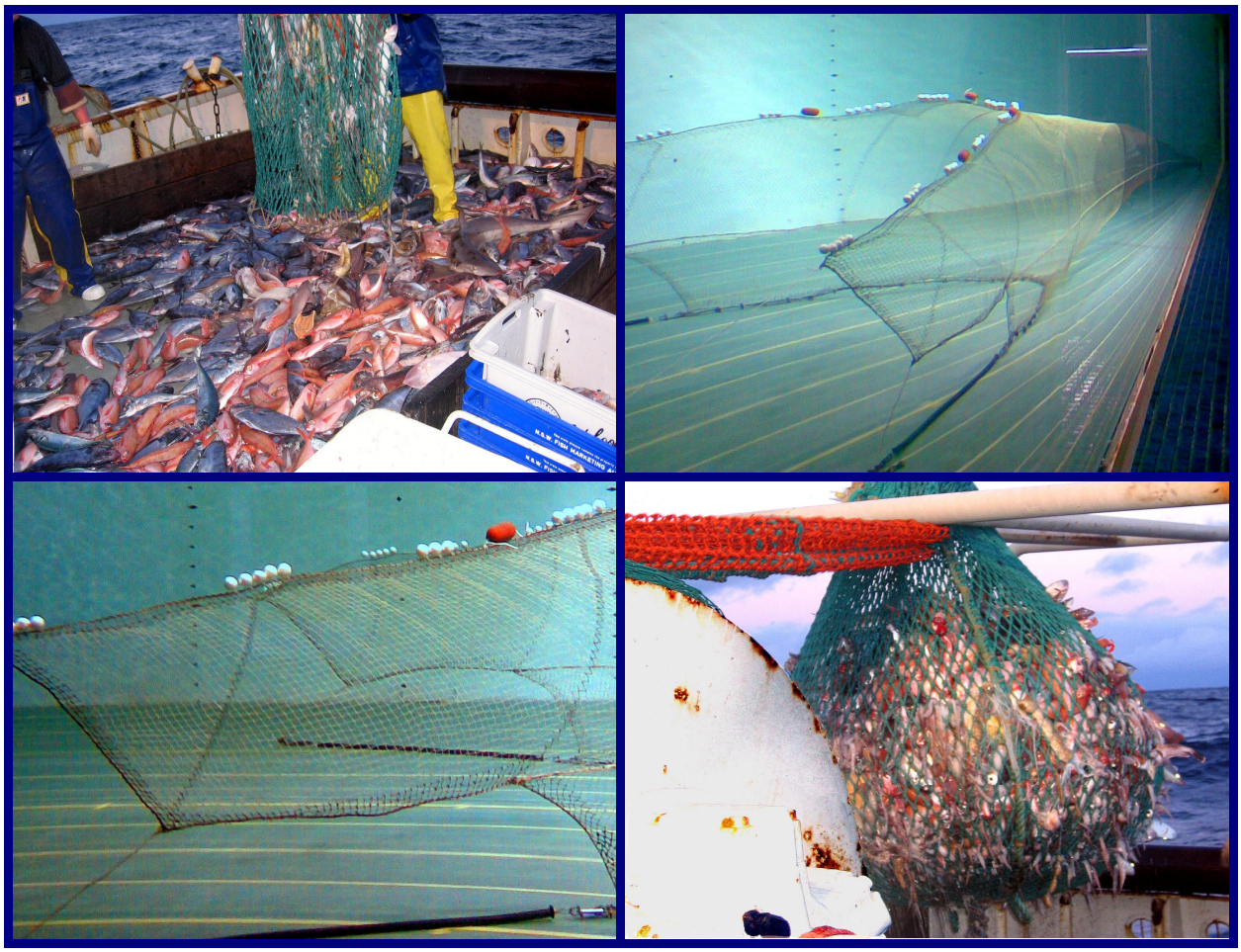
SESSF Industry Development Subprogram: Field trials of a high-lift trawl net for bycatch reduction



Matt Koopman, Russell Hudson, Ian Knuckey and Ian Leck

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FRDC Project 2007/039

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Published: Fishwell Consulting Pty Ltd
22 Bridge Street, Queenscliff VIC 3225

ISBN: 978-0-9805388-7-8

Preferred way to cite:

Koopman, M., Hudson, R., Knuckey, I. and I. Leck. (2009). SESSF Industry Development Subprogram: Field trials of a high-lift trawl net for bycatch reduction. AFMA Project 2007/039. Fishwell Consulting 25pp.

Table of Contents

List of Tables

List of Figures

2007/039 Field trials of a high-lift trawl net for bycatch reduction

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Objectives

1. Conduct a workshop to discuss the NetworkTN net and select a vessel to conduct sea trials
2. Carry out trials at sea to gauge the effectiveness of the NetworkTN net in reducing bycatch of undersize quota and non-quota species
3. Develop an extension strategy to ensure background and progress of project are adequately communicated to Industry, AFMA and the wider community

Non-technical Summary

OUTCOMES ACHIEVED

Data collected during this project has shown that the high-lift net has the potential to reduce catches of small, high-discard species such as small silver dory, blacktip cucumberfish and spikey dogfish. The 'cost' of a large decrease in discards was a reduction in the catch of commercially important deepwater flathead. Quality of the catch by the high-lift net was higher due to less damage to the fish in the codend, and shorter sorting times on deck because of reduced bycatch. Currently, four of the five trawl vessels operating out of Portland are using the high-lift net, and adoption by the wider trawl fleet may further reduce discard levels of small fish in accordance with Australian Fisheries Management Authority requirements.

The Commonwealth Trawl Sector (CTS) is a sub-fishery of the Southern and Eastern Scalefish and Shark Fishery (SESSF), managed by the Australian Fisheries Management Authority (AFMA). This diverse fishery targets as many as 30 species or species groups that are subject to Total Allowable Catch (TAC) limits, but catches many other byproduct and bycatch (discarded) species. Industry have been proactive in responding to the Australian

Government's directive and AFMA's response to that directive by investigating innovative methods to reduce bycatch.

NetworkTN, a small net-making company based in Portland, have developed a net with a larger than usual top panel. Reports by users of the net indicated the catch of smaller fish to be greatly reduced, and that retained fish were in better condition. Anecdotally, it appeared that this high-lift net was able to reduce bycatch and it had received strong endorsement from a range of fishers who were using the net. This report details trials of the high-lift net undertaken to describe and quantify the levels of bycatch reduction that are achieved.

Between 20 October and 13 November 2008, sea trials were undertaken off Portland, Victoria, to obtain quantitative estimates of catches using the high-lift net and a standard "control" net. A total of 64 shots were undertaken during the trial, however, 22 shots from the first three cruises were omitted from analysis of catch data due to gear damage and gear performance issues. Shots generally alternated between high-lift and the control net. The high-lift net caught significantly less of the several high-discard species including blacktip cucumberfish, spikey dogfish and small silver dory. This positive result was somewhat offset by reduced catches of at least one commercially important species, deepwater flathead.

Few differences in the length-frequency samples were observed between nets, and contradictory results were observed for the two species that did show differences. The control net caught more small silver dory than the high-lift net, while the opposite was observed for silver warehou.

The high-lift net also showed promise in reducing damage to the catch. Blue grenadier caught by the high-lift net appeared to be in better condition than those caught by the control net. Apart from reduced damage while in the net, reduced bycatch resulted in shorter sorting times and increased the overall quality of all species retained. Increasing the quality of retained fish may increase the profitability of the catch, and suggests that fish escaping through the mesh may be in better condition and increase their chances of survival.

The benefits of increased fuel efficiency while towing the high-lift net were not realised. Fuel efficiency is difficult to interpret because of the influence of so many external factors, such as current direction and strength. Although attempts were made to minimise the effects, these were not fully taken into account in this study. Increasing shot numbers and more closely monitoring and accounting for the range of variables that can impact on fuel consumption, are highly recommended in any future trials.

Overall, this trial revealed that the use of high-lift nets has the potential to greatly reduce the catch of high-discard species without reducing the catch of most commercial species. The apparent reduction in catch of high-discard species would reduce the time required of retained species to be on the deck while sorting. This, and reduced turbulence in the net increased quality of retained blue grenadier and could potentially increase the value of the catch. Wider adoption of the high-lift net in the CTF could further decrease discarding in accordance with AFMA's requirements; however, trials would need to be conducted to investigate the impact on catch of commercial species in eastern regions of the fishery, particularly where flathead species are important components of the catch.

Keywords: Commonwealth Trawl Sector, high-lift net, bycatch reduction

Acknowledgments

We wish to thank the owner, Mr Bert Tober, and the skipper and the crew of the Zeehaan for their professional approach to conducting the 2008 survey. We also wish to thank Dr Matt Broadhurst (NSW DPI) for advice on planning gear trials and Mike Gerner (AFMA) for his assistance in the field trials.

Background

The Commonwealth Trawl Sector (CTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF) ranges from Barranjoey Point (north of Sydney) to Cape Jervis in South Australia, and out to the edge of the Australian Fishing Zone (Figure 1). The fishing is managed through a system of output controls through the allocation of Individual Transferable Quotas (ITQs) and input restrictions through a limit on the number of vessels permitted to operate in the fishery and mesh size of nets. It is a multi-species fishery which catches 30 species or species groups subject to Total Allowable Catch (TAC) limits, many more non-quota commercial species. In addition, there are many hundreds of different bycatch species discarded at sea.

Trawl fisheries such as the CTS are generally considered to be relatively non-selective, and non-target species may represent a large component of the total catch. Retained and discarded catch have been monitored in the CTS since 1992 through onboard observer programs that collected information on the quantity, species composition, size and age structure of retained and discarded catch (Koopman *et al.*, 2007). Such observer programs have shown that approximately 35% of all fish caught are discarded including some commercially important quota species.

In December 2005, the Minister for Fisheries, Forestry and Conservation directed AFMA to cease overfishing, to recover overfished stocks, to avoid further species becoming overfished, and to manage the broader environmental impacts of fishing including protected species. AFMA has since released a Program for Addressing Bycatch and Discarding in Commonwealth Fisheries – An Implementation Strategy.

Despite research conducted during 1999 and 2001 which resulted in the mandatory introduction of large- or rotated-mesh panels to reduce trawl bycatch in the CTS (Knuckey and Ashby, 2009); bycatch levels remain a significant issue. During 2004, it was estimated that 2,859 t (12%) of quota species was discarded from a total quota catch of 24,181 t. Further from a total non-quota catch of 18,426 t, 12,863 t (70%) was discarded (Koopman *et al.*, 2005). Substantial amounts of the discarded fish were small fish, which are generally discarded in poor condition and unlikely to survive. Industry members and net makers continue to highlight other means to further reduce bycatch that would benefit from further investigation.

NetworkTN, a small net making company based in Portland, have developed a net (the high-lift or “balloon” trawl) that has a larger than usual top panel. Users of the net have reported that the catch of smaller fish was greatly reduced compared to standard nets, and that the retained commercial fish were generally in better condition. It was also proposed by the net maker that due to the shape of the net, the smaller fish that do escape should have minimal contact with the gear and would be more likely to survive than those that escape from standard trawl nets.

Need

The Australian Government's directive and AFMA's response indicate there is an ongoing need to reduce bycatch by trawlers in the SESSF. In addition to the installation of escape panels, the development of trawl nets that promote the escapement of small unwanted fish is an obvious step.

Anecdotally, it appears the high-lift net has been able to reduce bycatch and has received strong endorsement from a range of fishers who are currently using the net. Most have noted a substantial reduction in their bycatch, especially in smaller fish. To add support to scientific sea trial claims that high-lift nets are a legitimate bycatch reduction option, there was a need to undertake sea trials that enabled independent monitoring of the efficacy of high-lift nets in reducing bycatch and quantify this against standard trawl nets.

Objectives

1. Conduct a workshop to discuss the NetworkTN net and select a vessel to conduct sea trials
2. Carry out trials at sea to gauge the effectiveness of the NetworkTN net in reducing bycatch of undersize quota and non-quota species
3. Develop an extension strategy to ensure background and progress of project are adequately communicated to Industry, AFMA and the wider community

Methods

Workshop

A workshop was held in Portland on 29 January 2008 (Appendix 2) to discuss the merits of a high-lift net, select a vessel to conduct sea trials and plan the survey design and implementing the trial. The meeting was attended by SESSF skippers/owners (Mr Bert Tober, Mr Ross Mills and Mr Tom Bibby), scientists (Dr Matt Broadhurst and Dr Ian Knuckey) and AFMA management (Dave Johnson).

The fishing vessel Zeehaan was selected to conduct the trials because of its suitability as a working platform. Due to budget constraints the vessel would not be chartered, but would conduct the trials during normal fishing operations. Four tows would be conducted during the day. It was agreed not to consider depth as a formal factor in the trial design but to ensure that the two different gears were trialled in similar depths over the period of the trials by alternating the use of the nets on a regular basis. A fuel meter would be installed on the vessel to determine if there was any difference in fuel usage between the two nets.

Sea trials

The high-lift net trial was conducted during two periods, the first from 21 May to the 6 June 2008 (3 cruises), and the second from the 20 October to the 13 November 2008 (4 cruises) aboard the commercial fishing vessel *Zeehaan*. The vessel carried two nets; a typical CTS wing-trawl net used on the east-coast and made by a New South Wales net maker (the 'control net'); and a "high-lift" net. Nets were changed after each shot, apart from every fifth shot when the use of the net was repeated to reduce potentially confounding diurnal effects.

Operational and environmental data were collected for each shot. These included direction of shot, speed of shot, direction of current, wind speed and direction, swell height, sea conditions, depth range of shot, and engine revs at the start middle and end of each shot. Fuel flow was measured using a FloScan Series 75000 Multifunction Fuel Monitoring System. To reduce between-shot variability, all tows were conducted at as close to the same speed as practicable with the same propeller pitch for each shot and use of engine revs to control speed.

When a shot was completed, the net was hauled onboard and the catch emptied onto the deck. Retained species were gathered in fish bins and approximate weights of each species estimated. Discards were identified to species where possible and an approximate weight of each species estimated from the total weight of the discarded bycatch and the proportion of

that weigh that each bycatch species comprised. Length measurements were collected randomly during the survey for deepwater flathead, blue grenadier, silver warehou, latchet, pink ling, gemfish and jackass morwong. Length measurements used are shown in Appendix 3.

Fish quality

To assess fish quality, approximately 5–15 blue grenadier were randomly selected from the catch of several shots and given a rating based on their external condition from 0 (unacceptable condition, discarded) to 10 (quality excellent, no scales missing/skin damage). Mean quality ratings were calculated for fish from each net. Blue grenadier were chosen for quality assessment because they represent a valuable commercial species, are a relatively delicate species with small scales easily removed, and possessing a soft flesh.

Data analysis

The 22 shots conducted during the first three cruises (21 May to the 6 June 2008) were unsuccessful because: the first cruise was abandoned after a very large catch was taken (only 3 shots completed); on the second cruise the control net was badly damaged on the second shot and the high-lift net was used on the remainder of the cruise; during the third cruise, the skipper felt the high-lift net was not fishing as well as it could and shore-adjustments needed to be made to the foot rope. Hence, catch data from this period were omitted from analyses of catch rate data, however, length frequency, fish quality observations and fuel consumption data collected from the these cruises were analysed. This left 42 valid shots analysis of catch rate data.

In discussing results the terms:

- bycatch defines the catch of all species other than quota species, and includes species retained (byproduct);
- high-discard species to define species where more than 50% of the catch is historically discarded[A];
- low-discard species to define species where less than 50% of the catch is historically discarded[A].

[A]based on data collected during the 2000–2006 Integrated Scientific Monitoring Program (ISMP unpublished data).

For comparison of catch between the two nets, catch rates (kg/hr) were calculated to account for variability in shot duration. Total catch (kg) of each species are also presented. Preliminary analyses indicated there were no differences between day and night catches, so these data were pooled.

Comparisons of catch rates were made using two-sample *t*-tests where assumption of normality was met. One-tailed t-tests were used to compare catch rates of discarded species and catch rates of high-discard species to test the hypothesis that the high-lift net would catch less bycatch than the control net. To satisfy the assumptions of normality (Shapiro-Wilk test) and heteroscedacity (Levene's test), catch rates were transformed to ln (x+1). Where significant departures from normality in the catch rates were observed, the Wilcoxon rank sum test was used to compare catch rates.

Length-frequencies of blue grenadier, blue warehou, deepwater flathead, western gemfish, latchet, offshore ocean perch, pink ling silver dory and silver warehou from each net were plotted and compared using two-sample Kolmogorov-Smirnov tests ($P = 0.05$).

Fuel consumption was measured using a flow meter. Consumption rates were calculated from total litres used per shot and shot duration. Mean fuel consumption rates observed during shots with each net were compared using a two-sample *t*-test after checking of normality (Shapiro-Wilk test) and heteroscedacity (Levene's test).

Results and Discussion

Comparison of catch by each net

Of the 64 shots conducted, only 42 shots were considered valid and used in comparisons of catch rates between nets (see Methods section for explanation). A total of 20 valid shots were made with the control net and 22 valid shots were made with the high-lift net (Table 1). Tow speed ranged 2.4–3.0 kts and averaged 2.7 kts for both nets. Mean tow duration was 5.13 hr and 5.22 hr for the control and high-lift nets respectively.

Total catch of the high-lift net was 26,240 kg compared to 39,932 kg by the control net (Table 2). Due to the high 'between-shot variation', there were no statistically significant reductions in catch rates of discards or of high-discard species when using the high-lift net (Table 3); despite catch rates of these groups being 45–50% smaller (Table 5 and Figure 2). Discarded species that contributed the greatest biomass captured in the control net were silver dory, barracouta, spikey dogfish, threespine cardinalfish and blacktip cucumberfish. Of these five

species, only the differences in catch rates of blacktip cucumberfish and spikey dogfish were significant (Table 3 and Table 4). Mean catch rates of these two species in the control net was 5.26 kg/hr and 11.29 kg/hr respectively compared with 0.41 kg/hr and 2.29 kg/hr in the high-lift net respectively (Table 5). Overall, there was no appreciable difference in the total retained catch between the two nets; the two nets caught retained fish and low discard species at similar rates. While the overall performance of the high-lift net at reducing discards was encouraging, catch rates of the commercially valuable deepwater flathead in that net high-lift were significantly less (Table 4, Table 5 and Figure 2).

Length-frequency distributions for nine of the most commonly caught species showed few differences between nets (Figure 3). Significantly more small silver dory (< 18 cm) were caught by the control net. In contrast, significantly more small silver warehou were caught by the high-lift net than the control net. Blue grenadier sampled from both nets showed a similar bimodal distribution with modes at about 51 cm and 82 cm. There appears to be a higher percentage of small blue warehou, latchets, offshore ocean perch and pink ling caught by the control net but the sample sizes for the control net are low (approximately 50 fish for each of these species). Length-frequency distributions of deepwater flathead and western gemfish from each net are similar.

Comparison of fuel consumption and fish quality

Fuel consumption was recorded for 56 different shots (Table 6). Mean consumption rate when using the control net (79.77 L/hr) was slightly higher than that of the high-lift net (78.27 L/hr), but this difference was not significant. The range of fuel consumption rates was also similar 62.13–95.06 L/hr for the control net and 63.38–93.97 L/hr for the high-lift net. Fuel consumption rate is affected by other variables that were not recorded during this study, such as current direction and strength, and the direction of the tow in relation to the current. Increasing shot numbers in future trials and more closely monitoring and accounting for the range of variables that can impact on fuel consumption are required to further investigate the ability of the high-lift net to reduce fuel consumption rates.

Fish Quality

Blue grenadier caught in the high-lift net (mean quality rating = 7.3) appeared to be in better condition (retained more scales and less abrasions) than those caught by the control net (mean quality rating = 6.2). In particular, five fish in one shot using the control net were particularly badly damaged with a mean quality rating of 2.2. .

Table 1. Number of shots, mean (SD) shot speed (knots) and shot duration (h) of shots using each net configuration.

Net	Number of shots	Tow speed		Shot duration	
		Mean (knots)	SD	Mean (h)	SD
Control net	20	2.7	0.1	5.13	0.54
High-lift net	22	2.7	0.1	5.22	0.61

Table 2. Total catch (kg) of all species using each net configuration.

Species	Catch (kg)		
	Control net	High-lift net	Total
Antlered crab	5.0	1.0	6.0
Australian burrfish	70.0	106.2	176.2
Banded bellowsfish	16.0	36.2	52.2
Banded stingaree	16.0	6.0	22.0
Banded whiptail	10.2	12.9	23.1
Barracouta	1,410.0	995.0	2,405.0
Barred grubfish	2.2		2.2
Bearded rock cod		1.9	1.9
Beche-de-mer (fly)	109.0	70.0	179.0
Bight skate	16.0	6.0	22.0
Bigscale rubyfish	197.0	85.0	282.0
Blackfin ghostshark	10.0		10.0
Blacktip cucumberfish	567.3	45.8	613.1
Blue grenadier	1,322.0	2,030.5	3,352.5
Blue mackerel	20.0	3.0	23.0
Blue warehou	155.0	130.0	285.0
Blueband whiptail	0.1		0.1
Blue-eye trevalla	35.0	42.0	77.0
Bristlemouth and lightfish (fly)	0.1	1.0	1.1
Common sawshark	37.0	19.2	56.2
Conger eel		0.7	0.7
Cosmopolitan rubyfish	150.0	62.0	212.0
Cuttlefish (fly)	11.1	1.0	12.1
Deepsea flathead	317.5	115.5	433.0
Deepsea squid (fly)	157.0	16.0	173.0
Deepwater bug	700.2	247.0	947.2
Deepwater flathead	260.0	159.0	419.0
Deepwater stargazer		2.0	2.0
Eucla cod	0.1		0.1
Frostfish	51.0	57.0	108.0
Gargoyle fish	4.0	1.0	5.0
Gemfish	641.5	350.0	991.5
Giant crab	22.5	25.5	48.0
Gould squid	724.0	857.0	1581.0
Greeneye dogfish	21.0	17.0	38.0
Grey skate	20.0	30.7	50.7
Gummy shark	81.1	118.5	199.6
Hapuku	12.0	11.0	23.0
Hermit crab (fly)	0.5	0.2	0.7
Jack mackerel	462.0	242.0	704.0
Jackass morwong	29.0	146.0	175.0
King dory	31.0	28.0	59.0
Knifejaw	32.5	29.0	61.5
Lanternfish (fly)	1.0	0.3	1.3
Latchet	150.0	200.7	350.7
Longtail torpedo ray	9.0		9.0
Melbourne skate		40.0	40.0
Mirror dory	59.0	42.5	101.5
Octopus (fly)		1.0	1.0
Offshore ocean perch	61.4	102.7	164.1
Oilfish		7.0	7.0
Peacock skate	8.0	2.5	10.5
Pink ling	261.0	741.0	1,002.0
Pufferfish (fly)		30.0	30.0
Red cod		0.5	0.5

Table 2 continued.

Species	Catch (kg)		
	Control net	High-lift net	Total
Redbait	72.0	16.5	88.5
Ringed toadfish		2.0	2.0
Rock ling	1.0	5.0	6.0
Rusty carpetshark	26.0	13.3	39.3
Sandpaper fish		1.0	1.0
Sandyback stingaree	1.0		1.0
Sawtail catshark	14.0	3.2	17.2
School shark	142.0	35.0	177.0
Seastar (fly)	2.2	0.7	2.9
Sharpnose sevengill shark		2.5	2.5
Short-tail torpedo ray	8.0	17.0	25.0
Silver dory	26,505.0	15,964.0	42,469.0
Silver warehou	1,919.0	1,392.0	3,311.0
Skate (fly)	4.0		4.0
Snapper	6.0		6.0
Southern chimaera	10.0	15.0	25.0
Southern conger	49.0	90.5	139.5
Southern ocean arrow squid	117.0	42.0	159.0
Southern ribbonfish		16.0	16.0
Southern whiptail	68.4	48.5	116.9
Spider crab (fly)	40.5	14.1	54.6
Spikey dogfish	1,133.5	265.5	1,399.0
Sponge (fly)	44.0	11.0	55.0
Stargazer Speckled	160.0	161.0	321.0
Tasmanian numbfish	16.0	6.8	22.8
Thetis fish	0.2	10.2	10.4
Threespine cardinalfish	584.8	33.0	617.8
Tiger flathead	5.0	9.0	14.0
Toothed whiptail	246.6	365.1	611.7
Tusk	65.0	6.0	71.0
Velvet leatherjacket	10.5	8.0	18.5
Whitefin swell shark	397.0	408.5	805.5
Whitespotted dogfish		1.0	1.0
Whitespotted skate	8.0		8.0
Wide stingaree	0.5	1.0	1.5
Total	**39,931.5**	**26,240.4**	**66,171.9**

Table 3. Summaries of two-tailed t-tests comparing catches by each net. Significant differences (at *P*<0.05) are shown in italics. * Signifies one-tailed t-test.

Species/group	DF	t	P
Retained catch	40	0.72	0.474
Discarded catch*	40	1.43	0.081
High-discard species*	40	1.35	0.093
Low discard species	40	1.00	0.326
Silver warehou	40	1.25	0.220
Silver dory	40	1.30	0.201
Western gemfish	40	1.50	0.141

Table 4. Summaries of Wilcoxon rank sum test comparing catches by each net. Significant differences (at P<0.05) are shown in italics.

Species/group	W	P
Blue grenadier	214	0.890
Blue warehou	266	0.209
Pink ling	149	0.075
Blacktip cucumberfish	359	*<0.001*
Barracouta	244	0.535
Deepwater flathead	310	*0.020*
Deepsea flathead	285	0.101
Toothed whiptail	180	0.296
Threespine cardinalfish	271	0.188
Spikey dogfish	357	*<0.001*

Table 5. Total and mean (SD) retained and discarded catch per shot of all species using each net configuration (* denote significant difference).

Net	Control net		High-lift net	
	Mean (kg/shot)	SD	Mean (kg/shot)	SD
Retained catch rate	69.26	35.97	71.13	71.10
Discarded catch rate	321.15	339.29	162.91	185.58
Low discard species	68.64	37.08	62.08	45.03
High-discard species	321.76	338.76	171.96	210.94
Silver dory	257.29	284.59	142.82	189.74
Barracouta	15.28	42.19	8.92	28.70
Silver warehou	19.32	33.96	12.71	18.46
Blue grenadier	14.78	18.64	16.12	21.69
Western gemfish	6.28	8.71	3.09	3.27
Blue warehou	1.52	1.96	1.16	2.31
Pink ling	2.47	2.55	6.78	9.72
Blacktip cucumberfish	5.26*	9.89	0.41*	1.29
Deepwater flathead	2.71*	4.60	1.39*	3.35
Deepsea flathead	2.94	4.32	1.02	1.81
Toothed whiptail	2.26	5.56	3.18	6.95
Threespine cardinalfish	5.54	18.33	0.28	0.61
Spikey dogfish	11.29*	12.58	2.29*	4.16

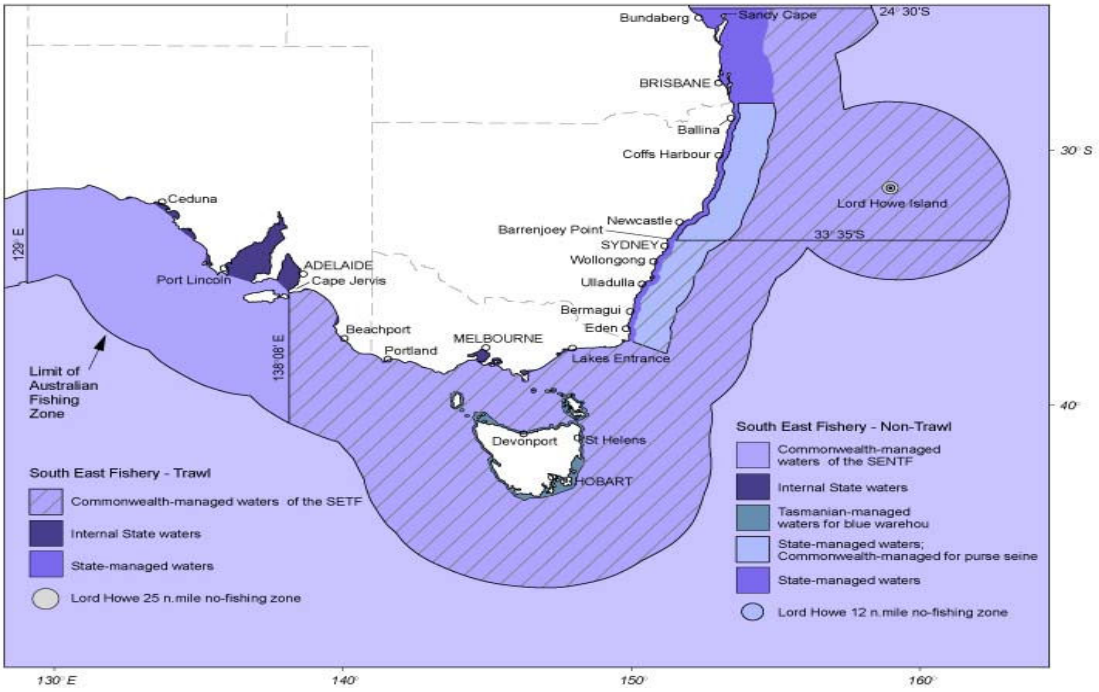
Table 6. Mean (SD) fuel consumption rate and number of shots measured using each net and for both nets combined.

Net	Mean fuel consumption rate (L/hr)	SD of fuel efficiency (L/hr)	Number of shots measured
Control net	79.77	8.24	25
High-lift net	78.27	7.64	31
All shots	78.94	7.88	56

Table 7. Mean (SD) quality rating of blue grenadier caught by each net.

Net	Mean quality rating	SD of quality rating	Number assessed
Control net	6.2	2.2	34
High-lift net	7.3	1.3	41
All shots	6.8	1.8	75

(a)



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(b)

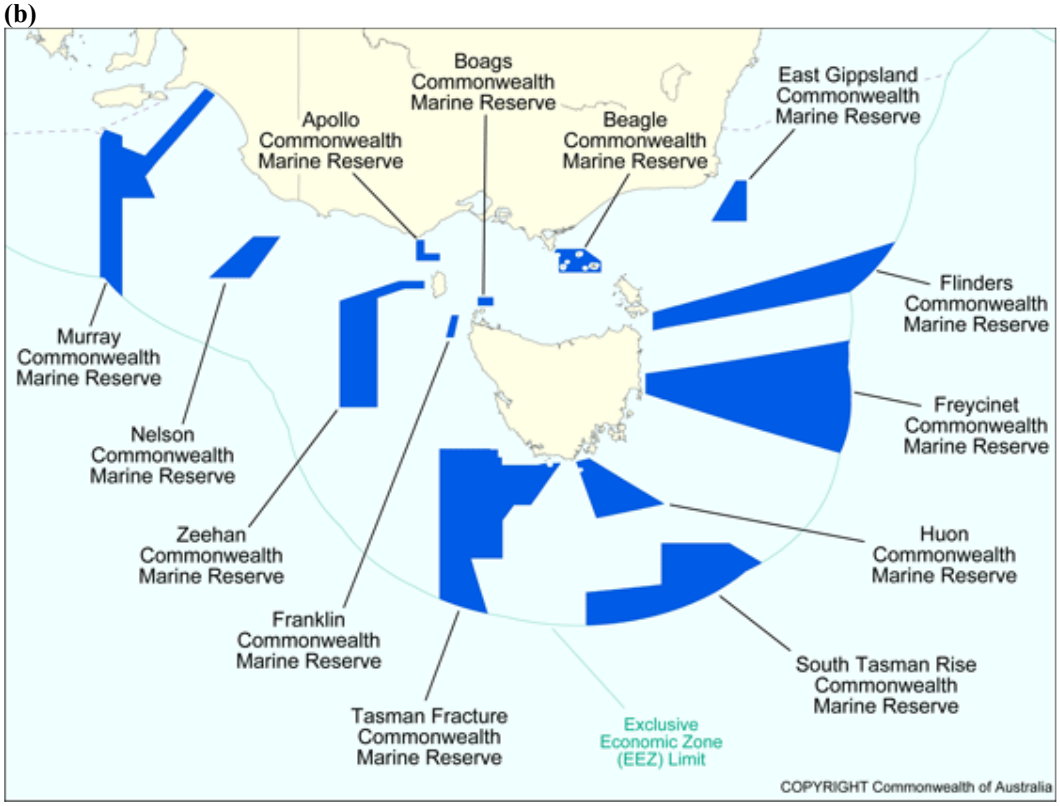

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Figure 1. Diagram (a) of the Commonwealth Trawl Sector and (b) of the Commonwealth marine protected areas.

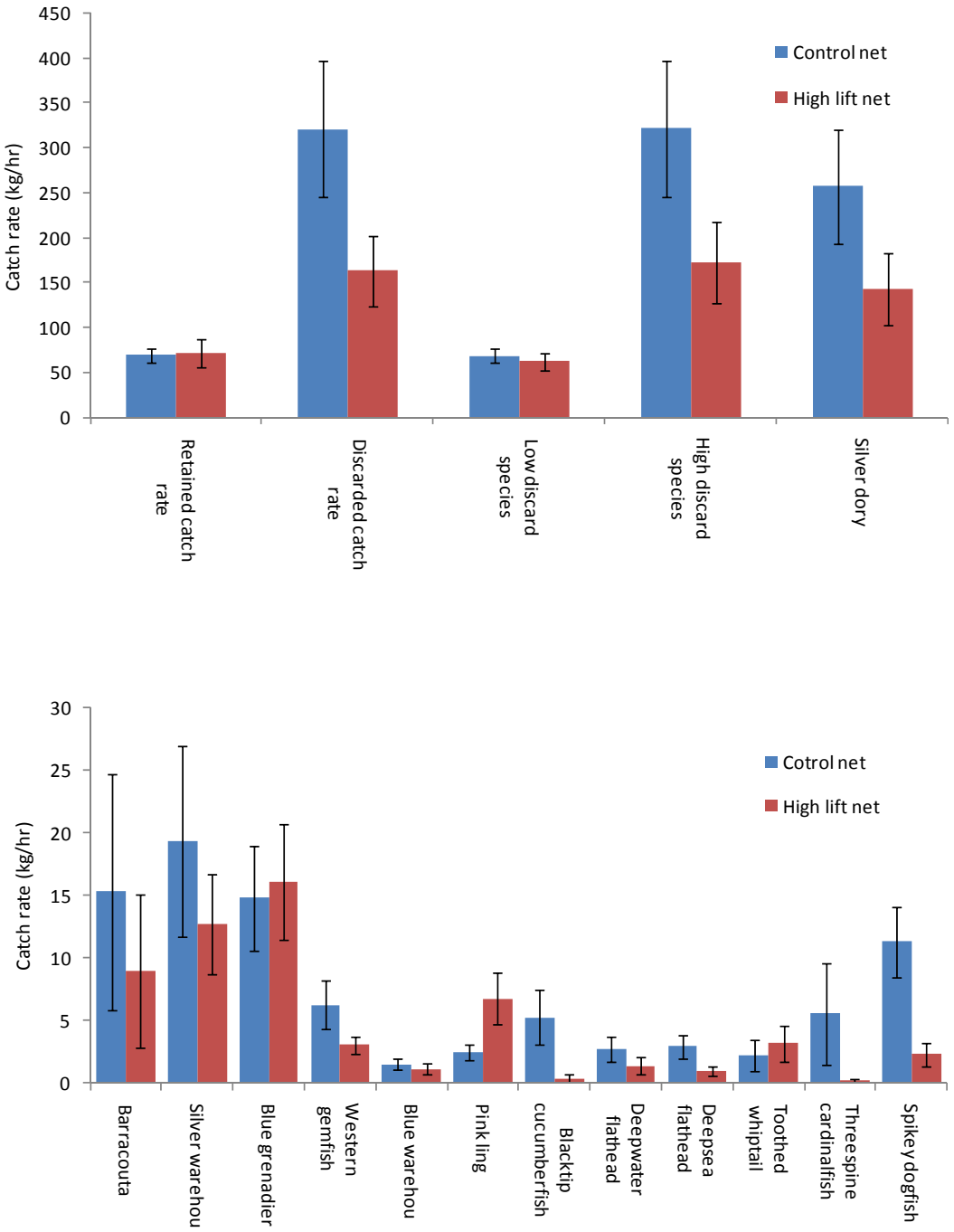
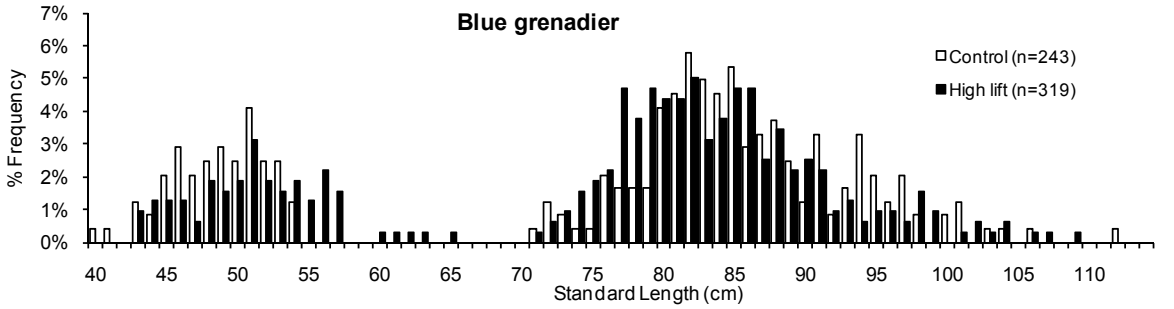
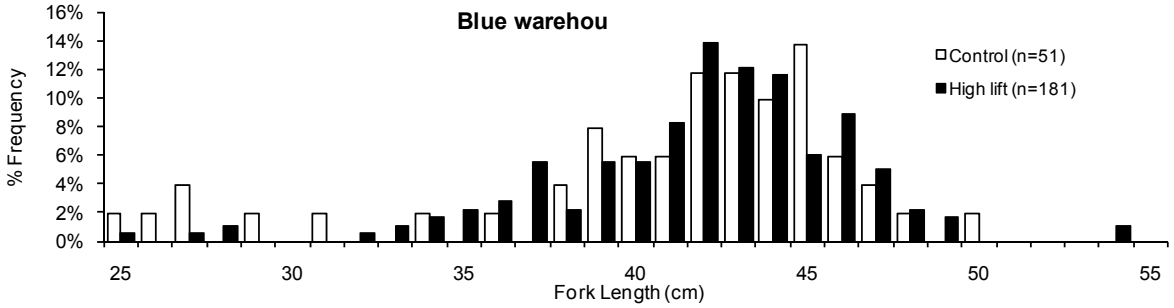
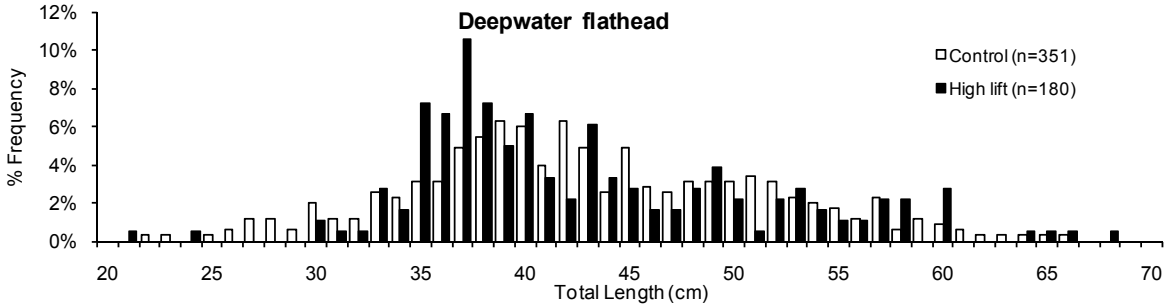
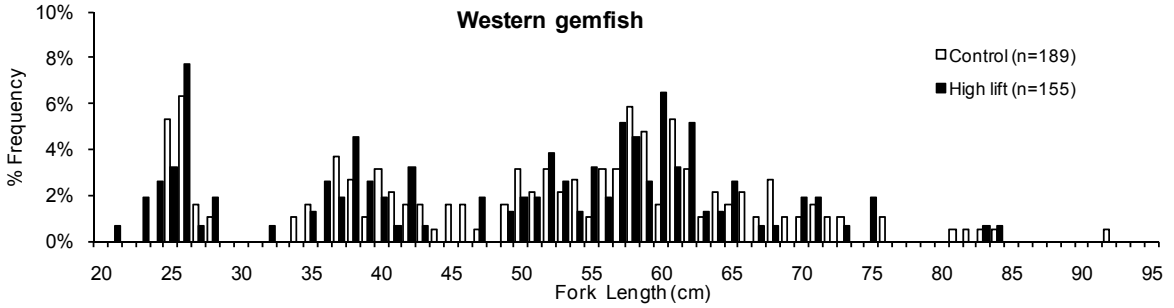


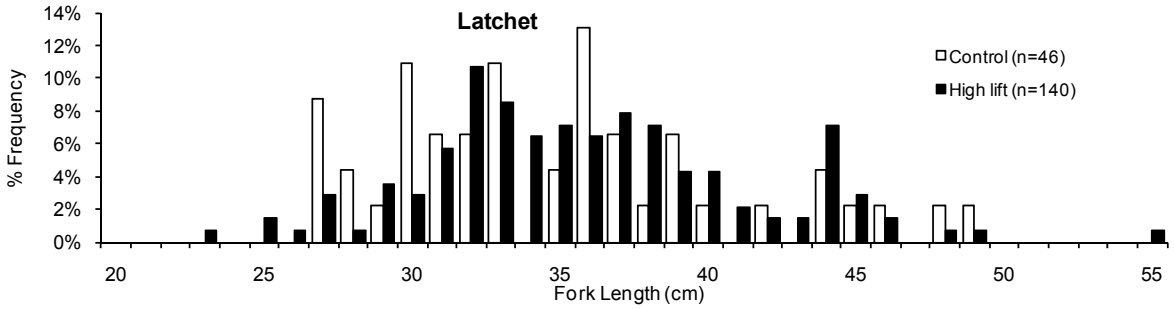
Figure 2. Comparison of mean (+/- SE) catch rates from each net of the retained and discarded species, low and high-discard species and of individual species that were caught in sufficient quantities to enable comparison.


Blue grenadier
% Frequency
Standard Length (cm)
Control (n=243)
High lift (n=319)


Blue warehou
% Frequency
Fork Length (cm)
Control (n=51)
High lift (n=181)


Deepwater flathead
% Frequency
Total Length (cm)
Control (n=351)
High lift (n=180)


Western gemfish
% Frequency
Fork Length (cm)
Control (n=189)
High lift (n=155)


Latchet
% Frequency
Fork Length (cm)
Control (n=46)
High lift (n=140)

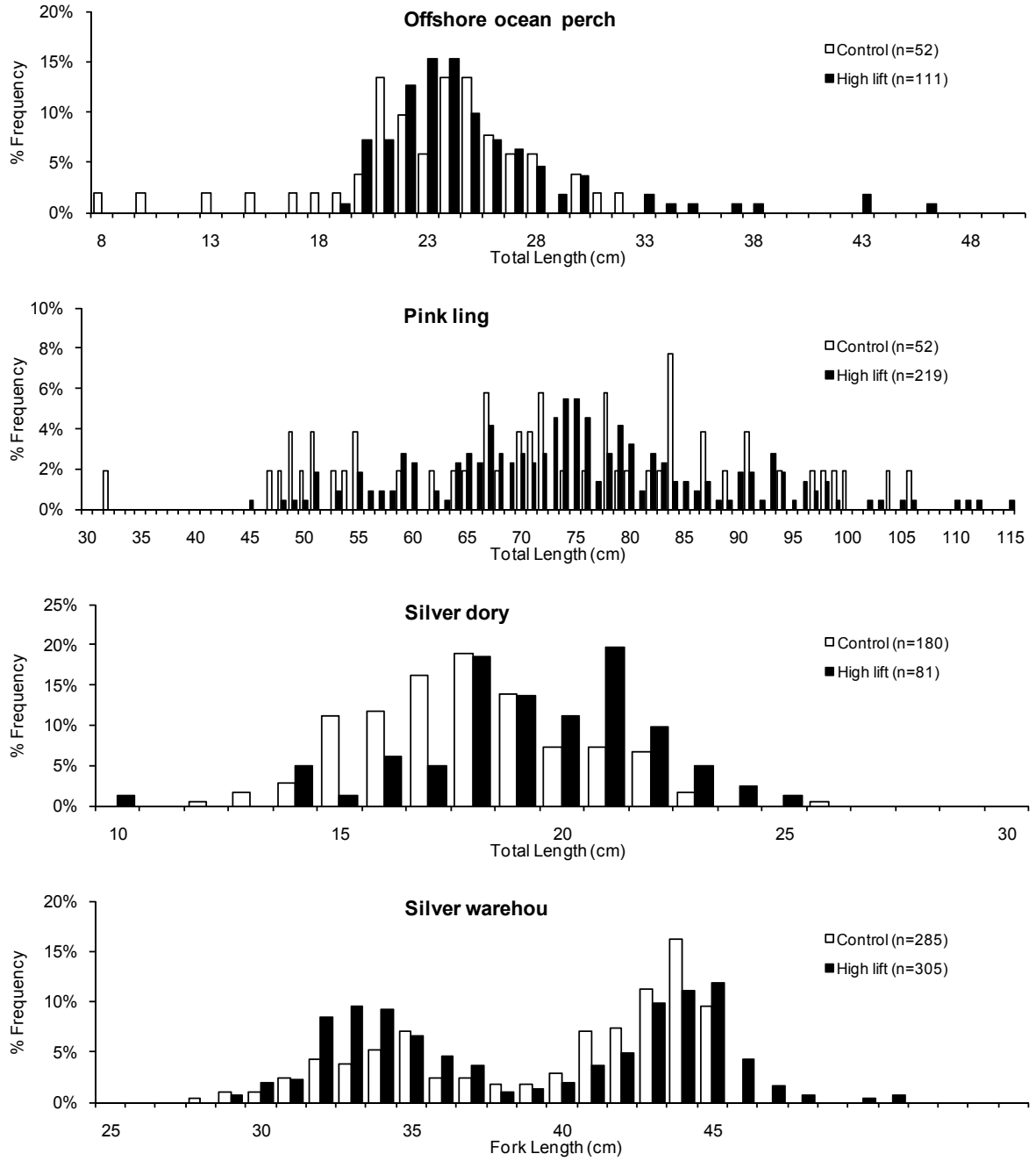


Figure 3. Length-frequency of blue grenadier, blue warehou, deepwater flathead, western gemfish, latchet, offshore ocean perch, pink ling, silver dory and silver warehou by the control and high-lift nets.

Benefits and Adoption

The immediate benefit of this project to CTS operators is knowledge of an alternative method of reducing the bycatch of small fish in commercial trawls. As with other sectors of the SESSF, the CTS is required to reduce bycatch and minimize discarding in accordance with AFMA's *Program for Addressing Bycatch and Discarding in Commonwealth Fisheries – An Implementation Strategy*. This trial has demonstrated that by using a high-lift net, catch rates

of some high-discard species are significantly reduced without an appreciable loss of commercial catches overall, however catches of one commercially important species – deepwater flathead – were significantly lower. A further benefit of the high-lift net could be realised in an increase in quality of fish species similar to blue grenadier that are susceptible to damage during fishing.

The results of this project will be disseminated to SESSF trawl industry members through the South East Trawl Fishing Industry Association (SETFIA) and the Great Australian Bight Industry Association (GABIA). Furthermore, the results of this project and report will be circulated to a wider range of stakeholders through articles and presentations detailed in the dissemination and extension plan (Appendix 5). The final report will also be mailed out to people and organisations listed in Appendix 6, and circulated through SETFIA members.

Further Development

The reduction in catches of deepwater flathead by the high-lift net may be unappealing to the SET operators. It is unclear if further refinement of the net to increase the deepwater flathead catch would increase the bycatch as well. This would be scope for further sea trials. The results from this trial have been encouraging and are to be disseminated on the internet at targeted websites and will be presented at industry/management meetings

Planned Outcomes

This project provided sufficient data to show that the high-lift net successfully reduced catches of several discard species, in particular blacktip cucumberfish, spikey dogfish and small silver dory. While not significant, the high-lift net caught about 50% less discards than the control net, however, the catch of one commercially important species (deepwater flathead) was also reduced. The power to detect a difference was reduced by three failed cruises (see Methods section for explanation), and more sampling is needed to improve our understanding of the effectiveness of the high-lift net.

These results demonstrate another step forward by industry in addressing the bycatch reduction in accordance with AMFA's response to the Ministerial Direction.

Conclusions

Forty-two successful tows were undertaken during 20 October and 13 November 2008 with the high-lift and control nets. Data collected showed that the high-lift net caught significantly less high-discard species such as blacktip cucumberfish, spikey dogfish and small silver dory. Overall, catch rates of high-discard species and discarded catch rates were 45–50% lower in the high-lift net, however these differences were not significant. These results are encouraging; however, the high-lift net also caught significantly less of the commercially important deepwater flathead.

The high-lift net also showed promise in reducing damage to some of the catch. Blue grenadier caught by the high-lift net appeared to be in better condition than those caught by the control net. Increasing the quality of retained fish may increase the profitability of the catch, and suggests that fish escaping through the mesh may be in better condition and have increased chances of survival.

The benefits of increased fuel efficiency while towing the high-lift net were not realised. Fuel efficiency is difficult to interpret because of influence of so many external factors such as current direction and strength. Although attempts were made to minimise the effects, these were not fully taken into account in this study. Increasing shot numbers and more closely monitoring and accounting for the range of variables that can impact on fuel consumption are highly recommended in any possible future trials.

References

Knuckey, I.A. and Ashby, C. (2009). Maximising yield and reducing discards in the South East Trawl Fishery through gear development and evaluation. Report to Fisheries Research and Development Corporation (FRDC Project 98/204).

Koopman, M., Talman, S.G., Gason, A.S.H., Stokie, T.K. and Berrie, S.E. (2005). Integrated Scientific Monitoring Program - South East Trawl Fishery Annual Report 2004. Report to Australian Fisheries Management Authority Project No. R03/1551. Primary Industries Research Victoria, Queenscliff.

Koopman, M., Gason, A.S.H. and Berrie, S.E. (2007). Integrated Scientific Monitoring Program - South East Trawl Fishery Annual Report 2006. Report to Australian Fisheries Management Authority Project No. R03/1551. Primary Industries Research Victoria, Queenscliff.

Appendix 1 - Intellectual Property

There is no intellectual property associated with this project.

Appendix 2 - Staff

Name	**Organisation**	**Project Involvement**
Ian Leck	NetworkTN	Principal Investigator
Ian Knuckey	Fishwell Consulting	Co-Investigator
Russel Hudson	Fishwell Consulting	Field Scientist
Matt Koopman	Fishwell Consulting	Analysis/Reporting

Appendix 3 - Species Sampled

Species sampled for length-frequency, number of fish measured and length measurement used.

Main retained species	Number of fish measured	Length code
Blue grenadier	556	SL
Blue warehou	232	LCF
Deepwater flathead	531	TL
Western gemfish	344	LCF
Latchet	186	LCF
Offshore ocean perch	163	TL
Pink ling	271	TL
Silver dory	261	TL
Silver warehou	590	LCF

SL = standard length; TL = total length, LCF = caudal fork length.

Appendix 4 - Workshop Program

Australian Government
Fisheries Research and Development Corporation

Design of Field Trials to Estimate Bycatch Reduction by a High-Lift Trawl Net

WORKSHOP PROGRAM
29th January 2008
The Richmond Henty - 101 Bentinck St Portland

Item			Speakers
1.	Welcome & project introduction	1000	Ian Knuckey
2.	SESSF Bycatch reduction project	1030	Dave Johnson
3.	Background and design of high-lift balloon trawl nets	1100	Ian Leck
4.	Preliminary results of commercial use of high lift nets	1130	Portland skippers
5.	Project input into overall SESSF bycatch reduction project and SETFIA workshop	1200	Steve Bolton
6.	Lunch	1230	
7.	Experimental design in gear field trials	1330	Matt Broadhurst
8.	Design of field trials to estimate bycatch reduction in high-lift trawl nets - Timing of the survey - Restriction of single vessel / single gear - Best fishing area for the trials - Data collection needs - Dissemination / publication of results	1400	General discussion
9.	Workshop close	1630	
10.	Boarding of vessel to view net design?	1700	Dependent on vessels in port
11.	Workshop Dinner	1830	TBA

Appendix 5 - Dissemination, and Extension Plan

Dissemination and Extension Plan

Objectives

To present the results of the project in a clear and concise manner to key bodies and provide some direction on its suitability as a tool for future assessments.

Target Audiences

- Participants of the fishing industry operating trawl gear
- Fisheries-based scientific community
- Relevant managers within the Australian Fisheries Management Authority
- Relevant seafood organisations

Key Messages

The high-lift net greatly reduces bycatch within the net, reduces sorting time on deck and reduces damage to retained fish

Methods

A slide show will be presented to SETMAC and SESSFRAG members detailing the project. It is envisaged articles will be submitted to Professional Fisherman Magazine and Seanet website. The results will be summarized and presented on the SETFIA's website.

Action Plan

After Project

Method	Responsibility	Completion date
Prepare and present slide shows Articles for publication Upload on Seanet and SETFIA websites	Fishwell	Within 2 months of acceptance of draft report

Evaluation

The project's success will be evaluated by the uptake of industry of the net. Further evaluation may involve analysing ISMP data. At present NetworkTN is reporting an increase in orders for trawl nets.

Appendix 6 - Mailing List

AFMA Steve Auld Box 7051 Canberra BC CANBERRA ACT 2610	DPI - Queenscliff Centre The Librarian 2a Bellarine Highway QUEENSCLIFF VIC 3225
South East Trawl Fishing Industry Association Simon Boag 12 Warleigh Grove BRIGHTON VIC 3186	NSW DPI Fisheries The Librarian PO Box 21 CRONULLA NSW 2230
GABIA Jeff Moore PO Box 596 ULLADULLA NSW 2539	DPI Qld - Southern Fisheries Centre PO Box 76 DECEPTION BAY QLD 4508
Barry Windle Chair GABMAC (C/o - AFMA) Box 7051 Canberra BC CANBERRA ACT 2610	RDPIFR - Fisheries GPO BOX 3000 DARWIN NT 0801
AFMA Beth Gibson Box 7051 Canberra BC CANBERRA ACT 2610	WA Fisheries and Marine Research Laboratories 39 Northside Drive HILLARYS WA 6025
GHATMAC Ian Freeman 53 Dirty Creek Rd CORINDI NSW 2456	SARDI Aquatic Sciences The Librarian PO Box 120 HENLEY BEACH SA 5022
National Library of Australia Legal Unit National Library of Australia CANBERRA ACT 2600	Seafood Services Australia Mrs Bronwyn Wilkinson PO Box 2188 ASCOT QLD 4007
CSIRO Division of Marine Research The Librarian GPO Box 1538 HOBART TAS 7001	Fisheries Research and Development Corporation Carolyn Stewardson PO Box 222 DEAKIN WEST ACT 2600
Gillnet, Hook and Trap Management Advisory Committee Mr Stephen McCormack 5 King Street MENTONE VIC 3194	AFMA Lisa Howdin Box 7051 Canberra BC CANBERRA ACT 2610
Tasmanian Aquaculture and Fisheries Inst. The Librarian Private Bag 49 HOBART TAS 7053	ABARE Mr Robert Curtotti 7b London Circuit CANBERRA CITY ACT 2610

SETMAC Mr Bill Nagle C/- AFMA Box 7051 Canberra BC CANBERRA ACT 2610	Australian Maritime College The Librarian Locked Bag 1399 LAUNCESTON TAS 7250
State Library of Victoria 328 Swanston Street MELBOURNE VIC 3000	Southern and Eastern Scalefish and Shark Fishery Assessment Group Box 7051 Canberra BC CANBERRA ACT 2610
GABRAG Rik Buckworth GPO Box 3000 DARWIN NT 0801	The State Library of South Australia GPO Box 419 ADELAIDE SA 5001
SLOPERAG Sandy Morison C/- AFMA Box 7051 Canberra BC CANBERRA ACT 2610	State Library of Tasmania 91 Murray Street HOBART TAS 7000
DEEPRAG Dr Jeremy Prince PO Box 168 SOUTH FREMANTLE WA 6162	Ian Cartwright Chair ComFRAB (c/o Sally McCarthy) Box 7051 Canberra BC CANBERRA ACT 2610
SESSFRAG Dr Tony Smith CSIRO GPO Box 1538 HOBART TAS 7001	Bert Tober Owner – Zeehaan PO Box 362 PORTLAND VIC 3305
State Library of New South Wales Macquarie Street SYDNEY NSW 2000	Michael Tudman Australian Fisheries Management Authority Box 7051, Canberra BC CANBERRA ACT 2610
State Library of Queensland PO Box 3488 SOUTH BRISBANE QLD 4101	State Library of Western Australia Alexander Library Building Perth Cultural Centre PERTH WA 6000
Northern Territory Library GPO Box 42 DARWIN NT 0801	Ian Leck NetworkTN PO Box 275 PORTLAND VIC 3305