



ANNUAL REPORT ON HEALTH MONITORING OF WILD ANADROMOUS SALMONIDS IN NORWAY 2018

Screening of migrating Atlantic salmon (*Salmo salar*) postsmolts from the Trondheim fjord for viral infections



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Sammendrag (norsk):

Very few virus infections found in migrating postsmolts from the Trondheim Fjord

Commissioned by the Norwegian Food Safety Authority, the Institute of Marine Research has studied the occurrence of several potential disease-causing viruses that are common in salmon farming in migrating postsmolts from Trondheim fjord in 2016. The postsmolts were caught in the mouth of the fjord, which is a national salmon fjord without fish farming activity, and therefore it is unlikely that this fish is exposed to infections from salmon farming. The incidence of SAV, PRV1, ILAV and PMCV infections was tested using the real-time RT-PCR method. SAV, PRV1, ILAV were not detected in any of the postsmolts. Low concentration of PMCV was detected in a single fish. The results show that the occurrence of these viruses is very low in wild salmon postsmolts in this area of the fjord.

Sammendrag (engelsk):

Svært få funn av virus i utvandrende postsmolt fra Trondheimsfjorden

På oppdrag fra Mattilsynet har Havforskningsinstituttet undersøkt forekomsten av flere mulige sykdomsfremkallende virus som er prevalent i oppdrett i utvandrende postsmolt fra Trondheimsfjorden i 2016. Postsmolten ble fanget i munning til fjorden, som er en nasjonal laksefjord uten oppdrettsaktivitet, og det er derfor lite sannsynlig at denne smolten er utsett for smitte fra oppdrett. Forekomsten av SAV-, PRV1-, ILAV- og PMCV-infeksjoner ble testet ved å bruke sanntids RT-PCR metoden. SAV, PRV1 og ILAV ble ikke påvist i postsmolten. Lav konsentrasjon av PMCV ble detektert i en fisk. Resultatene tyder på at infeksjoner med disse virusene er uvanlige i vill laks postsmolt i dette fjordområdet.

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1.1 - Introduction

Viral diseases are one of the major challenges facing Atlantic salmon farming in Norway that often lead to substantial economic losses (Table 1). The most common viral diseases in salmon farming the last five years are; pancreas disease (PD), caused by *salmonid alphavirus* (SAV), *heart and skeletal muscle inflammation* (HSMB), caused by a *piscine orthoreovirus 1* (PRV1), *cardiomyopathy syndrome* (CMS) caused by *piscine myocarditis virus* (PMCV) and *infectious salmon anaemia* (ISA) caused by ISA virus (ISAV).

Table 1: The number of registered viral disease outbreaks in fish farming in the last 5 years [1].

	2014	2015	2016	2017	2018
PD	142	137	138	176	163
HSMB	181	135*	101*	93*	104*
CMS	107	105*	90*	100*	101*
ISA	10	15	12	14	13

* Underreported.

Disease outbreaks in salmon farms may lead to increased infection pressure on neighbouring farms and local wild fish populations. There is increasing public concern of this negatively impacting wild salmonids in Norway. However, there are limited data on the prevalence of pathogens in wild salmonid populations [2]. It is difficult to quantify disease incidence and its impact in wild fish since sick individuals may be less catchable or may disappear unnoticed (e.g. due to predation). Therefore, it is challenging to evaluate the impact of disease in wild stocks since we normally are only able to collect infected but non-diseased fish such as individuals that has recently acquired or has survived an infection (carriers).

Pathogens that cause disease in farmed salmon can also infect wild salmon. The effect of fish farming on the infection status of wild salmon stocks may be evaluated by comparing pathogen prevalence in wild fish populations captured from coastal areas that have different fish farming intensities and disease outbreak profile.

Wild salmon may be infected by viruses prevalent in salmon farming; in rivers as parr by virus-infected farmed escapees and spawning wild salmon or from salmon farms in the fjord when migrating as postsmolts or returning as adults. Therefore, infection status in migrating postsmolts may represent a direct indicator of infection pressure from salmon farming during their migration routes. However, it is important to establish "background" prevalence of viral infections in migrating wild postsmolts before being eventually exposed to infection from fish farming. The Trondheim fjord is a national salmon fjord with no salmon sea farms (Fig. 1). Migrating postsmolts originated from rivers in the fjord may be used to study the occurrence of viral infections in wild fish exposed to no or limited infections from fish farming.

1.2 - Aim

The aim of the current study was to investigate the occurrence of SAV, PRV1, PMCV and ISAV infections in migrating wild Atlantic salmon postsmolts originating from rivers flowing into the Trondheim fjord.

1.3 - Materials and methods

Migrating postsmolts (N=200) were captured in the outer parts of the Trondheim fjord by trawling in May-June (Fig. 1), as part of the national salmon lice monitoring program [3]. The weight and length of the fish were determined and the postsmolts were then frozen (-20 °C) as soon as possible after capture. At autopsy, tissues from the gills, head kidney and heart were taken out from the fish while still frozen and were sent on dry ice to an accredited commercial laboratory for RNA extraction and virus testing (Pharmaq Analytiq AS). Analyses for SAV, PRV1, PMCV and ISAV viruses (for detection viral RNA) were performed on a mixed tissue samples by real-time PCR assays. Ct-values less than or equal 40 were considered positive.

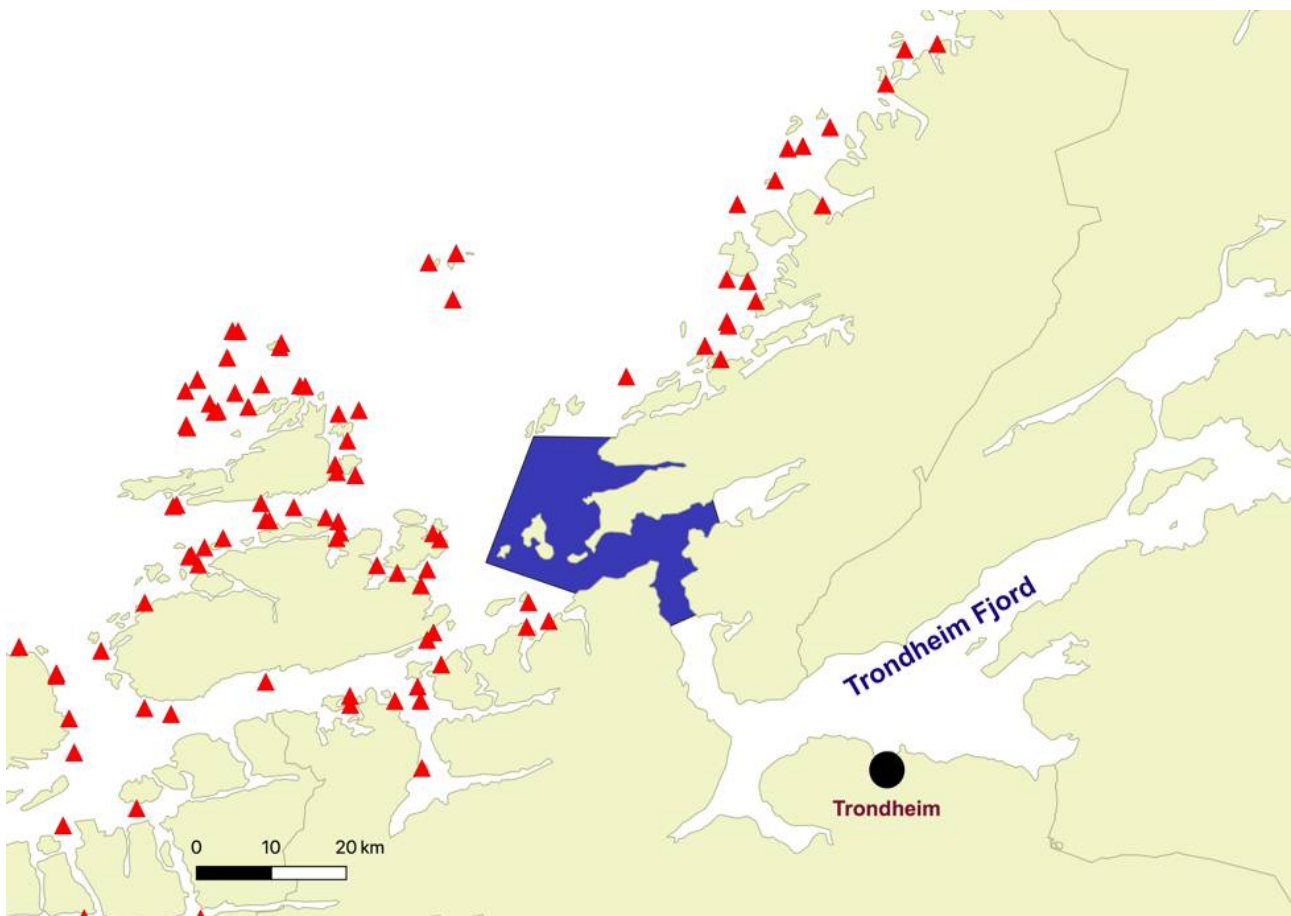


Fig. 1: A map showing the trawling area (blue) in the outer part of the Trondheim fjord and salmon farms (red triangles).

1.4 - Results

Virus infections in wild postsmolts from the Trondheim fjord.

SAV, PRV1 and ISAV were not detected in any of the tissues from the tested postsmolts. PMCV was detected in one single postsmolt (Ct-value 37).

1.5 - Discussion and conclusion

Except one PMCV-positive fish, none of the migrating postsmolts were infected with the tested viruses. The Trondheim fjord is a national salmon fjord with no fish farming activities (Fig. 1). Therefore, the postsmolts which were captured in the outer part (mouth) of the fjord were likely not exposed to viruses prevalent in salmon sea farms. The prevalence of virus infections in migrating postsmolt from the fjord likely reflects the infection status across the rivers of origin.

A single postsmolt was PMCV-positive showing a virus prevalence of 0.5 %. It is most likely that the PMCV-positive postsmolt in the current study was infected in river of origin. Indeed, a high prevalence (up to 19 %) of PMCV infection was found in wild parr from a river in western Norway [4]. Studies of escaped farmed salmon entering rivers in the Hardanger fjord showed that most of the escapees often are infected with one or more viruses, including PMCV [5, 6]. Therefore, escaped farmed salmon may act as pathogen vectors that may transfer infections to wild salmon populations in rivers. However, very low numbers of escaped farmed salmon were registered in the rivers located in the Trondheim fjord [7]. On the other hand, a low natural occurrence of PMCV infection in wild salmon populations in rivers can be excluded.

We previously reported that the prevalence of PRV1 was low (2-6%) in migrating postsmolts from western Norway, but still significantly higher compared to the current study [4]. The postsmolts from western Norway were captured in the outer part of the fjords after passing through areas with fish farming and therefore they may be contracted the virus either in their migration routes or in the rivers of origin.

The absence of SAV infection in the postsmolts is in accordance with our previous findings, suggesting that infection with this virus seems exceedingly rare in all life stages of salmon in Norway [4].

Avirulent ISAV infections are prevalent in salmon farming [8, 9] and may occur in wild adult salmon [ref. 10]. However, so far, we did not detect the virus in the migrating postsmolts [4].

The results from the current report showed very low prevalence of viral infections in migrating postsmolts originated from rivers located in the Trondheim fjord, suggesting that background natural occurrence of these viruses is very low in wild postsmolts. Time series of samples of migrating postsmolts from areas with different salmon farming intensities are needed to better evaluate the effect of infection pressure from aquaculture on the virus prevalence in wild salmon populations. The studies on migrating postsmolts will continue in the coming years in different fjord systems from south to north, covering larger parts of the Norwegian coastline.

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