Western Rock Lobster Council Inc.

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Fisheries Research and Development Corporation

INCREASED ECONOMIC EFFICIENCY FOR THE WESTERN ROCKLOBSTER FISHERY THROUGH IMPROVED POT DESIGN

(FRDC Project Number 2007/250)

FRDC FINAL REPORT

NOVEMBER 2008

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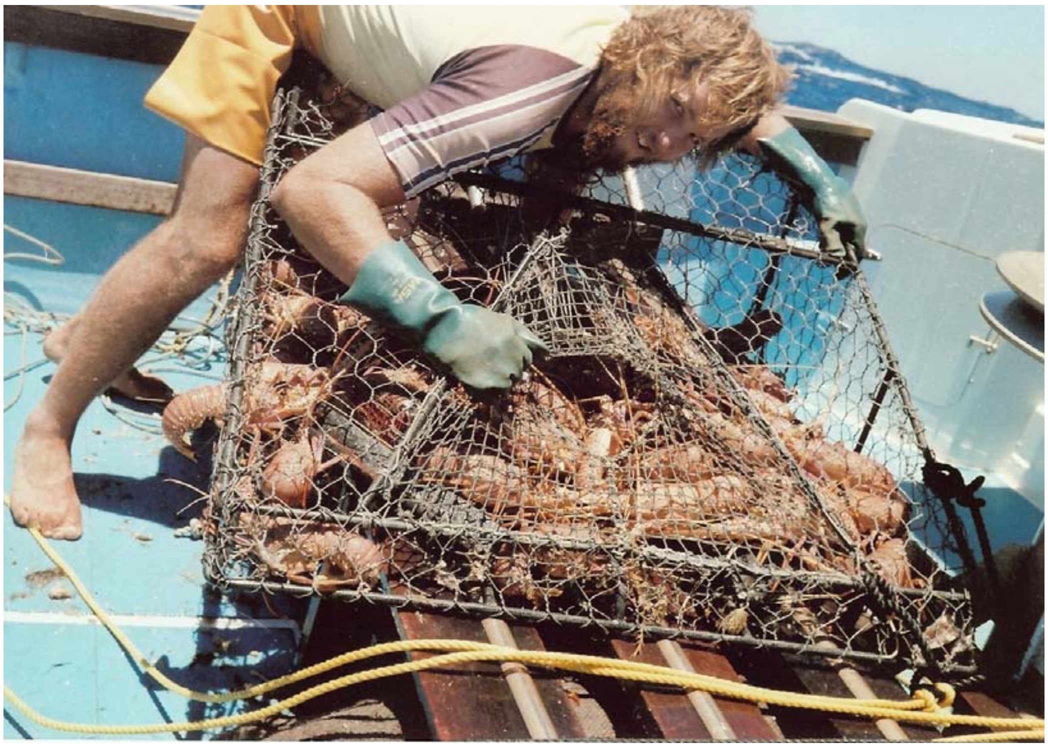
Increased economic efficiency for the Western Rocklobster Fishery through improved pot design



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Non technical Summary

2007/250 Increased economic efficiency for the Western Rocklobster Fishery through improved pot design

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OBJECTIVES:

1 To provide industry with the blueprint(s) of one or many pots that catch target size Western Rocklobster in a more efficient manner

2 To provide industry with estimates of the cost savings that would be achieved in the WRLF through the adoption of a more efficient pot

3 To optimise the economic efficiency of industry stakeholders without adversely affecting the exploitation rate

OUTCOMES ACHIEVED TO DATE

Pilot phase trial carried out over the reds phase (February-June) of the 2007/8 commercial West Coast Rocklobster fishing season. Industry driven initiative conducted in collaboration with the Department of Fisheries WA research division identified and trialed various pot designs, the most successful of which will be trialed throughout the 2008/9 commercial WRLF season.

An industry driven project steering committee decided to trial a modified batten rocklobster pot over the reds phase of the 2007/8 season (February – June) across all zones of the fishery. The intention of the steering committee was to design and introduce a more efficient pot to the Western Rocklobster Fishery which would address the ever increasing costs associated with landing lobster and reduce the industry carbon footprint. If a more efficient pot were to be found, further trials would then take place to derive a calibration factor so as to ensure the biological sustainability of the stock.

It was decided to stay with the original dimensions of the traditional batten pot in order to minimise the cost of uptake by the fishery. Modifications to the traditional batten pot included a parlour and two side entrances, both features have proved their worth in both European and South African rocklobster fisheries.

This new design pot was found to catch significantly less lobster over a one day soak time whilst no significant difference in catch rates was found over a two day soak.

Various modifications were made to the new design pot in the remaining months of the season without success. One fisherman decided to source and subsequently trial a long forgotten trap used in the 1980's with great success. This trap is comparatively larger in volume with 100% retention and therefore ideally suited to extended soak times. When deployed during the final two months of the 2007/8 season over two day soaks, this trap and was found to land significantly more lobster than the traditional batten pot. Catch rates are recognised as being notoriously low at this stage of the season and there is a growing trend among fisherman to end their season early in spite of processors offering the highest beach price.

Funding has been sought through the National Seafood CRC to trial these traps across all zones in 2008/9. If successful, these traps have the potential to minimise the major cost drivers namely number of pot lifts and days at sea for individual fisherman and ultimately alter the fishing pattern of the entire fleet.

KEYWORDS: **Western Rocklobster, pilot phase trial, new design pot**

Acknowledgements

Thanks go to the project steering committee; Professor Bruce Phillips, Dr Simon de Lestang, Dr Rhys Brown, Kevin Donohue, Alice Hurlbatt, Bruce Cockman, Bob Stone, Paul and John from Crackpots. Fisherman involved in the pilot phase trial; Steve Mcleary, Bob Stone, Peter Vinci, Peter Burton, Clinton Moss, Geoff Cockman, Chris Patman and Lance Litchfield. Thanks also go to Adrian Thomson from the Department of Fisheries WA and Professor Norm Hall from Murdoch University for assistance with the data analyses.

List of Acronyms

ANOVA	Analysis Of Variance
CL	Carapace Length
CPI	Consumer Price Index
CPUE	Catch Per Unit Effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation
RLIAC	Rock Lobster Industry Advisory Committee
WAFIC-IDU	Western Australian Fishing Industry Council Industry Development Unit
WA FRAB	Western Australian Fisheries Research Advisory Board
WRL	Western Rocklobster
WRLC	Western Rocklobster Council
WRLF	Western Rocklobster Fishery
Seafood CRC	Seafood Cooperative Research Centre
MSC	Marine Stewardship Council
DoF	Department of Fisheries Western Australia

Background

This project focused on improving the efficiency and thus the profitability of rocklobster fisheries through an improved design of lobster pot. The costs required to fish in the Western Rocklobster fishery increase each season. Some of these are a result of the competitive nature of this fishery, which has seen the acquisition of bigger boats and more efficient fishing aids such as radar, differential GPS and ocean mapping technologies. The economic impact of these increases has generally been offset by increased catch rates through the improved fishing efficiency generated by these technologies. More recently, however, some of the basic input costs for this industry have increased to levels that have started to severely impact on their profitability.

Since 1991/92 the cost of popular baits in the industry such Australian and New Zealand salmon and imported mackerels have increased by ~ 25%, while the costs of materials such as pots, ropes and floats have increased by ~ 20%. These increases, although substantial, have been minor when compared to that which has occurred in the price of diesel - a 135% increase over the same period (most occurring in the last five years). Labour costs, although more difficult to quantify, have anecdotally also risen at a far greater rate than CPI, due primarily to the attractive pay packets and conditions offered by the mining industry. These increased input costs have certainly not been balanced out by a corresponding increase in the price of lobsters. The beach price, i.e. that received by the fishermen per kg, has varied over the past 15 years, from $19.00 to $33.75, as supply and demand has changed with lobster abundance and variations in the exchange rate. However the overall trend in the beach price since 1991/92 has been an annual decline of $0.10 per kg lobster.

In addition to this economic pressure, it is envisaged both the sustainable use of fish bait species and reduction of transport related carbon emissions associated with diesel fuel will be subject to further scrutiny if this fishery is to continue its Marine Stewardship Council (MSC) ecological certification and its licence from the Department of the Environment and Heritage to export lobsters.

The use of more efficient lobster pots has the potential to alleviate many of these concerns. This option was identified and highly ranked in a recently completed bioeconomic assessment of this fishery (DoF, 2006). Using more efficient pots would allow the WRL fishery to achieve the same catch with a far reduced number of pots being used per boat. Each boat fishing with a smaller number of more efficient pots yet still producing the same catch would receive a direct decrease in costs associated with fuel, bait, pots, floats and ropes and a reduction in the chance of icon species becoming entangled with their gear. (See benefit/cost analysis).

If alternative pot designs were identified and approved for use, the decision to use more efficient lobster pots could still remain with each individual fisher, with the number of more efficient pots used being based on their current pot entitlement and suitable conversion factors developed during this project. As the current WRL management plan already contains the provision to determine the number of pots that can be used in a season based on total pot entitlements, it would not be difficult to adjust this system to enable annual usage rates to be varied based on a set of approved pot designs and conversion ratios.

Need

Given the current cost-price squeeze, the WA FRAB and the WRL Industry have highlighted business improvement/cost competitiveness within the fishing industry as a priority for research. For the WRL 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 total cost of ~$60 million (average cost per pot lift - $6.00). This is one area where input costs may be reduced.

The fishery currently has strict controls on the pot characteristics to maintain equity among participants and to ensure exploitation rates remain constant. By improving the catching efficiency of the pots the same annual landings could be achieved with a far lower number of pot lifts. For example, an increase in the fishing efficiency of a lobster pot by 10-20% would reduce pot lifts by 10-20% and return to the industry a minimum cost saving in excess of $3-6 million annually. An industry based working group will aim to develop more efficient pots which will provide additional cost savings in fuel and bait usage.

The decision to use more efficient pots could be undertaken at an individual fisher level, but this requires robust conversion rates for any modified design(s) to ensure that the integrity of the fishery's input based management system is not compromised.

Objectives

1. To provide industry with the blueprint(s) of one or many pots that catch target size Western Rocklobster in a more efficient manner

2. To provide industry with estimates of the cost savings that would be achieved in the WRLF through the adoption of a more efficient pot

3. To optimise the economic efficiency of industry stakeholders without adversely affecting the exploitation rate

Methods

1) Determine pot designs/attributes that were to be investigated

The WRLC formed a steering committee based on industry stakeholders (two from each zone), Dept. of Fisheries Scientists (Rhys Brown, Kevin Donohue & Simon de Lestang) and peak body representatives (Project P.I., WRLC board members, leading pot designers). The initial task of the steering committee was to develop a discussion paper on the relative merits of redesign of the catch unit in the fishery, the pot (*see* appendix). The paper will assess on a risk basis the relative costs and benefits associated with the redesign of a more efficient pot.

The discussion paper details the risk of management failure through the redesign of the pot and devise risk mitigation strategies for the remainder of the project.

A comprehensive literature review was then conducted relating to gear technology used in decapod crustacean fisheries worldwide.

Due to time constraints imposed on this project, this preliminary trial focused on a pot which will increase CPUE over the reds phases of the commercial season only.

Any further amendments to these designs were compiled by the principle investigator and presented to the project steering committee. The number of new design pots that were short-listed by the steering committee were kept to an absolute maximum of three. These pots were then blue-printed and constructed by local rocklobster pot designers involved in the project steering committee.

2) Preliminary trial across all zones of the fishery (15th January 2007 – 30th June 2008)

Eight commercial fishers (4) C zone, (2) B zone and (2) A zone were chosen to participate in the preliminary trial commencing at the start of the 2007/08 season. As discussed in the results section, modifications were made to the new design batten pots by numerous fishermen without success. One fisherman obtained another exemption to trial the 48 inch trap for the remaining eight weeks of the season and this data is presented in the results section and the cost benefit analysis (*see* results section).

Fishers were asked to exchange ten of their red neck batten pots for ten new design batten trial pots and to keep a pot-by-pot logbook, which was provided. These new design pots were deployed at the fisher's discretion. It should be mentioned that each participant still had the number of pots in the water that his licence stipulates. The fisher was then required to randomly allocate ten traditional, red neck batten pots to the control treatment group and these catch rates were compared directly with those of the experimental (new design) pots. In order to ascertain the direct effects of pot design on catch rate, the fisher was required to deploy each of the ten experimental and ten control treatment group pots at a similar depth, substrate type using the same species of bait. Thus in order to satisfy these requirements, the fisher would deploy both control and experimental pots in 'one foul swoop' i.e. on the same run or line.

For each pot, the catch (lobster's carapace length, sex, body condition and reproductive status), location and soak time was recorded in a logbook designed exclusively for the purpose of the preliminary trial. The principle and co-investigators endeavoured to independently monitor the catch composition of the new design and control pots on each vessel partaking in the trial on at least one occasion during the season. It was imperative that 100% recording of both target species and by-catch species occurred throughout these trials to obtain a true measure of the potential of each new pot design. Logbooks were collected throughout these trials on an ongoing basis and compiled into database format.

By the end of the 2007/08 fishing season the various pot comparisons i.e. new design batten pot and 48 inch trap and their respective fishing efficiencies were determined and presented on the RLIAC coastal tour.

3) Economic assessment of the efficiency of the 48 inch trap at the end of 2007/08 season

Using the pot efficiency conversion factors, an economic appraisal was performed to determine potential cost savings to the fishery through the use of the 48 inch trap. Additional factors incorporated into the analysis include varying levels of uptake by the industry and cost of replacing gear each season. Estimates of reductions in the major input cost driver in the fishery (i.e. the number of pot lifts) in addition to various related input costs (i.e. fuel, bait and labour) were provided using the 48 inch trap deployed over two day soak times in combination with the traditional batten pot used over one day soak times. The average number of days fished during the 2007/8 season was 140 composed of 70 one day soaks which occur at the start of the season when catch rates are high and 70 two day soaks which occur towards the latter stage of the season i.e. March – June 30th.

Statistical analyses

ANOVA

Homogeneity of variances among samples was tested by a regression plot of all residuals. This plot was found to be nonlinear and a log+1 transformation was then performed on all data. One way ANOVA was then used to test the null hypothesis that there was no difference in the mean number of size lobster caught using the new design batten pot and the traditional pots ($P > 0.05$). This test was carried out over both one and two day soak times for each fisherman from each zone. Pending on the outcome, the data from each fisherman was then pooled to represent the one zone. There were insufficient replicates over a two day soak for A zone fisherman to determine significance between fishing methods i.e. new design batten pot versus traditional batten pot. The 48 inch trap was trialled in C zone only for the reds phase of the 2007/8 season.

A zone fisherman – Abrolhos Island March 15th - June 30th
B zone fisherman – North of Jurien Bay to Big Bank
C zone fisherman – Mandurah to Jurien Bay

RANDOMISATION TEST

A second method of analysis was carried out to further validate the findings of the ANOVA.

Rather than performing a harsh transformation on the raw data, a randomisation test was used (Edgington 1995). Such a test is ideally suited to the type of data collected during the preliminary study, as it doesn't rely on assumptions of normality or equal variances. The null hypothesis, which is assumed to be true for the purpose of the trial, states that the two sets of data are drawn from the same distribution (i.e. the treatment has no effect on the value of catch per pot recorded for each pot lift). Comparisons between a control and treatment group of the same soak time are ideally suited to a two-sample situation when attempting to compare the means of two sets of values by determining a t-statistic.

Comparison between a control and a specific treatment group and soak time involves pooling all values, and randomly selecting, with replacement, another complete data set from these original two treatment groups. The total sample size is then halved and assigned to the set number 1, our control group and the other remaining half of the data set is assigned to set number 2, our treatment group. A measure of the difference between the means is then calculated with equal sample sizes and unequal variances using the standard formula (but recognising that this is not the t-statistic that would be used with a standard table of t-values). This value is calculated by subtracting the mean of the treatment group from the mean of the control group, then dividing by the estimate of the standard deviation of the difference between the means. This statistic was calculated 20,000 times producing a very large number of random observations of the values of the t-statistic that one would be likely to encounter if the null hypothesis was true.

The final step in the calculation was to calculate the test statistic from the original pooled set of data (comprised of the control and a treatment group across a respective soak time). A count was then performed of the number of times within 1,000 observations from the null hypothesis that a value of the test statistic is obtained that is equal to or exceeds the value calculated from the recorded data. This count was then divided by 1,000 to provide an estimate of the probability that a test statistic value as large as that which was observed in the deployment trial could have occurred by chance if the null hypothesis was true.

This is a single-tail test as all that is being tested is whether the total catch of rocklobster (size and undersized) obtained with the treated pots is significantly less than the catch obtained by the control pots using the same soak time. It is assumed that the test statistic calculated is an appropriate measure of the difference between the mean catch per pot lift recorded across each treatment group and soak time. An additional assumption of this study is that there are sufficient observations in the combined data set and that a random sample with replacement is representative of the distribution of values that would be recorded if the experiment had been repeated (at the same time as the original trial, at the same location, with the same density of rocklobster and under the same environmental conditions).

Results & Discussion

Figure One. Prototype pot side entrance (aerial view)

Figure Two. Prototype pot side entrance (side view)

Figure Three. New design batten pot used in pilot phase trial showing side entrance

Figure Four. New design batten pot used in pilot phase trial showing side entrance configuration

Figure Five. Prototype of 48 inch pot trialled by one fisherman

Figure Six. 48 inch traps ready to soak for 2008/9 season long trial (*see* Further Development section)

New design batten pot analysis

One day soak time

The first analysis for the pilot phase pot design trial involved a one-way ANOVA of all three fisherman's catch rates. Catch rates were found to be significantly different ($P < 0.05$) between individual fisherman in C zone of the fishery only. For the purpose of the figure below, the data from zone C has been pooled to further highlight this variability and allow some comparison to be made with the remaining fishing zones. Please note below: new = new design batten pot, trad = traditional batten pot.

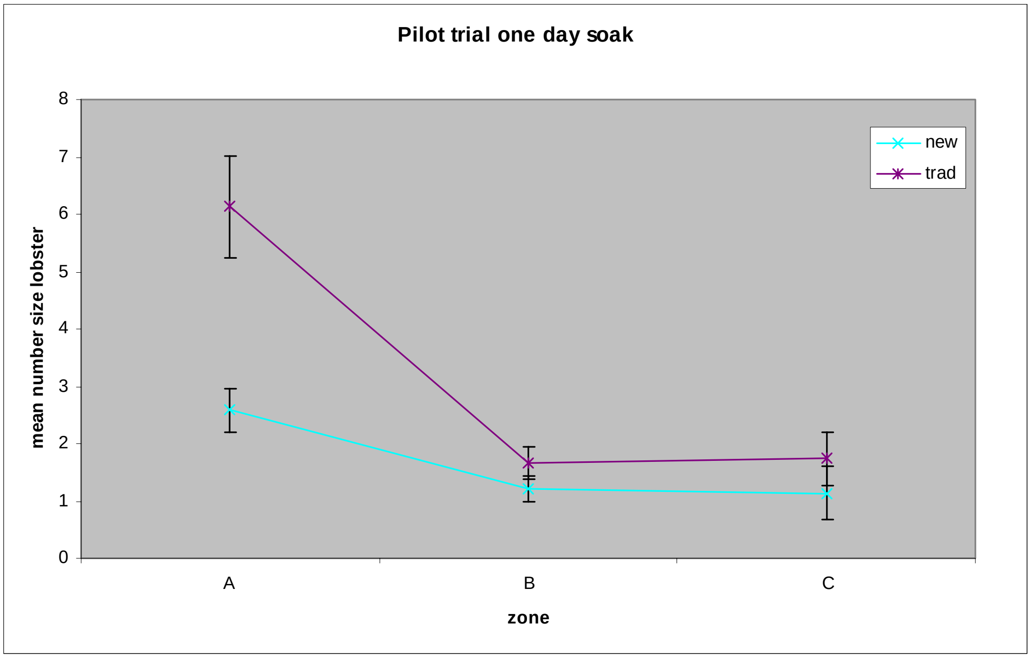


Figure Seven. Mean number (± 95% C.I.) of legal size animals trapped across all zones in pilot phase trial using a one day soak time.

After a log+1 transformation was performed on the data set, catch rates were found to be significantly higher over a one-day soak time using the traditional batten pot ($P < 0.05$) across all zones. As a result fishermen participated in this trial for a total of eight weeks only. The lowest catch rates over a one day soak were recorded in zone C (new design batten pot 1.14 ± 0.14) and zone B of the fishery (new design batten pot 1.22 ± 0.23).

Table One. Mean number (± S.E.) of legal sized animals trapped across all zones in pilot phase trial using a one day soak time. (Asterix denotes significance at the P < 0.05 level).

METHOD	zone A	zone B	zone C
new design	2.58 ± 0.19	1.22 ± 0.23	1.14 ± 0.11
traditional	6.13 ± 0.38*	1.66 ± 0.27*	1.61 ± 0.23*

Two day soak time

Over a two day soak time, no significant difference in catch rates was found between the traditional batten pot and the new design batten pot (P > 0.05). Please note in figure eight below; n= new design batten pot and t=traditional batten pot.

Figure Eight. Mean number (± 95% C.I.) of legal sized animals trapped across all zones in pilot phase trial using a two day soak time. (Asterix denotes significance at the P < 0.05 level).

A discernable overlap in catch rates and their corresponding confidence intervals was found to occur across all zones over a two day soak time. As was the case with a one day soak, irrespective of the treatment group, the lowest catch rates over a two day soak were recorded in zone C of the fishery (new design batten pot 1.40 ± 0.24).

Table Two. Mean number (± S.E.) of legal sized animals trapped across all zones in pilot phase trial using a two day soak time. (Asterix denotes significance at the P < 0.05 level).

METHOD	zone A	zone B	zone C
new design	5.58 ± 1.06	1.91 ± 0.19	1.40 ± 0.24
traditional	6.42 ± 1.08	1.86 ± 0.28	1.74 ± 0.17

48 inch trap analysis

ANOVA

The data collected by Bob Stone using a 48 inch trap was subjected to two methods of analysis. Firstly a one way ANOVA was used where the data was subjected to a log+1 transformation in order to meet the assumptions of a normal distribution. This method of analysis found no significant difference between catch rates using the 48 inch trap or traditional batten pot ($P > 0.05$).

Randomisation

A second method of analysis was carried out to further validate the findings of the ANOVA. In contrast to the ANOVA, the randomisation test found the 48 inch trap (2.64 ± 0.31) to catch significantly more legal sized lobster than the traditional batten pot (1.45 ± 0.06) using a two day soak time ($P < 0.02$).

These traps were trialled over the last eight weeks of the 2008/9 season when catch rates are recognised as being traditionally low. Particulars such as the tautness and size of the neck and the type of galvanised mesh used for the 48 inch trap were refined further as the season progressed. It is felt that the trap to be trialled throughout the 2008/9 season is an exact replica of those used to great effect in the 1980's.

Table Three. Original and resampled data Randomisation test from Bob Stone's last 8 weeks of 2007/8 season. (Asterix denotes significance at the $P < 0.05$ level).

Original	Traditional	48 inch trap
mean	1.45	2.64
n	65	66
sd	1.94	4.50
SE	0.06	0.31
t	-1.97**	

Resampled	1st half	2nd half
mean	1.06	1.94
n	65	66
sd	1.36	2.78
SE	0.03	0.12
V(diff)	0.15	
sd(diff)	0.38	
t	-2.31***	

Cost benefit analysis

The cost benefit analysis performed below incorporates two fishing methods, the traditional batten pot is used over one day soak times only and the 48 inch trap is used over two days soak times. This translates to two sets of gear being used each season which is in accordance with current industry practices i.e. a set of traditional batten pots for the whites phase of the season and a set of traditional batten pots for the reds season. This approach prevents pots from rotting away and allows them to dry out and be used for consecutive seasons.

The mean number of lobster caught during the reds phase of the season by C zone fisher Bob Stone using the 48 inch trap over two day soak times was 2.64 ± 0.31 legal size lobster. This estimate of catch per unit effort i.e. CPUE equates to an approximate 45% increase in efficiency over a two day soak time in comparison to CPUE using a traditional batten pot (1.45 ± 0.06). Throughout the 2007/8 season, the average number of days fished was 140 days comprising of 70 one day soaks and 35 two day soaks.

Table Four. Cost Benefit analysis for the Western Rocklobster fishery on uptake of 48 inch lobster trap based on varying levels of adoption and efficiency. (48 inch traps used for two day soak times whilst the traditional batten pot is used for one day soak times only).

Adoption rate	Reduction in pot lifts	Savings through reduced pot lifts ($)
10	180,000	1,080,000
15	270,000	1,620,000
20	360,000	2,160,000
25	450,000	2,700,000
50	900,000	5,400,000

NOTE: Number of pot lifts annually 10,000,000 @ $6 per lift. 2007/8 average 70 one day pot lifts /105 total pot lifts = 66.7% and 35 two day pot lifts/105 total pot lifts = 33.3%. A 45% increase in efficiency or CPUE over two day soaks equates to an 18.3% reduction in total pot lifts.

Outputs & Extension

The main outputs from this project were advice to industry and management including-

(1) A full appraisal of one or more designs for lobster pots that catch target size Western Rocklobster more effectively than pots currently used in the fishery. This includes not only an assessment of relative catch rates but also an analysis of the relative building costs, durability/lifespan, operational considerations and material supplies.

(2) For each of the more efficient pots, a conversion ratio of its catching efficiency compared to current pot designs would be calculated. This analysis would include a specific assessment of the robustness of this ratio and any other factor that may affect the utilisation of this ratio for the management of the fishery. As this trial was conducted during the later stages of the 2007/8 season only, this conversion ratio will be determined following the season long trial (*see* Further Development).

(3) An analysis of the impact of the new pot design on the relative capture rates of key by catch species.

(4) An economic appraisal of any likely cost savings that would be achieved from use of the new pot designs namely the 48 inch trap, along with the assumptions used in these calculations.

Planned Outcomes and Benefits

The main outcomes of this project included–

SHORT TERM:

(1) The decision on whether to adopt a new more efficient pot design with consequent benefits for improved efficiency and profitability within the industry.

(2) A full appraisal of one or more designs for lobster pots that catch target size Western Rocklobster more effectively than pots currently used in the fishery.

LONG TERM:

(1) Provide stakeholders in the WRLF and related rocklobster fisheries with estimates of the economic benefits associated with incorporating more efficient lobster pots into their fishing operations.

As previously stated, the new design pot used in this pilot phase trial was found to be less than successful when deployed over one day soak times. However, the comparatively larger 48 inch trap used by one fisherman was used successfully over two day soak times. A cost benefit analysis using this 48 inch trap has been constructed below.

Further Development

The WRLC in tandem with the Department of Fisheries W.A. will carry out further research throughout the 2008/9 season long trial in order to quantify potential deleterious effect(s) of the 48 inch trap on by-catch of icon species. The potential for any competitive effect which any new design pot may/may not have on traditional rocklobster pots will also be investigated. In addition to this, the impact of new design pots on existing occupational health and safety regulations within the fishery and potential for ghost fishing will also be investigated.

This trial commenced on November 15th 2008 and if found to be successful, this trap could potentially alter the fishing pattern of the entire fleet to focus on extended soak times season round. If a lobster trap could be introduced into this fishery with a volume approx twice that of traditional pots, thereby able 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. It is envisaged that the cost savings associated with this shift in fishing behaviour would translate to a more economically viable fleet. Pending the approval for use of the 48 inch trap, the decision to use these more efficient lobster methods of deployment would still remain with each individual fisher, with the number of 48 inch traps used being based on their current pot entitlement and suitable conversion factors developed during season long 2008/9 trial. As the current WRL management plan already contains the provision to determine the number of pots that can be used in a season based on total pot entitlements, it would not be difficult to adjust this system to enable annual usage rates to be varied based on an approved conversion ratio.

Conclusion

Catch rates over the reds phase of the 2007/8 West Coast Rocklobster season using the new design pot constructed under the supervision of the project steering committee were less than ideal. Over a one day soak time, catch rates were significantly greater across all zones of the fishery using the traditional batten pot catch than those recorded using the new design pot. Catch rates in the WRLF are traditionally highest in zone A, the northern zone of the fishery and a similar trend was observed in the current trial. The largest variation in catch rates between the new design (2.58 ± 0.19) and the traditional batten pot (6.13 ± 0.38) in the current study was found to occur in A zone of the fishery. The first two weeks of the Abrolhos Islands season result in the highest catch rates throughout the entire season across all zones. Catch rates recorded in the current study using the traditional batten pot ranged from 2-23 size lobster. Seemingly volume or capacity of the pot is the major restriction where catches of this size are concerned. The addition of a parlour and two side entrances to the traditional batten pot causing a reduction in the volume and therefore ‘catching power’ of the new design pot would no doubt exacerbate this phenomena observed in A zone of the fishery.

This pilot phase trial conducted across all zones in the Western Rocklobster fishery has provided the impetus for a further season long trial to be conducted across all zones using the 48 inch lobster trap. It is anticipated that outcomes such as an accurate calibration factor and insight into the relative capture rates of icon species will be achieved. Provided the estimates associated with each of these outcomes is sufficiently precise, there may be a provision made by the Department of Fisheries WA for a small scale implementation of these trap across the entire fishery for the 2009/10 season.

The potential cost savings outlined in the cost benefit analysis through the use of the 48 inch trap range from one million (10% more efficient, 10% adoption) to eleven million dollars (30% more efficient, 50% adoption). The natural attrition rate of the fleet is estimated at 5-7% per annum and the most recent effort reductions imposed across the fishery have the potential to double this estimate. Regardless of whether the WRLF maintains an input control management regime or shifts to output controls in the future, the advent of a pot which minimises operating costs will be well received by the fishery. Another benefit this trap has the potential to provide, albeit unquantifiable is the subsequent reduction in pressure on fishing grounds as a result of less pot lifts occurring. The potential for the WRLF to reduce it's carbon footprint associated with production could only be well received by peak bodies heading towards emissions trading (EMS) in 2010.

Appendix

Pilot investigation into improved pot design for the Western Rocklobster Fishery

Discussion Paper

29/10/07

Background

The costs required to fish in the Western Rocklobster fishery increase each season. Some of these are a result of the competitive nature of this fishery, which has seen the acquisition of bigger boats and more efficient fishing aids such as radar, differential GPS and ocean mapping technologies. The economic impact of these increases has generally been offset by increased catch rates through the improved fishing efficiency generated by these technologies. More recently, however, some of the basic input costs for this industry have increased to levels that have started to severely impact on their profitability.

Since 1991/92 the cost of popular baits in the industry such Australian and New Zealand salmon and imported mackerels have increased by ~ 25%, while the costs of materials such as pots, ropes and floats have increased by ~ 20%. These increases, although substantial, have been minor when compared to that which has occurred in the price of diesel - a 135% increase over the same period (most occurring in the last five years). Labour costs, although more difficult to quantify, have anecdotally also risen at a far greater rate than CPI, due primarily to the attractive pay packets and conditions offered by the mining industry. These increased input costs have certainly not been balanced out by a corresponding increase in the price of lobsters. The beach price, i.e. that received by the fishermen per kg, has varied over the past 15 years, from $19.00 to $33.75, as supply and demand has changed with lobster abundance and variations in the exchange rate. However the overall trend in the beach price since 1991/92 has been an annual decline of $0.10 per kg lobster. Given the current cost-price squeeze, the WA FRAB and the WRL Industry have highlighted business improvement/cost competitiveness within the fishing industry as a priority for research. 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 total cost of ~$60 million (average cost per potlift - $6.00). This is one area where input costs may be reduced.

The fishery currently has strict controls on the pot characteristics to maintain equity among participants and to ensure exploitation rates remain constant. By improving the catching efficiency of the pots the same annual landings could be achieved with a far lower number of pot lifts. For example, an increase in the fishing efficiency of a lobster pot by 10-20% would reduce pot lifts by 10-20% and return to the industry a minimum cost saving in excess of $3-6 million annually. An industry based working group will aim to develop more efficient pots which will provide additional cost savings in fuel and bait usage.

The decision to use more efficient pots could be undertaken at an individual fisher level, but this requires robust conversion rates for any modified design(s) to ensure that the integrity of the fishery's input based management system is not compromised

In addition to this economic pressure, it is envisaged both the sustainable use of fish bait species and reduction of transport related carbon emissions associated with diesel fuel will be subject to further scrutiny if this fishery is to continue its Marine Stewardship Council (MSC) ecological certification and its licence from the Department of the Environment and Heritage to export lobsters.

The use of more efficient lobster pots has the potential to alleviate many of these concerns. This option was identified and highly ranked in a recently completed bioeconomic assessment of this fishery (DoF, 2006). Using more efficient pots would allow the WRL fishery to achieve the same catch with a far reduced number of pots being used per boat. Each boat fishing with a smaller number of more efficient pots yet still producing the same catch would receive a direct decrease in costs associated with fuel, bait, pots, floats and ropes and a reduction in the chance of icon species becoming entangled with their gear.

If alternative pot designs were identified and approved for use, the decision to use more efficient lobster pots could still remain with each individual fisher, with the number of more efficient pots used being based on their current pot entitlement and suitable conversion factors developed during this project. As the current WRL management plan already contains the provision to determine the number of pots that can be used in a season based on total pot entitlements, it would not be difficult to adjust this system to enable annual usage rates to be varied based on a set of approved pot designs and conversion ratios.

Literature Review

Catchability of crustaceans in trap fisheries is influenced by a suite of factors namely physiological (Morgan 1979; Tremblay *et al.* 2006), behavioural and environmental (Miller 1990), variations in gear design and selectivity (Morgan 1979; Krouse 1989; Addison & Lovewell 1991) and of course increases in fishing efficiency (Caputi *et al.* 2000; Wright *et al.* 2006). As a result, numbers of animals and their size distribution retained in individual traps represent the size-specific catchability of the trap and provide no insight into the true abundance and distribution on the sea bed especially where abundances are high (Schoeman *et al*. 2002). When deciding on the design specifications of a more efficient pot for catching legal sized Western Rocklobster, *Panulirus cygnus*, these factors must be taken into account.

Despite most commercial fisheries having legal minimum length regulations, many undersize lobsters are caught and upon release are prone to exposure and injury leading to decreased growth rates and lower yields to the fishery (Brown & Caputi 1986) due to reduced fecundity (Lyons 1986). The importance of measures to prevent undersize lobsters from being trapped is further highlighted in Morgans's (1974) study of *Panulirus cygnus* which found that lobsters that had been caught using baited traps were more vulnerable to recapture. Optimal escape gap sizes have been derived for the Western Rocklobster fishery and various related fisheries using a size-selectivity curve (Brown & Caputi 1986; Treble *et al.* 1998; Groeneveld *et al.* 2005).

In addition to the use of escape gaps, numerous variables have been found to influence the ratio of size to undersize decapods in traps. Intra-specific behavioural interactions and the design of traps often result in increased catchability of larger animals (Richards *et al.* 1983; Miller 1990; Addison 1995; Frusher & Hoenig 2001; Green 2002). The extent to which aggressive encounters take place outside traps between large and small panulirids which deter smaller animals from entering traps has not been documented but is certainly the case with less gregarious relatives (Miller 1990). Seasonal variations in size-specific catchability have also been reported (Smith 1944; Tremblay & Smith 2001; Ihde *et al.* 2006), with moulting and mating periods found to have a neutralising effect on increasing catchability with size (Miller 1990; Ziegler *et al.* 2002). These phenomena ultimately result in increased catchability of small lobsters (both rock and clawed) throughout the fishing season as the larger, more trappable animals become depleted (Addison 1995; Miller 1990; Frusher & Hoenig 2001; Ziegler *et al.* 2002).

Furthermore several factors that may influences catches include trap shape and size; trap mesh size; bait type, competition between traps, and the soaktime of traps. Trap size can affect catch rates by influencing the density of animals in the trap (Miller 1978; Sheaves 1995). Furthermore, traps must be of sufficient size to be successfully deployed on desirable ground while also being easy to handle. A trap which allows the target animals easy access, but prevents escape i.e. parlour pots, are also desirable attributes. Entrances can vary according to number, shape, size and location (Miller 1990).

The shape of a particular trap has been found to be a significant factor with beehive traps (top entrances) catching fewer lobsters than either D-shaped (top entrance) or rectangular traps (side entrances) (Miller 1980). Rectangular traps reportedly trap larger sized lobsters although confounding design prevented determining whether this was due to the position of the entrance, the number of entrances or trap shape. A similar study found that if a trap was set at simulated random orientation to the current, three entrances provided better capture success than two entrances with maximum distance of the bait off the bottom also found to be critical (Miller 1980). While the same study found that when a side entry trap was set parallel to the current, a 65% success rate was reported in comparison to 7% when the entrance was set perpendicular to the current.

The mesh size used in traps is yet another variable which has the potential to significantly affect catch rates and size composition of the catch with larger mesh or more escape gaps reportedly corresponding to increased catch rates of larger animals due to decreased retention of smaller animals (Miller 1990; Treble *et al.* 1998; Schoeman *et al*. 2002).

The relationship between catch and soaktime for traps is curvilinear where the numbers of individuals caught in a trap increases with soak-time to a maximum, and an after extended period, numbers will either remain around the maximum or decline (Austin 1977; Miller 1979; Sheaves 1995). This theoretical maximum is reportedly overcome with either increasing the trap size, increasing bait quantity or preventing escapement (Miller 1980). A recent study on the effects of these factors on catches of *Jasus verreauxi* in inshore grounds found neither soak time or bait type to be significant factors (Montgomery 2005). Traps were found to become saturated after a period of one to two days. Similarly, a simulation model used to examine the effects of trap saturation on the catch predicted an asymptotic relationship with a decline in the variance:mean ratio of catch numbers per trap with density (Addison & Bell 1997).

The use of parlour pots to trap homarid lobster, *Homarus americanus* and *Homarus gammarus* has proven to be particularly effective (Lovewell 1979; Lovewell *et al.* 1988) allowing traps to be set for longer periods without a reduction in catch. The incorporation of an inner chamber or parlour containing bait with a non-return entrance increases the retention capability of a pot and is recognised as the most significant modification to trap design in recent years (Caddy 1988; Jennings *et al.* 2001). The Maine lobster fishery reportedly incorporate a second parlour into traps usually arranged in series, or at opposite ends of a trap (Caddy 1988). The extent to which these pots adversely affect stock abundance in the order of 12-25% as a result of ghost fishing has been discussed (Smolowitz 1978; Bullimore *et al.* 2001; Masroori *et al.* 2004) and as a result pots used in North America are now fitted with bio-degradable escape panels (Jennings *et al.* 2001; Kaiser *et al.* 1996).

It is widely accepted that the recent decline in the biomass of legal-sized animals combined with high exploitation rates in the Tasmanian rocklobster fishery has resulted in substantial changes to the size structure of the population with the bulk of the legal-sized biomass being recently recruited lobsters (Frusher *et al.* 1998; Frusher & Hoenig 2001). Similar findings have been reported in other commercial fisheries with exploitable stock representing a mere 6% of the total biomass in the South

African Lobster fishery *Jasus lalandii* (Johnston 1998). The Western Rocklobster fishery is experiencing record high exploitation or harvest rates as a result of untamed cumulative efficiency increases in the order of 3-6% per year (Wright *et al*. 2006) since the 1993/4 nominal effort reductions. The residual biomass of exploitable stock is therefore recognised as being far from 'ideal'. A pot which traps legal size animals more effectively without inadvertently reducing the residual biomass for future seasons due to unnecessary exposure would enhance the sustainability of the Western Rocklobster fishery from a biological and economic standpoint.

Minutes of steering committee meeting

Present: Paul pot manufacturer from Crackpots Inc. (P?)
Dr Simon de Lestang Dept. of Fisheries WA (co-investigator) (SDL)
Professor Bruce Phillips (BP)
Kevin Donohue RLIAC Executive Officer (KD)
Bruce Cockman professional B zone fisher (BC)
Andrew Winzer WRLC (AW)
Alice Hurlbatt WRLC Executive Officer (AH)

Apologies: Rhys Brown Dept. of Fisheries WA (RB)
Niel Dorrington professional C zone fisher (ND)
Terry Lisserman professional A zone fisher (TL)

The pilot trial will now be conducted predominantly during the reds of the 2007/8 season as a result of time constraints (AW).

As discussed in the literature review, the pilot trial aims to design a pot which retains predominantly legal sized animals and allows sub-legal sized animals to escape thereby reducing the effects of exposure (AW)

The committee agreed that due to the differences in catch rates across a season, more efficient pots should be designed to cater for both the whites and reds stage of the season (RB).

The committee agreed that no more than two pot designs should be trialled for each stage of the season mainly for compliance purposes.

It was first agreed that increasing the dimensions of almost any pot would increase it's potential to trap greater numbers of lobster. Trap size was therefore recognised as a potential confounding factor and it was decided to trial new, innovative design pots which are of identical dimensions to the existing batten pot used in the fishery. Modifications to trap size would be a factor to be considered further in the extended season long trials.
Professor Bruce Phillips reminded the steering committee that parlour pots were used in sampling studies conducted by CSIRO in the 60's and found to be very efficient. These pots are currently used in various homarid fisheries around the world. The parlour pots used in the Baja fishery, *Panulirus interuptus* are constructed using plastic coated wire mesh and have one side entrance, one bottom entrance and one parlour. Variations to this design for the pilot phase trials may include wooden slats as opposed to wire mesh, larger escape gaps and more of them and a bait bag hanging adjacent to the entrance i.e. in the middle of the kitchen.

Simon de Lestang agreed saying parlour pots are ideally suited to extended soaks and periods of low lobster abundance (the majority of the REDS).

The size and number of entrances was another point of contention. It was decided to limit the number of confounding factors and stay with one or two side entrances while the neck size would be in the order of 3-4 inches in a bid to target more legal sized animals (76mm-105mm CL). The number of entrances was a factor which could be tested further in the season long trials.

The arrangement of the necks was discussed further: the possible inclusion of finger necks, cod triggers/fingers to prevent escapees (banned by RLIAC), large finger necks for WHITES, red plastic necks for REDS. These finer variations could also be tested in the season long trial.

Simon de Lestang discussed the advantages associated with video trials replicated over time to avoid trapping and sampling bias, such as the high variability in animals which are attracted to pots and those which actually enter the trap. Bruce Phillips reminded the committee of the danger associated with having individual replicates and felt that as long as the outcomes of the power analysis were adhered to the outcomes of the pilot phase trial would be satisfactory. It was also suggested that video trials would be more beneficial in determining the effect of fine scale variations to pot design in the extended season long trials.

An additional pot design which the steering committee were interested in trialling was the traditional pot used in the fishery with two side entrances. Pending the degree of success, position of the bait possibly in a bag could be incorporated into the season long trial. Bruce Cockman raised the possibility of a traditional pot with a parlour which would prevent escapement although this would prevent any clear conclusions from being drawn as to the effect of a side entrance as opposed to the traditional entrance. Simon de Lestang recommended the neck be moved to the end of the traditional batten pot to accommodate a parlour for the pilot trial.

Simon de Lestang reminded the steering committee of the success he had in previous pot design trials using crab traps (hour glass shape fish very well).

Kevin Donohue reminded the steering committee that the dimensions or size of any design pot would have also have to satisfy occupational health and safety regulations.

Kevin Donohue and Simon de Lestang raised the discussion regarding observers for the pilot phase trials. Both volunteers and casual paid observers would be required throughout these trials if any meaningful outcomes were to be drawn. The project budget does accommodate casual paid observers and also relies on volunteers being sought from university work experience programs. Further statistical analysis would be conducted to ensure data recorded by fishers was not significantly different from data recorded by observers. The potential for this to occur is also minimised as a result of participants in the pilot phase trial being volunteers in previous fisheries and FRDC experiments.

Outcomes

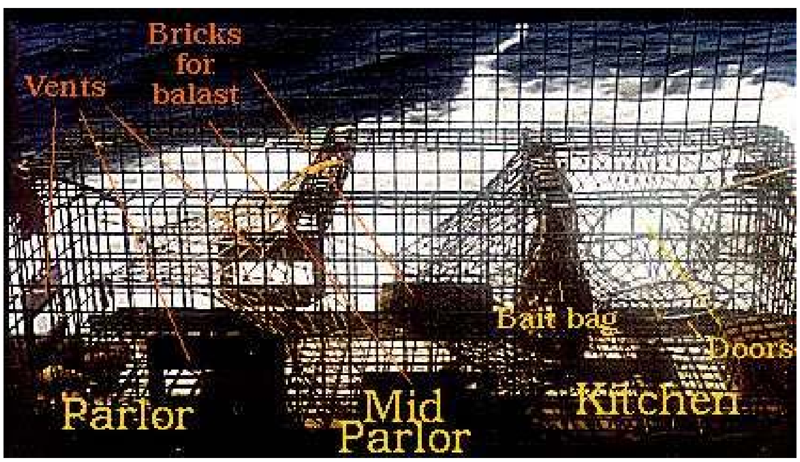
Pictures of parlour pot used in Baja fishery will be sought from Bruce Phillips (see below).

Next meeting date late November possibly without fishers whose input will be sought over email and/or phone.

Refinements to the two blue print designs will take place prior to the next steering committee meeting and finalised at the meeting.

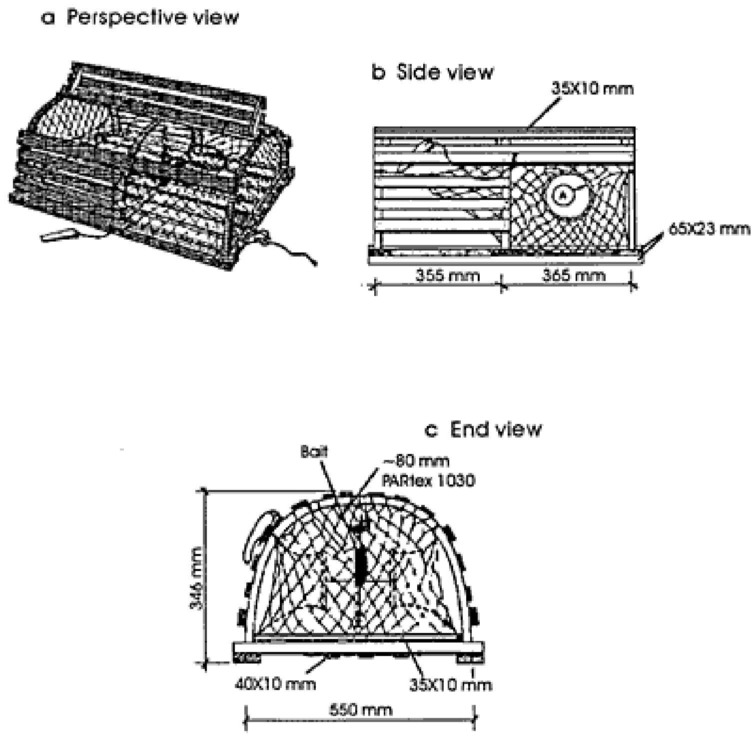
(1) Traditional batten pot with neck moved to end to accommodate a parlour
(2) Traditional batten pot with two side entrances with a parlour

VARIOUS PARLOUR POT DESIGNS

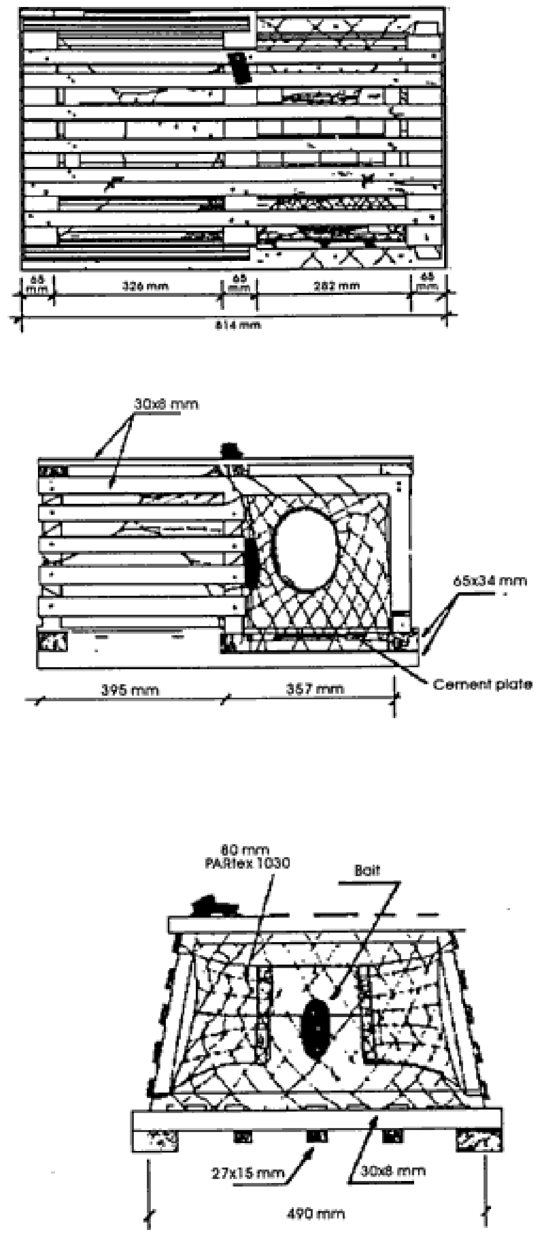


Quonsett huts (D shape) used in Maine fishery

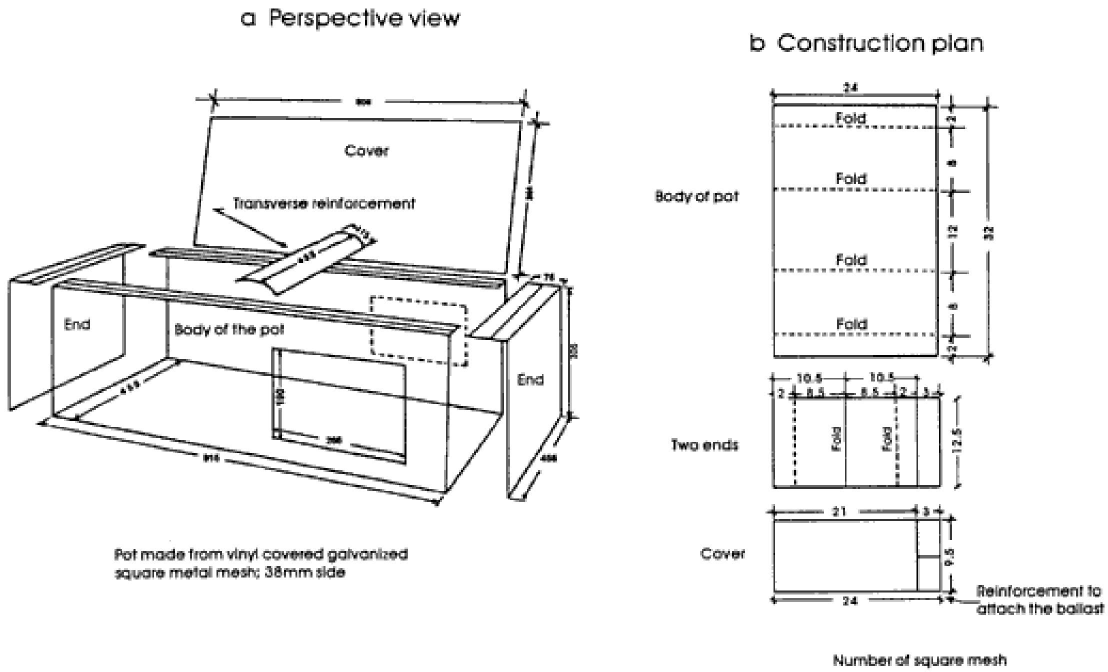
Lobster creels (United Kingdom)



Lobster pot (east coast of Canada)



Canadian plastic-covered metal lobster pot



Canadian plastic-covered metal lobster pot

Parlour pots used in Baja fishery

Parlour pots used in Baja fishery

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