APPENDIX A. COMPLETE LIST OF HYPOTHESES

NAME	EXPLANATION	PREDICTION
Overarching Hypotheses		
Critical period	Early marine **growth** through the first summer regulates survival over summer and at later life stages.	Larger body, faster growth, and/or higher fat content through late summer correlates with higher marine survival.
	Total marine survival is heavily influenced **by mortality** during the first spring/summer, irrespective of fish size.	High mortality occurs during the first spring/summer. Early marine mortality is correlated with total marine survival.
Fish – Growth, Outmigration Timing and Behavior[36]		
Outmigration timing	Outmigration timing of Chinook, Coho and steelhead influences the magnitude of predation, increase competition, or result in a mismatch between the presence of juvenile salmon and their prey. Outmigration timing may be influenced by hatchery practices and/or reduced diversity in salmon populations.	The outmigration timing of Chinook, Coho and steelhead has become more contracted or the peak outmigration time has shifted. Changes in outmigration timing/distribution correlate with changes in marine survival. (For mechanism, see affiliated hypotheses in prey and predator sections, below)
Distribution and Migration Pathways	Where Chinook and Coho rear while in the Salish Sea affects marine survival.	Populations of Chinook and Coho rear in distinct locations in the Salish Sea. Early marine survival, marine survival and/or growth is related to rearing location.
Residency	Resident-type behaviour and the duration of residence influence marine survival in the Salish Sea.	Residence time in the Salish Sea correlates with marine survival of Chinook and Coho. Reductions of estuary, eel grass, and/or kelp habitat in specific sub-basins correlates with lower survival or reduced growth.
Reduced habitat > Fish Behaviour	Reduced habitat availability has affected the behaviour (and reduced the diversity) of salmon while in the Salish Sea.	The amount of estuary and nearshore habitat has declined.
(Not directly addressed in this report) Metabolic effect	Growth is limited by the metabolic effects of temperature on juvenile salmon.	Growth decreases when outside a peak temperature window for metabolism, and we often see temperatures in the Salish Sea that are outside the peak window.

36. The "portfolio effect" hypothesis was removed but is broadly applicable here, and we can speak to it conceptually if it makes sense to do so.

Bottom Up - Prey availability[37]		
Prey Availability (Primary Hyp)	Variation in food supply is linked to juvenile salmon growth.	Timing, duration, quantity, spatial extent, and/or composition/quality of prey influence juvenile salmon growth.
Biogeochemistry > Prey availability	Outmigration timing of Chinook, Coho and steelhead influences the magnitude of predation, increase competition, or result in a mismatch between the presence of juvenile salmon and their prey. Outmigration timing may be influenced by hatchery practices and/or reduced diversity in salmon populations.	The outmigration timing of Chinook, Coho and steelhead has become more contracted or the peak outmigration time has shifted. Changes in outmigration timing/distribution correlate with changes in marine survival. (For mechanism, see affiliated hypotheses in prey and predator sections, below)
Outmigration Timing > Prey Availability (match/mismatch)	There is a mismatch between demand (outmigrant timing and fish size) and food supply.	Smolts that enter during the peak of prey availability grow faster, larger and/or have higher fat content. Peak availability of crucial prey and/or outmigration timing/fish size has shifted, decoupling the two. Changes in peak prey availability and/or outmigration timing/fish size correlate with changes in marine survival (see "fish" section).
Competition > Prey availability	The timing, duration, quantity, spatial extent, and/or composition/quality of salmon prey has declined due to a different state of circulation, water properties (e.g., temp, nutrients), and boundary forces (wind, temp, open ocean conditions, river inputs) in the 2000s vs. the 1970s/early 80s.	Juvenile salmon growth rates are inversely rated to the abundance of competitors. Marine survival decreases with increasing juvenile salmon and/or forage fish abundance. [e.g., Pink salmon, hatchery fish, herring, etc.].
Ocean acidification > Prey availability	Ocean acidification affects the productivity or quality of important zooplankton invertebrate prey for salmon (and forage fish). Ocean acidification may operate alone or synergistically with low oxygen, higher temperatures, and contaminants.	The timing, duration, quantity, spatial extent, and/or composition/quality of zooplankton are constrained as Salish Sea becomes more acidic.
Harmful Algae > Prey availability	Harmful algae indirectly affect salmon survival through food web and salmon prey impoverishment.	The timing, duration, quantity, spatial extent, and/or composition/quality of zooplankton are constrained by competition between primary producers of high and low nutritional value.

37. We assume the relationship to survival is through growth.

Top Down – Predation[38]		
Predator Abundance	An increase in the abundance of predators has led to higher juvenile salmon/steelhead mortality.	Mortality rates increase where the abundance of predators has also increased. Predation-based mortality rates account of a substantial amount of total marine mortality.
Specialization	Certain predators specialize in consuming juvenile Coho, Chinook and steelhead, and the number of predators that specialize has increased.	There is evidence that predators specialize in consuming juvenile salmon/steelhead in Puget Sound. Proportionately, the impact of specialists on salmon is greater than generalists. An increase in the number of harbour seal specialists correlates with lower marine survival.
Outmigration timing > Pulse prey abundance	Predation rates have increased due to large pulses juvenile salmon/steelhead entering the marine environment.	Mortality rates increase immediately following influxes of juvenile salmon and/or steelhead in the marine environment. Changes in outmigration timing/distribution correlate with changes in marine survival (see "fish" section).
Buffering/Prey Switching	The probability of being detected/targeted by predators may decrease with an increase abundance of alternative prey.	Mortality rates decrease with increasing abundance of a predator's primary prey items (e.g., hake and forage fish for harbour seals). A decline in predators' primary prey items is correlated with lower marine survival.
(not addressed in this report) Visibility	Juvenile salmon/steelhead mortality rates have increased with reduced turbidity and/or an increase in artificial light at night.	Turbidity has reduced and/or artificial increased during the outmigration period. Low turbidity and/or high artificial light correlates with lower marine survival.
(not addressed in this report) Ocean Acidification > Predation	Increased CO2 concentrations affect the nervous system and behaviour of salmon and steelhead. Chinook, Coho and steelhead mortality rates increase with increasing CO2 concentrations (cannot smell predators).	CO2 concentrations are high enough in the Salish Sea to affect the behaviour of salmon and steelhead. Mortality rates are higher in areas/at times with increased CO2 concentration.

38. Factors that were not assessed via the SSMSP include the impacts of sound, either exacerbating predation by impacting the hearing of salmon or ameliorating predation by affecting predators who use sound to forage.

Top Down - Disease, Contaminants and Harmful Algae		
Contaminants	Exposure to contaminants during one or more parts of a salmon's Salish Sea life history slows growth, increases disease susceptibility, and/or reduces marine survival.	Chinook, Coho and steelhead populations obtain higher contaminant loads, above thresholds affecting health and/or growth rates — in the river, while out-migrating as juveniles, and/or while residing in the Salish Sea through adult age. Those fish with higher contaminant loads have lower marine survival.
Harmful algae	Harmful algae directly affect salmon survival through acute or chronic toxicity or gill damage.	Direct mortality increases as prevalence and intensity of *Heterosigma* and other harmful algae increase.
Disease	Infected fish may die from infection and/or become more susceptible to predation.	Infection prevalence has increased. Mortality increases with increasing parasite or pathogen loads.