attempting to identify distinct population units (Gharett and Smoker, 1993).

In its analysis of run timing, NMFS found the time period of peak spawning for odd-year pink salmon populations to be highly variable among river systems in northwestern Washington. Pink salmon populations in the Strait of Juan de Fuca exhibit the earliest average date of peak spawning, while peak spawning of Nisqually River populations typically occurs an average of 1 month later. Timing of peak spawning of even-year pink salmon in the Snohomish river is about 3 to 4 weeks earlier than that of odd-year fish, even though these two groups use much of the same habitat.

In addition to differences in run timing, considerable variation in body size and shape is apparent among pink salmon populations. Available data indicate significant variation in the length of odd-year pink salmon among various drainages in Washington. In general, the smallest fish appear in cold, turbid rivers in Puget Sound (Nooksack and Nisqually Rivers), and along the Strait of Juan de Fuca (lower and upper Dungeness River), while the largest fish tend to exist in Hood Canal. Limited data regarding Snohomish River evenyear pink salmon suggest that this population contains the smallest pink salmon observed in Washington.

Comparisons of pink salmon length data among British Columbia and Washington indicate that, with the exception of Snohomish and Skagit River populations, odd-year pink salmon populations in Washington appear to be smaller than the average for odd-year British Columbia populations (Beacham and Murray 1985). However, this comparison is complicated by the fact that the Washington data were taken more recently than the British Columbia data. Even-year Snohomish River adult pink salmon are similar in size to pink salmon in even-year populations from the central mainland and northern Vancouver Island, but tend to be smaller than the even-year British Columbia average. Again, however, the data may not be strictly comparable, because they were taken in different years.

Some evidence exists for recent declines in body length of odd-year pink salmon in Washington. This aspect raises concern regarding the ability of natural populations of pink salmon to recover, since, in general, decreases in body size equate to decreased fecundity and decreased juvenile production (but see Ricker et al., 1978; Ricker, 1989). NMFS was unable to review any new data on body size in odd-year British Columbia pink salmon to determine

whether size has declined in these stocks (Ricker et al., 1978; Ricker, 1989). However, the decline in body length of odd-year Washington pink salmon is qualitatively similar to a decline in length observed in pink salmon returning to Auke Creek, AK, over the last 20 years. Further, data estimated from catches of southeastern Alaska pink salmon suggest similarly declining body length trends over an even longer period (Marshall and Quinn, 1988). Therefore, NMFS believes that this factor should be closely monitored to ensure that natural populations remain viable in the future.

Homing and straying are prominent features of Pacific salmon biology that can have significant effects on population structure. Consequently, these issues are relevant to ESU determinations for these species. Pink salmon have a widespread reputation for straying at higher rates than other species of Pacific salmon (Horrall, 1981). If true, the result may be a less conspicuous population structure and, potentially, reduced opportunity for local adaptations to be maintained. Few technically sound studies have been conducted to estimate straying rates of Pacific salmon and provide empirical evidence supporting the hypothesis that pink salmon stray at relatively higher rates than other species of Oncorhynchus is mixed (Quinn, 1993; Altukhov and Salmenkova, 1994). However, the rapid colonization of systems newly available to pink salmon indicates that this species has an unusual ability to expand into suitable habitat when conditions are favorable (Merrell, 1962; Kwain and Laurie, 1981; Heard, 1991).

It is difficult to say with any degree of certainty that pink salmon stray more frequently relative to other species of Pacific salmon. It is apparent that straying in pink salmon may be highly dependent on spawning location and on conditions at time of spawning. The consequences of straying on pink salmon populations are not clear, but such consequences may contribute to less conspicuous population structure and reduced local adaptations.

## Artificial Propagation

It is commonly believed that evenyear pink salmon were historically either absent from Washington or were at an abundance too low to sustain harvest (Rounsefell, 1938; Ellis and Noble, 1959). Consequently, WDF made several attempts earlier in this century to establish even-year pink salmon runs in northwestern Washington (WDF, 1916–1964; Neave, 1965; Roppel, 1982). More than 82 million pink salmon eggs

were transported from Alaska to various locations in Washington in evennumbered years between 1910 and 1932. In addition, more than one million odd-year Alaskan pink salmon eggs were brought into Washington from southeastern Alaska in 1929. An estimated 85 million juveniles released between 1911 and 1933 produced no recorded returns of even-year pink salmon adults to Washington rivers, including the Snohomish River (Ellis and Noble, 1959; Neave, 1965). Attempts to establish even-year pink salmon in Washington were renewed between 1944 and 1956 with the transport of nearly 4 million eggs from the Skeena River drainage in British Columbia, Canada. Of the 1.3 million fry released, at least several hundred are believed to have returned as adults. However, no evidence exists that returns were sustained beyond one or two generations (Ellis and Noble, 1959; Neave, 1965).

Even-year pink salmon in Washington are known only to occur in the Snohomish River (WDF et al., 1993). The origin of this population is uncertain; these fish may be endemic or may have resulted from one or more transplants of even-year fish from Alaska or Canada. Regardless of its origin, the Snohomish River even-year population has apparently been naturally self-sustaining for at least the last 18 generations (about 36 years).

In addition to stock transplants, relatively large numbers of pink salmon were produced in Washington hatcheries around Puget Sound from the early 1950's through the late 1980's. Transfers of fish among hatcheries and drainages were common during this period; however, very few pink salmon were transplanted to areas outside Puget Sound. Three hatcheries have dominated pink salmon production in Washington: Hood Canal Hatchery on Finch Creek in Hood Canal, Puyallup Hatchery on Voight Creek in south Puget Sound, and Dungeness Hatchery on the Dungeness River.

In recent years, only Hood Canal Hatchery has maintained an active pink salmon propagation program. Most hatchery production of pink salmon in Washington is composed of odd-year fish released from this facility. Originally, in 1953, broodstock for this hatchery was derived from adult pink salmon returning to the Dungeness and Dosewallips Rivers. Presently, this hatchery uses native broodstock, which are generally released into Finch Creek, the location of the hatchery. Over the past decade releases from Hood Canal hatchery have averaged about 1 million fry released every other year into Finch