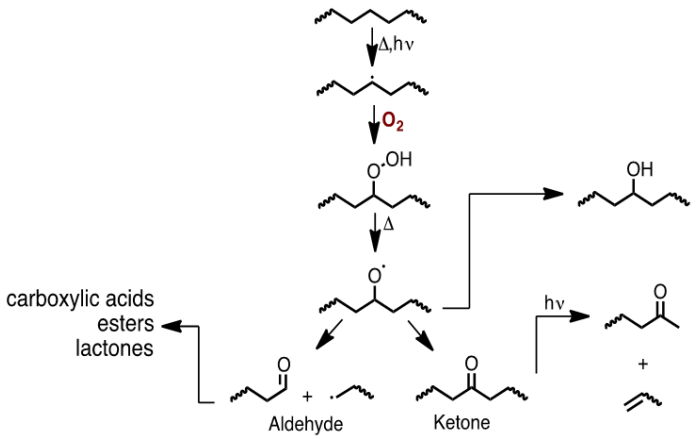
Electronic Supplementary Material (ESI) for Environmental Science: Processes & Impacts.

Supplementary Information

Photodegradation of polyolefin thin films in simulated freshwater conditions



Scheme S1. Generalized oxidation pathways for polyolefins.

Figure S1: Pictures of the plastics mounted on cardstock on a rotating platform in the photochemical reactor when exposed in air with arrow representing the rotation of the platform. Quartz beaker containing polymer thin film held in place by quartz test tubes. Beaker replaces the cardstock support and is simply placed on the rotating pedestal.

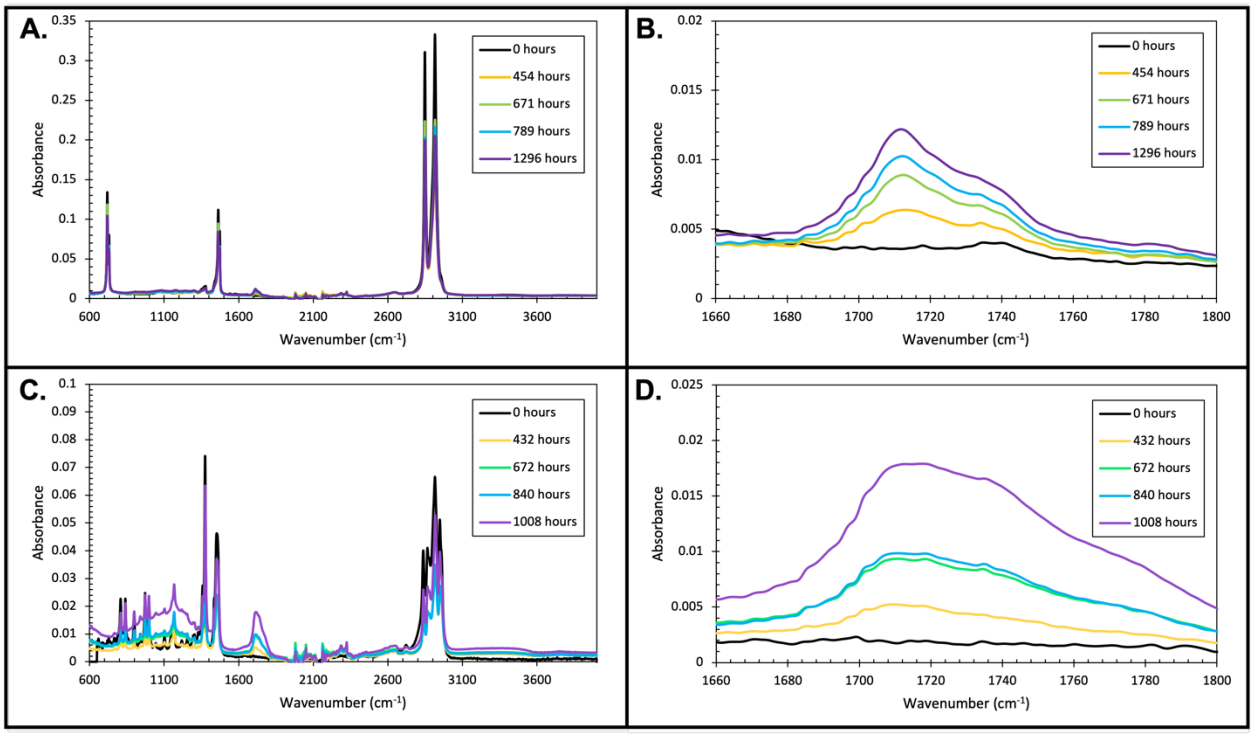


Figure S2. FTIR spectra of (A). PE and (C). PP irradiated with 350 nm light in air for varying amounts of time. It is observed that both have an increase in carbonyl characteristics in both PE (B) and PP (D).

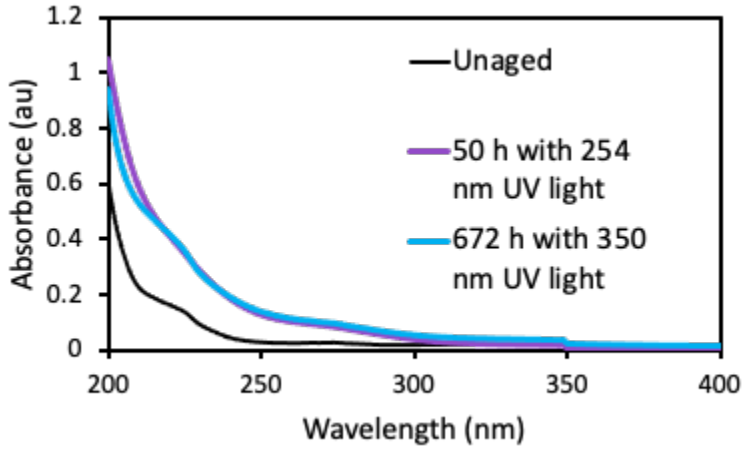


Figure S3. UV visible absorbance of PP films after irradiation with 254 nm or 350 nm UV light.

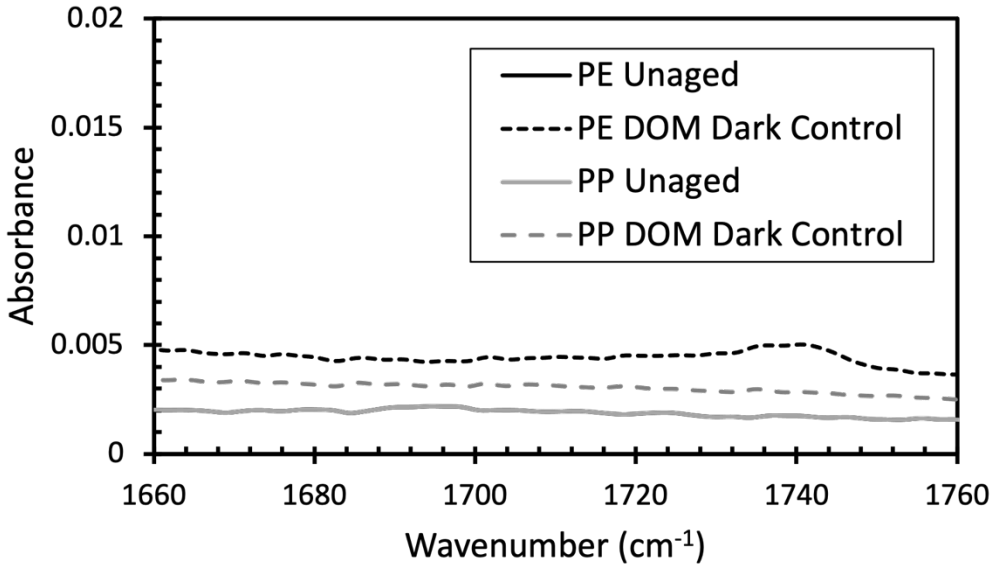


Figure S4: Samples of PE and PP soaked in a 10 mg C/L SRNOM for ~3 months. No band at ~1720 cm^{-1} is observed indicating no contribution of adsorbed DOM to the carbonyl band measurement of oxidation. A similar study of irradiated DOM followed by dark absorption revealed a similar spectra as the non-irradiated DOM.

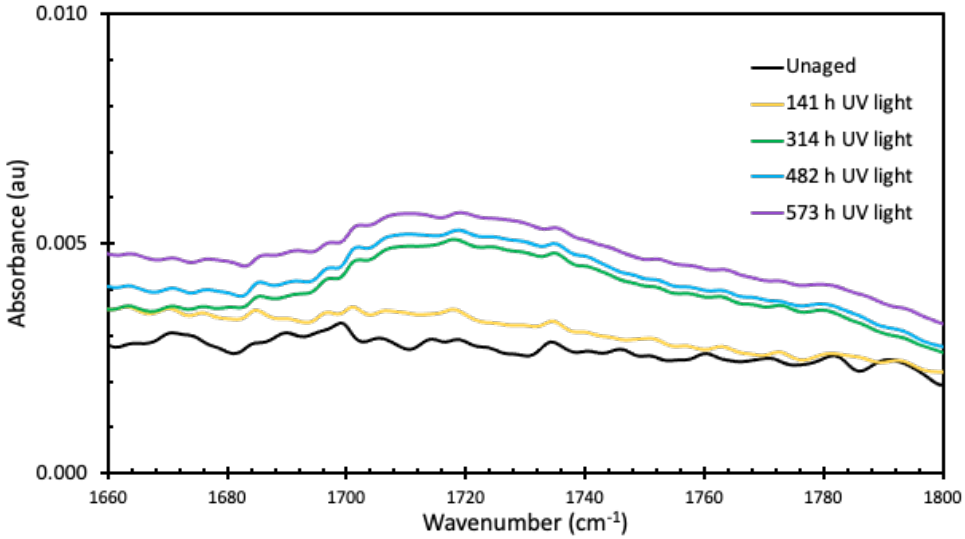


Figure S5. Polypropylene irradiated in "Instant Ocean" solution prepared as specified by the manufacturer with 254 nm UV light for varying amounts of time. While there is some observed oxidation, it is relatively small and could not be accurately integrated.

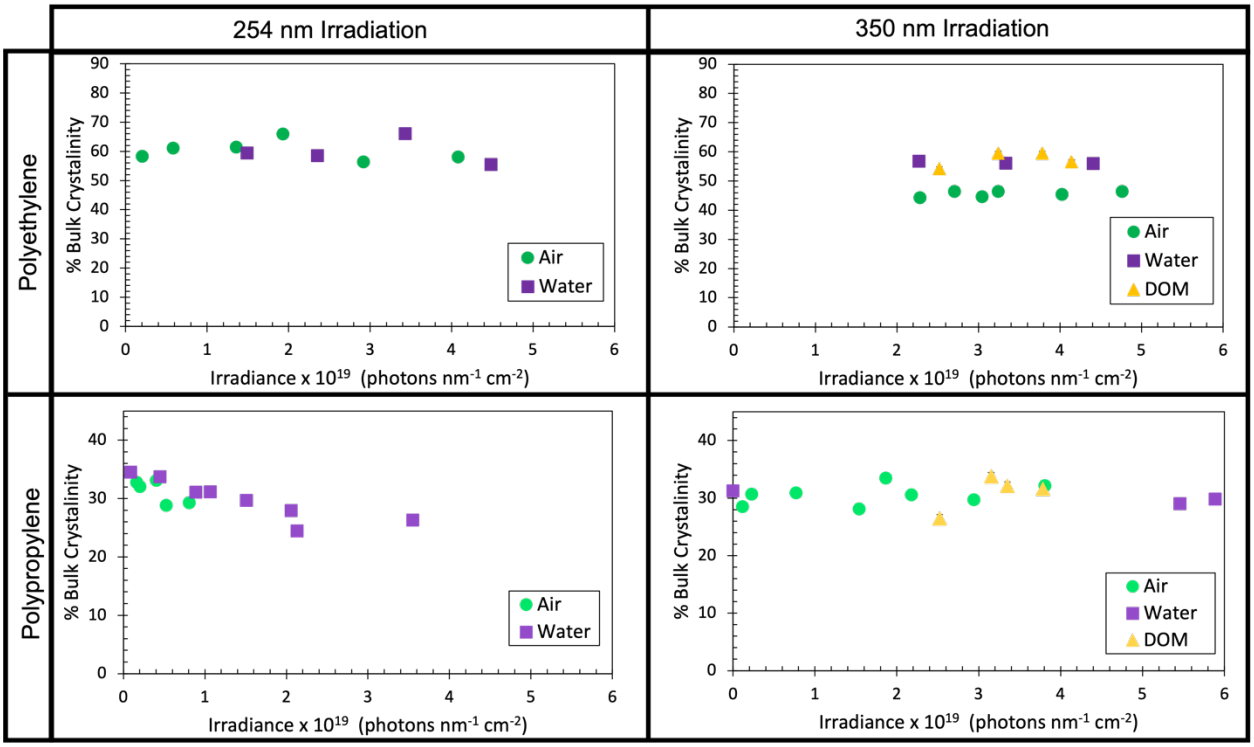


Figure S6: Bulk crystallinity of polyethylene and polypropylene as determined with differential scanning calorimetry.

Table S1: pseudo-first order reaction rate constants (per h) for carbonyl and vinyl indices. Standard error of modeled k reported in paratheses.

	Carbonyl Index			Vinyl Index		
Condition	254 nm Air	350 nm Air	Natural	254 nm Air	350 nm Air	Natural
PE	2.62E-3 (±3.4E-4)	1.48E-6 (±1.0E-7)	1.38E-6 (±2.1E-8)	1.03E-5 (±1.7E-10)	2.87E-4 (±4.3E-13)	8.98E-3 (±5.3E-10)
PP	1.01E-4 (±2.8E-6)	1.02E-5 (±7.0E-7)	8.60E-3 (±1.3E-3)	1.41E-1 (±4.5E-7)	2.89E-3 (±2.3E-10)	8.60E-3 (±1.7E-10)

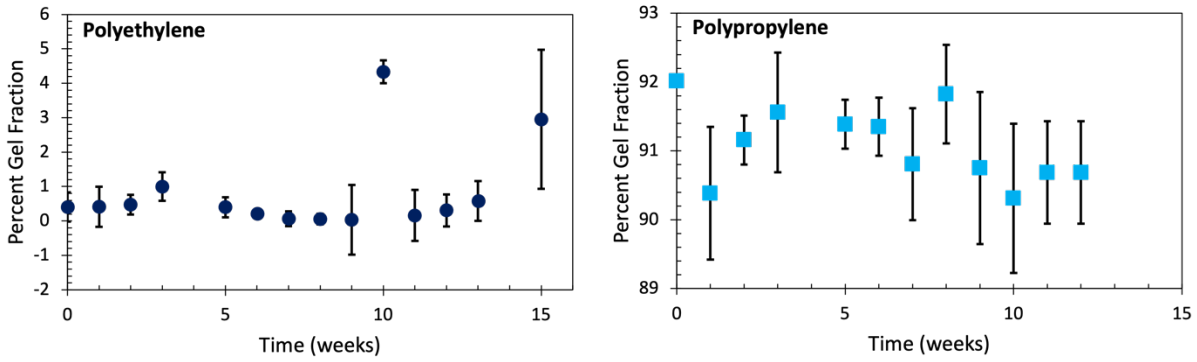


Figure S7: Percent gel fraction of polyethylene and polypropylene exposed to natural irradiations as determined by the mass percent of polymer that was insoluble in heated (110°C) xylenes. Minimal changes in the percent gel fraction were observed, indicating that crosslinking is not a primary pathway of degradation for these polyolefins.