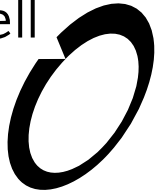


Boffa Miskell



Tuatua Survey 2023

Puwheke Beach Tuatua Population
Prepared for John and Andrea Sturgess



21 December 2023





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Cover photograph: Adult tuatua in swash zone at Puwheke Beach, © Ashley Flood, 2023

1.0 Introduction

1.1 Scope

Boffa Miskell Ltd were engaged by John and Andrea Sturgess to undertake a tuatua population survey within the intertidal zone at Puwheke Beach, Karikari Peninsula. This study builds on a baseline survey undertaken in 2020 (Collaborations, 2020).

1.2 Tuatua Biology

Tuatua (*Paphies subtriangulata*) belong to the family Mesodesmatidae, a group of moderate to large wedge-shaped surf clams that include toheroa (*Paphies ventricosum*), deepwater tuatua (*Paphies donacina*), and pipi (*Paphies australis*). Tuatua is extensively distributed around New Zealand in localised abundant populations, but mainly occurs around the North Island, and at more scattered locations in the northern South Island, Stewart Island, and the Chatham Islands.

Tuatua are ecological markers of fine, clean, fluid sands on ocean beaches with moderate wave exposure. This species has relatively high ecological significance for these beaches. Tuatua are an important prey species for many individuals in the ecosystem, being commonly preyed on by fish, birds and crustaceans (Knox, 2001). The filtration services that tuatua provide make it an important species for the ecosystem through reducing turbidity and facilitation of other species in the benthos (Gosling, 2003; Norkko et al., 2006).

The densest beds are found in the zone from the low intertidal to the shallow subtidal (down to about 4 m depth). The tuatua is a suspension feeder with short siphons. It is usually wedged only a few centimetres into the sand, with the straight siphonal end often characteristically exposed and discoloured by a green or brown algal film. Individuals are often dragged about the surface and redistributed by swash and backwash before actively burrowing back into the sand.

Tuatua have separate sexes (1:1 sex ratio) and reproduce by broadcast spawning, synchronously releasing eggs and sperm into the water column for external fertilisation. In north-eastern New Zealand, two main spawning periods have been documented, one between September and November, the other between February and April. Planktonic larval development takes about two to three weeks, so larvae have the potential to disperse widely if conditions allow. Larval settlement is thought to occur high in the intertidal, but spat and juveniles are highly mobile, moving around with the tidal flow before reburying themselves rapidly.

Tuatua appear to migrate down the beach to occupy the lower intertidal and shallow subtidal as they grow larger. Growth appears to be rapid but variable, with tuatua reaching 40-70 mm shell length in about 3 years. Maximal length is variable among areas, ranging from about 50 to 80 mm, and the maximum age is probably about 5 or more years.

1.3 Puwheke Beach

Puwheke Beach is located on the northern face of Karikari Peninsula, Northland. The beach extends between the headland at Motutara Bay (west) and Mt. Puwheke (east) and is

approximately 3.2 km in length (Figure 1). A small waterway discharges to the Coastal Marine Area (CMA), approximately midway between the headland and Mt. Puwheke and appears to be fed from the surrounding land and Lake Rotokawau. Public access to the beach is obtained via Puwheke Road, which terminates at the eastern end of Puwheke Beach.

Tuatua¹ (*Paphies subtriangulata*) are known to be present on Puwheke Beach which is popular for recreational and customary gathering. There is no minimum size for tuatua gathering; however, preference tends to be for adult sizes (i.e. 50 mm +) which are found in the swash zone to approximately 4 m depth subtidal and up to 150 are able to be collected per day.

Exposed sand beaches, such as Puwheke Beach, are increasingly under pressure from human population growth and recreation. As with many locations worldwide, vehicles are permitted to be driven on most sand beaches throughout New Zealand. Activities, such as vehicle driving can pose a significant threat to specialist fauna living in the sediment. Taylor (2013) found a positive linear relationship between the number of vehicle passes and tuatua mortality, and extrapolative modelling predicted that the long-term presence of users would be highly detrimental to shellfish. Reducing the temporal frequency and spatial extent of vehicle users on sand beaches could decrease shellfish mortality.

2.0 Methods

Methods undertaken are replicated from Collaborations (2020) to allow for direct comparisons (methods are summarised below).

2.1 Sampling

Sampling of tuatua populations was undertaken on the mornings of the 5th and 6th December 2023, during low tide.

A spaced transect method has been implemented along the full length of Puwheke Beach. Seven transects were mapped, approximately 500 m (Figure 1). Spaced transects allows the examination of special trends in shellfish size and distribution.



Figure 1: Locations of the seven sites along the length of Puwheke Beach, starting from Transect 1 at the western end of the beach.

¹ Species referred to as tuatua are of two species, *Paphies donacina* and *Paphies subtriangulata*, species found on Puwheke Beach are *P. subtriangulata*.

Along each transect 0.25 m² quadrat samples (0.5 m x 0.5 m) were spaced at 10 m intervals, starting with the last high tide mark and the final at the swash zone. The length of the transect ranged from 40 to 80 m. For clarity, the 'swash zone' refers to quadrats that were sampled within the water, quadrats above this swash zone are referred as 'intertidal'.

Sediment within the quadrat was removed carefully using a flat spade to a depth of 15 cm. The sediment was sieved through a 5 mm sieve. Shellfish that were caught in the sieve were recorded for numbers and the shell length of individuals. The number of shellfish per quadrat was multiplied by four (4) to give the density of shellfish per m².

In addition to the quadrat sampling, the surface sediment was scraped by running a flat spade over the top 10-20 mm of sediment along the full length of the transect from the high tide to the swash zone to identify where the band of shellfish are located.

Due to the naturally patchy distribution of tuatua, a visual search of the swash zone was also undertaken to get a broader understanding of tuatua presence, outside of the mapped transects. This was done by searching within this zone (10 m each side of the transect) for the hydroids of the tuatua. Collection within an area stopped when more than 25 individuals were recorded and was noted as 'abundant'.

All work was undertaken in accordance with Boffa Miskell Ltd Special Permit (SP761-2) issued by the Director General of the Ministry for Primary Industries (MPI) pursuant to Section 97(1) of the Fisheries Act 1996.

2.1.1 Data and Statistical Analysis

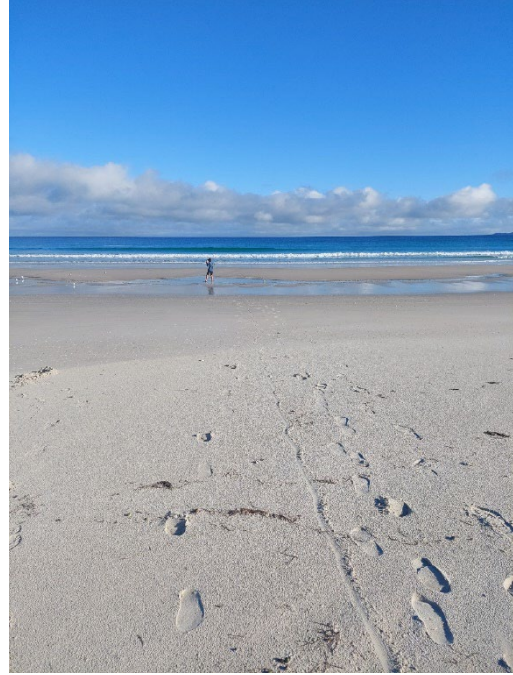
All tuatua were recorded for location, size and number. All data was recorded in Microsoft Excel spreadsheets and plotted where data sets allowed.

3.0 Results and Discussion

The western section (Transect 1 – 2) of the beach was characteristic of soft fine sand, with majority of the eastern end of the beach characteristic of courser sands with significant shell hash layers. Sediment composition and topography gradient were similar to that reported by Collaborations (2020).



Transect 1 (50 m): located at the western end of Puwheke beach consisted of fine sand and had a low gradient. Multiple bird were observed foraging (oyster catches, seagulls, blackback gulls).



Transect 2 (70 m): fine sand, moderate to low gradient, with a gutter intersecting site at 30 m above the subtidal swash zone. Multiple bird foraging (oyster catches, seagulls, blackback gulls, dotterels).



Transect 3 (70 m): moderate-coarse sand, low gradient, with a distinct shell hash layer at 20 mm depth.



Transect 4 (80 m): upper intertidal consisted of fine sands, with coarse sand and thick shell hash layer along the mid-to-lower intertidal. This transect is located just south of the unnamed waterway that discharges into the CMA.



Transect 5 (50 m): upper intertidal consisted of thick shell hash band and fine sands, with the mid-to-lower intertidal was coarse sand, with thick shell hash at ~30 mm depth.



Transect 6 (40 m): comprised of fine sands with a shell layer observed at ~30 mm depth. The intertidal zone was of moderate grade. Evidence of vehicle tracks were present.



Transect 7 (60 m): located at the eastern end of the beach and is the closest site to the vehicle entrance from Puwheke Road. The intertidal zone is of low grade and the sediment comprised of fine sands with some shell hash at the surface in the mid-lower intertidal zone.

3.1 Abundance

A total of 56 tuatua were found along Puwheke Beach within the transect quadrat sampling. Transect 2 was the most abundant along Puwheke Beach, with an approximate density of 62 individuals/ m² (Figure 2). No individuals were found along transect 5, using the quadrat sampling method. The majority (73%) of tuatua were found within the swash zone, and individuals found within the intertidal zone were restricted to the northern end of Puwheke Beach (Figure 2).

Searches within the swash zone found an additional 82 tuatua. Transect 2, 6 and 7 were categorised as ‘abundant’, where recording stopped after 25 individuals were found within these areas.

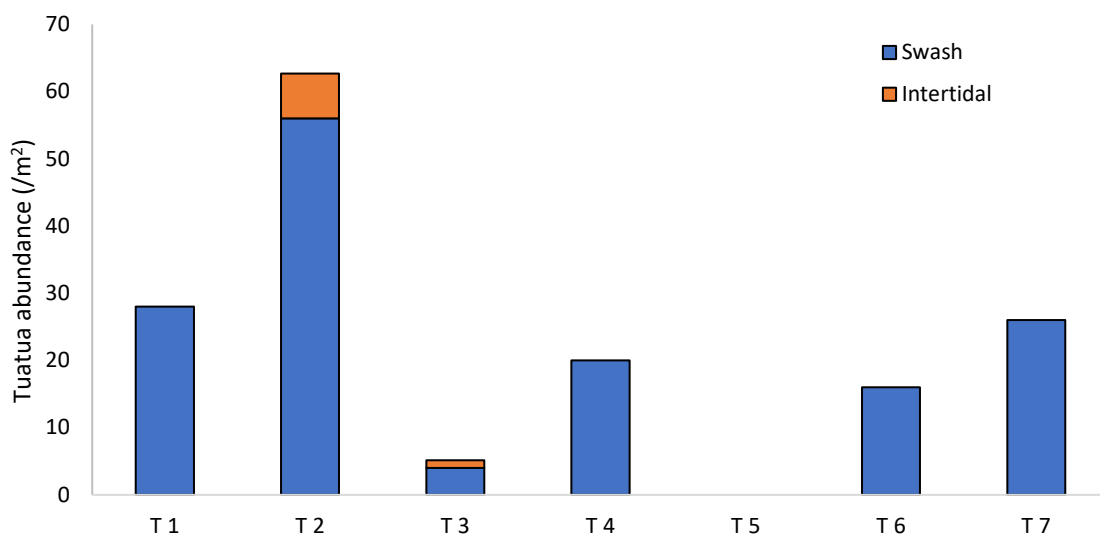


Figure 2: Tuatua abundances (m²) along the seven transects, within the swash or intertidal zones.

3.2 Size Distribution

Tuatua size distribution based on quadrat sampling, ranged from 4 mm to 65 mm, there was no apparent size distribution trends along the length of Puwheke Beach (Figure 2). However, when analysis included individuals found during swash zone searches, tuatua size appeared to increase as you moved east along the beach (Figure 3). The western end was primarily

dominated by juveniles with adult tuatua more abundant at the eastern end of Puwheke Beach (Figure 4).

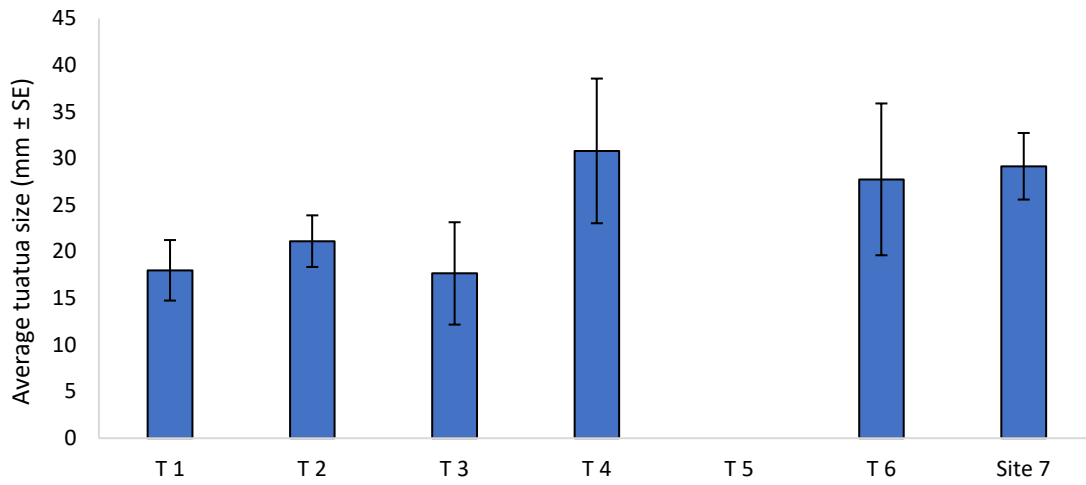


Figure 3: Average (\pm SE) tuatua size (mm) located at each transect.

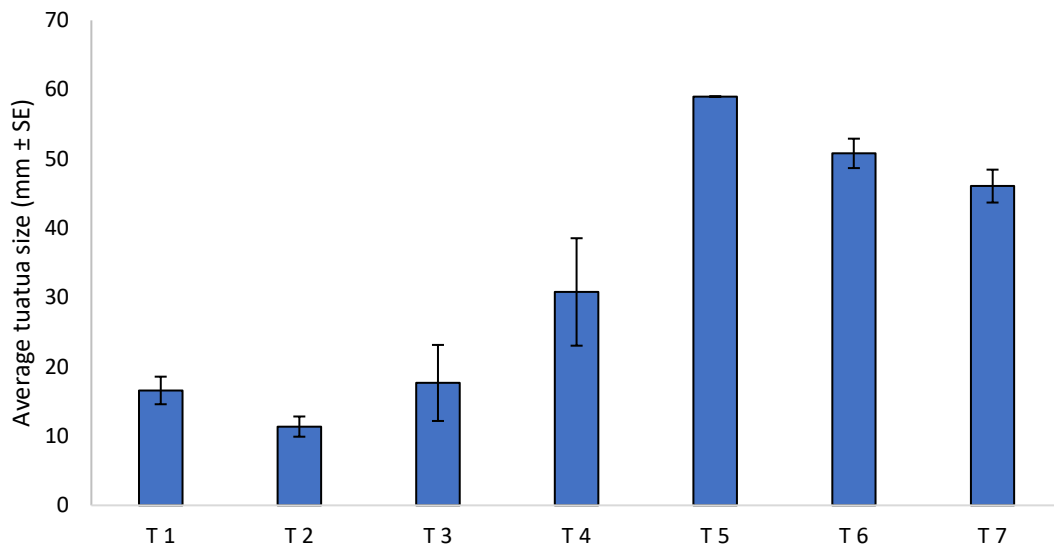


Figure 4: Average (\pm SE) tuatua size (mm) including individuals which were found during swash zone searches.

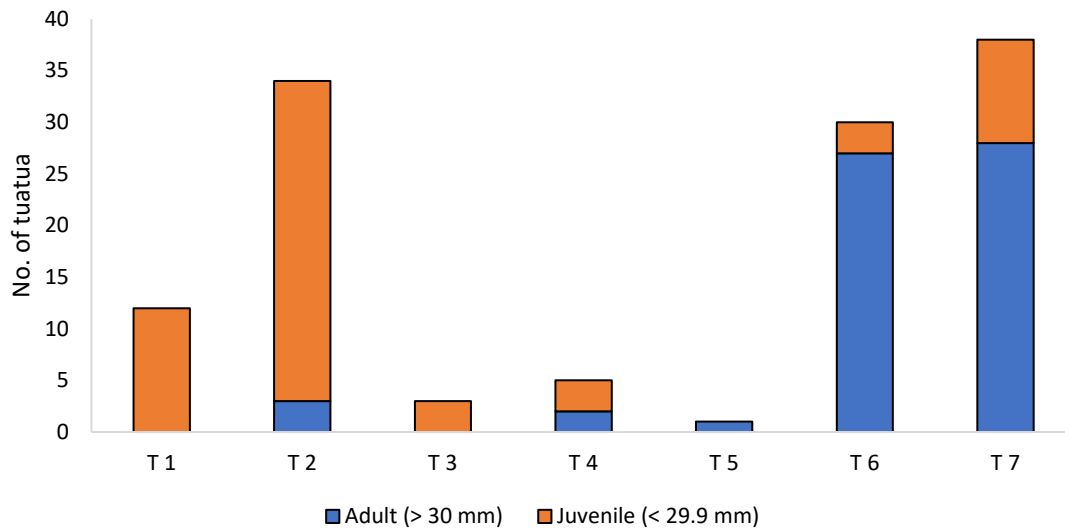


Figure 5: Number of tuatua found at each transects, including swash searches.

3.3 Comparisons with 2020 baseline survey

Tuatua distribution along Puwheke Beach appears to have shifted from that reported in the Collaborations (2020) survey. In 2020 tuatua were most abundant in the middle of the beach along transect 2 – 5. However, 2023 showed low numbers within transects 3 – 5, with abundance peaking at either end of Puwheke Beach (Figure 6). Transect 2 has remained consistent with being the most abundant tuatua location.

Interestingly, Collaborations (2020) found one juvenile (16 mm) tuatua in the intertidal zone at transect 5. Our 2023 assessment showed a notable increase in the presence of juveniles, particularly at the western end of Puwheke Beach, with the presence of juveniles classified as 'abundant' at transect 2 (Figure 7). This marked increase in juveniles, may be an indication of a successful spawning event, favourable environmental conditions and/ or a reduction of

stressors such as vehicles driving long the intertidal shoreline, especially down the western end of the beach.

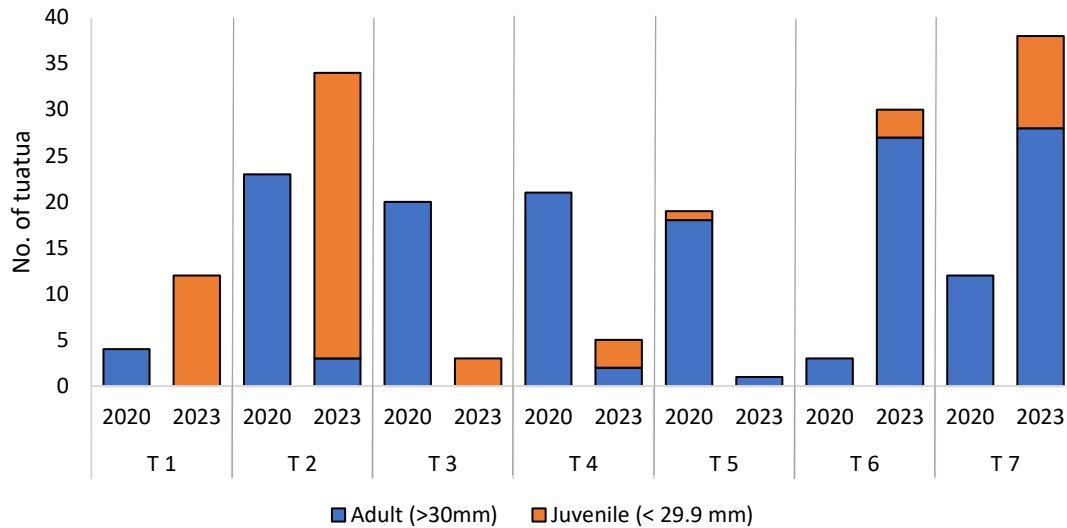


Figure 6: Number of tuatua found along each transect, comparing 2020 and 2023 survey.



Figure 7: Multiple juvenile tuatua found along Transect 2.

4.0 Conclusion

Tuatua abundances and distribution at Puwheke Beach were variable with juveniles predominantly located at the western end and adults found at the eastern end of the beach. The majority of tuatua were located within the swash zone, however, tuatua distribution along the western proportion of the beach extended into the intertidal zone. There was a notable decline in tuatua presence in the middle section of the beach, contrary to 2020 findings.

While adult tuatua are generally located within the subtidal area (swash zone), juvenile tuatua are generally located in the top 5 to 10 cm of sediment about 30 metres below the high tide line. This is also where vehicles are most frequently used, and it is estimated that every pass can cause around 5% mortality (Taylor, 2013). Collaborations (2020) reported high vehicle usage, especially over the COVID-19 lockdown, which may have contributed to their observed low

juveniles and individuals found within the intertidal zone. Tuatua distribution patterns observed in 2023, may also reflect vehicle usage patterns. Vehicles enter at the eastern end of Puwheke Beach and were observed predominantly using the middle portion of the beach. This may explain why no tuatua were found within the intertidal zone, and distribution was restricted to the swash zones. During our site visits no vehicles were observed driving all the way to the western end of Puwheke Beach which may have allowed juvenile tuatua to successfully take residence, especially within these essential intertidal habitats.

To help understand the population dynamics of tuatua at Puwheke Beach and the possible relationship with vehicle usage, it is recommended incorporating the frequency of vehicles, type of vehicles and tracks predominantly used along the beach by vehicles into future surveys. Assessing this usage compared with tuatua distribution may give a more informative conclusion of the effects of tuatua at Puwheke beach.

5.0 References

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