The previous Minister, after considering this assessment, advice from the Ministry and the views of sector groups (commercial and non-commercial) decided to reduce the TACC from 6 010 to 4 900 tonnes. This reduction was designed to initiate a rebuild of the stock.

### 7.2.2. The 1993 and 1994 TAC/TACC and Management Control Decisions

328. The 1993 fishery assessment of SNA 1 noted that the status of the SNA 1 stock was uncertain. However, the assessment concluded that the stock size was still about half the size that would support the MSY. There was also uncertainty about whether current catch levels were sustainable. At the lower bound of the assessment the stock was projected to decline, while at the higher bound it would rebuild.

329. It was clear from the uncertainty in the assessment of the state of the fishery that there was an urgent need for an updated biomass estimate, as the basis for assessing the stock was still the 1985 tagging estimate. To this end it was agreed a tagging study should be started in 1993-94 to provide a biomass estimate within two years. Research was also commissioned to improve the information on the extent of the recreational take.

330. The previous Minister, when announcing his 1993 TACC decision, noted that the TACC reduction in 1992 may have allowed a rebuild to begin. However, he stated his continuing concerns about overcatch, dumping, highgrading (discarding small or poor quality legal sized fish) and illegal activity and suggested that further steps were necessary to ensure that the fishery rebuilt at a reasonable rate. It was noted that the tagging study would provide an updated biomass estimate in two years and provide information for future decisions.

331. The conclusions of the 1994 assessment on the status of the SNA 1 fishery were similar to the conclusions of the 1993 assessment. In his 1994 TACC decision letter to sector groups, the previous Minister noted that although there was considerable uncertainty, the stock was estimated to be well below the level that would support the MSY and poor years of recruitment (the contribution made to the stock each year as young fish grow to a takeable size) were expected in the future. He wanted to reduce total removals in the interim by focusing on reducing juvenile mortality (the removal of snapper less than 25cm in length). He was unwilling to reduce the TACC, with its serious consequences for smaller operators, before considering what benefits could be achieved through the use of other controls. He also noted that the tagging programme and recreational fishing survey would produce a biomass estimate available for the following year and provide the basis for further management decisions.

### 7.2.3. The 1995 Fishery Assessment and TAC/TACC Decision for SNA 1

332. In 1995 the results of the 1994 tagging programme carried out by the National Institute of Water and Atmospheric Research (NIWA) gave the best assessment of the state of the SNA 1 fishery since 1985. The tagging programme provided an absolute estimate of biomass. Industry scientists participated in the design and analysis of this research. The assessment indicated that the estimated

overall biomass for SNA 1 was between 42 000 and 48 000 tonnes, as at the middle of the 1993–94 fishing year. The biomass level that would support the MSY ($B_{MSY}$) was estimated to be about 80 000 tonnes. The 1995 fishery assessment therefore indicated that SNA 1 fish stock was depleted and the biomass level was about half what it should be to support the MSY.

333. As discussed in **Section 3, Fishery Assessment**, the SNA 1 stock actually constitutes two substocks. The Hauraki Gulf/Bay of Plenty substock is the larger fishery (67% of total biomass) and its biomass was estimated to be about half the level it should be to support the MSY. The East Northland substock is much smaller (33% of total biomass), and although estimated to be at a biomass that can support the MSY, was predicted to decline at the current levels of removals. This substock has shown a rapid decline in biomass in recent decades. The estimated size of the SNA 1 substocks was not disputed by any sector group.

334. Further, although the Hauraki Gulf/Bay of Plenty substock was relatively stable from 1985 to 1994, this had been during a period when recruitment was estimated as 28% higher than the average. In 1995, projections for the next five years, based on the relationship between spawning success and larval abundance and water temperatures, suggested recruitment will only be 82% of the average level. This would detrimentally impact on stock rebuilding over the next five years.

335. Although the fishery was not in danger of imminent collapse or sharp decline, management action was considered necessary to initiate a rebuild because the assessment showed that it would otherwise continue to decline at the estimated level of total removals (commercial and non-commercial). The size of fish in the recruited biomass was also determined to be sub-optimal (too small). The harvesting of small fish is deleterious because a lower overall yield can be taken from the fishery.

336. The 1995 stock assessment and subsequent modeling carried out by NIWA scientists provided an estimate of the reductions in removals that would need to be implemented and maintained in order to rebuild to $B_{MSY}$ over various time periods. The length of time required for rebuild is also dependent on the level of recruitment in the future. As mentioned above, if recruitment were to be poorer than average for some period, this would impact on the stock. This factor could reduce the rate of rebuilding and add uncertainty, and therefore it was considered prudent to take management steps to ensure an increase in the stock size for snapper. Recruitment to the fishery in the next two years is expected to be poorer than average.

337. The assessment estimated that the total removals from SNA 1 would need to be reduced by at least 600 tonnes to prevent further decline in the whole stock in 1995–96. However, a reduction of this size would not provide for any rebuild of the stock towards $B_{MSY}$. As described earlier, the Ministry has always taken the

view that there is an implicit obligation in the 1983 (and 1996) Act to set TACs that will ultimately move the stock towards a level that will support the MSY. To achieve this, any reduction in catch had to be greater than 600 tonnes.

338. The previous Minister's final decision was, after having regard to a TAC determined at 5 600 tonnes and making an allowance of 2 600 tonnes for non-commercial fishers, to reduce the TACC from 4 938 tonnes to 3 000 tonnes. The extent of the reduction was based on the Minister's view of what was an acceptable rate of rebuild, taking into account the depleted stock status and the other considerations set out in the definition of TAC in the 1983 Act. Modelling results indicated that a TAC of 5 600 tonnes would allow the fishery to rebuild to the $B_{MSY}$ in about 20 years.

#### 7.2.3.1. Other Management Controls

339. In 1995 the previous Minister also made a number of other management decisions for SNA 1 which were aimed at assisting the rebuild of the fishery over the next twenty years. These measures included:

- closing an area from the inner Hauraki Gulf to Cape Rodney to commercial fishing from 1 October to 31 March;
- changing net mesh regulations to require the use of 125mm minimum codend mesh size all year round in shallow waters outside the Hauraki Gulf.

340. The seasonal area closure of part of the inner Hauraki Gulf to commercial fishing over the spring and summer months was primarily aimed at reducing the mortality of sub-legal snapper by reducing commercial fishing activity in areas of high juvenile abundance. Similarly, the requirement to use 125mm minimum codend mesh all year round in waters shallower than 100 metres outside the Hauraki Gulf was aimed at reducing the bycatch of juvenile snapper by trawlers.

341. Subsequent to the 1995 decisions, legal action by parties within industry prevented the implementation of the 3 000 tonne TACC in 1995–96. A separate action by Leigh Fishermen's Association prevented the enforcement of the area closure.

#### 7.2.3.2. Changes to Recreational Controls

342. On 13 October 1995 the non commercial daily bag limit for snapper was reduced from 15 to nine. In 1993 the bag limit for snapper was reduced from 30 to 20 per day, and in 1994 was further reduced to 15. Thus from 1993 to 1995 the daily bag limit for non commercial fishers was reduced by 70%. The assessment model estimates that the bag limit reduction to nine fish would have resulted in an 8% drop in the weight of the recreational catch.

343. In addition to the recreational controls implemented in 1995, over the previous few years also a number of other measures have been implemented which have had an impact on recreational SNA 1 fishing. These include:

- increasing the minimum mesh size for snapper set nets from 100 to 125mm;
- a number of closed areas for set net fishing;
- various restrictions on fishing in the Bay of Islands;
- increasing the recreational minimum legal size limit (MLS) from 25 to 27cm; and,
- restricting the number of hooks used on a recreational longline to a maximum of 25 per person and two longlines per vessel.

### 7.2.4. The 1996 Fishery Assessment and TAC/TACC Decision for SNA 1

344. The conclusions from the 1996 fishery assessment for each of the substocks were as follows:

- the larger Hauraki Gulf/Bay of Plenty substock was estimated to be about half the $B_{MSY}$. This substock was projected by 2005 to remain at this level with a 4 938 tonne TACC, but was projected by 2005 to increase in size with a 3 000 tonne TACC;
- the East Northland substock was estimated to be slightly above the $B_{MSY}$, and was projected by 2005 to increase at the TACC levels of 3 000 tonnes and 4 938 tonnes.

345. The previous Minister expressed concern that further delay in the implementation of the existing TACC of 3 000 tonnes will slow the start of the rebuild of SNA 1 from its present depleted level. The 1996 assessment for SNA 1 indicated that because of poor recruitment predicted to enter the fishery over the next two years the overall biomass would decline at the current level of total removals. Even with a TACC of 3 000 tonnes it was estimated that the biomass would still decline, albeit to a much lesser extent. The next strong (above average) year class of snapper was not predicted to start recruiting into the fishery until the fishing year 1998–99. Another strong year class was also predicted to recruit in 1999–2000. The previous Minister stated that this good recruitment will begin to rebuild SNA 1 but the extent of the rebuild will be dependent on a number of factors, in particular the controls limiting the total level of removals from the fishery.

346. In order to mitigate the effects of the predicted poor recruitment to SNA 1 through to 1998–99 and ensure that the fishery rebuilt strongly towards a biomass level that would support the MSY once better recruitment occurred, the previous Minister decided to set aside 2 600 tonnes for non-commercial fishers and maintain the TACC at its (then) existing level of 3 000 tonnes for the 1996–97 fishing year. The existing controls on recreational fishers were maintained for 1996–97.

## 7.3. Sustainability Measures

### 7.3.1. Effects of Fishing

347. The Ministry does not have any specific information on any effects of the commercial and non-commercial fishing methods on the environment in SNA 1, other than species captured. Overseas studies suggest there are effects of trawling on the benthic environment, but such studies have not yet been undertaken in New Zealand. There is anecdotal information of incidental seabird mortality associated with longline fishing but as yet no recorded data. In 1997–98, as part of a project on the mortality of commercial longline released snapper, there will be records kept of any incidental captures of seabirds (in particular black petrels) on longlines. This is a scoping project funded from Conservation Services Levies and it is proposed to possibly implement a wider observer programme in future.

### 7.3.2. Existing Controls

348. Existing controls that affect the commercial fishery for SNA 1 include administrative regulations that provide for catch reporting and QMS administration, sustainability controls to provide protection for juvenile snapper, and area and method controls to reduce conflicts within and between sectors. Non-commercial controls include bag and fishing effort restrictions that restrict catch, reduce the impact of non-commercial fishers on juvenile snapper and to limit catches in particular areas.

#### *7.3.2.1. Area Closures*

349. As shown by Maps 1.1–1.10 in **Attachment C**, the largest area closures in the SNA 1 fishery are to trawling and Danish seining. Most of these closures have been in place for a number of years and fulfil objectives including, the protection of juvenile snapper in nursery areas, reduction in conflict with other commercial snapper methods and non-commercial snapper fishing and the spreading of effort within the SNA 1 fishery. There are a number of commercial set netting area closures which have been introduced with the objective reducing fishing effort in particular areas, or minimising the chance of the loss of set nets. These measures may act to reduce catches of snapper in the areas of closure.

350. Area restrictions on commercial drag netting in Whangarei and Tauranga Harbour and seasonal closures to commercial fishing in the eastern Bay of Islands and adjacent to the Motu River provide protection for spawning and juvenile snapper, and act to reduce conflicts between sectors.

#### *7.3.2.2. Commercial Gear Restrictions*

351. The minimum legal size (MLS) for snapper taken in the commercial fishery is 25cm. Net mesh sizes have been set to minimise the capture of snapper below the MLS. The minimum codend mesh size for trawling was increased in 1995 to 125mm for all SNA 1 waters inside the 100 metre depth contour line all

year round. Danish seine nets have been required for many years to have a 125mm minimum mesh size. The minimum mesh size for commercial set and drag nets used to take snapper is 125mm.

352. Other controls limit effort that may be applied in specific areas by method to minimise conflicts or the potential for local depletion of fish species. These include controls that commercial nets must not be set more than a quarter of the width across any channel or bay, or within 60 metres of another net and a prohibition on the use of power to haul drag nets. Regulations restrict commercial set net lengths to a maximum of 1 000 metres inside harbours or if nets are set within two metres of the surface (an exception is the Firth of Thames where the maximum is 2 000 metres until September 1998). Outside harbours commercial set nets are restricted to a maximum of 3 000 metres (up to 6 000 metres may be authorised based on historical use).

### 7.3.2.3. Non-Commercial Controls

353. As noted earlier, since 1993, the recreational daily bag limit for SNA 1 has progressively decreased from 30 snapper per fisher per day to 20 (1993), to 15 (1994) to nine snapper (1995) per fisher per day. In 1994, the non-commercial minimum legal size limit for snapper was increased from 25cm to 27cm. These controls are intended to constrain the recreational catch of SNA 1.

354. Effort controls are set to minimise the capture of juvenile snapper and the likelihood that daily bag limits are exceeded. Minimum mesh size for non-commercial set nets is 125mm and for drag nets is 100mm. Non-commercial fishers are limited to using a maximum of 60 metres of set net and 40 metres of drag net. There is a restriction to carrying only one set net per vessel with the exception of a bait net. Area closures to set netting to minimise the chance of loss of set nets are the same for non-commercial and commercial set nets. Non-commercial longlines are restricted to a maximum of 25 hooks per line and a maximum of two longlines per vessel.

### 7.3.2.4. Summary

355. **Table 6** summarises the key existing controls in SNA 1 that apply to commercial and non-commercial fisheries.

**Table 6: Summary of Existing Management Controls in SNA 1.**

| Existing control | Commercial | Non-commercial |
|---|---|---|
| **Minimum legal size** | 25 cm | 27 cm |
| **Minimum set net mesh** | 125 mm | 125 mm |
| **Minimum drag net mesh** | 125 mm | 100 mm |
| **Maximum set net length** | 1 000 metres in harbours | 60 metres |
| | 3 000 metres outside harbours | 60 metres |
| **Maximum drag net length** | 135 metres | 40 metres |

### 7.3.3. Imposition of Other Controls

356. Industry, as part of its submission, recommends that there be continued development and implementation of an enhancement plan for the SNA 1 fishery. This plan is titled "Memorandum of Understanding on the Management of the QMA 1 Snapper Fishery" (hereafter referred to as the Memorandum) and was attached as Appendix 3 to the industry's 1996 TACC submission. A copy of the Memorandum was also forwarded to you this year under the cover of a letter from Mr Bruce Young dated 3 July 1997. The Memorandum suggests a range of other management strategies and controls that industry believes could be introduced to enhance the SNA 1 fishery by reducing current losses and wastage by both the commercial and non-commercial sectors.

357. Industry states that the 23 key elements to the Memorandum were developed in negotiations between the commercial and non-commercial sectors in 1996. MFish notes that the Memorandum is unsigned by the NZ Recreational Fishing Council. In a submission to you this year the NZRFC make a number of points in regard to the Memorandum, in particular:

a) the Council has not signed off, or ratified the Memorandum;

b) the private meetings held with SNA 1 stakeholders were on the understanding that the proposals were in addition and in conjunction to a 3 000 tonne TAC;

c) the Council discussed in detail industry's proposal to shelve the necessary quota instead of the Crown decreasing the TACC, but this was not acceptable to the stakeholders present;

d) any proposed rebuild technique initiated and eventually proven successful would instigate corresponding credits above the Council's recommended 2 600 tonne TACC.

358. The proposals contained in the Memorandum were discussed in detail in the 1996 Final Advice Paper on SNA 1. Below is an updated assessment of the different elements recommended in the Memorandum.

359. Many of the proposals in the Memorandum concern non-compliance with existing regulations and legislation. As a general comment MFish notes that the Compliance Business Unit of the Ministry of Fisheries has set the measurement of compliance in NZ fisheries as a key output for its future operations. Measuring compliance in fisheries is needed to measure the performance over time and to enable the allocation of limited enforcement resources in the most efficient manner.

360. In 1997–98 there is a research project to measure compliance in three important commercial fisheries that are part of the Quota Management System (QMS). The research will focus on one inshore finfish fishery (snapper), one inshore shellfish fishery (rock lobster), and one deep water fishery (orange roughy). These are three of the more commercially significant fisheries in NZ waters.

361. The general goal of the research is to provide a quantitative baseline on the perceptions of non-compliance with commercial fishery management measures. The specific objective is to *quantify the perceptions of the levels of non-compliance* in the commercial sector for the snapper, rock lobster and orange roughy fisheries, for licensed fish receivers and fishers in these fisheries, and for selected Quota Management System and effort control regulations facing the two groups of participants in each fishery. Another specific objective is to collect qualitative information on participants views of the effectiveness of measures to control non-compliance, ways to improve enforcement and compliance, and nature and extent of compliance problems in the selected fisheries.

362. The Ministry of Fisheries will use the survey results to gauge the level of perceived non-compliance, using the 1997 data as a base comparison against future years. Over time, the perceived level of non-compliance will be used as one of the factors to determine the amounts and allocation of enforcement resources.

### 7.3.3.1. *Minimising High Grading or Dumping of Snapper*

363. The Memorandum notes that high grading in the commercial fishery occurs because of economic considerations (dumping of poor quality or dead fish), or in response to the MLS (high grading to a safety margin above the MLS). It states that in the recreational fishery high grading occurs because fishers catch more than their bag limit and high grade to take home only the largest fish. The controls suggested to minimise the high grading or dumping of snapper are: prohibiting discard of dead fish of legal size by recreational fishers; adequate 'live' catching right portfolios before fishing; and, agreed percentage of observer coverage. These controls are discussed below.

*Prohibiting Discard of Dead Fish of Legal Size by Recreational Fishers*

364. The Memorandum proposes the prohibition of discarding of dead fish of legal size by recreational fishers. MFish notes that the current amateur regulations prohibit taking or possessing fish in excess of bag limits. They also require a person taking a fish under MLS to return that fish to the sea "taking all reasonable care to ensure their survival". Therefore, contrary to industry's suggestion, it is currently illegal to "throw back no.9 to take no.10 because it is bigger". However, it is not technically illegal to high-grade fish (return legally sized fish to the sea) while take is below the legal limit. This is prohibited for commercial fishing. Enforcing a regulation prohibiting return of legal sized fish to the sea would be very difficult given the large number of recreational fishing trips occurring during the year and contrary to the developing conservation ethic of some sport fishers who wish to return alive some fish caught. Educating fishers on handling and

mortality of snapper is far more likely to provide benefits to the stock. The Ministry has taken steps to achieve this by recently publishing an educational pamphlet for recreational fishers giving guidelines for the releasing of undersize fish and ways to minimise the incidence of gut hooking.

*Adequate 'Live' Catching Right Portfolios Before Fishing*

365. This proposal involves fishers holding a mandatory level of snapper quota holding before going fishing. Industry believes this would stop TACC over runs by preventing fishers deliberately fishing for snapper when they do not have quota. It suggests that compliance could be encouraged by the provision whereby the overrun of the TACC would allow the Minister to reduce the following years TACC.

366. It is likely that a large part of the motivation for this proposal was due to the TACC being exceeded by nearly 500 tonnes in 1992–93 due to some fishers taking advantage of the deemed value price for snapper being set too low. In response, the Ministry raised the deemed value price for SNA 1 thereby considerably decreasing the incentives and likelihood of the TACC being exceeded by an abuse of the deemed value system. In addition, under the Fisheries Act 1996 the introduction of Annual Catch Entitlements (ACE) will create further incentives for commercial fishers to fish responsibly. A commercial fisher will be required to hold sufficient ACE to cover catch before going fishing. It will be an offence to take fish in excess of ACE holdings. A commercial fisher will be liable for deemed values for any catch in excess of ACE held on a monthly basis. Finally, under the 1996 Act if the TACC is exceeded in any fishing year, up to 25% of ACEs generated in the following fishing year will be withheld by the Crown and not available for fishing.

*Agreed Percentage of Observer Coverage*

367. The Memorandum suggests an observer programme across all fishing methods but targeting high risk methods, areas, and seasons for dumping of snapper. An observer programme to address the illegal return of fish to the sea is discussed below in the section which considers the no MLS policy for power fishing methods.

### 7.3.3.2. Minimising Wasteful Fishing Mortality

368. The Memorandum suggests this strategy because the capture of sub-legal sized fish increases the total mortality of the fishstock; even though the fish that are released may die as a result of the capture process. Fish are also caught before they reach optimal size and the suggested controls may reduce the likelihood of small snapper being caught. The controls suggested are: no MLS for power fishing; escape panels in trawl nets; hook devices and types; prohibiting fishing by method, area and/or time in juvenile snapper areas; reviewing the recreational MLS; and, assessing the *Kaharoa* survey design to reduce capture of juvenile snapper. These controls are discussed below.

369. A large number of controls already exist on commercial fishing in SNA 1 including MLS, mesh sizes, other method restrictions and closed areas and seasons to protect juveniles, spawning aggregations and reduce interaction between sector groups (see **Section 7.3.2, Existing Controls**). In recent years a number of additional management controls for the commercial fishery have been put forward for consideration by MFish and as submissions from sector groups.

*No MLS for Trawlers and Danish Seiners*

370. Commercial fishers are currently required to return all undersize snapper to the sea. Some of these fish are likely to be dead or die subsequently. The mortality rates for single trawl and Danish seine released fish have in the past been assumed by the Snapper Fishery Assessment Working Group to be between 50 and 90%. There is information to suggest there is currently a significant level of illegal dumping of legal sized fish. Discarded fish are not counted against quota; this includes fish below the MLS and fish above the MLS that are illegally discarded as a result of 'highgrading' in the SNA 1 fishery. Currently there are low incentives for fishers to reduce their catch of undersize snapper.

371. The no MLS proposal involves eliminating the MLS for trawlers and Danish seiners (powered fishing methods). It is considered that together with an understanding by fishers of the benefits to the stock in reducing juvenile mortality, the no MLS proposal may create an incentive for fishers to change their fishing behaviour (eg time, location, and methods of fishing) so as to reduce their catch of small fish. Given the estimated high mortality of trawl and Danish seine released snapper, a 'land all fish' policy would be likely to reduce wastage of catch. In addition, because all snapper caught will count against quota there will be a reduction in fishing effort overall and with it a decrease in total fishing mortality.

372. Any reduction in the wastage of pre-recruits will lead to an increase in recruitment to the fishable biomass and therefore to a faster rebuild of the fishery. However, it is very difficult to estimate the benefits from a no MLS policy given the considerable uncertainties and assumptions which need to be made. The Memorandum notes that this measure would be less beneficial in years of high recruitment because the proportion of small snapper would be higher in the trawl catch.

373. The present regulations make it difficult for compliance officers to establish if high-grading of snapper is occurring because it must be established that fish above the MLS have been discarded. The change to no MLS for powered fishing methods would simplify enforcement, in that any dumping of snapper would become illegal. A level of at-sea and shed sampling would assist in monitoring the compliance with no MLS, and detecting fishers who are not landing the standard size range of fish. Additional resources would be necessary to fund at-sea operations to focus on this issue.

374. MFish acknowledges that without changes in fishing practices, or effective enforcement, a no MLS measure may not reduce mortality of small fish. Industry representatives involved in the trawl fishery have previously stated that it is not their intention to target or catch large amounts of small snapper, nor do they intend to give them a high market profile in domestic retail outlets. Industry has stated that companies and processors pay fishers based on quality not size of fish, which should discourage trawl and Danish seine fishers from highgrading their catch. However, MFish is aware that some size grades of snapper command higher export prices. Some in industry have previously noted a concern that a no MLS policy may encourage the development of a market for small fish. The appearance on the market of small fish may also create perception problems with the general public and recreational fishers who would regard no MLS for trawl methods as being inconsistent with their own MLS of 27cm and the commercial longline MLS of 25cm. It may be unlikely that even with an extensive educational programme informing the public of the possible benefits of such a proposal, that the proposal would be accepted by the public.

375. The industry trade associations representatives have in the past stated that they believe there is strong support within industry for the no MLS measure. They have also previously indicated a willingness to have observers in the fishery, but believe observers should not only to monitor trawl and Danish seine vessels but also cover other fishing methods, in particular longlining because of their concern for the current level of highgrading associated with this method. It is understood that the no MLS proposal has been opposed by the Leigh Fishermen's Association, and the NZRFC has only provided conditional support for the proposal provided that an extensive at sea observer programme also be implemented to gauge the success of the proposal.

376. In 1995 MFish developed a proposal to monitor the proposed no MLS measure for trawlers and Danish seiners in SNA 1 and SNA 8. The proposal included several mechanisms to monitor the performance of the no MLS policy. These mechanisms include: sampling the length composition of the landed snapper catch; a minimum programme for at-sea sampling by MFish observers in the Hauraki Gulf initially (230 observed fishing days which is equivalent to 70–80 fishing trips: currently there are 250 vessels which list snapper as their target species in the SNA 1 fishery); trawl and Danish seine vessels to provide detailed catch and effort data, including shot by shot information; and a survey of snapper market data to determine the value of snapper (port and market price) by grade and length category. The sampling of landed catch for length and age composition is part of a research project agreed for 1997–98. In 1995 the cost of the observer programme was estimated to be about $100 000. The Memorandum gives an estimated compliance cost of $75 000.

377. These proposals would provide monitoring of take of small snapper at sea (initially targeted in the Hauraki Gulf), relative to composition of landed catch. There would be difficulties in funding this monitoring programme because the required services for 1997–98 have already been agreed as part of the cost recovery process. You would need to go back to industry to fund the extra work.

378. MFish Compliance express some reservation about the ability to take prosecutions on the basis of comparison of length composition from observers with shed or vessel samples. They believe such prosecutions would be difficult and expensive to prove. They also suggest that processing and marketing imperatives mean that industry has preferred sizes and this will continue to influence the size of fish landed.

379. In summary, removal of the MLS for powered fishing methods (trawl and Danish seine) would probably only have a small positive benefit in terms of contributing to the rebuild of the fishery. However, this benefit is difficult to quantify. This proposal was recommended to the previous Minister in 1995 and 1996 but he deferred implementing the measure. He was concerned such a measure required good compliance to produce benefits to the stock as there may be considerable incentive for commercial fishers to dump undersize fish. Without changes in fishing practices, or effective enforcement, a no MLS measure may not reduce mortality of small fish. MFish notes that there is research proposed for 1998–99 (**SNA9802**) to characterise the proportion of juveniles in the commercial catch by fishing method within SNA 1. This research would provide important information to determine the total mortality associated with the respective fisheries and would allow a better assessment of the potential impact of a no MLS for trawls and Danish seines.

*Escape Panels and Trawl Mesh Size*

380. The Memorandum recommends that escape panels be required to be built into power fishing nets (trawl and Danish seine) to release small fish. MFish notes that NIWA was commissioned in 1995 to further investigate the effects of different mesh size and escape devices on the capture of pre-recruit snapper and other trawl species (john dory, sand flounder, and red gurnard). The final report on this research is due to MFish by 30 September 1997.

381. Preliminary analysis of results indicate, as expected, that as mesh size increases, less small snapper are caught. However, the fate of small fish passing through the net is currently unknown. The impact of larger mesh sizes on other trawl species appears to be uncertain because insufficient numbers were caught during the trials. There were difficulties experienced in the trialling of a sorting device (SORTX™) which consisted of a grid mounted into the belly of the trawl net. The grid allows small fish to escape capture in the codend of the net. The device only worked satisfactorily on two tows and only a small number of fish were caught. However, the mechanism showed good potential to reduce capture of small snapper.

382. In summary, it appears that further research is required to assess the potential benefits of increasing trawl mesh size or fitting sorting devices into trawl nets. No research is planned for 1997–98 on the selectivity of trawl mesh and sorting devices for snapper. However, MFish notes that there is research proposed for 1998–99 to assess the fishing gear modification options which are most likely to improve the escapement of juvenile snapper in the trawl and Danish seine fisheries; to determine the maximum likely fishing induced mortality of snapper passing

through trawl and Danish seine nets by evaluation of the number of encounters of fish with these nets; and to conduct sampling at sea of catches in SNA 1 in order to assess the proportion of snapper below the MLS in the catch, by area and method.

*Hook Size and Type*

383. The Memorandum recommends research on hook size and type used in the snapper fishery. The Ministry is currently supporting independent research into new hook designs that are intended to minimise the capture of small snapper, and the subsequent risk of mortality, and the incidence of gut hooking. Preliminary results indicate that the longline hook attachment developed by Paul Barnes not only reduces the incidence of gut-hooking and the number of small (less than 30cm in length) snapper caught, but also maintains a similar catch rate (by weight) to the normal longline hooks. MFish understands that further trials with the hook will be carried out in 1997–98. It is notes that there is a research project proposed for 1998–99 on the estimation of mortality of juvenile snapper (**SNA9802**) which includes assessment of the effects of modifications to hook designs and appendages on the rate of gut-hooking in juvenile snapper. There is also a proposal (part of **SNA9801**) to assess the effect of fishing gear modifications (such as hook modifications) on the potential yield per recruit from SNA 1. Further discussion of the use of final results from hook design research is contained in **Sections 7.3.3.10, Recreational Controls,** and **7.3.3.11, Commercial Longline MLS**.

384. Many factors are likely to influence mortality of line caught fish, most importantly how they are handled on capture. How any new technology is applied to the fishery will need to be considered carefully when research and trials have been undertaken. Education as to the benefits of a new hook type are likely to be preferable to regulation for the recreational sector. Ensuring compliance with any regulation would be difficult and would probably require a prohibition on possession of hooks other than of the approved type.

*Prohibit Fishing by Method, Area or Time in Juvenile Snapper Areas*

385. A number of closures already exist to reduce the impacts of fishing in areas of high juvenile mortality including closures to trawlers and seiners all year round in the inner Hauraki Gulf. In 1995 the previous Minister extended the 125mm trawl mesh size to all year round in waters less than 100 metres deep in the Auckland Fishery Management Area; and implemented a seasonal area closure (1 October–31 March) to all commercial fishing methods for finfish (except for set netting for flatfish, netting for grey mullet, eels and lampara and purse seine netting for bait fish) in part of the inner Hauraki Gulf. As you are aware, the High Court has directed a reconsideration of that part of the area closure extending north of Whangaparaoa Peninsula. Advice to you on this reconsideration is contained in **Attachment D, Inner Hauraki Gulf Closure (Northern Section).**

386. Imposition of additional controls such as closed areas and closed seasons would be introduced with the objective of protecting juvenile snapper or to reduce conflict between methods and/or sectors. Unless the closed areas or closed seasons are particularly extensive, it is unlikely that they will function to reduce the overall

level of removals. This is because the closure of an area to fishing may simply displace effort to other areas and may not therefore be successful in reducing overall removals. The impacts and effectiveness of measures that are evaluated as alternatives or additions to TACC reductions need to be considered carefully. Ensuring compliance of existing and any new closed areas is difficult and expensive for MFish Compliance because of the lack of resources for at-sea surveillance.

*Review of MLS for Recreational Fishers*

387. The Memorandum proposes a review of the recreational MLS. This issue is discussed below in **Section 7.3.3.10, Recreational Controls.**

*Reduce Juvenile Mortality Associated With the Kaharoa Surveys*

388. The Memorandum suggests that *Kaharoa* juvenile survey data be assessed to determine if juvenile mortality on the survey can be reduced. MFish notes that the *Kaharoa* surveys have taken place in the Hauraki Gulf since around 1982. The information has been used to derive a temperature recruitment relationship for snapper. The relationship is well established for the normal range of temperatures, however, further surveys have been proposed to test the extremes of the temperature recruitment relationship. The survey is not proposed to continue on an annual basis and was not carried out in 1996–97. A survey is planned for 1997–98 (November 1997, **INT9701**). Priority to any future survey proposal would need to be assigned on the basis of the value of extending the range of the relationship to cover extreme values. An average set of conditions may be sufficient.

### 7.3.3.3. *Minimising Black Market Activity*

389. The Memorandum suggests consideration of a number of measures that focus on reducing illegal take by redeployment of enforcement resources, improved monitoring and inspections, and the use of private investigators and Honorary Fishery Officers (HFOs). These measures are discussed below. In general MFish Compliance is disappointed that such a document has been put together without consultation. The Ministry has presented, at this year's plenary meetings on the proposed "Nature and Extent of Services" and to the Industry Compliance Strategy Group for comment the draft compliance strategy plan. Representatives of the fishing industry and other sector groups are in general supportive of this strategy plan.

390. There are frequent references, in respect of costs, to: "this cost should be achieved by redeployment of existing MoF resources" and "Stakeholders strongly support the use of North region budget being used for targeting black marketing in the North Region's fisheries." These suggestions are simplistic, comments which do not take account of the existing programme targeted at illegal activity in the fishery. There are no suggestions of the fisheries from which resources could be redeployed, and the suggestion that poaching problems should all be dealt with at the point of origin, does not fit with the enforcement strategy developed to provide the most efficient use of enforcement resources in the QMS environment.

391. MFish notes that in 1997–98, government approved additional 'new initiative' funding of $766 000 to target additional enforcement resources at high grading and dumping in the snapper fishery and the current black market in snapper. The Auckland District has had an increase in staffing from seven to 13 officers, and a Compliance Analyst has been appointed. As a result targeted enforcement at the snapper fishery has become the main thrust and increased attention is being focused on the correct completion of Catch Effort and Landing Returns.

*Private Investigators to Target Black Market Activity*

392. The Memorandum suggests that private investigators would target specific problem areas identified by stakeholders, and use appropriate techniques to uncover significant illegal activity.

393. MFish notes that it does not use private investigators for compliance functions as there is significant risk to the Crown associated with the exercise of statutory enforcement powers by other than Crown employees. Enforcement powers, including powers to stop, inspect, search, seize and arrest must be exercised with considerable discretion and responsibility. Other issues would arise in terms of the Privacy Act, access to confidential databases (entering commercial premises and obtaining commercial information), and conflicts of interest—private investigators would have established client bases which may include parties being investigated.

*Education of the Public So They Can Assist in Identifying Illegal Activity*

394. The Memorandum suggests better informing the public about management controls, the need for controls, and the use of 'hot lines' to report suspected breaches of the Act or regulations. MFish notes that education is an ongoing function of the Ministry which has a budget allocation annually. Compliance has recently increased its efforts in this direction with the increased emphasis on recent immigrants to New Zealand.

*Information Networks Improved*

395. The Memorandum suggests setting up systems (eg 0800 and 0900 numbers) for the public to report suspected illegal activity in the Auckland region. MFish notes that 0800 numbers and hotlines have been implemented in the

past, funded by industry and well advertised. MFish Compliance suggest few tangible benefits with significant costs in managing the information received which was generally of low value. For this reason they see poor return from diverting existing funding.

*Assessment of Black Market*

396. The Memorandum suggests an assessment of black market activities in all sectors of SNA 1 and that this be done by an independent survey company. MFish Compliance is currently undertaking a survey into the perceived levels of compliance in the SNA 1 fishery.

### 7.3.3.4. Removing Under-Reporting Opportunities

*Inspection of Premises by HFOs*

397. The Memorandum proposes the need for a defined target of more regular visits by enforcement officers of clubs, pubs, restaurants, churches, distribution and retail outlets. It suggests that this could be done by Honorary Fisheries Officers (HFOs), managed and controlled by Compliance Managers. MFish Compliance suggests this proposal and the others below concerning the use of HFOs show a significant misunderstanding about the business of fisheries compliance. The HFO network is made up of unpaid volunteers operating primarily in an educational role in the recreational fisheries environment. There is the suggestion that such volunteers could be responsible for the inspection of such premises every two weeks. There are currently approximately 3 000 such premises in the greater Auckland area, and inspections every two weeks would equate to 78 000 inspections per year. The numbers of HFOs needed for such a task is clearly unrealistic. When the necessary effort to train, support and supervise such a 'specialist team of HFOs' is considered ($12 000 per head for training plus administrative and support costs from operational staff), the proposal can only be described as totally unworkable. Another important matter in considering the use of HFOs for functions suggested by industry is the significant risk to the Crown associated with the exercise of statutory enforcement powers by other than Crown employees (see discussion above). Enforcement powers, including powers to stop, search, seize and arrest must be exercised with considerable discretion and responsibility.

*Inspection of Commercial Vessels and Dockside Monitoring*

398. The Memorandum proposes that HFOs could inspect the catch, gear, and fishing records on any fishing vessels taking snapper, reducing the need for Fishery Officers to undertake this routine work. MFish notes that, as per the comments above, these proposals ignore the fact that HFOs are unpaid volunteers who assist during their free time. Most have full-time jobs, their efforts generally incur some

expenses relating to their work which is not recompensed. To expect them to become involved in the monitoring of enforcement of compliance with commercial fishing law can only be viewed as an unrealistic attempt to minimise the costs of compliance services.

*Improve Reporting for Non-Commercial Fishery*

399. The Memorandum proposes that there is a need to determine the amount of recreational 'slippage'. The NZRFC and quota holders believe the data should be collected by HFOs gathering information at boat-ramps about actual catches by method of fishing, and regular telephone surveys of recreational fishers. MFish currently contracts research using diary and boat-ramp surveys to develop a database of quantitative information on non-commercial catch (refer to **Section 7.5, Research Planned for 1997–98** for further detail). The main objective of these surveys is to estimate the recreational harvest of species managed within the QMS. These projects will provide updated estimates for use in the fishery assessment working groups in 1998. Industry makes some suggestions for different mechanisms to collect information. These should be discussed and reviewed at the appropriate working group.

400. In addition SNA 1 quota holders want an estimate of catch by establishing reporting by fishers as they reach the boat-ramp or leave charter vessels. They suggest that fishers could record their catch on forms which would be posted at landing point 'post boxes'. The catch levels would be estimated directly from the post box data. The proposal of recreational fishers reporting their catch is also proposed by industry in its main submission and is discussed in **Section 7.4.1.1, Recreational Catch.**

*Review of Commercial Landing Points*

401. The Memorandum proposes that all landing points for snapper in QMA 1 must have an appropriate level of MFish monitoring and surveillance. It states that if a review provides MFish with a more manageable number of landing points that can be effectively monitored, then the landings of non-recorded snapper may be reduced and the fishery enhanced. MFish Compliance would support an initiative by quota holders to decrease the number of landing points. Such a step may assist to some degree in surveillance and compliance, however, it would have little impact on illegal fishing and black market operations.

*Dockside Monitoring*

402. The Memorandum proposes a voluntary programme of dockside monitoring to be developed by industry and independently audited. MFish Compliance have serious concerns about committing enforcement resources to designated landing sites. They believe that the current use of enforcement resources is more effective in combating illegal fishing and black market operations.

### *7.3.3.5. Ensure Sectors Remain Within TAC Limits*

*Set Bag Limits and Other Management Measures to Match the Expected Annual TAC*

403. The Memorandum states that bag limits and other management measures must ensure total recreational take does not exceed the annual allocation set by the Minister. It adds that people need to be educated on conservation and bag limits. MFish notes that there are currently measures in place that restrain recreational take. The Memorandum does not state whether the NZRFC supported this proposal or not. As discussed above, the current information is being updated to provide you with revised estimates of take. The Ministry will continue to advise you on management measures that can be implemented for recreational fishing following from your decisions on the allowance for non-commercial fishers. A primary purpose of the 400 strong HFO programme is to assist in the education and apprehension of recreational fishers breaching regulations.

404. MFish Compliance are of the view that the greatest returns for enforcement effort are likely to come through directing effort at the commercial illegal activities such as black marketing and dumping as it is this seetor which generally has the vessels and capability to do significant damage to the fishery.

405. Recreational controls (bag limits and MLS) are discussed in greater detail below in **Section 7.3.3.10, Recreational Controls**.

*Seasonal Limits*

406. The Memorandum proposes that once a target level of recreational catch was reached recreational snapper fishing would cease for the rest of the season, or the overrun would have to be internalised into the catch level for the next year, for example by reducing bag limits. The Memorandum states that this would be a control of 'last resort' and would only be necessary if other controls had failed to constrain recreational catches to TAC limits. It notes that if there was widespread opposition to this control enforcement costs would be high. Closed seasons for recreational fishers could be considered if you decided that additional measures were necessary to restrain recreational take. They have a number of disadvantages some of which are noted in the industry document. These include the public reaction to why they were prohibited to fish but the commercial fishers were not, creation of distortions in fishing practices such as a race for fish, any limitation on recreational catch may lead to a transfer of effort by Māori fishers to use their customary rights, and the difficulty of managing fishing for species with a snapper bycatch, if snapper fishing was stopped. In additional, unless there was a high level of voluntary compliance, enforcement based on at-sea surveillance would be difficult and expensive.

### 7.3.3.6. *Enhancement by Release of Reared Snapper*

407. The Memorandum suggests developing an enhancement programme to release one million six month old snapper into the fishery each year for three years. It suggests that quota holders would fund their share of the programme from a levy on the snapper. Further, it suggests that the Crown should pay 50% of costs because the benefit of the snapper enhancement will be available to all fishers. It estimates that the enhancement programme would require at least a three year trial to measure its effectiveness.

408. MFish believe there would high risks associated with this proposal as it stands. The technical difficulties of a project of this size would be difficult to overcome because of the short time frame suggested. Even if costs were no obstacle, it is possible that an attempt to undertake such a project without a development phase involving a pilot project would fail.

409. In the longer term, it is possible that an effective project could be developed. Successful hatcheries exist in Japan for snapper and NIWA has made significant progress in this area on a smaller scale. The release of one million juvenile snapper has the potential to increase the yield from the Hauraki Gulf to a limited extent. However, the amount of any increase in yield is highly uncertain as it depends on survival after release. Considerable research into the optimum manner, location, timing, and age of release would be required.

410. It is not possible to estimate the potential impact that releasing one million six month old fish each year would have on the yield available from the fishery. There are too many unknowns and uncertainties. It is possible that the survival rate to four years of age (25cm), which is when snapper recruit into the fishable biomass, may be very poor. Last year the assessment model estimated that on average about 11 million four year old snapper naturally recruit into the SNA 1 fishery annually. Given this level of mean recruitment a better option to consider than artificial enhancement is ways to reduce the mortality of pre-recruit wild snapper. Relatively small reductions in the proportion of pre-recruits killed by fishing would potentially have quite a large impact on the amount of recruitment into the fishery, and consequently the yield available from SNA 1.

### 7.3.3.7. *Empowerment of a Body to Represent Recreational Fishing Interests*

411. The Memorandum proposes empowerment, by legislation, of a body to represent recreational fishing interests. It states that the Crown would fund this body to provide advice on recreational fisheries management. MFish notes that it is not clear how this proposal is immediately relevant to the adjustment of management controls in the snapper fishery in area 1. The legislation provides for the Minister to consult with persons or organisations representative of interests in the fishery.

### 7.3.3.8. Spatial Conflict

412. The Memorandum proposes the separation in some areas of recreational and commercial fishers. It states that quota holders agree with the seasonal area closure in the Hauraki Gulf (south of Whangaparaoa). It also recommends the closure of Kawau Bay during periods of high juvenile snapper concentrations to commercial longliners and recreational fishers unless using suitable hooks and handling methods. MFish notes there are currently a significant number of area closures to commercial fishing methods for snapper in area 1 that have the effect of providing a spatial separation from recreational fishers. In regard to the seasonal area closure in Hauraki Gulf you are also referred to **Attachment D**.

### 7.3.3.9. Splitting the Substocks

413. The available information on SNA 1 suggests there are two substocks of snapper, East Northland and Hauraki Gulf/Bay of Plenty. Industry has suggested these should be managed separately. Separate management could be achieved by an Act of Parliament or through regulations. The Fisheries Act 1996 provides a process for separation of QMAs with sufficient quota holder support. This section is not yet commenced.

414. There are 199 existing quota owners in SNA 1. MFish notes that a formal split to the SNA 1 QMA would possibly be contentious and administratively difficult to achieve because of the need to reallocate quota among the existing 190 quota holders. There may be complexities involved with the splitting of quota between two substocks which have a different biomass status in relation to $B_{MSY}$. For example, the East Northland stock is at $B_{MSY}$ therefore the TAC (catch limit) would be set at the estimate of MSY. The Hauraki Gulf/Bay of Plenty stock is estimated to be about 60% $B_{MSY}$ and the TAC would be set to allow a rebuild to $B_{MSY}$ to occur over time.

415. Industry acknowledges that it may not be possible at this stage to implement an actual subdivision of SNA 1 into an East Northland QMA and Hauraki Gulf QMA, but suggest that a voluntary management agreement (which achieves the same objective) be implemented, as has occurred in relation to a number of other fisheries such as ORH 2A and 3B, but has not provided any documented proposals on how this could be formally achieved. It believes the large number of quota holders in SNA 1 does not make it impractical to achieve a subdivision by agreement. It notes that the ten largest quota owners hold 70% of the quota. A further 10 hold an additional 11%. As such, over 80% of the quota is owned by 20 companies. All of the other participants in the fishery fish into, and work very closely with, one or other of these 20 quota owners. Most of those small operators are dependent upon leasing quota from the larger quota owners to survive. Industry is of the view therefore that such a catch-spreading agreement could be implemented and managed by industry in the coming year, and requests the opportunity to work with the Ministry to achieve this.

416. Despite the difficulties involved with achieving a split in the QMA, MFish acknowledges that it could allow you to apply an appropriate management strategy separately to the two stocks over the longer term. Although it is likely that the overall TAC/TACC level (for both stocks combined) would be very similar to that set for the fishery as a whole. The Ministry believes there may be some merit in this proposal, but also considers that there could be a large number of implementation difficulties, even if the proposal was implemented as an internal industry voluntary arrangement. The Ministry recommends that you invite industry to submit a more definitive proposal that can be discussed with other stakeholders in 1998.

### *7.3.3.10. Recreational Controls*

*Daily Bag Limits*

417. As already noted the daily bag limit for recreational fishers has been reduced in recent years from 30 to nine snapper. The last change from 15 to nine was made in October 1995. Industry believes the bag limit should be significantly reduced to three or five to ensure a suitable restoration of the stock to $B_{MSY}$. It contends that the reduction from 15 to nine did not have, and was not expected or intended to have, any significant impact on the recreational catch. However, MFish notes that this change has been estimated by the snapper stock assessment working group to have reduced the recreational catch by about 8%. The 8% reduction in catch was estimated from the distribution of bag sizes in the 1994 boat-ramp survey.

418. Industry contends that if set low enough, bag limits can have an effect on controlling the total recreational catch, although it believes it would probably simply result in the more equal spreading or sharing of the available resource amongst recreational fishers. Industry believes further reductions in the bag limit is an alternative to a TACC reduction, or a means of mitigating the size of any TACC reduction.

419. Environmental groups have recommended a reduction in the bag limit to six. The NZRFC's position is that if the TACC is set at a level greater then 3 000 tonnes then the bag limit should be increased back to 30 fish per day. The NZ Trailer Boat Association state that any reduction to the bag limit would not be well received by recreational fishers.

420. In order that you may consider the impact of reducing the bag limit below nine, MFish has modelled the predicted reduction in recreational take based on results from the 1996 boat-ramp survey (**Table 7**). Results show that if a bag limit of five was implemented the predicted reduction by number (and weight) in recreational catch would be 12%, and for a bag limit of three it would be 30%.

421. It is relevant to note that there are a higher number of bags of nine snapper, as compared to bags of seven or eight snapper. This indicates that the nine snapper bag limit is restricting the catches of some fishers. In this model it is assumed that the level of non-compliance will essentially remain the same at lower bag limits. In other words, those recreational fishers currently not complying with the nine bag limit will continue to do so regardless of any reduction in the limit. Of course if the

limit was reduced to say one snapper per day then it is reasonable to assume that levels of non-compliance would probably increase. Industry provided an analysis carried out in 1995 by MFish on the effect of reducing the bag limit. However, this analysis used diary results not boat-ramp results and made an assumption of increasing non-compliance with even very small reductions in the limit.

**Table 7:** **Predicted impact on recreational catch of bag limits ranging from one to eight. Results are calculated using data from the 1996 boat-ramp survey.**

| Daily Bag Size | Number of catches recorded from 1996 boat-ramp survey | Cumulative predicted catch by number at each bag limit | Percent of total catch | Percent reduction |
|---|---|---|---|---|
| 0 | 3 264 | — | — | 100.0 |
| 1 | 1 644 | 5 710 | 31.9 | 68.1 |
| 2 | 1 292 | 9 776 | 54.5 | 45.5 |
| 3 | 875 | 12 550 | 70.0 | 30.0 |
| 4 | 577 | 14 449 | 80.6 | 19.4 |
| 5 | 429 | 15 771 | 88.0 | 12.0 |
| 6 | 274 | 16 664 | 93.0 | 7.0 |
| 7 | 205 | 17 283 | 96.4 | 3.6 |
| 8 | 189 | 17 697 | 98.7 | 1.3 |
| 9 | 225 | 17 922 | 100.0 | — |

*Review of Recreational Minimum Legal Size (MLS)*

422. The Memorandum proposes a review of the recreational MLS. MFish notes that in previous years, the NZRFC has stated that it believes an increase in the MLS should be considered in the future if the recreational catch is expanding to the point where it threatens the rebuild of SNA 1. As noted earlier, in 1994 the snapper MLS for recreational fishers was increased from 25 to 27cm. The snapper stock assessment working group estimated this increase to have reduced recreational catch by 10%. The benefits of increasing the MLS are dependent on assuming a high level of survivorship of released recreational fish. If survivorship is high then increasing the MLS (commercial and non-commercial) can lead to an increase in productivity of the SNA 1 fishery. Analysis has indicated that increasing the MLS for snapper towards 30cm increases the yield-per-recruit and thus the overall yield (MSY) available from the stock.

423. The results of research to estimate the mortality of sub-35cm snapper released into the sea after being taken by recreational lines have recently become available. These indicate that the mortality of lip hooked snapper caught from moderate depths (less than 20m) by recreational fishers is in the order of 5–10% when the fish are released immediately. Gut hooking of fish greatly increases snapper mortality. Even under favourable conditions (ie fish released immediately without the hook being removed), the mortality of gut-hooked released snapper was estimated to be 75–90%. It is not known what percentage of recreationally caught

snapper are lip or gut hooked.

424. MFish has used results from the 1996 boat-ramp survey to estimate the potential impact on recreational catch of an increase in the MLS from 27 to 30cm. The size composition of fish caught by recreational fishers in 1996 indicates that about 25% (by number) of fish caught are in the size range 27–29cm (inclusive). If the MLS was increased to 30cm this proportion of fish caught would need to be returned to the water. By weight, this equates to about 13.5% of the catch. Resulting mortality/survivorship would depend on a number of factors such as depth of capture, location of hook (whether the fish was lip or gut-hooked), and handling practices.

425. The Ministry has been actively encouraging initiatives that will decrease the mortality of juvenile (undersize) snapper. MFish has recently (1997) produced an educational pamphlet primarily for recreational fishers on how to release undersize fish. The pamphlet provides guidelines on the best methods for releasing fish that are smaller than legal size. It also makes suggestions on hook type and how to get the hook out, and suggests leaving the hook in for gut hooked fish. This pamphlet will be widely distributed by fishery officers in November and December as recreational fishing effort starts increasing and will be available in most fishing tackle shops and other outlets.

426. The Ministry is also supporting research into new hook designs that are intended to minimise the capture of small snapper and the incidence of gut hooking. Preliminary results indicate that for commercial longlines that a hook attachment developed by Paul Barnes not only reduces the incidence of gut-hooking and the number of small (less than 30cm in length) snapper caught, but also maintains a similar catch rate (by weight) to the normal longline hooks.

427. The Ministry is of the view that the issue of reviewing the MLS for recreational fishers should be considered in tandem with a review of the MLS for commercial longliners. This is for several reasons. In 1997–98 there will be further research (**SNA9702**) to quantify the proportions of snapper caught by commercial longline from different depths and hook capture sites (lip or gut hooked). The results (available 30 September 1998) will be used in conjunction with those from earlier work to determine the benefits of any potential future changes to the commercial MLS for longlines. Note there is a research proposal (part of **SNA9801**) for 1997–98 to assess the effect of various management control options (such as MLS) and fishing gear modifications (such as hook modifications) on the potential yield per recruit from the SNA 1 fishery. It is possible that results from this research could also be used to determine possible benefits of any change to the recreational MLS.

428. Any increase in the MLS would probably be better accepted, and therefore complied with, by recreational fishers if it was seen to be reviewed in conjunction with the commercial MLS. It would also be preferable to review the MLS once the results from the hook modification research has been completed and considered by the snapper stock assessment working group. At this time the implications of this hook attachment for recreational fishers could also be considered.

429. Another element to consider is that the proportion of recreationally caught fish in the 27–29cm size range (inclusive) is very high. As noted above 25% fall within this size band. The Hauraki Gulf/Bay of Plenty substock is predicted to be only 60% of $B_{MSY}$ at the start of 1997–98. This substock supports the bulk of the recreational catch, about 69% of the total for SNA 1. Data from the 1996 boat-ramp survey shows that the average size of recreational snapper taken in East Northland (which is at about $B_{MSY}$) is greater (34.7cm) than those taken in Hauraki Gulf/Bay of Plenty (33.2cm). Accordingly the proportion of recreational snapper taken in East Northland in the 27–29cm band is smaller than Hauraki Gulf/Bay of Plenty. As the fishery rebuilds the average size of snapper available in Hauraki Gulf/Bay of Plenty will increase and proportionally more fish will be greater than 30cm in length. The acceptance of, and thus compliance with, a 30cm MLS could be more tenable in a rebuilt fishery as the average size, and thus catch, would be greater.

430. In conclusion, research indicates small snapper caught by recreational fishers from shallow depths have a high probability of survival upon release. By using practices that avoid gut hooking of small snapper, recreational fishers would substantially reduce mortality of fish they catch and release. The MFish educational pamphlet giving guidelines for releasing undersize fish will assist recreational fishers to reduce juvenile snapper mortality. Results also indicate that the 1994 change to MLS for recreational snapper will have had some degree of positive benefit to the SNA 1 stock in terms of productivity.

431. It is recommended that a review of the recreational MLS be considered in tandem with a review of the commercial MLS for longlines. This review could take place in 1998–99 once the results from the 1997–98 research become available and can be considered by the stock assessment working group.

### *7.3.3.11. Commercial Longline MLS*

432. In the past, some industry representatives have suggested increasing the commercial longline MLS from 25 to 30cm. They believe this measure will allow the yield per recruit to increase, therefore decreasing the number of fish required to fill the TACC and allowing the uncaught fish to rebuild the stock. MFish notes that results from catch at sea sampling in the Hauraki Gulf during 1994 indicated that the proportion of snapper taken below the legal size of 25cm was greater for the longline method than for single trawl or Danish seine, particularly during spring and summer. These undersized fish are required to be released. In addition some of the fish below 30cm but over 25cm are also released (high-grading).

433. An increase in current MLS to 30cm would result in all fish in the 25–29cm size range being returned to the sea. Previously, MFish has estimated that

there may be some positive benefit to the stock with such an increase in MLS. This benefit is due to the increased yield from the fishery that occurs as the undersize fish that survive grow to a larger size. Yield per recruit analysis suggests that the optimum size at harvest for snapper is 30cm. However, any increase in yield is highly dependent on the assumed survival rate of released fish.

434. In 1996–97, research (**AKSN17**) was commissioned by MFish to estimate the mortality of sub-30cm snapper taken by commercial longlines (and recreational lines) and returned to the sea. The final results and report has not yet been completed, but is due to the Ministry by the end of September 1997. However, preliminary results have shown that released lip-hooked fish have a high probability of survival, whereas gut-hooked fish are more likely to die. Work programmed for 1997–98 is intended to quantify the proportions of lip- and gut-hooked snapper caught by the commercial longline fleet from different depth categories. In addition, preliminary evaluation of longline hook appendages has shown that these can substantially reduce the incidence of gut-hooking. Further assessment of the effectiveness of these appendages and perhaps other aspects of hook design will provide important results for possibly determining future management controls.

435. As noted previously, catch at sea sampling of the longline, Danish seine and trawl fisheries in the Hauraki Gulf was undertaken during 1994. Substantial seasonal and method differences in the proportion of juvenile snapper in the catches were shown. In 1998–99 it is proposed to characterize the proportion of juveniles in the catch by method for other areas within SNA 1. This will provide important information to determine the total mortality associated with the respective fisheries.

436. In summary, an increase in the MLS for certain fishing methods, in particular longlining, may be beneficial. To investigate this MFish has commissioned or proposed research:

- to determine survivorship of longline released fish (final results due September 1997, **AKSN17**);
- to quantify the proportions of lip and gut hooked snapper caught by the commercial longline fleet from different depth categories (final results due September 1998, **SNA9702**); and,
- to determine the proportion of juveniles caught in the fishery (proposed project with a completion date of 30 September 1999, **SNA9802**).

437. Results from the 1996–97 and 1997–98 research will be used to determine the benefits of any potential changes to the MLS for commercial longlines. As noted in an earlier section on Recreational Controls (**Section 7.3.3.10**)the results may also be useful in reviewing the current recreational MLS of 27cm. MFish

recommends that you defer reviewing the commercial longline MLS until the final results from this research becomes available (September 1998), and can be considered by the Snapper Stock Assessment Working Group. Note that there is discussion of the option of **removing** the MLS for commercial trawlers and Danish seiners in **Section 7.3.3.2.**

#### *7.3.3.12. The Coastal Marine Area*

438. Before setting or varying any sustainability measure, the Minister must have regard to any provisions of:

a) any regional policy statement, regional plan, or proposed regional plan under the Resource Management Act 1991; and

b) any management strategy or management plan under the Conservation Act 1987—that apply to the coastal marine area and are considered by the Minister to be relevant.

439. Parts of SNA 1 fall within the jurisdiction of the Northland, Auckland, Waikato and Bay of Plenty Regional Councils. All four Councils have draft regional policy statements and draft coastal plans applying to the coastal marine area within their jurisdiction. In addition, there are four Department of Conservation Conservancies, generally corresponding to the regional council geographic areas, with Conservation Management Strategies which also relate to parts of SNA 1.

440. On the basis of the Resource Management Act stipulation that functions of regional councils and the Minister of Conservation do not apply to the harvesting of aquatic organisms where this relates to Fisheries Act matters, there are no specific provisions in any of these documents referring to the setting of sustainability measures for snapper or other species. However, common in all of these documents, are general provisions referring to sustainable management of natural resources, and protection of (marine) ecosystems. On this basis it could be inferred that these agencies would be generally supportive of any measures adopted in the SNA 1 fishery which have the general intent of maintaining the population of this species at sustainable levels.

### 7.3.4. TAC Setting

#### *7.3.4.1. Stock Status in Relation to $B_{MSY}$*

441. The current status of the two substocks differs. The **East Northland** substock appears to be at about $B_{MSY}$. The **Hauraki Gulf/Bay of Plenty** substock is currently below $B_{MSY}$, and is estimated to be about 60% $B_{MSY}$ at the beginning of 1997–98. In tonnage terms, the biomass of this substock at the start of 1997–98 is predicted to be about 34 000 tonnes, 23 000 tonnes below $B_{MSY}$.

442. Overall, the SNA 1 fishery (both substocks combined) at 1 October 1997 is estimated to have a biomass of 50 700 tonnes. $B_{MSY}$ is estimated to be 73 580 tonnes.

443. When the assessment for SNA 1 this year is compared to the assessment

made in 1996, several differences are apparent:

- the 1997 assessment is much less certain than the assessment prepared in 1996;
- yields are similar to those estimated in 1996, despite the fact that considerable amounts of catch have been added to the previous years through the inclusion of the Japanese longline catch;
- the stock status of the east Northland substock is similar to that estimated in 1996 (about equal to $B_{MSY}$) while the stock status of the Hauraki Gulf/Bay of Plenty substock is higher than that estimated in 1996 (60% $B_{MSY}$ compared to about 46% $B_{MSY}$ in 1996).

444. The status of the Hauraki Gulf/Bay of Plenty substock appears to have improved when compared to last year's assessment, which concluded that this substock was about 46% $B_{MSY}$. However, the change in the status of this substock is not because of any rebuild in the current biomass of snapper, but because of a change in the parameters of the model used in 1997 which has changed the estimate of virgin biomass. Virgin biomass is now estimated to be about 244 000 tonnes (compared with 293 000 tonnes in the 1996 assessment) and $B_{MSY}$ is estimated to be 57 650 tonnes (compared with 74 100 tonnes in 1996). The biomass estimate for 1997–98 of about 34 300 tonnes is about the same as the biomass estimate of 33 800 tonnes from the 1996 assessment. In summary, although the estimates of virgin biomass and $B_{MSY}$ have changed, there has been no significant change to the overall biomass estimate for SNA 1.

#### *7.3.4.2. Uncertainty*

445. Section 10 of the Act (Information Principles) provides guidance in circumstances where there is uncertainty in the information available to make a decision. The section suggests that decision makers should be cautious when information is uncertain. The uncertainty in the SNA 1 stock assessment information is relevant, in terms of the information principles in the Act, in considering sustainability measures and the TAC/TACC.

446. The Plenary Report notes that the 1997 assessment is much less certain than the assessment prepared in 1996. This is partly because observation error was introduced into the estimation of the recruitment indices. Previously recruitment indices were treated as if they were known. Uncertainties in the estimates of selectivity (the average vulnerability of an age class relative to the average vulnerability) and M (natural mortality—which was modelled this year using values of 0.06, 0.075, and 0.09, compared to last year when only the value of 0.06 was used) were also raised this year.

447. The status of the East Northland substock was sensitive to the different values of M modelled. With increasing values of M, the stock status improves, estimates of virgin biomass ($B_0$) decrease and the level of MSY increases. For

example, using the basecase assumption of Japanese catches from 1960–77 equal to 30 000 tonnes, the status of this substock varied from 77% $B_{MSY}$ when M=0.06 (last years value), 103% $B_{MSY}$ when M=0.075 (basecase), to 110% when M=0.09.

448. The status of the Hauraki Gulf/Bay of Plenty substock was, in comparison, not as sensitive to the different values of M modelled as was the East Northland substock. As with the East Northland substock, when the value of M increases, the stock status improves, estimates of virgin biomass ($B_0$) decrease and the level of MSY increases. For example, using the basecase assumption of Japanese catches from 1960–77 equal to 30 000 tonnes, the status of this substock varied from 52% $B_{MSY}$ when M=0.06 (last years value), 60% $B_{MSY}$ when M=0.075 (basecase), to 64% when M=0.09.

449. As noted in **Section 3, Fishery Assessment**, stock projections into the future and risk analyses were not carried out for this year's assessment. One of the main reasons for this was that these is considerable uncertainty in the model concerning historical and future recreational catch levels. An attempt was made to model future growth of recreational catch using the 1985, 1994, and 1996 recreational catch estimates.

450. The model results indicated a 3.8% increase per year in recreational fishing mortality for Hauraki Gulf/Bay of Plenty and a 5.9% increase per year for East Northland. However, there appears to be little confidence in these estimates. This is because they were calculated using an inflated estimate of the 1996 recreational catch. The 1996 estimate was adjusted upward to make it comparable to the earlier estimates. The reason being an increase in snapper minimum legal size (MLS) was introduced in 1994 and a reduction in the bag limit (from 15 to nine) was introduced in 1995. These management changes are estimated to have reduced recreational catch by about 18% in total.

451. In addition, the Snapper Stock Assessment Working Group acknowledged there was uncertainty concerning the interpretation of the catch levels in 1985, 1994, and 1996 (ie were they poor, average, or good fishing years?). Some members of the Working Group felt that the catch estimates may be better explained by environmental conditions in each year. The relationship between recreational catch and environmental variables is the subject of a research study as part of the 1996–97 NIWA contract with MFish.

452. Agreement within the Working Group has yet to be achieved on how to proceed with the projections for recreational catch. Further work is to be carried out in 1997–98 on developing a model to predict future recreational catch and also on various other inputs (eg the value of M for SNA 1, selectivities, and year class estimation).

453. Industry has commented that it does not regard the lack of agreement within the Working Group on this issue as representing uncertainty in the assessment. It believes it represents a difference of view on the obligation to ensure sustainability. It states that MFish was not willing to have stock rebuild projected with recreational catches capped to a certain level. MFish notes that this is incorrect. The minutes of the Stock Assessment meeting of 10–11 March 1997

record that the Working Group had in fact agreed to do projections with both an upper limit on recreational catch and unconstrained recreational catch. Time constraints prevented the completion of this work.

### 7.3.4.3. *Yield Estimates From Fishery*

454. As noted earlier, yield estimates are similar to those estimated in 1996, despite the considerable amounts of catch that have been added to the assessment through the inclusion of the Japanese longline catch. Offsetting the increase in catch has been a decrease in the estimated virgin biomass because the historical pattern of recruitments (estimated from the Albert Park air temperatures) is no longer used in the assessment and the estimate of natural mortality (M) has increased.

455. **Table 8** below summarises the yield estimates for both substocks and for the fishery overall.

**Table 8:** **Yield estimates from the basecase assessment for both substocks and the total fishery.** Yield estimates include non-commercial catch and are based on commercial catch history with under-reporting which is assumed to continue at 10% in future years.

| | East Northland | HG/BOP | Total Fishery |
|---|---|---|---|
| **Maximum Constant Yield (MCY)** | 1 870 t | 6 470 t | 8 340 t |
| **Current Annual Yield (CAY)$_{97-98}$** | 1 920 t | 4 050 t | 5 970 t |
| **Equilibrium Current Surplus Production (CSP)$_{97-98}$ (assumes average recruitment)** | 1 865 t | 6 470 t | 8 335 t |
| **Predicted CSP$_{97-98}$ (uses predicted recruitment for 1997–98)** | 1 390 t | 5 207 t | 6 597 t |
| **Maximum Sustainable Yield (MSY)** | 1 870 t | 6 800 t | 8 670 t |

*MSY and Equilibrium CSP$_{97-98}$*

456. Industry believes the current TAC should be treated as being 8 032 tonnes. This represents a TACC of 4 938 tonnes plus 494 tonnes for the 10% overrun and a non-commercial allowance of 2 600 tonnes. It states that the current MSY of 8 670 tonnes for SNA 1 as a whole can, on average, sustainably support the current TAC of 8 032 tonnes, whilst still allowing 640 tonnes per annum to contribute to rebuilding the fishery. Industry contends that the 1996 diary survey estimated non-commercial (which includes some but not all customary catch) to have been about 2 200 tonnes (actually estimated to be 2 330 tonnes). Therefore the surplus yield available for rebuild could be about 1 000 tonnes per annum. At this rate, industry calculates SNA 1 would rebuild to $B_{MSY}$ in about 20 years (assuming that all of the surplus goes to the Hauraki Gulf/Bay of Plenty substock).

457. Industry states that the 1995 FAO guidelines on the precautionary approach provide that, if corrective measures (here an increase in the size of the

biomass) can be completed within 20 to 30 years, then they are still within the precautionary approach. Industry is of the view therefore that it is consistent with the precautionary approach to maintain the current TACC which can allow SNA 1 to be restored to $B_{MSY}$ over 20 to 30 years, assuming constraint of current recreational catches.

458. MFish notes that the fishery as a whole is not at $B_{MSY}$ and is therefore not currently producing the MSY of 8 670 tonnes. The yield available from the fishery that would, on average, maintain the biomass at its present level is the Equilibrium $CSP_{97-98}$, which is estimated to be 8 335 tonnes. This yield would sustainably support a TAC of 8 032 tonnes, whilst providing a surplus of 303 tonnes to contribute to the rebuild. The fishery is estimated to be 23 000 tonnes below $B_{MSY}$. At a rebuild rate of 303 tonnes per year the fishery would reach $B_{MSY}$ in about 70 years (again assuming that all of the surplus goes to Hauraki Gulf/Bay of Plenty).

*Recruitment Variability*

459. The Equilibrium CSP assumes constant (average) recruitment. However, the amount of young snapper maturing and recruiting into the fishable biomass of SNA 1 can vary widely between years. This is because the survival rate of young snapper is related to the water temperature during and after spawning. The warmer the water, the more young snapper survive to maturity. Snapper first reach maturity at about four years of age and are on average just above 24cm in length. Year classes are assumed to be fully recruited at age five. The amount of snapper recruiting into the fishery in each of the next four to five years is therefore able to be predicted using water temperature data from each of the previous four to five years.

460. For example, snapper that were spawned in the summer of 1994–95 will on average reach maturity (and a fishable size) in the summers of 1998–99 and 1999–2000. Water temperatures in the summer and autumn of 1994–95 were warmer than average and therefore a strong (about twice the average size) year class is predicted to start to enter SNA 1 in 1998–99. On the other hand, water temperatures during the summers of 1990–91, 1991–92, 1992–93, and 1993–94 were colder than usual and as a result poor recruitment was predicted from each of these year classes. Data collected from recent research surveys has confirmed that the 1991–92 and 1992–93 year classes are only about a third of the average size. The weak 1990–91, 1991–92 and 1992–93 year classes recruited into the fishery during the 1994–95, 1995–96 and 1996–97 fishing years. The weak 1993–94 year class will recruit over 1997–98.

461. The four year period of poor recruitment (1994–95 to 1997–98) has had and will have a significant impact on the available yield thus biomass of the fishery. As noted earlier, at the current levels of removals the biomass of both

substocks is predicted to decline from the start of 1996–97 to the start of 1997–98. The effect of the poor recruitment in 1997–98 with a TAC of 8 032 tonnes is discussed in the following section **Predicted $CSP_{97–98}$**.

462. As noted above, a strong year class (1994–95) is predicted to start recruiting into the fishery in 1998–99. The following year class (1995–96) is predicted to be above average, but not as strong as the 1995 year class. The 1996–97 year class is predicted to be below average. It is interesting to note that a strong El Nino weather pattern is forecast for this summer. El Nino conditions typically result in colder than average water temperatures in summer and autumn and therefore poor spawning success. The four consecutive years of poor recruitment already discussed are related to the persistent El Nino weather pattern experienced in New Zealand from 1990–91 to 1993–94. The last very strong El Nino effect was experienced in 1982–83. The year class of snapper spawned that year was less than 30% of the average size. It is reasonable to assume that the strong El Nino conditions forecast for this summer will similarly result in relatively cold water temperatures and thus spawning success for snapper. This would produce another poor year class that would recruit into the fishery in 2001–02.

463. In summary, recruitment into the SNA 1 fishery is variable. Spawning success is related to water temperatures during and after spawning. The warmer the water in summer and autumn the more young snapper survive to recruit into the fishable biomass. From 1990–91 to 1993–94 colder than average water temperatures resulted in four weak year classes of snapper and thus poor recruitment into the fishery from 1994–95 to 1997–98. This poor recruitment has had and will continue to have a significant impact on the available yield and thus biomass of SNA 1. Above average recruitment is predicted to enter the fishery in 1998–99 and 1999–2000. Average recruitment is predicted in 2000–01. Strong El Nino conditions forecast for this summer are likely to result in weak recruitment in 2001–02. Thus over the eight years from 1994–95 to 2001–02 the SNA 1 fishery will have had six years of poor recruitment.

*Predicted $CSP_{97–98}$*

464. The assessment model calculated the yield available from the fishery using the estimate of recruitment for 1997–98. Predicted $CSP_{97–98}$ refers to the greatest total catch that is estimated to result in no change in biomass over the 1997–98 fishing year. It does not allow for any rebuild of the stock. The estimates of Predicted $CSP_{97–98}$ are 5 207 tonnes for Hauraki Gulf/Bay of Plenty and 1 390 tonnes for East Northland, which total 6 597 tonnes for the whole fishery (considerably less than the 8 335 tonnes estimated assuming average recruitment). The difference between total removals (commercial and non-commercial) and the Predicted CSP can be used to estimate whether the biomass increases or decreases. Using a TAC of 8 032 tonnes as an estimated total catch, the biomass of the fishery would be predicted to decline by 1 435 tonnes during 1997–98.

465. The model also provided estimates for non-commercial catch in 1997–98. These are 1 803 tonnes for Hauraki Gulf/Bay of Plenty and 599 tonnes for East Northland, although as noted earlier there is currently no agreement on the modelling of future recreational catch. Further these estimates do not include all customary catch. Therefore, these estimates should be regarded as being very uncertain. If the estimates are combined with a commercial catch level of 4 938 tonnes (assuming a 25%:75% catch split and a 10% over-run) then the estimated total removals for the Hauraki Gulf/Bay of Plenty substock in 1997–98 are 5 877 tonnes. As this estimate is greater than the $CSP_{97-98}$ of 5 207 tonnes, the biomass of this substock will decline.

466. For the East Northland substock the total removals in 1997–98 under a commercial catch level of 4 938 tonnes are estimated to be 1 957 tonnes. This estimate is above the Predicted $CSP_{97-98}$ of 1 390 tonnes and therefore under this scenario the East Northland substock would decrease in size to slightly below $B_{MSY}$.

*Current Annual Yield (CAY)*

467. The CAY is determined by the exploitation rate (catch to biomass ratio) which would maximise the yield from a fishery over time. The CAY is calculated as a constant proportion of the biomass and as such increases and decreases in tandem with natural fluctuations in the stock biomass. If a CAY harvest strategy was implemented for a fishery the biomass would, regardless of its state relative to $B_{MSY}$, always be exploited at the appropriate level. The long term average yield from a fishery managed under a CAY strategy is termed the Maximum Average Yield (MAY) and is considered a close approximation of MSY.

468. For SNA 1, CAY corresponds to a catch to biomass ratio of 11.7% for East Northland and 11.8% for Hauraki Gulf/Bay of Plenty. Based on the biomass estimates for 1997–98, CAY estimates for East Northland and Hauraki Gulf/Bay of Plenty are 1 920 and 4 050 tonnes, respectively, an overall fishery wide total of 5 970 tonnes. If a TAC of 8 032 tonnes is assumed, then this would represent an exploitation rate of about 15.8% for the whole fishery in 1997–98.

469. One advantage of using a CAY strategy to set catch limits for SNA 1, is that it would use the information for which there is the greatest certainty, that is the estimates of current biomass and the optimum exploitation rate. No sector group has disputed either of these estimates. A CAY strategy does not depend upon knowing, with any certainty, the relationship of the current biomass to $B_{MSY}$. The determination of this relationship has been one of great debate in the SNA 1 stock assessment working group. The status of the Hauraki Gulf/Bay of Plenty substock has varied from in recent years from 46 to 64% $B_{MSY}$ as the inputs to the assessment model have been amended. However, the estimate of current biomass has varied by only about 500 tonnes from 1995–96 (33 800 tonnes) to 1997–98 (34 300 tonnes).

### 7.3.4.4. *Interdependence of Stocks*

470. Industry submits that any significant reduction in TACC for SNA 1 would have a significant affect on the ability of fishers to take bycatch of other quota species in the area of the fishery and would also affect target fisheries for species for which snapper is a bycatch. In the same way that industry suggests the distribution of catch between substocks in the fishery can be managed the industry has the ability to manage bycatch across the fishery.

471. The bycatch of snapper target fisheries and the occurrence of snapper as a bycatch varies by method and area and season. The Ministry has provided a report to industry in which catch profiles for the areas and seasons of the SNA 1 fishery are characterised. Such information can assist in planning bycatch implications in the fishery. The MAF Fisheries North publication ("Profiles of the Commercial SNA 1 Snapper Fishery"), hereafter referred to as the report, showed that longlining increased from 41% of the SNA 1 catch in 1989–90 to 49% in 1992–93, while conversely single trawling decreased from 30% (1989–90) of the catch to 22% (1992–93). The trend to the increasing reliance on longlining has continued as shown by 1994–95 data, the proportion of the snapper catch amongst the main methods was: longline 52%, trawling (single and pair) 26%, Danish seining 18% and set netting 3%.

472. The report states that there is little bycatch of other species when targeting snapper by longline, and also that there is comparatively little bycatch in the Danish seine snapper target fishery with the exception of catches of red gurnard in the Bay of Plenty. The MAF report does note, however, that for Danish seining there are high catch rates of snapper when targeting other species, but it is also noted that the bycatch ratios and low volumes of snapper actually being caught were highly variable. These additional comments suggest that Danish seining, like longlining, tends to be a snapper specific target fishery.

473. The Catch Effort Landing Return (CELR) data does not support any suggestion that a large SNA 1 TACC reduction will lead to a decrease or disappearance in the longline and Danish seine fisheries for other inshore species, as both of these methods have a very small bycatch of other species. It is mainly in the single and pair trawling methods that six other species (barracouta, gurnard, john dory, rig, tarakihi and trevally (MAF report)) are caught as a bycatch of snapper fishing, but that the degree of interaction varies between areas. The MAF report explains *"...that low target/bycatch ratios are typical of the Hauraki Gulf...and, to a lesser extent, the Bay of Plenty...In East Northland, there were higher proportions of bycatch species, the most significant of which was tarakihi . . .".* However, over the five fishing years from 1989–90 to 1993–94 the single and pair trawl SNA 1 proportional catch between areas was: 48% Hauraki Gulf; 31% Bay of Plenty; 21% East Northland. As such, it would appear that even for the trawling methods only a fifth of the trawl snapper catch is from East Northland. Estimated catches of SNA 1 taken as a target and bycatch of nominated target species for the period 1991–92 to 1995–96 is shown in **Table 11**.

474. The proportion of snapper taken as a target species ranges from 87.5 to 93.9% of the annual estimated catch. Bycatch levels in trevally, gurnard, john dory,

tarakihi and rig fisheries range between 0.2 and 3.4%. It is of note that the highest proportion of snapper as a bycatch of gurnard target fisheries occurred in the 1992–93 fishing year. It was in this year deemed values for snapper were lower than lease prices and a considerable overcatch of the SNA 1 TACC occurred.

### 7.3.4.5. *Social, Cultural and Economic Factors*

475. Section 13 of the Act requires that, in considering the way in which and rate at which a stock is rebuilt towards a level that can produce the MSY, the Minister shall have regard to such social, cultural, and economic factors as he or she considers relevant.

476. This section considers these factors principally as they relate to reductions in removals to achieve a rebuild. The benefits and impacts of other management controls are discussed in **Section 7.3.3, Imposition of Other Controls.**

477. Establishing a lower TAC by lowering total removals will have two general effects. Firstly, there will be disadvantages and costs to the commercial and non-commercial sectors if controls are adjusted to reduce their removals. These are discussed in the sections below, **Costs of Reducing Removals** and **Analysis of foregone benefit**. Secondly, there will be benefits to the commercial and non-commercial sectors of rebuilding the stock biomass to $B_{MSY}$. These are discussed in the section below, **Benefits of Rebuilding the Stock.**

478. The discussion and analysis of the costs and benefits of a TAC reduction presented below should be read with two important qualifications in mind. First, there is limited information available to MFish for a robust cost-benefit analysis. Second, non-market values are discussed in the section **Benefits of Rebuilding the Stock**, but have not been factored into the quantitative assessment of the implications of alternative stock rebuild strategies (**Analysis of Foregone Benefit**). It is salient to acknowledge the difficulty in placing a value on the benefits that will accrue from a stock rebuild. These benefits may not occur for a number of years, or decades, depending on the rebuild timeframe. In addition, many benefits, such as enhanced customary and recreational fishing, have no market value and are thus difficult to quantify.

479. In their submissions industry strongly supports your consideration of costs and benefits in determining the rate of movement toward $B_{MSY}$. In addition you should note that the Court of Appeal addressed this issue (*New Zealand Fishing Industry Association (Inc) and Ors v Minister of Fisheries and Ors, 22/7/97, Tipping J*). In this judgment it was held that:

> "The Minister acknowledged the impact his decision would have, but there was little if any analysis either in the advice paper or in the decision itself of the costs and benefits of all kinds to be derived or incurred either from the objective of moving to MSY or from the speed at which that should be done. Indeed the advice to the Minister suggested no great concern at the time frame for moving to MSY, yet there was apparently no consideration given in the decision to the differences which would flow to both costs and benefits if the time frame adopted were altered to 30 years, or any other period, from the

period of 20 years which the Minister ultimately fixed";

and

"the Minister would be wise to undertake a careful cost benefit analysis of a reasonable range of options available to him in moving the fishery toward MSY".

480. In their submission, industry's position is that the social, cultural, and economic factors must be considered in relation to setting the TACC as well as TAC, although these qualifiers are mentioned in s13 of the Act which sets the TAC. This position recognises that the proportion of the TAC represented by the TACC can change over time and that those factors will be relevant to such a decision. The TACC decision is based on the TAC and an allowance for non-commercial fishing interests and other fishing mortality. As indicated in the recent court decisions, the allowance decision is not one-dimensional—it must recognise the legitimacy of other (in this case commercial) stakeholders' interests in the fishery. Thus economic, social and cultural factors will inevitably affect the allowance decision, in turn affecting the sharing of the rebuilding costs between sectors. In addition **Section 2.7** above discusses a recent High Court decision which is relevant. This decision found that because the TACC is currently set under the 1983 Act, and the 1983 Act requires the Minister to have regard to the TAC when fixing the TACC, the factors which determine the TAC must also be considered when determining the TACC. Because of the reasons above, much of the material discussed in this section will be relevant for your consideration in **Section 7.4** where setting the TACC is considered.

*Costs of Reducing Removals*

481. **Section 4.1** summarises the industry's assessment of the economic and social impacts of a significant TACC reduction. They also refer you to a number (15 in total) of affidavits filed in judicial review proceedings over the last two years, and case studies of Moana Pacific and three northern communities.

482. Drawing from this material, the paragraphs below discuss some of the potential impacts of a TACC reduction. For some of these issues, such as foregone export receipts, the effects of different levels of TACC reduction are evident. For many other issues, it is difficult to assess the costs of different levels of reduction because the industry's submissions analyse the costs of a significant reduction only or discuss reductions in terms of the loss of the whole SNA 1 commercial fishery. Actual costs will depend very much on the individual circumstances of fishers and quota owners.

*Quota price*

483. Quota prices for snapper 1 for the period January 1990 to April 1997 are given in **Figure 5**.

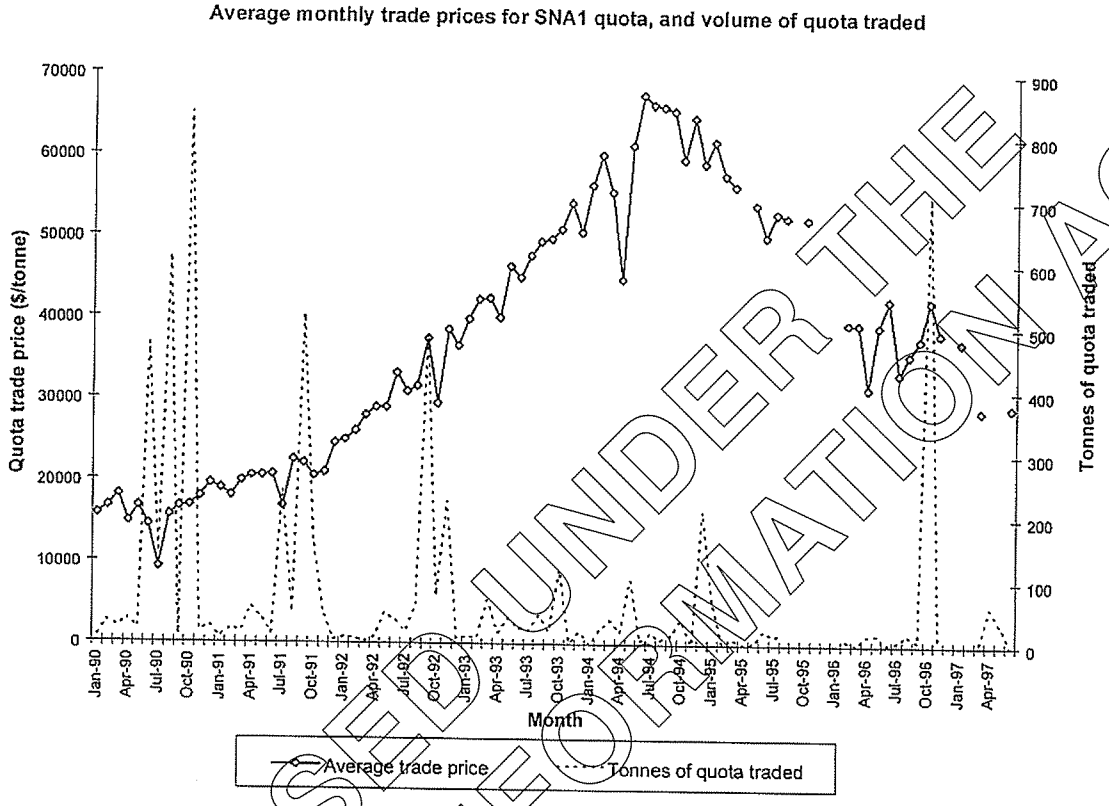


**Figure 5:** **Average quota price and tonnes traded for SNA 1 quota. The price of quota sold is expressed in current dollars.**

484. The price of SNA 1 quota has decreased from $56 900 per tonne in the 1993–94 fishing year to $37 000 per tonne over the last fishing year[1] (see **Table 9** and **Figure 5**). Industry suggests the decline in quota price is directly a result of confidence in the snapper fishing industry related to the Minister's 1 October 1995 decisions. However, the decline in price started well before this, and had declined by about 30% in the two years prior to 1 October 1995. Quota prices had been increasing steadily over the four years prior to 1993–94 from a price of $19 000 in 1990–91. Industry suggests that any significant TACC reduction will cause financiers to foreclose on many quota holders who purchased quota at the higher value levels. If quota prices decline further the industry would continue to lose equity value. However a decline in quota price cannot be directly attributed to TACC reductions. Quota prices in 1992–93 and 1993–94 increased despite the 1992 TACC reduction. Economic factors contributing to the price decline since 1993–94 include the strengthening New Zealand dollar, introduction of cost recovery, and lower market returns for snapper.

[1] Ministry of Fisheries, Quota Monitoring System reports

**Table 9:** **SNA 1 quota lease and sale prices. Average over October to September fishing years, except for 1996–97 which is October to June.**

| Year | Sale price ($) | Lease price ($) |
|---|---|---|
| 1990–91 | 19 067 | 2 224 |
| 1991–92 | 28 327 | 2 698 |
| 1992–93 | 41 719 | 3 515 |
| 1993–94 | 56 871 | 4 137 |
| 1994–95 | 52 358 | 4 388 |
| 1995–96 | 40 621 | 4 444 |
| 1996–97 | 37 072 | 3 335 |

Source: Quota monitoring system, MFish.

485. Lease prices show a similar trend to sale prices (**Table 9**). However, they continued to increase for two years after trade prices declined, and have only declined in the current fishing year. A TACC reduction may cause lease prices to increase, because of demand for the lesser amount of quota available, or may mean lease quota is no longer available. This would create problems for operators, probably smaller operators particularly, who are dependent on lease quota for all or part of their snapper catch. There are currently 51 quota holders who own no snapper quota, but who, in total, lease over 1 000 tonnes of quota. An increase in lease price would impact on the profitability, and potentially the economic viability, of their operations.

*Industry Structure and Quota Holdings*

486. Nine vertically integrated firms own more than 60% of the SNA 1 quota. Vertically integrated companies take part in both the fishing and processing aspects of the business. The rest is owned by the Treaty of Waitangi Fisheries Commission and a mixture of smaller companies and fishing operations, many of which do not process their catch in any significant way. It is probable that the cost structure of major quota holders is quite different from that of smaller fishers, however it is difficult to see how this may easily be taken into account.

487. As at July 1997, there were 196 registered owners of SNA 1 quota and 177 registered quota holders (see **Table 10**). (The total holding of any individual is the amount owned plus the amount leased). Fourteen legal entities hold 82.8% of the TACC, however, considering the association of companies the number of interests controlling these holdings is 10. Ownership of quota has a differing distribution as many companies have taken actions to shield quota holding companies from their fishing operations and Fisheries Act provisions for quota forfeiture. In total 23 legal entities own 82.9 % of SNA 1 quota. Within this number there are company arrangements that see control of these amounts in a lesser number of legal entities.

Table 10: **The distribution of SNA 1 quota owners and holders by tonnage categories, July 1997**

| Tonnes of quota | Number of quota owners | Number of quota holders |
|---|---|---|
| >500 | 2 | 3 |
| 100–499 | 10 | 9 |
| 50–99 | 4 | 2 |
| 25–49 | 7 | 7 |
| 10–24 | 29 | 24 |
| 5–9 | 29 | 25 |
| 1–4 | 66 | 49 |
| <1 | 49 | 58 |
| **Total:** | **196** | **177** |

488. The effect of any TACC reduction will vary with the scale of the quota holding or fishing operation, and the structure of the operations. A separate assessment, on the basis of scale of holdings and the nature of operations, may be required. For example, the single largest SNA 1 holder (MPFL) has a small fleet of vessels and relies extensively on owner operators to catch its quota. Sanford Ltd, on the other hand, is primarily an owner/catcher operation.

489. Another feature of industry structure is the large number of owners involved in the fishery. Of interest is the last 1% of the holding is held by 33% of the total number of quota owners (about 200). These are very small holdings and these may be held to cover bycatch, to complement lease, CAAQ or FAAQ arrangements, or may represent "lifestyle" fishers. However, many of the holdings in the order of 1–200 kg are probably being held by original quota holders in the hope of a stock rebuild, an increase in the TACC and expectations that 28N rights may be exercised.

490. The impact of a reduction in TACC on quota holders and owners is difficult to assess and will depend on the extent of any reduction, and will be very different between operators. The effect will depend on many variables including level of debt, the species mix of quota held and the extent to which the fisher is able to adapt operations to harvest less snapper. Some fishers may decide that harvesting their non-snapper holdings is uneconomic and exit the industry. It is apparent that some small players remain in the fishery despite poor returns. These individuals may be maximising values other than income, such as lifestyle.

*Bycatch Issues*

491. In industry's submission they provide a table showing sales revenue for 15 species. They suggest the primary annual revenue value of the fishery based around SNA 1 is around $125 million. This includes the total revenue for the whole SNA 1 TACC plus the revenue for the TACCs of all species taken with snapper 1, or fisheries for other species in which snapper is taken. To infer that the total catch of all these other species is linked with snapper, and the total revenue would be foregone as a result of a snapper TACC reduction, is not justified. Barracouta in area one (BAR 1) includes the whole of the east coasts of both islands. Some of these species are target

fisheries in their own right (eg grey mullet, bluenose, hapuka). Although snapper is taken in many of the mixed species fisheries in the area, a substantial proportion is taken by targeting as a relatively clean catch (see below).

492. The Ministry has provided a report to industry in which catch profiles for the areas and seasons of the SNA 1 fishery are characterised. Such information can assist in planning bycatch implications in the fishery. Estimated catches of SNA 1 taken as a target and as bycatch of other target species for the period 1991–92 to 1995–96 are shown in **Table 11**. The proportion of snapper taken in target snapper fisheries ranges from 87.5% to 93.9% of the annual SNA 1 catch. Bycatch levels in trevally, gurnard, john dory, tarakihi and rig fisheries range between 0.2 and 3.4% of the snapper catch.

**Table 11: Catch (tonnes) of SNA 1 for nominated target species, and % of annual SNA 1 catch.**

| Year | SNA | TRE | GUR | JDO | TAR | SPO | Other | Total |
|---|---|---|---|---|---|---|---|---|
| 1991–92 | 4771 | 96 | 68 | 35 | 44 | 22 | 44 | 5079 |
| | 93.9% | 1.9% | 1.3% | 0.7% | 0.9% | 0.4% | 0.9% | |
| 1992–93 | 4229 | 116 | 164 | 110 | 72 | 26 | 116 | 4833 |
| | 87.5% | 2.4% | 3.4% | 2.3% | 1.5% | 0.5% | 2.4% | |
| 1993–94 | 4124 | 89 | 70 | 87 | 71 | 24 | 43 | 4507 |
| | 91.5% | 2.0% | 1.5% | 1.9% | 1.6% | 0.5% | 0.9% | |
| 1994–95 | 4175 | 94 | 58 | 57 | 62 | 19 | 30 | 4495 |
| | 92.9% | 2.1% | 1.3% | 1.3% | 1.4% | 0.4% | 0.7% | |
| 1995–96 | 3661 | 49 | 37 | 102 | 64 | 8 | 50 | 3971 |
| | 92.2% | 1.2% | 0.9% | 2.6% | 1.6% | 0.2% | 1.3% | |

493. Industry submits that significant reduction in TACC would have major implications for fishers with respect to bycatch of a range of other species and would affect target fisheries for other species for which snapper is a bycatch. They suggest the 20 large quota holders would significantly retrench their activities and would no longer lease out quota to the approximately 200 small quota holders, with less than five tonnes of quota, who depend on the larger companies to provide them with additional lease quota to support a viable fishing operation.

494. However, the Ministry would assess that the industry has some ability to manage bycatch across the fishery. The bycatch in snapper target fisheries and the occurrence of snapper as a bycatch in other fisheries varies by method, area and fishing strategy. The economic effects of a reduced SNA 1 TACC can be offset to some extent by proportionally increasing the targeting of other inshore species relative to snapper in the catch mix. In addition, industry could reduce snapper targeting to provide adequate SNA 1 quota as a bycatch. This is will have implications because of the difference in value between quality grades of snapper. In general snapper associated with methods producing a higher bycatch of other species or snapper taken as bycatch tend to be of a lower quality and hence value.

495. The industry notes that some species harvested from the mixed species

fishery in the Northern Region (FMA1) are sold in conjunction with species from other regions to make up economic parcels for exporting, and so there are cost savings and benefits to other FMAs from the FMA1 fisheries. They point to similar synergies with the crustacea and shellfish fisheries of the Northern Region.

*Downstream*

496. A significant TACC reduction will cause economic hardship in terms of decreased profit and employment in the harvesting and processing sectors. Industry also draws your attention to downstream impact on related service industries, such as transport and repairs. Industry concludes there are many socio-economic benefits associated with fishing in community activities, the delivery of social services and attraction for outside commercial interests.

497. A study on economic multipliers by economic consultants BERL (Business and Economic Research Ltd) quoted by industry found that, for every dollar generated in the seafood industry, another $1.50 was generated in other industries, and an additional $1.60 was generated by downstream effects—giving a multiplier of 3.1 for every dollar earned by the seafood industry. The industry submissions suggest approximately 500 people are employed directly in the SNA 1 fishery. Depending on the extent of any reduction there will be implications for some people employed directly or in commercial activity related to fishing. The industry use a multiplier of 3.2 to estimate numbers affected. However, the use of economic multipliers has limitations. In particular they assume there is no alternative employment for the labour and other resources shed by the directly affected industries. This often leads to an overstatement of effects on income and employment, especially in the longer term. This assumption may be more relevant to the fishing communities outside the main urban areas where there are fewer employment opportunities. An additional point is that using an industry wide multiplier may not be appropriate for a product for which a large proportion (60%) is exported in a whole chilled form.

*Coastal Communities*

498. Snapper, because it is a relatively high value species, will be an important component of fishing in a number of small coastal communities in QMA 1. The impacts in these areas will be compounded by the fact that there will be few alternative sources of employment. In appendices to their submission, industry provides analyses of the impacts of the reduction on the Leigh, Great Barrier Island and Houhoura communities first included in their submissions in previous years. The industry suggests that companies will make decisions to catch the lower available quota at least cost, and as a result will rationalise their operations, leading to withdrawal from areas where transport costs from export destinations are highest. The analysis of the three communities by industry suggests fishing, directly and indirectly, employs 8–71% of the workforce, is a substantial contributor to economic turnover, and many fishers are dependent on leasing quota.

499. Industry also refers you to affidavits (15 in number) filed in the proceedings they instituted which describe the views of individuals on the impact of a reduction of the TACC to 3 000 tonnes. These affidavits also emphasise the economic value of the SNA 1 commercial fishery and its contribution to the

economies and employment in the northern metropolitan areas and coastal communities north of Auckland.

### *Non-Compliance*

500. In addition to the economic and social consequences, there are potential fisheries management implications of a substantial TACC reduction. For some operators, who may already be marginally economically viable, the lack of sufficient snapper quota may encourage fishers to act illegally. This could occur in a number of ways including dumping snapper for which insufficient quota is held, or by selling snapper other than through legal mechanisms. During consultation it was suggested that some fishers would respond to a reduction in this manner.

### *Fleet Restructuring*

501. A comparison of fleet structure and fishing days for two periods (Period 1: 1989–90 and 1991–92, and Period 2: 1993–94 and 1995–96) where the TACC was set at approximately 6 000 tonnes and 4 900 tonnes, respectively, is given in **Table 12.**

**Table 12: Number of vessels and days target fishing for Snapper 1 during the fishing years 1989–90, 1991–92, 1993–94 and 1995–96**

| | Period 1 | | | | Period 2 | | | |
|---|---|---|---|---|---|---|---|---|
| **Fishing year** | **1989–90** | | **1991–92** | | **1993–94** | | **1995–96** | |
| TACC | 5 981 | | 6 010 | | 4 928 | | 4 928 | |
| | *Vessels* | *Days* | *Vessels* | *Days* | *Vessels* | *Days* | *Vessels* | *Days* |
| Bottom longline | 311 | 15 178 | 322 | 18 101 | 285 | 18 185 | 159 | 11 982 |
| Single trawl | 60 | 2 199 | 60 | 2 510 | 40 | 1 543 | 44 | 1 700 |
| Danish seine | 27 | 1 083 | 31 | 1 980 | 22 | 1 304 | 20 | 805 |
| Set net | 115 | 1 754 | 132 | 2 553 | 96 | 1 342 | 57 | 661 |
| Bottom pair trawl | 13 | 295 | 9 | 212 | 8 | 190 | 9 | 171 |
| Beach seine | 19 | 285 | 22 | 195 | 14 | 47 | 11 | 48 |
| **Total** | **545** | **20 794** | **576** | **25 551** | **465** | **22 611** | **300** | **15 367** |

502. With a TACC of 6 000 tonnes in period 1, there does not appear to have been any significant fleet restructure . The situation is different in period 2 with a 4 900 TACC. Between 93–94 and 95–96 the number of vessels fishing decreased by 35% and the days fished decreased by 32%. The methods most reduced in this period were lining and setnetting, while trawling increased. Longline fish are usually of higher quality, and hence value, than trawl caught fish. The increase in trawling may be explained by the major quota holders, which are also processing companies, owning and operating their own trawlers.

503. The reduction in vessels and days fished since October 1993 may be a response to the 1992 TACC reduction (a decline of 18%). In the absence of further data on fleet structure for the 1996–97 fishing year, it is possible that the fishery is continuing to restructure and may remain overcapitalised for the current TACC.

504. A TACC reduction is likely to encourage further fleet restructuring. This adjustment will take some time due to lack of easy alternative employment opportunities for the vessels.

*Conclusion*

505. It is difficult to determine or quantify the effects of a TACC reduction because it will depend very much on individual circumstances and decisions, including quota owned , vessel used , level of debt, and the extent to which fishing operations can be adapted to the size of any reduction.

*Analysis of Foregone Benefit in the Commercial Snapper 1 Fishery*

506. A TACC reduction will have the direct result of foregone revenue from fish sales. This section considers an analysis that estimates the costs and benefits, in terms of foregone revenue from fish sales, as a result of different catch reduction scenarios[2]. This analysis cannot be considered a full cost benefit analysis since it does not examine the advantages and disadvantages of the management change to society. It is limited to an evaluation of the costs and benefits to the commercial sector only.

507. An economic definition of cost/benefit analysis (CBA) is the present value of expected benefits minus the present value of the expected costs ie the net present value, associated with a particular management change. A CBA may be performed on a number of different scenarios to derive the option with the greatest net present value. There are practical difficulties with the use of CBA in this context, not the least of which is the poor quality of information available.

508. In this section a deterministic model is used to indicate the possible future costs to industry of foregone harvests of fish based on alternative scenarios to rebuild the stock toward $B_{MSY}$. The technique has important limitations and it is necessary to emphasise these. For example the model is based on neo-classical economic theory with its inherent assumptions (perfect information, perfect competition), many of which we know in real world situations do not hold. Clearly the model is simplistic and does not include all commercial costs and benefits. It also makes other assumptions including assumptions regarding the biology of the fishery, that biomass rebuild is linear and non-stochastic, that recruitment is constant, industry cost structures remain the same, technology remains the same, and the price received remains constant. The analysis notably lacks consideration of costs and benefits to non-commercial fishers. These are considerably more difficult to quantify and are discussed in a later section.

509. For the purpose of evaluating the economic implication of various rates of snapper 1 rebuild, seven scenarios were examined (**Table 13**). So that scenarios can be compared, a number of factors were held constant across the scenarios:

a) stock rebuild assumed the current equilibrium surplus production of 8 335 tonnes was available each year and that 23 150 tonnes is required to

[2] Acknowledgement to Basil Sharp and Chris Batstone, Auckland University, and Peter Clough, NZIER

rebuild the stock to $B_{MSY}$;

b) all scenarios were run for 35 years ie after the various rebuild periods the stock size was maintained at $B_{MSY}$. Note that in scenario 1 stock size does not reach $B_{MSY}$ (this would take 76 years);

c) non-commercial removals were held constant at 2 600 tonnes as the stock rebuilds to $B_{MSY}$;

d) illegal removals were assessed as 10% of the TACC;

e) from the year $B_{MSY}$ was reached till the end of the run, the yield at $B_{MSY}$ (8 670 tonnes) was allocated between the sectors based on the proportion of current removals (commercial and illegal 68%, non-commercial 32%).

**Table 13: Descriptions of Scenarios**

| | |
|---|---|
| 1 | TACC maintained at current level of 4 938 tonnes |
| 2 | TACC reduced in 1997–98 to a level enabling the stock to rebuild in 10 years |
| 3 | TACC reduced in 1997–98 to a level enabling the stock to rebuild in 20 years |
| 4 | TACC reduced, over a three year period starting in 1997-98, to a level enabling the stock to rebuild in 20 years |
| 5 | TACC reduced in 1997–98 to a level enabling the stock to rebuild in 25 years |
| 6 | TACC reduced, over a three year period starting in 1997–98, to a level enabling the stock to rebuild in 25 years |
| 7 | TACC reduced in 1997–98 to a level enabling the stock to rebuild in 30 years |

510. **Table 14** shows the TACCs in tonnes for each scenario for specific years. The years shown indicate when the TACC changes under each scenario. Note that for the phased reductions (scenarios 4 and 6), a slight adjustment of TACC is made in the fourth year to achieve $B_{MSY}$ within the scenario timeframe.

**Table 14: TACCs for each scenario**

| Year | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| 1 | 4 938 | 3 109 | 4 161 | 4 679 | 4 372 | 4 749 | 4 512 |
| 2 | 4 938 | 3 109 | 4 161 | 4 420 | 4 372 | 4 560 | 4 512 |
| 3 | 4 938 | 3 109 | 4 161 | 4 161 | 4 372 | 4 371 | 4 512 |
| 4 | 4 938 | 3 109 | 4 161 | 4 115 | 4 372 | 4 346 | 4 512 |
| 10 | 4 938 | 5 360 | 4 161 | 4 115 | 4 372 | 4 346 | 4 512 |
| 20 | 4 938 | 5 360 | 5 360 | 5 360 | 4 372 | 4 346 | 4 512 |
| 25 | 4 938 | 5 360 | 5 360 | 5 360 | 5 360 | 5 360 | 4 512 |
| 30 | 4 938 | 5 360 | 5 360 | 5 360 | 5 360 | 5 360 | 5 360 |
| 35 | 4 938 | 5 360 | 5 360 | 5 360 | 5 360 | 5 360 | 5 360 |

**NB When the stock reaches this target level the commercial and non-commercial shares of the MSY will be in the same proportions as the current catch.**

Net present value (NPV) is assessed as:

$$NPV = \sum_{t=1}^{35} \left( \frac{B_t - C_t}{(1+r)^t} \right)$$

B = Benefits
C = Costs
r = discount rate
t = year

511. It was assumed that all snapper are exported and that the average export price of $6 700 per tonne remains constant.[3] A Statistics NZ survey suggested that the fixed and variable cost of operating a fishing boat is 80% of the gross margin. Gross margin is total revenue before costs. A discount rate of 15% is used which is assessed as a reasonable rate for a commercial activity like the fishing industry.

512. The results of calculating the NPV for each scenario are given in **Table 15**. The NPV is the discounted net revenue of the commercial fishery under each scenario. The foregone benefit is the change in NPV compared to the NPV of scenario 1. The percentage change in NPV from the "status quo" is shown in the last column.

**Table 15:**

| | Scenario | NPV ($millions) | Foregone benefit ($ millions) | Change in NPV (%) |
|---|---|---|---|---|
| 1 | "status quo" | 50.3 | 0 | 0 |
| 2 | 10 year rebuild | 37.2 | -13.1 | -26% |
| 3 | 20 year rebuild | 43 | -7.3 | -14.7% |
| 4 | 20 year rebuild with phased reduction | 43.7 | -6.6 | -13% |
| 5 | 25 year rebuild | 44.7 | -5.5 | -10.9% |
| 6 | 25 year rebuild with phased reduction | 45.3 | -5 | -9.9% |
| 7 | 30 year rebuild | 46 | -4.3 | -8.5% |

513. NPVs were also calculated by separately altering one variable at a time, using discount rates of 12% and 10%, a price of fish of $11 000 (as submitted by the industry), and a cost of fishing equivalent to 60% of the gross margin. The results, expressed as a percentage change in NPV from the 'status quo', are summarised in **Table 16**. The base model uses the parameters as in paragraph 509. above. These analyses result in different NPVs for each parameter changed, however, they do not alter the relative difference between the scenarios or the ranking of the scenarios in terms of foregone benefit.

[3] This price is taken from NZFIB, Export of Seafood Products, Report 5B, June 1997. Industry provide a revenue figure of $11 000 per tonne as an average of export sales and local sales. The difference in price may be because industry's figure is related only to snapper from area 1 which may be relatively highly valued.

**Table 16:** **Sensitivity to variation in model parameters expressed as percentage change in NPV from the "status quo" option.**

| Scenario | Base model | Discount rate 12% | Discount rate 10% | Price $11000/tonne | Cost of fishing 60% |
|---|---|---|---|---|---|
| 1 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 2 | -26.0% | -23.0% | -20.6% | -26.1% | -26.1% |
| 3 | -14.5% | -13.7% | -13.0% | -14.5% | -14.5% |
| 4 | -13.1% | -12.6% | -12.1% | -13.1% | -13.0% |
| 5 | -10.9% | -10.7% | -10.3% | -11.0% | -11.0% |
| 6 | -9.9% | -9.8% | -9.7% | -9.9% | -9.9% |
| 7 | -8.5% | -8.4% | -8.3% | -8.5% | -8.5% |

*Conclusion*

514. This analysis of foregone benefits should be considered an indicative result only, because of the large number of assumptions made. Actual costs and benefits may be quite different for a number of reasons including:

a) the importance of snapper in catch profiles, and therefore the impact on fishing for other species of loss of snapper quota;

b) the model assumes foregone benefits are related to TACC reductions in a linear manner;

c) the model assumes biomass increase will be linear; however actual increases will vary due to varying strength of recruiting year classes and other factors;

d) the model assumes the price of fish is constant, whereas actual price is determined by global trends in fish supply and demand;

e) increased biomass may reduce per unit harvesting costs, resulting in declining marginal costs over time;

f) the model assumes (for lack of a better alternative) that the cost of fishing is a fixed percentage of the price of fish, whereas the factors determining fishing costs (eg cost of capital, labour cost, fuel cost and catch rate) are independent of the price of fish.

515. Therefore the value of NPVs derived must be treated with caution. However, the use of this simple technique suggests that there would be a significant differences in NPV for SNA 1 associated with different rebuild scenarios, and therefore provides assistance in comparing the relative foregone benefits of the options.

516. Clearly any reduction in TACC causes foregone benefit in terms of revenue to industry from fish sales. The model indicates that a TACC reduction to achieve a rebuild over 10 years results in a 26% reduction in discounted net revenue over 35 years. In contrast, a TACC reduction to achieve a rebuild over 30 years only results in a 8.5% loss. This suggests a substantial difference in economic costs between 10

and 30 year rebuild periods. In comparison the difference in foregone benefit between a 20 and 30 year rebuild period is relatively modest—an additional 7%.

517. Industry has suggested that if TACC reductions are necessary, phased implementation should be considered. The model suggests that phasing in reductions over three years, for the same rebuild period, lowers foregone benefit by less than 2%. However, the model is likely to underestimate the benefit of phased reductions because it assumes TACC reductions are related in a linear manner to economic impact. Industry notes in their submission that if a necessary reduction is phased in, they can take steps to manage the process of scaling down operations. In contrast, a 'one hit' reduction may force retrenchment, such as closing processing plants, that might be avoided with more time to manage change.

518. The discount rate used in the analysis above is 15% which is assessed as a reasonable rate for a commercial activity like the fishing industry. However a significantly different social discount rate would be required if the full environmental and social costs and benefits were factored into a model of the social costs and benefits. However, reductions in the discount rate for this model of the fishing industry would increase the NPV of all the scenarios, leaving the ranking of the scenarios by foregone benefit unaffected.

519. Industry has strong incentives to defer and minimise TACC reductions for reasons including deferring economic impact, and the strategic interest in maintaining current share in the fishery. In addition the increased yield which will be available as a result of the stock rebuild is relatively low. Under these circumstances, as this analysis suggests, it is likely the NPV to the commercial sector of TACC changes to rebuild the stock, will be negative. Consequently, the industry's preferred rebuild strategy is likely to be that which corresponds to the longest rebuild period—this minimises the impact on their revenue stream during the period.

520. The simple deterministic model used above could be developed further, however a potentially more fruitful approach is the use of stochastic modelling using the maximum likelihood method. This is a more sophisticated technique that was unable to be evaluated in the time available to prepare this report. However, while making the result more precise, it is unlikely that the basic conclusion that the NPV of any rebuild strategy involving a TACC reduction will be negative to industry and the longer time period for the rebuild would be preferable from an industry standpoint, is unlikely to change irrespective of the model used.

## *Benefits of Rebuilding the Stock*

### *Introduction*

521. Benefits will accrue to the commercial and non-commercial sector with rebuilding the stock biomass to $B_{MSY}$. Although there is an explicit legal obligation to move the stock to $B_{MSY}$, this in itself would not justify a decision to impose the costs of additional controls on a sector. The decision itself would need to be seen to be reasonable. As discussed above, industry strongly supports your comparison of costs and benefits in considering rate of movement toward $B_{MSY}$ and the Court of

Appeal, in addressing this issue, suggested you consider "the costs and benefits of all kinds to be derived or incurred either from the objective of moving to MSY or from the speed at which that should be done".

522. In considering the benefits that will accrue from a rebuild, it is salient to acknowledge the difficulty in placing a value on (i.e. quantifying) benefits that may not occur for a number of years, or decades, depending on the rebuild timeframe. In contrast, the costs of a TACC reduction are relatively obvious and more quantifiable. Providing a quantifiable value on some of the benefits that will result from a rebuild is not an area the Ministry has experience with. Some of the techniques that could be applied are discussed below in the section **Increased Recreational Access**. As a result of this situation, the section below discusses benefits, but we are not able to incorporate these into a comparative analysis, such as a cost benefit analysis.

523. Based on the equilibrium current surplus production (CSP) value for 1997–98, the estimates of biomass, and current removals, the stock will recover very slowly over a period exceeding 70 years if no management steps are taken other than to restrain overall catch to current levels. Although industry may argue that, from their perspective, the benefits of a rebuild are minimal, this timeframe does not seem tenable. In the purpose of the Act, the definition of utilisation is "to enable people to provide for their social, economic and cultural wellbeing". The Act further specifies that the target stock level to achieve this is that which can produce the MSY. To adopt such a long time frame would seem to be in conflict with enabling non-commercial fishers to achieve the purpose of the Act.

*Increased CPUE*

524. One of the advantages that will become apparent as the stock rebuilds is an increase in CPUE or catch rate to both non-commercial and commercial fishers. Based on the current assessment, biomass of SNA 1 would increase from 50 700 tonnes to 73 580 tonnes overall. This is a 45% increase. The use of CPUE in stock assessments in New Zealand and overseas, such as stock reduction analyses, is dependent on the assumption of a direct relationship between CPUE and biomass. Assuming there is a direct relationship between biomass and catch rate we can expect that, overall catch rate will increase by 45% in proportion. The simple graph at **Figure 6** shows potential increase in catch rates over various rebuild times. The increase will of course not be linear, because of reasons including the effect of years of poor and good recruitment to the fishery. In addition it will not be uniform between areas. There are many factors that will influence catch rate for a particular fisher.

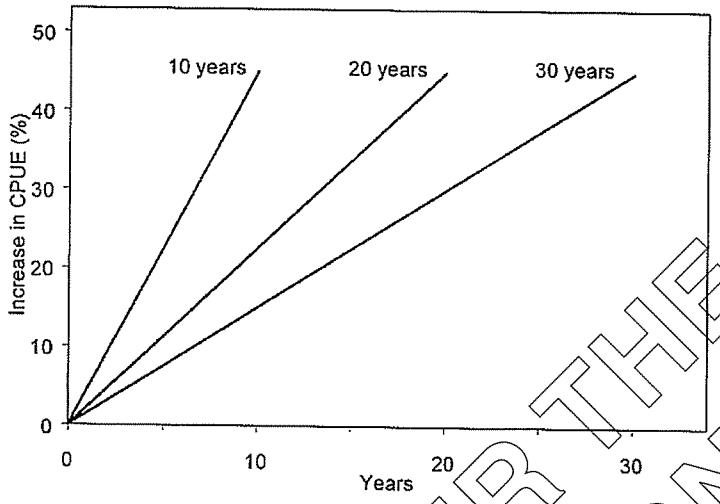


**Figure 6:** **Percentage increase in catch rate over various rebuild periods.**

525. With a reduction in removals that would achieve a rebuild to $B_{MSY}$, catch rate would increase by 45%. Based on the model in the section on **Analysis of Foregone Benefit** above and its assumptions, for this increase in catch rate to occur over 10 years, industry would forego 26% of net revenue over a 35 year period. A reduction in removals that would achieve a rebuild to $B_{MSY}$ in 20 or 30 years, the increase in catch rate over the first ten year period would be 22% and 14% respectively. Making a similar comparison, industry would forego (over 35 years) 14.5% or 8.5% of net revenue.

526. In addition to increasing as the stock rebuilds, catch rate will likely increase in the short term if a reduction in removals is implemented, because of reduced fishing effort on the stock. How positive this factor is for non-commercial fishers in the short term will depend on the extent to which commercial and non-commercial fishers catch the same fish in the same areas. If a reduction in removals is implemented sufficient to provide a rebuild in 20 years, under the same assumptions as used in the model in the **Analysis of Foregone Benefit** section above, catch will be reduced by 10%. This would increase the biomass, and as a result the catch rate.

527. Industry suggests catch rate is relatively unimportant to them because fishing targets aggregations and the fishing strategy is directed at ensuring the quality of fish rather than quantity. However, over time it is difficult to accept that a marked increase in catch rate would not be of benefit to industry. There will be increases in catch of snapper in fisheries and areas that may require adjustment to fishing operations. If increases in catch rate reduce the operating costs associated with fishing there is potential for increased profitability by reducing variable costs relative to revenue. The extent of this will depend on the effect of catch rate on the

variable costs of operating a vessel such as fuel, labour, and maintenance. The extent of increased profitability will also depend on the proportion of variable costs to fixed costs such as mortgage on the vessel as well as key factors such as export price and exchange rate.

528. Recreational interests strongly support restraint on commercial fishing to allow the stock to rebuild on the basis that recreational catch rates are not considered to be satisfactory. The concerns over low catch rates have also been raised by Iwi in some regional consultation meetings initiated by the Ministry. Iwi representatives in some areas also considered it important to weigh the financial implications of a reduced TACC against their concern for access and the long term sustainability prospects for the fishery.

*Increased Size of Fish*

529. Size of fish is important to recreational fishers. To some extent the size of fish caught by recreational fishers will continue to be influenced by the areas they fish. Available information suggest a substantial proportion of fish taken by recreational fishers are under the size limit (~25% in 1996 boat-ramp surveys) and must be returned to the water, with potential impact on the stock through mortality depending on handling of the fish and how the fish are hooked. Average size could be expected to increase as biomass increases. A qualitative assessment of this benefit can be inferred from the results of the 1996 boat-ramp survey by comparing fish size and weight in East Northland where the stock is slightly above $B_{MSY}$ with Hauraki Gulf/Bay of Plenty where the stock is substantially below $B_{MSY}$. These two sets of information suggest, respectively, an increase in length of 4.5% at $B_{MSY}$ and an increase in weight of 16% at $B_{MSY}$.

530. There are also potential benefits to commercial fishers of an increase in size of fish. Although fish quality is the key factor in value, there is information to suggest that highgrading of snapper smaller than 30cm occurs to maximise commercial return. In consultation meetings longline fishers have conceded they return legal sized, but small fish to the sea. Comparison of catch at sea and market samples for longlining in 1994 suggested that fish less than 30cm were under-represented in market samples relative to at-sea sampling. An assessment of the benefit in fish size can be inferred from the results of 1995–96 spring-summer market sampling of longline fisheries by comparing the proportion of fish under 30cm in the Hauraki Gulf, which was substantially below $B_{MSY}$ and East Northland, where the stock was slightly above $B_{MSY}$. Thirty five percent of fish were less than 30cm in the Hauraki Gulf, in comparison to 8% in East Northland. An increase in the average size of fish caught by commercial methods would also reduce the incidence of sub-legal mortality. There are also benefits in terms of fishing effort. Fishers are required to return undersize fish to the sea. An increase in average size of fish will mean less fishing effort is required to catch the same volume of legal sized fish.

531. The assessment suggests that the current exploitation rate for the whole fishery in 1997–98 will be about 15.8%. This is considerably in excess of the exploitation rate that would maximise the yield from the fishery over time of about 11.7–11.8%. An increase in stock size and reduction in exploitation rate to the optimum level would reduce the current growth overfishing of the stock overall and improve yield per recruit from the fishery.

*Increased Recreational Access*

532. In the past recreational fishers have made statements suggesting they believe "these fisheries are potentially economically worth vastly more to New Zealand being fished by the non-commercial sector". They have noted the considerable expenditure by recreational and tourist fishers on equipment, bait, accommodation and fuel. The Ministry has no quantitative information on which to evaluate this assertion for SNA 1. Much of this can be assumed to be a transfer payment—ie if not spent on fishing as a leisure activity would be spent on other pursuits, but for those operating in service industries, recreational fishing activity is a source of income and employment. Personal net benefit for many recreational fishers include recreational, aesthetic pleasure and saving expenditure on food. Though abstract in concept, there are many recreational fishers, and perhaps others, who would place a high value on the intrinsic value of the extra 23 000 tonnes of snapper associated with having the biomass at an optimal level. The information discussed in the paragraphs below suggests that fishing is very highly valued by a large number of New Zealanders. There are also potential benefits to New Zealand's international image from well managed fish stocks, and these are related to market advantages to fish exporters and others.

533. In the context of the SNA 1 management decision, valuation techniques could be used to estimate the non-market value of the proposed management change. These are difficult to quantitatively value, relative to the industry costs, export revenue, quota value etc that are discussed in the section above. However, there are methods available. Their application is contentious and there is a need for data that is not available at present. There are two approaches applied in these circumstances;

a) Revealed preference—in which spending is used as an estimator of value. This is typically undertaken by observing people's behaviour in markets which are related to the non-market product. The travel-cost method is typical—valuing what recreational users spend on trips;

b) Stated preference—the most common technique is contingent valuation in which a view is sought on the value persons place on a particular change using a wide scale survey and hypothetical questions. For example, respondents are asked whether (or how much) value would be placed on a 50% increase in catch rate, or an increase in average size of fish by 5cm.

534. If research was undertaken, these techniques could be used in the future to provide quantitative estimates of value to compare in models with values derived for commercial activity. This information could be used to compare the costs and benefits of management alternatives.

*Increased Recreational Satisfaction*

535. There is a very high interest in recreational fishing and snapper is a very important species to recreational fishers. In the Northern region the 1993–94 household telephone survey suggested over 250 000 marine recreational fishers in the region. Snapper was by far the most important recreational finfish species in QMA1 by a factor of five over the next most important species (kahawai).

536. Recreational fishers are dissatisfied with current catch rates. In submissions they suggest "current catch rates are abysmal in comparison to the 1960s". This is their qualitative assessment. The Ministry does not have any information on recreational catch over this period to support or refute such an assessment. However, as noted above catch rate is related to biomass. The biomass in the 1960s was more than double that currently.

*Increase in Yield*

537. The current biomass overall is at about 69% of the $B_{MSY}$ level. When that target biomass level is attained, based on the current equilibrium surplus production figure, there will be an additional annual yield of 335 tonnes. As noted above these fish will be larger and easier to catch than currently. Yield per recruit will improve and there could be an associated reduction in juvenile mortality. Any decrease in juvenile mortality would result in a proportional increase in available yield.

*Reduced Risk*

538. In general fisheries scientists would suggest there are a number of disadvantages that apply to a greater or lesser extent if stocks are exploited in excess of reference fishing mortality. These include those discussed in the paragraphs above and:

a) vulnerability to major fluctuations in recruitment (stock has reduced buffer against periods when recruitment is low);

b) risk of rapid reduction in stock size;

c) less stable stocks and catches from year to year as less year classes contribute to the exploited stocks and catches.

539. For SNA 1 some of these risks are mitigated by what we have learnt about the stock. The stock seems to have been relatively robust although the biomass has been driven well below optimal levels. Although there are substantial fluctuations in recruitment to the fishery, it is believed these may be more related to environmental conditions than a stock size/recruitment relationship. So although the stock exploitation rate is too high, and yield per recruit and yield are below optimum, there do not appear to be overt short term risks at the current stock size, although it

is important to note that stock projections into the future and risk analyses were not carried out as part of this year's assessment (refer to **Section 3. Fishery Assessment**). The process of estimating marine fish populations and their response to fishing pressure is fraught with uncertainty. This uncertainty suggests a measure of caution and that steps should be taken to address the shortcomings in the current assessment.

## 7.4. TACC Setting

540. The Fisheries Act 1983 specifies the matters to be taken into account in determining or varying any TACC after having regard to the TAC. This part of the 1983 Act will continue to apply until the relevant parts of the 1996 Act are commenced.

541. After having regard to the TAC determined under the 1996 Act and any TAC within the exclusive economic zone determined under the Territorial Sea, Contiguous Zone and Exclusive Economic Zone Act 1977, the Minister must allow for:

a) non-commercial interests in the fishery; and

b) any foreign allowable catch;

when recommending any variation in the TACC.

### 7.4.1. Allowance for Non-Commercial Users

542. Section 28D(1)(a) specifies that when setting or varying any TACC the Minister shall allow for non-commercial interests in the fishery but does not provide any guidance as to the amount that should be allowed. Consideration of all other stock mortality caused by fishing is added in section 21 of the Fisheries Act 1996. In considering how to allow for non-commercial interests in the fishery, the Ministry's view is that you should take into account issues including current and predicted non-commercial catch, sustainability, the impact on commercial fishers and the QMS and issues of concern to the non-commercial sector.

543. The NZRFC considers that section 28D of the 1983 Act and the 1989 Recreational Fishing Policy provide the recreational sector with a priority allocation ahead of the industry. However, the NZRFC acknowledges that their priority allocation claim is disputed by the industry. The Statutory Considerations section in the front of this document provides an interpretation of the relevant sections of the legislation and recent court substocks. From this material the Ministry concludes that the legislation does not imply a preference for non-commercial users over commercial users but rather that a reasonable allowance be made for non-commercial users. Although the Minister is not required to fully satisfy recreational fishers requirements, it is not contrary to the purpose of the Act for the Minister to make a decision to improve access to recreational fishers, either deliberately or incidentally.

544. It is clear that the Minister's overriding concern in providing an allowance for non-commercial fishers, and making any amendment to commercial rights, must

be to manage the fishery to achieve the target stock level through sustainable removals overall. The 1989 Recreational Fishing Policy represented the policy of the Government at that time. The clearest representation of current Government policy is found in the new fisheries legislation and the interpretation relevant to this issue is described above. You will be aware that the Ministry's work programme includes advice on an improved framework for recreational entitlements. This work will address the matters raised by the NZRFC and allow the development of a more comprehensive policy addressing allocation between sectors.

#### *7.4.1.1. Recreational Catch*

545. MFish is continuing to improve estimates of recreational catch through telephone/diary surveys being conducted as a project in the research contract. Some customary take is likely to be included in these estimates. The survey has been conducted simultaneously across the entire country and will build on the pilot survey conducted in the South region during 1991–92, and the subsequent surveys conducted in the Central (1992–93 and 1994–95) and North (1993–94 and 1994–95) regions. A simultaneous survey will avoid the problems of interpreting results from sequential surveys. Data collection was completed in November 1996 and updated information is available for SNA 1.

546. Recreational catch has been estimated from the 1996 telephone and diary survey at 2 330 tonnes. This is less than the 1994 diary survey estimate of 2 794 tonnes. The assessment model estimates recreational catch at about 2 400 tonnes for the 1997–98 fishing year. However, there is considerable uncertainty in the model concerning historical and future recreational catch levels. It is reasonable to assume that recreational catch will stay at about the same level, or possibly decrease, given the implementation of recent management controls and the low recruitment that is predicted to enter the fishery in 1997–98 and the impact that this will have on the biomass.

547. New work for 1997 aims to obtain some measure of the year to year variability in catch by monitoring a random sample of current diarists for a further year. As a result, it may be possible to derive another recreational catch estimate for SNA 1 for 1997 from this extension of the diary programme. In addition, the first stage of a national survey of recreational fishing from charter boats (**REC9703**) is also underway this year. This first phase will involve identifying contacts and designing a sampling programme on which to base a survey in 1997–98.

*Amendment to Controls*

548. **Section 7.3.3.10** above discusses the controls that could be adjusted to provide a decrease in removals taken by recreational fishers and the views expressed in industry and recreational submissions. A reduction in the bag limit from the current level of nine to five or three is predicted to reduce recreational catch by 12% and 30% respectively. Industry promotes bag limit reductions as an alternative to TACC reductions. In addition to strong resistance from recreational fishers, significant compliance issues will arise without a reasonable measure of support by

recreational fishers. There has been no direct consultation on the need for recreational controls.

549. Increase in the minimum legal size (MLS) for recreational fishers is the other principal measure discussed, although there are other alternatives including change in hook design. An increase in the MLS to 30cm would mean about 13% of fish currently taken would need to be returned to the water. A number of factors affect the gain from this measure because benefit is dependent on survivorship of those fish returned.

550. The allowance made for non-commercial interests is not a catch limit as such, in that the actual take by recreational and customary fishers is not determined by the Minister's decision. Rather the catch of non-commercial fishers is determined by ancillary management measures (eg daily bag limits, minimum legal sizes) which may be implemented by the Minister. Consistent with the findings of the courts, it is the Ministry's view that, when a TAC is set, the Minister will have an obligation to consider controls to constrain recreational fishing within that non-commercial allowance. Note that it is not intended that any allowance is a constraint on the catch of customary fishers.

551. In their submissions industry suggests that the licensing of recreational fishers is necessary part of a regime to constraint recreational catch. The SAWG was not able to agree on the appropriate way to model recreational catch. As noted above, the model currently in use predicts growth in recreational fishing mortality. However comparisons of catch estimates between recent surveys suggest declines in recreational catch. In these circumstances the Ministry does not assess that further measures are necessary for 1997-98 to restrain removals at about current levels. If you determine that further constraint is necessary, this can be achieved by amendment to management controls. In the short term, for SNA 1 there is no urgency to consider other industry suggestions such as in-season monitoring of recreational catch and closing seasons when the recreational allowance has been taken. Consideration will continue to be given to improving the assessment of recreational catch. Closed seasons would have significant implications for fishing for other recreational species. Until research is completed into the mortality of returned fish, the potential biological cost of returning snapper to the water after any season was closed cannot be determined.

552. Industry further submits that immediate controls are necessary on recreational charter boat activities, including licenses or permits under Section 11 of the Act, that they should be levied with cost recovery levies, and that they should be required to hold a catch entitlement. Industry appears to over-estimate the extent of charter boat catch. The best information available to MFish suggests that charter vessels are currently not accounting for a major share of the recreational snapper catch. The recreational telephone/diary survey estimated that 6% in 1994 and 7% in 1996 (provisional result) of snapper from the overall recreational catch

in the North Region was taken by recreational fishers on charter boats. Telephone diary surveys do not estimate catch of foreign visitors on charter vessels. A separate survey is being undertaken to assess charter vessel catch in 1995–96.

553. Although there is potentially the scope under provisions of the new Act to take some of the steps proposed by industry, there has not been sufficient time to consider whether there is conflict with other specific empowering provisions. Such regulations which could significantly impact on charter boat operators would require prior consultation, under the common law duty, with such operators.

554. Other than legal and administrative issues, policy issues arise in considering the necessity of implementing such measures. MFish note that charter vessels provide transport services to recreational fishers, yet proposals would have the effect of imposing commercial fishing requirements on a charter vessel operator who is neither taking fish nor doing so on someone else's behalf. Some elements of the industry proposal would appear to be outside the intended application of the Fisheries Act 1983 (and Fisheries Act 1996). MFish considers that fish taken from recreational charter vessels should be managed in the context of an overall framework for the management of recreational fisheries.

555. MFish has indicated that it intends to develop policy to better integrate recreational fishing with the QMS. Options to achieve this integration range from more sophisticated use of input controls such as size and bag limits to entitlements-based approaches. The development of an appropriate mechanism and any subsequent amendments to the Fisheries Act 1996, requires policy development, consultation and Government approval. This process will not be completed before the start of the 1997–98 fishing year. In conclusion, MFish considers that these proposals are more appropriately dealt with through consideration as a statutory amendment than by regulation. It is suggested that this be done as part of a wider consideration of options for integrating recreational fishing with the QMS.

*Consideration of Further Restraint*

556. In relation to how you may decide to allow for non-commercial fishing interests, in recent months the NZRFC has suggested you consider equity between the sectors. They point to recreational catch reductions resulting from a size limit increase and bag limit reductions. The minimum snapper legal size was increased from 25 to 27cm in 1994. For SNA 1, the Snapper Working Group estimated that the size limit change decreased the overall recreational catch tonnage at that time by 10%. The bag limit reduction is assessed to have decreased recreational catch by 8%. The NZRFC considers that it would be inequitable if industry was not to be restrained when measures have been imposed to reduce recreational catch by about 10%. This argument does not acknowledge the possible increases in recreational take since the 1985 tagging programme estimate.

557. Although the non-commercial sector has undoubtedly contributed to the stock decline, it is unlikely the stock would currently be below $B_{MSY}$ in the absence of commercial fishing. The commercial sector appropriated much of the value of fishing down the stock (this may have occurred in pre-QMS times, by previous

fishers and foreign vessels). Recreational fishers have expressed this in various ways; recreational and Māori traditional fishers have been "disenfranchised" by commercial fishing in the 1970s; and "all we are asking for is a reinstatement of our rights". Over time commercial fishing is likely to have contributed to a greater extent than non-commercial fishing to the depletion of the biomass. The biomass in the 1960s was more than double the current biomass. Commercial removals, as reported catch, totals about 257 000 tonnes since 1960. There are currently only three estimates of recreational catch, all from the last decade. These suggest catch levels in the order of 2 000 tonnes annually. Recreational catch is likely to have increased since the 1960s due to population growth and advances in fishing technology, although, as noted catch rates have likely decreased over this period. If an annual catch of 2 000 tonnes is assumed for the whole of this period total recreational removals would be in the order of 74 000 tonnes. Industry has therefore made a greater contribution to the decline in biomass since 1960 by a factor of nearly 3.5. An argument can be mounted on the basis of equity, that the cost of rebuilding, or gains of rebuilding, need not necessarily be shared equally.

558. As noted above, catch rate is an important element in satisfaction of recreational fishers. Information on recreational CPUE is available from a boat-ramp survey undertaken in the North Region in the summer/autumn period of 1991 and 1994. A similar survey was also conducted in the summer/autumn period of 1996 however the results of this survey have yet to become available. Recreational snapper CPUE for boat fishing increased by 50% between 1991 (0.4 snapper per fisher per hour) and 1994 (0.6 snapper per fisher per hour), with the increase in catch rates occurring in most of the sub-areas that were surveyed. These CPUE estimates translate to average snapper catch per boat fisher per trip of 1.15 (1991) and 1.9 (1994). In both years, CPUE was lowest in Tauranga Harbour (approximately 0.2 snapper per fisher per hour) and largest in the eastern Bay of Plenty (approximately 0.8 snapper per fisher per hour). Also in both years, catch rates in the inner and mid Gulf were about average for SNA 1. It should be noted that this catch data is for recreational boat fishing and that catch rates for recreational land-based fishing are generally considerably less than boat fishing.

559. Over time, as the stock rebuilds, it is practical to consider improving recreational access and satisfaction through the factors above including a better catch rate and larger size of fish. This need not necessarily result in an increase in recreational catch overall—with appropriate monitoring, controls can be adjusted to keep recreational fishing within an allowance determined by the Minister.

### 7.4.2. Customary Take

560. The Māori customary catch has not been determined and no allowance has been made for inclusion in the stock assessment. Fishing for snapper in both harbour and coastal environs is known to be of significance to east coast Iwi. Recreational take is predicted by the model to be about 2 400 tonnes for 1997–98, although as previously noted this is very uncertain. This figure is based on recreational diary and telephone surveys and boat-ramp information which is then projected forward on the basis of the exploitation rate of recreational fishers (the proportion of the biomass recreational fishers take) and the projected increase in

recreational effort and participation. Because of the methods used to collect this information it likely encompasses an unknown proportion of customary as well as recreational take.

561. At present there is no effective framework for monitoring customary take. There are a number of customary fishing representatives who represent Iwi, Trust Board or Runanga, and these groups have been involved in the Ministry's consultative processes on SNA 1. However, these groups do not necessarily have up to date information on customary take. Customary fishing is undertaken at the marae or Hapū level and there is currently no reporting structure in place to record customary fishing activity.

562. Section 10(c) of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 provides for the making of regulations to recognise and provide for customary food gathering by Māori and the special relationship between tangata whenua and those places which are of customary food gathering importance, to the extent that such food gathering is neither commercial nor for pecuniary gain or trade.

563. Work on the customary regulations has been on-going since 1992 and draft regulations are close to being finalised. The draft regulations will shortly be released to Iwi and Hapū and to interested parties to enable those groups to make comments. Any necessary changes to the regulations will be made prior to the regulations being passed into law.

564. The draft customary regulations are designed to devolve a large degree of responsibility for the management of customary non-commercial fishing to local Māori, an aim consistent with the principles of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 and the Fisheries Act 1996. The permitting system and reporting requirements contained within the draft regulations will enable accurate assessments of customary take and this information will be fed into the Ministry's TAC and TACC setting processes.

565. The customary regulations are not designed to put a cap on the level of customary take. However, they are designed to ensure that customary fishing is carried out in a manner that is consistent with the traditional management practices of Māori and the overall sustainability of the fishery.

566. There are some limited directed projects underway to assess customary take of eels (Ngai Tahu and Waikato) and rock lobster (East Northland and Gisborne/Mahia). If successful, it is intended similar projects may be undertaken in other regions of the country and for other species. However, until the customary regulations are finalised and implemented it is unlikely the Ministry will be able to accurately quantify customary take of snapper in Area 1.

567. There is very limited information available to the Ministry on the level of customary take of Snapper in SNA 1 through records of customary fishing permits issued by tangata whenua authorities in the SNA 1 area for the years 1989–1995.

568. Anecdotal evidence suggests that much of what may be considered by tangata whenua as 'customary take' takes place within the recreational bag limits.

While this practice generally provides sufficient fish for customary purposes it unintentionally removes these catches from considerations of customary take. In the absence of evidence to the contrary, current methods used to assess recreational fishing effort, such as boat-ramp surveys and fish tagging studies, will categorise these fishers as recreational rather than customary fishers.

569. In recent years the Minister has made an allowance of 2 600 tonnes for non-commercial take. The allowance made for non-commercial take in SNA 1 reflects an assessment of non-commercial use which takes into account the Māori practice of fishing under the amateur regulations as well as utilising customary fishing permits in some instances. Given the assessed recreational take this total allowance for non-commercial fishers would seem to make reasonable provision for the unknown extent of customary take. The allowance made for non-commercial fishing in SNA 1 in no way limits the extent of customary take. Rather, it makes allowance for overall non-commercial use based on the best information available to the Ministry on the extent of both recreational and customary take.

#### *7.4.2.1. Other Sources of Mortality*

570. The 1997 assessment allows for all sources of the illegal commercial catch (eg discards, under-reporting and poaching). The assessment model for SNA 1 allows for a 20% level of under-reporting prior to 1986, and an extra 10% each year from 1986 onwards. This level of allowance has been incorporated in yield estimates and consequently should be allowed for in future estimates of yield.

571. Other sources of fishing mortality associated with the commercial fishery include the mortality associated with the capture and return of under-sized snapper and mortality induced on snapper escaping through trawl meshes. The levels of such mortality are unknown. The mortality of snapper taken and released by trawl has been considered by the snapper working group to be in the range 50–90% but estimates of the total catch of under-sized snapper are not available.

572. The catch of under-sized snapper is not included in estimates of recreational catch, but it is known that less than 5% of the snapper measured at the boat-ramps were undersize. The snapper working group assumed there was an 80% survival of undersize snapper released by recreational fishers.

573. Current yield estimates are based on the exploited biomass and are yield levels for fish of legal size. Mortality on under-sized snapper effect recruitment levels to the fishery and any reduction in current levels will benefit the fishery. No additional allowance is recommended within current estimates of yield.

### 7.4.3. Setting the TACC

574. A number of options for potential adjustment to the TACC are discussed in this advice and in the concluding section below. The intent of any reduction would be to rebuild the fishery towards a level that will support the MSY. Industry has claimed that reducing the TACC in SNA 1 will result in reallocation of available catching rights from quota holders to non-commercial fishers and that this is unlawful. MFish does not accept that a reallocation of catching rights as argued by industry is a consequence of a TACC reduction for the 1997–98 fishing year. The extent to which a TACC reduction could give rise to an increase in the non-commercial share of the total catch over time will depend upon the actions taken to restrain non-commercial catch. There are options discussed in this paper to allow you to consider restraint of recreational catch, either in the short term, or following the availability of research commissioned to both quantify the recreational catch and obtain information which would allow a review of recreational controls (eg minimum legal size and daily bag limit).

575. Because they believe that no TACC reduction is warranted on the current stock information, the industry continues to infer that a reduction to the TACC in the current circumstances is being undertaken for non-sustainability reasons and the Crown should pay compensation. However, as the industry acknowledges at paragraph 67.3 in their submission, the courts have rejected the argument that catch reductions should be proportionate between commercial and non-commercial interests, and in fact saw no reason why the Minister should not be able to vary the ratio between commercial and recreational interests. Subject to the overall requirement that the Minister continue to act reasonably to attempt to stop any biomass rebuilding resulting from a TACC reduction being eroded by recreational fishing, a TACC reduction does not necessarily require the imposition of additional controls on recreational catch or an obligation to pay compensation.

576. The TACC is currently varied pursuant to sections 28D and section 28OB of the 1983 Act. Section 28OD(7) provides that no compensation shall be payable for any reduction in quota pursuant to section 28 of the Act. In addition, section 308 of the 1996 Act specifies that no action by the Crown for the purpose of ensuring sustainability, allocating quota at the time of introduction of a species to the QMS and some other administrative procedures, shall make the Crown liable to pay compensation or damages to any person. As noted above, the intent of a TACC reduction in the current circumstances would be to rebuild the fishery towards a level that will support the MSY.

577. Prior to 1 October 1996, the Minister of Fisheries was required to consider whether the reduction in commercial quota rights could be achieved by the Crown retaining or obtaining quota in the open market. This obligation was removed by the 12th Schedule of the Fisheries Act 1996. The industry refers to the general power conferred on the Director General by s28U of the 1983 Act to acquire, hold transfer, lease or cancel quota on behalf of the Crown. Industry suggests that the Crown should acquire quota under this section to mitigate the consequences of a TACC reduction and where a TACC reduction is intended to achieve reallocation between sectors. However, the general power under s28U to acquire quota is a

discretionary one. The legislature has clearly signalled in s28OD(7) that compensation is not generally payable for any TACC reduction. In addition the legislature specifically repealed the mandatory consideration formerly contained in s28D(b)(ii). Overall the legislative scheme suggests that TACC reductions are not intended to be achieved through purchase on behalf of the Crown. However, the legislation does not prevent the use of this power. For the reasons discussed in the above paragraphs, the reasons that industry advances that it should be considered do not hold. Any reduction would not be implemented to achieve reallocation. A TACC reduction implemented to assist in rebuilding the stock over a reasonable timeframe would not damage the integrity of the QMS or the settlement of Māori fisheries treaty claims, nor could it be portrayed as unjustified or inappropriate derogation of industry property rights.

## 7.5. Research Planned for 1997–98

578. During the course of this advice paper, the Ministry, where appropriate and relevant, has made reference to planned research to be carried out in SNA 1 for 1997–98. This section provides an overall summary of this research activity for your information and to assist you in the formulation of your final decisions regarding the management of this fishery in 1997–98.

579. In 1997–98 there is a large amount of research planned for SNA 1 which is the most valuable coastal finfish fishery in New Zealand. In total research involving or relevant to SNA 1 is to be carried out under seven different projects. In addition, MFish has limited funds in 1997–98 for research into customary Māori fishing take. The Ministry has been discussing with the Hauraki Māori Trust Board (HMTB) a research contract to determine the level of customary harvest of a number of species (including snapper) in the Hauraki area. It is understood that the HMTB is at the point of submitting a research proposal to MFish for consideration and the development of a formal contract.

### 7.5.1. Snapper Population and Modelling and Stock Assessment (SNA9701)

580. The overall objectives for this project are to carry out stock assessment of SNA 1 (and SNA 8), including estimating biomass and sustainable yields and to assess the impact of alternative harvest strategies and management measures on the stock trajectory of SNA 1.

581. Among the objectives for 1997–98 are:

- an update of the assessment of SNA 1 stocks using recreational catch estimates from the 1996 diary survey and catch at age data up to the end of 1996–97 from the commercial fishery in an age structured population model;
- a re-analysis of recapture data from the SNA 1 tagging programmes in 1984 and 1993 for sources of bias resulting from the possible failure of model assumptions;

- to compare the accuracy and robustness of alternative estimation techniques for biomass from tag recapture data. The best estimation method will be used to revise estimates of biomass in SNA 1 stocks from the 1984 and 1993 tag release programmes; and,
- to determine selectivity patterns for commercial fishing methods and the recreational fishery.

582. Final estimates of recreational catch for 1996 (and preliminary 1997 catches) will be available from the national recreational survey for each of the snapper stocks. These estimates will be used to model trends in the recreational fishery and predict future catch levels.

### 7.5.2. Estimation of Mortality of Juvenile Snapper (SNA9702)

583. The overall objectives of this project are to estimate total mortality of juvenile snapper in the commercial and non-commercial fisheries, and to determine the commercial length frequency and age structure of the snapper substocks for use in stock assessment models, by market sampling.

584. The objectives for 1997–98 are:

- to determine the proportion of snapper <30cm in length caught by commercial longlining by site of hook capture and by depth; and,
- to determine the commercial length frequency and age structure of the snapper substocks that comprise SNA 1 (and SNA 8) for use in stock assessment models, by market sampling.

585. Estimates of the mortality rate of snapper <30cm caught and released in both the commercial and recreational line fisheries are important for the estimation of total mortality rates incorporated into stock assessments and population modelling. Earlier work has quantified the mortality levels of line-caught snapper (in a seacage holding net) that had been caught from different depths and in different ways (eg gut hooked, lip hooked). The results of the work for 1997–98 will be used in conjunction with those from earlier work to determine the benefits of any potential future changes to the MLS.

586. The aim of market sampling is to estimate the age and length structure of snapper populations caught commercially. This provides catch-at-age information which may be combined with estimates of selectivity-at-age to estimate stock age composition. This information on age and length composition is an important input into estimation of year class strength in the age-structured models used for the assessment of SNA 1 productivity and yields. During periods between tagging biomass surveys, stock age composition is monitored by market sampling and this catch-at-age data is fundamental to the SNA 1 age structured model for estimating annual recruitment and hence biomass.

### 7.5.3. Estimation of Inshore Fish Abundance in the Hauraki Gulf and Adjacent Waters Using Trawl Surveys (INT9701)

587. The overall objective for this project is to determine the relative abundance of inshore finfish species (including juvenile snapper) in the Hauraki Gulf. Objectives for 1997–98 are:

- to determine the relative abundance and distribution primarily of juvenile snapper and secondarily of adult john dory and red gurnard in the Gulf and adjacent waters;
- to collect the data and to determine the length frequency, length-weight relationship, and reproductive condition of snapper (and other species) and the age-length relationship of snapper caught on the trawl survey.

588. The estimates of the relative year class strength of juvenile snapper contribute to the recruitment index developed based on the relationship between juvenile abundance and water temperature. This index is a important input into model projections of future biomass and yield for the following few years. The relationship is not well defined at the lower and upper extremes of the temperature range. The temperature-recruitment relationship predicts the 1995 snapper year class to be one of the strongest since the time series of trawl surveys began in 1982. The survey in November 1997, which will provide an estimate of the number of two year old fish from the 1995 year class, will improve the definition of the temperature-recruitment relationship at the upper end of the predictive range.

### 7.5.4. National Marine Recreational Fishing Survey (REC9701)

589. Objectives for 1997–98 for this project are:

- to complete the survey of about 1 000 fishers completing diaries for a second year (ended 31 December 1997);
- to compare catch and effort by diarists in 1996 and 1997;
- to estimate recreational catch taken in 1996 by QMA by species; and,
- to document changes that have occurred for the major recreational species between the regional and national diary surveys.

590. A national survey of recreational fishing (including area 1) has been carried out to provide estimates of the harvest from the 1996 calendar year. Most of the analysis of these results will be completed in 1996–97. However, throughout 1997 a sample of diarists will continue to be surveyed for a second year. The data collection part of the project will therefore continue into 1997–98. This sample will allow a comparison of catch and effort for these fishers in successive years.

591. The national survey follows a series of regional surveys completed in earlier years. Comparisons of catch and effort between the surveys should indicate whether the patterns or extent of recreational fishing have changed. Further surveys are proposed at three to five year intervals to monitor changes in harvest levels.

### 7.5.5. Modelling Recreational Fisheries (REC9702)

592. The objectives for 1997–98 are:

- to model the effect of changing bag limits and MLS on the total harvest of SNA 1 (and BCO 7);
- to determine the power of survey methods to detect changes in catch rates of snapper (and kahawai) by simulation modelling of boat-ramp and diary data; and,
- to compare fish size and catch rates of the 20 main species in the boat-ramp survey in the North region with results from earlier surveys in 1991 and 1994.

593. Recent surveys of recreational fishing have provided estimates of the catch and also indicative levels of effort. To provide a useful predictive model of the recreational fishery, it is necessary to interpret the changes in catch and effort and determine any trends.

594. The available data from telephone/diary surveys, boat-ramp surveys and aerial counts of vessels will be used to establish relationships between the total catch and effort and the various factors influencing fishing such as environmental variables (season, weather), time of year (holiday period, weekend), fishing methods and location. Such relationships may help in interpreting how well the estimates of recreational catch and effort from the diary surveys represents average conditions.

595. During 1996 a boat-ramp survey was conducted throughout the North region to measure the size of the main species in the catch. CPUE data was also collected on the forms, but this data has not yet been analysed. The purpose of the third objective is to evaluate fishing success in 1996 compared to the 1991 and 1994 results for the main recreational species.

### 7.5.6. National Survey of Recreational Fishing from Charter Boats (REC9703)

596. The overall objectives of this project are to determine the catch and effort of recreational fishing activities from charter boats, and to characterise the charter boat industry for recreational fishing. The specific objectives for 1997–98 are:

- to identify what species are being targeted and caught on charter boats in each area from logbooks;
- to estimate the annual catch of fish from charter boats by QMA from logbooks; and,
- to estimate the annual fishing effort by species targeted by QMA by the charter boat industry.

597. In recent years, the recreational fishing diary surveys have been conducted in each of the three MFish regions in order to estimate catch and effort by the recreational fishing sector. However, the recreational diary surveys do not provide a large enough sample of fishers to give an estimate of the charter boat catch. In addition, diary surveys do not include international tourist fishers who may form an important component of some fisheries.

598. The main objective of this project is to complete a one-off national survey of charter boats, to categorise the operations by area and season, and to estimate catch and effort for key species. A national survey is required as there are large differences in the fishing activities of charter boats around New Zealand. From this survey, the importance of local charter boat operations in key recreational fisheries will be identified. In 1997–98 detailed data (in addition to that collected in 1996–97) through a year-long logbook scheme.

### 7.5.7. Estimation of Recreational Catch and Effort in the MFish North Region (REC9706)

599. The overall objective is to estimate recreational catch and effort from selected areas in the MFish North region from boat-ramp surveys. In 1997–98 the objectives are to carry out surveys in Tauranga Harbour, Ohiwa Harbour, and Bay of Islands.

## 7.6. Research Proposed for 1998–99

600. There are a number of research projects proposed for 1998–99 that are relevant to, or involve, the SNA 1 fishery. These include the following.

### 7.6.1. Snapper Population Modelling and Stock Assessment (SNA9801)

601. The overall objectives for this proposed project are to carry out stock assessment of snapper, including estimating biomass and sustainable yields, and to assess alternative harvest strategies and management measures.

602. The objectives for 1998–99 are:

- to update the assessment of SNA 1 stocks in an age structured population model using: recreational catch estimates from the 1996 and 1997 national marine recreational fishing and charter boat surveys; catch at age data for spring and summer 1998–99 from the commercial longline fishery; revised estimates of biomass in SNA 1 stocks from the 1984 and 1993 tag release programmes;
- to update CPUE indices for the longline fishery in SNA 1;
- to determine the relationship between inter-annual growth variability and sea surface temperature in SNA 1 and 8 and then develop an algorithm for incorporating this proxy for measured growth into the stock assessment models;
- to assess the effect of various management control options (such as minimum legal size) and fishing gear modifications (such as hook modifications) on the potential yield per recruit from the SNA 1 fishery;

- to review estimates of natural mortality (M) and determine the most appropriate estimate from available data; and,
- to evaluate decision rules for rebuild of the SNA 1 fishery.

603. Updating the CPUE indices for the longline fishery in SNA 1 will provide useful trends in relative abundance for incorporation into the age-structure models. A relationship between sea temperature and recruitment has been established for SNA 1 and is used to predict year class strength in the assessment of this fishery. Research being conducted during 1996–97 (**PISN08**) is being undertaken to explain the growth variability in snapper in relation to temperature, using existing scale and otolith data. Further work will be required in order to describe this relationship and derive an algorithm by which it can be incorporated into the stock assessment models.

604. Management options for the snapper fisheries include the selection of appropriate minimum legal size limits. Modelling work is required to assess the effects of various MLS options on yield per recruit. These options are influenced by the mortalities associated with different fishing methods and size classes of fish. Mortalities of juvenile snapper are being assessed (**SNA9702**), and assessment of the potential benefits of modifications to fishing gear will assist in evaluating management controls which will deliver optimum yield per recruit.

605. The stock assessment models are dependent on the estimates of recruitment, growth and mortality for producing robust estimates of stock dynamics. A preliminary review of the natural mortality estimate (M) conducted during 1997 has suggested that 0.075 may be a better estimate for SNA 1 than the previously used 0.06. Further analysis of available data should provide an estimate of the most appropriate M for SNA 1.

606. Fisheries management decision making should take into account all relevant biological, social and economic factors which in turn are assessed and evaluated through the use of stock assessment tools, Cost Benefit Analysis, etc. Multi-attribute utility theory provides for the development of formal decision making tools. It is proposed that a preliminary assessment and trial of these methods in the SNA 1 fishery is undertaken during 1998–99.

### 7.6.2. Estimation of Mortality of Juvenile Snapper (SNA9802)

607. The overall objective for this proposed project is to estimate total mortality of juvenile snapper in the commercial and non-commercial fisheries. The objectives for 1998–99 are:

- to determine the mortality of juvenile snapper taken by commercial longlining in SNA 1 from depths >35m;
- to assess the fishing gear modification options which are most likely to improve the escapement of juvenile snapper in the trawl and Danish seine fisheries;
- to determine the maximum likely fishing induced mortality of snapper passing through trawl and Danish seine nets by evaluation of the number of encounters

of fish with these nets;

- to conduct sampling at sea of catches in SNA 1 in order to assess the proportion of snapper below the MLS in the catch, by area and method; and,
- to assess the effects of modifications to hook designs and appendages on the rate of gut-hooking in juvenile snapper.

608. Results from catch at sea sampling in the Hauraki Gulf during 1994 indicated that the proportion of snapper taken below the legal size of 25cm was greater for the longline method than for single trawl or Danish seine, particularly during spring and summer. These undersized fish are required to be released. In addition some of the fish below 30cm but over 25cm are also released. Recent research has shown that released lip-hooked fish have a high probability of survival, whereas gut-hooked fish are more likely to die. Preliminary evaluation of hook appendages has shown that these can substantially reduce the incidence of gut-hooking. Further assessment of the effectiveness of these appendages and perhaps other aspects of hook design will possibly provide important results for determining future management controls. Yield per recruit models suggest that improvements in yield in snapper fisheries can be achieved by raising the size of recruitment to the fishery. In addition to investigating ways of minimizing the capture of smaller snapper, there may be benefits in increasing the minimum size for the longline component of the commercial fishery.

609. Work programmed for 1997–98 is intended to quantify the proportions of snapper caught by the commercial longline fleet from different depth categories and hook capture sites (lip or gut hooked). Preliminary results from this work suggest that a substantial proportion of the longline catch is taken from depths greater than 35m and that the incidence of barotrauma may be high in snapper taken from these depths. Further work is proposed during 1998–99 to determine the mortality of snapper taken by longline from depths greater than 35m. The results will be used in conjunction with those from the earlier work to determine the benefits of any potential future changes to the minimum size limit.

610. Catch at sea sampling of the longline, Danish seine and trawl fisheries in the Hauraki Gulf was undertaken during 1994. Substantial seasonal and method differences in the proportion of juvenile snapper in the catches were shown. Characterization of the proportion of juveniles in the catch by method for other areas within SNA 1 will provide important information to determine the total mortality associated with the respective fisheries.

611. An earlier project (1995–96) investigated the relative selectivity of trawl mesh from 125–150mm mesh codends in the northern snapper fishery. Some preliminary trials were also conducted to examine the selectivity of a 'SORTX' type grid device in commercial bottom trawl gear, but results were inconclusive because of small sample sizes.

612. Knowledge of the selectivity of nets and the mortality associated with escapement is important for the accurate determination of total mortality associated with trawling and Danish seining. Improved escapement and survival of sub-legal sized fish will reduce wastage. At sea sampling of trawl catches will allow the assessment of the proportion of snapper below the MLS in trawl catches and so provide improved estimates of mortality associated with this fishery. In addition, a suitably designed at sea sampling programme will enable the collection of data describing the length and age composition of the catch.

### 7.6.3. Estimation of Snapper Year Class Strength (SNA9803)

613. The overall objective of this proposed project is to estimate the year class strengths of snapper. The proposed objectives for 1998–99 are to carry out sampling and estimate the relative year class strength of recruited snapper sampled from the commercial longline catch in SNA 1 during spring and summer.

### 7.6.4. Biomass Estimation for SNA 1 (SNA9804)

614. The objective for this proposed project is to carry out a mark-recapture programme in order to estimate the absolute biomass of snapper in SNA 1. The rebuild of the SNA 1 fishery to a level which will support the MSY is required. Estimates of absolute biomass at regular intervals will form an important part of the monitoring of the stock through the rebuild period. Biomass estimates are important components of the stock assessment modelling of this fishery. The model requires absolute biomass estimates at intervals of about five years. Between absolute biomass estimates, stock age composition is monitored by market sampling and the catch-at-age data is fundamental to the age-structured models for estimating and validating annual recruitment and hence biomass. The last estimate of absolute biomass for SNA 1 was determined from a mark-recapture programme during 1993–94. A mark-recapture survey in 1998–99 will provide an estimate for inclusion in the stock assessment modelling process of 2000 at the earliest.

615. Simulation modelling will be carried out in 1997–98 to determine which of the two methods used to analyse tagging results from the 1994 survey, either the Petersen or Observation error model, is better. Improved estimates of selectivity are also required for SNA 1 and the mark-recapture programme can be designed to provide these estimates.

### 7.6.5. Economic Analysis of the Northern Snapper Fisheries (SNA9806)

616. The objectives for this project are to analyse and assess the economic factors and values of the commercial and recreational snapper fishery in SNA 1, and to further develop economic models for the evaluation of a range of management options for the northern snapper fisheries.

617. Key elements in fisheries management decisions include the conservation of the fishstock, the economic efficiency, the employment generated, cost recovery and other more intangible social benefits. Fisheries management systems and processes develop in order to manipulate these elements into an optimum solution, taking into account the conflicting demands from different groups in society.

618. These fisheries management systems and processes provide decision rules that adjust and accommodate over time these conflicting demands. In New Zealand, the stock assessment process provides for the evaluation of each fishstock in terms of a reference biomass level. This advice on the reference biomass level is then considered by the Minister of Fisheries who sets a Total Allowable Catch (TAC). The Minister then allocates the TAC to customary, recreational and commercial fishers in a manner that he considers reasonable. In this process the key element is the state of the fishstock. Social and economic factors have, in the past, been considered via submissions by interested parties.

619. A formal and structured approach to the evaluation of these factors can be provided by the methods of Cost/Benefit Analysis (CBA). It is proposed that CBA is performed for a range of management options (to be provided by the Ministry) such that the social benefits may be optimised while ensuring the sustainability of the fishery and associated species. Assessments of the important economic factors and the value of the different sectors of the snapper fisheries will provide essential inputs to these Cost/Benefit Analyses.

# 8. CONCLUSION

### 8.1.1. Assessment

620. The change in the assessment relative to 1996 leads to an improved assessment of the overall stock status relative to $B_{MSY}$, however, the status of the two substocks differs. The East Northland substock appears to be at about $B_{MSY}$. The Hauraki Gulf/Bay of Plenty substock is currently below $B_{MSY}$, and is estimated to be about 60% $B_{MSY}$ at the beginning of 1997–98. In tonnage terms, the biomass of this substock at the start of 1997–98 is predicted to be about 34 000 tonnes, 23 000 tonnes below $B_{MSY}$. Overall, the SNA 1 fishery (both substocks combined) at 1 October 1997 is estimated to have a biomass of 50 700 tonnes. $B_{MSY}$ is estimated to be 73 580 tonnes. When the SNA 1 stock is rebuilt to $B_{MSY}$ the long term yield (MSY) available from the fishery is currently estimated to be 8 670 tonnes.

621. Section 10 of the Act provides guidance in circumstances where there is uncertainty in the information available to make a decision. The section suggests that decision makers should be cautious when information is uncertain. The 1997 assessment for SNA 1 is much less certain than the 1996 assessment. This uncertainty relates mainly to the prediction of future recreational catch and to various other inputs into the assessment model. Work is planned for 1997–98 to improve the assessment and there are a number of research initiatives underway this year and planned for the next year that will assist in addressing issues in the stock assessment and the consideration of management controls.

## 8.2. TAC Setting

622. Section 13 of the 1996 Act requires that the Minister set a TAC that enables the level of any stock whose current level is below that which can produce maximum sustainable yield to be altered in a way and at a rate that will result in the stock being restored to or above a level that can produce the MSY. That period will depend on the circumstances of a particular fishery and consideration of appropriate factors which are discussed below. The rate of rebuild to achieve $B_{MSY}$, and therefore the timeframe adopted to do so, is a matter of discretion for the Minister. In this context, Crown Law is of the opinion that in any particular year, provided the Minister is confident that it poses no risk to the stock, and there is an intent to move the stock towards $B_{MSY}$ over time, a catch level may be determined that will not immediately move the stock toward $B_{MSY}$. However, in the long term there is a clear imperative that target stock size must be that which will produce the MSY.

623. A range of options for TAC levels are available to you that will fulfil the requirement of the legislation to move the fishery over time to a level that can produce the MSY. These include;

a) making a reduction in removals sufficient to maintaining stock biomass at the current level;

b) maintaining overall removals at current levels which will provide a slow

rebuild of the stock;

c) making a reduction in removals that will achieve a rebuild of the stock over various timeframes;

d) adjusting removals to maintain the current exploitation rate or reduce the exploitation rate to optimum levels.

These options are considered in more detail below.

### 8.2.1. Relevant Factors

624. The Act is silent as to the time period over which the fishery should be moved toward $B_{MSY}$. That period will depend on the circumstances of a particular fishery and the appropriate considerations, in determining the way and the rate of rebuild, which are those stated section 13(3), namely social, cultural, and economic factors the Minister considers relevant. The rate of rebuild to achieve $B_{MSY}$, and therefore the timeframe adopted to do so, is a matter of discretion for the Minister. In this context, the Minister could, in any particular year, make a decision that allowed a fish stock to decline away from a level which would produce the MSY provided he or she has an intention or plan to rebuild the stock to the target level over a reasonable period of time.

625. MFish believe there are a range of social, cultural, and economic factors that are relevant to your consideration of an appropriate TAC level, and subsequently the TACC level. These factors are discussed in detail in **Section 7.3.4** and provide a framework to evaluate different management options. A TACC reduction will result in economic and social hardship in terms of loss in profit, employment and a consequential downstream reduction in economic activity. Impacts will be particularly severe on small operators, especially those who depend on leasing quota. Snapper, because it is a relatively high value species, will be an important component of fishing and related activities in a number of small coastal communities in QMA 1. The impacts in these areas will be compounded by the fact that there will be few alternative sources of employment. Industry provides analyses of the impacts of the reduction on the Leigh, Great Barrier Island and Houhoura communities. Industry notes that in the event of a significant reduction companies will likely rationalise their operations leading to retrenchment in areas where transport costs from export destinations are highest. This section also includes an analysis of forgone benefit in the commercial fishery at different levels of TACC reduction. This provides some information on the relative effect of different TACC reductions and different rebuild periods.

626. The benefits of rebuilding the stock to both the non-commercial and commercial sector are considered. These include an increase in the catch rate and average size of snapper. These will reduce effort necessary to catch fish and therefore the mortality rate caused of undersize fish. An increase in stock size and reduction in the current excessive exploitation rate would reduce the current growth overfishing of the stock overall and improve yield per recruit from the fishery. This stock is very important to non-commercial fishers and as the stock rebuilds to $B_{MSY}$ there will be improved access and satisfaction from fishing and a modest increase in total yield.

### 8.2.2. Non-Commercial Allowance

627. Section 28D(1)(a) specifies that when setting or varying any TACC the Minister shall allow for non-commercial interests in the fishery but does not provide any guidance as to the amount that should be allowed. Consideration of an appropriate allowance is discussed in **Section 7.4** on **TACC Setting**. In considering how to allow for non-commercial interests in the fishery, the Ministry's view is that you should take into account issues including current and predicted non-commercial catch, sustainability, the impact on commercial fishers and the QMS and issues of concern to the non-commercial sector. The Statutory Considerations section in the front of this document provides an interpretation of the relevant sections of the legislation and recent court substocks. From this material the Ministry concludes that the legislation does not imply a preference for non-commercial users over commercial users but rather that a reasonable allowance be made for non-commercial users. Although the Minister is not required to fully satisfy recreational fishers requirements, it is not contrary to the purpose of the Act for the Minister to make a decision to improve access to recreational fishers, either deliberately or incidentally.

628. Decisions in recent years have restrained recreational catch. Recreational fishers also draw your attention to the proportionally larger historical removals by industry and suggest that equity considerations should lead you to take steps to restrain commercial rather than recreational removals at this time. Over time, as the stock rebuilds, it is practical to consider improving recreational access and satisfaction through the factors above including a better catch rate and larger size of fish. This need not necessarily result in an increase in recreational catch overall - with appropriate monitoring, controls can be adjusted to keep recreational fishing within an allowance determined by the Minister. In recent years the Minister has made an allowance of 2 600 tonnes for non-commercial take. The allowance made for non-commercial take in SNA 1 reflects an assessment of non-commercial use which takes into account the Māori practice of fishing under the amateur regulations as well as utilising customary fishing permits in some instances. Given the assessed recreational take this total allowance for non-commercial fishers would seem to make reasonable provision for the unknown extent of customary take. The allowance made for non-commercial fishing in SNA 1 in no way limits the extent of customary take. Rather, it makes allowance for overall non-commercial use based on the best information available to the Ministry on the extent of both recreational and customary take.

629. Recreational catch has been estimated from the 1996 telephone and diary survey at 2 330 tonnes. This is less than the 1994 diary survey estimate of 2 794 tonnes. The assessment model estimates recreational catch at about 2 400 tonnes for the 1997–98 fishing year. However, there is considerable uncertainty in the model concerning historical and future recreational catch levels. It is reasonable to assume that recreational catch will stay at about the same level, or possibly decrease, given the implementation of recent management controls and the low recruitment that is predicted to enter the fishery in 1997–98 and the impact that this will have on the biomass.

630. You are required to make an allowance for non-commercial interests

should you decide to alter the TACC and set a TAC for the SNA 1 stock. The Ministry recommends an allowance of 2 600 tonnes for non-commercial interests and believes that no adjustment in controls is necessary to achieve this for 1997–98. Depending on the rate of rebuild of the stock, monitoring and assessment of non-commercial removals, and your decisions on an appropriate allowance in the future, further controls may be necessary in the short term to constrain removals to about this level. If this is your intent it will be useful for you to signal it in your decisions so that it can be discussed with recreational fishers in order to elicit a measures of support which is important for implementation. The options discussed below assume a non-commercial allowance of 2 600 tonnes and 'under-reporting' of commercial catch at 10%. Should you wish to consider a reduction in recreational removals at this time, **Sections 8.3.5 and 8.3.6** below discuss two options that could be considered.

### 8.2.3. TAC and TACC Options for 1997–98

#### *8.2.3.1. No Reduction in Current Biomass in 1997–98*

631. Recruitment (fish entering the fishable biomass greater than 25cm in each year) into the SNA 1 fishery is variable. Spawning success is related to water temperatures during and after spawning. The warmer the water in summer and autumn the more young snapper survive to recruit into the fishable biomass. From 1990–91 to 1993–94 colder than average water temperatures resulted in four weak year classes of snapper and thus poor recruitment into the fishery from 1994–95 to 1997–98. This poor recruitment has had and will continue to have a significant impact on the biomass and available yield of SNA 1. Above average recruitment is predicted to enter the fishery in 1998–99 and 1999–2000. Average recruitment is predicted in 2000–01. Strong El Nino conditions forecast for this summer are likely to result in weak recruitment in 2001–02. Thus over the eight years from 1994–95 to 2001–02 the SNA 1 fishery will have had six years of poor recruitment.

632. Predicted Current Surplus Production ($CSP_{97–98}$) refers to the greatest total catch that is estimated to result in no change in biomass over the 1997–98 fishing year. It takes account of the level of (poor) recruitment predicted to enter the fishery in 1997–98 and does not allow for any rebuild of the stock. The estimate of Predicted $CSP_{97–98}$ for the whole SNA 1 fishery is 6 597 tonnes.

633. To allow no reduction in the biomass for SNA 1 for 1997–98 would therefore require a TAC of 6 597 tonnes. Assuming a non-commercial allowance of 2 600 tonnes and 10% under-reporting for commercial catch, the TACC would need to be set at 3 633 tonnes.

634. MFish notes that a management strategy based on the Predicted CSP would require the TAC to be changed each year to take account of the natural variation in recruitment.

635. Industry believes that in determining the way and rate at which the stock moves towards $B_{MSY}$ you are required to recognise the variable nature of fisheries, and hence yield and stock size fluctuations. It states that this discretion to take into account the natural variability of the stock, and hence consider average recruitment and growth conditions, is recognised and provided for in section 11(1)(c) of the Act. Industry is of the view that it is sufficient that on average to have the fishery is moving towards $B_{MSY}$ over a period of time, rather than on a year by year basis.

*Status Quo*

636. As already stated, in order to allow no reduction in the biomass for SNA 1 for 1997–98, a TAC of 6 597 tonnes or less would have to be set. A TAC higher than this level would result in a decline in the SNA 1 biomass in 1997–98. Crown Law have advised that it would be lawful to allow the SNA 1 stock to decline further away from $B_{MSY}$ in 1997–98 provided there is a definite intention or plan to rebuild the stock to $B_{MSY}$ over a reasonable period of time.

637. Industry has recommended that the TACC be maintained at 4 938 tonnes and note that SNA 1 will rebuild to $B_{MSY}$ at the current TACC and existing non-commercial allowance. Industry states that if the TAC is 8 032 tonnes. (TACC of 4 938 tonnes plus 494 tonnes for the 10% under-reporting and a non-commercial allowance of 2 600 tonnes) then the Equilibrium Current Surplus Production estimate of 8 335 tonnes for SNA 1 can, on average, sustainably support this level of removals whilst still allowing 303 tonnes per annum to contribute to rebuilding the fishery (see discussion of Equilibrium CSP below in section titled **Rebuild in a Set Timeframe**). Given that the biomass for SNA 1 is 23 000 tonnes below $B_{MSY}$, it would take about 75 years to rebuild the fishery at a rate of 303 tonnes per year, using these assumptions.

638. Industry also contends that you should consider constraining the non commercial harvest (recreational and customary) to its 'present' (1996) level and suggested that would achieve a rebuild in about 40 years. The recreational catch in 1996 is estimated to be 2 330 tonnes. Industry used an earlier estimate of 2 200 tonnes in its submission but the estimate of 1996 recreational catch has since been updated. They also made no separate provision for customary take.

*Rebuild in a Set Timeframe*

639. The Equilibrium Current Surplus Production$_{97-98}$ is the yield available from the SNA 1 fishery as a whole that would, on average, maintain the biomass at its present level. Unlike the predicted CSP$_{97-98}$, it ignores recruitment variability and

instead assumes constant recruitment at the estimated average value. Equilibrium $CSP_{97-98}$ is estimated to be 8 335 tonnes, considerably higher than the Predicted $CSP_{97-98}$ of 6 597 tonnes. Equilibrium $CSP_{97-98}$ does not allow for any stock rebuild and therefore to achieve a rebuild, under average recruitment, the TAC must be set at a level lower than 8 335 tonnes. Using the Equilibrium CSP estimate of 8 335 tonnes, it is possible to calculate the TAC level required to achieve a rebuild in various timeframes.

640. Assuming a 2 600 tonne allowance for non-commercial fishers and a 10% under-reporting of commercial catch, the TACs and TACCs required for a variety of rebuild periods (10, 15, 20, 25, and 30 years) are shown in **Table 17**.

641. Industry sees no justification for imposing any particular timeframe within which the stock should be rebuilt. It is of the view that it should be sufficient that there is a greater than 50% prospect that the fishery is moving in the right direction. Having stated this, industry adds that given the current stock assessment places the fishery at 69% of $B_{MSY}$, it sees no reason why a 30 year timeframe should not be adopted, particularly as this still comes within the requirements of the FAO's analysis of the requirements of a precautionary approach.

642. Industry states that it is important to the wider fishing community that the integrity of the QMS be maintained by exploring a range of staged and measurable rebuild strategies for SNA 1. This could enable it to adjust to change, and provide for their intended well-being, while at the same time avoiding social and economic consequences. Further industry believes that if the TACC is to be reduced, and it is industry's position that it should not be, then the reduction should be no more than 200 tonnes. If any further reductions prove necessary in future years they suggest they are introduced in a staged fashion, based on subsequent years stock assessments. Industry states that in tandem with maintaining the TACC, or implementing a staged reduction of no more than 200 tonnes, a further mark-recapture estimate (tagging study) of SNA 1 be obtained in the near future. Industry states this tagging programme will be voluntarily resourced and supported by the SNA 1 quota holders.

643. The NZ Recreational Fishing Council (NZRFC) and the NZ Marine Transport Association recommend that the rebuild is achieved in 10 years and that the SNA 1 TACC should be set at 2 600 tonnes The NZRFC also now considers that the target for the rebuild of SNA 1 should be about 30% above $B_{MSY}$. The NZRFC believes there needs to be a 20% safety factor over and above the 10% under-reporting assumed for commercial catch.

644. Environmental groups (ECO, Greenpeace, Forest and Bird) consider the Hauraki Gulf-Bay of Plenty Fishery should be rebuilt within 10–15 years. They note the previous Minister agreed to a 20 year rebuild but now consider this period to be too long. They consider the 10–15 year time horizon would be consistent with your obligations under section 13(2)(ii) because it would involve less drastic

cuts on the commercial and recreational fisheries than a shorter time period, consistent with the biology of snapper, a longer time period would create uncertainty due to variable recruitment and any cuts may not result in the rebuild of the fishery; and, this time period is credible both to rebuild the fishery for future generations and to meet public concern over the state of the snapper fishery. Environmental groups state that they do not support a 'staged reduction' as it would slow the rebuild time and create uncertainty, especially with poor recruitment, as to whether there was any rebuild at all.

645. Iwi that were consulted at the meetings that were part of the northern regional consultation round provided a range of views on the SNA 1 TACC. Some supported no change to the TACC while others suggested a small reduction may be necessary but that this should be re-instated once the fishery rebuilt. Iwi in some areas also expressed concern over low catch rates and considered it important to weigh the financial implications of a reduced TACC against their concern for access and the long term sustainability prospects for the fishery.

646. A range of social, cultural, and economic factors are relevant to your consideration of an appropriate TAC level, and subsequently the TACC level that will provide different rebuild periods. A balance is needed between the costs of reducing removals and the benefits of rebuilding the stock. Commercial fishers emphasise the high economic and social costs in the industry. Non-commercial fishers seek a time horizon within which most fishers today will see tangible benefits.

*Exploitation Rate (CAY) Harvest Strategies*

647. Another management strategy to consider is setting the TAC based on the optimum exploitation rate (catch to biomass ratio) estimated for the fishery. This is typically termed a Current Annual Yield (CAY) harvest strategy. The CAY is determined by the exploitation rate (catch to biomass ratio) which would maximise the yield from a fishery over time. The CAY is calculated as a constant proportion of the biomass each year and as such increases and decreases in tandem with natural fluctuations in the stock biomass. If a CAY harvest strategy was implemented for a fishery the biomass would, regardless of its state relative to $B_{MSY}$, always be exploited at the appropriate level.

648. One advantage of using a CAY strategy to set catch limits for SNA 1, is that it would use the information for which there is the greatest certainty, that is the estimates of current biomass and the exploitation rate. No sector group has disputed either of these estimates. A CAY strategy does not depend upon knowing, with any certainty, the relationship of the current biomass to $B_{MSY}$. The determination of this relationship has been one of great debate in the SNA 1 stock assessment working group. The status of the Hauraki Gulf/Bay of Plenty substock has varied from in recent years from 46 to 64% $B_{MSY}$ as the inputs to the assessment model have been amended. However, the estimate of current biomass has varied by only about 500 tonnes from 1995–96 (33 800 tonnes) to 1997–98 (34 300 tonnes).

649. One perceived disadvantage to a CAY strategy, in some fisheries at least, is

that the TAC/TACC requires regular adjustment as the biomass changes in size with either natural fluctuations (if at $B_{MSY}$) or as part of a plan to move the biomass towards $B_{MSY}$. As stated earlier, industry does not favour a rebuild strategy for SNA 1 that would take a year to year approach to the setting of the TAC/TACC.

650. For SNA 1, CAY corresponds to a catch to biomass ratio of 11.7% for East Northland and 11.8% for Hauraki Gulf/Bay of Plenty. Based on the biomass estimates for 1997–98, CAY estimates for East Northland and Hauraki Gulf/Bay of Plenty are 1 920 and 4 050 tonnes, respectively, an overall fishery wide total (TAC) of 5 970 tonnes. Assuming a 2 600 tonne non-commercial allowance and 10% commercial under-reporting, this would give a TACC of 3 063 tonnes.

651. Assuming a TAC of 8 032 tonnes for 1996–97, an exploitation rate of 14.8% is estimated. This indicates that the stock is currently being exploited at a level higher than the optimum exploitation rate. As calculated in the previous paragraph a significant reduction in the current TAC would be required to bring the exploitation rate down to the optimum (CAY) level. An alternative to reducing the TAC to the 1997–98 estimate of CAY immediately is to consider a TAC that would result in no change to the current exploitation rate of 14.8%. This would give a TAC, based on a biomass of 50 700 tonnes, of 7 504 tonnes. Assuming a 2 600 tonne non-commercial allowance and 10% commercial under-reporting, this results in a TACC of 4 457 tonnes. A staged reduction of the TAC to the optimum exploitation rate could then be considered over time based on subsequent years stock assessments.

Table 17: **Summary of various TAC/TACC options to consider for SNA 1. In all cases it is assumed that the non-commercial allowance is 2 600 tonnes and there is 10% under-reporting of the TACC. All figures are in tonnes.**

| Options | TAC | TACC |
|---|---|---|
| **Status quo** | 8 032 | 4 938 |
| **Rebuild in set timeframe - assuming Equilibrium CSP of 8 335 tonnes** | | |
| 10 years | 6 035 | 3 122 |
| 15 years | 6 802 | 3 820 |
| 20 years | 7 185 | 4 168 |
| 25 years | 7 415 | 4 377 |
| 30 years | 7 568 | 4 516 |
| **No reduction in biomass in 1997–98—uses Predicted CSP for 1997–98 -** | 6 597 | 3 633 |
| **Exploitation rate (CAY) harvest strategies** | | |
| No change to current exploitation rate of 14.8% | 7 504 | 4 457 |
| Exploitation rate reduced to optimum level of 11.8% | 5 970 | 3 063 |

NB **The maximum TAC and TACC corresponding to the rebuild period stated are based on the assumptions (a) that the biomass needs to be increased by 23 000 tonnes in SNA 1 to reach $B_{MSY}$ and (b) that the non-commercial allowance will equal 2 600 tonnes each year until $B_{MSY}$ is reached.**

652. As noted earlier, the various TAC/TACC options described above are summarised in **Table 17**. The TAC/TACC values given for the status quo and five timeframe rebuild strategies (10, 15, 20, 25 and 30 years) assume the same level for all future years until the stock is rebuilt to $B_{MSY}$. The last three TAC/TACC options are figures for the 1997–98 fishing year only. The values of these would change in each subsequent year. All the values given are based on a deterministic model of the SNA 1 stocks. In the absence of any projections of the model incorporating the uncertainty in parameter values and future recruitment, they should be regarded as having only a 50% probability. Note that the uncertainty in the current assessment is discussed in more detail in **Section 7.3.4.2**.

## 8.3. Other Management Controls

653. A provision in the 1983 Act (now repealed) required that you consider the imposition of other management measures before implementing a TACC reduction. Based on the recent SNA 1 Court judgments, MFish advise that you should undertake a reasonable analysis of the options available to achieve a reduction in removals as an alternative to a TACC reduction.

654. MFish believe that for controls to be considered, they must be able to be effective and be implemented with some degree of certainty as to their effect to be a viable alternative to a TACC reduction. Amendment to the output control (the TACC) is clearly the primary management tool for QMS species. The effect on a fishery of implementing a control, other than a TACC change, is often complex and research may be required to evaluate its potential usefulness or otherwise before implementation.

655. Industry has suggested a range of other management controls that it believes would be appropriate and effective to provide for the rebuild of the snapper fishery. The majority of these proposed controls are contained in a draft Memorandum of Understanding (referred to as the Memorandum) that was produced following discussions between industry and the NZRFC in 1996. MFish notes that it is unsigned and the NZRFC have not ratified it. There are some measures that have promise and are currently being investigated through research to assess how they could be applied, their effectiveness and implications. MFish is uncertain of the potential of these measures with respect to prospects for immediate benefit to the stock. Further research will need to be completed and discussed in the appropriate fora to ascertain the benefits of particular proposals. For many measures further consultation will be necessary to consider implementation issues and the acceptance of the value of the measures.

### 8.3.1. Compliance Issues and Proposals

656. Many of the proposals in the Memorandum concern non-compliance with existing regulations and legislation. MFish notes that the Compliance Business Unit of the Ministry has set the measurement of compliance in NZ fisheries as a key output for its future operations. In 1997–98 there is a research project to provide a quantitative baseline on the perceptions of non-compliance with commercial fishery management measures in three important QMS fisheries, including snapper. The specific objective is to quantify the perceptions of the levels of non-compliance for licensed fish receivers and fishers in these fisheries, and for selected Quota Management System and effort control regulations facing commercial and non-commercial participants in each fishery. Another specific objective is to collect qualitative information on participants views of the effectiveness of measures to control non-compliance, ways to improve enforcement and compliance, and nature and extent of compliance problems. The survey results will be used to gauge the level of perceived non-compliance, using the 1997 data as a base comparison against future years. Over time, the perceived level of non-compliance will be used as one of the factors to determine the amounts and allocation of enforcement resources in fisheries such as SNA 1.

657. MFish Compliance also notes that some of the proposals regarding illegal fishing activity will be progressed in 1997–98, as a result of government approved additional 'new initiative' funding of $766 000 to target additional enforcement resources at high grading and dumping in the snapper fishery and the current black market in snapper. The Auckland District has had an increase in staffing from seven to 13 officers, and a Compliance Analyst has been appointed. As a result

targeted enforcement of the snapper fishery has become the main thrust and increased attention is being focused on the correct completion of Catch Effort and Landing Returns.

658. The Government has also approved funding to improve recreational fishing compliance through the HFO network. The Ministry believes the most effective way to increase the contribution of the HFO network is through improved coordination, training and support to enhance the 400 strong programme. The proposals include a focus on providing improved educational material that can be used in the community.

### 8.3.2. No Minimum Legal Size (MLS) for Powered Fishing Methods

659. Another proposal is to remove the Minimum Legal Size (MLS) for trawlers and Danish seiners. Fishers using these methods would therefore have to land all fish caught and this may create an incentive to reduce the capture of small fish. MFish notes that this would probably only have a small positive benefit in terms of contributing to the rebuild of the fishery. However, this benefit is difficult to quantify. This proposal was recommended to the previous Minister in 1995 and 1996 but he deferred implementing the measure. He was concerned such a measure required good compliance to produce benefits to the stock as there may be considerable incentive for commercial fishers to dump undersize fish. Without changes in fishing practices, or effective enforcement, a no MLS measure may not reduce mortality of small fish. MFish notes that there is research proposed for 1998–99 (**SNA9802**) to characterise the proportion of juveniles in the catch by fishing method within SNA 1. This research would provide important information to determine the total mortality associated with the respective fisheries and would allow a better assessment of the potential impact of a no MLS for trawls and Danish seines.

### 8.3.3. Escape Panels and Trawl Mesh Size

660. The Memorandum proposes that escape panels be required to be built into power fishing nets (trawl and Danish seine) to release small fish. A research project was commissioned in 1995 to assess the potential benefits of increasing trawl mesh size or fitting sorting devices into trawl nets. MFish notes that it appears from the preliminary results that further research is required. No research is planned for 1997–98 in this area. However, MFish notes that there is research proposed for 1998–99 (**SNA9802**) to assess the fishing gear modification options which are most likely to improve the escapement of juvenile snapper in the trawl and Danish seine fisheries; to determine the maximum likely fishing induced mortality of snapper passing through trawl and Danish seine nets by evaluation of the number of encounters of fish with these nets; and to conduct sampling at sea of catches in SNA 1 in order to assess the proportion of snapper below the MLS in the catch, by area and method.

### 8.3.4. Review of the Commercial Longline Minimum Legal Size (MLS)

661. In the past, some industry representatives have suggested increasing the commercial longline MLS from 25 to 30cm. They believe this measure will allow the yield per recruit to increase, therefore decreasing the number of fish required to fill the TACC and allowing the uncaught fish to rebuild the stock. MFish notes that an increase in the MLS for certain fishing methods, in particular longlining, may be beneficial. To investigate this MFish has commissioned or proposed research:

- to determine survivorship of longline released fish (**AKSN17**—final results due September 1997);
- to quantify the proportions of lip and gut hooked snapper caught by the commercial longline fleet from different depth categories (**SNA9702**—final results due September 1998); and,
- to determine the proportion of juveniles caught in the fishery (**SNA9802**—proposed project with a completion date of 30 September 1999).

662. Results from the 1996–97 and 1997–98 research will be used to determine the benefits of any potential changes to the MLS for commercial longlines. The results may also be useful in reviewing the current recreational MLS of 27cm (see below). MFish recommends that you defer reviewing the commercial longline MLS until the final results from this research becomes available (September 1998), and can be considered by the Snapper Stock Assessment Working Group.

### 8.3.5. Recreational Bag Limit

663. Industry believes the bag limit should be significantly reduced to three or five to ensure a suitable restoration of the stock to $B_{MSY}$. It states that further reductions in the bag limit is an alternative to a TACC reduction, or a means of mitigating the size of any TACC reduction. Environmental groups have recommended a reduction in the bag limit to 6. The NZRFC's position is that if the TACC is set at a level greater than 3 000 tonnes then the bag limit should be increased back to 30 fish per day. The NZ Trailer Boat Association state that any reduction to the bag limit would not be well received by recreational fishers.

664. MFish notes that the bag limit reduction from 15 to nine in 1995 is estimated to have reduced the recreational catch by about 8%. Results from recent modelling show that if a bag limit of six was implemented the predicted further reduction by number (and weight) in recreational catch would be 7%, for a bag limit of five it would be 12%, and for a bag limit of three it would be 30%.

### 8.3.6. Recreational MLS

665. The Memorandum proposes a review of the recreational MLS. MFish notes that in previous years, the NZRFC has stated that it believes an increase in the MLS should be considered in the future if the recreational catch is expanding to the point where it threatens the rebuild of SNA 1. In 1994 the snapper MLS for recreational fishers was increased from 25 to 27cm, which is estimated to have reduced recreational catch by 10%. Analysis indicates that increasing the MLS for

snapper towards 30cm increases the yield-per-recruit and thus the overall yield (MSY) available from the stock.

666. Research indicates small snapper caught by recreational fishers from shallow depths have a high probability of survival upon release. MFish has estimated the potential impact on recreational catch of an increase in the MLS from 27 to 30cm. Currently about 25% (by number) of fish caught are in the size range 27–29cm (inclusive). If the MLS was increased to 30cm this proportion of fish caught would need to be returned to the water. By weight, this equates to about 13.5% of the catch. Resulting mortality/survivorship would depend on a number of factors such as depth of capture, location of hook (whether the fish was lip or gut-hooked), and handling practices.

667. By using practices that avoid gut hooking of small snapper, recreational fishers would substantially reduce mortality of fish they catch and release. A recently published MFish educational pamphlet giving guidelines for releasing undersize fish will assist recreational fishers to reduce juvenile snapper mortality. Results also indicate that the 1994 change to MLS for recreational snapper will have had some degree of positive benefit to the SNA 1 stock in terms of productivity.

668. MFish recommends that a review of the recreational MLS be considered in tandem with a review of the commercial MLS for longlines. This review could take place in 1998–99 once the results from the 1997–98 research (**SNA9702**) on the mortality rate of commercial longline caught and released snapper become available and are considered by the stock assessment working group.

### 8.3.7. Hook Size and Type

669. The Ministry is currently supporting research into new hook designs that are intended to minimise the capture of small snapper and the incidence of gut hooking. Preliminary results indicate that the longline hook attachment developed by Paul Barnes not only reduces the incidence of gut-hooking and the number of small (less than 30cm in length) snapper caught, but also maintains a similar catch rate (by weight) to the normal longline hooks. MFish understands that further trials with the hook will be carried out in 1997–98. It notes that there is a research project proposed for 1998–99 on the estimation of mortality of juvenile snapper (**SNA9802**) which includes assessment of the effects of modifications to hook designs and appendages on the rate of gut-hooking in juvenile snapper. There is also a proposal (part of **SNA9801**) to assess the effect of fishing gear modifications (such as hook modifications) on the potential yield per recruit from SNA 1.

670. The use of final results from hook design research could be linked to a future review of the recreational and commercial MLS (see **Sections 8.3.4 and 8.3.6** above). Many factors are likely to influence mortality of line caught fish, most importantly how they are handled on capture. How any new technology is applied to the fishery will need to be considered carefully when research and trials have been undertaken. Education as to the benefits of a new hook type are likely to be preferable to regulation for the recreational sector. Ensuring compliance with any regulation would be difficult and would probably require a prohibition on possession

of hooks other than of the approved type.

### 8.3.8. Splitting the Substocks

671. The available information on SNA 1 suggests there are two substocks of snapper, East Northland and Hauraki Gulf/Bay of Plenty. Industry has suggested these should be managed separately. Separate management could be achieved by an Act of Parliament or through regulations. The Fisheries Act 1996 provides a process for separation of QMAs with sufficient quota holder support. This section is not yet commenced.

672. MFish notes that a formal split to the SNA 1 QMA would possibly be contentious and administratively difficult to achieve because of the need to reallocate quota among the existing 190 quota holders. There may be complexities involved with the splitting of quota between two substocks which have a different biomass status in relation to $B_{MSY}$.

673. Industry suggests that in the interim a voluntary management agreement be implemented. Industry has not yet provided any documented proposals on how this could be formally achieved. However, given that over 80% of the quota is owned by 20 companies, industry is of the view therefore that such a catch-spreading agreement could be implemented and managed by industry in the coming year, and has requested the opportunity to work with the Ministry to achieve this.

674. Despite the difficulties involved with achieving a split in the QMA, MFish acknowledges that it could allow an appropriate management strategy to be applied separately to the two stocks over the longer term. Although it is likely that the overall TAC/TACC level (substocks TACs and TACCs combined) would be very similar to ones set for the SNA 1 fishery as a whole. The Ministry believes there may be some merit in this proposal, but also considers that there could be a large number of implementation difficulties, even if the proposal was implemented as an industry voluntary arrangement. The Ministry recommends that you invite industry to submit a more definitive proposal that can be discussed with other stakeholders in 1998.

### 8.3.9. Enhancement

675. The Memorandum suggests developing an enhancement programme to release one million six month old snapper into the fishery each year for three years. MFish believe there would high risks associated with this proposal as it stands. The technical difficulties of a project of this size would be difficult to overcome because of the short time frame suggested. In the longer term, it is possible that an effective project could be developed. The release of one million juvenile snapper has the potential to increase the yield from the Hauraki Gulf to a limited extent. However, the amount of any increase in yield is highly uncertain as it depends on survival after release. Considerable research into the optimum manner, location, timing, and age of release would be required. A better option in the short term to increase the yield available from the fishery is to investigate controls that would reduce the mortality of pre-recruit wild snapper, such as escape panels, increased mesh size, and no MLS for trawls, and increasing the MLS for recreational fishers and commercial

longlines. Note that on average about 11 million four year old snapper naturally recruit into the SNA 1 fishery annually.

### 8.3.10. Inner Hauraki Gulf Closure (Northern Section)

676. A decision was made as part of the 1995 review of TACCs and Management Controls to implement a regulation closing parts of the inner Hauraki Gulf to commercial fishing from 1 October to 31 March each year. The Leigh Fishermen's Association Inc (LFA) gained interim relief pending a judicial review of the decision to implement this regulation. The High Court has given a reserved decision in respect of this closure, determining that the area extending generally southward from the Whangaparaoa Peninsula through the Rangitoto Channel, and the Tamaki Straight, is valid. The Court has, however, directed that the area extending generally northward between Whangaparaoa and Cape should be reconsidered, "with the Leigh Fishermen's Association Inc duly consulted". **Attachment D** discusses the background to the closure, the biological information and other issues associated with reconsideration, and provides recommendations.

### 8.3.11. Plan for the SNA 1 Fishery

677. Industry has suggested that a management plan be formulated for the SNA 1 fishery. The Ministry agrees that an indication of intent for the management of the fishery will be useful for the Ministry and stakeholder representatives. A central issue is the broad strategy for the rebuild of the fishery. The TAC and TACC options considered canvas some of the alternatives available including:

a) a constant catch strategy (removals are set at a level that will allow the stock to rebuild over time);

b) a constant exploitation rate strategy (removals are varied on an annual basis to maintain a chosen exploitation rate);

c) a goal for the rebuild period specified with removals varied to meet that target.

678. Industry has suggested that 'decision rules' be developed in consultation with the industry and other stake-holder groups for the SNA 1 fishery. It believes these decision rules should be based on those currently in place for certain orange roughy and rock lobster fisheries. MFish is of the view that the development of decision rules for SNA 1 is worth consideration and notes that there is proposed research in 1998–99 to evaluate decision rules for the rebuild of the SNA 1 fishery (**SNA9801**). However, it is of the firm view that in the short term the management measures should be implemented to initiate a rebuild of SNA 1 to $B_{MSY}$.

679. MFish also notes that there is a proposed project to carry out a mark-recapture programme in order to estimate the absolute biomass of snapper in SNA 1 (**SNA9804**). Estimates of absolute biomass at regular intervals will form an important part of the monitoring of the stock through the rebuild period. Biomass estimates are important components of the stock assessment modelling of this fishery. The model requires absolute biomass estimates at intervals of about five years. Between absolute biomass estimates, stock age composition is monitored by market sampling and the catch-at-age data is fundamental to the age-structured models for estimating and validating annual recruitment and hence biomass. The last estimate of absolute biomass for SNA 1 was determined from a mark-recapture programme during 1993–94. A mark-recapture survey in 1998–99 will provide an estimate for inclusion in the stock assessment modelling process of 2000 at the earliest.

680. Consideration of the need for restraint on recreational catch will also be an important component, depending on the rate of rebuild of the stock, monitoring and assessment of non-commercial removals, and your decisions on an appropriate allowance in the future. Other elements of the strategy might include consideration of implementing other management controls as research is completed to support such deliberation. **Table 18** below summarises current, planned, and proposed research and provides a timeframe over which various management controls could be considered over the next few years. If you agree that such an approach is useful the Ministry could put some effort into expanding this framework through discussion with stakeholders groups over the next fishing year. Note that the review periods indicated are not necessarily fixed. In the future there may be opportunities to advance the review period of some of the controls if industry was

willing to fund research outside the existing nature and extent decisions.

**Table 18:** **Research conducted (1996–97), planned (1997–98), and proposed (1998–99) that is relevant to the future review of various management controls for SNA 1.**

| Management Control | Research 1996–97 | Research 1997–98 | Research 1998–99 (proposed) | Possible Review period for management control |
|---|---|---|---|---|
| **Commercial longline MLS** | Survivorship of longline released fish (AKSN17). Final results due Sept. 1997. | Proportion of lip and gut hooked snapper caught by commercial longline (SNA9702). Final results due Sept. 1998. | Proportion of juvenile snapper caught by method in commercial fishery (SNA9802). Final results due Sept. 1999. | 1999–2000 |
| **Recreational MLS** | Survivorship of recreationally released fish (AKSN17). Completed. | - | - | 1999–2000 (review in tandem with commercial longline MLS) |
| **Removal of MLS for trawl and Danish seine** | — | - | Proportion of juvenile snapper caught by method in commercial fishery (SNA9802). Final results due Sept. 1999. | 1999–2000 |
| **Escape panels and trawl mesh size** | Final results from 1995 research due Sept/Oct. 1997. | - | Assessment of fishing gear modifications, and escapement mortality from trawl nets (SNA9802). Final results due Sept. 1999 | 1999–2000 |
| **Hook modifications** | Results due from research into hook attachment for longlines Dec. 1997 | Further trials with longline hook attachment | Assessment of effects of hook modification on rate of gut hooking in juvenile snapper (SNA9802) and effect of hook modifications on yield per recruit from SNA 1 (SNA9801). Final results due Sept 1999. | 1999–2000 |

## 8.4. Recommendations

681. It is recommended that you:

### 8.4.1. Allowance

a) **agree** to make an allowance for non-commercial fishers of 2600 tonnes;

b) **note** that if you wish to increase or decrease this allowance, the following options will need to be amended accordingly;

c) **note** that the options below provide an allowance of 10% of the TACC for under-reporting;

### 8.4.2. TAC and TACC Options

d) **indicate** your decision on a level of TAC and TACC for SNA 1 for the 1997–98 fishing year from the following options;

i) **set** a TAC at 6 597 tonnes and amend the TACC to 3 633 tonnes;

[*This reduction in removals is estimated to maintaining stock biomass at the current level for 1997/98* ]

ii) **set** a TAC at 8 032 tonnes and retain the TACC at 4 938 tonnes;

[*This is the current level of removals and is estimated to rebuild the stock to $B_{MSY}$ over a period of about 75 years* ]

iii) **set** a TAC and amend the TACC to one of the following options;

[*The third column in this table indicates the period over which this reduction in removals is estimated to rebuild the stock to $B_{MSY}$*]

| TAC (tonnes) | TACC (tonnes) | Rebuild period |
|---|---|---|
| 6 035 | 3 122 | 10 years |
| 6 802 | 3 820 | 15 years |
| 7 185 | 4 168 | 20 years |
| 7 415 | 4 377 | 25 years |
| 7 568 | 4 516 | 30 years |

iv) **set** a TAC at 7 504 tonnes and amend the TACC to 4 457 tonnes;

[*This reduction in removals is estimated to maintain the current exploitation rate of 14.8%* ]

v) **set** a TAC at 5 970 tonnes and amend the TACC to 3 063 tonnes;

[*This reduction in removals is estimated to reduce the current exploitation rate to an optimum of 11.8%*]

vi) **set** some other TAC and TACC based on consideration of the analysis contained in this final advice paper;

e) **note** that phased reductions could be considered for some of these management proposals and will likely mitigate the economic and social implications of TACC reductions;

f) **agree** that drafting instructions are forwarded to the Parliamentary Counsel Office for drafting of gazette notices to implement the decision noted above;

### 8.4.3. Other Controls

g) **note** that a number of management controls offer potential to achieve some reductions in removals but need further consideration and/or research to support implementation;

h) **note** that managing the two substocks separately could allow an appropriate management strategy to be applied separately to the two substocks over the longer term, but in the short term would require a more detailed industry proposed to implement;

### 8.4.4. Inner Hauraki Gulf Closure (Northern Section)

i) **confirm** the seasonal closure, to commercial finfish fishing, of an area of the inner Hauraki Gulf north and south of Whangaparaoa Peninsula, for the period 1 October–31 March each year;

OR

j) **confirm** the seasonal closure, to commercial finfish fishing, of an area the inner Hauraki Gulf south of Whangaparaoa Peninsula only, for the period 1 October–31 March each year;

OR

k) **confirm** the seasonal closure, to commercial finfish fishing, of an area of the inner Hauraki Gulf south of Whangaparaoa Peninsula, and part of the area to the north, for the period 1 October–31 March each year;

l) **make** no change to method exemptions provided in regulations;

m) **make** no change to the time period of the closure;

n) **note** that depending on your decision in i) to m) above amendments to regulations may be required by 1 October.

**M J Willing**
for Chief Executive
Ministry of Fisheries

APPROVED/NOT APPROVED/APPROVED AS AMENDED

Hon John Luxton
Minister of Fisheries
/ / 97

# GLOSSARY

## Technical Terms

| | |
|---|---|
| **AMP** | Adaptive Management Programme. |
| **B** | Biomass. The tonnage of fish greater than the Minimum Legal Size for commercial fishers. |
| **$B_0$** | Virgin Biomass. The biomass of a stock before any commercial or recreational harvesting. |
| **$B_{MAY}$** | Defined as the average biomass level under a CAY harvest strategy. |
| **$B_{MSY}$** | Biomass level that will support the Maximum Sustainable Yield. |
| **CAY** | Current Annual Yield. The one-year catch calculated by applying a reference fishing mortality to an estimate of the fishable biomass present during the next fishing year. The reference fishing mortality 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. |
| **CELR** | Catch Effort Landing Report. |
| **CPUE** | Catch Per Unit of Effort. |
| **CSP** | Current Surplus Production. Usually refers to the greatest total catch that would maintain a fishstock at its current biomass level. |
| **EEZ** | Exclusive Economic Zone. |
| **FLC** | Fisheries Liaison Committee. |
| **FMA** | Fishery Management Area. |
| **ITQ** | Individual Transferable Quota. |
| **LFR** | Licensed Fish Receiver. |
| **LFRR** | Licensed Fish Receiver. |
| **M** | Natural Mortality. A measurement of the rate of removal of fish from a population by natural causes. |

## Technical Terms (cont.)

| | |
|---|---|
| **MAY** | Maximum Average Yield. The average yield that would be obtained from a fishery over time under a CAY harvest strategy. |
| **MCY** | Maximum Constant Yield. The maximum constant catch that is estimated to be sustainable, with an acceptable level of risk, at all probable future levels of biomass. |
| **MLS** | Minimum Legal Size. |
| **MSY** | Maximum Sustainable Yield. In the 1996 Fisheries Act the MSY, in relation to any stock, is defined as the greatest yield that can be achieved over time while maintaining the stock's productive capacity, having regard to the population dynamics of the stock and any environmental factors that influence the stock. In practical terms, MSY cannot usually be measured directly. The biological reference points of MCY and CAY are typically used to approximate MSY. They embody the concept of MSY, apply to all conditions of stock size, account for stock fluctuations, and are measurable. |
| **QMA** | Quota Management Area. |
| **QMS** | Quota Management System. |
| **Recruitment** | The contribution made to the stock each year as young fish grow to a takeable size (ie the Minimum Legal Size). |
| **TAC** | Total Allowable Catch. The Minister of Fisheries is required under 1996 Fisheries Act to set a TAC that will move a stock towards a biomass level that will support the Maximum Sustainable Yield. |
| **TACC** | Total Allowable Commercial Catch. |
| **TCEPR** | Trawl Catch, Effort, and Processing Return. |
| **Virgin Biomass** | The biomass of a fishstock before any commercial or recreational harvesting. |

## Abbreviations

| | |
|---|---|
| **AFMA** | Auckland Fisheries Management Area. |
| **DOC** | Department of Conservation. |
| **ECO** | Environment and Conservation Organisations of New Zealand Incorporated. |
| **ECSI** | East Coast South Island. |
| **LFA** | Leigh Fishermen's Association |
| **MFish** | Ministry of Fisheries. |
| **NIWA** | National Institute of Water and Atmospheric Research. |
| **NZBGFC** | New Zealand Big Game Fishing Council. |
| **NZFIA** | New Zealand Fishing Industry Association. |
| **NZFIB** | New Zealand Fishing Industry Board. |
| **NZFIG** | New Zealand Fishing Industry Guild Inc. |
| **NZMTA** | New Zealand Marine Transport Association |
| **NZRFC** | New Zealand Recreational Fishing Council. |
| **RFBPS** | Royal Forest and Bird Protection Society of New Zealand Incorporated. |
| **SeaFIC** | New Zealand Seafood Industry Council |
| **TOKM** | Te Ohu Kai Moana (Treaty of Waitangi Fisheries Commission). |
| **UNCLOS** | United Nations Convention on the Law of the Sea. |
| **UNIA** | United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. |
| **WCSI** | West Coast South Island. |