

Research Insight

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Effects of Different Stocking Densities on the Growth Performance and Survival of Zhikong Scallop (*Chlamys farreri*)

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Abstract Stocking density is a key ecological and managerial factor influencing the performance and sustainability of bivalve aquaculture. This study investigated the effects of different stocking densities on the growth performance and survival rate of *Chlamys farreri* under controlled culture conditions. A gradient of stocking densities was established to evaluate variations in shell growth, body weight gain, specific growth rate, and survival dynamics. Results indicated that stocking density significantly affected both growth performance and survival outcomes. Moderate density treatments generally promoted optimal growth by balancing resource availability and metabolic demand, while excessively high densities led to reduced growth rates, likely due to intensified competition for food, decreased water exchange efficiency, and increased accumulation of metabolic wastes. Survival rates exhibited a declining trend with increasing density, with density-induced stress and susceptibility to disease identified as key contributing factors. Environmental parameters such as dissolved oxygen and particulate food availability further modulated density-dependent responses. A case-based comparison across different aquaculture systems highlighted the importance of adaptive density management strategies in improving production efficiency. Overall, the findings suggest that optimizing stocking density is essential for maximizing growth performance and ensuring high survival rates in *Chlamys farreri* aquaculture, providing practical implications for sustainable shellfish farming.

Keywords Stocking density; *Chlamys farreri*; Growth performance; Survival rate; Aquaculture management

1 Introduction

Zhikong scallop (*Chlamys farreri*) is an economically important cultured bivalve in northern China and a major contributor to regional shellfish aquaculture because of its high nutritional value and well-developed adductor muscle (Wang et al., 2023). The species is naturally distributed along the coasts of northern China, Korea, and Japan, and its commercial value has supported the expansion of suspended culture systems in multiple coastal regions. In scallop aquaculture, stocking density is a core husbandry factor because it directly shapes individual growth, survival, physiological condition, and final farm yield. Earlier work on *C. farreri* in Korea showed a clear negative correlation between stocking density and shell growth, while survival was highest at the lowest density treatment of 20 individuals per compartment. Similar density-dependent responses have been reported across other scallop species, where growth commonly declines as density increases, although survival does not always respond identically across species and production systems. For *C. farreri* specifically, the scientific problem is not simply whether density matters, but how density interacts with food supply, hydrodynamics, temperature, and seasonal physiology to alter growth performance and mortality risk. A depletion model from Sungo Bay showed that rearing density, food concentration, and water movement interact at the farm scale, and that a density of 50 ind m⁻³ could reduce growth from 0% to 100% when current velocity was low, indicating that density effects depend strongly on local carrying capacity. Semi-field experiments in Sishili Bay further demonstrated that increasing *C. farreri* density can deplete seston through intense filtration and biodeposition, thereby impairing scallop growth in a limited water column. Temperature adds another layer of complexity, because scallop growth and mortality are often amplified by warm conditions; in sea scallops, density effects were most pronounced during summer, and low-density nets performed better within favorable thermal windows. This framework is especially relevant for *C. farreri*, whose summer mortality episodes in China have long suggested that density-dependent stress operates together with reproductive load and environmental deterioration. Since 1996, mass summer mortalities have occurred in most