9.0 ESTUARINE HABITATS AND NATIVE SPECIES

9.1 Derwent estuary habitats

The Derwent estuary supports a wide variety of habitat types, which have been broadly mapped over an area of 197 km^2. Information on estuarine habitat types and their distribution has recently been compiled by the Derwent Estuary Program (DEP) into a web-based *Derwent Estuary Habitat Atlas*, through a grant supported by the Australian Government. Major estuarine habitat types are summarised in **Table 9.1** and their distributions illustrated in **Figures 9.1 – 9.3**. Further information about the habitat atlas is available on the DEP website at www.derwentestuary.org.au (go to Derwent Habitat and Species section), while the full GIS mapping products can be accessed on the Land Information Services Tasmania (LIST) website at www.thelist.tas.gov.au (under 'Manage Layers', go to Natural Environment/Coastal Values/Derwent Estuary Habitat Atlas). The distribution maps were created using data from: Lucieer *et al*. (2007), Seacare, Information Land Services (DPIPWE), Coastal Marine Branch (DPIPWE), and mapping projects undertaken for the DEP by North Barker Ecosystem Services.

As indicated in **Table 9.1**, unvegetated subtidal sand and silt habitats are the most abundant habitat type within the Derwent estuary, occupying over 86% of the estuary area. The next most abundant types are aquatic macrophytes (6.6%; dominated by *Ruppia* spp. growing on mudflats in the upper estuary), followed by intertidal sands (5.8%; mostly as sand flats in the lower estuary). Other habitats (wetlands, saltmarshes, seagrasses, kelp forests, reefs and rocky shores) comprise the remaining 1.5% of the estuary area. Although collectively small in area these other habitat types are critical for sustaining many species found within the estuary. These different habitats types are discussed in more detail in subsequent sections, as is the fringing coastal vegetation that borders much of the estuary.

There has been extensive pressure on estuarine habitats from urban and industrial development, climate change, and changes in catchment use and River Derwent flow. These pressures have contributed to siltation and organic deposition in the upper and middle estuary, as well as deterioration in water and sediment quality throughout the estuary. In addition, there have been extensive habitat losses, notably amongst wetlands, saltmarshes, tidal flats and other foreshore habitats due to development and foreshore reclamation, particularly in the middle reaches of the estuary, where many wetlands were used as municipal and industrial tips and later redeveloped as recreation areas. Giant kelp forests and seagrass beds also appear to have declined in the estuary. Overfishing of some native species and the introduction of non-native marine and intertidal species, have dramatically changed the community of organisms living in the Derwent estuary. Recent analyses of sediment records from bays in the middle and lower estuary also suggest significant declines have occurred in sediment quality and native mollusc assemblages over the past 120 years (**see Section 9.4.1**). There are, however, significant areas of habitat remaining within the Derwent estuary that support healthy functioning ecosystems, with abundant and diverse populations of native species, as described below.

Table 9.1: Summary of habitats in the Derwent estuary

Habitat	Area sq km	Percentage %
Subtidal	**174.05****	**88.21**
Sand	92.97	47.05
Silt	77.62	39.28
Rocky Reef	3.00	1.52*
Cobble Reef	0.27	0.14
Kelp Forest	0.26	0.13
Seagrass	0.18	0.09
Shallow subtidal to intertidal	**6.58**	**3.33**
Aquatic Macrophytes	6.58	3.33
Intertidal	**13.23**	**6.69**
Intertidal sand (sand flat / beach)	11.37	5.75
Unvegetated mud flat	0.96	0.48
Rocky shorelines	0.90	0.46
Intertidal to supratidal	**3.49**	**1.77**
Saltmarsh	2.16	1.09
Wetland	1.34	0.68
Other		
Shipwreck	0.01	0.00
TOTAL AREA OF ESTUARY	197.61	

Notes:
* = includes overlap between reef and kelp
** = kelp subtracted from subtidal due to overlap with reef

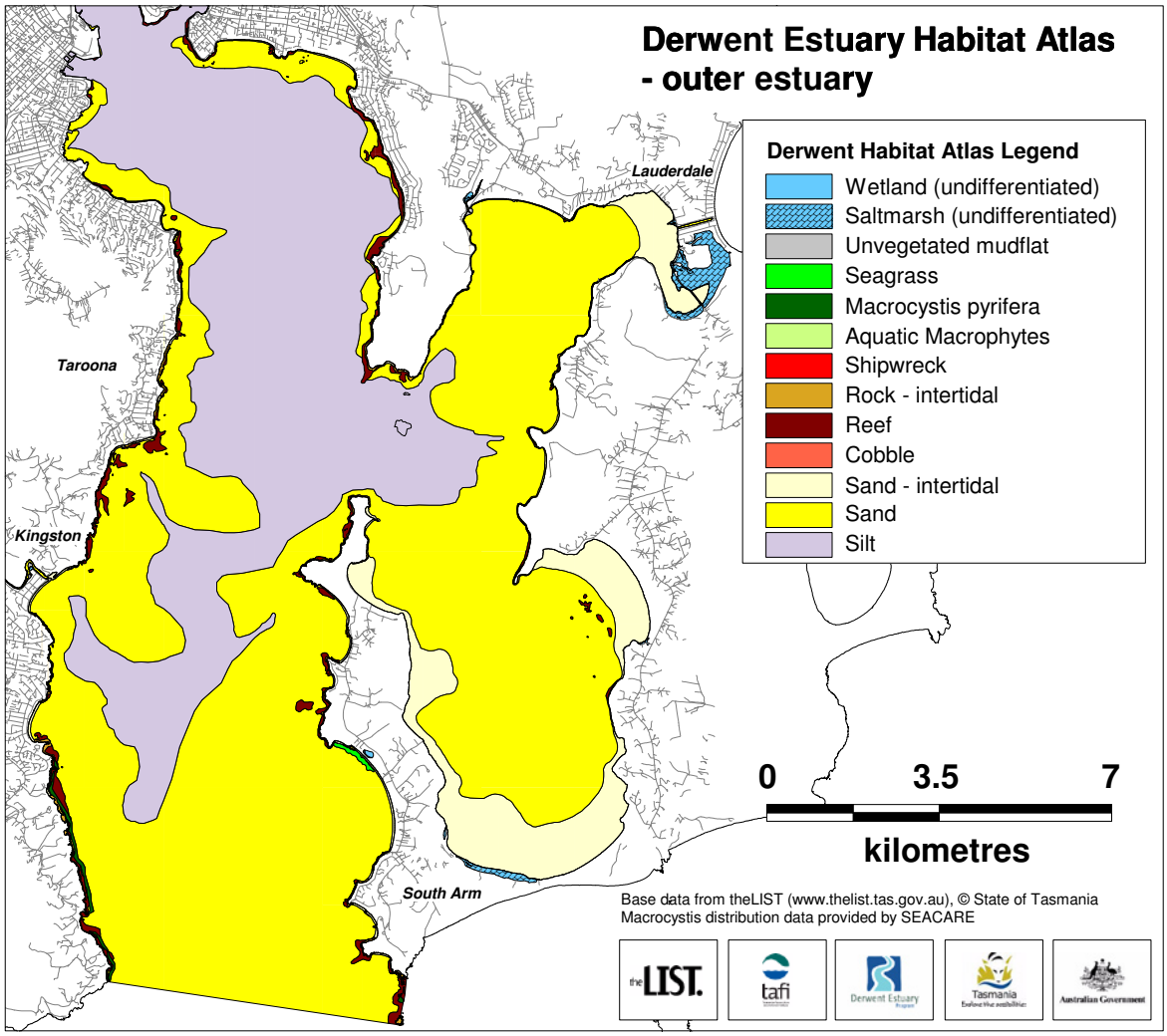
9.1.1 *Subtidal sands and silts*

Subtidal sands and silts are the dominant habitat types in the Derwent estuary. Sand predominates at shallower depths, covering 93 km^2 (i.e. 47%) of the estuary, while silt predominates in deeper areas, covering approximately 78 km^2 (i.e. 39%) of the estuary. The depth at which silt dominates becomes shallower up-estuary, from 25 m at the seaward extreme of the lower estuary to <5 m at Sullivan Cove and Kangaroo Bay. Subtidal sediments provide important substrate for microscopic algae, macroalgae, seagrasses and macrophytes and are a key habitat for benthic invertebrates. These sediments also perform a number of important ecological functions that maintain the overall health of the estuary, including denitrification, as discussed in **Section 5.4**.

Siltation has occurred in many Derwent subtidal (and intertidal) habitats as a result of land clearance, agriculture and urban development (Edgar *et al*. 2005). It appears that over the last 200 years silts have accumulated within many sheltered bays, particularly in the middle and upper estuary, impacting on public amenity and the biological values of these areas. These habitats have also been heavily impacted by historical discharges of heavy metals and organic matter (see **Sections 6.0 and 7.0**). Sediment-bound heavy metal concentrations are typically higher in subtidal silt than subtidal sand (see **Section 7.0**). Changes within soft sediment subtidal habitats can be detected through changing heavy metal, organic sediment, and mud (versus sand) concentrations and changes in benthic invertebrate species (see **Section 9.4.1**). Declining water quality and habitat disturbance has probably also contributed to the loss of seagrass beds from subtidal sediments in the middle and lower estuary, and Ralphs Bay, as described in **Section 9.1.3**.

Overfishing during the last 120 years has dramatically altered the structure and biology of subtidal sedimentary habitats in the Derwent estuary, most notably the conspicuous loss of native oyster and scallop beds along with their associated communities (Edgar and Samson 2004). The introduction of non-native species is also likely to have caused major impacts on these habitats, as introduced marine species can significantly alter the biological and chemical processes in subtidal sediments (Ross and Keough 2006). A notable example has been the formation of extensive beds of New Zealand screw shells (*Maoricolpus roseus*) within subtidal sands near the estuary entrance, as described by Macleod and Helidoniotis (2005), modifying this habitat into shelly gravel.

Figure 9.1: Distribution of habitat types in the lower reaches of the Derwent estuary



9.1.2 Rocky reefs and kelp forests

Subtidal rocky reefs

Subtidal rocky reefs collectively cover 3.2 km^2 (i.e., 1.6%) of the estuary (Lucieer *et al*. 2007). Although rocky reefs cover such a relatively small area, they are important to the overall species diversity within the estuary. Derwent estuary reef habitat varies substantially in structure, between the eastern and western shorelines, and in position along the estuary. In the lower estuary rocky reefs primarily occur as seaward extensions of the rocky shoreline. However in several places isolated reefs occur away from the coast and are surrounded by soft sediments (Lucieer *et al*. 2007). Sixty eight macroalgae species have been identified on the rocky reefs in the lower estuary (Sanderson 2000). In the lower estuary macroalgal distribution varies with water depth, with shallow areas dominated by *Lessonia corrugate* and *Ecklonia radiata*, and deeper areas dominated by *Carpoglossum confluens, E. radiata, Caulerpa* sp. and red algae species. Variation has also been observed in macroalgae between the eastern and western reefs in the lower estuary, with *Macrocystis pyrifera* (giant kelp) and introduced *Undaria pinnatifida* only observed on the western reefs. Along the eastern shore, the macroalgal assemblage was largely absent below 3 m water depth, and north of Opossum Bay the macroalage is less abundant. A greater oceanic influence from Storm Bay is thought to be a possible cause for some of the east-west macroalgal variation observed (Luccier *et al*. 2007). The subtidal rocky reef communities within, and just outside of, the Tinderbox Marine Protected Area were surveyed in 1992 and 1997 (Edgar and Barrett 2002) and can be used for the basis of future reef comparisons. The DEP and Tasmanian Aquaculture and Fisheries Institute (TAFI) are about to commence biological surveys on subtidal reef systems throughout the middle and lower Derwent estuary.

Figure 9.2: Distribution of habitat types in the middle reaches of the Derwent estuary

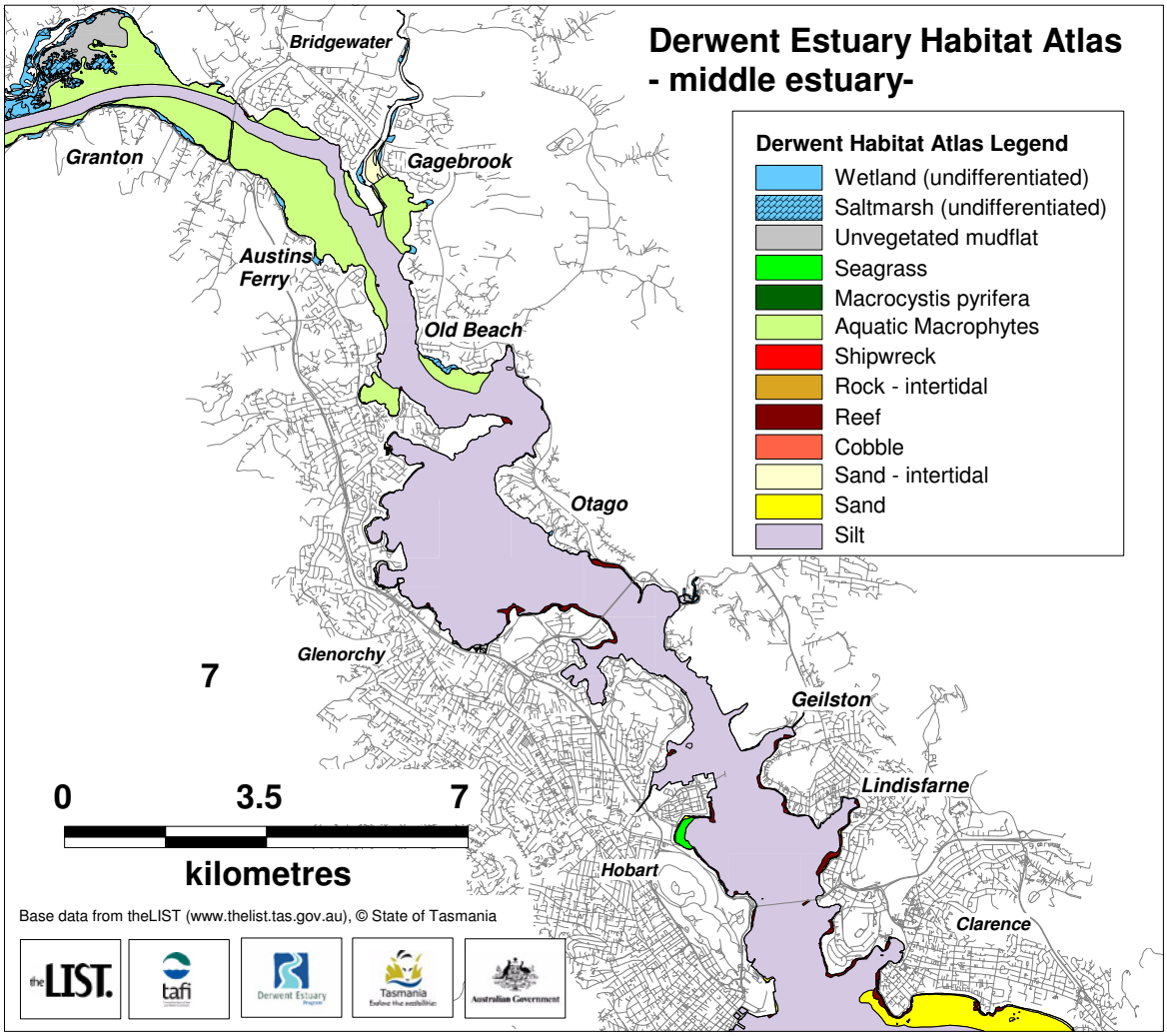
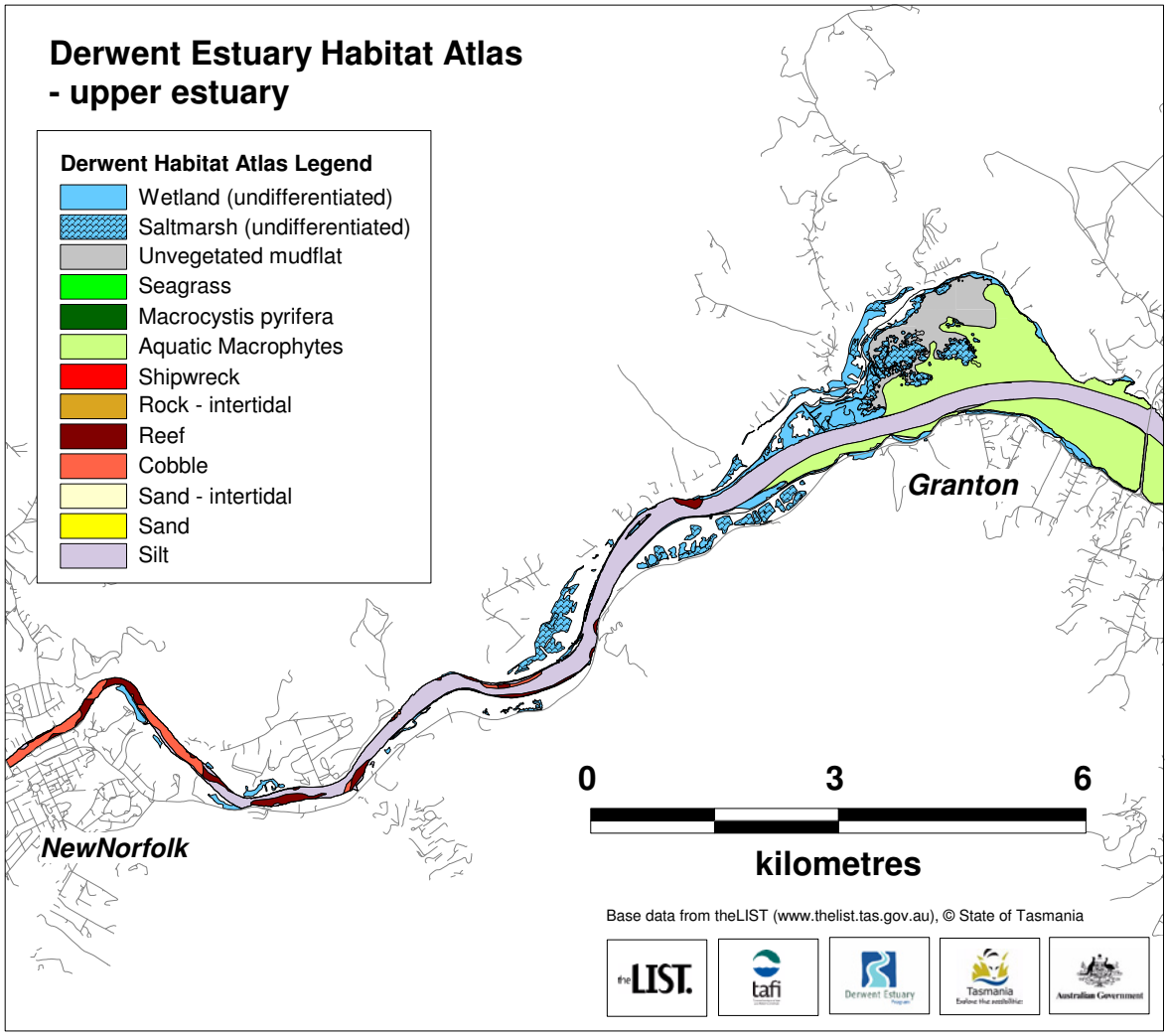


Figure 9.3: Distribution of habitat types in the upper reaches of the Derwent estuary



In the middle estuary, rocky reefs are narrow extensions of the rocky shoreline. There is a decrease in macroalgal abundance and diversity in the middle, estuary compared to the lower estuary (Jordan *et al*. 2001) and typically only small amounts of red and brown algae are present (Lucieer *et al*. 2007). Reef habitat of the middle estuary is influenced by environmental perturbations, both human-induced (enhanced turbidity and nutrients) and natural (intervals of high River Derwent flows result in lower salinity and reduce light levels due to high tannin levels). Freshwater events have been known to change the whole structure of reef habitats in the Derwent from macroalgae dominated systems to invertebrate dominated (A. Jordan, TAFI, *pers. comm. in:* Green and Coughanowr 2003).

Several subtidal rocky reefs and cobble areas occur in the upper estuary, within the main channel of the estuary, but there is little algal growth on these due to the low light levels and frequent freshwater flushing (Lucieer *et al*. 2007).

Giant string kelp forests

Several areas of the lower Derwent, along the Tinderbox Peninsula, contain giant string kelp forests (*Macrocytis pyrifera*) with brown algae (*Lessonia corrugate*) as a dominant species in the understory (Jordan *et al*. 2001). Giant kelp often grows to lengths of 30 m or more and provides habitat for many marine fish and invertebrates, including rock lobster, abalone, sea urchins and trumpeter. The most recent giant kelp survey in 1999 by Seacare Inc. Tasmania found that kelp covered 0.26 km^2 of the Derwent estuary (Sanderson 2000).

Declines in kelp beds within the Derwent estuary have been reported since the 1950s, particularly along the

estuary's eastern shore. Reefs affected by siltation in the Lindisfarne area have lost their kelp beds. The loss of this habitat has implications for the biodiversity of the middle and lower Derwent estuary. Major factors causing these losses include excessive sedimentation, warmer water temperatures and sea urchin infestation. Conversely, giant kelp appears to respond favorably to increased nutrient supply and is flourishing locally near the Blackmans Bay sewage outfall (C. Sanderson, TAFI, *pers. comm.* in: Green and Coughanowr 2003). Giant kelp transplanting trials were undertaken in the Derwent by Seacare Inc. Tasmania to assess the viability of reintroducing kelp to areas where it is believed to have disappeared or is in decline. A subsequent resurvey of these sites has indicated that the transplant trials have not been successful (S. Ibbott, 2009, Seacare, *pers. comm.*).

9.1.3 Aquatic macrophytes and seagrasses

Aquatic macrophytes and seagrasses generally occur in relatively shallow water, where there is adequate light penetration. These communities provide food, shelter and structural habitat for many invertebrates and fish, including a number of commercially important species. In the upper estuary these plants are the major primary producers and sustain an ecosystem with a considerably higher diversity and abundance of animals than in non-vegetated habitats.

Aquatic macrophytes are vascular plants that grow as submergent or floating vegetation, occasionally exposed above water during low tides. In this report, the term aquatic macrophyte is used to describe non-seagrass species which occur as a vegetation type defined by TasVeg as a *saline aquatic herbland*. This vegetation consists of a few species, dominated by *Ruppia* spp. (typically *R. megacarpa*), and in some places abundant *Lepilaena cylindrocarpa, Lamprothamnium* spp. and *Myriophyllum salsugineum* (NSR 2001). In the Derwent, aquatic macrophytes occur in the upper estuary in water depths <1.5 m.

Seagrasses are flowering plants adapted for life submerged in marine or estuarine environments. The dominant seagrass species in the Derwent estuary is *Heterozostera nigricaulis* (formerly *Heterozostera tasmanica*), with small populations of *Zostera mulleri*. The shallow aquatic macrophyte community around the Bridgewater causeway, dominated by *Ruppia megacarpa*, also contains less abundant seagrass *Heterozostera nigricaulis*, which becomes dominant towards the edge of the main channel of the Derwent estuary (at depths of 2 m) (Lucieer *et al*. 2007). This macrophyte/seagrass complex occurs south of the Bridgewater Causeway, in the mouth of the Jordan River, and adjacent to Austins Ferry, but is mapped as aquatic macrophytes (in **Figure 9.2**) due to the dominance of *Ruppia* (Lucieer *et al*. 2007).

Seagrass (*Heterozostera or Zostera*) dominated habitats are restricted to small beds within the lower and middle parts of the Derwent estuary with a combined area of around 0.18 km^2 (Lucieer *et al*. 2007). Seagrass beds in the lower Derwent occur within the northern part of Halfmoon Bay and consist entirely of *Heterozostera nigricaulis* to a depth of about 5 m. In the middle estuary, small seagrass beds consist primarily of *Heterozostera nigricaulis* and are found to a depth of about 3 m at: Cornelian Bay, Wilkinsons Point, the northern end of Dogshear Point, Woodville Bay and Old Beach (Jordan *et al*. 2001). Small amounts of *Zostera mulleri* are present in Cornelian Bay and Prince of Wales Bay (Lucieer *et al*. 2007).

Some changes in seagrass coverage were noted since an earlier Derwent estuary survey in Jordan *et al*. (2001), which include loss of seagrass beds at Opposum Bay, Dogshear Point, Wilkinsons Point, Woodville Bay and Old Beach. The seagrass beds of Cornelian Bay were previously noted to be in very poor health with sparse coverage and high epiphyte loading (Jordan *et al*. 2001). However their extent has now expanded across shallow areas of the bay (Lucieer *et al*. 2007). Many intertidal areas within middle estuary bays support seagrass (J. Whitehead, 2009, DEP, *pers. obs.*), but have not been included in previous boat based surveys as they were too shallow. Intertidal areas in Prince of Wales Bay support minor seagrass remnants amongst an extensive coverage of macroalgae (*Ulva* sp.), which is typically an indicator of eutrophication and may be contributing to low seagrass presence (J. Whitehead, 2009, DEP, *pers. obs.*). It is believed that the seagrass beds of the middle estuary are remnants of previously more widespread populations and there is concern that the remaining biomass may be insufficient for recruitment and maintenance of this habitat (A. Jordan, TAFI, *pers. comm.,* in: Green and Coughanowr 2003). Subsequent loss of some seagrass coverage throughout the middle estuary since the previous *State of the Derwent Estuary Report* supports this hypothesis.

Analysis of historic aerial photographs suggests that seagrass beds were formerly abundant throughout Ralphs Bay (Rees 1994). Recent surveys have not documented any regrowth of seagrass in Ralphs Bay (Lucieer *et al*. 2007, Aquenal 2008a), and further work is recommended to substantiate the past distribution of seagrass in this area of the estuary. The DEP is exploring different techniques for surveying and monitoring macrophyte and seagrass extent and condition, in collaboration with researchers from the University of Tasmania and TAFI.

9.1.4 Intertidal sand flats and mudflats

Intertidal sand flats and mudflats are low-lying areas that are inundated during high tides and are exposed during low tides. The Derwent estuary contains large areas of tidal flats (13.2 km^2), with mudflats predominating in the upper estuary and sand flats predominating in Ralphs Bay (particularly at Lauderdale, Mortimer Bay and the eastern side of South Arm). Tidal flats perform a wide range of essential functions. For example, these areas:

- contain large amounts of microscopic algae (microphytobenthos) and bacteria that play important roles in nutrient and organic matter cycling, denitrification and other biogeochemical processes;
- contain large numbers of invertebrates upon which fish, birds and other animals are dependent;
- are critically important habitats for wading shore birds;
- provide substrate for aquatic macrophytes, seagrass, and saltmarsh vegetation;
- protect shorelines from erosion and flood damage;
- moderate water temperatures.

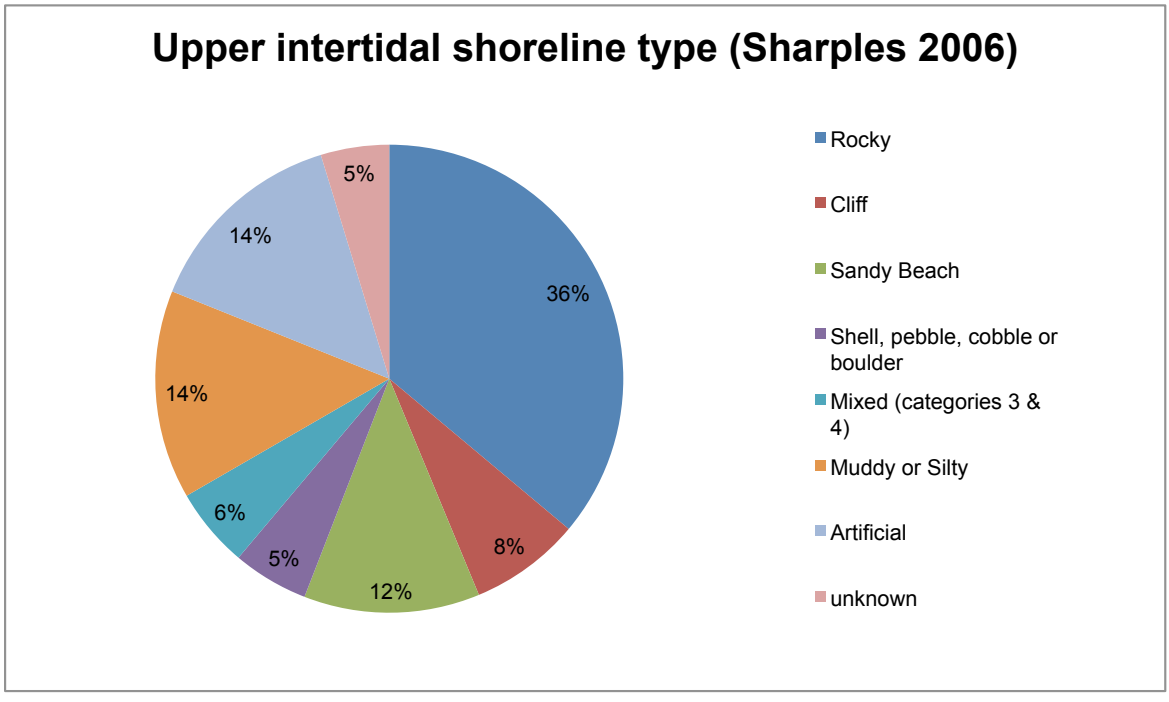
Although many of the sand and mudflats in the Derwent estuary appear to be unvegetated, these areas support large numbers of microscopic benthic algae (microphytobenthos). In the upper estuary, the relative abundance of microphytobenthos on the intertidal mudflats varies in proportion to the presence or absence of larger plants (notably macrophytes), which shade the underlying tidal flats and reduce the amount of light available for microphytobenthos photosynthesis (NSR 2001). In Ralphs Bay, the microscopic benthic algae distribution is relatively homogenous across the intertidal flats, but experiences some seasonal variation in algal abundance and species composition (Cook *et al*. 2007). The intertidal sand flats at Ralphs Bay are critically important for maintaining high levels of primary productivity in this intertidal ecosystem, with flow-on benefits to higher trophic levels, such as wading shorebirds (Cook *et al*. 2007).

The intertidal sand flats in Ralphs Bay, in conjunction with sand flats in the nearby Pittwater estuary, are internationally recognised for their significance to resident and migratory shorebirds (see **Section 9.4.3**). In contrast, intertidal mudflats (typically in the upper estuary) are not considered to be favourable habitats for wading shorebirds (Harrison 2008), but remain important areas for waterfowl and other species that also use the adjacent wetlands and saltmarshes.

9.1.5 Beaches and rocky shorelines

Beaches and rocky shorelines are a conspicuous part of the Derwent estuary, providing habitat for native species as well as public amenity and access to the estuary. The intertidal mean high water mark (MHWM) around the Derwent estuary is approximately 233 km long, and represents the length of the intertidal zone (the coastal strip between high and low tide). In reality this may be

Figure 9.4: Upper intertidal shoreline type in the Derwent estuary



Source: Sharples 2006

longer, as the convoluted salt marsh islands in the upper estuary have not been included in this calculation. It is possible to assess the relative proportion of intertidal beach and rocky shoreline around most of the estuary from geological and geomorphological data collected by Sharples (2006), based on mapping that extends up-estuary as far as Boyer. The following summary can be made about the nature of the Derwent estuary intertidal zone from the Sharples (2006) assessment (**Figure 9.4**).

Rocky shorelines comprise 84 km or 36% of the length of the Derwent intertidal zone and are notably found in the middle and lower estuary. Recent surveys of rocky intertidal communities in Ralphs Bay have documented 21 to 39 invertebrate species per site, falling within the range documented for other areas of eastern Tasmania (Aquenal 2008b). A number of intertidal rocky habitats within the Derwent estuary are now dominated by introduced species. Approximately 14% of the Derwent intertidal zone is artificial, largely as a result of land reclamation and wharf construction in the middle estuary. Sandy shorelines occur along approximately 12% of the Derwent estuary MHWM. The majority of sandy intertidal habitat is associated with sand flats.

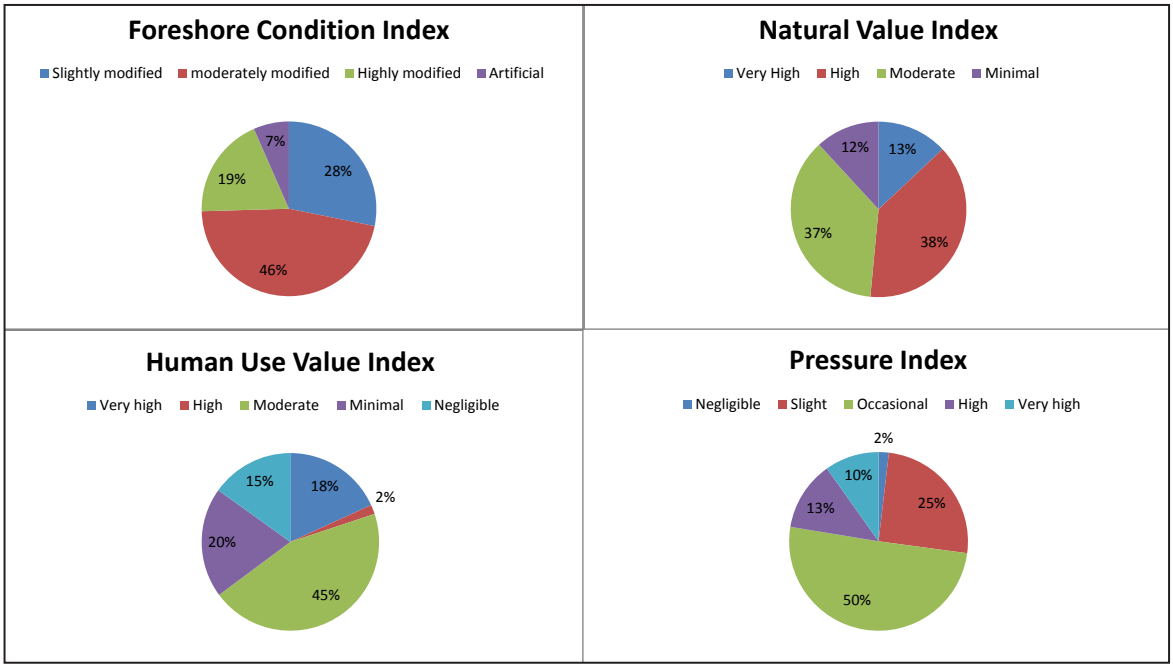
Assessment and mapping of intertidal zone values, condition and pressures in the Southern NRM Region (including the Derwent estuary) were commissioned by NRM South to better inform future management (Aquenal 2008b). Seventeen electronic mapping layers were produced, which were used to grade the intertidal zone based upon parameters such as biological values and conditions. **Figure 9.5** provides a summary of the Derwent estuary intertidal zone assessment for the key indices.

9.1.6 *Wetlands and saltmarshes*

Wetlands and saltmarshes are characterised by the presence of water, either permanently or periodically, and cover a 3.5 km area of the Derwent estuary. Saltmarshes occur on saline flats and estuarine areas fringing low energy coasts and are characterised by a high cover of salt tolerant species. They are variously dominated by succulent shrubs (samphire), grasses, sedges, rushes or herbs. Wetlands typically occur in the upper estuary (where more fresh water conditions typically occur) and in some places occur adjacent to saltmarsh vegetation.

Wetlands and saltmarshes provide valuable wildlife habitat, fish spawning grounds and nurseries, flood and erosion control, pollution abatement as well as visual and recreational amenities. Many wetland and saltmarsh plants actively regulate hydrology through a range of mechanisms such as transpiration, water-shading and sediment trapping. As water passes through wetlands and saltmarshes the combination of reduced current velocities

Figure 9.5: Derwent estuary intertidal zone assessment of i) natural value, ii) foreshore condition, iii) human use value, and iv) pressure (expressed as a relative % of the approximate 233 km of intetidal zone)



Source: data from Aquenal 2008b

and biochemical interactions with soils and plants acts as a natural filter, removing or attenuating silt, nutrients, pathogens, metals, hydrocarbons and other pollutants.

Many of the Derwent estuary's original wetlands and saltmarshes have been lost through land filling, foreshore reclamation, and draining and clearing for agriculture. The most extensive remaining area of wetland and saltmarsh complex is found along a 22 km stretch of the upper estuary, between New Norfolk and Dogshear Point. Other important wetlands and saltmarshes occur at Goulds Lagoon, Lauderdale (Racecourse Flats), southern Ralphs Bay and several other smaller communities. Several key wetland and saltmarsh areas are described in more detail below.

Derwent River Conservation Area and upper Derwent saltmarshes and wetlands

The Derwent River Conservation Area (gazetted in 1941) includes most of the upper Derwent estuary saltmarsh and wetland system below high water mark from near New Norfolk to Dogshear Point (22 km downstream). A coastal reserve of 30 m is present above the high water mark along some of the shoreline, but large areas of wetlands are in private ownership. The saltmarshes and wetlands of the upper Derwent estuary consist of several large areas of *saline sedgeland/rushland* (0.94 km^2, representing 70% of this vegetation type in the estuary) and *fresh water aquatic sedgeland and rushland* (1.05 km^2, representing 80% of this vegetation in the estuary). This vegetation borders the estuary and ranges in width from a few metres to several hundred metres in width. On better drained areas within the saltmarsh and wetland are large stands of *Leptospermum lanigerum* scrub, dry scrub dominated by *Acacia mearnsii*, and smaller stands of *Acacia – Bursaria* scrub, and *Eucalyptus ovata* woodland.

A complex network of saltmarsh islands between Granton and Bridgewater emerge from unvegetated and vegetated mudflats (dominated by the macrophtye genus *Ruppia*). These islands are relatively recent landforms that have largely developed since the 1940s. This is part of Tasmania's largest deltaic depositional environment and as such the region is listed as having geoheritage significance. See MacDonald (1995) for further detail. A study of the upper Derwent estuary was conducted as part of the *Norske Skog Ecological Risk Assessment* (Aquenal 2000), which included some mapping of saltmarshes, wetlands and other aquatic habitats.

In 2000, the DEP coordinated an initiative to purchase the 66 hectare wetland known as 'Murphys Flat', with support from the Natural Heritage Trust's National Reserve System Program and matching funding provided by the State Government, Derwent Valley Council and Norske Skog paper mill. The purchase of Murphys Flat increased the total area of upper estuary saltmarsh and wetland now under protection by approximately 30%. In 2006 several studies were conducted on vegetation, hydrology, water quality, and aquatic communities to assist in management of this site. The wetlands were found to support important populations of birds, fish, and platypus and also act as a natural filter, removing sediments, nutrients and other pollutants from the estuary waters. Murphys Flat receives freshwater input from the River Derwent and saltwater input from tidal action, creating a diversity of aquatic habitats, including saltmarsh, freshwater wetlands, and a possible meromictic pond located in the western part of the site (Kirkpatrick *et al*. 1997). Meromictic ponds (stratified water bodies with well defined halocline and saline bottom water) support a unique microscopic flora and fauna, and are extremely uncommon (Barmuta *et al*. 1995). If the meromictic pond is confirmed this may represent a limnological feature of national importance.

In 2008, the DEP commissioned further mapping of the Derwent's upper estuary saltmarshes and wetlands, as part of a National Heritage Trust funded project (North Barker 2008a). These vegetation maps have been incorporated within the *Derwent Estuary Habitat Atlas*.

The saltmarshes and wetlands of the upper Derwent estuary are listed as wetlands of national importance and state significance in the *Directory of Important Wetlands* (Environment Australia 2001). However, much of this habitat remains unprotected. The security of these saltmarshes and wetlands would be greatly enhanced by increasing their conservation status and preparing a regional management plan.

Goulds Lagoon Wildlife Sanctuary

The Goulds Lagoon Wildlife Sanctuary is located on the western shore of the Derwent estuary, 19 km northwest of Hobart. This shallow lagoon (8 hectares) is important as a feeding, resting and breeding ground for water birds and is a noted bird watching area. The major management issues at Goulds Lagoon are related to subdivision development in its small catchment, resulting in water quality decline (particularly from nutrient enrichment and sedimentation), weed invasion and disturbance of wildlife. The management issues of Goulds Lagoon have been reviewed in the *Goulds Lagoon Impact Study* (GCC, 1997). Protection of remnant wetlands, such as Goulds Lagoon, is very important as many of the original wetlands of the Derwent estuary have been destroyed, particularly those at the heads of small bays in the middle estuary. Goulds Lagoon and Otago Lagoon represent some of the last remnants of this type of wetland.

Lauderdale saltmarsh (including Racecourse Flats)

The Lauderdale saltmarsh occupies an area of approximately 1 km^2 and the vegetation communities were mapped in 2008 by North Barker for the DEP, using 2001 aerial photos. The vegetation is dominated by *succulent saline herbland* (ASS), 0.7 km^2, representing 88% of the Derwent estuary coverage of this vegetation type. This herbland can be divided into at least four different vegetation communities, which differ in species dominance (North Barker, 2008b). The next most common vegetation type within the Lauderdale saltmarsh is *saline sedgeland/rushland* (ARS), 0.2 km^2, representing 15% of the Derwent estuary coverage of this vegetation type. The complex mosaic of vegetation communities occurring here is in part due to variations in salinity, water and disturbance regimes. The Lauderdale wetland and saltmarsh is a critical habitat for the endemic Tasmanian saltmarsh moth, *Dasybela achroa*, which is listed as vulnerable under the Tasmanian *Threatened Species Protection Act 1995*. Only a few specimens of this moth have been recorded outside of this area. The saltmarsh community also contains two plants considered rare in Tasmania: the salt lawrencia (*Lawrencia spicata*) and the many-stemmed bluebell (*Wahlenbergia multicaulis*). This area has been impacted through past and current land uses, including infilling for the Lauderdale tip and associated leachate, altered hydrology, grazing, off-road vehicles, road construction, weeds and climate change (Clarence City Council 2008, North Barker 2008b).

9.2 Foreshore vegetation

Vegetation along the entire Derwent estuary foreshore (within 100 m of mean high water) has been mapped in detail by North Barker through projects supported by the Australian Government, NRM South, State Government and DEP (DTAE 2007, NorthBarker 2008a). The major foreshore vegetation groups and communities are listed in **Table 9.2**, with the relative proportions of the major vegetation groups illustrated in **Figure 9.6**. These vegetation groups can be broadly categorised as: 1) saltmarsh and wetland, 2) dry eucalypt forest and woodland, 3) non-eucalypt forest and woodland (e.g. she-oak forests), 4) scrub, heath and coastal complexes, and 5) native grassland she-oak forest, grassy woodlands/grasslands and dry eucalypt forest. Further information on specific foreshore vegetation groups, communities and their respective areas is provided in **Table 9.2**. Twelve of these vegetation communities are listed as threatened in the *Nature Conservation Act 2002*, in particular the dry eucalypt forest communities and saltmarsh and wetland communties.

An analysis of this information indicates that 51% of the foreshore has been cleared of native vegetation and consists predominantly of urban and rural land or exotic vegetation. The remaining 49% of the foreshore retains its native vegetation, of which about two-thirds consists

Figure 9.6: Derwent foreshore vegetation type (%), as mapped within a 100m swath above the mean high water mark

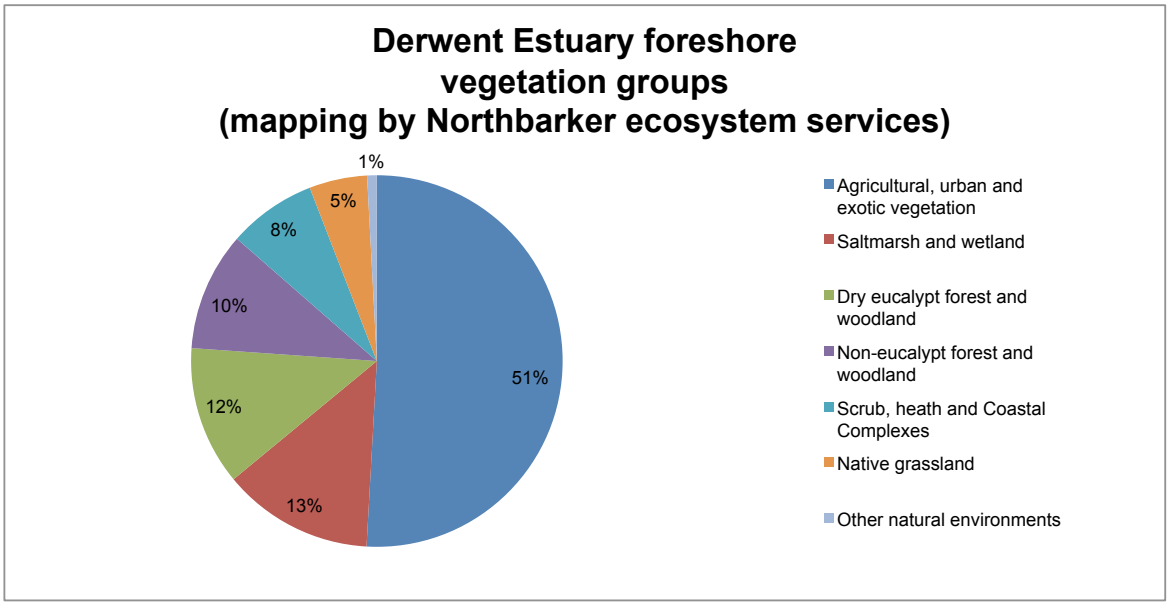


Table 9.2: Vegetation communities of the Derwent estuary foreshore

Vegetation Groups TASVEG code	Vegetation type	Area sq km	Area sq km
Agricultural, urban and exotic vegetation			**13.52**
FUM	Extra-urban miscellaneous	0.48	
FWU	Weed infestation	0.43	
FUR	Urban areas	8.60	
FMG	Marram grassland	0.12	
FPF	*Pteridium esculentum* fernland	0.06	
FPE	Permanent easements	0.03	
FPL	Plantations for silviculture	0.15	
FAG	Agricultural land	3.58	
FRG	Regenerating cleared land	0.07	
Other natural environments			**0.22**
ORO	Rock (cryptogamic lithosere)	0.07	
OSM	Sand, mud	0.06	
OAQ	Water, sea	0.09	
Scrub, heath and Coastal Complexes			**2.04**
SDU	Dry scrub	0.86	
SLW	*Leptospermum* scrub	0.93	
SBR	Broadleaf scrub	0.00	
SCA	Coastal scrub on alkaline sands	0.01	
SSC	Coastal scrub	0.16	
SAC	*Acacia longifolia* coastal scrub	0.05	
SRC*	Seabird rookery complex	0.04	
SRI*	Riparian scrub	0.01	
Dry eucalypt forest and woodland			**3.21**
DAM	*Eucalyptus amygdalina* forest and woodland on mudstone	0.10	
DAS	*Eucalyptus amygdalina* forest and woodland on sandstone	0.00	
DGL*	*Eucalyptus globulus* dry forest and woodland	1.20	
DOB	*Eucalyptus obliqua* dry forest and woodland	0.01	
DOV*	*Eucalyptus ovata* forest and woodland	0.31	
DPU	*Eucalyptus pulchella* forest and woodland	0.05	
DRI*	*Eucalyptus risdonii* forest and woodland	0.05	
DTO*	*Eucalyptus tenuiramis* forest and woodland on sediments	0.58	
DVG	*Eucalyptus viminalis* grassy forest and woodland	0.50	
DVS	*Eucalyptus viminalis* shrubby/heathy woodland	0.10	
DVC*	*Eucalyptus viminalis* – Eucalyptus globulus coastal forest and woodland	0.32	
Wet eucalypt forest and woodland			**0.01**
WGL	*Eucalyptus globulus* wet forest	0.01	
Non-eucalypt forest and woodland			**2.74**
NAV	*Allocasuarina verticillata* forest	1.74	
NBA	*Bursaria – Acacia* woodland and scrub	1.00	
Native grassland			**1.34**
GHC	Coastal grass and herbfield	0.22	
GCL	Lowland grassland complex	0.54	
GTL	Lowland *Themeda* grassland	0.16	
GPL	Lowland P*oa labillardierei* grassland	0.38	
GSL	Lowland sedgy grassland	0.03	
Saltmarsh and wetland			**3.49**
ARS*	Saline sedgeland/rushland	1.32	
ASF*	Fresh water aquatic sedgeland and rushland	1.32	
AHL*	Lacustrine herbland	0.00	
AHS*	Saline aquatic herbland	0.02	
ASS*	Succulent saline herbland	0.83	

*NOTE: North Barker vegetation mapping data were used to estimate the amount and type of native vegetation (TASVEG community categories) remaining along the Derwent estuary foreshore, based upon 2001 aerial photographs and field surveys. In the majority of areas mapping represents a 100 m strip of the foreshore above the MHWM. However, in those areas covered by wetlands and saltmarsh a wider vegetation swath has been mapped, adding approximately 3.18 km^2 in area to the mapping region).

* = vegetation communities listed as threatened through the *Nature Conservation Act 2002*.

See Harris and Kitchener (2005) for descriptions of the vegetation mapping units.

Table 9.3: Key attributes of major vegetation types along the Derwent estuary foreshore (excluding wetlands and saltmarshes)

Vegetation Type	Description	Areal extent/location	Conservation value/vulnerability
Scrub, Heath and Coastal complexes	Coastal vegetation consists of several structural formations, which contain species with morphological or physiological adaptions to salt spray. They include herbland, grassland, heath and scrub. The composition and structure of the vegetation is related to landform (e.g.dunes, swales, cliffs), soil conditions, erosional/accretional factors and exposure to salt laden winds.	In the Hobart region, coastal vegetation is best-developed on South Arm, with some of the most diverse and intact associations found within the South Arm State Recreation Area. Other important remnants of coastal complex vegetation include the Howrah-Bellerive dunes.	Coastal vegetation has a high priority for conservation because of its biological and aesthetic attributes. It is vulnerable to coastal erosion, mechanical disturbance and invasion by weeds (e.g. marram grass).
She-oak forest (non- eucalypt forest and woodland)	She-oaks (*Allocasuarina* spp.) are morphologically adapted to tolerate desiccating salt-laden winds and are typically associated with succulent scramblers and other salt-tolerant species.	Remnant she-oak forests are widely distributed around various parts of the lower Derwent foreshore. She-oaks are the dominant species in many foreshore reserves, for example in the Rosny Point / Kangaroo Bluff area.	CMany stands of she-oak forests have been lost to urban expansion along the foreshore. She-oaks forests are vulnerable to weed invasion and degradation by recreational use.
Native grasslands and grassy woodlands	Native grasslands and grassy woodlands are dominated by native grasses and widely-spaced eucalypts (particularly white gum – *E. viminalis*). They occur mainly in dry areas on dolerite or basalt soils. In the past, many grasslands were maintained by firing and marsupial browsing. This prevented dominance by woody species and maintained diversity of grassland flora.	Most grassy woodlands/grasslands along the foreshore are found in drier regions, particularly Clarence and Brighton (e.g. East Risdon Nature Reserve). The Domain also contains several important grassland communities, containing threatened species.	Native grasslands/ grassy woodlands are some of Tasmania's most endangered ecosystems. Expanding urban development, agriculture and poor fire management are the main threats.
Dry eucalypt forest	These forests are typically dominated by eucalypts with an understorey of hard-leaved shrubs, bracken, grasses and graminoids. There are many different communities, grading into grassy woodlands, she-oak forests and wet sclerophyll forests.	Dry sclerophyll forests are found along the Alum Cliffs between Taroona and Kingston.	

of forest/woodland and coastal scrub and the remainder consist of non-woody communities (e.g. wetlands, saltmarshes, and native grasslands). A number of important vegetation types remain along the foreshore of the Derwent estuary, particularly in areas protected as reserves. Further comments on Derwent estuary foreshore vegetation types other than wetlands and saltmarshes are provided in **Table 9.3.**

9.3 Threatened flora

A search of the DEP area on the DPIPWE *Natural Values Atlas* database indicates that there are 138 threatened plant species within the region, as indicated in **Table 9.4**. According to Tasmanian threatened species legislation, these threatened flora are classified as:

- Two species presumed extinct;
- 22 species endangered;
- 19 species vulnerable (one unofficial); and
- 88 species rare (five unofficial).

Note: unofficial species have not yet been formally listed under the *Threatened Species Protection Act 1995*.

Of the 138 threatened Tasmanian plant species in the DEP area, 21 species have 50% or more of their known distribution found in this area, and of these, nine species are found only in this region. The nine threatened endemic species include: *Caladenia sylvicola* (forest fingers), *Hydrocotyle laxiflora* (stinking pennywort), *Ozothamnus reflexifolius* (reflexed everlastingbush), *Parmelina pallida, Plantago gaudichaudii* (narrow plantain), *Prasophyllum perangustum* (knocklofty leek-orchid), *Thelymitra bracteata* (leafy sun-orchid), *Thesium australe* (southern toadflax) and *Veronica notabilis* (forest speedwell).

Table 9.4: Tasmanian-listed threatened plant species within the Derwent Estuary Program region

Threatened flora in DEP area Scientific name	Common name	Code Tas	Aust	Cons. Signif.	RFA Priority	NVA obs DEP	Tas	% TAS obs in DEP area
Acacia ulicifolia	juniper wattle	r		y	Y	2	242	0.83
Allocasuarina duncanii	conical sheoak	r		y	Y	23	23	13.04
Anogramma leptophylla	annual fern	v		y	Y	2	15	13.33
Aphelia gracilis	slender fanwort	r		y	Y	1	59	1.69
Arthropodium strictum	chocolate lily	r		y	Y	69	382	18.06
Asperula scoparia var. scoparia	prickly woodruff	r		y	Y	23	116	19.83
Asperula subsimplex	water woodruff	r		y	Y	2	28	7.14
Atriplex suberecta	sprawling saltbush	v				2	14	14.29
Austrodanthonia induta	tall wallabygrass	r		y	Y	159	201	79.10
Austrodanthonia popinensis	blue wallabygrass	e	EN			63	159	39.62
Austrostipa bigeniculata	doublejointed speargrass	r		y	Y	13	27	48.15
Austrostipa blackii	crested speargrass	r		y	Y	3	12	25.00
Austrostipa nodosa	knotty speargrass	r		y	Y	55	219	25.11
Austrostipa scabra	rough speargrass	r		y	Y	43	106	40.57
Austrostipa scabra subsp. falcata	sickle speargrass	pr		y	Y	10	19	52.63
Austrostipa scabra subsp. scabra	rough speargrass	pr		y	Y	3	6	50.00
Bolboschoenus caldwellii	sea clubsedge	r				11	53	20.75
Bossiaea obcordata	spiny bossia	r		y	Y	2	94	2.13
Brachyglottis brunonis	tasmanian daisytree	r		y	Y	19	48	39.58
Brachyscome perpusilla	tiny daisy	r		y	Y	1	3	33.33
Brachyscome radicata	spreading daisy	r		y	Y	1	32	3.13
Brachyscome rigidula	cutleaf daisy	v		y	Y	2	38	5.26
Brachyscome sieberi var. gunnii	forest daisy	r		y	Y	9	28	32.14
Caladenia anthracina	blacktip spider-orchid	e	CR	y	Y	4	23	17.39
Caladenia caudata	tailed spider-orchid	v	VU	y	Y	36	157	22.93
Caladenia filamentosa	daddy longlegs	r		y	Y	20	60	33.33
*Caladenia sylvicola**	forest fingers	e	CR	y	Y	6	6	100.00
Calocephalus citreus	lemon beautyheads	r				29	127	22.83
Calocephalus lacteus	milky beautyheads	r				5	121	4.13
Calystegia soldanella	sea bindweed	r				1	21	4.76
Carex gunniana	mountain sedge	r		y	Y	11	44	25.00
Carex longebrachiata	drooping sedge	r		y	Y	4	70	5.71
Carex tasmanica	curly sedge		VU	y	Y	46	133	34.59
Colobanthus curtisiae	grassland cupflower	r	VU	y	Y	1	121	0.83
Comesperma defoliatum	leafless milkwort	r		y	Y	1	32	3.13
Corunastylis nuda	tiny midge-orchid	r		y	Y	3	37	8.11
Corunastylis nudiscapa	bare midge-orchid	e		y	P	14	15	93.33
Cotula vulgaris var. australasica	slender buttons	r				1	34	2.94
Cuscuta tasmanica	golden dodder	r				4	10	40.00
Cynoglossum australe	coast houndstongue	r				21	145	14.48
Cyrtostylis robusta	large gnat-orchid	r		y	Y	8	66	12.12
Damasonium minus	starfruit	r				1	3	33.33
Deyeuxia benthamiana	benthams bentgrass	r		y	Y	4	31	12.90
Deyeuxia densa	heath bentgrass	r				3	44	6.82
Dianella amoena	grassland flaxlily	r	EN	y	Y	38	238	15.97
Diuris palustris	swamp doubletail	e		y	Y	6	48	12.50
Epacris acuminata	claspleaf heath	r	VU	y	Y	26	252	10.32
Epacris virgata (Kettering)		pv	PEN	y	Y	9	158	5.70
Epilobium pallidiflorum	showy willowherb	r				2	65	3.08
Eryngium ovinum	blue devil	v		y	Y	11	58	18.97
Eucalyptus morrisbyi	morrisbys gum	e	EN	y	Y	14	31	45.16
Eucalyptus risdonii	risdon peppermint	r		y	Y	249	406	61.33
Euphrasia scabra	yellow eyebright	e		y	Y	10	35	28.57
Gratiola pubescens	hairy brooklime	v		y	Y	1	13	7.69
Haloragis aspera	rough raspwort	v		y	Y	2	7	28.57
Haloragis heterophylla	variable raspwort	r		y	Y	8	71	11.27
Hibbertia basaltica	basalt guineaflower	e	EN	y	y	59	90	65.56
Hovea tasmanica	rockfield purplepea	r		y	Y	6	93	6.45
Hyalosperma demissum	moss sunray	e		y	Y	5	29	17.24
*Hydrocotyle laxiflora**	stinking pennywort	v		y	Y	5	5	100.00
Hypoxis vaginata	sheathing yellowstar	r		y	Y	4	77	5.19
Hypoxis vaginata var. brevistigmata	sheathing yellowstar	pr		y	Y	4	154	2.60
Isoetopsis graminifolia	grass cushion	e		y	Y	9	29	31.03
Isolepis habra	wispy clubsedge	r		y	Y	3	13	23.08
Juncus amabilis	gentle rush	r		y	Y	40	142	28.17
Juncus vaginatus	clustered rush	r		y	Y	1	29	3.45
Lachnagrostis punicea subsp. filifolia	narrowleaf blowngrass	r				2	3	66.67
Lachnagrostis punicea subsp. punicea	bristle blowngrass	r		y	Y	1	11	9.09
Lachnagrostis robusta	tall blowngrass	r				4	17	23.53
Lepidium hyssopifolium	soft peppercress	e	EN	y	Y	22	140	15.71
Lepidium pseudotasmanicum	shade peppercress	r		y	Y	111	221	50.23
Lepidosperma tortuosum	twisting rapiersedge	r		y	Y	6	36	16.67
Lepilaena patentifolia	spreading watermat	r				5	35	14.29
Lepilaena preissii	slender watermat	r				3	11	27.27

Threatened flora in DEP area Scientific name	Common name	Code Tas	Aust	Cons. Signif.	RFA Priority	NVA obs DEP	 Tas	% TAS obs in DEP area
Leucopogon virgatus var. brevifolius	shortleaf beardheath	r		y	Y	2	8	25.00
Limonium australe	yellow sea-lavender	r				3	39	7.69
Lobelia pratioides	poison lobelia	v		y	Y	1	30	3.33
Lotus australis	australian trefoil	r				2	59	3.39
Lythrum salicaria	purple loosestrife	v		y	Y	1	76	1.32
Olearia hookeri	crimsontip daisybush	r		y	Y	12	20	60.00
*Ozothamnus reflexifolius**	reflexed everlastingbush	v	VU	y	Y	10	10	100.00
Parietaria debilis	shade pellitory	r				1	54	1.85
*Parmelina pallida**		e		y	Y	1	1	100.00
Parmelina whinrayi		r				1	3	33.33
Pellaea calidirupium	hotrock fern	r		y	Y	3	62	4.84
Pentachondra ericifolia	fine frillyheath	r		y	Y	1	55	1.82
Pimelea curviflora var. gracilis	slender curved riceflower	r		y	Y	2	56	3.57
Pimelea flava subsp. flava	yellow riceflower	r		y	Y	20	648	3.09
*Plantago gaudichaudii**	narrow plantain	v		y	Y	1	1	100.00
Pomaderris elachophylla	small-leaf dogwood	v		y	Y	4	503	0.80
Pomaderris intermedia	lemon dogwood	r		y	Y	1	97	1.03
Potamogeton pectinatus	fennel pondweed	r				3	26	11.54
Prasophyllum amoenum	dainty leek-orchid	e	EN			1	14	7.14
Prasophyllum apoxychilum	tapered leek-orchid	e	EN	y	Y	2	33	6.06
*Prasophyllum perangustum**	knocklofty leek-orchid	e	CR	y	Y	4	4	100.00
Pterostylis squamata	ruddy greenhood	r		y	Y	3	46	6.52
Pterostylis wapstrarum	fleshy greenhood	e	CR			1	14	7.14
Pterostylis ziegeleri	grassland greenhood	v	VU	y	y	1	72	1.39
Pultenaea prostrata	silky bushpea	v		y	Y	1	53	1.89
Ranunculus pumilio var. pumilio	ferny buttercup	r		y	Y	4	29	13.79
Ranunculus sessiliflorus var. sessiliflorus	rockplate buttercup	r		y	Y	12	114	10.53
Rhodanthe anthemoides	chamomile sunray	r				1	90	1.11
Ruppia megacarpa	largefruit seatassel	r				7	21	33.33
Ruppia tuberosa	tuberous seatassel	r				3	5	60.00
Schoenoplectus validus	river clubsedge	r				1	25	4.00
Scleranthus brockiei	mountain knawel	r		y	Y	5	116	4.31
Scleranthus fasciculatus	spreading knawel	v		y	Y	18	126	14.29
Senecio squarrosus	leafy fireweed	r		y	Y	26	101	25.74
Senecio velleioides	forest groundsel	r		y	Y	5	38	13.16
Spyridium eriocephalum var. eriocephalum	heath dustymiller	e		y	Y	12	17	70.59
Spyridium vexilliferum var. vexilliferum	helicopter bush	r		y	y	5	208	2.40
Stellaria multiflora	rayless starwort	r		y	Y	3	129	2.33
Stenopetalum lineare	narrow threadpetal	e		y	Y	3	7	42.86
Stylidium despectum	small triggerplant	r				1	26	3.85
Teucrium corymbosum	forest germander	r		y	Y	15	101	14.85
*Thelymitra bracteata**	leafy sun-orchid	e				4	4	100.00
Thelymitra malvina	mauvetuft sun-orchid	e		y	Y	1	46	2.17
*Thesium australe**	southern toadflax	x	VU			1	1	100.00
Thismia rodwayi	fairy lanterns	r		y	Y	7	69	10.14
Triglochin minutissimum	tiny arrowgrass	r				1	26	3.85
Triptilodiscus pygmaeus	dwarf sunray	v				2	22	9.09
Uncinia elegans	handsome hooksedge	r		y	Y	1	26	3.85
Velleia paradoxa	spur velleia	v		y	Y	21	58	36.21
*Veronica notabilis**	forest speedwell	x		y	Y	1	1	100.00
Viola cunninghamii	alpine violet	r		y	Y	3	296	1.01
Vittadinia burbidgeae	smooth new-holland-daisy	pr		y	Y	3	31	9.68
Vittadinia cuneata var. cuneata	fuzzy new-holland-daisy	r		y	Y	8	144	5.56
Vittadinia gracilis	woolly new-holland-daisy	r		y	Y	57	193	29.53
Vittadinia muelleri	narrow leaf new holland daisy	r		y	Y	144	313	46.01
Vittadinia muelleri	narrowleaf new-holland-daisy	pr		y	y	144	313	46.01
Westringia angustifolia	narrowleaf westringia	r		y	Y	8	107	7.48
Wilsonia rotundifolia	roundleaf wilsonia	r				2	93	2.15
Xanthoparmelia amphixantha		e				2	21	9.52
Xanthoparmelia jarmaniae		v		y	Y	1	5	20.00
Xanthoparmelia molliuscula		e		y	Y	1	8	12.50
Xanthoparmelia oleosa		r		y	Y	1	2	50.00
Xanthoparmelia vicariella		r		y	Y	1	3	33.33
Xerochrysum bicolor	eastcoast everlasting	r		y	Y	1	59	1.69

* These type of species found only with the Derwent Region.

NOTES: Threatened species in Tasmania are listed subject to the following national and state Acts:

National: *Environment Protection and Biodiversity Conservation Act 1999* – Threatened species under the national schedule are classified as: EX) Extinct, EW) Extinct in the Wild, CR) Critically Endangered, EN) Endangered, VU) Vulnerable and CD) Conservation Dependent.

Tasmania: *Threatened Species Protection Act 1995* – Threatened species under Tasmanian legislation are classified as: x) presumed extinct (on the ground that no occurrence of the taxon in the wild can be confirmed during the past 50 years); e) endangered (in danger of extinction because long term survival is unlikely while the factors causing the species to be endangered continue operating); v) vulnerable (a species which is likely to become endangered while the factors causing it to be vulnerable continue operating) and; r) rare (a species which has a small population in Tasmania that is not endangered or vulnerable but is at risk).

9.4 Derwent estuarine fauna

9.4.1 Benthic macroinvertebrates

Benthic macroinvertebrates are organisms that live in or on sediments and are visible to the naked eye, including crustaceans (e.g. crabs and amphipods), molluscs (e.g. gastropods, bivalves, slugs and snails) and polychaetes (worms). Benthic macroinvertebrates are a critical component of a healthy ecosystem and occur in all Derwent estuary habitats. They can be used to assess the condition of biological communities with certain components being used as indicators of environmental stress. Infaunal and sessile epifaunal (surface dwelling) benthic macroinvertebrates make good environmental indicators because these species are relatively immobile and as such are unable to evade impacts such as nutrient enrichment and toxicant loading, and as a consequence they will reflect the cumulative impacts of environmental conditions.

Macroinvertebrate studies carried out in the Derwent estuary prior to 2003 – including Edgar *et al*. (1999), Aquenal (2000) and Sanderson 2000 – are reviewed in the previous *State of the Derwent Estuary Report* (Green and Coughanowr 2003). More recent investigations are summarised below.

A major decline has been seen in mollusc species diversity and abundance in the Derwent estuary over the last 120 years, as documented in sediment cores analysed by Edgar and Samson (2004) from five sites in the estuary (Geilston Bay, Kangaroo Bay, Tranmere, Ralphs Bay north and entrance). The mean shell number (per 5 cm sediment core interval) in 1890 was approximately 105, but had declined to approximately 45 by 1990. Similarly, mean shell diversity in 1890 was approximately 17 (per 5 cm sediment core interval), declining to approximately 8 by 1990. This decline in mollusc abundance and diversity has been linked to historic overfishing of scallops (*Pecten fumatus* and *Chlamys asperrimus*) and native oysters (*Ostrea angasi*), and the associated dredge fishing methods used in their capture (Edgar and Samson 2004). Native oyster and scallop beds would have provided an important habitat type within the Derwent estuary that are now absent. During the past century, the abundance of some native molluscs has declined in synchrony with rises in abundance of introduced taxa (Edgar *et al*. 2005). For example, the native mollusc *Theora fragilis* has disappeared since the 1950s, coinciding with the arrival and increased abundance of a similar species *Theora lubrica* (introduced from southeast Asia) (Edgar *et al*. 2005). The native species *Theora fragilis* has not been seen alive for the last two decades, and this is also the case for over 1000 of Tasmania's native mollusc species (Edgar *et al*. 2005).

A more recent survey of benthic macroinvertebrate communities associated with subtidal sediment habitats at 55 sites in the Derwent estuary was undertaken in 2004 (Macleod and Helidoniotis 2005). This survey assessed the macro-invertebrate community relationship to abiotic environmental variables. Eight major benthic invertebrate community groups were identified in the Derwent estuary, with each community group characterised by a particular combination of polychaete, bivalve, amphipod, ostracod, crab, gastropod, nemertean and/or brittle star species. The community distribution in the Derwent was found to be most strongly related to the sediment type, organic content and salinity regime. Species diversity in general increased and total abundance decreased towards the mouth of the estuary. The lowest diversity was in the upper estuary and in areas subject to tidal emersion, with certain upper estuary species found to be indicative of high organic loading. Heavy metal content in sediments (when calculated as a total) was not found to be a major determinant of benthic invertebrate community distribution, except in the most contaminated areas (Macleod and Helidoniotis 2005). However, the readily biologically available portion of the heavy metals that can be released into the porewater and overlying water column may influence benthic invertebrate distribution within subtidal habitats (Jeff Ross, 2009, TAFI, *pers. comm.*).

A study conducted on the benthic invertebrate communities of the intertidal sandflats in Ralphs Bay (near Lauderdale, Mortimer Bay and east of South Arm) found that this area also supports relatively healthy benthic invertebrate communities (Aquenal 2008a). The species richness of these intertidal sandflats indicated mid-range values when compared to other locations throughout south eastern Tasmania (Aquenal 2008a). The Shannon-Wiener diversity indices (a measure of species richness with regard to the proportion of the total count contributed by each species) calculated for the Ralphs Bay sandflats were high, indicating that the invertebrate communities generally consisted of a range of species at similar densities rather than a mixture of highly abundant and rare species (Aquenal 2008a).

Introduced marine species are also altering macroinvertebrate communities and habitats within the Derwent estuary (see **Section 11.0**).

9.4.2 Fish

Approximately 150 fish species have been documented in the middle and lower parts of the Derwent estuary (**Table 9.5**). The distribution of fish species depends primarily on their tolerance to salinity changes and available habitat. The fish communities in the Derwent estuary can be broadly classified as i) pelagic (living in the mid water column), ii) demersal (bottom dwelling on soft sediments) and, iii) reef species. Some species, such as flathead (typically associated with soft sediments)

Table 9.5: Fin fish of the middle and lower Derwent estuary

Scientific Name	Common Name	Scientific Name	Common Name
Acanthaluteres spilomelanuru	bridled leatherjacket	*Meuschenia freycineti*	six-spined leatherjacket
Acanthaluteres vittiger	toothbrush leatherjacket	*Mitotichthys mollisoni*	mollison's pipefish
Acanthopagrus butcheri	black bream	*Mugil cephalus*	sea mullet
Aldrichetta forsteri	yellow eye mullet	*Mustelus antarcticus*	gummy shark
Allomycterus pilatus	porcupine fish	*Neoplatycephalus richardsoni*	tiger flathead
Ammotretis liturata	spotted flounder	*Neosebastes thetidis*	thetis fish
Ammotretis rostratus	long snouted flounder	*Nesogobius hinisbyi*	orange-spotted goby
Aracana aurita	Shaw's cowfish	*Nesogobius pulchellus*	castelnau's goby
Anguilla reinhardtii	long-finned eel	*Nesogobius sp.1*	girdled goby
Aplodactylus arctidens	Marblefish	*Norflokia clarkei*	common threefin
Arenigobius bifrenatus	bridled goby	*Notolabrus fucicola*	purple wrasse
Argentina australiae	silverside	*Notolabrus tetricus*	blue-throat wrasse
Arripis spp.	Australian salmon-eastern/western	*Notopogon lilliei*	crested bellows fish
Aspasmogaster tasmaniensis	Tasmanian Clingfish	*Notorhynchus cepedianus*	seven-gilled shark
Asymbolus sp.	orange spotted catshark	*Omegophora armilla*	ringed toadfish
Atherinason brevirostrus	short-headed hardyhead	*Parablennius tasmanianus*	blenny
Atherinosoma microstoma	small-mouthed hardyhead	*Parablennius tasmanianus*	Tasmanian blenny
Atherinosoma presbyteroides	silverfish	*Parapercis allporti*	barred grubfish
Atypichthys strigatus	Mado Sweep	*Parascyllium ferrugineum*	rusty catshark
Bovichtus angustifrons	Dragonet	*Parika scaber*	velvet leatherjacket
Brachaluteres jacksonianus	pigmy leatherjacket	*Paristiopterus labiosus*	giant boarfish
Callorhynchus milii	elephant fish	*Parvicrepis parvipinnis*	smallfin clingfish
Cephaloscylliumlaticeps	draughtboard shark	*Pavoraja nitida*	peacock skate
Cheilodactylus spectabilis	banded morwong	*Pegasus lancifer*	sculptured seamoth
Chelidonichthys kumu	red gurnard	*Pempheris multiradiata*	common bullseye
Contusus brevicaudas	prickly toadfish	*Pentaceropsis recurvirostris*	long-snout boarfish
Crapatalus munroi	pink sandfish	*Platycephalus laevigatus*	rock flathead
Cristiceps australis	crested weedfish	*Pristiophorus cirratus*	common sawshark
Cyttus australis	silver dory	*Pristiophorus nudipinnis*	southern sawshark
Cyttus novaezelandiae	New Zealand dory	*Pseudaphritis urvilli*	congolli
Dasyatis thetidis	black stingray	*Pseudocaranx dentex*	silver trevally
Dinolestes lewini	long-finned pike	*Pseudogobius olorum*	blue-spotted goby
Diodon nichthemerus	globe fish	*Pseudolabrus psittaculus*	rosy wrasse
Dotalabrus aurantiacus	Castlenau's wrasse	*Pseudophycis bachus*	red cod
Emmelichthys nitidus	redbait	*Pseudophycis barbatus*	bearded rock cod
Engraulis australis	Australian anchovy	*Pseudorhombus jenynsii*	small toothed flounder
Eubalichthys gunnii	Gunn's leatherjacket	*Pterygotrigla polyommata*	latchet
Eubalichthys mosaicus	mosaic leatherjacket	*Raja cerva*	white spotted skate
Favonigobius tamarensis	tamar goby	*Raja lemprieri*	thornback skate
Foetorepus calauropomus	common stinkfish	*Raja sp.a*	long-nosed skate
Galaxias maculatus	common jollytail	*Raja whitleyi*	whitley's skate
Galaxias truttaceus	spotted mountain galaxias	*Rhombosolea tapirina*	greenback flounder
Galeorhinus galeus	school shark	*Sardinops neopilchardus*	pilchard
Genypterus tigerinus	rock ling	*Scobinichthys granulatus*	rough leatherjacket
Gnathagnus innotablis	bulldog stargazer	*Scomber australasicus*	blue mackerel
Gymnapistes marmoratus	soldierfish	*Seriolella brama*	blue warehou
Helicolenus percoides	red gurnard perch	*Seriolella punctata*	spotted trevalla
Heptranchias perlo	seven-gilled shark	*Sillago flindersi*	eastern school whiting
Heteroclinus perspicillatus	common weedfish	*Sphyraena novaehollandiae*	short-finned seapike
Heteroclinus puellarum	the girl's weedfish	*Squalus acanthias*	white-spotted dogfish
Hippocampus abdominalis	pot bellied seahorse	*Squalus megalops*	piked dogfish
Hippocampus breviceps	short-headed seahorse	*Stigmatopora argus*	spotted pipefish
Hydrolagus ogilbyi	Ogilby's ghost shark	*Stigmatopora nigra*	wide-bodied pipefish
Hyporhamphus melanochir	sea garfish	*Synchiropus calauropomus*	common stinkfish
Kathetostoma canaster	speckled stargazer	*Taratretis derwentensis*	Derwent flounder
Kathetostoma laeve	common stargazer	*Tasmanogobius lasti*	Lagoon goby
Latridopsis forsteri	bastard trumpeter	*Tetractenos glaber*	smooth toadfish
Latris lineata	Striped Trumpeter	*Thyrsites atun*	barracouta
Lepidotrigla modesta	grooved gurnard	*Torpedo macneilli*	torpedo ray
Lepidotrigla mulhalli	round-snouted gurnard	*Trachurus declivis*	jack mackerel
Lepidotrigla papilio	spiny gurnard	*Upeneichthys vlamingii*	southern goatfish
Lepidotrigla vanessa	butterfly gurnard	*Urolophus cruciatus*	banded stingaree
Leptatherina presbyteroides	silverfish	*Urolophus paucimaculatus*	sparsely spotted stingaree
Lesueurina platycephala	common sandfish	*Vanacampus poecilolaemus*	long-snouted pipefish
Lophonectes gallus	crested flounder	*Vincentia conspersa*	southern cardinal
Macruronus novaezelandiae	blue grenadier	*Zeus faber*	john dory
Meuschenia australis	brown-striped leatherjacket		

Source: DPIF (1998) with updates from A. Jordan, TAFI in State of the Derwent Estuary 2003)

and cod (reef dwellers) are permanent residents of the estuary, while others are transitory or seasonal migrants.

The following synopsis of pelagic, bottom and rocky reef dwelling fish found in the Derwent estuary is derived from Aquenal (2008a). Common species of pelagic fish include: the eastern Australian salmon *Arripis trutta*, silver trevally *Pseudocaranx georgianus*, barracouta *Thyrsites atun*, jack mackerel *Trachurus declivis*, silver dory *Cyttus australis*, school shark *Galeorhinus galeus*, gummy shark *Mustelus antarcticus* and white spotted dogfish *Squalus acanthias* (Prestedge 1996). Bottom-dwelling fish live over the most widespread habitat type within the estuary, consisting of soft sediments. Common bottom-dwelling fish include: sand flathead *Platycephalus bassensis*, school whiting *Sillago bassensis*, sea mullet *Mugil cephalus*, smooth toadfish *Torquigener glaber*, elephant fish *Callorhynchus milii*, flounder (e.g. long snouted *Ammotretis rostratus*, greenback *Rhombosolea tapirina* and Derwent *Taratretis derwentensis*), and skates (e.g. thornback *Dipturus lemrprieri*, Whitley's *Dipturus whitleyi*) (Prestedge 1996, Edgar *et al*. 1999). Many fish species are associated with the shallow rocky reefs, particularly in the lower estuary. These include: bastard trumpeter *Latridopsis forsteri*, banded morwong *Cheilodactylus spectabilis*, Shaw's cowfish *Aracana aurita*, draughtboard shark *Cephaloscyllium laticeps*, red cod *Pseudophycis bachus*, wrasse and leatherjacket species, seahorses and pipehorses, and a wide range of other species (Jordan *et al*. 2001).

An important component of the fish communities in the Derwent estuary includes those fish species that undertake seasonal migratory 'runs' between marine, estuarine and freshwater environments (**Table 9.6**). Migratory fish cannot pass upstream of Meadowbank Dam on the Derwent River, but do enter the Plenty River, Tyenna River, Styx River and a number of rivulets in the Hobart metropolitan area. An important migratory group

Table 9.6: Migratory fish of the upper Derwent estuary

Species	Life stage	Reason for migration	Direction	Time of year
1) Sea run trout *(Salmo trutta)*	Juveniles (smolts) Adults Adults Adults	Access to Sea Spawning in fresh water Return to Sea Feeding on whitebait	Downstream Upstream Downstream Upstream and Downstream	September to October April to May May to June August to November
2) Tasmanian Whitebait *(Lovettia sealii)*	Larvae Adults	Access to Sea Spawning	Downstream Upstream	September to November August to November
3) Common Jollytail *(Galaxias maculatus)*	Larvae Juveniles Adults	Access to Sea Return to fresh water Spawning in estuary General habitat	Downstream Upstream Downstream Local	May to June August to November April to June All year
4) Tasmanian Mudfish *(Galaxias cleaveri)*	Larvae Juveniles Adults	Access to Sea Return to fresh water General habit (Spawning)	Downstream Upstream Local	June to July August to November All year (May to June)
5) Spotted Galaxias *(Galaxias truttaceus)*	Larvae Juveniles	Access to Sea Return to fresh water	Downstream Upstream	May to June August to November
6) Black Bream *(Acanthopagrus butcheri)*	Larvae Juveniles Adults Adults	Access to estuary Dispersion through estuary Spawning in fresh/estuary Return to estuary	Downstream Downstream Upstream Downstream	November to February All year October to January October to January
7) Yellow Eyed Mullet *(Aldrichetta forsteri)*	Adults	Dispersion through estuary	Local	All year
8) Shortfinned eel *(Anguilla australis)*	Elvers Adults	Access to fresh water Access to sea	Upstream Downstream	November to January November to January
9) Pouched Lamprey *(Geotria australis)*	Velasia Macropthalmia	Spawning in fresh water Access to sea	Upstream Downstream	September to November September to December
10) Short-headed lamprey *(Mordacia mordax)*	Velasia Macropthalmia	Spawning in fresh water Access to sea	Upstream Downstream	November to January September to December

Source: Davies et al. (1988)

consist of small 'whitebait', made up of six separate fish species that migrate into the estuary from oceanic waters each spring. One whitebait species is the Tasmanian endemic *Lovettia sealii*, which is known to have a life cycle of just one year and occurs as a genetically distinct stock in the Derwent estuary (Blackburn 1950, Fulton and Pavuk 1988). Other whitebait species include galaxiids (common jollytail *Galaxias maculatus*, spotted galaxias *G. truttaceus* and the Tasmanian mudfish *G. cleaveri*) and the Tasmanian smelt *Retropinna tasmanica*. Whitebait are an important food source for larger migratory fish, which perform a simultaneous seasonal migration, in particular the introduced trout *Salmo trutta* (Davies *et al*. 1989).

The Tasmanian whitebait (*Lovettia sealii*) is considered to be a commercially threatened species in Tasmania (Zann 1995). After catches peaked in the late 1940s, populations declined leading to the closure of the fishery in 1974. Numbers have slowly increased since that time to sufficient levels for a limited recreational season since 1990 in a few rivers. Tasmanian whitebait is particularly vulnerable to influences on environmental quality since it has only a one-year life cycle. This means that an environmental disturbance that prevents or seriously impacts on reproduction or survival in any one year may have devastating implications.

Other fish with some transitory migratory-like movement within, and in some instances beyond the Derwent estuary, include black bream (*Acanthopagrus butcheri*), yellow-eyed mullet (*Aldrichetta forsteri*), eels (*Anguilla australis*), and lamprey (*Geotria australis and Mordacia mordax*).

Introduced fish species

Introduced trout *Salmo trutta* are a conspicuous species in the Derwent estuary. Two undesirable introduced fish species in the Derwent estuary are redfin perch (*Perca fluviatilis*) and tench (*Tinca tinca*). The Tasmanian native species of blackfish (*Gadopsis marmoratus*) found naturally in rivers from the north of state was also artificially introduced into the River Derwent in the early 1900's (Telfler 2002).

Fish breeding habitats

Nurseries for many small fish species tend to be concentrated in sheltered seagrass habitats since these are highly productive systems that provide food resources and suitable shelter for juvenile fish (Aquenal 2008a). The reported loss of most of the seagrass habitat within Ralphs Bay since the 1950s (Rees 1994) may have impacted the recruitment of some fish species. More recent seagrass declines within some areas of the middle estuary (see **Section 9.1.3**), may also affect recuritment. However, larger fish may still utilize shallow subtidal unvegetated sandy habitats (prevalent throughout large parts of the lower estuary and greater Ralphs Bay) as nursery areas (Aquenal 2008a).

The Derwent is considered to be a nursery area for a number of commercially important species, such as gummy and school shark. Commercial netting of these sharks is prohibited within the estuary (DPIF 1998). School shark recruitment appears to have declined in the Derwent, particularly in Ralphs Bay, where large numbers of school shark pups were recorded during the 1940s and 50s (Olsen 1954) but absent in the 1990s (Stevens and West 1997). This decline in shark numbers may be related to seagrass losses (Rees 1994) or to possible overfishing of the adult breeding stock (Lyle, 2009, TAFI, *pers. comm.*). Nevertheless, Ralphs Bay is still an important region for juvenile school shark, typically of one to two years in age (Stevens and West 1997).

Long-term trends

There is evidence of a decline in the average length of flathead from the Derwent estuary over the period 1991 to 2007 (Macpherson 2008). The estimated rate of decline varies from approximately 0.8 mm per year above Tasman Bridge to about 2.5 mm per year along the western shore of the Derwent (Macpherson 2008).

Big-bellied seahorses (*Hippocampus abdominalis*) have declined 79–98% over the period 2001–2004 in the Derwent estuary (Martin-Smith and Vincent 2005). This decline is possibly due to interactions with invasive species, disease or reproductive limitation (Martin-Smith and Vincent 2005).

Research on 28 Derwent estuary black bream (*Acanthopagrus butcheri*) caught in 2007 suggests that there has been little new recruitment (breeding events) within the upper estuary during the previous 13 years. The mean fish age (as of 2007) was 19, and the age ranges varied between 13 and 28 (Verdouw 2008). However, there have been juvenile black bream caught in the upper estuary during the last two years (T. Farrell, 2009, Inland Fisheries Service, *pers. comm.*)

9.4.3 Birds

A wide variety of birds depend upon the Derwent's diverse environments, including both permanent resident species and migratory visitors. Birds can be broadly categorised as waders, waterfowl, seabirds, woodland/forest birds and raptors. Estuarine habitats of particular importance to birds include the wetlands, tidal flats and shallow waters of the upper Derwent and Ralphs Bay, Goulds Lagoon and sheltered embayments in the middle/upper estuary. The dunes and beaches of the South Arm peninsula are also of great importance to seabirds and shorebirds, as are the bluffs at Fort

Table 9.7: Birds of the Derwent estuary region

Common Name	Scientific Name	Common Name	Scientific Name
Brown Quail	*Coturnix ypsilophora*	Galah	*Cacatua roseicapilla*
Musk Duck	*Biziura lobata*	Sulphur-crested Cockatoo	*Cacatua galerita*
Black Swan	*Cygnus atratus*	Rainbow Lorikeet	*Trichoglossus haematodus*
Australian Shelduck	*Tadorna tadornoides*	Musk Lorikeet	*Glossopsitta concinna*
Australian Wood Duck	*Chenonetta jubata*	Little Lorikeet	*Glossopsitta pusilla*
Mallard	*Anas platyrhynchos*	Green Rosella	*Platycercus caledonicus*
Pacific Black Duck	*Anas superciliosa*	Eastern Rosella	*Platycercus eximius*
Australasian Shoveler	*Anas rhynchotis*	Swift Parrot	*Lathamus discolor*
Chestnut Teal	*Anas castanea*	Blue-winged Parrot	*Neophema chrysostoma*
Australasian Grebe	*Tachybaptus novaehollandiae*	Pallid Cuckoo	*Cuculus pallidus*
Hoary-headed Grebe	*Poliocephalus poliocephalus*	Fan-tailed Cuckoo	*Cacomantis flabelliformis*
Little Penguin	*Eudyptula minor*	Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*
Short-tailed Shearwater	*Puffinus tenuirostris*	Shining Bronze-Cuckoo	*Chrysococcyx lucidus*
Shy Albatross	*Diomedea cauta*	Southern Boobook	*Ninox novaeseelandiae*
Wilson's Storm-Petrel	*Oceanites oceanicus*	Fork-tailed Swift	*Apus pacificus*
Australasian Gannet	*Morus serrator*	Laughing Kookaburra	*Dacelo novaeguineae*
Little Pied Cormorant	*Phalacrocorax melanoleucos*	Superb Fairy-wren	*Malurus cyaneus*
Black-faced Cormorant	*Phalacrocorax fuscescens*	Spotted Pardalote	*Pardalotus punctatus*
Little Black Cormorant	*Phalacrocorax sulcirostris*	Forty-spotted Pardalote	*Pardalotus quadragintus*
Great Cormorant	*Phalacrocorax carbo*	Striated Pardalote	*Pardalotus striatus*
Australian Pelican	*Pelecanus conspicillatus*	Tasmanian Scrubwren	*Sericornis humilis*
White-faced Heron	*Egretta novaehollandiae*	Scrubtit	*Acanthornis magnus*
Little Egret	*Egretta garzetta*	Striated Fieldwren	*Calamanthus fuliginosus*
Great Egret	*Ardea alba*	Brown Thornbill	*Acanthiza pusilla*
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Tasmanian Thornbill	*Acanthiza ewingii*
Swamp Harrier	*Circus approximans*	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Brown Goshawk	*Accipiter fasciatus*	Yellow Wattlebird	*Anthochaera paradoxa*
Grey Goshawk	*Accipiter novaehollandiae*	Little Wattlebird	*Anthochaera chrysoptera*
Collared Sparrowhawk	*Accipiter cirrhocephalus*	Noisy Miner	*Manorina melanocephala*
Wedge-tailed Eagle	*Aquila audax*	Yellow-throated Honeyeater	*Lichenostomus flavicollis*
Brown Falcon	*Falco berigora*	Strong-billed Honeyeater	*Melithreptus validirostris*
Peregrine Falcon	*Falco peregrinus*	Black-headed Honeyeater	*Melithreptus affinis*
Spotless Crake	*Porzana tabuensis*	Crescent Honeyeater	*Phylidonyris pyrrhoptera*
Purple Swamphen	*Porphyrio phorphyrio*	New Holland Honeyeater	*Phylidonyris novaehollandiae*
Dusky Moorhen	*Gallinula tenebrosa*	Tawny-crowned Honeyeater	*Phylidonyris melanops*
Tasmanian Native-hen	*Gallinula mortierii*	Eastern Spinebill	*Acanthorhynchus tenuirostris*
Eurasian Coot	*Fulica atra*	White-fronted Chat	*Epthianura albifrons*
Latham's Snipe	*Gallinago hardwickii*	Flame Robin	*Petroica phoenicea*
Bar-tailed Godwit	*Limosa lapponica*	Scarlet Robin	*Petroica multicolor*
Whimbrel	*Numenius phaeopus*	Pink Robin	*Petroica rodinogaster*
Eastern Curlew	*Numenius madagascariensis*	Dusky Robin	*Melanodryas vittata*
Common Greenshank	*Tringa nebularia*	Olive Whistler	*Pachycephala olivacea*
Red-necked Stint	*Calidris ruficollis*	Golden Whistler	*Pachycephala pectoralis*
Curlew Sandpiper	*Calidris ferruginea*	Satin Flycatcher	*Myiagra cyanoleuca*
Pied Oystercatcher	*Haematopus longirostris*	Grey Fantail	*Rhipidura fuliginosa*
Sooty Oystercatcher	*Haematopus fuliginosus*	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
Red-capped Plover	*Charadrius ruficapillus*	Dusky Woodswallow	*Artamus cyanopterus*
Double-banded Plover	*Charadrius bicinctus*	Grey Butcherbird	*Cracticus torquatus*
Hooded Plover	*Thinornis rubricollis*	Australian Magpie	*Gymnorhina tibicen*
Masked Lapwing	*Vanellus miles*	Black Currawong	*Strepera fuliginosa*
Pacific Gull	*Larus pacificus*	Grey Currawong	*Strepera versicolor*
Kelp Gull	*Larus dominicanus*	Forest Raven	*Corvus tasmanicus*
Silver Gull	*Larus novaehollandiae*	Skylark	*Alauda arvensis*
Caspian Tern	*Sterna caspia*	Richard's Pipit	*Anthus novaeseelandiae*
Crested Tern	*Sterna bergii*	House Sparrow	*Passer domesticus*
Rock Dove	*Columba livia*	Beautiful Firetail	*Stagonopleura bella*
Spotted Turtle-Dove	*Streptopelia chinensis*	European Greenfinch	*Carduelis chloris*
Common Bronzewing	*Phaps chalcoptera*	European Goldfinch	*Carduelis carduelis*
Brush Bronzewing	*Phaps elegans*	Welcome Swallow	*Hirundo neoxena*
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	Tree Martin	*Hirundo nigricans*

Source: D. Abbott and P. Park, Birds Tasmania, May 2009

Direction which support a short-tailed shearwater colony (also known as mutton-birds, *Puffinus tenuirostris*). Little penguins (*Eudyptula minor*) breed at a number of sites along the Derwent foreshore, particularly along the western shore of the lower estuary. The remnant bushland around the Derwent estuary supports a number of important woodland birds, including several threatened species such as forty-spotted pardalotes (*Pardalotus quadragintus)* and swift parrots (*Lathamus discolor)*. Over 120 birds have been recorded within the Derwent estuary region, as listed in **Table 9.7**. This list includes all bird species found within terrestrial and coastal habitats of greater Hobart, however, the following review focuses on those species utilizing estuarine habitats.

Shorebirds

Shorebirds feed along the shoreline and on intertidal flats, especially in the Ralphs Bay area. Derwent estuary shorebird habitats are closely linked to similar habitats in the Pittwater area (including the Pittwater-Orielton Lagoon Ramsar site), and the combined Derwent Estuary – Pittwater Area (DEPA) provides vital habitat for at least eight migratory (two Charadriidae, six Scolopacidae) and six resident shorebird species (Birds Tasmania records 2009). The DEPA is the southernmost destination on the East Asian-Australasian Flyway (EAAF), along which millions of Arctic-breeding migratory shorebirds travel to reach regular non-breeding grounds in Australia and New Zealand. Several of these species regularly occur in the DEPA, and the area is considered an internationally important site for one of these species, the red-necked stint (*Calidris ruficollis*) (Bamford *et al*. 2007). Another migratory species, the double-banded plover (*Charadrius bicinctus*) breeds in New Zealand and migrates to south eastern Australia in winter and has been observed in the DEPA (E. Woehler, 2009, Birds Tasmania, *pers. comm.*).

There has been a long-term decrease in the abundance of many of the migratory shorebirds observed in the DEPA (**Figure 9.7**), most notably the eastern curlew, which has experienced a decrease from the 1960s, to less than 25% of former numbers in 2003 and only 15% in 2008 (Reid and Park 2003, Mike Newman, in Olson (2008)). The decrease in migratory shorebird abundance in the DEPA is thought to be largely due to habitat loss throughout different parts of the EAAF (E. Woehler, 2009, Birds Tasmania, *pers. comm.*), however, local habitat loss is also contributing to this decrease.

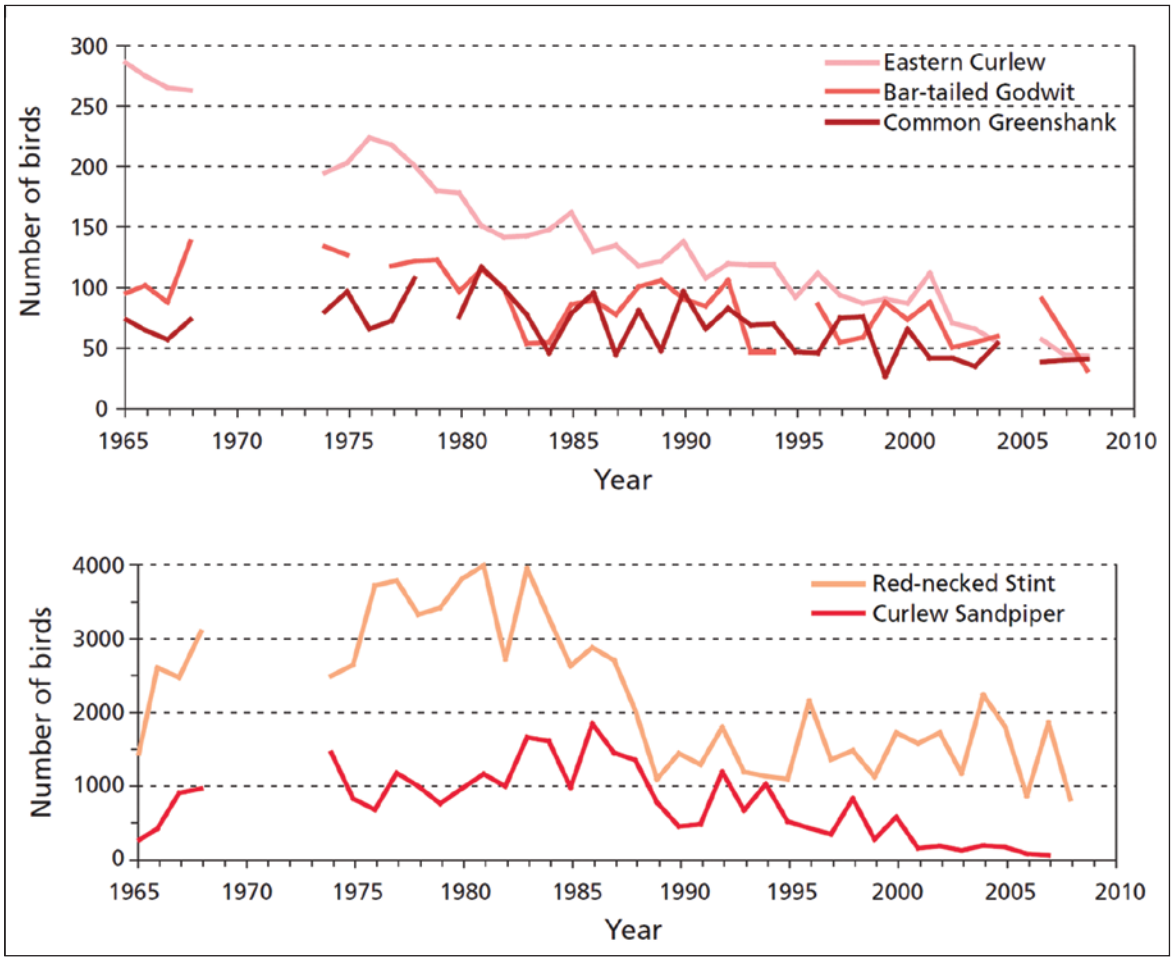
Habitat in the DEPA also supports at least six resident shorebird species (two Haematopodidae, four Charadriidae), including a nationally significant, sedentary population of Australian pied oystercatchers (*Haematopus longirostris*). The DEPA Australian pied oystercatcher population is the second-largest in mainland Tasmania and one of the largest in Australia (Lane 1987). The DEPA pied oystercatcher population has increased over the last 40 years, but shows considerable interannual variability (**Figure 9.8**). Another DEPA resident shorebird is the red-capped plover *(Charadnus ruficapillus)*. The red-capped plover is the most common breeding species of wader in Tasmania, and the South Arm area has been identified as one of the most important breeding areas for this species in southeastern Tasmania (BOAT 1982).

The effect of disturbance on breeding birds is complex, with differing effects with respect to stage in the breeding season, the type, intensity and duration of disturbance, and the availability of resources in the surrounding area (Aquenal 2008a). It is thought that disturbance to birds is only important when it has a fitness cost, through either reduced survival or fecundity (Gill *et al*. 2001). In the Ralphs Bay – South Arm area, human induced disturbance to shorebirds has included use of trail bikes, presence of horses and dogs on beaches, increasing coastal development (notably at South Arm and Rokeby), human recreational uses of the foreshore, and most recently, exceptional high tides causing roosting birds (notably pied oystercatchers) to move onto the roads at South Arm neck where they have subsequently been killed by cars (E. Woehler, 2009, Birds Tasmania, *pers. comm.*).

Wetland and saltmarsh birds

The upper Derwent estuary wetlands and saltmarshes support very high numbers of waterfowl, particularly in mid-summer, when over 2,500 black swans and 2000 ducks of several species are frequently present (**Figure 9.9**) (data from Stewart Blackhall, 2009, DPIPWE. This shallow, brackish area contains large expanses of submerged aquatic macrophytes (**Section 9.1.3**) making it an important and reliable feeding area for a wide range of species. As a gazetted Conservation Area, it also serves as a refuge for ducks during the annual three month hunting season, while its permanence means it may be a drought refuge for some species during dry periods. Several species of raptors (eagles, hawks and falcons) and ambush predatory birds (Australasian bittern, herons and egrets) are frequently observed hunting over the Derwent estuary marshes, and some of these birds have nesting sites in the region. Commonly observed birds of the Derwent estuary wetlands include the black swan, black duck, chestnut teal, musk duck, Eurasian coot, hoary headed grebe, pelican, great cormorant, little pied cormorant, silver gull, Pacific gull, great egret, white-faced heron, white-bellied sea eagle, marsh harrier, brown falcon, and masked lapwing (E. Woehler, 2009, Birds Tasmania, *pers. comm.*).

Figure 9.7: Trends in numbers of five species of migratory shorebirds in summer counts in the Hobart area



Source: Olson (2008)

Seabirds

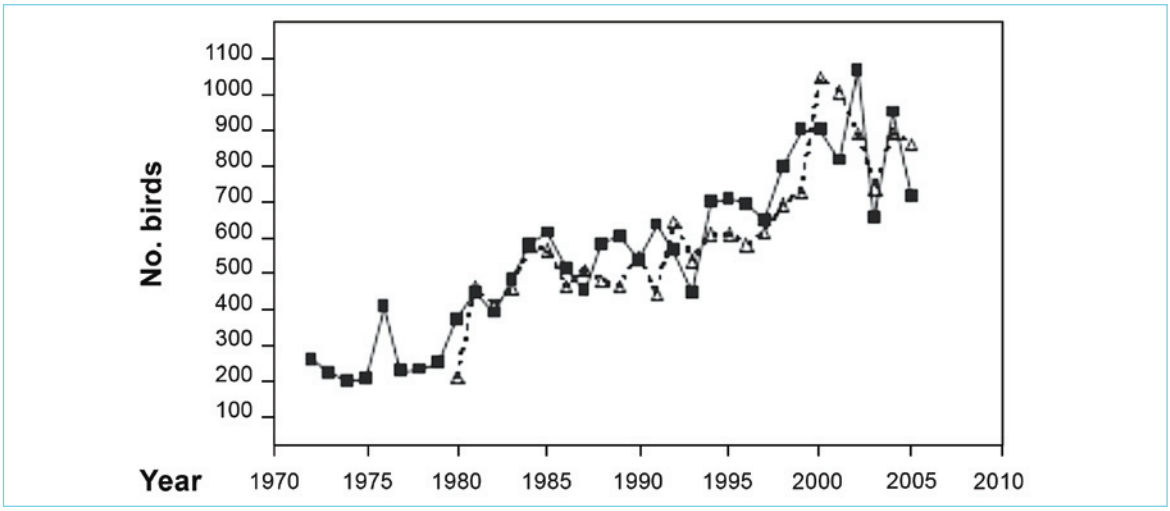
Seabirds include both resident species (gulls, cormorants and some species of terns) and several important migratory species such as short-tailed shearwaters (*Puffinus tenuirostris*) and Caspian terns (*Sterna caspia*) that breed locally. Winter counts have been undertaken since the 1980s on three species of gull that are resident in south eastern Tasmania. The annual counts are made during June, when the gulls have moved from their breeding islands to the coast, sports and agricultural fields, and urban rubbish tips. Kelp gulls are a relatively recent arrival to Tasmania, with the first record in the late 1950s and the first breeding record in the early 1960s. Their numbers in south eastern Tasmania have increased to between 6000 and 8000 birds. In contrast, there has been a decrease in the numbers of silver and Pacific gulls to half that observed 25 years ago throughout southeastern Tasmania (E. Woehler, Birds Tasmania, in Olson (2008)).

Penguins

The lower Derwent estuary supports several colonies of breeding little penguins (*Eudyptula minor* formerly known as fairy penguins) along its shoreline. Little penguins were historically more abundant in the estuary, but their population has been much reduced (Stevenson 2003, Stevenson and Woehler 2007). In Tasmania, less than 5% of the total little penguin population is found on the mainland, with the majority now found on off-shore islands. Derwent estuary little penguin populations face a variety of threats, including habitat degradation, human disturbance, predation (particularly by domestic pets) and gill netting.

In 2004, the DEP initiated a multi-staged collaborative project between local councils, State Government, industry, business and the community to address these threats, with financial support from the Australian

Figure 9.8: Trends in numbers of Australian pied oystercatchers observed in the Derwent estuary – Pittwater area during summer (solid line) and winter (dashed)



Source: data presented in Woxvold (2008)

Government. This project commenced with a detailed inventory of the distribution and abundance of little penguin habitat and nesting sites along the Derwent estuary shoreline, followed by regular monitoring of penguin numbers and breeding success.

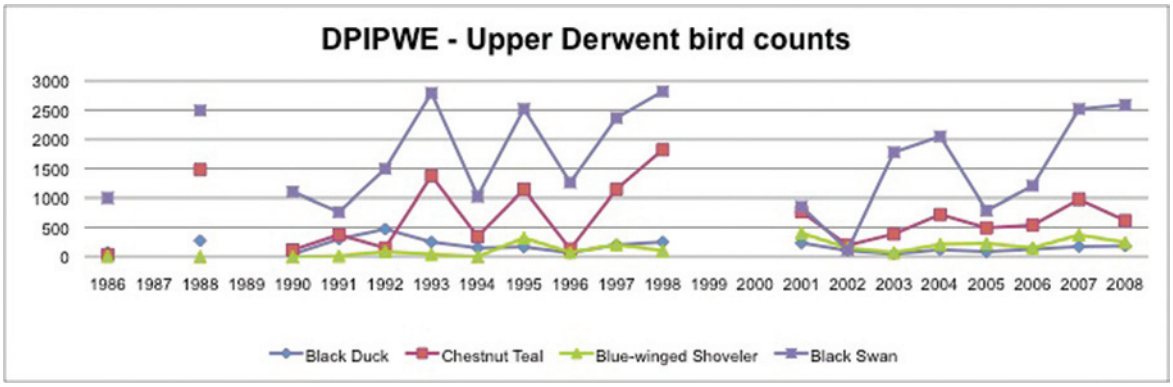
In stage one of the project, a total of 21 existing and former penguin-nesting areas were identified along the Derwent foreshore. Of these, nine were no longer occupied by little penguins, ten had fewer than ten breeding pairs, and the remaining two had fewer than 25 breeding pairs. A total of 98 breeding pairs were found during the 2004-05 survey, with two thirds of these located on land managed by local government.

All the existing nesting sites and some of the former sites surveyed on the Derwent foreshore exhibited the following features:

- hollows, cavities and shelter provided by natural features, vegetation, man-made structures and/or debris, that provide shade and adequate protection from wind, rain and predators;
- sheltered areas or refuges between landing spot and nesting site;
- an accessible landing point such as a beach or rock platform;
- no excessive noise, vibrations (such as those from earth moving equipment) or regular disturbance;
- limited foreshore illumination; and
- over 85% of occupied burrows in the Derwent estuary consisted of boulders, rock falls, rock crevices or rock walls.

This information was used to develop the *Derwent Estuary Penguin Project Management Recommendations and Guidelines (2005)*. This report addressed both

Figure 9.9: Trends in numbers of four waterfowl species observed in the upper Derwent estuary wetlands



Source: data from Stewart Blackhall, Wildlife Biologist, DPIPWE, March 2009

habitat management issues and the need for an ongoing community education campaign, and recommended that initial management activities focus on:

- protecting colonies from potential predators;
- limiting disturbance and habitat modification in and around existing colonies;
- maintaining unimpeded penguin access from landing site to nest site;
- maintaining and establishing protective cover from landing site to nest site;
- minimising illumination within penguin colonies; and
- creating a custodial relationship between local residents and local penguin colonies.

Stage two implemented a number of strategic management actions, including on-ground works at key sites to improve breeding success, educational activities and further monitoring. Key actions included the installation of over 125 artificial burrows, upgrading nearly 30 existing burrows, revegetating sites with more than 1,000 native plants grown by Understorey Network volunteers, and reducing encroachment by predators through erecting fencing, swing gates and signs at critical sites. The project raised awareness and understanding of how to protect penguins, particularly in primary schools and communities near penguin colonies, and was strongly supported by volunteers and local community groups. A total of 120 breeding pairs of penguins were found during more extensive monitoring in 2005-06.

Stage three involved further on-ground works at key sites (installation of another 150 artificial burrows, re-location of an existing walking track, weeding and revegetation with 1100 plants), educational and awareness-raining activities and further monitoring. In 2008-09, penguin colonies were found at 12 sites with the total breeding population estimated at 192 pairs, while in 2008-09, the total number of breeding pairs in the Derwent estuary was approximately 177 at 13 sites. The variation in population between years is within the range of natural fluctuation, and may be associated with factors such as changing availability of food resources. The on-going monitoring of penguin sites has shown that artificial burrows and burrow enhancement, fencing and signage have proven successful in expanding and protecting penguin habitat.

The knowledge and experience gained about little penguin management in the Derwent estuary has been captured in management guidelines: *Co-existing with Little Penguins in the Derwent Estuary: Information and Management Guidelines 2009.* The guidelines provide practical information for land managers and community groups/volunteers about managing little penguins in urban environments. A companion document was also developed that focuses on site-specific management information and recommendations for around the Derwent estuary. A forum for local government planners, community groups and natural resource managers was held to promote the management guidelines and share information to help conserve this species and its crucial habitats in Tasmania.

9.4.4 Marine mammals

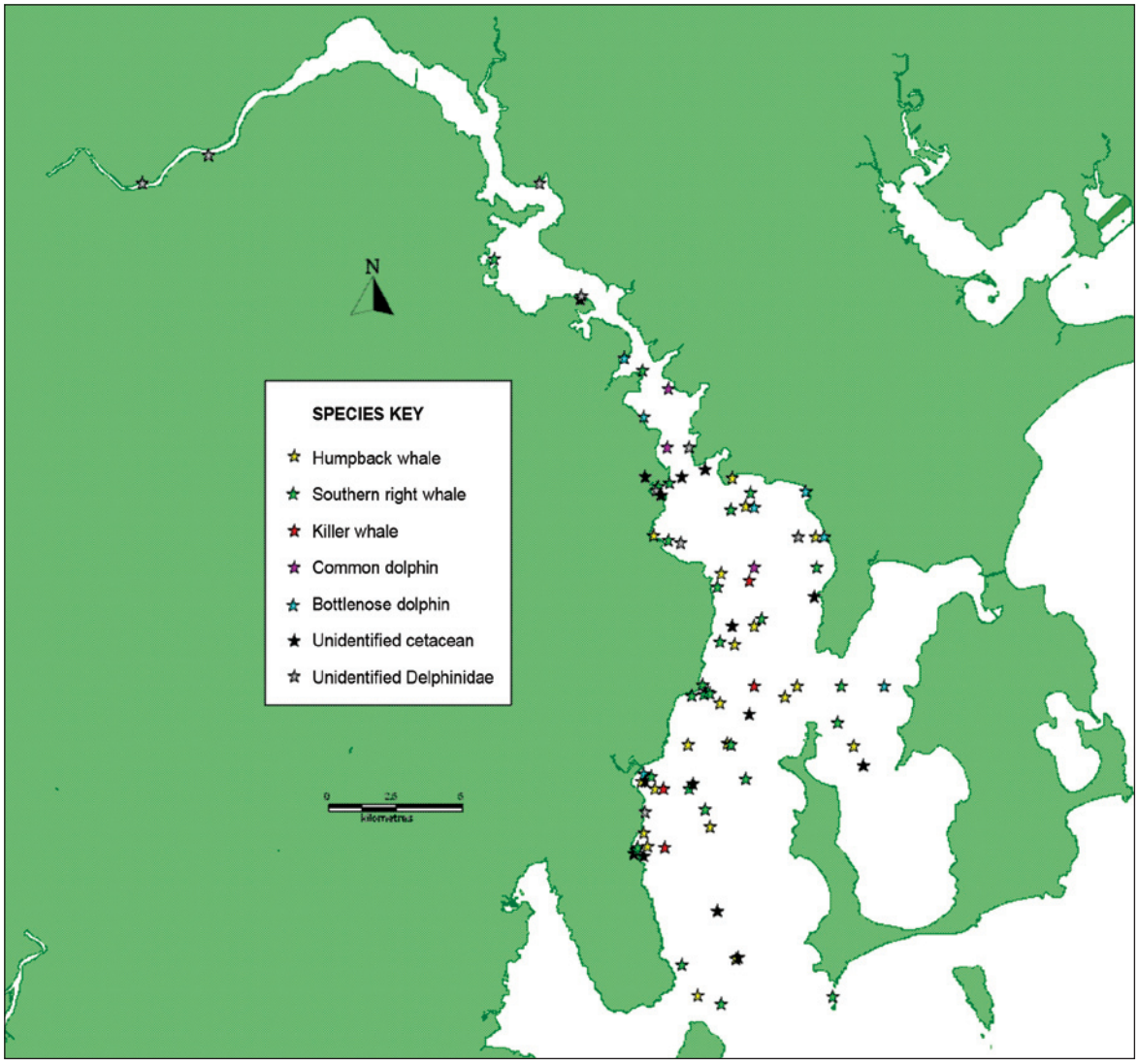
Several species of marine mammals visit the Derwent estuary, particularly in its lower reaches. These include dolphins, whales (southern right, humpback and orca) and seals. Both bottle-nosed and common dolphins are sighted frequently in the Derwent, at times as far up-river as Old Beach. Southern right whales and humpback whales (both endangered) are migratory, arriving in Tasmanian latitudes on their way from the Southern Ocean starting in mid-May, with numbers peaking in June and July. Both of these species were hunted close to extinction in the 19th century. Records of mother and calf sightings and even births in southeastern Tasmania have increased in recent years (RPDC 2006), suggestingthat populations may be slowly starting to recover. Seals are seen in the Derwent estuary and occasionally haul out on the foreshore, however, no regular haul-out or breeding sites occur in the estuary. Australian fur seals are regularly observed in the estuary, and occasionally other species are reported, including the leopard seal, New Zealand fur seal, southern elephant seal and Australian sea lion. In recent years the Biodiversity Conservation Branch (DPIPWE) has created and maintained cetacean (*Whalebase*) and pinniped (*Sealbase*) observation databases. It should be noted that these data have not been derived from methodical survey programs but represent opportunistic sightings data.

A review of Derwent estuary cetacean observations, cetacean strandings and pinniped observations is presented in Aquenal (2008a), derived from the DPIPWE *Whalebase* and *Sealbase* databases. According to this review, five cetacean species have been sighted in the Derwent estuary, including the southern right whale *Eubalaena australis*, humpback whale *Megaptera novaeangliae*, bottlenose dolphin *Tursiops truncatus*, killer whale *Orcinus orca* and common dolphin *Delphinius delphis*. As indicated in **Figure 9.10**, the majority of cetacean sightings have occurred within the lower estuary, with only approximately 10% of sightings occurring within the middle and upper estuary combined. The majority of middle to upper estuary sightings were of dolphins, with just two sightings of southern right whales in the middle estuary. In the lower estuary, the majority of sightings occurred along the western shoreline and mid channel of the estuary,

with clusters of sightings occurring around Blackmans Bay, Kingston Beach and Taroona (Aquenal 2008a). This is possibly biased due to increased observational opportunities adjacent to higher human habitation along these regions of the estuary (D. Lee, 2009, DPIPWE, *pers. comm.*). Humpback whales have also been sighted near the entrance to Ralphs Bay, and other cetacean species observed within Ralphs Bay. The timing of cetacean sightings in the Derwent estuary are consistent with known seasonal migration patterns, with the largest number of southern right and humpback whalessighted in the estuary during June and July, and killer whales present during late summer to early autumn. The common dolphin occurs in the estuary during winter (June to August), whilst bottlenose dolphins are present in the estuary at any time throughout the year (Aquenal 2008a).

A review of cetacean strandings in the Derwent estuary was also undertaken by Aquenal (2008a) using DPIPWE's Whalebase database records. Forty-seven cetacean strandings have been documented in the Derwent between 1912 and 2006, typically involving individual common dolphins *Delphinus delphis* or bottlenose dolphins *Tursiops truncates*. A total of 34 of these stranding occurred in Ralphs Bay, primarily on the shallow intertidal sandflats at the southern end of the bay, adjacent to the South Arm neck. This intertidal area has also experienced the majority of the mass stranding events within the estuary (11 of 12), with the largest occurring in 1998 (45 common dolphins) (Aquenal

Figure 9.10: Distribution of cetacean sightings recorded in the Derwent estuary between 1983 and 2006



Source: Aquenal 2008a – based on data contained in the Whalebase database of the Biodiversity Conservation Branch, DPIPWE 2008

2008a). It is likely that the bathymetry of southern Ralphs Bay intertidal flats posses a natural stranding risk to small cetaceans (D. Lee, DPIPWE, *pers. comm.*).

A review of seal (pinniped) sightings in the Derwent estuary was also undertaken by Aquenal (2008a) using DPIPWE's Sealbase database records (note that only unusual pinnipeds or those of management interest (e.g. injured or causing nuisance) are recorded in this database). Five pinniped species have been observed in the estuary: the Australian fur seal *Arctocephalus pusillus*, New Zealand fur seal *Arctocephalus fosteri*, leopard seal *Hydrurga leptonyx*, southern elephant seal *Mirounga leonina* and Australian sea-lion *Neophoca cinerea.* The latter species is represented by a solitary observation in Ralphs Bay. Pinniped sightings were distributed throughout the estuary, although the majority occurred in the lower estuary. The timing of the majority of sightings were as follows: leopard seals (winter/early spring), New Zealand fur seals (mostly recorded in autumn months), and Australian fur seals were recorded throughout the year (Aquenal 2008a). All recorded sightings of southern elephant seals occurred in the 1980s, and none have been documented in the estuary since 1982 (Aquenal 2008a), although it is likely unreported visitations have continued.

9.5 Threatened fauna

As listed in **Table 9.8**, 16 threatened species visit or inhabit the Derwent estuary, with an additional 18 species recorded along the foreshore and adjacent terrestrial habitats (note – this list excludes the greater River Derwent and Jordan River catchments). Threatened marine and estuarine species include the humpback and southern right whales (both endangered), fairy tern (rare), the New Zealand fur seal (rare) and the spotted handfish (endangered).

9.5.1 Spotted handfish

The critically endangered spotted handfish *Brachionichthys hirsutus* is endemic to southeastern Tasmania, and is currently only found in several sites in the lower Derwent estuary within a total area of less than 3 km^2 (Aquenal 2008a). Areas with spotted handfish have been periodically surveyed by CSIRO, with additional surveys conducted in 2007 by Aquenal, enabling the 2007 population to be estimated at between 1600 and 3550 adult individuals (Aquenal 2008a). More recent surveys by CSIRO in 2008 at some of the known occupied areas indicate these local populations are stable. Other CSIRO surveys in 2008 examined additional potential locations for the presence of spotted handfish but no new occupied areas were found. (M. Green, 2009, CSIRO, *pers. comm.*).

Throughout the 1960s, 70s and early 80s, handfish were frequently sighted by divers on the sediments along the eastern and western shores of the Derwent, and adjoining bays typically associated with sandy, or mixed sand/silt, subtidal sediments in water depths of 5-12 m. However, major declines occurred in the mid 1980's and extensive surveys of the estuary floor in 1994 and 1996 found only a handful of specimens at several locations throughout their former range. The levels of fish movement between remnant colonies is believed to be limited, as spotted handfish are relatively sedentary. They have a low breeding capacity, with eggs wrapped around erect structures on the seabed that consist primarily of stalked ascidians *Sycozoa* spp. but also include seagrass, sponges, small macroalgae (e.g. *Caulerpa* spp.) and polychaete worm tubes.

The spotted handfish is threatened by the loss or degradation of foraging and spawning habitat, possibly due to siltation, pollution and/or predation of the handfishes' preferred spawning habitat (the ascidian *Sycozoa* sp.) by the introduced seastar, *Asterias amurensis*. Other threats to the spotted handfish include poaching of fish for sale as aquarium specimens and – historically – scallop dredging and Danish seine fishing techniques that altered seafloor habitat conditions (Spotted Handfish Recovery Team 2002). The only known spotted handfish location outside the Derwent estuary, in Frederick Henry Bay, had a substantial population in 1999 but appears to have suffered a local extinction sometime prior to resurvey in 2005. The cause of this apparent local extinction is not known as the habitat remains good at this site. In Ralphs Bay, a population of adult fish occurs at a site previously thought to be lacking natural spawning substrates. However CSIRO surveys in Ralphs Bay during 2008 indicate that small sponges are predominantly used for egg attachment at this site. These sponges are fragile and egg loss appears to be high resulting in poor recruitment and a population dominated by adults (M. Green, 2009, CSIRO, *pers. comm.*). Seasonal filamentous algal growth has also been recently observed in this area, which is actively avoided by the spotted handfish (Aquenal 2008a).

Recovery Plan actions have been carried out since 1999, guided by the *Spotted handfish Recovery Plan 1999-2001,* a Tasmanian government Recovery Plan for 2002-2006 and more recently by the Commonwealth's Department of Environment and Water Resources *Recovery plan for four species of handfish.* The overall objective of the recovery efforts is 'to locate and secure existing populations of spotted handfish, reduce the

Table 9.8: Threatened fauna – Derwent estuary and surrounding catchment

Threatened flora in DEP area Scientific name	Common name	Code *Tas*	 *Aust*
ESTUARY			
+ *Arctocephalus forsteri*	New Zealand fur seal	r	
+ *Arctocephalus tropicalis*	sub-Antarctic fur seal	e	VU
* *Brachionichthys hirsutus*	spotted handfish	e	CR
+ *Eubalaena australis*	southern right whale	e	EN
+ *Carcharodon carcharias*	great white shark	v	VU
Diomedea cauta subsp. cauta	shy albatross	pv	PVU
Haliaeetus leucogaster	white-bellied sea-eagle	v	
* *Marginaster littoralis*	seastar	e	
+ *Megaptera novaeangliae*	humpback whale	e	VU
+ *Mirounga leonina*	southern elephant seal	e	VU
Numenius madagascariensis	eastern curlew	e	
Pateriella vivipara	live-bearing seastar	pv	
Podiceps cristatus	great crested grebe	v	
Poliocephalus cristatus subsp. australis	great crested grebe subspecies	pv	
Prototroctes maraena	Australian grayling	v	VU
Sterna nereis subsp. nereis	fairy tern	v	
ESTUARY CATCHMENT			
Accipiter novaehollandiae	grey goshawk	e	
Amelora acontistica	chevron looper moth	v	
Antipodia chaostola	chaostola skipper	e	
Antipodia chaostola subsp. leucophaea	chaostola skipper	e	
Aquila audax fleayi	wedge-tailed eagle	e	EN
Dasyurus maculatus	spotted-tailed quoll	r	VU
Dasyurus maculatus subsp. maculatus	spotted-tailed quoll	r	VU
Dasybela achroa	saltmarsh looper moth	v	
Discocharopa vigens	land snail	v	
Lathamus discolor	swift parrot	e	EN
Lissotes menalcas	mt. mangana stag beetle	v	
Litoria raniformis	green and gold frog	v	VU
Pardalotus quadragintus	forty-spotted pardalote	e	EN
Perameles gunnii	eastern barred bandicoot		VU
Pseudemoia pagenstecheri	tussock skink	v	
Roblinella agnewi	silky snail	r	
Sarcophilus harrisii	tasmanian devil	e	VU
Tyto novaehollandiae castenops	masked owl	e	

*Endemic to the estuary and surrounding bays
+ Source: Threatened Species Unit, DPIWE.
Note – pv and PVU = presumed vulnerable (this is an unoffical listing)

NOTES: Threatened species in Tasmania are listed subject to the following national and state Acts:

National: *Environment Protection and Biodiversity Conservation Act 1999*
Threatened species under the national schedule are classified as: EX) Extinct, EW) Extinct in the Wild, CR) Critically Endangered, EN) Endangered, VU) Vulnerable and CD) Conservation Dependent.
Tasmania: *Threatened Species Protection Act 1995*

Threatened species under Tasmanian legislation are classified as: x) presumed extinct (on the ground that no occurrence of the taxon in the wild can be confirmed during the past 50 years); e) endangered (in danger of extinction because long term survival is unlikely while the factors causing the species to be endangered continue operating); v) vulnerable (a species which is likely to become endangered while the factors causing it to be vulnerable continue operating) and; r) rare (a species which has a small population in Tasmania that is not endangered or vulnerable but is at risk).

chances of future decline, enhance populations in areas where numbers have been seriously depleted or lost and subsequently achieve down listing from the current *endangered* status' (Spotted Handfish Recovery Team 2002). A number of Australian Government funded projects have been carried out by CSIRO since 1996 to improve understanding of spotted handfish biology and to assess its status. These include the collection of baseline biological data, examination of habitat requirements, monitoring of the known colonies, development of techniques to assess population size and stability, and the establishment of captive husbandry protocols. The captive breeding program was successful in spawning and rearing juvenile spotted handfish. In addition, trials in the wild have succeeded in getting spotted handfish to spawn around artificial spawning substrates.

Several projects have been undertaken to assist handfish recovery through the installation of artificial and natural spawning substrates at sites lacking structure to which handfish can attach their eggs. Six-hundred artificial spawning substrates were deployed in 2002 at two sites in the Derwent and a trial was undertaken to see if translocated algae (*Caulerpa* spp.) from Frederick Henry Bay could be used as a handfish spawning substrate in the Derwent estuary. The trial was then expanded in 2004-05 with additional funding from NRM South and CSIRO. The transplant site was checked at the end of 2005 and most recently at the end of 2008. This transplanted algae was still growing in patches and handfish eggs had been found attached. In 2008 artificial structures were tested at the Ralphs Bay location with positive results regarding use by handfish for spawning and retention of the subsequent egg masses (M. Green, 2009, CSIRO, *pers. comm.*). Future surveys are needed late in 2009 to see if these retained eggs have resulted in a recruitment of juvenile handfish at the site. CSIRO have also collected 250 tissue samples for genetic study on the known populations but resources are required to complete this investigation.

9.5.2 *Derwent estuary endemic seastar* (Marginaster littoralis)

A Derwent estuary endemic seastar, *Marginaster littoralis*, has previously being recorded within intertidal habitats in the middle estuary. The status of this species is uncertain, and it may now be extinct due in part from the combined effects of pollution, invasive species pressures and habitat loss. A component of future DEP habitat surveys will include searches for *Marginaster littoralis*.