Incorporating species interactions in predicting kelp occurrence in North Coast benthic habitats

**Context:** Key algal species, like kelp, play a critical role in benthic habitats in the North Coast of British Columbia (BC). Marine ecologists are increasingly interested in how these critical biogenic habitat distributions will change in light of increasing frequency of marine heatwaves due to climate change.

Many existing approaches for predicting species occurrence within these habitats have relied predominantly on Species Distribution Models (SDMs), which often do not fully incorporate the crucial aspect of species relationships and biotic interactions. While SDMs have been valuable in identifying environmental factors that influence species distribution, primarily changing temperature and habitats considering increased marine heatwaves, they tend to overlook the complex web of interactions among species, including predation, competition, and mutualism that collectively shape dynamic community composition.

1. Objective questions: Can we predict the presence of specific algal species, particularly kelp, based on the presence of urchins and other invertebrates? Which species act as predictors for kelp occurrence (or absence)?
   * Urchin + kelp
   * Only urchins
   * Only kelp
2. Perturbations and stimuli: temperature, currents, wave exposure
3. System and environment: Benthic habitats along the North Coast of BC and southeastern Haida Gwaii
4. Temporal and spatial scales (description): Benthic habitats along the North Coast of BC and southeastern Haida Gwaii from September 2013 to August 2015
5. Temporal and spatial scales (extrapolation): Benthic habitats across coastal waters of the NE Pacific Ocean over the next decade (ie. What might these communities look like today?)
6. Factual information and concepts: Data from Fisheries and Oceans Canada from 2013-2015 consisting of 800 SCUBA transects and 848 drop camera deployments
7. Validation: comparison of model to subset of existing data set

**Methods:**

* Data collection: utilize existing dataset of 800 transects and 848 drop camera deployments which document the presence of invertebrates, algal species and substrate types from 2013-2015
* Data analysis: Create a mixed effect model to establish relationships between urchin presence, other invertebrate presence and specific algal species (determine fixed and random effects?)
* Calibration: use subset of dataset and refine based on observed patterns
* Validation: validate model by comparing predictions to new survey data

**Significance:** Understanding the interplay of species relationships within these ecosystems is essential for a more comprehensive and ecologically accurate assessment of species occurrence. Biotic interactions can act as key determinants in predicting which species are likely to coexist or compete in a given habitat. Therefore, incorporating species relationships into predictive models is vital to identify predictor species accurately and improve our ability to conserve and manage these ecologically significant coastal environments effectively. This study aims to address this critical gap by developing a model that considers the intricate network of species interactions, offering a more holistic perspective on species occurrence within North Coast benthic habitats.

Logistic regression