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Corrigendum

Corrigendum to "Bistability in a differential equation model of oyster reef height and sediment accumulation" [J. Theor. Biol. 289 (2011) 1–11]

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ABSTRACT

There was a mistake in the Matlab code we used to generate time series solutions of our model, Eqs. (16)-(18). The corrected text below replaces one paragraph on p. 7, and the figures below replace Figs. 4-5 on p. 8. There is no qualitative change to our results. However, there is a quantitative change in the initial dead oyster shell volume $B(0)$ needed for reef survival. The corrected threshold $B(0)$, about 0.40 m^3 per m^2 of sea floor, is more consistent with a recently experimentally estimated threshold of 0.30 m (Colden, Latour, and Lipcius, Mar Ecol Prog Ser 582: 1–13, 2017) than was our old incorrect threshold of about 0.12 m^3.

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We use numerical simulation to examine the bistable dynamics of (16)-(18) with parameters given in Table 3. We use the initial value of $O(0) = 0.01$ and $S(0) = 0.01$; i.e., there is a small amount of live oyster and also a small amount of sediment initially. We chose several different values of $B(0) : B(0) = 0.50, 0.30, 0.40$ and 0.39 (Fig. 4). For larger $B(0)$, the oyster population survives and reaches the large stable equilibrium (O_1, B_1, S_1), whereas the smaller $B(0)$ will drive the oyster population to local extinction. The critical level of initial reef height $B(0)$ is between 0.39 and 0.40. The transient dynamics with $B(0) = 0.40$ and $B(0) = 0.39$ when $0 \leqslant t \leqslant 20$ (Fig. 5) demonstrates that at the higher reef height, live oyster volume increases and eventually curbs sediment volume to a very small level due to oyster filtration and reef height. The slightly lower reef does not permit live oysters to filter the sediment sufficiently, and the sediment eventually covers both live and dead oysters. The specific reef heights(i.e., 0.39 and 0.40) that discriminate the two trajectories towards stability are likely to differ depending on natural variation in other parameters of the three equations, such that they should not be viewed as rigid values under all conditions. Rather, the key point is that a slight shift in initial conditions can drive the system towards two dramatically different trajectories.

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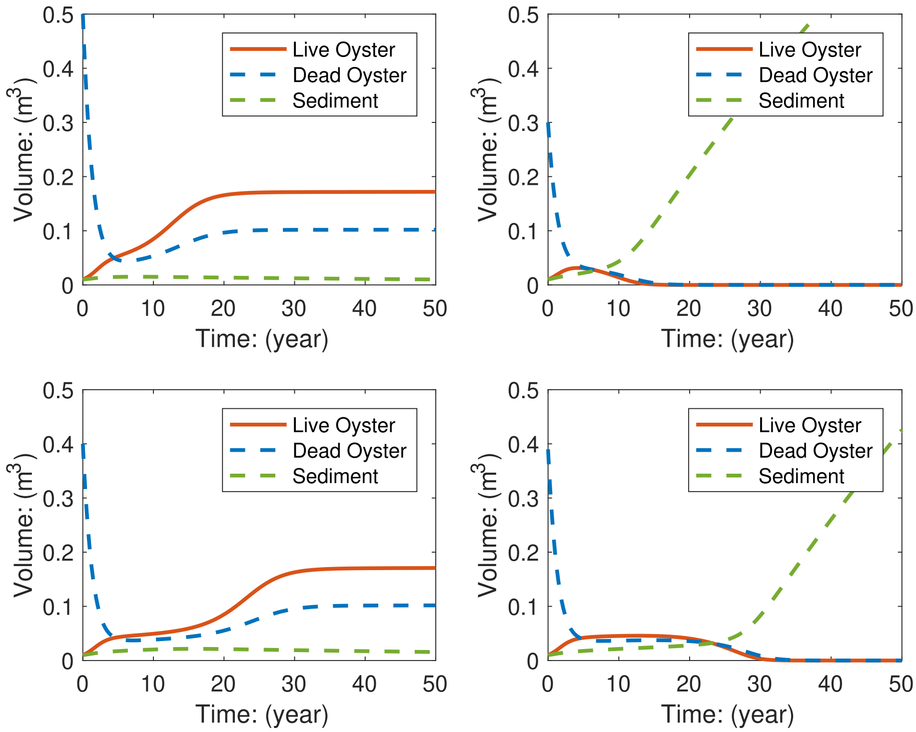

Fig. 4. Numerical solution ($0 \leqslant t \leqslant 50$) of (16)-(18) with parameters given in Table 3 for various initial reef heights. For all cases $O(0) = 0.01$ and $S(0) = 0.01$. (upper left) $B(0) = 0.50$; (upper right) $B(0) = 0.30$; (lower left) $B(0) = 0.40$; (lower right) $B(0) = 0.39$.

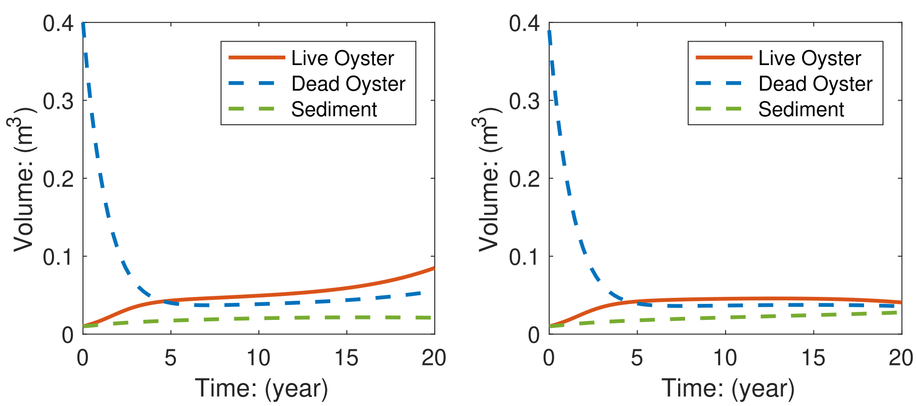

Fig. 5. Numerical solution ($0 \leqslant t \leqslant 20$) of (16)-(18) with parameters given in Table 3 for various initial reef heights. (left) Initial value $O(0) = 0.01, B(0) = 0.40$ and $S(0) = 0.01$; (right) Initial value $O(0) = 0.01, B(0) = 0.39$ and $S(0) = 0.01$.