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Abundance of Sea Louse (*Lepeophtheirus salmonis*) in Marine Salmon

Tayyaba Rani[1]*, Rana Danish Ali[2], Sarwat Mehmood[1], Nadia Nazish[1] and Nazia Ibrahim[1]

1. Department of Zoology, University of Sialkot, Sialkot 51310, Pakistan
2. Department of Chemistry, University of Narowal, Narowal 51600, Pakistan

*Corresponding Author: **tayyabanazim45@gmail.com**

ABSTRACT

Lepeophtheirus salmonis known as the salmon louse, is an ectoparasitic copepod from the Caligidae family, raising concerns due to its impact on wild juvenile Pacific salmon, particularly from salmon farming. Its life cycle includes both free-swimming and attached stages, with nauplius and infective copepod stages drifting in plankton before attaching to a host salmon and causing multiples diseases like skin lesions, ulceration, retarded growth and chronic infection leads to loss of fin. Growth is mainly influenced by temperature and salinity. This parasite significantly impacts the aquaculture industry, a great loss of economy in aquaculture per year globally. Some strategies are made to minimize economic losses all over the world.

Keywords: *Lepeophtheirus salmonis* (sea louse), Life cycle, Marine salmon

Introduction

Lepeophtheirus salmonis (salmon louse) is an ectoparasitic copepod from the Caligidae family infecting salmonids in the Northern Hemisphere [1]. These parasites have a life cycle with free-swimming nauplius and infective copepod stages. After finding a host, they molt through four chalimus stages [1]. The study aimed to create an in vitro culture and explain the generalized overview of developmental stages and control of *Lepeophtheirus salmonis*. Researchers developed a skin epithelial cell line from Atlantic salmon and introduced sterilized chalimus stages to facilitate attachment [2]. Adult female lice feed on blood, mucus, and skin, while males and juveniles feed primarily on mucus and skin. The lice secrete enzymes to aid in feeding, digestion, and altering the host's immune response. *L. salmonis* (sea lice) affects the immune and physiological systems of Atlantic salmon. Decades of research have revealed detailed insights into host resistance and parasite adaptation. Infected salmon experience impaired immune response and wound healing over time and in specific areas [3]. Juvenile *L. salmonis* parasites on Atlantic salmon caused pathological changes at attachment sites, including mechanical disruption and epidermal hyperplasia. Filament material spread laterally in the epidermis with minimal reaction. Chalimus activity led to chronic skin changes, with more severe effects in later stages. Redundant filaments caused fibroplasia and small nodular lesions, leaving melanized rings at old chalimus sites [4]. Intensive host farming can increase parasite abundance and alter selection pressures, potentially leading to increased virulence. A study on Atlantic salmon smolts infected with *L. salmonis* from wild or farmed hosts found that lice from farmed fish caused more skin damage and reduced weight gain more than lice from wild hosts [5-7]. There is a need for more evolutionary research on farmed animals, as intensive food production practices may act as a global experiment in parasite evolution. *Lepeophtheirus salmonis* significantly impacts the aquaculture industry, with economic losses exceeding 500 million USD in Norway and likely over 1 billion USD globally [8].

Abundance

Sea lice from salmon farming focus on their potential harm to wild juvenile Pacific salmon. It indicates infection of pink salmon in British Columbia's Broughton region in 2001 and a subsequent decline in spawning numbers in 2002 heightened these concerns [9]. While European research on sea lice primarily covers Atlantic salmon and sea-run brown trout, there are worries that it may not fully reflect the impacts on Pacific salmon. Nearly all sea lice on returning Chinook (99%) and over 80% on coho salmon were *L. salmonis*, mostly in motile stages with many ovigerous females. From May to July 2006, sea lice abundance increased on juvenile pink salmon smolts near adult capture sites [10]. Returning adult salmon are likely the primary natural reservoir for *L. salmonis* on the north coast.

Life cycle of *Lepeophtheirus salmonis*:

Salmon lice (*Lepeophtheirus salmonis*) are external parasites of salmonids about 10mm length in the North Atlantic and North Pacific [11]. Their life cycle includes free swimming nauplius stages and an infective copepod stage which float in the plankton surviving on internal lipid stores. After finding a host molts the copepodid through four chalimus stages. Its life cycle includes multiple free-swimming and attached stages.

Factors effects the *Lepeophtheirus salmonis*

1.Temperature

Average water temperatures ranged from 6.9 to 16.7°C at the surface, 6.9 to 10.5°C at 6m, and 6.8 to 8.9 °C at 18m [13]. Temperature significantly impacts sea lice development, with higher temperatures speeding up egg string production and embryonic development.

L. salmonis has a generation time of 4 weeks at 18°C and 8-9 weeks at 6°C. Preadult males mature faster than females and sea lice are larger and more fecund in colder water, although moulting success decreases at 2°C [14]. The infectivity of *L. salmonis* persists over winter in farmed salmon.

2.Salinity

The salmon louse, a stenohaline copepod, thrives in high salinity environments. While adult lice can endure freshwater for a few days, optimal survival and development occur in seawater with salinity above 23‰ [14]. Viable copepodids need at least 30‰ salinity. Eggs do not develop at 10‰, and nauplii fail to hatch at 15‰. Copepodids survive over one day at salinities above 10‰. Lower salinity levels are associated with reduced survival and poor infectivity of the lice.

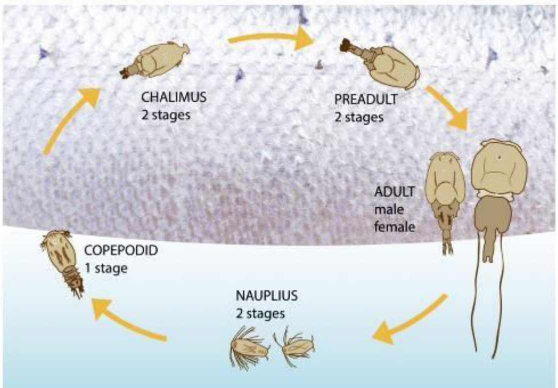

Fig. 2: Life cycle of the salmon louse *(Lepeophtheirus salmonis)* [12].

Clinical Signs

Heavily sea lice-infected fish show grey patches, hemorrhages and erosions, particularly around the head, dorsal area and perianal region with possible shallow ulcers on their flanks. Severe cases, especially with *Lepeophtheirus salmonis* can cause large ulcers exposing muscle more frequently seen in Europe than in the Pacific Northwest. Wild salmon in British Columbia have shown similar lesions [15]. *L. salmonis* cause skin lesions but do not penetrate the dermis. Severe infections can significantly damage pink salmon fins, potentially leading to complete fin loss.

Diagnosis

Diagnosing sea lice infections in Pacific Northwest salmonids involves microscopic examination of copepodid and chalimus stages. Caligus clemensi is identified by lunules, while *Lepeophtheirus salmonis* and *L. cuneifer* are distinguished by their third leg and genital structures. Identifying early developmental stages is challenging, and *L. cuneifer* early stages are not yet described [15]. Lice were considered alive if limb or stomach movements were visible under a stereomicroscope [16].

Treatments

Sea lice were treated using two main methods, oral treatments and chemical bathing to infected salmon:

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1. Oral treatments add drugs like Emamectin benzoate and Teflubenzuron to feed pellets [14].
2. Chemical bathing involves using compounds such as Deltamethrin, Azamethiphos, and hydrogen peroxide in an enclosed system, where fish nets are lifted and enclosed to apply the chemicals directly or through a leaky pipe.

Controls of *Lepeophtheirus salmonis*

To control sea lice in salmon farms, strategies include biological predators, vaccines, immunostimulants, drugs and good management practices [7]. Freshwater baths are ineffective, and selective breeding for resistant strains is challenging. Antiparasitic drugs, such as organophosphates, pyrethroids and macrocyclic lactones are the most effective methods. Bath treatments ensure uniform drug exposure but are labor-intensive and can lead to reinfection. In-feed treatments are less stressful for fish and safer for farmers but may result in uneven dosing [17].

Conclusion

Lepeophtheirus salmonis commonly known (sea louse) flush a significant threat to the marine salmon health and it's a great economic loss in aquaculture globally. Understanding about the general overview of this parasite and its developmental stages how get attached with marine salmon and affected them with their poison secretions and damages salmon economic value annually,then their clinical signs, diagnosis and treatment provides to the infected salmon. Salmon aquaculture itself is a significant economic activity, valued at approximately USD$20 billion annually. There are regulations in place, such as the maximum average of 0.5 female lice per salmon, which can influence farming practices and costs, leading to early harvests and causes great economy loss all over the world. So, Effective Sea louse control strategies must include physical, biological and chemical controls

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