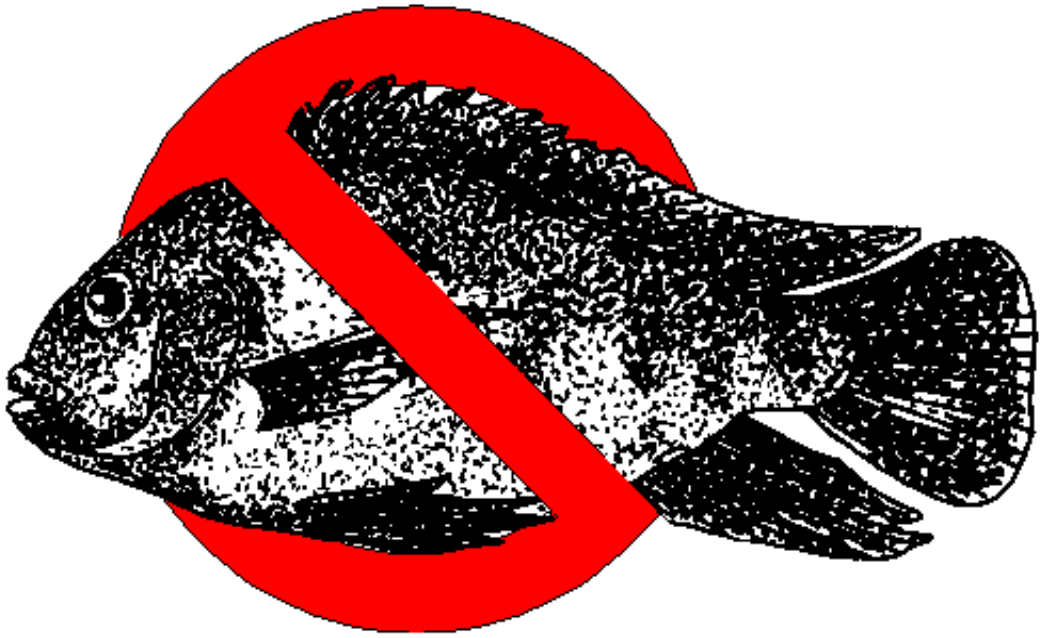
REGIONAL MANAGEMENT PLAN FOR TILAPIA (BARRON AND MITCHELL CATCHMENTS)



Prepared by the Barron/Mitchell Tilapia Management Group facilitated by the Queensland Fisheries Service.

Executive Summary

The noxious fish tilapia is now established in the upper Barron River including Tinaroo dam and has recently been found close to the dam wall. There is considerable community concern that tilapia will move out of the dam and infest the Mitchell River catchment. A stakeholder group was set up to ascertain the level of risk and develop a management plan for the Barron and Mitchell catchments. The major conclusion of the group was that action must be taken immediately to avert the potential environmental problem of tilapia infesting the Mitchell catchment and the Gulf Rivers system. It was also felt that whilst it was expensive to control the spread of tilapia now, it would be significantly more expensive, if not impossible, to control them in the future should they be found to have major impacts on commercial and recreational fisheries, tourism and biodiversity.

Impacts

Whilst the impacts of tilapia on native aquatic systems remains uncertain, possible significant impacts include:

- Impacts on the gulf commercial fisheries (valued at $79.87 million annually)
- Impacts on recreational fisheries and tourism in the Mitchell and Barron River catchments and the gulf rivers (75,706 visitors per year)
- movement into the Northern Territory via the Gulf Rivers system
- potential biodiversity implications for the Mitchell and the Gulf Rivers systems

Risk

Tilapia could potentially move into the Mitchell catchment via these translocation paths:

- Movement from Tinaroo through the irrigation channel into the Walsh River (major Mitchell River tributary)
- Movement first into the Barron catchment below Tinaroo through water releases or overtopping of the spillway and then:
- into the Mitchell catchment via flooded low lying country to the north of Mareeba (Biboohra)
- Into the Mitchell catchment via irrigation pumps and drains
- Direct translocation (ie. by humans)
- Movement directly into the Mitchell River via the northern irrigation channel and into the Mareeba wetlands.

The major outcomes of a qualitative risk assessment are:

- Tilapia can move into the Mitchell via a number of translocation paths.
- In the short term (within the next year), human translocation represents the greatest risk to the Mitchell catchment.
- In the longer term (within the next 5 years), movement into the Mitchell catchment via the irrigation channels represents an equally significant risk

The group felt that even though human translocation represented the greatest risk in the short term this did not mean that additional immediate action should not be taken to prevent their movement via the irrigation channel.

Actions

Preferred actions are as follows:

- The current education and extension strategy needs to be expanded in the Barron and Mitchell catchment areas.
- A multiple barrier system needs to be set up which consists of an electrical barrier in the channel just below the dam wall and two screens further down the channel.
- A monitoring program set up to measure the effectiveness of any actions taken.
- Research into the impacts of tilapia on native systems and into possible control mechanisms

It is felt that all these actions need to be initiated immediately.

Introduction

Tilapia (*Oreochromis mossambicus*) are present in the upper reaches of the Barron River and in Tinaroo dam. There is significant concern that they will invade the presently uninfested Mitchell catchment and hence the Gulf Drainage and other uninfested catchments in the region. There is also concern on the impact of tilapia on the native aquatic communities in the Barron catchment and on the recreational fishery in Tinaroo dam.

Tilapia are listed as a noxious fish under the *Queensland Freshwater Management Plan 1999*. As such it is unlawful to place them, or cause them to be placed into Queensland waters. Although there is very little information relating to the specific impacts of tilapia it is known that they are very effective competitors and quickly form self-maintaining populations because of their efficient reproductive strategy, flexible habitat preferences and simple food requirements. Invoking the precautionary principle, it is essential that action be taken now to control the spread of tilapia until it can be conclusively proven that they have no impact on biodiversity and economic values. It is almost impossible and very expensive to manage tilapia once they have established in an area and therefore from both an economic and conservation perspective priority should be given to preventing their spread to uninfested catchments. Acting now to prevent the movement of tilapia into the gulf system could potentially save billions of dollars in the future if tilapia are found to impact on the commercial and recreational fisheries and biodiversity.

This Plan recognises that responsibility for tilapia control lies with government, community and industry. It was put together after extensive community consultation and represents what the stakeholder group believes to be the most effective approach to dealing with the tilapia problem in this area.

The goals, priorities and activities in this plan have been identified using the information available at the meetings. Also some additional key issues were considered during the process, namely:

- *prevention* of tilapia infestation is feasible where effective barriers to reinvasion exist or can be erected and maintained;
- sustained tilapia *control*, rather than aiming for complete eradication, is the more realistic option for larger areas already infested with tilapia;
- for some areas, no tilapia management is the only practicable option given the currently available techniques. Until an effective technique is developed, for these areas it may be more sensible to direct resources to higher priority areas.
- It is very important that research into the ecology and biology of tilapia is continued and that research into possible control methods is initiated.

Vision

To prevent the spread of tilapia into uninfested catchments and to manage their impacts in already infested areas.

Goals

- Increase community understanding of the threat posed by tilapia in the region to biodiversity and the economy.

- Involve stakeholders through consultation and implementation of on-ground actions and control measures.

- Prevent the spread of tilapia from the Barron River catchment to uninfested catchments such as the Mitchell River catchment.

- Ensure that tilapia, within their present distribution within the Barron catchment, are maintained at a level that does not impact on biodiversity and economic values.

- Restrict the further spread of tilapia within the Barron R. catchment

- In the long term eradicate tilapia from the Barron River catchment and vigorously pursue all means to ensure that eradication/containment within the Barron River catchment occurs.

Constraints

- Limited knowledge of behaviour and ecology and impacts of tilapia and no research being done to redress this situation.
- Limited Resources
- Lack of public knowledge about the negative impact of tilapia
- Perception by some members of the public that tilapia should be utilised as an economic resource.
- Lack of any truly effective means of eradicating tilapia from such a broad geographic area.

Stakeholders

Queensland Fisheries Service and AFFS
SunWater
Local Shire Councils eg. Eacham, Mareeba, Atherton, Cairns.
The Barron River Integrated Catchment Management Group
The Mitchell River Watershed Management Group
The Queensland Conservation Council
The Tablelands Fish Stocking Society
Queensland Seafood Industry Association
Sunfish

Key Group[1]

AFFS - John Russell, Alf Hogan, Terry Vallance
QFS – Rachel Mackenzie Peter Jackson
SunWater –Jason Williams
Barron River ICM – Helen Adams, Jax Bergerson, Graham Dalip, Carol Schmidt, Bronwyn Robertson, Neville Simpson
Mitchell River ICM – Ben Westerberg, Hillary Kuhn, Dennis Rose
Tablelands Fish Stocking Group and Fishcare volunteers – Alana Freeman, Norm Freeman
Queensland Conservation Council – Tim Fisher

[1] Not all of these people sat on the committee simultaneously

The Problem

Tilapia were first reported in 1986 in the Barron and tributary streams above Tinaroo and were first observed in Tinaroo Dam near Severin creek in 1997. A survey conducted by QFS in October 2000 found tilapia in the northern part of the dam and in the lower reaches of Mazlin Ck. They are also well established in the southern parts of the dam. Sites surveyed are shown in Figure 1. Table 1 indicates where tilapia were found in the survey.

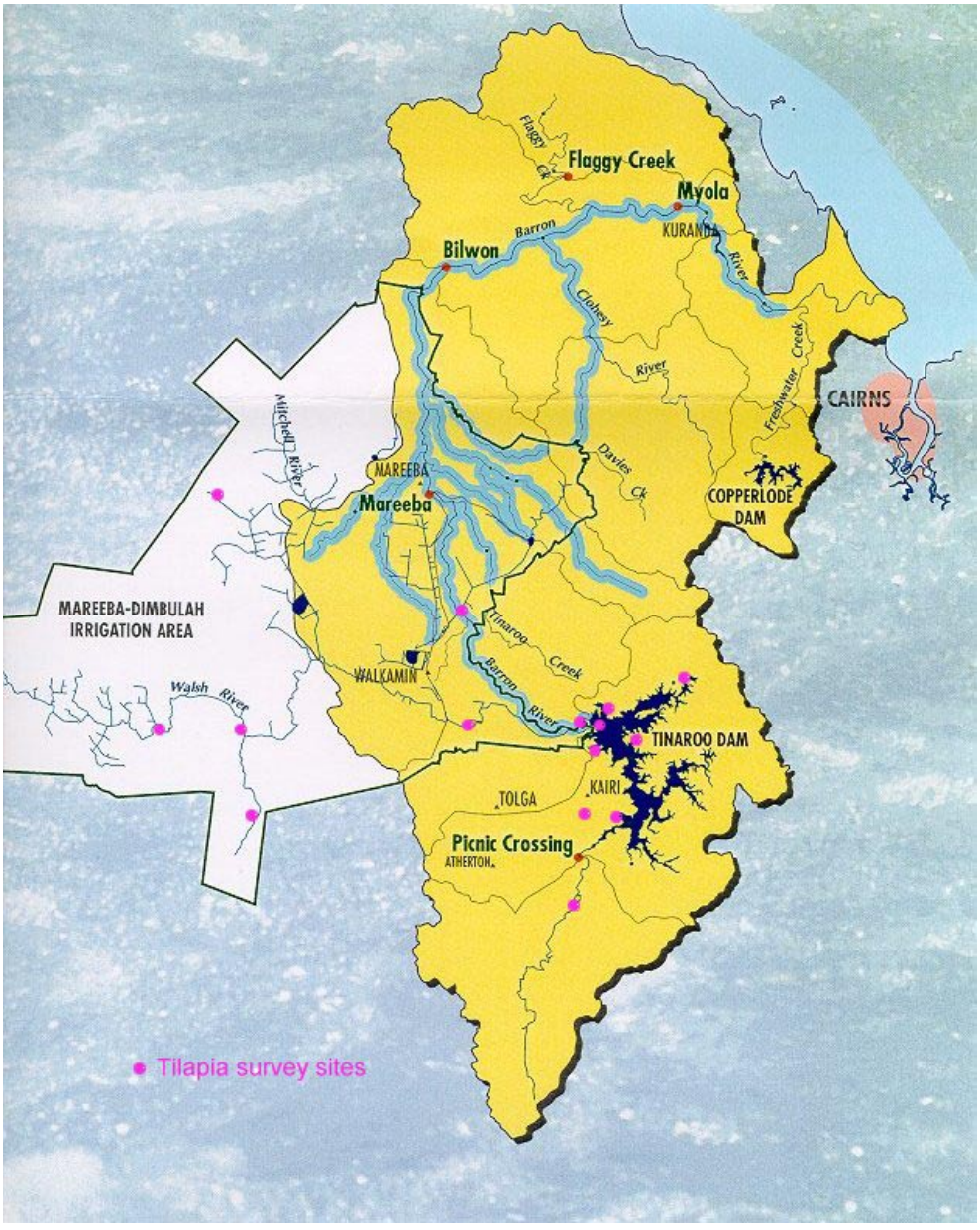


Figure 1 - Tilapia survey sites (excluding upper Johnstone River and Lake Mitchell)

Table 1

Site	Stream	Present
Moseley Road	Barron River	X
Lake Tinaroo, Mazlin Creek	Barron River	✓
Lake Tinaroo, Curri Curri	Barron River	X
Lake Tinaroo, Black Gully	Barron River	✓
Lake Tinaroo, Dam Wall	Barron River	✓
Lake Tinaroo, Crocodile Bay	Barron River	X
Lake Tinaroo, Robson's Creek	Barron River	X
Mazlin Creek, Kairi	Barron River	X
Tinaroo, Below Dam Wall	Barron River	X
Henry Hannam Drive	Barron River	X
West Barron Channel, Villella Rd	Barron/Walsh River	X
Channel Inflow	Walsh River	X
Collins Weir	Walsh River	X
Bruce Weir	Walsh River	X
Mareeba Wetlands	Mitchell River	X
Lake Mitchell	Mitchell River	X
Brett Fry's Dam	Johnstone River	X
Brett Fry's Place	Johnstone River	X

There are a number of possible mechanisms for tilapia to become established in the Mitchell system. These are:

- Movement from Tinaroo through the irrigation channel into the Walsh River (major Mitchell River tributary)
- Movement first into the Barron catchment below Tinaroo through water releases or overtopping of the spillway and then:
- into the Mitchell catchment via flooded low lying country to the north of Mareeba (Biboohra)
- Into the Mitchell catchment via irrigation pumps and drains
- Direct translocation (ie. by humans)
- Movement directly into the Mitchell River via the northern irrigation channel and into the Mareeba wetlands

Each of these scenarios is discussed in detail in the risk assessment.

Potential impacts of tilapia on the Mitchell catchment and the gulf rivers system.

Until further research is conducted it will be difficult to predict the impact of tilapia on native aquatic systems such as the Mitchell. However, the group identified the following issues:

- Should the Mitchell catchment become infested the potential for other Gulf rivers systems to become infested becomes significantly greater.

- The Gulf Commercial fishery is worth $79.87 million annually (ABARE, 2000). There is the possibility that tilapia will establish in the estuaries, which may impact on the nursery grounds for many important commercial species including prawns. There is also the potential for tilapia to impact on the commercial barramundi fishery, which is worth $5 million annually.

- Tilapia could move into the Northern Territory via the Gulf Rivers system

- The freshwater, estuarine and marine recreational fisheries in the gulf are of significant economic importance to the region and may be threatened by the presence of tilapia. 75,706 visitors visit the gulf region annually and it has been roughly estimated that almost half of these visitors went fishing whilst in the region (National and International Visitor Survey's, 1999, Bureau of Tourism Research).

- The Mitchell system contains a number of rare and threatened plant species and is considered to have a high level of species richness for fish.

- Significant biodiversity assets exist in the gulf plains that are periodically inundated by gulf rivers like the Mitchell. These include the southern gulf aggregation of wetlands that are recognised as having values consistent with RAMSAR listed wetlands. RAMSAR being an international treaty to protect habitats of migratory birds.

- Unlike the east coast, there are extensive lagoonal systems (both offstream and instream) and it is probable that tilapia populations will build up in these.

- There are a series of weirs and a large dam (Lake Mitchell) in the upper catchment and a population explosion of tilapia could impact on fishery for sooty grunter and other species.

- In artificial systems such as drains and ponds , particularly those which are rich in nutrients, populations can build up to very large numbers and this undoubtedly has an adverse impact on other fish (through loss of habitat and competition). These population explosions haven’t been observed to any great extent in natural systems to date.

Impacts on Fisheries Resources of Tinaroo and the Barron

Tinaroo Dam is a man-made structure and as such most of the species present in the dam were stocked. However, there are a number of fishes indigenous to the catchment that have established in the dam as a result of natural movement (eg rainbowfish). The major fisheries in Tinaroo are red claw and barramundi and there have been no studies to determine if tilapia impact on these species. In weirs on the Ross River, tilapia have co-existed with native fish including barramundi for many years although there are no data to determine what native fish populations were like before the introduction of tilapia and indeed before the construction of the weirs. There is also no information relating to the impact of tilapia on aquatic species that are not important recreationally.

The presence of tilapia in Tinaroo may reduce the perceived value of the dam as a recreational fishery because anglers will catch tilapia instead of Barramundi. However, there is also a possibility that a fishery based on tilapia could develop in Tinaroo because:

- Tilapia in Tinaroo are growing to a reasonable size (fish up to 40 cm were reported in the October DPI survey)
- Their flesh is of reasonable eating quality
- With the exception of barramundi, which is an expert fishery, there are few other suitable recreational fish species in Tinaroo

The group was extremely concerned about the possibility of tilapia becoming a targeted recreational species, as this would create an incentive for people to translocate them to other uninfested areas.

Risk Assessment

The degree of risk was determined by qualitatively assessing the likelihood of infestation occurring, and the impact the infestation would have on the values agreed to by the group. These values incorporate ecological, social, and commercial factors such as biodiversity, tourism and the commercial fisheries. The risk assessment was based on the translocation paths and looked at the level of risk in both the short[2] and long term (refer to Figures 1 and 2.).

Discussion of translocation paths

1. Tinaroo to Mitchell via irrigation channels

In theory, tilapia should be able to move into the irrigation channel from the dam via the outlet. There are a number of factors which should be considered when assessing the probability of fish using this route.

[2] In this case short term refers to within the next year and long term to the next five years

There is some doubt as to whether fish in the dam can inhabit the waters adjacent to the outlet from the dam into the channel all year round. Russell (1997) noted that Tinaroo was stratified for most of the year and that anoxic or low dissolved oxygen concentrations (<20%) existed in its hypolimnion. Depth of the theromocline, below which dissolved oxygen levels were low, varied throughout the period of stratification but was usually between 10 and 20m although MacKinnon and Herbert (1996) did find anoxic conditions at less than 10m. Mixing of the water masses through destratification generally resulted in uniform and higher oxygen concentrations throughout the water column. It is at these times that fish could potentially occupy water adjacent to the valve. In Tinaroo, Russell (1997) found destratification was generally complete by May and persisted until at least July. Similarly, MacKinnon and Herbert (1996) found destratification broke down for about three months during the same period.

For much of the year the deeper waters of Tinaroo adjacent to the dam wall were anoxic and theoretically unsuitable for fish. At other times fish are regularly observed on depth sounders in the vicinity of the dam wall and at all depths. Tilapia are known to occur waters that are low in oxygen. Also, during periods of high rainfall, cooler inflowing water flows under the impounded waters down the old river channel (Alf Hogan pers. Comm). It rises on impact at the dam wall. This inflowing water is oxygenated.

This may alter during particularly dry periods when the water level of the dam drops significantly and the outlet may be above the thermocline for much of the year. While the depth of the outlets and associated pressures are considerable, Hogan (pers comm.) maintains that fish such as silver perch and sooty grunter are known to have exited and survived both the river outlet and the irrigation outlet. It needs to be acknowledged however that any fish that travels through these valves must be subjected to considerable life threatening stresses and forces.

In the absence of screens, although there are siphons and other structures in the channel, it can be reasonably assumed that there are no barriers sufficient to inhibit the movement of fish throughout the network. The channel is used to directly supplement the Walsh River (Mitchell Catchment) for irrigation. Another branch of the channel also discharges into two-mile creek (Mitchell River tributary).

2. Movement by persons deliberately/unwittingly translocating fish directly into the Mitchell

There is little evidence of natural inter-basin translocations of tilapia in Queensland. It would appear that in most places where tilapia have become established, the translocations have been deliberate. For example, fish from the aquarium industry are suspected to be responsible for the original source of tilapia in the Townsville area and the pond on the golf course at Port Douglas which yielded an estimated 13 tonne of fish was also stocked. It is extremely difficult to stop someone who is intent on translocating fish and this highlights the importance of a thorough and effective education program

3. Movement by persons deliberately/unwittingly translocating fish directly into other catchments.

The comments above apply equally to other catchments, although the greater the distance between two catchments the less likely it would be for translocation to occur.

4. Tinaroo to Middle Barron

Once Tilapia become well established in Tinaroo it is very probable that, sooner or later, they will also become established in the Barron River below Tinaroo. This could occur by:

- Some fish surviving being washed over the spillway or through the river outlet or by water releases to supplement streams. It needs to be acknowledged that any fish moving over the spillway or through the valve would be subjected to considerable life-threatening forces.

- Deliberate translocations

Presently there is no evidence of tilapia in the middle Barron River between Tinaroo and the Barron Falls at Kuranda. The recent survey (October 2000) found no tilapia at sites in the Barron River below Tinaroo Dam. There is a separate, isolated, stock of *Tilapia mariae* which has been established for some years in the freshwater reaches of the Barron River (including Freshwater Creek) below the falls. The Barron Falls is an effective barrier to the upstream movement of these fish.

Another isolated stock of *T. mariae* was located in the 1980s in a farm dam in the Kuranda area above the falls. These were deliberately placed in the dam and were subsequently successfully eradicated by DPI.

5. *Movement from the Middle Barron to the Mitchell via flooded lowlands*

The Barron and the Mitchell Rivers are periodically and temporarily inter-connected through low-lying country to the north of Mareeba during heavy rain and floods. This needs further investigation as it has implications for the movement of fish during these periods

6. Middle Barron to Mitchell via pumps etc.

There are irrigation pumps that draw directly from the Barron and irrigate areas that run-off into the Mitchell. There is a possibility that tilapia could be moved via this means.

Figure 2

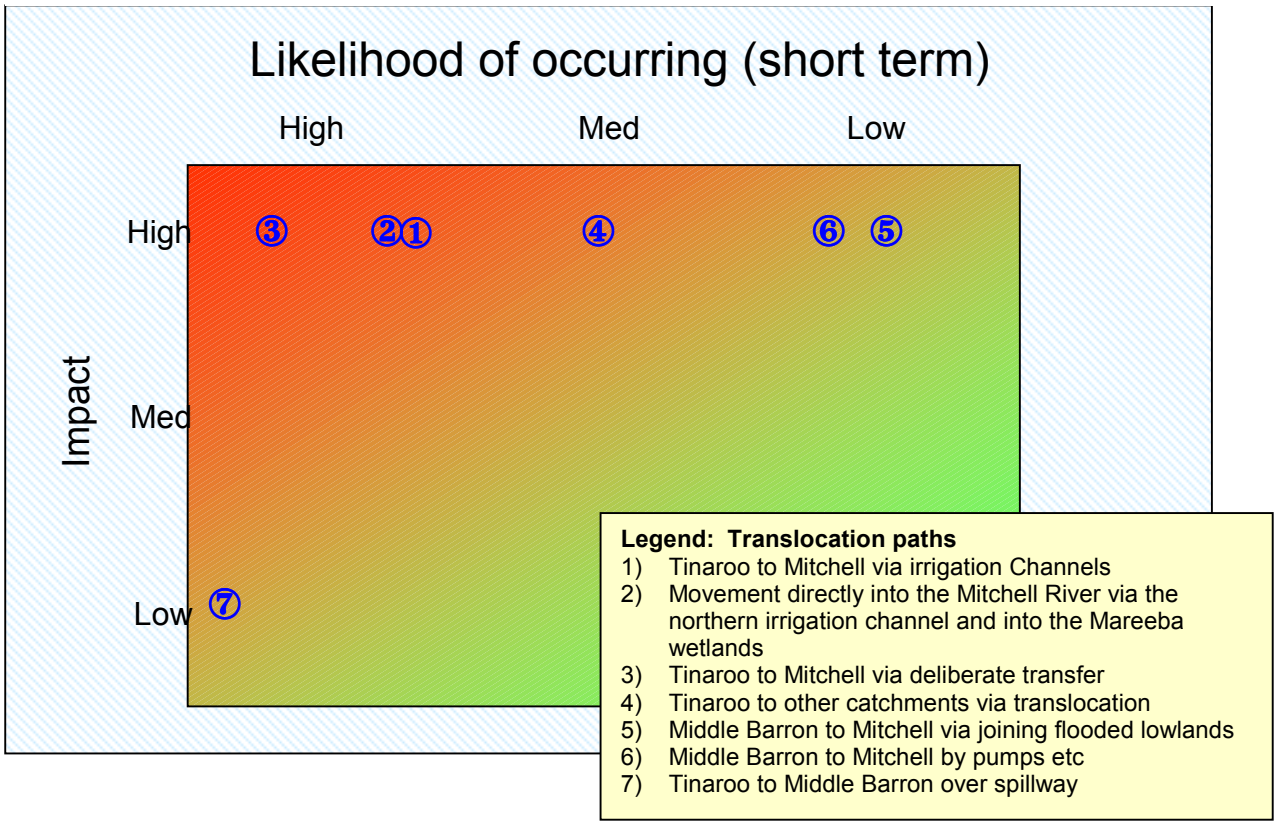
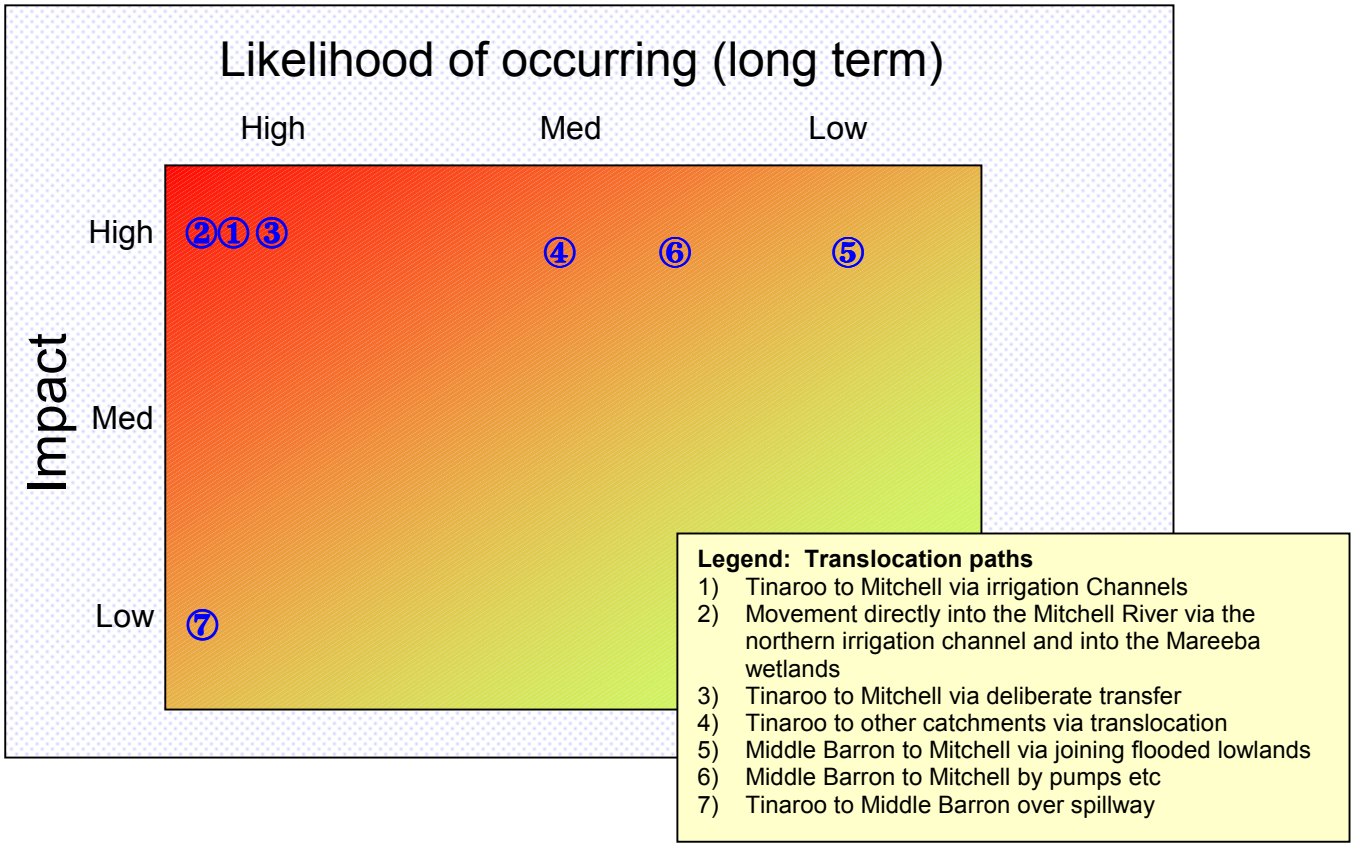


Figure 3



In the short term the highest risk is from human translocation into the Mitchell catchment however, in the long term movement via the irrigation system into the Mitchell also represents a very high risk.

The group agreed that whilst the risk of human translocation is high and requires a significant extension and education effort, this is not an argument for delaying or not undertaking other actions

As a result of this risk assessment the group concluded that priority should be given to preventing the spread of tilapia into the Mitchell via human translocation and the irrigation channels.

Priority Actions[3]

- *Increase public awareness of the issue*
- *Put in place a multiple barrier system to prevent tilapia entering the Mitchell via the irrigation channel*
- *Instigate research into biological control of tilapia*
- *Monitor all sites of infestation and the catchment as a whole to determine the rate of population increase and the success of any control measures*

Multiple Barrier System (proposed by David Smith of Smith-Root and agreed to by the group)

i) Design and install drum screen and wedge wire screen in downstream channels

ii) Develop and undertake research into electrical field requirements to stun and deter tilapia

iii) Explore the discharge channel barrier concept
This would consist of bottom mounted electrodes in the channel with a downstream rotating conveyor to carry fish and debris out of the channel for disposal.

The electrical field would be strong enough to stun all fish coming down the discharge channel. High voltage and appropriate pulse rates would ensure this.

iv) Install electrical barrier in discharge channel if feasible

v) Should the barrier in the discharge channel be unsuitable, research, design and install electrical barrier around outlet pipe in the dam.

It was agreed that the proposed research should be collaborative both in funding and execution, as there were benefits for the Queensland government and to Smith-Root.

[3] See table 3 for more detailed information

The multiple barrier system would be considerably less expensive than installing either a mechanical screen or electrical barrier across the outlet of the dam. It would also have fewer maintenance issues. The screens put in place further downstream would act as a back-up to give an almost 100% success rate. Because the eggs of tilapia do not appear to be viable unless "brooded" by the mother an electrical barrier would be appropriate. Further research needs to be done into the pulse rate required to stun tilapia effectively at all size classes.

Education and Extension

- Launch the Aquatic invaders Education module on the Atherton tablelands
- Maintain a sustained media campaign
- Erect signs around Tinaroo Dam
- Community Service announcements based on pre-recorded video footage
- Continued distribution of posters and brochures
- Training of Fishcare volunteers in pest fish issues
- Information on relevant web-sites
- Erect a permanent display in local Environmental Centres
- Continued input into QBFP displays
- Purchase models of tilapia for display
- Use "tilapia" bashes as an educational tool

Research into general biology of tilapia and biological control options

- Link in with universities to instigate research into the biology/ecology of tilapia
- Implement the research project into inducing sterility in male tilapia

Monitoring

- Monitoring needs to be undertaken before any capital works go ahead. This monitoring would ensure that tilapia are not already in the Mitchell and provide base line data to monitor the effectiveness of any control options put in place. There is potential to utilise existing baseline data gathered through various projects
- Data collection of fish species present in the Mareeba/Dimbulah Water Supply Scheme (MDWSS) can occur in conjunction with the injection of biocide used for channel maintenance

Long term Actions

- Reducing the population in the upper Barron catchment by poisoning isolated water bodies. This may only be feasible after two consecutive failed wet seasons and it is not certain that this will be possible.

- Continual Maintenance of channels using biocide (Acrolien) will potentially result in control of any Tilapia entering the MDWSS.

Table 2

Action	Estimated Cost	Responsibility	Comments	Timing (As of May 01)
Wedge wire screen (1mm aperture)	$10,000	SunWater and DNR	This would be a relatively straightforward process as no major changes need to be made to the channel.	ASAP
Rotating drum screen	$150,000	SunWater and DNR	This would require changing the route of the water slightly so there wasn't a 90 degree turn. Both screens are necessary because the water diverts to the Mitchell in each case.	ASAP
Research into electrical field requirements to stun and deter tilapia	$50,000	DPI (QFS/AFFS) and Smith-Root	Research has already been initiated by Smith-Root but it would be useful to conduct independent trials in QLD. This would have a state-wide application	ASAP
Explore the discharge channel barrier concept	$5000	SunWater, DPI, DNR and Smith-Root	This would require liaison between SunWater and Smith-Root	Once trials have finished.
Install electrical barrier in discharge channel if feasible	Up to $500,000	SunWater, DNR, Smith-Root	Final designs would depend on feasibility studies. Would only be installed after extensive surveys.	6-12 months
Complete research and design and install electrical barrier around outlet pipe in the dam if required	Up to $ 2 million	SunWater, DNR, Smith-Root	Would only be installed if the discharge channel barrier was not deemed acceptable. Would still require other screens to ensure 100% effectiveness	12 months plus
Launch the Aquatic invaders Education module on the Atherton tablelands	$2000	QFS, community, education department	The module will be completed by June.	July 01

Maintain a sustained media campaign	minimal	QFS, community	There has been significant media interest in this issue. This has been critical for raising awareness.	Ongoing
Erect signs around Tinaroo Dam	$1000	QFS, community	Signs have been in place since March 01	Done
Community Service announcements based on pre-recorded video footage	$10,000	QFS, community	Video footage would need to be shot	ASAP
Continued distribution of posters and brochures	$500	All stakeholders	Brochures and posters are available and are being distributed. May need to develop optimum distribution network	Ongoing
Training of Fishcare volunteers in pest fish issues	$500	QBFP, QFS	Some very keen volunteers are in the district and a workshop on pest fish issues would be useful	August 01
Information on relevant web-sites	minimal	All stakeholders		August 01
Erect a permanent display in local Environmental Centres	$1000	DPI and the community	Would depend on obtaining permission. Would require some more tanks etc for live displays.	September 01
Use “tilapia” bashes as an educational tool	minimal	Community	The Barron River ICM successfully ran the tilapia part of the Tinaroo Barra Bash in 2000. It is a condition of the permit that educational material be given to all competitors,	Annual
Purchase models of tilapia for display	$600	DPI	Life-like models mounted on board for display purposes cost about $100 each	October 01 (or before)
Continued input into QBFP displays	minimal	DPI		Ongoing
Link in with local universities to instigate research into the biology/ecology of tilapia	Less than $5000	DPI	Provide a small grant to post-grad students to encourage work into tilapia. Liaise with Universities about providing in-kind assistance	October 01
Implement the research project into inducing sterility in male tilapia (see attachment 1)	$150,000	DPI	This would be an extremely useful project and have state-wide application	ASAP

Monitoring program	$20,000 pa	DPI	A targeted monitoring program is required to support all other actions	ASAP
Data collection from channel poisoning	$5000 pa	DPI and SunWater		Bi-annually
Sustained control in upper catchment	$15,000	DPI and landholders	Reducing the population in the upper catchment by poisoning isolated water bodies. This would only be feasible after two consecutive failed wet seasons.	If conditions make it possible
Continuous use of biocide in the channel	minimal	SunWater	Use Acrolien via a drip feeding process. SunWater is looking to do this anyway but are still seeking approval. It is uncertain when and if this process would go ahead.	If possible.