FINAL
HISTORICAL DATA REVIEW
ON
MISSION RIVER AND ARANSAS RIVER TIDAL

Performed as part of Contract No. 582-8-80180 (TPWD Contract No. 184682)

Janet Nelson
James Tolan
Coastal Fisheries Division
Texas Parks and Wildlife Department
Austin, Texas

July 2008

Introduction

This historical data review was performed as part of an assessment of two tidally-influenced streams in Texas. The work was performed by Texas Parks and Wildlife Department (TPWD) under contract with the Texas Commission on Environmental Quality (TCEQ). Funding for the contract is from the United States Environmental Protection Agency (USEPA). Under the contract, TPWD Coastal Fisheries Division staff, led by the Ecosystem Resource Assessment Team, will collect data on two tidal streams, Mission River Tidal and Aransas River Tidal.

Tidal streams are highly productive transitional areas between the freshwater of the rivers and the saltwater of the bays. Tidal streams serve as nurseries for many fish and shellfish, including many important commercial and recreational species. Routine monitoring of several tidal streams have revealed dissolved oxygen measurements which are not meeting state water quality standards. Water quality management of these streams has been difficult because there are not currently any statewide criteria for assessing tidally influenced waterbodies, and these systems are naturally quite variable over space and time. The purpose of the previous Tidal stream Use Attainability analysis (UAA) study was to collect data in support of the development of a standardized methodology for assessing ecosystem health and assigning site-specific uses and criteria within tidally influenced portions of streams.

Based on the results of the UAA study, dissolved oxygen concentration did not appear to be one of the major structuring factors in the physical, chemical, or biological components of ecosystem health.

Little differences in the physical, chemical, or biological structure were found to exist on the mid coast tidal streams between the reference stream and either of the study streams. The greatest degree of difference in indicators of ecosystem health all involved upstream – downstream gradients that appear to be driven by salinity structure (the upper and middle stations were similar but significantly different from the lower station). These salinity-driven gradient conditions cut across all levels of ecological integrity that were measured for this study.

The analysis techniques applied to the salinity-mediated differences found in this study were equivocal; all the measures of ecosystem health on the study streams were very similar to the reference stream. As such, no biocriteria for tidal streams could be developed that would have applicability over large spatial scales.

The UAA study introduced a new assessment methodology to integrate the physical, chemical, and biological components of ecosystem health. TPWD will apply this methodology to the Mission River Tidal and the Aransas River Tidal. This would further develop the methodology for assessing the health of tidal streams.

The project will be conducted through FY2011. In 2008 and 2009 TPWD staff will collect data about flow, physico-chemical parameters, fish, shellfish, benthic

invertebrates, sediment, habitat, and water. In 2010, TPWD staff will analyze data and prepare a final report.

Site Descriptions

Aransas River

As described in the new Handbook of Texas Online (Handbook of Texas Online 2007), the Aransas River rises at the confluence of Olmos, Aransas and Poesta creek, two miles north of Skidmore in south central Bee County (at 28º 17' N 97º 14' W). It flows southeast for forty miles, forming the boundary between San Patricio and Refugio counties and continuing into Aransas County, where it empties into Copano Bay ten miles northeast of Rockport (at 28º 05' N, 97º 13' W). The river traverses flat rolling terrain with clay loam and sandy loam soils that support water-tolerant hardwoods, such as elms and oaks, and grasses. Aransas County altitude ranges from sea level to fifty feet. The level land, part of the coastal prairie, is generally poorly drained. The sub-tropical humid climate features mild winters and warm summers. The temperatures range in January from an average low of 46ºF to an average high of 63ºF, and in July from 76ºF to 91ºF. The average rainfall is 36 inches; the average humidity is 95 percent at 6 A.M. and 76 percent at 6 P.M. The growing season averages 305 days a year, with the last freeze in early February and the first freeze in mid-December. Oil was discovered in the county in 1936, and thirteen wells were in production in 1946 but it was not until the 1950's that oil was produced in large quantities. The total number of businesses in Aransas County in the early 1990's was about 450. Leading industries included agribusiness, tourism, oil and gas extraction, and fish packing. In 1990, approximately 33 percent of the land in Aransas County was in farms and ranches, and 14 percent of the farmland was under cultivation. Principal crops included sorghum, fruits, and nuts; the primary livestock products were from cattle.

Buccaneer Cove preserve is located at the mouth of the Aransas River and contains 856 acres of wetlands such as estuarine tidal flats and brackish marshes. This area is owned and managed by the Coastal Bend Land Trust whose primary goal are preserving and enhancing native wildlife habitat in the Coastal Bend (NOAA 2006). Welder Wildlife Refuge is located on the Aransas River riparian corridor. The Welder Wildlife foundation was created after the death of Robert M. Welder who directed that the refuge be managed for the conservation of native wildlife. Wetlands that exist on the refuge are lower coast riparian –hardwood corridor, prairie pothole and marsh-marsh fringing ponds and lakes (Moulton and Jacob 2001).

Aransas River above Tidal (Segment 2004) begins at the confluence of Poesta and Aransas Creeks in Bee County and is 35 miles in length. Aransas River Tidal (Segment 2003) begins at a point one mile upstream of US 77 in Refugio/San Patricio County, is 6 miles in length, and flows into Copano Bay.

Mission River

As described in the new Handbook of Texas Online (Handbook of Texas Online 2007), the Mission River is formed by the confluence of Blanco and Medio creeks in central Refugio County (at 28º 19' N, 97º 19' W) and runs southeast, past Refugio, for twenty-

four miles to its mouth on Mission Bay, an inlet to Copano Bay (at 28º 10N, 97º 10' W). It traverses gently undulating coastal prairies surfaced by clay and loam and spotted by groves of hardwoods and pines. It is home to a myriad of waterfowl and native slough grasses. Refugio County covers 771 square miles of generally flat land covered with tall prairie grasses and spotted in some areas with mesquite, live oak, prickly pear, and huisache. Elevations range from sea level to 100 feet in the northwest section. In 1982, 91 percent of the land in Refugio County was being used for farms and ranches; about 18 percent of the farmland was under cultivation. About 54 percent of the area's agricultural income that year derived from livestock, particularly cattle and hogs; crops included sorghum, cotton, corn, wheat and hay. Watermelons and pecans are also grown in the area. Natural resources include petroleum, natural gas, and industrial sand. In 1982, 56,470,457,000 cubic feet of gas-well gas, 39,920 barrels of condensate, 23,483,771 barrels of crude oil, and 50,934,814,000 cubic feet of casing-head gas were produced in the county.

The Fennessey Ranch is privately owned and consists of 4,000 acres of abundant wetlands, meadows, natural lakes, riparian woods and brush land bordered on three sides by the Mission River (Fennessey web site). The current economic base incorporates hunting, wildlife tours, photography, and cattle enterprises (Smith and Dilworth 1999).

Mission River Above Tidal (Segment 2002) begins at the confluence of Blanco and Medio Creeks in Refugio County and is 9 miles in length. Mission River Tidal (Segment 2001) begins at a point 4.6 miles downstream of US 77 in Refugio County, is 19 miles in length, and flows into Mission Bay.

Copano Bay is located in the San Antonio–Nueces Coastal Basin. The bay covers parts of Aransas and Refugio counties, while the watershed also encompasses Bee, Goliad Karnes and San Patricio counties. Mission Bay and Port Bay are sub-bays of Copano Bay and are included in Segment 2472.

Water Quality Standards

Water quality standards include designated uses for a water body, specific numerical criteria for certain water quality parameters, and narrative criteria. The Texas Surface Water Quality Standards (TSWQS) are set by the TCEQ and approved by the USEPA. The TCEQ has established aquatic life uses and associated criteria for all waters of the state. The numeric criterion for dissolved oxygen is a surrogate or indirect measure of whether the aquatic life use is being maintained.

Mission River Tidal Segment 2001 and Aransas River Tidal Segment 2003 have high aquatic life use (TCEQ 2006). The dissolved oxygen criteria for a tidal water body with a high aquatic life use are: daily average 4 mg/l, and daily minimum 3 mg/l. The dissolved oxygen criteria only apply in the "mixed surface layer," which in tidally-influenced water bodies is defined as "the portion of the water column from the surface to the depth at which the specific conductance is 6,000 umhos/cm greater than the specific conductance at the surface" (TCEQ 2006).

According to the *2004 Texas Water Quality Inventory and 303(d) List*, Copano Bay (Segment 2472) is impaired for bacteria in oyster waters (category 5c) in the area along the southern shore including Port Bay and the area near Bayside. There are concerns for total phosphorus in the area near FM 136, south of Bayside, and for depressed dissolved oxygen (DO) in the area near FM 188, west of Rockport.

There is a concern for depressed DO on Mission River above Tidal (Segment 2002). Mission River Tidal (Segment 2001) is impaired for bacteria (contact recreation). There is a concern for depressed DO on Aransas River above Tidal (Segment 2004). Aransas River Tidal (Segment 2003) is impaired for bacteria (contact recreation) and has a concern for orthophosphorus.

Previous and Current Studies

The Mission River tidal and the Fennessey Ranch fall within the Mission Aransas National Research Reserve (MANERR). For more information concerning ongoing research can be found at the Mission-Aransas reserve local website: http://www.utmsi.utexas.edu/nerr/. The MANERR has a System Wide Monitoring Program (SWMP). The purposes of the Reserve SWMP stations are to gain information on climatic and hydrological patterns that influence freshwater inflow in the Mission-Aransas Estuary, however none of these stations fall within the Mission River tidal.

According to the work plan on the web site: Texas State Soil and Water Conservation Board CWA §319(h) Agricultural/Silvicultural Nonpoint Source Grant Program FY 2006 Project Workplan (06-15): http://www.tsswcb.state.tx.us/files/contentimages/06-15-WP-CopanoSWQM-12-15-06.pdf a Total Maximum Daily Load (TMDL) study to address the bacteria in oyster waters in Copano Bay was initiated in 2003 by TCEQ. There are two major components to the study. The first is the development of a Bacteria Loadings Model for the Mission and Aransas Rivers subbasins of the San Antonio–Nueces Coastal Basin. The second component of the study is Bacteria Source Tracking for the area around and in Copano Bay. Three types of surface water quality monitoring will be conducted: routine ambient, targeted watershed, and effluent. Nueces River Authority (NRA) will conduct most of the work performed under this project including technical and financial supervision, preparation of status reports, surface water quality monitoring sample collection, and data management. This project will generate data of known and acceptable quality for surface water quality monitoring of river stations on Segments 2472 (Copano Bay), 2001 and 2002 (Mission River), and Segments 2003 and 2004 (Aransas River) for field, conventional (TSS and turbidity), flow (non-tidal river segments), and bacteria parameters to support the TMDL for bacteria in oyster waters in Copano Bay in Aransas and Refugio Counties (Appendix 1).
Nueces River authority NRA home page: http://www.nueces-ra.org/.

Smith and Dilworth published Mission Aransas Watershed Wetland Conservation Plan in 1999. This publication gives a good overview of the area encompassing Aransas, Refugio and San Patricio counties.

Review of Water Quality Data

According to the TCEQ 2008 water quality inventory, the Aransas River Tidal was fully supporting for Dissolved Oxygen (DO). Of 26 samples, all met screening criteria levels for the Aquatic Life Use (ALU). General use categories for pH, ammonia, and water temperature were also fully supporting in 28 samples collected. Recreational use categories of bacteria geomean and bacteria single sample *Enterococcus* were non-supporting with one exceedance of 23 samples for bacteria geomean and eleven exceedances of 23 samples for bacteria single sample. In the 2006 TCEQ water quality inventory the segment was non-supporting for *Enterococcus.* It was also listed as screening level concern for nitrate and orthophosphorus. In the 2004 TCEQ water quality inventory the segment was listed for *Enterococcus* non-supporting and concern for Orthophosphorus.

According to the TCEQ 2008 water quality inventory the Mission River Tidal was fully supporting for DO grab minimum and no concern for DO grab screening level. Of 28 samples assessed only one exceeded the screening level for ALU. General use categories for pH, ammonia and water temperature were also fully supporting in 28 samples collected. Recreational use categories of bacteria geomean and bacteria single sample *Enterococcus* were non-supporting with one exceedance of 28 samples for bacteria geomean and ten exceedances of 28 samples for bacteria single sample. In the 2006 TCEQ water quality inventory the segment was non-supporting for *Enterococcus.* In the 2004 TCEQ water quality inventory the segment was listed for *Enterococcus* non-supporting.

Wastewater Outfalls

The town of Woodsboro is the only wastewater discharge currently permitted in the Mission River Tidal Segment (WQ0010156-001 – Town of Woodsboro: 250,000 gpd: a ditch to Willow Creek to Sous Creek to Mission River Tidal; Basin Highlight Report, 2007). The Above Tidal Segment has two wastewater discharges currently permitted (WQ0010255-001 – Town of Refugio; and WQ0010748-001 – Pettus MUD: 105,000 gpd: Medio Creek to Mission River Above Tidal; see Figure 1).

There are no wastewater outfalls in the Aransas River Tidal segment, although five wastewater permits individually drain into an unnamed tributary of Chiltipin Creek and these enter Segment 2003 (WQ0010055-001 – City of Sinton: 15,000 gpd: San Patricio County Drainage District; WQ0010237-001 – City of Odem: 273,000 gpd; WQ0013412-001 – TxDOT: 380 gpd: Oliver Drainage Ditch; WQ0013641-001 – City of Sinton Rob and Bessie Welder Park: 15,000 gpd; and WQ0014119-001 – St. Paul WSC: 50,000 gpd). The Above Tidal Segment has four wastewater permits that currently drain into the Aransas River (WQ0010124-002 – City of Beeville: 3,000,000 gpd with provisions for irrigation of the grass and landscaping of the plant site: to Poesta Creek to the Aransas River Above Tidal; WQ0010124-004 – City of Beeville, Chase Field: 2,500,000 gpd; WQ0014112-001 – Skidmore WSC: 131,000 gpd; WQ0014123-001 – Tynan WSC: 45,000 gpd: Papalote Creek to the Aransas River).

Summary of SWQM TRACS Historical Data

A raw data report of all SWQM data on Segments 2001 and 2003 were obtained for the period of record ending November 28, 2007. Dissolved oxygen measurements have been collected at two stations on the Aransas River (Station 12947 – boat ramp on FM 629 south of Bonnie View and Station 12948 - at US 77) and a single station on the Mission River (Station 12943 – at FM 2678).

Mixed surface layer D.O. measurements

Because dissolved oxygen (D.O.) is the parameter of most concern for this study, an analysis was made of instantaneous D.O. measured at 0.3 meters or less from the surface (to approximate the mixed surface layer). Data collected between 5:00 and 9:00 a.m., which approximates the critical early morning period, was removed from the analysis. Over the period of record, a total of 174 surface D.O. measurements have been taken from Station 12948, with eight taken during this critical early morning period. The mean D.O. for the remaining 166 measurements was 7.93 mg/l, and values ranged from 3.1 to 14.2 mg/l. Far fewer samples were collected from Station 12947 (n = 21), with two samples collected prior to 9:00 am. The mean D.O. for the remaining 19 measurements was 8.12 mg/l, with values ranging from a low of 5.6 to a high of 11.6 mg/l. On Segment 2003, a total of 156 surface D.O. measurements were taken, with only two observations falling within the critical early morning period. The mean D.O. at Station 12943 was 7.69 mg/l, with values ranged from 1.6 to 14.4 mg/l.

Vertical profiles

No profile measurements were collected from Segment 2001. Data from eight sampling events are available to evaluate vertical profiles of dissolved oxygen and specific conductivity on Segment 2003. In each instance, profile measurements revealed that the water column was well-mixed with respect to the amount of D.O. present (Table 1). Only a single occasion (1/23/2007) revealed a salt wedge present in the water column (a difference between the surface and bottom specific conductance readings > 6000 umhos/cm). Even under these conditions, D.O. measurements from both the surface and bottom layers were nearly identical and revealed a well-mixed water column.

Trends Over Time

Routine field parameters, as well as conventional parameters from the mixed surface layer (measured at 0.3 meters or less from the surface) and collected anytime other than the critical early morning period (5:00 – 9:00 a.m.) are plotted for Stations 12947, 12948, and 12943. While data collection has not been continuous over time, most collections represent monthly or quarterly series.

Quarterly monitoring at Station 12947 began in October of 2004, although single sampling events took place in 1982 and again in 1988 (Figure 2). No samples exceeded the screening criteria for tidal waters for the parameters of temperature, D.O., or pH. Salinities at Station 12947 ranged from nearly fresh to <5. Conventional parameters at Station 12947 were also indicative of lower saline conditions, with solids (both suspended and dissolved), hardness, and free-ions (SO_4 and Cl) all falling in the lower range for estuarine waters (see Figure 3). Trends in biologically-coupled conventionals (nutrient parameters shown in Figures 4 and 5) could not be evaluated, as only a few samples comprised the collections from 12947.

A more complete record of both routine and conventional parameters were taken from Station 12948, with nearly monthly sampling from September 1968 until December 1974, then quarterly sampling from January 1975 through July 2004. Only a single event exceeded the temperature screening value of 35 ^{o}C (Figure 6), whereas six total events recorded D.O. lower than the recommended criteria value of 4 mg/l. The standards for pH were nearly always satisfied, with only a single observation above (9.1) and one below (6.0) the screening value. The time series for specific conductance reveals that the influence of saltwater intrusion is minimal at this station, with only a few records above a salinity value of 5 (approximately 10,000 umhos/cm). Conventional parameters at Station 12948 also reflect lower saline conditions, with solids (both suspended and dissolved), hardness, and free-ions (SO_4 and Cl) routinely in the low range for estuarine waters (see Figure 7). The highest values of Sulfate and Chloride both correspond to an anomalously high salinity event in November 1989. Two of the biologically-coupled conventionals (Chlorophyll-a and Total Organic Carbon) appear to be trending downward through time, whereas Nitrate+Nitrite appears to be trending upward (Figure 8). Total Phosphate (000650) and Orthophosphate (00665) were collected until the mid-1980, then subsequently replaced with Orthophospahte – Dissolved (70507) as the measure of the nutrient Phosphorus within the system. Orthophosphate also appears to be trending downward at Station 12948 (Figure 9).

Monthly sampling was conducted at Station 12943 from 1972 until 1974, with quarterly sampling comprising the remainder of the records from May 1969 to November 2007 (Figure 10). The only screening criteria to be exceeded at Station 12943 was D.O., with a total of five low D.O. events. Saltwater intrusion is far more evident on this tidal segment, with salinities ranging from fresh to 27.6 (specific conductance values range from 192 to nearly 60,000). There is no discernable trend in these salinity intrusion events. Conventional parameters at the station on Segment 2003 are markedly higher than on Segment 2001, with TDS (70300), Sulfate (00945) and Chloride (00940) all ranging an order of magnitude higher at Station 12943. These can be linked directly to the influence of the saltwater intrusion events (Figure 11). While Chlorophyll-a and Nitrate+Nitrite show no trend through time, Ammonia and Total Organic Carbon appear to be trending downward (Figure 12). Similar to the sampling techniques employed at Station 12948, Total Phosphate and Orthophosphate were dropped from collections in the mid-1980 and the remaining measure of Phosphorus in this Segment (Orthophosphate – 70507) shows a weak downward trend (Figure 13).

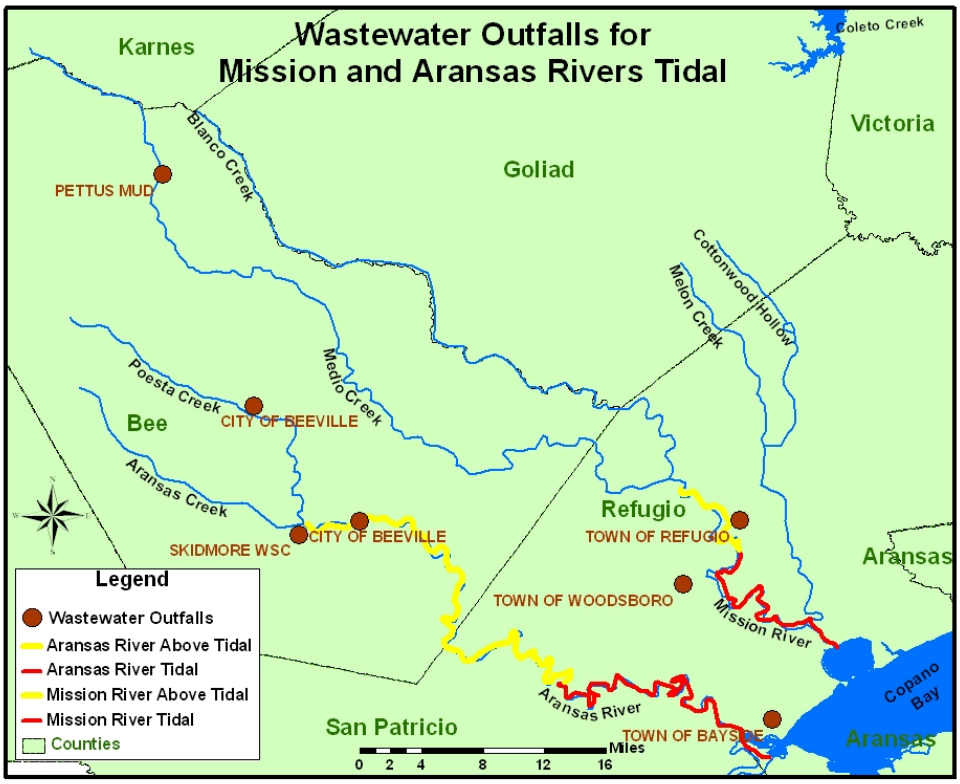

Figure 1. Map of wastewater outfalls for the Mission and Aransas Rivers Tidal.

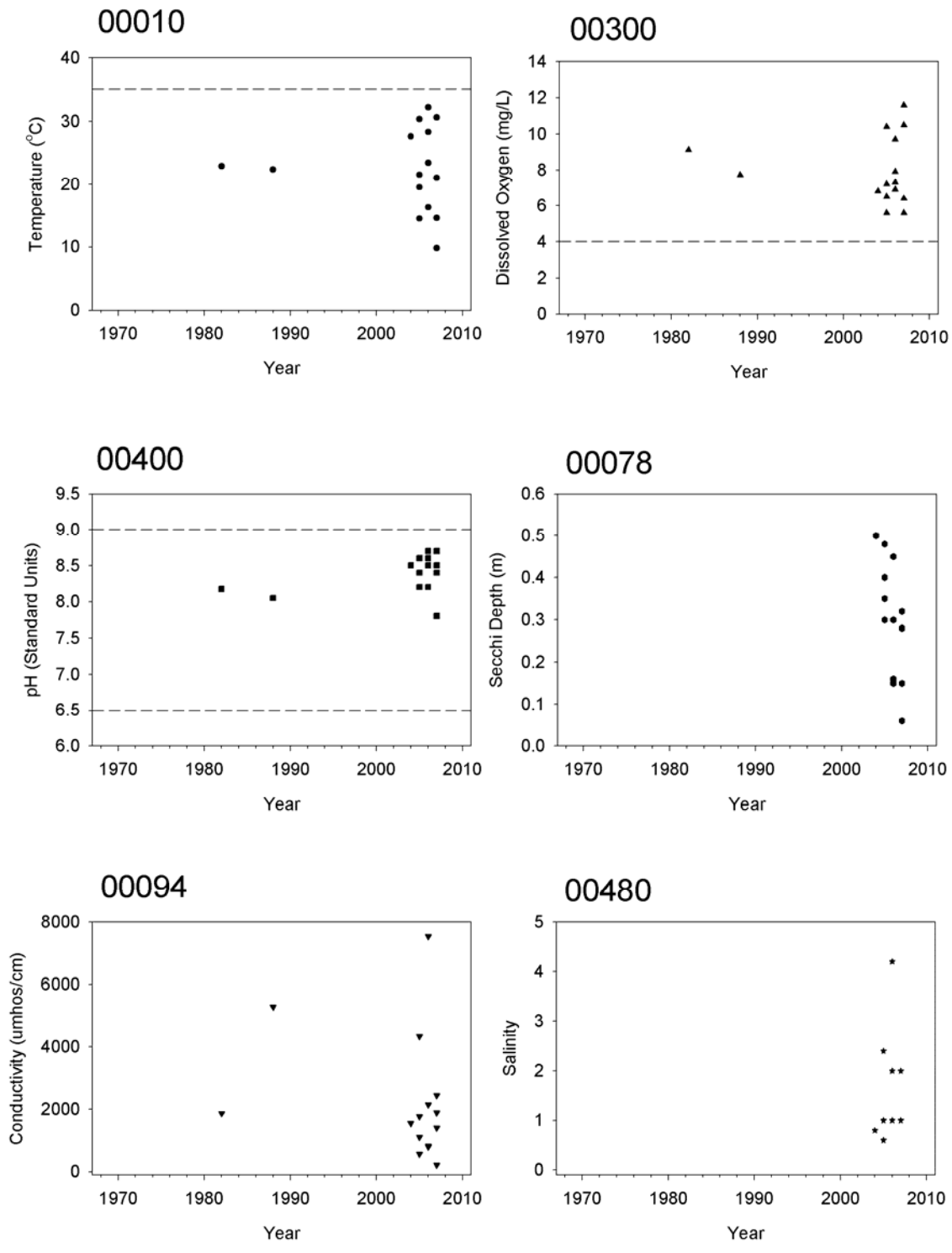

Figure 2. Time series of Field Parameters measured at Station 12947, Aransas River Tidal. Control lines for screening criteria added for Temperature (00010), D.O. (00300), and pH (00400).

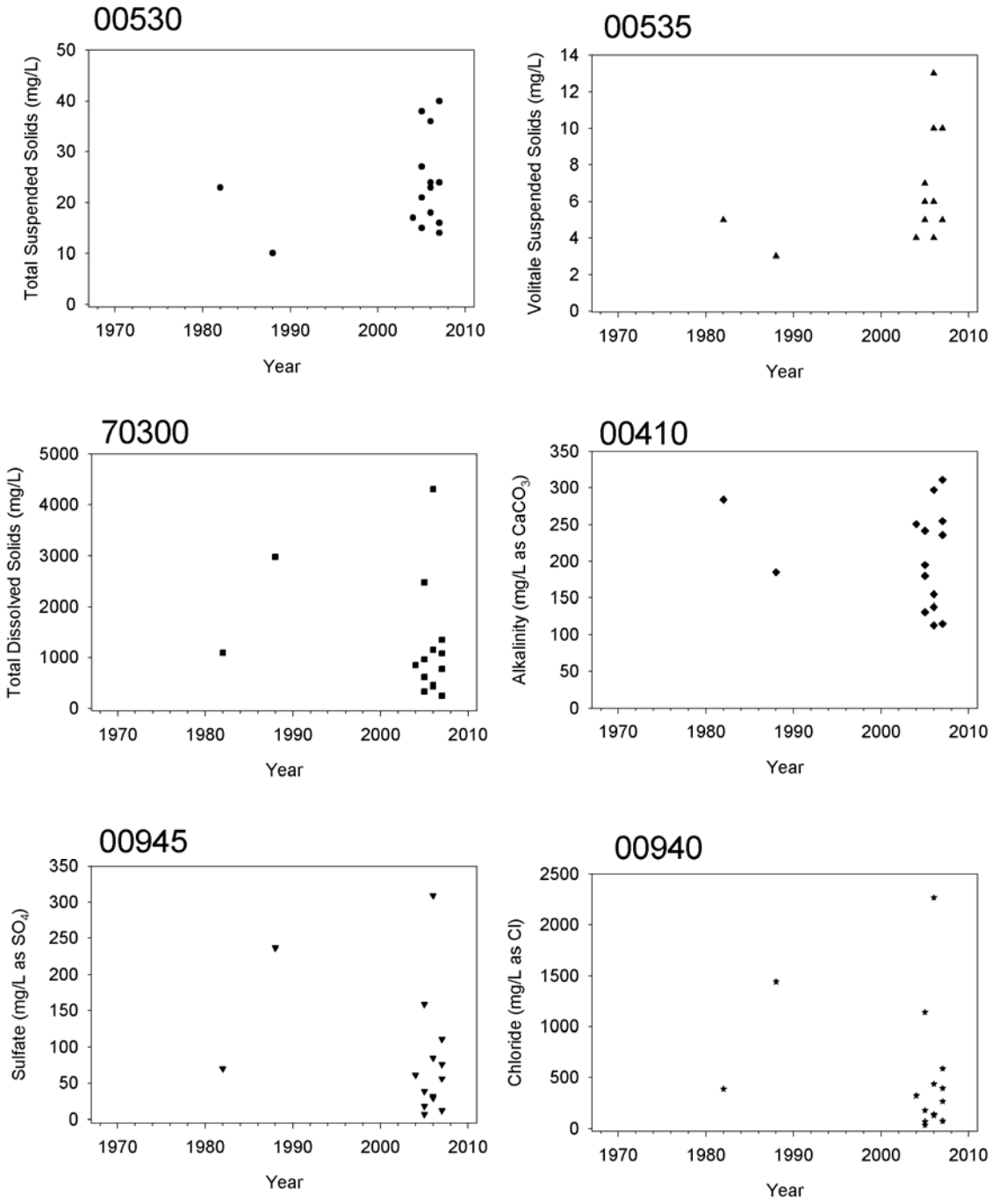

Figure 3. Time series of Conventional Parameters (TSS – 00530, VSS – 00535,TDS – 70300, Alkalinity – 00410, Sulfate – 00945, and Chloride – 00940) measured at Station 12947, Aransas River Tidal.

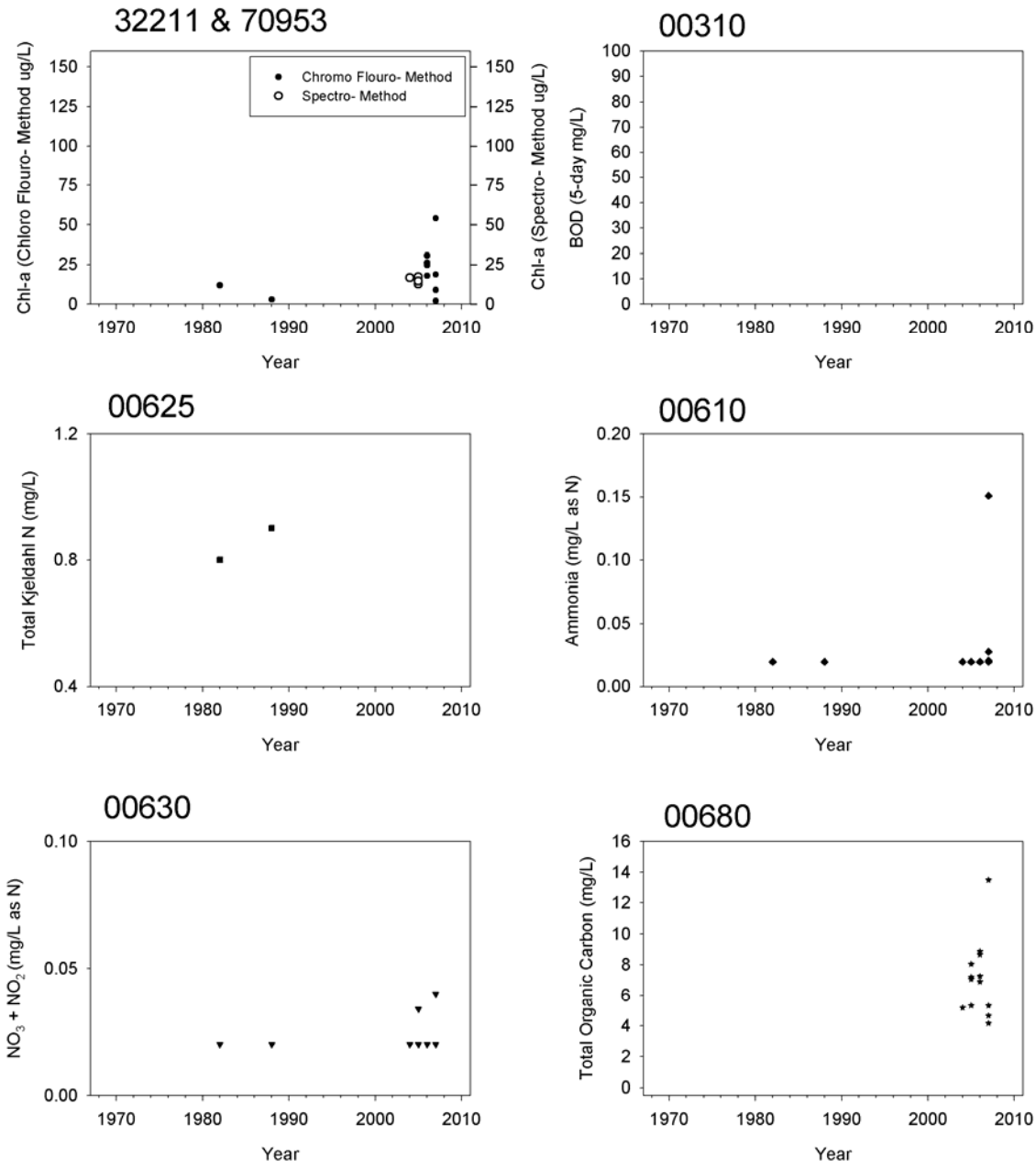

Figure 4. Time series of Conventional Parameters (Chlorophyll a – 32211 & 70953, BOD – 00310, Total N – 00625, Ammonia N – 00610, Nitrate+Nitrite – 00630, and TOC – 00680) measured at Station 12947, Aransas River Tidal.

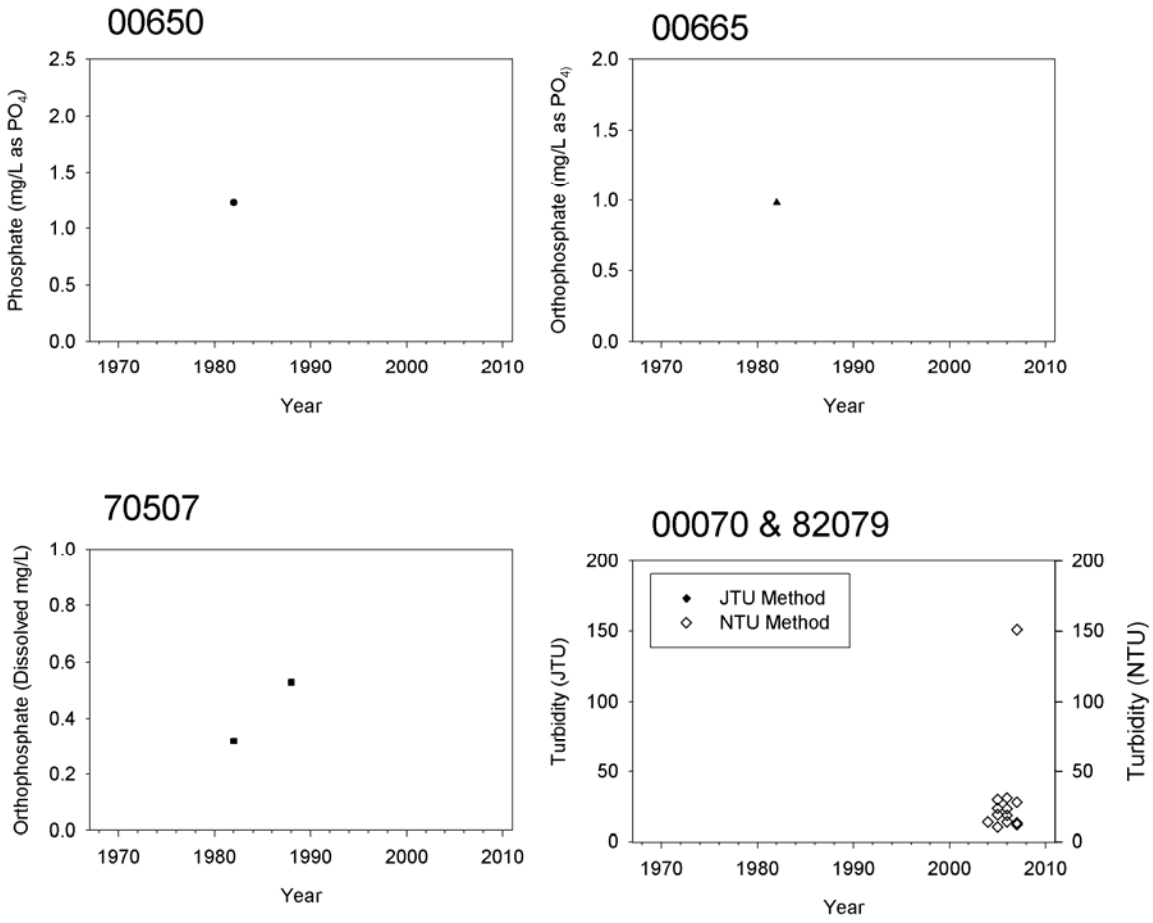

Figure 5. Time series of Conventional Parameters (Phosphate – 00650, Orthophosphate – 00665, Orthophosphate Dissolved – 70507, and Turbidity – 00070 & 82079) measured at Station 12947, Aransas River Tidal.

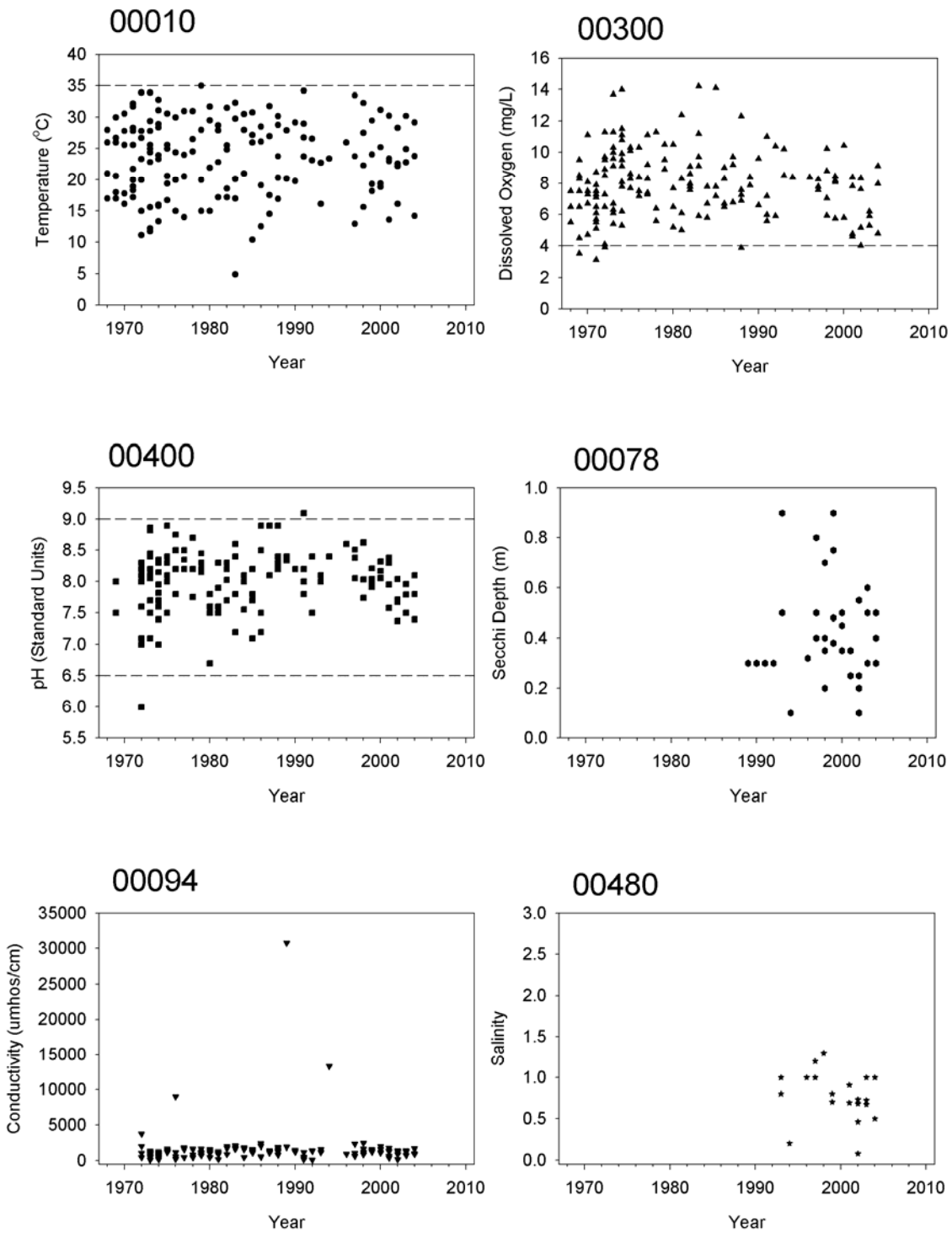

Figure 6. Time series of Field Parameters measured at Station 12948, Aransas River Tidal. Control lines for screening criteria added for Temperature (00010), D.O. (00300), and pH (00400).

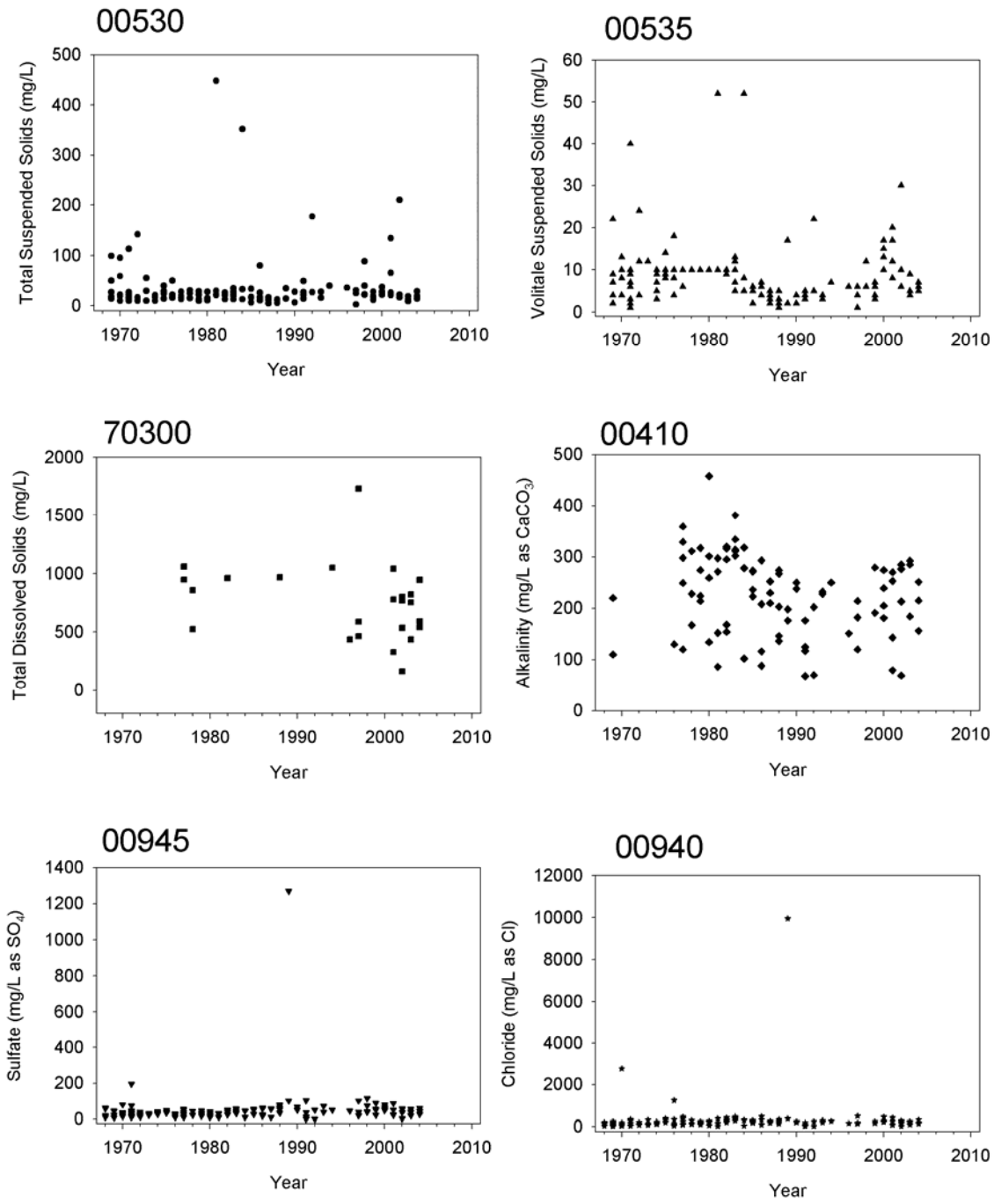

Figure 7. Time series of Conventional Parameters (TSS – 00530, VSS – 00535,TDS – 70300, Alkalinity – 00410, Sulfate – 00945, and Chloride – 00940) measured at Station 12948, Aransas River Tidal.

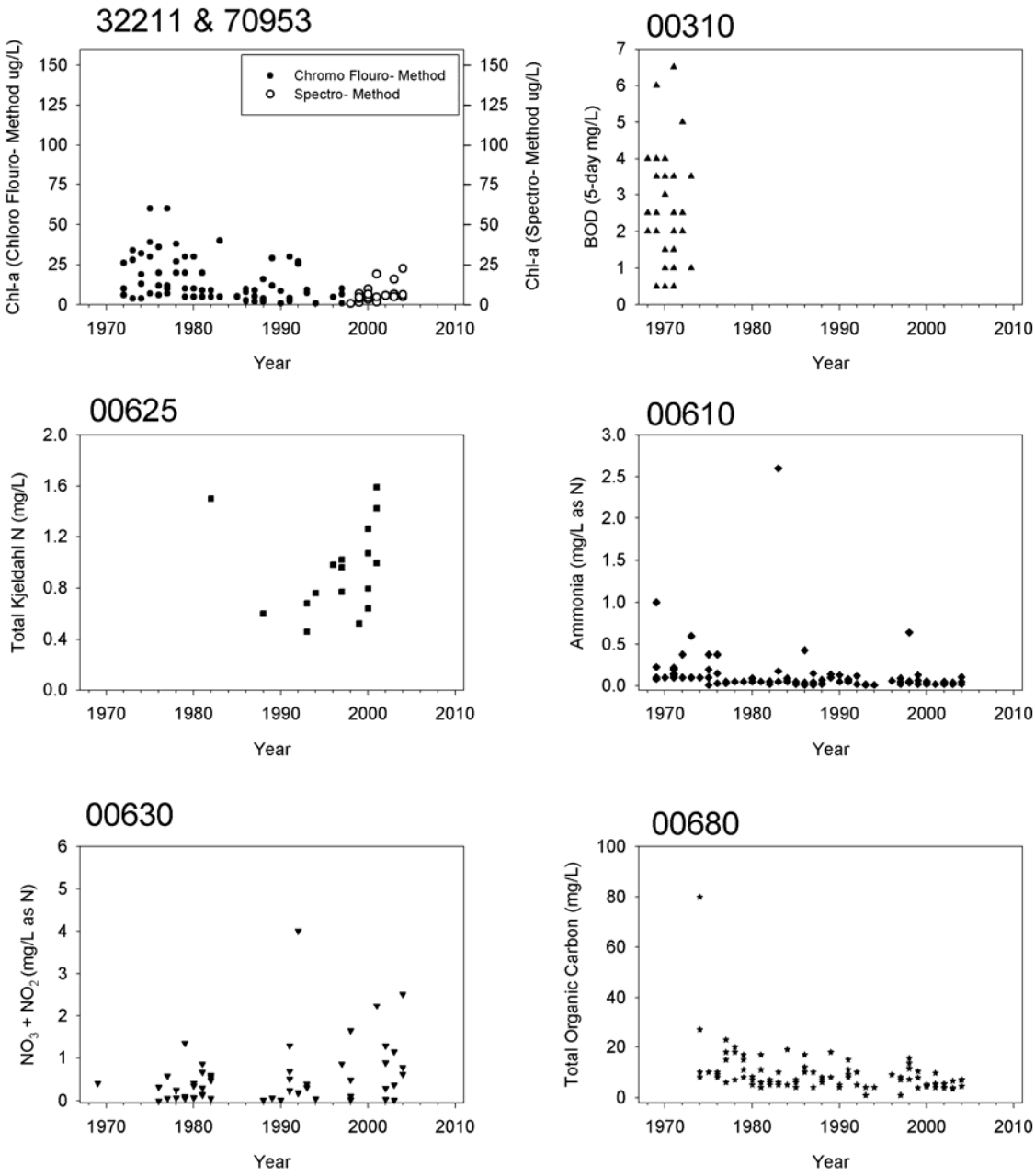

Figure 8. Time series of Conventional Parameters (Chlorophyll a – 32211 & 70953, BOD – 00310, Total N – 00625, Ammonia N – 00610, Nitrate+Nitrite – 00630, and TOC – 00680) measured at Station 12948, Aransas River Tidal.

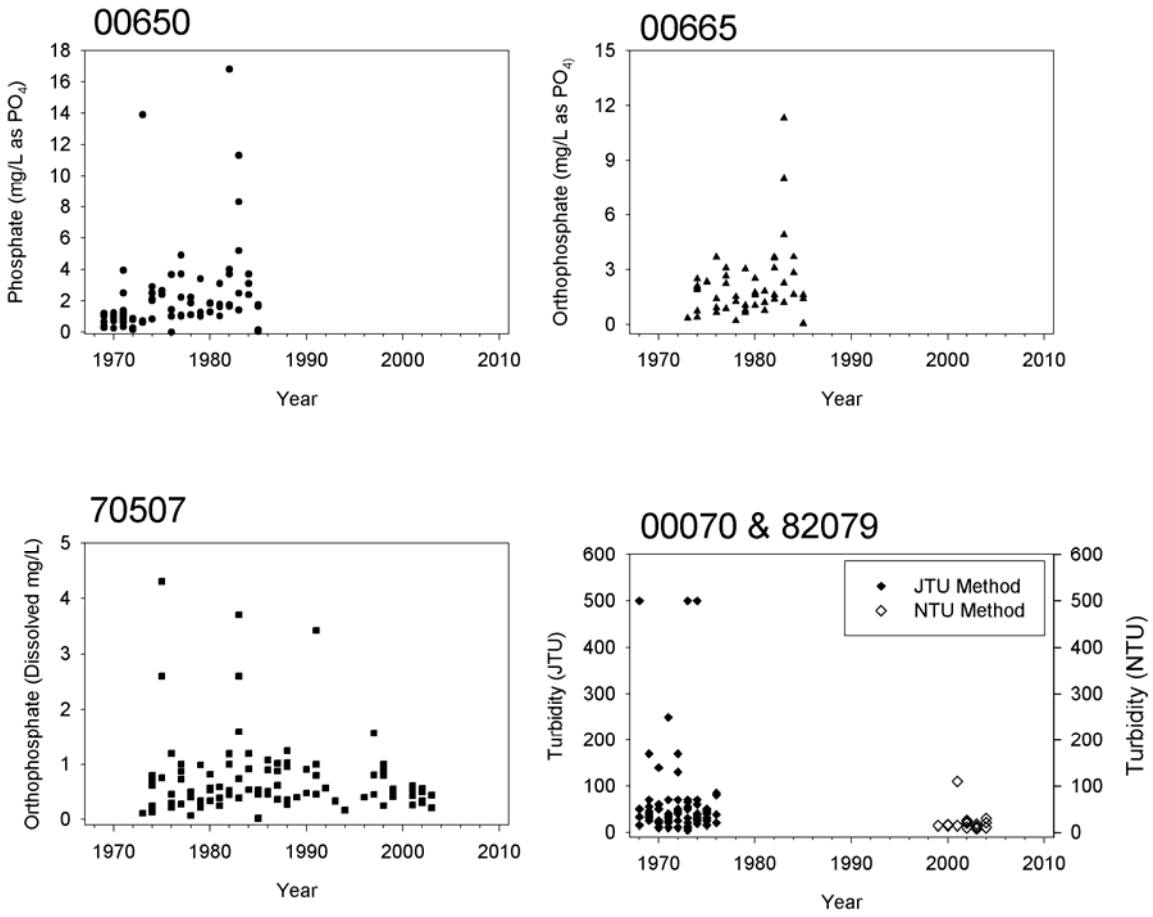

Figure 9. Time series of Conventional Parameters (Phosphate – 00650, Orthophosphate – 00665, Orthophosphate Dissolved – 70507, and Turbidity – 00070 & 82079) measured at Station 12948, Aransas River Tidal.

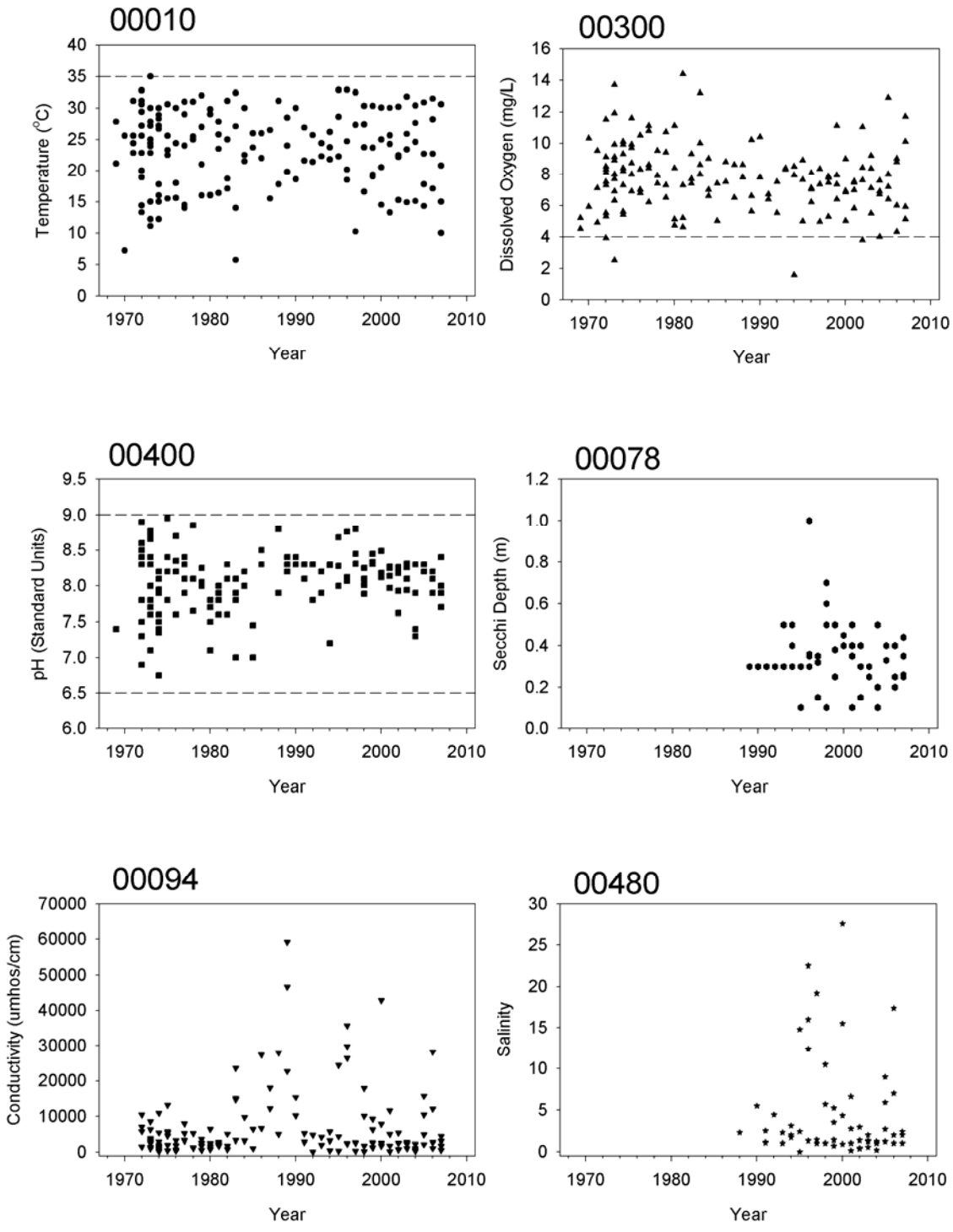

Figure 10. Time series of Field Parameters measured at Station 12943, Mission River Tidal. Control lines for screening criteria added for Temperature (00010), D.O. (00300), and pH (00400).

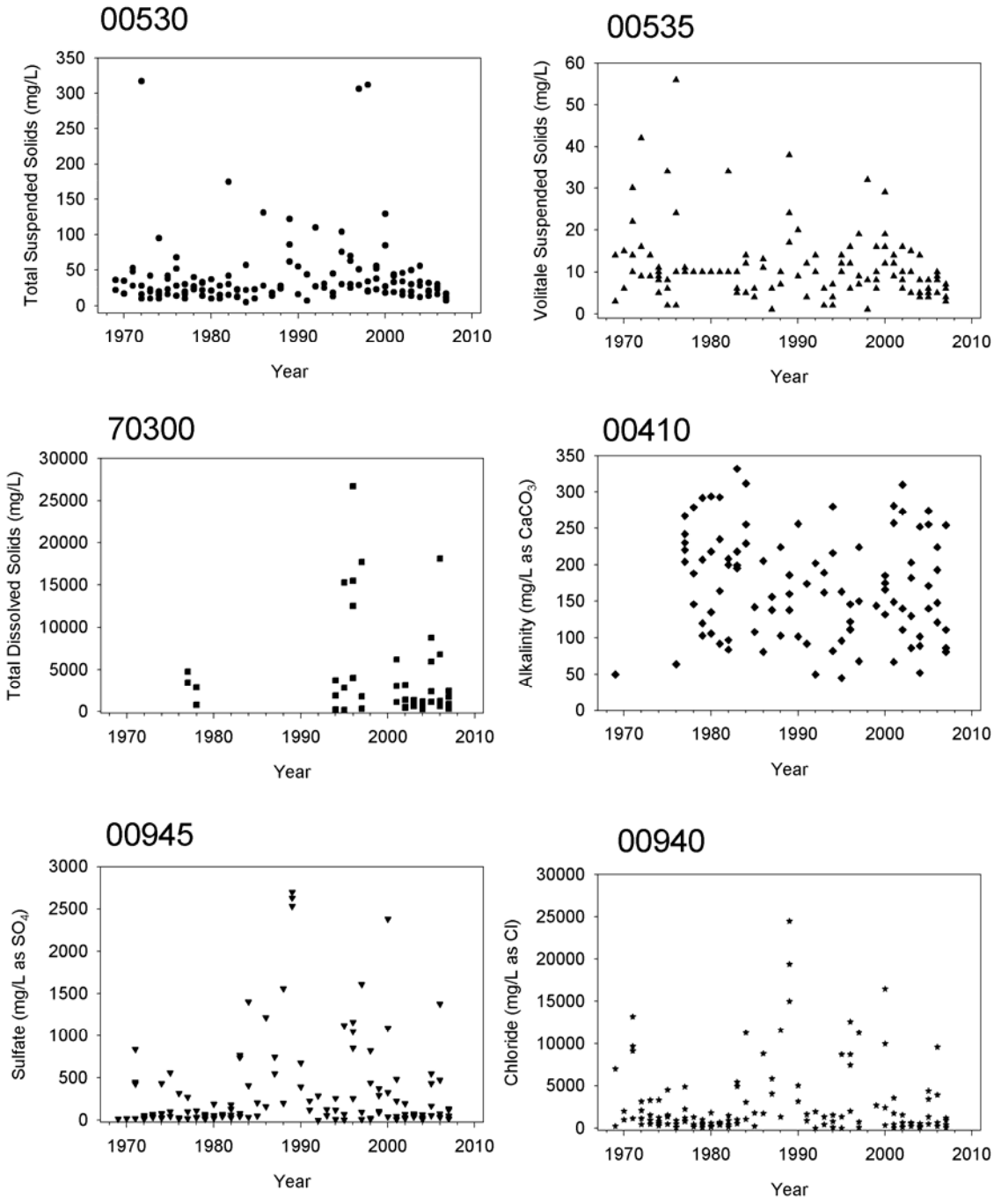

Figure 11. Time series of Conventional Parameters (TSS – 00530, VSS – 00535,TDS – 70300, Alkalinity – 00410, Sulfate – 00945, and Chloride – 00940) measured at Station 12943, Mission River Tidal.

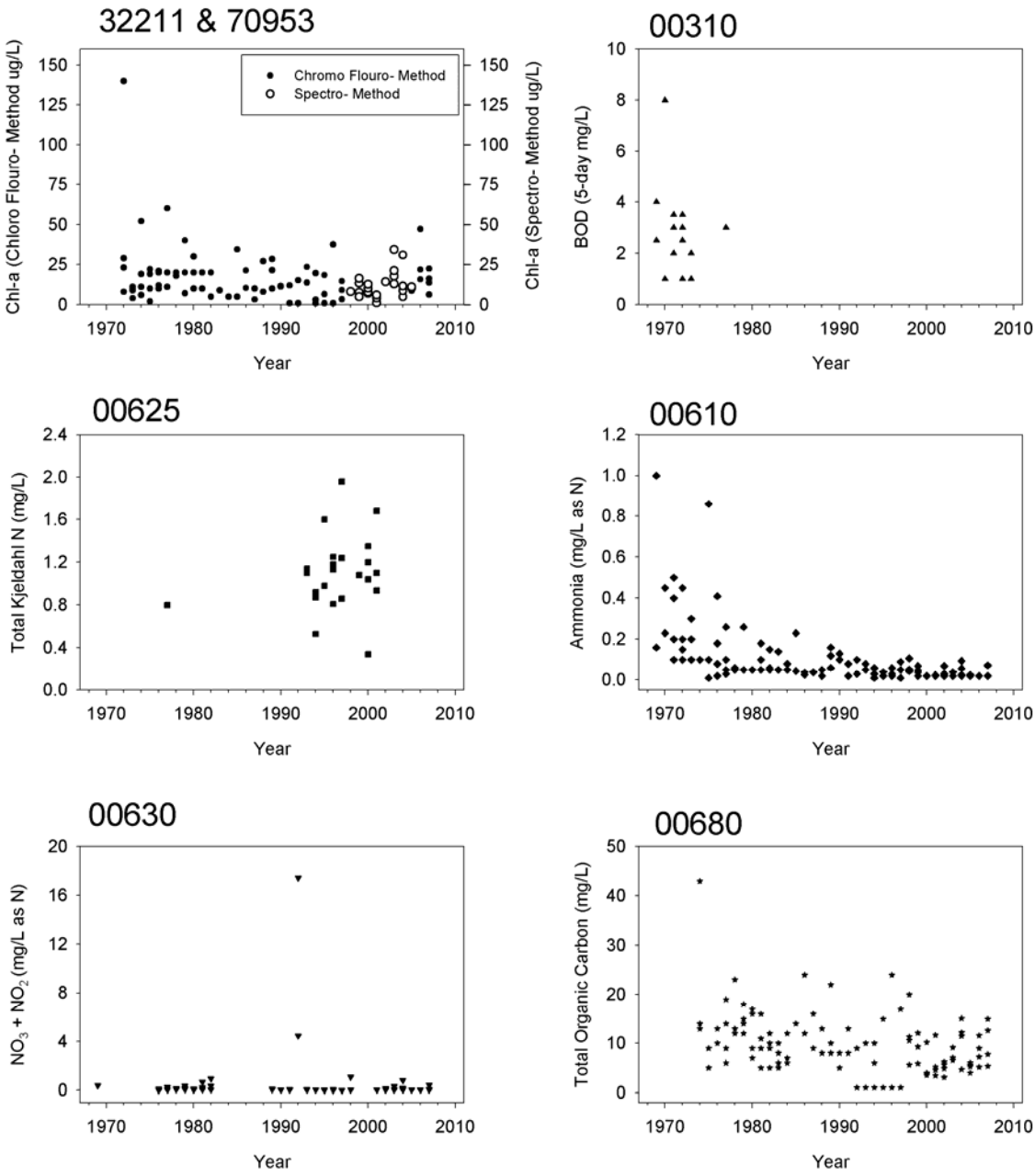

Figure 12. Time series of Conventional Parameters (Chlorophyll a – 32211 & 70953, BOD – 00310, Total N – 00625, Ammonia N – 00610, Nitrate+Nitrite – 00630, and TOC – 00680) measured at Station 12943, Mission River Tidal.

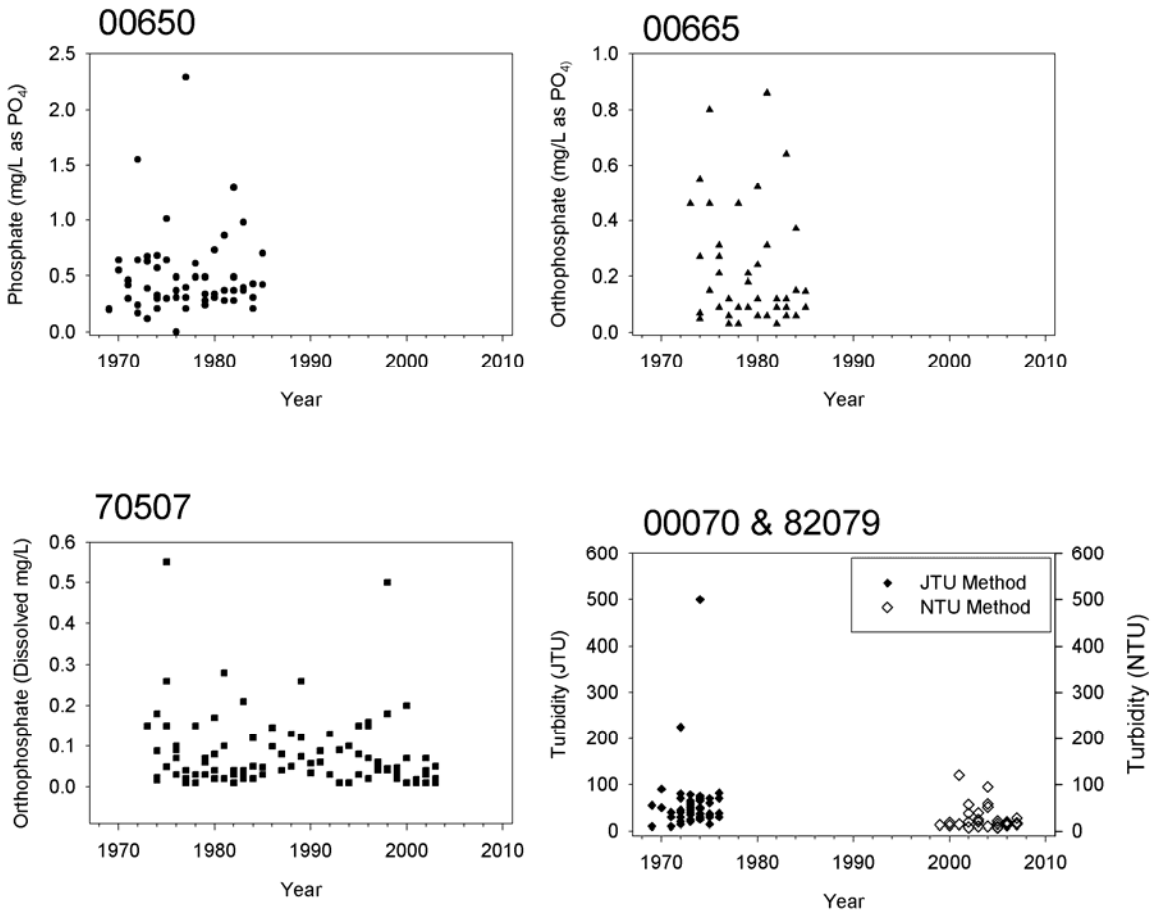

Figure 13. Time series of Conventional Parameters (Phosphate – 00650, Orthophosphate – 00665, Orthophosphate Dissolved – 70507, and Turbidity – 00070 & 82079) measured at Station 12943, Mission River Tidal.

Table 1. Water column profile measurements of Dissolved Oxygen (D.O. in mg/l) and Specific Conductance (Cond. in umhos/cm) from Station 12943 on the Mission River Tidal.

	Surface		Mid		Bottom	
Date	D.O.	Cond.	D.O.	Cond.	D.O.	Cond.
7/19/1977	6.2	3320			6.2	3320
1/17/1983	10.0	14720			7.8	18200
9/29/1993	8.3	4210	8.2	4260	8.1	3960
10/3/2006	6.0	1150	5.6	1160	5.6	1170
1/23/2007	10.1	3150	9.8	3370	8.9	9850
3/20/2007	5.9	601	5.7	682	5.6	808
6/19/2007	5.1	1800	4.2	2390	4.0	3490
11/28/2007	11.7	4730	11.7	4440	11.6	4450

REFERENCES

Basin Highlight Report, Nueces River Basin, San Antonio-Nueces Coastal Basin, Nueces-Rio Grande Coastal Basin. 2007. Prepared in cooperation with the Texas Commission on Environmental Quality, Clean Rivers Program. Nueces River Authority. 82 pp.

Fennessey Ranch web site (http://www.fennesseyranch.com/).

Handbook of Texas Online, s.v. "Aransas River." 2006b. http://www.tsha.utexas.edu/handbook/online/articles/CC/rbcez.htmL. Accessed March 2008

Handbook of Texas Online, s.v. "Aransas County." 2006b. http://www.tsha.utexas.edu/handbook/online/articles/CC/rbcez.htmL. Accessed March 2008

Handbook of Texas Online, s.v. "Bee County." 2006b. http://www.tsha.utexas.edu/handbook/online/articles/CC/rbcez.htmL. Accessed March 2008

Handbook of Texas Online, s.v. "Mission River." 2006b. http://www.tsha.utexas.edu/handbook/online/articles/CC/rbcez.htmL. Accessed March 2008

Handbook of Texas Online, s.v. "Refugio County." 2006b. http://www.tsha.utexas.edu/handbook/online/articles/CC/rbcez.htmL. Accessed March 2008

Moulton, D. W. and J. S. Jacob 2001. Texas Coastal Wetlands Guidebook. TAMU-SG-00-605.

NOAA 2006. Final Programmatic Environmental Impact Statement. Federal Approval of the Texas National Estuarine Research Preserve and Management Plan: The Mission – Aransas Estuary.

Smith E. H. and S. J. Dilworth. Mission/Aransas watershed wetland conservation plan. 1999. Texas General Land Office.

TCEQ. 2006. Surface Water Quality Monitoring Sampling Data Query.

TCEQ web page The Mission and Aransas Rivers and Copano Bay TMDL.