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$^{87}Sr/^{86}Sr$ as a quantitative geochemical proxy for ^{14}C reservoir age in dynamic, brackish waters: assessing applicability and quantifying uncertainties.

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Accurate geochronologies are crucial for reconstructing the sensitivity of brackish and estuarine environments to rapidly changing past external impacts. A common geochronological method used for such studies is radiocarbon (^{14}C) dating, but its application in brackish environments is severely limited by an inability to quantify spatiotemporal variations in ^{14}C reservoir age, or R(t), due to dynamic interplay between river runoff and marine water. Additionally, old carbon effects and species-specific behavioural processes also influence ^{14}C ages. Using the world's largest brackish water body (the estuarine Baltic Sea) as a test-bed, combined with a comprehensive approach that objectively excludes both old carbon and species-specific effects, we demonstrate that it is possible to use $^{87}Sr/^{86}Sr$ ratios to quantify R(t) in ubiquitous mollusc shell material, leading to almost one order of magnitude increase in Baltic Sea ^{14}C geochronological precision over the current state-of-the-art. We propose that this novel proxy method can be developed for other brackish water bodies worldwide, thereby improving geochronological control in these climate sensitive, near-coastal environments.