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REPUBLIC OF SOUTH AFRICA

SALDANHA BAY SEA BASED AQUACULTURE DEVELOPMENT ZONE SPECIALIST ENVIRONMENTAL MONITORING QUALITATIVE BIOFOULING SURVEY



AUGUST 2022



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EXECUTIVE SUMMARY

Introduction

The Marine Living Resources Fund (MLRF), a Schedule 3A Public Entity established in terms of the Public Finance Management Act, 1999 (Act No 1 Of 1999), under the auspices of the Department of Forestry, Fisheries and the Environment (DFFE), appointed Anchor Research and Monitoring (Pty) Ltd (Anchor) to undertake specialist monitoring in compliance with the environmental Sampling Plan, Environmental Management Program and Environmental Authorisation for the Saldanha Bay ADZ, for a period of two years (2021/2022). One of the specific tasks of this appointment was to conduct annual non-quantitative (i.e. qualitative) sampling of fouling organisms. This report presents the findings of diver surveys conducted at two sites in the Big Bay and Small Bay shellfish precincts during 2021.

Methodology

Fouling organisms were collected from aquaculture farm structures (buoys, ropes, chains and rafts) at two sites in the Saldanha ADZ Big Bay and Small Bay shellfish precincts on the 02 September 2021. This comprised a scientific diver scraping a 20 cm length of chain or rope. Alternatively, on larger structures, wall scrapes were undertaken using 0.04 m² quadrats. Once collected, samples were transferred to 2 litre buckets and preserved in 8% buffered formalin. Organisms were identified to species level where possible, and the results of this taxonomic analysis were compared to data collected by Llyod Sassman (DFFE).

Findings & Remarks

Previous research by DFFE identified 66 fouling species from aquaculture farm structures in the Saldanha ADZ. Sixteen of these were also collected during the 2021 Anchor survey, while an additional nine taxa were recorded. This fauna is dominated by the phyla Mollusca, Arthropoda and Chordata, with 95% of the taxa identified to species level. Only 23 and seven taxa were identified from the Small Bay and Big Bay precincts respectively, and only three species were shared with both sites and the DFFE study, including the ribbed mussel *Aulacomya atra*, Mediterranean mussel *Mytilus galloprovincialis* and Gilchrist's flatworm *Planocera gilchristi*. However, discrepancies are likely due to differences in sampling season, intensity and methodology. Overall, one alien and three invasive species were identified.

These results will be augmented by findings from the additional biofouling sampling of farm aquaculture structures in the Saldanha ADZ that was undertaken on the 4-5 July 2022. This will be further supplemented with DNA barcoding of select specimens, and underwater imagery, both of which will be included in the next report due in July 2023.

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1 INTRODUCTION

1.1 Background

An Aquaculture Development Zone (ADZ) comprises areas of water selected for their suitability for specific aquaculture sectors. The Saldanha ADZ provides opportunities for existing aquaculture operations to expand and new ones to be established, providing economic benefits to the local community through job creation and regional economic diversification. ADZs are intended to boost investor confidence by providing ‘investment ready’ platforms with strategic environmental approvals and management policies already in place, allowing commercial aquaculture operations to be set up without the need for lengthy, complex and expensive approval processes. It is anticipated that ADZs will create incentives for industry growth, provide marine aquaculture services and enhance consumer confidence.

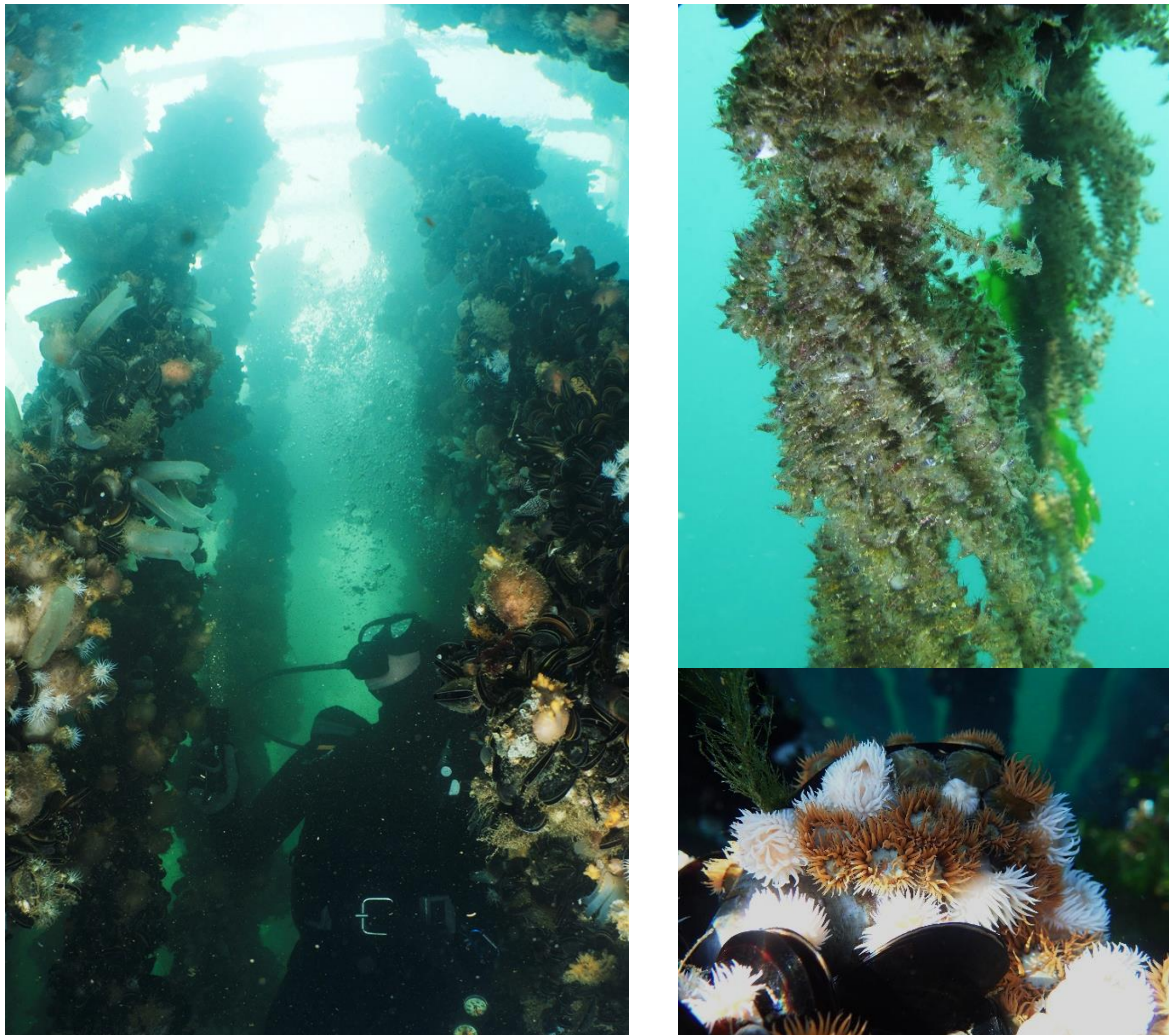


Figure 1-1. Fouling communities present in the Saldanha Bay ADZ.

The Marine Living Resources Fund (MLRF), a Schedule 3A Public Entity established in terms of the Public Finance Management Act, 1999 (Act No 1 Of 1999), under the auspices of the Department of Forestry, Fisheries and the Environment (DFFE), appointed Anchor Research and Monitoring (Pty) Ltd (Anchor) to undertake specialist monitoring in compliance with the environmental Sampling Plan, Environmental Management Program and Environmental Authorisation for the Saldanha Bay ADZ, for a period of two years (2021/2022). One of the specific tasks of this appointment was to conduct annual non-quantitative (i.e. qualitative) sampling of fouling organisms. This report presents the findings of diver surveys conducted at two sites in the Big Bay and Small Bay shellfish precincts during 2021.

1.2 Biofouling

Aquaculture farm structures provide a novel surface for the quick colonisation and proliferation of various fast-growing and highly competitive marine species with short-lived larvae (Fitridge *et al.* 2012, Megina *et al.* 2013, Janiak & Branson 2021). These fouling communities are commonly dominated by sessile, suspension-feeding organisms including ascidians, barnacles, bivalves, bryozoans, hydroids, polychaetes and sponges (Figure 1-1) (Millard 1951, Dicken *et al.* 2011, Fitridge *et al.* 2012). They also frequently include alien species that have been transferred both regionally and globally via shipping activity (Fitridge *et al.* 2012, Megina *et al.* 2016, Leclerc & Viard 2018). Consequently, hard artificial substratum within ports facilitates the introduction, establishment and regional spread of alien species (Janiak & Branson 2021, Outinen *et al.* 2021). Indeed, harbours are one of the most invaded habitats of the marine realm (Leclerc & Viard 2018), and comprise the highest concentration of marine alien species in South Africa (Picker & Griffiths 2017). Shipping is responsible for roughly 91% of marine introductions to South Africa, with the majority originating from the North Atlantic Ocean, and the likely vectors being ballast water and/or hull fouling (Robinson *et al.* 2020).

To date, 95 marine alien species have been reported from the South African coastline (Robinson *et al.* 2020). Of these, at least 67 alien species are known to occur along the west coast (Robinson *et al.* 2020), 29 of which are confirmed to be present in Saldanha Bay and/or Langebaan Lagoon (see Section 5 – Appendix 1). An additional 19 species are currently regarded as cryptogenic (of unknown origin, but very likely introduced) to Saldanha Bay and/or Langebaan Lagoon and genetic analyses are required to determine their status.

2 METHODOLOGY

Fouling organisms were collected from aquaculture farm structures (buoys, ropes, chains and rafts) at two sites in the Saldanha ADZ Big Bay and Small Bay shellfish precincts on the 02 September 2021 (Figure 2-1, Figure 2-2). This comprised a scientific diver scraping a 20 cm length of chain or rope. Alternatively, on larger structures, wall scrapes were undertaken using 0.04 m² quadrats. Once collected, samples were transferred to 2 litre buckets and preserved in 8% buffered formalin. Organisms were identified to species level where possible, and the results of this taxonomic analysis were compared to data collected by Llyod Sassman (DFFE).

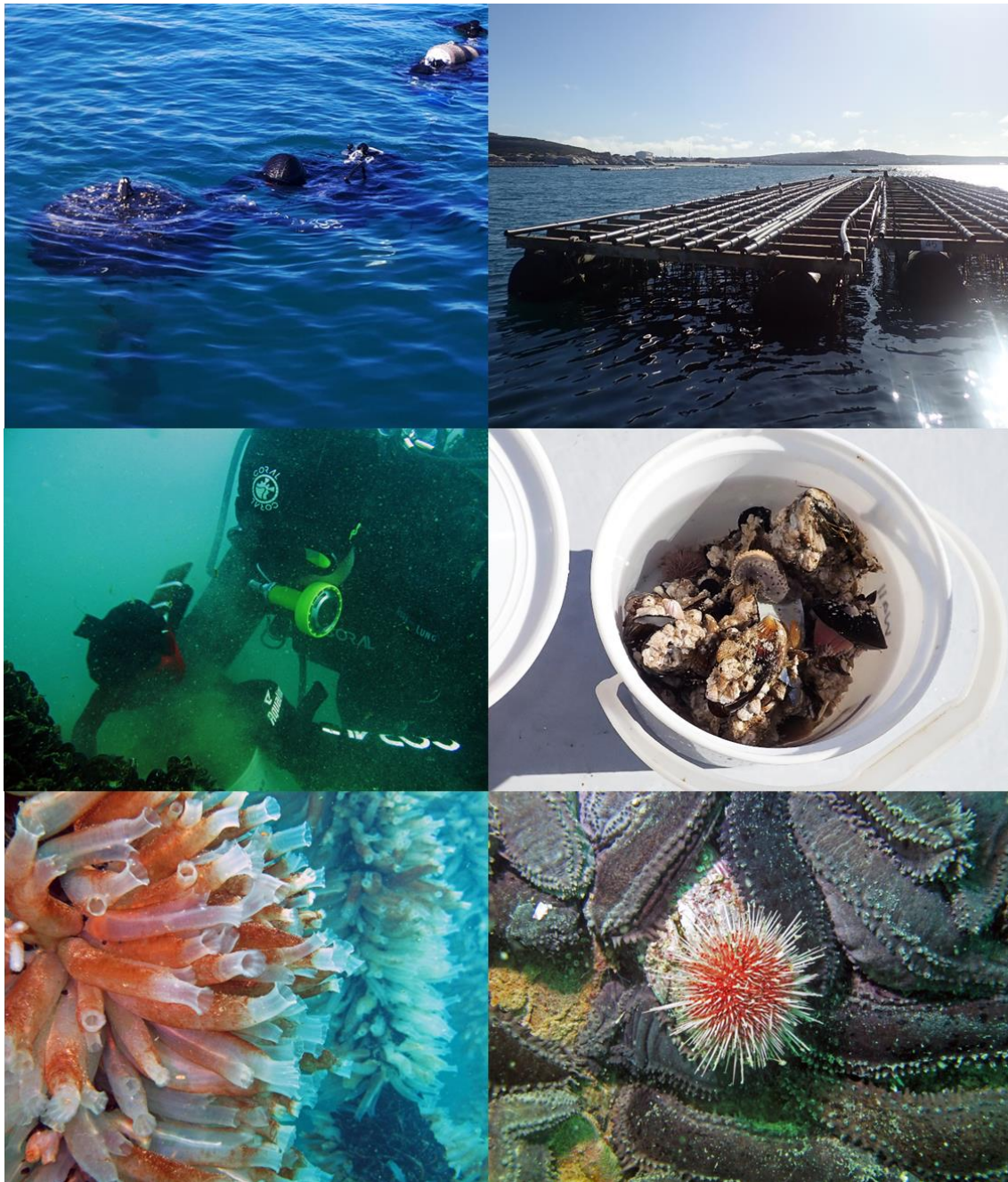


Figure 2-1. Anchor scientific divers collecting biota from aquaculture farm structures in the Saldanha Bay ADZ during 2021, and an example of the resultant sample prior to sorting and preservation (middle right).

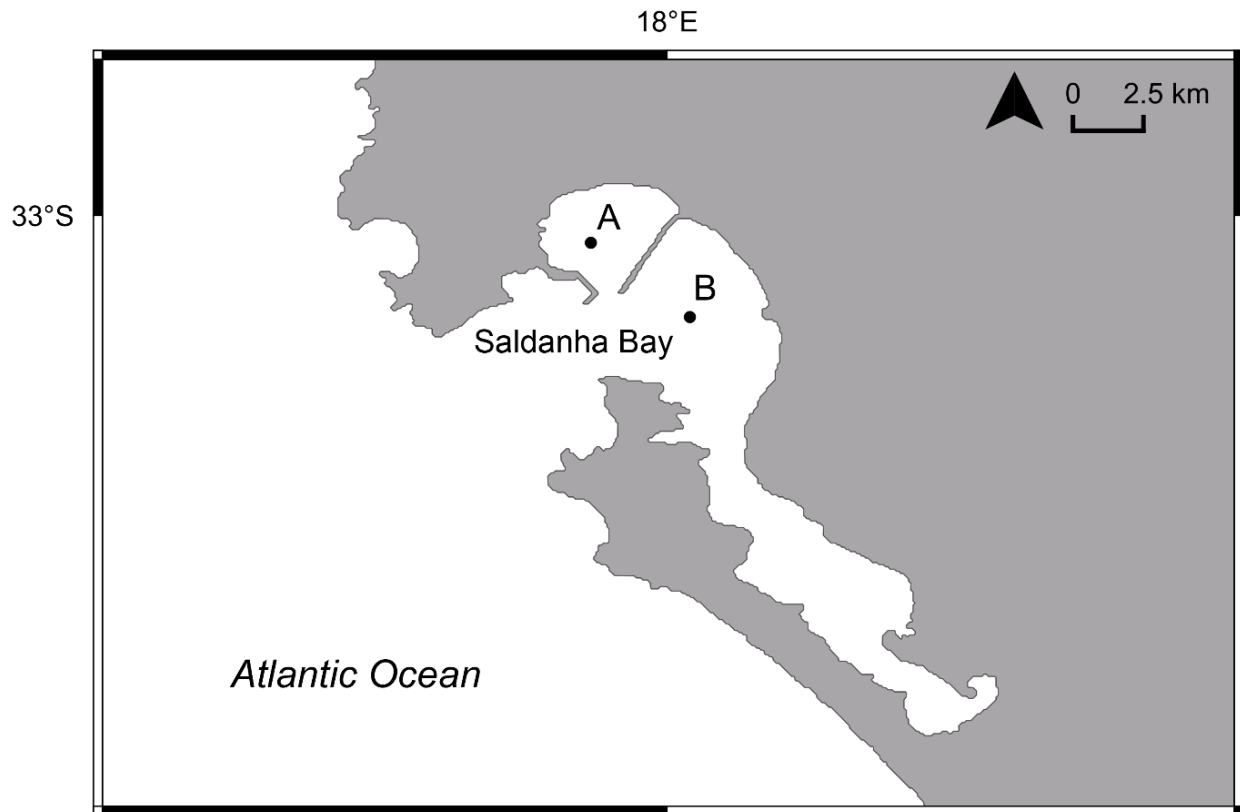


Figure 2-2. Locations where biota was sampled from aquaculture farm structures in the Saldanha Bay ADZ including in the A) Small Bay and B) Big Bay precincts.

3 FINDINGS & REMARKS

Previous research by DFFE identified 66 fouling species from aquaculture farm structures in the Saldanha ADZ (Figure 3-1, Table 3.1). Sixteen of these were also collected during the 2021 Anchor survey, while an additional nine taxa were recorded. This fauna is dominated by the phyla Mollusca, Arthropoda and Chordata (Figure 3-2), with 95% of the taxa identified to species level. Twenty-three taxa were identified from the Small Bay precinct, and only seven taxa identified from Big Bay, with only three species shared with both sites and the DFFE study, including the ribbed mussel *Aulacomya atra*, Mediterranean mussel *Mytilus galloprovincialis* and Gilchrist's flatworm *Planocera gilchristi*. However, discrepancies are likely due to differences in sampling season, intensity and methodology. Overall, one alien and three invasive species were identified. A synopsis of the state of knowledge of these introduced taxa is provided below.

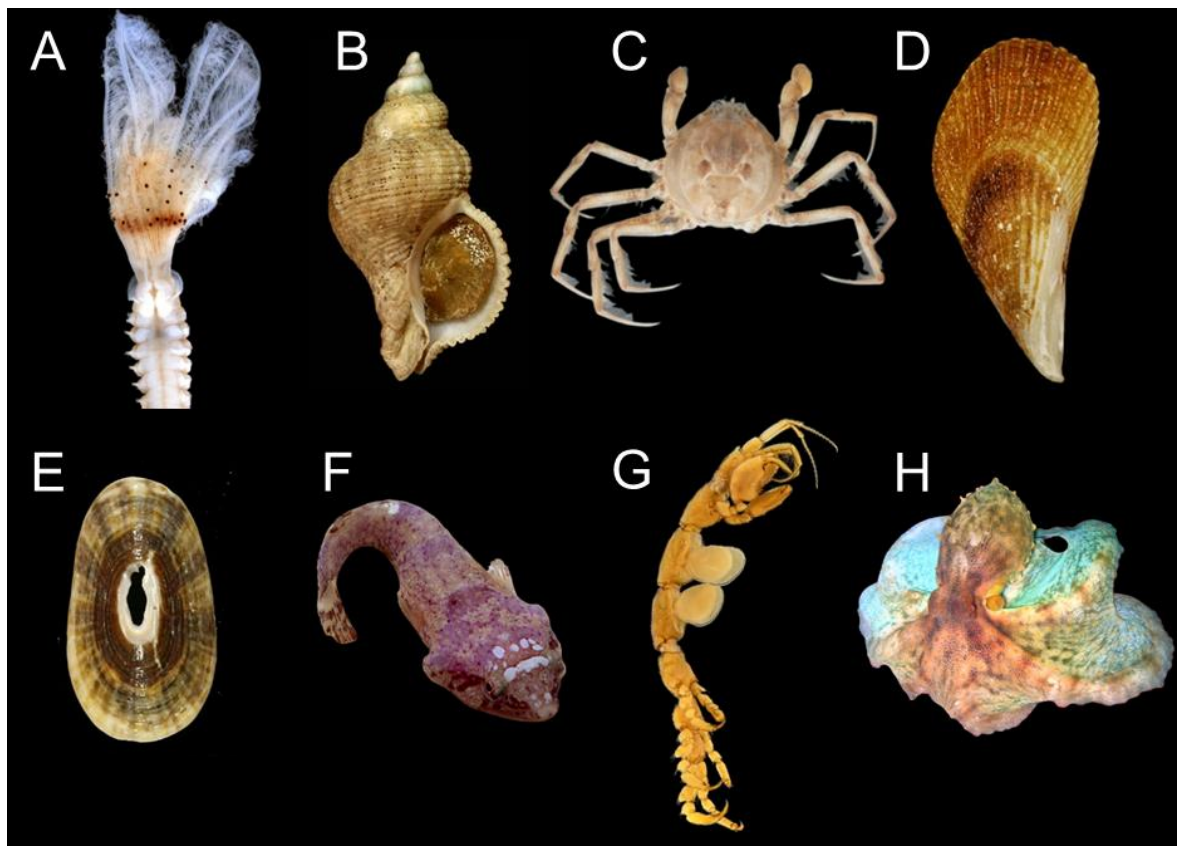


Figure 3-1. Selection of species from aquaculture farm structures in the Saldanha Bay ADZ as documented by DFFE and/or identified from the 2021 Anchor survey. A) gregarious fanworm *Pseudopotamilla reniformis* (E.A. Lazo-Wasem), B) dogwhelk *Nucella wahlbergi* (Joop Trausel & Frans Slieker), C) crown crab *Hymenosoma orbiculare* (J. Dawson), D) ribbed mussel *Aulacomya atra* (Joop Trausel & Frans Slieker), E) Cape keyhole-limpet *Fissurella mutabilis* (Joop Trausel & Frans Slieker), F) chubby clingfish *Apletodon pellegrini* (G. Zsilavec), G) skeleton shrimp *Caprella penantis* (NCSM), H) common octopus *Octopus vulgaris* (Roberto Pillon).

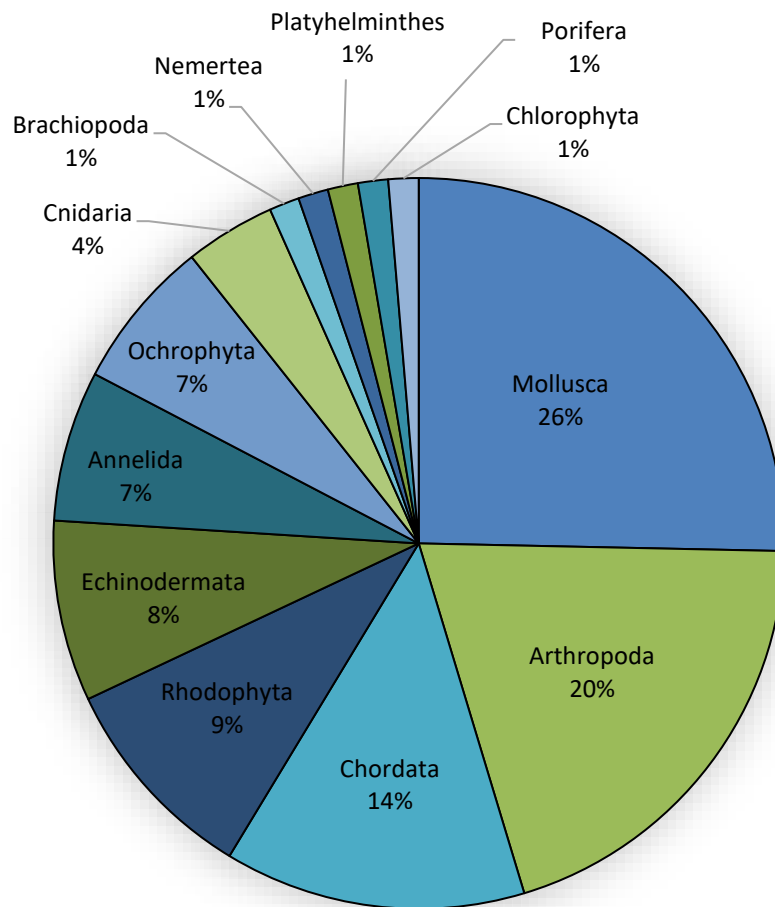


Figure 3-2. Phyla composition of the biota collected from aquaculture farm structures in the Saldanha Bay ADZ as documented by DFFE and/or identified from the 2021 Anchor survey.

3.1 Porcelain crab *Porcellana africana*, Alien

Porcellana africana was previously incorrectly identified as the European *P. platycheles* (Griffiths *et al.* 2018). To date, it is the first and only known alien porcelain crab in South Africa. This species is native to the region between Senegal and Western Sahara in Northwest Africa. It was most likely introduced via shipping, by means of ballast water or hull fouling. This species was first discovered in South Africa in relatively high numbers on Schaapen Island, Langebaan Lagoon in 2012 (Prof. George Branch 2012, pers. obs.). However, its date of introduction has been estimated to be between 2003 and 2009. It is now well established and abundant in Saldanha Bay on the northern, eastern and western shores. Here, it occurs across the intertidal zone under boulders and loose rocks as well as in beds of *Mytilus galloprovincialis*. This species should be monitored as it has the ability to expand its range and increase in number in a relatively short time period (Griffiths *et al.* 2018).

3.2 Disc lamp shell *Discinisca tenuis*, Invasive

Discinisca tenuis is a small disc-shaped brachiopod with a semi-transparent, hairy, fringed shell. It was first recorded in 2008 on oysters grown in Saldanha Bay (Haupt *et al.* 2010), and later recorded outside of the oyster culture operation on Schaapen Island (Peters *et al.* 2014). This species is endemic to Namibia, and is thought to have been introduced to South Africa via cultured oyster imports (Haupt *et al.* 2010). This species can reportedly reach very high densities and could become a significant fouling species in Saldanha Bay.

3.3 Solitary tunicate *Ciona robusta*, Invasive

Ciona robusta was initially misidentified as *C. intestinalis*, which was found to comprise two morphologically separate species. This species is a tall and cylindrical solitary ascidian with a soft, transparent test. It forms large aggregations on submerged structures in harbours and lagoons from Saldanha Bay to Durban. It was originally introduced from the North Atlantic prior to 1955. This species is an economically important pest and is known to smother mussels on aquaculture infrastructure, especially mussel ropes.

3.4 Mediterranean mussel *Mytilus galloprovincialis*, Invasive

Mytilus galloprovincialis was first detected from South Africa in 1979 (Mead *et al.* 2011), but its presence was only confirmed in 1984, likely due to confusion with the indigenous black mussel *Choromytilus meridionalis*. At this point, the population was already widespread in the country, being the most abundant mussel species on rocky shores between Cape Point and Lüderitz. This species has subsequently extended its distribution range as far as East London (Robinson *et al.* 2005). It is commercially cultured in Saldanha Bay and elsewhere, and is widely exploited by recreational and subsistence fishers (Robinson *et al.* 2005 & 2007).

These results will be augmented by findings from the additional biofouling sampling of farm aquaculture structures in the Saldanha ADZ that was undertaken on the 4-5 July 2022. This will be further supplemented with DNA barcoding of select specimens, and underwater imagery, both of which will be included in the next report due in July 2023.

Table 3.1. Species from aquaculture farm structures in Saldanha Bay as documented by DFFE and/or identified from the 2021 Anchor survey. Alien and invasive species are highlighted in **RED**.

Kingdom	Phylum	Class	Order	Family	Species	Common Name	DFFE	Small Bay	Big Bay
Animalia	Annelida		Sipuncula	Golfingiidae	<i>Golfingia (Golfingia) capensis</i>	Common peanut worm	X		
		Polychaeta	Phyllodocida	Nereididae	<i>Pseudonereis variegata</i>	Mussel worm	X		
				Polynoidae	<i>Lepidonotus semitectus</i>	Common scaleworm	X	X	
			Sabellida	Sabellidae	<i>Pseudopotamilla reniformis</i>	Gregarious fanworm	X	X	
			Terebellida	Cirratulidae	<i>Cirriformia capensis</i>	Orange thread-gilled worm	X		
	Arthropoda	Malacostraca	Amphipoda	Caprellidae	<i>Caprella equilibra</i>	Skeleton shrimp	X		
					<i>Caprella penantis</i>	Skeleton shrimp			X
				Leucothoidae	<i>Leucothoe spinicarpa</i>	Sponge amphipod	X		
			Decapoda	Hymenosomatidae	<i>Hymenosoma orbiculare</i>	Crown crab	X		
				Palaemonidae	<i>Palaemon peringueyi</i>	Sand shrimp	X		
				Palinuridae	<i>Jasus lalandii</i>	West coast rock lobster	X		
				Plagusiidae	<i>Guinusia chabrus</i>	Cape rock crab	X		
				Porcellanidae	<i>Porcellana africana</i>	Porcelain crab	X	X	
			Isopoda	Idoteidae	<i>Paridotea unguolata</i>	Green weed-louse	X		
				Sphaeromatidae	<i>Exosphaeroma porrectum</i>	Isopod	X		
			Tanaidacea		Tanaidacea sp.	Tanaid		X	X
		Pycnogonida	Pantopoda	Ammotheidae	<i>Tanystylum brevipes</i>	Compact sea spider	X	X	
		Thecostraca	Balanomorpha	Balanidae	<i>Austromegabalanus</i> sp.	Barnacle	X		
					<i>Notomegabalanus algicola</i>	White dwarf barnacle	X	X	
			Scalpellomorpha	Lepadidae	<i>Lepas (Anatifa) testudinata</i>	Goose barnacle	X		
	Brachiopoda	Lingulata	Lingulida	Discinidae	<i>Discinisca tenuis</i>	Disc lamp shell	X	X	
	Chordata	Actinopteri	Atheriniformes	Atherinidae	<i>Atherina breviceps</i>	Cape silverside	X		
			Blenniiformes	Blenniidae	<i>Scartella emarginata</i>	Maned blenny	X		
				Clinidae	<i>Clinus heterodon</i>	Westcoast klipfish	X		
			Gobiesociformes	Gobiesocidae	<i>Apletodon pellegrini</i>	Chubby clingfish		X	
					<i>Eckloniaichthys scylliorhiniceps</i>	Weed sucker	X		
		Asciidiacea	Phlebobranchia	Asciidiidae	<i>Ascidia caudata</i>	Crevise ascidian	X		
				Cionidae	<i>Ciona robusta</i>	Solitary tunicate	X	X	
			Stolidobranchia	Pyuridae	<i>Pyura stolonifera</i>	Redbait	X	X	

Kingdom	Phylum	Class	Order	Family	Species	Common Name	DFFE	Small Bay	Big Bay
				Styelidae	<i>Botrylloides magnicoecus</i>	White-ringed ascidian	X		
					<i>Botryllus gregalis</i>	Variable ascidian	X		
	Cnidaria	Anthozoa	Actiniaria	Actiniidae	<i>Actinia mandelae</i>	Plum anemone	X		
				Sagartiidae	<i>Anthothoe chilensis</i>	Striped anemone	X	X	
		Hydrozoa	Leptothecata	Sertulariidae	<i>Amphisbetia operculata</i>	Wiry hydroid		X	
	Echinodermata	Asteroidea	Velatida	Pterasteridae	<i>Pteraster capensis</i>	Brooding cushion-star	X		
		Crinoidea	Comatulida	Tropiometridae	<i>Tropiometra carinata</i>	Elegant feather-star	X		
		Echinoidea	Camarodonta	Parechinidae	<i>Parechinus angulosus</i>	Cape urchin	X	X	
		Holothuroidea	Dendrochirotida	Cucumariidae	<i>Pentacta doliolum</i>	Cask sea cucumber		X	
					<i>Roweia frauenfeldi</i>	Horseshoe sea cucumber	X		
				Phyllophoridae	<i>Thyone aurea</i>	Golden sea cucumber	X	X	
	Mollusca	Bivalvia	Cardiida	Donacidae	<i>Donax serra</i>	White mussel	X		
				Tellinidae	<i>Moerella tulipa</i>	Gilchrist's tellin	X		
			Galeommatida	Lasaeidae	<i>Lasaea turtoni</i>	Dwarf rusty clam	X		
			Mytilida	Mytilidae	<i>Aulacomya atra</i>	Ribbed mussel	X	X	X
					<i>Choromytilus meridionalis</i>	Black mussel	X		X
					<i>Mytilus galloprovincialis</i>	Mediterranean mussel	X	X	X
					<i>Perna perna</i>	Brown mussel	X		
			Pectinida	Pectinidae	<i>Pecten sulcicostatus</i>	Edible scallop	X		
					<i>Talochlamys multistriata</i>	Dwarf fan shell	X		
			Venerida	Veneridae	<i>Venerupis corrugata</i>	Corrugated Venus	X		
		Cephalopoda	Octopoda	Octopodidae	<i>Octopus vulgaris</i>	Common octopus	X		
		Gastropoda		Patellidae	<i>Helcion</i> sp.	Limpet		X	
			Cephalaspidea	Philinidae	<i>Philine aperta</i>	Shelled sand slug	X		
			Lepetellida	Fissurellidae	<i>Fissurella mutabilis</i>	Cape keyhole-limpet	X	X	
			Neogastropoda	Buccinoidea	<i>Burnupena lagenaria</i>	Variable burnupena	X		
				Marginellidae	<i>Prunum capense</i>	Cape marginella	X		
				Muricidae	<i>Nucella wahlbergi</i>	Dogwhelk		X	
			Pleurobranchida	Pleurobranchaeidae	<i>Pleurobranchaea bubala</i>	Warty pleurobranch	X		
			Trochida	Trochidae	<i>Gibbula multicolor</i>	Multicoloured topshell	X		
	Nemertea				Nemertea sp.	Ribbon worm		X	X
	Platyhelminthes		Polycladida	Planoceridae	<i>Planocera gilchristi</i>	Gilchrist's flatworm	X	X	X

Kingdom	Phylum	Class	Order	Family	Species	Common Name	DFFE	Small Bay	Big Bay
Chromista	Porifera	Demospongiae	Poecilosclerida	Microcionidae	<i>Clathria (Thalysias) hooperi</i>	Nodular sponge	X		
	Ochrophyta	Phaeophyceae	Dictyotales	Dictyotaceae	<i>Dictyota naevosa</i>	Spotted dictyota	X		
			Ectocarpales	Chordariaceae	<i>Leathesia marina</i>	Brown brains	X		
				Scytosiphonaceae	<i>Colpomenia sinuosa</i>	Oyster thief		X	
					<i>Petalonia fascia</i>	Brown algae	X		
			Laminariales	Lessoniaceae	<i>Ecklonia maxima</i>	Sea bamboo	X		
Plantae	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	<i>Ulva fasciata</i>	Ribbon sea lettuce	X		
	Rhodophyta	Bangiophyceae	Bangiales	Bangiaceae	<i>Porphyra capensis</i>	Purple laver	X		
		Florideophyceae	Ceramiales	Ceramiceae	<i>Ceramium arenarium</i>	Beaded ceramium	X		
			Gigartinales	Gigartinaceae	<i>Mazzaella convoluta</i>	Convolutated mazzaella	X		
			Gracilariales	Gracilariaceae	<i>Gracilaria gracilis</i>	Agar-weed	X		
			Halymeniales	Halymeniaceae	<i>Grateloupia longifolia</i>	Rippled ribbon-weed	X		
					<i>Pachymenia orbitosa</i>	Slippery orbits	X		
			Rhodymeniales	Rhodymeniaceae	<i>Rhodymenia pseudopalmata</i>	Palmate roseweed	X		

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5 APPENDIX 1

Table 5.1. Alien, invasive, naturalised and cryptogenic species that are likely to occur on the west coast of South Africa or have been confirmed to occur in Saldanha Bay and Langebaan Lagoon. Region of origin and likely vector for introduction (SB = ship boring, SF = ship fouling, BW = ballast water, BS = solid ballast, OR = oil rigs, M = mariculture, F = fisheries activities, I = intentional release) are listed. Data extracted from Mead *et al.* 2011 and Robinson *et al.* 2014, as well as recent published and unpublished research.

Taxon	Occurrence in Saldanha/Langebaan	Status	Origin	Vector	Reference
<u>PROTOCTISTA</u>					
<i>Mirofolliculina limnoriae</i>	Likely	Alien	Unknown	SB	Mead <i>et al.</i> 2011
<u>DINOFLAGELLATA</u>					
<i>Alexandrium minutum</i>	Likely	Alien	Europe	BW	Mead <i>et al.</i> 2011
<i>Alexandrium tamarense-complex</i>	Likely	Alien	N Atlantic/N Pacific	BW	Mead <i>et al.</i> 2011
<i>Dinophysis acuminata</i>	Likely	Alien	Europe	BW	Mead <i>et al.</i> 2011
<u>PORIFERA</u>					
<i>Suberites ficus</i>	Likely	Invasive	Europe	SF	Samaai and Gibbons 2005
<u>CNIDARIA</u>					
<u>ANTHOZOA</u>					
<i>Metridium senile</i>	Likely	Alien	N Atlantic/N Pacific	SF/OR	Mead <i>et al.</i> 2011
<i>Sagartia ornata</i>	Confirmed	Naturalised	Europe	SF/BW	Robinson and Swart 2015
<u>ECHINODERMATA</u>					
<u>ASTEROIDEA</u>					
<i>Heliaster helianthus</i>	Confirmed	Alien	South American Pacific	SF/BW	Peters and Robinson 2018
<u>HYDROZOA</u>					
<i>Coryne eximia</i>	Confirmed	Invasive	N Atlantic/N Pacific	SF/BW	Mead <i>et al.</i> 2011
<i>Gonothyrea loveni</i>	Likely	Alien	North Atlantic	SF/BW	Mead <i>et al.</i> 2011
<i>Laomedea calceolifera</i>	Likely	Alien	North Atlantic	SF/BW	Mead <i>et al.</i> 2011
<i>Obelia bidentata</i>	Likely	Naturalised	Unknown	SF/BW	Mead <i>et al.</i> 2011
<i>Obelia dichotoma</i>	Likely	Naturalised	Unknown	SF/BW	Mead <i>et al.</i> 2011
<i>Obelia geniculata</i>	Likely	Naturalised	Unknown	SF/BW	Mead <i>et al.</i> 2011
<i>Pachycordyle navis</i>	Likely	Alien	Europe	SF/BW	Mead <i>et al.</i> 2011
<i>Pinauy larynx</i>	Likely	Naturalised	North Atlantic	SF/BW	Mead <i>et al.</i> 2011
<i>Pinauy ralphi</i>	Likely	Alien	North Atlantic	SF/BW	Mead <i>et al.</i> 2011
<u>ANNELIDA</u>					

Taxon	Occurrence in Saldanha/Langebaan	Status	Origin	Vector	Reference
POLYCHAETA					
<i>Boccardia proboscidea</i>	Confirmed	Invasive	Eastern Pacific	M	David and Simon 2014; CAS unpublished data
<i>Capitella</i> sp.	Likely	Cryptogenic	Unknown	SF/BW	Mead <i>et al.</i> 2011
<i>Dodecaceria fewkesi</i>	Likely	Naturalised	North American Pacific	SF/BW	Peters <i>et al.</i> 2014
<i>Ficopomatus enigmaticus</i>	Likely	Invasive	Australia	SF	McQuaid and Griffiths 2014
<i>Janua pagenstecheri</i>	Likely	Alien	Europe	SF/BW	Mead <i>et al.</i> 2011
<i>Neodexiospira brasiliensis</i>	Confirmed	Invasive	Indo-Pacific	SF/BW	Mead <i>et al.</i> 2011
<i>Simplicaria pseudomilitaris</i>	Likely	Alien	Unknown	SF/BW	Mead <i>et al.</i> 2011
<i>Polydora hoplura</i>	Confirmed	Invasive	Europe	SF/BW	Simon 2011; David and Simon 2014
<i>Hydroides elegans</i>	Likely	Cryptogenic	Unknown	SF/BW	Robinson <i>et al.</i> 2016
<u>CRUSTACEA</u>					
CIRRIPEDIA					
<i>Amphibalanus amphitrite amphitrite</i>	Confirmed (AEC 2014)	Cryptogenic	Unknown	SF/BW	Mead <i>et al.</i> 2011
<i>Amphibalanus venustus</i>	Likely	Invasive	North Atlantic	SF	Mead <i>et al.</i> 2011
<i>Balanus glandula</i>	Confirmed	Invasive	North American Pacific	SF/BW	Robinson <i>et al.</i> 2015
<i>Perforatus perforatus</i>	Confirmed	Alien	North American Pacific	SF/BW	Biccard and Griffiths (Pers. Comm. 2017)
COPEPOD					
<i>Acartia (Odontacartia) spinicauda</i>	Likely	Alien	Western North Pacific	BW	Mead <i>et al.</i> 2011
ISOPODA					
<i>Dynamene bidentata</i>	Likely	Invasive	Europe	SF/BW	Mead <i>et al.</i> 2011
<i>Ligia exotica</i>	Likely	Cryptogenic	Unknown	SB	Mead <i>et al.</i> 2011
<i>Limnoria quadripunctata</i>	Likely	Alien	Unknown	SB	Mead <i>et al.</i> 2011
<i>Limnoria tripunctata</i>	Likely	Alien	Unknown	SB	Mead <i>et al.</i> 2011
<i>Paracerceis sculpta</i>	Likely	Alien	Northeast Pacific	SF/BW	Mead <i>et al.</i> 2011
<i>Synidotea hirtipes</i>	Confirmed	Cryptogenic	Indian Ocean	SF/BW	Mead <i>et al.</i> 2011
<i>Synidotea variegata</i>	Confirmed	Cryptogenic	Indo-Pacific	SF/BW	Mead <i>et al.</i> 2011
AMPHIPODA					
<i>Caprella equilibra</i>	Likely	Cryptogenic	Unknown	SF/BW	Mead <i>et al.</i> 2011

Taxon	Occurrence in Saldanha/Langebaan	Status	Origin	Vector	Reference
<i>Caprella mutica</i>	Likely	Alien	North-east Asia	SF	Peters and Robinson 2017
<i>Caprella penantis</i>	Likely	Cryptogenic	Unknown	SF/BW	Mead <i>et al.</i> 2011
<i>Chelura terebrans</i>	Confirmed	Invasive	Pacific Ocean	SF/SB	Mead <i>et al.</i> 2011
<i>Cerapus tubularis</i>	Confirmed	Invasive	North American Atlantic	BS	Mead <i>et al.</i> 2011
<i>Cymadusa filosa</i>	Likely	Cryptogenic	Unknown	BS	Mead <i>et al.</i> 2011
<i>Erichthonius brasiliensis</i>	Likely	Invasive	North Atlantic	SF/BW	Mead <i>et al.</i> 2011
<i>Erichthonius difformis</i>	Likely	Alien	Unknown, northern hemisphere	SF	Peters <i>et al.</i> 2014
<i>Ischyrocerus anguipes</i>	Likely	Invasive	North Atlantic	SF/BW	Mead <i>et al.</i> 2011
<i>Jassa marmorata</i>	Likely	Naturalised	North Atlantic	SF/BW	Conlan 1990; Mead <i>et al.</i> 2011
<i>Jassa morinoi</i>	Likely	Invasive	Eastern North Pacific	SF/BW	Conlan 1990; Mead <i>et al.</i> 2011
<i>Jassa slatteryi</i>	Confirmed	Invasive	North Pacific	SF/BW	Conlan 1990; Mead <i>et al.</i> 2011
<i>Paracaprella pusilla</i>	Likely	Cryptogenic	Unknown	SF/BW	Mead <i>et al.</i> 2011
<i>Orchestia gammarella</i>	Confirmed	Invasive	Europe	BS	Mead <i>et al.</i> 2011
DECAPODA					
<i>Carcinus maenas</i>	Confirmed (G. Branch pers. comm.)	Invasive	Europe	SF/BW/OR	Robinson <i>et al.</i> 2005
<i>Homalaspis plana</i>	Confirmed	Alien	South American Pacific	SF/BW	Peters and Robinson 2018
<i>Pinnixa occidentalis</i>	Confirmed (Anchor 2011)	Invasive	North American Pacific	BW	Clark and Griffiths 2012
<i>Porcellana africana</i> (Incorrectly identified as <i>Porcellana platycheles</i>)	Confirmed	Invasive	North East Atlantic	BW	Griffiths <i>et al.</i> 2018
<i>Xantho incicus</i>	Likely	Alien	France	M	Haupt <i>et al.</i> 2010
<u>INSECTA</u>					
COLEOPTERA					
<i>Cafius xantholoma</i>	Likely	Invasive	Europe	BS	Mead <i>et al.</i> 2011
<u>MOLLUSCA</u>					
GASTROPODA					
<i>Catrina columbiana</i>	Likely	Alien	North Pacific	SF/BW	Mead <i>et al.</i> 2011
<i>Littorina saxatilis</i>	Confirmed	Invasive	Europe	BS	Mead <i>et al.</i> 2011

Taxon	Occurrence in Saldanha/Langebaan	Status	Origin	Vector	Reference
<i>Tritonia nilsodhneri</i>	Likely	To be confirmed	Europe	SF/BW	Zsilavecz 2007
<i>Kaloplocamus ramosus</i>	Likely	To be confirmed	Unknown	SF/BW	Zsilavecz 2007
<i>Thecacera pennigera</i>	Likely	Cryptogenic	Unknown	SF/BW	Mead <i>et al.</i> 2011
<i>Anteaeolidiella indica</i>	Confirmed	Cryptogenic	Unknown	SF/BW	Mead <i>et al.</i> 2011
BIVALVIA					
<i>Bankia carinata</i>	Likely	Cryptogenic	Unknown	SB	Mead <i>et al.</i> 2011
<i>Bankia martensi</i>	Likely	Cryptogenic	Unknown	SB	Mead <i>et al.</i> 2011
<i>Crassostera gigas</i>	Confirmed	Invasive	Japan	M	Haupt <i>et al.</i> 2010; Keightley <i>et al.</i> 2015
<i>Dicyathifer manni</i>	Likely	Cryptogenic	Unknown	SB	Mead <i>et al.</i> 2011
<i>Lyrodus pedicellatus</i>	Likely	Alien	Unknown	SB	Mead <i>et al.</i> 2011
<i>Mytilus galloprovincialis</i>	Confirmed	Invasive	Europe	SF/BW	Robinson <i>et al.</i> 2005
<i>Semimytilus algosus</i>	Confirmed	Invasive	South Pacific	SF/BW	de Greef <i>et al.</i> 2013
<i>Teredo navalis</i>	Likely	Invasive	Europe	SB	Mead <i>et al.</i> 2011
<i>Teredo somersi</i>	Likely	Cryptogenic	Unknown	SB	Mead <i>et al.</i> 2011
<u>BRACHIOPODA</u>					
<i>Disciniscus tenuis</i>	Confirmed	Invasive	Namibia	M	Haupt <i>et al.</i> 2010; Peters <i>et al.</i> 2014
<u>BRYOZOA</u>					
<i>Bugula flabellata</i>	Likely	Invasive	Unknown	SF	Florence <i>et al.</i> 2007
<i>Bugula neritina</i>	Likely	Invasive	Unknown	SF	Florence <i>et al.</i> 2007
<i>Conopeum seurati</i>	Confirmed	Invasive	Europe	SF	McQuaid and Griffiths 2014
<i>Cryptosula pallasiana</i>	Confirmed	Invasive	Europe	SF	Mead <i>et al.</i> 2011
<i>Watersipora subtorquata</i>	Confirmed	Invasive	Caribbean	SF	Florence <i>et al.</i> 2007; Mead <i>et al.</i> 2011
<u>CHORDATA</u>					
ASCIDIACEA					
<i>Ascidia sydneiensis</i>	Likely	Invasive	Pacific Ocean	SF	Mead <i>et al.</i> 2011; Rius <i>et al.</i> 2014
<i>Ascidiella aspersa</i>	Likely	Invasive	Europe	SF	Mead <i>et al.</i> 2011; Peters <i>et al.</i> 2014; Rius <i>et al.</i> 2014
<i>Botryllus schlosseri</i>	Likely	Invasive	Unknown	SF	Mead <i>et al.</i> 2011; Peters <i>et al.</i> 2014; Rius <i>et al.</i> 2014
<i>Ciona robusta</i> (formally known as <i>Ciona intestinalis</i>)	Confirmed (Picker & Griffiths 2011)	Invasive	Unknown	SF	Mead <i>et al.</i> 2011; Rius <i>et al.</i> 2014; Brunetti <i>et al.</i> 2015

Taxon	Occurrence in Saldanha/Langebaan	Status	Origin	Vector	Reference
<i>Clavelina lepadiformis</i>	Confirmed (Picker & Griffiths 2011)	Invasive	Europe	SF	Mead <i>et al.</i> 2011; Rius <i>et al.</i> 2014
<i>Cnemidocarpa humilis</i>	Likely	Invasive	Unknown	SF	Mead <i>et al.</i> 2011
<i>Corella eumyota</i>	Confirmed	Cryptogenic	Unknown	SF	Mead <i>et al.</i> 2011
<i>Diplosoma listerianum</i>	Confirmed	Invasive	Europe	SF	Mead <i>et al.</i> 2011; Rius <i>et al.</i> 2014
<i>Microcosmus squamiger</i>	Likely	Invasive	Australia	SF	Mead <i>et al.</i> 2011; Rius <i>et al.</i> 2014
<i>Trididemnum cerebriforme</i>	Confirmed	Cryptogenic	Unknown	SF	Mead <i>et al.</i> 2011
<u>PISCES</u>					
<i>Cyprinus carpio</i>	Likely	Invasive	Central Asia to Europe	I	Mead <i>et al.</i> 2011
<u>RHODOPHYTA</u>					
<i>Antithamnionella spirographidis</i>	Confirmed	Invasive	North Pacific	SF/BW	Mead <i>et al.</i> 2011
<i>Antithamnionella ternifolia</i>	Likely	Cryptogenic	Australia	SF/BW	Mead <i>et al.</i> 2011
<i>Asparagopsis armata</i>	Likely	Invasive	Australia	Unknown	Bolton <i>et al.</i> 2011
<i>Schimmelmannia elegans</i>	Likely	Alien	Tristan da Cunha	BW	De Clerck <i>et al.</i> 2002
<u>CHLOROPHYTA</u>					
<i>Codium fragile fragile</i>	Confirmed	Invasive	Japan	SF/BW	Mead <i>et al.</i> 2011



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