FOCUS ON THE UPPER BASINS OF THE DUNGENESS RIVER SYSTEM

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Abstract

A poster presented at the conference characterizes the upper watersheds of the Dungeness River and its Gray Wolf River tributary located on the northeastern Olympic Peninsula of Washington State. The short, steep river system traverses 30+ miles from its headwaters in 7,000 ft + ridges of the Olympic Mountains to sea level in the Strait of Juan de Fuca. Until recently upper elevation climate data had been limited to monthly reporting from three snow courses in the proximity of the northwest corner of the watershed. Three Snotel sites are now operational in the northeast Olympics that provide telemetry reporting of temperature, precipitation, and snowpack data, summarized here.

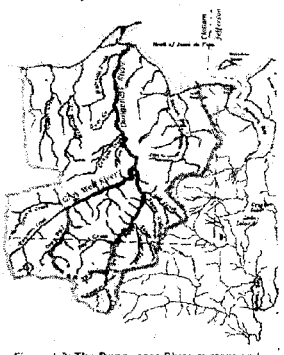

Figure 1 3: The Dungeness River system and related streams within the generalized watershed. Streams of Gardiner and Discovery Bay watershed to the east are indicated lightly.

Summary -- Figure 1 (left) illustrates the Dungeness River system. Numerous tributaries feed the upper Dungeness mainstem and the Gray Wolf River which join at about river mile 17. The upper basins include all above the USGS stream gage at river mile 11.8 where the river crosses through the northern foothills to the lowland coastal plain. These basins drain 156 sq miles. (Several independent smaller streams that begin on the north-facing slopes drain into Sequim Bay or directly to the Strait of Juan de Fuca and are considered as part of the broadly defined Dungeness watershed.) Figure 2 provides a map key illustrating the Olympic Peninsula and the portion discussed here. Figure 3 is an aerial depiction of the northeastern Olympic Mountains region shown in the key map, looking from the southwest toward the Dungeness watershed. The multiple high ridges of the Olympics and the generalized wet-season Pacific storms track from the west-southwest contribute to the rainshadow effect that characterizes the Dungeness watershed.

The arc of ridges that extend from Hood Canal and the Puget Lowland to the east to the Elwha River to the west define the southern boundary of the upper Dungeness and Gray Wolf basins. The Mt Crag Snotel site near Hood Canal on the east, the Waterhole Snotel site on Hurricane Ridge just west of the Gray Wolf basin, and the Dungeness Snotel site located in a protected valley joining the upper river, provide climate data to define the precipitation and snowpack regime of the Dungeness. Figures 4 and 5 provide views into the upper Dungeness and Gray Wolf basins, looking upstream from the north.

Figure 6 summarizes the snowpack measurement history of the watershed and vicinity, including monthly snow-course data beginning in 1949 and the recent Snotel data. The long decline in snowpack from the 1950s is evident, interrupted by the record snowpack of 1999. Figures 7 to 10 show data from the first winter, water year 2000, of the trio of Snotel sites.

Figure 11 illustrates long-term flow history of the Dungeness. An overall gradual decline in flow is evident, with shorter segments suggesting the influence of the Pacific Decadal Oscillation that affects Northwest weather patterns. The "off-scale" record flow of water year 1999 mirrors the record snowpack. Figures 12 to 15 illustrate the daily mean flows at the USGS river mile 11.8 gage for the latest four water years. The variations across the years between winter storm high flow events and large spring-summer runoffs from snowpack lead to the long-term bimodal flow pattern of the watershed.

Sources and Credits -- The three Snotel facilities are installed and maintained by the Natural Resources Conservation Service (NRCS). The Jamestown S'Klallam Tribe obtained and administered the grant funding for Dungeness and Waterhole Snotels. Olympic National Forest provided sites for Mt Crag and Dungeness Snotel units, and Olympic National Park (ONP) the site for the Waterhole Snotel. The snow course survey data is from NRCS, with most done by Jack Hughes of ONP. U S Geological Survey (USGS) Water Resources Division provided river flow measurements. PDO data are from U of WA JISAO. A Geographical Information System (GIS) software grant from Environmental Systems Research Institute to the Clarks (as "Clark Dungeness Studies") enabled the terrain analyses. A reference document, "Keys to an understanding of the natural history of the Dungeness River System", (1996, Welden and Virginia Clark), partially supported by the Puget Sound Water Quality Authority, provides information on the terrain, geology and climate, settlement history, surface and ground waters of the watershed, and an annotated bibliography. Updates in 1998 were supported by Clallam County's Planning Department. The "Keys .." document material is available on the www.DungenessRiver Center.org web-site.

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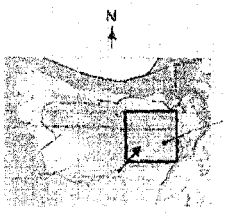
Fig 2: Key Map



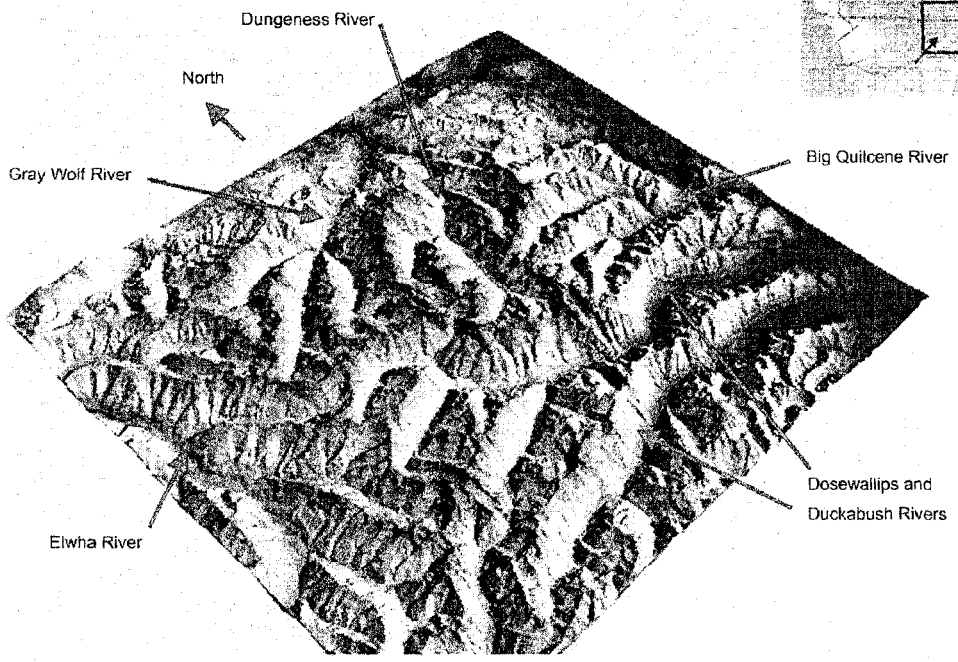


Fig 3: Northeast Olympics from southwest, toward Dungeness-Gray Wolf basins

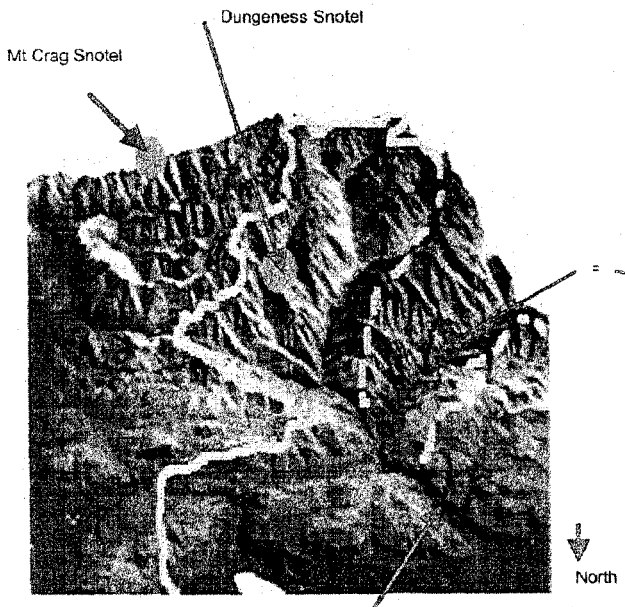


Fig 4: Upper Dungeness Basin

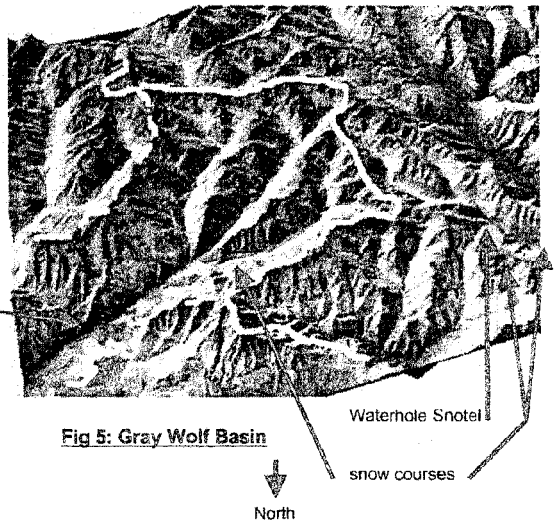


Fig 5: Gray Wolf Basin

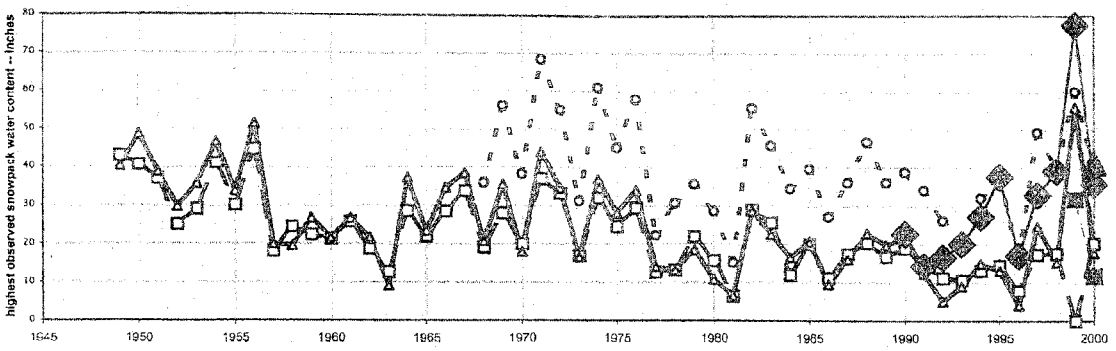


Fig 6: Snow Courses and Snotels measurements in the northeast Olympic Mountains for Water Years 1949-2000

The data are mostly the early April measurement for snow course surveys and the 1 April data from Snotel telemetry. Note the protracted downward trend from the 1950s into the 1990s and then record high measurements in Water Year 1999.

Snow Courses: Deer Park (small squares) 5200 ft elevation, south aspect; Hurricane (small triangles) 4500 ft, south aspect; Cox Valley (open circles) 4500 ft, protected northeast aspect.

Snotel Sites: Mt Crag (rotated squares) installed 1990, 3970 ft elevation, ridge location; Dungeness (squares) installed Wtr Yr 1999, 4022 ft, protected N-S valley location; Waterhole (solid large triangle) installed Wtr Yr 2000, 5000 ft, ridge location.

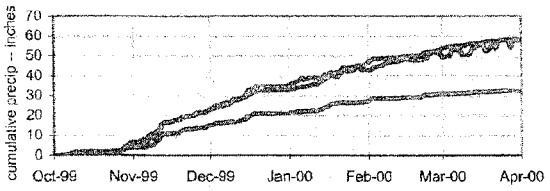


Fig7: Cumulative Precipitation at the three Snotel sites during Oct-March of Water Year 2000.

The top curve is Waterhole, the middle curve Mt Crag, the lowest Dungeness.

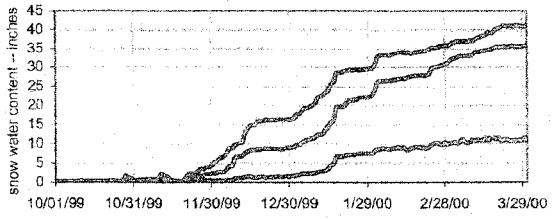


Fig 8: Snow Water Content at the Snotel sites during Oct-March of Water Year 2000.

The top curve is Waterhole, the middle is Mt Crag, the lowest is Dungeness.

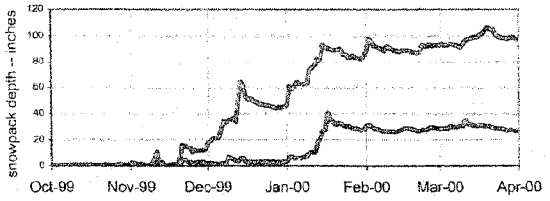


Fig 9: Snow Depth at Waterhole (the top curve) and Dungeness (the lower curve) Snotel sites during Oct-March of Water Year 2000.

(Mt Crag has no depth sensor)

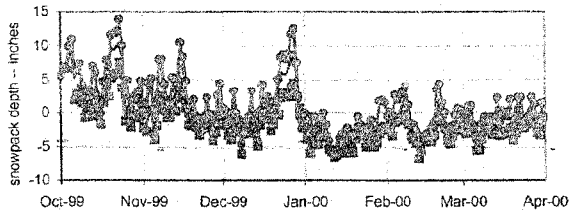


Fig 10: Mean daily temperatures at the Snotel sites during Oct-March of Water Year 2000.

Waterhole (squares) typically reports the lowest temperatures, while Dungeness (solid circles) reports the highest.

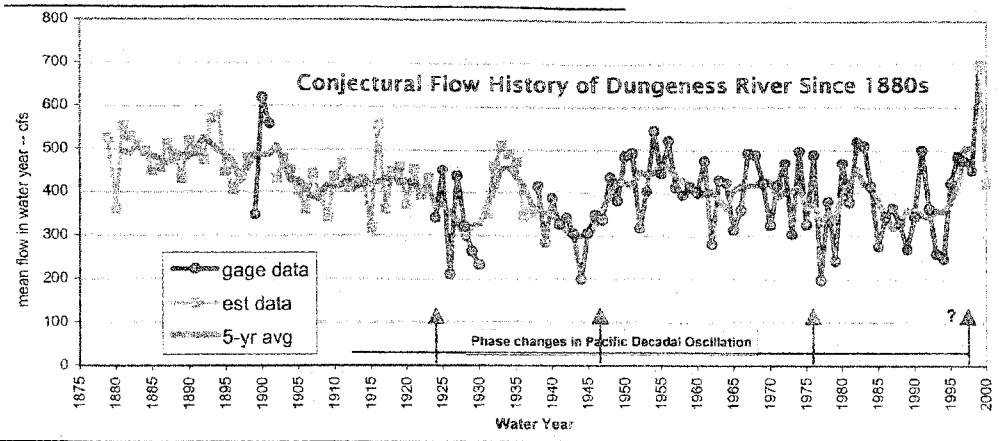


Fig 11: Conjectural flow history of the Dungeness River over the past 120 years, based on 73 water years of gage measurements and estimates from precipitation information. The estimated mean daily flow in the 1900 period was ~ 500 cfs, and only 375 cfs for the gaged period from 1930 until 1994. Higher flows in the years since 1994 have raised that to ~ 385 cfs. The 697 cfs mean for WY 1999 and the 845 cfs mean over the Apr-Sep period with runoff from the record snowpack are records well above any prior measured years.

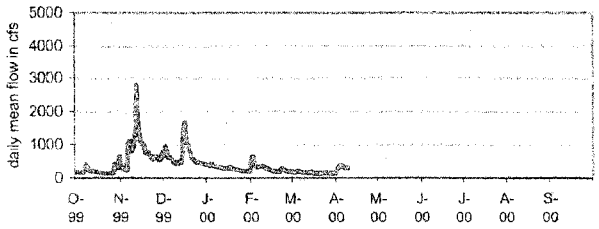


Fig 12: Daily mean flow in the Dungeness River for the Oct-March period of Water Year 2000. Winter storms were somewhat mild, and only moderate spring summer runoff is anticipated.

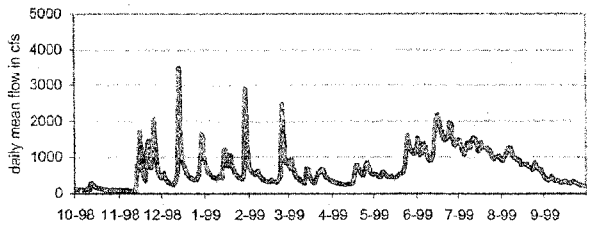


Fig 13: Daily mean flow in the Dungeness River for Water Year 1999 was a record 697 cfs. Flows from winter storms were over 50% above long-term, and Apr-Sep runoff from record snowpack were about 100% above the long-term average.

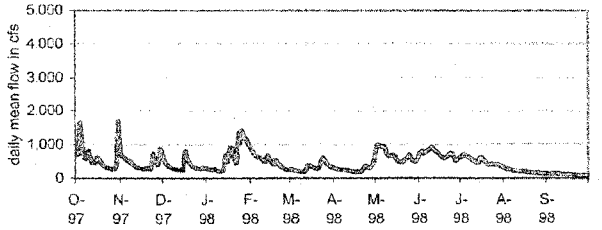


Fig 14: Daily mean flow in the Dungeness River for Water Year 1998. The water year mean of 451 cfs was well above the long-term, as was the Oct-March mean flow, although without major storms.

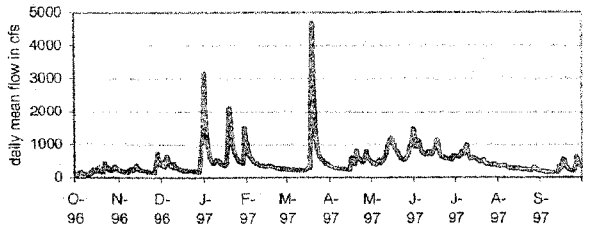


Fig 15: Daily mean flow in the Dungeness River for Water Year 1997. The water year mean of 473 cfs was well above long term, as were both the Oct-March and Apr-Sep periods. A Substantial storm occurred in early January and a major storm with high floods peaking at 6000 cfs mid March.