

Figure 6. Estimated Springsnail growth rates based upon average monthly size (mm) at study sites 1, 2, 3-OS, and 3-NS. See text for explanation of months chosen for analyses. Years included in the analyses were 1990 - 1992 (Site 1), 1990 - 1999 (Sites 2 and 3-OS), and 1994 - 2000 (Site 3-NS).



## Site 2

At the left seep in 2000, the percent springflow-covered (SFC) rockface ranged from 2 to 60% (Fig. 12 top). The percent rockface-wetted-but-lacking flow (W/LF) ranged from 10 to 100%, which was lower than previous years (Fig. 12 bottom). This is due to the rockface becoming dry in September. At the right seep, the percent SFC rockface in 2000 fluctuated between 30 and 40%, which was higher than previous years (Fig. 12 top). In 2000, percent rockface W/LF at the right seep ranged between 85 and 90%, which was consistent with previous years (Fig. 12 bottom). Very low water temperatures at Site 2 in 1993 were probably the result of thermometer exposure to air (Royer and Minshall 1993). Site 2 maintained relatively constant Min/Max temperatures during 2000 (Fig. 9). Minimum temperatures (20.5°C) were recorded in June and maximum temperatures (34.2°C) were recorded in September (Fig. 9). Site 2 maintained relatively constant daily average temperatures throughout 1997-2000 (Fig. 10). The sudden drops shown in Figure 10 are results of temperature data not being collected in December 1997 and 1998. There was a drop in temperature in June 2000 as a result of the temperature data logger falling over and being exposed to the air.

In July, daily averages were consistent with 1997-1999 data. Daily averages started to decline in September and October. Water chemistry values for 2000 were similar to those from previous years (Fig. 11).

## Site 3

The percent SFC rockface for Site 3-OS in 2000 ranged from 30% in October to 70% in August and was consistent with previous years (Fig. 12 top). The percent rockface W/LF in 2000 ranged between 85 and 95%, which also agreed with data from previous years (Fig. 12 bottom). Very low water temperatures at Site 3-OS in 1993 probably were the result of thermometer exposure to air (Royer and Minshall 1993). In 2000, temperatures varied widely, as in other years, from 16.7°C to 37.3°C (Fig. 9). Highest temperatures for the last decade (37.3°C) were recorded in August 2000. However, average daily temperatures were relatively constant throughout 1997-2000 (Fig. 10). The sharp drops shown between 1997, 1998, and 1999 are due to lack of data recorded in December 1997 and 1998 (Fig. 10). Water chemistry values for 2000 were similar to values from other years (Fig. 11).

## Site 3-NS

In 2000, the percent SFC at Site 3-NS ranged from 15 to 60% (Fig. 12), which was higher than previous years. Percent rockface W/LF ranged from 90 to 100% (Fig. 12), which was consistent with previous years. Water temperatures at Site 3-NS were the most variable of all the study sites, ranging from 11.3°C to 34.6°C (Fig. 9) in 1999. The temperature data logger malfunctioned in 2000 and daily minimum, maximum, and average temperatures were not recorded. During 2000, temperatures measured monthly

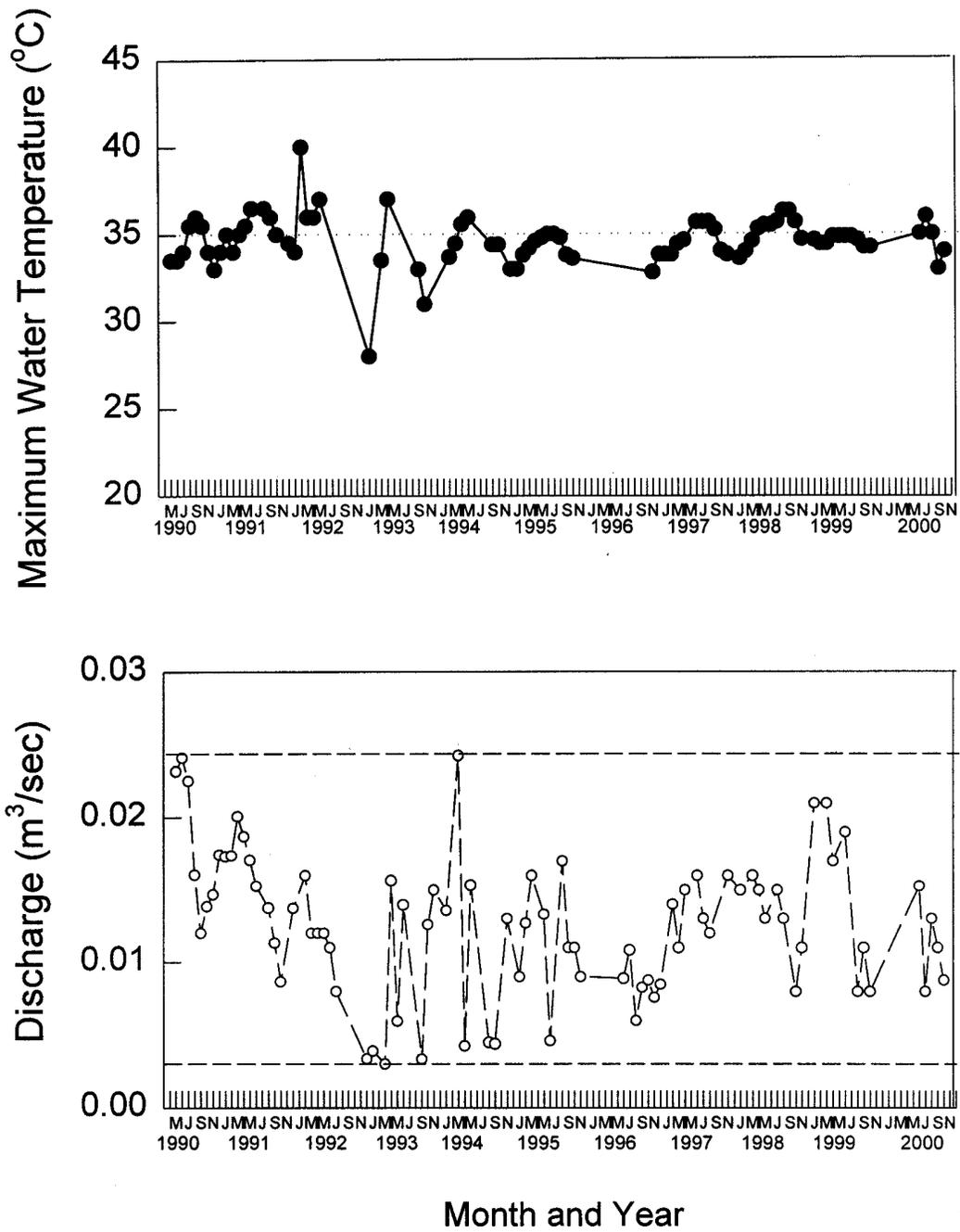


Figure 8. Discharge and maximum water temperatures for Site 1 (Hot Creek). Dashed horizontal lines indicate the maximum and minimum discharges measured at Hot Creek. Dotted horizontal line indicates thermal maximum temperature for *P. bruneauensis*.



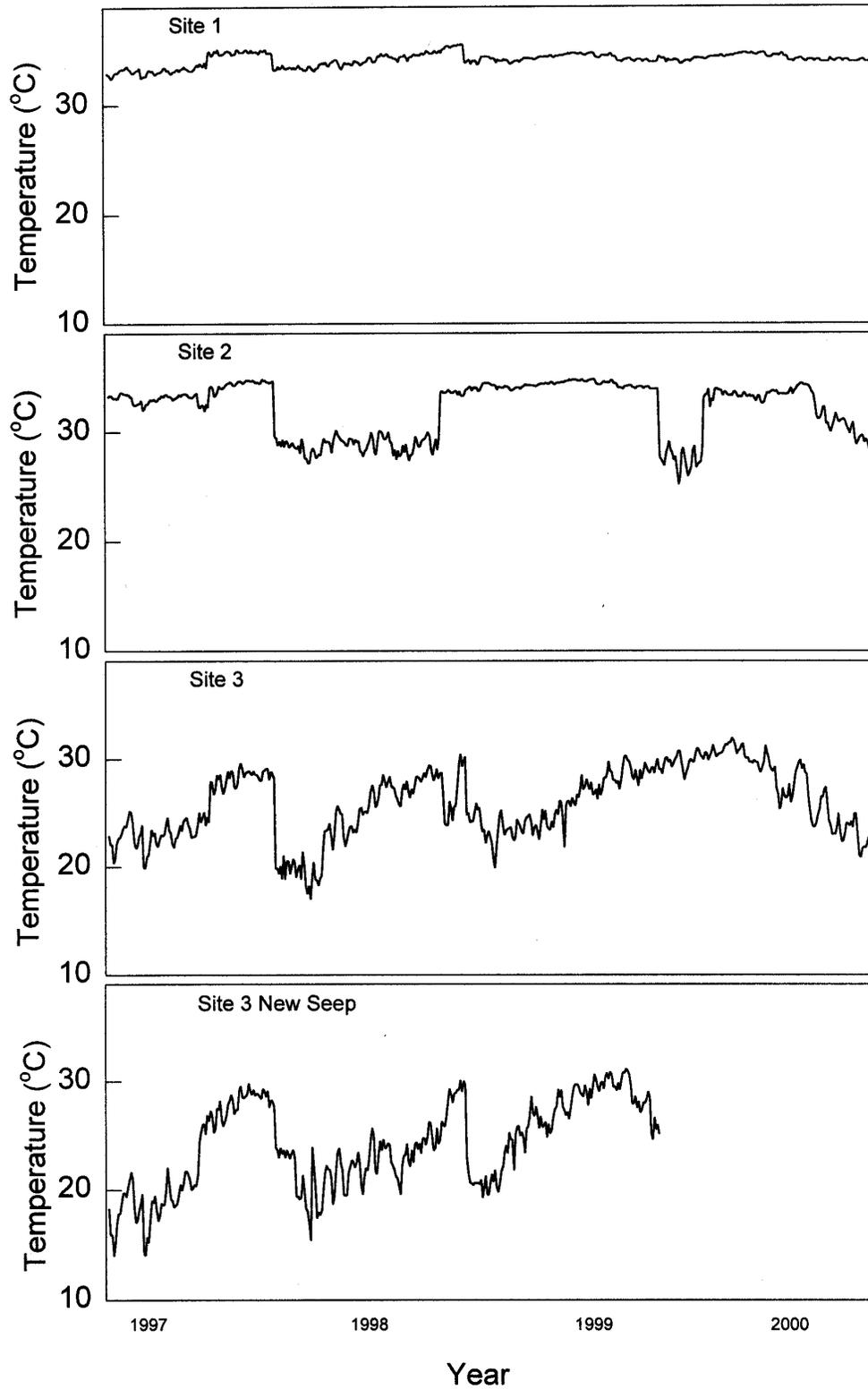


Figure 10. Daily mean temperatures for the Bruneau Springsnail study sites. The average daily temperatures collected from data loggers is plotted from 1997-2000 data. Data was not collected for December 1997 and 1998. Data collected June -October 2000.



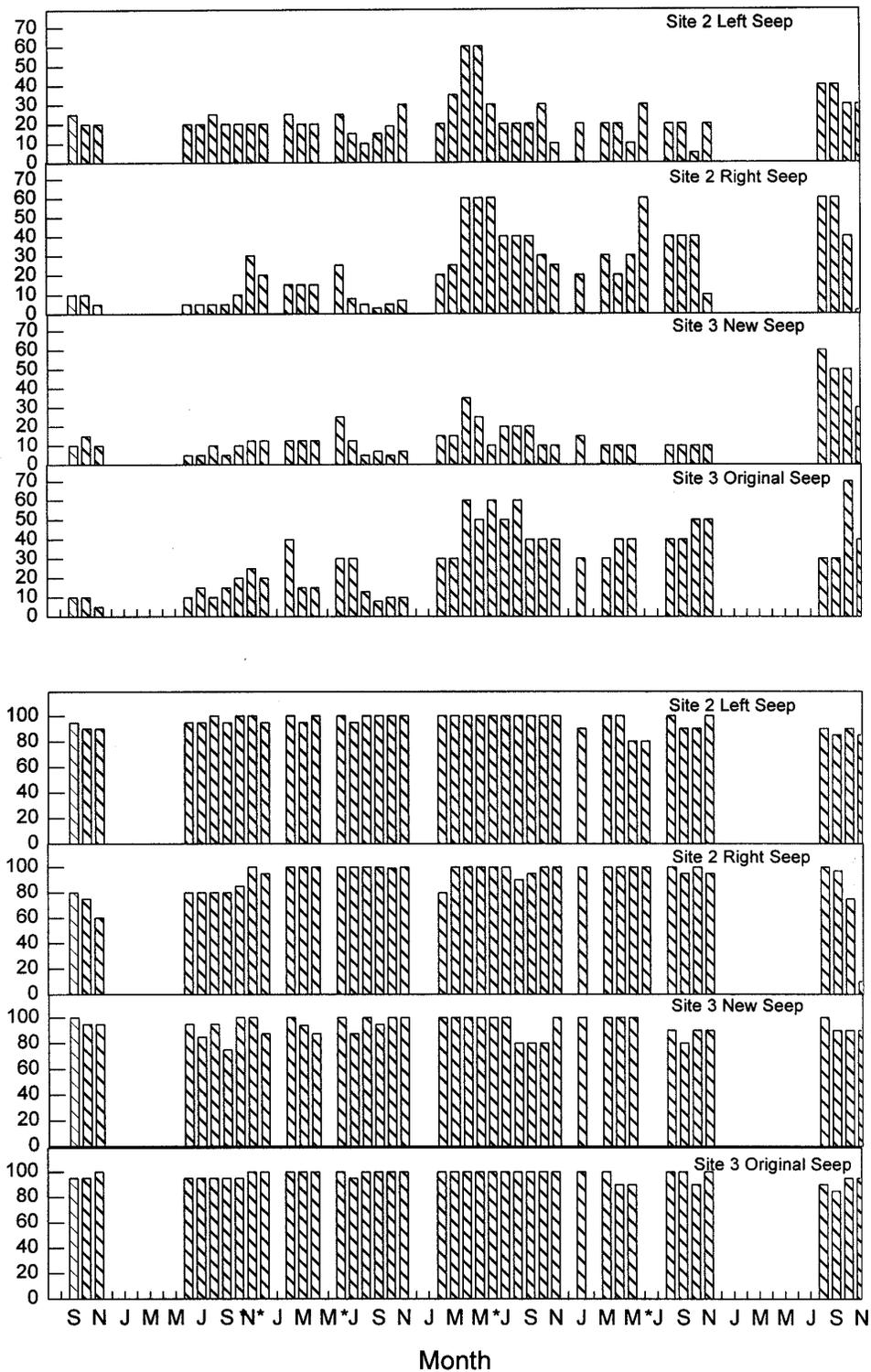


Figure 12. (Top) Percent springflow-covered rockface (SFC rockface) and (bottom) percent rockface, wetted, but lacking flow (rockface W/LF) for the Bruneau Springsnail study sites. Asterisks indicate that sampling occurred during rain events.

with a digital thermometer ranged from a low temperature of 24.1°C in September and a high temperature of 31°C in October. Slight drops in temperature between 1997, 1998, and 1999 are due to data not being collected in December 1997 and 1998 (Fig. 10). Water chemistry values remained consistent with data from previous years (Fig. 11).

## Periphyton

### Site 1 (Hot Creek)

In 2000, the highest value for chlorophyll-a (107.77 mg/m<sup>2</sup>) was obtained in July and the lowest value (27.92 mg/m<sup>2</sup>) was obtained in October (Fig. 13). The highest value for AFDM (22 g/m<sup>2</sup>), was obtained in June and the lowest value (3.8 g/m<sup>2</sup>) was obtained in October (Fig. 14). These values are within the range from previous monitoring years. Chlorophyll-a and AFDM values tended to be higher and much more variable at Site 1 than at any other study site (Figs. 13, 14).

### Site 2 (Upper Spring Rockface)

In 2000, the highest value for chlorophyll-a at Site 2 (29.1 mg/m<sup>2</sup>), was obtained in September and the lowest value (7.8 mg/m<sup>2</sup>), in July (Fig. 13). The highest value for AFDM (10.6 g/m<sup>2</sup>) occurred in August, while the lowest value (5.4 g/m<sup>2</sup>) was obtained in October (Fig. 14). These values fell within the range of measurements from previous years.

### Site 3-OS (Lower Spring Rockface)

Chlorophyll-a values for Site 3-OS were highest in August (23.1 mg/m<sup>2</sup>) and lowest in September (7.1 mg/m<sup>2</sup>) in 2000 and generally were lower than values from previous years (Fig. 13). The highest value for AFDM (11.8 g/m<sup>2</sup>) was obtained in June and the lowest value (3.9 g/m<sup>2</sup>) was obtained in August (Fig. 14). These values fell within the range of measurements from previous years, but were on the lower end of the range.

### Site 3-NS

The highest value for chlorophyll-a (22.4 mg/m<sup>2</sup>) was obtained in August and the lowest value (7.3 mg/m<sup>2</sup>) was in October (Fig. 13). The highest value for AFDM (12.5 g/m<sup>2</sup>) was obtained in August and the lowest value (5.7 g/m<sup>2</sup>) was found in October (Fig. 14). In June 2000 the site was overgrown and no chlorophyll samples were taken. In general, these values from July through October were slightly lower than those from previous years.

## Habitat Assessment at Hot Creek

Habitat assessment scores remained fairly constant between 1995 and 2000, with only seasonal changes in vegetation (in 1995 and 1996) being apparent (Table 1). Overall, scores for the riparian community were intermediate to high and substrate scores were low (Table 1).

## Discharge monitoring at the rockface seeps

Discharge measurements at all of the weirs were made between October 1997 and November 1999. In 2000, discharge measurements were made between June and October. In 2000, weir discharge at Site 3-NS ranged between 0.3 in July to 0.45 L/min in October, Site 3-OS ranged between 2.7 in July to 4.2 L/min in September, and Site 2 Right Seep ranged between 4.8 in August and September to 7.5 L/min in June (Fig. 15). The drop that occurred in June 1998 was due to breakdown of plastic sheeting at Site 2. The plastic was in poor condition and an unknown quantity of water flowed through the plastic and under the weir. The plastic was replaced in June 1998. Weirs located at Sites 3-OS and 3-NS should be accurate since no plastic was used in these locations. In the 25 months that discharge in the weirs has been measured, expected highs in spring (January-March) were shown (Fig. 15) as well as a gradual dropping that occurred April through November (Fig. 15). In 2000, discharge values differed throughout the five monitoring months. There was no trend between high and low discharges from June through October. Although less than three years of data exist at the weirs, 2000 was shown to contain the lowest values recorded for sites 3-OS and 3-NS. Site 2 discharge was higher than 1999.

## Intensive search for relict populations of *P. bruneauensis* in and around Hot Creek.

An intensive search along the length of Hot Creek (August 2000) revealed that there was still an apparent absence of springsnails in Hot Creek. Less than 50 springsnails were found on a small rockface seep, approximately 1.80 m out from Hot Creek in 1997 (Varricchione et al. 1998). In January 1998, less than 30 springsnails were found. In February through November of 1999, this rockface was dry and no springsnails were found. However, in 1999 less than 20 springsnails were found along the path of the small seep, which emerged below the rockface and trickled to Hot Creek.

In 2000, no springsnails were found along the path of the small seep. Due to thick vegetation along the path of the seep and little springsnail abundance, density sampling of the seep was not done.



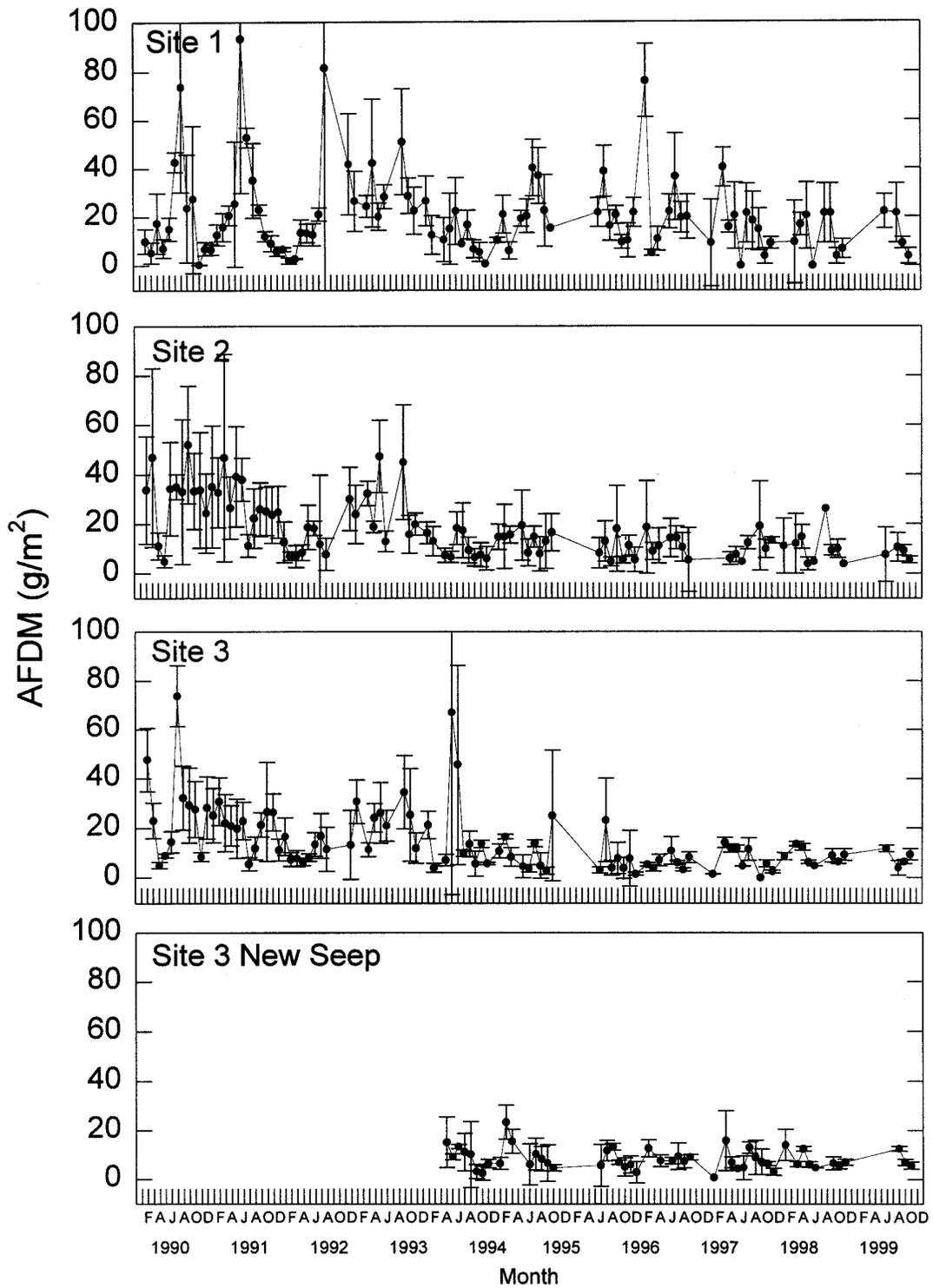


Figure 14. Periphyton ash-free dry mass (AFDM) values for the Bruneau Springsnail study sites. Error bars represent one standard deviation from the mean. (n=5 for Sites 1 and 2; n=3 for Site 3 and Site 3 New Seep).

Table 1. Habitat assessment scores for Site 1 (Hot Creek).

Year	Month	Bottom Substrate	Pool Substrate	Pool Variability	Canopy Cover	Channel Alteration	Deposition	Channel Sinuosity	Channel Capacity	Bank Stability	Bank Vegetation	Streamside Cover	Riparian Width	Total Score	Percent of Maximum
Maximum score possible:		20	20	20	20	15	15	15	15	10	10	10	10	180	100
1995	March	4	5	5	16	12	2	10	9	8	8	6	5	90	50
	May	4	5	5	16	12	2	10	9	8	8	8	5	92	51
	June	4	5	5	15	12	2	10	9	9	9	5	5	90	50
	July	4	5	5	14	12	2	10	9	9	10	5	5	90	50
	August	4	5	5	14	12	2	10	9	9	10	5	5	90	50
	September	4	5	5	14	12	2	10	9	9	10	5	5	90	50
	October	4	5	5	15	12	2	10	9	9	10	5	5	91	51
	November	4	5	5	15	12	2	10	9	9	9	6	5	91	51
1996	June	4	5	5	15	12	2	10	9	8	9	5	5	89	49
	July	4	5	5	14	12	2	10	9	8	10	5	5	89	49
	August	4	5	5	14	12	2	10	9	8	10	5	5	89	49
	September	4	5	5	14	12	2	10	9	8	10	5	5	89	49
	October	4	5	5	15	12	2	10	9	8	10	5	5	90	50
	November	4	5	5	15	12	2	10	9	8	10	6	5	91	51
	December	4	5	5	16	12	2	10	9	8	9	6	5	91	51
1997	July	4	5	5	15	12	2	10	9	8	10	5	5	90	50
1998	June	4	6	5	15	12	2	10	9	8	10	5	5	91	51
1999	June	4	6	5	15	12	2	10	9	8	10	5	5	91	51
2000	October	4	6	5	15	12	2	10	9	8	10	5	5	91	51

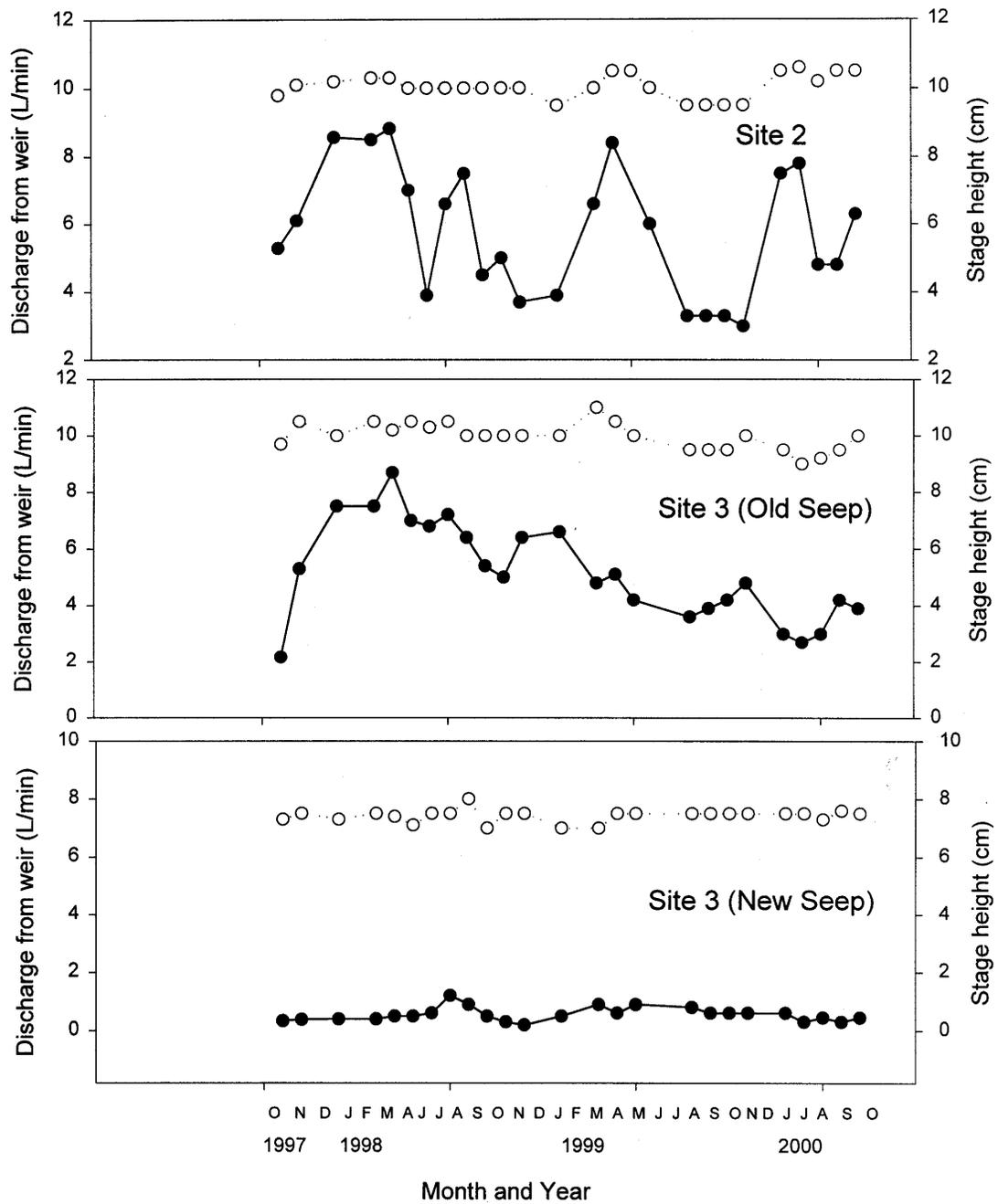


Figure 15. Discharge from the weirs placed approximately 1 m below rockface seeps at site 2a, 3OS, and 3NS. Solid circles represent weir discharge (L/min) and open circles represent weir stage height.