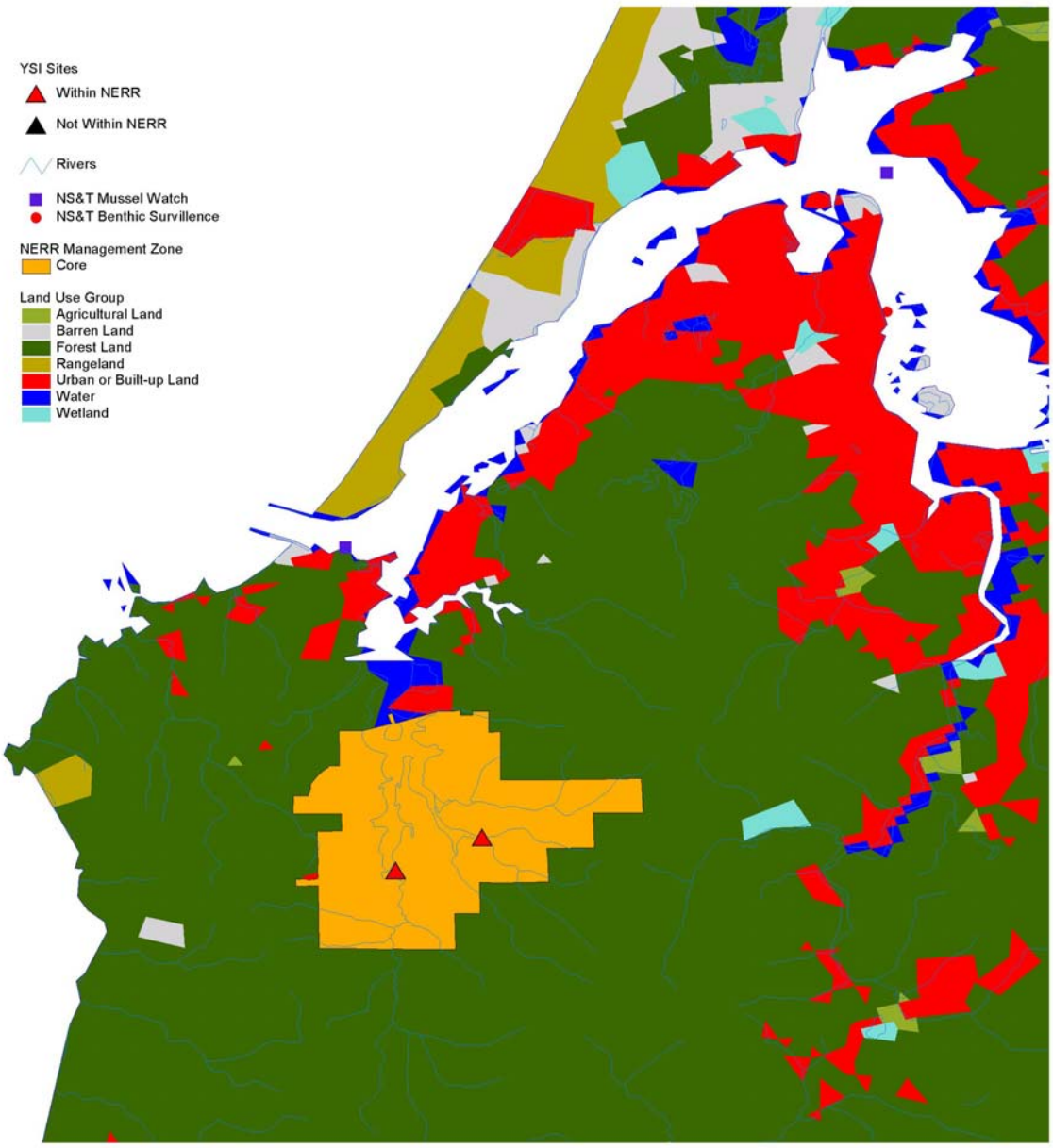
South Slough



South Slough, Stengstacken Arm (SOSSE)

Characterization

Stengstacken Arm, located approximately 7.7 km east of the mouth of the South Slough estuary in a tidal channel, functions as a reference site for this estuary. The creek/water body is about 2 km long (mainstream linear dimension), has an average depth of 5 m MHW, and an average width of about 150 m. At the sampling site, the depth is 3 m MHW. Natural marsh (4.3 ha) is located adjacent to the sampling site. Tides in South Slough are semidiurnal. Creek bottom habitats are predominantly soft mud colonized by *Zostera marina*. The dominant upland vegetation includes *Carex lyngbyei*, *Triglochin maritima*, *Distichlis spicata* and *Juncus* sp. Upland areas of the Sough Slough watershed are typical of the Coos Bay estuary watershed and include 30-50 year old mixed conifer forests, new and recovering clear-cut lands, and shrub covered slopes. The South Slough contains some stands of small trees over 80 years old and occasional specimens estimated to be well over 100 years old. Sitka spruce (*Picea sitchenis*), Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), and Port Orford cedar (*Chamaecyparis lawsoniana*) are the predominant conifers found in the upland forests. Deciduous upland trees include red alder (*Alnus rubra*) and Pacific wax myrtle (*Myrica californica*), with big leaf maple (*Acer macrophyllum*) and willows (*Salix* spp.) common in riparian areas. Upland land use near the sampling site includes commercial forestry, dairy farming, and residential development. Activities that potentially impact the site include waste from seafood processing plants, septic systems, and shore-based shipyards.

Descriptive Statistics

Twenty-six deployments were made at this site between Jan-Sep 1996, Feb-Jun 1997, Oct 1997-Jan 1998, and Nov 1998 (Figure 24). Mean deployment duration was 17.5 days. Only one deployment (May 1997) was less than 10 days.

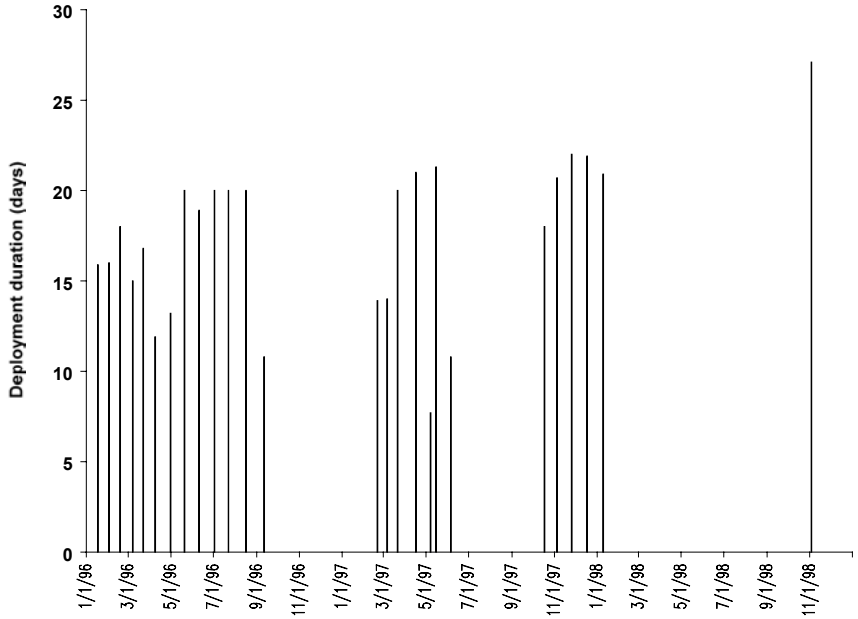


Figure 24. South Slough, Stengstacken Arm deployments (1996-1998).

Forty-six percent of annual depth data were included in analyses (64% in 1996, 50% in 1997, and 22% in 1998). Sensors were deployed at a mean depth of 0.6 m below the water surface. Scatter plots suggest strong fluctuations (> 1.5 m) in depth throughout the data set, except for Feb 1997. Harmonic regression analysis attributed 58% of depth variance to 12.42 hour cycles, 29% of depth variance to interaction between 12.42 hour and 24 hour cycles, and 13% of depth variance to 12.42 hour cycles.

Forty-three percent of annual water temperature data were included in analyses (64% in 1996, 50% in 1997, and 15% in 1998). Water temperature followed a seasonal cycle, with mean water temperatures 8-10°C in winter (1996, 1997) and 17-19°C in summer (Figure 25). Mean winter water temperature was slightly cooler in 1998 (6-8°C) than in 1996 and 1997 (8-10°C). Minimum and maximum water temperatures between 1996-1998 were 0°C (Dec 1998) and 27°C (May 1997), respectively. Scatter plots suggest strong fluctuations (≤ 5°C) in daily water temperatures and stronger fluctuations (≤ 10°C) in bi-weekly water temperatures throughout most of the data set. Harmonic regression analysis attributed 46% of temperature variance to interaction between 12.42 hour and 24 hour cycles, 44% of variance to 24 hour cycles, and 10% of variance to 12.42 hour cycles.

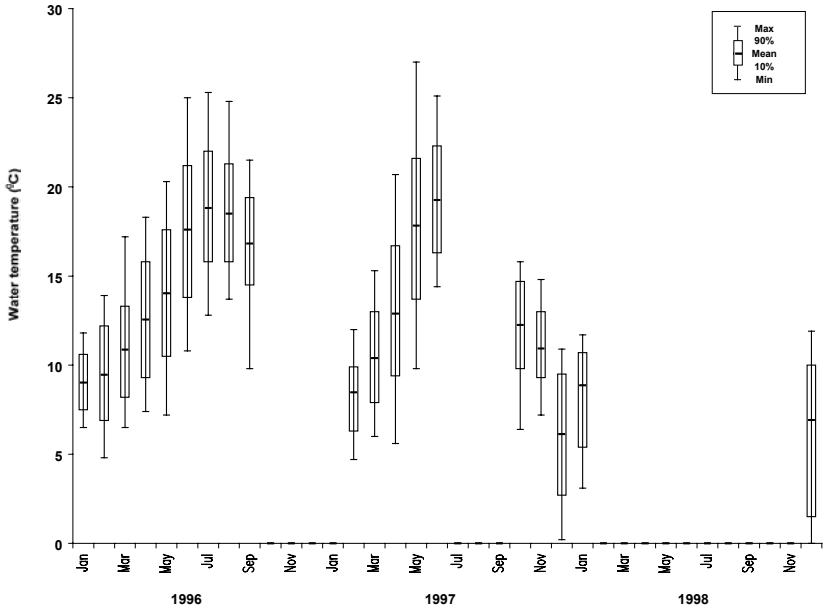


Figure 25. Water temperature statistics at Stengstacken Arm, 1996-1998.

Thirty-nine percent of annual salinity data were included in analyses (85% in 1996, 67% in 1997, and 8% in 1998). Mean salinity followed a seasonal cycle; however, very large variances (≥ 15 ppt) were associated with mean salinity readings throughout the data set (Figure 26). Mean salinity was greatest in summer 1996 (15-19 ppt) and least in winter 1996 and 1997 (≤ 5 ppt). Minimum salinity was always less than 2 ppt and maximum salinity was generally always greater than 20 ppt. Scatter plots suggest strong fluctuations in salinity equivalent to or in excess of annual variation in mean salinity (20 ppt). Harmonic regression analysis attributed 61% of salinity variance to 12.42 hour cycles, 24% of variance to interaction between 12.42 hour and 24 hour cycles, and 15% of variance to 24 hour cycles.

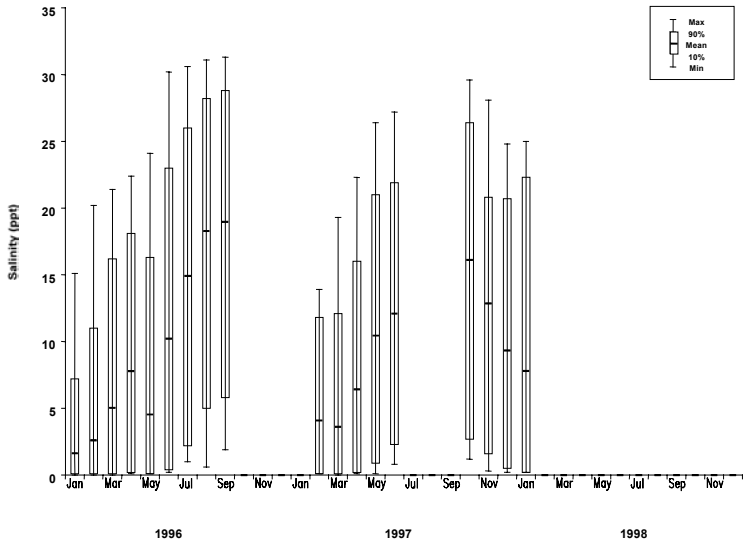


Figure 26. Salinity statistics at Stengstacken Arm, 1996-1998.

Twenty-nine percent of annual dissolved oxygen (% saturation) data were included in analyses (40% in 1996 and 1997, and 7% in 1998). Mean DO ranged from 69-99% saturation. Minimum and maximum DO were 0% saturation (Sep 1996) and 230.2% saturation (May 1997), respectively. Hypoxia was observed in one month (May 1997) and persisted for 2% of the first 48 hours post-deployment (Figure 27). Supersaturation was regularly observed in 1996 and 1997 and, when present, supersaturation persisted for 8.4% of the first 48 hours post-deployment on average. Scatter plots suggest minor fluctuations in percent saturation (20-40%) throughout the data set, with strong fluctuations (60-100%) observed for episodic events in summer 1996 and spring 1997. Harmonic regression analysis attributed 41% of DO variance to 24 hour cycles, 26% of DO variance to 12.42 hour cycles, and 33% of DO variance to interaction between 12.42 hour and 24 hour cycles.

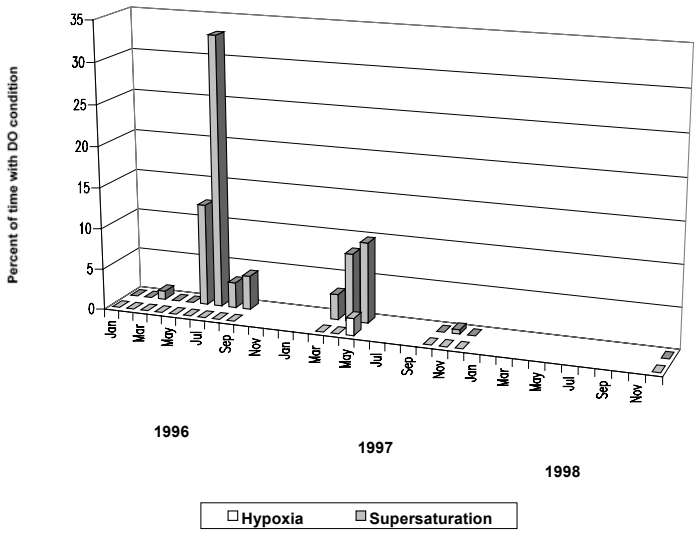


Figure 27. Dissolved oxygen extremes at Stengstacken Arm, 1996-1998.

South Slough, Winchester Arm (SOSWI)

Characterization

Winchester Arm is located in a tidal channel approximately 7.3 km west of the mouth of the South Slough estuary and serves as a management-treatment site. Winchester Arm is adjacent to the Winchester Tidelands Restoration Project, where dikes were removed from a 5.1 ha area in 1996 and 1998. Natural marsh (4.2 Ha) surrounds the project site. Winchester Arm is about 3 km long (mainstream linear dimension) and has an average depth of 6 m MHW. At the sampling site, the length is about 200 m, the width is about 30 m, and the depth is about 3 m MHW. Creek bottom habitats are predominantly soft mud colonized by *Zostera marina*. The dominant marsh vegetation near the sampling site is *Carx lyngbyei*, *Triglochin maritima*, *Distichlis spicata* and *Juncus* sp. Upland areas of the Sough Slough watershed are typical of the Coos Bay estuary watershed and include 30-50 year old mixed conifer forests, new and recovering clear-cut lands, and shrub covered slopes. The South Slough contains some stands of small trees over 80 years old and occasional specimens estimated to be well over 100 years old. Sitka spruce (*Picea sitchenis*), Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), and Port Orford cedar (*Chamaecyparis lawsoniana*) are the predominant conifers found in the upland forests. Upland deciduous trees include red alder (*Alnus rubra*) and Pacific wax myrtle (*Myrica californica*), with big leaf maple (*Acer macrophyllum*) and willows (*Salix* sp.) common in riparian areas. Upland land use near the sampling site includes commercial forestry, dairy farming, and residential development. Activities that potentially impact the site include waste from seafood processing plants, septic systems, and shipyards.

Descriptive Statistics

Twenty-eight deployments were made at this site between Jan-Aug 1996, Mar-Jun 1997, Oct 1997-Jan 1998, and Mar, Jul, Nov 1998 (Figure 28). Mean deployment duration was 16.9 days. Four deployments (Aug 1996; Apr, Jun 1997; Jul 1998) were less than 10 days.

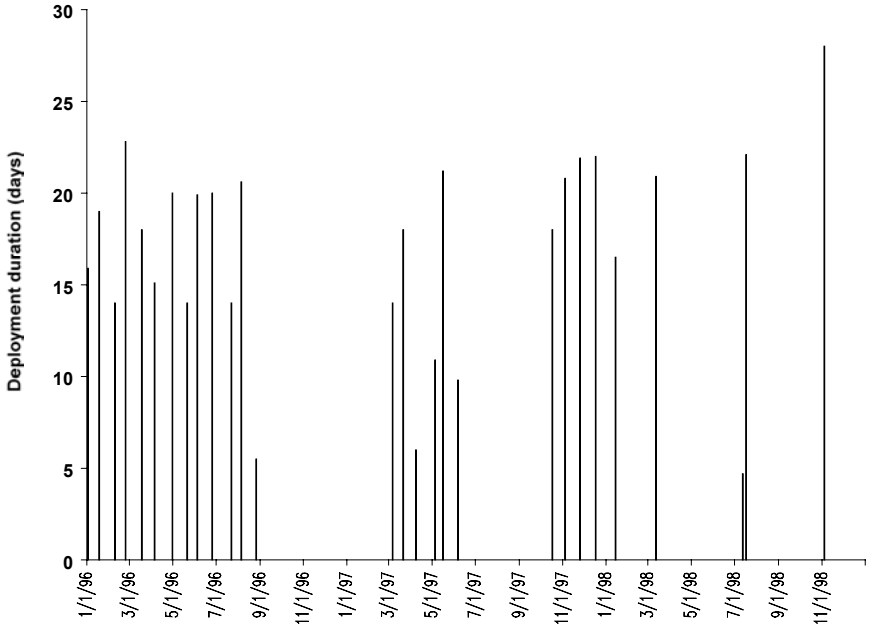


Figure 28. South Slough, Winchester Arm deployments (1996-1998).

Thirty-nine percent of annual depth data were included in analyses (53% in 1996, 39% in 1997, and 25% in 1998). Sensors were deployed at a mean depth of 1 m below the water surface. Scatter plots suggest strong fluctuations (≥ 2 m) in depth throughout the data set. Harmonic regression analysis attributed 67% of depth variance to 12.42 hour cycles, 17% of depth variance to 24 hour cycles, and 16% of depth variance to interaction between 12.42 hour and 24 hour cycles.

Forty-five percent of annual water temperature data were included in analyses (59% in 1996, 40% in 1997, and 35% in 1998). Water temperature followed a seasonal cycle, with mean water temperatures 8-10°C in winter and 17-19°C in summer (Figure 29). Minimum and maximum water temperatures were 1.2°C (Dec 1996) and 25°C (Jul 1998), respectively. Scatter plots suggest strong fluctuations (≤ 3°C) in daily water temperature and stronger fluctuations (≤ 7°C) in bi-weekly water temperature throughout the data set, particularly in spring and summer. Harmonic regression analysis attributed 39% of temperature variance to 24 hour cycles, 28% of temperature variance to 12.42 hour cycles, and 33% of temperature variance to interaction between 12.42 hour and 24 hour cycles.

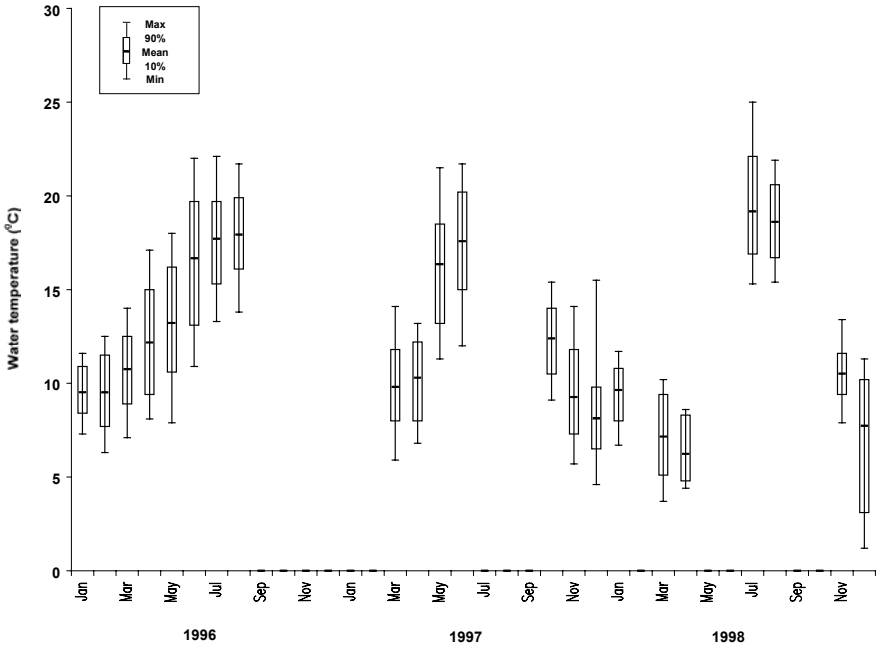


Figure 29. Water temperature statistics at Winchester Arm, 1996-1998.

Forty percent of annual salinity data were included in analyses (59% in 1996, 36% in 1997, and 25% in 1998). Mean salinity followed a seasonal cycle; however, large variances (≥ 20 ppt) were associated with mean salinity readings throughout the data set (Figure 30). Mean salinity was greatest (17-20 ppt) in summer and least in winter (< 5 ppt). Minimum salinity was always less than 2 ppt, except for Aug 1996 (4 ppt). Maximum salinity was always greater than 15 ppt, except for Apr 1998 (14.2 ppt). Scatter plots suggest bi-weekly fluctuations in salinity equivalent to or in excess of annual variation in mean salinity (15 ppt). Harmonic regression analysis attributed 55% of salinity variance to 12.42 hour cycles, 28% of salinity variance to interaction between 12.42 hour and 24 hour cycles, and 17% of salinity variance to 24 hour cycles.

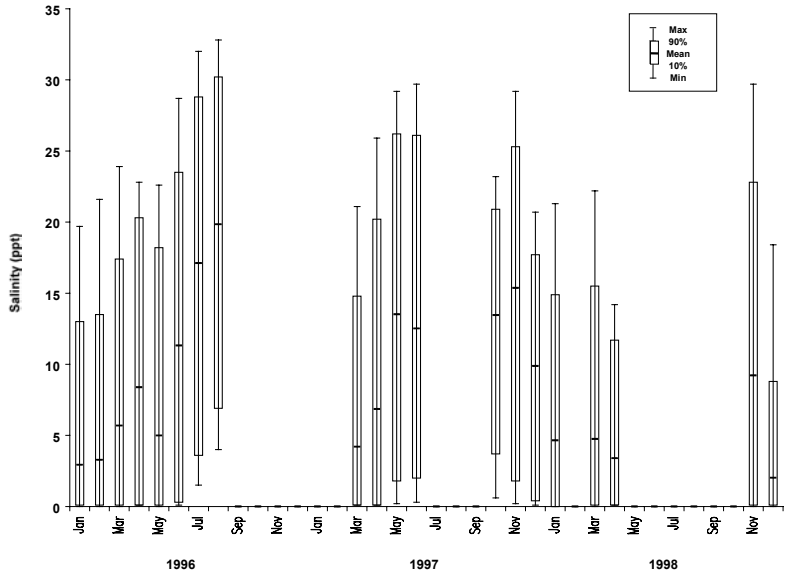


Figure 30. Salinity statistics at Winchester Arm, 1996-1998.

Thirty-one percent of annual dissolved oxygen (% saturation) data in 1996 and 17% of DO data in 1997 were included in analyses. Mean DO ranged from 64-111% saturation. Minimum and maximum DO was 10.9% saturation (Aug 1996) and 149% saturation (May 1997), respectively. Hypoxia was observed in one month (Jul 1996) and lasted 1% of the first 48 hours post-deployment (Figure 31). Supersaturation was observed in four months (May, Jul, Aug 1996 and May 1997) and, when present, supersaturation persisted for 14.2% of the first 48 hours post-deployment on average. Scatter plots suggest 20-40% fluctuation in percent saturation throughout the data set, with ≥100% fluctuation in Aug 1996 and Jun 1997. Harmonic regression analysis attributed 40% of DO variance to 24 hour cycles, 33% of DO variance to interaction between 12.42 hour and 24 hour cycles, and 27% of DO variance to 12.42 hour cycles.

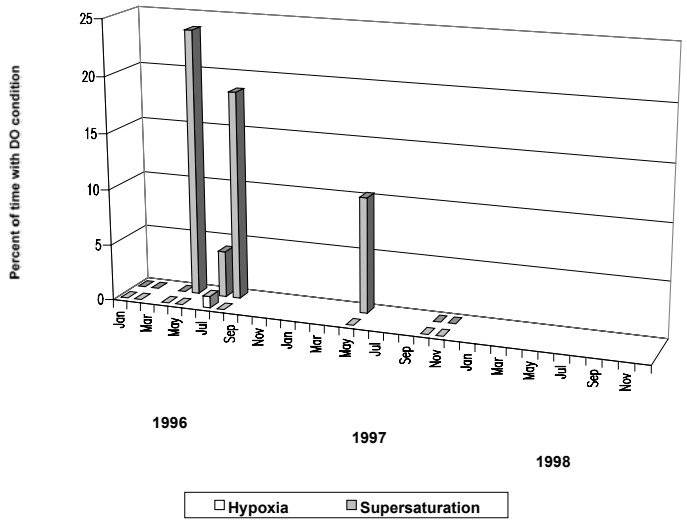


Figure 31. Dissolved oxygen extremes at Winchester Arm, 1996-1998.