



Ministry of Marine Resources
GOVERNMENT OF THE COOK ISLANDS

Manihiki Pearl Industry: 2014 Lagoon Status Report

August 2014

Author:

Tina Weier

Miscellaneous Report – 02/14

Contributors:

Dorothy Solomona
Tangi Napara
Ravengakore Tuteru
Wireless Pupuke
Uea Rongo

Ref no: **PSTW-02/0814**



PEARL SUPPORT DIVISION
Government of the Cook Islands

PO Box 85, Avarua, Rarotonga, Cook Islands

Tel: +682 28721

Fax: +682 29721

Email: rar@mmr.gov.ck

ABSTRACT

There are two limiting factors which affect the capacity of the Manihiki Lagoon for black pearl farming: 1) the number of *P. margaritifera* stocked should not exceed the natural levels of food production and oxygen availability, and 2) the amount of appropriate space /depth strata available for farming is limited. In order to minimize the risk of future disease outbreaks and support a sustainable black pearl industry, the Manihiki Lagoon Management Plan (LMP) was created by a working group of representatives from local and national government, active farmers and scientific experts. This report is the first comprehensive assessment of compliance with the LMP, and the line mapping completed during this survey, though not perfect, is a good starting place and will make future inspections feasible on a regular basis.

We calculate that there are currently 940,000 farmed shells in Manihiki: 460,000 spat and 480,000 cultured adult oysters distributed throughout 126 permitted farming areas. The largest farms are well distributed throughout the lagoon, with only 2 large farms in very close proximity to each-other. Of the 126 areas inspected, 13 were found to be empty, 65 failed to be in compliance with the LMP, and 48 passed inspection and were in compliance. The largest issues of non-compliance were sunken lines (66 areas have multiple sunken lines) and line spacing (63 areas lines were separated by less than 10 metres).

The total space available for pearl farming in the Manihiki lagoon, where depths are between 10-30 metres, is 2529 hectares. Of that area, the currently permitted pearl farms cover 1272 hectares, or 50% of the available space. An additional 610 hectares (25%) of space are "ghost farms": areas which were previously permitted in 1997 or 2011, but which were not renewed in the most recent permitting cycle.

The findings from this survey suggest that the Manihiki pearl industry is at the lowest recorded production level since 1991, but that it is well-poised for growth with the majority of active farmers working to follow the guidelines outlined in the LMP and sufficient spat to maintain current seeding rates. However, in order to support industry growth and ensure production of high quality pearls, it is critical that ghost and inactive farming areas are cleared so that they do not hinder the expansion of active farms and health of oysters in the lagoon. It will be impossible for active farmers to follow the LMP and maintain good oyster spacing if high quality farming areas are not available for their expansion and continue to be obstructed by unused and abandoned lines.

RECOMMENDATIONS

- 1) Every attempt should be made to make as much space available for active farmers as possible so that the industry can continue to grow.
- 2) Consider establishing a community spat collection area in the central portion of the lagoon, or setting aside central areas to be permitted specifically for spat collection. This will ensure consistent and healthy oysters are available for seeding.
- 3) Remove and recycle abandoned equipment in 'ghost farm' areas which are no longer permitted.
- 4) The MMR should continue annual inspections of all permitted farming areas to ensure compliance with the LMP and maximum utilization of the lagoon resources.
- 5) Expansions should only be granted to farmers whose currently permitted areas are in compliance with the LMP and are being actively utilized.

BACKGROUND

The Cook Islands black pearl industry was established in the 1980's and is one of the few income generating options for individuals living in the remote northern group of the country. For this reason, it is a priority sector for Cook Islands development from both economic and social perspectives. In recent years however, pearl farming numbers and overall export value have steadily declined from an industry peak of \$18 million in 2000 to less than \$400,000 in 2012. A number of factors led to this decline, but the primary cause is poor water quality created by over-crowding in the Manihiki lagoon.

The decline of the black pearl industry began at the end of 2000 with a disease outbreak and mass mortality of *P. margaritifera* throughout the lagoon. An investigation of the event was conducted by NIWA (Client Report: WLG 01/5) and they were unable to pinpoint any singular cause. The final conclusion reached was that due to over-stocking of *P. margaritifera* overall lagoon water quality had declined to levels which the oysters found intensely stressful and rendered them vulnerable to infection by opportunistic bacteria.

In response to the outbreak the Manihiki Lagoon Management Plan was enacted which outlines minimum standards of spacing and husbandry for farms in the Manihiki lagoon. The purpose of the Plan is to minimize the risk of future outbreaks and threats to the industry by ensuring that the lagoons carrying capacity is not exceeded and that oysters are not farmed too intensely in any one area, thus safeguarding the water quality as much as possible.

The purpose of this survey was to perform a comprehensive assessment of the state of the Manihiki pearl industry and compliance with the Manihiki Lagoon Management Plan.

METHODS

Farm Mapping: Using the boundaries previously established, each permitted area was surveyed and all farming equipment mapped. Where possible, a sketch was obtained from the permit holder of the layout of their area. A team member on snorkel swam to the end of each line and that point was marked with GPS. Concurrently a sketch of the farm layout was created to later match with the GPS points. All points were then entered into MapInfo Professional and utilized to create detailed maps of every line within every area in the Manihiki lagoon. See Appendix 3 for a full set of the 126 areas mapped.

Inspections: The Manihiki Lagoon Management Plan was used to create a checklist of key compliance criteria (Appendix 1). Using the previously created maps, each area was located using GPS and every line surveyed on snorkel by either Tina Weier or Tangi Napara. For every area the state of each line (sunken or up), spacing between lines, spacing of chaplets, number of shells per chaplet, spacing of collectors, number of shells per collector, and number of floats on the surface were recorded. Any snapped lines or floats on the surface were marked with a GPS point. This information was then entered into an Excel database for calculations.

Compliance Assessment: Lagoon Management Plan criteria were separated into two categories.

- A) Three criteria were deemed critical to lagoon water quality and oyster health: chaplets being at least 1 metre apart, 20 shells or fewer per chaplet and collector drops at least half a metre apart. If these criteria are not followed then shell densities are too high and will contribute to poor water quality and spread of disease. If any of these criteria were not met, an area was deemed to have failed inspection and not be in compliance.

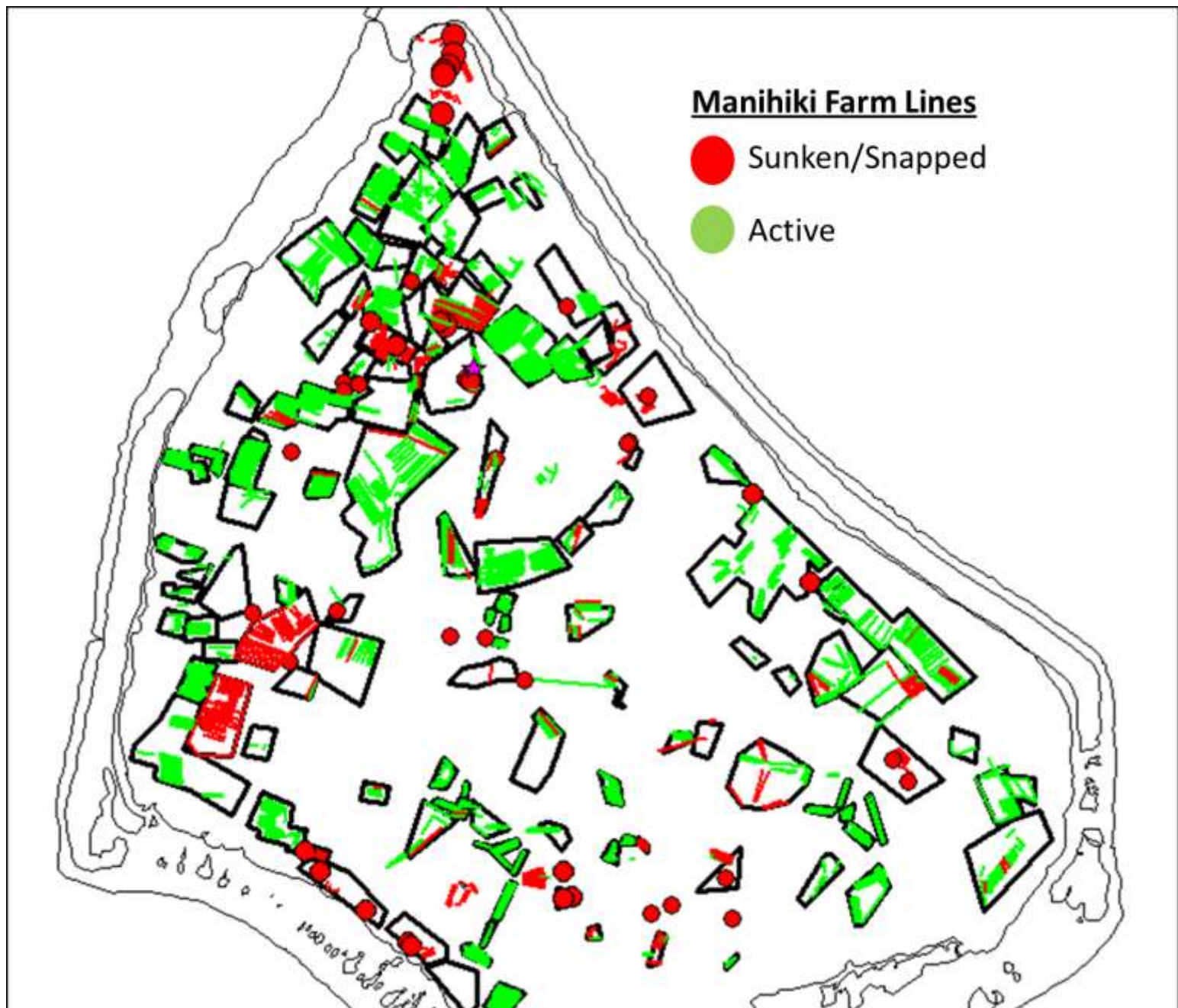
B) Four criteria which are important to the smooth functioning of the Manihiki pearl industry, but may not directly impact lagoon water quality, were deemed secondary: lines being spaced at least 10 metres apart, boat passage being clear, lines being properly buoyed, and there being a single layer of farm lines. If one of these criteria were not met, the farmer was advised that their area needs improvement but were deemed to pass inspection. If two or more of these criteria were not met, an area was deemed to have failed inspection and not be in compliance.

See Appendix 3 for photographic examples of the non-compliant farming practices.

RESULTS

Mapping & Census: One hundred and twenty six permitted areas were mapped and surveyed between November 2013 and July 2014, totalling approximately 79 kilometres of active farm lines and a further 100 kilometres of empty, inactive farm lines (Figure 1). We calculate that there are currently 940,000 farmed shells in Manihiki: 460,000 spat and 480,000 cultured adult oysters.

Figure 1. Map of currently permitted areas in Manihiki and accompanying lines. Green indicates active lines, red indicates sunken or snapped lines.

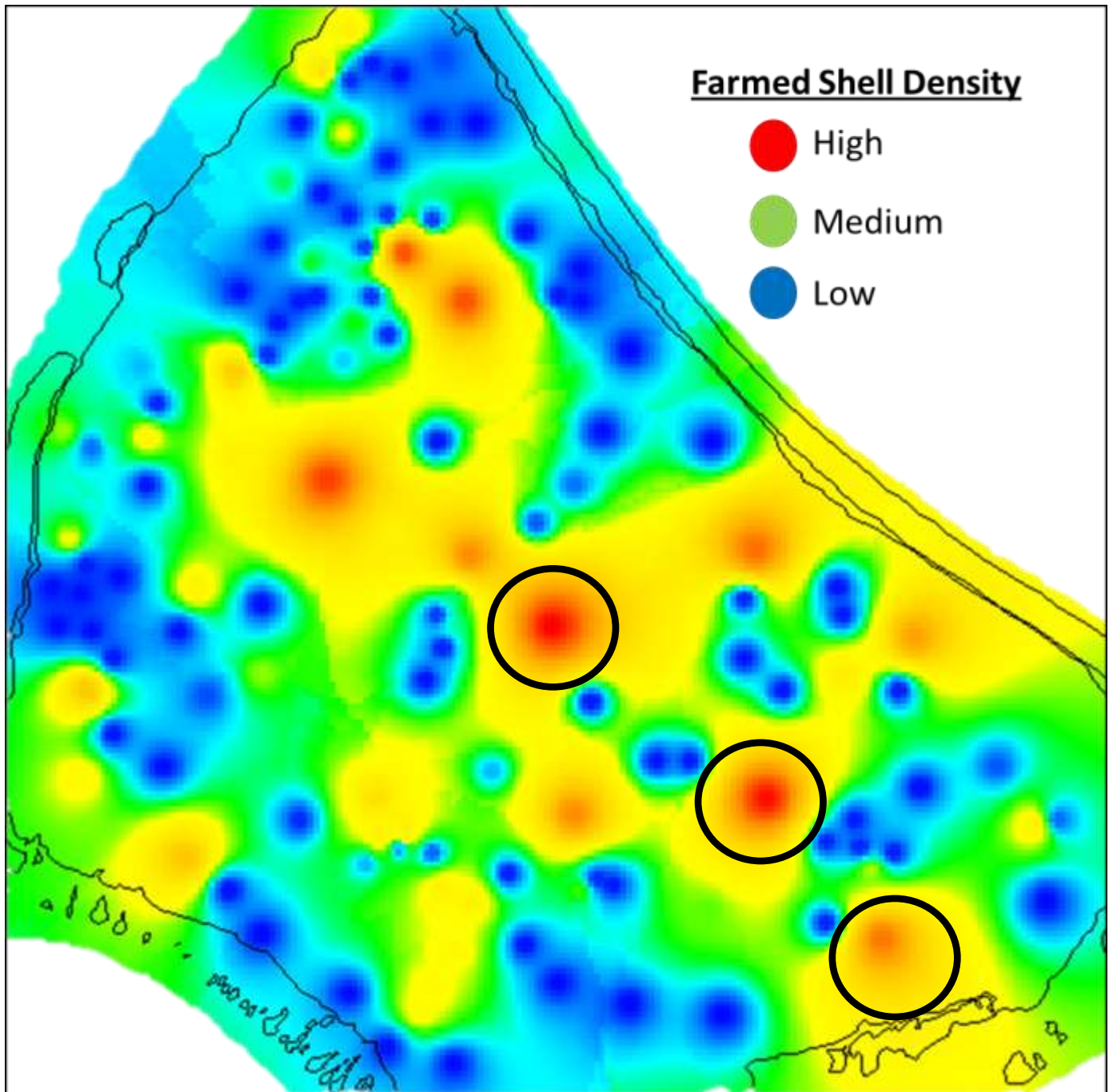


There are 173 spat collector lines which are visible on snorkel, totalling 26 kilometres in length. On average there were 7 oyster shells per collector. The largest number of shells observed on a collector (1 foot in length) was 60, however such large counts like this were only observed in a few areas. Additionally, as the majority of sunken lines are collectors, there are numerous spat lines which could not be included in the counts because they were too deep to assess oyster numbers. There were 3 kilometres of newly deployed spat collection lines from late 2013.

The 480,000 cultured oyster shells on chaplets were divided across 276 lines totalling 53 kilometres in length. Assuming that all oysters on chaplets with 20 shells each are un-seeded, at least 30% (144,000) of the 480,000 cultured shells on chaplets are virgin.

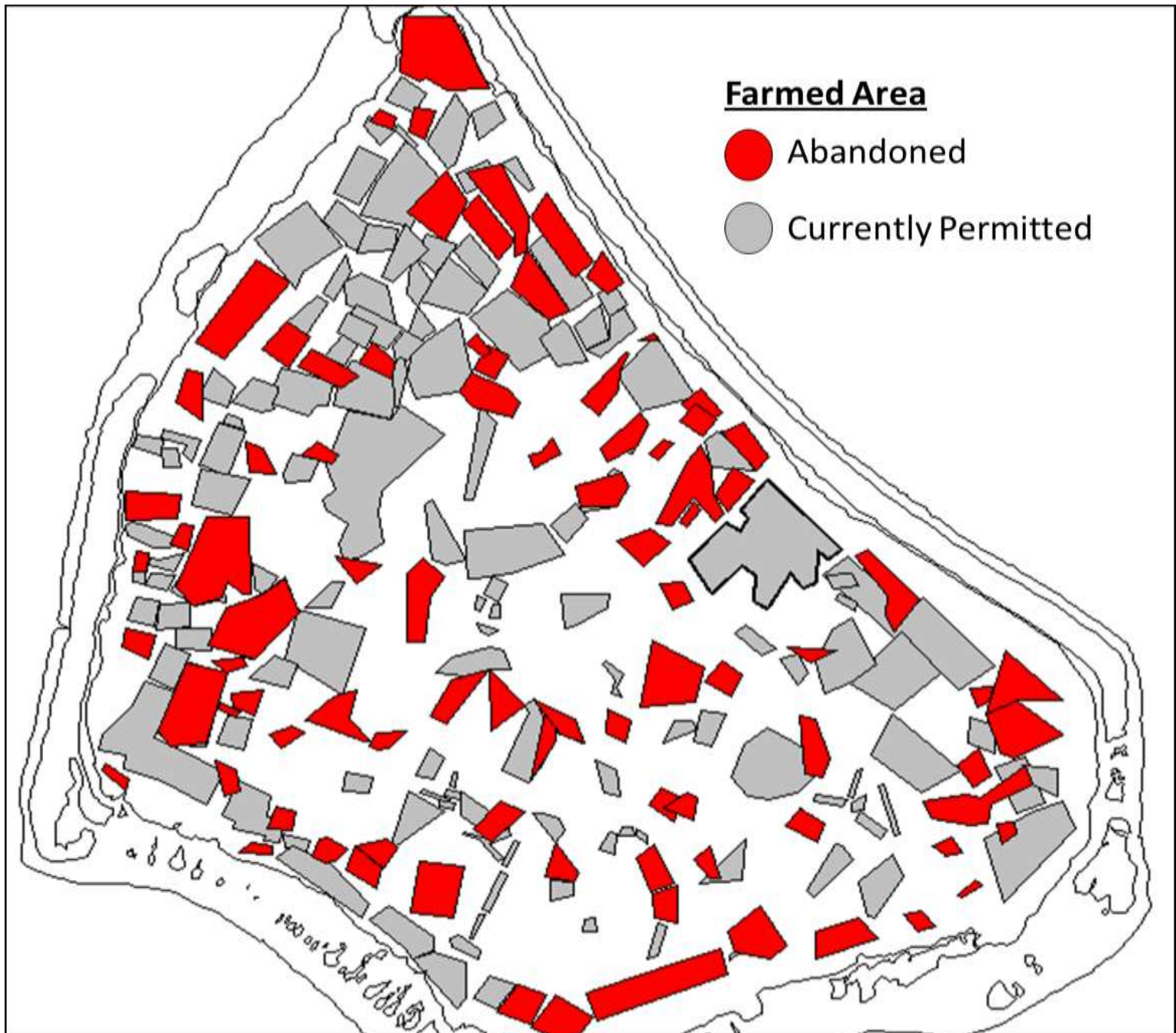
Though a large number of lines are concentrated in the northern Tukao Bay section of the lagoon (Figure 1), farmed oyster concentrations exhibit a different pattern. Greatest shell densities were observed in the central and southeast sections of the lagoon (Figure 2). The highest levels of spat collection success were also observed in the southeast quadrant of the lagoon (Figure 2 – areas outlined in black).

Figure 2. Farmed shell distribution in the Manihiki lagoon. Red indicates areas of highest density, blue lowest. Regions outlined in black are the spat collection areas of greatest success.



The total space available for pearl farming in the Manihiki lagoon, where depths are between 10-30 metres, is 2529 hectares. Of that area, the currently permitted pearl farms cover 1272 hectares, or 50% of the available space. An additional 610 hectares (25%) of space are “ghost farms”: areas which were previously permitted in 1997 or 2011, but which were not renewed in the most recent permitting cycle. Ghost farms for the most part have been completely abandoned and the owners have moved away, leaving farming equipment behind which impedes expansion and poses danger to current farms (Figure 3). Though the full extent of this issue has not yet been assessed, during the process of mapping the permitted areas and performing environmental monitoring a considerable amount of abandoned equipment was observed. When possible, this was also mapped.

Figure 3. Map of Manihiki farm areas. Grey coloration are currently permitted, red areas indicate ghost farms – several of which have been confirmed to contain abandoned equipment.



The number of cultured shells is the lowest ever recorded in Manihiki (Table 1) and has consistently declined since 1996 (Figure 4). The similar numbers of spat and adult oysters suggests that the industry is poised for maintenance with enough spat to support current seeding rates. However, in order to achieve growth a larger effort needs to be immediately invested in spat collection.

Table 1. Total number of farmed oyster's in Manihiki Lagoon

Year	# Farming Areas	Adult Oysters	Spat	Reference
1991	97	521,000	108,000	Tuara, 1991
1996	164	880,000	3,500,000	LEMMP, 1997
1999	111	1,525,000	1,078,000	Ponia et al. 1999
2014	126	480,000	460,000	This Report

Figure 4. Number of cultured oysters in Manihiki Lagoon 1991 – 2014.

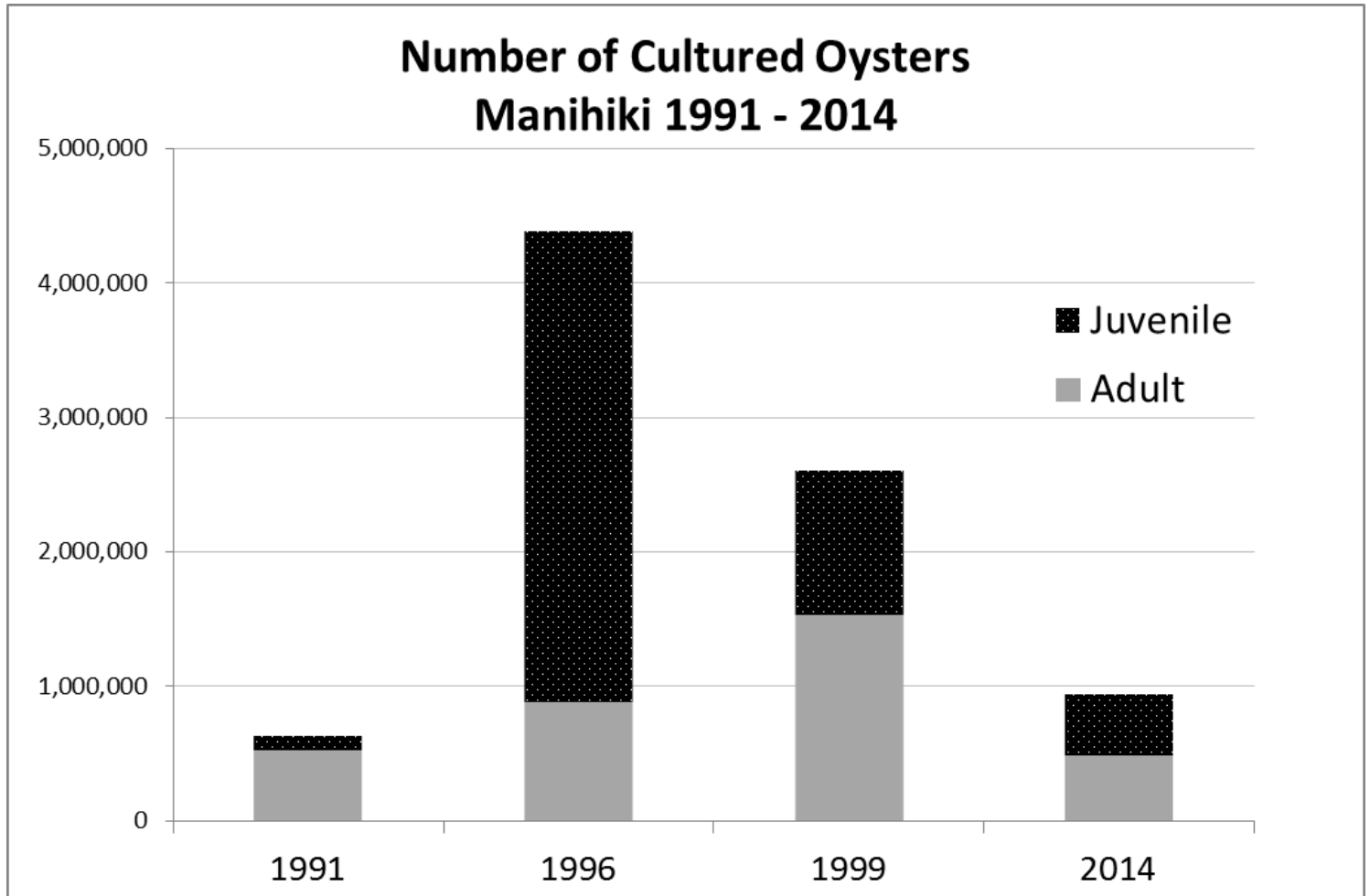
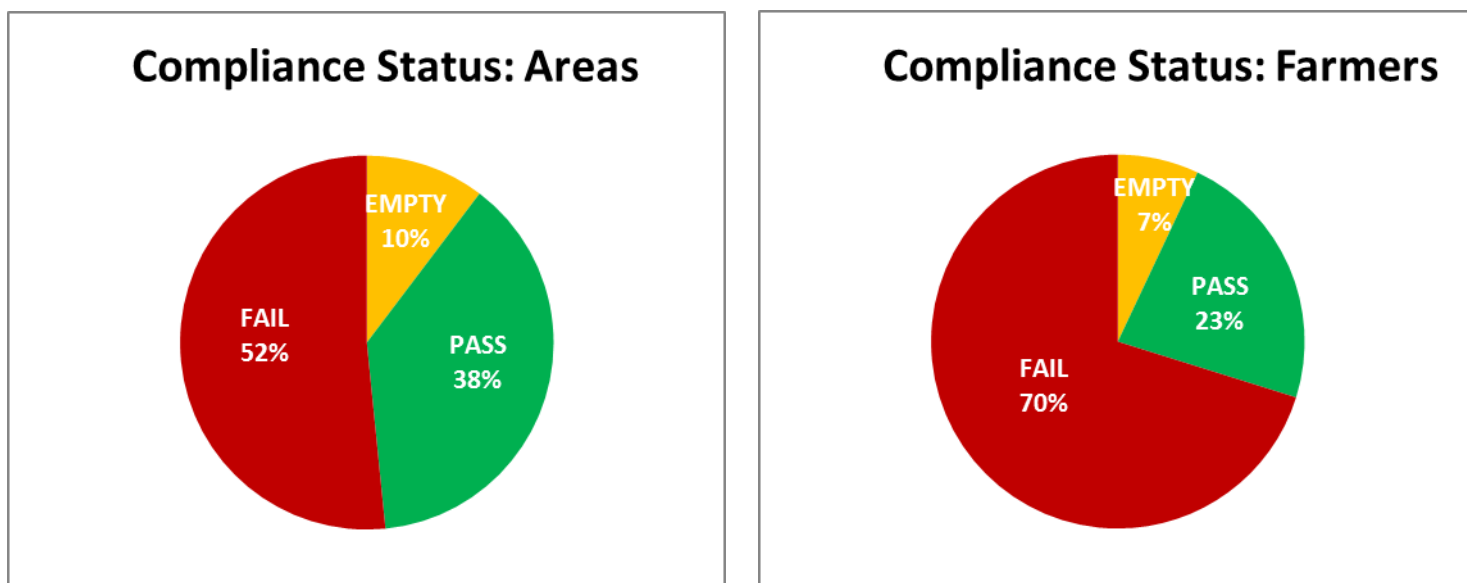


Table 2. Distribution of pearl farms according to number of cultured adult oysters 1996 - 2014

# Oysters	1996		1999		2014	
	% Farms	# Farms	% Farms	# Farms	% Farms	# Farms
0	50%	77	31%	34	61%	77
1 - 5,000	27%	41	23%	25	17%	21
5,000 - 20,000	15%	23	22%	24	17%	21
20,000 - 50,000	5%	8	19%	21	5%	6
50,000 +	3%	4	6%	7	1%	1

Compliance Assessment: There are currently 126 permitted areas in the Manihiki lagoon divided amongst 57 individual permit holders. Of the 126 areas, 13 were found to be completely **EMPTY**, 65 were not in compliance with the lagoon management plan and **FAILED**, and 48 were in compliance and **PASSED** inspection (Figure 5 - Areas).

Figure 5. Compliance distribution of the 126 currently permitted areas and 57 farmers.



When all areas permitted to a single individual were grouped together, 13 permit holders were fully in compliance with the lagoon management plan, 4 had only empty areas, and 40 had at least one area which was not in compliance (Figure 5 – Farmers). Some areas which are recorded in our inspections as empty likely contain lines which have sunken and thus could not be evaluated.

The largest issues of non-compliance were sunken lines (66 areas have multiple sunken lines) and line spacing (lines in 63 areas were separated by less than 10 metres). Chaplet spacing was generally good, with all but 7 areas having 1 metre or more between chaplets. Only one area failed due to number of shells per chaplet, where 30 small shells were observed on chaplets less than 1 metre apart. Spat collector drops were generally either well-spaced at half a metre apart, or much too close together. Fifteen areas failed due to having collector drops too close together. Twenty-nine areas had numerous floats on the surface posing a risk to boat traffic, in addition to the countless numbers of floats on the surface in ghost farms.

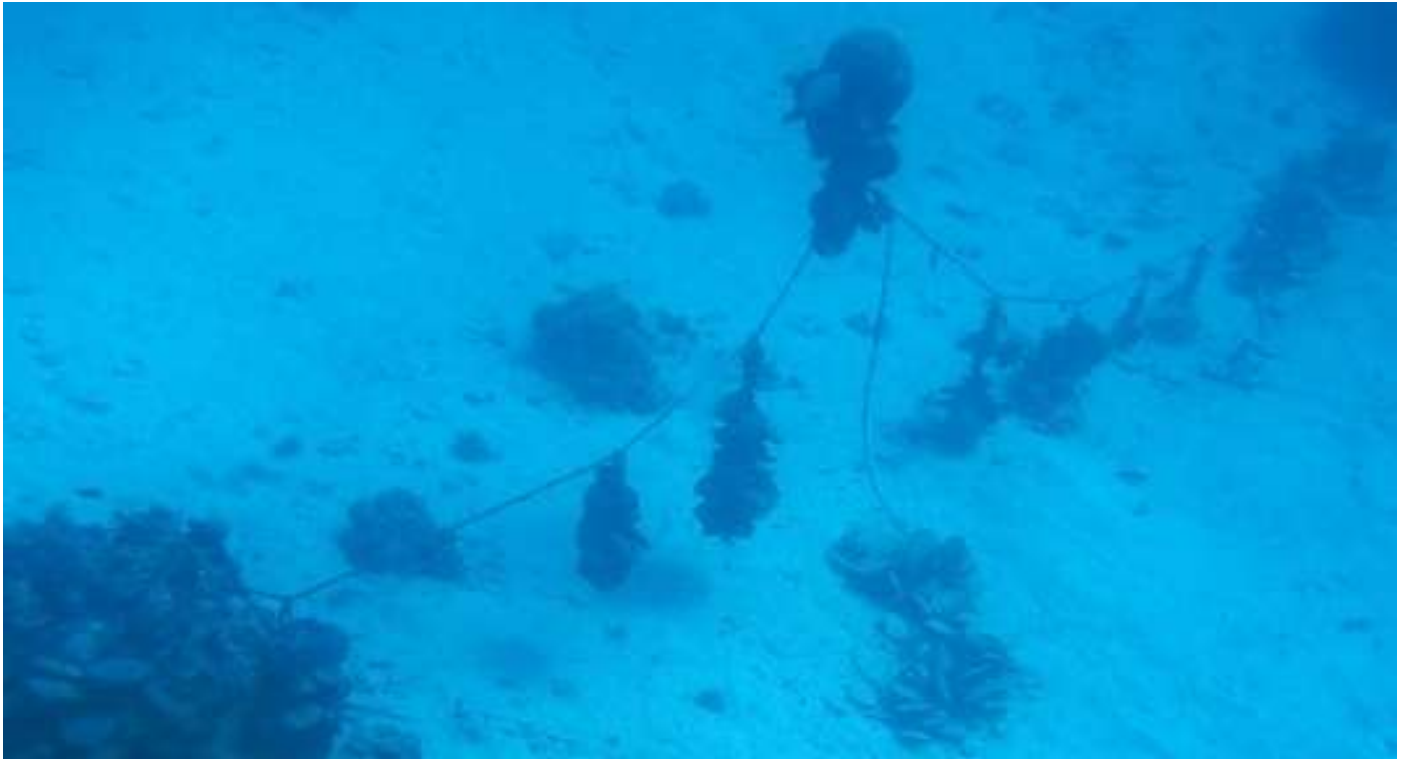
DISCUSSION

This survey, based upon direct observations rather than farmer reports, demonstrates the feasibility of comprehensive management and monitoring of pearl farms using GIS and field surveys. Regular monitoring of this kind by the Ministry of Marine Resources paired with the enforcement support of the Manihiki Island Government will ensure that the ecological sustainability and growth potential of the black pearl industry is maintained presently and in future years.

At this stage, there are two areas of priority which need to be addressed. First, that permitted areas which are inactive and unused not be allowed to persist. There is only limited space within the Manihiki lagoon which is ideal for farming, and in order for the industry to have the greatest chance for success and growth those areas need to be cleaned of old farming materials and made available for use by active farmers.

With the lagoon in its' current state, expansion for current farmers is very difficult and is resulting in the use of non-ideal locations. For example, several of the best areas for spat collection are currently held by inactive farmers who are not present on Manihiki. There are multiple areas with more than 50,000 shells on collector lines, all sitting on the bottom (Figure 6).

Figure 6. One of the most successful collector lines in Manihiki - an abandoned area held by a farmer not planning to return to Manihiki.



Second, that when active farmers request new areas in which to expand those areas are chosen based on the intended use of the area and local density of farming efforts. Areas in the central and southeast sections of the lagoon are very good for spat collection and should be prioritized for that purpose in order to ensure that healthy quantities young shells are available for future usage. Areas which are intended for hanging of seeded shells should be chosen based density of previously established farms so that no large farms are too close to each other resulting in hot spots.

ACKNOWLEDGEMENTS

Appreciation is extended to Tangi Napara, Uea Rongo, Wireless Pupuke and Ravengakore Tuteru for their assistance, without whom this survey would not have been possible.

REFERENCES

Ponia, B. Napara, T., Ellis, M. and Tuteru, R. 1999. Manihiki Island Black Pearl Farm Census and Mapping Survey. Miscellaneous Report: 22.

RDA International Inc. 1997. Lagoon Ecology Monitoring and Management Project, Manihiki Lagoon, Cook Islands. Final Report, 166 pp.

Tuara, P. 1991. Pearl Shell Population Count, Manihiki, Cook Islands. Report to the Ministry of Marine Resources, Cook Islands. 31 pp.

Farm Inspection Checklist

As per CODE OF PRACTICE of Responsible Pearl Farming Practices in Manihiki Lagoon
(Manihiki Pearl Farming Management Plan 2006-2016)

FARMER ID: _____

MAP #: _____

Satisfactory - S
Unsatisfactory - NS

Criteria	Comments	Score
2.1.1 Hanging Shells		
a) Farm lines separated by at least 10m.		
b) Chaplets with parau separated by at least 1m.		
c) Max 10 parau on each chaplet. Pre-ops may have up to 20.		
e) Only 1 layer of farm lines.		
2.1.2 Haruhau		
a) Haruharu lines separated by at least 10m.		
b) Haruharu collectors separated by at least 0.5m.		
2.1.3 Maintenance of Farm Lines		
a) Farm lines at least 2m below the surface.		
b) Lines do not interfere with the normal right of passage by boats across their farms.		
c) Boat access track between Tauhunu and Tukao is maintained.		
e) Farm lines adequately buoyed.		
2.1.5 Killing Vomits & Rejects		
b) Vomits and rejects are not banked on the seafloor at high densities.		
2.1.8 Disposal of fouling, waste and rubbish		
c) Disposal of waste is at least 10 m on the landward side from the high tide level.		
2.3.8 Keeping of Livestock		
a) No pigs kept on kaa.		

MMR Signature: _____

Date: _____

Farmer Signature: _____

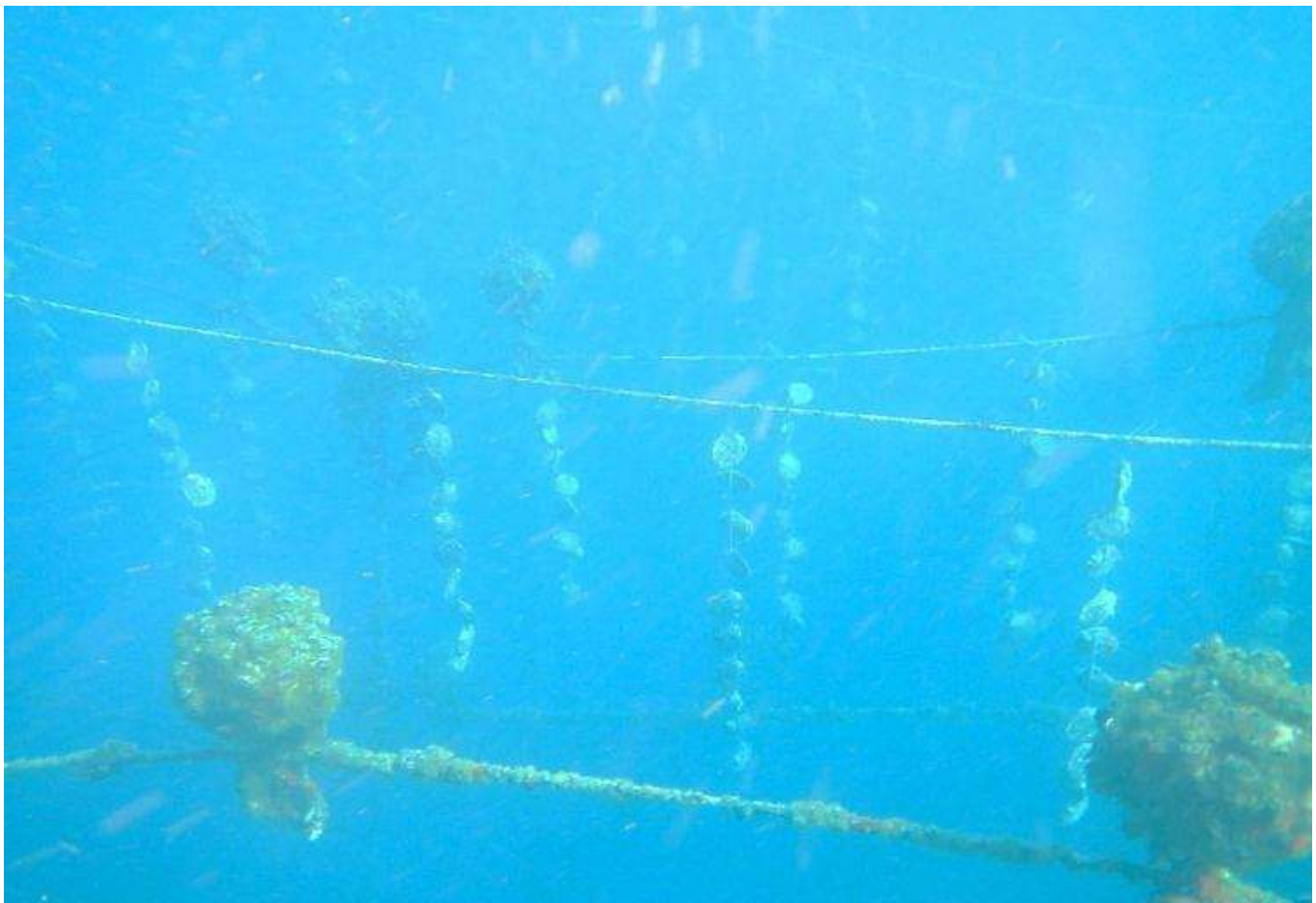
Date: _____

Appendix 2. Photographic examples of non-compliant farming practices in the Manihiki lagoon.



1. Sunken chaplet line on a currently permitted farm - 66 areas were found to have sunken lines.

2. Lines spaced less than 10 metres apart was the second largest cause of non-compliance.





3. 30 shells hung on a chaplet. It is commonly thought that because shells are smaller it is OK to hang them at high density. Small, young shells grow much faster than older shells and require just as much food to be healthy. That is also why you see so many dead shells on this chaplet.



4. Chaplets less than 1 metre apart. These chaplets are approximately .5 metre apart. Stocked at high density like this it is easy for disease to spread quickly and for the oysters to become malnourished.



6. Collector drops spaced less than .5 metre apart. If drops are not properly spaced then once oysters settle on them they will be at very high densities and not be able to get enough food or oxygen, resulting in poor health.



5. Double collector lines. Some farmers report maintaining 2 layers of lines, one of which always remains empty, in case shells need to be shifted deeper due to water quality or disease issues. Such practice is acceptable. Double collector lines however have the potential to create very high densities of animals in a small area. Such practice is not healthy for farmed oysters.

Appendix 3. Maps of all 126 currently permitted farming areas.