

6.3 Optimization of feeding strategies and regulation of feeding behavior

Feeding strategy must adapt to the combined effects of temperature, water quality, and fish appetite to avoid over- or under-feeding during hot periods. Under experimentally imposed high-temperature stress in common carp, an intermittent strategy of feeding every third day produced higher weight gain, better specific growth rate, lower feed conversion ratio, and enhanced digestive enzyme activities compared with daily feeding, while also improving antioxidant status. Behavioral analysis in *Pangasius* culture cages likewise shows that optimal feeding rates depend on weather-driven changes in temperature, pH, and dissolved oxygen, with higher intake feasible on warm, sunny days but reduced rations recommended during cloudy or rainy conditions to avoid waste and water quality deterioration (Yashashvi et al., 2023).

Technological tools for monitoring and regulating feeding behavior can further refine summer feeding management. Reviews of intelligent feeding control highlight that traditional fixed schedules often fail to match dynamic appetite and can lead to excessive or insufficient feeding, whereas behavior-based automatic systems use models, acoustic sensing, or computer vision to determine real-time demand. A complementary line of work on automatic recognition of feeding behavior shows that many methods can quantify feeding intensity, but accuracy in complex environments still needs improvement, pointing to the potential of data fusion and deep learning for precise control under fluctuating summer conditions (Li et al., 2020).

7 Case Study: Practical Health Management of Large Yellow Croaker under High-Temperature Conditions

7.1 Typical high-temperature aquaculture regions and system setup

Large yellow croaker farming is concentrated in warm, shallow coastal waters of southeastern China, where cage culture has become the dominant production mode and main source of national mariculture output. Typical cage-culture districts in Fujian such as Jiaocheng, Shacheng and Xiapu show regional differences in growth performance, with Xiapu fish achieving the highest asymptotic size and weight, suggesting that local hydrology and thermal regimes strongly affect production efficiency (Chen et al., 2020).

Summer sea surface temperatures in these regions increasingly approach 30 °C, narrowing thermal safety margins and challenging traditional floating cage systems that are shallow and restrict behavioural thermoregulation (Figure 3). Review work on large yellow croaker aquaculture highlights that floating sea-cages remain the main farming model, but deep-sea cages and indoor recirculating systems are being promoted to better simulate natural habitats and buffer environmental extremes, providing alternative setups for high-temperature seasons (Thanhhoa et al., 2020).

7.2 Application effects of integrated management measures

Case comparisons between nearshore cages and a mobile offshore aquaculture ship demonstrate how integrated environmental management directly improves health outcomes during warm months. The ship system maintained water temperatures mostly within 21.5 °C-28.5 °C and dissolved oxygen of 7.2-12.8 mg/L, with low ammonia and relatively low bacterial and *Vibrio* counts, and achieved 99.02 % survival and markedly higher growth than cages. By contrast, nearshore cages experienced prolonged high temperature and chronically low dissolved oxygen, conditions linked to oxidative stress, impaired digestion and immunity, and higher mortality, underlining the value of mobile or deeper systems that can track optimal water masses (Yu et al., 2023).

Nutritional and stock-management measures complement environmental control in mitigating heat stress. Long-term high stocking density elevates cortisol, antioxidant and stress-related enzymes, while depressing immune parameters, and authors recommend controlling final density to 14.41-18.71 kg/m³ in intensive systems to preserve health and product quality (Yu et al., 2024). During summer heat, targeted functional feeds such as inulin or fulvic acid have significantly improved growth, survival and thermal resilience, partly by enhancing energy metabolism pathways and beneficial gut microbiota, indicating that nutrition can offset some high-temperature pressures when integrated with environmental and density management.