



A. Santa Rosa Island with mean giant kelp canopy biomass for the summer of 2003. Red box shows the location of the kelp canopy in C – F. **B.** Time series of daily seawater nitrate concentration derived from sea surface temperature (solid blue line), modeled maximum daily significant wave height (grey bars) with large wave events likely to disturb kelp marked by black asterisks, and kelp canopy biomass from inside (solid red line) and outside (dashed red line) the red polygons shown in C – F, for the time period March 2003 – February 2004. Markers on the red lines show the Landsat derived kelp canopy estimates. Vertical dotted black lines show when seawater nitrate first dropped below $1 \mu\text{mol L}^{-1}$ (the concentration where giant kelp becomes nutrient limited; horizontal dashed blacked line), and 21 days afterward (the period when kelp exhausts internal nitrogen stores). Black scale bar shows the mean lifespan of a giant kelp frond. **C – F.** Seasonal mean canopy biomass with bathymetry shown as black lines. Area of kelp canopy in Spring is outlined in red polygons which is overlaid on all seasonal plots.