MONITORING OF ALGAL COMMUNITIES IN THE WEKIVA RIVER, ROCK SPRINGS RUN, JUNIPER CREEK, ALEXANDER SPRING CREEK AND SILVER GLEN SPRING RUN

Final Report

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EXECUTIVE SUMMARY

Florida's freshwater springs and their associated spring runs are important biological and recreational resources. Benthic and attached algae (periphyton) including filamentous macroalgae are natural components of these and other lotic systems. However, excessive growth of algae in springs, particularly large filamentous forms, may be detrimental to Florida's spring systems by altering habitat, degrading water quality and impacting recreational use.

The objective of the work described in this report was to more completely characterize periphytic algae in the Wekiva River and Rock Springs Run and examine relationships between these communities and water quality, comparing these systems to less impacted, reference streams (Alexander Spring Creek, Juniper Creek and Silver Glen Springs).

The two main sampling components of the study and the major findings of each is below:

1. Annual quantification of the distribution and coverage of macroalgae in the headsprings and spring-run streams of the Wekiva River, Rock Springs Run, Juniper Creek, Alexander Spring Creek and Silver Glen Spring Run.

- Benthic/floating mats of filamentous algae were most common in and around the headsprings and in wide, shallow areas with low canopy cover.
- The most extensive growths of filamentous algae were observed in the Wekiva River, Juniper Springs, Alexander Springs and Silver Glen Springs.
- The largest mats observed were of *Lyngbya wollei*, *Dichotomosiphon*/*Vaucheria* sp., *Hydrodictyon reticulatum* and *Compsopogon coeruleus*.

2. Quarterly sampling of periphytic algal communities from dominant substrates and water quality in selected segments from Wekiva River, Rock Springs Run, Juniper Creek, Alexander Spring Creek and Silver Glen Spring Run.

- Diatoms had the highest species richness of all algal groups on all substrates, at all sites and on all sampling dates.
- In terms of cell density and relative abundance, diatoms and cyanobacteria were dominant in almost all samples from all springs, with cyanobacteria more important in SAV samples.
- Diatoms were dominant or co-dominant in all samples in terms of biovolume and biovolume relative abundance.
- Few consistent patterns in relationships between water quality and biological parameters were found. Changes in water quality parameters affecting light availability and concentrations of various forms of nitrogen and phosphorus were most often correlated with total cell number, total biovolume, periphyton chl-*a* and periphyton AFDW.

INTRODUCTION/BACKGROUND

Florida's freshwater springs and their associated spring runs are important biological and recreational resources (Fisher 1994, Stevenson et al. 2004). Benthic and attached algae (periphyton) including filamentous macroalgae are natural components of these and other lotic systems, playing important roles in autochthonous production (Odum 1957, Vannote et al. 1980), chemical modulation (Lock et al. 1984) and nutrient cycling (Mulholland 1996), stabilization of benthic substrata (Stevenson 1996) and providing habitat for aquatic invertebrates and smaller meiofauna (Power 1990, Dodds and Guddder 1992). Excessive growth of algae in springs, particularly large filamentous forms, may be detrimental to Florida's spring systems by altering habitat and degrading water quality (Stevenson 1997, Stevenson et al. 2004).

Due to their rapid response to environmental changes periphytic algal communities can be useful indicators of stream water quality (Rosen 1995, Lowe and Pan 1996). Monitoring periphytic algal communities in selected spring-run streams in the Middle St. Johns River Basin of the St. Johns River Water Management District will enable better assessment of water quality and ecological conditions in these systems, allow assessment of the effects of elevated nutrient concentrations and other water quality conditions on algal community structure and contribute to the refinement of Pollution Load Reduction Goals (PLRG) for nutrients in the Wekiva River and Rock Springs Run.

The Wekiva River and Rock Springs Run have elevated nitrate and phosphorus levels due to human activities in their watersheds (WSI 2004). Alexander Spring Creek, Juniper Creek and Silver Glen Springs have lower nutrient levels and are considered to be "reference" spring-run streams (Florida Springs Task Force 2000, WSI 2004).

The objective of the current work is to more completely characterize periphytic algae in the Wekiva River and Rock Springs Run and examine relationships between these communities and water quality, comparing these systems to less impacted, reference streams (Alexander Spring Creek, Juniper Creek and Silver Glen Springs).

The project has two main sampling components:

1. Task 2: Annual quantification of the distribution and coverage of macroalgae in the headsprings and spring-run streams of the Wekiva River (WEKR), Rock Springs Run (RSR), Juniper Creek (JUNC), Alexander Spring Creek (ALXC) and Silver Glen Spring Run (SGLR).

2. Task 3: Quarterly sampling of periphytic algal communities from dominant substrates and water quality in selected segments from WEKR, RSR, JUNC, ALXC and SGLR.

Task 2: Quantify Macroalgal Distribution and Coverage

Purpose:
The purpose of this task was to semi-quantitatively describe the distribution and spatial coverage of filamentous macroalgae in each of the five spring-run streams and their headsprings on an annual basis. Macroalgae for the purposes of this task are defined as algae with a macroscopic thallus visible to the naked eye.

Methods:
To quantify macroalgal distribution and coverage, systematic sampling using transects was conducted along the length of each spring-run stream from (and including) the headspring to a selected downstream point in May-June 2007 and again in May-July 2008. Late spring and summer was chosen for Task 2 work to capture peak algal cover, based on part on an earlier periphyton study conducted on the Wekiva River and Rock Springs Run by GreenWater Laboratories in 2005. The downstream points for each site were as follows: WEKR-the confluence of Blackwater Creek, RSR-confluence of Wekiva River, JUNC- the bridge at Highway 19, ALXC-boat ramp at the end of FR552 and SGLR-the entrance to Lake George. Numbers of transects for each spring run was as follows: WEKR (25), RSR (16), JUNC (15), ALXC (15) and SGLR (10). Transects were at more-or-less regular intervals down each spring run with the exception of intervals being tighter near the headspring. Transect numbers ran from low to high representing relative distance from spring outflow. Individual transects were run from shoreline to shoreline.

Along each transect a 0.25 m^2 quadrat was set at five randomly selected locations. Macroalgal frequency, abundance and density were determined using the Braun-Blanquet scale. Frequency values range from 0 to 1, with 0 indicating no macroalgae observed in any of the five quadrats along a transect and 1 meaning at least some macroalgae observed in all five quadrats. Abudance values range from 0 to 5, with 0 representing 0% macroalgal cover in all five quadrats and 5 representing 100% macroalgal cover in all quadrats where macroalgae were observed. Density values range from 0 to 5, with 0 meaning 0% macroalgal cover in all five quadrats and 5 meaning 100% macroalgae cover in all five quadrats. Where water depth or turbidity/color precluded observation of the quadrat, presence/absence of algae was determined using a qualitative bottom grab. Substrate, macroalgal appearance, mode of attachment and (if possible) dominant macroalgal species composition was recorded. A GPS point was captured at the center of each transect using a WAAS-enabled Magellan MAP 330 hand-held Global Positioning System.

At each transect samples were collected for macroalgal identification in the laboratory. Wet mounts were made from the collected material and observed using a Nikon Eclipse TE200 inverted microscope equipped with phase contrast optics. Identifications were made to the lowest practical taxonomic level.

At each transect field water quality measurements were taken with a calibrated YSI 6600 Multi-Parameter Water Quality Monitor. Parameters measured included water

temperature, pH, dissolved oxygen (D.O.), conductivity and water depth. Water velocity was measured using an electronic flow meter.

Results:
Wekiva River (WEKR)
In both 2007 and 2008 lowest water temperature (07 = 24.1^{o}C, 08 = 23.9^{o}), D.O. (0.62 mg/L, 1.09 mg/L) and pH (6.70, 7.35) were recorded near the headspring (Fig. 1). Patterns in water temperature, D.O. and pH from headspring to downstream endpoint were similar between years, with the exception that 2008 temperature and D.O. at the 7 most downstream transects was lower than in 2007 (Fig. 1). Conductivity increased sharply near the downstream endpoint in both 2007 (maximum 870 umohs/cm at transect 24) and 2008 (836 umohs/cm at transect 24) (Fig. 2). Depth at midstream of transects displayed a similar pattern from upstream to downstream in 2007 and 2008, however there were differences in location of lowest water depth (0.48 m, transect 20 in 2007; 0.57 m, transect 17 in 2008) and highest water depth (2.70 m, transect 17; 2.54 m, transect 19) (Fig. 3). Current velocity ranged from 0.01 m/s to 0.30 m/s in both 2007 and 2008 (Fig. 3). There were more instances of current velocities of 0.20 m/s or more in 2008 (9) than in 2007 (6).

Macroalgal frequency was highest closet to the headspring in both years (Fig. 4). Frequency values were lower in wooded areas where the water dropped off sharply from the shoreline (Transects 12-16 and 21-24). These same areas had high macroalgal abundance levels (Fig. 5) because the shallow, shoreline areas tended to have mats of *Dichotomosiphon*/*Vaucheria* present. In both 2007 and 2008 macroalgal density fluctuated along the entire run. In 2007 maximum density occurred at transect 6 and in 2008 at transect 17 (Fig. 6). Macroalgal density was lowest in both years between transects 12 and 15 (Fig. 6).

Dominant macroalgae in the headspring were the cyanobacteria *Oscillatoria princeps*, *Oscillatoria* spp. and *Phormidium* spp. and the chlorophytes *Cladophora glomerata, Hydrodictyon reticulatum and Rhizoclonium hieroglyphicum*. The most common filamentous cyanobacteria observed in WEKR in 2007 were *Oscillatoria* cf. *simplicissima* (11 transects) and *Oscillatoria*/*Phormidium* spp and in 2008 *Oscillatoria princeps* (20 transects) and *O*. cf. *simplicissima* (18 transects) (Table 1). The most common chlorophyte macroalgae in both 2007 and 2008 were *Spirogyra* spp. (15 and 13 transects respectively), *Oedogonium* spp. (12/19) and *Cladophora glomerata* (10/15). The large chain-forming diatoms *Pleurosira laevis* and *Terpsinoe musica* were found at 10 and 15 transects respectively in 2007, and at 18 and 22 transects in 2008. Another common filamentous alga commonly observed (16 transects in 2007 and 13 in 2008) was *Dichotomosiphon*/*Vaucheria* sp. Despite being in different algal groups *Dichotomosiphon* (Chlorophyta) and *Vaucheria* (Xanthopyta) can be extremely difficult to differentiate when sexual reproductive structures are absent (Davis and Gworek 1972). The most common red alga (Rhodophyta) in 2007 was *Batrachospermum* sp. (present at 3 transects) and in 2008 was *Compsopogon coeruleus* (9 transects).

Rock Springs Run (RSR)

Water temperature, pH and D.O. followed a similar spatial pattern in 2007 and 2008 (Fig. 7). Water temperature (<24^{o}C) and D.O. (<4 mg/L) were lowest near the headspring, while pH (7.86 to 8.15) was relatively constant along the entire run (Fig. 7). Conductivity was also relatively constant (261-277 umohs/cm) along the entire run, although 2008 values tended to be higher than 2007 values at the downstream end (Fig. 8). Mid-transect water depth was highest (1.64 m) at transect 9 in 2007 and at transect 6 (3.05 m) in 2008. Mid-transect water depth was higher in 2008 than in 2007 at 13 of 16 transects (Fig. 9). In both years current velocity was high (0.3-0.7 m/sec) in transects located in the recreational area just below spring outfall (transects 1-3) and continued to be 0.3 m/sec or higher for the next two transects (4 and 5) (Fig. 9). Current velocity increased again at the downstream end of the run (Fig. 9). Between these two peak current areas, current velocity was 0.10 m/sec or less (Fig. 9).

Macroalgal frequency, abundance and density in 2007 all displayed the same pattern with highest values in the headspring (transects 1-3), midway along the spring run (transects 6 or 7 through 11) and near the confluence of the Wekiva River (transects 15-16) (Fig. 10-12). Frequency in 2008 was similar to 2007 except that higher values were observed between transects 4-6 and 12-13 (Fig. 10). Abundance and density were similar between 2007 and 2008 near the headspring, but were higher in 2007 from transect 6 to 11 and higher in 2008 from transect 12 to 15 (Fig. 11,12)

Dominant macroalgae in the headspring were the chlorophytes *Cladophora glomerata, Rhizoclonium hieroglyphicum* and *Spirogyra* sp., the cyanophytes *Phormidium* spp. and *Lyngbya wollei* and the red alga *Batrachospermum* sp. The most common filamentous cyanobacteria observed in RSR in 2007 were *Phormidium* spp. (12 transects) and *L. wollei* (6) and in 2008 were *L. wollei* (9) and *Oscillatoria* cf. *simplicissima* (6) (Table 2). The most common chlorophyte macroalgae in 2007 were *Cladophora glomerata* (8 transects) and *Oedogonium* spp. (7) and in 2008 were *C. glomerata* (8), *Oedogonium* spp. (8), *R. hieroglyphicum* (7), *Spirogyra* spp. (7) and *Stigeoclonium* sp. (7) The large-chain forming diatoms *Terpsinoe musica* and *Pleurosira laevis* were observed at 11 and 7 transects respectively in 2007 and 14 and 16 transects in 2008. *Dichotomosiphon*/*Vaucheria* sp. was found at 3 transects in 2007 and 8 transects in 2008 and the red alga *Batrachospermum* sp. was observed at 2 transects both years.

Juniper Creek (JUNC)

In both 2007 and 2008 water temperature displayed an increase (>24 ^{o}C) towards the end of the run where canopy cover was low (Fig. 13). Dissolved oxygen (9.73 mg/L) was highest at the springhead in 2007 and pH was highest at the springhead in both 2007 (8.99) and 2008 (8.86) (Fig. 13). Dissolved oxygen was higher in 2007 than in 2008 at the beginning and end of the run (Fig. 13). Conductivity showed a marked spike towards the end of the run in both years, with values over 1000 umohs/cm compared to around 115 umohs/cm at the springhead (Fig. 14). Mid-transect water depths were higher at the beginning, middle and end of the run in both 2007 and 2008 (Fig. 15). Depths were greater at 10 transects in 2008 compared to 2007 (Fig. 15). Lowest current velocity in both years was recorded at transects 1 and 2 (Fig. 15). These transects were located in the

main spring area, but upstream of the springhead itself. The peak current velocity found during both years was 0.70 m/s at transect 9 in 2007 (Fig. 15).

In 2007 macroalgal frequency had the maximum value of 1 near the headspring (transects 1-3), at transect 6 and at transects 10 through 12 (Fig. 16). In 2008 macroalgal frequency was higher than in 2007 at transects 4,5 and 7, but lower at transects 9-12 (Fig. 16). Macroalgae were observed at transect 15 in 2007 but not in 2008 and no macroalgae were seen at transect 8 in either year. Transect 3 was missed in 2008. Macroalgal abundance in both years was highest in the headspring (transects 1 and 2) and at transect 10 (Fig. 17). Macroalgal density displayed a similar spatial pattern as abundance in both 2007 and 2008 (Fig. 18).

The dominant macroalga in the headspring was *Lyngbya wollei*. The most common filamentous cyanobacteria observed in JUNC in both 2007 and 2008 were *L. wollei* (8 transects in 2007 and 6 transects in 2008), *Phormidium* spp. (7,9) and *Oscillatoria* spp. (4,10) (Table 3). The most common chlorophyte macroalgae were *Spirogyra* spp. (6 transects in 2007 and 8 transects in 2008), *Rhizoclonium hieroglyphicum* (5,6) and *Cladophora glomerata* (5,3). The large-chain forming diatom *Pleurosira laevis* was found at 7 transects in both 2007 and 2008 and *Terpsinoe musica* at 5 and 8 transects in 2007 and 2008 respectively. *Dichotomosiphon*/*Vaucheria* sp. was found at 3 transects in 2007 and 2 transects in 2008. The red alga *Batrachospermum* sp. was present at 1 transect in 2007 but was not observed in 2008.

Alexander Spring Creek (ALXC)

In both 2007 and 2008 water temperature decreased slightly from transects 1 to 9, before increasing along the remainder of the run (>27^{o}C at transect14) (Fig. 19). Dissolved oxygen decreased in both years from transects 1 to 4 (2.09 mg/L in 2007 and 1.61 mg/L in 2008), before increasing along the remainder of the run (maximum of 9.34 mg/L in 2007 and 8.12 mg/L at transect 13) (Fig. 19). Dissolved oxygen levels were generally lower than in 2008 than in 2007 (Fig. 19). There was little difference in pH between 2007 and 2008 and pH was relatively constant (7.89 to 8.40) along the entire run (Fig. 19). Conductivity in 2008 was higher than in 2007 at all but one transect (transect 1)(Fig. 20). Highest conductivity in both 2007 and 2008 was recorded at transect 1 (1208 umohs/cm in 2007 and 1200 umohs/cm in 2008), which was just downstream of the springhead (Fig. 20). Mid-transect water depth in the springhead area was higher in 2008 (>0.7 m) than in 2007 (<0.4 m) (Fig. 21). From transect 6 to the end of the run, mid-transect water depth displayed a similar pattern (Fig. 21). Maximum water depth in 2007 (1.81 m) was recorded at transect 15 and at transect 6 (1.23 m) in 2008 (Fig. 21). Current velocity was lower in 2008 than in 2007, but in both years varied only between 0.01 m/sec and 0.20 m/sec along the length of the run (Fig. 21).

Macroalgal frequency had a maximum value of 1 (macroalgae observed in all quadrats along a transect) in both 2007 and 2008 at transects 1-4 and 6 (Fig. 22). This same frequency was also observed at transect 7 in 2007 and at transects 5, 9 and 12 in 2008 (Fig. 22). Macroalgae were observed at transects 14 and 15 in 2008, whereas these transects were bare in 2007 and no algae were found at transect 11 in either year (Fig.

22). Macroalgal abudance was 3 or higher in both years at transects 1-6, with 100% cover in all quadrats with macroalgae recorded at transects 4-5. Macroalgal abundance was higher in 2007 than in 2008 at transects 8,9,10 and 13 and higher in 2008 than in 2007 at transects 7 and 12 (Fig. 23). Macroalgal density was 3 or higher at transects 1 through 6 in both 2007 and 2008, and also at transects 9 in 2007 and 7 in 2008 (Fig. 24).

Thick, expansive mats of the chlorophyte *Hydrodictyon reticulatum* were present in the headspring downstream of the spring outflow. The most common filamentous cyanobacteria observed in ALXC in 2007 were *L*yngbya *wollei* (7 transects) and *Lyngbya* cf. *aestuarii* (5) and in 2008 were *Oscillatoria princeps* (10 transects), *L*yngbya *wollei* (9) and *Lyngbya* cf. *aestuarii* (8) (Table 4). Large floating accumulations of the colonial filamentous cyanophyte *Gloeotrichia natans* were recorded at transect 10 and 11 in 2007. In both years gelatinous colonies of *Nostochopsis lobata* were commonly seen on woody debris in the lower end of the run. The most common chlorophyte macroalgae seen in 2007 were *Spirogyra* spp. (10 transects), *H. reticulatum* (7), *Rhizoclonium hieroglyphicum* (7) and *Cladophora glomerata* (5) and in 2008 were *Oedogonium* spp. (13 transects), *Spirogyra* spp. (9), *Ulva flexuosa* (7), *H. reticulatum* (6), *Rhizoclonium hieroglyphicum* (6) and *Cladophora glomerata* (5). The large-chain forming diatoms *Terpsinoe musica* and *Pleurosira laevis* were observed at 6 and 8 transects respectively in 2007 and at 7 and 12 transects in 2008. *Dichotomosiphon*/*Vaucheria* sp. was found at 2 transects in both years. The red alga *Batrachospermum* sp. was found at 1 transect in 2007 and *Compsopogon coeruleus* at 2 transects in 2008.

Silver Glen Spring Run (SGLR)

There was less than a 1^{o}C difference (22.72 ^{o}C to 23.69 ^{o}C) in water temperature between transects in both 2007 and 2008 (Fig. 25). There was little difference in pH from the headspring to the downstream end of the run in either 2007 (7.73 to 7.80) or 2008 (7.75 to 8.15) and also little difference between years (Fig. 25). Dissolved oxygen was low at the springhead (transect 1-3) in both years, ranging from 3.33-4.50 mg/L (Fig. 25). In 2007 D.O. increased towards the end of the run, reaching a maximum at transect 8 of 6.48 mg/L but in 2008 D.O. decreased towards the end of the run reaching a minimum of 3.64 at transect 9 (Fig. 25). In 2007 conductivity was highest (1,947 umohs/cm) at transect 1, which was located just downstream of outflow of smaller, secondary spring and in 2008 (1947 umohs/cm) at transect 4 (Fig. 26). Conductivity exceeded 1,800 umohs /cm the entire length of the run in both years (Fig. 26). Mid-transect water depth at the headsprings was greater in 2008 (0.77 m to 1.19 m) than in 2007 (0.45 m to 0.75 m), but was lower than 2007 for the remainder of the run (Fig. 27). In both 2007 and 2008 current velocity was highest at transects 1 (0.20 to 0.30 m/sec) and 3 (0.10 to 0.20 cm/sec) and was 0.10 m/s or less at all other transects (Fig. 27).

Macroalgae were found in all five quadrats (frequency = 1) at eight of the ten transects in 2007 and at all ten transects in 2008 (Fig. 28). Macroalgal abundance and density had the maximum value of 5 (100% cover in all five transects at transects 1 and 4 in 2007 and transects 3 and 7 in 2008 (Figs. 29,30). Macroalgal abundance and density was higher in 2008 compared to 2007 in 7 of 10 transects (Figs. 29,30).

Thick, expansive mats of the cyanophyte *Lyngbya wollei* were present in the small area of the secondary spring outflow and in the large roped off area in the recreational area downstream of the main spring outflow. *Lyngbya wollei* was dominant or co-dominant at all 10 transects in both 2007 and 2008. Other common filamentous cyanobacteria included *Oscillatoria* spp. (8 transects) and *Phormidium* spp. (6) in 2007 and Lyngbya sp. (8 transects) in 2008. Common chlorophyte macroalgae in both 2007 and 2008 included *Oedogonium* spp. (8 transects in both 2007/08), *Cladophora glomerata* (7,7) and *Rhizoclonium hieroglyphicum* (6,7) and in 2008 also included *Spirogyra* sp. (7 transects) and *Stigeoclonium* sp. (7). The large-chain forming diatoms *Terpsinoe musica* and *Pleurosira laevis* were observed at 1 and 4 transects respectively in 2007 and at 5 and 9 transects in 2008. No *Dichotomosiphon*/*Vaucheria* sp. or red algae were observed.

Fig. 1: WEKR Task 2 Water Temp., pH and D.O.

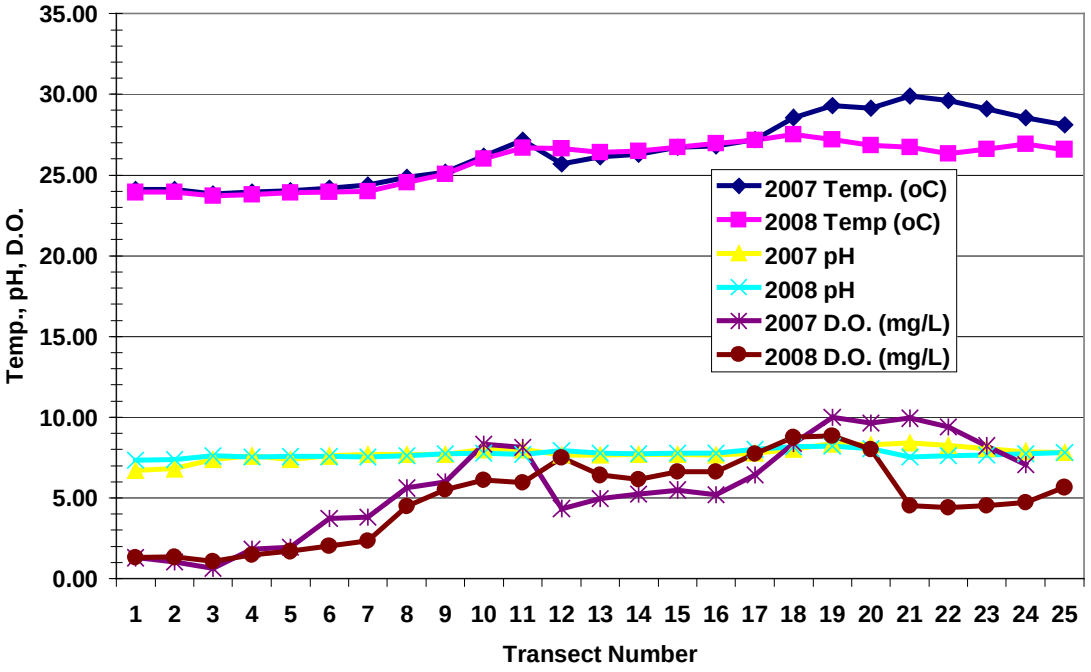

Fig. 2 WEKR Conductivity

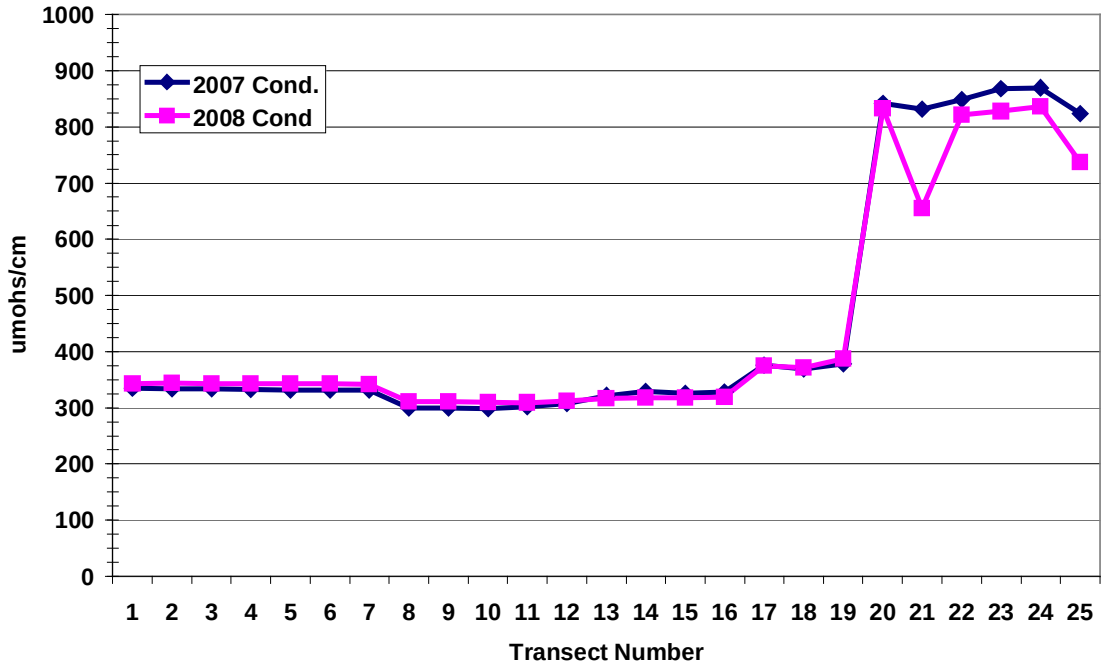

Fig. 3 WEKR Mid-Transect Water Depth and Current Velocity

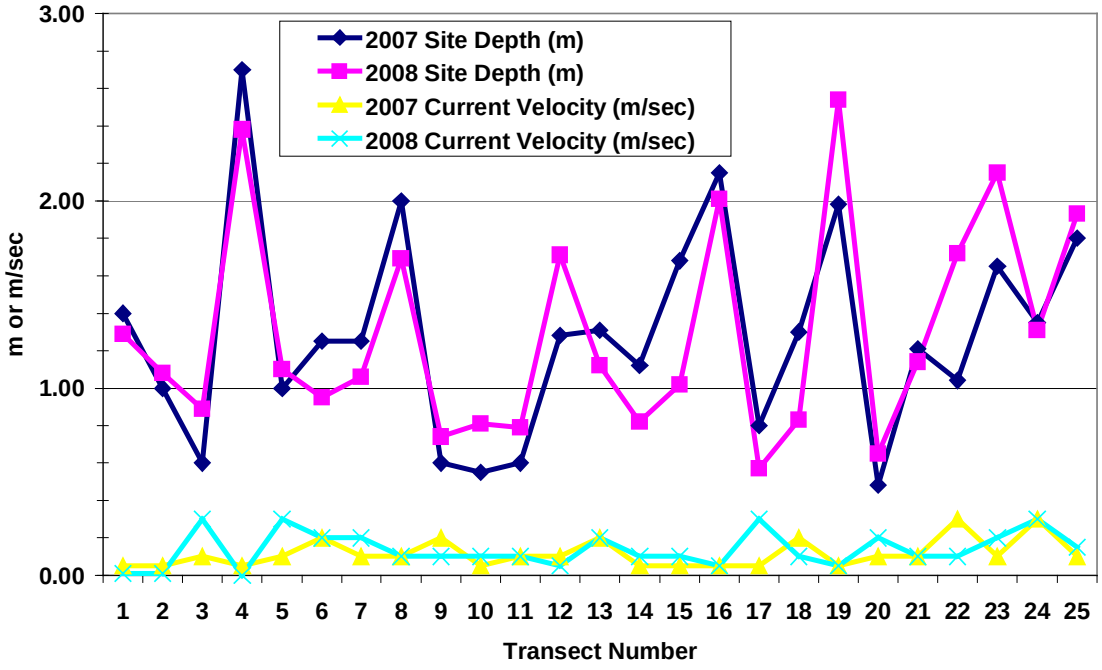

Fig. 4 WEKR Macroalgal Frequency

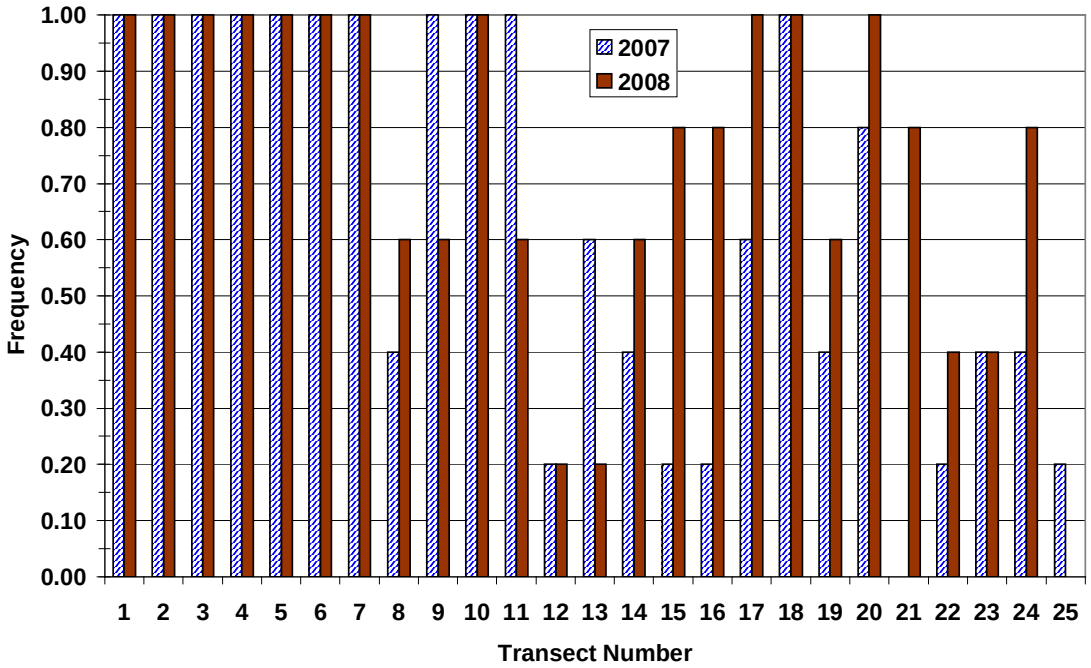

Fig. 5 WEKR Macroalgal Abundance

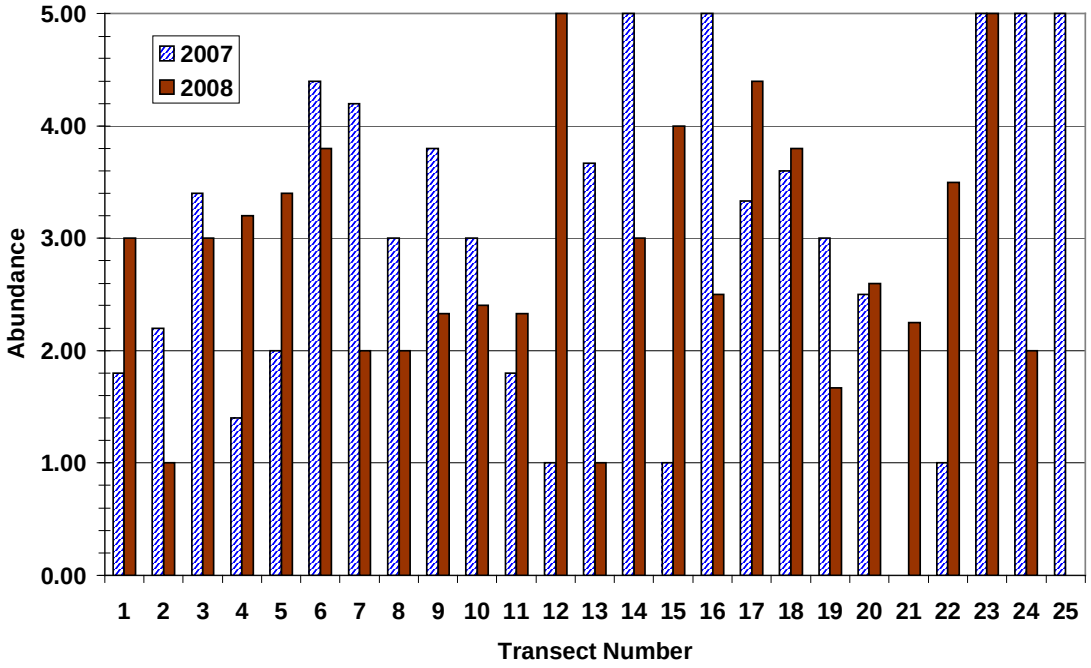

Fig. 6 WEKR Macroalgal Density

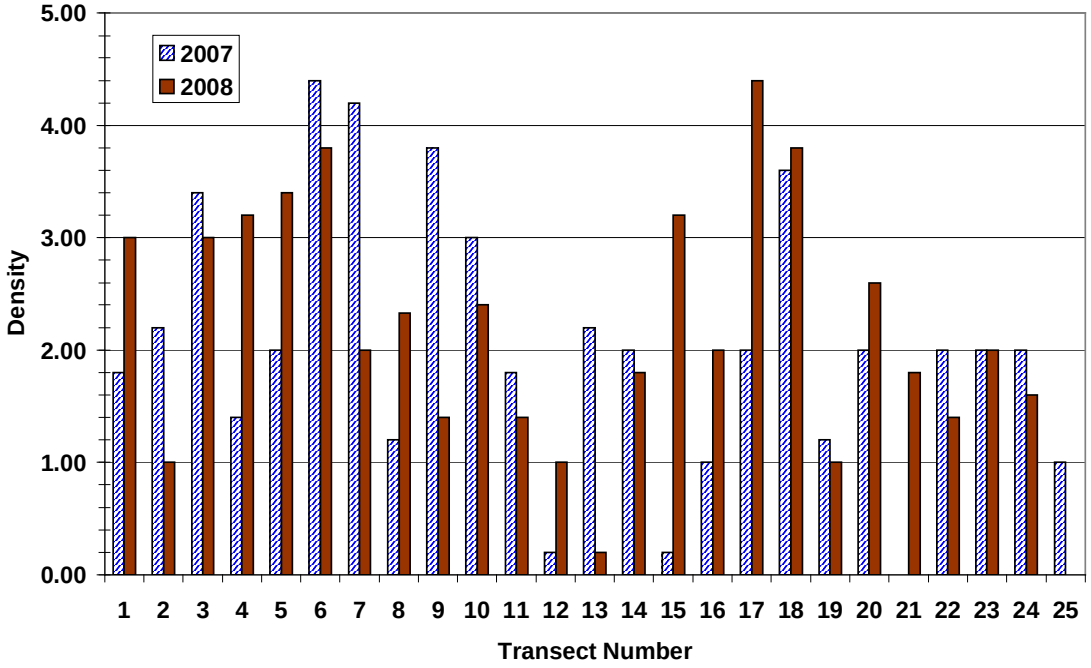

Fig. 7: RSR Task 2 Water Temp., pH and D.O.

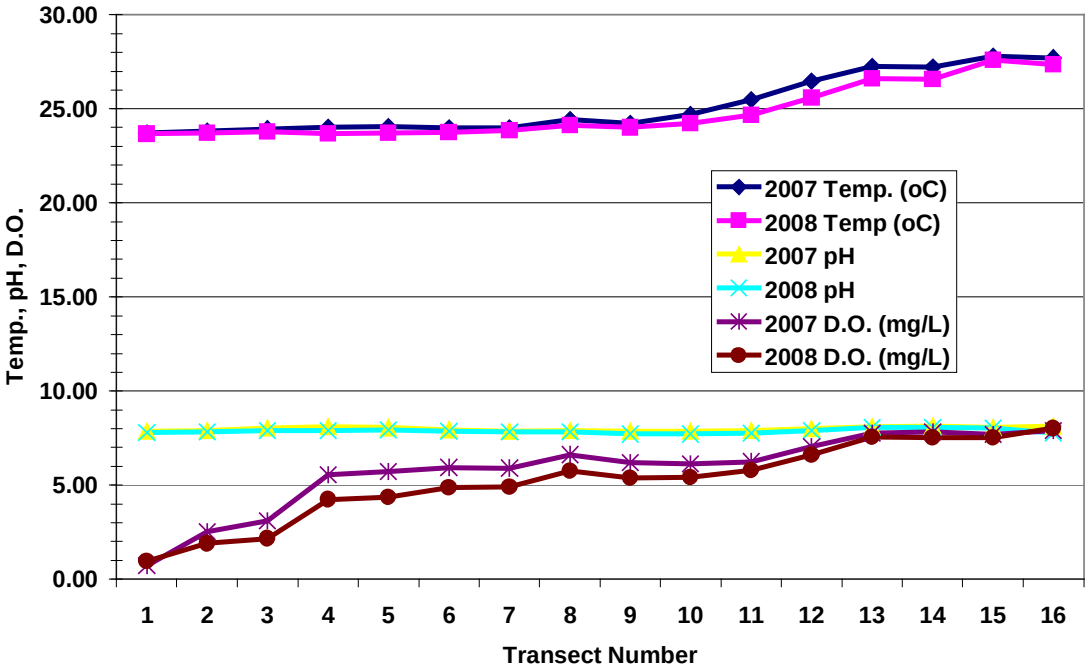

Fig. 8 RSR Conductivity

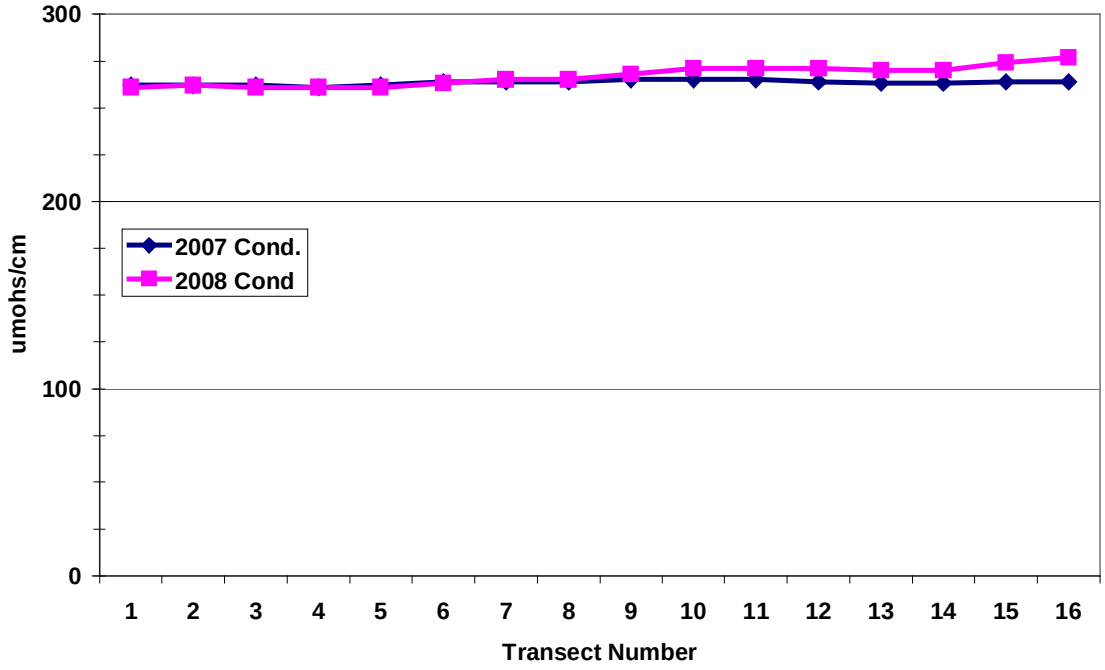

Fig. 9 RSR Mid-Transect Water Depth and Current Velocity

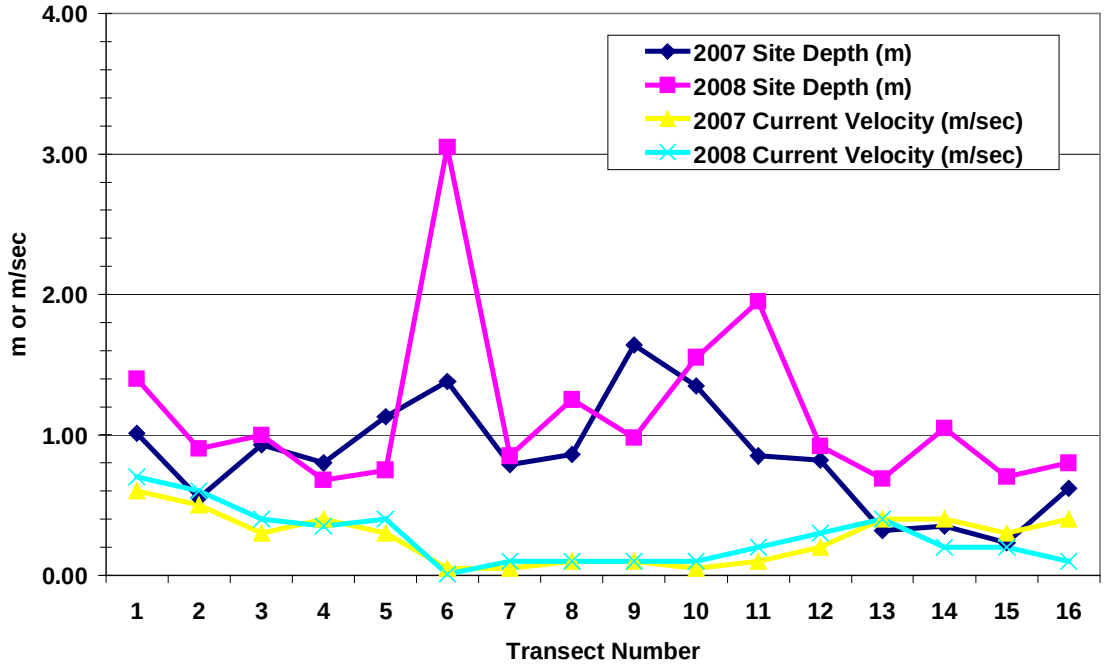

Fig. 10 RSR Macroalgal Frequency

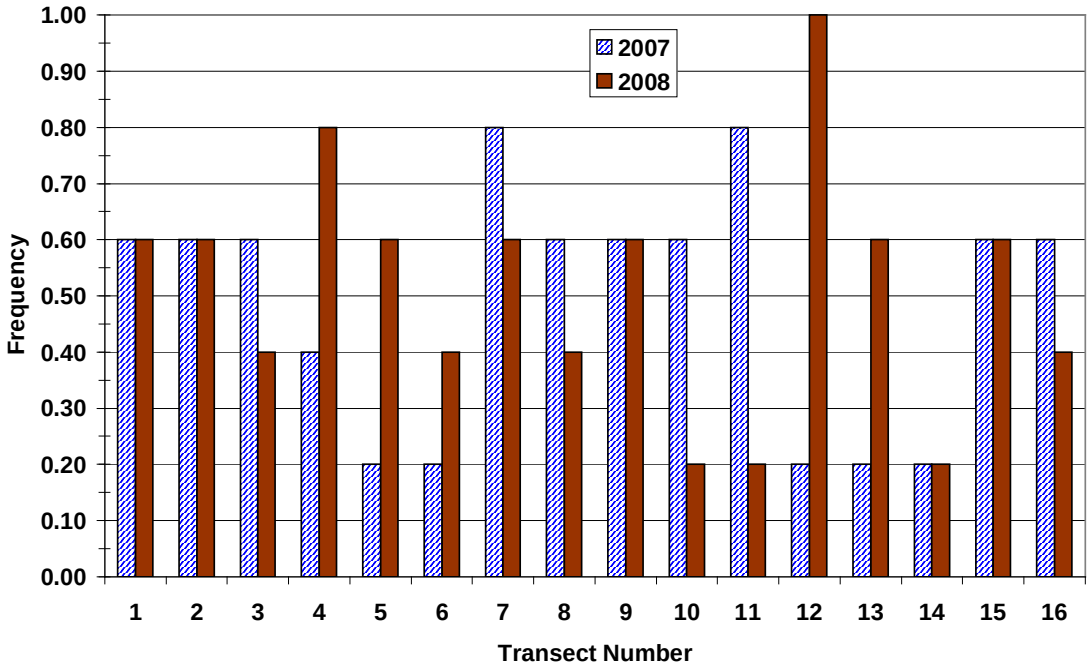

Fig. 11 RSR Macroalgal Abundance

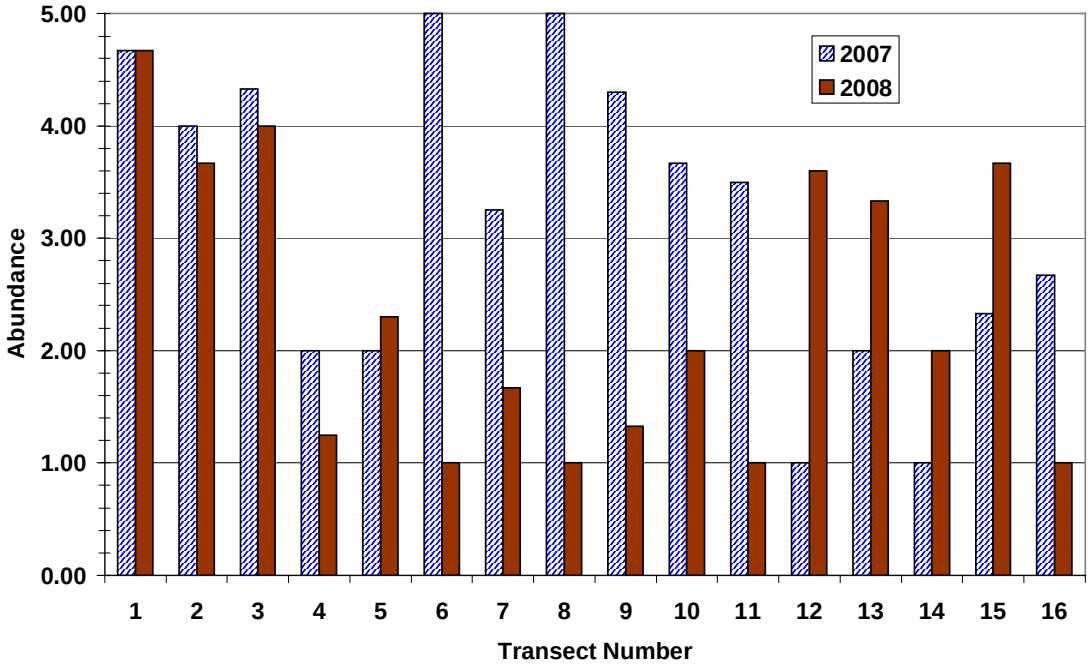

Fig. 12 RSR Macroalgal Density

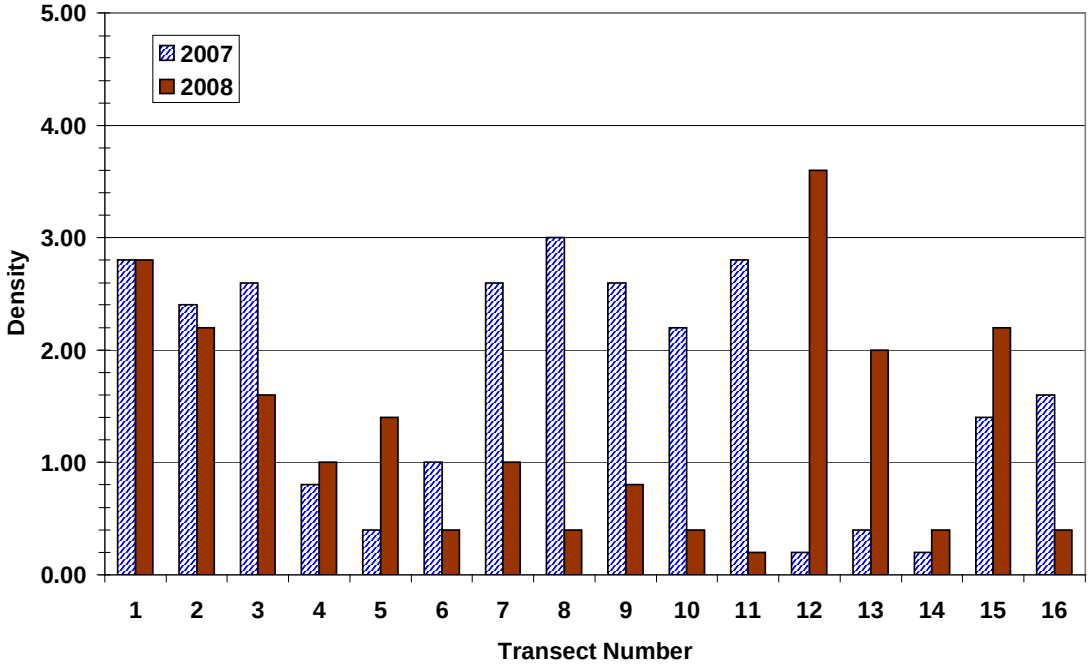

Fig. 13: JUNC Task 2 Water Temp., pH and D.O.

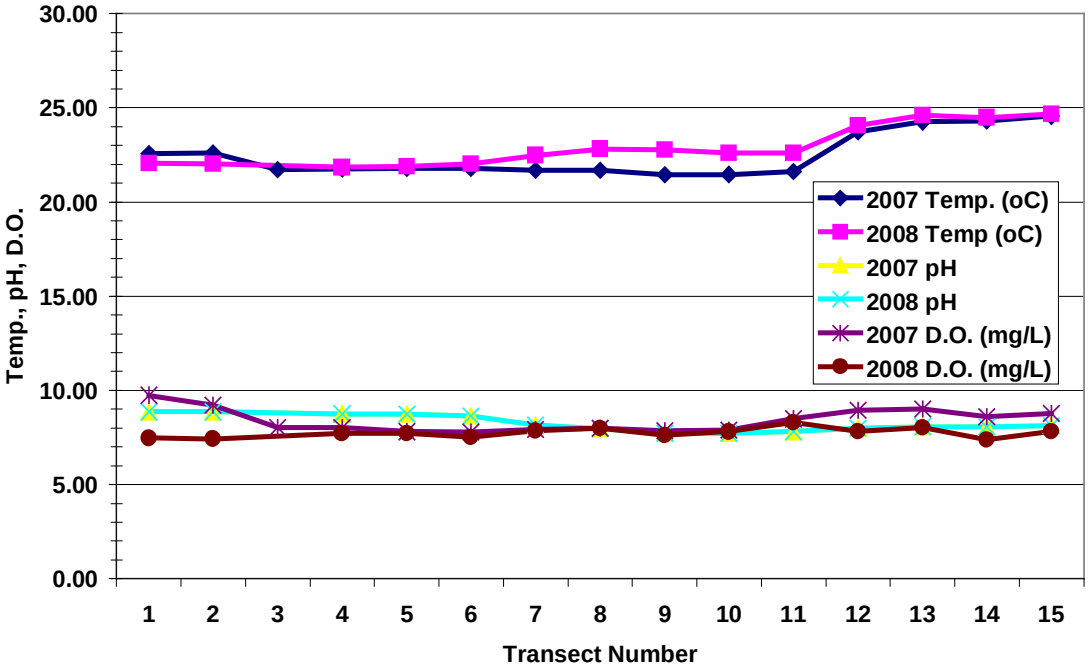

Fig. 14 JUNC Conductivity

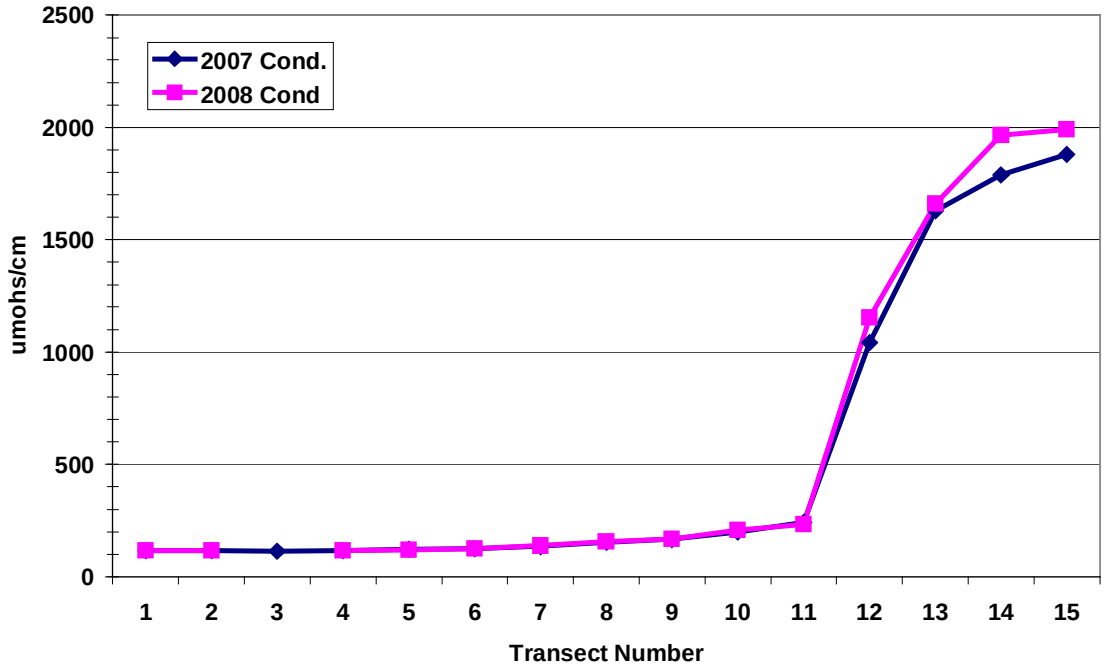

Fig. 15 JUNC Mid-Transect Water Depth and Current Velocity

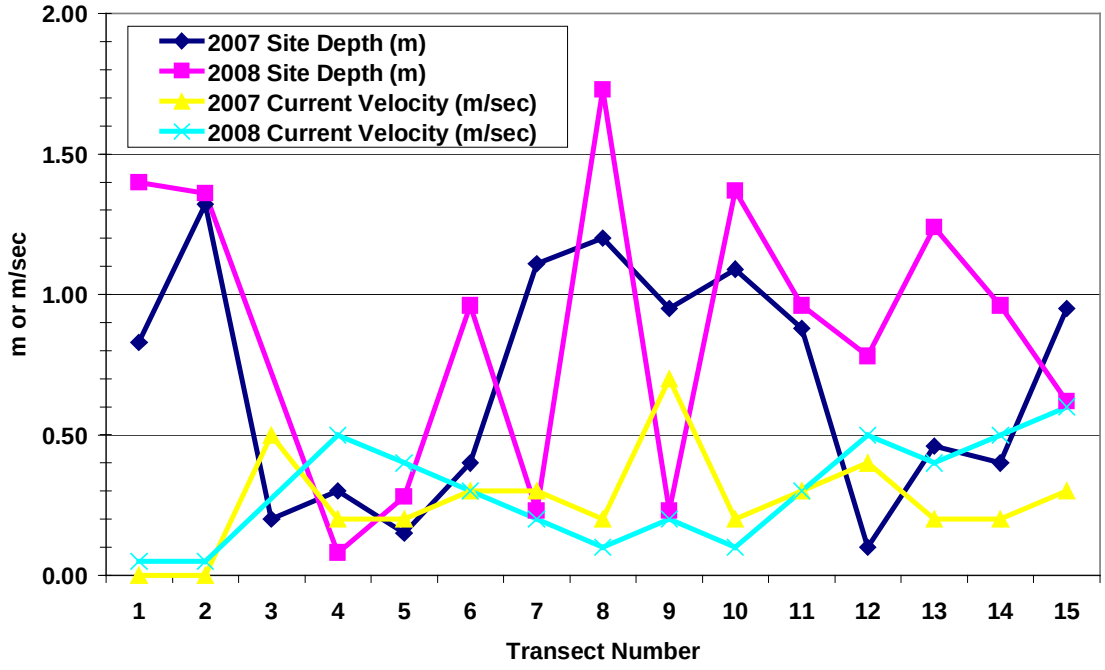

Fig. 16 JUNC Macroalgal Frequency

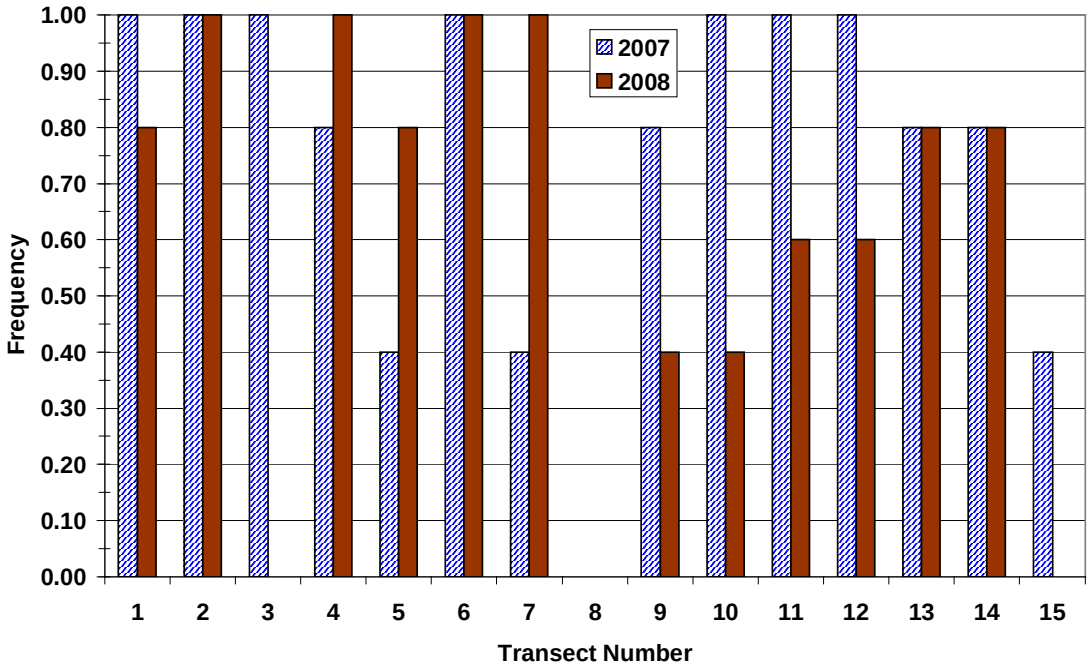

Fig. 17 JUNC Macroalgal Abundance

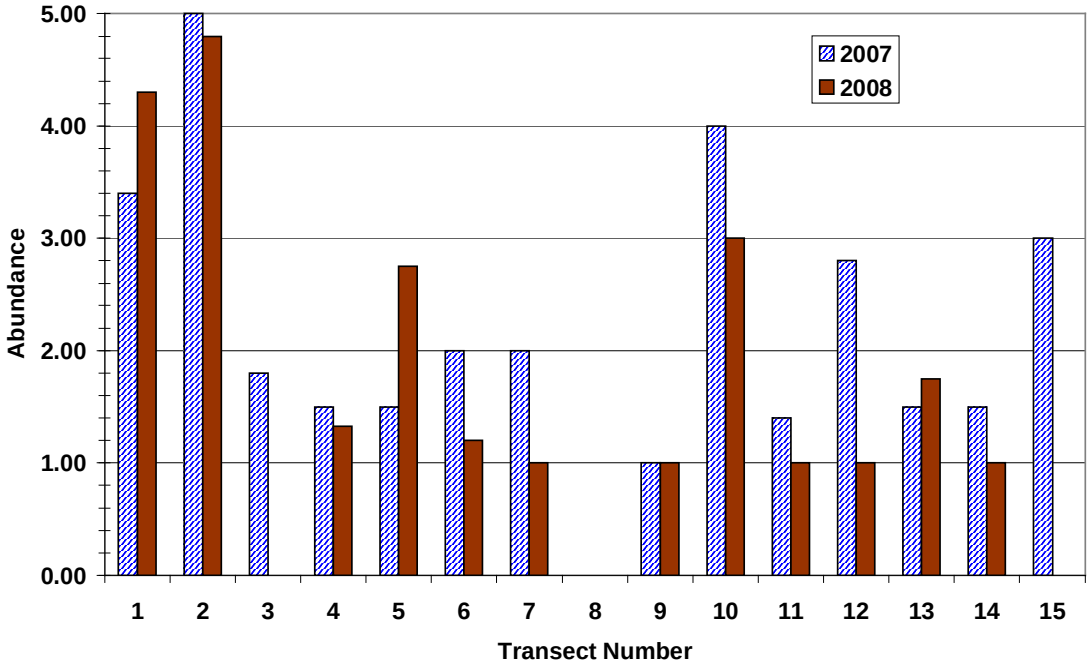

Fig. 18 JUNC Macroalgal Density

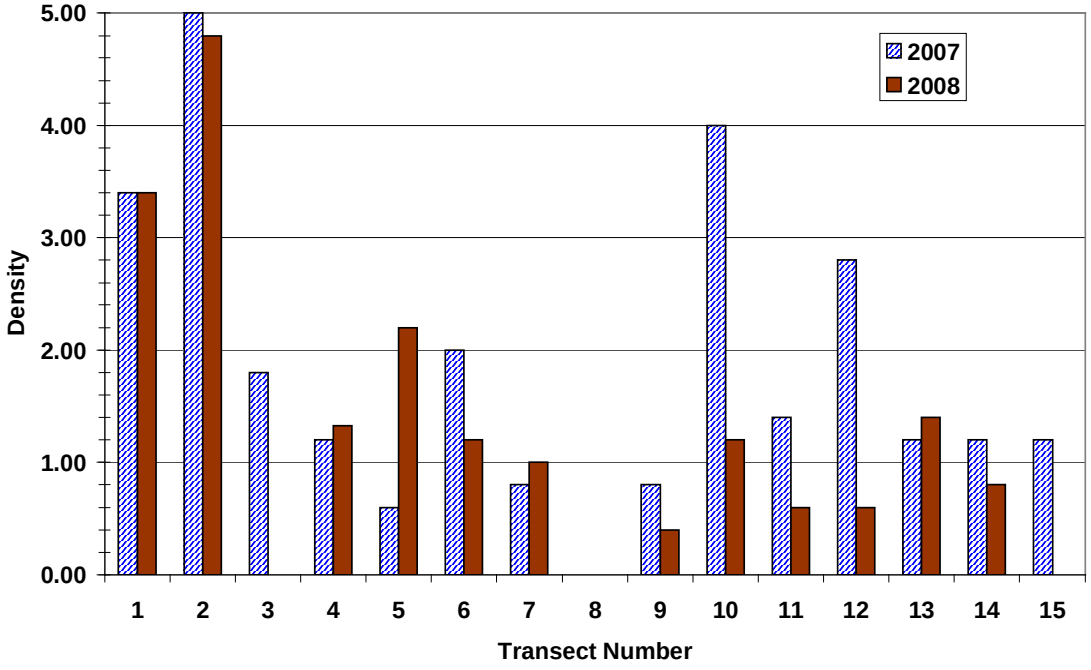

Fig. 19: ALXC Task 2 Water Temp., pH and D.O.

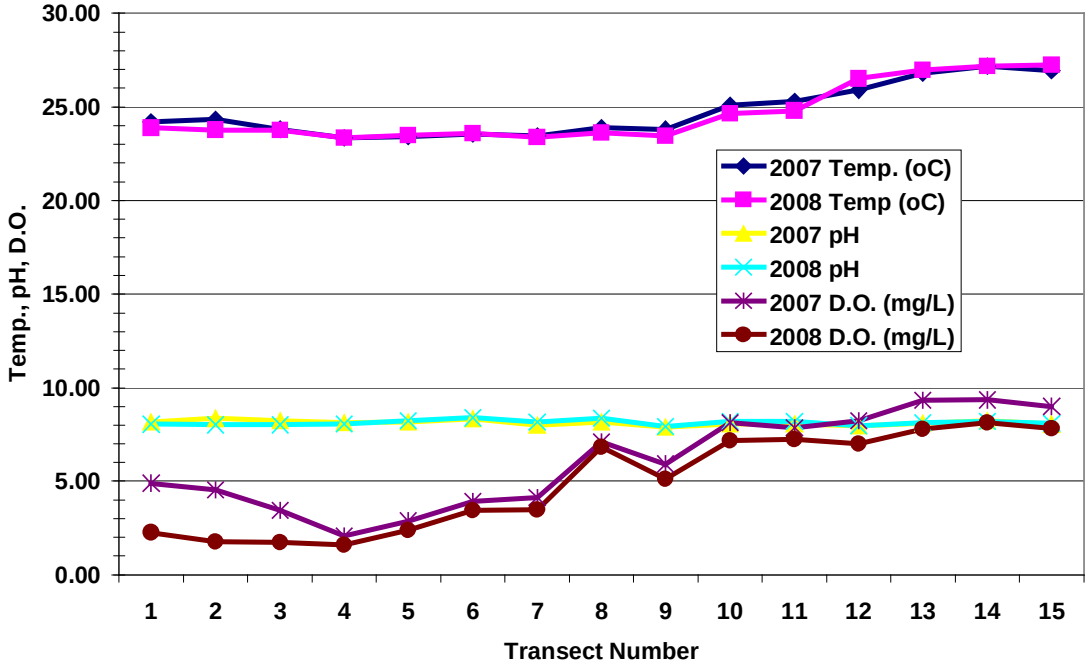

Fig. 20 ALXC Conductivity

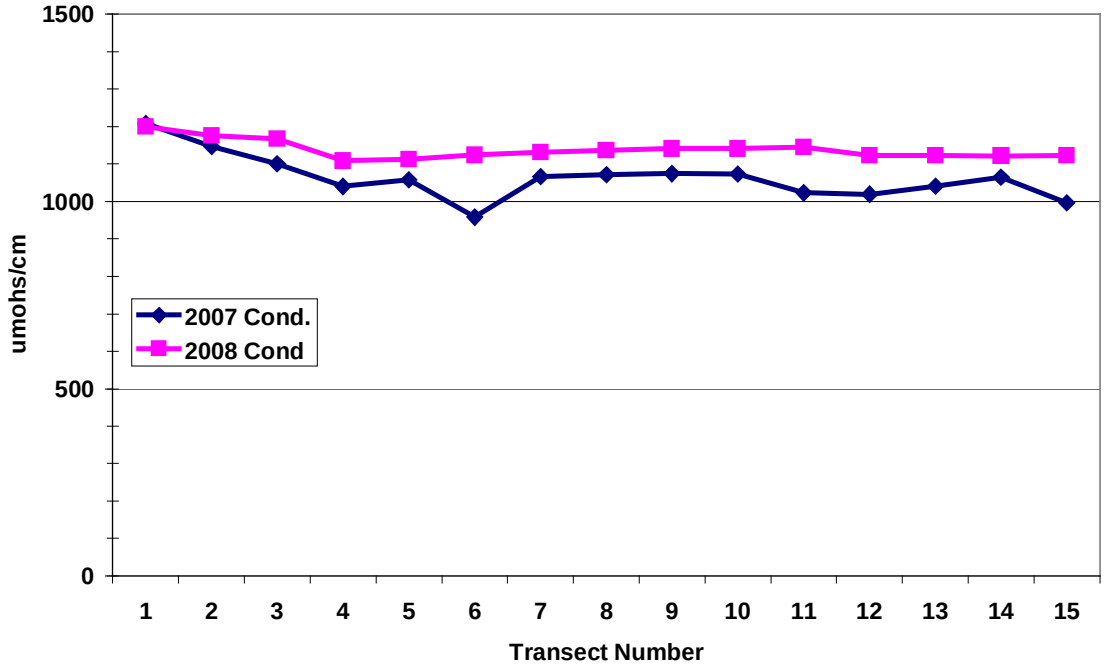

Fig. 21 ALXC Mid-Transect Water Depth and Current Velocity

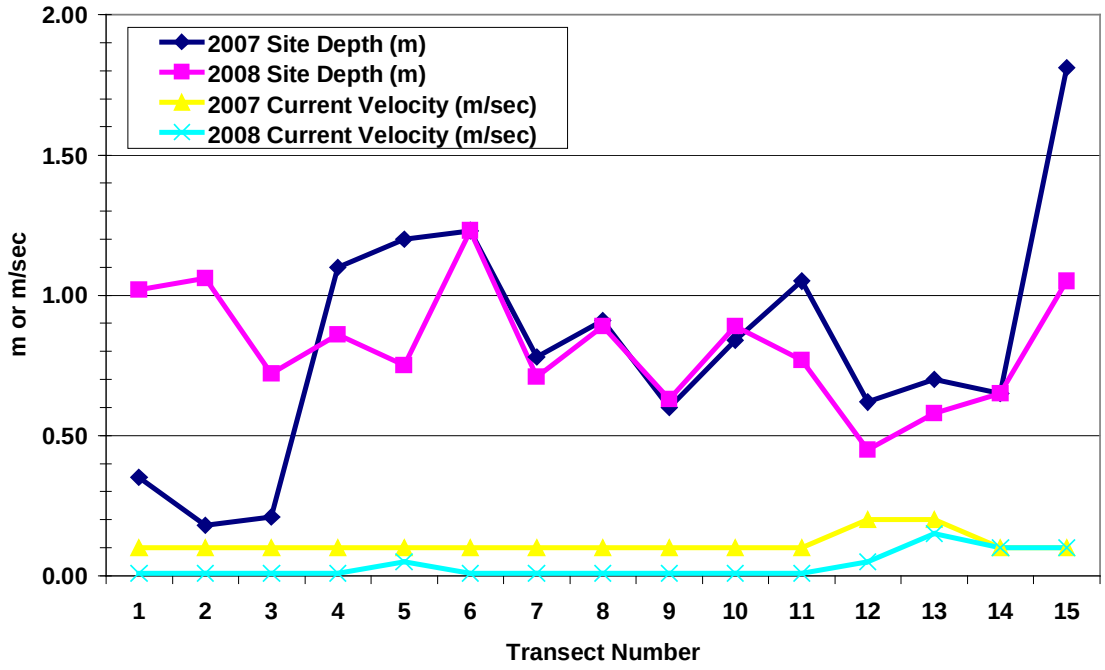

Fig. 22 ALXC Macroalgal Frequency

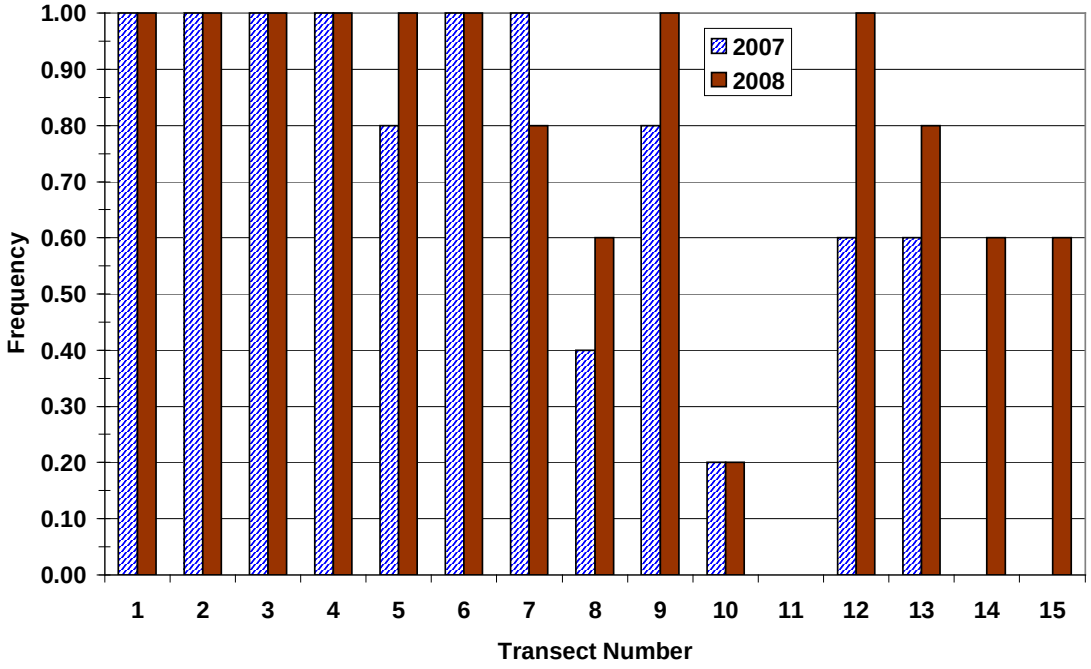

Fig. 23 ALXC Macroalgal Abundance

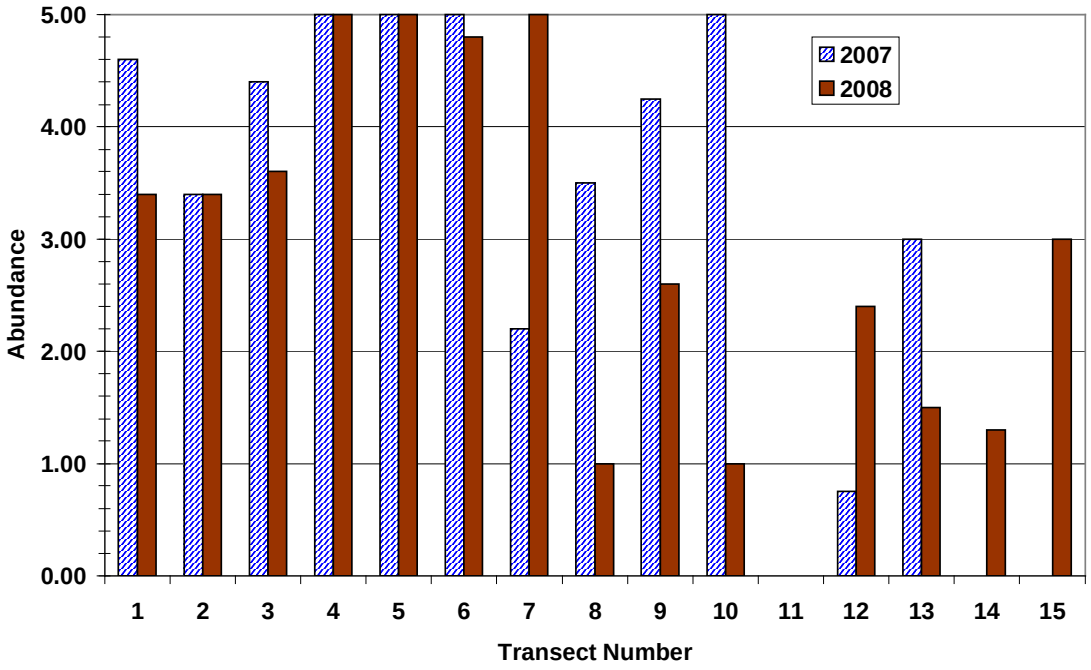

Fig. 24 ALXC Macroalgal Density

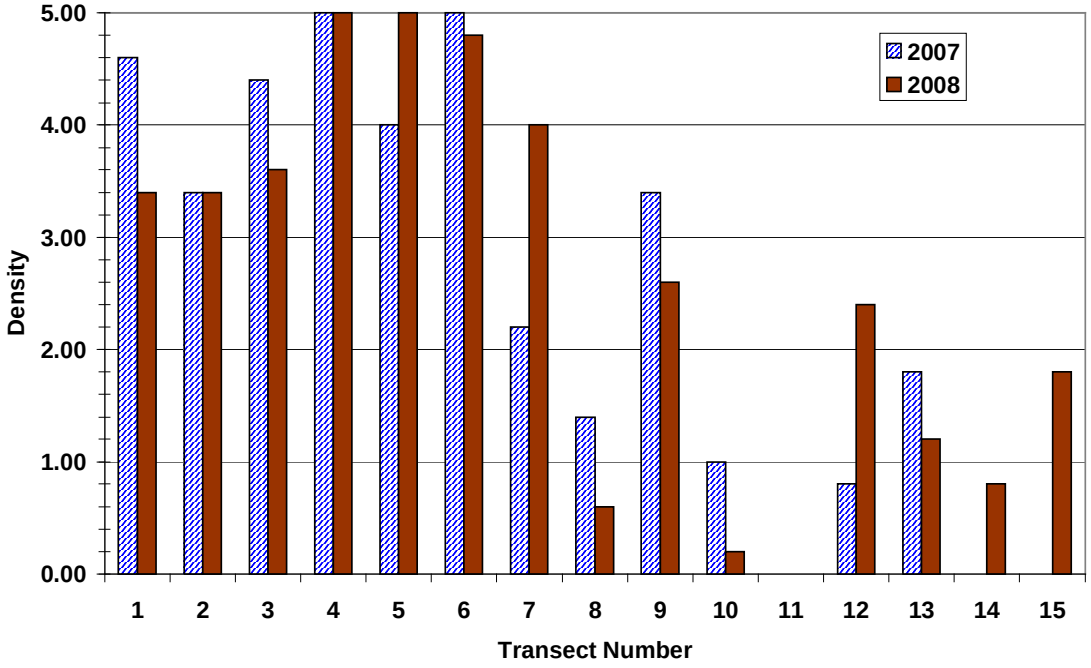

Fig. 25: SGLR Task 2 Water Temp., pH and D.O.

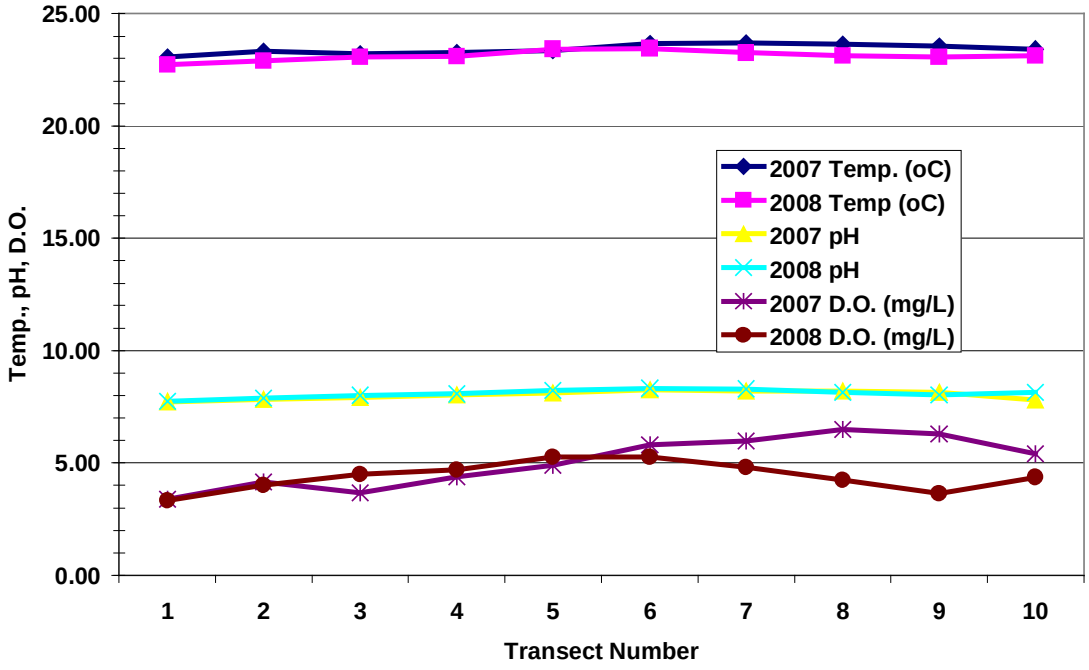

Fig. 26 SGLR Conductivity

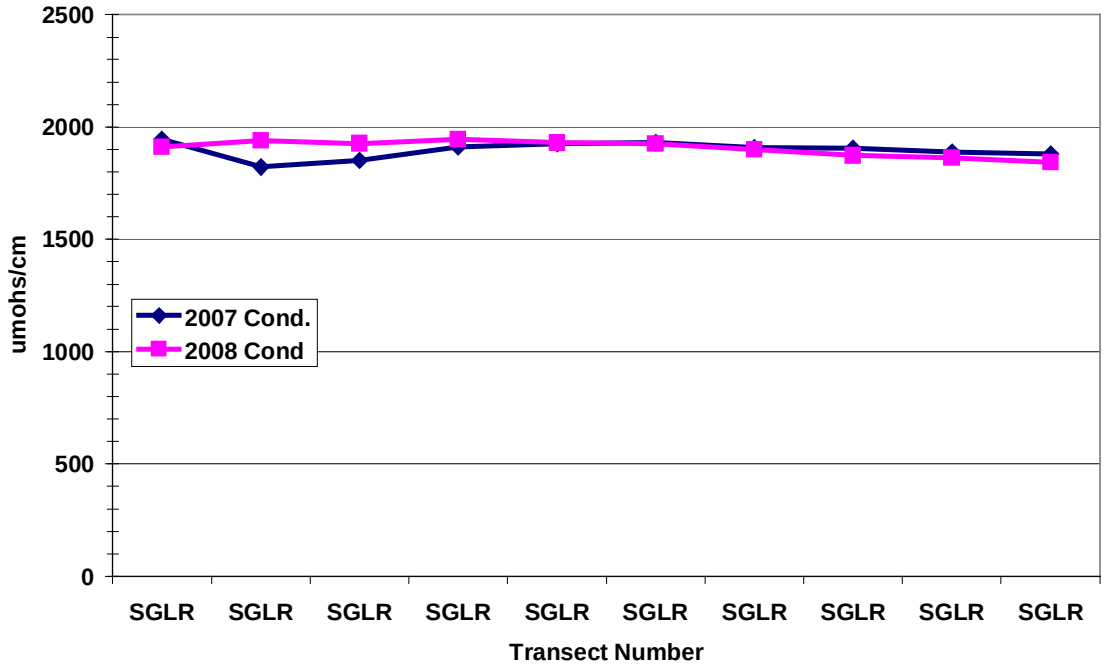

Fig. 27 SGLR Mid-Transect Water Depth and Current Velocity

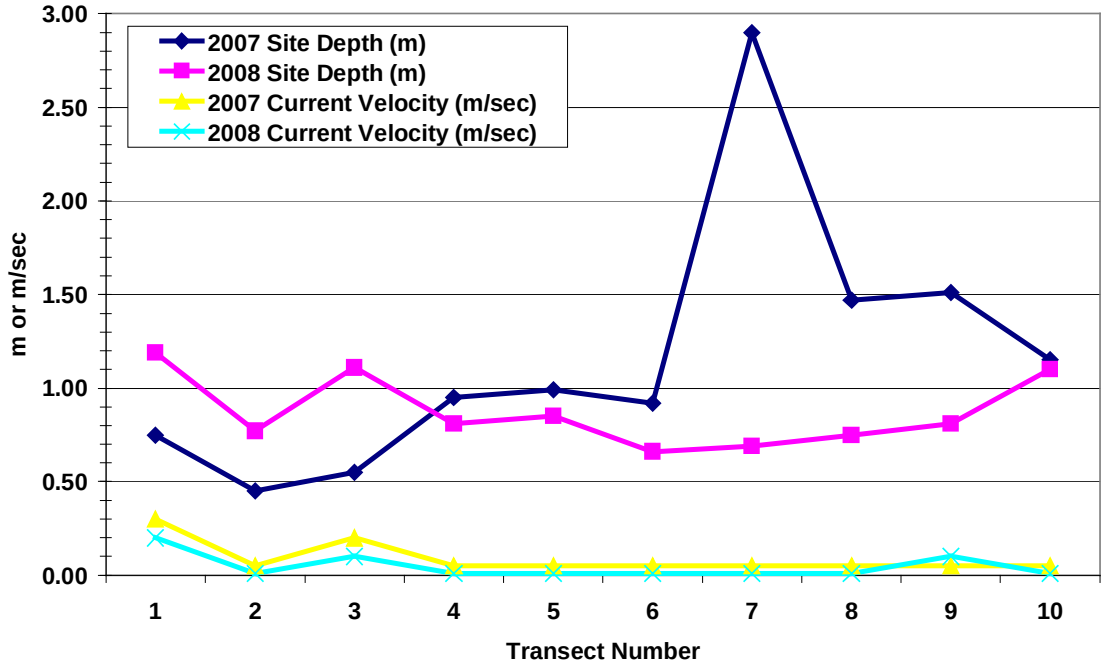

Fig. 28 SGLR Macroalgal Frequency

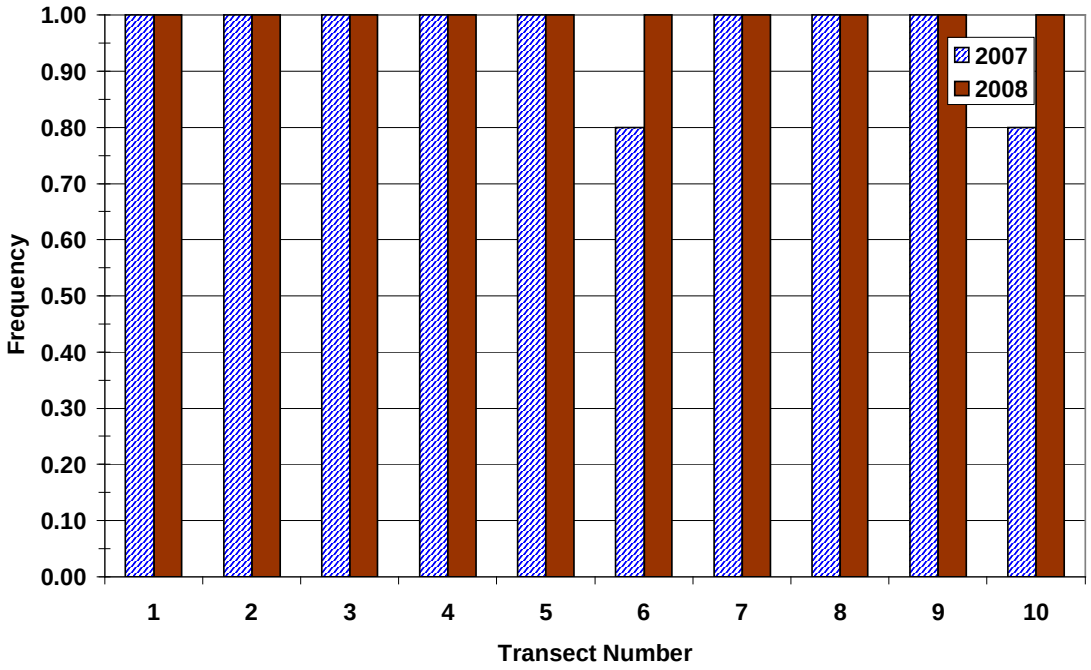

Fig. 29 SGLR Macroalgal Abundance

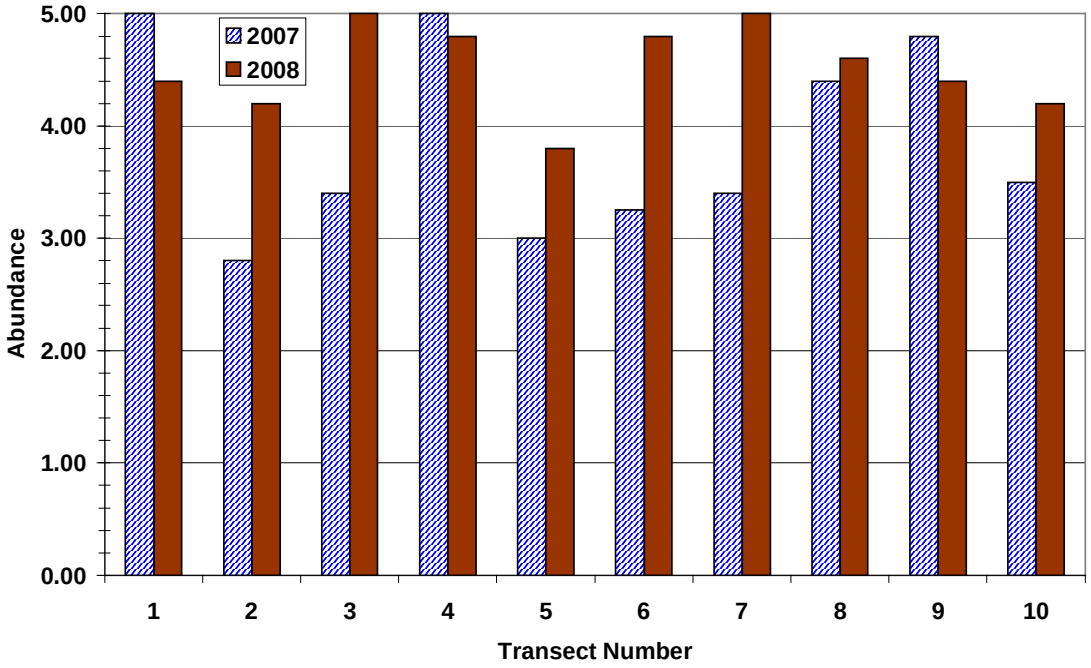

Fig. 30 SGLR Macroalgal Density

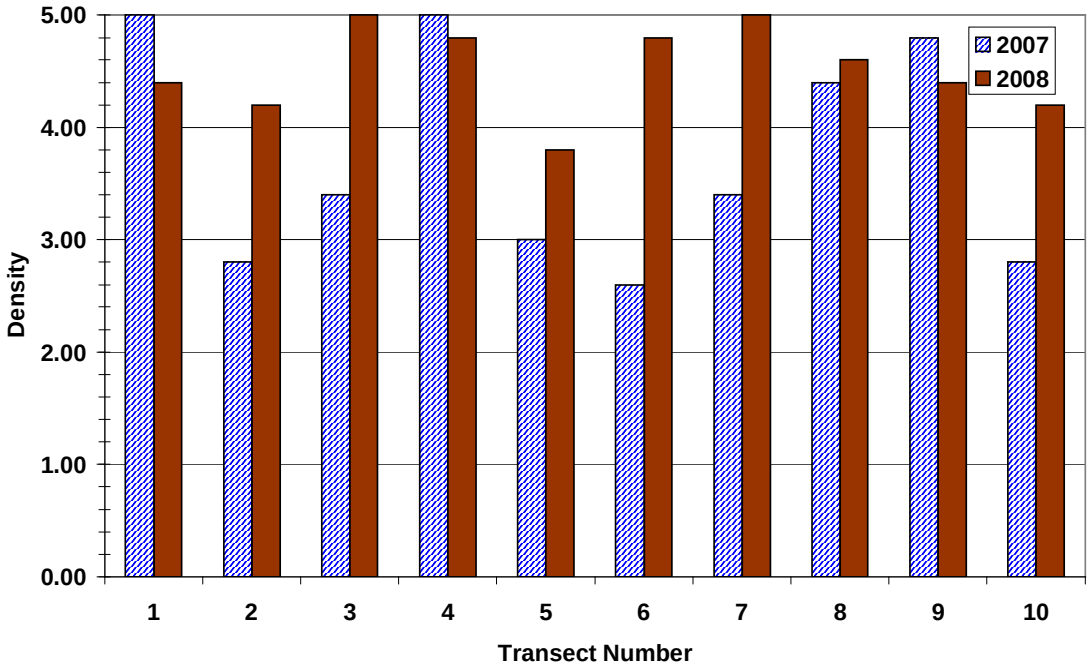

Table 1: WEKR Task 2 Macroalgae Species (Number of transects taxa were present out of 25 transects)

Taxa	Division	2007	2008
Pleurosira laevis	**Bacillariophyta**	**10**	**18**
Terpsinoe musica	**Bacillariophyta**	**15**	**22**
Cladophora glomerata	**Chlorophyta**	**10**	**15**
Coleochaete sp.	**Chlorophyta**	**0**	**2**
Hydrodictyon reticulatum	**Chlorophyta**	**2**	**3**
Mougeotia spp.	**Chlorophyta**	**6**	**4**
Oedogonium spp.	**Chlorophyta**	**12**	**19**
Rhizoclonium hieroglyphicum	**Chlorophyta**	**5**	**3**
Schizomeris leibleinii	**Chlorophyta**	**0**	**6**
Spirogyra spp.	**Chlorophyta**	**15**	**13**
Stigeoclonium spp.	**Chlorophyta**	**4**	**12**
Ulothrix sp.	**Chlorophyta**	**2**	**1**
Dichotomosiphon/Vaucheria spp.	**Chlorophyta/Xanthophyta**	**16**	**13**
Aphanothece stagnina	**Cyanobacteria**	**5**	**2**
Lyngbya wollei	**Cyanobacteria**	**7**	**10**
Oscillatoria cf. simplicissima	**Cyanobacteria**	**11**	**18**
Oscillatoria limosa	**Cyanobacteria**	**4**	**0**
Oscillatoria princeps	**Cyanobacteria**	**8**	**20**
Oscillatoria spp.	**Cyanobacteria**	**2**	**11**
Oscillatoria/Phormidium spp.	**Cyanobacteria**	**10**	**2**
Phormidium spp.	**Cyanobacteria**	**8**	**10**
Batrachospermum sp.	**Rhodophyta**	**3**	**3**
Compsopogon coeruleus	**Rhodophyta**	**1**	**9**
Thorea ramosissima	**Rhodophyta**	**1**	**0**

Table 2: RSR Task 2 Macroalgae Species (Number of transects taxa were present out of 16 transects)

Taxa	Division	2007	2008
Pleurosira laevis	**Bacillariophyta**	**7**	**14**
Terpsinoe musica	**Bacillariophyta**	**11**	**16**
Cladophora glomerata	**Chlorophyta**	**8**	**8**
Mougeotia spp.	**Chlorophyta**	**1**	**4**
Oedogonium spp.	**Chlorophyta**	**7**	**8**
Rhizoclonium hieroglyphicum	**Chlorophyta**	**4**	**7**
Schizomeris leibleinii	**Chlorophyta**	**0**	**2**
Spirogyra spp.	**Chlorophyta**	**3**	**7**
Stigeoclonium spp.	**Chlorophyta**	**6**	**7**
Dichotomosiphon/Vaucheria spp.	**Chlorophyta/Xanthophyta**	**3**	**8**
Calothrix sp.	**Cyanobacteria**	**1**	**1**
Homoeothrix sp.	**Cyanobacteria**	**0**	**1**
Lyngbya sp.	**Cyanobacteria**	**0**	**2**
Lyngbya wollei	**Cyanobacteria**	**6**	**9**
Oscillatoria cf. simplicissima	**Cyanobacteria**	**2**	**6**
Oscillatoria princeps	**Cyanobacteria**	**1**	**4**
Oscillatoria spp.	**Cyanobacteria**	**3**	**4**
Oscillatoria/Phormidium spp.	**Cyanobacteria**	**0**	**1**
Phormidium amoenum	**Cyanobacteria**	**0**	**1**
Phormidium favosum	**Cyanobacteria**	**1**	**2**
Phormidium puteale	**Cyanobacteria**	**5**	**0**
Phormidium retztii	**Cyanobacteria**	**1**	**1**
Phormidium terebriforme	**Cyanobacteria**	**0**	**2**
Phormidium spp.	**Cyanobacteria**	**10**	**2**
Batrachospermum sp.	**Rhodophyta**	**2**	**2**

Table 3: JUNC Task 2 Macroalgae Species (Number of transects taxa were present out of 15 transects)

Taxa	Division	2007	2008
Pleurosira laevis	**Bacillariophyta**	**7**	**7**
Terpsinoe musica	**Bacillariophyta**	**5**	**8**
Cladophora glomerata	**Chlorophyta**	**5**	**3**
Mougeotia spp.	**Chlorophyta**	**1**	**4**
Oedogonium spp.	**Chlorophyta**	**0**	**4**
Rhizoclonium hieroglyphicum	**Chlorophyta**	**5**	**6**
Spirogyra spp.	**Chlorophyta**	**6**	**8**
Stigeoclonium spp.	**Chlorophyta**	**0**	**1**
Ulothrix sp.	**Chlorophyta**	**0**	**2**
Ulva flexuosa	**Chlorophyta**	**2**	**1**
Dichotomosiphon/Vaucheria spp.	**Chlorophyta/Xanthophyta**	**3**	**2**
Calothrix sp.	**Cyanobacteria**	**2**	**5**
cf. Trichormus sp.	**Cyanobacteria**	**0**	**1**
Lyngbya cf. aestuarii	**Cyanobacteria**	**1**	**0**
Lyngbya wollei	**Cyanobacteria**	**8**	**6**
Lyngbya/Phormidium sp.	**Cyanobacteria**	**0**	**1**
Microchaete sp.	**Cyanobacteria**	**1**	**1**
Oscillatoria cf. simplicissima	**Cyanobacteria**	**0**	**7**
Oscillatoria princeps	**Cyanobacteria**	**0**	**1**
Oscillatoria spp.	**Cyanobacteria**	**4**	**7**
Oscillatoria/Phormidium spp.	**Cyanobacteria**	**1**	**2**
Phormidium spp.	**Cyanobacteria**	**7**	**9**
Scytonema/Tolypothrix sp.	**Cyanobacteria**	**0**	**2**
Batrachospermum sp.	**Rhodophyta**	**1**	**0**

Table 4: ALXC Task 2 Macroalgae Species (Number of transects taxa were present out of 15 transects)

Taxa	Division	2007	2008
Pleurosira laevis	**Bacillariophyta**	**8**	**12**
Terpsinoe musica	**Bacillariophyta**	**6**	**7**
Cladophora glomerata	**Chlorophyta**	**5**	**5**
Hydrodictyon reticulatum	**Chlorophyta**	**7**	**6**
Mougeotia spp.	**Chlorophyta**	**3**	**6**
Oedogonium spp.	**Chlorophyta**	**3**	**13**
Rhizoclonium hieroglyphicum	**Chlorophyta**	**7**	**6**
Spirogyra spp.	**Chlorophyta**	**10**	**9**
Stigeoclonium spp.	**Chlorophyta**	**0**	**1**
Ulva flexuosa	**Chlorophyta**	**2**	**7**
Dichotomosiphon/Vaucheria spp.	**Chlorophyta/Xanthophyta**	**2**	**2**
Anabaena sp.	**Cyanobacteria**	**0**	**5**
Gloeotrichia natans	**Cyanobacteria**	**3**	**1**
Hapalosiphon sp.	**Cyanobacteria**	**1**	**0**
Lyngbya cf. aestuarii	**Cyanobacteria**	**5**	**8**
Lyngbya wollei	**Cyanobacteria**	**7**	**9**
Lyngbya spp.	**Cyanobacteria**	**2**	**7**
Microchaete sp.	**Cyanobacteria**	**1**	**1**
Nostochopsis lobata	**Cyanobacteria**	**1**	**2**
Oscillatoria cf. simplicissima	**Cyanobacteria**	**0**	**5**
Oscillatoria limosa	**Cyanobacteria**	**0**	**4**
Oscillatoria princeps	**Cyanobacteria**	**1**	**10**
Oscillatoria spp.	**Cyanobacteria**	**3**	**5**
Oscillatoria/Phormidium spp.	**Cyanobacteria**	**0**	**1**
Phormidium spp.	**Cyanobacteria**	**4**	**5**
Scytonema crispum	**Cyanobacteria**	**1**	**0**
Scytonema/Tolypothrix sp.	**Cyanobacteria**	**0**	**2**
Batrachospermum sp.	**Rhodophyta**	**1**	**0**
Compsopogon coeruleus	**Rhodophyta**	**0**	**2**

Table 5: SGLR Task 2 Macroalgae Species (Number of transects taxa were present out of 10 transects)

Taxa	Division	2007	2008
Pleurosira laevis	**Bacillariophyta**	**4**	**9**
Terpsinoe musica	**Bacillariophyta**	**1**	**5**
Chaetomorpha sp.	**Chlorophyta**	**0**	**1**
Cladophora glomerata	**Chlorophyta**	**7**	**7**
Coleochaete sp.	**Chlorophyta**	**0**	**1**
Hydrodictyon reticulatum	**Chlorophyta**	**3**	**3**
Mougeotia spp.	**Chlorophyta**	**4**	**4**
Oedogonium spp.	**Chlorophyta**	**8**	**8**
Rhizoclonium hieroglyphicum	**Chlorophyta**	**6**	**7**
Spirogyra spp.	**Chlorophyta**	**3**	**7**
Stigeoclonium spp.	**Chlorophyta**	**2**	**7**
Ulothrix sp.	**Chlorophyta**	**2**	**0**
Ulva flexuosa	**Chlorophyta**	**3**	**3**
Anabaena sp.	**Cyanobacteria**	**1**	**6**
Calothrix sp.	**Cyanobacteria**	**1**	**2**
cf. Trichodesmium	**Cyanobacteria**	**0**	**1**
Lyngbya spp.	**Cyanobacteria**	**4**	**8**
Lyngbya wollei	**Cyanobacteria**	**10**	**10**
Lyngbya/Phormidium	**Cyanobacteria**	**0**	**1**
Microchaete sp.	**Cyanobacteria**	**0**	**2**
Oscillatoria cf. simplicissima	**Cyanobacteria**	**0**	**5**
Oscillatoria limosa	**Cyanobacteria**	**0**	**4**
Oscillatoria princeps	**Cyanobacteria**	**2**	**4**
Oscillatoria spp.	**Cyanobacteria**	**6**	**1**
Oscillatoria/Phormidium spp.	**Cyanobacteria**	**0**	**2**
Phormidium spp.	**Cyanobacteria**	**6**	**3**
Trichormus sp.	**Cyanobacteria**	**0**	**1**

Task 3: Algal and Water Quality Studies

Purpose

The purpose of this task was to conduct detailed, quantitative studies of periphytic algal communities and water quality within selected segments in the five spring-run streams on a quarterly basis.

Methods

Nine stream segments were sampled quarterly for water quality and algal periphyton community analysis. Two segments each were located in WEKR (WEKR1, WEKR3), RSR (RSR1, RSR2), JUNC (JUNC1, JUNC2) and ALXC (ALXC1, ALXC2) and one segment was located in SGLR (SGLR1). GPS points were captured at the beginning and end of each study reach using a WAAS-enabled Magellan MAP 330 hand-held Global Positioning System. Field sampling for Task 3 began in February 2007 and ended in May 2009.

Water Quality Analyses

Water quality sampling was concurrent with algal sampling. Field water quality measurements were taken with a calibrated YSI 6600 Multi-Parameter Water Quality Monitor at each location algae was sampled. Parameters to be measured included water temperature, pH, D.O., conductivity and water depth. At each sampling location a GPS point was captured, current velocity was measured using an electronic flow meter and canopy cover was determined with a hemispherical densiometer.

Samples for chemical water quality parameters were taken midstream at approximately the midpoint of the sampling reach, the location of which was recorded using GPS. Parameters measured included color, alkalinity, turbidity, total suspended solids, total organic carbon, dissolved ammonia (NH_4-D), dissolved nitrate-nitrite (NO_x-D), total Kjeldahl nitrogen (TKN), total phosphorus (TP) and dissolved orthophosphate (PO_4-D). Water samples were collected, processed and preserved according to the SJRWMD's "Standard Operating Procedures for the Collection of Surface Water Quality Samples and Field Data-Feb. 13, 2004" and FDEP's Standard Operating Procedures. Samples were kept on ice and brought to Advanced Environmental Laboratories (AEL) in Gainesville, Florida for analysis. Samples were brought to AEL no later than 12:00 p.m. on the day after collection.

Algal Community Analysis: Field Sampling

Within each segment dominant substrates were sampled for periphytic algae analysis. Substrate types included submerged stems of emergent vegetation (EMERG), leaf blades of submerged aquatic vegetation (SAV), woody debris (WD), sediments (SED) and benthic filamentous macroalgae (BFA). Table 6 shows substrates sampled at each segment and the nature of analyses to be conducted.

Three locations of each dominant substrate in a segment were sampled. A random number table was used to determine approximate number of meters from beginning of reach to the sampling location. The nearest dominant available substrate from that point

was sampled. A 0.25m^2 quadrat was randomly placed on the area of substrate to be sampled. Qualitative observations of the quadrat were made. From the quadrats samples were collected for algal identification (qualitative or quantitative), periphyton dry weight and ash-free dry weight (AFDW) and chlorophyll-*a*. The number of samples and replicates and the method of algal removal for each substrate type are summarized in Table 7.

For emergent vegetation samples pieces of stem from the water surface to ~20 cm below the surface were clipped from a minimum 6 plants using garden shears. For submerged vegetation samples leaf blades ~20 cm in length (if possible) were clipped from a minimum of 6 plants using garden shears or scissors. For woody debris a minimum of 6 pieces of ~20 cm length (if possible) were clipped using garden shears. For sediment epipelon and chl-*a* analysis samples were either collected by hand or using an Ekman dredge. The bottom half of a 3-1/2" petri dish was pushed into the sediment until filled. The top half of the petri dish was slid underneath to contain the sample. A total of nine petri dishes of sediment were taken (three from each of three Ekman grabs if used) and three put in each of three plastic bags. For benthic macroalgal mat samples macroalgae was removed from a portion or the entire area of a 0.25m^2 quadrat. All samples were placed in labeled plastic bags and transported on ice to the laboratory.

Two glass slide periphytometers (Wildco 156 Periphyton Sampler) were deployed at six sites: WEKR1, WEKR3, RSR1, JUNC1, ALXC1 and SGLR1. Periphytometers (PERI) were placed approximately four weeks prior to natural substrate/water quality sampling and recovered during sampling. For each periphytometer 2 to 6 slides were used for algal identification and enumeration, 3 for measurement of chl-*a* and 3 for measurement of AFDW. Methods for processing of slides were as described in Standard Methods No. 10300 C.

Algal Community Analysis: Laboratory Processing

Periphyton Removal:

For emergent vegetation, submerged vegetation and woody debris samples the six ~20cm lengths were cut in half making twelve ~10 cm lengths for each of the three sampling points in the reach. These were pooled and 4 randomly chosen pieces were scraped for algal ID and enumeration, 4 for dry weight/AFDW and 4 for chl-*a* analysis. Material was scraped with a soft or hard brush dependent on the nature of the substrate. Preliminary examinations were made to insure that the majority of algae were removed and a minimal amount of substrate material was included. Surface area of scraped surface (cm^2) was recorded. Observations of leaf blades using epi-fluorescence indicated that some small cyanobacterial forms were impossible to remove without including large amounts of leaf material in the samples. The impact of including leaf material in chl-*a* and AFDW analysis is likely greater than the omission of the small, attached/embedded cyanophytes.

Additional samples of vegetation, submerged vegetation and woody debris were removed for preparation of cleaned diatom slides. These slides were used to aid in diatom species identification in the Lugol's preserved samples and to contribute to the overall list of species found in each spring run.

Benthic macroalgae samples collected were analyzed for dry weight.

Material for chl-*a* analysis was filtered on to glass fiber filters and frozen prior to analysis.

Algal Identification and Enumeration

Material to be used for algal identification and enumeration was preserved in Lugol's Iodine Solution. Samples for algal identification and enumeration were homogenized with a blender prior to analysis. Multiple aliquots of homogenized sample were collected for algal ID and enumeration samples to reduce error due to patchiness.

Samples were analyzed using Utermöhl settling chambers and an inverted microscope. Enumeration was performed on a Nikon Eclipse TE200 inverted microscope equipped with phase contrast optics. Before beginning enumeration slides were scanned at low power to ensure that distribution of cells was relatively uniform. Only intact, viable cells were counted. Counts were made as natural units (cells, filaments, colonies). The goal was to count a total of 400-600 natural units per sample. A minimum of 10 and a maximum of 50 fields were counted at both 400X and 200X. An additional scan of the entire slide was made at 100X to count large and/or rare taxa. A maximum of 100 fields combined at 400 and 200X plus the 100X scan was performed on any sample.

For colonial and filamentous forms number of cells per colony or filament were recorded (20-30 filaments or colonies for each species if possible) and means used to calculate cells/natural unit. Cell biovolumes were calculated by measuring 10-15 cells (if possible; more if necessary depending on variability of species) for length, width and depth and applying the volumetric formula for the best fitted geometric shape or shapes (Hillebrand et al. 1999).

Samples for diatom slides were treated with concentrated H_2SO_4 and hydrogen peroxide and the resultant cleaned diatoms mounted in Naphrax mounting medium.

Dry Weight/AFDW Analysis

For dry weight of macroalgae samples filaments were separated by species (if possible), dried to a constant weight at 105^{o}C and weighed. If separation by species was not possible material was examined under the microscope and relative abundance of dominant species in the sample noted.

Samples for periphyton biomass were filtered on to pre-combusted, pre-weighed 47 mm GF/C filters. Filters were dried to a constant weight at 105^{o}C, weighed, placed in a muffle furnace at 500^{o}C for one hour and re-weighed to determine periphyton ash-free dry weight.

Chlorophyll-*a* Analysis

Material for chl-*a* analysis was filtered on to glass fiber filters. Samples for chl-*a* analyses were kept frozen and in the dark following processing and taken to AEL labs in

Gainesville. Chl-*a* was measured by AEL using District approved methodologies. Results were corrected for phaeophytins.

Sediment chl-*a* and AFDW
Sediment chl-a and AFDW were determined using EPA Method 3-58: Total solids, procedure for sediment samples with volatile solids determination (USEPA/Army Corps 1981) and Methods 10200H and 10300C: Chlorophylls and Phaeophytin analyses from Standard Methods for the Examination of Water and Wastewater (2005).

Statistical Analysis
Water quality differences between stream segments was analyzed using ANOVA followed by Fisher's PLSD. Differences between stream segments in periphytic algal cell density, biovolume, chl-*a* and AFDW were analyzed using the Kruskal-Wallis Test followed by Dunn's Procedure. Relationships between biological and water quality parameters were analyzed using Spearman Correlation. All statistical analyses were run using StatView for Windows, Version 5.0.1 (SAS Institute 1992-1998).

Results

Segment Descriptions:
WEKR1 began from just downstream of the lagoon area of Wekiwa Springs and ran for approximately 1000 m and was within the "WR-SEG1" sampled by WSI (2005). The dominant species of submerged aquatic vegetation (SAV) in the segment was *Najas quadalupensis* (water naid) (Table 8). Other SAV observed at collection points along the segment included *Hydrilla verticillata* and *Vallisneria americana* (wild celery). *Nuphar advena* (spatterdock, yellow cow-lily) was the dominant emergent/floating species (Table 8), with *Lemna* sp. (duckweed), *Hydrocotyle* sp. (water pennywort or dollarweed), *Pistia stratiotes* (water lettuce) and *Cicuta mexicana* (water hemlock) also noted. Shoreline vegetation was dominated (Table 8) by *Acer rubrum* (red maple), *Sabal* spp. (cabbage palm/saw palmetto) and *Persea* sp. (bay), with *Myrica cerifera* (wax myrtle), *Sambucus canadensis* (elderberry), *Fraxinus* sp. (ash) and *Quercus* spp. (oak) also observed. Filamentous green algae and red algae (*Batrachospermum* sp. or *Compsopogon coeruleus*) were regularly observed attached or entangled with SAV, *N. advena* stems and woody debris. Areas of benthic *Dichotomosiphon*/*Vaucheria* and the cyanophyte *Aphanothece stagnina* were also noted at times.

WEKR1 average channel width was 20 m (WSI 2005) and water depth ranged from 0.45 m to 1.90 m with a mean of 1.08 m (SD=0.32) and median of 1.10 m. Minimum current velocity (flow) was 0 m/sec and maximum was 0.20 m/sec with a mean of 0.08 m/sec (SD=0.04) and median of 0.10 m/sec. Canopy cover ranged from 2.2% to 99.0%, with a mean of 47.14% (SD=23.17) and median of 41.76% (Table 9).

WEKR3 was located on the Wekiva River and began approximately 1000 m upstream of the bridge at State Road 46, ended at the bridge and was within the "WR-SEG2" sampled by WSI (2005). The dominant species of SAV in the segment was *Vallisneria americana* (Table 8). Other SAV observed in the segment included *Najas guadalupensis*. *Nuphar advena* was the dominant emergent/floating species (Table 8). *Hydrocotyle* sp., *Lemna*

sp., *Wolffia* sp. (water-meal), *Salvinia* sp. (water fern, water spangles), *Pistia stratiotes*, *Eichhornia crassipes* (water hyacinth), *Alternanthera philoxeroides* (alligator weed), *Cicuta mexicana* and *Colocasia esculenta* (wild taro) were also noted. Shoreline vegetation was dominated (Table 8) by *Quercus* spp., *Sabal* spp. and *Taxodium* sp. (cypress). *Acer rubrum* and *Typha* sp. (cattail) were also observed. Filamentous green algae and red algae (*Batrachospermum* sp.) were regularly observed attached or entangled with *V. americana* and *N. advena* stems. Brownish diatom films and "filaments" were observed on *V. americana* leaf blades and *N. advena* stems.

WEKR3 average channel width was 124.2 m (WSI 2005) and water depth ranged from 0.10 m to 1.85 m with a mean of 0.68 m (SD=0.33) and median of 0.63 m (Table 10). Minimum current velocity (flow) was 0 m/sec and maximum was 0.35 m/sec with a mean of 0.09 m/sec (SD=0.06) and median of 0.10 m/sec (Table 10). WEKR3 had significantly lower mean canopy cover than all stream segments except ALXC1, JUNC2 and SGLR1 and ranged from 0% to 40.70% with a mean of 1.44% (SD=6.50) and median of 0%.

RSR1 was located downstream of the headspring and within the "RSR-SEG1" sampled by WSI (2005). Segment length was approximately 1000 m. The dominant species of SAV in the segment were *Vallisneria americana* and *Chara* sp. (musk-grass) (Table 8). *Nuphar advena* and *Hydrocotyle* sp. were the dominant emergent/floating species (Table 8). *Lemna* sp., *Pistia stratiotes*, *Cicuta mexicana* and *Pontederia cordata* (pickerelweed) were also noted. Shoreline vegetation was dominated by *Sabal* spp., *Quercus* spp. and *Persea* sp. (Table 8). *Taxodium* sp., *Fraxinus* sp., *Cyrilla racemiflora* (swamp titi), *Acer rubrum*, *Typha* sp., *Salix* sp. (willow), *Liquidambar styraciflua* (sweet gum), *Ludwigia* sp. (water-primrose) and *Carya* sp. (hickory) were also observed. Filamentous green algae were regularly observed attached or entangled with SAV and woody debris. Brownish diatom films and "filaments" were observed on *V. americana* leaf blades and woody debris.

RSR1 average channel width was 31.3 m (WSI 2005) and water depth ranged from 0.10 m to 5.34 m with a mean of 0.97 m (SD=0.95) and median of 0.72 m. Minimum current velocity (flow) was 0 m/sec and maximum was 0.60 m/sec with a mean of 0.11 m/sec (SD=0.11) and median of 0.10 m/sec (Table 11). Canopy cover ranged from 0% to 100.0% with a mean of 32.64% (SD=22.73) and median of 26.70% (Table 11).

RSR2 began approximately 1000 m upstream of the confluence with the Wekiva River and within the "RSR-SEG2" sampled by WSI (2005). The dominant species of SAV in the segment were *Vallisneria americana* and *Najas guadalupensis* (Table 8). *Nuphar advena* and *Hydrocotyle* sp. were the dominant emergent/floating species (Table 8). *Lemna* sp., *Pistia stratiotes*, *Cicuta mexicana*, *Pontederia cordata* and *Eichhornia crassipes* were also noted. Shoreline vegetation was dominated by *Sabal* spp., *Quercus* spp. and *Fraxinus* sp. (Table 8). *Taxodium* sp., *Cyrilla racemiflora*, *Acer rubrum*, *Persea* sp., *Liquidambar styraciflua*, *Sambucus canadensis*, *Myrica cerifera* and *Colocasia esculenta* were also observed. Filamentous green algae were regularly observed attached to or entangled with *N. advena* stems and woody debris. Brownish diatom films and

"filaments" were observed on *N. advena* stems and woody debris and patches of benthic *Dichotomosiphon*/*Vaucheria* sp. was recorded.

RSR2 average channel width was 37.5 m (WSI 2005) and water depth ranged from 0.20 m to 2.50 m with a mean of 0.61 m (SD=0.32) and median of 0.55 m. Minimum current velocity (flow) was 0.03 m/sec and maximum was 0.50 m/sec with a mean of 0.23 m/sec (SD=0.12) and median of 0.20 m/sec (Table 12). Mean water flow at RSR2 was significantly higher than at all other stream segments with the exception of JUNC2. Canopy cover ranged from 14.70% to 88.60% with a mean of 55.39% (SD=19.17) and median of 54.50% (Table 12). Mean canopy cover at RSR2 was significantly higher than at all other stream segments with the exception of JUNC1.

JUNC1 began approximately 1000 m upstream of the inflow of Fern Hammock Spring. The only species of SAV observed in the segment was *Vallisneria americana*, although *Chara* sp. was observed upstream (Table 8). No emergent/floating species were observed at collection points along transect (Table 8). Shoreline vegetation was dominated by *Ilex* sp. (holly), *Sabal* spp. and *Myrica cerifera* (Table 8). Other species observed along shoreline at collection points along the transect were *Lyonia lucida* (fetterbush), *Salix* sp., *Cephalanthus occidentalis* (buttonbush), *Acer rubrum*, *Cyrilla racemiflora*, *Quercus* spp., *Persea* sp. and *Typha* sp. Benthic mats of the filamentous cyanophyte *L. wollei* were frequently observed close to the shoreline. Filaments of *L. wollei* were also found entangled with *V. americana*. Diatoms and filamentous green algae on *V. americana* were observed less frequently.

JUNC1 average channel width was 10.2 m (WSI 2005) and water depth ranged from 0.20 m to 1.30 m with a mean of 0.54 m (SD=0.23) and median of 0.51 m. Minimum current velocity (flow) was 0.05 m/sec and maximum was 0.40 m/sec with a mean of 0.20 m/sec (SD=0.08) and median of 0.20 m/sec (Tab le 13). Mean canopy cover at JUNC1 was significantly higher than at all other stream segments and ranged from 10.60% to 96.90% with a mean of 62.95% (SD=18.68) and median of 67.00% (Table 13).

JUNC2 was located upstream of the SR19 bridge and within the "JC-SEG1" sampled by WSI (2005. Segment length was approximately 1000 m. The dominant species of SAV in the segment was *Potamogeton pectinatus* (Sago pondweed) (Table 8). Other SAV observed in the segment included *Vallisneria americana* and *Najas guadalupensis*. *Hydrocotyle* sp. was the dominant emergent/floating species (Table 8). *Lemna* sp., *Salvinia* sp., *Pistia stratiotes*, *Eichhornia crassipes*, *Cicuta mexicana*, *Eleocharis* sp. (spikerush), *Juncus* sp. (rush), *Pontederia cordata* and *Sagittaria* sp. were also noted. Shoreline vegetation was dominated by *Myrica cerifera*, unknown shrubs and unknown grasses (Table 8). *Salix* sp., *Persea*, *Quercus* spp., *Sabal* spp and *Solidago* sp. (goldenrod) were also observed. Filamentous green algae (including *Cladophora glomerata* and *Ulva flexuosa*) were regularly observed attached to or entangled with *P. pectinatus*. Brownish diatom films and "filaments" were also observed on *P. pectinatus*. Benthic clumps of *Dichotomosiphon*/*Vaucheria* were also recorded.

JUNC2 average channel width was 33.3 m (WSI 2005) and water depth ranged from 0.15 m to 2.10 m with a mean of 0.78 m (SD=0.40) and median of 0.72 m. Minimum current velocity (flow) was 0.10 m/sec and maximum was 0.80 m/sec with a mean of 0.34 m/sec (SD=0.13) and median of 0.30 m/sec (Table 14). Mean water flow was significantly higher at JUNC2 than at all other stream segments. JUNC2 had significantly lower mean canopy cover than all stream segments except WEKR3, ALXC1 and SGLR1 and ranged from 0.0% to 51.60% with a mean of 3.42% (SD=8.96) and median of 0.0% (Table 14).

ALXC1 began 1000m upstream of FR445 and was within the "ASR-SEG1" sampled by WSI (2005). The dominant species of SAV in the segment were *Vallisneria americana* and *Najas guadalupensis* (Table 8). Other SAV observed in the segment included *Ceratophyllum demersum* (coontail). *Nuphar advena* and *Hydrocotyle* sp. were the dominant emergent/floating species (Table 8). *Lemna* sp., *Pistia stratiotes, Eichhornia crassipes, Cicuta mexicana* and *Pontederia cordata* were also noted. Shoreline vegetation was dominated by *Typha* sp., *Quercus* spp. and *Sabal* spp. (Table 8). *Acer rubrum, Myrica cerifera* and *Pinus* sp. (pine) were also observed. Filamentous green algae (particularly *Cladophora glomerata*) were regularly observed attached or entangled with the SAV, sometimes forming extensive surface mats with extremely long filaments. Benthic patches of chlorophyte macroalgae were observed as well. *Lyngbya wollei* was found primarily close to the shore. Brownish diatom films and "filaments" were observed on SAV.

ALXC1 average channel width was 60.3 m (WSI 2005) and water depth ranged from 0.25 m to 1.01 m with a mean of 0.67 m (SD=0.18) and median of 0.71 m. Minimum current velocity (flow) was 0.0 m/sec and maximum was 0.20 m/sec with a mean of 0.10 m/sec (SD=0.04) and median of 0.10 m/sec (Table 15). ALXC1 had significantly lower mean canopy cover than all stream segments except WEKR3, JUNC2 and SGLR1 and ranged from 0.0% to 32.40% with a mean of 1.52% (SD=5.58) and median of 0.0% (Table 15).

ALXC2 began approximately 1000m upstream of the FR552 boat ramp and was within the "ASR-MB2" segment sampled by WSI (2005). The only species of SAV recorded at collection points was *Vallisneria americana* (Table 8). *Nuphar advena* and *Hydrocotyle* sp. were the dominant emergent/floating species (Table 8). Other emergent/floating species recorded were *Pistia stratiotes, Cicuta mexicana*, *Salvinia* sp., *Lemna* sp. and an unknown grass. Shoreline vegetation was dominated by *Quercus* sp., *Sabal* spp. and *Typha* sp. (Table 8). Filamentous green algae were regularly observed attached to or entangled with *N. advena* stems and woody debris. Gelatinous cyanophyte colonies (*Nostochopsis lobata*) were observed attached to woody debris. Brownish diatom films and "filaments" were observed on *N. advena* stems and woody debris and patches of benthic *Dichotomosiphon*/*Vaucheria* sp. were recorded.

ALXC2 average channel width was 48 m (WSI 2005) and water depth ranged from 0.22 m to 2.25 m with a mean of 0.87 m (SD=0.42) and median of 0.77 m. Minimum current velocity (flow) was 0.0 m/sec and maximum was 0.30 m/sec with a mean of 0.12 m/sec

(SD=0.08) and median of 0.10 m/sec (Table 16). Canopy cover ranged from 0.0% to 73.00% with a mean of 22.42% (SD=22.07) and median of 13.70% (Table 16).

SGLR1 was located along the west bank of the spring in the large roped off area downstream of the headspring, and in the short run of the secondary spring vent west of the main spring vent. The dominant species of SAV in the segment was *Vallisneria americana* (Table 8). Other SAV observed in the segment included *Najas guadalupensis*, *Chara* sp., *Hydrilla verticillata* and *Zannichellia palustris* (horned pondweed). *Eichhornia crassipes* and *Hydrocotlye* sp. were the dominant emergent/floating species (Table 8). *Pontederia cordata* was also observed. Shoreline vegetation was dominated by *Quercus* spp., *Sabal* spp. and *Myrica cerifera* (Table 8). Thick (>20cm deep), expansive mats of the cyanophyte *Lyngbya wollei* were present throughout the segment.

SGLR1 water depth ranged from 0.33 m to 1.95 m with a mean of 0.95 m (SD=0.34) and median of 0.95 m. Minimum current velocity (flow) was 0.0 m/sec and maximum was 0.50 m/sec with a mean of 0.11 m/sec (SD=0.13) and median of 0.05 m/sec (Table 17). SGLR1 had significantly lower mean canopy cover than all stream segments except WEKR3, JUNC2 and ALXC1 and ranged from 0.0% to 27.20% with a mean of 3.96% (SD=6.29) and median of 0.00% (Table 17).

Water Quality:
WEKR1
Field Measurements
Task 3 water quality field measurements for WEKR1 are summarized in Table 9. Water temperatures ranged from 22.21^{o}C to 24.64^{o}C with a mean of 23.50^{o}C (SD=0.65) and median of 23.61^{o}C. Values of pH varied from 6.65 to 8.38 with a mean of 7.51 (SD=0.22) and a median of 7.54. Dissolved oxygen readings had a low value of 1.02 mg/L and high value of 4.36 mg/L with a mean of 2.83 (SD=0.89) and a median of 3.00. Mean dissolved oxygen at WEKR1 was significantly lower than at all other stream segments. Conductivity varied from 304.0 umohs/cm to 540.0 umohs/cm with a mean of 342.3 umohs/cm (SD=23.0) and median of 341.5 umohs/cm.

Laboratory Measurements
Task 3 water quality lab measurements for WEKR1 are summarized in Table 9. Mean alkalinity at WEKR1 was significantly higher than at all other stream segments. Alkalinity varied from 92 mg/L to 126 mg/L with a mean of 120.67 mg/L (SD=10.91) and median of 124 mg/L. Color ranged from 5 cpu to 100 cpu with a mean of 19.44 cpu (SD=30.46) and a median of 10 cpu. Dissolved ammonia (NH_4-D) varied from 0 to 0.189 mg/L with a mean of 0.025 mg/L (SD=0.062) and median of 0.00 mg/L. Dissolved nitrate-nitrite (NOx-D) reached a low of 0.603 mg/L and a high of 1.050 mg/L with a mean of 0.772 mg/L (SD=0.158) and median of 0.756 mg/L. Minimum total Kjeldahl nitrogen (TKN) was 0.030 mg/L and maximum was 0.700 mg/L with a mean of 0.182 mg/L (SD=0.203) and median of 0.130 mg/L. Dissolved orthophosphate (PO_4-D) ranged from 0.092 mg/L to 0.126 mg/L with a mean of 0.117 mg/L (SD=0.011) and median of 0.117 mg/L. Mean PO_4-D at WEKR1 was significantly higher than at all other stream segments. Minimum total phosphorus (TP) was 0.109 mg/L and maximum was 0.161

mg/L with a mean of 0.126 mg/L (SD=0.016) and median of 0.120 mg/L. WEKR1 had significantly higher mean TP than all other stream segments with the exception of WEKR3. Total organic carbon (TOC) varied from 0.27 mg/L to 15.10 mg/L with a mean of 3.09 mg/L (SD=4.56) and median of 1.50 mg/L. Total suspended solids (TSS) reached a low of 0.0 mg/L and high of 3.00 mg/L with a mean of 1.11 mg/L (SD=0.93) and median of 1.00 mg/L. Turbidity ranged from 0.0 ntu to 0.92 ntu with a mean of 0.28 ntu (SD=0.30) and median of 0.15 ntu.

WEKR3

Field Measurements

Task 3 water quality field measurements for WEKR3 are summarized in Table 10. Water temperatures ranged from 16.16^{o}C to 27.95^{o}C with a mean of 23.93^{o}C (SD=3.84) and median of 25.45^{o}C. Values of pH varied from 7.21 to 8.79 with a mean of 7.88 (SD=0.41) and a median of 7.89. Dissolved oxygen readings had a low value of 4.01 mg/L and a high value of 13.29 mg/L with a mean of 8.41 mg/L (SD=2.57) and a median of 9.32 mg/L. Mean D.O. levels at WEKR3 were significantly higher than at all other stream segments. Conductivity varied from 302.0 umohs/cm to 497.0 umohs/cm with a mean of 386.9 umohs/cm (SD=45.8) and median of 381.0 umohs/cm.

Laboratory Measurements

Task 3 water quality lab measurements for WEKR3 are summarized in Table 10. Alkalinity varied from 90 mg/L to 126 mg/L with a mean of 111.89 mg/L (SD=12.53) and median of 115.0 mg/L. Mean alkalinity at WEKR3 was significantly higher than at all other stream segments with the exception of WEKR1. Color ranged from 5 cpu to 70 cpu with a mean of 28.33 cpu (SD=21.36) and a median of 20 cpu. Dissolved ammonia (NH_4-D) varied from 0 to 0.160 mg/L with a mean of 0.038 mg/L (SD=0.059) and median of 0.002 mg/L. Mean NH_4-D at WEKR3 was significantly higher than at all other stream segments. Dissolved nitrate-nitrite (NOx-D) reached a low of 0.205 mg/L and a high of 0.645 mg/L with a mean of 0.316 mg/L (SD=0.132) and median of 0.263 mg/L. Minimum total Kjeldahl nitrogen (TKN) was 0.090 mg/L and maximum was 0.800 mg/L with a mean of 0.354 mg/L (SD=0.209) and median of 0.290 mg/L. Dissolved orthophosphate (PO_4-D) ranged from 0.084 mg/L to 0.112 mg/L with a mean of 0.101 mg/L (SD=0.010) and median of 0.104 mg/L. Mean PO_4-D at WEKR3 was significantly higher than at all other stream segments with the exception of WEKR1. Minimum total phosphorus (TP) was 0.110 mg/L and maximum was 0.161 mg/L with a mean of 0.130 mg/L (SD=0.018) and median of 0.135 mg/L. Mean TP at WEKR3 was significantly higher than at all other stream segments. Total organic carbon (TOC) varied from 1.90 mg/L to 13.30 mg/L with a mean of 5.77 mg/L (SD=3.98) and median of 3.90 mg/L. Total suspended solids (TSS) reached a low of 1.00 mg/L and high of 15.00 mg/L with a mean of 4.33 mg/L (SD=4.36) and median of 4.00 mg/L. Turbidity ranged from 0.15 ntu to 5.28 ntu with a mean of 1.11 ntu (SD=1.73) and median of 0.45 mg/L. Mean turbidity at WEKR3 was significantly higher than at all other stream segments with the exception of RSR2.

RSR1

Field Measurements

Task 3 water quality field measurements for RSR1 are summarized in Table 11. Water temperatures ranged from 20.06°C to 25.26°C with a mean of 23.46°C (SD=1.32) and median of 23.93°C. Values of pH varied from 7.51 to 8.21 with a mean of 7.93 (SD=0.13) and a median of 7.92. Dissolved oxygen readings had a low value of 5.40 mg/L and a high value of 7.24 mg/L with a mean of 6.26 mg/L (SD=0.47) and a median of 6.28 mg/L. Conductivity varied from 255.0 umohs/cm to 272.0 umohs/cm with a mean of 262.7 umohs/cm (SD=4.4) and median of 262.0 umohs/cm.

Laboratory Measurements

Task 3 water quality lab measurements for RSR1 are summarized in Table 11. Alkalinity varied from 86 mg/L to 100 mg/L with a mean of 94.22 mg/L (SD=4.52) and median of 96 mg/L. Color ranged from 5 cpu to 20 cpu with a mean of 7.22 cpu (SD=5.07) and a median of 5 cpu. Dissolved ammonia (NH_4-D) varied from 0 to 0.049 mg/L with a mean of 0.015 mg/L (SD=0.021) and median of 0.00 mg/L. Dissolved nitrate-nitrite (NOx-D) reached a low of 0.986 mg/L and a high of 1.390 mg/L with a mean of 1.132 mg/L (SD=0.126) and median of 1.120 mg/L. Mean NOx-D at RSR1 was significantly higher than at all other stream segments. Minimum total Kjeldahl nitrogen (TKN) was 0.030 mg/L and maximum was 0.170 mg/L with a mean of 0.080 mg/L (SD=0.043) and median of 0.070 mg/L. Mean TKN at RSR1 was significantly lower than at all stream segments with the exception of JUNC1 and SGLR1. Dissolved orthophosphate (PO_4-D) ranged from 0.072 mg/L to 0.086 mg/L with a mean of 0.080 mg/L (SD=0.004) and median of 0.079 mg/L. Minimum total phosphorus (TP) was 0.081 mg/L and maximum was 0.119 mg/L with a mean of 0.092 mg/L (SD=0.013) and median of 0.087 mg/L. Total organic carbon (TOC) varied from 0.46 mg/L to 2.50 mg/L with a mean of 0.89 mg/L (SD=0.62) and median of 0.78 mg/L. Total suspended solids (TSS) reached a low of 0 mg/L and high of 4.00 mg/L with a mean of 1.89 mg/L (SD=1.36) and median of 2.00 mg/L. Turbidity ranged from 0.14 ntu to 0.43 ntu with a mean of 0.22 ntu (SD=0.09) and median of 0.20 mg/L.

RSR2

Field Measurements

Task 3 water quality field measurements for RSR2 are summarized in Table 12. Water temperatures ranged from 14.67°C to 28.43°C with a mean of 22.98°C (SD=4.14) and median of 23.61°C. Values of pH varied from 6.38 to 8.13 with a mean of 7.70 (SD=0.46) and a median of 7.88. Dissolved oxygen readings had a low value of 2.40 mg/L and a high value of 10.10 mg/L with a mean of 7.61 mg/L (SD=1.76) and a median of 7.85 mg/L. Conductivity varied from 256.0 umohs/cm to 716.0 umohs/cm with a mean of 327.5 umohs/cm (SD=132.6) and median of 282.0 umohs/cm.

Laboratory Measurements

Task 3 water quality lab measurements for RSR2 are summarized in Table 12. Alkalinity varied from 42 mg/L to 106 mg/L with a mean of 90.33 mg/L (SD=18.86) and median of 94 mg/L. Color ranged from 10 cpu to 240 cpu with a mean of 51.67 cpu (SD=75.95) and a median of 20 cpu. Mean color at RSR2 was significantly higher than at all other stream

segments with the exception of ALXC2. Dissolved ammonia (NH_4-D) varied from 0 to 0.063 mg/L with a mean of 0.016 mg/L (SD=0.024) and median of 0.00 mg/L. Dissolved nitrate-nitrite (NOx-D) reached a low of 0.061 mg/L and a high of 1.020 mg/L with a mean of 0.712 mg/L (SD=0.272) and median of 0.795 mg/L. Minimum total Kjeldahl nitrogen (TKN) was 0.060 mg/L and maximum was 1.730 mg/L with a mean of 0.456 mg/L (SD=0.506) and median of 0.280 mg/L. Mean TKN at RSR2 was significantly higher than at any other stream segment. Dissolved orthophosphate (PO_4-D) ranged from 0.037 mg/L to 0.090 mg/L with a mean of 0.072 mg/L (SD=0.015) and median of 0.075 mg/L. Minimum total phosphorus (TP) was 0.075 mg/L and maximum was 0.114 mg/L with a mean of 0.090 mg/L (SD=0.012) and median of 0.090 mg/L. Total organic carbon (TOC) varied from 1.62 mg/L to 40.70 mg/L with a mean of 8.63 mg/L (SD=12.36) and median of 4.00 mg/L. Mean TOC at RSR2 was significantly higher than at any other stream segment with the exception of ALXC2. Total suspended solids (TSS) reached a low of 0.0 mg/L and high of 7.00 mg/L with a mean of 3.89 mg/L (SD=2.09) and median of 4.00 mg/L. Turbidity ranged from 0.41 ntu to 3.43 ntu with a mean of 113 ntu (SD=0.98) and median of 0.95 mg/L. Mean turbidity at RSR2 was significantly higher than at any other stream segment other than WEKR3.

JUNC1

Field Measurements

Task 3 water quality field measurements for JUNC1 are summarized in Table 13. Water temperatures ranged from 20.37^{o}C to 22.78^{o}C with a mean of 21.99^{o}C (SD=0.50) and median of 21.96^{o}C. Values of pH varied from 7.66 to 8.61 with a mean of 8.20 (SD=0.22) and a median of 8.19. Dissolved oxygen readings had a low value of 6.66 mg/L and a high value of 8.54 mg/L with a mean of 7.75 mg/L (SD=0.48) and a median of 7.67 mg/L. Conductivity varied from 124.0 umohs/cm to 152.0 umohs/cm with a mean of 131.8 umohs/cm (SD=6.2) and median of 130.0 umohs/cm. Mean conductivity at JUNC1 was significantly lower than at all other stream segments.

Laboratory Measurements

Task 3 water quality lab measurements for JUNC1 are summarized in Table 13. Alkalinity varied from 38.0 mg/L to 54.0 mg/L with a mean of 45.56 mg/L (SD=4.77) and median of 46.0 mg/L. Mean alkalinity at JUNC1 was significantly lower than at all other stream segments. Color ranged from 5 cpu to 10 cpu with a mean of 6.11 cpu (SD=2.21) and a median of 5 cpu. Dissolved ammonia (NH_4-D) varied from 0 to 0.009 mg/L with a mean of 0.001 mg/L (SD=0.003) and median of 0.00 mg/L. Dissolved nitrate-nitrite (NOx-D) reached a low of 0.069 mg/L and a high of 0.146 mg/L with a mean of 0.089 mg/L (SD=0.025) and median of 0.081 mg/L. Minimum total Kjeldahl nitrogen (TKN) was 0.00 mg/L and maximum was 0.130 mg/L with a mean of 0.048 mg/L (SD=0.049) and median of 0.030 mg/L. Mean TKN at JUNC1 was significantly lower than at all stream segments with the exception of RSR1 and SGLR1. Dissolved orthophosphate (PO_4-D) ranged from 0.015 mg/L to 0.032 mg/L with a mean of 0.021 mg/L (SD=0.006) and median of 0.019 mg/L. Minimum total phosphorus (TP) was 0.017 mg/L and maximum was 0.029 mg/L with a mean of 0.025 mg/L (SD=0.004) and median of 0.027 mg/L. Mean TP at JUNC1 was significantly lower than at all stream segments with the exception of JUNC2 and SGLR1. Total organic carbon (TOC) varied from 0.010

mg/L to 1.04 mg/L with a mean of 0.503 mg/L (SD=0.328) and median of 0.500 mg/L. Total suspended solids (TSS) reached a low of 0.0 mg/L and high of 3.0 mg/L with a mean of 1.04 mg/L (SD=1.20) and median of 0.80 mg/L. Turbidity ranged from 0.01 ntu to 0.39 ntu with a mean of 0.18 ntu (SD=0.12) and median of 0.16 mg/L.

JUNC2

Field Measurements

Task 3 water quality field measurements for JUNC2 are summarized in Table 14. Water temperatures ranged from 18.67^{o}C to 24.92^{o}C with a mean of 22.45^{o}C (SD=1.64) and median of 23.25^{o}C. Values of pH varied from 6.72 to 8.23 with a mean of 7.80 (SD=0.27) and a median of 7.85. Dissolved oxygen readings had a low value of 5.42 mg/L and a high value of 8.52 mg/L with a mean of 7.28 mg/L (SD=0.81) and a median of 7.51 mg/L. Conductivity varied from 1,507.0 umohs/cm to 1,953.0 umohs/cm with a mean of 1,830.5 umohs/cm (SD=107.7) and median of 1,874.0 umohs/cm. Mean conductivity at JUNC2 was significantly higher than at all stream segments with the exception of SGLR1.

Laboratory Measurements

Task 3 water quality lab measurements for JUNC2 are summarized in Table 14. Alkalinity varied from 54.0 mg/L to 61.0 mg/L with a mean of 58.11 mg/L (SD=2.37) and median of 58.0 mg/L. Color ranged from 5 cpu to 30 cpu with a mean of 12.22 cpu (SD=8.33) and a median of 10 cpu. Dissolved ammonia (NH_4-D) varied from 0 to 0.015 mg/L with a mean of 0.005 mg/L (SD=0.007) and median of 0.00 mg/L. Dissolved nitrate-nitrite (NOx-D) reached a low of 0.009 mg/L and a high of 0.069 mg/L with a mean of 0.037 mg/L (SD=0.019) and median of 0.040 mg/L. Minimum total Kjeldahl nitrogen (TKN) was 0.040 mg/L and maximum was 0.190 mg/L with a mean of 0.110 mg/L (SD=0.055) and median of 0.090 mg/L. Dissolved orthophosphate (PO_4-D) ranged from 0.001 mg/L to 0.025 mg/L with a mean of 0.015 mg/L (SD=0.007) and median of 0.016 mg/L. Mean PO_4-D at JUNC2 was significantly lower than at all other stream segments. Minimum total phosphorus (TP) was 0.015 mg/L and maximum was 0.037 mg/L with a mean of 0.028 mg/L (SD=0.006) and median of 0.028 mg/L. Mean TP at JUNC2 was significantly lower than at all stream segments with the exception of JUNC1 and SGLR1. Total organic carbon (TOC) varied from 0.40 mg/L to 4.87 mg/L with a mean of 1.69 mg/L (SD=1.34) and median of 1.70 mg/L. Total suspended solids (TSS) reached a low of 1.0 mg/L and high of 9.0 mg/L with a mean of 4.27 mg/L (SD=2.31) and median of 4.00 mg/L. Turbidity ranged from 0.0 ntu to 1.21 ntu with a mean of 0.47 ntu (SD=0.44) and median of 0.32 mg/L.

ALXC1

Field Measurements

Task 3 water quality field measurements for ALXC1 are summarized in Table 15. Water temperatures ranged from 22.13^{o}C to 26.81^{o}C with a mean of 24.05^{o}C (SD=1.15) and median of 24.01^{o}C. Values of pH varied from 7.04 to 8.99 with a mean of 8.10 (SD=0.48) and a median of 8.10. Dissolved oxygen readings had a low value of 0.73 mg/L and a high value of 9.66 mg/L with a mean of 5.71 mg/L (SD=2.25) and a median

of 5.98 mg/L. Conductivity varied from 862.0 umohs/cm to 1,149.0 umohs/cm with a mean of 1,038.8 umohs/cm (SD=81.7) and median of 1,048.0 umohs/cm.

Laboratory Measurements

Task 3 water quality lab measurements for ALXC1 are summarized in Table 15. Alkalinity varied from 70.0 mg/L to 92.0 mg/L with a mean of 78.00 mg/L (SD=7.21) and median of 74.00 mg/L. Color ranged from 5 cpu to 100 cpu with a mean of 31.11 cpu (SD=33.15) and a median of 15 cpu. Dissolved ammonia (NH_4-D) varied from 0 to 0.125 mg/L with a mean of 0.022 mg/L (SD=0.041) and median of 0.0 mg/L. Dissolved nitrate-nitrite (NOx-D) reached a low of 0.004 mg/L and a high of 0.062 mg/L with a mean of 0.030 mg/L (SD=0.018) and median of 0.026 mg/L. Minimum total Kjeldahl nitrogen (TKN) was 0.008 mg/L and maximum was 0.340 mg/L with a mean of 0.160 mg/L (SD=0.118) and median of 0.130 mg/L. Dissolved orthophosphate (PO_4-D) ranged from 0.034 mg/L to 0.048 mg/L with a mean of 0.042 mg/L (SD=0.005) and median of 0.042 mg/L. Minimum total phosphorus (TP) was 0.037 mg/L and maximum was 0.056 mg/L with a mean of 0.047 mg/L (SD=0.006) and median of 0.047 mg/L. Total organic carbon (TOC) varied from 0.06 mg/L to 13.40 mg/L with a mean of 4.60 mg/L (SD=4.92) and median of 2.22 mg/L. Total suspended solids (TSS) reached a low of 0.0 mg/L and high of 5.0 mg/L with a mean of 2.00 mg/L (SD=1.66) and median of 2.00 mg/L. Turbidity ranged from 0.0 ntu to 0.54 ntu with a mean of 0.21 ntu (SD=0.17) and median of 0.18 mg/L.

ALXC2

Field Measurements

Task 3 water quality field measurements for ALXC2 are summarized in Table 16. Water temperatures ranged from 19.80^{o}C to 28.59^{o}C with a mean of 24.34^{o}C (SD=2.88) and median of 24.53^{o}C. Values of pH varied from 6.65 to 8.13 with a mean of 7.65 (SD=0.37) and a median of 7.81. Dissolved oxygen readings had a low value of 0.74 mg/L and a high value of 9.14 mg/L with a mean of 7.11 mg/L (SD=2.38) and a median of 8.19 mg/L. Conductivity varied from 762.0 umohs/cm to 1,119.0 umohs/cm with a mean of 1,003.9 umohs/cm (SD=90.3) and median of 1,002.0 umohs/cm.

Laboratory Measurements

Task 3 water quality lab measurements for ALXC2 are summarized in Table16. Alkalinity varied from 40.0 mg/L to 82.0 mg/L with a mean of 69.11 mg/L (SD=13.20) and median of 74.0 mg/L. Color ranged from 10 cpu to 240 cpu with a mean of 77.78 cpu (SD=86.10) and a median of 35.0 cpu. Mean color at ALXC2 was significantly higher than at all other stream segments. Dissolved ammonia (NH_4-D) varied from 0 to 0.064 mg/L with a mean of 0.014 mg/L (SD=0.024) and median of 0.0 mg/L. Dissolved nitrate-nitrite (NOx-D) reached a low of 0.005 mg/L and a high of 0.037 mg/L with a mean of 0.021 mg/L (SD=0.012) and median of 0.017 mg/L. Minimum total Kjeldahl nitrogen (TKN) was 0.0 mg/L and maximum was 0.800 mg/L with a mean of 0.352 mg/L (SD=0.303) and median of 0.190 mg/L. Dissolved orthophosphate (PO_4-D) ranged from 0.024 mg/L to 0.042 mg/L with a mean of 0.035 mg/L (SD=0.007) and median of 0.037 mg/L. Minimum total phosphorus (TP) was 0.022 mg/L and maximum was 0.059 mg/L with a mean of 0.047 mg/L (SD=0.011) and median of 0.048 mg/L. Total organic carbon

(TOC) varied from 0.90 mg/L to 31.10 mg/L with a mean of 11.05 mg/L (SD=11.11) and median of 4.77 mg/L. Mean TOC at ALXC2 was significantly higher than at any other stream segment with the exception of RSR2. Total suspended solids (TSS) reached a low of 1.0 mg/L and high of 7.0 mg/L with a mean of 3.44 mg/L (SD=1.94) and median of 4.00 mg/L. Turbidity ranged from 0.02 ntu to 3.63 ntu with a mean of 0.87 ntu (SD=1.19) and median of 0.42 mg/L. Mean turbidity at ALXC2 was significantly higher than at any other stream segment with the exception of WEKR3.

SGLR1

Field Measurements

Task 3 water quality field measurements for SGLR1 are summarized in Table 17. Water temperatures ranged from 22.99^{o}C to 24.21^{o}C with a mean of 23.32^{o}C (SD=0.36) and median of 23.14^{o}C. Values of pH varied from 7.27 to 8.79 with a mean of 8.08 (SD=0.30) and a median of 8.06. Dissolved oxygen readings had a low value of 2.51 mg/L and a high value of 8.22 mg/L with a mean of 4.42 mg/L (SD=1.42) and a median of 4.31 mg/L. Conductivity varied from 1,822.0 umohs/cm to 2,063.0 umohs/cm with a mean of 1,965.5 umohs/cm (SD=63.4) and median of 1,972.0 umohs/cm. Mean conductivity at SGLR1 was significantly higher than at any other stream segment.

Laboratory Measurements

Task 3 water quality lab measurements for SGLR1 are summarized in Table 17. Alkalinity varied from 62.0 mg/L to 72.0 mg/L with a mean of 66.78 mg/L (SD=3.07) and median of 66.00 mg/L. Color was 5 cpu for all samples analyzed. Dissolved ammonia (NH_4-D) varied from 0 to 0.015 mg/L with a mean of 0.003 mg/L (SD=0.006) and median of 0.0 mg/L. Dissolved nitrate-nitrite (NOx-D) reached a low of 0.045 mg/L and a high of 0.104 mg/L with a mean of 0.060 mg/L (SD=0.020) and median of 0.048 mg/L. Minimum total Kjeldahl nitrogen (TKN) was 0.0 mg/L and maximum was 0.080 mg/L with a mean of 0.022 mg/L (SD=0.028) and median of 0.010 mg/L. Mean TKN at SGLR1 was significantly lower than at all other stream segments with the exception of JUNC1 and RSR1. Dissolved orthophosphate (PO_4-D) ranged from 0.015 mg/L to 0.034 mg/L with a mean of 0.025 mg/L (SD=0.006) and median of 0.025 mg/L. Minimum total phosphorus (TP) was 0.015 mg/L and maximum was 0.041 mg/L with a mean of 0.029 mg/L (SD=0.008) and median of 0.027 mg/L. Mean TP at SGLR1 was significantly lower than at all other stream segments with the exception of JUNC1 and JUNC2. Total organic carbon (TOC) varied from 0.01 mg/L to 0.67 mg/L with a mean of 0.19 mg/L (SD=0.20) and median of 0.16 mg/L. Total suspended solids (TSS) reached a low of 0.0 mg/L and high of 5.0 mg/L with a mean of 1.91 mg/L (SD=1.96) and median of 1.20 mg/L. Turbidity ranged from 0.0 ntu to 0.62 ntu with a mean of 0.15 ntu (SD=0.21) and median of 0.07 mg/L.

Temporal Patterns of Select Water Quality Parameters at Select Segments

Dissolved Oxygen

Dissolved oxygen levels at SGLR1 were lower than at the other segments on all but two time periods: fall 2008 and spring 2009 (Fig. 31). At WEKR3 dissolved oxygen levels declined in summer, whereas declines in D.O. occurred from summer to fall at JUNC2 and ALXC2 (Fig. 31). A sharp drop in D.O. was observed in RSR in May 2009.

Conductivity

Conductivity was highest at JUNC2 and SGLR1 and lowest at WEKR3 and RSR2 (Fig. 32). The same general pattern in conductivity was observed at all sites: an overall decline from spring 2007 to summer 2008, followed by increasing values beginning fall 2008 or winter 2008/2009 (Fig. 32). Temporal changes in conductivity were generally relatively small. Exceptions to this were the increase from 280 to 714 umhos/cm at RSR2 between January and May 2009 and the decline from 1,927 to 1,728 umhos/cm at JUNC2 between June and October 2007 (Fig. 32).

Color

Color fluctuated at all segments with the exception of SGLR1, where it remained at a constant low (5 cpu) level for the duration of the study (Fig. 33). The remaining sites displayed multiple peaks in color, including a smaller peak in fall 2007 and a larger peak in summer/fall 2008 (Fig. 33). An additional large increase in color occurred at RSR2 from January to May 2009. Highest color values (240 cpu) were measured at ALXC2 and RSR2 (Fig. 33).

NO_x

NO_x concentrations were highest and most variable at WEKR3, exhibiting a smaller peak in December 2007 and a larger peak in January 2009 (Fig. 34). NO_x was not found at detectable levels on five sampling dates at RSR2, JUNC2 and ALXC2 (Fig. 34). Small peaks in NO_x occurred at RSR2 and JUNC2 in December 2007 and October 2008, with an additional peak at RSR2 in May 2009. ALXC2 NO_x concentrations peaked in December 2007 and July 2008. At SGLR1 NO_x levels were highest in March 2007 (Fig. 34).

Total Phosphorus (TP)

Total phosphorus concentrations were highest at WEKR3 and displayed a similar temporal pattern as NO_x (Fig. 35). A first peak occurred in December 2007 and a second peak in October 2008 (compared with January 2009 for NO_x). In RSR2 TP levels displayed a general decline from the beginning to the end of the study period (Fig. 35). Total phosphorus in JUNC2, ALXC2 and SGLR1 all showed a decline from spring to fall 2007, before increasing over the next three or four sampling periods and declining again towards the end of the study (Fig. 35). The exception to this final decline was at SLGR1 where TP concentrations increased from January to April 2009 (Fig. 35).

<u>Algal Periphyton Community Analysis</u>:

<u>Species Richness</u>

Diatoms (Bacillariophyta) had the highest number of species when all stream segments, substrates analyzed (PERI, SAV, WD) and sampling dates were combined (Fig. 36). Periphyton (PERI) samples had a mean of 37.8 (SE=0.94) diatoms species, woody debris (WD) a mean of 35.8 (SE=0.74) and submerged aquatic vegetation (SAV) samples a mean of 28.6 (SE=0.74). Cyanobacteria species were more common on SAV (10.3, SE=0.55) and PERI (7.5, SE=0.37) than on WD (5.1, SE=0.41).

WEKR

Diatoms (Bacillariophyta) had the highest number of species on both substrates collected at WEKR1 (PERI, WD) and WEKR3 (PERI, SAV), with a mean of over 30 diatoms species per sample for each (Fig. 37). Cyanobacteria species numbers were lower in WD (mean=3, SE=0.53) samples than in those from other substrates. Red algae (Rhodophyta) were present more often in WEKR1 than in WEKR3 samples. Diatoms had the highest number of species on all sampling dates in WEKR1 PERI (Fig. 38), WEKR1 WD (Fig. 39), WEKR3 PERI (Fig. 40) and WEKR3 SAV (Fig. 41). Total taxa richness in WEKR1 PERI samples varied from 39 to 61 species per sample, from 38 to 51 species in WEKR1 WD, from 36 to 65 in WEKR3 PERI samples and from 39 to 66 species per sample in WEKR3 SAV (Fig. 42).

RSR

Diatoms (Bacillariophyta) had the highest number of species on both substrates collected at RSR1 (PERI, WD) and on WD samples from RSR2, with a mean of over 35 diatoms species per sample for each (Fig. 43). RSR1 periphyton samples had the highest number of diatoms per sample with a mean of 47 (SE=1.24). Cyanobacteria species numbers were lower in WD samples from RSR2 (3, SE=0.50) than in WD samples from RSR1 (7, SE=0.92). Green algae (Chlorophyta) were present more often in RSR PERI (7, SE=0.47) samples than in the WD samples from either RSR1 or RSR2. Diatoms had the highest number of species on all sampling dates in RSR1 PERI (Fig. 44), RSR1 WD (Fig. 45) and RSR2 WD (Fig. 46). Total taxa richness in RSR1 PERI and RSR1 WD samples was higher on most sampling dates than in RSR WD samples (Fig. 47). Total taxa richness in RSR1 PERI samples varied from 61 to 74 species per sample, from 45 to 64 species in RSR1 WD samples and from 38 to 51 species per sample in RSR2 WD (Fig. 47).

JUNC

Diatoms (Bacillariophyta) had the highest number of species on both substrates collected at JUNC1 (PERI, SAV) and on SAV samples from JUNC2, with a mean of over 20 diatoms species per sample for each (Fig. 48). JUNC1 periphyton samples had the highest number of diatoms per sample with a mean of 40 (SE=1.89), followed by JUNC1 SAV (28.3, SE=1.74) and JUNC2 SAV (23, SE=1.40). Cyanobacteria species numbers were highest in SAV samples from JUNC1 (12, SE=0.88). Green algae (Chlorophyta) species numbers were lower in PERI samples from JUNC1 (0.7, SE=0.23) than in SAV samples from JUNC1 and JUNC2. Diatoms had the highest number of species on all sampling dates in JUNC1 PERI (Fig. 49), JUNC1 SAV (Fig. 50) and JUNC2 SAV (Fig. 51). Total taxa richness tended to be higher in JUNC1 PERI and JUNC1 than in JUNC2 SAV (Fig. 52). Total taxa richness in JUNC1 PERI samples varied from 39 to 59 species per sample, from 29 to 64 species in JUNC1 SAV samples and from 20 to 44 species per sample in JUNC2 SAV (Fig. 52).

ALXC

Diatoms (Bacillariophyta) had the highest number of species on both substrates collected at ALXC1 (PERI, SAV) and on WD samples from ALXC2, with a mean of over 25 diatoms species per sample for each (Fig. 53). Cyanobacteria species numbers were highest in SAV samples from ALXC1 (12, SE=1.05). Red algae (Rhodophyta) were

present more often in ALXC2 than in ALXC2 samples. Diatoms had the highest number of species on all sampling dates in ALXC1 PERI (Fig. 54), ALXC1 SAV (Fig. 55) and ALXC2 WD (Fig. 56). Cyanobacteria taxa richness at ALXC2 WD was higher in April 2009 than in any other months of the study (Fig. 56). Total taxa richness in ALXC1 PERI samples varied from 41 to 68 species per sample, from 40 to 70 species in ALXC1 SAV samples and from 32 to 67 species per sample in ALXC2 WD (Fig. 57).

SGLR

Diatoms (Bacillariophyta) had the highest number of species on both substrates collected at SGLR1 (PERI, SAV), with a mean of over 25 diatoms species per sample for each (Fig. 58). Cyanobacteria species numbers were highest in SAV samples from SGLR1 (14, SE=1.56). Diatoms had the highest number of species on all sampling dates in SGLR1 PERI (Fig. 59) and SGLR1 SAV (Fig. 60). Cyanobacteria taxa richness in SGLR1 SAV samples showed an increasing trend from October 2008 to April 2009 (Fig. 60). Total taxa richness in SGLR1 PERI samples varied from 33 to 70 species per sample and from 36 to 57 species per sample in ALXC2 WD (Fig. 61).

Total Cell Number

WEKR (Fig. 62)

Total cell numbers for WEKR1 PERI were generally lower than other locations and substrate types. Total cell numbers for WEKR1 WD declined from March to December 2007 and increased from March 2008 to January 2009. No periphytometer slides were recovered for algal analysis in October 2008 and January 2009 for WEKR1 and March 2007 for WEKR3. Total cell numbers for WEKR3 PERI decreased from October 2007 to December 2007 and remained low until increasing in January 2009. WEKR3 SAV total cell numbers were highest in spring and summer in both 2007 and 2008 and spring 2009. Total cell numbers in WEKR3 SAV were higher than for the other substrates on five of the nine sampling dates.

RSR (Fig. 63)

Total cell numbers for RSR1 PERI increased dramatically from March 2007 to June 2007 before declining again by October 2007. Total cell numbers for RSR1 WD decreased from March 2007 to October 2007 and remained low until a large increase in October 2008. No samples were collected from RSR1 in July 2008. RSR2 WD total cell numbers were on most sampling dates lower than either substrate at RSR1.

JUNC (Fig. 64)

Total cell numbers for JUNC1 PERI were highest in March 2007 and exhibited a large decrease in June 2007 and remained low until a smaller peak in April 2009. JUNC1 SAV total cell numbers were highest in spring and summer in both 2007 and 2008 and spring 2009. With the exception of December 2007, JUNC2 SAV total cell numbers were generally lower than either substrate at JUNC1.

ALXC (Fig. 65)

Total cell numbers for ALXC1 PERI declined from February 2007 to December 2007 and were lower in each quarter than for ALXC1 SAV and ALXC2 WD. Total cell

numbers for ALXC1 SAV were highest in September 2008. ALXC2 WD total cell peaked in spring of 2008 and 2009. The high error associated with these sampling dates was the result of one of the replicates on each date containing attached colonies of the colonial, filamentous cyanobacteria *Nostochopsis lobata*.

SGLR (Fig. 66)
In general total cell numbers in SGLR1 PERI were higher in 2007 than in 2008, with peak cell numbers observed in June 2007. Total cell numbers in SGLR1 SAV were higher from October 2008 to April 2009 than from October 2007 to March 2008, with highest densities occurring in October 2008 and April 2009.

Total Biovolume
WEKR (Fig. 67)
Total biovolume for WEKR1 PERI was lower than other locations and substrate types during the entire study period. WEKR1 WD total biovolume displayed peaks in spring 2007 and 2008, summer 2008 and winter 2009. With the exception of October 2007 and July 2008, total biovolume for WEKR3 PERI was lower than WEKR1WD and WEKR3 SAV on all sampling dates. WEKR3 SAV total biovolume was low throughout 2007 but increased in 2008 and 2009, with peak values recorded in March 2008 and January 2009.

RSR (Fig. 68)
Total biovolume for RSR1 PERI remained low and relatively constant throughout the study period. RSR1 WD total biovolumes were higher in 2008/09 than in 2007. Total biovolume for RSR2 WD was higher than for RSR1 samples on most sampling dates, with the exception of March 2008 and May 2009. Highest total biovolumes for RSR2 were found in October 2008 and January 2009.

JUNC (Fig. 69)
Total biovolume for JUNC1 PERI fluctuated throughout the study period but exhibited no large peaks. JUNC1 SAV total biovolume was highest in March 2008, July 2008 and January 2009. Total biovolume for JUNC2 SAV increased from March 2007 to December 2007, when a large peak in total biovolume occurred. This peak was primarily due to relatively large numbers of the diatom *Pleurosira laevis* on one sample. Another, smaller peak in total biovolume occurred in JUNC2 SAV in April 2009.

ALXC (Fig. 70)
Total biovolume for ALXC1 PERI fluctuated throughout the study period but exhibited no large peaks. Total biovolume in ALXC1 SAV peaked in winter and spring in both 2007/08 and 2008/09. ALXC2 WD total biovolume fluctuated throughout the study period but exhibited no large peaks. Lowest total biovolume for both ALXC1 PERI and ALXC2 WD occurred in July 2008.

SGLR (Fig. 71)
Total biovolume for SGLR1 PERI underwent a series of short increases and decreases during the study period. SGLR1 SAV biovolume decreased from March 2007 to June 2007 and increased from October 2007 to July 2008, when peak values were obtained.

Total biovolume for SGLR1 SAV then declined in October and remained relatively stable for the remainder of the study.

Cell Number By Algal Group

WEKR

In WEKR1 PERI samples diatoms (Bacillariophyta) and cyanobacteria had the highest cell numbers on all sampling dates (Fig. 72). Diatoms decreased in numbers from March 2007 to June 2007 before increasing each sampling period until reaching a peak in March 2008. Cyanobacteria cell numbers decreased from March 2007 to December 2007. Highest cyanobacteria cell numbers tended to occur in the spring. Peak green algae (Chlorophyta) cell numbers occurred in March 2008 while for red algae (Rhodophyta) that peak occurred in March 2007. Miscellaneous (a group composed of taxa that could not be put in one of the other algal groups) cell numbers remained relatively constant over the sampling period.

For WEKR1 WD samples diatoms had the highest cell numbers on 7 of 9 sampling dates (Fig. 73). Overall, diatom and cyanobacteria cell numbers were higher in 2008/09 than in 2007. Highest cyanobacteria cell numbers were found in January and May 2009. Red algae had peak numbers in March 2007. Numbers of green algae (Chlorophyta) and miscellaneous were low throughout the study period.

In WEKR3 PERI samples diatom cell numbers fluctuated throughout the study period (Fig. 74). Cyanobacteria cell numbers were the highest in October 2007, January 2009 and May 2009. The peaks in cyanobacteria cell numbers were mostly due to small-celled colonial species and thin, oscillatorialean filaments. Chlorophyte cell numbers were highest in May 2009 and rhodophyte numbers highest in January 2009.

In WEKR3 SAV samples highest cell numbers for diatoms occurred in the spring in all years of the study (Fig. 75). Highest cyanobacteria and chlorophyte cell numbers were observed on the same dates: June 2007, July 2008 and May 2009. Red algae had peak numbers in October 2008.

RSR

In RSR1 PERI samples diatom cell numbers fluctuated throughout the study period, with peak concentration in June 2007 (Fig. 76). A large peak in cyanobacteria cell numbers occurred in June 2007, primarily due to the thin filamentous species *Heteroleibleinia* sp. Green algae displayed two small peaks in cell number, one in June 2007 and the other in May 2009. Red algae were found at low densities in October 2007 and March 2008.

In RSR1 WD samples diatoms and cyanobacteria cell numbers displayed the same temporal pattern (Fig. 77). Numbers decreased from March 2007 to October 2007, remained relatively stable until increasing in October 2008. October 2008 was followed by a decline in diatom and cyanobacteria cell numbers in January 2009 but another increase occurred in May 2009. Peak diatom levels were seen in May 2009 while three large peaks (March 07, October 08 and May 09) were observed in cyanobacteria cell

numbers. Chlorophyte cell numbers were highest in May 2009. Red algae were found on six of the nine sampling dates.

In RSR2 WD samples diatom cell numbers fluctuated throughout the study period (Fig. 78). Three peaks (June 07, October 08 and May 09) were observed in cyanobacteria cell numbers. Chlorophyte cell numbers were highest in October 2008. Miscellaneous cell numbers were higher in RSR2 than in either of the RSR1 substrates. Low cell numbers of red algae were found on four of the nine sampling dates.

JUNC

In JUNC1 PERI samples diatoms, cyanobacteria and miscellaneous algae cell numbers were highest in March 2007 (Fig. 79). The large cyanobacteria peak in March 2007 was primarily due to the thin filamentous species *Heteroleibleinia* sp. A smaller peak in cyanobacteria cell numbers occurred in April 2009. Chlorophytes were only found on five of nine sampling dates and rhodophytes were absent on all sampling dates.

In JUNC1 SAV samples cyanobacteria were dominant in terms of cell number in spring and summer, with the highest density of cyanobacteria occurring in April 2009 (Fig. 80). This cyanobacteria peak in cell numbers was primarily due to small-celled colonial and thin oscillatorialean filamentous species. Diatom cell numbers were higher in the spring and summer of 2008 compared to 2007. Chlorophyte numbers were low throughout the study period. Red algae were only found on four of the nine sampling dates.

In JUNC2 SAV samples cell numbers of diatoms and cyanobacteria fluctuated throughout the study (Fig. 81). A large diatom peak in cell numbers was observed in December 2007. This large peak and the large error associated with it were due to large numbers of the pennate diatom *Cocconeis* sp. on one of the three replicate samples. Highest cyanobacteria cell numbers occurred in October 2008. Chlorophyte numbers were low throughout the study period. Red algae were only found on four of the nine sampling dates, all in 2008 and 2009.

ALXC

In ALXC1 PERI samples cell numbers of diatoms fluctuated throughout the study, with highest concentrations in February 2009 and April 2009 (Fig. 82). Cyanobacteria were highest in February 2007 after which they declined through December 2007 and fluctuated for the remainder of the study. The large cyanobacteria peak in February 2007 was primarily due to the thin filamentous species *Heteroleibleinia* sp. Chlorophyte cell numbers were highest in February and June 2007 and September 2008. Red algae were only found on one sampling date (December 2007). Numbers of miscellaneous algae were highest in February 2007.

In ALXC1 SAV samples diatom cell numbers were higher in 2008/09 than in 2007 (Fig. 83). Cyanobacteria cell numbers declined from February 2007 to December 2007 and fluctuated for the remainder of the study. Peaks in cyanobacteria cell numbers occurred in February 2007, March 2008 and September 2008. Cell numbers of green algae were highest in December 2007 due to the presence of the large filamentous species *Ulva*

flexuosa (formerly *Enteromorpha flexuosa*). Red algae were only found on two of the nine sampling dates, both in 2008.

In ALXC2 WD samples cyanobacteria cell numbers were the highest of all algal groups on all sampling dates (Fig. 84). Peaks in cyanophyte cell numbers occurred in March 2008 and April 2009. The large spike in cyanophyte cell numbers in March 2008 was primarily due to high numbers of the colonial, filamentous species *Nostochopsis lobata* and an unknown, thin oscillatorialean filamentous species. Cell numbers in all groups were low in September and December 2008. Chlorophyte numbers remained low throughout the study. Red algae were found on eight of the nine sampling dates, but always at low densities.

SGLR

In SGLR1 PERI samples cell numbers of diatoms and cyanobacteria fluctuated throughout the study (Fig. 85). Cyanobacteria cell numbers in general were higher in 2007 than in 2008. Peak cyanophyte numbers were observed in June 2007. This peak and the large error associated with it were due to large numbers of *Heteroleibleinia* sp. on one of the two replicate samples. Cell numbers of green algae were highest in October 2008 and red algae were only found on one sampling date (October 2008).

In SGLR1 SAV samples cyanobacteria were dominant in terms of cell numbers on all but one sampling date (July 2008) (Fig. 86). Highest concentrations of cyanobacteria occurred from October 2008 to April 2009. Diatom cell numbers fluctuated more and reached higher levels in 2008/09 compared to 2007. Chlorophyte cell numbers were highest in July and October 2008 and red algae were only found on one sampling date (December 2007).

Biovolume By Algal Group

WEKR

In WEKR1 PERI samples diatoms were dominant or co-dominant in terms of biovolume on all sampling dates (Fig. 87). Diatom biovolume exhibited a general pattern of increasing biovolume from March 2007 to March 2008. Red algal biovolume was higher in winter and spring and reached its maximum in March 2007. Green algae biovolume peaked in March 2008 and cyanobacteria biovolume in May 2009.

In WEKR1 WD samples diatoms were dominant or co-dominant in terms of biovolume on all sampling dates (Fig. 88). Diatom biovolume fluctuated throughout the study, reaching a maximum on January 2009. Red algae biovolume peaked in March 2007, with two smaller spikes occurring in July 2008 and January 2009. Green algae biovolume remained low throughout the study and cyanobacteria biovolume was highest in July 2008.

In WEKR3 PERI samples diatoms were dominant or co-dominant in terms of biovolume on all sampling dates (Fig. 89). Highest levels of diatom biovolume were reached in October 2007 and March and July 2008. Red algal biovolume peaked in January 2009

and green algae in May 2009. Cyanobacteria biovolume remained low throughout the study.

In WEKR3 SAV samples diatoms were dominant or co-dominant in terms of biovolume on all sampling dates (Fig. 90). Diatom biovolume remained fairly low in 2007 but reached higher levels in 2008/09, peaking in January 2009. Red algal biovolume peaked in October 2008. Biovolume of green algae was highest in the summer in both 2007 and 2008. Cyanobacteria biovolume remained low throughout the study.

RSR

In RSR1 PERI samples diatoms were dominant in terms of biovolume on all sampling dates (Fig. 91). No seasonal patterns in diatom biovolume were observed. Chlorophyte biovolume peaked in June 2007, but overall green algae biovolume was higher in 2008/09 than in 2007. Cyanobacteria biovolume was higher in 2007 than in 2008/09. Red algae biovolume remained low throughout the study.

In RSR1 WD samples diatom and cyanobacteria biovolume levels were higher in 2008/09 than in 2007 while red algae biovolume was higher in 2007 than 2008 (Fig. 92). Green algae biovolume was highest in March 2007 and May 2009.

In RSR2 WD samples diatoms were dominant in terms of biovolume on all sampling dates (Fig. 93). Diatom biovolume peaked in October 2008 and January 2009. Biovolumes in all other groups remained low throughout the study.

JUNC

In JUNC1 PERI samples diatoms were dominant or co-dominant in terms of biovolume on all sampling dates (Fig. 94). There was a decreasing trend in diatom biovolume from March to October 2007, after which biovolumes increased and remained high for the remainder of the study. Cyanobacteria biovolume was highest in October 2007 and April 2009 and green algae biovolume peaked in March 2007. Red algae were not present on any sampling dates.

In JUNC1 SAV samples diatoms were dominant in terms of biovolume on all sampling dates (Fig. 95). The three highest diatom biovolume levels were attained in 2008/09, with the peak occurring in April 2009. The large April 2009 peak in diatom biovolume was primarily due to a large species of *Synedra*. Chlorophyte and cyanophyte biovolumes fluctuated throughout the year, mostly at relatively low levels compared to the diatoms. Red algae biovolume remained low throughout the study.

In JUNC2 SAV samples diatoms and green algae were dominant or co-dominant in terms of biovolume on all sampling dates in 2007 and diatoms were biovolume dominants in all 2008/09 samples (Fig. 96). Diatom biovolume peaked in December 2007. This large peak and the large error associated with it were due to accumulations of the large pennate diatom *Pleurosira laevis* on one of the three replicate samples. Green algae biovolume was highest in June and October 2007. Cyanobacteria and red algae biovolume remained low throughout the study.

ALXC

In ALXC1 PERI samples diatoms were dominant or co-dominant in terms of biovolume on all sampling dates (Fig. 97). No seasonal patterns in diatom biovolume were observed. Cyanobacteria biovolume was highest in July and September 2008. Green algae and red algae biovolume remained low throughout the study.

In ALXC1 SAV diatom biovolume was higher in 2008/09 than in 2007 (Fig. 98). Biovolume of green algae was highest in December 2007 due to the presence of the large filamentous species *Ulva flexuosa*. Cyanobacteria and red algae biovolume remained low throughout the study.

In ALXC2 WD diatom biovolume was highest in the winter and spring months (Fig. 99). Cyanobacteria biovolume peaked in March 2008 and April 2009. Green algae and red algae biovolume remained low throughout the study.

SGLR

In SGLR1 PERI samples diatoms were dominant in terms of biovolume on all sampling dates (Fig. 100). No seasonal patterns in diatom biovolume were observed. Cyanobacteria biovolume peaked in June 2007 while that of green algae and red algae was highest in October 2008.

In SGLR1 SAV samples there was a trend of increasing diatom biovolume from March 2007 to July 2008 (Fig. 101). After the July peak, diatom biovolume decreased and remained relatively stable for the remainder of the study. Cyanobacteria biovolume fluctuated throughout the study with peak levels occurring in March 2007.Green algae biovolume was higher in 2008/09 than in 2007. Red algae biovolume remained low throughout the study.

Relative Abundance by Cell Number

WEKR

Diatoms and cyanobacteria made up the majority of total cell numbers in WEKR1 PERI samples (Fig. 102). Diatoms accounted for from 42% to 81% of total cell numbers, peaking in December 2007, and cyanobacteria from 11% to 41%, peaking in June 2007. Green algae reached a maximum contribution of 5% in March 2008, miscellaneous algae 15% in June 2007 and red algae 3% in March 2007.

In WEKR1 WD samples diatoms accounted for from 39% to 83% of total cell numbers, peaking in March 2008, and cyanobacteria from 2% to 50%, peaking in May 2009 (Fig. 103). Red algae made up 38% of total cell numbers in March 2007. Maximum contribution of green algae was 4% from June to December 2007. Relative abundance of miscellaneous algae reached a maximum of 19% in June 2007.

In WEKR3 PERI samples diatoms accounted for from 14% to 86% of total cell numbers, peaking in March 2008, and cyanobacteria from 8% to 70%, peaking in October 2007 and January 2009 (Fig. 104). Green algae reached a maximum contribution of 23% in May 2009, miscellaneous algae 14% in June 2007 and red algae 8% in January 2009.

In WEKR3 SAV samples diatoms accounted for from 14% to 86% of total cell numbers, peaking in December 2007, and cyanobacteria from 8% to 70%, peaking in October 2007 and July 2008 (Fig. 105). Green algae ranged from a minimum of 3% to a maximum of 31% in June 2007. Miscellaneous algae reached a maximum contribution of 12% in October 2008 and red algae 19% also in October 2008.

RSR

Diatoms and cyanobacteria made up the majority of total cell numbers in RSR1 PERI samples (Fig. 106). Diatoms accounted for from 22% to 85% of total cell numbers, peaking in March 2007, and cyanobacteria from 8% to 71%, peaking in June 2007. Green algae ranged from a minimum of 1% to a maximum of 19% in May 2009. Miscellaneous algae reached a maximum contribution of 7% in October 2007 while red algae never made up more than 0.02% of total cell numbers.

In RSR1 WD samples cyanobacteria and diatom cell number relative abundance displayed opposite patterns from March 2007 to December 2007 (Fig. 107). Diatoms accounted for 19% of total cell numbers in March 2007 and 70% in December 2007 while cyanobacteria accounted for 76% of total cell numbers in March 2007 and 27% in December 2007. Green algae reached a maximum contribution of 8% in May 2009, miscellaneous algae 17% in June 2007 and red algae 2% in October 2007.

In RSR2 WD samples diatoms accounted for from 21% to 91% of total cell numbers, peaking in December 2007, and cyanobacteria from 2% to 68%, peaking in May 2009 (Fig. 108). Green algae reached a maximum contribution of 6% in October 2008 and miscellaneous algae 30% in March 2007, while red algae never made up more than 0.2% of total cell numbers.

JUNC

Diatoms and cyanobacteria made up the majority of total cell numbers in JUNC1 PERI samples (Fig. 109). Cyanobacteria had the highest relative abundance in terms of cell number from March to October 2007 and again in April 2009, while diatoms had the highest abundance from December 2007 to January 2009. Diatoms accounted for from 19% to 91% of total cell numbers, peaking in September 2008, and cyanobacteria from 6% to 73%, peaking in March 2007. Green algae reached a maximum contribution of 1% in March 2007 and July 2008 and miscellaneous algae 10% in June 2007, while red algae were not present in any samples.

Cyanobacteria made up the majority of total cell numbers in JUNC1 SAV samples (Fig. 110). Cyanobacteria accounted for from 48% to 86% of total cell numbers, peaking in April 2009. Diatoms accounted for from 9% to 32% of total cell numbers, peaking in January 2009. Green algae reached a maximum contribution of 2% in March 2008 and miscellaneous algae 20% in January 2009, while red algae never made up more than 0.2% of total cell numbers.

In JUNC2 SAV samples diatoms accounted for from 14% to 76% of total cell numbers, peaking in March 2008, and cyanobacteria from 6% to 84%, peaking in October 2008

(Fig. 111). Green algae relative abundance in terms of cell number was higher in 2007 than in 2008/09, with a maximum value of 11% in October 2007. Miscellaneous algae reached a maximum contribution of 20% in January 2009 while red algae never made up more than 0.2% of total cell numbers.

ALXC

Diatoms and cyanobacteria made up the majority of total cell numbers in ALXC1 PERI samples (Fig. 112). Diatoms accounted for from 22% to 75% of total cell numbers, peaking in December 2007, and cyanobacteria from 17% to 65%, peaking in June 2007. Green algae ranged from a minimum of 0.4% to a maximum of 10% in December 2008. Miscellaneous algae reached a maximum contribution of 8% in February 2007 while red algae was only found on one sampling date (December 2007) and only had a relative abundance of 0.1%.

Total cell numbers in ALXC1 SAV samples were dominated by cyanobacteria, which accounted for from 48 % to 89% of total cell numbers, with peak relative abundance in June and September 2007 (Fig.113). Diatom relative abundance in terms of cell number was generally higher in 2008/09 than in 2007. Diatom relative abundance ranged from 4% to 49%, peaking in April 2009. Green algae reached a maximum contribution of 30% in December 2007 and miscellaneous algae 8% in February 2007, while red algae never made up more than 0.03% of total cell numbers.

Total cell numbers in ALXC2 WD samples were dominated by cyanobacteria, which accounted for from 53 % to 85% of total cell numbers, with peak relative abundance in March 2008 (Fig.114). Diatom relative abundance ranged from 4% to 37%, peaking in December 2007. Green algae relative abundance in terms of cell number was higher in 2008 than in 2007, with a maximum value of 18% in July 2008. Miscellaneous algae reached a maximum contribution of 20% in February 2007 and red algae 2% in April 2009.

SGLR

Diatoms and cyanobacteria made up the majority of total cell numbers in SGLR1 samples (Fig. 115). Diatom relative abundance in terms of cell number was higher in winter and spring months in 2008/09 than in winter/spring 2007. Diatom relative abundance ranged from 25% to 93%, peaking in April 2009. Cyanobacteria relative abundance in terms of cell number was higher in 2007 than in 2008/09. Cyanobacteria accounted for from 4% to 68% of total cell numbers, peaking in June 2007. Green algae ranged from a minimum of 2% to a maximum of 12% in October 2008. Miscellaneous algae reached a maximum contribution of 8% in March 2007 and red algae 0.2% in October 2008.

Cyanobacteria were the dominant contributors to total cell numbers in SGLR1 SAV samples (Fig. 116). Cyanobacteria accounted for from 41% to 88% of total cell numbers, peaking in June 2007 and January 2009. Diatom relative abundance ranged from 7% to 58%, peaking in July 2008. Green algae reached a maximum contribution of 12% in October 2008 and miscellaneous algae 9% in March 2007, while red algae was only found on one sampling date (December 2007) and only had a relative abundance of 0.1%.

Relative Abundance by Biovolume

WEKR

Diatoms were the dominant contributors to total biovolume in WEKR1 PERI samples (Fig. 117). Diatoms accounted for from 52% to 89% of total biovolume, peaking in March 2008. Red algae biovolume relative abundance ranged from 1% to 35%, peaking in March 2007 and cyanobacteria accounted for from 0.1% to 38% of total biovolume, peaking in May 2009. Green algae reached a maximum contribution of 6% in March 2008 and miscellaneous algae never contributed more than 1% to total biovolume.

Diatoms were the dominant contributors to total biovolume in WEKR1 WD samples (Fig. 118). Diatoms accounted for from 52% to 97% of total biovolume, peaking in December 2007. Red algae biovolume relative abundance ranged from 1% to 47%, peaking in March 2007. Peak cyanobacteria relative biovolume (26%) occurred in July 2008. Green algae reached a maximum contribution of 9% in June 2007 and miscellaneous algae never contributed more than 1% to total biovolume.

In WEKR3 PERI samples diatoms were the dominant contributors to total biovolume on all sampling dates (Fig. 119). Diatoms accounted for from 54% to 97% of total biovolume, peaking in March 2008. Red algae biovolume relative abundance was highest in October 2008 (21%) and January 2009 (39%). Green algae biovolume relative abundance ranged from 1% to 38%, peaking in May 2009. Cyanobacteria and miscellaneous algae had maximum biovolume relative abundances of 2% and 1% respectively.

In WEKR3 SAV samples diatoms accounted for from 27% to 97% of total biovolume, peaking in December 2007 and March 2008 (Fig. 120). Red algae biovolume relative abundance peaked in both October 2007 (25%) and October 2008 (60%). Green algae biovolume relative abundance ranged from 2% to 54%, peaking in June 2007. Cyanobacteria and miscellaneous algae had maximum biovolume relative abundances of 7% and 2% respectively.

RSR

In RSR1 PERI samples diatoms were the dominant contributors to total biovolume on all sampling dates (Fig. 121). Diatoms accounted for from 73% to 99% of total biovolume, peaking in March 2007. Green algae biovolume relative abundance ranged from 0.3% to 23%, peaking in June 2007. Cyanobacteria biovolume relative abundance ranged from a minimum of 0.4% to a maximum of 15% in October 2007. Miscellaneous algae reached a maximum contribution of 2% in June 2007 and red algae 0.3% in March 2008.

In RSR1 WD samples diatoms were the dominant contributors to total biovolume on all sampling dates (Fig. 122). Diatoms accounted for from 47% to 97% of total biovolume, peaking in December 2007. Cyanobacteria biovolume relative abundance ranged from a minimum of 2% to a maximum of 32% in October 2008. Chlorophyte biovolume relative abundance peaked in March 2007 (19%) and May 2009 (18%). Red algae were a larger contributor to total biovolume in 2007 than in 2008/09, with a peak percent total

biovolume of 22% occurring in March 2007. Miscellaneous algae reached a maximum contribution of 1% in both March and June 2007.

Diatoms were the dominant contributors to total biovolume on all sampling dates in RSR2 WD samples (Fig. 123). Diatoms accounted for from 89% to over 99% of total biovolume. Cyanobacteria reached a maximum contribution to total biovolume of 10% in March 2007, green algae 5% in March 2008 and both miscellaneous algae and red algae reached a maximum biovolume contribution of 2% in May 2009.

JUNC

In JUNC1 PERI samples diatoms were the dominant contributors to total biovolume on all sampling dates (Fig. 124). Diatoms accounted for from 53% to 99% of total biovolume, peaking in December 2007. Cyanobacteria biovolume relative abundance ranged from a minimum of 0.7% to a maximum of 47% in October 2007. Green algae reached a maximum contribution to total biovolume of 4% in March 2007 and miscellaneous algae 1% on that same date. Red algae were not observed in JUNC1 PERI samples.

In JUNC1 SAV samples diatoms accounted for from 9% to 30% of total biovolume, peaking in October 2007 (Fig. 125). Cyanobacteria biovolume relative abundance ranged from a minimum of 10% to a maximum of 23% in March 2007. Green algae biovolume relative abundance ranged from 0.5% to 11%, peaking in March 2007. Miscellaneous algae reached a maximum contribution of 2% in March 2007 and red algae 4% in January 2009.

In JUNC2 SAV diatoms and green algae were the dominant contributors to total biovolume in 2007 and diatoms were dominant in 2008/09 (Fig. 126). Diatoms accounted for from 42% to 99% of total biovolume, peaking in January and April 2009. Green algae biovolume relative abundance ranged from a minimum of 0.2% to a maximum of 57% in October 2007. The high values in June 2007 were due to the filamentous species *Cladophora glomerata* and *Ulva flexuosa* and in October 2007 were due to *C. glomerata*. Cyanobacteria reached a maximum contribution to total biovolume of 5% in October 2008 while miscellaneous algae and red algae never exceeded 1% of total biovolume.

ALXC

In ALXC1 PERI samples diatoms were the dominant contributors to total biovolume in 2007 and diatoms and cyanobacteria were the dominant contributors to total biovolume in 2008 (Fig. 127). Diatoms accounted for from 28% to 98% of total biovolume, peaking in September 2007 and April 2009. Cyanobacteria biovolume relative abundance ranged from a minimum of 1% to a maximum of 69% in September 2008. Green algae reached a maximum contribution to total biovolume of 10% in June 2007 while miscellaneous algae and red algae never exceeded 1% of total biovolume.

In ALXC1 SAV samples diatoms accounted for from 47% to 96% of total biovolume, peaking in December 2008 (Fig. 128). Cyanobacteria biovolume relative abundance ranged from a minimum of 3% to a maximum of 34% in September 2007. Green algae

biovolume relative abundance ranged from 0.05% to 35%, peaking in December 2007. Miscellaneous algae and red algae never exceeded 1% of total biovolume.

Diatoms were the dominant contributor to total biovolume in ALXC2 WD samples on all sampling dates with the exception of March 2008, when cyanobacteria were biovolume dominants (Fig. 129). Diatoms accounted for from 40% to 94% of total biovolume, peaking in December 2008. Cyanobacteria biovolume relative abundance ranged from a minimum of 1% to a maximum of 47% in March 2008. Green algae biovolume relative abundance ranged from 1% to 22%, peaking in July 2008. Miscellaneous algae reached a maximum contribution of 3% in March 2008 and red algae 16% in April 2009.

SGLR

In SGLR1 PERI samples diatoms were the dominant contributors to total biovolume on all sampling dates (Fig. 130). Diatoms accounted for from 77% to over 99% of total biovolume, peaking in April 2009. Cyanobacteria biovolume relative abundance ranged from a minimum of 0.1% to a maximum of 18% in March and December 2007. Green algae biovolume relative abundance ranged from 0.1% to 17%, peaking in October 2008. Red algae reached a maximum contribution of 2% in March 2008 and miscellaneous algae never exceeded 1% of total biovolume.

In SGLR1 SAV samples, as relative abundance of diatoms increased from March 2007 to December 2007 relative abundance of cyanobacteria decreased, after which both fluctuated for the remainder of the study (Fig. 131). Diatoms accounted for from 24% to 91% of total biovolume, peaking in December 2007. Cyanobacteria biovolume relative abundance ranged from a minimum of 8% to a maximum of 74% in March 2007. Green algae made a larger contribution to total biovolume in 2008/09 than in 2007, peaking at 43% in October 2008. Miscellaneous algae reached a maximum contribution of 1% in June 2007 and red algae 0.4% in December 2007.

Chlorophyll Analysis

WEKR

At WEKR1 chlorophyll-*a* (chl-*a*) levels were higher in 2008/09 than in 2007 for emergent and woody debris samples (Fig. 132). On most sampling dates at WEKR1 periphytometer (Peri) chl-*a* levels were lower than those of the natural substrates. Sediment chl-*a* at WEKR1 was highest in March 2008 (Fig. 133). At WEKR3 emergent chl-*a* fluctuated throughout the study, peaking in May 2009 (Fig. 134). WEKR3 submerged aquatic vegetation (SAV) chl-*a* was higher in 2008/09 than in 2007. Periphytometer chl-*a* fluctuated throughout the study at WEKR1, peaking in July 2008.

RSR

RSR1 emergent chl-*a* levels were low throughout the study period until a large peak occurred in May 2009 (Fig. 135). Woody debris samples from RSR1 displayed trends of increasing chl-*a* from March 2007 to December 2007 and March 2008 to May 2009. RSR1 periphytometer chl-*a* fluctuated throughout the study, peaking in May 2009. Sediment chl-*a* at RSR1 exhibited a decreasing trend from spring to winter in both 2007 and 2008 (Fig. 136). At RSR2 both emergent and woody debris chl-*a* tended to be higher

in 2008/09 than in 2007 (Fig. 137). Woody debris chl-*a* at RSR2 peaked in October 2008. Sediment chl-*a* at RSR2 fluctuated throughout the study, with a much lower chl-*a* concentration measured in October 2008 (Fig. 138).

JUNC

JUNC1 SAV chl-*a* levels fluctuated throughout the study, although most of the highest concentrations were measured in 2008/09, peaking in April 2009 (Fig. 139). Periphytometer chl-*a* levels also fluctuated throughout the study, with maximum concentration July 2008. Sediment chl-*a* at JUNC1 varied throughout the study, with a much lower chl-*a* concentration measured in April 2009 (Fig. 140). JUNC2 SAV chl-*a* concentrations increased from February 2007 to December 2007, but were more variable in 2008/09 (Fig. 141). Minimum sediment chl-*a* concentration in JUNC2 samples occurred in October 2008 and was followed by peak concentrations in January and April 2009 (Fig. 142).

ALXC

ALXC1 emergent, SAV and periphytometer chl-*a* levels displayed an upward trend from February 2007 to December 2007 (Fig. 143). In 2008/09 emergent and periphytometer chlorophyll-*a* levels were low until peaking in December or April 2009. ALXC1 SAV chl-*a* concentrations displayed an upward trend from March 2008 to April 2009. In ALXC2 emergent and woody debris chl-*a* both varied throughout the study period and both reached maximum levels in April 2009 (Fig. 144). In 2007 ALXC2 sediment chl-*a* levels were highest in February and December (Fig. 145). No sediment samples were collected at ALXC2 in 2008, as sampling was accidentally switched to SAV samples. Sediment chl-*a* levels in April 2009 were comparable to those seen in February and December 2007.

SGLR

SGLR1 SAV chl-*a* was generally higher in 2008/09 than in 2007 (Fig. 146). Periphytometer chl-*a* concentrations at SGLR1 decreased from March 2007 to December 2007 before becoming more variable in 2008/09.

Ash Free Dry Weight Analysis (AFDW)

WEKR

At WEKR1 emergent AFDW was low and variable throughout the study, while woody debris AFDW was higher in 2008/09 than in 2007 (Fig. 147). Periphytometer AFDW at WEKR1 was higher in 2007 then in 2008/09. WEKR1 sediment AFDW peaked in December 2007 (Fig. 148). At WEKR3 emergent AFDW remained low throughout the study (Fig. 149). SAV AFDW was higher in 2008/09 than in 2007, peaking in March 2008, while periphytometer AFDW tended to be higher in 2007 than in 2008, with a maximum value in June 2007.

RSR

At RSR1 emergent AFDW was low and variable throughout the study, while woody debris AFDW peaked in October of both 2007 and 2008 (Fig. 150). RSR1 periphytometer AFDW tended to be higher in 2007 than in 2008, with a maximum value

in June 2007. Sediment AFDW at RSR1 peaked in June 2007 and then declined through October 2008 (Fig. 151). At RSR2 emergent AFDW was low throughout the study, while woody debris AFDW displayed a large peak in March 2007 (Fig. 152). Sediment AFDW at RSR2 peaked in June 2007 and May 2009 (Fig. 153).

JUNC

In 2007 JUNC1 samples SAV AFDW peaked in June and periphytometer AFDW in December, while in 2008/09 both substrates had maximum AFDW in April 2009 (Fig. 154). With the exception of October 2007 samples, JUNC1 sediment AFDW was higher in 2007 than in 2008/09 (Fig. 155). At JUNC2 SAV AFDW exhibited relatively small fluctuation throughout the study until a large peak occurred in April 2009 (Fig. 156). Sediment AFDW at JUNC2 peaked in February 2007 and April 2009 (Fig. 157).

ALXC

At ALXC1, emergent samples displayed an overall upward trend in AFDW from February to December 2007 (Fig. 158). Emergent AFDW was more variable in 2008/09 and peaked in April 2009. ALXC1 SAV AFDW was higher in 2008/09 than in 2007 while periphytometer AFDW fluctuated over the course of the study. No clear patterns in emergent AFDW were apparent at ALXC2 (Fig. 159). Following a peak in February, AFDW in ALXC2 woody debris samples remained variable for the remainder of the study. ALXC2 sediment samples showed an overall upward trend in AFDW from February to September 2007, before a precipitous decline in December 2007 (Fig. 160). By April 2009 ALXC2 sediment AFDW levels were more comparable to that seen in the earlier 2007 samples.

SGLR

In SGLR1 submerged aquatic vegetation AFDW peaked in December 2007 and July 2008 (Fig. 161). AFDW in SGLR1 periphytometer samples fluctuated throughout the course of the study.

Macroalgal Mat Samples

With the exception of SGLR1, mats of macroalgae were not frequently encountered at the Task 3 sampling sites. At ALXC1 floating mats of attached *Cladophora glomerata* (151.2 gdw/m^2) were encountered in December 2007. Benthic mats of *Lyngbya wollei* were sampled twice at JUNC1, once in October 2007 (526.24 gdw/m^2) and once in December 2007 (62.08 gdw/m^2). Large and persistent benthic mats of *Lyngbya wollei* occurred at SGLR1. Overall biomass of these mats tended to be higher in 2007 than in 2008/09 (Fig. 162).

Segment Comparisons:

Segment comparisons were made using the Kruskal-Wallis Test followed by Dunn's Procedure. In figures 163-178 columns sharing a letter are not significantly different.

Periphytic Algal Cell Density

Periphytic algal cell density on SAV over the entire study period was significantly higher at WEKR3, JUNC2, ALXC1 and SGLR1 than at JUNC2 (Fig. 163). Cell density on

woody debris was significantly higher at WEKR1 and RSR1 than at RSR2 (Fig. 164). No significant difference in cell density on periphytometers was detected (Fig. 165).

Periphytic Algal Biovolume

Periphytic algal biovolume on SAV over the entire study period was significantly higher at WEKR3, ALXC1 and SGLR1 than at JUNC1 and JUNC2 (Fig. 166). SAV periphytic algal biovolume at WEKR3 was also significantly higher than at SGLR1. Periphytic algal biovolume on woody debris was significantly higher at WEKR1 and RSR2 than at ALXC2 (Fig. 167). Periphytic algal biovolume on periphytometers was significantly higher at WEKR3 and ALXC1 than at WEKR1 (Fig. 168).

Periphyton chl-*a*

Periphyton chl-*a* on SAV over the entire study period was significantly higher at WEKR3 than at JUNC1 and JUNC2 and was significantly higher at ALXC1 than at JUNC1 (Fig. 169). The variability caused by a small number of high chl-*a* measurements may explain why JUNC2 was not significantly different than ALXC1 and SGLR1. Periphyton chl-*a* on woody debris was significantly higher at WEKR1 and RSR1 than at ALXC2 (Fig. 170). No significant difference in periphyton chl-*a* on periphytometers was detected (Fig. 171). Periphyton chl-*a* on emergents was significantly higher at WEKR1 and WEKR3 than at ALXC2 (Fig. 172). Sediment chl-*a* was significantly higher at RSR1 and RSR2 than at JUNC2 (Fig. 173).

Periphyton AFDW

Periphyton AFDW on SAV over the entire study period was significantly higher at WEKR3 than at JUNC2 (Fig. 174). Periphyton AFDW on woody debris was significantly higher at WEKR1 and RSR2 than at ALXC2 (Fig. 175). No significant difference in periphyton AFDW on periphytometers was detected (Fig. 176). Periphyton AFDW on emergents was significantly higher at WEKR1 and ALXC1 than at RSR1 (Fig. 177). Sediment AFDW at WEKR1 was significantly higher than at RSR1, RSR2, JUNC1 and JUNC2 (Fig. 178). ALXC2 sediment AFDW was also significantly higher than at JUNC2.

<u>Substrate Comparisons</u>

Substrate comparisons were made using the Kruskal-Wallis Test followed by Dunn's Procedure. In figures 179-190 columns sharing a letter are not significantly different.

Total periphytic algal cell numbers (all stream segments combined) were significantly higher on SAV samples than on periphytometer samples (Fig. 179). There were no significant differences in cell numbers of diatoms (Bacillariophyta) or green algae (Chlorophyta) between substrates (Figs. 180,181). Cyanobacteria cell numbers were higher on SAV samples than on periphytometer or woody debris samples (Fig. 182). Red algae (Rhodophyta) cell numbers were significantly higher on woody debris samples than on periphytometer or SAV samples (Fig. 183).

Total periphytic algal biovolume (all stream segments combined) was significantly higher on woody debris samples than on periphytometer or SAV samples (Fig. 184). Diatom

biovolume was significantly higher on woody debris samples than on periphytometer or SAV samples (Fig. 185). There was no significant difference in biovolume of green algae or cyanobacteria between substrates (Figs. 186,187). Red algae biovolume was significantly higher on woody debris samples than on periphytometer or SAV samples (Fig. 188).

Chlorophyll-*a* concentration (all stream segments combined) was significantly lower on emergent samples than on periphytometer, SAV or woody debris samples (Fig. 189). AFDW (all stream segments combined) was significantly lower on emergent samples than on periphytometer, SAV and woody debris samples and significantly higher on woody debris samples than on periphytometer or SAV samples (Fig. 190).

Relationships Between Water Quality and Biological Parameters

WEKR1

At WEKR1 total suspended solids (TSS) was negatively correlated with diatom (BACIL) cell number, green algae (CHLOR) biovolume, cyanobacteria (CYANO) biovolume, red algae (RHODO) biovolume, total cell number and periphyton chl-*a* (Table 18). CHLOR cell number was also negatively correlated with cover and CHLOR biovolume was negatively correlated with TOC. Nutrient parameters with significant positive correlations with biological parameters included NH_4-D (periphyton chl-*a*) and TKN (sediment chl-*a*). Nutrient parameters with significant negative correlations with biological parameters included PO_4-D (CYANO biovolume, periphyton chl-*a*), TKN (RHODO cells, RHODO biovolume) and TP (sediment chl-*a*). Turbidity was positively correlated with periphyton chl-*a* and periphyton AFDW. Sediment AFDW was negatively correlated with water temperature and positively correlated with conductivity.

WEKR3

At WEKR3 BACIL numbers were negatively correlated with TKN, TOC and color and positively correlated with pH (Table 19). The only significant correlation with BACIL biovolume was a positive one with PO_4-D. CHLOR cell number and biovolume were both positively correlated with water temperature and negatively correlated with conductivity, dissolved oxygen and TP. In addition CHLOR cell numbers had a significant negative relationship with TOC and CHLOR biovolume with NO_x-D. CYANO cell numbers and biovolume were both positively correlated with water temperature and negatively correlated with TP. CYANO cell numbers were also negatively correlated with conductivity while CYANO biovolume had a negative correlation with TOC, TKN and color. RHODO cell numbers and biovolume were positively correlated with TKN, TOC, TP, COLOR and NO_x-D and negatively correlated with water temperature. There was a negative correlation between total cell number and TOC, TP, color and TKN and a positive correlation with water temperature. There were no significant correlations between total biovolume and any of the measured water quality parameters. Periphyton chl-*a* was positively correlated with TSS.

RSR1

At RSR1 BACIL biovolume was negatively correlated with turbidity (Table 20). CHLOR cell number and biovolume were negatively correlated with alkalinity and positively

correlated with TSS. CHLOR cell number was also positively correlated with NO_x-D while CHLOR biovolume was negatively correlated with conductivity and positively correlated with pH. CYANO cell number and total cell number were both negatively correlated with conductivity and alkalinity and positively correlated with TSS. Periphyton chl-*a* was positively correlated with NO_x-D, cover and TSS and negatively correlated with alkalinity, turbidity and PO_4. Periphyton AFDW was positively correlated with cover. Sediment AFDW was negatively correlated with water flow and NO_x-D and positively correlated with turbidity and PO_4-D.

RSR2

BACIL cell number and biovolume at RSR2 were positively correlated with NO_x-D (Table 21). BACIL biovolume was also positively correlated with D.O. and negatively correlated with water temperature. CYANO cell number was positively correlated with dissolved oxygen. CYANO biovolume was negatively correlated with conductivity and positively correlated with NO_x-D and TSS. Both total cell number and total biovolume were positively correlated with NO_x-D. Total biovolume was also positively correlated with D.O. and negatively correlated with water temperature. There was a negative correlation between periphyton chl-*a* and PO_4-D and a positive correlation between periphyton chl-*a* and turbidity. Sediment chl-a was negatively correlated with NH4-D, TKN and color positively correlated with pH. Periphyton AFDW was positively correlated with D.O. and pH and negatively correlated with conductivity while sediment AFDW was negatively correlated with water flow.

JUNC1

At JUNC1 BACIL cell number and biovolume were negatively correlated with PO_4-D and positively correlated with TP and dissolved oxygen (Table 22). In addition BACIL cell number was positively correlated with turbidity and BACIL biovolume was negatively correlated with TSS. CHLOR cell number and biovolume were positively correlated with turbidity. CYANO cell numbers and biovolume were both positively correlated with turbidity and TP and negatively correlated with PO_4-D. CYANO biovolume also had a positive correlation with dissolved oxygen. RHODO cell number and biovolume were both negatively correlated with water temperature. Total cell number and total biovolume were both negatively correlated with PO_4-D and positively correlated with D.O., TP and turbidity. There was also a positive correlation between total cell number and pH and a negative correlation between total biovolume and TSS. Periphyton chl-*a* was positively correlated with TP and negatively correlated with PO_4-D, NO_x-D and TKN. Periphyton AFDW was negatively correlated with alkalinity and sediment AFDW was negatively correlated with NH4-D.

JUNC2

At JUNC2 both BACIL cell number and biovolume were negatively correlated with TSS and TOC (Table 23). BACIL cell number was positively correlated with pH while BACIL biovolume was positively correlated with D.O. and negatively correlated with alkalinity. CHLOR cells and biovolume were both positively correlated with PO_4–D and negatively correlated with dissolved oxygen. CHLOR biovolume was also positively correlated with color and TKN and negatively correlated with NO_x-D. Dissolved oxygen

was positively correlated with CYANO cell number but negatively correlated with CYANO biovolume. CYANO biovolume was positively correlated with PO_4-D, color and TKN. Total biovolume was negatively correlated with alkalinity, TSS and NO_x-D. Periphyton AFDW was negatively correlated with TOC. Sediment AFDW was negatively correlated with color, turbidity and TP and positively correlated with NH_4-D.

ALXC1

At ALXC1 BACIL cell number and biovolume were both negatively correlated with conductivity and BACIL biovolume was positively correlated with TKN (Table 24). Both CHLOR cell number and biovolume were positively correlated with turbidity and color. CYANO cell number and biovolume were both positively correlated with turbidity. In addition CYANO biovolume was positively correlated with color, alkalinity and TKN and negatively correlated with conductivity. Periphyton chl-*a* and AFDW were both positively correlated with NH_4-D and negatively correlated with TSS. Periphyton chl-*a* was also negatively correlated with color, TOC and conductivity.

ALXC2

At ALXC2 both BACIL cell number and biovolume were negatively correlated with TOC, TKN, color and turbidity and positively correlated with alkalinity and conductivity (Table 25A). There was also a positive correlation between BACIL cell number and pH. CYANO cell number and biovolume were positively correlated with pH and alkalinity. CYANO cell number was also negatively correlated with color and TOC and CYANO biovolume was positively correlated with conductivity. Both total cell number and total biovolume were positively correlated with pH and alkalinity and negatively correlated with color and TOC. Total biovolume was also negatively correlated with TKN and canopy cover and positively correlated with D.O. and conductivity. Sediment chl-a was negatively correlated with canopy cover and TKN and positively correlated with NO_x-D (Fig. 25B). Periphyton AFDW was only positively correlated with water flow. Sediment AFDW was positively correlated with TKN and water temperature and negatively correlated with conductivity, PO_4-D and dissolved oxygen.

SGLR1

At SGLR1 BACIL cell number was positively correlated with turbidity (Table 26). CHLOR cell number and biovolume were both negatively correlated with NO_x-D, and canopy cover and positively correlated with PO_4-D and TSS. There was also a positive correlation between CHLOR cell number and turbidity. CHLOR biovolume was negatively correlated with conductivity and positively correlated with water temperature. CYANO cell number was positively correlated with water temperature and PO_4-D and negatively correlated with conductivity and water flow. RHODO cell number and biovolume were positively correlated with NH_4-D. Total cell number was positively correlated with PO_4-D and turbidity and negatively correlated with NO_x-D. Total biovolume and periphyton chl-*a* were both positively correlated with TP and negatively correlated with canopy cover. Periphyton chl-*a* was also negatively correlated with alkalinity.

Conclusions

The periphytic algal communities in the five springs examined in this study have two easily recognizable components: benthic or floating accumulations of (primarily) filamentous algae and communities attached to submerged substrates. Task 2 of the current study (which annually examined visible periphytic algal communites from the headspring to some distance downstream) better covered the first component and Task 3 (short stream segments sampled quarterly) the second component.

While periphytic algae were found along the length of all stream runs, benthic/floating mats of filamentous algae were most common in and around the headsprings and in wide, shallow areas with low canopy cover. The most extensive growths of filamentous algae were observed in the Wekiva River, Juniper Springs, Alexander Springs and Silver Glen Springs. In the Wekiva River a benthic mat of *Dichotomosiphon*/*Vaucheria* sp. was present in the lagoon section just downstream of the headspring in 2007 and in 2008 extensive growths of the filamentous red alga *Compsopogon coeruleus* were present downstream of the lagoon in the upper reaches of the river in 2008. In Juniper Springs a persistent benthic mat of the cyanophyte *Lyngbya wollei* with smaller amounts of the green alga *Spirogyra* was present in the springhead, just upstream from the spring outlet. Alexander Springs had a large persistent benthic mat of the green alga *Hydrodictyon reticulatum* in the springhead and occasional floating/attached mats of the green algae *Cladophora glomerata* and *Ulva flexuosa* in the wide, shallow zone just upstream of FR445. Large floating accumulations of the filamentous, colonial cyanobacteria *Gloeotrichia natans* were observed in the downstream section of Alexander Creek in 2007 and globular colonies of the filamentous cyanobacteria *Nostochopsis lobata* were seen attached to woody debris in the downstream section of Alexander Creek in 2007 and 2008. An extensive, persistent benthic mat of *Lyngbya wollei* was present in the springhead area of Silver Glen Springs. Brown-colored "filaments" of diatoms, composed mainly of *Pleurosira laevis* and *Terpsinoe musica*, were observed at times on SAV and woody debris in all springs.

The algal communities found in the current study are similar to those found in previous studies conducted on Florida spring systems. Most of the algal taxa listed by Whitford (1956) in his study of springs in Florida were found in the current study. Whitford (1956) and Stevenson et al. (2004) found that *Lyngbya wollei* (as *Plectonema wollei* and *Lyngbya majuscula* respectively) formed large and abundant mats in some freshwater springs. Stevenson et al. (2004) found that relatively few filamentous macroalgae formed thick mats in Florida springs, including *Lyngbya wollei* (as *L. majuscula*), *Vaucheria*, *Dichotomosiphon* and *Compsopogon*. These were some of the main large mat formers found in the current study. Stevenson et al. (2004) found that *Lyngbya*, *Vaucheria* and *Dichotomosiphon* were characteristic of high nutrient springs while *Cladophora*, *Hydrodictyon* and *Spirogyra* were characteristic of low nutrient springs. Whitford (1956) described mats of *Hydrodictyon reticulatum* in Weekiwachee Springs and Crystal River similar to the mat of this species found at Alexander Springs in this study. Dominant algal taxa in the current study are similar to those found in the previous study conducted by GreenWater Laboratories on the Wekiva River and Rock Springs Run (2005).

Diatoms had the highest species richness of all algal groups on all substrates, at all sites and on all sampling dates. Diatoms were also found to have the highest species diversity in the Wekiva River and Rock Springs Run in the 2005 GreenWater Laboratories study. Periphytometer slides tended to have higher diatom richness than other substrates. Green algae and cyanobacteria tended to be less diverse on woody debris compared to other substrates. Red algae species richness was low at all springs throughout the study with only three species recorded in Task 2 (*Batrachospermum* sp., *Compsopogon coeruleus* and *Thorea ramosissima*) and two (*Batrachospermum* sp. and *C. coeruleus*) in Task 3 samples.

In terms of cell density and relative abundance, diatoms and cyanobacteria were dominant in almost all samples from all springs, with cyanobacteria more important in SAV samples. Red algae had higher numbers on woody debris samples than on other substrates. Diatoms were also dominant or co-dominant in all samples in terms of biovolume and biovolume relative abundance. Diatoms were also found to be the dominant algal group in terms of biovolume in the 2005 GreenWater Laboratories study. Cyanobacteria had a larger effect on total cell number than on total biovolume due to the cyanobacteria community being dominated by small-celled colonial and filamentous forms. Green algae and red algae had a larger impact on total biovolume than on total cell number owing to the fact that their representatives tended to be large filamentous forms.

Total cell numbers were lower on periphytometer samples than on those from other substrates. Total biovolume was higher in woody debris samples than on periphytometer and SAV samples. This was due to the abundance of large diatom species such as *Pleurosira laevis*, *Synedra* spp. and *Terpsinoe musica* in these samples. Diatom and red algae biovolume was higher on woody debris samples than on those from other substrates. Total cell numbers and total biovolume in Wekiva River samples tended to be higher than in those from Juniper Creek and Alexander Creek.

Chlorophyll-*a* concentration and AFDW were lower on emergent samples than on those from other substrates. Woody debris samples had higher AFDW than did periphytometer, SAV and emergent samples. Chlorophyll-*a* and AFDW in Wekiva River samples tended to be higher than in those from Juniper Creek and Alexander Creek.

Overall, Wekiva River and Rock Spring Run stream segments had higher nitrogen and phosphorus levels compared to segments from Juniper Creek, Alexander Creek and Silver Glen Springs. Of the spring runs in this study Wekiva River and Rock Spring Run stream segments were on the low end in terms of conductivity and the high end in terms of alkalinity.

Few consistent patterns in relationships between water quality and biological parameters were revealed through Spearman Correlation analysis. Changes in factors affecting light availability (color, TSS, TOC, turbidity and canopy cover) and concentrations of various forms of nitrogen and phosphorus were the water quality parameters most often correlated with total cell number, total biovolume, periphyton chl-*a* and periphyton AFDW. Forms of nitrogen were most highly correlated with total cell number, total

biovolume, periphyton chl-*a* and periphyton AFDW at RSR2 and ALXC1. Forms of phosphorus were most highly correlated with theses parameters at JUNC1 and SGLR1. Total cell number was not correlated with any of the measured water quality parameters at JUNC2 and ALXC1. Total biovolume was not correlated with any of the measured water quality parameters at WEKR1, WEKR3 and RSR1. Periphyton chlorophyll-*a* was not correlated with any of the measured water quality parameters at JUNC2 and ALXC2 and periphyton AFDW was not correlated with any of the measured water quality parameters at WEKR3 and SGLR1. Results of other studies on Florida springs also show complex relationships exist between water quality and periphyton communities. Stevenson et al. (2004) found that periphyton chl-*a* and AFDW did not correlate with any of the environmental variables measured in their study. Fisher (1991) found that differences in light availability were the primary cause for the differences observed in periphyton communities from two reaches of the Wekiva River. Hornsby et al. (2000) found that periphyton cell density and biovolume was positively correlated with nitrate concentration in spring-influenced sections of the Suwannee River, Withlacoochee River and Santa Fe River.

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Table 6: Dominant substrates sampled and analyses to be conducted in each study segment for Task 3 – Algal and Water Quality Studies.

Segment	EMERG	SAV	WD	SED	BMA
WEKR1	Chl a & AFDW on 3 replicates, qualitative species ID		Chl a, AFDW & algal ID, enumeration and biovolume on 3 replicates	Chl a analysis on 3 replicates and qualitative species ID	When encountered during SED sampling
WEKR3	Chl a & AFDW on 3 replicates, qualitative species ID	Chl a, AFDW & algal ID, enumeration and biovolume on 3 replicates			When encountered during SED sampling
RSR1	Chl a & AFDW on 3 replicates, qualitative species ID		Chl a, AFDW & algal ID, enumeration and biovolume on 3 replicates	Chl a analysis on 3 replicates and qualitative species ID	When encountered during SED sampling
RSR2	Chl a & AFDW on 3 replicates, qualitative species ID		Chl a, AFDW & algal ID, enumeration and biovolume on 3 replicates	Chl a analysis on 3 replicates and qualitative species ID	When encountered during SED sampling
JUNC1		Chl a, AFDW & algal ID, enumeration and biovolume on 3 replicates		Chl a analysis on 3 replicates and qualitative species ID	When encountered during SED sampling
JUNC2		Chl a, AFDW & algal ID, enumeration and biovolume on 3 replicates		Chl a analysis on 3 replicates and qualitative species ID	When encountered during SED sampling
ALXC1	Chl a & AFDW on 3 replicates, qualitative species ID	Chl a, AFDW & algal ID, enumeration and biovolume on 3 replicates			When encountered during SED sampling
ALXC2	Chl a & AFDW on 3 replicates, qualitative species ID		Chl a, AFDW & algal ID, enumeration and biovolume on 3 replicates	Chl a analysis on 3 replicates and qualitative species ID	When encountered during SED sampling
SGLR1		Chl a, AFDW & algal ID, enumeration and biovolume on 3 replicates			*L. wollei* dry weight

Table 7: Summary of dominant substrate sampling, sample processing and algal removal for Task 3 – Algal and Water Quality Studies.

Dominant Substrate Type	# of Replicates/ Segment	Pooled Samples/Replicate	Algae Removal Method
EMERG	3	4-10cm stem lengths each for algal ID (qualitative), chl-*a* and AFDW	Scraping
SAV	3	4-10cm leaf blade lengths each for algal ID and enumeration, chl-*a* and AFDW	Scraping
WD	3	4-10cm branch lengths each for algal ID and enumeration, chl-*a* and AFDW	Scraping
SED	3	3 Petri dishes each for algal ID (qualitative) and chl-*a*	N.A.
BMA	1	All or portion of macroalgae in 0.25m^2 quadrat	Hand
PERI	2	3 glass slides each for algal ID and enumeration, chl-*a* and AFDW	Scraping

Table 8: Dominant vegetation found in each stream segment in Task 3-Algal and Water Quality Studies

	DOMINANT	DOMINANT	DOMINANT
SITE	SAV	EMERG/FLOATING	SHORELINE VEG.
WEKR1	*Najas guadalupenis*	*Nuphar advena*	*Acer rubrum*, *Sabal* spp., *Persea* sp.
WEKR3	*Vallisneria americana*	*N. advena*	*Quercus* spp., *Sabal* spp., *Taxodium* sp.
RSR1	*V. americana* *Chara* sp.	*N. advena* *Hydrocotyle* sp.	*Sabal* spp., *Quercus* spp., *Persea* sp.
RSR2	*V. americana*, *N. guadalupensis*	*N. advena* *Hydrocotyle* sp.	*Sabal* spp., *Quercus* spp., *Fraxinus* sp.
JUNC1	*V. americana*		*Ilex* sp., *Sabal* spp. *Myrica cerifera*
JUNC2	*Potamogeton pectinatus*	*Hydrocotyle* sp.	*M. cerifera*, unknown grasses
ALXC1	*V. americana* *N. guadalupensis*	*N. advena* *Hydrocotyle* sp.	*Typha* sp., *Quercus* spp., *Sabal* spp.
ALXC2	*V. americana*	*N. advena* *Hydrocotyle* sp.	*Quercus* spp., *Sabal* spp.
SGLR1	*V. americana*	*Eichhornia crassipes* *Hydrocotyle* sp.	*Quercus* spp., *Sabal* spp., *M. cerifera*

Table 9: WEKR1 Task 3 Water Quality Summary 2007-2009

	n	Mean	SD	Median	Min	Max	25th%	75th%
Temp (oC)	94	23.50	0.65	23.61	22.21	24.64	23.10	23.90
pH	94	7.51	0.22	7.54	6.65	8.38	7.49	7.59
D.O. (mg/L)	94	2.83	0.89	3.00	1.02	4.36	2.24	3.45
Cond. (umhos/cm)	94	342.3	23.0	341.5	304.0	540.0	340.0	344.0
Depth (m)	94	1.08	0.32	1.10	0.45	1.90	0.89	1.23
Flow (m/sec)	93	0.08	0.04	0.10	0.00	0.20	0.05	0.100
Cover (%)	85	47.14	23.17	41.76	2.20	99.00	29.30	66.10
Alk (mg/L)	9	120.67	10.91	124.00	92.00	126.00	122.00	126.00
Color (cpu)	9	19.44	30.46	10.00	5.00	100.00	5.00	15.00
NH4-D (mg/L)	9	0.025	0.062	0.000	0.000	0.189	0.000	0.012
NOx-D (mg/L)	9	0.772	0.158	0.756	0.603	1.050	0.651	0.855
TKN (mg/L)	9	0.182	0.203	0.130	0.030	0.700	0.063	0.190
PO4-D (mg/L)	9	0.117	0.011	0.117	0.092	0.126	0.114	0.125
TP (mg/L)	9	0.126	0.016	0.120	0.109	0.161	0.116	0.131
TOC (mg/L)	9	3.09	4.56	1.50	0.27	15.10	1.32	2.31
TSS (mg/L)	9	1.11	0.93	1.00	0.00	3.00	0.75	1.25
Turb (ntu)	8	0.28	0.30	0.15	0.00	0.92	0.11	0.41

Table 10: WEKR3 Task 3 Water Quality Summary 2007-2009

	n	Mean	SD	Median	Min	Max	25th%	75th%
Temp (oC)	63	23.91	3.84	25.45	16.16	27.95	23.04	26.90
pH	63	7.88	0.41	7.89	7.21	8.79	7.65	8.10
D.O. (mg/L)	63	8.41	2.57	9.32	4.01	13.29	5.96	10.24
Cond. (umhos/cm)	63	386.9	45.8	381.0	302.0	497.0	358.5	409.8
Depth (m)	63	0.68	0.33	0.63	0.10	1.85	0.50	0.78
Flow (m/sec)	63	0.09	0.06	0.10	0.00	0.35	0.50	0.10
Cover (%)	54	1.44	6.50	0.00	0.00	40.70	0.00	0.00
Alk (mg/L)	9	111.89	12.53	115.00	90.00	126.00	107.00	120.00
Color (cpu)	9	28.33	21.36	20.00	5.00	70.00	13.75	42.50
NH4-D (mg/L)	9	0.038	0.059	0.002	0.000	0.160	0.000	0.068
NOx-D (mg/L)	9	0.316	0.132	0.263	0.205	0.645	0.253	0.338
TKN (mg/L)	9	0.354	0.209	0.290	0.090	0.800	0.253	0.397
PO4-D (mg/L)	9	0.101	0.010	0.104	0.084	0.112	0.094	0.110
TP (mg/L)	9	0.130	0.018	0.135	0.110	0.161	0.114	0.141
TOC (mg/L)	9	5.77	3.98	3.90	1.90	13.30	2.81	8.11
TSS (mg/L)	9	4.33	4.36	4.00	1.00	15.00	1.00	4.50
Turb (ntu)	8	1.11	1.73	0.45	0.15	5.28	0.25	1.04

Table 11: RSR1 Task 3 Water Quality Summary 2007-2009

	n	Mean	SD	Median	Min	Max	25th%	75th%
Temp (oC)	97	23.46	1.32	23.93	20.06	25.26	22.54	24.44
pH	97	7.93	0.13	7.92	7.51	8.21	7.85	8.01
D.O. (mg/L)	97	6.26	0.47	6.28	5.40	7.24	5.81	6.62
Cond. (umhos/cm)	97	262.7	4.4	262.0	255.0	272.0	259.0	266.0
Depth (m)	97	0.97	0.95	0.72	0.10	5.34	0.53	0.91
Flow (m/sec)	97	0.11	0.11	0.10	0.00	0.60	0.05	0.10
Cover (%)	88	32.64	22.73	26.70	0.00	100.00	15.63	47.50
Alk (mg/L)	9	94.22	4.52	96.00	86.00	100.00	92.50	96.50
Color (cpu)	9	7.22	5.07	5.00	5.00	20.00	5.00	6.25
NH4-D (mg/L)	9	0.015	0.021	0.000	0.000	0.049	0.000	0.029
NOx-D (mg/L)	9	1.132	0.126	1.120	0.986	1.390	1.038	1.188
TKN (mg/L)	9	0.080	0.043	0.070	0.030	0.170	0.048	0.103
PO4-D (mg/L)	9	0.080	0.004	0.079	0.072	0.086	0.078	0.083
TP (mg/L)	9	0.092	0.013	0.087	0.081	0.119	0.083	0.099
TOC (mg/L)	9	0.89	0.62	0.78	0.46	2.50	0.575	0.833
TSS (mg/L)	9	1.89	1.36	2.00	0.00	4.00	0.75	3.00
Turb (ntu)	8	0.22	0.09	0.20	0.14	0.43	0.17	0.22

Table 12: RSR2 Task 3 Water Quality Summary 2007-2009

	n	Mean	SD	Median	Min	Max	25th%	75th%
Temp (oC)	87	22.98	4.14	23.61	14.67	28.43	22.80	24.62
pH	87	7.70	0.46	7.88	6.38	8.13	7.68	7.95
D.O. (mg/L)	87	7.61	1.76	7.85	2.40	10.10	7.44	8.44
Cond. (umhos/cm)	87	327.5	132.6	282.0	256.0	716.0	276.0	305.0
Depth (m)	87	0.61	0.32	0.55	0.20	2.50	0.40	0.75
Flow (m/sec)	87	0.23	0.12	0.20	0.03	0.50	0.10	0.30
Cover (%)	78	55.39	19.17	54.50	14.70	88.60	41.80	66.70
Alk (mg/L)	9	90.33	18.86	94.00	42.00	106.00	91.75	98.00
Color (cpu)	9	51.67	75.95	20.00	10.00	240.00	13.75	47.50
NH4-D (mg/L)	9	0.016	0.024	0.000	0.000	0.063	0.000	0.035
NOx-D (mg/L)	9	0.712	0.272	0.795	0.061	1.020	0.682	0.856
TKN (mg/L)	9	0.456	0.506	0.280	0.060	1.730	0.240	0.445
PO4-D (mg/L)	9	0.072	0.015	0.075	0.037	0.090	0.068	0.080
TP (mg/L)	9	0.090	0.012	0.090	0.075	0.114	0.081	0.098
TOC (mg/L)	9	8.63	12.36	4.00	1.62	40.70	3.05	7.68
TSS (mg/L)	9	3.89	2.09	4.00	0.00	7.00	2.75	5.25
Turb (ntu)	8	1.13	0.98	0.95	0.41	3.43	0.51	1.14

Table 13: JUNC1 Task 2 Water Quality Summary 2007-2009

	n	Mean	SD	Median	Min	Max	25th%	75th%
Temp (oC)	63	21.99	0.50	21.96	20.37	22.78	21.71	22.26
PH	63	8.20	0.22	8.19	7.66	8.61	8.04	8.33
D.O. (mg/L)	63	7.75	0.48	7.67	6.66	8.54	7.55	8.23
Cond. (umhos/cm)	63	131.8	6.2	130.0	124.0	152.0	128.0	135.0
Depth (m)	63	0.54	0.23	0.51	0.20	1.30	0.38	0.63
Flow (m/sec)	63	0.20	0.08	0.20	0.05	0.40	0.20	0.20
Cover (%)	54	62.95	18.68	67.00	10.60	96.90	50.10	75.04
Alk (mg/L)	9	45.56	4.77	46.00	38.00	54.00	43.00	48.00
Color (cpu)	9	6.11	2.21	5.00	5.00	10.00	5.00	6.25
NH4-D (mg/L)	9	0.001	0.003	0.000	0.000	0.009	0.000	0.001
NOx-D (mg/L)	9	0.089	0.025	0.081	0.069	0.146	0.071	0.099
TKN (mg/L)	9	0.048	0.049	0.030	0.000	0.130	0.007	0.100
PO4-D (mg/L)	9	0.021	0.006	0.019	0.015	0.032	0.016	0.024
TP (mg/L)	9	0.025	0.004	0.027	0.017	0.029	0.024	0.028
TOC (mg/L)	9	0.503	0.328	0.500	0.010	1.040	0.275	0.683
TSS (mg/L)	9	1.04	1.20	0.80	0.00	3.00	0.00	2.15
Turb (ntu)	8	0.18	0.12	0.16	0.01	0.39	0.11	0.24

Table 14: JUNC2 Task 2 Water Quality Summary 2007-2009

	n	Mean	SD	Median	Min	Max	25th%	75th%
Temp (oC)	63	22.45	1.64	23.25	18.67	24.92	21.17	23.64
pH	63	7.80	0.27	7.85	6.72	8.23	7.72	7.92
D.O. (mg/L)	63	7.28	0.81	7.51	5.42	8.52	6.72	7.84
Cond. (umhos/cm)	63	1830.5	107.7	1874.0	1507.0	1953.0	1808.8	1895.8
Depth (m)	63	0.78	0.40	0.72	0.15	2.10	0.52	0.96
Flow (m/sec)	63	0.34	0.13	0.30	0.10	0.80	0.23	0.40
Cover (%)	55	3.42	8.96	0.00	0.00	51.60	0.00	1.20
Alk (mg/L)	9	58.11	2.37	58.00	54.00	61.00	56.00	60.00
Color (cpu)	9	12.22	8.33	10.00	5.00	30.00	5.00	16.25
NH4-D (mg/L)	9	0.005	0.007	0.000	0.000	0.015	0.000	0.010
NOx-D (mg/L)	9	0.037	0.019	0.040	0.009	0.069	0.026	0.046
TKN (mg/L)	9	0.110	0.055	0.090	0.040	0.190	0.068	0.160
PO4-D (mg/L)	9	0.015	0.007	0.016	0.001	0.025	0.012	0.018
TP (mg/L)	9	0.028	0.006	0.028	0.015	0.037	0.025	0.031
TOC (mg/L)	9	1.69	1.34	1.70	0.40	4.87	0.68	1.91
TSS (mg/L)	9	4.27	2.31	4.00	1.00	9.00	3.05	5.25
Turb (ntu)	8	0.47	0.44	0.32	0.00	1.21	0.12	0.84

Table 15: ALXC1 Task 3 Water Quality Summary 2007-2009

	n	Mean	SD	Median	Min	Max	25th%	75th%
Temp (oC)	63	24.05	1.15	24.01	22.13	26.81	23.14	24.80
pH	63	8.10	0.48	8.10	7.04	8.99	7.76	8.46
D.O. (mg/L)	63	5.71	2.25	5.98	0.73	9.66	4.63	7.25
Cond. (umhos/cm)	63	1038.8	81.7	1048.0	862.0	1149.0	984.3	1107.0
Depth (m)	62	0.67	0.18	0.71	0.25	1.01	.58	0.80
Flow (m/sec)	63	0.10	0.04	0.10	0.00	0.20	0.10	0.10
Cover (%)	55	1.52	5.58	0.00	0.00	32.40	0.00	0.00
Alk (mg/L)	9	78.00	7.21	74.00	70.00	92.00	73.50	81.50
Color (cpu)	9	31.11	33.15	15.00	5.00	100.00	8.75	47.50
NH4-D (mg/L)	9	0.022	0.041	0.000	0.000	0.125	0.000	0.30
NOx-D (mg/L)	9	0.030	0.018	0.026	0.004	0.062	0.020	0.039
TKN (mg/L)	9	0.160	0.118	0.130	0.008	0.340	0.070	0.248
PO4-D (mg/L)	9	0.042	0.005	0.042	0.034	0.048	0.039	0.045
TP (mg/L)	9	0.047	0.006	0.047	0.037	0.056	0.043	0.052
TOC (mg/L)	9	4.60	4.92	2.22	0.06	13.40	0.86	9.00
TSS (mg/L)	9	2.00	1.66	2.00	0.00	5.00	0.75	3.00
Turb (ntu)	8	0.21	0.17	0.18	0.00	0.54	0.12	0.29

Table 16: ALXC2 Task 3 Water Quality Summary 2007-2009

	n	Mean	SD	Median	Min	Max	25th%	75th%
Temp (oC)	89	24.34	2.88	24.53	19.80	28.59	22.23	26.63
pH	89	7.65	0.37	7.81	6.65	8.13	7.36	7.92
D.O. (mg/L)	89	7.11	2.38	8.19	0.74	9.14	6.95	8.43
Cond. (umhos/cm)	89	1003.9	90.3	1002.0	762.0	1119.0	937.0	1084.0
Depth (m)	89	0.87	0.42	0.77	0.22	2.25	0.60	1.01
Flow (m/sec)	88	0.12	0.08	0.10	0.00	0.30	0.10	0.20
Cover (%)	80	22.42	22.07	13.70	0.00	73.00	4.86	38.10
Alk (mg/L)	9	69.11	13.20	74.00	40.00	82.00	63.00	78.50
Color (cpu)	9	77.78	86.10	35.00	10.00	240.00	13.75	125.00
NH4-D (mg/L)	9	0.014	0.024	0.00	0.00	0.064	0.000	0.025
NOx-D (mg/L)	9	0.021	0.012	0.017	0.005	0.037	0.013	0.033
TKN (mg/L)	9	0.352	0.303	0.190	0.00	0.800	0.128	0.615
PO4-D (mg/L)	9	0.035	0.007	0.037	0.024	0.042	0.030	0.042
TP (mg/L)	9	0.047	0.011	0.048	0.022	0.059	0.042	0.054
TOC (mg/L)	9	11.05	11.11	4.77	0.90	31.10	2.65	17.55
TSS (mg/L)	9	3.44	1.94	4.00	1.00	7.00	1.75	4.25
Turb (ntu)	8	0.87	1.19	0.42	0.02	3.63	0.24	0.99

Table 17: SGLR1 Task 3 Water Quality Summary 2007-2009

	N	Mean	SD	Median	Min	Max	25th%	75th%
Temp (oC)	63	23.32	0.36	23.14	22.99	24.21	23.05	23.51
pH	63	8.08	0.30	8.06	7.27	8.79	7.91	8.24
D.O. (mg/L)	63	4.42	1.42	4.31	2.51	8.22	3.18	5.12
Cond. (umhos/cm)	63	1965.5	63.4	1972.0	1822.0	2063.0	1926.5	2006.8
Depth (m)	63	0.95	0.34	0.95	0.33	1.95	0.70	1.10
Flow (m/sec)	63	0.11	0.13	0.05	0.00	0.50	0.00	0.20
Cover (%)	54	3.96	6.29	0.00	0.00	27.20	0.00	5.40
Alk (mg/L)	9	66.78	3.07	66.00	62.00	72.00	64.75	68.50
Color (cpu)	9	5.00	0.00	5.00	5.00	5.00	5.00	5.00
NH4-D (mg/L)	9	0.003	0.006	0.000	0.000	0.015	0.000	0.005
NOx-D (mg/L)	9	0.060	0.020	0.048	0.045	0.104	0.047	0.071
TKN (mg/L)	9	0.022	0.028	0.010	0.000	0.080	0.000	0.035
PO4-D (mg/L)	9	0.025	0.006	0.025	0.015	0.034	0.022	0.030
TP (mg/L)	9	0.029	0.008	0.027	0.015	0.041	0.025	0.036
TOC (mg/L)	9	0.19	0.20	0.16	0.01	0.67	0.08	0.23
TSS (mg/L)	9	1.91	1.96	1.20	0.00	5.00	0.00	4.00
Turb (ntu)	8	0.15	0.21	0.07	0.00	0.62	0.015	0.20

Table 18: Results of Spearman Correlation for WEKR1

Biological Parameter	Water Quality Parameter	Rho	p-value
BACIL Cells	TSS	-0.441	0.0073
CHLOR Cells	COVER	-0.480	0.0163
CHLOR Biovolume	TSS	-0.446	0.0067
CHLOR Biovolume	TOC	-0.423	0.0101
CYANO Cells	TSS	-0.493	0.0027
CYANO Biovolume	TSS	-0.514	0.0018
CYANO Biovolume	PO_4	-0.350	0.0334
RHODO Cells	TKN	-0.344	0.0366
RHODO Cells	TSS	-0.344	0.0422
RHODO Biovolume	TKN	-0.352	0.0323
TOTAL Cells	TSS	-0.529	0.0013
Chl-*a*	TURBIDITY	0.504	0.0001
Chl-*a*	TSS	-0.462	0.0002
Chl-*a*	PO_4	-0.317	0.0106
Chl-*a*	NH_4-D	0.256	0.0392
SEDIMENT chl-*a*	TP	-0.448	0.0450
SEDIMENT chl-*a*	TKN	0.440	0.0489
AFDW	TURBIDITY	0.315	0.0196
SEDIMENT AFDW	WATER TEMPERATURE	-.637	0.0044
SEDIMENT AFDW	CONDUCTIVITY	0.499	0.0257

Table 19: Results of Spearman Correlation for WEKR3

Biological Parameter	Water Quality Parameter	Rho	p-value
BACIL Cells	TKN	-0.503	0.0017
BACIL Cells	TOC	-0.482	0.0026
BACIL Cells	COLOR	-0.465	0.0037
BACIL Cells	pH	0.447	0.0255
BACIL Biovolume	PO_4	-0.343	0.0324
CHLOR Cells	WATER TEMPERATURE	0.675	0.0007
CHLOR Cells	CONDUCTIVITY	-0.528	0.0082
CHLOR Cells	D.O.	-0.515	0.0101
CHLOR Cells	TP	-0.389	0.0152
CHLOR Cells	TOC	-0.358	0.0255
CHLOR Biovolume	WATER TEMPERATURE	0.722	0.0003
CHLOR Biovolume	CONDUCTIVITY	-0.622	0.0019
CHLOR Biovolume	D.O.	-0.615	0.0021
CHLOR Biovolume	NO_x-D	-0.367	0.0218
CHLOR Biovolume	TP	-0.363	0.0234
CYANO Cells	WATER TEMPERATURE	0.532	0.0078
CYANO Cells	TP	-0.420	0.0088
CYANO Cells	CONDUCTIVITY	-0.410	0.0405
CYANO Biovolume	TP	-0.540	0.0007
CYANO Biovolume	WATER TEMPERATURE	0.576	0.0040
CYANO Biovolume	TOC	-0.434	0.0067
CYANO Biovolume	TKN	-0.366	0.0222
CYANO Biovolume	COLOR	-0.363	0.0236
RHODO Cells	TKN	0.555	0.0005
RHODO Cells	TOC	0.528	0.0010
RHODO Cells	TP	0.406	0.0113
RHODO Cells	COLOR	0.372	0.0202
RHODO Cells	NO_x-D	0.363	0.0235
RHODO Cells	WATER TEMPERATURE	-0.423	0.0343
RHODO Biovolume	TKN	0.559	0.0005
RHODO Biovolume	TOC	0.533	0.0009
RHODO Biovolume	TP	0.412	0.0101
RHODO Biovolume	COLOR	0.378	0.0182
RHODO Biovolume	NO_x-D	0.364	0.0232
RHODO Biovolume	WATER TEMPERATURE	-0.423	0.0343
TOTAL Cells	TOC	-0.405	0.0114
TOTAL Cells	TP	-0.394	0.0139
TOTAL Cells	WATER TEMPERATURE	0.483	0.0157
TOTAL Cells	COLOR	-0.357	0.0256
TOTAL Cells	TKN	-0.326	0.0415
Chl-*a*	TSS	0.241	0.0450

Table 20: Results of Spearman Correlation for RSR1

Biological Parameter	Water Quality Parameter	Rho	p-value
BACIL Biovolume	TURBIDITY	-0.368	0.0403
CHLOR Cells	ALKALINITY	-0.486	0.0041
CHLOR Cells	TSS	0.398	0.0186
CHLOR Cells	NO_x-D	0.381	0.0244
CHLOR Biovolume	CONDUCTIVITY	-0.595	0.0043
CHLOR Biovolume	TSS	0.481	0.0044
CHLOR Biovolume	ALKALINITY	-0.451	0.0076
CHLOR Biovolume	pH	0.505	0.0155
CYANO Cells	CONDUCTIVITY	-0.729	0.0005
CYANO Cells	TSS	0.440	0.0093
CYANO Cells	ALKALINITY	-0.405	0.0167
TOTAL Cells	CONDUCTIVITY	-0.698	0.0080
TOTAL Cells	ALKALINITY	-0.417	0.0136
TOTAL Cells	TSS	0.412	0.0149
Chl-*a*	ALKALINITY	-0.502	0.0001
Chl-*a*	NO_x-D	0.377	0.0035
Chl-*a*	COVER	0.423	0.0037
Chl-*a*	TURBIDITY	-0.344	0.0122
Chl-*a*	TSS	0.319	0.0134
Chl-*a*	PO_4	-0.280	0.0301
AFDW	COVER	0.502	0.0006
SEDIMENT AFDW	WATER FLOW	-0.524	0.0075
SEDIMENT AFDW	NO_x-D	-0.443	0.0239
SEDIMENT AFDW	TURBIDITY	0.436	0.0365
SEDIMENT AFDW	PO_4	0.379	0.0532

Table 21: Results of Spearman Correlation for RSR2

Biological Parameter	Water Quality Parameter	Rho	p-value
BACIL Cells	NO_x-D	0.397	0.0471
BACIL Biovolume	NO_x-D	0.551	0.0058
BACIL Biovolume	D.O.	0.494	0.0135
BACIL Biovolume	WATER TEMPERATURE	-0.489	0.0144
CYANO Cells	D.O.	-0.397	0.0470
CYANO Biovolume	CONDUCTIVITY	-0.484	0.0155
CYANO Biovolume	NO_x-D	0.464	0.0204
CYANO Biovolume	TSS	0.394	0.0488
TOTAL Cells	NO_x-D	0.409	0.0409
TOTAL Biovolume	NO_x-D	0.551	0.0058
TOTAL Biovolume	D.O.	0.494	0.0135
TOTAL Biovolume	WATER TEMPERATURE	-0.489	0.0144
Chl-*a*	PO_4	-0.403	0.0052
Chl-*a*	TURBIDITY	0.308	0.0460
SEDIMENT chl-*a*	NH_4-D	-0.492	0.0121
SEDIMENT chl-*a*	TKN	-0.418	0.0331
SEDIMENT chl-*a*	PH	0.404	0.0395
SEDIMENT chl-*a*	COLOR	-0.398	0.0422
AFDW	D.O.	0.342	0.0167
AFDW	CONDUCTIVITY	-0.293	0.0405
AFDW	PH	0.288	0.0441
SEDIMENT AFDW	WATER FLOW	-0.557	0.0045

Table 22: Results of Spearman Correlation for JUNC1

Biological Parameter	Water Quality Parameter	Rho	p-value
BACIL Cells	PO_4	-0.550	0.0004
BACIL Cells	TP	0.508	0.0012
BACIL Cells	D.O.	0.579	0.0032
BACIL Cells	TURBIDITY	0.333	0.0430
BACIL Biovolume	PO_4	-0.527	0.0007
BACIL Biovolume	TP	0.474	0.0024
BACIL Biovolume	D.O.	0.565	0.0040
BACIL Biovolume	TSS	-0.315	0.0437
CHLOR Cells	TURBIDITY	0.422	0.0103
CHLOR Biovolume	TURBIDITY	0.445	0.0068
CYANO Cells	TURBIDITY	0.496	0.0026
CYANO Cells	PO_4	-0.441	0.0047
CYANO Cells	TP	0.337	0.0309
CYANO Biovolume	D.O.	0.508	0.0096
CYANO Biovolume	PO_4	-0.398	0.0108
CYANO Biovolume	TP	0.338	0.0305
CYANO Biovolume	TURBIDITY	0.341	0.0382
RHODO Cells	WATER TEMPERATURE	-0.405	0.0388
RHODO Biovolume	WATER TEMPERATURE	-0.405	0.0388
TOTAL Cells	PO_4	-0.505	0.0012
TOTAL Cells	D.O.	0.565	0.0040
TOTAL Cells	TP	0.414	0.0080
TOTAL Cells	TURBIDITY	0.427	0.0094
TOTAL Cells	pH	0.385	0.0499
TOTAL Biovolume	TP	0.501	0.0014
TOTAL Biovolume	PO_4	-0.556	0.0040
TOTAL Biovolume	D.O.	0.558	0.0044
TOTAL Biovolume	TSS	-0.351	0.0245
TOTAL Biovolume	TURBIDITY	0.332	0.0437
Chl-*a*	TP	0.485	0.0022
Chl-*a*	PO_4	-0.415	0.0087
Chl-*a*	NO_x-D	-0.403	0.0107
Chl-*a*	TKN	-0.367	0.0201
AFDW	ALKALINITY	-0.334	0.0370
SEDIMENT AFDW	NH_4-D	-0.403	0.0441

Table 23: Results of Spearman Correlation for JUNC2

Biological Parameter	Water Quality Parameter	Rho	p-value
BACIL Cells	TSS	-0.549	0.0051
BACIL Cells	TOC	-0.538	0.0061
BACIL Cells	pH	0.455	0.0233
BACIL Biovolume	TOC	-0.545	0.0054
BACIL Biovolume	TSS	-0.543	0.0056
BACIL Biovolume	D.O.	0.415	0.0342
BACIL Biovolume	ALKALINITY	-0.390	0.0466
CHLOR Cells	PO_4	0.545	0.0055
CHLOR Cells	D.O.	-0.407	0.0380
CHLOR Biovolume	PO_4	0.540	0.0059
CHLOR Biovolume	NO_x-D	-0.490	0.0125
CHLOR Biovolume	D.O.	-0.450	0.0216
CHLOR Biovolume	COLOR	0.381	0.0523
CHLOR Biovolume	TKN	0.379	0.0531
CYANO Cells	D.O.	0.535	0.0064
CYANO Biovolume	D.O.	-0.554	0.0047
CYANO Biovolume	PO_4	0.460	0.0189
CYANO Biovolume	COLOR	0.410	0.0366
CYANO Biovolume	TKN	0.405	0.0387
TOTAL Biovolume	ALKALINITY	-0.601	0.0022
TOTAL Biovolume	TSS	-0.530	0.0069
TOTAL Biovolume	NO_x-D	-0.479	0.0146
AFDW	TOC	-0.510	0.0093
SEDIMENT AFDW	COLOR	-0.444	0.0264
SEDIMENT AFDW	TURBIDITY	-0.453	0.0334
SEDIMENT AFDW	TP	-0.401	0.0447
SEDIMENT AFDW	NH_4-D	0.390	0.0511

Table 24: Results of Spearman Correlation for ALXC1

Biological Parameter	Water Quality Parameter	Rho	p-value
BACIL Cells	CONDUCTIVITY	-0.526	0.0073
BACIL Biovolume	CONDUCTIVITY	-0.547	0.0053
BACIL Biovolume	TKN	0.339	0.0281
CHLOR Cells	TURBIDITY	0.421	0.0104
CHLOR Cells	COLOR	0.317	0.0397
CHLOR Biovolume	TURBIDITY	0.421	0.0104
CHLOR Biovolume	COLOR	0.343	0.0261
CYANO Cells	TURBIDITY	0.366	0.0258
CYANO Biovolume	TURBIDITY	0.394	0.0166
CYANO Biovolume	COLOR	0.307	0.0464
CYANO Biovolume	ALKALINITY	0.306	0.0473
TOTAL Biovolume	TKN	0.349	0.0237
TOTAL Biovolume	CONDUCTIVITY	-0.432	0.0276
Chl-*a*	NH_4-D	0.378	0.0017
Chl-*a*	TSS	-0.336	0.0053
Chl-*a*	COLOR	-0.260	0.0309
Chl-*a*	TOC	-0.251	0.0368
Chl-*a*	CONDUCTIVITY	-0.273	0.0467
AFDW	NH_4-D	0.259	0.0342
AFDW	TSS	-0.248	0.0426

Table 25A: Results of Spearman Correlation for ALXC2

Biological Parameter	Water Quality Parameter	Rho	p-value
BACIL Cells	TOC	-0.646	0.0010
BACIL Cells	TKN	-0.626	0.0014
BACIL Cells	COLOR	-0.582	0.0030
BACIL Cells	D.O.	0.570	0.0036
BACIL Cells	pH	0.549	0.0052
BACIL Cells	TURBIDITY	-0.573	0.0060
BACIL Cells	ALKALINITY	0.505	0.0101
BACIL Cells	CONDUCTIVITY	0.402	0.0402
BACIL Biovolume	TKN	-0.569	0.0037
BACIL Biovolume	D.O.	0.489	0.0126
BACIL Biovolume	TURBIDITY	-0.520	0.0126
BACIL Biovolume	TOC	-0.486	0.0132
BACIL Biovolume	COLOR	-0.424	0.0305
BACIL Biovolume	CONDUCTIVITY	0.396	0.0435
BACIL Biovolume	ALKALINITY	0.396	0.0435
CYANO Cells	COLOR	-0.422	0.0316
CYANO Cells	pH	0.421	0.0319
CYANO Cells	ALKALINITY	0.409	0.0371
CYANO Cells	TOC	-0.392	0.0455
CYANO Biovolume	CONDUCTIVITY	0.425	0.0301
CYANO Biovolume	pH	0.401	0.0407
CYANO Biovolume	ALKALINITY	0.394	0.0445
TOTAL Cells	pH	0.481	0.0142
TOTAL Cells	COLOR	-0.481	0.0142
TOTAL Cells	ALKALINITY	0.451	0.0214
TOTAL Cells	TOC	-0.449	0.0219
TOTAL Biovolume	TKN	-0.556	0.0046
TOTAL Biovolume	TOC	-0.534	0.0065
TOTAL Biovolume	D.O.	0.531	0.0068
TOTAL Biovolume	COLOR	-0.485	0.0133
TOTAL Biovolume	pH	0.478	0.0148
TOTAL Biovolume	TURBIDITY	-0.478	0.0218
TOTAL Biovolume	ALKALINITY	0.448	0.0225
TOTAL Biovolume	CONDUCTIVITY	0.442	0.0241
TOTAL Biovolume	COVER	-0.399	0.0419

Table 25B: Results of Spearman Correlation for ALXC2

Biological Parameter	Water Quality Parameter	Rho	p-value
SEDIMENT chl-*a*	COVER	-0.534	0.0544
SEDIMENT chl-*a*	NO_x-D	0.582	0.0357
SEDIMENT chl-*a*	TKN	-0.538	0.0526
AFDW	WATER FLOW	0.376	0.0085
SEDIMENT AFDW	TKN	0.718	0.0097
SEDIMENT AFDW	CONDUCTIVITY	-0.675	0.0150
SEDIMENT AFDW	PO_4	-0.647	0.0197
SEDIMENT AFDW	WATER TEMPERATURE	0.610	0.0278
SEDIMENT AFDW	D.O	-0.537	0.0529

Table 26: Results of Spearman Correlation for SGLR1

Biological Parameter	Water Quality Parameter	Rho	p-value
BACIL Cells	TURBIDITY	0.327	0.0470
CHLOR Cells	NO_x-D	-0.471	0.0026
CHLOR Cells	PO_4	0.444	0.0044
CHLOR Cells	TSS	0.399	0.0107
CHLOR Cells	COVER	-0.426	0.0298
CHLOR Cells	TURBIDITY	0.330	0.0445
CHLOR Biovolume	PO_4	0.425	0.0065
CHLOR Biovolume	NO_x-D	-0.412	0.0083
CHLOR Biovolume	COVER	-0.482	0.0140
CHLOR Biovolume	TSS	0.378	0.0156
CHLOR Biovolume	CONDUCTIVITY	-0.470	0.0165
CHLOR Biovolume	WATER TEMPERATURE	0.384	0.0503
CYANO Cells	WATER TEMPERATURE	0.449	0.0222
CYANO Cells	CONDUCTIVITY	-0.446	0.0230
CYANO Cells	WATER FLOW	-0.413	0.0352
CYANO Cells	PO_4	0.301	0.0538
RHODO Cells	NH_4-D	0.326	0.0368
RHODO Biovolume	NH_4-D	0.326	0.0386
TOTAL Cells	PO_4	0.362	0.0206
TOTAL Cells	NO_x-D	-0.343	0.0280
TOTAL Cells	TURBIDITY	0.343	0.0368
TOTAL Biovolume	COVER	-0.438	0.0255
TOTAL Biovolume	TP	0.316	0.0432
Chl-*a*	TP	0.478	0.0025
Chl-*a*	ALKALINITY	-0.475	0.0027
Chl-*a*	COVER	-0.545	0.0064

Fig. 31: Dissolved Oxygen At Select Segments

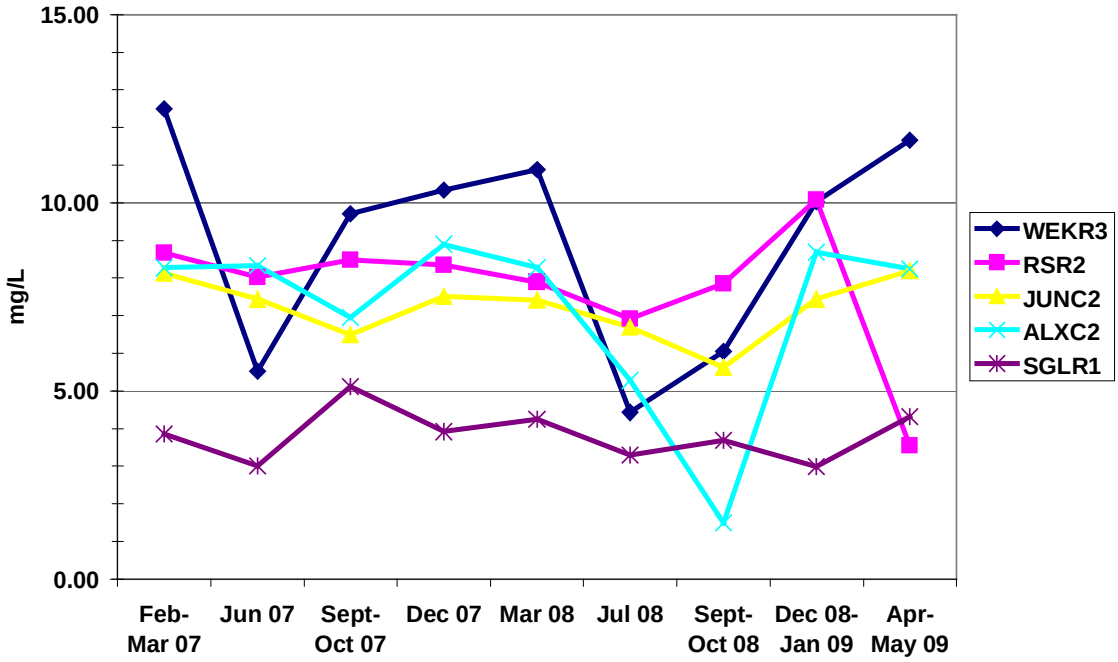

Fig. 32: Conductivity At Select Segments

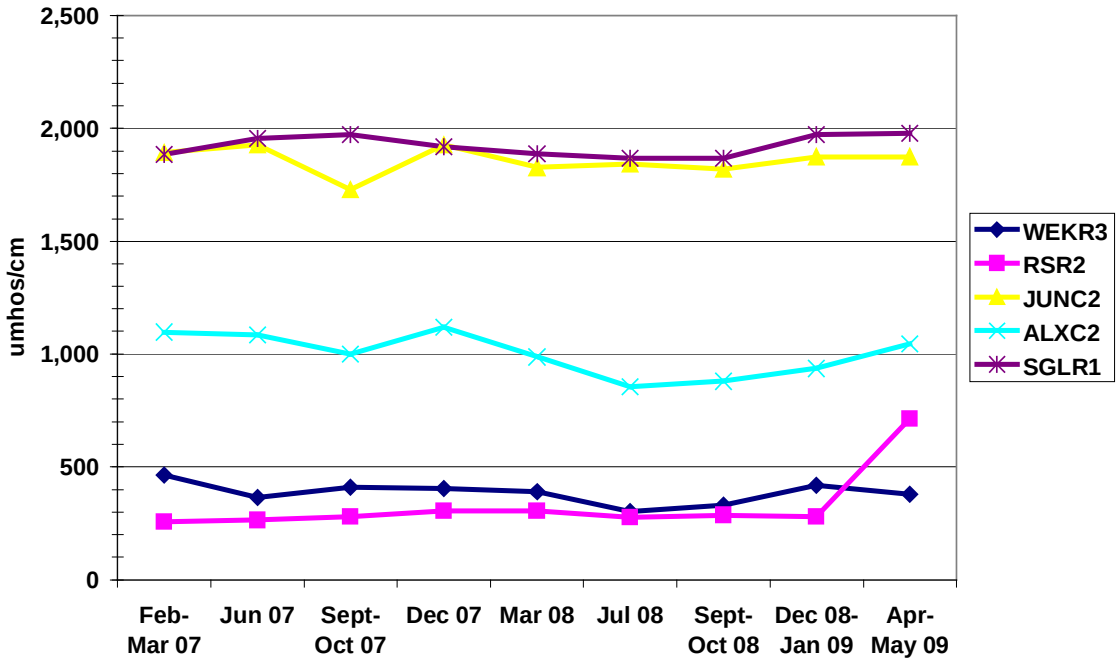

Fig. 33: Color At Select Segments

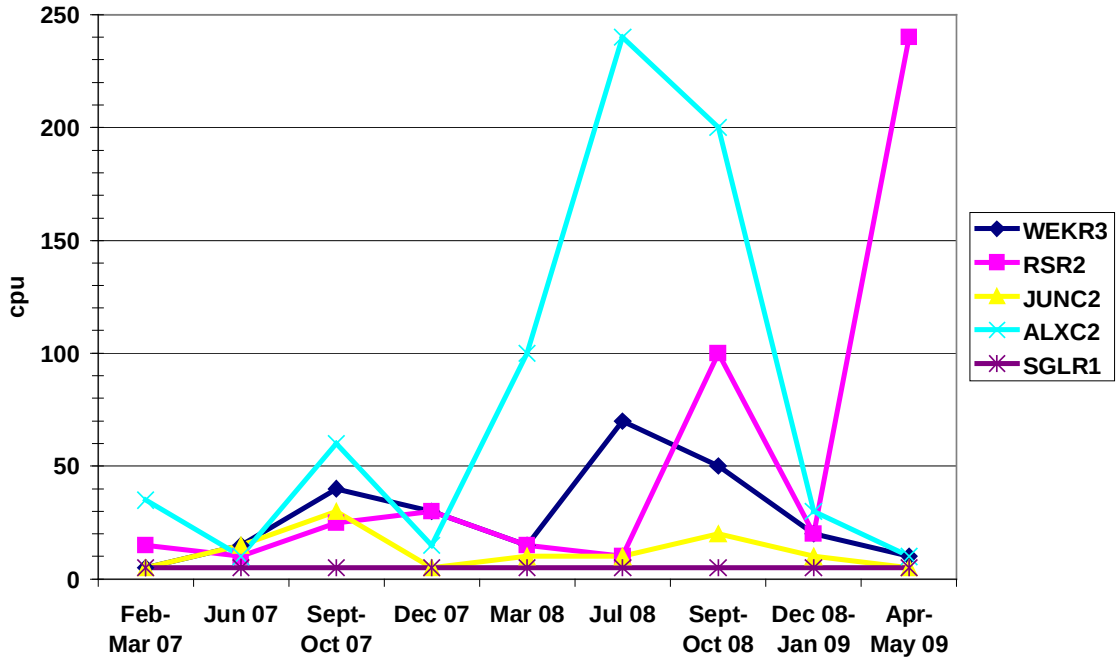

Fig. 34: NO_x At Select Segments

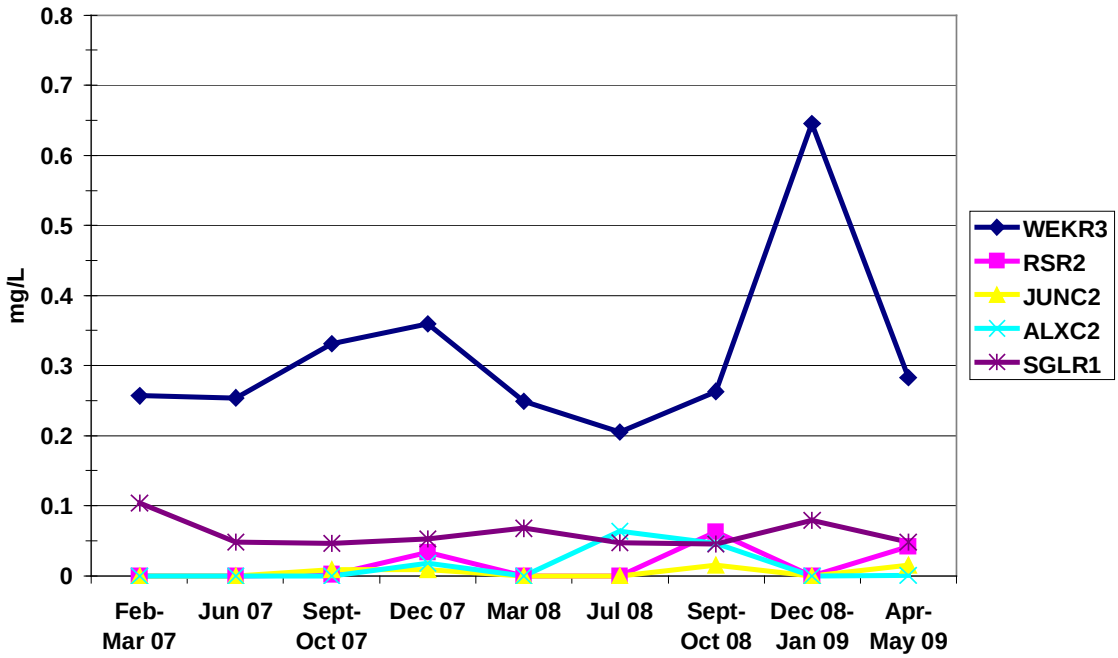

Fig. 35: Total Phosphorus (TP) At Select Segments

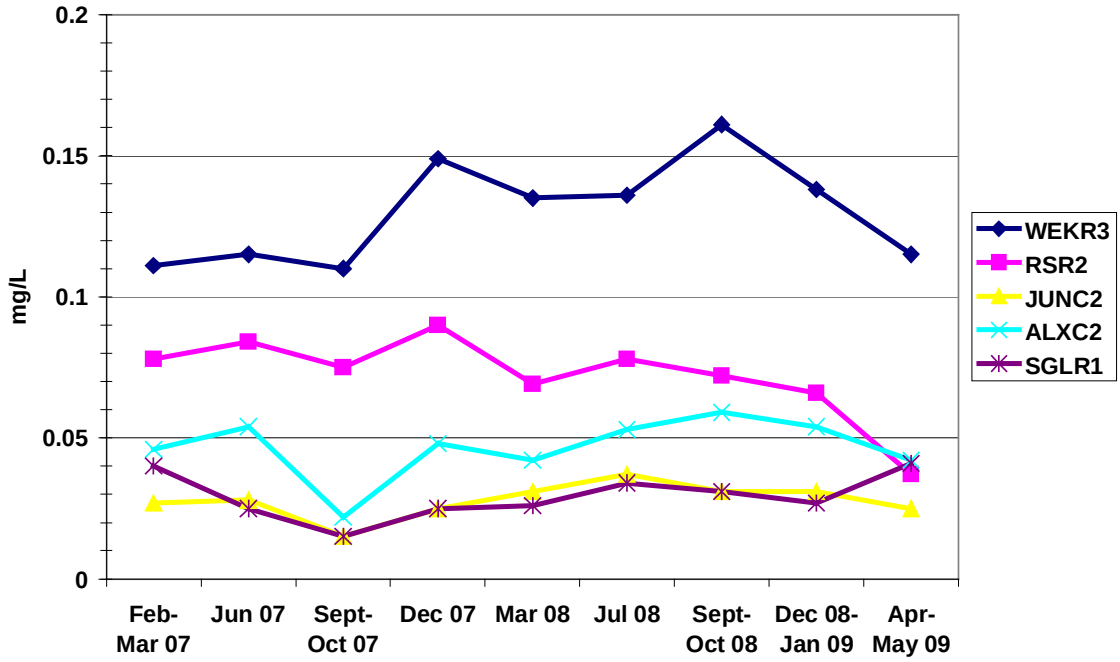

Fig. 36: Number of Species Per Substrate: All Sites

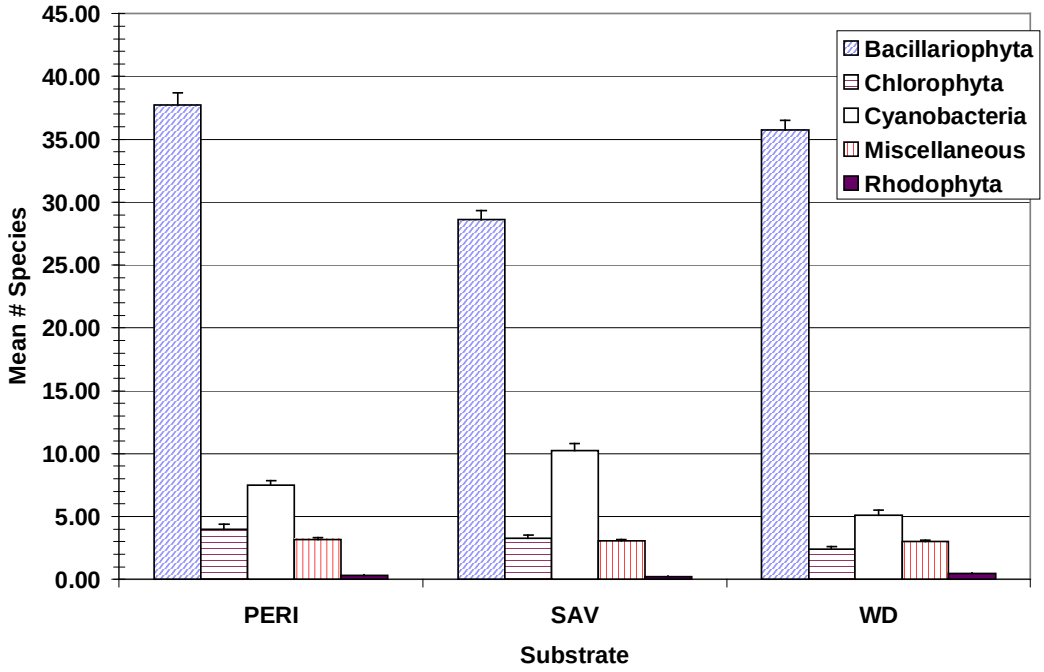

Fig. 37: WEKR Species Number Per Substrate

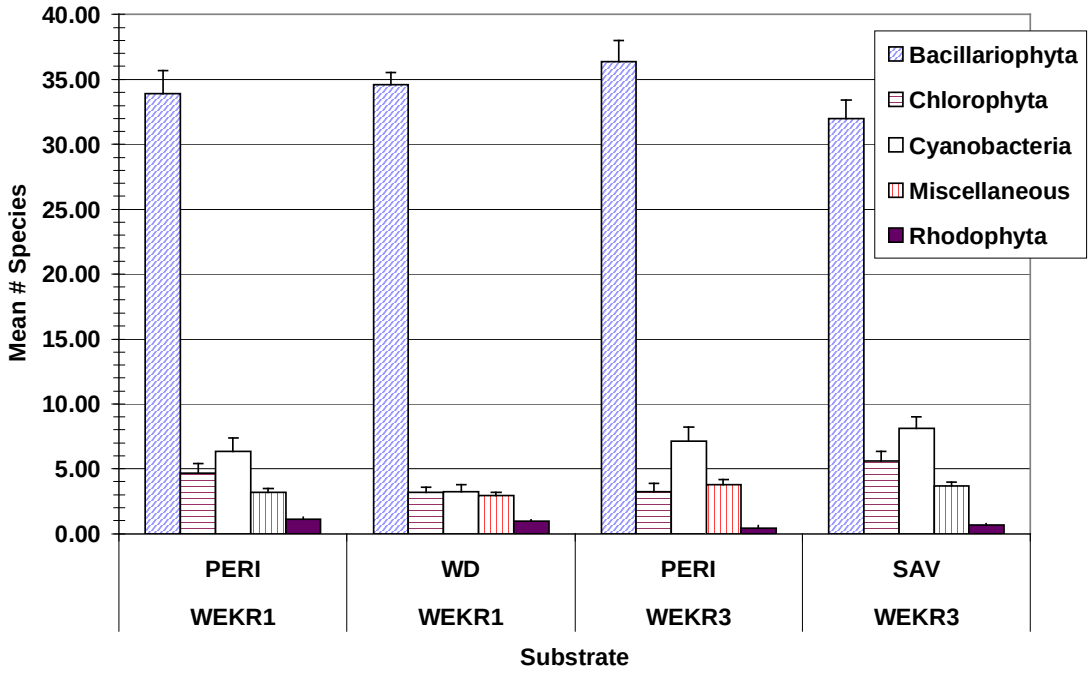

Fig. 38: WEKR1 PERI Taxa Richness by Group

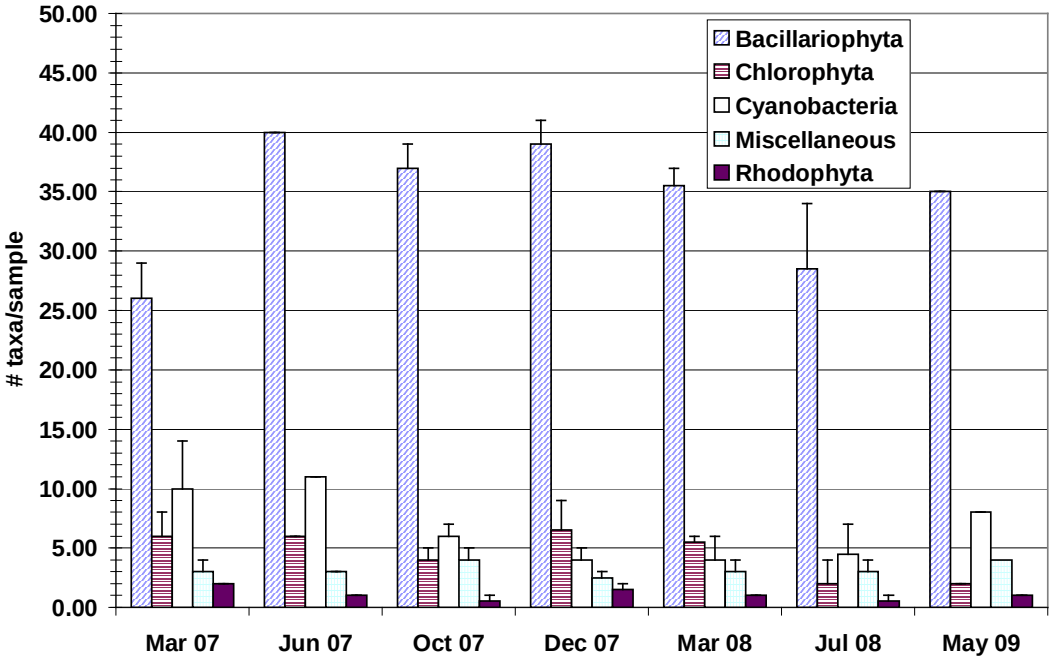

Fig. 39: WEKR1 WD Taxa Richness by Group

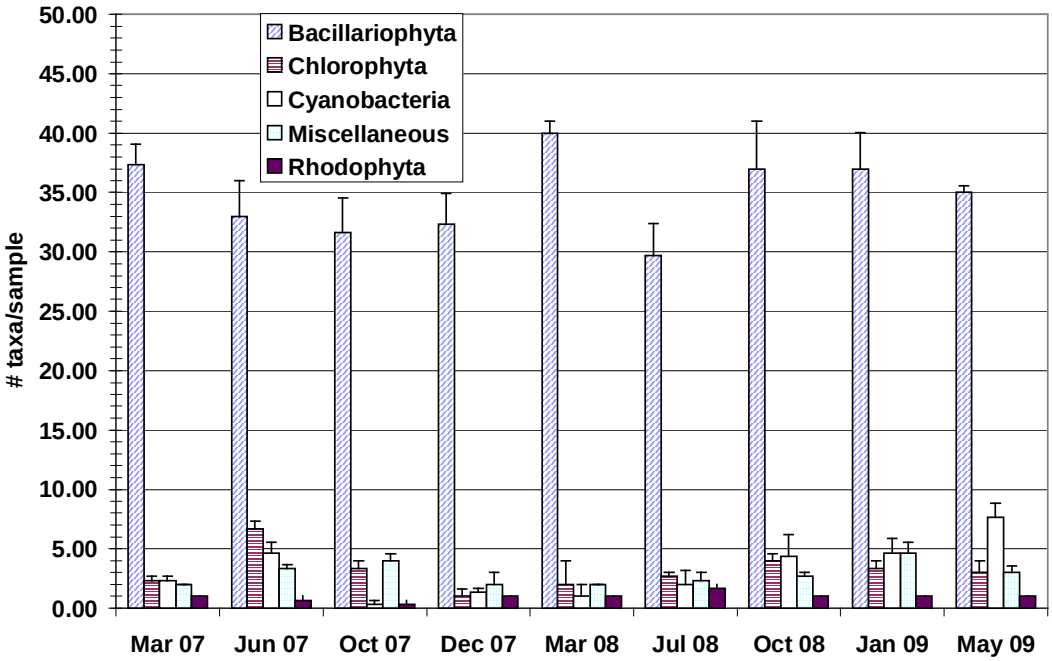

Fig. 40: WEKR3 PERI Taxa Richness by Group

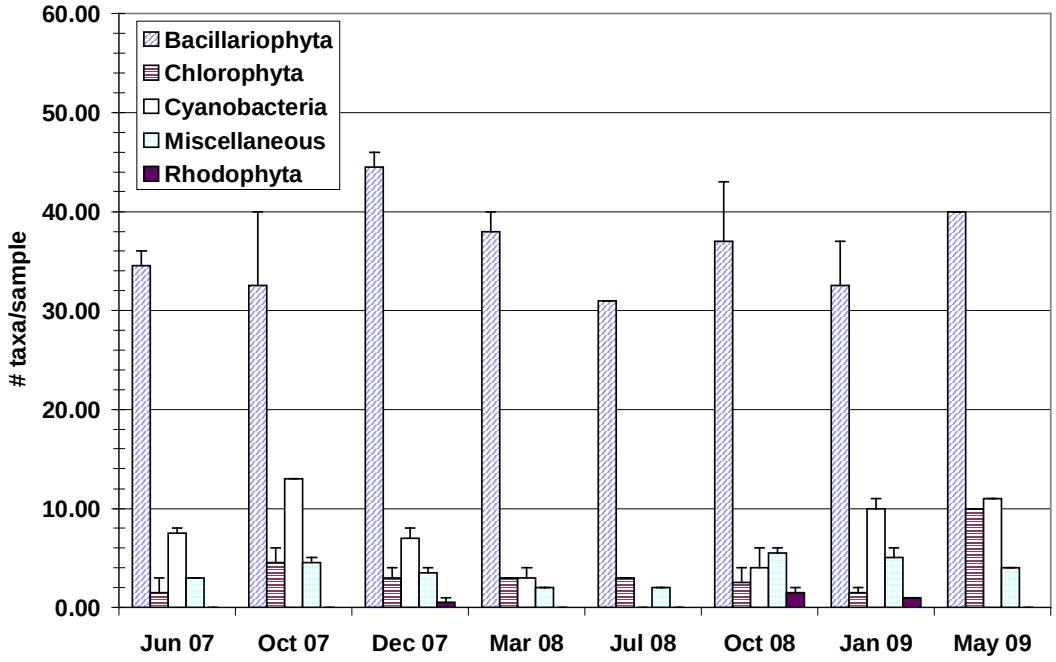

Fig. 41: WEKR3 SAV Taxa Richness by Group

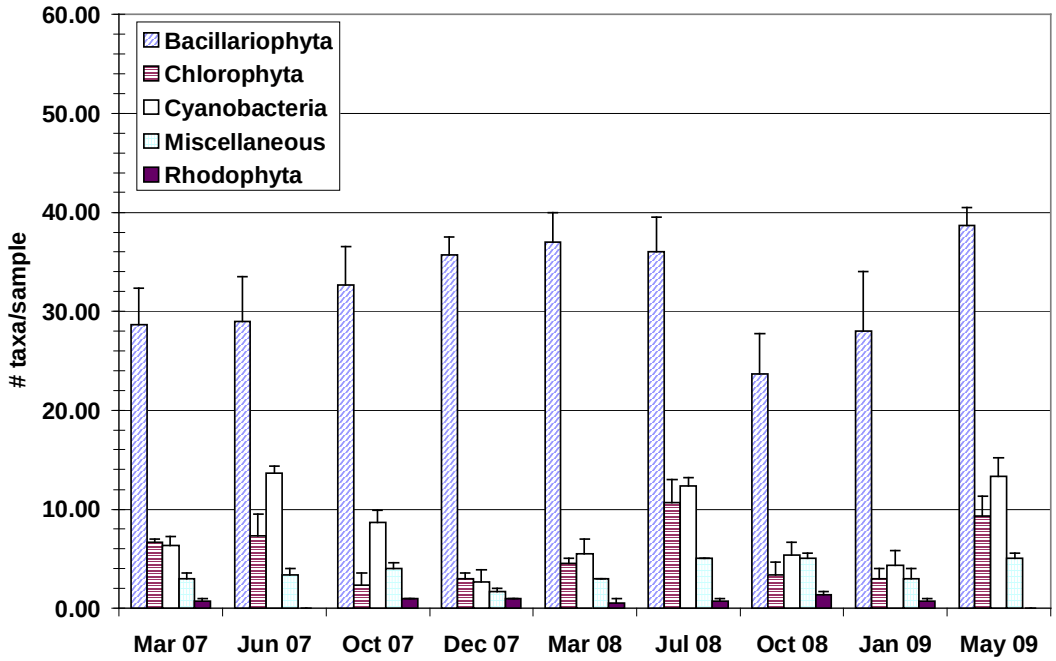

Fig. 42: WEKR Total Taxa Richness

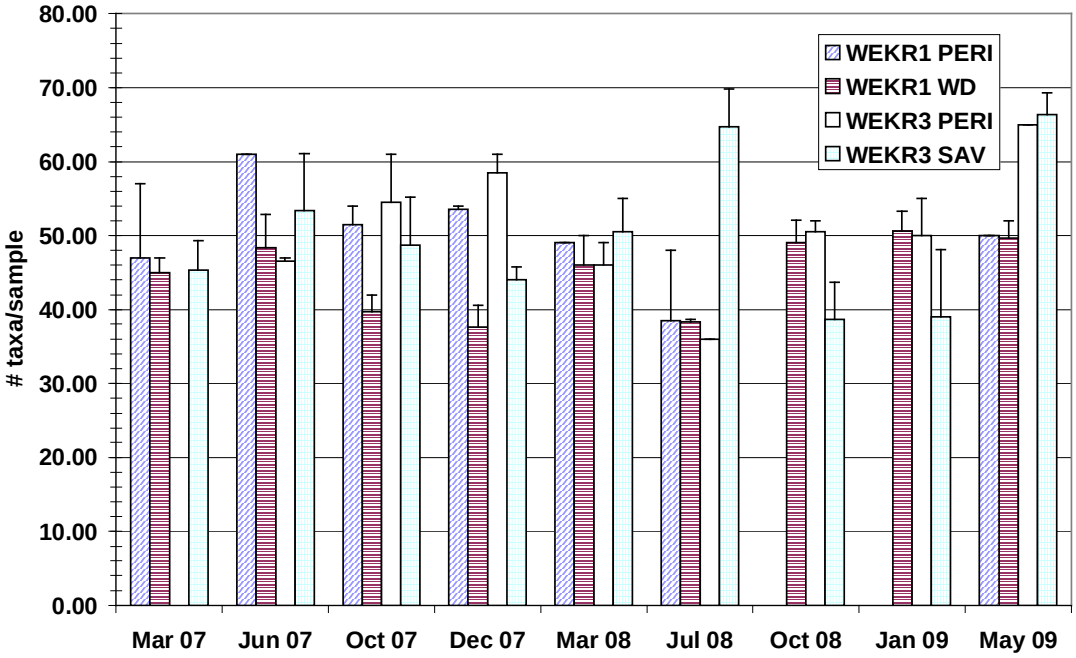

Fig. 43: RSR Species Number Per Substrate

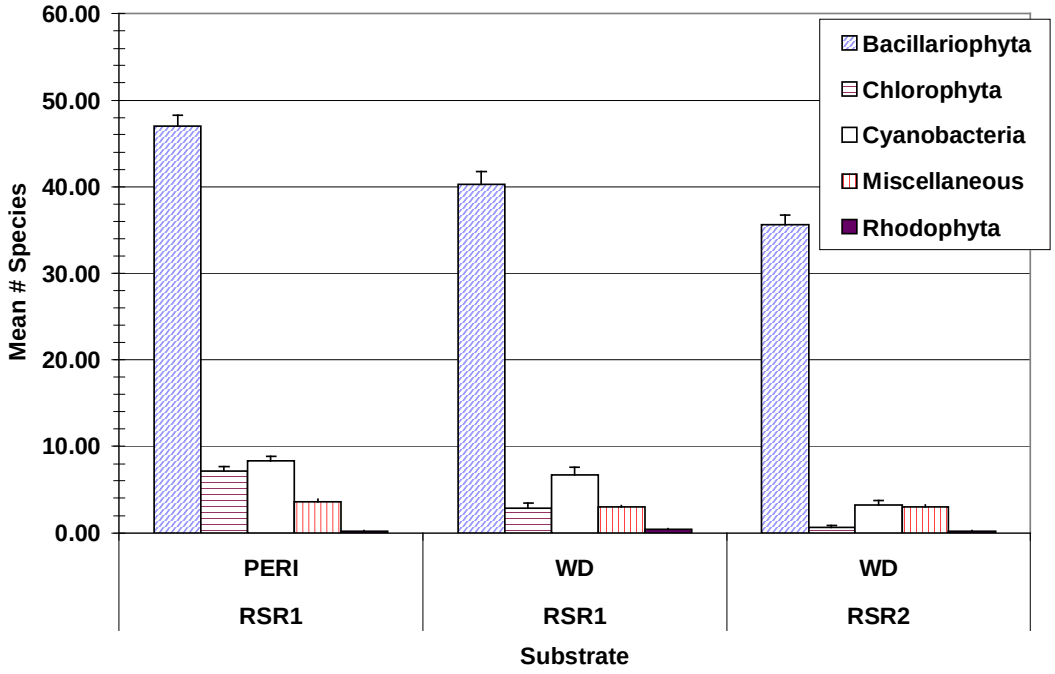

Fig. 44: RSR1 PERI Taxa Richness by Group

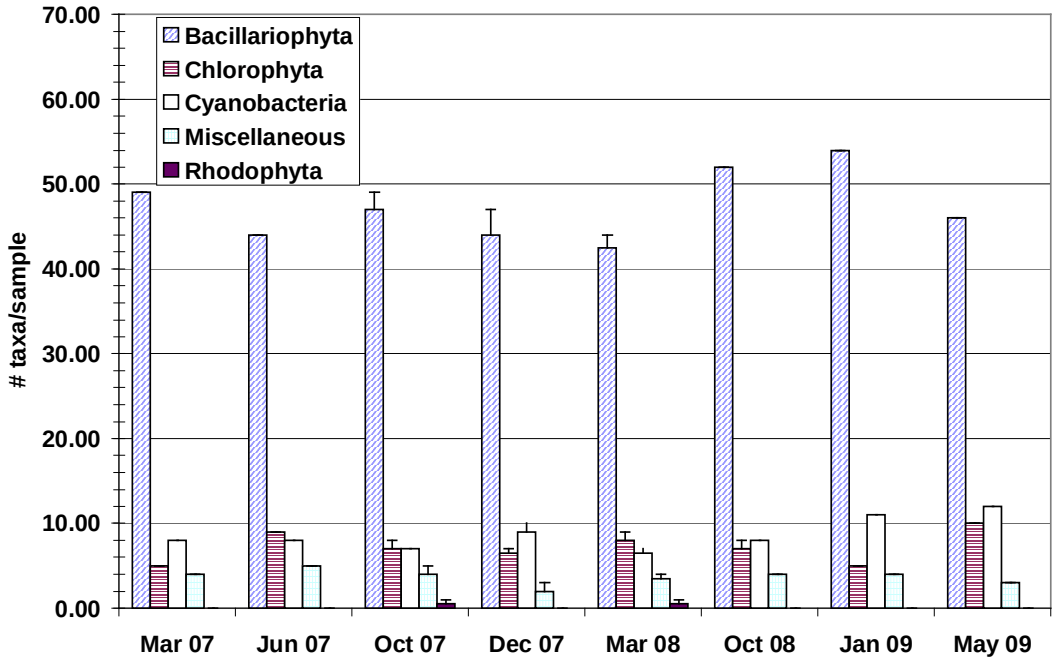

Fig. 45: RSR1 WD Taxa Richness by Group

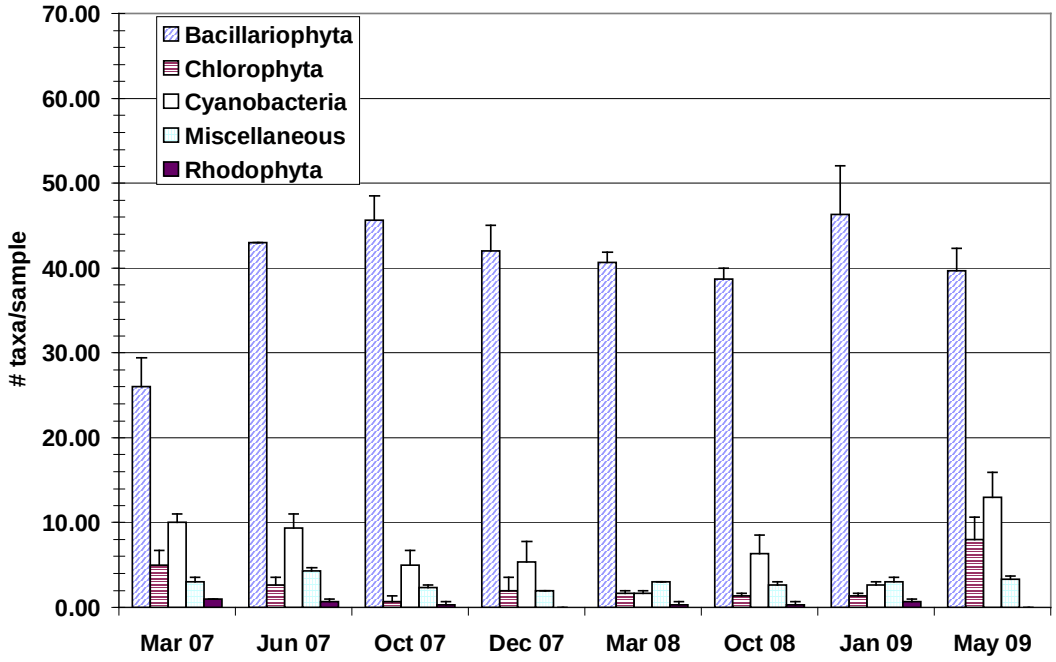

Fig. 46: RSR2 WD Taxa Richness by Group

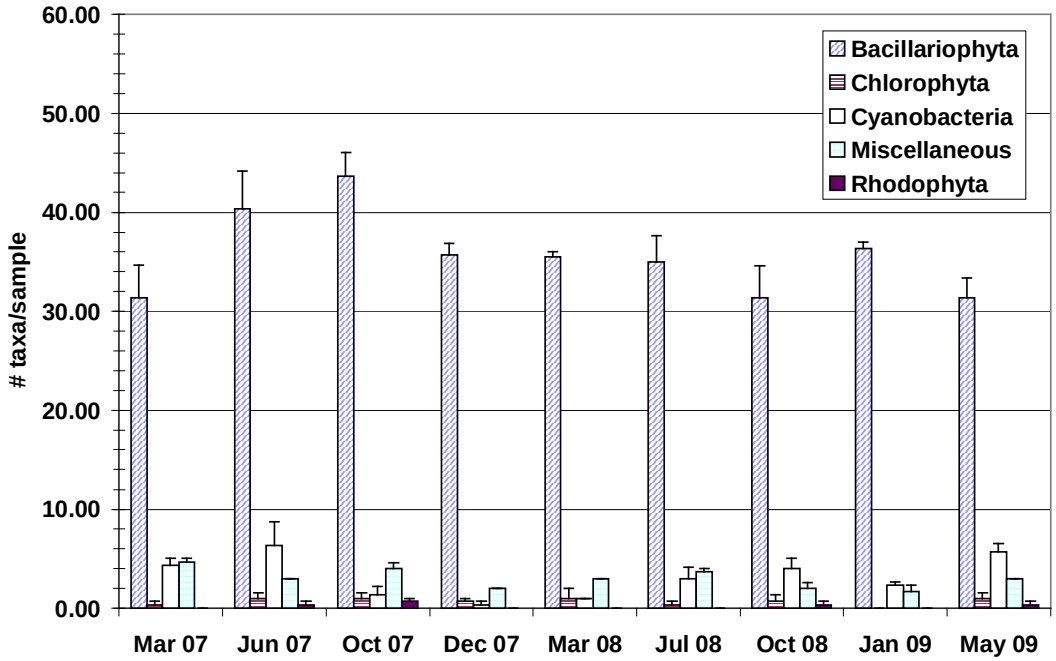

Fig. 47: RSR Total Taxa Richness

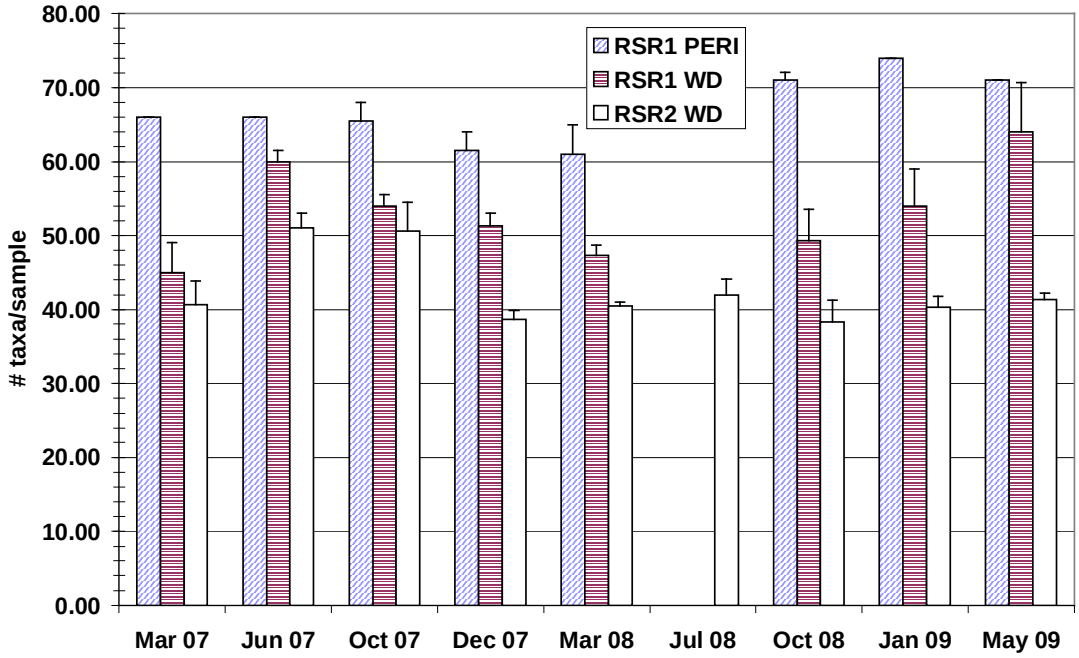

Fig. 48: JUNC Species Number Per Substrate

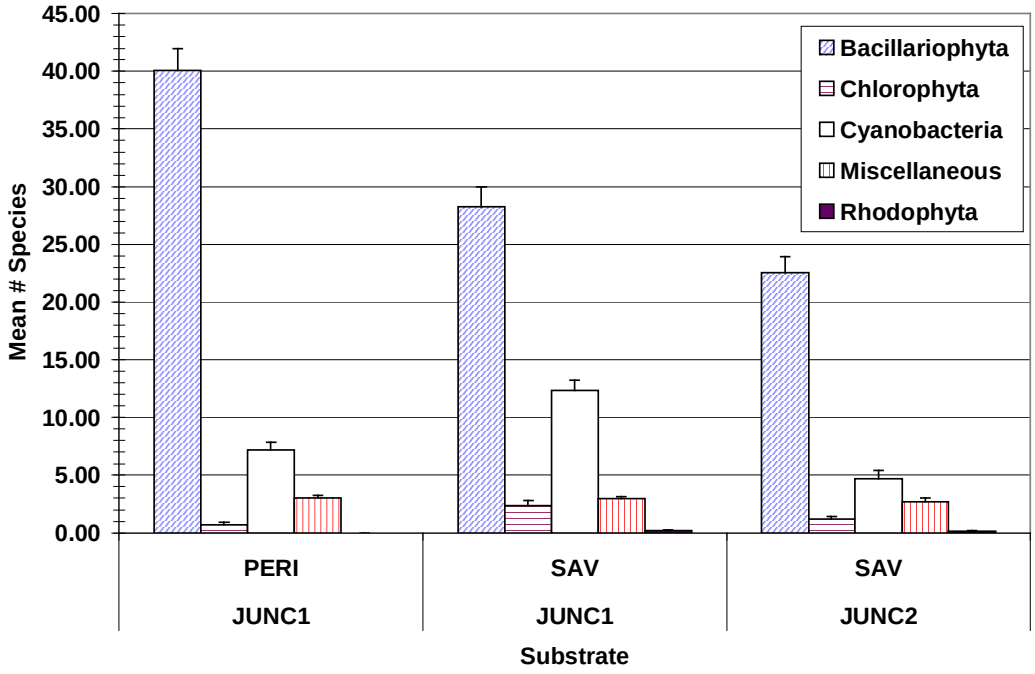

Fig. 49: JUNC1 PERI Taxa Richness by Group

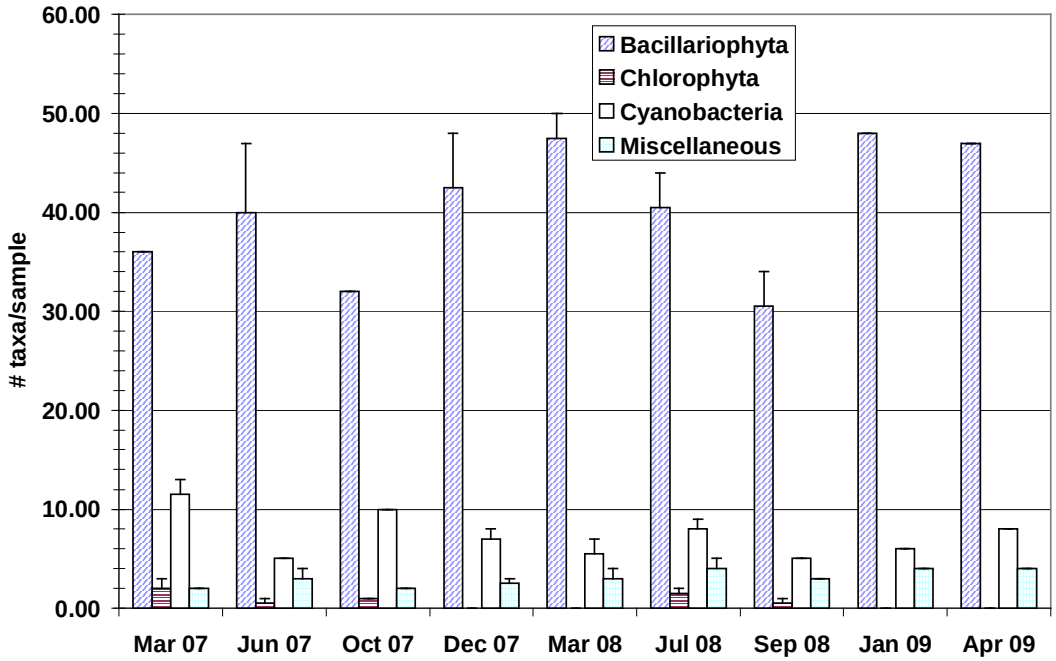

Fig. 50: JUNC1 SAV Taxa Richness by Group

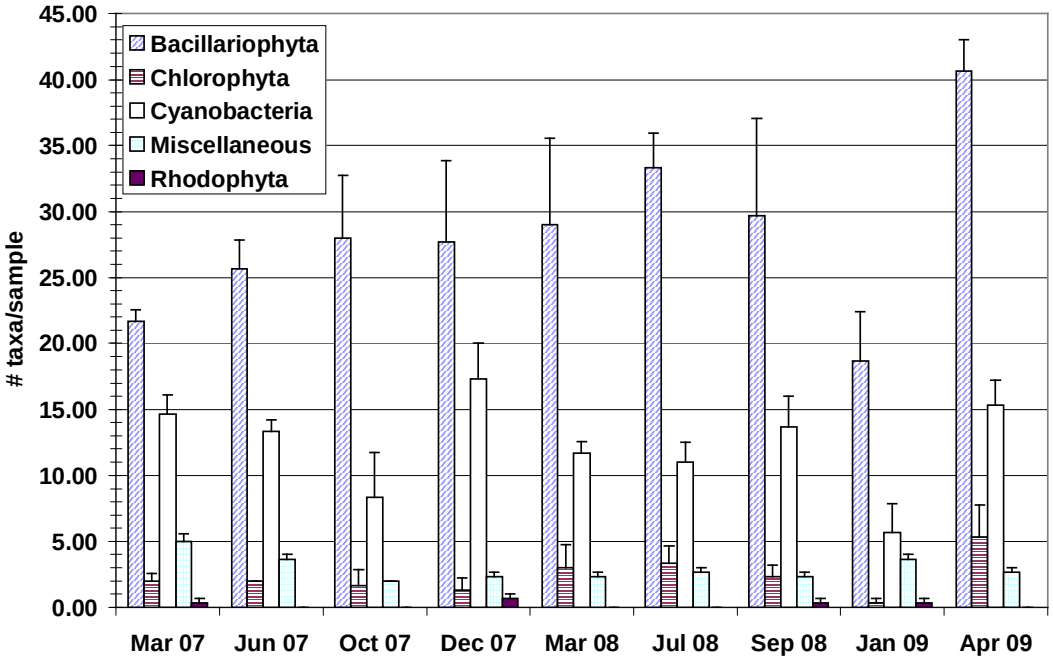

Fig. 51: JUNC2 SAV Taxa Richness by Group

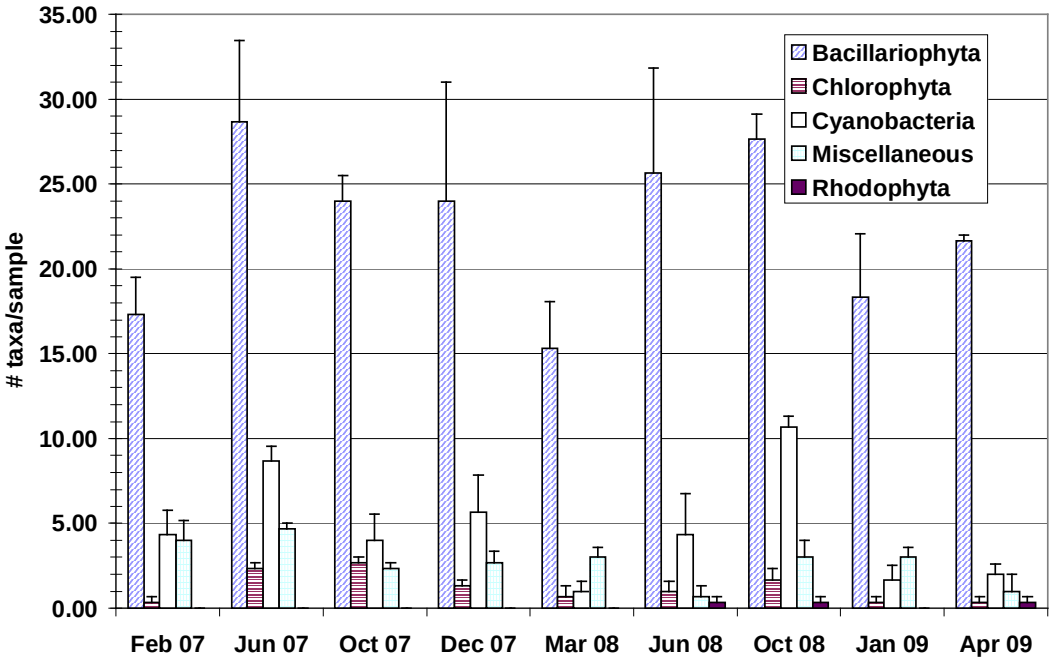

Fig. 52: JUNC Total Taxa Richness

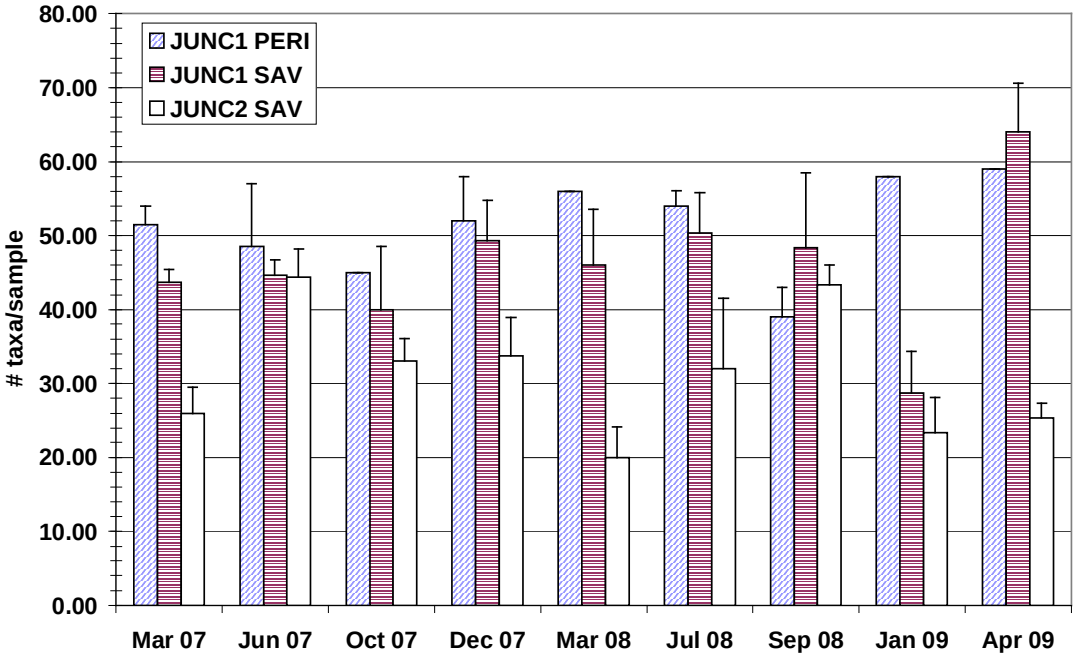

Fig. 53: ALXC Species Number Per Substrate

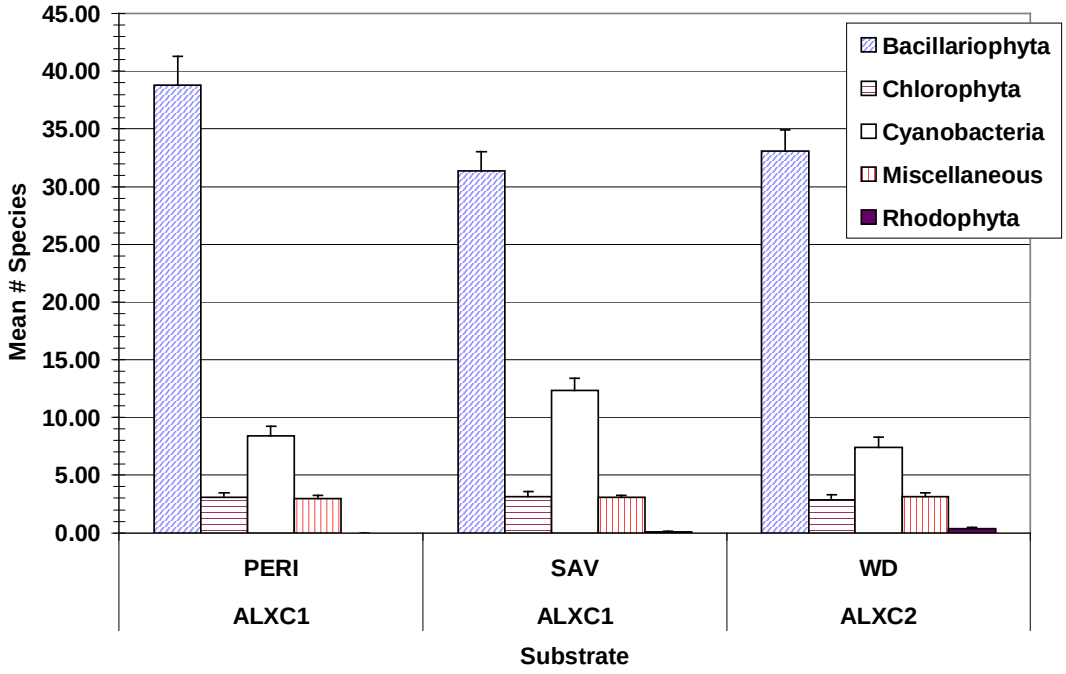

Fig. 54: ALXC1 PERI Taxa Richness by Group

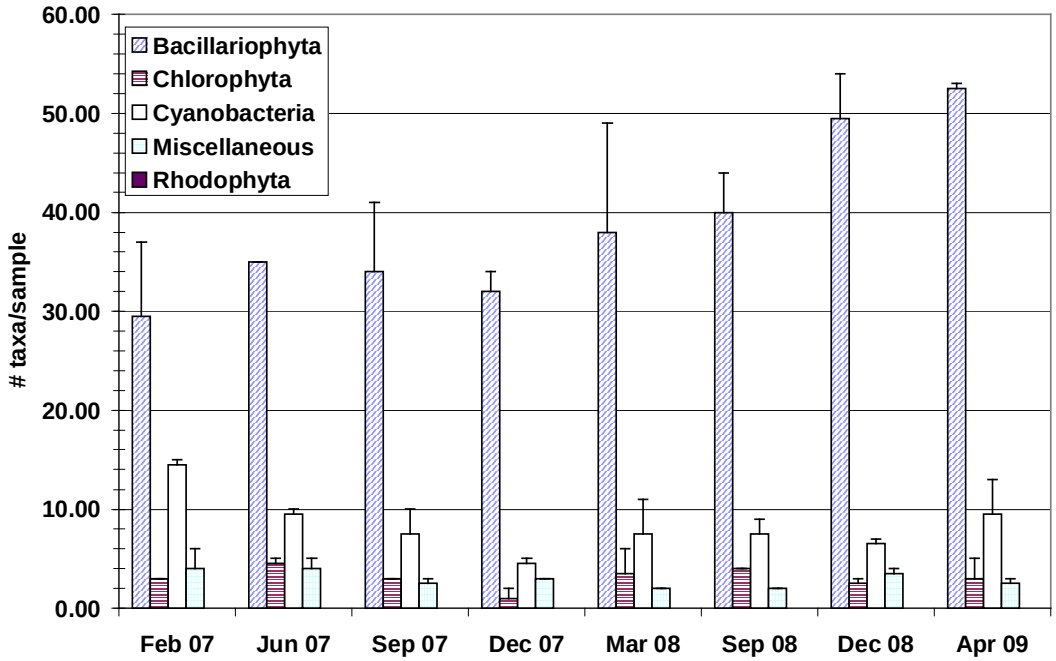

Fig. 55: ALXC1 SAV Taxa Richness by Group

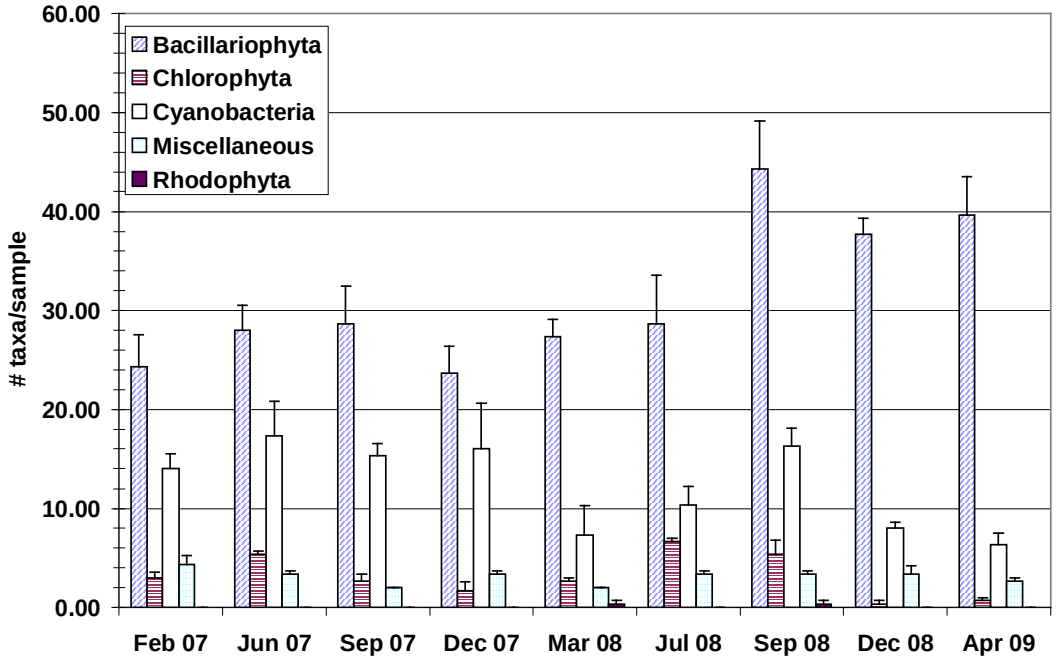

Fig. 56 ALXC2 WD Taxa Richness by Group

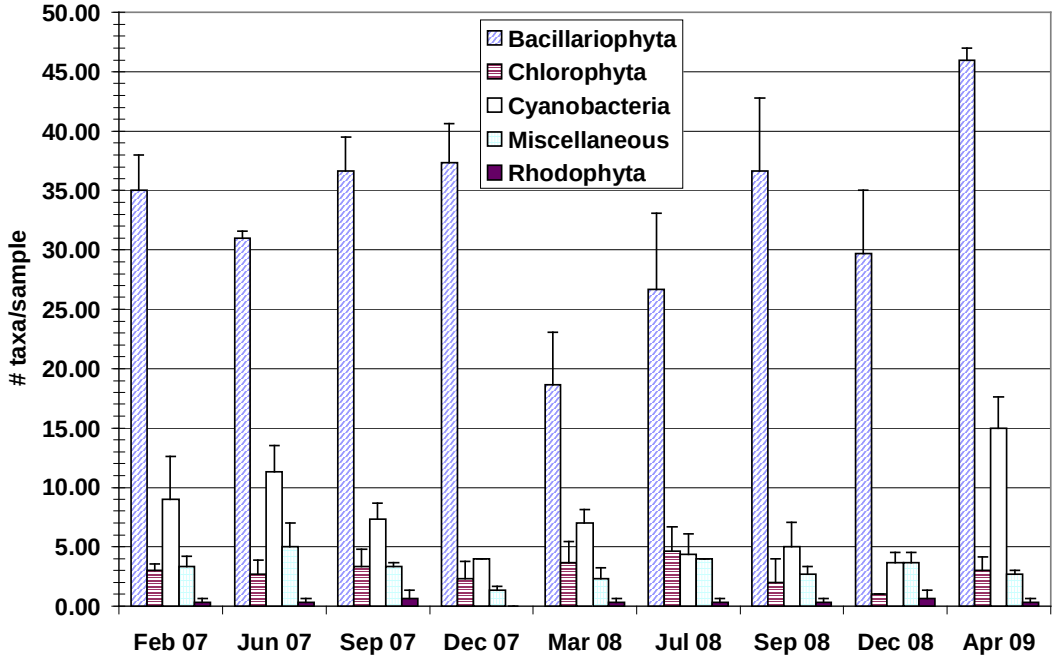

Fig. 57: ALXC Total Taxa Richness

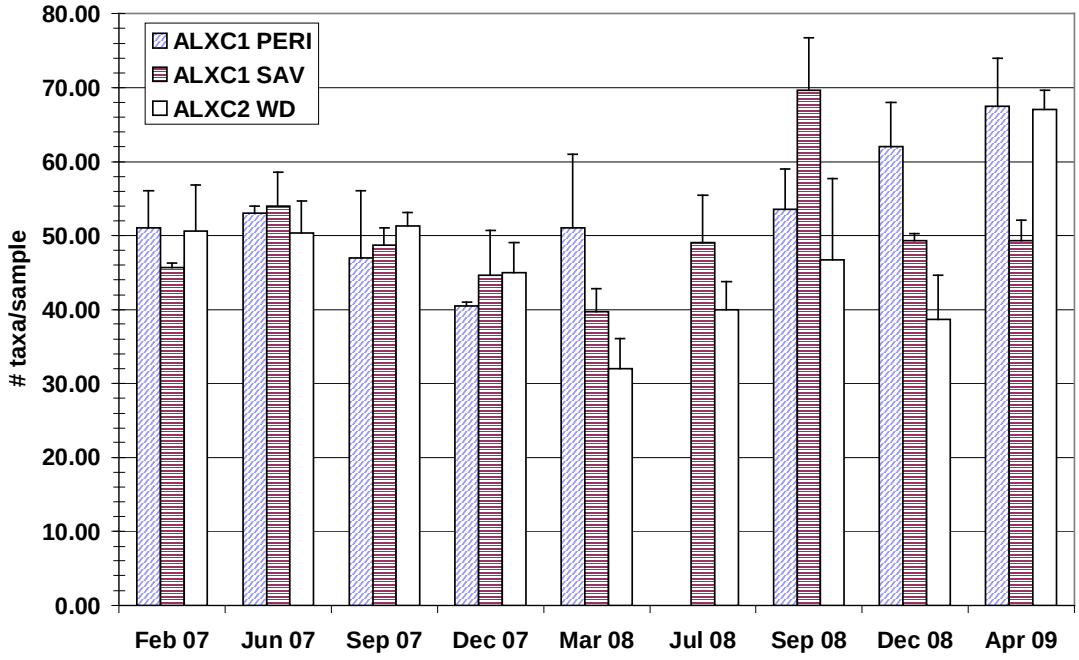

Fig. 58: SGLR Species Number Per Substrate

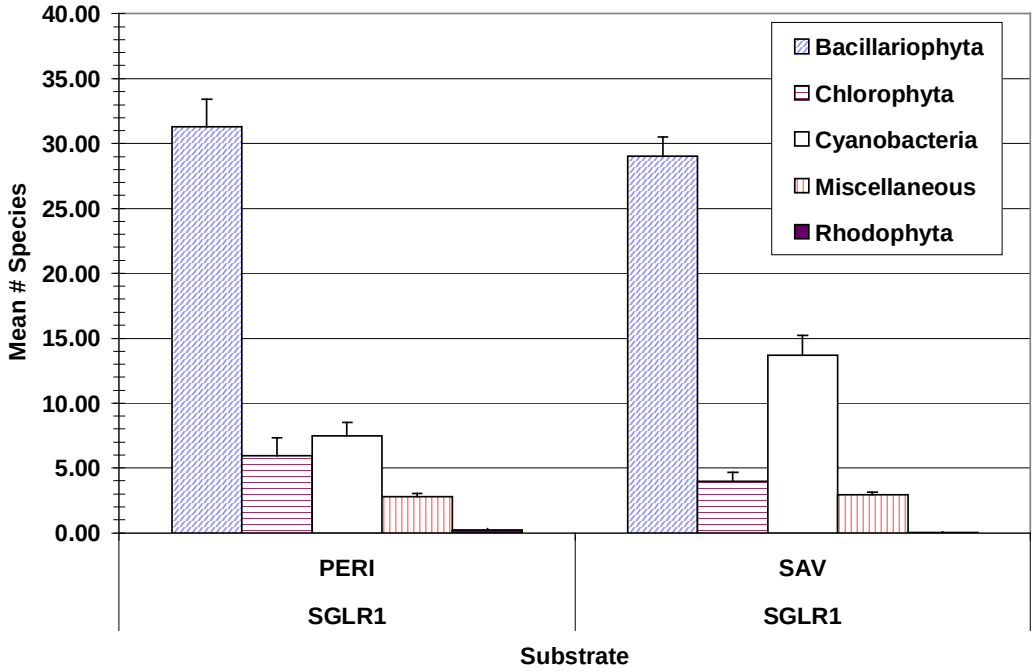

Fig. 59: SGLR1 PERI Taxa Richness by Group

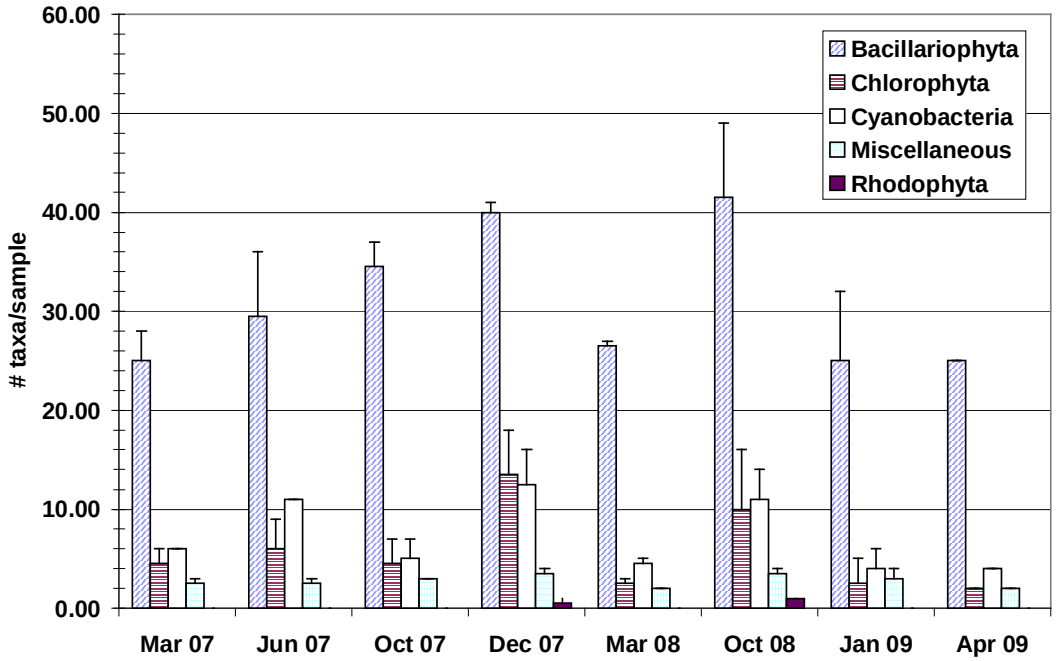

Fig. 60: SGLR1 SAV Taxa Richness by Group

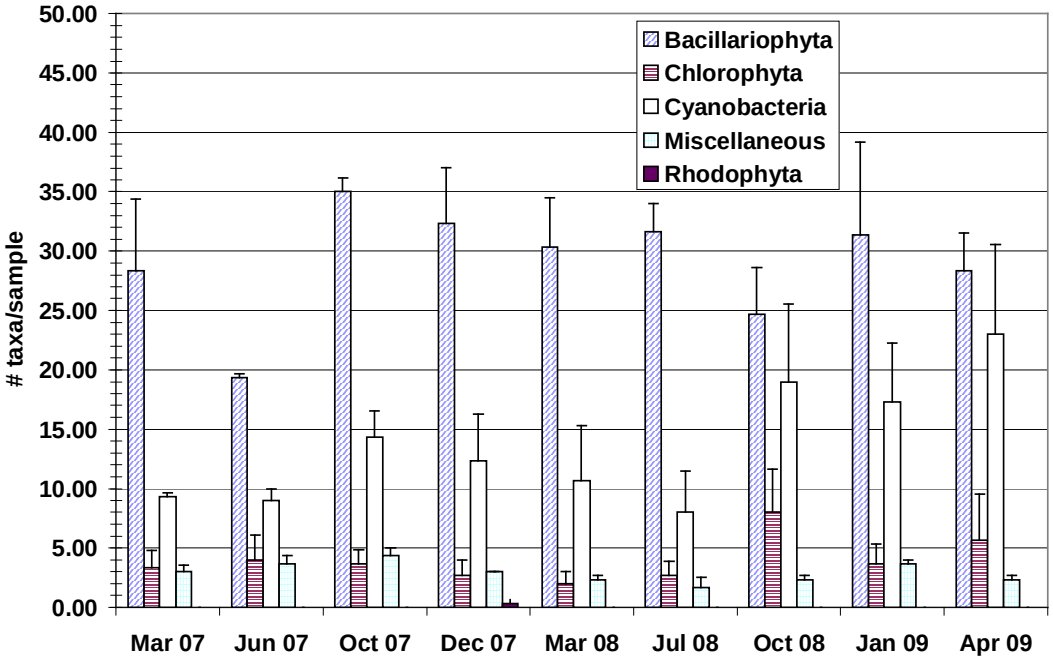

Fig. 61: SGLR Total Taxa Richness

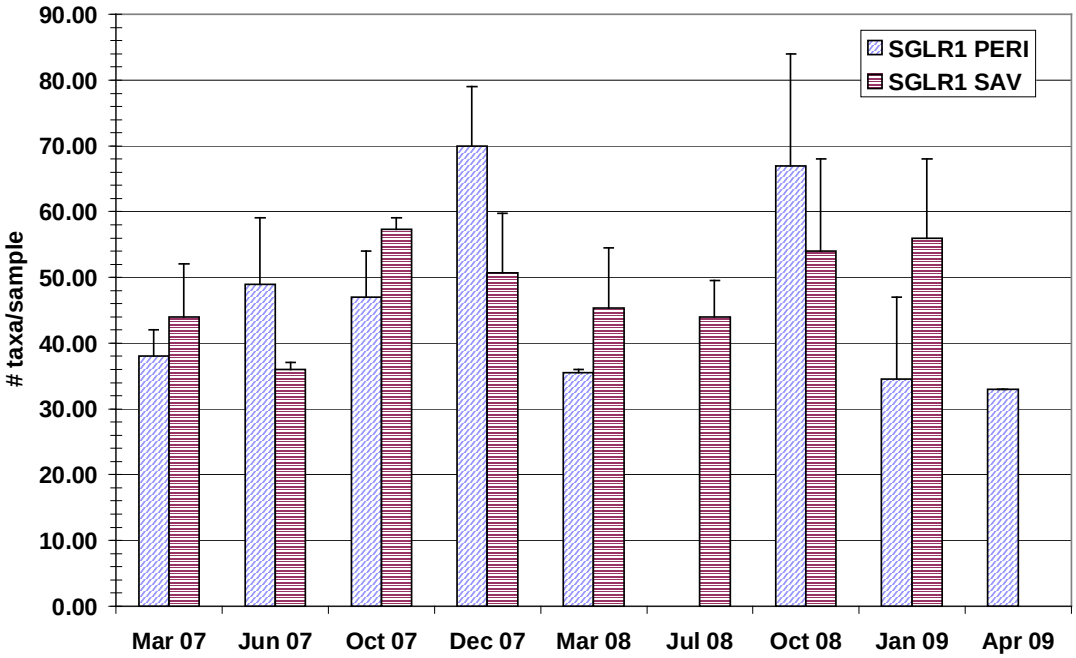

Fig. 62: WEKR Cell Number

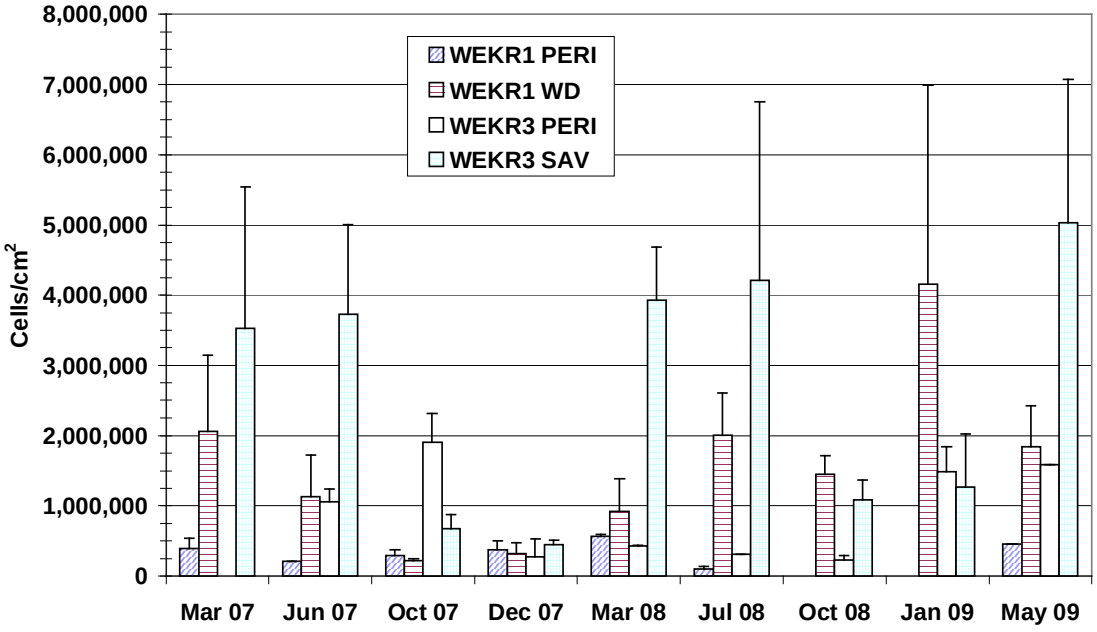

Fig. 63: RSR Cell Number

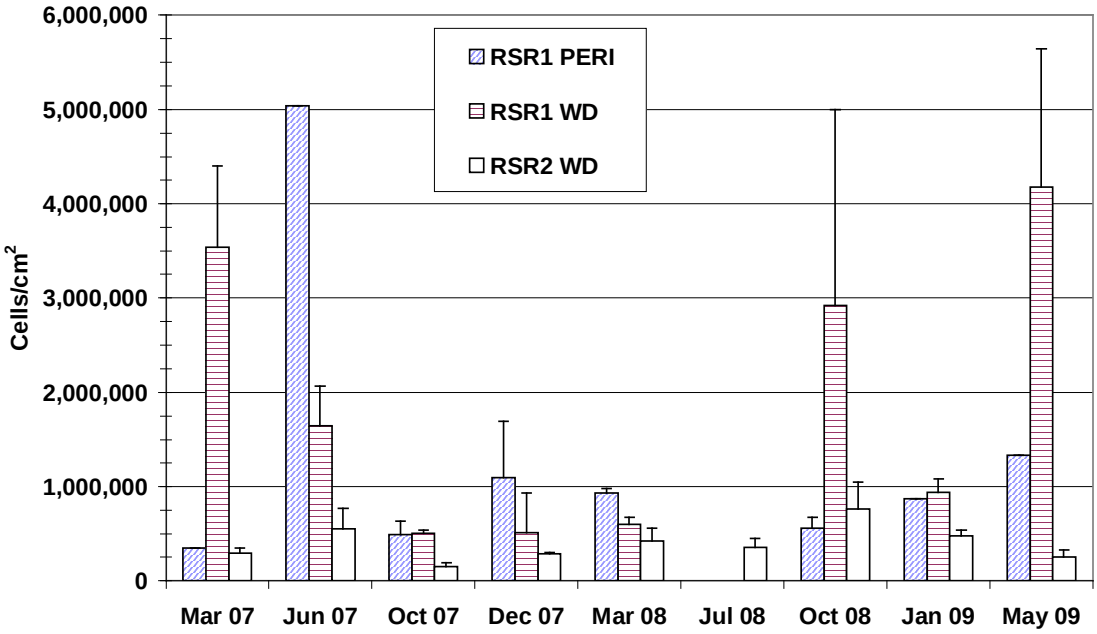

Fig. 64: JUNC Cell Number

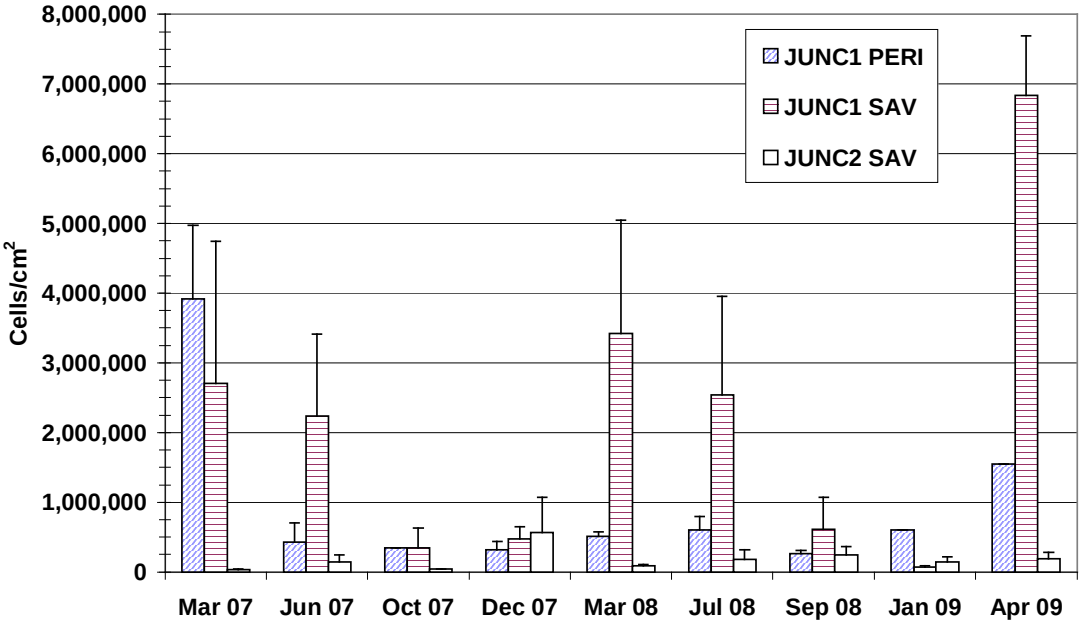

Fig. 65: ALXC Cell Number

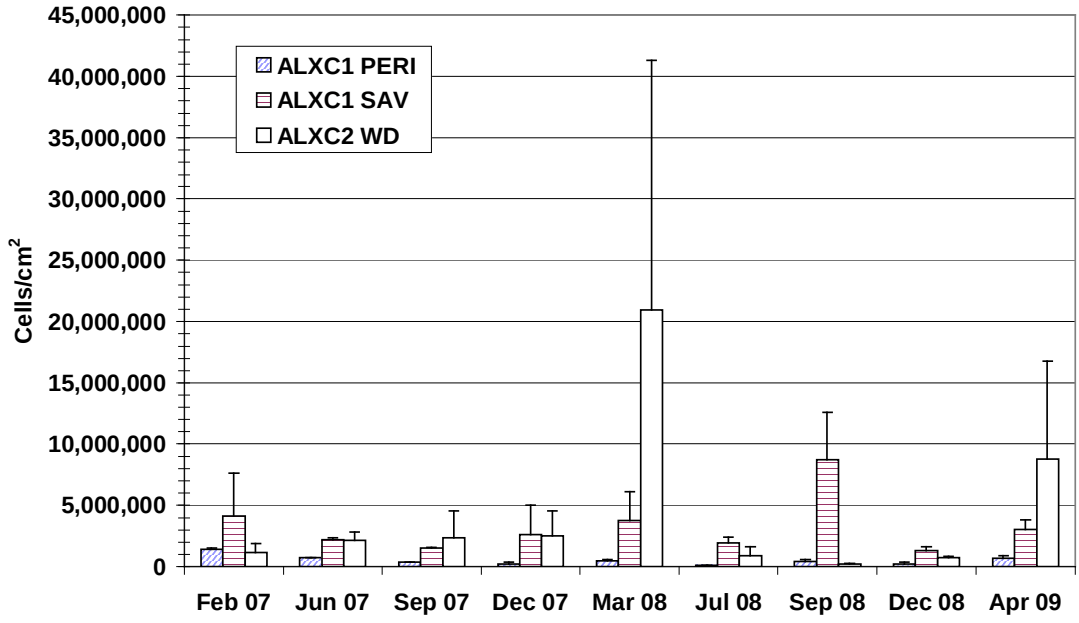

Fig. 66: SGLR Cell Number

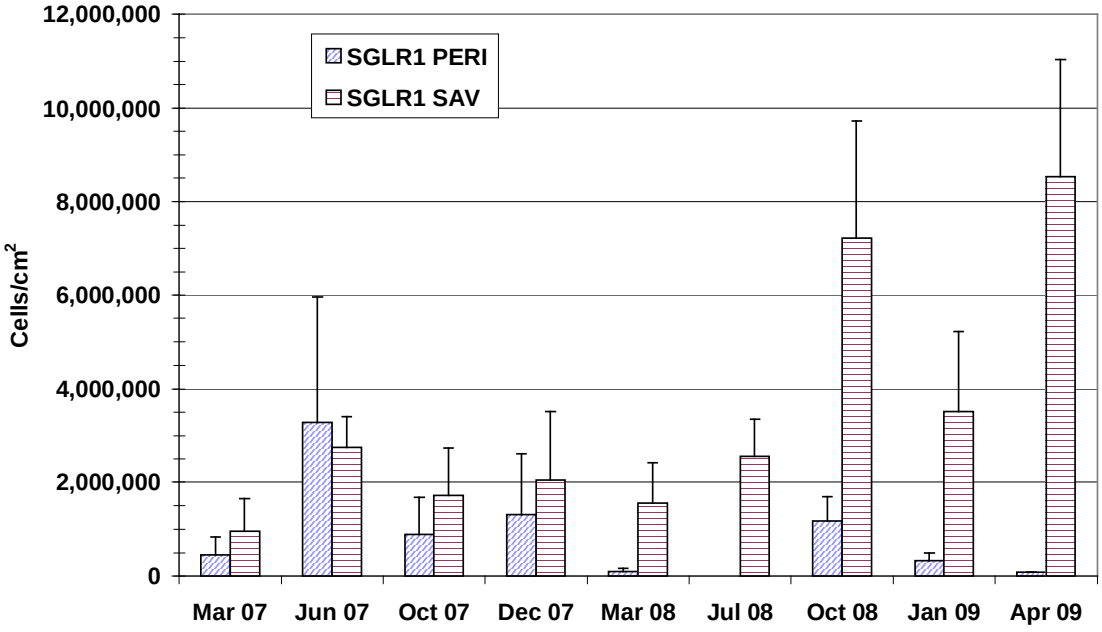

Figure 67: WEKR Biovolume

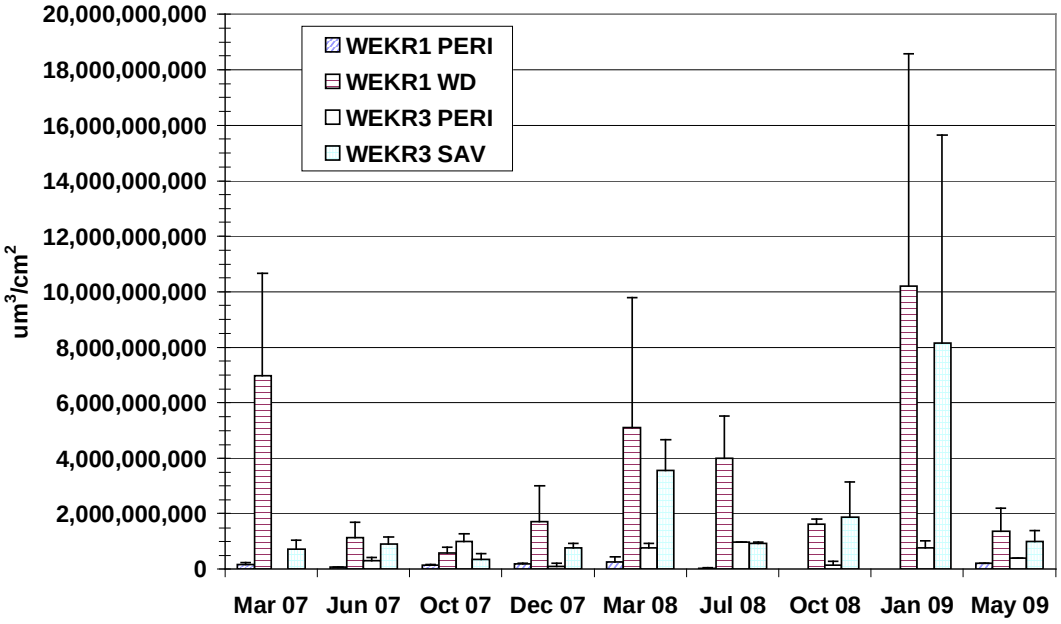

Fig. 68: RSR Biovolume

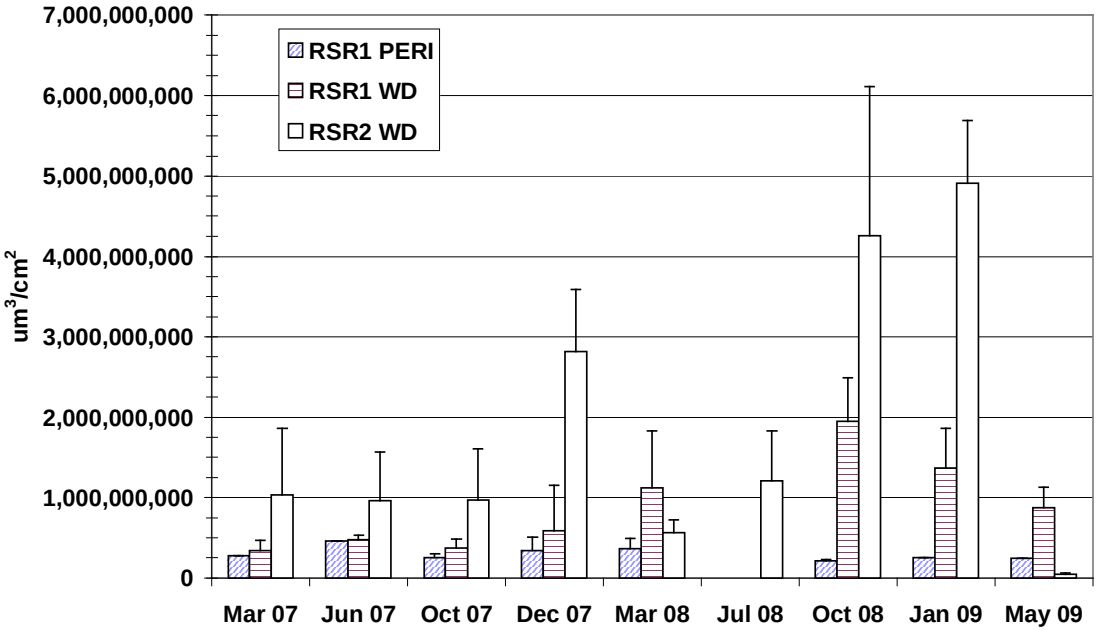

Fig. 69: JUNC Biovolume

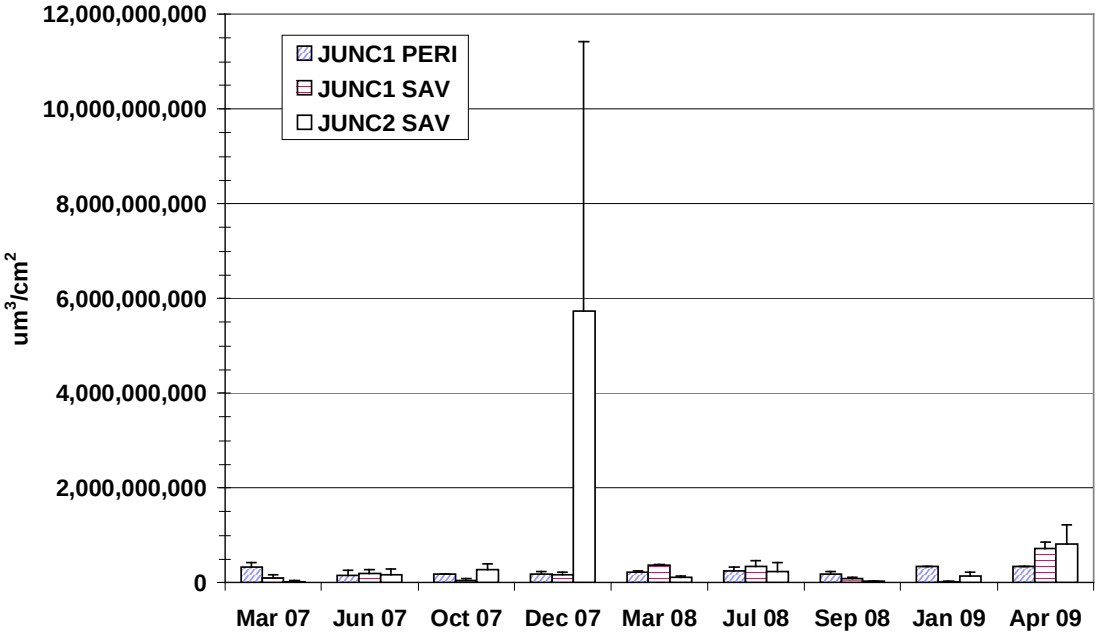

Fig. 70: ALXC Biovolume

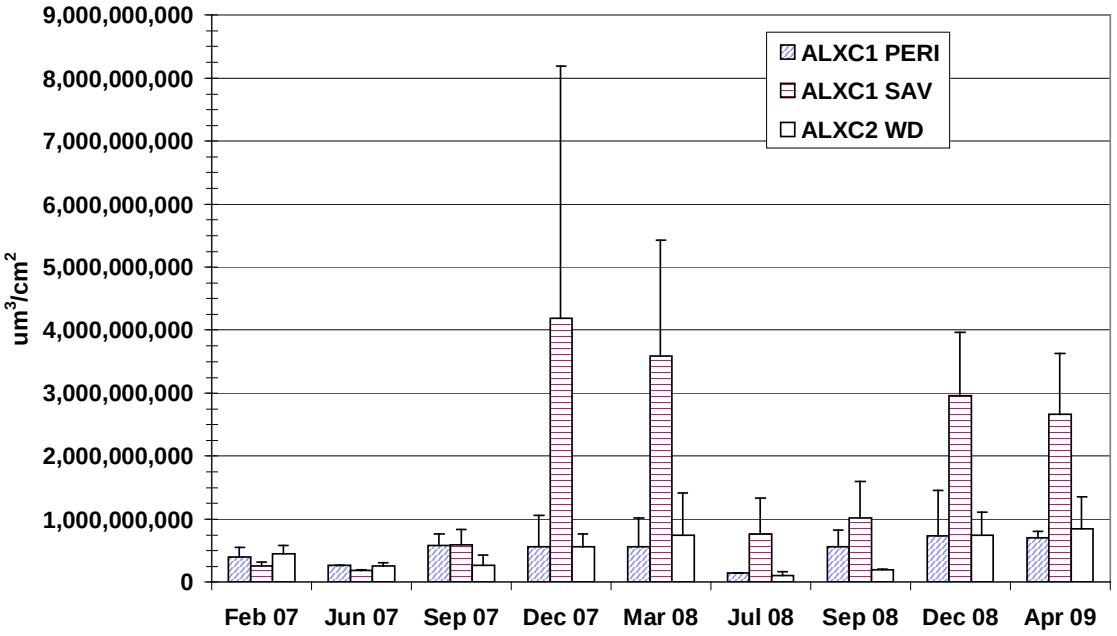

Fig. 71: SGLR Biovolume

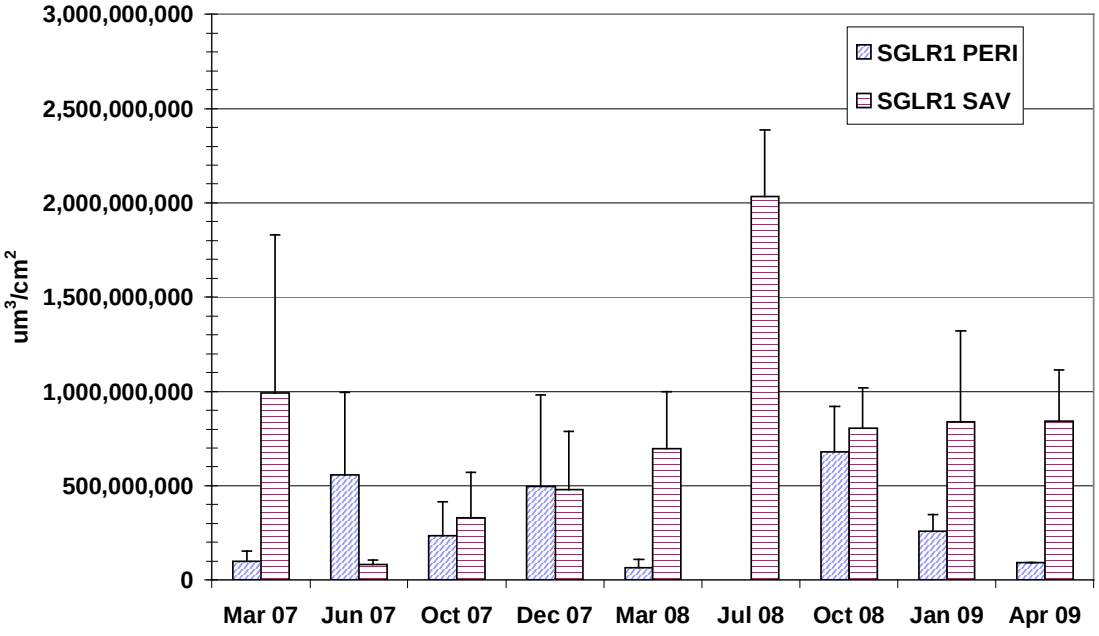

Fig. 72: WEKR1 PERI Cell Number by Group

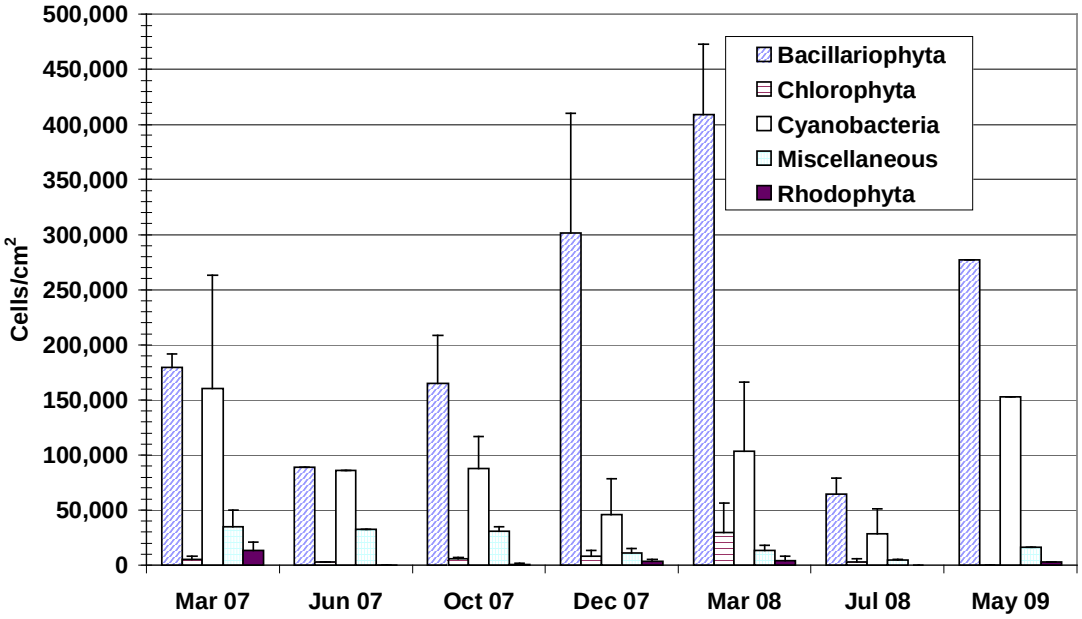

Fig. 73: WEKR1 WD Cell Number by Group

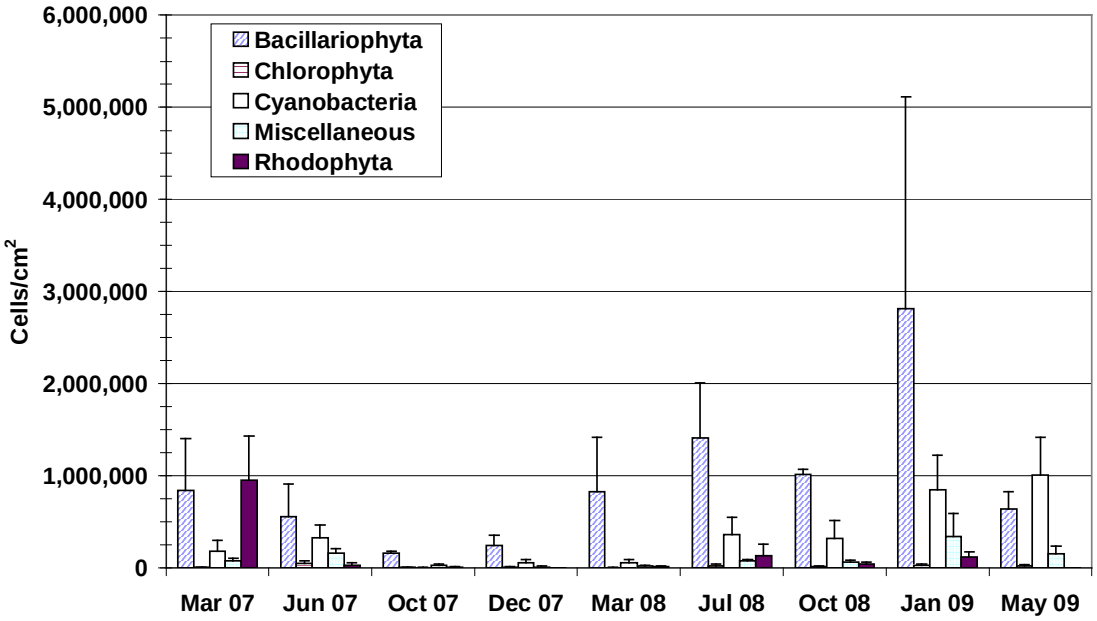

Fig. 74: WEKR3 PERI Cell Number by Group

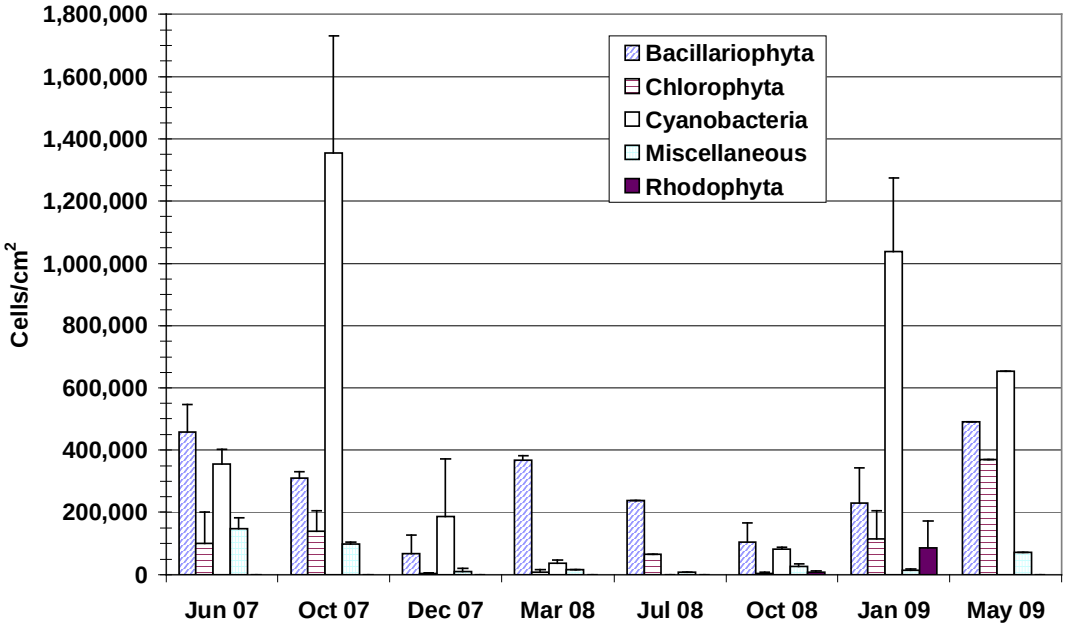

Fig. 75: WEKR3 SAV Cell Number by Group

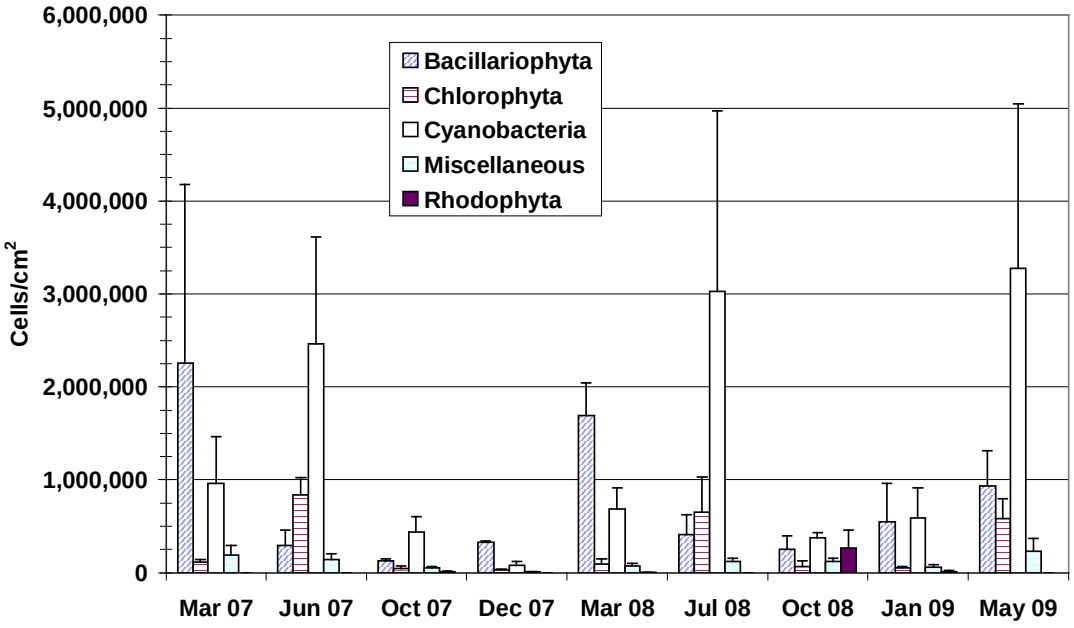

Fig. 76: RSR1 PERI Cell Number by Group

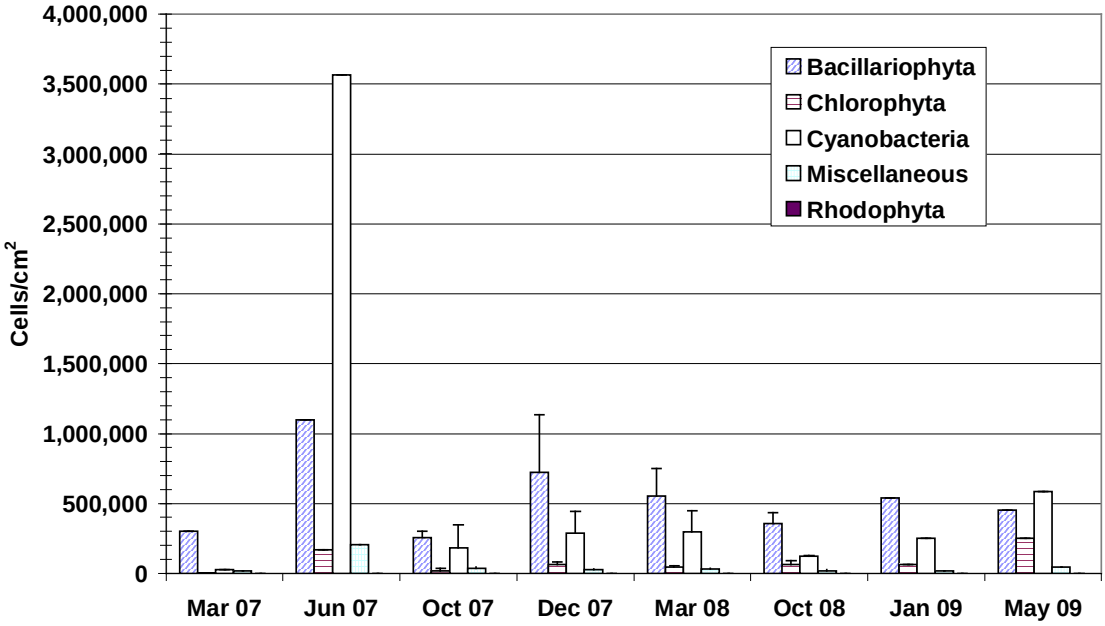

Fig. 77: RSR1 WD Cell Number by Group

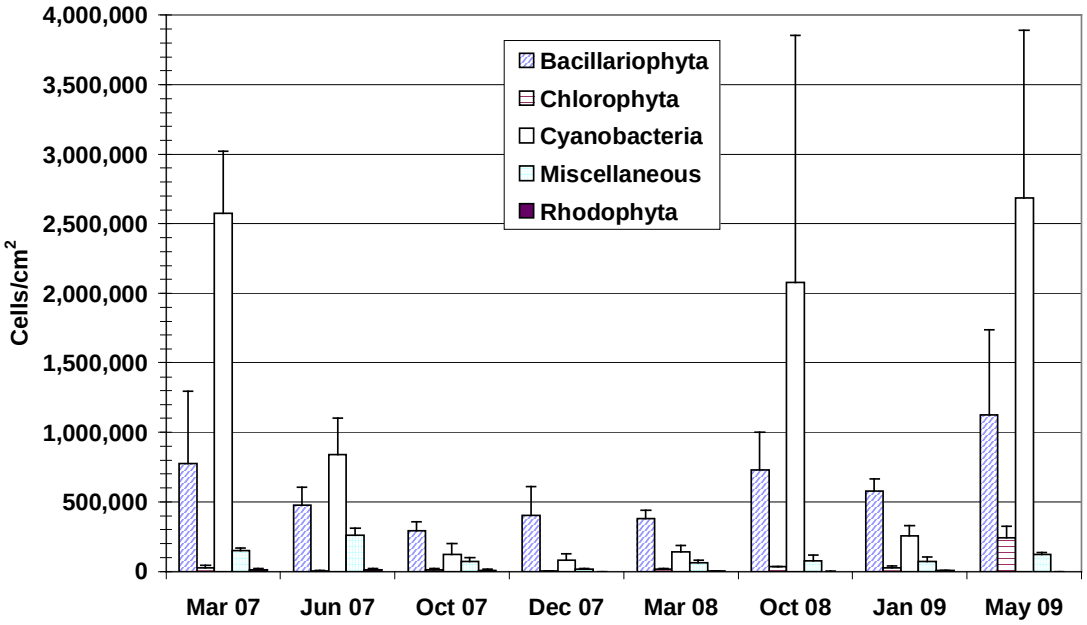

Fig. 78: RSR2 WD Cell Number by Group

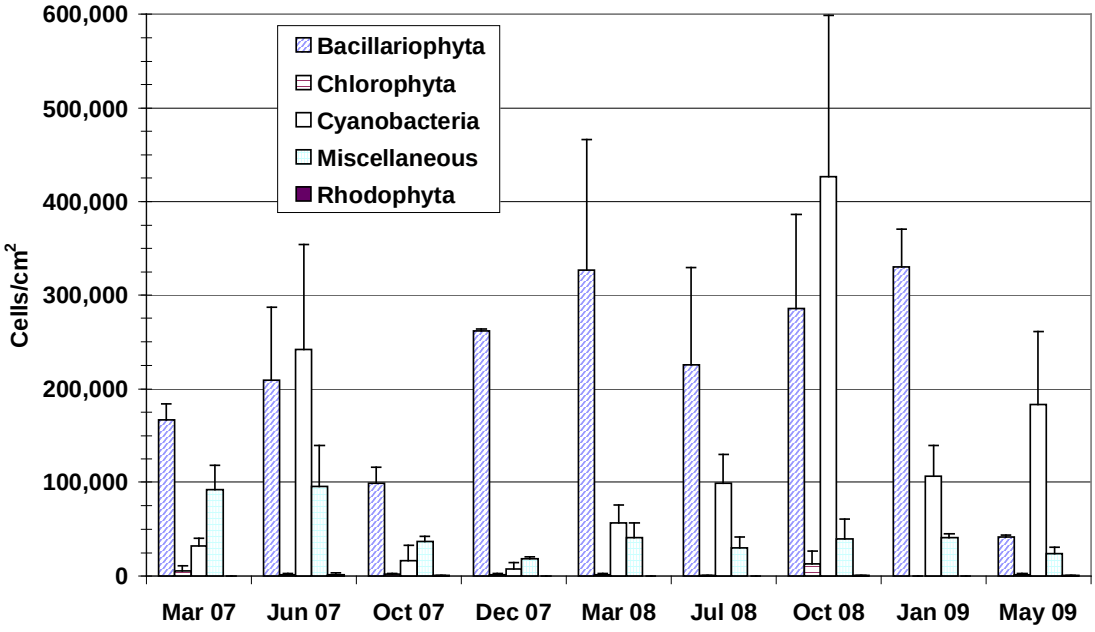

Fig. 79: JUNC1 PERI Cell Number by Group

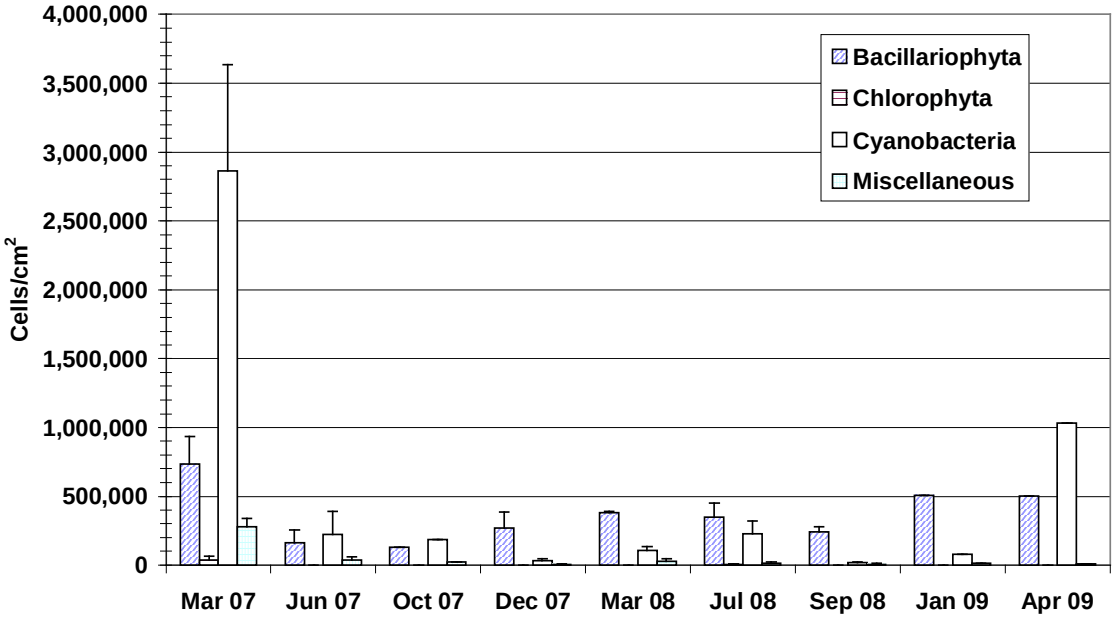

Fig. 80: JUNC1 SAV Cell Number by Group

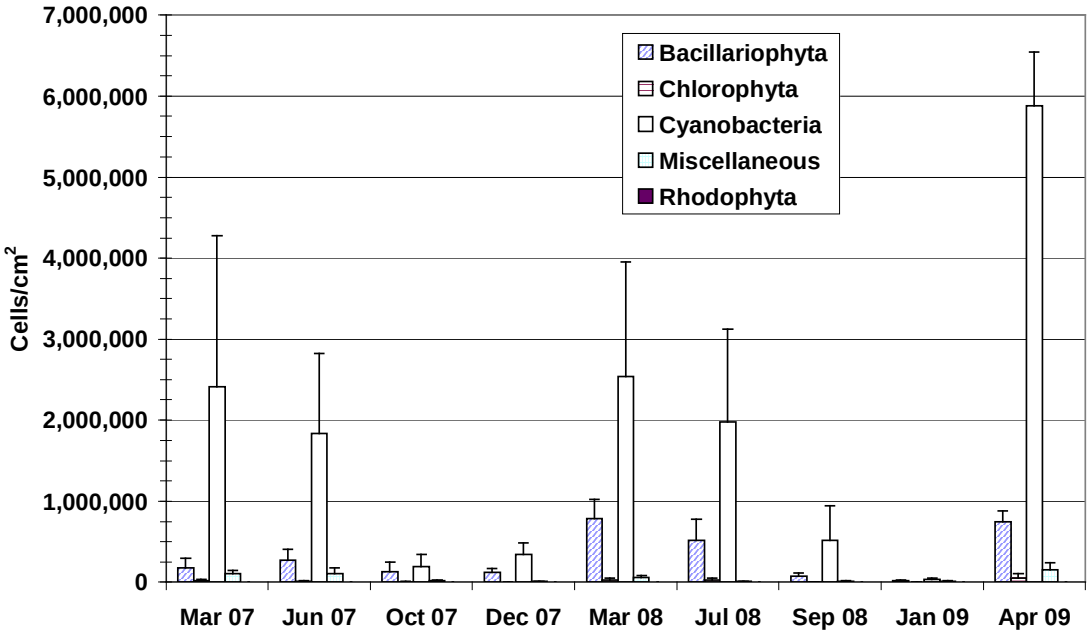

Fig. 81: JUNC2 SAV Cell Number by Group

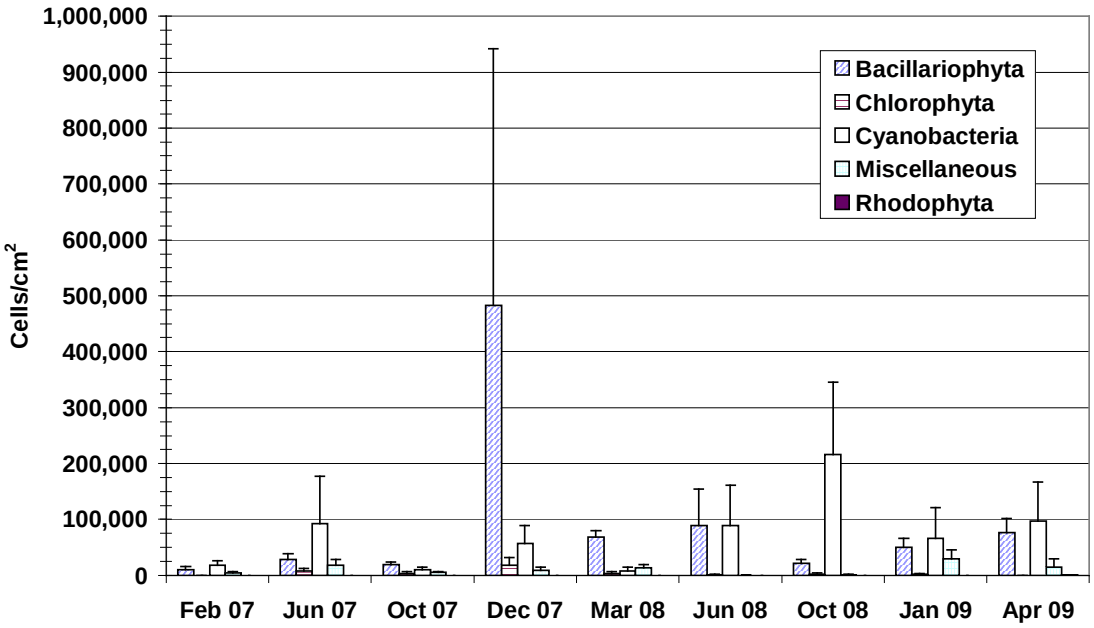

Fig. 82: ALXC1 PERI Cell Number by Group

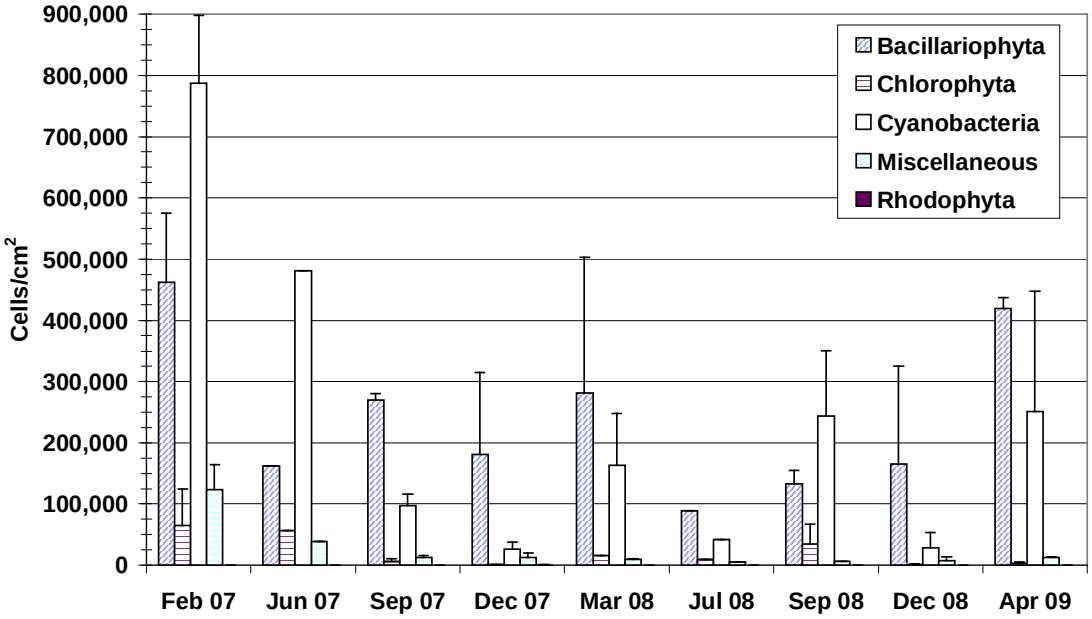

Fig. 83: ALXC1 SAV Cell Number by Group

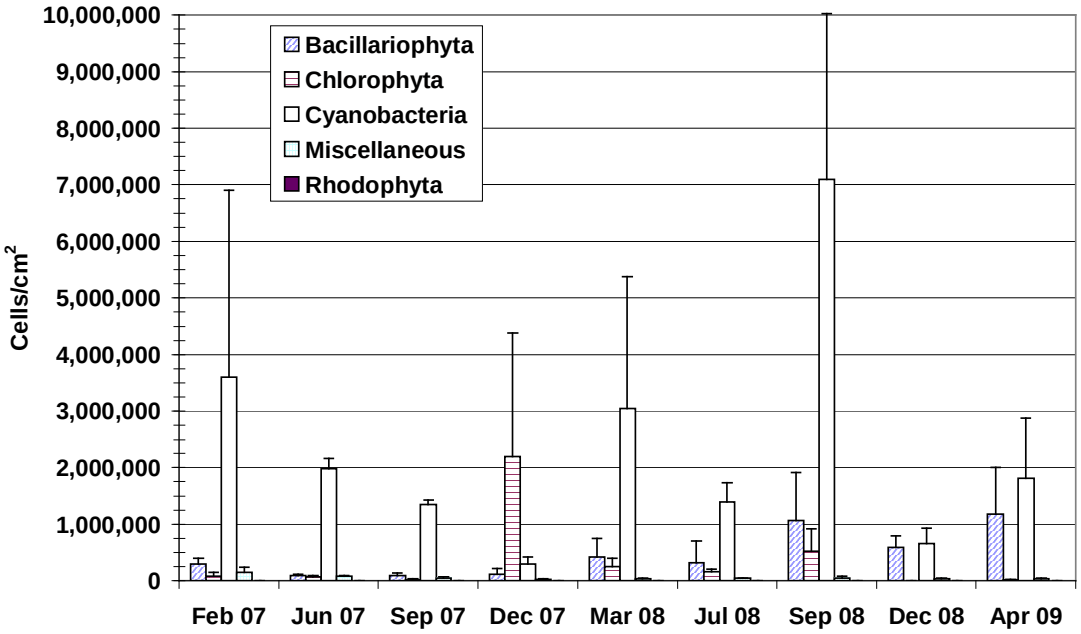

Fig. 84: ALXC2 WD Cell Number by Group

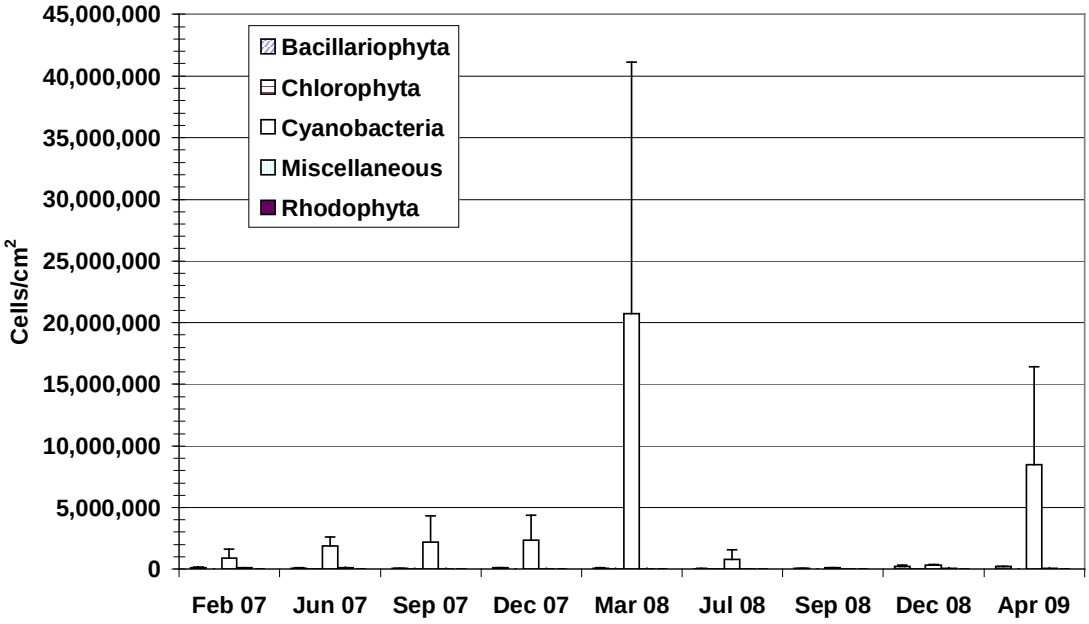

Fig. 85: SGLR1 PERI Cell Number by Group

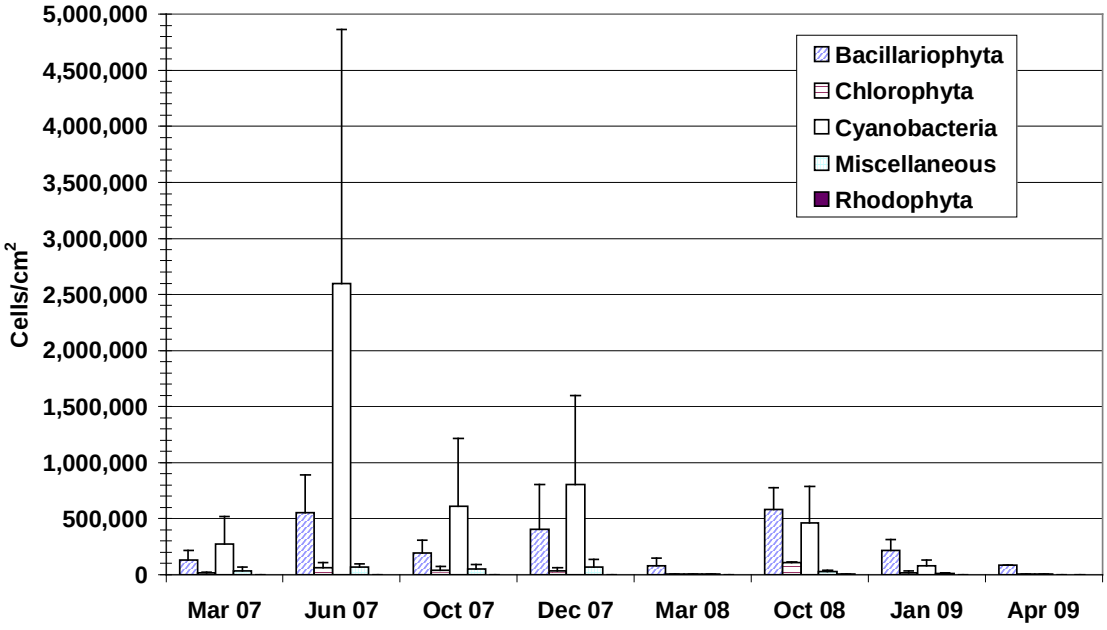

Fig. 86: SGLR1 SAV Cell Number by Group

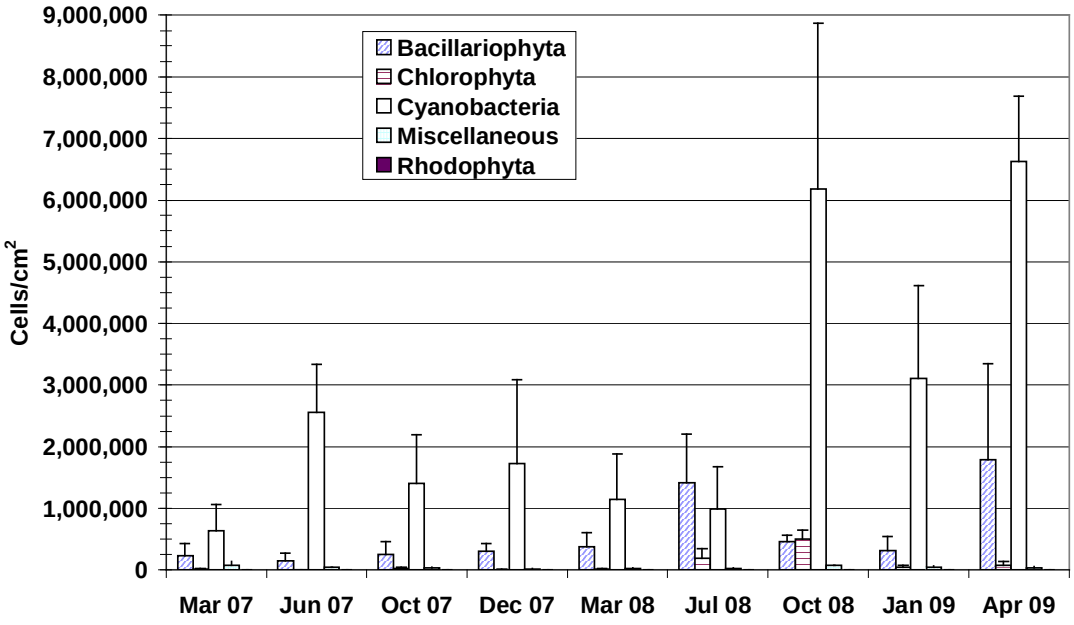

Fig. 87: WEKR1 PERI Biovolume by Group

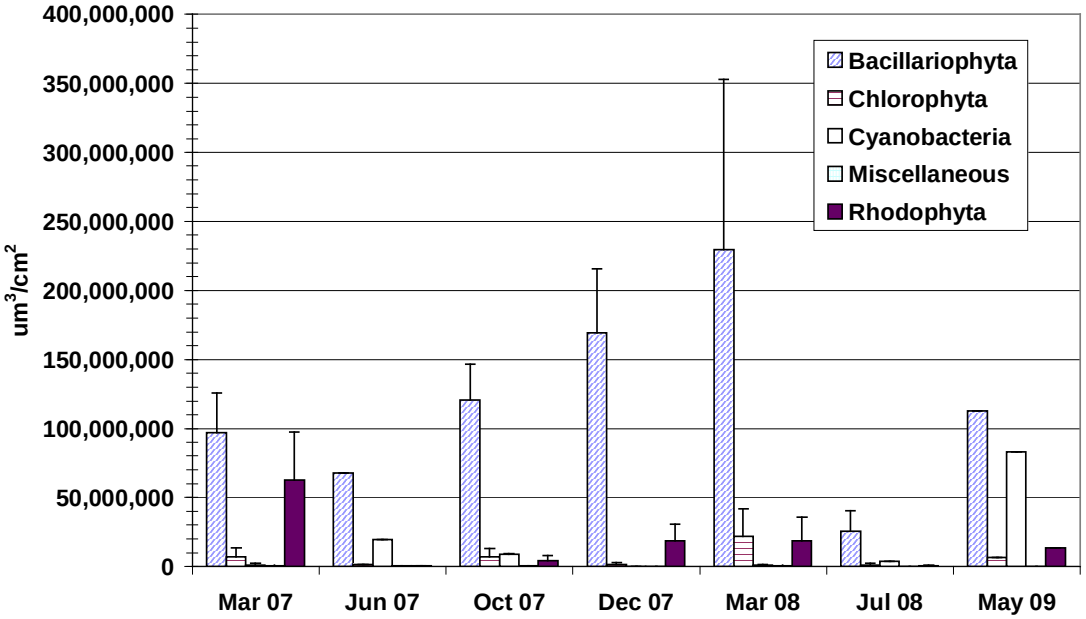

Fig. 88: WEKR1 WD Biovolume by Group

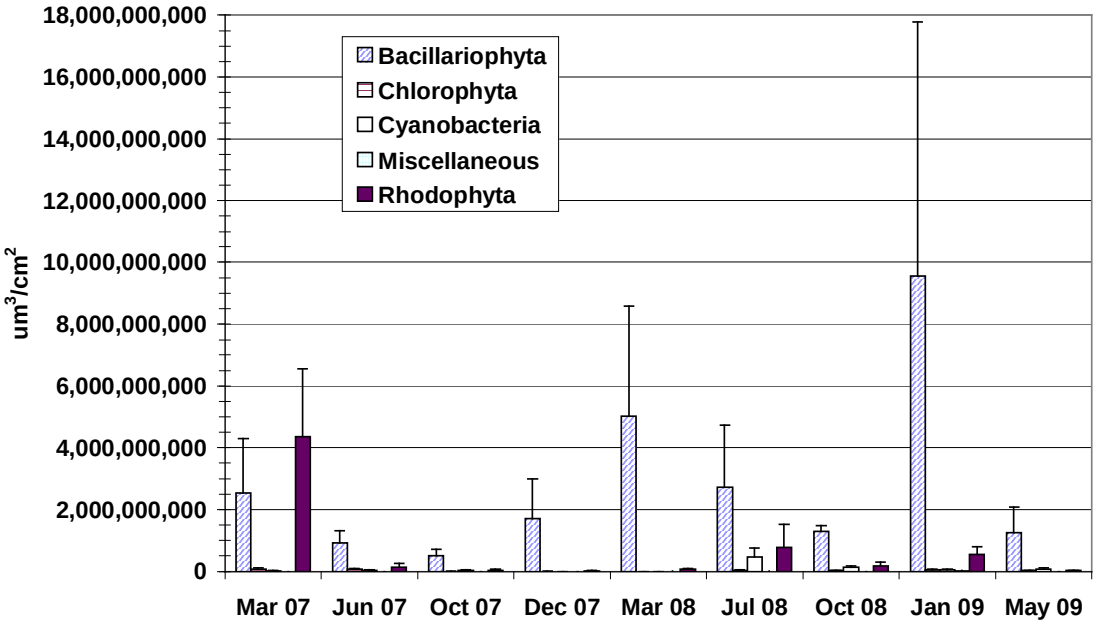

Fig. 89: WEKR3 PERI Biovolume by Group

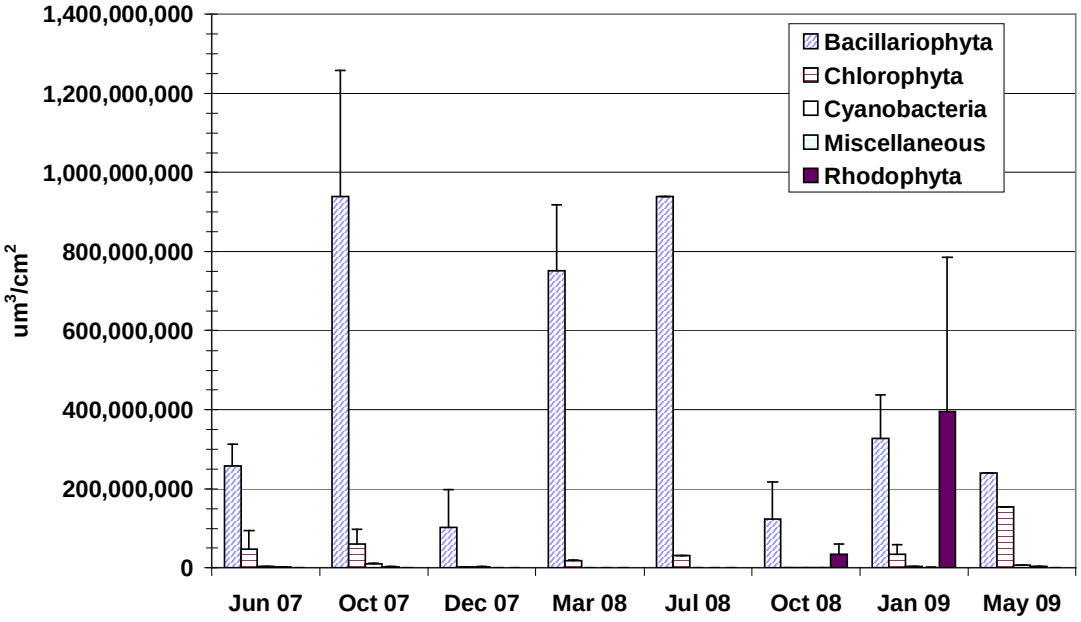

Fig. 90: WEKR3 SAV Biovolume by Group

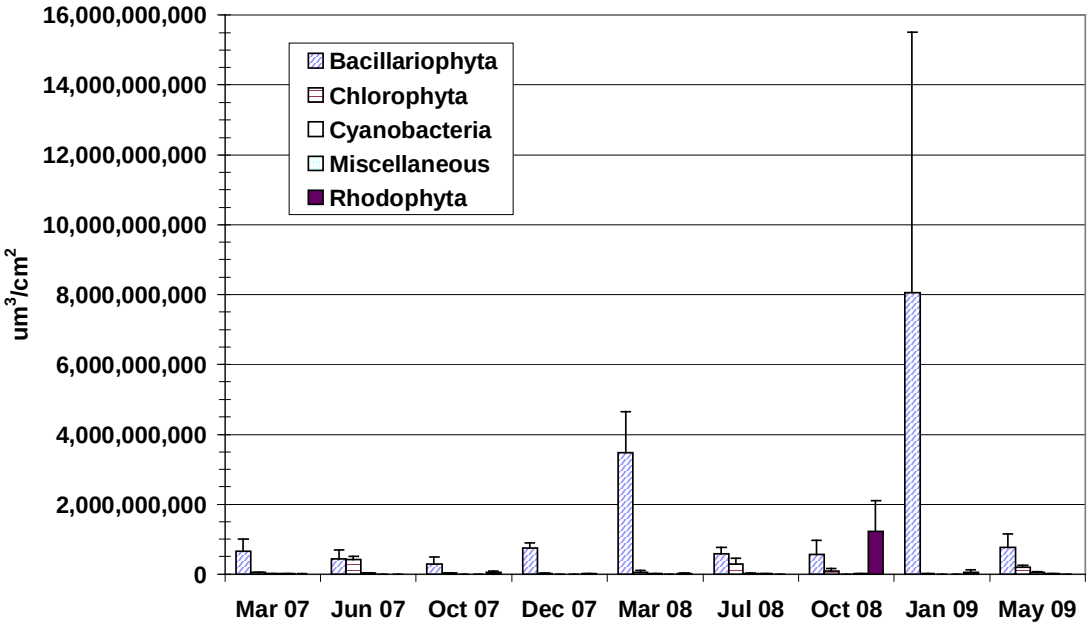

Fig. 91: RSR1 PERI Biovolume by Group

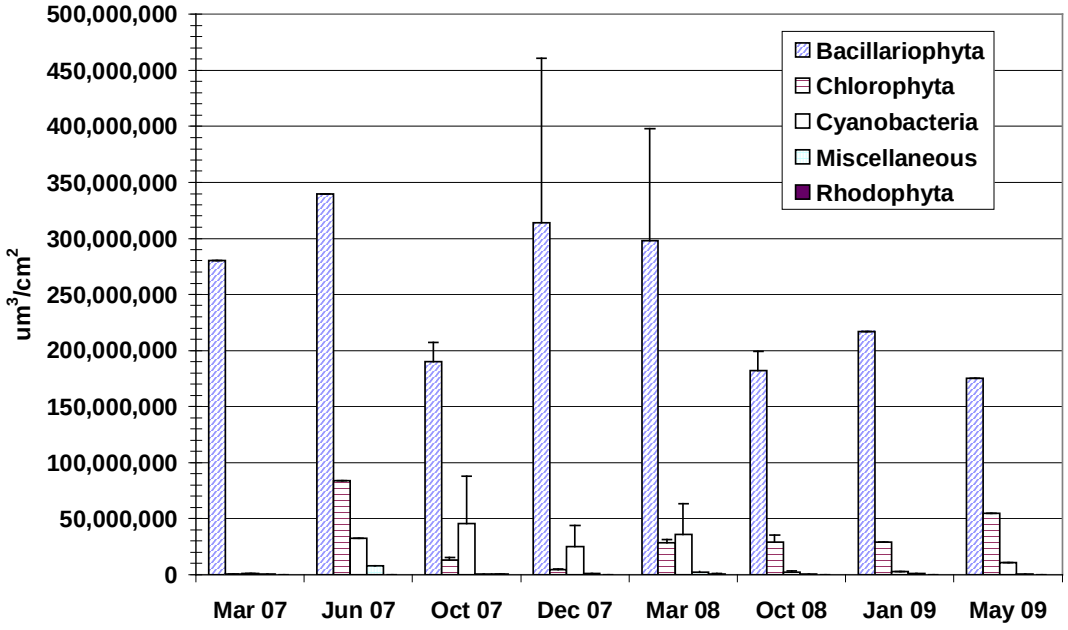

Fig. 92: RSR1 WD Biovolume by Group

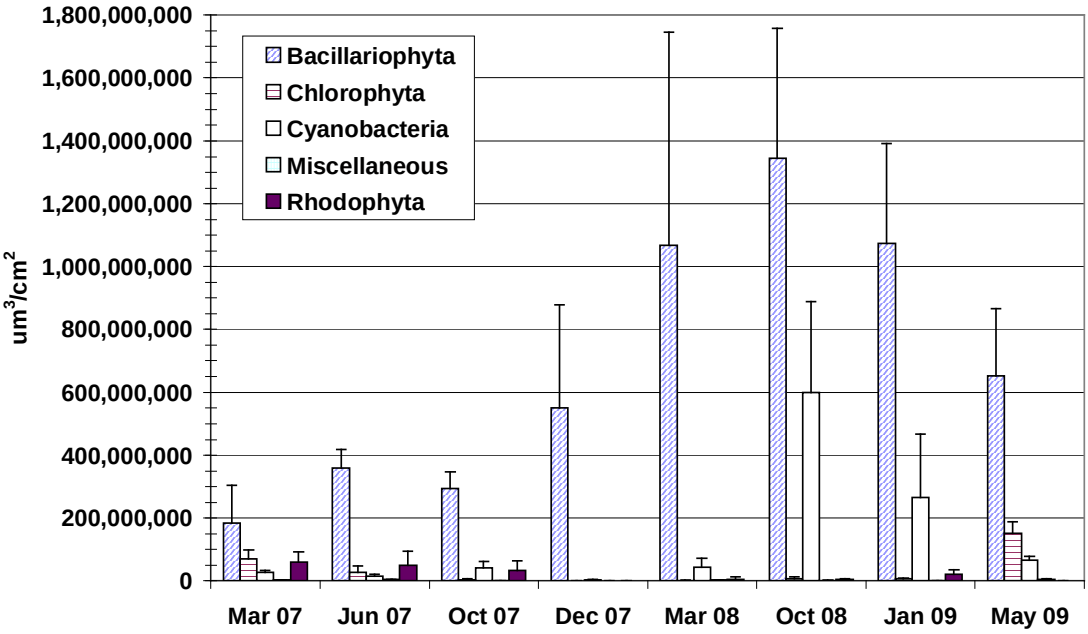

Fig. 93: RSR2 WD Biovolume by Group

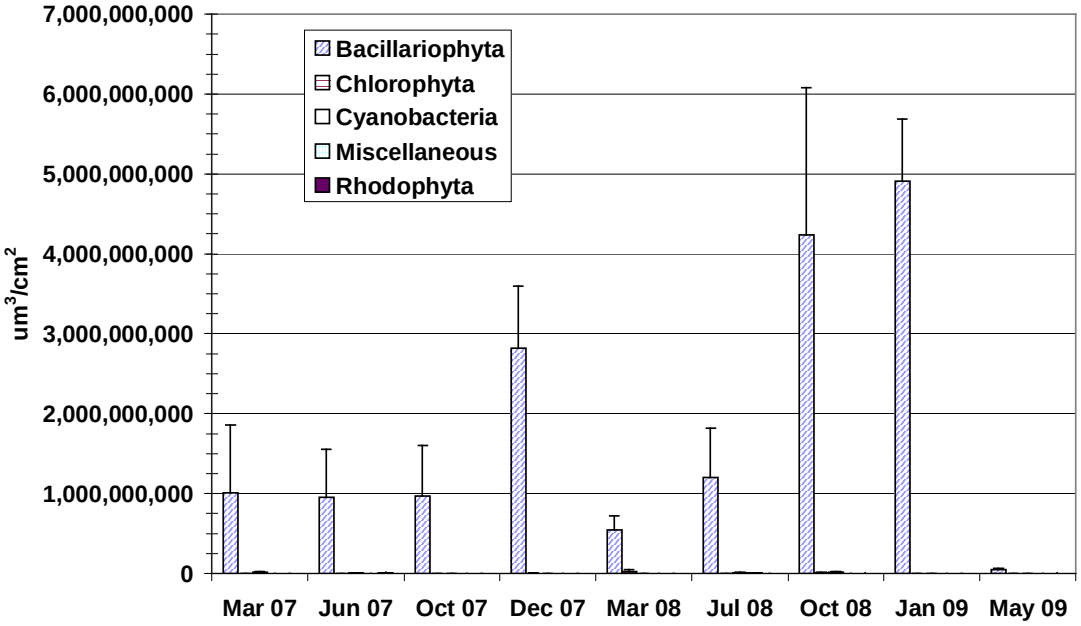

Fig. 94: JUNC1 PERI Biovolume by Group

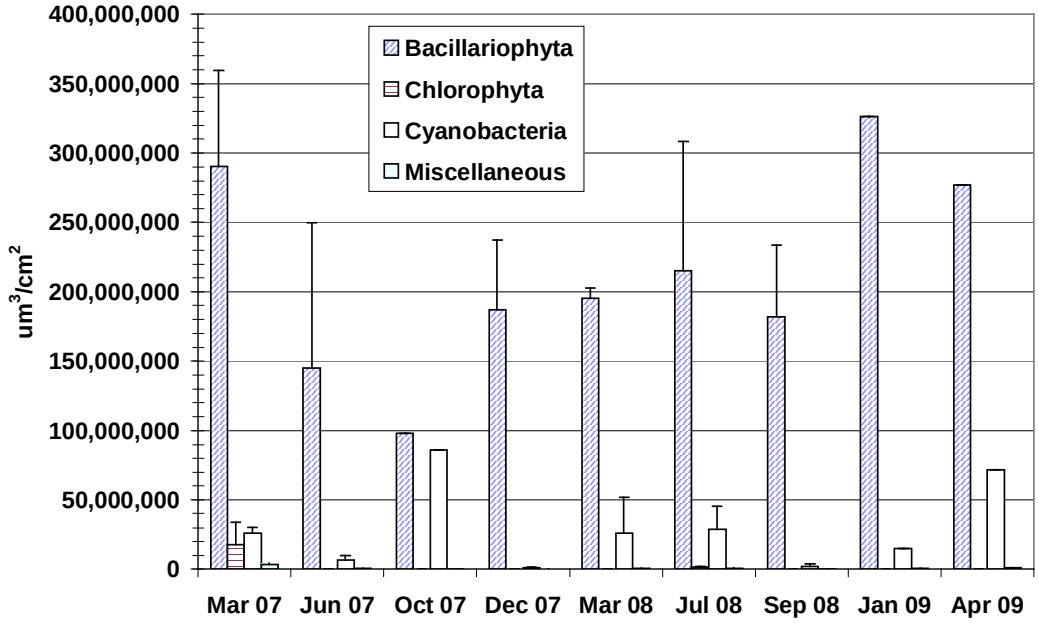

Fig. 95: JUNC1 SAV Biovolume by Group

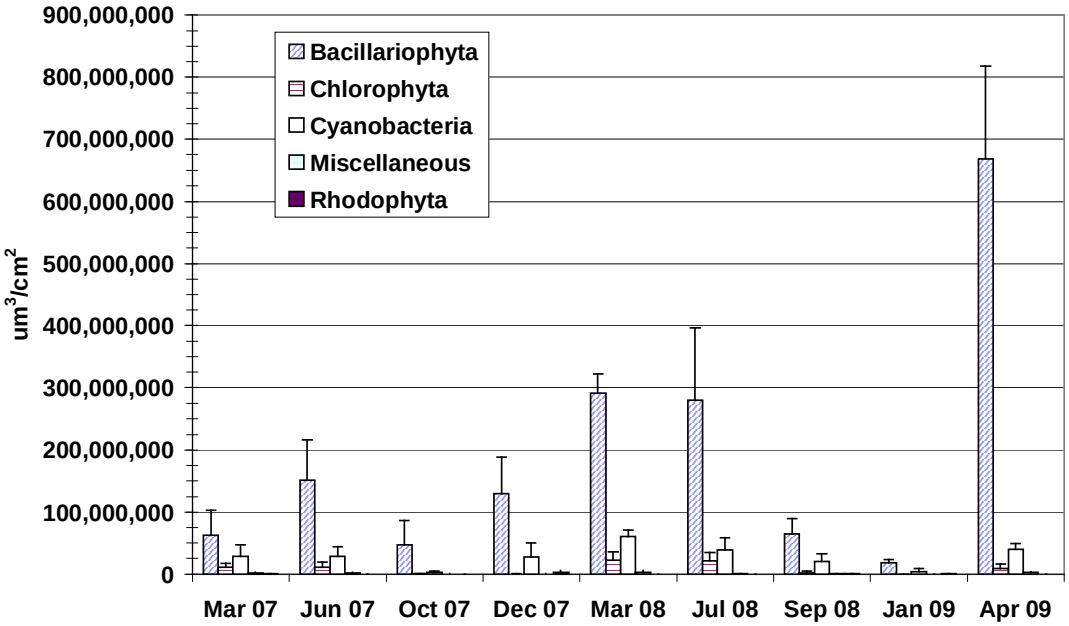

Fig. 96: JUNC2 SAV Biovolume by Group

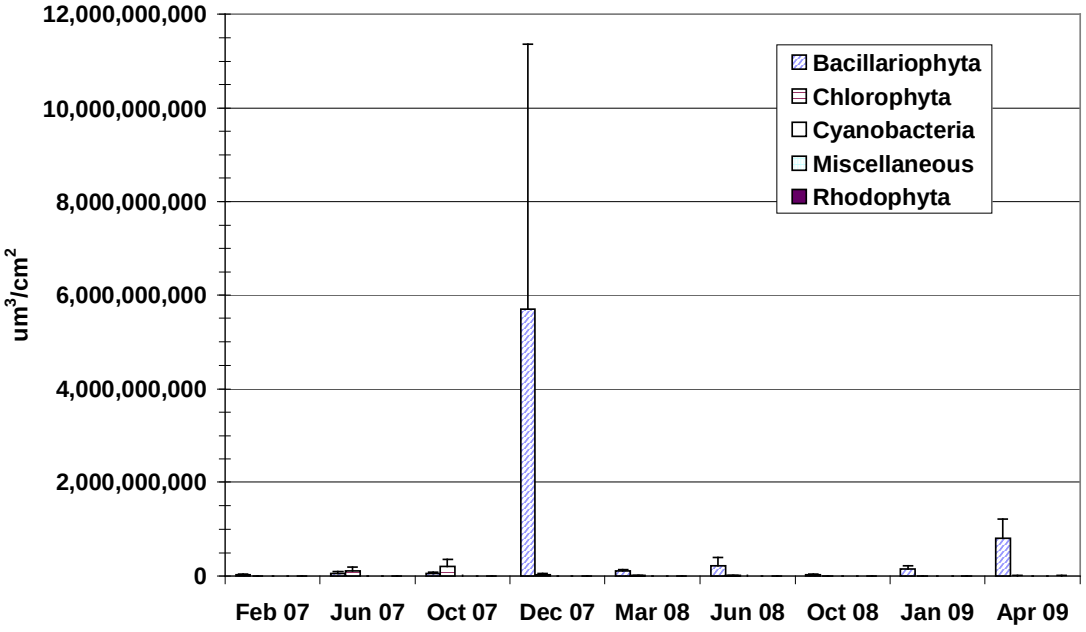

Fig. 97: ALXC1 PERI Biovolume by Group

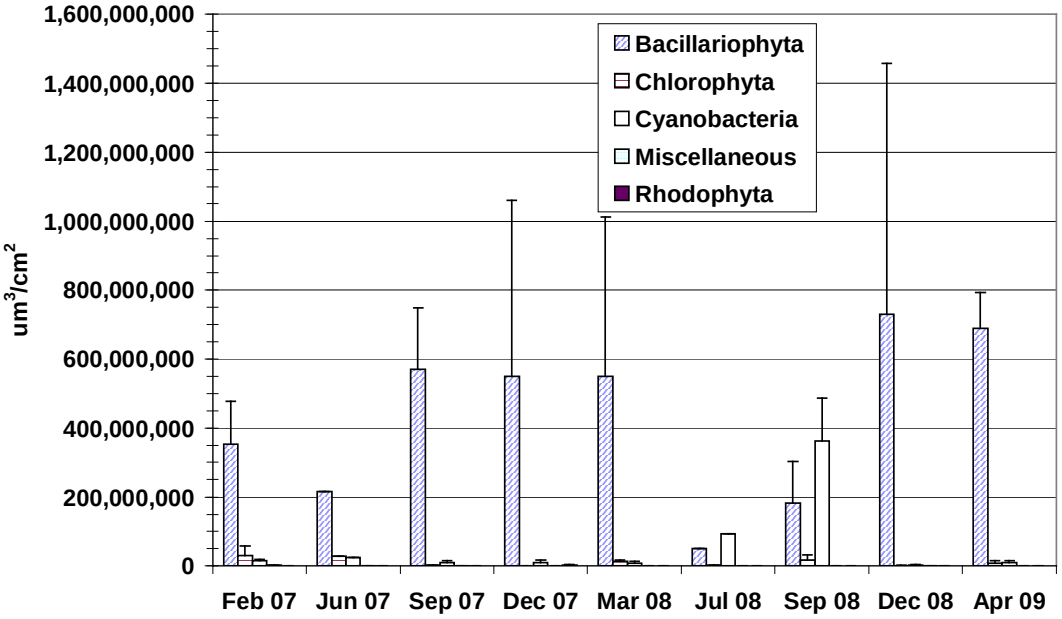

Fig. 98: ALXC1 SAV Biovolume by Group

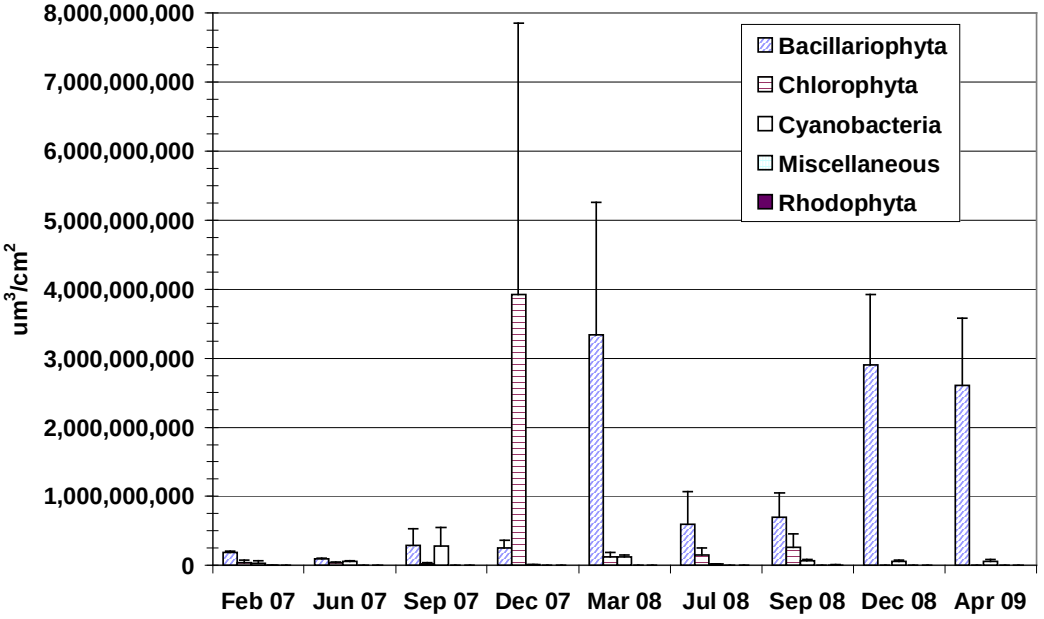

Fig. 99: ALXC2 WD Biovolume by Group

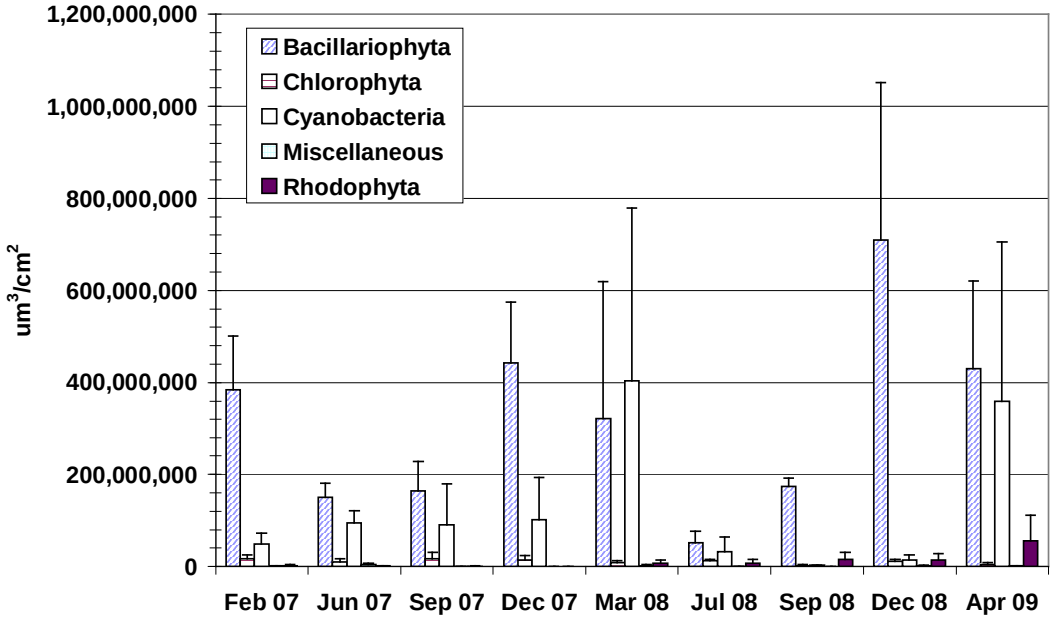

Fig. 100: SGLR1 PERI Biovolume by Group

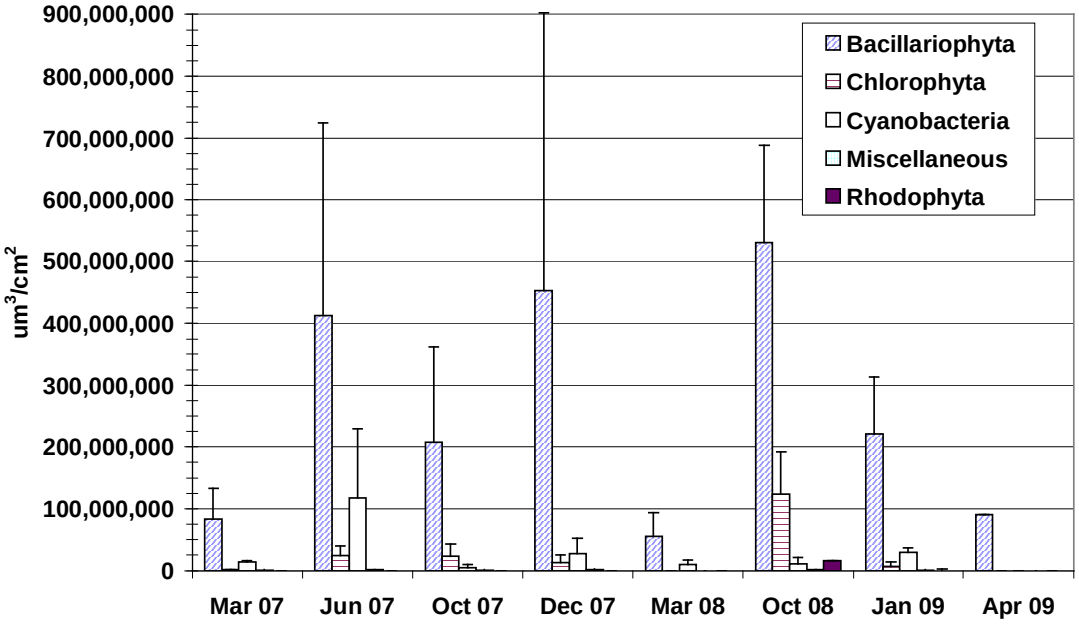

Fig. 101: SGLR1 SAV Biovolume by Group

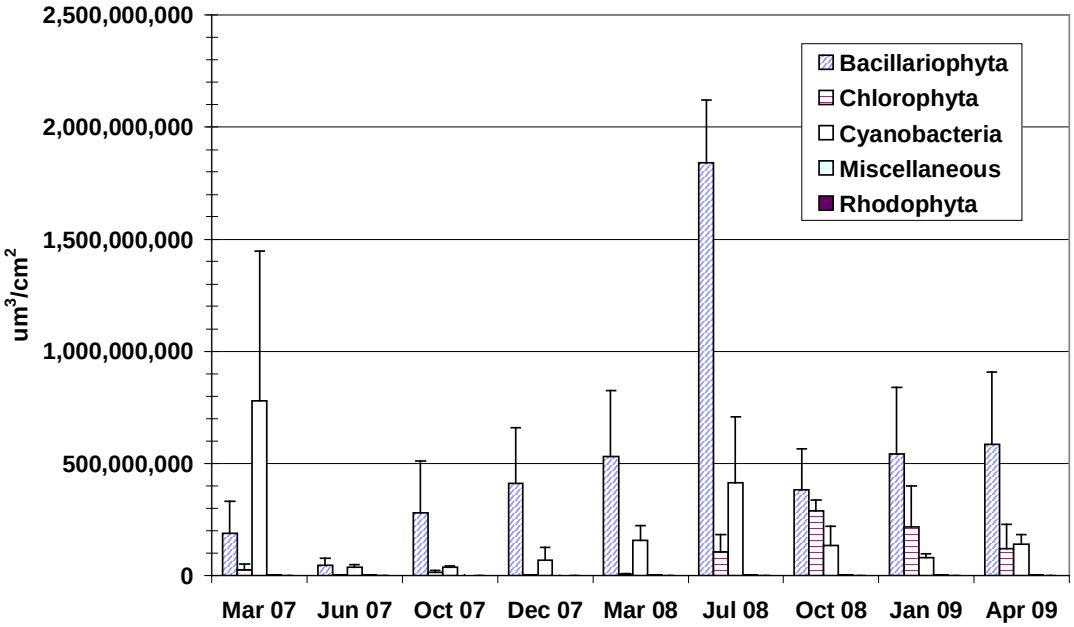

Fig. 102: WEKR1 PERI Relative Abundance by Cell Number

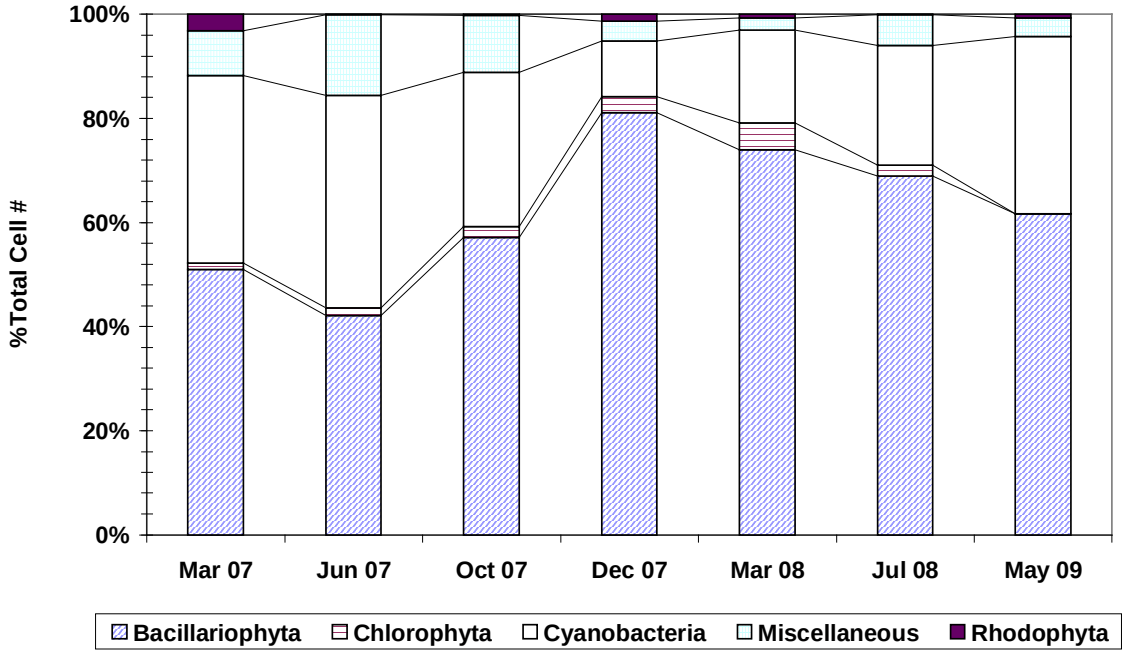

Fig. 103: WEKR1 WD Relative Abundance by Cell Number

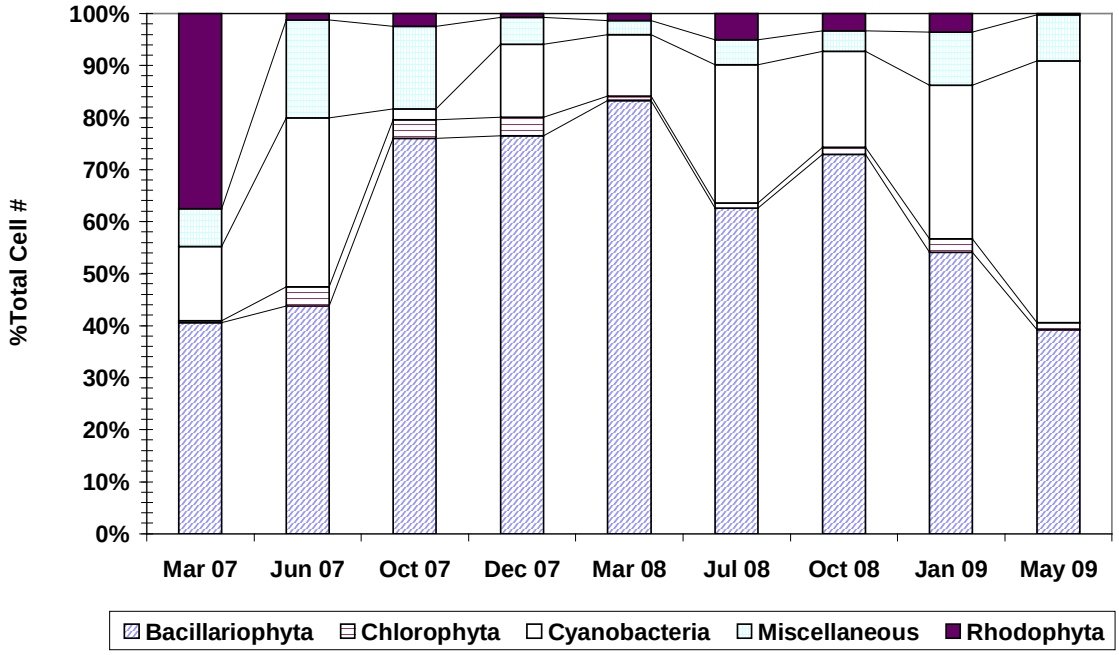

Fig. 104: WEKR3 PERI Relative Abundance by Cell Number

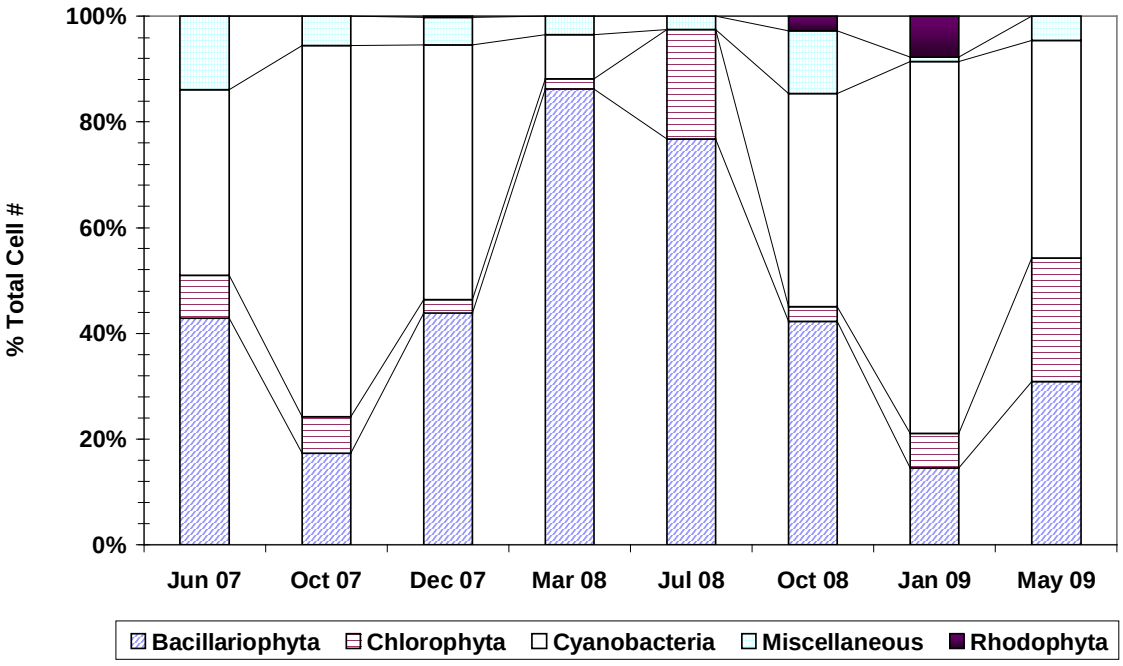

Fig. 105: WEKR3 SAV Relative Abundance by Cell Number

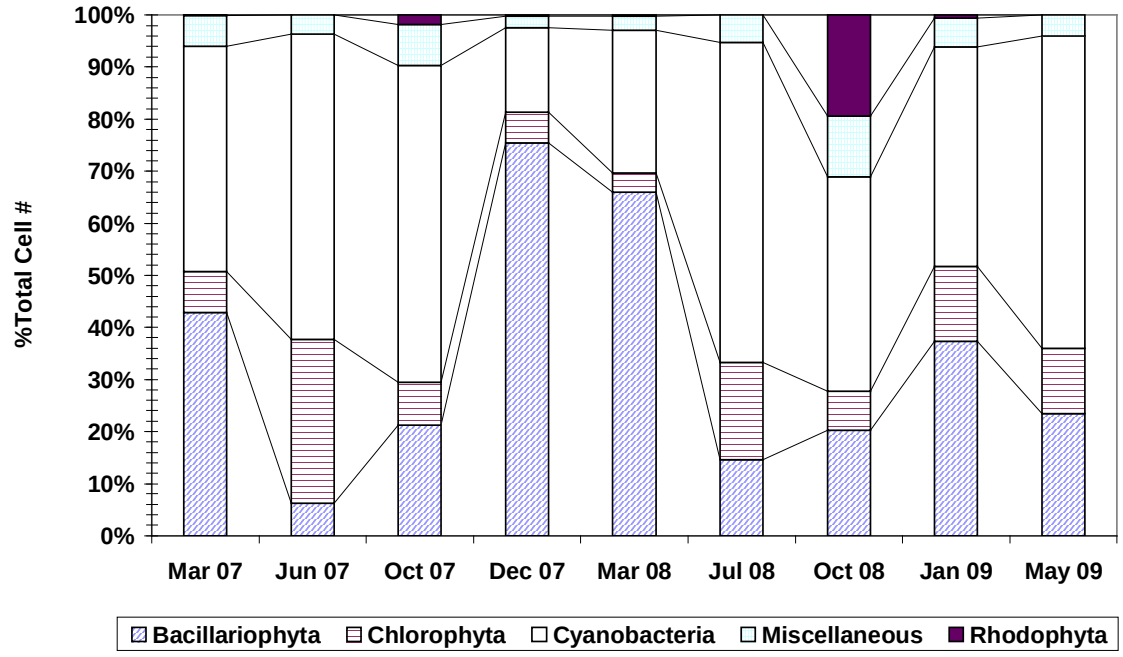

Fig. 106: RSR1 PERI Relative Abundance by Cell Number

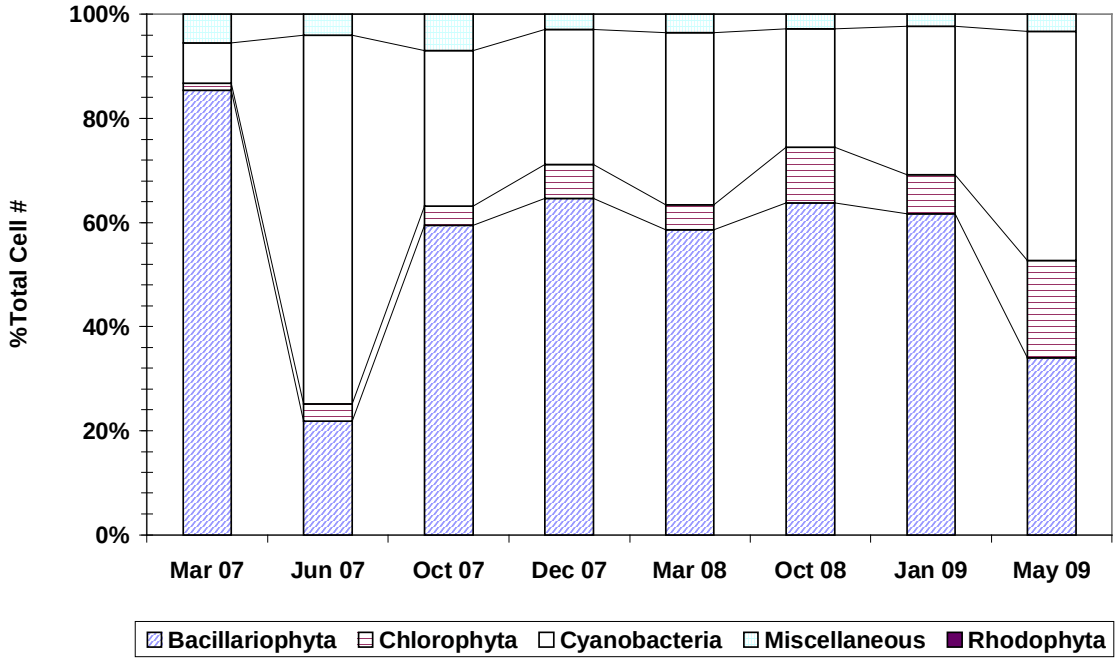

Fig. 107: RSR1 WD Relative Abundance by Cell Number

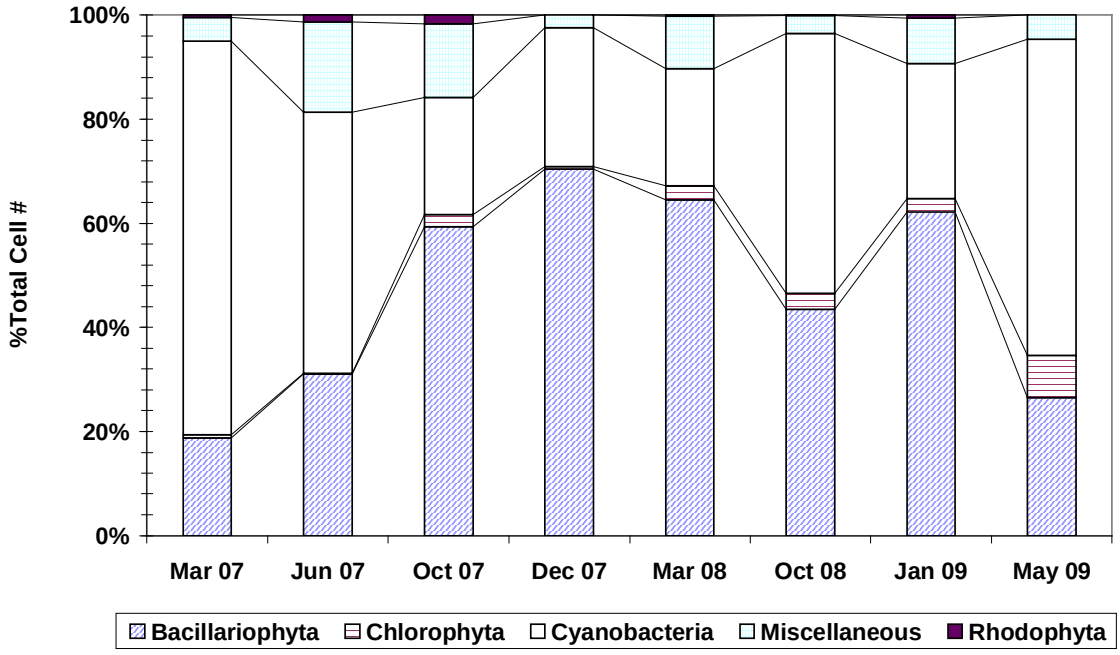

Fig. 108: RSR2 WD Relative Abundance by Cell Number

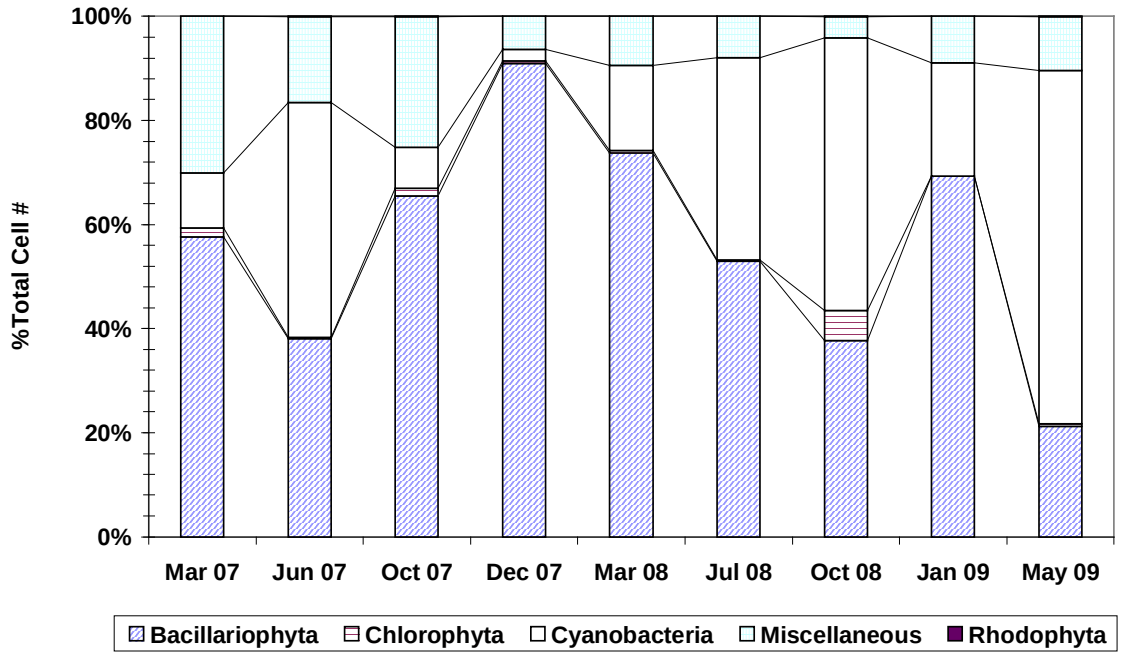

Fig. 109: JUNC1 PERI Relative Abundance by Cell Number

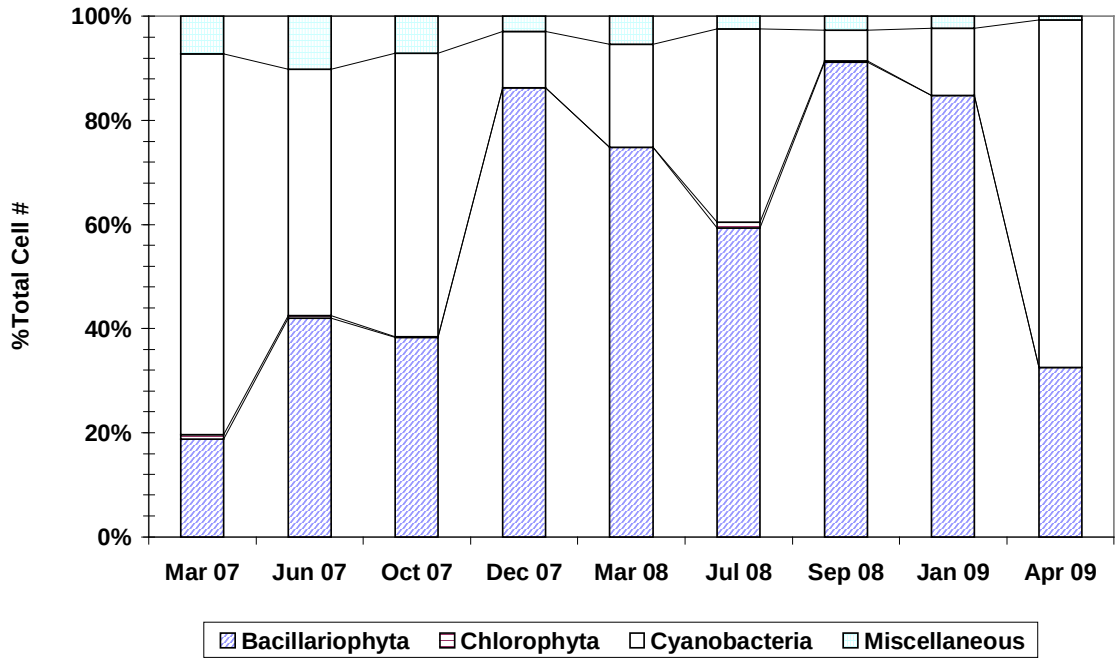

Fig. 110: JUNC1 SAV Relative Abundance by Cell Number

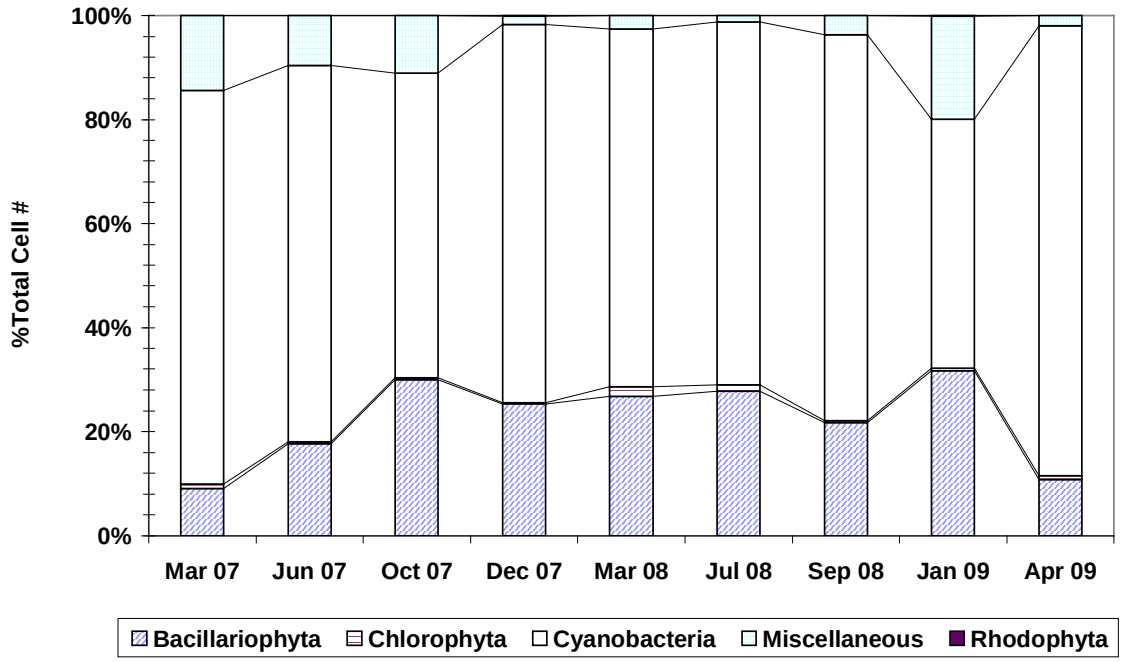

Fig. 111: JUNC2 SAV Relative Abundance by Cell Number

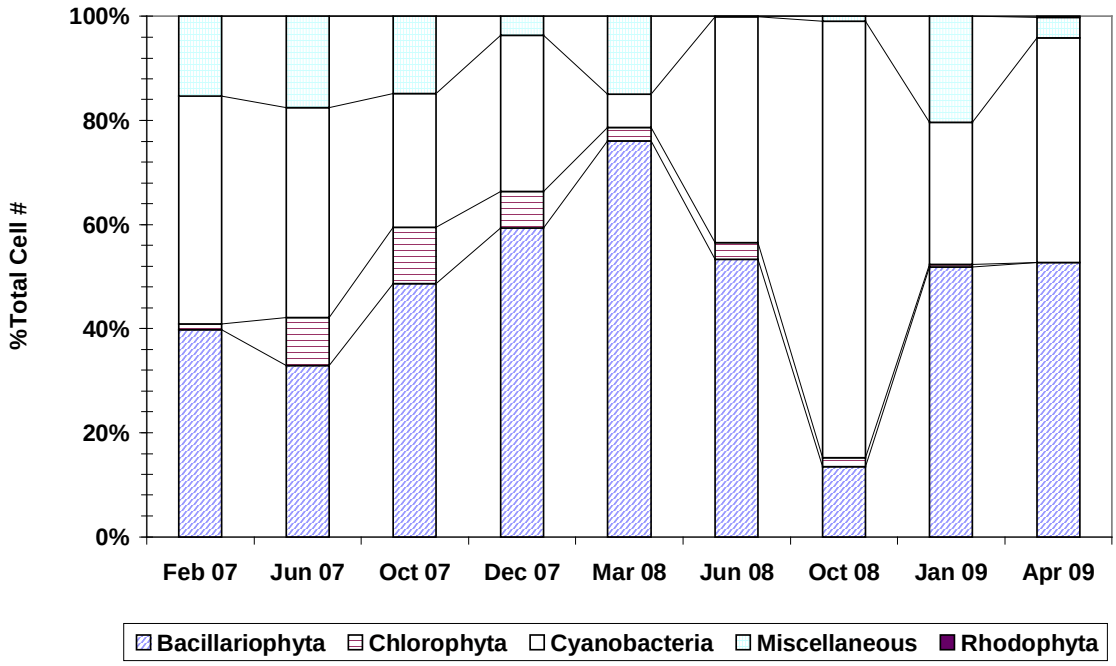

Fig. 112: ALXC1 PERI Relative Abundance by Cell Number

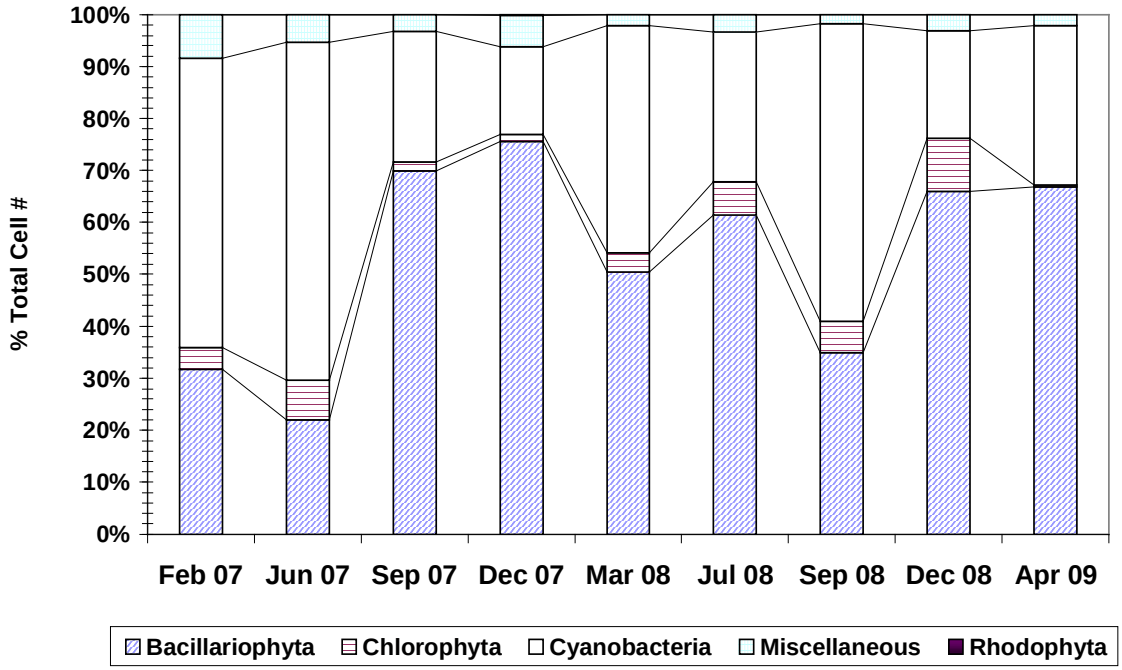

Fig. 113: ALXC1 SAV Relative Abundance by Cell Number

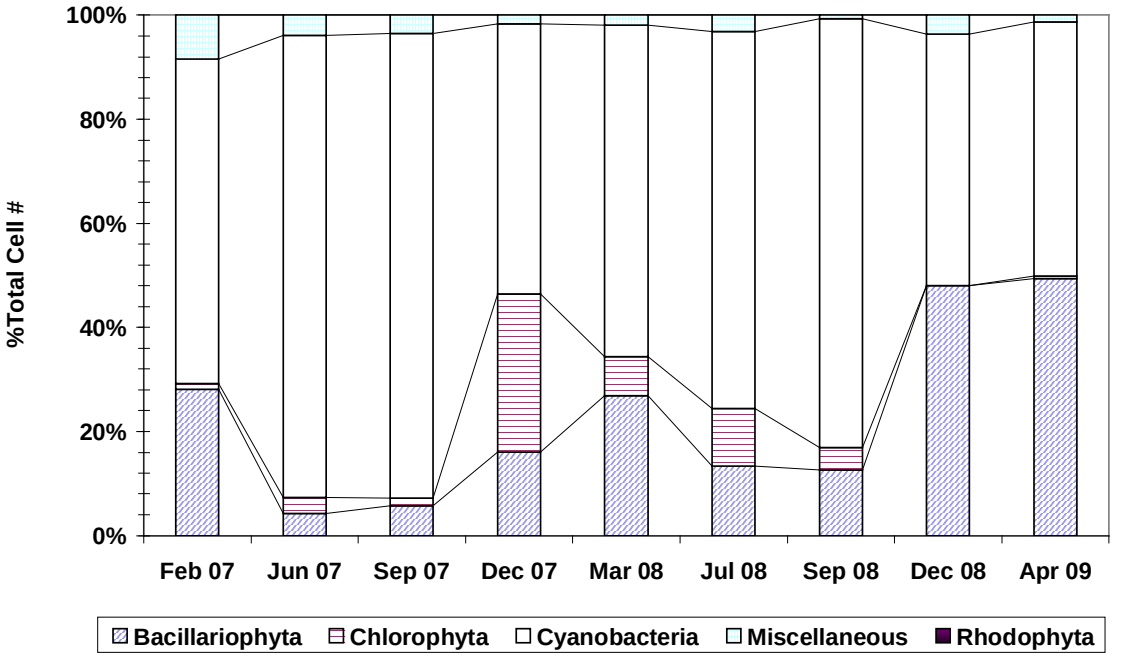

Fig. 114: ALXC2 WD Relative Abundance by Cell Number

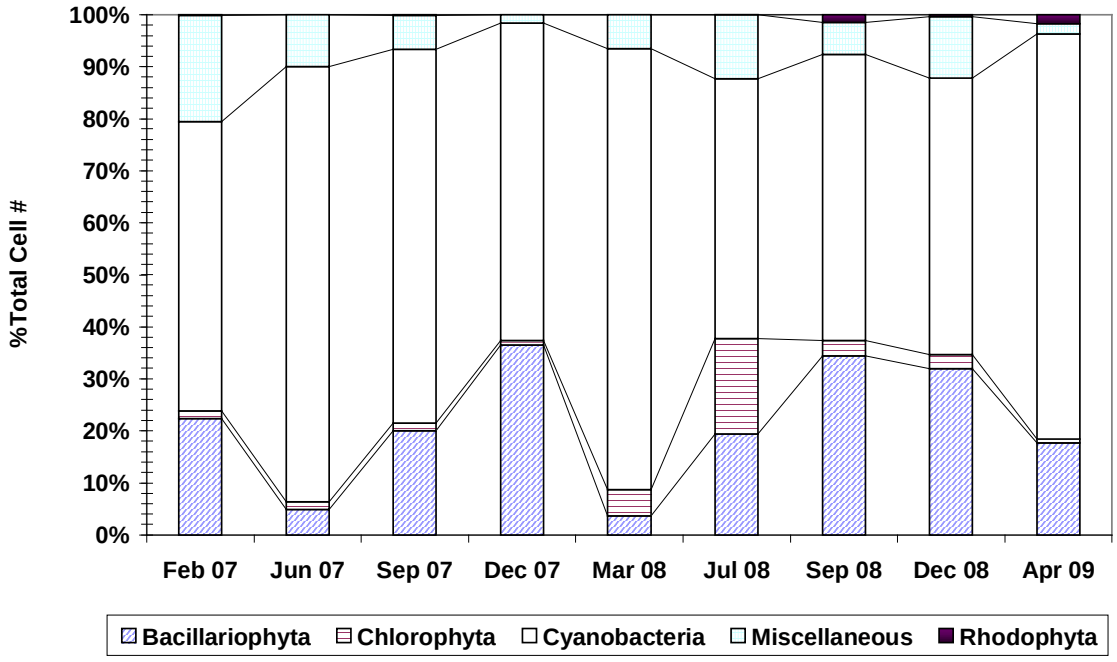

Fig. 115: SGLR1 PERI Relative Abundance by Cell Number

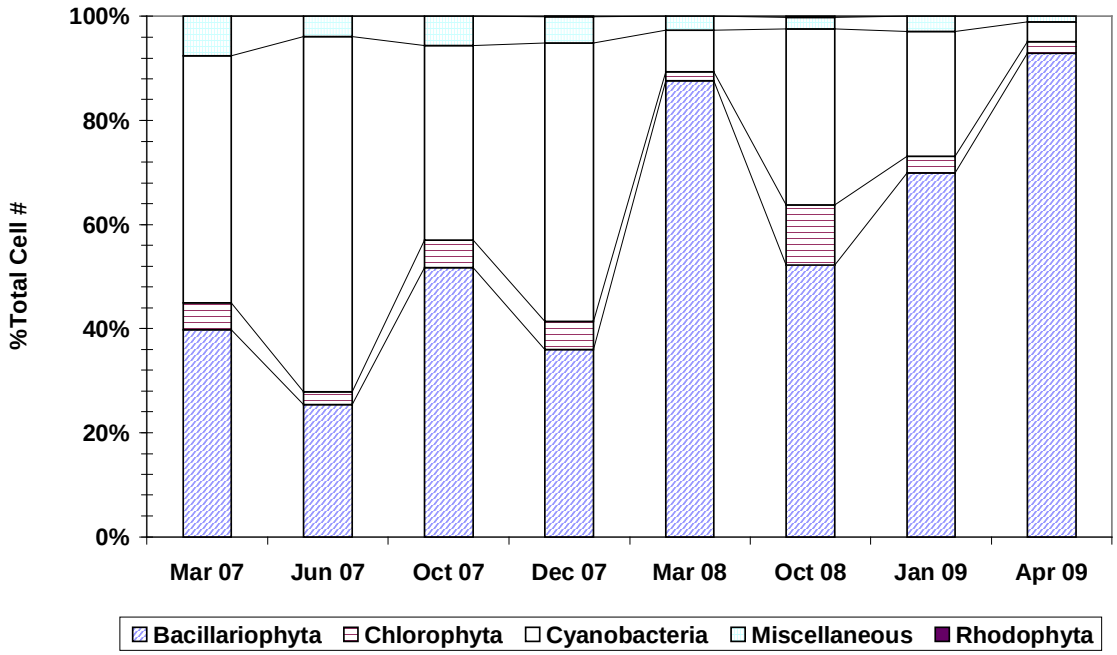

Fig. 116: SGLR1 SAV Relative Abundance by Cell Number

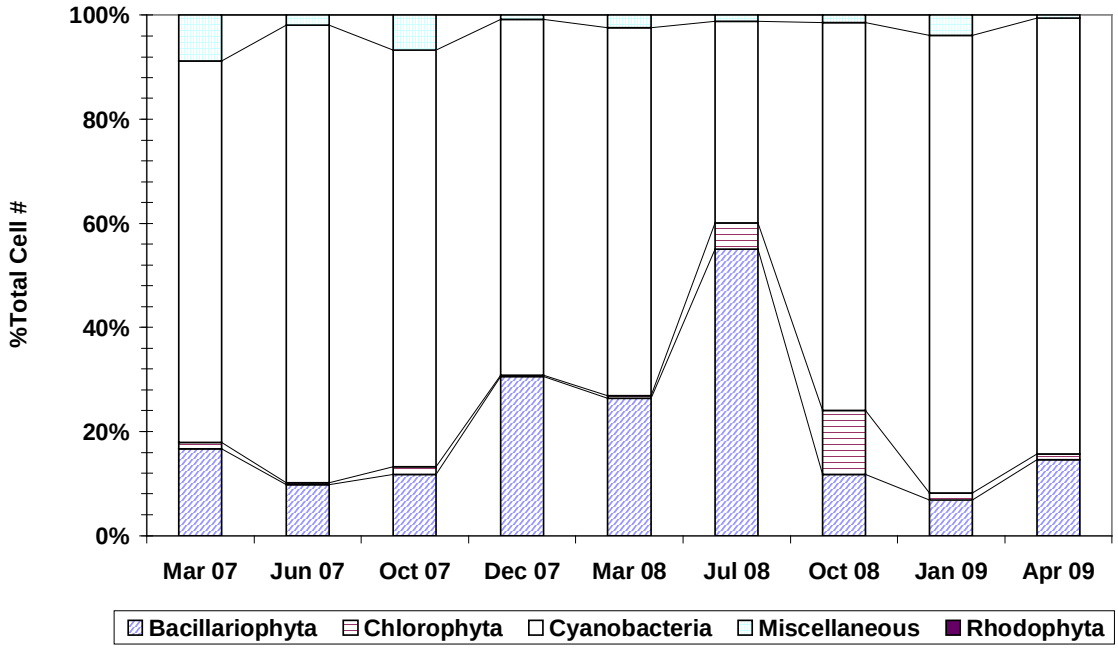

Fig. 117: WEKR1 PERI Relative Abundance by Biovolume

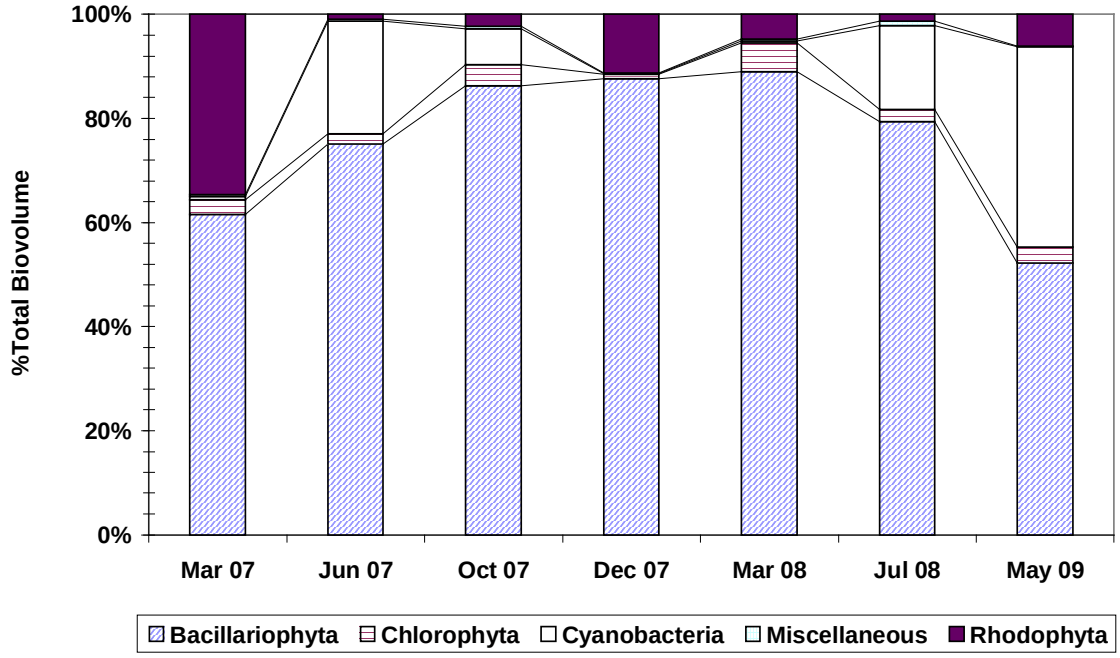

Fig. 118: WEKR1 WD Relative Abundance by Biovolume

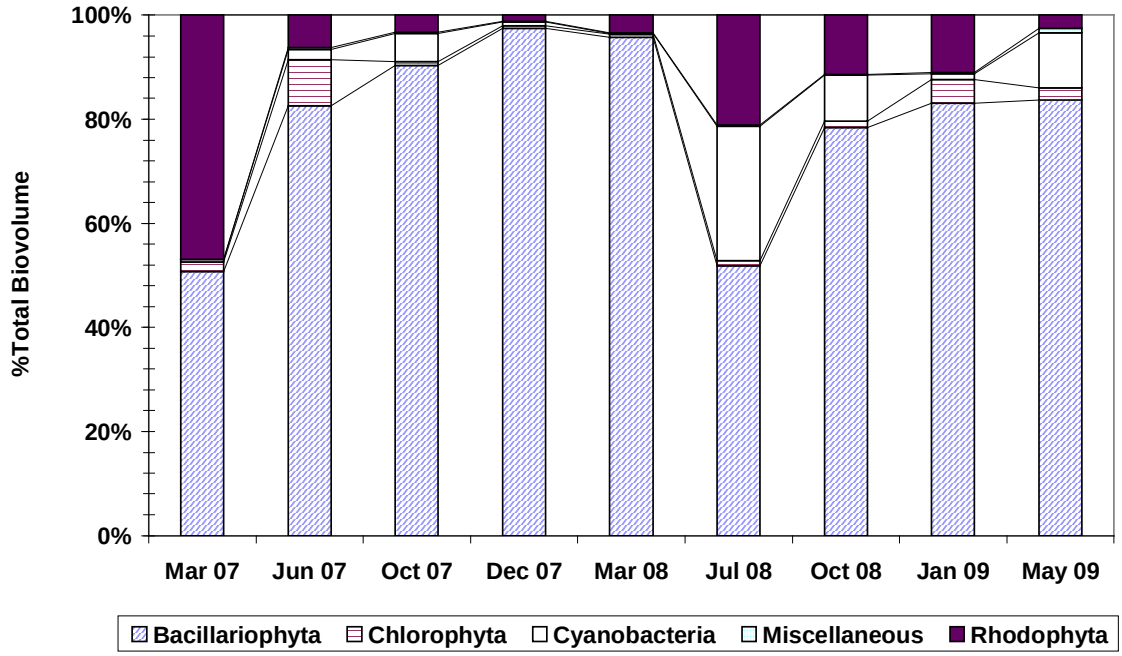

Fig. 119: WEKR3 PERI Relative Abundance by Biovolume

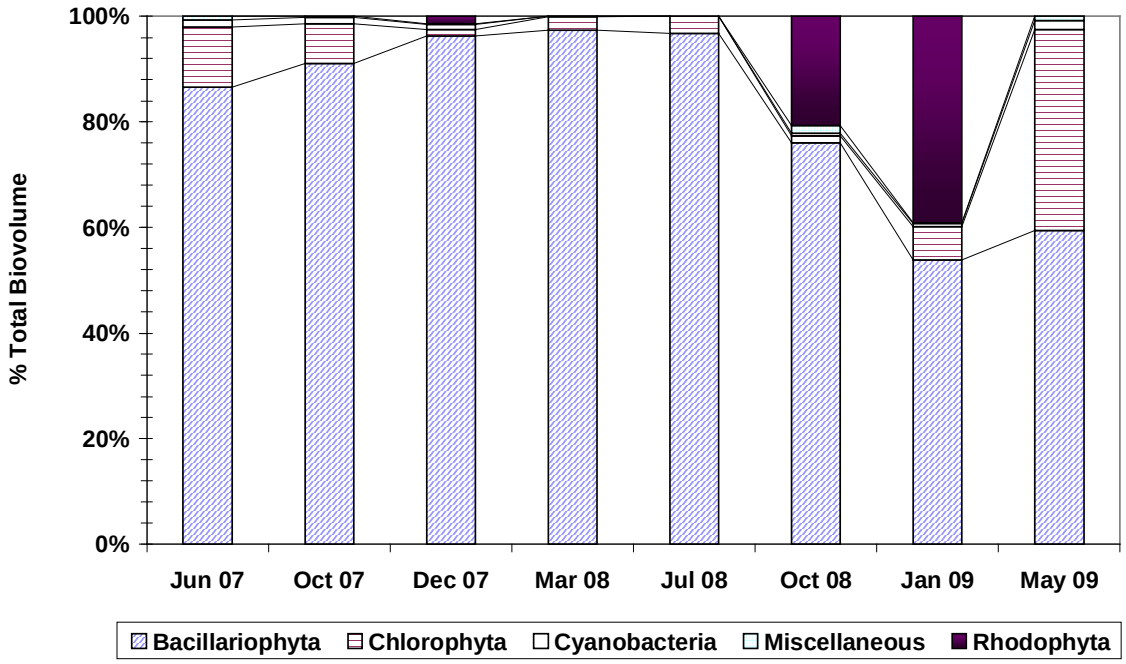

Fig. 120: WEKR3 SAV Relative Abundance by Biovolume

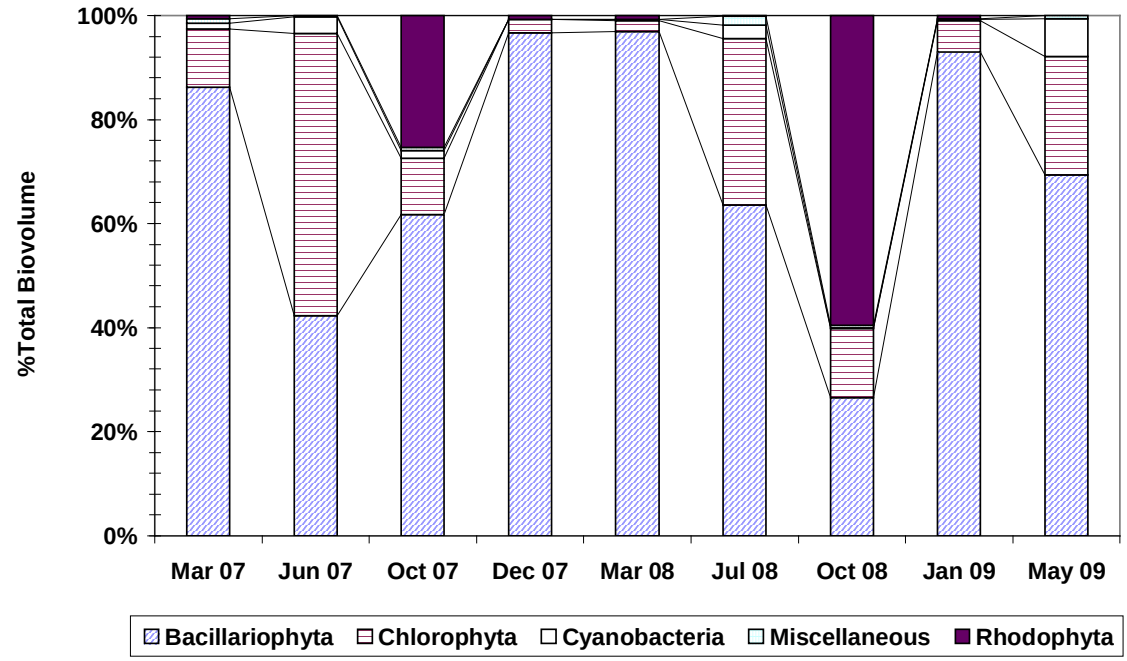

Fig. 121: RSR1 PERI Relative Abundance by Biovolume

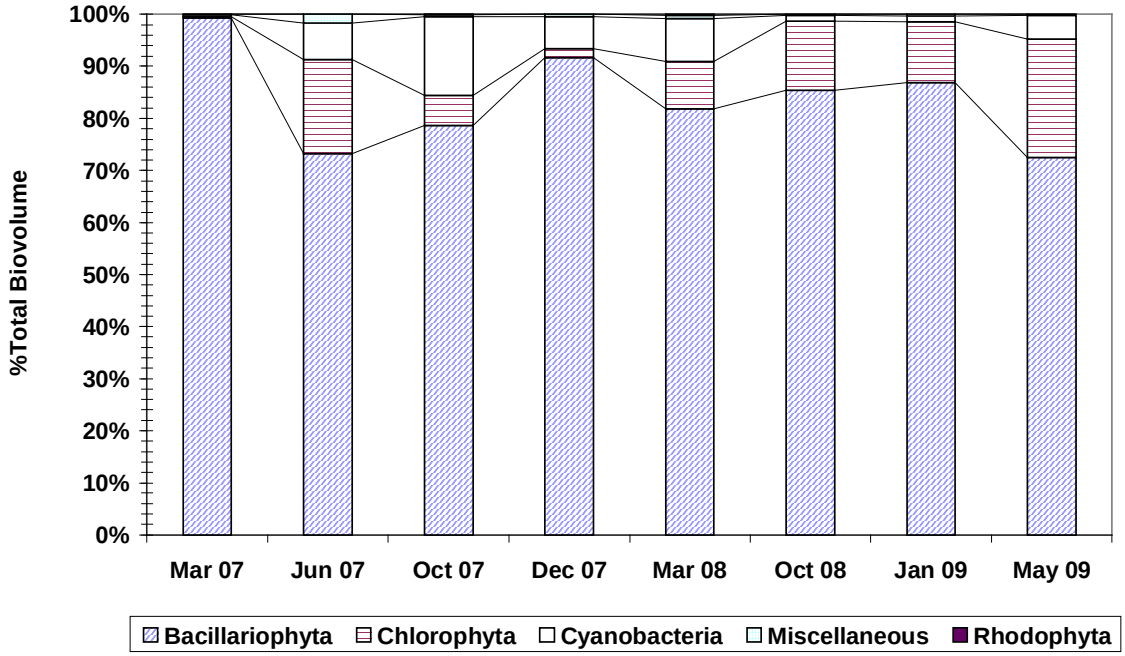

Fig. 122: RSR1 WD Relative Abundance by Biovolume

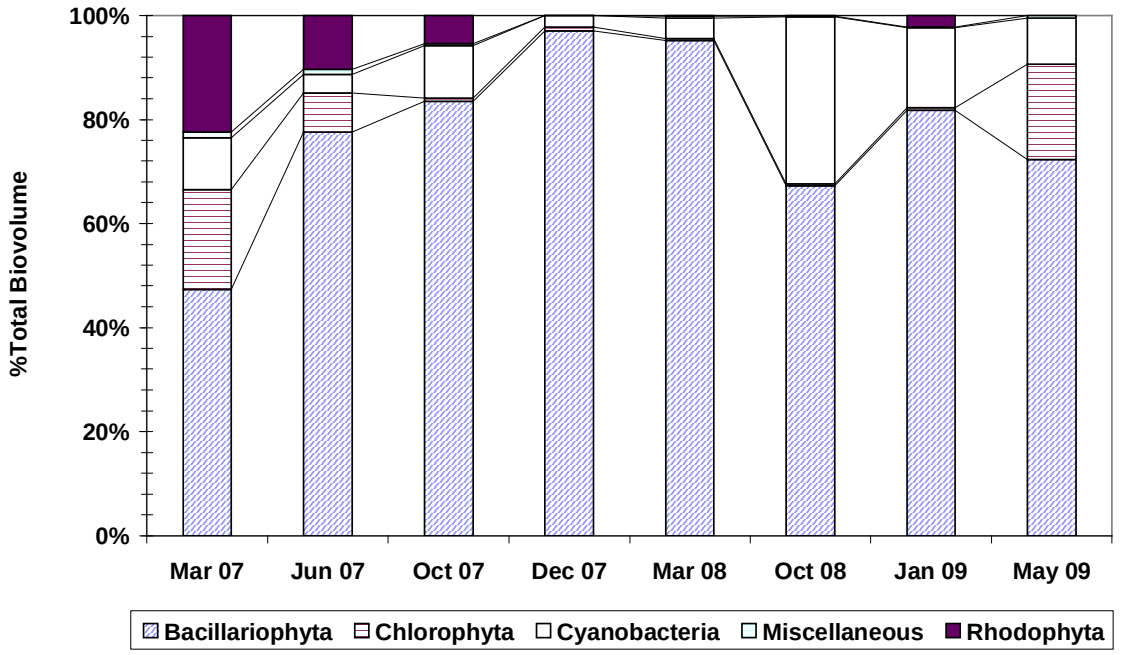

Fig. 123: RSR2 WD Relative Abundance by Biovolume

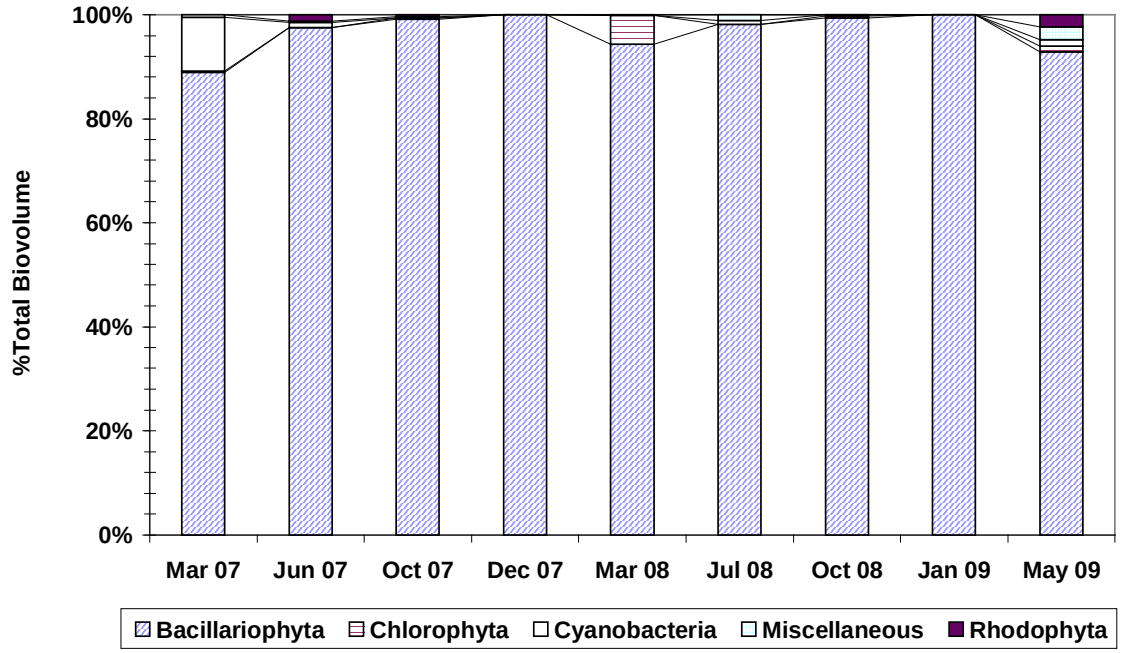

Fig. 124: JUNC1 PERI Relative Abundance by Biovolume

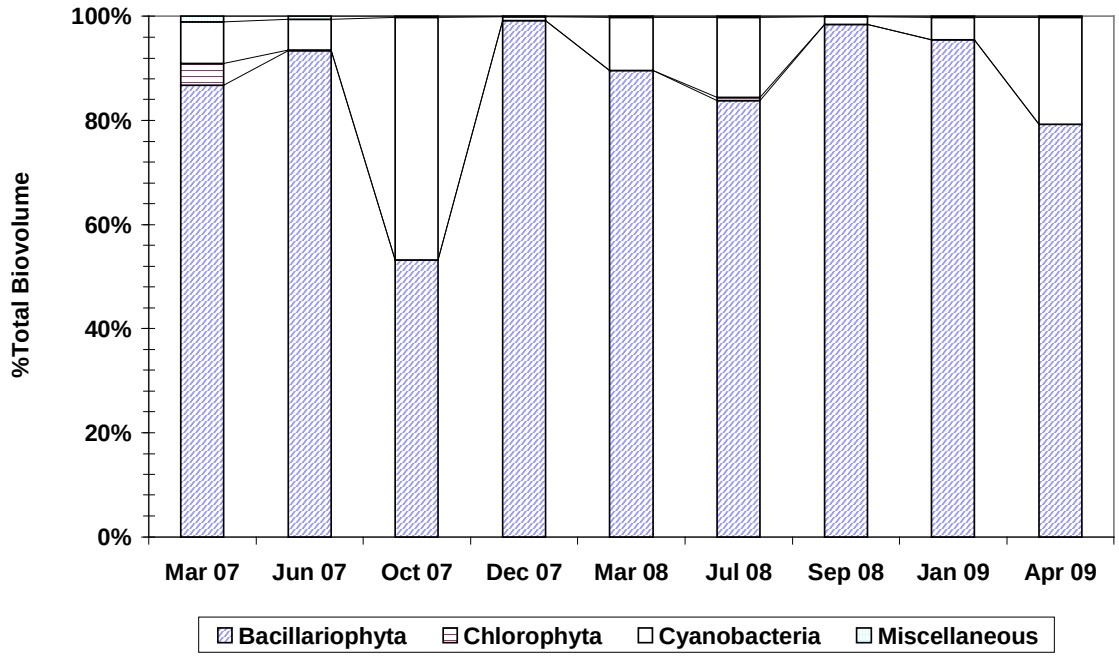

Fig. 125: JUNC1 SAV Relative Abundance by Biovolume

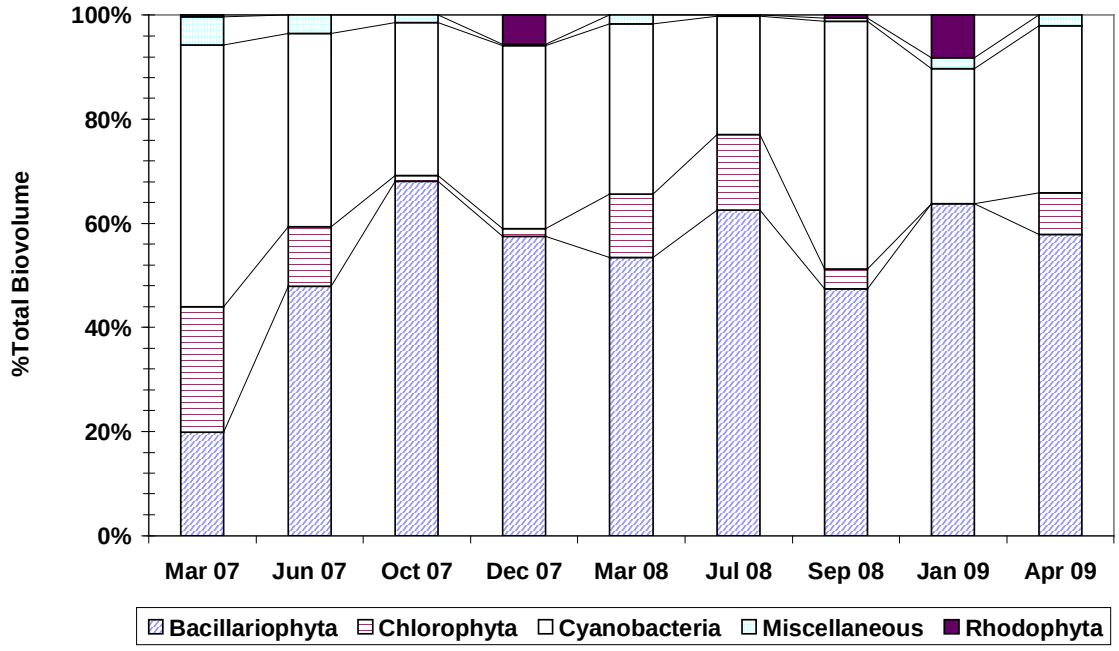

Fig. 126: JUNC2 SAV Relative Abundance by Biovolume

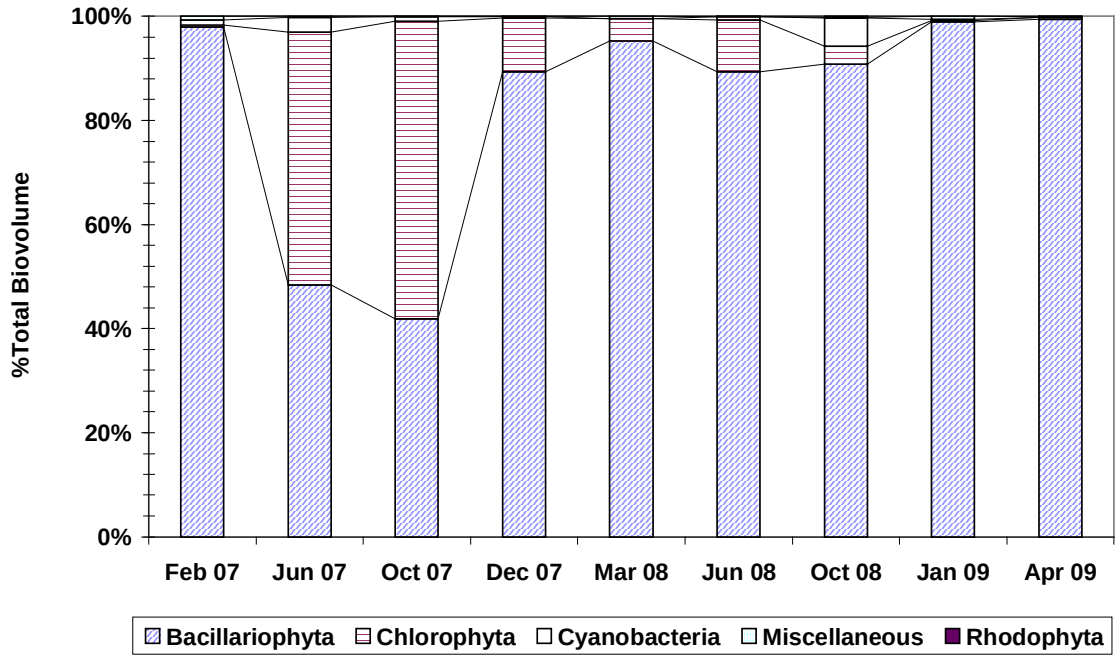

Fig. 127: ALXC1 PERI Relative Abundance by Biovolume

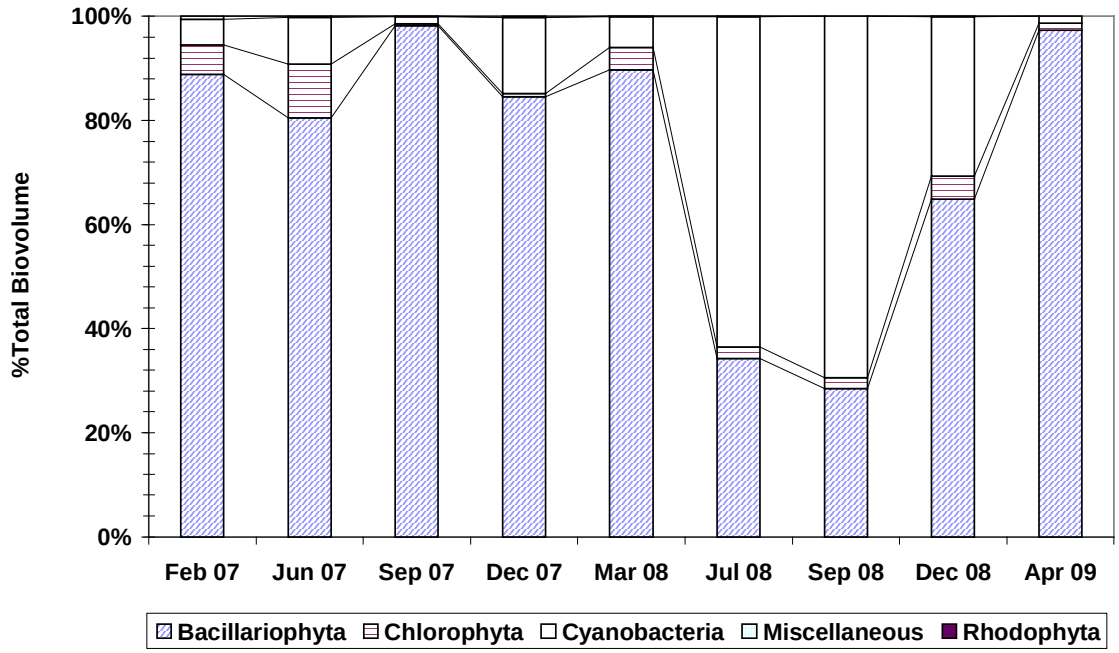

Fig. 128: ALXC1 SAV Relative Abundance by Biovolume

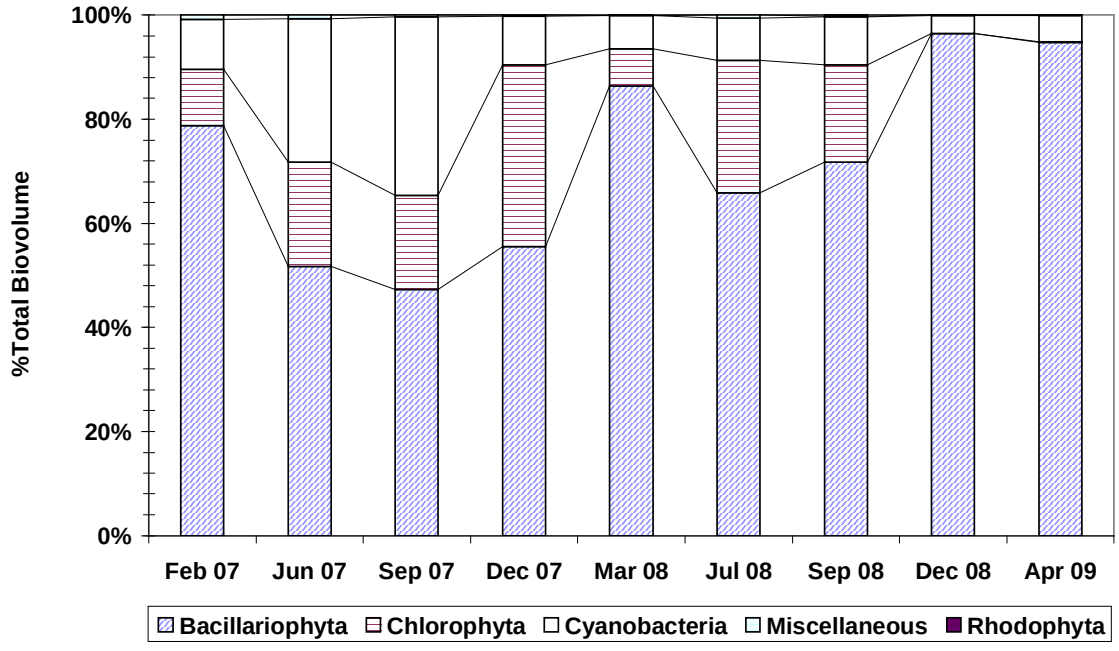

Fig. 129: ALXC2 WD Relative Abundance by Biovolume

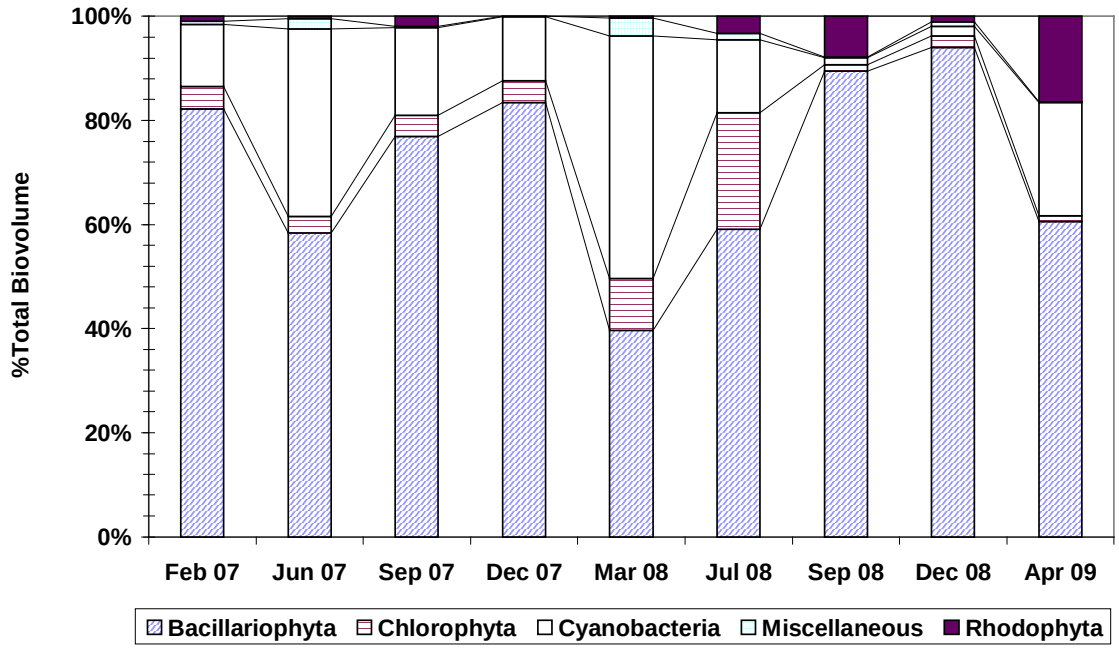

Fig. 130: SGLR1 PERI Relative Abundance by Biovolume

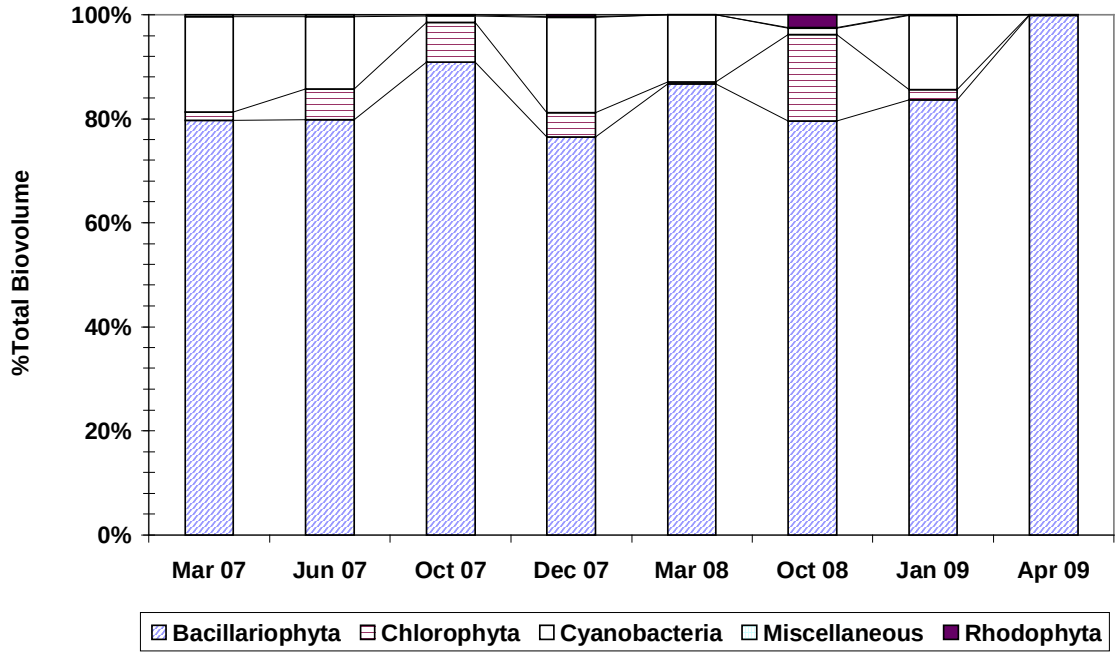

Fig. 131: SGLR1 SAV Relative Abundance by Biovolume

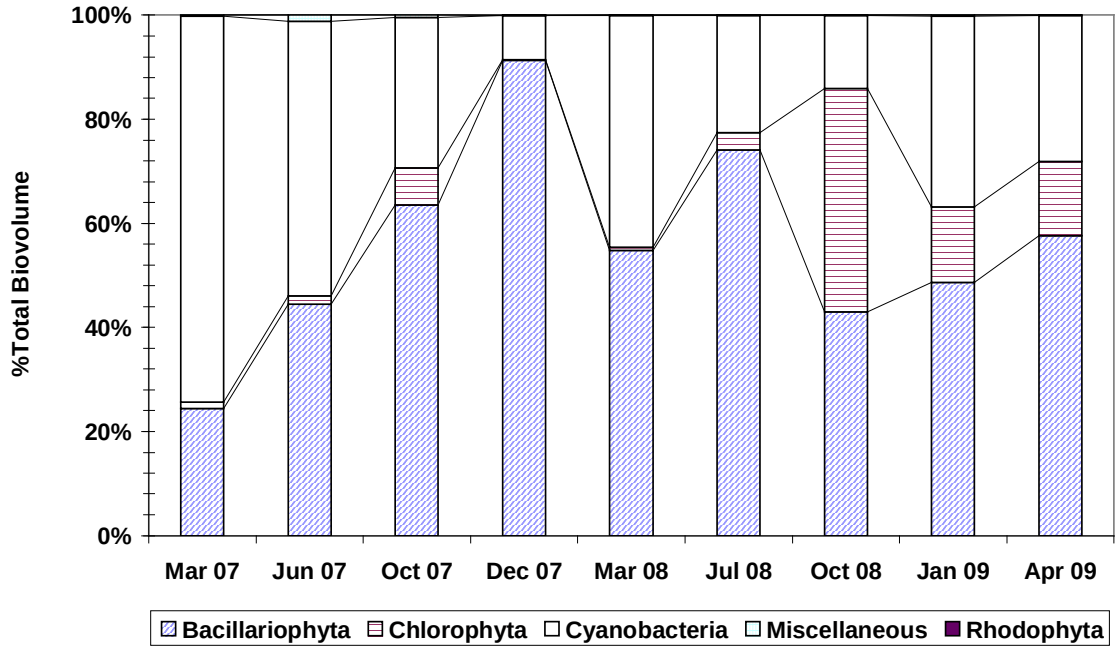

Fig. 132: WEKR1 Emergent, Woody Debris and Periphytometer Chl-*a*

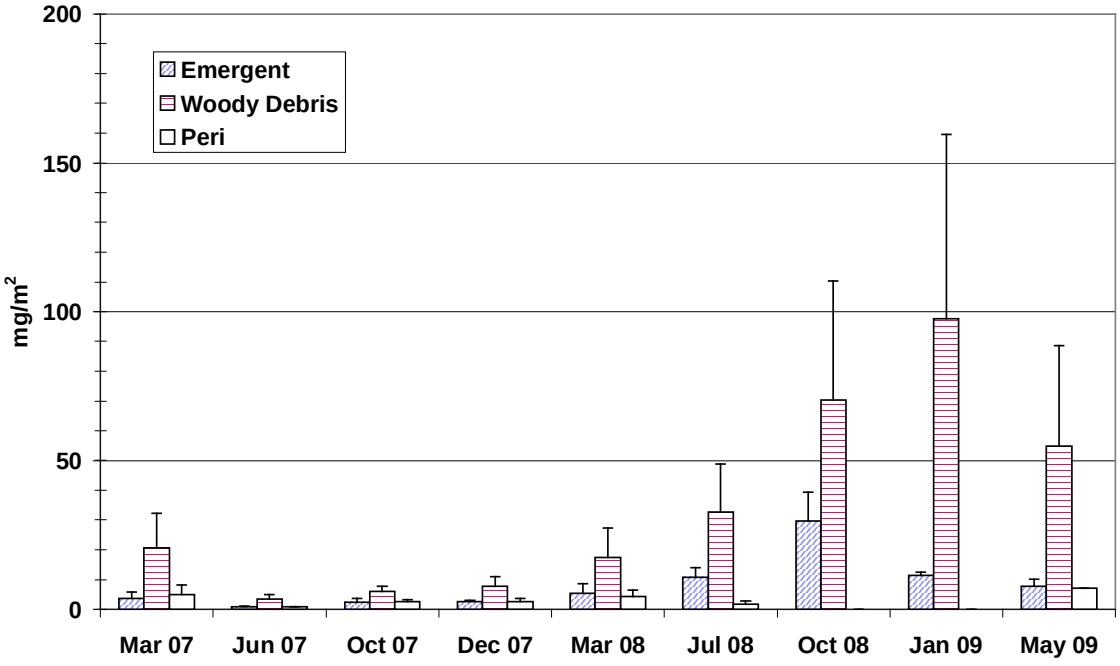

Fig. 133: WEKR1 Sediment chl-*a*

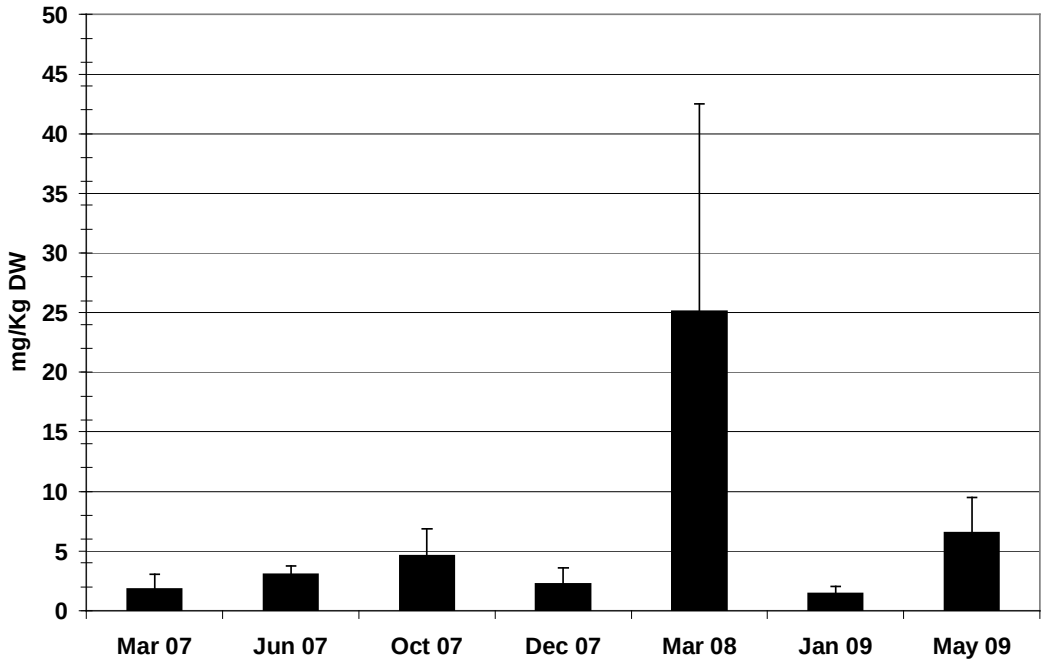

Fig. 134: WEKR3 Emergent, SAV and Periphytometer Chl-*a*

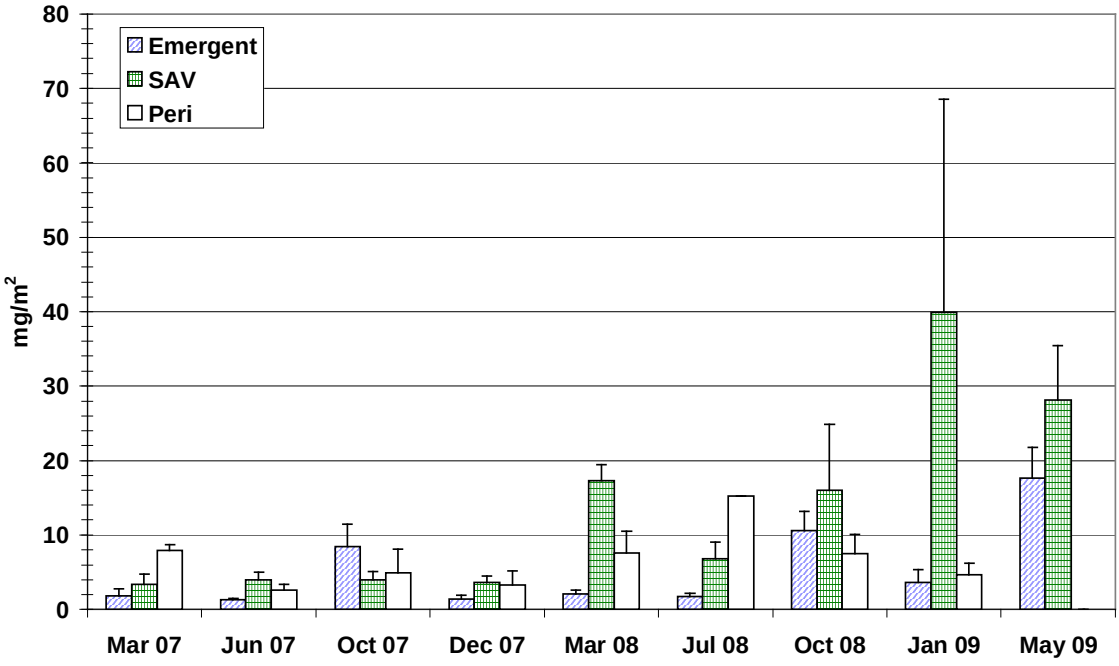

Fig. 135: RSR1 Emergent, Woody Debris and Periphytometer Chl-*a*

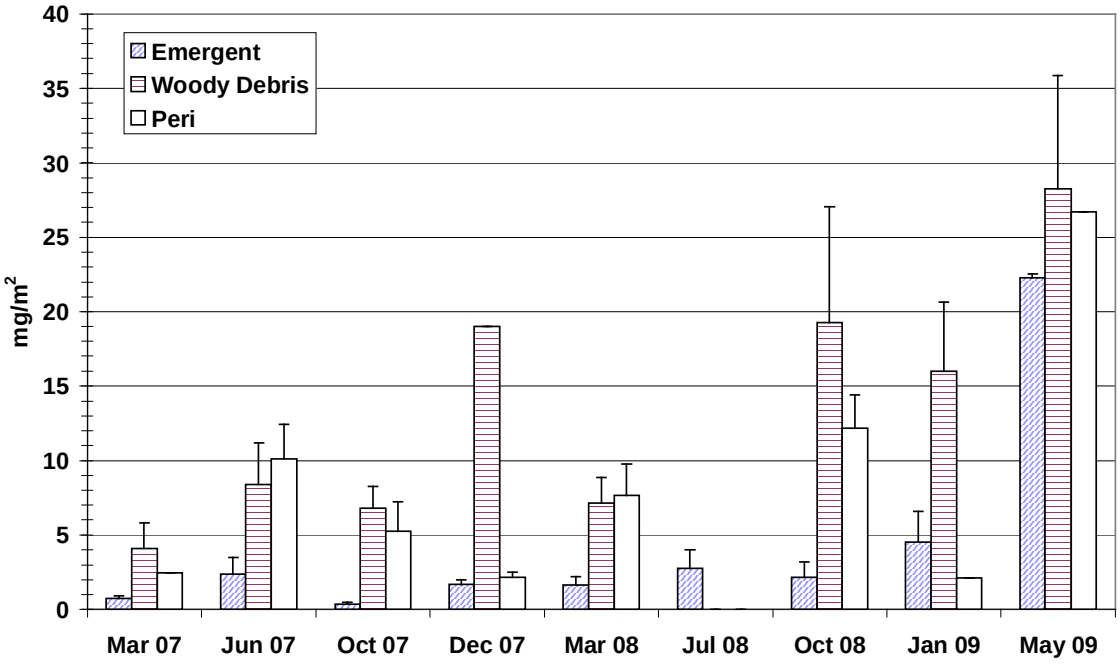

Fig. 136: RSR1 Sediment chl-*a*

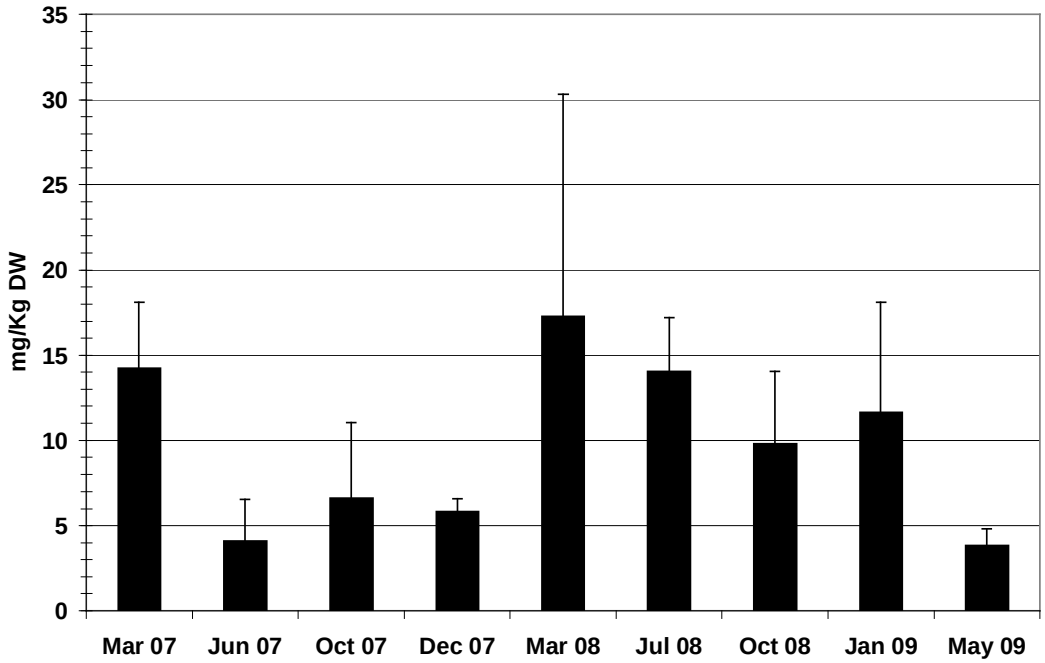

Fig. 137: RSR2 Emergent and Woody Debris Chl-*a*

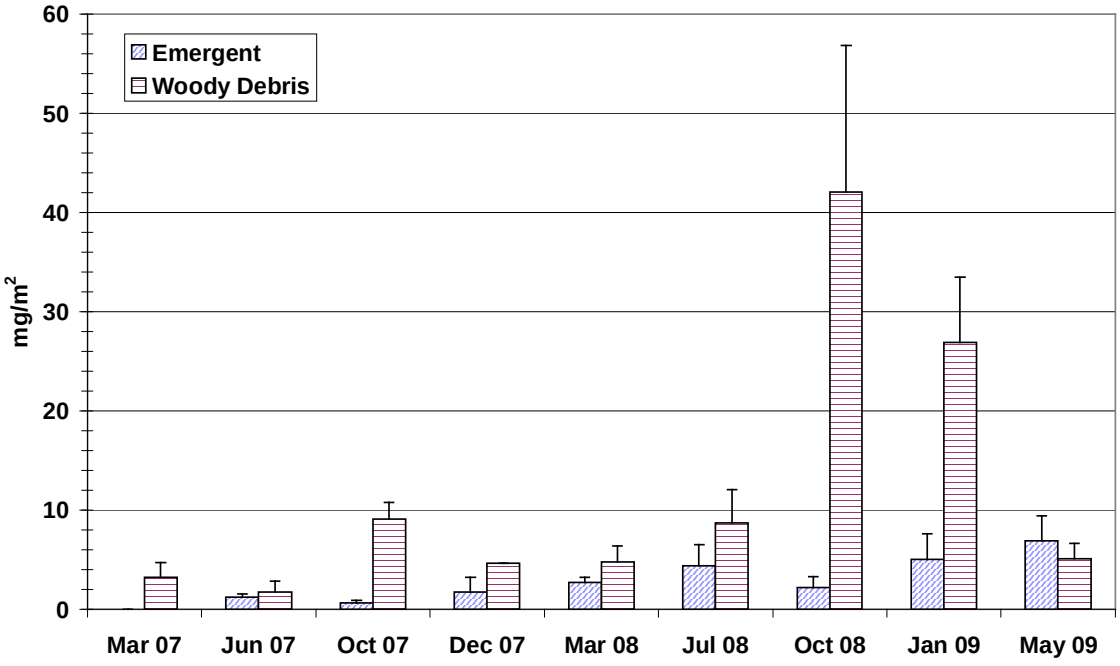

Fig. 138: RSR2 Sediment chl-*a*

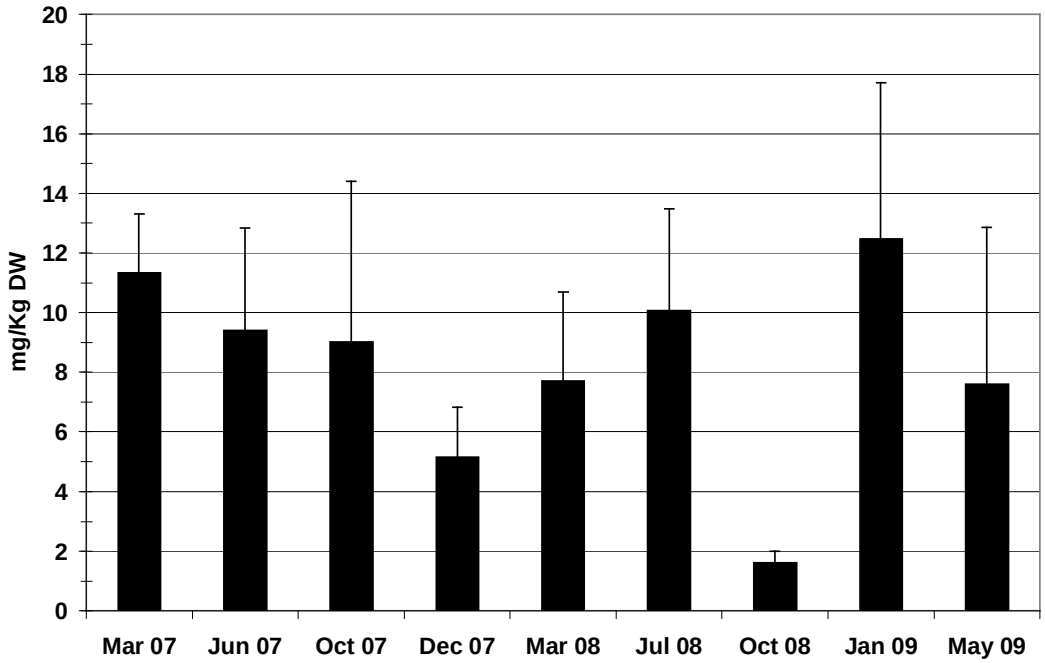

Fig. 139: JUNC1 SAV and Periphytometer Chl-*a*

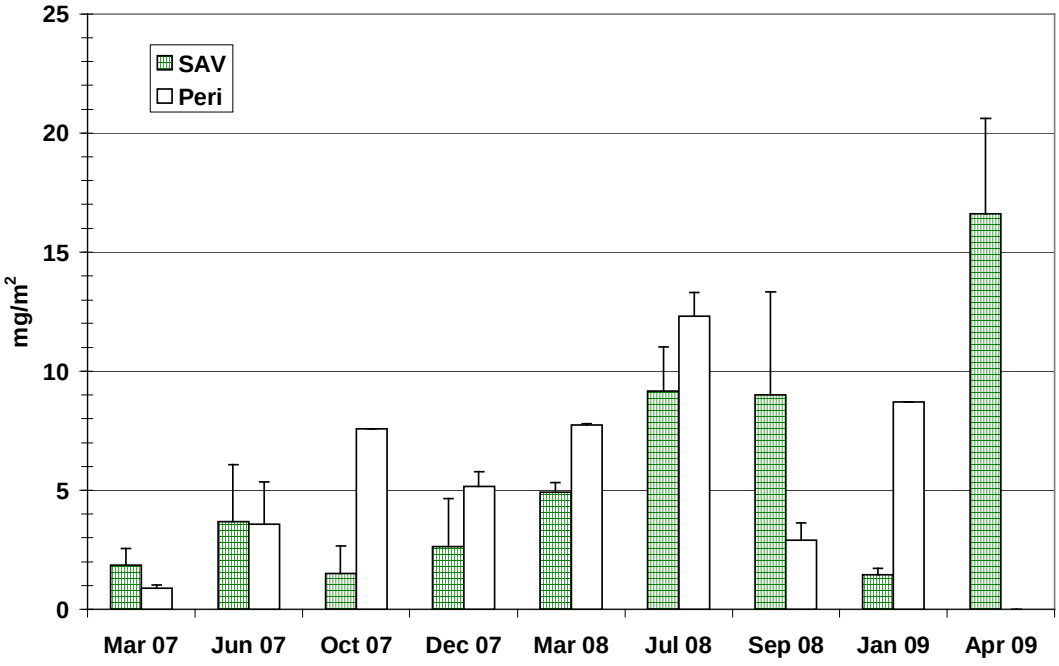

Fig. 140: JUNC1 Sediment chl-*a*

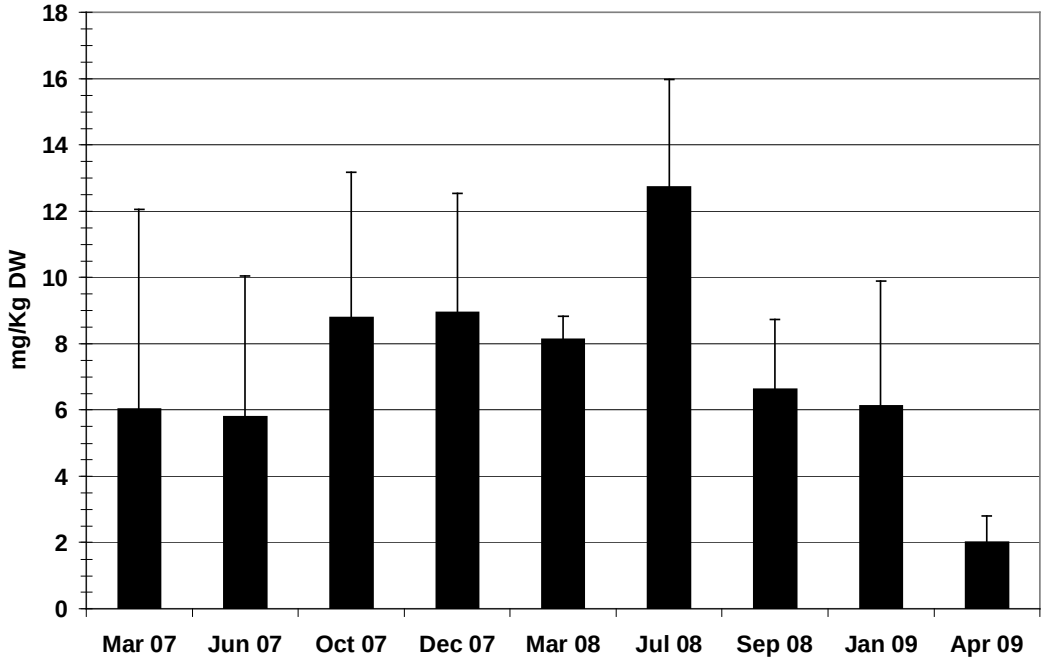

Fig. 141: JUNC2 SAV Chl-*a*

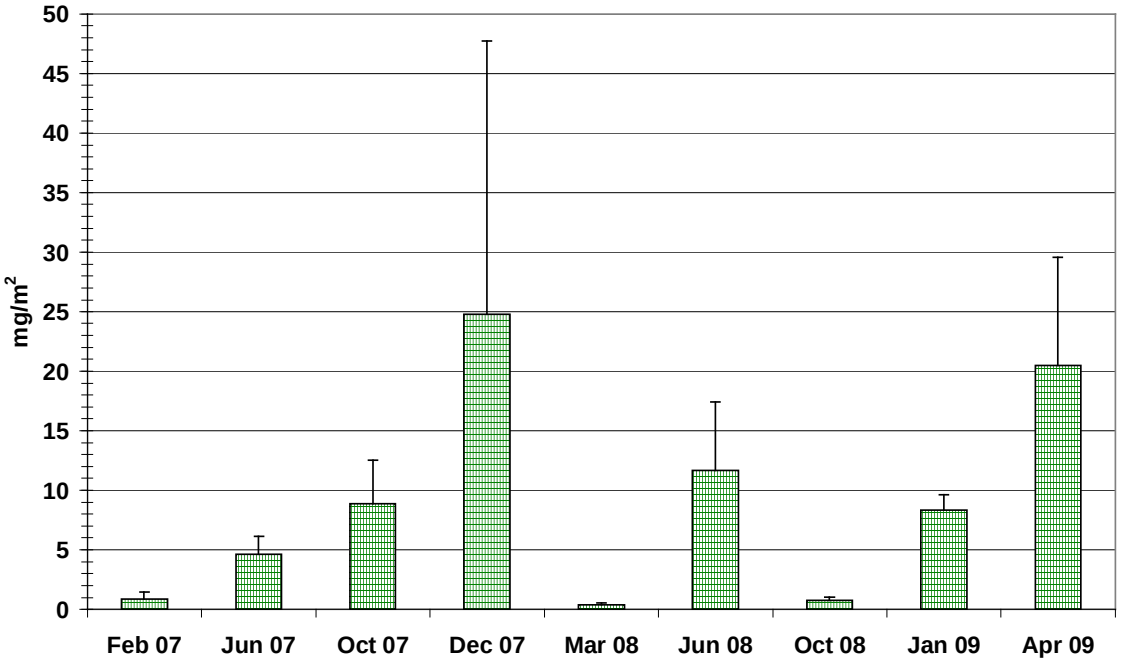

Fig. 142: JUNC2 Sediment chl-*a*

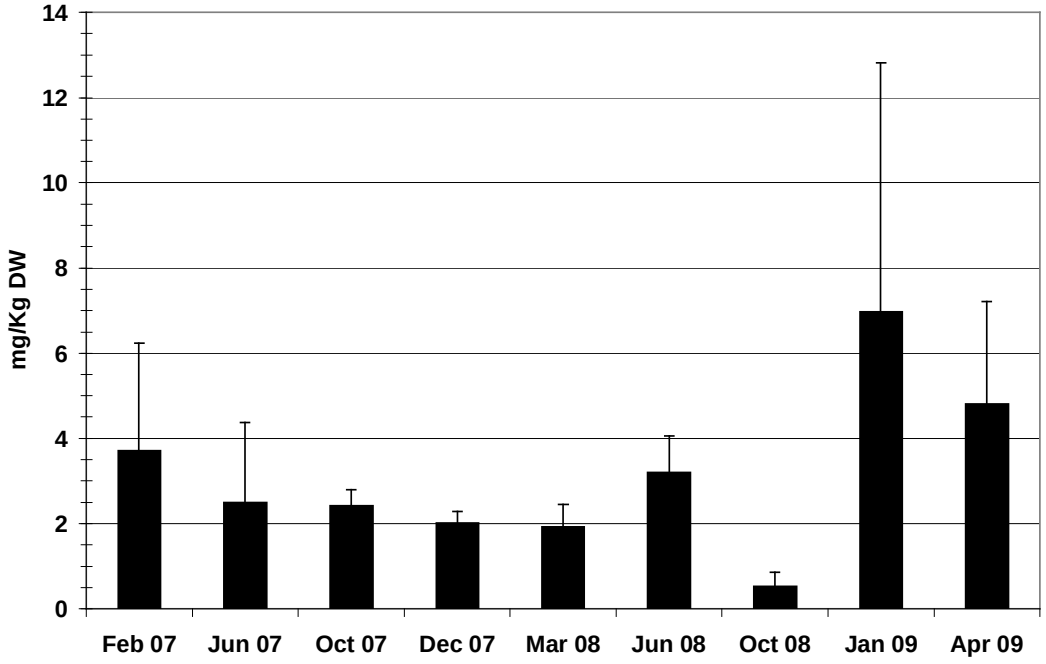

Fig. 143: ALXC1 Emergent, SAV and Periphytometer Chl-*a*

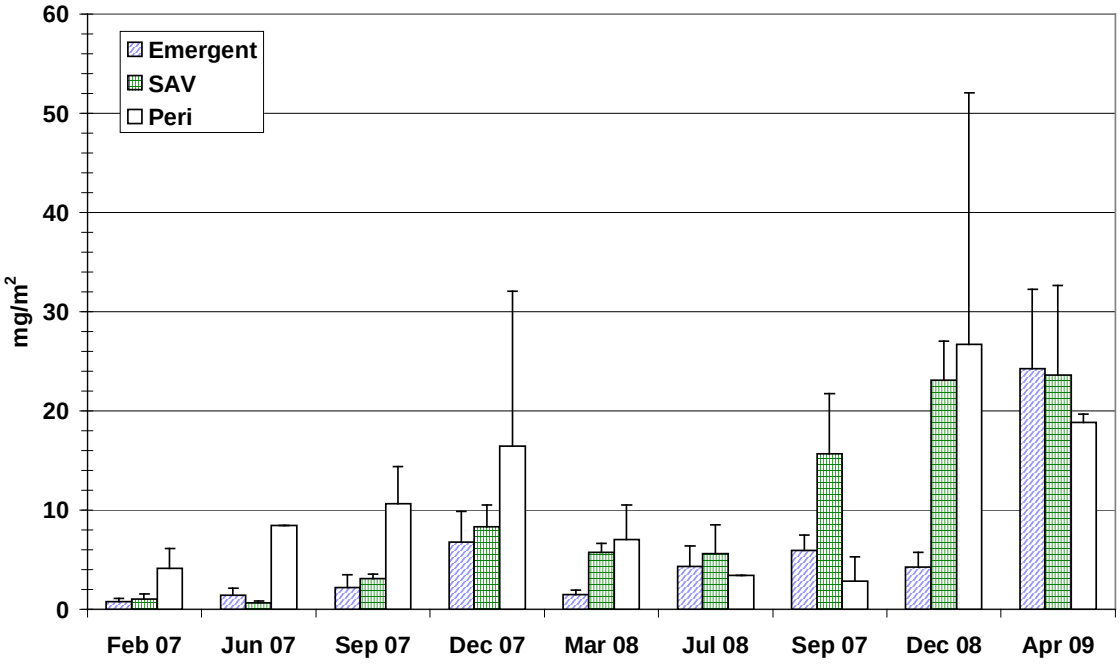

Fig. 144: ALXC2 Emergent and Woody Debris Chl-*a*

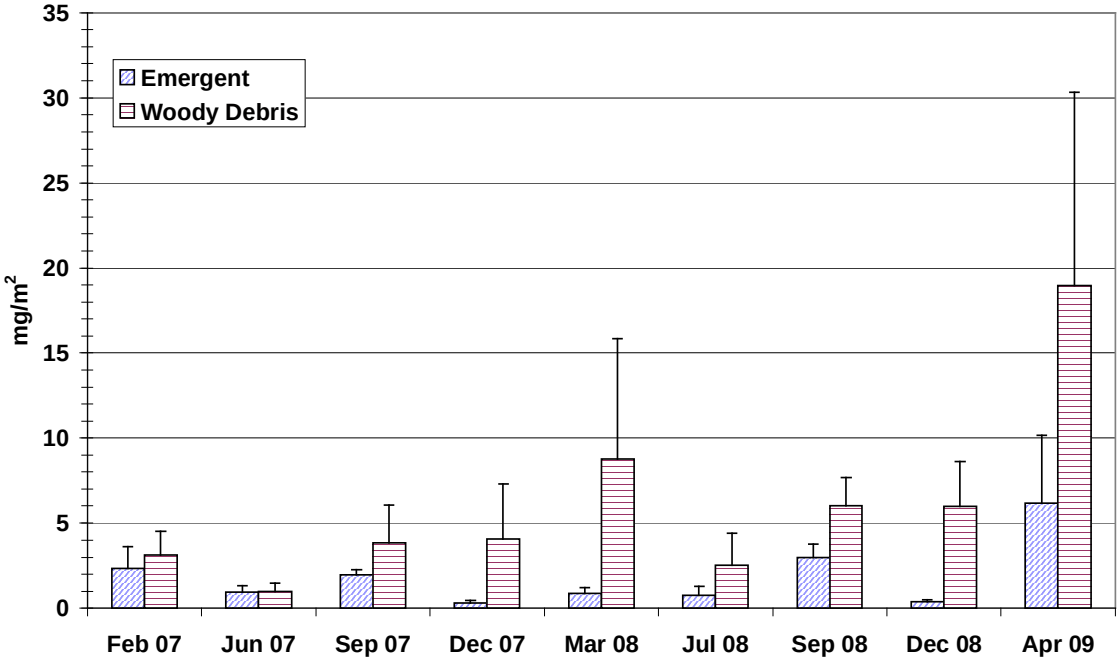

Fig. 145: ALXC2 Sediment chl-*a*

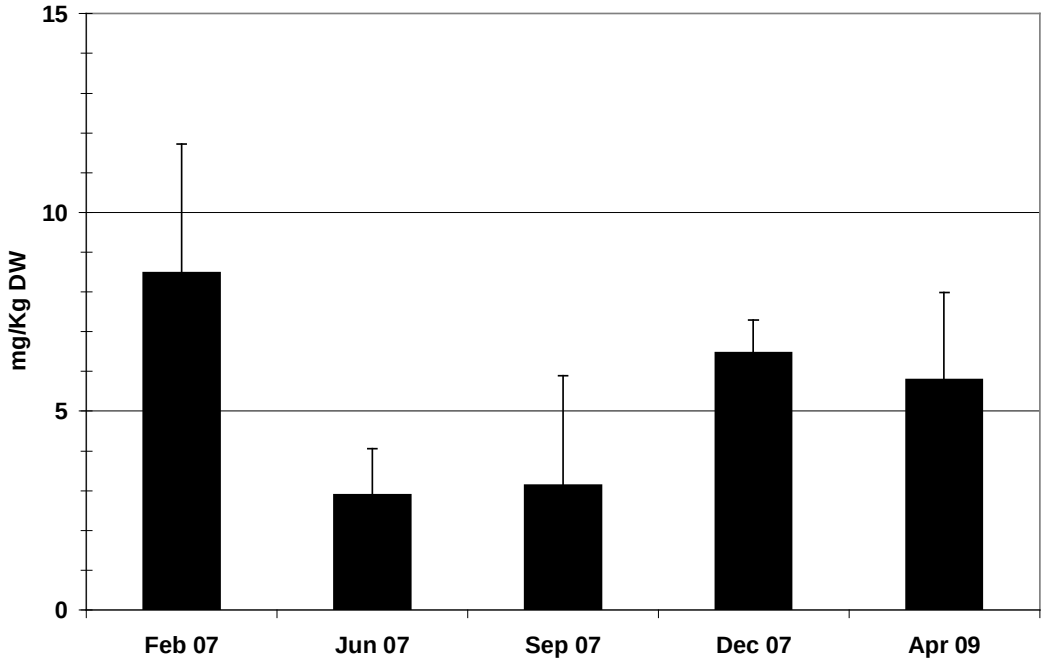

Fig. 146: SGLR1 SAV and Periphytometer Chl-*a*

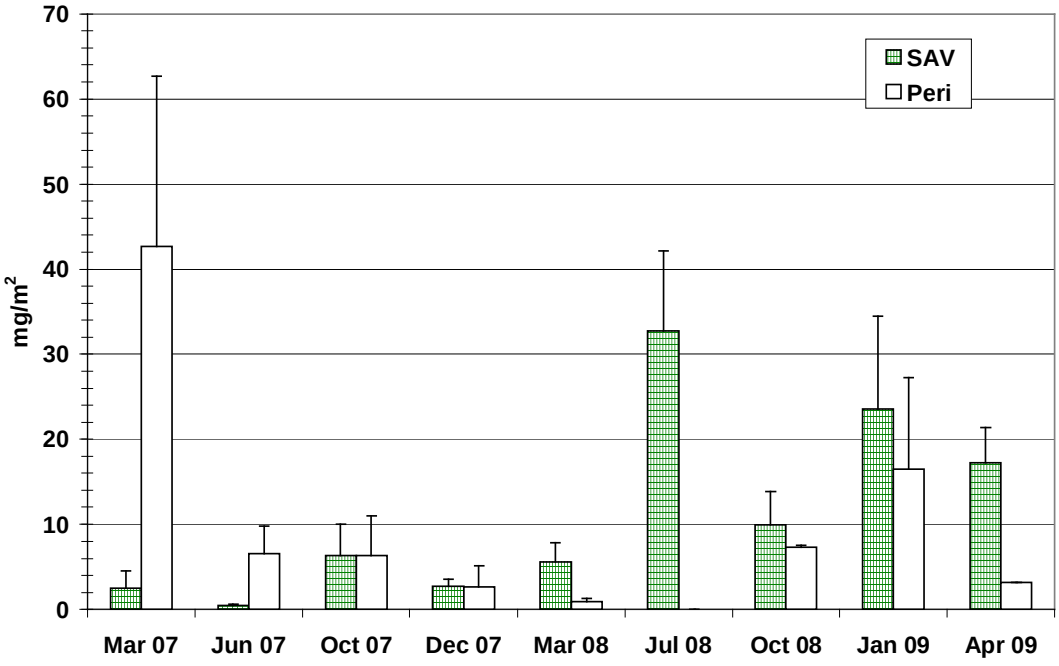

Fig. 147: WEKR1 Emergent, Woody Debris and Periphytometer AFDW

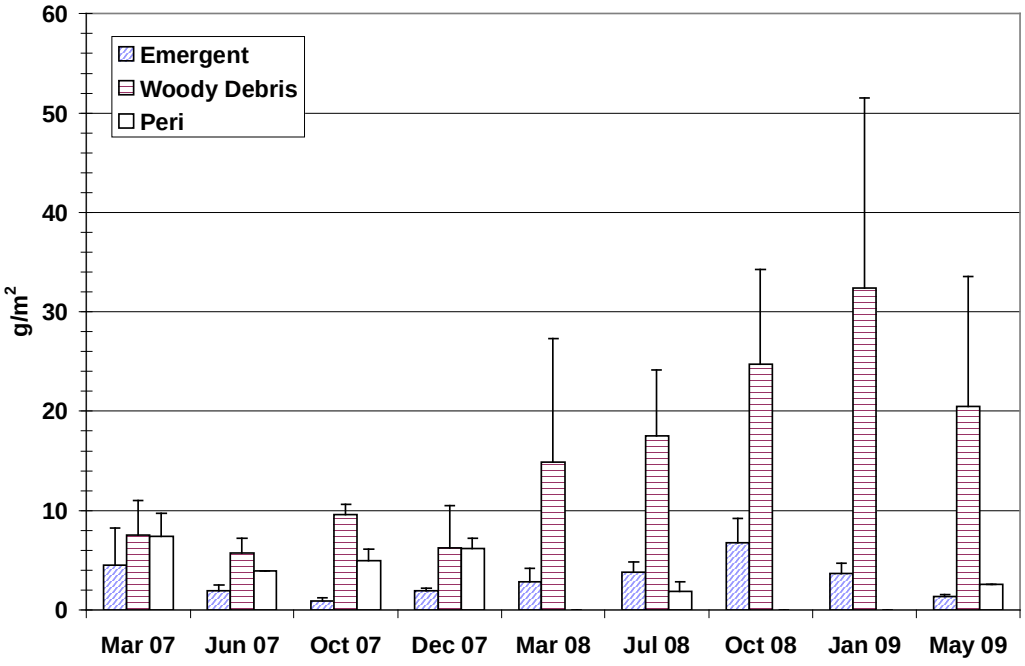

Fig. 148: WEKR1 Sediment AFDW

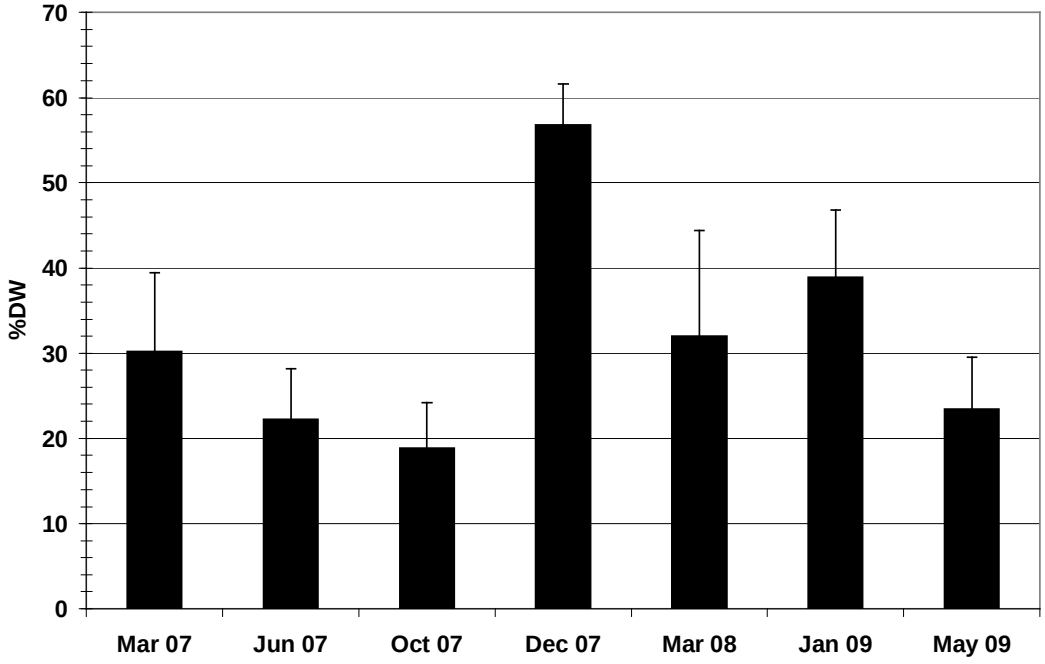

Fig. 149: WEKR3 Emergent, SAV and Periphytometer AFDW

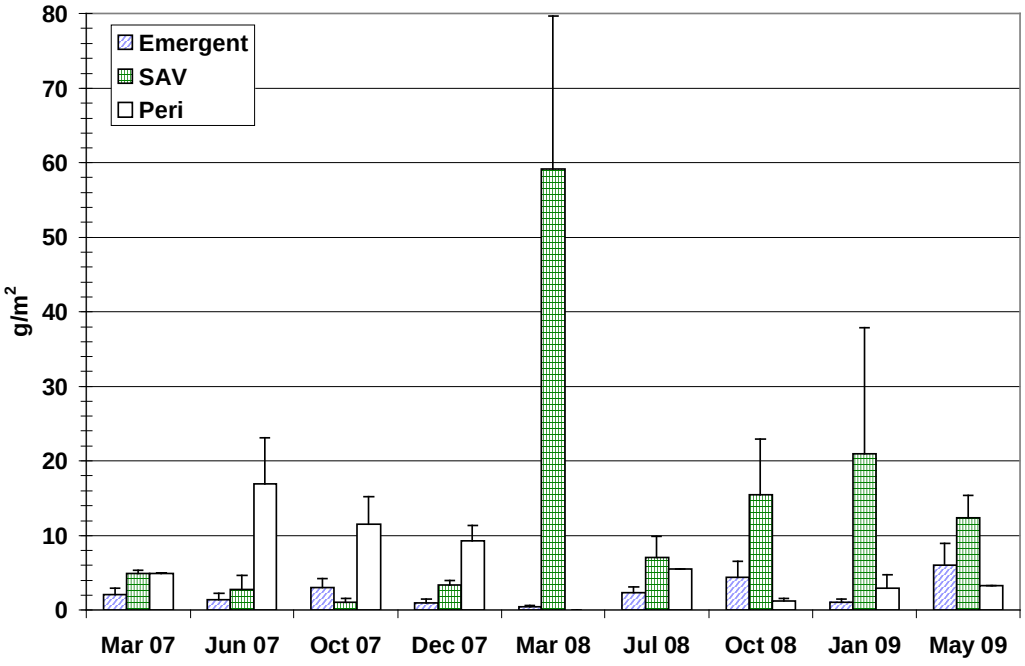

Fig. 150: RSR1 Emergent, Woody Debris and Periphytometer AFDW

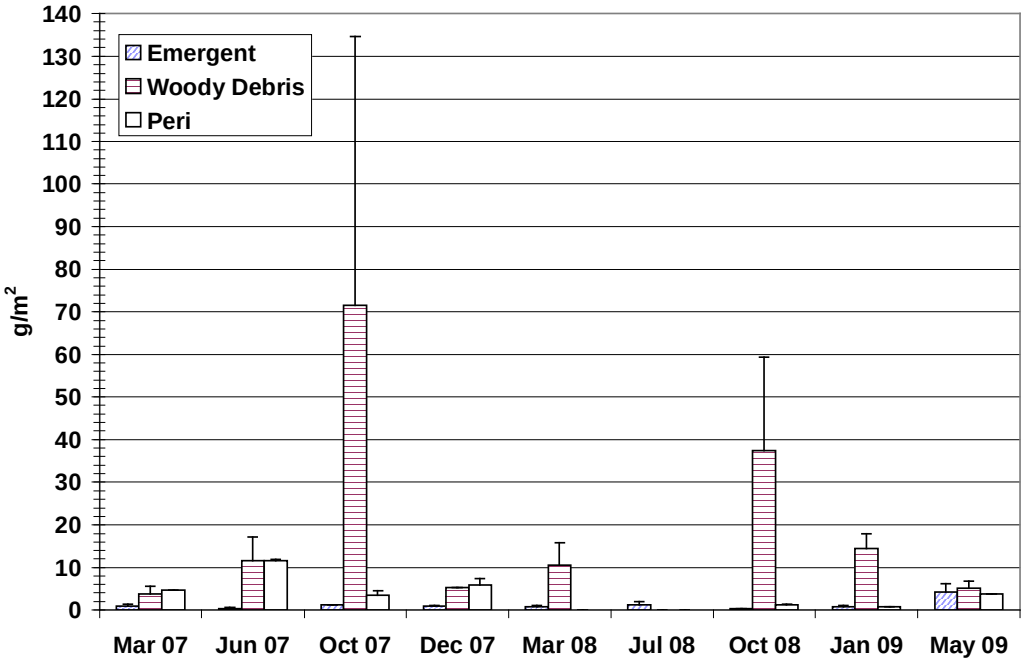

Fig. 151: RSR1 Sediment AFDW

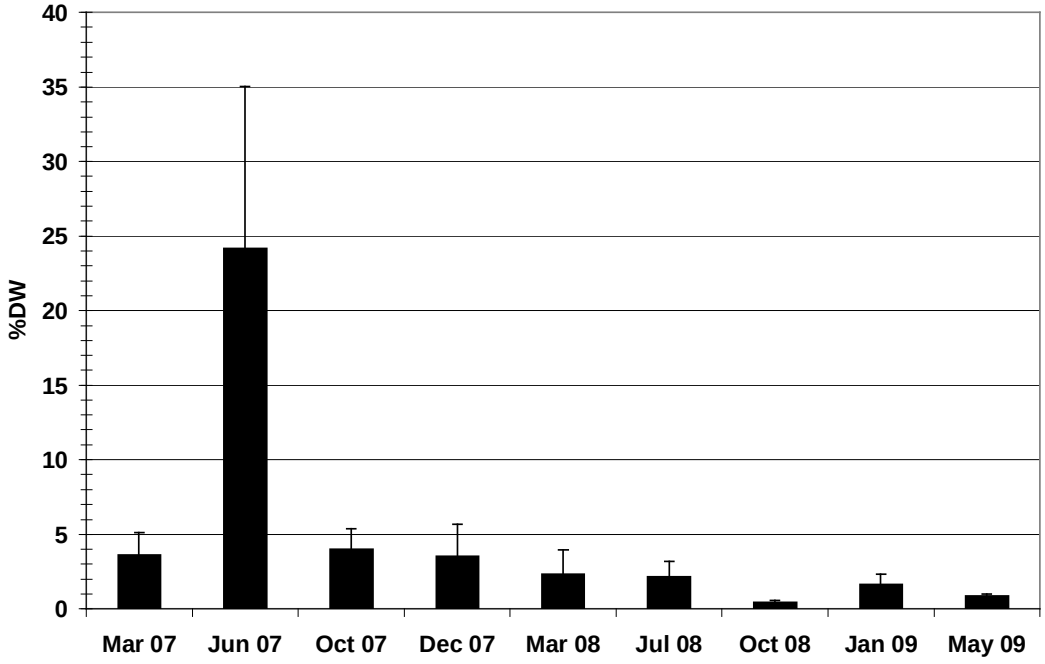

Fig. 152: RSR2 Emergent and Woody Debris AFDW

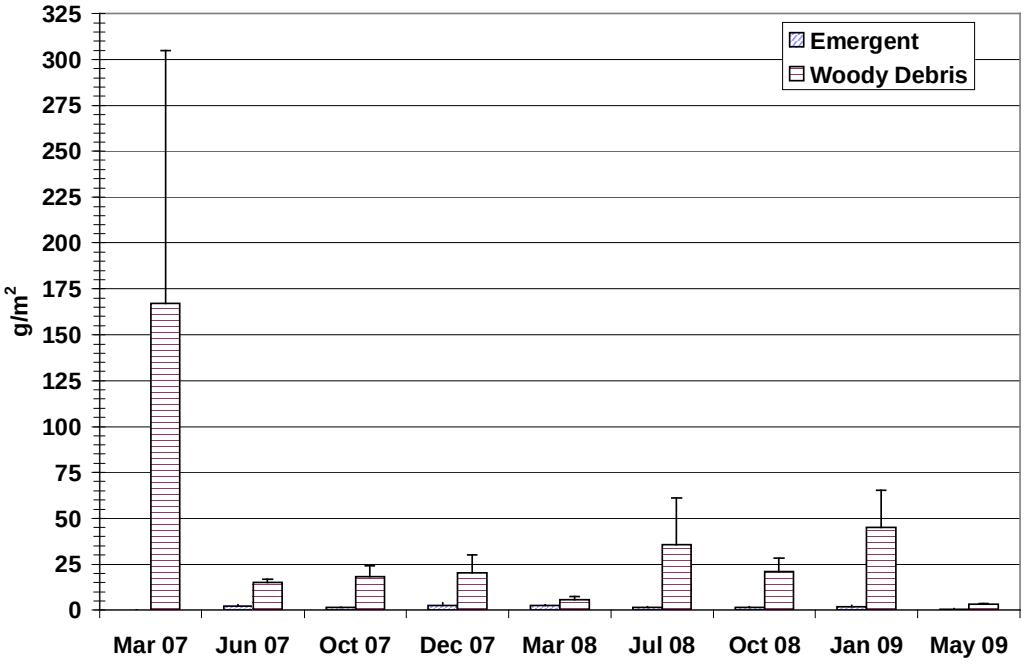

Fig. 153: RSR2 Sediment AFDW

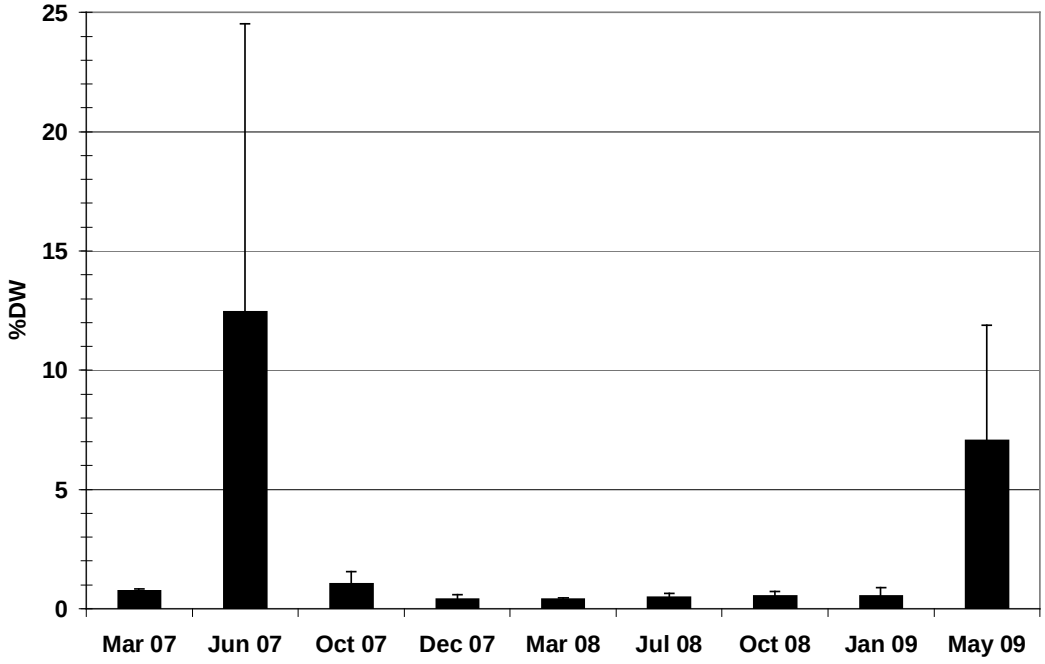

Fig. 154: JUNC1 SAV and Periphytometer AFDW

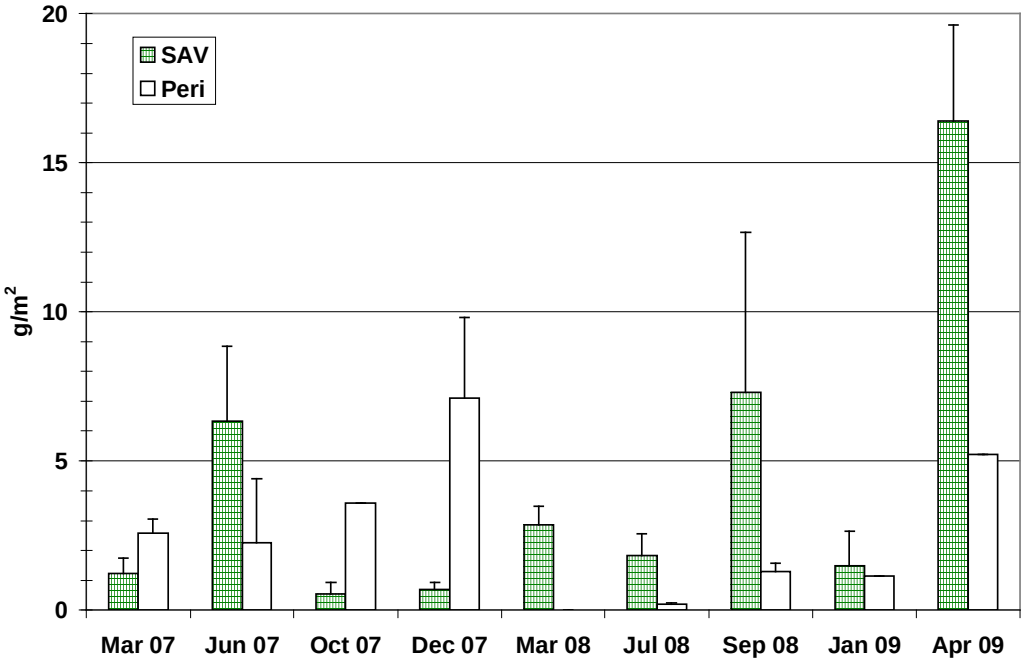

Fig. 155: JUNC1 Sediment AFDW

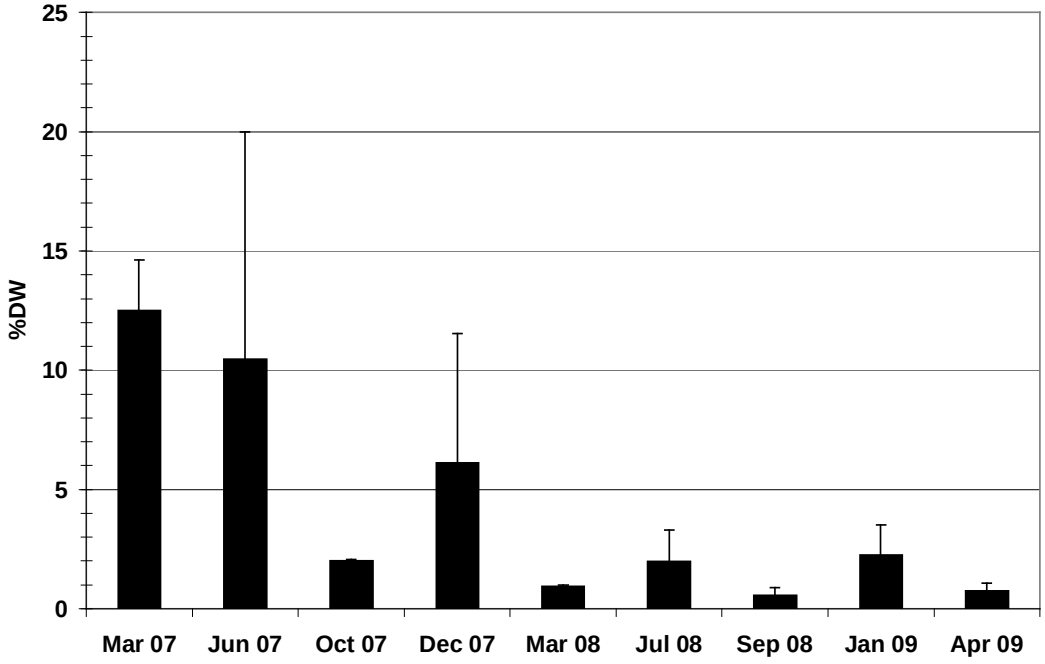

Fig. 156: JUNC2 SAV AFDW

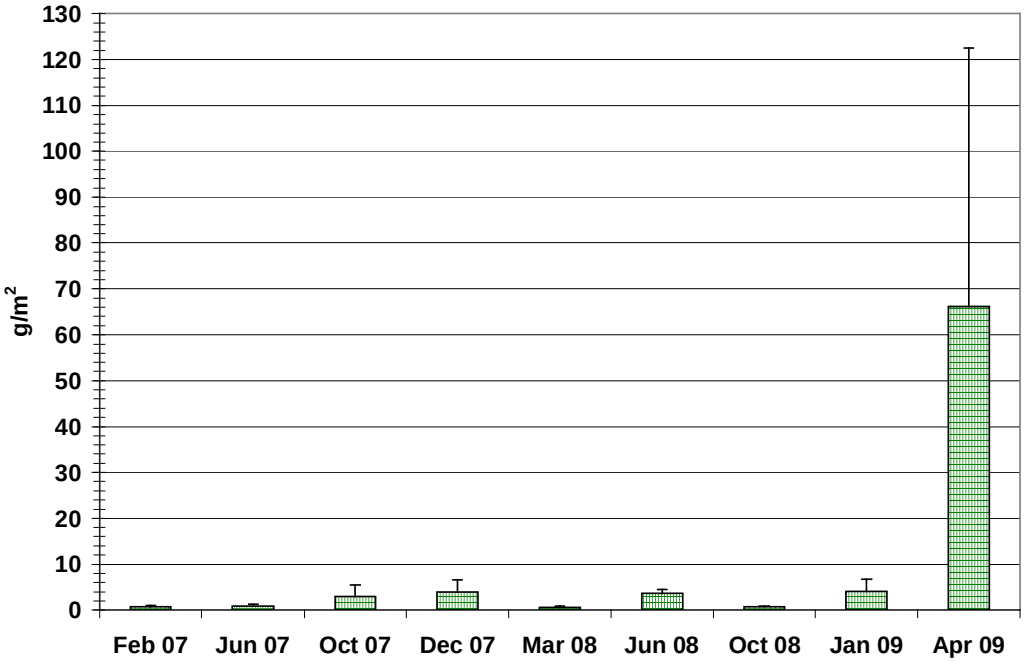

Fig. 157: JUNC2 Sediment AFDW

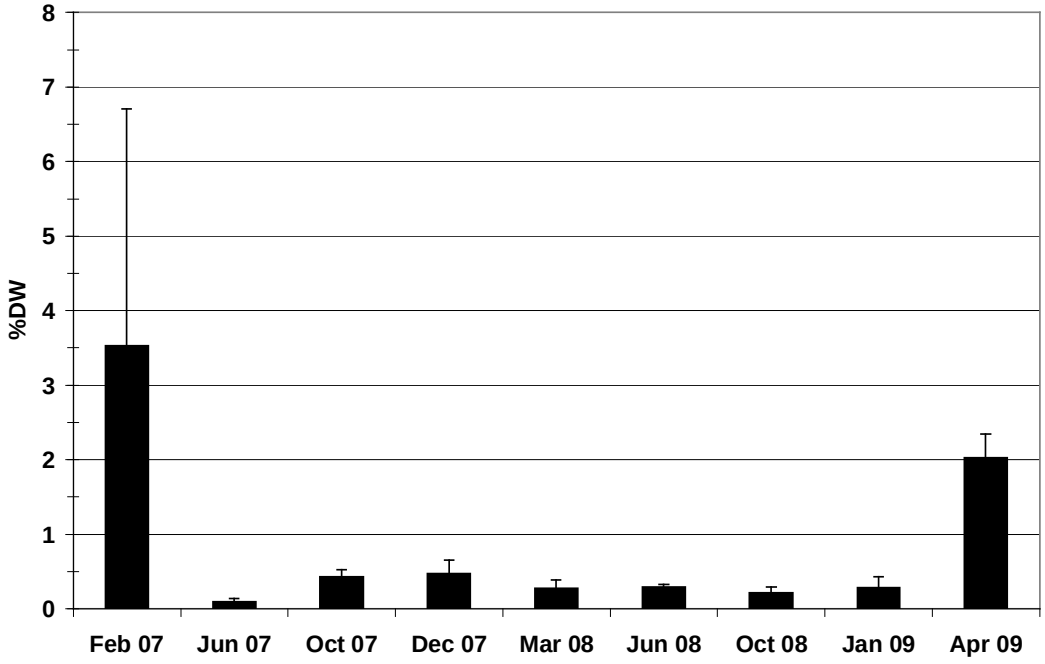

Fig. 158: ALXC1 Emergent, SAV and Periphytometer AFDW

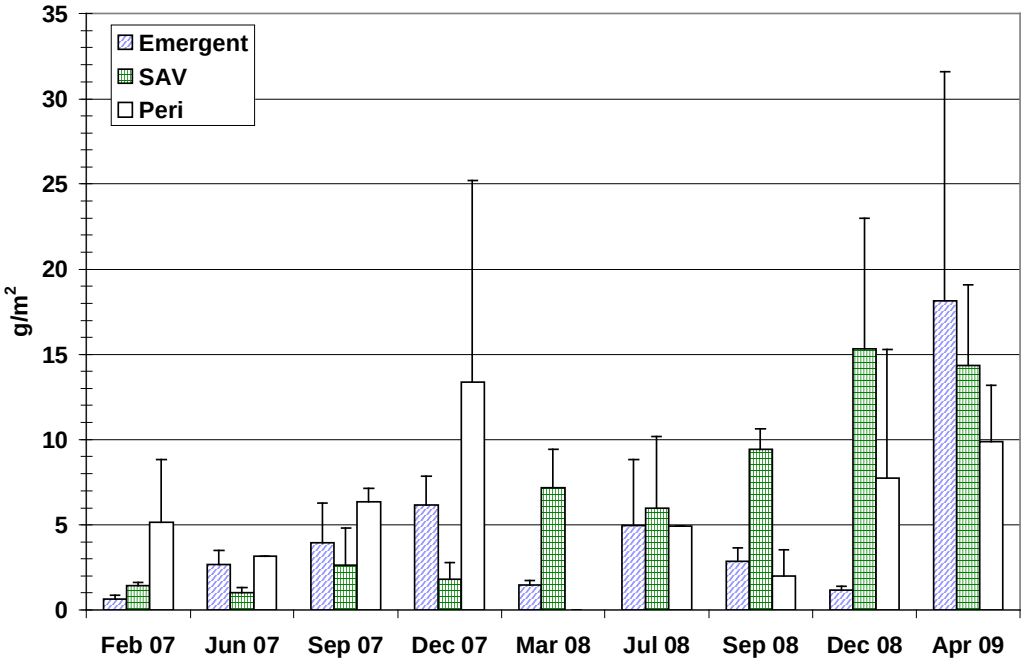

Fig. 159: ALXC2 Emergent and Woody Debris AFDW

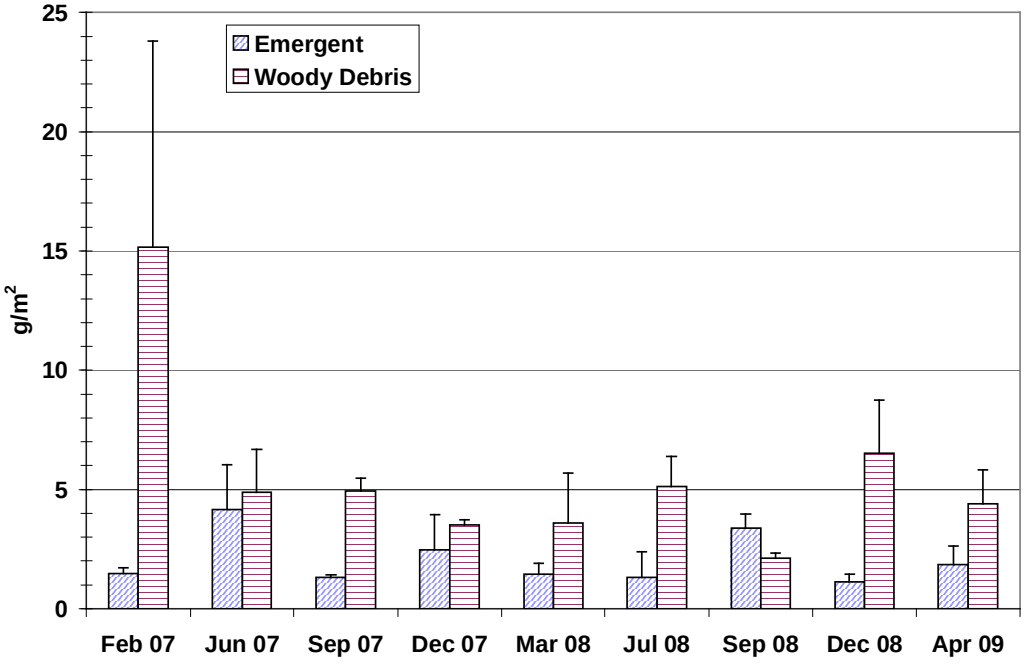

Fig. 160: ALXC2 Sediment AFDW

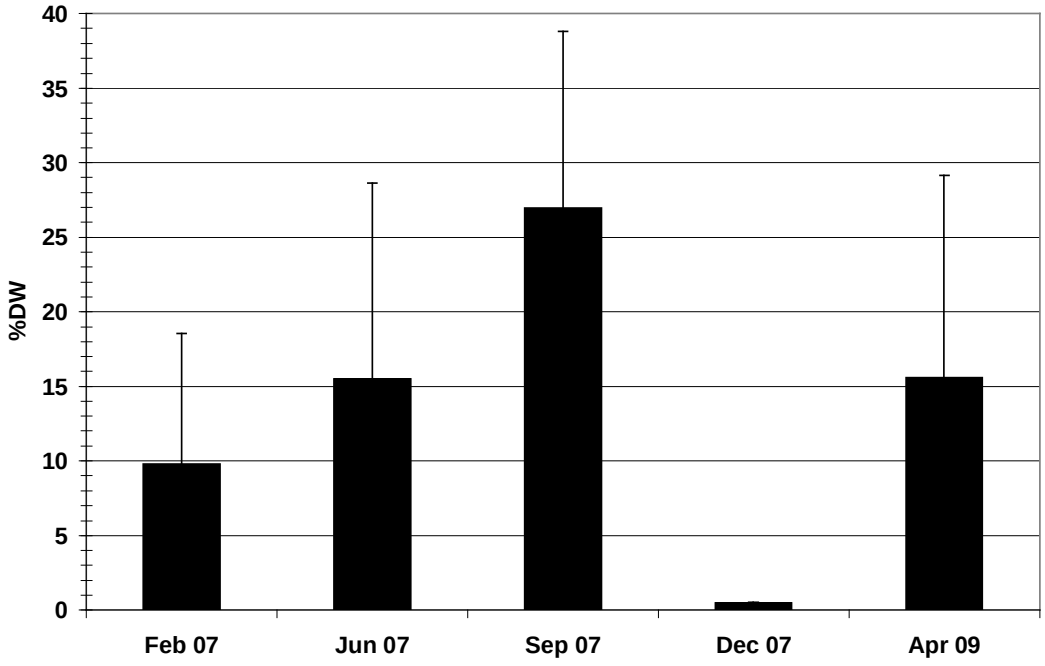

Fig. 161: SGLR1 SAV and Periphytometer AFDW

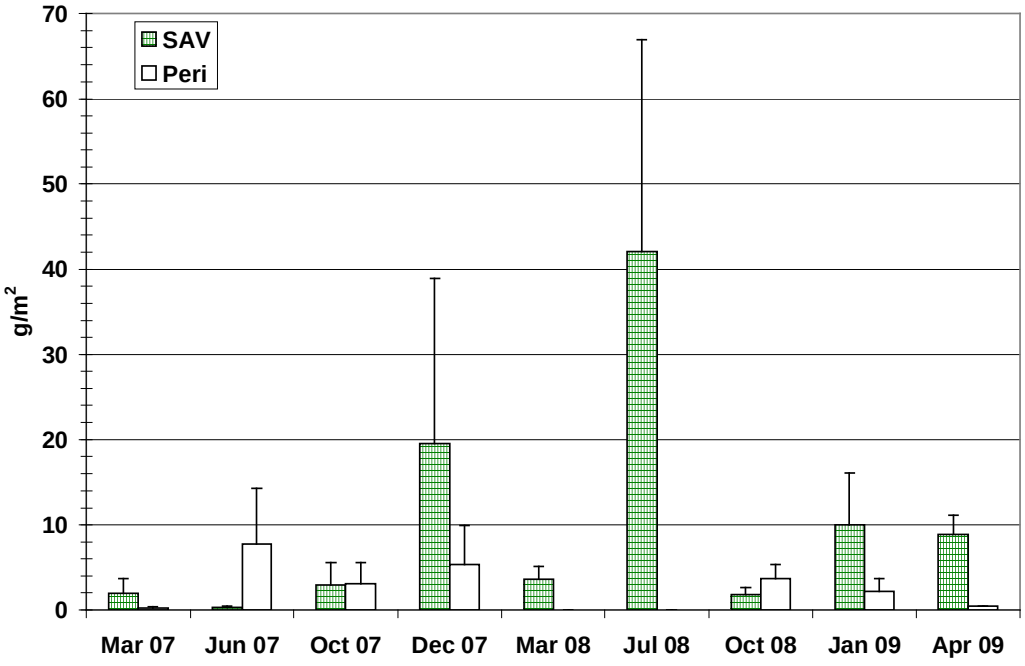

Fig. 162: SGLR1 Macroalgal Mat Dry Weight

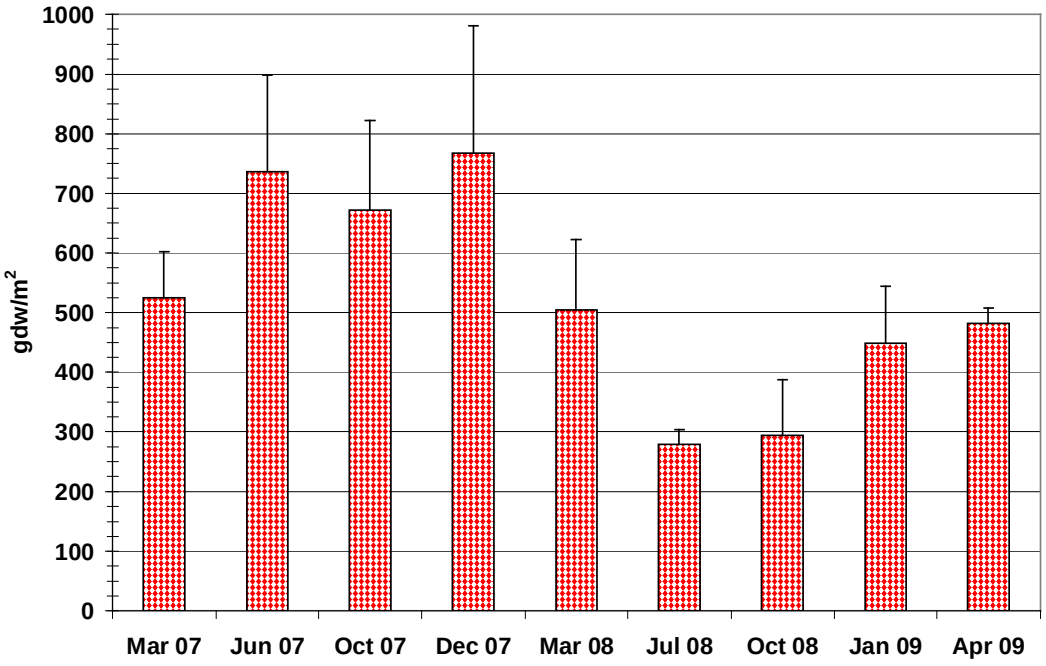

Fig. 163: SAV Median Cell Density

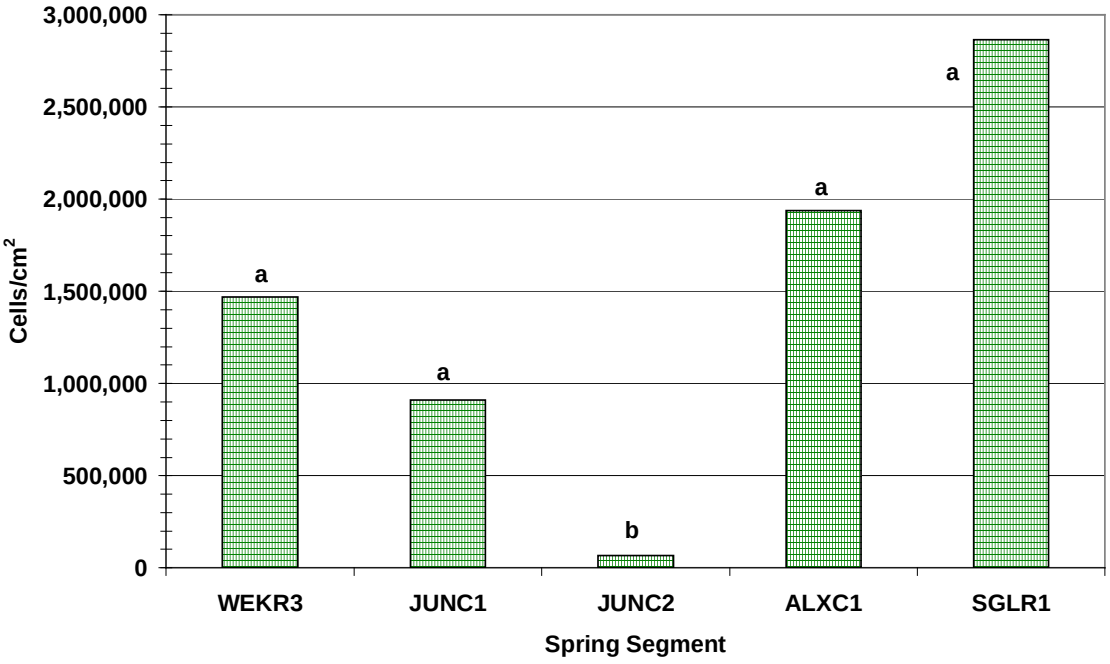

Fig. 164: Woody Debris Median Cell Density

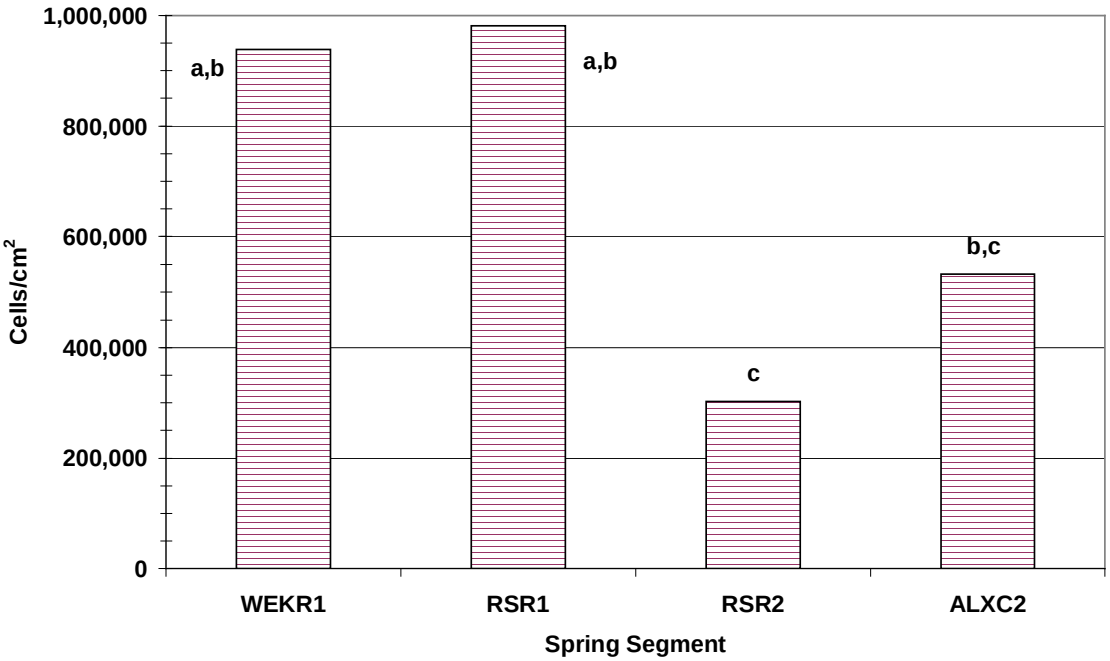

Fig. 165: Periphytometer Median Cell Density

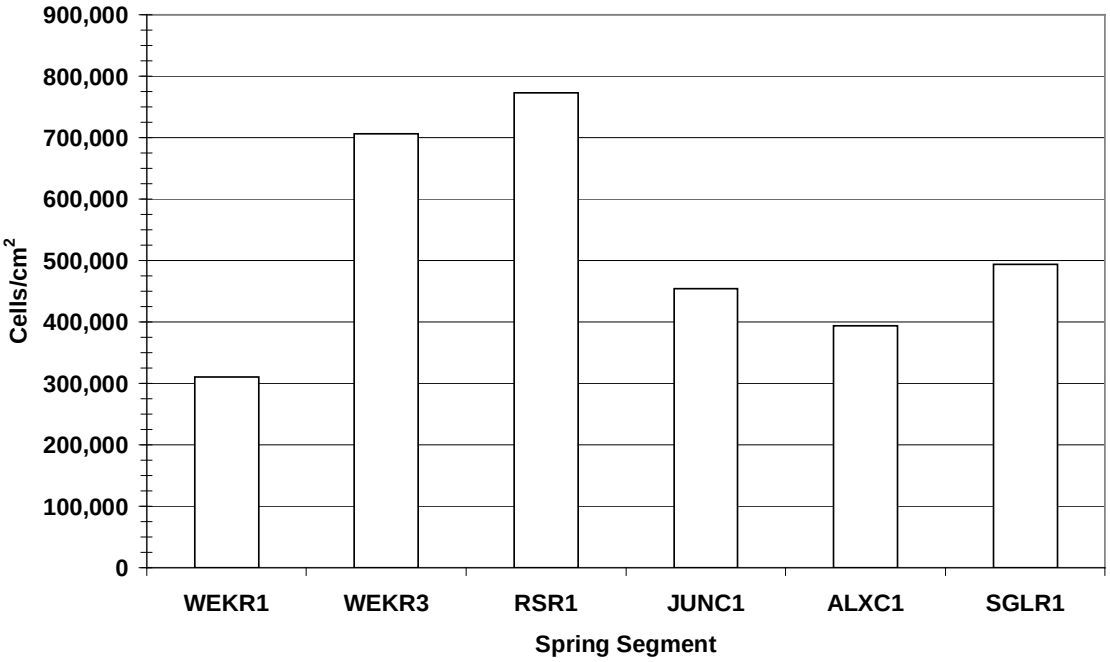

Fig. 166: SAV Median Biovolume

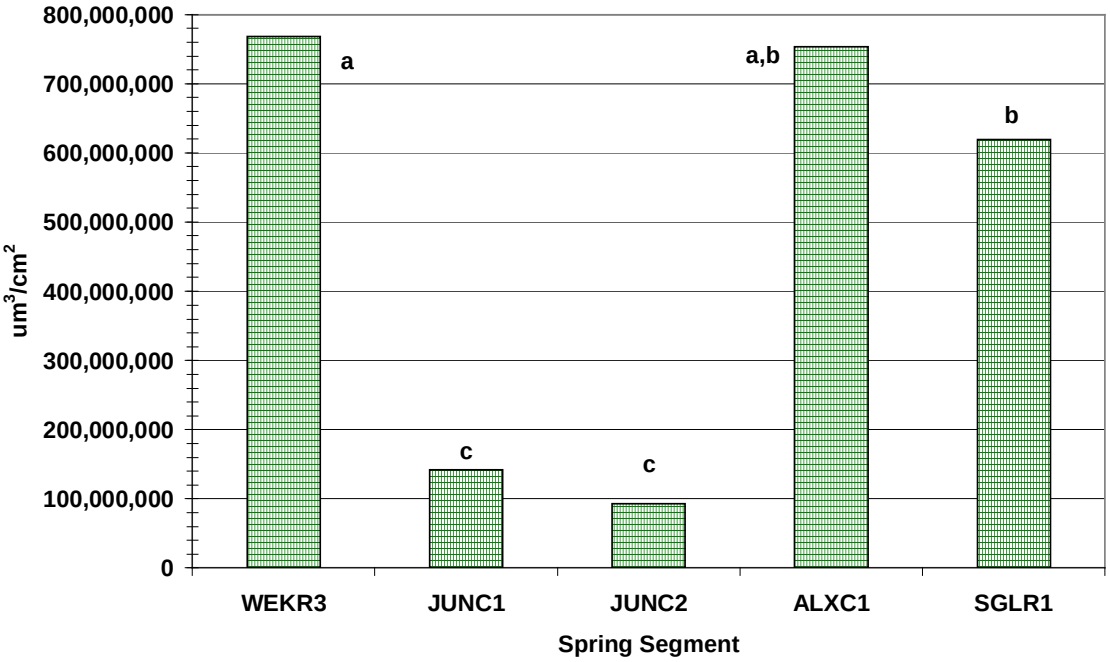

Fig. 167: Woody Debris Median Biovolume

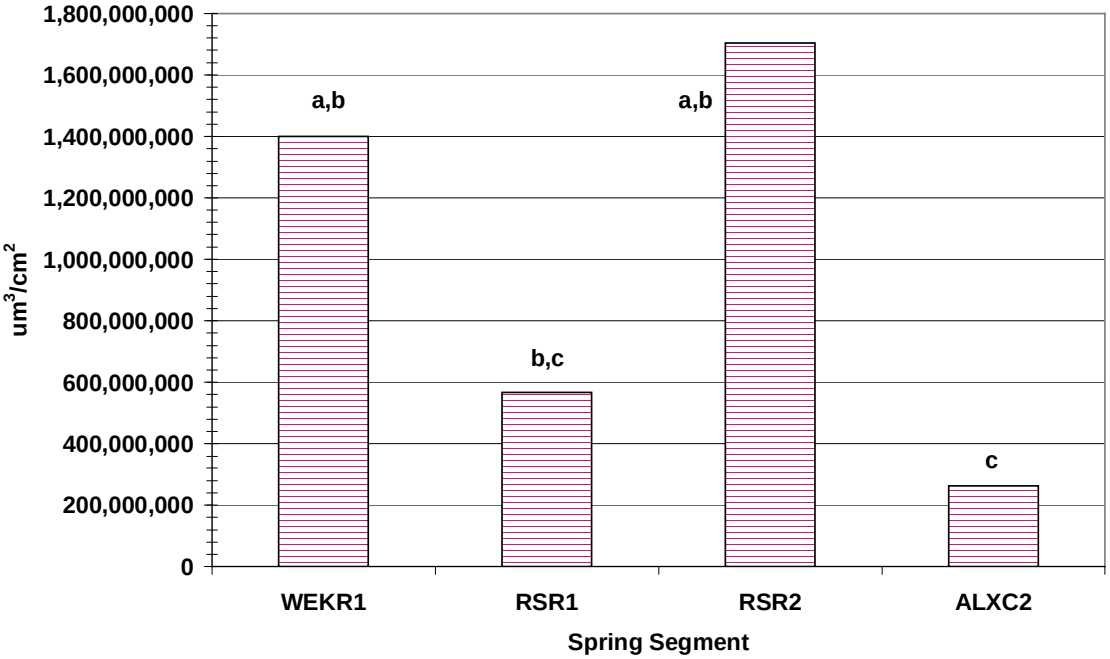

Fig. 168: Periphytometer Median Biovolume

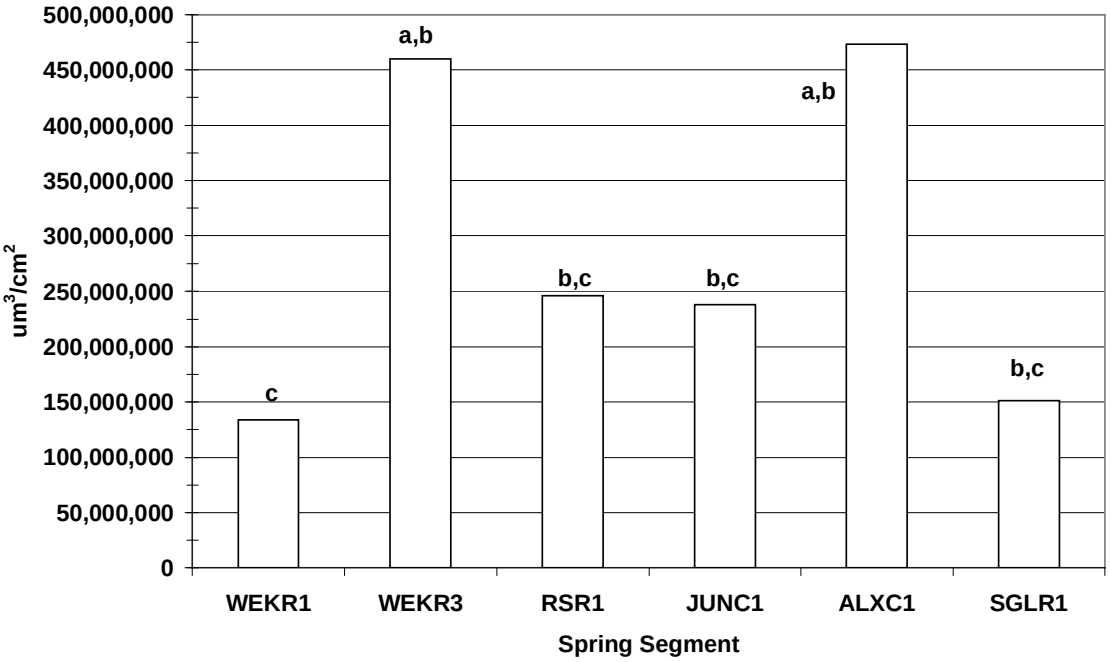

Fig. 169: SAV Median chl-*a*

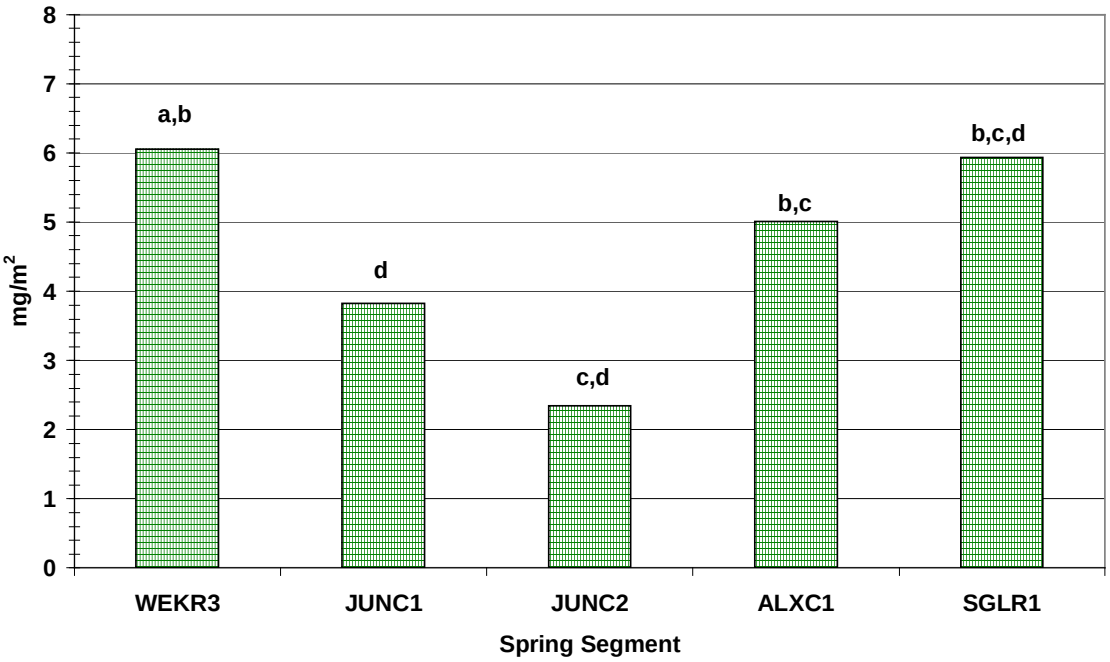

Fig. 170: Woody Debris Median chl-*a*

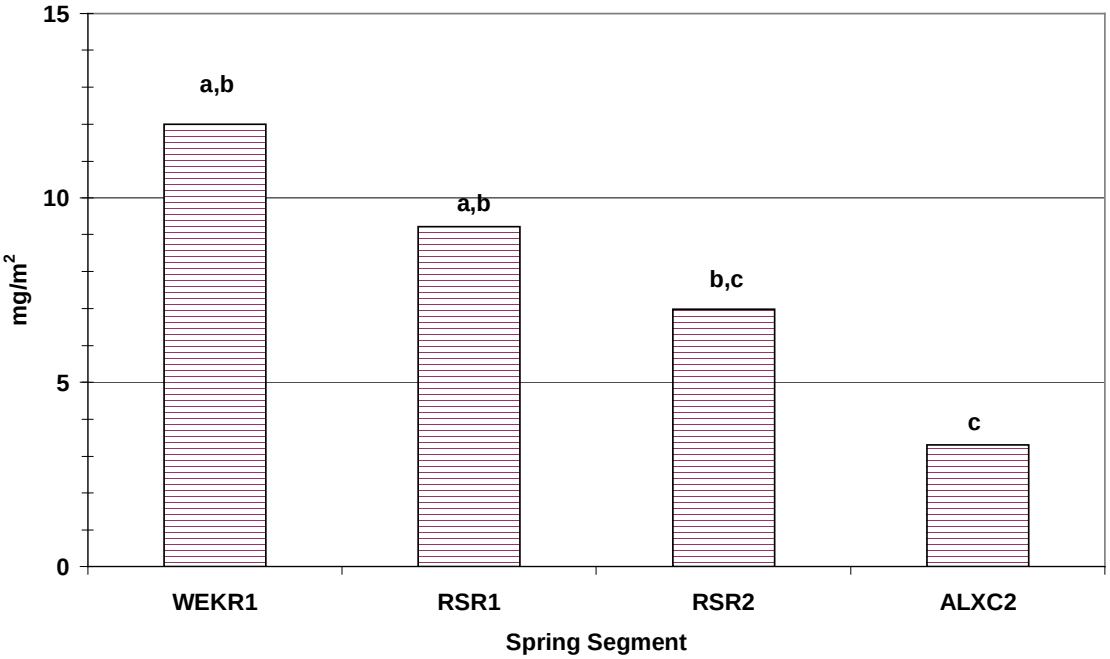

Fig. 171: Periphytometer Median chl-*a*

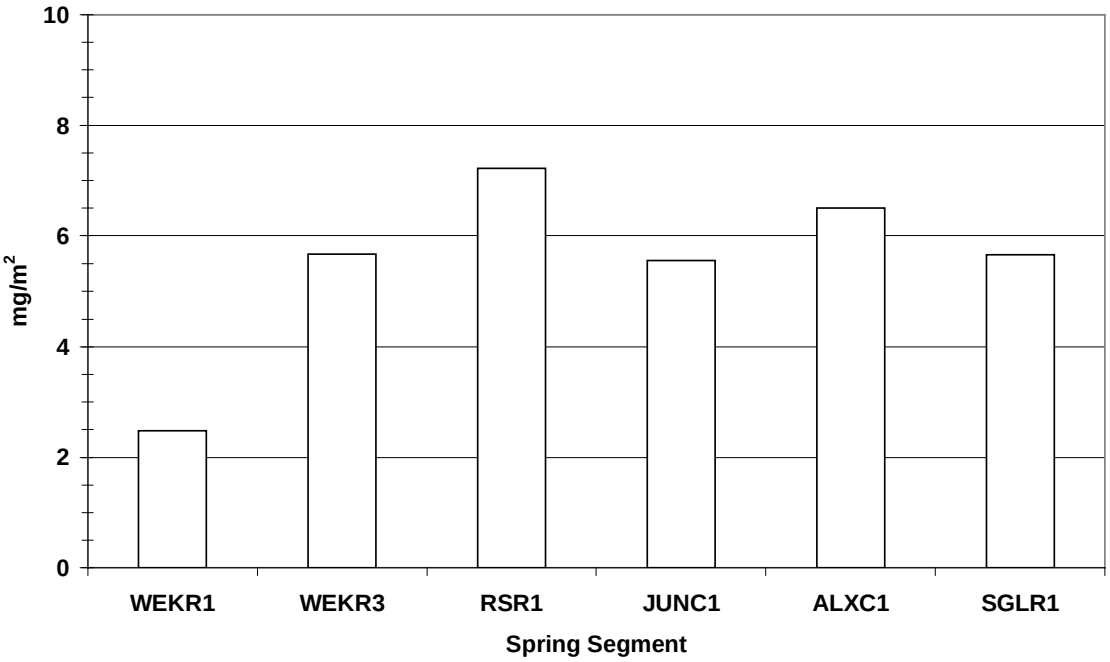

Fig. 172: Emergent Median chl-*a*

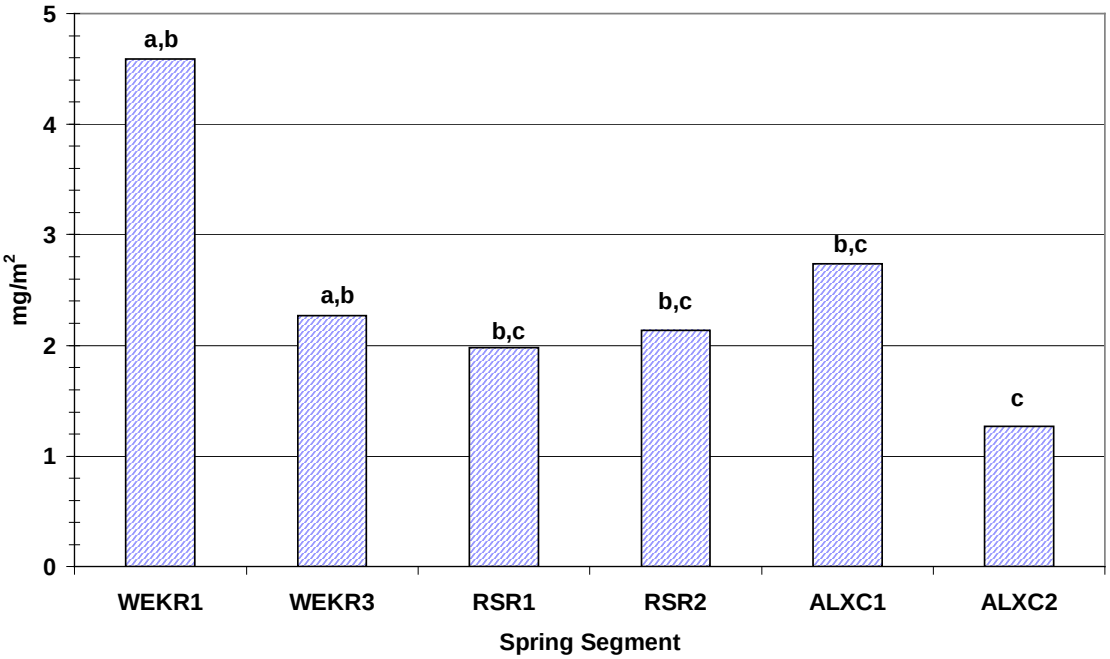

Fig. 173: Sediment Median chl-*a*

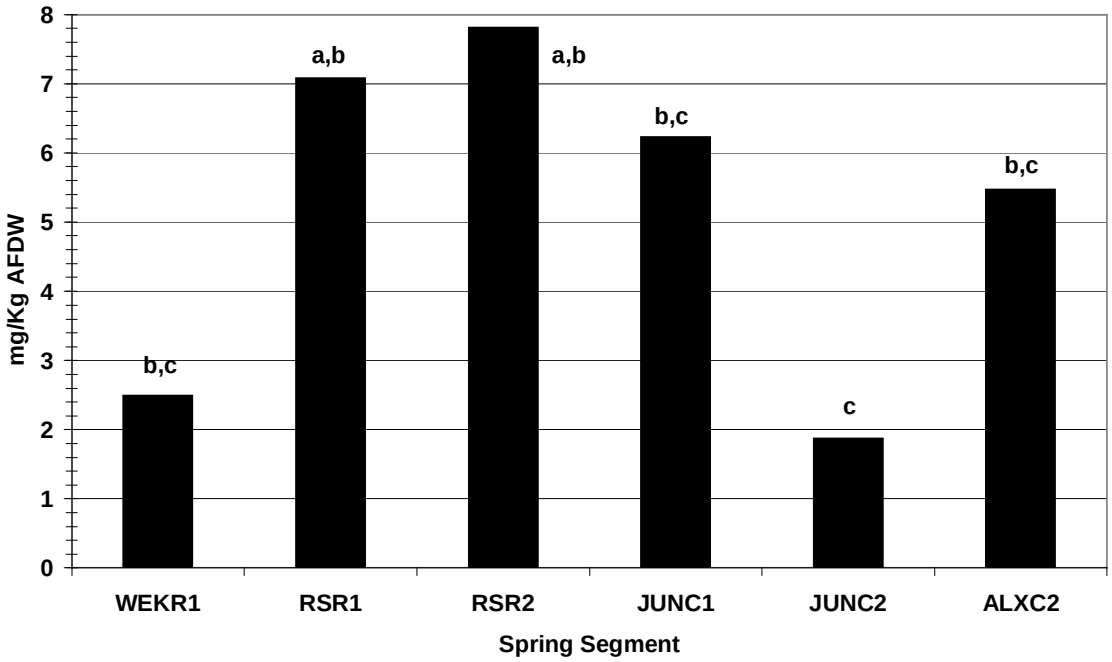

Fig. 174: SAV Median AFDW

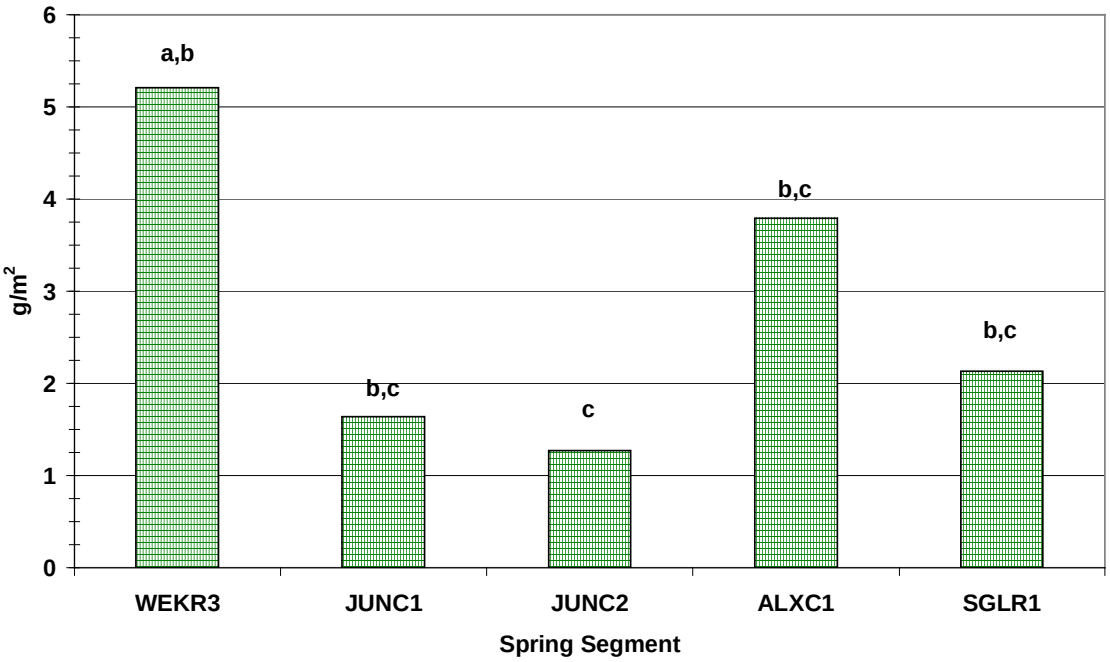

Fig. 175: Woody Debris Median AFDW

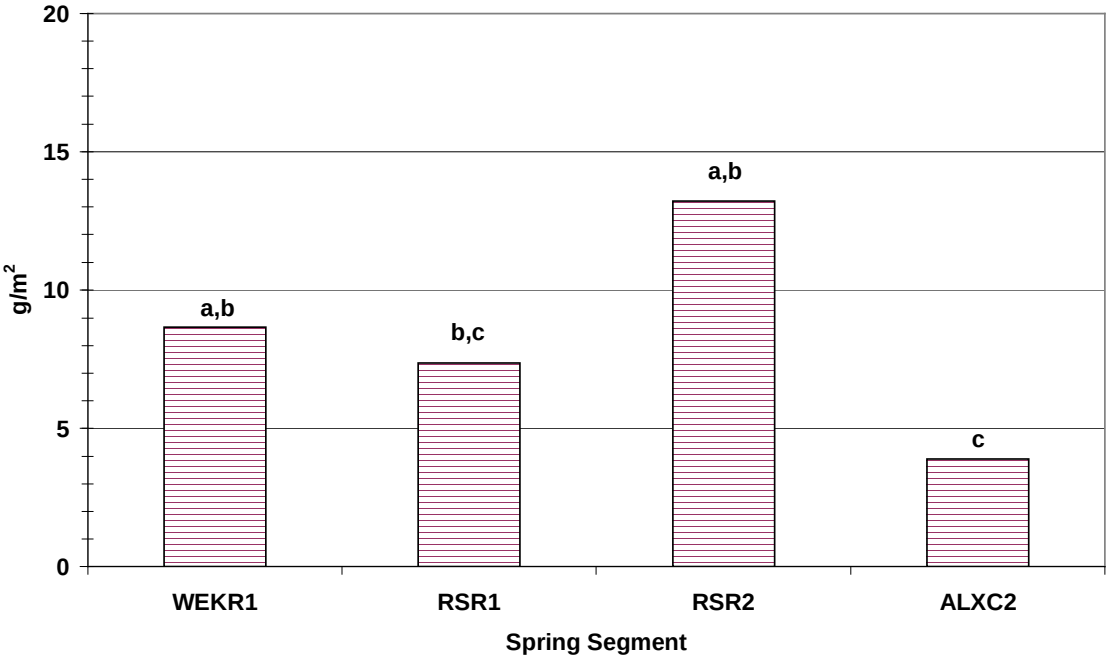

Fig. 176: Periphytometer Median AFDW

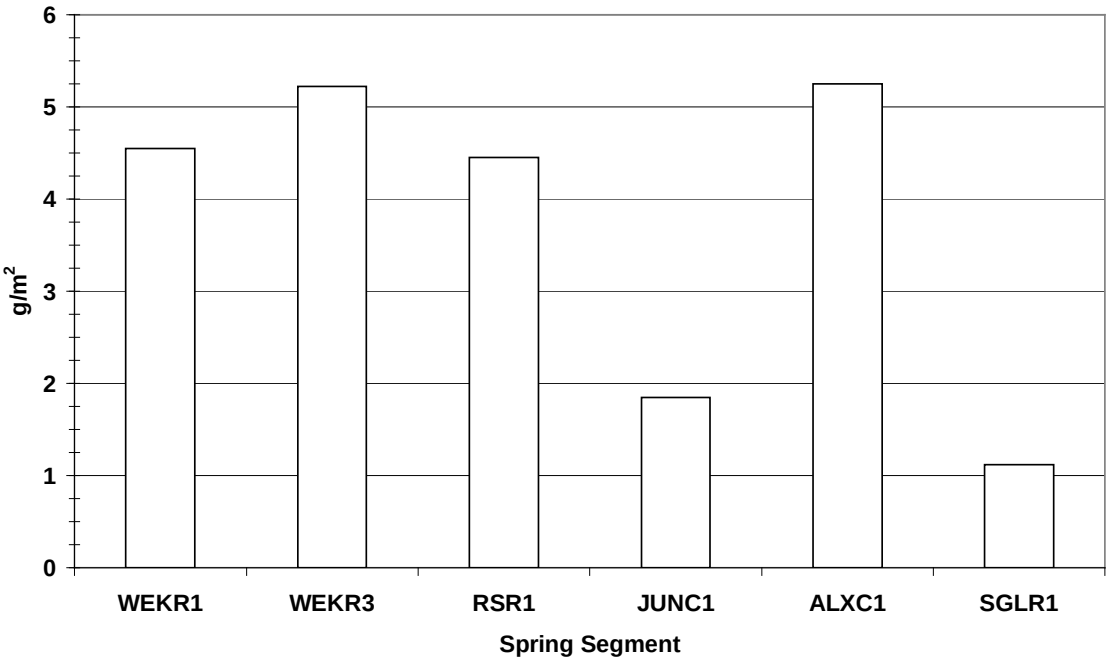

Fig. 177: Emergent Median AFDW

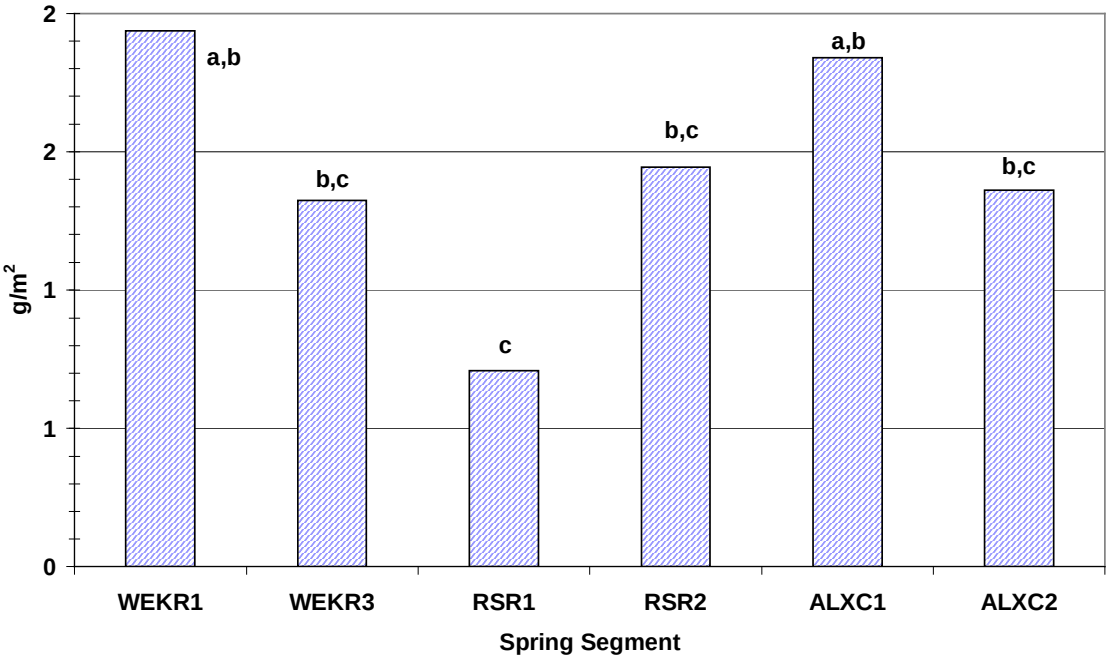

Fig. 178: Sediment Median AFDW

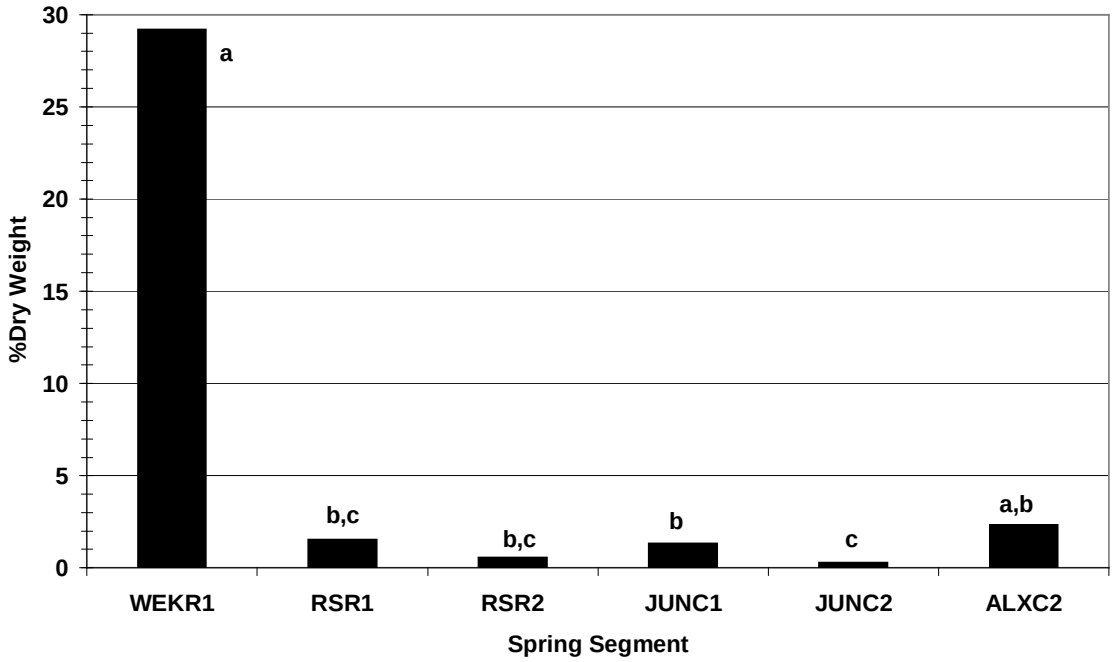

Fig. 179: Median Total Cell Number Per Substrate

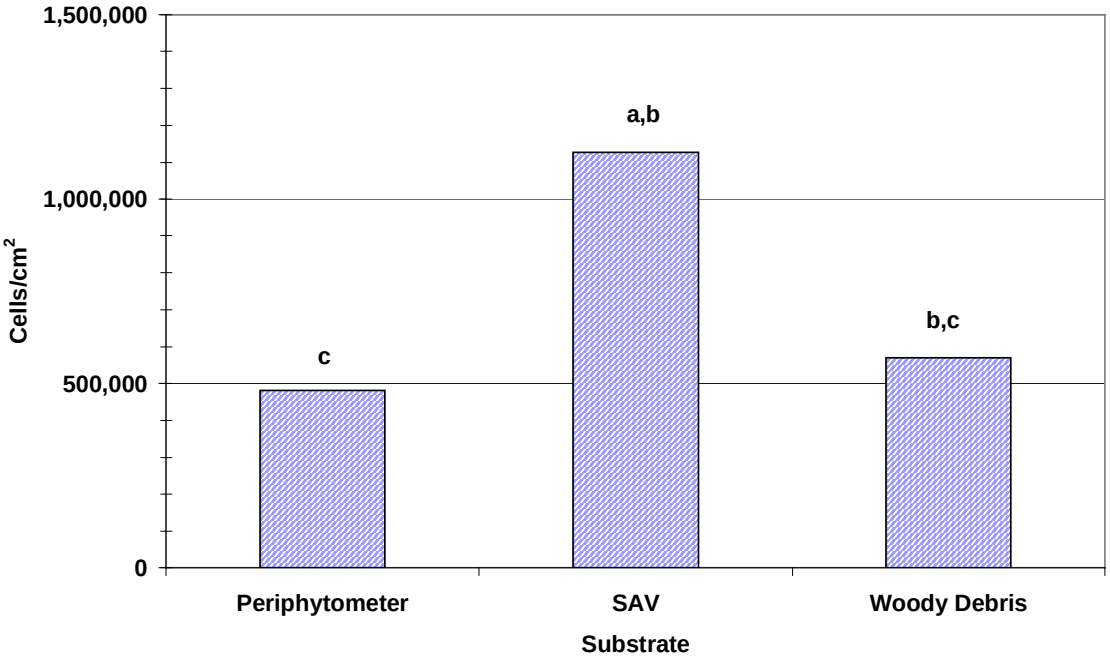

Fig. 180: Bacillariophyta Median Cell Number Per Substrate

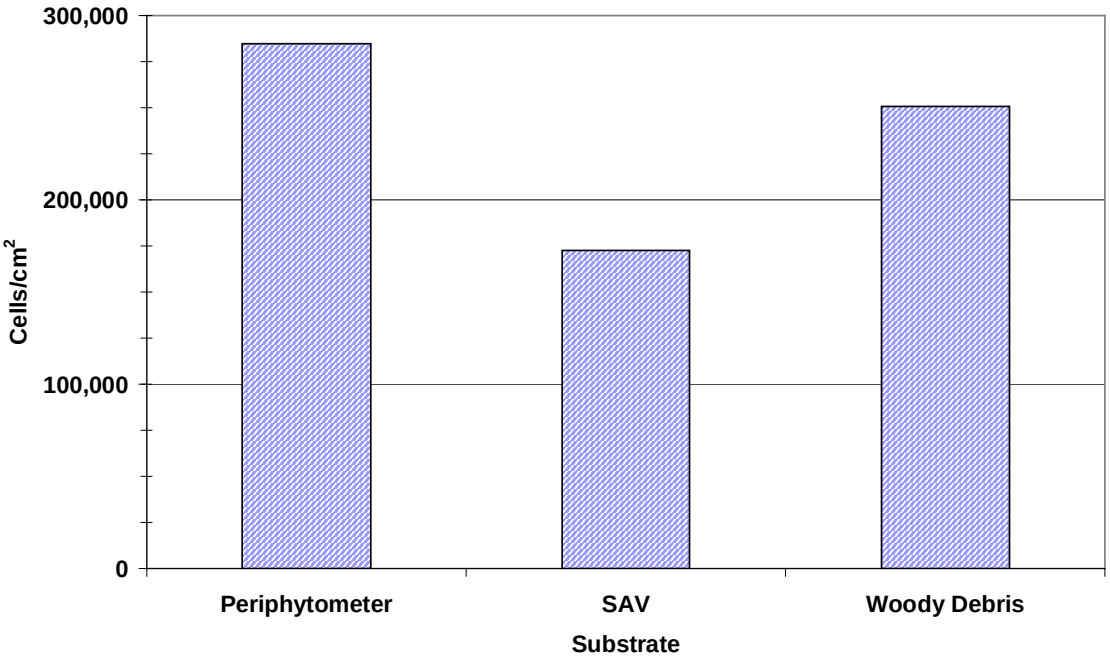

Fig. 181: Chlorophyta Median Cell Number Per Substrate

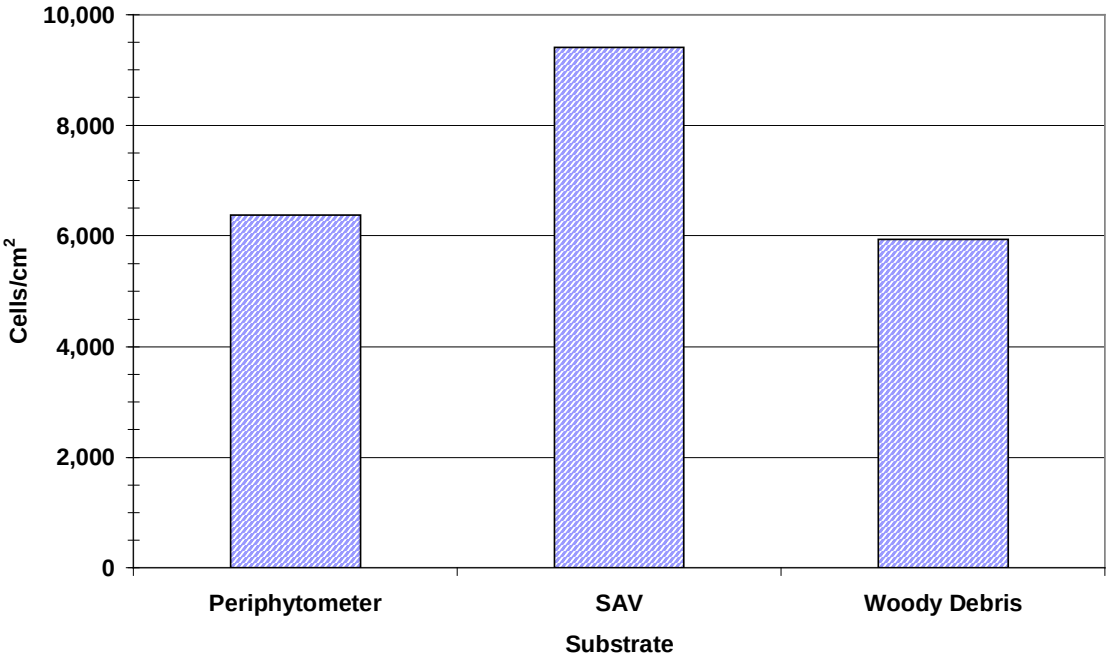

Fig. 182: Cyanobacteria Median Cell Number Per Substrate

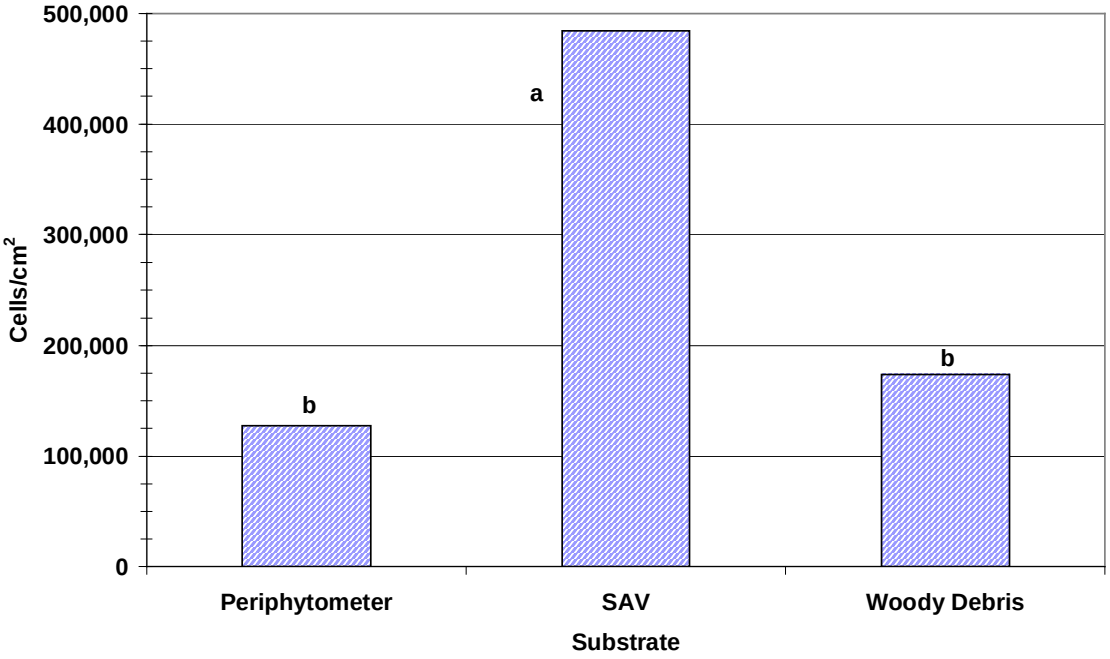

Fig. 183: Rhodophyta Mean Cell Number Per Substrate

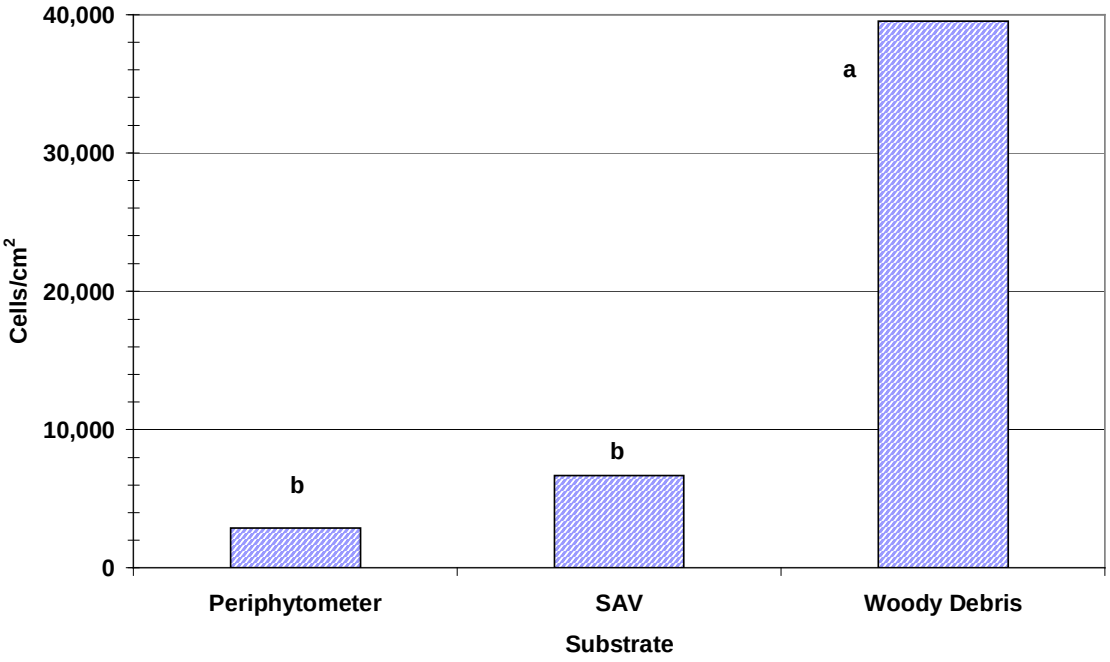

Fig. 184: Median Total Biovolume Per Substrate

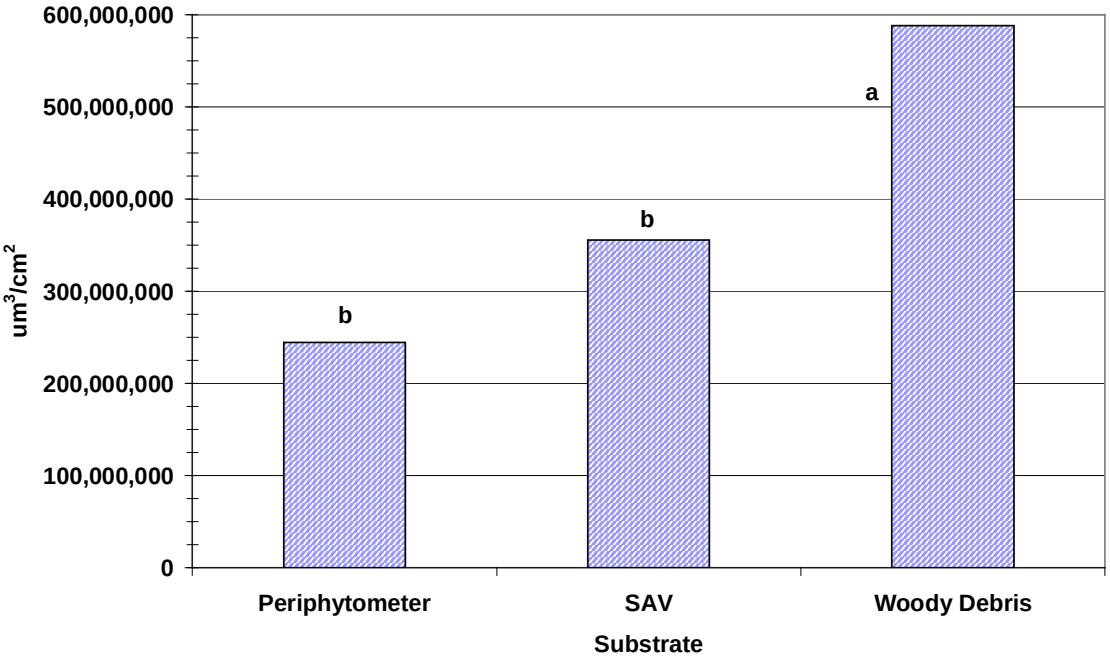

Fig. 185: Bacillariophyta Median Biovolume Per Substrate

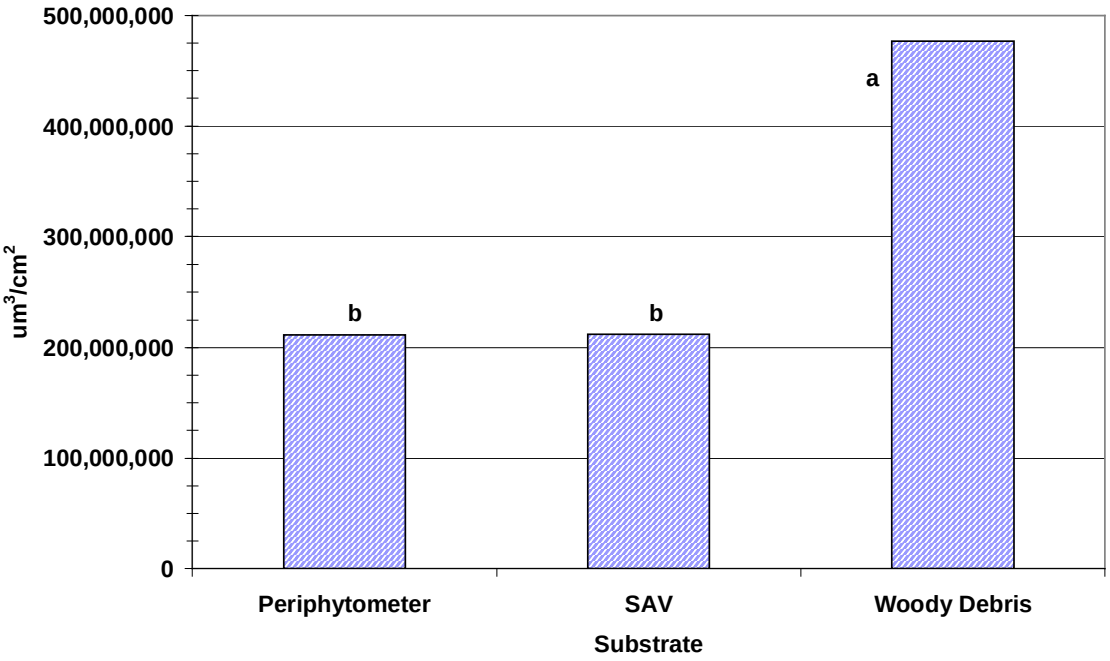

Fig. 186: Chlorophyta Median Biovolume Per Substrate

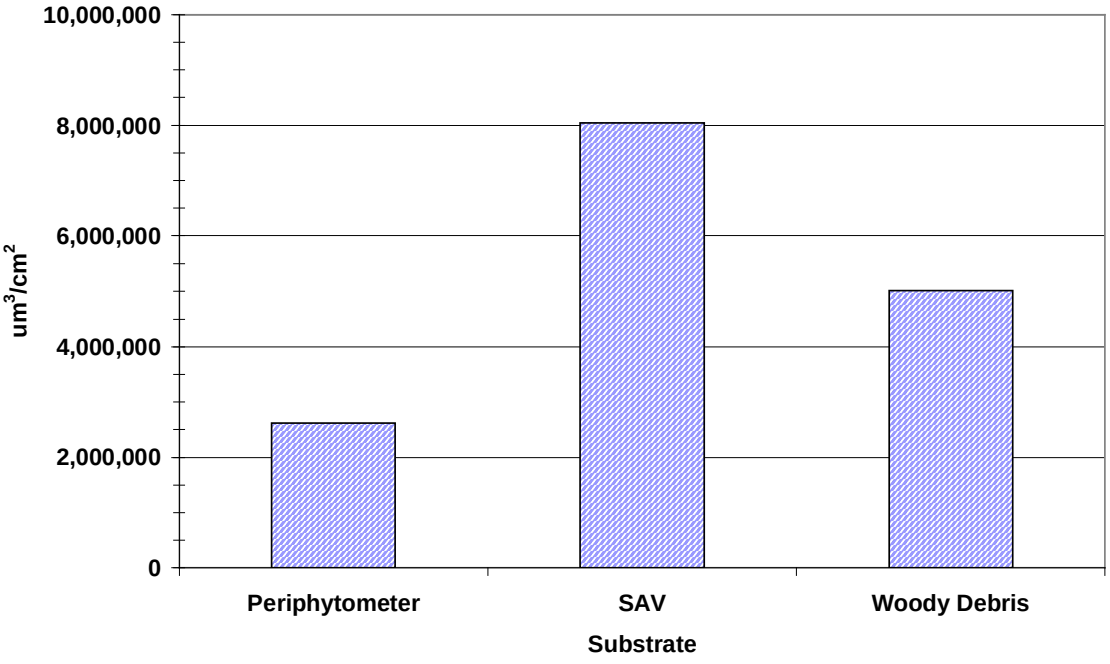

Fig. 187: Cyanobacteria Median Biovolume Per Substrate

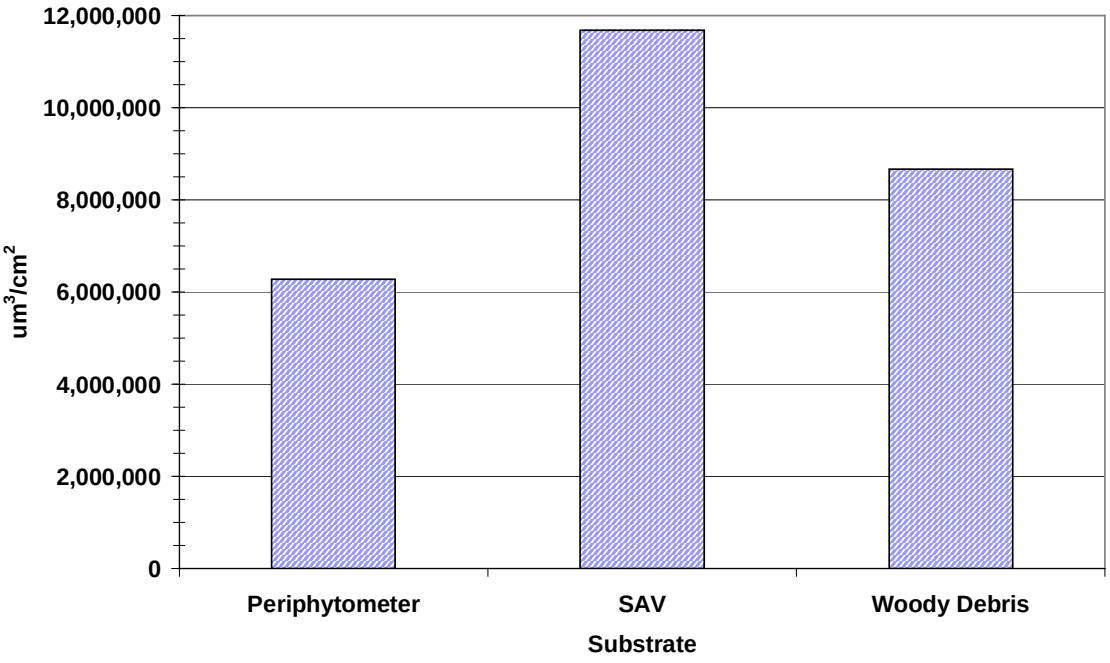

Fig. 188: Rhodophyta Mean Biovolume Per Substrate

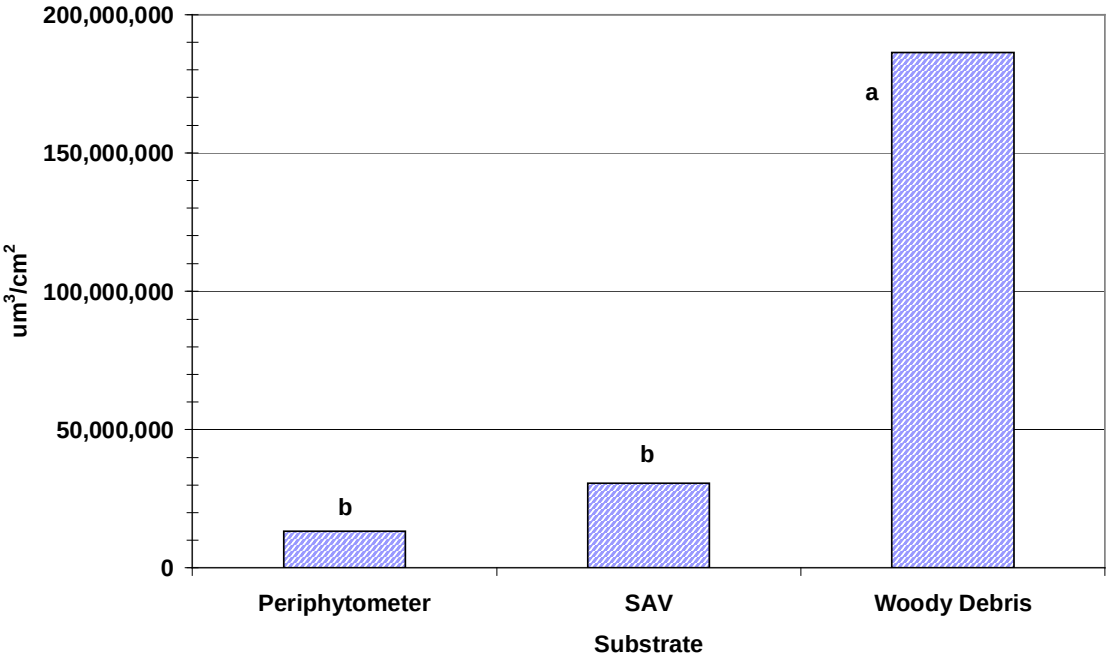

Fig. 189: Median chl-*a* Per Substrate

Fig. 190: Median AFDW Per Substrate