16	0.98	1.17	13.78	18.80
9S	B	26	11	91	0.90	4.57	30.52	13.08	1.77	2.80	1.37	14.42	18.90
10	S	26	11	91	0.66	1.09	34.89	19.71	1.11	0.98	1.41	19.22	18.30
10	B	26	11	91	1.25	4.17	47.98	16.14	1.37	3.20	1.32	10.89	20.10
11	S	26	11	91	0.37	0.29	32.70	26.59	0.81	1.18	2.05	32.68	18.00
11	B	26	11	91	0.49	0.96	38.16	25.06	0.63	1.79	1.99	28.84	18.10
12	S	26	11	91	0.72	17.76	35.98	150.74	1.53	2.39	6.57	176.80	15.80
12	B	26	11	91	1.25	11.39	65.43	177.66	2.69	5.02	8.31	179.13	16.60
SB	S	26	11	91	8.80	56.20	30.52	5.44	1.58	1.99	1.32	1.60	14.90
SB	B	26	11	91									
1	S	9	12	91									
1	B	9	12	91									
1A	S	9	12	91	0.84	0.20	17.70	10.34	2.15	2.37	0.86	6.41	28.60
1A	B	9	12	91	1.02	0.20	8.15	9.16	1.66	2.04	1.08	0.64	27.20
2S	S	9	12	91	0.66	0.15	17.70	11.76	2.65	2.86	1.21	10.25	29.00
2S	B	9	12	91	0.78	0.20	16.50	11.29	2.54	2.86	1.32	10.89	28.40
3	S	9	12	91	0.55	0.11	18.89	12.48	2.87	3.03	1.27	10.41	29.10
3	B	9	12	91	0.78	1.54	20.08	12.24	2.76	3.36	1.35	11.89	29.10
4N	S	9	12	91	0.66	0.11	23.66	11.29	2.54	3.03	0.95	11.45	29.60
4N	B	9	12	91	0.90	0.06	18.89	15.32	2.21	3.36	1.49	10.25	27.90
4S	S	9	12	91	0.61	0.20	20.08	10.58	3.58	4.02	1.14	9.61	29.80
4S	B	9	12	91	0.84	0.45	21.28	10.82	3.75	4.69	1.27	9.29	28.40
4P	S	9	12	91	0.72	0.15	21.28	14.85	3.14	3.69	1.18	11.53	29.40
4P	B	9	12	91	0.90	0.15	21.28	14.37	3.14	4.52	1.27	11.53	26.80
5	S	9	12	91	0.84	0.11	26.05	16.51	4.69	4.85	1.88	18.26	32.40
5	B	9	12	91	0.90	1.54	21.28	13.42	3.03	4.36	1.62	13.78	28.50
5N	S	9	12	91	0.66	0.06	21.28	12.95	2.15	2.70	1.47	10.25	29.70
5N	B	9	12	91	1.02	1.54	18.89	12.48	2.26	3.53	1.44	10.89	28.70
5S	S	9	12	91	0.61	0.11	18.89	16.03	3.53	4.02	1.70	16.34	32.00
5S	B	9	12	91	1.07	0.20	17.70	13.42	3.09	4.02	1.29	15.38	29.50
6	S	9	12	91	0.61	0.15	20.08	16.03	1.71	2.37	1.73	16.98	28.50
6	B	9	12	91	1.13	0.20	108.40	19.11	2.98	49.08	3.35	17.62	28.00
7	S	9	12	91	0.66	0.20	17.70	17.22	1.05	2.04	2.16	16.34	26.50
7	B	9	12	91	1.07	0.20	22.47	4.38	1.66	2.70	2.10	16.98	26.70

TAR-PAMLICO RIVER NUTRIENT DATA IN uM FOR 1991

STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
7N	S	9	12	91	0.55	0.11	28.44	14.61	1.21	2.37	1.70	12.50	29.10
7N	B	9	12	91	1.19	0.15	27.24	21.01	2.15	3.36	2.10	21.63	28.10
7S	S	9	12	91	0.72	0.15	17.70	14.85	2.87	3.53	1.40	17.62	31.10
7S	B	9	12	91	1.90	1.54	21.28	20.77	3.14	4.02	2.23	23.07	29.50
8	S	9	12	91	0.66	0.06	20.08	18.64	0.39	0.88	2.44	22.43	26.80
8	B	9	12	91	1.90	0.15	23.66	19.11	1.32	2.04	2.40	21.15	27.40
9N	S	9	12	91	0.61	0.01	21.28	28.12	0.22	1.21	3.14	38.90	25.00
9N	B	9	12	91	1.90	0.11	27.24	29.07	0.39	1.21	3.27	35.96	23.70
9S	S	9	12	91	1.13	0.11	16.50	24.80	1.44	2.53	2.64	25.63	26.90
9S	B	9	12	91	1.96	0.11	22.47	19.59	1.76	2.70	2.16	21.79	25.90
10	S	9	12	91	0.96	0.06	23.66	29.07	0.22	1.71	3.37	30.44	23.90
10	B	9	12	91	10.70	0.11	24.86	30.64	1.16	2.20	4.02	33.41	26.00
11	S	9	12	91	1.02	0.15	24.86	28.36	0.06	1.71	3.48	34.29	23.10
11	B	9	12	91	1.13	0.20	29.63	43.44	0.61	1.87	4.97	50.35	24.70
12	S	9	12	91	1.19	21.95	48.72	86.50	0.99	3.53	4.40	165.01	20.50
12	B	9	12	91	1.25	22.80	48.72	77.10	0.94	3.20	4.06	127.24	20.00
SB	S	9	12	91	13.30	57.57	42.76	9.16	2.26	4.02	1.94	4.48	16.00
SB	B	9	12	91									
1	S	17	12	91									
1	B	17	12	91									
1A	S	17	12	91									
1A	B	17	12	91									
2S	S	17	12	91									
2S	B	17	12	91									
3	S	17	12	91	0.91	0.32		8.33	3.21	5.25	0.67	5.77	23.00
3	B	17	12	91	1.02	0.42		8.60	2.91	5.34	0.92	7.37	22.70
4N	S	17	12	91									
4N	B	17	12	91									
4S	S	17	12	91	0.80	0.52		9.00	3.25	5.53	0.74	7.37	21.80
4S	B	17	12	91	0.86	0.52		7.12	3.29	5.25	0.78	7.05	23.30
4P	S	17	12	91	0.91	0.27		9.94	3.76	6.29	0.75	5.77	20.90
4P	B	17	12	91	0.74	0.37		7.93	3.91	7.05	0.72	4.17	24.20
5	S	17	12	91	0.86	0.32		9.00	3.53	5.06	0.74	7.69	19.70
5	B	17	12	91	0.74	0.32		9.14	2.66	5.72	0.30	8.01	23.40
5N	S	17	12	91									
5N	B	17	12	91									
5S	S	17	12	91	1.08	0.57		10.75	3.17	5.91	0.90	8.01	18.90
5S	B	17	12	91	0.80	0.66		7.93	3.44	5.25	0.83	8.65	23.20
6	S	17	12	91	0.91	8.46		10.21	3.44	5.53	1.04	8.65	18.90
6	B	17	12	91	0.91	0.57		9.27	3.13	6.10	0.88	7.05	23.30
7	S	17	12	91	1.02	0.42		13.30	2.04	4.58	1.18	8.65	18.30
7	B	17	12	91	0.74	0.37		20.02	2.35	5.25	2.40	11.21	23.00
7N	S	17	12	91	0.80	0.27		14.11	2.04	4.11	1.22	12.82	18.00
7N	B	17	12	91	0.91	0.37		16.39	2.08	6.57	1.72	9.93	22.70
7S	S	17	12	91	0.80	0.32		6.90	2.27	4.30	1.18	3.52	18.50
7S	B	17	12	91	0.80	0.57		13.44	2.39	5.62	1.25	10.57	22.60
8	S	17	12	91	0.69	0.27		13.44	1.61	5.72	1.35	8.65	17.90
8	B	17	12	91	0.74	0.32		12.90	1.53	4.49	1.21	9.29	21.70
9N	S	17	12	91	1.25	0.27		20.29	2.15	5.06	1.69	23.39	16.90
9N	B	17	12	91	0.86	0.47		19.48	1.41	4.39	1.94	16.02	19.90
9S	S	17	12	91	0.91	0.27		20.02	1.80	4.01	1.92	17.25	17.50
9S	B	17	12	91	0.86	1.45		17.33	1.45	4.30	1.94	14.42	21.10

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STA	DEP	DA	MO	YR	NH4	NO3	DKN	PN	PO4	TDP	PP	CHL A (ug/l)	F
10	S	17	12	91	1.25	1.16		18.00	1.33	4.30	1.68	14.27	16.60
10	B	17	12	91	1.02	1.36		15.99	1.49	4.11	1.70	13.14	20.40
11	S	17	12	91	1.02	0.42		26.34	0.98	3.63	2.38	11.85	16.20
11	B	17	12	91	1.20	0.71		32.25	0.98	3.82	3.53	20.03	19.50
12	S	17	12	91	1.36	13.94		98.39	1.18	3.63	7.88	147.74	14.10
12	B	17	12	91	1.54	15.67		80.03	1.29	4.30	2.26	126.63	16.60
SB	S	17	12	91	10.26	65.58		3.76	2.19	3.54	0.94	5.55	10.10
SB	B	17	12	91									