

# **Cawarral Creek Declared Fish Habitat Area**

Central Queensland  
Assessment Report  
2013

Prepared by: Queensland Parks and Wildlife Service, Marine Resources Management, Department of National Parks, Sport and Racing

© State of Queensland, 2013.

The Queensland Government supports and encourages the dissemination and exchange of its information. The copyright in this publication is licensed under a Creative Commons Attribution 3.0 Australia (CC BY) licence.



Under this licence you are free, without having to seek our permission, to use this publication in accordance with the licence terms.

You must keep intact the copyright notice and attribute the State of Queensland as the source of the publication.

For more information on this licence, visit <http://creativecommons.org/licenses/by/3.0/au/deed.en>

#### Disclaimer

This document has been prepared with all due diligence and care, based on the best available information at the time of publication. The department holds no responsibility for any errors or omissions within this document. Any decisions made by other parties based on this document are solely the responsibility of those parties. Information contained in this document is from a number of sources and, as such, does not necessarily represent government or departmental policy.

If you need to access this document in a language other than English, please call the Translating and Interpreting Service (TIS National) on 131 450 and ask them to telephone Library Services on +61 7 3170 5470.

This publication can be made available in an alternative format (e.g. large print or audiotape) on request for people with vision impairment; phone +61 7 3170 5470 or email <[library@nprsr.qld.gov.au](mailto:library@nprsr.qld.gov.au)>.

#### Citation

Jupp RY. 2013. Cawarral Creek Declared Fish Habitat Area: Assessment Report. Brisbane: Department of National Parks, Sport and Racing, Queensland Government.

#### Acknowledgements

The preparation of this report was funded by the Gladstone Port Corporation's offsets program. A special thanks to Cameron Mulville and Michelle Adams (QPWS) for providing their time, knowledge and enthusiasm for field surveys to document the habitats of Cawarral Creek. Thanks to Marcus Sheaves and Bill Sawynock for providing data and Dave Sully for the mapping presented in this report. Input provided by Dr John Beumer and Kurt Derbyshire is greatly appreciated.

August 2013.

# Contents

Executive Summary .....	1
Recommendations .....	1
Chapter 1 Introduction .....	2
1.1 Fisheries management, fish habitats and fisheries .....	2
1.2 Purpose of report .....	2
Chapter 2 Defining the Cawarral Creek Study Area .....	3
2.1 Cawarral Creek declared FHA Description .....	3
2.2 Local Authority Boundaries .....	3
Chapter 3 Faunal Communities in Cawarral Creek and surrounding estuaries .....	6
3.1 Introduction .....	6
3.2 Data Sources .....	6
3.3 Results .....	6
3.4 Discussion .....	6
3.5 Conclusion .....	6
Chapter 4 Habitat Diversity .....	7
4.1 Introduction .....	7
4.2 Habitat diversity of Cawarral Creek .....	8
4.2.1 Marine waters >6m deep .....	9
4.2.2 Marine waters <6m deep .....	9
4.2.3 Aquatic beds .....	9
4.2.4 Coral reefs .....	9
4.2.5 Sand, shingle or pebble beaches .....	9
4.2.6 Estuarine waters .....	10
4.2.7 Intertidal flats .....	12
4.2.8 Marshes and salt pans .....	13
4.2.9 Mangrove communities .....	14
4.2.10 Marine swamps/ lagoons .....	15
4.2.11 Freshwater swamps/lagoons .....	16
4.2.12 Rocky structures .....	17
4.2.13 Surf bars .....	18
4.2.14 Overhanging/Undercut waterway banks .....	18
4.3 Surrounding land habitat values .....	19
4.4 Management Issues .....	19
4.5 Conclusions .....	20
References .....	21
Appendix A: Species of Fishes and Crustaceans recorded in the Cawarral Creek declared FHA .....	22

## Executive Summary

This report provides an overview of the fish habitats within the existing Cawarral Creek declared Fish Habitat Area (FHA). The Cawarral Creek declared FHA, located 10km south of Emu Park and 45km east of Rockhampton in Central Queensland, encompasses 3,130 hectares of tidal and intertidal lands of the Cawarral and Coorooman Creeks. It is declared a management A area, under the Fisheries Act 1994 which provides the highest level of management and protection for FHAs.

The Cawarral Creek FHA was originally declared in 1994. It received a relatively low rating in the Declared Fish Habitat Area Network Assessment Report 2012 (Batton et al. 2012) largely due to limited knowledge of the diversity of fish habitats within its boundaries. Subsequently, an investigation was launched to identify and report on the range of fish habitats within this system.

The following report documents the Cawarral Creek declared FHA to contain a productive, diverse and healthy ecosystem, with an abundance of recreationally and commercially targeted fish species. Essential fish habitats within the declared FHA include intertidal banks, mangrove lined channels, saltmarsh, salt pans and rocky structures. The diversity and range of fish habitats identified has expanded current knowledge of the declared FHA and increased its habitat value rating. Several parcels of land adjoining the declared FHA were also found to include significant and similar fish habitat values that complement the existing declared FHA and contribute to local fisheries productivity.

Several unlawful structures and a weed infestation were identified within the declared FHA and recommendations are outlined below to manage these issues.

## Recommendations

- Surrounding land parcels to the south and east of the declared FHA contain areas of important fish habitat. Consideration should be given to options of adding these fish habitats to the declared FHA, or engaging in management agreements with current landholders to provide ongoing protection of these vital fish habitats.
- Several unlawful artificial structures were identified on the banks of waterways within the declared FHA. Consultation and liaison with Queensland Boating and Fisheries Patrol is presently being undertaken as part of the Instream Structure inventory program (Lawrence et al. 2010). However further education may be required for adjoining landholders as to activities that may be authorised within a management A declared FHA.
- An emerging issue of para grass (*Urochloa mutica*) infestation was identified in the freshwater upper reaches of Coorooman Creek within the declared FHA. Consultation with local natural resource management groups is required to determine appropriate management of these upstream areas.

# Chapter 1 Introduction

Commencing in 1969, Fish Habitat Areas, declared under the *Fisheries Act 1994* are fundamental to the protection of the state's critical fish habitats. Currently 70 declared fish habitat areas along the Queensland coast protect more than 1.1 million hectares of high quality fish habitats, contributing to the sustainability of local and regional fish stocks.

The Cawarral Creek Fish Habitat Area (FHA) was originally declared on 9th December 1994. It is located in Central Queensland, 10 kilometres (kms) south of Emu Park and 45kms east of Rockhampton. Encompassing an area of 3,130 hectares, it captures the majority of the tidal and intertidal lands of Cawarral and Coorooman Creeks, as well as some upstream portions of freshwater reaches.

The surrounding area is primarily utilised for grazing and residential development. The main residential hubs adjoining the declared FHA are the townships of Keppel Sands to the south and Emu Park to the north-east. Tourism and recreational and commercial fishing activities are important economic inputs for the region.

The Cawarral Creek declared FHA comprises a creek system of high quality un-impacted estuarine fish habitats. Its declaration as a management A area provides the highest level of management and protection for FHAs.

## 1.1 Fisheries management, fish habitats and fisheries

Estuaries are amongst the most productive natural habitats in the world (McLusky & Elliott 2004) and coastal and estuarine habitats are integral to the reproduction and survival of many indigenous, recreational and commercially targeted fish species. Quinn (1992) has estimated that more than 75% of species landed in Queensland's commercial fisheries rely on a variety of habitats found in healthy estuaries during some part of their lifecycle.

As a result of human induced impacts, mangrove and salt marsh systems are amongst the most threatened ecological systems globally (Bridgewater & Cresswell 1999). The maintenance and appropriate management of these and other key fish habitats is vital to ensure future sustainability of Queensland's fish stocks. The declared FHA network strategy 2009-14 (DEEDI 2010) recognises the reliance of many species on multiple habitats during their lives and that protecting these habitats and their interconnectivity plays a crucial role in supporting fisheries. The declared FHA network has the added benefit of providing a safety net in protecting habitats that are presently poorly understood which may be found to have substantial fisheries values (Baker & Sheppard 2006).

## 1.2 Purpose of report

The Cawarral Creek declared FHA received a relatively low rating in the 2012 Declared Fish Habitat Area Network Assessment Report due to limited knowledge of its fish habitat values. As a result of this rating, a project to assess its habitat values was incorporated into a larger Central Queensland declared FHA investigations program, funded by the Gladstone Port Corporation's Western Basin dredging and disposal offsets program. This report provides an updated overview of the habitats contained within the Cawarral Creek declared FHA as they relate to the declared FHA selection criteria (NPRSR 2013).

## Chapter 2 Defining the Cawarral Creek Study Area

### 2.1 Cawarral Creek declared FHA Description

The Cawarral Creek declared FHA (Figure 2.1) encompasses an area of 3,130 hectares (ha) which incorporates the large majority of tidal and intertidal areas of Cawarral and Coorooman Creeks (Figure 2.2). Boundary realignment in 2003 facilitated the inclusion of portions of freshwater in the upper reaches of Cawarral and Coorooman Creeks. Declared FHA boundaries generally follow property or cadastral boundaries, cease 20 metres downstream and parallel to road alignments/crossings and exclude any area of a channel marked by navigational aids.

There are three access points for launching vessels into the estuary:

- an all tide ramp on the northern bank of the estuary, accessible from Zilzie (23°17'57S, 150°46'9E). This ramp is the most utilised and was upgraded in 2009 to accommodate 56 parking bays.
- a half-tide ramp on the southern bank of the estuary, accessible from Keppel Sands (23°19'17S, 150°47'28E). There is no designated parking area for this ramp and it can only accommodate up to six trailers.
- an all tide private ramp on the north west bank of the estuary, upstream of the junction with Cawarral Creek (23°18'10S, 150°45'6E).

### 2.2 Local Authority Boundaries

Presently the Cawarral Creek declared FHA lies within the administrative boundaries of Rockhampton Regional Council (RRC). As a result of a referendum conducted in March 2013, the previous Livingstone Shire Council will de-amalgamate from RRC as of 1st January 2014 and resume responsibility for the Capricorn Coast, which includes the Cawarral Creek declared FHA.

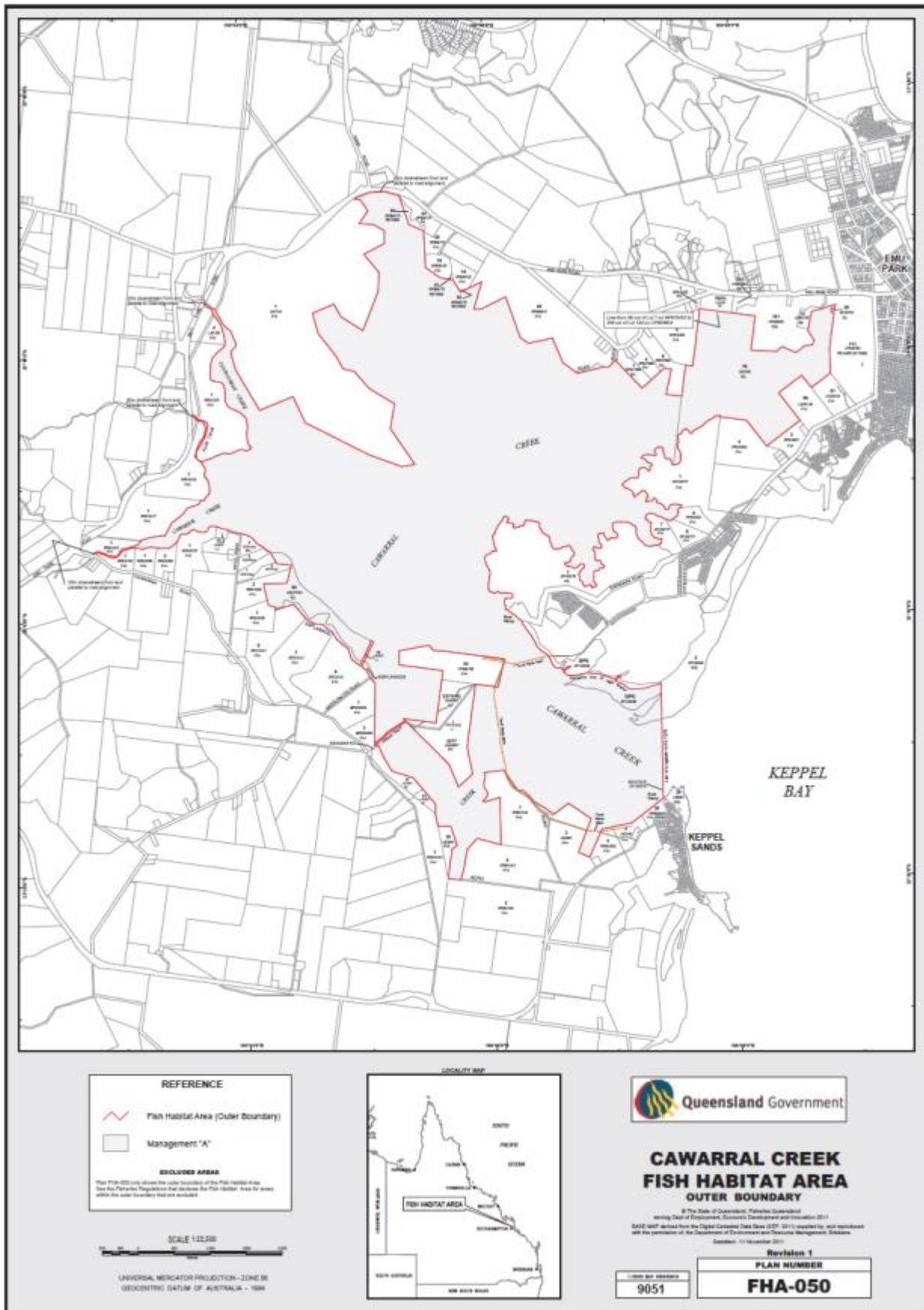
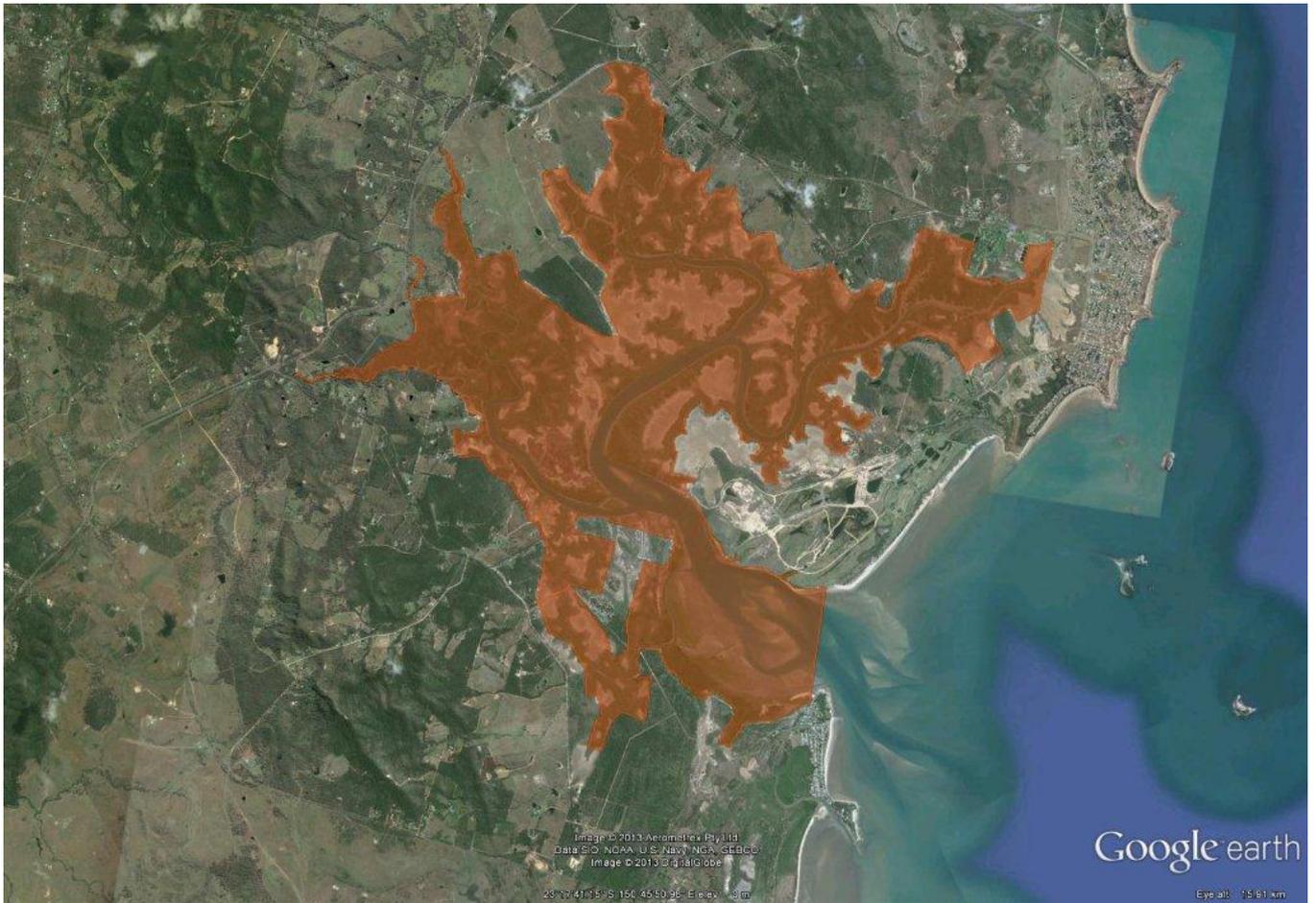


Figure 2.1: Cawarral Creek declared FHA Plan showing boundary.



**Figure 2.2: Tidal and intertidal areas in and adjoining the Cawarral Creek declared FHA.**

# Chapter 3 Faunal Communities in Cawarral Creek and surrounding estuaries

## Chapter Summary

A list of 70 fish species have been identified for the purpose of expanding on existing knowledge relating to the Cawarral Creek declared FHA. Information was sourced from literature and recreational fish catches.

The diversity and abundance of commercial, indigenous and recreationally targeted fish species are testament to the productivity and value of the fish habitats within and surrounding the Cawarral Creek declared FHA.

## 3.1 Introduction

There is an impressive representation of essential fish habitats within the Cawarral Creek declared FHA. These foster a high variety of fish species, many of which are significant for their recreational and commercial value. The abundance of shelter, feeding and breeding sites enables a diverse range of fish species to inhabit the creek system, which also provides significant habitat for other vertebrate species.

## 3.2 Data Sources

Information on fish communities inhabiting Cawarral Creek declared FHA was sourced to expand on existing knowledge relating to its values and therefore it was not considered necessary to complete fish sampling studies. The following information was documented from published literature, recreational fisher catch records and data supplied by Infish Australia and James Cook University (JCU). Commercial netting is prohibited in Cawarral Creek under the Fisheries Regulation 2008 so catch data is not available from that fishing sector.

## 3.3 Results

Trailer counts at the Zilzie boat ramp conducted by Infish Australia recorded an average of 20 or more trailers a day for approximately 35% of the days where trailer surveys were conducted. Usage increased significantly after the ramp was upgraded, with 78 trailers counted on one occasion. Fishing effort was measured from Winter 2007 - Summer 2008/09 and averaged at 2.5 fishers per trip, fishing for 4.5 hours, with a total effort of 11 hours. The average overall catch rate was 10.6 fish caught and 3.5 fish kept per trip. The most commonly caught species were pikey bream (*Acanthopagrus berda*), barred javelin (*Amniataba percoides*) and mud crab (*Scylla serrata*).

A total of 70 fish species were recorded from available data, as outlined in Appendix A. Due to the variety of common names attributed to fish by recreational anglers, it is difficult to determine all the individual species of particular fish families. A wide variety of economically important species were found to utilise the Cawarral Creek declared FHA, including highly sought after species such as the barramundi (*Lates calcarifer*), mangrove jack (*Lutjanus argentimaculatus*) and mud crab (*Scylla serrata*). In addition to fish species, other vertebrates such as estuarine crocodiles (*Crocodylus porosus*) and wader bird species are known to frequent the declared FHA.

## 3.4 Discussion

The high usage of the creek system by anglers and diverse range of recreationally and commercially important species identified within the Cawarral Creek declared FHA is a testament to its productive fish habitats. Additionally, information sourced suggests many of these fish species can be found in large numbers throughout the creek and in adjacent inshore waters (Capricorn Region Salvation Army 2013, Lynch 2004, Lynch 2013).

## 3.5 Conclusion

The Cawarral Creek declared FHA is an important estuarine system for local recreational fishers. It is heavily utilised and consistently produces high catch rates for anglers. The variety of fish species and abundance of fish numbers recorded is a testament to the valuable and highly productive fish habitats contained within and surrounding the declared FHA.

## Chapter 4 Habitat Diversity

### Chapter summary

There is an impressive representation of essential fish habitats within the Cawarral Creek declared FHA, including mangrove lined creeks, saltpan and saltmarsh, rocky structures and intertidal flats. The abundance of shelter, feeding and breeding sites fosters a healthy variety of indigenous, recreational and commercially targeted fish species, as outlined in Chapter 3.

Fish species utilising the estuary rely on different habitats with daily tidal influences, seasonally and at different stages of their lifecycle. The FHA program recognises this complex and interrelated reliance and the importance of protecting the full suite and interconnectivity of habitats within an area for future fisheries resource sustainability. The protection of these areas is essential to adequately manage and maintain the productivity of local and regional fish stocks.

### 4.1 Introduction

Estuarine habitats directly support local inshore and offshore fisheries through their provision of food, shelter, breeding, nursery areas and sediment filtration. Many recreationally and commercially important fish species rely on estuarine environments for some or all of their lifecycle, for example, mud crabs, barramundi, flathead and prawns (Walker 1997) and many offshore game fish rely on bait fish that spend a part of their lifecycle in coastal estuarine systems (QDEH 1994). The Cawarral Creek declared FHA supports a large and diverse range of valuable fish habitats including mangrove lined channels, intertidal flats, salt marshes and saltpans.

## 4.2 Habitat diversity of Cawarral Creek

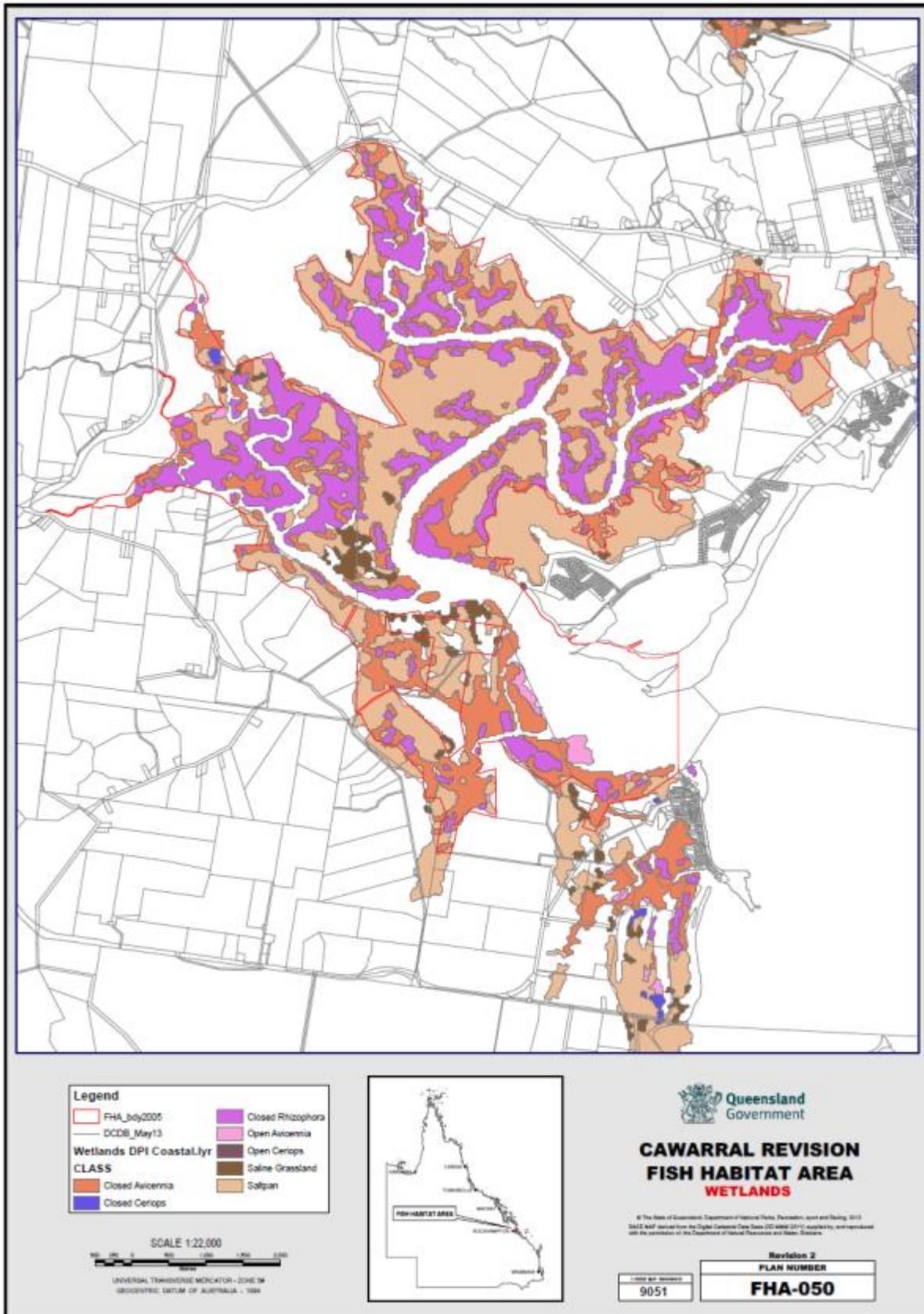


Figure 4.1: Cawarral Creek Habitat Diversity map.

This section describes the occurrence and characteristics of the habitat classifications used for declared FHA assessment.

#### **4.2.1 Marine waters >6m deep**

The Cawarral Creek declared FHA boundary lies within the estuarine mouth, excluding inshore marine waters.

#### **4.2.2 Marine waters <6m deep**

The Cawarral Creek declared FHA boundary lies within the estuarine mouth, excluding inshore marine waters.

#### **4.2.3 Aquatic beds**

There is no evidence of seagrass meadows in existing habitat mapping of the Cawarral Creek declared FHA.

#### **4.2.4 Coral reefs**

There is no evidence of coral reefs in existing habitat mapping of the Cawarral Creek declared FHA.

#### **4.2.5 Sand, shingle or pebble beaches**

The lower reaches of the declared FHA contain large areas of sand and pebble beaches. These habitats support communities of algae which provide food sources for zooplankton and filter feeding invertebrates (Zeller 1998). Insects and burrowing animals, such as small crustaceans, worms and molluscs are common to these habitats and attract indigenous, recreational and commercially targeted fish species such as whiting, bream, flathead and mullet.



**Figure 4.2: Sandy beach typical of those in the lower reaches of Cawarral Creek declared FHA.**



**Figure 4.3: Pebble Beach in the lower reaches of the Cawarral Creek declared FHA.**

#### **4.2.6 Estuarine waters**

The Cawarral Creek declared FHA consists of two main estuaries, the Cawarral and Coorooman Creeks which drain into Keppel Bay. This creek system supports a productive mud crab fishery as well as many other significant fish species which rely on estuarine waters and their habitats for periods of their life (Zeller 1998). It has been estimated that more than 75% of species landed in Queensland's commercial fisheries rely on a variety of habitats found in healthy estuaries during some part of their lifecycle (Quinn 1992). The largest percentage of recreational fishing effort in Queensland occurs in estuarine systems (45% state wide), with yellow fin bream, whiting and flathead as the most common species caught (Taylor et al. 2012).



**Figure 4.4: Main estuarine waterways of Cawarral Creek declared FHA.**



**Figure 4.5: Estuarine waters of Cawarral Creek declared FHA.**

#### 4.2.7 Intertidal flats

Extensive intertidal flats exist throughout the lower reaches of the declared FHA where the estuary drains into Keppel Bay. These habitats develop in sheltered places where the water velocity slows and are important sedimentation areas, with high productivity and nutrient value. Intertidal flats support a diversity of burrowing and surface fauna and interstitial algae providing a direct food source for fish species (Long & McKinnon 2002).



**Figure 4.6: Intertidal sand flats toward the mouth of the Cawarral Creek declared FHA.**

#### 4.2.8 Marshes and saltpans

The Cawarral Creek declared FHA contains large expanses of salt marshes and saltpans creating the interface between the mangrove forests and waterways and adjoining terrestrial lands. Many of these habitats are vegetated with saltcouch and upper littoral succulents.

Despite the relatively low duration and inundation of intertidal saltmarshes and saltpans, these habitats have been found to have significant habitat values for many species of fish, including those of economic importance such as bream, whiting and mullet (Thomas & Connolly 2001, Mazumder et al. 2006). In a study of the use of subtropical saltmarsh habitats by fish species, (Thomas & Connolly 2001) found there was no significant difference between the species richness captured in vegetated and un-vegetated habitats, with a high number and diversity of estuarine resident and estuarine/marine fish species utilising the entirety of these habitats, some captured over 400 metres from sub-tidal water.



Figure 4.7: Saltmarsh typical of those throughout the Cawarral Creek declared FHA.

#### 4.2.9 Mangrove communities

Mangroves are among the most productive and biologically diverse ecosystems in the world and in central to north Queensland, are integral to the health of the Great Barrier Reef ecosystem (Hogarth 1999, Goudcamp & Chin 2006). Mangrove forests consist of distinct communities growing within the intertidal zone of estuaries, coastal rivers and bays (Loveday 1999) and play a vital role in preventing coastal erosion, trapping sediment and filtering land run-off. These habitats are crucial to the biological productivity and food webs of coastal waters and provide critical nursery areas for many indigenous, commercial and recreationally important fish species (Goudcamp & Chin 2006).

Within the Cawarral Creek declared FHA, extensive forests of mangroves line the estuarine system and small creeks. Communities are dominated by Closed *Aegiceras*, Closed *Rhizophora* and Closed *Avicennia* species.



Figure 4.8: Closed *Avicennia* mangrove communities lining the Cawarral Creek branch of the declared FHA.

#### 4.2.10 Marine swamps/ lagoons

Shallow swamps are located in the lower reaches of the declared FHA, between Horton's Creek and the main channel. The extent and permanence of these habitats would depend upon tidal patterns and rainfall. Shallow swamps such as these have the capacity to support a range of fish species including juvenile barramundi (Baker & Sheppard 2006).



**Figure 4.9: Example of marine swamps found in the lower portion of the Cawarral Creek declared FHA.**

#### 4.2.11 Freshwater swamps/lagoons

Realignment of boundaries in 2003, to match cadastral boundaries as per the digital cadastral database, enabled upstream fresh waters to be included within the declared FHA. While the extent and duration of connectivity with the estuarine system are difficult to determine, it is most likely that flow occurs only during rainfall events. These upstream waters provide valuable freshwater habitats for use by juveniles of a range of marine species such as barramundi, mangrove jack, mullet and tarpon (Baker & Sheppard 2006).



Figure 4.10: Freshwater lagoon inside the Cawarral Creek declared FHA boundary. (Upper reaches)

#### 4.2.12 Rocky structures

Rocky structures provide a hard substrate for the attachment of rich algal flora and immobile invertebrate communities (barnacles, oysters and tube worms), contributing to the primary production within waterways (Zeller 1998). Cawarral Creek declared FHA contains intertidal rocky structures as well as rocky bars throughout its creek system which remain partially submerged at low tide. Horton's Creek contains a rocky outcrop that is well known as an aggregation point for salmon and bream (Capricorn Region Salvation Army 2013).



**Figure 4.11: Intertidal rocky structures at the junction of Horton's Creek and the main channel.**



**Figure 4.12: Intertidal rocky bank in the lower reaches of Cawarral Creek declared FHA.**

#### 4.2.13 Surf bars

Cawarral Creek declared FHA is encompassed within the estuarine system and protected by adjoining land forms, so there are no surf bars in the declared FHA.

#### 4.2.14 Overhanging/Undercut waterway banks

Overhanging and undercut waterway banks provide shelter and protection for juvenile fish species and their prey species. These banks normally form as a result of natural erosion processes. However, this can be accelerated by the wash resulting from significant boat activity (Baker & Sheppard 2006). Within the Cawarral Creek declared FHA, natural undercut banks are found along many of the waterways.



Figure 4.13: Undercut bank typical of the bank structure throughout the Cawarral Creek declared FHA.



Figure 4.14: Overhanging bank typical of bank structure throughout Cawarral Creek declared FHA.

### 4.3 Surrounding land habitat values

A study of lands adjoining the Cawarral Creek declared FHA has identified several parcels of land with high fish habitat values. Within these parcels, mangrove forests, saltpans and saltmarshes that receive diurnal inundation adjoin the southern and eastern boundaries of the declared FHA. These lands complement the values of the existing declared FHA and currently contribute considerably to the productivity and effective functioning of the creek system.

### 4.4 Management Issues

In the process of undertaking this report, several unlawful artificial structures were identified within the declared FHA. Management options for this issue are presently being assessed through the related declared FHA Instream Structure Inventory Program (Lawrence et al. 2010).



**Figure 4:15: Example of unlawful artificial structure within the Cawarral Creek declared FHA.**

A weed management issue is emerging within the upper reaches of Coorooman Creek's freshwater section. The primary concern is the spread of para grass (*Urochloa mutica*) along the banks of this waterway. Para grass, primarily used as a fodder species, is an aggressive invader and has the capacity to threaten natural wetland ecosystems through outcompeting native plant species and clogging waterways, reducing light penetration and oxygen levels (Hannan-Jones & Csurhes 2012).



**Figure 4.16: Para grass infestation within the Cawarral Creek declared FHA.**

## **4.5 Conclusions**

The Cawarral Creek declared FHA is host to a high quality and diverse range of fish habitats that interact and connect with each other. These habitats support a variety of fisheries that are important to the indigenous, commercial and recreational fishing sectors. Surrounding land parcels adjacent to the declared FHA have been identified as containing high value fish habitats and are also making a valuable contribution to the effectiveness of the system. Issues identified include unlawful artificial structures and weed infestation.

The interconnectivity of habitats and their functioning is a fundamental requirement for productive and sustained fisheries and the importance of protecting all available habitats within an area is a central focus of the declared FHA concept (NPRSR 2013, Baker & Sheppard 2006). The Cawarral Creek declared FHA highlights the importance of this concept and provides evidence of its effectiveness.

The habitat assessment of the Cawarral Creek declared FHA has addressed the relatively low rating received in the Declared Fish Habitat Area Network Assessment Report 2012 (Batton et al. 2010). It has confirmed and documented that the declared FHA contains high fish habitat diversity and as a result the low rating can be revised upwards.

### **Recommendations**

- Surrounding land parcels to the south and east of the declared FHA contain areas of important fish habitat. Consideration should be given to options of adding these fish habitats to the declared FHA, or engaging in management agreements with current landholders to provide ongoing protection of these vital habitats.
- Several unlawful artificial structures were identified on the banks of waterways within the declared FHA. Consultation and liaison with Queensland Boating and Fisheries Patrol are presently being undertaken as part of the Instream Structure Inventory Program (Lawrence et al. 2010). However further education may be required for adjoining landholders as to activities that may be authorised within a management A declared FHA.
- An emerging issue of para grass (*Urochloa mutica*) infestation was identified in the freshwater upper reaches of Coorooman Creek within the declared FHA. Consultation with local natural resource management groups is required to determine appropriate management of these upstream areas.

## References

- Baker, R & Sheppard R 2006, *Fisheries Resources of Albatross Bay, Gulf of Carpentaria*, DPI, Queensland, 90pp.
- Batton, R, Derbyshire K & Sheppard R 2012, *Declared Fish Habitat Area Network Assessment Report*, DAFF, Queensland. <http://www.nprsr.qld.gov.au/managing/pdf/assessment-report.pdf>
- Bridgewater, PB & Cresswell, IA 1999, Biogeography of mangrove and saltmarsh vegetation: implications for conservation and management in Australia, *Mangroves and saltmarshes* vol 3, no. 2, pp117-125.
- Capricorn Region Salvation Army 2013, *Coorooman Creek*, viewed 24th April 2013, <http://salvos.org.au/capregion/heavens-anglers/hot-spots/coorooman-creek/>
- Department of Agriculture, Fisheries and Forestry (DAFF) 2013, *Coastal Habitat Resource Information System (CHRIS)*, DAFF, Queensland. [http://chrisweb.dpi.qld.gov.au/website/ArcIMS\\_CHRIS/viewer.htm?Project=3](http://chrisweb.dpi.qld.gov.au/website/ArcIMS_CHRIS/viewer.htm?Project=3)
- Department of Employment, Economic Development and Innovation (DEEDI) 2010, *Declared Fish Habitat Area network strategy 2009-14: Planning for the future of Queensland's declared Fish Habitat Area network*, DEEDI, Queensland. <http://www.nprsr.qld.gov.au/managing/pdf/declared-network-strategy.pdf>
- Department of National Parks, Recreation, Sport and Racing (NPRSR) 2013, *Fish Habitat Area selection, assessment, declaration and review*, NPRSR, Marine Resource Management Operational Policy, 31pp. <http://www.nprsr.qld.gov.au/managing/pdf/selection-assessment-declaration-review.pdf>
- Goudcamp K & Chin A 2006, 'Mangroves and Saltmarshes' in Chin A (ed) *The State of the Great Barrier Reef On-line*, Great Barrier Reef Marine Park Authority, Townsville. Viewed 20th May 2013, [http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0020/3971/SORR\\_Mangroves\\_Saltmarshes.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0020/3971/SORR_Mangroves_Saltmarshes.pdf)
- Hannan- Jones M & Csurhes S 2012, *Invasive species risk assessment: Para grass Urochloa mutica*, Department of Agriculture, Fisheries and Forestry, Biosecurity Queensland, Queensland, 28pp.
- Hogarth, PJ 1999, *The biology of mangroves*, Oxford University Press, New York, 228pp.
- Lawrence M, Sully, D, Beumer, J & Couchman, D 2010, *Fisheries Guidelines for conducting an inventory of instream structures in coastal Queensland* (revised version), Department of Employment, Economic Development and Innovation, Fish Habitat guideline FHG 007 update.
- Long P & McKinnon S 2002, *Habitats and Fisheries Resources of the Fitzroy River Estuary (Central Queensland)*, DPI, Queensland, 104pp.
- Lovelock, C 1999, *Field Guide to the Mangroves of Queensland*, Australian Institute of Marine Science, Townsville, Queensland, 72pp.
- Lynch, S 2004, *Bumper salmon season*, [fishingmonthly.com.au](http://www.fishingmonthly.com.au), viewed 20th May 2013, <http://www.fishingmonthly.com.au/Articles/Display/7678-Bumper-salmon-season>
- Lynch, S 2013, *Fire, flood and feast*, [fishingmonthly.com.au](http://www.fishingmonthly.com.au), viewed 20th May 2013, <http://www.fishingmonthly.com.au/Articles/Display/7678-Bumper-salmon-season>
- Mazumder D, Saintilan N & Williams, RJ 2006, Trophic relationship between itinerant fish and crab larvae in a temperate Australian saltmarsh, *Marine and Freshwater Research*, vol. 57, no. 2, pp193-199.
- McClusky, DS & Elliott, M 2004, *The estuarine ecosystem: ecology, threats and management*, Oxford University Press, New York, 214pp.
- Queensland Department of Environment and Heritage (QDEH) 1994, *Curtis Coast Study Resource Report*, QDEH, Rockhampton Qld, 171pp.
- Quinn RH (1992) *Fisheries resources of the Moreton Bay region*. Queensland Fish Management Authority, Queensland, 52pp.
- Taylor, S, Webley, J & McInnes, K 2012, *Queensland's 2010 statewide recreational fishing survey*, viewed 4th June 2013, [http://www.daff.qld.gov.au/28\\_18273.htm](http://www.daff.qld.gov.au/28_18273.htm).
- Thomas BE & Connolly RM 2001, 'Fish use of subtropical saltmarshes in Queensland, Australia: relationships with vegetation, water depth and distance onto the marsh', *Marine Ecology Progress Series*, vol. 209, pp.275-288.
- Walker, M 1997, *Fisheries Resources of the Port Curtis and Capricorn Regions*, Queensland Fisheries Management Authority, Queensland, 48pp.
- Zeller, B 1998, *Queensland's Fisheries Habitats - current condition and recent trends*, DPI, Queensland, 211pp.

# Appendix A: Species of Fishes and Crustaceans recorded in the Cawarral Creek declared FHA

## Family

Species	Common Name
<b>Fish</b>	
Polynemidae (Threadfin Salmon)	
<i>Eleutheronerna tetradactylum</i>	Blue Threadfin salmon
<i>Polydactylus sheridani</i>	King salmon
<i>P. multiradiatus</i>	Australian threadfin
Sillaginidae (Whiting)	
<i>Sillaginidae maculata</i>	Trumpeter whiting
<i>S. ciliata</i>	Sand whiting
<i>S. sihama</i>	Northern whiting
Carangidae (Jacks and Trevallys)	
<i>Caranx ignobilis</i>	Giant trevally
<i>Scomberoides commersonianus</i>	Giant Leatherskin queenfish
<i>Pantolabus radiatus</i>	Fringefin trevally
<i>Gnathonodon speciosus</i>	Golden trevally
Lutjanidae (Tropical snappers)	
<i>Lutjanus argentimaculatus</i>	Mangrove jack
<i>L. johni</i>	Golden snapper
<i>L. russelli</i>	Moses snapper
Platycephalidae (Flathead)	
<i>Platycephalus endrachtensis</i>	Bar-tailed flathead
<i>P. fuscus</i>	Dusky flathead
Mugilidae (Mullet)	
<i>Liza subviridis</i>	Greenback mullet
<i>Mugil cephalus</i>	Sea mullet
Sparidae (Porgies)	
<i>Acanthopagrus australis</i>	Yellowfin bream
<i>A. berda</i>	Black/Pikey bream
<i>A. pacificus</i>	Pacific seabream
Scombridae (Mackerels, Tuna, Bonitos)	
<i>Scomberomorus semifasciatus</i>	Broad-barred mackerel
<i>S. queenslandicus</i>	School mackerel
Sciaenidae (Drums or Croakers)	
<i>Argyrosomus japonicus</i>	Jewfish/Mulloway
<i>Protonibea diacanthus</i>	Black jewfish
<i>Nibea soldado</i>	Silver jewfish
<i>Johnius pacificus</i>	Pacific croaker
Centropomidae (Sea Perches)	
<i>Lates calcarifer</i>	Barramundi

Terapontidae (Grunters)	
<i>Amniataba percooides</i>	Barred grunter
Haemulidae (Grunts)	
<i>Diagramma pictum</i>	Painted sweetlip
<i>Plectorhinchus</i> sp.	Sweetlip
<i>Pomadasys kaakan</i>	Javelin grunter
Leptobramidae (Beach salmon)	
<i>Leptobrama muelleri</i>	Steelback salmon
Ariidae (Sea Catfishes)	
<i>Arius graeffei</i>	Blue catfish
Soleidae (Flatfish)	
<i>Paradicula setifer</i>	Paradice's Sole
Dasyatidae (Stingrays)	
<i>Himantura undulata</i>	Leopard whipray
Muraenesocidae (Pike Congers)	
<i>Muraenesox cinereus</i>	Pike Eel
Carcharhinidae (Requim Sharks)	
<i>Carcharhinidae</i> spp.	Shark
Tetraodontidae (Toadfishes, puffers)	
<i>Arothron manilensis</i>	Narrow-lined puffer
<i>Chelonodon patoca</i>	Milkspotted puffer
<i>Marilyna pleurosticta</i>	Banded toadfish
<i>Tetractenos hamiltoni</i>	Common toadfish
Ambassidae (Asiatic glassfishes)	
<i>Ambassi vachellii</i>	Vachelli's glass perchlet
Apogonidae (Cardinalfishes)	
<i>Apogon</i> sp.	Cardinalfish
Eleotridae (Sleepers)	
<i>Butis butis</i>	Duckbill sleeper
Callionymidae (Dragonets)	
<i>Callionymus sagitta</i>	Arrow dragonet
Drepaneidae (Sicklefishes)	
<i>Drepane punctata</i>	Spotted sicklefish
Gerreidae (Mojarras)	
<i>Gerres filamentosus</i>	Whipfin silver-biddy
Clupeidae (Herrings, shads, sardines, menhadens)	
<i>Herklotsichthys castelnaui</i>	Castelnaud's herring
<i>Sardinella</i> sp.	Sardinella
Gobiidae (Gobies)	
<i>Karsten tottoyensis</i>	Goby
Leiognathidae (Ponyfish)	
<i>Leiognathus equulus</i>	Common ponyfish
<i>Nuchequula gerroides</i>	Decorated ponyfish

Cynoglossidae (Tonguefish)	
<i>Paraplagusia bilineata</i>	Double lined tonguesole
<i>P. guttata</i>	Spotted tonguesole
Synodontidae (Lizardfish)	
<i>Saurida</i> sp.	Lizardfish
Siganidae (Rabbitfishes)	
<i>Siganus lineatus</i>	Golden lined spinefoot
Engraulidae (Anchovies)	
<i>Stolephorus</i> sp.	Anchovy
<i>Thryssa hamiltonii</i>	Hamilton's thryssa
Ephippidae (Spadefishes, batfish and scats)	
<i>Platax orbicularis</i>	Orbicular batfish
Paralichthyidae (Large tooth flounders)	
<i>Pseudorhombus arsius</i>	Large tooth flounder

### **Crustaceans**

Penaeidae (Penaeid Prawns)	
<i>Penaeus merguensis</i>	Banana prawn
<i>P. indicus</i>	Indian prawn
<i>P. esculentus</i>	Tiger prawn
<i>Parapenaeopsis sculptilis</i>	Rainbow shrimp
<i>Metapenaeus bennettiae</i>	Greasy back prawn
<i>Metapenaeopsis novaeguineae</i>	Northern velvet shrimp
<i>Atypopenaeus formosus</i>	Orange shrimp
Callianassidae (Ghost Shrimps)	
<i>Trypaea australiensis</i>	Yabby
Portunidae (Crabs)	
<i>Scylla serrata</i>	Mud Crab
Palaeomonidae (Shrimp)	
<i>Palaemonetes</i> sp.	Ghost shrimp