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Management Objectives in New Zealand's ITQ System

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Abstract

Management of New Zealand's fisheries is based on two broad over-riding goals – providing for the utilisation of fisheries resources while ensuring sustainability. Current fisheries legislation requires that a very specific sustainability objective be met, i.e. the Total Allowable Catch (TAC) must be set at a level that will maintain stocks at or above a level or move them towards the level that will support the Maximum Sustainable Yield. The Total Allowable Commercial Catch (TACC) is set within the TAC after allowing for Maori, recreational, and other non-commercial interests. The levels at which both the TAC and TACC are set can be qualified by economic factors, environmental factors, fishing patterns, interdependence of stocks and generally recommended standards. To deal with the large differences in the quality and quantity of information available for different stocks, yield estimation is based on two interpretations of MSY. The application of the sustainability and other objectives to the important snapper, hoki, and orange roughy fisheries is described.

Keywords: management objectives, maximum sustainable yield, New Zealand, sustainable utilisation, total allowable catch, total allowable commercial catch

Introduction

A Quota Management System (QMS) using Individual Transferable Quotas (ITQs) was introduced into New Zealand's fisheries on 1 October 1986. As of 1 July 1996 there were 30 species or species groups in the QMS. The fishery for each species is divided into a number of different fishery management units, officially designated as Fishstocks.The number of Fishstocks range from 2 to 10 for any given species, with a total of 179 different Fishstocks in the QMS. There are 10 different Quota Management Areas (QMAs) (Figure 1) in the QMS, and each Fishstock is composed of one or more QMAs. Each of the 179 Fishstocks has a Total Allowable Catch (TAC) which is reviewed annually.

Management Objectives

Management of New Zealand's fisheries is based on two broad over-riding goals – providing for the utilisation of fisheries resources while ensuring sustainability. These terms are defined in New Zealand legislation as follows:

Sustainability means

(a) maintaining the potential of fisheries resources to meet the reasonably foreseeable needs of future generations, and

(b) avoiding, remedying, or mitigating any adverse effects of fishing on the aquatic environment.

Utilisation means

conserving, using, enhancing, and developing fisheries resources to enable people to provide for their social, economic, and cultural well-being.

In addition the legislation has a set of *environmental principles* that requires the recognition of and provides for the maintenance of:

(a) associated or dependent species, and

(b) the range of aquatic ecosystems and their genetic diversity.

Within the ITQ system the main instrument for achieving the sustainability goal is the TAC. Decisions on changes to and the setting of TACs are made annually by the Minister of Fisheries at the conclusion of a formal decision making process.

Current legislation requires that the TAC

- must be set at a level that will maintain stocks at or above a level or move them towards the level that will produce the Maximum Sustainable Yield (MSY)

- as qualified by

  economic factors
  environmental factors
  fishing patterns
  interdependence of stocks
  generally recommended standards

Within the TAC the commercial sector is allocated a Total Allowable Commercial Catch (TACC). The TACC is set allowing for

- Maori customary non-commercial fishing interests
- recreational interests
- other non-commercial interests
- any allowable catch for foreign fishing

Before reducing a TACC to achieve the sustainability goal, regard must be given as to whether or not the imposition of other controls on the taking of fish would be sufficient to maintain the fish stock at a level where the TACC could be sustained.

Definitions of Maximum Sustainable Yield

Because of the large differences in the quality and quantity of information available for different Fishstocks, an assessment strategy based on two interpretations of MSY has been developed. The first is a static interpretation and is called the Maximum Constant Yield (MCY). It is based on taking the same catch from the fishery year after year. The second is a dynamic interpretation and is called the Current Annual Yield (CAY). It is recognised that as fish populations fluctuate in size, it is necessary to alter the catch every year to get the best yield from the fishery

Estimates of MCY and CAY are used as biological reference points when setting TACs and don't necessarily translate directly into TACs. However, estimates of the biomass that will produce MCY or CAY are used as estimates of the stock size that will support the MSY. Other information, such as results from fishery models, is used to determine if current TACs are allowing the stock to move towards a size that will support the MSY.

Maximum Constant Yield

MCY is defined as:

> The maximum constant catch that is estimated to be sustainable, with an acceptable level of risk, at all probable future levels of biomass

Five methods are used to estimate MCY. The method chosen for a particular Fishstock depends on the data available and the exploitation history of the fishery. The five methods are:

1. New fisheries

   $MCY = 0.25F_{0.1}B_0$

where B_0 is an estimate of virgin recruited biomass. New fisheries become developed fisheries once F has approximated or exceeded M for several successive years, depending on the lifespan of the species.

2. Developed fisheries with historic estimates of biomass

   $MCY = 0.5F_{0.1}B_{av}$

where B_{av} is the average historic recruited biomass and the fishery is believed to have been fully exploited.

3. Developed fisheries with adequate data to fit a population model

   $MCY = 2/3MSY$

where MSY is the deterministic maximum equilibrium yield. If the current biomass is less than the level required to sustain a yield of 2/3MSY then

$$MCY = 2/3CSP$$

where CSP is the deterministic current surplus production.

4. Catch data and information about fishing effort (and/or fishing mortality), either qualitative or quantitative, without a surplus production model

$$MCY = cY_{av}$$

where c is the natural variability factor, which depends on M and ranges from 0.6 to 1.0, and Y_{av} is the average catch over an appropriate time period.

5. Sufficient information for a stochastic population model

This is the preferred method for estimating MCY but is the method requiring the most information. It is the only method that allows some specification of risk associated with an MCY.

Current Annual Yield

CAY is defined as:

> The one year catch calculated by applying a reference fishing mortality, F_{ref}, to an estimate of the fishable biomass present during the next fishing year. F_{ref} is the level of (instantaneous) fishing mortality that, if applied every year, would, within an acceptable level of risk, maximise the average catch from the fishery.

The strategy of applying a constant fishing mortality, F_{ref}, from which the CAY is derived each year is an approximation to a strategy which maximises the average yield over time. This leads to the concept of the Maximum Average Yield (MAY), which is the long term average catch when the catch each year is the CAY.

Two methods are used to estimate CAY

1. Catch equation

Where there is an estimate of current recruited biomass, CAY may be estimated from the appropriate catch equation. The appropriate form of the catch equation depends on the way that fishing mortality occurs during the year. For many fisheries it is reasonable to assume that fishing is spread evenly through the year, so the Baranov catch equation is appropriate and CAY is given by:

$$CAY = (F_{ref}/(F_{ref} + M))(1 - e^{-(Fref + M)})B_{beg}$$

where B_{beg} is the stock biomass at the beginning of the fishing year.

2. Status quo methods

Where information is limited but the current (possibly unknown) fishing mortality is thought to be near the optimum, there are various "status quo" methods that may be applied.

Application to New Zealand's Fisheries

Of the 179 Fishstocks in the QMS, 30 were created largely for administrative purposes around an offshore island group that is lightly fished for a few species (QMA 10 in Fig. 1). Based on the 1995 stock assessments, only 14 (9.4%) were estimated to be below the size that will support the MSY (B_{MSY}). These were three orange roughy (*Hoplostethus atlanticus*), three snapper (*Pagrus auratus)*, and eight rock lobster (*Jasus edwardsii*) Fishstocks. Strategies to rebuild the stock size to B_{MSY} are now in place for all these Fishstocks. Twelve (8.1%) Fishstocks were estimated to be above and 48 (32.2%) at or near B_{MSY}. The status of the remaining 75 (50.3%) of Fishstocks relative to B_{MSY} was not known.

The application of the available stock assessment information to achieve the management objectives for the important orange roughy, hoki, and snapper fisheries is described below.

Chatham Rise orange roughy

New Zealand's largest orange roughy fishery is on the Chatham Rise in QMAs 3 and 4 (Fig. 1). This fishery is carried out offshore in 700 to 1500 m water depth and has no non-commercial fishing interests. As a result of successive stock assessments that indicated substantial reductions in stock size and unsustainable TACCs and catch levels, the TACC for this fishery has been reduced from a high of 38 300 t in 1988-89 to 7200 t for 1995-96.

The relevant 1994 (for the 1994-95 fishing year) and 1995 (for 1995-96) stock assessment results are summarised in Table 1. The population model for orange roughy indicates that B_{MSY} is 29% of B_0. The 1994 assessment indicated that the stock in 1994-95 would be at 10-17% B_0, half or less of B_{MSY}. The estimate of the status quo catch for 1995-96 was 8400 to 13 400 t. Further modelling indicated that a catch of 7200 t would provide a 75% probability that the stock size would increase from 1994-95 to 1995-96. The Minister of Fisheries decided to reduce the TACC for Chatham Rise orange roughy to 7200 t based on these results.

Hoki

The hoki fishery is managed as one Fishstock comprising QMAs 1 through 9 with one TACC. This fishery is carried out primarily offshore in 300 to 700 m and has no substantive non-commercial fishing interests. The hoki fishery developed from one with catches of about 30 000 t in the early 1980s to become New Zealand's largest fishery with a TACC of 240 000 t in 1995-96. Management is complicated by the fact that although two biological stocks are recognised (western and eastern stocks), they are managed under one TACC. This discussion will be confined to the western stock, where the results of recent stock assessments have indicated substantial increases in stock size during the last few years.

The relevant 1994 (for the 1994-95 fishing year) and 1995 (for 1995-96) stock assessment results are summarised in Table 2. The population model for hoki indicates that B_{MAY} is 38% of B_0. The assessments indicated that the stock would be at about 80% B_0 in 1994-95 and about 109% B_0 in 1995-96, substantially greater than B_{MAY}.

In 1994-95 the fishery on the western stock took 105 000 t out of a total catch of 175 000 t for the two stocks combined. The MCY estimate for the western stock for that year was 135 000 to 160 000 t and the CAY estimate 342 000 to 466 000 t. The stock assessment results indicate a large increase in biomass for the western stock in the next few years. There is a very low probability that biomass would be reduced below B_{MSY} in 5 years even with a TACC increase of 100 000 t, 70 000 t of which was assumed would be taken from the western stock. Despite the optimistic prognosis on stock size, for economic reasons the fishing industry supported only a modest increase in the TACC for 1995-96 from 220 000 t to 240 000 t .

Snapper

The snapper fishery is New Zealand's largest inshore finfish fishery with estimated landings of 6842 t by commercial fishers and 3260 to 3780 by non-commercial interests for all areas combined in 1993-94. The fishery in QMA 1 is the single largest snapper fishery, with commercial landings of 4831 t and an estimated non-commercial catch of 2600 t in 1994-95. Snapper is the most sought after species by recreational fishers and of significant cultural importance for Maori.

The relevant 1994 (for the 1994-95 fishing year) and 1995 (for 1995-96) stock assessment results for QMA 1 are summarised in Table 3. The population model for snapper indicates that B_{MSY} is 25% of B_0. The 1994 assessment indicated that the stock was about half B_{MSY} for the Hauraki Gulf/Bay of Plenty substock and the East Northland substock combined. The 1995 assessment separated the substocks with different results (Table 3).

The estimated combined commercial and non-commercial catch in 1994-95 of about 7400 t was greater than the estimated CSP for 1995-96 of 6930 t and would have resulted in a decline in stock biomass. As a result the Minister of Fisheries set a TAC of 5600 t for the fishery. The TACC was reduced from 4928 t to 3000 t and 2300 t set aside for recreational fishers and a specific allowance of 300 t made for Maori customary take.

Future Issues

Two major issues will face New Zealand's fisheries managers in the future as they attempt to meet the management objectives.

The first is the need to more clearly define the rights of non-commercial interests and their shares of the TAC. Currently input controls such as closed seasons and areas and bag and size limits are used to limit the non-commercial share of the catch. These have proven to be blunt instruments, and other mechanisms to quantify the non-commercial share are being investigated.

The second issue is the development of operational management objectives to satisfy the environmental principles of maintaining associated or dependent species and the range of aquatic ecosystems and their genetic diversity. These principles are contained in the fisheries legislation passed in 1996 and are new for fisheries managers to deal with.

Table 1. Estimates of biomass, yield, and the Total Allowable Commercial Catch for orange roughy on the Chatham Rise. $B_{MSY}(\%B_0)$ = the mid-season biomass that will support the Maximum Sustainable Yield as a % of the virgin biomass, $B_{CURRENT}(\%B_0)$ = the mid-season biomass in the particular year as a % of the virgin biomass, MCY = Maximum Constant Yield, CAY = Current Annual Yield, status quo catch is the catch that will result in no change in the beginning of season biomass from one year to the next, TACC = Total Allowable Commercial Catch

Estimate	1994-95	1995-96
$B_{MSY}(\%B_0)$	29%	29%
$B_{CURRENT}(\%B_0)$	10-17%	10-16%
MCY (t)	3500-5900	3100-5200
CAY (t)	2900-4800	3200-5100
Status quo catch (t)	7600-12 500	8400-13 400
TACC (t)	8000	7200

Table 2. Estimates of biomass, yield, landings and the Total Allowable Commercial Catch for the western stock of hoki. $B_{MAY}(\%B_0)$ = the mid-season biomass that will support the Maximum Sustainable Yield as a % of the virgin biomass, $B_{CURRENT}(\%B_0)$ = the mid-season biomass in the particular year as a % of the virgin biomass, MCY = Maximum Constant Yield, CAY = Current Annual Yield, TACC = Total Allowable Commercial Catch

Estimate	1994-95	1995-96
$B_{MAY}(\%B_0)$	38%	38%
$B_{CURRENT}(\%B_0)$	~80%	109%
MCY (t)	135 000-160 000	130 000
CAY (t)	342 000-460 000	540 000
Landings (t)	105 000	not available
TACC (t)	220 000	240 000

Table 3. Estimates of biomass, yield, catch, and the Total Allowable Commercial Catch for snapper in QMA 1. $B_{MSY}(\%B_0)$ = the mid-season biomass that will support the Maximum Sustainable Yield as a % of the virgin biomass, $B_{CURRENT}(\%B_0)$ = the mid-season biomass in the particular year as a % of the virgin biomass, MCY = Maximum Constant Yield, CAY = Current Annual Yield, CSP = Current Surplus Production, TAC = Total Allowable Catch, TACC = Total Allowable Commercial Catch

Estimate	1994-95	1995-96
$B_{MSY}(\%B_0)$	25%	25%
$B_{CURRENT}(\%B_0)$	13-15%	East Northland = 25% Hauraki Gulf/Bay of Plenty = 13%
MCY (t)	3470-6130	6930
CAY (t)	3400-6000	4110
CSP (t)	4300-8400	6930
Total catch (t)	7431	not available
Commercial	4831	not available
Non-commercial	2600	not available
TAC (t)	not set	5600
TACC (t)	4928	3000

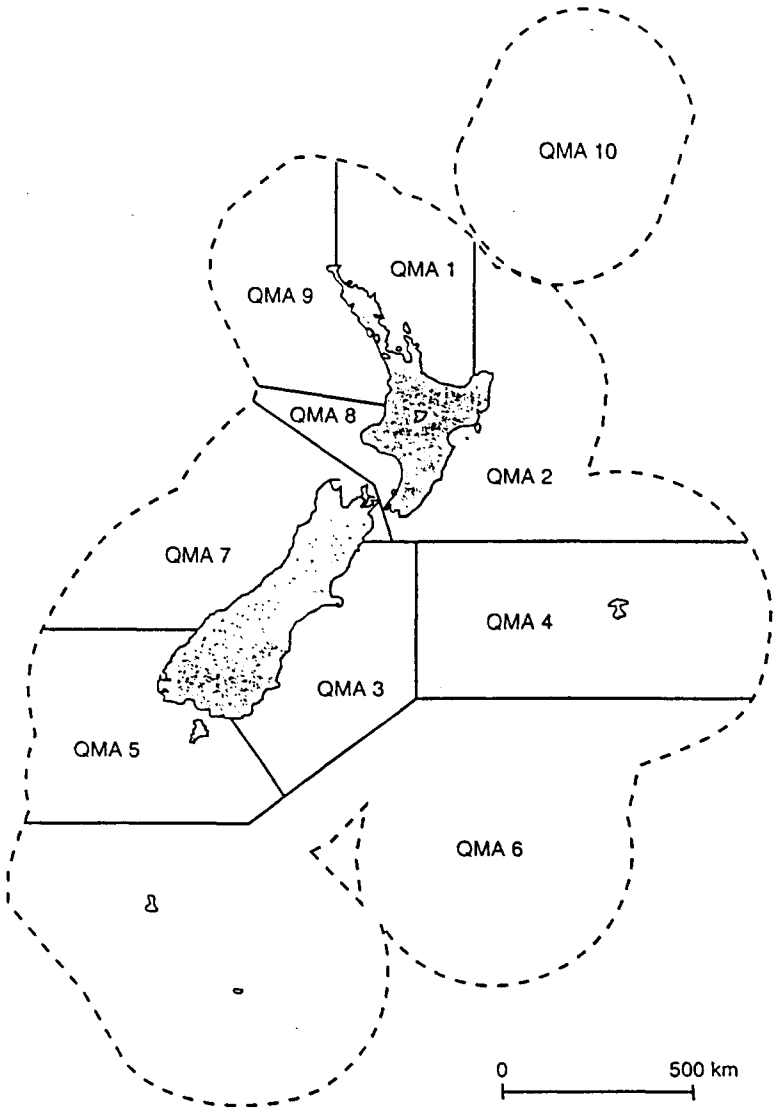

Fig. 1. Locations of the 10 quota management areas (QMAs) in New Zealand's quota management system.