

Historical Trends in Rate of Fishing and Productivity of Bristol Bay and Chignik Sockeye Salmon

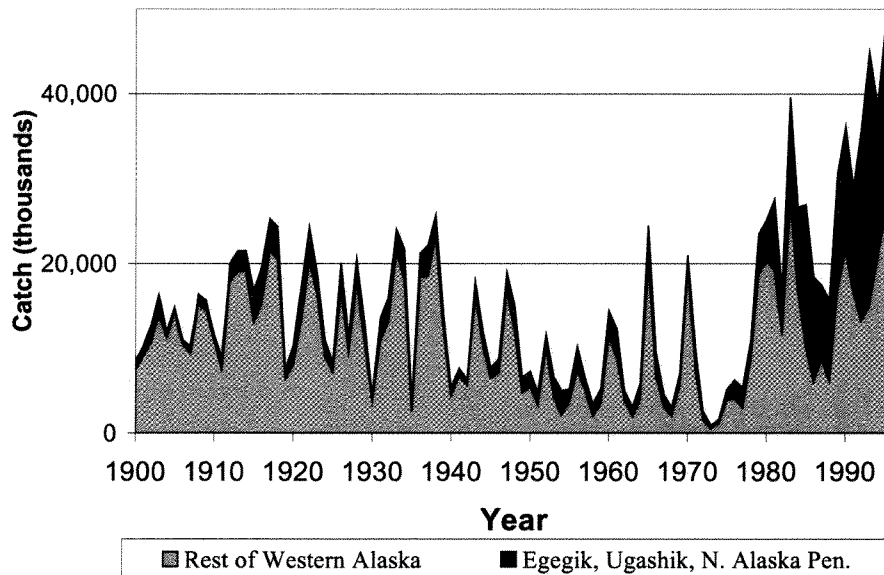
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Historical salmon catch data have been related to long-term environmental data in support of the hypothesis that large-scale salmon production is driven by decadal-scale climatic processes (Hare and Francis 1995; Beamish and Brouillon 1993). However, the historical Alaskan salmon catches have been affected by political and economic factors independent of climatic influences (Cooley 1961). The large increase in western Alaska sockeye catch in the late 1970s has been often cited as evidence for the late 1970 regime shift in the North Pacific



Ocean (Hare and Francis 1995). However, a large component of this increased catch, since the late 1970s, came from fisheries in the Egegik, Ugashik, and North Alaska Peninsula fishing districts (Fig. 1). The fishing effort in these fishing districts was very low prior to 1950, and recent increases in western Alaska sockeye catches cannot be attributed solely to a North Pacific regime shift.

Complete assessment of catch and escapement by age is available since the 1956 run year for Bristol Bay river systems and since

Fig. 1. Western Alaska sockeye salmon catch, 1900 - 1997 partitioned into Egegik, Ugashik, North Alaska Peninsula Districts, and other fishing districts of western Alaska (Nushagak, Naknek-Kvichak, Togiak, and Kuskokwim Districts).

the 1922 run year for Chignik early- and late-runs of sockeye salmon. These data sets were extended to the 1904 run year for Bristol Bay fishing districts (Nushagak, Naknek-Kvichak, Egegik, and Ugashik) and to the 1895 run year for the Chignik pooled early- (Black Lake) and late-runs (Chignik Lake). The early period catches and fishing effort (powerboat driftnet equivalent vessel days for Bristol Bay fishing districts, and trap days for the Chignik fishing district) were used to estimate total runs during the periods prior to routine escapement enumeration. The total run by age was estimated based on average district age composition from the recent periods. Complete returns (return by age from parent escapement) for the 1904-1991 Bristol Bay brood years and 1895-1991 Chignik brood years were constructed from the extended base of total run by age.

Ricker-type escapement return relationships were fit to the data and time-series of anomalies in production were constructed. The trends in productivity anomalies are believed to be the best indicator of long-term climate changes because trends in catches reflect changes in pattern of fishing. There was a high degree of autocorrelation in production anomaly, with alternating multi-year episodes of low and high production observed for all stocks. In general, there were similar patterns of production anomaly among the stocks of sockeye salmon examined (Fig. 2). The production anomalies during period from the turn of the century to early-1930 brood

years was generally positive, during the period from the mid-1940 to the late-1960 brood years generally negative, and during the period from the late-1970 to early-1990 brood years generally positive.

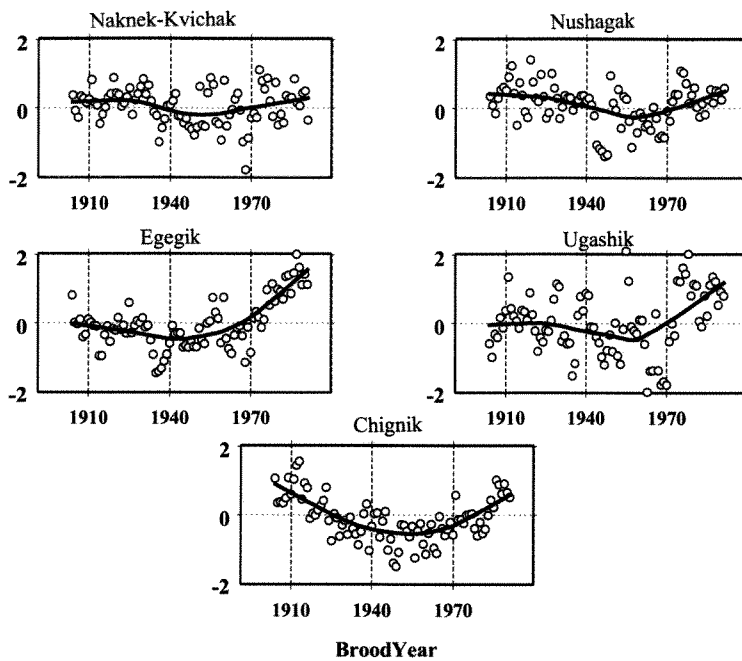


Fig. 2. Trends in sockeye production anomaly (solid line is loess fit and points are in \ln (observed return/predicted return)) from fitted Ricker-type spawner recruit relationship, 1904-1991 brood years for Naknek-Kvichak District, Nushagak District, Egegik District, Ugashik District, and Chignik District.

There were differences in pattern of abundance and exploitation rate among the stocks. The runs to the Nushagak and Chignik districts were low in early 1950s and have increased steadily since. The runs to Ugashik were very low in the early to mid 1970s. The off-cycle runs to Egegik were lowest in the early 1970s. The off-cycle runs to Naknek-Kvichak district were very low from the late 1950s to the early 1970s, however there is no trend in the cycle-year runs since the fishery was initiated. The Nushagak District, Ugashik District, off-cycle Naknek-Kvichak District, and Chignik District had periods of very low catch and escapement levels. In general, stocks that were fished heavily during episodes of low production were depleted. The periods of time that depletion of stocks occurred was not consistent among stocks and suggests that the interaction of fishing and climate-induced variation in productivity determines abundance of salmon.

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