



Koi herpesvirus: its potential as a biological control agent for carp in Australia

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Koi herpesvirus – the disease

- First described outbreaks in Israel in 1998
- Now worldwide distribution
 - Not yet in Australia (exotic disease!)
- High mortality (70-100%) in all age groups of carp
 - Common carp (*Cyprinus carpio carpio*)
 - Koi carp (*C carpio koi*)
 - No other species affected
- Transmission
 - Horizontal – low levels of virus required
 - Vertical - ?

Koi herpesvirus – the disease (cont.)

- Outcome of infection is temperature-dependent
 - Max. losses when water temp: 17o – 26oC
 - Most outbreaks in Spring
- Pathogenesis
 - Entry site: Skin
 - Systemic infection -> excretion via gills, faeces, urine
 - Death due to loss of function of gills, kidney, gut
- Re-named 'Cyprinid herpesvirus-3' (CyHV-3)
 - CyHV-1: mortality, "carp pox"
 - CyHV-2: goldfish haematopoietic necrosis virus

KHV – biological control of carp?

- Therefore,
 - Specificity of the virus
 - Sensitivity of the target species
 - High mortality in the target species
 - Wide age-range of affected species
- All of these factors suggest that KHV may potentially be a good biological control agent for carp in Australia
 - Chose an Indonesian isolate of KHV

Koi herpesvirus – achievements

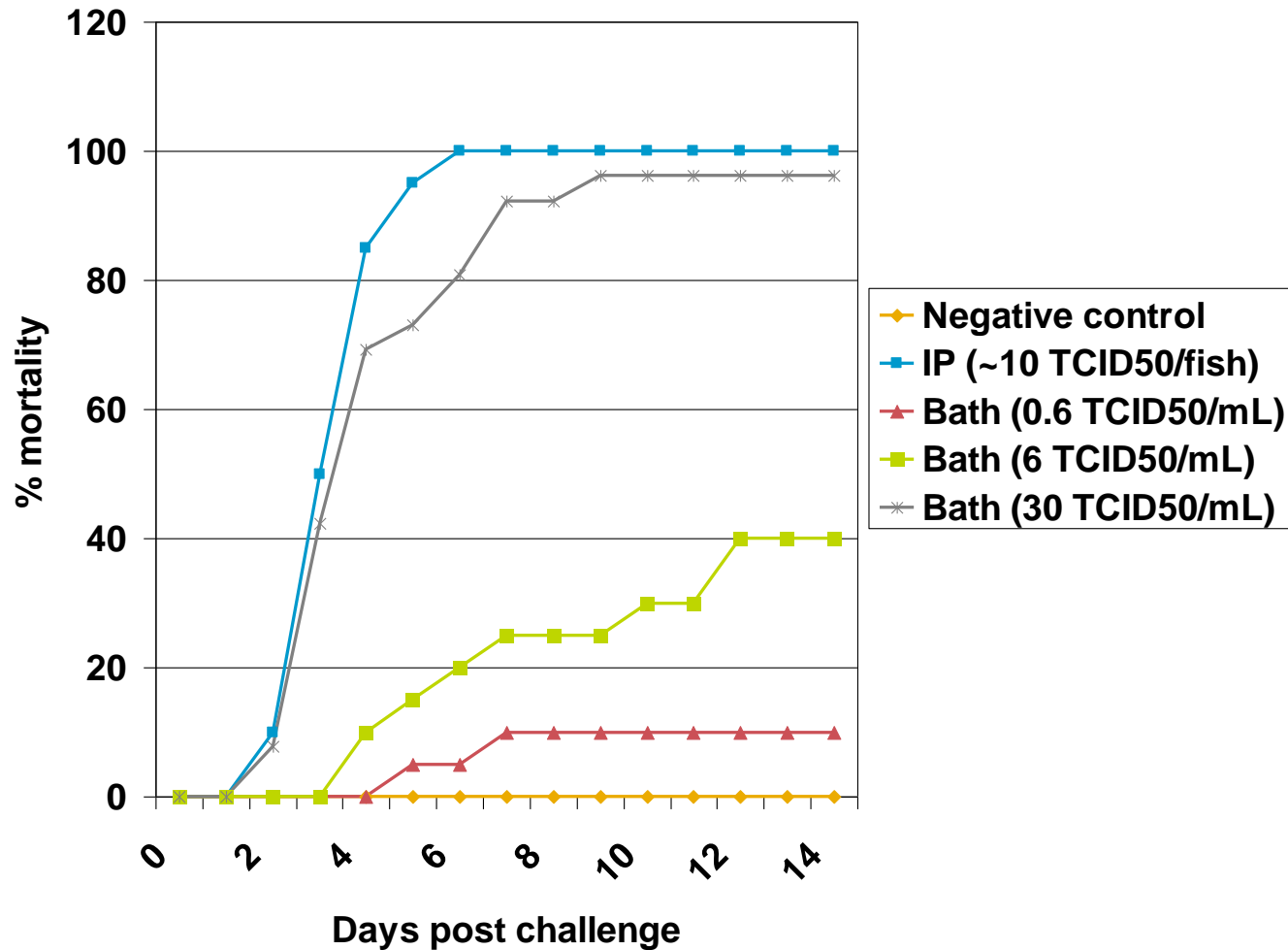
Introduced a range of technical procedures

- Viral culture systems
 - KF-1 cell line
- Immunohistochemistry / immunocytochemistry
- Molecular detection methods
 - No. of KHV-specific conventional PCRs
 - KHV-specific TaqMan assay
- Electron microscopy

Koi herpesvirus – achievements

- Does KHV kill Australian carp?
 - Australian wild carp **are** susceptible to KHV
 - Mortality is dose-dependent, and size-dependent

KHV-induced mortality in juvenile carp



KHV – lesions in carp



Gill necrosis



Skin necrosis

Koi herpesvirus – achievements

- Does KHV kill Australian carp?
 - Australian wild carp **are** susceptible to KHV
 - Mortality is dose-dependent, and size-dependent

Koi herpesvirus – achievements

- Does KHV kill Australian carp?
 - Australian wild carp **are** susceptible to KHV
 - Mortality is dose-dependent, and size-dependent
 - Larvae
 - **Japanese work**
 - Juveniles
 - **Course of disease is temperature-dependent**
 - **Very short clinical course**
 - **High mortality**
 - Mature fish (20-30 cm)
 - **Lower % mortality?**
 - **Carp-goldfish hybrids**

Koi herpesvirus – achievements

- **Susceptibility issues**
 1. **Carp-goldfish hybrids have lower mortality**
 - **Serendipitous results**

Characterization of fish in a KHV challenge trial

- Fish that died following challenge with KHV
 - 5/5 bath-infected mortalities were carp
 - 2/2 IP-inoculated mortalities were carp
- Fish that survived following challenge with KHV
 - 3/5 bath-infected survivors were hybrids
 - 7/7 IP-inoculated survivors were hybrids

Koi herpesvirus – achievements

- **Susceptibility issues**
 1. **Carp-goldfish hybrids have lower mortality**
 - Serendipitous results
 - Conflicting results in the literature
 - Need data on the prevalence of hybrids
 - **Collaborate with Paul Brown, Fisheries Victoria**
 - **Molecular approach using 12S nuclear gene**
 2. **Survey wild carp for cyprinid herpesviruses**
 - Test for viruses cross-reactive with KHV
 - Nursery 'hot spots' in the M-D Basin
 - **Collaborate with Dean Gilligan, NSW Fisheries**
 - **Molecular approach using a viral DNA polymerase gene**

Koi herpesvirus – achievements

- Does KHV affect native fauna?
 - Tested susceptibility of:
 - Murray cod, golden perch, silver perch (*Bidyanus bidyanus*)
 - Infected by immersion, and by IP inoculation
 - Dose of IP virus: 10^2 - 10^3 times greater than min. req'd to induce disease in carp
 - Held for 28 days post exposure to KHV
 - Looked for evidence of virus (PCR) and tissue damage (histopathology)
 - Carp used as positive controls
 - **No evidence of virus replication or disease in non-target species**

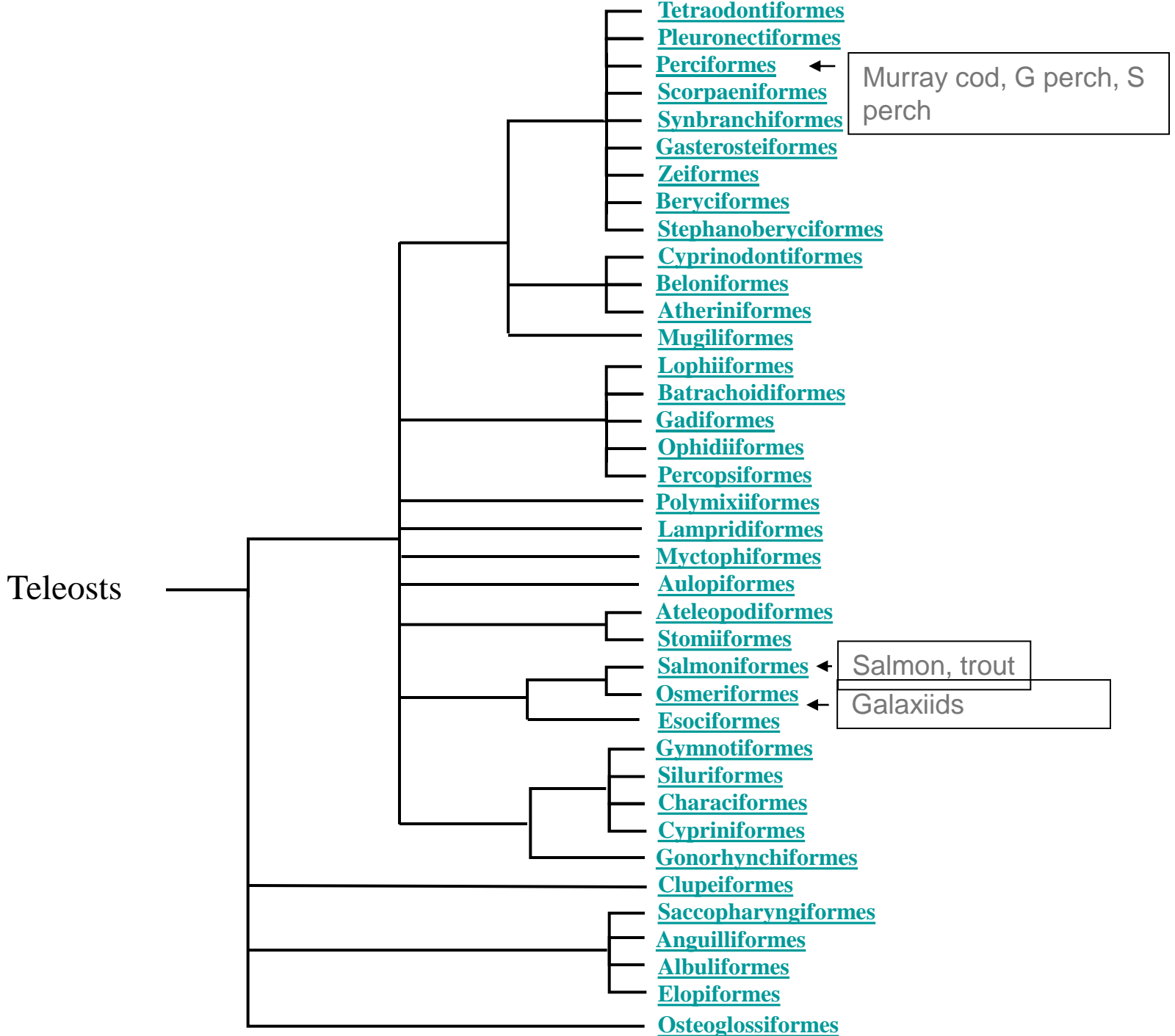
Koi herpesvirus – future activities

- **Epidemiology of KHV infection**
 - Aim: understand the spread and persistence of KHV in carp and the environment
 1. Sensitivity to infection
 - **Carp extraordinarily sensitive to KHV**
 - **Useful to have data on precise sensitivity for specific age-groups**
 - **Targeted release of virus**
 2. Excretion of KHV
 - **The dynamics/amount of virus produced by an infected carp**
 - **Completed one trial to supply preliminary information**

Koi herpesvirus – future activities

Epidemiology of KHV infection (cont)

3. Survey wild carp for cyprinid herpesviruses
 - **Most samples collected**
 - **Lab analysis ready to begin**
4. Estimate the prevalence of hybrid carp in Victorian waters
 - **All samples collected**
 - **Lab analysis has now begun**
5. Further non-target species testing
 - **Families Galaxiidae, Salmonidae**



Koi herpesvirus

- Potential as a biological control agent for carp in Australia
 - Early days yet, but.....
 - Targeted, strategic release
 - Used in conjunction with other carp control procedures