GRASSLAND BYPASS PROJECT

QUARTERLY NARRATIVE AND GRAPHICAL SUMMARY

January - March 2001

August 7, 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 fifth year of the GBP in the quarter including January through March 2001.

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. At Station A, near the inlet to the San Luis Drain, maximum flows of 83 cfs occurred on March 7, with average flows of 45 cfs for the quarter. Station B, the point of discharge of the San Luis Drain into Mud Slough (North), had flows well under 150 cfs, averaging 47 cfs this quarter (Figure 3). Maximum flow at Station B, 82 cfs, occurred March 8.

Maximum and average flows at this station were slightly higher 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 215 cfs, slightly lower than for the same period the previous year (223 cfs). A maximum flow of 452 cfs occurred at Station D on March 11. Typical for this time of year, average flow from the SLD (Station B) was only about 22% of the average total flow in Mud Slough (North) (Station D). Flows at Station F (Salt Slough) averaged 287 cfs for the quarter. The highest flow in Salt Slough (714 cfs) occurred on March 8.

At Station N in the San Joaquin River, flows averaged 1204 cfs this quarter. The maximum flow measured was 2990 cfs on March 8-9. Flows here were much lower than for this quarter in the previous year (2938 cfs average).

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.

Flows at Station B averaged 47 cfs for the quarter, with a minimum of 20 cfs on January 2-3, and a maximum of 82 cfs on March 8 (Figure 5b). Selenium concentrations at Station B had a minimum of 44 µg/L on January 7 and a maximum of 96.8 µg/L on March 19 (Figure 5c).

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 17.9 lbs/day for the quarter. The maximum daily selenium load discharge (35.6 lbs/day) occurred on March 7. The cumulative selenium load discharge for the first quarter was 1608 lbs, similar to the same period last water year (1587 lbs).

Selenium concentrations at Station N (San Joaquin River at Crow's Landing) averaged 3.4 µg/L for the quarter (Figure 6b), much higher than this period the previous year (1.8 µg/L). The highest concentration for the quarter, 6.1 µg/L, was measured on March 21. The minimum concentration for the quarter, 1.5 µg/L, occurred on January 12-13. Calculated monthly loads at Station B (255 and 574 lbs in January and February, respectively) accounted for much of the loads for those months at Station N (316 and 667 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 this water year beginning October 2000 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 January through March 2001, 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 75 µg/L in this quarter, compared to 69 µg/L for Station B.

Selenium concentrations in Mud Slough (North) upstream of the GBP discharge (Station C) averaged 0.7 µg/L for the quarter, with a maximum concentration for the quarter of 1.3 µg/L on March 1 and 15 (Figure 7). For any collected samples with selenium concentrations below the detection limit of 0.4 µg/L, concentrations for those samples were assumed at half the detection limit in calculating the average. Concentrations were much higher in Mud Slough (North) downstream of the GBP discharge (Station D), averaging 18.7 µg/L, with a maximum of 40 µg/L on March 29.

Selenium concentrations in Salt Slough (Station F) and the wetland water supply channels (Stations J, K, L2, M2) frequently have reached or exceeded 2 µg/L in the past. One objective of the GBP is to maintain monthly mean selenium concentrations below 2 µg/L at these locations. In this quarter, weekly measurements equaled or exceeded 2 µg/L once at Station F, six times at Station J, seven times at station K, eleven times at Station L2, and seven times at Station M2 (Figure 8). The monthly mean concentration exceeded 2 µg/L at Station J in March, at Station K in February and March, at Station L2 in all months, and at Station M2 in February (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 0.8 µg/L, ranging from below detection (<0.4 µg/L) to 1.6 µg/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 been maintained to provide data for biological monitoring, but calculating selenium mass balances is not recommended given the intermittent inflows upstream of Station H. Weekly samples collected at Station N this quarter averaged 3.4 µg/L of selenium, ranging from 1.7 to 4.9 µg/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, H, J, K, L2, M2, and N (Figures 10 and 11).

IV. 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. Biological monitoring data will be presented and discussed in the GBP Annual Report for the water year (October 2000-September 2001).

V. 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 (Figures 12-15).

Fathead minnow growth was significantly reduced compared to controls in tests with water from Stations B and C in February. Fathead survival was significantly lower for Station F in February. *Daphnia* survival was reduced for Station C in January, and reproduction was not significantly affected in all months. *Selenastrum* growth was also not significantly reduced in water from any stations.

VI. 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 16-19 for Stations A, B, C, D, E, F, and I.

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 µg/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 weir (M2) for water year 2001. Samples below detection limit of 0.4 µg/L are assigned value of 0.2 µg/L in calculating averages.

	F	J	K	L2	M2
October 2000	0.7	1.0	1.0	2.0	1.1
November 2000	0.5	1.2	0.9	3.1	0.9
December 2000	0.9	1.5	1.1	2.8	1.1
January 2001	0.8	1.4	1.1	2.3	1.6
February 2001	1.0	1.9	2.6	3.1	2.1
March 2001	1.5	4.1	5.2	3.4	2.0

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

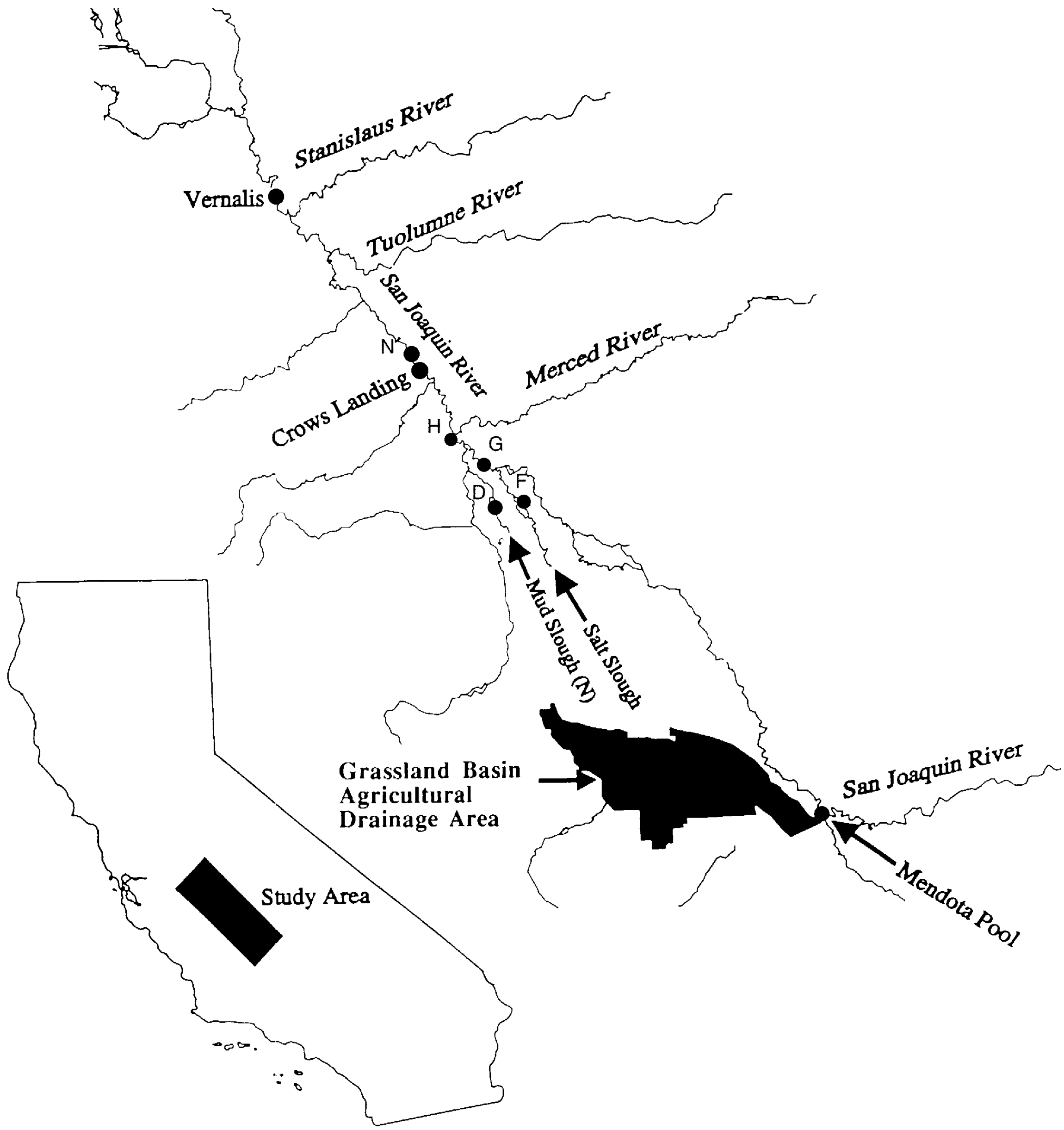


Figure 2. Schematic diagram showing locations of GBP monitoring stations relative to major hydrologic features of the study area.

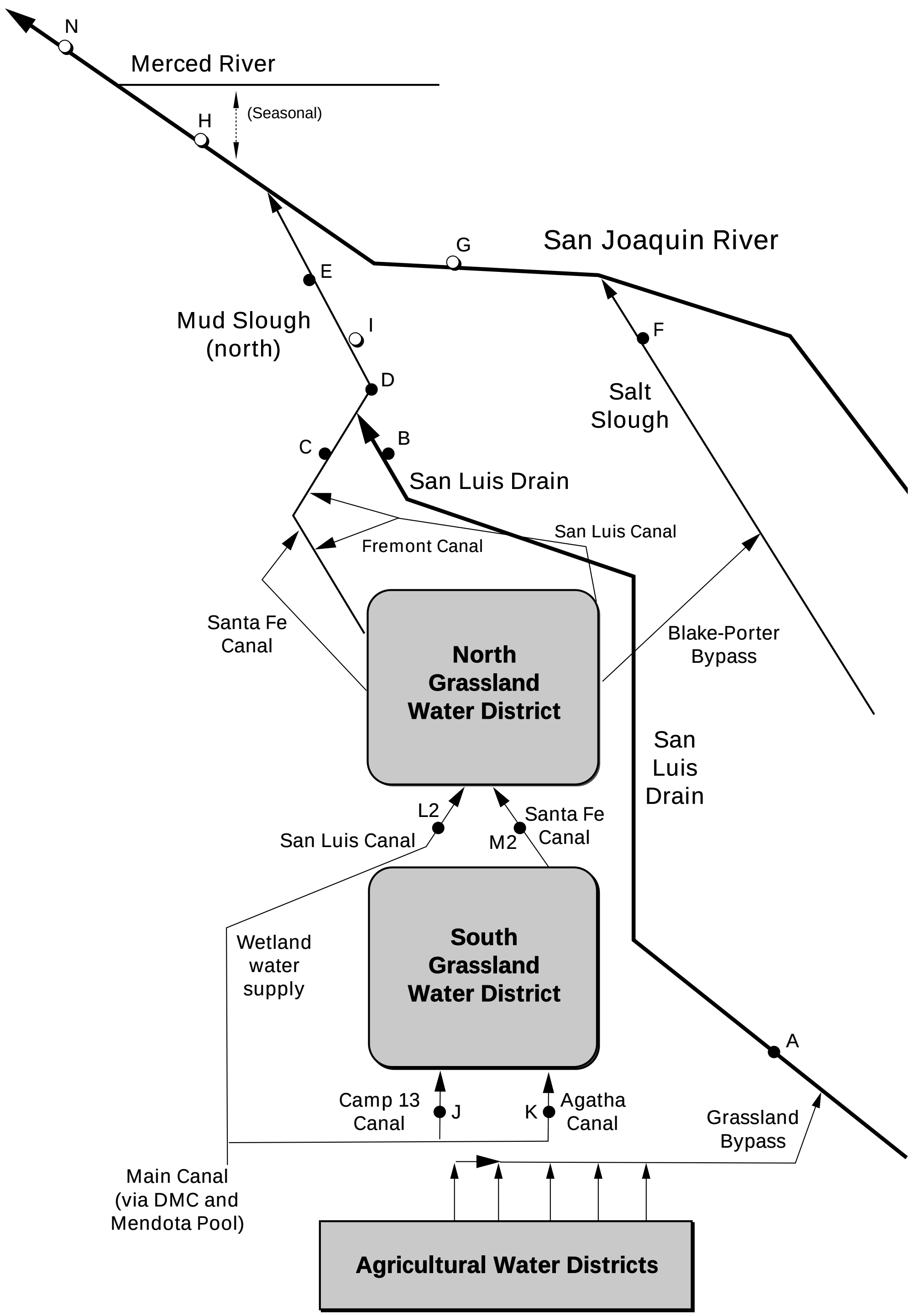


Figure 3. Daily mean flows (cfs) at GBPCMP stations. Flow at Station A is recorded as a daily mean. Flows at Stations B, D, F, and N are recorded at 15 min intervals. Note different scales of vertical axis.

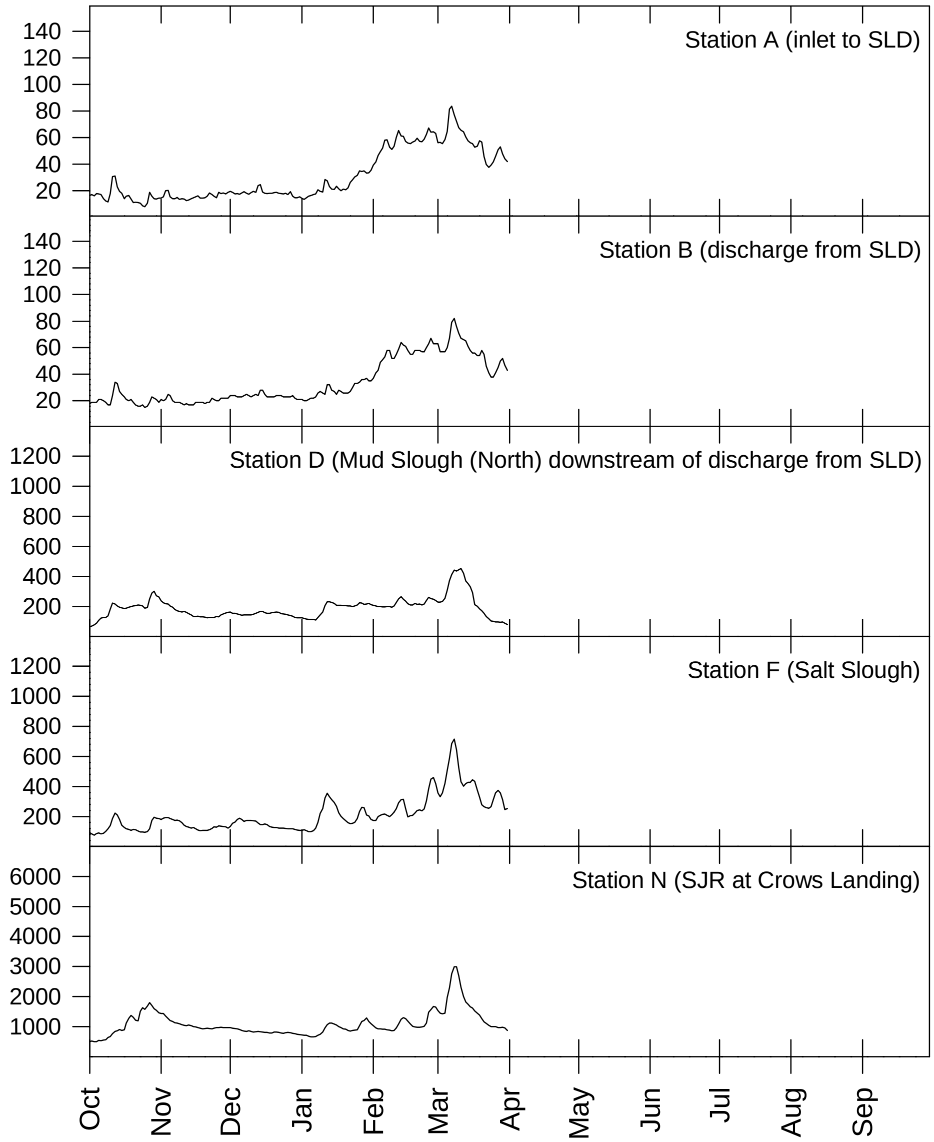
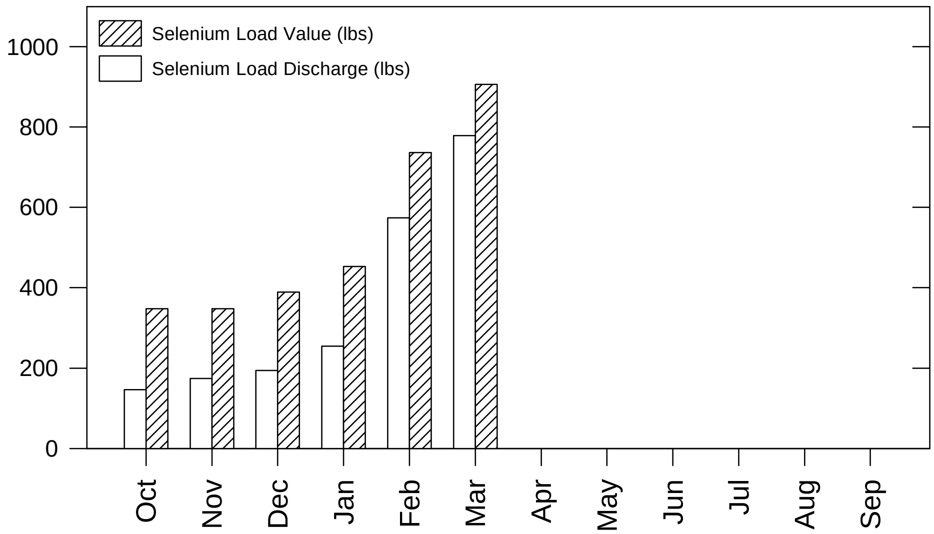


Figure 4. Comparison of monthly selenium load discharge from the terminus of the San Luis Drain (Station B) with the monthly load values in the Interim Use Permit for the 5th year of the GBP (USBR 1995).



Water Year 2001	Load value (lbs)	Selenium load discharge (lbs)	Amount over load value (lbs)
Oct 2000	348	146	NA
Nov 2000	348	174	NA
Dec 2000	389	194	NA
Jan 2001	453	255	NA
Feb 2001	736	574	NA
Mar 2001	906	779	NA

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

Figure 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.

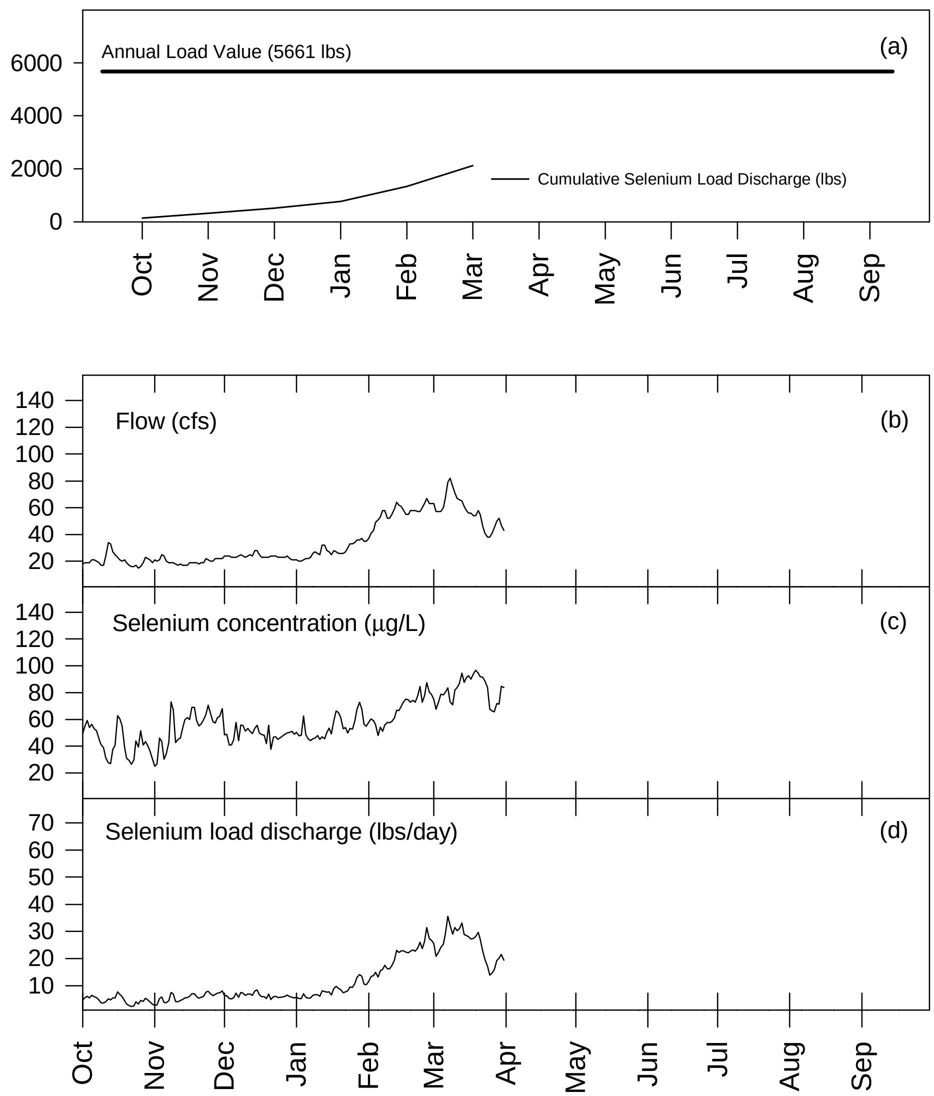


Figure 6. Daily average flows and selenium concentrations at Station N (San Joaquin River at Crow's Landing).

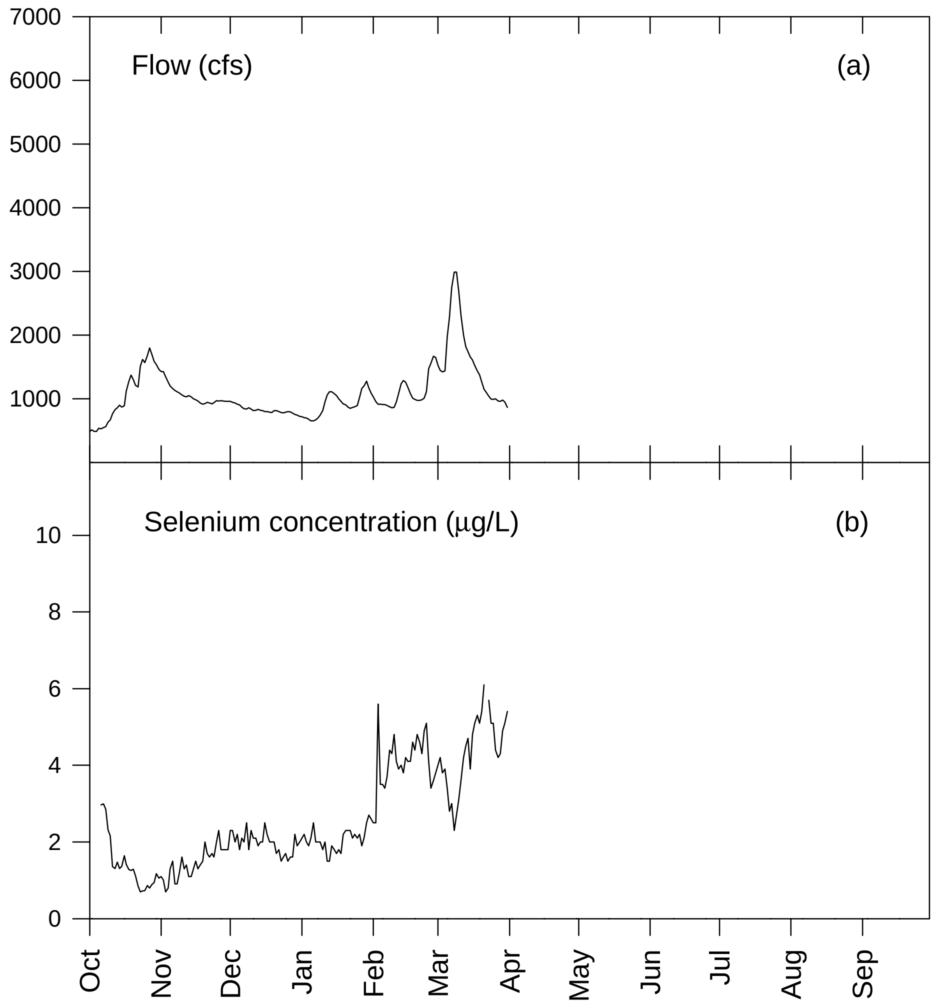


Figure 7. Selenium concentrations (µg/L) at Station A (near the inlet to the San Luis Drain), Station B (discharge from the San Luis Drain), Station C (Mud Slough (North) upstream of the GBP discharge), and Station D (Mud Slough (North) downstream of the GBP discharge). Data from weekly samples.

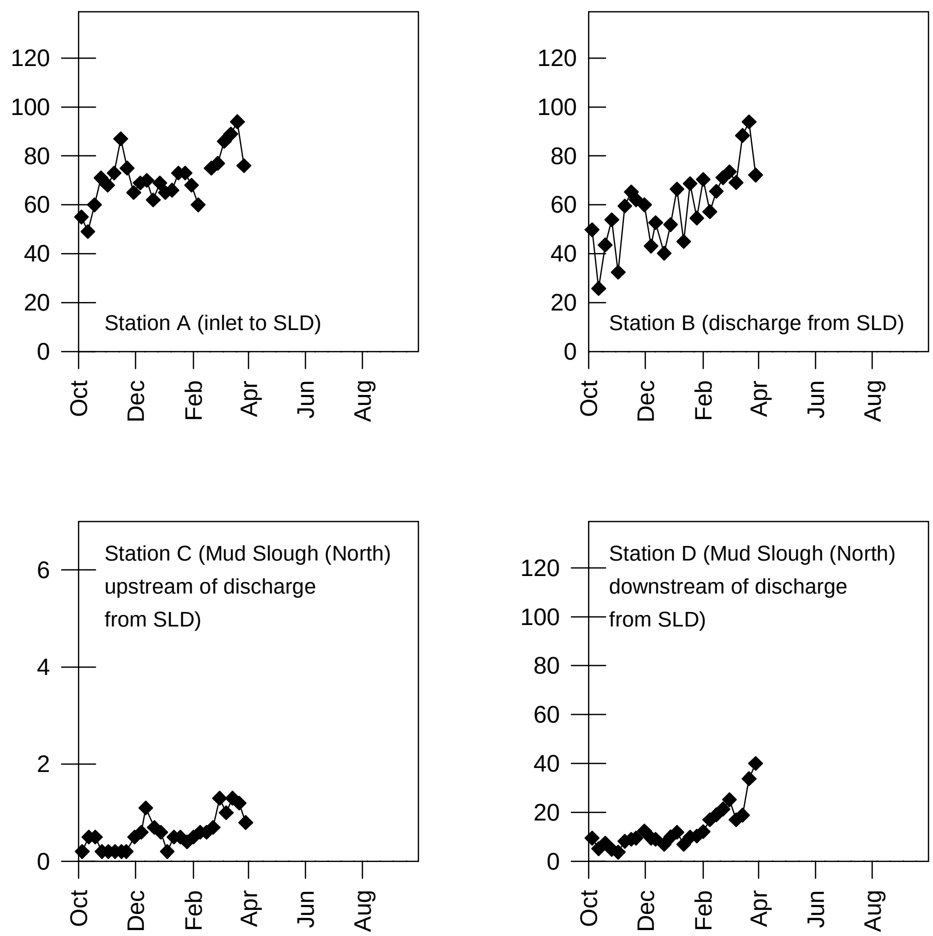


Figure 8. Selenium concentrations (µg/L) at Station F (Salt Slough) and in the wetland water supply channels at Station J, Station K, Station L2, and Station M2. Data from weekly samples.

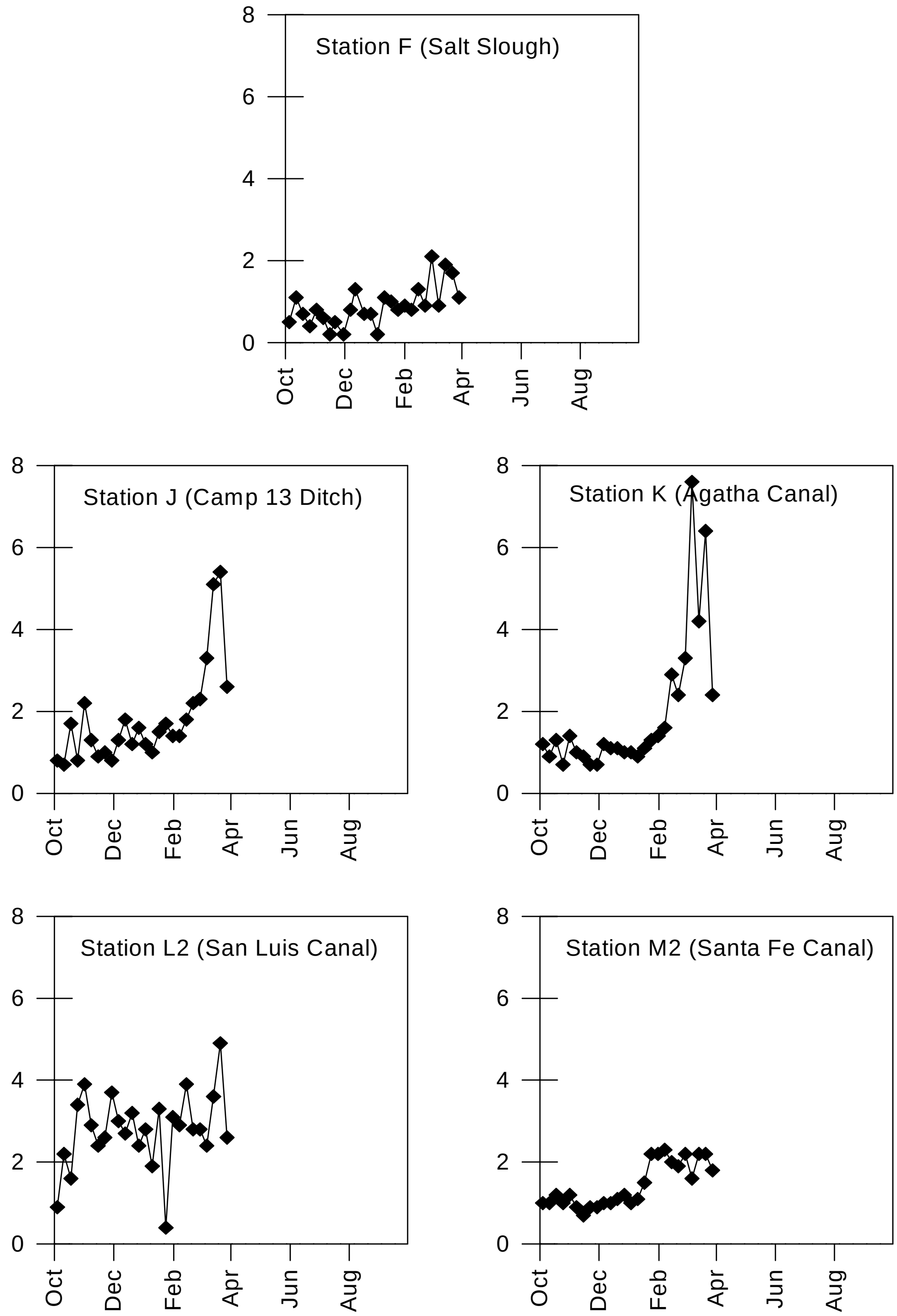


Figure 9. Selenium concentrations (µg/L) at San Joaquin River Stations G (San Joaquin River upstream of Mud Slough (North) confluence), H (San Joaquin River downstream of Mud Slough (North) confluence), and N (at Crow's Landing, downstream of Merced River confluence). Data from weekly samples. Station H data intended for use with biological monitoring data.

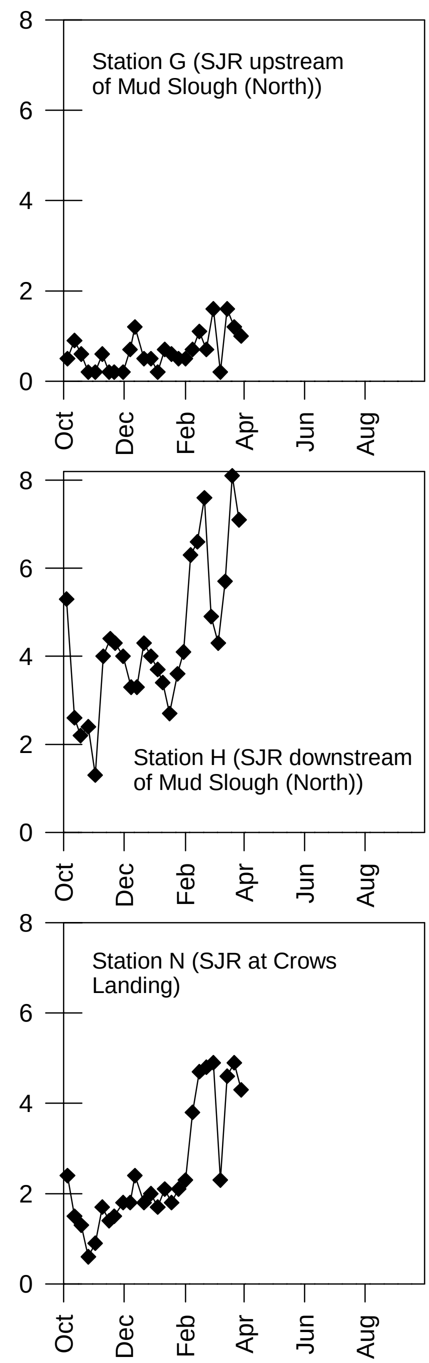


Figure 10. Daily average specific conductance (μS/cm) derived from measurements at 15 min intervals at Stations B (discharge from the SLD), D (Mud Slough (North) downstream of the GBP discharge), F (Salt Slough), and N (San Joaquin River at Crow's Landing).

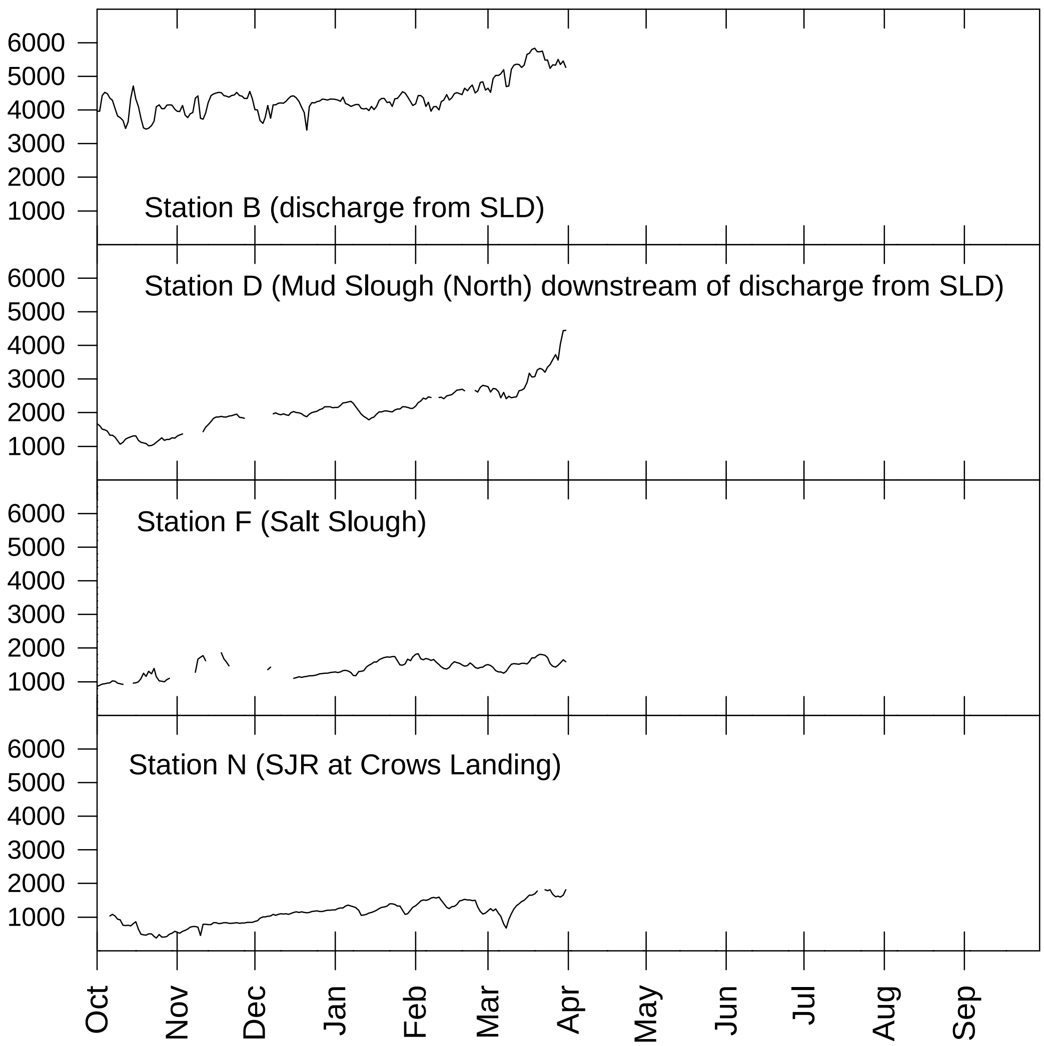


Figure 11. Specific conductance (µS/cm) in weekly grab samples. Letters indicate stations. Station H data intended for use with biological monitoring data.

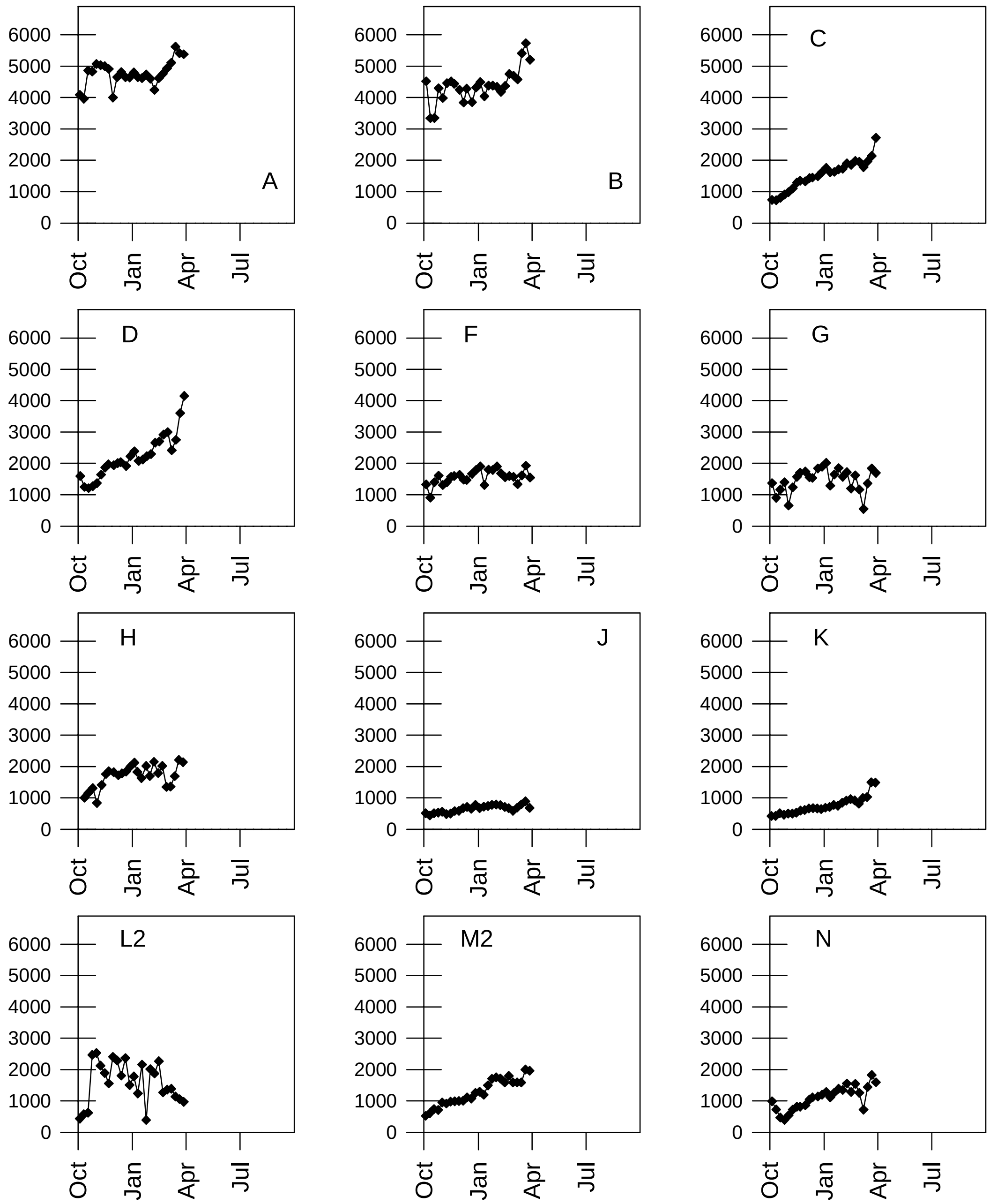


Figure 12. Comparison of toxicity test results from Station B with results from the Delta Mendota Canal reference location. The different tests are described in the text.

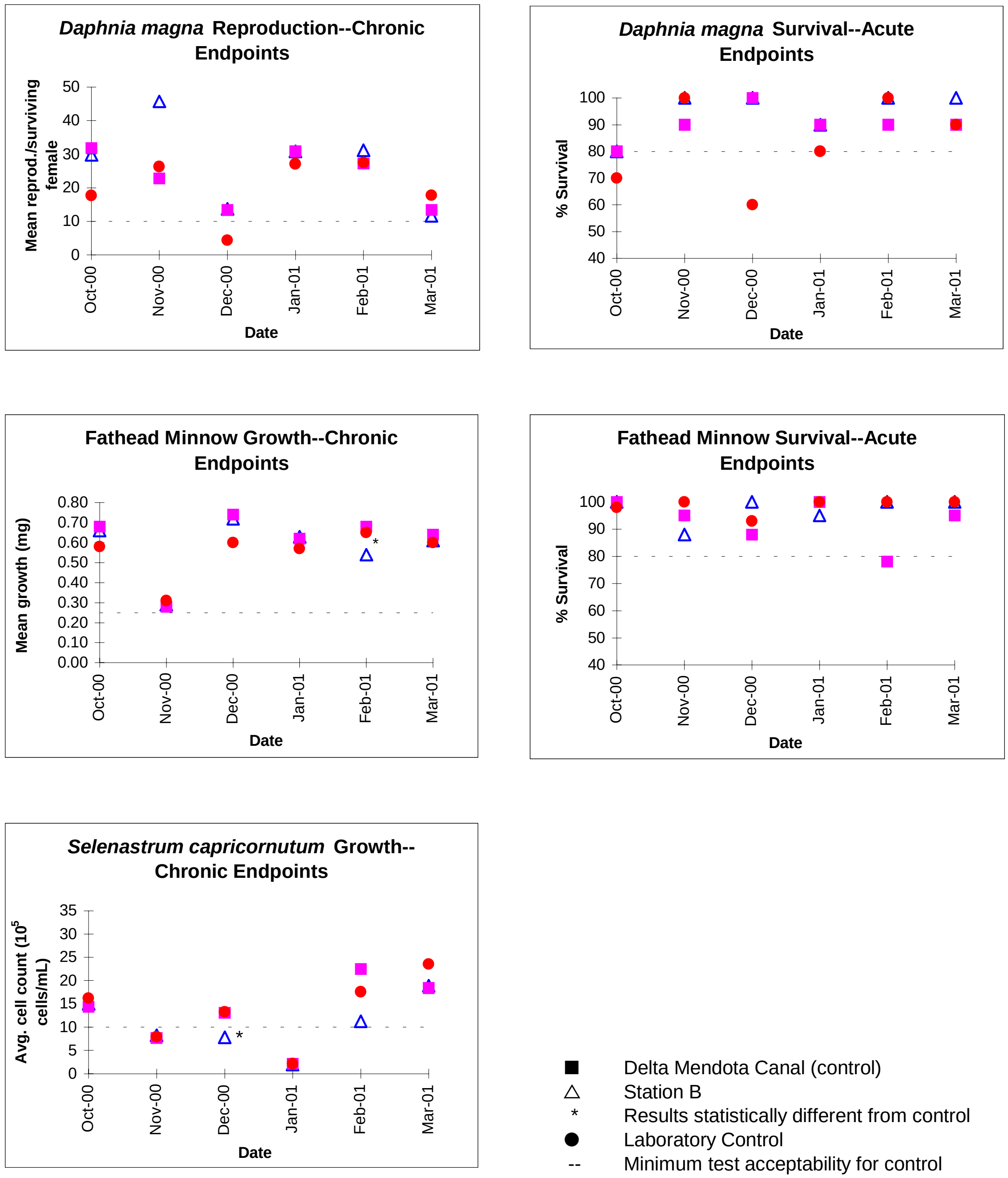
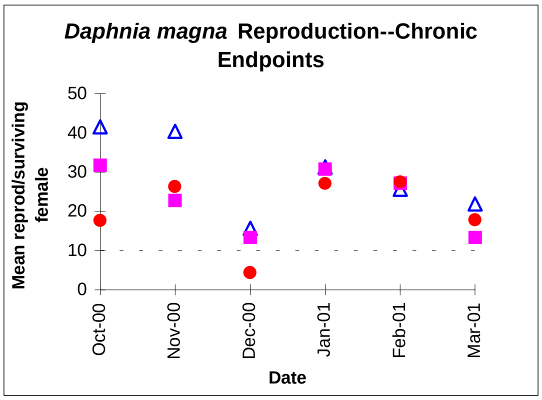
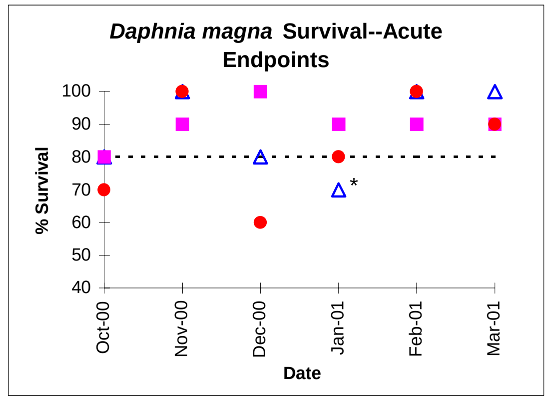
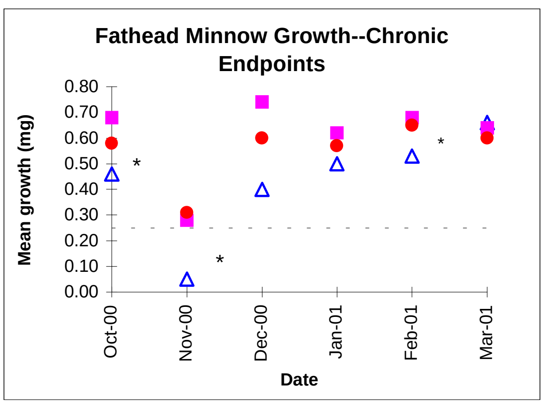
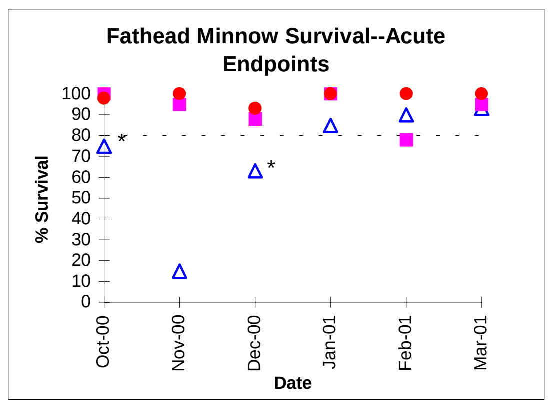


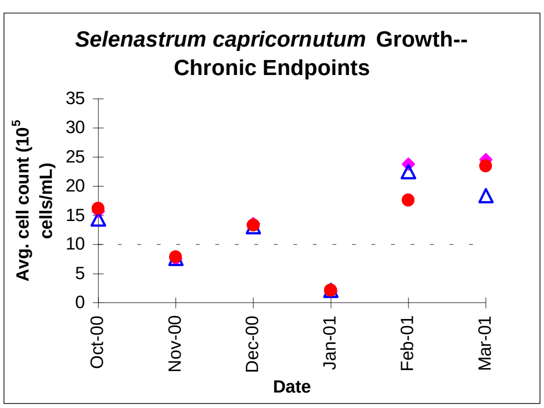
Figure 13. Comparison of toxicity test results from Station C with results from the Delta Mendota Canal reference location. The different tests are described in the text.











■ Delta Mendota Canal (control)
△ Station C
* Results statistically different from control
● Laboratory Control
-- Minimum test acceptability for control

Figure 14. 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.

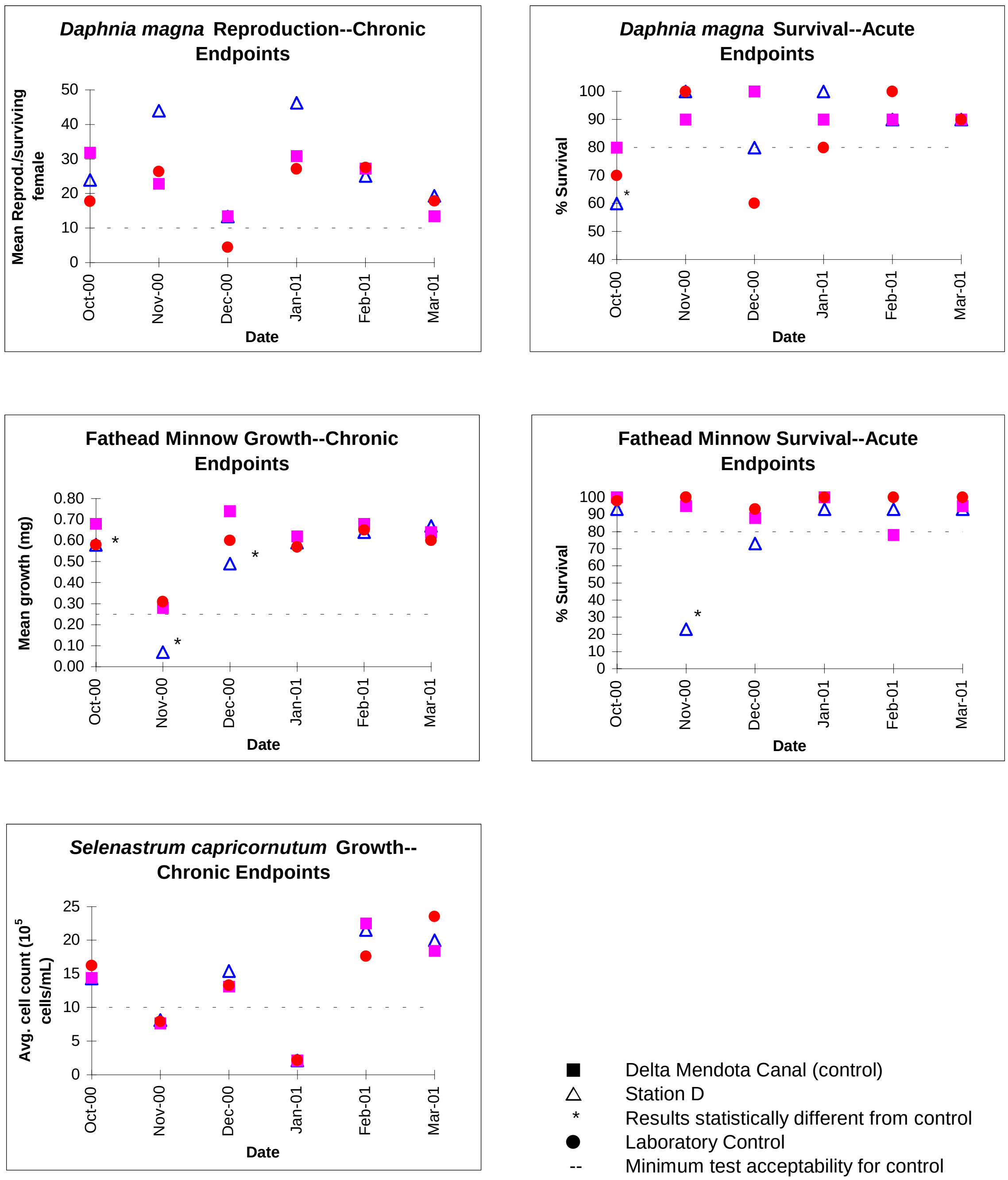
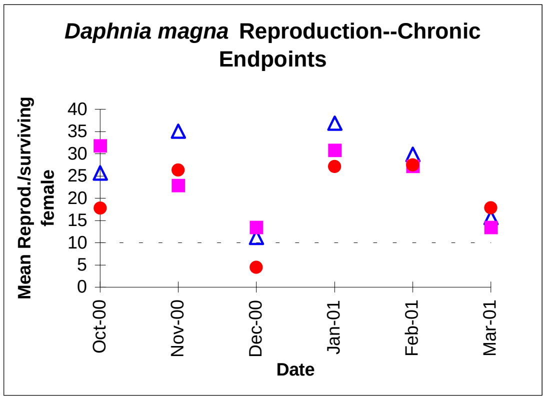
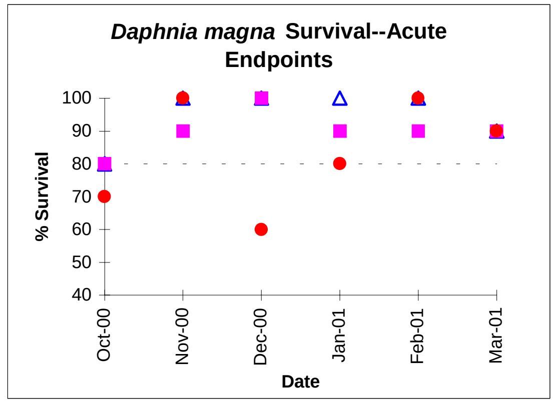
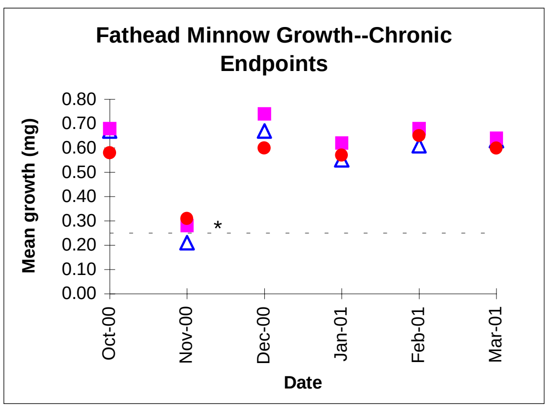
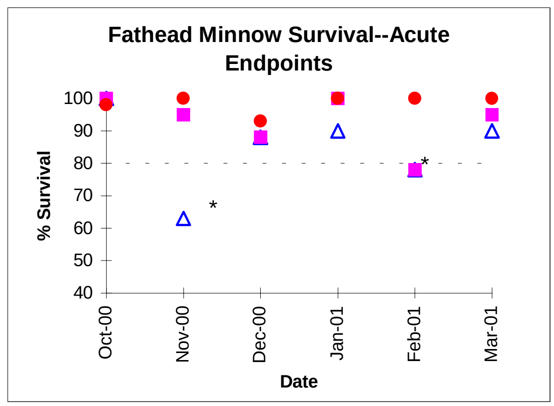


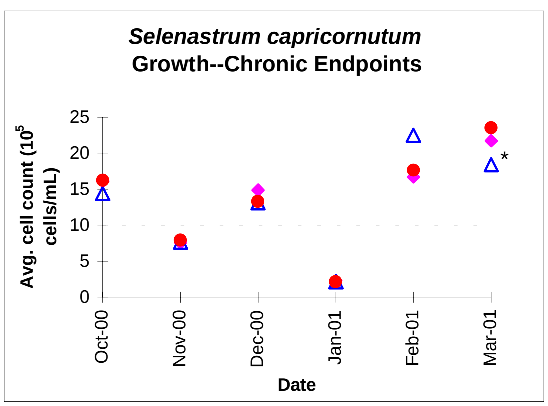
Figure 15. Comparison of toxicity test results from Station F with results from the Delta Mendota Canal reference location. The different tests are described in the text.





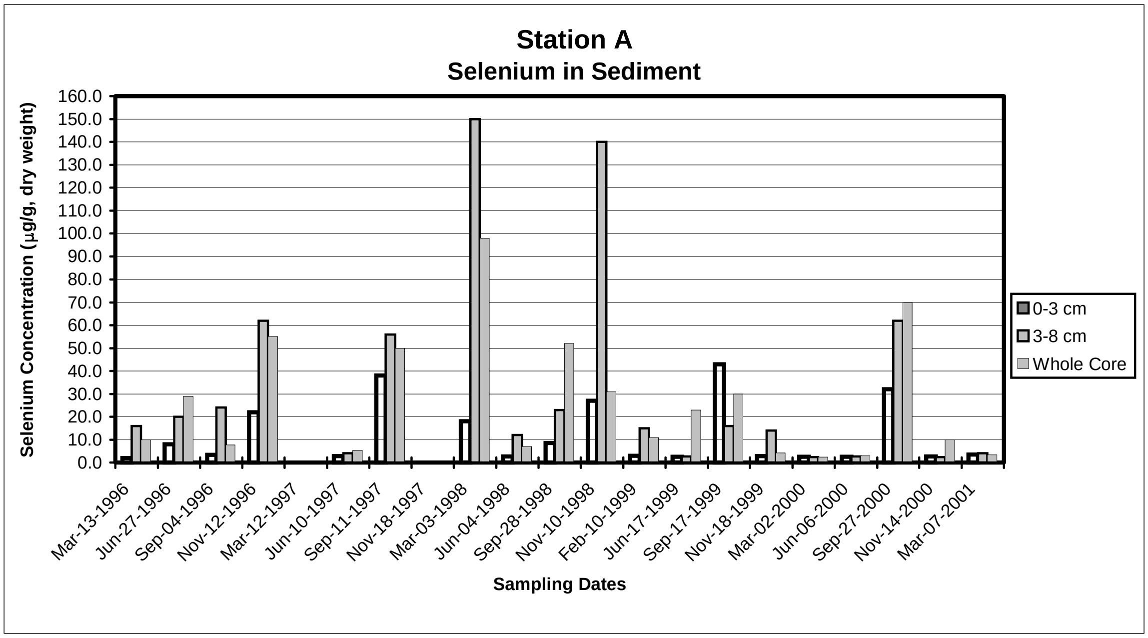






■ Delta Mendota Canal (control)
△ Station F
* Results statistically different from control
● Laboratory Control
-- Minimum test acceptability for control

Figure 16. 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.



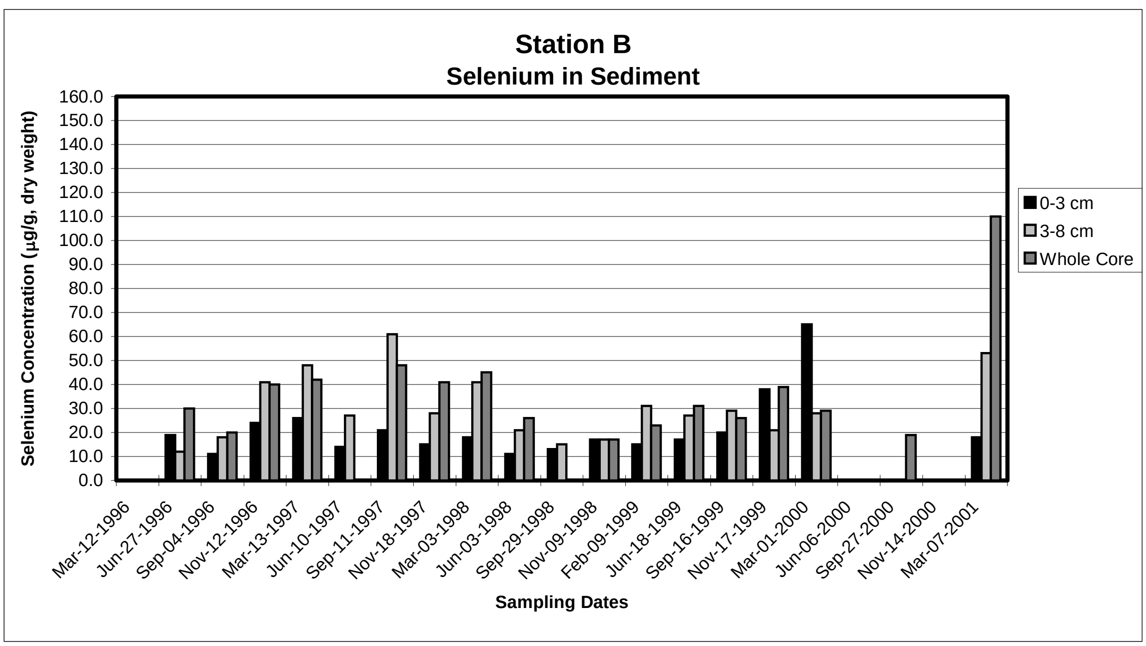
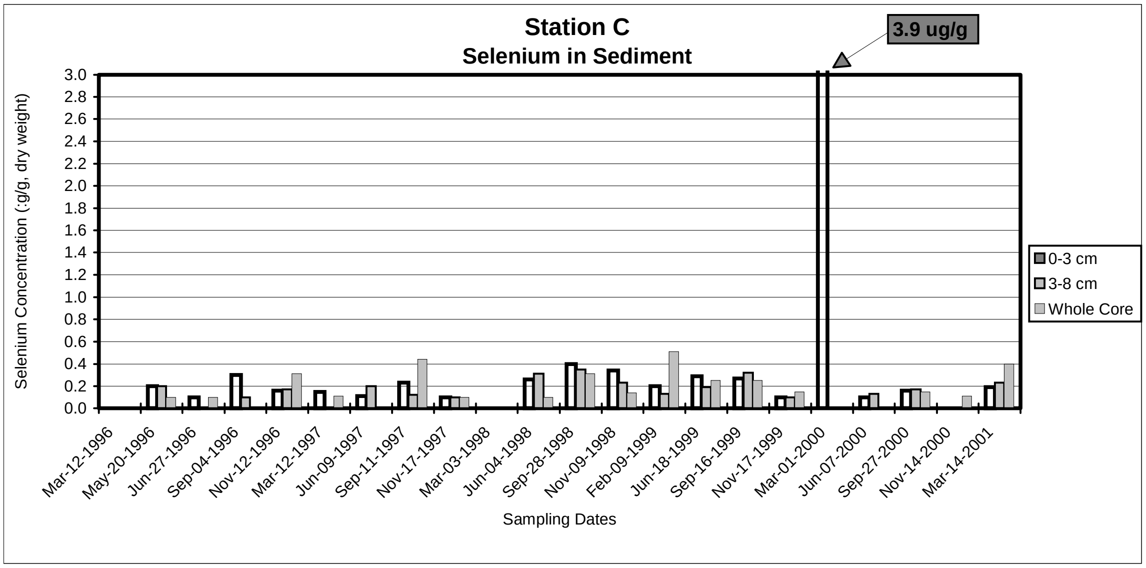


Figure 17. Selenium concentrations in sediment at sites C (Mud Slough upstream of the GBP discharge) and D (Mud Slough downstream of the GBP discharge). Samples not tested at sites C and D on March 12, 1996 and March 3, 1998. Other missing bars indicate concentrations were below limits of detection.



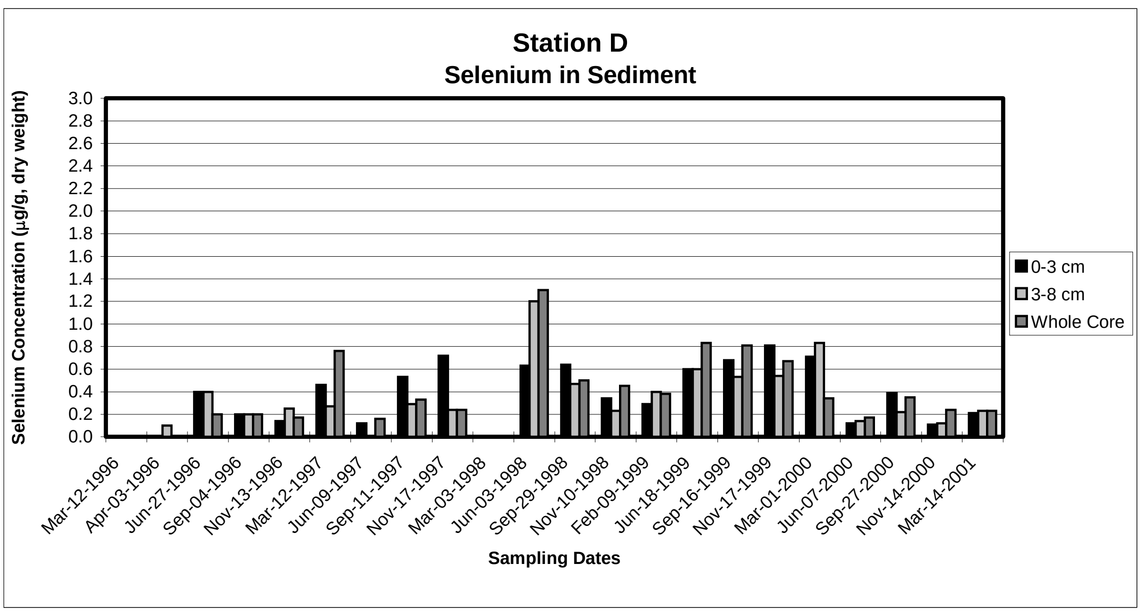
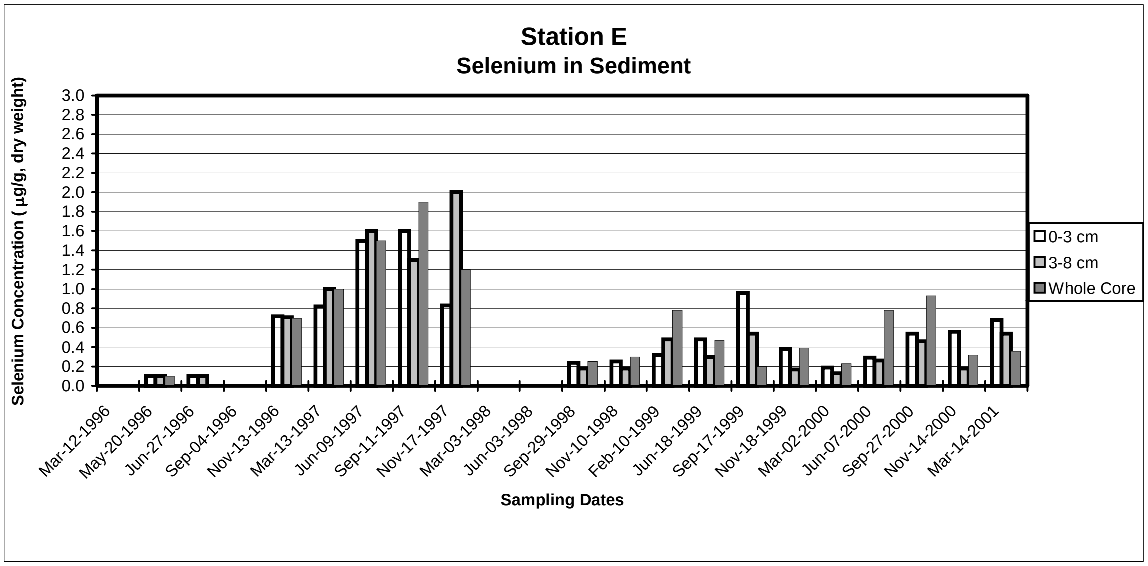


Figure 18. Selenium concentrations in sediment at sites E (Mud Slough at Highway 140) and F (Salt Slough). Samples not tested at Site E on March 12, 1996, September 4, 1996, March 3, 1998, and June 3, 1998 and at Site F on March 12, 1996. Other missing bars indicate concentrations were below limits of detection.



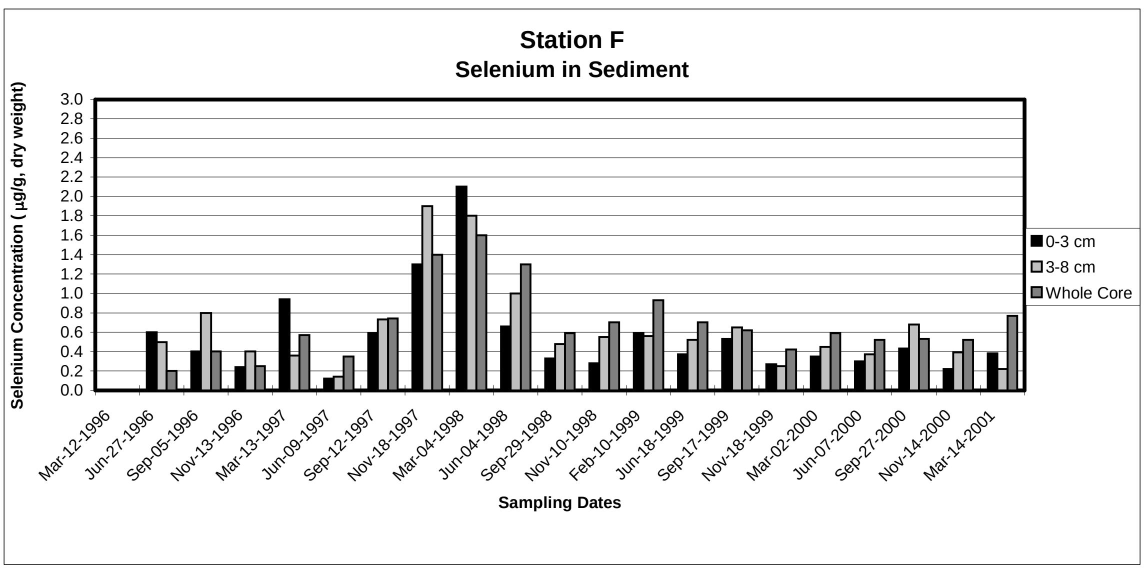


Figure 19. Selenium concentrations in sediment at site I (Mud Slough back water annual site)