

Risks to Wild Freshwater Fisheries from Viral Haemorrhagic Septicaemia (VHS) Disease

Summary

- There is a risk of transfer of VHSV from farmed to wild freshwater fish species and vice versa.
- There is evidence that a reservoir of infection may be created in wild freshwater fish species. This may pose a risk of re-infection of farms (eg rainbow trout).
- There are no reports of VHSV infection leading to significant disease outbreaks in wild freshwater fish stocks.
- Based on evidence from outbreaks in farms and experimental evidence, free living rainbow trout, brown trout, whitefish, grayling and pike may be at risk of disease.
- Available evidence suggests a high infection pressure would be required to initiate a disease outbreak in wild fish (eg shedding of virus from an infected farm).

Evidence

There is a risk of transfer of VHSV from farmed to wild freshwater fish species and vice versa

The transfer of infection between free-living and farmed fish in the freshwater environment has been suspected in many cases during the 40-year history of VHS control in both Denmark and Germany (Skall, pers comm). Indeed, VHSV-infected free-living, mainly feral fish including brown and rainbow trout, have been identified on several occasions (Ahne & Jørgensen 1993, Enzmann et al. 1987, 1992, 1993; Jørgensen 1982; Meier et al. 1986; Olesen & Jørgensen 1983). Furthermore a correlation between infection status of nearby fish farms and evidence of infection in free living rainbow trout has been established in Denmark (Skall, pers comm.). While the direction of viral transmission (ie farm to wild or wild to farmed fish) is often difficult to ascertain, VHSV which causes disease in rainbow trout is widely believed to have been introduced to rainbow trout aquaculture from a marine source (Snow et al., 2004). Since isolates from wild freshwater fish are genetically similar to those causing disease outbreaks in farms (Einer-Jensen et al., 2004), these viruses therefore probably originated in association with aquaculture. Evidence from Denmark and Germany indicates that once VHSV is established in a water catchment system as a result of disease in farms, the virus may become enzootic and wild carrier fish may present a risk of re-infection of farmed fish. Such re-infection of farms is likely linked to the presence of a large number of highly susceptible host species and the artificial conditions under which they are cultured.

Mechanisms of Transmission of VHS

VHS is believed to be primarily spread through transport of live infected fish (Skall, 2005) though it can also be transmitted via contaminated water (Jorgensen, 1973). In the latter case, such incidences are usually correlated with the presence of clinical disease on

rainbow trout farms which have the potential to create a large infection pressure via the shedding large quantities of virus. There are no reports of VHS having been spread via angling activities or angling equipment.

Free living freshwater fish species which might be at risk of infection with VHSV in Europe

The freshwater host range for VHSV was recently reviewed by Skall et al. (2005). Evidence of VHS infection has been demonstrated in a range of wild-caught freshwater species including brown trout (*Salmo trutta*), white fish (*Corgonus* sp), grayling (*Thymallus thymallus*) pike (*Esox lucius*) and European eel (*Anguilla anguilla*) (Castric et al., 1992; Enzmann et al. 1987, 1992, 1993; Thiery et al, 2002). Free living rainbow trout can also be infected and are believed to be a primary risk factor in the transmission of VHS disease from wild to farmed fish in Denmark (Skall pers comm.). Other species which have been demonstrated to replicate virus experimentally include Brook trout (*Salvelinus fontinalis*) (Rasmussen, 1965), Golden trout (*Oncorhynchus aguabonita*) (Ahne et al, 1976) and Rainbow trout x coho salmon (Ord et al., 1976). VHSV has never been isolated from Atlantic salmon in freshwater despite extensive routine monitoring. Infection of a small proportion of carrier individuals has been demonstrated following water-borne infection (de Kinkelin & Castric, 1982; King et al., 2002) but such experiments involved artificially high levels of infection pressure which most likely would not be encountered in the wild fish environment.

Evidence for disease occurrence in wild freshwater fish

Outbreaks of disease have never been reported in wild fish, although disease outbreaks are often difficult to identify in wild stocks. Losses in farmed rainbow trout and brown trout aquaculture (Jørgensen, 1980; de Kinkelin and le Berre, 1977) suggest that these species of wild fish could be at risk of disease. Fluctuations in the prevalence of antibodies over a period of four years have also been interpreted as suggesting the maintenance of an epidemic within wild populations of brown trout (Enzmann et al., 1992). VHSV has also been reported to induce mortality in pike (*Esox lucius*) in experimental studies and in a hatchery situation (Meier and Jørgensen, 1980; Enzmann et al., 1993). Infections of whitefish with VHSV were reported in Germany and Switzerland (Ahne & Thomsen 1985; Meier et al., 1986) with fish showing typical VHS clinical signs. Whitefish have also been shown to be susceptible to VHS in experimental trials (Skall et al., 2004). VHS disease has been demonstrated in Atlantic salmon following injection with VHSV but not by water-borne transmission (de Kinkelin & Castric, 1982).

31 May 2006

References

- Ahne W. & Jørgensen P.E.V. (1993) Prevalence of neutralising antibodies to IHNV and VHSV in free-living and cultured rainbow trout in Germany. *Bulletin of the European Association of Fish Pathologists* 13, 7–9.
- Ahne, W., Negele, R.D. & Ollenschlager B. (1976) Verleichende Infektionsversuche mit Egtved-Viren (Stamm F1) bei Regenbogenforellen (*Salmo gairdneri*) und Goldforellen (*Salmo aguabonita*). *Berliner und Munchener Tierarznei Wochenschrift* 89, 161-164.
- Ahne W. & Thomsen I. (1985) Occurrence of VHS virus in wild white fish (*Coregonus* sp.) *Zentralblatt für Veterinärmedizin* 32, 73-75
- Castric J., Jeffroy J., Bearzotti M. & de Kinkelin P. (1992) Isolation of viral haemorrhagic septicaemia virus (VHSV) from wild elvers *Anguilla anguilla*. *Bulletin of the European Association of Fish Pathologists* 12, 21–23.
- De Kinkelin P. & le Berre M. (1977) Isolement d'un Rhabdovirus pathogène de la Truite Fario (*Salmo trutta* L., 1766). *C.R.Acad.Sc.Paris* 284, 101-104
- De Kinkelin, P. & Castric, J. (1982) An experimental study of the susceptibility of Atlantic salmon fry, *Salmo salar* L., to viral haemorrhagic septicaemia. *J. Fish Dis* 5, 57-65.
- Einer-Jensen K., Ahrens P., Forsberg R. & Lorenzen N. (2004) Evolution of the fish rhabdovirus viral haemorrhagic septicaemia virus. *Journal of General Virology* 85, 1167–1179.
- Enzmann P.-J., Konrad M., Parey K. & Wetzlar H. (1987) Natürliches wirtsspektrum des virus der viralen hämorrhagischen septikämie der regenbogenforelle. *Tierärztliche Umschau* 42, 228–230.
- Enzmann P.J., Konrad M. & Rapp J. (1992) Epizootiological studies on viral haemorrhagic septicaemia in brown trout *Salmo trutta fario*. *Diseases of Aquatic Organisms* 12, 143–146.
- Enzmann P.-J., Konrad M. & Parey K. (1993) VHS in wild living fish and experimental transmission of the virus. *Fisheries Research* 17, 153–161.
- Jørgensen P.E.V. (1982) Egtved virus: occurrence of inapparent infections with virulent virus in free-living rainbow trout, *Salmo gairdneri* Richardson, at low temperature. *Journal of Fish Diseases* 5, 251–255.
- Jørgensen P.E.V. (1980). Egtved virus: the susceptibility of brown trout and rainbow trout to eight virus isolates and the significance of the findings for the VHS control. In Ahne W (Ed.): *Fish Diseases*. Springer-Verlag, Berlin 1980; Pages 3-7.
- Jørgensen, P.E.V. (1973) Artificial transmission of viral haemorrhagic septicaemia (VHS) of rainbow trout. *Rivista Italiana di Piscicoltura e ittiopatologia* 8, 101-102
- King J.A., Snow M., Skall H.F. & Raynard R.S. (2001) Experimental susceptibility of Atlantic salmon *Salmo salar* and turbot *Scophthalmus maximus* to European freshwater and marine isolates of viral haemorrhagic septicaemia virus. *Diseases of Aquatic Organisms* 47, 25–31.
- Meier W., Ahne W. & Jørgensen P.E.V. (1986) Fish viruses: viral haemorrhagic septicaemia in white fish (*Coregonus* sp.). *Journal of Applied Ichthyology* 2, 181–186
- Meier W. & Jørgensen P.E.V. (1986) Isolation of VHS virus from pike fry (*Esox lucius*) with haemorrhagic symptoms. Pages 8-17 in W. Ahne (Ed.) *Fish Diseases*. Springer-Verlag, Berlin.
- Meier W, Jørgensen P.E.V. Isolation of VHS virus from pike (*Esox lucius* L.) with hemorrhagic symptoms. In Ahne W (Ed.): *Fish Diseases*. Springer-Verlag, Berlin 1980; pages 8-17
- Olesen N.J. & Jørgensen P.E.V. (1983) Egtvedsyge (VHS) i fritlevende regnbueørreder. *Ferskvandfiskeribladet* 81, 130–132.
- Ord, W.M., Le Berre, M. & de Kinkelin, P. (1976) Viral haemorrhagic septicaemia; Comparative susceptibility of rainbow trout (*Salmo gairdneri*) and hybrids (*S. gairdneri* x *Oncorhynchus kisutch*) to experimental infection. *Journal of the Fisheries Research Board of Canada* 33, 1205-1208

Rasmussen C.J. (1965) A biological study of the Egtved disease (INUL). *Annals of the New York Academy of Sciences* **126**, 427–460.

Skall, H. F., Olesen, N. J. & Møllgaard, S. (2005) Viral haemorrhagic septicaemia virus in marine fish and its implications for fish farming – a review. *Journal of Fish Diseases* **28**, 509-529.

Skall H.F., Sliereendrecht W.J., King J.A. & Olesen N.J. (2004) Experimental infection of rainbow trout *Oncorhynchus mykiss* with viral haemorrhagic septicaemia virus isolates from European marine and farmed fishes. *Diseases of Aquatic Organisms* **58**, 99–110.

Snow M., Bain N., Black J., Taupin V., Cunningham C.O., King J.A., Skall H.F. & Raynard R.S. (2004) Genetic population structure of marine viral haemorrhagic septicaemia virus (VHSV). *Diseases of Aquatic Organisms* **61**, 11–21.

Thiéry R., de Boisséson C., Jeffroy J., Castric J., de Kinkelin P. & Benmansour A. (2002) Phylogenetic analysis of viral haemorrhagic septicaemia virus (VHSV) isolates from France (1971–1999). *Diseases of Aquatic Organisms* **52**, 29–37.

