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The occurrence of viral infection in juvenile salmon parr from rivers located in northern Norway

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Report XXII. The occurrence of viral infection in juvenile salmon parr from rivers located in northern Norway

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Abstract

The results in the current report showed very low prevalence of viral infections in parr form rivers located in northern Norway. The prevalence of these viruses in parr from northern Norway did not differ from the prevalence in parr collected from other areas with higher fish farming intensities or frequent viral disease outbreaks.

Key words:
Atlantic salmon, salmo salaris, viral disease, Troms, Finnmark, Målselva, Tana, Altaelva, Lakselv, Kongsfjordelva, Komagelva, Vestre Jakobselv, Grense Jakobselv

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1. Introduction

Viral infections are one of the major challenges facing Atlantic salmon farming in Norway, often leading to disease outbreaks (Table 1) and to substantial economic losses. 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 (HSMI), caused by a piscine orthoreovirus 1 (PRV1), cardiomyopathy syndrome (CMS) caused by piscine myocarditis virus (PMCV), infectious salmon anaemia (ISA) caused by ISA virus (ISAV) and infectious pancreatic necrosis (IPN) caused by IPN virus (IPNV).

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

	2017	2018	2019	2020	2021
PD	176	163	152	158	101
ISA	14	13	10	23	25
HSMB	93*	104*	79*	161*	188*
CMS	100*	101*	82*	154*	155*
IPN	23*	19*	23*	22*	20*

* Underreported [2].

It is believed that pathogen exchange between farmed and wild salmon occurs and that disease outbreaks in salmon farms may lead to increased infection pressure on wild fish populations. There is an 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 [3]. 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 pathogens on individuals as well as stocks in nature, 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).

Wild salmon may be infected by viruses prevalent in salmon farming; in rivers as fry or parr by virus-infected farmed escapees and spawning wild salmon, or from salmon farms in the fjord when migrating as smolts or returning as adults. Therefore, infection status in parr in rivers may represent an indicator of infection pressure from salmon farming especially through escaped farmed salmon in these rivers.

Since 2012, the Institute of Marine Research (IMR) has been monitoring of virus infections in wild salmonids in Norway addresses the environmental impact of disease transmission from Norwegian fish farming to wild fish.

The program aims to investigate the occurrence of pathogen infections in wild salmonids captured from different Norwegian coastal areas and rivers with different farming intensities and disease outbreak frequencies. Each year selected sets of fish are analysed in order to complement or complete our data and time series. The generated knowledge from the program contributes to the institute's main goal/strategy in providing advice and further development of sustainable management of aquaculture and is utilized in the IMR's annual risk assessment of Norwegian fish farming.

2. Aim

The aim of the current study was to investigate the occurrence of SAV, PRV1, PMCV, ISAV and IPNV infections in wild parr captured in selected rivers in northern Norway.

3. Materials and methods

Parr were sampled from 8 rivers in 2019-2020 (Fig. 1). Weight and length of all fish were recorded, and the fish were then frozen (-20 ºC) as soon as possible. At autopsy, tissues from the gills, head kidney and heart were taken from the fish while still frozen and preserved at -80 ºC. Tissue samples for analysis were sent on dry ice to an accredited commercial laboratory for RNA extraction and virus testing (Pharmaq Analytic AS). Samples with a PCR cycle-threshold (Ct) value equal or below 37.0 were considered positive. All fish were tested for the five most prevalent viruses in salmon farming in Norway (SAV, PRV1, PMCV, ISAV and IPNV; Table 1) by real-time RT-PCR assays (for detection viral RNA). A total of 341 fish were tested were used in the current report.

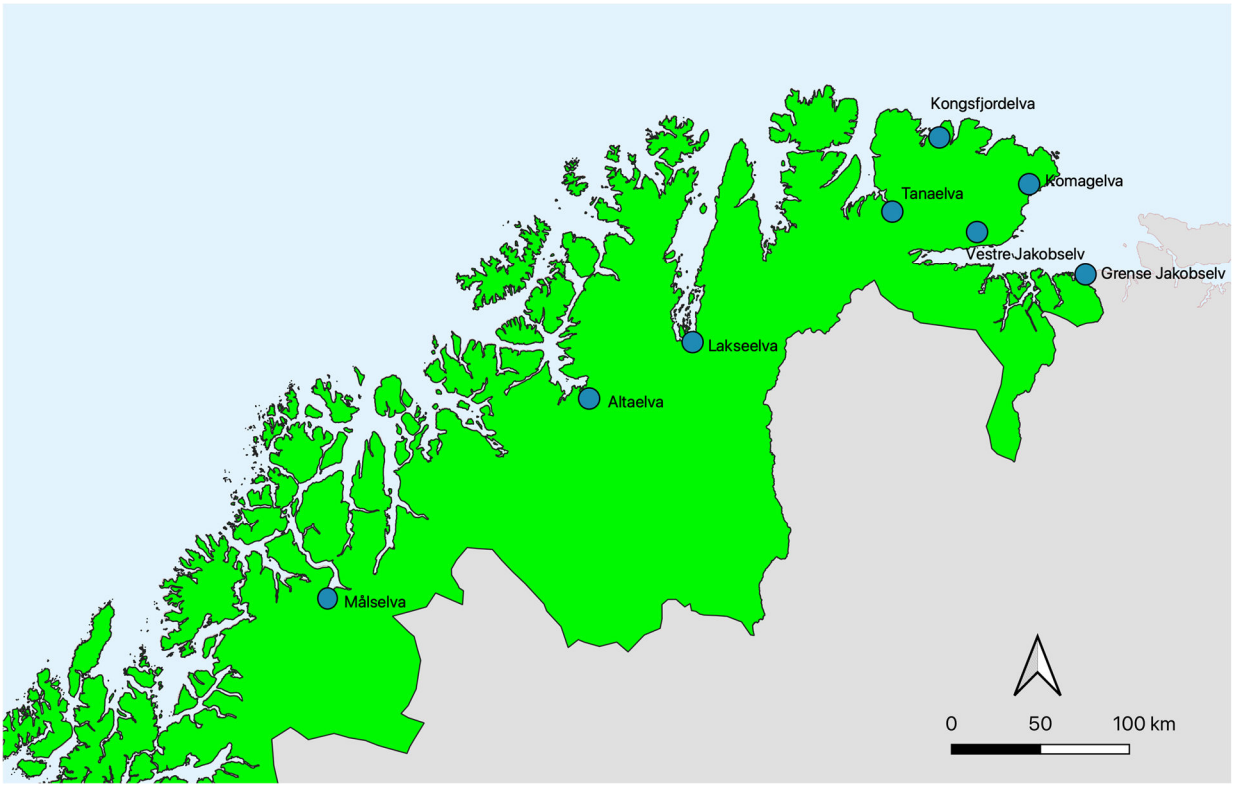

Fig. 1: A map showing the rivers where juveniles (parrs) were collected.

4. Results

Virus infections in wild migrating smolt and postsmolts.

SAV, PRV1 and IPNV were not detected in any of the tissues from any of the tested parr (Table 2). ISAV was detected in 4 fish (Ct-value 32-36) and PMCV was detected in 3 parrs (Ct-value 27-37).

Table 2: The numbers and the collection sites of tested fish and the numbers of virus-positive smolt.

River (Year)	N.	SAV+	ISAV+	PRV1+	PMCV+	IPNV+
Kongsfjordelva (2019)	26	-	-	-	-	-
Komagelva (2019)	40	-	-	-	-	-
Vestre Jakobselv (2019)	47	-	2	-	-	-
Grense Jakobselv (2019)	48	-	-	-	-	-
Tanaelva (2020)	47	-	-	-	1	-
Lakseelva (2020)	44	-	2	-	-	-
Altaelva (2020)	45	-	-	-	1	-
Målselva (2020)	44	-	-	-	1	-
Total	**341**	**-**	**4**	**-**	**3**	**-**

-: not detected

5. Discussion and Conclusion

SAV infection is uncommon in salmon farming in northern Norway. The virus was not detected in any of the tested parr irrespective of river of origin or year. Our previous published results have also shown that none of returning sea caught adult salmon from the northern Norway was infected with SAV [4].

On the other hand, PRV1-infection is common in fish farming and the virus was frequently detected in wild adult salmon (prevalence between 5 and 35%) [1, 4-8]. It was also shown that the prevalence of the virus increases with fish age [4]. PRV1 was not detected in any of the wild juveniles from rivers included in the current study. These results are in agreement with our previous observations of low (0-5%) occurrence of PRV1 infection in wild parr from other rivers [8].

The number of IPN outbreaks in salmon farming have shown a significant decline in the last years due to the use of IPNV-resistant QTL smolt. The absence of IPNV infection in parr in the current study supports our previous reports that have shown that IPNV infection in wild salmon, irrespective of life stage, is uncommon [8].

In the current report, PMCV was detected in 3 wild juveniles (1%) from 3 different rivers. CMS (caused by PMCV) has been a growing problem in Norwegian fish farming in the recent years [1]. The occurrence of PMCV infection in wild salmon varies in time and space but is generally very low [8, 9]. However, a high prevalence (up to 19 %) of PMCV infection was found in wild parr from a river in western Norway [8]. Studies of escaped farmed salmon entering rivers in the Hardangerfjord showed that most of the escapees often are infected with one or more viruses, including PMCV [10, 11]. Therefore, escaped farmed salmon may act as pathogen vectors that may transfer viral infections such as PMCV to wild salmon populations in rivers. On the other hand, a low natural occurrence of PMCV infection in wild salmon populations in rivers cannot be excluded.

Very low ISAV concentrations were detected in 4 fish (1%) from 2 rivers. The virus variant (avirulent HPR-0 or virulent HPR-del) could not be confirmed as it was not possible to sequence

the virus due to low viral-RNA concentrations in the positive samples. ISAV HPR-0 is prevalent in Norwegian salmon farming, but virulent ISAV-del is less prevalent in salmon farms (around 20 annual disease outbreaks). Our previous study showed that ISAV (HPR-0) was detected in 7% of wild returning adult salmon from northern Norway [12]. Our annual heath monitoring reports and the published date confirm that ISAV (HPR-0) infection in wild salmon may occur at low level, and that this occurrence is not associated with salmon farming [13-16].

The absence of SAV, PRV1 and IPNV and the low prevalence of ISAV and PMCV infections in the tested parr from northern rivers is consistent with previous reports from wild adult salmon and parr from other Norwegian rivers [4, 6, 7, 12, 13, 17-19]. Our previous and current findings showed no apparent relationship between the occurrence of viral infections in parr and the fish farming intensity, the number of escapees or the frequency of disease outbreaks in collection area. These observations may indicate that wild salmon are in general exposed to a low viral infection pressure from fish farming. However, the possibility that infection may lead to rapid disappearance, altered behaviour or biased sampling of the infected fish and therefore may affect the results, cannot be ruled out.

The results in the current report showed very low prevalence of viral infections in parr form rivers located in northern Norway. The prevalence of these viruses in parr from northern Norway did not differ from the prevalence in parr collected from other areas with higher fish farming intensities or frequent viral disease outbreaks.

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