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Appendix A The influence of junction hydrodynamics on entrainment of juvenile salmon into the interior Sacramento-San Joaquin River Delta

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River junctions where water may follow two or more alternative pathways (diffluences) could be critical points in river networks where aquatic migratory species select different migration routes. Federally listed Sacramento River Chinook salmon juveniles must survive passage through the tidal Sacramento – San Joaquin River Delta in order to successfully out-migrate to the ocean. Two of the four main migration routes identified for salmon in the Sacramento River direct them to the interior of the delta, where salmon survival is known to decrease dramatically. Migration route selection is thought to be advection-dominated, but the combination of physical and biological processes that control route selection is still poorly understood. The reach in the Sacramento-River where the entrances of the two lower-survival migration routes are located is strongly influenced by the tides, with flows reversing twice daily, and the two diffluences are located in the outside of the same Sacramento River bend where secondary circulation occurs. Three dimensional simulations are conducted, both in the Eularian and Lagrangian frame, to understand tidal and secondary-circulation effects on the migration route selection of juveniles within this reach of the Sacramento River. Although salmon behavior is reduced to the simplest (passively-driven neutrally-buoyant particles), the preliminary results here presented are consistent with previous studies that show that during the flood tide almost all the flow, and thus, all the salmon, are directed to the interior delta through these two migration routes. Simulated fish entrainment rates into the interior of the delta tend to be larger than those expected from flow entrainment calculations alone, particularly during ebb tides. Several factors account for these tendencies. First, the fraction of the flow diverted to the side channel in the shallowest layers tend to be higher than in the deeper layers, as a result of the secondary circulation that develops in the main river. The secondary circulation acting upstream also causes the surface-biased salmon distribution to be skewed towards the outside of the bend as they approach the entrance to the migration routes. As a result of these effects, the fraction of entrained particles in the shallowest 4 m of the water column remains higher than 50% during the course of a tidal cycle.