Poster

Application of genetic & reproduction technologies to Murray cod for aquaculture and conservation

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Background

Murray cod is an Australian icon with significant commercial, recreational, conservation and cultural value. The species is highly regarded by anglers for sport and consumption. Until recently it supported a relatively small but valuable commercial fishery. During the 1970s and 1980s methods to mass produce fingerlings for stock enhancement (for recreation & conservation) were developed and today more than one million fingerlings are produced annually by hatcheries for release into the wild. During the 1990s, demand for Murray cod in the market for human consumption supported the development of technologies for grow-out in aquaculture facilities. Today in excess of 150 tonne/annum of farmed Murray cod are sold into domestic and international markets.

The aquaculture industry in Australia is expanding. However, such expansion will need to accommodate changing consumer demands, social trends and environmental imperatives. With the recent listing of Murray cod as a threatened species nationally, and the introduction of translocation guidelines and quality assurance certification for hatcheries, it will be necessary for both government and industry to have access to reliable cost effective genetic technologies to enable proactive management of native fish gene pools to comply with ESD requirements.

The application of advanced genetic and reproduction technologies to augment conventional breeding programs have the potential to significantly improve the production and environmental performance of various high value, inland finfish species such as Murray cod. Well-managed breeding programs incorporating genetic selection of favourable traits (e.g. growth, survival, disease resistance, etc.), have resulted in tremendous gains in production performance and reliability, and increased profitability of culture animals. Application of these technologies will also provide for adjunct benefits to the management of native finfish biodiversity, particularly for species which are declining in the wild and yet continue to be managed for multiple purposes (i.e. commercial, recreation, conservation).

The project

A genetic selection and breeding program for Murray cod has been initiated by the Department of Primary Industries, Primary Industries Research Victoria (PIRVic) with funding from the Our Rural Landscapes (ORL) Initiative. Principal drivers for this program are to apply innovative genetic and reproduction methods to enhance profitability and sustainability of inland aquaculture species (Murray cod) and to conserve/enhance the biodiversity of wild stocks (**Figure 1**). The objectives of the project are to:

- Develop genetic technologies (marker-assisted selection, etc.) to produce new domesticated strains of Murray cod that are suited to aquaculture production for human consumption.
- Develop controlled reproduction technologies (chromosome manipulation, sex manipulation, cryopreservation, hybridisation and/or hormone therapies etc.) for Murray cod and other chosen species to enable year-round production of elite, quality assured seedstock for various markets.
- Develop genetic technologies to manage the production of genetically diverse 'wild strain' seedstock for conservation management purposes.

This project will generate new capabilities to apply advanced genetic and reproduction technologies to achieve economic and environmental sustainability outcomes within the aquaculture industry. A domesticated selected broodstock gene pool will be established for marker-assisted breeding to create high performing strains of fish for aquaculture grow-out purposes. Use of only fully domesticated stock for this purpose will eliminate dependency on wild stocks, which is a plus for biodiversity.

Comprehensive databases and sophisticated genetic assessment tools for identification, management and maintenance of wild and domesticated genotypes for commercial, recreational and conservation purposes will be developed. Reproduction technologies will provide for improved production through enhanced performance, biosecurity and IP protection (ie high performing, sterile seedstock

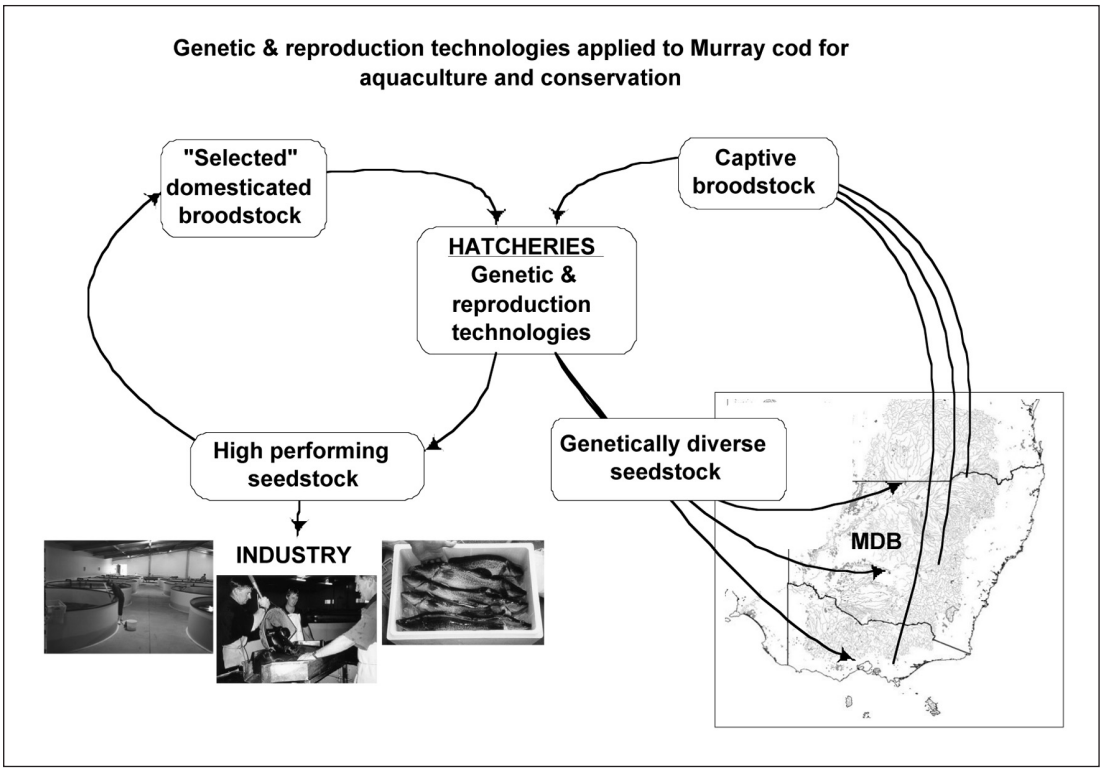

Figure 1 Application of hatchery-based genetic and reproduction technologies for production of genetically diverse 'wild strain' Murray cod seedstock for conservation management purposes, and high performing domesticated seedstock for aquaculture purposes.

for aquaculture), as well as improved genetic management of matings for production of genetically diverse seedstock for release into the wild. Technologies and guidelines for selective breeding for aquaculture purposes and associated risk analysis to ensure long-term genetic integrity, biosecurity and biodiversity of captive and wild stocks will be developed for breeding and stock enhancement programs.

Enhanced natural biodiversity will be achieved through improved broodstock and seedstock management to protect the natural gene pool of endemic fish stocks (including the identification of more appropriate genetically-based management units for wild populations), increased understanding of patterns of genetic diversity across the range of the species and more effective and efficient stock enhancement programs for recreation and stock conservation purposes. Genetically sound management strategies will minimise adverse effects of restocking and thus promote the long-term survival of wild populations with flow of benefits to anglers and future generations. The knowledge and techniques gained during this project will be useful for future projects on other stocked Australian native species.

Progress and future research

Since commencing the project in October 2003, a founder population comprising Murray cod seedstock from 31 separate spawnings has been established in custom built facilities at DPI, Snobs Creek, and captive broodfish have been transferred to controlled environment facilities in preparation for controlled breeding trials.

Over 700 historical (dried scale samples) and 1,000 contemporary tissue samples have been gathered and DNA extraction methods have been successfully applied to these samples. A microsatellite library for Murray cod has been developed and, to date, 36 microsatellite markers have been optimised for use and at least 14 of these are highly polymorphic. A review of the distribution of Murray cod in the wild, including identification of stocking sites, is in progress. Further sampling will need to be undertaken to ensure thorough coverage of Murray cod distribution, particularly from areas least likely to have received hatchery seedstock.

During 2004/05 a trait index will be developed to identify favourable traits for aquaculture purposes and microsatellite markers will be developed for Quantitative Trait Loci (QTL) screening. In order to determine the effective population size in captive broodfish, microsatellite DNA markers will be used to assess parentage of captive-spawned Murray cod fingerlings (based on spawnings at DPI, Snobs Creek), and will also provide information on genetic diversity in current captive stocks. In order to determine as accurately as possible the natural genetic structure and diversity of wild populations we will also perform microsatellite analysis of historical (scale/otolith) pre-stocking samples and relatively undisturbed contemporary populations. Widely collected contemporary (tissue/scale) samples will be compared to assess impacts of past restocking on genetic diversity and structure. Controlled reproduction trials will commence and an assessment of gamete cryopreservation techniques for aquaculture and conservation purposes will be undertaken.