DETERMINATION OF SEDIMENTATION RATES IN TOMALES BAY, CALIFORNIA USING A GEOGRAPHIC INFORMATION SYSTEM

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By

John J. Rooney

Thesis Committee:

Stephen V. Smith, Chairperson
Charles H. Fletcher
Francis J. Sansone

ABSTRACT

A geographic information system (GIS) was used to calculate sedimentation rates for Tomales Bay, California. Surfaces were constructed using digitized bathymetric data from National Ocean Service navigational survey charts published in 1861, 1931, 1957 and 1994 with a public-domain Unix-based software package, Generic Mapping Tool (GMT), that has GIS capabilities. The surfaces were subtracted from each other to determine the volume of sediment that accumulated in the Bay between navigational surveys. The assumption is made that sediment deposited in Tomales Bay remains there. Thus, sedimentation in the basin approximates sediment delivery to Tomales Bay. Bay-wide average sedimentation rates were found to be 1.8 kg $m^{-2} yr^{-1}$ for the 1861-1931 interval, 5.8 kg $m^{-2} yr^{-1}$ for the 1931-1957 interval, 1.0 kg $m^{-2} yr^{-1}$ for 1957-1994, and 2.8 kg $m^{-2} yr^{-1}$ for the entire period from 1861-1994. These rates were compared with results hindcast from existing models relating rainfall in the watershed to runoff and sediment yield. GIS results for the 1861-1931 and 1957-1994 intervals agree rather well with the sediment yield model, while that model apparently underestimates sedimentation for the 1931-1957 interval. Differences between the two sets of rates apparently reflect changes in land-usage that effected both erosion in the watershed and, after a lag time of several decades, sediment accumulation in the bay. Discrepancies between the GIS results and radiometrically based estimates of sedimentation may reflect limited coverage for the radiometrically dated cores, together with overestimated recent sedimentation because of sediment mixing from large scale bioturbation.