Mitigating Seabird Interactions with Trawl Nets

A REPORT COMMISSIONED BY DEPARTMENT OF CONSERVATION PROJECT MIT 2006/02

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Part 1: Executive Summary

Summary

Nets used in the deepwater trawl fleet of New Zealand have in the past been responsible for up to half of recorded seabirds captured. The trawl warps (cables) are responsible for the majority of the remainder. There has been research and implementation of measures both in NZ and internationally to reduce warp strikes and captures in recent years and hence the proportion of net captures has risen. It is apparent that trawl nets on average capture and retain a differing set of species than warps, generally representing shearwaters and petrels capable of diving well below the sea surface. However larger seabirds are captured also.

The Department of Conservation of New Zealand requested research into the issue of trawl net captures with a view to innovating and proving effective options to mitigate this particular problem. This report acknowledges previous work both particular to that specific request and where the problem has been researched or formally discussed elsewhere.

Mostly this paper reports on specific trials undertaken in the field on measures agreed to have a probability of success. This agreement was formed from information provided by that previous work, as well as expert knowledge.

Trawl net captures occur while the trawl itself is at or near the surface, with the diving capability of the seabirds involved being the determinant of how prolonged the risk is. Whilst observation is difficult, it is general accepted that offal discharge will keep seabirds in attendance of a vessel, and that seabirds will put themselves at risk to compete for this food source. Also seabirds are cued by the sound of a vessels winches to the hauling of the net and again will compete for food items in the hauled net. If the net retains food items after the catch is removed, then during shooting seabirds will be attracted to the net at that time also. Seabirds can become entangled or trapped in the meshes (thereby being injured or drowned) or become captured by the trawl itself and be drowned. Some seabirds are captured during hauling in of the trawl and are released alive. It is noted that when events (e.g. operational failure or heavy weather) prolong the time the net is on the surface, the risk of multiple seabird captures increases.

It was considered that any method that reduced the spatial volume of netting available on the surface to either entangle or allow entry of seabirds was a logical step. It was also thought that such a reduction may increase the rate at which the net sinks below the risk zone. Hence it was determined to trial two measures:

1. During hauling have the vessel turn off its straight course such that as the net is retrieved aboard it is compressed against the stern ramp quarter and “closed up”.
2. Bind the net with twine (as initially tested in the South Georgia icefish fishery) that bundles netting together during shooting until either broken or untied by the spreading force of the trawl doors.

These trials were carried out on two large stern trawlers operating midwater (pelagic) trawls. It was important to measure whether the methods imposed any operational or a safety risk to the vessel, catch or crew as well as other unforeseen impacts. Also observed was the behaviour of seabirds around the vessel in regard the various treatments. The field trips on two vessels were generally successful but did not trial bottom trawls.

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Part 1: Executive Summary, Continued

Key Results

Key results were:

- Turning the vessel was already a critical component of the deck operation of the vessels in regard fleeting their nets.
- Seabirds attend the haul in greater numbers than when shooting the net and appear to be using sound based cues
- Net binding can be carried out on the type of trawl and vessels used in the trials safely but mistakes can occur causing non-operation of the trawl
- It is difficult to objectively measure sink rate of the trawl
- No seabirds were captured during these trials despite aggressive behaviour by them at times

Conclusion

In conclusion it appears that general anecdotal information about seabird behaviour around trawlers is consistent with this work. Whilst it is apparent that binding can be achieved on pelagic trawls, this work does not provide strong evidence that it is always required as risk during shooting can be low despite seabird attendance. It would be useful to trial the method on bottom trawls in another fishery, e.g. squid or hoki, to determine if there is more value in this measure. We consider that net binding would be a useful measure where circumstances dictate that net captures on shooting of the trawl are a real problem.

In regard vessel turns to close the net during hauling, it is suggested that some quick and simple trials are carried out under observation on a vessel where this is not the norm and consider its usefulness subsequently. Again it is likely that this method will lend itself as an additional measure to those circumstances where a vessel is having an issue with particularly high numbers of aggressive birds.

Acknowledgement

Clement & Associates Ltd would like to thank Sealord Group Ltd for access to their vessels for the sea trial part of this project.

Part 2: Background

Objectives

The Department of Conservation (DoC) Project MIT 2006/02 has the overall objective to reduce captures of seabirds in trawl nets.

The specific objectives of this project are:

a. To characterise the nature and extent of interactions between seabirds attracted to trawl vessels and trawl nets;

b. To identify ways in which these interactions can be avoided or reduced; and

c. To trial methods that show potential to reduce these interactions

The first two of these specific objectives have been completed in a report "Net Captures of Seabirds During Trawl Fishing Operations in New Zealand Waters", NIWA Report WLG2008-22 (Baird, S.J. (2008) and during a workshop http://www.doc.govt.nz/conservation/marine-and-coastal/commercial-fishing/marine-conservation-services/meetings-and-project-updates/6-may-2008/.

Edited notes from the workshop are reproduced here to demonstrate the pathway taken to meet the third objective. Attendees at the workshop included scientists, skippers, Ministry of Fisheries fisheries observers and managers involved in seabird mitigation issues.

Reference was made to previous interest/expert group meetings held previously by both DoC (2005) and Southern Seabird Solutions (SSS) (2006). It is notable that many of the items of discussion were similar to those of previous gatherings. Relevant parts of the SSS meeting notes are appended in Appendix 5.

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Meeting Notes from 6 May 2008

Seabird Trawl Net Captures: Notes from Meeting held Tuesday 6 May 2008
Department of Conservation, Manners Street, Wellington

Present:

Suze Baird – NIWA
Johanna Pierre – DoC
Stephanie Rowe – DoC
Christopher Robertson – Wildpress Ltd
Richard Wells – Clement & Associates Ltd
John Cleal – Clement & Associates Ltd
David Middleton – SeaFIC
Matt Saunders – MFish Observer
Julian Hall – MFish Observer
Chris Carey – Vessel Skipper, Independent Fisheries Ltd

Apologies:

Jason Williamson – South East Resources Ltd
Ed Melvin - (left after S Baird presentation)
Susan Waugh – Birdlife International (left after S Baird presentation)

Purpose of Meeting:

1. Presentation by Suze Baird of analysis of seabird captures using MFish database
2. Discuss above
3. Discuss options for further research into net capture mitigation
   i) More "paper" research
   ii) Further analysis of existing information
   iii) At sea or other technical trials of mitigation options

Summary of Suze Baird (NIWA) Report:

- Highest diversity of seabirds are captured in FMAs 3, 4, 5 & 6; most captures identified as net captures in 3,5,6
- Most seabirds identified as net captures were captured January to June
- Captures occur across the deepwater trawl fleet
- Two primary factors – attractant offal, discard or fish in trawl – entanglement (via gear on surface)
- Risk of capture can be linked to anything that increases these factors
- Hence fishing practices or operations have a direct impact, as well as weather and mechanical failures that exacerbate these
- Noted that individual vessels stand out (i.e. capture rates not characterised by a similar level across entire fleet)
- Three main taxa stand out – sooty shearwaters, white capped albatross, white chinned petrels
- Noted that much information in report is qualitative (i.e. observer comments/diaries etc) and that for a significant number of captures there was not information on which to base analysis. Hence this summary needs to be used with some caution, especially the numbers included.

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Meeting Notes from 6 May 2008 (cont)

Key Opening Points:

- Seabirds habituated to attending fishing vessels
- Seabirds use acute sight (probably colour vision) hearing and smell to hone in on vessels and are aware of vessel activity signals (winch noise, factory smell, discard activity etc)
- Majority of seabirds identified as captured in nets are sooty shearwaters followed by whitecapped albatrosses, then white chinned petrels and Salvin's albatrosses
- Majority of identified net captures occur during daylight hours
- Offal understood to be a primary driver of seabird attendance and risk of interaction, but during hauling net is a key attractant due to content of fish
- Noted that regulatory, voluntary and experimental measures underway to minimise offal discards to reduce these as a risk factor and hence not to be a primary focus of this discussion. Difficult as yet to ascertain impacts of current measures on net captures
- Noted that fleet can be characterised by production, engineering and fishing gear types
- Noted that whilst large birds (albatross) tended to exhibit injury, more than half of shearwaters drowned without injury
- Noted that it appears that more birds are taken on haul and that food items in the net act as an attractant
- Captured sooty shearwaters are landed with "natural" food in their stomach's, that they may have taken from trawl nets or away from fishing operations. White chinned petrels more often have material that can be identified as offal in their stomachs when they are landed dead on deck
- The data analysed pertain almost entirely to the deepwater fleet due to observer placement
- Freshers thought to capture less seabirds than factory trawlers for a variety of reasons, including location, time of fishing, discharge patterns
- Tabled and noted contents of workshops held by DoC in 2005 and Southern Seabird Solutions Trust (SSS) in 2006 regarding seabird mitigation generally and net captures in particular

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Meeting Notes from 6 May 2008 (cont)

Options for Further Information Generation:

- Fleet characterisation – it is suggested that there would be value in documenting the current fleet (deepwater) parameters
- It was considered useful to draft a list of optimum vessel parameters
- There was considerable discussion about "stickers" being an attractant on shooting. It was noted that there was a lot of variation in level of diligence across vessels in sticker removal. This appeared to be based on crew numbers, experience and factory activity imperatives.
- There are differing operating parameters and risk (prolonged surface time) profiles for bottom trawl and midwater trawl operations. These are characterised in the table below:

Table 1: Risk parameters and vessel capabilities based on trawl net type.

Risk	Bottom Trawl	Midwater Trawl
Surface time during shooting	Low	Medium
Surface time during hauling	Medium	High
Mesh size wings	Small (0.3m)	Large (0-60m)
Surface tangle risk	Low	Medium/high
On surface during turn	No	Yes
Shoot immediately after haul – lag time	No	Sometimes
Stickers – remove	Less net to clear	More net to clear
Net in water during repairs	No	Yes

- The option of net binding (closing up trawl with light twine which breaks when doors are deployed) was discussed. This would keep meshes closed during shooting. Apparent that this method has been trialled and/or is used in fisheries of Falklands, South Georgia and Alaska.
- Factors that impinge on duration of net on surface were considered:
  - Weather slowing haul time
  - Gear size
  - Winch and sweep winch speed
  - Deck or net gear failure (operational expertise or aged gear)
  - Crew experience or skills
  - Method of deck operations (fleeting etc)
  - Presence/absence of net roller
- Tangled headlines and net monitors of mid water trawls can cause delays in getting gear below surface. While this is not common it has been linked to capture events.

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Meeting Notes from 6 May 2008 (cont)

Deterrents:

These were discussed as listed:

- Acoustic (above water) by either electrical or sonic devices. Generally considered that level of noise required (hard deterrent) over risk distance (250 – 750m) made this option unlikely
- Noise could be generated at human audible levels (gas cannon, siren, compressed air shockwave) or at levels not audible to us. Crew comfort, stress, an issue, potential for harm to seabirds also an issue.
- Acoustic (below water for diving birds)
    - Noted that contact made with some suppliers of "pingers" for marine mammals
    - Noted that ASDIC devices thought to have scared birds
    - Noted that to date no known devices that are effective for either seabirds or marine mammals
- Nets
    - Options discussed were tapes or streamers (especially at codend). These were trialled by John Cleal on a trawler and tangled
    - Coloured or fluorescent netting – noted that trawls were already built in white, blue, black, green, grey and orange, and this does no appear to deter seabirds
    - Alter mesh shape to reduce scissor action
    - Recognised that net deterrent would help haul as well as shoot. Options not considered to be "winners"
- Lights
    - Strong constant light? Anecdotal evidence suggests squid jiggers and other vessels hold birds away
    - Strobe or bright flashing directional light to deter or confuse
    - Not likely to be effective during day
    - Need to consider risks in regard to navigation, effect on other vessels or crew
- EMPs
    - Electro magnetic pulses were mentioned and are not understood but are listed for some further research

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Meeting Notes from 6 May 2008 (cont)

Summary:

- Key drivers are food attractant and gear on surface risk
- Most difficult issue is diving birds targeting food in trawl on haul
- Mitigation must be affordable, safe to crew, other vessels and environment (including seabirds!)
- Fleet can be characterised by operation and gear
- Captures can be characterised by bird type
- Analysis of observed data provides a guide to issues as do autopsy results
- Effect of offal management to date not certain but based on anecdotal reports and known past data should lead to reduced albatross interactions. However, the contents of the net are also attracting birds during the haul, and offal management will not reduce this other attractant

Part 3: Introduction

Net captures of seabirds in NZ

As noted incidental trawl net captures of seabirds occur in New Zealand (NZ) as well as other trawl fisheries (Baird. S. (2008), Bull. L. (2007), Varty, N. *et al* (2008)).

As the mitigation of these particular interactions is more challenging, less progress mitigating seabird incidents has been made to date (and less information on techniques is available) than for either longline (hook) captures or trawl warp strikes.

It is apparent in NZ trawl fisheries that the composition of species in net captures are mainly "small" birds (i.e. shearwaters and petrels) compared to predominantly "large" birds (i.e. albatross) in warp captures. To an extent this may result from better retention capabilities of nets compared to warps. It is reasonable to suggest that seabirds retrieved from nets are a useful measure of the species composition involved in this particular interaction.

Few methods to reduce trawl net captures have been trialled and documented despite national and international discussion (e.g. SSS Workshop 2006, DoC Workshop 2005).

One exception is work done on net binding and reported by Varty, N. *et al* (2008) in the CAMMLR icefish fishery near South Georgia.

Here, a relatively small set of trials were undertaken and reported on. There were few seabird interactions recorded but the trial highlighted issues in the process itself.

The concept of reducing the spatial extent of netting on the surface (the acknowledged risk, Bull (2007) and speeding up the sinking process to escape the attention of diving birds, which are the predominant species in the capture statistics (Baird 2008) is understandable. Baird's work also suggested that more seabirds are captured during haul rather than shooting. This can be problematic to accurately quantify as there are difficulties in the recording of this information by Ministry of Fisheries (MFish) fisheries observers.

Net binding is proposed as a means of reducing this risk during one phase of the risk period (i.e. during shooting). By tying the net at regular intervals with a twine or material that breaks under the force applied as the trawl doors spread open, the mesh netting volume near the surface can be reduced. Obviously once the trawl netting is below the surface and "out of harms way" the doors will start to act and break the binds to allow the trawl to open normally.

The workshop held in conjunction with this project also noted that as a trawler turns during shooting or hauling, that the stern quarter of the ramp will act to close the netting. It was considered that this may be a method to explore closing the meshes during hauling

Hence from the above studies, workshops and relatively minor trials it was concluded by us and agreed by DoC that a set of NZ experiments on net binding and closing by vessel turns was a useful step in determining efficiency.

Part 4: Methods and Materials

Introduction

Two possible methods were identified to reduce the bulk of netting on the surface, and hence reduce the risk to birds. These are:

1. Turning the vessel during hauling to "close up" the net at the surface
2. Net binding when shooting

While net binding has been tried in the Falkland Islands, neither of these methods has been thoroughly tested and reported on from elsewhere in the world, so there is little information available on their implementation, on the practical implications or on their effectiveness.

The trials undertaken here were preliminary trials with the primary objective to determine if and how these methods can be applied. Information was also gathered on effects on seabird behaviour.

These trials were carried out on trawlers using midwater (pelagic) trawls. These trawls are much larger than bottom trawls, with much larger meshes, so the amount of netting floating on the surface is greater and the risk of birds getting entangled in the netting is theoretically greater.

Trial 1 – Closing Net by Turning the Vessel During Hauling

Background

The mesh in trawl nets spreads out on the surface after the trawl doors are on the vessel and while the net itself is being hauled aboard. While the net is on the surface, birds swim around or dive on or in the net to feed.

Turning the vessel while hauling can "close up" the net, reducing the amount of netting on the surface. Closing up the net also reduces mesh opening, so it is suggested that adopting this as standard practice could reduce the chance of birds swimming or diving into the net and becoming injured or drowned.

However, there are practical issues associated with this method:

1. On busy fishing grounds, or in bad weather, it may be difficult for vessels to continue turning safely. Risks include collision with other vessels or injury to crew on a rolling deck. The Captain will need the discretion to do a continuous turn or a series of turns from side to side
2. Some vessels use a net drum to stow the trawl. This has the advantage of greatly increasing hauling speed, but it is important that the net is fed onto the net drum correctly to prevent subsequent problems when shooting. It will be necessary to establish whether hauling the net up one side of the stern ramp can be done without causing problems when stowing or shooting the net, or causing safety issues on the deck

It was also essential to establish that this method did not increase risks to marine mammals or cause other unforeseen operational or safety problems.

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Trial 1 – Closing Net by Turning the Vessel During Hauling (cont)

Method

1. Trials were carried out on two distinct and contrasting vessel types:
   a. A domestic fresh fish trawler. This vessel is reasonably typical of those vessels which haul the net onto a net roller
   b. A foreign factory trawler. It is proposed to use a foreign charter vessel typical of those which do not have a net roller
2. The trials were in the following area and duration:
   a. Fresh fish trawler, Cook Strait: 3-4 fishing days, with 1-2 shots per day, totaling up to a maximum of 8 shots
   b. Factory trawler, West Coast of North Island: 6-8 sea days (including transit to and from grounds), with 2-3 shots per fishing day, totaling up to a maximum of 18 shots
3. The Captain was asked to haul alternate tows as follows:
   a. Haul in line with normal practice (the vessel steamed in a straight line while hauling)
   b. Turn while hauling; the Captain turned the vessel sufficient to pull the net to one side of the stern ramp, which closed up the meshes.

Monitoring

The observer recorded the following in regard to each trial tow:

1. The degree of helm required to close up the netting;
2. The estimated width of netting at the midpoints of each of the following sections of the net, at the point when that section of the net starts to come aboard the vessel:
   a. Head of the net (the rope section) – this part of the net is usually comprised of ropes 4 to 40m in length, rather than meshes
   b. Large mesh section, typically containing 800 to 2000mm mesh
   c. Medium mesh section, typically containing 120 to 600mm mesh
3. The time required to haul the net on board, from the time the wing end weights are stowed, to the time the codend is completely on board
4. The numbers of seabirds (categorised into albatrosses, petrels or shearwaters) on, or immediately adjacent to the net. This count was made at intervals during the haul
5. General subjective observations. The observer noted for report on the following:
   a. Effectiveness of this technique in closing up the net and reducing risk to birds
   b. Effect on safety of vessel and crew, and on gear handling
   c. Effect on seabird behaviour

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Trial 2 – Binding the Net During Shooting

Background

When a trawl net is shot away, birds often swim or dive into the meshes to feed on fish remains in the net or fish waste drifting behind the vessel.

It has been suggested that if the net meshes remain closed when the net is shot, birds will be less likely to get trapped in the net. This can be achieved by tying the net at intervals in a manner that releases when the doors spread the net open.

It is likely this will also result in the net sinking faster (as there will be less surface area causing drag) which will reduce the time the net is available for birds to dive on.

Limited trials have been carried out on this method in the Falkland Islands, where one or two plies from a three ply sisal rope with a breaking strain of 110kg were used. Results from a small number of trials suggest this method could successfully reduce bird mortality (although seabirds encountered during these trials were very low (Varty, N. *et al* (2008).

Figure 1: Midwater trawl net being shot away with synthetic rope bind visible around net as it passes over stern roller, *FV Taimania*, 2008

An alternative method of net binding is to use a stronger rope wrapped around the net and tied with one or two overhand hitches, forming a slip knot.

Both methods were trialled to determine which is the most practical.

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Part 4: Methods and Materials, Continued

Trial 2 – Binding the Net During Shooting (cont)

Method

1. Trials were carried out on the *FV Taimania* and *FV Aleksandr Buryachenko* the same as for the turning while hauling experiments, (Trial 1).
2. Because net binding is not an established technique, the trial focussed on developing one or more workable methods; this required some experimentation. The following treatments were undertaken:
   a. The first tow was shot in the normal way, to observe how the net deployed and how birds behaved around the net
   b. The next three tows trialled the sisal rope knot method
   c. The next three tows trialled the synthetic rope slip knot method
   d. On subsequent tows, the three methods (no tie; sisal; synthetic) were alternated

   In each case, the amount of netting on the surface, and the sink rate, was measured.

Monitoring

The observer made observations on each tow as follows:

1. Visual observations on the behaviour of the net
2. Measured the sink rate of the net (i.e. the time the net takes to sink 2m below the surface)
3. Recorded the numbers of seabirds active on or near to the net
4. Observed the practicality of the method and its effects on vessel operations and safety.

The prescribed methodologies and observation recording forms are attached in Appendix 3.

A briefing note for vessel captains was developed to help in communicating the objectives and processes for these trials. This included the processes around permission for use of video equipment.

Net Binding Rope Material

Table 2: Types of binding materials as used on *FV Taimania* during the trials

FV Taimania		
Bind Type	**Material Name**	**Diameter** (mm)
Mussel Lashing	FilmLash (PPE)	7
Duradan	PPE	10
Donaghys	Cotton 60g	1.5

Table 3: Types of binding materials as used on *FV Aleksandr Buryachenko* during the trial

FV A. Buryachenko		
Bind Type	**Material Name**	**Diameter** (mm)
Mussel Lashing	FilmLash (PPE)	7
Duradan	PPE	10
Sisal	Manila	10

Part 5: Results

Vessels and Areas

Access to vessels *FV Taimania* and *FV Aleksandr Buryachenko* was provided by Sealord Group Ltd.

Initial results in the form of a Field Report were presented by John Cleal who conducted and observed both sets of trials (attached as Appendix 4).

This has been appended so that the reader can gain a better knowledge of the processes and the fishing operations involved. It is considered this is useful for those either considering further research or implementation of this or similar methods.

The trials were undertaken during September 2008 in Cook Strait on *FV Taimania*, and during December 2008 west of the Taranaki Bight on *FV Aleksandr Buryachenko* (see Figure 2 below).

Results can be summarised into the following parts:

- Turning vessel during hauling
- Sink rate
- Seabird observations
- Net binding

Trial Areas

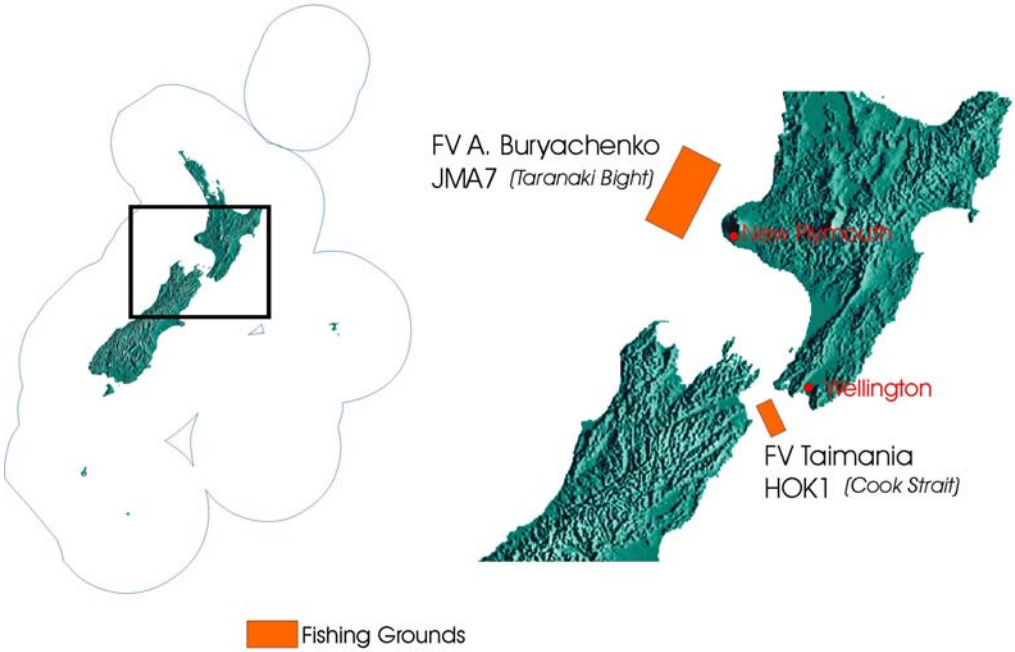

Figure 2: General description of operational areas where trials took place on *FV Taimania* and *FV Aleksandr Buryachenko* in 2008.

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Turning Vessel During Hauling

As is apparent from the Field Report, due to the deck and gear arrangements, both vessels already turn in one direction, or 'weave' or deviate from a straight line to optimise laying the net either on deck or onto a net drum while hauling the net aboard.

Figure 3: Retrieval of midwater trawl onto *FV Aleksandr Buryachenko*, with slight port helm turning the vessel to ensure net comes aboard on the port side of the trawl deck. The stern ramp quarter is acting to close the meshes by pressure on them,

Due to this, recording of a control (i.e. not turning), which was operationally impossible, became unfeasible and the trial *per se* was aborted on both vessels for this reason.

Sink Rates

As can be seen from the Field Report, sink rate measurement posed immediate problems despite the desirability to objectively qualify them. While a methodology that works well for longline gear (i.e. a plastic bottle tied to gear) was an obvious choice, it proved to be a poor one for this project and no results are available other than to note that this method does not work on trawl gear.

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Seabirds

Seabirds in attendance of both vessels were recorded. Apart from one species group in regard to *FV Aleksandr Buryachenko*, there are more birds about during hauling (Figures 5 and 7), than shooting.

On neither trial were seabirds observed or recorded entangled or captured. None were retrieved from the net or codends when they were brought onboard and cleared of catch.

Video footage show seabirds, particularly in Cook Strait, were highly focussed on the codend during haul and generally avoided the relatively higher risk meshes. Some birds would remain standing on the codend while attempting to extract whole fish from it, even as it finally entered the vessel's stern ramp (see below Figure 4).

Figure 4: Giant Petrel trying to get fish out of net on codend of *FV Taimania* in Cook Strait.

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Seabirds attending *FV Taimania*

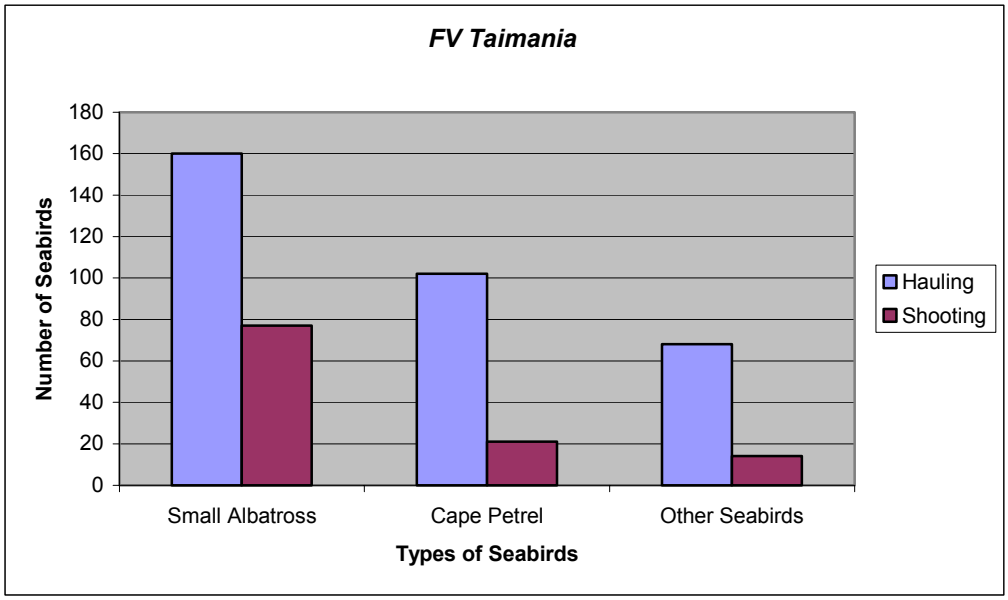

Figure 5: Types of seabirds observed in attendance during shoot and haul on *FV Taimania*

Figure 6: Mixed species composition of seabirds gathered aft of *FV Taimania* in Cook Strait as codend approaches ramp, being hauled by the gilson winches. Larger albatross spp. tended to remain in the background as can be seen top centre of this picture. Note catch sensors on codend, September 2008.

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Seabirds in attendance *FV A Buryachenko*

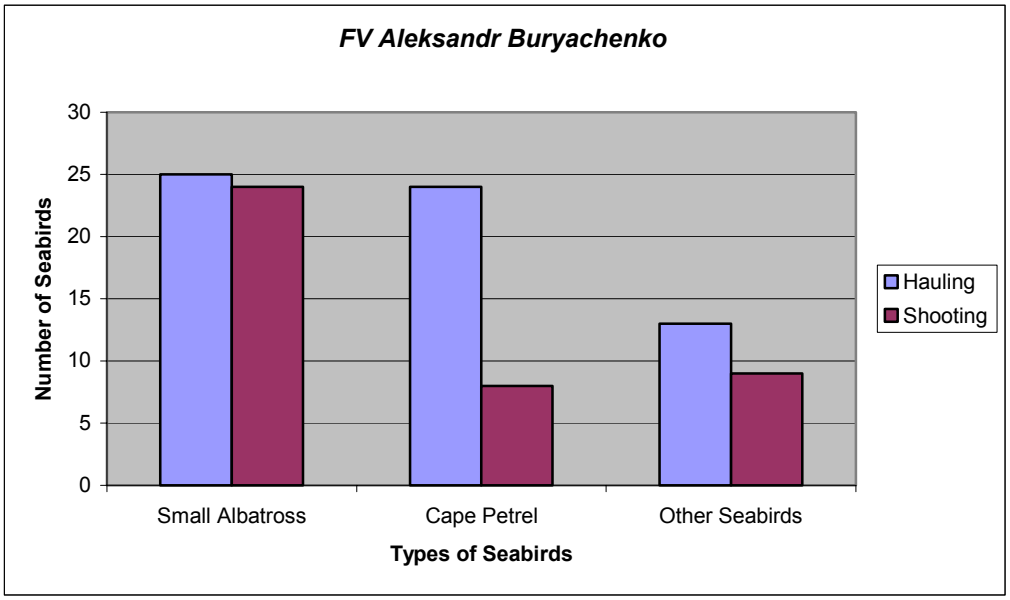

Figure 7: Types of seabirds in attendance during shoot and haul on *FV Aleksandr Buryachenko*

Figure 8: Seabirds attending *FV Aleksandr Buryachenko* while towing off Taranaki Bight, December 2008. There were generally far fewer seabirds in this area at this time than in the set of trials onboard *FV Taimania*.

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Part 5: Results, Continued

Net Binding

Results of binding trials are tabulated in Tables 4 and 5.

The results from *FV Taimania* show that all cotton ties broke (Table 4). It also shows one operational failure in that the ties failed to loosen under trawl door spreading force and therefore the net was retrieved at the end of the tow 'unopened' (i.e. had failed to fish). The field trip report notes that this was due to placement of the binds in the centre part of the trawls length. This failure was not detectable by the vessels net monitoring system which only records the trawl mouth opening at the headline.

The results from *FV Aleksandr Buryachenko* show 8 fully monitored tows, during which the trawl always opened and ties either coming loose or letting go before desirable was a relatively rare event (although did occur) (Table 5). Note that due to cotton's total failure in the first set of trials, it was not included in the trial set, and as evidence suggested that fraying was an issue with mussel lashing (Figure 6, Appendix 4, Field Report) in this second trial, steps were taken (taping) to prevent such fraying and hence non-opening of trawls.

Summary

Table 4: Consolidated results on all tows where binding was fully observed and recorded on *FV Taimania*. Note that on Tow #12 the trawl had not opened and was still bound upon haul. Cotton failed comprehensively and was judged unworthy of further tests.

FV Taimania								
Tow #	Binding Information				Performance			
	Bind Type	# of Binds	Twists in Bind	Intervals between binds (m)	Held	Loose	Let Go	Broken/Failed/Held Net Closed
3	Mussel lash	4	3	15-20	3		1	
5	Cotton	4	Tied	15	0	0		4 (all broke)
6	Mussel lash	4	3	15	4			
10	Mussel lash	4	3	15	4			
12	Mussel lash	4	3	15	3		1	Net Failed to open during tow

Table 5: Consolidated results on all tows where binding was fully observed and recorded on *FV Aleksandr Buryachenko*. Note that while some binds came loose during shooting, there were no failures that lead to inoperable trawls or loss/failure of the binding materials.

FV A. Buryachenko								
Tow #	Binding Information				Performance			
	Bind Type	# of Binds	Twists in Bind	Intervals between binds (m)	Held	Loose	Let Go	Broken/Failed/Held Net Closed
4	Mussel lash	8	3	10-12	6	2		
6,10,12	Mussel lash	10	3	10	8	1	1	
13	Mussel lash	5	3	10	10			
	PPE	5	4					
16	Mussel lash	5	3	9-10	10			
	PPE	6	4					
19	Mussel lash	5	3	8-10	10	2		
	PPE	7	4					
21	Mussel lash	6	3	8-10	10	1		
	Sisal	6	4				1	

Vessel and Net Characteristics

Table 6: Operational measures of each trial vessel's trawl gear and handling characteristics as well as maximum number of binds per trawl type.

Characteristic	*FV Taimania*	*FV A. Buryachenko*
Net Type	Midwater (28/17)	Midwater (116/728)
Average Shot Time (mins)	Not Recorded	18
Haul Time (mins)	13.5	20
Net Length (m)	<80	225
Max Number of Binds	4	12
Deck Crew	5	6
Deck Net Storage	Net Roller (single net)	Fleeted on Deck (dual nets)

Part 6: Discussion

Turns

It appears from these results that a major part of the existing New Zealand deepwater trawl fleet (approximately 20 vessels) must already be executing turning movements when hauling their gear to facilitate optimal handling and storage on deck or net drum. This may be constrained at times by a lack of seaway or heavy weather, but such circumstances would not be the norm.

The extent to which other vessel types using predominately bottom trawls operate is not certain and could be monitored by MFish Observers, if considered useful.

Sink Rate

The anecdotal remarks from those onboard the vessels in the trial suggest the gear does “sink faster” when net binding is done. This has not been able to be quantified and it may be considered complicated to do so. Broader questions about the use of net binding need to be answered before resources are put to this question.

Seabirds

It is logical, provided offal discharge and stickers are being effectively managed, that seabirds will be most attracted during hauling when real food items are available. This logic is supported by the results.

Despite the seasonal variation (separated by 3 months), region and vessel operation (hoki fresher versus jack mackerel freezer), bird behaviour (but not numbers) was reasonably consistent between the two sets of trials.

We were surprised by the large numbers of seabirds in Cook Strait and gratified that, despite their abundance and feeding aggression as the codend was hauled to the ramp, that none were captured. It also seems clear from the Field Report that birds cued to winch noise in particular to begin to ‘home in’ on the surfacing net during hauling. This supports other anecdotal evidence from seagoing observers.

The lack of aggressive diving birds, such as sooty shearwaters or white chinned petrels, during these trials is an issue. These species represent 50-80% of current net captures in the southern squid trawl fishery.

Therefore, perhaps a simple set of net binding trials, based on these ones, could be undertaken in the squid trawl fishery.

However, these results also suggest that net binding is not required to mitigate captures in those particular fisheries where trials took place.

Continued on next page

Net Binding

These trial results are based on the operations of one large factory trawler operating two long midwater trawls with a permanent deck crew, and one relatively small fresh fish trawler using trawl gear of half the length and a non-permanent deck crew.

Despite the significant differences, both vessels appear capable of quickly and safely binding this type of trawl.

It was shown that it can go wrong and a failed net opening is not only a significant cost in wasted effort, but a major de-motivator to crew. There is also a risk that a partially opened trawl could be damaged if towed into a dense fish mark.

There is also a determinable limit somewhere near the headline of a trawl, where binding is not possible due to the forces applied directly on shooting and prior to the doors entering the water. This means that for midwater trawls at least, part of the head section will remain unbound.

Materials

The results suggest that there are some clear rules that make sense:

- It is easier to bind with twists rather than use a breaking twine

Binding should meet these criteria:

- Material of reasonable 'slipperiness',
- Diameter or strength plus number of twists need to match the forces involved and these are greater at the head of the net
- Binds should be tied to the selvedge to prevent loss and speed of use
- Fraying of the ends must be prevented

Whilst these two vessels managed well with binding, based on our experience, we have rated different vessel operations and configurations with a degree of difficulty for net binding. This is presented in Figure 9 and total scores by vessel type are shown in Table 7. The higher the score, the greater the estimated difficulty.

It can be determined from this that very large trawlers, using solely midwater gear and with permanent deck crew score best. Currently 'Russian' BATM class trawlers such as *FV Aleksandr Buryachenko* meet this category in New Zealand waters.

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Vessel Operation Compatibility to Net Binding

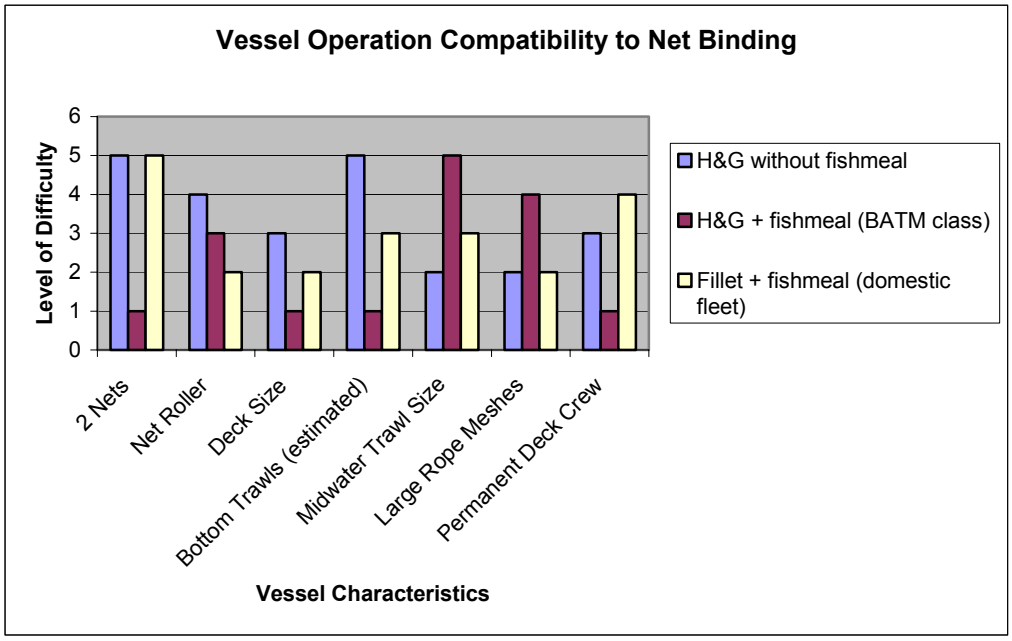


Figure 9: Level of difficulty surmised by trial information and estimated by experience for operations not covered in the trials. This suggests that BATM class vessels are most easily able to net bind, and Japanese designed and built vessels currently employed in New Zealand least so.

Table 7: Aggregated scores from Figure 8

Low Score More Suited to Net Binding		
	H&G without fishmeal	24
	H&G + fishmeal (BATM class)	16
	Fillet + fishmeal (domestic fleet)	21

Part 7: References

Varty, N., Sullivan, B.J. and Black, A.D. (2008). FAO International Plan of Action-Seabirds: An assessment for fisheries operating in South Georgia and South Sandwich Islands. Birdlife International Global Seabird Programme. Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire, UK.

Baird, S.J. (2008). Net captures of seabirds during trawl fishing operations in New Zealand Waters. National Institute of Water & Atmospheric Research Ltd, Greta Point, Wellington, New Zealand. WLG 2008-22

Bull, L.S. (2007) Reducing seabird bycatch in longline, trawl and gillnet fisheries. *FISH and FISHERIES* **8**. 31-56.

Part 8: Glossary of Species Mentioned in Text

Fish Species

Common Name	Scientific Name	MFish Code
Barracouta	*Thyrsites atun*	BAR
Frost fish	*Lepidopus caudatus*	FRO
Hoki	*Macruonus novaezelandiae*	HOK
Jack mackerel	*Trachurus declivis, Trachurus novaezelandiae, Trachurus murphyi*	JMA
Ling	*Genypterus blacodes*	LIN
Silver warehou	*Seriolella punctata*	SWA
Spiney dogfish	*Squalis acanthias*	SPD

Seabird Species

Common Name	Scientific Name
Cape pigeon	*Daption capense*
Giant petrel	*Macronectes giganteus, Macronectes halli*
Northern royal albatross	*Diomedea sanfordi*
Salvins albatross	*Thalassarche salvini*
White capped albatross	*Thalassarche steadi*

Appendix 1: Trial Observation and Recording Protocols

Reducing the Quantity of Netting on the Surface

A review of seabird captures in trawl nets has shown that many birds, especially petrels and shearwaters, are captured during shooting or hauling by becoming tangled in the meshes and drowning.

One suggested approach to reduce this source of mortality is to reduce the quantity of netting on the surface during shooting and hauling. Different methods have been proposed for shooting and hauling phases:

1. Hauling: if the vessel is turned while the net is hauled, the netting is pulled to one side of the stern ramp which "closes up" the net in the water
2. Shooting: the net is bound at intervals with rope that breaks or slips once the mouth of the net is spread open, so its quantity is reduced until the net is shot away and under water

This project will trial both these methods, to measure their practicality and effectiveness. The trials will also need to determine whether there is any increased risk of capturing marine mammals when these procedures are used.

Part 1: Closing Net by Turning the Vessel During Hauling

During this part of the trial, you will ask the Captain to turn the vessel while the body of the net is being hauled aboard, in order to close up the net.

Because this approach has not been trialled before, an important object is to determine how to maneuver the vessel to close up the net, while not creating hazards to the vessel or the crew.

You will need to discuss the objective of the trial with the Captain, work with him to determine what amount of turn is required to close up the net, and what type of turn (continuous or side-to-side) is most appropriate given weather and presence of other vessels on the grounds.

It is important that safety of the vessel or crew is not compromised at any time.

Continued on next page

Appendix 1: Trial Observation and Recording Protocols, Continued

Methodology

Data will be collected, during daytime tows only, by:

1. Visually monitoring the behavior of the net, and taking video recordings of selected hauls
2. Estimating the quantity of net on the surface
3. Monitoring the number of seabirds on or around the net

You will also make observations on the practicality of this method on vessel operation, and any effects on safety or vessel operations.

Observation procedure

Remember the deck can be one of the most dangerous places on the vessel. You should consider your safety before beginning observations. It is good practice to inform the bridge whenever you are going to be working on the deck.

Chose a location on the deck or the aft gantry that is safe and gives you a good view of the net during hauling.

Observations should be carried out on all tows if possible.

Observations will be recorded on the form attached (see Appendix 3). The form provides for some numerical estimates, but general observations on the effectiveness and effects of turning the vessel while hauling are also important.

Trial tows

Experimental tows should be alternated with normal tows, that is every second tow (where practical) should involve the vessel turning to close up the net. At all times, the Captain will have the sole discretion as to whether the trial tow should proceed.

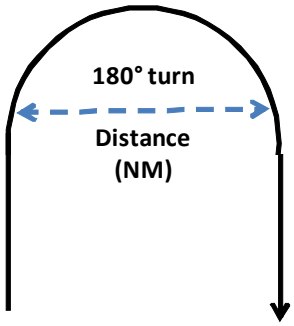
Continued on next page

Appendix 1: Trial Observation and Recording Protocols, Continued

Methodology cont

Completing the form

1. Complete one sheet for each tow (attached Appendix 3)
2. Information on vessel and tow – for each tow, fill in the information at the top of the form:
   a. Date and vessel name
   b. Turning/not turning – whether this is a standard tow or the vessel turns while hauling
   c. Wind speed and swell height
   d. Time – record the time the doors are up and hauling recommences, then the time the last of the codend is brought aboard, and calculate the total hauling time
   e. Heading change – enter the rudder angle the Captain applies to close up the net
   f. Continuous or S-turns (side to side) – record which method the Captain uses to keep the net closed up
   g. During turning, the amount of seaway required to complete a 180°turn



3. Offal and waste fish discharge – discharging fish or fish waste during the haul will have an effect on bird behaviour; tick the appropriate box for discharge from sump/scupper or processing waste (offal)
4. Width of net: The purpose of this observation is to measure how much the net closes up when the vessel turns, and if all or only parts of the net close up. The net is divided into four sections. At the point when each section starts to come aboard the vessel, estimate the width of that and following sections of the net at their midpoint. These sections are:
   a. Head section – this is the rope section immediately behind the ground rope
   b. Large mesh – this is the large mesh section
   c. Medium mesh – this is the section immediately in front of the lengthener
5. Estimated number of seabirds – at the same points as item 3 above, estimate the number of birds attending the net or on the water within 5m of the net, by type of activity; bobbing means birds swimming or feeding on the water, flying means birds in the air
6. Captures – record any birds that are caught in the net; if any birds are caught, the vessel will still need to record this in the Non-fish Protected Species Catch Return form at the end of the voyage
7. General observations – record your observations in relation to the questions on the back of the form

Video recording

Please take a video recording of one complete haul of each type.

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Appendix 1: Trial Observation and Recording Protocols, Continued

Typical Net Plan

Typical midwater trawl net plan.

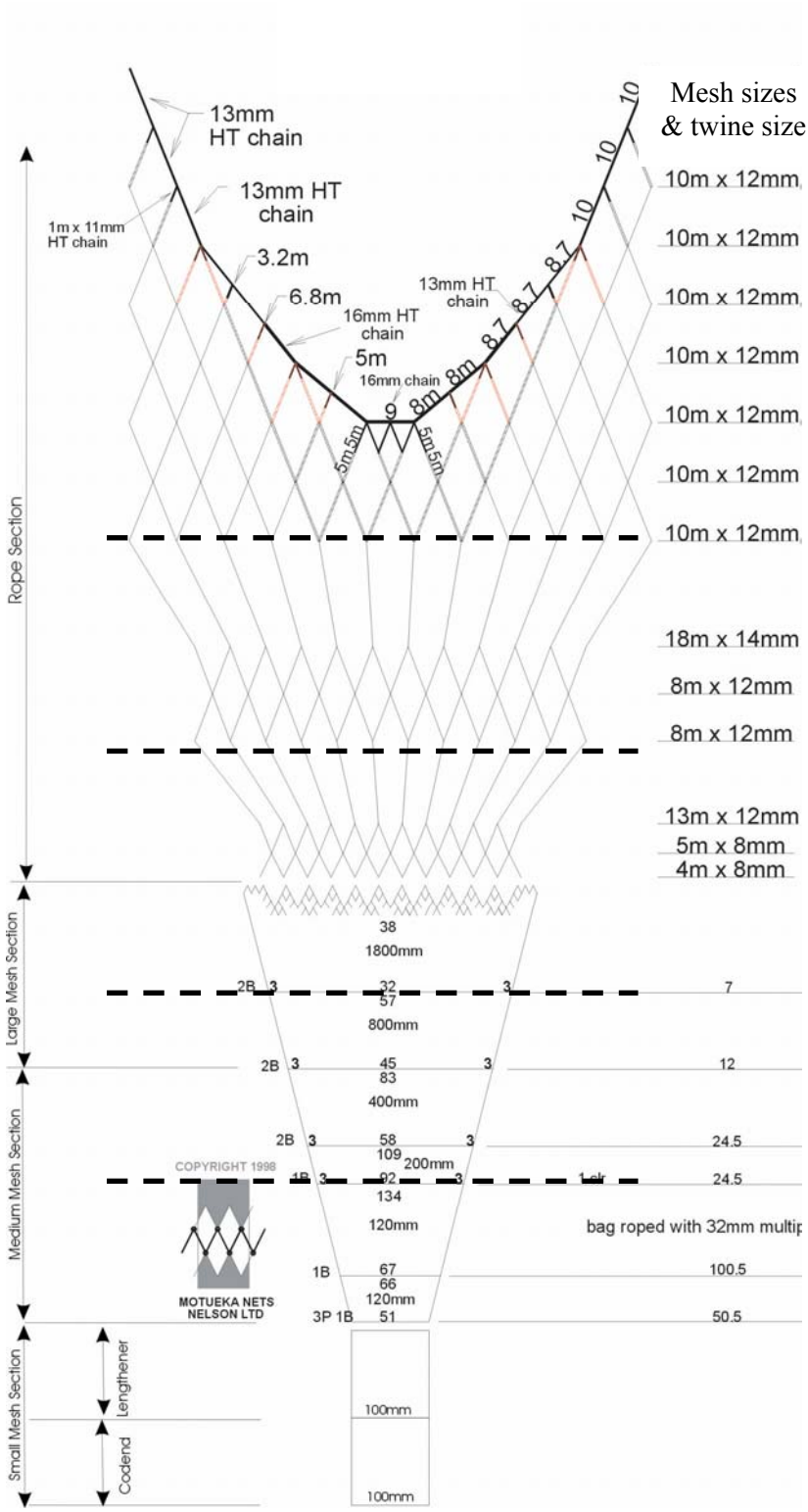

Figure 10: Dashed lines show initial positions of ties for the net binding trial

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Appendix 1: Trial Observation and Recording Protocols, Continued

Part 2: Binding the Net While Shooting

Purpose

One method which has been suggested to reduce the risk of seabird mortality is to reduce the quantity of netting on the surface by binding the net while shooting. The net is tied at intervals with rope that either breaks or slips undone when the net starts to spread. The purpose of this is to bunch up the net and so reduce the amount of mesh floating on the surface.

A secondary benefit is that the net should sink faster when tied, because water resistance is reduced.

This trial is being carried out to determine methods of net binding and operational practices which will allow nets to be bound during shooting, without preventing the net opening properly when deployed.

Because only limited trials of this method have been carried out before, the primary purpose of this project is to develop methods of binding the net so the quantity of the net is reduced while shooting, but the net opens properly once it is under the surface.

Continued on next page

Appendix 1: Trial Observation and Recording Protocols, Continued

Alternative Methods of Binding the Net

You will test two different methods of binding the net. It will be necessary to refine these methods so they hold the net closed while the net is being fed off the stern of the vessel, but release every time when the net is sinking:

1. Use a rope which will break when the net starts to spread:
    a. Take a 2m length of 3-4mm sisal rope; tie it along one third of its length to a selvedge so it won't slip; then pass the long end around the net and tie the two ends together
    b. Repeat this at intervals until the front of the lengthener. Initially use four ties on the net in the positions shown in Figure 10, one behind the ground rope, one in the middle of the rope section, the third where this section joins the large mesh section, and the fourth where the large mesh join the medium mesh
    c. If the net billows out between ties, fit additional ties as required
    d. It is recommended that you use a single ply from the 3-ply sisal rope for the first shot, then if this fails before the nets is fully deployed, two or three plies on subsequent shots
2. Use a rope tied in such a way it will slip when the net starts to spread:
    a. Take a 2m length of 10mm synthetic rope; tie one end to a selvedge so it won't slip down the net; then wrap the rope around the net twice and pass it under itself once or twice (to form a slip knot) then pull tight. It is recommended you use one slip knot initially, increasing this to two if it slips too readily
    b. Repeat this at intervals until the front of the lengthener. Initially use four ties on the net in the positions shown in Figure 10, one behind the ground rope, one 2/3 of the way along the string section, one midway along the large mesh section, and the last half way along the medium mesh
    c. If the net billows out between ties, apply further ties between these positions as required

Fixing the ropes around the net that has been fleeted onto the deck can be made easier by passing a rope under the net, then using this to lift the net while each binding is tied; the rope is then slid along to the next binding position.

Where a net drum is used, you will need to find the best location to tie the net as it is fed off the drum.

Continued on next page

Appendix 1: Trial Observation and Recording Protocols, Continued

Methodology

1. Trials will be carried out on daylight tows only;
2. Each approach to tying the net will be trialed for several consecutive tows until you are comfortable you have a workable method. It is suggested you observe the following sequence:
   a. Shoot the first tow of the trip in the normal way, so you can observe how the net deploys and how birds behave around the net
   b. Spend the subsequent three tows trialing the sisal rope method
   c. Spend the following three tows trialing the synthetic rope method
   d. On subsequent tows, alternate the three methods (no tie; sisal; synthetic)
3. Please assist the crew in fixing the ties to the net
4. Once the net is ready to be shot away, find a safe place on the deck or stern gantry from where to observe the net and associated bird behaviour
5. Data will be collected by:
   a. Visually monitoring the behavior of the net, and taking video recordings of selected shots
   b. Estimating the quantity of net on the surface while it is shot away
   c. Measuring the sink rate of the net; this is determined by tying a 100mm yellow float to the start of the mid-section of the net (that is, where the rope section of the net is attached to the large meshes) using a 2m cord, and recording when the float disappears under the surface
   d. Monitoring the number of seabirds on or around the net
   e. Observing the behaviour of birds attending the net
   f. You will also make observations on the practicality of this method on vessel operation, and any effects on safety or vessel operations

Materials required

You will need to take the following with you:

1. Data recording forms (as attached) (Appendix 3)
2. Stop watch with split timer
3. The following ropes:
   a. 100m 100kg sisal rope
   b. 100m 10mm synthetic rope
4. Three 100mm coloured floats.

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Appendix 1: Trial Observation and Recording Protocols, Continued

Methodology cont

Completing the form

Observations will be recorded on the form attached (Appendix 3). The form provides for some numerical estimates, but general observations on the effectiveness and effects of turning the vessel while hauling are also important.

Complete one sheet for each tow

1. Information on vessel and tow – for each tow, fill in the information at the top of the form:
    a. Date and vessel name
    b. Experiment type – whether this is a standard tow or the net is bound using one of the two binding methods
    c. Wind speed and swell height
    d. Times: record the time when:
        i. The codend away
        ii. The headline in water
        iii. The doors under the water
    e. Headline height – request the Captain to measure headline height when the headline of the net is at 50m depth, this is to indicate whether the ties have all released at this depth
    f. Offal and waste fish discharge – discharging fish or fish waste during the haul will have an effect on bird behaviour; tick the appropriate box for discharge from sump/scupper or processing waste (offal)
2. Mark the positions of the ties on the net plan
3. Estimated number of seabirds – at the point when the codend enters the water, estimate the number of birds attending the net or on the water within 5m of the net, by type of activity; bobbing means birds swimming or feeding while floating, flying means birds in the air
4. Captures – record any birds that are caught in the net; if any birds are caught, the vessel will still need to record this in the Non-fish Protected Species Catch Return form at the end of the voyage

Video recording

Please take a video recording of one complete shot of each type (normal; sisal; synthetic).

Appendix 2: Briefing Notes for Vessel Operators and Master

Introduction

A review of seabird captures has shown that many birds, especially petrels and shearwaters, are killed during shooting or hauling when they swim or dive into the net and can't escape.

One suggested approach to reduce this source of mortality is to reduce the quantity of netting floating on the surface while hauling and shooting. Two different methods have been proposed to achieve this:

1. **Hauling the net**: turn the vessel while the body of the net is being brought aboard, so the net is bunched up on one side of the stern ramp
2. **Shooting the net**: bind the net while shooting with a number of rope ties that will either break or slip undone when the net is spread; the ties prevent the meshes billowing out until the net is below the surface, and so reduce the risk of birds becoming entangled in the meshes

These trials are being carried out to test the effectiveness of these techniques in changing bird behavior and reducing the risk of mortality, and to determine the practicality of using them on a working fishing vessel.

Trials will be run on two trawlers of different types. Your vessel has been chosen as it is typical of a number of boats in the New Zealand fishing fleet.

It is important to stress that these methods are in the early stage of development, and limited trials have so far taken place. Therefore we are asking for your assistance in trying and refining these methods to help find workable ways of reducing bird mortality in the net.

Planned Experiments

We wish to run experiments on your vessel to test the practicality of these methods in reducing the quantity of netting on the surface, and in reducing the risk of seabird captures.

An observer will be onboard to carry out the trials. He will be observing the effectiveness of these strategies, their effectiveness at closing up the net, their effect on seabird behaviour, and any practical or safety issues.

During the trial, you should observe normal offal control and warp strike mitigation practices.

If seabirds are captured, you should continue to report these as normal.

Continued on next page

Appendix 2: Briefing Notes for Vessel Operators and Master, Continued

Trial 1: Closing the Net While Hauling

1. You will be asked to test the two different options – hauling as normal, and turning the vessel to close up the net. On alternating tows you will either shoot the net in the normal way, or turn the vessel while shooting the net to reduce the flow of water through the net, and hence to reduce the amount of netting on the surface
2. There are two options which could achieve this objective – doing a single continuous turn, or turning from side to side (S-turn). You should use the method which you consider is the most effective, taking into account crew safety, collision avoidance, and effect on handling and stowing the net
3. We appreciate that one or both of these options may not be practical or safe in certain circumstances, for example, in rough weather or where there are a number of other vessels nearby. It is also uncertain how sharply the vessel needs to turn to close up the net. We therefore request that you discuss this experiment with the observer and agree only on practices which you, as master, consider can be carried out safely

Trial 2: Binding the Net While Shooting

The experiment will involve the following:

1. Approximately one third of the tows will shoot the net in the normal fashion, one third will have light sisal rope tied around the net at several positions along its length, and one third will use synthetic rope tied in a slip knot around the net at several positions along its length. The first trial tows will use light bindings to minimise the risk of them staying tied when the net starts fishing; if these are too weak, later tows will use stronger ties
2. The observer will take video images of the net while it is shot away, and make a series of observations of the behaviour of the net and the behaviour of birds around the net
3. You will be asked to determine the headline height of the net when it is 50m below the surface to determine if the bindings have broken. It would be useful for you to monitor the headline net monitor to see if it shows when the ties are released and normal headline height achieved
4. During trials, your vessel should deploy warp strike mitigation devices as normal. During the experiment, the mitigation used should be consistent throughout (i.e. additional mitigation should not be added during the experiment)
5. It has already been demonstrated that seabird captures, especially of large birds (albatrosses and mollymawks), is increased when offal is discharged during hauling and shooting. We therefore ask that you be particularly diligent in preventing discharge of waste fish or fish waste during shooting and hauling. Please advise the observer when offal discharge has taken place
6. If seabirds or other protected species were captured during any tows, you should continue to report these as normal

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Appendix 2: Briefing Notes for Vessel Operators and Master, Continued

Video Footage	The observer will wish to take video footage of the two trials. The consent of the Master will be sought before any videoing takes place. Video will only be taken of the net in the water and associated bird activity during the two trials, and of the net binding on the deck. The Master will be able to review the video footage before it is taken ashore, and if required has the final say whether this footage, or which parts of it, can be used. A full copy of the video will be supplied to the vessel operator after the vessel berths.
Safety and Operational Decisions	The Master will at all times have the final say on whether specific trials are carried out, and may vary the way these are done as necessary to ensure safe operation of the vessel.

Appendix 3: Trial Data Forms and Protocols

Observation form: Closing Net by Turning the Vessel During Hauling

Date: (dd:mm:yyyy) ___ : _____ : _____ Vessel name: _____ Turning/not turning _____

Wind speed _____ Swell height (meters) _____ Offal discharge Sump/scupper ☐ Factory waste ☐

Time, doors up: _____ : _____ Time, codend on board: _____ : _____ Haul duration (from doors up): _____ minutes

Helm required to close up net _____ degrees Continuous turn or side to side: _____ Seaway required for 180°turn _____ NM

	Refer Fig. 1	Head (rope mesh)		Large mesh		Medium mesh			
Width of netting, m	Head section								
	Large mesh								
	Medium mesh								
		Flying	Bobbing	Flying	Bobbing	Flying	Bobbing	Captures	
								Captured	Released
Estimated No. Seabirds within 5m	Large albatross								
	Small albatross								
	Cape petrel								
	Other seabirds								

General observations:

1. **Effectiveness of manoeuvre at closing up net:**
   a. Does the manoeuvre effectively close the net up along its length, or just part of its length?
   b. Does the vessel need to keep turning for the entire hauling process to keep the net closed up?

2. **Vessel navigation and safety:**
   a. Can the vessel complete manoeuvre safely given weather or the proximity of other vessels?
   b. Does the manoeuvre create any safety issues on deck?
   c. Does the manoeuvre have any effect on stowing or subsequent shooting of the net?

3. **Seabird behaviour:**
   a. Is there any obvious difference in seabird diving or bobbing behaviour?
   b. Is seabird activity on the net changed, e.g. do birds dive on or swim into the net more or less often?
   c. Does closing the net up create any new risks to seabirds or marine mammals, e.g. is it harder for birds to get out of the net?

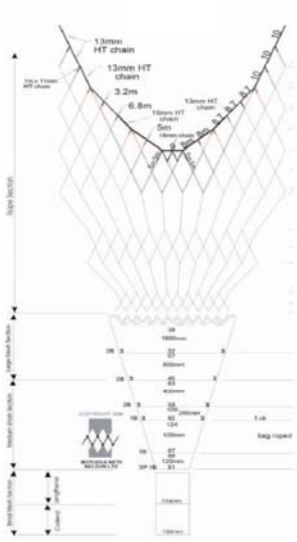
Continued on next page

Observation form: Tying the Net While Shooting

Date: (dd:mm:yyyy)	___ : ____ : _____	Vessel name:	_____	Tied (None, Sisal, PE)	_____
				Sump/scupper	☐
Wind speed	_____	Swell height (meters)	_____	Offal discharge	Factory waste ☐
Number of ties	_____	Estimated distance between ties	_____	Headline height when net at 50m	_____
Time, codend away	_____ : _____	Time, headline in water	_____ : _____	Time, doors under water:	_____ : _____

Number of seabirds on the net when wing-end weights enter the water

		Flying	Bobbing	Captures
Estimated No. Seabirds	Large albatross			
	Small albatross			
	Cape petrel			
	Other seabirds			



Mark actual positions of ties on this net plan

General observations:

1. **How effectively does tying the net reduce the quantity of netting on the surface:**
   a. Does tying the net close it up effectively along its length?
   b. Are the meshes fully closed up or do they billow out between the tows?
   c. Do the ties break or slip before the net is below the surface?
   d. Are any ties still tight when the net is brought back aboard the vessel?

2. **Vessel navigation and safety:**
   a. Does tying the net create any safety issues on deck?

3. **Seabird behaviour:**
   a. Is there any obvious difference in seabird diving or bobbing behaviour?
   b. Does it change seabird activity on the net, e.g. do birds dive on or swim into the net more or less?
   c. Does closing the net up create any new risks to seabirds around the net, e.g. is it harder for birds to get out of the net?

Appendix 4: Field Report

Field Report – Seabird Trawl Net Capture Mitigation Trials

Trials conducted and reported by John Cleal

– *F.V. Taimania* (6 -10 September 2008)
– *F.V. Aleksandr Buryachenko* (1 - 7 December 2008)

Vessel and fishing gear specifications

FV Taimania

43m LOA, 2500 h.p. fresh fish stern trawler, GRT- 798t
Targeting Hoki in the Cook Strait spawn fishery (June-Sept), steams from Nelson and fishes Cook Strait and lands fish to Picton, before returning to Nelson at the end of the week.
All fish placed whole/green in 50L fish bins, iced and placed in the refrigeration hold (chilled).
The Cook Strait spawn fishery is predominantly clean hoki with very little by-catch apart from small quantities of ling, warehou and spiny dogfish. The vessel targets hoki marks in 280 to 380 m depth range. Generally 3 to 4 trawl shots (15 to 20 ton of fish per shot is ideal) and time on the fishing grounds is approximately 8 to 12 hrs

Fishing gear
Midwater trawl - 28-17 Sealord midwater net; 36-42 metres headline opening (see Appendix 1).
Bridles – 150 metres
Doors - 6.5 m2 high aspect ratio super vees

Crew
Captain - Raymond Armstrong
1st Mate – Rhys Walton
Chief Engineer – Tony Currie
Total crew -15

Trip port schedules
Sailed, Sealord Nelson - Sat 6th Sept 08, ETD 07:00 hrs

Picton Unload (1)
Date - Sun 7th September
Time - ETD 06:30 hrs; ETD noon

Picton Unload (2)
Date- Mon 8th
Time- ETA 06:30 hrs ETD 11:00 hrs

Picton Unload (3)
Date - Tues 9th
Time – ETA 04:00 hrs ETD 10:30 hrs

Nelson Unload (4)

Date - Wed 10th
Time - ETA 15:00 hrs

F.V. Aleksandr Buryachenko

A BATM Class freezer stern trawler with H&G factory and fishmeal plant.
MNZ: Number 126570
LOA: 104.5 m
GRT: 4407
Power: 5148 kW
Processing capacities: Factory – 60 pwt/day, fishmeal plant capacity 40 tonne raw material/day

Fishing gear

Midwater (MW) trawls x 2 (plan in Appendix 2)
60m maximum headline height opening 40m chain ground rope
Bridles: 2 x 75 m (150 m total) Doors: 9.0 m^2 WV, KEL
MW weights: 400 kg per side Door spread: 125 m estimated

Fishing area for sea trials

Target Fishery - JMA7 in FMAs 7 and 8, 30 to 50 nm west and north west of New Plymouth (MFish Statistical Area's 40 & 41)

Crew

Captain – Yuri Khlybov
Chief Trawl Master – Albert Verstyuk
Total crew - 77

First Sea Trial on *FV Taimania*

Observations and Comments

Saturday 6th September

After a 12-hour steam from Nelson the vessel arrived on the Cook Strait fishing grounds at 18:00 hrs and the skipper started searching for the best fishing area, he did not shoot the gear until 18:45 hrs. The light was fading but I thought we might try to observe a normal shot and establish a sink rate of the net. No ties/binds were placed on the net but by the time the skipper shot the gear night was falling and I was not able to see the net aft of vessel to make proper observations.

It also became evident that with the Picton port calls and unloading schedules at 08:00 hrs each morning the vessel will not get back to the fishing grounds until 15:00 hrs each afternoon. This meant most of the fishing would take place at night, leaving only enough time to observe one or two daylight shots each day.

We fitted a float (4 L plastic oil container) to do a sink rate but this was crushed on the stern and became entangled with the meshes; it had to be hauled back and reset. The skipper was not happy with tying a float to the mesh in the middle of the net as it may tangle the mesh and stop trawl from opening. Also it was evident that the sink rate was not going to be able to be properly measured, with different sea states, different tides/currents, and variable vessel speed when shooting, changes the way the net sits on the surface and amount of time the net takes to sink; hence it was decided to discontinue this measurement (a very different scenario to the more steady situation of measuring sink rates of longline gear whilst setting).

Videoed the shoot and haul (12 t of fish landed). The netting spread was approximately 2/3 m wide on the surface when shooting. Both other shots were night shots, no observations were able to be carried out.

Sunday 7th September

Unloaded in Picton at 08:00 hrs, back out to the grounds by 15:00 hrs, first daylight shot demonstrated successful use of the net binding process using 4 ties of mussel rope. Three ties stayed together, the 4th was placed to close to the head of the trawl and came undone. The net roller spread this part of the net open and ties will need to be placed further down the net when using a net roller. Most the ties just fall off in the water when the net spreads apart.

The net is checked on haul because if ties become entangled in the net they could cause the net to tangle or not open, any loose rope that has washed back into meshes are removed by the crew on haul.

Figure 1: Crew net binding, *FV Taimania* 2008

The larger rope meshes in the head of the net do not appear to pose much risk to seabirds, the smaller 2 m to 0.4 m meshes could entangle or capture seabirds.
The netting on the surface was tied together and was reduced from 1 to 2 m to less than 0.5 m when floating. The net opened well and the mussel rope held together while the net was on the surface as required. Four ties (net binds) will be enough for binding this relatively small net, 6 or more may be required on a much larger (longer) net.

With the second daylight shot the net was bound with cotton string (tied and knotted). The cotton was wrapped around the net twice and knotted but all the binds broke as the net was moved down the deck, the process was changed and done again with three wraps of the net but the binds all still broke on deck. With no other suitable net binding material on the vessel that could be used that would break, I decided to stop this treatment.

Turning the vessel on haul to close up the net works well, though this can only be done by turning the vessel side to side (weaving). The net roller must have the angle altered during haul to keep an even layer of netting across the net roller. Ten degrees of helm turns the stern enough to close up the net on the corner of the stern ramp.

Monday 8th September

Back out on the fishing grounds at 14:30 hrs after unloading in Picton earlier that day. First shot net binding with mussel rope, this worked well, reducing the mesh volume on the surface by 2 to 3 times of that when not bound. The haul was completed turning the vessel side to side to close up the net, this also worked well. Again it's obvious that you cannot haul the net without turning the vessel (if you have a short deck and a net roller) to fleet the net onto the net roller, so the treatment of no turns during hauling was discontinued.

Figure 2: 28-17 Midwater trawl on the net roller and codends on deck ready to shoot, *FV Taimania* 2008

Heaps of birds around, took some footage of the haul from the fantail, birds all over the codend. Birds arrive on cue (sound of winches) and numbers depend on other vessels in the vicinity hauling at the same time. The few dozen birds following the vessel during the tow increased sharply once the winches were put in gear, by the time the bridles are onboard there many more birds arriving flat out until the cod end hits the surface, by then 100s or even 1000's of birds are immediately behind the vessel. It's an all out attack on the codend for 5/10 mins., but ten minutes after the codend is on deck most have disappeared leaving just a few birds following the mainly whole (SPD) discard trial when the fish is sorted and boxed in the factory.


Figure 3: Hundreds of birds follow the codend during hauling, *FV Taimania* 2008

The second shot was without net bindings, the net opens approximately one to two metres more depending on what part of the net you are observing, i.e. the net has codend material of small mesh, large mesh and rope meshes, all float/spread out differently on the surface. Tried to haul with the vessel not turning (best it could while still winding the net on to the roller) the net was open much wider compared to when the vessel turns closing up the net.

Very few birds were observed around the vessel when shooting the gear, all the action was on haul. Apart from a handful of big albatrosses (royals etc) we only had mollymawks (Salvin's, whitecapped) and cape pigeons around the vessel. No diving birds were seen. With these sorts of birds present there was very little or no risk of capturing any birds when shooting.

Figure 4: Seabirds (mostly Salvins and whitecapped albatross, with some Cape petrels) around the codend approx 60m behind the vessel, *FV Taimania* 2008

On hauling, though hundreds/thousands of birds were around the codends, there is very little chance of capture in these smaller meshes. In my opinion capture could only occur in the bigger meshes 300/400 mm to 2.0 m meshes. During this trip birds only concentrated further back on the smaller mesh areas, where the risk of capture must be very low. Also noted most birds stayed further back where the codend had surfaced and not at the vessel stern area, until the codends are winched to the vessel. As birds are only interested in the codends where the mesh size is 100 mm, birds did not venture further up the net to the large mesh.

Tuesday 9th September

Back out on the fishing grounds at 15:00 hrs after unloading in Picton earlier that day.
First shot net tied with mussel rope, 4 ties spaced evenly approx 15 m apart starting from the second set of long rope meshes.

For the first time these ties were lashed to the selvedge rope then tied with a hitch in the normal manner, this will stop the ties falling off and should help the crew on deck, as they will not need to find the correct place to tie the ropes on subsequent tows.

Also this practice stops the ropes falling off to the ocean floor and stops wastage
The 4 ties may not be enough (consider 6 maybe best for larger nets) depending on the size of the trawl. Four is suitable for this small net, although some netting billows out in-between the ties. As the ties are now fixed to the selvedges this will speed up the process of binding for the following shots.

On haulback all the ties/binds were still on the net, some had wound their way through other meshes, these had to be un-tangled as the net was fleeted on to the net roller

Figure 5: Trawl being hauled, net bind did not release, still tightly bound around the net at the completion of tow *FV Taimania* 2008

The skipper stopped the haul and ensured crew untangled these ties before the net went back on to the net roller so they were clearly free and ready for use when the gear is shot next.

Second shot, the ties were re-used and only took 30 odd seconds for each bind, (no time lost looking for position to tie the binds, re-using rope is a big help to the crew).
During the tow the alarm bells starting ringing when the skipper took good marks with the net but the catch sensors did not go off.

He took more marks and still the catch sensor did not come on, in frustration the net was hauled and it was found the 3rd tie/bind had not let go. As it was a tie well down the net the headline was open so all things looked normal on the net monitor. The bridge electronics (the net monitor) would not show the skipper that the net was not fully open, where as if it was a tie closer to the head line the net monitor would show a decreased net opening and this would alert the skipper that some thing was not right.

Upon closer inspection it was found the mussel tie was badly frayed, this frayed end had a lot of grip and tangled through the meshed locking off the net. The skipper stopped net binding from then on. To prevent this from reoccurring either a new tie is to be used each time or the rope if its to be reused must have all the frayed ends cut off clean and/or with the mussel rope burnt (melted) to stop fraying. Other option is to look for a more durable rope material.

Figure 6: Mussel rope showing how it frays after use, bind on right is unused. This fraying was implicated in a failed release that ended in a wasted tow by the vessel, *FV Taimania* 2008

Summary

Observations

Observed 7 daylight shots and 6 daylight hauls

Shooting

- Net binding x 1 with knotted cotton
- Net binding x 2 with mussel rope
- Net binding x 2 with mussel rope tied to salvage
- No bonding x 2 net not tied

Hauling

Close up net by turning vessel; all hauls

Changes are required to the observation form:

1. Remove the sink rate information and exchange this with better questions the time it takes to shoot the gear and the time to place on the binding compared to when there are no bindings
2. Time net is hauled from deck
3. Time the wing end weights leave the deck
4. Time the doors enter the water
5. How the birds are counted needs to changing, the protocol says count birds within 5m of the net but the form is worded count birds on the net itself

Net Binding

The use of a net roller makes this a simple process on deck, it is not an issue for the crew to carry out, four binds were placed on the net around 15m apart taking approx 30 to 45 seconds each to attach. It definitely closes up the net volume on the surface by 2 to 4 times that of the unbound net.

This was a small net and the trials were carried out in good weather conditions, the number of ties and slip knots would need to be increased under different conditions to prevent the net binds falling off the net before the net has reached the water.

The mussel rope worked well but is very prone to chafing and becoming frayed, this is not ideal for long term use, its very important that the binds if left on the net are untangled out of meshes each haul and any loose, chaffed ends cut back. You cannot let the surface area of the rope increase and become worn or it will either grip or not let go or tangle up in the mesh and stop the net from opening.

Its evident that there are very few birds present during shooting because of this I could not differentiate the difference in risk to the birds between the net bound or unbound nets, and at no time was it evident that a capture could (or indeed did) occur.

Net binding works well on this vessel, good weather conditions and the net roller made tying the net a simple task.

It's not worth continuing with finding a suitable rope/twine etc that is knotted and then breaks when the force of the net opening is applied. Using a larger diameter rope applied with slipknots makes it easier for the crew, ensuring the rope does not fray is the key to reusing this material. More ties would be needed for bigger trawls, but I see no reason why net binding would not be easily carried out on a vessel without a net roller if it was deemed there was a risk of captures during shooting.

The next sea trial should be on a foreign charter vessel without a net roller using much larger midwater nets to check if the deck operation is going to be as straight forward as it was on this vessel.

Closing the net by turning the vessel while hauling

This procedure is an every day event for this vessel. I could not carry out the two treatments to get the comparisons between not turning the vessel and turning the vessel to measure the difference in the netting volume on the surface.

The captain adds 5 to 10 degrees of helm and turns the vessel's stern from side to side as he hauls the net to the net drum to fleet the net evenly across the 4 m wide net drum.

During the few moments the net is hauled straight up the stern ramp, the net is considerably wider and can lay out across the water surface 1 to 2 m, when he turns the vessel the netting is compressed on the stern ramp into a 0.5 m wide tube but this only holds its shape out 5 to 15 m aft of the stern, when the netting can still drift wider apart.

It is evident during the haul that it's the larger mesh that could pose the highest risk to seabird. The large rope meshes at the head of the mid water trawl only have a few joins that could trap a bird. The 100 to 300 mm mesh at the end of the trawl (back of net and lengtheners/codends) also are low risk as the mesh is too small for birds to become entangled, however in the 300 mm to 2.0 m mesh in certain weather conditions could trap diving birds and large birds bobbing down (1.0 m) could also become entangled in this mesh.

Vessels with net rollers make up only approximately 20 to 25% of the deepwater fleet, further trials on a vessel without a net roller will be required. Other vessels pull the net aboard with stops to fleet sections of the net at a time and lay these on deck. Fleeting the net compared to using a net roller takes much longer, this vessel using a small mid water net could haul the net onto the net roller and have the codends onboard in around 10 to 15 minutes. Other much larger vessels having to fleet the net onboard may take 2 or 3 times that time, this would increase the risk of captures.

Without offal discharges during the haul and also without the presence of diving birds there was little risk of seabird captures. Though there are hundreds of birds present during the haul, birds stayed with the codend, as this was the only food source.

Bird numbers would increase as soon as the winches were turned on and once the doors reached the vessel numbers increased significantly until the codends hit the surface when hundreds of birds would pool 100 to 200 m astern of the vessel and as the bridles are winched in, some birds (5 to 100) would follow the codends on the surface right to the stern, the rest of the flock (most of the birds) would remain back where the codends hit the surface looking for fish that could of fallen out of the meshes at that time.

Second Sea Trial on *FV Aleksandr Buryachenko*

General Fishing and Observation Activity

The vessel was targeting jack mackerel (JMA7) approx 40 nm west of New Plymouth.
Generally 5 hour tows, two MW nets on deck, one fishing the other ready for shooting if required. Both nets are used each day.

During the day fishing is hard down on the bottom, with the net closed up to approx 30 m (or 50%) of headline height, towing at 5.0 knots in 130 to 150 m depth of water. The fish schools are highly mobile so time is spent searching each day. A fleet of 4 similar BATM class vessels fish in the same general area. During the height of the season 7 BATM vessels may target JMA7.

The fleet moves off the day time flat ground out to the banks and drop offs in 150 to 200 m at night as the fish move up with the feed close to the surface. The fish are more scattered in long thin marks close to the surface.

The vessel has two identical nets; either one can be shot. Generally if there is a reasonable amount of fish in a tow, this is hauled and the other net shot, then the first net is tipped down to the pounds and cleaned. This also makes it easy to prepare for net binding as the crew can make and fit the net binding ties to the spare trawl without losing fishing time while the other net is fishing (Figure 7).

Figure 7: Trawl deck, with two midwater trawls; starboard side ready to shoot, the port net is being cleaned of stickers, *FV Aleksandr Buryachenko* 2008

The trawl is shot away quickly off the deck, the operation slows when the large head line kite and net monitor is deployed, this takes 5 minutes; the headline sits on the surface approx 100 m back for another 5 minutes while doors are being deployed and does not sink below the surface until the doors have approximately 80 m of warp paid away.

During hauling the vessel turns 5 to 10 degrees of helm to keep the net to either starboard or port so it can fleet the net to that side of the deck, but when the headline and net monitor comes up the ramp the vessel is turned back straight for a few minutes so this gear can come up the centre of the stern ramp without damage.

Normally the captain will shoot the gear with the vessel head to wind, then turn back on to his tow line and then let the doors away; the head line has been on the surface being towed for up to 10 minutes at that stage. Wing ends are fully closed during this process so there is no real risks of incidental catch of seabirds or marine mammals.

When fishing is steady tows are generally around 5 hours long, averaging 20 t of jack mackerel (JMA). During the week I was onboard, on most days' four tows were completed with catches between 10 and 35 tons. By-catch included frost fish, barracouta and horse mackerel.

The vessel can freeze 60 ton of product per day i.e.100 green weight tonnes (GWT) to the factory each day (larger size grades of JMA is dressed and hand gutted, smaller JMA is packed whole). The fish meal plant can process approximately 40 tons of raw material each day. The vessel is fitted with a batching/ buffer tank and can hold and batch discharge 1200 kg's of offal when required.

I observed three shots and hauls per day, starting at 05:30 hrs through to 21:00 hrs. I spent an hour or so each day doing warp strike, offal discharge (scupper) and seabird observations from the stern ramp during tows. Approximately half the hauls and shots were also observed from the stern ramp, the rest from the bridge.

The port trawl was net bound so that 75% of all shots with this net were bound, both daylight and night-time shots. I observed some night shots as well. The deck crew was happy to bind the trawl for every shot, whether I required it or not. The starboard net was not bound; recall that both nets are identical.

Very little bird activity was observed, 20 to 40 small albatrosses well behind the vessel each day, the odd giant petrel and some days, flocks of cape pigeons. Birds were well back from the stern (40 to 200 m) and no interactions were seen with either warps or nets. Shallow (approx 120 to 150 m) water fishing does mean the warps don't enter the surface until approx 17-20 m astern and are often exposed (4-5 m outside) out from the port or starboard side of the vessel as the vessel makes turns when fishing.

Potential feed discharge is intermittent via sumps and scuppers, just enough to keep these birds following the vessel all day. This feed consisted mainly of factory floor water, fish juice and some offal scraps. No offal discharges occurred during the sea trials.

No marine mammals were seen during the sea trials and no seabirds captured.

Daily Observations and Comments

Mon 1st Dec 2008

I transferred to the vessel at the Nelson pilot station at 20:30 hrs Monday night after the vessel had undertaken 12 hours sea trials following a 7 week survey and maintenance period. The vessel steamed throughout the night to the jack mackerel grounds (JMA7) West of New Plymouth.

Tues 2nd Dec

The captain shot the gear at 07:00 hrs. With a new crew (just had 6 months off) it took around 30 mins to get the gear in the water; the captain mentioned this would normally take much less time.

The vessel runs two sets of trawl gear on the deck; both sets are made ready to shoot at any one time. The trawl deck is approx 50 m long, generally one net is hauled and the other is then shot away. Note: *No birds! No discharge as factory not operating!*

Fishing in 120 to 140 m depth the net is hard down on the bottom and closed up to 30 m headline height in the general area 38.00 S & 173.30 E, approx 40 nm north west of New Plymouth. (other BATMs, *FV Mainstream, FV Meridian-1* and *FV Ivan Golubets* are in the same area also targeting JMA).

I started observations with the commencement of the haul of the port trawl at noon with 14 tons mainly jack mackerel (JMA) and 2 tons frost fish (FRO). Once the headline is onboard the chief mate turns the vessel 5 to 10 degrees of helm to keep the net within the port side of the trawl deck, until the lengthener arrives at the stern ramp.

Note: *I will observe the next haul if this operation continues it is not going to be worthwhile undertaking observations of this treatment (closing the net by turning the vessel). This is done every shot to get the gear onboard as normal operational practice.*

Second shot at 15:00 hrs, some birds starting to show (20 to 30) as processing started, I went to the stern and monitored the discharge, small scupper/sump discharge mainly juice, a few small pieces of offal, enough to keep a few birds behind the vessel, (mainly white capped albatross) feeding 50 to 150 m back. Warps are entering the water approx 17 m behind the stern.

Bafflers deployed, while the port and starboard side booms are very good construction (touching the water) the two booms aft over the stern covering the warps are very short and hang only a couple of meters down, this could be to stop tangling with the warps .
Still very little discharge and the few birds content to be feeding well back unlikely to see any captures as risk is low. This was hauled and observations carried out at 20:00 hrs

From this time the port net set up with the 7 mm mussel lashing rope, net binds and starboard net left with no binds. Both nets are identical.

All net binds ties are knotted to either the selvedges or a single rope mesh so they will not fall off and can be re-bound and re-used each time (see Figure 8).

Wed 3rd Dec

Up at 05:15 hrs to see the first net bound trawl shot away, to find the crew had already used this trawl during the night, and had just finished hauling the tow, as I was told it would not be used until daylight they had "jumped the gun". The port net with 8 net binds tied to selvedges (see Figures 8 and 9) and then all binds had three hitches applied, was shot away during the night (not sure how many held) and the net fished normally.

06:00 hrs; crew re-tied all 8 binds; the net was shot away again.

Note: *it's very important crew find, check and re-tie all binds placed on the net, missing any could lead to one be tangled in the mesh this would stop the net from opening during the following tow (All rope binds have the ends melted and taped to stop fraying or this will cause the rope binds to tangle.) The crew used sellotape.*

Net is shot away in 8 minutes, with the netting going away quickly, no binds seen slipping off during the shot. This was a short 2 hour tow, with not much fish around, the haul was observed at 08:30 hrs. While

the vessel steamed searching for fish, the crew fitted 2 more ties to the net; one in the bigger rope meshes the other into the smaller 600 mm mesh making 10 in total. We are now binding 80 to 100 m of the entire trawl.

Note: *I would like to tie some binds up towards the head rope meshes, as these spread out quite a bit. I think as soon as the large ropes hit the water the ties will slip and fall off, I will fix two more ties in a few days to test this.*

10:00 hrs, the net was shot away, two binds seen slipping a bit loose but staying bound on the netting during shooting. All seemed to hold up and keep the mesh together. It's very difficult to know once the netting hits the water if it's staying together, visibility is poor once the gear gets 20 to 40 m astern and semi submerges.

Figure 8: Mussel rope (net bind) tied to the rope mesh so it will not fall off, *FV Aleksandr Buryachenko* 2008

Figure 9: Reverse side of the above net bind, (following from Fig. 8) showing the three hitch slip knot which un-ties when the trawl spreads, *FV Aleksandr Buryachenko* 2008

Hauling is slow, getting the doors disconnected and the bridles onboard, then the net fleeted on the deck, from the time the doors hit the stern it's averaging around 20 minutes. The headline is on the surface for all of this time. While the doors are up, the net is closed and for the most part the meshes are pulled tight around the stern, all reducing the risk of seabird captures.

Three shots away net binding today, no issues although we increased the number of binds from 8 to 10 binds, crew had no problems or lost any time doing this extra work, they just fitted into their normal net cleaning and preparation work, I estimate the net binding was taking no more than 2-3 minutes to check and retie all ten binds each shot.

Will do one or two more shots with the mussel rope then switch to a 10 mm PPE Duradan (manline) rope which should be more durable and have a better grip and hold the larger head rope meshes tightly bound when shooting. After an inspection the mussel rope is still in good condition, keeping the ends taped together to prevent fraying is the key.

The net is pulled across the corner of the stern ramp to close it up so it can be fleeted to the required side of the deck, the other reason the vessel pulls the netting together it makes it much easier for the deck crew to place strops every 20 to 40 m on the netting to pull the netting up the deck and fleet it into position ready for cleaning and making ready for next shot (Figures 10 and 11 below).

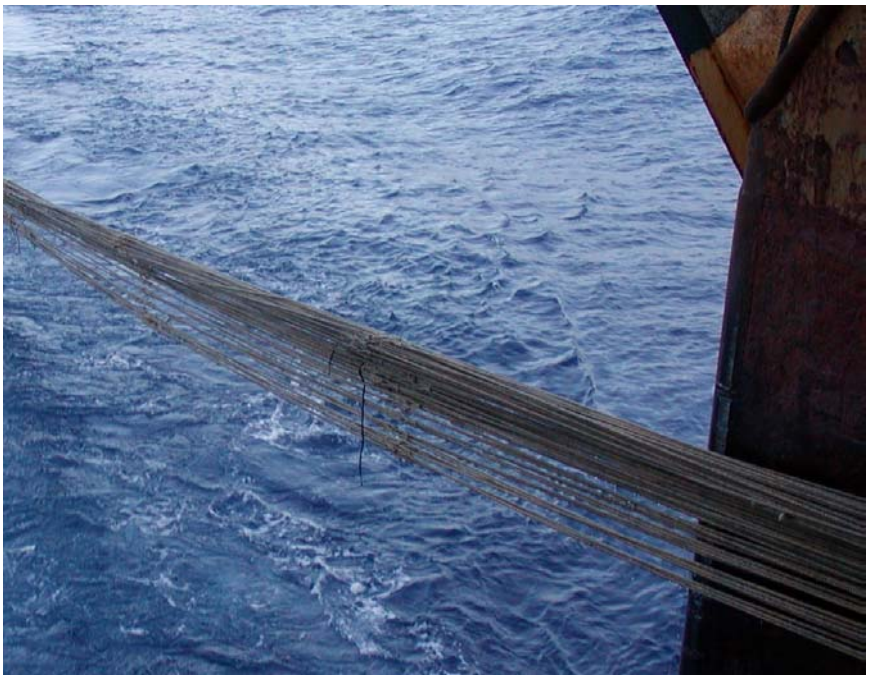


Figure 10: Hauling; the vessel turns to pull the mesh across the port corner of the stern ramp to guide the net to the port side of the deck. Note mussel net bind (centre of picture) attached and loose on hauling, *FV Aleksandr Buryachenko* 2008.

Figure 11: Crew strop and pull/winch the net in sections, fleeting it on the deck, *FV Aleksandr Buryachenko* 2008.

As it is going to be impossible to get the gear on deck without turning the vessel I am not going to be able to complete this prescribed treatment. I have decided to stop this part of the trials (as I had to onboard *FV Taimania*). I will however still record all the other data around haul times, net width and seabird activity as per the treatment form, but this vessel cannot follow the no turning treatment as the vessel must turn every haul this will be recorded on every form.

Thurs 4th Dec

First daylight haul at 11:30 hrs, (video haul from stern) good footage of the starboard net coming aboard, rope meshes and headline, showing large headline and kite brought aboard. While the netting is closed up on the stern the bigger, heavier meshes in the front of the trawl hang down (1 to 2 m) from when they leave the surface to the stern ramp, (see Figure 12) so while they are "closed up" against the corner of the stern ramp some are hanging down several metres as they bridge the gap between the water and stern ramp.

Figure 12: Head line, kite and large rope meshes, hauling onboard, *FV Aleksandr Buryachenko* 2008

12:30 hrs shot the port net, with 10 net binds. Missed the video footage as could not get back down the aft deck. Gear went over quickly; vessel hauls one net just up the deck and out of the way from the stern ramp and immediately shoots the other net. Observed most of the net binds holding well, (one let go, another became very loose)

This is the 6th shot these net binds have done, crew not even bothered by the net binding process, just takes crew a few minutes on haul to pull them out (untangle) and then while they clean the net just re-tie. This practice particularly suits this type of two net operation as the net is carefully cleaned, bundled together and fleeted along the deck so tying the binds during this time takes no extra effort. Huge deck space and large crew number obviously also helps. As the net binds are tied permanently to the net at each location, once tied on, it's no time to find and retie the same binds each tow.

Fri 5th Dec

06:00 hrs first daylight shot, with 10 net binds (mussel rope) at 10 m intervals, 8 binds hold firm and the netting goes away bound tightly, 2 binds let go (video footage of this shot) shows the bigger rope meshes in the head of the trawls spread as the headline is set away this places more tension spreading the ropes and pulling the net binds un-done.

One possible solution is placing stronger binds in this area, risk is over doing it and the trawl not opening so will leave this for now. Tomorrow we are placing more of the 10 mm Duradan PPE (manline) net binds at ten metre intervals. We will cover all meshes from the 600 mm mesh up to the 12 m rope mesh in the head of the trawl. Going any further up (closer to the headline) is not going to work as the spreading forces of the ropes in the head line when shooting means you cannot effectively tie these meshes.

After a meeting with the trawl master, its decided only to use 5 of the 10 mm PPE rope binds in the head of the trawl to try and give better holding power to these larger rope meshes, these will also be tied with 4 twists or hitches giving them more grip. Figure 8 below shows the 10 mm PPE rope net bind tied to the mesh and the 4 twists to grip the bind and slip out when the doors spread the net.

The other 5 mussel rope binds will be left as is, as these hold the smaller mesh well, the trawl master is concerned if we use the larger binds on the smaller mesh it may not slip or let go and stop the meshes from opening as there is much less spreading force in these areas when shooting.

Figure 13: Binding of 10 mm PPE rope with 4 twists placed on the rope meshes, *FV Aleksandr Buryachenko* 2008

Shot the net at 12:00 hrs with 5 x 10 mm PPE with 4 twists and 5 x 7 mm mussel rope with 3 twists. All 10 ties held together, the rope meshes in the head of the trawl were bound tightly and remained so until out of sight, the rope meshes around these binds were held in approx 350-400 mm diameter and the mesh did not billow out in-between binds (see Figure 14) the binds could even be placed slightly further apart out to 12-14 m)
The net sits just below the water so it's very difficult to see more than a few net binds as they sink, but clearly in Figure 14 below, nothing is getting into this trawl.

Figure 14: First three (of ten) 10 mm PPE binds on the large rope meshes holding in place at 10 m intervals, *FV Aleksandr Buryachenko* 2008

While the thought of going to heavy material with strong binds could short cut testing of different binds and twists to hold them, one has to be careful not to overdo it. The first time the net does not open and the captain has towed it for 5 hours and the factory then runs out of fish, would be the end of the trials.

The net was hauled and I watched every tie come to the surface; all binds had slipped off and the codend held 30 ton of mackerel.

Figure 15: No net binding, some mesh floats/lays out across the surface (compare with Figure 13), *FV Aleksandr Buryachenko* 2008

The starboard net was shot at 15:00 hrs. Figure 15 shows some of the netting billow out without the net binds. Shooting the net without binds definitely shows the difference, but as the net is quickly gone from view it's hard to say exactly how much more the net is spread out on the surface. The net sits lower in the water when bound as the netting does not drift over the water surface, but to be fair the netting (when the shot is done normally) is in the water and held quite tightly and gone within minutes; the unconstrained netting appears to stay within a 1m radius. I cannot see that this would normally pose much of a risk to seabirds. It's only when the netting leaves the deck with very little tension and just floats off in to the water, that stack mesh appears to pose a potential risk.

The shot at 15:00 hrs had the head line badly tangled and it took 4 attempts to get it away, that's four times the head line was hauled in and shot away again, leaving the rest of the mesh on the surface for 50 minutes. It's at this time the risk of capture is greatest, if this was the squid fishery and then add offal discharge or diving birds it would have been a different story, then you could get multiple captures, you need a combination of factors (birds, offal and/or fish in net and gear failure) to occur to get multiple seabird captures, in the mackerel fishery this time of year there's so few birds around and no diving birds so less risk!

Sat 6th Dec

Last night the port net was tied and shot away, proof the crew have no issue with this practice; this has happened most nights net binding continues without me being present.

05:30 hrs shot port trawl, bind number two (2nd from the trawl head) not tied properly or at all by crew as falls off or hangs down as soon as it leaves the stern ramp, all other binds held, the 1st bind normally slips off but the bigger 10 mm PPE rope with four twist holds much better on the larger rope meshes in the head of the trawl. For this shot we only had the first 3 x 10 mm PPE binds having 4 twists, all other binds had 3 twists

10:40 hrs hauled 20 tons mackerel, tipped fish, pounds full, wait for processing.

13:00 hrs shoot starboard trawl (no binds), problem again with this net and headline line tangles again; need to haul and re-shoot, problems from last night when this trawl head line tangled several times still evident. While the netting does not billow out all over the surface as one would think but only floats off 1 or 2 m wide on the surface, depending on the tension applied when shooting and the sea state. This does not always occur, some shots the netting is bundled together and not much less than when it is bound.

Next shot we will see if we can close up the big rope meshes closer to the head line, 2 further 10 mm PPE net binds will be placed at 12 m intervals further up the larger rope meshes net to see if it will stay in place, covering approx 120 m of the net with 12 binds.

Set up port trawl with, net binding x 12 ties:

- 3 x PPE 10 mm rope binds with 4 twists in the big rope meshes
- 4 x PPE 10 mm rope binds in the medium mesh with 3 twists
- 5 x 7 mm mussel rope binds in the small mesh with 3 twists

Shot gear 23:00 hrs, (port net 12 binds as above). Binds in place from the 600 mm small mesh to the 24 m rope meshes and the net is tied within 40 m of the headline.
On shooting all mussel rope binds hold and all but one of the 10 mm PPE, the 2nd bind comes loose and slips off as it leaves the stern ramp as the tension comes on, the first bind holds. Impossible to add more binds as the rope meshes in the head of the trawl spread too far when shooting. The only other way to hold the headline ropes closed would to have a twine set to break under load (breaking rope) not slip hitch system as we are trialing.

Sun 7th Dec

The original 7 mm mussel lashing binds have now been on the net for 5 days, none have broken or been replaced and these binds would have completed 13 shots and are still in very good condition, no wear or fraying is visible, it is important to have the ends melted and then taped to prevent fraying.

Changing the PPE 10 mm rope for the 10 mm manila (sisal) rope today, and complete one or two net bind trials.

11:00 hrs shoot gear, with combination of 7 mm mussel rope and 10 mm sisal rope, all 12 binds hold, and the three 24 m head line rope meshes hold, with 4 twists.

Figure 11: Trawl master Valeri net binding with 10 mm sisal rope, *FV Aleksandr Buryachenko* 2008

This was the 21st observed daylight tow, plus 4 night shots that we tied were completed by the crew. Most of the full length of the trawl is now bound and holding until it's under the water.

We could go to heavy rope and more twists but this may be pushing it, the net may not open, at present I can see no requirement for trials of further types of ropes, there would be many different types of rope that would do the job just as well. Admittedly it's all been done in good weather, may require heavier applications under different conditions.

Weather is good today, forecast is for 25 knots tomorrow and 30 knots on Tuesday, I have called a vessel out from New Plymouth to pick me up at 21:00 hrs, rather than risk getting stuck on board for several more days. As the vessel does not have a rescue boat I must climb down a pilot ladder and jump onto waiting boat, risky in bad weather.

Summary: Net binding

Net binding deck practices and fishing operations

Net binding on this type of vessel (BATM) was a relatively simple task, deck crew had no issues with the practice nor did the captain have any concerns around fishing performance. Note; this vessel has a huge deck space, runs two trawls and dedicated deck crew not always required in the factory so time is available to bind the net.

Attaching the net binds took 8-10 minutes work at the start of the sea trials, these binds were permanently attached to the selvedge lines, each bind was approximately 1500 mm long with the ends melted and tapped (with packaging tape/sellotape, but insulation tape would do) The binds were placed 8 to 10 m apart starting from the 400 mm mesh up to the 8 m rope mesh in the head of the trawl. Each bind was tied to one side of the mesh (selvedge rope) and on the other (opposite) side three twists (slip hitches) where applied, so when the netting spread apart these twists let go or slip out leaving the net bind hanging off the selvedge for the rest of the tow. These net binds are located during the haul, (or when the net is being cleaned) untangled, then re-tied ready for the next shot.

It is important the net binds are checked, if any are found to be frayed or knotted these should be replaced as they will eventually not slip or untie and will cause the trawl not to open.

Initially we started with 8 binds this was increased to 10 binds, these were all mussel lashing, and we found that the mussel lashing was not strong enough to hold the larger rope meshes at the head of the trawl bound during shooting.

During the course of the trials several different types and sizes of net binds were tested. The objective is to hold the mesh in a tight bind during shooting, without any slipping loose or un-tying, while still ensuring the trawl opens when the doors are shot away and the spreading force opens the trawl.

The 7 mm mussel lashing holds the finer small mesh well but did not always hold the weight of the larger rope meshes, the first half of the mussel lash binds were replaced with heavy 10 mm PPE rope and more twists added to hold the bind the larger rope meshes.

By the end of the trials we had 12 net binds on the trawl, 5 x 7 mm mussel lashing binds in the finer meshes 8 to 10 m apart with 3 twists. In the front of the trawl 7 net binds holding the larger rope meshes with 10 mm PPE with 4 twists.

Another net bind rope material tested in place of the 10mm PPE rope was 10 m manila (sisal) rope which also worked well in holding the larger ropes bound in the front of the trawl.

In my opinion you could go to a heavier rope (with more grip) in this type of net, remembering this vessel has 6,900 hp and large doors with plenty of spreading power. Eventually this trawl could have stronger binds that would hold fast in the head of the net as I was doing these trials in good weather you could need more holding strength in heavy weather conditions I feel sure the net would still open when the doors spread.

Its horses for courses, you need to ensure the binds do not slip off; you need to bind as far up the larger rope meshes as possible. Binds need to be relatively close together 8m with the lighter mesh to 10 to 12 m apart in the bigger meshes. If I could re set them for heavy weather I would place the lot at 8 m spacing's along the trawl. Net binding will only work if the binds are relatively close together and all hold in place, if one slips the weight of the mesh placed on the other binds increases and often two or three binds then drop /slip out.

There is a limit you can bind up to in the head of the trawl, the larger rope meshes within the first 20 to 30 m in this trawl could not be bound (using this method) as the binds would always slip out due to the spreading force on the headline, wing-ends and ground rope when shooting, by the end of the trials we were binding approx 130 m (or half) of the length of this trawl.

The BATM deck system using two nets made net binding "a non event". Crew would shoot one net then clean, bind and fleet the other trawl out ready for the next shot, net binding took a few seconds for each bind. Meaning that while one net is fishing the crew have several hours to check, clean (remove stickers) and carry out repairs, net binds suits this type of deck fishing operation.

For other vessels with one operational MW net and half the crew numbers (which is most of them) this practice will be more inconvenient as you must haul, tip codend, clean and tie/bind the net all in the few minutes between hauling and shooting. In saying that apart from securing the ties in place at the start of a voyage for the rest of the tows binding takes seconds to apply.

Ropes Used to Net Bind

Film lashing rope (mussel rope) 7 mm
Duradan (manline) PPE rope; 10 mm
Manila rope (sisal) 10 mm

Net binding to reduce seabird captures

While net binding is relative easy process to carry out on deck and fishing operations are not affected by net binding (when binds are applied correctly) whether it will reduce the number of captures on shooting is another matter.

Unlike hauling when net captures can be easily quantified, noticeable and because of the fish in the net occurs much more often, capture information when shooting is not well documented. It's thought 20 to 30% of bird captures occur when shooting, I would estimate most of this would because of offal discharges and or gear failures during that time. We must also remember captures during shooting are recorded against bottom trawls also, these must be in the smaller meshes and most are diving birds.

I would think that captures in the mesh of MW nets would be mainly the result of gear failure, often the head line and or net monitor get tangled and net hauling and re shooting, any offal discharges during this time would greatly increase the risk of capture.

When the net is shot away normally and there is tension on the net, most of the mesh is in a tight bundle, generally sitting just under the water surface and it's very hard to notice the difference between a bound net or unbound.

My belief is that the smaller meshes (600 mm to 2 m) cause captures of diving birds, they dive into the open mesh which then closes on them but I would think albatross captures would occur in the larger head line ropes, and these are very difficult if not impossible to bind. We also know that albatross generally come into this headline area only if offal has been discharged into the path of the trawl while on the surface. Again birds found in the netting hours later when the trawl is hauled in the codend could have been caught anywhere so information on just how most captures occur when shooting is limited.

I suspect stopping offal discharges when the net is on the surface, is going to make bigger inroads to reducing net captures when shooting than net binding (which is really the ambulance at the bottom of the cliff). Larger birds would mainly become entangled in the bigger mesh as its stretched out across the water and held tightly by the bridles out of the water from the stern ramp (spiders web). While half of these bigger meshes can be bound, the first ropes off the headline and wings cannot or if they can it will take bigger ropes and heavier binds than I was willing to try. I doubt if you can bind the head line and wings together as the bridles, winches or net rollers onboard pull them apart.

Again there would not be many occasions when birds are captured during shooting, when there is no offal discharge or the gear has been shot without incident. I am also not sure if when the net had to be hauled and re shot several times when there is a tangle if the binds would hold. If this practice can be shown or considered to reduce captures it should be used as a contingency measure when a vessel has had many birds attacking the net on shooting, which one would think would not be that often.

I still think most MW captures occur when there are breakdowns or gear failures, net binding will not be as successful if the gear is left in the water and partially hauled and shot again (this can happen many times during one failed shot) binds will slip and fall out. It's during this time (could be up to an hour) trying to fix the problem when offal could be discharged if batching capacity is reached, then you have an increased risk of multiple capture.

I feel we need more information from the squid fishery when many of the net captures occur. Better observations on when are where birds are caught during shooting is needed. Brief a couple of MFish observers on net binding and give them a questionnaire to complete each time there's a net capture during shooting would help achieve this. Perhaps briefing the vessel officers and a

Observer and if they start getting net captures on shooting and there is a high risk of further net captures, try one or two shots net binding, and see if captures stop!

We need to know more about net captures and net binding when shooting;

- What meshes are more susceptible to capturing birds and why?
- Are captures only occurring during gear failures, i.e. prolonged times with netting on the surface?
- Are different bird species interacting with different parts/sections of the trawl and why?
- Is net binding able to effectively reduce sufficient net captures to justify its use?

Summary: Closing the net by turning the vessel

This procedure is an every day event for this vessel during normal operations (as was also seen on *FV Taimania*). As the vessel works two trawl nets on deck it must store each net tightly to the port or starboard side of the deck to fit them both onboard and out of each other's way.

I could not carry out the two treatments to get the comparisons between not turning the vessel and turning the vessel to measure the difference in the netting volume on the surface.

The captain adds 5 to 10 degrees of helm and turns the vessels stern in one slow continuous circle as he hauls the trawl. This closes the trawl netting up on the corner of the stern ramp and makes it easier for the crew to place stops on the mesh to pull it up the deck and ensures the netting is kept on the port or starboard side of the trawl deck which is essential when working two sets of trawls on the one deck.

When the headline and net monitor is hauled up the stern ramp there is few moments when the vessel is straightened to allow the wider headline, kite, floats and net monitor up the stern ram without getting damaged, damage would be likely if it was pulled tightly across the stern ramp so the captain turns the vessel back and straight for approx 1 minute to haul this part of the trawl aboard, once on deck the vessel is turned.

Other vessels with only one net that don't have a net roller would only need to pull the trawl straight up the stern and would not need to turn the vessel to close up the net. These vessels, mainly Korean, may benefit from turning the vessel at times of high risk to close up the meshes.

Hauling on this vessel without a net roller and having the net fleeted up the deck in stages takes approx twice as long compared to using a net roller on a much more modern trawler.

While the meshes are closed up in a vertical line on a horizontal plane they can still have 1m fall down the corner of the stern ramp and out to the water surface, but this practice appears to reduce the surface area by more than 50% so must reduce the risk of capture.

Summary: Observations and Treatments

Observations

Observations made approx half from bridge other from stern

- Observed 12 daylight shots and 1 night time shots
- Observed 9 daylight hauls and 1 night time hauls

Shooting

Net binding (all ties knotted to selvedge)

- 1 shot with 8 x 7 mm mussel rope net binds with three twists in slip hitch
- 3 shots with 10 mussel rope net binds with three twists in slip hitch

- 2 shots with 6 x mussel rope binds and 4 x 10 mm PPE rope net binds with three twists in slip hitch
- 2 shots with 5 x mussel rope binds with three twists and 7 x PPE rope binds with 3 twists in slip hitch
- 2 shots with 5 x mussel rope binds with three twists and 7 x PPE rope binds four with 3 twists and first four with 4 twists in slip hitch
- 2 shots with 5 x mussel rope binds with three twists and 7 x PPE rope binds all with 4 twists in slip hitch
- 1 shot with 5 x mussel rope binds with three twists and 7 x 10 mm Sisal rope binds four with 3 twists and first 3 with 4 twists in slip hitch

Hauling

Close up net by turning vessel; all hauls.

- No hauls recorded not turning; vessel must turn every haul to get gear aboard.
- Forms completed on bird activity and haul times each daylight haul.

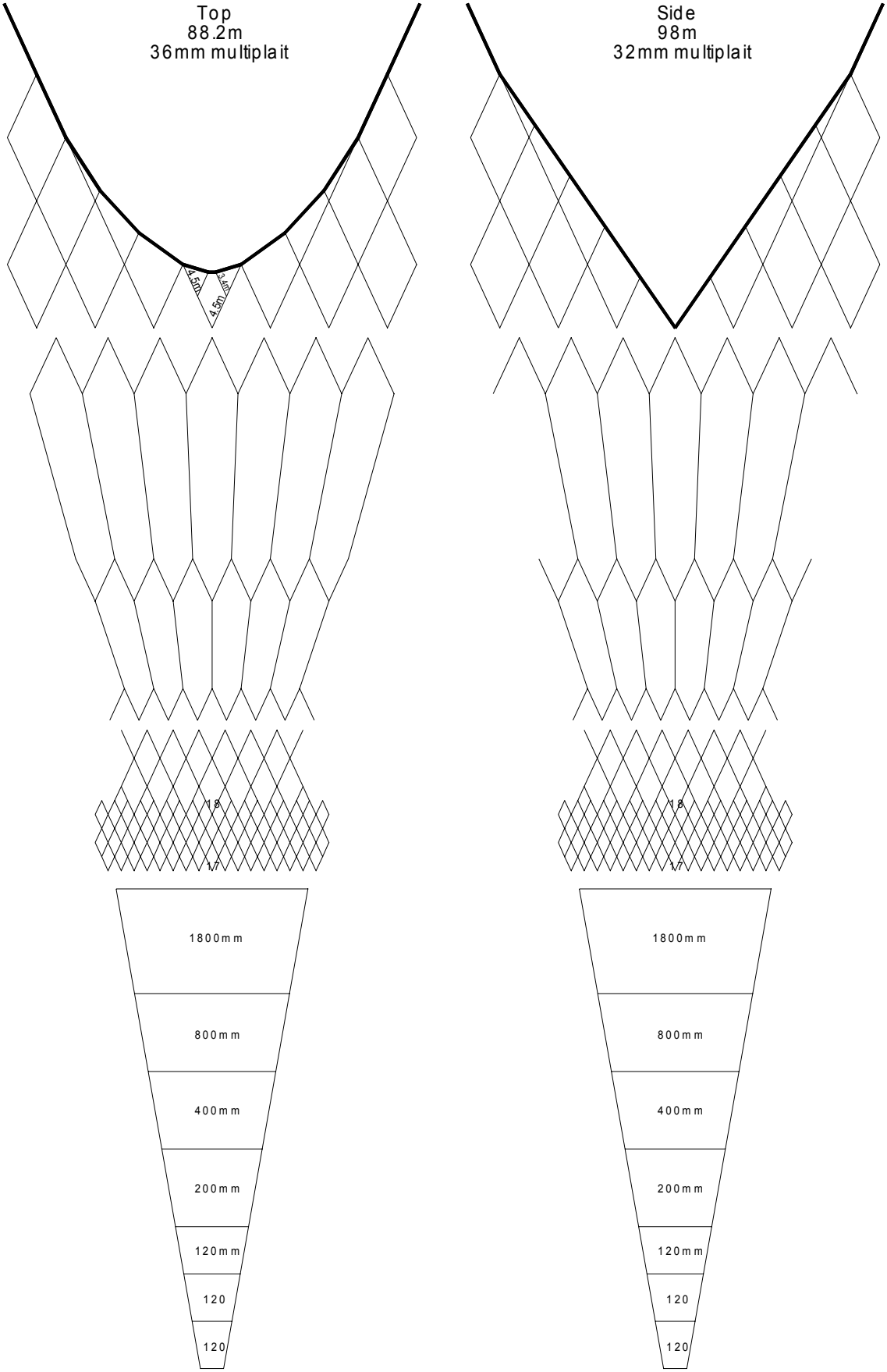
Explanation of the protocols and form records

1. Seabirds numbers were counted flying sitting/bobbing behind the vessels stern out to 300 m and approx 100 m width
2. Forms were changed to show better timing of hauling and shooting
3. Haul; doors up, headline on deck and codend on deck
4. Shooting; codend off deck, headline off deck, doors away.
5. Added comments on forms if any points of interest during hauling or shooting
6. No offal discharged during hauling or shooting but scuppers continually discharge factory water and intermittent discharge some small offal pieces in this water

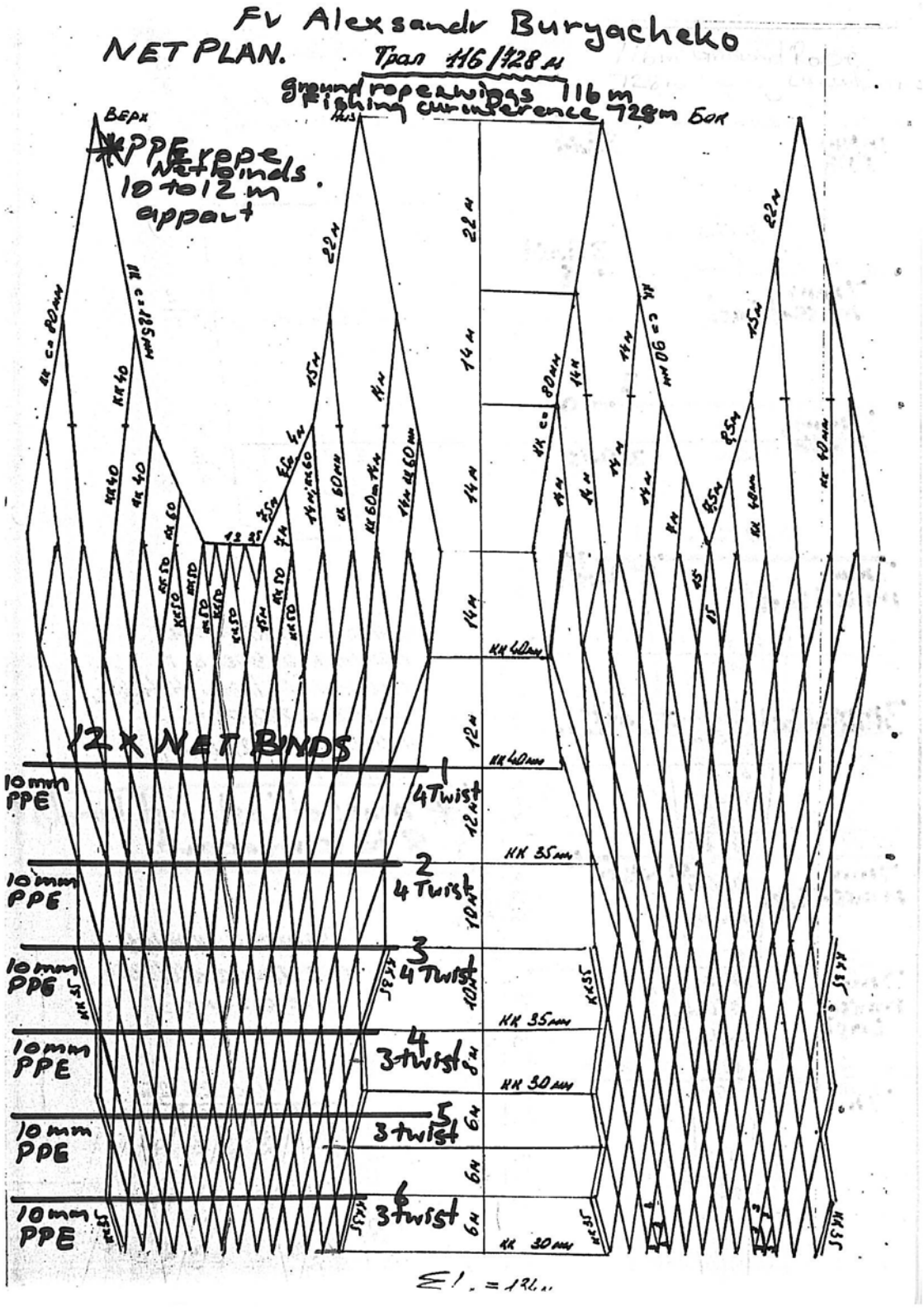
No warp strikes or seabird net captures were observed during the trials nor were any marine mammals seen during the observation periods.

Appendix 1: *FV Taimania* 28-17 midwater net

28-17



Appendix 2: *FV Aleksandr Buryachenko* Net Plan



Appendix 5: SSS Trawl Workshop Meeting Notes September 2006

Southern Seabird Solutions Trawl Workshop September 2006

Work Group 1 Net Captures

Next Steps in New Zealand and Opportunities for International Collaboration Workshop Discussion

Groups considered different topics and reported back on next steps and how to keep in communication after the workshop.

Group 1 – A closer look at some of the net solutions

This Group reconsidered:

- Modification to net mesh – square paned instead of diamond
- Pressure sensory device
- On surface – noise/smoke, remote control
- Binding net – net closed off on shooting – reducing float time on surface
- Sheet device to cover net disguising net and content on surface

The ideas were separated into hauling and shooting and ranked:

Shoot – ranked A&B	Haul – ranked A&B
A – Remove stickers first (deck cleaning)	A – Gear maintenance, use net roller for quicker haul
A – Bind mid water nets (would need to assess net roller problem)	B – Acoustics (below and above water)
A – No offal discharge	A – No offal discharge
B – Acoustics	B – Strategic discharge when problems

Other – ranked B&C

B – Focus lights on deck / other colours

C – Smoke?

C – Tori line “kontiki” / door

Next Steps

- Review the NZ trawl fisheries Code of Practice
- Trial net binding
- Outline steps that will be taken to educate crew in Vessel Management Plans
- Incorporate into the NPOA research and policy
- DoC lead trials on high-ranked ideas
- Research to find out more about the problem (i.e. percentages of seabird captures on the shoot or haul)