2.3.1 Other Viruses Isolated from Fish

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A. Introduction

In the course of laboratory examinations using fish cell culture assays to detect infectious viruses or during inspections to show freedom from specific pathogens, replicating agents other than those listed in the Blue Book are sometimes encountered that can confound a diagnosis. While some of these viruses have been shown to be of low or undetermined virulence for fish and currently not of regulatory or reporting concern, other agents are emerging pathogens that have been associated with disease conditions and are potential candidates for future chapters of the Blue Book. Here, we provide a brief description of some of the viruses that are not included in the current version of the Blue Book, the cell culture conditions used to isolate them, a photograph of their cytopathic effect (CPE) and a short list of references. The list is limited to viruses for which a molecular assay has been published that, while typically not validated, can be used to confirm their identity.

B. Aquareoviruses

Description of the virus:

Aquareovirus virions are non-enveloped, spherical particles of approximately 70 nm in diameter with a double capsid shell. The genome consists of 11 segments of double-stranded RNA. Members include the Chum salmon virus, Golden shiner virus, $13p_2$ reovirus from shellfish, Channel catfish reovirus, Grass carp virus, and many others that have been isolated across a broad host and geographic range. Aquareoviruses are usually isolated at low titer from normal fish or shellfish that are being examined for other pathogens. Genogrouping is used to place various isolates into seven species within the genus *Aquareovirus* in the family *Reoviridae.*

Methods for isolation:

Aquareoviruses are typically isolated from ovarian fluids or internal organs of asymptomatic fish. Most grow best in the CHSE-214 cell line, but also have been isolated using other lines. Aquareoviruses tend to grow best at incubation temperatures near the optimum of the host species (15-25°C) and produce a characteristic syncytial form of CPE in 5-10 days (Fig. 1). A PCR assay for aquareoviruses is described in Seng et al. (2004).

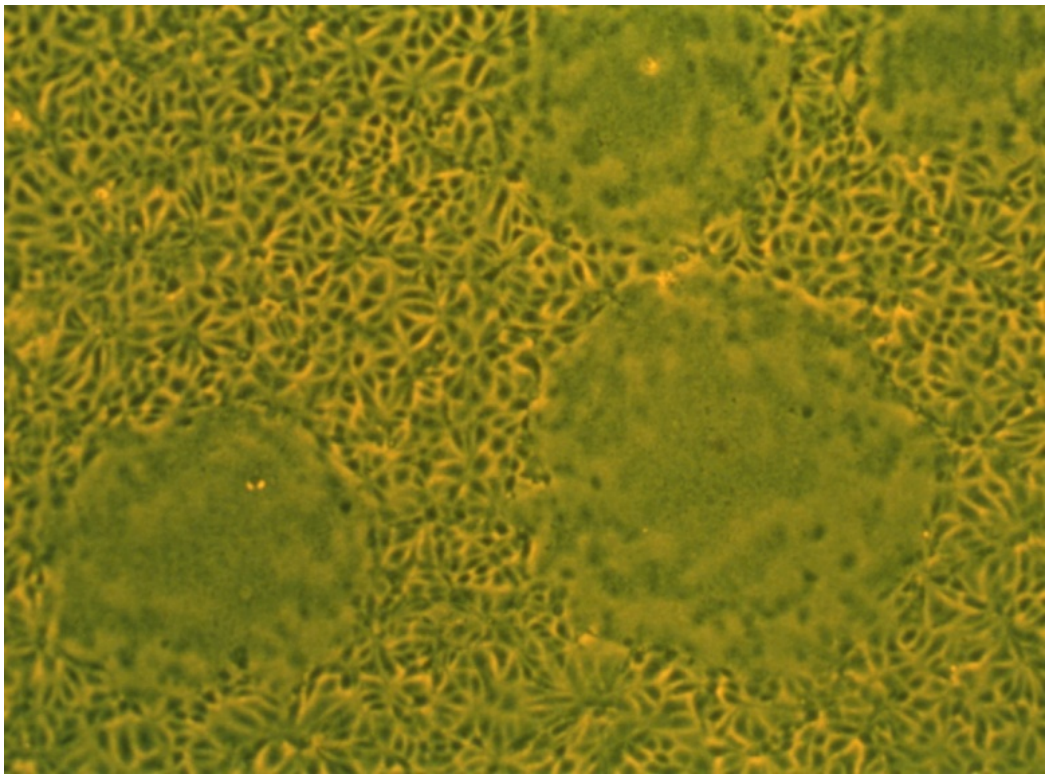

Figure 1. Cytopathic effects in CHSE-214 cells following infection by the Chum salmon virus (CSV). Photo by J.R. Winton

C. Hepeviruses

Description of the virus:

Hepevirus virions are non-enveloped, small round particles of approximately 30 nm in diameter. The genome consists of a single molecule of capped, polyadenylated, positive-sense, single-stranded RNA. Best known for producing type E Hepatitis in humans, the Cutthroat trout virus (CTV) is the only known example from fish. CTV has been isolated from normal adult trout broodstocks in several parts of the western United States, but has not been associated with disease. The virus is proposed as the type species of a new genus *Cutrovirus* in the family *Hepeviridae*.

Methods for isolation:

CTV is typically isolated from ovarian fluid or internal organ samples of asymptomatic fish at spawning. The virus grows slowly in CHSE-214 cells at 15°C and produces a diffuse CPE in 14-21 days (Fig. 2). A PCR assay for CTV is described in Batts et al. (2011).

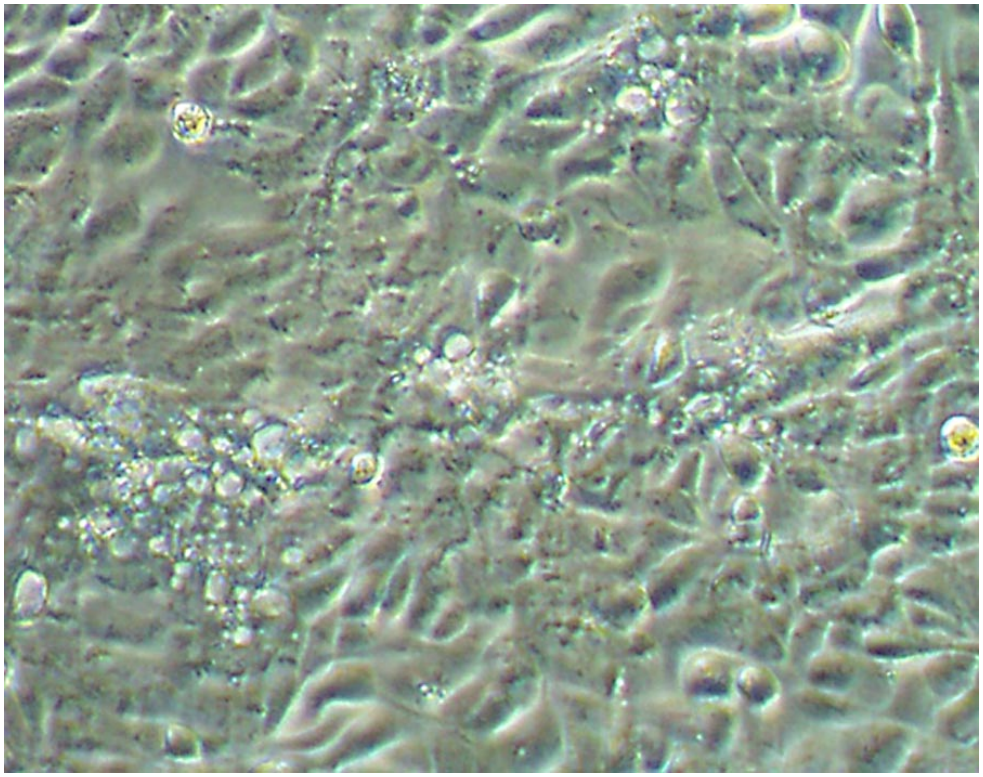

Figure 2. Cytopathic effects in CHSE-214 cells following infection by the Cutthroat trout virus (CTV). Photo courtesy of R. Hedrick

D. Paramyxoviruses

Description of the virus:

Paramyxovirus virions are large, enveloped, pleomorphic particles of 150 nm or greater in diameter. The genome consists of a single molecule of negative-sense, single-stranded RNA. Mainly known as pathogens of mammals, birds and reptiles, two species of paramyxoviruses have been isolated from fish, the Atlantic salmon paramyxovirus (ASPV) from diseased Atlantic salmon *Salmo salar* reared in saltwater net-pens in Norway and the Pacific salmon paramyxovirus (PSPV) from normal adult Chinook salmon *Oncorhynchus tshawytscha* returning to rivers along the west coast of North America from California to Alaska. PSPV has not been associated with disease in salmonids. The salmon paramyxoviruses, ASPV and PSPV, have been proposed as species with a genus *Aquaparamyxovirus* of the family *Paramyxoviridae*.

Methods for isolation:

The Pacific salmon paramyxovirus is typically isolated from reproductive fluids or internal organ samples of asymptomatic adult salmon (mainly Chinook) at spawning. The virus grows quite slowly in CHSE-214 cells at 15°C and produces a diffuse type of CPE in 14-28 days (Fig. 3). A PCR assay for PSPV is described in Batts et al. (2008).

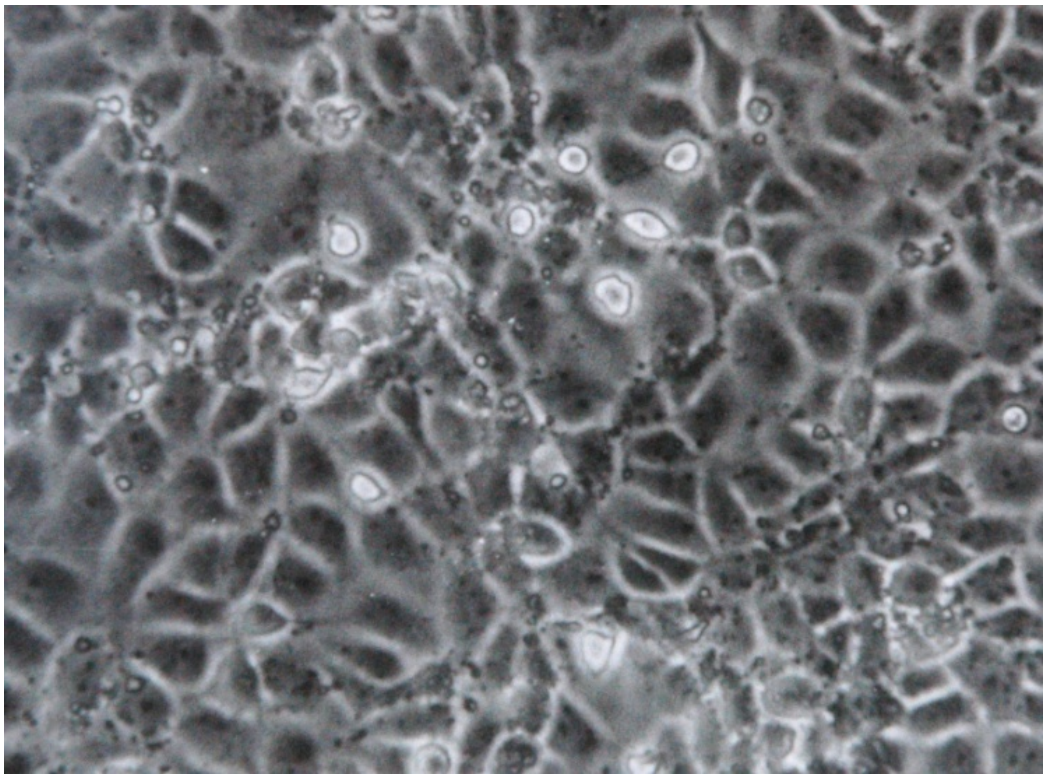

Figure 3. Cytopathic effects in CHSE-214 cells following infection by the Pacific salmon paramyxovirus (PSPV). Photo from Winton et al. (1985).

E. Nidoviruses

Description of the virus:

The nidoviruses are a large order of viruses containing pathogens affecting a broad range of species from shrimp to humans. The morphology of the enveloped virions of nidoviruses ranges from largely spherical particles of 120-160 nm to rod-shaped or bacilliform particles of 50 by 170 nm. The genomes of nidoviruses are composed of a single molecule of positive-sense, single-stranded RNA and include some of the largest genomes known for RNA viruses. Two nidoviruses are known from fish, the white bream virus (WBV), isolated from healthy white bream in Germany, and the fathead minnow nidovirus (FHMNV) that has been isolated from both healthy and diseased fathead minnows *Pimephales promelas* in the midwestern portion of the United States. FHMNV is proposed as the second species of the genus *Bafinivirus* in the family *Coronaviridae* within the order *Nidovirales.*

Methods for isolation:

The fathead minnow nidovirus has been isolated from internal tissues of fathead minnows, principally from the upper midwestern United States, but is likely more widespread. The virus grows well at 15°C in the EPC or FHM cell lines and produces a syncytial type of CPE in 3-7 days (Fig. 4). A PCR assay for FHMNV is described in Batts et al. (2012).

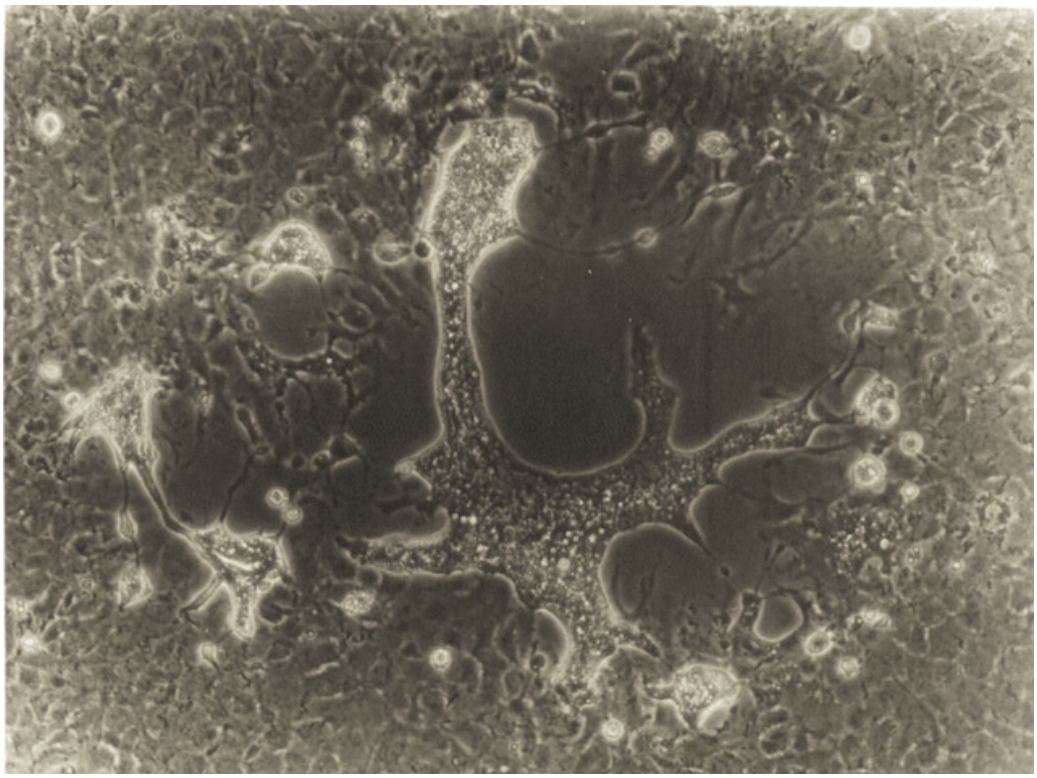

Figure 4. Cytopathic effects in EPC cells following infection by the Fathead minnow nidovirus (FHMNV). Photo from Iwanowicz and Goodwin (2002).

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