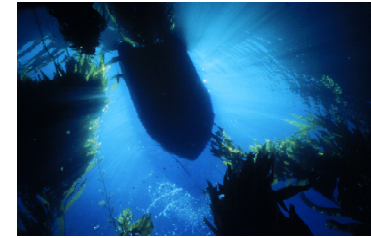




## Demography of Giant Kelp Populations at San Nicolas Island, California

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**The Giant Kelp, *Macrocyctis pyrifera***, is a perennial canopy-forming alga, which provides much of the structure and biomass of central and southern California kelp forests. Here, we present data from sites monitored for almost 20 years to examine factors affecting the demography of *Macrocyctis*.

**San Nicolas Island** is located 100 km off mainland southern California. Six benthic study sites (10 – 12 m deep) have been sampled semi-annually there since 1980 (with a few exceptions). At each site, on five 20 m<sup>2</sup> permanent plots, macro-invertebrates and kelps are counted, the holdfast diameters of adult *Macrocyctis* are measured and many are tagged (figure 1). Here the data are pooled from two adjacent sites on the west end of the island (West End sites) and from two sites on neighboring reefs on the south side (Dutch Harbor sites) to contrast areas where different processes dominate.

Figure 1. Measuring holdfast of tagged *Macrocyctis*.

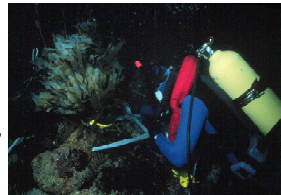
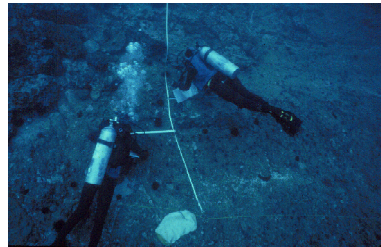


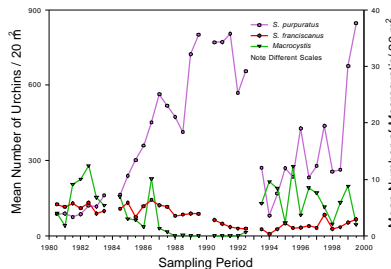
Figure 2. Sampling the West End sites in 1988.



### West End Sites

From the beginning, grazing by sea urchins has been the most obvious factor affecting *Macrocyctis* at the West End, but its peak densities don't always correspond to urchin density. The purple urchin, *Strongylocentrotus purpuratus*, replaced the larger red urchin, *S. franciscanus*, as the numerically dominant species in 1983. From the late 1980s to the early 1990s it reached high grazing densities and excluded *Macrocyctis* from the sites (figures 2, 3). For unknown reasons the density of both urchin species fell dramatically in 1994 resulting in a high recruitment of *Macrocyctis*. In the last few years, *S. purpuratus* counts have rebounded resulting in a matrix of kelp and urchin dominated patches. There is a higher turnover of *Macrocyctis* plants here with few surviving for two years (figure 4)

Figure 3. Mean density of urchins and adult *Macrocyctis* at West End over time.



### Dutch Harbor Sites

In contrast, counts of both urchin species at Dutch Harbor remained low and relatively constant over time but the counts of *Macrocyctis* show seven distinct recruitment pulses (figure 5). These peak densities have a periodicity of 2.5 to 3.5 years. Densities fall rapidly after recruitment, returning to moderate levels within 6 – 12 months. The peak densities of *Macrocyctis* at the West End over the last six years had a shorter period. It is not clear what controls the periodicity of this pattern. A plot of mean *Macrocyctis* count and mean holdfast diameter over time reveals an inverse relationship between the two (figure 6). As a few individuals grow larger and produce canopy-forming fronds most members of the cohort are probably shade out. Tagged plants rarely reached 3 years of age.

Figure 5. Mean density of urchins and adult *Macrocyctis* at Dutch Harbor over time.

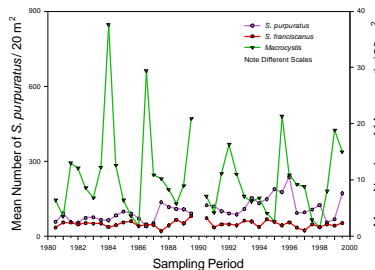


Figure 4. Survival of tagged *Macrocyctis* at West End and Dutch Harbor. Only plants originally tagged with a holdfast diameter < 11cm included.

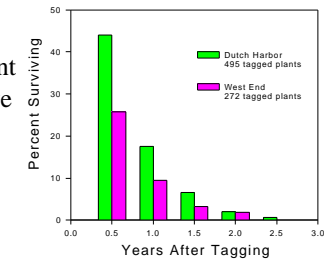
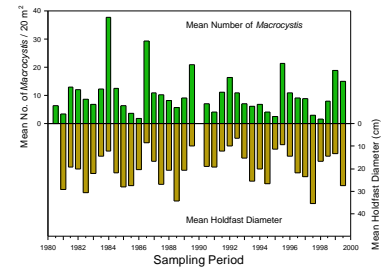


Figure 6. Mean density of adult *Macrocyctis* and mean holdfast diameter at Dutch Harbor over time.



### Conclusions

- At Dutch Harbor, where grazing is insignificant, *Macrocyctis* populations fluctuate on a cyclical pattern, which is at least in part a result of intraspecific competition.
- Sea urchin grazing has heavily influenced *Macrocyctis* populations at the West End for many years. When grazing pressure is not too severe, it may lead to a higher turnover rate with more frequent recruitment pulses.

### Acknowledgements

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