Giant Kelp (*Macrocystis pyrifera)* and Hydrographic Variability in Nearshore Sitka Sound, Alaska

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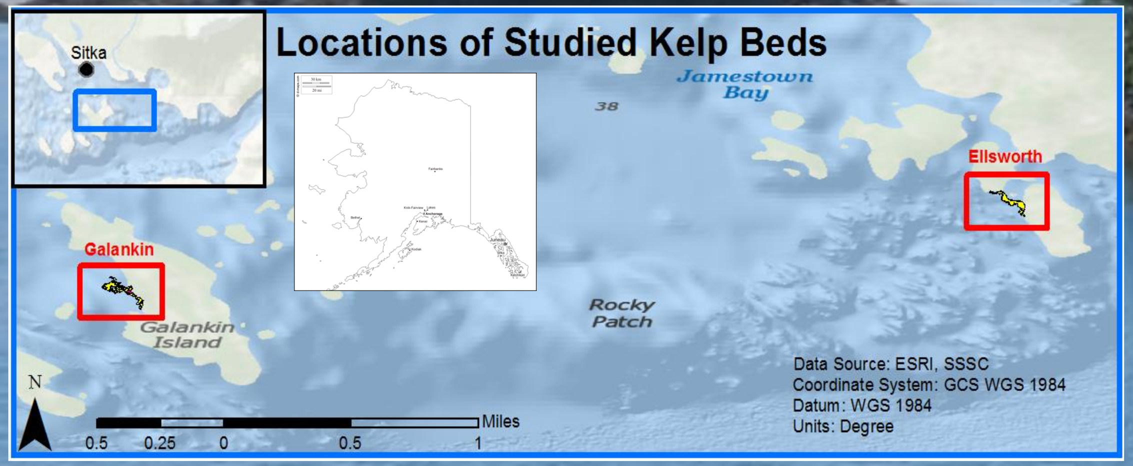
Introduction

Kelp beds serve an important role in coastal resilience by providing critical habitat for marine species of both economic and conservation value. Their physical structure also serves to stabilize the water column, dampening wave action and buffering marine communities from thermal extremes (Steneck et al. 2002). As cold-water species, kelps are vulnerable to climate change, so it is important to understand their current ecological role in order to predict future impacts.

We conducted a study to determine the extent to which kelp (*Macrocystis pyrifera*) beds act as thermal buffers in Sitka Sound, a coastal region in southeast Alaska .

Hypothesis: Kelp beds serve to reduce current and wind mixing of the water column, promoting hydrographic stability.

- **Prediction 1:** Kelp beds minimize fluctuations in surface and bottom temperature over time.
- **Prediction 2:** Kelp beds lead to warmer surface temperatures and a deeper thermocline.
- **Prediction 3:** Spatial extent of kelp beds is relatively constant over time.



Methodology

Water temperature was continuously monitored every 15 min from June 27 to July 20, 2016 at two kelp beds (Galankin and Ellsworth)in Sitka Sound. Vertical temperature profiles of the water column and spatial extents of kelp canopy were also measured.

- U24-002-C HOBO Data Loggers was placed at surface and bottom of each kelp forest.
- HOBO TidbiT v2 Temp Loggers monitored surface and bottom temperatures of a control site adjacent to each kelp site.
- A 6920 YSI sonde was used to collect weekly vertical temperature profile data of the kelp and control sites at high and low tides.
- GPS hardware and ArcGIS software was used to measure spatial extent of the kelp canopy weekly at high and low tides.

Water temperature over time

Galankin Site   Ellsworth Site

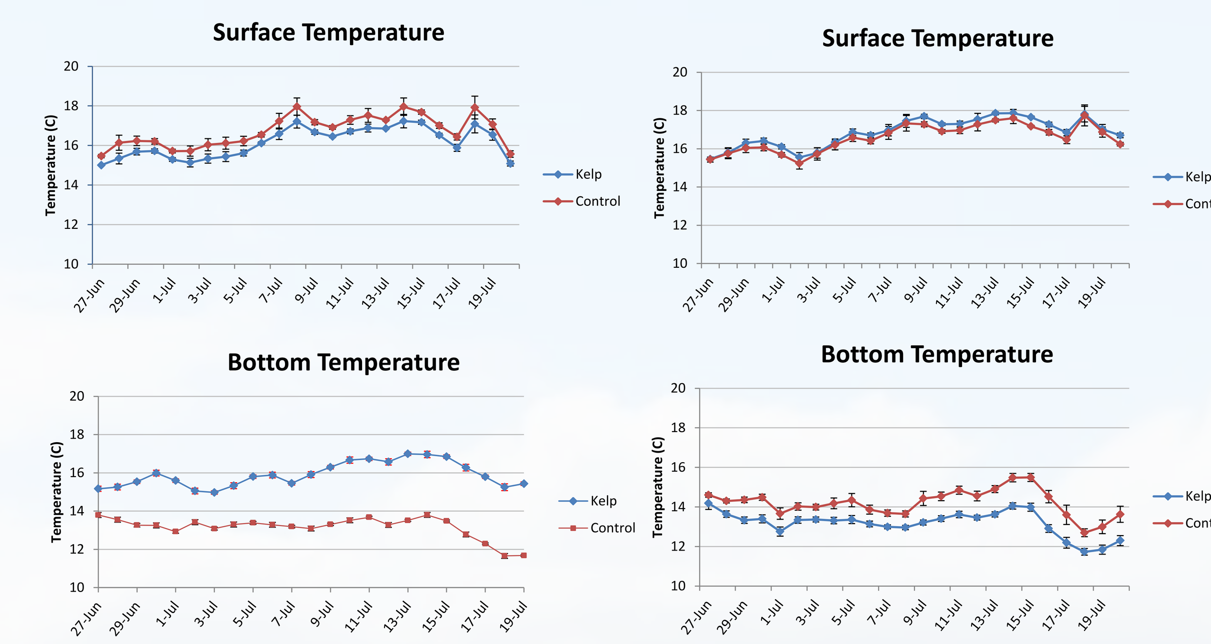


Figure 1: Mean daily temperature ± SD (surface and bottom) at Galankin (left) and Ellsworth (right) and their respective control (non-kelp) sites.

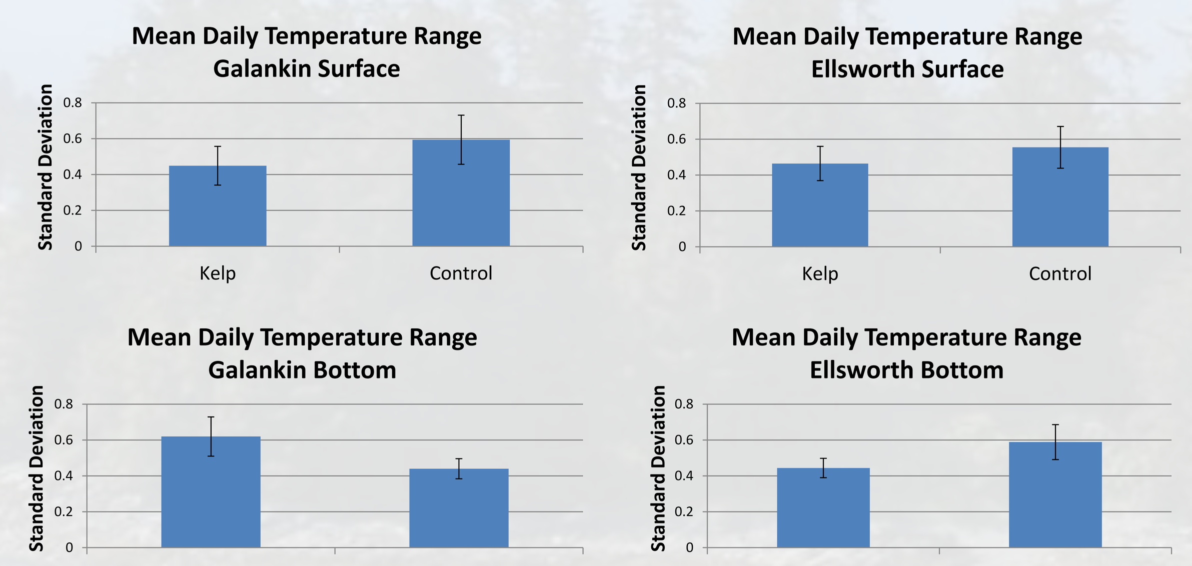
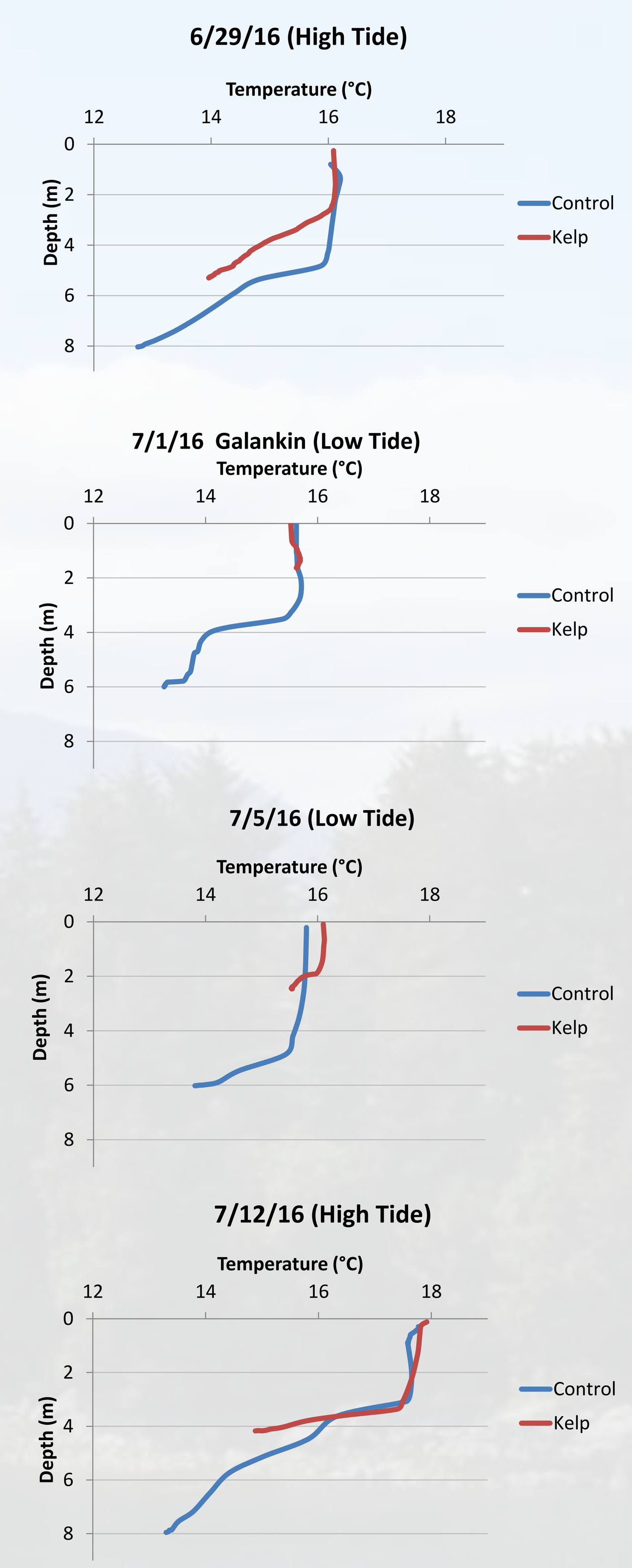


Figure 2: Average daily variation (measured as mean standard deviation [±SD]) of daily average temperatures) at Galankin (left) and Ellsworth (right) and their respective control (non-kelp) sites.

Water column structure

Galankin Site   Ellsworth Site



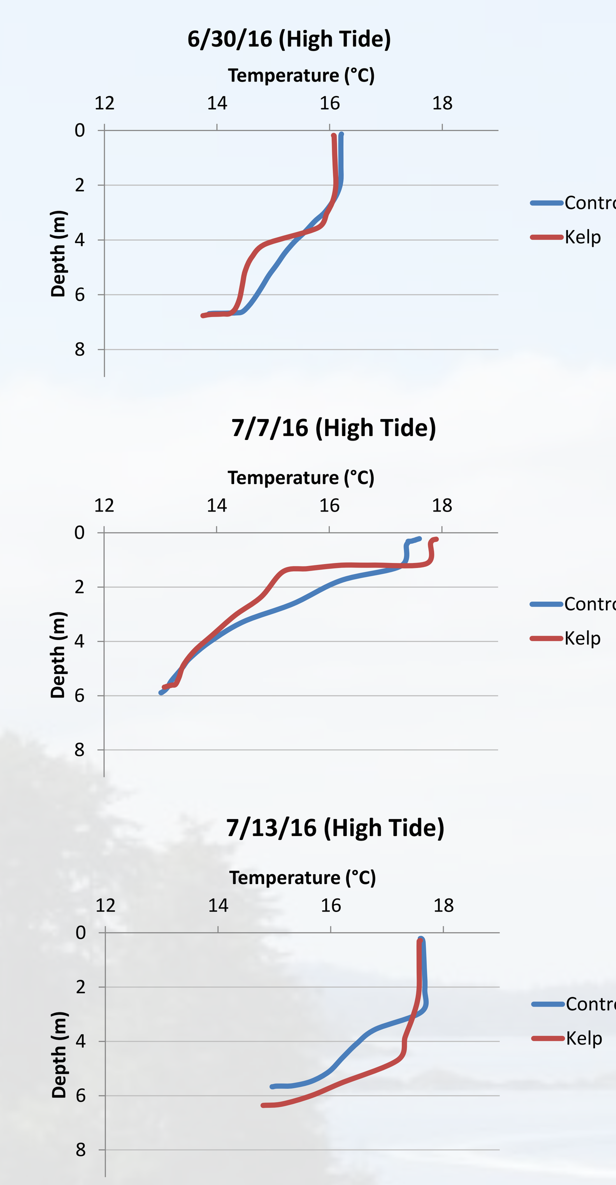


Figure 3: Temperature vertical profiles for kelp sites (Galankin and Ellsworth) and adjacent control sites.

Kelp bed spatial extent over time

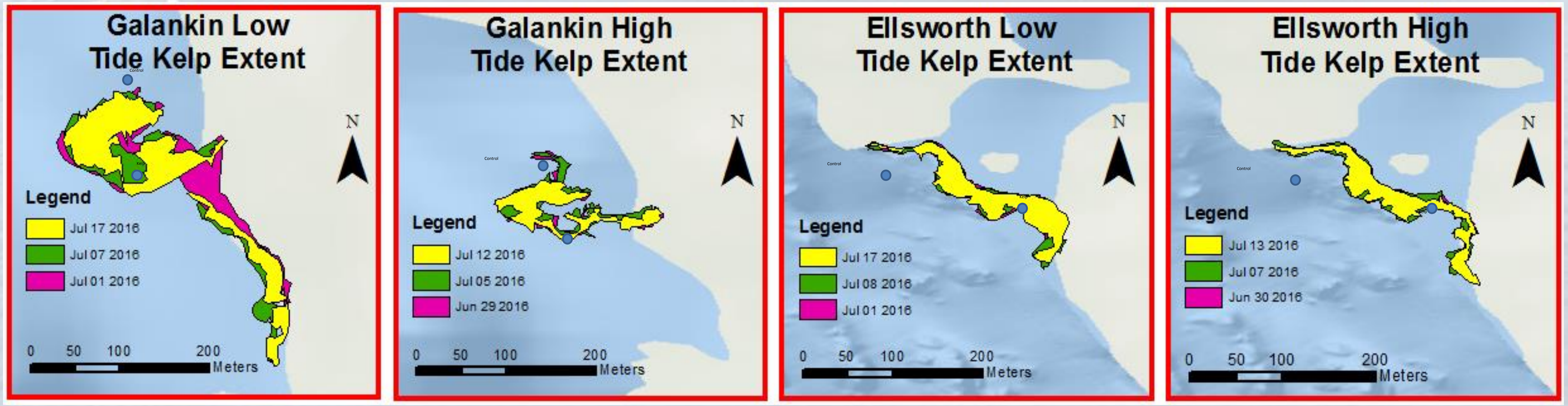


Figure 4: Spatial extent of Galankin and Ellsworth kelp beds at high and low tides on three different dates over a three-week period.

Results

Kelp *did not* appear to reduce fluctuations in water temperature.

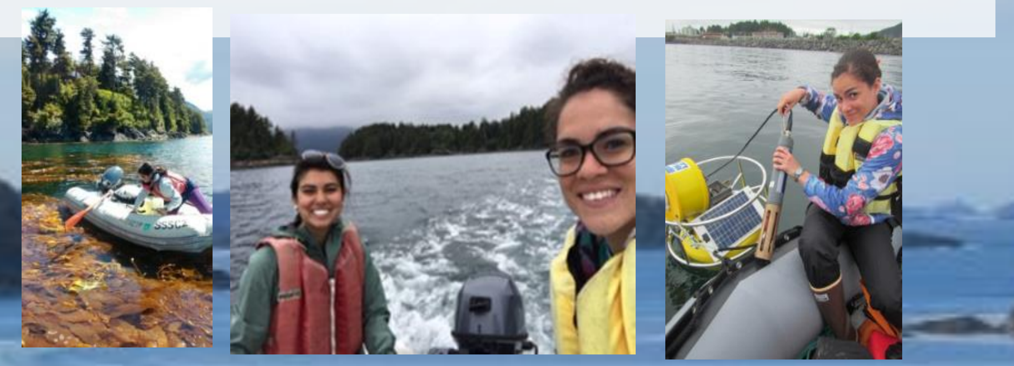
- Sea surface temperature varied from 5°C to 19.3°C at Galankin and from 3.9°C to 19.4°C at Ellsworth (Fig. 1).
- Bottom temperature was less variable, ranging from 6.7°C to 15.6°C at Galankin and from 6.1°C to 16.1°C at Ellsworth (Fig. 1).
- Overall, temperature ranges at the control sites (4.4- 19.4°C and 4.4-21.1°C) were not consistently different from the kelp sites (Fig. 2).

There was *no consistent difference* in water column structure between kelp and control sites.

- We found no *consistent* difference in thermocline depth between kelp and control sites (Fig. 3).

Tidal cycle strongly affected the geographical size of kelp canopy cover.

- Average canopy size of the Galankin kelp bed was 3,893 m^2, n = 3, with a notable increased in size during the study. Average size of Ellsworth was 3,019 m^2, n = 3 (Fig. 4).
- The canopy area of the Galankin kelp bed increased over the study period.



Discussion

We did not find strong support for the hypothesis that *Macrocystis* kelp beds act as a thermal buffer in Sitka Sound Alaska. It is possible that the two kelp beds we studied were not large enough to have a detectable effect on temperature in the water column. Measurements taken at larger kelp beds may lead to different results.

We did find that the spatial extent of the kelp canopy varied considerably with tidal range. It is possible that mixing associated with strong tidal currents in the region could minimize any stabilizing effect kelp might otherwise have on water temperature in the water column.

Future work will incorporate measurements collected over a longer time period to evaluate interactions between water temperature and season. An additional control site will be added with a YSI-equipped harbor buoy recently deployed in the nearshore Sitka Sound.

Literature Cited

Steneck et al. 2002. Kelp forest ecosystems: biodiversity, stability, resilience, and future. Environmental Conservation 29(4): 436-459.

Acknowledgements

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