

MANGAIA

NEARSHORE MARINE ASSESSMENT

2018



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





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NEARSHORE MARINE

ASSESSMENT

Prepared for the Mangaia Island Government, Traditional Leaders and Community

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Ministry of Marine Resources



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This book is an abbreviated form of the 2018, Mangaia
Nearshore Invertebrate and Finfish Assessment



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Original Text: English

Design and Layout: Ministry of Marine Resources

Front Cover: Mangaia Cliff, Reef Flat and Reef Crest Photo: Kirby Morejohn/MMR

Rear Cover: Lake Tiriara Photo: Kirby Morejohn/MMR

Header Image: Mangaia Photo: Kirby Morejohn/MMR

Avarua, Rarotonga, Cook Islands, 2018



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ACKNOWLEDGEMENTS

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

Meitaki ngao to Papa Mayor Teremoana Akeke for his support and leadership in this project. The Ministry of Marine Resources would also like to graciously thank Taokia [Sone] Taokia, Vaikaute Paio, Poroa Arokapiti, the Mangaia Fishing Club, Mangaia Island Government, Traditional Leaders and Community.

Additionally we would like to acknowledge our internal staff, Director of Inshore Fisheries Koroa Raumea, R2R Project Manager Teariki Rongo, Mangaia Fisheries Officer Tua Matepi, Communications Officer Helen Greig and Fisheries Officer Chloe-Ane Wragg for their direction and assistance.



Ministry of Marine Resources Staff meet with Mangaia Island Council. Photo: Teariki Rongo





INTRODUCTION

Mangaia is the southernmost island in the Cook Islands group, located approximately 200 km southeast-east of Rarotonga. This island is geologically classified as a raised coral atoll (locally known as *makatea*) due to its uplifted, fossil coral cliffs. With a terrestrial area of 5,000 ha, Mangaia is the second largest island within the Cook Islands group in terms of landmass. A shallow reef flat encircles the island, varying in width from 30 m along the southeast windward point, to 200 m on the leeward, northern face.

Mangaia is divided into six districts, locally known as *puna* (Fig. 1). Each *puna* has its own traditional leadership and management. At the time of our survey, 19 – 28th March 2018, the *puna* of Tavaenga, Keia, Veitatei and Tamarua each had roughly half of their nearshore waters closed to harvest under *ra'ui*. All nearshore water of *puna* Karanga was closed to harvest under *ra'ui* and all water of *puna* Ivirua was open to harvest.

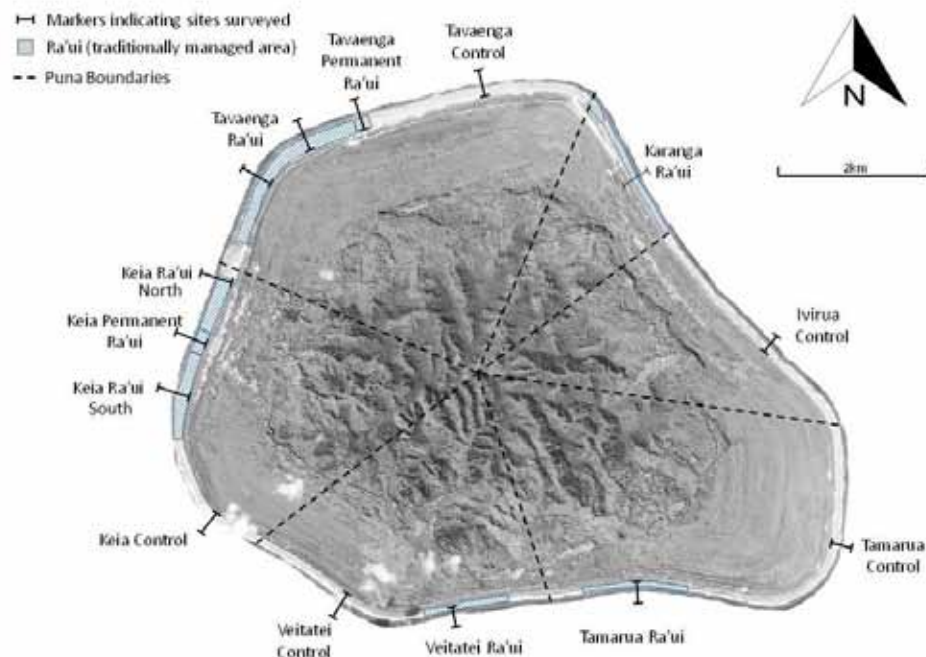


Fig. 1. Mangaia *puna* boundaries, survey sites and traditionally managed areas. Map source: Google DigitalGlobe.

Mangaia *ra'ui* fisheries management system is actively managed and enforced by the Mangaia Island Council and the island's traditional leaders. To allow resource-valuable species to recover, *ra'ui* are formed. When traditional leaders decide stocks have sufficiently recovered, *ra'ui* are lifted and the area is opened to harvest.



Tavaenga Ra'ui was last opened on 22nd December, 2017 and closed on 29th December, 2017. Keia Ra'ui South was opened from 6 am – 6 pm on 24th March, 2018. Keia Ra'ui North was opened from 6 am – 6 pm on 10th March, 2018. The non-permanent Keia *ra'ui* are not generally managed in north and south sections, but when the Mangaia Island Council heard of MMR's survey plans, they postponed opening the southern extent of the *ra'ui* until MMR officers were on island. This allowed us to collect data before and after harvest to quantify harvest impact on reef invertebrate species.

Two permanent closures of the reef flats were recently introduced. Tavaenga's permanent *ra'ui* was implemented in 2017 but was opened in early 2018 to harvest *Tridacna* spp. (*paua*) for sale. The Keia permanent *ra'ui* was implemented in early 2018. Permanent closures are not traditionally used in this region which indicates an adoption of western management ideas into the local, traditional management system.

METHODOLOGY

Surveys in Mangaia took place from the 19th to 28th of March, 2018. Within each *puna*, survey sites were selected to include *ra'ui* and nearby control areas (unregulated areas open to harvest) (Fig. 1). Finfish, invertebrates and substrate data were collected within each survey site. Surveys were conducted with SCUBA in 10 m of water, and snorkel and walk sampling along the reef and within the reef flat.

Data collection of all species included identification to the lowest possible taxonomic classification, counts, and measurements when applicable. 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 or species of interest. Due to the shallow depths of water within the reef, photoquadrats were only gathered on SCUBA beyond the reef. For impacts of the Keia Ra'ui harvest, reef invertebrate surveys were performed before and after *ra'ui* opening.



RESULTS

Invertebrates



A large *paua* (*Tridacna squamosa*) in 10 meters of water inside Tavaenga Ra'ui.

Photo: Kirby Morejohn/MMR

A total of 27,718 individuals were observed across 135 transects, representing 46 different invertebrate taxa. The most frequently observed invertebrate was the *ungakoa* (*Dendropoma* spp.), where a total of 10,860 individuals were recorded across all transects. The *kina* (*Echinometra mathei*), was the second most common invertebrate with a total of 7,075 individuals recorded. The *vana* (*Echinothrix diadema*), was the third most common invertebrate observed overall ($n = 1,200$), but *vana* was the most common invertebrate species ($n = 465$) recorded over the reef.

The total abundance of reef invertebrates ranged from 170 ± 51 ind./100 m² at Veitati Ra'ui to 953 ± 55 ind./100 m² at Tavaenga Control. Of the reef transects, Veitatei Control had the greatest invertebrate richness (9 ± 1 ind./40 m²).



Overall, *paua* densities were greatest in Keia Ra’ui South (30 ± 9 ind./100 m²) where densities were at least two times greater compared to all other sites ($p < 0.001$; Fig. 2). Significant differences among survey sites were detected ($p < 0.001$) where Keia Ra’ui South had significantly greater densities of *paua* than all other sites (Fig. 2). *Paua* length frequencies were normally distributed in the puna of Keia and Tavaenga (Fig. 3). Within the remaining four *puna*, a wide range of sizes were observed but in very low frequencies.

Results from surveys of other southern group islands show *paua* densities in Mangaia to be the highest of the inhabited islands (Fig. 4). While *paua* densities were only greater than Mangaia on the uninhabited islands of Manuae and Takutea, current Mangaia densities are likely lower than historic, unfished populations.

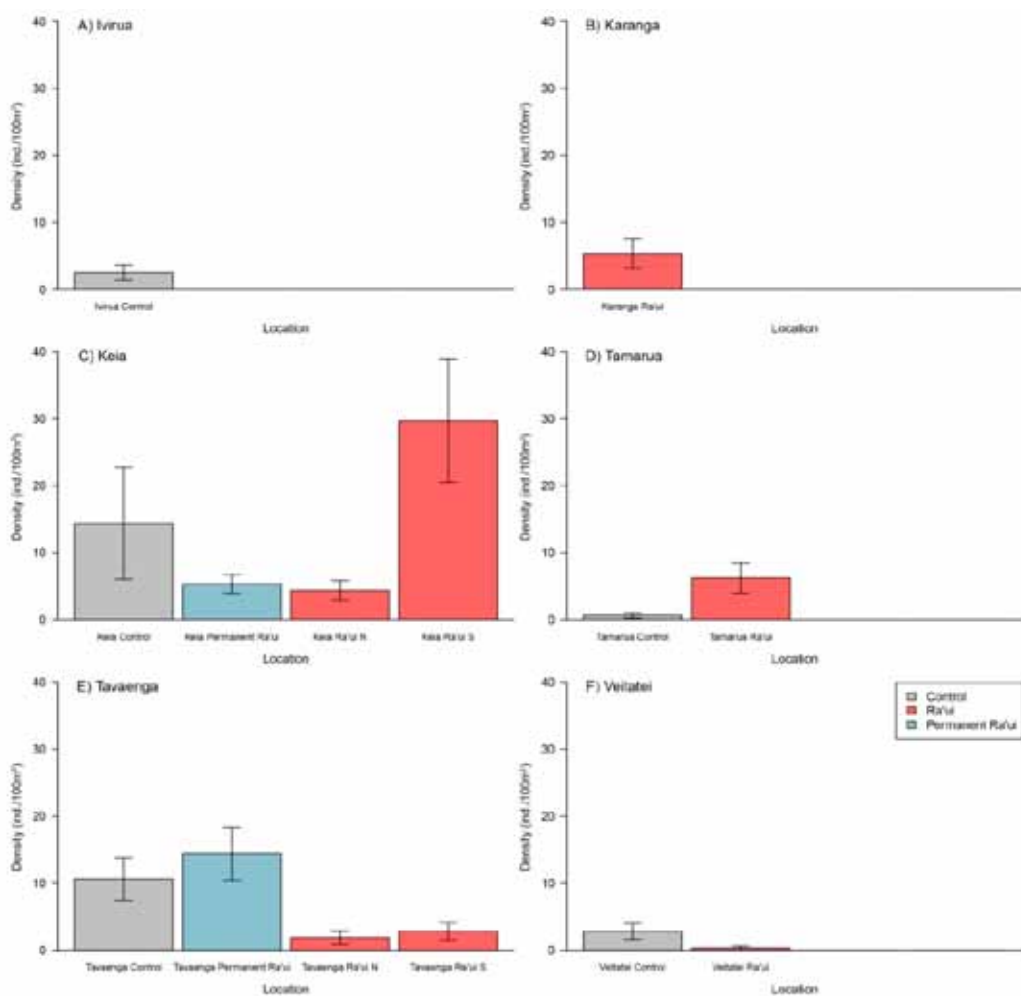


Fig. 2. Mean *Tridacna* spp. densities (± 1 S.E.) from reef habitats.

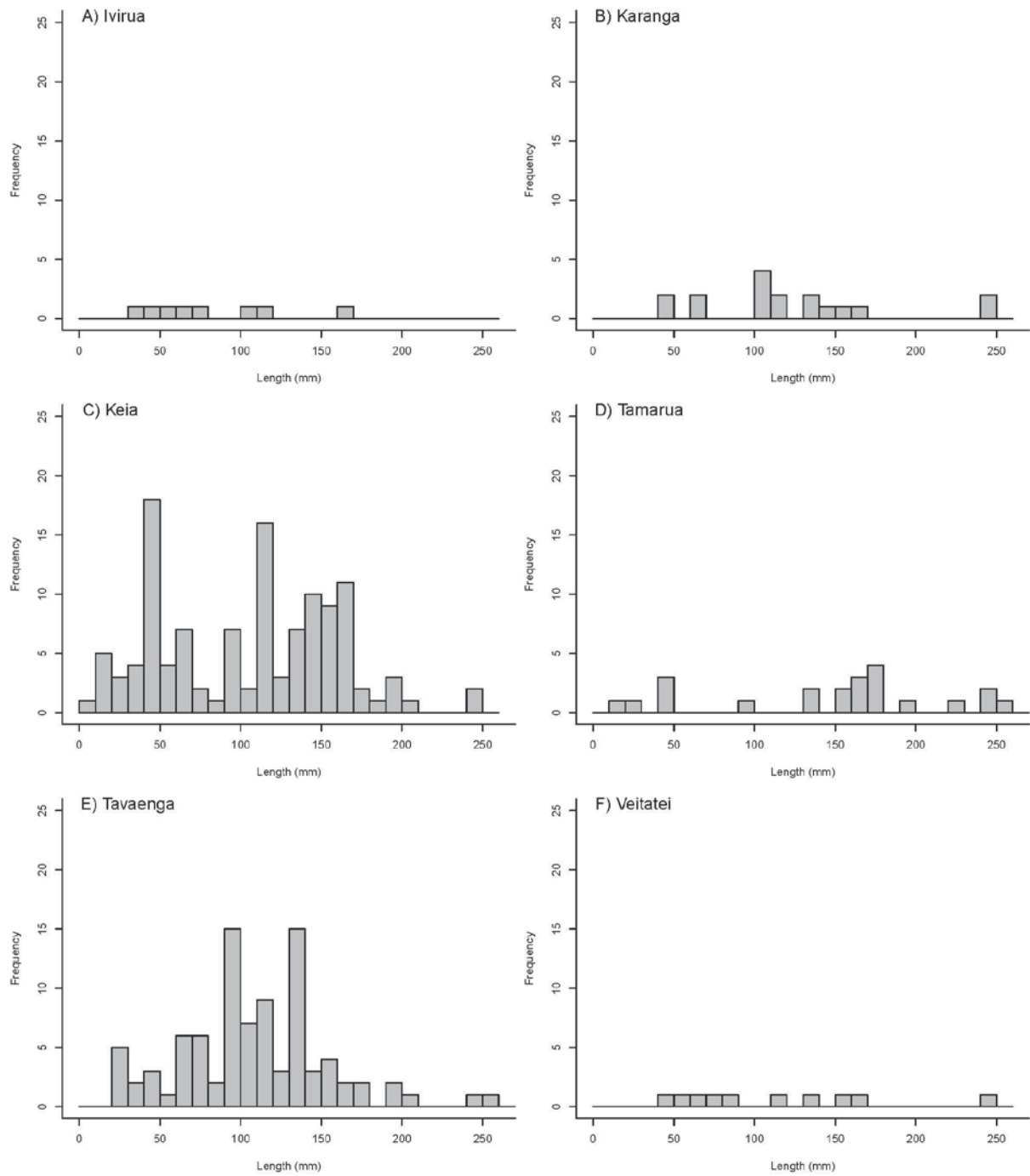


Fig. 3. *Tridacna* spp. length-frequencies within each puna.

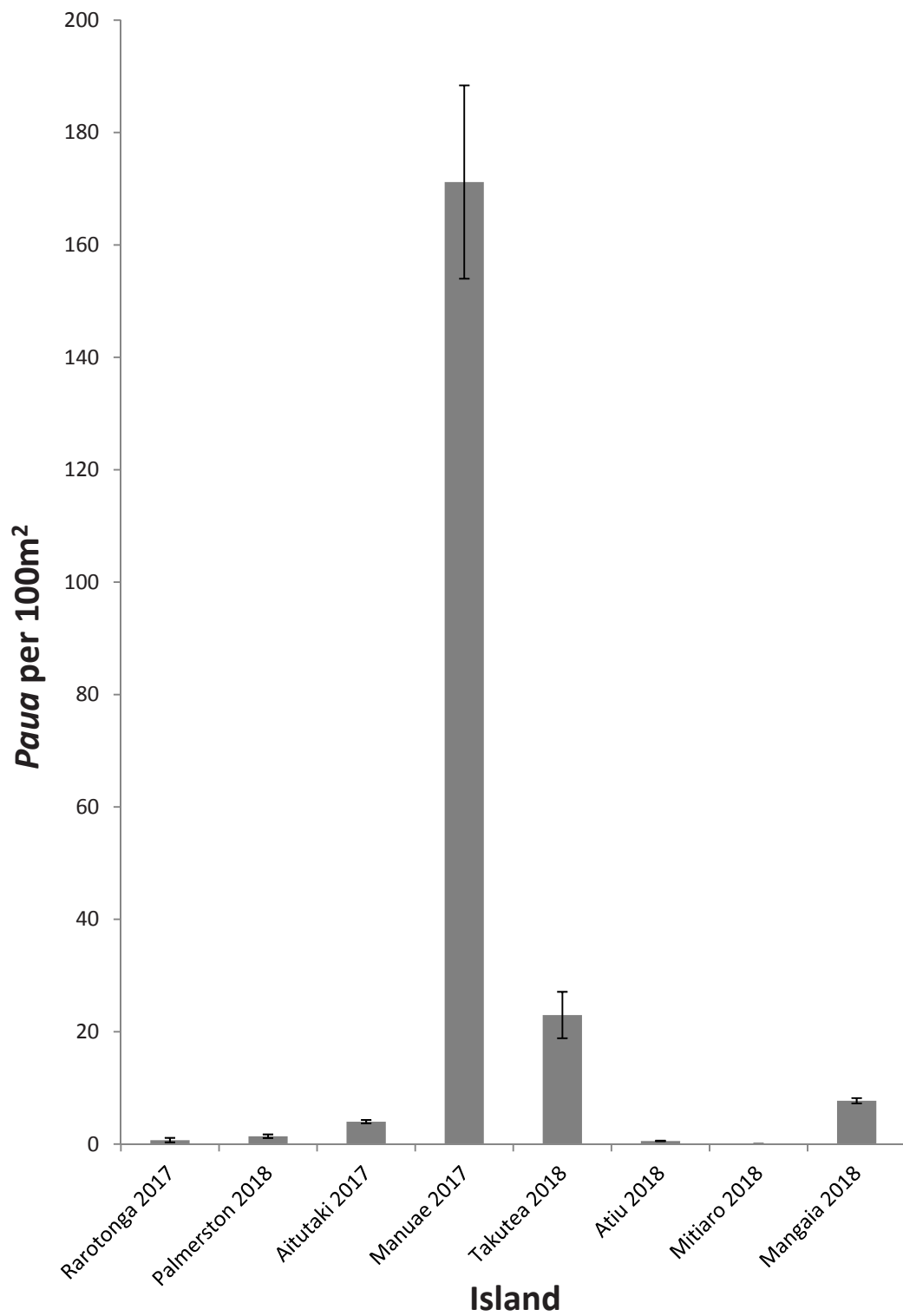


Fig.4. Paua densities from recent surveys of Southern Group islands.



Finfish

A total of 5,369 finfish were observed across 14 transects, representing 95 different taxa. The most frequently observed species was the *maito* (*Ctenochaetus striatus*), where a total of 1,120 individuals were recorded. Other frequently observed fish included *Chromis acares* (n = 758) and *Chromis vanderbilit* (n = 599).

Finfish numbers were highest within the survey site Tavaenga Ra'ui North with a density of 406 ind./100 m². Overall, the *puna* of Keia and Tavaenga had the highest finfish densities (182 and 250 ind./100 m² respectively) and Veitatei, the lowest (96 ind./100 m²).

Fish species diversity ranged from 25 species/50 m² in Keia Control to 39 species/50 m² in Keia Permanent Ra'ui. Overall, species richness between *puna* was similar.

Finfish densities across survey sites for several species of interest are presented in Table 1. *'Iku-toto* (*Acanthurus achilles*) were observed only within the Keia Control (n = 3) and Tamarua Control (n = 5) survey sites. The only *pipi* (*Kyphosus* spp.) observed was a single animal within Veitatei Ra'ui. *Mū* (*Monotaxis grandoculis*) were only observed within Tavaenga Permanent Ra'ui (n = 2), Tavaenga Ra'ui South (n = 1) and Tamarua Control (n = 1). *Ume* (*Naso unicornis*) were only observed within the Karanga Ra'ui (n = 2), Keia Control (n = 2) and Tavaenga Permanent Ra'ui (n = 6). *Maemae* and/or *Morava* (*Siganus* spp.) were only observed within the Ivirua Control (n = 1) and Veitatei Control (n = 1). *Tiovi* (*Acanthurus triostegus*) were observed only within Keia Ra'ui North (n = 80). *Umeume* (*Naso lituratus*) were observed at all sites with the exception of Keia Control. The *puna* of Tavaenga and Keia had the highest overall densities. *Pakati* and *u'u* (Scaridae) were observed in all sites except Tavaenga Ra'ui North and Tavaenga Ra'ui South. *Katoti* (*Centrotype loricula*) were observed at all sites with the exception of Ivirua Control.

Fish taxa of interest which were unobserved on transect included *urua* (*Caranx ignobilis*), *maratea* (*Cheilinus undulatus*), *vete* and *takua* (*Mulloidichthys* spp.) and *mango/papera* (Carcharhinidae).



A popular fish for divers and aquarists, the *katoti* (flame angel - *Centropyge loricula*) was more frequently observed in Mangaia than other Southern Group islands. Photo: Kirby Morejohn/MMR



Whitemouth moray eels (*Gymnothorax meleagris*) were common along the reef drop-off within the *puna* of Keia and Tavaenga. Photo: Kirby Morejohn/MMR

Table 1. Density of special interest finfish species (ind./100 m²)

Maori Name	<i>'Ika-toto</i> <i>Acanthurus</i> <i>achilles</i>	<i>Pipi</i> <i>Kyphosus</i> <i>spp.</i>	<i>Mā</i> <i>Monotaxis</i> <i>grandoculis</i>	<i>Ume</i> <i>Naso</i> <i>unicornis</i>	<i>Maemae &</i> <i>Morava</i> <i>Siganus spp.</i>	<i>Tiovi</i> <i>Acanthurus</i> <i>tristegus</i>	<i>Umeume</i> <i>Naso</i> <i>Lituratus</i>	<i>Pakaiti &</i> <i>U'u</i> <i>Scaridae</i>	<i>Karoti</i> <i>Centropryge</i> <i>loricula</i>	<i>Urna</i> <i>Caranx</i> <i>ignobilis</i>	<i>Maratea</i> <i>Chelinus</i> <i>undulatus</i>	<i>Iete & Takua</i> <i>Mulloidichthys</i> <i>spp.</i>	<i>Mango/Papera</i> <i>Carcharhinidae</i>
<u>Ivirua</u>													
Ivirua Control	X	X	X	X	0.5	X	1.5	2	X	X	X	X	X
<u>Karanga</u>													
Karanga Ra'ui	X	X	X	1	X	X	0.5	2	4.5	X	X	X	X
<u>Keia</u>													
Keia Control	1.5	X	X	1	X	X	X	2	0.5	X	X	X	X
Keia Permanent Ra'ui	X	X	X	X	X	X	7.5	1	17.5	X	X	X	X
Keia Ra'ui North	X	X	X	X	X	40	11	2	9	X	X	X	X
Keia Ra'ui South	X	X	X	X	X	X	9	1.5	11	X	X	X	X
<u>Tamarua</u>													
Tamarua Control	2.5	X	0.5	X	X	X	3	1.5	3	X	X	X	X
Tamarua Ra'ui	X	X	X	X	X	X	1	1	0.5	X	X	X	X
<u>Tavaenga</u>													
Tavaenga Control	X	X	X	X	X	X	7.5	1.5	4	X	X	X	X
Tavaenga Permanent Ra'ui	X	X	1	3	X	X	3	1.5	7.5	X	X	X	X
Tavaenga Ra'ui North	X	X	X	X	X	X	5	X	7.5	X	X	X	X
Tavaenga Ra'ui South	X	X	0.5	X	X	X	6	X	4	X	X	X	X
<u>Veitiatei</u>													
Veitiatei Control	X	X	X	X	0.5	X	3	1.5	0.5	X	X	X	X
Veitiatei Ra'ui	X	0.5	X	X	X	X	3	1.5	1.5	X	X	X	X



Keia Ra'ui South *Paua* Harvest



Aronga tautai (fishers) harvest reef resources in the early morning rain. Photo: Kirby Morejohn/MMR

With the opening of the Keia Ra'ui, *paua* density declined from 29.69 ± 9.18 ind./100 m² before harvest to 12.50 ± 4.20 ind./100 m² after harvest, but this decline was not significant ($p = 0.111$, Fig. 4). Differences in the distribution of *paua* sizes were detected with average *paua* length decreasing significantly from 141.45 ± 5.35 mm before harvest to 69.7 ± 7.89 mm after harvest ($p < 0.001$, Fig. 5).

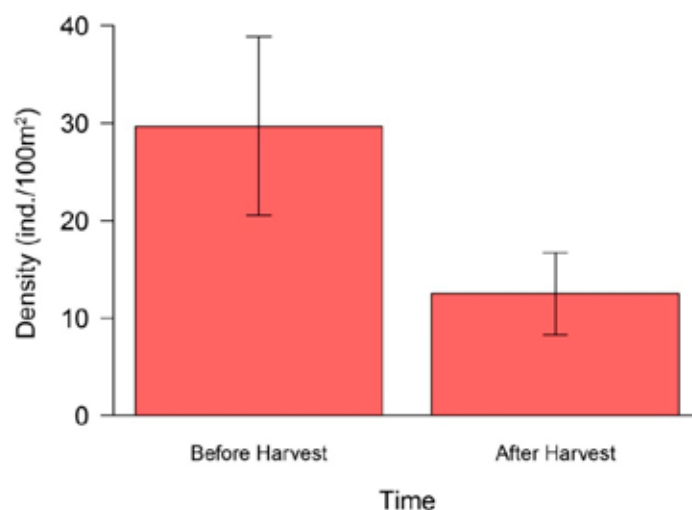


Fig. 4. Keia Ra'ui South, *Tridacna* spp. densities (± 1 S.E.) before and after *ra'ui* harvest on March 24th 2018.

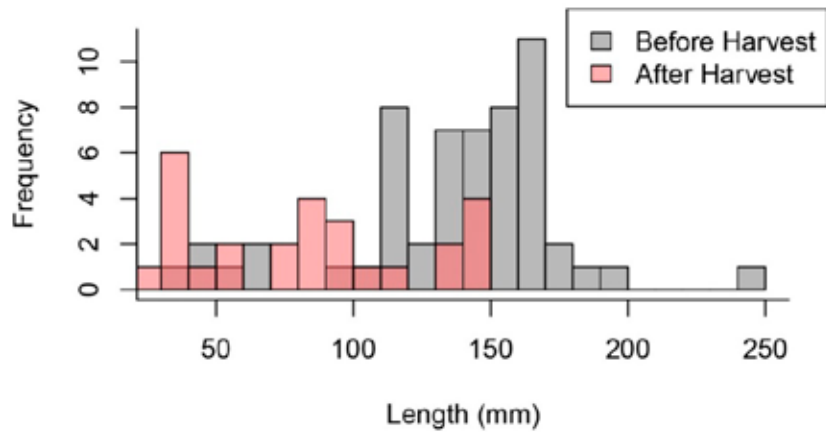


Fig. 5. Keia Ra’ui South, *Tridacna* spp. length-frequencies before and after *ra’ui* harvest.

Coral and Substrate

Photoquadrats gathered outside the reef were primarily composed of hard substrate (bare pavement), followed by macroalgae and crustose coralline algae (Fig. 6). Across all sites, live coral cover averaged less than 20%. Live coral cover was greatest at Tamarua Control. Hard corals were more frequently observed than soft corals. Bleached corals were rarely observed. Macroalgae, such as the calcified green alga *Halimeda* spp., had a relatively large presence, averaging 31% coverage across all survey sites (Fig. 6).

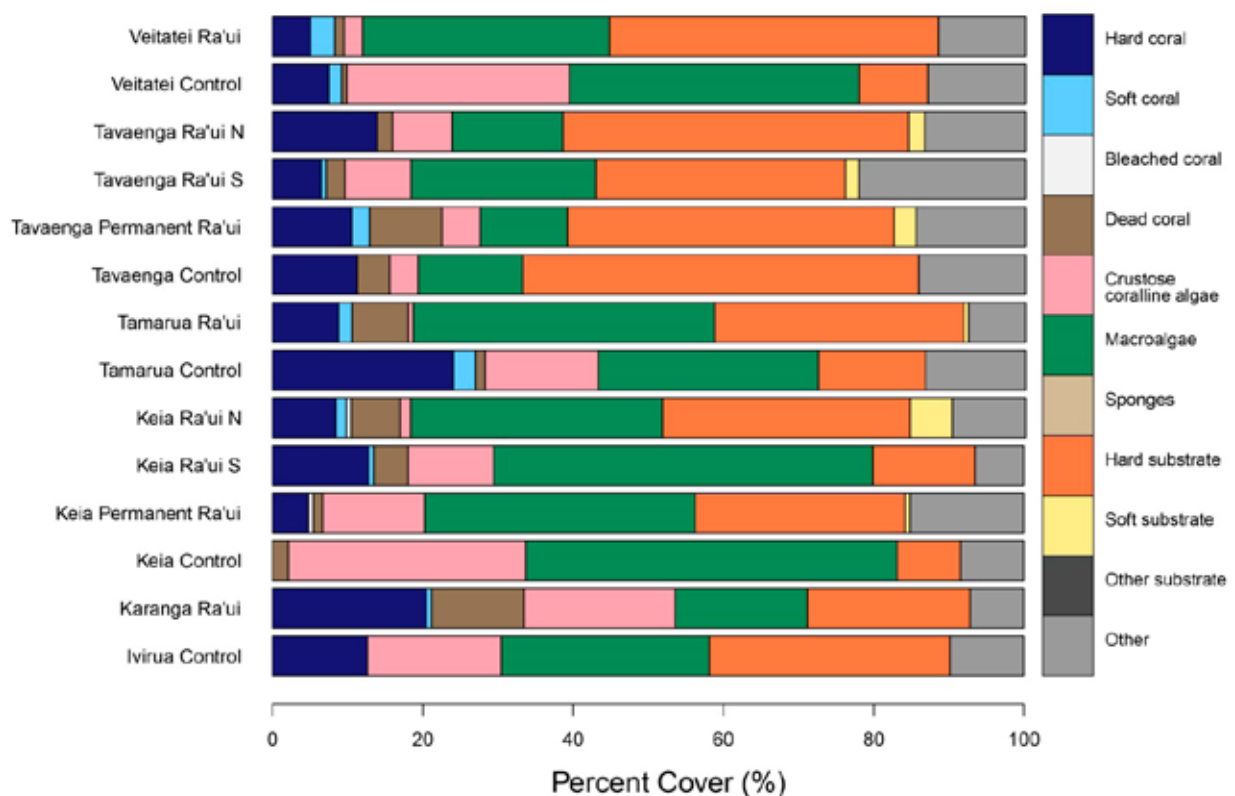


Fig. 6. Substrate type and percent cover from over reef sites.

RECOMMENDATIONS

Mangaia is the only inhabited island in the Southern Cooks where our data show the *ra'ui* system of traditional marine resources management is actively functioning and allowing species to recover between harvests. This is an accomplishment that should give the local resource managers (Mangaia Island Council and Traditional Leaders) great pride. Furthermore, the willingness to adopt new management strategies (e.g. by initiating permanent *ra'ui* sites) shows a continued drive to enhance ecosystem health for the benefit of nearshore species and local communities.

Outlined below are suggested recommendations that should have little immediate impact in the quantity of species harvested, but should have considerable long term positive benefits for subsistence fishers, and for ecosystem biodiversity, health and resilience in Mangaia. These recommendations may be accepted or modified to suit the need of fishers, communities and managers.

Overall:

- Ban on sale of nearshore species
 - Profiting from sale of natural resources encourages harvests greater than what can be used for immediate subsistence purposes and can lead to overharvest
- Never open permanent *ra'ui*
- Increase sizes of permanent *ra'ui*

Paua:

Of the targeted reef species in the Indo-Pacific, *paua* may be the most easily overharvested. Careful management of this species is imperative for its survival.

- Impose conservative minimum size limit (e.g. 150 mm)
- Impose conservative daily bag limit (e.g. 30 *paua* / person / day)
- Never harvest *paua* from over the reef or from permanent *ra'ui*

Maratea:

As a predator of *taramea* (crown-of-thorns starfish), the *maratea* is an important reef species. *Maratea* are slow to grow and long-lived which make them easily overfished.

- Ban on *maratea* fishing

Photo Opposite: Taokia [Sone] Taokia nets a shoal of *pipi* (*Kyphosis vaigiensis*) during the Keia Ra'ui harvest.
Photo: Kirby Morejohn



