1. Paragraph 1
   1. Predators play a crucial role in regulating prey populations, which can have widespread effects on the way ecosystems function (Lafferty TREE review, Paine citation?).
   2. Generally, researchers quantify the interactions strength of a predator and its prey, by quantifying the relationship between the prey consumption per predator and prey density (i.e. the functional response).
   3. Most models of predator-prey interactions assume that the interaction strength between a predator and its prey is constant ( *this isn’t true the R-W equation assumes that per-capita interaction strength is dependent on prey-density…)* or solely dependent on prey density or predator density.
      1. *For instance, in the case of the R-W model, the number of prey consumed per predator is dependent on prey density.*
   4. BUT, the interaction strength between a predator and prey can vary across space and time due to variation not only in a) prey density, or b) predator density but also due to:
      1. Predators interacting with prey differently in different habitats (Paine)
      2. Stochasticity in recruitment or mortality (Navarette and Berlowe)
      3. Individual variation in metabolic rates (cite?)
      4. Ontogenetic diet shifts
      5. Habitat dimensionality and complexity (Parwar et al. 2012, Barrios-O’Neill 2016)
      6. OR variation in body size
2. Paragraph 2
   1. Scientists have always known that body size is critical to the way that an organism functions (Kleiber 1932, Brose 2010).
   2. Metabolic rates scale with the body mass of the individual due to xxx, leading to allometric relationships between body mass and reproduction, …., or consumption (Brown et al. 2004).
   3. Therefore, predator-prey interaction strengths, or the functional response, must in part be dependent on body size. Generally,
      1. Theory and empirical evidence suggest that handling time should decline as a power law function of predator mass and prey mass (Yodzis and Innes 1992).
      2. Attack rates are expected to increase according to power law functions of predator and prey mass, or as a function of the predator:prey body mass ratio, resulting in a hump shaped relationship between attack rates and the predator:prey body size ratio (Wahlstrom et al. 2000, Aljetlawi et al. 2004, Vucic-Pestic et al. 2010, McCoy et al. 2011, Uiterwaal et al. 2017).
   4. Metanalysis of predator-prey pairs across taxa or within taxa show that the scaling coefficients on the functional response with body size of predators and prey vary across taxa and often differ from theoretical expectations (Rall et al. 2012). However, body-size dependent generalized formulations of the functional response can offer reasonable predictions of interactions strength without experimental data (Kalinkat et al. 2013 *Check this!!!*).
   5. Studies that compare across taxa, or at the average body size of predator-prey pairs within a taxa, offer a prediction of what might be happening for ontogenetic variation in interaction strength among a single predator prey pair.
   6. Based on general theory, we should be able to predict when and where predators will have a strong regulatory role based on body size.
3. Paragraph 3
   1. Understanding the relationship between body size and the functional response is important because it can have dramatic consequences on the way we think about predator’s ability to regulate prey. Previous work has shown that incorporating body size dependence:
      1. can scale the time period of predator-prey population oscillations (Yodzis and Innes 1992)
      2. can restrict consumer-resource coexistence to specific body size ratios (Weitz and Levin 2006) that are consistent with body size ratios seen in nature (Brose et al. 2006 *check citation*)
   2. Furthermore, increases in body size ratios have been shown to promote stabilizing type III responses and increase species persistence in complex food webs (Brose et al. 2006b *check citation, also Berlowe PNAs*)
   3. Natural populations of predator and prey, however, vary in density and size distributions across space and time. Thus the interaction strength between a predator and its prey may be dependent on spatial scale (cite the Eco Letters paper), and its feasible that a mosaic of predator-prey interactions within sub-communities could control the persistence of predator-prey across the metacommunity. Therefore, an outstanding question is how does variation in body size of predators and prey across space and time affect predators ability to regulate prey at larger scales.
4. Paragraph 4
   1. To examine how…., we estimated the size dependence of the interaction strength between a commercial important marine predator, Panularus interruptus, and its ecological significant prey, the purple sea urchin.
   2. Lobsters and urchin exist as a loosely linked predator prey pair.
      1. Globally, lobsters exhibit size-dependent foraging on urchins (CITE), and have been implicated in controlling urchin populations, although the strength of top down control by California Spiny Lobster is debated (CITE).
   3. This is an intriguing study system to examine these questions because the body size ratios of lobsters and urchins vary, likely to do spatially-explicit patterns in recruitment dynamics or variation in fishing predators due to an existing system of MPA’s established across southern California.
   4. Furthermore, urchins play an outsized role in regulating giant kelp abundance, and can under certain circumstances reach high densities that results in the total removal of kelp biomass and reductions in species richness and abundance of rocky reef communities.
   5. We first describe variation in body size ratios in the Santa Barbara channel. We then conducted a laboratory experiment to determine the size dependency of interaction strengths across a ~ 700x increase in body size ratios. And finally, we predicted predation pressure across the landscape to compare how estimated predation pressure would differ with and without consideration for body-size dependence.