



# Shoalwater Bay Training Area Pest Fish Management Strategy

Melinda Scanlon, Timothy Marsden & Matthew Moore



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July 2011

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# Acknowledgements

## Information contained in this Strategy has been obtained from:

1. DEEDI Pest Fish Operational Strategy 2010-2015 (Draft).
2. Pearce, Malcolm. 2006. Development of a Surveillance Program for Catchments Vulnerable to the Spread of Freshwater Exotic Fish with Particular Reference to the Gulf of Carpentaria (Draft). DEEDI.
3. DEEDI Noxious Fish: Rapid Response Manual 2008.
4. Moore, M. and Marsden, T. 2011. Addressing Threats Posed by Invasive Aquatic Animals on Shoalwater & Corio Bay Ramsar Wetlands. Department of Employment, Economic Development and Innovation (DEEDI). Internal Report.

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# Executive Summary

This strategic pest fish management plan is an outcome of recent pest fish surveys undertaken by Fisheries Queensland (FQ) in the greater Shoalwater and Corio Bay region. The pest fish surveys were a component of the 'Addressing the Threats Posed by Invasive Aquatic Animals on Shoalwater and Corio Bay Ramsar Wetlands' project, which was funded under the Federal Government's 'Caring for our Country' natural resource management initiative. The purpose of this management plan is for use by the Department of Defence who manage Shoalwater Bay Training Area (SWBTA).

There is growing community concern regarding the effects of pest fish species on native fish and their habitats, particularly in important environmental areas. The impacts of most introduced non-indigenous species on native fish populations are generally poorly known; however, in pest species that have been studied impacts can include competition for food and space, predation on eggs and fry, and habitat degradation.

The strategy here within has been designed especially for the Australian Department of Defence who manage SWBTA; a relatively pristine environmental area containing a diverse and unique freshwater fish fauna including endangered and restricted species. Protecting this area from pest fish incursion is not just a State and Federal Government issue, it is also a local community issue, and through engaging all key stakeholders, it is anticipated that effective control and success on the ground can be achieved.

In order to prevent pest fish incursions in the SWBTA, it is important that several recommendations are considered. These recommendations are:

- Regular electrofishing surveys be performed by Fisheries Biologists (every 2 years for streams that are easily accessed and every 5 years for more remote waterways, i.e. Dismal Swamp, to monitor fish communities (active surveillance);
- The Active Response plan be implemented should a pest fish be found.
- An education program organised by Fisheries Queensland and Fitzroy Basin Association that includes defence environmental officers and local residents be implemented, which emphasises the pristine nature of the greater Shoalwater Bay region and how it can be protected cooperatively;
- Defence environmental managers responsible for the management of SWBTA and local landholders with property on or adjacent to waterways that flow into or from SWBTA

become familiar with local fish species and are vigilant to any fish community changes (passive surveillance).

# Introduction

Shoalwater & Corio Bay Ramsar wetlands are located on the Central Queensland coast (Figure 1) and cover an area of approximately 239, 100 ha. The southern boundary of the wetlands is approximately 50 kms north east of Rockhampton. The listing of Shoalwater and Corio Bays aquatic habitats as wetlands of international significance (Ramsar wetlands) was formalised in 1996, creating the largest Ramsar listed wetlands on the east coast of Australia. The majority of the Ramsar wetlands fall within SWBTA, and includes the intertidal areas, adjacent lands and marine waters (up to highest astronomical water mark) from Broome Head in the north to the southern boundary of SWBTA and the intertidal areas of Corio Bay in the south (wetlands.org 2005).

The Shoalwater and Corio Bay region is acknowledged both nationally (National and Commonwealth Heritage listing) and internationally (World Heritage & Ramsar listed wetlands) as an area containing outstanding natural heritage values worthy of protection and promotion. The area's terrestrial, marine and five major estuarine environments represent the largest area in central east Queensland containing representative coastal, subcoastal, aquatic landscapes and ecosystems with relatively undisturbed habitat areas containing significant floral and faunal assemblages, including populations of rare and threatened species ([ramsar.wetlands.org](http://ramsar.wetlands.org) 1995).

The area occurs in an ecotone between tropical and subtropical faunas, containing many diverse and unique aquatic habitat types unequalled in its biogeographic region, including: freshwater lagoons, swamps, perched lakes, sinkholes, peat swamps, perennial groundwater fed and intermittent streams. Its geographical location in the transitional zone combined with its unique and minimally impacted aquatic habitat types has lead to a high diversity of freshwater fish fauna, with 26 recorded species; four of which exhibit their northern most range distribution: the short-headed lamprey, *Mordacia mordax*, ornate rainbowfish, *Rhadinocentrus ornatus*, honey blue-eye, *Pseudomugil mellis* and firetail gudgeon, *Hypseleotris galii*. Most significant is the isolated sub-population of the endangered honey blue-eye, *Pseudomugil mellis*, recorded from Dismal Swamp. The absence of exotic pest fish, high diversity and unique aquatic habitats make this biodiverse region significant on a national scale.

Aquatic eco-systems of SWBTA have generally been poorly studied. In 1993 the first freshwater fish survey was undertaken by the Australian Museum. This survey discovered a single specimen of the endangered honey blue-eye (*Pseudomugil mellis*), several fish species exhibiting their northern range distribution and no exotic pest fish species. The second and most recent freshwater

fish survey undertaken in SWBTA was carried out by Fisheries Queensland between 2009-2011. This survey confirmed the presence of an isolated but viable and healthy population of endangered honey blue-eye (*Pseudomugil mellis*) located in Dismal Swamp. Importantly, the survey found no pest fish species, making SWBTA significant on a national scale. The latest survey also found an additional species (short-headed lamprey, *Mordacia mordax*) exhibiting its northern range distribution, adding to the diversity of the areas unique fish communities.

Unfortunately, established populations of exotic pest fish including mosquitofish (*Gambusia holbrooki*) (Figure 2), guppy (*Poecilia reticulata*) (Figure 3) and goldfish (*Carassius auratus*) (Figure 4) have been recorded from rivers and streams to the north and south of SWBTA. The establishment of exotic pest fish populations in nearby catchments and the lack of recent studies in the region have greatly increased the threat of pest fish impacting SWBTA (Moore & Marsden, 2011).

The introduction and spread of exotic pest fish is a major threat to the biodiversity of native fish populations and the ecological sustainability of their associated aquatic habitats. The spread of exotic pest fish into the aquatic habitats of SWBTA would be detrimental to the regions freshwater fish communities and particularly threatening to the small isolated population of endangered *Pseudomugil mellis* (Moore & Marsden, 2011). *P.mellis* prefers lowland wallum habitats that are generally characterised by acidic darkly stained oligotrophic waters with abundant submergent and emergent macrophytes (Pusey *et al*, 2004). Anthropogenic impacts, including pest fish species *Gambusia holbrooki*, have been implicated in the demise of *P.mellis* in wallum habitats of south-east Queensland. Arthington and Marshall (1993) suggest that *P.mellis* populations only occur at 18 localities in Australia, so threat of pest fish must be taken seriously.

Shoalwater Bay's biological diversity, large size and unique undisturbed habitats, make this wilderness area a benchmark for scientific research. The introduction and spread of pest fish into Shoalwater Bay's aquatic habitats would greatly diminish its integrity and vicarious nature to the detriment of Australia's national heritage. The impacts of most introduced non-indigenous fish species on native fish populations are generally poorly known; however, for pest species that have been studied impacts can include competition for food and space, predation on eggs and fry, and habitat degradation.

As custodians of the environment, Federal, State and local governments, and the public as a whole, have a responsibility in the management of pest fish. The successful control of pest fish in Queensland is complex, and requires a co-ordinated approach with all stakeholders playing a role. Leadership is currently provided at the State level by the Department of Employment, Economic

Development and Innovation (DEEDI) through the agencies of Fisheries Queensland and Biosecurity Queensland.



**Figure 2.** Mosquitofish (*Gambusia holbrooki*) found in the Fitzroy Basin and just south of Yeppoon at Kinka.



**Figure 3.** Guppy (*Poecilia reticulata*) found in the Fitzroy Basin.



**Figure 4.** Goldfish (*Carassius auratus*) found in the Fitzroy Basin.

To achieve optimal effectiveness, integrated pest management that uses multiple approaches and combines different methodologies, must be employed. This means that both stakeholder responsibilities and opportunities for community involvement and co-operation need to be clearly identified. In contrast to many other pest plant and animal problems (e.g. exotic weeds and rabbits), there is often little apparent private landholder benefit in controlling pest fish; rather, pest fish are usually only offensive once they are in waterways and wetlands that are highly public.

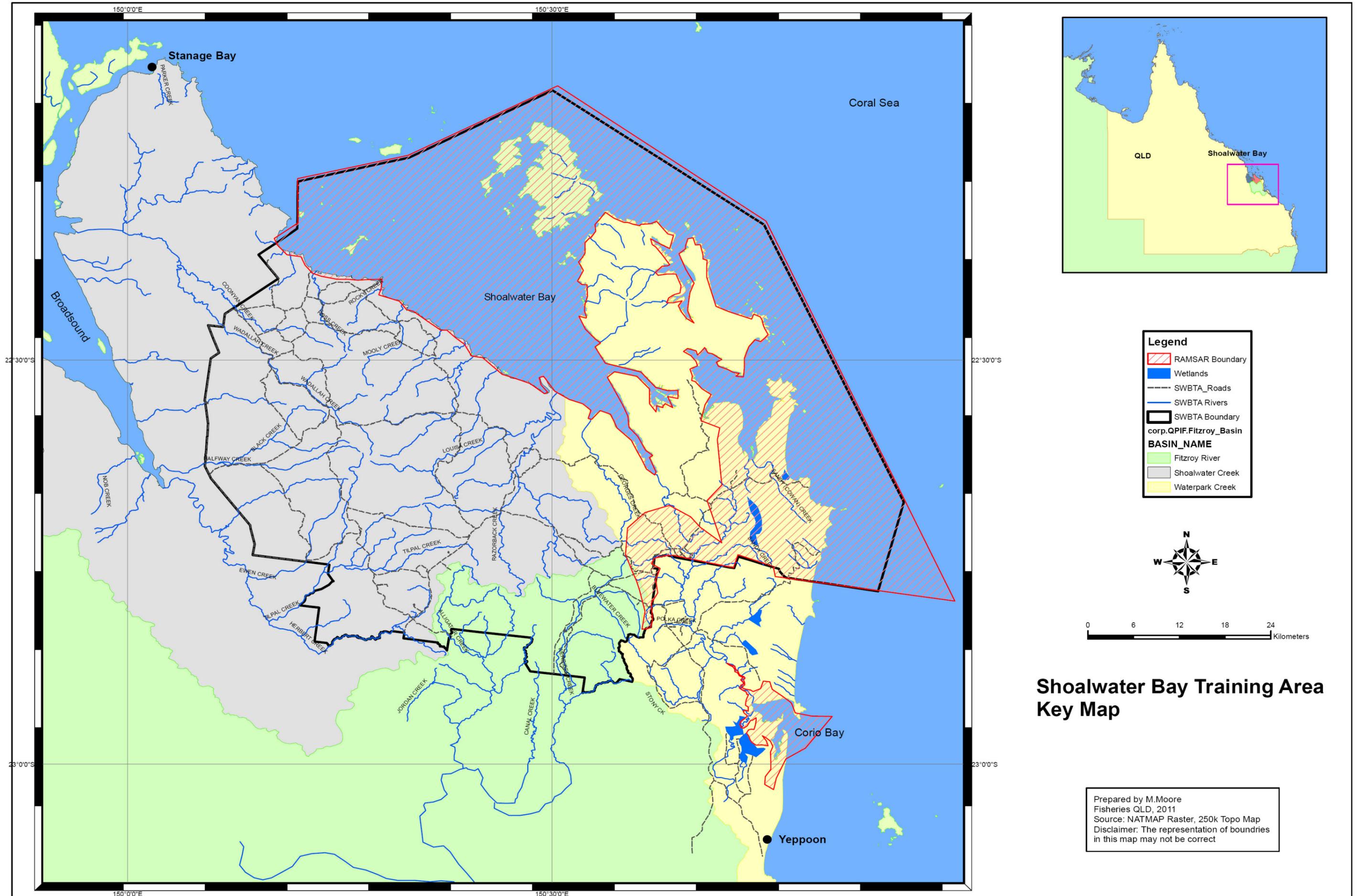
If this particular Strategy is to be effective, individuals, including Defence land managers and personnel, interested community groups and local landholders, need to participate in management actions and education activities that aim to foster cooperative partnerships.

The Shoalwater Bay Pest Fish Management Strategy has been developed by Fisheries Queensland, and it partners with the freshwater fish surveys undertaken in the greater Shoalwater and Corio Bay region as part of the 'Addressing the Threats Posed by Invasive Aquatic Animals on Shoalwater and Corio Bay Ramsar Wetlands' project.

The purpose of this Strategy is to protect the native fish species of the internationally listed Ramsar wetlands and adjacent waterways through the following objectives:

- Ensure that Defence land managers are informed about responsibilities, threats and responses;
- Provide up to date response guidelines in accordance with national and State legislation and policy;
- Develop effective cooperative partnerships to enhance the prevention of pest fish incursions;
- Increase local community understanding of the importance of the area, pest fish and their management;
- Provide important recommendations for Defence land managers to ensure the prevention of pest fish incursions into the future.

**Figure 1.** Shoalwater Bay Training Area site location map



### Shoalwater Bay Training Area Key Map

Prepared by M.Moore  
 Fisheries QLD, 2011  
 Source: NATMAP Raster, 250k Topo Map  
 Disclaimer: The representation of boundaries  
 in this map may not be correct

# Background Information

## Definitions

The following definitions apply in relation to their use in this strategy:

**Pest fish:** those fish species that cause, or have the potential to cause, a negative social, economic and/or ecological impact and can include not only declared noxious species but also non-indigenous and translocated species.

**Noxious:** refers to a plant or animal declared harmful by Queensland statute law.

**Non-indigenous:** not native to Australia.

**Translocated species:** refers to any native species intentionally or accidentally released into an environment outside its natural range.

**High risk catchments:** river drainage basins or sections of river drainage basins which are susceptible to new infestations by pest fish, often due to their proximity to existing infestations.

A new incursion is the sighting of one or more pest fish specimens in a new catchment, before they are evaluated as established in that catchment.

**Ramsar:** The Convention on Wetlands (Ramsar, Iran, 1971) -- called the "Ramsar Convention" -- is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories. For more information visit <http://www.ramsar.org>.

# Relevant Legislation, Regulations and Responsibilities of Stakeholders

## Federal

Under the Australian Constitution, specific and clear responsibility for the legislative and administrative framework within which natural resources are managed, lies with the State and Territory governments. The Commonwealth's involvement in environmental matters focuses on matters of national environmental significance and fulfilling Australia's international obligations.

The two main Government departments with responsibility for environmental protection are the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) and the Department of Agriculture, Fisheries and Forestry (DAFF).

SEWPaC has responsibility for managing invasive species which pose a threat mainly to environmental values. Its efforts are focussed on the control and management of established invasive species. Its key legislation is the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

One of the objectives of the EPBC Act is to promote a co-operative approach to the protection and management of the environment that involves governments, the community, landholders and indigenous peoples. The EPBC Act provides a framework for the management of invasive species by providing a list of key threatening processes which require threat abatement plans (TAPs). Under the EPBC Act there is the provision for threat abatement plans to be made jointly with the States and Territories or with agencies of those States and Territories. Key threatening processes are those that threaten the survival, abundance or evolutionary development of a native species or ecological community. No fishes are currently listed as key threatening processes under the Act.

Section 301A of the EPBC Act also provides for the development of regulations for the control of non-native species. Under the EPBC Act regulations may provide for the establishment and maintenance of a list of species, other than native species, whose members threaten or would likely threaten biodiversity. Regulations may also regulate or prohibit trade in members of a species between Australia and other countries, between States and Territories, and by constitutional corporations. Australia currently allows the importation of specific species of ornamental fish, subject to quarantine measures established by an import risk analysis of

ornamental finfish. The species permitted importation are listed on SEWPaC's *List of specimens suitable for live import* under the EPBC Act.

DAFF's responsibility is to manage invasive species which pose a threat mainly to production values. Its key legislation is the Quarantine Act 1908 (the Quarantine Act). Most of DAFF's efforts and responsibilities are aimed at protection and response to newly identified invasive species, as distinct from established invasive fish populations.

Under the Quarantine Act the Commonwealth Government has responsibility in relation to pre-border and border monitoring, detection and control arrangements in respect of humans, animals and plants. It provides power to prohibit imports, enter, seize and dispose. Measures in the Quarantine Act are implemented by the Australian Quarantine and Inspection Service (AQIS), an operating group within DAFF. AQIS provides quarantine inspection for the arrival of fish or their products into Australia (based on SEWPaC's *List of specimens suitable for live import*), and inspection and certification for a range of fish and fish products exported from Australia.

## **State**

The key legislation relating to the regulation and control of pest fish in Queensland is the *Fisheries Act 1994* and *Fisheries Regulation 2008*.

Provisions in the Act cover the import, possession and release of noxious and non-indigenous fisheries resources in Queensland. Specifically, Division 5 of the Act dictates that a person must not unlawfully bring noxious or certain non-indigenous fish into Queensland; they must not possess, rear, sell or buy noxious or certain non-indigenous fish; or release noxious or non-indigenous fish into Queensland waters. An exception applies to certain non-indigenous fish listed in the Fisheries Regulation 2008 (see below). Further, the Act states that a person who unlawfully takes or possesses noxious or certain non-indigenous fish (i.e. without a permit) must kill it to prevent it or its progeny from entering Queensland waters. For a complete list of non-indigenous fish that can be kept in Queensland without a permit (as long as they cannot escape) see the DEEDI website ([www.deedi.qld.gov.au](http://www.deedi.qld.gov.au)).

Offenders are subject to a maximum penalty of 2000 penalty units, and provision is made in the Act to allow for recovery of costs associated with removing and destroying pest fish. The Act also allows the Chief Executive to order the destruction or containment of noxious or non-indigenous fish if they are considered a significant threat to other fisheries resources or fish habitats.

The *Fisheries Regulation* contains the list of declared noxious fish species that are prohibited, plus a list of 'allowable' non-indigenous fish that can be kept under certain conditions that relate to ensuring Queensland's wild fisheries and habitats are protected from harm. These lists are found in Schedule 6 of the Regulation. Queensland will continue to add new prohibited species into legislation to reflect the expanding national noxious fish list.

On the ground, the Queensland Government responds to reports of pest fish by conducting fish community surveys of the waterway(s) in which pest fish have potentially been sighted. If pest fish are found, then several measures to eradicate the pest fish may be implemented including netting and trapping, introduction of predatory fish or as a last resort the application of a piscicide.

The ongoing monitoring of waterways throughout Queensland is undertaken by Queensland Fisheries as part of various environmental projects/partnerships.

## Department of Defence

As a Commonwealth organisation, the Australian Department of Defence (DoD) is bound by Commonwealth legislation and policy, and also by State environmental legislation, policies and standards where Commonwealth ones are absent or less stringent. In addition, the DoD have their own Environmental Strategic Plan which aims to ensure that responsible management is implemented and the highest possible standards are upheld while undertaking military and civilian activities. Some of the commitments listed in this strategy include:

- Comply with the requirements of the Environment Protection and Biodiversity Conservation Act (EPBC).
- Manage domestic (and international) biosecurity risks during all movements of Defence goods, services, equipment and vehicles across land, sea and air.
- Participate in whole of government environmental initiatives and partnerships with universities and State agencies.
- Foster community and stakeholder engagement through relevant forums such as Environmental Advisory Committees.

In order to fulfil these commitments successfully, it is recommended that DoD land managers encourage responsible pest fish management by:

- Becoming familiar with the environmental importance of the area to native fish and being aware of potential threats to these fish communities;
- Participating in local pest fish-related initiatives (where possible);
- Raising awareness and helping to prevent the accidental or deliberate release of pest fish; and
- Helping detect and report new pest fish incursions.

## Local council

SWBTA falls within the Rockhampton Regional Council (RRC) Local Government Area. RRC are currently in the process of drafting a new Pest Management Plan 2011-2015. However, under Local Law No. 35: *Control of Pests*, the council may declare an animal species causing local problems to be a 'pest' and implement local control and compliance measures.

According to the Rockhampton Regional Council, its key roles in pest management include:

- surveillance
- early detection through monitoring (data collection and assessment)
- compliance and enforcement (ensure compliance with Act)
- create and maintain local planning framework for pest animals
- mapping infestations
- raising awareness through education and training
- adopt/refine/implement operational procedures developed by DEEDI

## Communities

The local community will participate and encourage responsible pest fish management by:

- Participating in local pest fish-related initiatives;
  - Raising awareness and helping to prevent the accidental or deliberate release pest fish;
  - Helping detect and report new pest fish incursions;
- and
- Initiating local stewardship of the pristine aquatic environment.

# Threats

## Potential Sources of Pest Fish

Results from the corresponding Shoalwater and Corio Bay pest fish survey confirmed that there are currently no pest fish incursions in the confines of SWBTA. However, lands adjacent to SWBTA pose a threat as potential sources for the introduction of pest fish making the Training Area a 'high risk catchment'.

The waterways of SWBTA have been divided up into three catchment areas (Figure 1) and the threats to each area are discussed. The three grouped areas are:

- South - Waterpark Creek (Including GBRMP catchment streams)
- West - Fitzroy River catchment
- North West - Broadsound/Shoalwater Bay catchment

## Waterpark Creek

By far the biggest source point that threatens SWBTA is the Waterpark Creek catchment area to the south. The waterways of this catchment originate from some of the most remote and pristine parts of the Area; from the Coast Range in the south near the town of Byfield, and to the north of Corio Bay in Byfield National Park. Some of these streams are outside SWBTA and flow through Byfield State Forest and Byfield National Park before flowing into Waterpark Creek and out into the GBRMP. During years of above average rainfall these streams become perennial in nature with peak flows occurring during the wet season. To the north east of Waterpark Creek catchment are many small short groundwater fed sandy substrate streams which originate from Manifold Hills before flowing directly into the GBRMP. Further to the north there are also many short coastal streams draining the Peninsula Range, before flowing into the GBRMP.

Recent fish community sampling undertaken by Moore and Marsden (2011) failed to record any pest fish species within the Waterpark Creek catchment and the short coastal streams draining Manifold Hills. Streams draining Peninsula Range have not yet been sampled. However, this areas remoteness and lack of large river systems which have the potential to transport pest fish via flood plumes and on-shore drift, indicates that this is a low risk catchment. The close proximity of the Waterpark Creek catchment to the small peri-urban township of Byfield makes this catchment

potentially vulnerable to new pest fish incursions, while the small streams draining the Manifold Hills are low risk.

### Byfield Farm Dams

Most farm dams within the small township of Byfield overflow directly into the Waterpark Creek catchment. No pest fish have been recorded in any of the surveyed farm dams in Byfield (Moore and Marsden, 2011). However, humans have historically been primary vectors in the translocation of pest fish, so the small peri-urban township of Byfield is one of the most likely point sources for potential pest fish incursions.

### 'Iwasaki' - Wetlands of National Significance

The 'Iwasaki' wetlands have been placed on the directory of important wetlands in Australia due to their significance on a national scale. The wetlands cover an area of approximately 646 ha and are potentially the largest privately owned wetlands in Australia (Moore and Marsden, 2011). The wetlands have been created through the construction of bund walls which form the boundary between the Ramsar listed wetlands of Corio Bay and the Iwasaki wetlands. The bund walls which prevent saltwater intrusion have formed artificial wetlands creating significant amounts of productive wetland habitat. These lowland wetlands provide critical habitat essential for the life cycle of many of the regions fish species and migratory waterbirds. Unfortunately, the bund walls have created barriers which prevent passage of most diadromous fish species from migrating into these wetland habitats. Therefore the wetlands are not providing the essential environmental services they should be, to the detriment of the regions fish communities and fisheries resources.

Prior to the aquatic survey of north Iwasaki, the wetland had experienced a large scale chemical spray in an attempt to eradicate large swathes of the aquatic weed species *Hymenachne*. While this weed programme had successfully eradicated most of the *Hymenachne*, some still remains, while the dead and dying *Hymenachne* on the bottom of the wetland may have detrimentally affected the water quality, with the wetland experiencing extremely low dissolved oxygen levels. Overall the wetland habitats of Iwasaki are poor to good.

Recent fish community sampling undertaken by Moore and Marsden (2011) of north and south Iwasaki wetlands did not record any pest fish species. The close proximity of the wetlands to the coastal town of Yeppoon indicates that there is a medium threat of pest fish incursion.

## **Fitzroy River Catchment**

### Fitzroy Basin streams

Fitzroy River catchment draining streams originate in the hills of the Coast Range in the west of the SWBTA. These streams make up a very small component of the Fitzroy River catchment. Generally these streams are ephemeral in nature, flowing during the wet season before constricting back to a series of isolated waterholes. Pest fish species mosquitofish (*Gambusia holbrooki*), guppy (*Poecilia reticulata*) and goldfish (*Carassius auratus*) have been recorded in parts of the Fitzroy River Basin, and therefore there is a high likelihood that pest fish could migrate into Fitzroy Basin streams of SWBTA. However, no pest fish species were recorded during recent fish community sampling of Werribee Creek, the largest Fitzroy Basin tributary originating in SWBTA (Moore and Marsden, 2011).

## **Broadsound/Shoalwater Bay Catchments**

Waterways of this catchment originate in the hills and mountains of the Normanby Range and Coast Ranges in the north-west and western sections of SWBTA. Streams in this part of the SWBTA are ephemeral, flowing during the wet season before contracting back to a series of isolated waterholes. Streams flow directly to the sea via a complex estuarine system, contain no barriers to fish passage and are generally in good condition.

The lower reaches of many Broadsound catchment streams are located outside SWBTA, and therefore cross public access roads. Though there is only a minimal risk of pest fish incursion, there is potential for pest fish to make their way into the lower reaches of these streams. The most likely pest fish incursion would come as a result of humans releasing aquarium fish via the public access road or from surrounding homesteads backing onto Broadsound catchment waterways. There is a high likelihood that any pest fish incursions into the lower reaches of Broadsound streams would eventually make their way upstream and into SWBTA.

## **Vectors**

Vectors are literally methods by which pest fish can be carried into a new area (Figure 5).

### **People**

#### **Releasing aquarium fish**

The most common source of pest fish incursions the world over, are from people who dispose of unwanted aquarium fish into waterways. This most commonly occurs when people relocate and do not wish to take pet fish with them. This issue may not be pertinent to DoD staff or overseas troops who operate within SWBTA due to the nature of activities undertaken at SWBTA and general restrictions on access to the area enforced by DoD, but it is still a potential threat.

#### **Translocation**

Inadvertent translocation from one waterway to another can occur when water is collected and transported from one area to another, and also from boats that store ballast water, have live wells or simply from water taken onboard during transit. Not only can live fish be transported this way, but also their eggs, which may not be as visible to the naked eye. Screening stations have been constructed on various irrigation systems including the Mitchell River and in South East Queensland to prevent the downstream passage of the tiny eggs and fry of tilapia (Webb 2007).

The intentional translocation of non-indigenous fish throughout Australia occurs for purposes such as domestic consumption (e.g. tilapia) and angling. For example, it is believed that there have been at least three separate introductions via human translocation of tilapia in northern Queensland with genetic evidence identifying three different strains of the species (Webb 2007). Additionally, in April 2005, two adult male tilapia were collected from the irrigation channel leading from Lake Tinaroo into the Mitchell River in a location suggesting that they were deliberately released (Webb 2007).

#### **Using pest fish as live bait**

Translocation can also occur when anglers collect pest fish for live bait. For example:

- tilapia collected in the Cairns region were used as live bait by anglers in Cape York (Webb 2007)
- specimens collected from the Endeavour River, Cooktown may have been used or intended for use as live bait, but either escaped or were discarded (Webb 2007)

## Stocking

People become vectors for pest fish spread when they stock farm dams, ornamental ponds and aquaculture ponds with non-indigenous fish species for domestic consumption, sport or harvest. The proviso of the Fisheries Act 1993 for the stocking of such impoundments with non-indigenous fish is that there be no risk of their escape and also in order to stock farm dams, the species must be local to the area. This issue links in with the next vector, flooding.

## Flooding

Flooding is a regular occurrence in the tropics with seasonal rains bringing heavy deluges, localised flooding and often widespread flooding. When this occurs, fish that have been released into standing water bodies such as farm dams or ornamental ponds can escape into waterways in floodwaters. This has been extensively documented for tilapia in the upper Barron River, Atherton Tablelands (Webb et al., 1997), in Ross Creek (Arthington *et al.*, 1984) Ross River (McKay 1984, Bluhdorn et al. 1990) and Sachs Creek and Ross Dam, Townsville (Webb, 2007).

Flooding within catchments can also assist in the spread of pest fish by connecting normally isolated waterways, dry season lagoons and drowning out barriers that would normally prevent the upstream and downstream dispersal of pest fish. An example of this is the rapid natural dispersal of the three-spot gourami, *Trichopterus thricogaster*:

- First reported in 1998 from a sugar cane channel and several lagoons associated with Sheep Station Creek, the species has now established breeding populations in the lower Burdekin region (Webb 2007).
- In 2005 the species was collected near East Barrattas Creek and from Upper Barratta Creek a neighbouring catchment to Sheep Station Creek and has now spread almost to the Haughton River and its catchment (Webb 2007).

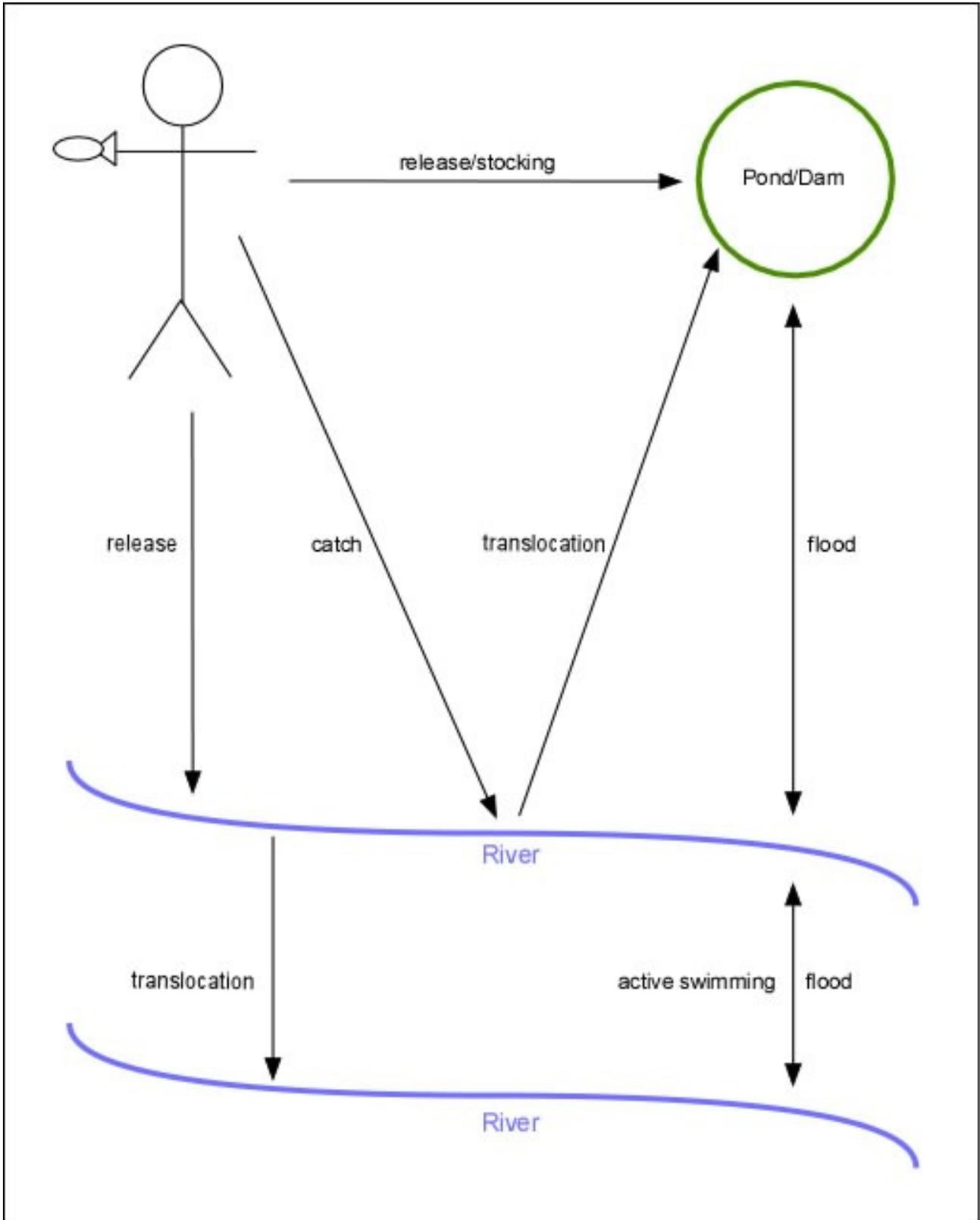
Flood plumes emanating from infected waterways primarily to the south of the Training Area are further potential vectors for infestation. Pest fish flushed out and suspended in these freshwater plumes may survive to be carried northwards by long shore drift currents that run parallel to the coastline. Opportunistic fish may then migrate into adjacent waterways of the Training Area causing new infestations. This process is believed to have caused the dispersal of *O. mossambicus* throughout the small creeks to the north of Townsville (see Arthington et al. 1984, 1994, Webb 2003)

## Active Swimming

Many fish species are known to migrate extensively within river systems throughout their different life stages; and others, being opportunistic, will move simply to find new habitats with greater space and/or food supplies. In this way, it is highly feasible and a legitimate threat, that pest fish from the Fitzroy Basin could move into SWBTA.

Examples of active swimming incursion include: tilapia in the Ross and Burdekin River catchments and swordtail (*Xiphophorus helleri*), in the Gregory River:

- between 1978 and 2000, the range of two tilapia species, *Oreochromis mossambicus* and *Tilapia mariae*, increased from approximately 1% to about 75% of the total catchment area in the North-East Drainage Division (Webb, 2007);
- tilapia spread through more than 3000km of waterways in the Burdekin River catchment over four years (Burrows, 2009);
- swordtails (*Xiphophorus helleri*), found in the upper Gregory River catchment (Dryander National Park), near Proserpine, are believed to have migrated to this part of the waterway and established populations away from predators (Scanlon and Marsden, 2010).



**Figure 5.** Common vectors for pest fish spread.

# Priority Actions

## Active Participation

An education program (run by Fisheries Queensland), which includes (but is not limited to) DoD, local residents, community groups, recreational users, conservation organisations and researchers that live in the Shoalwater Bay area is highly recommended. It would focus on several key topics, including:

- the pristine quality of the area
- the meaning and importance of Ramsar listings
- the unique fish communities of the area
- fish identification
- pest fish; threats, vectors and prevention
- what to do if a pest fish is sighted

## Active and Passive Surveillance

In order to prevent and protect the area from invasive pest fish incursions, both active and passive surveillance is necessary.

### Active Surveillance

An active surveillance program uses a scientifically structured sampling program to obtain high quality data. Active surveillance is limited in ability to detect infestations due to time, resources, detection methods and relatively small representative sample to infer the actual occurrence level. The possibility of not detecting an infestation can occur with this structure. The degree of accuracy of the active surveillance program, however, may be estimated from the number of samples.

Surveillance programs may use four types of sampling frequency.

1. Continuous surveillance: Short time frame of daily to weekly sampling events.
2. Periodic surveillance: Sampling occurs monthly to six monthly intervals with multiple sampling per year.
3. Cyclic surveillance: Yearly or more sampling periods.
4. Once-off surveillance: Sampling only occurs on one occasion.

Choice of sampling frequency is dependant on resource availability, time and biological characteristics of the organism trying to be detected. For the SWBTA, cyclic surveillance is recommended, with accessible areas surveyed every 2-3 years and remote areas every 5 years.

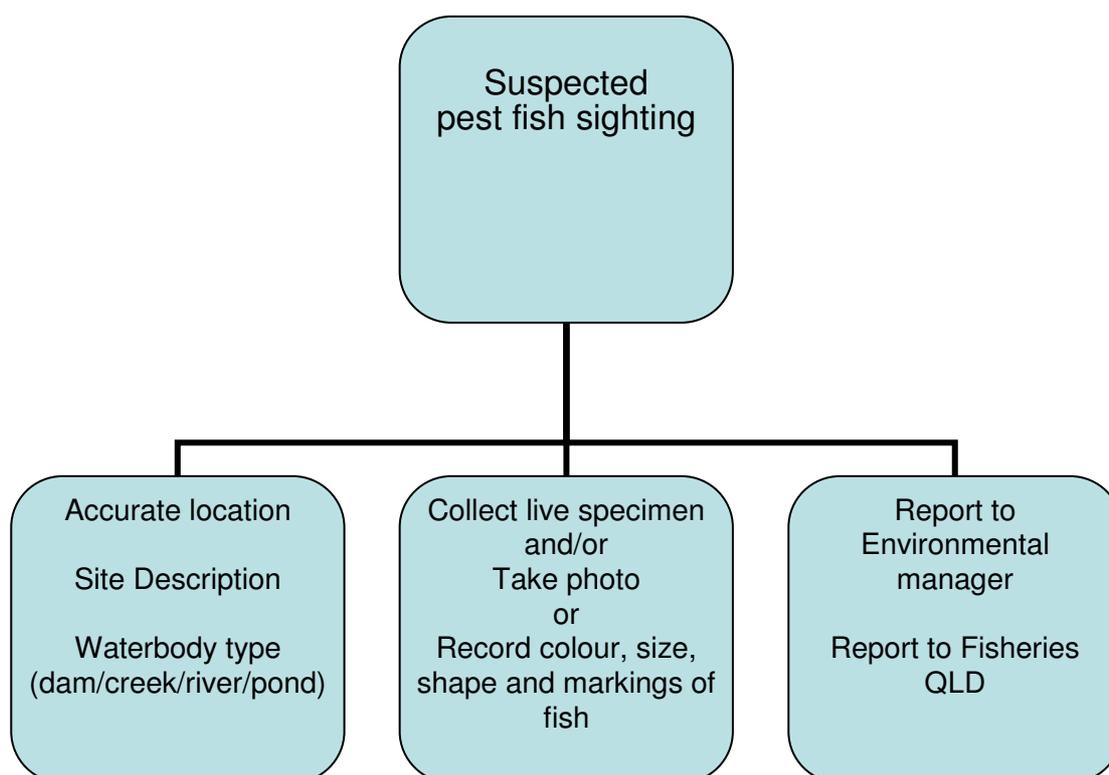
### Passive Surveillance

Surveillance programs for the detection and reporting of pest freshwater fish species in Queensland waters has been mainly reliant on passive surveillance techniques. Passive Surveillance is undertaken with no formal scientific structure and involves reporting from the community on an *ad hoc* basis. This method has detected nearly all new pest fish incursions in Queensland, however, it has also meant that pest fish must be established in enough numbers to be noticed, so is often too little too late.

Despite this, the advantages of passive surveillance include covering vast geographical areas, detection of newly introduced species to an area that would normally go unnoticed, community ownership of the process and time to detect an infestation may decrease. Such surveillance needs to be performed by everyone within and surrounding the SWBTA, including: members of the DoD (where possible) and members of the public occupying neighbouring properties. To be successful, those undertaking active surveillance would need to become familiar with the native fish of local waterways and so that noticeable changes to fish communities may be detected.

## Active Response

An overview of the response procedures is shown in the flowchart (Figure 6). If a pest fish is thought to have been sighted, it is important that it is immediately reported to Fisheries Queensland. This can be done by calling the DEEDI hotline on 13 25 23.



**Figure 6.** Overview of the response procedures

It is important to:

1. Identification: It is extremely important that the suspicious fish is correctly identified. If possible, **collect** a live sample or **take a photo** of the suspicious fish. If no specimen is available, record as many details as possible, including the **colour**, **size** and **shape** of fish and any distinguishing **markings**.
2. Location: Record the location (as precise as possible) of where the pest fish was sighted.
3. Report: It is important that the incident is reported immediately to a Defence Environmental Officer who will collect all relevant information and collate it into a Pest Fish Reporting Form (appendix 1) and contact/forward it to a Fisheries Queensland pest fish Biologist. See important contacts, Appendix 2.

## Conclusion

It is no secret that the land and aquatic environments within SWBTA are generally in excellent condition, with large areas of un-disturbed aquatic habitats containing unique, endangered and restricted fish species. It is however, not publically known that the area is potentially threatened by the lands and aquatic environments that surround it. In order to protect SWBTA from pest fish incursions, it is important that environmental managers of SWBTA and residents adjoining SWBTA and its surrounds are informed of the threats and the how they can be abated. To do this, cooperation between Fisheries Queensland, Department of Defence and local residents is required. It is anticipated that active surveillance in the form of biennial pest fish surveys undertaken by Fisheries Biologists and passive surveillance from environmental managers within SWBTA and by residents adjoining and surrounding SWBTA will greatly increase the likelihood of pest fish incursions being noticed, reported and dealt with before they have a chance to spread throughout the area and its sensitive aquatic ecosystems. Active surveillance over a range of representative habitats, particularly those containing endangered and restricted fish species such as Dismal Swamp, is required to ensure the continued survival of these species is not threatened by any future pest fish incursions.

## Recommendations

In order to prevent pest fish incursions in the SWBTA, it is important that several recommendations are considered. These recommendations encompass and require both the cooperation of Fisheries Queensland, Department of Defence who manage SWBTA and the public who reside on adjacent lands. The recommendations are:

- Department of Defence land managers and local landholders become familiar with the local fish species and are vigilant to any fish community changes;
- Regular surveys performed by Fisheries Biologists (every 2 years for streams that are easily accessed and every 5 years for more remote waterways) to monitor fish communities. It is anticipated that that the biennial surveys would take 2-3 days.
- The Active Response plan should be followed should a pest fish be found;
- An education program run by Fisheries Queensland that includes Department of Defence environmental managers and local residents be implemented, with emphasis placed on the pristine quality of the area and how it can be protected cooperatively.

# Appendix 1-

## Pest Fish Reporting Form

Name: _____
Address: _____
_____
Phone: _____

### Sighting details

Date when you saw the fish: _____
Where did you see the fish? (GPS point if possible, or as much detail as possible)
_____
_____
_____
_____
Is it on private property?
_____

### Waterbody details

What sort of waterbody was the pest fish caught in (eg. creek, dam, river, lake, pond)?
_____
Depth of waterbody: _____
Width of waterbody: _____
Length of waterbody: _____

### Fish Details

Have you seen this type of fish before (if yes, where)?
_____
What species of fish do you think it is? _____
Is there a specimen or photo of the fish available (if yes, where)?
_____
Length of fish: _____ Shape of fish: _____ Colour of fish: _____
Does the fish have any markings?
_____

## Important Contact Details

To report a pest fish sighting and/or to submit an online pest fish reporting form, please contact the:

**Customer Service Centre for the Department of Employment, Economic Development and Innovation**

**Phone: 13 25 23** (cost of a local call within Queensland) or +61 7 **3404 6999**

8 am to 6 pm Monday, Tuesday, Wednesday and Friday 9 am to 6 pm Thursday
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Email: [callweb@dpi.qld.gov.au](mailto:callweb@dpi.qld.gov.au)

Fax: +61 7 3404 6900

## References

Arthington, A.H. and Blühdorn, D.R. 1994. Distribution, genetics, ecology and status of the introduced cichlid, *Oreochromis mossambicus*, in Australia. *Mitteilungen Internationale Vereinigung für Theoretische und Angewandte Limnologie*. **24**: 53-62.

Arthington, A.H., McKay, R.J., Russell, D.J. and Milton, D.A. 1984. Occurrence of the introduced cichlid *Oreochromis mossambicus* (Peters) in Queensland. *Australian Journal of Marine and Freshwater Research*. **35**: 267-272.

Arthington, A.H. and Marshall, C.J. 1993. Distribution, ecology and conservation of the honey Blue-eye, *Pseudomugil mellis*, in south-eastern Queensland. Final Report to the Australian Nature Conservation Agency Endangered Species Program. Volume 1. Australian Nature Conservation Agency, Canberra.

Blühdorn, D.R., Arthington, A.H. and Mather, P.B. 1990. The introduced cichlid, *Oreochromis mossambicus*, in Australia: a review of distribution, population genetics, ecology, management issues and research priorities. In: D.A. Pollard (ed.) *Introduced and Translocated Fishes and their Ecological Effects*. Proceedings No. 8, Australian Government Publishing Service, Canberra, pp. 83-92.

Burrows, D. 2009: <http://www.mitchell-river.com.au/news-and-issues/Tilapia%20Presentation%20Walsh%20Tour%20May09.pdf>

McKay, R.J. 1984. Introductions of exotic fishes in Australia. In W.R. Courtenay Jr and J.R. Stauffer (eds), *Distribution, Biology and Management of Exotic Fishes*. The John Hopkins University Press, Baltimore, pp.117-199.

Moore, M. and Marsden, T. 2011. Addressing Threats Posed by Invasive Aquatic Animals on Shoalwater & Corio Bay Ramsar Wetlands. Department of Employment, Economic Development and Innovation (DEEDI). DEEDI, Brisbane, Queensland.

Pusey, B.J., Kennard, M.J. and Arthington, A. (2004). *Freshwater Fishes of North-Eastern Australia*. CSIRO publishing: Collingwood, Victoria.

RamsarWetlands: [ramsar.wetlands.org/Database/Searchforsites/tabid/765/language/en-US/Default.aspx](http://ramsar.wetlands.org/Database/Searchforsites/tabid/765/language/en-US/Default.aspx). 1995.

Scanlon, M. and Marsden, T. 2010. Pest Fish Populations in The Whitsunday Region. DEEDI, Brisbane, Queensland.

Webb, A.C. 2003. The Ecology of Invasions of Non-indigenous Freshwater Fishes in Northern Queensland. PhD dissertation, School of Tropical Biology, James Cook University, Townsville.

Webb, A.C. 2007. Status of Non-native Freshwater Fishes in Tropical Northern Queensland, Including Establishment Success, Rates of Spread, Range and Introduction Pathways. *Journal & Proceedings of the Royal Society of New South Wales*, **140**: 63-78.

Webb, A.C., Hogan, A.E. and Graham, P.A. 1996. Survey to determine the distribution of the Mozambique Mouthbrooder (tilapia), *Oreochromis mossambicus*, in the Upper Barron River catchment with recommendations for management. DPI Walkamin.

Wetlands.org: <http://www.wetlands.org/reports/ris/5AU044en.pdf>. 2005.