EFFECTS ON SITUK RIVER AND RUSSELL FIORD

After Hubbard Glacier impounds Russell Fiord, the newly formed "Russell Lake" would fill in 7-14 months and then overflow into the Situk River. The ice dam will likely form between March and July (Trabant et al. 1991). It may fail and rebuild several times before finally stabilizing, causing extreme oscillations in Situk River flow.

Overflow from Russell Lake would severely impact Old Situk River and the main-stem Situk River downstream from its confluence. Situk River discharge is expected to swell from 6 m^3/s (present summer average) to approximately 220 m^3/s, exceeding 1,400 m^3/s during peak flows (Mayo 1988). The main stem would widen from 25 m (average) up to 2,500 m. Because of glacial runoff into Russell Lake, the "new" Situk River would be cooler and turbid. Old-growth forest in the floodplain would be destroyed, and log jams would intensify flooding. River substrate would be scoured, shifted, and often replaced with sediment. Aquatic vegetation, fish, and invertebrates would be decimated in many areas.

The main stem between Forest Highway 10 and Old Situk River (Fig. H.2) also would be affected as flood waters backed up. This area of the river would be deeper, cooler, and slightly turbid. The river upstream of the highway would not be directly impacted by flooding, but may have increased groundwater flow (Clark and Paustian 1989).

The Situk estuary would be reshaped by flooding. Floodplain analysis indicates that the "new" river would empty directly into the ocean via the Lost River (Paul 1988). The river mouth would be approximately 1,300 m wide, with numerous braids and secondary channels. The mouths of the Ahrnklin and Kunayosh rivers (Figs. H.1, H.2) eventually may move westward and share the Situk River's ocean entrance (Paul 1988). The Situk estuary may increase in size and could contain more tidal sloughs. Temperature and salinity would decrease, and turbidity would increase.

Russell Fiord would change dramatically with the creation of Russell Lake. Rising water would inundate most spawning and rearing habitat in inlet streams, flood 36 km^2 of vegetated shoreline, and increase water surface area from 196 km^2 to 233 km^2 (Clark and Paustian 1989). The lake would develop a surface lens of fresh water and become a sediment trap. Much of the suspended sediment in glacial runoff would settle out in the lake. Water overflowing into the Situk River, therefore, would be less turbid than water entering Russell Lake. A more detailed description of the hydrological effects of flooding on the Situk River and Russell Fiord is provided in Mayo (1988) and Clark and Paustian (1989).

EFFECTS ON SALMONIDS AND HABITAT

The greatest impact on fish habitat would be from initial flooding. Initial effects of flooding on habitat depend on the duration and timing of floods. A single large flood would impact less than a series of floods. After an ice dam in Russell Fiord collapses, Situk River flow would decrease by 90% and many channels would dry up, stranding fish and dewatering redds. Important rearing habitat—such as willow edges and pools with woody debris—would be scoured, filled, or washed away. Spawning habitat would be inundated, covered with debris, or buried in sediment. Rearing fish would be displaced to river margins and off-channel areas or washed to sea. Initially, food production probably would be depressed. Habitats would be unstable for several years as the river channel adjusts to increased flow and changes in sediment and debris.

Eventually, the Situk River would stabilize as it regains its former channel. More rearing habitat could become available because of the creation of Russell Lake and the increased size of the Situk River. Habitat quality, however, would probably be reduced because of cooler water and increased sediment and turbidity.

Adults

Upstream migration of adult anadromous fish would be affected by flooding. During initial flooding, many adult fish may avoid the river because of the extremely high sediment load, as coho and chinook did in the Toutle River, Washington, after Mount St. Helens erupted (Martin et al. 1984). As turbidity decreases with time, fish probably would return, but may change their migration timing and habitat use. For example, pink salmon in the Bella Coola River, British Columbia, delayed migration and used alternate spawning areas to avoid periods of glacial turbidity (Wickett 1958). Adults may migrate sluggishly because of lower water temperature (Bjornn and Reiser 1991), and they may migrate along river margins to avoid high water velocity. The transformation of the Situk River into a large, glacial river does not preclude successful salmonid migration and spawning. Large, glacial rivers in Southeast Alaska (Taku and Stikine Rivers) provide good migration and spawning habitat for adult salmon and steelhead[22] (Eiler et al. 1988).

Effects of flooding on adult fish migration depend on timing and duration of floods. A flood in November, for example, would impact coho and fall steelhead, whereas a flood in June would impact sockeye, chinook, pink, and Dolly Varden (Fig. 1.3). A flood lasting a long time or successive floods over a year would impact all adult salmonids in the Situk River (Fig. 1.3).

Flooding would affect spawning habitat of some species more than others. About 40% of pink and 50% of chum spawn inside the flood zone and would be heavily impacted by flooding. Chinook, sockeye, and fall steelhead would be least affected because most (95%) spawn outside the flood zone. Effects on coho and spring steelhead would be moderate because about 30% of coho and 25% of spring steelhead spawn inside the flood zone. Adult Dolly Varden were not studied, but based on high juvenile densities in Old Situk River (Study 2), most probably spawn inside the flood zone. In addition to salmonids, 100% of eulachon spawn inside the flood zone.

Although the preferred spawning areas of most species would not be directly impacted by flooding, they could be indirectly affected because of competition. Adults that would normally spawn within the flood zone may move to areas away from flooding or may stray to nearby rivers (Elwood and Waters 1969). After Mount St. Helens erupted, coho and chinook straying from the Toutle River increased dramatically (Martin et al. 1984). Redd superimposition and biological oxygen demand from heavier use of unflooded spawning habitat could cause poor freshwater survival (Heard 1978). With returns as high as 300,000 fish, pink salmon would cause the most competition because the majority would probably move from the flood zone to spawn in the upper main-stem Situk River.

During initial flooding, a high percentage of spawning habitat in Old Situk River and the main-stem Situk River would be destroyed by scouring and deposition. Eggs in the gravel would be washed away or buried. If streamflow fluctuates widely, eggs spawned at high water may be dewatered as flow drops. Eggs deposited after the river stabilizes would have longer incubation periods because of cooler water. Late emergence could cause increased freshwater residence, delayed seaward migration, and reduced survival.

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[22]J. Edgington and J. Lynch, Alaska Dep. Fish and Game, Commercial Fish Div., P.0. Box 667, Petersburg, AK 99833. Unpubl. data.

Juveniles

Juvenile salmonids would be affected most if initial flooding is in summer. Overall, about 70% of the juvenile salmonids in the Situk and Lost River watersheds (excluding lakes and most of Tawah Creek watershed) rear in the flood zone in summer. Sockeye would be least affected by flooding because most are lake-type and rear outside the flood zone—nearly all ocean-type sockeye however, rear in the flood zone. Most coho (67%) and Dolly Varden (90%) and about one-half of steelhead rear inside the flood zone in summer. After emergence, chinook fry rear upstream of the flood zone, but nearly all (98%) move downstream and rear inside the flood zone for about 3 weeks while migrating to sea. Thus, flood timing would determine which juvenile fish are initially most affected: a spring flood would spare most chinook; a flood after July would spare most smolts (Fig. P.1). Regardless of timing, juvenile coho, steelhead, and Dolly Varden should recolonize areas disrupted by flooding more quickly than sockeye or chinook because they are more widely distributed in the watershed.

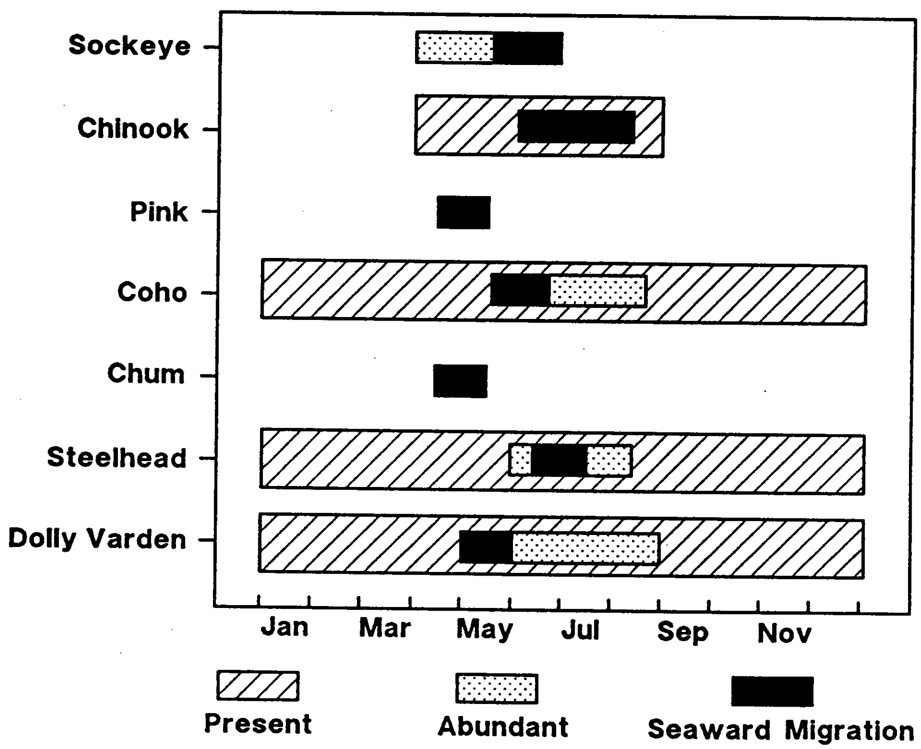

Figure P.1—Estimated time juvenile salmonids are present in the Situk River.

Most juvenile salmonids winter outside the flood zone and would be spared from winter flooding. In fall, juvenile salmonids commonly move to wintering areas (i.e., lakes and tributaries) from which they migrate the next spring as smolts (Cederholm and Scarlett 1981; Murphy et al. 1984; Brown and Hartman 1988). Of the 1.3 million smolts that migrated from the Situk River in 1990 (Study 7), only moderate percentages of sockeye (34%) and coho (33%), and virtually no steelhead wintered inside the flood zone—nearly all chinook migrate to sea their first year and do not winter in fresh water. Thus, most winter habitat would be unaffected by flooding. The Old Situk River, however, is an exception: over 130,000 juvenile salmonids (parr and smolts) emigrated from this tributary in spring 1989 (Study 6). Regardless of where juveniles winter, all seaward migrants must migrate through the flood zone.

The cooler, turbid floodwaters from Russell Lake would affect the distribution, emergence, and growth of some fish species in the Situk River. Studies in the glacial Taku River show that sockeye and chinook rear successfully in turbid waters (<350 NTU), whereas coho and steelhead avoid the turbid river and rear in clearwater tributaries or off-channel beaver ponds (Thedinga et al. 1988; Murphy et al. 1989). Coho, however, successfully rear in the less turbid (<100 NTU) Kenai River, Alaska (Bendock and Bingham 1988).

After flooding, salmonids in the flood zone would emerge later and grow slower. In the lower Taku River, age-0 coho average 50 mm FL in September (Murphy et al. 1989) compared to nearly 70 mm FL in the lower Situk River. Similarly, age-0 chinook in the Taku River average only 60 mm FL by early August (Murphy et al. 1989), whereas by this time in the Situk River they had already migrated to sea at a size of 80 mm FL (Study 4).

Life-history patterns of the ocean-type stocks may disappear after flooding. Most ocean-type sockeye emerge and rear inside the flood zone until they migrate to sea in June. Ocean-type chinook rear within the flood zone for about 3 weeks before migrating to sea. Thus, flooding may eliminate these life-history patterns. Cooler water and slower growth could increase freshwater residence from 4-6 months to 1 or more years, causing increased freshwater mortality. Conversely, ocean-type sockeye may survive and even flourish after the river stabilizes. In the glacial Taku River, ocean-type sockeye rear successfully in side sloughs and beaver ponds (Thedinga et al. 1988).

Estuary

Effects of flooding on anadromous fish habitat in the estuary are uncertain and depend on the configuration of the river channel, basin, barrier islands, and tidal sloughs during initial flooding and after stabilization. The most likely scenario is that the "new" river would develop a delta at its mouth and empty directly into the ocean (Paul 1988). Some ocean-type salmonids that now rear in brackish-water tidal sloughs and the lower river would probably be swept to sea before they could grow large enough to tolerate seawater. Age-1 and older smolts would be less affected because they do not spend much time in the estuary. If the barrier islands and estuary basin remain intact, the estuary could serve as a refuge for age-0 salmonids swept from the "new" Situk River.

Most marine fish species in the estuary, such as starry flounder and sculpin, probably would not be severely impacted by flooding. Marine fish would probably recolonize flood-damaged areas near the river mouth or move to areas adjacent to the Situk River. The loss of the estuary, however, would probably eliminate juvenile Dungeness crabs, which generally prefer estuarine habitats for nursery areas[23].

Russell Fiord

Impoundment would submerge most anadromous fish habitat in Russell Fiord streams. Streams in the fiord are short and steep, and most fish rear and spawn in lower reaches which would be flooded as water rises in the lake. Thus, after impoundment, rearing and spawning would be limited to marginal or unsuitable habitat in fiord streams. Hubbard Glacier would block access to anadromous fish streams in Russell Fiord, but a new migration corridor into Russell Lake would open via the Situk River after the lake is filled. Marine fish and crustaceans entrapped in Russell Lake would eventually die because of anoxic conditions in the deep saltwater lens.

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[23]C. E. O'Clair, National Marine Fisheries Service, Auke Bay Lab., 11305 Glacier Hwy., Juneau, AK 99801-8626. Pers. commun., Aug. 1992.