Appendix S1

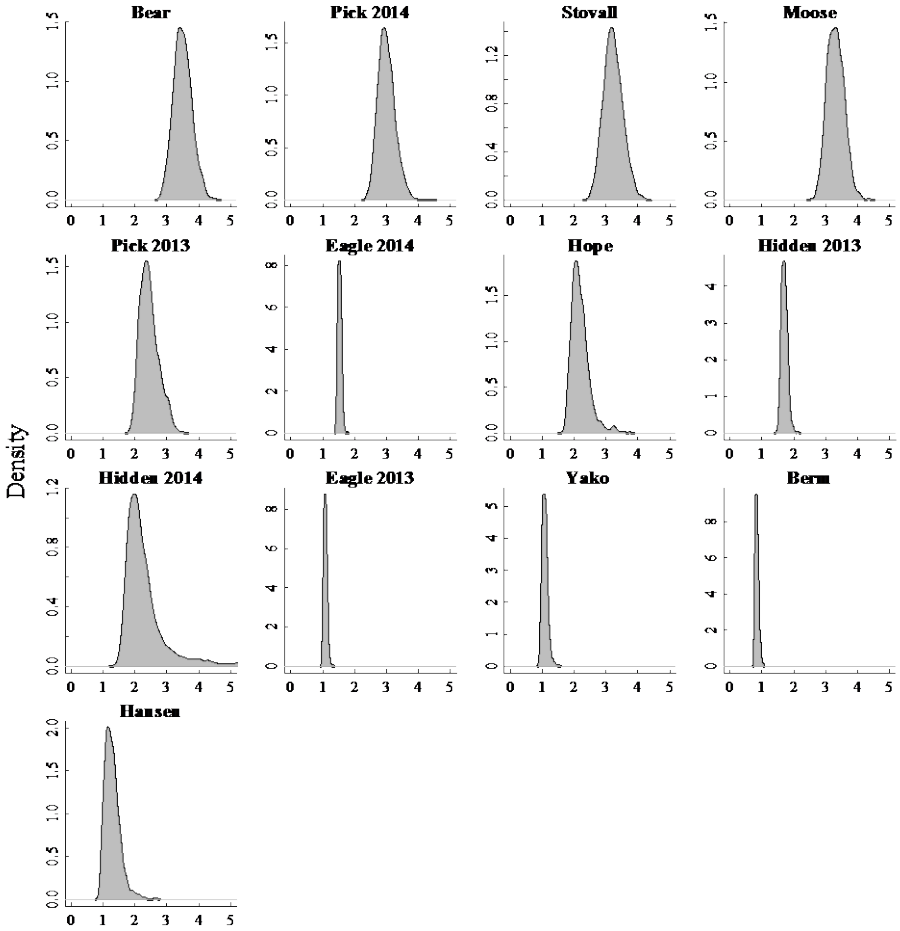

Figure S1. Posterior distributions for parameter β which controls the contributions of recent photosynthetic substrates to ecosystem respiration. The larger the value of β, the smaller the contribution of R_p to total ecosystem respiration. For the sites plotted in the top row, the single-source model fit the data equally well as the two-source model when an uninformative prior was used. Here we present the posterior distributions for β when an informative prior (based on estimates for the other streams) was used (normal distribution, mean=1.6, std dev 0.5).

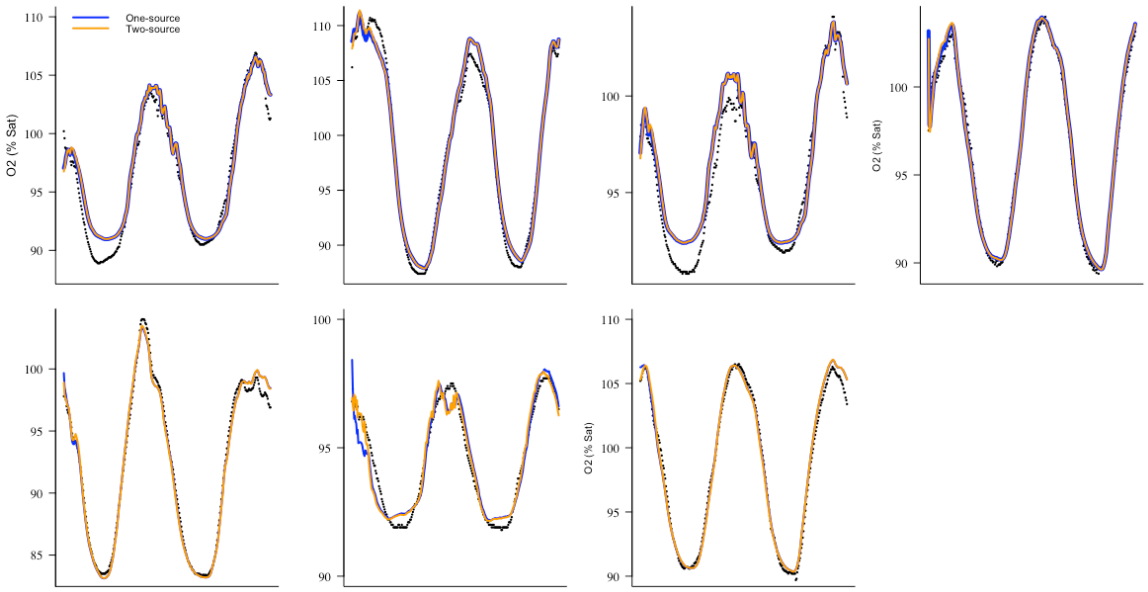

Figure S2. Plots of observed oxygen concentration (black dots) versus the predicted values from the single-source (blue line) and the two-source (gold line) models. Panels A-D are for streams where there was no significant difference in the performance of the single-source and two-source models. In all other panels, the two-source model had a substantially lower WAIC and, thus, provided a better fit to the data (see Table 2).

Table S1. Parameter values used in model scenarios presented in Figure 1. The model was run with two values of β (1.14, 3) to simulate two distinct levels of the importance of ecosystem respiration supported by labile photosynthetic products. Each of these values of β was crossed with different values of R_b to produce P:R ratios of 1 and 1.5. For β=1.14 these values were 20 and 7, respectively; for β=3 these values were 37 and 24.

Parameter	**Value**
E_b	0.65
E_p	0.32
B	1.14, 3
k_{20}	0.1
Sigma	97.53673
O_{start}	12300
alphaPI	0.3
P_{max}	100
Altitude	10
AtmPressCorr	0.998815
Salinity	0
Tref	278.5
Boltzmann k	8.62E-05
Schmidt(20)	531.2
avg Depth	0.4

Table S2. Comparison of WAIC values for the one-stage and two-stage metabolism models across 4 stream*year combinations where the single-stage model fit best, but where the two-stage model was fit with an informative prior on β (mean and std dev of β for all other stream*year combinations). Estimates of key parameters (β, k) and summaries of select metabolism variables (P, R_t, R_p, G; mg O_2 m^{-2} d^{-1}) are given for each of the two models. Parameter estimates for models fit without a prior on β are given in Table 1.

		WAIC		Two-source model								One-source model				
Stream	**Year**	**wAIC one-source**	**wAIC two-source**	**β**	**P**	**Rt**	**Rp**	**Rp/Rt**	**G**	**k**	**P:R**	**P**	**R**	**G**	**k**	**P:R**
N. Bear	2014	**-802**	-787	-3.49	3299.8	4644.6	161.0	0.03	2820.0	0.25	0.71	3172.02	4519.86	2836.68	0.25	0.70
Pick	2014	**-654**	-648	-2.98	4042.1	4316.1	245.6	0.06	2559.4	0.17	0.94	3862.86	4143.06	2621.08	0.18	0.93
Stovall	2014	**-943**	-932	-3.21	1542.1	2890.8	103.3	0.04	1741.2	0.20	0.53	1477.97	2849.91	1773.44	0.20	0.52
Moose	2013	**-1381.4**	-1371.8	-3.30	4042.1	3738.2	153.6	0.04	1873.8	0.17	1.08	2383.05	3595.71	1881.04	0.17	0.66

Table S3. Water chemistry sampled for a diel cycle in nine of the study streams. Most values are means of duplicate samples, except where samples were lost in transit from the field in which case values are derived from a single sample.

Stream	Type	DOC ($mg\ L^{-1}$)	TDN ($mg\ L^{-1}$)	C:N	Abs 350 ($10\ cm^{-1}$)	SUVA ($L*mg\ C^{-1}*\ m^{-1}$)
Berm	Noon	1.50	1.21	1.2	0.05	0.96
	6pm	1.44	1.33	1.1	0.08	1.56
	Dusk	1.86	1.68	1.1	0.08	1.12
	Dawn	1.59	1.37	1.2	0.05	0.98
Cottonwood	Noon	0.89	0.52	1.7	0.01	-0.04
	6pm					
	Dusk	0.84	0.55	1.5	0.02	0.58
	Dawn	0.79	0.59	1.4	0.02	0.42
Eagle	Noon	3.89	0.80	5.0	0.30	2.36
	6pm	5.17	1.05	4.9	0.28	1.59
	Dusk	3.90	0.69	5.7	0.34	2.59
	Dawn	4.23	0.98	4.3	0.29	2.25
Elva	Noon	1.51	0.97	1.6	0.00	-0.06
	6pm	1.90	1.19	1.6	0.03	0.32
	Dusk	0.98	1.05	0.9	0.01	0.41
	Dawn	0.92	0.77	1.2	0.03	0.64
Hansen	Noon	1.32	0.84	1.6	0.12	2.54
	6pm	2.79	0.65	4.3	0.11	0.92
	Dusk	1.80	0.84	2.1	0.12	1.84
	Dawn	1.91	0.71	2.7	0.11	1.56
Hidden	Noon	1.41	0.71	2.0	0.06	1.53
	6pm	1.72	0.87	2.0	0.12	1.72
	Dusk	2.20	1.06	2.1	0.10	1.25
	Dawn	2.09	0.93	2.2	0.06	1.01
Joe	Noon	0.68	0.67	1.0	0.00	0.16
	6pm	0.81	0.74	1.1	0.04	1.18
	Dusk	0.93	0.98	0.9	0.03	0.85
	Dawn	0.99	0.68	1.4	0.03	0.78
Pick	Noon	1.64	1.01	1.7	0.15	1.08
	6pm	1.46	0.60	2.6	0.06	1.08
	Dusk	2.26	1.05	2.1	0.08	0.78
	Dawn	1.47	0.79	2.0	0.04	0.80

Seventh	Noon	1.05	0.50	2.1	0.04	1.44
	6pm	2.44	0.69	3.6	0.08	1.24
	Dusk	1.46	0.84	1.7	0.07	1.38
	Dawn	1.08	0.60	1.8	0.08	2.01