

Extensive literature review on vectors and reservoirs of AHL-listed pathogens of fish

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Abstract

On request of the EU Commission, EFSA carried out an Extensive Literature Review (ELR) to provide a list of vector species or reservoirs species of pathogens of crustaceans, listed in Annex II to the AHL, aiming to update the Annex of Implementing Regulation (EU) 2018/1882. In this Technical Report, the detailed review protocol of the ELR and assessment of potential vector and reservoir species of fish pathogens listed in Annex II to the AHL is described: highly polymorphic region-deleted infectious salmon anaemia virus (HPRΔ ISAV), Koi herpes virus (KHV), epizootic haematopoietic necrosis virus (EHNV), infectious haematopoietic necrosis virus (IHNV) or viral haemorrhagic septicaemia virus (VHSV) were detected. In total 3,205 research publications were collected for abstract screening and from these, 155 were selected for further full text analysis. In the final data collection and assessment 84 relevant research publications were used for extracting information on vector and reservoir species of the above crustacean pathogens. The results for crustacean species for which scientific evidence indicates that a role as vector species or reservoir species is likely are presented as tables in the supplementary material of this report.
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Key words: Vector, Reservoir, fish, highly polymorphic region-deleted infectious salmon anaemia virus, cyprinid herpesvirus-3, epizootic haematopoietic necrosis virus, infectious haematopoietic necrosis virus, viral haemorrhagic septicaemia virus

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¹ Expert contributing under the Independent Scientific Advice scheme - more information on <https://www.efsa.europa.eu/en/infographics/efsa-isa-scheme-why-what-how>

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1 Introduction

1.1 Background and terms of reference as provided by the requestor

In accordance with Article 8 of Regulation (EU) 2016/429 (AHL), the disease-specific rules for listed diseases provided in the AHL, and the rules adopted pursuant to that Regulation, apply to listed species. In compliance with that Article, the Commission shall establish a list of animal species or groups of species, which pose a considerable risk for the spread of specific listed diseases based on the capability of those animals to carry those specific diseases. Animal species or groups of animal species shall only be added to the list if they pose a considerable risk for the spread of a specific listed disease because they are vectors or reservoirs for that disease, or scientific evidence indicates that such role is likely.

The list of vector species, which is set out in the fourth column of the table in the Annex to Implementing Regulation (EU) 2018/1882, was carried forward from the list, which was previously set out in Commission Regulation (EU) 1251/2008. The Commission now requires scientific advice to inform an amendment to that list, to ensure that only species, which comply with Article 8 of the AHL are listed. This amendment may involve species, which are currently set out in the fourth column of the Annex to Implementing Regulation (EU) 2018/1882 being removed and/or new species being added to that list.

It should be noted that vector species of aquatic animals are not listed in the OIE Aquatic Code² or in the OIE Aquatic Manual³. In the disease specific chapters of the OIE Aquatic Manual however, as well as listing susceptible species, other species which have shown incomplete evidence of susceptibility are listed, as are species in which PCR positive results have been reported, but where an active infection has not been demonstrated. In 2020, the EU Reference Laboratories (EURLs) for fish, crustaceans and molluscs, with the assistance of experts, reviewed those non-susceptible species, which are listed in the OIE Manual, in an effort to determine whether or not, they could be considered to be vectors of specific listed diseases. The reports which have been prepared by the EURLs and which have been furnished to the Commission, may be of assistance to the risk assessor in providing the scientific advice, which is currently sought. The three reports (concerning fish, molluscs and crustaceans) accompany this letter. It should however, be noted that these reports also contain information concerning susceptible species to the listed diseases, which is not pertinent to this request for a scientific opinion.

In addition, for those species and groups of species referred to above, which should be listed in accordance with Article 8 of the AHL, scientific advice is also required concerning the conditions under which these species should be regarded as vectors or reservoirs for the purposes of movements.

The conditions under which these species should be regarded as vectors are set out in Annex I to Commission Delegated Regulation (EU) 2020/990⁴ and in Annex XXX to Commission Delegated Regulation (EU) 2020/692⁵. It should be noted that the conditions set out in Annex I to Commission Delegated Regulation (EU) 2020/990 are not identical to the conditions set out in Annex XXX to Commission Delegated Regulation (EU) 2020/692, and both sets of conditions are different to those which were previously set out in columns 3 and 4 of Annex I to Commission Regulation (EC) 1251/2008.

² OIE Aquatic Animal Health Code, 2021, 23rd Edition.

³ OIE Aquatic Manual, 2021, 8th Edition.

⁴ Commission Delegated Regulation (EU) 2020/990 of 28 April 2020 supplementing Regulation (EU) 2016/429 of the European Parliament and of the Council, as regards animal health and certification requirements for movements within the Union of aquatic animals and products of animal origin from aquatic animals (OJ L 221, 28 April 2020, p.42).

⁵ Commission Delegated Regulation (EU) 2020/692 of 30 January 2020 supplementing Regulation (EU) 2016/429 of the European Parliament and of the Council as regards rules for entry into the Union, and the movement and handling after entry of consignments of certain animals, germinal products and products of animal origin (OJ L 174, 3.6.2020, p.379).

Terms of reference

In view of the above, the Commission asks EFSA for a scientific opinion on the listing of vector species of aquatic animals in accordance with Article 8 of Regulation (EU) 2016/429, as follows:

- (1) For each of the aquatic diseases listed in Annex II to the AHL, an assessment concerning which species or groups of species of aquatic animals pose a considerable risk for their spread based on the fact that:
 - (i) they are vector species or reservoirs for that disease, or
 - (ii) scientific evidence indicates that such role is likely.

For each of the species or groups of species, which are assessed to be vector species or reservoirs of the listed diseases, or where scientific evidence indicates that such role is likely, they should be aquatic animals which are not already listed as susceptible to the listed disease.

- (2) For each of the species or groups of species, which are assessed to fulfil the requirements for listing by virtue of being a vector or reservoir of a listed disease, or where scientific evidence indicates such a role is likely, an assessment of the suitability of the conditions under which they should be regarded as vectors or reservoirs for the purposes of movements. These conditions are set out in Annex I to Commission Delegated Regulation (EU) 2020/990 and in Annex XXX to Commission Delegated Regulation (EU) 2020/692, however, alternative conditions should be proposed, if the conditions which are set out in those Regulations, are assessed to be unsuitable.

2 Methodology

2.1 Methodologies

This ELR aims to assess the role of fish species as vectors or reservoirs species of specific pathogens listed by the AHL, by gathering all scientific evidence available regarding the parameters presented in Annex A.

Review question:

- 1. What is the evidence generated by experimental infection studies demonstrating transmission of pathogen 'A' from vector species 'X' on or in which Pathogen A was detected, to a species 'Y'?**
- 2. What is the evidence generated by experimental infection studies or field studies, demonstrating the detection of Pathogen A on or in species X, without further evidence of transmission of pathogen A to a species 'Y'?**

Pathogen A refers to pathogens listed by the AHL, affecting fish, that are listed in Table 1.

Table 1. Listed pathogen affecting fish

Pathogen
Infection with HPR-deleted infectious salmon anaemia virus
Koi herpes virus disease
Epizootic haematopoietic necrosis
Infectious haematopoietic necrosis

Viral haemorrhagic septicaemia

Table 1. Listed pathogens affecting fish species to be assessed

Eligibility criteria:

The eligibility criteria for experimental and field studies are listed in Table 2 and 3.

Table 2. Study eligibility criteria for experimental infection studies

Element	Criteria	Level of screening
Publication type	Primary research publications (peer reviewed)	Title and abstract
		Full-text
Language	EU language	Title and abstract
		Full-text
Study type	Experimental infections	Title and abstract
Study design	Experimental study design	Title and abstract
	Only one single species X can be included per time per experimental unit	Full-text
Population	Species X and Y are aquatic animal species belonging to fish	Title and abstract
	Species X should not be a known susceptible species listed in Commission implementing regulation (EU) 2018/1882	Title and abstract Full text
Exposure	Exposure to pathogen A (AHL listed pathogens listed in Table 1)	Title and abstract
		Full-text
Outcome	Demonstration of pathogen A present in or on species X	Full-text
	Species Y must be experimentally exposed to pathogen A, either by direct or indirect contact with species X (cohabitation, immersion, ingestion)	
	Remark: these are outcomes used as eligibility criteria.	

Table 3. Study eligibility criteria for field studies

Element	Criteria	Level of screening
Publication type	Primary research publications (peer reviewed)	Title and abstract
		Full-text
Language	EU language	Title and abstract
		Full-text
Study type	Field studies	Title and abstract
Study design	Case studies, prevalence studies, surveillance reports, etc.	Title and abstract
Population	Species X is aquatic animal species belonging to fish	Title and abstract

	Species X should not be a known susceptible species listed in Commission implementing regulation (EU) 2018/1882	Full-text
Exposure	Exposure to pathogen A (AHL listed pathogens listed in Table 1)	Title and abstract
		Full-text
Outcome	Demonstration of pathogen A present in or on species X	Full-text
	Remark: these are outcomes used as eligibility criteria.	

1. Methods for searching the results

3 Information sources

Information sources used in the review are listed in table 4

Table 4: Information sources consulted

Information source	Platform
Scopus	Scopus.com (Elsevier)
CAB Abstracts	Web of Science (Clarivate)
Web of Science Core Collection - Science Citation Index Expanded - Emerging Sources Citation Index	Web of Science (Clarivate)

4 Reference management

Full references and abstracts were downloaded from Endnote 20 and uploaded into the Literature Review software DistillerSR® (Evidence Partners) by EFSA.

5 Search strategy

For each of the aquatic animal group specific combinations of search terms will be applied. The use of Boolean operators (AND, OR, NOT), truncation (\$) and wildcard (*) symbols will assure that search terms account for synonyms, abbreviations and spelling variants, enhancing thus the sensitivity of the search strategy.

The search strings will be a combination of 2 elements:

String I: name of the pathogens and diseases listed in Table 1, with alternative names when relevant, and

String II: selection of experimental studies (*experiment* OR transmission*) or field detections (*detect**)

2. Methods for study selection

The reviews were carried out in Distiller®, under the license owned by EFSA. EFSA was responsible to set up the project in distiller, run the search in Endnote and upload the references.

Thereafter one team of 8 reviewers carried out the reviews. An overview of the extensive literature review process is provided in Figure 1.

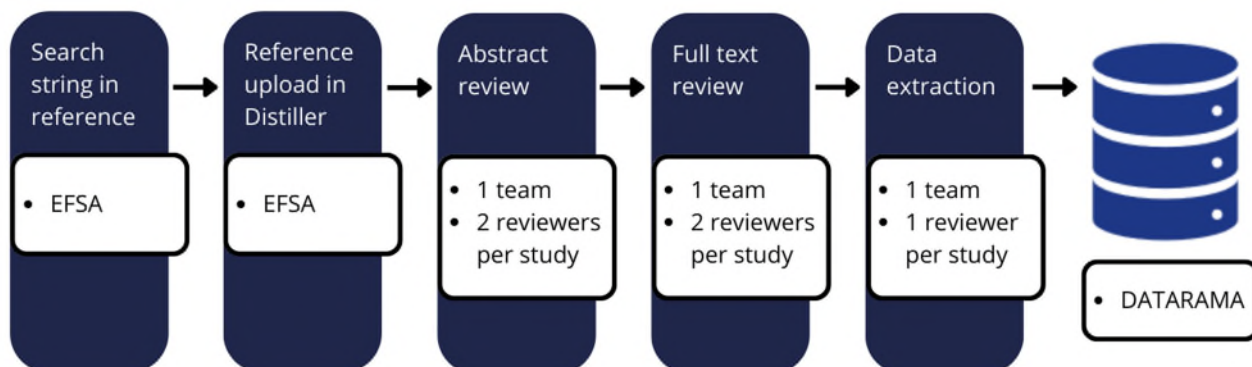


Figure 1. Overview of the extensive literature review process. Datarama is DistillerSR®’s database, from which data can be exported for manipulation.

After the specific search strings were applied in the reference manager (e.g., Endnote in EFSA), duplicates were removed in Endnote, whereafter a reference output file containing all results is uploaded to Distiller.

The review flow is visualised in Figure 2. Level 1 screening for eligibility was performed jointly for both experimental and field studies, while level two screening and data extraction were specific for either experimental infections or field studies.

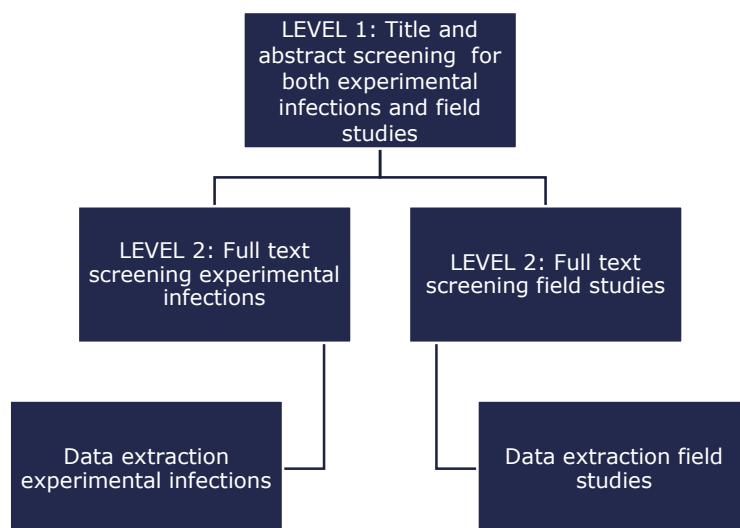


Figure 2. Review workflow to be applied for the output references for each of the aquatic species groups of interest.

Title and abstract review

The level 1 selection process involved the screening of title and abstract using a screening checklist developed according to the eligibility criteria defined in section 1 above. If the information contained in the title or abstract was not relevant for the research objectives (any of the eligibility criteria are not met), the article was not selected for full text assessment. The first level of screening was performed independently and blindly by two researchers (i.e., two reviewers per study). Conflicts were resolved before going to the second level. To solve conflicts, reviewers

discussed their reasoning and reached a consensus decision. Reasons for exclusion were recorded by Distiller.

Full text review

The level 2 selection process involved the screening of full text using a screening checklist developed according to the eligibility criteria defined section 1 above. This step was carried out by two reviewers. Conflicts were resolved before going to the second level. To solve conflicts, reviewers discussed their reasoning and reached a consensus decision. Reasons for exclusion were recorded by distiller.

Both level 1 and level 2 screenings involved an initial phase of harmonisation and training regarding the assessment of study eligibility criteria, across all screeners of each objective. During the selection process, Distiller will record automatically:

- Total number of unique records (title/abstracts) identified through electronic search
- Number of records excluded after level 1 screening
- Records (full text) potentially eligible
- Number of records excluded after level 2 screening (by reason for exclusion)
- Final number of studies included in the review

3. Methods for data collection

From those studies that passed both selection levels, data collection was performed using forms set up in Distiller® provided in Annex A. These forms ensured that data validity checks were performed during data collection, in particular compliance to the data types specified in the forms.

Changes to the existing forms during the review were avoided to ensure that all data collected were compatible with the data already collected in previous SLRs and were easy to be summarised. However, if adjustments or improvements to the data collection structure provided in Annex A are shown to be needed during the review process, those will be thoroughly documented during the course of the project.

One reviewer per study individually extracted data from studies that have passed both screening for relevance, but a quality assurance process was applied, as detailed below.

Authors of primary studies were contacted to provide missing data.

4. Data quality assurance

The following data quality assurance practices will be performed

1. New reviewers are always trained by a reviewer experienced in the process
2. Harmonisation rounds are performed in the beginning of each screening level, with reviewers sharing notes and thoughts on 5 papers before working independently
3. A "helpsheet" is developed for each SLR containing detailing instructions for the screening process. When a reviewer has questions about the eligibility or the format of data collection for any specific paper, the question is shared among the entire group by MS TEAMS, providing the paper refID so that the group can consult the reference in Distiller and discuss the question. If needed, the question is forwarded to the working group. Once consensus is reached, the specific questions and the reached agreement are documented in the helpsheet for future reference in the TEAMS folder.

4. One project leader experienced in the review is responsible for regularly reviewing the progress of the screening and running data validation checks directly in Distiller (using the datarama) or exporting the data.
5. In the data collection step, a free-text box is provided at the end of every form. Reviewers can use this box to take any notes on study quality issues notes, relevant data which could not be captured, or any other discrepancies or points worth noting. All forms with note in this box are reviewed by the project manager, and if they cannot be solved, they are passed to the EFSA working group.

3 Assessment

3.1 Prisma workflow

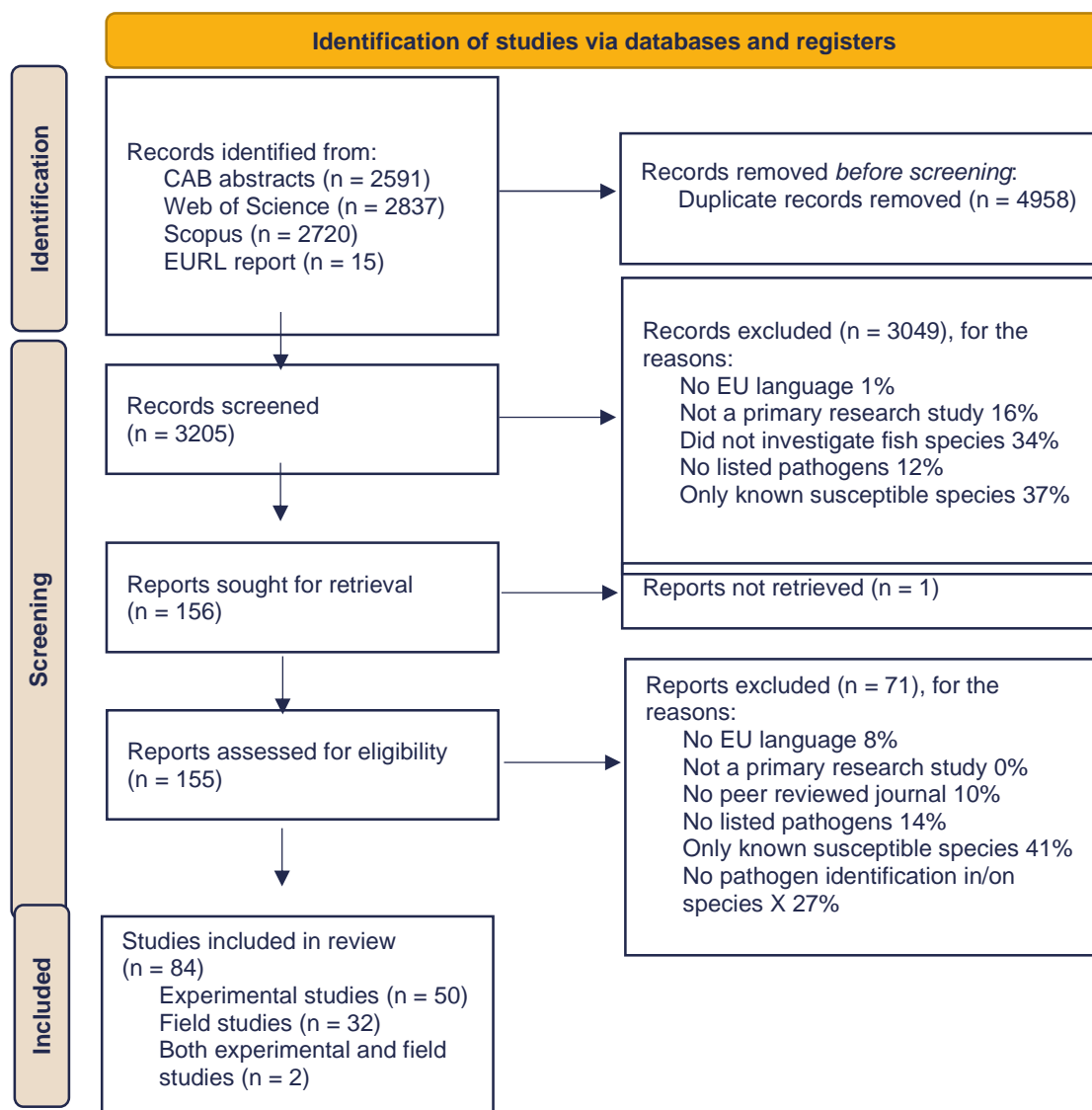


Figure 3: Prisma flowchart documenting the review process




Figure 3 provides an overview of the different steps in the review process. In total 3205 research publications were collected for abstract screening and from these 155 were selected for further full text analysis. In the final data collection and assessment 84 relevant research publications.

3.2 Data extraction tables

The results for crustacean species for which scientific evidence indicates that a role as vector species or reservoir species is likely are presented in Annex A under the 'Supporting information' section in the online version of this scientific output.

Appendix I – List of known susceptible species

Listed susceptible species for each listed disease according to the Annex to Implementing Regulation 2018/1882 as amended by Implementing Regulation (EU) 2022/925.

Listed diseases	SUSCEPTIBLE SPECIES	
	Scientific names	Common names
Epizootic haematopoietic necrosis	<i>Ameiurus melas</i>	Black bullhead
	<i>Bidyanus bidyanus</i>	Silver perch
	<i>Esox lucius</i>	Northern pike
	<i>Galaxias olidus</i>	Mountain galaxias
	<i>Gambusia affinis</i>	Mosquito fish
	<i>Gambusia holbrooki</i>	Eastern mosquitofish
	<i>Macquaria australasica</i>	Macquarie perch
	<i>Melanotaenia fluviatilis</i>	Crimson spotted rainbow fish (Murray river rainbowfish)
	<i>Oncorhynchus mykiss</i>	Rainbow trout
	<i>Perca fluviatilis</i>	Pike-perch
	<i>Sander lucioperca</i>	Zander
Viral haematopoietic septicaemia	<i>Alosa immaculata</i>	Pontic shad
	<i>Ameiurus nebulosus</i>	Brown bullhead
	<i>Ambloplites rupestris</i>	Rock bass
	<i>Ammodytes hexapterus</i>	Pacific sand lance
	<i>Aplodinotus grunniens</i>	Freshwater drum
	<i>Centrolabrus exoletus</i>	Rock cook
	<i>Clupea harengus</i>	Atlantic herring
	<i>Clupea pallasii pallasii</i>	Pacific herring
	<i>Coregonus artedii</i>	Cisco
	<i>Coregonus clupeaformis</i>	Lake whitefish
	<i>Coregonus lavaretus</i>	European whitefish
	<i>Ctenolabrus rupestris</i>	Goldsinny wrasse
	<i>Cyclopterus lumpus</i>	Lumpfish
	<i>Cymatogaster aggregata</i>	Shiner perch
	<i>Dorosoma cepedianum</i>	American gizzard shad
	<i>Danio rerio</i>	Zebra danio
	<i>Engraulis encrasicolus</i>	European anchovy
	<i>Esox lucius</i>	Northern pike
	<i>Esox masquinongy</i>	Muskellunge
	<i>Fundulus heteroclitus</i>	Mummichog
	<i>Gadus macrocephalus</i>	Pacific cod
	<i>Gadus morhua</i>	Atlantic cod
	<i>Gaidropsarus vulgaris</i>	Three-bearded rockling
	<i>Gasterosteus aculeatus</i>	Three-spine stickleback
	<i>Labrus bergylta</i>	Ballan wrasse
	<i>Labrus mixtus</i>	Cuckoo wrasse

Listed diseases	SUSCEPTIBLE SPECIES	
	Scientific names	Common names
Viral haematopoietic septicaemia	<i>Lampetra fluviatilis</i>	European river lamprey
	<i>Lepomis gibbosus</i>	Pumpkinseed
	<i>Lepomis macrochirus</i>	Bluegill
	<i>Limanda limanda</i>	Common dab
	<i>Merlangius merlangus</i>	Whiting
	<i>Micropterus dolomieu</i>	Smallmouth bass
	<i>Micropterus salmoides</i>	Largemouth bass
	<i>Micromesistius poutassou</i>	Blue whiting
	<i>Morone americana</i>	White perch
	<i>Morone chrysops</i>	White bass
	<i>Morone saxatilis</i>	Striped bass
	<i>Mullus barbatus</i>	Red mullet
	<i>Neogobius melanostomus</i>	Round goby
	<i>Notropis atherinoides</i>	Emerald shiner
	<i>Notropis hudsonius</i>	Spottail shiner
	<i>Oncorhynchus kisutch</i>	Coho salmon
	<i>Oncorhynchus mykiss</i>	Rainbow trout
	<i>Oncorhynchus mykiss X</i>	Rainbow trout X
	<i>Oncorhynchus kisutch hybrids</i>	coho salmon hybrids
	<i>Oncorhynchus tshawytscha</i>	Chinook salmon
	<i>Paralichthys olivaceus</i>	Bastard halibut
	<i>Perca flavescens</i>	American
	<i>Pimephales notatus</i>	Bluntnose minnow
	<i>Pimephales promelas</i>	Fathead minnow
	<i>Platichthys flesus</i>	European flounder
	<i>Pleuronectes platessa</i>	European plaice
	<i>Pomatoschistus minutus</i>	Sand goby
	<i>Pomoxis nigromaculatus</i>	Black crappie
	<i>Raja clavata</i>	Thornback ray
	<i>Salmo marmoratus</i>	Marble trout
	<i>Salmo salar</i>	Atlantic salmon
	<i>Salmo trutta</i>	Brown trout
	<i>Salvelinus namaycush</i>	Lake trout
	<i>Sander vitreus</i>	Walleye
	<i>Sardina pilchardus</i>	European pilchard
	<i>Sardinops sagax</i>	South American pilchard
	<i>Scomber japonicus</i>	Pacific chub mackerel
	<i>Scophthalmus maximus</i>	Turbot
	<i>Solea senegalensis</i>	Senegalese sole
	<i>Sprattus sprattus</i>	European sprat
<i>Symphodus melops</i>	Corkwing wrasse	
<i>Thaleichthys pacificus</i>	Eulachon	
<i>Trachurus mediterraneus</i>	Mediterranean horse mackerel	
<i>Trisopterus esmarkii</i>	Norway pout	

Listed diseases	SUSCEPTIBLE SPECIES	
	Scientific names	Common names
		<i>Thymallus thymallus</i>
	<i>Uranoscopus scaber</i>	Atlantic stargazer
Infectious hematopoietic necrosis	<i>Esox lucius</i>	Northern pike
	<i>Onchorynchus clarkii</i>	Cutthroat trout
	<i>Oncorhynchus keta</i>	Chum salmon
	<i>Oncorhynchus kisutch</i>	Coho salmon
	<i>Oncorhynchus masou</i>	Masu salmon
	<i>Oncorhynchus mykiss</i>	Rainbow trout
	<i>Oncorhynchus nerka</i>	Sockeye salmon
	<i>Oncorhynchus tshawytscha</i>	Chinook salmon
	<i>Salmo marmoratus</i>	Marble trout
	<i>Salmo salar</i>	Atlantic salmon
	<i>Salmo trutta</i>	Brown trout
	<i>Salvelinus alpinus</i>	Arctic char
	<i>Salvelinus fontinalis</i>	Brook trout
<i>Salvelinus namaycush</i>	Lake trout	
Koi herpes virus disease	All varieties and subspecies of <i>Cyprinus carpio</i> and <i>Cyprinus carpio</i> hybrids e.g. <i>Cyprinus carpio</i> × <i>Carassius auratus</i> , <i>Cyprinus carpio</i> × <i>Carassius carassius</i>	
Infection with HPR-deleted infectious salmon anaemia virus	<i>Oncorhynchus mykiss</i>	Rainbow trout
	<i>Salmo salar</i>	Atlantic salmon
	<i>Salmo trutta</i>	Brown trout

Appendix II – Complete search strings

Summary of the results

	CAB Abstracts	Web of Science	Scopus	After de-duplication
Infection with HPR-deleted infectious salmon anaemia virus	358	370	400	526
Koi herpes virus disease	367	375	365	494
Epizootic haematopoietic necrosis	92	112	86	147
Infectious haematopoietic necrosis	889	1,011	923	1,412
Viral haemorrhagic septicaemia	885	969	948	1,189
After de-duplication:				3,191
Including the references of the EUR report				3,206

Search strings

Infection with HPR-deleted infectious salmon anaemia virus

Terms
ISAV
Isa virus
Isavirus*
infectious salmon anaemia
Infectious salmon anemia
(HPR)-deleted ISAV

CAB Abstracts

Set	Query	Results
#1	TS=(ISAV OR Isavirus* OR "isa virus*" OR (infectio* NEAR/3 (salmon OR salmons OR salmoni*) NEAR/3 (anemia* OR anaemia*)))	575
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	3,854,967
#3	#1 AND #2 and English or Spanish or French or Polish or Norwegian or Unspecified or Slovak (Languages)	358

Web of Science Core Collection

Set	Query	Results
#1	TS=(ISAV OR Isavirus* OR "isa virus*" OR (infectio* NEAR/3 (salmon OR salmons OR salmoni*) NEAR/3 (anemia* OR anaemia*))	595
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	12,014,499
#3	#1 AND #2 and Meeting Abstract (Exclude - Document Types) and Polish or Spanish or English (Languages)	370

Scopus

Set	Query	Results
#1	TITLE-ABS-KEY (isav OR isavirus* OR "isa virus*" OR (infectio* W/3 salmon W/3 anemia*) OR (infectio* W/3 salmon W/3 anaemia*) OR (infectio* W/3 salmons W/3 anaemia*) OR (infectio* W/3 salmonid* W/3 anemia*) OR (infectio* W/3 salmonid* W/3 anaemia*))	596
#2	TITLE-ABS-KEY (detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	22,552,050
#3	(TITLE-ABS-KEY (isav OR isavirus* OR "isa virus*" OR (infectio* W/3 salmon W/3 anemia*) OR infectio* W/3 salmon W/3 anaemia*) OR (infectio* W/3 salmons W/3 anaemia*) OR (infectio* W/3 salmons W/3 anaemia*) OR (infectio* W/3 salmonid* W/3 anemia*) OR (infectio* W/3 salmonid* W/3 anaemia*))) AND (TITLE-ABS-KEY (detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Spanish") OR LIMIT-TO (LANGUAGE , "Polish") OR LIMIT-TO (LANGUAGE , "French")))	400

Koi herpes virus disease

Terms
Cyprinid herpes virus 3
Cyprinid herpesvirus 3
Koi herpes virus*
Koi herpesvirus*
CyHV-3
KHV

CAB Abstracts

Set	Query	Results
#1	TS=("Cyprinid herpes virus 3" OR "Cyprinid herpesvirus 3" OR "Cyprinid herpes viruses 3" OR "Cyprinid herpesviruses 3" OR "Koi herpes virus*" OR "Koi herpesvirus*" OR CyHV-3 OR (KHV AND (virus* OR herpesvirus*)))	535
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	3,854,967
#3	#1 AND #2 and English or Polish or Czech or German or Hungarian or Serbian or Dutch or Italian or Slovak or French (Languages)	367

Web of Science Core Collection

Set	Query	Results
#1	TS=("Cyprinid herpes virus 3" OR "Cyprinid herpesvirus 3" OR "Cyprinid herpes viruses 3" OR "Cyprinid herpesviruses 3" OR "Koi herpes virus*" OR "Koi herpesvirus*" OR CyHV-3 OR (KHV AND (virus* OR herpesvirus*)))	512
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	12,014,499
#3	#1 AND #2 and Meeting Abstract (Exclude – Document Types) and Polish or Hungarian or German or English (Languages)	375

Scopus

Set	Query	Results
#1	TITLE-ABS-KEY ("Cyprinid herpes virus 3" OR "Cyprinid herpesvirus 3" OR "Cyprinid herpes viruses 3" OR "Cyprinid herpesviruses 3" OR "Koi herpes virus*" OR "Koi herpesvirus*" OR cyhv-3 OR (khv AND (virus* OR herpesvirus*)))	480
#2	TITLE-ABS-KEY (detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	22,552,050
#3	(TITLE-ABS-KEY ("Cyprinid herpes virus 3" OR "Cyprinid herpesvirus 3" OR "Cyprinid herpes viruses 3" OR "Cyprinid herpesviruses 3" OR "Koi herpes virus*" OR "Koi herpesvirus*" OR cyhv-3 OR (khv AND (virus* OR herpesvirus*)))) AND (TITLE-ABS-KEY (detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "German") OR LIMIT-TO (LANGUAGE , "Hungarian") OR LIMIT-TO (LANGUAGE , "Polish"))	365

Epizootic haematopoietic necrosis

Terms
EHNV
EHN Virus

Epizootic haematopoietic necrosis
Epizootic hematopoietic necrosis
Epizootic necrosis haematopoietic
Epizootic necrosis hematopoietic

CAB Abstracts

Set	Query	Results
#1	TS=(EHNV OR "EHN virus*" OR "Epizootic haematopoietic necros*" OR "Epizootic hematopoietic necros*" OR " Epizootic necrosis haematopoietic" OR "Epizootic necrosis hematopoietic")	118
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	3,854,967
#3	#1 AND #2 and Spanish or English (Languages)	92

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Set	Query	Results
#1	TS=(EHNV OR "EHN virus*" OR "Epizootic haematopoietic necros*" OR "Epizootic hematopoietic necros*" OR " Epizootic necrosis haematopoietic" OR "Epizootic necrosis hematopoietic")	113
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	12,014,499
#3	#1 AND #2 and English or Spanish (Languages)	112

Scopus

Set	Query	Results
#1	TITLE-ABS-KEY (EHNV OR "EHN virus*" OR "Epizootic haematopoietic necros*" OR "Epizootic hematopoietic necros*" OR " Epizootic necrosis haematopoietic" OR "Epizootic necrosis hematopoietic")	95
#2	TITLE-ABS-KEY (detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	22,552,050
#3	(TITLE-ABS-KEY (detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")) AND (TITLE-ABS-KEY (ehnv OR "EHN virus*" OR "Epizootic haematopoietic necros*" OR "Epizootic hematopoietic necros*" OR " Epizootic necrosis haematopoietic" OR "Epizootic necrosis hematopoietic")) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "French") OR LIMIT-TO (LANGUAGE , "Spanish"))	86

Infectious haematopoietic necrosis

Terms
Infectious haematopoietic necrosis
Infectious hematopoietic necrosis
Haematopoietic necrosis virus
Hematopoietic necrosis virus
IHNV
IHN Virus
Infectious haematopoietic necrosis virus

CAB Abstracts

Set	Query	Results
#1	TS=("Infectious haematopoietic necros*" OR "Infectious hematopoietic necros*" OR "Haematopoietic necrosis virus*" OR "Hematopoietic necrosis virus*" OR IHNV OR "IHN virus*")	1,450
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	3,854,967
#3	#1 AND #2 6 and Abstract Only (Exclude – Document Types) and English or French or Spanish or German or Polish or Czech or Croatian or Italian or Portuguese or Serbo Croatian (Languages)	889

Web of Science Core Collection

Set	Query	Results
#1	TS=("Infectious haematopoietic necros*" OR "Infectious hematopoietic necros*" OR "Haematopoietic necrosis virus*" OR "Hematopoietic necrosis virus*" OR IHNV OR "IHN virus*")	1,491
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	12,014,499
#3	#1 AND #2 and Meeting Abstract (Exclude – Document Types) and English or Spanish or Polish or French or German (Languages)	1,011

Scopus

Set	Query	Results
#1	TITLE-ABS-KEY ("Infectious haematopoietic necros*" OR "Infectious hematopoietic necros*" OR "Haematopoietic necrosis virus*" OR "Hematopoietic necrosis virus*" OR IHNV OR "IHN virus*")	1,279
#2	TITLE-ABS-KEY (detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR	22,552,050

	transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	
#3	TITLE-ABS-KEY (detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation") AND (TITLE-ABS-KEY ("Infectious haematopoietic necros*" OR "Infectious hematopoietic necros*" OR "Haematopoietic necrosis virus*" OR "Hematopoietic necrosis virus*" OR ihnv OR "IHN virus*")) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Spanish") OR LIMIT-TO (LANGUAGE , "Polish") OR LIMIT-TO (LANGUAGE , "French") OR LIMIT-TO (LANGUAGE , "German") OR LIMIT-TO (LANGUAGE , "Croatian"))	923

Viral haemorrhagic septicaemia

Terms
Viral haemorrhagic septicaemia
viral hemorrhagic septicemia
Egtved virus
Haemorrhagic septicaemia virus
Hemorrhagic septicemia virus
VHSV
VHS Virus

CAB Abstracts

Set	Query	Results
#1	TS=("Viral haemorrhagic septicaemia" OR "viral hemorrhagic septicemia" OR "Egtved virus*" OR "Haemorrhagic septicaemia virus*" OR "Hemorrhagic septicemia virus*" OR VHSV OR "VHS virus*")	1,431
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	3,854,967
#3	#1 AND #2 and English or German or French or Spanish or Polish or Czech or Serbo Croatian or Bulgarian or Croatian or Danish or Italian or Norwegian or Portuguese or Romanian or Slovak or Slovenian (Languages)	855

Web of Science Core Collection

Set	Query	Results
#1	TS=("Viral haemorrhagic septicaemia" OR "viral hemorrhagic septicemia" OR "Egtved virus*" OR "Haemorrhagic septicaemia virus*" OR "Hemorrhagic septicemia virus*" OR VHSV OR "VHS virus*")	1,540
#2	TS=(detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "co habitation")	12,014,499
#3	#1 AND #2 and Meeting Abstract (Exclude - Document Types) and English or German or Polish or French (Languages)	969

Scopus

Set	Query	Results
#1	TITLE-ABS-KEY ("Viral haemorrhagic septicaemia" OR "viral hemorrhagic septicemia" OR "Egtved virus*" OR "Haemorrhagic septicaemia virus*" OR "Hemorrhagic septicemia virus*" OR VHSV OR "VHS virus*")	1,373
#2	TITLE-ABS-KEY detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "cohabitation")	(22,552,050
#3	(TITLE-ABS-KEY ("Viral haemorrhagic septicaemia" OR "viral hemorrhagic septicemia" OR "Egtved virus*" OR "Haemorrhagic septicaemia virus*" OR "Hemorrhagic septicemia virus*" OR vhsv OR "VHS virus*")) AND (TITLE-ABS-KEY (detect* OR experiment* OR isolat* OR occurren* OR susceptib* OR transmit* OR transmiss* OR inoculat* OR immersion OR ingestion OR cohabitation OR "cohabitation")) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "German") OR LIMIT-TO (LANGUAGE , "French") OR LIMIT-TO (LANGUAGE , "Polish") OR LIMIT-TO (LANGUAGE , "Croatian") OR LIMIT-TO (LANGUAGE , "Spanish")))	948



Annex A – Assessment of potential vectors and reservoir species of pathogens of fish, listed in Annex II to the AHL

Annex A is available under the 'Supporting Information' section on the online version of the scientific output.