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Letter to the Editor

Correction to an estimate of production for *Deleatidium*

Scrimgeour (1991) has estimated annual production for the leptophlebiid mayfly *Deleatidium* in the flood-prone Ashley River of the South Island of New Zealand. His estimate (60.6 g DW m^{-2}) is the highest recorded value for this genus and one of the highest estimates from anywhere for a lotic ephemeropteran. Unfortunately, it is based on an incorrect application of the size-frequency technique for calculating production.

Table 1 of Scrimgeour (1991) shows the data used in calculating production, in particular (column 2) the values for the abundance of the various size-classes present in the winter generation. The sum of these values (38 600 individuals m^{-2}) should be an estimate of the mean abundance of *Deleatidium* during the winter months. (See Benke & Wallace (1980) and Waters & Crawford (1973) for futher clarification of how to calculate production using the size-frequency technique.) This value, however, is higher than any estimate of density for the population recorded by Scrimgeour between February and November (1000–10 000 individuals m^{-2} and shown in his fig. 1), the period over which this generation developed. Either the units for the y-axis of fig. 1 are incorrect or the density values given in table 1 are wrong. If the units are incorrect (by say an order of magnitude) then the mistake is easy to rectify. If, on the other hand, the units in fig. 1 are correct (and the values for mean density given in the abstract bear this out), then the calculation given in his table 1 is wrong and production has been overestimated by an order of magnitude.

Whatever the solution to these problems may be, Scrimgeour further confuses matters by "correcting" his estimate of production for the winter generation with a cohort production interval (CPI) correction of 1.2. This is not a valid procedure since a summer generation also occurs, and its production is estimated

Table 1 Calculation of annual production for *Deleatidium* in the Ashley River using the size-frequency method using density data in Scrimgeour (1991).

Size group (mm)	Mean density (No. m^{-2})	Dry weight (mg)	Biomass (mg m^{-2})	ΔN	Weight at loss, W (mg)	Weight lost WΔN	×9 (mg m^{-2})
0.2–0.4	627	0.015	9.4				
				–100	0.022	–2.2	–19.8†
0.4–0.6	727	0.029	21.1				
				100	0.041	4.1	36.9
0.6–0.8	627	0.053	33.2				
				112	0.077	8.6	77.4
0.8–1.0	515	0.100	51.5				
				88	0.147	12.9	116.1
1.0–1.2	427	0.192	82.0				
				28	0.253	7.1	63.9
1.2–1.4	399	0.314	125.3				
				40	0.493	19.7	177.3
1.4–1.6	359	0.672	241.2				
				148	0.888	131.4	1182.6
1.6–1.8	211	1.103	232.7				
				111	1.587	176.2	1585.8
1.8–2.0	100	2.070	207.0				
				100	2.070	207.0	1863.0
	Mean = 3992 m^{-2}		Mean = 1003.4 = 1.0 g m^{-2}				Sum = 5103.0 = 5.1 g m^{-2}

Total production (P) = 5.1 × 1.45 (mean CPI correction) = 7.4 g m^{-2}.
†Negative value discarded

Table 2 Re-calculation of production of the winter generation of *Deleatidium* in the Ashley River using the size-frequency method.

Size group (mm)	Mean density (No. m^{-2})	W (mg)	B (g m^{-2})	ΔN	Weight at loss W (mg)	Weight lost WΔN	×9 (g m^{-2})
0.2–0.4	462	0.015	0.007				
				–187	0.022	–4.1	–0.037†
0.4–0.6	649	0.029	0.019				
				81	0.041	3.3	0.030
0.6–0.8	568	0.053	0.030				
				72	0.077	5.5	0.050
0.8–1.0	496	0.100	0.050				
				135	0.147	19.8	0.178
1.0–1.2	361	0.192	0.069				
				99	0.253	25.0	0.225
1.2–1.4	262	0.314	0.082				
				–11	0.493	–5.4	–0.049†
1.4–1.6	273	0.672	0.184				
				147	0.888	130.5	1.175
1.6–1.8	126	1.103	0.139				
				101	1.587	160.3	1.443
1.8–2.0	25	2.070	0.052				
				25	2.070	51.8	0.466
			Mean = 0.632				Sum = 3.567

†Negative values discarded

Table 3 Winter, summer, and annual production (P), mean biomass (B), and turnover rates (P/B) for larval *Deleatidium* collected from the Ashley River. Annual production was calculated by summing production of the winter and summer generations. Incorrect estimates are from Scrimgeour (1991), correct estimates are those based on recalculations using mean density for each of the larval size classes.

Production period	P (g m^{-2} yr^{-1})		B (g m^{-2})		Turnover ratio (P/B)	
	Incorrect	Correct	Incorrect	Correct	Incorrect	Correct
Winter	51.40	3.57	7.59	0.63	6.77	5.67
Summer	9.17	0.94	0.87	0.07	10.54	13.42
Annual	60.57	4.51	5.34	0.70	8.35	6.44

separately. To make matters worse this latter estimate has also been multipied by a CPI correction (1.7 in this case). When two generations occur over a 12-month period and production is estimated separately for each (using the size-frequency technique), it is quite incorrect to use a CPI correction to adjust the resulting estimates to give annual production; the two estimates should simply be summed to give this quantity. It is only valid to use a CPI correction to give annual production, if the original estimate (calculated with the size-frequency technique) is based on mean densities derived from samples taken **throughout** the year (Benke 1984). In this case, Scrimgeour could have calculated mean densities for the various size classes using data from the 12 sets of samples taken monthly during the year of his study. The resulting estimate for production should then have been multiplied by the mean CPI correction (1.45), i.e., the average of 1.2 and 1.7.

I have carried out these calculations (Table 1) assuming that the density data given by Scrimgeour in his fig.1 are correct. I estimated the proportions of the population in each size class from the numbers given in his fig.2. The estimate of annual production that results is 7.4 g DW m^{-2} (P/B = 7.4). This value is well within the range (2.5–19.6 g DW m^{-2}) of annual values recorded previously for this genus in New Zealand streams and rivers. Thus Scrimgeour's conclusion that *Deleatidium* shows a high level of production in the physically harsh environment of a flood-prone river is incorrect.

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Reply: My estimates of annual production of the leptophlebid mayfly *Deleatidium* in the flood-prone Ashley River, New Zealand, were indeed incorrect. Errors resulted from: (1) inappropriate use of cohort production intervals (CPI) and (2) the use of total larval densities for each larval size class rather than their mean densities (column 2, table 1 in Scrimgeour 1991). Marchant correctly recognised these errors; his recalculated annual production estimated from larval densities for each of the size classes from my published figures more likely resembles actual production.

I have recalculated production, based on actual data, to remedy my earlier calculation errors and to confirm the accuracy of Marchant's estimate. I calculated production of the winter and summer generations separately and then summed these values to estimate annual production. Thus, these changes in production calculations overcome the two sources of error described by Marchant.

When production is recalculated, winter (Table 2), summer, and annual production are considerably lower than initial estimates (Table 3) and my revised estimate of annual production (4.51 g DW m^{-2}) is 1.6 times lower than that calculated by Marchant (7.4 g DW m^{-2}). Additionally, my revised estimate is within the 2.5–19.6 g DW m^{-2} range reported for this genus elsewhere in New Zealand (Collier 1988). Thus, my earlier contention that *Deleatidium* exhibits high annual production in the flood-prone Ashley River, New Zealand is not warranted.

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