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DISTRIBUTIVE JUSTICE IN ALLOCATING INDIVIDUAL CATCH QUOTA IN A FISHERY

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ABSTRACT

On 1 October 1993, the southern zone of the South Australian rock lobster fishery introduced a management scheme based on Individual Transferable catch Quotas (ITQ). This marked a departure from the input controls, which have operated in the fishery since 1968, based principally on limiting the number of tradeable licenses and lobster pots in the industry. ITQs involves the allocation of shares or specific quantities of the total allowable catch to individual fishing operators. The basis of allocation has been a contentious issue and is having a significant impact on the level of acceptance of ITQs as a management tool.

This paper describes the allocation method adopted by the Management Committee and addresses the concept of distributive justice relating to the equitable and fair allocation of individual quotas in the rock lobster fishery. It compares it with other alternative allocation methods, and provides a means of understanding, evaluating and responding to claims of distributive injustice.

1. INTRODUCTION

The common property nature of an unmanaged fishery means that no individual has exclusive rights over the resource, or any part of it. Without any central management arrangements and restrictions on individual fishing effort, each fishing operator will have an incentive to harvest as much of the resource as possible. What they don't take, someone else will. Without proper regulation, over exploitation of the fish stock and inefficient use of labour and capital will occur. This phenomenon is often referred to as the 'tragedy of the commons'.

Management is an attempt to remove the various elements of the common property problem so that there is more control over the exploitation of the fish stocks and the long-run viability of the fishery. Management refers to the regulatory arrangements which are imposed to control who is allowed to fish, and how, where, when and what they can fish. The basis of this regulation is the creation, allocation and application of access rights, or fishing privileges, among competing interests. With new, or changing management arrangements not all competing interests can have what they feel entitled to or want, and claims of unjust allocation and issues of fairness and justice will be raised.

Removing excess fishing capacity has traditionally been the essential and central component of management. Fishing effort refers to the factors or components of fishing that are applied to the stock of fish. It is a measure of the number of boats, number and dimension of traps (nets, pots, cages), catching power and spatial distribution, time spent fishing, skill of the crew and technology applied to fishing. A major problem with attempting to regulate a component of effort is that often effort can be maintained through an increase in another component. This type of management inevitably results in economic distortions which lead to further increases in fishing capacity and hence tends to render control of the fishery progressively more difficult. This style of fisheries management has been described by Clarke (1985) as 'regulation by maximisation of inefficiency'.

It is becoming increasingly recognised that what is required in management is a refinement in the allocation of basic access rights to the fish resources with some method of attaching more exclusive private rights to the resource itself. One method which does this (other than sole private ownership) is the allocation of individual transferable catch quotas, commonly referred to as ITQs. An ITQ is a legally defensible right to catch, land and market a quantity of fish over a certain period of time, held by an individual or firm and is tradeable in asset markets.

It is expected that an ITQ management scheme will shift the need for adjustment of effort from the hands of the managers to the control of fishers themselves. As long as fish stocks are abundant enough to ensure that each quota can be filled, each operator has no reason to put in excessive amounts of effort into fishing. As a consequence, fishers will become more focussed on the opportunities to improve the efficiency of their operations, and the value of the fish that they harvest. The idea of placing a limit on the total catch from the fishery and then allocating a proportion of the total catch to each fishing operator so that they each have an exclusive right over their share is appealing in theory. It is a concept that is increasingly being used in commercial fishery regulation and has been introduced into the South Australian Southern Zone rock lobster fishery.

2. BACKGROUND

The southern rock lobster (*Jasus edwardsii*) inhabits reef areas ranging from south-western Western Australia across southern Australia and New South Wales, to the coastal waters around

New Zealand. It is the basis of one of Australia's largest fisheries. It is currently South Australia's most valuable fishery with a four year average production, to 1992/93, of 2792 tonnes worth around \$55 million.

The southern rock lobster has been trapped in South Australian waters since the 1880s but the fishery did not develop fully until the late 1940s and the early 1950s when the overseas market in frozen tails was established (Copes 1978). A period of rapid expansion followed with large increases in fishing effort and total catch. Effort in the rock lobster fishery is counted as 'potlifts', that is, the total number of times all pots are pulled in a season. Between 1959 to 1966 the number of potlifts increased from 388,000 to 3,152,000 in South Australian waters. Although the total catch of rock lobster increased, the catch rate (kilograms of lobster in every pot lift) steadily declined. This period also saw increases in vessel efficiency and rapidly advancing technology and high capital investment in fishing power (Lewis 1981). Concern by Government and industry at these trends led to the introduction, in February 1968, of licence and pot limitation (with restrictions on pot design) as primary means of halting further increases in effort. Restrictions on the capture of spawning females and undersized lobster are further measures that protect the fish resource. Effort reductions have since been effected predominantly through pot reductions, a licence buy-back scheme, and seasonal closures. Fishing licenses and pot entitlements are transferable, however, minimum and maximum pot numbers per licence apply.

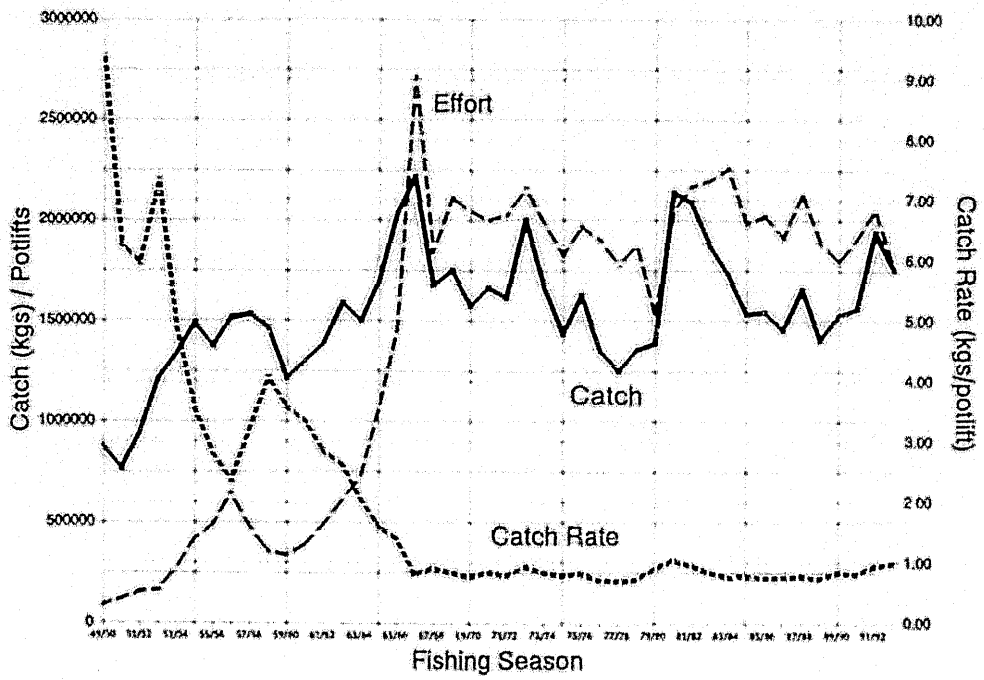
A total of 11,923 pot entitlements are endorsed on 190 fishing licenses. There has been up to 2,200 tonnes of rock lobster captured in a season between October and April. The Southern Zone has suffered the typical regulation/ adjustment pattern that is usually experienced in a fishery managed by input controls. The continual adoption of new technology in vessel and gear design, navigational and fish locating systems enabled fishing operators to increase fishing effort and improve the effectiveness of catching lobster. Continual adjustment of input controls were necessary in an attempt to control effort at required levels to maintain total catch within biologically acceptable limits.

Figure 1 shows the historic reportings of catch, effort and consequential implied catch rate in the Southern Zone. The rapid expansion of the fishery and the effort applied in harvesting rock lobster from the 1950s to the mid-1960s is clearly evident. Since management was introduced in 1968 effort has been controlled to some degree and it is clear that catch rates have been relatively stable. A yield curve, derived by Copes (1978) and updated by Prescott and Lewis (1992) using the surplus production modelling method, suggests that rock lobster stocks tend to be non self-regulating. That is, the stock is not easily depleted and tend to give continuously large yields even under high levels of exploitation. The fear is, however, that there will be some threshold level of parental stock depletion that will interfere with recruitment and lead to a sudden collapse in fish stocks.

In a report prepared for all rock lobster licence holders in South Australia, Prescott and Lewis (1992) presented a summary of all available information and an assessment of the South Australian rock lobster fishery. Their assessment of the Southern Zone was clear in its conclusions that the fishery is over-exploited and faces a high risk of recruitment failure.

Prescott and Lewis strongly recommended, as a matter of immediate biological necessity, that management measures be put in place to ensure that annual catch does not exceed sustainable yield, estimated to be 1600 tonnes. The Southern Zone Integrated Management Committee (IMC), the body responsible for the management of the fishery, accepted the recommendation of the report. Prior to the opening of the 1992/93 Southern Zone season, a total allowable

Figure 1
 Catch and effort data for the Southern Zone rock lobster fishery, 1949-93



catch (TAC) of 1650 tonnes was set. This created a competitive, or 'olympic' catch quota. On 4 March 1993 the Minister of Primary Industries implemented an early closure of the Southern Zone Fishery as the quota had been achieved. The closure took effect on midnight 31 March 1993, one month earlier than the normal end of season.

The IMC reviewed the catch quota scheme and implemented an ITQ scheme for the 1993/94 fishing season with a new TAC of 1700 tonnes.

3. THE ISSUES

The success, or otherwise, of an ITQ management system depends on the biological, economic, social and political circumstances of the fishery to which it is being employed. There can be many problems associated with the formulation, implementation and operation of a new scheme which is fundamentally different to an existing scheme and where there are characteristics of the fishery and fishing operators which require regulatory arrangements that may compromise the benefits of an ITQ scheme.

The level of acceptance and support among fishing operators in the fishery is critical for ITQs to be an effective and appropriate management tool. Fishery management is only as good as the extent to which fishing operators comply with the regulations that are put in place. The nature and characteristics of the Southern Zone fishery and the problems associated with enforcing regulatory arrangements makes an ITQ management scheme in the Southern Zone very susceptible to cheating and consequent failure if it does not receive substantial support and commitment from within the fishery. The high value/low volume aspects of the fish, together with numerous landing points, the easy interaction with pleasure craft and other vessels at sea, and a keen consumer demand for a very saleable product are seen as being major weaknesses in implementing and enforcing an individual transferable catch quota scheme in the Southern Zone.

If the allocation of quota is not accepted and supported by the licence holders, and is seen to be inequitable and unfair, then their compliance to the ITQ management arrangements is likely to be low. The 25 years of management based on transferable pot entitlements together with a large variation in fishing skills and investments provided an intractable problem in determining individual catch quotas on a fair and equitable basis.

The licence holders in the Southern Zone rock lobster fishery have well established shares in tradeable pot entitlements and established catch histories. Two factions within the fishery emerged over the issue of quota allocation. One side advocated the distribution of quotas on the basis of established shares in pots, while the other side supported distribution according to established shares in catch histories.

This issue created distress and dissension among the fishers, and the IMC found it a difficult process to achieve an acceptable method of allocation that was seen to be just and fair to all participants. The question of fairness and justice, however, goes beyond the initial allocation of individual catch quotas. It encompasses the ownership and trading arrangement of quotas, as well as other restrictions that may be imposed on some and not on others, whether by design or by default.

4. THE CONCEPT OF DISTRIBUTIVE JUSTICE

Distributive justice in the allocation of individual catch quotas is about determining individual shares in the TAC that is fair to all participants and reflects the established 'rights' of each individual to the fish resource. According to Loomis and Ditton (1993), there are two major conceptual approaches in the allocation of fishery resources among competing interests: equity theory and relative deprivation.

In a society where economic values pervade all aspects of social life, equity is often the central principle of distributive justice. This relates to the belief that rewards should be distributed according to the proportion of contributions (Deutsch 1985). That is, people who contribute more should get proportionately more than those who contribute less. A person would expect their ratio of outcomes to inputs to be equal to the ratio of another person's outcome to inputs. Inequality or injustice occurs when the ratios are unequal, and the person with the lower ratio perceives the relationship to be inequitable. However, although people may agree on the principle of proportionality they may still disagree as to whether the distribution of rewards is just in particular circumstances. They may have differing views as to what kinds of rewards, contributions and investments are to be considered relevant in applying the rule, or how they are assessed.

Deutsch (1985) expanded the perspective of equity theory to include psychological, physiological and social values. The essential values of justice are those values that foster effective social cooperation to promote individual well-being, and include the values of equality and need. When both social and economic factors are considered together the evaluation of allocation decisions become complex and personal. The concept of relative deprivation also needs to be understood. Central to this is the idea that simply lacking in some desired good or opportunity does not itself lead to feelings of resentment, dissatisfaction or anger. However, when deprived persons compare themselves with non-deprived persons, the result is relative deprivation (Loomis and Ditton 1993). In other words, equity is only one of several decision rules upon which evaluation of justice and fairness can be made.

As Deutsch (1985) discusses, there are three values which can be used as a basis for distributing outcomes (conditions or rewards) among a group or community. Where economic productivity is a primary goal, equity becomes the dominant principle of distributive justice. If the fostering and maintenance of enjoyable social relations is the common goal, equality will be the dominant principle, and in circumstances where the common goal is the fostering of personal development and welfare, then need is the value base of distribution.

Equality refers to treating people identically, without regard to circumstance. It signifies that different participants are of equal value and worth in a relationship, and mutual esteem and solidarity is a necessary condition for its survival. With regard to the allocation of catch quotas in a fishery, it means that each individual would get the same quota as all others, and that there is no discrimination made between one fisher and another. An application of this method of allocation is in the South Australian Abalone fishery (Muse and Schelle 1989) where the annual TAC is divided equally to each of the licensed abalone divers.

Distribution on the basis of need has, as its premise, the concerns of individuals of a group for the development and welfare of all members. The duty to help those who are less fortunate, and to provide them with a greater share of resources so that they may also participate in the activities of the group as a competent member is, as Deutsch (1985) discusses, fundamental in a fostering and caring oriented group that relies on the progress of all its members for survival.

Distribution on the basis of equity, in contrast, has as its premise, competition for scarce resources and the maximisation of production. Deutsch (1985) explains it thus:

Assigning scarce resources of production to those most able to use them is likely to result in the largest production and is socially equitable in the sense that those who receive the largest input of resources from a cooperative system should be the ones who produce the largest amount for that system.

The Southern Zone rock lobster fishing operators have always operated in a competitive, rather than a solidarity or care oriented environment. This is not to say that certain social values are unimportant, or that licence operators have total disregard for others in their fishery. Maintenance of a viable community oriented fishery and opportunities for local employment and ownership of commercial fishing operations are frequently expressed desires of fisheries management. It is important that the process of industry adjustment be allowed to occur efficiently and effectively and that new entrants be encouraged along with allowing those to retire from the fishery to do so with dignity and value. Similarly, the opportunities for individual growth should be available equitably to all licence holders in the fishery.

Economic productivity, however, is the primary goal of each individual and of the fishery in total. Equity, rather than equality or need, as discussed above, appears to be the dominant principle of distributive justice in the allocation of the total allowable catch.

5. THE BASIS OF EQUITABLE DISTRIBUTION

Recognising that proportionality is the principle by which the individual catch quotas should be determined, there remained the dilemma of which factor of fishing right was appropriate for a fair and just allocation: the number of pot entitlements or; the quantity of lobster captured.

Shares in pot entitlements

The number of pots is just one factor of the inputs of fishing. The inputs to fishing activities have been the capital invested in vessels, fish location equipment, pots and associated hauling equipment, labour, and the variable costs of fishing. Other than a maximum limit on fishing days in a season, and number of pot entitlements that are available in the fishery and that each individual licence holder can possess, all other inputs are unrestricted in terms of what each fisher can utilise. Pots, and the licence to fish the resource, are tradeable items and have been recognised as the legal basis of a licensed fisher's entitlements to the lobster resource.

All fishing entitlements (pots) currently held in the fishery could be bought or sold at a value determined by the market forces. The income earning potential of the pots for the purchaser was a significant determinant of pot values. However, other factors such as future shifts in management policies, inflation, credit constraints and investment desires all influence the price licence holders were prepared to pay to transfer pots (Staniford 1993). It reflects the expected long-term profit, including capital gains, which may have been derived from owning and using a pot.

Management surcharges and levies have, in the past, been charged on a 'by pot' basis despite the recognition that this was inequitable due to the variance of catch rates. Each pot entitlement, however, had the same rights attached with respect to catching lobster and therefore had the same investment value. The IMC recognised the importance of maintaining equity with respect to the number of pot entitlements that each licence operator had invested in

Shares in total catch

The contribution of each operator in the fishery is also reflected in the quantity of catch that each is able to harvest. The catch levels of each fisher is an indication of the investments made in pots, vessel and equipment, labour (including operator's own time), fishing areas and fishing skills. Individuals have, over time, physically and financially geared their fishing operations to achieve a certain level of catch. The expectation of maintaining a certain level of catch every year is particularly important to an operator that is financially geared to that level of catch. Whether they were recent entrants to the fishery, having had to meet the market price for pot entitlements, or an established operator who had upgraded on vessel and equipment, it appeared only fair and just that they were not discriminated against.

Some consideration, however, had to be given to those who may have speculated on the influence on changing management policies. As Staniford (1993) hypothesised, some of the more recent trading of pots and increases in the value of pots in the Southern Zone may have been influenced by the impending quota management scheme and the expectation that relative pot share was to be a determinant in the allocation of individual catch quota. This could also have influenced the behaviour of fishers in increasing fishing effort and over-reporting catch levels to secure a greater share of the total catch on the expectation that relative catch share was to be a determinant in the allocation of quota.

Just as it was important to maintain equity with respect to the number of pot entitlements, it was also important to maintain equity with respect to individual fisher's level of catch. Thus the proportionality rule should reflect each fisher's relative share in the total number of pot entitlements in the fishery as well as the total catch of lobster from the fishery.

6. DETERMINATION OF RELATIVE SHARES

Determining relative shares of pots and catch becomes an issue given the number of pots that had been traded over time and the variation in each fisher's annual catches each season and given that all fishing operators were aware of the possibility of a quota-based management scheme back in 1991. At what point in time should the number of pots that each licence holder be used as the basis for determining their share of total pots in the fishery, and what fishing season or seasons should be used to determine each fisher's relative share of total catch of the fishery?

It was decided, by the IMC, that the relative share of pots was to be determined by the number endorsed on each fishing licence at the 1 October 1993 (the start of the 1993/94 fishing season). So, for example, a licence holder with 40 pots had a relative share of $40 \div 11,923 = 0.335\%$ of total pot endorsements. The calculation of the relative share of the historic catch was more complex and took into consideration notification made by the Director of Fisheries in a letter written in June 1991 to all licence holders in the Southern Zone of the possible introduction of a quota-based system of management. As discussed earlier, this could have influenced the behaviour of fishers in increasing fishing effort and over-reporting catch levels to secure a greater share of the total catch on the expectation that relative catch share was to be a determinant in the allocation of quota. It was decided by the IMC that individual's catch records for the three fishing seasons 1988/89 to 1990/91 were to be used as the basis for determining the historic catch for each licence holder.

Total catches for each season for each individual was dependent on a number of factors, including the number of pots that were used. Because of the constant trade in pots it was

necessary to calculate the average catch per pot used in each season. The catch per pot for the best two years were averaged and multiplied by the number of pots endorsed on the licence at the end of the 1990/91 fishing season. This provided the historic base catch for each licence holder fishing in the 1988-91 period.

A problem arose if a pot or a licence had been transferred since the end of the 1991 fishing season. A new entrant to the fishery would not have had an established catch history. Two options were considered: to use the catch rates of the previous holder of the licence, or; apply a standard catch rate on all pots that had been transferred. The latter was agreed upon and, based on the average annual catch per pot for the total fishery, a rate of 135 kilograms per pot was used.

The total standard catch for all pots purchased since 1991 was added to the historic base catch of the licence to calculate the base for determining the relative share that each fisher had of the total catch of the fishery.

7. THE NUMBER AND VALUE OF QUOTA UNITS

A quota unit can either be defined as an absolute value - a fixed quantity - or a relative value - a percentage of TAC. If, for reasons such as ease of conversion, a fixed quantity of catch is used where 1 unit = 100 kilograms, then for a TAC of 1700 tonnes, 17000 units will be distributed in the initial allocation. If, over time, the TAC is changed to 1400 tonnes then 3000 units will have to be withdrawn from the fishery and some equitable method of reducing the number of units is needed.

By defining the quota units as a percentage of TAC the total number of units will remain fixed with any adjustments in TAC. The value of a quota unit, in terms of allowable catch, will change and each fisher will be affected equally according to the number of units they hold. For example, if 20,000 units were initially established, then each unit will be equivalent to 1/20000th of the TAC, or 0.005%. At a TAC of 1700 tonnes each unit is worth 85 kilograms of allowable catch. If TAC is subsequently reduced to 1400 tonnes, then each unit is worth 70 kilograms. The total number of units remains constant, but the value of each unit changes. It is this definition of a quota unit this applies in the Southern Zone fishery. The number of units, however, relates to the existing number of lobster pots in the fishery.

The restrictions on the number of pots in the Southern Zone fishery and their transferability has resulted in a market for pots. Pots have been the 'currency' of fishing entitlements and have been the basis of industry levies and main focus of management for many years. There are 11,923 pots currently in the fishery and it was deemed essential that pot limits be retained and that they remain as the unit of fishing endorsement. This policy, therefore, effectively restricts the definition of a quota unit to an existing pot entitlement. The value of this unit is a fixed relative share of the TAC equivalent to -

$$1 \text{ Unit} = \left(\frac{1}{11923} \right) \times \frac{100}{1} = 0.0083871\% \text{ of TAC}$$

With the TAC established at 1700 tonnes for the 1993/94 season, each quota unit was worth a catch value of 142.58 kilograms.

Figure 2
Distribution of fishers by catch rate per pot

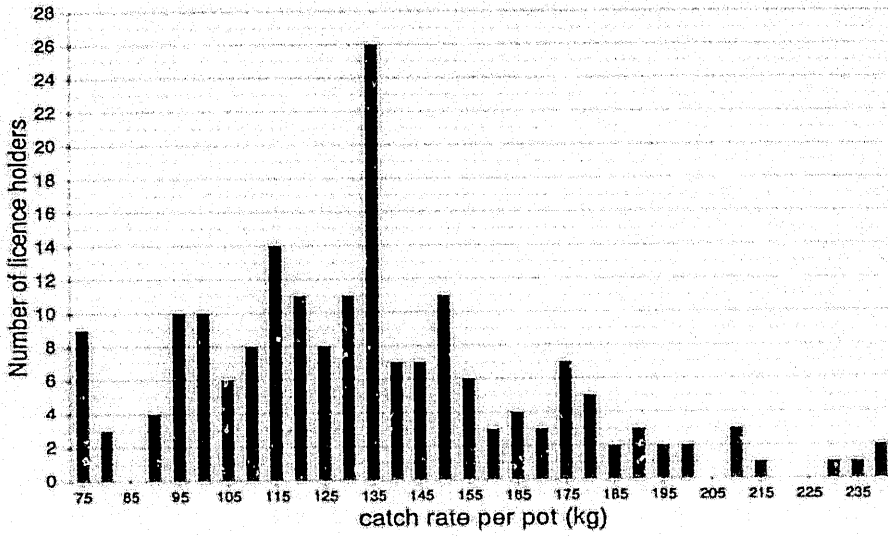
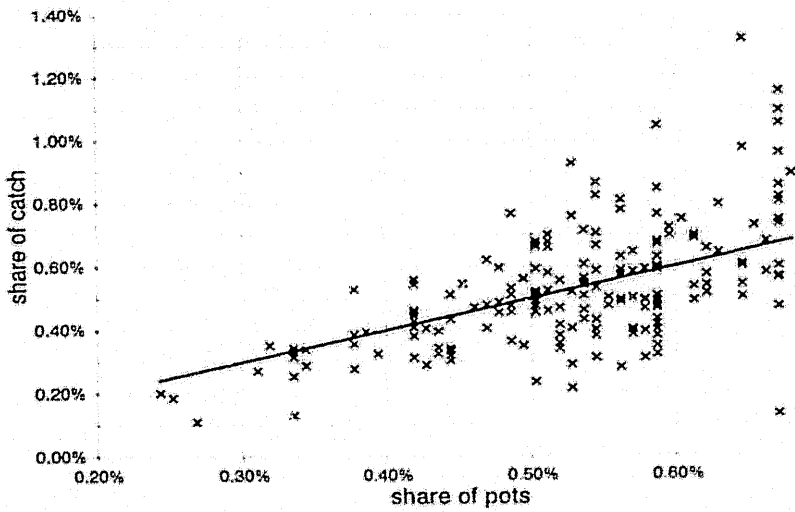


Figure 3
Relative shares of pots and historic catch



8. ALTERNATIVE ALLOCATION METHODS

The catch values of existing units of fishing entitlement (pots), based on the established catch histories of each licence holder, varied from 25 to 270 kilograms. The distribution of 'established' unit catch values prior to the allocation of quota is shown in figure 2. Similarly, for each individual fisher in the Southern Zone, the relative shares of catch and pots were not equal. This is illustrated in figure 3. If the allocation of quota were to be based on these shares then it is clear that those licence holders above the line in figure 3 would benefit if allocation of quota shares was based on catch histories, whilst those below the line would prefer an allocation based on pot numbers. Compromises had to be made by each licence holder to arrive at a solution for the total fishery. The issue of distributive justice, therefore, relates to which, and how many individuals, had to compromised what, and how much.

Four alternative allocation methods were assessed for their distributive affect. They were, allocation by:

1. relative shares in historic base catch;
2. relative shares in pots;
3. combination of relative shares; and
4. adjusted preferred relative share.

For each method the share of total units that each licence holder was allocated was compared to their share of historic catch and share of pots.

At this point, it is important to realise that what is at stake for each licence holder is the prospect of losing either some asset value of entitlement which they have as tradeable pot units, or some income earning potential reflected in the quantity of lobster that they have been capturing in the past seasons.

Allocation by relative shares in historic base catch

The formula used in determining the shares of quota units for each individual based on their historic base catch was:

$$S_i = \frac{c_i}{C_N} \times \frac{100}{1}$$

where

S_i = individual's quota shares

c_i = individual's historic base catch

C_N = total historic base catch for the fishery

This method of allocation retains each individual's established relative share of the total fishery catch. However, it re-distributes units from those fishers who have a history of low catch rates to those with high catch rates. This is illustrated in figure 4. Of the 190 fishing operators in the Southern Zone, 97 will benefit by being allocated a greater relative share in fishing units than they possess. An equivalent of 1245 units are re-distributed from 93 fishers (to the left of A in figure 4) to 97 fishers (to the right of A). Although they retain their shares in the total catch of the fishery, their shares in the capital base of the fishery has declined. The operators with low catch rates incur the burden of this method of allocation and thus it would not be favourable to them. There are fishers who lose more than one-half of their share in units, with

Figure 4
Relative gains and losses with allocation by catch share

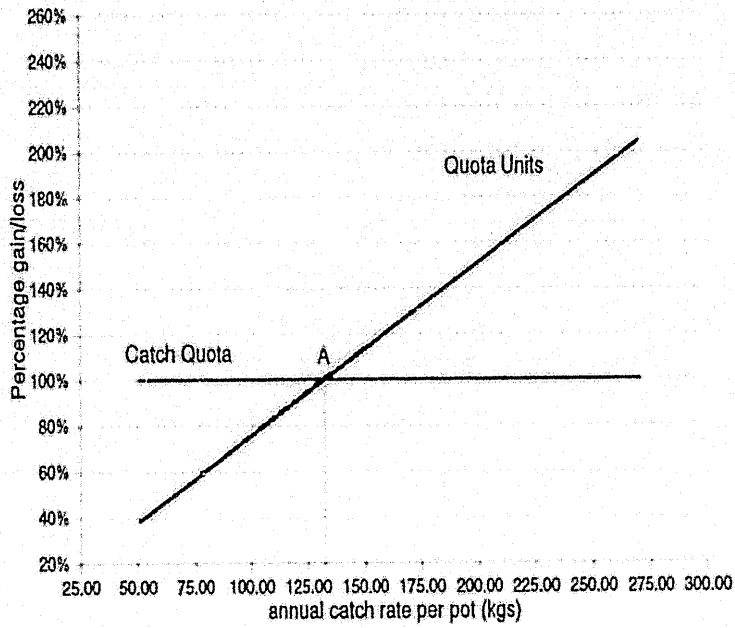
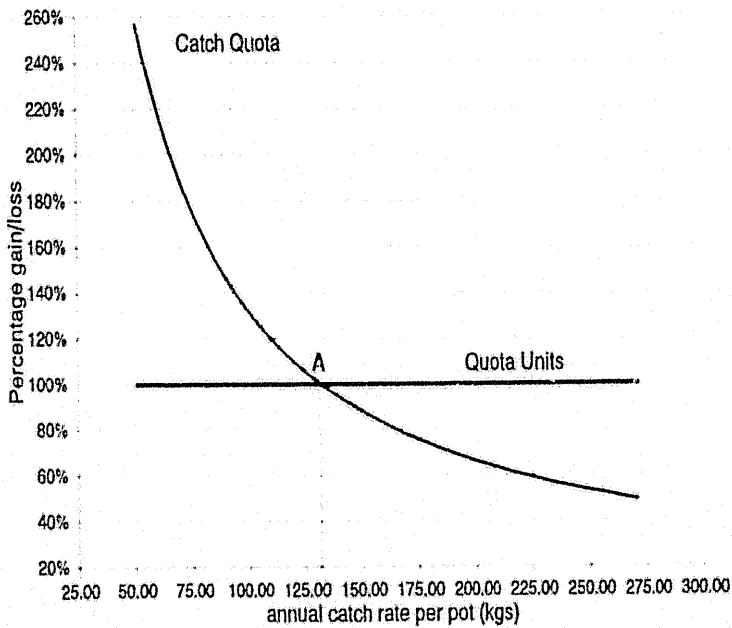


Figure 5
Relative gains and losses with allocation by pot share



others being allocated twice as much as they currently possess. This is a re-distribution of 'wealth' with no compensation, or re-distribution of income earning capacity and hence is inequitable.

Allocation by relative shares in pots

The formula for allocating quota shares according to the number of pots held by individual fishing operators was:

$$S_i = \frac{p_i}{P_N} \times \frac{100}{1}$$

where

$$p_i = \text{individual's number of pots}$$

$$P_N = \text{total number of pots}$$

Individual fishers' relative share of fishing units is not affected by this allocation method, so the relative wealth of each fisher stays the same. What is affected, however, is the income earning potential of each licence, or the individual fisher's relative share of the total catch. Fishing operators who have been achieving high catch rates per pot are severely disadvantaged and lose a significant proportion of their expected annual catch to which they have geared themselves up to achieve. The relative gains and losses are illustrated in figure 5. An equivalent of 177,534 kilograms of allowable catch (or 10.4% of TAC shares) are re-distributed from the 97 high catch fishers to the 93 low catch fishers. Again, there is no compensation for this re-allocation. Fishers at the top end of the catch rate scale, the 'highliners', lose up to one half of their established shares in total catch, while those at the lower end of the scale gain more than double their established catch share. This method of allocation, like the allocation by relative shares in historic base catch, is inequitable.

Allocation by combination of relative shares

The results of the two allocation methods described above suggest that a satisfactory compromise would be an allocation based on a combination of catch shares and pot shares.

The formula used to determine the allocation of quota shares was:

$$S_i = \left[\left(\frac{c_i}{C_N} \times \alpha \right) + \left(\frac{p_i}{P_N} \times \beta \right) \right] \times \frac{100}{1}$$

where

$$\alpha = \text{catch weighting}$$

$$\beta = \text{pot weighting}$$

This method of allocation does not preserve either the relative share of catch or fishing units for individuals, but moderates the re-distributional effects by providing compensation. For some fishers there is a compensation of shares in catch for shares in fishing units, and for others the compensation is the other way round. The rate of compensation depends on the weighting. For example, if there is equal weighting applied to catch shares and pot shares, then the re-distribution effects, as illustrated in figure 6 apply. The 93 low catch fishers lose a

Figure 6
Relative gains and losses with allocation by 50:50 pot and catch share

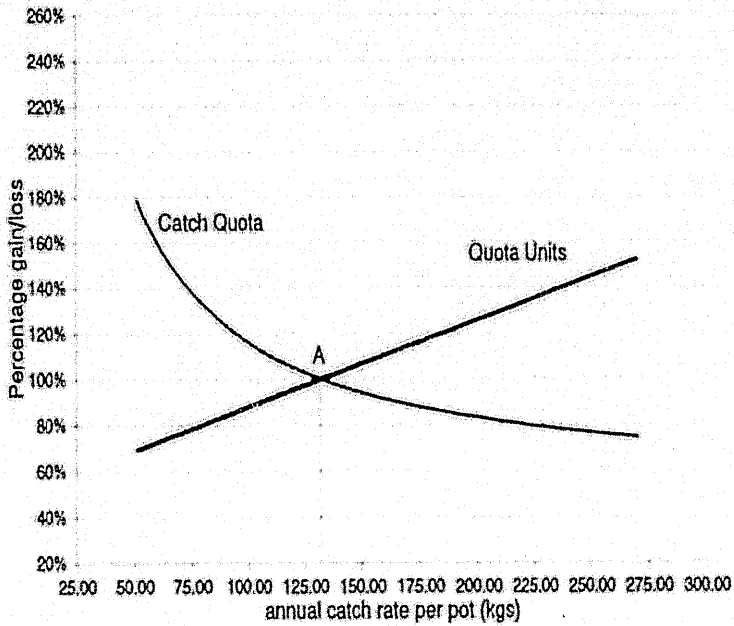
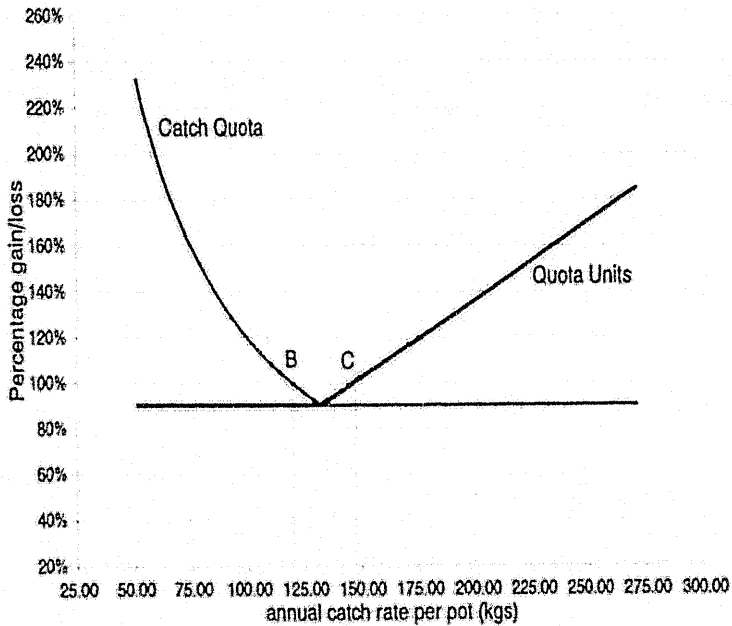


Figure 7
Relative gains and losses with allocation by adjusted preferred share



proportion of their fishing units, but are compensated by a gain in catch shares. An equivalent of 623 units are re-allocated from the low catch fishers to the high catch fishers, with a compensatory re-allocation of catch of 88,767 kilograms.

A weighted shares method of quota allocation appears to be a more equitable, and thus a more favoured alternative than the two earlier extremes. However, it is clearly evident that there will be those in the fishery who consider the income earning capacity is far more important to them than the imputed 'wealth' in fishing entitlements. Others, on the other hand, consider that their relative 'wealth' in fishing entitlements is more important to them than their shares in catch.

Allocation by adjusted preferred share

The adjusted preferred share method of allocation recognises the desire of fishers to be allocated quota units according to their greatest relative share of either pots or the historic catch. The high catch fishers would desire allocation to be based on the relative shares of catch, as they retain their catch level and are allocated a greater share in the available fishing units in the fishery. On the other hand the low catch fishers would prefer the allocation by shares in pots. They retain their unit shares and are allocated a greater share in the total catch. Clearly, every individual cannot be given their preferred share as the total of these shares will be greater than one. If an initial allocation of the 1700 tonne TAC or 11,923 entitlement units is made according to every individual's preferred share, then more than the 1700 tonnes or 11,923 units will be allocated. An adjustment would then be necessary in everybody's allocation. It would appear fairer, even though it is actually arbitrary, if the adjustment is standard for all fishers.

The formula for determining the allocation of individual quota shares by this method was:

$$S_i = \left[S_i^* \times \frac{1}{\sum S_i^*} \right] \times \frac{100}{1}$$

where

$$S_i^* = \text{individual's preferred share}$$

$$\sum S_i^* = \text{Total of preferred shares}$$

Applying this method to the Southern Zone fishery, the total of preferred shares is 1.10661. The adjustment factor is, therefore, 0.90366. This means that all licence holders are allowed 90.566% of their preferred share value. The re-distribution of catch shares and unit shares, if this method is applied, is illustrated in figure 7.

With this approach no-one gets to lose more than about 10% of either their established catch shares or their unit shares. There are 723 units re-distributed from 137 fishers, to the left of C, to 53 high catch fishers. Similarly, catch shares equivalent to 108,324 kilograms, are re-distributed from 118 fishers, to the right of B, to 72 low catch fishers. There are some fishers, however, who get less than their original shares of units or catch. There are 65 fishers between B and C in figure 7 who lose 288 units and 43,423 kilograms in total.

9. THE ALLOCATION OF TAC IN THE SOUTHERN ZONE FISHERY

The Southern Zone IMC adopted the Adjusted Preferred Shares method for determining each individual's catch quota for the 1993/94 season but not for determining the share of quota units. With pot restrictions still being enforced, and because of the long established trade in pot entitlements it was deemed essential that the pot entitlement remain as the unit of trade and that the distribution of these fishing entitlements is not affected.

The ITQ scheme is essentially on trial for the 1993/94 season, and management arrangements are to be reviewed at the close of the season. Therefore, it was considered unwise to redistribute entitlements in the fishery, or have any relaxation on pot restrictions as they currently exist if these changes were only temporary.

This allocation method, therefore, distributes an unequal quantity of catch quota per pot endorsed on each licence. In other words the quota units are not standard. The number of pot entitlements according to the amount of catch quota attached to them is illustrated in figure 8, and varies from 129 to 234 kilograms per pot. The Adjusted Preferred Shares method provides a minimum quota allocation to licence holders whose historic catch levels are low.

The minimum catch quota allocation per pot is determined by the relative share value of one pot in the fishery. One pot entitlement has the share value of 0.000083871 (ie. $1 \div 11,923$). With the total historic base catch of the fishery being 1,577,944 kilograms, for a licence holder to have an equivalent share value in their catch they would have to have an historic base catch per pot of 132.23 kilograms (ie. $0.000083871 \times 1,577,944$). Any fisher who has an historic base catch per pot less than 132.23 kilograms would be allocated a catch quota according to their shares of pots, while those who have achieved a higher catch rate will be allocated on the basis of their share of total catch.

The minimum catch quota allocation per pot would be:

$$\begin{aligned} & [\text{share value of a pot}] \times [\text{TAC}] \times [\text{adjustment factor}] \\ & = 0.000083871 \times 1,700,000 \times 0.90366 \\ & = 128.74 \text{ kilograms} \end{aligned}$$

Accordingly, the adjustment factor reflects the proportion of the TAC that is allocated equally to every pot in the fishery, with the remainder being allocated to the high catch fishers on a proportional basis. In other words, the Adjusted Preferred Shares method of allocating catch quotas is equivalent to a method that allocates 90.37% of the TAC equally to all pots, with the other 9.63% being extra allocation to fishers with historic base catch per pot greater than 132.23 kilograms.

The relative gains and losses and the re-distribution of catch shares are illustrated in figure 9. High catch fishers lose approximately 10% of their established share of the historic catch, with this being allocated to the low catch fishers. Catch shares equivalent to 108.324 kilograms are re-distributed from 118 high catch fishers to 72 low catch fishers. There is no compensation for this re-distribution. This raises the question: has an injustice been done?

Given that pot shares were retained, then a more equitable allocation of fishing quota for the season would have been based on the established catch shares so that all individuals are allowed to catch an equivalent share to what they have been catching in past seasons and retain their share of fishing units. The adjusted preferred shares method of allocating catch discriminates against the high catch fishers, and favours the low catch fishers, if distributive justice is

Figure 8
Distribution of catch quota per pot entitlement

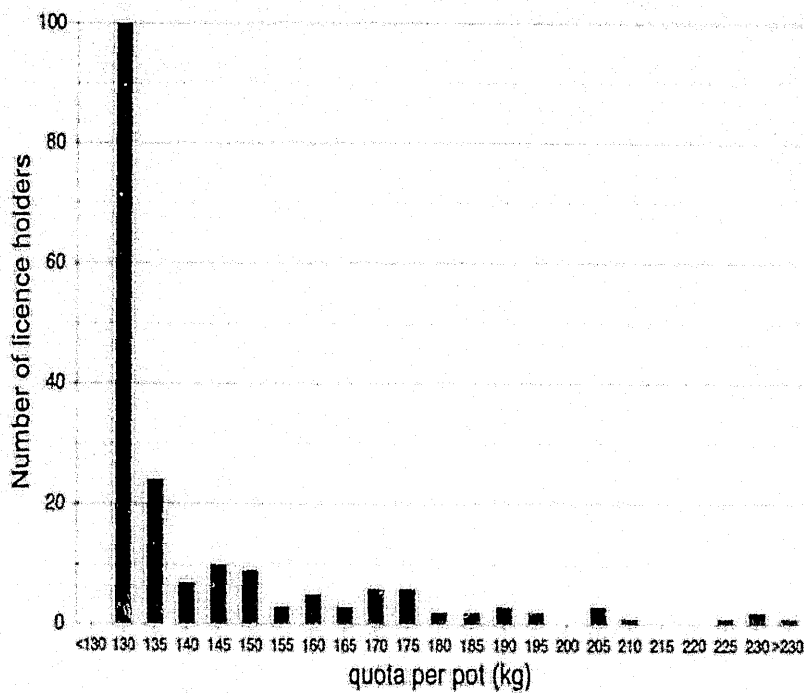


Figure 9
Relative gains and losses with allocation of catch quota in the Southern Zone

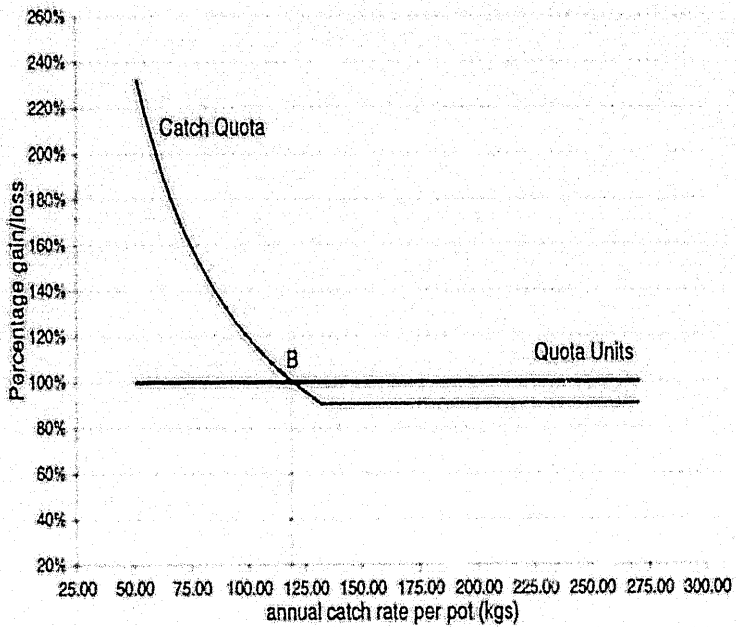
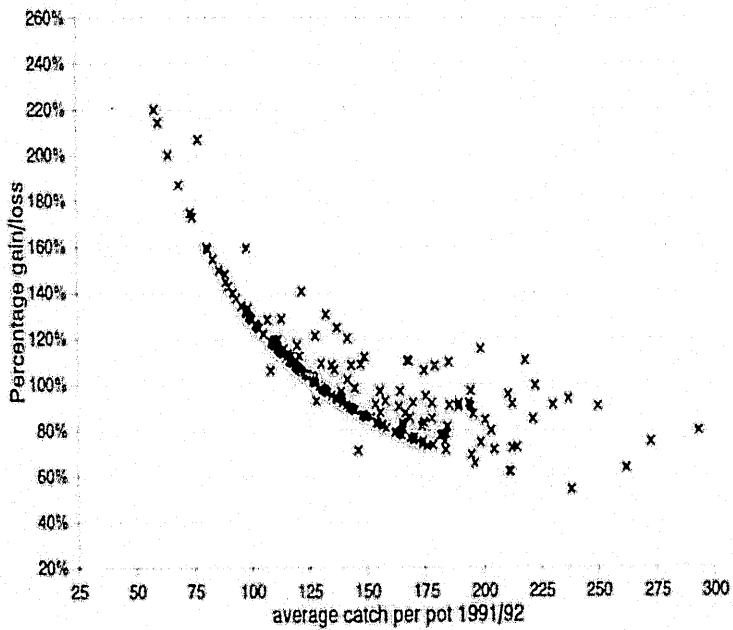


Figure 10
Relative gains and losses with allocation of catch quota compared to 1991/92 catch in the Southern Zone



measured strictly on the equity principle. However, there exists other perspectives which are recognised within the fishing community and the concept of relative deprivation needs to be considered.

Under the input regulation management arrangements all pots are regarded as being equal in terms of their potential fishing power, even though in practice this was not realised. Some fishers chose not to expand and increase their fishing effort, or operated in different location where fish are smaller or less abundant. That choice existed. Under an ITQ scheme that choice is taken away. Their catch is restricted by a quota limit.

Further, there is the opinion that the continual enforcement and restrictions that have been imposed are brought about by the fishing behaviour of the 'highliner' operators with their continual push to capture more fish. Giving them a catch quota which rewards them for this behaviour appears to be inconsistent with the principles of fisheries management.

For many recent entrants to the fishery substantial investment costs have been incurred. For these operators it is necessary to achieve high catches to survive financially. Disallowing them continuation of high catch levels could force some out of the fishery. The process and rules associated with the determination of the historic base catch of these licence holders, where the standard 135 kilograms per pot applies, may have unfairly treated them. Further, the three years selected for determining the historic base catch are relatively poor catch years when compared to the 1991/92 fishing season (see figure 1). This more recent season is 'fresher' in people's minds and is clearly a year on which they would prefer their history to be based. However, even if this one season is used, the relative catch shares of the majority of fishers changes only marginally because everybody's catches improved by much the same extent. There are many who in fact would be disadvantaged if 1991/92 catch records were used. From Figure 10 it is obvious that there are a number of licence holders who have been allocated a catch quota for the 1993/94 fishing season which is greater than the catch that they had achieved in the 'high catch year' of 1991/92. There are, on the other hand, many who have been allocated less than they had caught in that year.

It is evident that the two advocated methods of allocation have created disharmony in the fishing community and this has been reflected in the process of management negotiations and decision making within the IMC. It is a complex, and somewhat untenable choice. Time and further understanding of the issues are likely to test the adjusted preferred allocation method that was adopted. It does appear, however, that the allocation principle applied in the Southern Zone rock lobster fishery is a good compromise to the alternatives explored.

The principles of justice and fair treatment to all licence holders goes beyond the initial allocation of catch quota for a season. It extends into the trading conditions of fishing entitlements and quota, and to the distribution of TAC in subsequent fishing seasons (assuming the ITQ scheme remains). There remains the issue of whether any individual, or group is unfairly advantaged or disadvantaged with the rules that apply.

10. JUSTICE IN TRADE AND FUTURE ALLOCATIONS

Under the existing ITQ arrangements the pot remains as the transferable entitlement of fishing, and pot restrictions continue to apply. As such, a licence holder is restricted to a maximum of 80 pots endorsed on their licence. The intent of this rule is to restrict the fishing effort of any individual to the use of 80 pots.

Pots can be traded with the allocated catch quota 'attached'. This means that a licensee with an allocated season quota of 150 kilograms per pot, can sell a pot but also has to transfer with that pot 150 kilograms of quota to the purchaser. There has to be sufficient uncaught quota remaining on the vendor's licence to be transferred with the pot. This transferred quota amount is only valid for the current fishing season. Upon transfer, however, the pot entitlement also becomes a fixed catch quota entitlement which provides the purchaser a perpetual right to a fixed amount of catch quota equivalent to 0.0083871% of the ruling TAC. In other words, a traded pot after 1 October 1993 will be allocated TAC on the 'by pot' method in the future.

Catch quota cannot be transferred without the transfer of a pot entitlement, nor can catch quotas be 'leased'. Effectively, under the new management arrangements, this means that a fisher with 80 pots does not have the facility to purchase any extra quota for a season to utilise excess capacity. Further, as pots and licences are transferred over time, a licence holder with a high catch history and with the maximum holding of pots will see a diminution in the level of catch quota associated with their pot holding.

If the TAC remains at 1700 tonnes for the following season it will need to be re-allocated to all licence holders taking into account the transfers of the new quota units (i.e. the re-defined pot values at 0.00838% of TAC). If 100 pots, for example, were traded during the previous fishing season, then 14,246 kilograms (ie $100 \times 0.00838 \times 1700000$) of quota is already assigned to the purchasers of the pots and the remaining 1,685,754 kilograms of TAC is allocated to all licensed fishers according to the adjusted preferred shares method. As pots are traded over time, the amount of TAC distributed by the adjusted preferred shares method becomes less. Eventually, all pots will be of equal quota value. The time it takes for this to eventuate, however, may be many years.

The restrictions of quota trading, as they currently exist, clearly impede efficiency in fishing operations. Not only will a licence holder, with a maximum of 80 pots and surplus fishing capacity, not be able to increase, or even maintain their allowable catch over time, but also a fisher who has uncaught quota and, for some reason, is not able to fulfil the quota for that season, is not able to lease the quota without relinquishing pots.

10. DISCUSSION

The allocation method adopted in the Southern Zone, and the rules associated with trading of quota, protects the investment values of the fishing entitlements but re-distributes catch shares from the fishers with traditionally high catch rates to those with low catch rates per pot. While this appears to be inequitable and unfair, there are certain social values that are important in maintaining harmony in the fishing community which are considered. The initial allocation decision is very much a political decision and not entirely based on the principles of equity and proportionality as established earlier in this paper.

There also appears to be some serious consequences for the high catch licence holders, who have not only lost some of their catch shares to the low catch licence holders, but also face a continual erosion of their catch shares over time as more pots are traded and the quota allocation per pot converges to a standard rate. The pot restrictions, as they exist, are particularly discriminatory against those fishers who hold the maximum allowable pot entitlements.

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