Mangawhai SEA habitat assessment

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Authors/Contributors:

Richard Griffiths
Andrew McDonald
Nick Bamford
Melodie Pene
Neels van Tonder
Neihana Umuroa
Stacey Wiseman
Penny Hales
Ricky Eyre

For any information regarding this report please contact:

Richard Griffiths
richardg@nrc.govt.nz

Northland Regional Council
Private Bag 9021
Whangārei Mail Centre
Whangārei 0148

Phone: 09 470 1200
Freephone: 0800 002 004
Fax: 09 470 1202
Email: info@nrc.govt.nz

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Introduction

In the Proposed Regional Plan for Northland (Northland Regional Council 2016), three marine significant ecological areas (SEAs) have been identified in the Mangawhai Estuary. In September 2019, Northland Regional Council (NRC) conducted a habitat assessment of these SEAs. This report documents the key findings of that survey.

Methods

Study area

Mangawhai estuary is located on the east coast of the Northland peninsula (Figure 1).

Figure 1. Mangawhai Estuary.

Sampling sites

For the northern SEA, transects were located 50m apart with stations located 50m along each transect (Figure 2). In the mid and southern SEAs, transects were located 100m apart with stations located 100m along each transect (Figure 3 & 4).

Figure 2. Sample locations in the northern SEA.

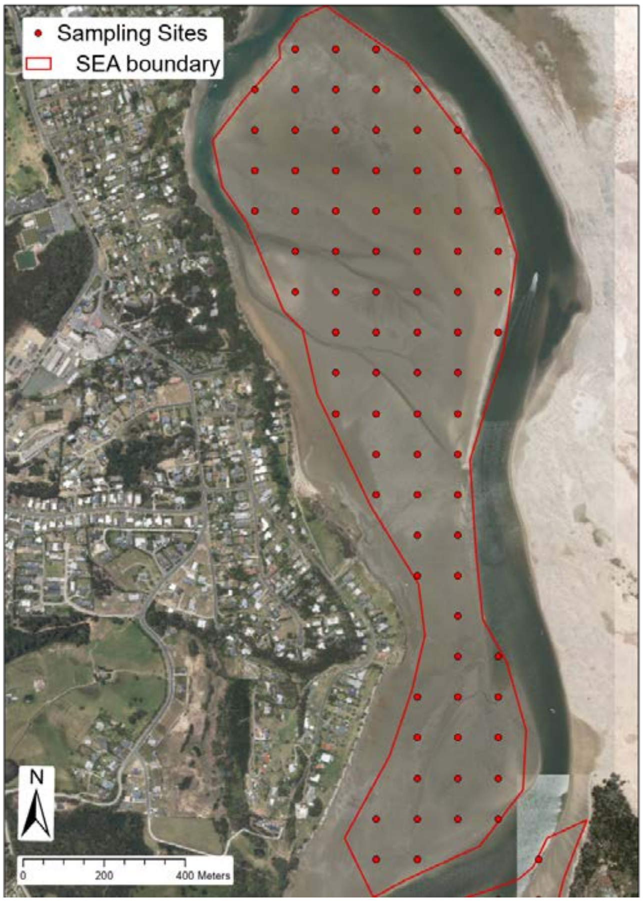

Figure 3. Sample locations in the mid SEA.

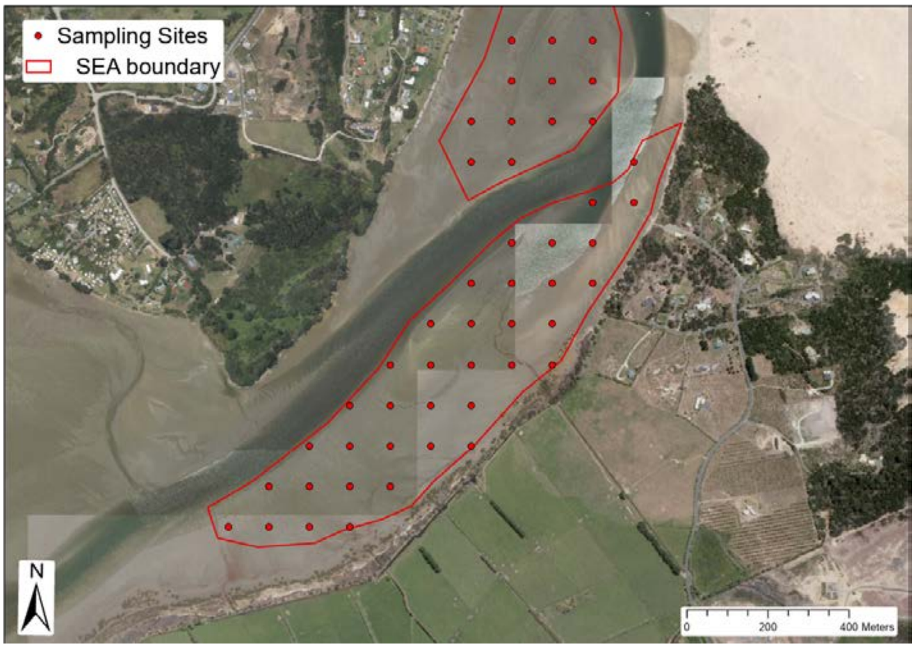

Figure 4. Sample locations in the southern SEA.

Sampling methods - substrate

At each sampling station the substrate was classified into one of nine categories (Table 1). These categories were developed by Griffiths *et al.* (2019) from the sediment categories in the Estuary Monitoring Protocol (Robertson *et al*., 2002) and an intertidal habitat survey of Waikato estuaries conducted by Needham *et al.* (2013).

Table 1. Substrate categories.

Substrate categories	Description
Very soft mud	The surface appears brown with a black anaerobic layer below. When walking on the substrate you'll sink greater than 5cm.
Soft mud	The surface appears brown with a black anaerobic layer below. When walking on the substrate you'll sink 2-5cm.
Firm mud/sand	A mixture of mud and sand, the surface appears brown with a black anaerobic layer below. When walking on the substrate you'll sink 0-2cm.
Firm sand	Firm sand flats may be mud-like in appearance but are granular when rubbed between the fingers, and solid enough to support an adult's weight without sinking more than 1-2cm. Firm sand may have a thin layer of silt on the surface making identification from a distance impossible.
Mobile sand	The substrate is clearly recognised by the granular beach sand appearance and the often rippled surface layer. Mobile sand is continually being moved by strong tidal currents and often forms bars and beaches. When walking on the substrate you'll sink less than 1cm.
Soft sand	Substrate containing greater than 99% sand. When walking on the substrate you'll sink greater than 2cm.
Very soft sand	Substrate containing greater than 99% sand. When walking on the substrate you'll sink greater than 5cm.
Gravelfield	Sediment characterised by unconsolidated gravel (2-20mm diameter). Visually observed to cover ~70-100% of sediment surface to the extent that very little (or none) of the underlying sediment is visible.
Shell hash	The substrate is dominated by shells.

Sampling methods - epifauna

At each sampling station, a 0.25m^2 quadrat was placed on the ground and all animals (excluding shellfish) were recorded. In addition, any crustacean burrows, algae, seagrass or mangroves within the quadrat were recorded.

Sampling methods – incidental observations

Any unusual flora or fauna encountered between stations was recorded. In addition, bird observations were recorded at each SEA.

Sampling methods - shellfish

Samples were collected by taking a sample unit consisting of two adjacent, circular cores (with a 150mm diameter) pushed into the substrate to a depth of 150mm. The contents from the two cores were aggregated (so each sample unit covered a cross sectional area of 0.0353m^2) and passed through a 6mm aperture sieve. All cockles (*Austrovenus stutchburyi),* wedge shell (*Macomona Liliana)* and pipi *(Paphies australis*) retained on the sieve were counted. A photograph was taken of all the shellfish, and the images were analysed using Photoblique v2.0.16. This software allows the user to set the spatial scale of the photographs using a reference measure, such as a ruler, and then measure the shell length of each shellfish (Figure 5). In order to allow for batch processing of the spatial scale of the photographs, each field officer had a specially adapted 20L bucket. The lid of each bucket had a hole drilled through it and an indent to match their phone's camera. This ensured that each photograph was taken at the same height and centred in the middle of the bucket.

The shell length measurements made using Photoblique were exported as a csv and used to calculate the proportion of juveniles and adults, and to estimate the biomass of cockles.

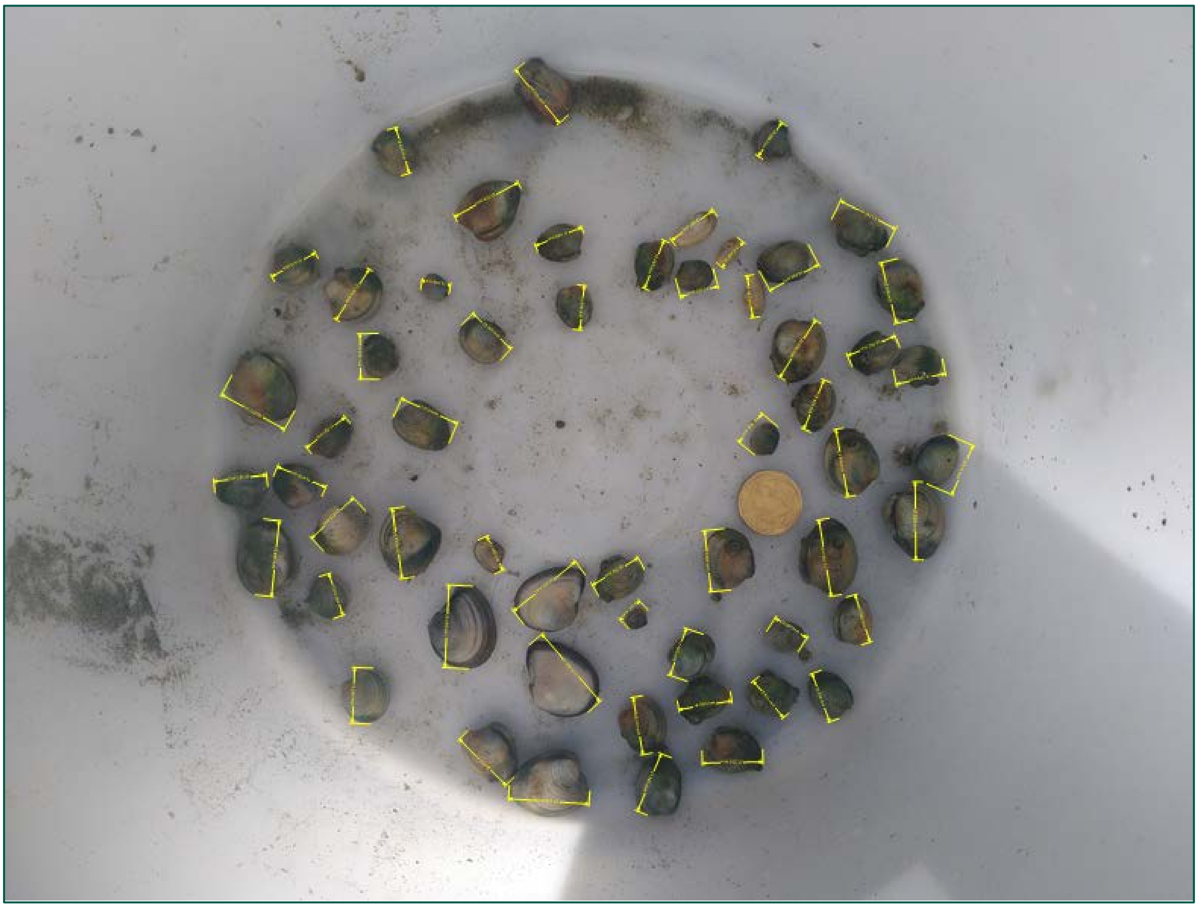

Figure 5. Shellfish measurements using Photoblique v2.0.16.

Data analysis – shellfish

The mean density (per square metre) and standard error was estimated for juvenile and adult cockles and wedge shells in each SEA. Cockles 15mm or greater in shell length and wedge shell 30mm or greater were classified as adults (Griffiths *et al.* 2019). Very few pipis were recorded, so juvenile and adult densities were not estimated separately. Instead the mean density (per square metre) and standard error was calculated for all pipis.

For the purpose of this survey each SEA was treated as one stratum. The total population for each stratum was estimated by calculating the average density (per square metre) and then multiplying this by the area of the SEA using the formula:

$$Total\ population\ (X) = \sum_{i-1} W_i \bar{x}_i$$

Where: W_i is the stratum area (m^2), and $\bar{x}_i$ is the average density (per square metre) in stratum *i.*

Length weight relationship

The weight of individual shellfish was estimated using the length of each shellfish and an established length-weight relationship:

$$W = aL^b$$

The relationship between length-weight relationship derived by Williams *et al.* (2009) for cockles at Snake Bank, Northland, where a = 0.00014 and b = 3.29, was used to estimate cockle biomass. W is weight in g and L is length in mm.

There are currently no established length-weight relationships for wedge shell as it is not a commercially important species, therefore biomass was not calculated for wedge shells. There are established length-weight relationships for pipi, but as very few pipi were recorded in the survey, biomass was not estimated.

Results – substrate

Substrate in the northern SEA was predominantly firm sand with some mobile sand found in the upper intertidal area towards the north-western area of the SEA (Figure 6). Substrate in the mid SEA was predominantly firm sand in northern area of the sandflat with a combination of mobile sand, shell hash and mobile sand towards the south of the sandflat (Figure 7). Substrate in the southern SEA was predominantly firm sand, with some areas of mobile sand and a smaller area of soft sand (Figure 8).

Figure 6. Substrate type in the northern SEA.

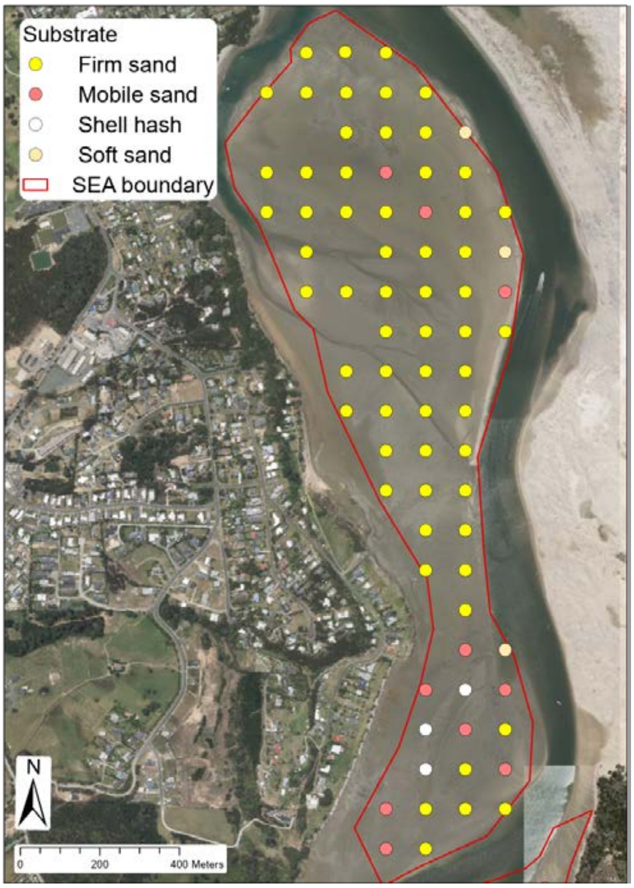

Figure 7. Substrate type in the mid SEA.

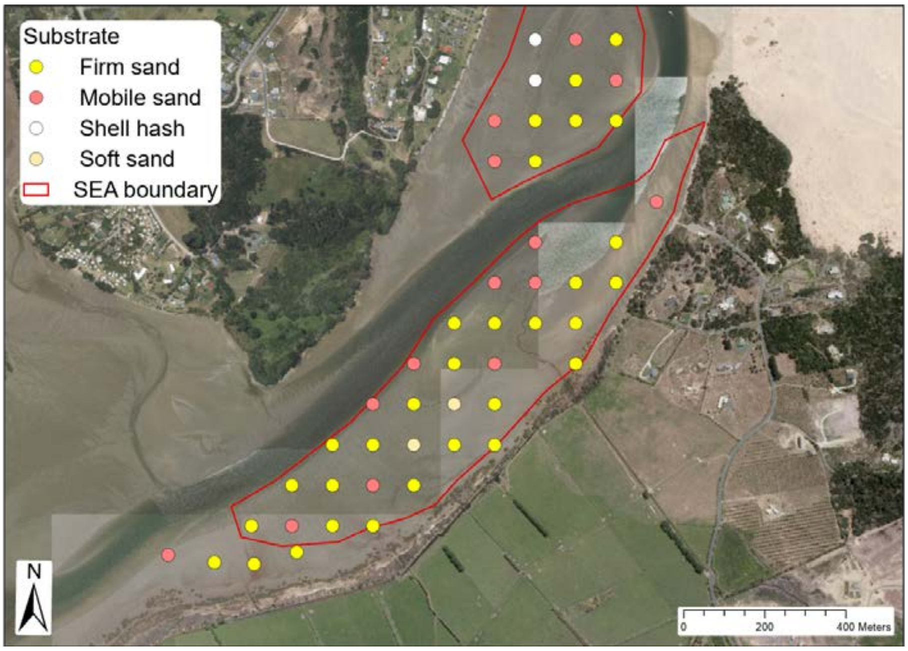

Figure 8. Substrate type in the southern SEA.

Results - epifauna

In total, 17 different taxa of benthic invertebrate were recorded (Table 2). No non-native taxa were recorded. One unusual organism, *Hydatina physis*, was recorded in the southern SEA. *H. physis* or Rose petal bubble shell is a species of sea snail, a marine opisthobranch gastropod mollusc. It is relatively uncommon in New Zealand (Andrew Spurgeon pers com). This is the first recording of the species in Mangawhai or the Kaipara District (source: http://www.mollusca.co.nz/).

Table 2. Epifauna recorded in Mangawhai.

Taxa	Common name
Austrovenus stutchburyi	Tuaki/Tuangi, Cockle
Paphies australis	Pipi
Macomona Liliana	Hanikura, Wedge shell
Fellaster zelandiae	Kina papa, Sand dollar
Hydatina physis	Rose petal bubble shell
Diloma subrostratum	Top shell
Austrominius modestus	Estuarine barnacle
Zeacumantus lutulentus	Koeti, Horn shell, Spire shell
Chiton glaucus	Papatua kakāriki, Chiton
Cominella glandiformis	Mud flat whelk
Cominella adspersa	Kawari, Speckled whelk
Anthopleura aureoradiata	Mud flat anemone
Notoacmea helmsi	Limpet
Patiriella sp	Cushion star
Unidentified worm	Unidentified worm
Unidentified crab	Unidentified crab
Unidentified shrimp	Unidentified shrimp

Results – incidental observations

In total ten different taxa of bird were recorded (Table 3).

Table 3. Bird taxa recorded at Mangawhai.

Northern SEA	Mid Sea	Southern SEA
Haematopus unicolor, Variable oystercatcher	*Haematopus unicolor,* Variable oystercatcher	*Haematopus unicolor,* Variable oystercatcher
Charadrius obscurus, Tūturiwhatu, Dotterel	*Charadrius obscurus,* Tūturiwhatu, Dotterel	*Charadrius obscurus* Tūturiwhatu, Dotterel
Larus dominicanus, Black-backed gull	*Larus dominicanus,* Black-backed gull	*Larus dominicanus,* Black-backed gull
Larus novaehollandiae, Red-billed gull	*Larus novaehollandiae,* Red-billed gull	*Larus novaehollandiae,* Red-billed gull
		Stemidae, unidentified Tern
	Sternula nereis, Tara-iti, Fairy Tern	
	Platalea regia, Spoonbill	*Platalea regia,* Spoonbill
	Limosa lapponica, Bar-tailed godwit	*Limosa lapponica,* Bar-tailed godwit
	Himantopus himantopus, Pied stilt	
		Morus serrator, Australasian Gannet

Results - cockles

Northern SEA

The extent of the northern SEA was determined to be $0.052km^2$. The total population of cockles in the SEA was estimated to be 49.7 million (Table 4). The total biomass was estimated to be 169.6 tonnes (Table 5). High densities were found throughout the SEA although lower densities were found higher up the intertidal zone towards the north-western corner of the SEA (Figure 9).

Table 4. Cockle density and population found in northern SEA.

	Juvenile cockles	Adult cockles	All cockles
Sample size	20	20	20
Mean density per square metre	170	785	955
Standard error	54.5	151.1	178.7
Stratum area (m^2)	52055	52055	52055
Total population (millions)	8.8	40.9	49.7

Table 5. Cockle biomass found in northern SEA.

Sample size	Mean biomass (g/m^2) (SE)	Stratum Area (m^2)	Total (tonnes)
20	3257 (750.4)	52055.25	169.6

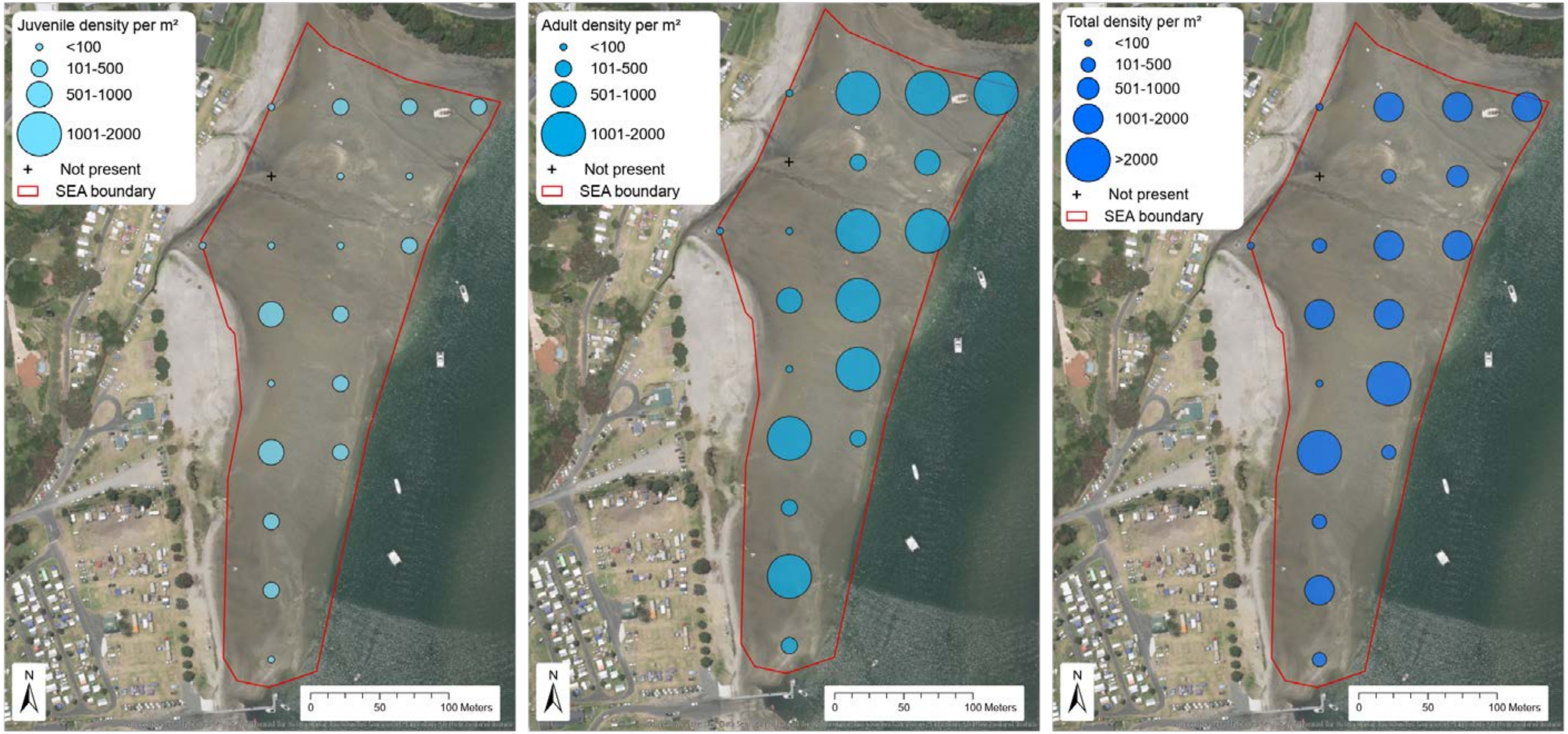

Figure 9. Cockle densities in the Northern SEA.

Mid SEA

The 2019 population of cockles in the SEA was calculated to be 659.6 million (Table 6). The total biomass was estimated to be 1577.3 tonnes (Table 7). The highest densities were found towards the northern edge of the sandflat, with densities as high as 3452 individuals per square metre at the tip of the sandflat. High densities were also recorded in the middle section of the sand flat and at the southern end of the SEA (Figure 10).

Table 6. Cockle density and population found in the mid SEA.

	Juvenile cockles	Adult cockles	All cockles
Sample size	76	76	76
Mean density (per square metre)	252	563	816
Standard error	34.4	61.1	80.1
Stratum area (m^2)	807955	807955	807955
Total population (millions)	203.9*	454.5*	659.6*

* There is a small difference between the juvenile and adult population and the total population because some cockles could not be measured due to broken shells.

Table 7. Cockle biomass found in the mid SEA.

Sample size	Mean biomass (g/m^2) (SE)	Stratum Area (m^2)	Total (tonnes)
76	1952 (227.7)	807955	1577.3

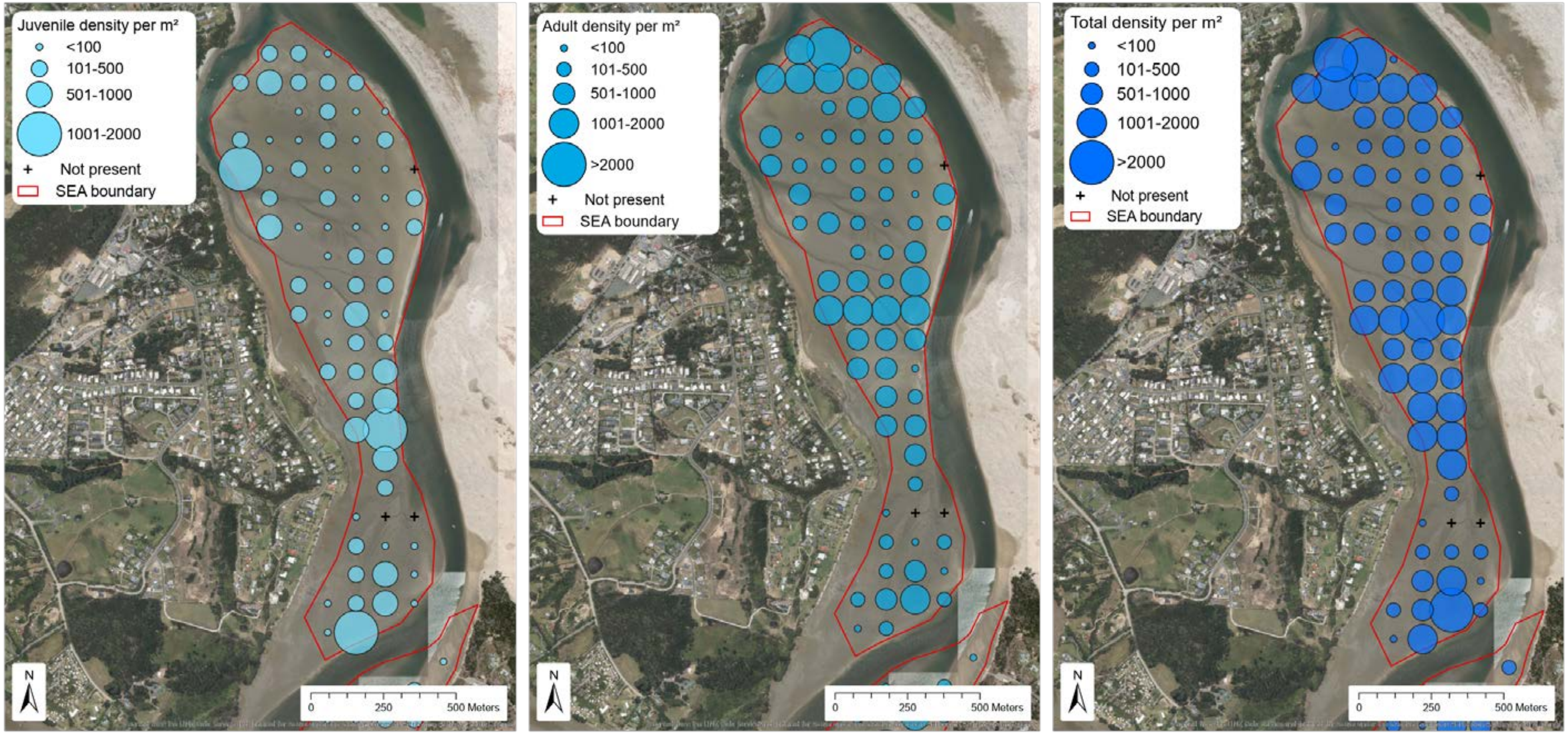

Figure 10. Cockle densities in the mid SEA.

Southern SEA

The 2019 population of cockles in the SEA was calculated to be 245.3 million (Table 8). The total biomass was estimated to be 608.4 tonnes (Table 9). High densities were found throughout the SEA (Figure 11). There was only one site in the southern SEA where cockles were not present. This site was high up the intertidal area very close to the shoreline where cockles would not be expected to occur.

Table 8. Cockle density and population found in the southern SEA.

	Juvenile cockles	Adult cockles	All cockles
Sample size	33	33	33
Mean density (per square metre)	169	518	687
Standard error	32.0	83.0	108.7
Stratum area (m^2)	357151.9	357151.9	357151.9
Total population (millions)	60.3	185.0	245.3

Table 9. Cockle biomass found in the southern SEA.

Sample size	Mean biomass (g/m^2) (SE)	Stratum Area (m^2)	Total (tonnes)
33	1703 (293.9)	357151.9	608.4

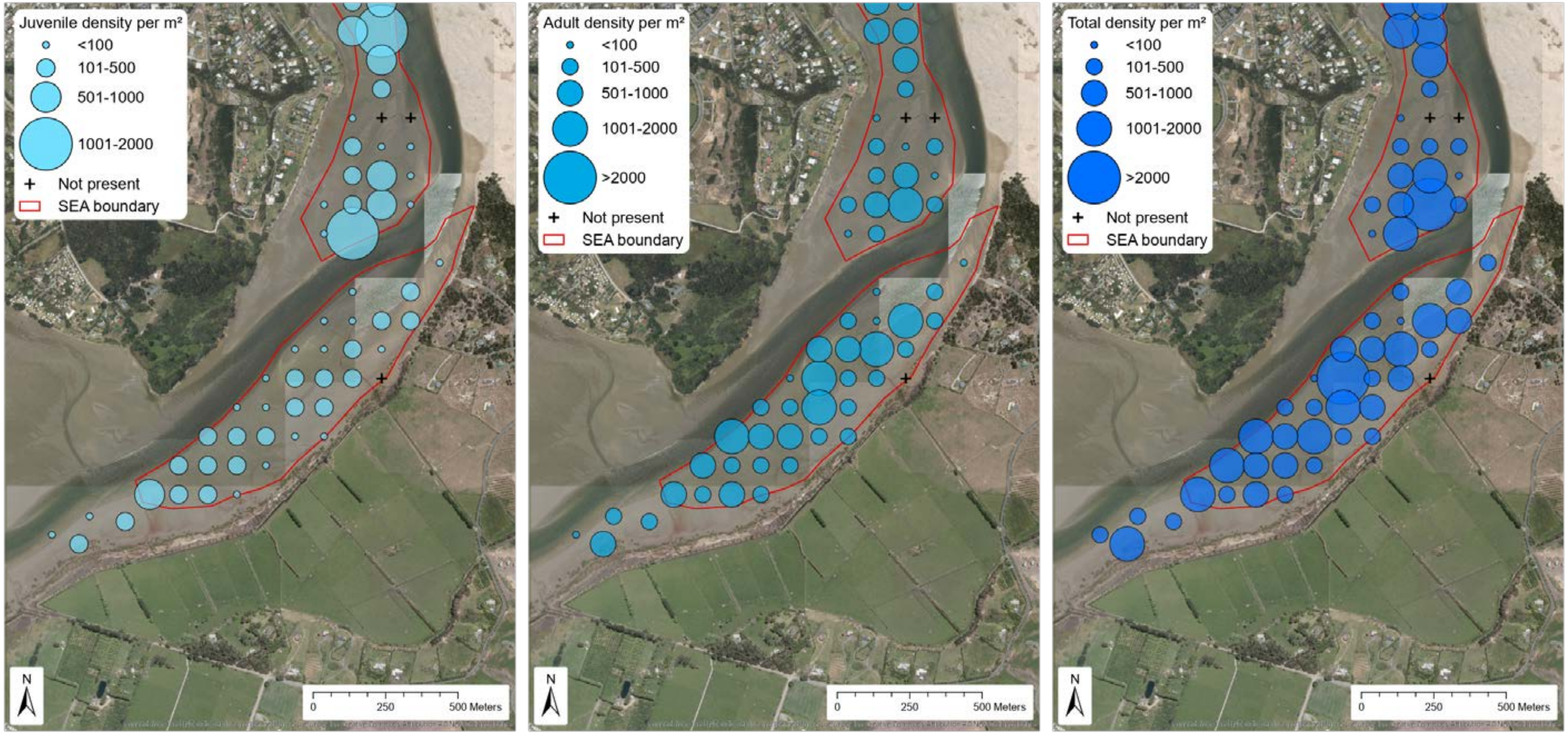

Figure 11. Cockle densities in the southern SEA.

Results – wedge shell

Northern SEA

The 2019 population of wedge shell in the SEA was calculated to be 4.2 million (Table 10). High densities were found throughout the SEA although lower densities were found higher up the intertidal zone (Figure 12).

Table 10. Wedge shell density and population found in the northern SEA.

	Juvenile wedge shells	Adult wedge shells	All wedge shells
Sample size	20	20	20
Mean density (per square metre)	48	33	81
Standard error	9.9	8.3	15.9
Stratum area (m^2)	52055.2	52055.2	52055.2
Total population (millions)	2.5	1.7	4.2

Mid SEA

The 2019 population of wedge shells in the SEA was calculated to be 89.6 million (Table 11). High densities were recorded throughout the SEA, although lower densities were found along the eastern edge of the SEA (Figure 13).

Table 11. Wedge shell density and population found in mid SEA.

	Juvenile wedge shells	Adult wedge shells	All wedge shells
Sample size	76	76	76
Mean density (per square metre)	83	28	111
Standard error	10.0	4.7	11.4
Stratum area	807955	807955	807955
Total population (millions)	66.8	22.9	89.6

Southern SEA

The 2019 population of wedge shell in the southern SEA was calculated to be 40.7 million (Table 12). High densities were found throughout the SEA (Figure 14). Additional samples collected outside the southern boundary of the SEA, contained moderate to high densities of wedge shells.

Table 12. Wedge shell density and population found in southern SEA.

	Juvenile wedge shells	Adult wedge shells	All wedge shells
Sample size	33	33	33
Mean density (per square metre)	86	28	114
Standard error	10.7	4.6	12.2
Stratum area (m^2)	357151.9	357151.9	357151.9
Total population (millions)	30.6	10.1	40.7

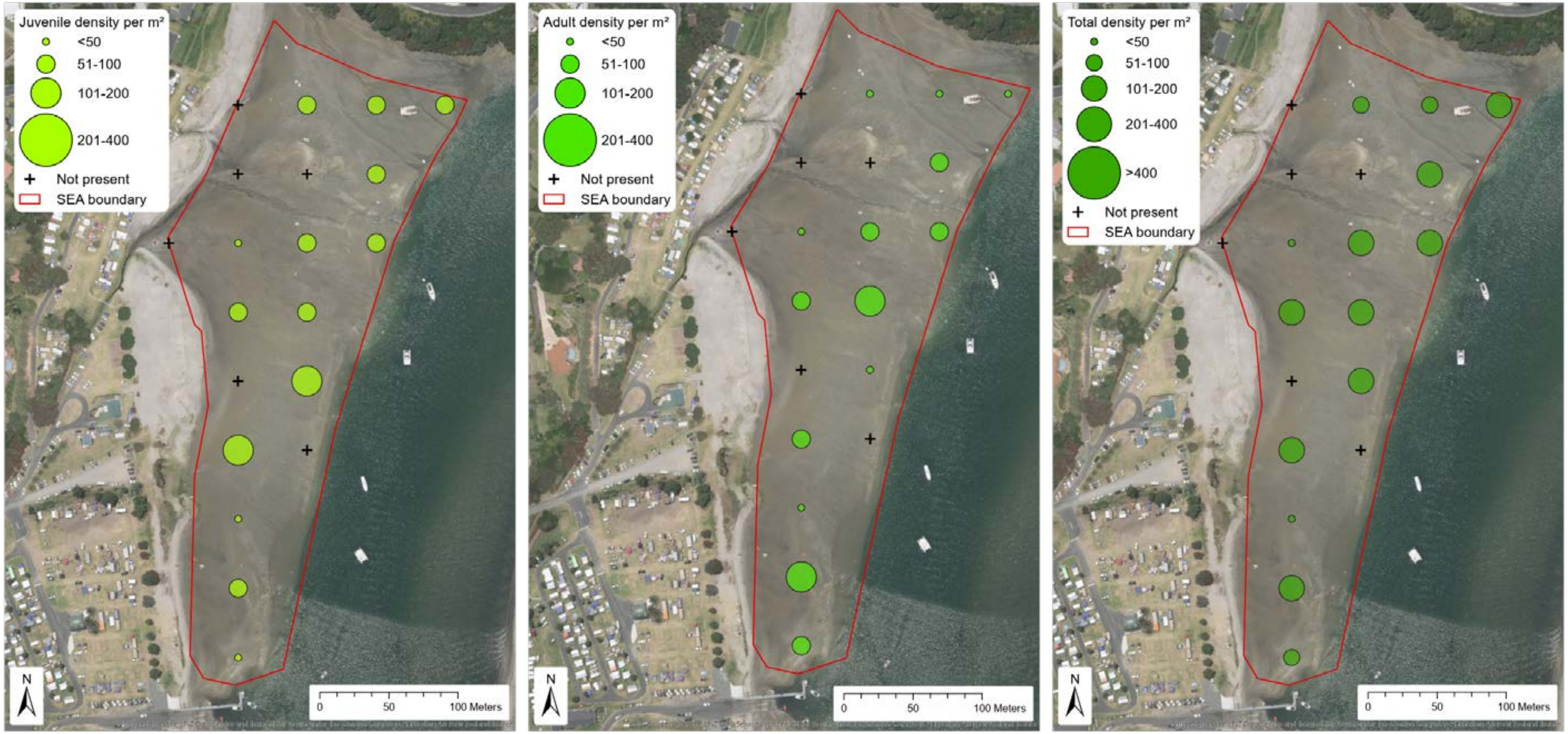

Figure 12. Wedge shell densities in the northern SEA.

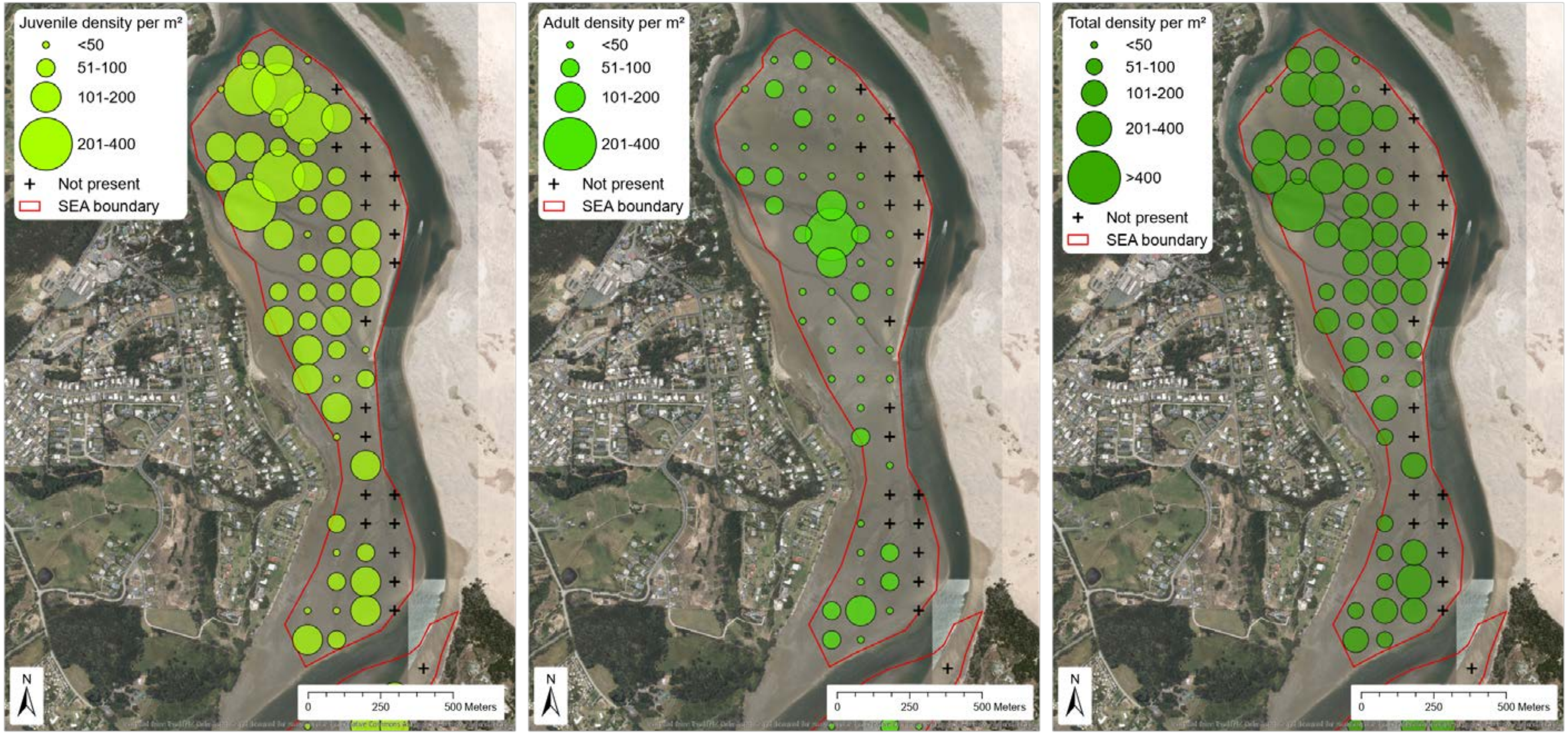

Figure 13. Wedge shell density in the mid SEA.

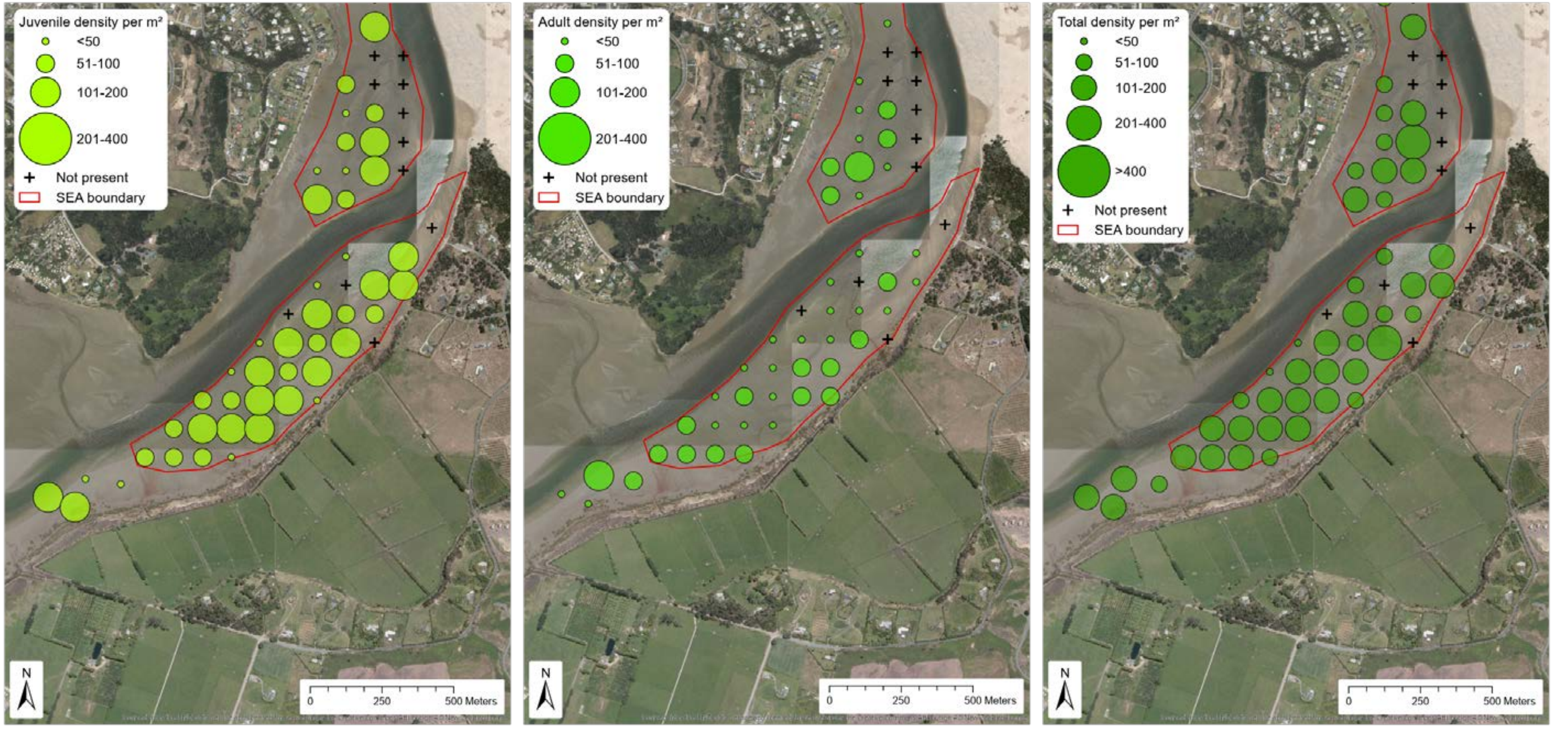

Figure 14. Wedge shell densities in the southern SEA.

Results – pipi

Northern SEA

The 2019 population of pipi in the northern SEA was calculated to be 1.3 million (Table 13).

Table 13. Pipi density and population found in northern SEA.

Sample size	Pipi density (per m^2) (SE)	Stratum Area (m^2)	Total (million)
20	25 (44.8)	52055.25	1.3

Mid SEA

The 2019 population of pipi in the mid SEA was calculated to be 7.9 million (Table 14).

Table 14. Pipi density and population found in the mid SEA.

Sample size	Pipi density (per m^2) (SE)	Stratum Area (m^2)	Total (million)
76	10 (2.5)	807955.3	7.9

Southern SEA

Only three pipi were recorded in the southern SEA. The population of pipi in the northern SEA was estimated to be 32,468 (Table 15).

Table 15. Pipi density and population found in southern SEA**.**

Sample size	Pipi density (per m^2) (SE)	Stratum Area (m^2)	Total
33	0.1 (0.1)	357151.9	32468

Summary

Substrate

Substrate in all three SEAs was comprised of mainly firm sand, with some areas of mobile sand. A recent habitat assessment of Ruakaka Estuary indicated that firm sand and mobile sand were important substrate types for cockles and wedge shells (Griffiths *et al.* 2019).

Epifauna

In total, 17 different taxa were recorded. The diversity of taxa recorded, and the individual species present were indicative of a healthy sand flat. No non-native taxa were recorded.

Birds

In total, ten taxa of birds were recorded. The diversity and numbers of bird taxa recorded was high for an intertidal sand flat (personal observation).

Cockles

The Ministry of Primary Industries has used a density of 25 cockles (>30mm shell length) per square metre, as a guideline to identify areas which may need management control (Pawley, 2012). Separately, Hewitt & Funnel (2005) developed an ecological classification for their survey of benthic habitats in the southern Kaipara Harbour, which was subsequently used by Griffiths (2014) in a survey of the northern Kaipara Harbour. Hewitt and Funnell (2005) classified cockle habitat if adult densities were greater than 226 individuals per square metre.

The mean density of adult cockles (>15mm shell length) in the northern, mid and southern SEA was 785, 563 and 518 individuals per square metre respectively. The current survey therefore indicates that all three SEAs contain extensive cockle beds.

Wedge shell

Needham *et al.* (2013) developed a classification system which classifies wedge shell habitat if densities are equal or greater than four individuals (>30mm shell length) from a 15 x 15cm area (177 individuals per square metre). The same classification criteria were used by Griffiths *et al*. (2019) in a habitat survey of Ruakaka Estuary.

The mean density of adult wedge shell (>30mm shell length) in the northern, mid and southern SEA was 33, 28 and 28 individuals per square metre respectively. The current survey therefore indicates that although wedge shells were found throughout all three SEA, the densities were generally below the number required to be classified as wedge shell habitat.

Pipi

Low densities of pipi were recorded in all three SEAs. Pipi are generally found from the low intertidal to subtidal zone. The current SEA boundary does not extend sufficiently down the tidal range to include subtidal habitat where large densities of pipi may be present.

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Northland Regional Council

P 0800 002 004

E info@nrc.govt.nz

W www.nrc.govt.nz