Self-declaration of freedom from infection with Salmonid Alphavirus (SAV) of the Republic of Korea

Self-Declaration sent to the World Organisation for Animal Health (WOAH) on 01 June 2023 by Dr Dongsik Lee, the Delegate of the Republic of Korea to the WOAH on behalf of the National Fisheries Products Quality Management Service (NFQS), Ministry of Oceans and Fisheries.

1. Introduction

The Republic of Korea has implemented targeted surveillance of Infection with Salmonid Alphavirus (SAV) for at least the last two years with no detection of the disease as well as continuously met the basic biosecurity conditions at least for one year prior to commencement of targeted surveillance, meeting the requirements for self-declaration of freedom from SAV provided in Chapters 1.4 and 3.1 and Article 10.5.4 of the *Aquatic Animal Health Code* (the *Aquatic Code*) of the World Organisation for Animal Health (WOAH). And Republic of Korea fulfilled the conditions defined in Pathway 3 - Targeted surveillance in Article 1.4.3 of the *Aquatic Code*.

The country has conducted targeted surveillance of SAV in susceptible species as specified in Article 10.5.2 of the *Aquatic Code* for the last three years since 2020 in accordance with Chapter 1.4 of the *Aquatic Code* and Chapter 2.3.8 of the *Manual of Diagnostic Tests for Aquatic Animals* (the *Aquatic Manual*) of WOAH, demonstrating no detection of the disease. Salmonids are farmed in the land-based facilities of which rearing water is supplied from the groundwater, so fish escaping from farms during flooding are not supposed to survive. Salmonid aquaculture farms operated in the Republic of Korea neither share nor are bordered by waters of any other country. Therefore, on 1 June 2023 the Delegate of the Republic of Korea to WOAH declares that the country is free from Infection with Salmonid Alphavirus.

2. Basic biosecurity conditions in the Republic of Korea

2.1. Aquatic biosecurity system in the Republic of Korea

Under its Aquatic Life Disease Control Act enacted in 2008, the Republic of Korea has established a systematic national disease control and quarantine infrastructure along with financial resources to support the system and implemented the system as follows.

- - Under Articles 7 and 9 of the Act, the national aquatic life disease control system has established an early detection and reporting system for aquatic life disease.

- - The early detection system has been in place since 2008. The occurrence of an infectious aquatic animal disease leads to clinical and technical follow-up measures at the affected farms by trained aquatic animal health professionals or veterinarians.
- - Under Article 38 (Education on Disease Control) of the Act, the government provides education on the control of aquatic organism diseases for farmers and aquaculture business entities every two years. And under Article 10 of the Enforcement Rule of the Aquatic Life Disease Control Act, aquatic organism disease control officers who are aquatic organism disease inspector or veterinarian have received education on the control of aquatic organism diseases.
- - Clinically infected animals reported by farms or animals sampled during surveillance activities are sent to disease identification institutions for aquatic organisms or the National Fishery Products Quality Management Service (NFQS) for laboratory diagnosis under Article 10 of the Act.
- - If tested positive the animals are sent for a confirmatory diagnosis by the NFQS. With a confirmed case, the Korean government implements a systematic epidemiological investigation to understand the scale of disease outbreak, trace the source of infection, and identify the transmission mechanism under Article 11 of the Aquatic Life Disease Control Act as well as develops reasonable control measures to prevent the recurrence of the disease.
- - If an occurrence of aquatic infectious disease is confirmed, the equipment, tools, etc. of the affected facility shall be disinfected, incinerated, or buried and affected aquatic organisms shall be subject to measures like stamping out and isolation/movement control, etc. under Articles 13-19 of the Act.

The Republic of Korea carries out quarantine of imported aquatic organisms to prevent the introduction of exotic diseases into the country and protect its ecosystem. Aquatic organisms imported for transplant, human consumption, ornament, and research & survey shall undergo quarantine inspections according to Articles 22-32 of the Act. The Republic of Korea improved quarantine efficiency by adopting a standard form of health certificate. The country enhanced import quarantine by mandating a health certificate for all imported fishery products using the standard form as well as adding emerging overseas diseases of concern identified through import risk analysis to its list of notifiable diseases subject to quarantine.

2.2. Basic Biosecurity Conditions for Infection with Salmonid Alphavirus (SAV) in the Republic of Korea

Infection with SAV is listed as a nationally notifiable disease in the Republic of Korea under Article 2 of the "Enforcement Rule of the Aquatic Life Disease Control Act". All measures related to surveillance and disease control are implemented as specified in the Aquatic Life Disease Control Act to ensure that basic biosecurity conditions for this disease should be properly achieved.

In terms of surveillance of SAV, both targeted (twice a year) and general surveillance are carried out, and the surveillance data are all uploaded and maintained in the national integrated network for aquatic life disease control as stipulated in Article 5-2 of the Aquatic Life Disease Control Act. The detection or any suspicious case (e.g., swimming slowly at the water surface and/or mortality) of SAV must be reported to the competent authority through the early detection system. A laboratory test as well as a confirmatory diagnosis of SAV is performed following the procedure specified in Article 2.3.8.4 of the *Aquatic Manual*. If an SAV case is finally confirmed by a confirmatory diagnosis, epidemiological investigations and control measures shall be implemented to prevent the transmission and spread of the disease.

3. Control and Management of Infection with Salmonid Alphavirus (SAV) in the Republic of Korea

3.1. Susceptible species to SAV in the Country

Article 10.5.2 of the *Aquatic Code* refers to Arctic charr (*Salvelinus alpinus*), Atlantic salmon (*Salmo salar*), common dab (*Limanda limanda*), and rainbow trout (*Oncorhynchus mykiss*) as susceptible to SAV.

The Republic of Korea currently farms rainbow trout and Atlantic salmon. Rainbow trout is farmed and produced using the freshwater flow-through culture system in Korea. Atlantic salmon has been listed as a potential risk species by the Ministry of Environment since 2016, and an introduction of this species into the country should be approved by the ministry. In Korea, 5 local government research institutes (2 institutes of Gangwon-do; 1 Chungcheongbuk-do; 1 Gyeongsangbuk-do; and 1 Busan Metropolitan City) import eyed Atlantic salmon eggs to farm at laboratory for the purpose of researching on the land-based aquaculture technology, with no commercial production. These farmed Atlantic salmon are currently kept in separate rearing tanks and go through regular disease tests (at least

twice a year) with fish carcasses being treated and disposed of by the Ministry of Environment. There are no wild species susceptible to SAV in the country.

As of 2022, there are 161 rainbow trout farms in Korea, most (>89.4%) of which are located in the provinces of Gangwon-do (58.4%), Gyeongsangbuk-do (19.9%), and Chungcheongbuk-do (11.2%) (Table 1 & Figure 1). The national annual production of rainbow trout is approximately 3,043 tons as of 2022 (Table 2).

However, there was a noticeable decrease in production in 2020 and 2021. In the period 2020 and 2021, the global outbreak of COVID-19 pandemic negatively affected rainbow trout economic activity. Particularly, those affected rainbow trout markets such as restaurant and local festival. The producers had estimated the optimal supply rate based on the demand forecasting.

Table 1. Number of rainbow trout (*O. mykiss*) farms in the Republic of Korea in 2022. (Source: NFQS)

Province	Gyeonggi -do	Gangwon -do	Chungcheongnam -do	Chungcheongbuk -do	Jeollabuk -do	Gyeongsangnam -do	Gyeongsangbuk -do	Total
No. of farms	7	94	5	18	3	2	32	161

Table 2. Total production of rainbow trout (*O. mykiss*) in the Republic of Korea. Unit: M/T (Source: Statistics Korea)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Rainbow trout	3,015	3,067	3,390	3,304	3,064	3,066	3,358	3,179	3,285	2,414	2,483	3,043

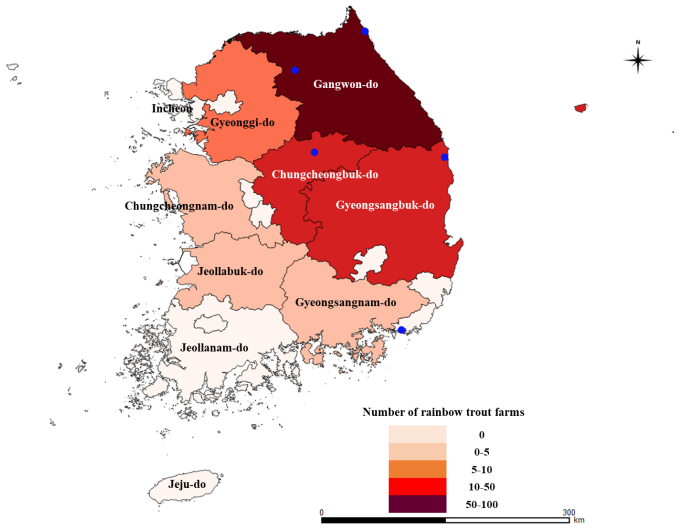

Figure 1. Distribution of rainbow trout (*O. mykiss*) farms and Atlantic salmon (*S. salar*,) ● institutes in Korea in 2022.

3.2. General Surveillance of SAV

Infection with SAV has been listed as a notifiable disease since 2008 in the country and a year-round routine surveillance system has been put in place. General surveillance of SAV is routinely implemented for persons that own, manage, and operate aquaculture premises subject to surveillance. In general surveillance activities, inspectors carry out interviews and questionnaire surveys to obtain information on the history and the current status of disease occurrence, mortalities, etc. The information helps operate the early detection system of disease introduction. Since 2011, inspectors have made on average at least two visits per farm every year to perform inspections on SAV occurrences (Table 3).

Table 3. Number of general surveillance activities for Salmonids from 2011 to 2022. (Source: NFQS)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
No.	19	19	203	648	743	714	602	424	170	277	448	764	5,031

3.3. Targeted Surveillance of SAV

To demonstrate the country's freedom from SAV, the targeted surveillance program that is carried out over the entire year to capture potential seasonal variations was designed according to Chapter 1.4 of the WOAH *Aquatic Code*. The sample size required to demonstrate the country's freedom from the disease in years from 2020 to 2022 was calculated by the FreeCalc two-stage sampling (Table 4 & Figure 2). The number of units to be sampled from the population of 161 rainbow trout farms (sample size) was calculated using the two-stage sampling method. The first sampling stage to select aquaculture establishments (farms) employed parameters of 2% farm-level prevalence, 35% individual-level prevalence, 95% test sensitivity, 90% target cluster sensitivity (SeH), and 95% target system sensitivity (SSe, confidence level). The farm sample size required for targeted surveillance was calculated as 95 farms. The number of sample farms was divided by administrative units (cities and provinces) to plan a targeted surveillance program. In the second stage, the animal sample size per farm was calculated by applying the following parameters: 95% test sensitivity, 97% test specificity, 35% individual-level prevalence, 5% type Ⅰ error, 5% type Ⅱ error, and a population of 60,000 animals. From these parameters, the required animal sample size was calculated as 15 per farm.

15-30 animals per farm were sampled from 95 rainbow trout farms from 2020 to 2022. A total of 2,919, 5,764, and 3,797 animals were selected in 2020, 2021, and 2022, respectively to be tested for SAV, and all showed negative results (Table 4).

These results indicate that the country has been free for the last 3 years from SAV at a confidence level of 95%.

Table 4. Targeted surveillance of rainbow trout (O. mykiss) from 2020 to 2022 with two-stage sampling. (Source: NFQS)

Year	Targeted surveillance		Gyeonggi-do	Gangwon-do	Chungcheongnam-do	Chungcheongbuk-do	Jeollabuk-do	Gyeongsangnam-do	Gyeongsangbuk-do	Total
2020	Total No. of farms		7	94	5	18	3	2	32	**161**
	Required sample size	No. of farms	4	55	3	11	2	1	19	95
		No. of samples (2 times)	96	1,320	72	264	48	24	456	2,280
	Tested sample size	**No. of farms**	**3**	**60**	**-**	**13**	**1**	**-**	**19**	**96**
		No. of tested samples (2 times)	**89**	**1,790**	**-**	**403**	**31**	**-**	**606**	**2,919**
2021	Total No. of farms		7	94	5	18	3	2	32	**161**
	Required sample size	No. of farms	4	55	3	11	2	1	19	95
		No. of samples (2 times)	96	1,320	72	264	48	24	456	2,280
	Tested sample size	**No. of farms**	**7**	**55**	**-**	**12**	**2**	**1**	**19**	**96**
		No. of samples (2 times)	**420**	**3,300**	**-**	**690**	**420**	**60**	**874**	**5,764**
2022	Total No. of farms		7	94	5	18	3	2	32	**161**
	Required sample size	No. of farms	4	55	3	11	2	1	19	95
		No. of samples (2 times)	96	1,320	72	264	48	24	456	2,280
	Tested sample size	**No. of farms**	**6**	**55**	**1**	**11**	**2**	**1**	**19**	**95**
		No. of tested samples (2 times)	**240**	**2,200**	**40**	**439**	**80**	**40**	**758**	**3,797**

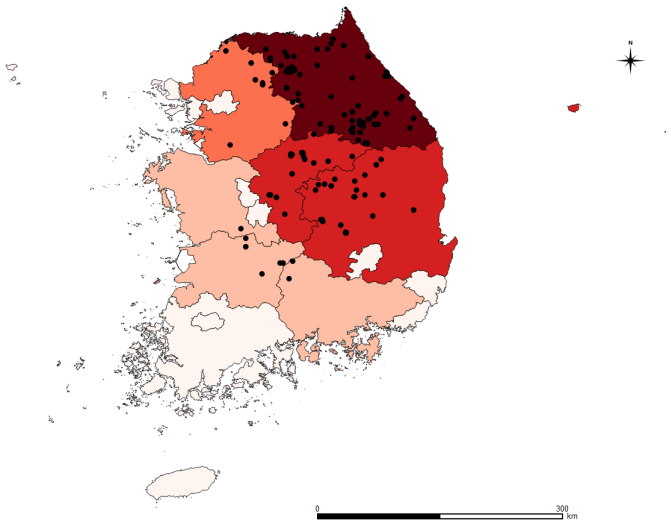

Figure 2. Sampling sites (•) of rainbow trout (*O. mykiss*) farms for targeted surveillance from 2020 to 2022 with two-stage sampling.

4. Quarantine of SAV in the country

4.1. Import quarantine

The Republic of Korea has been carrying out quarantine of imported aquatic organisms since December 2008, under the Aquatic Life Disease Control Act to prevent the introduction of exotic diseases into the country and protect its ecosystem. As specified in Articles 22 (Quarantine of exported and imported organisms), 23 (Things designated for quarantine purpose), 27 (Quarantine inspection on imports), and 31 (Quarantine inspection on exports) of the Act, the government carries out quarantine inspections of 26 kinds of notifiable diseases in live fish, shellfish, crustacean species for transplant, human consumption, ornament, testing, research and survey, frozen and chilled abalone, oysters, and shrimps, and diagnostic reagents including pathogens.

The country formulated a standard form of health certificate, which improved quarantine efficiency by encouraging exporting countries to issue health certificates using the standard form. The Republic of Korea enhances import quarantine by mandating a health certificate for all imported fishery products and adding emerging overseas diseases identified through import risk analysis on its list of notifiable diseases subject to quarantine.

The standard form of health certificate should includ the following requirements:

- - Health inspection was conducted in facilities designated by competent authorities in exporting countries.
- - Any clinical sign of diseases listed in the Aquatic Life Disease Control Act of the Republic of Korea was not be observed.
- - Any pathogenic agent of diseases* was not detected from laboratory tests based on the *Aquatic Manual* of WOAH or the diagnostic methods approved by the Republic of Korea.
- * For salmonids: epizootic haematopoietic necrosis virus (EHN), salmon anaemia virus (ISA), viral haemorrhagic septicaemia virus (VHS), salmonid alphavirus (SAV) and Gyrodactylus salaris

The Republic of Korea requires all imports of species susceptible to SAV for transplant to go through laboratory examinations of the disease and only those that pass the examinations are allowed to enter the country. Those that fail the exams are returned or incinerated. Susceptible species to SAV that were imported to the country for transplant from 2014 to 2022 are eyed eggs of Atlantic salmon (*S. salar*) and rainbow trout (*O. mykiss*) (Table 5). It is required that eyed eggs of these two species that are to be imported for transplant in the country should pass laboratory tests to demonstrate the absence of SAV and obtain a health certificate before leaving the exporting country. Once arriving in the country, the imported eyed eggs should go through a laboratory test for SAV in accordance with methods provided in the *Aquatic Manual* of WOAH and only those that have passed the test are allowed for customs clearance. The quarantine procedure for importing susceptible species to SAV will be maintained even if the self-declaration of the country's freedom from the disease is published by the WOAH.

Table 5. Import quarantine count for transplants from 2014 to 2022. (Source: NFQS)

Species	2014		2015		2016		2017		2018		2019		2020		2021		2022	
	No.	kg	No.	kg	No.	kg	No.	kg	No.	kg	No.	kg	No.	kg	No.	kg	No.	kg
Atlantic salmon (*S. salar*, eyed eggs)	-	-	1	34	1	65	1	30	1	30	-	-	-	-	1	7	8	38
Rainbow trout (*O. mykiss*, eyed eggs)	10	289	12	386	12	457	9	415	9	401	8	318	5	114	5	178	10	192

5. Measures implemented to maintain freedom

To maintain the country's freedom status from SAV, the Republic of Korea will continue its targeted surveillance activities and basic biosecurity conditions in accordance with the provisions of Article 10.5.8 of the *Aquatic Code* and the quarantine in accordance with the provisions of Articles 10.5.9~15 of the *Aquatic Code*.

6. Conclusion

The Republic of Korea had continuously met the basic biosecurity conditions for at least one year prior to the commencement of targeted surveillance of SAV and implemented targeted surveillance of the disease for the past three years with no detection of SAV, meeting the requirements for self-declaration of freedom from SAV provided in Chapters 1.4 and 3.1 and Article 10.5.4 of the *Aquatic Code*.

SAV is a reportable disease under its Aquatic Life Disease Control Act enacted in 2008, and there are regular ongoing awareness programs in place to encourage prompt reporting of SAV suspicions.

The Republic of Korea carries out quarantine of imported aquatic organisms to prevent the introduction of exotic diseases and has implemented measures to maintain freedom from SAV.

Based on the above results, the Delegate of the Republic of Korea finally declares that the country obtains the status of country freedom from Infection with SAV as of 1 June 2023 as the country has fulfilled the requirements for a self-declaration of country freedom from the disease provided in Chapter 1.4 of the *Aquatic Code* and Chapter 2.3.8 of the *Aquatic Manual*.

Annex 1.

Statement to be included in the self-declaration document.

I, the undersigned, **Dr. Dongsik Lee**

Delegate of **Republic of KOREA**

to the World Organisation for Animal Health (WOAH, founded as OIE), takes responsibility for the self-declaration of freedom from **Salmonid Alphavirus (SAV)**

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Drawn up on **1st June, 2023**

Signature of the Delegate: _____