Control of introduced fish and crayfish in the Vasse-Wonnerup Ramsar Wetland: Final MERI report

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CARING FOR OUR COUNTRY PROJECT REPORT

Progress Report for the period 1 December 2012 to 30 June 2013, i.e. FINAL REPORT

Project ID: OC12-00871
Grantee Name: Murdoch University
Project Name: Control of introduced fish and crayfish in the Vasse-Wonnerup Ramsar Wetland
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Report authorised by: Dr Stephen Beatty

1. Report on MERI Implementation

1. Overview of Project Progress

Our project has continued to progress well during the final reporting period and by the end of the project we have achieved all the foundational activities, immediate outcomes and project activities, which contribute directly to the longer-term outcome and Aspirational goals of the Caring For Our Country program (Fig. 1). Succinct yet comprehensive comments on each component of the program logic are provided below. Comments from the previous progress reports are given in italics.

Foundational activities

Murdoch team assembled:

We have assembled a team to guide this project which comprises Drs Stephen Beatty, James Tweedley and David Morgan, Associate Professor Alan Lymbery and Professor Ian Potter. All members of this team have extensive experience working in freshwater and estuarine environments and are experts in the biology and ecology of both native and feral fish. Since the last progress report (June 2012) we have expanded the team to include Ms Vanessa Boladeras. Vanessa has joined the team as an Honours student and will assist in the on-ground ‘removal’ activities as well as analysing the data generated by the surveying and removal of the introduced species.

The Murdoch team remained the same in this reporting period.
Consultation with managers:

At all stages of the project we have liaised with local and governmental managers namely, the Department of Parks and Wildlife (DPaW) [formerly the Department for Environment and Conservation; DEC] the Department of Water (DoW) the Department of Fisheries (DoF), the Geographe Bay Catchment Council (GeoCatch), the South West Catchment Council (SWCC) and the Shire of Busselton. These organisations have helped choose the most effective sampling sites and put us in contact with local landholders where necessary. Consultation with managers has continued to occur. This now takes place in the regular steering committee meetings (see below).

Steering committee meetings have continued to occur regularly and to be scheduled, see supporting documents for a list of the dates of the meetings. James Tweedley and Stephen Beatty were invited by the mayor of Busselton on 17th July 2013 to present the findings of this project to the mayor and his councillors. Those findings were very well received and fuelled interesting discussion regarding future management of the Vasse-Wonnerup ecosystem, particularly with regard to addressing stressors such as introduced fishes and eutrophication. It is expected that the current project will result in additional works being carried out in the Vasse-Wonnerup ecosystem relating to improving health of the fish communities and thus the system.

Selection of sites:

With the help of local management agencies, particularly DPaW, the locations of the sites at which feral fish removal activities would be undertaken were confirmed. This local knowledge, together with our (Murdoch’s) expertise, resulted in a sound sampling design for the control program being developed. Twenty eight locations in the Vasse-Wonnerup Wetland another five in each of the tributary rivers and boat electrofishing of the entire lower Vasse river were selected (see attached maps). As of November 2013 four fieldtrips have been undertaken and removal activities completed at each site. The success of these activities is testament to the sound selection of these sites determined during the early stages of the project which is due to the input from local managers.

The same sites were sampled again during February and May 2013, meaning that each site has now been sampled six times over the duration of this project (18 months).

Intermediate outcomes

Project steering committee established:

The project steering committee has been set up and comprises representatives from Murdoch University and all local and regional managers and government agencies and catchment groups, namely DPaW, Geocatch, SWCC, DoF, DoW and the Shire of Busselton. The committee has met three times since the commencement of the project and June 2012. The minutes from each of the meeting are attached in the supporting documentation. Between July and November 2012 the steering committee met in Busselton on two occasions, i.e. on August 16 and November 29. The next meeting is scheduled for February 2013.

Steering committee meetings have continued to occur regularly as scheduled, see supporting documents for a list of the dates of the meetings. Such was the success of these meetings that they will continue to take place after the conclusion of this project, all be it less frequently. This is because we were granted funding to continue fish surveys and feral fish removal for another two seasons (i.e. until November 2013). The meetings proved an excellent forum for researchers and managers from local government agencies to openly discuss the ecological issues facing the Vasse-Wonnerup wetland and to canvass ideas to overcome those issues.

MERI plan developed:

This has been done and approved by members of the project steering committee and representatives from the Australian Government. This plan has been circulated to all people involved in the project. Following the last milestone report in June 2012 the MERI plan has been reviewed and found to remain effective.

Again the MERI plan was reviewed in November 2012 and found to remain effective, thus no modification were made.
Consult latest scientific literature:

Before commencing the project, literature searches were undertaken to ensure all our information relating to areas and aspects of the project were fully up to date. All new information uncovered during this exercise has been synthesised and incorporated into the project. Vanessa, as part of her Honours degree, is writing a literature review on the effects of degradation on estuarine environments. This will require her to search for relevant information that has been published since the commencement of this project. Her literature review will be key in helping summarise the impacts of feral species in estuarine systems elsewhere in the world and drawing parallels with this project. This review will be completed by May 30th 2013.

A number of scientific papers are currently being written using data collected during the removal of feral fish and the associated spatial and temporal documentation of native fish communities throughout the Vasse-Wonnerup estuarine and riverine habitats (see attached list). This scientifically robust sampling approach and the data it has produced will greatly assist state and local authorities manage the Vasse-Wonnerup system by providing a solid baseline upon which to monitor future ecological change. In undertaking this feral fish mapping and removal project and in preparing subsequent scientific papers, we have undertaken an extensive literature search relating to introduced species and estuarine and freshwater ecosystems.

Community awareness and education program implemented:

This program was set in motion (see later and attachments). This program has continued, see below for more details.

The community awareness and education program was a major theme of the work carried out in this reporting period. The community awareness program underpinned a key component of our risk management strategy that aimed to prevent future pest fish introductions in this region. See below and attached documents for full details.

Project activities

Boat electrofishing:

This has been undertaken twice since the project began (i.e. in February and May) in accordance with the agreed milestones. A map has been provided showing the extent of the electrofishing on each sampling occasion. To date 625 goldfish have been removed from the lower Vasse River. In the two successive sampling trips (Aug and Nov 2012) another 53 goldfish have been caught. These fish ranged from 4cm in length to 40 cm and up to 2 kg in weight! The lower catch rate in this reporting period, despite similar eradication effort, reflects the fact that the goldfish population has been greatly reduced by the removal program. Furthermore, in November 22 goldfish in the lower Vasse River were surgically fitted with acoustic tags. This will enable the movements of the remaining goldfish in the system to be tracked. This should allow us to find goldfish ‘hotspots’ and target these areas for the two last sampling trips (Feb and May 2013). In addition, this acoustic tracking study will precisely determine how this feral species moves into and around the system and will allow effective management plans to be produced to combat this species.

Since November, we have completed the boat electrofishing goldfish removal program that has now resulted in the removal of a total of 842 goldfish from the lower Vasse River. During late November 2012, we instigated a world-first goldfish acoustic tracking study. This study has already provided much needed information on individual goldfish movements and will run for a period of 12 months at the end of which the tagged goldfish will be removed. Up until 18th July 2013 (i.e. ~7 months after tagging), the acoustic array had recorded 354,468 individual detections at the eight receivers from the 21 tagged fish. All but two fish had ‘visited’ the Town Bridge and it was clearly being used as a regular shelter for a number of individuals. The species has been shown to be able to move relatively large distances in the Vasse River presumably as part of feeding activities. For example, movements of more than 2.2 km over a 24 hour period were recorded. More than 50% of tagged individuals moved into the New River Wetland and more than a quarter have also entered the Vasse-Wonnerup Ramsar site. The information we receive during winter and spring 2013 will confirm where the key spawning sites are for this species that will then guide ongoing control program and possibly enable the screening of the population to ‘trap’ breeding individuals within their spawning habitats.
Fyke netting and backpack electrofishing:

This has been done at the 20 riverine sites (5 per tributary river; see attached map) on two occasions. This sampling resulted in the removal of ~50 goldfish and over 20,000 eastern gambusia and even resulted in the eradication of gambusia from one location. Since July 2012, two further fieldtrips have been conducted using fyke netting and backpack electrofishing in the upper reaches of the rivers. Due to the success of this eradication, enormous numbers of the eastern gambusia have been removed. These individuals have been preserved and are currently being counted. We estimate that the total numbers of feral fish removed in this reporting period will run into the 10's of thousands. Furthermore, the fieldtrip conducted in November 2012 identified that the lower reaches of the Sabina, Abba and Ludlow rivers represent important refuge habitats for freshwater species and that considerable downstream migration of the endemic Western Minnow, Nightfish and Western Pygmy Perch occurred into those refuge habitats as the systems subsided. These findings represent important new information on the understanding of the movement patterns for these species in the main channel of rivers in south-western Australia and will prove extremely valuable in the identification and protection of summer refuge habitats.

Since November, we have completed the 18 month seasonal sampling program that included a total of six major sampling events. This has resulted in a thorough understanding of the distribution and life-histories of all native and introduced fishes in the Vasse-Wonnerup rivers and will contribute to the long-term management of these rivers and the system more broadly. Importantly, the thorough surveys did not reveal any unexpected pest species incursions. Key sections of the rivers identified as being of greatest ecological value from a fish community perspective were the lower reaches as they housed the greatest diversity and were the key spawning and recruitment sections. Furthermore, the degree of ‘fin-nipping’ of native fish by the highly aggressive Eastern Gambusia was recorded and this will provide valuable information regarding trends in injuries of native fish in relation to habitat characteristics or densities of pest fish.

The project resulted in the capture of 66,944 fish and crustaceans belonging to a total of 12 species, including: three native freshwater fishes, three native estuarine fishes, two introduced fishes, two native freshwater crayfish, one introduced freshwater crayfish, one native shrimp). The program has resulted in the removal of 26,081 introduced Eastern Gambusia and 842 goldfish from the rivers. Importantly, no other introduced species were detected as part of the comprehensive seasonal monitoring program in the estuary or rivers of the Vasse-Wonnerup. Furthermore, this project has provided a valuable baseline dataset for long-term monitoring of both the native and introduced fish communities in these rivers to assess how future management actions can improve these ecosystems. A key recommendation is the ongoing community education as to the impacts of introduced aquatic species to help mitigate the risk of additional introductions.

Seine netting:

This has been done at each of the 28 sites in the Vasse-Wonnerup wetland on four occasions (see attached map). This sampling, after the first three fieldtrips, had removed 4,379 eastern gambusia and 2 goldfish. The samples from the fourth sampling trip (November) are still being analysed, however, we did detect a substantial number of juvenile goldfish in both the Lower Vasse River Wetlands and the Upper Vasse Estuary. This is an incredibly important finding as it shows that, after spawning, the adult goldfish remain in the freshwater of the Lower Vasse River, but that some of their offspring move (or get swept down by the water flow) in to the upper reaches of the estuary. This would allow them to use the estuary like a ‘salt bridge’ and access other tributary rivers and increase their distribution. Fishing using seine netting also catches native estuarine fish species (the vast majority of which are released alive). This survey technique has resulted in the occurrence of 25 native fish species being recorded, some of which have never been recorded before, and enabled us to gain an understanding of the spatial and temporal patterns in their abundance. This is vital data that can be used by management agencies to develop effective management plans for this internationally important wetland system.

Seine netting at the 28 sites in the Vasse-Wonnerup wetland was undertaken again in February and May 2013, thus completing the six consecutive seasons worth of sampling. In total during this project 342 samples (336 as part of the sampling regime and another eight to opportunistically target and eradicate introduced fishes in feral ‘hotspots’). This sampling effort resulted in the surveying of 154,378 fish representing 32 species, of which 6,313 belonged to two introduced fish species, the Eastern Gambusia (5,814) and the goldfish (499). This is an incredibly high number for an estuary (as these are essentially freshwater fish species) and reflects the extent of their proliferation in the adjoining rivers before this project began. This project has mapped their distribution and identified a hotspot for the Eastern Gambusia in the Lower Vasse
River Wetland and shown that young goldfish penetrate the Upper Vasse Estuary in November. We have secured funding from GeoCatch to undertake two more sampling trips to see whether, due to our sampling efforts in the Lower Vasse River, whether we had a serious effect on the abundance of goldfish utilising the estuary. As if this continues they have the potential to invade other systems (see details in above progress report).

Community education program & increased landholder awareness:

Between the commencement of the project and June ten media releases and/or educational activities have been conducted. These are listed with evidence in the supporting documentation. This program included media releases, newspaper articles, interviews and a fieldtrip with children from a local high school. In the last reporting period we focused on promoting the project and generating as much publicity as possible (see last milestone report for a list of outputs). Therefore, the community education this time focused on using the interested generated by the promotion to get attendance at a community workshop held in Busselton on August 16 2012. Promotion before the event included an email to members of local catchment councils, an article in the local newspaper including a cartoon (attached) and a radio interview on a local ABC station. The event was well attended and a follow up news article was written (attached). We were also successful in applying for funding through the Department of Planning’s Coastwest Scheme (attached) to run another workshop at the end of this project to promote the work done and to prevent the introduction of new or existing species into the system. This community workshop will also launch a leaflet (which will be made available through local government agencies and online) which will send a similar message. These activities are schedules to be completed by June 30 2013.

A community workshop was held in Busselton (the town through which the Vasse River and Vasse-Wonnerup wetland flow through) in July 2103 and was attended by 38 people. This workshop was funded by a Coastwest grant totaling $8,007, which we obtained to build further on the community awareness and education program we undertook as part of the current project. This additional funding paid for the production of an identification and information leaflet on feral fish in the system. The leaflet provides information on the Vasse-Wonnerup, shows the introduced fish species currently in the system and details their biology and why they are dangerous. It also show native species and introduced species not currently found in the system, but ones that occur nearby and thus to watch out for. Finally and importantly, it details how to stop these fish spreading and what to do it if you see an introduced species in this or any other water bodies. This leaflet was promoted, along with this project and the community workshop in a press-release, which was picked up by multiple agencies and we also did TV and radio interviews. Full details are given in the supporting documentation.

Feral fish and crayfish densities reduced in 1,115 ha of the Vasse-Wonnerup wetland system thus ensuring these species to not detrimentally impact on the systems ecological values:

The adaptive approach of this project allowed us to refine our control efforts as the information on pest species was gathered. A major positive during this extensive and intensive survey and removal program was that no new introduced species (i.e. previously unknown to occur in the system) were detected. It is often that case that when removing an introduced species, sampling reveals that there are another one or two introduced species occurring in low number, however, that was not the case in the Vasse-Wonnerup. This information will be critical to future management as it now allows clarity and confidence in the allocation of resources for ongoing control efforts.

Over the course of this project 154,378 fish were surveyed and 6,313 introduced fish and one crayfish were removed from the Vasse-Wonnerup Wetland system, this represents, to the author's knowledge the largest and most comprehensive removal of introduced fish from an estuary. This was particularly the case for 499 goldfish we removed, as these species do not usually penetrate the estuarine waters and their presence in decent numbers reflects the abundance of these species in the rivers before this removal program was undertaken. The rivers yielded 66,944 fish and crustaceans of which 26,081 introduced Eastern Gambusia and 842 Goldfish were removed including the temporary eradication of Eastern Gambusia from one location. Only five individuals of the introduced Yabby were removed reflecting this species was found in very low abundances.

The effectiveness of the removal of Goldfish from the system, which became our top priority due to the presence of only two other introduced species both with little chance of eradication, was particularly successful and the information we have gathered as part of this project will guide future control of the species in this system and elsewhere. Opportunistic removal activities, governed by funding availability, run between
2003 and 2011 had removed <100 on each of the nine sampling occasion, however, during this intensive 18 month removal program we were able to remove 842, *i.e.* more than in the 8 years previous to this project. Furthermore, the effectiveness of this removal will become apparent when additional sampling of the Lower Vasse River Wetland and upper Vasse Estuary occurs in August and November 2013 to quantify how significantly this species was impacted by our efforts during this removal program. It is expected that our removal of large numbers of mature Goldfish during this project will significantly reduce their recruitment rate following breeding that will occur in September 2013. This will be reflected by far fewer numbers being detected in the Ramsar wetland during the upcoming sampling in November 2013.

In summary, we have broadly achieved our aim of lowering the densities of introduced species in the Vasse-Wonnerup; particularly with regard to Goldfish and this will mitigate this species impact on the estuarine environment, which is the section listed under the Ramsar convention. The positive impact of the reduction of Goldfish numbers in the Lower Vasse River will become particularly apparent following the breeding season when we expect far fewer recruits will be detected during the upcoming sampling in November 2013. Populations of Eastern Gambusia densities in the tributary rivers were temporarily reduced, however, due to the breeding capacity of this species and the fact that they are almost impossible to eradicate completely (although we did achieve this at one site when water levels were very low), without draining the entire system, there numbers recovered between control events.

We recommend that:

1) The control and potential eradication of Goldfish be an ongoing focus in the Vasse-Wonnerup system.

2) Continued public education on the impact of pest species should occur to prevent future introductions into the Vasse-Wonnerup system.

3) Riparian protection and revegetation occur in the lower reaches of rivers to increase habitat complexity and shelter for native freshwater fishes to reduce the impact of Eastern Gambusia.

4) Ongoing annual monitoring should occur in both the rivers and estuarine habitats to detect any future pest fish introductions to allow a rapid management response.
2. Lessons learned

Sites in the upper Vasse and Wonnerup estuaries (see attached map) proved impossible to access using our boat in both February 2012 and 2013 and May 2012, as the water becomes very shallow in places due to high levels of evaporation and decreased riverine input during summer. Therefore, to access these areas we were able to borrow an Argo (http://www.argoatv.com.au), an amphibious all-terrain vehicle, from the Department of Parks and Wildlife (DPaW), who are members of the project steering committee. This enabled us to reach these upper areas of the wetland system and conduct our sampling. This was made possible due to our strong relationship with DPaW brought about by their involvement in the planning stages of this project, their strong presence on project steering committee and recognition of the importance of this project.

A number of the river sites dried seasonally. This was not unexpected; however, the implications for conservation hotspots for freshwater fish were quite distinct. That is, the lower reaches of the rivers had the highest diversity and abundance of freshwater fishes and these were found to move out of summer refuge pools to breed during the high flow periods. Therefore, instream barriers would be impacting several species in terms of preventing those movements and limiting access to additional potential upstream spawning habitats. Therefore, prioritisation of these barriers for mitigation and removal should occur to increase population connectivity for native fishes. Furthermore, riparian protection and revegetation should occur in the lower reaches of rivers to increase habitat complexity and shelter for native freshwater fishes to reduce the impact of Eastern Gambusia.

Unanticipated outcomes

The use of the Argo allowed us to sample the upper reaches of the Vasse and Wonnerup estuaries, which in the summer become markedly hypersaline as evaporation occurs. During sampling in the upper Vasse estuary in February 2012 with DPaW we found a number of eastern gambusia (Gambusia affinis), a feral...
freshwater fish, swimming around in water with a salinity of 73 ppt. This is over twice full strength seawater, an incredible feat for a freshwater fish. This is a record for Australia, and possibly even the world!

Goldfish were another feral freshwater fish we aimed to remove from the Vasse-Wonnerup. We knew that large numbers of these fish resided in the Lower Vasse River, as a largely opportunistic (governed by funding availability) removal program we have conducted had removed <100 on each of the nine sampling occasion between 2003 and 2011. However, in February 2012 as part of this program over 550 fish were removed. This unexpected catch was probably caused by the New River Wetland (a wetland adjoining the Lower Vasse River), drying up and the goldfish moving out of this area and into the river where they were caught. This event helped improve the success of this project in terms of targeting large numbers for removal but probably highlighted that the wetland is an important habitat for the species. The acoustic tracking study will provide additional information on the species movement which will allow even more refinement of the removal program to increase its efficiency.

3. Improvement

The running of this project has gone smoothly and to plan. We have conducted all the activities we had committed to within the timeframe. We reviewed all our methodology, MERI plan / program logic at the end of each reporting period (i.e. for each progress report), but made no changes. The success of this project was down to a number of factors

1) The team of staff assembled by Murdoch University. Each member of the team was experienced in their respective fields and all contributed during the life of the project.

2) The selection of the members of the project Steering committee. This committee comprised representatives from the following organisations, Department of Parks and Wildlife (formerly the Department of Environment and Conservation), the Department of Water, the Department of Fisheries WA, Geographe Bay Catchment Council, South West Catchments Council and the Shire of Busselton. Not only did this committee cover all the bases in terms of local managers and NRM groups, we also chose members from those organisations who would champion this project. Furthermore, these were people to had extensive local knowledge, which greatly added to the project. Thus when issues of tricky situations bit arise we were able to enlist the help of those organisations.

3) High level of interest from the local community and media agencies about this project. This resulted in us being able to promote the project through TV, radio, printed and electronic articles and community workshops are of which well received and attended. We deliberately used the goldfish as a ‘flagship’ educational pest species as it can capture the publics interested being easily related to.
## Project name: Control of introduced fish and crayfish in the Vasse-Wonnerup Ramsar Wetland

### 2. Progress and achievements against Caring for our Country Targets and approved milestones / outputs / activities

<table>
<thead>
<tr>
<th>Description of activities during this reporting period</th>
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<tbody>
<tr>
<td>This is broken down according to the 7 milestones/outputs and activities (see left). Note that milestones 1, 2 and 3 were completed in the March–June 2012 reporting period. The descriptions of these along with the proportions of the milestones completed previously are given on the next page.</td>
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#### Activity Reporting

**March–June 2012 reporting period**

4) The final two remaining seasonal sampling trips (i.e. control events) have been conducted as per our milestone agreement. Thus all six trips are now complete. On each sampling trip the number of fish species is recorded at 48 sites across the wetland and its tributary rivers, with all introduced fishes euthanized. Sampling in the wetland yielded 154,378 fish representing 32 species, of which 6,313 belonged to two introduced species, the Eastern Gambusia (3,814) and the goldfish (499). Now for the first time a quantitative dataset is available for the fishes of the Vasse-Wonnerup, which will enable managers to monitor the system from a 'fish perspective', which is something they have never been able to do.

5) We continued to target the hotspots identified earlier in the project where introduced fish were particularly prevalent. In the wetland two such spots were identified one for the Eastern Gambusia and another for Goldfish. Both of these have been mapped and local management agencies informed during steering committee meetings. Importantly, no other introduced species were detected as part of the comprehensive seasonal monitoring program in the estuary or rivers of the Vasse-Wonnerup.

6) The control program has removed a total of 842 of goldfish from the lower Vasse River and 499 from the Vasse Estuary. This compares with only 643 from prior opportunistic goldfish control efforts conducted since 2003. This highlights the benefit of having a well resourced, coordinated approach to pest animal control. While we did record a general reduction in numbers during the control program, its success will be gauged this spring through additional estuarine sampling when we will determine whether juvenile recruitment has been reduced in the Lower Vasse River Wetland compared to November 2012. The removal of Eastern Gambusia, while positive in terms of the huge numbers removed, is more difficult to determine due to the ubiquitous distribution and large numbers throughout all systems sampled. The key management action, along with ongoing goldfish removal and possibly containment (see acoustic tracking information), will be the prevention of additional species being introduced. The current project has been a major step towards this goal due to its high profile and major public interest it generated.

7) Our community education plan continued to gain momentum, culminating in a community workshop held on Busselton on 17 July. This workshop detailed the results of this project to community and local managers and also launched a leaflet on the introduced fish in the systems (see supporting documentation for a copy). To promote this event we did a radio interview of a local ABC station, released a press-release, were interviewed by GWN7 on the 6pm news and advertised in the local paper. To create maximum exposure we worked together with GeoCatch and SWCC through our project steering committee. (copies of the media are attached in the supporting documentation).

**Summary of issues and management actions implemented**

Dr James Tweedley and Stephen Beatty were invited to give a presentation to the mayor of Busselton and his councillors to discuss the findings of this project and discuss potential management options.

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### Table: Project progress and achievements

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Description</th>
<th>Current Progress</th>
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<tbody>
<tr>
<td>1</td>
<td>Prioritise introduced species to be targeted in control program</td>
<td>100% completed in the March–June 2012 reporting period</td>
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<tr>
<td>2</td>
<td>Identify appropriate effective control methods</td>
<td>100% completed in the March–June 2012 reporting period</td>
</tr>
<tr>
<td>3</td>
<td>Undertake risk management to identify any potential unintended impacts of established control methods</td>
<td>100% completed in the March–June 2012 reporting period</td>
</tr>
<tr>
<td>4</td>
<td>Determine the seasonal distribution and abundances of known introduced and native species</td>
<td>30% completed in the March–June 2012 reporting period</td>
</tr>
<tr>
<td>5</td>
<td>Undertake control procedures in targeted introduced species hotspots as identified by the monitoring program</td>
<td>30% completed in the March–June 2012 reporting period</td>
</tr>
<tr>
<td>6</td>
<td>Monitor the effectiveness of the control program</td>
<td>100% completed in this reporting period.</td>
</tr>
<tr>
<td>7</td>
<td>Development and implement a community education program aimed at preventing</td>
<td>30% completed in the March–June 2012 reporting period</td>
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### Caring for our Country reporting template

**Project ID:** OC12-00871

**November 2010**

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Description of activities during the March-June 2012 reporting period

1) We have identified goldfish as the introduced species to prioritise during this study. This is because, of the two feral fish and one feral crayfish that we have recorded to date in the project, we feel that given its biological and ecological characteristics, we have the best chance to control the goldfish population. However, every effort will be made to remove as many eastern gambusia and yabbies as is possible.

2) Before commencing the control program Drs Stephen Beatty, James Tweedley and A. Prof. Alan Lymbery, together with local managers, identified key locations where feral fish and crayfish removal would occur on each of the six sampling occasions. Each of these sites was visited and a suite of particular control methods assigned to each of those sites individually. Each of the control methods has been tested and proven effective in other similar situations.

3) When electrofishing in the riverine areas, assessments of the health of native fish stunned during the fishing process (and subsequently released) have been undertaken. These analyses showed that, as predicted, once the native fish have recovered from the initial electric shock they can be returned to the river with no adverse effects. The researchers from Murdoch together with local managers are remaining alert to any changes in the ecosystem due to the removal of the feral fish. However, to date none have been detected.

4) To date two of the six seasonal sampling trips (i.e. control events) have been conducted as per our milestone agreement. On each sampling trip the number of each fish species is recorded at 48 sites across the wetland and tributary rivers. This has enabled us to develop a very good ‘picture’ of the seasonal distribution and abundances of both feral and native fish across these areas. During these events over 55,000 fish from 23 species have been recorded in the wetland and > 25,000 from the tributary rivers. In total some ~20,000 eastern gambusia and ~ 680 goldfish have been removed from the system.

5) Our initial sampling has identified several locations where feral fish were particularly prevalent. In these cases, the locations were monitored and extra control events were undertaken to reduce the population as far as possible. This occurred in a single site in the lower Vasse River wetland where gambusia were extremely abundant and at a location on the Abba river where the entire population of gambusia was able to be eradicated. These sites will continue to be monitored during the remaining control events and new hotspots will continue to be identified.

6) Not completed yet (see below)

7) Our community education plan is in full swing. A list of the outputs from this program are provided (with examples) in the supporting documentation. Our approach has been three fold. i) produce media releases highlighting the commencement of the project, these were also distributed to a wider audience through local newspapers. ii) Linking with local managers (SWCC) to promote the project and iii) the organisation of a fieldtrip for local high school students to come a watch the control program in action and learn about the biology/ecology and detrimental effect of feral fish following their accidental release into the natural environment. Further activities are planned during the next milestone period, including appearances on local radio, publications in magazines and a community presentation/workshop.

Description of activities during the July-November 2012 reporting period

1, 2 and 3 were completed in pervious reporting period.

4) To date four of the six seasonal sampling trips (i.e. control events) have been conducted as per our milestone agreement. On each sampling trip the number of each fish species is recorded at 48 sites across the wetland and tributary rivers. This has enabled us to develop a very good ‘picture’ of the seasonal distribution and abundances of both feral and native fish across these areas. During these events over 85,000 fish from 25 species have been recorded in the wetland and > 50,000 from the tributary rivers. In total some ~40,000 eastern gambusia and ~ 680 goldfish have been removed from the system.

5) Our initial sampling has identified several locations where feral fish were particularly prevalent. In these cases, the locations were monitored and extra control events were undertaken to reduce the population as far as possible. This occurred in a single site in the lower Vasse River wetland where
gambusia were extremely abundant and at a location on the Abba river where the entire population of gambusia was able to be eradicated. These sites will continue to be monitored during the remaining control events and new hotspots will continue to be identified. Once such hotspot has been identified in the Lower Vasse River Wetland. This spot has been subject to additional sampling and local management authorities were been informed about this area during Novembers steering committee meeting.

6) Not completed yet (see below)

7) Our community education plan is in full swing. A list of the outputs from this program, in this reporting period, is provided in the supporting documentation. Our approach in this reporting period focused on the running of a community workshop to provide some preliminary results to the public and highlight the dangers of releasing introduced fish species into natural environments. The success of this community workshop led to us applying for funding to promote the results of this study. This was successful and another workshop will be run in June 2013 and will be accompanied by a leaflet which will be used in school visits by catchment groups, put in pet stores and made available online.

**Supporting documentation**

**Appendix 1:** Sampling map including site coordinates.

**Appendix 2:** List of steering committee meetings.

**Appendix 3:** Introduced fish awareness leaflet.

**Appendix 4:** List of community awareness and education outputs.

**Appendix 5:** Scientific articles to be published using the data collected during this project.
Appendix 1: Sampling map including site coordinates.

Map showing the location of sampling activities in the Vasse-Wonnerup Wetland system
Site co-ordinates of sampling activities in the Vasse-Wonnerup Wetland system

<table>
<thead>
<tr>
<th>Region of system</th>
<th>Site Code</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deadwater</td>
<td>DW1</td>
<td>-33.36.004</td>
<td>115.26.354</td>
</tr>
<tr>
<td></td>
<td>DW2</td>
<td>-33.36.269</td>
<td>115.26.074</td>
</tr>
<tr>
<td></td>
<td>DW3</td>
<td>-33.36.485</td>
<td>115.25.825</td>
</tr>
<tr>
<td></td>
<td>DW4</td>
<td>-33.36.659</td>
<td>115.25.700</td>
</tr>
<tr>
<td>Wonnerup Inlet</td>
<td>IT1</td>
<td>-33.36.690</td>
<td>115.25.444</td>
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<tr>
<td></td>
<td>IT2</td>
<td>-33.36.814</td>
<td>115.25.346</td>
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<tr>
<td></td>
<td>IT3</td>
<td>-33.36.944</td>
<td>115.25.316</td>
</tr>
<tr>
<td></td>
<td>IT4</td>
<td>-33.37.072</td>
<td>115.24.978</td>
</tr>
<tr>
<td>Upper Wonnerup Estuary</td>
<td>WU1</td>
<td>-33.35.806</td>
<td>115.27.041</td>
</tr>
<tr>
<td></td>
<td>WU2</td>
<td>-33.36.006</td>
<td>115.26.989</td>
</tr>
<tr>
<td></td>
<td>WU3</td>
<td>-33.36.304</td>
<td>115.26.973</td>
</tr>
<tr>
<td></td>
<td>WU4</td>
<td>-33.36.473</td>
<td>115.26.864</td>
</tr>
<tr>
<td>Lower Wonnerup Estuary</td>
<td>WL1</td>
<td>-33.36.774</td>
<td>115.26.614</td>
</tr>
<tr>
<td></td>
<td>WL2</td>
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<tr>
<td></td>
<td>WL3</td>
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<tr>
<td></td>
<td>WL4</td>
<td>-33.36.821</td>
<td>115.25.636</td>
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<td>Lower Vasse Estuary</td>
<td>VL1</td>
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<tr>
<td></td>
<td>VL2</td>
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<td></td>
<td>VL3</td>
<td>-33.37.884</td>
<td>115.24.820</td>
</tr>
<tr>
<td></td>
<td>VL4</td>
<td>-33.37.211</td>
<td>115.24.811</td>
</tr>
<tr>
<td>Upper Vasse Estuary</td>
<td>VU1</td>
<td>-33.38.998</td>
<td>115.21.939</td>
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<tr>
<td></td>
<td>VU2</td>
<td>-33.39.149</td>
<td>115.22.360</td>
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<tr>
<td></td>
<td>VU3</td>
<td>-33.39.072</td>
<td>115.22.956</td>
</tr>
<tr>
<td></td>
<td>VU4</td>
<td>-33.38.850</td>
<td>115.23.483</td>
</tr>
<tr>
<td>Lower Vasse River Wetland</td>
<td>WT1</td>
<td>-33.39.186</td>
<td>115.21.034</td>
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<tr>
<td></td>
<td>WT2</td>
<td>-33.39.224</td>
<td>115.21.085</td>
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<td></td>
<td>WT3</td>
<td>-33.39.213</td>
<td>115.21.198</td>
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<td>WT4</td>
<td>-33.39.224</td>
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</table>
Maps showing the locations of sampling activities in the tributaries of the Vasse-Wonnerup Wetland
Site co-ordinates of sampling activities in the tributaries of the Vasse-Wonnerup Wetland system

<table>
<thead>
<tr>
<th>Tributary</th>
<th>Site Name</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vasse</td>
<td>Vasse below diversion drain</td>
<td>-33.41.202</td>
<td>115 21.906</td>
</tr>
<tr>
<td></td>
<td>Vasse diversion drain</td>
<td>-33 41.129</td>
<td>115 21.666</td>
</tr>
<tr>
<td>Ludlow</td>
<td>Ludlow @ Tuart Drive</td>
<td>-33 36.224</td>
<td>115 28.854</td>
</tr>
<tr>
<td></td>
<td>Ludlow @ Tutunup Rd</td>
<td>-33 39.938</td>
<td>115 35.940</td>
</tr>
<tr>
<td></td>
<td>Ludlow @ Warms/Downs Rd</td>
<td>-33 37.237</td>
<td>115 34.782</td>
</tr>
<tr>
<td></td>
<td>Ludlow Capel-Tutunup (J Wells)</td>
<td>-33 36.592</td>
<td>115 33.372</td>
</tr>
<tr>
<td></td>
<td>Ludlow @ Bussell Hwy</td>
<td>-33 36.748</td>
<td>115 29.706</td>
</tr>
<tr>
<td>Abba</td>
<td>Abba @ Tuart Drive</td>
<td>-33 38.369</td>
<td>115 25.920</td>
</tr>
<tr>
<td></td>
<td>Abba @ Williamson Rd</td>
<td>-33 42.861</td>
<td>115 30.858</td>
</tr>
<tr>
<td></td>
<td>Abba Ludlow-Hithergreen Rd</td>
<td>-33 41.986</td>
<td>115 30.234</td>
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<tr>
<td></td>
<td>Abba Bussell Hwy</td>
<td>-33 38.806</td>
<td>115 26.268</td>
</tr>
<tr>
<td></td>
<td>Abba @ Vasse Hwy</td>
<td>-33 45.736</td>
<td>115 32.970</td>
</tr>
<tr>
<td>Sabina</td>
<td>Sabina @ Piggott Rd</td>
<td>-33 45.793</td>
<td>115 27.030</td>
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<tr>
<td></td>
<td>Sabina @ Tuart Drive</td>
<td>-33 39.193</td>
<td>115 24.612</td>
</tr>
<tr>
<td></td>
<td>Sabina Wonnerup East/Giles Rd diversion drain</td>
<td>-33 42.392</td>
<td>115 26.388</td>
</tr>
<tr>
<td></td>
<td>Sabina @ Barracks Drive</td>
<td>-33 38.749</td>
<td>115 24.54</td>
</tr>
<tr>
<td></td>
<td>Sabina @ Bussell Hwy</td>
<td>-33 39.495</td>
<td>115 24.846</td>
</tr>
</tbody>
</table>
Map showing the extent of boat electrofishing in the lower Vasse River. Green bars equal extent of sampling in Feb and red bar that in May. Note that the limits of the boat electrofishing are determined by the water levels in the river.
Appendix 2: List of steering committee meeting and members

Members

Dr Stephen Beatty Murdoch University
Dr James Tweedley Murdoch University
Associate Professor Alan Lymbery Murdoch University
Mr Mark Allen Murdoch University
Ms Vanessa Boladaras Murdoch University

Mr Jim Lane Department of Parks and Wildlife (formerly Department of Environment and Conservation)
Mr Alan Clarke Department of Parks and Wildlife (formerly Department of Environment and Conservation)
Mr Kim Williams Department of Parks and Wildlife (formerly Department of Environment and Conservation)

Dr Krish Seewraj Department of Water
Dr Kath Lynch Department of Water

Mr Michael Burgess Department of Fisheries
Mr Bruce MacKay Department of Fisheries

Dr Emily Hugues-dit-Ciles South West Catchments Council
Mr Craig Bohm South West Catchments Council

Ms Jen Mitchell Geographe Bay Catchment Council
Ms Jenelle Carter Geographe Bay Catchment Council

Mr Will Oldfield Shire of Busselton

List of meeting dates

December 9th 2011, Geographe Bay Catchment Council offices, Busselton
February 15th 2012, Goose Café, Busselton
May 22nd 2012, Equinox Café, Busselton
August 16th 2012, Equinox Café, Busselton
November 29th 2012, Equinox Café, Busselton
June 6th 2013, Equinox Café, Busselton
To be announced December 2013.
Appendix 3: Introduced fish awareness leaflet.

**The Vasse-Wonnerup**

The Vasse-Wonnerup Estuary is a Ramsar listed wetland of global importance and is home to over 37,000 birds, many of which migrate here annually from their breeding grounds in the Northern Hemisphere. They come to the wetlands to feed on the copious supply of aquatic organisms and renew their energy stores for their western journey halfway across the world.

Fish are an important component of the diet of some waterbirds and it is not surprising that fish populations in the Vasse-Wonnerup are highly abundant. Over 30 different species of native fishes inhabit the system, including popular angling targets such as Black Bream and King George Whiting.

**A catchment under threat**

In recent years, the catchment has come under increasing threat from declining water quality and excessive nutrient runoff which has caused numerous fish kills. Flow reductions due to diversion dams and declining rainfall caused by climate change have exacerbated these impacts.

The introduction of Goldfish into the Vasse River is another threat to the ecosystem. Goldfish stir up sediment as they feed, and the growth of cyanobacteria is stimulated upon passage through their gut, which contributes to algal blooms. Other introduced species like the Eastern Gambusia and Yabbie compete with, consume, and harass native species.

**What's being done?**

Scientists from Murdoch University have been controlling feral Goldfish in the Vasse River since 2003. In 2012, they began research into introduced and native species in the Vasse-Wonnerup catchment including mapping seasonal distributions, studying movement patterns, determining salinity tolerances, and continuing the removal of feral species. As of mid-2013, almost 2,000 Goldfish have been removed from the Vasse River and estuary.

**What can I do to help?**

- Never release exotic species into natural waterways; this can cause major harm to aquatic ecosystems and it is illegal.
- Design ponds and dams so exotic species cannot escape into natural waterways during heavy rain or flooding.
- Dispose of unwanted aquatic pets by returning them to the place of purchase, or by placing them in a bag of water in the fridge until motionless and then freezing the bag.
- Dispose of aquarium water on dry land as it can ruin our native species, parasites, and diseases.
- Report sightings or captures of exotic species in the wild to FISHWATCH on 1800 815 567, don’t return them to the water after capture.
- Instead of exotic species, keep local native species such as Western Pygmy Perch which prey on the larvae of pest insects including mosquitoes and midges.
- Circulate this leaflet among your local community to promote awareness of feral aquatic species and the damage they cause.

Photographs and text

Mark Allen, Sophie Beaver, Susan Hyden, &
David Morgan (Murdoch University); Carey Allen, Bindi Beaton.

For more information visit www.freshwaterfishgroup.com

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Rivers and resident species of the Vasse–Wonnerup

The Vasse–Wonnerup Estuary is fed by four main river systems (from west to east) Vasse, Collie, Alkira, and Larder. A total of six freshwater fish species (four native, two introduced) and three freshwater crustacean species (two native, one introduced) have been recorded in these rivers. The most common native species are the Western Minnow and the Nightlatch. Additionally, a small number of primarily estuarine species also commonly occur in the lower reaches of these rivers (see lower right panel).

Introduced species include the widespread Eastern Gambusia which is highly abundant, especially during summer. The North American species was introduced widely throughout Australia during the 1930s as a biological control for mosquitoes. However, it is not as effective at this task as native fishes like the Western Pugnacious Perch, and it competes with and displaces the native fishes. The Goldfish (of Asian origin) was discovered in the Vasse River in 2007 but was probably introduced during the 1990s. The Vasse population has the fastest recorded growth rate of any wild population in the world. It is a remarkably hardy and adaptable species and a serious pest both in Australia and abroad. The Vasse (these eastern Australia) is uncommon in the Vasse–Wonnerup catchment.

Other feral fishes occurring in south-western Australia

These species, and a number of other exotic have not been recorded in the Vasse–Wonnerup but do occur in streams and waterbodies in other parts of south-western Australia. Many of them are popular ornamental species and were probably released into the wild, intentionally or otherwise, by members of the general public. Sightings or captures of these or other exotic species (not listed here) in fresh waters of the Vasse–Wonnerup or elsewhere should be reported to FISHWATCH on 1800 815 507.

Feral species

Gambusia affinis (Eastern Gambusia) - female

Goldfish (Carassius auratus) - numerous color morphs are present

Golden Bellied Perch (Leporinus guttatus)

Tilapia (Oreochromis niloticus)

Western Pugnacious Perch (Leporinus guttatus)

Nightlatch (Bnellia purpurea)

Native species

Western Minnow (Leporinus guttatus)

Western Gold Minnow (Culterius obtusirostris)

Nelson (Cheniox pedersoni)

Murray (Cheniox pumilio)

Native cyprinids & freshwater species

Western Murray (Cheniox pumilio)

Western Minnow (Leporinus guttatus)

Scott River (or Blanca) (Ogilby (Prochilodus oligilbyi)

Kangaroo Island (Cheniox pumilio)}
### Appendix 4: List of community awareness and education outputs.

<table>
<thead>
<tr>
<th>Activity and/or output</th>
<th>Details</th>
<th>Date</th>
<th>Attached</th>
</tr>
</thead>
<tbody>
<tr>
<td>Announcement at the Freshwater Fauna Roadshow</td>
<td>Announcement and promotion of the project at a community forum at the Freshwater Fauna Roadshow in Busselton</td>
<td>24/11/2011</td>
<td>No</td>
</tr>
<tr>
<td>Australian Society for Fish Biology Newsletter December 2011</td>
<td>Promotion of the project to biologists in Western Australian Activities Report section of the ASFB Newsletter</td>
<td>Dec 2011</td>
<td>No</td>
</tr>
<tr>
<td>Steering committee meeting</td>
<td>Meeting at Geocatch of the first steering committee meeting that discussed the project with input from DPaW, DoF, DoW, SWCC and GeoCatch</td>
<td>09/12/2011</td>
<td>No</td>
</tr>
<tr>
<td>Website update</td>
<td>Update of the project on <a href="http://www.freshwaterfishgroup.com">www.freshwaterfishgroup.com</a> and <a href="http://www.estuarine-ecosystems.webs.com">www.estuarine-ecosystems.webs.com</a></td>
<td>Feb 2012</td>
<td>Yes</td>
</tr>
<tr>
<td>Newspaper article: Canning Times</td>
<td>Newspaper article highlighting the problems Goldfish and Koi Carp pose to waterways</td>
<td>07/02/2012</td>
<td>No</td>
</tr>
<tr>
<td>Media release: Murdoch University</td>
<td>Media release from Murdoch promoting the project. This became the top news story for that week on the Murdoch website.</td>
<td>08/02/2012</td>
<td>Yes</td>
</tr>
<tr>
<td>Newspaper article: Busselton-Dunsborough Mail</td>
<td>Story entitled ‘Fishy Vasse-Wonnerup Ramsar wetland project receives funding’ promoting the project.</td>
<td>09/02/2012</td>
<td>Yes</td>
</tr>
<tr>
<td>Newspaper article: Busselton-Dunsborough Times</td>
<td>Story entitled ‘Uni to study impact of introduced species’ promoting the project.</td>
<td>10/02/2012</td>
<td>Yes</td>
</tr>
<tr>
<td>Community field day: Georgiana Molloy Senior High School</td>
<td>48 students in years 8, 10 &amp; 100 from Georgiana Molloy came out to the Lower Vasse River to watch goldfish be caught and listened to talks of introduced fish. All students were given a free id book on local freshwater fish.</td>
<td>20/03/2012</td>
<td>Yes</td>
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<tr>
<td>Online article: Science Network</td>
<td>Online article entitled ‘Introduced fish species’ impact assessed’ promoting the project.</td>
<td>26/03/2012</td>
<td>Yes</td>
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<tr>
<td>Online article: South West Catchments Council</td>
<td>Online article entitled ‘Vasse Wonnerup fish research from the seat of a kayak’ promoting the project. This article resulted from taking a NRM staff member out sampling.</td>
<td>02/04/2012</td>
<td>Yes</td>
</tr>
<tr>
<td>Activity and/or output</td>
<td>Details</td>
<td>Date</td>
<td>Attached</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>Newspaper article:</td>
<td>Publication entitled 'Fishing for answers: Fish research project sheds new light on the Vasse Wonnerup Wetlands' promoting the project.</td>
<td>July 2012</td>
<td>Yes</td>
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<tr>
<td>Coastlines</td>
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<td></td>
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<tr>
<td>Australian Society for</td>
<td>Promotion of the project to biologists in Western Australian Activities Report section of the ASFB Newsletter</td>
<td>July 2012</td>
<td>Yes</td>
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<td>Fish Biology Newsletter July 2012</td>
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<tr>
<td>Newspaper article:</td>
<td>Newspaper article entitled ‘Action plan for feral fish discussed’ promoting a community workshop showing the preliminary results for this project.</td>
<td>08/08/2012</td>
<td>Yes</td>
</tr>
<tr>
<td>Busselton-Dunsborough Mail</td>
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<td></td>
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<tr>
<td>Radio interview: ABC</td>
<td>Stephen Beatty interview by Ron Tait. Stephen discussed the dangers of introduced fish species and promoted the community workshop.</td>
<td>08/08/2012</td>
<td>Yes</td>
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<td>south-west</td>
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<tr>
<td>Community workshop:</td>
<td>Community workshop held at Abbey Beach Resort in Busselton.</td>
<td>16/08/2012</td>
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<td>Abbey Beach Resort</td>
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<tr>
<td>Newspaper article:</td>
<td>Newspaper article entitled ‘Feral fish infiltrating the Vasse-Wonnerup Estuary' discussing the results of the community workshop</td>
<td>22/08/2012</td>
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<tr>
<td>Busselton-Dunsborough Mail</td>
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<tr>
<td>Newspaper article:</td>
<td>Newspaper article entitled ‘Fish fauna survey provides new insights into the Vasse-Wonnerup Wetland System' promoting this project</td>
<td>Sept 2012</td>
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<tr>
<td>Wetlands Australia</td>
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<tr>
<td>Radio interview: ABC</td>
<td>James Tweedley interview by Jessica Swann. Stephen discussed the dangers of introduced fish species and promoted the community workshop.</td>
<td>10/07/2013</td>
<td>Yes</td>
</tr>
<tr>
<td>south-west</td>
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<tr>
<td>Media release:</td>
<td>Media release from Murdoch promoting the results of this project and a community workshop.</td>
<td>10/07/2013</td>
<td>Yes</td>
</tr>
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<td>Murdoch University</td>
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<tr>
<td>Online article:</td>
<td>Repeated the media release from Murdoch University(see above)</td>
<td>10/07/2013</td>
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<tr>
<td>Silobreaker</td>
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<tr>
<td>Online article:</td>
<td>Repeated the media release from Murdoch University(see above)</td>
<td>10/07/2013</td>
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<tr>
<td>Phys org and repeated elsewhere</td>
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<tr>
<td>Online article:</td>
<td>Repeated the media release from Murdoch University(see above)</td>
<td>10/07/2013</td>
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<td>Australia New Guinea Fishes Ass. Q.land</td>
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<td>Email</td>
<td>Repeated the media release from Murdoch University(see above)</td>
<td>11/07/2012</td>
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<td>Activity and/or output</td>
<td>Details</td>
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<td>----------</td>
</tr>
<tr>
<td>Newspaper article:</td>
<td>Newspaper article entitled ‘Dangers to estuaries revealed’ promoting a community workshop showing the preliminary results for this project.</td>
<td>12/07/2012</td>
<td>Yes</td>
</tr>
<tr>
<td>Busselton-Dunsborough Times</td>
<td>TV interview: James Tweedley and Stephen Beatty interviewed by GWN7 and talked about the dangers of releasing feral fish and how to destroy them humanely.</td>
<td>18/07/2012</td>
<td>Yes</td>
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<tr>
<td>Newspaper article:</td>
<td>Newspaper article entitled ‘Researchers unveil feral fish effects’ discussing the results of the community workshop</td>
<td>02/08/2012</td>
<td>Yes</td>
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<tr>
<td>Busselton-Dunsborough Times</td>
<td>Newspaper adverts placed in Busselton Dunsborough Mail: 3rd &amp; 10th July 2013 and in the Busselton Dunsborough Times: 5 July 2013.</td>
<td>Various</td>
<td>Yes</td>
</tr>
<tr>
<td>Social media</td>
<td>Social media to promote Murdoch press release in July 2012 (Murdoch Twitter account) and the community workshop (GeoCatch Facebook page)</td>
<td>Various</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>July 2013</td>
<td></td>
</tr>
</tbody>
</table>
Tackling invasive fish and crayfish in the internationally recognised Vasse-Wonnerup Ramsar wetland system

$2000 HONOURS SCHOLARSHIPS AVAILABLE!!

The Freshwater Fish Group and Fish Health Unit in collaboration Estuarine Research Group at the Centre for Fish, Fisheries and Aquatic Ecosystems Research, Murdoch University, have recently secured a major grant from the Federal Government’s Caring For Our Country program to undertake a comprehensive fish survey in the Vasse-Wonnerup Ramsar wetland system and its rivers. Previous work by the research team has identified introduced fish and crayfish as key threats to the ecological health of south-western Australian aquatic ecosystems. In the Vasse River, a number of invasive species of concern are present, including Goldfish, Mosquitofish and the Yabby. These pose a serious threat to this internationally recognised wetland. Despite this threat, no information exists on the broader distribution of these and potentially other feral aquatic species in the system.

As part of the survey, the project will identify pest species hotspots, prioritise the threats posed by those species, and undertake control programs to reduce their ecological impact. Gaining this knowledge will allow future planning of control efforts to help mitigate the many impacts that pest fish and crayfish have on unique aquatic ecosystems such as the Vasse-Wonnerup. The project, led by Drs Stephen Beatty, James Tweedley and Associate Professor Alan Lynam, will have a strong emphasis on community education to help prevent further introductions of pest species into the unique south-western Australian waterways and involves a variety of partner organisations including GeoCatch, Department of Environment and Conservation, Department of Fisheries, Department of Water and South West Catchments Council along with local school and community groups.

For information about the Honours Scholarships available, email s.beatty@murdoch.edu.au

Exert from www.freshwaterfishgroup.com

Invasive Fish species in the Vasse-Wonnerup Ramsar wetland, estuary and rivers

The Freshwater Fish Group and Fish Health Unit, in collaboration with our Estuarine Research Group, have recently secured a major grant from the Federal Government’s Caring For Our Country program to undertake a comprehensive fish survey in the Vasse-Wonnerup Ramsar wetland system and its rivers. The study aims to identify pest species hotspots, prioritise the threats posed by these species and undertake control programs to reduce their ecological impact. Read more...

Freshwater Fish Group & Fish Health Unit
Centre for Fish & Fisheries Research

and on another page of the website

Honours project - Invasive species in the Vasse-Wonnerup wetland
- we have now filled this position - look out for future project updates

This project will:
- Investigate invasive fish and crustacean species and the damage they are doing to this important wetland which is a key RAMSAR site.
- Survey the estuary habitat for new species populations.
- Have a strong emphasis on community education to help prevent further introductions of pest species into this unique south-western Australian wetland.


These Honours projects come with a $2,000 honours scholarship. For more details on these opportunities, please email Dr. Beatty.

More information on the project and the freshwater fishes of Western Australia can be found at the Freshwater Fish Group website.

We need you!

If you have a passion for estuaries and the organisms that inhabit them, and want to begin your journey into postgraduate research, please contact us:

s.beatty@murdoch.edu.au
j.tweedley@murdoch.edu.au

Created by Chris Hallett Copyright ©2011

Exerts from http://estuarine-ecosystems.webs.com
Murdoch researchers to tackle invasive fish species


Fishy Vasse-Wonnerup Ramsar wetland project receives funding

Uni to study impact of introduced species

THE impact of introduced species on the Vasse-Wonnerup wetland system will be investigated, after Murdoch University researchers won a $215,000 grant to carry out the work.

A team from the Centre for Fish, Fisheries and Aquatic Ecosystems will undertake a comprehensive fish survey in the Vasse-Wonnerup wetland system and its rivers.

Project leader Stephen Beatty said while little was known about native fish fauna, invasive species including goldfish, eastern gambusia and the yabby in the Vasse River posed a serious threat.

“They can compete with native species for food and habitat, they introduce diseases, disturb habitat and are predators of native fish and their eggs,” he said. The project would put a strong emphasis on community education to help prevent further introductions of pest species into unique South West waterways.

“Invasive species often enter the river system through people dumping aquarium fish into waterways,” Dr Beatty said.

Fishing for answers
Fish research project sheds new light on the Vasse Wonnerup Wetlands

By Dr. James Towsey, Centre for Fish & Invertebrate Research, Murdoch University

The Vasse and Wonnerup estuaries, located near the town of Busselton, are recognised as a wetland of international importance under the Ramsar Convention on Wetlands. To help understand this dynamic wetland, researchers at Murdoch University undertook the first quantitative survey of the fish fauna of this iconic system in January 2012. This project, supported by the South West Catchments Council, through funding from the Australian Government’s Caring for our Country program and the Department of Planning (Western Australia), aimed to understand the fish community and its potential to support sustainable fishery management.

During the study, six different fish species were recorded, all of which are native to the Vasse River. These species include the brown trout, which is a valuable indicator species for ecosystems health. The presence of these species indicates that the Vasse Estuary is a healthy and productive system.

In environmental conditions like those experienced in the Vasse Estuary, species are adapted to withstand the large changes in water temperatures and salinity that occur during the year. Two species of native freshwater fish were also collected from the Vasse Estuary during the study. These species are known to occur in the lower Vasse River, but this was the first time that they have been recorded in the estuary.

This finding is a cause for concern, as these species compete with native fish for food and habitat. Introduced species, such as carp, can outcompete native species and can even outcompete native species. Therefore, the fact that these species were recorded in the Vasse Estuary means that they can tolerate moderate levels of salinity and may be able to move upstream and establish populations in the estuary and its tributaries.

Unfortunately, since this initial finding, Murdoch University received separate funding from the Australian Government’s Caring for our Country program to survey and eradicate introduced species from the Vasse and Wonnerup estuaries and their tributary rivers. This project has a community engagement component and is part of the South West Catchments Council’s Caring for our Country program.
Western Australia

- A study examining the spatial and temporal patterns in feral and native fish communities in the estuarine and freshwater environments of the Ramsar listed Vasse-Wonnerup wetland system is underway. The project is led by Stephen Beatty, Alan Lymbery and James Tweedley will run until 2013 and will include targeted, prioritised control of pest fishes that has so far resulted in the removal of over 500 Goldfish (more than 200 kg) and revealed the species penetrates into the estuarine habitats.

James Keleher with the world record Pearl Cichlid from a wetland near Perth. Photo S. Beatty

Exert from the Australian Society for Fish Biology Newsletter July 2012
Media Monitors report on the interview Dr Stephen Beatty did with Ron Tait from ABC south-west
1. Introduction and objectives of the event:

<table>
<thead>
<tr>
<th>Theme of event</th>
<th>Fish of the Vasse-Wonnerup Estuary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region addressed</td>
<td>South West Catchment Authority</td>
</tr>
<tr>
<td>Theme</td>
<td>Raising awareness and increase knowledge on the estuary fish fauna of the South West, Southern River and Wonnerup Estuary</td>
</tr>
<tr>
<td>Background</td>
<td>SWCC and Research have joined forces to develop funding to conduct fish surveys and fish control in the Vasse-Wonnerup estuary. This presentation was arranged to inform the general public and stakeholders on the results of fish surveys.</td>
</tr>
<tr>
<td>Objective</td>
<td>To present findings of fish surveys and fish control activities in the Vasse-Wonnerup estuary</td>
</tr>
<tr>
<td>Location</td>
<td>Abbey Beach Resort</td>
</tr>
<tr>
<td>Date</td>
<td>Thursday 16th August 2012</td>
</tr>
<tr>
<td>Facilitator</td>
<td>Mark Batter, SWCC &amp; Peter Terry, Western Australian Museum</td>
</tr>
<tr>
<td>Total number of participants</td>
<td>35</td>
</tr>
<tr>
<td>Total number of evaluations returned</td>
<td>25</td>
</tr>
</tbody>
</table>

2. Promotion evidence (media coverage before the event):

Title: Action plan for feral fish discussed

Fish of the Vasse-Wonnerup Estuary Presentation evening Thursday 16 Aug 8.30pm - 9.00pm Abbey Beach Resort

- Part of the Vasse-Wonnerup Estuary management plan, a partner of the Western Australian Government program
- A collaborative effort between local councils and scientist undertaking these surveys and the presentations of the results of these surveys & analysis in the estuary by the SWCC & Western Australian Museum

A special mention was also conducted an ABF South West with Mark Batter interviewing Dr. Stephen Beatty. Photo located in the event MBB file. In E:

3. Evidence of day deliverables and activities: Include and/or copy if possible or insert link to document and handouts provided on the day:

<table>
<thead>
<tr>
<th>Time</th>
<th>Responsibility</th>
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</thead>
<tbody>
<tr>
<td>4pm</td>
<td>Arrive and register</td>
</tr>
<tr>
<td>4.30</td>
<td>Fish surveys</td>
</tr>
<tr>
<td>5.30</td>
<td>Presentation of results of fish surveys &amp; analysis by SWCC</td>
</tr>
<tr>
<td>6.00</td>
<td>Q&amp;A</td>
</tr>
<tr>
<td>6.30</td>
<td>Q&amp;A &amp; end of session</td>
</tr>
</tbody>
</table>

3.2 Agenda

- Fish of the Vasse-Wonnerup Estuary:
  - Presentation of results of fish surveys & analysis by SWCC
  - Q&A

3.3 Handouts

No specific handouts were developed for this presentation, however information provided on the evening included:

- Vasse-Wonnerup Estuary Heritage site study
- Western Australian Museum
- Presentation of results of fish surveys & analysis by SWCC

Promote Fisheries of the SWCC
South West Catchments Council review of the Community Workshop held in Busselton on 16 August 2012
Feral fish infiltrating the Vasse-Wonnerup Estuary

By Nathan Meres  Aug 22, 2012 2:33am

The salinity of the estuary was the topic of discussion at the Southwest Catchment Council and Ordinances most recent seminar.

The presentation followed the first quantitative survey of fish species in the Vasse-Wonnerup Estuary.

The seminar, presented by Dr James Tweedley, Dr Stephen Beadley and Associate Professor Aidan Lynam, covered the problem of feral fish and the control plans which will be implemented to reduce their numbers.

Dr James Tweedley from Murdoch University said the most exciting and daunting discovery was the gourami in the estuary.

"Gourami are a fresh water fish, to find them in the estuary was quite a surprise and the first time we have seen them in that environment."

"Potentially what they could be doing is using the estuary as a salt bridge between freshwater sources."


Wetlands Australia

National Wetlands Update September 2012

Issue No. 21, September 2012

Download

Fish fauna survey provides new insights into the Vasse-Wonnerup Wetland System

James Tweedley & Colin Hefti, Murdoch University

The Vasse-Wonnerup wetland is a diverse, internationally important system located near the town of Bunbury, Western Australia. The Ramsar listed systems are regarded as the most productivity wetlands in Western Australia and suffer from a multiplicity of detrimental effects, including salinisation, saltpans, weeds and fish kills.

In January 2012 Murdoch University undertook a survey of the fish fauna of the Vasse-Wonnerup wetland. The survey was funded through the South West Catchment Council from the Australian Government’s Caring for our Country program with assistance from the Western Australian Department of Environment and Conservation’s Science Division.

Sampling regime and preliminary results

A seine net was used to sample the fish communities at five sites in each of the Vasse and Wonnerup estuaries (the largest components of the wetland) with the aim of determining the number of species, density and composition of the fish fauna at a total of 50 sites. Fish were collected from the mainstream waters of the estuaries, comprising six species across four families.

Media Monitors report on the interview Dr James Tweedley did with Jessica Swann from ABC south-west

Research reveals estuary threats

July 10, 2013

Print This Post

Two new studies have shed light on the health of Busselton’s waterways.

Researchers from Murdoch University spent time in the iconic Vasse-Warnerup estuary, surveying introduced fish species and measuring nutrient levels in the sediment.

The introduced fish study and removal program, funded through the Caring For Our Country program, found that introduced fish species were thriving.

"In the estuary, we found 29 species of native fish, along with two introduced freshwater species," said Dr James Tweedley, of Murdoch University.

"Sadly, we found the highly invasive Eastern Gambusia in the estuary and in all four tributary rivers too."

The study also found that goldfish, which are not native to the area, seasonally invade the estuary following winter rains.

"These goldfish are highly mobile and seem to be able to tolerate saltier water," Dr Tweedley said.

Research reveals estuary threats

Two new studies have shed light on the health of Busselton's waterways.

Researchers from Murdoch University spent time in the iconic Vasse-Wonnerup estuary, surveying introduced fish species and measuring nutrient levels in the sediment.

The introduced fish study and removal program, funded through...

READ FULL ARTICLE

"If these high levels of nutrients continue, it could result in a collapse of the sea grass meadows in areas of the estuary, with flow on effects to the rest of the ecosystem."  
Research reveals estuary threats [Published PhysOrg.com - Jul 10 2013]

"The sediment we analysed from the bottom of the estuary was high in nutrients. But sediment collected from the water itself had up to 10 times more nitrogen and phosphorus" Dr Tweedley said

Research reveals estuary threats [Published PhysOrg.com - Jul 10 2013]

"The big concern is that this ability could see goldfish using the estuary as a 'bridge' to colonise other rivers."

Research reveals estuary threats [Published PhysOrg.com - Jul 10 2013]

http://news.silobreaker.com/research-reveals-estuary-threats-5_2266952105044475927

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http://esciencenews.com/sources/physorg/2013/07/10/research.reveals.estuary.threats

Exert from the Busselton-Dunsborough Times July 12 2012
Researchers unveil feral fish effects

Feral fish are wreaking havoc in the city’s waterways.

An 18-month study by Murdoch University has revealed shocking evidence about the detrimental effect feral fish have on Vasse-Wonnerup Estuary.

Researchers trapped and removed 35,000 feral fish from the river system, which are decimating native fish species and exacerbating the growth of toxic algal blooms.

Murdoch scientist James Tweedley said the biggest finding was the spread of goldfish weighing up to 2kg in the lower Vasse River.

Dr Tweedley said the goldfish were able to survive saltier water than expected and people feared the fish could use the estuary as a bridge to other rivers.

“Goldfish dig up sediment which stirs up nutrients and promotes the growth of algal bloom,” he said. “They can actually exacerbate algal bloom by eating and expelling it.”

Dr Tweedley presented his findings alongside Murdoch colleagues, research doctors Jane Chambers and Stephen Beatty at a free public lecture in Busselton last month.

GeoCatch’s Jen Mitchell said the lecture revealed the complex issues of the Vasse-Wonnerup system.

Media Monitors report on the interview Dr James Tweedley did with the Busselton-Dunsborough Times to highlight the outcomes of the community workshop.

Example of one of the averts for the community workshop placed in the local newspapers (Busselton Dunsborough Mail and Busselton Dunsborough Times)
Caring for our Country reporting template

https://twitter.com/MurdochUni/status/355143857073164290

https://www.facebook.com/pages/GeoCatch/226603014089579

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**Caring for Our Country**

**Our Water**

**Feral Fish in the Vasse-Wonnerup Estuary**

Feral fish have invaded Busselton's iconic Vasse River. Murdoch researchers took this amazing pic! pic.twitter.com/uLwy6U5F0I

@MurdochUniNews

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**GeoCatch**

Here's something for you! GeoCatch is hosting the next seminar in our Bay OK 2013 Seminar Series on July 17th. Researchers from Murdoch University will be presenting information on the ecology of the Vasse-Wonnerup wetlands system, including fish fauna and feral fish control program.

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**Ecology of the Vasse-Wonnerup**

There are still places available at our upcoming “Ecology of the Vasse-Wonnerup” event on Wednesday, 17 July 2013. If you’re interested in attending, please contact our office on 9781 0111.


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**GeoCatch**

11 July

These topics will be presented by Murdoch University Researchers, Dr Stephen Beatty, Dr James Tweedley & Dr Lisa Massey

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**GeoCatch**

12 July

Have you noticed the tv ads from the Home River Ocean campaign? The message is simple, we all need to work together to protect our waterways. Check out their website for more information.


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**GeoCatch**

4 July

A workshop will be held on Wednesday, 17 July 2013 on the Ecology of the Vasse-Wonnerup. There will be presentations by Murdoch University Researchers, Dr Stephen Beatty, Dr James Tweedley & Dr Jane Chambers. To register and for venue information please contact GeoCatch on 9781 0111 by Monday, 15 July.

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Page 39 of 41
Appendix 5: Scientific articles to be published using the data collected during this project.

**Paper 1:** Fish community structure in a hypersaline estuary. *Estuarine, Shelf and Coastal Science*

A paper showing how the spatial and temporal distribution of fish in the Vasse-Wonnerup is driven by the marked changes in salinity which occur seasonally.

**Paper 2:** Drivers of freshwater fish communities in seasonally flowing rivers in south-western Australia. *Freshwater Biology*

A paper showing how the abundance of native and introduced freshwater fish and crustacean species in the tributaries of the Vasse-Wonnerup are influence by habitat variables.

**Paper 3:** First occurrence of the goldfish in an estuarine environment. *Bioinvasion Records*

A paper documenting the seasonal immigration of juvenile goldfish into the Vasse-Wonnerup Wetland from the Lower Vasse River and raising the possibility that these goldfish if not removed could use the estuary as a ‘bridge’ to invade other tributaries.

**Paper 4:** Estuaries may act as bridges for the spread of invasive goldfish in south-western Australia. *Biological Invasions*

A paper showing the results of laboratory studies of the salinity tolerance of ‘wild’ goldfish from the Lower Vasse River and pet store goldfish and using hydrological modelling demonstrate that goldfish may use the Vasse Estuary as a ‘saltbridge’ to invade other freshwater systems (*i.e.* the other tributaries).

**Paper 5:** Movement patterns of an invasive freshwater fish: implications for control. *Biological Invasions*

A paper showing the results of the acoustic tracking and that Goldfish may use the New River Wetland as a breeding area. This paper will also demonstrate how acoustic tracking can be used to inform targeted removal efforts, raising the effectiveness of control measures.
**Paper 6:** Increased density of *Gambusia affinis* leads to increased severity of fin-nipping for native freshwater fishes. *Ecology of freshwater fishes*

A paper showing the occurrence of fin damage on native species in the tributary rivers of the Vasse-Wonnerup and how incident rate and severity of the damage vary both among species and are correlated with the abundance of Gambusia.

**Paper 7:** Salinity tolerance of different populations of *Gambusia affinis* across Western Australia: implications for estuarine management. *Marine and Freshwater Research*

A paper showing the salinity tolerances of *Gambusia* from several locations across Western Australia with varying salinities. Also details the world record *Gambusia* caught in a salinity of 72 in the Vasse-Wonnerup in February 2012.