Spectrum

A fish-killing virus

About 15 or 20 years ago, anglers started noticing large die-offs of redfin perch — a fish much sought-after by the recreational fishing fraternity — in the early summer in lakes of north-eastern Victoria.

The phenomenon has been reported almost every year since, mainly in Victoria, although a few cases have occurred further afield in south-eastern New South Wales. At first nobody took much notice, and the large mortalities were put down to environmental effects. But now we know differently...

In 1984, fisheries scientists Dr Jeremy Langdon and Dr John Humphrey, from the Australian Fish Health Reference Laboratory, decided to investigate. They took three moribund specimens of the little fresh-water fish from a massive fish-kill in Lake Nillahcootie, near Benalla, Vic., and called in Dr Alex Hyatt of CSIRO's Australian Animal Health Laboratories (AAHL).

The scientists suspected that they were dealing with an infection, perhaps caused by a new or exotic virus. To test this idea, they inoculated rainbow trout cells in culture with samples from the most damaged organs of the dead fish, namely the liver, spleen, and pancreas. Ten days later, some of the cultured cells were seen to be dying. The effect could be reproduced if fluid from this culture was added to another. The electron microscope revealed virus particles in the fluid of the affected cell cultures.

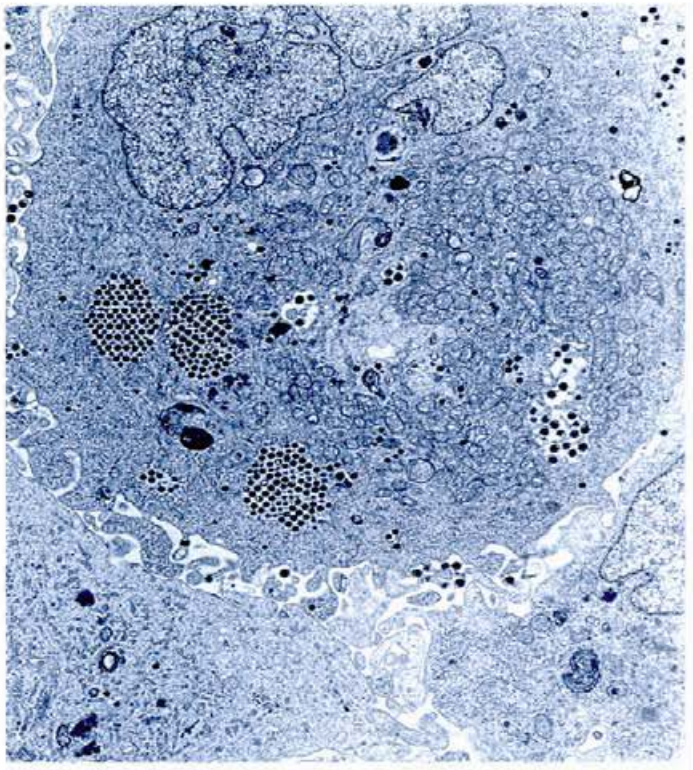
From their size (about 150–170 nanometres in diameter, a nanometre being one-millionth of a millimetre), shape, and means of manufacture in the host cells, Dr Hyatt, a virologist, concluded that these viruses belong to a family called the iridoviruses. In the last 10 years, a number of iridoviruses have been identified overseas in amphibians and fish.

The scientists christened the new find epizootic haematopoietic necrosis virus, or EHNV for short. The name refers to the fact that the disease occurs in outbreaks (an epizootic is essentially an animal equivalent of epidemic), usually among young fish when they swarm together in shallow waters in the early summer, and causes the destruction (necrosis) of their blood-making (haematopoietic) tissues, which eventually kills most of those infected.

Since identifying the virus, Dr Hyatt and his colleagues have been working on ways of quickly detecting it. They have now perfected a number of immunologically based diagnostic tests for it, using light or electron microscopy and other techniques.

They also found that the virus is remarkably hardy; it can survive for more than 100 days at about 15°C in the presence of protein — therefore dried-up carcasses or fish mucus would be ideal hiding spots. It can quite possibly survive on fishing nets and rods, and so can easily spread. One thing eludes it, however — it cannot stay alive for long inside warm-blooded creatures: it is completely inactivated after 24 hours at 40°C.

One most interesting question about the new virus is still to be resolved: where does it come from? Its host, the redfin perch (*Perca fluviatilis*), is not a native. Records show that current stocks probably all derive from a few English fish brought to Tasmania in 1861 and Victoria in 1868. Now the species occurs in south-western Western Australia, Tasmania, and the south-eastern part of the continent, but the Tasmanian and Western Australian populations are probably not infected, as no reports of summer mass mortalities are on record there.



Aggregates of virus particles (black circles) within an infected fish cell. The cell nucleus is the grey lobed region at the top; portions of two other cells can be seen in the bottom third of this electron micrograph.

Did the virus come to Australia with the original specimens from England, or is it native? And if it was recently introduced, how many native or other introduced species of commercial or recreational importance could it infect?

At the moment, perch in England and other European countries are not known to be infected. Since the initial discovery, Dr Langdon has broadened the investigation here. He tested the virus on 11 species of native and introduced fresh-water fish, assessing their susceptibility to the full-blown disease.

Laboratory experiments on transmission of the disease cannot prove that fish that succumbed would necessarily do so upon exposure in the wild, but the scientists believe they would. Some fish only showed signs of disease when actually injected with the virus, and these species are considered less likely to be badly affected in the wild.

The research showed that the native Macquarie perch and the Murray cod were both susceptible, but not the Australian bass. Among fish of greatest economic importance, juvenile rainbow trout (completely unrelated to redfin) also fell victim, but the Atlantic salmon only succumbed when injected. Recently, two outbreaks of the disease in rainbow trout farms in New South Wales and one in Victoria have been confirmed — a worrying sign, as Australia is building up an export trade of disease-free rainbow trout eggs to the rest of the world.

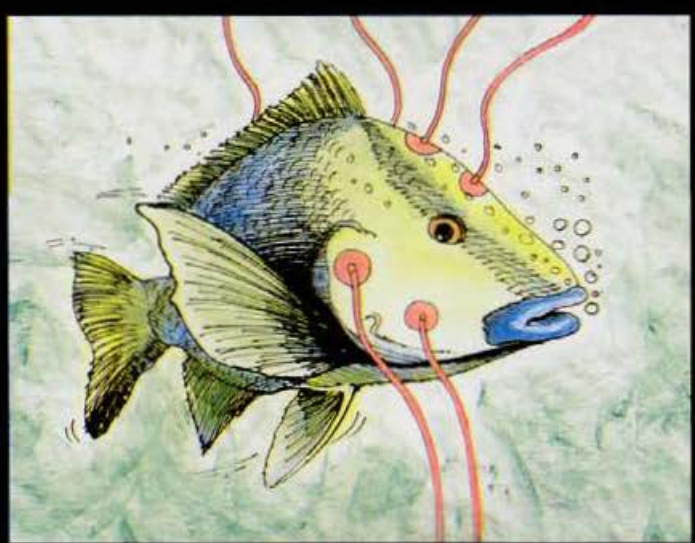
The studies confirmed that redfin perch was the most highly susceptible species — especially the juveniles. Older fish are inherently less

Dead juvenile redfin perch on the shores of Lake Nillahcootie, Vic.

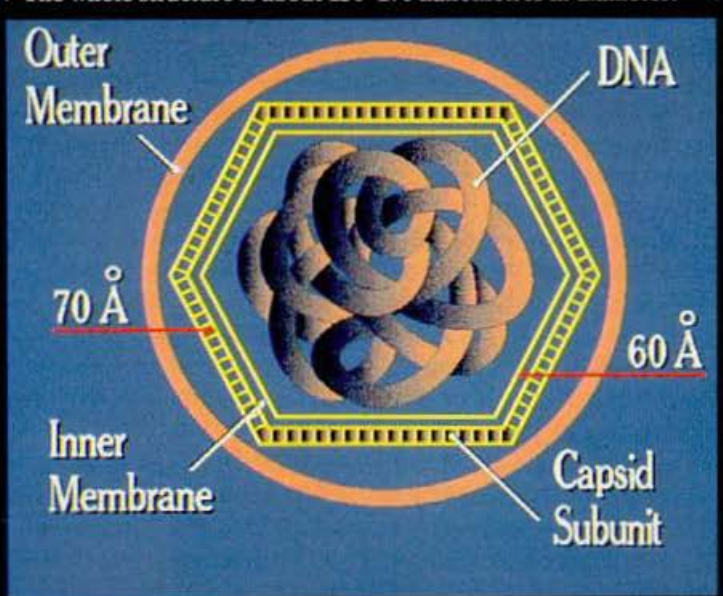
Waiting for the fish to bite...

suceptible or may possess immunity derived from surviving the infection when young. In the wild, the scientists' 'guesstimate' is that 90–95% of the fish die from the infection. The few that survive probably carry the virus for the rest of their lives, continuing to shed it as adults and so causing recurrent infections among juveniles.

Another introduced species also fell victim to EHN virus—



The structure of the EHN virus. A hexagonal protein capsid surrounds its DNA. Beyond the capsid lies an outer membrane. The whole structure is about 150–170 nanometres in diameter.



the mosquito fish (*Gambusia* sp.), imported to Australia in the 1940s in an attempt to control mosquito numbers. And these fish might well have brought the virus with them then. Their geographic range coincides with that of redfin. They are not known to suffer outbreaks, but that's probably because they are too small to be of interest to anglers, and so are not monitored. So far, nobody has tested mosquito fish populations for the presence of the virus.

Dr Hyatt and his colleagues have compared EHN virus with other known fish iridoviruses. Their results showed that it does not resemble any other described species in its family — it's unique. Very little work has been done anywhere in the world on fish iridoviruses, and it's not possible yet to determine whether the new find is indigenous or exotic.

Whatever its origin, the fact remains that having the virus means we must now be careful, even though its effect on redfin perch stocks cannot be quantified. (While most anglers claim a reduced catch

of the smaller redfin in recent years, detailed fisheries statistics are lacking.) Stocking infected waterways with susceptible fish would clearly be unhelpful, and redfin perch should not be moved to new locations.

Roger Beckmann

First virus isolation from Australian fish: an iridovirus-like pathogen from redfin perch, *Perca fluviatilis*. L.J.S. Langdon, J.D. Humphrey, L.M. Williams, A.D. Hyatt, and H.A. Westbury. *Journal of Fish Diseases*, 1986, **9**, 263–8.

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Experimental transmission and pathogenicity of epizootic haematopoietic necrosis virus (EHNV) in redfin perch, *Perca fluviatilis* L., and 11 other teleosts. J.S. Langdon. *Journal of Fish Diseases*, 1989, **12**, 295–310.