

EXECUTIVE SUMMARY:

Project 8: Predation on Fraser River Sockeye Salmon

Surviving in the ocean is living in a state of fear; fear of being eaten by birds, mammals and other fish. To the marine predator, it does not really matter what it consumes as long as the prey is about the right size. From this perspective, the Fraser River sockeye salmon is like many other species — an inviting mouthful swimming in the open water masses.

Sockeye salmon are repeatedly faced with making two choices throughout their life cycle. They can hide and limit risk of predation, but feed little and grow slowly—or they can stay in the open and risk being eaten, but feed a lot and grow quickly. It is a constant tradeoff where they are damned if they do and damned if they don't. Sockeye salmon, like other fish, have successfully dealt with this dilemma through evolutionary time by developing a complicated life history that includes moving between ranges of habitats varying in the risks they represent. Minimizing predation forms an important part of this strategy.

Spawning in nutrient-poor streams and moving on to lakes has been an important part of the life-history strategy of sockeye salmon because neither of these habitats can maintain year-round predator populations that are abundant enough to severely impact varying numbers of sockeye salmon. A similar strategy may be at play for the larger sockeye in the open blue water ocean — where fish can hide at depth from predators during day, and feed at shallower depths from dawn to dusk under the cover of darkness. Between the lakes and the open ocean lies a dangerous stretch through the Fraser River and the Strait of Georgia, and along the British Columbia coast to Alaska. Predators are likely to gather to prey upon the ample and seasonal supply of outward bound and returning sockeye salmon. Making it through the gauntlet likely depends upon the size and speed of the migrating sockeye, the feeding conditions they encounter — and the species and numbers of predators that seek to eat them.

Naming the predators of sockeye salmon should not be a difficult task given that everyone likely loves sockeye—but scientifically supported ecosystem-level information about predator species (numbers, diets, trends, and distributions) is sparse throughout the sockeye salmon range. Research in freshwater has largely concentrated on fish species of interest to anglers, and has provided some information on stomach contents, but little to no information about the abundance and trends of potential predators. More information is available from marine systems, but it is again almost exclusively for commercially important fish species, and largely absent for other predator species in the ecosystems.

A review of the available scientific literature reveals a wide range of species holding the remains of sockeye salmon in their stomachs, but only a few of these predators have specialized in targeting sockeye, and there are no studies showing that a predator has consumed sufficient numbers over the past three decades to pose a population threat to sockeye salmon. There is no sign of a smoking gun among the long list of potential predators of Fraser River sockeye salmon.

The list of prime predator suspects in the long term-decline in survival rate of Fraser River sockeye salmon as well as in the disappearance of the 2009 run of Fraser River sockeye is relatively short. Caspian terns and double-crested cormorants feed on sockeye smolts in freshwater and may be increasing in numbers, while lamprey may be a major factor in the

Fraser River estuary. In the Strait of Georgia, the “usual suspects” among the fish predators (spiny dogfish, and coho and chinook salmon) have all declined in recent decades, and individually seems unlikely to have had any major impacts on sockeye salmon. Through the Strait of Georgia and Queen Charlotte Sound there are a number of potential predators of which sablefish is one of the more surprising. Sablefish is known as a deepwater species, but the juveniles are more coastal and known to feed on salmon smolts in the early summer months when supply is ample. Arrowtooth flounder is another potential predator, which has increased dramatically in recent decades, and could potentially be a predator on sockeye salmon during their first months at sea. Some species of marine mammals have been documented eating salmon smolts, but none have been seen taking sockeye salmon smolts.

Feeding conditions may have changed for the potential predators of sockeye salmon in the Northeast Pacific Ocean in recent decades. Previously abundant prey species such as walleye pollock and Pacific cod in the Gulf of Alaska, and Pacific jack mackerel, Pacific mackerel, and Pacific hake further south have declined, and could have potentially shortchanged the predators. Such a change could have increased predation pressure on sockeye, but data are unavailable to assess this possibility.

Once in the open ocean, sockeye salmon appear to draw the predatory attention of salmon sharks, blue sharks, and an obscure species fittingly called daggertooth. All three species likely increased in recent decades (after the 1992 UN ban on driftnet fisheries) — and two of them (salmon sharks and daggertooth) may favor sockeye. Unfortunately, data for these species is also too sparse to draw conclusions about their potential role in the poor return of Fraser River sockeye in 2009, but their life histories suggest relatively stable numbers that should not have exerted greater predation upon sockeye in any single year relative to others.

In addition to the daggertooth and sharks, marine mammals also consume adult sockeye salmon. However, sockeye are not an important part of marine mammal diets compared to the other species of salmon. No studies have reported marine mammals consuming sockeye salmon in the open ocean. However, small amounts of sockeye have been found in the stomachs or fecal samples collected from Steller sea lions, northern fur seals, harbour seals, killer whales, and white-sided dolphins feeding over the continental shelf and inside waters of British Columbia. Seal and sea lion populations have increased significantly in British Columbia and southeast Alaska since the late 1970s. However, the available data indicate that sockeye salmon is not a preferred prey species among marine mammals.

Overall, the list of potential predators of sockeye salmon is long, but only a few of these species might have individually been a major factor in the decline of Fraser River sockeye salmon based on their diets and indications of increasing population trends. Thus, the evidence that any single predator caused the decline of Fraser River sockeye salmon is weak or nonexistent. Instead, predation is more likely to be part of the cumulative threats that sockeye contend with. Cumulative threats are far more difficult to evaluate than a single factor. In the case of Fraser River sockeye salmon, stress from higher water temperatures, more in-kind competition due to increased escapement with resulting lower growth, and running the gauntlet through predators whose alternative prey may have diminished, may all have had cumulative effects. Assessing the cumulative effects of these and other stresses will require integrated evaluation.

Evaluating why the survival of Fraser River sockeye declined requires knowing what happened in each of the habitats the fish passed through. Finding correlations between survival rates and environmental indicators is not an explanation. An explanation requires uncovering the underlying mechanisms that affect survival, and calls for information about ecosystem resources

and interactions. In theory, this information should have been available through the DFO Ecosystem Research Initiatives to study and evaluate ecosystem-level information instead of single species assessments, as has been the case until now. However, this initiative by DFO appears to have been little more than an intention supported with insufficient funding. Integrated management is seemingly at a standstill in British Columbia. This lack of a coordinated system to gather and assess ecosystem-level information limits the overall ability to better assess the effects of predation on Fraser River sockeye salmon.