Department of
Primary Industries and
Regional Development

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Ocean Reef Marina

Abalone Habitat and Biomass Baseline Survey Report - PUBLIC VERSION

Baseline Survey and Monitoring Plan

Background and Rationale

As part of the environmental approval process for the development of the Ocean Reef Marina (ORM), the Minister for Environment issued a "Statement that a proposal may be implemented" (MS 1107) subject to several implementation conditions and procedures. Two such conditions were No. 8 Social Surroundings (abalone baseline survey) and No. 9 Social Surroundings (abalone monitoring and management).

Condition 8-1: Prior to the commencement of construction, the proponent shall prepare and submit an Abalone Habitat and Biomass Baseline Survey to the requirements of the CEO in consultation with the Department of Primary Industries and Regional Development and the Department of Biodiversity, Conservation and Attractions.

Condition 8-2: The Abalone Habitat and Biomass Baseline Survey required by Condition 8-1 shall detail the proposed methodologies for the baseline surveys.

Condition 9-1: Prior to the commencement of construction, the proponent shall prepare and submit an Abalone Habitat and Biomass Monitoring Plan to the requirements of the CEO in consultation with the Department of Primary Industries and Regional Development and the Department of Biodiversity, Conservation and Attractions.

This report details the required Baseline Survey methodology, monitoring and results in line with the Abalone Habitat and Biomass Baseline Survey (AHBBS) Plan and the Abalone Habitat and Biomass Monitoring Plan (AHBMP).

Overall Objective

Implement the Abalone Habitat and Biomass Baseline Survey and Monitoring Plan for the Roe's abalone (*Haliotis roei*) population within the Burns Beach Reef complex north of the ORM development.

Objectives

(1) Assist Strategen-JBS&G in the design and implementation of the Abalone Habitat and Biomass Baseline Survey Plan (Baseline Survey) and the Abalone Habitat and Biomass Monitoring Plan (Monitoring Plan).
(2) Undertake the Baseline Survey prior to ORM construction with defined survey locations (Burns Beach Reef), methodology, and reporting.
(3) Undertake the Monitoring Plan for a period not less than 5 years after construction of the marina breakwaters with defined survey locations (Burns Beach Reef), methodology, frequency and reporting.
(4) Monitor success of the Translocation Program at designated release locations.

Timing

The Baseline Survey and Monitoring Plan will be completed during January to April each year to ensure it occurs during optimum weather conditions and aligns with DPIRD's annual Fishery-Independent Surveys (FIS). The conditions stipulate the Baseline Survey be complete prior to construction being initiated and the Monitoring Plan to occur for a

period not less than 5 years following construction of the breakwaters. Monitoring of the translocation sites will occur as part of this Baseline Survey and Monitoring Plan.

Baseline Survey

The scope of the Baseline Survey is outlined in the approved Abalone Habitat and Biomass Baseline Survey Plan (JBSG56726-124305 (Rev 2) 2020).

Survey Region

The Baseline Survey occurred along the Burns Beach Reef complex north of the proposed ORM Development (Figure 1). The survey region can be separated into five distinct zones:

- Development Envelope
- Abalone Monitoring Zone A: 0-500 m
- Abalone Monitoring Zone B: 500-1500 m
- North of the Abalone Monitoring Zone (1,500 m to 2,500 m north)
- Different Reef Complex (2,500 m to 10,000 m north)

Site Locations

Ten site locations were identified and utilised in the Baseline Survey (Figure 1 and Table 1):

- Development Envelope (x1)
- Abalone Monitoring Zones (x6)
- Reference sites outside the Abalone Monitoring Zone (x2)
- Control Site (x1)

All 10 sites were established by DPIRD with two of the sites within the Abalone Monitoring Zone specifically created for this Baseline Survey. Four of the sites are from DPIRD's long-term FIS monitoring program of the Perth Metropolitan Roe's abalone Fishery and form part of a data sharing arrangement. The remaining four sites were established by DPIRD for the 2015 Abalone Habitat and Abundance Baseline Survey that was conducted by BMT to inform the Public Environmental Review (PER) for the Proposal. Nine of the sites will be used for the ongoing Monitoring Plan.

Development Envelope Site

The site AB1 is located within the Development Envelope and was established for the 2015 abalone survey undertaken to inform the PER for the ORM Proposal. This site has been monitored by DPIRD for three out of the four years since the initial survey.

Abalone Monitoring Zone Sites

The Beaumaris and AB1A sites are in Zone A (0-500 m) and located 0.23 and 0.42 km north of the Development Envelope, respectively. AB1B, AB2, Shenton Avenue and AB3A are located within Zone B (500-1500 m) and range from 0.64 to 1.36 km north of the Development Envelope.

The Beaumaris and Shenton Avenue sites are long-term DPIRD FIS monitoring sites along the Burns Beach Reef complex. Sites AB2 and AB3A were established for the 2015 abalone survey undertaken to inform the PER for the ORM Proposal.

Two new sites, AB1A and AB1B, were established either side of the 500 m Monitoring Zone boundary north of the Development Envelope. This was in direct response to the review of the AHBBS against the Ministerial Conditions for the Proposal and the requirement to confirm if impacts to abalone habitat and biomass extend more than 500 m from the Development Envelope. These sites contain the nearest measurable abalone stock that could provide robust abundance estimates as close as practicable to the boundary separating Monitoring Zone A and B, with site AB1A only 80 m south and site AB1B 140 m north of this boundary.

Reference Sites

The Burns Beach and AB4 sites have been selected as reference sites and are located greater than 1500 m north of the Development Envelope and outside the Monitoring Zones (zone of influence). These sites are at the northern extent of the Burns Beach Reef complex and have suitable nearshore reef habitat and known Roe's abalone stock. The Burns Beach site is a long-term DPIRD FIS monitoring site located 1.8 km north of the Development Envelope. Site AB4 is the northern most site along the Burns Beach Reef complex and is located 2.15 km north of the Development Envelope. This site was established for the 2015 abalone survey to inform the PER for the ORM Proposal.

Control Site

The Mindarie site is a long-term DPIRD FIS monitoring site located 7.7 km north of the Development Envelope. This site provides a regional baseline and is representative of a nearshore reef complex that supports abalone habitat but distinct from the Burns Beach Reef complex.

Table 1: Abalone Habitat and Biomass Baseline Survey site locations and distance from the Ocean Reef Marina Development Envelope (ordered south to north) - redacted.

Site	Easting	Northing	Latitude	Longitude	Approx. distance north of Development Envelope (km)
Development Envelope					
AB1					
Abalone Monitoring Zone A (0-500m)					
Beaumaris					
AB1A					
Abalone Monitoring Zone B (500-1500 m)					
AB1B					
AB2					
Shenton Avenue					
AB3A					
Reference Site (outside of 1500m Abalone Monitoring Zone)					
Burns Beach					
AB4					
Control Site (outside of local reef system but within 10 km)					
Mindarie					

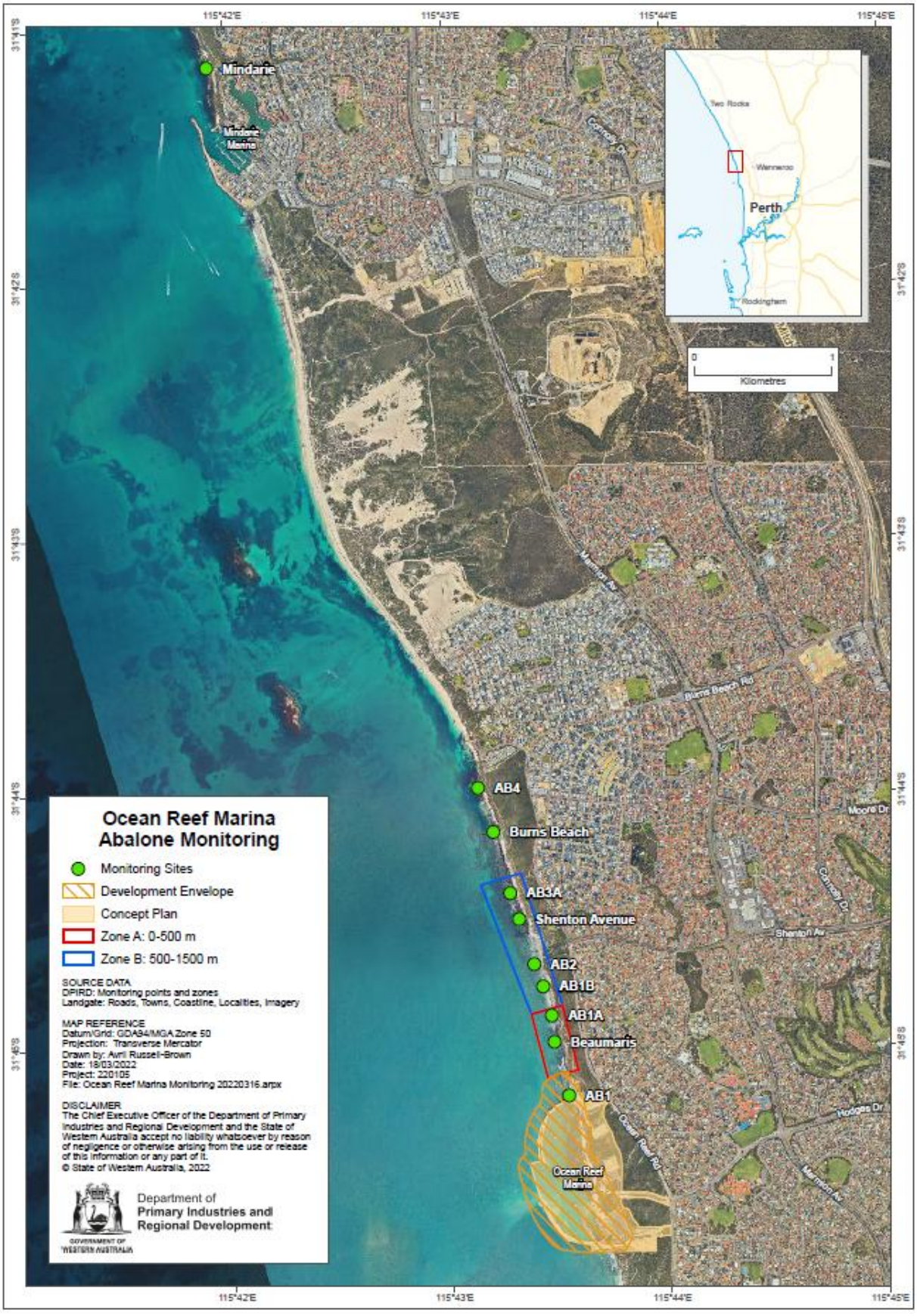

Figure 1: Abalone Habitat and Biomass Baseline Survey (monitoring) site locations, Monitoring Zones A and B, Ocean Reef Marina Development Envelope and Concept Plan.

Survey Methodology

To determine whether there are any adverse changes to abalone habitat and biomass, baseline data was collected as defined in the Abalone Habitat and Biomass Baseline Survey Plan. The population structure and numbers of Roe's abalone for each site was identified as the key parameter to be evaluated. Annual monitoring of population structure is important, given it provides an understanding of harvestable biomass, spawning biomass and recruitment of juvenile abalone for a given survey, while also identifying whether there is variation/change in the population over time.

The sites were surveyed using DPIRD's transect method based on Hancock (2004) as described in Hart et al. (2018). Roe's abalone population structure and numbers were quantified for both the nearshore reef platform and subtidal habitats at each of the sites. The reef platform was further subdivided into three habitats (outer, middle, inner). The survey methodology involves surveying fixed quadrats of 0.25 and 0.5 m^2 at each site and counting and measuring all abalone within these quadrats (Figure 2). Abalone which have the tip of their swirl within the quadrat frame were considered 'in' the quadrat and therefore their maximum length measured.

This abalone survey methodology and reporting is as per the FIS used by DPIRD for the management of the Perth Metropolitan Roe's abalone Fishery (DPIRD 2023). The outcomes of the FIS are presented to both the commercial and recreational fishing sectors as part of the annual stock assessment and Total Allowable Catch (TAC) setting process.

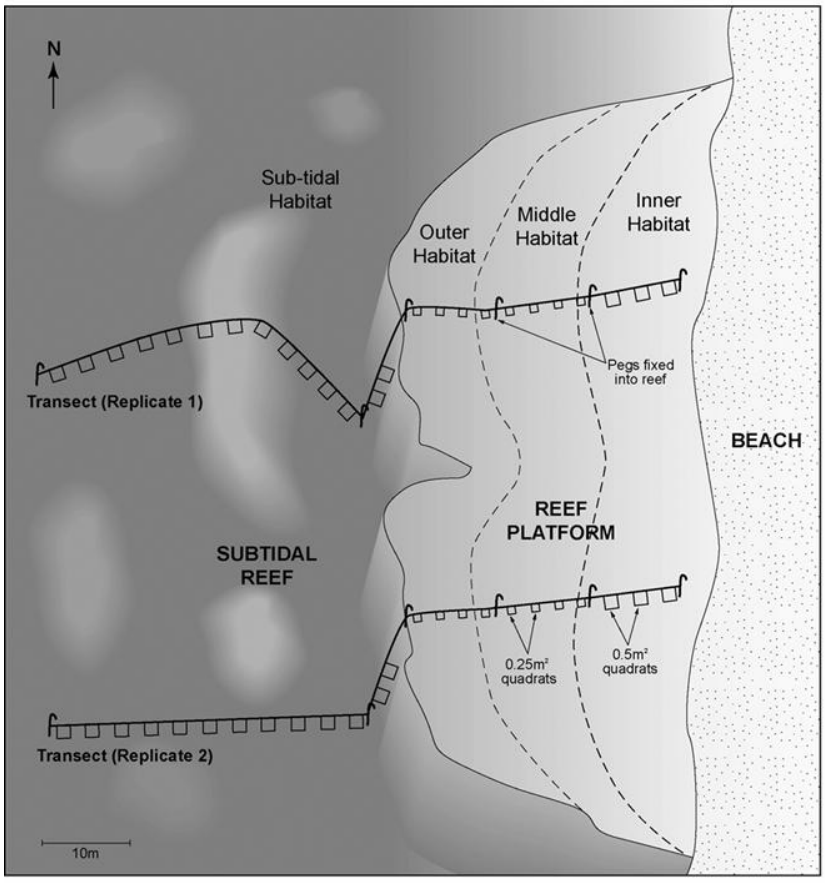

Figure 2: Schematic representation of Roe's abalone habitat and the survey design used to monitor the populations (Source: Hancock 2004).

Summary statistics of the relevant abalone parameters were calculated for each of the survey sites by habitat type (platform and subtidal):

- total Roe's abalone numbers per transect
- Roe's abalone density (abalone.m^2)
- percentage per size class (Hancock 2004) and legal and sub-legal classifications

Age classes were determined based on the Roe's abalone maximum length, as defined in Hancock (2004) and represented in Table 2. The legal minimum size limit for recreational Roe's abalone fishing in Western Australia is 60 mm shell length. Therefore, Roe's abalone smaller than 60 mm were classified as sub-legal size and those 60 mm or greater as legal size.

Table 2: Roe's abalone size classes and associated age classes as defined by Hancock (2004).

Size (mm)	Age (years)
< 17	0 – 1
17 – 32	1 – 2
33 – 50	2 – 3
51 – 60	3 – 4
61 – 70	4 – 5
>70	5+

Monitoring Plan

The scope of the Monitoring Plan is outlined in the approved Abalone Habitat and Biomass Monitoring Plan (JBSG56726-124304 (Rev 5) 2021).

Nine of the ten monitoring sites from the Baseline Survey will be utilised in the Monitoring Plan. The AB1 (Resolute) site will not be incorporated as it is within the Development Envelope. All methods, analysis and reporting will be carried out as mentioned above in the Baseline Survey.

Baseline Survey Results

All Baseline Survey sites had Roe's abalone present in both the platform and subtidal habitats (Table 3). Roe's abalone transect counts in the platform habitat ranged from 219 abalone at site AB4 to 456 abalone at the Burns Beach site (a long term DPIRD FIS site), both of which are Reference Sites. The AB1A site had the highest subtidal habitat transect count with 473 abalone and Mindarie, the Control Site, had the lowest with 35 abalone (Table 3).

Roe's abalone density was greater in the platform than subtidal habitat for 9 out of the 10 sites, with only the AB1A site having a Roe's abalone density greater in the subtidal habitat (Table 3). Density of Roe's abalone in the platform habitat was greater than 109 abalone.m^2 at 9 of the 10 sites. The AB4 site had the lowest Roe's abalone platform density with 87.6 abalone.m^2 (± 18.0 S.E.), while the AB2 site had the highest with 172.8 abalone.m^2 (± 28.0 S.E.). Density in the subtidal habitat was greater than 100 abalone.m^2 at only the two sites, AB1A and AB3A. The Beaumaris site was the only site within Abalone Monitoring Zone A or B with a density of less than 40 abalone.m^2 in the

subtidal, while the Control Site Mindarie had the lowest subtidal density at 7.0 abalone.m^2 (± 3.3 S.E.)

The Baseline Survey Roe's abalone population structure at each site was presented for both the platform and subtidal habitats. Every Roe's abalone age class was present in the platform habitat at all 10 sites (Figure 3 and Figure 4). The Burns Beach site had the greatest proportion of 0–1 year old Roe's abalone, with this age class making up 19% of the total platform stock, while the AB1A, AB1B, Shenton Avenue and AB3A sites all had the lowest proportion at 3%. The AB1A site had the greatest proportion of the 5+ age class making up 33% of the platform stock, while the Shenton Avenue site had the lowest proportion at 4%.

Large Roe's abalone dominate the population structure in the subtidal habitat with all 10 sites having 5+ year olds in the highest proportion. (Figure 5 and Figure 6). This was highlighted by the Beaumaris, AB2, AB3A, Burns Beach and Mindarie sites all having greater than 50% of the Roe's abalone present in the 5+ years old cohort. Roe's abalone that have reached legal size (over 4 years old) make up a minimum of 60% of the subtidal stock from across all 10 sites, with Mindarie having 97% of the stock over this age (5+ years). In the subtidal habitat all age classes were only present at five out of the ten Baseline Survey sites, with 0–1-year-old animals making up the lowest proportion. The AB1 site was the only site with a proportion of this age class in the subtidal habitat over 5%.

The proportion of sub-legal and legal sized Roe's abalone differed across the 10 Baseline Survey sites (Figure 7 and Figure 8). However, 6 of the sites were within 5% of exhibiting an even proportion of sub-legal to legal sized Roe's abalone (e.g. 50% sub-legal and 50% legal). Six of the sites had a larger proportion of legal sized animals, while three sites had more sub-legal and AB1 had an even distribution of legal and sub-legal Roe's abalone. The AB3A site had the largest proportion of legal sized (67%), while the Mindarie site had the smallest proportion of legal sized Roe's abalone (24%).

Conclusion

The Roe's abalone population along the Burns Beach Reef complex showed little variation across the five distinct monitoring zones north of the ORM Development Envelope. However, there was variability between individual sites even within close proximity of each other. For example, the two Reference Sites which are separated by only 350 m indicated that the Burns Beach site had twice the density of Roe's abalone in both the platform and subtidal habitat than the AB4 site. In general, the Roe's abalone density was greater in the platform than subtidal habitat, with every Roe's abalone age class present in the platform habitat across all 10 sites. In the subtidal habitat, large Roe's abalone dominate the population structure with 5+ year old abalone having the highest proportion at all sites.

This survey provides a baseline for the Roe's abalone population along the Burns Beach Reef complex to determine any potential impacts following the ORM construction.

Table 3: Total Roe's abalone numbers and density (abalone.m^2 ± S.E.) in both habitat types (platform and subtidal) at each Baseline Survey site location.

Site	Habitat	Count	Density (S.E.)
Development Envelope			
AB1	Platform	274	109.6 (22.5)
	Subtidal	356	79.1 (18.8)
Abalone Monitoring Zone A			
Beaumaris	Platform	420	113.6 (15.5)
	Subtidal	63	14.0 (5.3)
AB1A	Platform	274	121.8 (24.5)
	Subtidal	473	135.1 (32.1)
Abalone Monitoring Zone B			
AB1B	Platform	391	156.4 (46.8)
	Subtidal	246	54.7 (20.5)
AB2	Platform	432	172.8 (28.0)
	Subtidal	207	41.4 (16.7)
Shenton Avenue	Platform	355	117.1 (20.2)
	Subtidal	200	66.7 (13.3)
AB3A	Platform	330	132.0 (25.3)
	Subtidal	463	102.9 (19.2)
Reference Site			
Burns Beach	Platform	456	163.3 (18.6)
	Subtidal	365	81.1 (15.9)
AB4	Platform	219	87.6 (18.0)
	Subtidal	166	36.9 (15.2)
Control Site			
Mindarie	Platform	420	121.3 (36.2)
	Subtidal	35	7.0 (3.3)

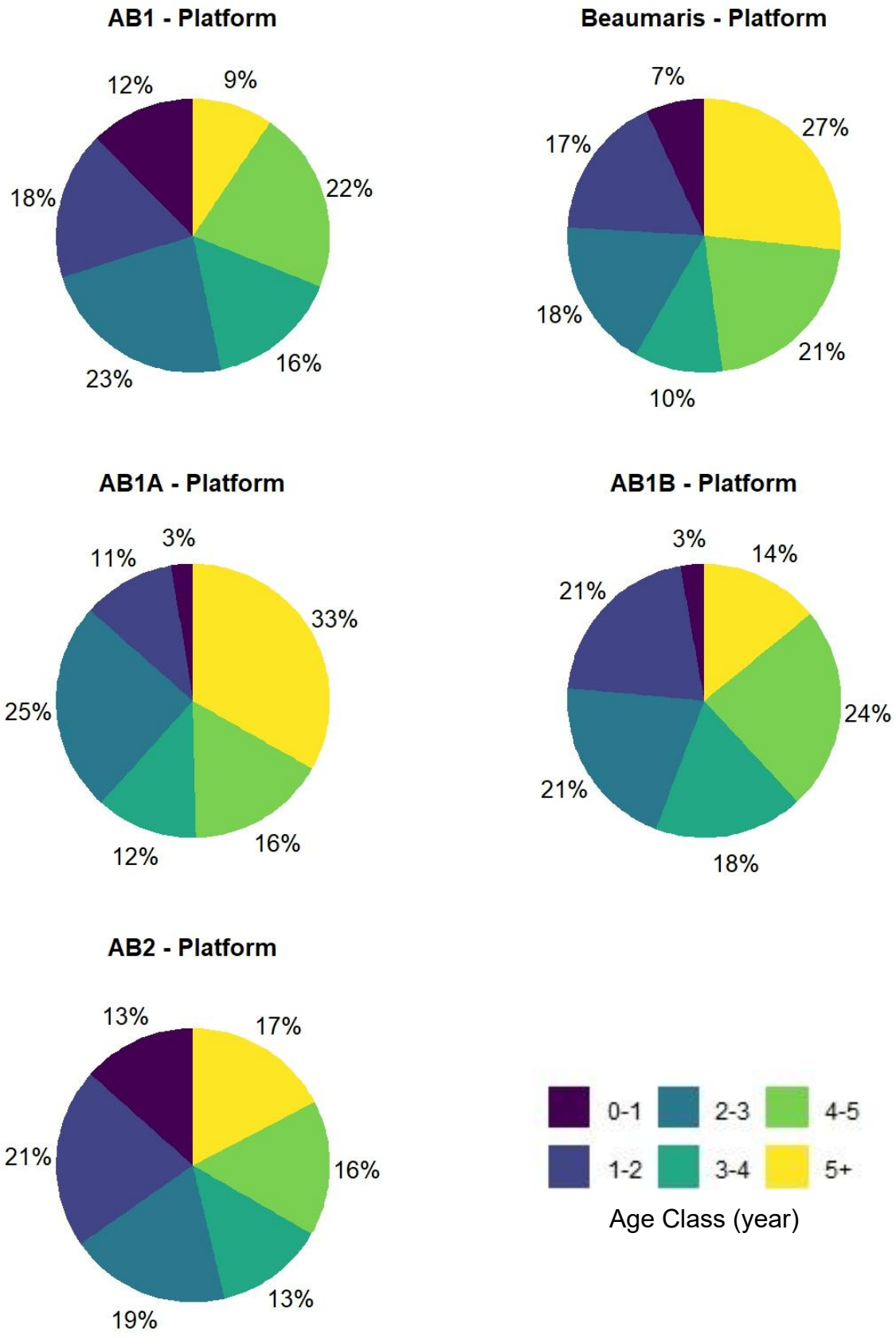

Figure 3: Proportion of Roe's abalone in each age class in the platform habitat at the AB1, Beaumaris, AB1A, AB1B and AB2 Baseline Survey sites.

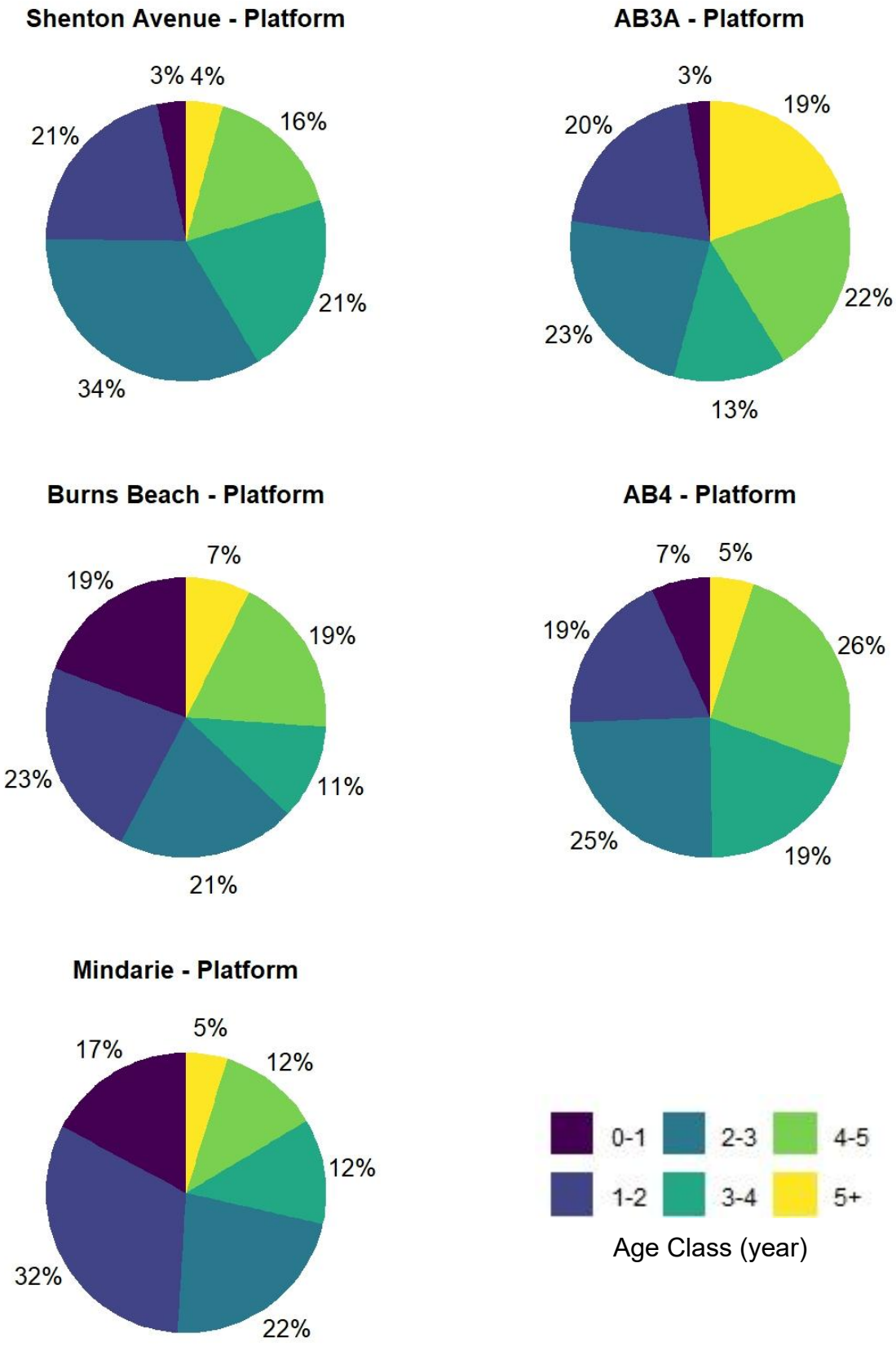

Figure 4: Proportion of Roe's abalone in each age class in the platform habitat at the Shenton Avenue, AB3A, Burns Beach, AB4 and Mindarie Baseline Survey sites.

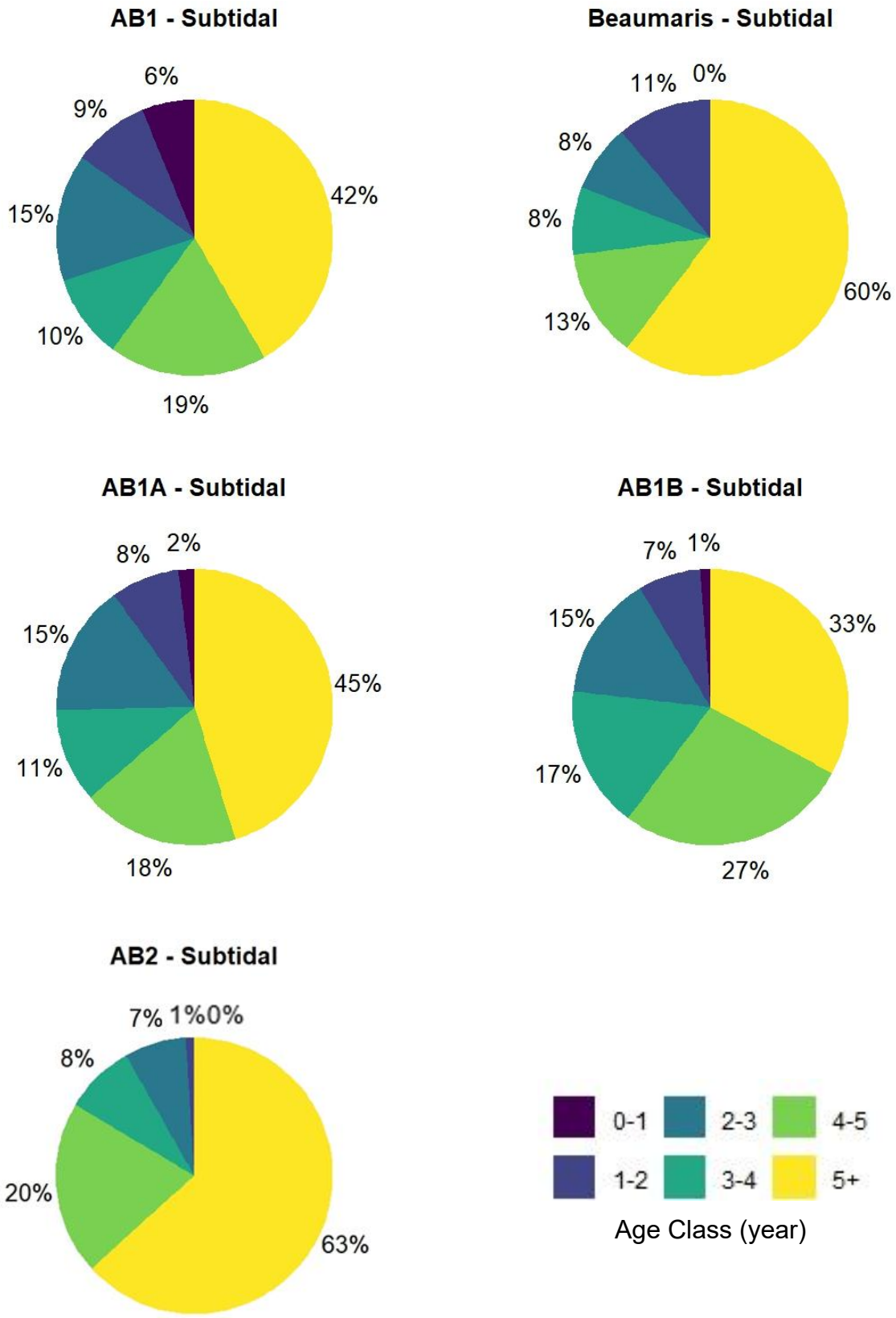

Figure 5: Proportion of Roe's abalone in each age class in the subtidal habitat at the AB1, Beaumaris, AB1A, AB1B and AB2 Baseline Survey sites.

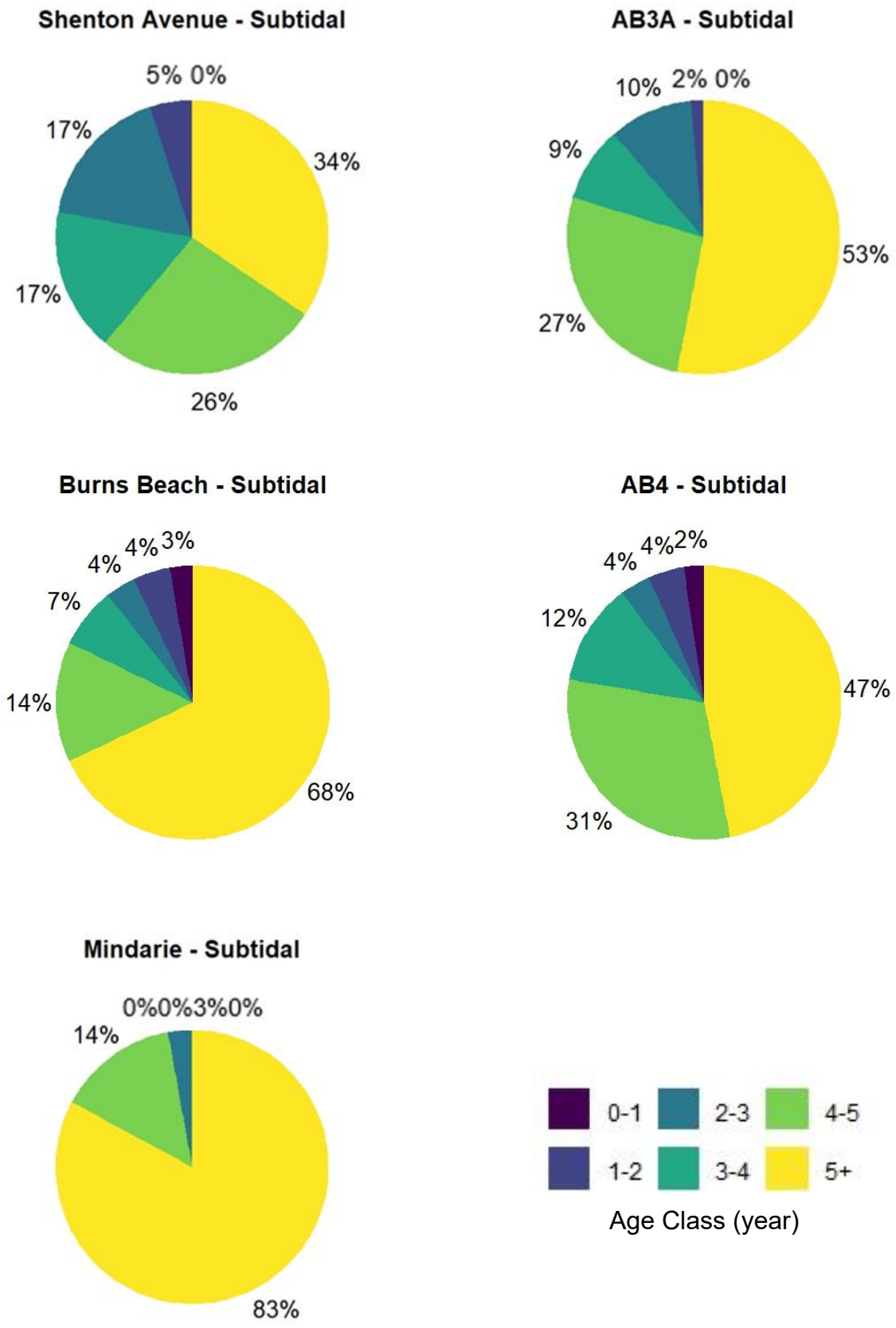

Figure 6: Proportion of Roe's abalone in each age class in the subtidal habitat at the Shenton Avenue, AB3A, Burns Beach, AB4 and Mindarie Baseline Survey sites.

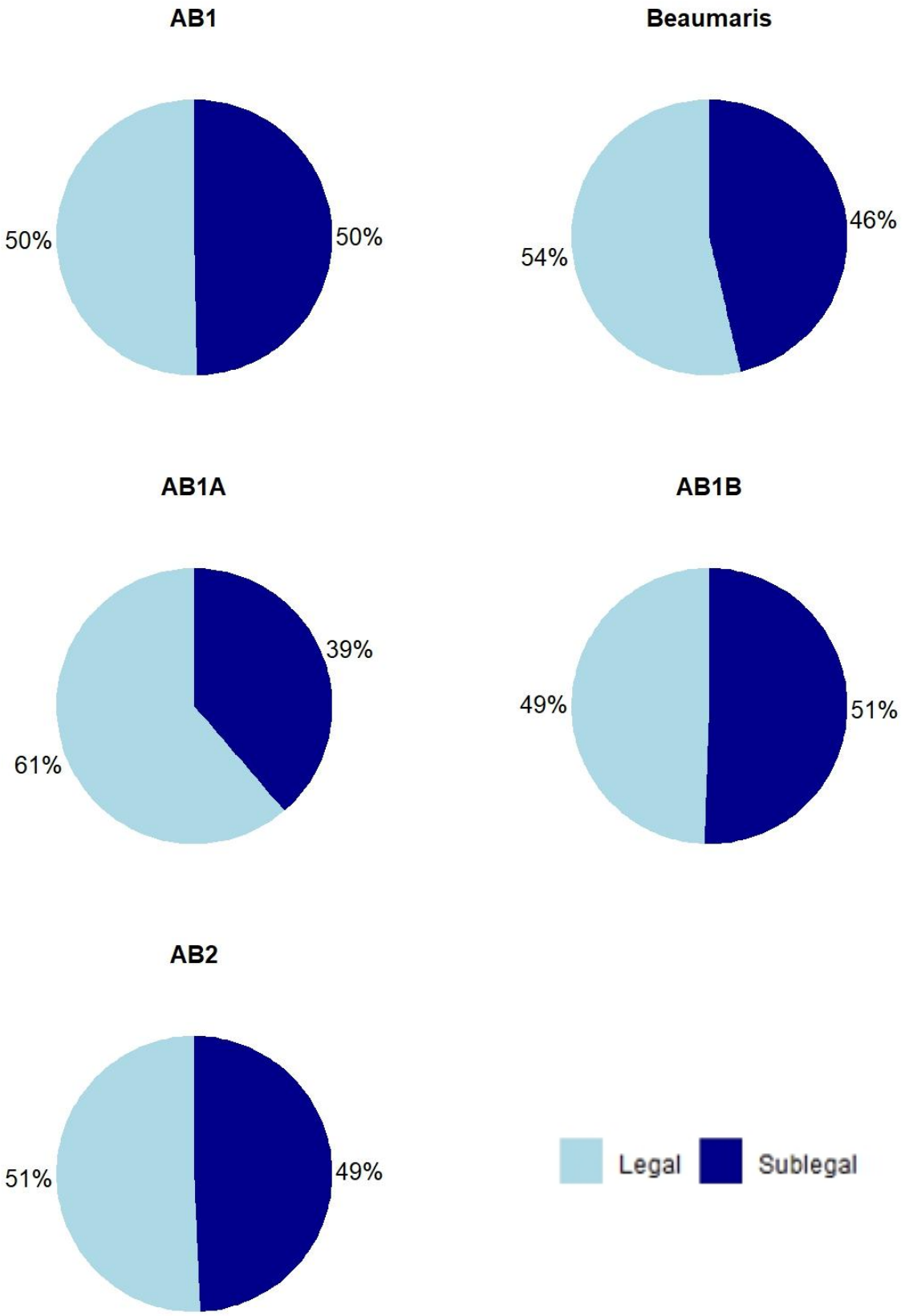

Figure 7: Proportion of Roe's abalone in the legal and sub-legal size classes at the AB1, Beaumaris, AB1A, AB1B and AB2 Baseline Survey sites.

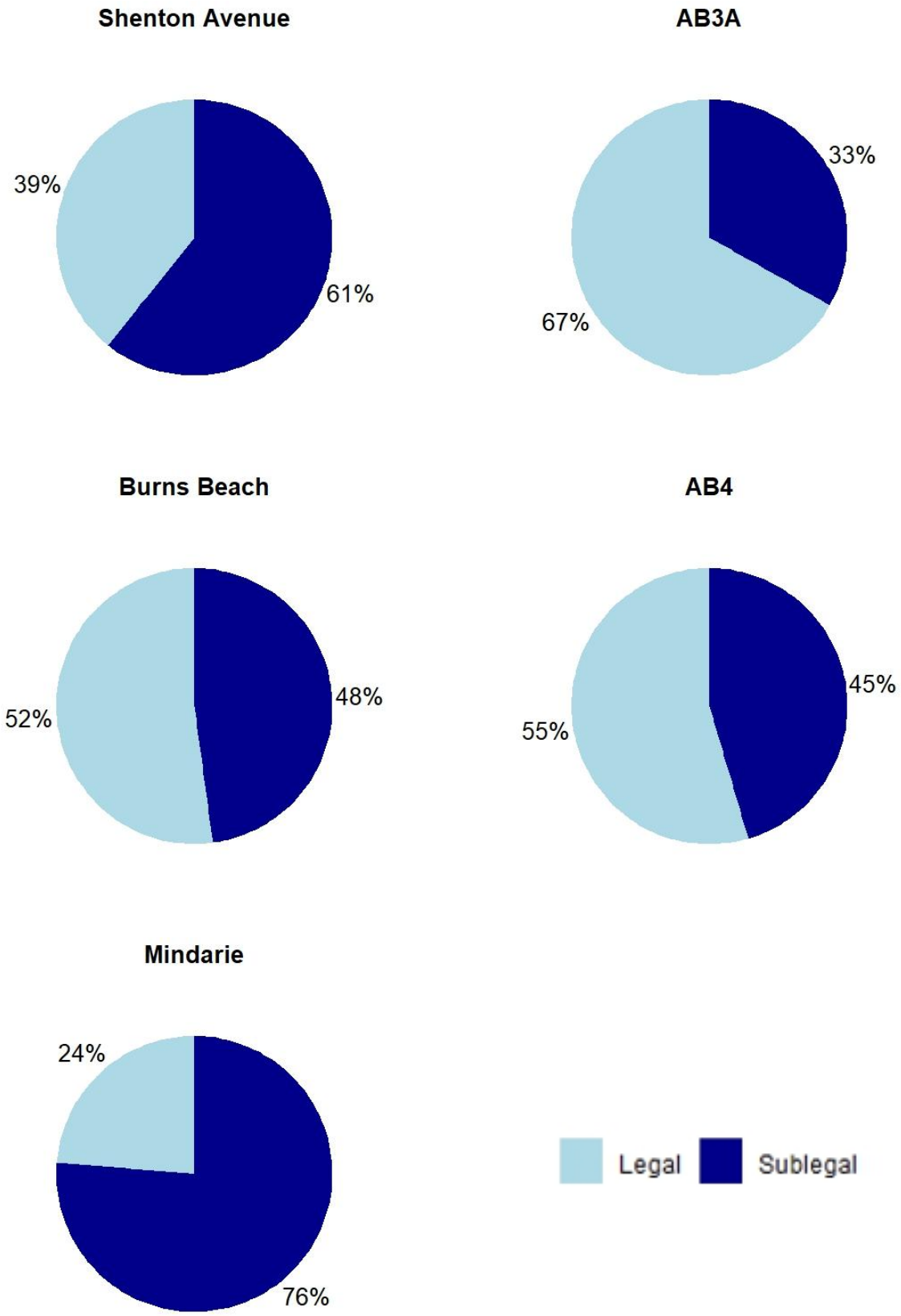

Figure 8: Proportion of Roe's abalone in the legal and sub-legal size classes at the Shenton Avenue, AB3A, Burns Beach, AB4 and Mindarie Baseline Survey sites.

Translocation Program

Background and Rationale

In late 2017, the Department of Primary Industries and Regional Development (DPIRD) and DevelopmentWA (formerly LandCorp) commenced an investigation into potential offset strategies for the Roe's abalone population directly impacted by the Ocean Reef Marina (ORM) development. This collaboration has focused on a translocation program but at that time also examined potential stock and habitat enhancement opportunities.

As part of the environmental approval process for the development of the ORM, the Minister for Environment issued a "Statement that a proposal may be implemented" (MS 1107) subject to several implementation conditions and procedures. One such condition was No. 9 Social Surroundings (abalone monitoring and management).

Pursuant to Condition 9-1: Prior to the commencement of construction, the proponent shall prepare and submit an Abalone Habitat and Biomass Monitoring Plan to the requirements of the CEO in consultation with the Department of Primary Industries and Regional Development and the Department of Biodiversity, Conservation and Attractions.

Condition 9-2: The Abalone Habitat and Biomass Monitoring Plan required by Condition 9-1 shall:

(1) identify options for translocating abalone from within the Development Envelope to other suitable habitat, including consideration of timing, biosecurity and genetic differences between the population relocated and the population and environment at the receiving location, and monitoring program to confirm outcomes from any translocation.

This report details the Translocation Program objectives, methodology, monitoring and the baseline survey results for the monitoring locations.

Overall Objective

Identify options for translocating Roe's abalone from within the ORM Development Envelope to suitable habitat and implement an appropriate translocation program.

Objectives / Benefits

(1) Translocate approximately 10-15 t of adult Roe's abalone biomass to facilitate an increase in spawning biomass within other areas of the Perth Metropolitan Roe's abalone Fishery.
(2) Commercial fisher's involvement in the Translocation Program.
(3) Translocation of Roe's abalone to the devastated fishery north of Kalbarri (conservation project).
(4) Provide a specific avenue for consultation with stakeholders affected by ORM.

Options for Translocation Program

Roe's abalone can be translocated from the Development Envelope to anywhere within the species range in Western Australia. The potential release locations included:

(1) Perth Metropolitan Roe's abalone Fishery
(2) Devastated Roe's abalone fishery north of Kalbarri
(3) Other Roe's abalone population locations within Western Australia

The potential release locations outside of the Perth Metropolitan Roe's abalone Fishery were investigated but deemed to have a high risk of translocation/release mortality. The increased stress from long distance translocation due to extended time out of water, potential husbandry requirements and transportation system malfunction, coupled with the availability of commercial fishers outside the Perth Metropolitan Roe's abalone Fishery were all potential risk factors. Difference in sea surface temperature (SST) between areas in Western Australia has been shown to create adaptive differentiations in Roe's abalone populations (Sandoval-Castillo et al. 2015), which is an important consideration for any translocation or enhancement program. A stock recovery project had indicated the potential viability of translocating to the devastated Roe's abalone fishery north of Kalbarri on an experimental scale (Strain et al. 2019). However, undertaking a translocation program on the scale proposed by Condition 9-2 (10-15 t of adult Roe's abalone biomass) required significant improvements/modifications to the translocation methodology and system. Given the rationale above, the translocation of Roe's abalone only occurred within the Perth Metropolitan Roe's abalone Fishery. The scale (numbers of abalone) and release locations of the Translocation Program were dependent on the timing of harvest, resourcing and start date of the ORM construction.

Timing

The majority of the Translocation Program was completed between March and May 2020 to ensure it occurred during optimum weather conditions and had the highest availability of West Coast Abalone Divers Association (WCADA) members. This timing also aligned with the ORM Baseline Survey, DPIRD's annual Fishery-Independent Surveys (FIS) and ensured the program was completed prior to the commencement of the ORM construction.

Biosecurity

DPIRD is the authority responsible for regulating translocations of live fish under the Fish Resources Management Act 1994 (FRMA). The Translocation Program complied with DPIRD's "Policy for Managing Translocations of Live Fish into and within Western Australia". Applications made under this policy include assessment of the biosecurity risk by the Aquatic Disease Specialist at DPIRD. The Department uses a risk-based assessment process to evaluate and regulate translocations of live fish in Western Australia (WA). Any requirement deemed necessary by DPIRD to undertake investigations into the biosecurity of the Translocation Program has occurred.

Genetics

The Translocation Program complied with DPIRD's Translocation Policy as outlined in the Biosecurity Section above. A comprehensive evaluation of Roe's abalone genetic population differentiation has been completed by Sandoval-Castillo et al. (2015). Through the screening of genome-wide variation this study showed the existence of one single abalone meta-population with high connectivity across the geographic range sampled. Therefore, there are currently no genetic zones assigned for Roe's abalone in WA. As such, translocation of Roe's abalone from within the Development Envelope to other suitable habitat within WA is unlikely to pose any significant genetic risk.

Translocation Methodology

The Translocation Program was executed by DPIRD with assistance from the WCADA. Licensed commercial abalone fishers on surface supply breathing apparatus (SSBA) harvested adult Roe's abalone (> 45 mm shell length; 5 mm above size at which Roe's abalone reach sexual maturity) from both the platform and subtidal habitats within the Development Envelope. The Roe's abalone were collected using current commercial harvesting techniques (chipping), placed in catch bags and remained in water until required to be transported. The harvested Roe's abalone were transported by a commercial abalone vessel in catch bags, laid on the deck under wet hessian (to remain cool and moist), from Burns Beach Reef to predefined release locations between Hillarys and Trigg Island (< 45 min steam). At each release location, all abalone catch bags were weighed and a random sample of 200 Roe's abalone counted and weighed to determine an average weight per abalone and the total number of abalone translocated.

At the release locations, divers transferred each catch bag from the transport vessel into the defined release area. The translocated Roe's abalone were released by hand onto the nearshore reef substrate ensuring they were not clumped together. All Roe's abalone were distributed evenly throughout the release location in both the platform and subtidal habitat. Once all Roe's abalone were released, the vessel returned to the Development Envelope to repeat the process until the weather was no longer conducive for either harvest or release.

Information on the biomass and health of Roe's abalone removed from the Development Envelope by the commercial fishers and then released at each receiving location was recorded. Total biomass translocated was estimated by calculating the total weight harvested and translocated from each transport with the average weight of individual animals.

Translocation Monitoring Program

For all translocations within the Perth Metropolitan Roe's abalone Fishery (specifically the Hillarys to Trigg Island section), multiple release locations within this stretch of Roe's abalone habitat were selected based on several parameters:

- The total amount of abalone to be translocated as part of this program
- The potential receiving locations topography and abalone abundance
- Accessibility based on weather conditions
- Ability to conduct monitoring surveys

Three receiving locations (release sites) were surveyed prior to the translocation being undertaken to determine a baseline population structure (Table 4 and Figure 9). These monitoring release sites will be surveyed post translocation (within a year) and then as per the Abalone Habitat and Biomass Monitoring Plan.

Table 4: Abalone Translocation Program release site locations within the Hillarys to Trigg Island stretch of the Perth Metropolitan Roe's abalone Fishery (ordered north to south)- redacted.

Site	Easting	Northing	Latitude	Longitude
South MAAC				
North Centaur				
North Bailey				

Figure 9: Abalone Translocation Program Monitoring Release Locations, Ocean Reef Marina Monitoring Zones A and B, Development Envelope, and Concept Plan.

Survey Methodology

Roe's abalone population structure and numbers were surveyed using DPIRD's transect methods based on Hancock (2004), adapted from Hart et al. (2018) and as described in Strain et al. (2019). To detect change in population structure at the translocation monitoring sites the survey methodology was modifying by increasing the number of replicates (quadrats). The rationale for this variation in survey method is described in Strain et al. (2019) as a result of the outcomes of the Kalbarri Translocation Program undertaken between October 2011 and November 2019.

At each translocation monitoring site, a fixed peg indicated the 0 m mark for each transect that radiated out across the platform and subtidal habitat (Figure 10). Transects were spaced evenly across both the platform and subtidal habitats, and their bearing to the 0 m fixed peg recorded. Between two and four 0.5 m^2 quadrats were positioned along each transect in areas that represented the abalone population for the site. The length of each transect was determined by the presence or absence of abalone.

Divers used wrist compasses and a survey reel to position each transect, tensioning the reel with a weight. Divers did not measure but counted all the abalone observed in each quadrat. The counts were separated into three size categories; 0-32 mm, 33-60 mm and > 61 mm. Abalone which had the tip of their swirl within the quadrat frame were considered 'in' the quadrat and therefore were counted.

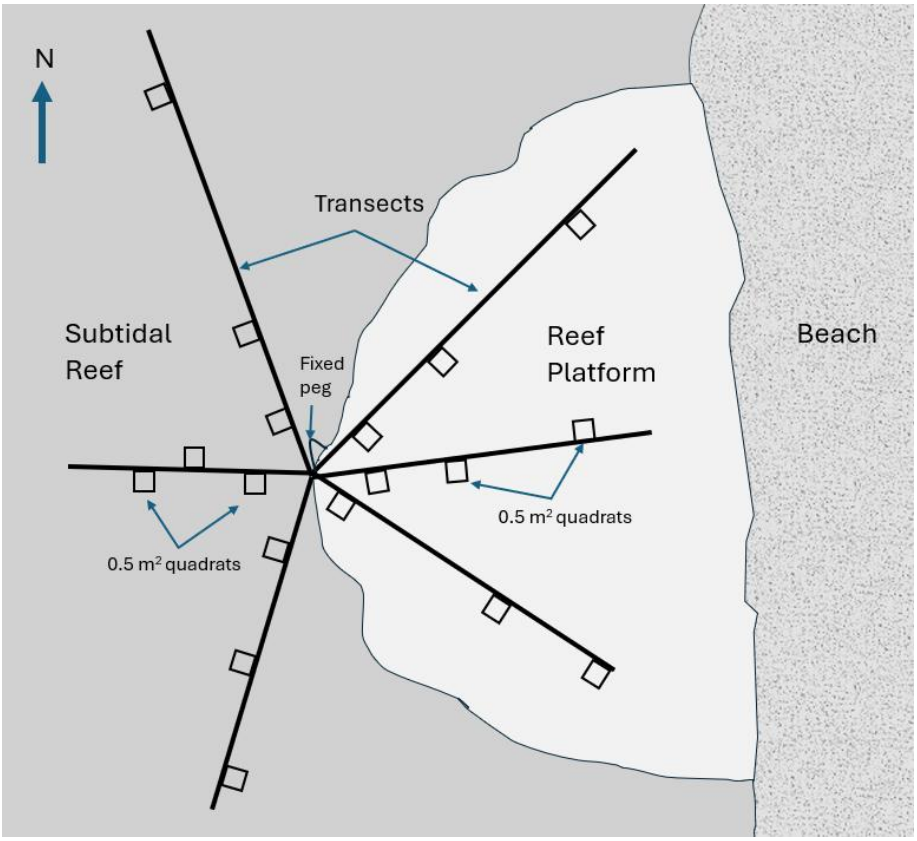

Figure 10: Schematic representation of Roe's abalone habitat and the survey design used at the Abalone Translocation monitoring site locations.

Summary statistics of the relevant abalone parameters were calculated for each of the translocation monitoring sites by habitat type (platform and subtidal):

- total Roe's abalone numbers per transect
- Roe's abalone density (abalone.m^2)
- percentage per size classes (Hancock 2004) and legal and sub-legal classifications

Age classes were determined based on the abalone size using the maximum length size classes as defined in Hancock (2004) and have been pooled in 2-year age groups (Table 5). The legal minimum size limit for recreational Roe's abalone fishing is 60 mm. Therefore, Roe's abalone smaller than 60 mm are classified as sub-legal and those 60 mm or greater are legal size.

Table 5 Roe's abalone size classes and associated age classes as defined by Hancock (2004) pooled in 2-year age groups.

Size (mm)	Age (years)
<32	0 – 2
33 – 60	2 – 4
>61	4+

Translocation Baseline Survey Results

Total numbers of Roe's abalone varied substantially between the translocation monitoring sites, with the South MAAC site having significantly less Roe's abalone than both the North Centaur and North Bailey sites in both the platform and subtidal habitats (Table 6). The North Centaur site had the largest number of Roe's abalone in the platform habitat and subsequently the highest density of 97.7 abalone.m^2 (± 10.7 S.E.). The North Centaur and North Bailey sites had a similar density of Roe's abalone on the subtidal habitat.

All three translocation monitoring sites had representation of the three 2-year pooled age classes on the platform habitat (Figure 11). The North Bailey site had the largest proportion (12%) of Roe's abalone less than 2 years old. On the subtidal habitat, only the South MAAC site didn't have any 0-2 year old Roe's abalone present. All 3 translocation monitoring sites across both the platform and subtidal habitats had greater than 50% of the Roe's abalone in the 4+ age class (> 61 mm shell length), with the South MAAC subtidal the highest at 87%. The high proportion of large Roe's abalone is also shown in Figure 12 with all three translocation monitoring sites having 65% or greater legal sized abalone.

Table 6: Total Roe's abalone numbers and density (abalone.m^2 ± S.E.) for both habitat types (platform and subtidal) for each Abalone Translocation monitoring site location.

Site	Habitat	Count	Density (S.E.)
South MAAC	Platform	49	16.33 (3.6)
	Subtidal	61	10.2 (1.9)
North Centaur	Platform	586	97.7 (10.7)
	Subtidal	238	79.3 (17.7)
North Bailey	Platform	285	63.3 (8.8)
	Subtidal	358	79.6 (11.4)

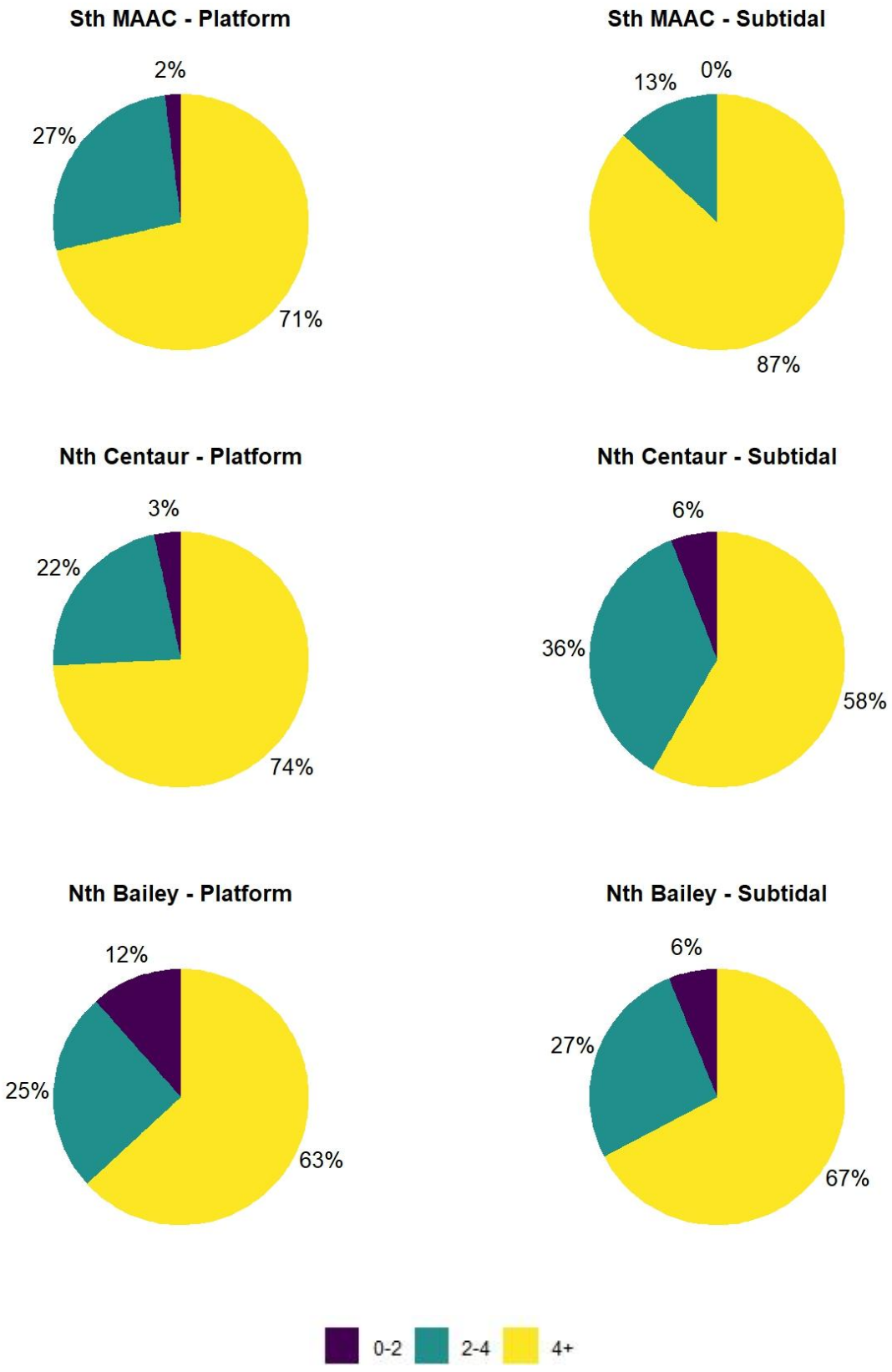

Figure 11: Proportion of Roe's abalone in each of the 2-year pooled age classes in the platform and subtidal habitats at the South MAAC, North Centaur and North Bailey Abalone Translocation monitoring site locations.

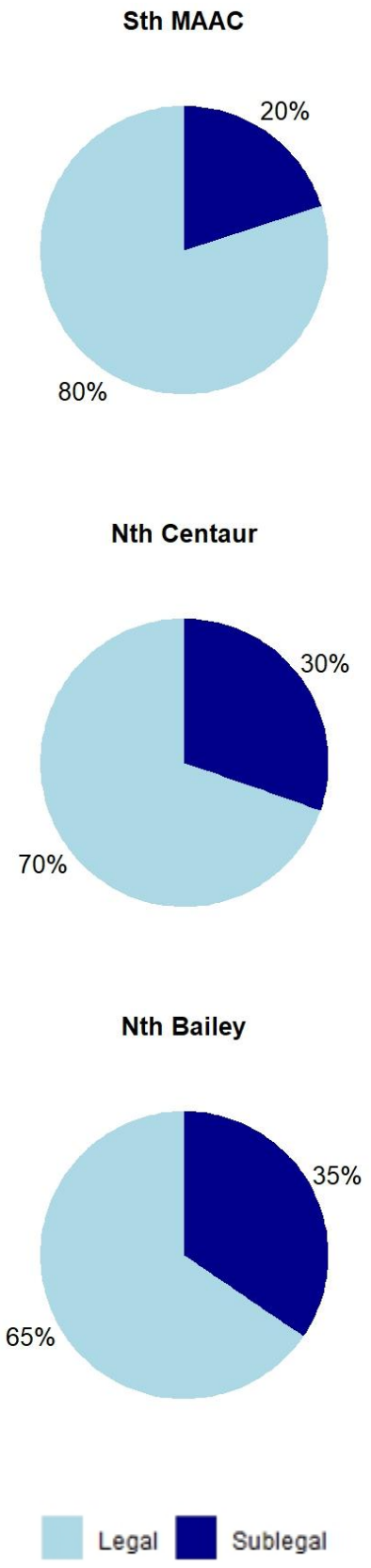

Figure 12: Proportion of Roe's abalone in the legal and sub-legal size classes at the South MAAC, North Centaur and North Bailey Abalone Translocation monitoring site locations.

References

DPIRD (2023). Abalone Resource of Western Australia: Harvest Strategy 2021–2026. Fisheries Management Paper No. 283. Department of Primary Industries and Regional Development, Western Australia, Perth. 56pp.

Hancock B (2004). The Biology and Fishery of Roe's Abalone *Haliotis roei* Gray in South-Western Australia, with Emphasis on the Perth Fishery. PhD thesis, University of Western Australia, Western Australia.

Hart A, Strain LWS and Brown J (2018). Regulation dynamics of exploited and protected populations of *Haliotis roei*, and their response to a marine heatwave. ICES Journal of Marine Science, doi:10.1093/icesjms/fsy064.

Sandoval-Castillo J, Robinson N, Strain L, Hart A and Beheregaray LB (2015). Use of next generation DNA technologies for revealing the genetic impact of fisheries restocking and ranching. Australian Seafood CRC Report No. 2012/714. Flinders University, Adelaide, 47pp.

Strain LWS, Brown J and Hart AM (2019). Recovering a collapsed abalone stock through translocation. Australian Seafood CRC Project No. 2011/762. Fisheries Research Report No. 292 Department of Primary Industries and Regional Development, Western Australia. 92pp.

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