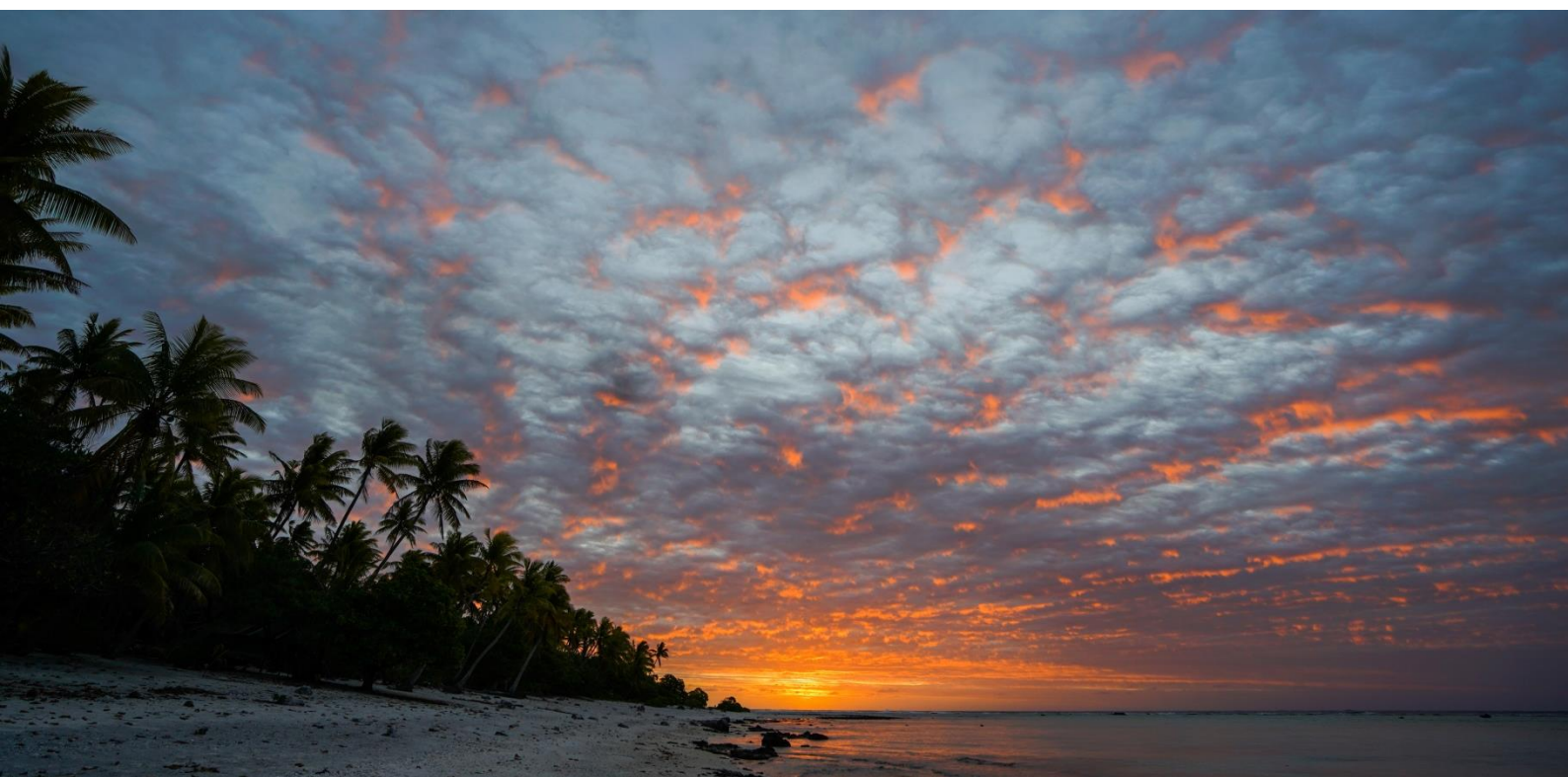


# PALMERSTON

## NEARSHORE MARINE ASSESSMENT

2019



Ministry of Marine Resources  
TU'ANGA O TE PAE MOANA  
COOK ISLANDS





# PALMERSTON

## NEARSHORE MARINE

### ASSESSMENT

Prepared for the Palmerston Community and Island Council

*Dr. Lara Ainley and Kirby Morejohn*

Ministry of Marine Resources



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Original Text: English

Design and Layout: Ministry of Marine Resources

Front Cover: Palmerston, Cook Islands Photo: Lara Ainley/MMR  
Back Cover: Primrose Island, Palmerston, Cook Islands Photo: Lara Ainley/MMR

Avarua, Rarotonga, Cook Islands, 2019

# CONTENTS

<b>ACKNOWLEDGEMENTS .....</b>	<b>3</b>
<b>INTRODUCTION.....</b>	<b>4</b>
<b>METHODOLOGY .....</b>	<b>6</b>
<b>RESULTS &amp; OBSERVATIONS .....</b>	<b>8</b>
Finfish.....	8
Parrotfish .....	9
Invertebrates .....	10
<i>Paua</i> ( <i>Tridacna</i> spp.).....	12
Substrate .....	15
Turtles.....	17
<b>MANAGEMENT RECOMMENDATIONS .....</b>	<b>19</b>



MMR Fisheries Officer, Bill Marsters, next to a *punga* at Palmerston Photo: Lara Ainley/MMR

## ACKNOWLEDGEMENTS

MMR would like to extend a gracious thank you to Papa Mayor Taepae Marsters and Executive Officer Arthur Neale for their support and leadership in this project. MMR also would like to thank the Palmerston Island Council, Palmerston Fishing Club, Simon Marsters and Bob Marsters for their navigational expertise. We would like to acknowledge the work and contributions of Director of Inshore Fisheries Koroa Raumea, Project Officer Teariki Rongo and Fisheries Officers Bill Marsters, Sonny Tatuava, Tua Matepi, Gordon Teatai and Taimana Mataora.

This work was made possible with funding provided by the United Nations Development Programme (UNDP) Ridge to Reef Project (R2R) and MMR core funding.

This publication is dedicated to the memory of Gordon Teatai as his last marine survey with our team before he passed away in March 2019.



MMR Fisheries Officers Tua Matepi and Gordon Teatai taking a short break from turtle surveys in Palmerston Photo: Kirby Morejohn/MMR



# INTRODUCTION

Palmerston is approximately 500 km northwest of Rarotonga. This island is classed as a true atoll and has six main islets scattered around a 31 km fringing reef, encircling an impressive 3,900 ha inner lagoon. The lagoon has scattered coral heads, locally called *punga*, that break the surface on low tides. Palmerston has the lowest population of all permanently inhabited Cook Islands and all residents live on the eastern-most islet, Home Island.

The residents of Palmerston play multiple roles in their day to day life, and because of this, Palmerston has a community-oriented approach to the management of its marine resources. Palmerston is known for its abundant populations of parrotfish. Other species of note known to occur in Palmerston include the Small Giant Clam (*Tridacna maxima*), Humphead Wrasse (*Cheilinus undulates*), Loggerhead Turtle (*Caretta caretta*), and Green Turtle (*Chelonia mydas*). On the IUCN Red List<sup>1</sup>, these species are listed as conservation dependent<sup>2</sup>, endangered, critically endangered in the South Pacific, and endangered, respectively.

The people of Palmerston have a long history of subsistence fishing and harvesting of marine resources. However, over the past 30 years or more, Palmerston fishers have engaged in commercial gillnetting of parrotfish which are exported to Rarotonga. Previously collected data and anecdotal evidence suggests a decline in the parrotfish populations that coincide with the development of the commercial parrotfish trade, raising concerns about the sustainability of this fishery.

In 2007 a fisheries management plan was developed by the Ministry of Marine Resources for Palmerston. The objective of this plan was to create a framework towards ecosystem-based management and planning for marine resources, and particularly for the sustainable management of the parrotfish fishery. However, overfishing of parrotfish remains a major threat to Palmerston's ecosystem and economy.

Protecting and conserving the biodiversity of coastal and marine ecosystems in the Cook Islands is critical to the health and well-being of local communities, but also to the resilience of the marine ecosystems and the sustainable future of the marine resources.

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<sup>1</sup> IUCN 2019. The IUCN Red List of Threatened Species. Version 2019-1. <https://www.iucnredlist.org>

<sup>2</sup> The category conservation dependent is defined as "dependent on conservation efforts to prevent it from becoming threatened with extinction"

Effective management of marine resources is essential to minimise the increasing environmental degradation to marine ecosystems through both natural and human-induced impacts. However, any potential management recommendation must balance the needs of the environment and marine resources with the needs of the communities that depend on them. Efforts to monitor and manage marine resources in Palmerston have made limited progress.

This survey aims to identify areas of high abundance and diversity; assess the abundance and distribution of species of interest; and, compare current stocks to historical records for parrotfish and paua. The data gathered, combined with historical data may help inform management decisions on the current and future status of the marine ecosystem and important marine resources in Palmerston.



Pacific Longnose Parrotfish (*Hipposcarus longiceps*) caught in a gillnet on the reef in Palmerston  
Photo: Kirby Morejohn/MMR



## METHODOLOGY

The marine biodiversity assessment in Palmerston occurred from October 22<sup>nd</sup> to November 6<sup>th</sup>, 2018. Surveys were conducted at six locations around the atoll (Figure 1). The number and approximate placement of each site was determined by assessing multivariate Bray Curtis<sup>3</sup> similarities between fish and between invertebrate communities using previously collected data<sup>4</sup>. Where previous data suggested community similarities, a single location was identified for the marine biodiversity assessment. There were no active *ra'ui* in Palmerston at the time of this assessment. Based on prevailing weather and hydrodynamic conditions, the leeward side of Palmerston is to the west and the windward side of the island is to the east.

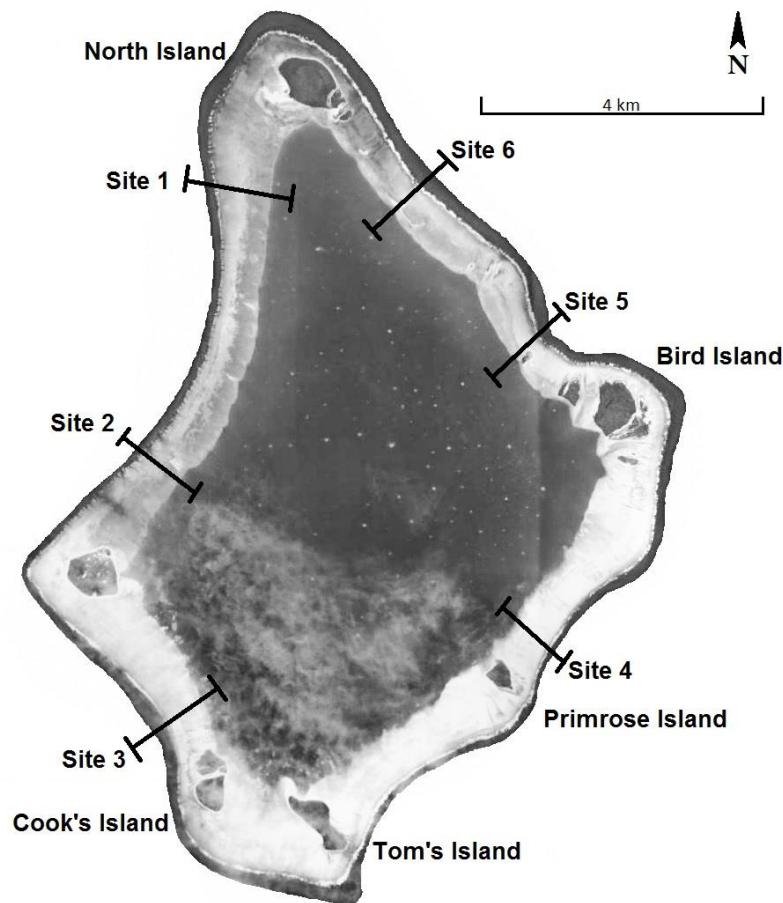


Figure 1. Map of Palmerston, Cook Islands, showing locations of the six survey sites. Map source: Google DigitalGlobe

<sup>3</sup> Bray, J. R. and J. T. Curtis. 1957. An ordination of upland forest communities of southern Wisconsin. Ecological Monographs 27:325-349

<sup>4</sup> Cook Islands Country Report: Profile and results from survey work at Aitutaki, Palmerston, Mangaia and Rarotonga - 2007

Finfish, invertebrate and substrate surveys were conducted within lagoon/*punga*, back reef, reef flat, reef crest and fore reef habitats (where possible). Transect surveys were conducted using SCUBA at 10 m depth in the fore reef habitat. Snorkel and walk sampling were used in the other habitats. Finfish transects surveyed a 50 x 4 m area and invertebrate transects a 40 x 1 m area. Finfish and substrate surveys were replicated once per habitat at each site. Invertebrate surveys were replicated four times per habitat at each site. For finfish, fork length measurements (mm) were visually estimated. For invertebrates, length measurements were recorded (mm) for the first ten individuals of locally harvested species.

Data collection of all species included identification to the lowest possible taxonomic classification, counts, and measurements where applicable. For data analysis, abundance counts were standardised to density (individuals per 100 m<sup>2</sup>) and richness/diversity was represented as the number of species or taxa per area of each transect. Substrate data was represented as percent coverage.

Due to limited habitat availability, finfish and substrate surveys were conducted at only four of the six sites in the back reef habitat. Marine biodiversity for *punga* habitats was assessed qualitatively using photo and video media.

Turtle nest surveys were conducted on all vegetated islets in Palmerston to identify and locate preferential turtle nesting beaches. For each islet, active turtle nests were located by identifying a pair of turtle tracks (up and down the beach slope) leading to a depression in the sand indicating a turtle nest. The location of turtle nests were recorded with handheld GPS.

## RESULTS & OBSERVATIONS

### Finfish

A total of 2,232 individual finfish were observed across ten transects, representing 91 different taxa or species. The most frequently observed finfish species were *Ctenochaetus striatus* (Striped Bristletooth), *Halichoeres ornatissimus* (Ornate Wrasse) and *Thalassoma lutescens* (Surge Wrasse) and each were present in all fore reef transects. *Chromis acares* (Midget Chromis) had the highest density of finfish. The average density of *C. acares* was 134 ind./100 m<sup>2</sup> and was observed exclusively in fore reef habitats. The average total density (all species) of finfish was 167 ind./100 m<sup>2</sup> in the fore reef habitat, and 29 ind./100 m<sup>2</sup> in the back reef habitat. Higher densities of fish were typically observed on the western and northern areas of Palmerston, at sites 1, 2 and 6.

Total finfish diversity was approximately three times greater in the fore reef than in the back reef habitats (average diversity was 33 and 11 species or taxa, respectively). The greatest diversity of finfish was observed in the fore reef habitats of sites 1, 5 and 6 in the north-east of Palmerston.

Finfish densities on *punga* were lower than expected and likely related to the poor coral cover and health. Nevertheless, fish densities were still greater on *punga* (with better habitat availability) and included sensitive species like the humphead wrasse (*Cheilinus undulatus*). Reef sharks were common around lagoon *punga* and at times aggressive.



Abundant goatfish found at Duke's Pool, Palmerston Photo: Lara Ainley/MMR

## Parrotfish

Parrotfish were observed almost exclusively in the fore reef habitat. Overall, the average density of parrotfish observed in the fore reef was 5 ind./100 m<sup>2</sup>. The greatest densities were observed at sites 1, 5 and 6 in the north-east of Palmerston. In the fore reef, parrot fish diversity ranged from one to six different species identified per transect.

Based on previous reports and data<sup>5</sup>, parrotfish catch estimates have declined since the 1970s (Figure 2). However, data collection on the parrotfish fishery in Palmerston has been poor. Since 2018 MMR has introduced a more streamlined method for artisanal fishery data collection which will improve the estimation of catch records. In 2018, a total of 11 t of parrotfish were caught and recorded by Fisheries Officers in Palmerston.

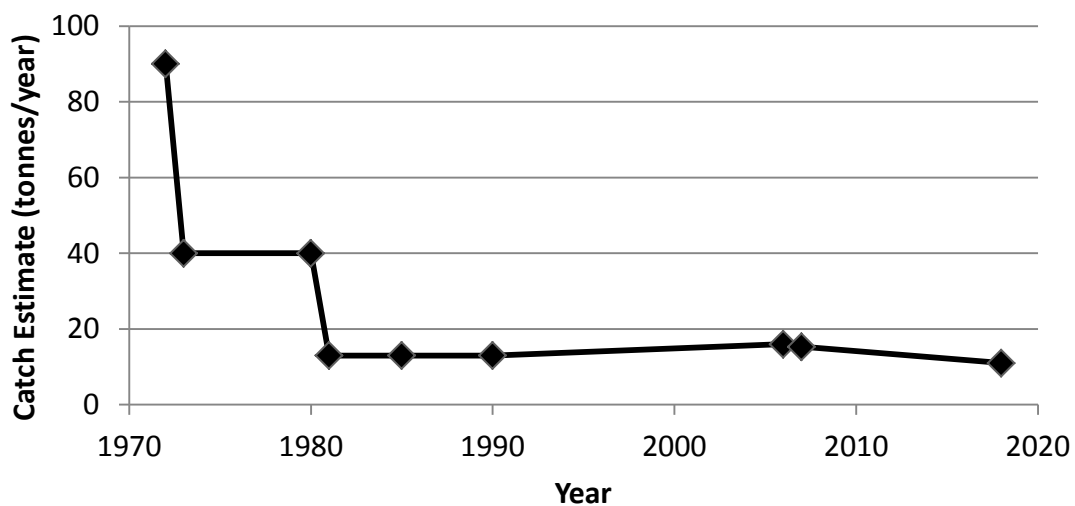


Figure 2. Estimated catch (tonnes/year) for parrotfish in Palmerston. Information taken from past reports and management plans. Information for 2018 taken from the TAILS App and Artisanal fisheries database, managed by MMR and SPC.

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<sup>5</sup> Cook Islands Country Report: Profile and results from survey work at Aitutaki, Palmerston, Mangaia and Rarotonga - 2007

## Invertebrates

Across all habitats, a total of 4,466 individuals were observed over 78 invertebrate transects, representing 33 different invertebrate taxa. The most densely observed invertebrate was *Dendropoma* spp., occurring in 65% of transects. Other commonly observed invertebrate species include the bivalve *Chama* spp., the sea urchin *Echinometra mathaei* and the sea cucumber *Holothuria atra*.

The greatest total densities of invertebrates were observed on the north-western reefs of Palmerston at sites 1, 2 and 6 (Figure 3). These sites are located on the leeward side of the atoll where there may be greater protection from prevailing weather and better habitat available for larval settlement. Within each site, greater abundances appear to be within the back reef habitat and decrease towards the reef crest (Figure 3). Differences between average total densities of invertebrates were significant between sites ( $p < 0.001$ ), and between habitats ( $p < 0.001$ ).

Spatial patterns of species diversity match closely with total invertebrate density, where the greatest numbers of species/taxa were observed within the back reef habitats at the western sites 1, 2 and 3 ( $p = 0.035$ ). Similarly, higher diversity was observed at locations on the leeward side of the atoll where there may be greater protection from prevailing weather and better habitat available for a greater variety of species to settle.

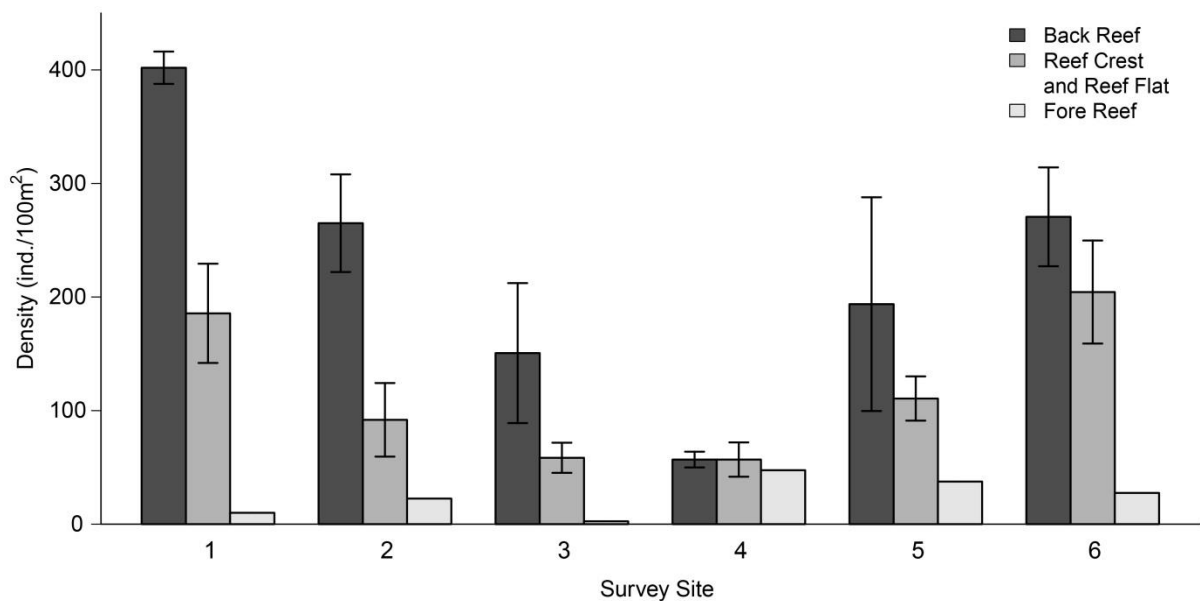
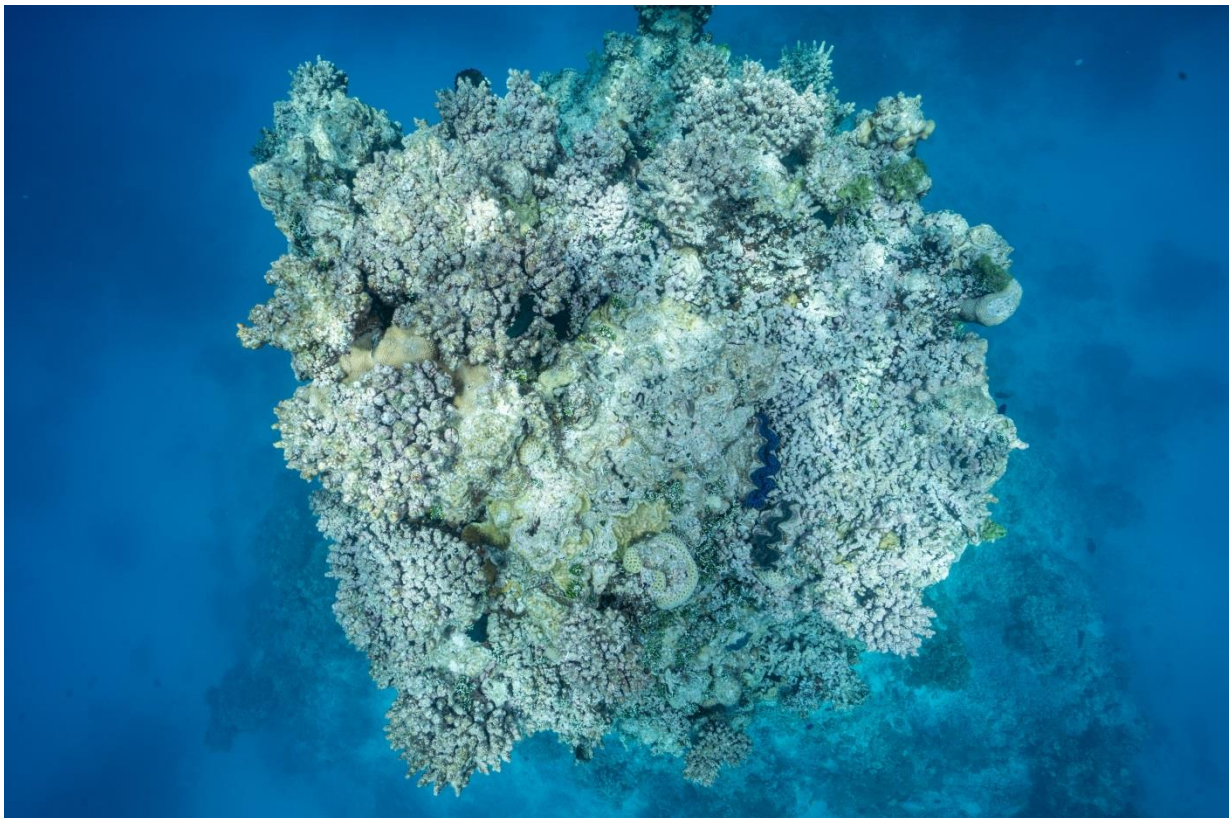


Figure 3. Total density (mean  $\pm$  1.S.E.) of invertebrates in the back reef, reef crest and reef flat, and fore reef habitats at six locations around Palmerston Atoll, Cook Islands.

The Greenfish sea cucumber (*Stichopus chloronotus*) was a commonly observed species with an average density across all transects of 7 individuals per 100 m<sup>2</sup>. The greatest individual densities were recorded in the reef crest and reef flat habitat at sites 3 and 4 in the south of Palmerston Atoll, but overall the greenfish was most frequently observed within the back reef habitats. Greenfish were not observed within fore reef habitats. The high densities of greenfish at sites 3 and 4 contributed to significant differences between sites ( $p = 0.004$ ). Sites 3 and 4 generally had fewer total invertebrates and lower diversity and it may be possible that greenfish are more successful in less favourable habitats with reduced competition for resources.



Top down view of a small *punga* in the central Lagoon of Palmerston highlighting some of the diversity of invertebrates in this marine environment, including *paua* and greenfish Photo: Kirby Morejohn/MMR

Invertebrate species recorded on lagoon *punga* included *Stichopus chloronotus*, *Tridacna maxima*, *Linkia laevigata*, and *Chama* sp. The team did not observe any pearl oyster (*Pinctada margaritifera*) or pipi oysters (*Pinctada maculata*). White phase *L. laevigata* were frequently observed in the fore reef habitat. These strikingly white sea stars have not been observed by MMR scientists in any of the recent Southern Group surveys and should be investigated further.

### ***Paua* (*Tridacna* spp.)**

Across all transects, a total of 42 *paua* (*Tridacna* spp.) were observed, representing less than one percent of all invertebrates recorded. This very low average density of *paua* translates to less than two individuals per 100 m<sup>2</sup>. Most *paua* were observed within the back reef habitat on the western side of Palmerston at sites 1, 2 and 3; this was consistent with the spatial distribution and diversity of all invertebrates (Figure 4). The lengths of observed *paua* ranged from 30-230 mm, with an overall average of 110 mm.

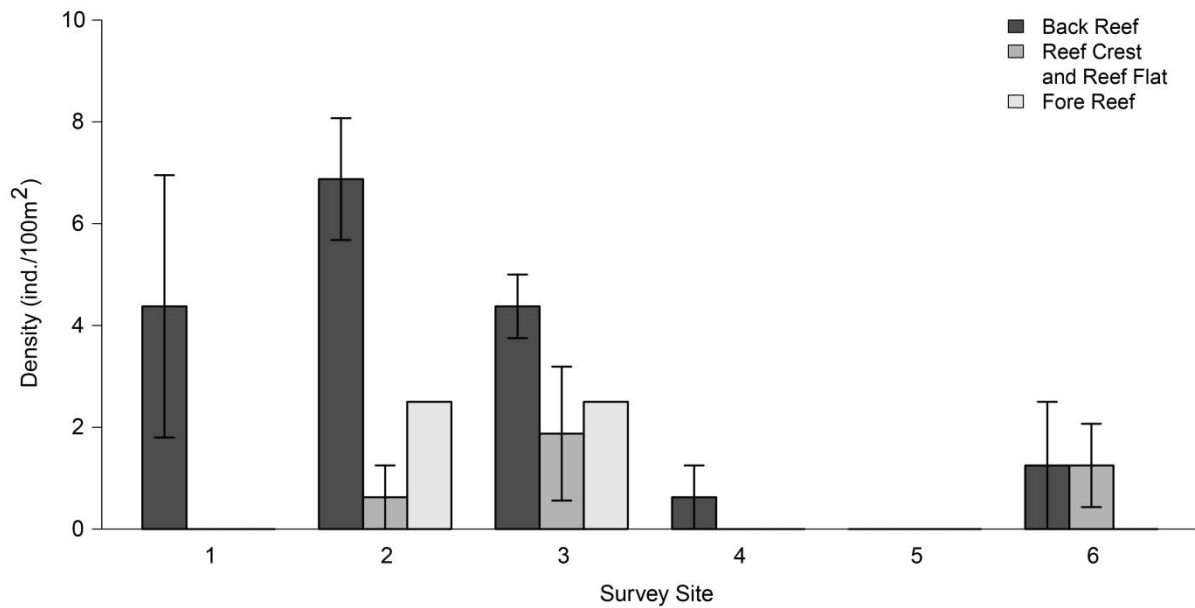


Figure 4. Density (mean  $\pm$  1.S.E.) of Tridacnid clams (*paua*, *Tridacna* spp.) in the back reef, reef crest and reef flat, and fore reef habitats at six locations around Palmerston Atoll, Cook Islands.

There is little historical data available on the density of *paua* in Palmerston. From the information available, the average density of *paua* has declined drastically between 1988 and 2007 and has remained at the current low densities observed during this survey. This is consistent with anecdotal evidence reporting a *paua* population crash in the 1980s (Figure 5). Comparing the *paua* density of Palmerston to other recently surveyed islands in the Southern Group, Palmerston has the lowest relative density than the atolls of Aitutaki and Manuae (Figure 6), and two of the makatea islands Mitiaro and Mangaia. Notably, all inhabited islands across the Southern Group, including Palmerston, have much lower *paua* densities than the uninhabited islands of Manuae and Takutea.



An approximately 25 cm *Tridacna squamosa* specimen in the Palmerston Lagoon Photo: Lara Ainley/MMR



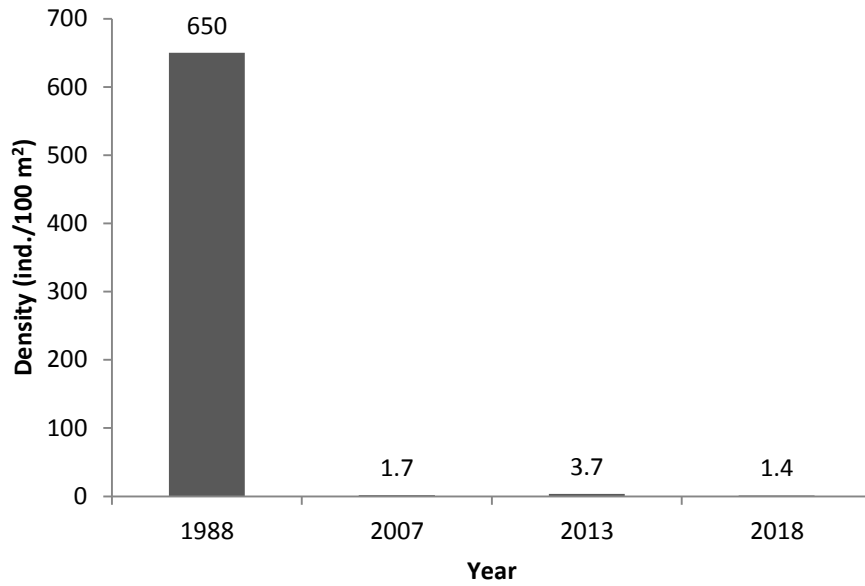


Figure 5. Average density of *paua* (*Tridacna* spp.) in Palmerston from historical reports<sup>6</sup> and previously collected data from MMR. 2018 data reported from this survey. Actual densities reported above columns. Note, uneven time periods between measurements and reports.

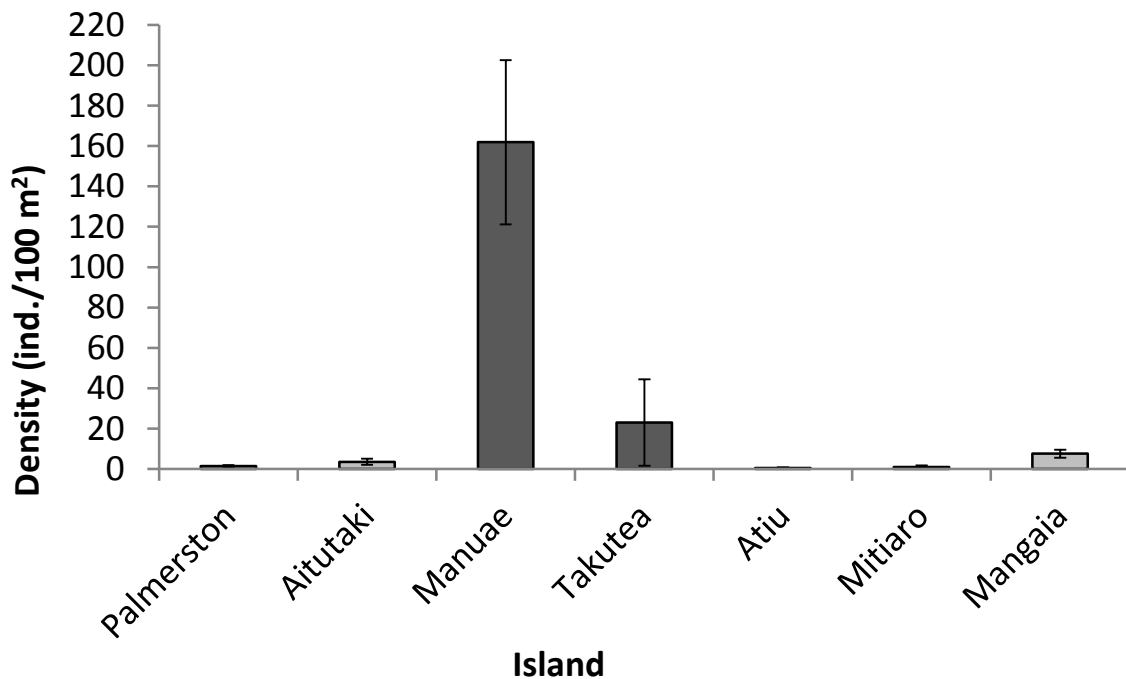


Figure 6. Density (mean  $\pm$  1 S.E.) of Tridacnid clams (*paua*, *Tridacna* spp.) recorded during recent surveys in the Southern Group of the Cook Islands, 2017-2018. Light grey bars represent inhabited islands and dark grey bars represent uninhabited islands.

<sup>6</sup> Preston, 1995. The Marine Resources of Palmerston Island, Cook Islands. SPC Inshore Fisheries Research Project Technical Document No. 10. 65pp

## Substrate

Substrate cover was consistent in the reef flat and reef crest habitats. On average, live coral cover (including hard and soft corals) was very low and the reef crest habitat had high crustose coralline algae cover. These habitats were dominated by rubble and dead coral, particularly on the windward side of the atoll.

In the fore reef habitat, live coral cover was approximately 2.5 times greater in the northern sites 1, 5 and 6. This is consistent with these sites also having greater abundances and diversities of finfish and invertebrates. Average live coral cover across all sites was approximately 23%. This was typical compared to other Southern Group islands. Overall, Palmerston was dominated by other substrate such as sand and rubble with a reasonable component of dead coral and crustose coralline algae, similar to Takutea and Atiu (Figure 7).

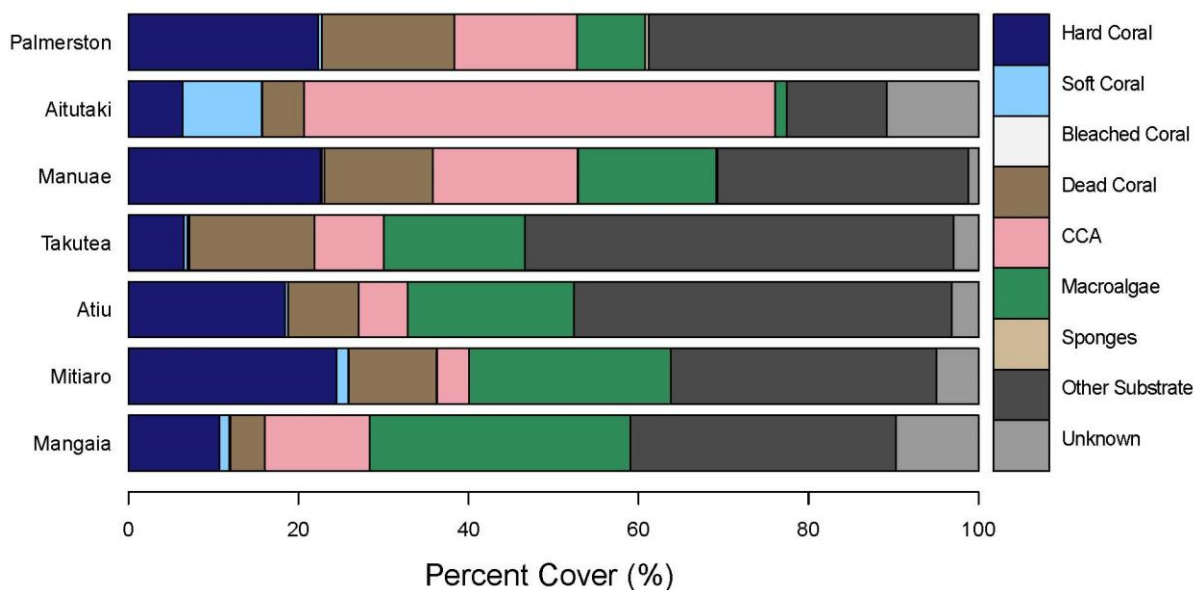


Figure 7. Average percent cover of major substrate categories in Southern Group islands of the Cook Islands.

Substrate cover of lagoon *punga* was primarily composed of dead coral and hard substrate. Representative photos taken in the Palmerston lagoon provide a visual comparison, demonstrating that overall coral cover has declined between 2005 and 2018 (Figure 8). These declines are more likely driven by warm water events and other environmental impacts.

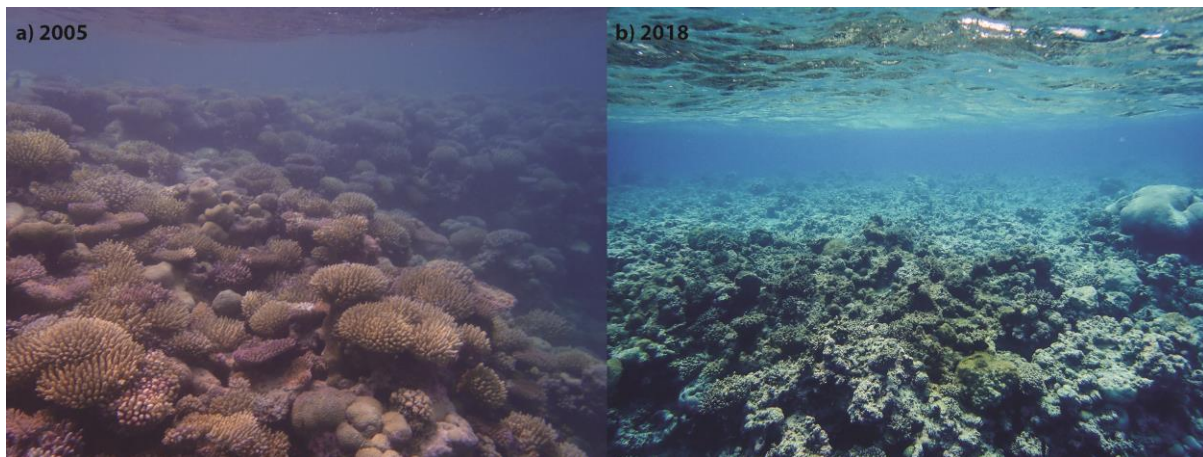


Figure 8. Photographs of Palmerston reef, coral cover in 2005 and 2018. Photo: SPC/MMR (left) and Lara Ainley/MMR (right)

## Turtles

Palmerston was thought to have healthy populations of turtles. According to the Palmerston community, Cook's and Tom's Islets in the south are frequently visited by nesting turtles (Figure 1). Occasionally turtles will nest at Primrose Islet and rarely at Bird and North Islets. Green turtles (*C. mydas*) predominantly nest seasonally on these islets over the summer from November to March.

Active turtle nests were predominantly found at Cook's Islet in the south-east of Palmerston with 20 nests found on the main two Cooks Islets and four found on the small vegetated adjacent islet to the north (Table 1). There were approximately four times more active turtle nests identified on Cooks Islet in the south east area of Palmerston than on any other islet or motu.

Table 1. Number of active turtle nests (identified by a set of tracks up and down the beach leading to a turtle nest) recorded on each of the main vegetated islets in Palmerston, Cook Islands. Records for each islet include counts of turtle nests found on adjacent, smaller motus in the relative vicinity of the main islet.

<b>Island</b>	<b>Turtle Nest Number</b>	<b>Island</b>	<b>Turtle Nest Number</b>
Home	0	Primrose	3
North	0	Tom's	5
Bird	5	Cook's	24



Turtle tracks leading to a turtle nest on Primrose Islet in Palmerston, Cook Islands Photo: Lara Ainley/MMR



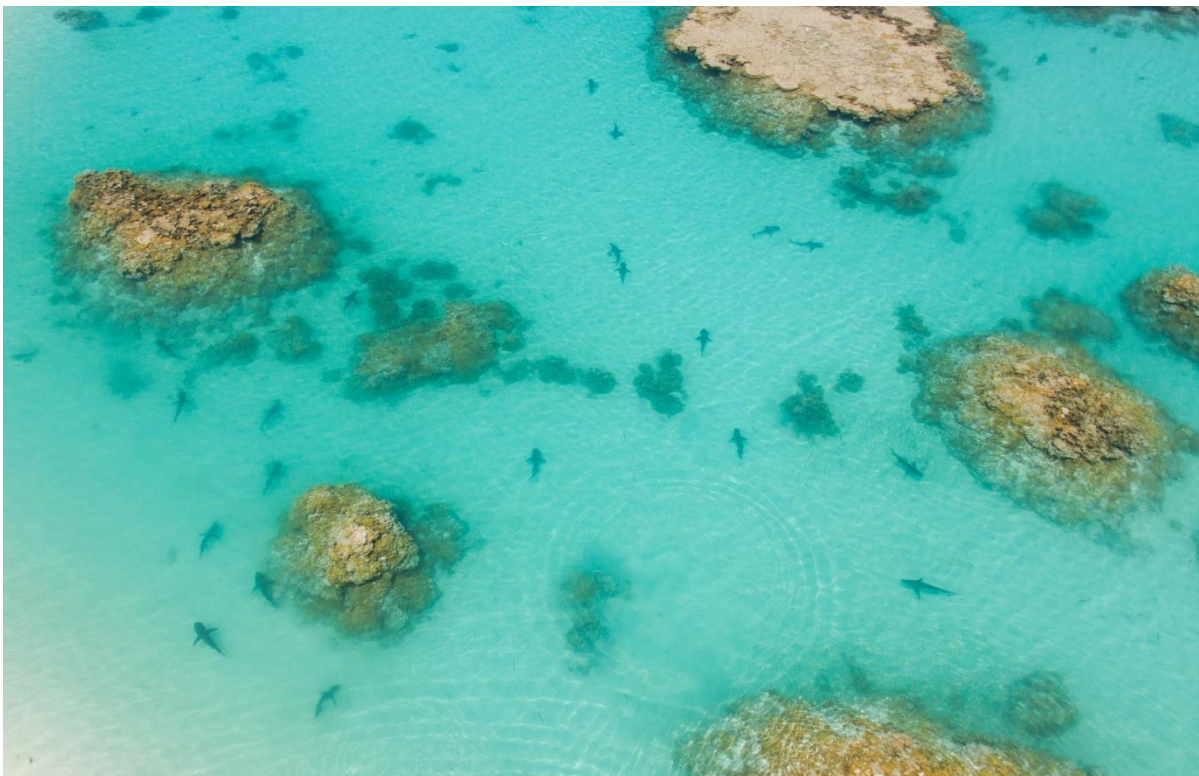
A Green Sea Turtle (*Chelonia mydas*) resting on a *punga* in the central lagoon of Palmerston, Cook Islands Photo: Kirby Morejohn/MMR

## MANAGEMENT RECOMMENDATIONS

Like many places around the world, the dependence on and impact of human development on the natural environment places increasing stress on natural resources. In order to maintain balance, mitigate impacts, conserve species, protect environments and ensure a sustainable future; resource management is often required. Management strategies should seek to optimise the balance between the needs of the resources and environment with the needs of the communities that depend on them. Outlined below are some management recommendations that target increased conservation of marine resources while balancing the needs of the Palmerston community in the long-term.

- Maintain accurate records of parrotfish catches in the artisanal fishery through MMR fisheries officers. This includes reporting and recording total number and average weight and size of each species of parrotfish caught in Palmerston on a regular basis.
- Quantify and regulate trade of parrotfish outside of Palmerston.
- Limit total catch of parrotfish
- If using gill nets, use 5-inch mesh size gill nets to reduce the fishing impact on smaller sized fish that haven't yet reached sexual maturity. In Australia and the United States of America, minimum catch sizes for all species of parrotfish are approximately 25cm.
- Reduce fishing effort on parrotfish by learning and implementing alternate fishing methods that target other pelagic species.
- Restrict all harvest of *paua* for an extended period of time (5-10 years) to re-build sustainable population densities.
- Create specific *paua* harvest areas (after closure) and enforce minimum size and daily bag limits for *paua*.
- Continue monitoring the population density of *paua*.
- Create marine reserves with no take and no fishing restrictions. These restrictions will have spill-over effects to adjacent areas where fishing and harvest is allowed.

- Avoid feeding sharks (through the disposal of fish scraps or otherwise) to minimise potentially aggressive interactions with people.
- Leave nesting female turtles and nests alone and avoid targeting turtles for consumption.
- Consider the intrinsic value of the marine biodiversity – value beyond food resources. Initiate activities to promote and enhance marine biodiversity.



An abundance of Grey Reef Sharks (*Carcharhinus amblyrhynchos*) are frequently observed around Duke's Pool, a popular swimming location in the lagoon at Palmerston. This behaviour may be a result of regular fishing activities and feeding opportunities at this location. Photo: Kirby Morejohn/MMR

