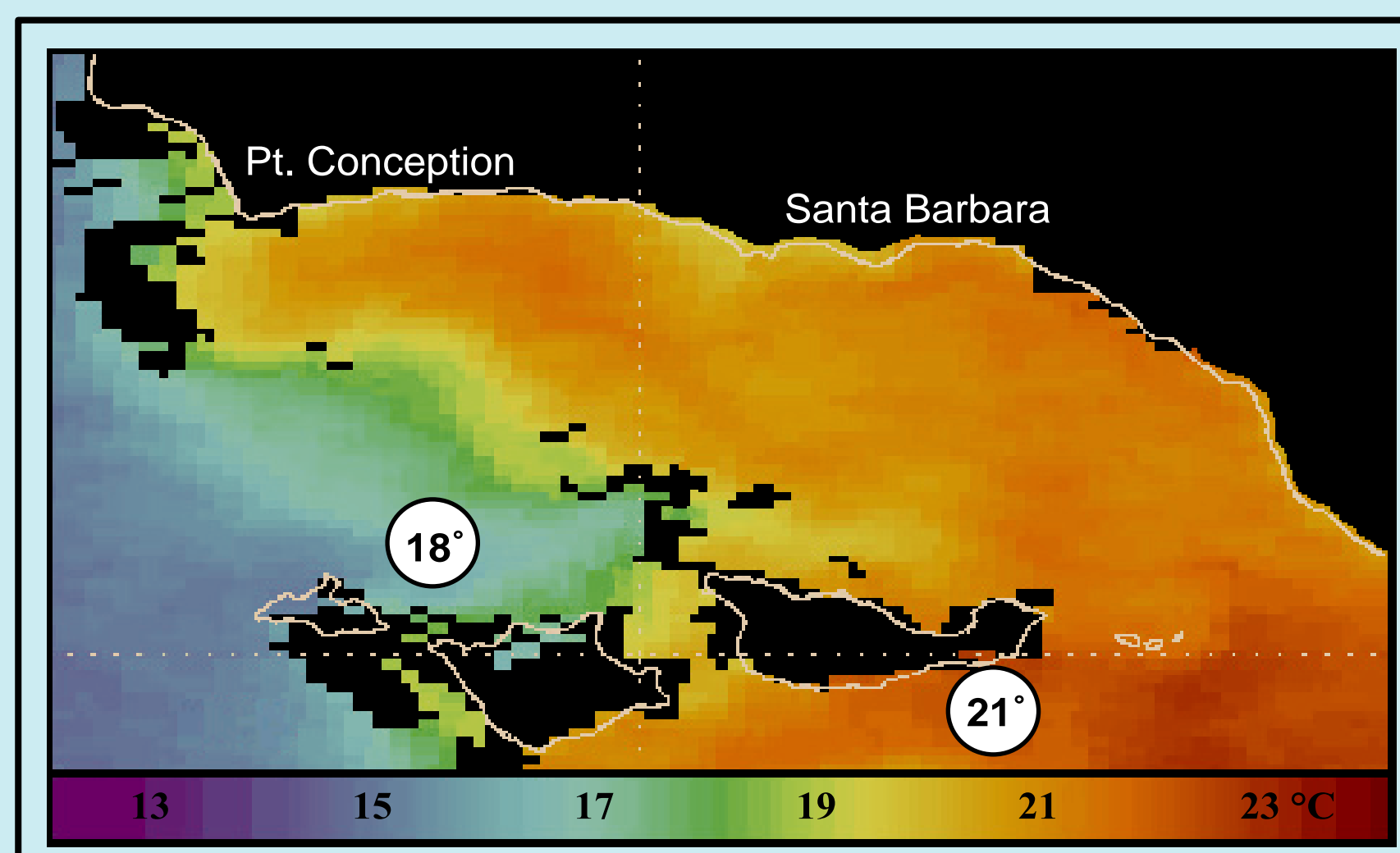


# ULTRAVIOLET SPECTRAL REGULATION OF PHYTOPLANKTON BIOMASS, PIGMENTATION AND CDOM DYNAMICS IN DIVERSE CALIFORNIA COASTAL WATERS

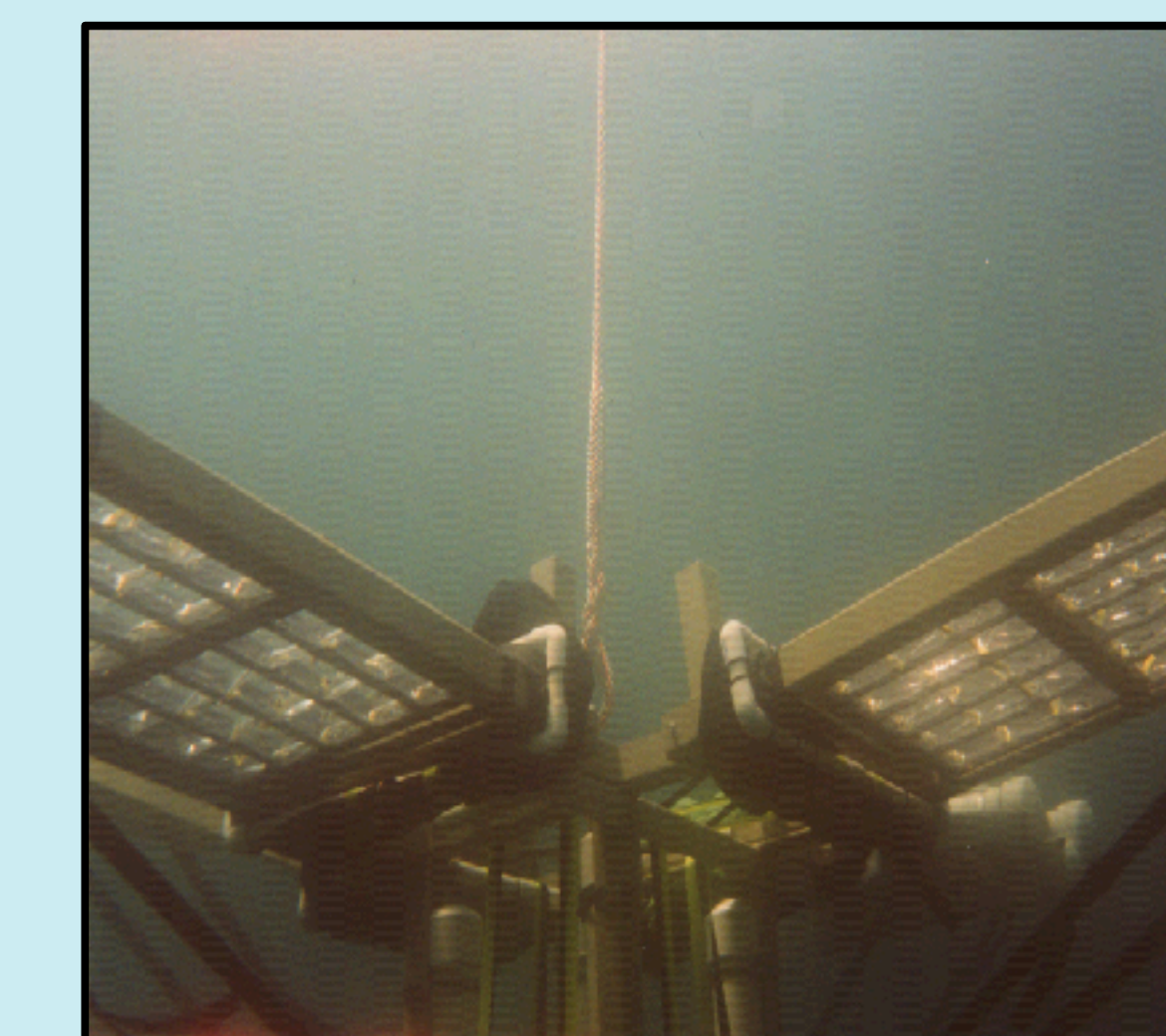
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SUPACC 3 - 8/27/98 - 9/10/98



The 1998 Solar Ultraviolet Productivity Algorithms for Coastal California (SUPACC) studies represent findings of 4 seasonal cruises designed to determine the range & sources of variability of spectral UVR effects on phytoplankton production & community dynamics. Here we present data for one summer day that show the considerable range of UVR responses with respect to short term changes in biomass, photophysiology, community structure and surrounding concentration of cDOM. These UVR responses underlie those described for primary production. Such evaluations are important for a better understanding of which & how different cell, community & bio-optical parameters are regulated by natural solar UVR. Results are also important to understanding trends in UVR biological responses that could be assignable to geographic and/or temporally coherent regions of the oceans.

Undewater View of Drifter



## Background

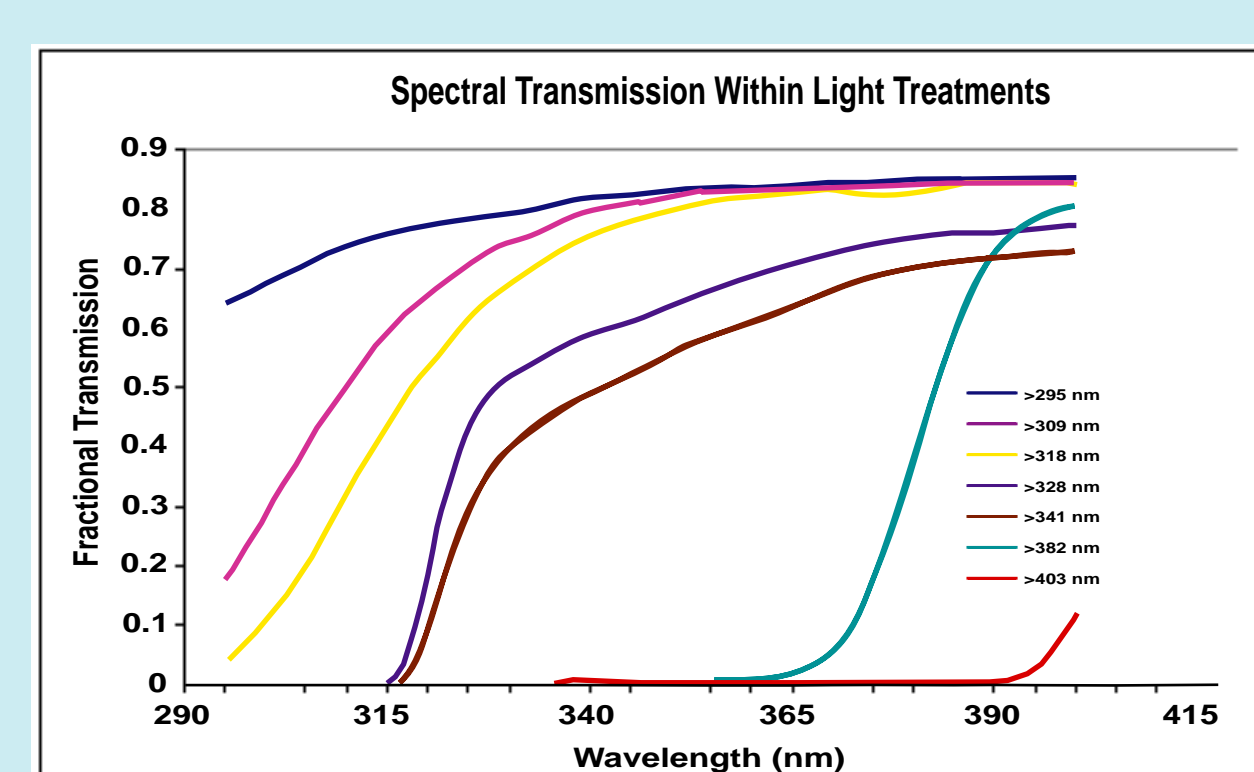


Fig 1: Spectral transmission Within Light treatments. Displayed is the spectral transmission of the external light field that penetrates to the sample. Seven different light treatments were used to examine the effects due to various doses of radiation, as well as separating UVA and UVB responses.

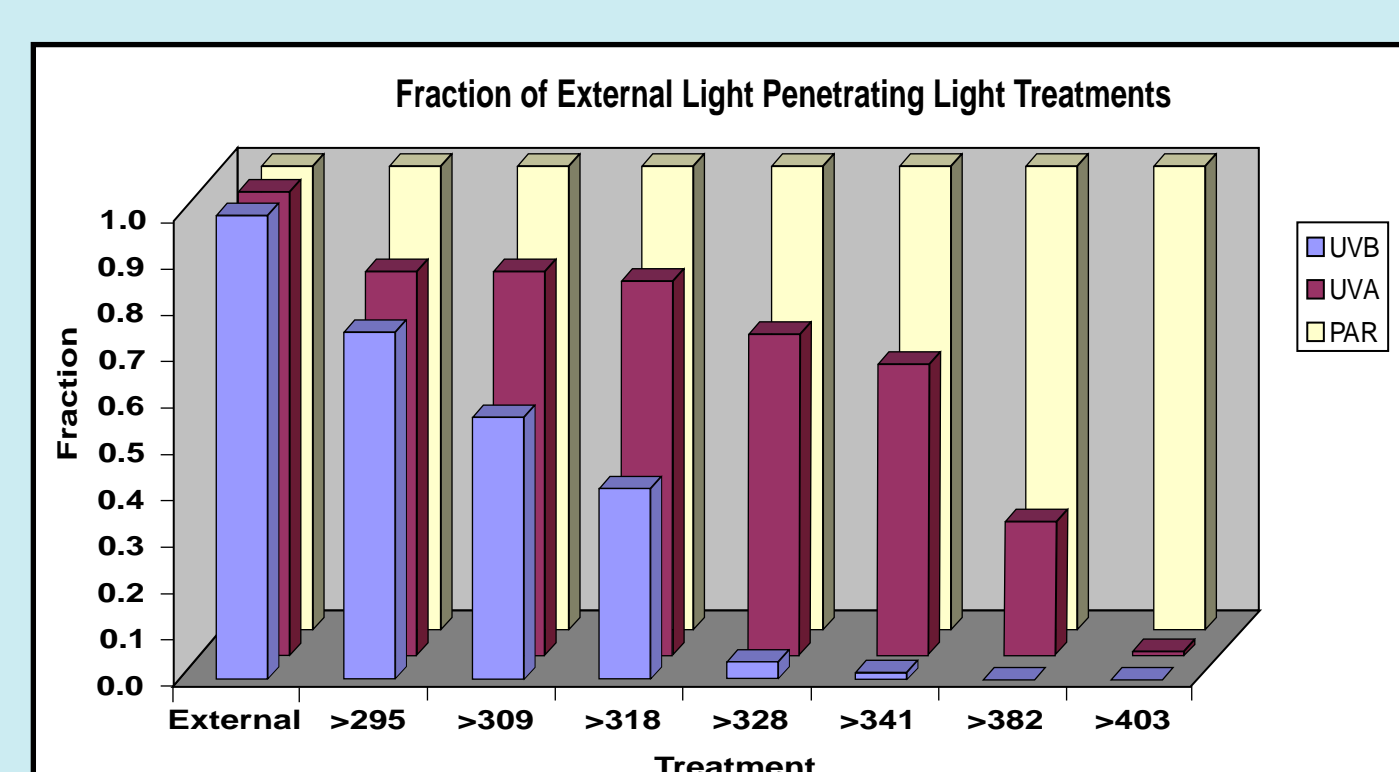


Fig 2: Fraction of External Light. This graph shows the fraction of external light that penetrates into the light treatments. The light field is broken up into PAR, UVA and UVB in order to better show the types and relative doses of UVR that are affecting each individual light treatment.

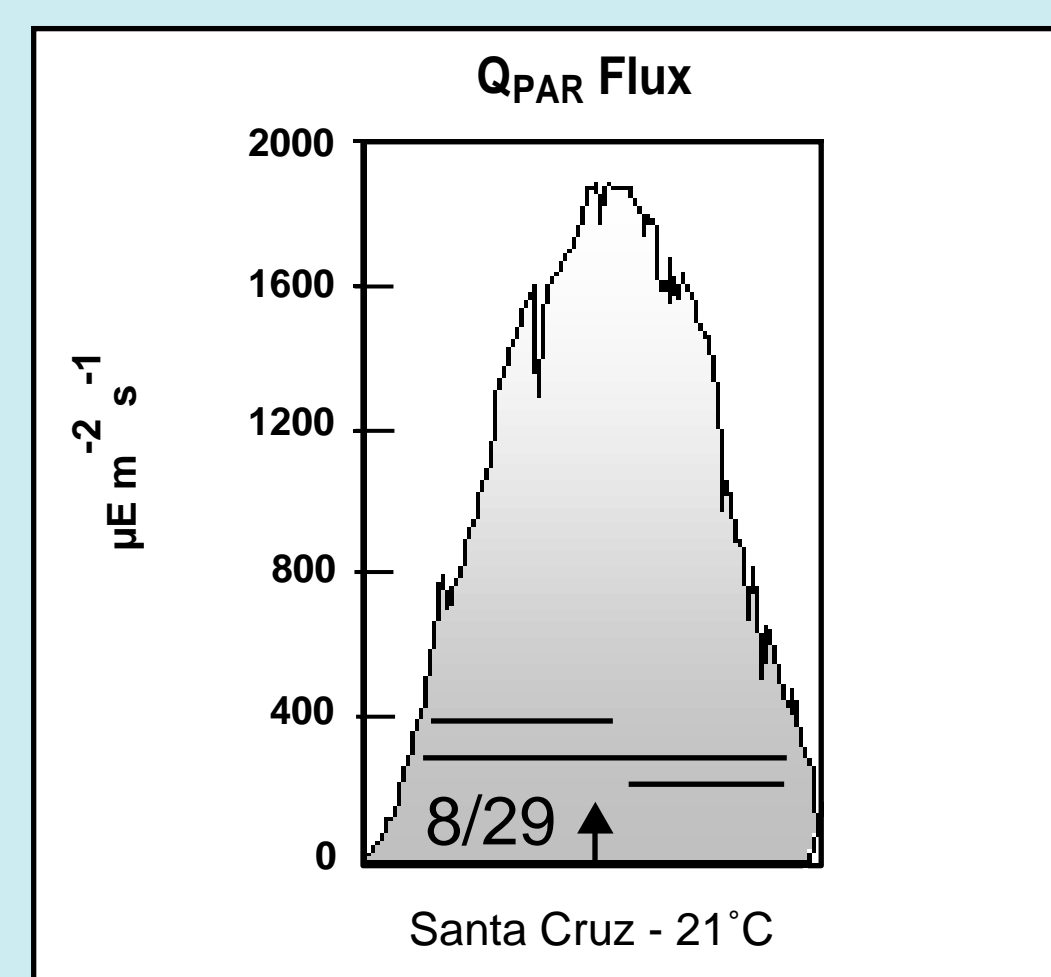


Fig 3: QPAR Flux Over the Day. QPAR was measured using a shipboard GUV and integrated over the full day. The black horizontal bars show the time of day the UVR drifters were deployed, while the black arrow represents solar noon.

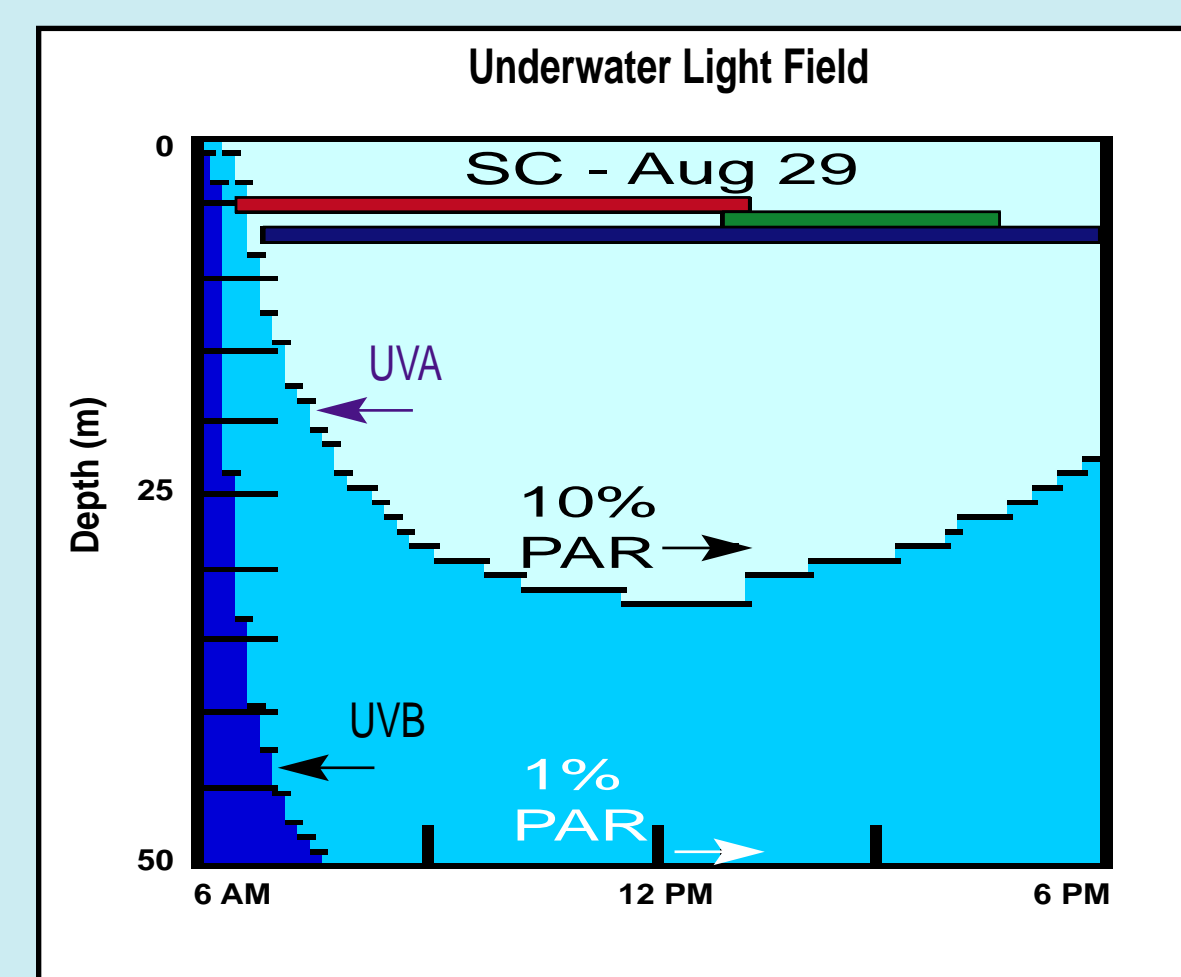


Fig 4: Underwater Light Field. The underwater light field is derived from several different vertical profiles over the day. The purple arrow indicates the biological limit of UVB, while the black arrow indicates it for UVA. The horizontal bars represent the times of drifter deployment.

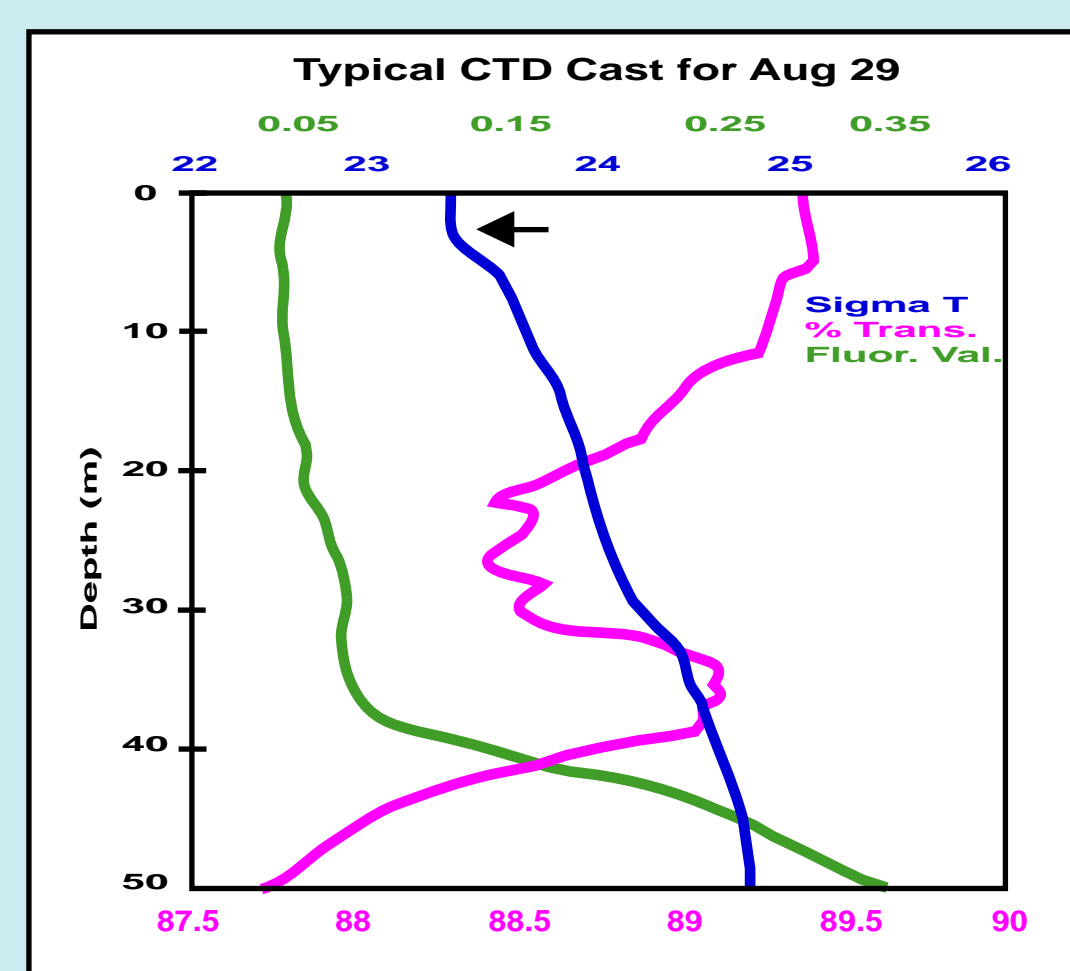


Fig 5: Typical CTD Cast. Shows the physical characteristics of the water column where the samples were retrieved. The black arrow indicates the depth at which samples were collected, showing that the samples were from a near surface stratified layer. The black arrow also indicates the depth that the UVR drifters were deployed.

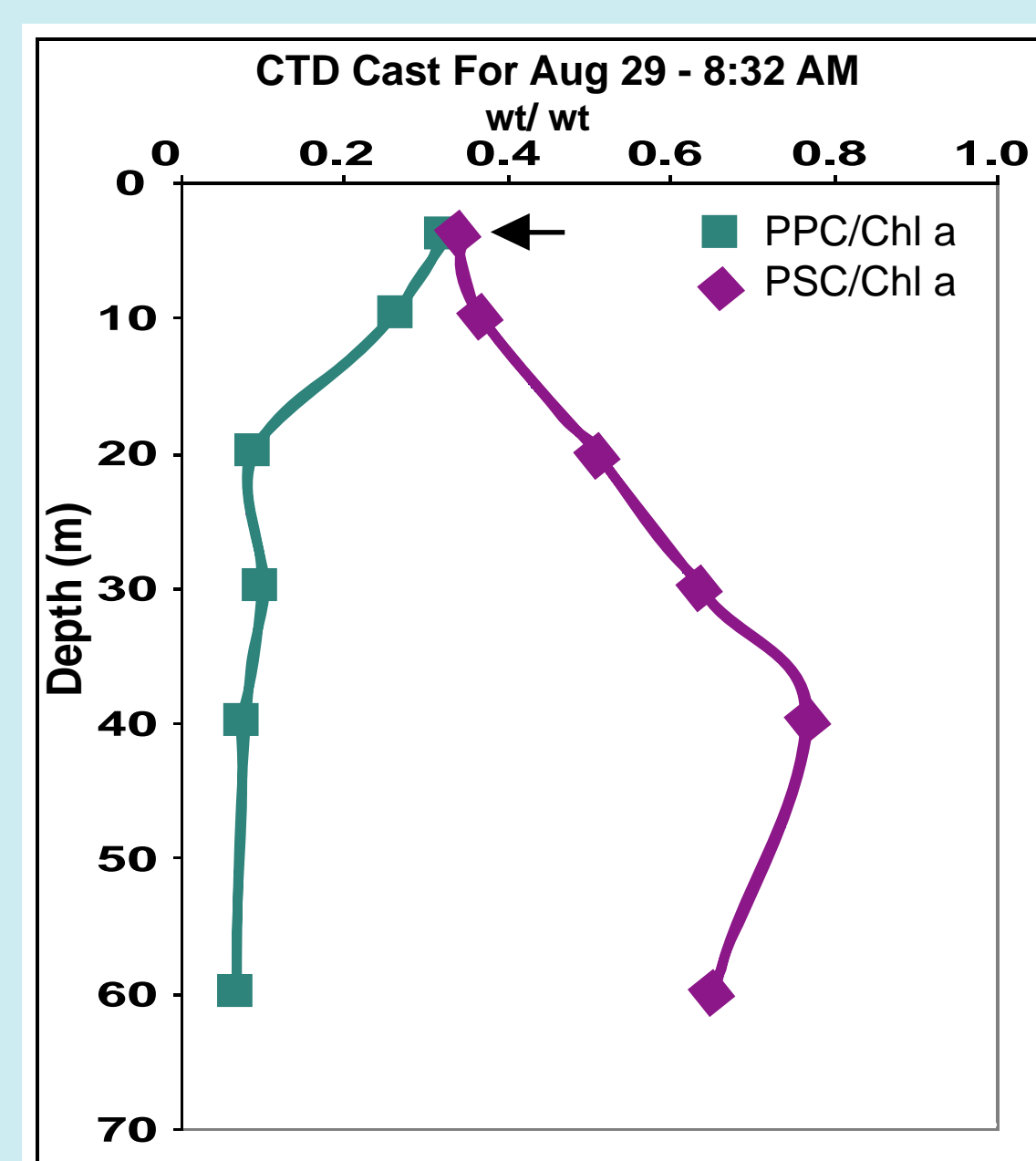


Fig 6: Depth Profile of PSC and PPC. The PSC (Photosynthetic Carotenoids) and PPC (Photoprotective Carotenoids) depth profiles give evidence of micro-stratification within the water column. Other physiological and physical data sets show that this condition is prevalent over time scales of days. Note, the lower PSC:Chl a ratio near the surface, indicates that the sample collected at that depth (black arrow), was adapted to high light conditions.

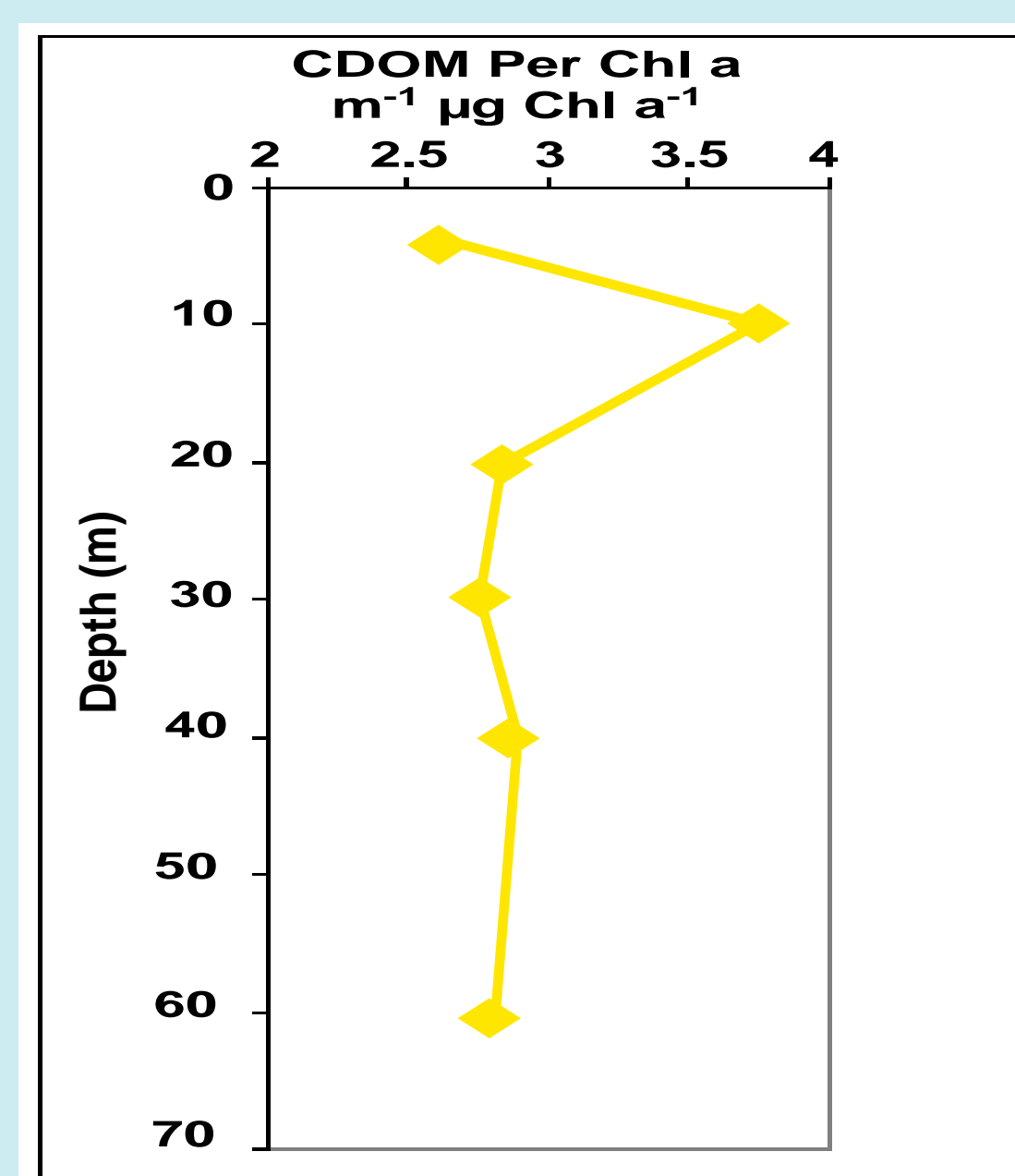


Fig 7: Depth Profile of CDOM Per Chl a. The depth profile of CDOM per Chl a gives further evidence that the water column was well stratified at the time of sampling.

## In Situ Results

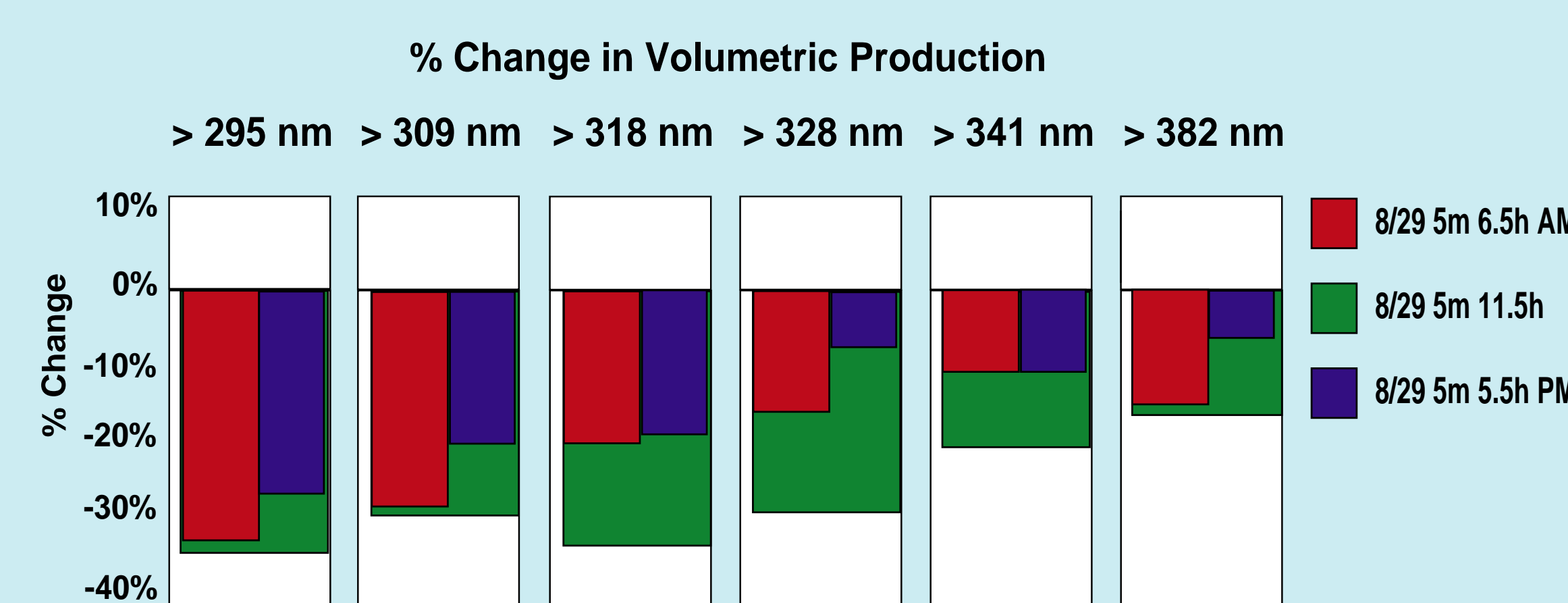


Fig 8: Spectral UV Impacts on Primary Production. These results, which are in percent change of volumetric production relative to 400nm, show that there is a dose dependent response. In all incubations, as the amount of UVA and UVB radiation is increased, there is a corresponding loss in production per volume. However, the greatest impacts occur when UVB is added.

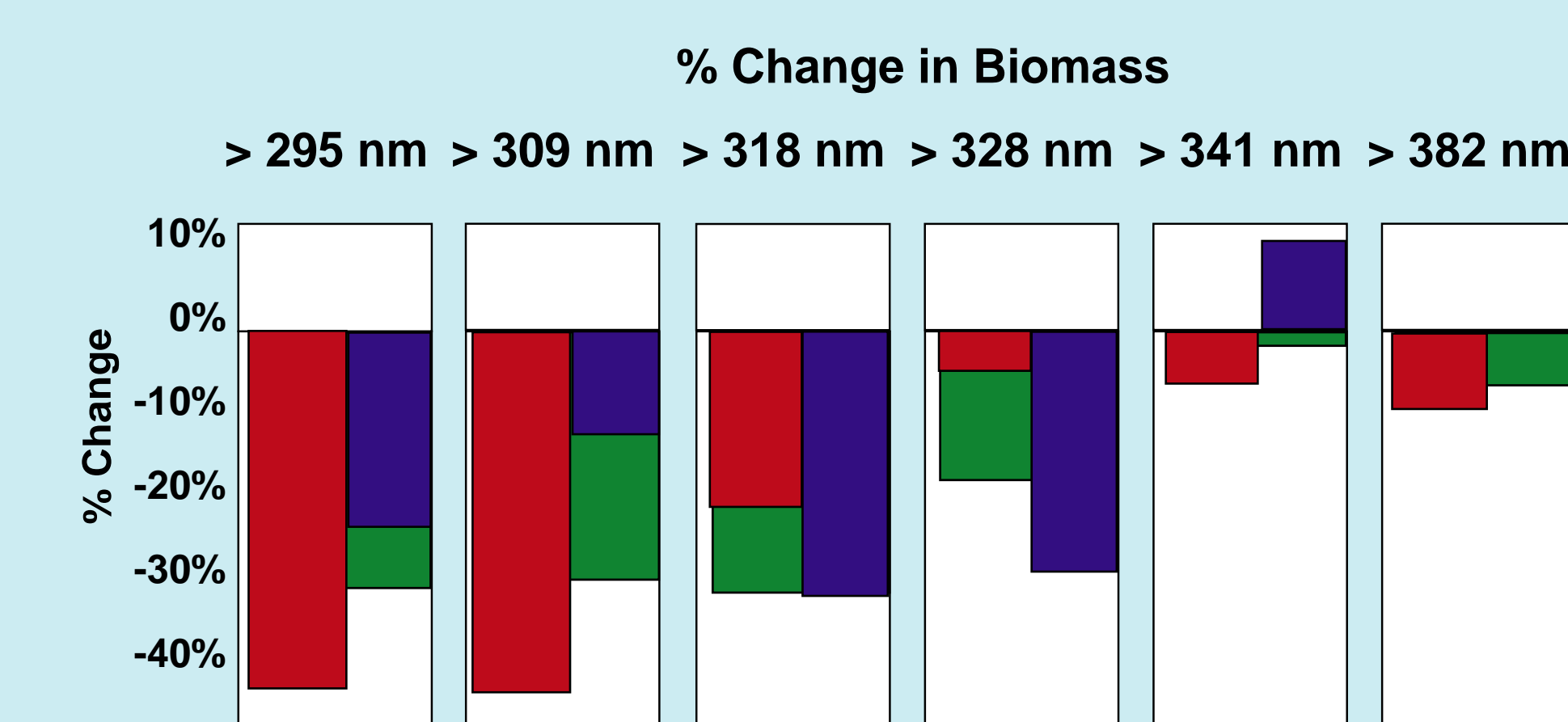


Fig 9: Spectral UV Impacts on Biomass. These results, which are in percent change of volumetric biomass relative to 400nm, do not show as strict of a dose dependent response. However, in all UVR drifters Chl a bleaching occurs due to UVB radiation.

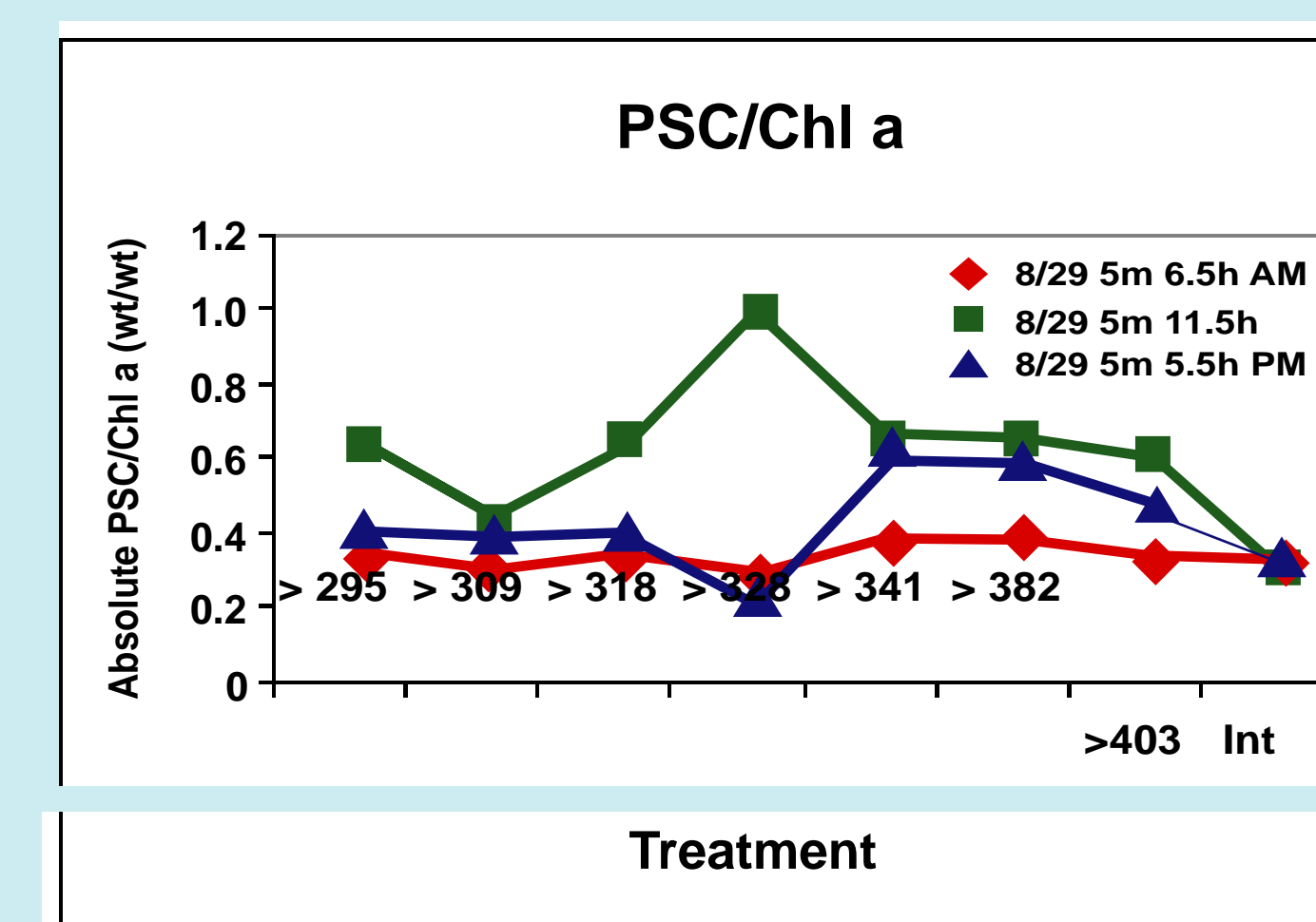


Fig 10: Ratio of PSC to Chl a. The full day drifter sees an enhancement of PSC relative to Chl a in light treatments that only received UVA radiation. As UVB radiation is added, it negates the enhancement effects of UVA. A similar pattern is seen for the afternoon drifter, though the enhancement is lower at intermediate wavelengths. There is no effect seen in the morning drifter.

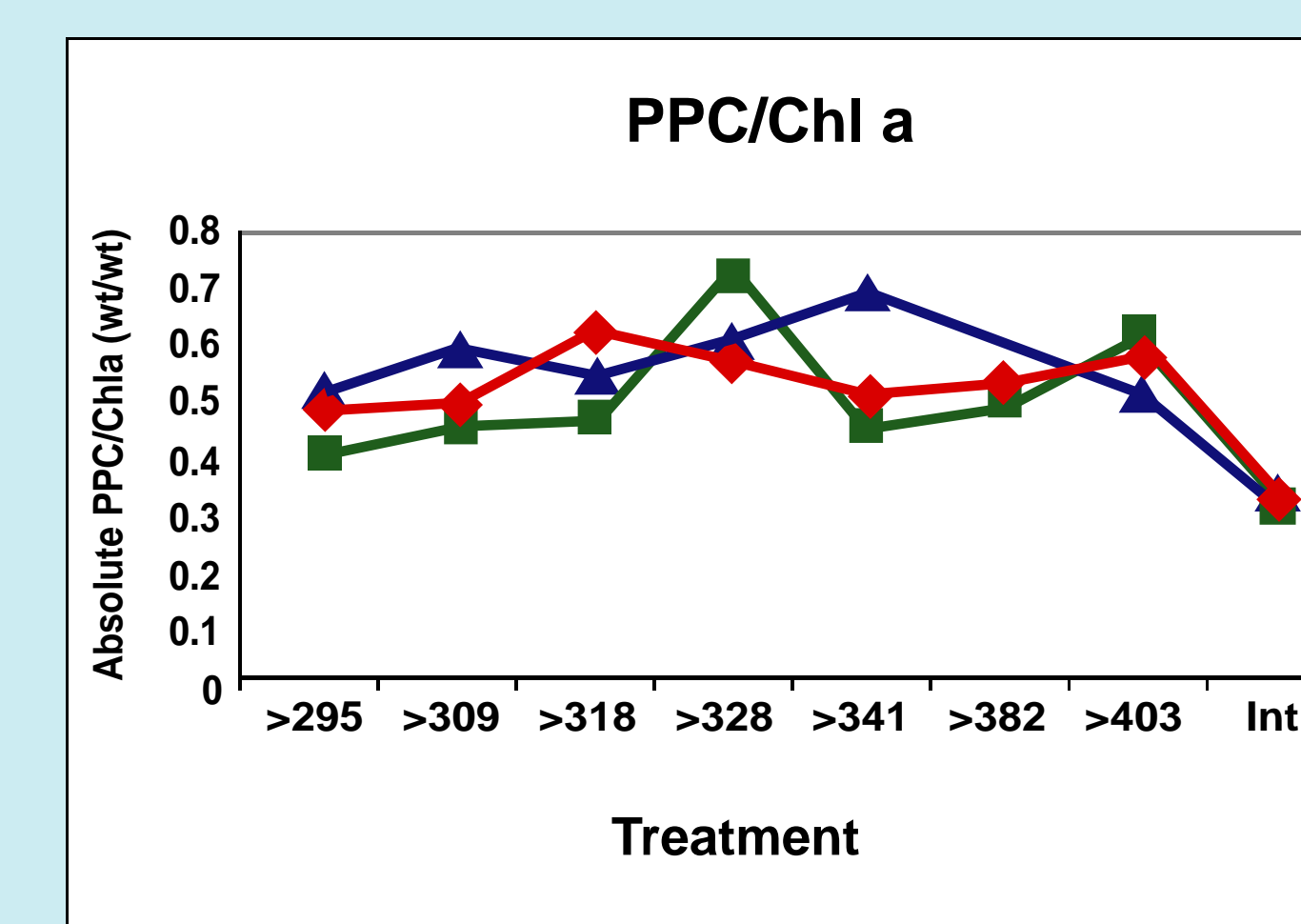


Fig 11: Ratio of PPC to Chl a. There is no distinct pattern in response to UVR observed. However, there is a slight increase in PPC/Chl a in the UVA range, while there is a decrease when UVB

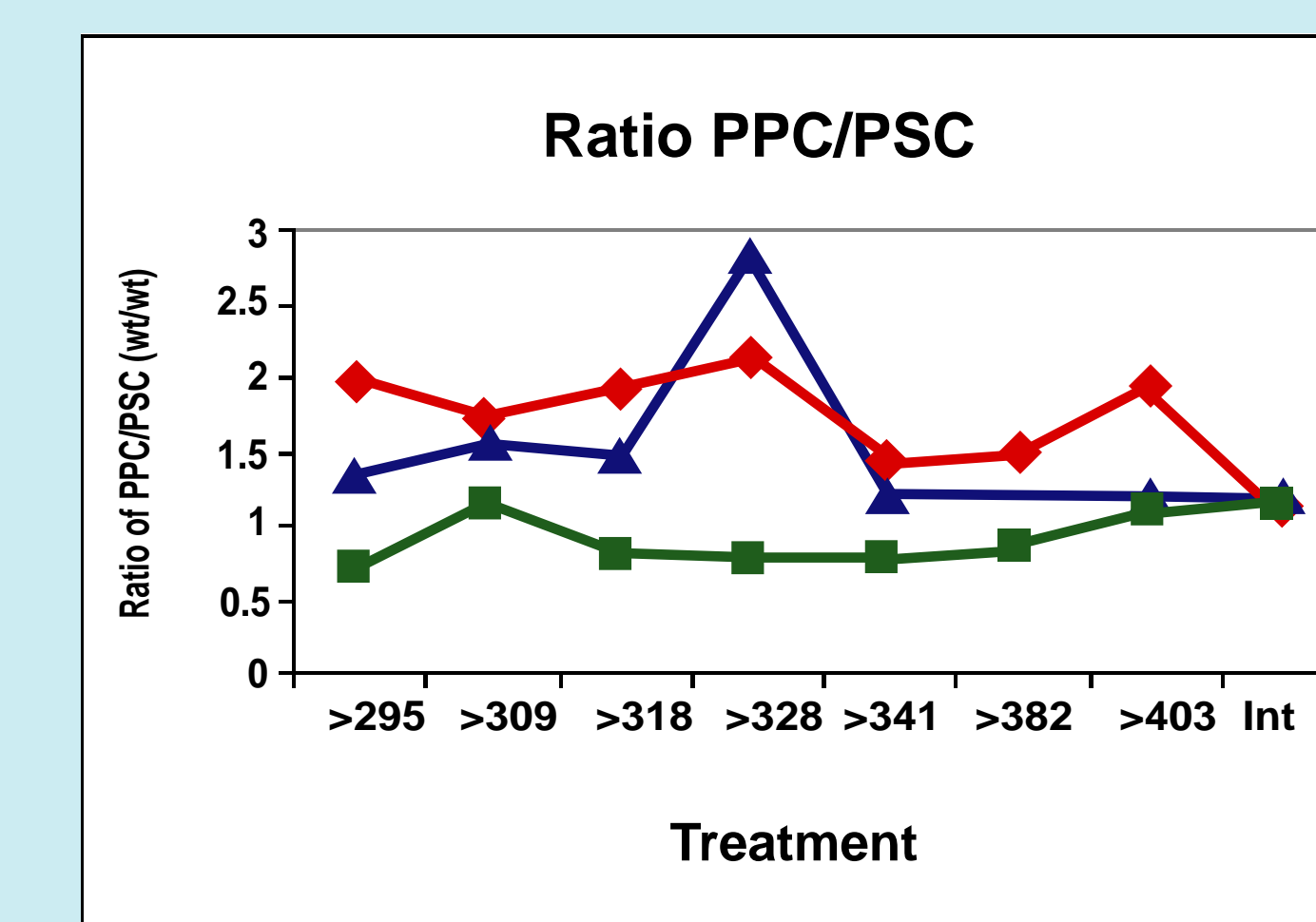


Fig 12: Ratio of PPC to PSC. The full day drifter does not show a change in the PPC to PSC ratio suggesting that there were similar effects on both the PPC and PSC. However, both of the half day drifters show an increase in PPC compared to PSC as UV radiation is added, suggesting that there was different responses by the PPC and PSC over shorter light doses.

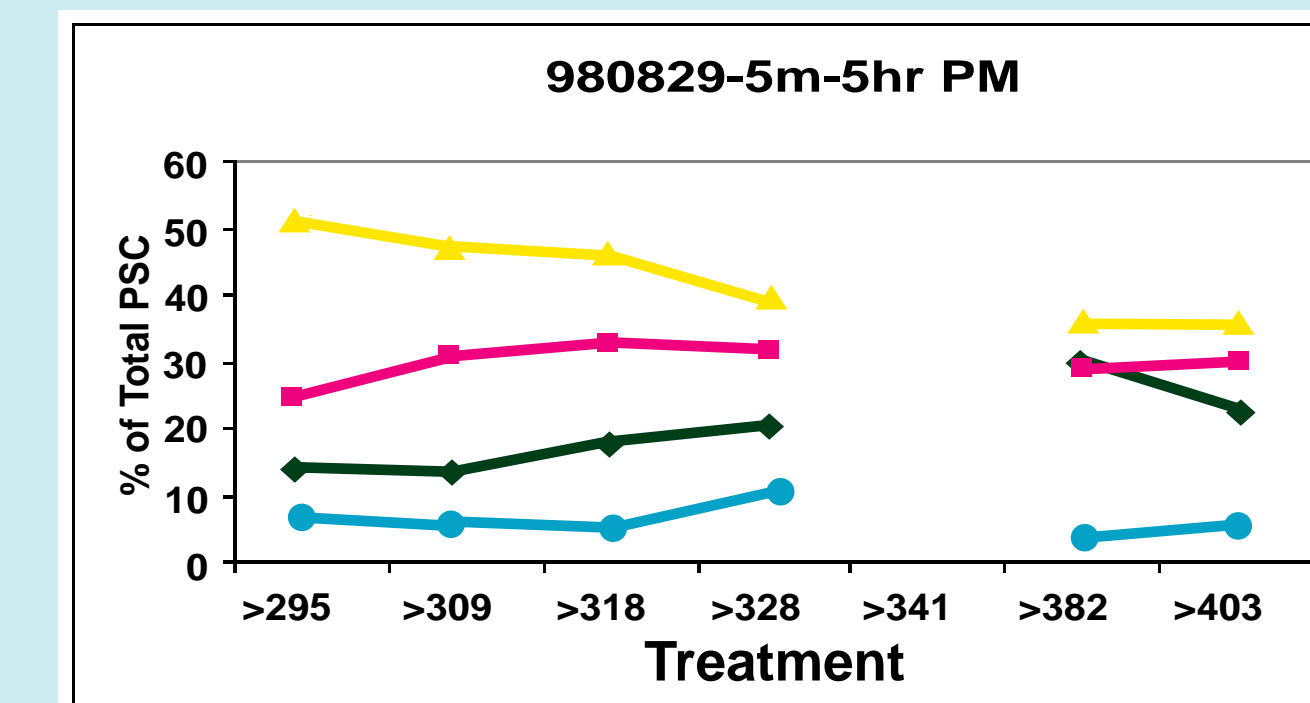
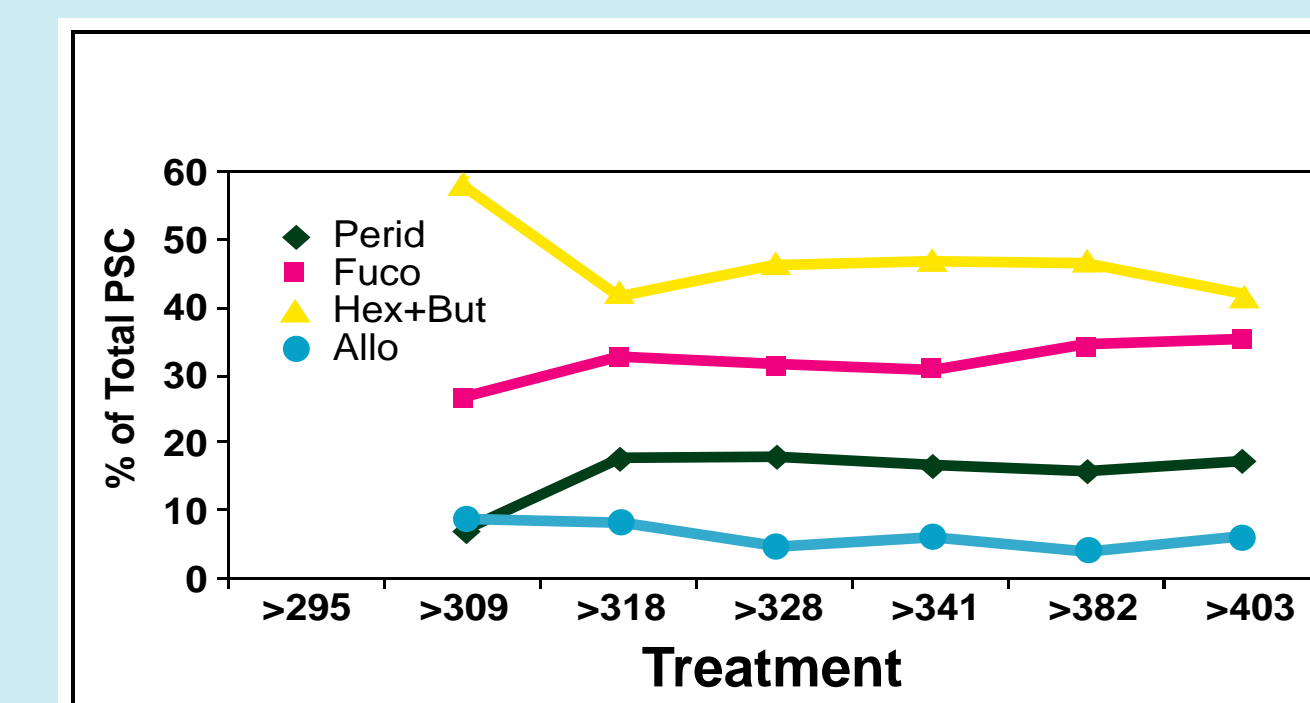
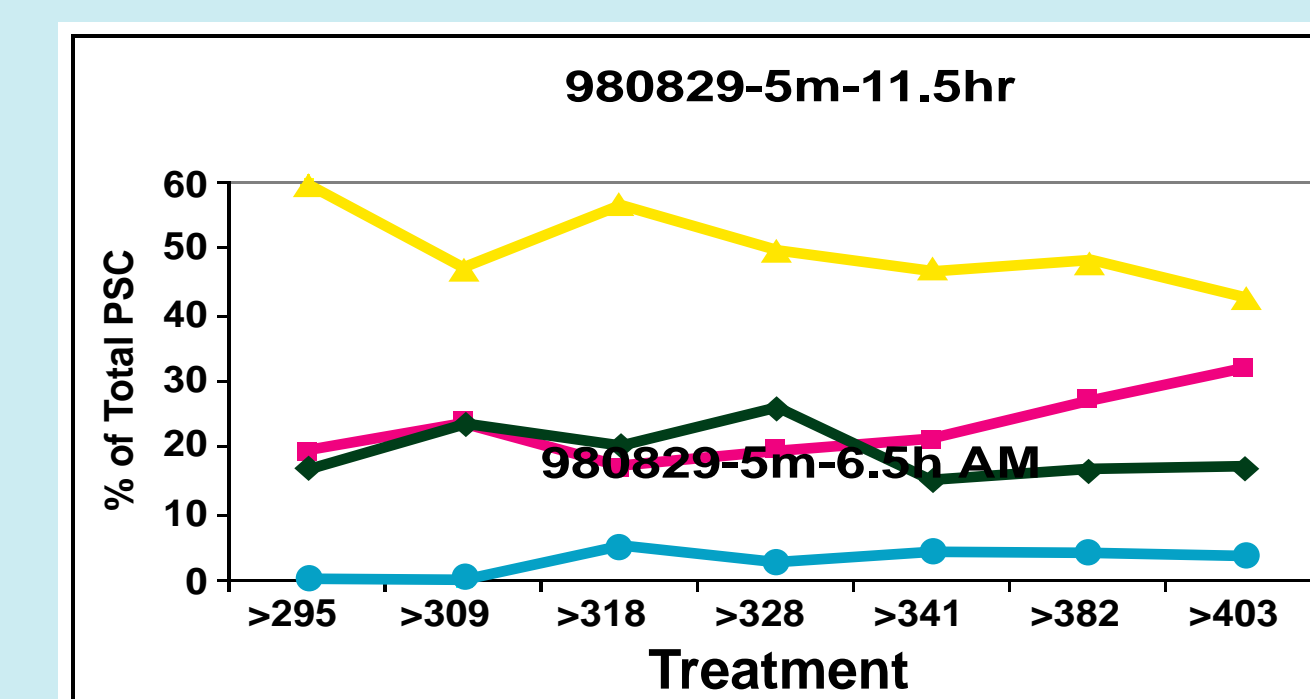


Fig 13: Changes in Community Assemblages. Biomarker pigments were used to examine the effects of UVR on community assemblages. The biomarker pigments represent the following algal groups: Fucoxanthin- Diatoms, Peridinin-Dinoflagellates, Alloxanthin-Cryptophytes and 19-Hex-Fucoxanthin + 19-But-Fucoxanthin- Phytoflagellates (Prymnesiophytes + Pelagophytes). In all three of the incubations, there is a shift towards the phytoflagellates as UVR is added. In the full day experiment (Top) the increase in phytoflagellates was coupled with a loss of diatoms and cryptophytes, while there was no loss of dinoflagellates. During the 6.5 hr AM (Middle) and the 5.5 hr PM (Bottom) drifters there was an equal loss of both diatoms and dinoflagellates, with little change in cryptophytes. This evidence shows that a shift in community assemblages due to UVR is present and that the magnitude is dose dependent.

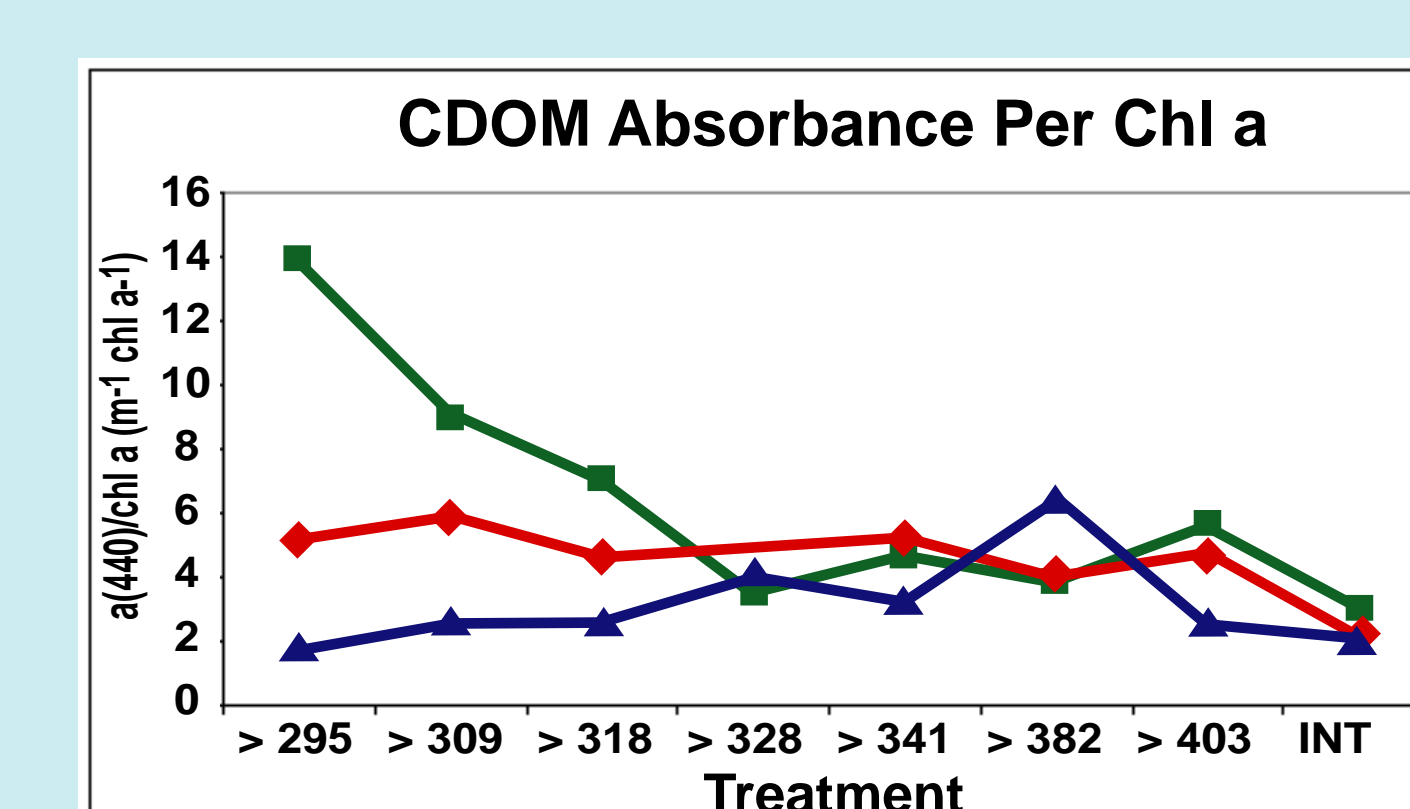


Fig 14: CDOM Per Chl a. The greatest increase of CDOM with increasing UVR occurs in the full day drifter. However, most of the increase is due solely to UVB exposure. The morning and afternoon drifters which, have a smaller light dose, show slight variability at different wavelengths but overall have the same relative concentration of CDOM per Chl a.

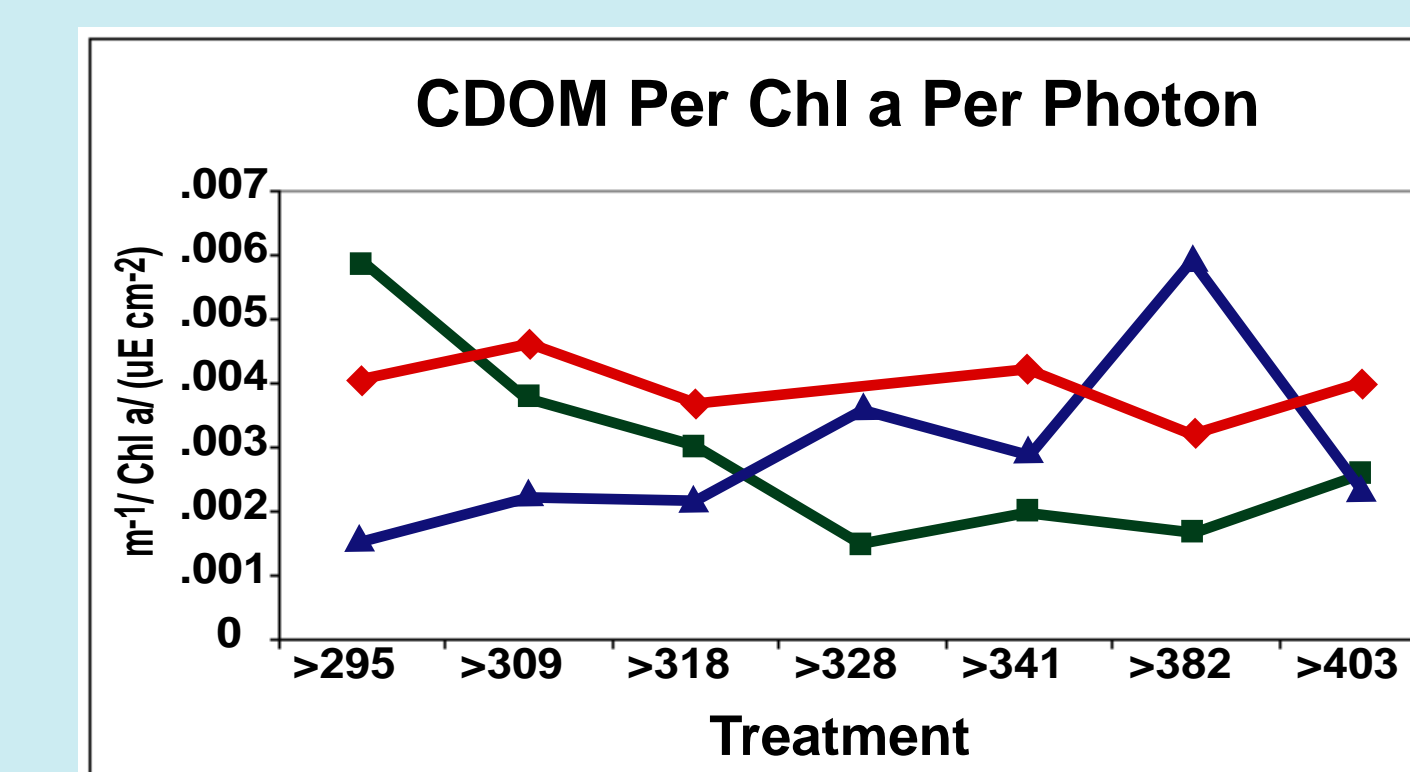


Fig 15: CDOM Per Chl a Per Photon. On a per photon basis, the same general patterns as the above figure hold true. However, when normalized per photon, the response shown is also due to spectral changes. This together with Fig 14 indicates that the response is both dose and spectrally dependent.

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