CHAPTER 3
PHYSICAL/CHEMICAL PARAMETERS

This chapter provides information on the parameters of temperature, salinity, and dissolved oxygen as measured during the 2000 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 2000, 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 2000 ranged from 140 to 2,405 m^3/sec/day (Figure 3-1, Appendix Table B-1). The primary peaks in daily flows occurred in January, March through June, and December with flows over 1,000 m^3/sec/day. Periods of low daily flows of 100-200 m^3/sec/day occurred in September and October (Figure 3-1, Appendix Table B-1).

The 2000 monthly freshwater flow rates were generally comparable to the long-term (1947-1999) monthly average flow rates, however spring and early summer flows in 2000 were higher 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 2000 monthly flows were higher than average for most of the year except in the fall. The flow in June 2000 was the highest observed for that month since 1974.

3.2 POUGHKEEPSIE WATERWORKS TEMPERATURES

Long-term (1951-2000) 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 2000 was 0.4°C in mid-February (Appendix Table B-4). Water temperatures in 2000 remained relatively low (<3°C) through early March, increased erratically during the spring and early summer, and reached a high of 24.2°C in mid-August. Temperatures started to decline by mid-September (Figure 3-2).

The 2000 mean water temperature profile was similar to the long-term (1951-1999) average temperatures in the winter and fall. During the spring, 2000 temperatures were near long-term maximum temperatures in mid-March, early April, and mid-May, but near long-term minimum temperatures in June (Figure 3-2). Throughout the summer of 2000, water temperatures were well below average levels.

3.3 HUDSON RIVER SURVEYS

3.3.1 Spatiotemporal Pattern in Temperature

Average weekly water temperature measured during the 2000 LRS/FSS increased from the beginning of sampling in March to early July, remained relatively constant through the summer,

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 25.0°C and regional mean values were between 24.1 and 25.5°C (Poughkeepsie Waterworks daily temperatures averaged 23.7°C for this period) (Appendix Table B-5). Lowest values occurred during March when the mean temperature in the lower river was 3.4°C and regional mean temperatures from Battery to Cornwall ranged from 2.0 to 4.8°C (Poughkeepsie Waterworks daily temperatures averaged 3.1°C for this period). Water temperatures in 2000 were consistently with the long-term (1974-1999) average temperatures observed in previous Hudson River surveys except during the late spring and summer when temperatures were well below average (Figure 3-3).

Temporal patterns in the 2000 BSS temperature data resembled the pattern observed in LRS/FSS measurements with summer peak temperatures around 26°C achieved in early August (Figure 3-3). Mean weekly regional temperatures at the peak were 23.8 to 27.6°C (Appendix Table B-6). BSS mean temperatures during the spring and summer of 2000 were generally below the average observed in the long-term (1974-1999) record, but were near normal during the fall (Figure 3-3). Minimum mean temperatures of 12-17°C were recorded during the last week of sampling that began on 16 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 2000 LRS/FSS was lowest in April at approximately 2-6 parts per thousand (ppt) in the Yonkers region (Appendix Table B-7) when freshwater flows were highest. Salinity values increased only slightly throughout the spring and summer as higher than normal inputs of freshwater kept salinity at lower than normal levels (Figure 3-4). Salinity peaked in November with values approaching 2 ppt in the Cornwall region.

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 2000 BSS, the salinity pattern was atypical with low salinity throughout the summer increasing to maximum, although still below normal, values in the fall (Appendix Table B-8). Minimum salinity of 1 ppt in the Yonkers region in June increased to only 8 ppt by November (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 2000, dissolved oxygen, as recorded in the LRS/FSS, declined from peak mean weekly regional values of 11.2-13.8 mg/L on 6 March to minimum mean levels of 5.6-7.6 mg/L on 31 July when temperature was elevated (Figure 3-5, Appendix Table B-9). Dissolved oxygen concentrations in 2000 followed the general pattern of the long-term (1974-1999) mean values except in April when concentrations

were higher than normal, especially in the upper regions of the Hudson River estuary (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 2000 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 63 percent, the minimum recorded during the week of 28 August from the Indian Point region.

Data collected in the 2000 BSS (Appendix Tables B-10 and B-12) indicated similar mean regional dissolved oxygen and percent oxygen saturation to that recorded in the LRS/FSS. When compared to the long-term (1974-1999) average dissolved oxygen, 2000 values were below normal for most of the sampling season (Figure 3-5), but percent oxygen saturation levels did not drop below 60 percent and were usually above 80 percent.

Link to Chapter 4

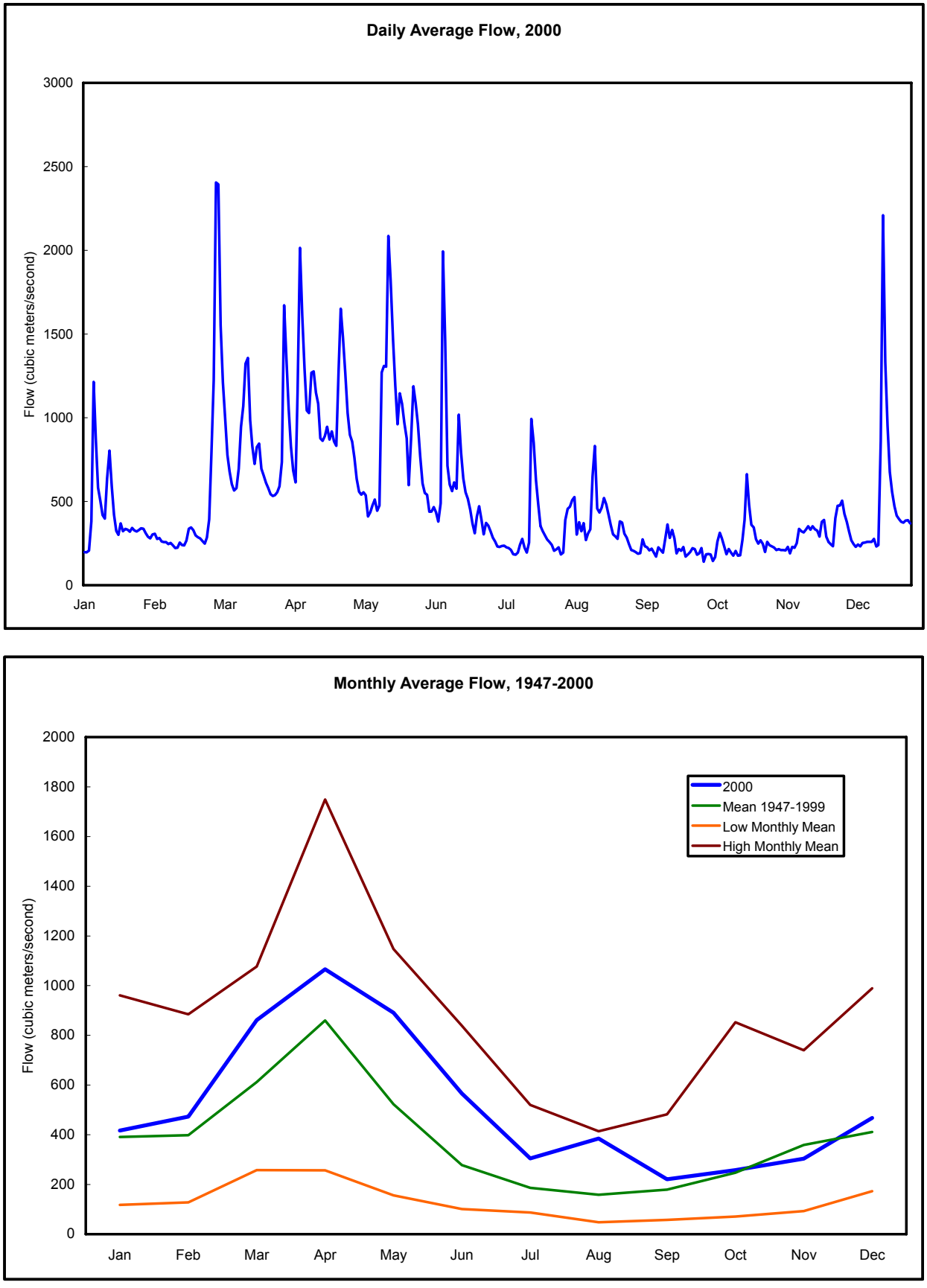

Figure 3-1. Hudson River daily average flow rate in 2000 and monthly average flow rates from 1947 to 2000, Green Island, New York.

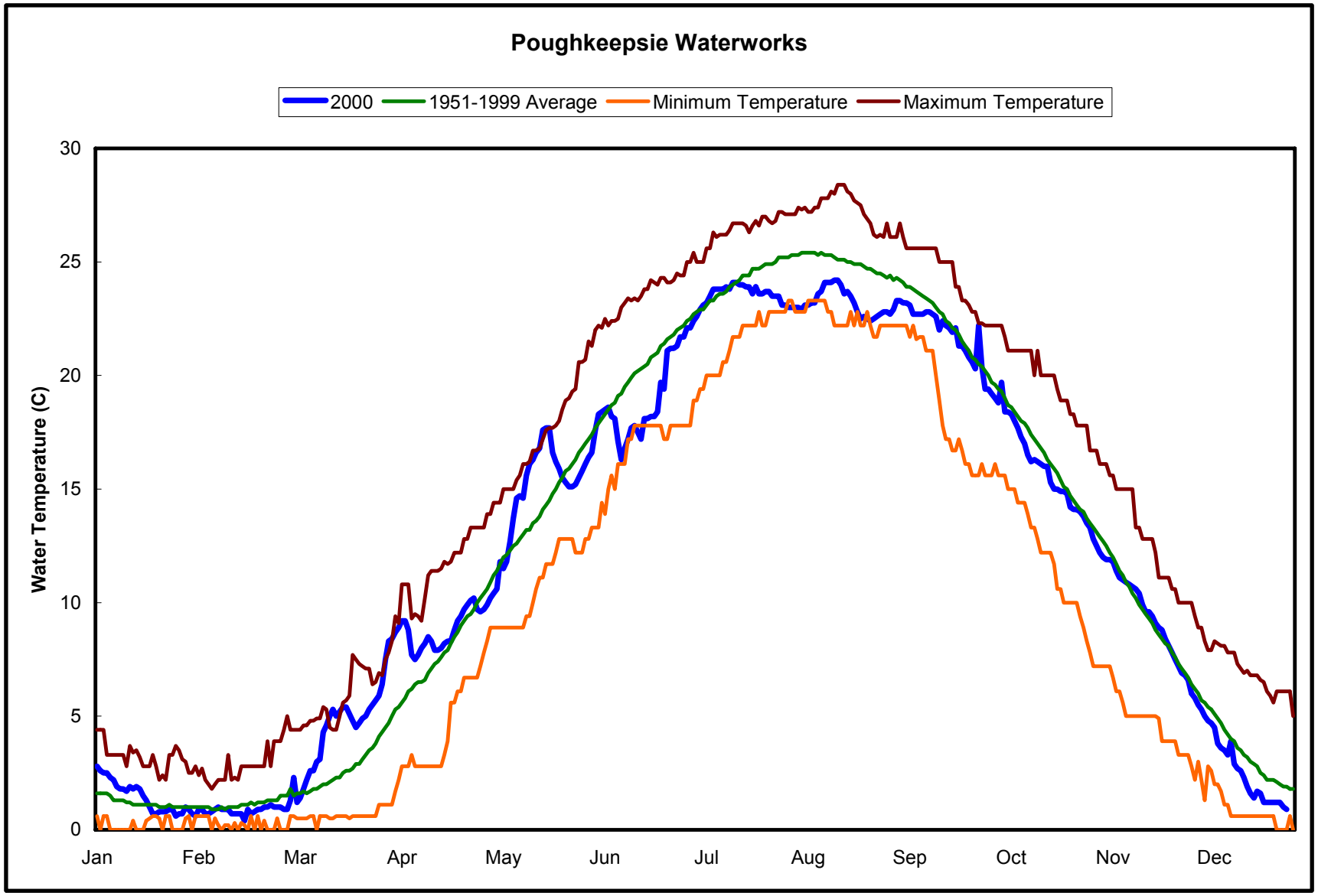

Figure 3-2. Seasonal variations in water temperature from 1951 to 2000 as measured at Poughkeepsie Waterworks.

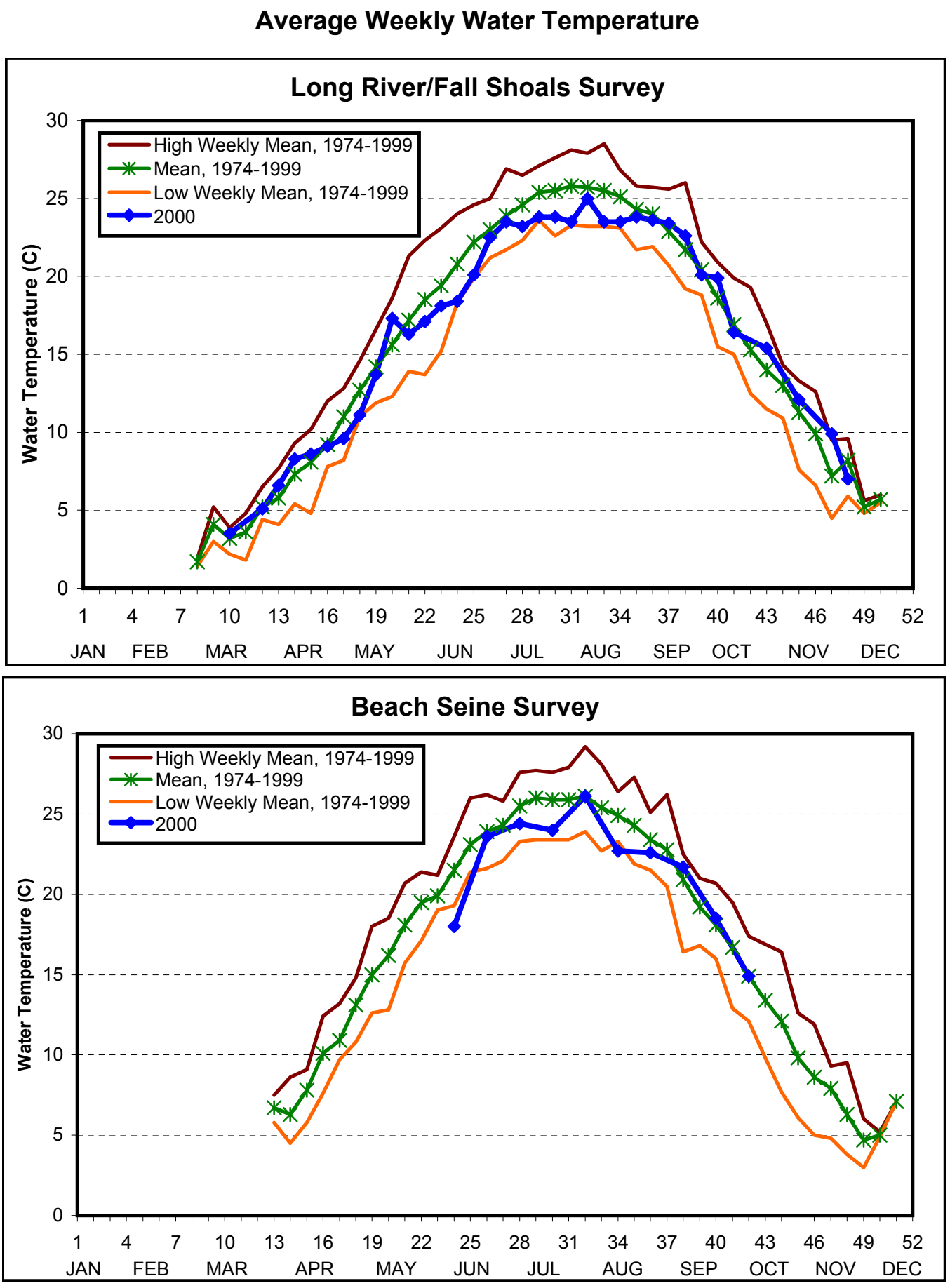

Figure 3-3. Seasonal variations in water temperature from the Hudson River surveys, 1974-2000.

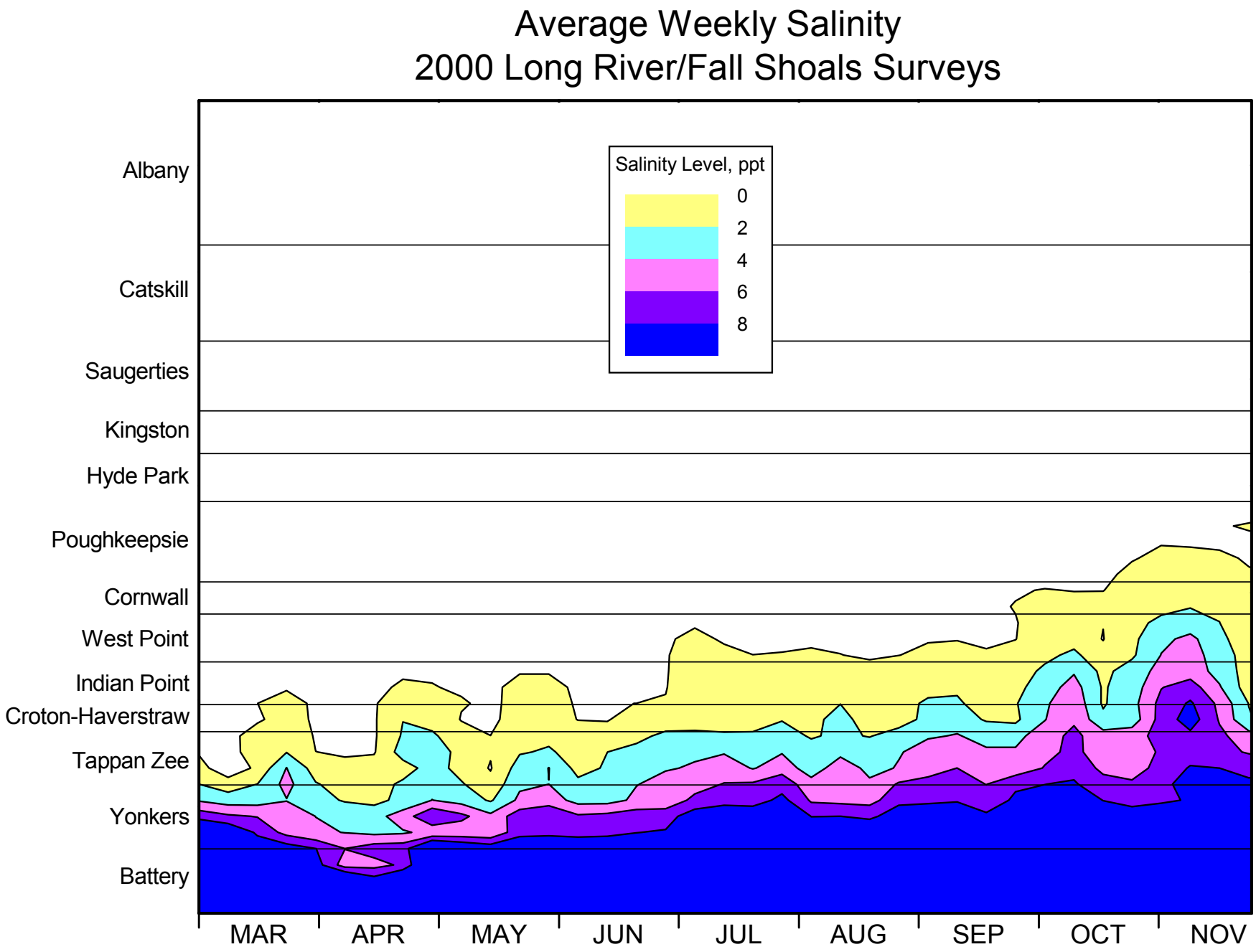

Figure 3-4. Seasonal variations in average weekly salinity from the 2000 Long River/Fall Shoals surveys.

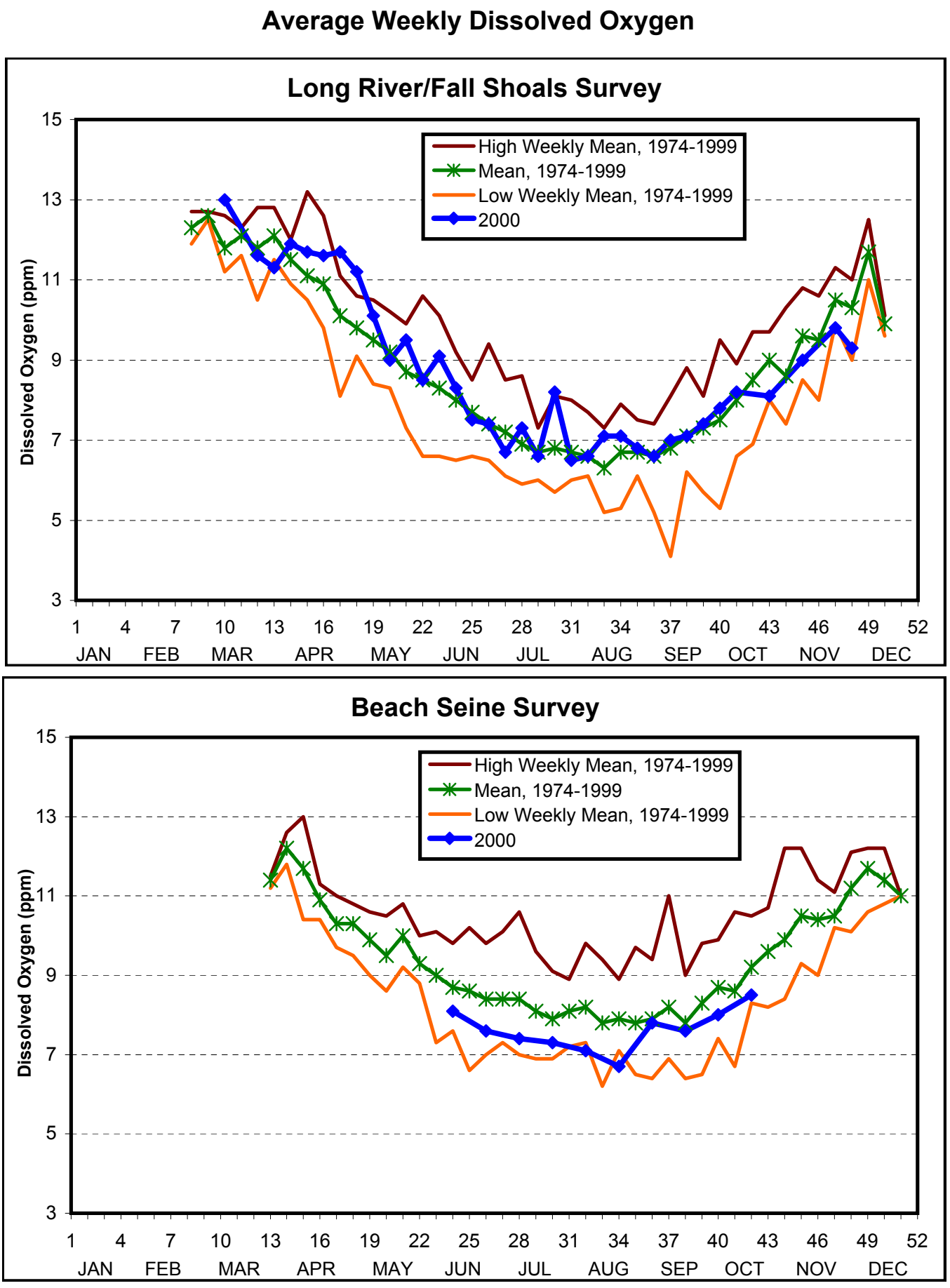

Figure 3-5. Seasonal variations in dissolved oxygen from the Hudson River surveys, 1974-2000.