

GRASSLAND BYPASS PROJECT

QUARTERLY NARRATIVE AND GRAPHICAL SUMMARY

July - September 2000

February 1, 2001

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 GBP and the Grassland Drainage Service Area are shown in Figure 1. A schematic of the GBP showing the hydrology of the GBP and sampling locations is provided in Figure 2. The GBP has removed much of the agricultural subsurface drainage from wetland water supply channels in the Grassland Water District and from Salt Slough, but it has increased quantities of agricultural subsurface drainage in the six miles of Mud Slough (North) that receive the re-routed water. The Grassland Bypass Project Compliance Monitoring Program (GBPCMP) has been in place since October 1996 and is designed to evaluate whether the terms and conditions of the GBP are being met. Specific conditions for the GBP 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 2000). 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>.

This report provides information for the fourth year of the GBP in the quarter including July through September 2000.

II. FLOW MONITORING

Flow data in the GBP 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 into Mud Slough (North) from the San Luis Drain may not exceed 150 cfs (USBR 1995).

Daily mean flow data for Stations A, B, D, F, and N are shown in Figure 3. Flows at Station A, near the inlet to the San Luis Drain, averaged 49 cfs for the quarter, with a maximum flow of 71 cfs on July 11. At Station B, the point of discharge of the San Luis Drain into Mud Slough (North), flows were well under 150 cfs, also averaging 49 cfs this quarter (Figure 3). Maximum flow at Station B, 67 cfs, occurred August 19. Maximum and average flows were moderately lower than for the same quarter last year.

Of the two monitoring stations at Mud Slough (North) above and below the GBP discharge (Stations C and D, respectively), flow is measured only at Station D. The average flow at Station D for the quarter was 60 cfs, somewhat lower than for the same period the previous year (76 cfs). A maximum flow of 82 cfs occurred at Station D on July 9. Average flow from the SLD (Station B) was 82% of the average total flow in Mud Slough (North) (Station D). Flows at Station F (Salt Slough) averaged 168 cfs for the quarter. The highest flow in Salt Slough (257 cfs) occurred on July 5.

At Station N in the San Joaquin River, flows averaged 635 cfs this quarter. The maximum flow measured this quarter was 764 cfs on July 10. Flows here were slightly higher than for this quarter in the previous year (567 cfs average and 718 cfs maximum).

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 agricultural subsurface drainage to the wetland channels, and to evaluate potential adverse effects of the GBP discharge and of waters in Mud Slough (North) below the discharge on test organisms. Electrical conductivity, pH, boron, and selenium concentrations provided by the CVRWQCB are considered in draft form at the time of preparation for this report.

Selenium

Daily Selenium Measurements

Selenium concentrations are measured daily at Stations B and N using autosamplers (USBR 1996). Daily selenium load discharge is computed at Station B, and monthly totals are shown in Figure 4. Monthly total selenium load discharges were below the selenium load values in each month of this quarter.

Figure 5d shows daily selenium load discharges from the GBP (from the terminus of the San Luis Drain as measured at Station B), which averaged 10.8 lbs/day for the quarter. The maximum daily selenium load discharge (16.8 lbs/day) occurred on September 4. Flow at Station B averaged 49 cfs for the quarter with a minimum of 18 cfs on September 14, 27, and 28, and a maximum of 67 cfs on July 10 (Figure 5b). Selenium concentrations at Station B had a minimum of 23.3 µg/L on August 15 and a maximum of 70.9 µg/L on September 28 (Figure 5c). The cumulative selenium load discharge for the quarter was 991 lbs., nearly 15% lower than the same period last year. Cumulative load discharge for the sampling year was 4603 lbs (Figure 5a), 10% lower than the previous year's total.

Selenium concentrations at Station N (San Joaquin River at Crow's Landing) averaged 3.2 µg/L for the quarter (Figure 6b), the same as in the previous quarter. The highest concentration for the quarter, 5.0 µg/L, was measured on July 3. The minimum concentration for the quarter, 1.5 µg/L, occurred on September 16. In this quarter, only August had complete sets of daily flow and selenium concentration data for both Stations

B and N, and calculated monthly loads at Station B (324 lbs) were virtually identical to loads at Station N (316 lbs) calculated in the same manner.

Weekly Selenium Measurements

Selenium concentrations are measured in weekly grab or composite samples collected at 11 sites. Concentrations in samples for the water year beginning October 1999 are shown in Figures 7 through 9.

Selenium concentrations for Station A were previously measured in weekly grab samples, which have been replaced by weekly composite samples starting January 2000. For the quarter including July through September 2000, average selenium concentrations in weekly samples collected near the inlet to the San Luis Drain (Station A) were slightly higher than those near the point of discharge into Mud Slough (Station B) (Figure 7). Station A averaged 42 $\mu\text{g/L}$ in this quarter, compared to 39 $\mu\text{g/L}$ for Station B.

Selenium concentrations in Mud Slough (North) upstream of the GBP discharge (Station C) averaged 0.9 $\mu\text{g/L}$ for the quarter, with a maximum concentration for the quarter of 2.0 $\mu\text{g/L}$ on August 24 (Figure 7). Concentrations were much higher in Mud Slough (North) downstream of the GBP discharge (Station D), averaging 30 $\mu\text{g/L}$, with a maximum of 45 $\mu\text{g/L}$ on August 31.

Selenium concentrations in Salt Slough (Station F) and the wetland water supply channels (Stations J, K, L2, M2) frequently have reached or exceeded 2 $\mu\text{g/L}$ in the past. One objective of the GBP is to maintain monthly mean selenium concentrations below 2 $\mu\text{g/L}$ at these locations. In this quarter, weekly measurements equaled or exceeded 2 $\mu\text{g/L}$ four times at Station L2 and three times at Station M2 (Figure 8). The monthly mean concentration exceeded the 2 $\mu\text{g/L}$ objective at Station L2 in July (Table 1).

In the San Joaquin River, weekly selenium samples were collected at sites upstream of the GBP discharge (Station G) and downstream of the Merced River (Station N) (Figure 9). Selenium concentrations at Station G averaged 0.7 $\mu\text{g/L}$, ranging from below detection (0.4 $\mu\text{g/L}$) to 1.0 $\mu\text{g/L}$. Station H was previously believed to be upstream of influence from the Merced River, but seasonal inflows from the Merced have been found upstream of Station H. Sampling at this station has therefore been discontinued. Weekly samples collected at Station N this quarter averaged 3.1 $\mu\text{g/L}$ of selenium, ranging from 1.6 to 4.9 $\mu\text{g/L}$.

Specific conductance

Specific conductance is measured at 15 min intervals at Stations B, D, F, and N, and in weekly grab samples at Stations A, B, C, D, F, G, J, K, L2, M2, and N. These data are presented in Figures 10 and 11. Sampling at Station H has been discontinued for reasons mentioned previously. Seasonal patterns of specific conductance were similar to those of the previous year.

IV. SEDIMENT MONITORING

Sediment quality is measured in the 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. Stations 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.

Sediment selenium data for the project to date are presented in Figures 12-15 for Stations A, B, C, D, E, F, and I.

V. BIOLOGICAL MONITORING

Biological monitoring is conducted throughout the GBP area on a quarterly basis (USBR 1996). Tissue sampling in the GBPCMP is 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 analyzed for selenium residues to assess impacts to fish and wildlife. Muscle fillets from gamefish are analyzed for selenium to assess human health risks. These data will be presented and discussed in the GBP Annual Report for this water year (October 1999 - September 2000).

VI. TOXICITY TESTING

The purpose of the GBP toxicity testing program is to evaluate the potential adverse effects of the GBP discharge and of waters in Mud Slough (North) below the discharge on test organisms. Monthly toxicity tests are conducted in the laboratory using water collected from Stations B, C, D, and F. Test results from these stations 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. Toxicity endpoints were not significantly different from controls in tests for any month this quarter (Figures 16-19).

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. 2000. 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. Monthly mean selenium concentrations (in $\mu\text{g/L}$) from weekly samples collected at Salt Slough (Station F) and the wetland water supply channels, Camp 13 Ditch (Station J), Agatha Canal (K), San Luis Canal at splits (L2), and Santa Fe Canal at wier (M2) for water year 2000. Samples below detection limit of $0.4 \mu\text{g/L}$ are assigned value of $0.2 \mu\text{g/L}$ in calculating averages.

	F	J	K	L2	M2
October 1999	0.7	1.0	0.9	0.9	1.0
November 1999	0.8	1.5	1.3	1.5	0.8
December 1999	0.8	0.9	0.7	1.0	0.9
January 2000	0.6	1.1	0.9	1.1	0.6
February 2000	1.1	2.1	1.4	2.9	1.6
March 2000	1.2	1.4	1.1	1.8	1.3
April 2000	0.9	2.0	1.8	2.0	1.7
May 2000	1.1	1.6	1.4	1.6	1.8
June 2000	1.0	1.5	1.3	2.2	1.9
July 2000	1.0	1.2	1.0	2.3	2.0
August 2000	0.8	0.9	0.8	1.6	1.5
September 2000	0.9	0.9	0.9	0.9	1.0

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

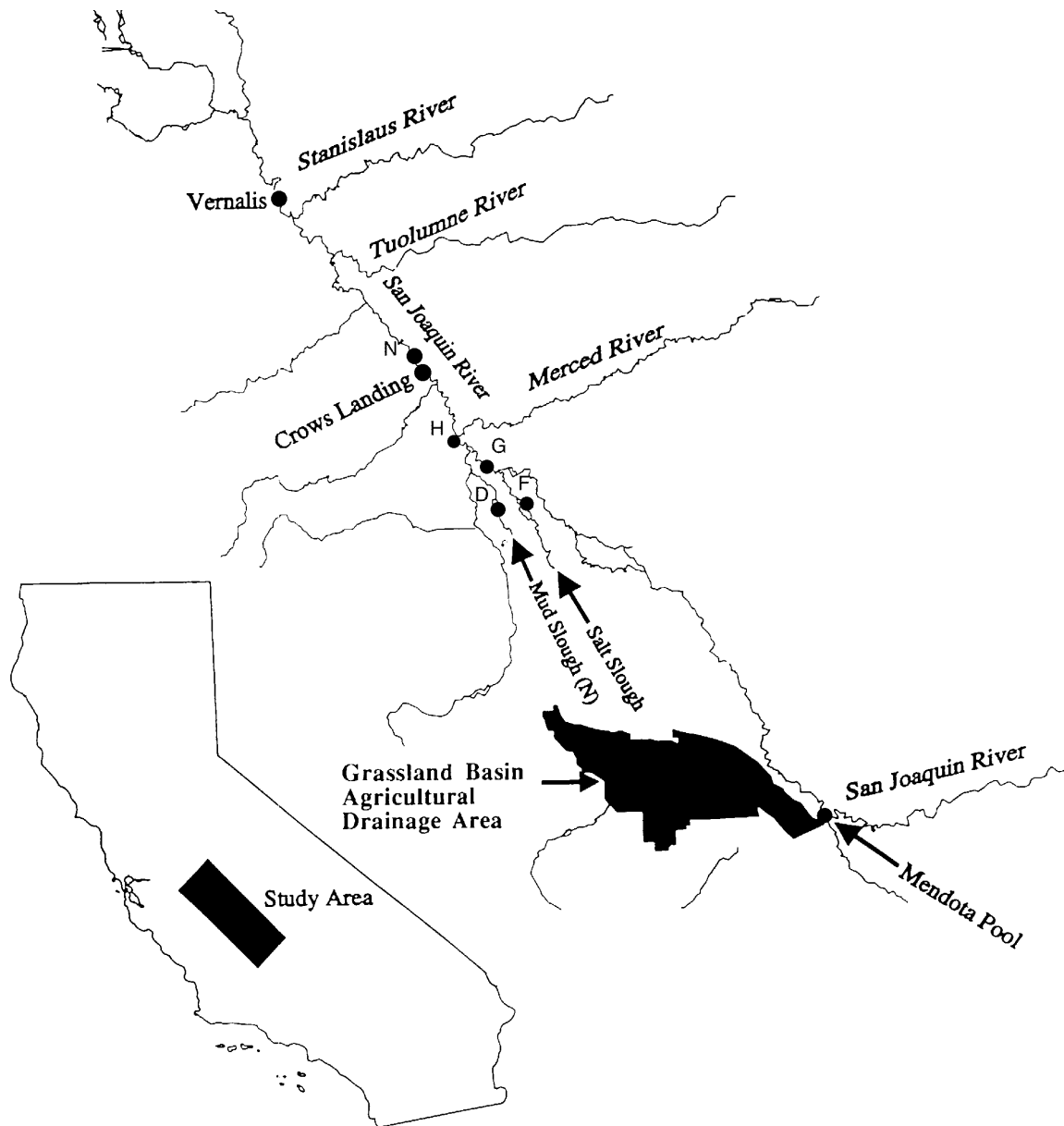


Figure 2. Schematic diagram showing locations of GBP monitoring stations relative to major hydrologic features of the study area.

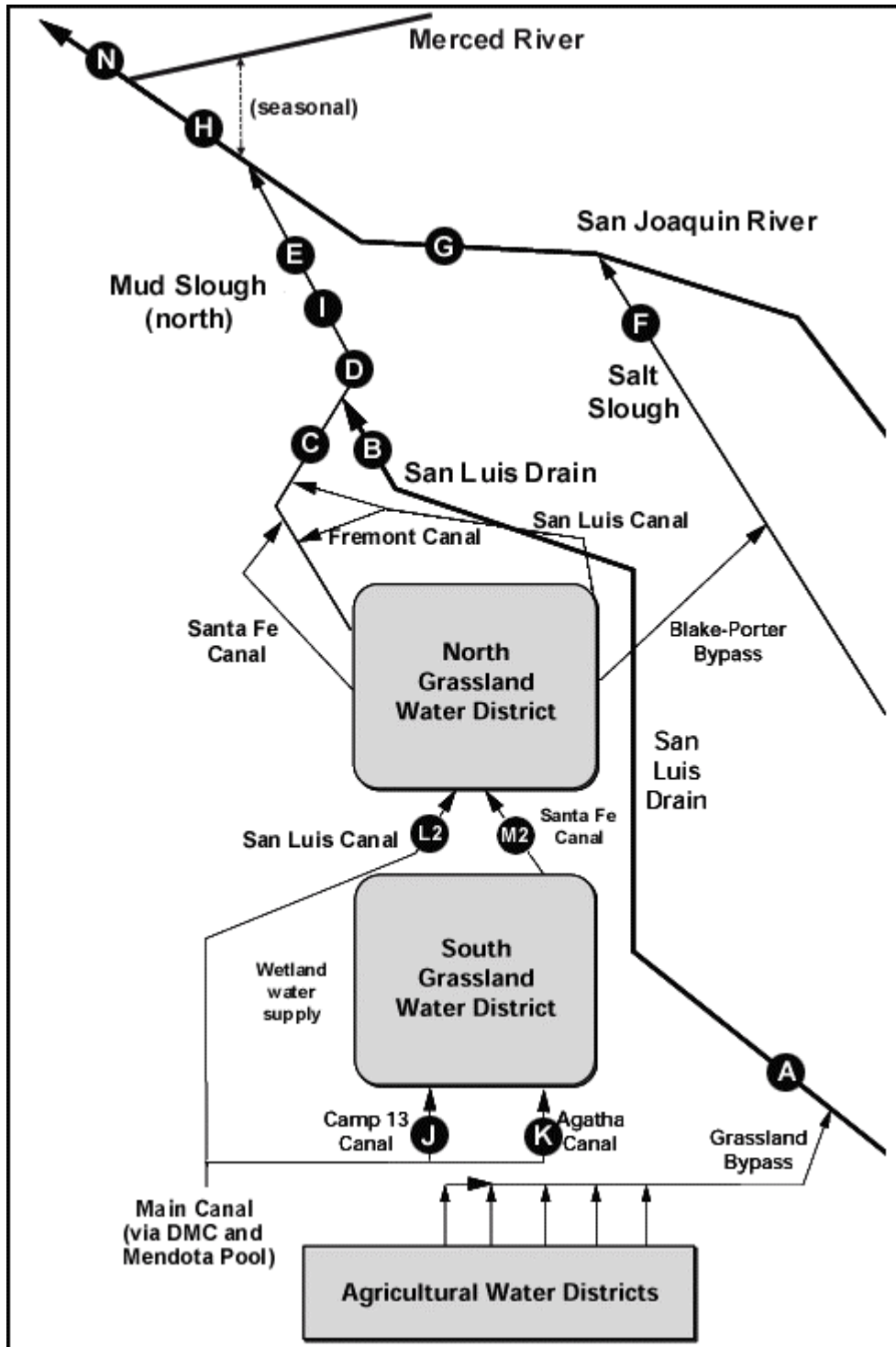


Figure 3. Daily mean flows (cfs) at GBPCMP stations. Flow at Station A is recorded as a daily mean. Flows at Stations B, D, F, and N are recorded at 15 min intervals. Note different scales of vertical axis.

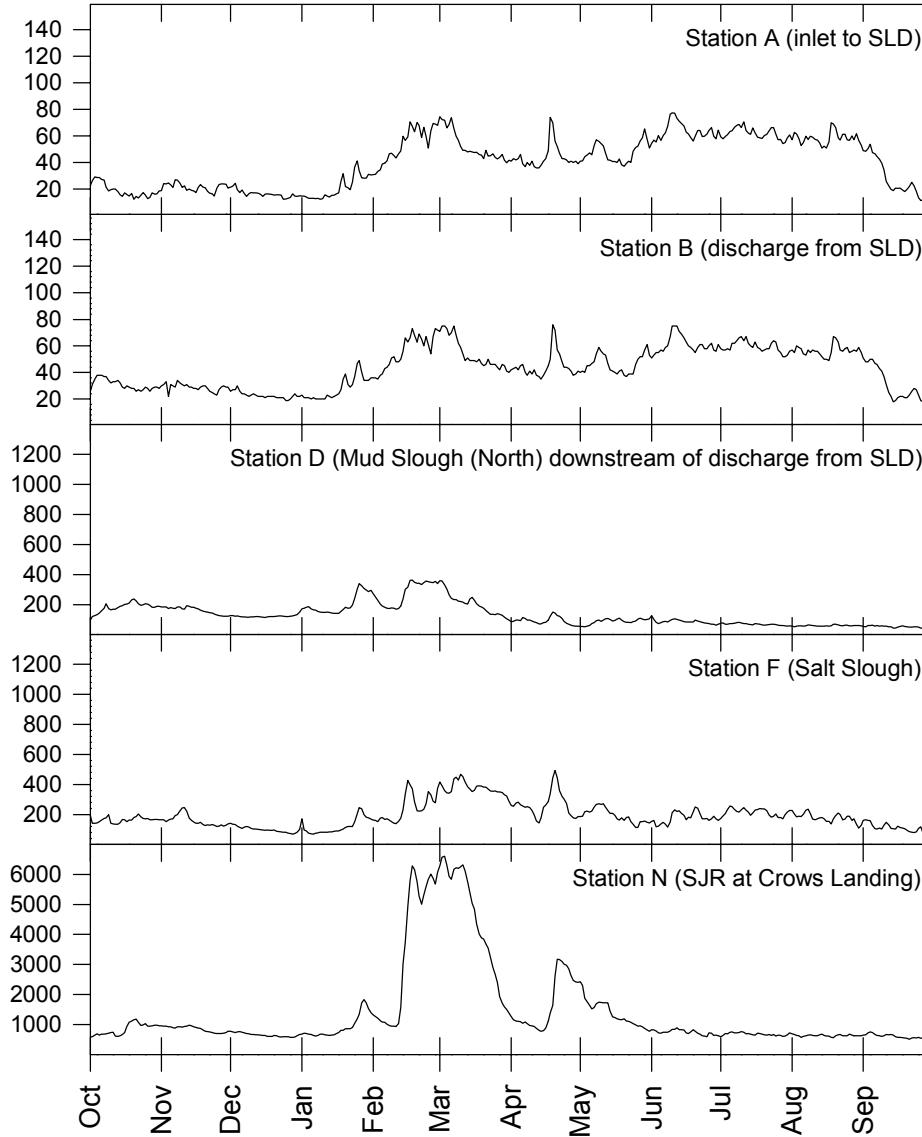
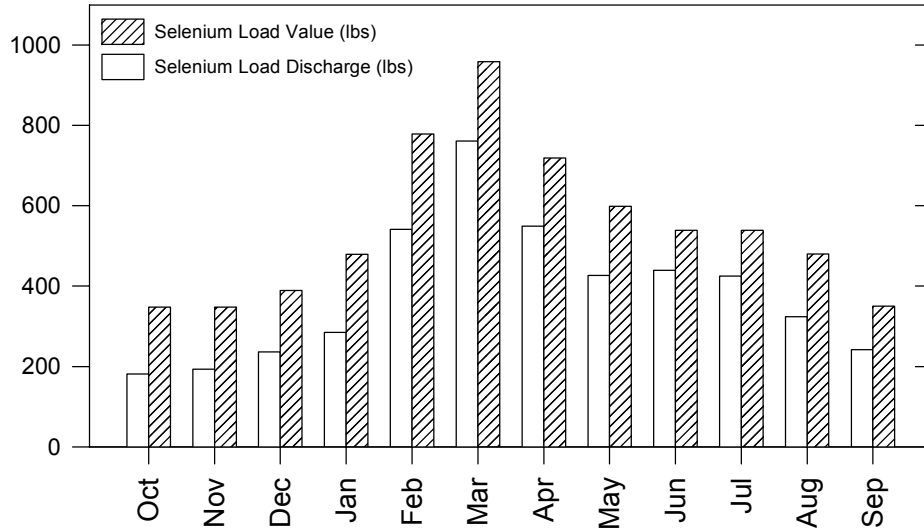


Figure 4. Comparison of monthly selenium load discharge from the terminus of the San Luis Drain (Station B) with the monthly load values in the Interim Use Permit for the 4th year of the GBP (USBR 1995).



Water Year 2000	Load value (lbs)	Selenium load discharge (lbs)	Amount over load value (lbs)
Oct 1999	348	181	NA
Nov 1999	348	193	NA
Dec 1999	389	236	NA
Jan 2000	479	285	NA
Feb 2000	779	541	NA
Mar 2000	959	761	NA
Apr 2000	719	549	NA
May 2000	599	427	NA
Jun 2000	539	439	NA
Jul 2000	539	425	NA
Aug 2000	480	324	NA
Sep 2000	350	242	NA

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

Figures 5. Selenium concentrations and selenium load discharge at Station B (discharge from SLD): a) comparison of cumulative load discharge and load values; b) daily average flows; c) daily average selenium concentrations; and d) calculated daily average load discharge.

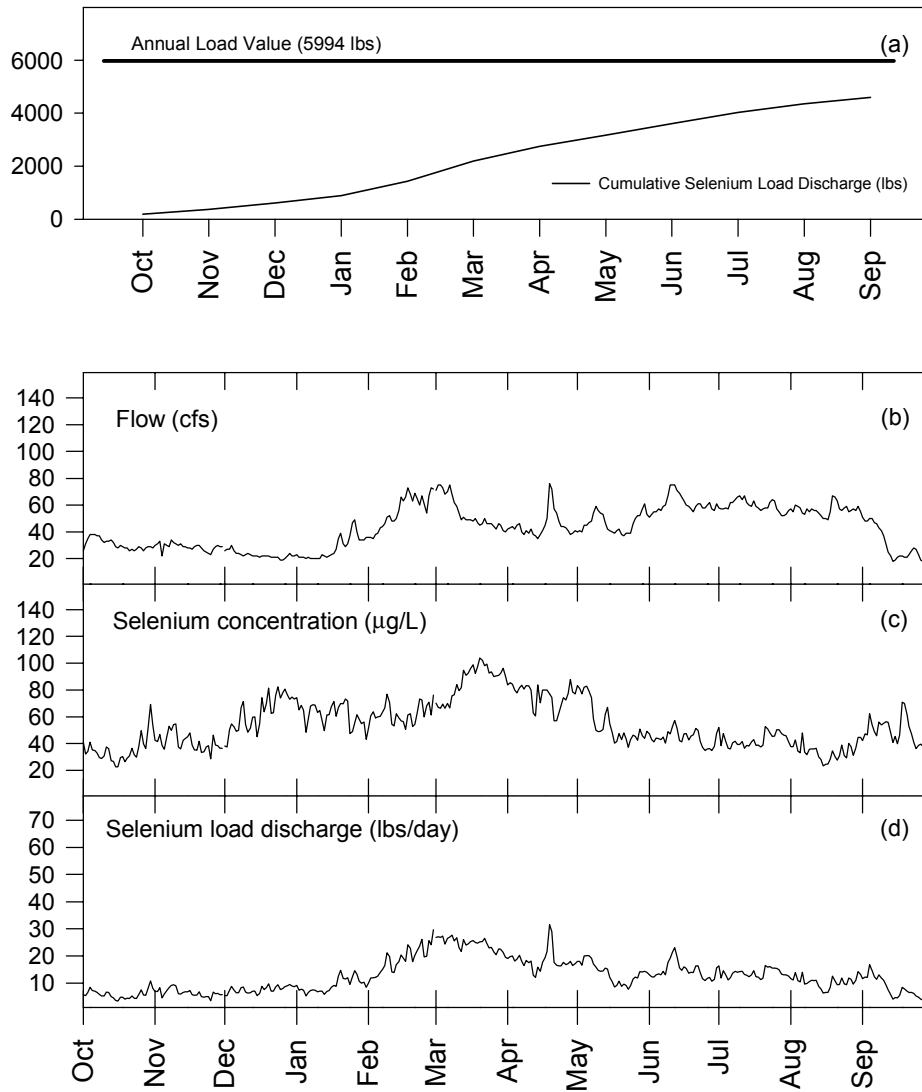


Figure 6. Daily average flows and selenium concentrations at Station N (San Joaquin River at Crow's Landing).

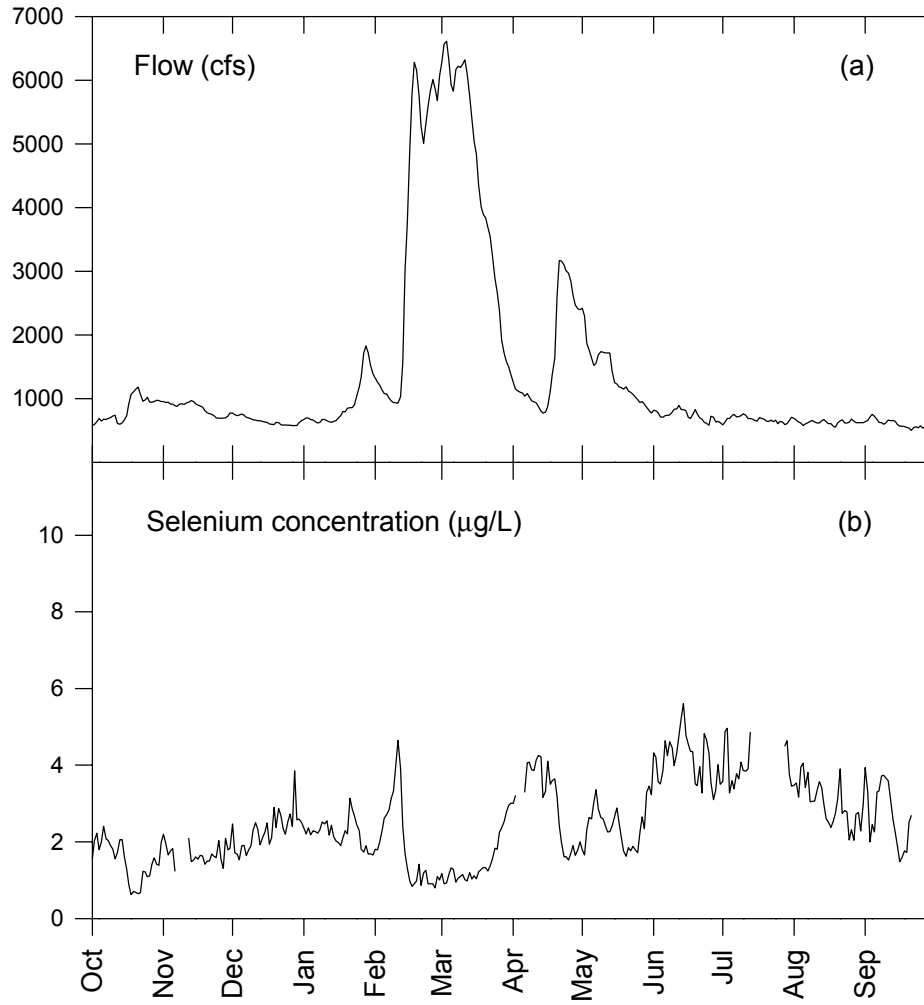


Figure 7. Selenium concentrations ($\mu\text{g/L}$) at Station A (near the inlet to the San Luis Drain), Station B (discharge from the San Luis Drain), Station C (Mud Slough (North) upstream of the GBP discharge), and Station D (Mud Slough (North) downstream of the GBP discharge). Data from weekly samples.

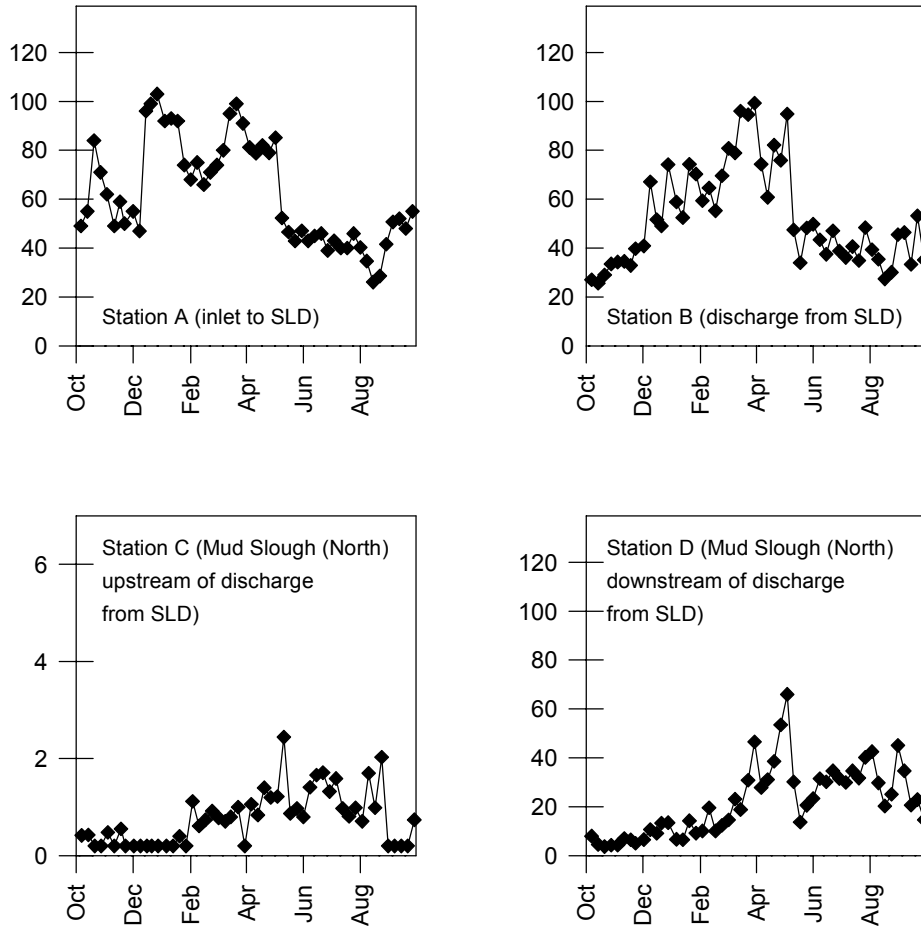


Figure 8. Selenium concentrations ($\mu\text{g/L}$) at Station F (Salt Slough) and in the wetland water supply channels at Station J, Station K, Station L2, and Station M2. Data from weekly samples.

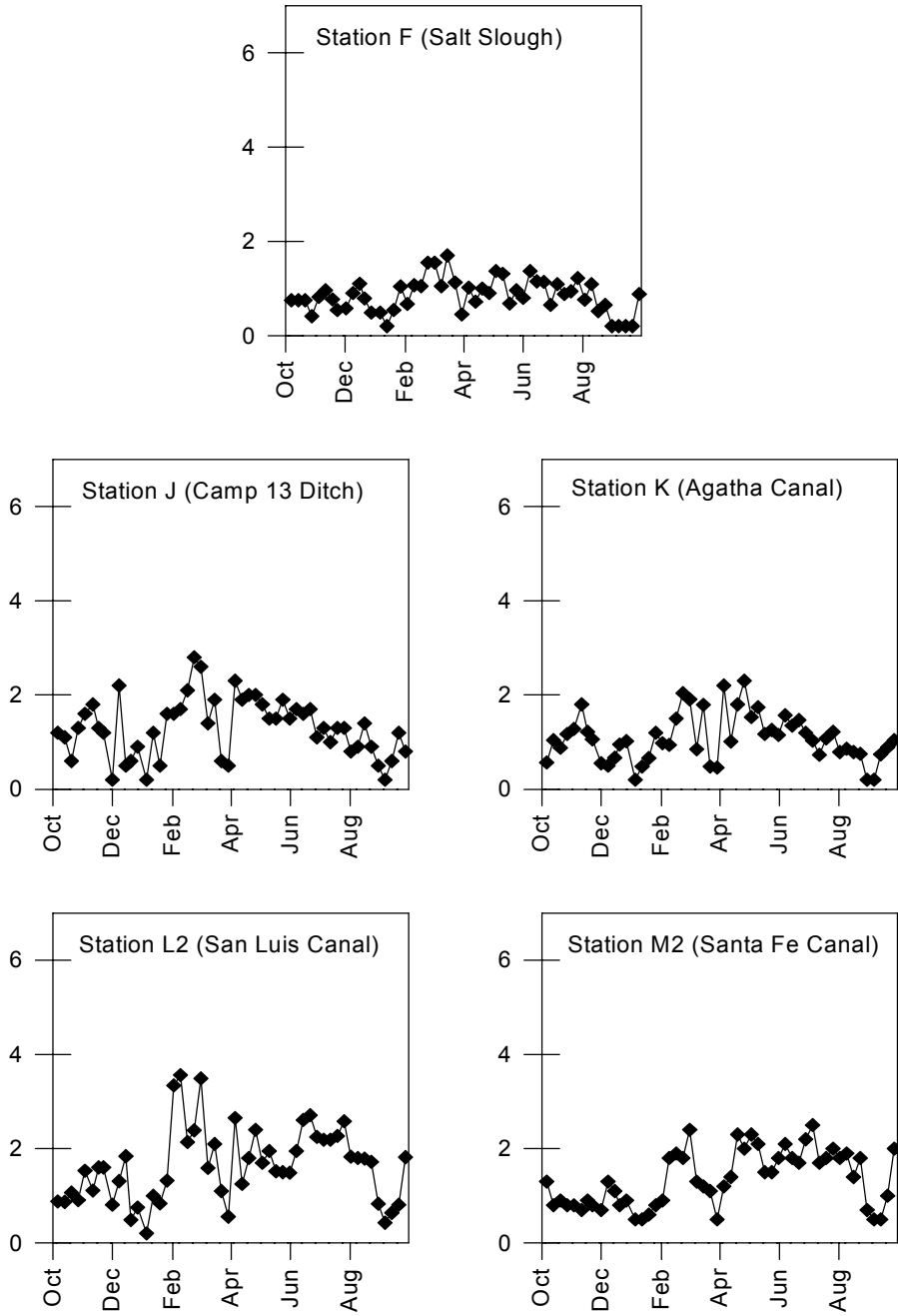


Figure 9. Selenium concentrations ($\mu\text{g/L}$) at San Joaquin River Stations G (San Joaquin River upstream of Mud Slough (North) confluence), H (San Joaquin River downstream of Mud Slough (North) confluence), and N (at Crow's Landing, downstream of Merced River confluence). Data from weekly samples.

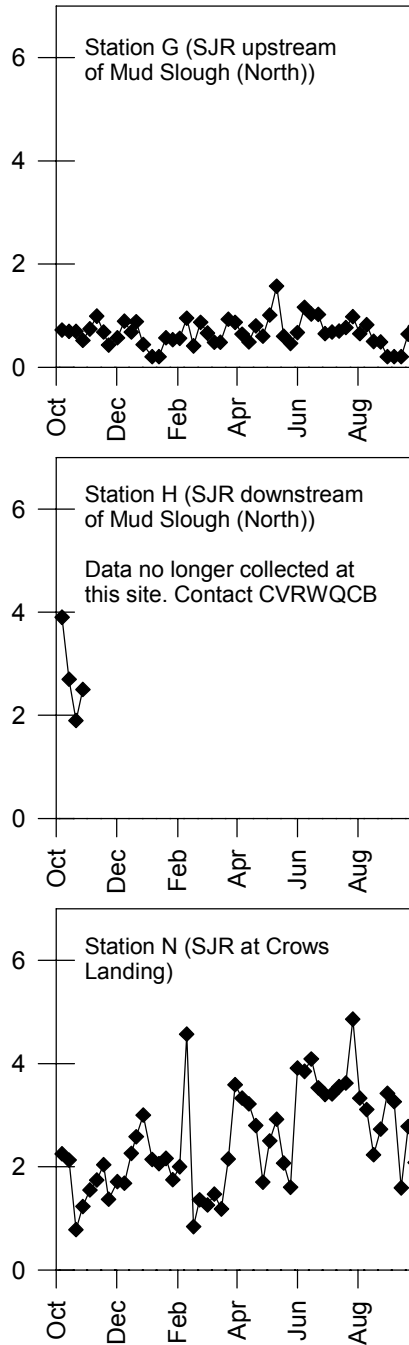


Figure 10. Daily average specific conductance ($\mu\text{S}/\text{cm}$) derived from measurements at 15 min intervals at Stations B (discharge from the SLD), D (Mud Slough (North) downstream of the GBP discharge), F (Salt Slough), and N (San Joaquin River at Crow's Landing).

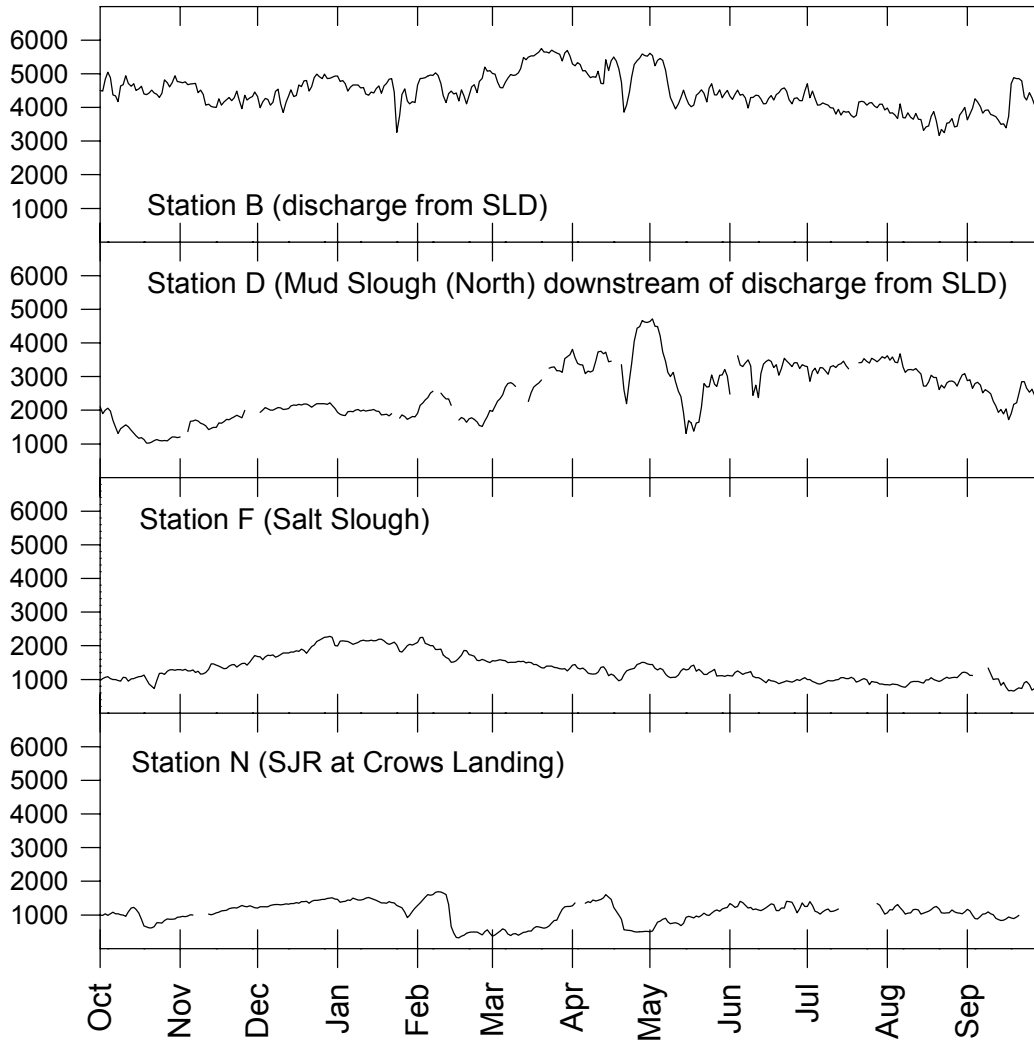


Figure 11. Specific conductance ($\mu\text{S}/\text{cm}$) in weekly grab samples. Letters indicate stations.

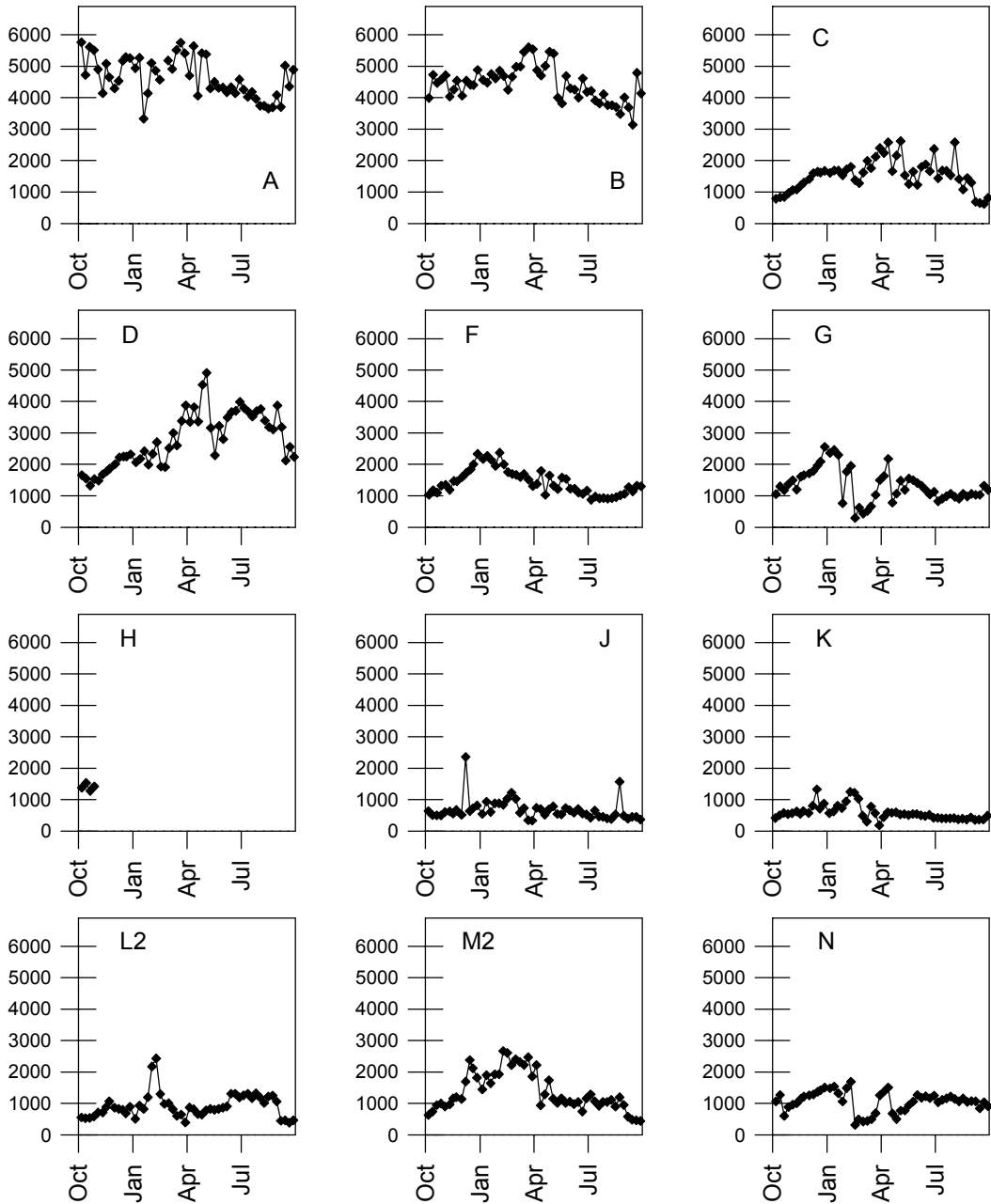


Figure 12. Selenium concentrations in sediment at sites A (inlet to San Luis Drain) and B (discharge from San Luis Drain). Samples not tested at Site A on March 12, 1997 and November 18, 1997 and at Site B on March 12, 1996 and June 6, 2000. Concentration in whole core sample at Site B on June 10, 1997 was 0.11 µg/g dry weight.

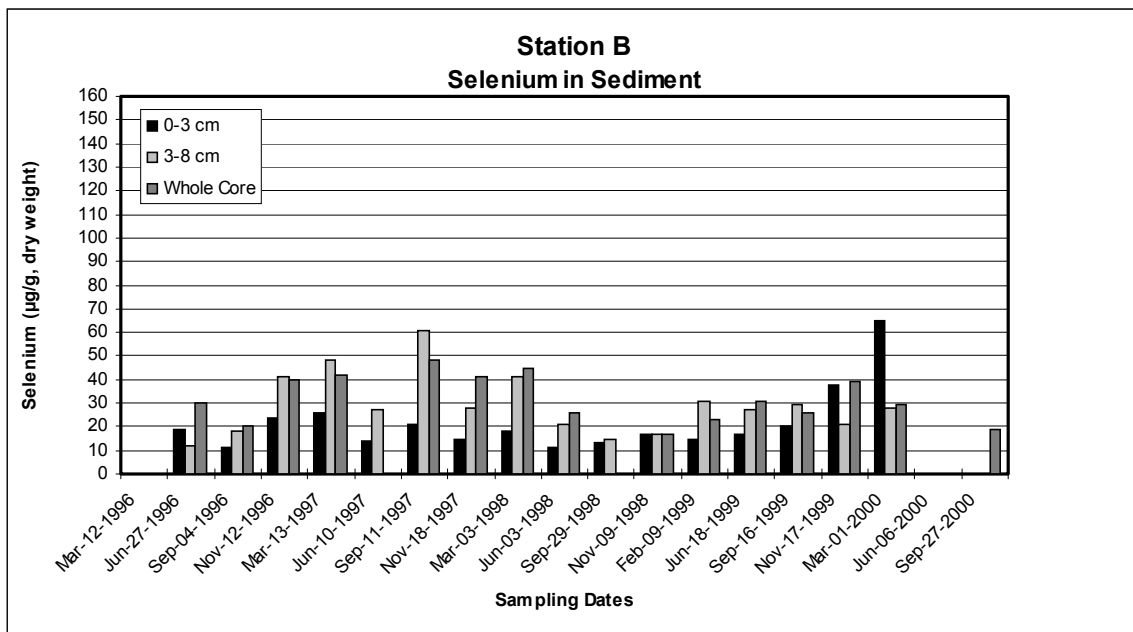
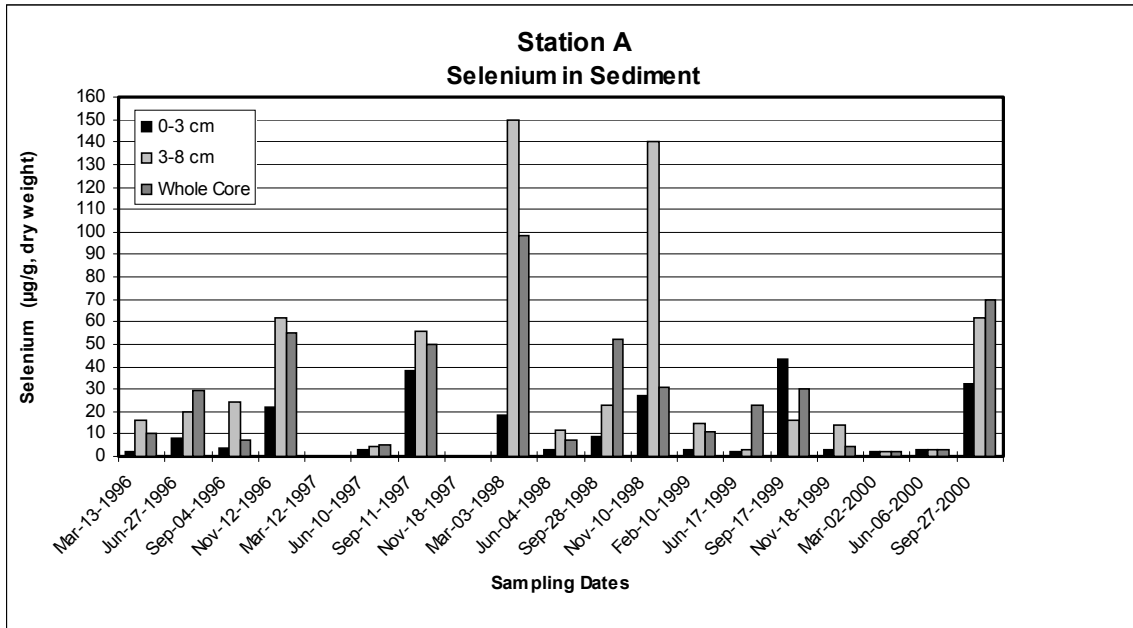


Figure 13. Selenium concentrations in sediment at sites C (Mud Slough upstream of the GBP discharge) and D (Mud Slough downstream of the GBP discharge). Samples not tested at sites C and D on March 12, 1996 and March 3, 1998. Other missing bars indicate concentrations were below limits of detection.

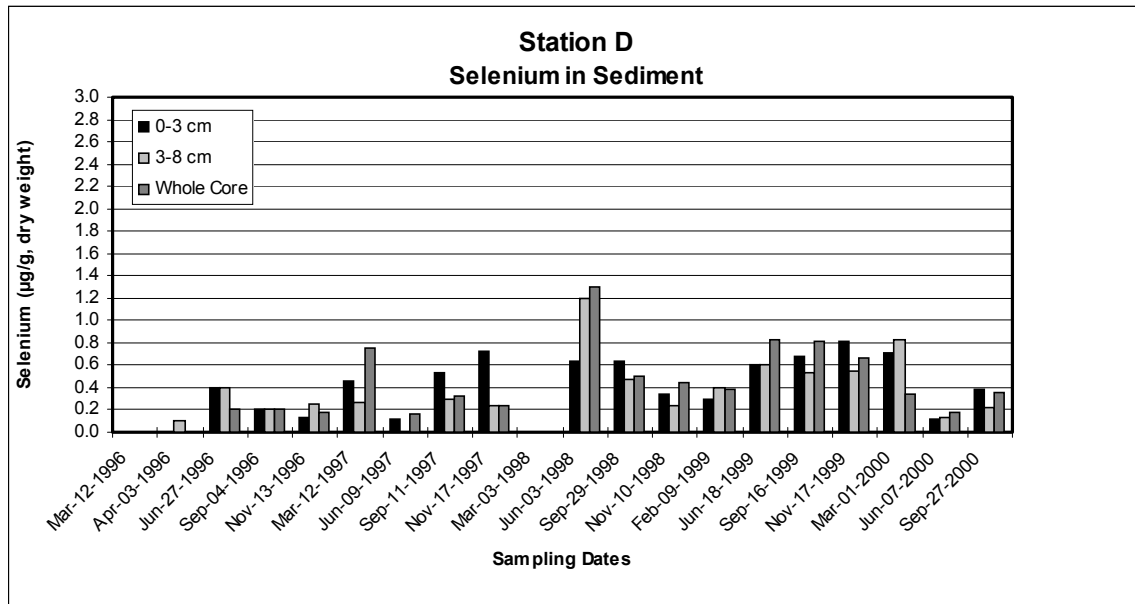
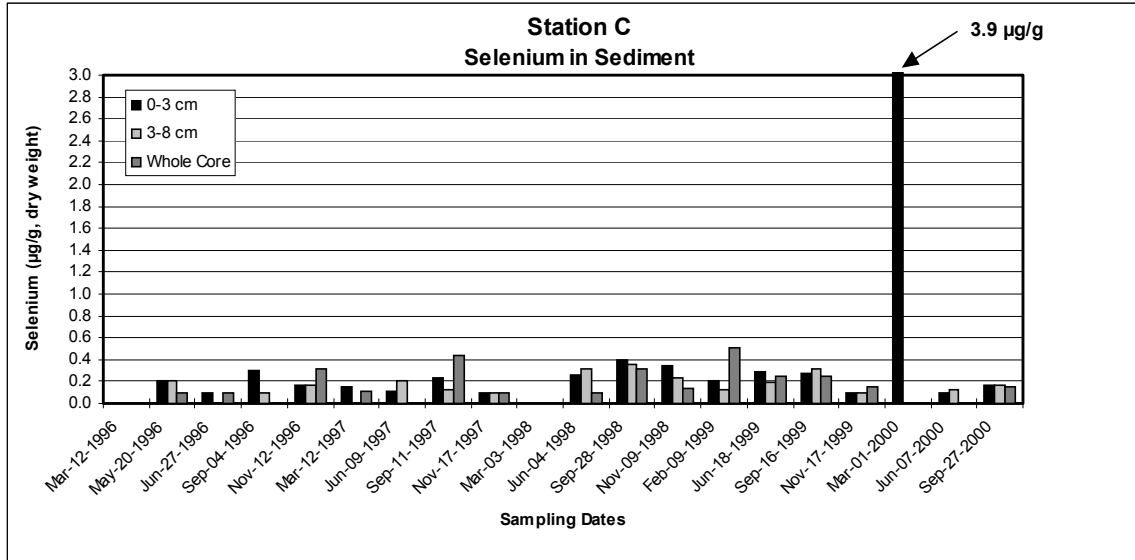


Figure 14. Selenium concentrations in sediment at sites E (Mud Slough at Highway 140) and F (Salt Slough). Samples not tested at Site E on March 12, 1996, September 4, 1996, March 3, 1998, and June 3, 1998 and at Site F on March 12, 1996. Other missing bars indicate concentrations were below limits of detection.

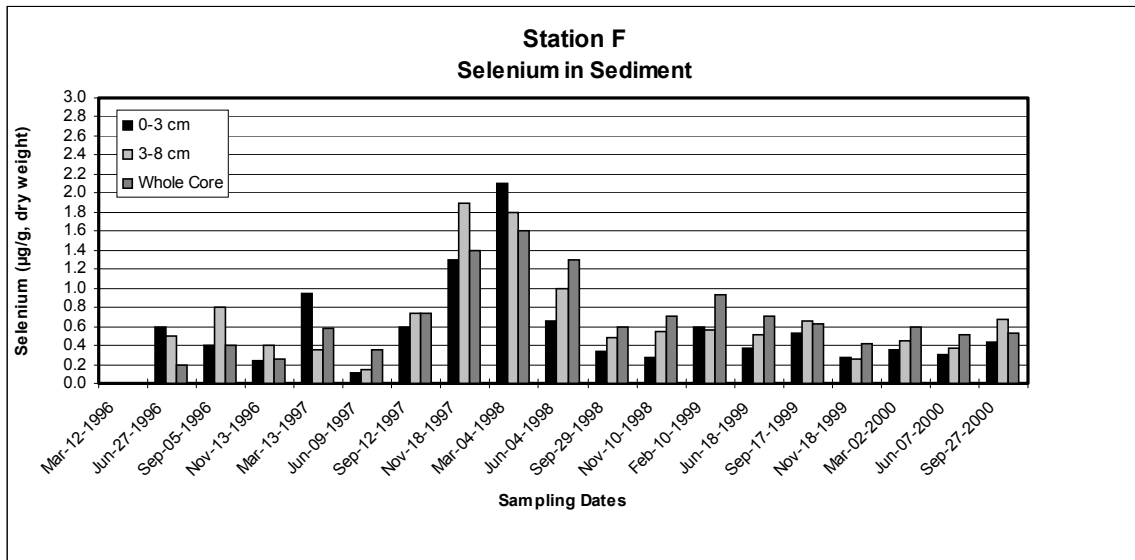
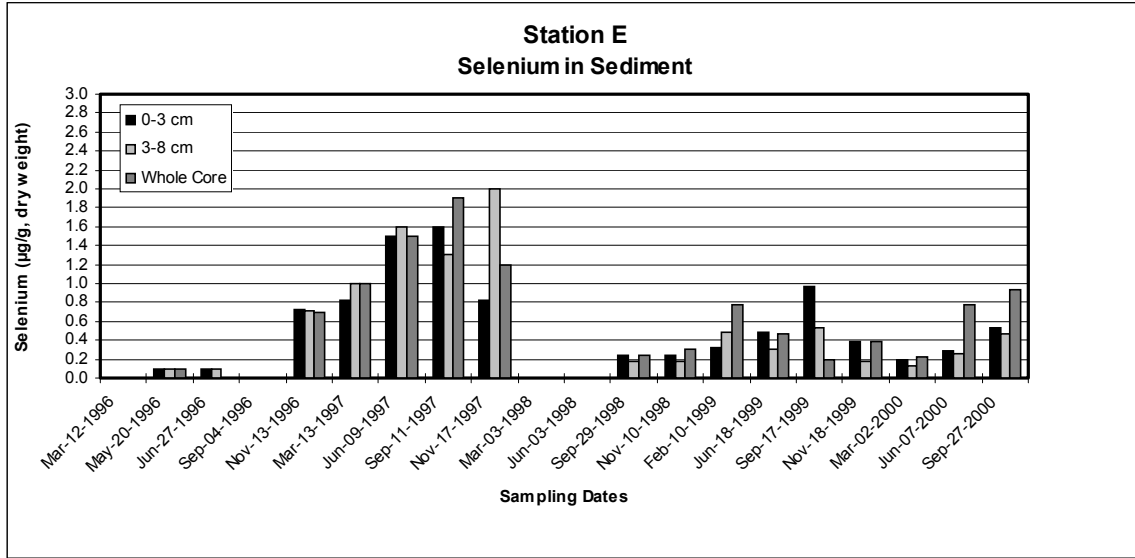


Figure 15. Selenium concentrations in sediment at site I (Mud Slough back water annual site)

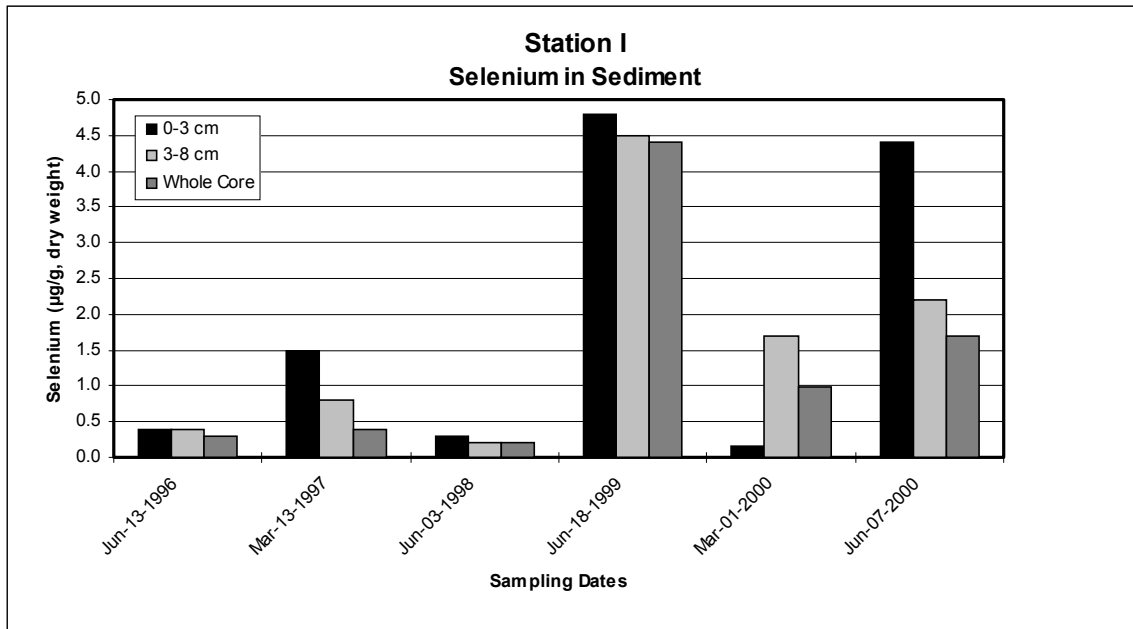


Figure 16. Comparison of toxicity test results from Station B with results from the Delta Mendota Canal reference location. The different tests are described in the text.

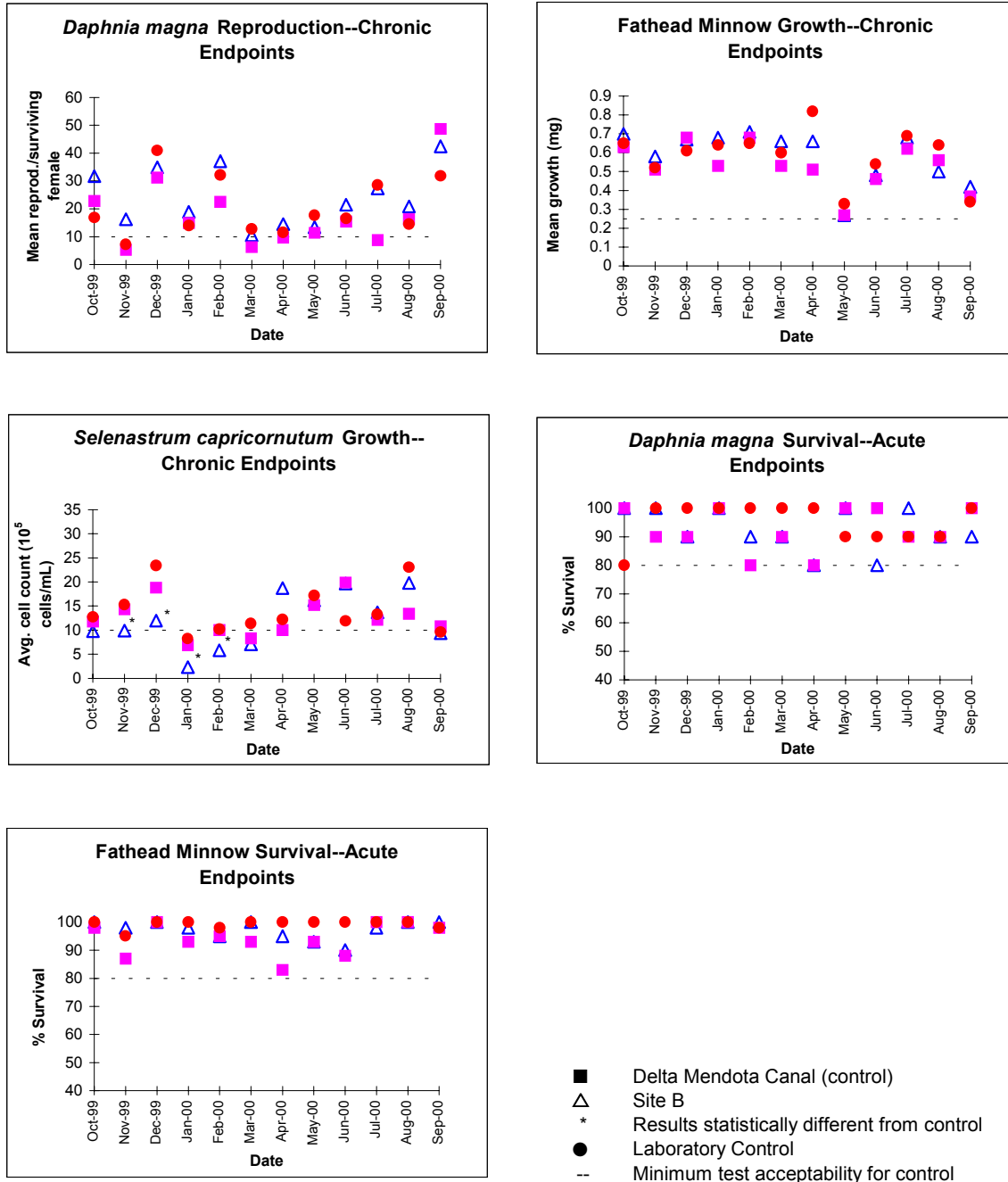


Figure 17. Comparison of toxicity test results from Station C with results from the Delta Mendota Canal reference location. The different tests are described in the text.

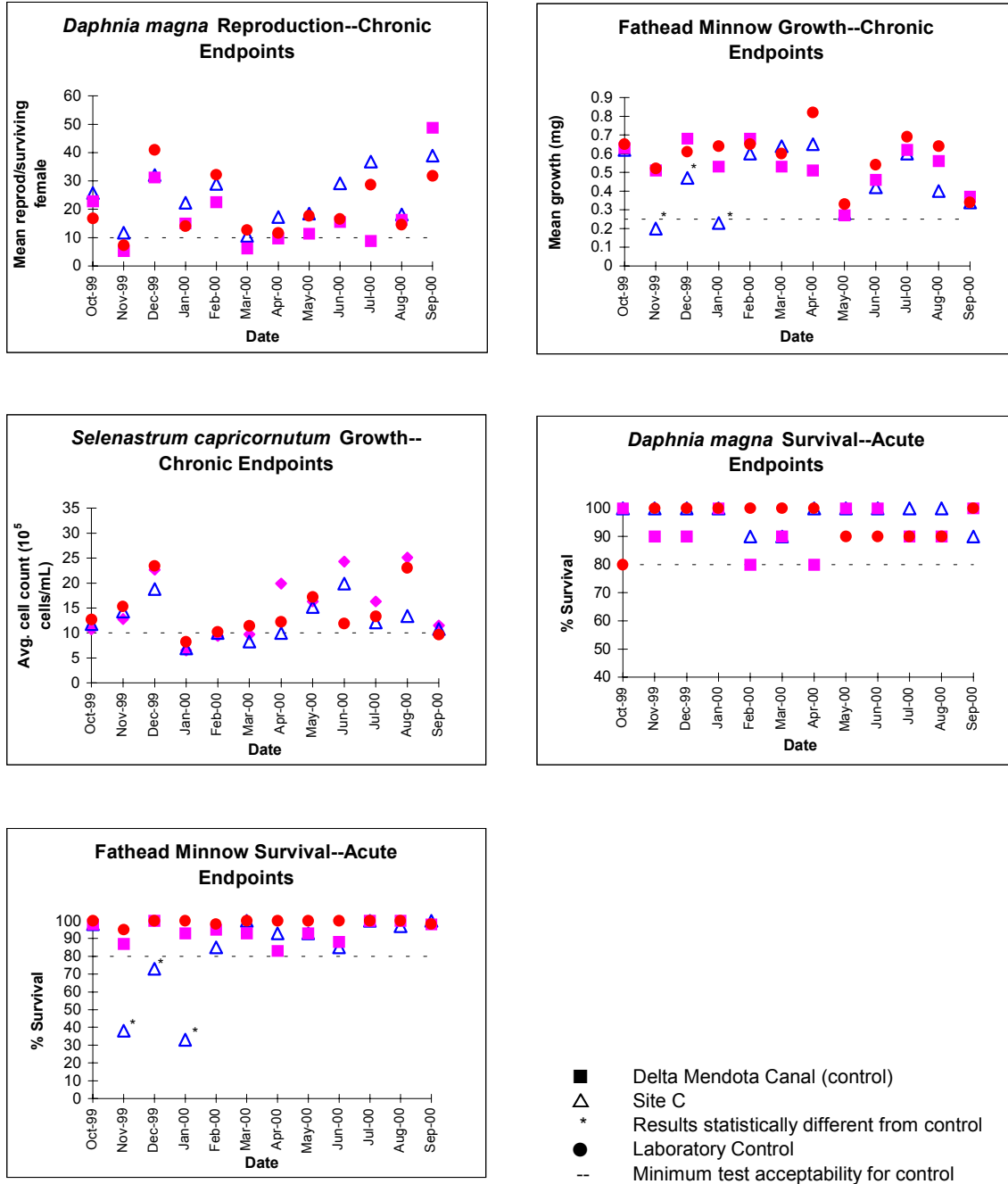


Figure 18. Comparison of toxicity test results from Station D with results from the Delta Mendota Canal reference location. The different tests are described in the text.

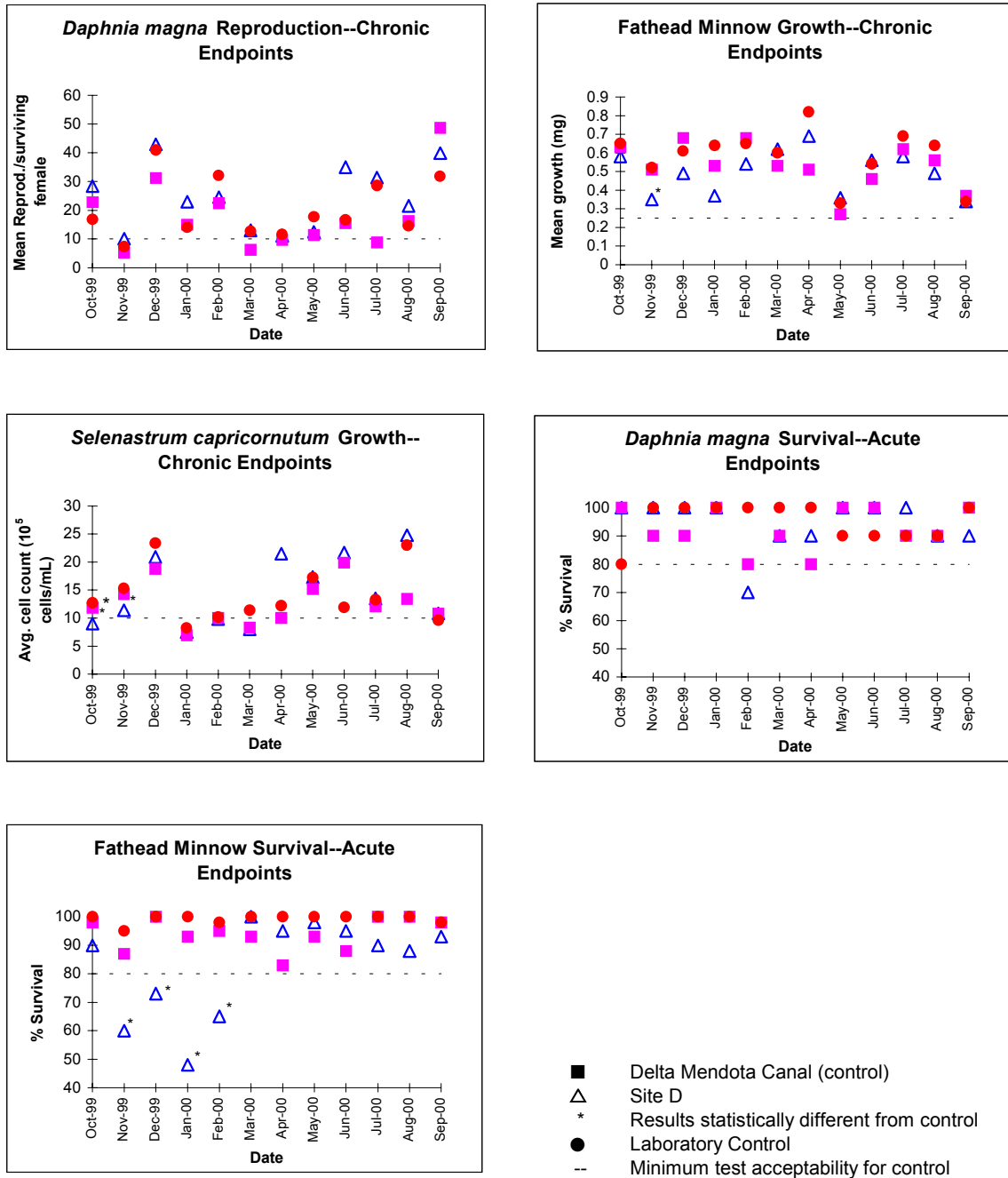


Figure 19. Comparison of toxicity test results from Station F with results from the Delta Mendota Canal reference location. The different tests are described in the text.

