



# Symbiotic Sentinels: Exploring Lumpfish–Salmon Interactions in Modern Aquaculture

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## ABSTRACT

**C**yclopterus genus belongs to the family Cyclopteridae, its common name is Lumpsuckers or lumpfish. Its only species belong to this family is *Cyclopterus lumpus*.

In previous years Lumpfish are considered as source of roe which is processed and used as a substitute to cavier. But nowadays lumpfish is used to control sea lice in farming industries. In salmon farming, sea lice pose a significant challenge causing a high mortality rate and limiting growth. This parasite results in physical as well as biochemical damage and leads to losses in production and treatment costs. Infestation by the sea lice *Lepeophtheirus salmonis* and to lesser extent *Caligus elongatus* are major challenges in sea cage- based aquaculture of salmonids. In this, we will study about the role of lumpfish and its relationship with salmon farming.

**Keywords:** Lumpfish, Salmon farming, Sea lice.

## Introduction:

Cyclopterus genus belongs to the family Cyclopteridae, its common name is Lumpsuckers or lumpfish. Its only species belong to this family is *Cyclopterus lumpus*. Its habitat is benthopelagic and mainly oceanodromus fish lives at a depth range of 0-868m, usually it is more common at a depth of 50-150m. It is found in North Atlantic and adjacent parts of the Artic Ocean, ranged from Chesapeakebay (rarely) on the North American coast and Spain on the European coast. In Western Atlantic species are distributed in Nunavut, Hudson Bay to James Bay and Labrador in Canada to New Jersey in USA; rarely to Chesapeake Bay in USA and Bermuda also in Eastern Atlantic regions of Barents Sea, Iceland. It has 5 to 9 dorsal



spines, 9 to 11 dorsal rays, 9 to 10 anal soft rays and 28 to 29 of vertebrae. The first dorsal fin is covered by thick layer of skin looks like a high crest with embedded spines. Presence of Bony tubercles and it is arranged in 3 widely separated rows of large flattened tubercles on each side of body. The pelvic fin is modified as ventral sucking disc. It is basically a solitary fish and exhibit a homing instinct. Adult of this group normally inhabit in rocky bottoms and also occur in floating seaweeds. Juveniles are found among algal clumps in bays and fjords moving offshore as they mature. The ventral side of males become reddish in colour and females turn blue-green during spawning season. This lumpfish species has been designated “Near Threatened” by the International Union for the Conservation of Nature and Natural Resources (IUCN). Lumpfish have various uses such as egg is more valued and which make it as an expensive caviar and whole fish is eaten in Nordic countries, marketed fresh or smoked and also used as cleaner fish in salmon farming.

In salmon farming, sea lice pose a significant challenge causing a high mortality rate and limiting growth. This parasite results in physical as well as biochemical damage and leads to losses in production and treatment costs. Sea lice infection typically causes up to a 16% reduction in production biomass, leading to an approximately 9% loss in farm revenues for the Norwegian salmon industry. Various innovative solutions have been developed to tackle this problem. At this time the use of Lumpfish (*Cyclopterus lumpus*) as a cleaner fish was considered the most effective, safe, and environmentally friendly solution. Recent research confirms that Lumpfish may be a good source of B12 and D3 vitamins, while environmental pollutants and heavy metals are below the EU maximum levels, making it safe for human consumption. This study focusses on the role and impact of lumpfish used in salmon farming.

### **Parasites in Salmon Farming:**

Parasites that affect salmon farming include sea lice, *Spironucleus salmonicida* and Anisakis. Sea lice (*Lepeophtheirus salmonis*), a parasite that attaches to the skin of salmon and affects mostly appetite and growth, but can lead to severe wounds and death if left unchecked (A.K. Imsland et al, 2014). Sea lice are associated with higher private costs of production and also threat to wild salmon stocks. Losses to farmers include not only lower salmon biomass to sell (due to less growth) but also lower prices because larger salmon sell for higher price per kilo.

Sea lice develop resistance to chemotherapeutants over time, creating the need for more powerful chemicals and potentially more polluting effluent into the environment surrounding



fish farms. This likely contributed to the decline of the chemical bath treatment frequency since 2016.

### **Treatments for controlling Sea lice:**

Common treatment measures include removal of sea lice mechanically like use of lasers, brushing or spraying with fresh or warm water, bathing the salmon in chemicals (e.g. Hydrogen peroxide), adding medicinal components to feed that prevent the sea lice attaching to the fish and releasing cleaner fish in the net cage shows treatment frequencies for these options from 2012 to 2018. The efficacy and cost-effectiveness of these treatments depend on dosage (for chemicals and feed), treatment duration, sea temperature, stage within the cycle, sea lice density, fish size and distance from other farms. A disadvantage of palliative treatments is that they lead to increased fish stress, injury, and wounds resulting in reduced growth and increased mortality. Currently, the main species used for cleaning parasites in salmon aquaculture are corkwing *Symphodus melops*, Goldspiny *Ctenolabrus rupestris*, ballan *Labrus bergylta* and rock cook *Centrolabrus exoletus* wrasses and lumpfish *Cyclopterus lumpus*.

### **Lumpfish vs Sea Wrasses:**

Labrid fishes (ballan wrasse, *Labrus bergylta*, and goldsinny wrasse, *Ctenolabrus rupestris*) are most widely used as cleaner fish to delouse farmed Atlantic Salmon in sea net pens. Commercial production of wrasse, particularly of ballan wrasse, has developed based on delousing efficiency, sustainability, disease management and welfare. Wrasse exhibit winter dormancy and can't feed below 6°C, limits their use as cleaner fish over winter. Even at 4°C, lumpfish continue feeding and can be ready for use in salmon farms 4 months, much sooner than ballan wrasse which typically require 1.5 years. Currently, all lumpfish used as cleaner fish by the salmon farming industry.

### **Role of Lump fish in Salmon farming:**

In previous years Lumpfish are considered as source of roe which is processed and used as a substitute to cavier. In early 20<sup>th</sup> century lumpfish get some economic value. Lumpfish was for the first time introduced as a cleaner fish in the Faroese salmon farming industry in late 2014 (K. Eliassen et al,2018). Nowadays lumpfish is used to control sea lice in salmon farming industries. Lumpfish thrive in cold waters which is used as cleaner fish in salmon farming done in winter season. The egg of the species is brought to hatchery and grown for 6 to 8 months



and initially the hatched fishes are weaned with natural feed and then artificial diet is provided, then they are stocked in farmed cages.

### **Lumpfish Grazing and its Efficacy:**

There are many experimental trials provide some results on efficacy of using lumpfish for biological control of parasite in farmed salmon fishes (Adam Powell et.al,2017). Cleaner fish reduce the impact of lice infestations on salmon growth and also limit the spread of parasites and protect wild fish stocks. Using cleaner fish reduces the need for other treatments, also decreases fish stress and effluents mixed in water from chemical treatments. The use of this fish has no impact on human health but act as a vector for diseases to other fishes. Empirical research revealed that cleaner fish reduce the level of sea lice but they grow larger it become less effective. *L. salmonis* was found in 13.5% of these stomachs, and of the 13.5%, around 80% also had *C. elongatus* in their stomach. Lumpfish seem to favour zooplankton as prey when it is available. The efficacy of lumpfish is judged by evaluating the gut content and farming data indicate effective lice grazing of lumpfish when stocked (Albert Kjartan Dagbjartarson Imsland and Patrick Reynolds,2022).



Gut content of stocked lumpfish from Scotland

### **Sea lice Grazing and Lumpfish size:**

Imsland et al. investigated the possible size effect of sea lice grazing efficiency in lumpfish. The result shows that the small lumpfish of initial size approximately 20g have a higher preference for natural feed compared to larger fishes. When small size lumpfish (initial weight 54g) is reared with Atlantic salmon significantly lowers the sea lice infection level but also there is an indication of sea lice grazing was reported when large size lump fish (initial weight



360g) is reared. But in general trend there was a decrease in sea lice grazing as the lump fish grew and varies between the families which is based on genetic composition of lumpfish population.

### **Lump fish in Salmon Farming: Problems**

Compared with salmon, lumpfish have a lower cortisol response and metabolic rate, are solitary, have a weaker swimming ability and a reactive response to threat; they also prefer colder and deeper waters, are much less domesticated, live longer, feed lower in food web (GARCIA de LEANIZ et al.2021). At the time of molts introduced into the cages, lumpfish populations are stocked and be maintained with the salmon throughout their marine culture. Lumpfish showed signs of sexual maturation at 450 g and exhibited weak lice grazing efficacy after reaching sexual maturation. Fungal infection is a common disease of adult lumpfish in captivity and can be a major cause of mortality. Parasitic worms have been recorded in over 60% of lumpfish in some Polish populations, including the cestode *Eubothrium crassum*, the nematodes *Contracaecum osculatum*, *Dichelyne minutus* and *Hysterothylacium aduncum*, and the acanthocephalans *Corynosoma strumosum*. The efficacy of sealice grazing is decreased when large size fishes are stocked (Adam Powell et.al,2017). Lumpfish are fed adequately, particularly important in sea cages, as the species is at risk of malnutrition.

### **Practices to Increase Lumpfish Efficacy:**

GARCIA de LEANIZ et al. 2021, suggest the best practices to increase the efficacy of Lumpfish in Salmon Farming are,

1. Weaning the fish to live feed condition before sea pen transfer.
2. To put lumpfish out in sea cages in the autumn and this with a reduced period in the sea (up to 6–7 months).
3. Small lumpfish have the highest appetite for lice.
4. Adaptation to salmon reduces stress at sea cage stocking, which helps to improve the welfare of lumpfish.
5. To feed the lumpfish separately with a special form of feed when they are in salmon cages.
6. The use of lumpfish in low water current areas which increase the swimming speed and efficacy of fish.



### **Welfare and deployment of lumpfish:**

The welfare and deployment in lumpfish need to be better quantified and information on stocking densities during culture, optimal tank design and rearing conditions were needed. In the wild the colour of lumpfish is resemblance to the seaweed colour, so the light intensity, photoperiod and tank colour may also affect the growth of juvenile fishes. Screen-out lumpfish with deformed suckers at the earliest opportunity, keep densities within optimal values for the species, typically <math><60\text{kg/m}^3</math>, reduce potential disturbance and handling as much as possible, provide shelters and cover in tanks, check water quality regularly, Grade frequently, as adequate for the size and condition of the fish, vaccinate against infectious diseases are the practical ways of improving the welfare of lumpfish (Albert Kjartan Dagbjartarson Imsland and Patrick Reynolds,2022).

### **Conclusion:**

The ultimate aim in developing Lumpfish industry which produce disease free salmon fishes reared in sea pens and cages. It is an emerging sector that use of fishes to delousing in salmon farming and also maintains the health of the reared salmon and the cleaner fish. Commercial production of lumpfish is based on the ability for preying on sea-lice and also consider there is no disease transfer occurs between Lumpfish and farmed salmon. In recent years, lumpfish markets are evolved and large number of frozen and filleted form of fish are exported to China. There may be some opportunities for reuse of lumpfish as broodstock for the selection of particular strains in captive breeding programmes, as well as the harvesting of lumpfish for use in animal feeds and perhaps also for human consumption. We conclude that lumpfish is used as a cleaner fish and also now its emerging as a food in Asian fish markets.

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