Reef Watch South Australia

Surveys across six reefs in the Adelaide and Mt Lofty Ranges Natural Resource Management Region 2008 - 2009

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A report to the Conservation Council of South Australia Inc.

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Role of Reef Health Observations and Reef Watch

Investigations into the health of reefs on the Adelaide metropolitan coast were initiated in 1996, with follow up/expanded observations conducted in 1999, 2005 and 2007 (Cheshire *et al.* 1998, Cheshire and Westphalen 2000, Turner *et al.* 2007, Collings *et al.* 2008). Results of these surveys indicate a zone of degraded reefs on the most urbanised stretch of the Adelaide coast, possibly extending as far south as Seacliff (i.e. from Semaphore to Brighton). However, there have also been disturbing signs of a possible decline of reefs further south, in particular Horseshoe Reef and Noarlunga Reef, where there has been substantial expansion of southern suburbia (Cheshire and Westphalen 2000, Turner *et al.* 2007). Expansion of the zone of degradation to the extensive reef systems on the Fleurieu Peninsula coast has been raised as a key area of concern from Reef Health surveys (Cheshire and Westphalen 2000, Turner *et al.* 2007), although note that Collings *et al.* (2008) suggested that there were signs of improvement in reef health status for some metropolitan reefs.

Degraded reefs on the Adelaide coast are typified by a lack of large robust canopy-forming, brown macroalgae and a dominance of large areas of bare substrate and/or turfing/filamentous red macroalgal species (Cheshire and Westphalen 2000, Turner *et al.* 2007). High mussel cover has also been observed at Horseshoe Reef and may be either a cause or response to reef decline (Smith 2000). Increased sedimentation has been speculated as the primary cause for reef health decline in the Adelaide region (Cheshire and Westphalen 2000, Greig 2000, Smith 2000, Turner 2004), although a direct causal linkage has yet to be confirmed (Turner *et al.* 2007). Investigations of fish and invertebrate abundances as well as the presence of marine pests, canopy cover, bare substrate, mussel cover, turfing macroalgae cover and the presence of sediments form the basis of the indices of reef health developed by Turner *et al.* (2007). However, while this approach has been used in other Reef Health observations (2007; Collings *et al.* 2008) as well as Reef Watch data (CCSA 2009), it needs to be realised that these indices are still open to substantial debate as to their parameterisation, calculation and even validity as a measure of reef status. It is strongly recommended that use of these indices be considered in light of the need for further research and development in this area.

Community-based monitoring of reef systems has occurred since the late 1990s with an initial emphasis on developing broader awareness and education of reef health issues (Turner *et al.* 2006). However, while the data collected has been of high quality, the somewhat haphazard spatiotemporal approach to the observations made analyses and interpretation rather problematic (CCSA 2009). In response, over the last twelve months Reef Watch surveys have been developed with an increased degree of sophistication such that they were able to make a substantial contribution to understanding both the status and dynamics of reef systems on the Adelaide metropolitan region.

Reef Watch surveys for the period from September 2008 to May 2009 have included a structured approach that has focused on these six reefs (Figure 1):

- Broken Bottom, a degraded reef off Glenelg,
- Hallett Cove, a healthy exposed reef,
- Noarlunga North Inside and Noarlunga South Inside, which might be considered to be “at risk” sites that have shown signs of decline,

- Second Valley on the Fleurieu Peninsula, considered to be a healthy reef, and
- The Bluff (Rosetta Head) at Victor Harbour, also considered a healthy reef.

The status of the above reefs is based on the results of Reef Health surveys from 2005 (Turner *et al.* 2007) and 2008 (Collings *et al.* 2008). Reef Watch observations therefore encompass reefs that may be cause for concern (Noarlunga area) relative to degraded (Broken Bottom) and healthy locations (Hallet Cove, Second Valley and The Bluff). Changes in reef community composition at any of these sites can thus be placed in an appropriate context.

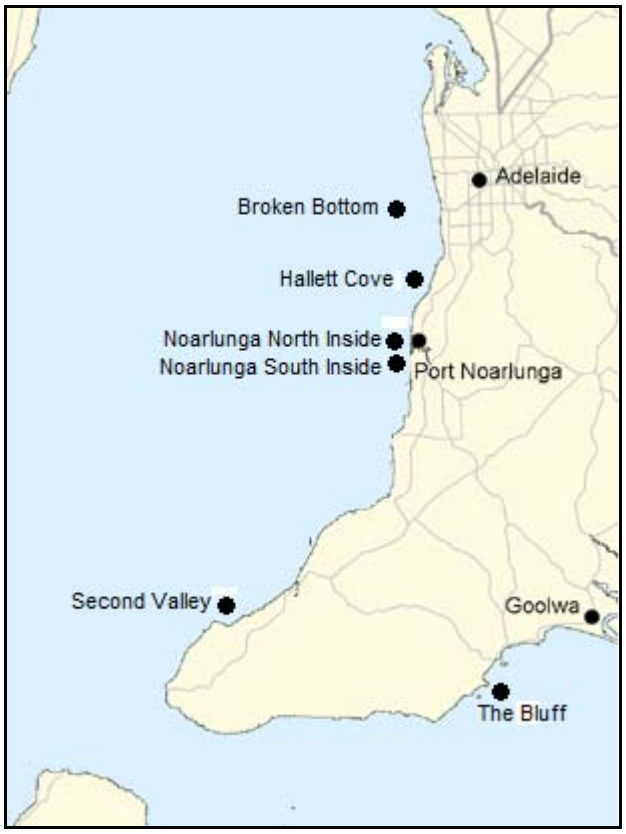

Figure 1 - Map of the AMLR NRM region showing the location of the reefs considered.

This report summarises the Reef Watch data collected between September 2008 and May 2009 across six reef sites on the Adelaide and Mt Lofty Ranges Natural Resource Management (AMLR NRM) coast (Figure 1). Analyses considered are focussed around reef status indices developed by Turner *et al.* (2007) as well as on the findings and recommendations from previous reporting for Reef Watch data (see Collings *et al.* 2008, CCSA 2009).

Aims

The aims of this report are therefore to:

1. Describe Reef Watch data in light of recommendations from previous analyses.
2. Consider Reef Watch data through the approach provided by the Turner *et al.* (2007) indices.
3. Propose areas where sampling might be further improved.

Methods, indices and the available data

Methods

For the purposed of this report, reef status (or health) is based around observations from four reef community strata;

- Sessile reef community composition (based on Line Intercept Transects - LITs).
- Fish community composition (Fish transects)
- Invertebrate community composition (Invertebrate transects)
- Invasive species observations (Feral or in Peril observations)

The methods employed in obtaining reef data are based around those used in Reef Health investigations, a full summary of which may be found in Turner *et al.* (2007), although note that the taxonomy employed within Line Intercept Transects (LIT) as well as Fish and Invertebrate surveys are rather different (see Appendix A).

Feral or in Peril observations are not based on a structured sampling approach, but nonetheless form a useful additional data resource in this context (see Reef Watch; http://www.reefwatch.asn.au/fpreport.html, accessed July 2009).

Reef status indices

The primary tool for investigating Reef Watch data are the indices of reef status developed by Turner *et al.* (2007) although it needs to be noted that that not all 11 indices could be considered (Table 1). A full description of each index including their calculation as well as some of their limitations is found in Turner *et al.* (2007). Further interpretation and critiquing of the indices are to be found in Collings *et al.* (2008) and CCSA (2009).

Table 1 - Eleven indices developed by Turner *et al.* (2007) to describe the environmental status (or "health") of reef systems on the South Australian coast. Note that those in red text were considered in this report.

Index type	Index	Data source
Areal cover	Areal cover of canopy-forming macroalgae	LIT
	Areal cover of turfing macroalgae	LIT
	Areal cover of mussel mats	LIT
	Areal cover of bare substrate	LIT
Abundance	Size and abundance of blue-throated wrasse	Fish
	Abundance of site-attached fish	Fish
	Abundance of mobile invertebrate predators	Invertebrate
Presence	Presence of invasive taxa	Feral or in Peril
	Presence of high sedimentation	No Data
Species richness	Richness of macroalgae	Not Used
	Richness of mobile invertebrates	Not Used

The index scores from the above can be averaged to develop an overall indicator of reef health for each group of observations (in this instance based around site and season – see below).

Given the substantial differences in taxonomy between the Reef Health surveys that use the above indices (Turner *et al.* 2007, Collings *et al.* 2008), the species richness indices were not employed in this analysis.

The sedimentation index was not also employed owing to a lack of data.

Survey data, index results and discussion

Reef Watch reef survey data for 2009

The Reef Watch surveys from September 2008 to May 2009 covered six sites along the AMLR coast, surveyed across three seasons (spring, summer and autumn; Figure 1; Table 2). Although not all sites are represented in each season, this dataset comprises a substantial improvement over previous data in terms of the balance of observations (see CCSA 2009). In addition, LIT data were generally more representatively obtained, such that observations at each comprised multiples of 5 m transects, with the majority (7 out of 11 site-season combinations) comprising 20 m or more of LIT. Earlier LIT data, while accurately collected, was frequently limited in terms of the overall transect length, such that its representativeness was suspect (CCSA 2009).

Table 2 - Reef Watch surveys for the AMLR NRM coast from September 2008 to May 2009.

Site	Season		
Broken Bottom			Autumn
Hallett Cove	Spring	Summer	Autumn
Noarlunga North Inside	Spring		
Noarlunga South Inside	Spring		
Second Valley	Spring	Summer	Autumn
The Bluff	Spring	Summer	

In contrast to earlier Reef Watch data, there is a spatiotemporally aligned set of observations from across LIT, Fish transects and Invertebrate transects, meaning that reef status is based on the same number of indices in each instance. Again this approach forms a substantial improvement over previous surveys.

Feral or in Peril data for 2009

Feral or in Peril data comprised some 41 records across 11 locations around the AMLR NRM coast, although note that these sites do not entirely align with those of the broader reef surveys. Importantly, the Feral or in Peril data now includes data on surveys where no feral species were observed, a key lack in earlier surveys (CCSA 2009).

The only invasive marine species observed in the Feral or in Peril program for the AMLR NRM Coast across the survey period was the European fanworm (*Sabella spallanzanii*) at Brighton Jetty, West Beach Boat Ramp, Noarlunga Jetty and Noarlunga Reef. Importantly, most of these locations comprise artificial substrates in relatively sheltered locations, which this pest appears to favour (Boxall and Westphalen 2003). In spite of the appearance of *S. spallanzanii* on the Noarlunga Jetty and Noarlunga Reef, the reef is considered to remain free of this pest and there is more recent data from Feral or in Peril to confirm this notion. However, encroachment of European fanworm onto Noarlunga Reef, in particular the more sheltered inner side, remains a point of concern. Boxall and Westphalen (2003) indicate that as of 2002 *S. spallanzanii* was as far south as Brighton, but that Seacliff, Hallett Cove and Noarlunga were then free of this species. Spread of this pest to sheltered areas further south along the coast should be expected, but Feral or in Peril

data from Second Valley and Rapid Bay suggest that these locations are still uninfected. Results of this nature highlight the critical importance of reporting a "no pest observed" result.

Index results

Reef status across all site-season combinations was either "Caution" (required) or "Good", with no reefs rated as "Poor" (Table 3). Index results based on the Reef Watch 2009 survey would appear to suggest that Broken Bottom has improved relative to previous observation (see below), but that the Noarlunga Reef sites are still intermediate in terms of health status. Apart from investigation of the Reef Watch data, index results can be compared with earlier Reef Health studies, specifically the Turner *et al.* (2007) survey in 2005 and Collings *et al.* (2008) observations in 2007. In addition, there is some capacity to observe the effect of season on reef status, although an in-depth consideration of differences between sites and/or seasons would be best achieved via a multivariate analytical approach.

Table 3 - Overall reef status index results for Reef Watch observations for September 2008 to May 2009 (see Turner *et al.* (2007).

Site	Season		
	Spring	Summer	Autumn
Broken Bottom			Caution
Hallett Cove	Good	Good	Good
Noarlunga North Inside	Caution		
Noarlunga South Inside	Caution		
Second Valley	Good	Caution	Good
The Bluff	Good	Caution	

Comparison between surveys

Comparison of the Reef Watch 2009 results is best done using the observations that are seasonally aligned with Turner *et al.* (2007) that considered from summer-autumn 2005 and Collings *et al.* (2008) that surveyed from autumn-winter 2007. Broken Bottom, Hallett Cove and Second Valley autumn observations (BRB_Autumn, HAL_Autumn and SVA_Autumn) are therefore best, although summer observations could also be compared (HAL_Summer, SVA_Summer and BLF_Summer). Observations from the spring should not be directly compared to previous surveys, owing to the confounding influence of seasonal differences (see below; CCSA 2009). However, it also needs to be remembered that index results in this report are based on only eight of the 11 indices and some caution is required in comparing between surveys. Some consideration might be given to reanalysis of earlier surveys (specifically the results of Turner *et al.* 2007 and Collings *et al.* 2008) using the same group of indicators that are available to Reef Watch.

It is also unlikely that many of the surveys were undertaken in exactly the same points on the respective reefs (Noarlunga is an exception) and consequently small-scale variability in reef composition may affect index results. Use of permanent transects (or at least fixed areas) with observations targeted to specific periods would alleviate spatiotemporal factors.

Broken Bottom (BRB_Autumn)

The Caution status for the Broken Bottom site, which was labelled as Poor in 2005 and 2007 Reef Health surveys suggests a degree of improvement to the site and may reflect the observations noted by Collings *et al.* (2008) that there were signs of recovery at some degraded areas. However, in term of individual indices, the macroalgal canopy cover at Broken Bottom still rated as zero. While this result is in line with previous surveys it also means that improvement to reef status came mostly from high ratings for site attached fish and mobile invertebrate predators (both 100; Table 4). Evidence from previous analyses of Reef Watch data suggest that the site attached fish index is less reliable in determining reef status relative to those related to cover (specifically LIT data; CCSA 2009). In addition, there was limited alignment between species used in the mobile invertebrate index between Reef Watch and Turner *et al.* (2007, see Appendix A) and this index is therefore also likely to be the less informative. Alignment of Reef Watch survey taxa relative to those employed in Reef Health for mobile invertebrates is required, although development of a functional form approach, rather than one based on species may prove more tractable in a field setting. However, the latter may prove difficult to achieve without professional involvement.

Improvements to reef status are probably best confirmed through observations of establishment and growth of larger canopy-forming macroalgae, although degraded reefs on the northern Adelaide metropolitan coast may be a substantial distance from a reliable source of propagules.

Hallett Cove (HAL_Summer and HAL_Autumn)

Hallett Cove in both summer and autumn rated as Good and reflects previous observations for these sites (Turner *et al.* 2007, Collings *et al.* 2008), although note that summer and autumn index results for Reef Watch 2009 were identical (HAL_Autumn and HAL_Summer; Table 4).

Individual index scores at Hallett Cove varied substantially between 2005, 2007 and 2009 (see Table 4; Turner *et al.* 2007, Collings et al 2008). The canopy cover index score of 100 in 2005, -1 in 2007 and zero for the comparable Reef Watch observation. Site attached fish was rated at 47 in 2005, 53 in 2007 and 100 in 2009, with mobile invertebrate predators rating 78 in 2005, zero on 2007 and 100 in 2009. Turner *et al.* (2007) and Collings *et al.* (2008) also included results for the blue-throated wrasse (73 and 27 respectively for 2005 and 2007), but none were observed in 2009. The inclusion of blue-throated wrasse as an indicator should be reconsidered as the occurrence of this species appears to be sporadic.

In spite of the apparent decline of reefs to the north and (possibly) the south, Hallett Cove appears to retain a high level of health. Possibly it's slightly more exposed position relative to reefs elsewhere on this stretch of coast, in particular the inside of Noarlunga, helps keep the reef free of sediments.

Table 4 - Reef status indices for each site-season considered by Reef Watch in the period September 2008 to May 2009. See Turner *et al.* (2007) for the details of each index. Note that the blank cells in the results (notably the columns for turf, mussels and invasive species) are "Null" values for the index score and not zeros or no data.

Site and Season	Status	Overall Score	Canopy	Turf	Mussels	Bare	Site attached fish	Mobile invertebrate predators	Wrasse	Invasive
BRB_Autumn	Caution	60	0			39	100	100		
HAL_Autumn	Good	67	0				100	100		
HAL_Spring	Good	78	46				88	100		
HAL_Summer	Good	67	0				100	100		
NNI_Spring	Caution	38	34			0	58	100	0	
NSI_Spring	Caution	49	49				47	100	0	
SVA_Autumn	Good	99	98				100	100		
SVA_Spring	Good	100	100					100		
SVA_Summer	Caution	59	39			12	100	100	45	
BLU_Spring	Good	100	100				100	100		
BLU_Summer	Caution	51	81				29	42		

Noarlunga North Inside

The Noarlunga North Inside observations were obtained in spring (Table 3) and had an overall rating of Caution. Although this reflects the results of previous observations for this site (Turner *et al.* 2007, Collings *et al.* 2008), a direct comparison of individual indices is not recommended owing to seasonal differences in the observations.

Noarlunga South Inside

As with the above, Noarlunga South Inside observations were obtained in spring (Table 3) and also had an overall rating of Caution. This site was rated as Poor in 2005 (Turner *et al.* 2007) and Caution in 2007 (Collings *et al.* 2008). Similarly, while this result supports the previous observations, further direct comparison of individual indices is not recommended owing to seasonal differences.

Second Valley (SVA_Autumn)

Second Valley in autumn rated as Good, which is in line with previous observations (Turner *et al.* 2007, Collings *et al.* 2008). This site is typified by high canopy macroalgal cover (100, 100 and 98 for 2005, 2007 and 2009 respectively, as well as high ratings for site attached fish (100 in all instances) and mobile invertebrate predators (50, 92 and 100 respectively; Table 4). Note that there was a decline in reef status for this site in summer (see below).

The Bluff (BLF_Summer)

The Bluff in summer rated as Caution (overall score of 51) most probably owing to a lower canopy cover index of 81, versus 100 in 2005 when it rated as Good (note this

site was not surveyed in 2007). Site attached fish and mobile invertebrate predators also rated lowly in 2009 (29 and 42 respectively), although these indices were even lower in 2005 (5 and 28 respectively). This apparent loss of canopy macroalgae appears to have happened over a relatively short period, as index results for the preceding spring indicate a healthy reef (overall rating of 100 with canopy index of 100; Table 4). This change is therefore likely to be in response to either a seasonal shift in reef composition and/or a storm event. The latter may have relatively more influence at The Bluff compared to other sites considered in this survey owing to its exposed location. This result highlights the need to consider changes in reef condition, particularly those based on index information in light of site-specific factors.

There are also factors related to the survey that may affect the data. Diving conditions, in particular swell and visibility may influence the capacity to collect data, particularly at locations such as The Bluff that can be extremely difficult (personal observation).

Seasonal differences

The need for care in interpreting reef status indices is demonstrated in the results for Second Valley and The Bluff, where there was a dip in status from Good in spring to Caution in summer and then Good again in summer (for Second Valley – there was no data for The Bluff in summer; Table 3). Both sites show a loss of canopy macroalgal cover in the summer, although The Bluff also appeared to have fewer site-attached fish and mobile invertebrate predators (Table 4). Similarly, although Hallett Cove retained a Good rating across all seasons (Table 3), there were substantial differences in the canopy macroalgal cover index (Table 4).

Certainly there are substantial seasonal changes in macroalgal cover that occur on healthy reefs across the course of a year. These changes may be quite large, particularly amongst canopy-forming species of *Cystophora* and *Sargassum* (Edgar 1983, Edgar *et al.* 2004, Collings 1996, Collings *et al.* 2008). Similarly, while site attached fish implies a fixed residency, for some species of fish this status may change according to life cycle imperatives and/or external factors, both natural (e.g. predators, competitors and/or storm events) or anthropogenic (e.g. fishing, boating and/or diving disturbance). Similarly, mobile invertebrate predators may undergo changes due to species-specific or external influences. For example, giant cuttlefish (*Sepia apama*) will die soon after spawning (Australian Museum; http://www.australianmuseum.net.au/Giant-Cuttlefish, Accessed July 2009), which may lead to substantial change in the mobile invertebrate index that is not related to the health of the system.

While seasonal data from all sites would be the best approach to identifying reef status, in the absence of this capacity, focus should be given to obtaining data from all sites within one season (preferably autumn for comparison purposes) and then use a small number of sites (for example Hallett Cove and Noarlunga) for obtaining data across seasons (including winter). This approach may form the best balance of spatial and temporal coverage, in particular where resources are limited.

Improvements to indices

It needs to be realised that the status indices developed by Turner *et al.* (2007) were never intended to be the definitive approach to reef health assessment. There is a need for critical assessment of the validity, parameterisation and calculation of each index, responding to the criticisms raised in both Collings *et al.* (2008) and CCSA (2009). This requires a careful consideration of the available data with a view to developing more robust analyses and is therefore beyond the scope of Reef Watch. However, current Reef Watch data may make a valuable contribution to such a process, particularly with respect to highlighting seasonal differences.

For the immediate future, some rationalisation of the indices should be considered. The blue-throated wrasse index requires data on both size as well as the number of fish observed. Current Reef Watch data includes values for the number of fish and therefore the average size of fish from previous surveys had to be employed. A similar approach was employed in previous reporting for Reef Watch data (CCSA 2009). However, blue-throated wrasse were observed only at three of the 11 site-season combinations and the value of this index as a monitoring tool, at least in this context, may be open to question.

LIT data are critical to understanding reef status and it is important that both the quantity and quality of these data are maintained. While the majority of site-season observations were sufficient, four sites were still rather short (10-16 m) rather than the minimum of 20 m (although note that the preferred distance is actually 40 m).

A functional-form approach to site attached fish and mobile invertebrate predators should also be considered, although the broader reliability of these indices in their current form should also be considered.

Conclusions and recommendations

Reef Watch data for 2009 are of a similar standard to that achieved in previous years, but with a significant improvement in survey structure such that they are far more tractable in terms of analysis and interpretation. Beyond the use of the Turner *et al.* (2007) indices, there are a range of additional analyses that might be considered in terms of site and seasonal differences between reefs within each of the datasets (LIT, Fish and Invertebrates) as well as overall, but these approaches are outside the scope of the current report. However, it should be noted that the status indices only employ a subset of the available data.

Index results based on Reef Watch data are in line with those of earlier Reef Health surveys for 2005 (Turner *et al.* 2007) and 2007 (Collings *et al.* (2008), but also highlight the effect of seasonal differences on index results.

A number of recommendations can be identified from these results.

1. While seasonal data from all sites would be the best approach to identifying reef status, in the absence of this capacity, focus should be given to surveying all sites within one season (preferably autumn for comparison purposes) and then use a small number of sites (for example Hallett Cove and Noarlunga) for obtaining data across seasons (including winter). This approach may form the best balance of spatial and temporal coverage, in particular where resources

are limited. Alternatively, rather than seasonal data, surveys at all sites should be undertaken twice yearly (e.g. autumn and spring).

2. Use of permanent transects (or at least fixed survey areas) with observations targeted to specific periods would alleviate spatiotemporal factors. These can be as simple as a fixed starting location and a compass bearing such that the same patch of reef (note not necessarily exactly the same transects) are considered.

3. Further development of the reef status indices is required. In the immediate term, the inclusion of blue-throated wrasse as an indicator should be reconsidered as the occurrence of this species appears to be sporadic.

4. Alignment of Reef Watch survey taxa relative to those employed in Reef Health for mobile invertebrates is required, although development of a functional form approach, rather than one based on species may prove more tractable in a field setting. However, the latter may prove difficult to achieve without professional involvement.

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Appendix A – Taxa used in Reef Watch surveys

Lifeforms used for Line Intercept Transects

Lifeform	Description	Index
ATTAN	Attached animal	NA
BBIG	Brown big	Canopy
BKELP	Big kelp	Canopy
BSMALL	Brown small	NA
DDD	No data	NOTUSED
ENC	Encrusting	NA
MOBAN	Mobile animal	NA
MUSSELS	Mussel bed	Mussels
RBIG	Red big	NA
RCORAL	Red coralline	NA
ROCK	Bare rock	Bare
RSMALL	Red small	NA
SAND	Bare sand (on rock)	Bare
START	Transect start	NA
TURF	Turf	Turf

Fish species observed in Reef Watch surveys

Common	Species	Site Attached	Blue throated wrasse
Black-Spotted Wrasse	*Austrolabrus maculatus*	YES	NO
Blue Groper	*Achoerodus gouldii*	YES	NO
Blue-Throated Wrasse	*Notolabrus tetricus*	YES	YES
Bullseye	*Pempheris* spp.	YES	NO
Drummer	*Kyphosus sydneyanus*	NO	NO
Dusky Morwong	*Dactylophora nigricans*	NO	NO
Goat Fish	*Upeneichthys vlamingii*	NO	NO
Goby		YES	NO
Herring Cale	*Odax cyanomelas*	YES	NO
Horseshoe Leatherjacket	*Meuschenia hippocrepis*	YES	NO
Hulafish	*Trachinops* spp.	NO	NO
Long-finned Pike	*Dinolestes lewini*	NO	NO
Long-Snouted Boarfish	*Pentaceropsis recurvirostris*	NO	NO
Magpie Perch	*Cheilodactylus nigripes*	YES	NO
Moonlighter	*Tilodon sexfasciatus*	YES	NO
Old Wife	*Enoplosus armatus*	YES	NO
Ornate Cowfish	*Aracana ornate*	YES	NO
Other Leatherjacket		YES	NO
Other Wrasse		YES	NO
Rainbow Cale	*Odax acroptilus*	YES	NO
Scalyfin	*Parma victoriae*	YES	NO
Senator Wrasse	*Pictilabrus laticlavius*	YES	NO
Southern Sea Carp	*Dactylosargus arctidens*	NO	NO
Sweep	*Scorpis* spp.	NO	NO
Toadfish		NO	NO
Weed Whiting	*Siphonognathus* spp.	NO	NO
Western Bluedevil	*Paraplesiops meleagris*	YES	NO
Western Talma	*Chelmonops curiosus*	YES	NO

Common	Species	Site Attached	Blue throated wrasse
Yellow-Headed Hulafish	*Trachinops noarlungae*	YES	NO
Yellow-Striped Leatherjacket	*Meuschenia flaviolineata*	YES	NO
Zebra fish	*Girella zebra*	NO	NO

Invertebrate species observed in Reef Watch surveys

Common	Species	Index
Amblypneustes	*Amblypneustes* spp.	NO
Blacklipped abalone	*Haliotis* spp.	NO
Bullseye	*Pempheris*	FISH
Cenolia (feather star)	*Cenolia* spp.	NO
Centrostephanus	*Centrostephanus tenuispinus*	NO
Coscinasterias (11 arm star)	*Coscinasterias muricata*	YES
Dicathais	*Dicathais orbita*	YES
Goniocidaris	*Goniocidaris tubaria*	NO
Greenlip abalone	*Haliotis laevigata*	NO
Heliocidaris	*Heliocidaris erythrogramma*	NO
Hermit crab		NO
Holothurian (sea cucumber)	*Stichopus* spp.	NO
Moonlighter	*Tilodon sexfasciatus*	FISH
Nepanthia	*Nepanthia troughtoni*	NO
Patiriella brevispina	*Patiriella brevispina*	NO
Pentagonaster (firebrick star)	*Pentagonaster dubeni*	NO
Petricia	*Petricia vernicina*	NO
Phasianella	*Phasianella* spp.	NO
Phyllacanthus	*Phyllacanthus irregularis*	NO
Plagusia (red bait crab)	*Plagusia chabrus*	NO
Queen scallop	*Equichlamys bifrons*	NO
Rock lobster	*Jasus edwardsii*	YES
Small fish		FISH
Tosia	*Tosia* spp.	NO
Turbo torquatus	*Turbo torquatus*	NO
Turbo undulatus	*Turbo undulatus*	NO
Uniophora	*Uniophora granifera*	YES
Western Bluedevil	*Paraplesiops meleagris*	FISH
Western Talma	*Chelmonops curiosus*	FISH
Whelk/triton complex		YES