Improving profitability in the Western Rocklobster Fishery using a new rock lobster trap

Andrew Winzer, Roy Melville-Smith, Simon de Lestang, & Adrian Thomson

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OBJECTIVES:

1. To collect data on the catching efficiency of a 1.2 m lobster trap which will assist policy makers and fishers (stakeholders in the fishery) in basing future decisions on whether to modify policy and behaviour.

2. To calculate the potential cost savings which arise through the use of a reduced number of more efficient 1.2 m traps in tandem with a modified fishing behaviour.

Non-technical Summary

OUTCOMES ACHIEVED TO DATE
During the project an additional two pots were included in the evaluation, so that three pot designs were evaluated.

One design, the side entrance batten pot with a broad base, when combined with different fishing strategies of longer pot soaking times during the whites phase of the Western Rocklobster fishing season, has the potential to increase the catch for a similar number of pot lifts made by a standard pot by 50%.

Depending on uptake in the use of the new pot design and the need for an associated change in fishing strategy to realize its improved catching potential, this project could lead to multi-million dollar savings in fishing costs.

Another feature of the new pot design is that it catches fewer under sized lobsters. It's use therefore has the potential to lead to a reduction in the handling of sub legal discarded lobsters, running into hundreds of thousands of animals. Any reduction in the unnecessary handling and release of undersized animals could be expected to have a beneficial flow-on effects in terms of future catch through reduced discard mortality rates.

This project commenced in the 2008/09 season and at that time the Western Rocklobster fishery was managed by input controls. The motivation for this study was that it was realised that a more efficient pot would reduce the number of pot hauls, and that this in turn would increase profitability of the fishery by reducing the amount of bait used, the amount of time at sea, fuel usage and overall wear and tear on equipment.

During the course of this project, three different pot designs were trialled against the standard batten pot design. These were: (i) a 1.2 m trap that had been successfully used by Western Rocklobster fishermen in the 1980s, which was trialled in the 2008/09 reds and whites season; (ii) a side entrance batten pot of similar dimensions to the standard pot, hereafter termed the 'side neck pot', trialled in the 2008/09 reds and 2009/10 whites season; and (iii) a side entrance batten pot with a broad base, hereafter termed the 'broad based pot', trialled in the 2008/09 reds and 2009/10 white season.

Trials of the new pot designs were undertaken in more than one management zone and for one and more than one-day soaking times. In nearly all instances, standard batten pots proved to be more successful in catching lobsters than the 1.2 m trap and the side neck pot. However, the broad based pot design proved to be more effective than standard pots under particular conditions.

In the trials conducted during the reds part of the 2008/09 season, catches of legal sized lobsters made by broad based pots were not significantly different to those made by standard pots for one day and greater than one day soaking times. It was of note though that the broad based pots tended to catch fewer undersized lobsters, with one area in the fishery showing this difference to be significant.

Trials of the broad based pots during the early part of the 2009/10 whites season showed that while they were not significantly different in terms of their ability over standard pots to catch legal sized lobsters on one day soaking periods, they were superior to the standard pot on two day soaks. Over three, four and five day soak times the results became less clear-cut, with some indication that the superior catch rates of the broad based pots over two day soak periods was not necessarily maintained over longer soak times.

In contrast to the ability of the broad based pots to catch and retain legal sized lobsters in the 2009/10 whites season, this pot design caught significantly fewer under sized lobsters over two day soaking periods. As with legal sized lobsters, the smaller catch of legal sized lobsters was less clear-cut over longer than two day soak times.

In summary, broad based pots show promise as a pot design that will achieve similar catches to the standard pot over one day sets, but significantly better catches of legal sized lobsters and fewer under sized lobsters on two day sets. The broad based pot appears to have particular potential for two day sets in the whites part of the season. Having said this, there is a need to qualify these statements by pointing out that they are based on a limited data set and that more data will be required to provide greater confidence in these results.

The results suggest that the use of broad based pots during the whites fishing season combined with longer pot soaking times would be expected to lead to multi-million dollar cost savings through reduced pot lifts - regardless of whether there was an input or output management system in place. Futhermore, there would be a substantial reduction in the handling of sub legal discarded lobsters, running into hundreds of thousands of animals. Any reduction in the unnecessary handling and release of undersized animals could be expected to have beneficial flow-on effects in terms of future catch.

KEYWORDS: Western Rocklobster, pot, top entrance, side entrance, profitability, *Panulirus cygnus*

Acknowledgements

Thanks go to all the fishermen and crews that participated in these pot trials.

1.0 Background

An FRDC funded project (2007/250) (Winzer 2008) was undertaken over the 2007/08 reds part of the Western Rocklobster fishing season (February-June), trialling a new design of the standard Western Rocklobster batten pot. The aim of that project was to develop a pot that was more efficient at catching lobsters than the existing one.

It was accepted that under the input control regime that the fishery was operating under at the time, that a more efficient pot would reduce the number of standard pot hauls. The benefit of this would be reduced operating costs through reduced fuel usage by spending less time at sea, as well as reduced bait costs by having fewer pots to bait.

The pot that was trialled kept with the dimensions of the standard pot so as to minimise any uptake costs by industry. It differed with the standard Western Rocklobster pot by having two side entrances instead of a top entrance and by having a parlour. Unfortunately the new design was less efficient than the existing pot design. It caught significantly fewer lobsters over a one-day soak and similar numbers to the existing pot over a two-day soak.

In the course of this trial one fisherman decided to source and test the efficiency of a much larger trap that had been used in the Western Rocklobster fishery in earlier years. His trials during the final two months of the 2007/08 season using these large side-entrance traps, known as 48 inch traps (hereafter termed 1.2 m traps) because that is their diameter, showed promising results. Based on limited data, the 1.2 m traps landed significantly more lobsters than the standard batten pots.

As a result of these promising results, the Seafood CRC funded this project to test the catching efficiency of the 1.2 m traps against standard pots in all three zones of the fishery and through all months of the 2008/09 fishing season.

1.1 Need

Given the current cost-price squeeze, the WA Fisheries Research Advisory Board and the Western Rocklobster Industry have highlighted business improvement/cost competitiveness within the fishing industry as a priority for research. For the Western Rocklobster fishery, this situation has resulted primarily from a relatively static beach price for lobster and increasing fuel, labour and other input costs. A major driver for input costs in this fishery is the number of pot lifts which is currently about 10 million annually, equating to a cost of ~$60 million (average cost per potlift - $6.00). If a lobster trap could be introduced into this fishery with a volume approximately twice that of standard pots, thereby enabling fishers to capitalise on the gregarious nature of the animal whilst preventing escapees, the fishing behaviour of the fleet would adapt accordingly to focus on primarily extended soaks i.e. 48 and 72 hours.

The fishery currently has strict controls on the pot characteristics to maintain equity among participants and to ensure exploitation rates remain constant. The introduction of a lobster trap which causes a reduction in the number of pot lifts has the potential to

enhance the primary measure of exploitation in the Western Rocklobster fishery, namely catch per unit effort (CPUE). A 10-20% reduction in pot lifts over an entire season would result in cost savings to the tune of $6-12 million annually.

The decision to use more efficient pots could be undertaken at an individual fisher level, but this requires defined and robust conversion rates for any modified design(s) to ensure that the integrity of the fishery's input based management system is not compromised. The potential for further cost savings arising through the purchase and maintenance of licences containing lesser numbers of entitlements is also likely.

1.2 Objectives

1. To collect data on the catching efficiency of a 1.2 m lobster trap which will assist policy makers and fishers (stakeholders in the fishery) in basing future decisions on whether to modify policy and behaviour.

2. To calculate the potential cost savings which could be expected to arise through the use of a reduced number of more efficient 1.2 m lobster traps in tandem with a modified fishing behaviour.

2.0 Methods

The same eight fishermen, four from Zone C, two from Zone B and two from Zone A, that participated in trialling the parlour trap (Winzer 2008), were again sought to assist in trialling 10, 1.2 m traps for the full 2008/09 fishing season (25 November 2008 – 20 June 2009). For a description of the 1.2 m traps and other pots that were trialled in this study, see Appendix 3.

The number of participants in the trial and the length of the trial was considered adequate to allow a statistically robust comparison between the fishing ability of the 1.2 m trap relative to 10 standard red neck batten pots under conditions of (i) different soak times, (ii) shallow and deepwater, (iii) migrating whites and non-migratory reds animals (iv) swell and calm conditions (v) high and low catch periods during the season (vi) within and across management zones.

Participants in the trial were required to exchange the use of eight red neck batten pots for ten of the 1.2 m traps being trialled and to keep a daily pot-by-pot log book of the location and depth where the pots were set, as well as the carapace length, sex, shell state and reproductive condition of all legal, undersize and setose lobsters caught (see sample form in Appendix 4).

Participants were required to allocate ten standard red neck batten pots (Fig. 1.1, Appendix 3) as a control group so that the catch rates of legal, undersize and setose lobsters by these pots could be compared in a pair-wise fashion, to those of the 1.2 m traps. In order to establish the direct effects of pot design on catch rate, the fishermen

participating in the trial were required when fishing, to set the paired experimental and control pots at a similar depths, on similar substrate types and to use the same species of bait in the two pot types.

In addition to the 1.2 m traps, participants in Zones A and B trialled two types of batten pots during the reds period (February to June) of the 2008/09 season. Both batten pot designs were roughly similar in dimensions to the standard pot used in the Western Rocklobster fishery. One design, termed a broad based pot, differed from the standard pot by having a broad base and two side entrances instead of a top entrance (Fig. 1.2, Appendix 3). The second design, termed a side neck pot, had a base of the same dimensions as a standard pot, but differed from the standard pot by having two side entrances similar to the broad based pot, but on different sides to those on the broad based pot (Fig. 1.3, Appendix 3).

A decision was made for all interested participants that had taken part in the 2008/09 trap trials, to continue trialling the broad based batten pot into part of the whites phase of the 2009/10 season, so as to get catch rate data for this pot during a high catch period as well as a period when much of the catch is undersized. Seven of the eight participants of the earlier trial agreed to trial the broad based batten pot from the start of the season on 15 November 2009 to the Christmas break on 24 December 2009.

Under the exemption for participants to trial the broad based pot during the whites 2009/10 season, it was agreed that they could use five pots of this style over and above the number of pots on their entitlements. This exemption also allowed participants to deploy an additional three broad based batten pots in exchange for three standard pots off their entitlement.

The design of the broad based pot against standard pot trial was similar to what has already been described for the trails of 1.2 m traps against standard pots. The standard (control) and modified pots were to be deployed in a pair-wise fashion, in the same depth on similar ground and using the same species as bait in the experimental and control pots.

2.1 Data analysis

The catching efficiency of different pot types in this study were examined by ANOVA.

In the 2008/09 season, the analysis considered the results from the three management zones separately and the data have been presented in that way, taking depth and time of season (reds and whites) into account. As noted in the methods, during this season the catching efficiencies of more than one pot type was compared to a standard pot in two of the three zones. The data have been analysed and presented separately for catches of legal- and under sized lobsters, for pot soaking times of one day or more than one day. Least squares means (LSM) have been presented as the standardized catch rates (catch rates that have the effects of fisher removed). Least square means are appropriate when the experimental design is unbalanced (unequal number of replicates across treatments) and are the same as the arithmetic mean if the design is balanced.

In the 2009/10 season, only the catching efficiency of one pot type, the broad based pot, was compared to standard pots and only six weeks of data (15 November to 24

December 2009) during the whites season, was considered. In this case the analysis was done in a slightly different way. It firstly used the pair-wise design of the study to examine the proportional difference in the catches between the two pot types between the factors of water depth and soak time. In the second analysis, catch was considered the dependent variable and was examined between the factors of water depth, soak-time and pot type. The data have been analysed and presented separately for legal- and under sized lobsters, for pot soaking times of one, two, three or four soaking days.

2.2 Establishing the economic benefit to a modified pot

Any economic benefit of modified pots over the standard pot design was calculated by the reduction in pot hauls using a modified pot which would be needed to achieve the same catch as for a standard pot, based on the daily cost of hauling a pot being $6 per pot. This cost per pot haul is the same figure as used by Winzer (2008).

3.0 Results

2008/09 season trial

Data books were returned by all (n=8) participants involved in trialling the 1.2 m pots during the 2008/9 season.

Data for the three management zones are presented first for legal- and then for under sized lobsters.

Legal sized lobsters

Zone A

Three different pot types were trialled in this zone against the standard pot design. Significantly fewer ($P<0.05$) legal sized animals were landed by the 1.2 m trap and side neck pot in comparison to standard pots over both one and two or more day soak times (Fig. 1). There was no significant difference in catch rates between the broad based batten pot and standard batten pot for either of the soaking periods considered (Table 1).

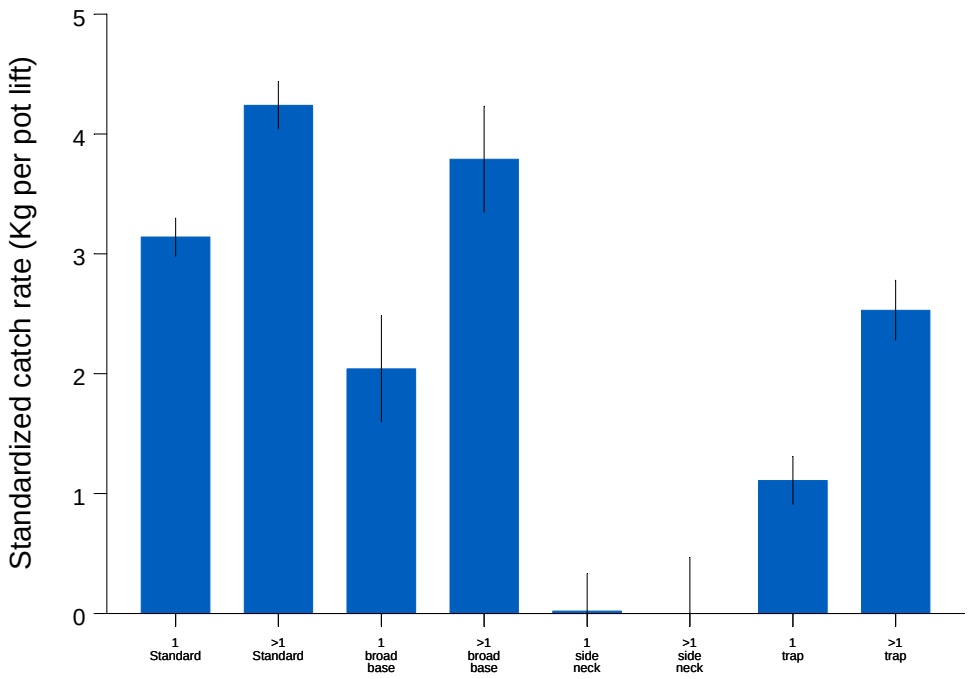

Fig. 1 : Least squares mean estimates of catch rates (kg per pot lift) for legal sized Western Rocklobsters in Zone A, using different trap types set for one day and greater than one day soak times during the 2008/09 whites and reds fishing season.

Table 1: Significance test comparisons of catch rates for legal sized Western Rocklobsters in Zone A during the 2008/09 season, using standard pots against modified pots for one and greater than one day soak times. * denotes significance at P>0.05 level.

Pot type	Soak time	P.value
trap	1	< 0.01*
trap	>1	0.01*
broad base	1	0.46
broad base	>1	0.64
side neck	1	< 0.01*
side neck	>1	0.02*

Zone B

Three different pot types were trialled in this zone against the standard pot design. Significantly fewer (P<0.05) animals were landed by the 1.2 m trap and side neck batten pot in comparison to standard pots over both one and two or more day soak times and in both the red and whites periods of the season (Fig. 2). There was no significant difference (P > 0.05) in catch rates

between standard batten pots and the broad base batten pot over one or more than one day pot soaking times in the red part of the season (Table 2) and no data to compare the catching capabilities of broad based pots during the whites season.

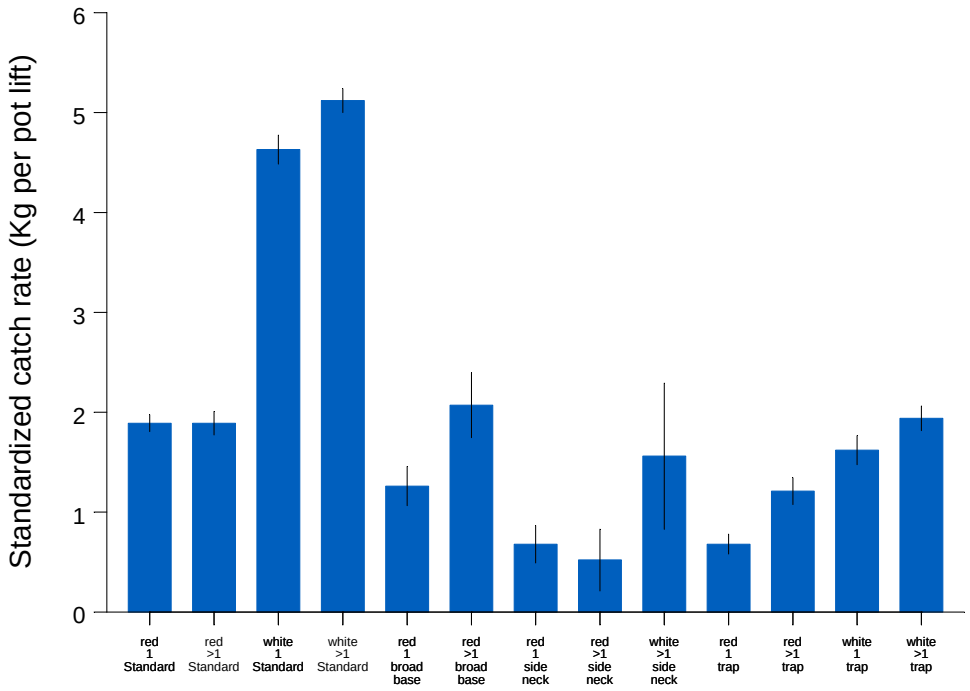

Fig. 2: Least squares mean estimates of catch rates (kg per pot lift) for legal sized Western Rocklobsters in Zone B, using different trap types set for one day and greater than one day soak times during the 2008/09 whites and reds fishing season.

Table 2: Significance test comparisons of catch rates for legal sized Western Rocklobsters in Zone B during the 2008/09 season, using standard pots against modified pots for one and greater than one day soak times. * denotes significance at P>0.05 level.

Season	Pot type	soak time	P.value
red	side neck	1	< 0.01*
red	trap	1	< 0.01*
white	trap	1	< 0.01*
red	trap	>1	0.04*
white	trap	>1	< 0.01*
red	broad base	1	0.15
red	broad base	>1	0.51
red	side neck	>1	0.06

Zone C

Only the 1.2 m trap was trialled against standard pots in this zone (Fig. 3). Significantly fewer ($P<0.05$) lobsters were landed in this zone by the 1.2 m trap during both the red and whites part of the season for one day soaking times, but not for greater than one day pot soaking periods (Table 3).

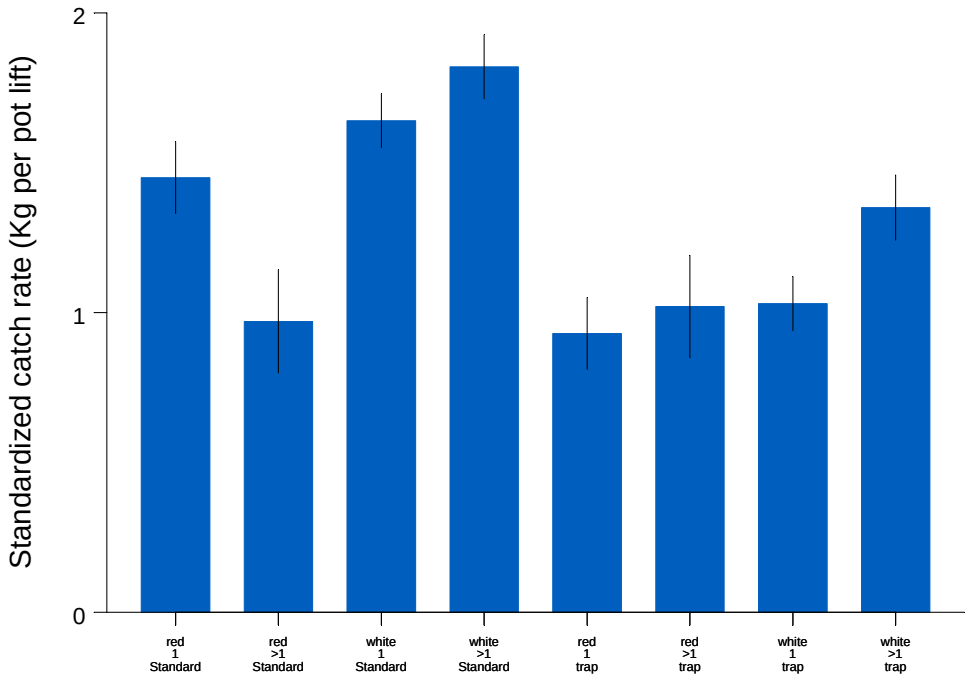

Fig 3: Least squares mean estimates of catch rates (kg per pot lift) for legal sized Western Rocklobsters in Zone C, using standard batten pots and 1.2 m experimental traps set for one day and greater than one day soak times, during the 2008/09 whites and reds fishing season.

Table 3: Significance test comparisons of catch rates for legal sized Western Rocklobsters in Zone C during the 2008/09 season, using standard pots against 1.2 m traps for one and greater than one day soak times. * denotes significance at P>0.05 level.

Season	Pot type	Soak	P.value
red	trap	1	< 0.01*
white	trap	1	< 0.01*
red	trap	>1	0.88
white	trap	>1	0.11

Zone A under sized

Three different pot types were trialled in this zone against the standard pot design (Fig. 4). As with the legal sized catch in this zone, significantly fewer (P<0.05) lobsters were landed by both the 1.2 m trap and broad based batten pot in comparison to standard pots over both one and two or more day soak times (Table 4). There was no significant difference in catch rates between the broad based batten pot and standard batten pot for either of the soaking periods considered (Table 4).

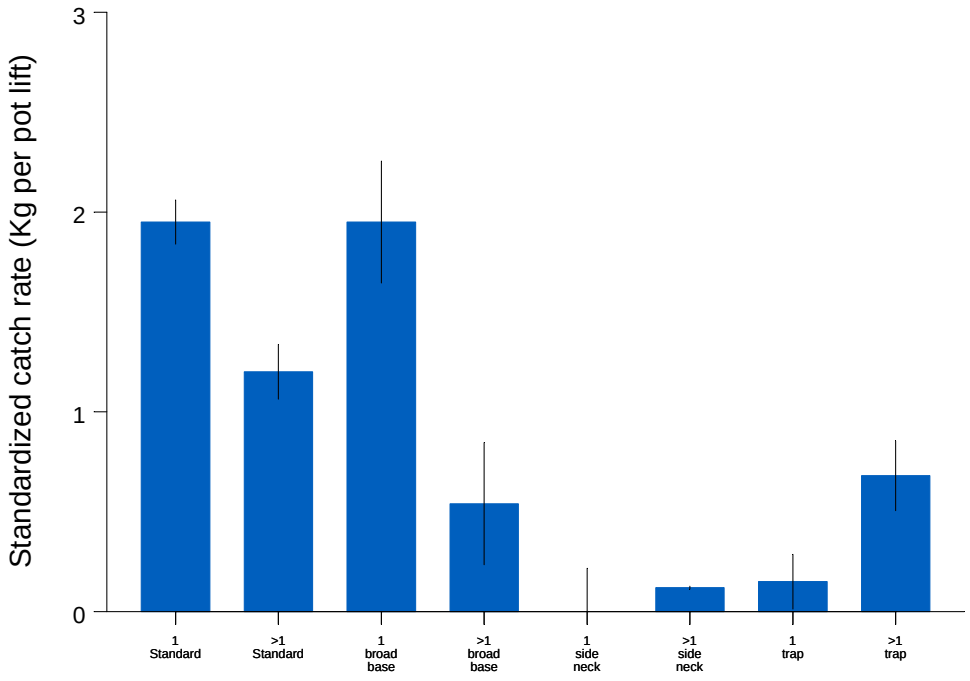

Fig. 4: Least squares mean estimates of catch rates (kg per pot lift) for under sized Western Rocklobsters in Zone A, using different trap types set for one day and greater than one day soak times, during the 2008/09 whites and reds fishing season.

Table 4: Significance test comparisons of catch rates for under sized Western Rocklobsters in Zone A during the 2008/09 season, using standard pots against modified pots for one and greater than one day soak times. * denotes significance at P>0.05 level.

Pot type	Soak time	P.value
trap	1	< 0.01*
trap	>1	0.03*
broad base	1	0.20
broad base	>1	0.30
side neck	1	< 0.01*
side neck	>1	< 0.01*

Zone B under sized

Three different pot types were trialled in this zone against the standard pot design (Fig. 5). Significantly fewer (P<0.05) under sized lobsters were landed by the 1.2 m trap, side neck batten and broad based pot in comparison to standard pots over both one and two or more day soak times during the reds part of the season (Table 5). There were no data to compare catches by the broad based and side entrance batten pots against standard pots in the whites season, but there were data for the 1.2 m trap. The trap showed no significant difference (P>0.05) in the number of under sized lobsters that it caught compared to the standard pot design (Table 5).

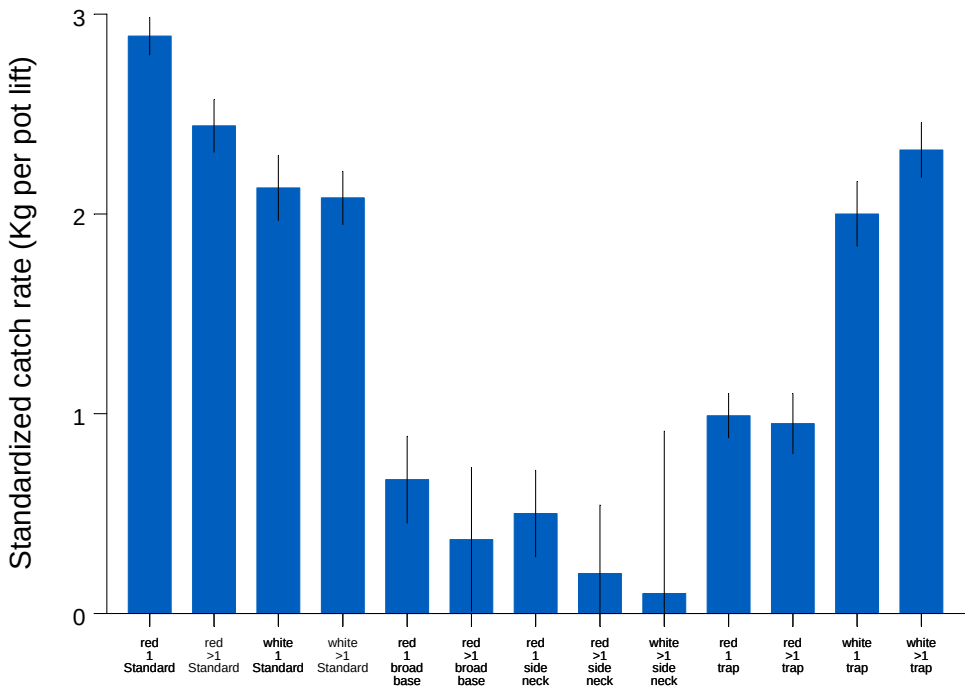

Fig. 5: Least squares mean estimates of catch rates (kg per pot lift) for under sized Western Rocklobsters in Zone B, using different trap types set for one day and greater than one day soak times, during the 2008/09 whites and reds fishing season.

Table 5: Significance test comparisons of catch rates for under sized Western Rocklobsters in Zone B during the 2008/09 season, using standard pots against modified pots for one and greater than one day soak times. * denotes significance at P>0.05 level.

Season	Pot type	Soak	P.value
red	trap	1	< 0.01*
white	trap	1	0.80
red	trap	>1	< 0.01*
white	trap	>1	0.57
red	broad base	1	< 0.01*
red	broad base	>1	< 0.01*
red	side neck	1	< 0.01*
red	side neck	>1	< 0.01*

Zone C under sized

Only the 1.2 m trap was trialled against standard pots in this zone (Fig. 6). The number of under sized lobsters landed by the 1.2 m trap during the whites part of the season for longer than one day soaking times was significantly (P<0.05) less than for the standard

pots. However, the traps retained significantly (P<0.1) more undersize lobsters than standard pots for one day soak times. During the reds part of the season 1.2 m traps retained significantly (P<0.01) fewer undersize lobsters for greater than one day soak times; over this same part of the season there was no significant difference between the two pot types in undersize retention rates for one day soak times (Table 6).

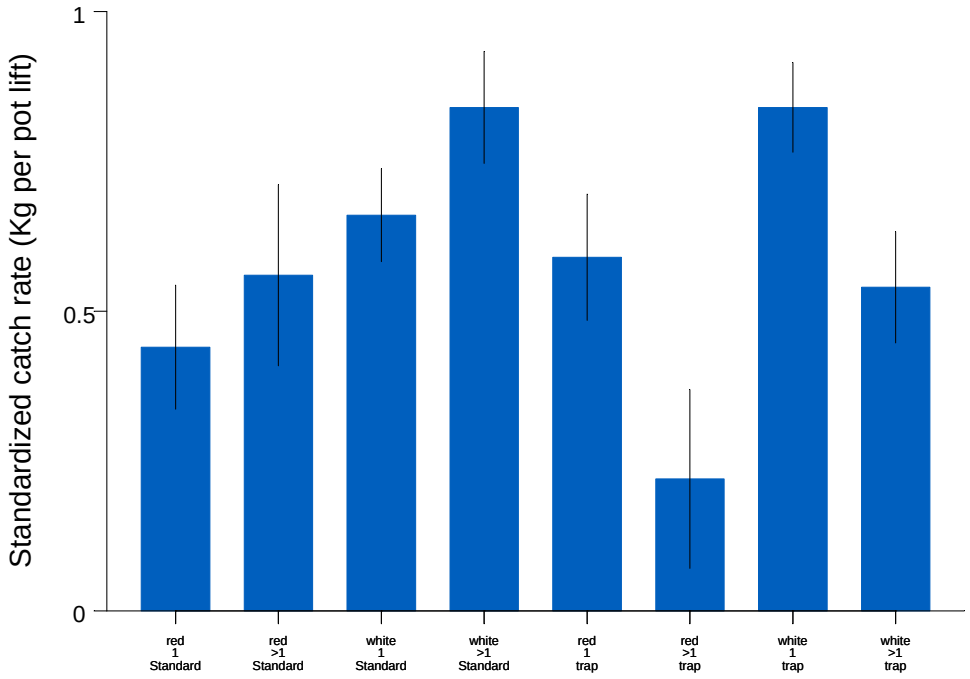

Fig. 6: Least Square Mean estimates of catch rates (kg per pot lift) for under sized Western Rocklobsters in Zone C, using standard pots and 1.2 m traps set for one day and greater than one day soak times, during the 2008/09 whites and reds fishing season.

Table 6: Significance test comparisons of catch rates for under sized Western Rocklobsters in Zone C during the 2008/09 season, using standard pots against 1.3 m traps set for one and greater than one day soak times. * denotes significance at P>0.05 level.

Season	Pot	Soak	P.value
red	trap	1	0.29
white	trap	1	0.09
red	trap	>1	0.06
white	trap	>1	0.02*

Summary of the results

While it is of interest to view the results across zones, it is more important to get an overall perspective of the performance of the different pot modifications across the fishery. It would be expected that if one of the pot modifications was to perform well in one zone, that it would be likely to perform well in the other zones. Results for the 2008/09 season have therefore been tabulated for all zones and for legal and under sized lobsters in Table 7.

In viewing Table 7, it should be borne in mind that the recording of significantly higher catches of legal sized lobsters per pot is a positive attribute when considering the characteristics of different pot designs, but the reverse is true if the same pot were to catch significantly higher numbers of under sized lobsters.

In general, the 1.2 m trap did not perform well compared to the standard batten pot (Table 7). Only in Zone C during the whites did it compare with the standard pot by mostly catching similar numbers of legal and under sized lobsters to the standard pot.

The side entrance pot was not used at all during the whites season and in the reds season was used only in zones A and B. As with the 1.2 m pot, the side entrance pot did not perform well compared to the standard batten pot (Table 7).

The broad based pot had the most potential of those that were trialled. As with the side entrance pot, data were limited to only the reds part of the season and only for Zones A and B. In Zone A, there was no significant difference for either legal or under sized lobster catches made by one day or longer than one day sets. In Zone B, catches of legal sized lobsters were not significantly different compared to the standard pot for short or long sets, but a positive aspect was that catches of under sized lobsters made by broad based pots in this Zone were significantly less than those of the standard pot design for both short and long sets.

In both Zones, the mean catch of the broad based pot for short and long sets in the whites season was slightly less than for standard pots, but a positive aspect was that catches had considerably larger upper least square means (Figs. 1 and 2) compared to the standard pot. This indicates the potential for the larger volume of the broad based pots to catch more lobsters during the high catch periods than the standard pot.

Table 7: Combined results of the 2008/09 trial comparing the ability of different pot designs to catch Western Rocklobsters against the standard batten pot used in the fishery. Data have been compared across all zones, legal and under sized lobsters, and for all modified pot types that were trialled. The performance of the pots has been considered relative to standard pots and has been expressed as either 'worse', which refers to the modified pot catching significantly (P<0.1) less than the standard pot, 'not significant' where there is no significantly discernable difference in the performance of the pot relative to the standard pot, or indicating where 'no data' were available.

legal sized		Zone A			Zone B			Zone C	
	broad base	side entrance	1.2 m trap	broad base	side entrance	1.2 m trap	broad base	side entrance	1.2 m trap
whites season 1-day sets	no data	no data	no data	no data	no data	worse	no data	no data	worse
whites season >1 day sets	no data	no data	no data	no data	no data	worse	no data	no data	not significant
reds season 1-day sets	not significant	worse	worse	not significant	worse	worse	no data	no data	worse
reds season >1 day sets	not significant	worse	worse	not significant	worse	worse	no data	no data	not significant
under sized									
	broad base	side entrance	1.2 m trap	broad base	side entrance	1.2 m trap	broad base	side entrance	1.2 m trap
whites season 1-day sets	no data	no data	no data	no data	no data	not sig	no data	no data	worse
whites season >1 day sets	no data	no data	no data	no data	no data	not sig	no data	no data	worse
reds season 1-day sets	not significant	worse	worse	worse	worse	worse	no data	no data	not significant
reds season >1 day sets	not significant	worse	worse	worse	worse	worse	no data	no data	worse

2009/10 whites season trial

Data books were returned by six of the seven participants that agreed to trial the broad based pots during the 2009/10 whites season.

Data for the three management zones are presented first for legal sized lobsters and then for under sized.

The proportional differences in the catches of legal sized lobsters made by standard and broad based pots across the factors of water depth and soak-time, is shown in Table 8 and Fig. 7. Pot soaking time was shown to be a highly significant variable affecting catch of legal sized lobsters ($P<0.01$) (Table 8). From Fig. 7 it can be seen that there was little difference in catch between the two pots for one day and for four and five day soak times, but for particularly two and to a lesser extent three day soaks the broad based pot took a substantially greater proportion of the catch.

The same analysis was used to examine differences in the proportion of under sized lobsters caught by the two pot designs (Table 9 and Fig. 8). None of the differences were statistically significant, because as Fig. 8 shows, there was a high degree of variability for different soak times. Fig. 8 shows in particular, that there was very little difference between the proportions for one day soak periods, but a smaller proportion of the catch taken by the broad based pot on two and four day soak periods.

Table 8: Summary of ANOVA examining the proportional difference of legal sized Western Rocklobsters produced from two types of lobster pot in five depth ranges and over five soaking periods.

Factor	Df	SSq	Mean Sq	F value	Pr(>F)
Depth (D)	4	0.08	0.02	0.29	0.89
SoakTime (S)	**4**	**0.91**	**0.22**	**3.42**	**< 0.01**
D * S	9	0.36	0.36	0.60	0.79
Residuals	702	46.7	0.07		

Table 9: Summary of ANOVA examining the proportional difference of under sized Western Rocklobsters produced from two types of lobster pot in five depth ranges and over five soaking periods.

Factor	Df	SSq	Mean Sq	F value	Pr(>F)
Depth (D)	4	0.80	0.20	2.15	0.07
SoakTime (S)	4	0.80	0.20	2.15	0.07
D * S	8	0.84	0.10	1.13	0.34
Residuals	490	45.5	0.09		

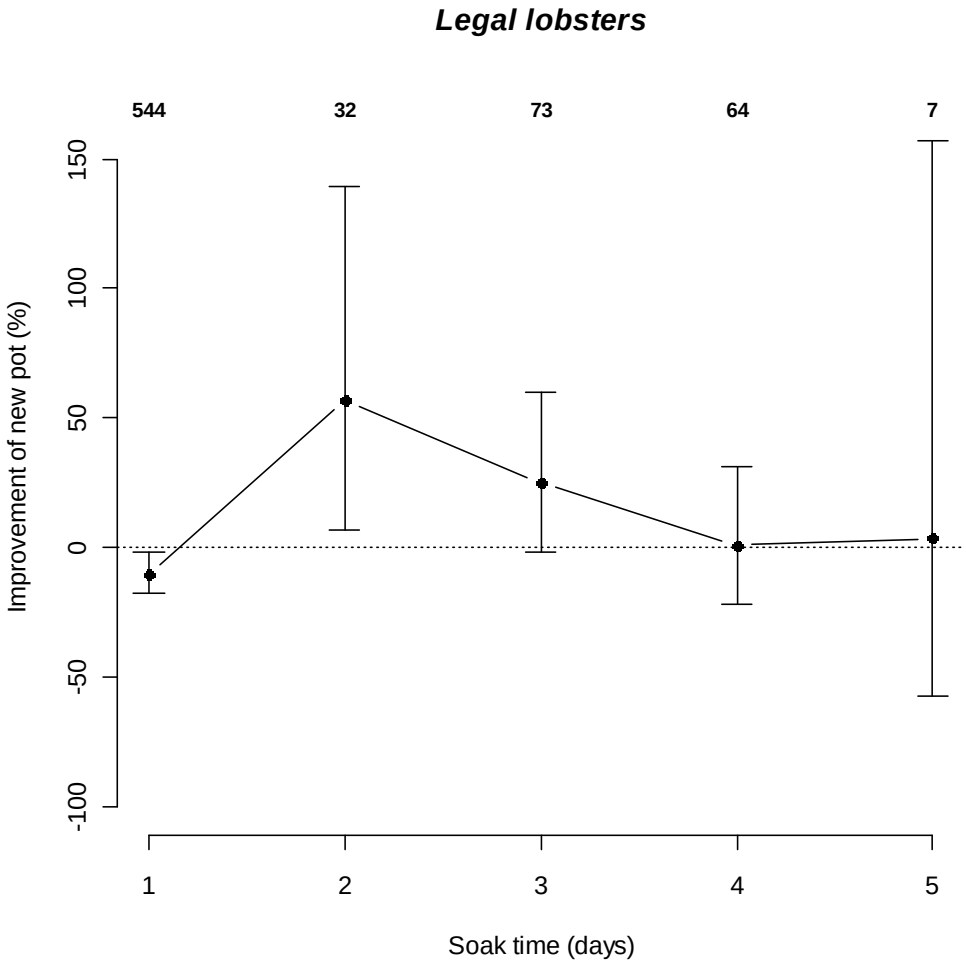

Fig. 7. The proportional difference (expressed as a percentage) in the catch of legal sized Western Rocklobsters made during the 2009/10 whites season by broad based pots relative to standard pots for different pot soaking times. Sample sizes are shown in bold above the plot.

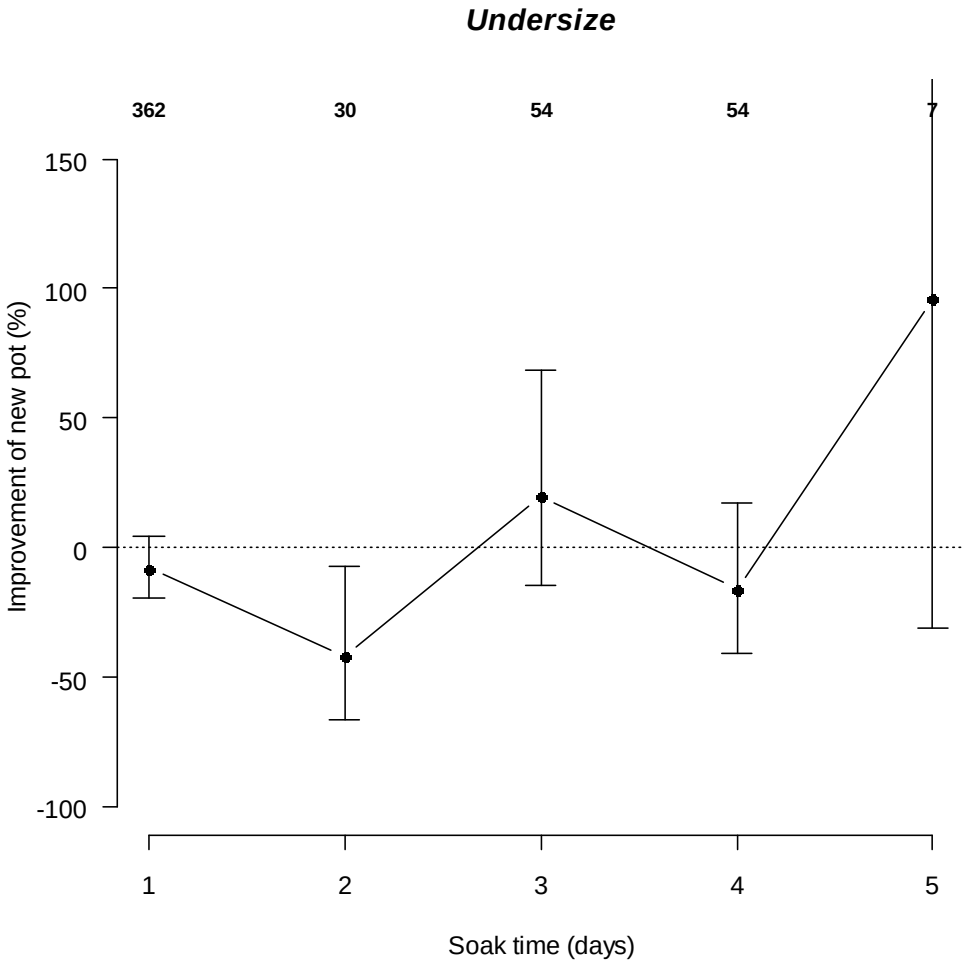

Fig. 8: The proportional difference (expressed as a percentage) in the catch of under sized Western Rocklobsters made during the 2009/10 whites season by broad based pots relative to standard pots for different pot soaking times. Sample sizes are shown in bold above the plot.

The second analysis examined the efficiency of broad based pots compared to standard pots by comparing the catch of legal sized (Table 10) and under sized lobsters (Table 11), using water depth, soak-time and pot type as factors in the ANOVA.

For legal sized lobsters, soak time, depth and the interaction between pot type and soak time was significant (Table 10; $P<0.01$). From Fig. 9 it can be seen that both the standard and broad based pots caught similar numbers of legal lobsters for one day soaking times and that the numbers of lobsters retained by both pots increased for longer soaking times. Of particular note however, was that broad based pots caught substantially more legal sized animals for two and three day soaks than standard pots.

In the case of under sized lobsters, soak time, depth and the interaction between depth and soak time was significant (Table 11; P<0.001). As with legal sized lobsters, both pot types caught similar numbers of under sized lobsters on one day soaking times, but in contrast to the legal size catch rates, fewer under sized lobsters were caught on two of the three longer pot soak times (particularly the two-day soak period and to a lesser extent, the four day soak time).

Table 10. Summary of ANOVA examining the proportional difference of legal sized Western Rocklobsters produced from two types of lobster pot in five depth ranges and over five soaking periods.

Factor	Df	SSq	Mean Sq	F value	Pr(>F)
Depth (D)	**4**	**269.4**	**67.34**	**97.50**	**<0.01**
SoakTime (S)	**4**	**108.4**	**36.12**	**52.29**	**<0.01**
Pot Type (P)	1	0.33	0.33	0.48	0.49
D * S	9	11.41	1.26	1.83	0.06
D * P	4	0.42	0.11	0.15	0.96
S * P	**4**	**6.96**	**2.32**	**3.36**	**0.02**
D * S * P	9	2.43	0.27	0.39	0.94
Residuals	1450	1001.49	0.691		

Table 11. Summary of ANOVA examining the proportional difference of under sized Western Rocklobsters produced from two types of lobster pot in five depth ranges and over five soaking periods.

Factor	Df	SSq	Mean Sq	F value	Pr(>F)
Depth (D)	**4**	**207.53**	**51.88**	**79.19**	**<0.01**
SoakTime (S)	**3**	**26.04**	**8.68**	**13.25**	**<0.01**
Pot Type (P)	1	1.56	1.55	2.37	0.12
D * S	**9**	**57.21**	**6.36**	**9.70**	**<0.01**
D * P	4	2.15	0.54	0.82	0.51
S * P	3	1.33	0.45	0.68	0.56
D * S * P	9	1.38	0.15	0.23	0.99
Residuals	1450	949.93	0.655		

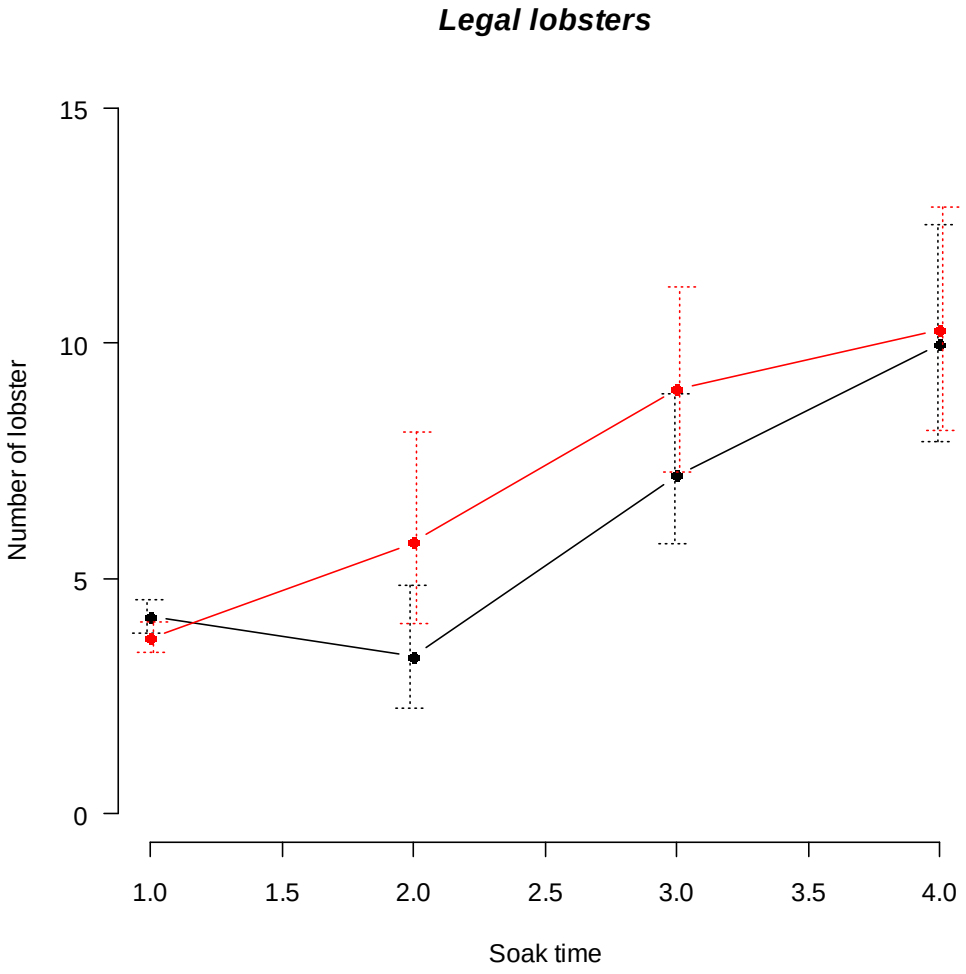

Fig. 9: Numbers of legal sized Western Rocklobsters per pot, for catches made for different pot soaking times by broad based (red line) and standard pots (black line) during the 2009/10 whites season

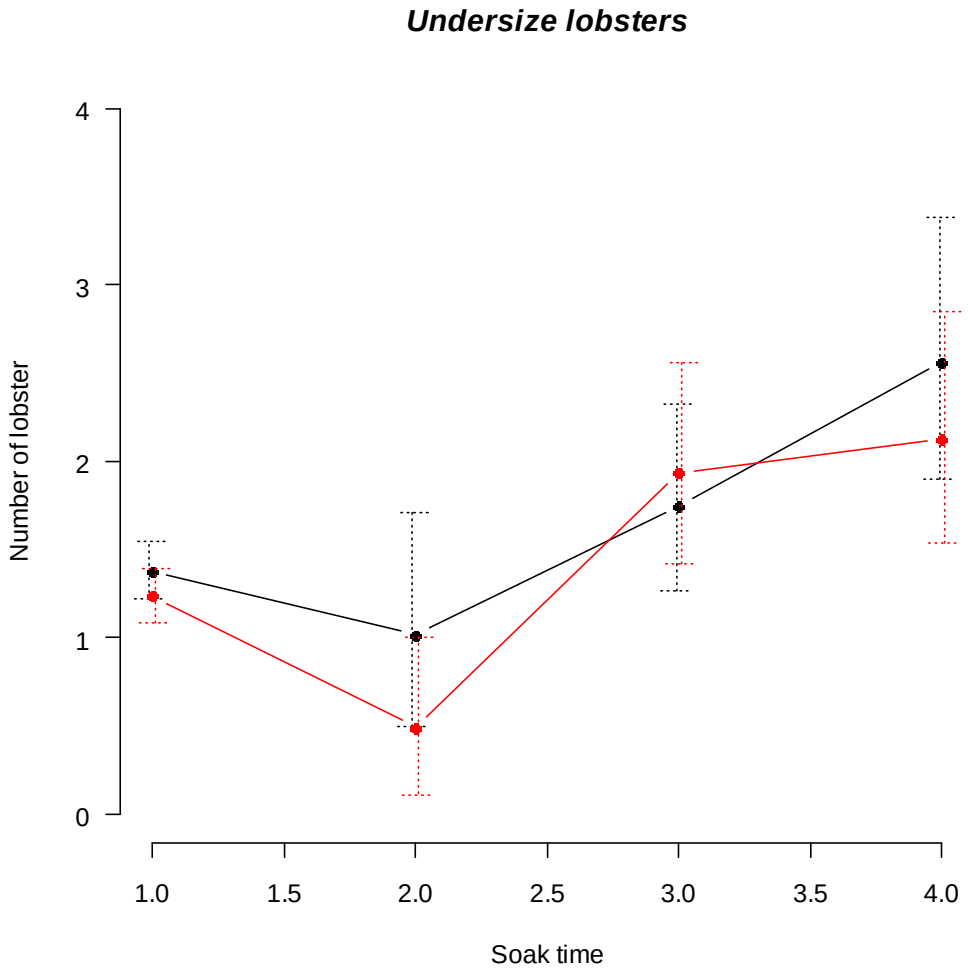

Fig. 10: Numbers of under sized Western Rocklobsters per pot, for catches made for different pot soaking times by broad based (red line) and standard pots (black line) during the 2009/10 whites season.

Potential cost savings through the use of the broad based pot design

The results from modified versus standard pot catch rates suggests that there would be no advantage in using broad based pots during the reds part of the season or for one day soaking times in the whites season, but there would be advantages to using them using the modified pots for two day soaking periods during the whites part of the season.

In the light of the uncertainty as to the way that fishermen will apportion their fishing effort across the lobster season in the forthcoming and subsequent seasons, it is necessary to make some very broad assumptions about likely seasonal fishing strategies and costs. For the benefit of calculating the potential reduction in pot lifts

and therefore the likely cost savings of moving to broad based pots, the following has been assumed:

(i) the two coastal zones will catch a combined total of 4000 t, of which half of the catch will be taken during the whites part of the season.
(ii) Catch rates using standard pots will be 1 kg potlift^{-1} (therefore requiring 2 million potlifts to take the coastal whites catch).
(iii) All fishermen using standard pots will pull their pots daily. Those using broad based pots will pull their pots every second day – effectively increasing their catch rate by 50% (see Fig. 10).
(iv) The daily catch of undersized lobsters that need to be discarded is 1.2 animals per pot haul on one day pot soak times, compared to 0.5 animals for two day soak times (see Fig. 10).
(v) Each pot lift is considered to cost $6 (figure provided in Winzer (2008)).

Based on the above assumptions, estimates of potential cost savings and reduction in discarded sub legal sized lobsters has been presented in Table 12. These figures have been calculated at five different levels of adoption rate of broad based pots and associated two day soak fishing strategy of that gear, by the Western Rocklobster fleet.

Table 12: Cost benefit analysis for the Western Rocklobster fishery on uptake of broad based pots during the whites fishing season at various levels of adoption. Assumptions behind these estimates are provided in the main text.

Adoption rate (% of the fleet)	Reduction in pot lifts	Reduction in sub legal discarded catch (numbers of lobsters)	Savings through reduced pot lifts ($)
10	200,000	140,000	840,000
20	400,000	280,000	1,680,000
30	600,000	420,000	2,520,000
40	800,000	560,000	3,360,000
50	1,000,000	700,000	4,200,000

4.0 Discussion

The Western Rocklobster fishery has been going through a period of unprecedented change over the last few years. Operating costs, such as labour and fuel have soared, product sales were stifled during the global financial crisis, there has been a severe downturn in puerulus settlement leading to concerns about the state of the brood stock which has resulted in pot reductions and extended periods closed to fishing.

In the light of these changes fishermen have been very focused on examining ways to increase profit in their operations. One of the obvious areas that could lead to increased profitability through efficiency is through the development of a more efficient pot and it is for this reason that stakeholders have been enthusiastic in pursuing and collaborating on this project.

At the start of this project and for the 2008/09 trials, the aim was to collect data comparing catches from standard pots with those of 1.2 m traps. The trials were conducted across both the whites and reds seasons in Zones B and C and across the reds part of the season in Zone A for one and longer day sets. In nearly all instances, the standard pot proved to achieve significantly better catches than the 1.2 m pot.

It is unclear why the 1.2 m pots performed below expectations given that they were considered to be very successful when used in the 1980s and when trialled during the final stages of the 2007/08 pot trials (Winzer, 2009). It could be that the neck of the pot needed futher refinement – those that built these pots for the trail had not been able to find the original design of the neck for these pots that had been used in the 1980s and had had to improvise (Bob Stone, pers. comm.). There was general consensus amongst the fishermen who trialled these pots in this study, that the animals were too readily able to escape from the traps.

The side neck pots were clearly ineffective compared to the other designs that were trialled. This may well be because the funnel entrances were close together and to some extent restricted space in the pot given that the pot size was no different to a standard pot. By contrast, the broad based pots, which also have side rather than top entrances, were shown to be very effective pots under particular conditions, presumably because they had more space available due to their larger dimensions.

In the pot trials conducted during the reds part of the 2008/09 season in Zones A and B, the catches made by the broad based pots were not significantly different to those made by standard pots during both one day and greater than one day soaking periods. Of interest though, was the fact that they had substantially larger upper least square means estimates compared to standard pots for sets longer than one day. This suggested that they might have potential to catch and hold greater numbers of animals than standard pots during high catch periods. There was also an indication in the data for Zone A which was supported by a statistically significant result in Zone B, that the broad based pot catches fewer under sized lobsters compared to standard pots.

The trials conducted in the early part of the whites season during 2009/10, showed that while the broad based pot was not significantly different in terms of its ability to catch legal sized lobsters on one day soaking periods, it was superior to the standard pot on two day soaks. Over three, four and five day soaks the results became less clear-cut, with some indication that the superior catch rates of the broad based pots over two day soaks was not necessarily maintained over longer soak times.

In contrast to the ability of the broad based pots to catch and retain legal sized lobsters, this pot design caught significantly fewer under sized lobsters over two day soaking periods. As with legal sized lobsters the lesser catch of under sized lobsters was less clear cut over longer than two day soak times. The significant interaction between depth and soak time may have been caused by the fact that there are more legal sized lobsters at depth and dominance effects resulting from increased catches of legal sized lobsters with soak time, would discourage the entry of under sized lobsters into the pots.

In summary, broad based pots show promise as a pot design that will achieve similar catches to the standard pot over one day sets, but significantly better catches of legal sized lobsters and fewer under sized lobsters on two day sets. The broad based pot appears to have particular potential for two day sets in the whites part of the season. Having said this, there is a need to qualify these statements by pointing out that they are based on a limited data set. In the case of the 2009/10 whites season dataset, there were only six fishermen who supplied data for the six week period between 15 November and 24 December. Given that that time of year is a peak catch period, most of the data was for one day soak periods (Figs. 7 and 8), with data for the longer soak times coming from weekends when regulations in the 2009/10 season prohibited fishermen in the Western Rocklobster fishery from fishing over weekends.

There are a large number of factors that have been identified in the literature as affecting the ability of particular pot designs to catch and retain spiny lobsters, clawed lobsters and crabs. In some cases particular design characteristics work in opposition to each other – for example ease of entry into a pot would be a desirable characteristic, but that characteristic would be likely to also permit easy escapement, which would potentially counter those benefits. The entrances into the broad based pot would seem to prevent equivalent or less escapement than the top entrance of the standard pot, as evidenced by the similar catch of the two pot types during the reds and the superior catch rates of the broad based pots during two day soaks in the whites.

Generally, it is accepted that top entrance beehive-shaped traps catch fewer lobsters than rectangular side entrance traps (Miller 1980) and that escape gaps increase the catch rates of larger animals by decreasing the retention of small animals (Miller 1990; Treble et al. 1998).

It is likely that the success of the broad based pot in this study is in part attributable to its side entrances combined with the increase in the interior space provided by the design assisting in preventing those pots from becoming saturated as quickly as the standard pot design.

Intra-specific behavioural interactions between lobsters in the immediate vicinity of pots, inside pots and even between lobsters inside and outside pots, has an important influence on catch rates and the size composition of the catch. Large, dominant individuals can deter smaller lobsters from entering a pot (Richards et al., 1983; Miller 1990 and Frusher and Hoenig 2001). The additional distance, albeit relatively small, that is provided by the larger dimensions of the broad based pot may be a factor in limiting interactions between lobsters. However, it is not obvious how

the dimensions of the broad based pot could have influenced the catch rates of under sized lobsters compared to standard pots for two day soaking periods in the whites, in the way that the results suggest it did.

Potential cost savings through the use of the broad based pot design

One of the objectives of this study was to calculate the potential cost savings which could be expected to arise through the use of a reduced number of more efficient pots, in tandem with modified fishing behaviour.

As has already been noted, comparisons in catch rate between standard pots and modified broad based pots will require more data before their respective capabilities can be considered with confidence.

Western rocklobster fishers are very adept at using particular types of pots compatible with the regulations, that they believe will give them a competitive advantage over other fishermen. For example, some fishermen, particularly in the Fremantle area, use stick beehive shaped pots when they fish in the deep water. Others in this and other parts of the fishery, use light coloured pine batten pots during the whites so as to mimic the light coloured sand habitat across which the whites migrate, only to change to pots with dark jarrah battens later in the season when the lobsters are targeted on reef habitat. It is therefore highly likely that if legal, there would be uptake in the use of broad based pots by Western Rocklobster fishermen at certain times of the year.

There is uncertainty as to how fishermen will distribute their fishing effort across the season from 2010/11 onwards, now that the fishery has moved to output controls. In the past, fishermen would fish intensively during the whites part of the season when lobsters are very catchable and no fisherman would intentionally set pots for a two day soak apart from during the first few days into the season when the whites are moulting and have yet to start feeding. In recent years fishermen have been forced to set their pots for longer periods within the whites season because of legislated changes aimed at reducing fishing effort by preventing fishermen from setting their pots over weekends. This ‘weekends off’ ruling is set to be retained for at least the 2010/11 season.

Given the assumptions that have been outlined in the results, there is good indication that the uptake of the broad based design pot in the industry could lead to multi-million dollar cost savings through reduced pot lifts. Futhermore, it is estimated that there would be a substantial reduction in the handling of sub legal discarded lobsters, running into hundreds of thousands of animals. It is well known that the handling and release of undersized Western Rocklobsters can negatively influence their growth and survival after release (Brown and Caputi 1983). Any reduction in unnecessary handling and release of undersized animals could be expected to have flow-on effects in terms of future catch.

Benefits and adoption

The potential beneficiaries of this research will be the fishermen, however benefits will be unlikely to be realised until the 2011/12 fishing season.

The Western Rocklobster fishery is currently (2010/11 fishing season) moving from input to output controls. In the short term at least, many of the input controls such as restrictions on pot size and design and pot limits, are being retained by managers of the fishery. In the longer run, one would expect that to obtain the benefits of output controls that there will be a relaxation of many of the input restrictions.

The results of this research will be communicated to fishermen during the 2010 Coastal Tour and there will be opportunity to consider the use of broad based pots in the fishery in the future. Several of the fishermen that took part in these trials have indicated their interest in being able to use this style of pot.

5.0 Further Development

It is clear that broad based pots do have the potential to perform better than standard pots under some circumstances. However, it has been noted throughout this report that the data were based on only a small number of fishermen trialing the different pot designs. To obtain greater clarity and confidence in the performance of the broad based pot through the fishing season and for different pot soaking times, it will be necessary to greatly increase the amount of data on which these assessments of pot fishing ability are based.

Planned Outcomes

This project had at its inception, the objective of providing stakeholders in this fishery with a trap that with associated fishing behaviour, would have the potential to improve the profitability of individuals and therefore ultimately the industry as a whole.

The original trap that was tested did not meet this objective, but a subsequent design has achieved this objective by increasing catch rates of standard pots set overnight, by 50% when compared to the new pot design set for a two day soak time. In addition the pot catches few under sized lobsters and the reduced discard mortality resulting from this feature will have flow-on effects in terms of reduced discard mortality rates and improved growth rates through less handling of sub legal sized animals.

The Western Rocklobster fishery has recently moved to output control (2010/11 season onwards) but in the short term some features of input controls remain, one of which is that the size and design of pots that can be used in the fishery is stipulated

in the management plan for the fishery. Once the new management system is in place it will be possible to consider the next steps for promoting the economic benefits for selective use of the broad based pot. It may be that there is a need to get legislation changed to allow for the use of a new pot design. However this may not be necessary if existing input control features restricting pot designs other than the approved standard pot is removed from the management plan in the future.

Conclusion

This project set out to improve profitability in the Western Rocklobster fishery by providing a more efficient pot design. The new design is now available from this project – a pot that performs very efficiently at catching legal sized lobsters over extended soak times, at least during the whites season and one that retains far fewer under sized lobsters than the standard pot. These features would be expected to improve profitability of fishing operations for those that choose to construct these pots and make use of them within the season. The main project objectives have therefore been achieved.

However, because of the very overwhelming management changes that are being undertaken in the fishery at the present, it will likely be some while before those responsible for developing policy in the fishery are able to turn their attention towards clearing the way in legislation for the introduction of alternative pot designs.

More effective and efficient pot designs are key factors in improving profitability in any fishery and while this project has been successful in this aim, this work is by no means the final word on the subject. The development of more efficient pots should be an ongoing aim in the fishery and we believe that the goodwill between research and industry established by this project will provide the basis for fruitful future pot design developments.

6.0 References

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7. APPENDICES

APPENDIX 1

INTELLECTUAL PROPERTY:

There is no identifiable intellectual property arising from the project

APPENDIX 2

STAFF:

Dr Andrew Winzer	Western Rocklobster Council
Dr Roy Melville-Smith	Curtin University
Dr Simon de Lestang	Department of Fisheries
Mr Adrian Thomson	Department of Fisheries
Mr Brad Armstrong	Argosea Research and Training
Ms Vicky Kay	Western Rocklobster Council

APPENDIX 3

Pot designs used in the trials reported in this study

The batten pots used in this study were variations of a standard (control) commercial rocklobster pot. The dimensions of a standard pot for the Western Rocklobster fishery as laid down by the Fish Resources Management Act 1994 and Regulations are shown in Fig 1.1.

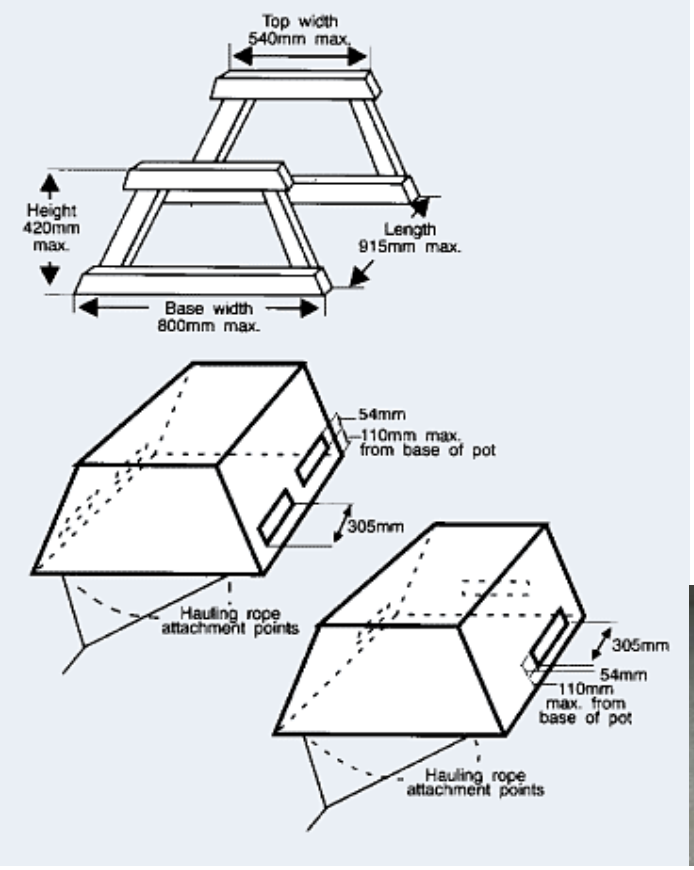

Fig. 1.1: Standard pot dimensions from Department of Fisheries, Government of Western Australia (2005). Image to the right of the diagram shows plastic 'red neck' entrance that is used in standard pots.

The broad based pot differed in dimensions from the standard pot by being 920 mm wide. The height and length were the same as a standard pot, but there was no entrance at the top of the pot. Instead of a top entrance, there were two side entrances, one at the front of the pot where the hauling rope is attached and the other at the rear end of the pot (Fig. 1.2). The funnel entrances from the front and rear were made from 2" (50 mm) prawn trawl mesh and where the two funnels met in the centre, there was a gap that allowed the lobsters to move from the funnel into the pot.

The side neck pot had exactly the same dimensions as a standard pot. As with the broad based pot, there was no entrance at the top of the pot, but instead there were two side entrances on each of the long sides of the pot towards to front where the hauling rope is attached (Fig. 1.3).

The 1.2 m trap is shown in Fig. 1.4. The trap measured 1200 mm across X 375 mm high and had a single side entrance. The traps were covered with 25 mm galvanised wire netting, with the entrance and funnel made from 25 mm prawn trawl mesh.

Fig. 1.2: Broad based pot with battens removed to show the entrance arrangement.

Fig. 1.3: Side neck pot. The second entrance was on the opposite side of the pot.

Fig. 1.4: Single entrance 1.2 m trap.

APPENDIX 4

Datasheet used to recorded the sampling details and catch for each pot

Rock Lobster Length Frequency

Vessel name: _____ Reg. No: _____ Date: _____

Latitude: _____ Longitude: _____ Depth: _____

Was there evidence of Octopus? YES / NO

CL	Males		Females					CL	Males		Females				
	Red	White	Red	White	Spawn	Tar spot	Setose		Red	White	Red	White	Spawn	Tar spot	Setose
20								89							
21								90							
22								91							
23								92							
24								93							
25								94							
26								95							
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