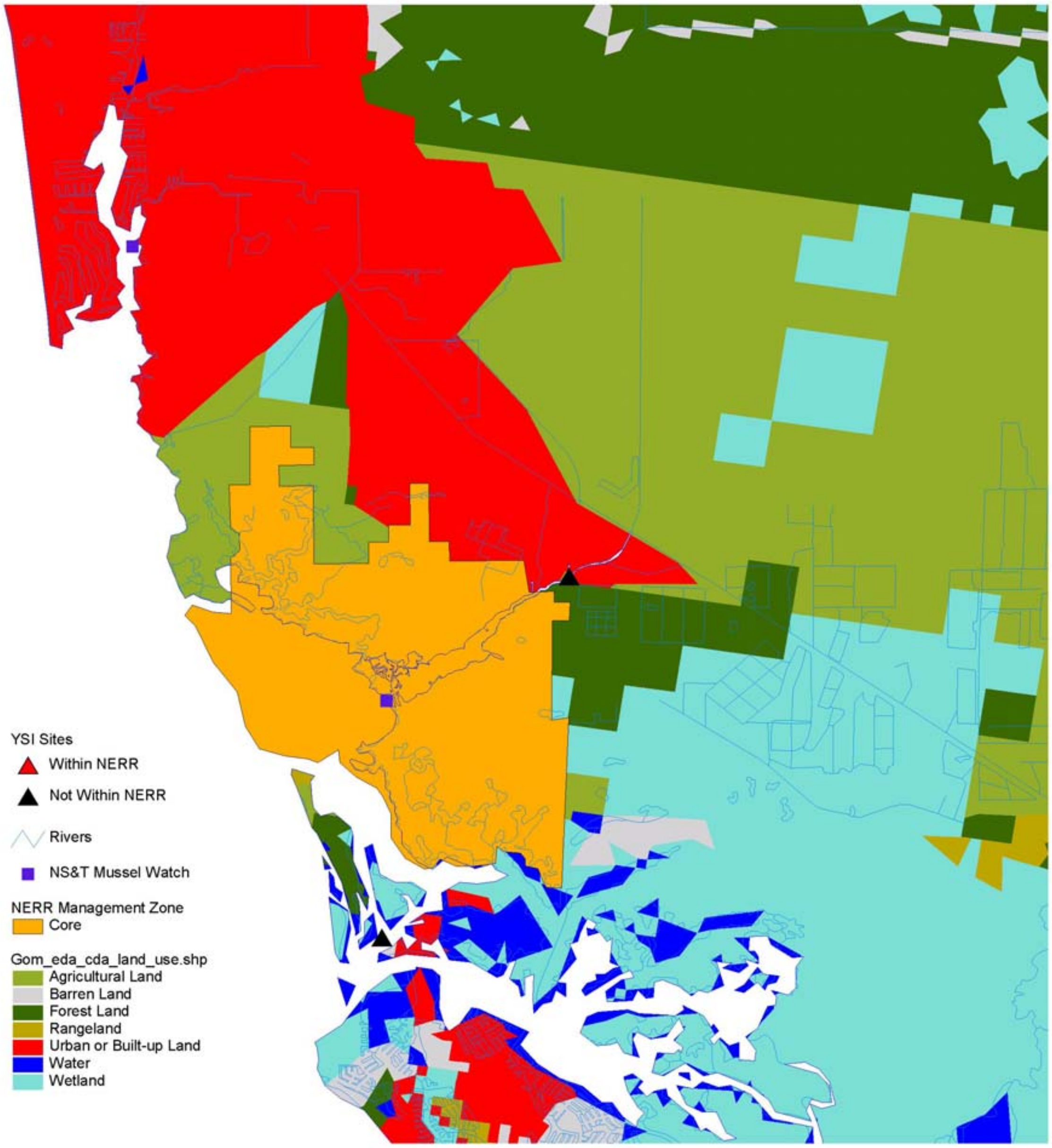
Rookery Bay


YSI Sites
Within NERR
Not Within NERR
Rivers
NS&T Mussel Watch
NERR Management Zone
Core
Gom_eda_cda_land_use.shp
Agricultural Land
Barren Land
Forest Land
Rangeland
Urban or Built-up Land
Water
Wetland

Rookery Bay, Blackwater River (RKBBR)

Characterization (Latitude = 25° 58'04" N; Longitude = 81° 35'27" W)
Tides at Blackwater River are mixed and range from 0 m to 1.71 m (average 0.73 m). The monitoring site is located 2.1 km downstream of the headwaters (near a dredged boat basin) at a juncture leading to a small bay named Mud Bay. Blackwater River is roughly 7.5 km long (mainstream linear dimension), has an average mid-channel depth of 2 m MHW, and an average width of 193 m. At the sampling site, the water depth is approximately 2 m MHW and the width is 35 m. This site is located within the mesohaline region of the estuary. Creek bottom habitats are predominantly fine sand and there is no bottom vegetation. The dominant bank vegetation near the sampling site is red mangrove. The dominant natural vegetation of the watershed is hydric pine and cypress. Upland land use near the sampling site includes Collier Seminole State Park and a boat basin located approximately 2.1 km upstream. Activities that potentially impact the site include agricultural runoff, runoff from a two-lane highway (SR 41) and altered flow regimes in the watershed due to canals. The Blackwater River watershed is managed by public ownership (90%) and much of this protected area has intact cypress sloughs and other wetland vegetation. Due to greater natural mangrove buffer and less intensive watershed land uses, the Blackwater system represents a more pristine estuarine habitat relative to Henderson Creek.

Descriptive Statistics
Twenty-one deployments were made at this site between Feb-Dec 1998, with equal coverage during all seasons (Figure 175). Mean deployment duration was 14.3 days. Only one deployment (Sep) was less than 10 days.

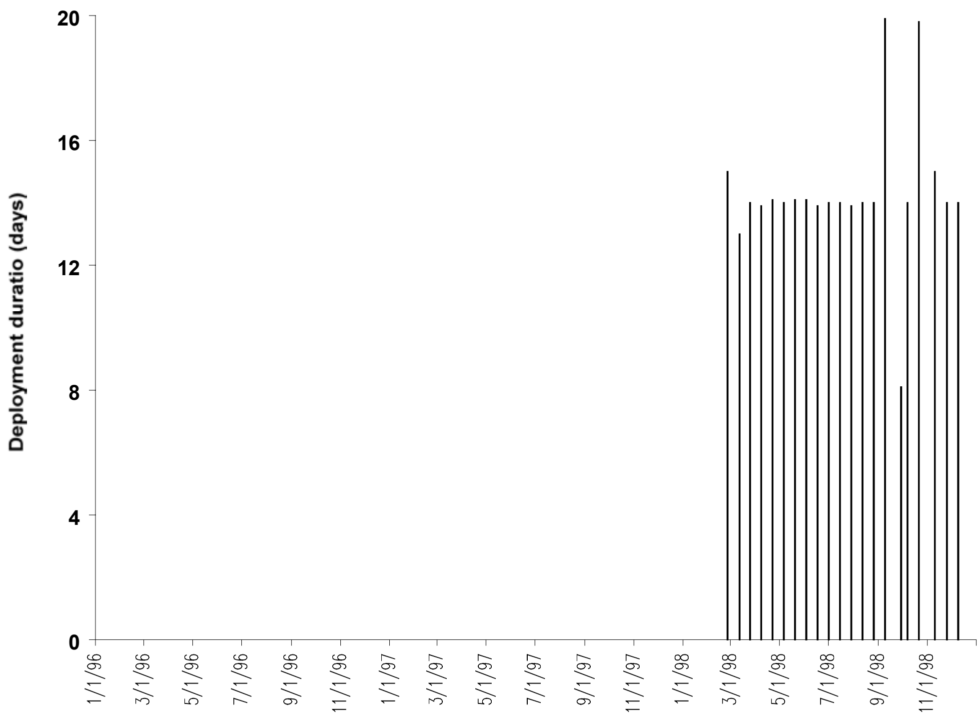


Figure 175. Rookery Bay, Blackwater River deployments (1996-1998).

Eighty-five percent of depth data in 1998 were included in analyses. Sensors were deployed at a mean depth of 1.7 m below the water surface and 0.2 m above the bottom sediment. Scatter plots suggest moderate daily and bi-weekly fluctuations (0.5-0.8 m) throughout 1998. Harmonic regression analysis attributed 46% of depth variance to 12.42 hour cycles, 43% of depth variance to interaction between 12.42 hour and 24 hour cycles, and 11% of depth variance to 24 hour cycles.

Eighty-five percent of water temperature data in 1998 were included in analyses. Water temperature followed a seasonal cycle, with mean water temperatures 22-25°C in spring and fall and 28-31°C in summer (Figure 176). Minimum and maximum water temperature between 1996-1998 was 15°C (Mar 1998) and 35.4°C (Jul 1998), respectively. Scatter plots suggest strong fluctuations (2-4°C) in daily water temperature, with stronger fluctuations (4-10°C) in bi-weekly water temperature. Harmonic regression analysis attributed 51% of temperature variance to interaction between 12.42 hour and 24 hour cycles, 40% of variance to 24 hour cycles, and 9% of variance to 12.42 hour cycles.

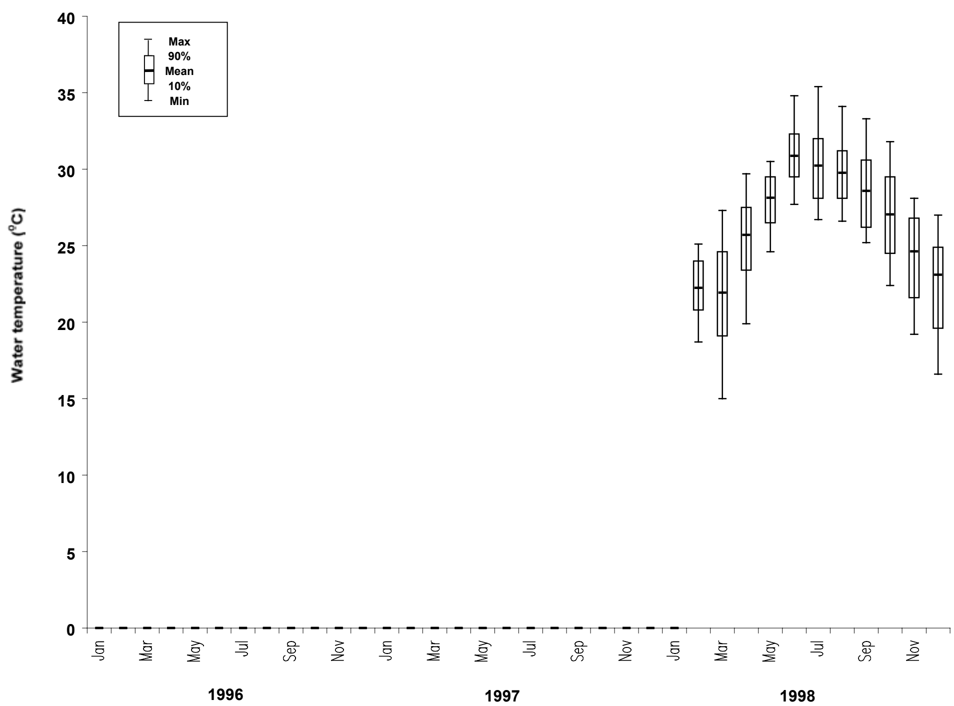


Figure 176. Water temperature statistics at Blackwater River, 1996-1998.

Eighty-five percent of salinity data in 1998 were included in analyses. Salinity followed a seasonal cycle, with mean salinity 27-33 ppt in Apr-Jun and 9-13 ppt in Aug-Nov; however, large variances (15-25 ppt) were associated with mean salinity values throughout the data set (Figure 177). Minimum and maximum salinity in 1998 was 1.4 ppt (Sep) and 36 ppt (May), respectively. Scatter plots suggest large fluctuations (≤ 5 ppt) in daily salinity and even larger fluctuations (5-15 ppt) in bi-weekly salinity. Harmonic regression analysis attributed 47% of salinity variance to interaction 12.42 hour and 24 hour cycles, 38% of salinity variance to 12.42 hour cycles, and 15% of salinity variance to 24 hour cycles.

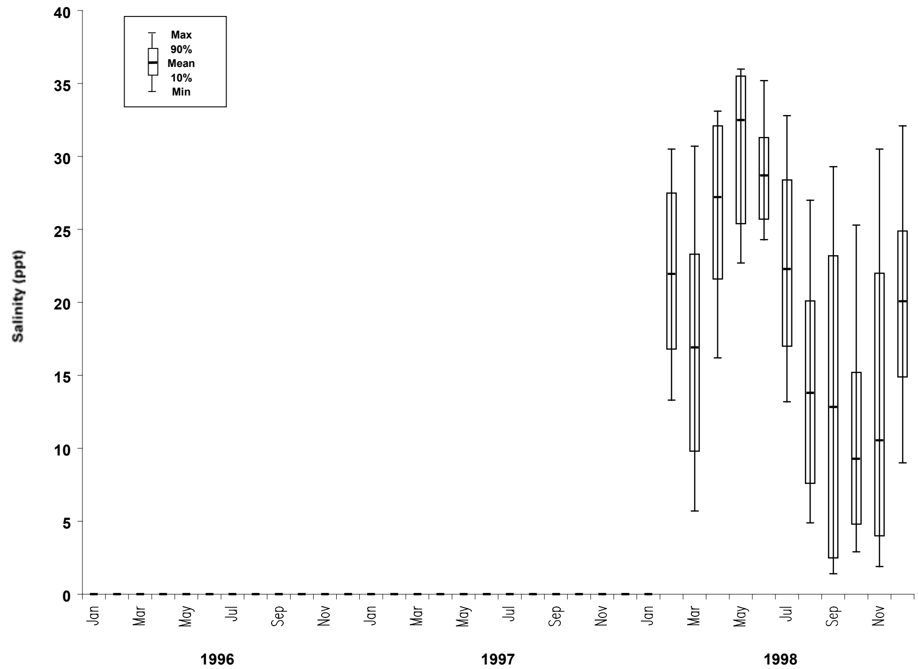


Figure 177. Salinity statistics at Blackwater River, 1996-1998.

Sixty-one percent of dissolved oxygen (% saturation) data in 1998 were included in analyses. Mean DO was greatest in Mar-Jun (36-60% sat) and least in Jul-Oct (16-20% sat). Mean DO < 1% saturation and was observed in Jul, Aug, and Oct. Mean DO was 54-130% saturation. Hypoxia was observed from May to Dec and, when present, persisted for 45.8% of the first 48 hours post-deployment (Figure 178). Supersaturation was only observed in Mar 1998 and persisted for 2% of the first 48 hours post-deployment. With exception of Mar 1998, fluctuations in daily and bi-weekly percent saturation were 20-100%. Harmonic regression analysis attributed 61% of DO variance to interaction between 12.42 hour and 24 hour cycles, 22% of DO variance to 24 hour cycles, and 17% of DO variance to 12.42 hour cycles.

Photosynthesis/Respiration

Over three quarters (79%) of the data used to calculate the metabolic rates fit the basic assumption of the method (heterogeneity of water masses moving past the sensor) and was used to estimate net production, gross production, total respiration and net ecosystem metabolism (Table 34). Instrument drift during the duration of the deployments was not a significant problem at this site. Total respiration greatly exceeded gross production at Blackwater River; thus, the net ecosystem metabolism and P/R ratio indicated that this was the most heterotrophic site in the Reserve system (Figure 179). In addition to being the most heterotrophic site, this was also the only site that never had a single day when it was autotrophic. Temperature was significantly ($p<0.05$) correlated with total respiration and net ecosystem metabolism. Respiration increased as temperature increased, while net ecosystem metabolism became more heterotrophic as temperature increased. Salinity was significantly ($p<0.05$) correlated with gross production and net ecosystem metabolism. Gross production increased as salinity increased, while net ecosystem became more autotrophic as salinity increased.

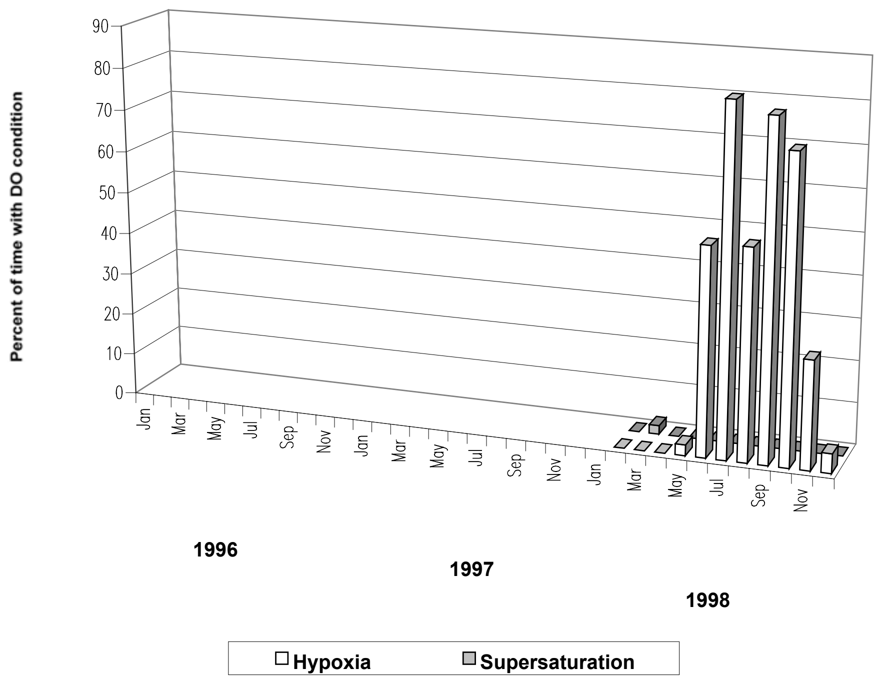


Figure 178. Dissolved oxygen extremes at Blackwater River, 1996-1998.

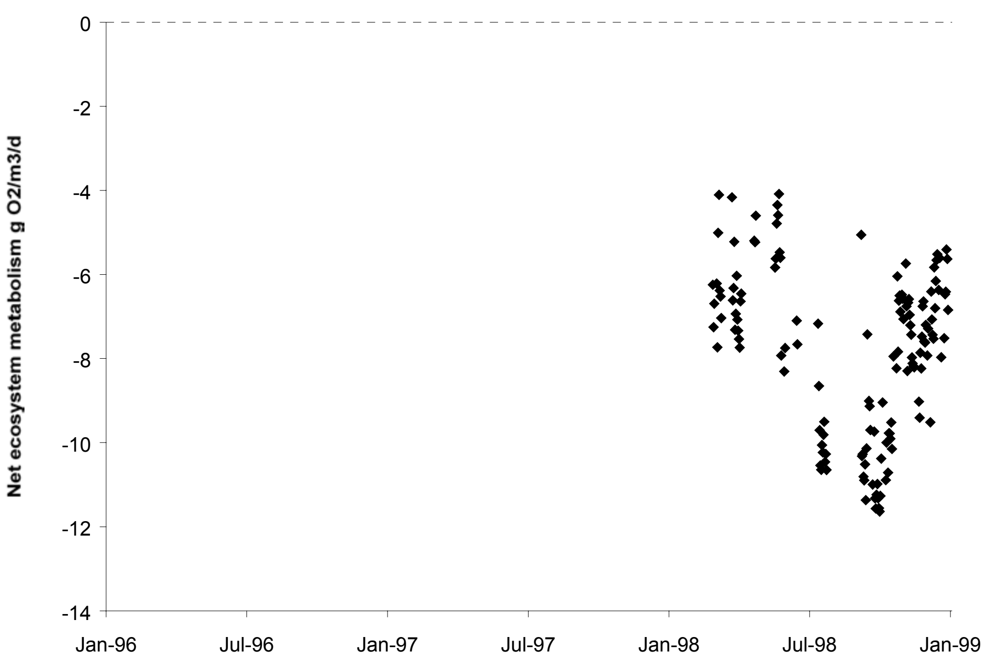


Figure 179. Net metabolism at Blackwater River, 1996-1998.

Table 34. Summary of metabolism data and statistics at Blackwater River, 1996-1998.

Blackwater River	mean	s.e.
Water depth (m)	2.0	
Net production gO_2/m3/d	-0.78	0.10
Gross production gO_2/m3/d	2.21	0.15
Total respiration gO_2/m3/d	6.14	0.15
Net ecosystem metabolism g O_2/m3/d	-3.92	0.09
Net ecosystem metabolism g C/m2/y	-1074	
P/R	0.36	
Statistical results		
Drift – paired t-test		
Gross production	ns	
Total respiration	ns	
Net ecosystem metabolism	ns	
Percent useable observations	79 %	
Paired t-test on gross production and total respiration	$p < 0.001$	
Correlation coefficient	Temperature	Salinity
Gross production	ns	0.24
Total respiration	0.36	ns
Net ecosystem metabolism	-0.51	0.48

Rookery Bay, Upper Henderson Creek (RKBUH)

Characterization (Latitude = 26° 02' 56" N; Longitude = 81° 42' 04" W)
Tides at Upper Henderson Creek are mixed and range from 0 m to 2.76 m (average 1.06 m). The monitoring site is located in upper Henderson Creek, approximately 130 m downstream of a four-lane highway (SR 951) that crosses the creek. The creek is 4.4 km long (mainstream linear dimension), has an average mid-channel depth of approximately 2 m MHW, and an average width of 239 m. At the sampling site, the depth is 2 m MHW and the width is 40 m. This site is within the mesohaline region of the estuary. Creek bottom habitats are predominantly fine sand and there is no bottom vegetation. The dominant marsh vegetation near the sampling site is red mangrove. The dominant natural vegetation of the watershed is hydric pine and cypress. Upland land use near the sampling site includes residential areas with septic systems. Watershed activities that potentially impact the site include non-point source pollution from road runoff, drift of mosquito control pesticides, runoff from upstream agricultural areas and leachate from nearby residential septic systems. The amount of water released from this weir can sometimes overwhelm natural tidal salinity patterns. The historic Henderson Creek watershed is approximately 50% under public ownership and much of this protected area has intact cypress sloughs and other wetland vegetation. Canals and water use for agriculture and human consumption have altered the hydroperiod of this watershed. Consequently, the Henderson watershed receives non-point source pollutant runoff from a variety of sources.

Descriptive Statistics
Fifty-two deployments were made at this site between Nov 1996 and Dec 1998, with equal coverage during all seasons (Figure 180). Mean deployment duration was 14.9 days and only two deployments (Nov 1996, Sep 1998) were less than 10 days.

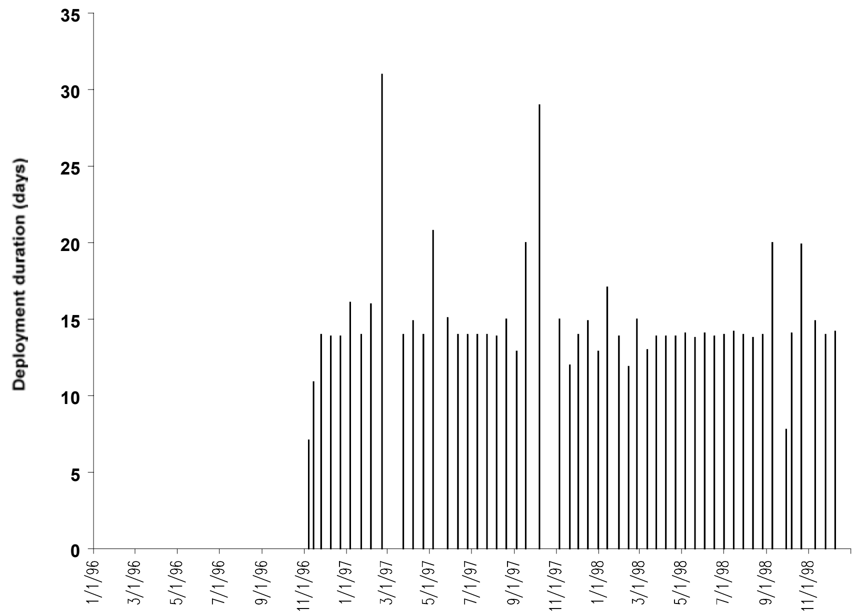


Figure 180. Rookery Bay, Upper Henderson Creek deployments (1996-1998).

Sixty-eight percent of annual depth data were included in analyses (15% in 1996, 94% in 1997, and 95% in 1998). Sensors were deployed at a mean depth of 1 m below the water surface and 0.2 m above the bottom sediment. Scatter plots suggest strong fluctuations (1-1.2 m) in depth throughout the data set. Harmonic regression analysis attributed 45% of depth variance to interaction between 12.42 hour and 24 hour cycles, 41% of depth variance to 12.42 hour cycles, and 14% of depth variance to 24 hour cycles.

Sixty-eight percent of annual water temperature data were included in analyses (15% in 1996, 94% in 1997, and 95% in 1998). Water temperature followed a seasonal cycle, with mean water temperatures 21-24°C in winter and 29-30°C in summer (Figure 181). Minimum and maximum water temperatures between 1996-1998 were 13.3°C (Jan 1997) and 34.1°C (Jul 1998), respectively. Scatter plots suggest strong fluctuations (≤ 3°C) in daily water temperature and even stronger fluctuations (5-10°C) throughout the data set, with strongest fluctuations in winter. Harmonic regression analysis attributed 56% of temperature variance to interaction between 12.42 hour and 24 hour cycles, 33% of temperature variance to 24 hour cycles, and 11% of temperature variance to 12.42 hour cycles.

Sixty-seven percent of annual salinity data were included in analyses (14% in 1996, 94% in 1997, and 95% in 1998). Salinity at this site is affected by alterations in natural timing and quantities of freshwater inflow due to the operation of a weir that is situated at the creek's headwaters. Mean salinity was least in summer (5-10 ppt) and greatest in winter (28 ppt, 1997), although mean winter salinity was much greater in 1998 (10-15 ppt) than in 1997 (Figure 182). Scatter plots suggest strong fluctuations (5-10 ppt) in salinity, with very strong fluctuations (≥ 15 ppt) during episodic events in Jul, Aug, Oct and Dec 1997 and most of 1998. Harmonic regression analysis attributed 65% of salinity variance to interaction between 12.42 hour and 24 hour cycles, 19% of salinity variance to 24 hour cycles, and 16% of salinity variance to 12.42 hour cycles.

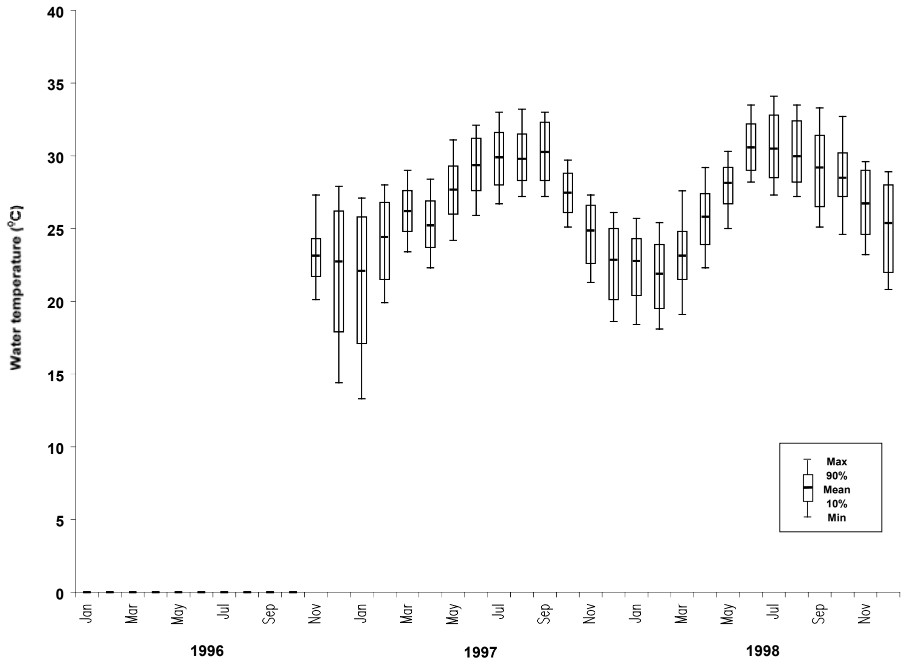


Figure 181. Water temperature statistics at Upper Henderson Creek, 1996-1998.

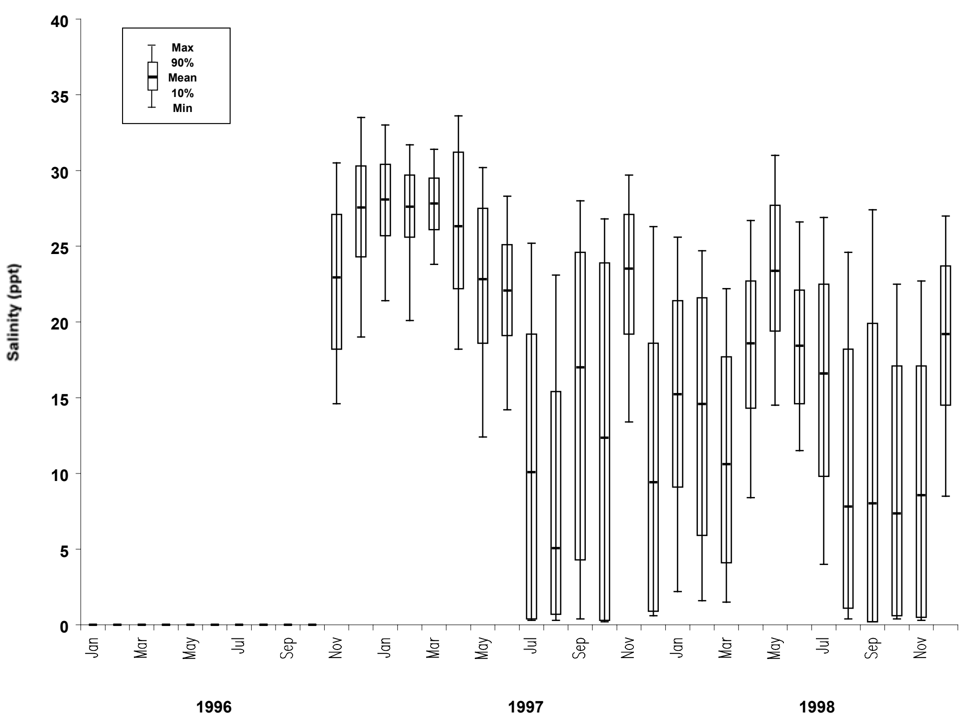


Figure 182. Salinity statistics at Upper Henderson Creek, 1996-1998.

Fifty-two percent of annual dissolved oxygen (% saturation) data were included in analyses (15% in

1996, 77% in 1997, and 65% in 1998). Mean DO followed a seasonal cycle, with mean DO between 50-100% saturation in winter and spring and mean DO between 30-50% saturation in summer (except Aug 1997) and fall. Minimum and maximum DO between 1996-1998 was 0% saturation (Jul 1997, Mar-May 1998) and 285.3% saturation (Dec 1996), respectively. Hypoxia was regularly observed in 1998 and summer 1997 (Figure 183). When present, hypoxia persisted for 21.8% of the first 48 hours post-deployment on average. Supersaturation was only observed in Dec and Jan and, when present, supersaturation persisted for 15.8% of the first 48 hours post-deployment on average. Scatter plots suggest strong fluctuations (40-100%) in percent saturation throughout the data set. Harmonic regression analysis attributed 49% of DO variance to interaction between 12.42 hour and 24 hour cycles, 40% of DO variance to 24 hour cycles, and 11% of DO variance to 12.42 hour cycles.

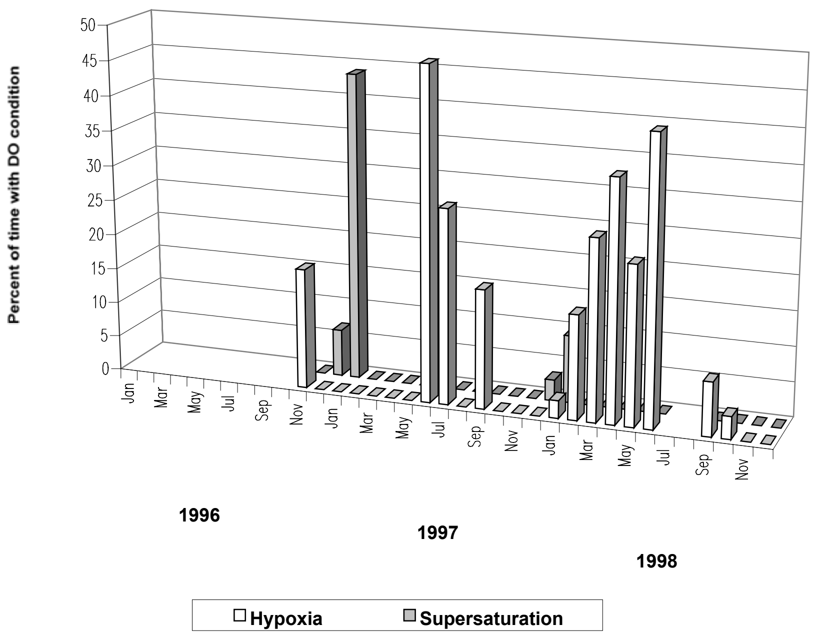


Figure 183. Dissolved oxygen extremes at Upper Henderson Creek, 1996-1998.

Photosynthesis/Respiration

Over four fifths (88%) of the data used to calculate the metabolic rates fit the basic assumption of the method (heterogeneity of water masses moving past the sensor); however, instrument drift was a problem at this site. There was a significant difference in total respiration rates between the first 2 days of the deployment and the total length of the deployment. Because of this only the first 2 days of each deployment (14% of the observations) were used to estimate net production, gross production, total respiration and net ecosystem metabolism (Table 35). Total respiration greatly exceeded gross production at Upper Henderson; thus, the net ecosystem metabolism and P/R ratio indicated that this was one of the most heterotrophic sites in the Reserve system (Figure 184). Temperature was significantly ($p<0.05$) correlated with total respiration and net ecosystem metabolism. As temperature increased, respiration and net ecosystem metabolism became more. Salinity was not significantly ($p<0.05$) correlated with any metabolic measurement.

Table 35. Summary of metabolism data and statistics at Upper Henderson Creek, 1996-1998.

Upper Henderson	mean	s.e.
Water depth (m)	2.0	
Net production $gO_2/m3/d$	-0.47	0.17
Gross production $gO_2/m3/d$	3.10	0.24
Total respiration $gO_2/m3/d$	5.2	0.28
Net ecosystem metabolism g $O_2/m3/d$	-4.72	0.28
Net ecosystem metabolism g C/m2/y	-577	
P/R	0.60	
Statistical results		
Drift – paired t-test		
Gross production	ns	
Total respiration	ns	
Net ecosystem metabolism	$p < 0.001$	
Percent useable observations	88 %, 14 %	
Paired t-test on gross production and total respiration	$p < 0.001$	
Correlation coefficient	Temperature	Salinity
Gross production	ns	ns
Total respiration	0.30	ns
Net ecosystem metabolism	-0.47	ns

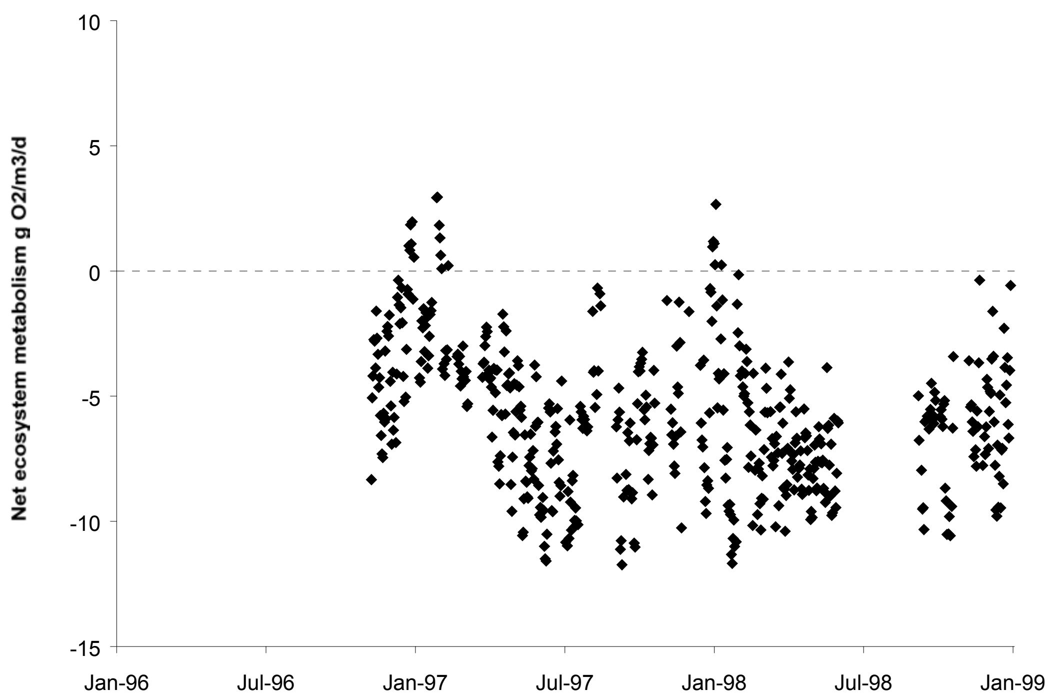


Figure 184. Net metabolism at Upper Henderson Creek, 1996-1998.