CHAPTER 3
PHYSICAL/CHEMICAL PARAMETERS

This chapter provides information on the parameters of temperature, salinity, and dissolved oxygen as measured during the 2005 surveys. Although parameters were measured with the BSS, emphasis will be placed on data from the LRS/FJS 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's Water Treatment Facility are discussed. Physical and chemical parameters are presented in Appendix B.

3.1 GREEN ISLAND DAM FLOWS

During 2005, 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. At the time of publication, the data from October through December 2005 were provisional. The daily flow in 2005 ranged from 95 to 3,339 m^3/sec/day (Figure 3-1, Appendix Table B-1). The primary peak in daily flow occurred in April with flows over 3,000 m^3/sec/day and secondary peaks occurred in January and December with flows over 1,500 m^3/sec/day. Periods of daily flow less than 200 m^3/sec/day occurred in July and August (Figure 3-1, Appendix Table B-1).

The 2005 monthly freshwater flow rates were comparable to the long-term (1947-2004) monthly average flow rates, with highest flows seen in April and again in November and December and lowest flows during summer months (Figure 3-1, Appendix Table B-2). The monthly average flows during the fall months of 2005 were consistently higher than average. When compared to monthly average flow rates since the Hudson River surveys began in 1974 (Appendix Table B-3), the 2005 monthly flows were very similar to the long-term average flows for most of the year, but were higher than average during the fall.

Average annual freshwater flow for the Hudson River as estimated at Green Island during 1947 to 2005 has varied from a minimum of 219 m^3/sec/day in 1965 to a maximum of 603 m^3/sec/day in 1976 (Figure 3-2, Appendix Table B-4). For 2005, the provisional average annual flow of 451 m^3/sec/day was the 15th highest flow in the 59 years of data.

3.2 POUGHKEEPSIE'S WATER TREATMENT FACILITY TEMPERATURES

Long-term (1951-2005) daily temperature records are available from the Poughkeepsie's Water Treatment Facility, located just north of the City of Poughkeepsie, New York, at RM 76. The lowest recorded temperature in 2005 was 0.5°C occurring in January, February, and March (Appendix Table B-5). Water temperatures in 2005 remained relatively low (<3°C) through mid-March, increased steadily during the spring and early summer, and reached a high of 27.8°C in mid-August. Temperatures started to decline in late September and cooled rapidly until the end of October (Figure 3-3).

The 2005 mean water temperature profile was similar to the long-term (1951-2004) average temperatures for most of the year except in the summer when temperatures were warmer than average (Figure 3-3). During this period, 2005 temperatures were near long-term maximum temperatures and even exceeded the long-term maximum in September. Average annual water temperature for the Hudson River as measured at Poughkeepsie's Water Treatment Facility

during 1951 to 2005 has varied from a minimum of 11.29°C in 1960 to a maximum of 13.96°C in 1998 (Figure 3-4, Appendix Table B-6). For 2005, the average annual temperature of 12.94°C was the 13th highest temperature in the 55 years of data.

3.3 HUDSON RIVER SURVEYS

3.3.1 Spatiotemporal Pattern in Temperature

Average weekly water temperature measured during the 2005 LRS/FJS increased from the beginning of sampling in March to early August and then began decreasing until the end of the sampling program in December (Figure 3-5). This temporal pattern observed throughout the Hudson River estuary closely reflected that recorded at Poughkeepsie's Water Treatment Facility. Average weekly temperatures measured during the LRS/FSS were similar to concurrent Poughkeepsie's Water Treatment Facility temperatures. Peak river temperatures occurred during early August when the river-wide mean temperature, as measured from Battery to Poughkeepsie, was 28.1°C and regional mean values were between 25.3 and 29.6°C (Appendix Table B-7) (Poughkeepsie's Water Treatment Facility daily temperatures averaged 27.6°C for this period). Lowest values occurred during mid-March when the mean temperature in the lower river was 2.5°C and regional mean temperatures from Battery to Cornwall ranged from 1.4 to 3.0°C (Poughkeepsie's Water Treatment Facility daily temperatures averaged 1.8°C for this period).

Average weekly water temperatures in 2005 were consistent with the long-term (1974-2004) average temperatures observed in previous Hudson River surveys except during summer when temperatures were above average (Figure 3-5). From late July through mid-October, average temperatures in 2005 were near or exceeded the highest weekly mean temperatures for the 32-year period. Average annual water temperature measured during the LRS/FSS from 1974 through 2005 has varied from 19.1°C in 1983 to 23.6°C in 1991 (Figure 3-5, Appendix Table B-8). For 2005, the average annual temperature of 22.1°C was the 4th highest temperature in the 32 years of data.

Temporal patterns in the 2005 BSS temperature data resembled the pattern observed in LRS/FJS measurements with summer peak temperatures around 28.4°C achieved in early August (Figure 3-6). Mean weekly regional temperatures at the peak were 26.5 to 30.2°C (Appendix Table B-9). Minimum mean temperatures of 14-18°C were recorded during the last week of sampling that began on 17 October.

Average weekly temperatures during the 2005 BSS were higher than the average temperatures observed in the long-term (1974-2004) record for most of the sampling season and, in the early fall, they were greater than the long-term high weekly mean temperatures (Figure 3-6). Average annual water temperature measured during the BSS from 1974 through 2005 has varied from 21.3°C in 1974 to 25.7°C in 2005, setting a new record high in 2005 for the 32 years of data (Figure 3-6, Appendix Table B-10).

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. The overall pattern of salinity, as measured during the 2005 LRS/FJS, showed fluctuating levels in spring during periods of varying freshwater inputs, increasing values in summer, and declining values in fall (Figure 3-7). Salinity was lowest in early April

when the river-wide mean value was 0.6 parts per thousand (ppt) and regional values were as low as 6.6 ppt in the Battery region (Appendix Table B-11). Maximum salinity was observed in late summer when regional values were above 20 ppt in the Battery region and extended to over 2 ppt in the Cornwall region.

The spatiotemporal pattern of salinity observed during the BSS typically resembles that observed during the LRS/FJS: increasing salinity during the summer and decreasing levels in the fall. Actual salinity measured during the BSS was lower than during the LRS/FJS because of the tendency for the denser, saline water to follow the deeper channel rather than the shorezone area. In the 2005 BSS, the salinity pattern was typical with low salinity in the late spring, increasing values during the summer, and declining values in the fall (Appendix Table B-12). Maximum salinity of 12.4 ppt in the Yonkers region in late August decreased to 0.3 ppt in mid-October (Appendix Table B-12). 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 2005, dissolved oxygen, as recorded in the LRS/FJS, declined from peak mean weekly regional values of 11-13 mg/L in late March to minimum mean levels of 4-6 mg/L in mid-August (Figure 3-8, Appendix Table B-13).

Average weekly dissolved oxygen concentrations in 2005 were lower than the long-term (1974-2004) average values except during the fall when concentrations were slightly above average (Figure 3-8). High summer temperatures in 2005 contributed to summer dissolved oxygen values in 2005 that were near or exceeded the low weekly mean for the long-term record. Average annual dissolved oxygen measured during the LRS/FSS from 1974 through 2005 has varied from 7.0 mg/L in 2005 to 8.6 mg/L in 1984, setting a new record low in 2005 for the 32 years of data (Figure 3-8, Appendix Table B-14).

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 2005 LRS/FJS were usually above 70 percent for most of the sampling season with occasional dips below 70 percent in the summer especially in the downriver regions (Appendix Table B-17). Individual mean weekly regional values were never lower than 56 percent, the minimum recorded during late September from the Battery region.

Data collected in the 2005 BSS (Appendix Tables B-15 and B-18) indicated similar mean regional dissolved oxygen and percent oxygen saturation to that recorded in the LRS/FJS. When compared to the long-term (1974-2004) average weekly dissolved oxygen, 2005 values were well below average for the sampling season and were below historic minimum values during some weeks (Figure 3-9), but percent oxygen saturation levels did not drop below 67 percent and were usually in the 70 to 85 percent range.

Average annual dissolved oxygen measured during the BSS from 1974 through 2005 has varied from 6.4 mg/L in 2005 to 8.8 mg/L in 1991, setting a new record low in 2005 for the 32 years of data (Figure 3-9, Appendix Table B-16).

Link to Chapter 4

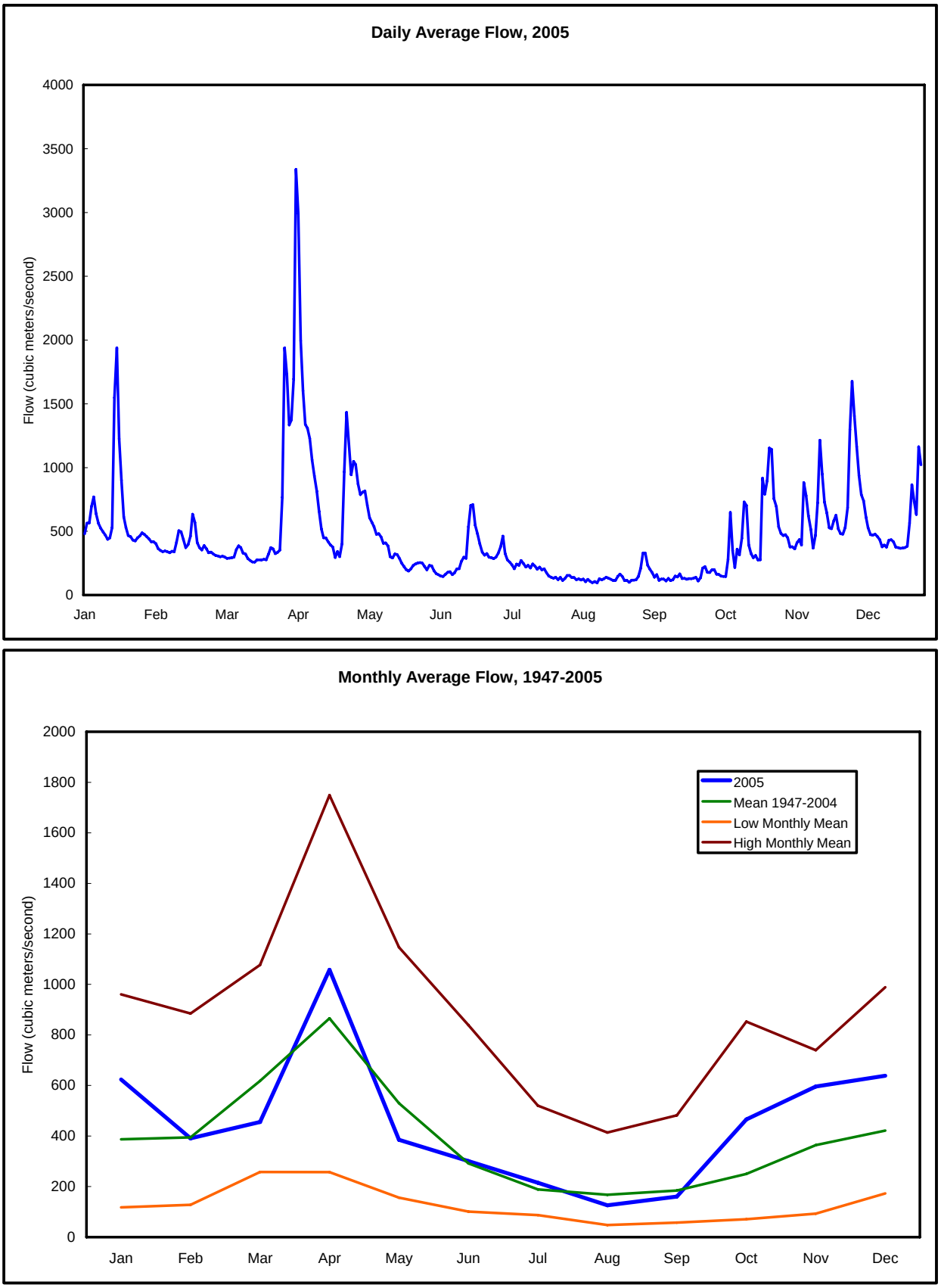


Figure 3-1. Hudson River daily average flow rate in 2005 and monthly average flow rates from 1947 to 2005, Green Island, New York. (Note: Data for October through December 2005 are provisional.)

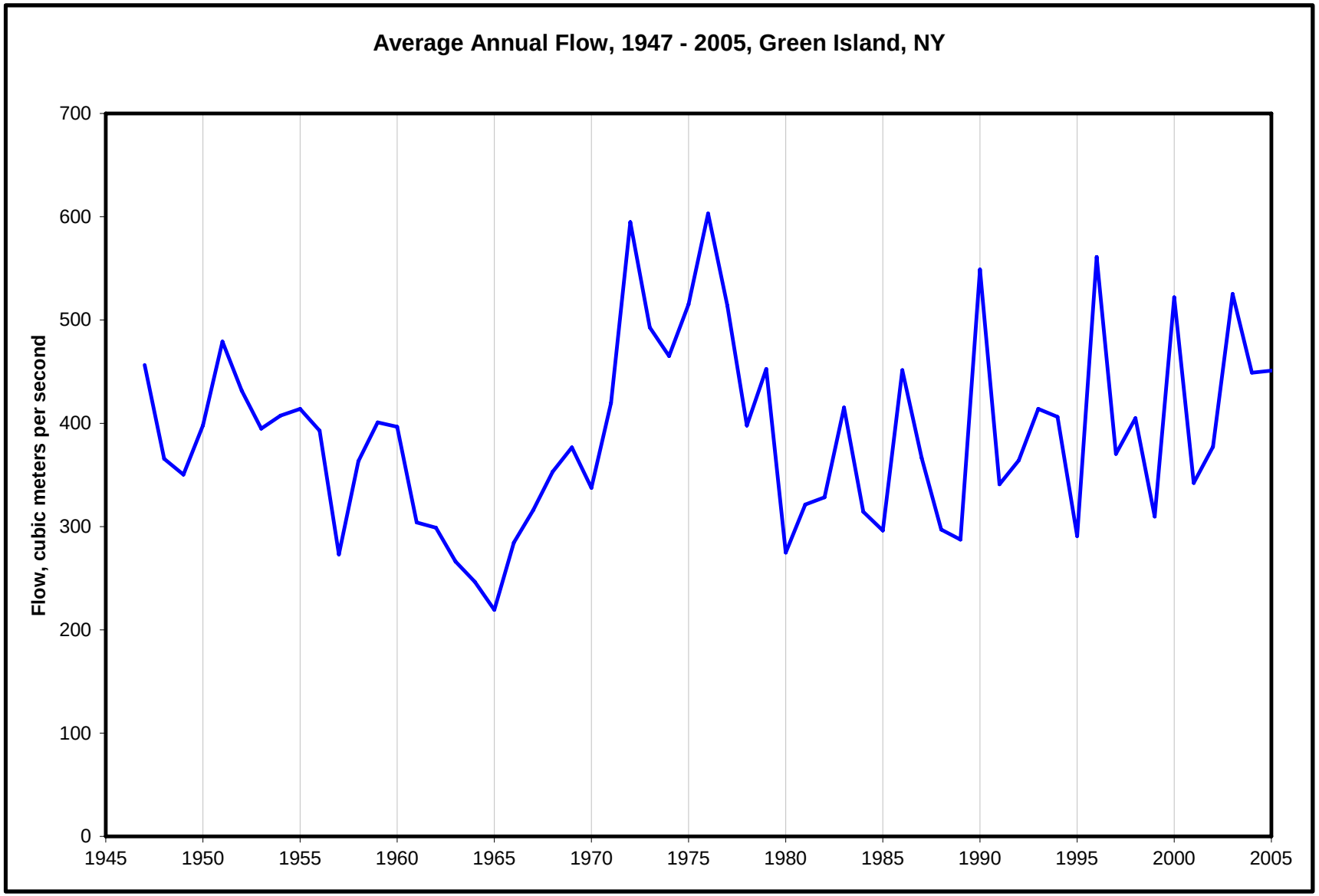


Figure 3-2. Average annual Hudson River flow from 1947 to 2005, Green Island, New York. (Note: Data for 2005 are provisional.)

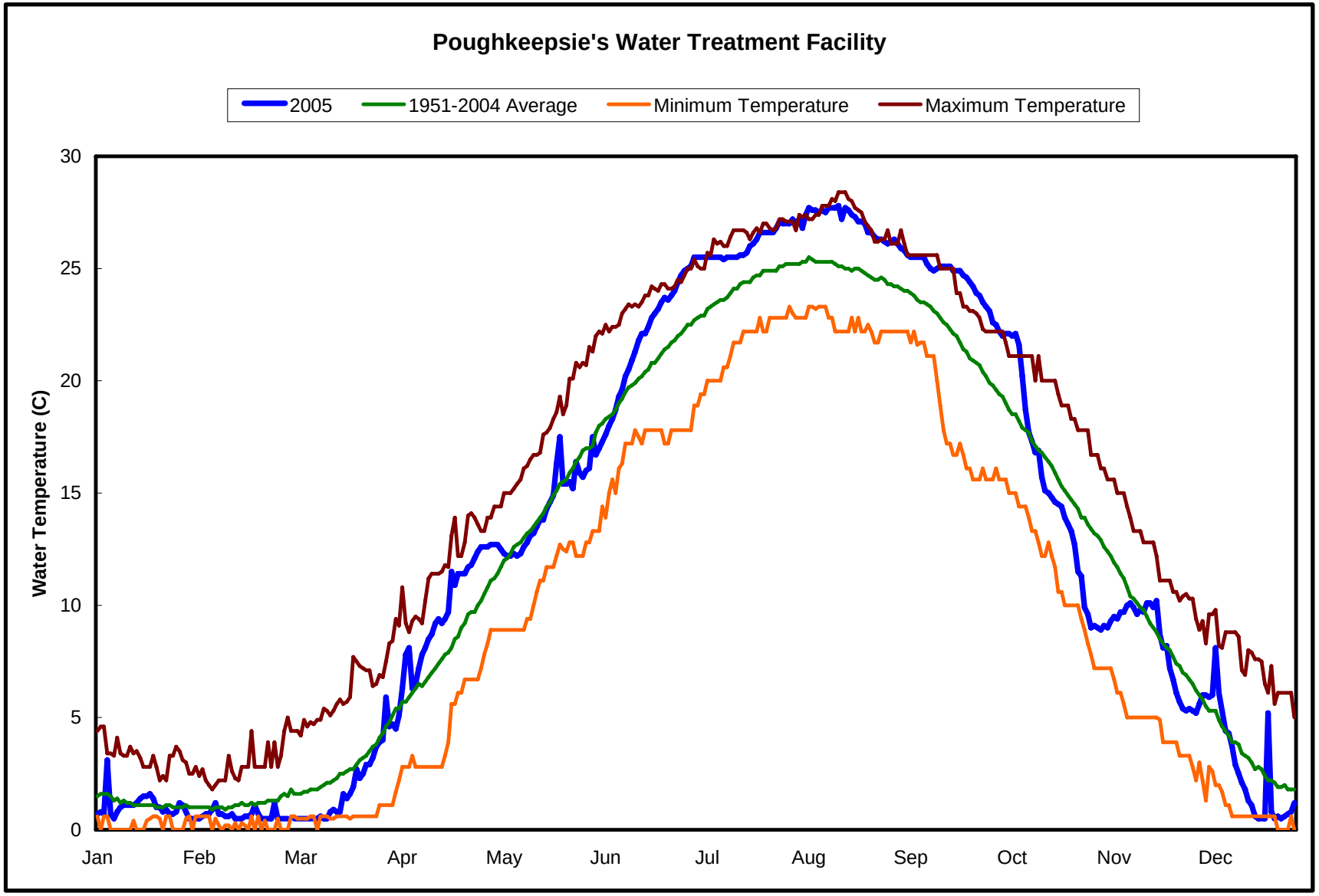


Figure 3-3. Seasonal variations in water temperature from 1951 to 2005 as measured at Poughkeepsie's Water Treatment Facility.

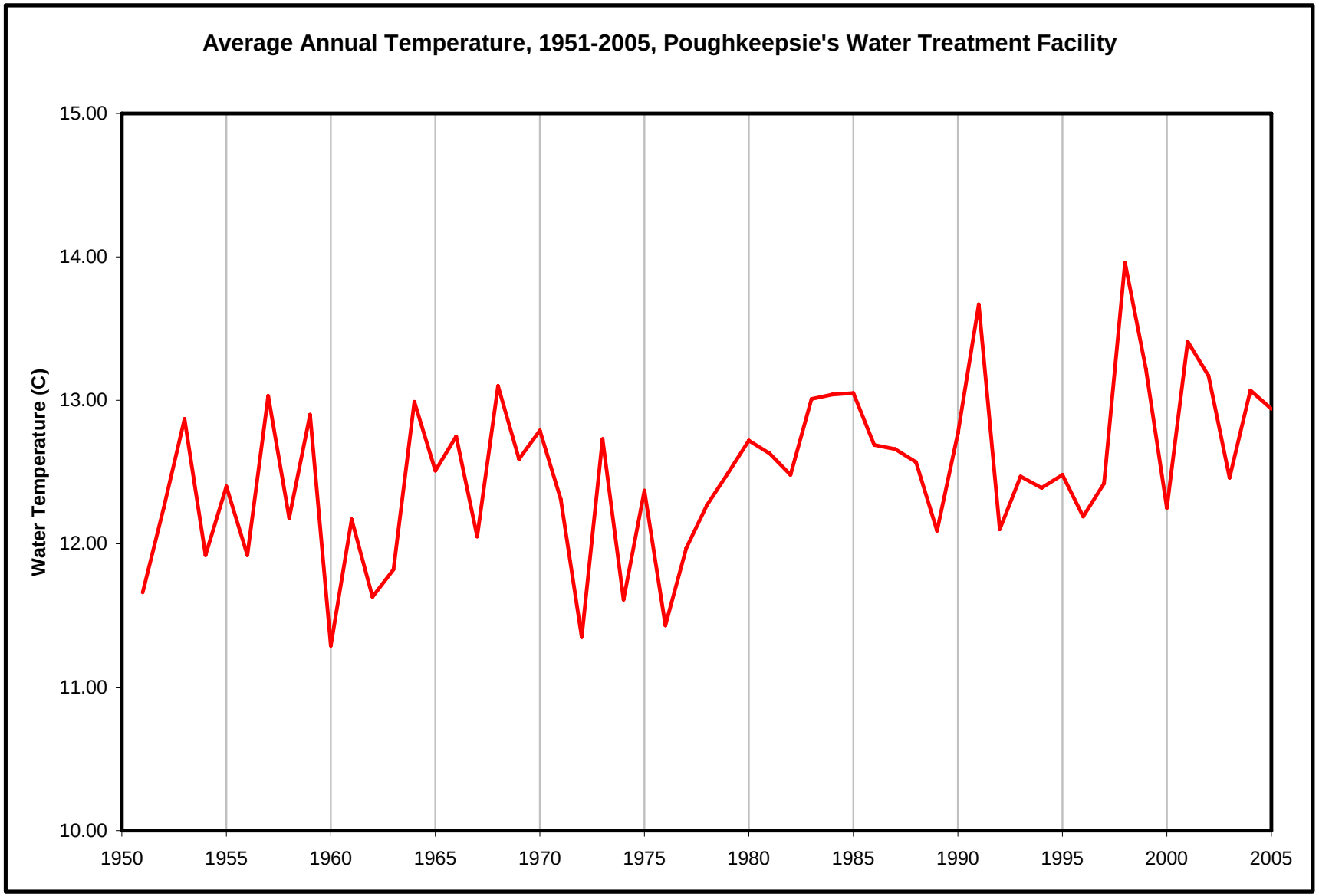
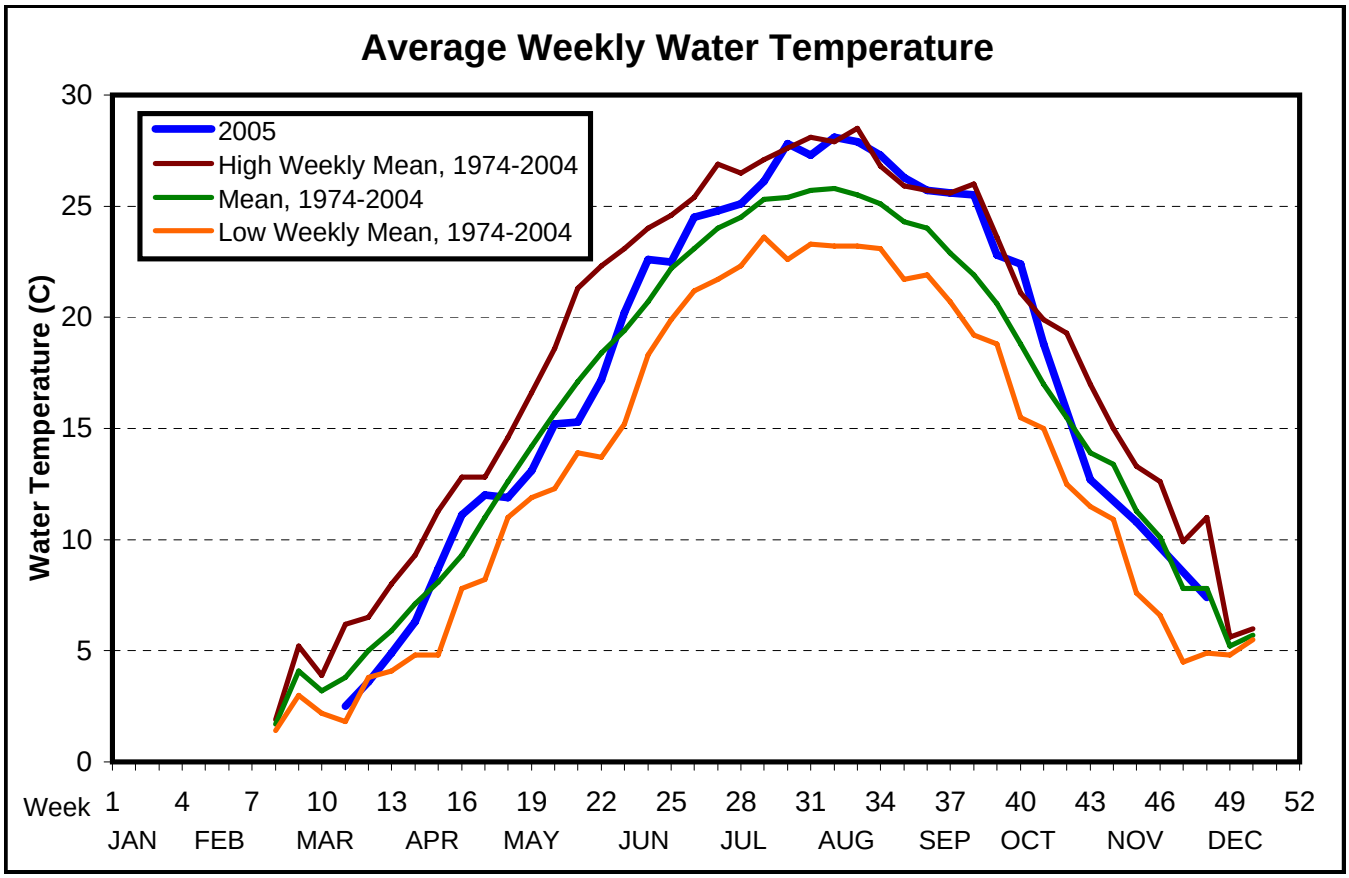


Figure 3-4. Average annual water temperature from 1951 to 2005 as measured at Poughkeepsie's Water Treatment Facility.

Long River/Fall Juvenile Survey



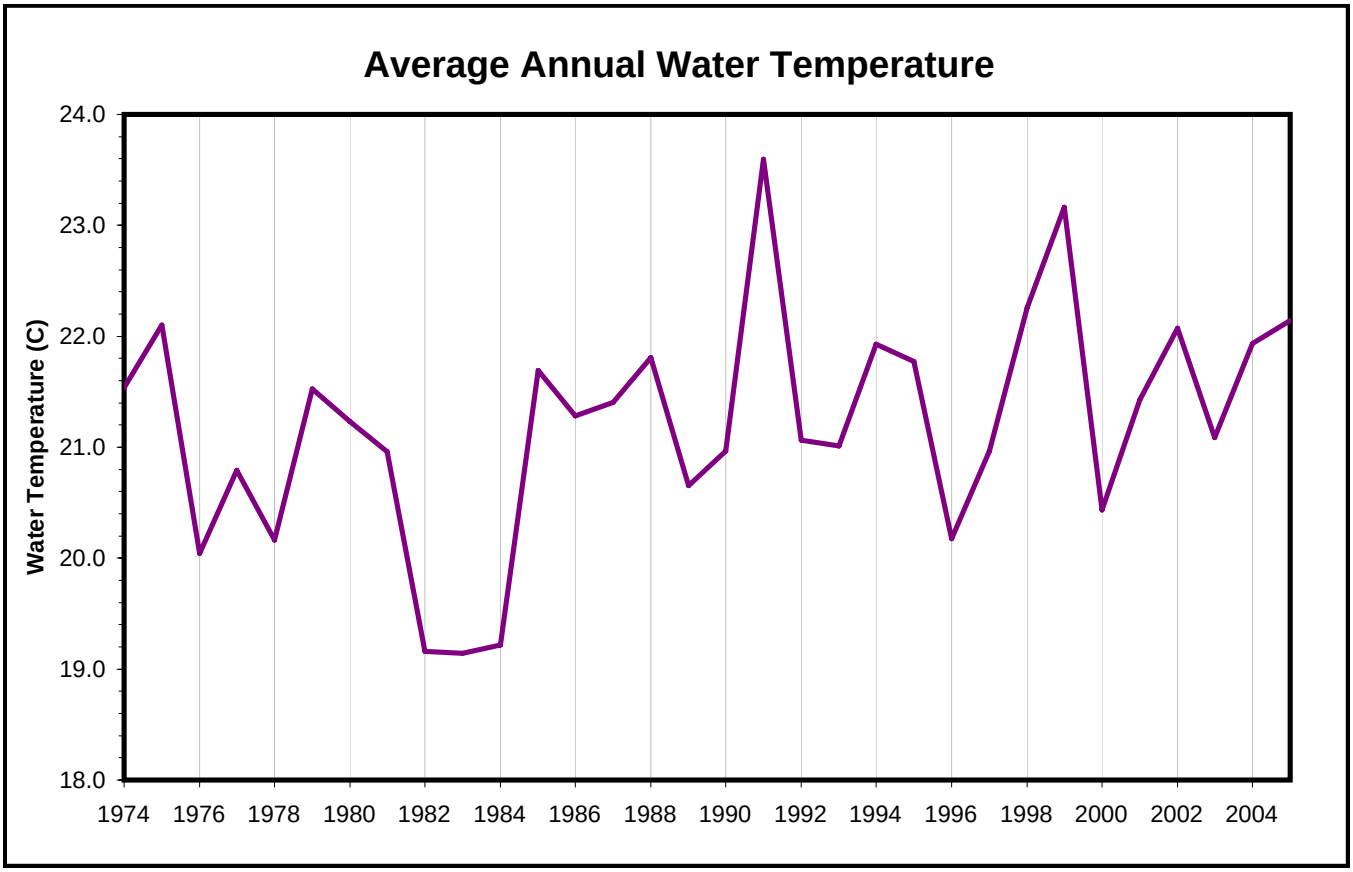
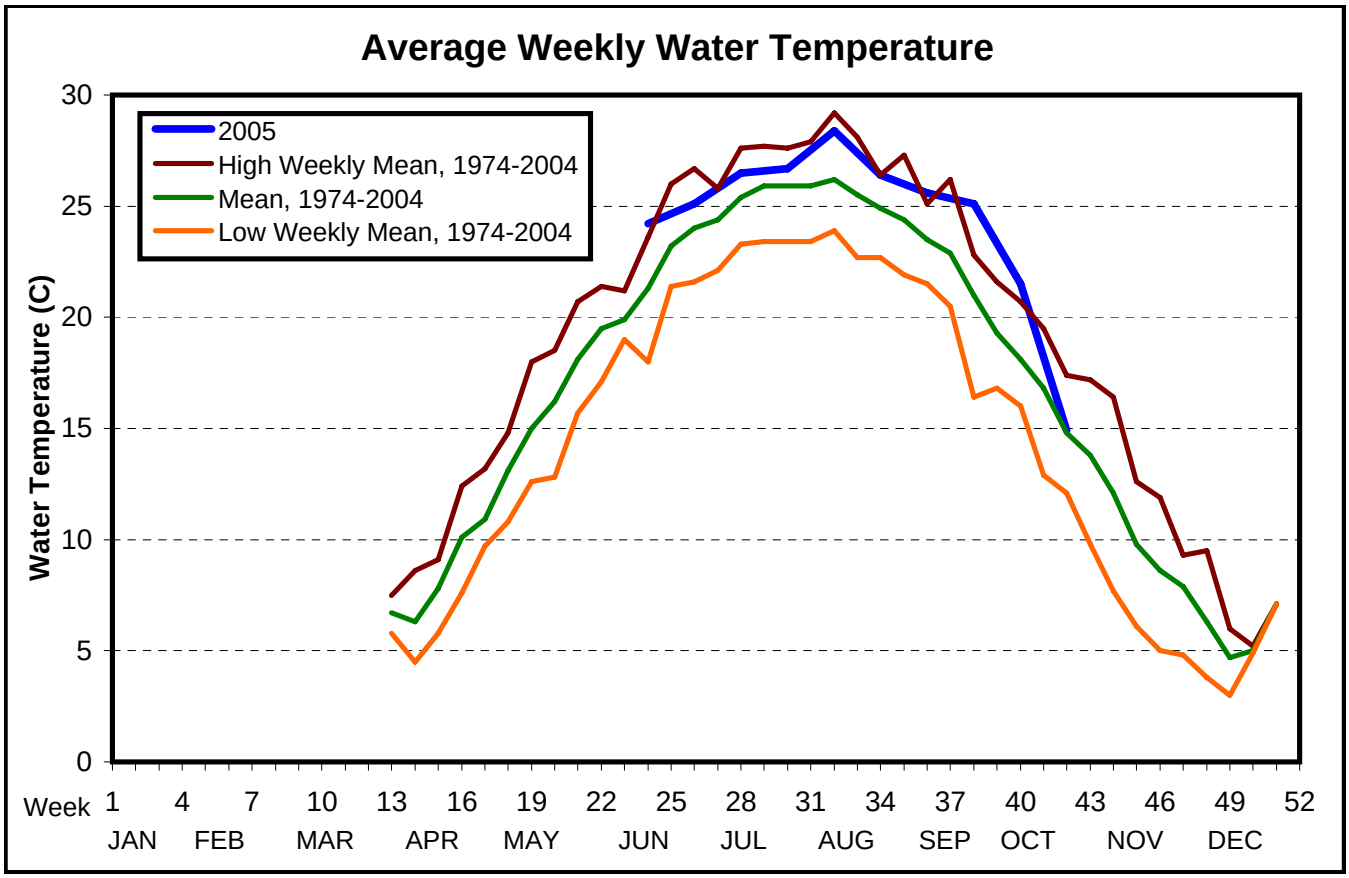


Figure 3-5. Seasonal and annual variations in water temperature from the Long River/Fall Juvenile surveys, 1974 - 2005.

Beach Seine Survey



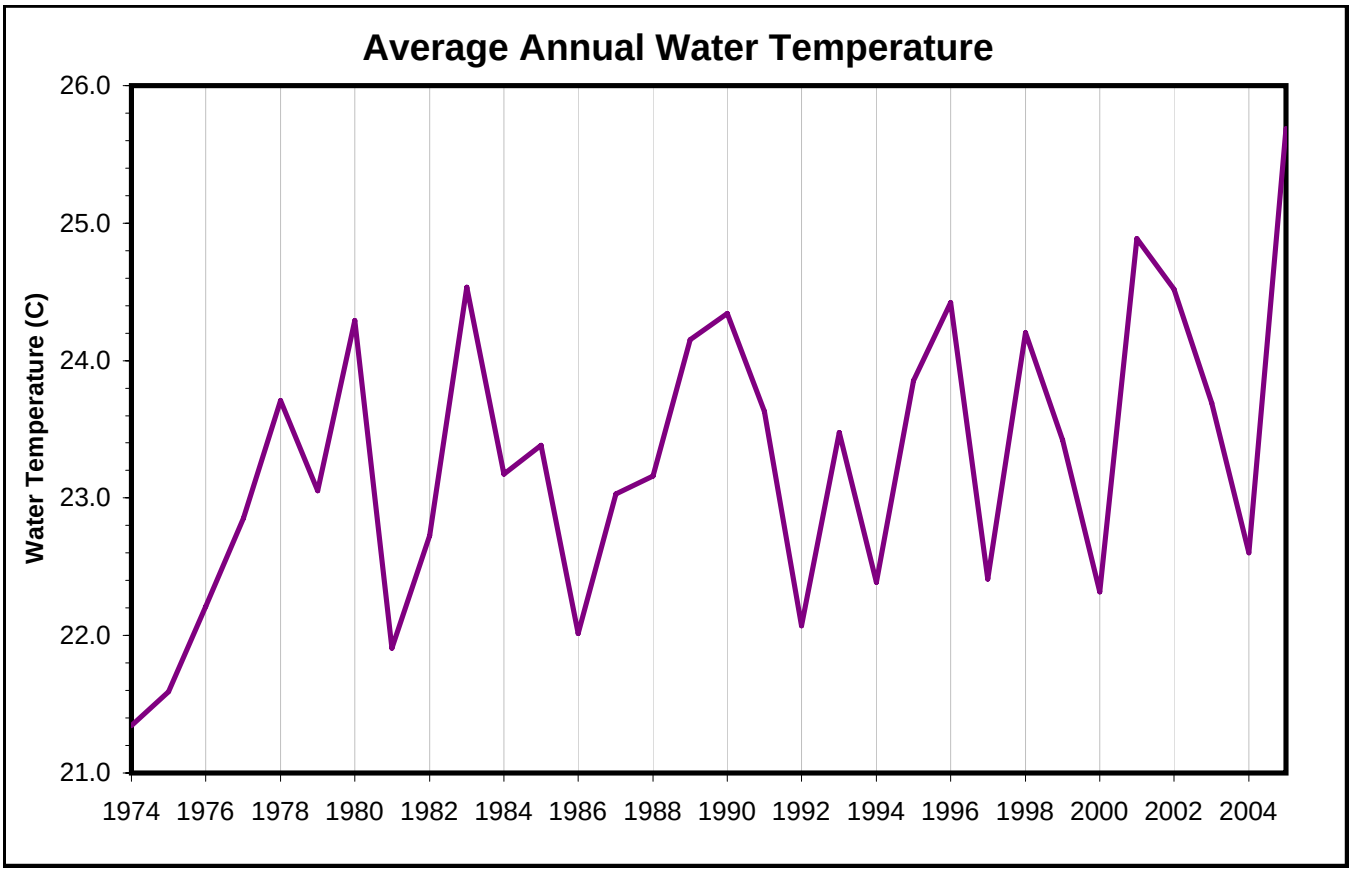


Figure 3-6. Seasonal and annual variations in water temperature from the Beach Seine surveys, 1974 - 2005.

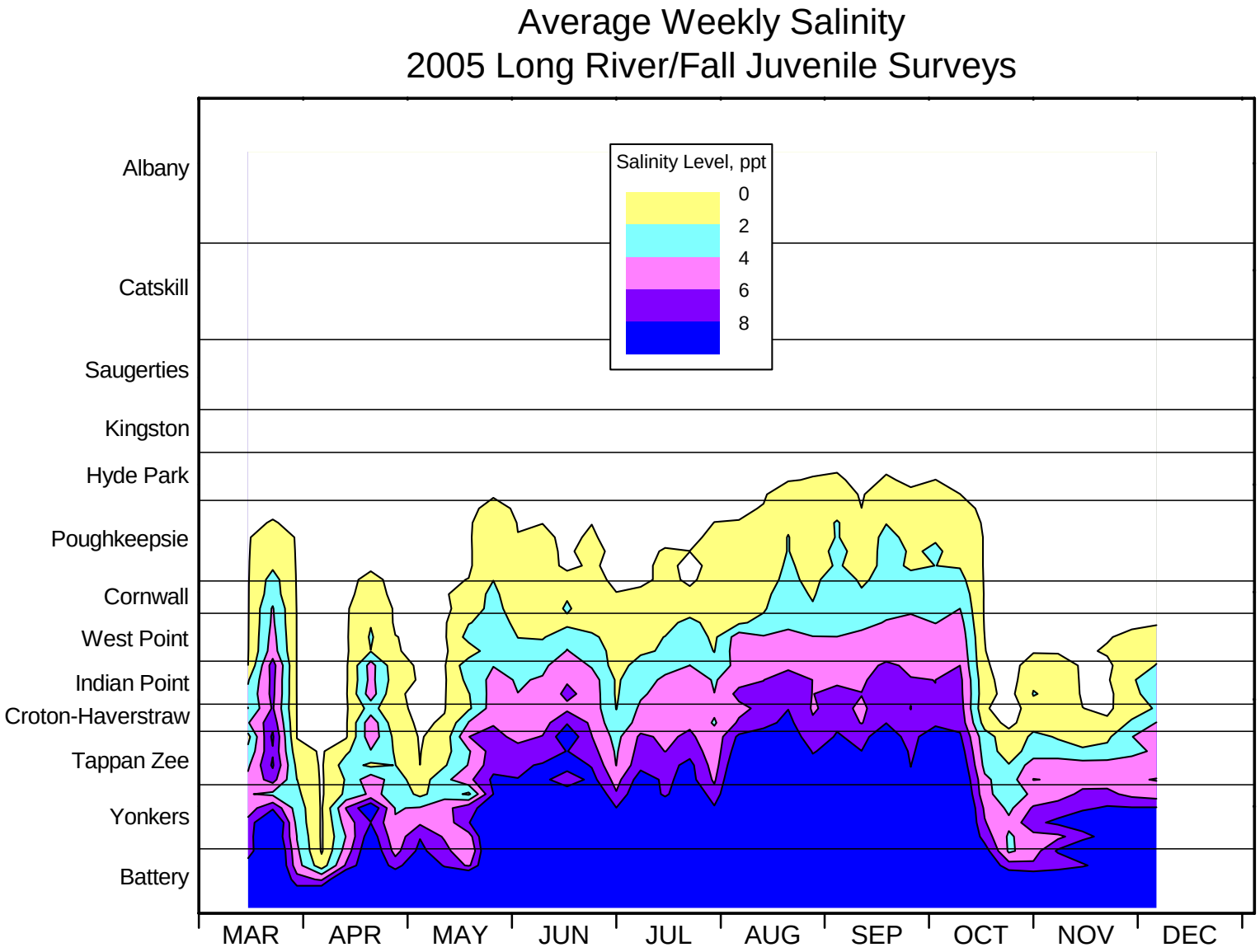
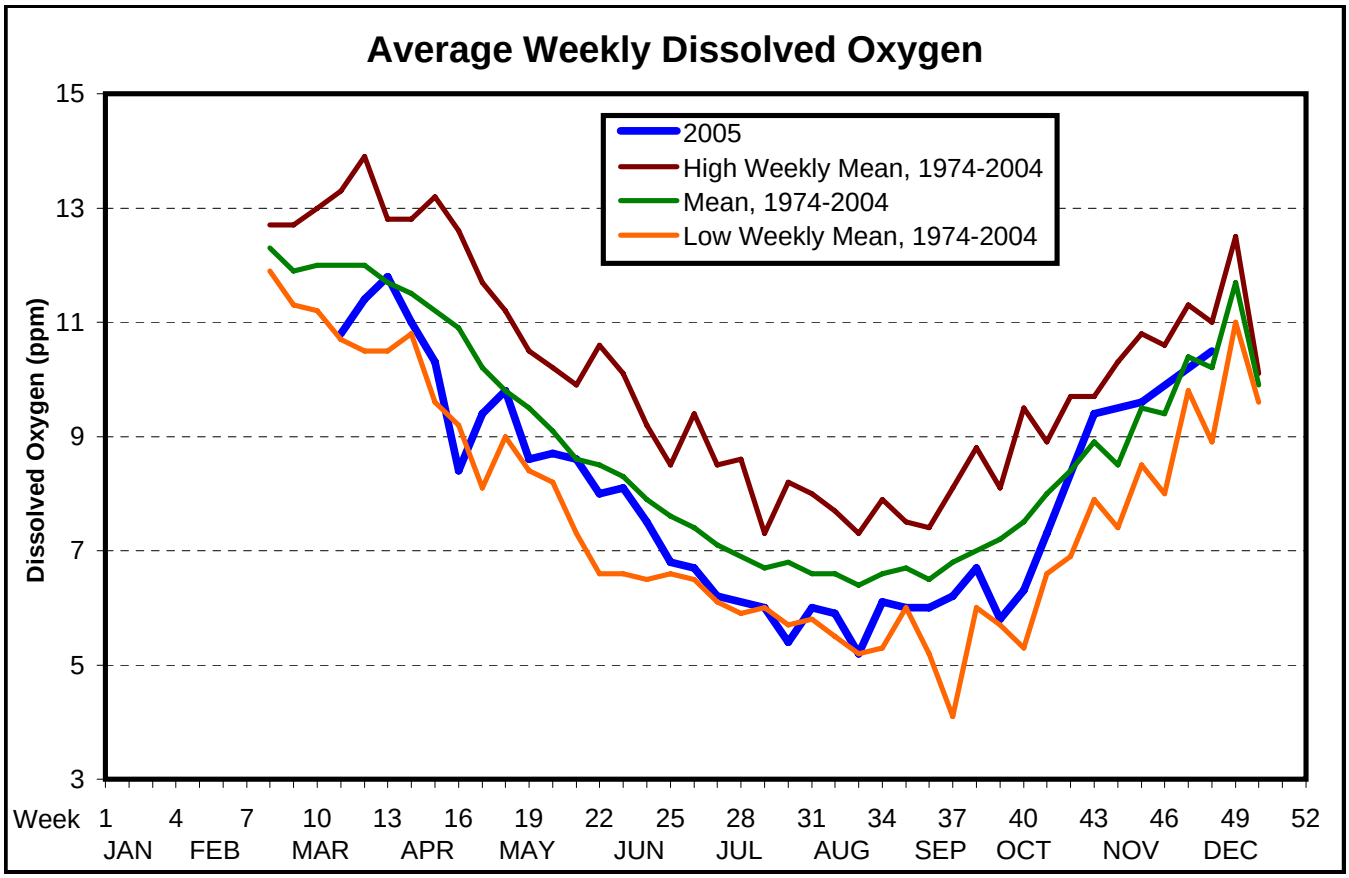


Figure 3-7. Seasonal variations in average weekly salinity from the 2005 Long River/Fall Juvenile surveys.

Long River/Fall Juvenile Survey



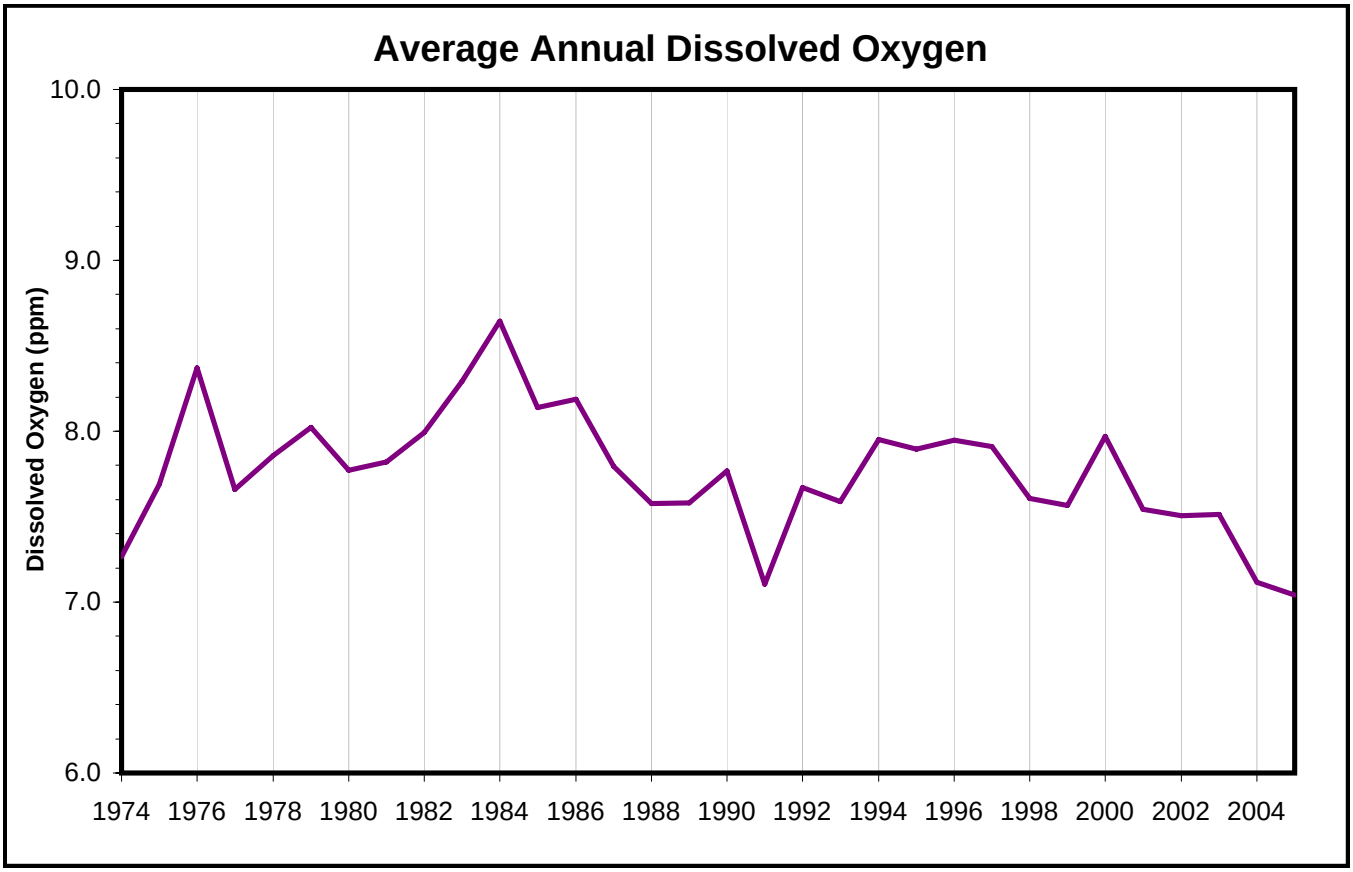
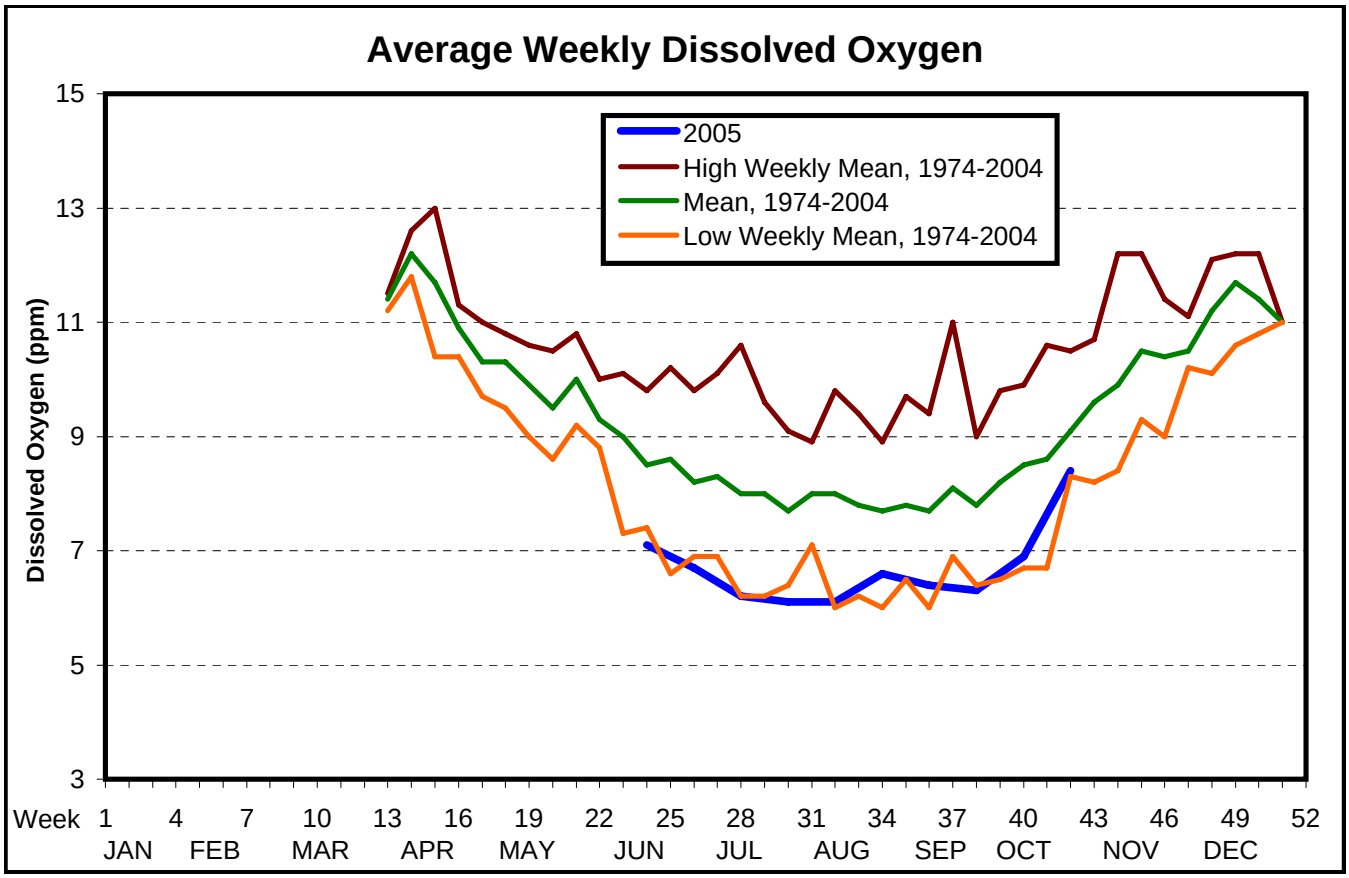


Figure 3-8. Seasonal and annual variations in dissolved oxygen from the Long River/Fall Juvenile surveys, 1974 - 2005.

Beach Seine Survey



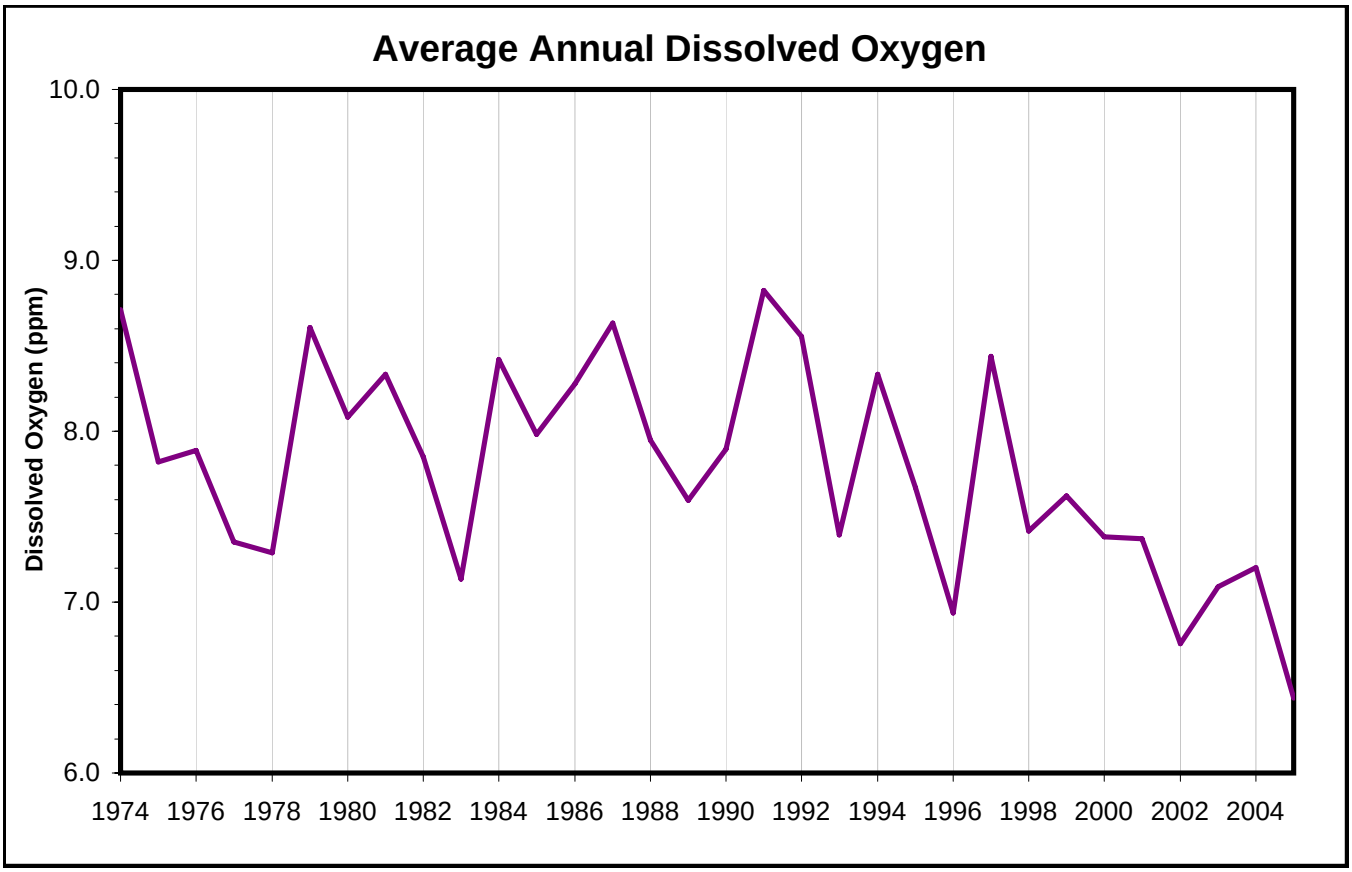


Figure 3-9. Seasonal and annual variations in dissolved oxygen from the Beach Seine surveys, 1974 - 2005.