

TEMPORAL VARIATION IN A PALEOLIMNOLOGICAL RECORD ARISING FROM A TROPHIC CASCADE¹

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Abstract. A food-chain model based on trophic cascade theory predicts substantial variance in ecosystem function at time scales near the lifespan of the dominant predator. We tested this prediction using time series (1889–1982) of algal pigment concentrations in annually laminated sediments from a lake dominated by planktivorous fishes with lifespans of 3–5 yr. For pigments that are deposited in sediments mainly by herbivory and are known to be direct indicators of the trophic cascade (alloxanthin, pheophorbide *a*), variance was pronounced at scales similar to the fish lifespan, consistent with predictions of the model. Several other sedimentary pigments that have mainly pelagic sources (native chlorophylls, α -carotene) also had variance peaks consistent with predictions of the model. Pigments with multiple sources (fucoxanthin, lutein-zeaxanthin, β -carotene, pheophytin *c*) had only weakly significant or nonsignificant variance peaks. Pigments with mainly terrestrial sources (pheophytins *a* and *b*) had no variance peaks. These results indicate that some of the variance in this paleolimnological record is due to the trophic cascade. Since the scale of this variance component is ≈ 3 –5 yr, a 5-yr moving average filters out variance due to the trophic cascade. Residuals from the 5-yr moving average accentuate variance due to the trophic cascade. Filtering of the pheophytin time series revealed longer-term cycles (≈ 15 yr), which may arise from terrestrial or climatic processes.

Key words: food web processes; fossil pigments; lake; lake sediment; paleolimnology; pigment; predation; sedimentation; time series; trophic cascade; variability.