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Physical complexity of salmon-producing rivers of western North America

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Salmon are a declining keystone species of Pacific river ecosystems. To assist salmon conservation efforts around the North Pacific Rim, we developed and analyzed a geospatial database of landscape features in western North America. The database design optimizes parameter extraction, streamlines data maintenance, standardizes processing workflow and provides users with simultaneous access. We quantified and classified physical complexity by catchment basin for all rivers draining into the Pacific Ocean from California to northern Alaska. The objective was to use complexity metrics in relation to data describing salmon stocks to determine potential productivity river by river. Landsat remote sensing data were used to route drainages across Digital Elevation Model (DEM) data to extract floodplain, network, and catchment features; large rivers in relatively flat terrain may be more accurately quantified with this novel approach. Variables including catchment area and perimeter length; mean, standard deviation and coefficient of variation in catchment elevation and floodplain area; and density of hydrojunction nodes were measured. Overall physical complexity of each catchment basin was quantified (in relation to potential salmon production) and used to rank all catchments by composite metrics of variables computed by mean rank and principal components analysis. In relation to latitude, catchment elevation statistics decreased, floodplain statistics increased, and node density was independent. The ranking of overall catchment physical complexity corresponded with estimates of salmon abundance. The resulting database provides a systematic ranking of physical habitat potential as a tool to address questions about landscape structure and biological productivity at regional to continental extents.