

Keeping coldwater ornamental fish is very popular in the UK, but according to **Keith Way**, owners need to be aware of the wide range of virus diseases that can decimate their stock.



Coldwater and tropical ornamental fish are the third most popular pet in the UK after cats and dogs. The English Housing Survey in 2001 estimated that over 3 million homes owned ponds with the intent of attracting wildlife. The Ornamental Aquatic Trade Association (OATA) estimated in 2008 that 2.1 million households in the UK had a garden pond containing ornamental fish.

Koi carp (*Cyprinus carpio koi*) and goldfish (*Carassius auratus*) are the species most commonly kept in garden ponds and coldwater aquaria. Aquatic retail outlets sell and distribute a wide range of ornamental fish species, including many varieties of goldfish and ornamental varieties of carp, orfe (*Leuciscus idus*), tench (*Tinca tinca*) and grass carp (*Ctenopharygodon idella*).

#### Virus diseases

The first disease of fish to be described, later recognized to be caused by a virus, was carp pox. The existence of a pox affecting carp was documented by the famous medieval Swiss zoologist Konrad von Gessner as early as 1558. He named the condition 'Karpfenpocke' because the epidermal hyperplastic lesions bore some resemblance to smallpox, which was prevalent in the human population in Europe in the 16th century. The disease will be familiar to many hobbyists, which is seen as raised white or translucent patches on the skin of koi and common carp in winter and spring (Fig. 1). Carp pox, like chicken pox in humans, is

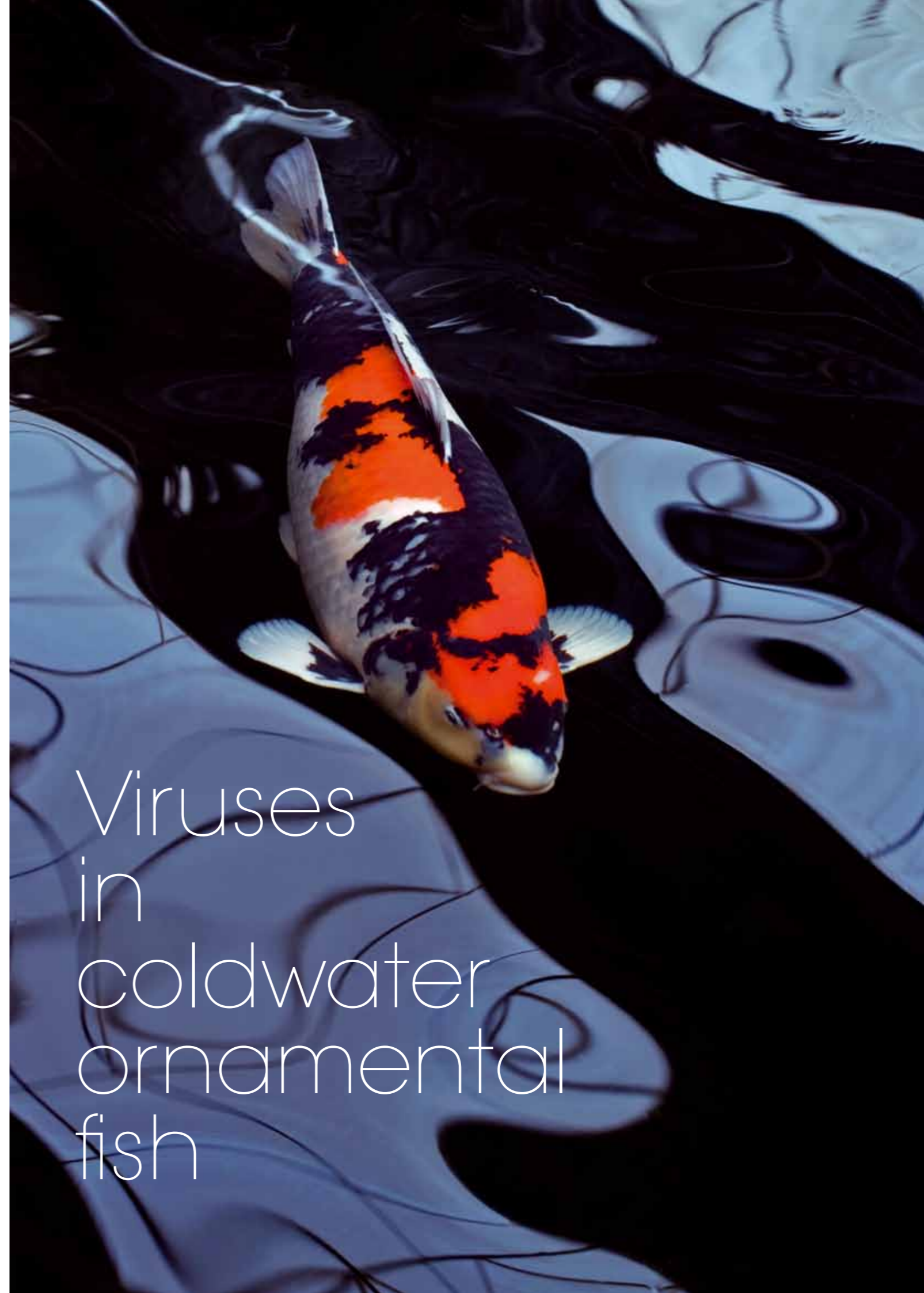
▲ Fig. 1. A carp displaying epidermal hyperplasia, typical of carp pox. K. Way

► An ornamental koi carp. Stockxpert / Jupiter Images

caused by a herpesvirus. The presence of a virus was confirmed by electron microscopy in the 1960s, but was not isolated in cell culture until the 1980s.

With the discovery of non-filterable disease agents, or viruses, in the late 19th century there came a greater realization of the role that viruses may play in infectious diseases of fish. However, the breakthrough for fish virology came with the general developments in virological techniques that blossomed in the 1950s and 60s. In particular, visualization of viruses by electron microscopy, improvements in protein and nucleic acid analysis and, most significantly, the isolation of viruses on continuous (immortal) fish cell lines. At the same time, aquaculture around the world developed in the 1960s and 70s, and farming of fish and fish-keeping rapidly increased. With these developments and, more recently, the global increase in trade in ornamental fish there has been an increase in new diseases and the emergence of serious virus diseases.

Viruses that have caused serious but isolated disease outbreaks in cyprinid species and some ictalurid (catfish) species, and may affect coldwater ornamental fish, include aquareoviruses, coronaviruses, poxviruses and iridoviruses. More serious disease epidemics in ornamental species have been caused by rhabdoviruses and herpesviruses.



# Viruses in coldwater ornamental fish

## Fish rhabdoviruses

Viruses in the family *Rhabdoviridae*, genus *Vesiculovirus*, are bullet-shaped and enveloped, and contain single-stranded RNA. They affect a wide range of mainly freshwater fish species and cause an acute haemorrhagic disease.

There are two vesiculoviruses that are known to cause serious disease in cyprinids. Spring viraemia of carp (SVC; Fig. 2) in the past was known by several names including infectious ascites, infectious dropsy and rubella. The vesiculovirus causing the acute form of the disease (SVCV) was isolated in 1971, and the chronic form of the disease characterized by skin ulcers, caused primarily by the bacterium *Aeromonas salmonicida*, was renamed carp erythrodermatitis. Naturally occurring SVC infections have been reported from a number of cyprinid hosts, including common and koi carp, crucian carp (*Carassius carassius*), goldfish and grass carp.

Tench rhabdovirus (TenRV) is closely genetically related to SVCV and has been isolated from a number of cyprinid hosts, including species that are often kept as ornamental fish, such as tench, orfe and rudd (*Scardinius erythrophthalmus*). Both SVC and TenRV exhibit similar symptoms where fish appear darker in colour and may display exophthalmia (pop-eye), haemorrhages on the skin and base of the fins, pale gills and abdominal distension or dropsy.

The geographical range of SVC and TenRV was for many years limited to European countries that experience low water temperatures in winter. However, since 1998, Brazil, the USA and Canada have reported SVC disease outbreaks and the virus has been detected in carp in China. Some of

the viruses isolated during these outbreaks have been shown to be a new genetic strain distinct from the European strain of SVC.

## Cyprinid herpesviruses

Viruses in the family *Herpesviridae* are large, complex viruses containing linear double-stranded DNA. Most animal species are hosts to at least one herpesvirus – humans host nine herpesviruses, including viruses causing cold sores and chicken pox. Herpesviruses are also found in a number of fish species, including pike, catfish, walleye, sturgeon, salmon and turbot. Ornamental cyprinid species, such as koi and goldfish, are hosts to at least three herpesviruses, including carp pox (cyprinid herpesvirus 1, CyHV-1).

Cyprinid herpesvirus 2 (CyHV-2) causes a disease known as herpesviral haematopoietic necrosis (HVHN). This disease was first reported as the cause of epizootics in juvenile goldfish in Japan in 1992 and 1993, and reports followed of isolated cases, with similar disease aetiology and high mortality (50–100%), in the USA, Taiwan, Australia and the UK. Although not associated with large disease epidemics, CyHV-2 appears to be globally distributed and present at a high prevalence in cultured goldfish populations. The disease occurs when fish are subjected to stress and held at water temperatures permissive for virus replication.

Cyprinid herpesvirus 3 (CyHV-3) is the cause of koi herpesvirus disease (KHVD), a contagious and acute viraemia first seen in common and koi carp, and affecting other varieties such as mirror and ghost carp (*Cyprinus carpio goi*). The first serious disease epidemics were seen

in 1998 and over the next 5 years the virus devastated carp populations in countries around the world. It is thought that infected carp surviving at low temperatures may be reservoirs of the virus, and international trade in ornamental carp has facilitated the rapid global spread of the disease.

Similar to CyHV-2, the disease signs associated with CyHV-3 infection are seen at water temperatures between 16 and 25 °C. Fish suffering from these diseases display signs of lethargy, anorexia and pale patches on the skin and gills. During CyHV-3 infections, signs also include marked enophthalmia (sunken eyes) and pale discoloration or reddening of the skin, which often has a rough texture. However, the most consistent changes are seen in the gills (Fig. 3), which may be swollen, discoloured, necrotic and covered in excess mucus. Internally, the fish may show very few disease signs, but during CyHV-2 infections

the goldfish may be anaemic, the kidney enlarged and the spleen may display distinctive white nodules (Fig. 4).

## Avoiding disease problems

Disease outbreaks caused by aquatic viruses serve to remind the ornamental fish industry of the need for avoidance or prevention of disease through good hygiene and biosecurity practices. Poor fish transport conditions, rapid turnover of imported stock and lack of quarantine facilities all contribute to the spread of disease. No licensed antiviral vaccines are available for ornamental fish, and chemical and antibiotic treatments, used to treat bacterial, fungal and parasite infections, are ineffective. OATA advise hobbyists and retailers to adopt a biosecurity policy to reduce the risk of introducing and spreading disease. This includes buying fish from reliable sources with a known disease history, strict quarantine

and hygiene measures, and effective water disinfection and sterilization.

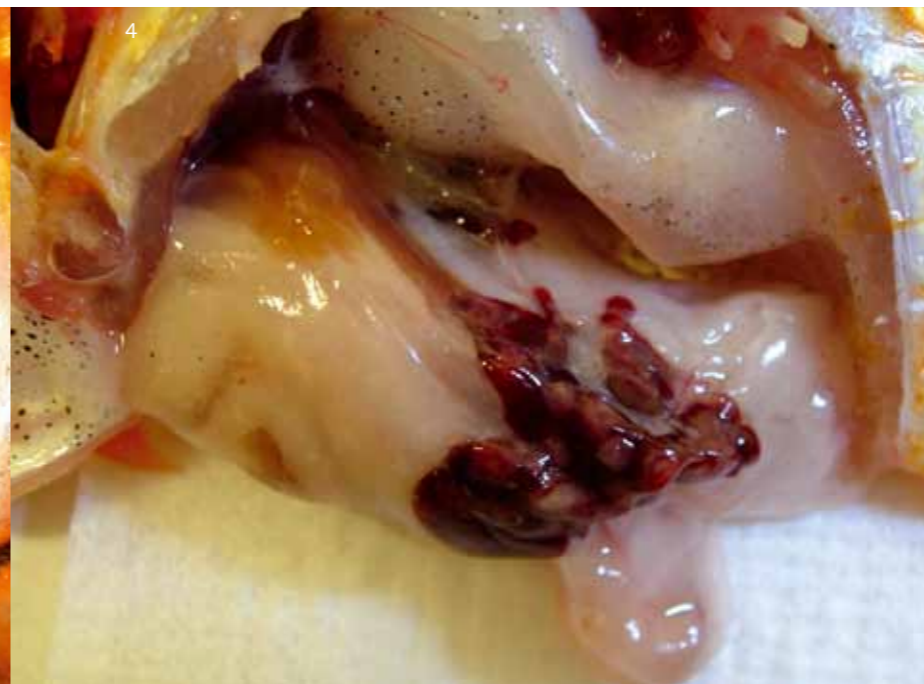
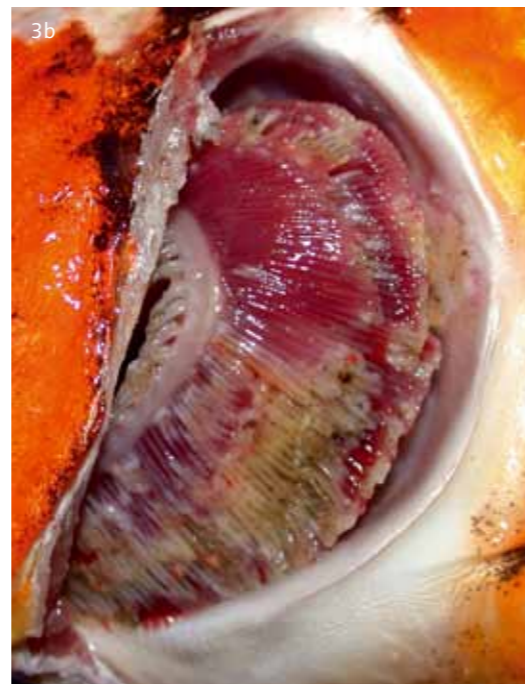
Healthy populations of ornamental fish are generally not threatened by virus diseases. The virus diseases described are mostly seen when environmental conditions change or other stress factors affect the fish. Outbreaks of viral disease are most often observed in fish recently introduced into a pond or retail facility and suffering from handling and transport stress. Fish under stress or at low water temperatures also experience suppression of their immune system. The poor physiological and immunological condition of fish undoubtedly contributes to the severity of disease outbreaks as has been shown in carp populations during SVC and KHV outbreaks.

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## Further reading

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◀ Fig. 2. Electron micrograph of SVC rhabdovirus particles. K. Way

◀ Fig. 3. Gills of (a) a healthy koi carp, and (b) of a koi carp suffering from koi herpesvirus disease. K. Way

▼ Fig. 4. White nodules in the spleen of a goldfish suffering from herpesviral haematopoietic necrosis. K. Way