New Zealand Inshore Trawl Gear and Operations Survey

A REPORT COMMISSIONED BY

SEAFOOD INNOVATIONS LTD
&
SEAFIC

APRIL 2008

Report Prepared by:

CLEMENT & ASSOCIATES LTD
FISHERIES ADVISORS & ANALYSTS
98 Vickerman St | PO Box 1460 | Nelson, New Zealand | Phone: 64 3 545 7020 | Fax: 64 3 545 7021 | Email: clement@fishinfo.co.nz

Table of Contents

Disclaimer: While every effort has been made to ensure the accuracy of this report Clement & Associates Limited accepts no liability for any errors of fact or opinion expressed herein.

Project Objective

Objective

"To identify current gear technology and operating practices in the inshore trawl fishery".

The project will deliver a baseline study of trawl gear used in the inshore fishing fleet. Trawl vessel operators and trawl gear manufacturers will be canvassed to identify the configuration, components and nature of trawl gear use in different operations to develop an overall picture of trawl gear use in New Zealand inshore fisheries. This information can then be fed into an assessment process to identify opportunities and priorities for drag reduction.

There is currently no database on trawl gear configuration and use in New Zealand that can be utilised for an assessment process.

General Approach

The general approach is to consult with vessel operators, and net suppliers to build a picture of trawl gear configuration and use in New Zealand.
The steps are as follows:

- Identification of vessel operators that use trawl gear
- Identification of net manufacturers and suppliers
- Development of an analytical framework
- Development of an empirical questionnaire
- Interviews with trawl operators at 12 inshore ports using the questionnaire to identify:
    - Configuration, materials, mesh design and components used in trawl gear
    - Substrate types
    - Target species and fish behaviour
    - Operation of vessels when towing gear (tow speeds, duration etc.)
    - Fuel efficiency tools in use (net monitors, fuel flow meters etc.)
    - Any other relevant considerations

Summary

Highlights

This summary process highlighted that inshore trawlermen are:

- Ready to talk about their operations in order to “help us help them”
- There are less trawlers operating in New Zealand inshore fisheries than expected
- Survey captured approximately 80% of current operators
- Data can be compared by region or across regions to highlight variances in specification and operation of gear or knowledge gaps
- Database very powerful given volume of information and level of participation

Overall there were not a lot of major surprises in the information collected. However the database does show strong regional differences in activity and operation.

Innovations

There are good innovations and practices occurring throughout the country, but generally on a perceived basis, costs and risk are precluding much innovation.

Database

The database as is created, due to the quantity of information and the level of participation, is a very powerful tool to further work on identifying solutions for drag reduction and subsequent energy savings.

It can be utilised to:

- Analyse operational or gear specification variations by
  - Region or within a region
  - Vessel capacity
  - Target species
- The database can also indicate knowledge gaps around key energy use issues.

For the first time ever a clear picture of those actual operational parameters that have a direct affect on energy consumption in the inshore fleet can be analysed.

Next Steps

There is now the need to:

- Ensure the lessons learned in collecting this information are used when communicating with the fleet
- Get fishermen involved in analysis of the information at detail level to ramp up cross pollination of existing good practice
- Use fishermen to help identify issues and experts to support development of solutions
- Create an action plan such that opportunities can be defined and addressed
- Develop a robust communication strategy
- Get started

Introduction

Introduction

As noted in the Project Objective, this report endeavours to set out three pieces of information:

a. How the data was collected and learning from this process
b. The database itself and the type of information that can be gleaned from it
c. A "first look" at opportunities to reduce fuel consumption per unit catch in our inshore trawl fisheries

The report assumes a reasonable level of understanding of trawl fisheries in general and does not seek particularly to remind readers of the known factors surrounding vessel and towed gear resistance or the broad science of fish behaviour and related trawl design and operation.

The information presented tends to use averages as a result. These are useful to give a broad understanding of variation but further analysis of the information to consider variation within the averaged data will also be essential. The database provides for analysis of deviation and other variance information that has not been fully explored here.

Methods

Data Gathering

This project always envisaged a questionnaire type survey as the basis for gathering the required data. There were potential risks associated with this:

- Fishermen being reticent about passing on sensitive or commercial information
- Questions being irrelevant or vague (poor survey design)
- Lack of response

These issues were dealt with in the development and use of the questionnaire.
It was important to have fishers involved in the initial design. The first round of design included people who were involved in the overall project design, two trawlermen, and the database designer. This ensured we created a questionnaire (attached Appendix 1) that had utility and acceptability from all perspectives. Secondly we then "test drove" the questionnaire using a few local fisherman. This highlighted a few more issues which were sorted prior to launch.

Key components of the questionnaire were:

- Information about the vessel and operator and region of operation
- Vessel specifications including engineering
- Fishing operations (trawl grounds, tow speeds and target species)
- Electronics
- Trawls, trawl doors, warps and rigging as well as manufacturer

The main thrust of data collection was "one on one" interviews by a well known trawlerman and FishSafe mentor. This was planned to create the right environment for robust answers. An article on the project outlining its aims, processes and those involved was placed in Seafood NZ prior to raise awareness.
Finally, copies of the questionnaire were posted to many fishermen or placed with company representatives for distribution.

A list of potential candidates was derived from both FishServe and SITO databases. Contact was also made with Port or Fishing Associations as well as major fishing companies. We acknowledge the support from FishSafe in providing information and thank them for it.

As a general rule we did not include vessels over 28m.

Database & Information Creation

A simple database was created using MS ACCESS™. As the questionnaire was deliberately designed to furnish this, the process was uncomplicated. It was necessary to create rules to turn any Imperial measurements such as feet and fathoms (still common in the inshore fisheries) into metric.
<u>Presentation of data was done on a regional basis to ensure both confidentiality and reasonable merging of the fleet. Care was taken to ensure the value of individual information was not lost by "over merging" or combining significantly different operations.</u>

Results

Survey Process

It was found that there was nil response to posted or distributed survey forms. However response to “one on one” interviews either by phone or in person drew a 100% successful response rate.

The databases used to define potential pool of trawlers suggested that over 300 were in existence around NZ. In the field enquiries reduced this to less than 200 (approx. 188) and of these 153 (81%) were surveyed. It is apparent that many vessels listed as trawlers have either been disposed of or are deployed into other fisheries such as tuna lining.

By visiting the key ports (Figure 1) and making contact, the project was able to gather information on vessels operating from over 35 bases around NZ. A further benefit was anecdotal or supporting information that attended the survey interview.

General Operator Information

Background information was sought to identify levels of experience in the fleet and the extent to which vessels are operated by their owners. This is detailed in Tables 1 and 2. Over 25% of vessels are contract skippered and generally they have half the “time at the wheel” of owner operators.

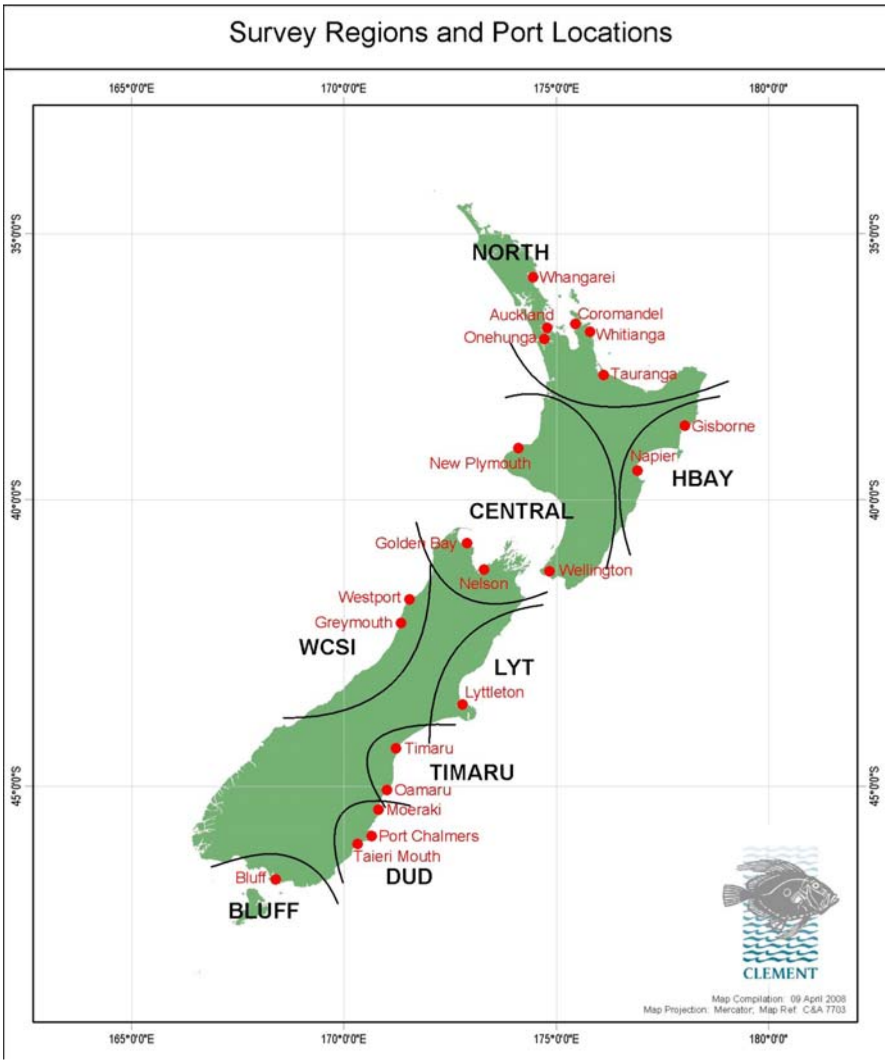

Figure 1: Survey Regions & Port Locations as referenced in Table 1.

Continued on next page

Owner Operators vs Contract Skippers breakdown

Table 1: Proportion of owner operators versus contract skippers by region with relative experience in years on the vessel.

	No. of surveyed vessels per region	% of owner operators	% of contract skippers	Av. time running vessel in years (owner operators)	Av time running vessel in years (contract skippers)
NORTH	16	56	44	4	2
HBAY	18	56	44	7	2
CENTRAL	28	71	29	12	7
WCSI	24	88	12	10	6
LYT	17	65	29	10	5
TIMARU	16	75	25	10	4
DUD	20	95	5	9	N/A
BLUFF	14	57	43	16	8
Overall	153	**72**	**28**	**10**	**5**

Owner Operators vs Contract Skippers summary

Table 2: The number of owner-operators versus contract skippers in the surveyed fleet.

Owner Operator	110
Contract skipper	42
Not specified	1

Continued on next page

Vessel Age and Size

Further data gathered regarding vessel size by length overall (loa), and age is presented in Table 3. The age data confirmed expectations that vessels in the inshore fleet are well aged, with building occurring in the 1960-70 period. This appears to be more so in the North Island.

Table 3: Size in metres (loa) and age of vessels by region. Included is proportion over 30 years.

	Number of surveyed vessels per region	Average size (m)	Average age (yrs)	% vessels over 30 years old	Average Hp
NORTH	16	19	36	75	390
HBAY	18	14	34	28	251
CENTRAL	28	15	33	43	270
WCSI	24	15	39	71	199
LYT	17	16	32	53	239
TIMARU	16	15	30	56	214
DUD	20	13	37	65	186
BLUFF	14	16	37	71	224
Overall	153	**15**	**35**	**57**	**245**

Vessel Engineering Information

Table 4 shows some key engineering parameters. The northern North Island stand out as areas of higher horsepower engines and greater gearbox reductions. Engine use as measured by hours varies without pattern. Given that fuel filter servicing is recommended (under standard operating conditions) every 4-500 hours it is apparent the high horsepower fleet in the North is attending to this better than the southern sector. There is an obvious major lack of knowledge regarding the power curve as it relates to vessel rpm (and fuel consumption).

Table 4: Engineering information and knowledge regarding key parameters

	No. of vessels per region	% skippers who think engine well tuned	Average Hp	Average hours on engine	% skippers who know power/fuel curve	Average fuel filter service (hrs)	Average gearbox reduction
NORTH	16	81	390	8871	13	465	4.1
HBAY	18	83	251	12813	22	853	3.4
CENTRAL	28	89	270	13637	29	975	3.4
WCSI	24	92	199	9048	13	476	3.3
LYT	17	88	239	14616	29	818	3.0
TIMARU	16	88	214	16864	25	969	3.5
DUD	20	85	186	9584	10	783	2.7
BLUFF	14	93	224	6739	21	818	3.2
Overall	**153**	**87**	**245**	**11,738**	**20**	**773**	**3.3**

Continued on next page

Monitoring Systems

The ability of trawlermen to monitor certain operating parameters was explored. Table 5 lists the proportion of the fleet that can accurately assess key measures such as vessel position (and hence speed), continuous fuel usage and fishing gear performance.

Table 5: Regional levels of monitoring systems use

Region	No. of vessels	% with Flow Gauge	% with Pressure Gauge	% with GPS	% with plotter	% with net monitor	% with catch monitor	% with door sensor
NORTH	16	19	31	100	100	25	0	0
HBAY	18	0	17	100	100	6	0	0
CENTRAL	28	4	36	100	96	21	0	0
WCSI	24	4	25	100	100	17	0	0
LYT	17	24	18	94	94	12	0	6
TIMARU	16	0	31	100	100	25	6	0
DUD	20	10	10	100	100	0	0	0
BLUFF	14	7	21	100	100	0	0	0
Overall	153	**8**	**24**	**99**	**99**	**14**	**1**	**1**

Fishing Operation and Gear Information

A large part of the survey focussed on trawl gear and its use. The relative resistance of trawl gear components is understood (Wileman D.A. 1984; Hou E. and Robertson J.) but the overriding variable affecting changes in drag is tow speed (resistance increasing exponentially in relation to velocity). Different fish are known to require differing tow speeds depending on the particular behaviour and locomotion capabilities such as burst speed and endurance of the species (Wardle C. S.; ICES MSS, 1992). This has been learned both by experience of fishermen relating instantaneous catch rates over time and by experimental work particularly overseas (UK). It is generally regarded by the fleet that species such as snapper and trevally require higher tow speeds than flats. This is reflected in the data presented in Table 6. It also suggests higher average fleet tow speeds where these species predominate, i.e. the top half of the North Island. This effort is generally reflected in the rpm required as a proportion of engine capability, as shown in Table 7.

Continued on next page

Tow Speed vs Target Species

Table 6: Regional average tow speed in knots by target species.

	SNA	TRE	HOK	GUR	TAR	FLA	RCO	WAR	BAR	Average
NORTH	3.1	3.6	3.0	3.0	2.9	3.5			3.3	3.2
HBAY	3.1	3.1		2.8	3.0	2.7		3.1		3.0
CENTRAL	3.2	3.4		2.9	3.0	2.9	3.0	3.2	3.3	3.1
WCSI			3.5	2.5	2.9	2.5	2.6	3.1	3.1	2.9
LYT				2.6	2.8	2.6	2.9	3.2		2.8
TIMARU				2.7	3.0	2.5	2.6	3.0	3.0	2.8
DUD				2.3	2.3	2.3	2.3			2.3
BLUFF				2.5		2.5				2.5
Overall	**3.1**	**3.5**	**3.3**	**2.8**	**2.9**	**2.6**	**2.6**	**3.1**	**3.1**	**2.9**

Tow Speeds

Table 7: Demand on engine to achieve tow speed for target species.

Target Species	**% of Tow RPM to max Revs**
SNA	80
TRE	78
HOK	81
GUR	76
TAR	78
FLA	74
RCO	75
WAR	81
BAR	78

Continued on next page

Headline Height

Headline height is a characteristic that varies according to the behaviour of the target species. Snapper and trevally require high opening nets as they tend to both school off the seabed and choose more escape paths, e.g. upwards, than species such as flats and gurnard. Table 8 illustrates little variation in average measures for this range of types.

Table 8: Average net headline opening in metres for the 3 sizes of trawl gear used by the inshore fleet.
** one response was removed from this calculation due to data error

	No. of vessels per region	Average net height (m) - low	Average net height (m) - medium	Average net height (m) - high
NORTH	16	1	3	5
HBAY	18	2	3	5
CENTRAL	28	2	3	5**
WCSI	24	1	3	4
LYT	17	1	3	4
TIMARU	16	1	3	8
DUD	20	1	3	N/A
BLUFF	14	1	3	N/A
Overall	153	**1**	**3**	**5**

Netting Characteristics

Tables 9-11 show various characteristics of netting used to build trawls. These are grouped as low opening (1-2m), medium (2.1-3.7m), high (3.8m+).

There is little variation in largest mesh size by trawl group, with the least occurring in the low opening trawls. Few trawls are utilising knotless netting or materials other than polyethylene (PE). This combined with results on Table 12 regarding alternative mesh use orientation (T90) demonstrates that a traditional construction and materials methodology is still preferred in NZ inshore fleet.

Table 9: Low opening (1-2m) trawls with most common largest mesh size, number incorporating knotless netting and netting material, by region.

	No. of vessels per region	Largest mesh size (mm)	% of knotless netting	Material used other than polyethylene
NORTH	1	152	0	None
HBAY	6	305	17	None
CENTRAL	7	229	14	None
WCSI	18	152	6	None
LYT	9	152	11	None
TIMARU	5	152	0	None
DUD	14	152	0	None
BLUFF	13	152	8	None
Totals	**80 vessels**	**Mode: 152mm (6")**	**Avg. 6%**	

Continued on next page

Netting Characteristics (cont)

Table 10: Medium opening (2.1-3.7m) trawls with most common largest mesh size, number incorporating knotless netting and netting material, by region.

	No. of vessels per region	Largest mesh size (mm)	% of knotless netting	Material used other than polyethylene
NORTH	6	457	17	None
HBAY	7	229	0	None
CENTRAL	14	305	0	None
WCSI	7	229	0	None
LYT	8	457	13	None
TIMARU	13	305	0	None
DUD	6	203	17	None
BLUFF	7	254	14	None
Totals	**75 Vessels**	**Mode: 152mm (6”)**	**Avg. 5%**	

Netting Characteristics (cont)

Table 11: High opening (3.8m+) trawls with most common largest mesh size, number incorporating knotless netting and netting material, by region.

	No. of vessels per region	Largest mesh size (mm)	% of knotless netting	Material used other than polyethylene
NORTH	9	457	22	None
HBAY	3	305	0	None
CENTRAL	9	457	0	None
WCSI	3	229	33	None
LYT	2	229	50	None
TIMARU	3	229	0	33 % Nylon
DUD	0	N/A	N/A	None
BLUFF	0	N/A	N/A	None
Totals	34 Vessels	**Mode: 305mm (12”)**	**Avg. 12%**	

Netting Characteristics (cont)

There has been some interest and discussion regarding panels of so called “T90” style netting, initially developed overseas, where the panels of meshes are hung differently in the construction of the trawl which allows for improved water flows through the net. Table 12 shows the level of use of this method, which is believed to offer potential benefits in catch selection, by-catch reduction, improved catch rates and drag reduction.

The table below summarises the proportion of fishers using meshes on the side as opposed to straight on, for the three types of net surveyed – low opening, medium opening and high opening.

Table 12: Use of panels in trawls with netting hung rotated 90^{o} from usual orientation.

Mesh direction	Low opening nets (%)	Medium openings nets (%)	High opening nets (%)	**Overall (%)**
Standard	93	91	94	**92**
On side (T90)	6	8	0	**6**
Not Specified	1	1	6	**2**
Total No. nets	100% (80 nets)	100% (75 nets)	100% (34 nets)	100% (189 nets)

Continued on next page

Trawl Manufacturers vs Trawl Type Produced

Based on the survey, fishing gear sales are dominated by three manufacturers (producing over 50% of all trawls) with the two highest producers (Milligan and Gourock's being based in the North Island and South Island respectively) as shown in Table 13. Netsheds have not been contacted to confirm these findings. There is a greater tendency for fishermen needing low opening (i.e. flatfish) trawls to build nets themselves and it is apparent that many operators use only one trawl.

Table 13: Trawl manufacturers and production proportions by trawl type

Net Manufacturer	Low opening nets (%)	Medium openings nets (%)	High opening nets (%)	**Overall (%)**
Gourock's	23	33	15	**26**
Hampidjan	1	8	3	**4**
Kenton's	5	4	3	**4**
Milligan	4	16	50	**17**
Motueka Nets	5	9	6	**7**
Networkz	21	12	0	**13**
North Beach	4	0	3	**2**
Self made	17	3	3	**9**
Winchester	9	0	0	**4**
Other	10	15	18	**13**
Total No. nets	100% (77 nets)	100% (75 nets)	100% (34 nets)	100% (186 nets)

Trawl Door Material

There were clear variances in trawl door construction in relation to region, this apparently once again driven by target species. The higher horsepower trawlers of the upper North Island opting exclusively for steel doors, whereas southern regions where flats predominate as the target species shows a much greater use of wooden construction. Other included stainless steel and plastic. Table 14 shows results.

Table 14: Trawl door construction material by region.

	No. of vessels per region	% Alloy	% Steel	% Wood	% Other material
NORTH	14	0	71	21	7
HBAY	28	4	89	7	0
CENTRAL	20	5	40	55	0
WCSI	18	0	94	6	0
LYT	17	0	76	24	0
TIMARU	16	0	100	0	0
DUD	16	0	38	50	13
BLUFF	24	0	67	33	0
Overall	**153**	**1**	**73**	**24**	**2**

Continued on next page

Trawl Door Size and Weight

Trawl door size (by area and weight showed the expected progression upwards when compared to vessel horsepower). The extent to which these trawl door sizes shown in Table 15 match the net drag based on twine surface area (tsa) of the trawl is not known as tsa is not recorded, although calculable (e.g. Ferro R.).

Table 15: Trawl door size and weight in relation to vessel horsepower.

HP Range	Average door size (m^2)	Average door weight (kg)
0-99	1	105
100-99	2	120
200-099	2	193
300-399	2	323
400-499	3	417
500-599	3	367
600-699	3	507
700-799	No vessels in this range	
800-899	No vessels in this range	
900-999	3	900
>1000	4	1100

Continued on next page

Ground Rope vs Seabed

Few fishermen knew the weight of their groundrope (although the length was universally known and is a "standard" measure or index of a trawl's "size"). It can be noted from Table 16 that it appears the choice of groundrope material is made based on more factors than just seabed type. This is borne out by further anecdotal evidence collected during the survey. Chain is popular not only on hard seabed types but where fish species that stay "hard down" such as flats and stargazer are predominant targets.

Table 16: Ground rope type and material in relation to regional predominant seabed type

	Predominant seabed type	chain	rope bound	rubber	other material
NORTH	Hard	1	14	2	1
HBAY	Soft	4	11	4	1
CENTRAL	Soft	18	4	11	1
WCSI	Hard	22	0	6	
LYT	Soft	9	1	11	
TIMARU	Hard	6	1	16	
DUD	Hard	23	0	2	
BLUFF	Hard	18	0	2	
Overall	Hard	101	31	54	3

General Knowledge

Table 17 shows differing levels of knowledge for various operational measures. It shows that much ingrained knowledge is in regard catch efficiency rather than fuel optimisation.

Table 17: Knowledge levels for selected parameters

Well known operating parameters	% know
Net dimensions and materials	95-100
Rigging dimensions	95-100
Tow duration and rpm	95-100
Engine operating characteristics	95-100
Fuel filter change	95-100
Average level of knowledge	% did not know
Trawl door weight	18
Engine service record	14
Knowledge gaps	% did not know
Twine surface area of trawl	99
Ground rope weight	80
Trawl door operating angle	75
Propeller dimensions	52

Continued on next page

Discussion

Survey Process

As noted in the results, mailout of questionnaires was a clear failure with nil returns. The "one on one" interviews were obviously the better route but were relatively time consuming. The personalised process allowed for a better "feel" for what is occurring in the fishery and creates the relationship for better communication in the future. However, it also creates a responsibility for us (based on an expectation from the interviewees) that something will happen, i.e. there will be positive outcomes from the process. Fishermen through this process made it plain that they welcome more information via a variety of media such as Seafood NZ and internet.

Not only has the survey given us information to consider energy saving opportunities, it is, due to its comprehensive nature, a valuable information foundation and tool for industry to utilise internally for other fishery issues management.

Fishing Vessel Engineering

It is plain that we are in an industry with an aged fleet. However while average engine age is at the upper level of average life expectancy (11,500hrs actual versus 10-15,000 expected life) it is obvious that the fleet is based on aged hulls with regular if not frequent engine (and assume propeller) replacement. Gains to be made from an engineering perspective are likely to come from a more consistent approach to maintenance based on a better understanding of the benefits. Discussions with marine engineers suggest that air filter, cooling water and other regular preventative maintenance are paramount to both engine life and fuel consumption. More communication on this would be beneficial. There is a definite lack of knowledge around propellers and engine servicing which requires addressing. Obviously such issues have been solidly approached before (e.g. Gilbert L., 1983) so either information provided in the past has failed to create change, the vessels involved have new propulsion systems or the message has been lost or forgotten. This is amply demonstrated by the current knowledge gap around engine performance curves.

Monitoring Systems

It is apparent that while there has been almost total uptake on navigation systems (GPS and associated plotters) there is very low use of fuel or gear monitoring equipment. The fixed costs of such systems are problematic but this demonstrates a clear miss in regard to operators being able to go from a total catch focus to catch vs fuel use optimisation.

Continued on next page

Fishing Operations and Trawl Gear

In general the information tabulated in this report shows patterns that were reasonably expected by the authors:

- Regional differences (some attributable to target species)
- Clear differences in tow speed and horsepower in the fisheries involving fast swimming fish
- Strong knowledge base around catching perspectives of trawls with definite knowledge gaps about drag components and engineering component performance
- Some innovation but also some strong regional practices (which are <u>either</u> unchanged traditions or proven methods)
- Generally traditional design, materials and construction of trawls

This shows that largely there is a "system" or pattern to fishing gear and operational decisions. It will be essential to further interrogate this database so that variations and regional differences can be ascertained and analysed. This should be done in a "workshop" manner with a group of fishermen involved to both ask the questions and analyse the results. Based on the anecdotal reporting there is evidence to suggest that more cross pollination of ideas locally and regionally would be valuable and that "secrecy" is not the factor preventing this, rather a lack of trusted or simple communication systems.

It is shown that there are relatively few major suppliers of trawl gear. Any beneficial modifications could be rapidly disseminated to the manufacturers. A noticeable lack is information on twine surface area information for trawls. This is something that should be considered to be supplied by the manufacturer (a simple spreadsheet model can be utilised to calculate) so that buyers know how much potential drag they are buying into. Further this information can be used to match trawl doors to nets.

The operational requirements demanded by catching snapper and trevally (plus barracouta) in the northern North Island make this a very high energy fishery. It is typified by higher hp vessels towing bigger nets, faster than the industry norm.

There is a clear lack of development in inshore trawl doors and no stand out commercial supplier. This has lead to industry persisting with 'tried and true" formulas which would benefit from testing against other options.

General Knowledge

This small set of results shows that "they know what they know and they know it well". However it also demonstrates that most well ingrained knowledge is generally focussed on total catch efficacy and not fuel efficiency. This is understandable given past relative cheapness of fuel and when addressed will be a major area of improvement in fuel saving.

In regard trawl door operation, few fishermen knew the angle of attack of their trawl doors, and those who did often only believed they did (based on general empirical evidence). This is an area where some simple training tools would go a long way to removing some of the mystery of trawl door operation.

Continued on next page

Anecdotal

Perhaps the most important finding here was that a major hurdle to better performance is knowledge transfer. There is a real thirst for information or support. It has, to a greater or lesser extent, been offered in the past during previous "fuel crises" and yet any past gains have been lost either through lack of implementation or industry memory losses. It is critical to attain better outcomes this time around. It is likely that the basis of this survey and what was learned regarding fisher input and lack of utility in a "mailout" approach should be considered before planning any communication or education strategy.

There are currently no less than 5 standout innovations or processes already underway that could possibly be harnessed to the benefit of more operators:

a. Proposed gear trials involving solid grid sections to release fish and improve water flow
b. Danish seining which has legacy issues both in legislation and efficacy but which deserves further research
c. Twin-rigging for flats in particular
d. New age materials for nets and rigging
e. T90 panels

Immediate Opportunities

- Select regions where strongest variations to the norm are occurring and identify cause of variances and solutions
- Follow up with netsheds to confirm findings and seek twine surface area information
- Use an appropriate forum to "redo" an engineering education package which should include use of fuel monitors where appropriate
- Use database in a workshop environment, with fishers, to ascertain detailed beneficial cross pollination options
- Develop solutions to overuse of energy by using experts to deal with issues raised
- Utilise FishSafe forums and mentors to provide trustworthy and personal liaison
- Create a communication strategy that works, i.e. where information is assimilated, implemented and persisted with
- Develop program to explore, prove and communicate improvements in trawl net and door design and materials that either improve catch efficiency or reduce drag

References

Fish Behaviour, Trial Efficiency and Energy Saving Strategies	Wardle, C.S.	FIIT Working Paper (date unknown)

Fish Behaviour in Relation to Fishing Operations
ICES Marine Science Symposium	Bergen 1992

Project "Oilfish", Investigation of the Resistance of Trawl Gear
Wileman, D.A.	Danish Institute of Fisheries Technology	1984

Drag Formulae for Two Types of Demersal Trawls
Hou, E. and Robertson, J.H.B	Marine Laboratory, Aberdeen (date unknown)

The Calculation of the Twine Surface Area of Net
Ferro, R.S.T.	Marine Laboratory, Aberdeen (date unknown)

Fishing Vessel Fuel Control
Gilbert, L.	Fishing Industry Training Council, Wellington	1983

Appendix 1: Survey Questionnaire

Page 1

Inshore Trawl Gear Survey
(Confidential to Clement & Associates Ltd)

1 Introduction

Operator Name:	
Address:	
Phone Number:	
Vessel Name:	
Skipper Name:	

2 Vessel Specifications

Length (feet):		
Beam (feet):		
Age:		
Flopper Stoppers:	Y	N
Hull Cleaned every:	mnths	

1b Usual Operating Region:

AKL		W.C.	
BOP		LYT	
HBAY		TIM	
WANG		DUD	
WGTN		BLF	
NSN		Other	

1a

Owner/operator:	Y	N	
Time running this vessel:	yrs		
Crew share fuel cost:	Y	N	N/A
Months per year trawling:			

3 Hull Construction:

Wood	
Steel	
Concrete	
Alloy	
Fiberglass	
Other	

4 Engine Make:

Cummins		
Gardiner		
Cat		
Volvo		
Scania		
GM		
Ford		
Perkins		
Other		
Turbo?	Y	N

4a Propeller:

Diameter	in	
No. of blades		
Nozzle	Y	N
Pitch		

4b

Gearbox reduction:	: 1

5 Fuel Monitoring system

No	
Flow gauge	
Pressure gauge	

Fishing Operations

6 Average Regional Seabed Type

Hard (sand small stones)	%
Soft (mud)	%
Foul	%

6a

Shallow fishing warp : Depth ratio	: 1
Deep fishing warp : depth ratio	: 1

7 Maintenance / operation

Do you know your power/fuel curve?	Y	N
Do you believe your engine is well tuned?	Y	N
Max HP/Max revs		
Hours on engine		
When last injector service	hrs	
When last fuel filter service	hrs	

8

Target Species:	% of fishing	Tow Speed Tow RPM		Net Type (opening) Low (3-6ft)	Med (6-12ft)	High (12ft+)	Ave Tow Duration (hrs)
SNA				L	M	H	
TRE				L	M	H	
HOK				L	M	H	
SDO				L	M	H	
GUR				L	M	H	
TAR				L	M	H	
FLA				L	M	H	
RCO				L	M	H	
WAR				L	M	H	
BAR				L	M	H	
Other				L	M	H	

Continued on next page

Page 2

Vessel Operations

9

Electronic Equipment		
GPS	Y	N
Plotter	Y	N
Net Monitor	Y	N
Catch Monitor	Y	N
Door Spread Sensor	Y	N
Other?	Y	N

What different nets do you use? If you use more than one please put their details under the relevant height below for each of them.

10

Net Details:	Low opening (3-6ft)	Medium opening (6-12ft)	High opening (12ft +)	Other
Name of Net				
Manufacturer				
# of panels (2 or 4)				
Bottom or midwater				
Groundrope length (ft)				
Groundrope type (rubber/chain/rope bound/bobbins/other)				
Groundrope diameter (inches) or mm if chain				
Groundrope weight				
Headline height (ft)				
Twine surface area				
Largest mesh size (inches)				
Mesh straight on or on side	Str / Side	Str / Side	Str / Side	Str / Side
Material twist or braid	T / B	T / B	T / B	T / B
Material is poly/nylon or other	P / N / O	P / N / O	P / N / O	P / N / O
Knotless netting	Y / N	Y / N	Y / N	Y / N
Codend length (meshes)				
Float size (inches)				
Number of floats				
Net been altered	Y / N	Y / N	Y / N	Y / N

11

Sweeps & Bridles:	Low opening (3-6ft)	Medium opening (6-12ft)	High opening (12ft +)	Other
Bottom bridle (length / diameter)	Len / Dia	Len / Dia	Len / Dia	Len / Dia
Bottom bridle lay (left or right)	L / R	L / R	L / R	L / R
Top bridle (length / diameter)	Len / Dia	Len / Dia	Len / Dia	Len / Dia
Sweep (length / diameter)	Len / Dia	Len / Dia	Len / Dia	Len / Dia
Sweep lay (left or right)	L / R	L / R	L / R	L / R
Sweep material (wire / chain / synthetic / bonded)	W / C / S / B	W / C / S / B	W / C / S / B	W / C / S / B

Continued on next page

Page 3

12

Warps Material:		
Wire		
Synthetic		
Lay	L	R
No. strands		
Diameter	mm	

Doors:

13

Backstrops:	
Wire	
Chain	
Synthetic	

14

Size:	Sq ft	Sq m
Weight:	kgs	
Age:		

14a

Type	
Manufacturer	
Angle of attack / cut	

14b

Material	
Wood	
Steel	
Alloy	
Other	

Date:		Interviewer Name:	

General Comments