Site selection

Sites were selected to establish a gradient in historical kelp variability. Specifically, we used historic kelp canopy biomass estimates from satellite imagery (*see* data package *kelp biomass in the canopy from Landsat* at https://portal.edirepository.org/nis/mapbrowse?scope=knb-lter-sbc&identifier=74) to estimate the number of times in the period 2008-2018 when kelp patches experienced persistent (> 6 month) and significant (> 80%) reductions in biomass, according to

$$E = \sum_{t_0}^{t_n} \begin{cases} 1, & k_{t-1} > \tilde{k} \cdot k_t < 0.2 * k_{t-1} \cdot k_{t+1} < 0.2 * k_{t-1} \\ 0, & otherwise \end{cases}$$

where E is the total number of events a kelp patch experienced between t_0 = 2008 to t_n = 2018, $\tilde{k}$ is the median kelp biomass of a patch over the 10-year interval, and k_t is the biomass of kelp in a patch in quarter t. We defined patches according to previous work delineating patches with asynchronous kelp biomass dynamics (*see* data package *California giant kelp patch definitions* here: https://portal.edirepository.org/nis/mapbrowse?scope=knb-lter-sbc&identifier=101).

We selected patches from all candidate patches within ~ 40 miles of Santa Barbara harbor, such that patches varied in the historic persistence of giant kelp, from patches that have experienced one persistent decline in biomass to patches that experience almost annual (e.g. > 8) persistent declines in biomass.

Survey techniques

We conducted all surveys in accordance with the methods used in annual kelp community surveys (*see* methods listed in each of the data packages below for more detail). Broadly, we estimated the abundance (as percent cover or density, by size) of ~225 taxa of reef algae, invertebrates, and fish and converted to biomass (i.e., wet mass, dry mass, decalcified dry mass, ash free dry mass) using published taxon-specific algorithms. All surveys were conducted September-October 2018. At each site we surveyed 3 transects separated by a minimum distance of 30 m.

The list of data packages:

KFCD percent cover of algae, invertebrates and bottom substrate :
https://portal.edirepository.org/nis/mapbrowse?scope=knb-lter-sbc&identifier=15
KFCD abundance and size of reef fish :
https://portal.edirepository.org/nis/mapbrowse?scope=knb-lter-sbc&identifier=17
KFCD abundance and size of giant kelp :
https://portal.edirepository.org/nis/mapbrowse?scope=knb-lter-sbc&identifier=18
KFCD abundance of algae and invertebrates :
https://portal.edirepository.org/nis/mapbrowse?scope=knb-lter-sbc&identifier=19
KFCD - Biomass of algae, invertebrates and fish :
https://portal.edirepository.org/nis/mapbrowse?scope=knb-lter-sbc&identifier=50