

## Multi-year study of the effects of *Ulva* sp. blooms on eelgrass *Zostera marina*

Suzanne V. Olyarnik<sup>1,\*</sup>, John J. Stachowicz<sup>2</sup>

<sup>1</sup>Bodega Marine Reserve, University of California Davis, PO Box 247, Bodega Bay, California 94923, USA

<sup>2</sup>Evolution and Ecology, University of California Davis, One Shields Avenue, Davis, California 95616, USA

\*Email: svolyarnik@ucdavis.edu

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### Supplement.

**Environmental factors and *Ulva* biomass.** We plotted *Ulva* biomass against 3 environmental parameters (light, Fig. S1; upwelling, Fig. S2; and rainfall, Fig. S3) and ran correlations to detect any patterns. We did several iterations of analyses, using different variations of the *Ulva* response variable (biomass at peak of bloom, date of bloom onset, duration of bloom). We also explored different characterizations of the environmental parameters. For rainfall, these included the amount of rainfall after *Ulva* onset, amount during the period February to June, total proportion of bloom days that had rain, and the number of days with large rain events (12.7 mm) from March to June. For light availability, we used the number of hours the minimum photosynthetically active radiation (PAR) exceeded 3 different thresholds (100, 200, and 300  $\mu\text{mol m}^{-2} \text{s}^{-1}$ ) in the month before *Ulva* onset, the number of hours PAR exceeded the threshold in 2 wk before onset, the number of hours PAR exceeded the threshold during the bloom season (described as February to September), and the number of hours PAR exceeded the threshold in the month before the peak *Ulva* biomass in each year. For upwelling, we ran the same iterations as for light availability, substituting the number of days upwelling occurred (upwelling index > 0). Here we present a subset of plots of the 3 environmental factors with *Ulva* biomass.

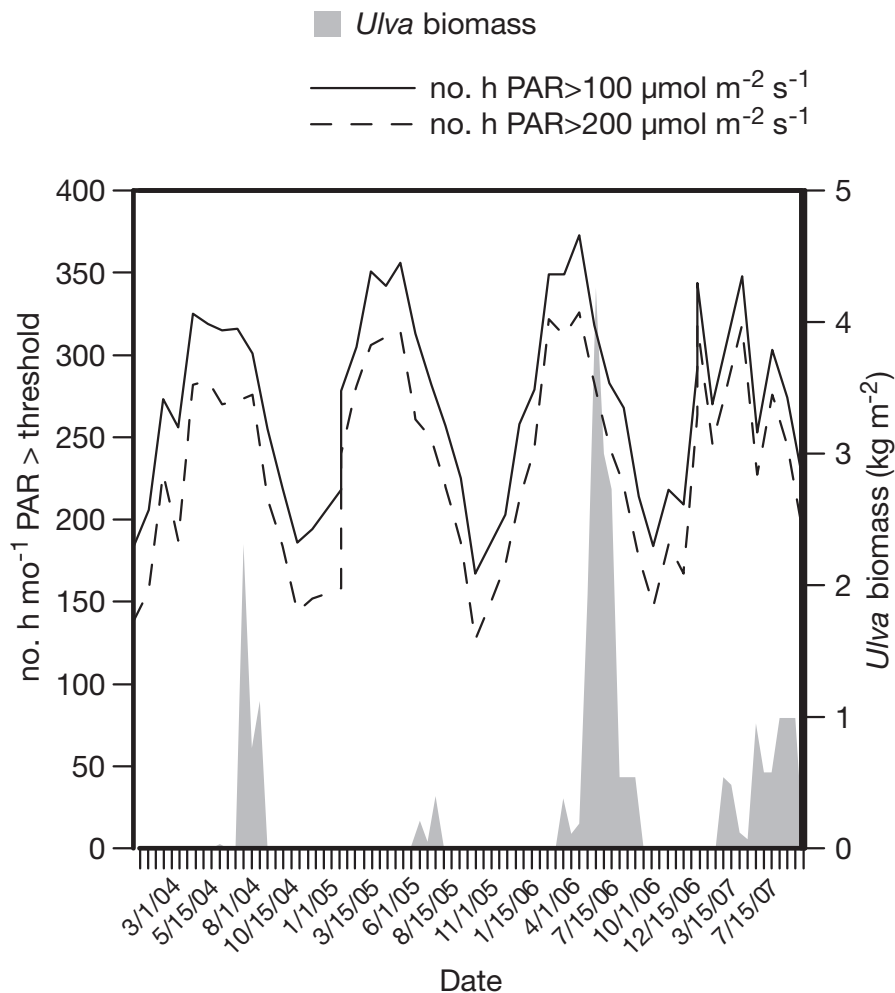


Fig. S1. Light availability and *Ulva* biomass. The lines represent the number of hours per month that minimum PAR ( $\mu\text{mol m}^{-2} \text{s}^{-1}$ ) exceeded a threshold. Light availability was not higher preceding the large bloom in 2006 compared to other years. PAR data taken at the Bodega Marine Laboratory in Bodega Bay, approximately 2.5 km from the experiment location (University of California Davis 2008). Dates are given as mo/d/yr

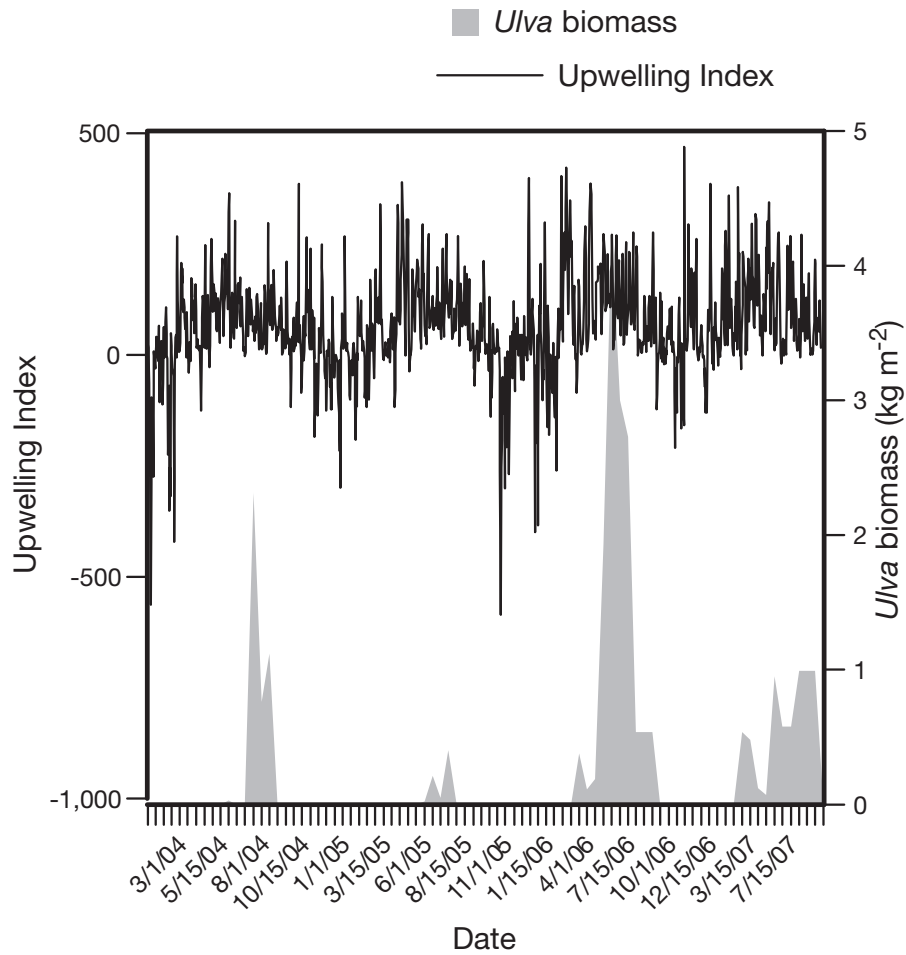


Fig. S2. Daily upwelling index and *Ulva* biomass. Positive index values indicate upwelling; negative values indicate downwelling. Upwelling events were not stronger or more frequent before the large *Ulva* bloom in 2006 compared to other years; conversely, it appears there were more and stronger episodes of downwelling in the months preceding the 2006 bloom. Upwelling index provided by the Pacific Fisheries Environmental Laboratory, NOAA Fisheries Service Environmental Research Division ([www.pfeg.noaa.gov/products/pfel/](http://www.pfeg.noaa.gov/products/pfel/)). Data provided for 39°N, 125°W, approximately 185 km northwest of Bodega Bay. Dates are given as mo/d/yr

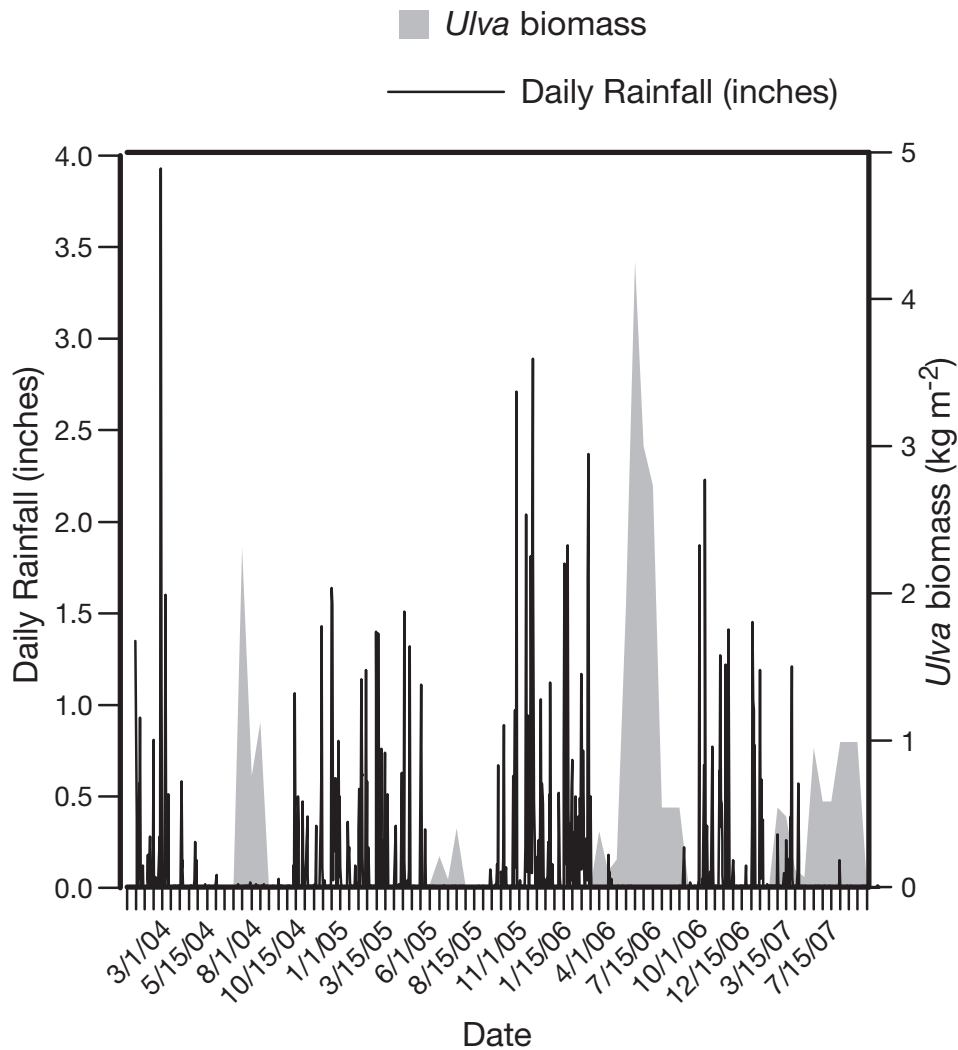


Fig. S3. Daily rainfall and *Ulva* biomass. Rainfall and *Ulva* both show large interannual variation, but they do not exhibit a coordinated pattern. There was a large spring rainfall event before the big *Ulva* bloom in 2006, but the months preceding the summer with the second largest *Ulva* biomass (2004) were very dry. While the longest duration blooms in 2006 and 2007 experienced more rainfall after the onset of the bloom, this can be explained by the fact that the blooms started earlier compared to 2004 and 2005. Rainfall data taken at the Bodega Marine Laboratory in Bodega Bay, approximately 2.5 km from the experiment location (University of California Davis 2008). Conversion: 1 inch = 25.4 mm. Dates are given as mo/d/yr

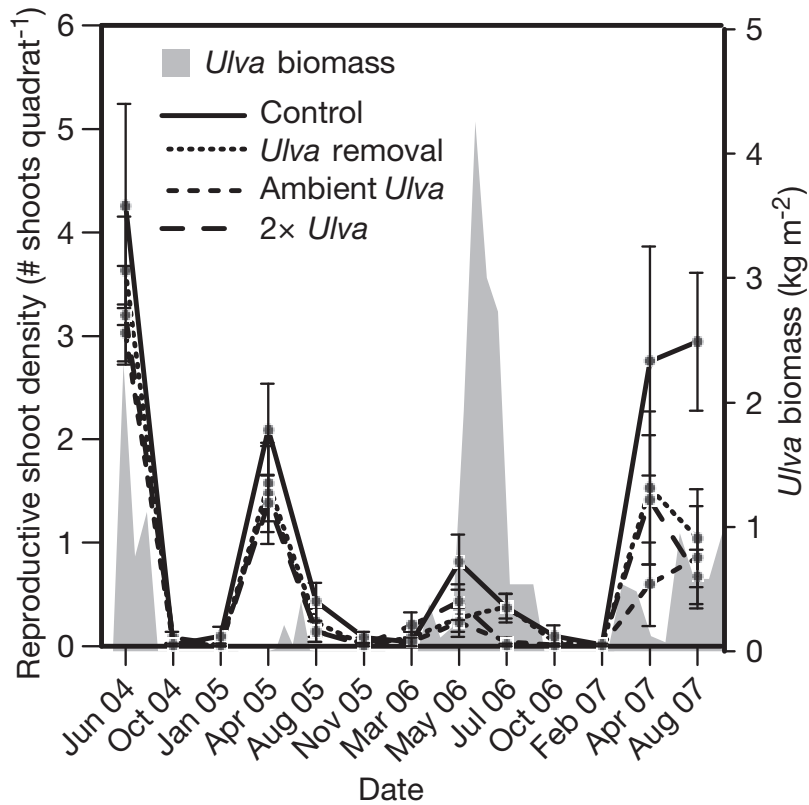


Fig. S4. *Zostera marina* reproductive shoot density by treatment. We counted the number of reproductive shoots in 3 randomly chosen 20 cm × 20 cm quadrats from each plot during all sampling times, including a baseline sampling in June 2004 prior to *Ulva* manipulations. There were no significant treatment or site effects on reproductive shoot density. Error bars are  $\pm 1$  standard error

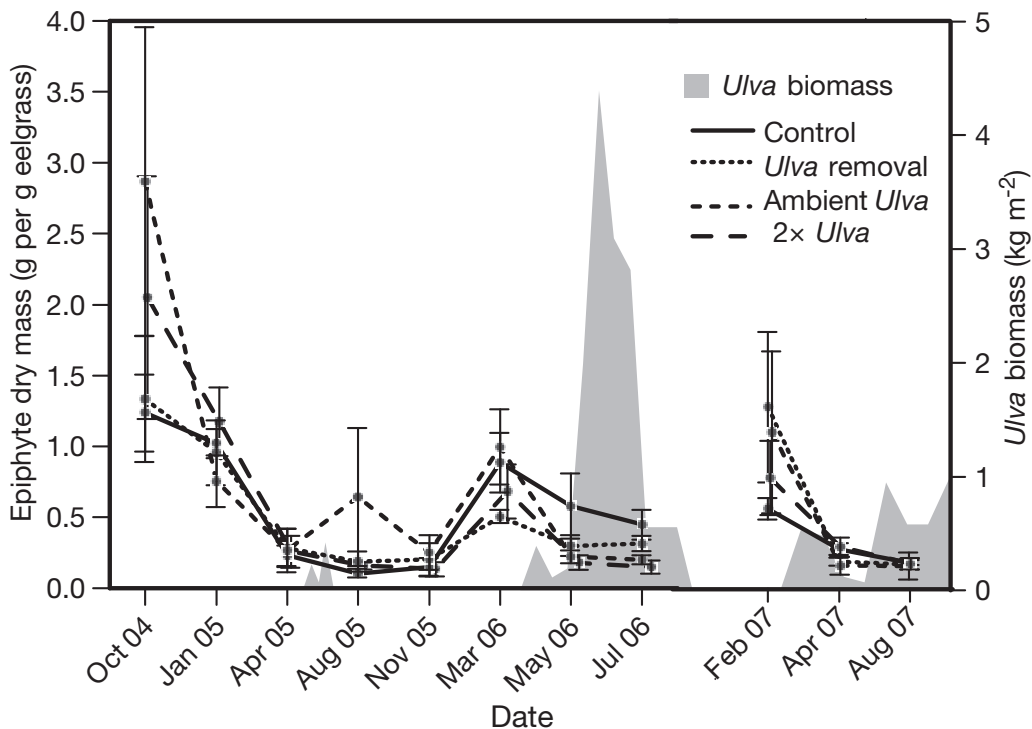


Fig. S5. Epiphyte load by treatment. All the blades from 2 shoots in each quadrat were scraped into a container of deionized water, which was then filtered onto glass fiber filters. These were dried to constant weight then placed in a 500°C muffle furnace for 15 min to determine ash-free dry mass. Relative differences among treatments were similar for dry mass and ash-free dry mass; therefore, only dry mass is presented. There were no significant differences among treatments or sites for any of the sampling times. Samples from October 2006 were lost. Error bars are  $\pm 1$  standard error

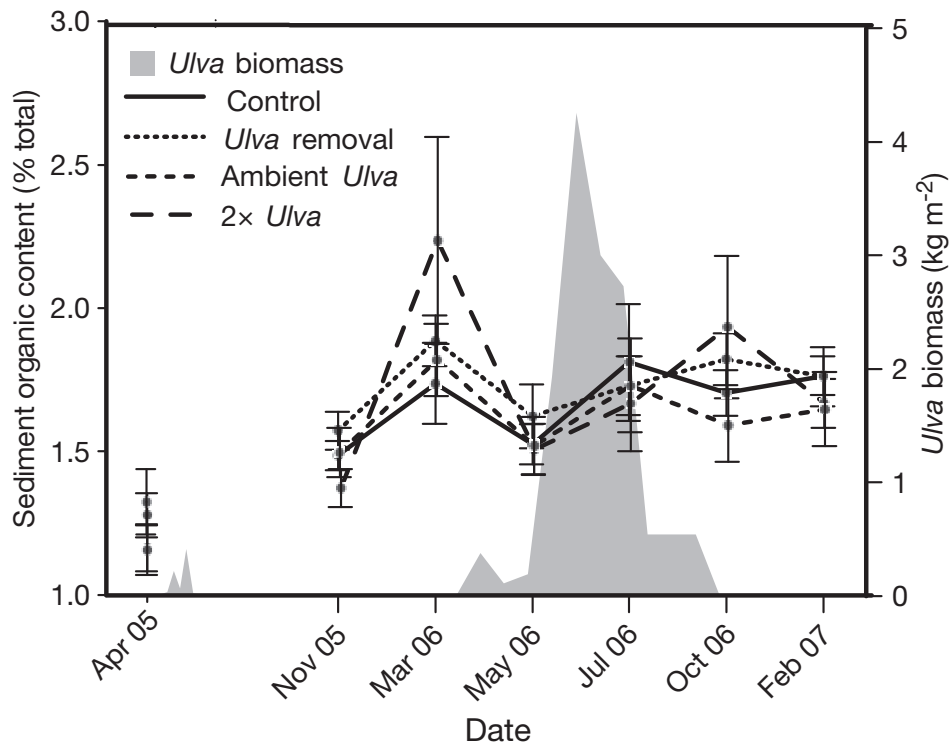


Fig. S6. Sediment organic content for a subset of sampling times. We collected 3 sediment cores (2.5 cm diameter  $\times$  5 cm deep) from each plot during a subset of sampling times from spring 2005 to winter 2007. Cores were bagged in the field and frozen upon return to the laboratory (within 1 to 2 h). Sediment organic content was measured by defrosting samples at room temperature, drying to constant mass, and igniting in a 450°C furnace for 2 h and reweighing. There were no significant differences among treatments or sites. Although the 2 $\times$  treatment had 40% higher sediment organic content in March and October 2006, it was not statistically different from the other treatments. Error bars are  $\pm 1$  standard error