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EX-POST COST BENEFIT ANALYSIS

PROJECT NO: 92/66

National diagnostic tests for the detection of Epizootic haematopoietic necrosis virus (EHNV) and certification of EHNV-free fish

PREPARED FOR THE FRDC

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TABLE OF CONTENTS

NON TECHNICAL SUMMARY

This report describes the benefit cost analysis for FRDC funded project 'National diagnostic tests for the detection of Epizootic haematopoietic necrosis virus (EHNV) and certification of EHNV-free fish' (Project No. 92/66). The project was implemented by CSIRO Animal Health Laboratory (AHL) and the Elizabeth Macarthur Agricultural Institute (EMAI), NSW.

The objectives of the project were:

(1) Select optimum EHNV detection protocols and establish these as national tests.

(2) Investigate the use of inactivated antigen in antigen capture ELISAs which would facilitate the distribution of the diagnostic tests

(3) Use diagnostic tests to determine the minimum sampling sizes and types of samples required for disease-free certification of commercial stocks

(4) Optimise immunological tests that detect EHNV and anti-EHNV antibodies, from field animals.

(5) Identify tissues/organs within host organisms where the virus replicated

(6) Differentiate the major strains of Australian iridoviruses.

The project developed a test to enable detection of EHNV in field samples and subsequent infected tissue cells. The characteristics of the test were also determined providing a specificity of 99-100% and a sensitivity of 60%. Approximately 24 testing kits have been distributed to animal health laboratories in Australia (all States) and to government laboratories in Canada, Europe, India, Singapore and the United States.

A single isolate of EHNV which can infect both redfin perch and rainbow trout was identified by the project as having a specific restriction enzyme digestion profile. The research showed that it is theoretically possible to track a specific strain of EHNV though the Australian environment utilising specific molecular techniques developed by the project. Other tests developed by the project enabled the differentiation of EHNV from other iridoviruses in Australia, Bohle iridovirus (which affects amphibians) and other exotic iridoviruses.

AAHL and EMAI on EHNV had already carried out preliminary research before the start of this project, but costs of this initial research are unavailable. The total project costs were just under $970,00 of which FRDC contributed $370,000 or 38% of total research costs.

There are three main avenues by which the research could produce benefits: prevention of the spread of EHNV in finfish within Australia; prevention of the spread of EHNV in other countries and; prevention of the spread of EHNV in amphibians and reptiles.

The tests have enabled the effective and routine screening for the EHNV virus in New South Wales, Victoria, Western Australia, South Australia and Tasmania. EHNV is a notifiable disease under the International Aquatic Animal Health Code developed by the Office International des Epizooties. The tests developed by the project are detailed in the OIE Diagnostic Manual of Aquatic Animal Health and are used to comply with OIE requirements which requires competent authorities of exporting countries to test consignments of live fish or ova susceptible to EHNV and provide these consignments with an international aquatic animal health certificate.

It was difficult to ascribe monetary benefits to this project in terms of the mitigation of losses of stock in commercial rainbow trout farms and losses of wild native fish from the spread of EHNV. This was because the project focused on preventing the spread of a disease before it had become a significant problem. To estimate losses, analysis would need to be carried out on the probability of EHNV spreading and causing losses to farmed fish and native fish, requiring more data than is currently available . Furthermore, the project and subsequent research found that EHNV causes low mortality rates which do not exceed mortality rates commonly found in rainbow trout farms. Isolating mortalities of EHNV from other causes of mortalities would only be possible if widespread data was available on mortalities in rainbow trout farms in Australia. Estimation of conservation or tourism values of mortalities of wild native fish infected with EHNV would be based on too many unsubstantiated assumptions rendering such estimation virtually meaningless.

However, the difficulty in quantifying benefits should not be interpreted to imply that the research was without value. The research produced significant non-quantifiable benefits in terms of preventing the spread of EHNV to farmed and wild fisheries nationally and internationally and enabling testing for similar viruses in amphibians and reptiles.

One way some of the benefits of this project could have been captured in Australia would have been to sell, rather than give away, test kits to laboratories in other countries. Although this was not considered by FRDC, the AAHL or AMAI at the time the project was conceived, future FRDC funded projects where there is potential for benefits to be generated from the creation and subsequent to ownership of intellectual property, should address these issues at project conception. Given the scale of expenditure, an ex-ante, basic benefit cost analysis of the project would have highlighted the need to sell testing kits to maximise benefits from the project.

EX-POST COST BENEFIT ANALYSIS OF PROJECT NO: 92/66

National diagnostic tests for the detection of Epizootic haematopoietic necrosis virus (EHNV) and certification of EHNV-free fish

Agency: **CSIRO Animal Health Laboratory**

FRDC Sub-Programme: **Fisheries Habitat- the Ecosystem**

1 Research Objectives

- Select optimum EHNV detection protocols and establish these as national tests.
- Investigate the use of inactivated antigen in antigen capture ELISAs which would facilitate the distribution of the diagnostic tests
- Use diagnostic tests to determine the minimum sampling sizes and types of samples required for disease-free certification of commercial stocks
- Optimise immunological tests that detect EHNV and anti-EHNV antibodies, from field animals.
- Identify tissues/organs within host organisms where the virus replicated
- Differentiate the major strains of Australian iridoviruses

2 Background

Epizootic haematopoietic necrosis virus (EHNV) is a fatal disease of finfish that was first recognised in 1986. The disease is confined to Australia and is endemic to south-eastern Australia. Since 1986, the disease has spread progressively in the Murrumbidgee River system through New South Wales and ACT. A similar spread has been observed in the

Murray River in South Australia. Tasmania and Western Australia remain free of infection. Two species of finfish are affected naturally by EHNV: redfin perch and rainbow trout. Redfin perch occurs in many river systems and impoundments in southeastern Australia. Outbreaks of the disease in redfin perch have occurred in Victoria, New South Wales and South Australia where it has resulted in near decimation (95%) of redfin populations over three weeks and thus affected the recreational fishery in these areas. Outbreaks of EHNV have also occurred in rainbow trout farms in NSW and in Victoria. The virus has also been transmitted under laboratory conditions to a range of native fish including Macquarie perch, silver perch, mosquito fish and Murray cod thus posing a threat to the conservation of native fish.

EHNV is one of five diseases of finfish that are notifiable to the Office International des Epizooties (OIE). This means that there are stringent conditions on the classification of EHNV-free countries, zones and farms. Movement and importation of live fish of any species or their spawning products (eggs, ova, milt) must be accompanied by an international animal health certificate from the exporting country certifying that the consignment originates from either a country declared to be EHNV-free or from a farm officially declared to be EHNV-free.

At the time of the project, there was no effective diagnostic test for EHNV that could be used to certify that fish or their spawning products were EHNV free. Research undertaken at the Australian Animal Health Laboratory (AAHL) and the Elizabeth Macarthur Agricultural Institute (EMAI) of NSW Agriculture had already initiated the development of diagnostic tests including an antigen detection ELISA. These tests had been used to detect EHNV in clinical samples from field samples and rainbow trout hatcheries. The next steps were to select optimum EHNV detection protocols, establish these as national tests and to investigate the use of inactivated antigen in antigen capture ELISAs which would facilitate the distribution of the diagnostic tests to state veterinary laboratories. This project, with the objectives described in section 1 was aimed at addressing these needs.

3 Research Findings

There were two main components to the research: the development of a diagnostic test and differentiation of the major strains of EHNV.

3.1 Development of a diagnostic test

A test was developed which incorporated the best reagents from the AAHL and the EMAI. The test enables detection of EHNV in field samples and subsequent infected tissue cells. Sites of replication of EHNV in rainbow trout and redfin perch were consistently found in the kidney, liver and spleen – organs that are relatively straightforward to collect. Because the virus is extremely stable over long periods of time as well as being highly infectious, the positive control in the test was a non-infectious virus (antigens) in order to minimise any possibility of inadvertent spread of the virus. The characteristics of the test were also determined providing a specificity of 99-100% and a sensitivity of 60%. Approximately 24 testing kits have been distributed to animal health laboratories in Australia (all States) and to government laboratories in Canada, Europe, India, Singapore and the United States.

3.2 Differentiation of major strains of EHNV

A single isolate of EHNV can infect both redfin perch and rainbow trout. This was identified as having a specific restriction enzyme digestion profile. As various EHNV isolates, identified by specific restriction enzyme digestion profiles exist in Victorian and New South Wales environments, the research showed that it is theoretically possible to track a specific strain of EHNV though the Australian environment utilising specific molecular techniques developed by the project. Other tests developed by the project enabled the differentiation of EHNV from other iridoviuses in Australia, Bohle iridovirus (which affects amphibians) and other exotic iridoviruses. However these tests require specific laboratory skills found at AAHL and EMAI.

4 Benefit Cost Analysis

There are two major components of net economic benefit in cost/benefit analysis - producer's surplus and consumer's surplus. Producer's surplus is a measure of net economic benefits created in the harvesting and processing sector from a specific research project. Although a simplified explanation, producer's surplus can be thought of as additional profits generated. In addition, if the research findings induce increases in production and employment, then to the extent that previously unemployed labour is employed, the associated wages would also be included as a benefit in producer's surplus.

Consumer's surplus is a measure of net economic benefits to consumers. For example, if a research project induces an increase in product supply that in turn results in a decrease in prices on the domestic market, then domestic consumers would be better off. Consumer surplus is simply a measure of this improvement in consumer well-being.

In simple terms, to undertake the benefit/cost analysis, it is necessary to estimate all economic benefits that flow from the research findings. Benefits are then compared to the financial cost of research, plus any economic costs that are required to capture the benefits.

4.1 Costs

Total project costs were $968,350 of which FRDC contributed $367,578 or 38% of total research costs.

4.2 Potential Benefits

There are three main avenues by which the research could produce benefits: prevention of the spread of EHNV in finfish within Australia; prevention of the spread of EHNV in other countries and; prevention of the spread of EHNV in amphibians and reptiles.

Prevention of the spread of EHNV in finfish within Australia

The tests developed by the project make it possible to identify endemic areas in Australia and screen for EHNV at government hatcheries. This, combined with controls on the export of live fish from endemic areas, has the potential to have a significant positive impact on containing the spread of EHNV.

Prevention of the spread of EHNV in finfish in other countries

By making the test kits available to laboratories in other countries, a potential benefit of the project is to prevent the spread of EHNV to finfish in other countries.

Prevention of the spread of EHNV and similar viruses in amphibians and reptiles

Similar viruses are found in amphibians and reptiles. Use of the the tests to identify EHNV and other similar viruses in amphibians and reptiles imported into Australia can prevent the spread of EHNV.

4.3 Realisation of Benefits

Prevention of the spread of EHNV in finfish within Australia

The New South Wales government has established an endemic infection zone in southeastern New South Wales that includes catchment areas of all known infected farms and all impoundments where EHNV is known in redfin perch. Endemically infected farms are permitted to sell fish and fillets but unless health certification is undertaken (using the diagnostic tests developed by the project), the farms are not permitted to export live fish or ova from the zone. Furthermore, all government owned salmonid farms in New South Wales, regardless of their location, must undertake certification testing for EHNV prior to distribution of fish or ova, using the diagnostic tests developed by the project. This requires sampling ova or fingerlings from sufficient fish to detect a 2% prevalence of infection with 95% confidence.

In Western Australia, all imports of live salmonids and redfin perch from other Australian States have been banned since 1988. Imports of live silver perch, golden perch and

Murray cod (all carriers of EHNV) have been restricted since 1987 to prevent the spread of EHNV into the state. The antigen-ELISA for EHNV is available at the Animal Health Laboratory, South Perth, with positive control samples being held in a secure facility. A program to screen specifically for EHNV was begun at Pemberton Trout Hatchery in 1996, following the techniques recommended by EMAI. Samples collected from 1996/97, 1997/98 and 1998/99 production all tested negative for EHNV. One submission of 150 silver perch was also tested for EHNV prior to import into the State.

In South Australia, salmonids must be certified free of notifiable diseases by relevant authorities in Victoria, New South Wales and Tasmania before they are imported into South Australia.

In Victoria, the Victorian Institute of Animal Science (VIAS) which has the EHNV antigen ELISA test investigates fish health problems on salmonid farms using routine procedures. EHNV is tested for if there are clinical signs or histopathology indicating a viral agent. A Virological Survey of Trout Hatcheries is currently in progress. This involves sampling ova and milt at spawning from 60 fish per hatchery and virological testing (including EHNV). Samples have been collected from ten trout farms and one Atlantic salmon farm. There is an ongoing program to monitor trout hatcheries for EHNV with all results, to date, being negative.

Prevention of the spread of EHNV in finfish in other countries

EHNV is a notifiable disease under the International Aquatic Animal Health Code developed by the Office International des Epizooties. The tests developed by the project are detailed in the OIE Diagnostic Manual of Aquatic Animal Health and are used to comply with OIE requirements which requires competent authorities of exporting countries to test consignments of live fish or ova susceptible to EHNV and provide these consignments with an international aquatic animal health certificate.

The OIE names the two researchers involved in the project, Dr A Hyatt and Dr R Whittington as the only two reference experts for EHNV in the world.

Prevention of the spread of EHNV and similar viruses in amphibians and reptiles

The findings of this project together with the diagnostic tests have been used to:

- detect similar viruses in an illegally imported python from Papua New Guinea for AQIS and AFFA;
- formed the basis of an in-depth study for the biological control of cane toads for Environment Australia and ;
- investigated the factors responsible for the worldwide decline in amphibians, as part of a United States National Science Council international research programme.

4.4 Net benefits

It is difficult to ascribe monetary benefits to this project in terms of the mitigation of losses of stock in commercial rainbow trout farms and losses of wild native fish from the spread of EHNV. This is because the project focused on preventing the spread of a disease before it had become a significant problem. To estimate losses, analysis would need to be carried out on the probability of EHNV spreading and causing losses to farmed fish and native fish. This requires more data than is currently available[1]. Furthermore, the project and subsequent research has found that EHNV causes low mortality rates which do not exceed mortality rates commonly found in rainbow trout farms. Isolating mortalities of EHNV from other causes of mortalities would only be possible if widespread data was available on causes of mortalities in rainbow trout farms in Australia. Estimation of conservation or tourism values of mortalities of wild native fish infected with EHNV would be based on too many unsubstantiated assumptions rendering such estimation virtually meaningless.

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[1] According to the project leaders, the OIE has assessed, in general terms, non-quantifiable risks of the spread of EHNV in other countrieswhich is the reason EHNV is notifiable.

However, the difficulty in quantifying benefits should not be interpreted to imply that the research was without value. The research has produced significant non-quantifiable benefits in terms of preventing the spread of EHNV to farmed and wild fisheries nationally and internationally and enabling testing for similar viruses in amphibians and reptiles.

5 Concluding comments

EHNV is an OIE notifiable disease, the tests developed by the project are the best diagnostic tests available, and the AAHL and AMAI are the only laboratories in the world with EHNV antigens. One way some of the benefits of this project could have been captured in Australia would have been to sell, rather than give away, test kits to laboratories in other countries. Although this was not considered by FRDC, the AAHL or AMAI at the time the project was conceived, future FRDC funded projects where there is potential for benefits to be generated from the creation and subsequent to ownership of intellectual property, should address these issues at project conception.

Given the scale of expenditure, an ex-ante, basic benefit cost analysis of the project would have highlighted the need to sell testing kits to maximise benefits from the project.