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Chapter 3: The Chinook Salmon Life Cycle – Connecting a Diverse Watershed

The Green/Duwamish and Central Puget Sound Chinook salmon life cycle provides a common thread linking together a diverse watershed. Each of the five distinct subwatersheds plays a critical role in the Chinook salmon life cycle. Recovery of a viable salmon population hinges on collective action across the watershed to improve aquatic habitat. The conceptual life cycle model presented in the 2005 Salmon Habitat Plan remains an important tool for assessing aquatic habitat needs in relationship to priority stressors that adversely impact survival at distinct life history stages and across different life history types. Understanding aquatic habitat needs throughout the life cycle and how they relate observed bottlenecks in survival allows recovery managers to strategically focus limited resources where they are expected to provide the largest benefit to recovery objectives. Figure 5 highlights the relationship between the subwatersheds and specific life history phases.

Adult Upstream Migration/ Spawning

Chinook salmon enter the Green/Duwamish between July and October. Timing of river entry and upstream migration is impacted by water temperature and flow. Spawning generally occurs mid-September through October, between approximately river miles 25 and 61. Spawning primarily occurs within the Lower and Middle Mainstem Green River and Newaukum Creeks. Additional spawning occurs in Soos, Burns and Covington Creeks. Fish passage to the upper watershed has been blocked by a combination of the Tacoma Headworks Diversion Dam (1911) and Howard Hanson Dam (1961). Although fish passage was provided at the Tacoma facility in 2007, a downstream fish passage facility has not been completed at Howard Hanson Dam. The dams also block natural gravel delivery and transport; however, available spawning habitat does not appear to be a limiting factor in Chinook recovery.

Egg Incubation/Emergence

Egg incubation and alevin emergence generally occurs September through January within the same reaches where spawning occurs. Timing is variable and influenced by water temperatures – warmer temperatures drive an earlier emergence. High-flow events and sedimentation during this critical development period can scour redds and result in high mortality. As a result, flow management at Howard Hanson Dam influences incubation/ emergence success.

Juvenile Freshwater Rearing/ Migration

Juvenile Chinook salmon rear in the Lower and Middle Green subwatershed from mid-December to mid-July. The length of the freshwater rearing period varies among life history types (Figure 5) and is influenced by habitat availability and flows. Subyearling Chinook rely on low-velocity habitats, including mainstem river margins, pools, and off-channel habitats. Rearing habitat availability is a limiting factor for Chinook productivity. Extensive flood control facilities and floodplain development have disconnected floodplain habitats, reduced habitat complexity, and eliminated much of the historic freshwater rearing habitat. Instream flows influence accessibility of off-channel rearing habitats. During low-flow periods, off-channel habitats and floodplain wetlands may become disconnected from the mainstem. In contrast, high-flow events may flush juvenile Chinook downstream if they are unable to access suitable refuge habitat. Given the connection to instream flows, flow management at Howard Hanson Dam can impact habitat connectivity/ availability during the rearing period.

Juvenile Estuary Rearing

Subyearlying Chinook salmon generally migrate downstream into the Duwamish estuary between February and July, with fry-type life histories predominantly entering earlier in the year (Feb-Mar) than parr (May-Jun). Residence times in the Duwamish vary considerably, with some fish spending days and others (i.e., estuarine reared fry) spending weeks to months in the estuary. The Duwamish Estuary – specifically the transition zone (RM 1-9) – is critical for juvenile salmon making the physiological transition from fresh to salt water. Juvenile Chinook salmon rely on shallow, low gradient habitats (e.g., marshes, mudflats, and tidal sloughs) to escape stronger currents and support efficient foraging and growth prior to entering Puget Sound. Extensive industrial development along the Duwamish has transformed the estuary to an industrial waterway, resulting in extensive loss of slow water rearing habitats and contamination of sediments. The lack of high-quality habitat may contribute to accelerated downstream migration and reduced survival upon entry into Puget Sound.

Figure 4. *The Salmon Cycle*

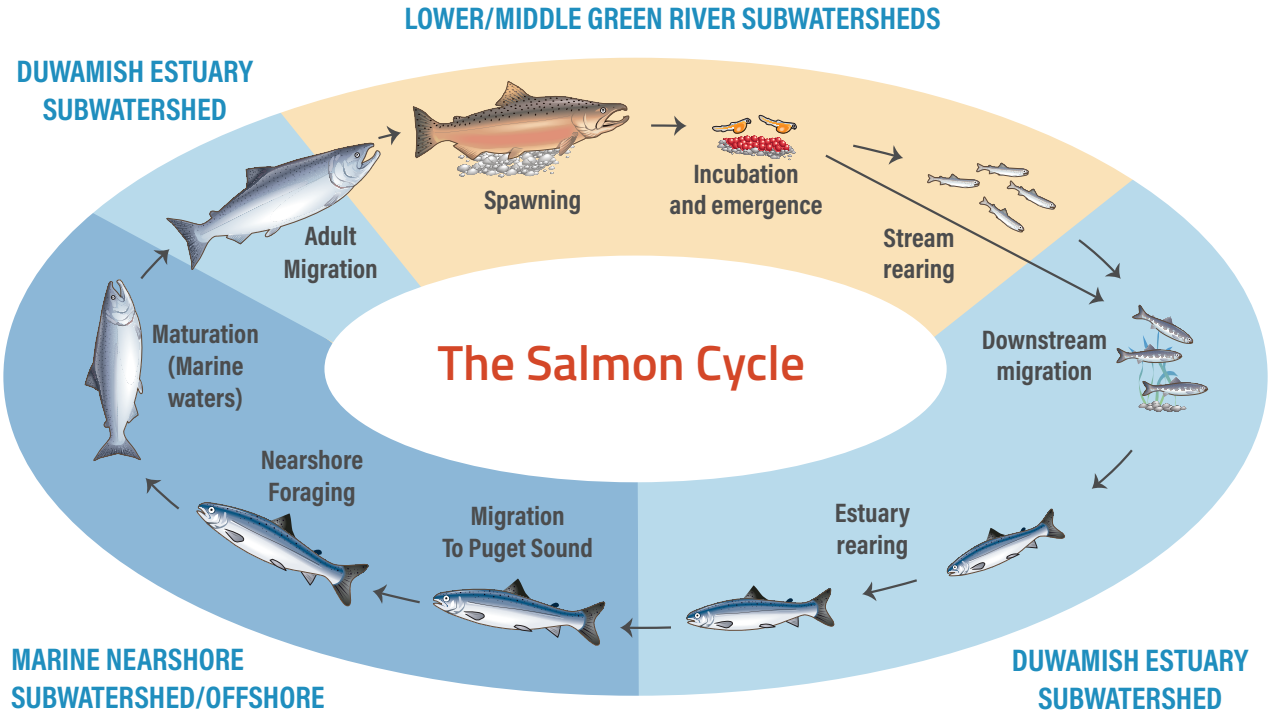
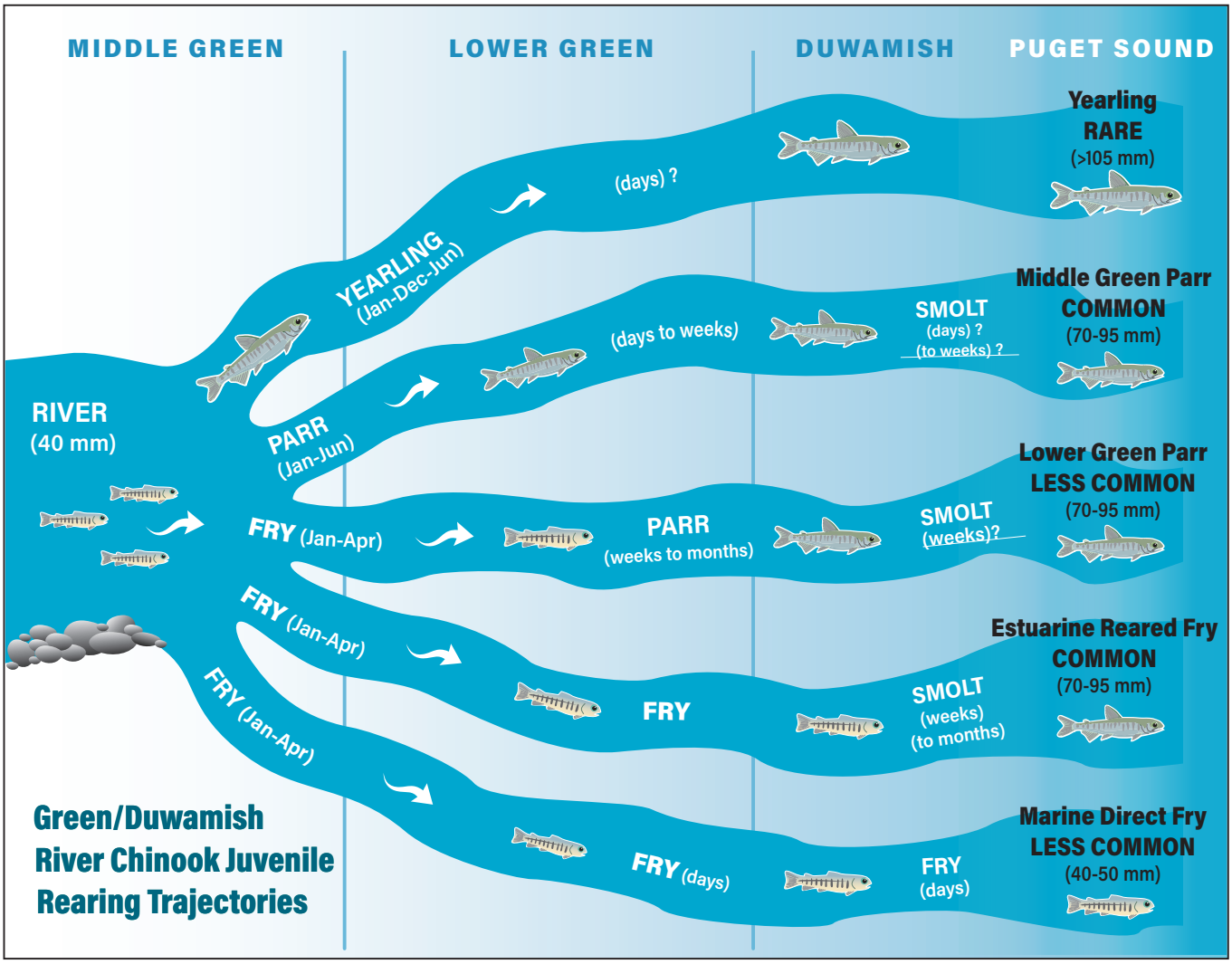


Figure 5. *Primary Chinook salmon life history types in the Green River (updated and modified from Ruggerone and Weitkamp 2004).*



Marine Nearshore Rearing

Juvenile Chinook salmon generally rear in the Puget Sound nearshore from later winter through fall. Shallow nearshore habitats support foraging, growth, and refuge from predators, while also providing a migratory corridor to offshore waters. Although considerable uncertainty surrounds marine nearshore habitat use by juvenile Chinook salmon, it is widely accepted that the early marine rearing period is a critical period of growth that strongly influences long-term survival. The Central Puget Sound marine nearshore waters not only support Green River Chinook, but also at least eight different stocks of Puget Sound Chinook salmon. Shoreline development has extensively modified nearshore habitat and processes in WRIA 9. The most intense shoreline modifications are located in urbanized Elliott Bay, with more natural shorelines located along the largely rural Vashon Island.

Ocean Migration

By fall, most Green River Chinook exit the Strait of Juan de Fuca and migrate north along the outer coast of Vancouver Island. While Chinook salmon may spend up to five years in marine waters, most Green River Chinook spend two to three years at sea before returning to spawn. In addition to predators, Chinook salmon are subject to various commercial fisheries during their marine migration.