Appendix 1 to Agenda item B5

MANILA CLAM TRIAL FISHERY PUBLIC SUMMARY REPORT

January 2025

Summary:

- Manila clams (*Ruditapes philippinarum*) are commercially valuable shellfish native to the western-Pacific that were introduced to Europe in the 1970s for the purpose of aquaculture. Since then, the species has established naturalised populations across the south coast of the UK, recently reaching the Thames Estuary.
- KEIFCA has been monitoring the abundance and distribution of Manila clams in the Thames Estuary. Initial data suggests that the population has reached a size that is potentially economically viable for a small-scale fishery. KEIFCA has run a trial fishery to collect data on this potential fishery.
- In October 2024, eight fishing vessels were chosen to harvest Manila clams in two beds in the Thames Estuary as part of a closely monitored trial fishery. The vessels used a wide range of fishing gear designs within three broad categories – dredges without water injection (dry dredges), suction dredges, and water injection batch dredges.
- During the trial fishery, KEIFCA collected size and damage data from harvested clams and cockles through sea-based boarding operations. At the conclusion of the trial fishery, all trialists were interviewed with questions focussing on the processing and selling of clams, feedback on the running of the trial, and perspectives on a future fishery.
- The trial collected a substantial amount of valuable data and provided the foundations for future trials and a potential future fishery in the Thames Estuary.
- Water injection batch dredges were concluded to be the most suitable gear type for harvesting clams. They present an economically viable method of harvesting Manila clams with low damage rates. Dry dredges did not work to harvest clams, and hydraulic suction dredges were efficient but had higher damage rates.
- Cockles were rarely retained while harvesting Manila clams.
- The range of riddles designed and constructed for use in this trial were effective at sorting undersized clams from the catch, allowing them to be discarded and legal catch to be landed.
- All trialists that landed commercial quantities of catch were able to sell the entirety of it, with catch being sold to the live market for either relaying or further processing for consumption. The UK market was able to sustain the entirety of the catch produced in the trial, with the potential for market growth over time.
- The results from this trial have indicated that a Manila clam fishery may be viable in the Thames Estuary, but that further trials and input from Natural England will be necessary. KEIFCA recommends running a bottom impact experiment, a riddling experiment, and another trial fishery at the end of 2025.

Background

Manila clams (*Ruditapes philippinarum*) are filter-feeding shellfish native to the sub-tropical and temperate coasts of the western Pacific (Brusà et al., 2013; Moura et al., 2017). They are found buried in soft sediments in intertidal and shallow sub-tidal areas (Joo et al., 2021). Manila clams have successfully spread throughout the northeastern Pacific, Indian Ocean, and Mediterranean Sea (Goulletquer, 1997). Fast growth, a long spawning period, and adaptability to a range of environmental pressures has allowed the successful establishment of Manila clam populations across the world (Goulletquer, 1997; Brusà et al., 2013). Manila clams are a high-value, commercially important species, and its global spread can also be attributed to deliberate human introduction for the purpose of establishing fisheries (Goulletquer, 1997; de Montaudouin et al., 2016; Moura et al., 2017).

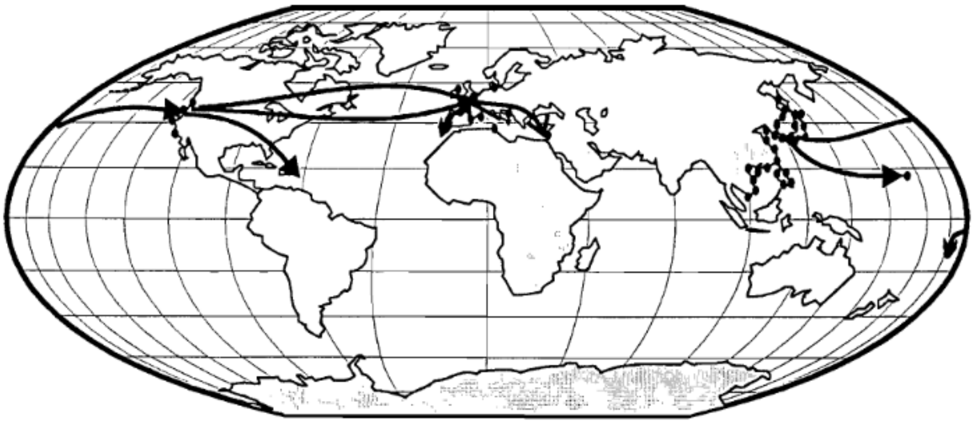

Figure 1: Worldwide spread and distribution of the Manila clam (Goulletquer, 1997).

Manila clams were accidentally introduced to the Pacific Coast of North America in the 1930s and spread naturally up the coast to British Columbia (Bidegain et al., 2013). Manila clams were then purposely imported from the United States of America (USA) to France in the 1970s (Dang et al., 2010). After this, several transfers within the European Union resulted in the establishment of populations throughout the continent (Dang et al., 2010; Bidegain et al., 2013). Today, Manila clams are one of the most commercially exploited bivalves in the world, and in 2020 made up 24% of global bivalve production (Mamede et al., 2024). Aquaculture comprises the majority of Manila clam production, with major fisheries including China, Korea, Italy and the USA (Goulletquer, 1997). Wild caught fisheries are rare, with only Portugal and the United Kingdom (UK) harvesting clam beds without significant intervention.

In the UK, significant local populations have been established in Poole Harbour on the south coast, which is one of the only Manila clam fisheries in the UK. Emerging populations can be found spreading towards the south-east of England, including within the Thames Estuary. Manila clams have been present in the Thames Estuary for some time, with local fishermen reporting sightings to the Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA) ten years ago. Since then, KEIFCA have monitored clam abundance and distribution in the Thames Estuary, but numbers have not reached commercially viable levels until recently. Manila clam abundance has increased rapidly, likely due to warming waters making conditions increasingly suitable for Manila clams to establish. Initial data suggests that commercial quantities have been reached, and that a small-scale fishery may be viable. With fishing opportunities becoming limited in the Thames Estuary, the establishment of a sustainable Manila clam fishery presents a much-needed income stream for inshore fishermen.

KEIFCA ran a trial fishery in October 2024, with the aim of understanding the economic viability and sustainability of a small-scale Manila clam fishery, as management must be informed by data specific to the Thames Estuary. Shellfish populations are highly variable spatially, and Manila clams are no exception, reported to have high levels of variation in growth rate, spawning, environmental tolerance, and shell morphology between populations (Moura et al., 2017; Tan et al., 2020; Caill-Milly et al., 2021). Additionally, the Thames Estuary is towards the northern limit of the species range and is significantly more exposed to wave energy than other commercially harvested Manila clam beds in the UK. Therefore, although other UK Manila clam fisheries can be used to draw information from, it is likely that the Thames Estuary stock will respond differently to harvesting pressure. Local fishermen have also expressed concern regarding the impact of a Manila clam fishery on the existing Thames Estuary cockle fishery. This fishery has been a mainstay in the Thames Estuary for decades and represents a key industry for the local fishing community. Manila clams inhabit a similar environment to cockles, and as such, care must be taken to ensure that harvesting clams will not put cockle beds under additional strain and put the existing fishery at risk. KEIFCA's initial data suggests that viable Manila clam stocks are located within a complex network of Marine Protected Areas (MPAs), which means that further consideration must be given to the environmental impact of a potential Manila clam fishery (Figure 2). Any established fishery must be compatible with the conservation objectives of all MPAs in the area and adhere to Natural England's (NE) conservation advice.

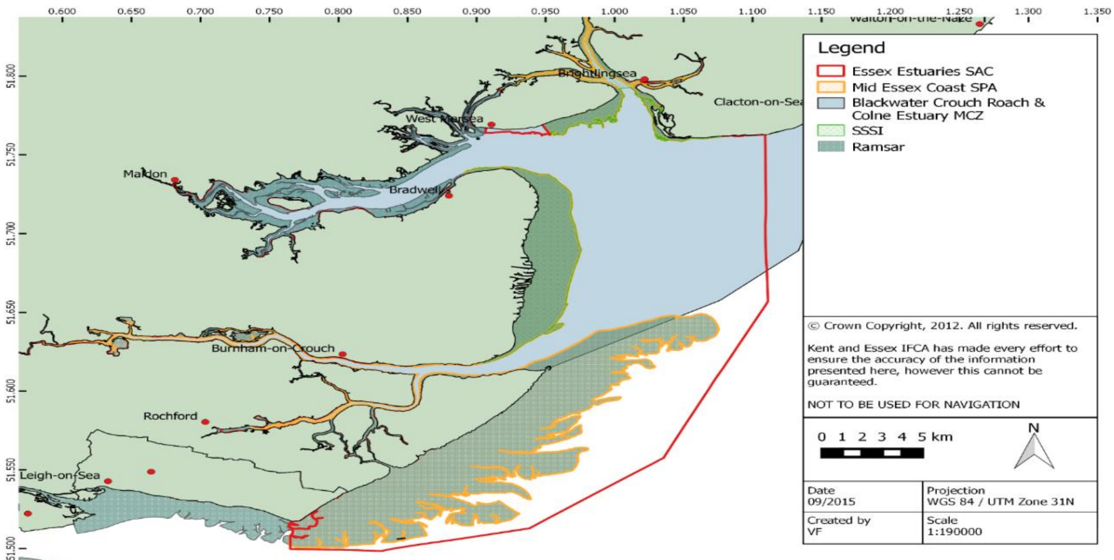

Figure 2: Designated Marine Protected Areas that potentially viable Manila clam stocks are located within. There is a complex network, with many designations overlapping one another.

KEIFCA designed the Manila clam trial fishery with these things in mind, and collaborated closely with local fishermen and NE, to collect the information necessary to potentially set up a low-impact, small-scale, sustainable Manila clam fishery in the future.

Trial Objectives

The 2024 Manila clam trial fishery aimed to determine whether there is a design of fishing gear that can harvest Manila clams in the Thames Estuary in a way that is economically viable, sustainable, and produces a high-quality product. To achieve this aim, eight fishing vessels harvested Manila clams, and KEIFCA aimed to collect a range of information from them:

1. Impact of Manila clam fishing gear on the seabed
2. Assess whether fishing activity would pass an HRA
3. Damage rate on clams harvested (damage rate on any other shellfish harvested)
4. Speed of fishing/ efficiency rate of gear (on a range of ground types/ areas)
5. Efficiency in separating undersized clams, clams from cockles, and undersized cockles.
6. Quality of clams harvested
7. Profitability of fishing
8. Opportunities for local economy
9. Assess compliance/enforcement of the fishery

KEIFCA successfully addressed objectives 2 – 9 through the 2024 Manila clam trial.

Trial Framework

<u>Trialists</u>

Fifteen local fishermen submitted a written application to participate in the trial fishery which were assessed against marking criteria and then ranked by a panel of KEIFCA members. Overall, the standard of these applications was very high, and eight vessels were chosen to participate in the trial.

Across the eight vessels, three fishing gear types were designed and constructed for use in the trial. These were suction dredges, water-injection batch dredges, and dry batch dredges. Two riddle types were designed and constructed for use in the trial – flatbed and rotary riddles. For information about each gear type, see Appendix A. See Table 1 for the gear and riddle type used by each trialist.

*Table **1**: List of participants in the 2024 Manila clam trial fishery, detailing fishing and sorting gear used, and overall vessel length category.*

Trialist	Gear Type	Dredge bar spacing (mm)	Riddle	Riddle bar spacing (mm)	Vessel Size (m)
Batch_1	Water injection batch dredge	22	Rotary	21	10 – 14
Batch_2	Water injection batch dredge	19	Flatbed	19	<10
Batch_3	Water injection batch dredge	22	Rotary	22 – 25	10 – 14
Batch_4	Water injection batch dredge	19	Flatbed	19	<10
Suction_1	Suction dredge	16 – 22	Rotary	22	10 – 14
Suction_2	Suction dredge	16	Rotary	18 – 22	10 – 14
Dry_1	Dry dredge	20	Flatbed	N/A	<10
Dry_2	Dry dredge	16	Flatbed	20	<10

Framework

The trial occurred over four weeks, from the 1st to the 25th of October 2024. During the first week, no landings were allowed, but fishermen were able to test their gear. In the three weeks following, two trips per week were allocated to each participating vessel, with catch allowances set between 300kg and 500kg per trip (Table 2). All clams landed had to be over 35mm in length, due to the enforced legal minimum size of the species.

*Table **2**: Timing, trip allowances, and catch allowances that each vessel was required to adhere to throughout the 2024 Manila clam trial fishery.*

Week	Start	Finish	No. Trips	Landings allowed per trip
1	1 Oct @ 05:00	5 Oct @ 18:00	5	NO LANDINGS
2	6 Oct @ 18:00	11 Oct @ 12:00	2	300kg
3	13 Oct @ 18:00	18 Oct @ 12:00	2	300kg
4	20 Oct @ 18:00	25 Oct @ 12:00	2	500kg

The trial was restricted to two areas within the Thames Estuary – the Buxey and Maplin Sands (Figure 3).

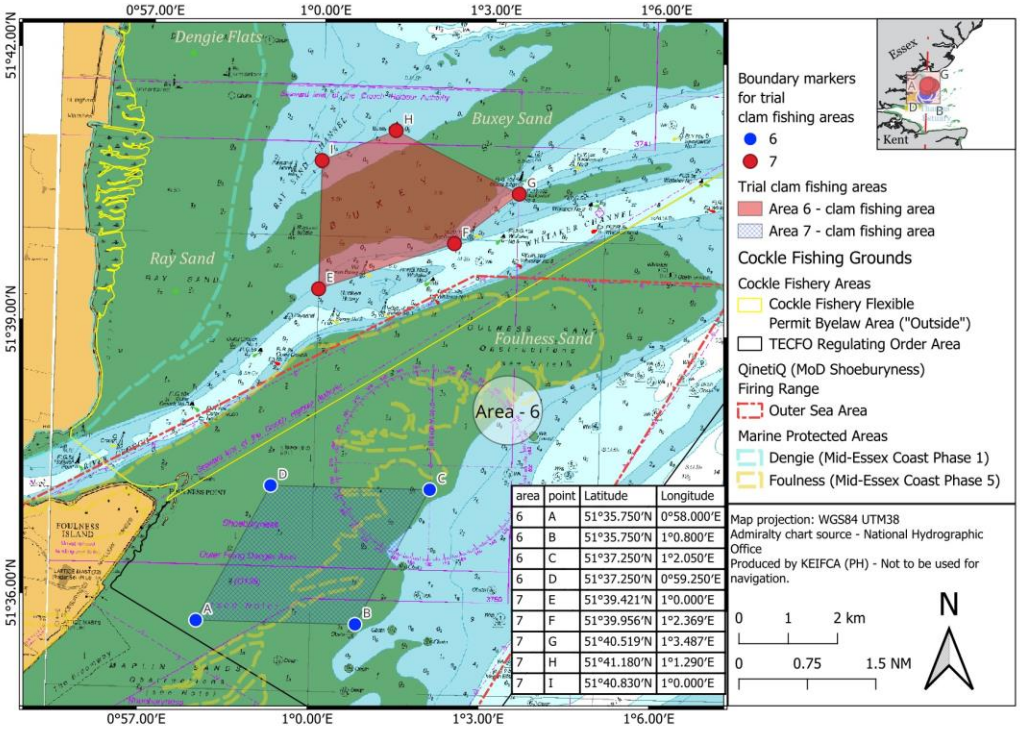

Figure 3: Map of the areas allowed for Manila clam harvesting in the 2024 Manila clam trial fishery. The blue area is the Maplin Sands, and the red area is the Buxey Sand.

<u>Data collection</u>

To collect data on the fishing operations participating in the Manila clam trial fishery, collaboration and coordination was required before, during and after the fishery.

Before the trial began, each vessel was provided with a handheld GPS unit which recorded the vessel's position for all trips to ensure compliance and collect information on fishing footprint. Furthermore, each set of clam-harvesting and sorting gear was measured for all eight vessels, including measurements of alternative gear sets that a vessel may switch to (many trialists had multiple options for the dredge blade and water injection jets).

During the trial, KEIFCA used WhatsApp to remain in contact with trialists, having to know when and where all eight vessels were conducting their two fishing trips per week. Knowing the fishing plans of each trialist in advance allowed KEIFCA to coordinate its boarding operations to meet fishers at sea to collected samples. Two patrol boats were used to collect samples – FPV Nerissa, out of Ramsgate, and FPV Vigilant out of Brightlingsea. Trialists were communicative and willing to adjust fishing plans better align with KEIFCA's operations, but despite good communication, boarding operations were challenged by poor weather conditions. Most vessels were boarded on more than one of their fishing trips each week, with a total of 28 boardings completed by KEIFCA within the three weeks of the trial.

Each time a vessel was boarded, three replicate dredge tows were conducted by the vessel. During each tow, a KEIFCA officer collected two samples from the catch once it had been sorted – one from the catch that was going to be retained, and another from the catch that was going to be discarded (returned to sea). A total of six samples per boarding were then processed. Processing involved dividing the sample into species (cockles and clams), size (over 35mm and under 35mm) and level of damage (whole, chipped smashed). Each group was counted and weight, and from this data, damage rate and proportion of undersize catch were calculated. KEIFCA also conducted several shore-based landing inspections throughout the trial, weighing overall catch and recording any undersize clams.

After the trial concluded, interviews were conducted to gather information from the trialists including self-perceived success, viability of a future fishery, market conditions, and feedback on the operation of the trial by KEIFCA.

For more detailed methodology, refer to Appendix B.

Results

The trial fishery successfully collected data on the economic viability and sustainability of three different Manila clam gear types in the Thames Estuary. This data has set the foundations for further evidence gathering and has begun to demonstrate how a small-scale fishery could be successful in the Thames Estuary.

<u>Gear type</u>

Of the three gear types tested in this trial, water injection batch dredges were the most successful at harvesting Manila clams. Water injection batch dredges worked well, could harvest clams within an economically viable timeframe, and had low damage rates. Interview responses unanimously agreed that future trials should focus on water injection batch dredges, instead of retaining use of suction or dry dredges.

The two trialists using dry dredges did not land commercial quantities of clams at any point during the trial. Both trialists attempted to harvest Manila clams on multiple occasions, with one trialist altering their dredge significantly mid-way through the trial but was still unable to harvest clams. Both trialists reported that their dredges failed to penetrate the sediment and instead skimmed across the surface of the seabed. Both trialists suggested that the ground was too hard, and that water injection is required to fluidise the sediment and allow a blade to pass through.

Water injection batch dredges achieved very low damage rates throughout the trial (Figure 4). Achieving and maintaining low damage rates is important for both the sustainability of the stock, and the value of the product. Minimal levels of physical damage to individuals that are being discarded increases their probability of survival, and ability to contribute to future fishable stock through growth and reproduction. Low damage rates to discarded catch therefore increase the sustainability of the fishery in the long term. Keeping damage rates low in retained catch is also important, as this increases the proportion of catch that survives the depuration process and can be sold into the live market. Therefore, in order to maintain a thriving, sustainable fishery, both financially and ecologically, low damage rates are essential.

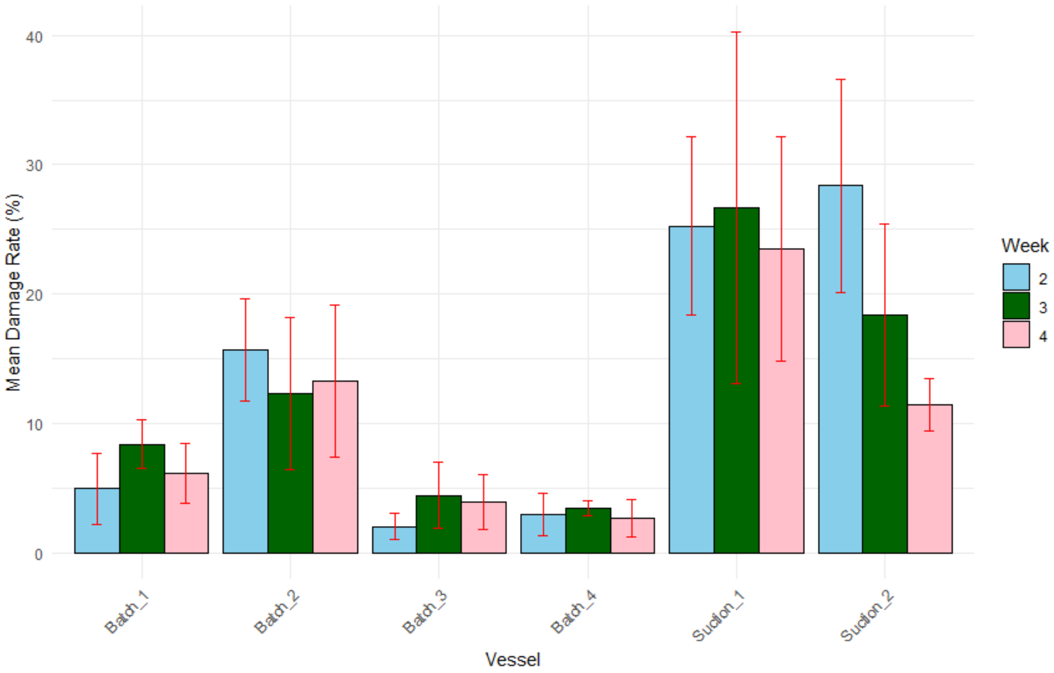

Figure 4: Average damage rates of each trialist per week. Standard deviation is represented by the red error bars.

Suction dredges had higher damage rates than water injection batch dredges throughout the trial (Figure 5). One trialist using a suction dredge was able to decrease their damage rate significantly over the course of the trial by making alterations to their fishing gear. However, water injection batch dredges had immediately low damage rates, and, unlike trialists using suction dredges, were all new dredges made from scratch. It was reported that the short duration of the trial limited the ability for trialists using new fishing gear on a new species to alter gear for the express purpose of reducing damage rates. Although the trial was long enough to improve efficiency and at-sea operations, there was a lot of progress yet to be made. Many could identify what alterations may reduce damage rates, but did not have the time to make or test them, indicating that water injection batch dredges are generally low impact.

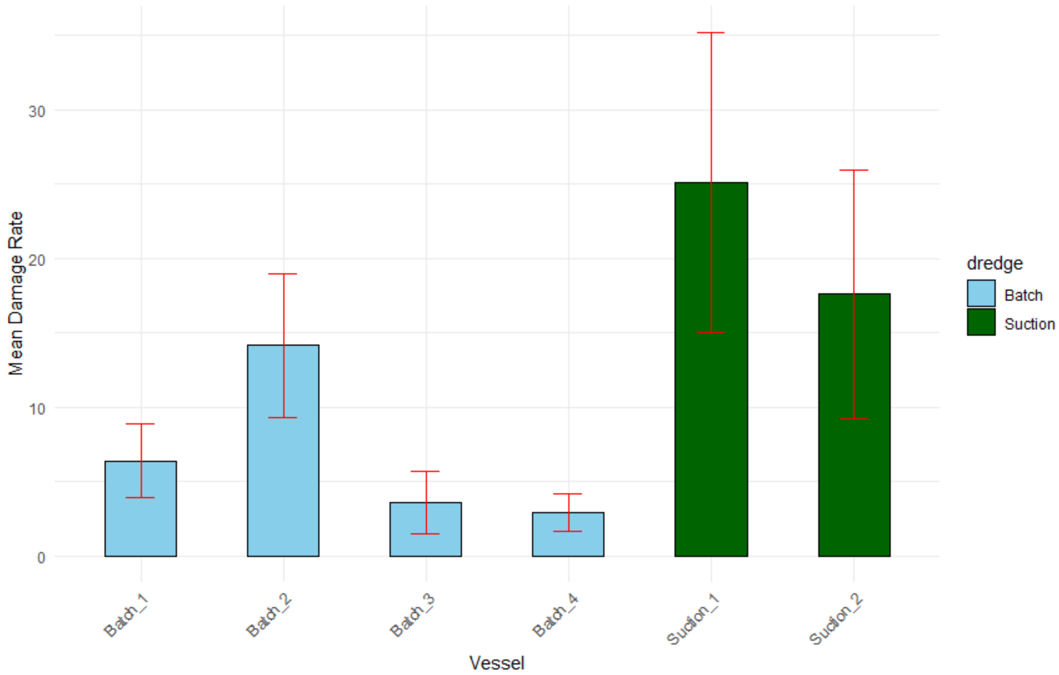

Figure 5: Average damage rate across the fleet during the Manila clam trial fishery, colour-coded by type of dredge.

Both dredge types were only able to fish certain states of the tide – with enough water to safely access the shallow sand banks, but low water enough to allow dredges to reach the seabed. Generally, vessels had several hours around low tide to fish. Suction dredges were able to harvest their catch within 30 minutes to an hour of actively fishing, whereas water injection batch dredges generally harvested their catch within the window around a single low tide, around 4 hours. However, as the trial progressed, fishing times for water injection batch dredges were reduced to as little as 2 hours. Trialists reported that if harvesting their catch took the length of a single tide, the operation could be economically viable, however, if fishing time exceeded a single tide, the viability of the operation reduces significantly, as they would have to wait at sea during high tide until the next viable fishing opportunity.

Cockles

Initial data suggests that the gear types tested in this trial were able to effectively separate Manila clams from cockles. There were relatively few cockles found in samples taken throughout the trial fishery. Over 18,500 clams were counted, compared to approximately 3,000 cockles (Figure 6, Figure 7).

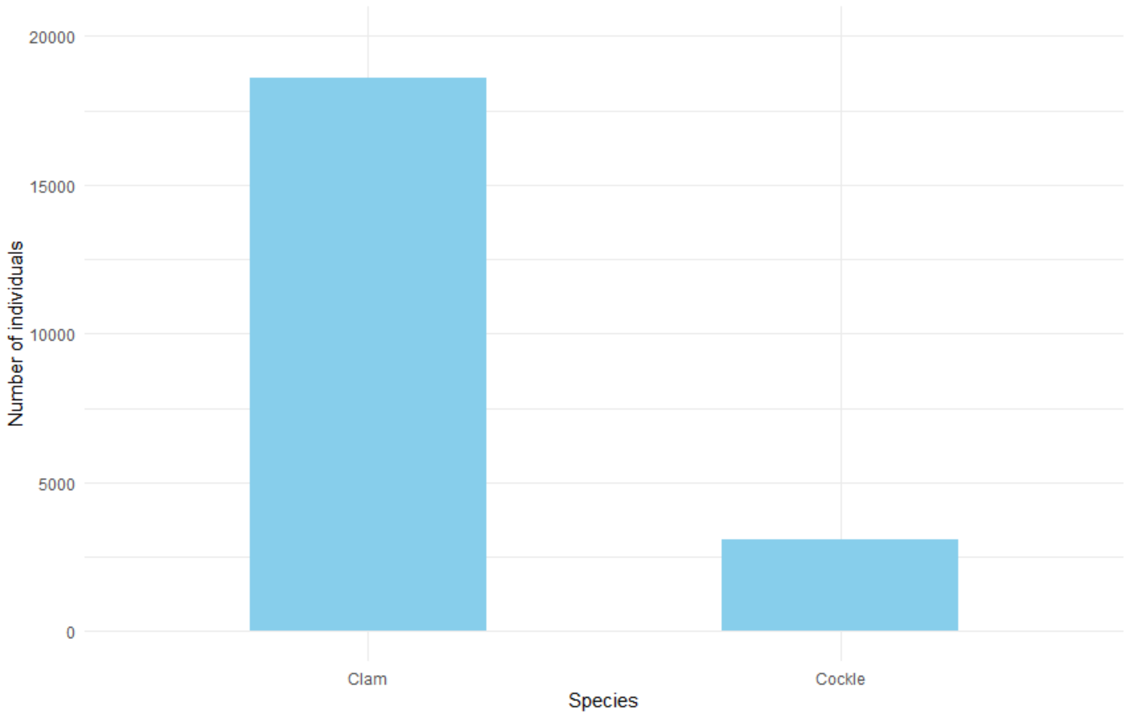

Figure 6: Number of clams compared to cockles counted in all samples processed as part of the Manila clam fishery.

Figure 7: A typical sample taken during the Manila clam trial with Manila clams on the left and cockles on the right.

Almost all cockles sampled during the trial were part of discard samples, with only 4 individuals counted in retained samples throughout the trial (Figure 8). Although some cockles are harvested while clam fishing, the sorting process generally ensures that they are discarded overboard and back to the seabed, rather than retained in catch and removed from the system.

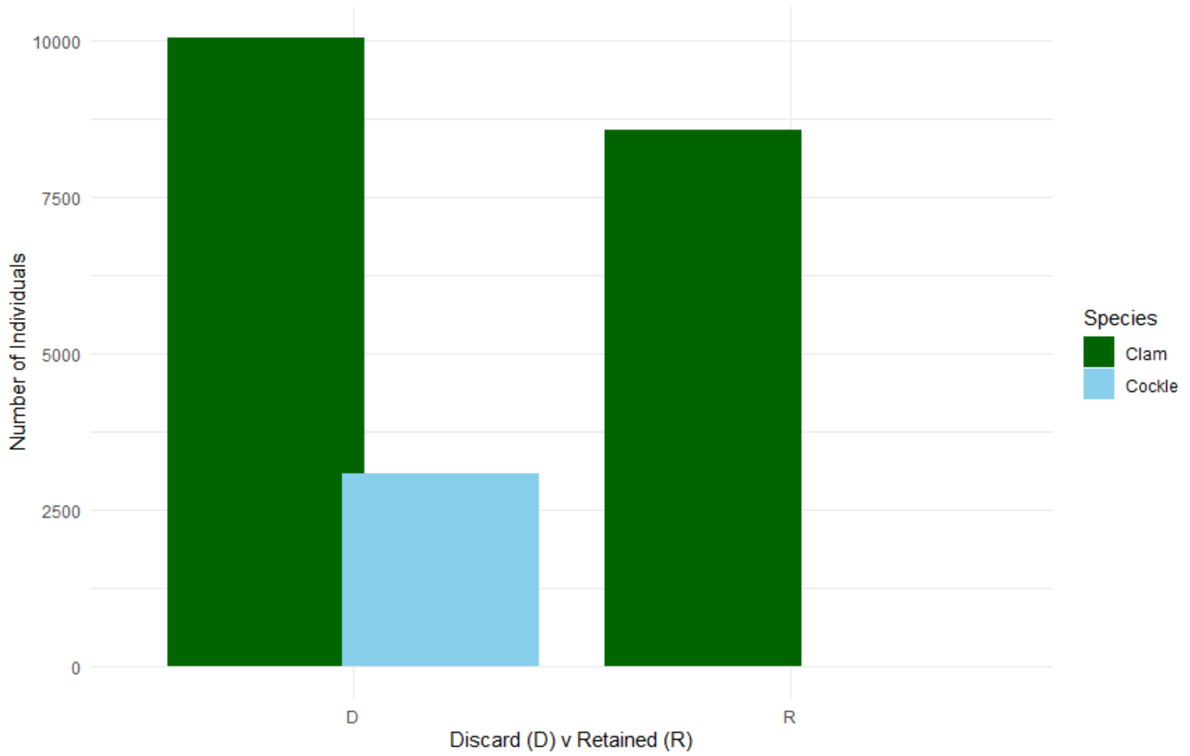

Figure 8: Number of cockles and clams counted in discard (D) compared to retained (R) samples.

The lack of cockles in samples, especially discard samples, from the trial fishery may be owed to riddle and dredge bar spacing. The Manila clam minimum size of 35mm is much larger than the cockle minimum size of 16mm, and therefore the bar spacing of sorting equipment targets a different size class to cockles (Table 1).

KEIFCA will take a precautionary approach in future, aware that as Manila clam beds are increasingly harvested, increases in cockle bycatch may occur. Therefore, more data on cockles will be collected during future trials, in order to monitor the impact of Manila clam fishing on cockle beds.

Sizeable catch

A range of riddle designs were used throughout the trial, which were all effective at sorting sizeable clams from undersize clams. The fleet used both flatbed and rotary riddles, with a range of bar spacings between 18mm and 22mm (Table 1, Figure 9). Hand sorting was also used by many trialists to further ensure that undersize clams and cockles were not landed, and that only high-quality clams were provided to buyers.

Figure 9: Trialists using a flatbed riddle to sort undersize Manila clams from sizeable Manila clams during the trial fishery.

The percentage of retained catch composed of undersize clams was low across all trialists, with a fleet average of 2.05%. One vessel had no undersize clams present in any clams across the entirety of the trial (Figure 10). As seen in Figure 10, there were a number of sizeable clams being returned to the seabed in the discard portion of the catch.

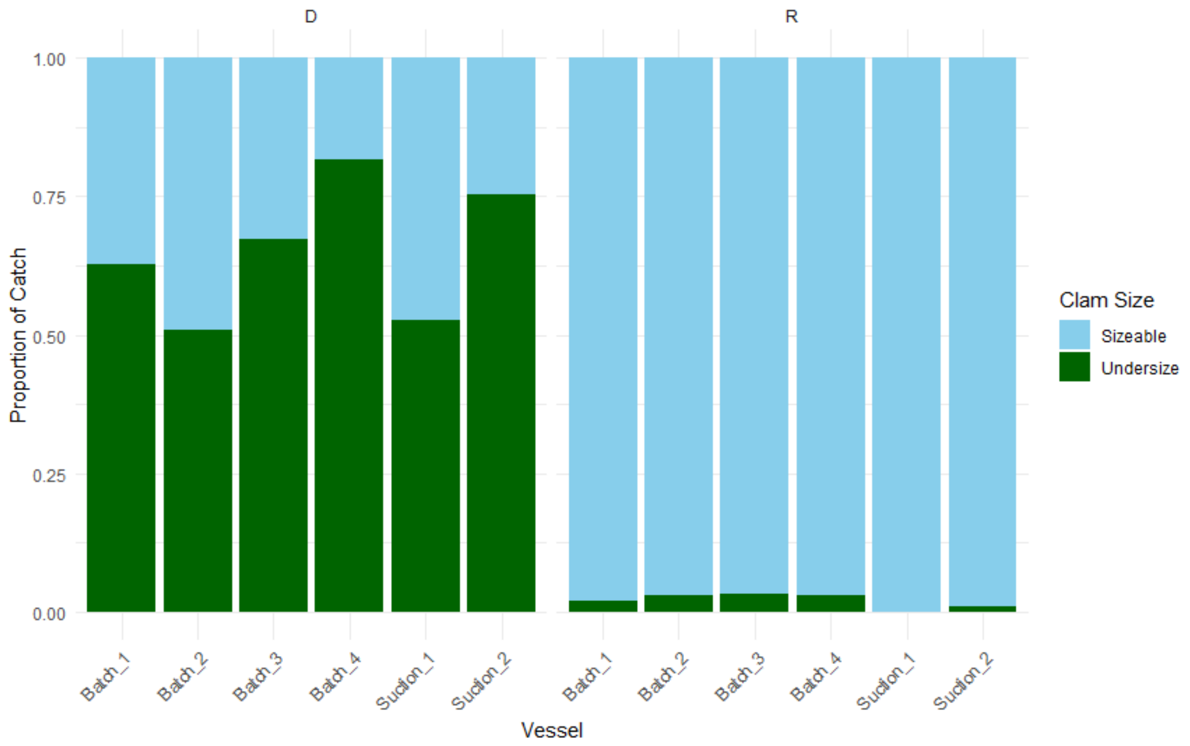

Figure 10: Proportion of sizeable and undersize catch present in discard (D) and retained (R) samples across the Manila clam trial fishery fleet.

Initial data thus indicates that the range of bar spacings and riddle designs used by trialists was effective at sorting sizeable clams from undersize clams. No clear trend was found regarding the effectiveness of sorting between types of riddles (flatbed vs rotary) or riddle bar spacing. KEIFCA recommend further experimentation specifically investigating the impact of riddle bar spacing on size composition of retained and discarded catch, to determine optimal riddle bar spacing for a future Manila clam fishery.

<u>Market</u>

All Manila clams that were landed in the trial fishery were sold live to both domestic and European markets. Clams were sold either to be depurated for selling on to restaurants, or to be relayed for future harvest. The live market is characterised by a high quality, high value product that is able to survive multiple days of transport, depuration, and further selling. Very few clams were depurated in the Kent and Essex District with most ending up on the south coast, where clam depuration infrastructure and a thriving local clam market exists. Several trialists expressed interest in establishing depuration operations in the district but reported the need for confidence in the continuation of Manila clam harvesting in the Thames for the investment to be made.

Every vessel that landed commercial quantities of catch was able to sell the entirety of their catch throughout the course of the trial. Therefore, the market was able to take on the level of catch allowed for this trial, which totalled approximately 13 tonnes. Selling Manila clams was considered by participants as the easiest part of the trial, and all reportedly received reasonable prices for their catch, similar to that of the Poole fishery. Overall, there is a strong indication that the live market for Manila clams is accessible by the Thames Estuary inshore fleet.

Trialists believe that there is potential for growth in the clam market, and that this growth can be supported by maintaining a high-quality product that is reliably available each year. Individual company branding was also identified in post-trial interviews as an important factor in increasing demand for clams in the district. Trialists reported that branding Manila clams as a local, small-scale fishery from each independent business could promote growth in the market, but that using the Thames Estuary could have a detrimental impact on sales. Trialists also reflected concern that large increases in landings in following years may flood the market and drop prices, making their operations no longer financially viable. This further highlights the need for the fishery to remain small-scale in future.

Trial Reflection

The 2024 Manila clam trial fishery was a success, collecting a vast amount of essential data that can be used in assessing the viability and management of a future fishery. Trialist investment, knowledge and extensive collaboration with KEIFCA allowed for this level of evidence to be collected, and a direction for future trials can be seen.

Owing to careful planning, resource allocation, and the hard work of officers at sea, over three weeks, KEIFCA conducted 28 boardings, and collected and processed 165 samples. As a result, an extensive database has been generated, which allows for well-evidenced recommendations to be made from this trial. Post-trial interview data also indicates that trialists were pleased with the set-up and running of the trial, in particular the high level of communication from KEIFCA, and the ability to design and test a range of gear types (Figure 11).

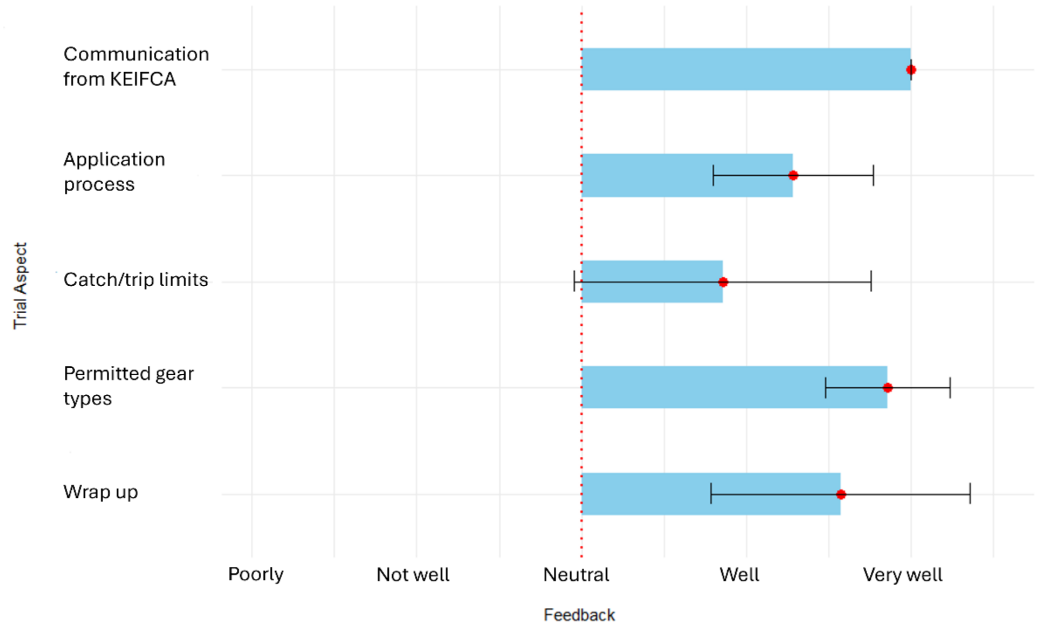

Figure 11: Average responses from trialists regarding how KEIFCA did in several aspects of the setting up and running of the 2024 Manila clam trial fishery.

The success of this trial is owed largely to trialist expertise, and their significant investments made into creating gear and setting up buyers. Most trialists designed and constructed dredges from scratch, drawing on their own knowledge along with that of other fishermen – both local and from areas with existing UK clam fisheries. Six of eight trialists were able to land and sell commercial quantities of Manila clams within a week of testing novel gear on a new species. They were then able to further adapt and improve their gear and operation as the trial progressed. Most vessels reported that they felt as though they had personally succeeded in the trial fishery, with the average personal success rating on scale of one (unsuccessful) to five (successful) being 4.1.

Collaboration between KEIFCA and the trialists underpinned the success of this trial, and due to significant effort put in from both parties' essential data has been collected, and a way forward can now be mapped.

Figure 12: KEIFCA officers working with trialists to take samples of catch during the trial fishery.

Next Steps

Objectives 2 – 9 were achieved during this trial. Objective 1, assessing the impact of Manila clam fishing gear on the seabed was not fully addressed owing to resource limitations. While the activity was not fully carried out, KEIFCA and one vessel carried out an initial trial in order to develop the methodology to assess the ground impact, should the trial be renewed or continued in 2025. The data presented in this report is did not include what remained on the seabed, only what was brought onboard fishing vessels. This is an important objective for the development of the trial fishery given the overlap of the activity with MPAs and the consequent requirement for Habitat Regulations Assessment (HRAs) to be carried out.

Further evidence is required in order to move towards a sustainable, small-scale Manila clam fishery in the Thames. The data from this trial has shown what next steps are required:

- Producing the 2024 Manila Clam Trial Fishery Technical Report, providing further data analysis and detail for the purposes of recording information for future management decisions.
- A bottom impact study aiming to address Objective 1 – assess the environmental impact of water injection batch dredges and ensure the compatibility of a fishery with conservation objectives of MPAs in the area.
- A riddle length and bar spacing study aiming to determine an optimal dimensions and parameters for effectively sorting undersize clams and cockles from the catch.

Conclusions and Recommendations

The 2024 Manila clam trial fishery was a success, producing a vast amount of data. Water injection batch dredges were concluded to be the most suitable gear type for harvesting clams. They present an economically viable method of harvesting Manila clams with low damage rates. Dry dredges did not work to harvest clams, and suction dredges were efficient but had higher damage rates. Cockles were rarely retained while harvesting Manila clams, which suggests that the two species can effectively be separated. The range of riddle designs used in this trial effectively sorted undersized clams from the catch, allowing them to be discarded and legal catch to be landed. All trialists that landed commercial quantities of catch were able to sell the entirety of it, with all being sold to the live market for either relaying, or further processing for consumption. The UK market was able to sustain the entirety of the catch produced in the trial, with the potential for market growth over time.

Based on initial data collected during the 2024 Manila clam trial fishery, KEIFCA recommends the following:

- A 2025 trial fishery focussing on fleet level impacts and understanding of the fishery.
- Further experiments and trials focus only on water injection batch dredges. They were shown to be the most viable gear type out of the three tested, and thus should move forward into future trials.
- Cockle data continue to be collected throughout future trials. Close monitoring of the impact of Manila clam harvesting on the existing cockle fishery is important, and so the ability for clam fishing and sorting gear to separate cockles from clams should be continuously assessed.
- A standard riddle bar spacing be carried through to future trials, the specification subject to the results from the riddle study. Standardising bar spacing going forward will allow for a more robust assessment of the sorting capabilities of a Manila clam fishing fleet.

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Appendix A

Dredge design

Water-injection suction dredges use a jet to fluidise sediment immediately in front of a blade which funnels the softened sediment and contents into the dredge body. The dredge body consists of parallel metal bars, spaced dependent on the target species and size to allow undersize catch or bycatch to escape the dredge. A pump is used to suction solids from inside the dredge body to a mechanical rotating riddle, which discards undersize catch of the side of the vessel, and retained catch of size onboard.

A water-injection batch dredge also uses a jet to fluidise sediment. A toothed or solid blade runs through the sediment to funnel shellfish into the dredge body. The body consists of metal bars, similar to the suction dredge, however due to the absence of a pump, the dredge must be raised from the seabed to access and sort catch, as the harvest is retained in the dredge body.

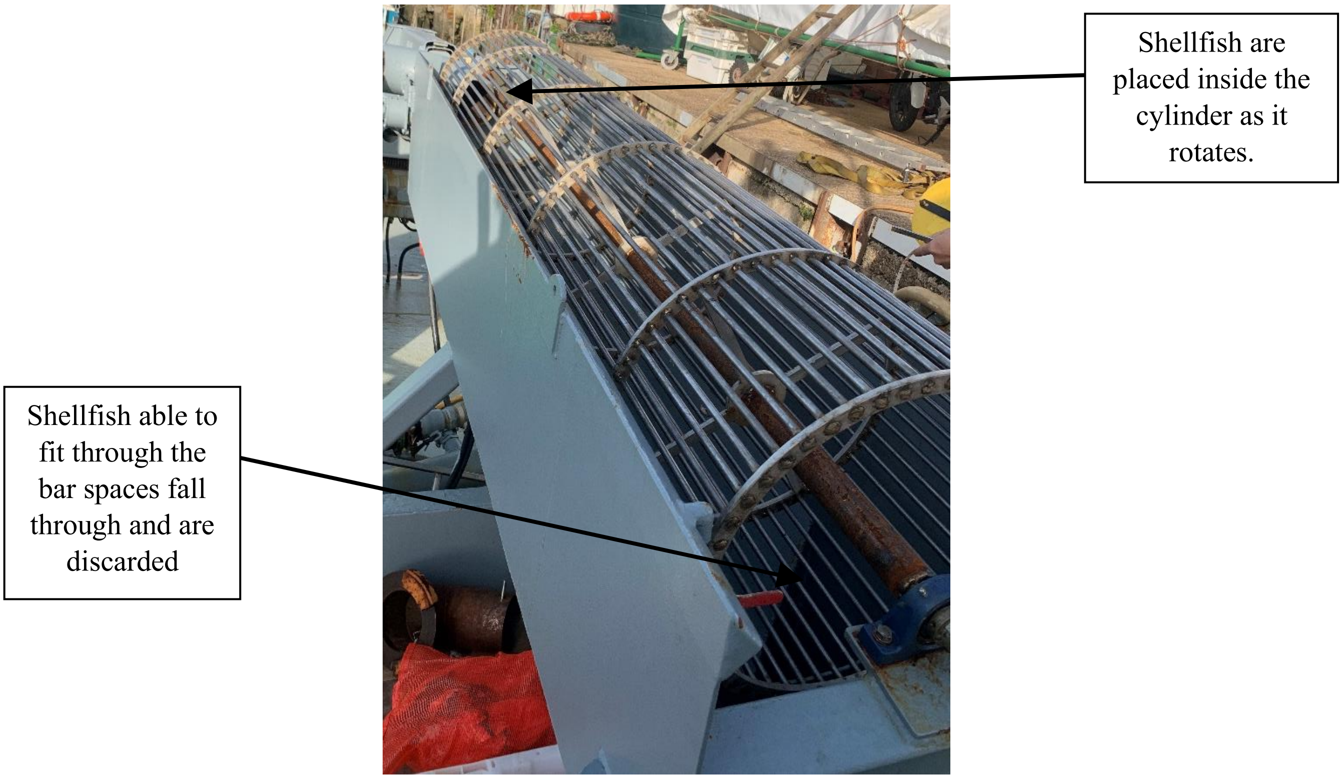
A dry batch dredge is similar to a water-injection batch dredge, but does not have a jet to fluidise the sediment.

Riddle design

A riddle is used to sort undersize and sizeable shellfish so that only legal catch is retained to be landed and sold, and all other catch is discarded. The two broad types used in this trial were flatbed and rotary riddles.

A flatbed riddle is generally a chute with a barred grate. The barred grate is made up to have specific bar spacing to target a size-class of shellfish. Shellfish are placed on the barred grate, and all shellfish that fall through are deemed undersize and end up at the bottom of the chute where they can be collected and discarded back over the side. Shellfish that cannot fall through are deemed sizeable and retained to be landed and sold.

A rotary riddle is a cylindrical structure made of metal bars, again spaced to target a particular size class of shellfish. Rotary riddles are generally mechanised, with the cylinder rotating as shellfish are added.



Appendix B

Sample collection SOP

Batch dredge

1. Record date, officer initials, PLN and management area before boarding the target vessel.
2. Board fishing vessel.
3. Record the length of fishing operation, and the total tonnage aboard.
4. Ask the skipper if there are any changes to the fishing or sorting gear since the pre-fishery gear measurements. Note any changes and their rationale.
5. Ask the skipper if he's happy to conduct a tow for you to take samples from.
6. Record the time when the dredge enters the water. Record the speed of the vessel during the tow. If the speed changes throughout the tow, record the range of speeds observed. Record the time when the dredge exits the water.
7. Take a photo of the fullness of the dredge when it exits the water.
8. Ask the skipper to separate the catch into retained and discard using his sorting equipment.
9. Take a portion of the discarded catch (this will have to be done differently dependent on the design of the specific batch dredger that is being sampled) that fills the 2.5L sample bucket (standardised in the kit). If a full container cannot be taken from the discard portion of the tow, take the entirety of cockles and clams from the discard catch and note it. Empty the sample bucket into sample bags with a label inside detailing the date, vessel, tow number, and "discard".
10. Fill up the sample bucket with retained catch. If a full container cannot be taken from the retained portion of the tow, take the entirety of cockles and clams from the retained catch and note it. This will have to be done differently dependent on the design of the specific batch dredger that is being sampled. Empty the sample bucket into sample bags with a label inside detailing the date, vessel, tow number, and "retained".
11. Repeat two more times during independent dredge tows.
12. Bring samples back to Nerissa for processing.

Suction dredge

1. Record date, officer initials, PLN, and management area.
2. Ask the skipper if there are any changes to his fishing or sorting gear since the pre-fishery inspection. Note any changes and their rationale.
3. Ask the skipper if he's happy with where he's fishing, and for you to take samples.
4. Record the speed of the vessel during fishing.

5. Wait 30 seconds to 1 minute after gear starts fishing before taking samples. Collect a sample bucket full of shellfish coming from the retained tube going into the hold. Record the time when the sample was taken.
6. Ask a crew member to hold a fine meshed net under the discharge chute until a sufficient sample is taken to fill a sample bucket. Record the time when the sample was taken.
7. Transfer both samples into respective sample bags with the appropriate label.
8. Repeat two more times throughout the fishing trip.
9. Record the length of fishing operation, and the total tonnage aboard. This step will occur whenever the officer is about to leave the vessel.

<u>Sample Processing SOP:</u>

The following should be applied to a single sample and repeated across all samples.

1. Separate the sample into cockles and clams.
2. Sort cockles into undersize (<16mm) or of size (>/= 16mm) using a 16mm riddle. Count the number of cockles in each group.
3. Sort undersize cockles into a further three groups; "undamaged", "chipped", or "heavily damaged" individuals. Repeat this for cockles of size. This should result in six groups of cockles. Weigh each of these groups to the nearest gram.
4. Sort clams into undersize (<35mm) or of size (>/= 35mm) using a 35mm gauge. Count the number of individuals in each group.
5. Sort the undersize clams into a further three groups; "undamaged", "chipped", or "heavily damaged" individuals. Repeat for the clams of size. This should result in six groups of clams. Weigh each of these groups to the nearest gram.