CHAPTER 3
PHYSICAL/CHEMICAL PARAMETERS

This chapter provides information on the parameters of temperature, salinity, and dissolved oxygen as measured during the 1999 surveys. Although parameters were measured with the BSS, emphasis will be placed on data from the LRS/FSS because these surveys encompassed the entire fish sampling period. In addition, freshwater flow data obtained from the U.S. Geological Survey for the Green Island Dam near Troy, New York, and daily water temperature data from the Poughkeepsie Waterworks are discussed. Physical and chemical parameters are presented in Appendix B.

3.1 GREEN ISLAND DAM FLOWS

During 1999, daily freshwater flow for Green Island, New York was estimated from discharge data provided by the U.S. Geological Survey for the Hudson River above Lock 1, the Mohawk River at Cohoes, and the Mohawk River diversion at Crescent Dam. The daily flow in 1999 ranged from 66 to 1,650 m^3/sec/day (Figure 3-1, Appendix Table B-1). The primary peaks in daily flows occurred in January, March, April, and September with flows over 1,000 m^3/sec/day. Periods of low daily flows of 100-200 m^3/sec/day began in June and continued through mid-September (Figure 3-1, Appendix Table B-1).

The 1999 monthly freshwater flow rates were generally comparable to the long-term (1947-1998) monthly average flow rates, however spring and summer flows in 1999 were lower than the average (Figure 3-1, Appendix Table B-2). When compared to monthly average flow rates since the Hudson River surveys began in 1974 (Appendix Table B-3), the 1999 monthly flows were about average for most of the year except in the late spring when flows were lower. The flow in June 1999 was the lowest observed for that month since 1974.

3.2 POUGHKEEPSIE WATERWORKS TEMPERATURES

Long-term (1951-1999) daily temperature records are available from the Poughkeepsie Waterworks, located just north of the City of Poughkeepsie, New York, at RM 76. The lowest recorded temperature in 1999 was 0.7°C in early February (Appendix Table B-4). Water temperatures in 1999 remained relatively low (<3°C) through mid-March, then began increasing in late March and reached a high of 27.4°C in early August. Temperatures started to decline by late August (Figure 3-2).

The 1999 mean water temperature profile was similar to the long-term (1951-1998) average temperatures, except that it was consistently warmer than average in late spring and summer (Figure 3-2). In July and early August 1999, water temperatures were near maximum levels.

3.3 HUDSON RIVER SURVEYS

3.3.1 Spatiotemporal Pattern in Temperature

Average weekly water temperature measured during the 1999 LRS/FSS increased from the beginning of sampling in March through July, and then decreased until the end of the sampling program in October (Figure 3-3). This temporal pattern observed throughout the Hudson River estuary closely reflected that recorded at Poughkeepsie Waterworks. Average weekly

temperatures measured during the LRS/FSS were similar to concurrent Poughkeepsie Waterworks temperatures. Peak river temperatures occurred during early August when the river-wide mean temperature was 28.0°C and regional mean values were between 27.2 and 28.9°C (Poughkeepsie Waterworks daily temperatures averaged 27.3°C for this period) (Appendix Table B-5). Lowest values occurred during March when the mean temperature in the lower river was 4.9°C and regional mean temperatures from Battery to Cornwall ranged from 3.2 to 5.4°C (Poughkeepsie Waterworks daily temperatures averaged 4.3°C for this period). Water temperatures in 1999 were consistently warmer than the long-term (1974-1998) average temperatures observed in previous Hudson River surveys during late spring and summer (Figure 3-3). Temperatures in July and early August were among the highest observed since 1974.

Temporal patterns in the 1999 BSS temperature data resembled the pattern observed with LRS/FSS measurements except that summer peak temperatures around 27°C were achieved in late July (Figure 3-3). Mean weekly regional temperatures at the peak were 27.2 to 29.5°C (Appendix Table B-6). BSS mean temperatures during the late spring and early summer of 1999 were among the warmest observed in the long-term (1974-1998) record, but declined in the fall on par with the long-term average temperatures (Figure 3-3). Minimum mean temperatures of 12-16°C were recorded during the last week of sampling that began on 18 October.

3.3.2 Spatiotemporal Pattern in Salinity

Seasonal variations in salinity occur in response to freshwater inputs to the Hudson River Estuary: increasing freshwater flows lead to decreasing salinity and, likewise, decreasing flows will increase salinity. Salinity measured during the 1999 LRS/FSS was lowest in early April at approximately 4 parts per thousand (ppt) in the Yonkers region (Appendix Table B-7) when freshwater flows were high. Salinity values increased gradually throughout the spring and early summer to maximum levels in late summer (Figure 3-4). Salinity peaked in August with values near 1 ppt as far north as the Poughkeepsie region. As freshwater flow increased again in September, salinity declined rapidly and remained at reduced levels through November.

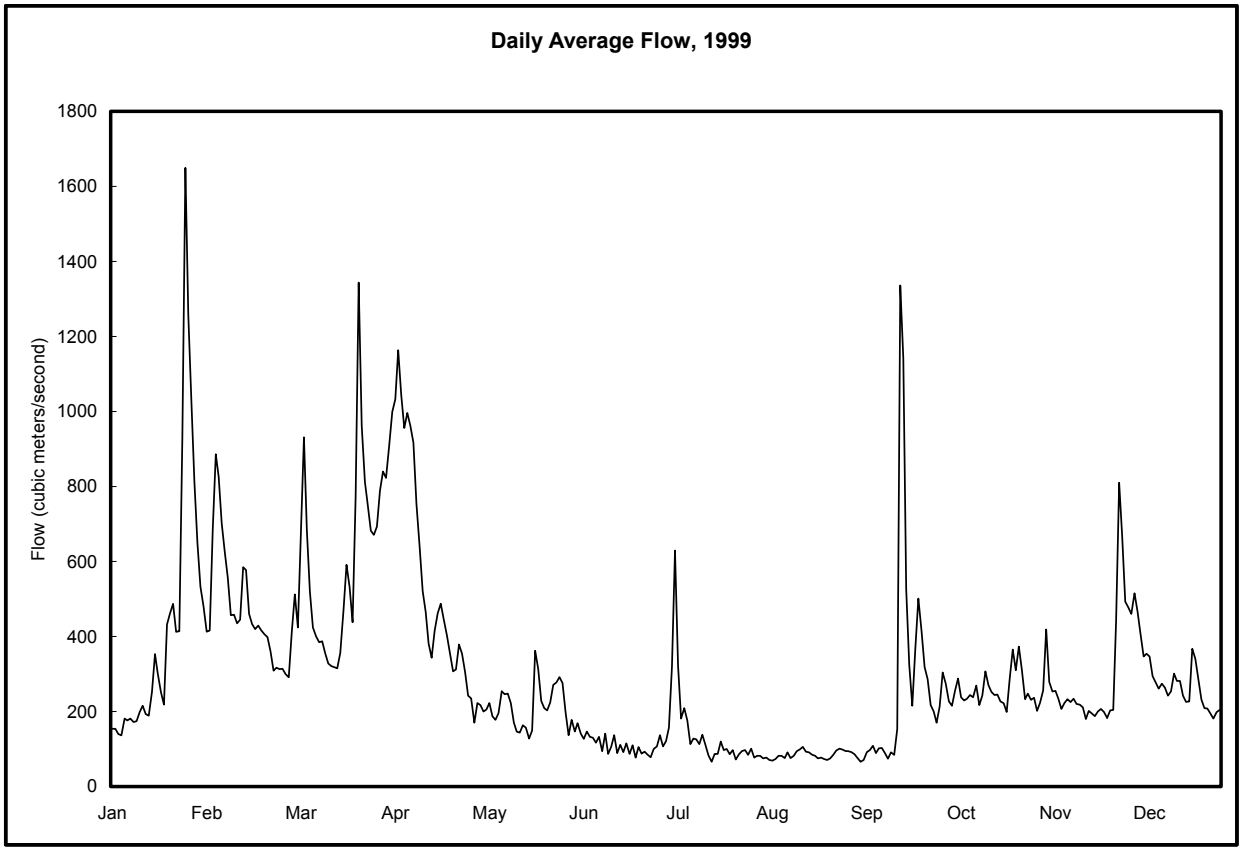
The spatiotemporal pattern of salinity observed during the BSS typically resembles that observed during the LRS/FSS: increasing salinity during the summer and decreasing levels in the fall. Actual salinity measured during the BSS was lower than during the LRS/FSS because of the tendency for the denser, saline water to follow the deeper channel rather than the shorezone area. In the 1999 BSS, salinity was relatively uniform throughout the late spring and summer, but declined rapidly in late September and remained low through October (Appendix Table B-8). Salinity levels reached a summer peak during the week of 6 September (13.6-1.1 ppt from Yonkers to Poughkeepsie) (Appendix Table B-8). Mean weekly regional salinity was highest in the Yonkers region and decreased upstream.

3.3.3 Spatiotemporal Pattern in Dissolved Oxygen

Dissolved oxygen concentration varies inversely with temperature and salinity. The seasonal pattern of dissolved oxygen typically observed during the Hudson River surveys consists of high concentrations in the spring, declining to minimum values in the summer, and increasing levels in the fall. As temperatures rose in the spring and summer of 1999, dissolved oxygen, as recorded in the LRS/FSS, declined from peak mean weekly regional values of 11.1-12.6 mg/L on 22 March to minimum mean levels of 4.0-7.5 mg/L on 13 September when temperature and salinity were elevated (Figure 3-5, Appendix Table B-9). Dissolved oxygen concentrations in 1999 followed the general pattern of the long-term (1974-1998) mean values (Figure 3-5).

Percent oxygen saturation relates the theoretical limit of oxygen saturation (adjusted for temperature and salinity influences) to the observed dissolved oxygen concentrations. Mean weekly regional percent saturation based on measurements taken during the 1999 LRS/FSS was usually above 80 percent for most of the sampling season with occasional dips to 70 percent in the late summer especially in the downriver regions (Appendix Table B-11). Individual mean weekly regional values were never lower than 60 percent, the minimum recorded during the week of 13 September from the Battery region.

Data collected in the 1999 BSS (Appendix Tables B-10 and B-12) indicated slightly higher mean regional dissolved oxygen and percent oxygen saturation than recorded in the LRS/FSS during the summer and fall. When compared to the long-term (1974-1998) average dissolved oxygen, 1999 values were below normal periodically during the sampling season when water temperatures were high (Figure 3-5), but percent oxygen saturation levels did not drop below 68 percent and were usually above 80 percent.



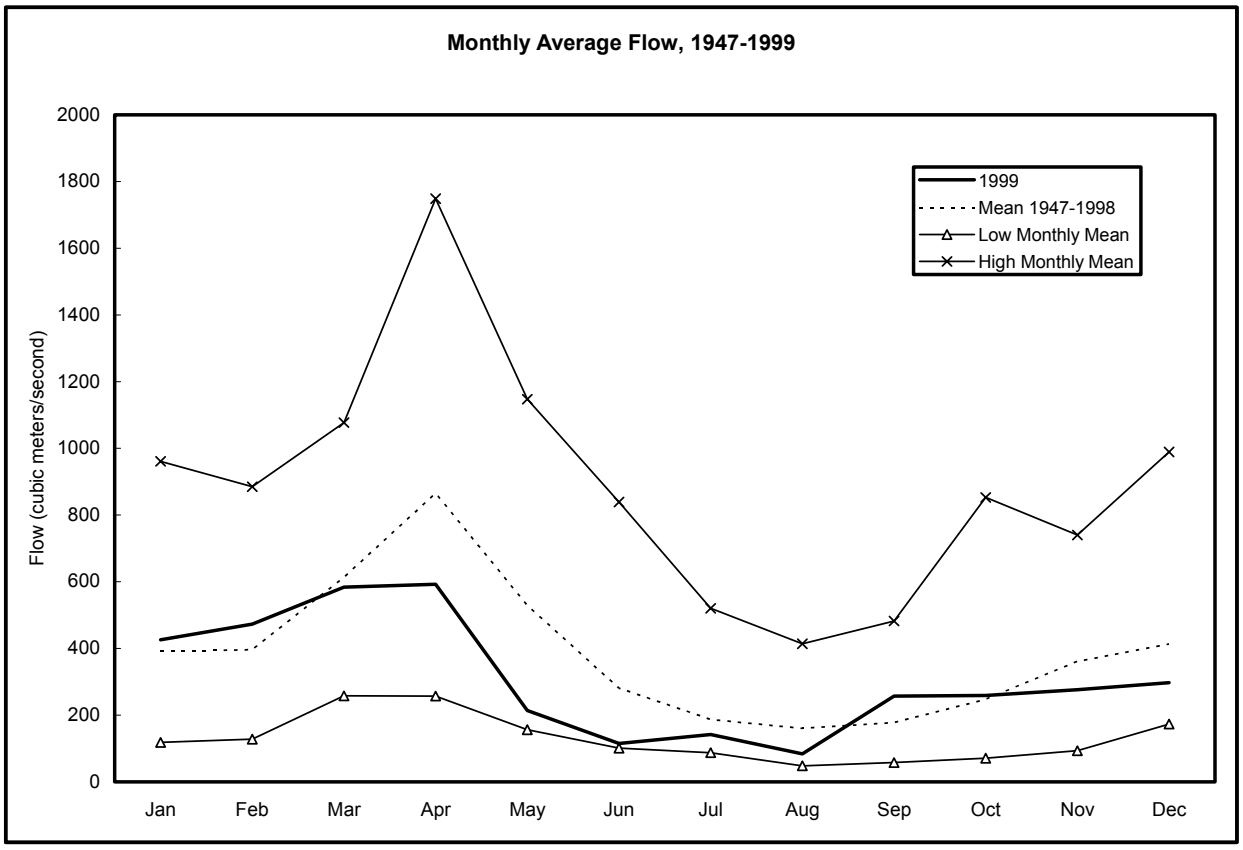


Figure 3-1. Hudson River daily average flow rate in 1999 and monthly average flow rates from 1947 to 1999, Green Island, New York.

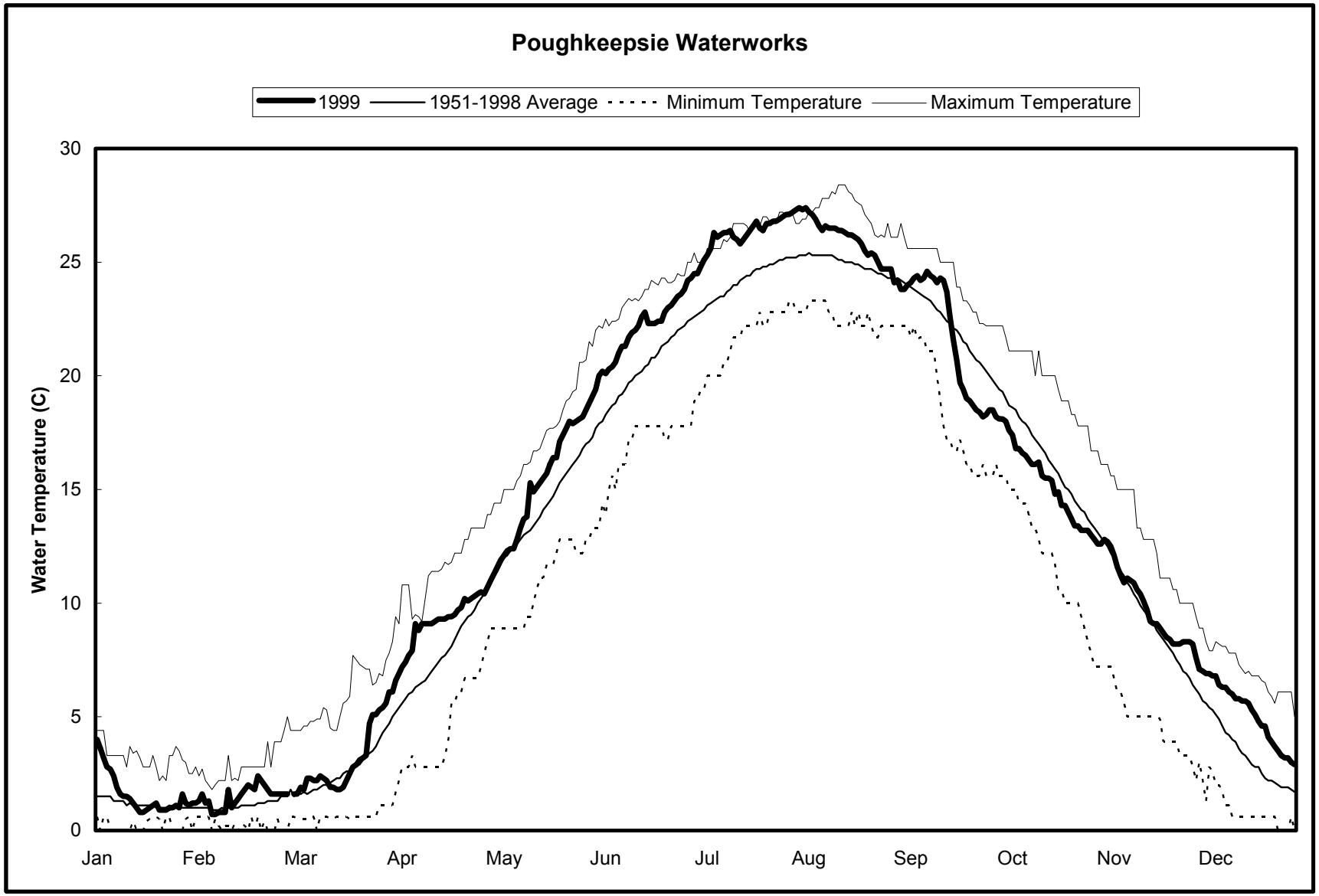


Figure 3-2. Seasonal variations in water temperature from 1951 to 1999 as measured at Poughkeepsie Waterworks.

Average Weekly Water Temperature

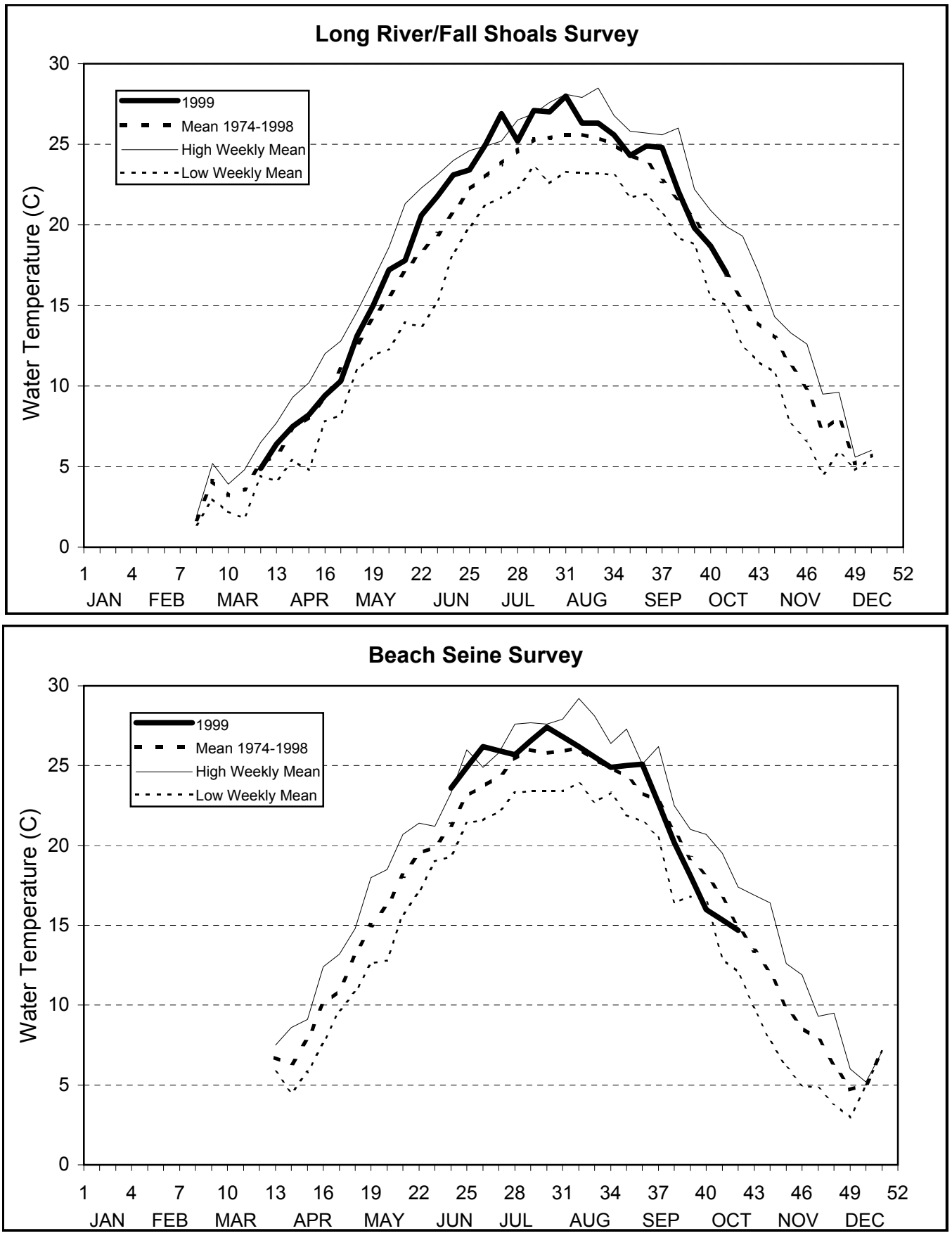


Figure 3-3. Seasonal variations in water temperature from the Hudson River surveys, 1974-1999.

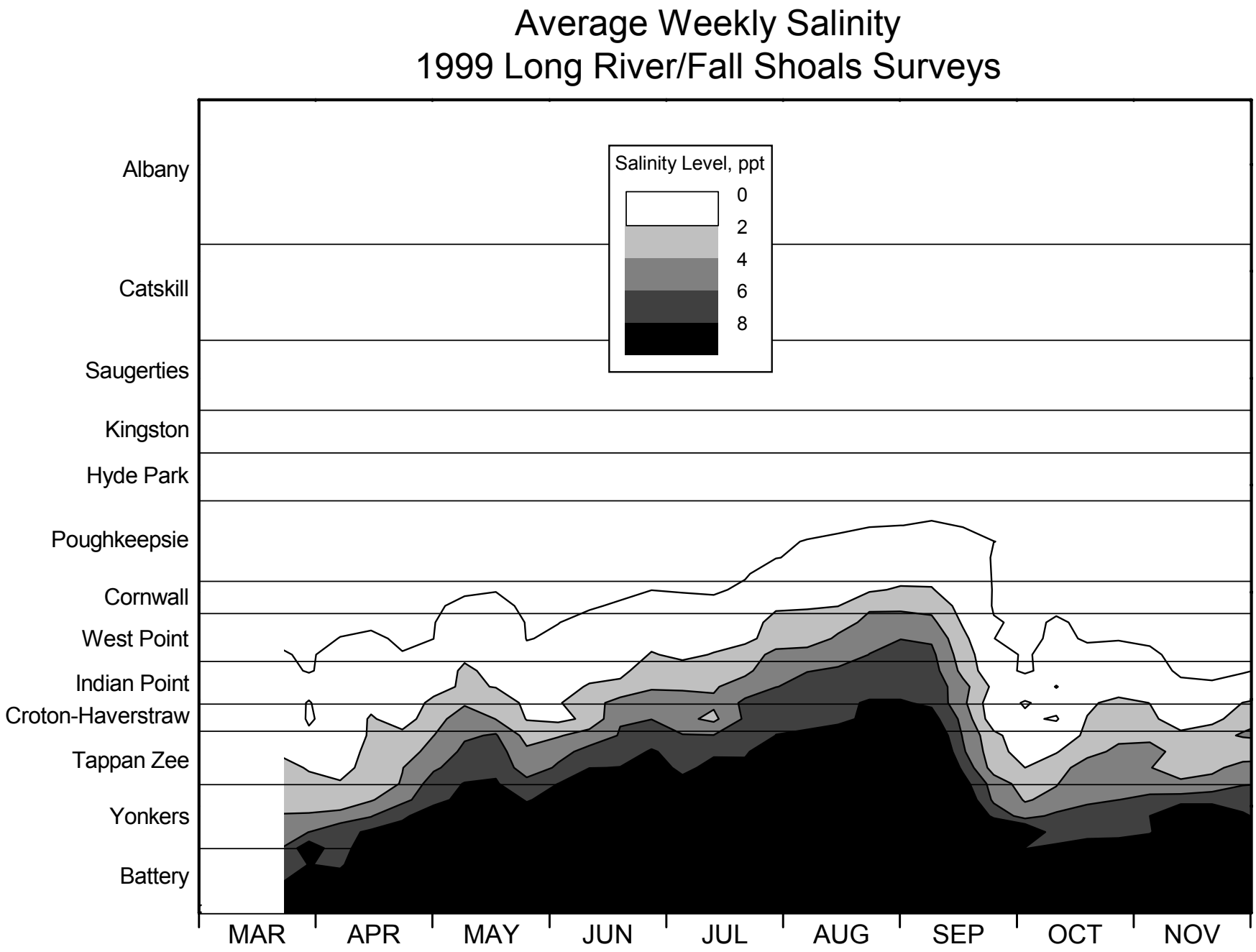
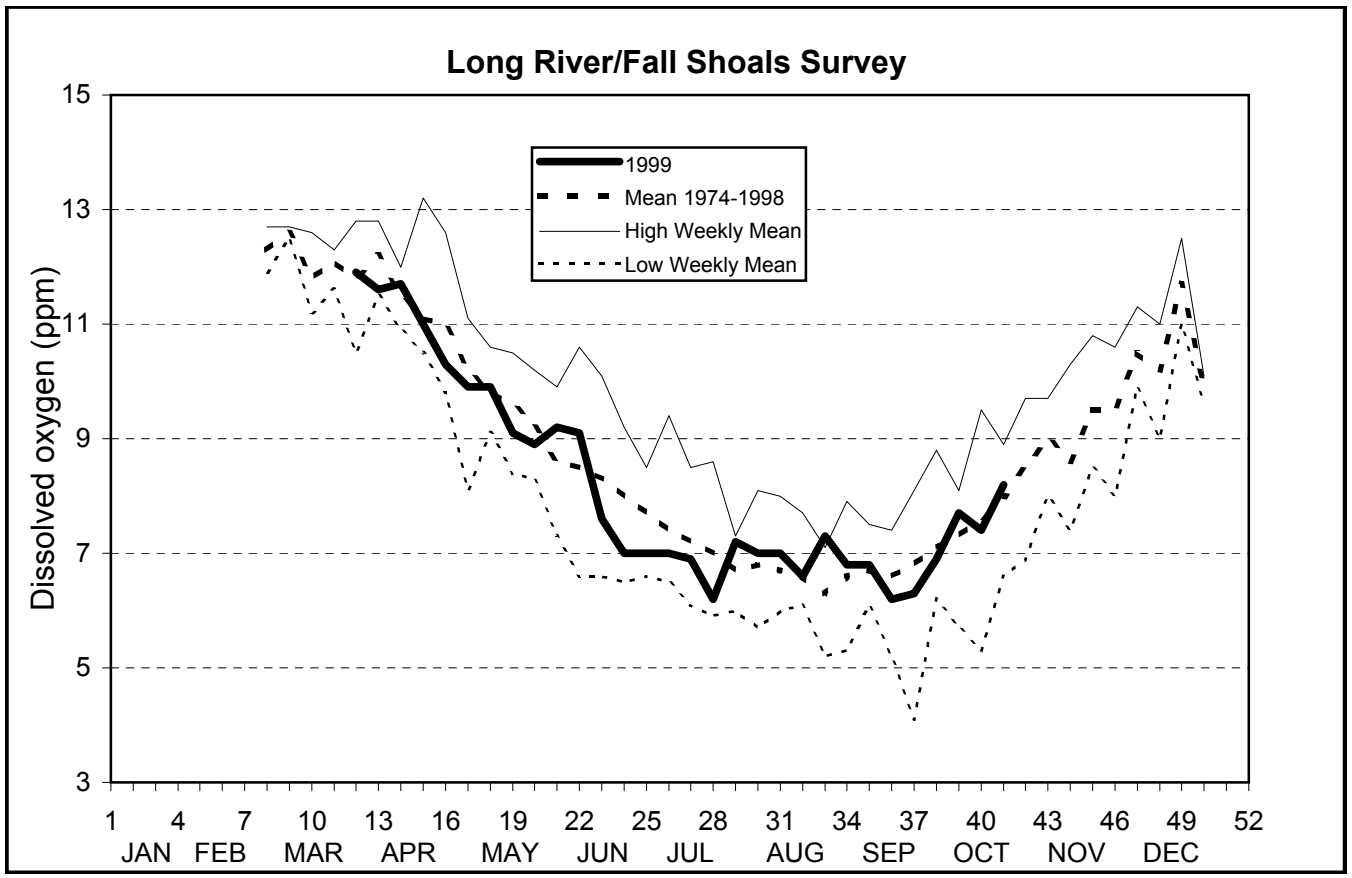


Figure 3-4. Seasonal variations in average weekly salinity from the 1999 Long River/Fall Shoals surveys.

Average Weekly Dissolved Oxygen



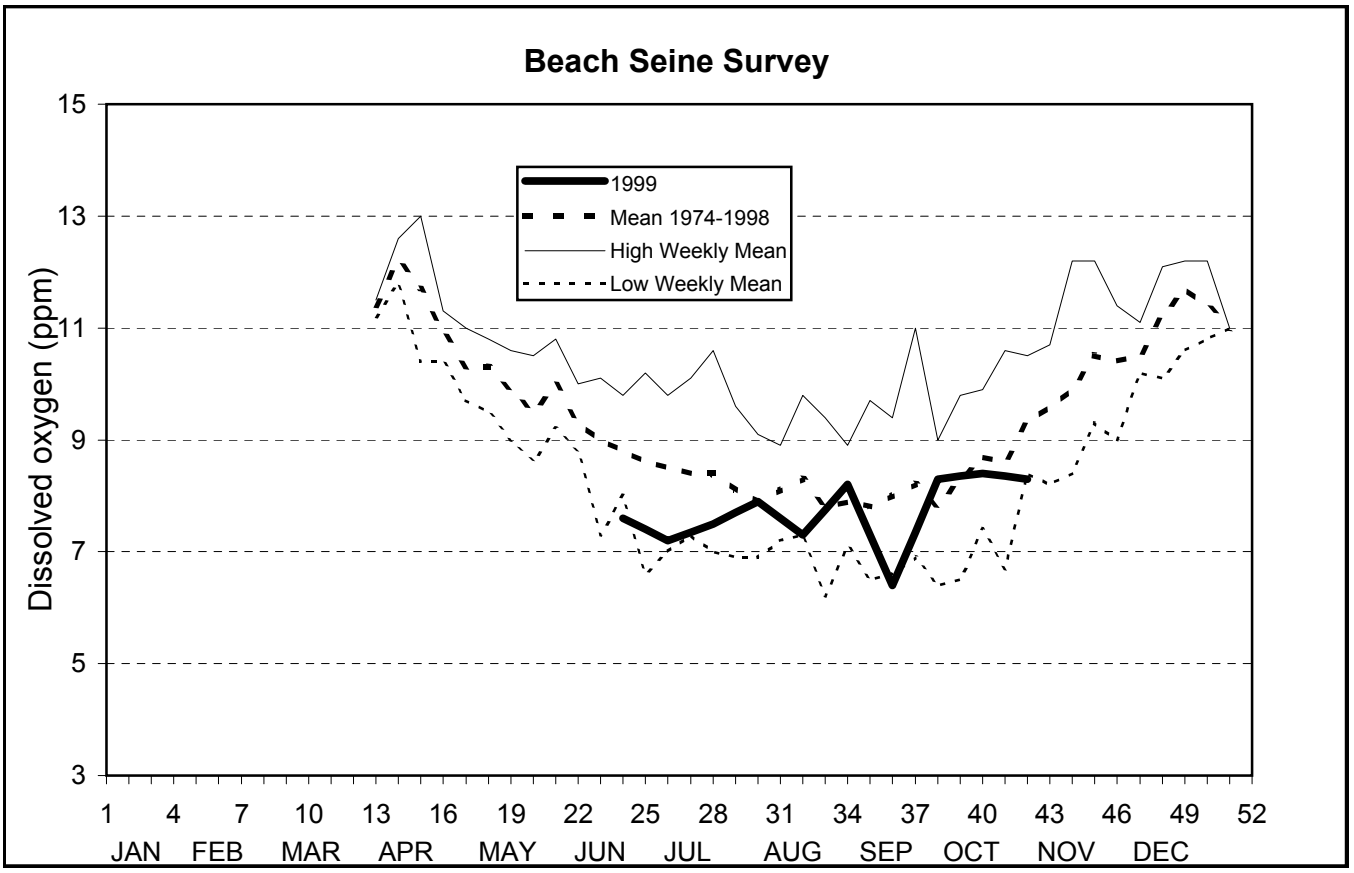


Figure 3-5. Seasonal variations in dissolved oxygen from the Hudson River surveys, 1974-1999.