General thesis ideas that need to be rearranged:

From spatial chapter, some needs moving to intro chapter:

Pacific salmon species have complex life history strategies that can impact survival from smolts to adults, and species interactions during the early marine phase are still not well understood (\*). Pink salmon are the smallest smolts to begin the marine migration (as small as 0.2 g \*), due to their short, obligate life cycle of two years. Chum salmon are the second smallest species when leaving freshwater habitats, with various amounts of time spent rearing in estuaries (\*). Smaller salmon smolts are often the most vulnerable to predators and require sufficient food resources to grow to a critical size during this period to survive their first winter in the ocean (\*). Salmon growth during the early marine period has been shown to affect adult survival in all five species of Pacific salmon (\*), therefore, prey quality and quantity are crucial. The variability in early marine growth of different species and stocks of salmon make predicting adult returns challenging, resulting in many returns being much lower or higher than expected (\*). Salmon have to cope with multiple stressors in freshwater and oceanic environments, such as warming, disease, predation, fishing, habitat loss, pollution, and more, and achieving sufficient food for growth and resilience in order to overcome these challenges is paramount. As scientists and managers who hope to understand salmon dynamics, these relationships between species, their prey and environmental interactions must be viewed very holistically. Therefore, studies investigating multiple species potentially competing for prey resources in various environments are required to learn more about the challenges that young salmon face.

… The data was transformed using an arc sine square root transformation, common for proportional data metrics to correct skewed data. Bray-Curtis dissimilarity metrics were then calculated for clustering and ordination analyses, to determine and visualize the differences in diets between the salmon species, sites and regions.

Pacific salmon are central to the cultures, economy and ecosystems within the Pacific Northwest, migrating from freshwater to the Pacific Ocean then returning to their natal habitats. Chum and pink salmon are species that leave freshwater early after emergence and head strait towards the estuary and the ocean and are therefore relatively small and can grow quickly. These young salmon must contend with the physiological challenges of smoltification, multiple predators and successfully capturing prey for energy in their new marine environment. There is high mortality for salmon smolts, research has shown growth in the early marine phase strongly helps determine the cohort strength during the first winter at sea and adult survival.

Prey availability and salmon foraging behaviour are important factors in order to grow quickly during early marine life and the salmon species have unique behaviour and preferences. Patchiness of zooplankton in the ocean leads to relatively generalist salmon feeding, however, there are energetic trade-offs and decisions regarding the effort it takes to capture prey items. Pink salmon are dominant competitors for food resources, actively feeding on the crustacean zooplankton of all sizes, and in high abundance years, pink salmon can cause trophic cascades. Chum salmon, on the other hand, have more adaptable feeding strategies, with the tendency to prey shift towards gelatinous zooplankton in response to competition or limited food resources. Therefore, while pink and chum salmon are both planktivorous during early marine life, these salmon species have the potential to compete for food or will occupy different trophic niches.

The zooplankton communities migrating salmon encounter are largely determined by bottom up effects, such as physical mixing, nutrients, temperature, salinity and phytoplankton. In southern British Columbia, most juvenile salmon migrate northward through the Strait of Georgia, a seasonally stratified and productive region, then salmon reach the Discovery Islands. A complex archipelago, the Discovery Islands has tidally mixed waters and high freshwater influence and research has shown most of this area to be food-limiting for sockeye salmon. Furthering the difficulty of this migration, the deep and narrow Johnstone Strait is also well-mixed and a “trophic gauntlet” for sockeye salmon, and potentially for pink and chum salmon. Along this route situated between Vancouver Island and mainland B.C., salmon then migrate through Queen Charlotte Strait, where they may be able to replenish and forage successfully.

The conditions salmon encounter in this region of B.C. will likely be comparable to environments they will continue to migrate through, along the coast into the Gulf of Alaska. Coastal ocean conditions can vary from high freshwater inputs to purely oceanic, sheltered inlets to exposed areas, rocky shores to eelgrass habitats and high to low productivity levels. Therefore, not only does the Discovery Islands and Johnstone Strait region represent an important section of the salmon migration route, but is a microcosm of coastal conditions, transitioning from warm, fresh, stratified channels to a cold, saline, well-mixed, deep strait.

The purpose of this study is to quantify diet similarity between juvenile pink and chum salmon across high and low foraging opportunities to determine potential species competition. Further, is this area of Discovery Islands and Johnstone Strait a trophic gauntlet for juvenile pink and chum salmon and what are the salmon foraging strategies and trophic niches in this area?