# UNDERSTANDING THE ISSUES INVOLVED IN IMPLEMENTING A QUOTA MANAGEMENT REGIME

# AND

# AN ASSESSMENT OF ITS POTENTIAL FOR USE IN THE NORTHERN TERRITORY MUD CRAB FISHERY

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## ABSTRACT

There has been considerable discussion recently on what may be the best management regime for the Northern Territory (NT) mud crab fishery. This has come in the form of a formal review of the Management Plan and through a period of public consultation in respect to an environmental audit of the fishery by the Commonwealth through Environment Australia.

For the last 20 years the fishery has been managed under an input regime, which has seen the fishery grow to become the most valuable commercial fishery managed by the NT, as well as proving a source of food and recreational enjoyment for non-commercial stakeholders.

As the use of quota has become a common tool in fisheries management the question has been raised whether an output based management regime could improve compliance, maximise returns and eliminate inefficiencies in the fishery.

This dissertation has sought to clarify the issues involved in implementing a quota management regime and determine its potential for use in the NT mud crab fishery. It does not attempt to assess the appropriateness of the existing management regime in place for the Fishery,

This analysis showed that, at the present time, it would not be appropriate to move to quota management in the NT mud crab fishery.

The key reasons for this are that there are:

- a number of practical and logistical difficulties to over come
- unresolved access rights
- a lack of socio-economic data on which decisions can be based
- inadequate legislation and policy to deal with quota
- deficient consultative processes
- the inability to set a biologically valid TAC
- no apparent stakeholder support for a move to quota.

## INTRODUCTION

This dissertation does not attempt to assess the appropriateness of the existing management regime in place for the Northern Territory Mud Crab Fishery, but instead is a theoretical appraisal of the suitability, or otherwise of the fishery for a shift to quota management.

Basically put, quota is a fishery management technique that limits the catch in a fishery to a predetermined limit, the TAC (total allowable catch). The TAC is then apportioned to those participating in the fishery, often in the form of ITQ's (individual transferable quota) which are transferable and tradable rights to take a specific quantity of the TAC. The TAC is adjusted each year to try and reach some measure of sustainability (Annala 1996).

There has been considerable discussion on what is the best management regime for the Northern Territory (NT) mud crab fishery. This has come in the form of a formal review of the management plan and through a period of public consultation in respect to an environmental audit of the fishery by Environment Australia.

An input-based system has been in place for 20 years and has seen the fishery grow to become the most valuable NT managed commercial fishery, as well as providing food and recreational enjoyment for non-commercial stakeholders (Hay and Kelly 2002).

However, as the use of quota has become a common tool in fisheries management, there is a view that a change to quota would improve compliance, maximise returns and eliminate inefficiencies in the fishery.

This dissertation has approached the question of the appropriateness of using quota in this fishery in three separate steps.

Firstly, by undertaking a broad analysis of the fundamentals of output-based management, highlighting the positive and negative aspects and assessing the major issues that arise with quota management. From that exercise, a general decision analysis table was prepared to act as a checklist that could be used to assess the appropriateness of fisheries in general for ITQ. Examples from other jurisdictions and literature were used to highlight key issues and to provide a sound understanding of implications.

Secondly, the characteristics of the NT mud crab fishery were documented and then assessed against the key issues identified in the decision analysis table.

Finally, an assessment of the suitability of using ITQ in the NT mud crab fishery was made. Suggestions and directions are offered as to a process that could be followed and key areas that should be addressed before any decision is made to move to quota management.

## GENERAL OVERVIEW OF FISHERY MANAGEMENT TECHNIQUES

To explore the potential for quota management in the NT mud crab fishery it was essential to have a sound understanding of fishery management techniques.

Management controls generally fall within two categories; input or output. Both seek the same outcome - to try and restrict the overall catch to within some measure of sustainable yield.

The choice of techniques depends on the characteristics of the fishery, stakeholder requirements and the type of information required for reliable cost-effective assessment, management and compliance.

Input controls restrict catching potential by limiting fishing effort, typically using closures, gear and vessel restrictions, or controlling the number of fishers or fishing days. This management technique is often considered a scientific basis for management, working around fishery permutations (King 1995).

Output controls attempt to restrict what can be taken from the fishery and include size limits, possession limits and catch quota. This technique is often considered an economic basis for management, working on the premise of reducing inefficiencies (Walters & Pearse 1996).

Very often, a combination of both input and output controls are used.

Further information on both techniques follows.

## INPUT CONTROLS

The catch taken in an input managed fishery is theoretically linked to the size of stock available and does not have a specified annual allowable catch although effort controls are designed to keep the fishery within predetermined catch limits. Major input control measures used are closures, effort controls (King 1995) or allocation of fishing territories (ed. Ramm 1996).

Input controls are often considered less expensive to administer than output controls and in theory, allow the catch to fluctuate in relation to stock abundance, especially once latent effort has been taken up. This is especially the case in fisheries where recruitment levels fluctuate, based on stock-recruitment relations or environmental vagaries.

Input controls work by progressively placing more inefficiencies on those in the fishery (King 1995) or by reducing the number of participants, so as to theoretically reduce fishing power and thereby catch taken. It relies on assessing the catchability of the

target species. However, this can change due to behavioral modifications, technological changes or modified fisher/fleet activity.

Experience have shown that a reduction in nominal permitted fishing is generally accompanied by an increase in technology, or changing fishing patterns that take catch levels back up to, or beyond the initial level (King 1995, Commonwealth Government of Australia 2000). This technology creep can be factored into regulation, but it becomes a circuitous process with regulation continually trying to limit the effects of improved technology.

In worst-case scenarios in input controlled fisheries, situations similar to what occurred in Canada in the 1980's can arise. In that case over 435 halibut vessels were competing for the resource which lead to continual restrictions until by 1990 the fishery was open for only 6 days (Dewes 1998).

## OUTPUT CONTROLS

Output controls include a number of management techniques such as size limits, possession limits and catch quota. This dissertation will focus on catch quota and Individual Transferable Quota (ITQ) as the output control.

Basically, quota is a fishery management technique that limits the catch in a fishery to a predetermined limit, the TAC (total allowable catch) which is then apportioned to those participating in the fishery and is adjusted each year trying to move towards some measure of sustainability (Annala 1996). ITQ's are transferable and tradable rights to take a specific quantity of the TAC (Annala 1996).

Quota in the 70's was the simple approach of giving each fisher a fixed longterm annual amount that could be caught. The Government could then buy quota if the TAC needed to be reduced or sell it if there was more available. However, with fluctuations and unpredictability in stocks leading to the need to reduce TAC's, it proved difficult for Government to reduce quota holdings (Annala 1996).

Quota management is now almost universally based on a variable percentage share of the annual estimated TAC, not a fixed amount (Walters & Pearse 1996). Based on a number of criteria, shares of the catch are then allocated to various stakeholders wishing to utilise the resource. The shares can be fixed, proportional, transferable or not (Dewees 1998). ITQ is now a common technique as it allows quota holders to permanently or temporality transfer all or a portion of their share of the fishing rights to others.

Using ITQ as a tool to manage access and resource distribution is based in economic theory. It purports to encourage efficiencies, as less efficient operators can be removed by the more efficient and their quota utilised during periods of high return or demand (King 1995). This allows fishers the flexibility to choose when and where fishing takes place, as quota can be traded to meet business or financial needs.

Quota could also be used by Government as a social or legal tool by the allocation of quota to particular groups. It could also be applied if Government policy wished to set aside community based quota to protect lifestyles in certain areas (Dewees 1998, Bjordal 1999) or to deal with indigenous fishing rights (Squires et al 1998).

Output controls are best suited to fisheries that have:

- long lived species
- stable stock or resource fluctuations well understood
- selective fishing methods
- well understood stakeholder activities
- known bycatch issues; and
- reliable annual stock assessments.

Often quota has often been used as a method of last resort when all else has failed in capping total catch and fisheries are in crisis (Walters & Pearse 1996).

Much has been written about ITQ's with views ranging from undying support, to complete abhorrence. A large proportion of these views may be related to how ITQ's have been applied, under what circumstances and to which fishery. In some instances matters that may be considered positive in a particular fishery may have a negative outcome and vica versa in another.

Some of these possible positive and negative aspects are briefly highlighted in the following sections.

## POSSIBLE POSITIVE ASPECTS OF USING ITQ

Quota management and more specifically the use of ITQ's have been heralded by many as the savior of developed and developing fisheries. Quota is claimed to have three main outcomes:- positive conservation outcomes, increased economic efficiencies and mechanisms to establish balance between competing users (Major 1997). It should also lead to minimal Government intervention (Annala 1996). This being the case an appropriately designed quota system should produce aggregate benefits for society overall (Arnason 1997).

One reason for the support of quota is that some feel more comfortable with the notion that if you can determine an amount that can be harvested and set the allowable catch to that figure, many of the negative factors prevalent in open access or input managed fisheries should be controlled.

Quota, in theory, heralds the end of the race for fish, maximised returns from the fish taken and constructive economic changes in fisheries (Dewes 1998). Much of this is based on the theory that under ITQ's fishers will seek to maximise profits, efficient

fishers will harvest more and minimise inefficiencies, whilst the inefficient have incentives to exit (Dewes 1998, Squire et al 1998). This should lead to positive restructuring and rationalisation of Industry (Branson 1997).

Quota was also initially developed with conservation outcomes in mind. This was to be achieved using operational incentive and market mechanisms to increase individual catch within a predetermined safe limit, not through overcapitalisation or increased fishing activity (Squire et al 1998) leading to greater resource stability and sustainable catches (Branson 1997). Often this means a focus on maximising quality, not quantity (Annala 1996).

It is suggested that ITQ's provide strong incentives for holders to manage the resource with a long-term business view, as they need ongoing returns from holdings, as well as maintaining value for future sale. These economic gains may not be obvious in the short to medium term, but should become evident in the long term (Excel & Kaufmann 1999) and can be measured by the market price of quota (Anderson 1997).

Quota often leads to a shift from the original quota holders to others, generally processors and marketers. This allows these sectors to more efficiently control the supply chain and human resource issues. If catch can be predictably delivered, it is easier to plan for processing and marketing, which could lead to improved quality and prices. Managers however need to be conscious of 2$^{nd}$ generational social and anti-competitive issues if quota becomes aggregated in the hands of a few or foreign interests.

Recreational, customary and commercial allocations, as well as conservation rights, can be covered by setting an overall TAC and then allocating appropriate quota to the various sectors. This may have some difficulties in real life, but at least it provides a mechanism to adjust the allocation mix to meet requirements.

As ITQ's create quasi property rights from a common property resource there is generally a high incentive for 'owners' to pay for research, management and compliance (Annala 1996, Anderson 1997). This can have benefits to the public, in that these costs, now generally paid for by revenue gained through taxes, could be redirected to other projects. Additional funding for Government can be addressed by shifting some, or all, of the financial burden to Industry through a cost recovery program, by charging a resource rent, or by the Crown retaining quota to pay for ongoing research, management, compliance and administration.

The issue of bycatch is a complex problem in many fisheries, be they quota managed or not. ITQ does have techniques that theoretically could be used to address this problem. Examples are the setting of appropriate and realistic initial allocations that match actual catches, allowing the banking of quota, flexible transfer of quota, retroactive trading, quota species substitution, valued based methods, setting high penalties for breaching limits or providing positive rewards for not (Annala 1996,

Squires et al 1998). However, all these measures may complicate management in the future

There are clearly a number of positive reasons to implement quota. It provides fishers ownership, some perpetuity and market rights that allow flexibility to buy fish that best suit needs, encourages economic efficiencies, provides allocation mechanisms and provides Government with funding options.

## POSSIBLE NEGATIVE ASPECTS OF USING ITQ

There is extensive literature on why the use of ITQ's may not be the magic answer for all fisheries management problems. On of the major reasons is that there have been well publicised examples of ITQ's poor record in ensuring sustainability, stability and optimising economic performance, along with practical difficulties of monitoring and enforcement (Karagiannakes 1996, Morgan 1997, Feldman 1998).

Many new fishery management theories decry quota and suggest developing alternatives such as constant exploitation rate strategies through effort controls, refugia and minimum biomass spawning requirements (Caddy 1999). Modeling has shown for some fisheries that harvest rate strategies outperformed quota fisheries by a factor of three and placed the stocks at lower risk of collapse (Blok et al. (n.d)) and constant effort policies outperformed quota in other instances (Jacobson & Taylor 1985).

Fisheries scientists have had a relatively poor record in determining stock size (Walters & Pearse 1996). This has contributed to fishery collapses as fishers put additional effort into a fishery to catch the level of yield that is supposedly available, whilst managers have been unaware of impending disaster. The obvious question is why should stock assessments for quota be any more reliable or correct.

Annual biomass estimates are a priority for quota managed fisheries, but there is a need for feedback mechanisms for in-season monitoring to ensure catches do not exceed the TAC (Walters in publ). As the many uncertainties and assumptions involved in any assessments may become invalid or change during the course of the year, mechanisms need to be available to adjust catch levels mid year. This would a have a number of social, economic, political and legal ramifications under quota.

Quota holders have incentives to high-grade catch or underreport to maximise return on investment. High-grading involves the dumping of less valuable catch if higher valued catch becomes available. These two practices can lead to the situation where the total catch taken is higher than what is actually reported and fish product is wasted with fishers incomes possibly reduced. Of course these practices can also occur under non-quota management.

Bycatch issues are often seen as a problem in multi-species quota fisheries. Fishers may go over quota when targeting a particular species but end up catch quantities of another specie(s). This can lead to quota over or under runs (Annala 1996). Often

bycatch issues can be addressed by technical solutions to minimise catch, such as developing gear that targets a particular catch based on species behavior or using closures (Bjordal 1999). Another issue with bycatch his that the first step in addressing it is to have clearly identified the species and quantities involved (Kennelly 1999), but this is not always possible in quota managed fisheries if no provisions are made for the take of bycatch.

Over time quota often concentrates in the hands of a few. As a result some social issues may arise due to losses of jobs in smaller centres (Bjordal 1999) as market forces seek to maximse returns from the fishery through the closure of less efficient processing facilities and the buyout of inefficient fishers.

Many allocation and implementation processes have been less than ideal and lead to numerous legal challenges, a high level of dissatisfaction and lack of stakeholder support for quota (Excel & Kaufmann 1997).

One of the key objections from Industry relates to the perception that ITQ fisheries are more expensive to participate in and administer (Excel et al 1999) and that Industry gets burdened with the cost through some user pays system.

Finally, many existing non-quota fisheries perform very well and meet many of the same objectives sought under quota, but with the flexibility to allow smaller fishers to continue to operate. That being the case many think that if it isn't broke why fix it.

## KEY ISSUES

The previous sections provided an understanding of the basic characteristics of ITQ management. The following key factors relating to the core of the ITQ system became evident and are considered in more detail in the following section. These are:

- stock assessment and TAC setting
- allocation
- costs (including enforcement)
- implementation processes (including legislation)
- stakeholder support

It is intended to build a better understanding of these matters in the next sections, by discussing aspects of these issues and using examples to highlight situations.

### STOCK ASSESSMENT AND TAC SETTING

To function effectively, quota management requires an annual predictive estimate of the amount that can be harvested from the fished stock within acceptable risk levels that can be adjusted each year (Annala 1996). The success of output controls are

inextricably linked to the setting of the TAC with quota management increasing the need for reliable and timely estimates (Walters 1996, Walters & Pearse 1996).

### THE INITIAL ASSESSMENT

The initial TAC can be calculated a number of ways, some founded on sound methodology, others less so. Assessments have generally been based on historical abundance, averages, the use of catchability indices, through survey estimates, or a combination.

As a starting point it is essential to have an understanding of the stock structure and distribution of the species harvested to develop a sound comprehension of fishing related mortalities from all sectors, including unretained catch so as to identify who 'owns' and prosecutes the stock. Problems occur if the stock is shared by other States with differing management objectives, or if the catch is not included in any assessment.

In an ideal system, estimates are required for the individual catch shares for commercial, recreational, indigenous and scientific use purposes so as to build up a picture of the total removals from the fishery. However, estimates for the non-commercial sectors are difficult to determine. Recreational levels are generally based on estimated participation rates and individual catches, or possession limits. For other sectors, the process involves even more guesswork, but verifiable assessment processes should be developed for all non-commercial sectors.

Many initial stock assessments for quota fisheries are adhoc and rushed (Excel & Kaufman 1997). An example of this was for the South East Trawl (SET) Fishery in which the TAC was based on average catches during the period 1986 to 1991. This was when the fishery was in a period of decline with major uncertainties due to misreporting, bycatch issues and inadequate supervision (Staples & Tilzey 1993).

The use of averages hides yearly fluctuations, downward trends and diminishes credibility of initial and future assessments (Anderson 1997). However, if a fishery has been reporting the same landing for many years and is fully exploited, such an approach may be a cost-effective option.

Consideration must also be made as to at what stage of the capture and storage process, weights are reported for quota. Live product that has high moisture content such as abalone or crab could have a body weight variation of 20% from time of capture to processing, especially if tanks are used during holding or transport (Gorfine 2000). This could lead to a situation of over or under reporting depending on when weights are taken.

### SUBSEQUENT STOCK ASSESSMENTS

Subsequent assessments may need to be based on fishery independent information as experience has shown that CPUE, which is the basis for most models, is fraught with

uncertainty with ITQ fishing increasing its unreliability. This is because under ITQ's fishing patterns and catchability characteristics change and this deteriorates the 'random' nature of fishing under input management (Corkett 1997, Walters & Pearse 1996). The use of CPUE therefore may be dangerous when assessing stock size under quota as the fisheries may have no intrinsic response to changes in abundance (Clarke 2001).

Fishery independent surveys may then play a bigger role in assessments, but these have inherent problems with high variance that increases the risk which future research may not being able to resolve (Perry et al 1999). Refinements to estimates may only possibly be learned through trail and error, which is not readily available in ITQ fisheries (Walters & Pearse 1996).

### RELIABILITY OF ASSESSMENTS

Walters (1977) noted that fisheries assessments are highly unpredictable and uncertain often without even a general understanding about many of the basic mechanisms or fisheries interactions. This does not appear to have changed over time with growing concerns by some observers over the last decade about the accuracy and effectiveness of fishery assessments in general, as overall the setting of TAC's have not proved effective, or precautionary in preventing stock depletion (Feldman 1998, Caddy 1999).

Misreporting and bycatch issues can seriously affect the reliability of assessments. Errors in scientific estimates, largely due to miscalculations of dumped fish were identified as a major cause of the North America groundfish stock collapse (Baker 1994, Walters & Pearse 1996, Charles 1998) and along with an over reliance on quota management, exacerbated the collapse of the fishery. In this instance the stock assessors were considered the best in the world, using state of the art techniques, but they could not predict with enough certainty the imminent collapse of the fishery (Longhurst 1998). Instances of underreporting can be extreme in some fisheries, especially if the product has a high value. For example the NZ rock lobster fishery is believed to be at least 25% underreported due to illegal catches (National Research Council 1999).

The costs involved in refining some estimates can be prohibitive and in certain instances, no amount of resources will provide a finer assessment, or increase reliability (Perry et al 1999).

### UNCERTAINTY AND RISK

There have been deep suspicions expressed of single species assessment as they are part of a complex ecosystem with many unknown interlinkages (Walters in publ) with little of the impact actually known (Harvey & Coon 1997, Arnason 1998).

Therefore calculating a single species biomass is always an uncertain operation with a high level of risk and potential for large errors (Charles 1998). However, the more parameters used, the more complex the model becomes as each variable has its own level of uncertainty (Walters & Pearse 1996).

Whatever model is used, explicit recognition of uncertainty in each step is required (Perry et al 1999). Uncertainty comes in three forms, random fluctuations, ambiguity of parameter estimations and lack of knowledge of the fishery system (Charles 1998, Pearse & Walters 1999).

This uncertainty can be severe in developing fisheries when information can not be obtained and analysed fast enough (Perry et al 1999). In these instances there may be a need to be adaptive and flexible with exploitation levels modified as new data becomes available - but this is not always possible with quota fisheries (Polacheck et al 1999). Changing TAC's when the data is uncertain can be risky, but an adaptive management approach as used in NZ, varying the TAC and then assessing and monitoring the impact on the resource could be used (Annala 1996).

TAC setting can be related to the level of risk that stakeholders are prepared to accept. This means many assessments undertaken by Government tend to be cautious, erring on the precautionary side (Charles 1998), whereas industry often errs on the side of higher risk. A range of interpretations about stock status and consequences of management actions are common and are difficult for managers and stakeholders to resolve. When a TAC is set, it provides an illusion of certainty and unchangability and this can exacerbate collapses if assessments are incorrect (Charles 1998).

SOCIAL OR POLITICAL INFLUENCES

Social engineering or political influences may also be factored into the assessment and in some instances the TAC may be constrained by such policies (Corkett 1997). This occurred with the North American cod fishery where scientists estimated the TAC at 125,000t, but administrators set it at 197,000t. This was based on perceived economic gains and acceptance of a higher level of risk without any scientific basis. This contributed to the collapse of the fishery, cost billions of dollars in aid and the loss of thousands of jobs (Walters & Pearse 1996, Karagiannakes 1996, Charles 1998, Grafton et al 2000).

As the aim of TAC setting should be to maximise longterm biological and economic returns, it is therefore necessary to vary catch from year to year as the stock size changes due to environmental fluctuations and fishing. A theory is that the maximum catch permitted each year should be based on the lowest longterm TAC, with an additional variable quota calculated annually. This would allow for some level of business certainty. Policy decisions such as the 50% rule, which was in place in Canada, and set the following years fishing level at the rate halfway between the current level and the actual estimate could be eliminated (Charles 1998, Grafton et al 2000).

HARVEST LEVELS

Along with the stock size assessment, crucial decisions must also be made as what are appropriate harvest levels. A key point is that the only safe harvest level to recommend is zero, but even so, accidents and natural variation can still lead an unprosecuted fishery to extinction, with fishing exacerbating problems. The 'surprise' factor due to uncertainty must therefore always be considered.

Unfortunately, outcomes are always more or less uncertain with levels of risk dependant on a wide variety of biological, social and economic considerations (Pearse & Walters 1992). One thread is common however - no one wants to see the fishery collapse, but calls for risk free quota often lead to low TAC's being set. Many may be so conservative that forgone catch could wipe out any future economic gain, especially if those loses have a cumulative effect (Walters & Pearse 1996, Walters 1998).

Managers must ensure that robust management programs compliment the level of risk so that even if the 'surprise' is potentially disastrous, the resource can recover (Charles 1998). It is essential that Managers have a sound understanding about the stock, fishery, users and the implications of advice provided by scientists.

It appears that due to the need for the setting of an annual TAC for quota there may need to be a change in the way scientists study the resource. There is danger in merely extrapolating history to explain the current, as is the case with most assessments now, which have been a looking back exercise (Walters & Pearse 1996). This means a need for a shift from basic research, frequently poorly designed surveys and often inept assessments undertaken at leisure, to timely, cost effective and well planned defendable, predictive assessments (Walters 1998). These must be done to allow consultation to take place to assess reliability, accuracy (Walters & Pearse 1996) and discuss risk levels.

## ALLOCATION PROCESS

Once the scientific process (in theory at least) of determining the initial TAC has been completed, the political and legal minefield of allocation must be undertaken. Many of the ongoing problems with quota fisheries can be related directly to the allocation process (Excel & Kaufmann 1997).

Without fail, these processes have proved to be acrimonious, disputed and subject to various administrative and legal challenges. This process can be affected by a number of factors, including legislative constraints, lobbying by individuals, personalities involved and differing goals for each fishery and participants (Excel et al 1999).

As this process can be extremely involved and complicated, care must be taken so that this process, which should be inclusive, doesn't become difficult for stakeholders to comprehend or participate in, as this could lead to major disputes in the future.

## METHODS OF ALLOCATION

Three main ways have been identified to distribute quota (Economic Consulting Services 1997).

First, by way of administrative process that sees Government decide. This allows tight control and a range of political and socio-economic issue to be factored in. However, there may be equity issues with initial allocations, windfall gains, economic inefficiencies, discontent, pressure on decision-makers to maximise profits or allocations to individuals and preferential, or biased treatment (Morgan 1995).

Second, by way of equal opportunity through lotteries. This method takes no account of commitment, history or financial status.

Third, market forces can be used by way of auction or tender. These are often used for other natural resource allocations such as timber, oil and water rights (Morgan 1995). This method is economically efficient, generates revenue and is self-selective, but again takes no cognizance of history, commitment or pioneering work in the fishery and may see quota aggregate in the hands of a few.

Whatever process is decided on, it should:

- provide equity
- be legally defendable; and
- not lead to overfishing, waste or inefficiencies

## WHAT SPECIES AND WHO TAKES IT

A key starting point is to have identified the species being considered, if the stock is fished or shared with a number of states or fisheries and whether they will abide by the allocation process (Caddy 1996).

An example of the need for this to be clearly agreed to occurred with Southern Bluefin Tuna (SBT). Japan, NZ and Australia developed a trilateral process to determine the TAC and allocate quota. This itself has been plagued by a number of problems with parties attempting to fish outside the agreement. However, an even more serious issue was the lack of defined allocation for states not party to the agreement, such as Indonesia, which may take up to one third of the total catch (Polacheck 1999). This leads to the situation where in theory no matter how well managed the trilateral part of the fishery is, outside influences can lead to the TAC being overfished.

Bycatch allowances in fisheries outside the allocated quota can also cause problems, especially if the product is valuable, or the permitted levels are high (Excel & Kaufmann 1997).

An understanding of all user groups requirements in respect to access to the resource should have been clarified is in the stock assessment process so there should be a clear understanding of the total catch being discussed. An example of the importance of this point was shown for the NZ snapper fishery where the most significant sector was from recreational fishing which accounted for almost 60% of the total catch taken (Batsone & Sharp 1999).

SETTING AND ADJUSTING ALLOCATIONS

The commercial allocations are generally based on financial commitment and catch history. Under this scenario, some fishers may actually be rewarded for poor stewardship by having high levels of capitalisation and taking the greatest catch. These very activities are often the major cause of problems with fisheries. A contrary view has been put that perhaps a 'bonus' should be made to those who have contributed to research or used the stock 'wisely' (Caddy 1996).

Allowances should also be made for environmental purposes, indigenous, subsistence, recreational, and wider society requirements prior to individual allocations to commercial fishers (Caddy 1996, Kidd 1996). Such allocations could be determined by allocating a percentage of the TAC to each sector. The Spanish mackerel and Mud Crab fisheries in the NT have proposed such a move with a share of the resource being attributed to each of the user groups with all management adjustments based on the percentage allocation (Clarke 2001, NTG 2001). Agreement could also be reached to cover conservation concerns by legislating that regardless of what TAC is determined, a minimum stock size must always be maintained in relation to virgin biomass (Pearse & Walters 1992).

Prior to finalisation of the initial allocation, 2$^{nd}$ generational issues should be clarified as quota shifts from the initial fishers, generally to the larger processors and distributors. To minimise disputes in the future it is essential to determine what are appropriate minimum and maximum holdings and levels of foreign ownership, before transfers take place.

DISPUTE RESOLUTION

As the allocation process is in reality a redistribution of wealth, Governments generally wishes to lead with the fishery agency in control. This often leads to disputes. There may be benefits in minimising Government involvement and transferring the quota allocation process to an independent group (Pearse & Walters 1992, Excel & Kaufman 1997). This would achieve four key things in respect to fishers; they would assume responsibility for decisions, need to look longterm, bear the brunt of decisions and have a stake in collecting better data (Pearse & Walters 1992).

Excel and Kaufman (1997) have suggested as part of the allocation there is a need to define a process to deal with any disputes, as legal challenges have a significantly

negative effect on the use of ITQ's otherwise the range of appeals can be extensive. For the SET it included a review committee, internal Government reviews, administrative appeals tribunal, the federal court and Senate Committee. For this reason, it is imperative to confine and minimise appeal processes and set aside quota to cover appeals.

SUMMARY

Most decisions made when allocating quota are politically and legally irreversible so outcomes should be legally defendable with clear decision rules in place. With respect to commercial allocations, the key point are:

- identifying species, bycatch, stock and harvesters
- setting a clearly identified TAC and level of risk or safeguards
- the proportion of TAC available for commercial use
- an allocation formula that specifies who is eligible
- a process that is legally defendable and limits the appeals process
- a formula developed that takes relevant factors into account when the quota is being allocated. This generally takes into account catches in recent years, levels of capitalisation and commitment but could perhaps not merely be a formula based on quantities, but on some fished 'wisely' basis?
- recognition of where fishing activity took place, as stock density and abundance may be different in particular areas where individuals have fished
- contribution to health of resource, environmental stewardship, research and development
- definition of right (length, divisibility, tradability)
- quota over-harvest and carry-over policy
- compliance with international environmental instruments (Tsamenyi & McIlgorm 1999).

## COSTS

Another key factor that must be considered with putting in place an ITQ system are the costs involved.

ITQ's have many characteristics of property and as such many economists favor them as they decrease incentives to overcapitalise and increase efficiencies. However, enforcement is costly and difficult and many fishers still try to overfish, so a command-control scenario often still remains (Townsend 1998).

This cost involved are not just the running expenses of the management system, compliance and ongoing administration, but also for timely and accurate stock assessments and initial and ongoing set up costs for stakeholders.

It also covers the less tangible matters such as the 'cost' of giving away a common property resource to a few without a full understanding of what the future value of that resource may be, or who may be assigned ownership in the future. Also, social costs that may develop as a result of market driven processes where the resource is utilised by a few when previously it was accessed by many.

These major costs are briefly discussed.

**Compliance**

The setup and ongoing compliance costs can be substantial for an ITQ-based fishery. This is partly due to the change of direction from field based detection of gear infringements, or offences in progress, to a focus on balancing the books and the associated paper trail required to detect sophisticated breaches of quota (Annala 1996). Costs such as certification stations, dockside scales or electronic monitoring systems can add thousands of dollars to the program (Excel et al 1999).

If the ITQ scheme has input controls as well, which is common in many quota fisheries (National Research Council 1999), the costs could escalate even higher with few of the efficiencies that could arise from a compliance perspective gained.

Compliance programs can have varying approaches depending on the characteristics of the fishery and resources available. The most common is a paper trail approach that captures those involved in owning, catching, storing, transporting and selling quota species. Other possibilities are dockside monitoring, paging systems, VMS, observer programs, product identification or a combination.

There may also need for a new group of compliance officers whose training is as land based auditors, not field based (Annala 1996). There may be associated costs involved in recruiting, training or transferring staff.

However, compliance costs may be reduced by increased use of technological aids such as VMS and automated reporting systems. These have seen a dramatic decrease in cost of over 70% from 1993 to 1999 (Marshall 1999). On the other hand, salaries and associated on-costs for officers will only increase over time.

If the product has a high value, black market potential increases. The incentive to underreport increases, as does the sophistication of those breaching the law, leading to higher compliance costs. It is estimated that the NZ rock lobster fishery had a 25% quota overrun (National Research Council 1999).

Significant savings though may be possible if there is a cultural change in the way Industry approaches illegal activity. The NZ experience has generally seen a cultural shift from a competitive to collaborative, with strong conservation values. This has seen a change in attitude amongst fishers in respect to compliance. Overfishing in the

past was the thing to do, because like cheating on taxes, it was only stealing from the Government, but cheating on quota is considered stealing from mates (Major 1997).

A compliance strategy that outlines the paper trail, observer programs, daily records and cross verification processes must be costed and readily available for scrutiny with the penalty structures determined prior to the system commencing (Excel et al 1999).

There is a vital need to ensure that the legislation in place to adequately cover the full requirements for the compliance program for quota management. This will include the ability to monitor the financial workings, books and accounts of a number of persons/companies in the seafood and transport industry.

**Ongoing administration**

The cost of administering ITQ programs are generally higher than for input fisheries.

Examples from Commonwealth fisheries show management costs ranged from 4.6 to 14.7% of the landed value in quota fisheries and from 1.75 to 5.2% for non-quota fisheries. On an annual vessel basis, the cost for ITQ fisheries averaged $14,000 and non-quota $9,000 per vessel (Kaufmann et al 1999). In Qld, the cost of management for the spanner crab fishery increased by almost 15% from $369,000 under an input system to $418,000 under quota (Excel & Kaufmann 1999).

As ITQ's create quasi property rights from common property, questions arise as to who should pay for research, management and compliance. Often the implementation of a quota system sees a change to user pays and the development of cost recovery mechanisms to fund the program. Government may contribute to cover public good aspects, but the commercial sector bears the brunt (Anderson 1997). This issue is at the forefront of many discussions.

This often leads to calls for administration costs to be pruned to minimise Industry contributions. Paradoxically, whilst cuts are being considered, the documentation requirements, record keeping and assessments must be precise and often of a highly technical nature. This can lead to the situation where costs may actually be higher.

A precise costing should be undertaken, as some expenses could be reduced for items such as logbooks if electronic lodgment was possible, or compliance and research if more collaborative work was undertaken. This is often very difficult in real life to demonstrate conclusively, as generally the costs are readily quantifiable in the form of equipment (i.e. VMS) or loss of jobs, but the actual benefit may be less tangible and therefore harder to quantify, especially in the short term (Marshall 1999).

Many ITQ based fisheries have observer programs and their costs can be high. In NZ there are up to 50 observers employed to monitor fisher activity funded by Industry (France 1999). Some fisheries however feel that the cost is justified. The USA west coast tuna fishery has 100% industry funded observer coverage, as they feel it reduces

the overall impact on their operations by outside influences, such as pressures from environmental groups which use anecdotal information as a basis for determining incidental take of dolphins in the fishery (ed. Nolan 1999). They now have independent quantitative data from the observers on which to base their case.

The paper burden for fishers will increase with ITQ's, but with the implementation of the Goods and Services Tax (GST) in Australia, the record keeping aspect of fishers should have improved and this should enable them to better manage information requirements for compliance (Major 1997).

**Timely and accurate stock assessments**

Many of the issues involved with stock assessment have been covered previously, but the need for more accurate, timely, predictive and reliable assessments could lead to greater expenses, not withstanding possible cost reductions arising from stakeholder assistance and collaboration.

**Stakeholder participation costs**

Not including cost recovery aspects, stakeholders will need to allocate resources to cover the matters discussed below.

Funds will be required to purchase and maintain weighing equipment, VMS, pagers and other equipment that complies with standards demanded by the administrators. Some of this equipment may initially be very expensive, but as with most technology, these costs will decrease over time.

Industry funded stock assessment experts will have to review proposed TAC's, remembering previous discussions on the level of acceptable risk for the various stakeholder groups. There will be a need for lawyers, scientists, advocates and lobbyists to test systematically the validity of all assumptions in models and processes and seek changes if appropriate.

Industry will need lawyers to draft contracts dealing with the purchase, sale or lease of quota and undertake administrative or legal appeals if individuals or groups feel detrimentally affected by allocation decisions.

Brokers fees will apply, especially if quota congregates in the hands of a few and access becomes difficult. The question of capital gains and stamp duties must also be assessed, as fishers will buy, sell and lease quota on an ongoing basis.

Costs related to the setting of an inappropriate quota, either too high or low, have been previously canvassed, but it must be remembered that if quota is set too low, the economic gains lost to the fishery may never be regained. If catch is high graded, or discarded, due to a lack of quota, this could lead to reduced income for some and wasted product.

If insufficient quota has been allocated to an individual they will have to source funds to purchase additional fishing capacity – this can be a major issue for some of the larger players in the fleet.

**Other costs**

There are three further costs that may not be easily calculated, but should also be taken into account.

First, the cost associated with the giving away of a common property resource to a few. This is generally done without an understanding of what the value of that resource may be in the future or who may be assigned ownership through legal processes. Native Title judgments in the future could possibly see significant area of water and resources transferred to indigenous Australians, especially in the NT (Northern Territory Seafood Council 2002b).

Second, social issues may arise as the market driven process leads to centralisation of ownership and jobs may be lost with smaller communities losing income (Anderson 1997). This has lead in some Icelandic rural areas to what is termed municipal bankruptcy (National Research Council 1999).

Third, the impact there may be to other fish stocks as fishers sell their quota and possibly prosecute other fisheries (Squires et al 1998).

Some of these factors may not be quantifiable, but they will certainly generate debate and may cloud or hinder the effective use of ITQ in a fishery.

## IMPLEMENTATION PROCESS

One of the greatest threats to successful management change is inadequate planning (Bartol et al 2001) and this has been identified as a crucial area in implementing quota management (Excel & Kaufmann 1997).

One of the basic concepts of change management is agreeing on what the changes hope to achieve and in what timeframe (Bartol et al 2001). It therefore essential that the reasons for changing to ITQ are clearly understood. Multiple, conflicting or a lack of clear objectives have been proffered as significantly contributing to fishery management collapses, including the Canadian groundfish fishery (Sinclair et al 1996, O'Boyle & Zwaneburg 1996).

It is suggested that Government generally have the following objectives in mind, even if not implicitly stated; sustainable management, equity, environmental protection, economic efficiencies, enforceability and cost recovery options (Economic Consulting Services 1997).

If these, or some other objectives have not been clearly identified and agreed to through a consultative process with appropriate timelines, milestones, measures and a set of decision rules in place (FAO 1996, Bartol et al 2001) there will always be dispute as to the need for and the subsequent success, or otherwise of the scheme. If these matters are clarified and there is adequate planning there is a greater chance of success and lower costs in the long run (Excel & Kaufman 1997).

It has been suggested placing a moratorium on transfers until stakeholders and administrators have had a chance to familiarise themselves with the system. This allows those who have received the initial market windfall gains (allocated quota holders) to consider options, as well as giving the 2nd generation buyers who pay for the right to use the resource an opportunity to assess the fishery and reduce speculative activity (Economic Consulting Services 1997).

Excel and Kaufman (1997) in their review of the SET provide a classic example of the importance of the implementation process in the change to ITQ. Quota was seen as the solution to overexploitation and excess capacity in the SET, but many of the ongoing problems can be directly related to the implementation process. This was a case where there was inadequate planning with the system was introduced in haste, as the fishery appeared to be under biological and economic threat. There was a lack of meaningful industry involvement with timelines based on unrealistic Ministerial deadlines, which took precedents over operational realities. Many of the issues overlooked have previously been highlighted, such as funding, realistic costings, penalties, over harvest strategies, TAC setting, assessment methods, allocation formula, compliance implications, the appeals process and most importantly a lack of industry acceptance. This did not give optimal outcomes as the bureaucracy was not prepared and industry hadn't been allowed the opportunity to adequately assess scenarios, or proposed processes to identify inaccuracies, loopholes, areas of dispute or unworkable scenarios that would lead to conflict, or failure of the system (Branson 1997).

As part of the implementation process it essential that sufficient planning, consultation and analysis have been undertaken to ensure that the following have been addressed:

- agreement on objectives and measures
- timelines
- certainty of process
- a legal and administrative system is in place, including a tort system for quota trading
- adequate staffing for current and future needs
- sufficient ongoing funding
- agreed cost recovery levels
- adjustment measures, with decision rules in place to manage in good and bad times
- minimum, maximum and foreign holdings agreed to
- the stage at which weights are recorded.

### STAKEHOLDER SUPPORT

Many of the issues previously raised would be of minimal consequence if there were a high level of stakeholder support. This doesn't mean just Industry, but Government and the general public. As many of the decisions are politically and legally irreversible, stakeholders need to be comfortable with the process and outcomes.

A consultative approach where the regime has not been developed in isolation generally provides outcomes with the greatest level of support (Bartol et al 2001). This is especially so if stakeholders have had the opportunity to test the system for faults and offer remedial advice (Branson 1997).

Industry can assist by contributing their extensive understanding of the resource and nature of the fishery, enhancing existing data, providing research direction and possibly financial contribution to clarify areas of dispute, or those which are poorly understood. This could be invaluable in reducing risks by improving information exchange and data collection through a cooperative approach.

The NZ fishing industry is now a staunch supporter of ITQ's as they feel it leads to positive restructuring and rationalisation, greater resource stability, sustainable catches, transparency and provides a more inclusive process (Branson 1997) as well as the development of a more cooperative approach to conservation, compliance and research (Major 1997). Legislating for an inclusive process for consultation and decision-making can possibly strengthen this view (Annala 1996).

By the inclusion of stakeholders in discussions and regime development, including allocation, Government can be absolved of much of the blame for decisions with a greater incentive for industry to resolve issues amongst themselves instead of finger pointing at bureaucrats.

## DECISION ANALYSIS TABLE

The information so far has highlighted that as a precursor to implementing ITQ's a decision analysis table or matrix should be developed to guide administrators and stakeholders through the process by highlighting key issues, thereby ensuring important matters have been considered, discussed and most importantly outcomes documented.

The key matters identified, which should be included in such a table relate to:

- fishery characteristics/stock assessment and TAC setting
- allocation/implementation
- costs
- administrative capacity

- legislation and compliance
- stakeholder support, including objective setting
- consideration of other management options.

These key points along with the subheadings in the table at Appendix I can be used as a guide for working with a range of fisheries. Although all the elements may not necessarily be required in all instances, in others further matters may need to be added depending on the fishery.

The table could be expanded to include meeting outcomes/actions, records of other matters or decisions against each subheading that should be recorded as part of the process.

Some subjective ratings system of each subheading item can be undertaken. However, extreme care must be taken to not solely rely on some scoring system, as in some cases nearly all of the factors may provide a positive outcome, but if one or two crucial elements fail (e.g. can't determine TAC), the whole system could be jeopardised and destined for failure.

The next section in this dissertation documents the characteristics and features of the NT mud crab fishery, prior to using it as a case study and assessing it against the matters noted in Appendix I.

## BACKGROUND ON THE NT MUD CRAB FISHERY

The NT Mud Crab Fishery covers all NT tidal waters and is managed by the NT Government under the Offshore Constitutional Settlement (OCS) by means of the Mud crab Fishery Management Plan. It is the most valuable wild harvest commercial fishery under NT jurisdiction (Hay & Kelly 2002).

The Fishery targets a single species using baited pots to take live crabs. Although crabbing is generally permitted in all tidal waters of the NT, it has historically taken place in coastal and estuarine areas. There are some restrictions to access in Aboriginal areas and due to Government closures such as the prohibition of commercial fishing within Kakadu National Park (Hay & Kelly 2002).

From 1984 to 2001 the annual commercial landings have grown from around 20 to over 1000 tonnes (Figure 1 and Table 1) (Hay & Kelly 2002). This equates to an average annual increase of approximately 6%. Landings for 2002 may be up to 40% down on 2001 figures (Hay, T. 2002, pers.comm.).

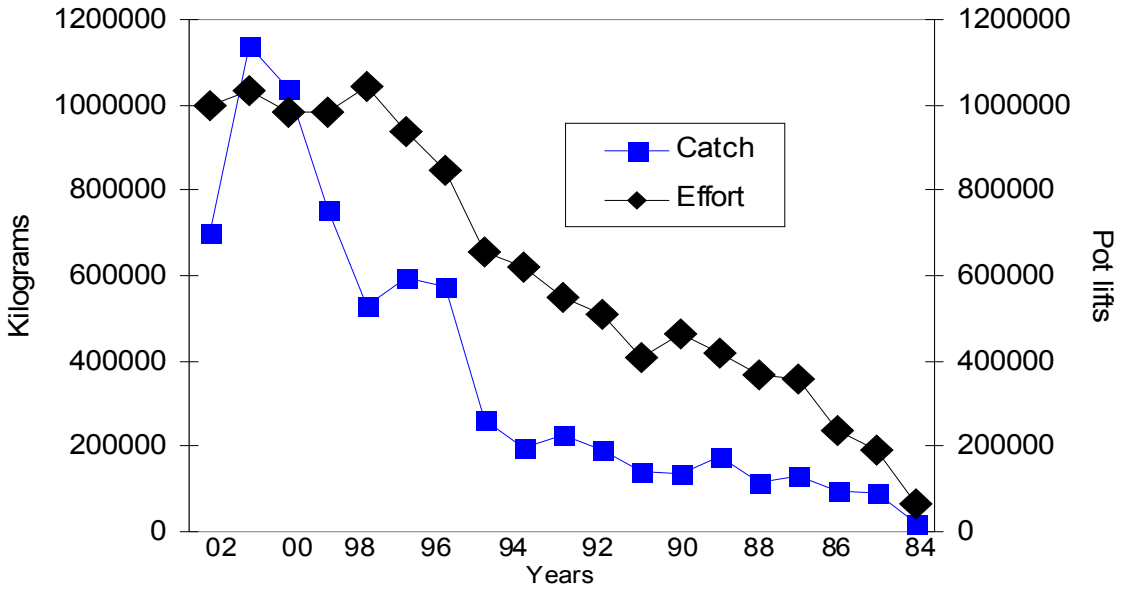


Figure 1: Annual Commercial Landings and Effort in the NT Mud Crab Fishery

## SPECIES

Four species of *Scylla* have been identified (Keenan et al 1998) with the NT fishery based on *S. serrata* (Figure 2) with small numbers of *S. olivacea* taken, mainly in the western region of the NT (Knuckey 1999, Hay & Kelly 2002).

*Scylla sp*. are a large, omnivorous, aggressive, portunid crab, which undergo a series of moults to increase in size. Based on NT research, they reach 100-120mm carapace width in the first year and 130-170mm in the second year (Knuckey 1999).

Figure 2: An Example of a Male *Scylla serrata* – the Mud Crab

The existing size limits are 130mm for males and 140mm for females.

Around 50% of females are mature at 136.5mm carapace width and research indicates that nearly all have mated (Knuckey 1996, 1999). The presence of sperm in males occurs at around 115mm with functional maturity, based on the presence of mating scars, commencing at 125mm, but generally between 150-165mm (Knuckey 1996, 1999). All female mud crabs apparently mate, but only 30% of males exhibit scaring (Knuckey 1996, 1999).

Mating can only occur with recently moulted females who can store the males spermatophores for a number of months. They can spawn a number of times from a single mating producing up to seven million eggs (Heasman 1980).

Around November, females migrate offshore to spawn (Hill 1994) and no longer appear in the catch in any numbers (Knuckey 1999). The eggs hatch into free-swimming larvae called zoea, which move inshore with other plankton and undertake moults until they become juvenile crab of around 4mm.

Mud crabs live for up to four years with the fishery targeting animals in the one to two year age classes (Knuckey 1999).

## STATUS OF THE RESOURCE AND RESEARCH

Conservative management arrangements have been in place since the mid 1980's. These controls restrict fishing effort, through gear restrictions and limited entry licensing and protect breeding stocks through minimum size limits.

Research has focussed on assessing the effectiveness of these strategies by analysis of logbooks, biological monitoring of catches, surveys and experimental data. This is expanded on in the 2000 Fishery Assessment Report (Hay & Calogeras 2001).

There is a sound understanding of basic information on growth, size at maturity as well as some information on reproductive behaviour and movement (Knuckey 1999). Little information on recruitment or migration has been collected.

The minimum size limit for female mud crabs was increased from 130 to 140mm in 1996 based on research that indicated such a move would provide protection for over 70% of females from direct fishing mortality until maturity (Knuckey 1999).

Since the mid 1990's, a monthly commercial mud crab monitoring program has not identified a significant decline in carapace width (Hay & Calogeras 2001), but data for 2002 is not yet available. This monitoring is undertaken as it is believed that a decrease could signify some level of overfishing.

The resource is heavily fished in some areas with modeling suggesting more than 70% of the stock may be harvested annually in these areas, with the fishery depending on annual recruitment, rather than an accumulation from previous seasons (ed. Ramm 1996).

Although there have been large increases in catch and effort over time, analysis indicates that with the fishing practices in place and exploitation rates to date, there appears to be little risk of recruitment overfishing (ed. Buckworth in prep). However, if fishing pressure is excessive in discrete areas, some seasonal localised depletion may become evident (ed. Buckworth in prep).

The use of monthly CPUE data, from compulsory logbooks, to solely monitor the status of the fishery is not considered suitable, as catchability is unknown and the targeting nature of fishers does not adequately show any variation in CPUE (ed. Ramm 1996). Additionally, logbooks do not record discarded catch, or mortalities between point of capture and delivery to processors, or provide accurate or valid spatial and effort information (ed. Ramm 1996).

Modeling based on data up to 1996 showed a good fit using catch/effort data (Knuckey 1999). However, by 1999 the model no longer fitted, due to significant increase in catches that could not be explained by a catch/effort relationship. It has been hypothesized that the increase in catches from 1996 to 2001 was most likely due to significant pulses of recruitment in relation to favorable environmental conditions (ed.

Ramm 1996) in combination with increased fishing pressure and expansion of fishing grounds (ed. Buckworth in prep).

Consequently, no stock recruitment relationship or stock size estimate has been determined, even using a number of world recognised stock assessment experts at specific workshops (Ramm ed. 1996).

As an alternate, research is focusing on identifying critical mud crab habitat and estimating abundance per unit of critical habitat (Hay & Kelly 2002). This methodology is hoped to prove useful in developing models that can estimate stock size and exploitation rates. Experimental work to date has shown in some instances that in excess of 800 mud crabs of varying size have entered traps in a narrow 2km stretch of creek within an eight day period (Hay, T. 2002, pers.comm.). This technique however still relies on enticing crabs into baited pots and therefore may have many of the same biases found in fishery dependent data.

## STAKEHOLDERS

The major user group is the commercial sector, whilst recreational fishers utilise the resource and Indigenous fishers use crab as an important food source. There is also a requirement to ensure sufficient crabs remain in the environment to maintain the ecosystem. In the future there may be a need to source aquaculture broodstock from the wild (Calogeras & Hay 2001).

To provide an overview, each sector is briefly discussed.

### COMMERCIAL FISHERY

Initial development occurred in the 1980's with an increase in catches from under 20t to 100t (Mounsey 1989) leading to a series of more restrictive regimes that replaced the open access arrangements. Since 1985 the fishery has been limited entry with only existing licences renewed and provisions for licensees to sell or lease their licences. In 2000 a licence was valued at around $300,000 (Northern Territory Seafood Council 2000a)

The 49 licences are held by individuals or companies with no maximum holdings, but there must be majority Australian ownership. Licensees generally do not fish themselves, but lease to others. This is often to major processing companies, who engage fishers to supply them. These crabbers tend to move from licence to licence over time. Most come from an Asian background and the large majority do not have English as first language (Calogeras 2000).

Crabbers operate from open 4.0 to 6.2m aluminum dinghies powered by outboard motors ranging from a single 40 to twin 130 horsepower units (Figure 3). Crabbers may travel in excess of 100km to set their pots and then stay in the vicinity for a number of days before returning to a base to unload the catch. Most crabbers carry

fuel, food, bait and other living items on their dinghies, but may have small, isolated, camps with limited facilities (Figure 4). A few have generators, but technologic aids such as satellite phones are rare, with faxes, computers and electronic scales nonexistent.

Figure 3: Typical Commercial Crabbing Boats

Figure 4: Typical Commercial Crabbing Camps

Each crabber can use a maximum of 60 pots which are baited with fresh meat or fish and are checked at least daily, but more often if tides or other conditions are favorable. Pots are hand-hauled and the crabs are checked for size and degree of 'fullness'. Non-commercial specimens are generally returned to the water alive.

Live crabs are stored in moist hessian lined crates (Figure 5) and transported to Darwin at least weekly, by refrigerated trucks, prior to grading, packing and onshipping to market. All weights for fishery reporting purposes are based on this dry weight received in Darwin. If crabs are held in water at camps, or placed in tanks at the processors facilities, there will be an increase in the weight of crabs and this has an obvious implication for quota reporting.

Figure 5: Typical Hessian Lined Storage Crates for Live Mud Crabs

The bycatch of non-target species is almost non-existent. There is however a catch of post-moult mud crabs which contain little meat (often termed empty or not full) and due to an Industry initiative are illegal to be in possession off. If checked at sea, these crabs can be returned to the water will fill with meat after feeding and will become marketable within a short period (NTCFA 2001). If returned to shore, or freighted to Darwin there will be mortalities which are not fully reported.

The total retained catch in 2001 was 1037 tonnes taken using a reported 983,500 potlifts and valued at $13 Million. It is the most valuable NT wild harvest fishery representing 40% of the total value of NT landings (Hay & Kelly 2002). Unpublished

data for 2002 suggests that catches may be down by as much as 40% (Hay, T. 2002, pers.comm.), but no report is available from Government at this stage.

Catches under individual licences have increased substantially from an average of ½ a tonne in 1984 to over 15t in 2001 (C-Aid Consultants 2002).

Eighty percent of the catch is taken in the remote western Gulf of Carpentaria in the vicinity of Borroloola and the Roper River, with lesser catches in the Darwin Area. There is little activity on the west coast or adjacent to Arnhemland (Figure 6).

Most catch is landed at four to five areas in the NT; Darwin, Borroloola, Roper River, and Shady Camp (see Figure 6). Catches from a number of fishers in each area are consolidated and transported to Darwin prior to marketing. All crabs are currently airfreighted live out of Darwin (Hay & Kelly 2002).

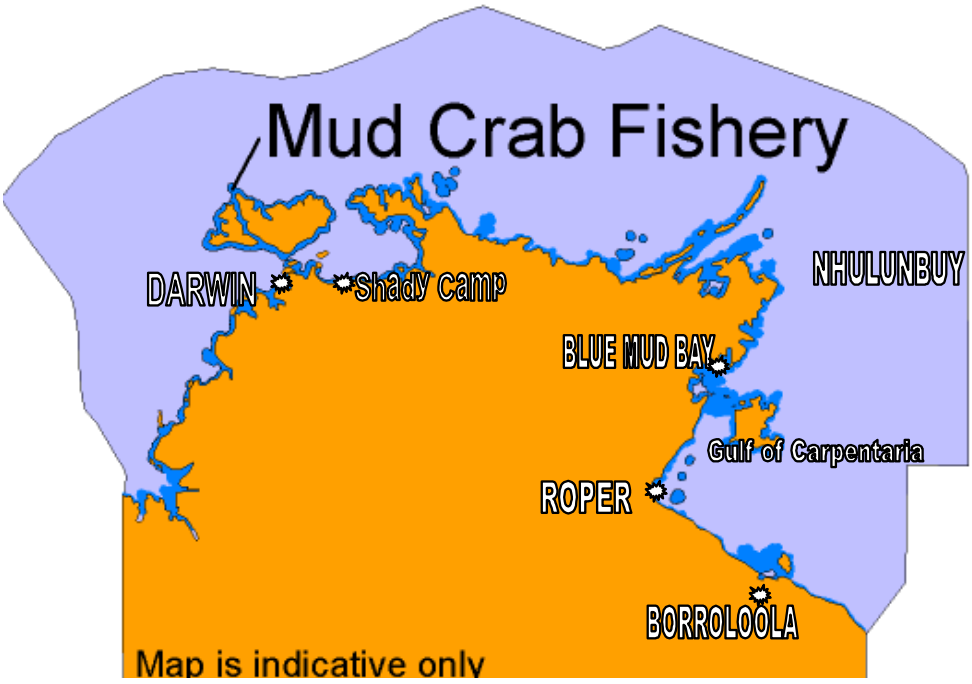


Figure 6: Map of the NT Showing Major Crabbing and Landing Areas

It is believed that some crabbers overpot, and although convictions are low, industry has pushed since 1996 to have these penalties significantly increased. Government has yet to complete the necessary legislative amendments even though all sectors support such a move (Calogeras & Hay 2001).

## OTHER COMMERCIAL FISHERIES

Negligible bycatch of mud crab is reported from other fisheries, with all other commercial fisher prohibited from selling crab (C-Aid Consultants 2002).

## RECREATIONAL FISHERY

Mud crabbing is a popular activity for many recreational fishers and is often undertaken in conjunction with other fishing in coastal and estuarine area. Since 1985 there has been no recreational licensing, but gear restrictions and possession limits apply.

Most catch is taken with traps or dilly pots with the techniques used similar to the commercial sector. Darwin accounts for 65% of the catch with 25% from the Borroloola region (Coleman 1998).

The most recent information on participation and catch rates comes from 1995 where it was estimated that recreational fishers caught 75,000 mud crabs of which around 50,000 were retained (Coleman 1998). This equated to around 45 tonnes (Calogeras & Hay 2001).

## FISHING TOUR OPERATORS

This licence allows operator to take people on charters where only recreational fishing gear can be used and the catch not sold. Rules apply as for the recreational sector.

The targeting of mud crab is a low priority for this sector with around one tonne caught and 20% released (Calogeras & Hay 2001).

## INDIGENOUS

Indigenous people are entitled to use recreational fishing gear to crab, as well as traditional methods. The *Fisheries Act 1988 (NT)* guarantees their rights to utilise the fish and aquatic resources in a traditional manner.

There are a number of Native Title and Land Rights cases currently taking place, or pending, challenging the validity of the Government to control, or issue rights to fish in intertidal, internal and offshore waters.

Also, under the *Aboriginal Land Act 1992 (NT*), two kilometre sea closures can be put in place adjacent to land which has already been granted under the *Aboriginal Land Act*. This could have the affect of prohibiting access and fishing adjacent to 84% of the NT coastline.

No reliable information has been published on this sector, but mud crabs are believed to be an important food source for many coastal Aboriginals.

### COMMUNITY AND ENVIRONMENT

Community and environmental stakeholders are non-extractive users who generally wish to ensure:

- long-term ecological sustainability of the resource and dependant species
- that the quality of life is preserved for future generations; and
- that fishing activities do not detrimentally effect the environment (Clarke 2001).

This fishery has recently undergone an environmental assessment by Environment Australia and has been granted an exemption under the *Environment Protection and Biodiversity Conservation Act* 1999 (Cwlth) (EPBC Act) (C-Aid Consultants 2002, Hay & Kelly 2002). This means that the for the purposes of the wildlife trade provisions in part 13A of the EPBC Act, the fishery is considered to be managed in an ecologically sustainable way.

The recently introduced industry Code of Practice also seeks to address a number of environmental issues.

### AQUACULTURE

Considerable work is still required on the commercial production of mud crabs, but access to broodstock from the wild will be required (Hay & Kelly 2002).

Currently there are no formal access rights for aquaculturists who now have to source broodstock from existing commercial licensees. If no specific allocation is made for broodstock harvest, difficulties such as have been experienced in sourcing tiger prawn broodstock from the Northern Prawn Fishery (Clarke, R. pers. comm.) could stifle development of this sector.

## COMPLIANCE

Compliance functions are undertaken not by Fisheries Department Officers, but by Police who are seconded to the Marine and Fisheries Enforcement Unit (MFEU). There is no formal compliance strategy between Fisheries and MFEU and any changes in management would require extensive negotiations between the agencies.

The vast majority of enforcement resources currently focus on field based activities relating to gear offences to try to reduce incidences of overpotting in the commercial sector.

Some basic desktop audits are undertaken comparing fishers logbooks, processor returns and airline records. Those transporting or selling crabs retail are not required to keep or provide documentation for compliance. Few powers exist to undertake extensive audits.

## EXISTING LEGISLATIVE AND CONSULTATIVE ARRANGEMENTS

The *Fisheries Act 1988 (NT)* expressly provides for the need for the Director of Fisheries to develop management plans for specific declared fisheries to conserve, enhance, protect, utilise, and manage the fish and aquatic life resources. The mud crab fishery is one such fishery.

The Mud Crab Fishery Advisory Committee (MCFAC) is the peak advisory group to the Director of Fisheries and is a statutory body appointed under the *Fisheries Act.* It has representatives from the commercial and recreational sectors and Government, but no indigenous, conservation or community representatives. MCFAC was responsible for the development of the Mud Crab Fishery Management Plan (the Plan) and continues to have a formal legislative requirement under the *Fisheries Act* to advise on the ongoing management of the fishery (Hay & Kelly 2002).

Informal consultation also takes place with representatives of peak sectorial groups, individuals and via a series of Aboriginal Consultative Committees which facilitate Government and indigenous discussion on marine issues (Hay & Kelly 2002).

There is a great deal of concerns by some stakeholder groups on the impact of the pending court cases dealing with indigenous aspiration to the marine resources of the NT. These concerns are based on the high level of uncertainty relating to long term resource access.

The existing Plan came into force in 1991 formalising arrangements from 1985 that capped potential commercial effort, access to the resource and regulated the recreational sector. The regime was conservative to allow for orderly development and to maximise sustainability of the fishery by minimising the chance of effort overrun and overcapitalisation, which is common in many developing fisheries (Calogeras & Hay 2001). Limited entry licensing, gear restrictions, area closures and minimum size limits were used to achieve the above aims, but no specific objectives have been legislated.

Any proposed amendment to the Plan must be made available for a minimum period of public scrutiny and comment prior to drafting and implementation. The Plan is currently under formal review with the following specific objectives proposed (NTG 2001):

- to maintain long term sustainability of the resource
- to achieve the optimal and quality yield mix from the resource
- to minimise impact on unretained catch, protected wildlife, the environment and the ecological processes on which they rely
- to create equitable, quality fishing opportunities for all stakeholder groups
- to govern through a cost effective, easily understood and administered management regime.

Key performance indicators and triggers are proposed to compliment these objectives (NTG 2001).

As a result of the recent public comment periods, for the management plan review and the EA environmental assessment, there has been no support for a significant change in the existing management arrangements, although aspects of allocation to indigenous groups were raised. No comments were received supporting a change to quota management (MCFAC – unpublished report 2002).

The *Fisheries Act* has general provisions that allows for quota-based fisheries, but many of the basic requirements necessary to adequately manage an ITQ wild harvest fishery are missing. Therefore any specific change to ITQ would require a rewrite of the Plan as well as significant amendments to the *Fisheries Act*. These major deficiencies are a lack of provisions to allow for:

- allocation and adjustment measures
- a simple appeals process
- definition of rights
- cost recovery provisions
- adequate compliance powers and penalties;
- clarity over assessments, TAC setting and risk levels.

There are also no policies or legislation in place to address issues such as compliance strategies, implementation processes or 2$^{nd}$ generational matters.

**Table 1:** Commercial Catch and Effort in the NT Mud Crab Fishery by Major Area 1984 – 2002

| Year | Total | | Borroloola | | Roper | | Blue Mud | | West | | Darwin | | Arnhem | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Catch | Effort | Catch | Effort | Catch | Effort | Catch | Effort | Catch | Effort | Catch | Effort | Catch | Effort |
| 02 est | 700000 | 1000000 | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* |
| 01 | 1139000 | 1034412 | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* | NA* |
| 00 | 1037755 | 983524 | 533992 | 453580 | 277289 | 225120 | 73300 | 64860 | 487 | 1800 | 130202 | 207564 | 23410 | 30600 |
| 99 | 754812 | 981060 | 315175 | 430680 | 199903 | 253380 | 115044 | 113700 | 70 | 540 | 99016 | 148080 | 25605 | 34680 |
| 98 | 528325 | 1042157 | 285983 | 543570 | 134301 | 222000 | 34380 | 43035 | 1933 | 10320 | 47842 | 171872 | 23886 | 51360 |
| 97 | 595014 | 936276 | 329518 | 407100 | 152847 | 267102 | 18966 | 24780 | 4050 | 12360 | 58448 | 151494 | 31185 | 73440 |
| 96 | 572704 | 846204 | 333664 | 397315 | 169254 | 280850 | 10587 | 19680 | 738 | 3945 | 40280 | 106839 | 18181 | 37575 |
| 95 | 264263 | 656329 | 115043 | 262118 | 74835 | 185170 | 12020 | 20880 | 706 | 3444 | 38715 | 129007 | 22945 | 55710 |
| 94 | 199060 | 622092 | 87547 | 288145 | 55364 | 143980 | 4142 | 8520 | 3331 | 14400 | 26979 | 105127 | 21698 | 61920 |
| 93 | 226222 | 547794 | 129475 | 256860 | 512000 | 127781 | 11295 | 25025 | 1029 | 1920 | 19964 | 80538 | 13259 | 55670 |
| 92 | 192722 | 510968 | 95213 | 193120 | 56881 | 125700 | 6754 | 19440 | 1601 | 12280 | 23594 | 135758 | 8680 | 24670 |
| 91 | 143064 | 410088 | 47109 | 85860 | 53864 | 136380 | 0 | 0 | 1804 | 6570 | 31772 | 158858 | 8514 | 22420 |
| 90 | 134152 | 462920 | 38701 | 84720 | 22275 | 61740 | 0 | 0 | 1222 | 3240 | 64264 | 281120 | 7690 | 32100 |
| 89 | 174498 | 417578 | 30568 | 45600 | 80385 | 142380 | 0 | 0 | 123 | 400 | 58377 | 213102 | 5046 | 16096 |
| 88 | 115757 | 369150 | 25191 | 65160 | 46175 | 88025 | 0 | 0 | 2096 | 10855 | 40336 | 195214 | 1960 | 9896 |
| 87 | 129361 | 356136 | 35091 | 72055 | 37463 | 62154 | 0 | 0 | 1045 | 4694 | 50361 | 185429 | 5402 | 31804 |
| 86 | 95496 | 235933 | 43309 | 73824 | 7021 | 12907 | 19 | 65 | 2640 | 5520 | 38273 | 129697 | 4234 | 13920 |
| 85 | 90260 | 193462 | 44707 | 65490 | 1811 | 4090 | 0 | 0 | 1382 | 4564 | 40051 | 112278 | 23090 | 07040 |
| 84 | 18795 | 63568 | 4678 | 8810 | 3062 | 21406 | 146 | 450 | 0 | 0 | 10909 | 32902 | 0 | 0 |

NA* - this data was not available from the Fisheries Division

Major areas for compulsory commercial logbook reporting purposes based on the fishing grids below (see Appendix II for grid map).

| | |
|---|---|
| Arnhem | 1129, 1130, 1131,1132,1134,1229,1234,1235,1236 |
| Darwin | 1230,1231,1232 |
| West | 1529,1429,1329,1330,1530 |
| Blue Mud | 1335,1336 |
| Roper | 1434, 1435, 1535 |
| Borroloola | 1536, 1537,1636,1637 |

## DISCUSSION - SUITABILITY OF ITQ FOR NT MUD CRAB FISHERY

This paper now considers the information obtained in the first general section of the dissertation on quota management and applies the major issues identified to the NT Mud Crab Fishery.

Importantly this dissertation does not attempt to assess the appropriateness of the existing management regime in place, but instead undertakes a theoretical appraisal of the suitability or otherwise of the fishery for ITQ management.

By undertaking the extensive general review of quota management it provided an understanding of the implications for fisheries in general. This was invaluable in identifying the key aspects of quota management, pitfalls, as well as ways to ensure that a new system would have the greatest chance of success.

By recording the characteristics of the NT mud crab fishery and taking cognizance of the key issues identified in Appendix I, it ensured that all major aspects of the fishery that should be considered for ITQ management were documented.

It is proposed to consider these key issues, by posing a series of questions relating to ITQ management and then responding, based on the characteristics of the NT mud crab fishery.

**Can a valid annual stock assessment and subsequent TAC be determined for the NT mud crab fishery?**

Having an annual TAC has been identified as one of the factors that ITQ fisheries live or die by.

Although many of the basic characteristics of the fishery are well documented, significant doubts exist about the validity of effort, reported catch and spatial activity and these variables are generally the basis of most stock assessment models.

The understanding of the biology of the fishery is also deficient in some crucial aspects in that there is little knowledge of offshore stages of the lifecycle, recruitment, mortality, range and movement.

There is also a high level of uncertainty in estimates of harvest rate and factors affecting stock size and catchability of mud crabs. Although it is believed that crab numbers are affected by environmental factors, which can significantly influence recruitment and survivability in the fishery, no research has, or is planned to verify this. Also, there is no recent measure of catches for non-commercial sectors to factor into any assessments.

Even by undertaking a series of workshop with recognised stock assessment experts, it has proved impossible to determine biomass, stock size or any other measure of

resource availability from which to determine a scientifically validated TAC using existing assessment tools. This problem is exacerbated as many current models were developed for finfish and continually growing species, not necessarily short lived, highly fecund species that moult such as mud crabs (Perry et al 1999).

Commercial catches have been increasing for the last 15 years, but will most likely show a decrease of up to 40% in 2002. The use of averages is therefore not considered a scientifically defendable option for setting the TAC, as catches in the fishery are still fluctuating and there is no real understanding of the basis for these variations (Anderson 1997). Therefore an averages based TAC could place the resource under threat, or forgo economic gain.

ITQ's could bias catch towards specific crab types based on market preferences i.e.; small males and females for domestic or extra large males for export. This may have some impact on the resource depending on whether quota is issued in crab numbers or weight, as the difference in size can be significant. For example legal size crab range from around 350g to over 2kg (Knuckey 1999). This means a quota of 10t could account for the removal of between 5,000 to 28,500 individuals. The impact of this on the resource would need to be assessed.

Little is know about the distribution of the two species taken in the fishery. Although the catch of *S. olivacea* is currently low, if activity moved to new areas, especially the western NT, the catch of *S. olivacea* could increase substantially as it is believed the species may be more prevalent in those areas. That being the case it is unclear if *S. serrata* and *S. olivacea* should be separate quota species or not. Distributions and abundance of these two species needs to be clarified to resolve this matter.

Fishery independent sources of data are currently being developed through an FRDC project, which uses habitat and estimates of abundance per area of habitat as a proxy for stock size. This information may be suitable for use in future stock assessment models. However, this project still relies on the same fishing method as the commercial sector, enticing crabs into baited pots and therefore may have many of the same biases.

If theoretically a stock estimate can be developed, the appropriate harvest level would still need to be determined to calculate the TAC. Current harvest levels are estimated at about 70-90% of the stock in areas heavily fished. However, there is no understanding of the rate of replenishment from new recruits, migration from unfished areas and the impacts of high harvest rates during times of low recruitment. Although protection of as little as 10% of the biomass, as with blue crab in the USA may be sufficient (Greer 2000), no safe limit has been determined at this stage.

**Is there clarity over the long-term jurisdictional control of the resource?**

The NT currently has jurisdictional control of the resource under OCS arrangements and shares that responsibility with no other state.

However, this may become an issue in the future, as numerous questions are still unresolved in respect to long term indigenous rights, including those resulting from pending native title and Aboriginal Land Rights claims which seek to gain control, or restrict access to the resource, waters and land.

This uncertainty clouds the ability of Government to determine access with certainty, especially as much of this fishery occurs in the rivers and intertidal area adjacent to Aboriginal land. As such, any rights attributed under quota would have to be issued subject to resolution of these issues.

On the other hand, quota could potentially be used as a tool to resolve this ongoing social and legal issue by allocating a portion of any existing and future quota to indigenous Australians. This proved successful as a legal bargaining tool in NZ where 40% of quota was allocated to Maori as part of the Treaty of Waitangi settlement (Dewees 1999). Its resolution was believed to have been a less painful process due to the ability to use quota to allocate rights (O'Regan 1996, Batsone & Sharp 1999, Hersoug 2000).

**Is the legislation and policies in place to make the change to quota management?**

This question covers a range of matters and includes provisions relating to tools for allocation, cost recovery and implementation processes.

Although the *Fisheries Act* has general provisions that allow for quota-based fisheries, many of the basic requirements necessary to adequately manage an ITQ based wild harvest fishery are missing. Therefore, any change to ITQ would require a rewrite of the Plan as well as significant amendments to the *Fisheries Act*.

These major deficiencies relating to a lack of provisions allowing for:

- allocation and adjustment measures
- simple appeals process
- definition of rights
- cost recovery
- adequate compliance powers and penalties;
- clarity over assessments, TAC setting and risk levels.

In respect to allocations, mechanisms are proposed in the draft management plan to determine the percentage share of catch per stakeholder groups. These provisions would need to be enshrined in the *Fisheries Act*, as well as determining how they would be used in any allocation or adjustment formula. Clarity of non-commercial and commercial rights are not addressed at all. Further, as non-commercial allocations do

not generally provide quantifiable rights, they are often difficult to clarify in legislation (Branson 1994, Bess & Harte 2000).

It has been suggested by some sources, to minimise complaints of Government bias, that an independent group be convened to distribute quota, but no provisions exist for such a group. Neither do they exist to allow the use of auction or tender as a means to allocate quota.

The only appeals process now available relies on matters going before the Local Court. It is therefore slow, adversarial, cumbersome and not a fishery specific means to quickly and efficiently deals with disputes over quota. The SET was a prime example of a fishery without a well thought out appeals structure. This contributed significantly to the difficulties experienced in that fisheries quota allocation process.

The existing legislation does not have provisions to extract a cost recovery from Industry for any quota scheme or means to disburse those funds, if collected. As this aspect is often a key matter when discussions about the use of ITQ's are taking place this is a high priority.

To effectively undertake compliance for ITQ fisheries there is generally a need to change the focus of enforcement from a field based function to that of auditors. This would require extensive provision to be included in the Act to allow officers to undertake sophisticated audits and inspections of a wide range of records of all those persons and companies involved in the catching, transporting, storing and selling of quota species.

As can be seen extensive policy and legislative work would be required to deal with the above general issues as well as for the development of compliance strategies, over harvest policies, 2nd generational issues, implementation processes as well as fishery specific provisions.

As previously mentioned, relatively simple changes to legislation seeking to increase penalties, which have been supported by all stakeholders, still have not been drafted although agreement was reached in 1996.

An additional matter that would need to be considered is broadening the representation at the formal consultative forum, MCFAC, to include other stakeholders such as indigenous, conservation and community representatives.

**Can the existing administrative system cope with a change to quota management?**

As there are only a small number of operators in the NT, it should not prove difficult to develop an administrative system to manage under ITQ. However, many more people may need to be licensed/registered to provide returns and records to cover all stages of

handling of quota species. This may lead to a much greater load on staff and the system.

Even at this stage, the existing system appears inadequate in providing timely information relating to harvesting or licensing and as such, new data systems would most likely need to be developed. An example of this delay is evident in that there is no formal information on catch during 2002 at all and only general data for 2001 became available in late September 2002. Information would need to be available in a timelier manner for ITQ, especially as mud crabs are a short-lived species and the fishery targets year one and two classes.

None of the existing staff in Fisheries or MFEU have worked in an active quota system, no tort system is in place for registering and tracking quota and there would certainly be a need for officers with accounts and auditing training to come into the system.

As there is no legal officer in Fisheries, all legal queries must be outsourced, which can add to delays in finalising a range of issues that may arise with quota systems.

Adequate recruitment, training and the purchase and development of appropriate software, hardware and procedures would be a prerequisite to a change in management. These matters should not prove difficult to undertake in a well managed and resourced organisation, but recent funding by the NT Government to Fisheries has generally seen ongoing reductions in core funding.

**Does industry have the capacity to manage and deal with possible operational constraints under a quota system?**

Although the paper burden for fishers may increase with ITQ's, Industry should have the capacity to keep necessary records as the implementation of GST has forced an improvement in record keeping. This should enable fishers to better manage information requirements for compliance.

However, vessels and camps are basic and are not suitable for any sophisticated equipment or to accommodate observers. Most do not have satellite phones and none have computers or faxes. Also, most existing crabbers have very poor English skills and may have great difficulties in understanding the system, completing paperwork and easily complying with many technical requirements.

As operations currently occur in very remote areas, how and where compliance facilities and processes would be implemented would be an issue. Some concerns as to accurate record keeping for quota could occur with discarding of dead or slow crab prior to shipping to town and of actual weights if crabs are held in tanks at any stage of the process due to water uptake.

It is believed that the incidence of illegal activity may be high in the fishery at this time, but convictions are low. Achieving high levels of compliance to quota regulations may

be difficult at first and require a high level of control and enforcement presence with the associated costs.

Many of the above matters may be less of an issue as quota shifts to 2nd generational owners who may seek to improve infrastructure, employ better equipped fishers and improve and manage the product flow and paper trail more efficiently.

**Is there strong stakeholder support for a change of management technique through an inclusive process?**

There has been no apparent support from any source, especially the major stakeholder groups, identifying ITQ as a preferred option for the fishery. In fact, support has been solid for maintenance of the existing regime. A change to ITQ could therefore be difficult to implement due to the lack of support for such a move.

This may alter if stakeholders could clearly see the aim of any change and the resultant benefits. This would be more likely to occur if stakeholders were heavily involved in the development of any new regime and were well educated on the pros and cons of ITQ management. This particular industry has already made cultural shifts and have shown they are prepared to resolve issues internally if a benefit can be seen. This is evident in recent examples such as developing a code of practice, pressuring Government for higher penalties, banning the take of empty crabs and increasing size limits.

As previously mentioned the existing consultative process would need to become more inclusive before any changes should be considered. If there was a Government policy shift to consider quota, additional representatives should be at the table to discuss clearly the needs for any change and what the proposed outcomes, costs and benefits to all groups would be.

**Will there be a social or economic benefit if quota was implemented?**

As no analysis has been undertaken as to the economic benefits and social impacts that flow from the existing fishery, let alone under a different regime scenario, it is difficult to determine if there will be any discernable costs or benefits. This is often very difficult to demonstrate conclusively anyway, as costs are often more quantifiable in the form of equipment or job loss, but the benefits may be less tangible and take longer to be realised and therefore are harder to quantify or 'prove' to stakeholders.

However, there may be significant inefficiencies in the fishery that output based management could improve. Matters such as limiting over-capitalisation, changing the culture to fish for quality not quantity, and encouraging greater cooperation in respect to compliance and research could be addressed.

Theoretically there may be advantages from a fishery efficiency and marketing perspective as the need to out-compete other fishers may diminish if ITQ's were implemented at an appropriate level so that fishers could target catch to maximise

returns. This may prove to be difficult in practice due to constraints based on market requirements, sex and size preference, seasonal changes in sex composition, crab quality and quantities.

Currently there isn't a full costing of compliance. Such an exercise would provide an opportunity to compare the existing costs with any proposed costs under quota management. However, for this to take place a precise compliance strategy would also need to be developed so that stakeholders can assess any benefits that may flow from the change. It must also be remembered that costs generally increase under ITQ.

There would almost certainly be greater costs to industry through some cost recovery scheme. The actual impact on their businesses is difficult to determine at this stage without more information. However, there will be additional imposts, including the need to fund lawyers, stock assessment experts and brokers as well as dealing with capital gains tax and stamp duty arising from the purchase, sale and transfer of quota.

On the other hand existing Government resources spent on administering and managing the fishery could be redirected to other projects if cost recovery was put in place. An interesting problem arises under a cost recovery scenario if catches decline and industry does not have the resources to adequately fund research, compliance and administration. Who would fund these activities?

In nearly all cases the development of ITQ fisheries sees a downsizing of operations in smaller towns with a resultant decrease in employment. There is no reason to expect any difference in the NT.

A particularly difficult issue relates to what affects there will be to society from the giving away of a common property resource to a few, especially with the uncertainty of access in the NT due to unresolved indigenous issues. However, it must be remembered that bringing in ITQ does not necessarily mean that Government has to surrender control, or rights to assert state ownership. It only provides a right to access and exploit the stock under criteria and rules defined by the property right (Economic Consulting Services 1997).

## CONCLUSION

This study has sought to clarify the issues involved in implementing a quota management regime and to then determine if such a scheme could be used in the NT mud crab fishery. The discussion is timely as the fishery has been subject to a series of formal reviews through periods of public consultation.

This dissertation has shown that the use of quota as a fisheries management tool could have positive as well as negative outcomes, often depending on a range of factors relating to stock status, resources available, level of stakeholder support and understanding of the fishery to name a few. It is important to remember that there may be no correct answer when it comes to selecting a fishery management regime.

However, whatever system is used, it should be able to be adjusted over time to take into account changes in fishing activity, stock size, unforeseen natural perturbations and to meet management objectives which may change over time. As the system becomes more complicated, there will invariably need to be a high level of control and this could reduce some efficiency benefits that may flow from ITQ.

This analysis has showed that, at the present time, there would appear to be few benefits in moving to ITQ management in the fishery. The key reasons for this finding are highlighted below.

There are a number of practical difficulties that may limit the effectiveness of quota management, such as the remote nature of the fishery, small inadequate vessels, basic camps and lack of equipment such as phones, faxes or computers. Also, the poor English skills of most crabbers may make it difficult for them to understand and comply with many of the complex requirements that are part of a quota based system. This would almost certainly require a high level of enforcement to achieve a high level of compliance, especially in the early stages of implementation.

Numerous questions are still unresolved in respect to long term indigenous rights, including those resulting from pending native title and Aboriginal Land Rights claims which seek to gain control, or restrict access to the resource, waters and land. This clouds the ability of Government to determine access and rights with certainty, especially as much of this fishery occurs in the rivers and intertidal area adjacent to Aboriginal land. This is an important aspect for any quota issued under an ITQ system, as any rights attributed under quota would have to be issued subject to resolution of these issues. On the other hand, quota could potentially be used as a bargaining tool to resolve this matter by allocating a portion of any quota to the relevant indigenous Australians.

Quota management lives and dies on the setting of an annual TAC and being able to adjust it regularly to reach some level of long term sustainable catch. This investigation showed that due to the uncertainty about stock size and inability to set a biologically

valid TAC there is little identifiable benefit in putting in place quota to protect the resource. As a result, any catch limit would most likely need to be set conservatively to minimise risk to the resource and this could possibly forgo future economic gain.

The use of averages is also not considered a viable option for setting the TAC as the fishery is still subject to substantial unexplained fluctuations. The use of averages when a fishery is in such a state is fraught with danger.

Although not possible to quantify, due to a lack of any economic or social data, there may however be benefits from a fishery efficiency and marketing perspective. Matters such as limiting over-capitalisation, changing the culture to fishing for quality not quantity, and encouraging greater cooperation in respect to compliance and research could possibly be addressed. Theoretically these efficiencies may come about as the need to out-compete other fishers may diminish if ITQ's were implemented at an appropriate level so that fishers could target catch to maximise returns. This may prove to be difficult in practice due to constraints based on market requirements, sex and size preference, seasonal changes in sex composition, crab quality and quantities. As a prerequisite to any significant management change a socio-economic evaluation should be undertaken

Although the *Fisheries Act* has general provisions that allow for quota-based fisheries, significant legislative and policy work would be required to underpin any change to ITQ management to deal with issues such as:

- allocation and adjustment measures, including the use of an independent group, 2$^{nd}$ generational issues and over harvest policies
- simple appeals process
- definition of rights for all sectors
- cost recovery and disbursement provisions
- adequate compliance powers and penalties
- clarity over assessments, TAC setting and risk levels.

To undertake all the above would require extensive changes to the existing legislation and based on past performance this would take considerable time to complete.

Importantly, there has been no support from any source, especially the major stakeholder groups, identifying ITQ management as a preferred option for the fishery. Support has been solid for maintenance of the existing regime and participants support for change has been identified as a crucial aspect to undertake this or any other type of management change. Based on precedents in other fisheries, a change to ITQ may be difficult to implement in the face of such a lack of support unless stakeholders could clearly see the aim of any change and the resultant benefits. This would be more likely to occur if stakeholder groups were heavily involved in the development of any new regime and were well educated on the costs/benefits of ITQ systems.

The existing consultative process needs to become more inclusive to provide a forum for indigenous, community and environment representatives as well as the existing commercial, recreational and Government representatives. These additional representatives should be at the table to discuss the needs for any change and what the proposed outcomes and benefits would be to all groups and the resource. It must be remembered that the best outcomes generally come about through a full consultative process.

Based on the evidence to date there would appear to be few, if any, benefits in a move to ITQ management in the fishery at this stage. However, if the following were adequately addressed a change could possibly be considered at some time in the future:

- identify the reason for change and determine if the existing system can fix it
- if the existing system is deficient, determine if ITQ can provide the outcome desired - if so set clear objectives and timelines
- ensure a reliable and timely TAC can be set and adjusted, based on the fisheries perturbations
- have a system in place to handle the change
- develop cost recovery options and agreement on who will pay for what
- ensure the allocation and appeals process is fool proof
- develop a compliance and research strategy
- undertake a full costing
- gain stakeholder support through a transparent consultative process.

The NT Mud Crab fishery still has a long way to go before the above prerequisites have been addressed. The best advice would appear to be to not make decisions in haste. Fully cover the essential issues noted above before venturing too much further down the quota management route, as once you go down the road, turning back is difficult.

# APPENDIX I: DECISION ANALYSIS TABLE FOR QUOTA MANAGEMENT

**KEY TO RATINGS**

- **H** well understood, process in place or considered
- **M** some understanding, some process in place or considered to some extent
- **L** little understanding, little process in place or not really considered
- **N** no, unclear or conflicting understanding or process in place or not considered

| ***KEY FACTOR*** | **RATING** | **COMMENTS ON KEY FACTORS** |
|---|---|---|
| ***FISHERY CHARACTERISTICS/STOCK ASSESSMENT*** | | Many of the basic characteristics of the fishery are quite well documented. |
| *species taken* | H | |
| *catch* | M | Doubts exist about the validity of effort due to reported overpotting, multiple |
| *effort* | M | checking and the targeting nature of the fishery. Likewise, reported catch which is |
| *participants* | H | rising, only relates to crab that arrives at the processors and does not include |
| *existing licences* | H | mortalities from point of capture to the processor, who may or may not report |
| *vessels* | H | moralities. |
| *fishing patterns* | H | |
| *areas fished* | H | There is no economic assessment of the fishery. |
| *bycatch* | H | |
| *selectivity* | H | There may be significant inefficiencies in the fishery. |
| *ports of landing* | H | |
| *preferred catch* | H | Domestic market preference is for female and smaller crabs and larger males for |
| *value of fishery* | H | export. Highgrading under quota management could bias catch towards specific |
| *level of capitalisation* | N | crab types. |
| *economic profile* | N | |
| *marketing* | H | Much basic biological information on the fishery has been gathered, but offshore |
| *reproductive behavior* | H | stages of the lifecycle, recruitment to the fishery range and movement are not well |
| *larval dispersal* | N | understood. There is a high level of uncertainty in estimates of harvest rate, |
| *lifespan* | H | mortality, recruitment and factors affecting stock size and catchability of mud crabs. |
| *recruitment* | L | |
| *growth* | H | The fishery is believed to be fully exploited, but there is a high level of uncertainty in |
| *age /size at maturity* | H | this assessment. |
| *age structure* | H | |
| *mating success* | H | It has proved impossible to determine biomass, stock size or any other measure of |

| | | |
|---|---|---|
| *sex ratio* | H | available resource from which to determine a scientifically justified Total Allowable Catch. |
| *catchability* | N | |
| *range and distribution* | L | |
| *aggregation patterns* | L | Catches have been increasing for the last 15 years, but have suffered a significant decrease in 2002, so the use of averages is not a defendable option for setting a TAC. |
| *preferred habitats* | L | |
| *movement or migration* | L | |
| *mortality* | M | |
| *migration* | L | There is little understanding of the place that the mud crab has in the ecosystem and the impact of the existing harvest. It is believed that crab numbers are affected by environmental factors that significantly influence recruitment and survivability in the fishery, but nothing is verified. |
| *stock structure* | M | |
| *stock units* | L | |
| *harvest and exploitation rates* | M | |
| *vulnerability to capture* | M | |
| *virgin biomass* | N | Fishery independent sources of data are currently being developed through an FRDC project. This may provide a greater understanding of stock size on completion in 2005, but the project still relies on enticing crabs into baited pots. |
| *development status of fishery* | M | |
| *live - v - processed weight* | H | |
| *safe harvest levels* | N | |
| *uncertainty in estimations* | H | The fleet vessels are generally under 5 metres and there is no provision for observers or onboard verification. |
| *level of risk* | H | |
| *use of averages to set TAC* | N | |
| *environmental impact / understanding of random fluctuations* | L | |
| *place in ecosystem* | N | |
| *fishery independent data* | L | |
| *monitoring program* | M | |
| *observer programs* | L | |
| *spatial abundance* | L | |
| ***ALLOCATION*** | | |
| *jurisdiction* | H[*1] | The NT Government has management control of the resource and shares that responsibility with no other state. [(1)] However, native title issues cloud the ability to determine access with certainty, with legal challenges to the states right to manage the resource pending. This is especially relevant as much of this fishery occurs in the intertidal area and as 84% of the coastline is adjacent to Aboriginal land, which extends to low water. Resource ownership may become an issue in the future. |
| *international conventions & instruments* | H | |
| *ownership of resource* | N | |
| *legally defensible mechanism* | N | |
| *quota proportional or fixed* | N[3] | |
| *ability to alter quota mid season* | N[3] | |
| *allocation method* | N[3] | |

| | | |
|---|---|---|
| *appeals process* | M[*2] | The Act allows for quota based fisheries and the new proposed objectives for the fishery specify that allocations must be optimal and fair. If quota was appropriate it could be put in place, but this would require a rewrite of the management plan.<br><br>Mechanisms are proposed in the reviewed management plan to determine share of catch for stakeholder groups.<br><br>There is no allocation method or definition of rights in the Act. Additional difficulties may arise as the licensees do not fish and have used numerous crabbers on their licence over time. A fair method will be difficult to determine.<br><br>(2) Appeals after an internal assessment by Fisheries must go to the Local Court for judgement.<br><br>If experimental fishing takes place in unfished areas, (which equates to around 50% of the Territory), there may be additional resource available.<br><br>(3) Policies required for quota management do not exist and still need to be developed. |
| *certainty of process* | N[3] | |
| *chance of political interference* | H | |
| *consultative process* | H | |
| *decision rules in place* | N[3] | |
| *definition of rights* | N | |
| *legislation in place* | N | |
| *over harvest and carry over policy* | N[3] | |
| *minimum and maximum holdings* | N[3] | |
| *foreign ownership* | H | |
| *TAC share for each group* | L | |
| *equity rules* | N[3] | |
| *decision rules* | N[3] | |
| *timelines* | N[3] | |
| *access to initial quota* | N[3] | |
| *new resource discoveries* | N[3] | |
| *2nd generational issues* | N[3] | |
| *transition periods* | N[3] | |
| ***COSTS*** | | |
| *cost recovery options* | N | There is currently no means to recover costs in the NT legislation. This will require a change to the Act.<br><br>Determination of the exact costs of management may be difficult to determine. The two different arms of Government (Fisheries and PFMEU) need to liaise closely to fully cost the fishery out. Nothing has been published, or been made available to stakeholders to date.<br><br>Without an agreed compliance strategy that can be considered it is also difficult for stakeholders to assess the benefits of any management change.<br><br>(4) There is a need to undertake an economic profile of the fishery to determine if the capacity to pay for management, administration and compliance exists. |
| *capacity for industry to pay* | N[4] | |
| *research funding* | M | |
| *contribution to conservation* | M | |
| *cost of management regime* | N | |

| | | |
|---|---|---|
| | | Some existing research funding takes place through an industry levy and options are available to channel existing licensing monies towards research.<br><br>Conservation contributions have been addressed through the Code of Practice and fishing practices adopted across the whole fishery. |
| ***ADMINISTRATIVE CAPACITY***<br>*sufficient trained staff*<br>*technical expertise available*<br>*technology in place*<br>*ability to meet deadlines*<br>*tort and licensing system* | <br>N<br>N<br>N<br>N<br>N | There are only a small number of licences in the NT, so in theory it should not prove difficult to develop an administrative system to manage under quota.<br><br>The existing databases can not supply or track in a timely way for fishery information relating to harvesting or licensing. New data systems would need to be developed.<br><br>A number of simple changes to legislation were agreed to by all stakeholders in 1996 and have not been enacted yet – significant changes to move to quota would take many years to resolve.<br><br>None of the existing staff have worked in a quota system before, no tort system is in place and there is no legal officer in Fisheries.<br><br>The NT Fisheries Division and the PFMEU are not equipped to move to quota. |
| ***LEGISLATION AND COMPLIANCE***<br>*compliance strategy*<br>*staff trained to enforce quota*<br>*capacity to keep records*<br>*high grading*<br>*black market potential*<br>*reporting to stakeholders*<br>*continue with existing controls*<br>*adequate legislation to cover all matters* | <br>N<br>N<br>M<br>N<br>N<br>N<br>H<br>N | There is no existing strategy or compliance reports prepared. A strategy would need to be developed for quota management.<br><br>Officers would need extensive training.<br><br>Issues of high grading and black market potential could increase if the value of the product increased due to reduced supply via quota. However, an effective paper trail could reduce the incidence of these issues occurring.<br><br>Industry has the capacity to keep records but their vessels/camps are not really suitable for any sophisticated equipment. Some concerns as to accurate record keeping could occur with discarding of dead or slow crab prior to shipping to town |

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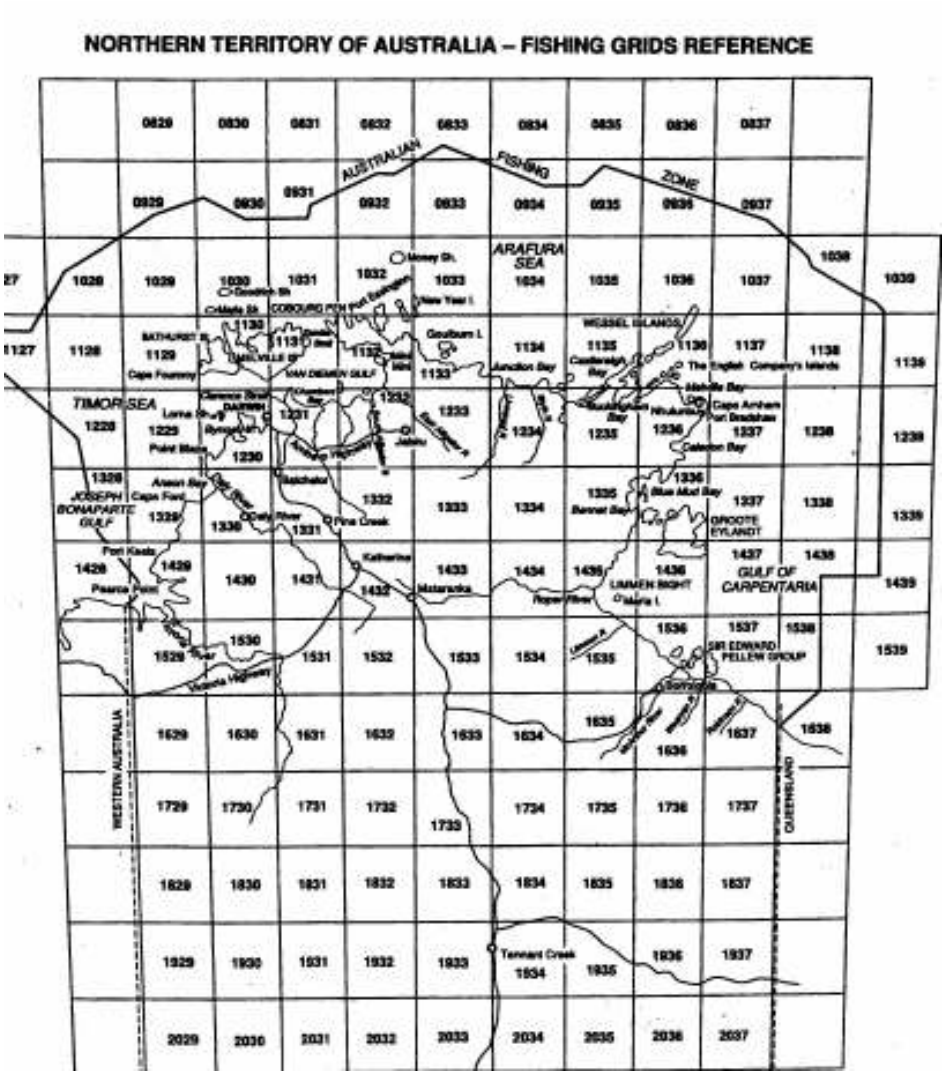
| | | and of actual weights if crabs are put into tanks due to the water take up.<br><br>There would most likely need to be continuation of many of the existing controls, especially relating to minimum size as markets favor smaller crabs which are often immature or have not had a chance to contribute to the reproductive capacity o the fishery.<br><br>The existing legislation is deficient in many of the basic requirements for quota management. |
| ***STAKEHOLDER SUPPORT***<br>*consultative process*<br>*social issues and impacts*<br>*impact on remote areas*<br>*management objectives*<br>*measures of success*<br>*understanding of input and output management* | <br>M[5]<br>N<br>N<br>N[6]<br>N<br>L | No submission supporting a change to output management were received during the period of public comment for the management plan or EA assessments.<br><br>[5] The existing consultative process is deficient in that there is no indigenous, community or environment representatives.<br><br>[6] The proposed objectives and measures for the fishery in the draft management plan would allow quota management. A change in Government policy and significant consultation would be required to make such a change and clear needs and outcomes still need to be identified.<br><br>No analysis has been undertaken as to the economic benefits and social impacts that flow from the existing fishery, let alone if the regime was changed. |
| ***OTHER MANAGEMENT OPTIONS***<br>*level of risk of change of technique*<br>*refugia*<br>*closures*<br>*constant exploitation*<br>*effort controls*<br>*fishing territories* | <br>H<br>H<br>H<br>N<br>H<br>H | These have been discussed and considered in the recent reviews. Maintaining the existing controls was favored. |

## APPENDIX II: NT FISHING GRID MAP USED FOR FISHERIES REPORTING PURPOSES



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