

The Effects of Salinity on the Growth and Survival of Marine Fish Larvae

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Abstract: A rapidly growing industry, aquaculture contributes significantly to the supply of high-quality animal protein in both industrialized and developing nations. With significant development potential, it has become one of the most promising industries globally. By the turn of the century, it is anticipated to account for around 25% of the world's total fisheries. The central nervous system, endocrinological, and neuroendocrine systems are among the "internal factors" that regulate fish's continual development and growth. They are also among the vertebrates that rely heavily on their surroundings. Among other things, the effects of water salinity on fish development and improvement have been the subject of various investigations. Saltiness is fundamental for most of species' egg treatment and brooding, yolk sac resorption, early embryogenesis, swim bladder development, and larval development. Saltiness has a significant impact on the distribution of species and the composition of aquatic animal communities. For example, even in species that can survive in a variety of salt levels, salinity can impact the development rates and metabolic expenses of both adults and juveniles. In addition to these physiological and metabolic impacts, salinity can have an impact on the advantages and disadvantages of parental behaviors. The impact of salinity on marine fish larvae's growth and survival are covered in this study.

Keywords: Marine Fish Larvae; Salinity; Growth; Survival.

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I. Introduction

The impact of salinity on marine fish larvae's growth and survival are produced by the majority of marine teleost (bony) fishes. Newly hatched larvae are frail, underdeveloped, and retain many embryonic traits. They are typically 1 to 5 mm long. Their eyes, fins, and mouth parts are typically immature when they hatch. In the sea, larvae float and spread out. Before entering the juvenile stage, the majority pass away. The larval stage starts off as a yolk-sac, which is a nonfeeding stage that consumes stored yolk. It then progresses to an actively feeding larva and, finally, changes into a juvenile that resembles a tiny adult in appearance. Transformation frequently includes major morphological changes (e.g., eels, struggles, herring) or might be less observable (e.g., cods, basses, ocean breams) inside a couple of days to over a year subsequent to incubating. Lengths at transformation are generally under 25 mm, however a few eels can go from a couple of millimeters to numerous centimeters. The different, some of the time odd, set-up of larval sorts that are assembled addresses a scope of variations that advance endurance and wellness in marine conditions from estuaries to the remote ocean. It is important for fish to grow and survive during their early life stages to fisheries scientists and management because variations in those processes can result in variances of at least ten times in the number of recruits that reach catchable size. Mortality causes are rarely assessed. Scientists have known since the early 1900s that turbulence, frontal systems, and ocean circulation may be important physical factors influencing larval survival. Major regulators of survival and growth are also biological factors, particularly those related to larval nutrition and predation. The success of the reproductive attempt, which fisheries experts refer to as "recruitment," is determined by a combination of biological and physical factors. In figure 1 displays the Anatomic Feature of Fish Larvae below.

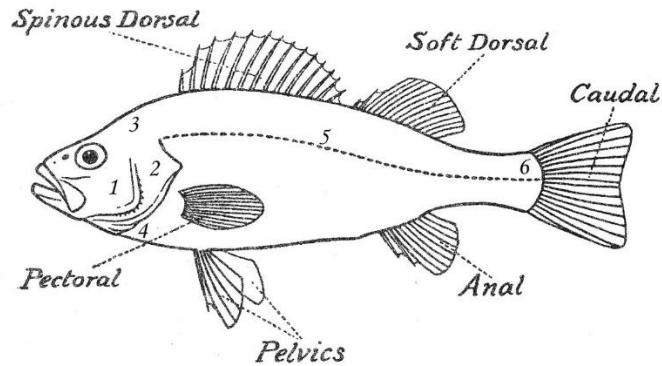


Figure 1: Anatomic Feature of Fish Larvae

Recruitment procedures affect both the early (eggs) and later (juveniles) phases and are not limited to the larval stage. Although the larval stage is significant, it is not a crucial stage in and of itself, and its proportional significance in determining the success of recruitment can change from year to year and season to season. The hatchlings of marine fishes, known as ichthyoplankton, are every now and again pelagic, drifting in the sea and connecting with pelagic hunters as well as planktonic prey. In any event, for species that form into herbivores as adolescents or grown-ups, most fish hatchlings are rapacious during the larval stage, eating minuscule planktonic creatures. Thus, bigger nektonic and planktonic animals feed on larval fishes. Ontogeny and development empower escape from the shaky larval stage. During planktonic life, the constant dangers of starvation and predation mean that only a small percentage of the thousands of freshly formed larvae survive. Marine fish eggs and larvae are gathered using specially made traps or fine-mesh plankton nets. Surveys are used to estimate the ranges, numbers, variety, and design of "ichthyoplankton" networks, including the communications among hatchlings and their hunters and prey conducted at sea. In fisheries management, these surveys are occasionally a part of stock assessments.

II. Life Cycle of Fish

It's possible that the larval stage has the biggest influence on the amount of subsequent recruitment. The "critical period" concept, which was put forth in the early 1900s, suggested that the incidence of famine during the period of yolk-sac fatigue, when hatchlings at first required microscopic fish as food, was the essential calculate impacting variety year-class enlistment achievement (Miller, 2023). The likelihood of craving and transportation to unsatisfactory nursery settings are the two components. Hjort's idea filled in as the establishment for later endeavors to make sense of varieties in enlistment. The chance of critical and unusual mortality during the larval period drove numerous researchers to speculate that coarse requirements on the volume of enlistment are set during the larval stage as opposed to further down the road. Cushing's "match-jumble" idea, which expands on Hjort's hypotheses, accentuates the significance of fleeting occurrence in the elements of microscopic fish spawning and bloom, which is the primary food source for fish larvae (Houde, 2008). This theory is supported, particularly for species that have brief spawning seasons in high-latitude waters. Larval growth and survival are guaranteed when spawning and spring plankton blooms "match," whereas substantial mortality occurs when they "mismatch." Another theory that links variation in larval survival to feeding is the "stable ocean" hypothesis. It explains how strong upwelling and storm wind relaxation produced a stable, vertically stratified ocean where fish larval and prey strata overlap, enhancing larval survival and nutrition (Houde et al., 2009). For species that live in coastal upwelling regimes, the theory is well supported. The proposal leverages circulation patterns in coastal waters that are well-mixed to identify spawning areas while preserving eggs and larvae, which is in contrast to the match-mismatch theory. According to this theory, the controller of recruitment variability is not nutritional factors but rather physics and circulation characteristics shows in figure 2.

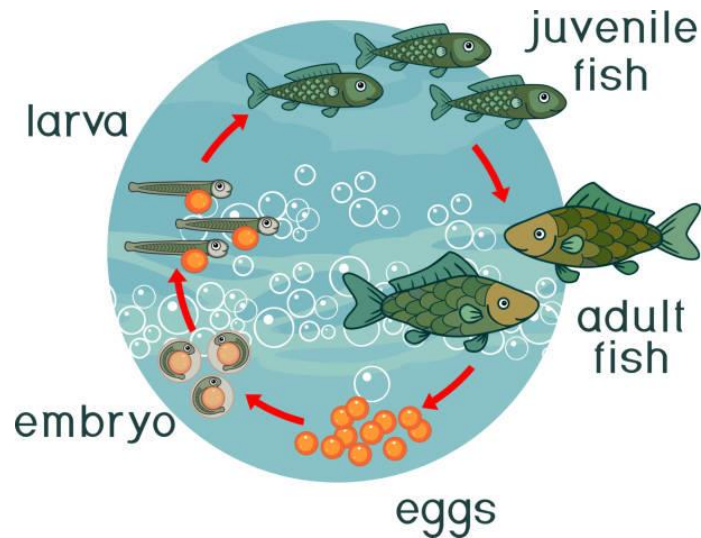


Figure 2: Sequence of Stages of Development of Fish from Egg Roe to Adult Fish

Fish larvae need to eat often in order to grow quickly, which is necessary for high survival. The availability of appropriate types and sizes of prey, which are typically zooplankton that are 50–100 μm in width, is necessary for the successful start of feeding. There is a high correlation between larval size (more specifically, mouth size) and the size of the prey that is devoured (Primo, 2021). Perhaps the most frequent food source for tiny fish larvae is copepod nauplii. Among the tiniest vertebrates on Earth, marine fish larvae grow incredibly fast and progress through a wide range of life stages, each with physiological and behavioral repercussions. They begin as drifting zooplankton and eventually evolve into actively swimming nekton. As larvae quickly progress through ontogenetic phases with drastically differing swimming and visual capacities, optimal foraging methods are similarly expected to shift during the early stages of life. In terms of choosing their prey, larval fish must make clear trade-offs that are theoretically applicable to different communities and trophic relationships (Leis et al., 2021). Comparatively large (small) prey items, for instance, give more (less) energy gain per prey item for a given size predator, but they are met less (more) frequently and are more difficult (relatively simple) to capture. Given these trade-offs, predators should only choose larger prey items at high prey concentrations and feed more haphazardly during low prey concentrations. This is primarily due to the frequency of encounter events with various prey sizes and types.

III. Effects of Salinity on Marine Fish Larvae

One of the most significant variables influencing fish development and survival at various phases of life is salinity. Numerous marine fish congregate close to estuaries to spawn, allowing the eggs and early larval stages to develop in low-salinity water (Holliday, 1969). Before migrating to the sea, some fishes, such as *Salmosalar L.*, grow their larvae in freshwater environments and travel to freshwater waters to spawn. Salinity can have a direct impact on fish survival or an indirect one by influencing the quantity of plankton, which is the primary food source for early larval stages. Fielder et al., (2005) that fish growth is impacted by salinity It was discovered that the strength of year-classes and salinity are positively correlated. concluded that wind was linked to the rise in salinity, which supports this conclusion. Salinity and year-class strength did not, however, appear to be significantly correlated. Later argued that other elements, like as temperature and plankton, have an impact on the strength of year-classes. Numerous researchers have examined how salinity affects freshwater fish as well as anadromous and catadromous fish. The size, age, and species of fish all affect their capacity to osmoregulate and survive in varying salinities. Controlling fluctuations in salinity is one of the most crucial aspects of aquaculture when the temperature is appropriate. Accordingly, fish in their early phases of development are frequently extremely vulnerable to the effects of salt stress. Because it influences the amount of energy required for osmoregulation, salinity has an impact

on the physiology of eggs and larvae, which directly impacts their growth and survival. Salinity also affects the growth and hatching of fish eggs (Pistevos et al., 2017).

The limitations on year-class abundance development and reproductive success are primarily imposed during the undeveloped and larval stages, despite the fact that marine fish are floating in the tiny fish. A lot of the variety in endurance to enrollment might happen during the over 35 days that marine fish hatchling ordinarily last. Control might be for the most part thickness free during these stages, notwithstanding hypothetical and displaying studies proposing that thickness reliance, even at low levels, could be a strong controller of early-life elements. Better limitations are set up during the adolescent stage, when there might be a shift towards thickness reliance. Year-class size and enrollment level can be set during both the larval and adolescent stages. Significantly, the impacts of poor larval endurance are seldom relieved by high adolescent endurance. High larval stage endurance doesn't ensure enlistment achievement, nonetheless, as year classes might fizzle at the adolescent stage. The moment, hard to-quantify changes in development or death rates over weeks or months are usually what determine recruiting success rather than episodic events that result in high mortalities. There are many eggs and larvae at first, furthermore, their development and death rates are high and inconsistent. Indeed, even slight changes in those rates ensure notable differences in cohort survival if they are not counterbalanced during the juvenile stage. It appears that marine fish larvae rely heavily on size to survive. Compared to their freshwater counterparts, marine fish larvae are frequently smaller. Compared to freshwater larvae, they typically have hatch weights that are nearly ten times lower.

IV. Conclusion

This study emphasizes how crucial salinity is to marine fish larvae's development and survival. The results show that maintaining optimal salinity ranges is crucial in aquaculture environments because they can altogether influence the development and endurance of marine fish hatchlings. Marine fish hatchlings are exceptionally delicate to changes in saltiness, which can altogether affect their development and endurance. This study takes a gander at what saltiness means for the development and endurance of marine fish hatchlings. We followed the turn of events and endurance of the marine fish species' hatchlings over a 30-day period. *Sparus aurata* subjected to varying salinity levels (20, 25, 30, 35, and 40 ppt). Our findings demonstrate that salinity has a major impact on marine fish larvae's development and survival. Compared to larvae raised at lower (20 ppt) or higher (40 ppt) salt levels, those raised at salinity levels of 25–35 ppt exhibited greater growth and survival rates. It was discovered that the ideal salinity range for *S. aurata* larvae growth and survival was between 30 and 35 ppt. Our research has implications for the culture of marine fish species in aquaculture and emphasizes the significance of salinity in the marine fish's early life stages.

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