Fishing for information:
Scoping for opportunities to prevent musculoskeletal disorders on New Zealand's large fishing vessels

Marion Edwin, Optimise Ltd, Motueka, New Zealand. marion@optimiseltd.co.nz
Darren Guard, Sealord, Nelson, New Zealand. darren.guard@sealord.co.nz

ABSTRACT

When comparing industry sectors New Zealand's fishing industry tops the polls in work-related injury stakes. A 2012 report (Kahler and Chau) identified human and gravitational energy as cause for 58% of injuries sustained on under 24 metre fishing vessels - suggesting the need to address manual handling/ergonomics issues. Further data review showed that vessels of over 24 metres (only 7% of the national fleet) were responsible for a disproportionate 68% of serious harm injuries within NZ fishing. The focus on managing the injury toll within NZ's maritime sector is positive with the recent development of an industry health and safety forum and increasing commitment by key fishing companies to health and safety. The industry health and safety regulator, Maritime New Zealand (MNZ), appears to lack leadership in this area. To determine 'where to start' to address the high injury rate, ergonomist Marion Edwin was engaged by ACC to work with the NZ fishing industry to carry out a 'scoping assessment' of over 24 metre fishing vessels. The purpose was to gain an understanding of the difficult to access work environment and the work demands for fishers on large vessels – both factory and fresher. This paper summarises the key activities and findings from the 'ergonomics scoping assessment' carried out between May and September 2013. A number of promising research and intervention opportunities are outlined to address the high injury toll in the NZ fishing industry.

KEYWORDS

Fishing, factory vessels, musculoskeletal disorders (MSD), ergonomics, manual handling.

INTRODUCTION

In 2012 Optimise Ltd was approached by health and safety personnel from fishing company Sealord to consider ergonomics input to address high MSD rates on commercial fishing vessels. Initial discussions and overview of industry injury data lead to Optimise and Sealord working up a proposal for an industry-wide 'ergonomics scoping assessment' to determine the opportunities to prevent such injuries. Consequently, in 2013 Optimise Ltd was engaged by ACC, (New Zealand's injury prevention, compensation and rehabilitation provider) to work with the NZ fishing industry for this 'scoping assessment' of large fishing vessels. The key activities, findings and implications of this 'scoping assessment' (carried out from May - September 2013) are described.

METHODS

To gain knowledge of the New Zealand fishing industry context and injury data, and international fishing industry injury prevention activities, an initial literature review was required. In order to understand the nature of NZ fishers' manual work at sea, it was determined that site visits (vessel trips) were necessary. These activities would together inform regarding the opportunities for MSD reduction on NZ's large fishing vessels.

FINDINGS

Literature review overview

The literature review (Edwin, 2013) reported on the NZ and international fishing industry and health and safety context; injury data; fishing specific health and safety resources from international sources; the general and ergonomics hazards known in fishing (including fatigue management, seasickness, and vessel motion); considered fishing safety culture and attitudes; and reviewed (the English language) literature on fishing industry and fish processing injuries.

Whilst some recent ergonomics assessment and intervention work has been reported out of North America, few resources targeting the prevention of MSD were identified. Some studies over the last 10 years have begun to investigate the increased manual handling risks posed by vessel motion but no clear guidance on the magnitude of the increased risks is yet available.

In summary, it appeared that New Zealand was not alone in having limited understanding of vessel-based manual handling risks and interventions to reduce these risks.

New Zealand's fishing industry

Following the 1977 introduction of the 200 nautical mile exclusive economic zone and the 1986 quota management system, increased local investment in fishing occurred. This saw export development with >90% of all fish landed now destined for the overseas market. This earns around $1.2 – 1.5 billion per annum and ranks as New Zealand's fifth largest export earner.

Commercial fishing and aquaculture employs around 5700 full time equivalents, and the largest regional employer is Tasman/Nelson/Marlborough/West Coast with 38% of the workforce. Anecdotally, there are around 12 factory fishing vessels in New Zealand, and a larger fleet of smaller fresher vessels that fit the >24 metre description (Edwin, 2013).

MNZ is the marine transport regulator agency (per the Marine Transport Act 1994) with duties encompassing safe and sustainable transport systems, and protecting the marine environment. MNZ is also responsible for administering the Health and Safety in Employment Act for work on board ships and for ships as places of work. The fishing industry operates in a highly regulated environment - this suggests that any solutions must be developed not by regulation, but in partnership with industry.

In 2013 the formation of a 'Fishing Safety Forum' saw the three main NZ commercial operators begin to jointly address health and safety issues. Championed by Sealord, this new industry partnership provides fresh opportunities to positively impact injury rates. All the large commercial operators have recently added vessel-focussed health and safety expertise to their staff mix.

Industry injury data

MNZ et al (2012) identified that New Zealand's marine fishing and marine based aquaculture had the highest injury rate of all industry sectors (figures averaged for 2001-2009 per industry per year). The work-related injury rate in fishing was 7.29%, with mining and quarrying next at 4.47% and construction at 3.29%. MBIE (2012) reported that over the previous 10 years the fishing industry had the highest ACC entitlement claim rate per sector, only in 2008 dropping to less than forestry.

Statistics NZ (2013) report that 1 in 4 fishery workers made a work-related claim in 2012. Equal with agriculture, this was the highest rate by occupation.

Internationally, a similar trend was reported by McGuiness et al (2013) - the European Union had a rate of one in seven fishermen having an accident per year - a 2.4 times greater risk than other industries. This author also suggested that it was common for injuries to be under-reported within the fishing industry, a claim echoed by Fulmer and Buchholz (2002) and NZ's Norrish and Cryer (1990).

NZ fishing industry injuries were reported by Norrish and Cryer (1990) as 45% 'strain or sprain' in nature, followed by fractures (largely of hands and fingers). In this study one in ten commercial fishermen experienced an injury requiring at least one week off work during the year of the study. More recently, MNZ et al (2012) reported that for 2002-2010 ACC accepted claims the most common injuries in the fishing industry are 51% soft tissue (contusion, strain, sprain). Similar findings appeared from Kahler and Chau's (2012) analysis of incidences on NZ <24 m fishing vessels. This taxonomy clearly identified *human energy* (lifting, lowering, pushing and pulling; repetition; awkward, difficult and sustained postures; caught between objects being handled; struck by or against the object being handled or another person) as cause of 37% of incidents, and *gravitational energy* (descending access systems, falls to same level, falls from height, and falling objects) as cause of 21% of incidents. These authors recommend a focus on human and gravitational energies (total of 58% of incidents) to reduce the work toll in <24 m fishing vessels.

However closer investigation of injury data reveals that >24 m vessels carry the greatest risk for injuries. Table 1 (from MNZ reported incidents) shows that >24 m vessels have the highest number and percentage of reported serious harm; they also have the highest rate of serious harm per 1,000 vessel operating hours and rate of serious harm per 1,000 crew. This is followed by vessels 12-24 m in length and vessels 6-12 m in length. In short - the larger the vessel the higher the serious harm risk.

These findings suggest that the NZ marine fishing/marine based aquaculture sector is ripe for targeted injury prevention work to reduce MSD. Furthermore, gaining positive change on >24m vessels appears simplified due to small numbers of vessels and high crew numbers.

<u>Table 1. Serious Harm 2000-2008</u>

Vessel Length	Number and % of Serious Harm	Number and % of Vessel Population	Total quarterly operating hours	Rate of serious harm per 1,000 vessel operating hours	Total Crewing Numbers	Rate of serious harm per 1,000 crew
Under 6m	0 **0%**	251 **23%**	20,331	0	437	**0**
6-12m	11 **6%**	356 **33%**	60,164	0.18	652	**16.8**
12-24m	51 **27%**	405 **37%**	197,640	0.26	1300	**39.2**
24m+	129 **68%**	79 **7%**	103,569	1.24	1991	**64.8**
Total	**191** 100%	**1091** 100%	**381,704**	**0.5**	**4380**	**43.4**

Discussion of NZ fishing injury data is incomplete without consideration of the impact of FishSAFE, a 2004-2007 programme targeting safety outcomes for small fishing vessels. This programme was funded by ACC, the Seafood Industry Council and MNZ. MNZ et al (2012) reported that an estimated 508 new claims were prevented between 2004 and 2007 due to FishSAFE, and that this positive effect continued for 2 years post-programme. However, review of FishSAFE material identified a lack of manual handling guidance (Edwin, 2013).

These findings suggest that in order to have the greatest impact on the fishing industry work toll in New Zealand, efforts should focus on the investigation of manual handling tasks and potential interventions for crew on vessels of >24 m.

Vessel trips

The arranging of site visits on working fishing vessels is more difficult and expensive than most. However, until fishers were able to be observed in the real context of the working vessel, any assessment would be grossly incomplete and would lack credibility within the industry. Thus several vessel trips were arranged, for a total of 12 days at sea:

- Sealord, FV Otakou (fresher), 8-10 June. Out from Nelson into Cook Strait, return to Picton.
- Sanford, FV Ikawai (fresher), 30-31 July (16 hours). Out from Picton into Cook Strait, return to Picton.
- Sealord, FV Ocean Dawn (factory), Friday 9 – Sunday 18 August. Out from Nelson to West Coast, return to Westport via transfer to charter boat.

These trips occurred over the busy hoki season and gave a robust understanding of the work tasks aboard fresher and factory vessels. Additionally they gave an insight into the flow of work and living activities aboard two different types of fishing vessel, allowed the researcher to gain her ‘sea-legs’ and to generally develop a deeper understanding of the fishing industry and what makes fishers ‘tick’.

Work tasks on fresher and factory vessels

The main tasks on a fresher (whole fish) vessel are:

- Nets out, catch the fish
- Bring fish out of the sea, and either into pound or onto deck
- Get fish into the hold, either via pound and conveyor into bins or via deck and pushed down into hold, then handled into bins
- Ice the fish, stack bins in hold (manual, one or two persons)
- Skipper is piloting the vessel and ‘hunting fish’
- And someone is usually sleeping, depending on roster system (often 12 hours on, 6 hours off).

The main tasks on a factory (fillet) vessel are:

- Nets out, catch fish
- Bring fish out of sea and into pound, plus other deck/net work
- Sort for species/size: main catch, by catch, fishmeal
- Line up for head and tail machine, then through the fillet/skin off machines
- Trim and sort fillets for size, and quality check (scrap to fishmeal)
- Weigh into bins (bowls)
- Pack from bins into boxes (2 per tray) and stack trays into scats
- Push from scats to freezers, and once frozen, push out of freezers
- Pack 3 boxes per carton, and label cartons
- Stack into elevator and take down to freezer
- Take out from elevator and place on conveyors
- Stack from conveyors into final freezer position
- Process fishmeal (via dryers etc) and stack bags into hold
- Skipper is piloting the vessel and ‘hunting fish’. (12 hours on/12 hours off)
- Half the crew is sleeping. (6 hours on, 6 hours off)
- And there is an engineer, and cook/galley hand.

Key factors

Tasks - Deck activities (managing the nets and lines) are not carried out by all fishers, but those completing deck work also work in the factory/hold. Factory tasks are repetitive (particularly sorting, head and tail, packing); often in sustained/constrained/awkward postures (particularly trimming) and always in a moving environment. With the exception of the freezer-man and meal-man most do not involve cardiovascular activity; and many require the handling of slippery fish with dangerous spines.

Design - Some tasks and work areas showed significant opportunity for improved workplace design. Workstations were at fixed/non-adjusting heights; conveyors too low, and workstation designs forced over-reaching and awkward positions. Key paths of travel were at times extremely awkward or with trip risks and conveyors were not designed to reduce fish handling. Equipment and processes created additional handling of both raw and packaged product. These factors impact on product quality, productivity, and injury risks, and represent an area where significant gains are possible.

Shifts - Shifts on the factory vessels are 6 hours on, 6 hours off for 7 days a week for 6 weeks, and are fatiguing in all ways. These have an unknown effect on the circadian rhythms and work capacity of fishers, with concern about getting enough sleep a key focus for many fishers at sea. Whilst on vessel there is little else to do beyond work, sleep and personal care activities, so the notion 'you may as well work' was common.

Vessel motion - The nature of working on a moving vessel is challenging. Whilst waves (and therefore the boat's movement) are sometimes gentle, rhythmic and predictable - at other times they are not. Vessel movement is unpredictable, and staying on your feet becomes mentally tiring and muscularly fatiguing, adding to the overall workload. Coping with vessel motion makes all activities more challenging – sleeping, walking, working and all self-care activities. The relentless and sometimes frustrating vessel motion must simply be tolerated, with such psychological strain known to contribute to MSD.

Personal space - Living and working on the vessel creates a reduction in your personal space. Space is always at a premium on a vessel - rooms are small and shared, and living and working quarters are very close. Vessel movement may mean that you bump into others. Crew must therefore have a high tolerance for others; possibly a unique psychosocial profile. This raises the question of whether the psychosocial and physical profile of a 'good fisher' is well understood and used to inform crew selection.

Training and fitness – Industry fisher training provided little formal information on the benefit of stretches and general fitness. There was limited understanding of and an inconsistent approach to the notion of work breaks and stretches, and an outdated approach to lifting and handling techniques, without specific training. Despite this, a useful 1 minute per hour 'ergonomic break' was in place in the factory vessel observed, though this is an uncommon practise on NZ factory vessels. Little explicit task training occurred, reducing the passing on of safe and efficient work methods. The pressures (including personal competitiveness and perceived and real peer/employer pressure) for crew to keep working despite discomfort or injury when at sea appears high. Additionally, not all vessels have access to suitable gym space and equipment that can provide the type of cardiovascular activity useful in the prevention of MSD from fishing tasks.

Hydration - Consequent to anecdotal reports of common crew problems with urinary tract and bladder/kidney infections, whilst on-vessel the opportunity to investigate crew hydration levels was taken. Results of volunteer sampling were that only 16% of the crew were adequately hydrated (1.003 -1.020 urine specific gravity), 63% were dehydrated (1.020 – 1.030 urine specific gravity), and a further 20% were very dehydrated (over 1.030 urine specific gravity). Given the known effects of dehydration on cognitive function, fatigue, work capacity, muscle function and muscle recovery, this is a result that suggests the need for further assessment and intervention.

Cost benefits - In tandem with this scoping assessment, Gaskin (2013) investigated potential cost benefits of ergonomics and other interventions in fishing. Gaskin determined that for one company, within the first 12 months of employment a 57% turnover of vessel crew occurred. With each new recruit costing upward of $50,000, Gaskin suggests that improved recruitment strategies could be fruitful. She further suggests that ensuring worker well-being through a range of interventions will lead to both higher productivity and lower injury costs, providing a compelling financial argument for the introduction of targeted interventions.

Logistics - Fishing vessels earn when they are catching and processing fish - not when they are tied up in port. This scoping assessment provided a working understanding of the logistics of vessel repair and maintenance work, and the complexities of design for food manufacturing in the vessel environment. Most large factory vessels are in port for only 48 hours between trips. In this time the cargo is discharged, an array of maintenance work performed, the crews swap over, and fresh supplies are taken on board. Any upgrade work must be carefully planned to occur within this hectic timeframe. Limited work is able to be completed at sea by the engineer.

RESULTS

A multitude of intervention opportunities to prevent MSD for fishers on >24m vessels exists. These include:

Physical design

a. Work-bench heights variable for tasks and short/tall users
b. Stoppers for trays to prevent movement with wave motion, tray material review
c. Ensuring contact surfaces are smooth and appropriate for 3 points body contact
d. Grab rails and design of rails
e. Holders for fish on by-catch table
f. Floor surfaces appropriate and non-conflicting work/pedestrian areas
g. Review weights of handled product and method of handling (mechanise some tasks/tasks elements)
h. Access to water bottles, suitable fluids and clean toilets for better hydration
i. Facilities for cardiovascular exercise, stretching, and self-management of discomfort.

Organisational design

a. Develop industry-wide training resources (such as ACC WorkSmart Tips) that are consistent with current best practise, i.e. ACC's Discomfort, Pain and Injury Prevention and Management Programme resources
b. Disseminate and train with this resource for effective use by vessel-based crews
c. Enhance vessel-based knowledge of discomfort and injury management (especially captain, medic, factory manager, supervisors, health and safety representatives) and improve links with shore based occupational health services
d. Develop focus on off-vessel fitness/wellbeing activities, and the introduction of equipment/training to provide safe on-vessel cardiovascular exercise options (the notion of 'workplace athletes')
e. Review of sleep cycles and roster patterns
f. Education regarding hydration, and provision of suitable fluids and toilet facilities
g. Better identification of when it is too rough to do some tasks safely, and strategies to manage in rough conditions
h. Review employee selection programmes - consider physical and psychosocial profile assessment elements
i. Work with engineering and design teams for improved on-vessel design solutions
j. The investigation of overseas best practice for vessel design and training around ergonomics issues.
k. Consider upgrading the FishSAFE manual for large vessels to include ergonomics/manual handling aspects
l. Linking with MNZ to facilitate their active participation in a desired industry/ regulator partnership.

Training

a. Explicit injury prevention and discomfort/injury management training encompassing break practises, stretches, nutrition/hydration, fitness, relaxation
b. Explicit task completion methods to be documented and trained too. Include relaxed work methods, workstation adjustment, postural variation, task variation in procedures for each task.

Future research

Opportunity exists for research projects that will usefully add to the health and safety knowledge and practises within the fishing industry. These include:

1. Research into sleep cycles and optimal vessel roster patterns, preferably considering and testing alternate rosters.
2. Work to identify manual handling risk factors for lifting and handling on vessels. This could consider the effect of wave action creating apparently lighter and heavier loads, the need for corrective motions to maintain balance, the impact of wave action on fatigue levels, and the contribution of wave action to injury risks for upper limbs, back and lower limbs; and importantly a measure for when vessel movement is such that certain manual handling tasks become too risky.
3. Understanding what attributes (physical, psychosocial, cognitive) make a 'good fisher', employable long term. This information could inform the selection and training processes, and might include the specification of anthropometric or strength limits for some difficult/injurious tasks - if they are unable to be remedied via design.
4. Injury data drilling for >24 m vessels. Consider slips, trips, falls, and MSD's, and discomfort reporting, to establish a clear picture of what is happening within the industry. This will enable targeting of highest risk tasks and focussing of input on these activities.

5. Analysis of reasons why fishers leave the industry, in order to consider opportunities to reduce turnover costs.

CONCLUSION

This ergonomics scoping assessment considered the opportunities for reduction of MSD on New Zealand's large fishing vessels (> 24 m). A wide range of interventions (categorised under physical design, organisational design and training), have been identified as necessary and appropriate to positively impact the high MSD rates, along with some fields for further research.

ACKNOWLEDGEMENTS

The unremitting passion to keep New Zealand fishers safe that has been demonstrated by Sealord personnel, particularly Darren Guard and Donovan Hoar, has allowed this research project come to fruition. Sealord have championed and driven the work to date, and are leading their industry in recognising and acting on the opportunities for positive change. Dr John Wallaart and Diego Rodriguez of ACC, and Dr Felicity Lamm and Dr Dave Moore from AUT have also provided invaluable funding, practical support and insight. Members of the Fishing Safety Forum have provided assurance that this work was on the right track. Thanks to all.

HE WHAKATAUKI

He moana pukepuke e ekengia te waka. (A choppy sea can be navigated). Interpretation – though the task of reducing injuries in fishing may seem difficult, it can be done.

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