GRASSLAND BYPASS PROJECT

QUARTERLY NARRATIVE AND GRAPHICAL SUMMARY

April - June 1998

October 5, 1998

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 irrigation return 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, 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 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 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 GBP are being met. Specific conditions for the GBP include monthly and annual selenium load values from the San Luis Drain into Mud Slough, 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. The data and detailed background information on the GBP are also available on the Internet at the following address:

www.mp.usbr.gov/mp400/irrdrn/grasslnd/grasslnd.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. According to the Interim Use Permit, discharge flows into Mud Slough from the San Luis Drain may not exceed 150 cfs (USBR 1995).

Flows in the San Luis Drain (Stations A and B) generally declined from the unusually high levels of February and March (Figure 3). An exception to this general trend occurred for a few days in mid-May, when flow in the drained reached approximately 140 cfs, approaching the maximum flows recorded for the GBP in February and March. Flow at Station A averaged 76.4 cfs for the quarter, slightly lower than the average at Station B (77.9 cfs).

Of the two monitoring stations in Mud Slough 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 143 cfs. The discharge from the San Luis Drain (Station B) accounted for an average of 54% of the total flow in Mud Slough (Station D). Flows in Salt Slough (Station F) averaged 287 cfs for the quarter. Average flow at both Station D and Station F was higher than that observed in the corresponding quarter in 1997.

Flows at Station N remained high in April - June, averaging 13,457 cfs. This was higher than the average flow measured in January - March (10,139 cfs). In April - June 1997 the average flow at Station N was only 1062 cfs, less than 10% of the average flow in April - June 1998. Flows at Station N were relatively constant, with a minimum of 11,300 cfs and a maximum of 16,700 cfs.

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 of the GBP discharge and of waters in Mud Slough below the discharge on test organisms.

Chemical Monitoring

Selenium

Daily Selenium Measurements

Daily selenium concentrations are measured at Stations B and N using autosamplers (USBR 1996). Monthly total selenium load discharge is computed at Station B. Monthly totals are shown in Table 1 and illustrated in Figure 4a.

Selenium load discharge from the GBP (discharge from the terminus of the San Luis Drain as measured at Station B) averaged 41.0 lbs/day for the quarter. The maximum daily selenium load discharge (69.1 lbs/day) occurred on May 15. Selenium load discharge fluctuated considerably during the quarter, but generally declined from high loads in early April to low loads in late June (Figure 4e). The cumulative selenium load discharge for the quarter was 3732 lbs. For the April - June period in 1997 the cumulative load was 2740 lbs.

Selenium concentrations at Station N (San Joaquin River at Crow's Landing) averaged 1.0 ug/L for the quarter. The highest concentration was measured on May 8 (1.7 ug/L).

Weekly Selenium Measurements

Selenium concentrations are measured in weekly grab samples collected at 12 stations (Figures 6-8). The quarterly average selenium concentration near the inlet to the San Luis Drain (Station A, 97 ug/L) was slightly lower than that near the point of discharge into Mud Slough (Station B, 101 ug/L) (Figure 6).

Selenium concentrations in Mud Slough upstream of the GBP discharge (Station C) from October-March averaged 1.2 ug/L, with a maximum concentration of 1.7 ug/L (Figure 6). Concentrations were higher in Mud Slough downstream of the GBP discharge (Station D) than upstream at Station C (note differences in scales). Concentrations at Station D averaged 54 ug/L, with a maximum of 104 ug/L on May 28. The average concentration at Station D during the same quarter in 1997 was 53 ug/L, very similar to the average for April - June 1998.

Selenium concentrations in Salt Slough (Station F) averaged 0.9 ug/L, with a maximum of 1.4 ug/L. In April, selenium concentrations in the wetland water supply channels (Stations J, K, L, and M) were frequently higher than 2 ug/L (Figure 7). In May and June only one sample at these four stations was higher than 2 ug/L (2.5 ug/L on June 10 at Station J).

In the San Joaquin River, weekly selenium samples were collected at stations upstream of the GBP discharge (Station G), downstream of the discharge and above the Merced River (Station H), and downstream of the Merced River (Station N) (Figure 8). Selenium concentrations at Station G were low, averaging 0.3 ug/L. Concentrations were higher at Station H, averaging 2.3 ug/L and reaching a maximum of 3.3 ug/L on April 16.

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, H, J, K, L, M, and N. These data are presented in Figures 9 and 10.

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 below the discharge. 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. A 7-day *in situ* survival test using 4-day-old fathead minnow larvae was conducted at Stations B, D, F, and a reference site (Windmill) on a quarterly basis from the beginning of the GBP until

August 1997, but has not been conducted since that time. Laboratory toxicity test results are summarized below; complete datasets are presented in the GBP Monthly Data Reports and GBP Quarterly Data Reports. Figures 11 - 14 summarize the toxicity test results by station.

In the fathead minnow tests, many samples have exhibited significantly reduced survival or growth, but the GBP discharge does not appear to be the source of the agents responsible for these reductions. In this quarter, reduced survival and growth were only observed for Station F in June. No fathead minnow tests performed on samples from Stations B, C, or D exhibited reduced survival or growth.

In the *Daphnia* tests, no field samples caused a reduction in survival. Survival in the laboratory controls for the *Daphnia* survival test, which has occasionally been low in past sampling, was again low in all three months.

In the *Daphnia* reproduction test, no field samples were significantly reduced relative to the Delta-Mendota control. Reproduction in a control sample from the Delta Mendota Canal in June was lower than in the field samples, and failed to meet the acceptability criterion for the test. Reproduction in the laboratory control sample in June was zero.

In the *Selenastrum* tests significant inhibition of growth was observed in two of three samples from Station B, where growth inhibition has frequently been observed in past sampling, and in May at Station F. No other samples inhibited *Selenastrum* growth.

IV. SEDIMENT MONITORING

Sediment Quality Monitoring

Sediment quality is measured in the San Luis Drain and in Mud and Salt Sloughs. The purpose of monitoring sediment chemistry in the San Luis Drain is to assess whether selenium concentrations in Drain sediments are approaching the California Department of Health Services hazardous waste criterion (100 ug/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 and organic carbon concentrations are provided in the Quarterly Data Report. Selenium concentrations are summarized in Figures 15 - 17. Selenium concentrations in sediment exhibit a high degree of variability, even within sediments collected at the same location, so apparent trends should be interpreted with caution.

Sediment Quantity Monitoring

A survey to estimate the quantity of sediment in the San Luis Drain is conducted annually. Results will be summarized and reported when they are available.

V. BIOLOGICAL MONITORING

Organisms are collected 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. Results of these efforts are discussed in the GBP Annual Report.

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.

Grassland Area Farmers. 1997. Grassland Bypass Channel operations during two major storm events in January 1997. Report to the Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.

Grassland Area Farmers. 1998. Grassland Bypass Project Storm Event Operations: February, 1998. Submitted by the Grassland Area Farmers, April 10, 1998.

Summers Engineering. 1998. Letter to Grassland Bypass Project Oversight Committee, June 11, 1998.

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 (Station B) with the monthly load values in the Interim Use Permit (USBR 1995).

	Selenium load discharge (lbs)	Monthly load value (lbs)	Amount over monthly load value (%)
Oct 1997	248	348	na
Nov 1997	207	348	na
Dec 1997	178	389	na
Jan 1998	335	533	na
Feb 1998	965	866	11
Mar 1998	1,600	1,066	50
Apr 1998	1,554	799	95
May 1998	1,371	666	106
Jun 1998	807	599	35

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

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

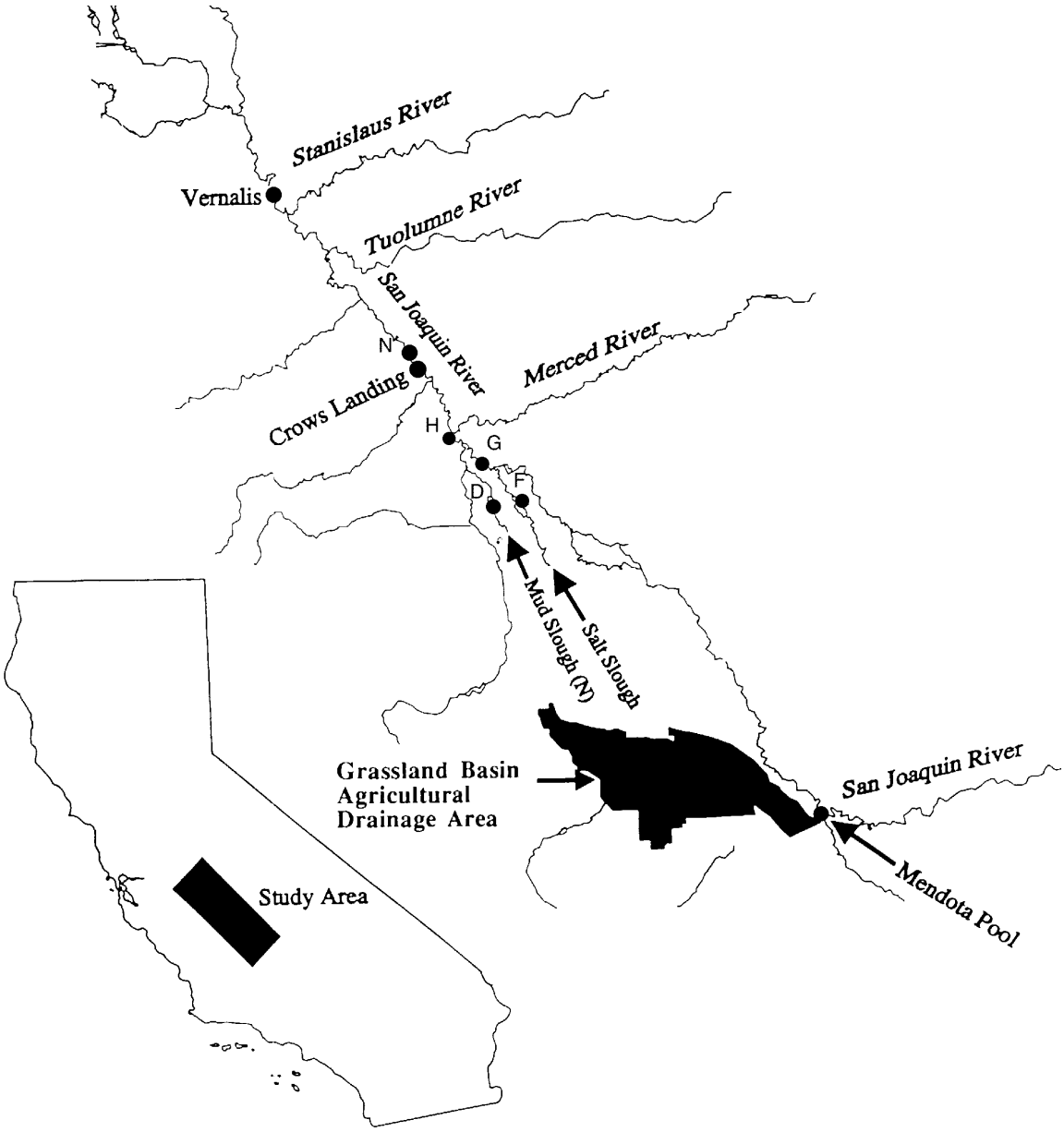


Figure 2. Schematic diagram showing locations of GBP monitoring stations relative to major hydrologic features of the study area.

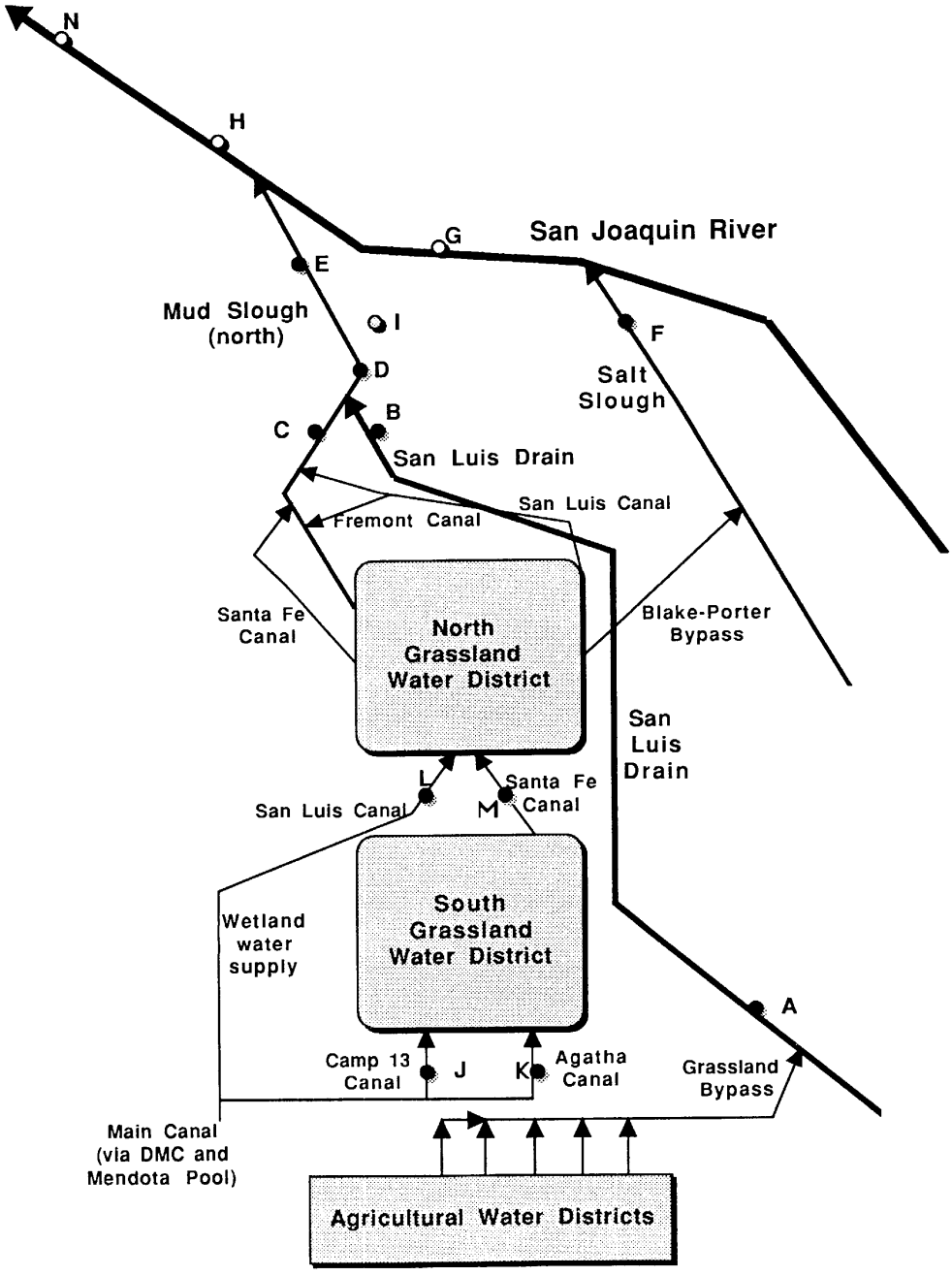


Figure 3. Daily mean flows (cfs) at GBPCMP stations. Flow at Station A is recorded as a daily mean. Flows at Stations B, D, F, and N are recorded at 15 min intervals. Note different scales of vertical axes and break in vertical axis for Station N.

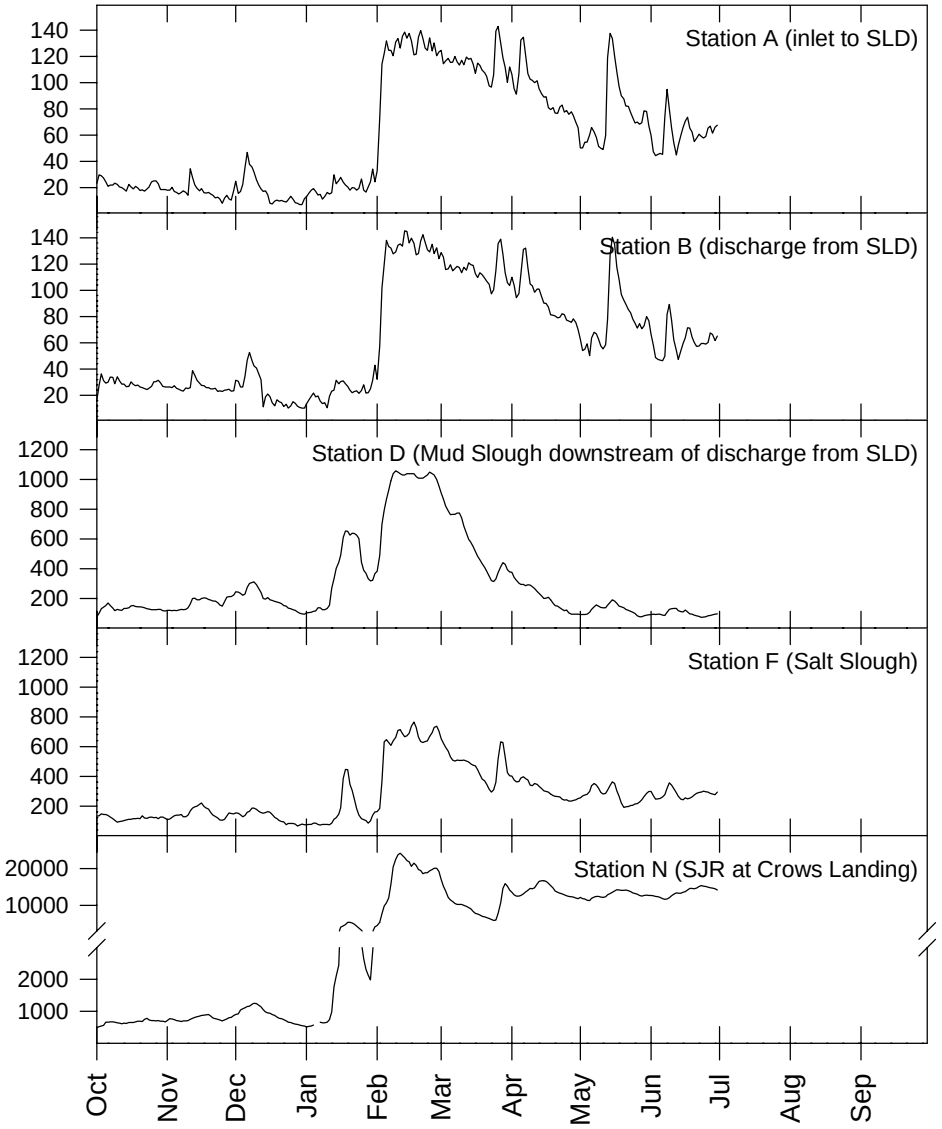


Figure 4. Selenium concentrations and selenium load discharge at Station B (discharge from SLD): a) comparison of monthly load discharge and load values; b) comparison of cumulative load discharge and load values; c) daily average flows; d) daily average selenium concentrations; and e) calculated daily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

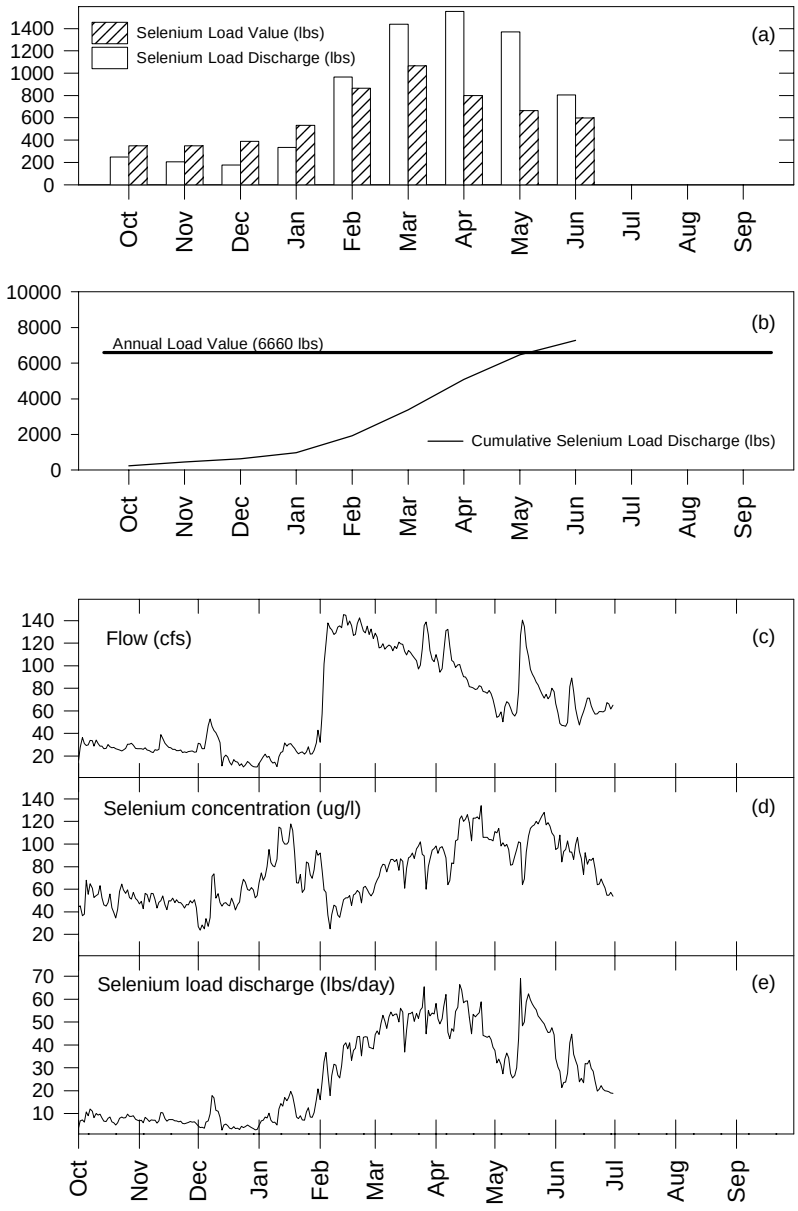


Figure 5. Daily average flows and selenium concentrations at Station N (San Joaquin River at Crow's Landing). Note break in vertical axis for flow plot.

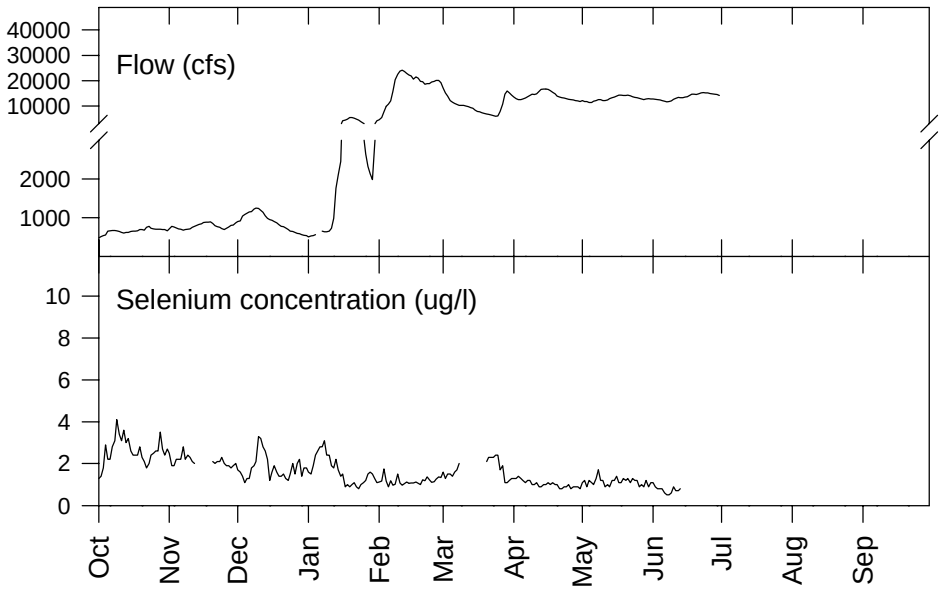


Figure 6. Selenium concentrations (ug/L) at Station A (near the inlet to the San Luis Drain), Station B (discharge from the San Luis Drain), Station C (Mud Slough upstream of the GBP discharge), and Station D (Mud Slough downstream of the GBP discharge). Data from weekly grab samples.

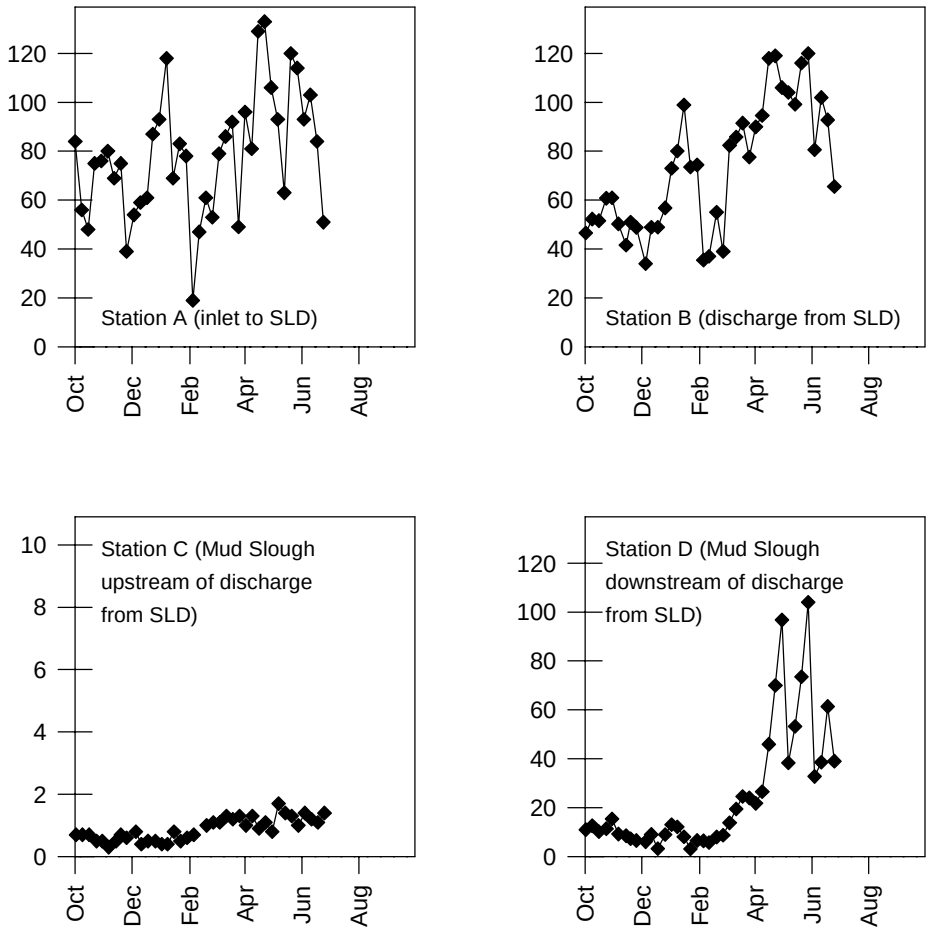


Figure 7. Selenium concentrations (ug/L) at Station F (Salt Slough) and in the wetland water supply channels at Station J, Station K, Station L, and Station M. Data from weekly grab samples.

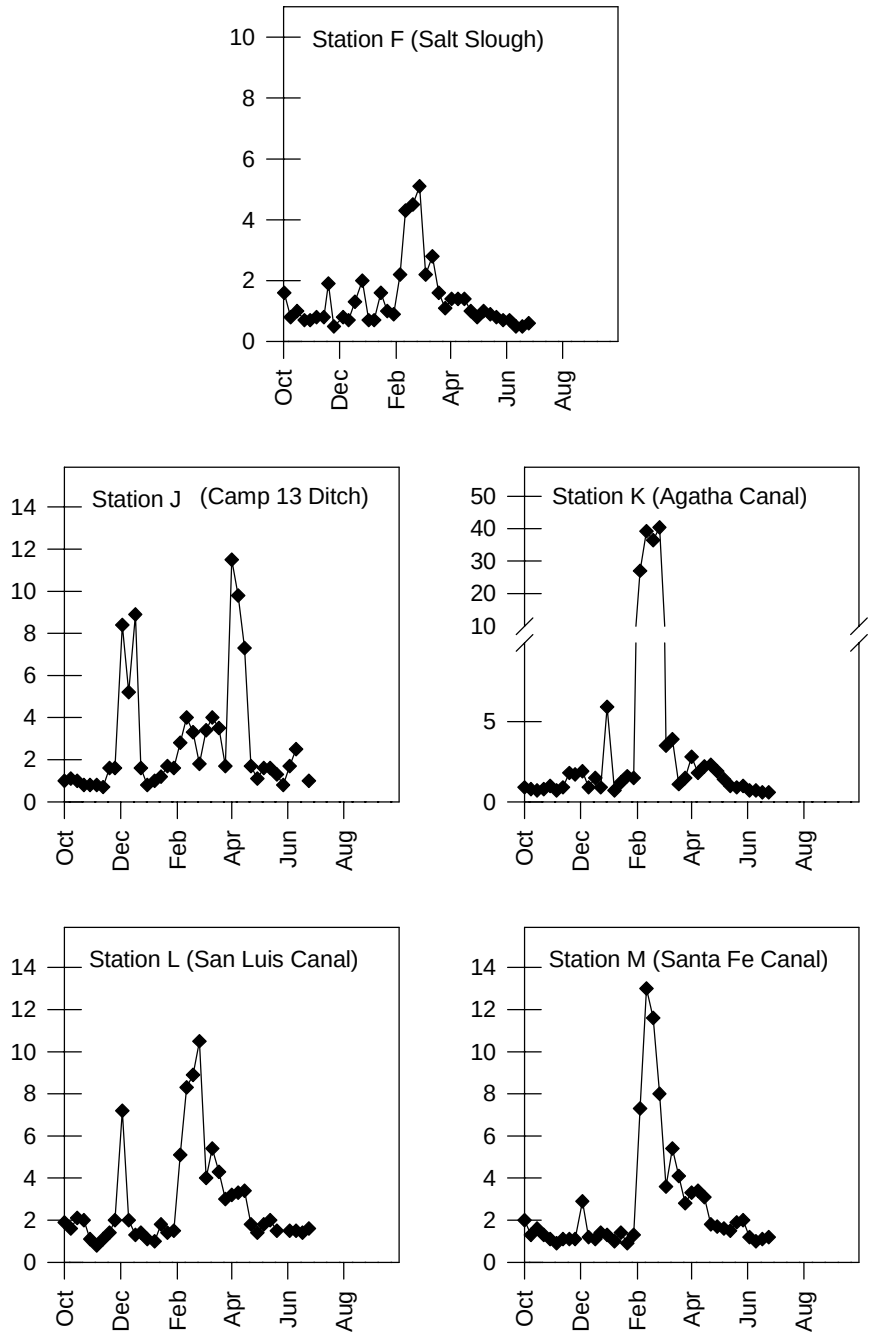


Figure 8. Selenium concentrations (ug/L) at San Joaquin River Stations G (San Joaquin River upstream of Mud Slough confluence), H (San Joaquin River downstream of Mud Slough confluence), and N (at Crow's Landing, downstream of Merced River confluence). Data from weekly grab samples.

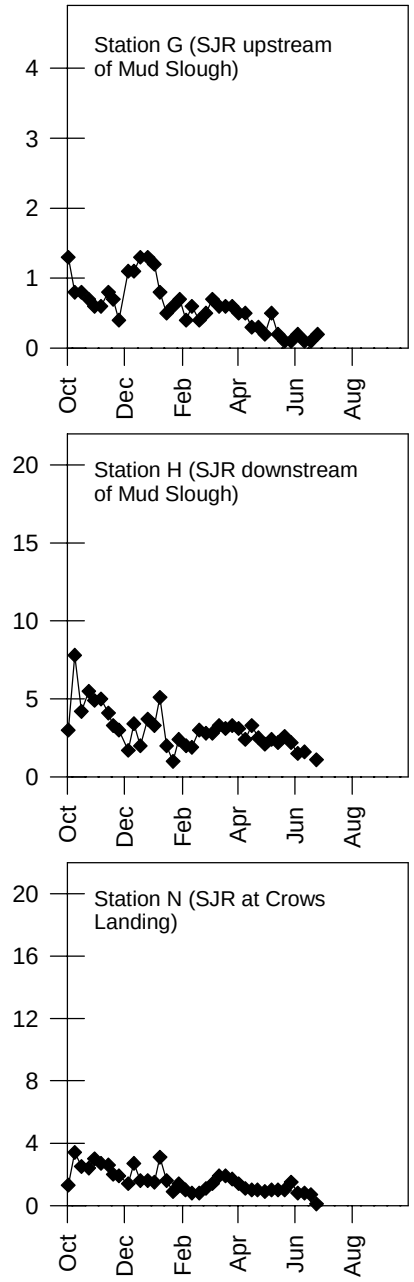


Figure 9. Daily average specific conductance (µS/cm) derived from measurements at 15 min intervals at Stations B (discharge from the SLD), D (Mud Slough downstream of the GBP discharge), F (Salt Slough), and N (San Joaquin River at Crow's Landing).

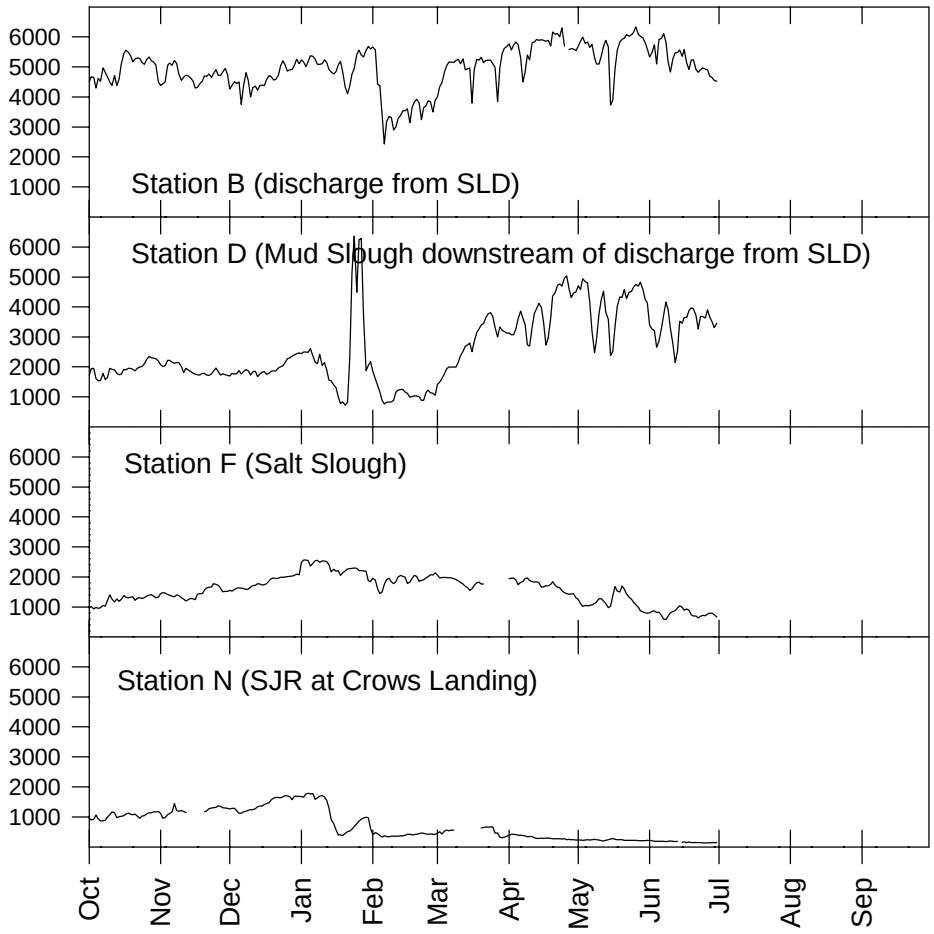


Figure 10. Specific conductance (µS/cm) in weekly grab samples. Letters indicate stations.

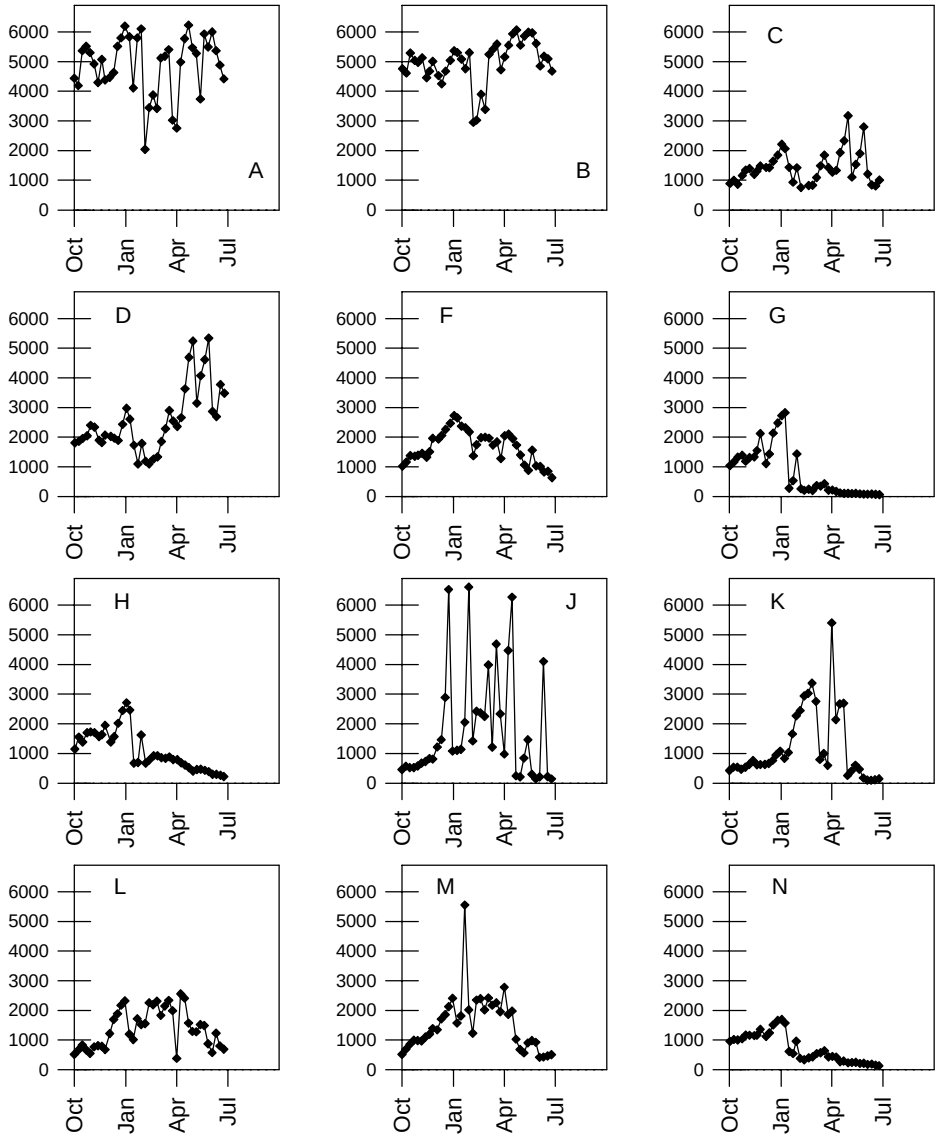


Figure 11. Comparison of toxicity test results from Station B with results from the Delta Mendota Canal reference location. The different tests are described in the text.

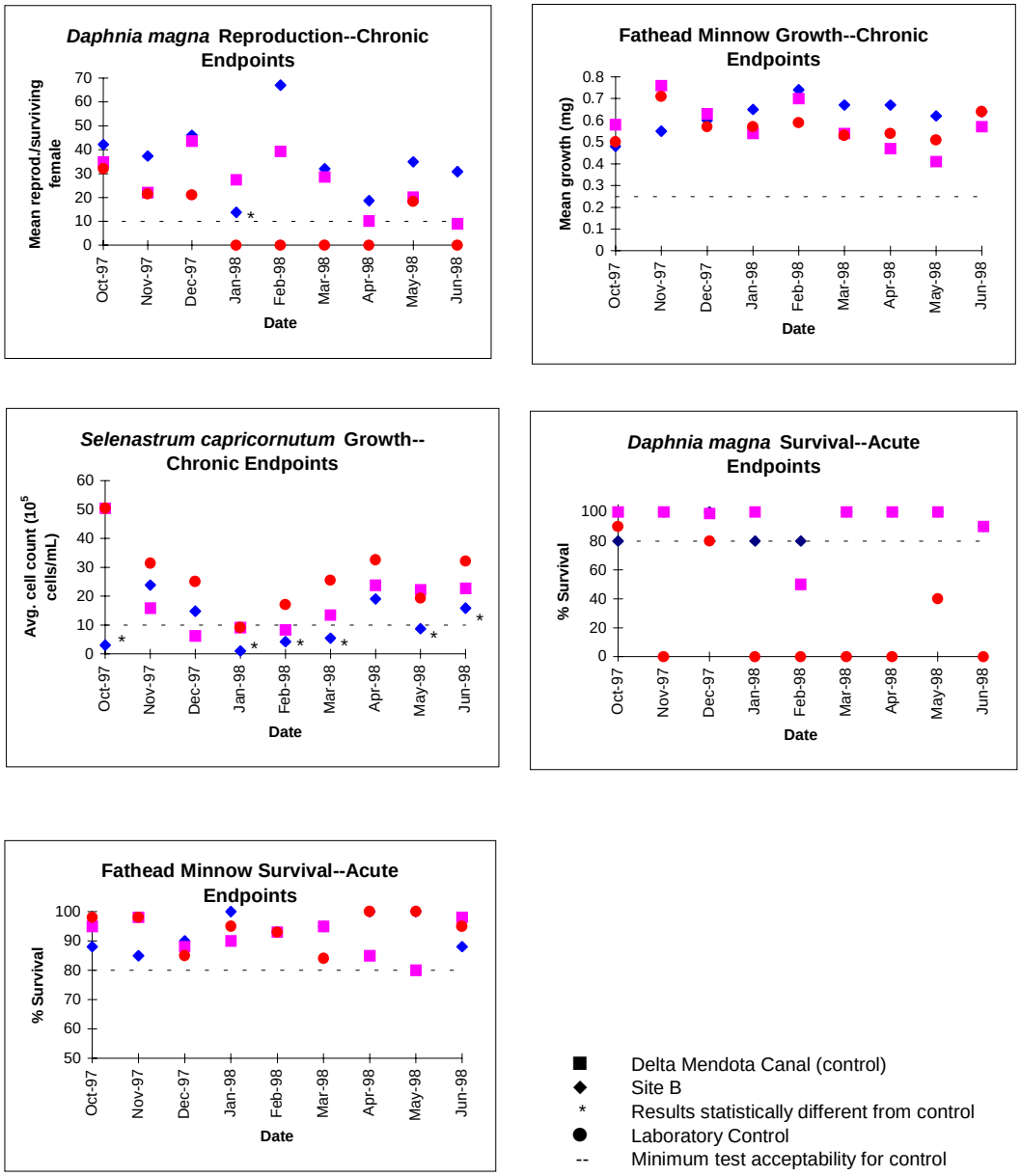


Figure 12. Comparison of toxicity test results from Station C with results from the Delta Mendota Canal reference location. The different tests are described in the text.

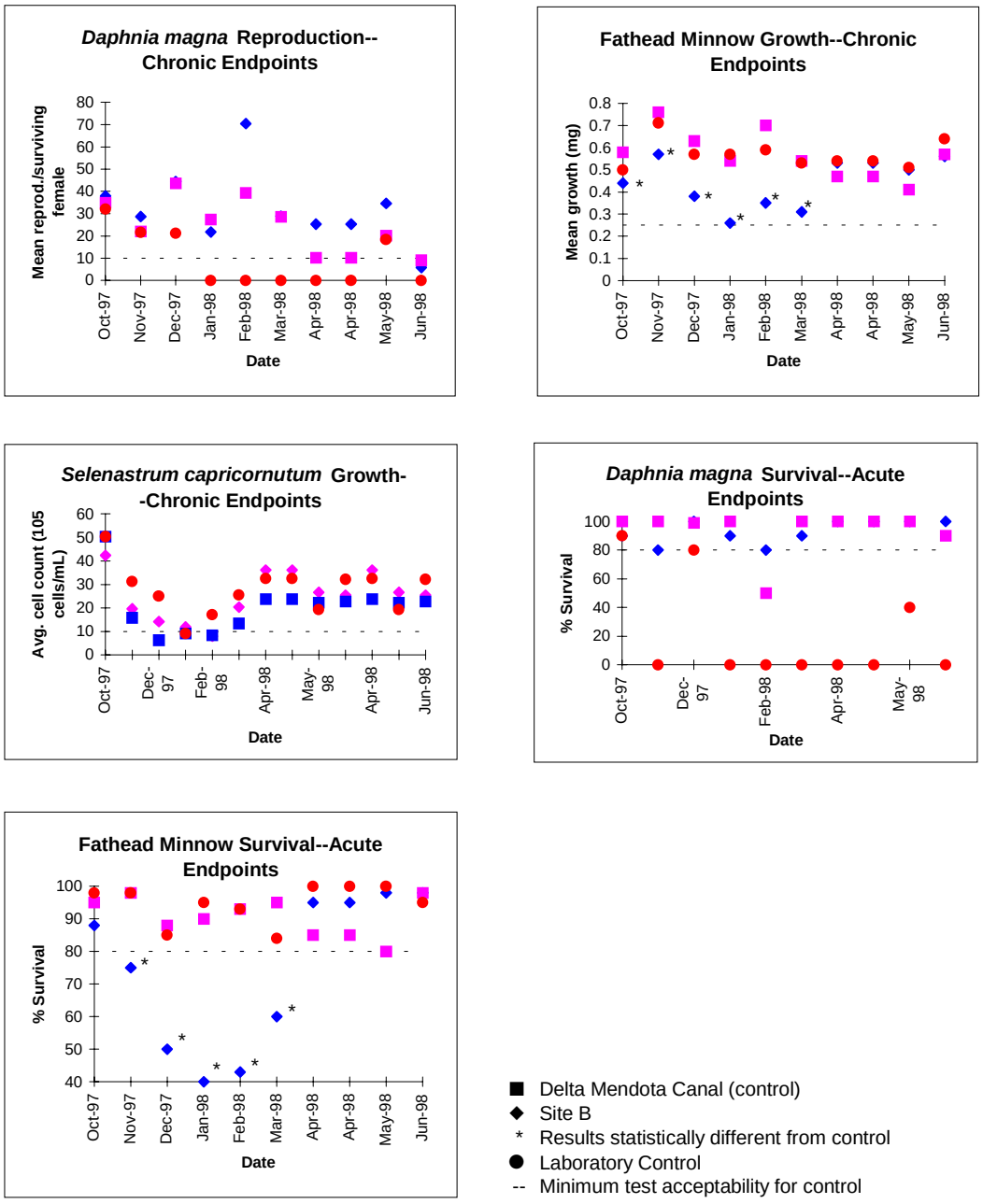


Figure 13. Comparison of toxicity test results from Station D with results from the Delta Mendota Canal reference location. The different tests are described in the text.

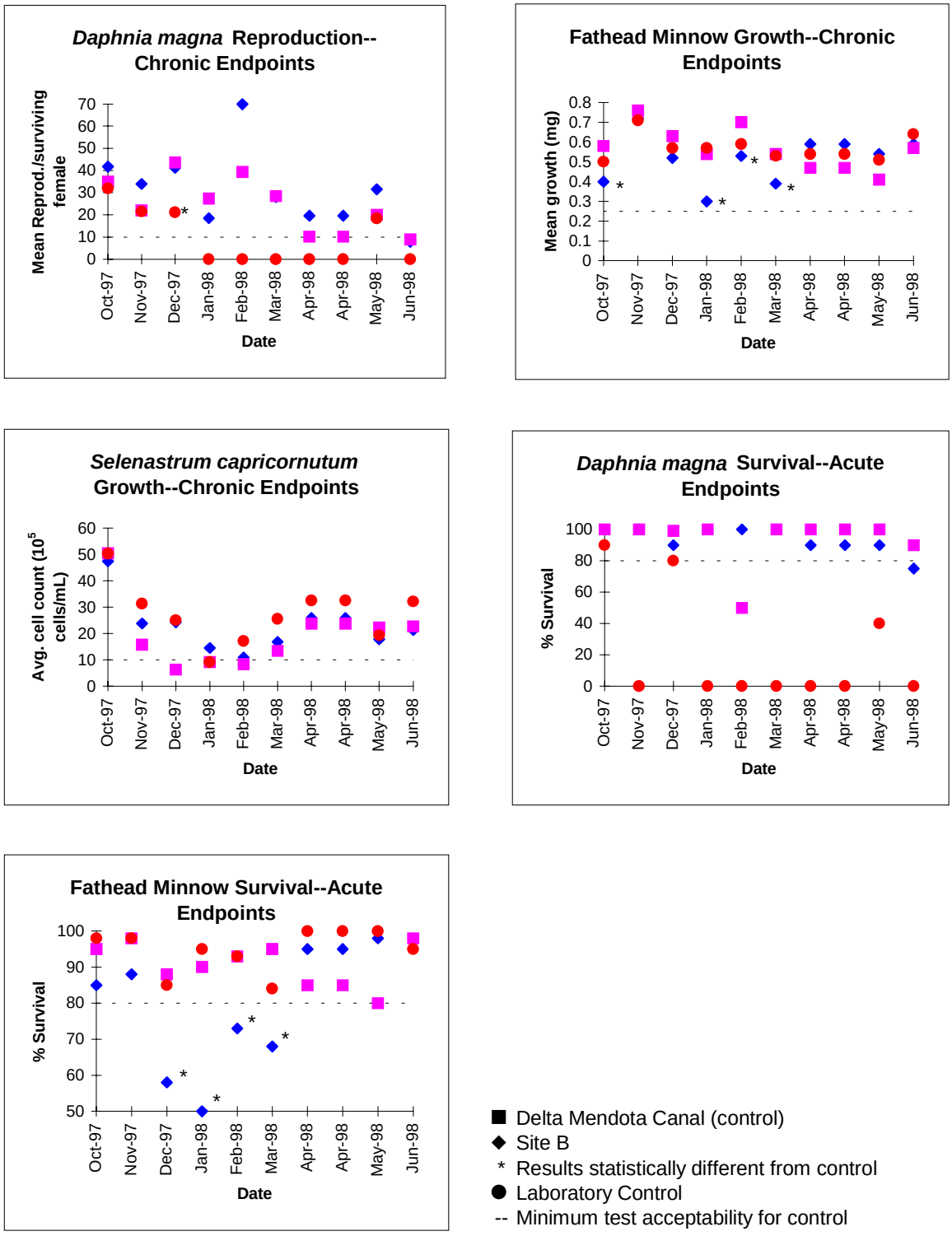


Figure 14. Comparison of toxicity test results from Station F with results from the Delta Mendota Canal reference location. The different tests are described in the text.

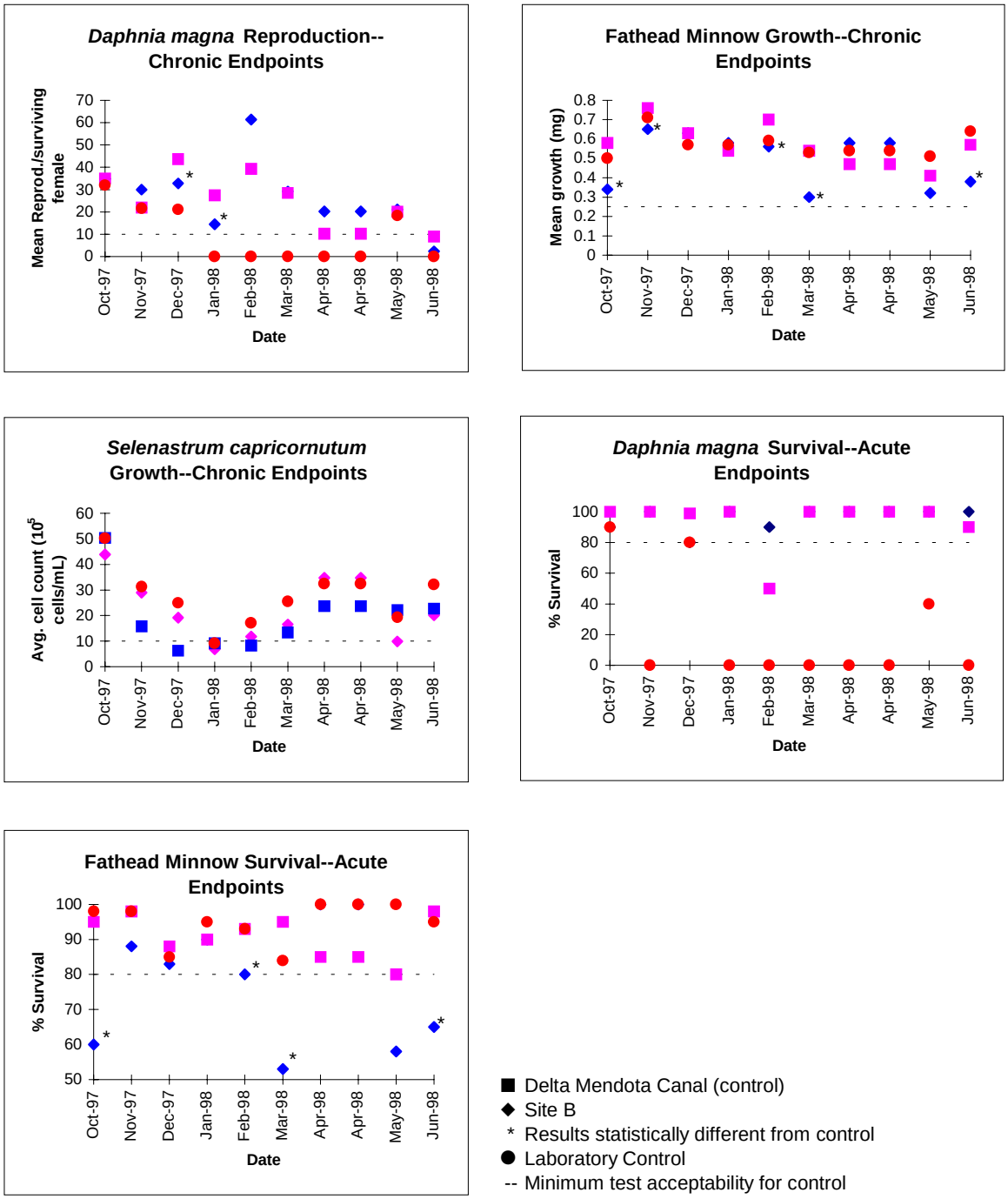
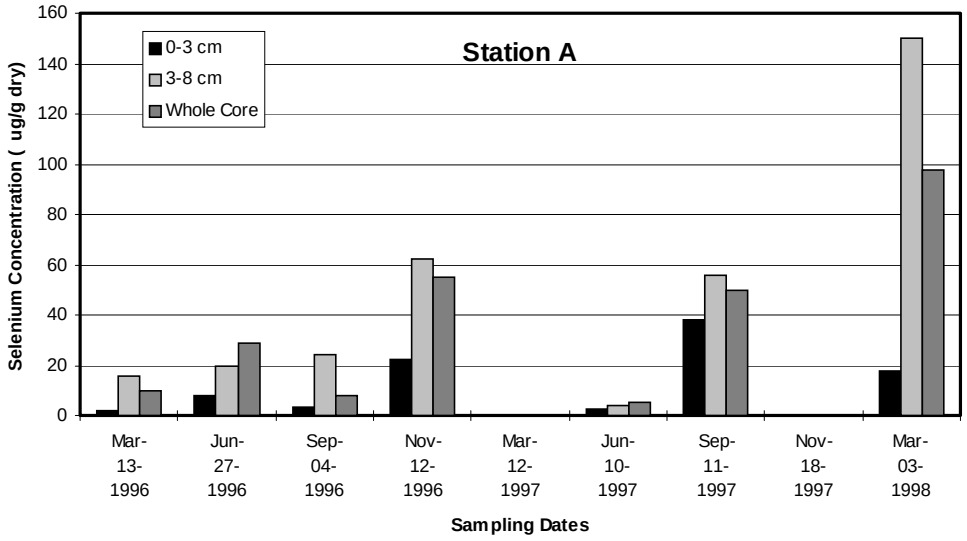


Figure 15. Selenium concentrations in sediment at Stations A (inlet to San Luis Drain) and B (discharge from San Luis Drain). Samples not tested at Station A on March 12, 1997 and November 18, 1997 and at Station B on March 12, 1996. Concentration in whole core sample at Station B on June 10, 1997 was 0.11 ug/g dry weight.



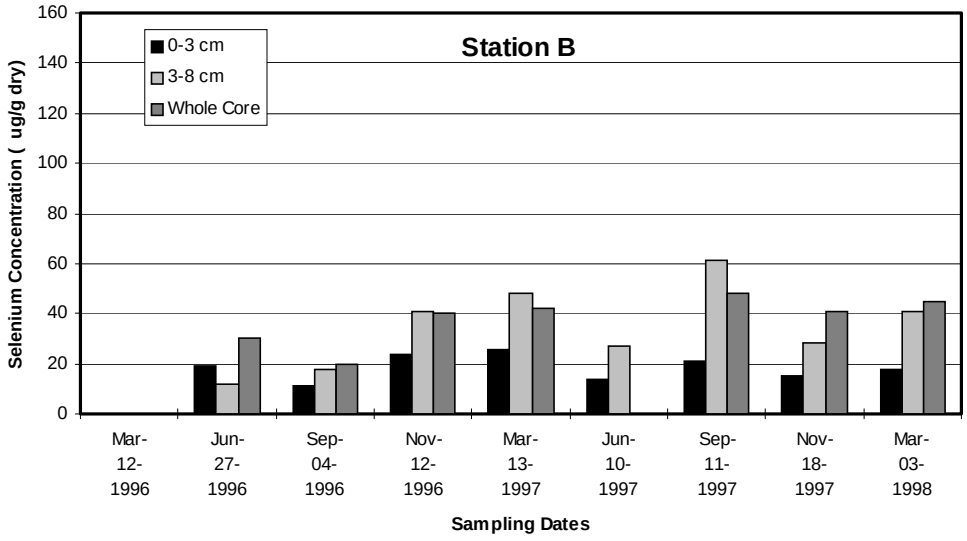
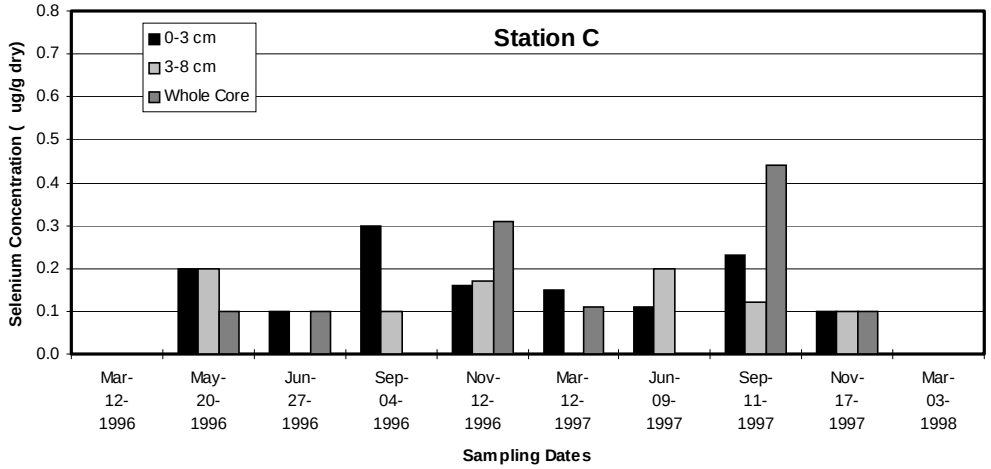


Figure 16. Selenium concentrations in sediment at Stations C (Mud Slough upstream of the GBP discharge) and D (Mud Slough downstream of the GBP discharge). Samples not tested at Stations C and D on March 12, 1996 and March 3, 1998. Other missing bars indicate concentrations were below limits of detection.



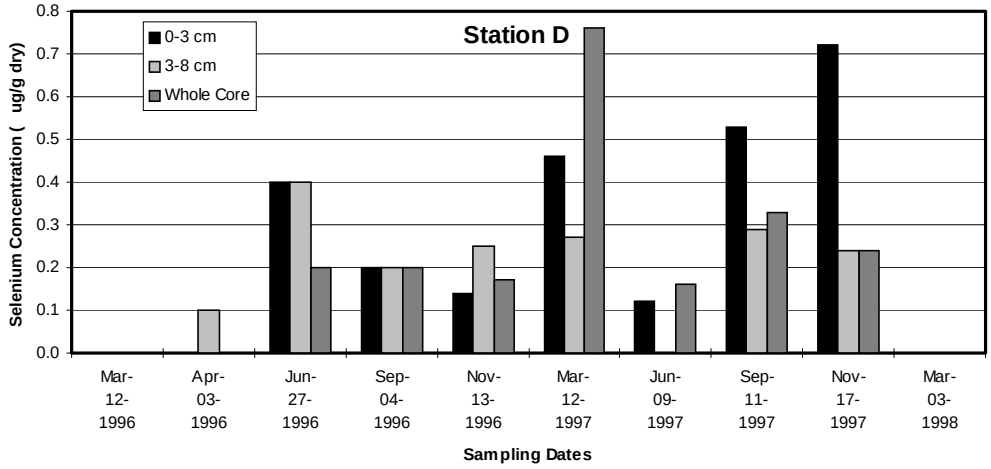


Figure 17. Selenium concentrations in sediment at Stations E (inlet to San Luis Drain) and F (discharge from San Luis Drain). Samples not tested at Station E on March 12, 1996, September 4, 1996, and March 3, 1998 and at Station F on March 12, 1996. Other missing bars indicate concentrations were below limits of detection.