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Assessing variation in skeletal production from surface death assemblages on the basis of age-frequency distributions

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Age-frequency distributions of dead skeletal material that capture information on the elapsed time since death of individuals on the landscape or seabed provide decadal- to millennial-scale windows into the history of production and on the processes that lead to skeletal disintegration and burial. However, models quantifying the dynamics of skeletal loss assumed that skeletal production has been constant during accumulation of death assemblages. Here, we assess the joint effects of temporally-variable production and skeletal loss on the shape of postmortem age-frequency distributions. We show that the modes of such distributions will tend to be shifted to younger age cohorts relative to the true timing of past production pulses. This shift in the timing of a past production will be higher where loss rates are high and/or the rate of decline in production is slow. We apply the models combining the dynamic of loss and production to death assemblages with the deposit-feeding bivalve Nuculana taphria from the Southern California continental shelf, finding that (1) an onshore-offshore gradient in time averaging is dominated by a gradient in the timing of production, corresponding to the tracking of shallow-water habitats under a sea-level rise, and (2) model estimates of the timing of past production are in good agreement with an independent sea-level curve.