

For scallops, oxygen limitation also suppresses energy acquisition and survival rather than acting only as a background water-quality variable. In northern bay scallops, hypoxia reduced algal clearance by 88%, and the combination of hypoxia with high temperature reduced clearance by 97%, showing that low oxygen can sharply constrain feeding performance (Tomasetti et al., 2023). Dynamic Energy Budget modeling in *Argopecten purpuratus* likewise showed that the negative effects of hypoxia on growth and reproduction were explained by decreased assimilation and reserve mobilization, while severe summer events were better explained when additional maintenance costs were imposed by sulfide-associated stress.

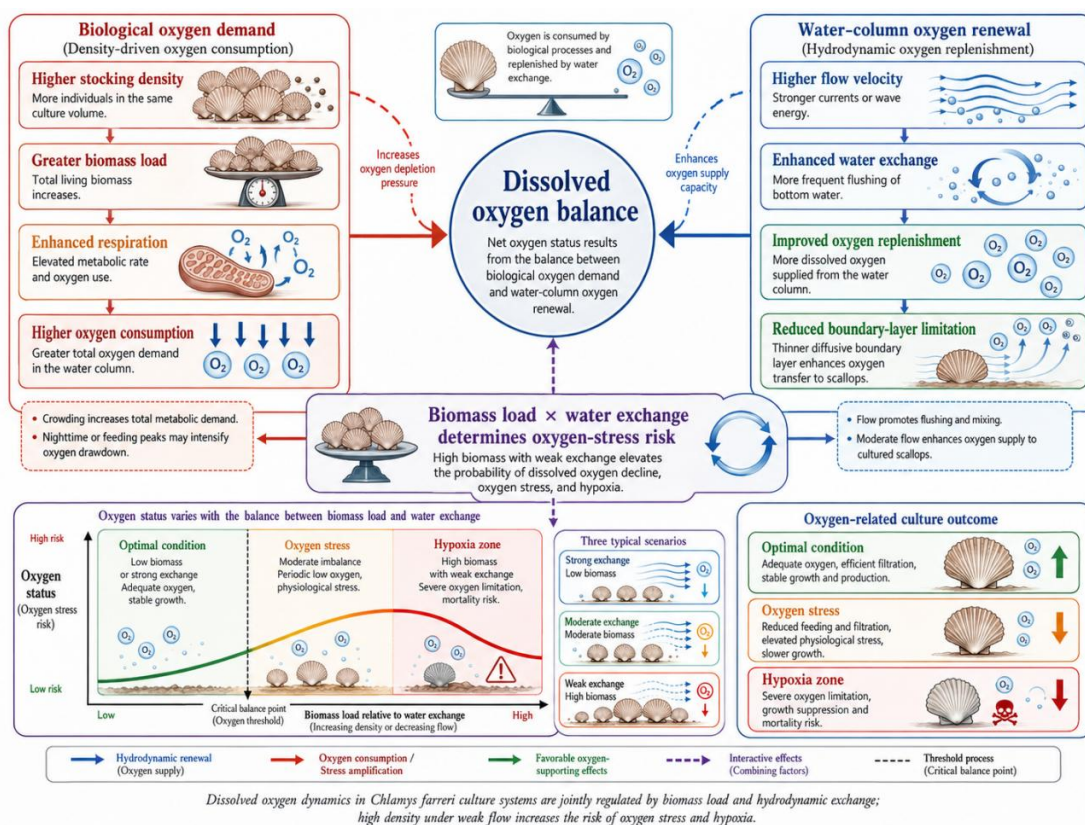


Figure 3 Conceptual model illustrating the coupled effects of stocking density and water exchange on dissolved oxygen dynamics in scallop aquaculture systems. Oxygen availability is determined by the balance between biological oxygen demand and hydrodynamic oxygen renewal

7.2 Changes in feed resource utilization efficiency

The effect of stocking density on feed resource utilization in *C. farreri* is mediated chiefly through seston depletion and density-dependent changes in filtration. A semi-in situ experiment in Sishili Bay showed that the presence of scallops strongly reduced seston and chlorophyll a in the water column, and increasing density in a limited water mass caused seston depletion that impaired scallop growth. The same study found that both filtration rate and biodeposition rate were negatively correlated with scallop density but positively related to seston concentration, indicating that crowding lowers the per-capita efficiency of resource capture as local food becomes depleted.

This density effect is nonlinear because feeding efficiency depends not only on food amount but also on hydrodynamics and seston structure. A depletion model for Sungo Bay predicted that at 50 ind·m⁻³, density could reduce scallop growth by anywhere from 0% to 100% when current velocity was below 20 cm/s, which shows that identical stocking levels can have very different nutritional consequences under different flow regimes (Bacher et al., 2003). At the physiological level, clearance rate in *C. farreri* follows a unimodal response to particle volume and chlorophyll concentration, peaking at about 7.1 l·h⁻¹·g⁻¹ when seston volume was 2.0 mm³/L and chlorophyll a was 5.3 µg/L before declining at higher concentrations, so excessive suspended load does not continuously improve food use.