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LETTER OPEN ACCESS

Bivalve Farming Is Not a CO₂ Sink: From Myth to Legend, Where Is Science?

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We recently published a paper entitled “Cracking the Myth: Bivalve Farming Is Not a CO₂ Sink” [1], which challenges the growing narrative that bivalve aquaculture sequesters atmospheric CO₂. We demonstrated that, when considering the full biogeochemical picture, bivalve farming in fact contributes to CO₂ emissions. By clarifying these dynamics, our intention was to correct a misconception and prevent the misclassification of shellfish aquaculture as a carbon sink.

A response entitled “The Legend Continues: The Critical Evidence Showing That Bivalve Farming Is a Carbon Sink with a Novel Budget Framework” [2] was published in the same journal. In this letter, the authors rely on estimated air–sea CO₂ fluxes in a mussel aquaculture area, published in He et al. [3], and state “Our observations of air–sea CO₂ flux provide definitive evidence that mussel farming can be characterized as a weak carbon sink, although its effectiveness is constrained by seasonal variations.”

A careful examination of the data and methods presented in the article on which their response is founded reveals critical methodological and interpretative biases. He et al. [3] report that the bivalve farming area investigated is actually a strong source of CO₂ to the atmosphere in summer and fall (between 10 and 40 mmol CO₂ m⁻² d⁻¹) while being a very weak sink in spring (~−0.15 mmol CO₂ m⁻² d⁻¹). In addition to this significant misinterpretation of their data, the conclusion is fundamentally flawed for two key reasons.

First, it seems that the authors did not estimate air–sea CO₂ fluxes outside the aquaculture area. This omission makes it impossible to isolate the effect of aquaculture on the CO₂ dynamics. In fact, the few studies comparing CO₂ fluxes within and outside bivalve farms suggest that the surrounding environment—unaffected by farming activity—exhibits a stronger CO₂ sink than the aquaculture zones themselves [4, 5]. In their response letter, the authors present a schematic of the carbon budget both inside and outside the mussel farm that includes air–sea CO₂ fluxes, despite the absence of data for the external area [2]. Without such data, the external component of their framework is purely speculative. Although a Letter to the Editor can serve as a forum for proposing speculative ideas or hypotheses, it is essential that such speculation be clearly distinguished from evidence-based conclusions.

Second, although the manuscript does not state it explicitly, it appears that CO₂ fluxes were only estimated during daylight hours—and notably, no sample was taken in winter. Consequently, the dataset overrepresents periods of high photosynthetic activity, overestimating CO₂ uptake and/or underestimating CO₂ outgassing.

In conclusion, although the response letter of He et al. [2] represents an effort to integrate theoretical, observational, and experimental approaches, it suffers critical limitations. The interpretation that bivalve farming can be definitively characterized as a CO₂ sink is not supported by the cited paper. Assessing

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the impact of shellfish farms on air–sea CO₂ fluxes requires robust, year-round measurements. These must include well-chosen reference sites located outside the farming area, sufficient replication to ensure statistical reliability, and a sampling frequency capable of capturing diel, seasonal, and interannual variability. Equally important is a comprehensive evaluation of carbon stocks and fluxes across key ecosystem compartments, such as bivalves, phytoplankton, and sediments, as well as exchanges with adjacent systems.

Disclosure

The authors have nothing to report.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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