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Commentary: Stable isotopes of carbon (δ^{13}C) and oxygen (δ^{18}O) from vaquita (*Phocoena sinus*) bones as indicators of habitat use in the Upper Gulf of California

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A Commentary on

Stable isotopes of carbon (δ^{13}C) and oxygen (δ^{18}O) from vaquita (*Phocoena sinus*) bones as indicators of habitat use in the Upper Gulf of California

by Rodríguez-Pérez M-Y, Sánchez-Velasco L, Rosas-Hernández M-P, Hernández-Camacho CJ, Cervantes FA, Gallo-Reynoso JP, Arreguín-Sánchez F and Godínez VM (2024) *Front. Conserv. Sci.* 5:1490262. doi: 10.3389/fcosc.2024.1490262

Introduction

Rodríguez-Pérez et al. (2024)'s discussion of our analyses of oxygen isotopes in mollusk shells and fish otoliths (Rodriguez et al., 2001; Dettman et al., 2004; Rowell et al., 2005, Rowell et al., 2008) is both misleading and wrong.

Discussion

Rodríguez-Pérez et al. (2024) state, "This [isotopic] enrichment in clams and fish has been related to a population decline in species such as *Mulinia coloradoensis*, *Cynoscion othonopterus*, and *Totoaba macdonaldi* and has been attributed to high temperatures due to environmental change caused by the blocking of the flow of the Colorado River toward the UGC [Upper Gulf of California] (Rodriguez et al., 2001; Dettman et al., 2004; Rowell et al., 2005, 2008)."

Although we (Kowalewski et al., 2000) documented a decline in the population of the bivalve mollusk *Mulinia californiensis* (now *Mulinia modesta*), we did not document changes in the population sizes of the sciaenid fish *Cynoscion othonopterus* and *Totoaba macdonaldi*.

Rodríguez-Pérez et al. (2024) are wrong to state that we attributed the change in $\delta^{18}O$ values to higher temperatures. We showed that the change resulted from a decrease in Colorado River influx and the consequent increase in salinity in the delta region of the UGC.

$\delta^{18}O$ values in skeletal carbonates (both mollusk shell and fish otoliths) are sensitive to both the temperature and $\delta^{18}O$ of the surrounding water. Warmer water will reduce $\delta^{18}O$ values, as will a mix of Colorado River and Upper Gulf of California (UGC) marine water. Figure 2 in Dettman et al. (2004) documented the relationship between $\delta^{18}O$ of UGC water and salinity and compared $\delta^{18}O$ values in skeletal carbonates from before the cessation of Colorado River flow to $\delta^{18}O$ values in skeletal carbonates after the cessation of Colorado River flow to the UGC. As Dettman et al. (2004) further noted, the effect of the $\delta^{18}O$ of the water is far greater than the effect of temperature on the $\delta^{18}O$ of the skeletal carbonates. We corrected for the temperature effect on skeletal carbonate by comparing $\delta^{18}O$ values for the same season of the year.

Dettman et al. (2004) concluded: "Almost all our fossil samples are more negative in $\delta^{18}O$ than the no-flow bivalve record. This offset to more negative values is due to growth in less saline water in the delta region." A very similar conclusion on fish otoliths was reached in Rowell et al. (2005) and Rowell et al. (2008).

At no point did we suggest that the cessation of the Colorado River flow led to an increase (or decrease) of the temperature of the UGC. Our stable isotope data demonstrated that salinity changes are responsible for the large difference in UGC conditions before and after the limitation/cessation of Colorado River flow.

Rodríguez-Pérez et al. (2024) do not present any evidence that Colorado River water is colder than water of the UGC. In fact, the river's temperature near its mouth on August 4, 2024 was 32.2°C (Waterdata.usgs.gov, 2025), greater than the 31.3°C average August maximum of UGC water at San Felipe, Mexico (Seatemperature.org, 2025). A cessation of flow would most likely cause a summer decrease in UGC water temperature, not an increase.

Conclusion

We agree with Rodríguez-Pérez et al. (2024) on the importance of understanding the biological consequences of the cessation of Colorado River flow to Upper Gulf of California habitats. Stable isotope studies of animal remains are valuable for understanding environmental conditions encountered by animals in changing habitats. We hope that our comment adds to this understanding and improves the scientific rigor of research on this topic.

Author contributions

KF: Writing – original draft, Writing – review & editing. DD: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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