GRASSLAND BYPASS PROJECT

QUARTERLY NARRATIVE AND GRAPHICAL SUMMARY

July 1999 – September 1999

March 1, 2000

A cooperative effort of:
U.S. Bureau of Reclamation
Central Valley Regional Water Quality Control Board
U.S. Fish and Wildlife Service
California Department of Fish and Game
San Luis & Delta-Mendota Water Authority
U.S. Environmental Protection Agency
U.S. Geological Survey

Report prepared by the San Francisco Estuary Institute

I. INTRODUCTION

The Grassland Bypass Project (GBP) intercepts agricultural subsurface drainage flows south of the Grassland Water District and conveys them through the northernmost 28 miles of the San Luis Drain to a discharge point in Mud Slough (North), a tributary of the San Joaquin River. The location of the Project and the Grassland Drainage Service Area are shown in Figure 1. A schematic of the GBP showing the hydrology of the Project and sampling locations is provided in Figure 2. The GBP has removed agricultural drainage from wetland water supply channels in the Grassland Water District and from Salt Slough, but has increased quantities of agricultural drainage in the six miles of Mud Slough (North) that receives the re-routed drainage water. A detailed monitoring program, the Grassland Bypass Project Compliance Monitoring Program (GBPCMP) has been in place since October 1996 to evaluate whether the terms and conditions of the Project are being met. Specific conditions for the Project include monthly and annual selenium load values from the San Luis Drain into Mud Slough (North), selenium load reductions over the long term, removal of subsurface agricultural drainage from the wetland water supply channels, the prevention of significant adverse environmental impacts, and the prevention of significant adverse effects on human health. Detailed background information on the GBP is documented in the "Finding of No Significant Impact and Supplemental Environmental Assessment (FONSI)" and the Interim Use Permit (USBR 1995). The comprehensive monitoring plan (USBR 1996) and the Quality Assurance Project Plan (Entrix 1997) contain detailed descriptions of the sampling and analytical methods employed in the GBPCMP.

The purpose of the Quarterly Narrative and Graphical Data Summary series is to provide an overview of the data collected in the most recent quarter of the GBP. Complete listings of the data are provided in Monthly Data Reports and Quarterly Data Reports (SFEI 1998). The data and detailed background information on the GBP are also available on the Internet at the following address:

http://www.mp.usbr.gov/mp150/grassland/HomePage/Homepage.html.

II. FLOW MONITORING

Flow data in the GBPCMP are measured to allow computation of selenium load discharge, to establish seasonal flow patterns, and to determine the influence of the discharge from the San Luis Drain on the hydrology of Mud Slough (North). According to the Interim Use Permit, discharge flow into Mud Slough (North) from the San Luis Drain may not exceed 150 cfs (USBR 1995).

Flows near the inlet of agricultural drainage into the San Luis Drain (Site A) averaged 55 cfs for the quarter, slightly higher than flows at the point of discharge of the San Luis Drain into Mud Slough (North) (Site B), which averaged 56 cfs (Figure 3). Maximum flows for this quarter were 83 cfs on August 28 at Site A and 82 cfs on August 29 at Site B.

Of the two monitoring sites in Mud Slough (North) above and below the GBP discharge (sites C and D, respectively), flow is measured only at Site D. The average flow at Site D for the quarter was 76 cfs. A maximum flow of 117 cfs occurred at Site D on August 30. Discharge from the SLD (Site B) accounted for an average of 74% of the total flow in Mud Slough (North) (Site D). Flows in Salt Slough (Site F) averaged 182 cfs for the quarter. The highest flow in Salt Slough (275 cfs) occurred on July 31.

At Site N in the San Joaquin River, flows averaged 587 cfs this quarter. The maximum flow measured was 718 cfs on August 4.

III. WATER QUALITY MONITORING

Water quality data in the GBP are collected to evaluate compliance with selenium load values given in the FONSI and the Interim Use Permit (USBR 1995), to evaluate compliance with the commitment to not discharge drainage to the wetland channels, and to evaluate potential adverse effects on test organisms of the GBP discharge and of waters in Mud Slough (North) below the discharge.

Selenium

Daily Selenium Measurements

Selenium concentrations are measured daily at sites B and N using autosamplers (USBR 1996). Monthly total selenium load discharge is computed at Site B. Monthly totals are shown in Table 1 and illustrated in Figure 4a. Monthly total selenium load discharge was below the selenium load value in each month of this quarter.

Selenium load from the GBP (discharge from the terminus of the Drain as measured at Site B) averaged 12.5 lbs/day for the quarter. The maximum daily selenium load discharge (20.5 lbs/day) occurred on July 9. Flow at Site B averaged 56 cfs for the quarter with a minimum of 4.3 cfs on September 29 and a maximum of 21 cfs on July 9. Selenium concentrations at Site B varied between a minimum of 24 µg/L on August 25 and a maximum of 64.5 µg/L on September 26. The cumulative selenium load discharge for the quarter was 1154 lbs. The cumulative selenium load discharge for the period October 1998 to September 1999 was 5125 lbs.

Selenium concentrations at Site N (San Joaquin River at Crow's Landing) averaged 4 µg/L for the quarter. The highest concentration was measured on July 11 (5.9 µg/L). The minimum concentration for the quarter, 2.0 µg/L, was measured on September 30. Discharge at Site B accounts for nearly all of the selenium load measured here.

Weekly Selenium Measurements

Selenium concentrations are measured in weekly grab samples collected at 12 sites. Concentrations for the period beginning October 1998 are shown in Figures 6-8.

Average selenium concentrations near the inlet to the San Luis Drain (Site A) were higher than those near the point of discharge into Mud Slough (North) (Site B) (Figure 6). Site A averaged 48 µg/L versus 41 µg/L for Site B in this quarter.

Selenium concentrations in Mud Slough (North) upstream of the GBP discharge (Site C) averaged 1.3 µg/L, with a maximum measured concentration of 2.2 µg/L for the quarter on July 1 (Figure 6). Concentrations were much higher in Mud Slough (North) downstream of the GBP discharge (Site D) than upstream at Site C (note differences of scales in graphs). Concentrations at Site D averaged 34 µg/L, with a maximum of 51 µg/L on August 5.

Selenium concentrations in Salt Slough (Site F) and the wetland water supply channels (Sites J, K, L2, M2) frequently reach or exceed 2 µg/L. In this period, measurements reached these levels at Sites J (once), K (twice), L2 (6 times), and M2 (6 times). None of the samples reached or exceeded 3µg/L this quarter.

In the San Joaquin River, weekly selenium samples were collected at sites upstream of the GBP discharge (Site G), downstream of the discharge but above the Merced River (Site H), and downstream of the Merced River (Site N) (Figure 8). Selenium concentrations at Site G were low, averaging 0.7 µg/L, ranging between 0.5-0.9 µg/L. Concentrations were about an order of magnitude higher at Site H, averaging 6.6 µg/L during the same period and ranging from 3.0-11.1 µg/L.

Specific conductance

Specific conductance is measured at 15 min intervals at sites B, D, F, and N, and in weekly grab samples at sites A, B, C, D, F, G, H, J, K, L, M, and N. These data are presented in Figures 9 and 10. Some data for Site D (Mud Slough North) are pending at the time of preparation of this report.

IV. SEDIMENT MONITORING

Sediment quality is measured in San Luis Drain and in Mud and Salt Sloughs to assess whether selenium concentrations in drain sediments are approaching the California Department of Health Services hazardous waste criterion (100 µg/g wet weight) and to provide information on the fate and transport of selenium within the Drain. Sites in Mud and Salt Sloughs are monitored to determine whether changes in sediment chemistry in these locations occur as a result of the GBP and to provide data that can be used in conjunction with biological data to assess accumulation or depletion of selenium in the aquatic food web.

Selenium concentrations in sediments have varied considerably over time and within cores at a given site. For example, at Site A in September 1999 (Figure 11), the sample collected at a depth of 0-3 cm had a concentration of 43 µg/g dry weight, versus 2.5 µg/g in June and 8.5 µg/g at the same depth in September the previous year. Unlike most previous samplings, Site A for September 1999 also had higher selenium near the

surface (0-3 cm) than at the depth of 3-8 cm, which had a selenium concentration of 16 µg/g. This variability does not appear to be due to the analytical methods. Interpretation of these data will be provided in the GBP Annual Report for the year October 1998 - September 1999.

The annually sampled Station I (at Mud Slough back water) is included in this quarterly report. Concentrations in the core collected this year (over 4 µg/g throughout the core) are much higher than samples in previous years (generally averaging below 1 µg/g, with a maximum of 1.5 µg/g at the surface in 1997).

V. BIOLOGICAL MONITORING

Biological monitoring is conducted throughout the GBP area on a quarterly basis (USBR 1996). Tissue sampling in the GBPCMP is being performed to assess the potential for adverse impacts to fish and wildlife and to assess public health risks. Food web organisms (aquatic plants, invertebrates, and fish) are being analyzed for selenium residues to assess impacts to fish and wildlife. Muscle fillets from gamefish are being analyzed for selenium to assess human health risks. These data will be presented and discussed in the GBP Annual Report for the year October 1998 - September 1999.

VI. TOXICITY TESTING

The purpose of the GBP toxicity testing program is to evaluate the potential adverse effects to test organisms of the GBP discharge and of waters in Mud Slough (North) below the discharge. Monthly toxicity tests are conducted in the laboratory using water collected from sites B, C, D, and F. Test results from these sites are compared to results obtained using water from the Delta-Mendota Canal. Monthly toxicity tests include: the 7-day chronic fathead minnow (*Pimephales promelas*) larvae survival and growth test; the 7-day chronic water flea (*Daphnia magna*) survival and reproduction test; and the 4-day chronic algal (*Selenastrum capricornutum*) growth test. A 7-day *in situ* survival test using 4-day-old fathead minnow larvae is conducted at sites B, D, F, and a reference Site (Windmill) on a quarterly basis.

Only the growth test for fathead minnow chronic toxicity showed a significant difference from the controls for Site F in August 1999. Although there was low survival relative to the controls in the fathead minnow acute toxicity test at Site F for August and September, these results were judged not to be significant because of high variance.

REFERENCES

Entrix, Inc. 1997. Final Draft Quality Assurance Plan for the Compliance Monitoring Program for the Use and Operation of the Grassland Bypass Project. Prepared for the U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

SFEI. 1998. Monthly and Quarterly Data Reports for the Grassland Bypass Project. Available from SFEI or on the Internet at http://www.sfei.org/grassland/reports/gbppdfs.htm.

USBR. 1995. Finding of No Significant Impact and Supplemental Environmental Assessment, Grassland Bypass Channel Project, Interim Use of a Portion of the San Luis Drain for Conveyance of Drainage Water through the Grassland Water District and Adjacent Grassland Areas. U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

USBR. 1996. Compliance Monitoring Program for Use and Operation of the Grassland Bypass Project. U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

Table 1. Comparison of monthly selenium load discharge from the terminus of the San Luis Drain (Site B) with the monthly load values in the Interim Use Permit (USBR 1995).

	Load value (lbs)	Selenium load discharge (lbs)	Amount over load value (%)
Oct 1998	348	277	NA
Nov 1998	348	226	NA
Dec 1998	389	241	NA
Jan 1999	506	284	NA
Feb 1999	823	609	NA
Mar 1999	1013	799	NA
Apr 1999	759	529	NA
May 1999	633	482	NA
Jun 1999	569	524	NA
Jul 1999	569	462	NA
Aug 1999	506	418	NA
Sep 1999	350	275	NA

NA: not applicable (load discharge was less than load value)

Figure 1. Map of the Grassland Bypass Project. Locations of sites D, F, G, H, and N are indicated.

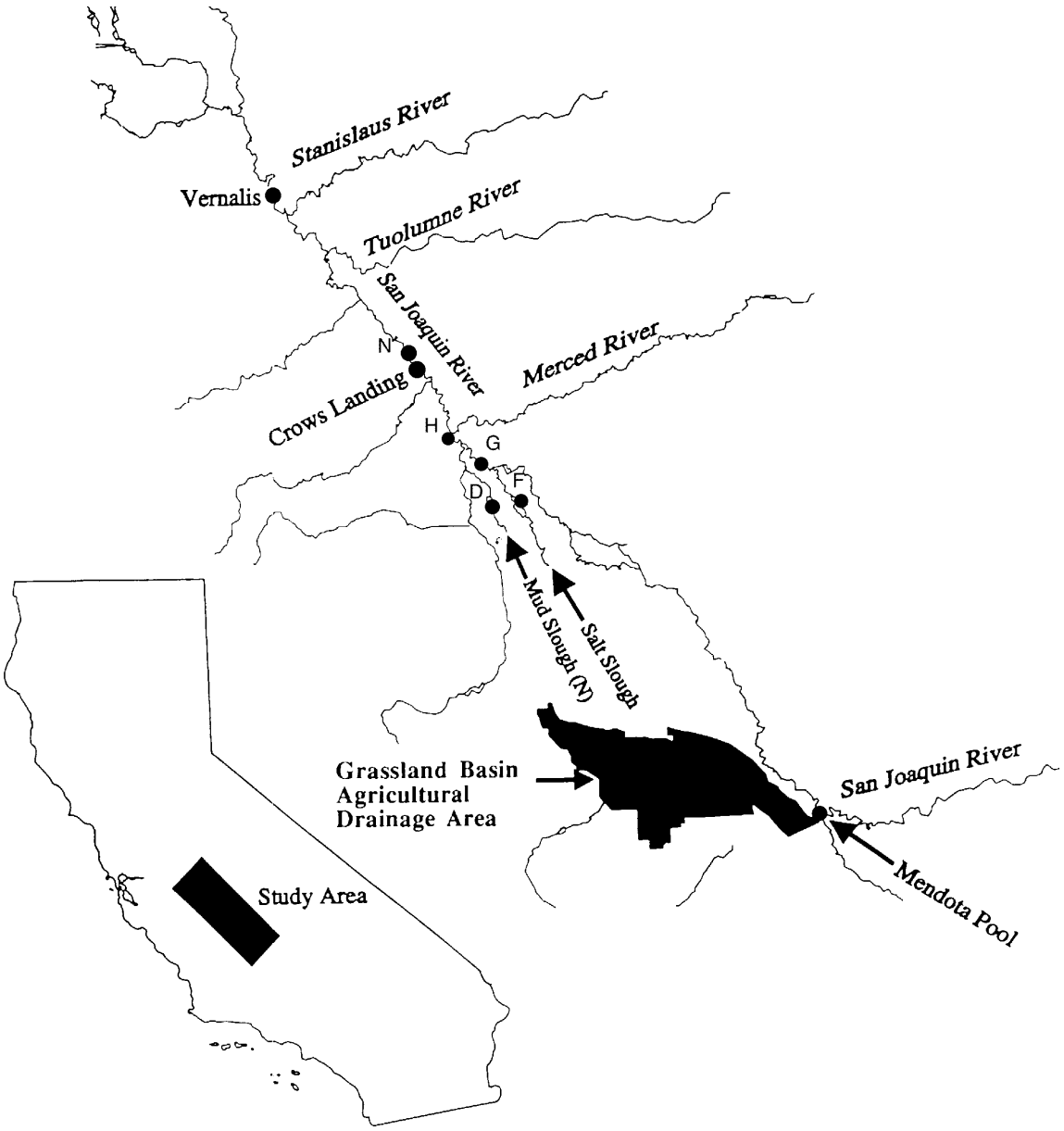


Figure 2. Schematic diagram showing locations of GBP monitoring sites relative to major hydrologic features of the study area.

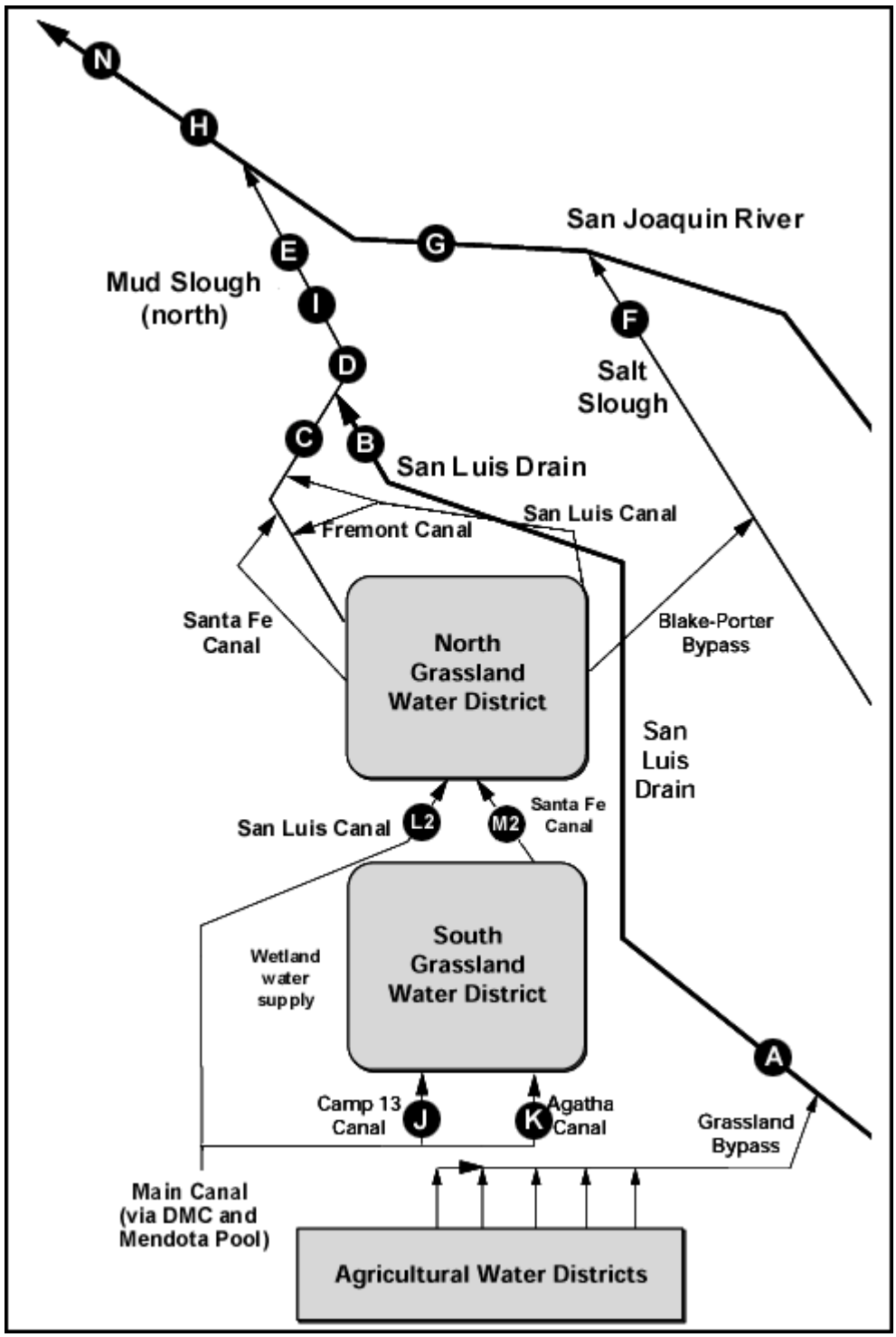


Figure 3. Daily mean flows (cfs) at GBPCMP sites. Flow at Site A is recorded as a daily mean. Flows at sites B, D, F, and N are recorded at 15 min intervals. Note different scales of vertical axes.

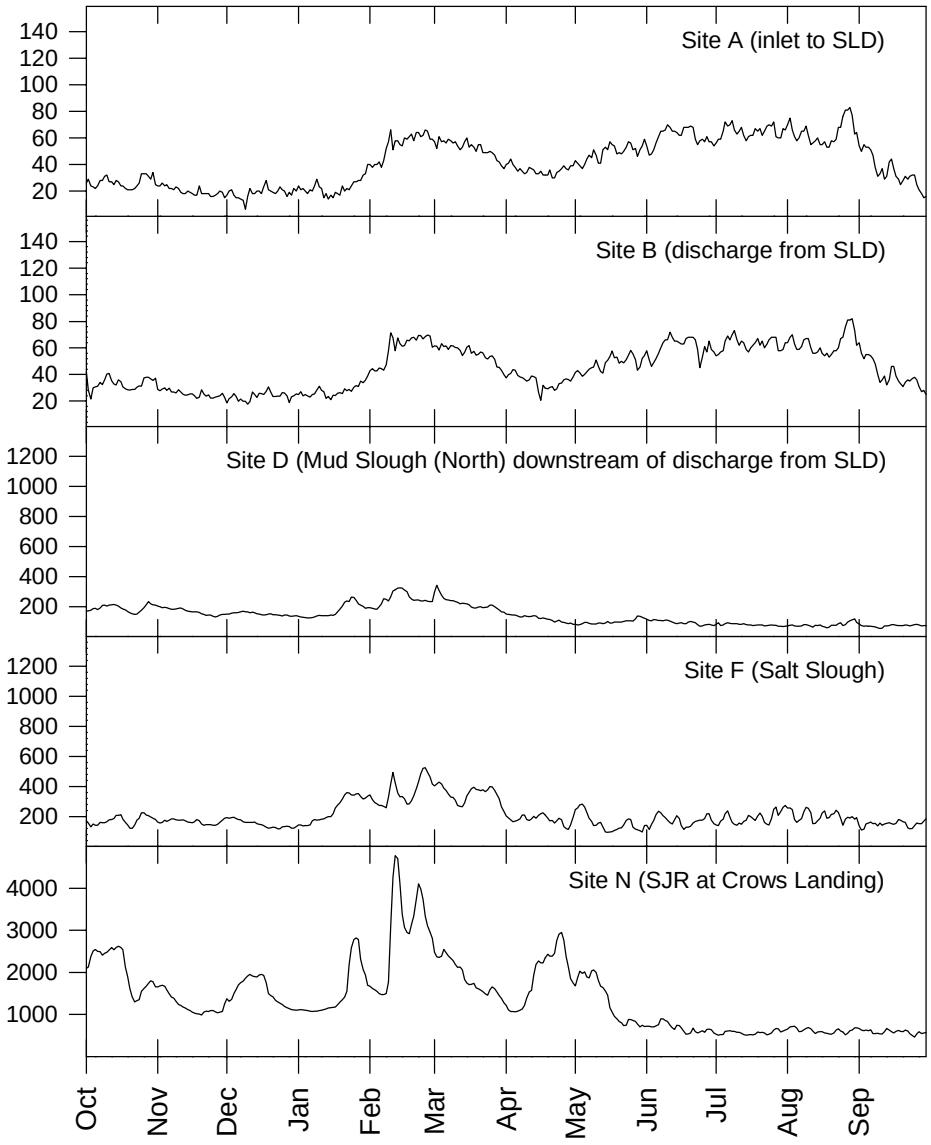


Figure 4. Selenium concentrations and selenium load discharge at Site B (discharge from SLD): a) comparison of monthly load discharge and load values; b) comparison of cumulative load discharge and load values; c) daily average flows; d) daily average selenium concentrations; and e) calculated daily average load discharge.

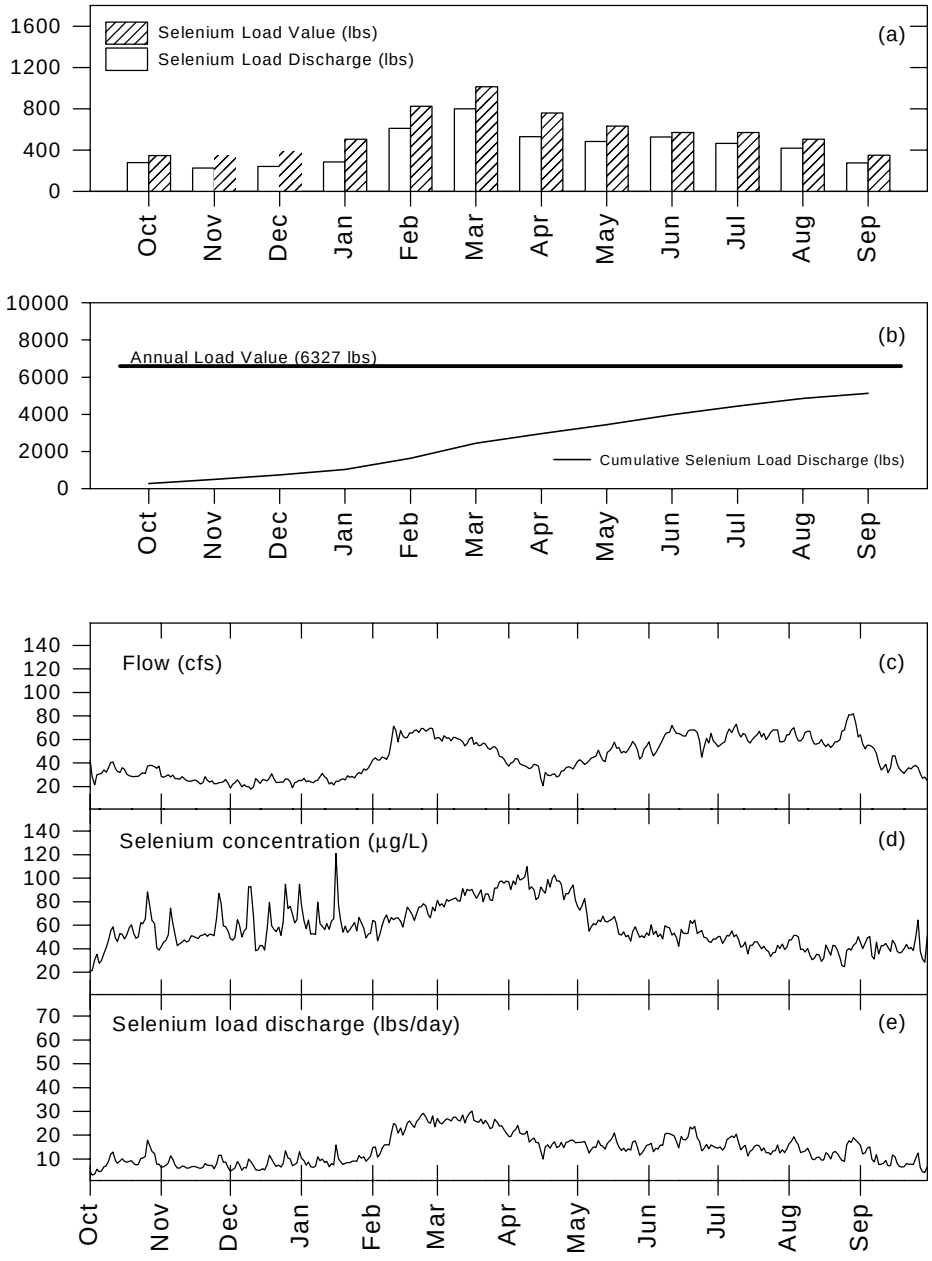


Figure 5. Daily average flows and selenium concentrations at Site N (San Joaquin River at Crow's Landing).

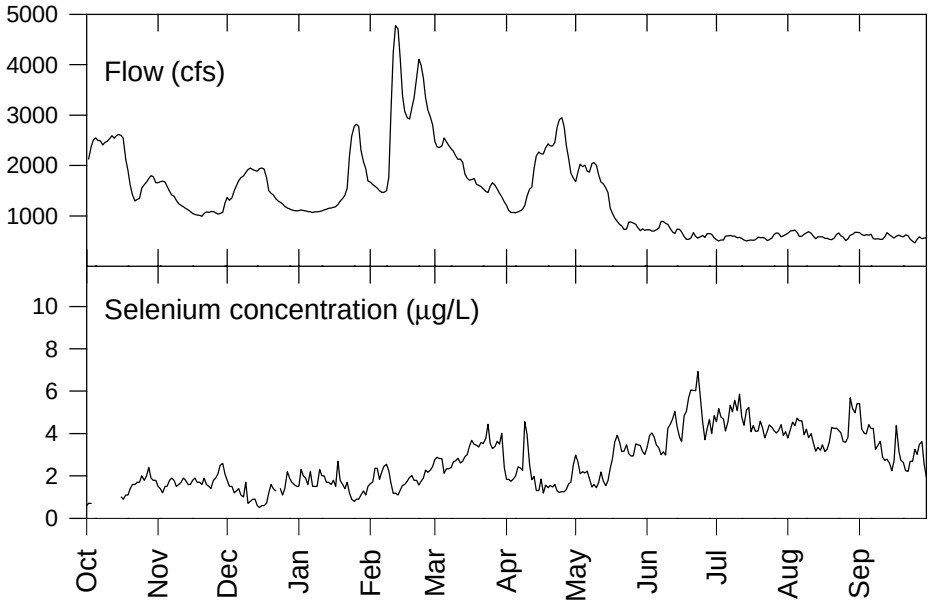


Figure 6. Selenium concentrations (µg/L) at Site A (near the inlet to the San Luis Drain), Site B (discharge from the San Luis Drain), Site C (Mud Slough (North) upstream of the GBP discharge), and Site D (Mud Slough (North) downstream of the GBP discharge). Data from weekly grab samples.

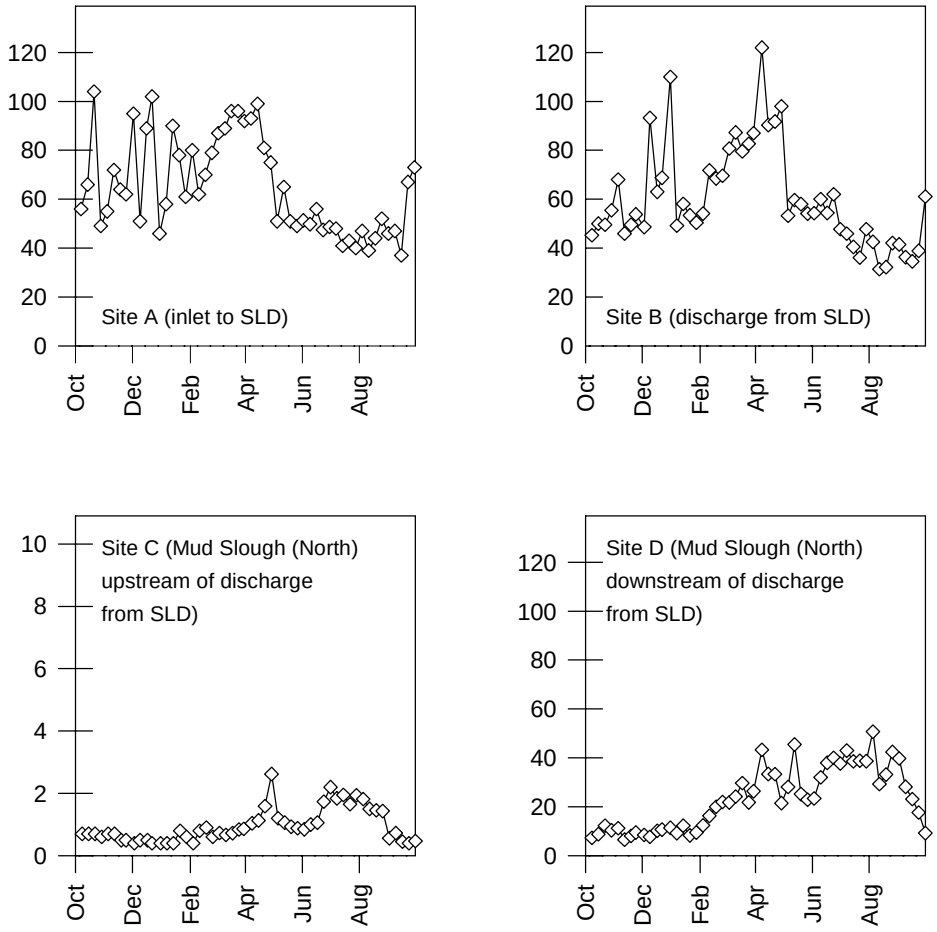


Figure 7. Selenium concentrations (µg/L) at Site F (Salt Slough) and in the wetland water supply channels at Site J, Site K, Site L2, and Site M2. Data from weekly grab samples.

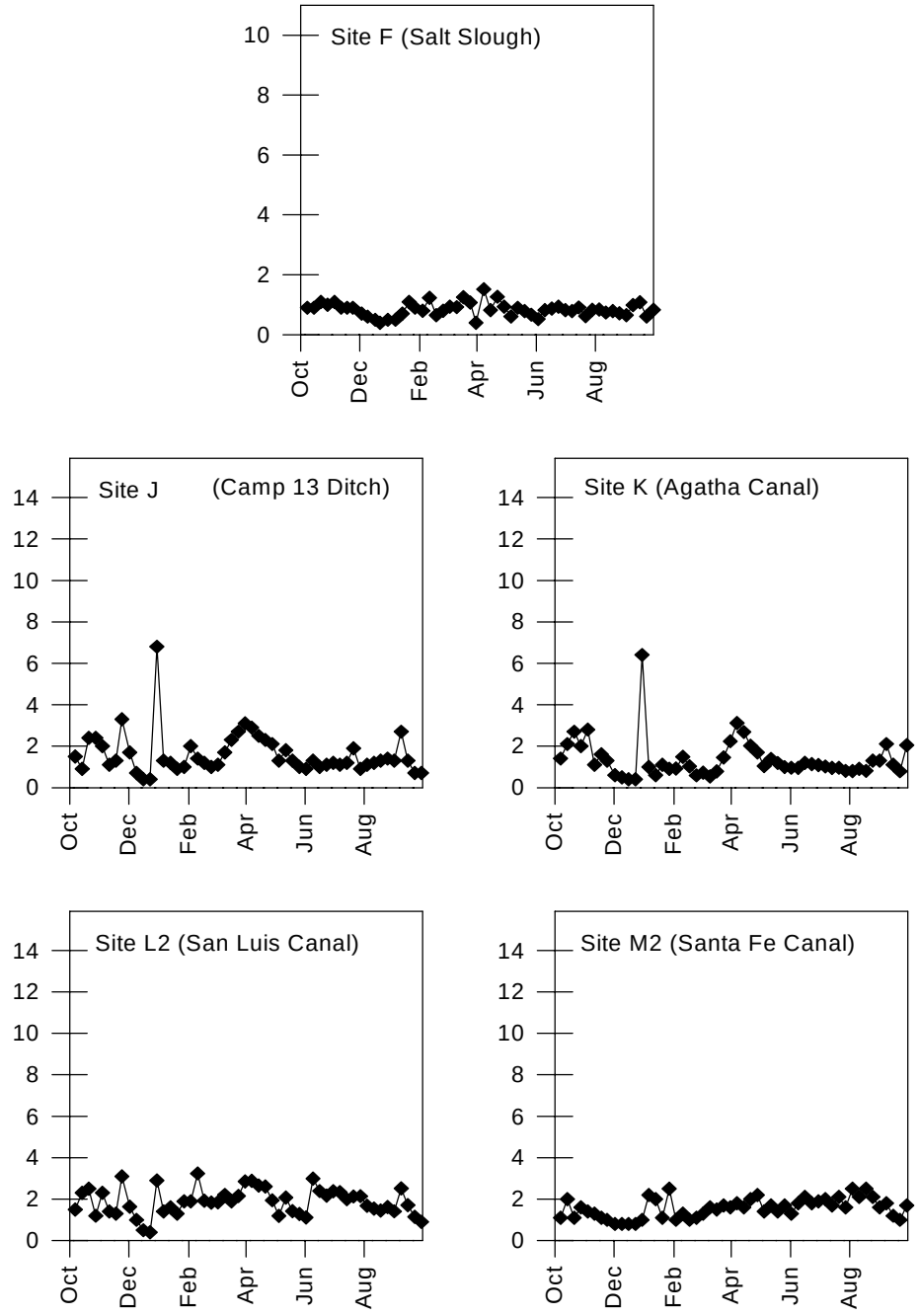


Figure 8. Selenium concentrations (µg/L) at San Joaquin River sites G (San Joaquin River upstream of Mud Slough (North) confluence), H (San Joaquin River downstream of Mud Slough (North) confluence), and N (at Crow's Landing, downstream of Merced River confluence). Data from weekly grab samples.

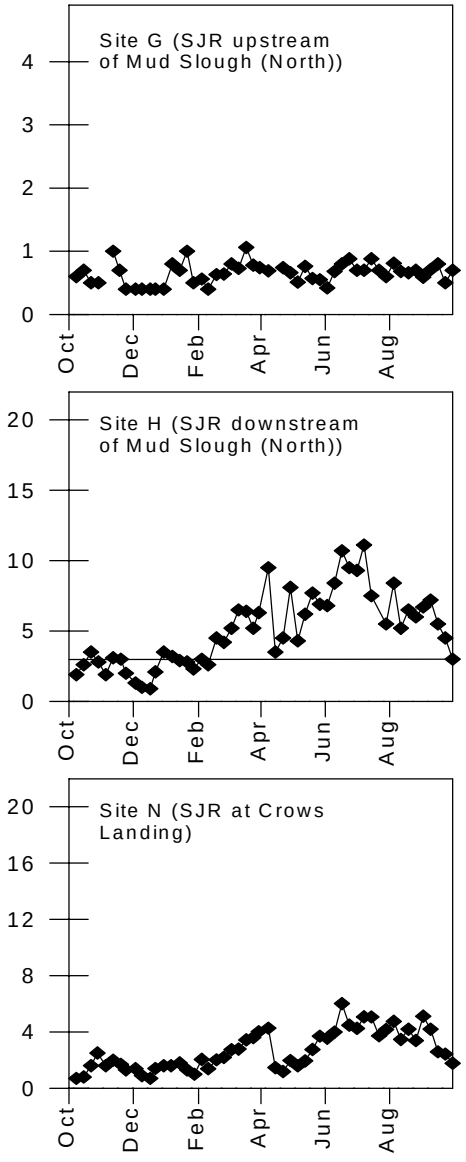


Figure 9. Daily average specific conductance (µS/cm) derived from measurements at 15 min intervals at sites B (discharge from the SLD), D (Mud Slough (North) downstream of the GBP discharge), F (Salt Slough), and N (San Joaquin River at Crow's Landing).

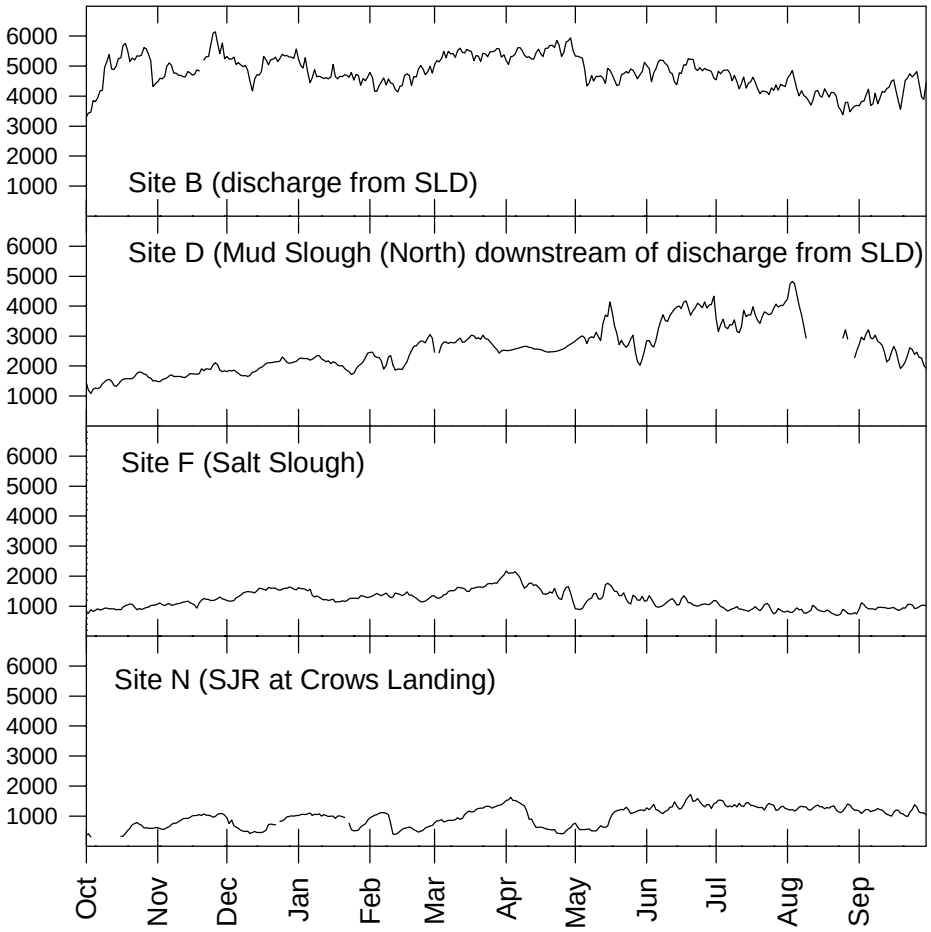


Figure 10. Specific conductance (µS/cm) in weekly grab samples. Letters indicate sites.

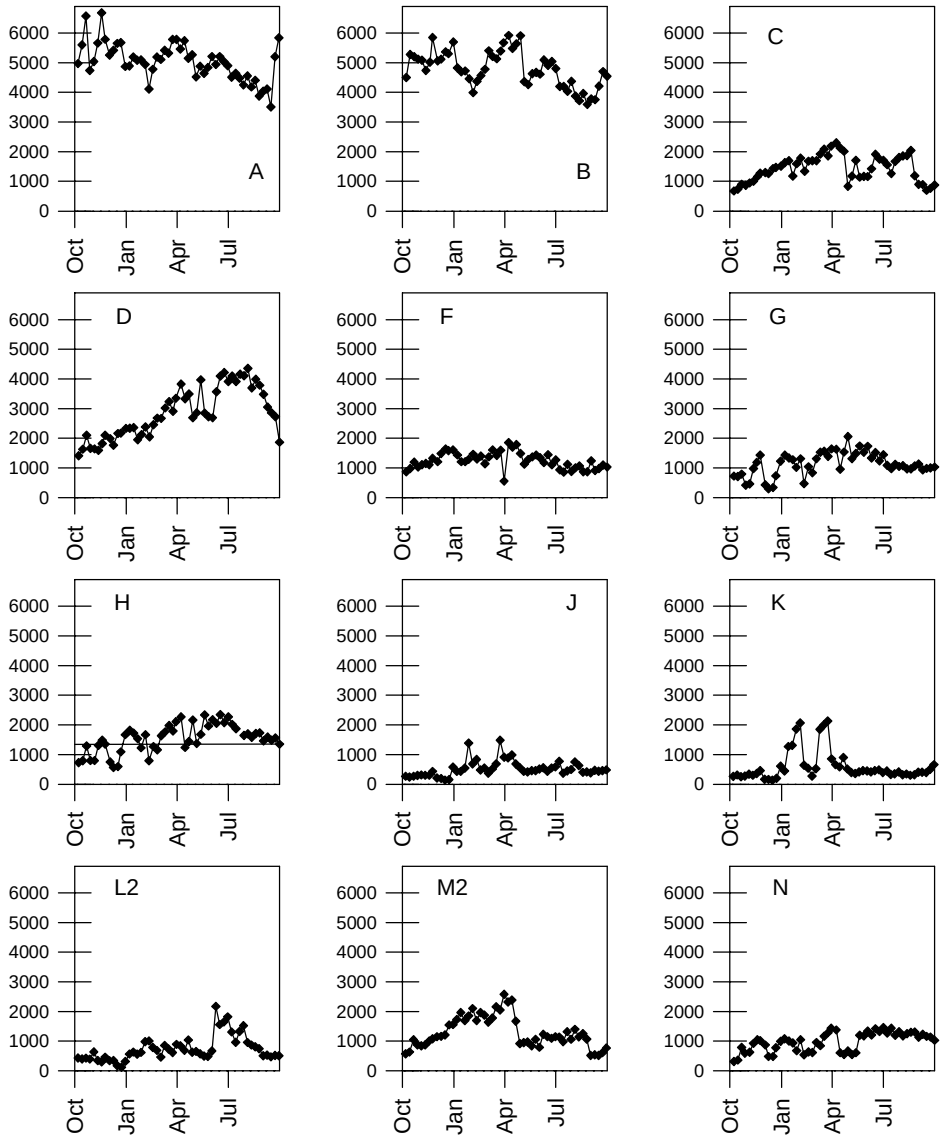
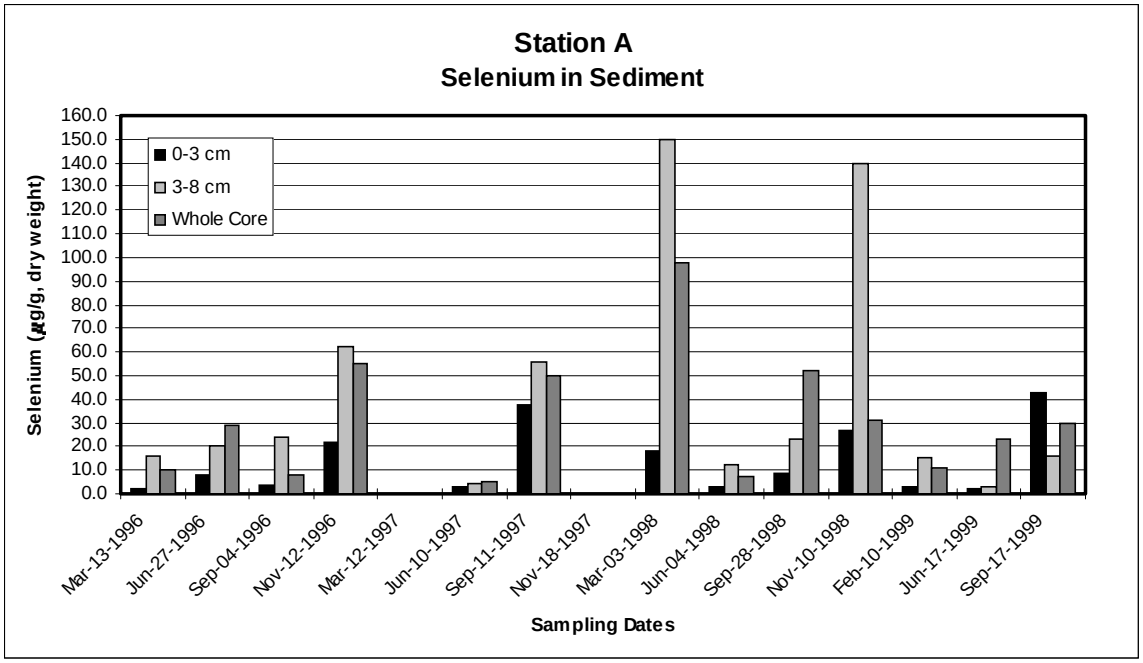


Figure 11. Selenium concentrations in sediment at sites A (inlet to San Luis Drain) and B (discharge from San Luis Drain). Samples not tested at Site A on March 12, 1997 and November 18, 1997 and at Site B on March 12, 1996. Concentration in whole core sample at Site B on June 10, 1997 was 0.11 µg/g dry weight.



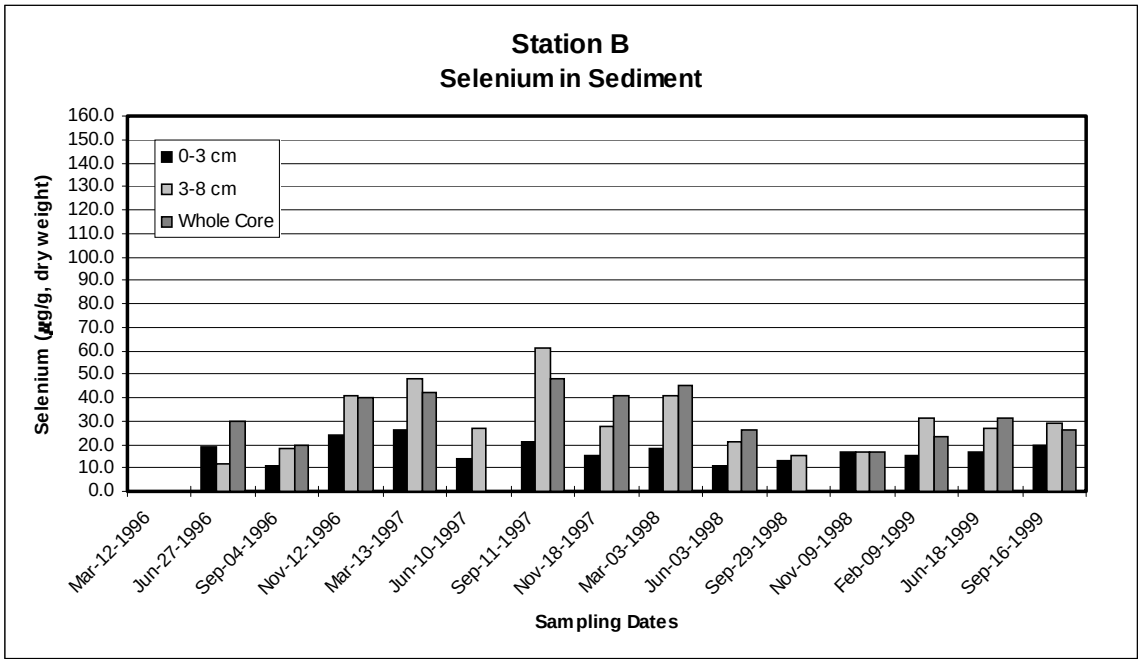
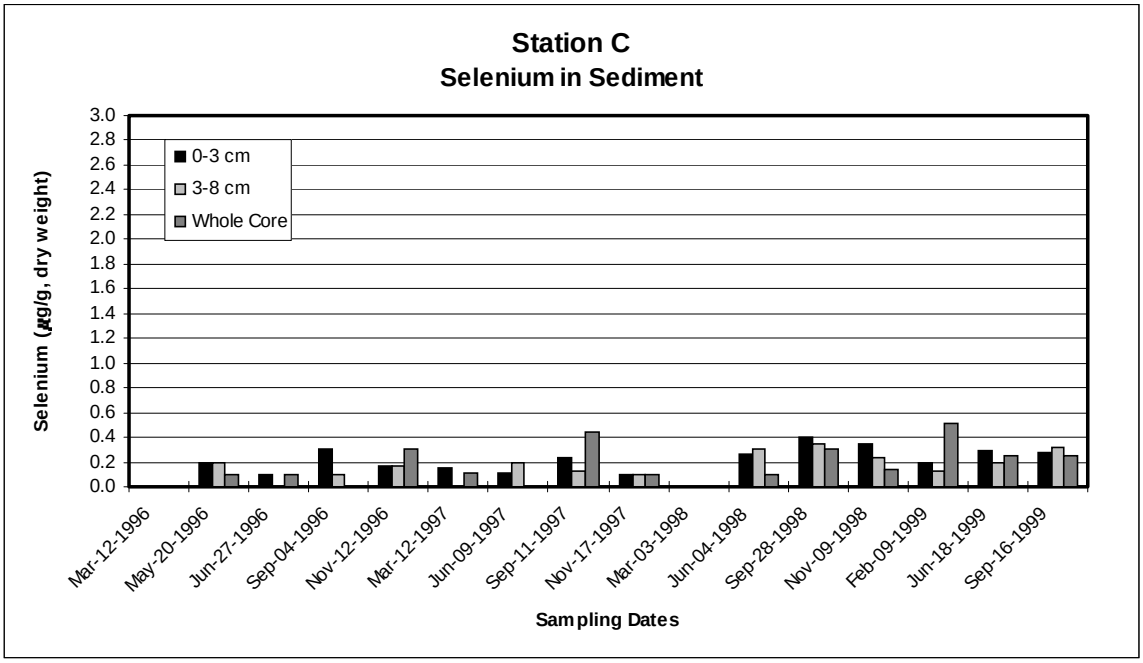


Figure 12. Selenium concentrations in sediment at sites C (Mud Slough upstream of the GBP discharge) and D (Mud Slough downstream of the GBP discharge). Samples not tested at sites C and D on March 12, 1996 and March 3, 1998. Other missing bars indicate concentrations were below limits of detection.



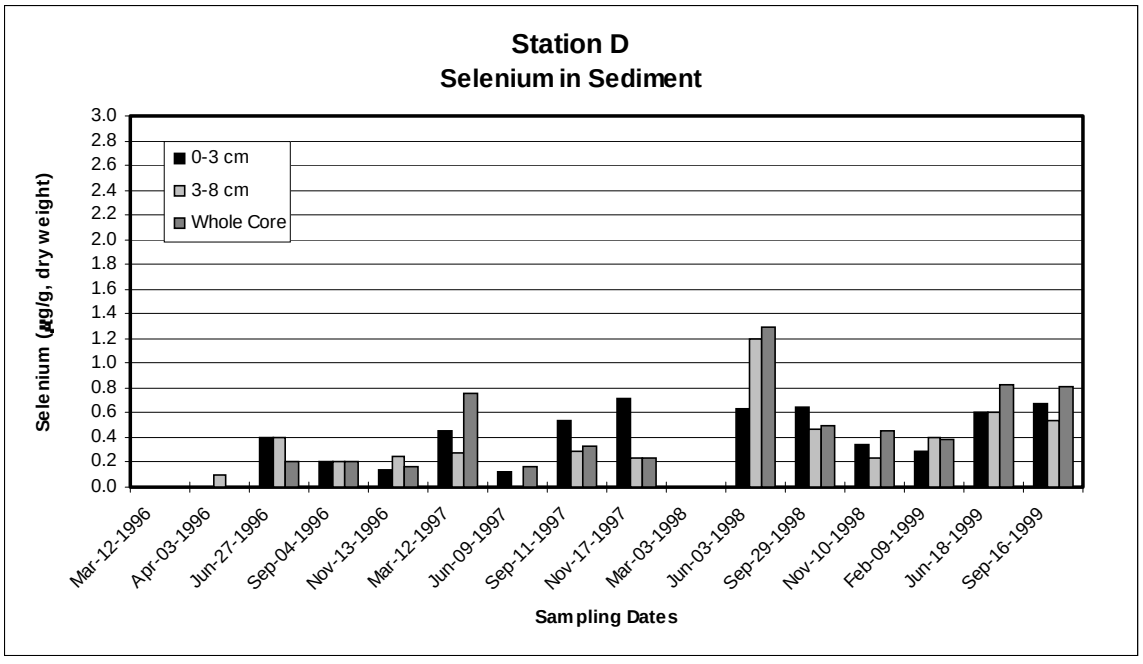
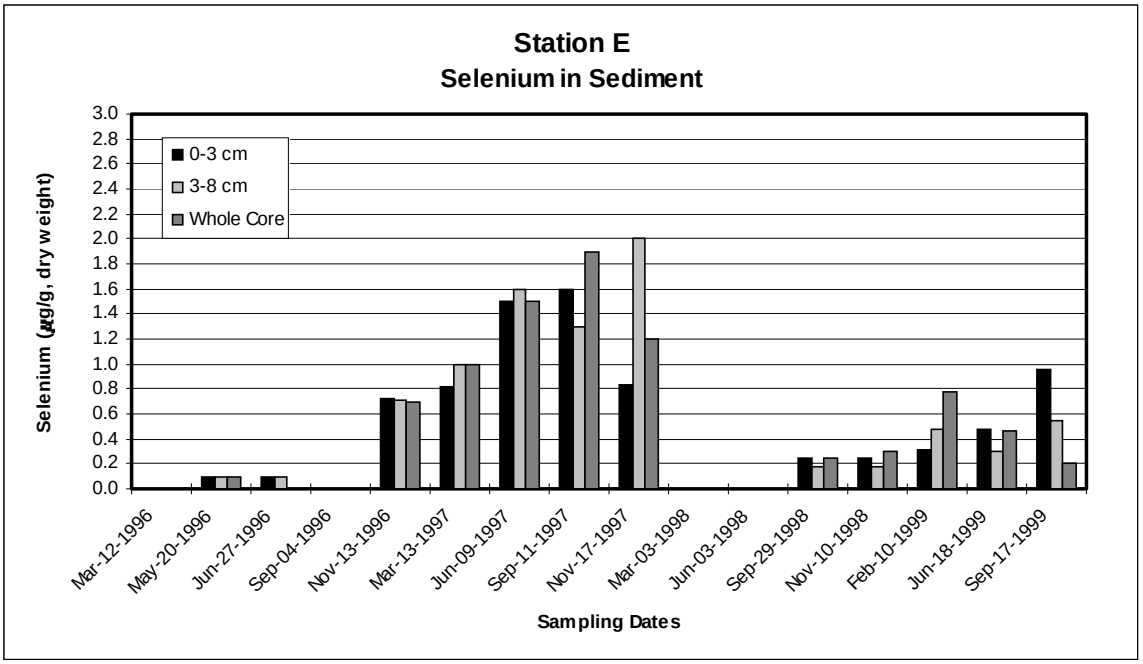


Figure 13. Selenium concentrations in sediment at sites E (Mud Slough at Highway 140) and F (Salt Slough). Samples not tested at Site E on March 12, 1996, September 4, 1996, March 3, 1998, and June 3, 1998 and at Site F on March 12, 1996. Other missing bars indicate concentrations were below limits of detection.



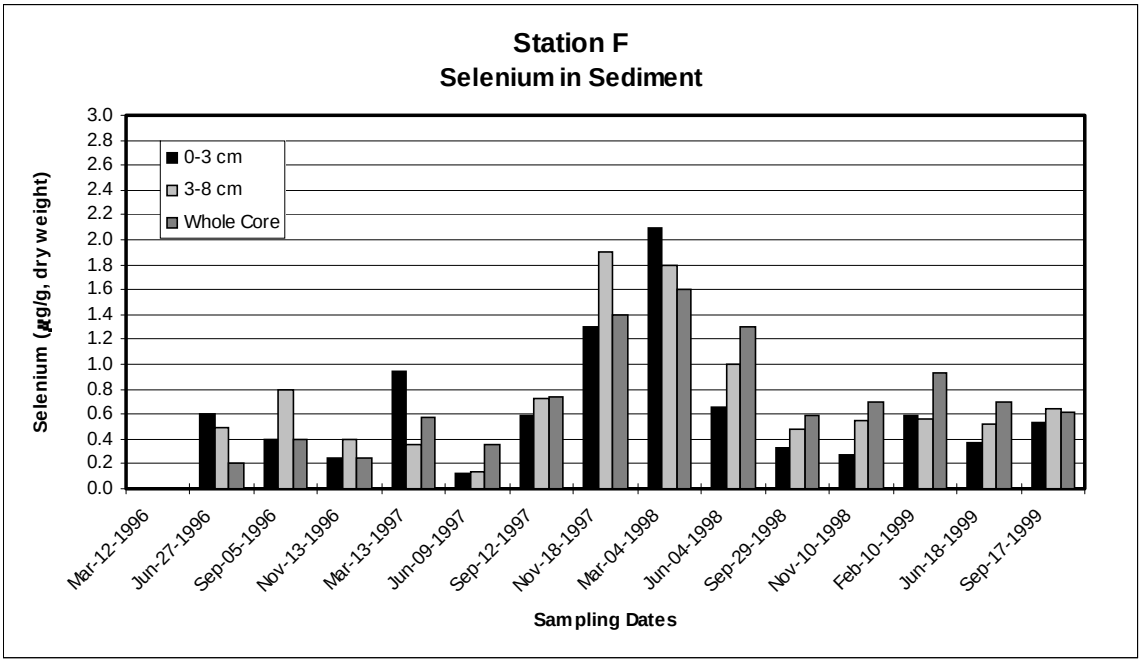


Figure 14. Selenium concentrations in sediment at site I (Mud Slough back water annual site).

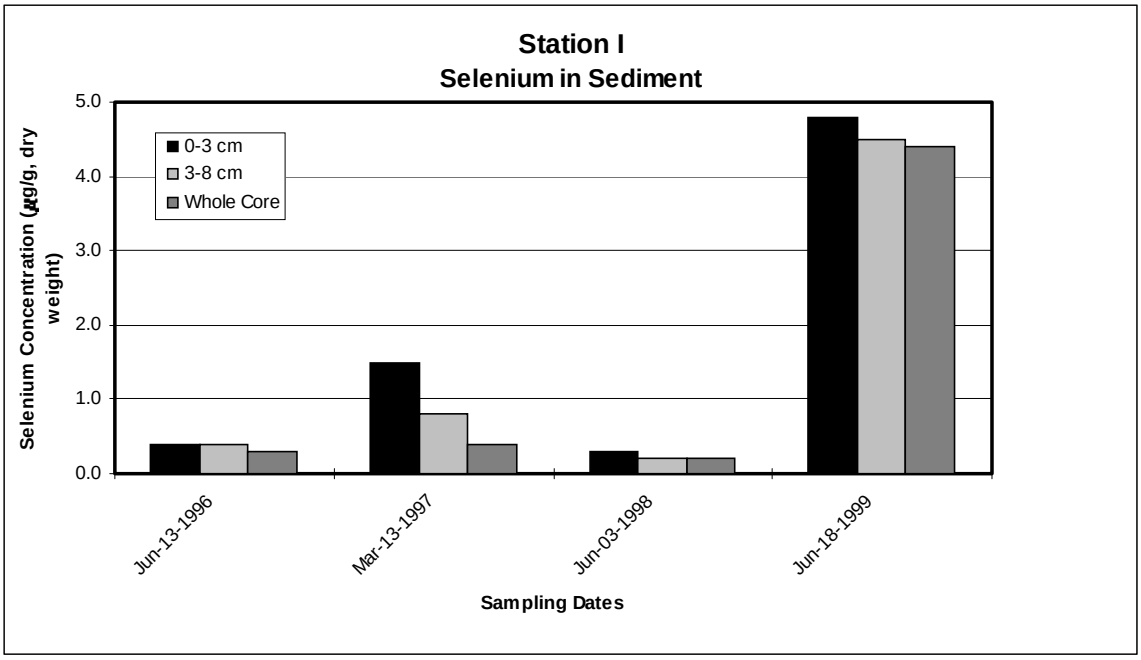


Figure 15. Comparison of toxicity test results from Site B with results from the Delta Mendota Canal reference location. The different tests are described in the text.

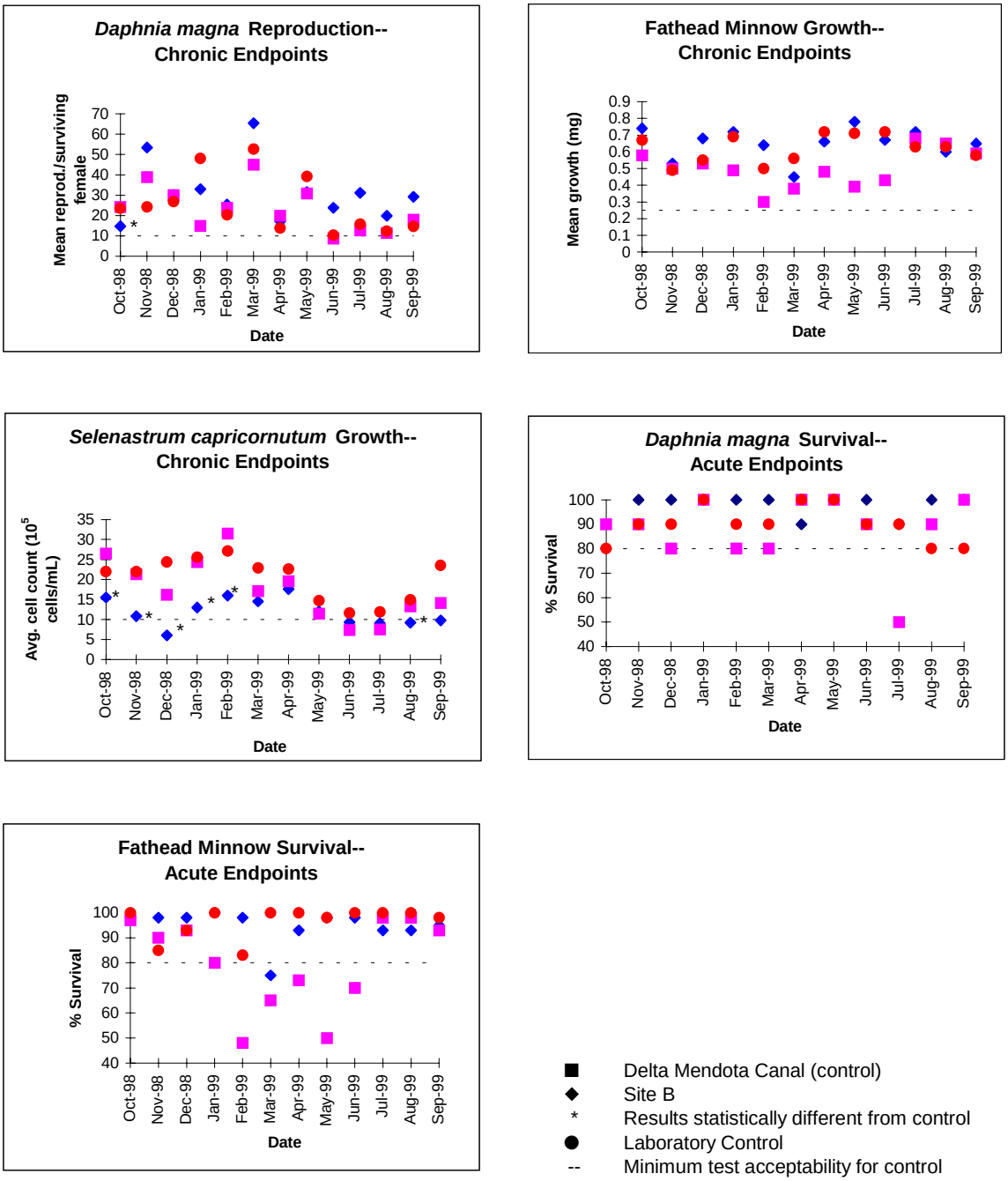


Figure 16. Comparison of toxicity test results from Site C with results from the Delta Mendota Canal reference location. The different tests are described in the text.

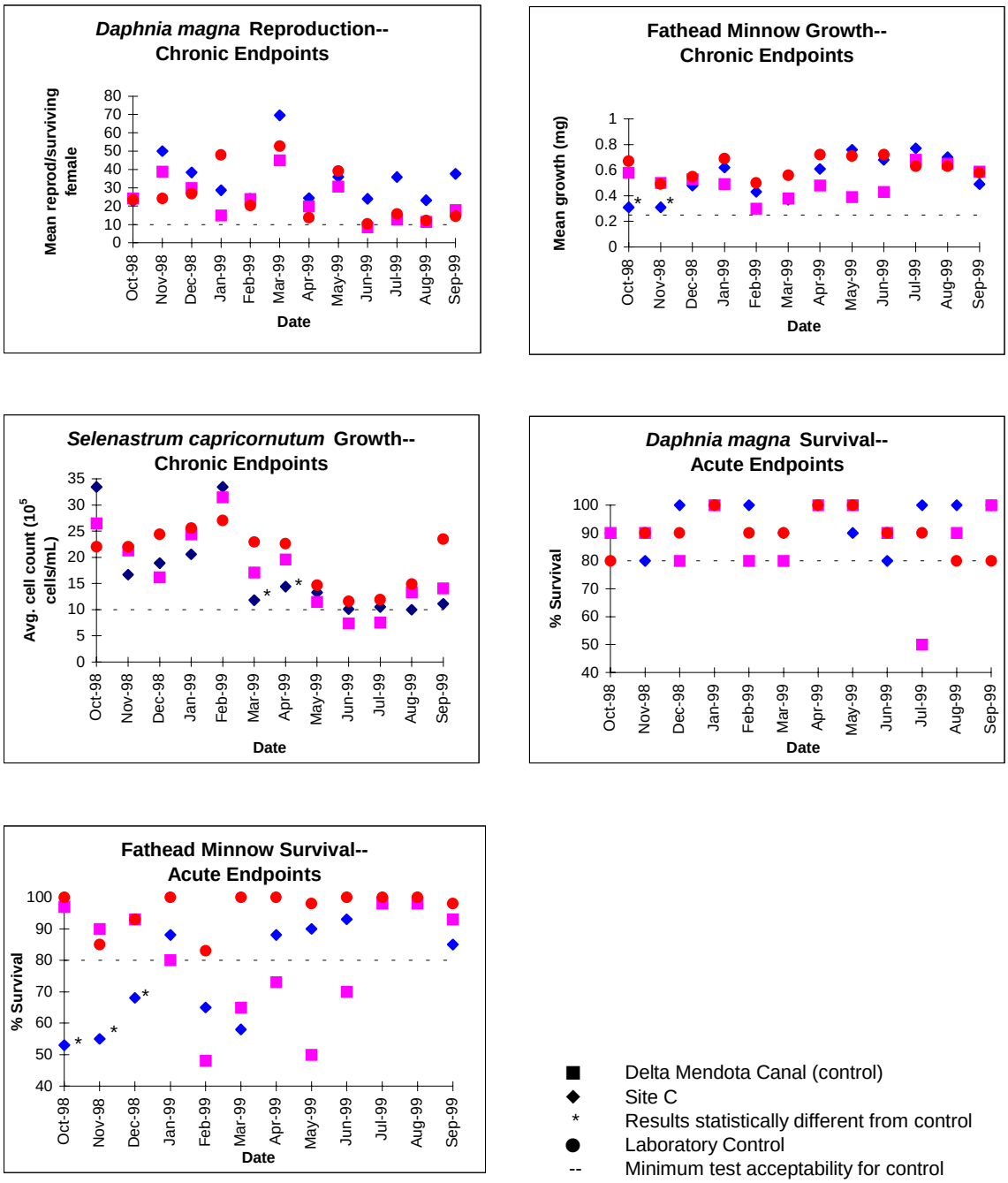


Figure 17. Comparison of toxicity test results from Site D with results from the Delta Mendota Canal reference location. The different tests are described in the text.

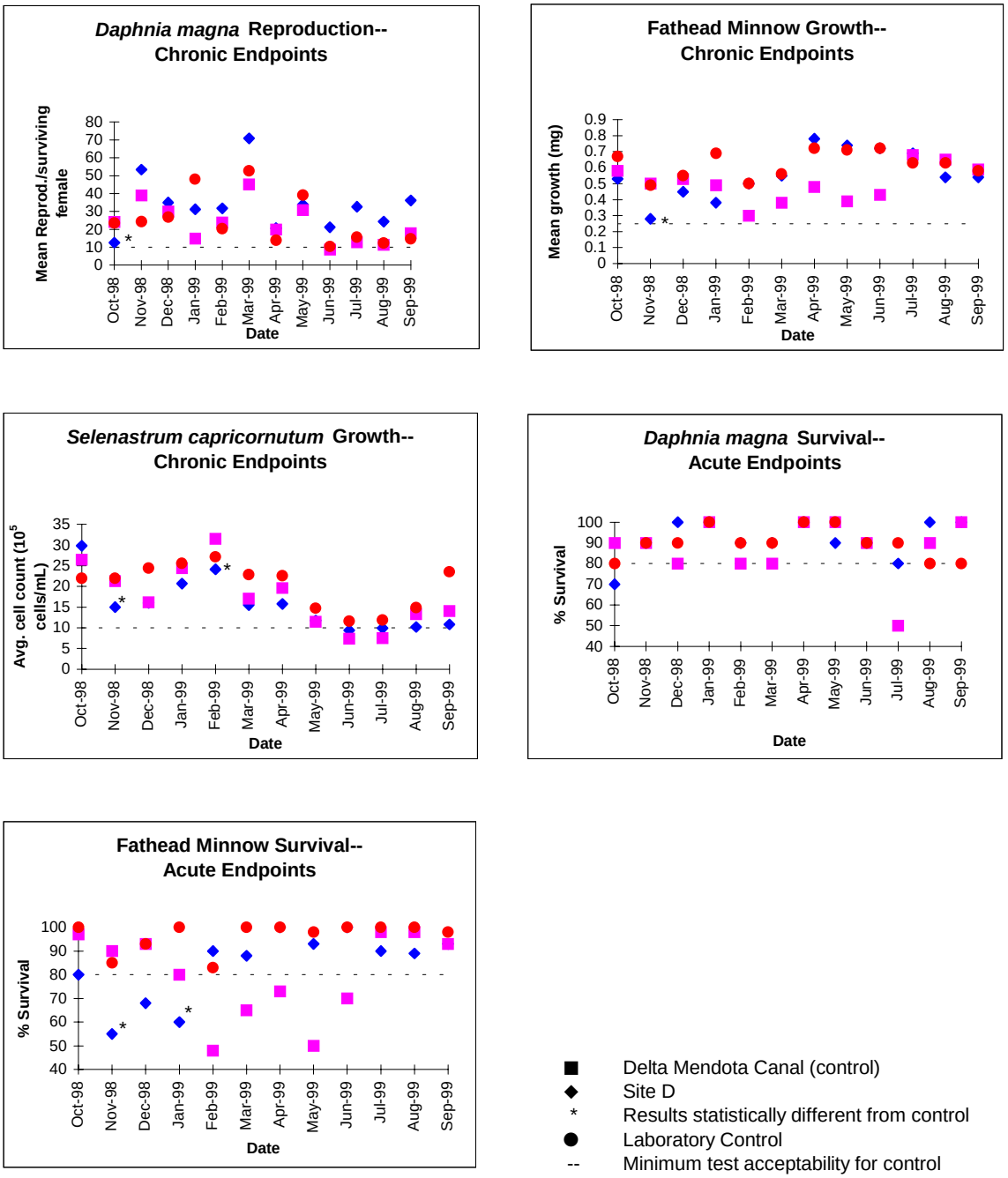


Figure 18. Comparison of toxicity test results from Site F with results from the Delta Mendota Canal reference location. The different tests are described in the text.