

SALDANHA BAY SEA BASED AQUACULTURE DEVELOPMENT ZONE ANNUAL BENTHIC REDOX SURVEY INCLUDING THE ONCE OFF SURVEY OF SMALL BAY		
	Findings by Anchor Research and Monitoring	Preliminary way forward with regards to the scientific findings to be undertaken forward by the DEFF: Fisheries Management
1.	<p>Sulphide concentrations in sediments were not measured during these surveys due to the lack of an appropriate instrument for measuring these data but. It is acknowledged that this is a critical tool in assessing the impacts of aquaculture on the benthic environment in all the ADZ precincts including Small Bay.</p>	<p>The Terms of Reference (ToR) for the appointment of Anchor Research and Monitoring included a once-off chemical transect survey of sulphide (S²⁻) to establish the oxic status of the lease areas in Small Bay. The ToR indicated that the DEFF would provide a Sulphide probe for this analysis.</p> <p>The DEFF procured a sulphide probe for the measurement of sulphides, however following delivery which was held up at customs during the initiation of the national lockdown, it was discovered that the instrument was not suitable for field measurements of sulphides as envisaged and that field-based equipment is not available at all-only laboratory-based analytical equipment, thereby precluding their measurement in the field as per the ToR.</p> <p>Redox measurements were taken to substitute the measures of sulphide. Sulphide measurements will be undertaken during the next survey following familiarisation of the new instrument purchased by DEFF and of the operation of the instrument. These measurements will be undertaken by a new service provider to be appointed in October/November 2020.</p>
2.	<p>Redox values were used as proxy for sulphide concentrations, but again it is acknowledged that measuring sulphide concentrations would provide additional valuable information on the state of the benthic environment and allow for the validation of redox measurements taken to date.</p>	<p>The new service provider will be required to undertake the once-off chemical transect survey of sulphides in Small Bay as originally intended.</p>
3.	<p>Redox measurements yielded highly variable readings among sites. Several factors (e.g. sediment granulometry and organic content) may influence redox values in sediment and, as an additional measure, these should be analysed in the future. These sediment characteristics (granulometry and organic content) can also be used to monitor potential impacts of ADZ development and will allow better use to be made of the sediment samples collected in future.</p>	<p>Granulometry and organic content collected in the Redox (chemical) survey was not a requirement of the original Sampling Plan but will be considered as part of Chemical surveys going forward. The frozen 2020 sediment samples may be considered for analysis for granulometry and organic content in future monitoring</p>

		appointments.. These measurements are part of the monitoring requirements for the survey in 2021 as per the Sampling Plan. The Baseline survey also measured these parameters. (
4.	The presence of the abrasion platform in Big Bay prevented the collection of sediment samples at certain sites and may cause the concentration of organic matter in depressions at others. Determining the extent and nature of platform would help in interpreting findings from future surveys and in the assessment of impacts of aquaculture development in Saldanha Bay as a whole.	Follow up research will be done on the extent and nature of abrasives platform. The Sampling Plan methodology will be revised for the Big Bay precinct and will detail an appropriate sampling methodology that includes rock substrate going forward.
5.	In instances where farming structures fall over hard substrata, redox and sulphide measurements are not considered suitable tools for monitoring the health of the benthic environment as sediment cannot be collected and these analyses require sediment. Alternative means for monitoring the health of the benthic environment in these areas (e.g. assessment of visual or photo-quadrats) needs to be identified and implemented in the future.	Alternative methodologies will be investigated for monitoring the health of the benthic environment on hard substrata and the Sampling Plan will be revised accordingly.
6.	The two reference stations in Small bay SB C1 and SB C3 are not at a comparable depth to the impact sites. Reference sites located at a similar depth to the impact sites would provide a more accurate reference to measure redox and sulphide impacts against.	New and or additional reference sites will be located in Small Bay at depths similar to the impact sites. Proposed sites were included in the redox survey report and these will be included in the next survey.
Management recommendations are based primarily on the statistical analyses of the data collected during the 2020 survey		
1.	The majority of the impact sites surveyed within the four ADZ precincts in Saldanha Bay (Big Bay, Outer Bay North, Outer Bay South and Small Bay) fall within the stipulated thresholds, and it is recommended that these sites be surveyed again in April 2021 in accordance with the ADZ sampling Plan requirements.	A repeat Redox survey will be commissioned in April/May 2021 this survey will be more detailed as per the requirements stipulated in the Sampling Plan which will include sampling of the macrobenthos and other parameters. The Sampling Plan recommends that if thresholds are exceeded, further sampling is undertaken. However, these thresholds are being exceeded in areas that do not have aquaculture thereby demonstrating the value of the baseline assessment and raising the possibility that the thresholds are too low to be of use in this context and may need to be revised. The next survey in April/May 2021 will give more information in terms of macrobenthos.
2.	The same applies to the sites in Big Bay (B4) and Outer Bay North (NB1) where, in 2020, measured redox values exceeded stipulated thresholds and were significantly different to their respective reference stations, but no aquaculture activity was present in the immediate vicinity.	
3.	Similarly, while the redox values recorded at SB2 in Small Bay exceeded the stipulated threshold, measured values were not significantly different from the two reference stations in this area, and thus should not trigger any management action. This precinct should be surveyed again along with the new	

recommended reference stations during the 2021 annual redox and sulphide survey.	
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SALDANHA BAY SEA BASED AQUACULTURE DEVELOPMENT ZONE BASELINE BENTHIC SURVEY REPORT	
<p>1. Due to the presence of hard substrata, the number of sites sampled does not meet the required amount stipulated in the sample plan. Monitoring macrofauna at the replacement sites surveyed during the 2020 chemical survey (Appendix 1), where known soft substrata is present would increase the number of impact sites to required amount. The timing of future chemical, sediment and macrofauna surveys to coincide with the SOB sampling (Autumn) would facilitate comparisons between sediment chemical characteristics and macrofauna communities without seasonal effects.</p>	<p>The number of sampling sites will be increased. In future sampling will coincide with the State of the Bay sampling.</p>
<p>2. Access to the invertebrate taxonomic reference collections from previous surveys would facilitate refinement of the overall species list for the area, resolving ambiguous species definitions among service providers. A macrofauna reference collection of the specimens collected from the ADZ would be invaluable.</p>	<p>Invertebrate taxonomic reference collections will be created to allow of comparison of results and conclusions between service providers. Development of this reference collection will be included in the new service provider's Terms of Reference to be appointed in October/November 2020.</p>
<p>3. Despite high abundance and species richness in Saldanha Bay, the natural occurrence of certain dominant species causes the Shannon-Weiner Diversity index to fall below the stipulated threshold of $H' = 3$ throughout the three ADZ precincts. A revised H statistic threshold calculated from reference or baseline sites would be a more locally applicable threshold value.</p>	<p>A revised H statistic threshold will be calculated for the baseline sites for a local threshold value.</p> <p>This highlights the importance of reference stations for comparison with non-impacted sites. In addition, the next surveys will measure whether the index has changed significantly to measure impact over time and compare with the baseline.</p>
<p>4. Cumulative abundance-biomass plots (ABC curves) of macrobenthic communities (Warwick 1993), also called k-dominance curves, would be additional useful tools in the analysis of macrobenthic invertebrate data.</p>	<p>This recommendation will be considered for the next survey and the Sampling Plan will be amended accordingly.</p>
<p>5. Infaunal Trophic Index (ITI) and AZTI Marine Biotic Index (AMBI) are more suited to analysing Northern Hemisphere macrofaunal communities, while the locally developed Biological Traits Analysis (BTA) with Fuzzy logic may be more suitable for future macrobenthos surveys in Saldanha Bay.</p>	<p>This recommendation will be considered for the next survey and the Sampling Plan will be amended accordingly.</p>

6.	<p>The extent of the abrasion platform present in Big Bay is currently un quantified. The proportion of this habitat type impacted by current and future mariculture activities is unknown, (especially in view of the fact that the dispersion model shows strong scouring here. A full detailed bathymetry survey using side scan sonar or multibeam echosounder of the ADZ precinct and historical extent of the abrasion platform would map the current extent of the abrasion platform in Big Bay.</p>	<p>. Historic State of the Bay monitoring sites do not coincide with the new sampling sites and so did not detect these rocky outcrops. The Environmental Authorisation condition 46 indicates that benthic sampling needs to be undertaken prior to new operators starting operations which was undertaken with the baseline sampling. Further research will be undertake to determine the extent, the patchiness and species diversity and composition on rock outcrops to inform management measures within the ADZ.</p> <p>A study will be commissioned with the new service provider to investigate the Big Bay precinct area. Based on the findings of this investigation a further study will be commissioned to determine the species community in the area on rocky outcrops.</p>
7.	<p>The video footage and bathymetry provided by Molapong as well as the photographs taken by AR&M divers shows patches of exposed reef present in the finfish lease area. The reef appears to be mostly low profile <1m in height which may be periodically inundated with sand, however, outcrops of reef >1m in height were evident. This is a poorly/unstudied habitat type within Saldanha Bay and there is a dearth of information on its extent, and the nature and type of biotic communities present. The ADZ monitoring programme should be updated to include suitable methods for monitoring potential aquaculture impacts on this habitat type.</p>	<p>The Sampling Plan will be revised to take into account the presence of the abrasion platform so that the impacts of the farming can be monitored on hard bottom substrate as well as sandy bottom. The sediment and chemical dynamics of the platform will be the subject of additional research since the dispersion model did not suggest that there will be significant accumulations of wastes or organic compounds on the seabed in Big Bay due to the existing wave regime.</p>
8.	<p>Suitable reef impact sites (n=3) in the finfish area and suitable reference sites (n=3) should be surveyed by scientific divers using transect or quadrat surveys to quantify key biotic components of this reef habitat. An alternative approach could be the use of underwater visual survey by means of divers with cameras, drop cameras or a Remote Operated Vehicle (ROV). All methods of surveying this habitat will rely on acceptable underwater visibility which is not common in Big Bay. In situ benthic surveys by divers, however, may be more easily undertaken than underwater video surveys in conditions of reduced visibility, but all options should be considered. It is critical that whichever survey method is employed, it must be repeatable for ongoing future monitoring. Ideally this monitoring should (as per the soft sediment</p>	<p>An investigation of the Big Bay precinct will be undertaken to quantify the biotic components of the abrasion platform and low lying reef areas as detailed above.</p>

	monitoring programme) follow a BACI design, although it may not be practically feasible to complete a survey prior to installation of fish cages on the site.	
9.	Analysis and interpretation of the results of the bathymetric and underwater reef habitat surveys must provide practical advice to support the ongoing adaptive management of the Big Bay ADZ precinct.	Ongoing monitoring will inform the management of the ADZ.