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# Drug Resistance of Sea Lice Caligus rogercresseyi in Chile

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**Abstract**

The sustained increase in salmonids production has leaded to the proliferation of caligidosis caused by the sea lice Caligus rogercresseyi. In order to reduce the effects of this ectoparasite, a series of products and methodologies has been tested. Emamectin benzoate, Azamethiphos and pyrethroids (Deltamethrin and Cypermethrin) immersion baths have been tested, unfortunately all of them caused resistance of the sea lice consequently resistance towards these drug treatments is rapidly growing in most salmon farming facilities in Chile. An alternative method controlling the caligidosis, the synchronization of treatments between neighboring farms, has been introduced.

## Introduction

Aquaculture has become an important component of Chilean economy, mainly in the southern regions, where salmon farming is an active industry. Increase in salmonids production volumes, associated to high cultivation densities and close proximity between centers, has facilitated the development and expansion of caligidosis in the geographical areas where this activity takes place, contributing to both elevate the parasitic load and promoting the spread and prevalence of this epidemic [1,2]. Caligidosis in Chile, is caused by Caligus rogercresseyi [3], a native parasite of the rock cod (Cuvier) Eleginops maclovinus [4]. The life cycle of C. rogercresseyi includes eight developmental stages: two planktonic nauplii, an infective copepodite, four attached Chalimus stages and an adult stage, without pre-adult stages. Free living nauplii larvae are released from the paired egg strings attached to the adult female [5]. The literature suggests the parasite was transmitted from the native species to rainbow trout (Oncorhynchus mykiss W.) and Atlantic salmon (Salmo salar L.), because they are more susceptible to infection. However, in the last years, some juvenile stages of this parasite have also been found infecting smolts of Coho salmon (Oncorhynchus kisutch W.) after they have been transferred from freshwater [6].

In order to either, mitigate or eliminate the effects of this ectoparasite, a series of products and methodologies has been tested, including the use of disinfectants, antiparasitics, drugs, vaccines, natural products, predators, biocontrol fish, thermal baths, fresh water, ultrasound, electricity, optical laser, fences or skirts, baits, traps, etc. [7]. The literature indicates in Chile, between 2000 and 2007, the only treatment against C. rogercresseyi was the emamectin benzoate, which lost effectiveness after being used during that period (resistance); consequently, it was replaced by organophosphates applied by bath [8], followed by oral treatments [2,9]. Currently, the synthetic pyrethroids: deltamethrin and cypermethrin, are the most commonly used bath products for controlling C. Rogercresseyi which are administered topically through immersion treatments. However all these chemicals fail in controlling the infection, because immersion treatments do not produce a long lasting effect; so the anti-parasitic treatment inefficacy may be due: to low sensitivity of sea lice to drugs, inadequate drug administration procedures, and/or re-infestation from external sources of sea lice, such as infected neighboring farms [10].

Sea lice re-infestation from external sources can reduce the effectiveness of treatment by rapidly increasing the lice levels immediately post-treatment. Consequently resistance towards available drug treatments is rapidly growing in most salmon farming facilities in Chile; resistance mechanism include over expression of P-gps, CYPs, GST, carboxyl esterases, changes in glutamate- and histidine-gated ion channels and over expression of metabolic enzymes such as CYPs, GST, superoxide dismutase, mutations in the VDSC gene, and reduced cuticle penetration.

## Conclusion

As a result of the increases in resistance of the salmon sea lice to the anti-parasitic drugs; synchronization of treatments (between neighboring farms) has been proposed as a strategy to improve immersion treatment performance [11]. Results indicate that synchronization was closely associated with lower adult lice levels from weeks 5 to 7 after treatment. This relationship appeared to be linear, suggesting that higher levels of synchronization may result in lower adult sea lice levels during these weeks. These findings suggest that synchronization between neighboring farms may improve the performance of immersion treatments by keeping sea lice levels low for a longer period of time [11].

However, using pesticides in marine waters can produce changes on microbial photo and chemoautotrophic carbon uptake. Although variable, these effects show significant alterations of carbon fixation fluxes if a single pesticide is applied as opposed to a combination of two or more compounds; i.e. Emamectin benzoate can potentially act as a depressor of carbon fixation while azamethiphos can stimulate primary production in conditions of nutrient limitation or deficiency. The effect of pesticides may be related to the magnitude of primary production and favorable conditions for phytoplankton activity [11].

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