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Strong resonance explains cycles in sockeye salmon populations
CHRISTIAN GUILL, BARBARA DROSSEL, TU Darmstadt, Institute of Condensed Matter Physics — The number of spawning sockeye salmon that return to their native streams in the Fraser river basin exhibit striking four-year oscillations, the dimension of which being no less notable than the widely known cycles of lynx and snowshoe hare in Canada. The period of the oscillation corresponds to the dominant generation time of these fish, and the phase differs between different stocks. Various not fully convincing explanations have been attempted, ascribing this phenomenon to transient effects, to stochastic influences, to depensatory predation, or to genetic effects. We show that these oscillations can be explained as a stable dynamical attractor of the population dynamics, resulting from a strong resonance near a Neimark Sacker bifurcation. This explains not only the long-term persistence of these oscillations, but also reproduces correctly the sequence of two strong years followed by two weak years. Furthermore, it explains the observations that the oscillations occur only in oligotrophic lakes, and that they do not occur in salmon species that have a longer generation time.

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