In situ estimate on salmon louse nauplii production at a fish farm

G. á Norði, K. Simonsen , Ø. Patursson

Fiskaaling
Aquaculture Research Station of the Faroes

Abstract

Abundance and depth distribution of planktonic sea lice were investigated in relation to hydrodynamics at a salmon farm in Sundalagið, Faroe Islands.

Lepeophtheirus salmonis and *Caligus elongatus* were present at the farm. Nauplii dominated the planktonic stages (>95%) while copepodids were absent from most samples. The highest observed copepodid density was 0.3 ind. m^{-3}, which is within the range found in open water.

No diurnal vertical distribution pattern was observed for salmon lice nauplii in the net cages, which were most abundant in the top meter of the water column. The nauplii decreased with depth. At 1 m depth, nauplii density was inversely proportional to the current speed at the same depth.

From this relation, and the abundance of adult female sea lice on the farmed fish, the *in situ* nauplii production was calculated to be within 26−68 nauplii female $^{-1}$ d $^{-1}$. The lower end of this range is similar to production rates suggested by laboratory studies at similar temperatures (7.8°C).

Introduction

Salmon farms are identified as contributors to the salmon lice infection pressure of both farmed and wild salmonids. However in field observations of planktonic sea lice stages are scarce and to our knowledge, *in situ* observations of production and survival of nauplii have not been accomplished.

In this study, 2 snapshots of sea lice abundance at a fish farm are presented in relation to the concurrent hydrodynamics, solar insulation and sea lice counts on the farmed fish.

Further, it is demonstrated how an *in situ* estimate on the nauplii production can be accomplished from such high-resolution measurements.

Methods

Plankton surveys were conducted by surface tows with a plankton net around the farm and by using a plankton pump at 1, 4 and 6 m depth in a fish cage. The entire sample content was investigated under a stereomicroscope and sea lice were identified.

Water current measurements were performed adjacent to the cages 1 m depth with a SeaGuard RCM SW (www. aanderaa.com).

The study was conducted towards the end of the farming cycle when sea lice prevalence on farmed fish was at its maximum.

A spatial and a temporal survey of sea lice distribution were conducted.

First, on February 7, 2014 the spatial distribution of sea lice was investigated at 1 m depth at 14 different sites inside and around the fish farm. Samples were taken in daylight within5 h.

The second survey investigated temporal changes in sea lice abundance in one of the net cages at the farm. Plankton samples were consecutively taken at 1, 4 and 6 m depth every third hour over a 24 h period. The survey began on May 6, 2014.

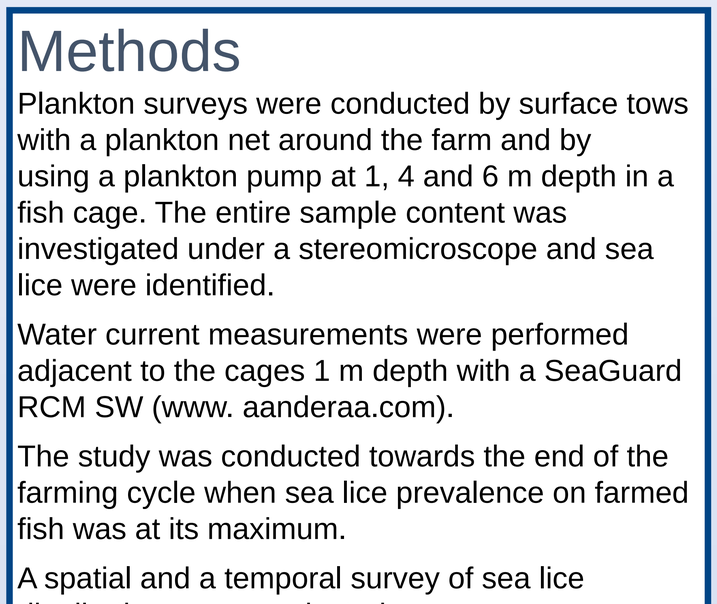

Figure 1. Left; plankton net. Right; content from a ~200 m tow with plankton net during winter

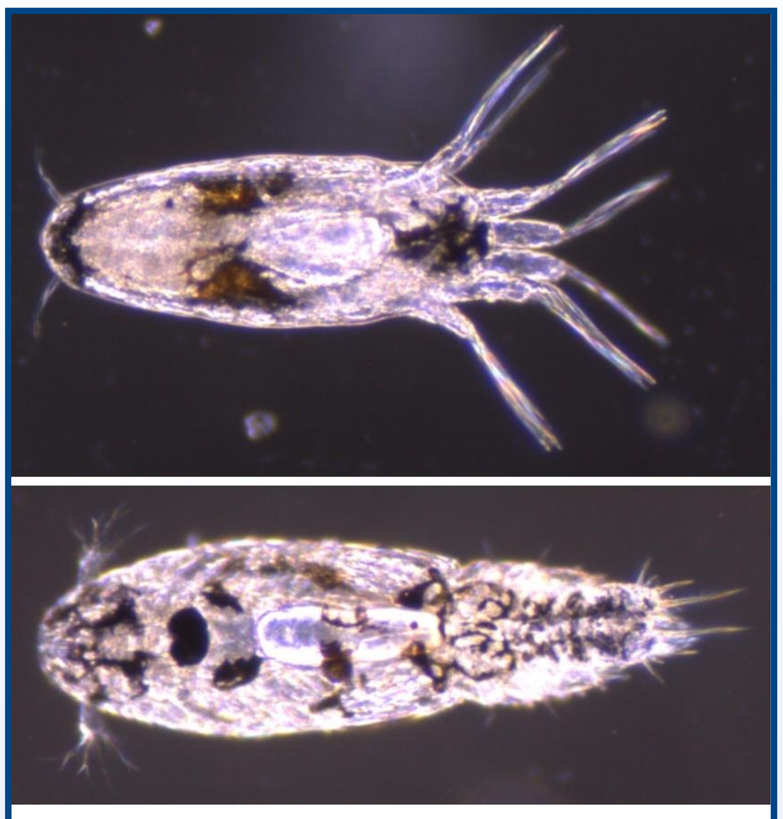

Figure 2. *Lepeophtheirus salmonis* nauplii (top) and copepodid (bottom). Photos by Eirikur Danielsen

Study site

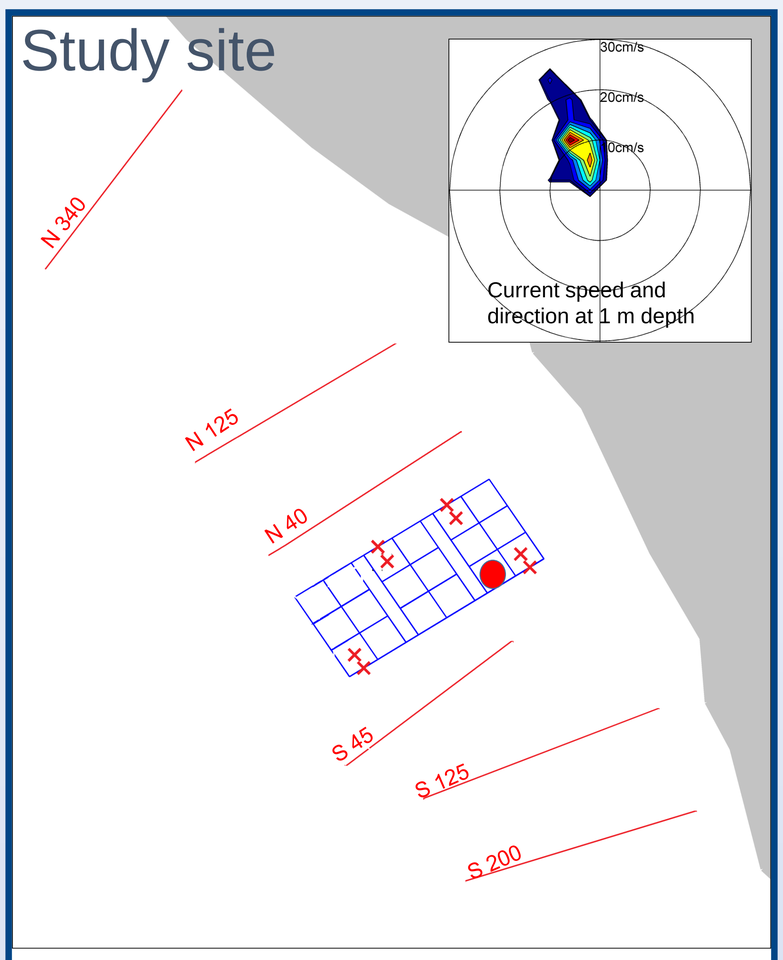

Figure 3. Location of fish farm (blue) and sampling stations for the spatial survey (lines and +) and at the nauplii produciton estimate temporal survey (●). Distribution of current speed and direction is shown in the upper right corner.

Spatatial variations

Nauplii were highly abundant downstream the farm and virtually absent upstream. The few observations of copepodids, were made upstream the farm and in the cages.

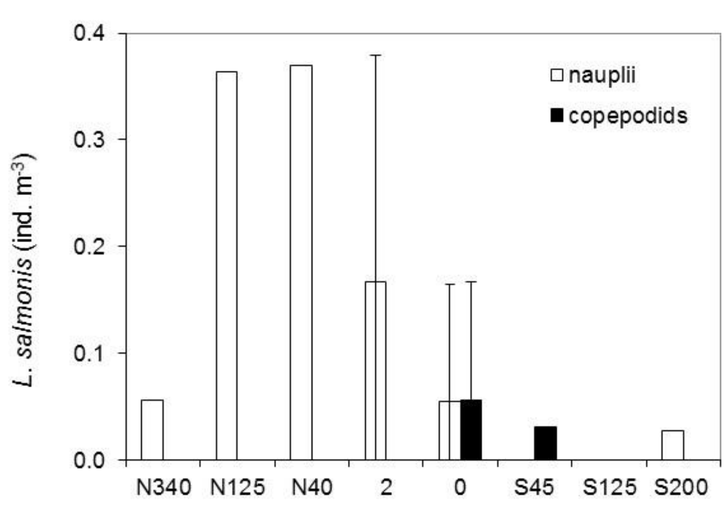

Figure 4. Nauplii and copepodid abundance at various distances downstream (N) and upstream the farm (S). The number denote the distance from the farm in m.

In situ estimate

Samples were collected every 3 hours at 1, 4, and 6 m depth for 24 hours.

An in situ estimate on salmon louse production was calculated from:

- The invert relation between current speed and nauplii abundance (Fig. 5)
- The nauplii depth distribuiotn (Fig.6)
- The abundance of adult female sea lice on the farmed fish

Nauplii production was within 26-68 nauplii female $^{-1}$ d $^{-1}$, the temperature was (7.8 °C)

Nauplii abundance varies with current speeds

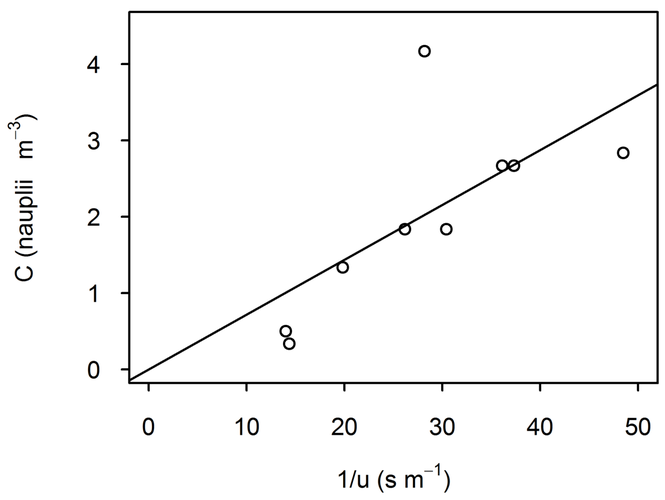

Figure 5 *Lepeophtheirus salmonis* nauplii abundance (*C)* relativeto the inverted current speed (1/*u)* perpendicular to the cage at 1 m depth. The line denotes the linear relationship between inverted current speed and nauplii abundance $C = 0.072\ (1/u)$ ($R2 = 0.87$, $p < 0.001$)

Nauplii depth distribution

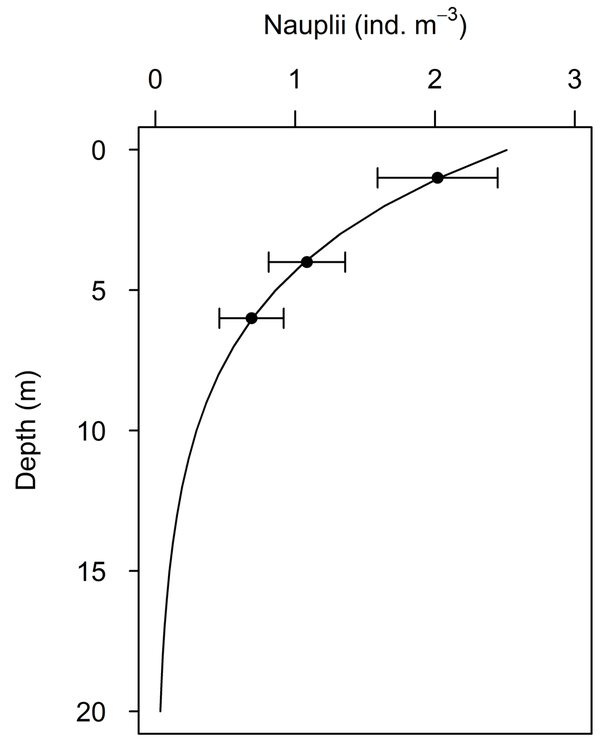

Figure 6. Depth distribution of salmon lice nauplii in the fish cage (average ± SE, n = 9 at 1 m and n = 8 at 4 and 6 m depth). The line shows the fitted exponential decrease in nauplii abundance (*Y)* with depth (*z*) down to the bottom of the cage: $Y = 2.5e{-}0.215z$

Acknowledgements.

This research was financially supported by the Faroese Reserch Council. We thank P/F Bakkafrost for access to the farm and data and Eirikur Danielsen and Esbern Jóannes Patursson for assistance in the field and analysing samples.

Further information on the study:

á Norði G, Simonsen K, Patursson Ø (2016) A method of estimating *in situ* salmon louse nauplii production at fish farms. Aquacult Environ Interact 8: 397 - 405