Appendix S1

Table S1. Mean (± SE) percent elemental contents, molar ratios, and fungal biomass of oak litter from 3 quality treatments fed to *P. lepida.*

Quality	% C	% P	% N	P:C (nmol P μmol^{-1} C)	Fungal biomass (% dry mass)[1]
Low	48.7 (0.1)	0.041 (0.002)	1.39 (0.04)	0.327 (0.013)	3.63 (0.52)
Med	48.5 (0.2)	0.047 (0.003)	1.36 (0.07)	0.375 (0.028)	5.62 (0.67)
High	48.2 (0.1)	0.091 (0.006)	1.53 (0.04)	0.733 (0.046)	5.37 (0.41)

[1]Calculated from ergosterol contents using a conversion of 5.5 mg ergosterol g^{-1} fungal biomass (Gessner and Chauvet 1993)

Literature cited:

Gessner, M.O. and E. Chauvet. 1993. Ergosterol-to-biomass conversion factors for aquatic hyphomycetes. Applied and Environmental Microbiology 59: 502-607.

Table S2. Field measures of standing detrital stocks, detritivore biomass, and litter P:C ratios across a selection of aquatic ecosystems. See the two right-hand columns for direct comparison to experimental conditions in the present study (18-160 g litter stocked g^{-1} *P. lepida* biomass; resource P:C=0.327 to 0.733 nmol P μmol^{-1} C).

Source	Location	System	Site (treatment)	Sampling month	Detrital standing stock[1]	Detritivore biomass	Units[2]	Detritus: Detritivore mass ratio	Leaf litter P:C[3]
Wallace et al. 1999	Georgia, U.S.A.	Low-order streams	C53 (Reference) Before	Year-round	149.4	0.700	g AFDM m^{-2}	213	
			C53 (Reference) After	Year-round	258.9	0.726	g AFDM m^{-2}	357	
			C55 (Litter-exclusion) Before	Year-round	111.1	0.401	g AFDM m^{-2}	277	
			C55 (Litter-exclusion) After	Year-round	7.1	0.187	g AFDM m^{-2}	38	
Cross et al. 2006	Georgia, U.S.A.	Low-order streams	C53 (Reference)	Year-round	234	0.630	g AFDM m^{-2}	371	0.206[4]
			C54 (Nutrient-enriched)	Year-round	101	0.954	g AFDM m^{-2}	106	0.326[4]
Venarsky et al. 2014	Alabama, U.S.A.	Cave streams	Hering	Seasonal	10.1	3.57E-04	g AFDM m^{-2}	28315	
			Limrock	Seasonal	14.8	1.87E-04	g AFDM m^{-2}	79144	
			Tony Sinks	Seasonal	20.5	3.53E-04	g AFDM m^{-2}	58140	

Prater et al. 2015	Arkansas, U.S.A.	Low-order streams	Sweet Water	March-April	8	0.110	g DM m^{-2}	73	0.547
			Illinois	March-April	4	0.168	g DM m^{-2}	24	0.580
			Cannon	March-April	20	0.150	g DM m^{-2}	133	0.386
			Fane	March-April	6	0.098	g DM m^{-2}	61	0.362
			NFWOC	March-April	2	0.155	g DM m^{-2}	13	0.503
			Wildcat	March-April	13	0.046	g DM m^{-2}	283	1.011
			Flint	March-April	4	0.076	g DM m^{-2}	53	0.729
			Chambers	March-April	7	0.139	g DM m^{-2}	50	0.992
Entrekin et al. 2007	Michigan, U.S.A.	Low-order streams	Shane upstream	Year-round	153	0.0185	g AFDM m^{-2}	8270	
			Shane downstream	Year-round	87	0.0107	g AFDM m^{-2}	8131	
			State upstream	Year-round	90	0.0129	g AFDM m^{-2}	6977	
			State downstream	Year-round	203	0.0238	g AFDM m^{-2}	8529	
			Walton upstream	Year-round	149	0.0166	g AFDM m^{-2}	8976	
			Walton downstream	Year-round	266	0.0128	g AFDM m^{-2}	20781	

[1]Reported as either leaf litter or coarse benthic organic matter standing stocks
[2]AFDM=ash-free dry mass
[3]Leaf litter molar phosphorus:carbon (nmol P μmol^{-1} C) contents; reported where data were available.

[4]Litter P:C ratios reported in Cross et al. (2003)

Literature cited:

Cross, W. F., J. B. Wallace, A. D. Rosemond, and S. L. Eggert. 2006. Whole-system nutrient enrichment increases secondary production in a detritus-based ecosystem. Ecology 87:1556–1565.

Entrekin, S.A., E.J. Rosi-Marshall, J.L. Tank, T.J. Hoellein, and G.A. Lamberti. 2007. Macroinvertebrate secondary production in 3 forested streams of the upper Midwest, USA. Journal of the North American Benthological Society 26: 472-490.

Prater, C., E. J. Norman, and M. A. Evans-White. 2015. Relationships among nutrient enrichment, detritus quality and quantity, and large-bodied shredding insect community structure. Hydrobiologia 753:219–232.

Venarsky, M. P., B. M. Huntsman, A. D. Huryn, J. P. Benstead, and B. R. Kuhajda. 2014. Quantitative food web analysis supports the energy-limitation hypothesis in cave stream ecosystems. Oecologia 176:859–869.

Wallace, J.B., S.L. Eggert, J.L. Meyer, and J.R. Webster. 1999. Effects of resource limitation on a detrital-based ecosystem. Ecological Monographs 69: 409-442.

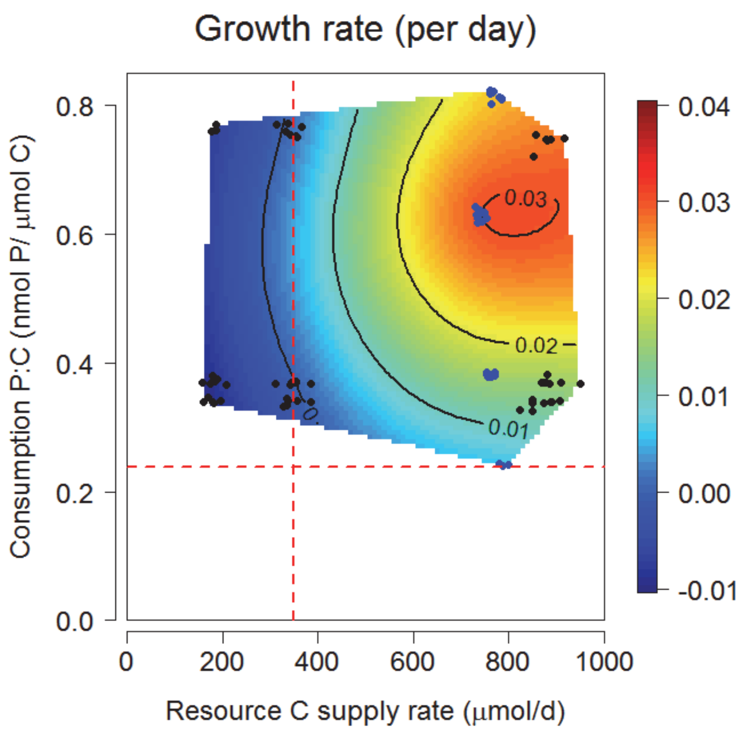

Figure S1. Response surface fitted to growth rates of *P. lepida* larvae across a gradient of resource supply rates (quantity) and P:C contents (quality). The black datapoints represent individuals from the present experiment fed oak litter. The blue datapoints represent individuals from a separate experiment with 3rd and 4th-instar *P. lepida* larvae fed a P:C gradient of oak litter (Halvorson et al. 2015). The vertical and horizontal red dotted lines represent zero growth thresholds for resource supply (350 µmol C d^{-1}) and P:C (0.239 nmol P μmol^{-1} C), respectively. Larval growth exhibits an optimum at ~750 µmol C d^{-1} and 0.62 nmol P μmol^{-1} C.

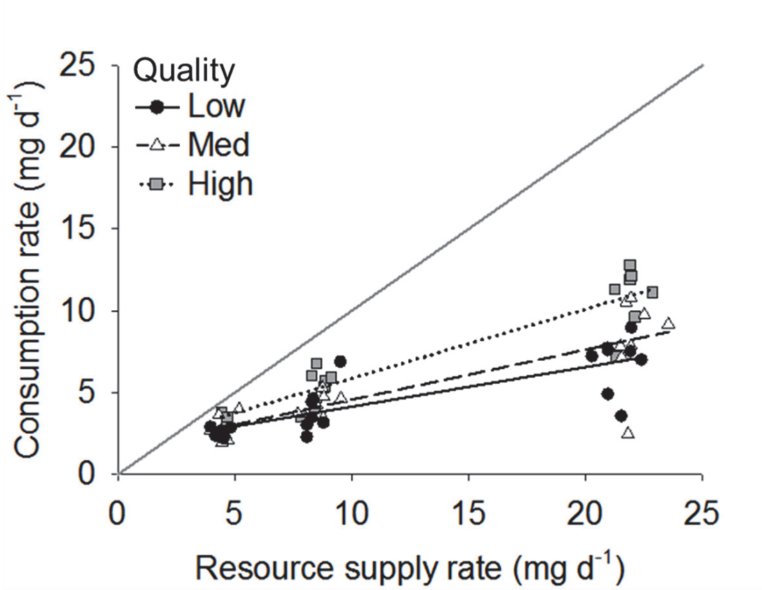

Figure S2. Average *P. lepida* resource consumption rates across a gradient of resource supply rates during consumption trials. Each point represents one single individual and units are in dry mass. The solid gray line describes a 1:1 relationship indicating complete depletion of supplied resources.

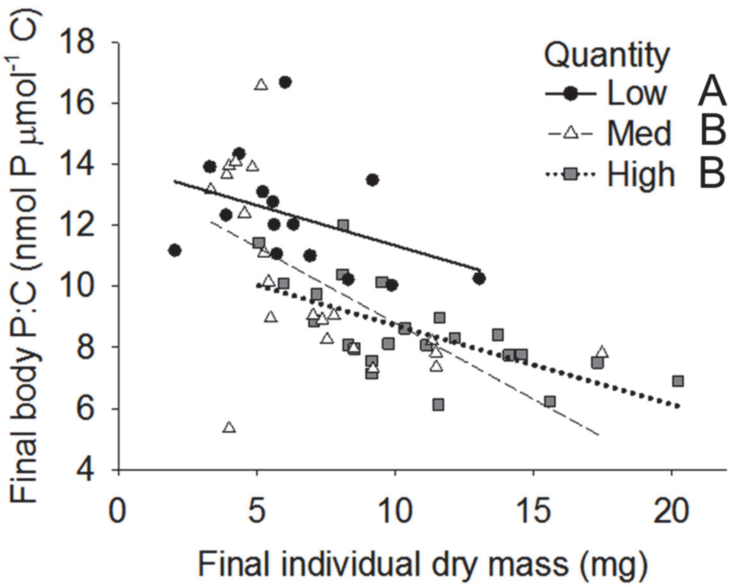

Figure S3. Final body P:C contents plotted against final dry mass of individual *P. lepida* fed varying quantities of leaf litter during the growth experiment. The ANCOVA indicated slopes were homogeneous across quantity levels (dry mass*quantity interaction $F_{2,53}$=1.24, P=0.299). After accounting for dry mass effects, body P:C differed across quantity levels (ANCOVA $F_{2,55}$=5.74, P=0.005), as designated by letters in the figure legend based on Tukey's Honestly Significant Difference (P<0.05).