SMOLTIFICATION OF NATURALLY REARING

YAKIMA RIVER SPRING CHINOOK SALMON

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In this work we describe the physiological and endocrine patterns associated with growth and smoltification in wild spring chinook salmon (*Oncorhynchus tshawytscha*) juveniles from the Yakima River, a tributary of the Columbia River located in central Washington. Fish were sampled from June, approximately three months post-emergence, through May of the following year when fish initiated smolt out-migration as yearlings. Sampling was conducted with electro-shock gear and seines over a 200 km stretch of river. Fish were sampled in both up-river reaches, where fish resided for over a year, and lower river reaches, to which fish migrated in the fall and over-wintered, before smolt out-migration the following spring. Migrating smolts were also collected at a lower river fish bypass facility at Prosser Dam during the out-migration period.

Parameters examined include fish size, condition factor, body silvering, stomach fullness, liver glycogen, body lipid, plasma thyroxine (T_4), plasma insulin-like growth factor I (IGF-I), and gill Na^+K^+ -ATPase. Distinct, dynamic changes were found in each of the parameters examined. Elevated growth rates were evident from June through October and from February through April, little or no growth was observed from late fall through the winter months. Liver glycogen and body lipid levels were elevated through the early fall. The fish became catabolic in November-December and low levels of glycogen and lipid were found by February. Significant increases in both parameters were found in late February and March, however, these stores were significantly depleted in out-migrating smolts. Plasma T_4 and IGF-I values increased in the spring coincident with smoltification. Very high values for IGF-I were found in out-migrating smolts. Gill Na^+K^+-ATPase activities showed a distinct increase in the spring, coincident with smoltification. Highest values were found in migrating smolts.

Overall, a distinct anabolic - catabolic shift was found in November and a catabolic to anabolic shift in February (Figure 1). Low feeding rates, growth rates, and reduced metabolic reserves were expected to occur in winter months. Increased feeding rates (inferred from stomach fullness data), condition factor, liver glycogen, body lipid, and plasma IGF-I levels were all found in February-March, when water temperatures were still quite cold. Studies of hatchery or laboratory fish have not shown dramatic anabolic increases in the spring. Previous work has suggested that hatchery smolts do not perform as well as wild smolts. We suggest that the dynamic anabolic rebound found in February in wild fish may have synergistic effects with the endocrine process of smoltification, resulting in more synchronized physiological changes and a superior smolt.

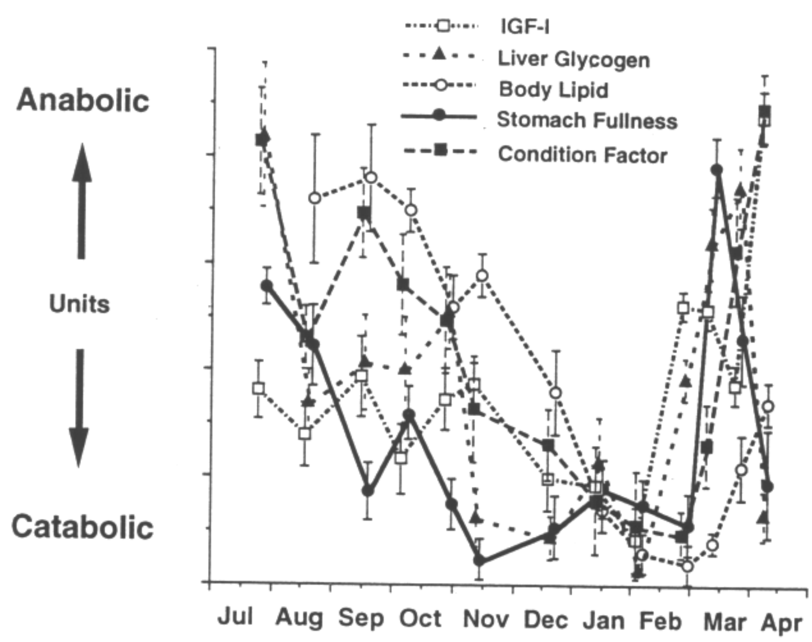

Figure 1. Anabolic/catabolic pattern of spring chinook salmon in the Yakima River 1993 - 1994.

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