LOWER RIO GRANDE MONITORING STUDY

FINAL REPORT
PERIOD: Aug. 31, 2004-Mar. 31, 2006

Submitted to the Texas Water Development Board
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Executive Summary

The goal of the project was to collect basic data on water flow and water quality in the tidal segment of the Lower Rio Grande. Towards that goal, three river monitoring sites were established (El Jardin, Rio A and Rio F). At two of these sites, continuous water quality monitor sondes were deployed and bimonthly river surveys were performed at all three sites. Continuous water quality data collection was only partly accomplished due to a variety of problems. Bimonthly river surveys were performed on schedule starting in April 2005. Sonde data has been transmitted along with this report in an electronic format. River survey data has been transmitted along with each quarterly report.

Graphical summary of bimonthly river survey data indicates that the three sites differ substantially in average water column salinity, dissolved oxygen and river flow.

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Scope of Work

Lower Rio Grande Flow and Water Quality Study

This cooperative, interagency contract is for the purpose of collecting basic data for the Lower Rio Grande River and Rio Grande Delta for use in hydrologic modeling and assessment of estuary health. During the project period (Sept. 1, 2004 to Mar. 31, 2006), UTPA staff will:

- Establish three flow/water quality monitoring stations along the lower Rio Grande downstream of the last Brownsville, TX weir. The location of the stations will be selected in consultation with TWDB staff. At each station, a water quality meter will be installed and at one station a recording tide meter will be installed.
- The equipment at each station will receive maintenance at least every 60 days but preferably at 30-day intervals. During maintenance, the probes will be cleaned, serviced and field calibrated, batteries checked and replaced if necessary, and data downloaded onto electronic storage media. Deviations from this schedule shall be reported to the Contract Manager.
- The sensor data will be transmitted to the Contract Manager within three weeks of each service trip by e-mail, CD or Zip disk.
- Every 60 days a "mid-stream"(in U.S. waters) river survey will be performed at each flow/water quality station. During each survey, water temperature, salinity, depth, pH and dissolved oxygen will be measured at 0.5 m intervals or in water less than 0.5 m deep at the top and bottom.
- Within 60 days of project termination, a data report for the river surveys will be prepared by the Principal Investigator and submitted to the Contract manager.

Description of Research

The goal of the project was to collect basic data on water flow and water quality in the tidal segment of the Lower Rio Grande. The Lower Rio Grande is generally poorly studied, especially the tidal segment. Flow measurements are commonly made above the Brownsville weir in relation to irrigation needs but below the weir there has been little interest or need from an irrigation perspective to monitor the river.

Water quality in this segment is monitored by TCEQ (Segment 2301). According to TCEQ, this 49-mile segment is suitable for aquatic life use, contact recreation use, general use and fish consumption use (TCEQ, 2002). In the 2002 Texas Water Quality Inventory, concern for algal growth was noted for this segment (this segment was not re-assessed for the 2004 report). Interestingly, there were no nutrient enrichment (ammonia, nitrate/nitrite, or phosphorus) concerns for this segment, however, only a portion of the segment was assessed.

To address the need for basic river data, three river monitoring stations were established. At these locations, continuous water quality monitor sondes were deployed and bimonthly river surveys were performed. Unanticipated problems arose during the project that hampered data collection.

Methods

Monitoring site descriptions:
El Jardin (25°52'31.8" N, 97°27"18.6" W)
This station is located about 200 m downstream of Brownsville weir and 75.9 km upstream of GOM (Gulf of Mexico). River is about 15 m wide at this point. Also location of USGS staff gauge. Sonde housing on vertical metal pole was installed in April 2005 about 10 m downstream of USGS gauge. Banks are very steep and about 15m high. Access may be limited during heavy rains.

Rio A (25°57.580 N, 97°13.660 W)
This station was selected for sediment and water sampling during the original project with UTMSI. It is 18.7 km upstream of GOM and 57.2 km downstream of Brownsville weir. River is about 50m wide at this point. In April 2005, a vertical metal pole for sonde housing was installed. Housing was not installed since no sonde was available. Banks are moderately steep and about 5m high. Access may be limited during heavy rains.

Rio F (25°57'49.8" N, 97°9'31.9" W)
This station is 3.2 km upstream of the GOM and 72.7 km downstream of Brownsville weir. River is about 60 m wide at this point. In April 2005, sonde housing on a vertical metal pole was installed at this site. Banks are 0-2 m high at this site. Access may be limited during heavy rains and coastal flooding.

Bimonthly river surveys: Approximately mid-month, a small jon boat is used to access Rio A and F. El Jardin site is accessed by truck and the use of waders. At each site, two stations are monitored: one mid-stream and the other ½ distance between the US shore and the mid-stream location. At each station, at every 0.5 m depth water temperature, specific conductivity, pH, salinity and dissolved oxygen are measured using a HydroLab Quanta multi-parameter sonde and display unit. This unit is calibrated before each trip. In addition, water current speed and direction is recorded at every 0.5 m depth using a Marsh-McBirney Model 21 water flow meter. Field data is recorded on a field data sheet which is later entered in an Excel spreadsheet for transmittal.

Water quality sondes and installation: Greenspan sondes manufactured in Australia were selected by David Brock (now retired) of the TWDB for use in the project. Two models are being currently used- Greenspan CTD 350 and Greenspan CS 304. Both sondes have internal logging capability and monitor water temperature and specific conductivity while the CTD 350 also measures depth. CS 304 does not measure depth but does measure dissolved oxygen and pH. Initially, vertical metal poles were installed in the river bottom with a cement footing with a PVC housing attached to each pole. Except for the El Jardin site, this installation was not sufficiently tamper-resistant so a fully-submersed horizontal PVC housing anchored to the bottom was developed and is in use since February 2006 at Rio A and Rio F.

WQ sonde maintenance and calibration: Once deployed, sondes have been visited nearly monthly for maintenance and data downloading. During each visit, the sonde is removed from the PVC housing, cleaned of biological growth, inspected and then the data downloaded to a field computer. Batteries are checked and if below 9.8 volts new batteries are installed. About every 3 months, sondes are brought back to the lab for more thorough cleaning and calibration of conductivity, dissolved oxygen and pH using Greenspan manual protocols.

Collected Data

Bimonthly river survey data: River surveys have been conducted in 9 April 2005, 17 June 2005, 27 Aug 2005, 22 Oct 2005, 23 Dec 2005, and 14 Feb 2006. This data has been transmitted to the TWDB project manager along with each quarterly report.

Sonde data: Sonde data collection has been more difficult than anticipated. The issues have been transmitted to the TWDB Project Manager in a series of email messages. Unfamiliarity with the Greenspan sondes has been one issue and product support from Greenspan and Stevens Water Monitoring Systems have been problematic. The sonde at Rio A was removed within two weeks of deployment. In addition, there have been the usual issues i.e., floods and low water associated with river data collection not uncommon in Texas. The bulk of the tractable issues is being or has been resolved so it is anticipated that future data collection efforts will be more continuous.

On 21 Sept. 2005, the sondes at Rio F (CS 304, 021936) and El Jardin (CTD 350, 021027) were retrieved because of imminent hurricane (Rita). One sonde (019549) was deployed in early Nov. 2005. Sonde 021027 (CTD 350) was not redeployed due to problems in downloading the data. Sonde was sent back for service. This sonde was also sent back for service on 6 May 2006 for service due to crack in top of housing and data downloading problem. This sonde has been returned and is being evaluated before redeployment. A new sonde is needed for Rio A but has not been ordered due to performance issues of this sonde brand.

Rio F data record:
6 Aug. 2005 – 21 Sept. 2005, data collection frequency: 15 min., Rio 2 (CS 304 SN 021936)
14 Feb. 2006 – 21 Apr. 2006, data collection frequency: not consistent, Rio 1 (CTD 350 021027)
27 May 2006 – 8 Jun. 2006, data collection frequency: 60 min., Loaned sonde (CS 304 17837)
8 Jun. 2006 – 18 July 2006, data collection frequency: 60 min., Loaned sonde (CS 304 17837)
File name: Rio F All
File size: 1873 KB
File format: MS Excel

Rio A data record:
No data. Sonde stolen. New housing installed, new sonde needs to be installed.
Sonde: Rio 2 (SN 021936), CS 304

El Jardin data record:
6 Aug. 2005 – 21 Sept. 2005, data collection frequency: 15 min., Rio 1 (CTD 350 SN 021027)
2 Nov. 2005 – 23 Dec. 2005, data collection frequency: 60 min., Rio 3 (CS 304 SN 019549)
23 Dec. 2005 – 14 Feb. 2006, data collection frequency: 60 min., Rio 3 (CS 304 SN 019549)
1 Mar. 2006 – 21 Apr. 2006, data collection frequency: 60 min., Rio 3 (CS 304 SN 019549)
25 May 2006 – 8 Jun. 2006, data collection frequency: 60 min., Rio 3 (CS 304 SN 019549)
8 Jun. 2006 – 18 July 2006, data collection frequency: 60 min., Rio 3 (CS 304 SN 019549)
File name: El Jardin All
File size: 2059 KB
File format: MS Excel

Highlights of river survey data

Based on river survey average water column values, the three monitoring sites differ most in salinity and flow. Temperature follow the expected seasonal changes with highest average water column temperature in July-August and lowest in December to February (Fig. 1). Also as expected, salinity was generally but not always (see Dec. 2005) highest at Rio F, the site closest to the Gulf of Mexico (Fig. 2). The El Jardin site, furthest from the Gulf of Mexico, always had low salinities (<2 PSU). Dissolved oxygen was always in excess of 5 mg/L at all sites with the lowest values occurring in August 2005 (Fig. 3). River flow was typically highest at El Jardin (Fig. 4). This is not surprising considering that the channel is narrowest here and the banks are very steep. Access to the mid-station at El Jardin is often not possible due to the high water level and high current speed.

Salinity increases with depth most noticeably at Rio F and less so at Rio A (Fig. 5) reflecting the salt wedge that occurs in this tidal segment. Oxygen also varies with depth but in contrast to salinity decreases with depth. River flow generally decreases with depth.

Just based on the river survey data, it is apparent that the three sites are substantially different. Analysis of sonde data will likely support this contention.

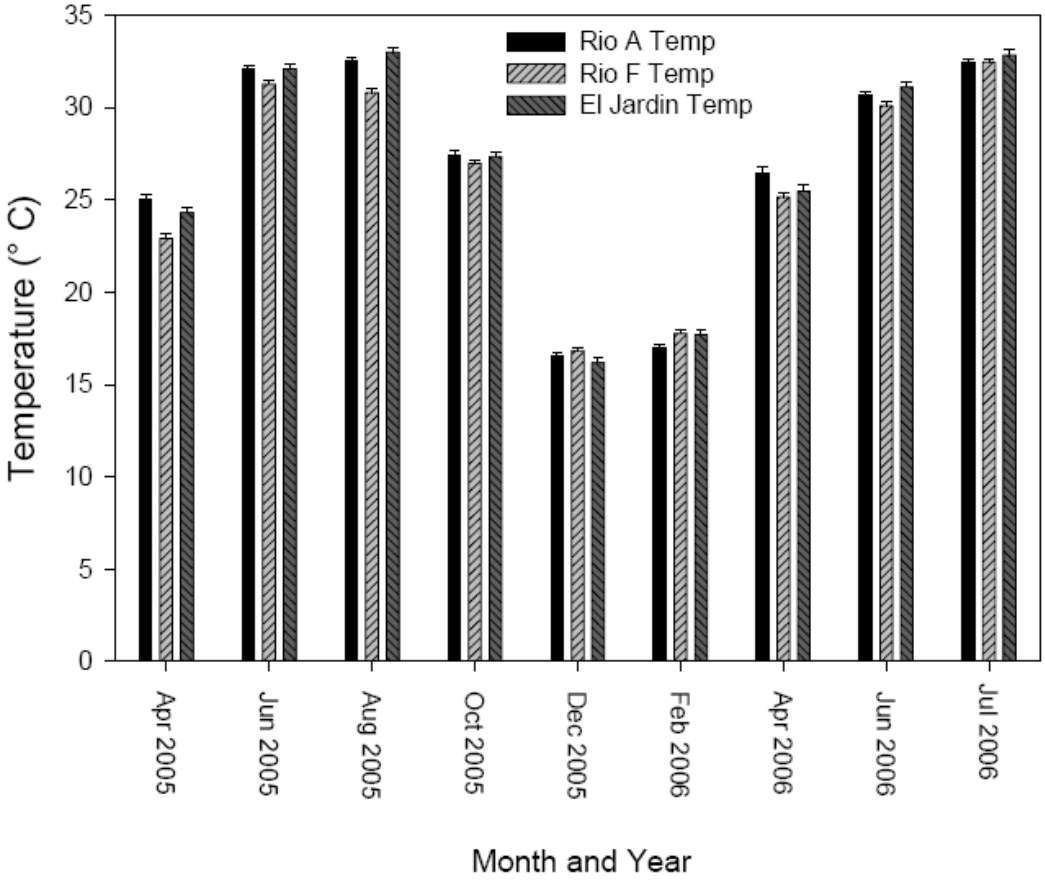

Figure 1. Average water column temperature (°C) for the three study sites for the period April 2005 to July 2006 based on river surveys.

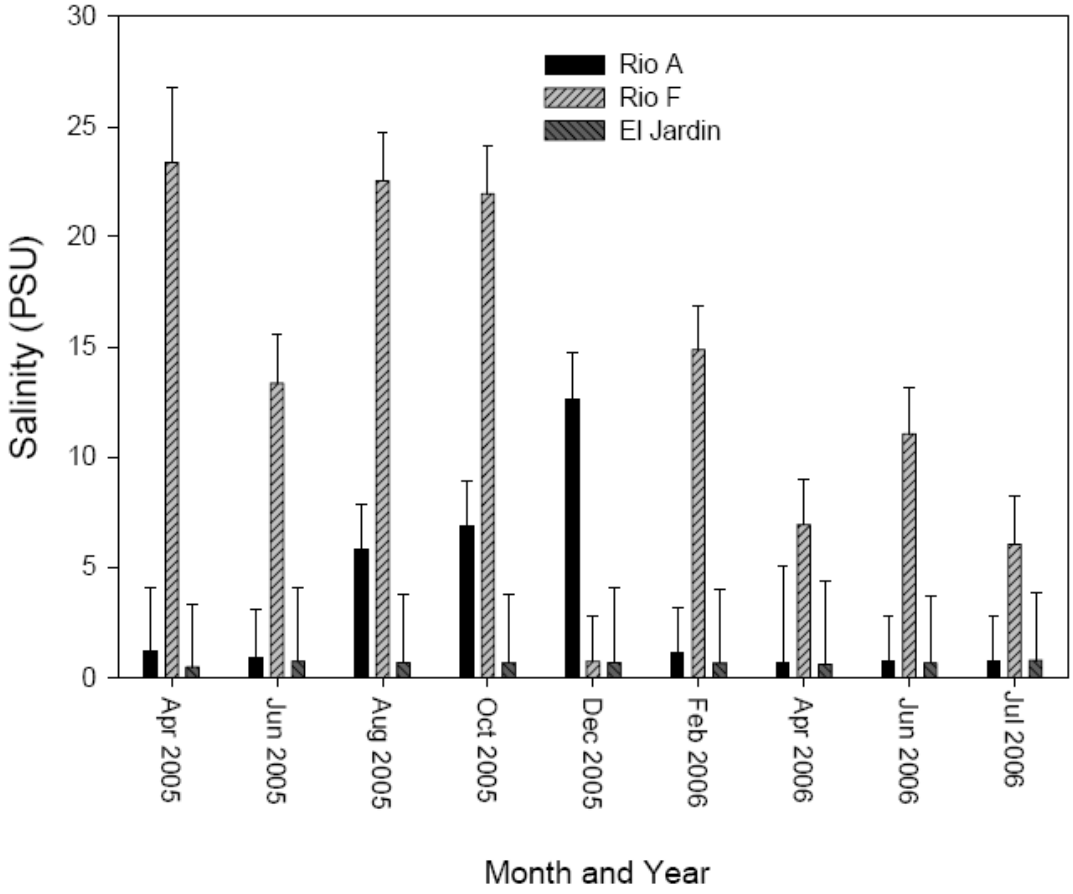

Figure 2. Average water column salinity (PSU) for the three study sites for the period April 2005 to July 2006 based on river surveys.

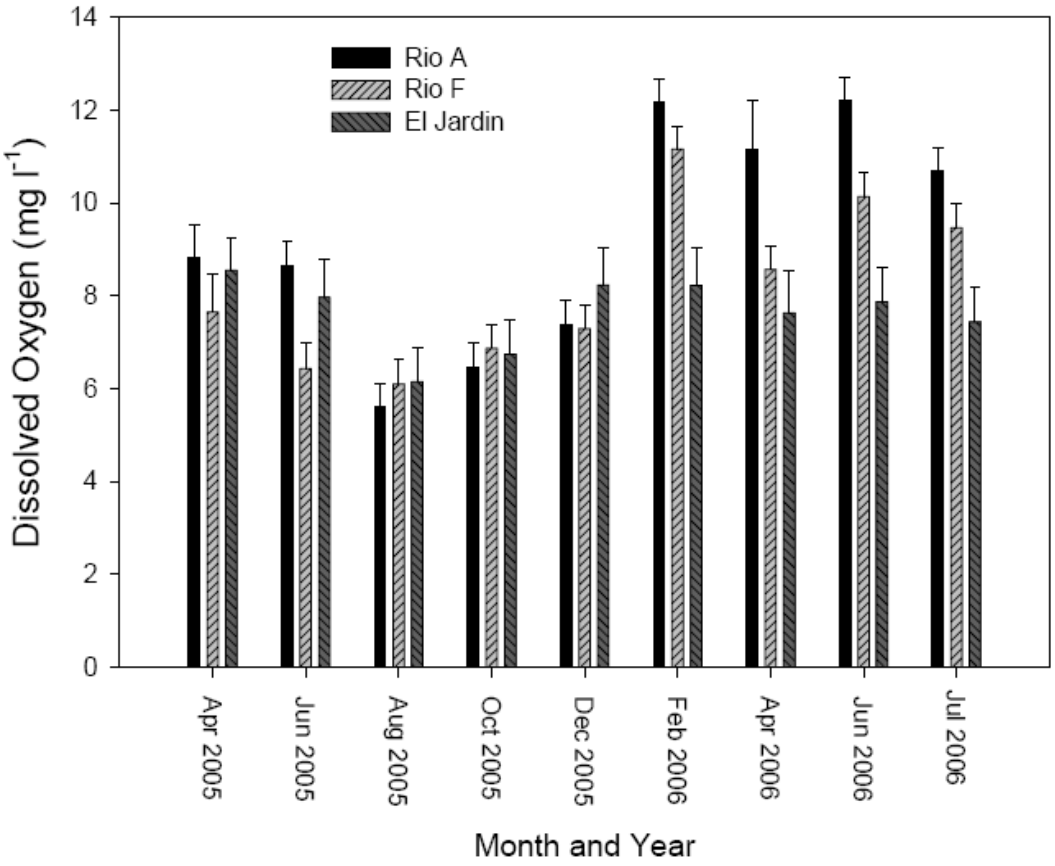

Figure 3. Average water column dissolved oxygen (mg/L) for the three study sites for the period April 2005 to July 2006 based on river surveys.

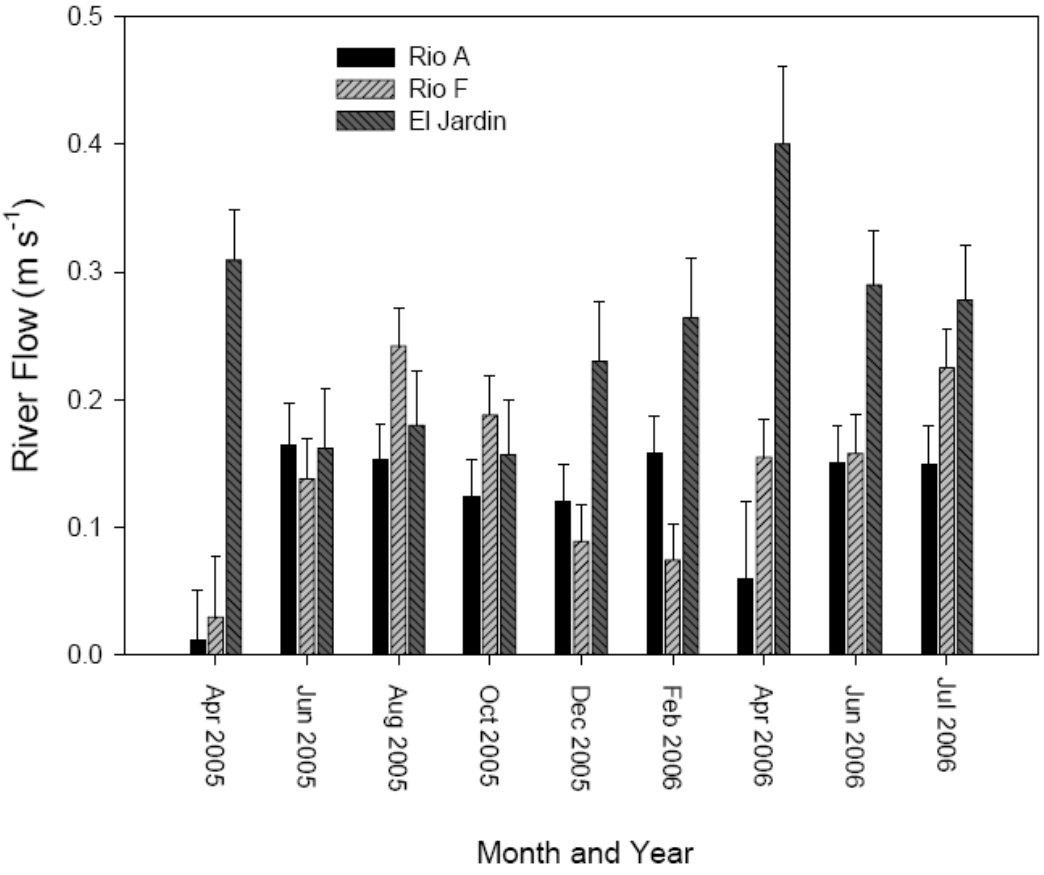

Figure 4. Average water column flow (m/sec) for the three study sites for the period April 2005 to July 2006 based on river surveys.

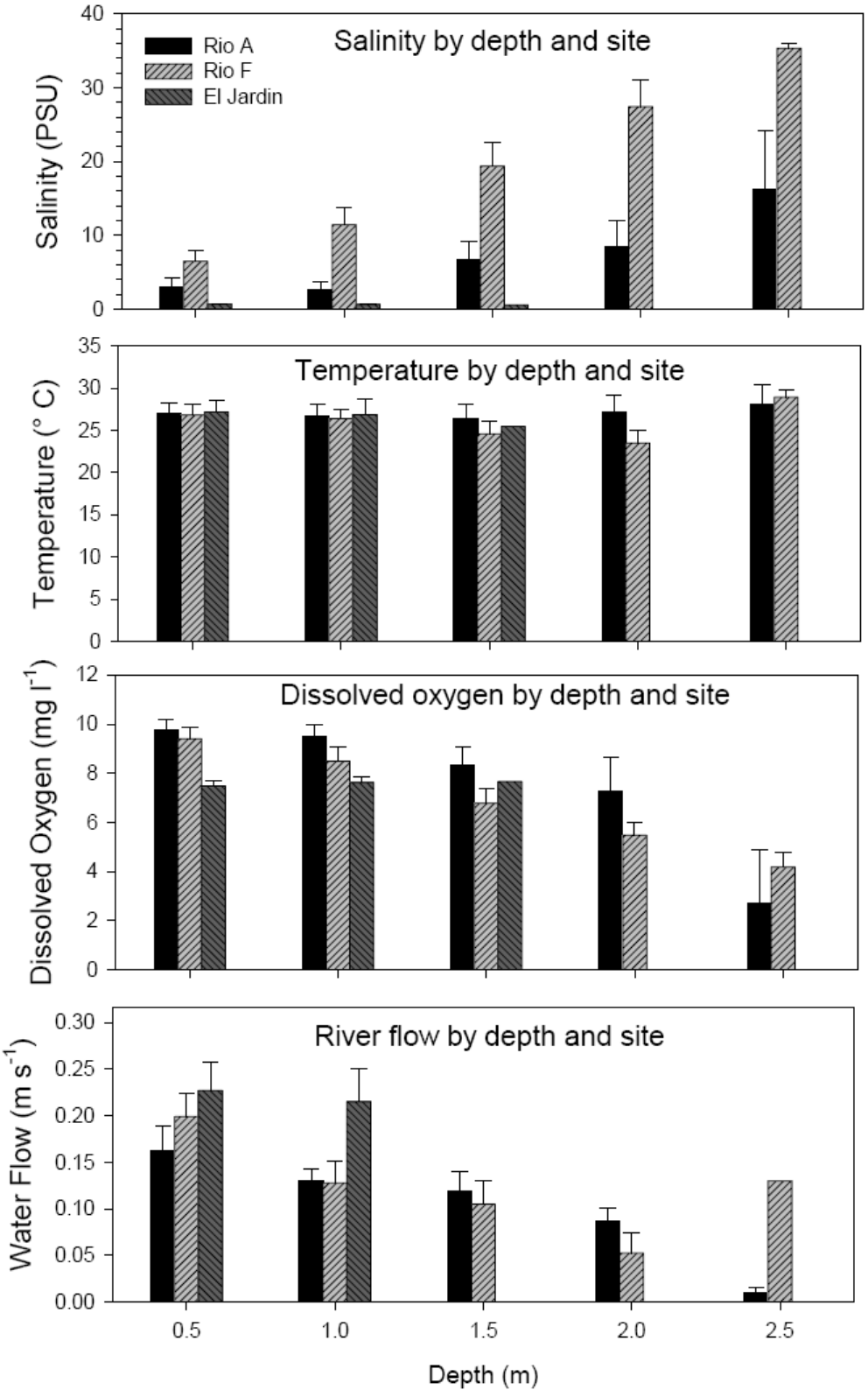

Figure 5. Salinity, temperature, dissolved oxygen and flow at 0.5, 1.0, 1.5, 2.0 and 2.5 m at each monitoring site averaged for period of record, April 2006 to July 2006.

Literature Cited

Anon. 2002. 2002 Texas Water Quality Inventory. Texas Commission on Environmental Quality. www.tceq.state.tx.us/compliance/monitoring/water/quality/data/04twqi/basins/riogrande.html