Department of National Parks,
Recreation, Sport and Racing

Fisheries Resources of Balaclava Island, Fitzroy River

Central Queensland

2014

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

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Contents

List of Acronyms and Abbreviations

CMP	Coastal Management Plan
CQRP	Central Queensland Regional Plan
DAFF	Department of Agriculture, Forestry and Fisheries
DIWA	Directory of Important Wetlands in Australia
FHA	Fish Habitat Area
FRA	Fisheries Resource Assessment
GBRMPA	Great Barrier Reef Marine Park Authority
GBRMP	Great Barrier Reef Marine Park
GBR	Great Barrier Reef
GPC	Gladstone Ports Corporation
NPRSR	Department of National Parks, Recreation, Sports and Racing
PAH	Polycyclic aromatic hydrocarbons
PCCC	Port Curtis Coral Coast
PPDA	Priority Port Development Area
SPP	State Planning Policy
SPRP	Coastal Protection State Planning Regulatory Provision
TUMRA	Traditional Use of Marine Resources Agreement

Executive summary

This Fisheries Resource Assessment (FRA) report provides an overview of the habitat and fisheries resources of the Balaclava Island study area. It is a compilation of information and data sourced from literature, reports and field surveys. Included is information relating to surrounding land uses, disturbances, administrative and legislative jurisdictions, as well as any other impacts and considerations for fisheries resource management in the area.

One of the main purposes of this report is to assess the suitability of the study area to be included as part of the Fitzroy River declared Fish Habitat Area (FHA). This assessment of suitability is done by assessing the study area against a series of criteria under two categories—fisheries (four criteria) and fish habitat criteria (eight criteria). The presence of any regionally unique fish habitat features is also assessed.

The Balaclava Island study area lies within the Fitzroy River, Central Queensland, and encompasses 16,069ha, comprised of a large portion of Balaclava Island as well as adjacent tidal lands. The Gladstone Ports Corporation (GPC) has committed 5002ha of strategic port land as an environmental offset under the Western Basin Dredging and Disposal Project offsets program, with a further 7622ha committed as an advance offset. These lands make up the majority of the Balaclava Island study area.

The Fitzroy River is approximately 480km long and drains the largest catchment on the east coast of Australia. The Fitzroy River FHA was declared in 2008 and covers 293,253ha of the tidal waters from Nerimbera boat ramp (23°25'S, 150°35'E) to the river's mouth. It encompasses a diverse range of essential fish habitat including mangrove lined channels, extensive saltpans and saline grasslands, mud and sand flats, rocky headlands and brackish lagoons. It is considered a vital component for the management and sustainability of Central Queensland's fish stocks.

The estuarine habitats within the Fitzroy River declared FHA are essential to the lifecycle of many recreational, indigenous and commercially targeted fish species. The role of a declared FHA is to protect these essential habitats from development activities, whilst still allowing community use for boating, fishing and recreational activities.

The fish habitats of the Balaclava Island study area were assessed against the above criteria and were found to be representative of the level of high quality and diverse fish habitats that the declared FHA network aims to protect. It contains extensive mangrove communities, saltpans and marshes, intertidal mud and sand flats and rocky structures. It supports important recreational and commercial fisheries within its boundaries, as well as in adjacent waters and fish surveys throughout the study area indicate it is utilised as nursery habitat. Water quality remains at a high level within the Fitzroy River and there are no artificial structures within the Balaclava Island study area. The lands within the Balaclava Island study area have not been developed and are adequately buffered from adjacent land uses.

An FRA of the Fitzroy River (Long & McKinnon 2002) was compiled as part of the original FHA declaration process. It is a compilation of a vast amount of available data and information, field surveys and community knowledge. This report draws on information already contained within the Fitzroy River FRA as well as additional field surveys and fish surveys specifically conducted in the Balaclava Island study area. The current report should be read in conjunction with the original Fitzroy River FRA to gain a thorough and comprehensive overview of the Balaclava Island study area's interrelatedness with the Fitzroy River declared FHA.

The Balaclava Island study area fulfils all of the four fisheries criteria and the eight habitat criteria. The incorporation of this area into the existing Fitzroy River declared FHA will have the benefit of increasing the declared FHA's size and habitat and provide protection to the high quality fish habitats contained within the study area. It is recommended the Balaclava Island study area be incorporated into the management 'A' Fitzroy River declared FHA.

Recommendation

Proceed to public consultation with a view to incorporate the Balaclava Island study area into the existing Fitzroy River declared FHA under the *Fisheries Act 1994*. (Chapter 11 outlines the suitability of the Balaclava Island study area as compared to the declared FHA selection criteria).

Chapter 1 Introduction

The Fitzroy River, located in Central Queensland, is approximately 480km in length flowing from the junction of the Mackenzie and Dawson Rivers at Duaringa to Keppel Bay on the Queensland coast. Its catchment covers an area of 142,645km², making it the largest on the east coast of Australia. The regional city of Rockhampton, with a population of just over 61,000, is located adjacent to the upper tidal reaches of the Fitzroy River, approximately 45km upstream of the river mouth. The remainder of the catchment is dominated by farming and mining.

The Fitzroy River Fish Habitat Area (FHA) was declared in March 2008. It covers an area of 29,253ha from the Nerimbera boat ramp (23°25'S, 150°35'E, approximately 37km upstream of the mouth) to the river's mouth and incorporates parts of the adjacent Raglan and Casuarina Creeks and the wetland systems surrounding North Curtis Island. The Fitzroy River declared FHA is considered a vital component for the management and sustainability of Central Queensland's fish stocks. It encompasses a diverse range of essential fish habitats including mangrove lined channels, extensive saltpans and saline grasslands, mud and sand flats, rocky headlands and brackish lagoons. These habitats play a critical role in the productivity of important commercial, recreational and indigenous fisheries resources in the region and the Fitzroy River declared FHA is widely recognised by recreational and commercial fishers as a fishery of regional and state significance (Long & McKinnon 2002).

Port Alma is situated at the southern end of the Fitzroy River delta. The principle industries in this area are the Port Alma shipping terminal, providing access for ships transporting explosives and general cargo (Chapter 6.2), salt production (Chapter 6.3) and fishing. The Gladstone Port Corporation (GPC) has considered expansion of Port Alma facilities for use as an alternative port to neighbouring Gladstone Harbour. As such, at the time of declaration of the Fitzroy River declared FHA, several parcels of land toward the mouth of the river, included in the original Fitzroy River study area, were omitted from the declared FHA due to conflict with proposed future port development activities. This report revisits some portions of land within this area for possible incorporation into the Fitzroy River declared FHA as this land is no longer under consideration for port facilities.

1.1 Fisheries management, fish habitats and fisheries

Estuaries are considered to be among the most productive natural habitats in the world (McLusky & Elliott 2004) and a diverse range of estuarine habitats are important to the future sustainability of Queensland's fisheries. Fish utilise estuarine habitats for a variety of purposes and stages in their lifecycle for example, the high productivity of estuarine systems enables juvenile fish species to grow more rapidly than in the marine environment, reducing their susceptibility to predation. Iconic Queensland species such as mud crabs utilise estuarine systems for the majority of their lifecycle and barramundi require estuarine habitats for spawning and larval stages.

The Fitzroy River plays an important role in the ecology, culture, economy and lifestyle of the Central Queensland region and is regionally significant for its fisheries values. In the Fitzroy River mouth alone, 210 tonne (t) of fish to the value of more than $2.2 million was landed by commercial fishers in 2012 (DAFF 2013a). Recreational fishing also generates substantial income for the region, supporting a range of local businesses. It is a popular pursuit in Central Queensland, with approximately 42,000 or 20% of Fitzroy division residents aged five years and over fishing in 2010, which is higher than the state average of 17% (Taylor et al. 2012).

A large proportion of all fish targeted by indigenous, commercial and recreational fishers rely on coastal and estuarine habitats. The importance of estuaries to local economies is highlighted by Quinn (1992), who 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. Many of these species are also significant to recreational and indigenous fisheries.

Disturbance through urban and industrial development and run-off, land reclamation and land clearing all negatively impact upon estuarine systems. As a result of human induced impacts, mangrove and salt marsh systems are amongst the most threatened ecological systems globally (Bridgewater & Cresswell 1999). A key component to the maintenance and sustainability of Queensland's fish stocks is the protection and management of these essential habitats which is provided by declared FHAs.

1.2 Regional fish habitat focus

Commencing in the late 1960's, FHAs are declared under the *Fisheries Act 1994* and are fundamental to the protection of the state's key fish habitats. The declared FHA network strategy recognises the complex and interrelated 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. It 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).

Research has shown that the management of fish habitats at a regional scale, incorporating a wide range of essential habitats rather than the protection or management of isolated habitats or species, is a much more effective response to protecting fisheries resources. Consequently, expansion of the declared FHA network is fundamental to ensuring a comprehensive, adequate and representative network of key fish habitats are protected for future sustainability. This opportunity to expand the existing Fitzroy River declared FHA will assist in closing some of the fragmented boundaries of the declared FHA, providing connectivity of protected fish habitats.

1.3 Purpose of report

As part of the offsets program for the Western Basin Dredging and Disposal Project (GPC 2013), GPC has committed an area of 5002ha of port land for assessment of its suitability to be incorporated into the existing Fitzroy River declared FHA. A further 7622ha of GPC's land has been incorporated into this study area and has been committed as an advance offset (Figure 2.1).

This report provides an updated overview of the habitats contained within these parcels of land, as well as additional tidal lands adjoining these lands, as they relate to the declared FHA criteria (NPRSR 2013). It provides a summary of information relevant to the declared FHA criteria in addition to management issues, surrounding land uses and other impacts and considerations to the management of fisheries resources in the area. This report should be read in conjunction with the original FRA for the Fitzroy River Estuary (Long & McKinnon 2002). For the purposes of this report, the study area will be referred to as the Balaclava Island study area.

Chapter 2 Defining the Balaclava Island study area

2.1 Fitzroy River declared FHA and Balaclava Island study area description

The existing Fitzroy River declared FHA encompasses an area of 29,253ha of tidal and intertidal areas of Fitzroy River, Casuarina Creek, Raglan Creek and the wetland systems surrounding North Curtis Island. Declared FHA boundaries generally follow property or cadastral boundaries, cease 20m downstream and parallel to road alignments/crossings and exclude any area of a channel marked by navigational aids.

The GPC have committed two portions of Lot 18 on Plan DS727 amounting to 12,624ha of land to current and advanced environmental offsets, to be assessed for their suitability for inclusion into the existing Fitzroy River declared FHA. This land covers part of a harbour reserve; however GPC will not be developing this as port land. Other tidal areas adjoining this land (referred to as "Other Addition" on Figure 2.1) have been included in the Balaclava Island study area to link these areas to the existing declared FHA, bringing the study area's total to 16,069.16ha (Figure 2.1).

2.2 Local authority boundaries

The Fitzroy River declared FHA lies within the boundaries of Rockhampton and Gladstone regional councils and Livingstone Shire Council. The Balaclava Island study area lies within the administrative boundary of Gladstone Regional Council.

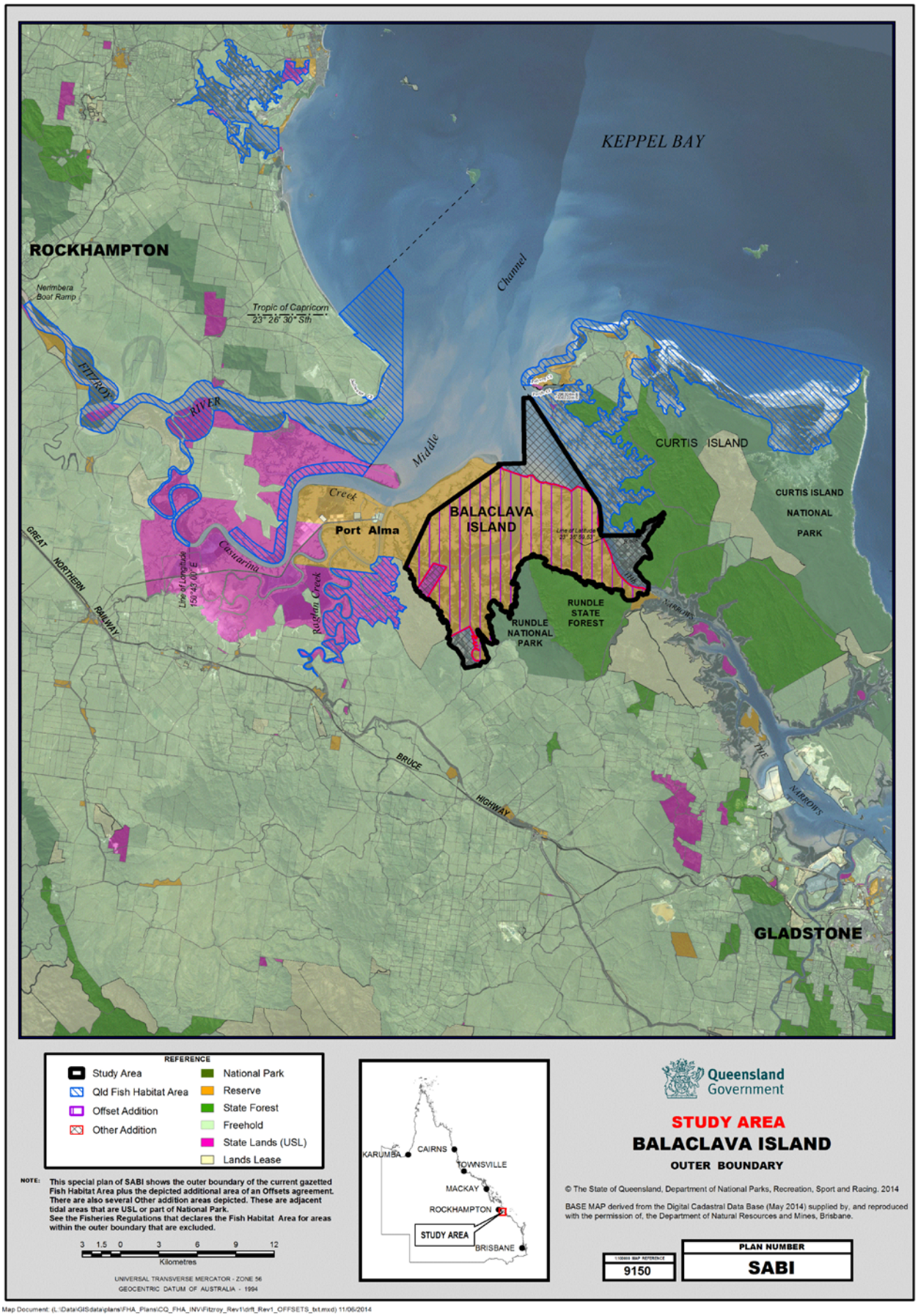


Figure 2.1: Balaclava Island study area

Chapter 3 Faunal communities in the Balaclava Island study area

Chapter Summary

The Balaclava Island study area is utilised by a wide range of fish and crustacean species, many of which are also found in adjacent waters within the Fitzroy River declared FHA. The study area is a nursery ground for juvenile fish species and supports a healthy population of adult mud crabs. This supports existing information that indicates the Balaclava Island study area contains important habitat for local fisheries.

3.1 Introduction

The criteria for FHA declaration (NPRSR 2013) requires that an area contain fish species richness that is comparable to regional benchmark waterways and a high diversity and abundance of regionally targeted fish species. The following chapter analyses data and literature relating to the fish species of the study area to determine the fish assemblages, diversity and richness of the Balaclava Island study area.

3.2 Data sources

Information on the fish species inhabiting the Fitzroy River has previously been gathered by Long and McKinnon (2002) from existing literature and data. In order to substantiate this data and determine fish assemblages specifically within the Balaclava Island study area, fish surveys were conducted in January 2014 (Sheaves et al. 2014). Fish sampling was performed over three days with the use of beam trawl equipment at a range of sites within the study area. It is important to note that beam trawl, by its nature, is biased toward the capture of small fish and was the only equipment utilised in these surveys. Therefore, it is likely larger adult fish were present at the time of sampling, but not captured.

Mud crab data was acquired from monitoring conducted in locations within Connors Creek by the Department of Agriculture, Forestry and Fisheries (DAFF) from 2002 until 2009 (DAFF 2013b). Information sourced from DAFF's Coastal Habitat Resources Information System (CHRIS; DAFF 2013a) and recreational fishing reports provide an overview of the fish species targeted by recreational, indigenous and commercial fisheries.

3.3 Results

The following results relate to fish surveys conducted in January 2014 (Sheaves et al. 2014). For more detailed information on the faunal communities of the adjacent Fitzroy River declared FHA, refer to Long and McKinnon (2002).

Long & McKinnon (2002) documented 97 fish species, 12 species of prawn and 3 crab species that are or are most likely to be present in the Fitzroy River, from the barrage to the river's mouth (Appendix B). Sheaves et al. (2014) verified 23 of these species and added 17 previously unrecorded species (Appendix A). Overall, 81 individual fish and 182 crustaceans were caught in recent fish surveys, representing 16 families and 19 species.

All fish captured were juvenile (below reproductive size) apart from the glass perchlet (*Ambassis vachellii*), barramundi (*Lates calcarifer*) and mud crab (*Scylla serrata*) samples. However, as previously mentioned, this is most likely due to the limited sampling equipment utilised.

On the other hand, mud crab (*S.serrata*) monitoring data (DAFF 2013a) recorded large numbers of adult mud crabs, particularly females. 47.8% of all mud crabs captured between 2002 and 2009 were of a reproductive size, of these 39.6% were females.

According to local fishing reports (Lynch 2014; Capricorn Region Salvation Army 2014), Connor Creek is well known for large bream (*Sparidae* spp.), jewfish (*Sciaenidae* spp.) moses snapper (*Lutjanus russelli*), barramundi (*L. calcarifer*) and grunter (*Pomadasys argenteus*) catches. The beaches within the study area are utilised by commercial netters targeting whiting (*Sillaginidae* spp.), mullet (*Mugilidae* spp.), salmon (*Polynemidae* spp.) and barramundi (*L. calcarifer*) (Lynch 2014). Annual average catches for commercial fish species in and adjacent to the Balaclava Island study area exceeds 170t and includes species such as barramundi (*L. calcarifer*), mud crab (*S. serrata*), shark (*Carcharhinidae* spp.), threadfin salmon (*Polynemidae* spp.), grunter (*Pomadasys* spp.), flathead (*Platycephalidae* spp.), banana prawns (*Fenneropenaeus merguiensis*) and mullet (*Mugilidae* spp.).

3.4 Discussion

Fish surveys conducted in January 2014 recorded similar fish abundances, assemblage compositions and species richness to those previously recorded in adjacent areas in the lower Fitzroy River. Topographically simple habitats dominate both areas and comparable high turbidity levels throughout the Fitzroy delta would indicate that similar species may be found in both the study area and the lower Fitzroy River (Sheaves et al. 2014). This information and the similarity of assemblage compositions recorded between the study area and the lower Fitzroy River suggests that species lists generated for the lower Fitzroy River could be used to supplement an inventory list of the Balaclava Island study area (Sheaves et al. 2014). Therefore, based upon previous surveys, there is likely to be a minimum of 33 species of fish, 7 species of prawns and the mud crab (*Scylla serrata*) present in the Balaclava Island study area.

The large majority of juvenile fish captured indicates that the study area is utilised as a nursery area for many fish species. Although the surveys both in January 2014 and earlier in 2002 and 2003 showed low abundance, the value of a nursery area cannot necessarily be determined solely by population numbers (Sheaves et al. 2006). Factors such as habitat quality (i.e. producing larger and faster growth), utilisation of surrounding habitats and their connectivity and local fisheries significance have a substantial bearing on the value of an individual habitat (Sheaves et al. 2006).

The Balaclava Island study area is also essential habitat for the rare snub-fin dolphin (*Orcaella heinsohni*). A small pod of approximately 84 animals exclusively utilise the study area and nearby waters (Cagnazzi 2013). Other species include estuarine crocodiles (*Crocodylus porosus*) listed as vulnerable under Queensland's *Nature Conservation Act 1992,* Indo-Pacific humpback dolphin (*Sousa chinensis*), listed as near threatened and a large diversity of wader bird species.

3.5 Conclusion

The large number of juvenile fish species and reproductive sized mud crabs indicates that the fish habitats within the Balaclava Island study area hold significant values to local fisheries production. According to Sheaves et al. (2014) the data gathered in recent surveys indicates that the fish and crustacean assemblages within the Balaclava Island study area are an excellent representation of the fish communities of the lower Fitzroy River system. Therefore the habitats within Balaclava Island study area hold similar values to those of the existing Fitzroy River declared FHA.

It is likely a more comprehensive inventory of fish that utilise the study area could be achieved with further seasonal sampling.

Chapter 4 Fisheries of the Balaclava Island study area

Chapter Summary

In conjunction with the adjacent Fitzroy River declared FHA, the Balaclava Island study area supports a range of highly productive commercial and recreational fisheries that are significant to the region's economy.

Although the fishing grid for the Balaclava Island study area contains limited fishing grounds, more than $2.2 million in catch was landed by commercial fishers in the grid in 2012. Recreational fishing is also important to the economy of the region with a total annual consumer surplus for recreational fishing in the Capricorn region valued at $5.53 million.

4.1 Introduction

Commercial, recreational and indigenous fishing is important to Queensland's culture, lifestyle and economy. This is particularly so in Central Queensland and highlighted by Gladstone Regional Council, which considers fishing one of the four major industries of the region, alongside manufacturing, processing and tourism (GRC 2012).

The productivity of local and regional fisheries is an indication of the quality and availability of appropriate fish habitats, with many fish targeted by fishers relying on habitats contained within estuarine environments. A healthy and diverse range of fish habitats are contained within the Balaclava Island study area. These habitats contribute to the productivity of the adjacent Fitzroy River declared FHA and support a range of highly productive commercial and recreational fisheries that are significant to the region's economy. This is indicated by the Fitzroy River being the greatest contributor to barramundi stocks in the region (Dunstan 1959; as cited in Capricorn Sunfish Inc 2002). Barramundi is an iconic species in Queensland and economic evaluations indicate that one barramundi may be worth up to $153 to the economy of Queensland from the recreational fishing sector (Robinson & Cully 2003).

This chapter documents the study area's productivity by presenting catch and value data for commercial and recreational fisheries, the results of which suggest that this system is significant to the region's inshore and estuarine fisheries.

4.2 Fishery data sources

Data on commercial fishing output levels has been sourced from the CHRIS database (DAFF 2013a). Since 1988 Queensland's commercial fisheries catch statistics have been recorded on CHRIS, which includes a computer based compulsory commercial fisheries logbook program that stores catch and effort by location. Queensland is broken into 30 minute grids for the purposes of recording commercial catch and effort and the Balaclava Island study area is contained within grid R30 (Figure 4.1).

Recreational fishing data was also sourced from the CHRIS database (DAFF 2013a), which has been recording recreational data since 1997 and the 2010 statewide recreational fishing survey (Taylor et al. 2012).

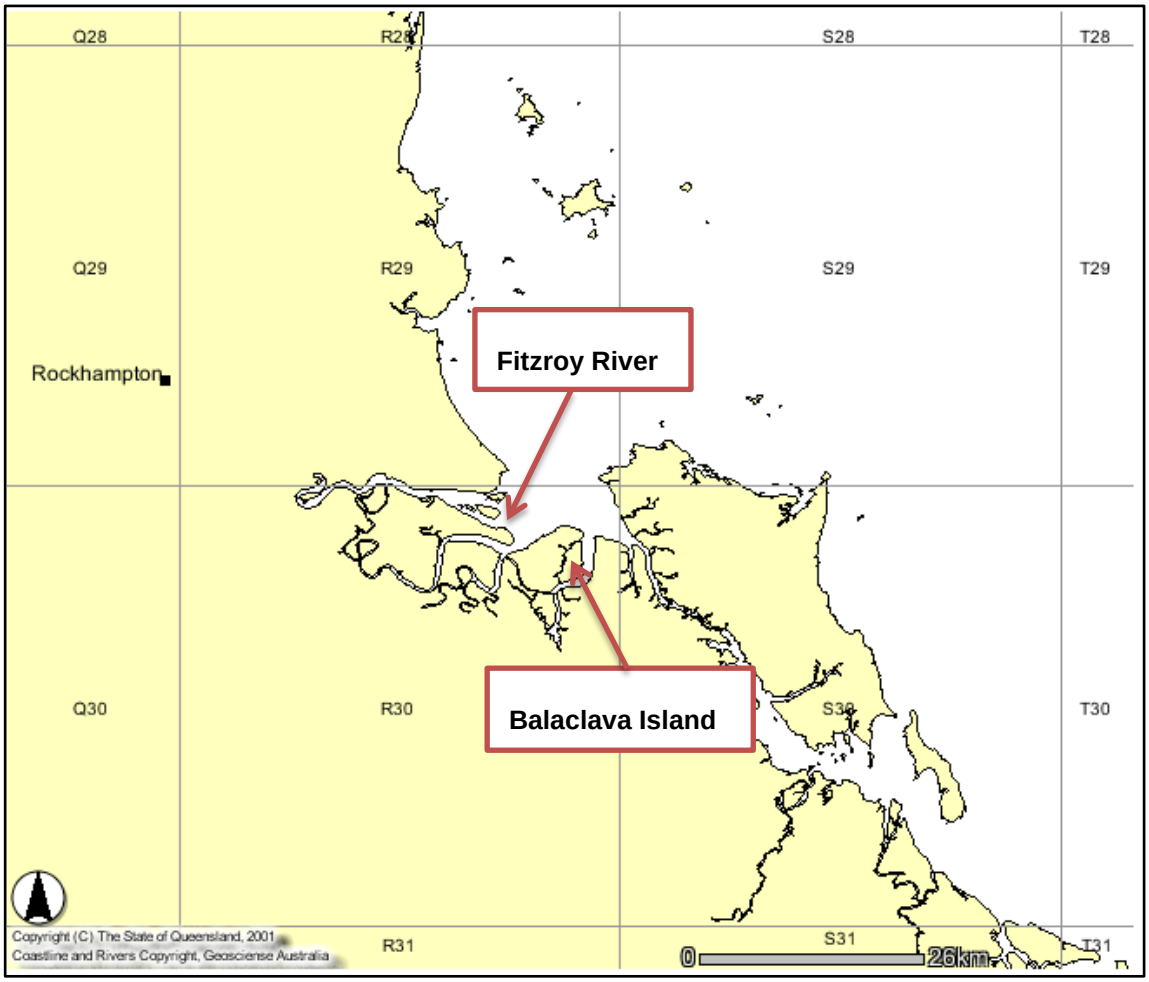


Figure 4.1: 30 minute commercial catch grids around the Balaclava Island study area (Grid R30) (source: DAFF 2013*a*).

4.3 Commercial fishing

The Fitzroy River supports productive and economically important commercial fishing operations. In 2012, the commercial fishing catch gross value of production (GVP) in the Balaclava Island study area and adjacent waters (Grid R30) exceeded $2.2 million (Figure 4.2) (DAFF 2013a).

A variety of fishing methods are employed within the Balaclava Island study area and most commercial fishers have multiple licences that allow them the flexibility of operating in a range of fisheries (e.g. net and crab). Due to confidentiality requirements, data for fisheries with less than five boats operating is not accessible through CHRIS (DAFF 2013a) so the following figures may omit some data and underestimate the actual fisheries values.

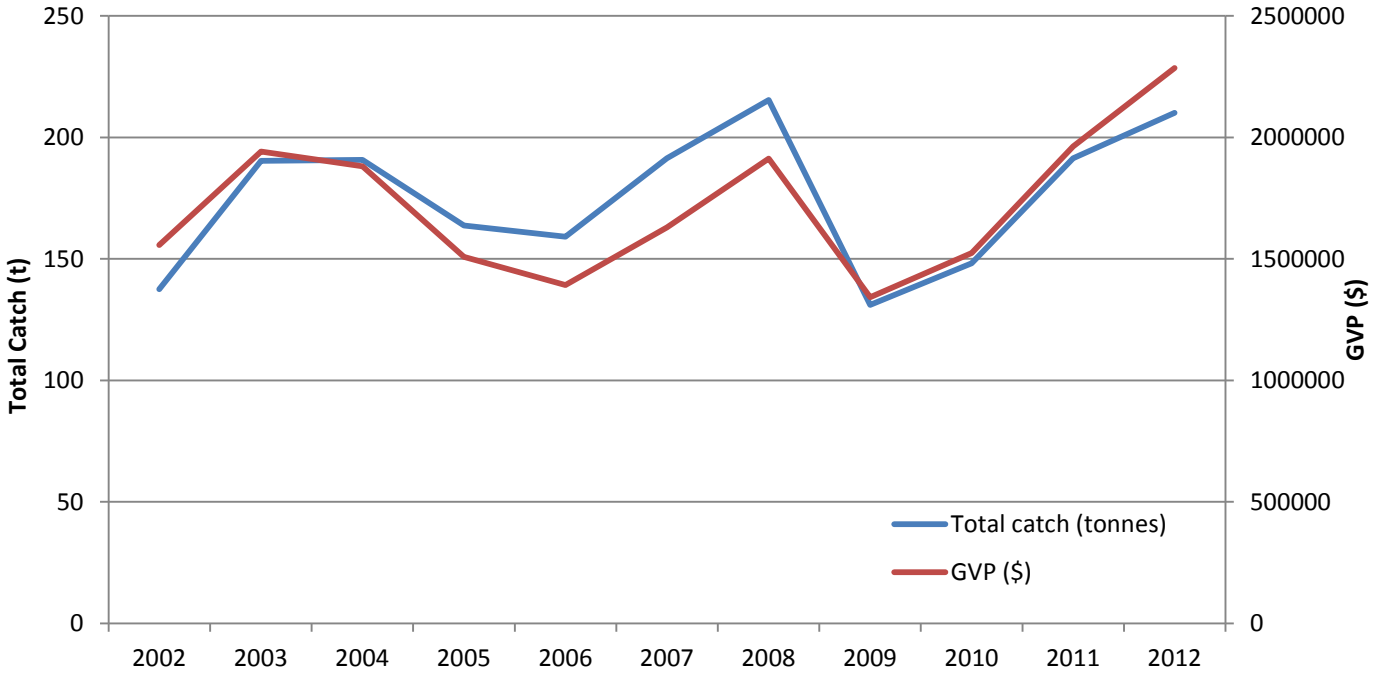


Figure 4.2: Total commercial catch (tonnes) and gross value of product (GVP) of fish and crabs in the Balaclava Island study area 2002-2012 (data sourced from DAFF 2013a)

4.3.1 Mud crab fishery

The mud crab fishery has the highest commercial value within Grid R30 with an average annual harvest of 65t between 2002 and 2012, producing an average GVP of approximately $1.04 million. Up to 39 commercial crab fishers were recorded operating in this grid in one year during this time. Central Queensland landed 19% of Queensland's total mud crab catch in 2011 with crabs from Grid R30 making up almost a third of this (DAFF 2013a; DAFF 2013b). Climatic conditions can cause natural variability of mud crab catch rates with increased catch rates positively correlated to high rainfall (DAFF 2013b). This is demonstrated in Figure 4.3, which clearly shows an elevated catch rate following extensive flooding in Central Queensland in 2010–11.

Monitoring programs (DAFF 2013a) show large numbers of mud crabs caught in Connor Creek (within the study area) between 2002 and 2009. An average of 23% of male crabs caught each year were above the legal size limit as regulated under the Queensland Fisheries Regulation 2008 and an annual average of 40% of all crabs caught were females of a reproductive size.

Mud crabs (*Scylla serrata)* are caught using crab pots which are set in estuaries or near-shore areas. Several fishery input management methods apply to the commercial fishery, including requirements to return females to the water, the use of a maximum of 50 crab pots per licence and kept crabs must be a minimum size of 15cm across the crab's carapace.

Although the number of licences operating in the East Coast mud crab fishery are declining, the catch, catch rate and number of days fished are increasing (DAFF 2013b). This can place pressure on the sustainability of the mud crab fishery and highlights the need to incorporate habitat management and protection initiatives into current fishery input management methods (e.g. size limits and gender and apparatus restrictions). Juvenile and adult mud crabs depend upon appropriate near shore habitat, utilising sheltered estuaries, mangrove-lined channels, mud flats and mangrove forests for sourcing food and sheltering in burrows (Ryan 2003). They are therefore vulnerable to impacts caused by the degradation of estuarine habitats. The declared FHA network is an important component for the protection of these habitats and the future sustainability of the mud crab fishery. Expansion of the Fitzroy River declared FHA through the addition of the Balaclava Island study area will enable the protection of additional habitat essential for the sustainability of this productive fishery.

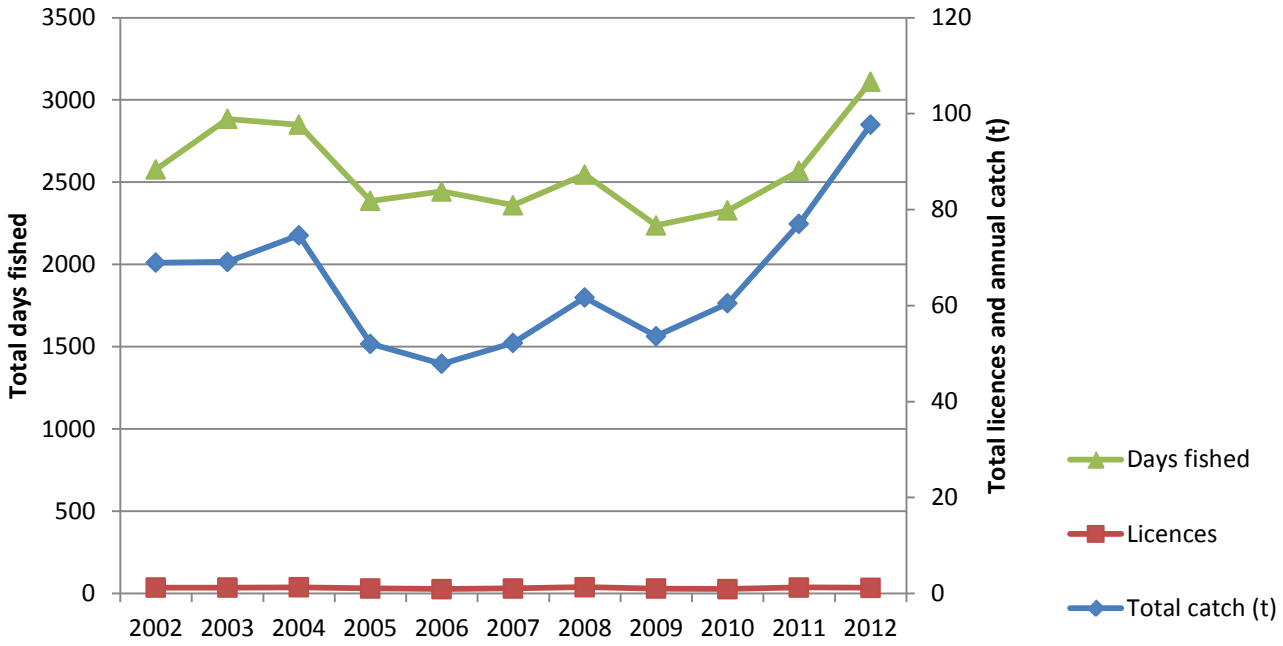


Figure 4.3: Total effort and catch for the commercial mud crab fishery in the Balaclava Island study area and adjacent waters (Grid R30) 2002–12 (data sourced from DAFF 2013a)

4.3.2 Inshore net fisheries

The annual average catch from the inshore net fishery within Grid R30 was 77t between 2002 and 2012, which equated to a GVP of almost $420,000 (Figure 4.4). This is quite a significant catch considering the limited area of available fishing ground within Grid R30 (Figure 4.1). The high level of available fish habitats and size of the Balaclava Island study area suggests that it is most likely contributing to the fisheries productivity in a much wider area by providing regionally significant spawning, nursery and juvenile habitats for a range of fish species as well as contributing migratory recruits to other regional waterways (Long & McKinnon 2002).

A variety of apparatus are used within inshore net fisheries including mesh nets, haul (seine nets) and tunnel nets of varying sizes and mesh sizes, dependent upon legislation and fishing area (Zeller & Snape n.d.). The main species of fish targeted include shark (*Carcharhinidae* spp.), barramundi (*Lates calcarifer*) and threadfin salmon (*Polynemidae* spp.), with low numbers of a variety of other fish species recorded including grunter (*Pomadasys argenteus*), flathead (*Platycephalidae* spp.) and mullet (*Mugilidae* spp.). All of these species depend upon estuarine and inshore habitats for parts or all of their lifecycle.

Individual graphs for the most commonly caught fish species, shark, barramundi and threadfin salmon are contained in Appendix C.

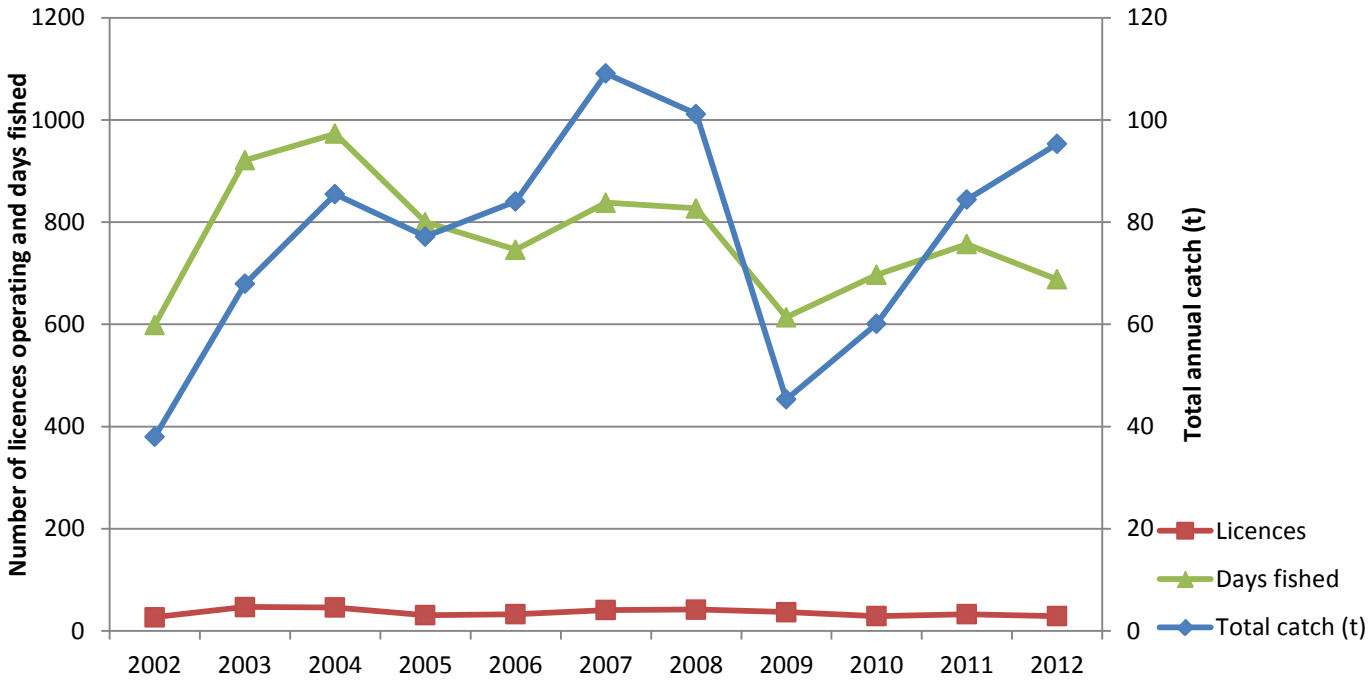


Figure 4.4: Total licences, effort and catch for the commercial inshore net fishery in the Balaclava Island study area and adjacent waters (Grid R30) 2002-12 (data sourced from DAFF 2013a)

4.3.3 Inshore beam trawl fisheries

Banana prawns (*Fenneropenaeus merguiensis*) are the primary species targeted by commercial fishers licenced for the inshore beam trawl fishery within Grid R30. Small numbers of coral (*Metapanaeopsis crassissima*) and greasy prawns (*Metapenaeus bennettae*) are also recorded in catch data (DAFF 2013a). As with the inshore net fishery, the trawl fishery in Grid R30 is relatively small in comparison to other commercial fishing grids. The total average annual trawl harvest from 2002–12 was 31.54t, equating to a GVP of over $255,000 (Figure 4.5). A large proportion of the area within Grid R30 is zoned a habitat protection area under the Great Barrier Reef Coast Marine Park which prohibits trawling and other sections are within areas restricted by port activity (e.g. an explosive exclusion zone and port channel).

The river and inshore beam trawl fishery is confined to estuarine and inshore operations, involving vessels less than 9m in length. Trawlers operate under the T8 fishery symbol within the mouth of the Fitzroy River with trawlers regulated to tow a single 5m headrope trawl, with a mesh size no smaller than 31mm. Juvenile prawns are primarily caught in beam trawls, with otter trawlers working in deeper estuarine waters and offshore more likely to take adult prawns (Kingston 2004).

Banana prawns are relatively short lived, having a life span of one to two years. They spawn in open waters and gradually migrate toward estuarine nursery areas over several weeks, whilst still in their larval stage. Post larval banana prawns settle in mangrove-lined muddy estuaries which provide a protected environment and abundant food supply. Juvenile prawns are tolerant to a broad range of salinities and may travel kilometres upstream of a river to almost freshwater (Tanimoto et al. 2006). Adolescent and adult prawns then move back into coastal waters where they continue to grow, mature, mate and spawn in open waters (Tanimoto et al. 2006).

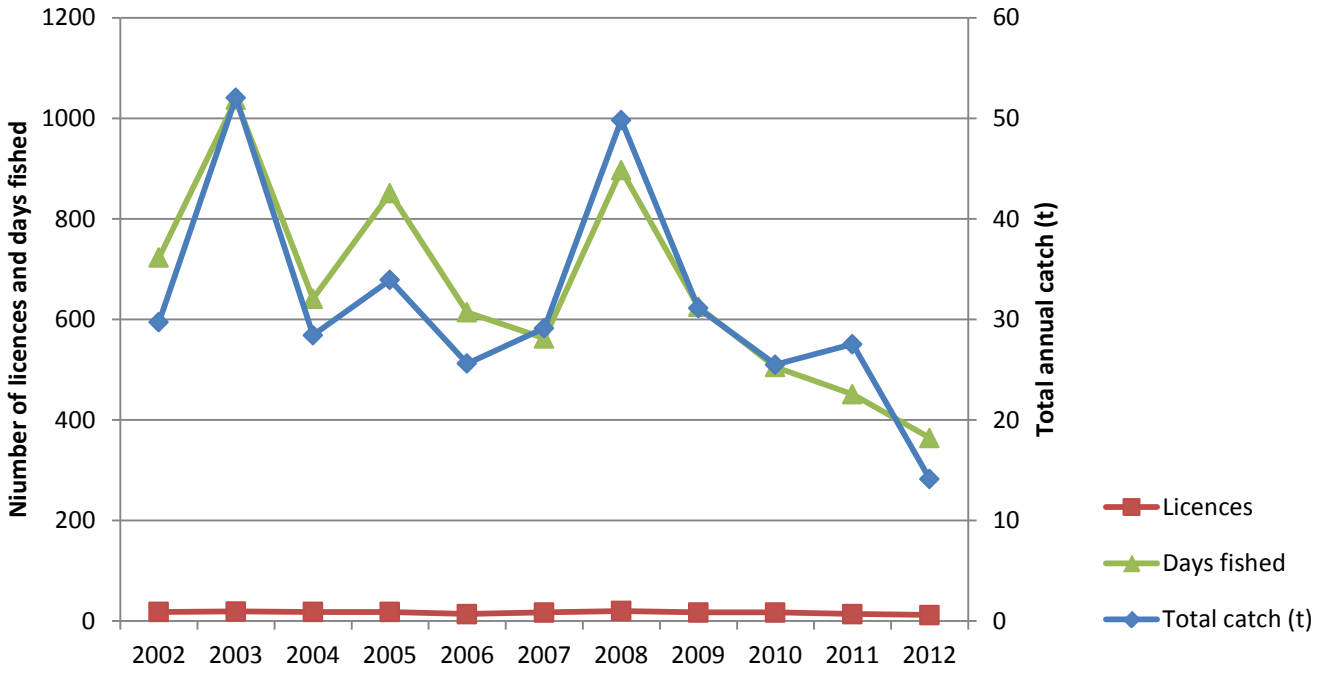


Figure 4.5: Total effort and catch for the commercial beam trawl fishery in the Balaclava Island study area and adjacent waters (Grid R30) 2002–12 (data sourced from DAFF 2013a)

4.4 Indigenous fishing

In addition to being a source of food, traditional fishing by indigenous people is a valuable component of their connection with traditional responsibilities of land management and kinship and important for their cultural lifestyle, religion and ceremonial occasions (Henry & Lyle 2003). In recognition of the rights of Indigenous people to continue their cultural practices and to encourage cooperative management within the Great Barrier Reef Marine Park (GBRMP), Traditional Use of Marine Resources Agreements (TUMRA) have been implemented since 2005.

A TUMRA describes how Traditional Owners intend to manage their natural resource take and activities within the GBRMP and outlines their chosen level of involvement in preserving the local fisheries and marine resources. The Port Curtis Coral Coast (PCCC) TUMRA area, accredited in August 2011, is the largest agreement of its kind (GBRMPA 2013). Covering an area of 26,386km², it extends from Burrum Heads, south of Bundaberg, to the northern end of Curtis Island and Fitzroy River mouth and represents the Gooreng Gooreng, Gurang, Bailai and Tarebilang Bunda Traditional Owners.

The PCCC TUMRA allows permits to be issued for the hunting of one green turtle (*Chelonia mydas*) per person and prohibits the hunting of dugong (*Dugong dug*on) (GDC 2013). The level of traditional fishing presently occurring in the Balaclava Island study area and surrounding waters is undocumented.

4.5 Recreational fishing

Recreational fishing in Queensland has a significant participation rate and is important to the State's economy, culture and lifestyle. Approximately 703,000 Queenslanders fished in Queensland waters between July 2009 and June 2010, which represents 17% of the population aged five years and older (Taylor et al. 2012). Recreational fishers account for a substantial proportion of the total annual catch of some fish species, with results of surveys showing that recreational catch may exceed commercial figures in some areas and species for example spotted mackerel (*Scomberomorus munroi*) and tailor (*Pomatomus saltatrix*) (SPCC 1984, Henry 1984; as cited in Henry & Lyle 2003; Taylor et al 2012). Yellowfin bream (*Acanthopagrus australis*) and whiting (*Sillaginidae* spp.) are the two most commonly caught fish by recreational fishers in Queensland (Taylor et al 2012).

The Capricorn Coast region has a large population of recreational fishers which provides a significant economic flow on effect to other industries and businesses. Direct effects can be demonstrated through charter vessel industries, fishing and tackle shops, fishing magazines and boat builders, whereas indirect effects extend to accommodation providers, fuel suppliers and food outlets (Williams 2002). Prayaga et al. (2009) highlights the value recreational fishers place upon their opportunity to fish within the Capricorn Coast region, estimating the total annual consumer surplus as $5.53 million. This expenditure makes recreational fishing an important industry to the local economy.

In April 2013, there were 9226 recreational boats registered in the Rockhampton Regional Council area, which is an increase of 6.4% from 2012 (Capricorn Enterprise 2013). The majority of these boats are between 3 and 6 metres, which indicates an increase in fishing effort from the recreational sector as the main purpose for smaller boats up to about 8m is for fishing activities (Sawynock et al. 2013).

The Balaclava Island study area is within the Fitzroy statistical division for fisheries monitoring. Over 3 million fish were captured in the Fitzroy region in 2005, with almost 1.6 million released (DAFF 2013a). The most caught fish within the Fitzroy statistical division is mud crab (*Scylla serrata*), followed by whiting (*Sillaginidae* spp.), bream (*Sparidae* spp.) and cod (*Serranidae* spp.) (Taylor et al. 2012). Fitzroy residents caught almost 30% of the state's recreational harvest for redthroat emperor (*Lethrinus miniatus*) and jewfish (*Sciaenidae* spp.) and contributed significantly to the total catch of tropical species such as striped snapper (*Embiotoca lateralis*) and red emperor (*Lutjanus sebae*) (Taylor et al. 2012).

The Fitzroy River declared FHA is a popular destination for recreational fishers within Central Queensland. The river provides many angling opportunities from the land however due to its location, fishing within the Balaclava Island study area is restricted to the use of a vessel. A public boat ramp is located at Port Alma, or vessels can travel from boat ramps further upstream or from Rosslyn Bay.

The Balaclava Island study area provides sheltered waterways and prime angling habitat with the opportunity to catch many recreationally targeted fish species such as barramundi (*Lates calcarifer*), mud crab (*Scylla serrata*) and salmon (*Polynemidae* spp.) (Long & McKinnon 2002). Within Connors Creek, bream (*Sparidae* spp.), jewfish (*Sciaenidae* spp.) moses snapper (*Lutjanus russelli*), barramundi (*L. calcarifer*) and grunter (*Pomadasys argenteus*) are commonly targeted species with bream and grunter known to school around rocky structures (Capricorn Region Salvation Army 2013).

Chapter 5 Habitat diversity

Chapter summary

The Balaclava Island study area contains a complex and diverse range of high quality fish habitats. It is dominated by mud flats and salt pans with extensive mangrove lined waterways. Habitats such as those found within the Balaclava Island study area are essential to the life cycle of many recreational, indigenous and commercially targeted fish species and this area, in conjunction with the Fitzroy River declared FHA, plays a major role in the fish productivity of the region.

5.1 Introduction

Fisheries sustainability relies on the availability of healthy, diverse, interconnected fish habitats. The maintenance and protection of these essential habitats is critical to ensure Queensland's future fish stocks. Estuarine habitats are particularly important to fishery sustainability as many recreational, indigenous and commercially important fish species rely on estuarine environments for some or all of their lifecycle, for example, mud crabs (*Scylla serrata*), barramundi (*Lates calarifer*), flathead (*Platycephalus* spp.) and prawns (*Penaeidae* spp.) (Walker 1997). In fact, Quinn (1992) estimates that more than 75% of all species landed in Queensland's commercial fisheries rely on the variety of habitats found in healthy estuaries during some or all of their lifecycle.

The Fitzroy River declared FHA contains a high diversity of fish habitats including extensive saltpans and saline grasslands fed by mangrove lined creeks, mud and sand flats, rocky headlands and brackish lagoons. The Balaclava Island study area complements this range of habitats and is representative of the level of high quality and diverse fish habitat that declared FHAs aim to protect. This was noted in the original habitat assessment (Long & McKinnon 2002) and confirmed by field surveys undertaken in the course of preparing this report. In conjunction with the adjacent declared FHA, this extensive range of relatively undisturbed fish habitats is a major contributor to the fish productivity of the region (Long & McKinnon 2002).

In addition to their direct fisheries values, the health and integrity of the adjacent GBRMP relies heavily on the effective functioning of estuarine systems within its catchment area (Figure 5.1). Mangroves and saltmarsh provide an important buffer between the land and the GBRMP, filtering land run-off, improving the quality of water entering the GBRMP lagoon and buffering the coastline from storms and cyclones (Goudcamp & Chin 2006). Between 1946 and 2002, approximately 840ha of mangroves and saltmarshes in the Fitzroy River were reclaimed for salt farms, agriculture and the expansion of Port Alma (Goudcamp & Chin 2006). It is important that essential fish habitats such as those within the Balaclava Island study area are afforded protection from further degradation and development in order to support the region's ecology and fisheries sustainability.

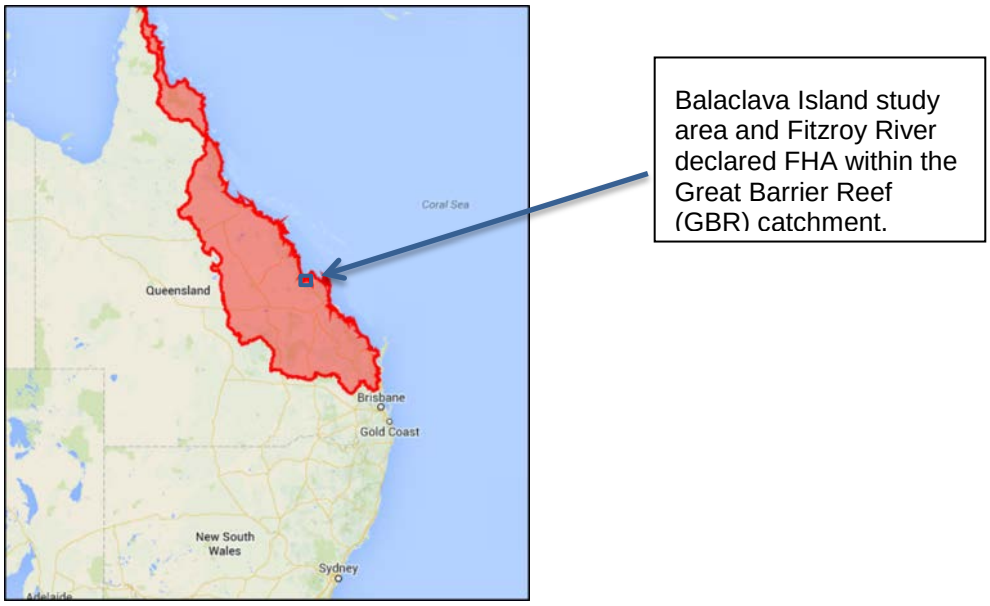


Figure 5.1: Queensland map showing the Great Barrier Reef catchment area

5.2 Habitats of the Balaclava Island study area

The Balaclava Island study area contains a diverse range of relatively un-impacted essential fish habitats. The topography is typically low and flat with saltpans as the dominant landform (Long & McKinnon 2002). The maximum tidal range is 5.9 metres and much of Balaclava Island is inundated twice daily by tidal waters (Eberhard 2012). Between 1941 and 1999, there was an increase in saltpan area which equated to approximately the same amount of decrease in mangroves (Duke et al. 2003). A possible cause for this could be decreases in rainfall and/or humidity in the area, providing an environment more conducive to saltmarsh than mangrove growth (Duke et al. 2003).

Connor Creek, the main waterway dividing the Balaclava Island study area is deeper and less turbid than surrounding waterways and may be more conducive to phytoplankton and microphytobenthos, which, with seagrass and macroalgae, form the basis of the food chain on which higher aquatic organisms rely (i.e. crabs, fish and molluscs) (Webster et al. 2006).

The following habitat descriptions are based upon previous studies by Long and McKinnon (2002) and confirmed by field surveys conducted in the preparation of this report. The descriptions outline the Balaclava Island study area habitats as they relate to the declared FHA selection criteria (NPRSR 2013).

5.2.1 Marine waters >6m or <6m deep

The Balaclava Island study area lies within the estuarine section of the Fitzroy River and therefore does not contain any inshore marine waters.

5.2.2 Aquatic beds

There are no known seagrass meadows within the Balaclava Island study area.

5.2.3 Coral reefs

There are no known coral reefs within the Balaclava Island study area.

5.2.4 Sand, shingle or pebble beaches

There is a range of sand, shingle, shell and pebble beaches in the Balaclava Island study area, particularly along the northern foreshore and within Connors Creek (Figures 5.2, 5.3, 5.4). These beach habitats support algae communities which provide food sources for zooplankton and filter feeding invertebrates (Zeller 1998). Insects and burrowing animals, such as crustaceans, worms and molluscs are common to these areas and attract indigenous, recreational and commercially targeted fish species such as whiting, bream, flathead and mullet.

Figure 5.2: Sand beach along the northern shoreline of the Balaclava Island study area.

Figure 5.3: Sandy beach within Connor Creek, Balaclava Island study area.

Figure 5.4: Shell beach within Connor Creek, Balaclava Island study area

5.2.5 Estuarine waters

An estuary is a partially enclosed body of water where freshwater from rivers and streams meet and mix with saltwater from the ocean. Freshwater inflow is a key factor that defines an estuary and contributes to the biological and physical attributes that create important spawning, nursery and feeding habitats for many commercial, recreational and indigenous targeted species (Halliday & Robins 2007).

The large catchment area of the Fitzroy River means that substantial freshwater flows travel through the estuary after significant rain events and can inundate the majority of Balaclava Island study area when coinciding with king tides. Elevated terrestrial lands within Balaclava Island study area contribute to local freshwater flow and small channels have developed adjacent to these lands that catch water run-off. The extensive estuarine waterways within the Balaclava Island study area flow to Keppel Bay (Figure 5.5).

Figure 5.5: Estuarine waters of Bob's Creek, Balaclava Island study area.

5.2.6 Intertidal flats

Intertidal flats are dynamic habitats, supporting a diversity of burrowing and surface fauna and interstitial algae which provides a direct food source for fish species (Long & McKinnon 2002). These habitats develop in sheltered places where the water velocity slows and are important sedimentation areas, with high productivity and nutrient value.

Significant loads of sediments and nutrients move through the Fitzroy River estuary during summer flow events (Webster et al. 2003) which, when deposited, contribute to the intertidal flats which are common within the Balaclava Island study area (Figure 5.6). The northern sections of the Balaclava Island study area contain extensive intertidal sand flats and mud flats occur throughout the study area.

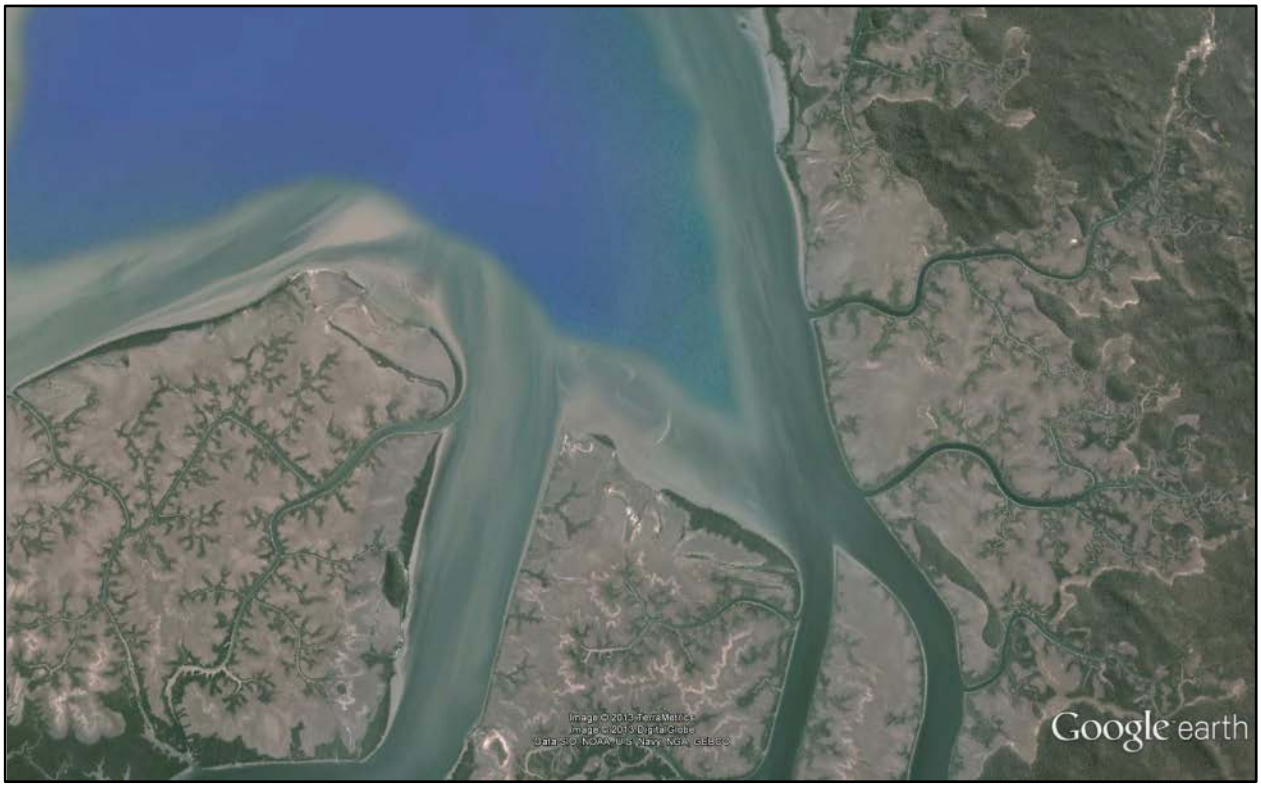


Figure 5.6: Intertidal sand flats on the northern foreshore of Balaclava Island study area (Image courtesy of Google Earth).

5.2.7 Marshes

Saltmarshes provide habitat and food for fish species and act as a buffer and filter of nutrients, reducing erosion and maintaining water quality (Daly 2013). Although intertidal saltmarshes and saltpans generally receive only short periods of inundation (many are inundated only during spring tides) a diverse range of fish species utilise these habitats, many of which are of economic importance such as bream, whiting and mullet (Thomas & Connolly 2001; Mazumder et al. 2006; Daly 2013).

Saltmarshes provide temporary refuge which enables juvenile fish to avoid larger predators and the plant detritus and the wide variety of invertebrates that inhabit saltmarsh environments (e.g. crabs, prawns, insects, worms, spiders and mosquito larvae) are a rich and abundant source of food (Daly 2013). Fish have been found to travel more than 400m from subtidal waters onto both vegetated and unvegetated saltmarshes (Thomas & Connolly 2001).

The Fitzroy estuary contains vast areas of intertidal saltmarshes, the majority of which are in and adjacent to the Balaclava Island study area (Figure 5.7). These habitats are largely devoid of vegetation apart from occasional communities of saltwater couch (*Sporobolus virginicus*) and samphires and the waterfront edges are bordered by small mangrove lined drainage channels (Long & McKinnon 2002). The saltmarsh and saltpans of the Balaclava Island study area are not inundated daily and as such are only available to fish on spring tides. Long & McKinnon (2002) suggest the intertidal marshes of the Fitzroy River mouth may be integral to local and regional prawn fisheries and these marshes provide alternate habitat and feeding opportunities for crab species.

Figure 5.7: Saltpan within and typical of those in the Balaclava Island study area, showing recent inundation.

5.2.8 Mangrove communities

Mangrove forests consist of flowering plants that form distinct communities within the intertidal zone of estuaries, coastal rivers and bays (Lovelock 1999; Goudcamp and Chin 2006). They are amongst the most productive and biologically diverse ecosystems in the world and are crucial to the biological productivity and food webs of coastal waters. The shelter and abundant food sources provided by mangrove habitats support important nursery areas for recreational, indigenous and commercially targeted species such as prawns, bream and mackerel, as well as non-commercial species that become food sources for larger species (e.g. billfish and marlin) when they migrate to open waters (Lovelock 1999). These habitats also play a vital role in preventing coastal erosion, trapping sediment and filtering land run-off which makes them integral to the health of the GBR (Hogarth 1999; Goudcamp & Chin 2006).

The Fitzroy River declared FHA contains extensive and relatively pristine intertidal mangrove forests (Long & McKinnon 2002). The accumulation of sediment at the river mouth has resulted in the expansion of mangrove communities, with two new mangrove islands forming within the boundaries of the declared FHA between 1941 and 1999 (Goudcamp & Chin 2006).

The main waterways of the Balaclava Island study area are primarily lined with mangrove communities (Figures 5.8, 5.9). Networks of drainage lines are fringed with a mix of mangrove species, providing food and shelter for a range of fish predator and prey species. Mangrove distribution is dependent upon environmental factors such as inundation levels and frequency, salinity and wave action (Lovelock 1999; Goudcamp & Chin 2006) and the dominant species along the seaward edges (to the north) of the Balaclava Island study area is red mangrove (*Rhizophora stylosa*), which is highly tolerant of regular inundation. Drainage lines through the saltpans are vegetated with mixed holly (*Acanthus ilicifolius*), river (*Aegiceras corniculatum*), grey (*Avicennia marina*), yellow (*Ceriops tegal*) and milky (*Excoercaria agollocha*) mangroves (Long & McKinnon 2002).

Figure 5.8: Mixed mangrove communities typical of Balaclava Island study area.

Figure 5.9: Closed Rhizophora mangrove communities along Connors Creek, Balaclava Island study area.

5.2.9 Brackish to saline lagoons

Brackish to saline lagoons have fewer predators and provide abundant food sources and sheltered environments for juvenile fish species (Brehmer et al. 2013; Verdiell-Cubedo et al. 2013). Nursery areas such as these contribute significantly to enhanced growth and condition of the early stages of fish species (Verdiell-Cubedo et al. 2013). There are no permanent brackish lagoons within the Balaclava Island study area however inundation of saltpans at spring tides enables movement of fish to semi-permanent tidal pools, providing a transitory feeding habitat for larval and juvenile fishes (Long & McKinnon 2002).

5.2.10 Brackish to freshwater swamps

The Balaclava Island study area is prone to total inundation during spring tides therefore there are no freshwater swamp habitats.

5.2.11 Rocky structures

Rocky structures contribute to primary production within waterways through the provision of a hard substrate for the attachment of rich algal flora, immobile invertebrate communities (e.g. barnacles, oysters and tube worms) are also prevalent in this habitat (Zeller 1998). The crevices provided by rocky habitats provide refuge, feeding opportunities and nursery areas for a wide variety of adult and juvenile fish (NSW Fisheries 1999, as cited in Long & McKinnon 2002; Raedemaecker et al. 2010) and as such are often extremely productive fishing grounds for recreational fishers

The Balaclava Island study area contains subtidal and intertidal rocky structures of varying proportions, primarily within Connors Creek. In some areas, rocky substrates run from the bank into the main channel, whereas other areas have deep holes between the bank and the rocky structure. Recreational fishers were observed at several of these structures during field trips for the preparation of this report.

5.2.12 Surf bars

The Balaclava Island study area lies within the protection of the Fitzroy River and therefore does not contain any surf bars.

5.2.13 Overhanging/undercut waterway banks

Overhanging and undercut waterway banks provide shelter and protection for juvenile fish species and ambush cover for predatory fish. The normal formation of these banks is through natural erosion processes however this can be accelerated by the wash resulting from significant boat activity (Baker & Sheppard 2006).

Strong tidal currents within the Balaclava Island study area have facilitated the formation of substantial areas of eroded banks. These banks are generally located on the outside of waterway bends, where higher water velocities have eroded the bank substrate (Long & McKinnon 2002; Figure 5.10).

Figure 5.10: Eroded bank in the Narrows, Balaclava Island study area

5.3 Unique habitat features

The addition of the extensive range of key fish habitats within the Balaclava Island study area provides the opportunity to significantly reduce the fragmented and disjointed boundaries of the Fitzroy River declared FHA. The fish habitats of the Balaclava Island study area are representative of the level of high quality and diverse fish habitats that the declared FHA network aims to protect. It contains extensive mangrove communities, saltpans and marshes, intertidal mud and sand flats and rocky structures. These habitats would enhance the existing declared FHA which is currently recognised as a major contributor to local and regional fisheries and considered a fishery of regional and state significance (Long & McKinnon 2002).

Fish survey data has indicated that the study area is utilised as a nursery area for many fish species. The availability of a range of undisturbed fish habitats within the Balaclava Island study area contributes to requirements for effective juvenile habitat including the provision of high quality habitat (i.e. producing larger and faster growth) and connectivity for utilisation of surrounding habitats (Sheaves et al. 2006).

The waters in and adjacent to the Balaclava Island study area are also critical habitat to resident populations of Australian Snub-fin dolphins (*Orcaella heinsohni*) and Indo-Pacific humpback dolphins (*Sousa chinensis*). Both dolphins are identified as critical priority species for conservation under the Department of Environment and Heritage Protection's 'Back on Track' species prioritisation framework and hold near threatened status under the *Nature Conservation Act 1992*.

5.4 Conclusions

The Balaclava Island study area contains a diverse and complex range of high quality fish habitats that contribute to the productivity of the region's fish stocks. Habitats found within estuarine environments are essential to the life cycle of many recreational, indigenous and commercially targeted fish species and as such, these areas should be afforded appropriate protection.

The declared FHA network aims to ensure a comprehensive, adequate and representative range of fish habitats are protected to support the state's fisheries through the inclusion, linkage and management of all available fish habitat types within an area. Therefore, the incorporation of the Balaclava Island study area's range of habitats into the Fitzroy River declared FHA would enhance the existing declared FHA and ensure these essential fish habitats are protected from developmental impacts.

Chapter 6 Riparian zone

Chapter summary

The presence of a healthy riparian zone is a good indication of the impact of surrounding land uses on a waterway. Much of the Balaclava Island study area is low lying and tidal and therefore not conducive to the formation of terrestrial vegetation however small isolated parcels of land within the study area are elevated and contain healthy and diverse terrestrial vegetation. The Balaclava Island study area is bounded by protected areas, grazing lands and waterways and overall, the riparian zones adequately buffer estuarine areas from the low level intensity of adjacent land uses.

6.1 Introduction

Riparian zones are the terrestrial vegetation communities that grow along a watercourse, providing an interface between land and water. These communities provide significant ecological value and biological functions and are critical to the protection and maintenance of fisheries resources. Waterways bordered with well-developed, healthy and intact riparian vegetation generally support higher levels of productivity than those lacking a vegetative buffer zone (Bavins et al. 2000). Benefits derived from a healthy and functioning riparian buffer zone include:

- flood control
- improvement of water quality through sediment and chemical capture and filtering
- stabilisation of shorelines
- shading
- a buffer from adjacent land uses
- physical habitat
- erosion control through improved bank stability
- protection of fish and wildlife habitats (Bavins et al. 2000; Baker & Sheppard 2006).

The importance of these functions suggests that the presence and health of riparian vegetation provides a good indication of the impact of surrounding land uses on a waterway and its resilience to these impacts.

6.2 Riparian zones within Balaclava Island study area

A large portion of the Balaclava Island study area is low lying and tidal and therefore not conducive to the formation of terrestrial vegetation. Throughout the study area however, small isolated areas of elevated land do exist and these areas generally contain healthy, intact and diverse vegetative communities (Figure 6.1). Rundle Range National Park and Rundle State Forest adjoin the study area to the south and south east and the south west is bordered by grazing land. The remainder of the study area is bounded by water.

The Balaclava Island study area is undeveloped and adjacent land uses do not appear to have had an impact upon its riparian zone. Overall, the general level of vegetation cover present appears to provide adequate riparian function given the low level intensity of adjacent land uses (Long & McKinnon 2002).

Figure 6.1: Terrestrial vegetation adjacent to Connors Creek, Balaclava Island study area

6.3 Conclusion

Although much of the Balaclava Island study area is not conducive to the formation of terrestrial vegetation, small pockets of land above the tidal influence have maintained a healthy riparian zone. Adjacent land uses are low intensity and the level of vegetation cover present appears to adequately buffer the estuarine habitats from these uses.

Chapter 7 Climate, catchment flows and impoundment structures

Chapter summary

The Fitzroy catchment covers an area of 142,645km². It has a subtropical climate with an average annual rainfall above 800mm. There are more than 15 impoundments in the catchment, the most downstream being the Fitzroy River Barrage which contains a fishway and releases regular environmental flows. Fish can migrate through the fishway, or alternatively bypass the barrage and travel through floodplains.

The Rockhampton region has a subtropical climate with an average annual rainfall of 813.3mm. Temperatures range from 9.5 °C in winter to 31.9 °C in summer. The highest rainfall and temperatures occur in January and February (Figure 7.1). Rainfall and run-off are highly variable within the Fitzroy River catchment, with extended dry periods followed by major flood events (Long & McKinnon 2002; Fitzroy Partnership for River Health 2013).

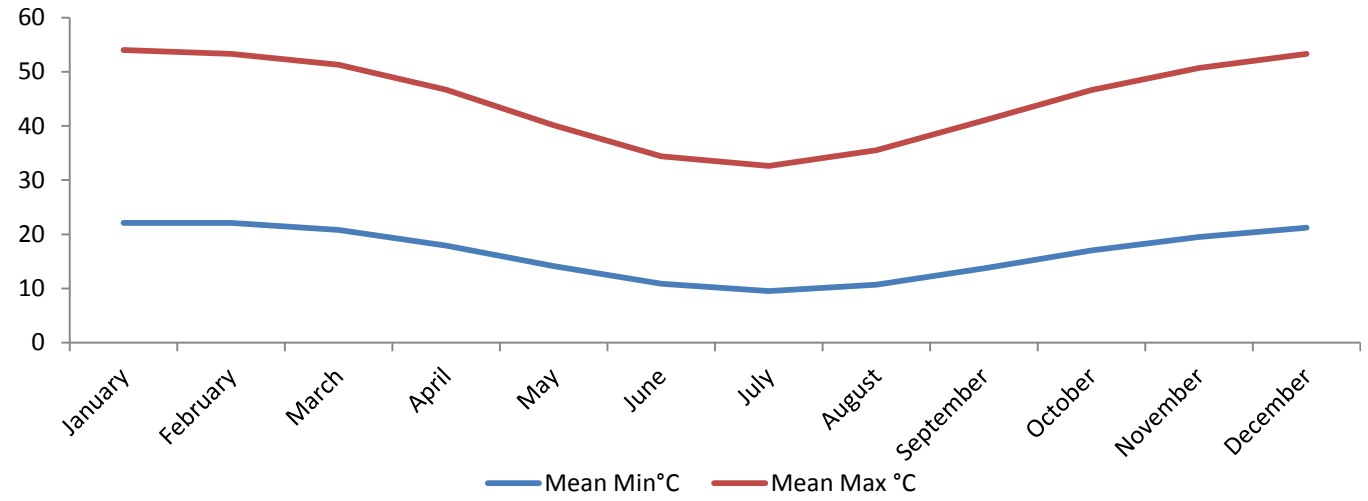
The Fitzroy River catchment covers an area of 142,645km². Numerous water impoundments (>15) have been constructed within the catchment to store and supply water for irrigation, urban, stock and industrial uses (Long & McKinnon 2002). These impoundments impact on natural hydrology, geomorphology and water quality.

The Fitzroy Barrage, located downstream of all other impoundments, was constructed in 1970 and restricts tidal flow to waters above it (Long & McKinnon 2002). Water for the Rockhampton region is sourced from the pondage area behind the Fitzroy River Barrage (FRW 2013). Weirs, barrages and impoundment structures alter water flow and have a major impact on some fish species such as barramundi, freshwater eels and sea mullet, by dividing fish populations, preventing fish migration and restricting re-colonisation and movement for feeding and spawning purposes (McKinnon et al. 1995; Halliday & Robins 2007). Large rainfall events allow freshwater flows to breach the barrage, however through the majority of the year the only freshwater entering the estuary is a small discharge of treated waste water from Rockhampton and limited flows required under the Fitzroy Basin Resource Operations Plan (ROP) and for the barrage fishway (Webster et al. 2006). The ROP ((former) DERM 2004) details the rules that guide the allocation and management of water with inclusions for a seasonal base flow management strategy for the Barrage, dependent upon inflows to Eden Bann weir.

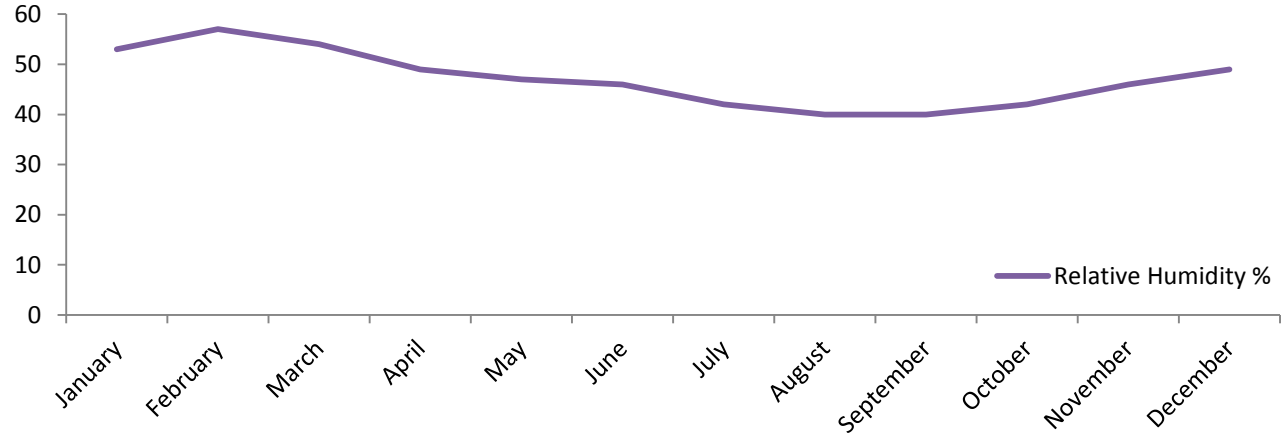
A pool and weir fishway was incorporated into the Fitzroy barrage during its construction however it proved ineffective for the movement of fish upstream (Kowarsky & Ross 1981). This was replaced by a vertical slot fishway which consists of a gradually sloped concrete channel divided to create a series of pools that allow fish to move up the fishway into the waters above the barrier (Melbourne Water n.d.). Water is released from the upstream Eden Bann weir to maintain the level of water stored in the Barrage at approximately 0.4m below full supply level ((former) DERM 2011a) which enables the fishway to continue functioning. Changing the fishway resulted in greatly improved fish passage, with a total of 23,000 fish counted utilising the fishway over a 16 month period (Stuart & Mallen-Cooper 1999). Fish can also bypass the barrage during the wet seasons, travelling upstream through adjacent floodplains (Kowarsky & Ross 1981).

A comprehensive report on Fitzroy River catchment flows is provided by Long and McKinnon (2002).

Graph A



Graph B



Graph C

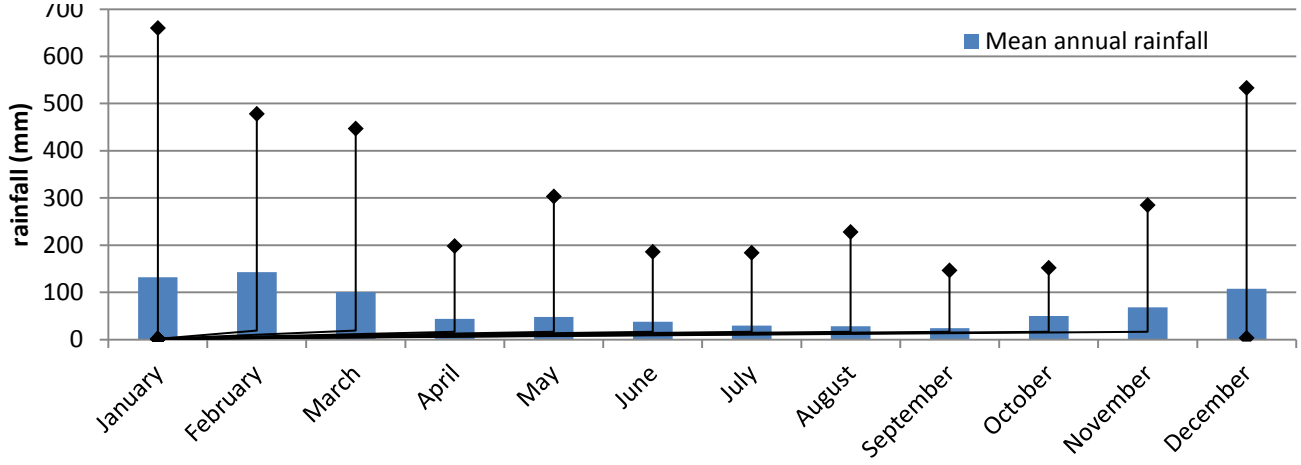


Figure 7.1: Rockhampton monthly climate averages measured by the Bureau of Meteorology (BoM 2013). (a) Maximum and minimum temperatures (between 1993 and 2013); (b) 3pm relative humidity (between 1993 and 2010); and (c) rainfall. Lines show range (between 1994 and 2013).

Chapter 8 Water quality

Chapter summary

Water quality provides a good indication of a waterway's health and resilience to surrounding land uses. Run-off and discharge can impair water quality which can have a detrimental effect upon the plants and animals inhabiting the waterway.

Water quality recordings for the Balaclava Island study area show it to be in relatively good condition, with few exceedences from National guidelines and trigger values.

8.1 Introduction

Water quality is a good indicator of the health of a waterway and the effectiveness of riparian buffer zones. Adjacent land uses can have a detrimental impact upon waterways through the introduction of sediment, toxins and chemicals however natural events can also influence water quality. For example, floods affect dissolved oxygen (DO) and salinity levels and destabilise the sediment substrate.

Water quality guidelines are based upon the National Water Quality Management Strategy (ANZECC 2000) developed by the Australian and New Zealand Environment and Conservation Council (ANZECC). ANZECC outlines trigger values (TVs) based upon the toxicity testing of a range of species to indicate the presence of contaminants and quality of water. TVs provide a measure of the likelihood of organisms being impacted however exceeding a TV does not necessarily signify the water is harmful, but indicates the need for further investigation or action.

Due to the intensive agricultural uses of the Fitzroy catchment significant loads of sediments and nutrients and some pesticides (Atrazine, Tebuthiuron and Diuron) (Webster et al. 2006) move through the Fitzroy estuary and offshore during summer flow events. The impacts of these contaminants on the ecology of the estuary are largely unknown (Webster et al. 2003). However, the Fitzroy Partnership for River Health (2013) found the water quality of the Fitzroy delta to be in fair condition following water quality testing between 2010 and 2011.

8.2 Water quality

8.2.1 pH

The alkalinity and acidity of a waterway is measured in pH. pH ranges between 0 (strongly acidic) and 14 (strongly alkaline). A pH of 7 is neutral. Acidic water has the capacity to damage the gills and skin of fish which leads to increased susceptibility to fungal and bacterial infection (former) DERM 2011b). The recommended range of pH in estuarine waters is 7 to 8.4. Water quality testing adjacent to the Balaclava Island study area recorded a range from 6.8 to 8.4, with an average of 7.7 between 2006 and 2011 ((former) DERM 2011).

8.2.2 Dissolved oxygen concentration

Fish extract dissolved oxygen (DO) from water through their gills and depend upon it for their survival. Many aquatic plants also rely on DO. Fish kills can occur in waters with persistently low oxygen levels (<50% saturation) whereas algal blooms can initiate supersaturated levels of oxygen above 100%. The Fitzroy Partnership for River Health (2013) found that DO levels were close to or better than water quality guidelines most of the sampling period. DO levels adjacent to the Balaclava Island study area have been recorded in ranges from 81% to 96%. 2010 and 2011 had quite variable ranges, most likely due to episodes of flooding over that period, which tends to reduce levels of DO due to the aerobic decomposition of high levels of organic matter by microbes in the estuary ((former) DERM 2011b).

8.2.3 Water temperature

Sudden changes to water temperature can have an impact on fish health and extended cold winters can affect fish immunity functions (DERM 2011b). There is no recommended temperature range for estuarine waters however average temperatures 2.5km upstream from the Fitzroy River mouth ranged between 23° and 24.9° between 2005 and 2011 ((former) DERM 2011).

8.2.5 Turbidity

Turbidity is the measure of light scattering by suspended particles in the water column. Excessive suspended particles reduce light penetration, blocking light necessary for phytoplankton growth (Webster et al. 2003) and can smother benthic organisms such as mussels and microphytes, transport contaminants and irritate fish gills (Fitzroy Partnership for River Health 2013). Turbidity levels around the Balaclava Island study area are elevated however sampling indicates that it rarely rises above water quality guidelines (Fitzroy Partnership for River Health 2013).

8.2.6 Salinity

Salinity is a significant indicator of freshwater flushing within an estuary and is affected by changes in river flows and exchange. As the Fitzroy River experiences large variations in freshwater flow throughout the year, salinity levels are quite variable as well. In the months following the summer wet season salinity gradually increases (Webster et al. 2006) and during flood events salinity drops significantly. For example in 2010 and 2011 the salinity dropped to as low as 0.08g/L whilst the river was flooding from values around 35g/L prior to flood events ((former) DERM 2011).

8.3 Sediment quality

Nutrients and chemicals attach and bind with suspended sediment particles, which coagulate and sink to the sediment layer. These contaminants are generally stable but activities such as floods, dredging and burrowing organisms can destabilise toxins which can then have an adverse effect on the surrounding environment and harm fisheries resources.

The high intensity of agricultural and mining activities within the Fitzroy basin have the capacity to make a significant contribution to pesticide and metal pollution in the Fitzroy estuary (Webster et al. 2006). Some fertilisers contain metal contaminants (e.g. cadmium and phosphate salts), cattle dips have previously incorporated arsenic compounds and mining activities disturb the earth's surface exposing a variety of minerals (Webster et al. 2006).

Herbicides used in agricultural practices can wash into waterways and the herbicides Atrazine, Tebuthiuron, Diuron, Fluometuron, Hexazinone, Prometryn and Simazine have been detected in samples collected during summer inflows with concentrations often exceeding ANZECC trigger values (Webster et al. 2006).

Sediment sampling in the Fitzroy estuary found concentrations of nickel, chromium, antimony and arsenic (in one sample) exceeded TVs for either the low or high interim sediment quality guidelines (Webster et al. 2006). According to Webster et al. (2006) the presence of chromium and nickel are consistent with the presence of geological sources of these metals in the Central Queensland region.

Polycyclic aromatic hydrocarbons (PAHs) are organic pollutants that can be naturally synthesised by bacteria, plants and fungi or produced as a direct result of human activities and have the ability to be extremely toxic, mutagenic or carcinogenic (Webster et al. 2006). PAHs are present in the Fitzroy River however none of the sampling in the delta show exceedences of the ANZECC (2000) trigger value. A major contributor to PAHs in the Fitzroy Basin may arise from the disturbance of coal seams during mine operations and historical burning of vegetation (Webster et al. 2006).

8.4 Dredging Operations

On average, approximately 30,000m³ of sediment is dredged every five years to maintain the Port Alma shipping channel. There are four approved spoil grounds, three offshore in Keppel Bay and one adjacent to Balaclava Island, outside of the study area. However, only the spoil ground adjacent to Balaclava Island is currently being utilised.

8.5 Conclusion

Although the Fitzroy River is subject to a significant degree of disturbance, particularly in the catchment area upstream, water quality is generally within acceptable limits in the Balaclava Island study area. A variety of herbicides and metals have been found in elevated levels within the Fitzroy estuary. However, all other water parameters were within appropriate guidelines and showed variations dependent upon seasonal changes.

Chapter 9 Land use within and adjacent to Balaclava Island study area

Chapter summary

Surrounding land uses can have a significant impact upon waterways, particularly if there is not an adequate buffer between the two. Currently the Balaclava Island study area has not been developed. Adjacent industries to the Balaclava Island study area are low intensity and located at some distance, therefore having limited impact on the values of the area. A development proposal near both the existing Fitzroy River declared FHA and the Balaclava Island study area was declared a coordinated project by the Coordinator-General but the declaration has lapsed.

9.1 Introduction

The Rockhampton region covers a total area of 18,356km² and includes the main urban centres of Emu Park, Gracemere, Mount Morgan, Rockhampton and Yeppoon. Approximately 115,399 people were residing in the Rockhampton regional council area in 2012 (Capricorn Enterprise 2013).

The Rockhampton region's gross product was $5.2 billion in 2010, with mining the prominent industry in the wider Fitzroy region (Capricorn Enterprise 2013). This encompasses a diverse range of industries within the catchment, many of which have an impact upon the Fitzroy River through water allocation, sediment run off and discharge of water from mines. Agriculture, forestry and fishing accounted for 13.8% of all businesses registered in the Rockhampton regional council area in 2011–12 (Capricorn Enterprise 2013).

In 2009, the region's coastal area supported:

- beef production
- horticulture
- meat processing
- magnesite mining and magnesia production
- salt, silica sand and limestone extraction
- explosives manufacture and storage
- electricity generation, distribution and retail
- defence training and logistics
- retail trade
- education services, health and community services
- tourism (DETE 2010).

Land uses adjacent to coastal areas have the capacity to cause significant detrimental effects through impacts such as habitat destruction and degradation, reduced water quality, pollution and sediment run-off. To retain productive and healthy waterways, it is essential to ensure adherence to environmental guidelines and maintain an adequate buffer between activities that can cause damage.

The Balaclava Island study area has a very low level of human disturbance and little impact from adjacent land uses. There is no industry or other development within the Balaclava Island study area and adjacent land uses are generally low intensity, located away from the study area (Figure 9.1).

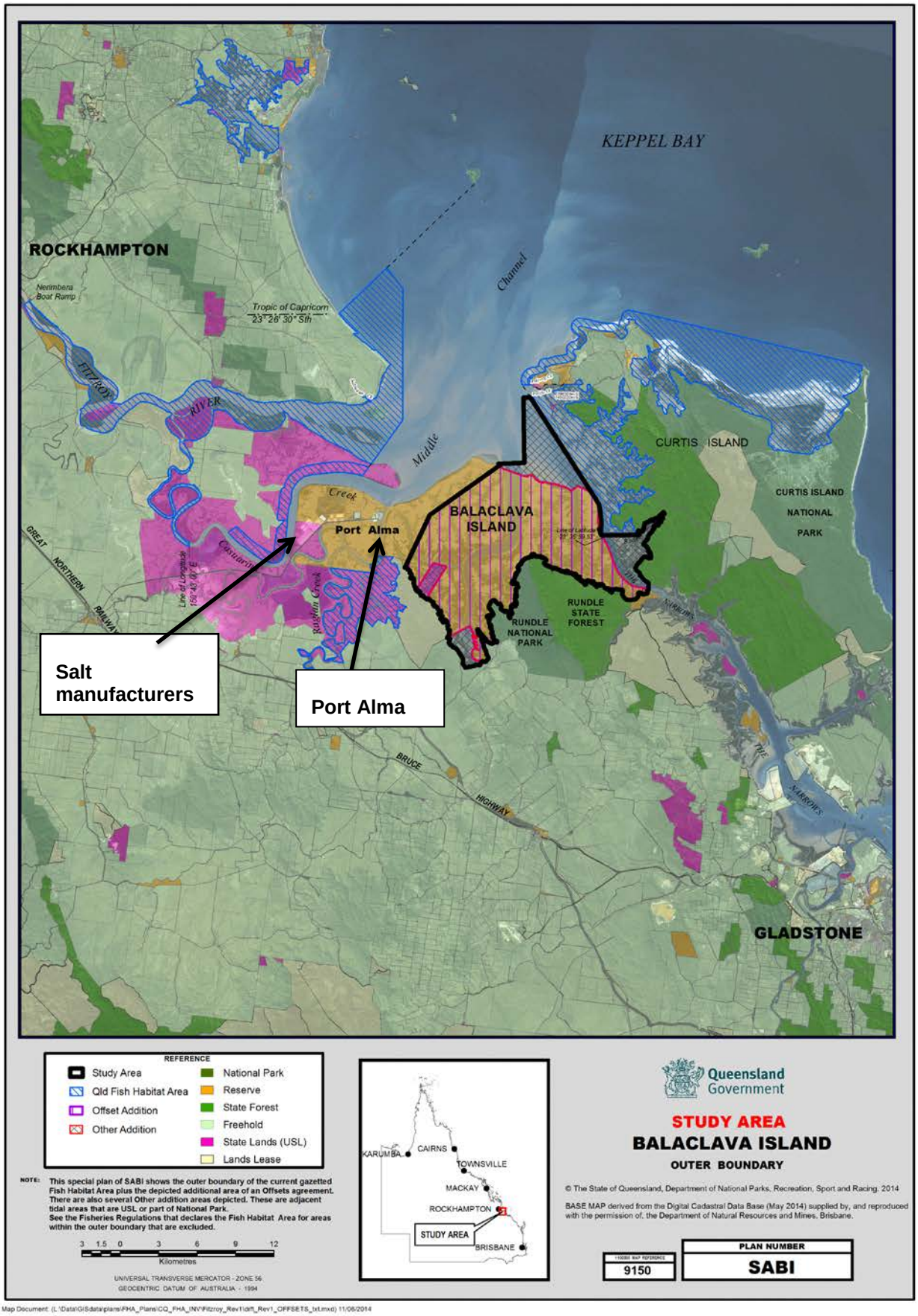


Figure 9.1: Nearest industrial land use.

9.2 Gladstone Port Corporation activities

The Gladstone Port Corporation operates the Port Alma Shipping Terminal adjacent to the Balaclava Island study area (Figure 9.2) at the mouth of Raglan Creek (23°34'S, 150°51'E). The Port has three berths, two for general cargo and one dolphin berth for handling bulk liquids, and can accommodate vessels up to 180m in length (GPC 2011). Berths are supported by infrastructure suitable for handling containers of dry and refrigerated cargo (GPC 2011). The principal cargoes handled are class 1 explosives, ammonium nitrate, bulk tallow and military equipment for exercises held regularly at Shoalwater Bay to the north of Rockhampton (MSQ 2013).

The Port maintains a shipping channel for berth access to a width of 100m wide and a minimum depth of 7m (Long & McKinnon 2002). Due to a buffer zone and the distance of the port facilities from the study area there is minimal impact on the Balaclava Island study area fish habitat values from the Port Alma Shipping Terminal.

Figure 9.2: Port Alma shipping terminal (photo courtesy of Peter Long)

9.3 Salt production

Cheetham Salt and Olsson's Pacific Salt operate salt production activities at Bajool, adjacent to Port Alma. Both companies extract salt by pumping seawater into shallow concentrating ponds and utilising natural solar and wind evaporative processes. This process of salt extraction means that the annual production is variable and dependent upon the weather. Cheetham Salt is the larger of the two operators, extracting approximately 220,000 tonnes of salt per year. Olsson's Pacific Salt has a smaller production of approximately 30,000 tonnes. These activities are more than 5km away from the Balaclava Island study area.

9.4 Other land uses

The south eastern side of the Balaclava Island study area is bounded by Rundle Range National Park and Rundle State Forest and the majority of the eastern section is contained within a Habitat Protection Zone of the Great Barrier Reef Coast Marine Park. The western boundary aligns to designated strategic port land which is not currently utilised for any purpose. The remainder of adjacent lands are utilised for cattle grazing.

9.5 Artificial structures

The presence of artificial structures is an indication of human induced impacts upon the fisheries values of a waterway. The Balaclava Island study area does not contain any artificial structures, indicating that it has had little exposure to physical disturbance.

9.6 Future development proposals

ESSO Australia Resources Pty Ltd hold a mining exploration permit that covers a part of the Balaclava Island study area (figure 9.3). Exploration permits are issued to investigate what minerals and gases exist in an area, their quality and quantity. Permits allow holders to undertake exploration activities including prospecting and surveying, sampling (water, rock and soil), drilling, ancillary environmental studies, conduct geophysical surveys and soil testing. Permits generally do not allow holders to conduct production activities or make permanent changes to the landscape. Mining activities do not require approval under the *Fisheries Act 1994* however conditions about mining in an FHA may be imposed on an environmental authority under the *Environmental Protection Act 1994* (Derbyshire et al. 2008).

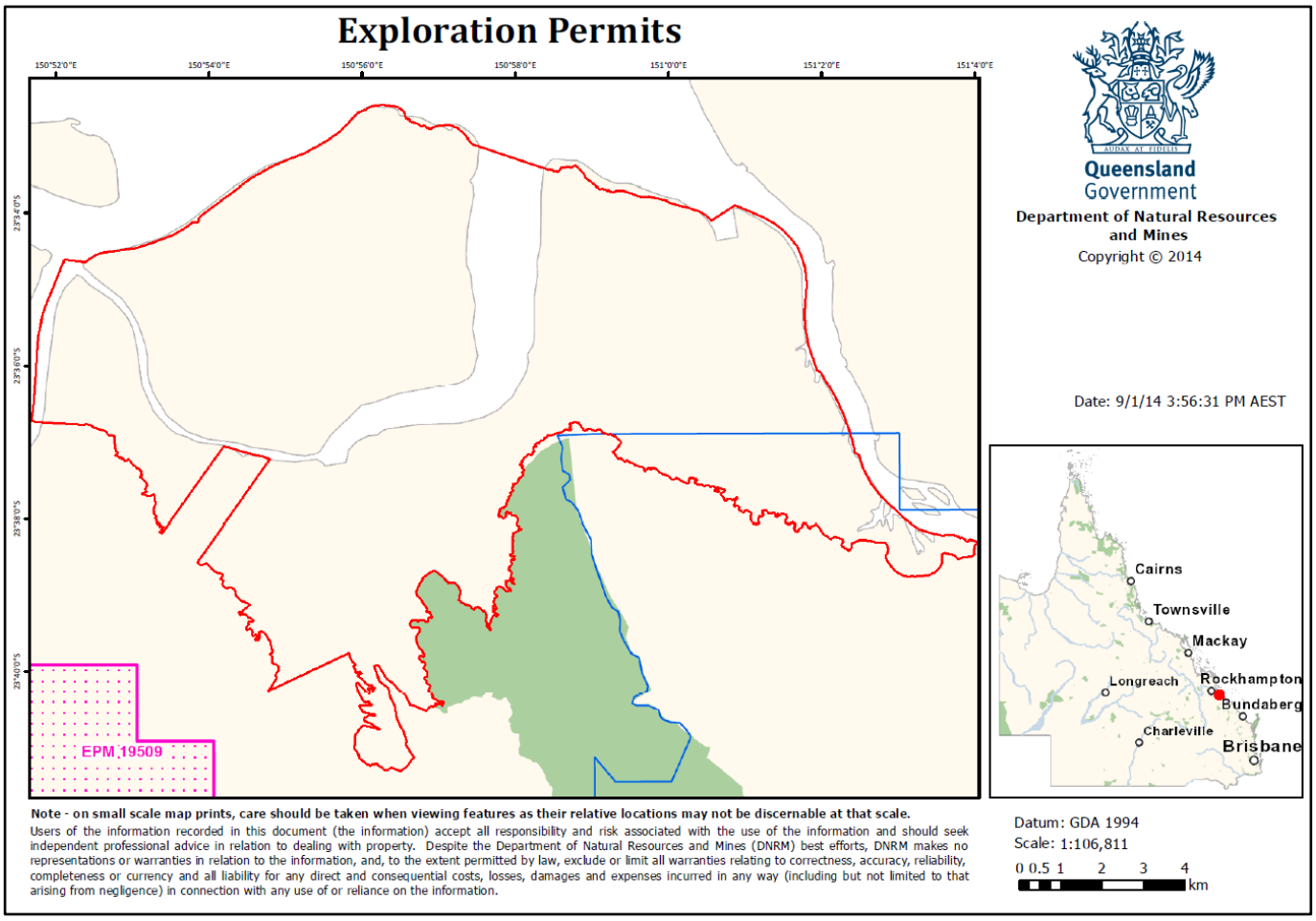


Figure 9.3: Mining exploration permit (denoted by the blue line) on Balaclava Island study area- denoted by the red line.

Until recently, a new coal port facility at Port Alma, the Fitzroy Terminal, had been proposed by the Mitchell Group and declared a 'coordinated' project by the Coordinator-General. The Fitzroy Terminal, if approved, would have involved the construction of a new 13km rail line, 3km covered conveyor system, stockyards and a barge loading facility in Raglan Creek, upstream of the existing Port Alma shipping terminal and close to the south west boundary of the Balaclava Island study area. Shallow draft barges were planned to transport coal from the berth for transfer to larger export vessels anchored offshore with a 24 hour, 7 day a week capacity (Mitchell Ports 2013). Proposed infrastructure relating to this project was aligned to the existing Fitzroy River declared FHA boundary. The proponents failed to submit the Environmental Impact Statement within the required timeframe and its 'coordinated' project declaration lapsed on 5 May 2014.

9.7 Conclusion

The current adjoining land uses have minimal impact upon the Balaclava Island study area. Surrounding land uses are generally low intensity and adequate buffer zones exist to alleviate any detrimental effects to the fish habitat values of the Balaclava Island study area.

Chapter 10 State and regional planning and management

Chapter summary

Various local, state and national legislative provisions are in place to protect and guide planning and development for the inshore and estuarine habitats of the Fitzroy River declared FHA and Balaclava Island study area. Key planning mechanisms for the study area include the State Planning Policy, the Central Queensland Regional Plan, the Calliope Shire Planning Scheme and GPC's strategic plan. The planning challenge is to strike a balance between different interests while maintaining the natural condition of the study area.

10.1 Introduction

Coastal development can have significant negative impacts upon adjacent habitats, water quality and ecosystems, which can be detrimental to the plants and animals that inhabit and rely upon these areas. To protect these sensitive areas, a range of legislative provisions are in place to guide planning and management decisions within coastal zones. This chapter summarises the relevant national, state and regional provisions that are in place to guide coastal protection and development within the Balaclava Island study area.

10.2.1 State Planning Policy

The State Planning Policy (SPP) is the primary instrument used by the state and local governments for assessing development in coastal zones and coastal management districts. This recently introduced policy replaces the Coastal Protection State Planning Regulatory Provision (SPRP) which was enacted under the *Coastal Protection and Management Act 1995*. The new approach aims to clarify the planning policies previously in place by revoking multiple policies based upon social, economic, environmental and health priorities and replacing them with a consolidated 'one state' planning policy. The SPP outlines matters considered to be of state significance, which include coastal environments, water quality and biodiversity. Local government planning and assessment processes are required to reflect these state interests through appropriate consideration and protection of such things as:

- matters of national and state environmental significance (including declared FHAs),
- strategic offset areas,
- protecting species and species habitat, ecosystems and ecosystem services and other natural values to the greatest extent practicable,
- and maintaining or enhancing ecological connectivity.

The SPP is supported by the Coastal Management Plan (CMP) for planning and development decisions affecting coastal resources on public coastal lands. The CMP is primarily aimed at local government who are responsible for managing areas of public coastal land and beaches however other specialist coastal managers will benefit from the policies and information contained within the plan. The plan provides guidance and direction to achieve the objectives of the *Coastal Protection and Management Act 1995*, which are to:

- provide for the protection, conservation, rehabilitation and management of the coastal zone, including its resources and biological diversity
- have regard to the goal, core objectives and guiding principles of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone
- ensure decisions about land use and development safeguard life and property from the threat of coastal hazards
- encourage the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone.

10.2.2 Great Barrier Reef World Heritage Area

The Great Barrier Reef World Heritage Area (GBRWHA) encompasses an area of approximately 348,000km² from Baffle Creek (north of Bundaberg) to Cape York and is the world's most extensive coral reef system, with some of the richest biological diversity on Earth.

The Australian and Queensland Governments have a cooperative and integrated approach to managing the GBR. The Great Barrier Reef Marine Park Authority (GBRMPA) is the Australian Government entity responsible for the overall management of the GBR, and the Queensland Government's Department of National Parks, Recreation, Sport and Racing (NPRSR) oversees the day to day management. For inshore and intertidal areas, State Marine Parks have been declared by the Queensland Government to complement the protection provided by the GBRMP. The marine parks are zoned to define activities that are allowed in each area and separate potentially conflicting activities.

The Balaclava Island study area is within the GBRWHA and sections are incorporated within the State Great Barrier Reef Coast Marine Park. The northern boundary is within a general use zone and the eastern boundary is within a habitat protection zone. Habitat protection zones aim to manage and protect sensitive habitats through preventing potentially damaging activities such as trawling.

10.2.3 Significant wetlands

The Directory of Important Wetlands in Australia (DIWA) is a cooperative project involving Australian, state and territory governments. First published in 1993, the DIWA identifies nationally important wetlands and provides information on wetlands, their ecology and their social and cultural values. Although not a statutory document, it guides management decisions by highlighting the ecological significance of an area.

To be considered nationally important, a wetland must meet at least one of the six criteria:

- biogeographic representativeness
- important ecological or hydrological functions
- provision of animal habitat during times of vulnerability or adverse conditions
- support for more than 1% of the national population of any taxa
- support for threatened taxa or communities
- historical or cultural significance.

The most recent edition of DIWA, published in 2001, listed 904 nationally important wetland sites across the nation, covering an area of 57,904,254ha, and includes the Fitzroy River delta and floodplains (inclusive of the Balaclava Island study area). The Balaclava Island study area's listing on DIWA highlights the significance of its fish habitats and wetland values.

Ramsar wetlands however do maintain some level of legislative protection. Ramsar sites are wetland areas that are recognised under the Convention on Wetlands of International Importance (Ramsar convention) as being of international significance in terms of hydrology, ecology, botany, zoology or limnology (SEWPC 2011). The *Environmental Protection and Biodiversity Conservation Act 1999* enhances the management and protection of Australia's Ramsar wetlands by regulating activities that will or are likely to have a significant impact upon the site. The nearest Ramsar wetlands to the Balaclava Island study area are Shoalwater and Corio Bays, approximately 75km and 110km, respectively, to the north.

10.2.4 Declared Fish Habitat Areas

Fish Habitat Areas (FHAs) are declared under the *Fisheries Act 1994* and are fundamental to the protection of the state's critical fish habitats. The declared FHA network strategy (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. Management of declared FHAs enables the protection of essential fish habitats from physical disturbance caused by development, whilst still allowing community access for such activities as boating and legal fishing.

The Balaclava Island study area is adjacent to the management 'A' Fitzroy River declared FHA. The Balaclava Island study area, which was included in the original Fitzroy River study area, was omitted from the original declaration of the Fitzroy River FHA due to conflict with future port development activities. As part of the offsets program for the Western Basin Dredging and Disposal Project (GPC 2013), GPC has committed 5002.10ha of their lands within the Balaclava Island study area for assessment and inclusion into the existing Fitzroy River declared FHA, with a further 7621.90ha committed as an advance offset as the area is no longer required for port development. This opportunity to expand the existing Fitzroy River declared FHA will assist in closing some of the fragmented boundaries of this area, providing connectivity of protected fish habitats.

10.2.5 Regional and local government plans

Local Councils are required to prepare planning schemes under the *Sustainable Planning Act 2009*. Planning schemes integrate and balance the economic, social and environmental needs and aspirations of the local community whilst focusing on land use, development, infrastructure and valuable features of an area to drive decisions on land use and change (SDIP 2013). The *Sustainable Planning Act 2009* emphasises the delivery of sustainable planning outcomes by encouraging the incorporation of:

- preparation of a strategic land-use plan
- increased emphasis on community engagement - to ensure all of the community's needs are reflected in the final plan
- greater flexibility—to cater for unexpected changes
- new streamlined ways for local governments to amend their planning scheme to reflect these changed circumstances (SDIP 2013).

Gladstone Regional Council is preparing a planning scheme but until it is finalised the planning schemes of the former Gladstone City, Calliope and Miriam Vale Shire Councils remain in effect. The Calliope Shire Planning Scheme covers the study area. The Gladstone Regional Council acknowledges the importance of maintaining the health of its waterways and riparian communities and has incorporated the need to ensure the integrity of its waterways through protection from inappropriate land uses into its planning schemes (GRC 2012).

The Central Queensland Regional Plan (CQRP) is in place to assist and provide guidance to Local Councils in their planning and policy making. The CQRP plan aims to effectively manage the high level of growth in the Central Queensland area, particularly relating to mining and agriculture, by incorporating the key state interest matters addressed in the SPP with a regional focus. The focus of the plan is to:

- protect the region's priority agricultural land uses from incompatible resource development by mapping priority agricultural areas and identifying assessment criteria that will apply to resource activities undertaken in a priority agricultural area
- protect the future of towns in the region by mapping priority living areas and initiating legislative amendments that will allow local governments to determine whether or not resource activities can be located within a priority living area
- identify infrastructure opportunities for the region
- provide regional direction in relation to other state interests.

10.2.6 Port management

There are a range of planning mechanisms in place to direct future expansion of the port, including the Queensland Ports Strategy (DSDIP 2014), the Great Barrier Reef Ports Strategy (DSDIP 2012) and the GPC's 50 year strategic plan (GPC 2012).

The GBR Ports Strategy aims to balance building an efficient port network within Queensland to support economic growth, with the minimisation of environmental impacts to the GBR. It incorporates strategies such as restrictions to port development in and adjoining the GBR World Heritage Area to within port limits until 2022, rigorous analysis of port decisions and impacts to the GBR and environmental assessments of the cumulative impacts of port activities.

The Queensland Ports Strategy builds on the GBR Ports Strategy and is the Queensland Government's blueprint for managing the state's port network until 2024. Key actions in the strategy include the establishment of five Priority Port Development Areas (PPDAs) and introduction of a statutory guideline for port master planning. The aim of focusing on five PPDAs is to restrict port development and prohibit capital dredging and expansion of additional port facilities outside of these areas (until 2024). Port Alma will not be declared a PPDA.

The GPC's 50 year strategic plan, first published in 1992 and updated in 2012, supports the management, development and operation of port facilities and services. According to this plan, all port facility expansions are located within the Gladstone harbour.

10.3 Conclusion

The inclusion of the Fitzroy River delta and Balaclava Island study area in the DIWA highlights its importance to regional ecology and biodiversity. Various local, state and national legislation and guidelines are in place to afford protection to the inshore and estuarine habitats of the Fitzroy River declared FHA and Balaclava Island study area. The challenge is to use these mechanisms to find a balance between different interests while maintain the natural condition of the area.

Chapter 11 Suitability for inclusion of the Balaclava Island study area into the Fitzroy River declared FHA

Chapter summary

The Balaclava Island study area fulfils all of the four fisheries criteria and the eight habitat criteria. The incorporation of this area into the existing Fitzroy River declared FHA will have the benefit of increasing the declared FHA's size and habitat and provide protection to the high quality fish habitats contained within the study area. It is recommended the Balaclava Island study area be incorporated into the management 'A' Fitzroy River declared FHA.

11.1 Introduction

Fish Habitat Areas are declared under the *Fisheries Act 1994* and are fundamental to the protection of the state's essential fish habitats. The declared FHA concept recognises the complex and interrelated reliance of many species on multiple habitats during their lives and aims to protect these habitats and their interconnectivity by restricting development and physical alteration, whilst still allowing for public access and legal fishing activities.

The FHA Selection, Assessment, Declaration and Review Policy (NPRSR 2013) provides a set of criteria to determine an area's suitability for declaration as an FHA (Appendix D). This chapter summarises the findings of this report in relation to the FHA selection criteria.

Although the FHA selection criteria is a vital proponent to the eventual declaration of an FHA, it is only the first step in the process. The long term integrity of declared FHAs is dependent upon community support and as such, candidate areas that are assessed as meeting the requirements of the FHA selection criteria are subject to extensive public consultation to gauge community and stakeholder support.

11.2 Assessment of Balaclava Island study area in relation to the declared FHA selection criteria

The aim of this Fisheries Resource Assessment is to assess the suitability of the Balaclava Island study area for incorporation into the Fitzroy River declared FHA. A brief summary of the assessment of the Balaclava Island study area against each of the criteria is provided below.

Fisheries Criteria

1. High fish species richness

Long and McKinnon (2002) documented 97 fish species, 12 species of prawn and 3 crab species that are or are most likely to be present in the Fitzroy River. Independent sampling in January 2014 verified 11 of these species and documented a further 8 previously unrecorded species within the Balaclava Island study area. Similarity of habitats and assemblage compositions indicate that species lists generated for the lower Fitzroy may supplement an inventory list for the Balaclava Island study area (Sheaves et al. 2014). Given this information, the study area compares favourably with regional waterway benchmarks such as the Fitzroy and Calliope Rivers.

- *The fish species richness of the Balaclava Island study area is similar to that of a comparable regional benchmark waterway*—**compatible with FHA.**

2. High diversity and abundance of regionally targeted fish species

Fish surveys, catch data and anecdotal evidence from fishing reports shows the Balaclava Island study area to support a diverse and abundant range of species that are important to recreational, indigenous and commercial fisheries. A high number of mud crabs (*Scylla serrata*) have been documented during monitoring surveys in the area and popular fish species known to utilise the area include barramundi (*Lates calcarifer*), bream (*Sparidae* spp.) and jewfish (*Sciaenidae* spp.).

- *>15 regionally targeted species in high abundance (Chapters 3 & 4)*—**compatible with management 'A' area.3. Supports existing fisheries**

A productive and economically important commercial and recreational fishery exists within the Balaclava Island

study area. Commercial fishing operators landed more than 210t of fish from within and directly adjacent to the Balaclava Island study area in 2012 and it is a popular destination for recreational anglers. Targeted fish species include mud crabs, barramundi and threadfin salmon.

- *Major commercial fisheries within the area (Chapter 4.3)*—**compatible with management 'A' area.**

4. Supports external/regional fisheries

The fish habitats contained within the Fitzroy River declared FHA and Balaclava Island study area play a critical role in the important commercial, recreational and indigenous fisheries resources of the region. The study area provides important spawning and nursery habitat for these targeted species. Recreational fishing within the Capricorn Coast has an estimated total annual consumer surplus of $5.53 million and the region supports a large and productive commercial fishing fleet.

- *Major commercial and recreational fishing occurs adjoining the area and in adjacent offshore waters, targeting species that are directly linked to the area (Chapter 4, 5)***—compatible with management 'A' area.**

Fish Habitat criteria

1. Large in size

The Balaclava Island study area encompasses 16, 069.16ha.

- *>500ha (Chapter 2)***—compatible with management 'A' area.**

2. Diverse habitat types

There is an impressive representation of high quality diverse fish habitats contained within the Balaclava Island study area. It contains 8 of the 14 habitat types outlined in the NPRSR FHA selection criteria (NPRSR 2013).

- *>7 habitat types represented (Chapter 5)***—compatible with management 'A' area.**

3. Presence of a functioning riparian buffer zone

The riparian zones within the Balaclava Island study area are well vegetated and relatively pristine. The general level of vegetation cover present appears to provide adequate riparian function given the low intensity of adjacent land uses.

- *>80% of the length of the riparian zone is adequately vegetated and functioning effectively (Chapter 6)*— **compatible with management 'A' area.**

4. Limited disturbance from artificial in-stream structures

There are no in-stream structures within the Balaclava Island study area.

- *No in-stream structures (Chapter 9)*—**compatible with management 'A' area.**

5. Good water quality

Overall, water quality in the Balaclava Island study area is within water quality guidelines. High levels were shown in an isolated sample of arsenic and antimony however these chemicals are not part of the physio-chemical indicators for water quality guidelines.

- Water quality standard meets the Queensland Water Quality Guidelines ((former) DERM 2009)—**compatible with FHA.**

6. Limited disturbance from, or ongoing reduction of impacts from, water impoundment structures

The Fitzroy River ROP specifies a seasonal base management strategy that requires environmental flows to be released from the Barrage. A functional fishway exists at the Barrage, enabling fish movement upstream and alternative passageways are provided through floodplains.

- *Water planning specifies the requirement for environmental flows and ongoing monitoring of aquatic ecosystems (Chapter 7)*—**compatible with FHA.**

7. Limited interaction with development of major significance to the state

The Port Alma shipping terminal is on strategic port land, located over two kilometres from the Balaclava Island study area and has no direct impact or interaction with the area.

- *No adjoining land developments of major significance to the State (Chapter 9)*—**compatible with FHA.**

8. Compatible with adjacent land and aquatic planning

Much of the lands adjacent to the Balaclava Island study area are designated terrestrial and marine protected areas. The terrestrial lands within Balaclava Island study area boundary are designated environmental lands by GPC, Rundle Range National Park and Rundle State Forest adjoin to the south and south - east and the State Great Barrier Reef Coast Marine Park adjoins the east. Strategic port land abuts the western border of the study area, however it is currently undeveloped.

- *Adjacent land and aquatic planning compatible with intent of the strict management 'A' area (Chapter 9)*— **compatible with management 'A' area.**

Regionally unique features

The Balaclava Island study area delivers the opportunity to provide connectivity of the existing Fitzroy River declared FHA boundary. Its utilisation as juvenile habitat and provision of critical habitat for the Snub-fin and Indo-Pacific humpback dolphins makes it regionally unique.

- Presence of regionally unique natural fish habitat features (Chapter 5)—**compatible with FHA.**

11.3 Conclusion

The Balaclava Island study area contains a diverse range of relatively un-impacted essential fish habitats and is representative of the level of high quality fish habitat that declared FHAs aim to protect. In combination with the Fitzroy River declared FHA it supports important local and regional indigenous, recreational and commercial fisheries.

The Balaclava Island study area clearly meets all requirements to be suitable for declaration as an FHA and it is recommended the proposal proceed to public consultation with the view to incorporate it into the existing management 'A' Fitzroy River declared FHA.

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Appendix A: Fish species recorded in the Balaclava Island study area

(Sheaves et al. 2014)

Family Species	Common name
Fish	
Clupeidae (Herring)	
Escualosa thoracata	White Sardine
Engraulidae (Anchovies)	
Stolephorus sp.	Anchovy
Thryssa hamiltoni	Hamilton's Anchovy
Hemiramphidae (Garfishes or Halfbeaks)	
Zenarchapterus buffonis	Buffon's River Garfish
Platycephalidae (Flathead)	
Platycephalus fuscus	Dusky Flathead
P. indicus	Bar-tailed flathead
P. endrachtensis	Northern sand flathead
Centropomidae (Sea Perches)	
Lates calcarifer	Barramundi
Ambassinae (Perchlets)	
Ambassis vachelli	Glass Perchlet
Callionymidae (Perchlets)	
Callionymus sagitta	Arrow dragonette
Haemulidae (Grunts)	
Pomadasys kaakan	Javelin grunter
Sparidae (Porgies)	
Acanthopagrus australis	Yellowfin Bream
Gerriidae (Mojarras)	
Gerres filamentosus	Whipfin Silver-biddy

Synodontidae (Lizardfishes)	
Harpadon translucens	Glassy Bombay duck
Sillaginidae (Whiting)	
Sillago sihama	Northern whiting
Sciaenidae (Drums or Croakers)	
Johnius pacificus	Pacific croaker
Leiognathidae (Ponyfishes)	
Leiognathus equulus	Common Ponyfish
Nuchequula gereoides	Decorated Ponyfish
Mugilidae (Mullet)	
Rhinomugil nasutus	Shark Mullet
Valamugil/Moolgarda spp.	Mullet
Polynemidae (Threadfin Salmon)	
Polydactylus multiradiatus	Australian Threadfin
Eleutheronema tetradactylum	Fourfinger Threadfin
Eleotrididae (Gudgeons)	
Ophiocara porocephala	Northern Mud Gudgeon
Butis butis	Duckbill sleeper
Gobiidae (Gobies)	
Acentrogobius gracilis	Blue spotted mangrove goby
Karsten totoyensis	Blind goby
Soleidae (Soles)	
Paradicula setifer	Sole
Cynglossidae (Tongue Soles)	
Paraplagusia bilineatia	Double lined tongue Sole
P. guttata	Tongue Sole
Cynglossus sp.	Tongue Sole
Tetraodontidae (Toadfishes, puffers)	
Marilyna pleurostictus	Banded Toadfish
Chelonodon patoca	Milk-spotted Puffer

Crustaceans

Penaeidae (Penaeid Prawns)

Fenneropenaeus merguiensis	Banana Prawn
Metapanaeus bennettae	Bay Prawn
Parapenaeopsis sculptilis	Rainbow Prawn
Metapanaeopsis novaeguineae	Prawn
Paneaus esculentus	Brown Tiger Prawn
Atypopenaeus formosus	Go Home Prawn

Palaemonidae (Macrobrachium)

Paleomonetes atribunes	Shrimp

Portunidae (Crabs)

Scylla serrata	Mud Crab

Appendix B: Species of fish, crustaceans and molluscs recorded or likely to be found in the Fitzroy River declared FHA.

(Long & McKinnon 2002)

* Confirmed to be in the Balaclava Island study area (Sheaves et al. 2014)

Family Species	Common name
Fish	
Carcharhinidae (Requim Sharks)	
Carcharhinus obscurus	Black Whaler Shark
Carcharhinus leucas	Bull Shark
Various species	Shark
Myliobatidae (Eagle Rays)	
Aetobatus narinari	White spotted eagle ray
Dasyatidae (Stingrays)	
Himantura uarnak	Long-tailed Ray
Various species	Ray
Anguillidae (Freshwater Eels)	
Anguilla reinhardtii	Long-finned Eel
Clupeidae (Herring)	
Herklotsichthys castelnaui	Southern Herring
H. koningsbergeri	Spotted Herring
Nematalosa come	Hairback Herring
N. erebi	Bony Bream
Sardinella sp.	Pilchard
Various species	Herring
Engraulidae (Anchovies)	
**Stolephorus sp.*	Anchovy
**Thryssa hamiltoni*	Hamilton's Anchovy
T. setirostris	Longjaw Glassnose
T. aestuaria	Estuary Anchovy
Megalopidae (Tarpon)	
Megalops cyprinoides	Tarpon / Ox Eye Herring
Elopidae (Giant Herring)	
Elops hawaiensis	Giant Herring

Chirocentridae (Wolf Herrings)

Chirocentrus dorab	Wolf Herring

Chanidae (Milkfishes)

Chanos chanos	Milkfish

Ariidae (Sea Catfishes)

Arius graeffei	Blue Catfish
A. thalassina	Salmon Catfish
Various species	Catfish

Belonidae (Longtoms)

Strongylura strongylura	Black Spot Longtom
S. kreffti	Longtom

Synodontidae (Grinners)

Harrpadon translucens	Ghost Grinner

Hemiramphidae (Garfishes or Halfbeaks)

Hemirhamphus robustus	Three By Two Garfish
Hyporhamphus regularis	River Garfish
Arrhamphus sclerolpis	South east Snub-nosed Garfish
**Zenarchapterus buffonis*	Buffon's River Garfish

Pegasidae (Dragonfish)

Pegasus volitans	Long tailed Dragonfish

Scorpaenidae (Scorpionfish)

Notesthes robusta	Bullrout
Scorpaenidae sp.	Scorpionfish

Platycephalidae (Flathead)

**Platycephalus fuscus*	Dusky Flathead
**P. indicus*	Bar-tailed flathead
Suggrundus sp.	Flathead
P. arenius	Sand flathead

Centropomidae (Sea Perches)

**Lates calcarifer*	Barramundi

Ambassinae (Perchlets)

Ambassis marianus	Yellow Perchlet
A. agassizi	Perchlet
**A. vachelli*	Glass Perchlet

Serranidae (Cods and Groupers)

Ephinephelus coioides	Estuary Cod
E. malabaricus	Malabar Cod
E. lanceolatus	Queensland Groper
Various species	Cod

Terapontidae (Grunters)

Pomadasys argenteus	Small Spotted Javelin Fish/Grunter
P. kaaken	Spotted Javelin Fish
Terapon sp.	Trumpeter
T. theraps	Banded Trumpeter

Apogonidae (Cardinalfishes)

Siphamia roseigaster	Pinkbreast Siphonfish

Haemulidae (Grunts)

Plectorhynchus gibbosus	Brown Morwong
P. sp.	Morwong
Lethrinus laticaudis	Brown/Grass Sweetlip

Sparidae (Porgies)

**Acanthopagrus australis*	Yellowfin Bream
A. berda	Black/Pikey Bream

Monodactylidae (Butterbream)

Monodactylus argenteus	Diamond Fish / Butter Bream

Leptobramidae (Beach salmon)

Leptobrama muelleri	Beach salmon

Lobotidae (Tripletail)

Lobotes surinamensis	Tripletail

Gerriidae (Mojarras)

Gerres subfasciatus	Silver Biddy
**G. filamentosus*	Threadfin Silver-belly
G. abbreviatus	Silver Biddy

Drepanidae (Sicklefish)

Drepane punctata	Spotted Sickle Fish

Sillaginidae (Whiting)

Sillago analis	Golden-lined Whiting
S. maculata	Winter Whiting
S. ciliata	Sand Whiting
**S. sihama*	Northern Whiting
Various species	Whiting

Pomatomidae (Tailor)

Pomatomus saltrix	Tailor

Sciaenidae (Drums or Croakers)

Argyrosomus japonicus	Jewfish/Mulloway
Protonibea diacanthus	Black jewfish
Nibea soldado	Silver Jewfish
Johnius vogleri	Little Jewfish
Austronibea oedogenys	Yellow Tailed Croaker
Various species	Jewfish

Girellinae (Luderick)

Girella tricuspidata	Luderick

Scatophagidae (Scat fishes)

Selenotoca multifasciata	Striped Butterfish
Scatophagus argus	Spotted Scat

Leiognathidae (Ponyfishes)

**Leiognathus equulus*	Common Ponyfish
L. equulus	Ponyfish

Carangidae (Jacks and Trevallys)

Alectis indica	Diamond Trevally
Caranx melampygus	Spotted Trevally
Gnathanodon speciosus	Golden Trevally
Caranx ignobilis	Giant Trevally
Parastromateus niger	Black Pomfret
Scomberoides commersonianus	Giant Leatherskin Queenfish
Seriola sp.	Amberjack
Trachinotus sp.	Dart

Lutjanidae (Tropical snappers)

Lutjanus argentimaculatus	Mangrove Jack
L. johni	Golden Snapper
L. russelli	Moses Snapper

Mugilidae (Mullet)

Liza subviridis	Greenback mullet
L. argentea	Flat-tail Mullet
Mugil cephalus	Sea Mullet
Paramugil georgii	Fantail Mullet
Myxus elongatus	Sand Mullet
Valamugil seheli	Blue-tailed Mullet
Squalomugil nasutus	Popeyed Mullet

Polynemidae (Threadfin Salmon)

**Eleutheronerna tetradactylum*	Blue Threadfin Salmon
Polydactylus macrochir	King Threadfin
P. plebeius	Striped Threadfin/ Puttynose Perch

Sphyraenidae (Barracudas)

Sphyraena barracuda	Great Barracuda
S. jello	Pickhandle Barracuda

Echeneididae (Suckerfishes)

Remora remora	Remora Suckerfish

Callionymidae (Dragonets)

Callionymus sagitta	Dragonet

Eleotrididae (Gudgeons)

**Ophiocara porocephala*	Northern Mud Gudgeon

Gobiidae (Gobies)

Arenigobius frenatus	Goby
Glossogobius biocellatus	Sleepy Goby
Leme sp.	Burrowing Goby
Brachyamblyopus coecus	Black Lined Sleepy Goby
Butis butis	Crimson-Tipped Goby
Goby species	Juvenile too small to identify species

Siganidae (Rabbitfishes)

Siganus guttatus	Golden-lined Spinefoot
S. spinus	Black Spinefoot
S. lineatus	Spinefoot
S. sp.	Spinefoot

Scombridae (Mackerels, Tuna, Bonitos)

Scomberomorus semifasciatus	Broad-barred Mackerel
S. queenslandicus	School mackerel
S. commerson	Spanish mackerel
S. munroi	Spotted Mackerel

Stromateidae (Pomfret)

Parastromateus niger	Black Pomfret

Paralichthyidae (Sand Flounders)

**Pseudorhombus arsius*	Large-toothed flounder
Various species	Flounder

Cynglossidae (Tongue Soles)

**Paraplagusia bilineatia*	Double lined tongue Sole
**P. guttata*	Tongue Sole
**Cynglossus* sp.	Tongue Sole

Monacanthidae (Filefishes, Leatherjackets)

Paramonacanthus sp.	Filefish

Triacanthodidae (Triplespines)

Tripodichthys angustifrons	Yellow-fin Tripod fish

Tetraodontidae (Toadfishes, puffers)

**Marilyna pleurostictus*	Banded Toadfish
**Chelonodon patoca*	Milk-spotted Puffer
Torquigener sp.	Toadfish
Tetractenos hamiltoni	Common Toadfish
Arothron manilensis	Narrow-lined Toadfish

Crustaceans

Squillidae (Mantis Shrimps)

Squilla sp.	Mantis Shrimp

Penaeidae (Penaeid Prawns)

Melicertus plebejus	Eastern King Prawn
**Fenneropenaeus merguiensis*	Banana Prawn
Metapenaeus ensis	Greasyback Prawn
**M. bennettae*	Bay Prawn
M. macleayi	School Prawn
Trachypenaeus fulvus	Hardback Prawn
Penaeus endeavouri/ensis	Endeavour Prawn
P. esculentus semisulcatus/monodon	Tiger Prawn
P. monodon	Leader Prawn
Metapenaeopsis sp.	Coral Prawn
**Parapenaeopsis sculptilis*	Rainbow Prawn
Atypopenaeus formosus	Go Home Prawn

Alpheidae (Clicker Prawn)	
Alpheus sp.	Clicker Prawn
Palaemonidae (Macrobrachium)	
Macrobrachium sp.	Machrobrachium
Serestidae (Shrimp)	
Acetes sp.	Shrimp
Portunidae (Crabs)	
Portunus pelagicus	Blue Swimmer Crab
**Scylla serrata*	Mud Crab
Scyllaridae (Bugs)	
Thenus sp.	Bug
Pectinidae (Scallops)	
Amusium sp.	Scallops

Molluscs

Sepiolidae (Bobtail Squids)	
Euprymna sp.	Mickey Mouse Squid
Idiosepius sp.	Seagrass Squid
Loliginidae (Pencil Squids)	
Loliolus sp.	Bay Squid

Appendix C: Catch and effort for the most targeted fish species in the Balaclava Island study area commercial net fishery (Grid R30) 2002–12

(data sourced from DAFF 2013a)

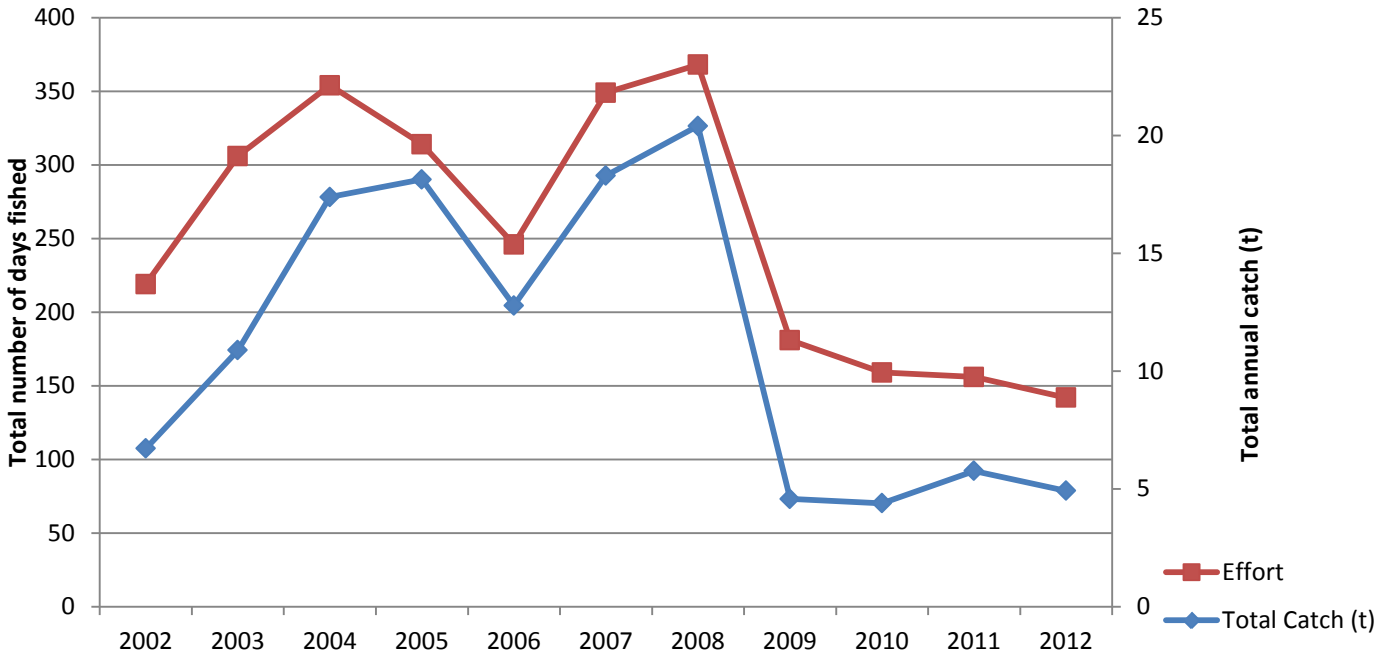

Figure C1: Catch and effort for shark species in the Balaclava Island study area commercial net fishery 2002-12 (Grid R30).

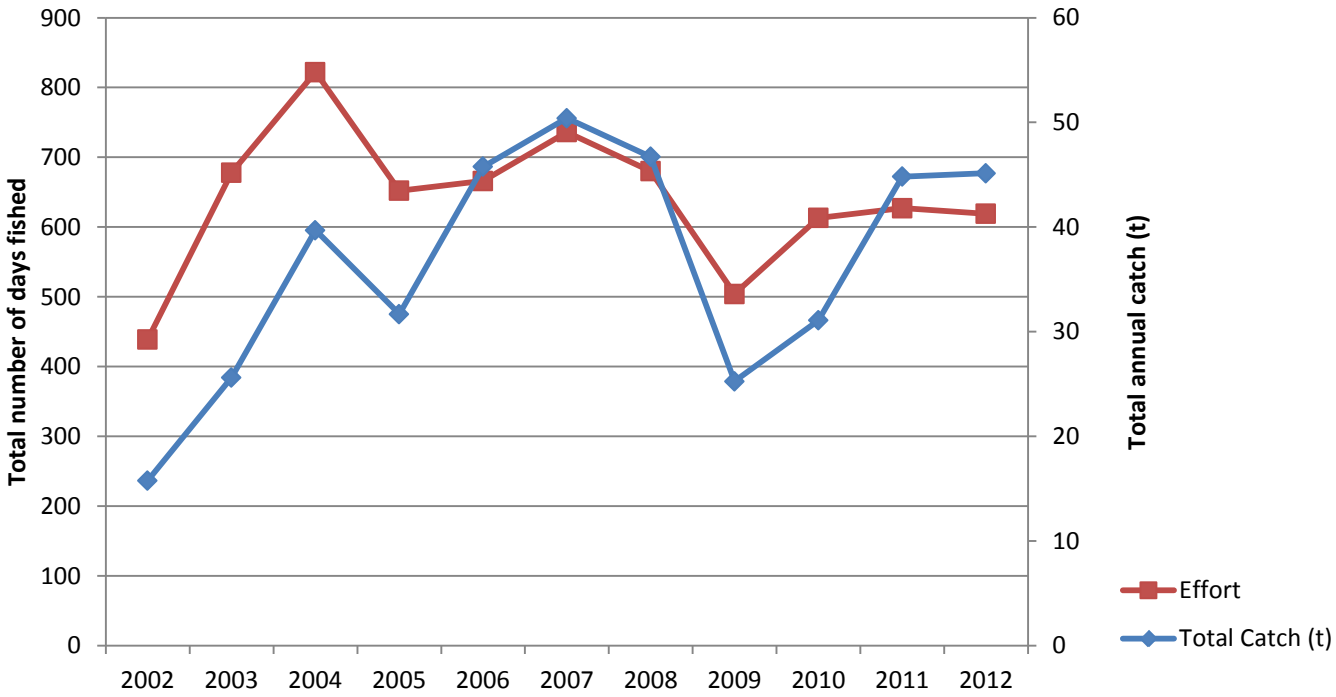

Figure C2: Catch and effort for threadfin salmon species in the Balaclava Island study area commercial net fishery 2002-12 (Grid R30).

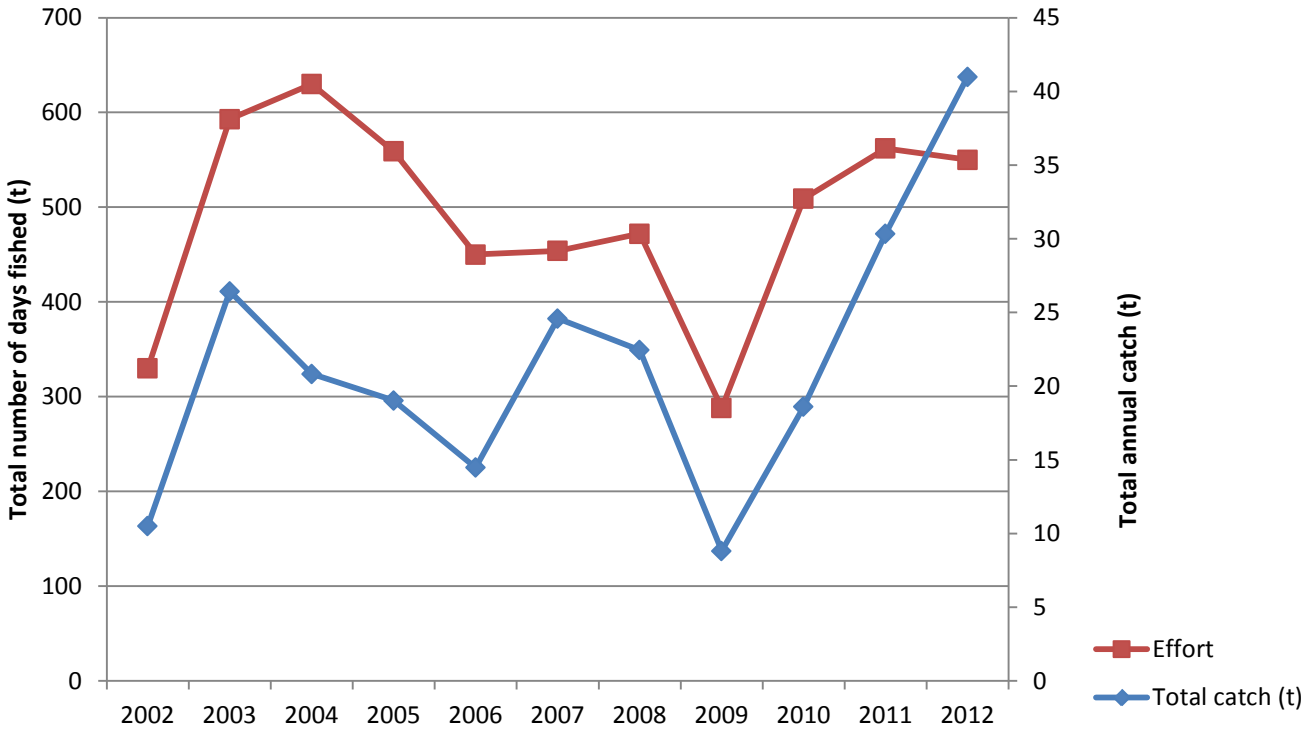

Figure C2: Catch and effort for barramundi in the Balaclava Island study area commercial net fishery 2002-12 (Grid R30).

Appendix D: Declared Fish Habitat Area assessment criteria

(NPRSR 2013)

Fisheries criteria	**Compatible with management 'B' area**	**Compatible with management 'A' area**
High fish species richness	Fish species richness similar to that of comparable regional 'benchmark' waterways.	
High diversity and abundance of regionally targeted fish species (adult or juvenile)	>10 regionally targeted fish species highly abundant.	> 15 regionally targeted fish species highly abundant.
Supports existing fisheries	Regular use of area by commercial, recreational or traditional fishers.	Major commercial and/or recreational and/or traditional fishery within area.
Supports external / regional fisheries	Commercial, recreational or traditional fishing occurs adjoining the area or in adjacent offshore waters, targeting species that are directly linked to the area.	Major commercial, recreational or traditional fisheries occurs adjoining the area or in adjacent offshore waters, targeting species that are directly linked to the area.

Fish habitat criteria	**Compatible with management 'B' area**	**Compatible with management 'A' area**
Large in size	> 100ha	> 500ha
Diverse habitat types	> 4 habitat types represented	> 7 habitat types represented
Presence of a functioning riparian buffer zone	> 50% of the length of the riparian zone is adequately vegetated and functioning effectively.	> 80% of the length of the riparian zone is adequately vegetated and functioning effectively.
Limited disturbance from artificial in-stream structures	Minimal disturbance from artificial structures (e.g. jetties, boat ramps, revetments). Average separation between structures 100–400 m and / or < 5% of the riverbank altered by artificial structures.	Nil to minimal disturbances from artificial structures (e.g. jetties, boat ramps, revetments). Average separation between structures > 400 m and / or < 5% of the riverbank altered by artificial structures.
Good water quality	Water quality standard meets the Queensland Water Quality Guidelines ((former)DERM 2009) or water quality objectives under the Environmental Protection (Water) Policy 2009 where applicable, for the protection of aquatic ecosystems; or Documented water quality improvement program is in place to enable the area to meet the Queensland Water Quality Guideline or water quality objectives within five years or less.	

Limited disturbance from, or ongoing reduction of impacts from, water impoundment structures	1. No water impoundment structures are present on the main stream and any major tributary of the main stream; or 2. The main stream and any major tributaries of the main stream only have water impoundment structures that: • allow for > 75% of flows to overtop the structure or are managed to release adequate (from a fisheries perspective) environmental flows; and • drown out regularly enough to allow for adequate fish passage or have a functional fishway; or 3. Fish passage and environmental flows in the main stream and any major tributaries will be maintained and a proposed program of water management activities will ensure a net improvement in fish passage and / or environmental flows within a 10 year timeframe.	
Limited interaction with developments of major significance to the state	No developments of major significance to the state are present within or adjoining the area; or Any adjoining developments of major significance to the state are in a location and can be appropriately buffered to ensure that they will have no existing or future impacts on the area.	
Compatible adjacent land and aquatic planning	Adjacent land and aquatic planning compatible with intent of management B area.	Adjacent land and aquatic planning compatible with intent of the strict management A area.
	No reduction in habitat values through inappropriate public or a proliferation of private structures or impacts from development.	

Regionally unique features	**Compatible with management 'B' area**	**Compatible with management 'A' area**
Presence of regionally unique natural fish habitat features	Contains one or more regionally unique features, e.g. habitat type, spawning ground, nursery location or habitat assemblage.	