The Columbia River as a System: an Oceanographic Point of View

David A. Jay, Professor
Portland State University
PO Box 751
Portland, OR 97207
e-mail: djay@cecs.pdx.edu

The Columbia River basin and associated oceanic waters present scientists and managers with a difficult problem of multiple, interacting scales. Scientists typically focus on processes and environments at a scale consonant with the analytical tools being used, and managers have defined responsibilities in specific geographic areas. In contrast, the Columbia Basin encompasses parts of seven states and two provinces in the US and Canada. The relevant "associated oceanic waters" cover a large part of the Northeast Pacific Ocean. Successfully implementing salmon recovery poses the daunting task of bringing together all the pieces to create an understanding of the system as a whole. This presentation uses field observations, remote sensing and model results to provide an overview of the physics of the system and some current issues affecting survival of juvenile salmonids, with an emphasis on processes in the estuary and coastal ocean. One of the difficulties in understanding the system is the movable nature of the functional components and habitats. For example, the Columbia plume has four components defined mainly by density contours: the lift-off zone, tidal plume, plume near-field, and plume far-field. The estuary and the tidal river are demarcated by a highly mobile boundary, the upstream limit of salinity intrusion (usually between RM-10 and RM-35), whereas tidal influence extends to Bonneville Dam. From a physical point of view, the primary forcing variables on the river basin side are the quality and quantity of river inflow at the head of the estuary, including such factors as sediment load and temperature. The primary forcing variables on the oceanic side are the tides and coastal circulation properties. The tides at the mouth of the estuary, the tidal response of the river, riverine and sediment inputs, and river water temperature all exhibit trends that impact vital habitats (or the ability of juvenile salmonids to use those habitats) in the fluvial, estuarine and coastal parts of the system. Changes in flow and tides, along with diking, have drastically reduced shallow water habitat area (SWHA) below Bonneville Dam.