5 Survival Rate and Mortality Patterns under Different Systems

5.1 Disease incidence and mortality dynamics

Disease is a major source of mortality in sea bass culture, and outbreaks can cause rapid stock losses when pathogen exposure coincides with intensive farming conditions (Yue and Guo, 2025). In Chinese sea bass specifically, pond investigations in Zhuhai found clear contrasts between high- and low-mortality ponds, with the high-mortality pond showing significantly different bacterial community structure and function, indicating that mortality events are closely tied to the surrounding microbial environment (Deng et al., 2021). This pattern suggests that disease incidence in pond systems is not only a matter of host infection, but also of ecological imbalance in the culture water. As pond systems become more intensified, the probability that unfavorable microbial shifts will amplify mortality risk appears to increase.

Pathogen-specific studies show that mortality dynamics can be abrupt and severe in both pond and cage systems. In farmed L. *maculatus*, *Aeromonas veronii* caused acute death marked by hemorrhagic lesions, and experimental infection produced mortality within 24 h, reaching 100% at the highest challenge dose (Wang et al., 2022). In marine cage culture, a sudden disease outbreak with significant mortality was linked to coinfection by *Vibrio harveyi* and *Photobacterium damselae* subsp. *piscicida*, and dual infection produced faster and more pronounced mortality than single-pathogen challenge (Zhou et al., 2024). Together, these findings indicate that mortality under different farming systems depends not only on whether pathogens are present, but also on whether the system promotes pathogen proliferation, coinfection, and rapid transmission through dense fish populations.

5.2 Environmental stability and survival regulation

Environmental stability is a direct regulator of survival because fish mortality rises when water quality fluctuates beyond the range that the stock can physiologically tolerate. In earthen pond seabass culture, survival remained statistically similar across the tested densities when temperature, dissolved oxygen, pH, salinity, transparency, and ammonia stayed within suitable ranges, showing that stable water conditions can buffer survival even when density increases (Nhan et al., 2022). More broadly, seabass culture reviews identify site suitability, salinity maintenance, and water quality control as basic requirements for reducing mortality in both pond and cage farming. This means that system effects on survival are mediated less by the label of the system itself than by how consistently that system maintains acceptable culture conditions.

Recirculating and industrialized systems aim to improve survival precisely by stabilizing the rearing environment. Good water quality in RAS is described as crucial for successful growth and survival, and real-time monitoring is increasingly used to provide warnings of critical situations before they develop into mortality events (Lindholm-Lehto, 2023). Evidence from seabass culture also indicates that inconsistent water quality and traditional tank management can lead to contaminant accumulation, disease, stunted growth, and high mortality, whereas RAS-based white seabass culture achieved survival above 75% under maintained water quality conditions (Jais et al., 2024). These results support the view that environmental regulation is one of the main survival advantages of recirculating systems, although that advantage depends on reliable filtration, sensor performance, and timely management responses.

5.3 Stress-induced mortality mechanisms

Stress-induced mortality typically develops through chronic crowding, endocrine activation, oxidative damage, and immune suppression rather than through a single isolated event. High stocking density in cultured fish consistently elevates cortisol and other stress indicators, and in juvenile Chinese sturgeon reared in RAS it also suppressed growth and reduced immune and antioxidant capacity. Comparable evidence from grass carp shows that long-term overcrowding increases cortisol, decreases lysozyme, complement, and IgM, and drives an unbalanced inflammatory response, demonstrating a plausible mechanistic path from crowding stress to greater vulnerability and eventual mortality (Li et al., 2023). These mechanisms are highly relevant to Chinese sea bass because farming systems differ fundamentally in crowding intensity, water exchange, and the persistence of stress exposure.