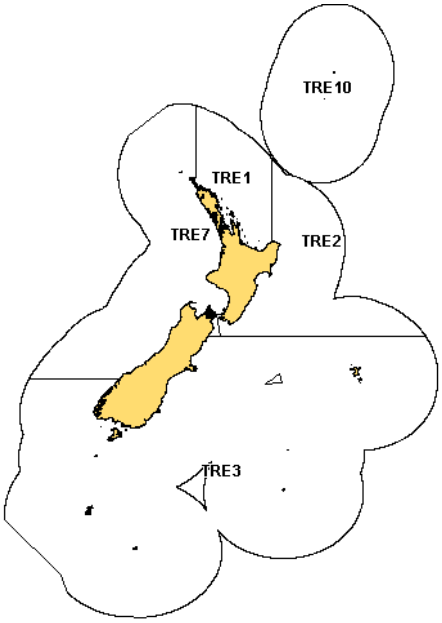
TREVALLY (TRE)

(*Pseudocaranx dentex*)
Arara



1. FISHERY SUMMARY

Trevally was introduced into the QMS in 1986 with five QMAs. The TAC was set under the provisions of the 1983 Fisheries Act and accordingly refers to only the commercial catch limit. Allowances for customary fishers, recreational fishers and an allowance for others sources of mortality have not yet been set.

1.1 Commercial fisheries

Trevally is caught around the North Island and the north of the South Island, with the main catches from the northern coasts of the North Island. Trevally is taken in the northern coastal mixed trawl fishery, mostly in conjunction with snapper. Since the mid 1970s trevally has been taken by purse seine, mainly in the Bay of Plenty, in variable but often substantial quantities. Setnet fishermen take modest quantities. Recent reported trevally landings and actual TACs are shown in Table 1.

Table 1: Reported landings (t) of trevally by Fishstock from 1983 to 2003–04 and actual TACs (t) from 1986–87 to 2006–07.

Fishstock		TRE 1		TRE 2		TRE 3		TRE 7		TRE 10
QMA (s)		1		2		3, 4, 5, 6		7, 8, 9		10
	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC
1983*	1 534	–	77	–	3	–	2 165	–	0	–
1984*	1 798	–	335	–	1	–	1 707	–	0	–
1985*	1 887	–	162	–	1	–	1 843	–	0	–
1986*	1 431	–	161	–	3	–	1 830	–	0	–
1986–87†	982	1 210	237	190	< 1	20	1 626	1 800	0	10
1987–88†	1 111	1 210	267	219	< 1	20	1 752	1 800	0	10
1988–89†	818	1 413	177	235	< 1	20	1 665	2 010	0	10
1989–90†	1 240	1 493	275	237	18	20	1 589	2 146	0	10
1990–91†	1 011	1 495	273	238	8	22	2 016	2 153	0	10
1991–92†	1 169	1 498	197	238	< 1	22	1 367	2 153	<1	10
1992–93†	1 328	1 505	247	241	< 1	22	1 796	2 153	<1	10
1993–94†	1 162	1 506	230	241	< 1	22	2 231	2 153	0	10
1994–95†	1 242	1 506	179	241	< 1	22	2 138	2 153	0	10
1995–96†	1 175	1 506	211	241	< 1	22	2 019	2 153	0	10
1996–97†	1 174	1 506	317	241	< 1	22	1 843	2 153	0	10
1997–98†	1 027	1 506	223	241	3	22	2 102	2 153	0	10
1998–99†	1 469	1 506	284	241	24	22	2 148	2 153	0	10
1999–00†	1 424	1 506	309	241	3	22	2 254	2 153	0	10

Table 1: *(Continued)*

Fishstock		TRE 1		TRE 2		TRE 3		TRE 7		TRE 10
QMA (s)		1		2		3, 4, 5, 6		7, 8, 9		10
2000–01†	1 049	1 506	211	241	< 1	22	1 888	2 153	0	10
2001–02†	1 085	1 506	243	241	< 1	22	1 856	2 153	0	10
2002–03†	1 014	1 507	270	241	< 1	22	2 029	2 153	0	10
2003–04†	1 111	1 507	251	241	< 1	22	2 186	2 153	0	10
2004–05†	977	1 507	319	241	< 1	22	1 945	2 153	0	10
2005–06†	1 149	1 507	417	241	< 1	22	1 957	2 153	0	10
2006–07†	789	1 507	368	241	0	22	1 739	2 153	0	10

QMA (s)	Total	
	Landings	TAC
1983*	3 779	–
1984*	3 841	–
1985*	3 893	–
1986*	3 425	–
1986–87†	2 845	2 230
1987–88†	3131	3 259
1988–89†	2 651	3 688
1989–90†	3 122	3 906
1990–91†	3 308	3918
1991–92†	2 733	3 921
1992–93†	3 371	3 931
1993–94†	3 624	3 932
1994–95†	3 559	3 932
1995–96†	3 405	3 932
1996–97†	3 333	3 932
1997–98†	3 355	3 932
1998–99†	3 925	3 932
1999–00†	3 989	3 932
2000–01†	3 148	3 932
2001–02†	3 185	3 933
2002–03†	3 313	3 933
2003–04†	3 548	3 933
2004–05†	3 241	3 933
2005–06†	3 524	3 933
2006–07†	2 897	3 933

Commercial catches have typically been lower than the TAC in TRE 1 (about 30%) and TRE 7 (10%), but have exceeded the TAC in TRE 2 for the past five fishing years. In the past two years, catches in TRE 2 have exceeded the TAC by 70% and 50%.

1.2 Recreational fisheries

Recreational fishers catch trevally by setnet and line. Although highly regarded as a table fish, some trevally may be used as bait. There is some uncertainty with all recreational harvest estimates for trevally as presented in Table 2.

Table 2: Estimated number of trevally harvested by recreational fishers by Fishstock. (Source: Tierney *et al*. 1997; Bradford, 1997; Bradford, 1998; Boyd & Reilly, 2002; Boyd *et al*. 2004).

	TRE 1				TRE 7			
Survey Year	Number	CV (%)	Range	Estimated Harvest (t)	Number	CV (%)	Range	Estimated Harvest (t)
1992	186 000	-	240–280	260	68 000	-	65–120	92.5
1994	180 000	9	-	228#	62 000	18	-	78.5
1996	194 000	7	215–-255	234	67 000	11	60–80	70
2000	701 000	13	5 90.9–764	677.4	69 000	27	58.8–102.6	80.7
2001	449 000	19	-	434.2	107 000	21	-	124.3
	TRE 2				TRE 3			
Survey Year	Number	CV (%)	Range	Estimated Harvest (t)	Number	CV (%)	Range	Estimated Harvest (t)
1992	10 000	-	15–25	20	6 000	-	-	7.6#
1994	-	-	-	-	-	-	-	-
1996	9 000	19	10–15	13	2 000	-	-	2.5#
2000	153 000	60	63.2–256.6	1 599	10 000	45	5.6-14.8	10.2
2001	32 000	23	-	339	2 000	46	-	1.7

#No harvest estimate available in the survey report, estimate presented is calculated as average fish weight for all years and areas by the number of fish estimated caught.

Recreational harvest estimates by fish stock have been obtained from national telephone diary surveys undertaken in 1996 and 2000, with a follow up survey in 2001. Regional telephone diary surveys were undertaken in 1991–92 in the South Region, 1992–93 in the Central Region and in 1993–04 in the North Region.

A telephone diary or personal interview diary survey (2000 & 2001) has three main components: i) the population that fishes recreationally, the group eligible to complete diaries; ii) a diary survey which generates the mean catch in the eligible population; and, iii) the mean weight of the catch, usually estimated from boat ramp surveys. The Recreational Fisheries Working Group (RTWG) concluded that the methodological framework used for telephone interviews produced low eligibility figures for the 1996 and previous surveys. Consequently the harvest estimates derived from these surveys are unreliable.

Comparisons between boat ramp and diary estimates of snapper catch per fisher-trip indicate that there are inconsistencies between the observational and diary information. These inconsistencies, suggest to the RTWG that the diary methodology used in these surveys produces unreliable estimates of total catch. In addition, there was concern expressed by the RTWG about very high estimates from the 2000 survey in FMA 2 (TRE 2). Relative comparisons may be possible between stocks within these surveys.

Mean weight, the third component of the diary survey, introduces uncertainty in the estimates of total weight of recreational catch. However, it is possible to bypass this problem by using the estimated catch in numbers.

The RTWG recommends that the harvest estimates from the diary surveys should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a methodological error; and, c) the 2000 and 2001 estimates are implausibly high for many important fisheries.

Survey results suggest annual recreational catches from TRE 1 and TRE 7 are around 250–500 t and 70–110 t, respectively. Recreational catch levels as a percentage of total removals are likely to be in to order of ~5% for TRE 7 and ~20% for TRE 1.

1.3 Customary non-commercial fisheries

Trevally is an important traditional and customary food fish for Maori. No quantitative information is available on the current level of customary non-commercial take.

1.4 Illegal catch

No quantitative information is available on the level of illegal trevally catch. An estimate of historic illegal catch is incorporated in the TRE 7 stock assessment model catch history (see Table 5).

1.5 Other sources of mortality

No quantitative estimates are available regarding the impact of other sources of mortality on trevally stocks. Trevally are known to occur in sheltered harbour and estuarine ecosystems particularly as juveniles. Some of these habitats are known to have suffered substantial environmental degradation.

2. BIOLOGY

Trevally are both pelagic and demersal in behaviour. Juvenile fish up to 2 years old are found in shallow inshore areas including estuaries and harbours. Young fish enter a demersal phase from about 1 year old until they reach sexual maturity. At this stage adult fish move between demersal and pelagic phases. Schools occur at the surface, in mid-water and on the bottom, and are often associated with reefs and rough substrate. Schools are sometimes mixed with other species such as koheru and kahawai. The occurrence of trevally schools at the surface appears to correlate with settled weather conditions rather than with a specific time of year.

Surface schooling trevally feed on planktonic organisms, particularly euphausids. On the bottom, trevally feed on a wide range of invertebrates.

Trevally are known to reach in excess of 40 years of age. The growth rate is moderate during the first few years, but after sexual maturity at 32 to 37 cm fork length (FL), the growth rate becomes very slow. The largest fish are typically around 60 cm FL and weigh about 4.5 kg, however much larger fish of 6–8 kg are occasionally recorded.

Fecundity is relatively low until females reach about 40 cm FL. They appear to be partial spawners, releasing small batches of eggs over periods of several weeks or months during the summer. Biological parameters relevant to stock assessment are shown in Table 3.

Table 3: Estimates of biological parameters.

Fishstock	Estimate			Source
1. Natural mortality (*M*)				
See section 4.1.4				
2. Weight = a(length)^b (Weight in g, length in cm fork length).				
			Both sexes	
		a	b	James (1984)
TRE 1		0.016	3.064	
3. von Bertalanffy growth parameters				
			Both sexes	
		L_∞	k	t_0
TRE 1		47.55	0.29	-0.13
TRE 7		46.21	0.28	-0.25

3. STOCKS AND AREAS

There are no new data that would alter the stock boundaries given in previous assessment documents.

4. STOCK ASSESSMENT

Yield estimates for TRE 7 were updated in 2005 on the basis of recent catch information, abundance indices, two new proportions-at-age series, improvements to the CPUE index, improvements in model structure and stock assessment modelling. There are no new data that would alter the yield estimates given in the 1999 Plenary Report for the other trevally stocks. A stock assessment was attempted for TRE 1, but was not accepted by the Pelagic Working Group as no abundance index was available. Subsequently, the TRE 1 yield estimates are based on commercial landings data and the results of a historical stock reduction analysis. Yield estimates for TRE 2 and TRE 3 were derived from commercial landings data.

Estimates of absolute biomass are not available for any stock. Biomass indices are available from *Kaharoa* trawl surveys of the Hauraki Gulf, Bay of Plenty, east Northland, and the west coast of the North Island. These relative indices are unlikely to be directly proportional to true stock abundance due to the following factors: (a) the mixed demersal-pelagic nature of trevally; (b) trawl survey gear efficiency is not optimal for the sampling of trevally; and (c) a direct correlation has been found to exist between sea surface temperature during surveys and relative biomass. These factors are most likely to confound any visible trend in the relative abundance indices for trevally produced from past trawl surveys.

4.1 Challenger, Central West and Auckland West (TRE 7)

4.1.1 CPUE

Four CPUE indices have previously been considered in TRE 7; a psuedo-standardised index from 1977–78, a trevally target index from 1989–90, a snapper bycatch index from 1989–90, and a

combined CPUE index from 1990 to 2002 which included a target predictor variable (either trevally or snapper) and area-month interaction. In the last assessment two standardised indices were used: (a) the pseudo-standardised index, and (b) the combined CPUE index, which was felt to more likely to be tracking changes in abundance than the trevally target or snapper bycatch indices, as it exhibited less inter-annual variability than these indices.

In the most recent assessment only the combined CPUE index was used (updated to 2004), with the pseudo-standardised index being dropped, as fits within the model led to highly implausible biomass estimates. After exploration of the CPUE standardization, the Working Group adopted the revised combined CPUE for use in the model (Table 4).

Table 4: Standardised single trawl CPUE indices (relative year effects) with number of vessel days fished from 1989–90 to 2003–04.

Fishing year	Year of relative effect?	CPUE index	CV	Number of days
1989–90	1990	145.5	0.14	525
1990–91	1991	142.5	0.14	477
1991–92	1992	103.8	0.14	661
1992–93	1993	77.1	0.13	1 145
1993–94	1994	92.9	0.13	905
1994–95	1995	100.1	0.13	852
1995–96	1996	86.8	0.13	994
1996–97	1997	87.8	0.13	1 046
1997–98	1998	74.2	0.12	1 490
1998–99	1999	78.1	0.13	1 278
1999–00	2000	73.5	0.13	1 049
2000–01	2001	69.8	0.13	1 044
2001–02	2002	75	0.13	955
2002–03	2003	95.1	0.13	673
2003–04	2004	93.3	0.13	833

4.1.2 Catch History

Commercial catch records for TRE 7 date back to 1944. Before that time the stock is assumed to have been lightly exploited and close to its virgin state. It is likely that reported catches prior to 1970 are underestimates of the true catch due to large-scale discarding of fish (James 1984).

Over the period since 1944, there has also been a recreational and customary catch as well as an illegal or non-reported catch. For the purposes of modelling the TRE 7 stock, it is necessary to make allowance for mortality due to discarded fish, recreational catch, customary catch, and non-reported catch. The agreed catch history for the model is given in Table 5.

Table 5: Catch history (t) for the TRE 7 fishery including total annual reported commercial catch, estimated discarded (D) commercial catch, estimated non-reported commercial catch, recreational catch, and customary catch. (The year denotes the year at the end of the fishing year).

Year	Reported landings	D	Under-reported catch	Rec. catch	Cust. catch	Total	Year	Reported landings	D	Under-reported catch	Rec. catch	Cust. catch	Total
1944	3	2	1	14	15	34	1960	595	128	119	48	10	900
1945	3	2	1	16	15	36	1961	471	101	94	51	10	727
1946	3	2	1	18	15	38	1962	543	116	109	53	10	831
1947	14	7	3	20	15	59	1963	662	142	132	55	10	1 001
1948	8	4	2	23	15	52	1964	534	114	107	57	10	822
1949	7	4	1	25	15	52	1965	544	117	109	59	10	839
1950	15	8	3	27	15	68	1966	1 080	60	216	61	10	1 427
1951	36	18	7	29	15	105	1967	1 493	83	299	64	10	1 949
1952	31	16	6	31	15	99	1968	1 515	84	303	66	10	1 978
1953	103	52	21	33	15	223	1969	1 322	73	264	68	10	1 737
1954	78	39	16	36	15	184	1970	1 682	0	336	70	10	2 098
1955	138	69	28	38	15	288	1971	2 037	0	407	70	10	2 524
1956	130	65	26	40	15	276	1972	2 226	0	445	70	10	2 751
1957	296	148	59	42	15	560	1973	2 320	0	464	70	10	2 864
1958	343	172	69	44	15	642	1974	2 024	0	405	70	10	2 509
1959	351	176	70	46	15	658	1975	1 598	0	320	70	10	1 998

Table 5: (*Continued*):

Year	Reported landings	D	Under-reported catch	Rec. catch	Cust. catch	Total	Year	Reported landings	D	Under-reported catch	Rec. catch	Cust. catch	Total
1976	1 894	0	379	70	10	2 353	1991	2 016	0	202	70	12	2 300
1977	2 113	0	423	70	10	2 616	1992	1 367	0	137	70	12	1 586
1978	2 322	0	464	70	10	2 866	1993	1 796	0	180	70	12	2 058
1979	2 600	0	520	70	10	3 200	1994	2 231	0	223	70	12	2 536
1980	2 493	0	499	70	12	3 074	1995	2 138	0	214	70	12	2 434
1981	2 844	0	569	70	12	3 495	1996	2 019	0	202	70	12	2 303
1982	2 497	0	499	70	12	3 078	1997	1 844	0	184	70	12	2 110
1983	2 165	0	433	70	12	2 680	1998	2 103	0	210	70	12	2 395
1984	1 707	0	341	70	12	2 130	1999	2 148	0	215	70	12	2 445
1985	1 843	0	369	70	12	2 294	2000	2 254	0	225	70	12	2 561
1986	1 678	0	336	70	12	2 095	2001	1 888	0	189	70	12	2 159
1987	1 626	0	163	70	12	1 871	2002	1 810	0	181	70	12	2 003
1988	1 752	0	175	70	12	2 009	2003	2 050	0	205	70	12	2 337
1989	1 665	0	167	70	12	1 914	2004	2 156	0	216	70	12	2 454
1990	1 589	0	159	70	12	1 830							

4.1.3 Catch at Age

The last assessment included annual age frequency distributions available from the target TRE 7 single trawl fishery from 1997–98 to 2000–01. There is only one year of catch-at-age data available for the pair trawl method (1997–98). These data did not suggest a significant difference in the age composition of the catch between pair and single trawl methods (Hanchet 1999).

In order to determine if the natural mortality could be better estimated, two additional proportions-at-age series from earlier in the fishery were included in the model: (1) a series covering the years 1971–74 derived from research sampling carried out by the vessel *James Cook*, and (2) a series derived from market sampling carried out in the 1974–76 and 1978–79 fishing years. These data were useful in the assessment, but further exploration is required with respect to the sampling protocols, data validation, and the weighting given to the data.

No age-frequency data are available from the recreational and customary catches.

4.1.4 Estimate of Natural Mortality (*M*)

James (1984) estimated total mortality of trevally caught by research trawl in the western Bay of Plenty using catch curve analysis. He obtained estimates ranging from 0.61 to 0.76 for younger fish (ages 0–6), 0.03 for older fish (ages 7–34) and 0.3 for the oldest fish (ages 35–46). A recent unpublished estimate of *M*, based on catch curve analysis for snapper, a species with similar growth characteristics and slightly higher lifespan than trevally, equalled 0.075 (Annala *et al*. 1999).

Exploratory model fits which attempted to estimate natural mortality were unreliable, and it was decided to set natural mortality at 0.10 (the same value as for the last assessment). Sensitivity tests were conducted using two *M* values, 0.05 and 0.15). An *M* value of 0.05 gave a more pessimistic assessment result, whilst an *M* value of 0.15 gave implausible assessment results. When *M* was estimated within the model it gave a value of 0.073. In this respect the additional years of catch sampling data have provided additional information, although further exploration of *M* is still required.

4.1.5 Model Structure

In 2005 the observational data were incorporated into an age-based Bayesian stock assessment to estimate stock size. The stock was considered to reside in a single area, with no partition by sex or maturity. In the model age groups were 1–20 years, with a plus group of 20+. The model covers the period 1944 through to 2005 (recorded catch begins in 1944).

There is a single time step in the model, in which the order of processes is ageing, recruitment, maturation, growth, and mortality (natural and fishing). Recruitment numbers followed a Beverton-

Holt relationship with steepness of 0.75. All fish in the model are assumed to be mature, and growth follows a von Bertalanffy curve.

The model was fitted to: (a) a combined (either trevally or snapper targeted) CPUE index for the years 1990 to 2004, (b) a research sampling proportions-at-age series for 1971 to 1974, (c) a market sampling proportions-at-age series covering 1974 to 1976 and 1978 to 1979 (d) a commercial proportions-at-age series for 1997 to 2000.

Selectivity was modeled with a double half normal selectivity, with the mode fixed. Separate selectivity curves were used for the research survey data and commercial.

The limbs for the double normal selectivities were estimated (2 parameters for each), as was virgin recruitment, the scaling constant between CPUE and biomass, and the year class strengths for 1960–1997. Exploratory model fits in which it was attempted to estimate natural mortality were unsuccessful, and it was set at 0.10 (the same value as for the last assessment).

Sensitivity analyses were carried out to examine the sensitivity of the model results to alternative model assumptions including relative weightings given to the proportions-at-age and CPUE data, the value used for the natural mortality, and the exclusion of individual observational data sets.

4.1.6 Results

The revised base case analysis estimated that the spawning biomass gradually declined during the 1940s and 1950s (Figure 1). The rate of decline increased in the 1960s and 1970s consistent with the increase in the total annual catch. In the late 1980s and early 1990s, there was a small increase in the biomass as annual catches declined following the introduction of TRE 7 to the QMS and the establishment of the TAC. There was also a coincidental increase in estimated recruitment during the same period. Since the mid-1990s, the spawning stock biomass is predicted to have declined slightly.

In the base case the current biomass is estimated to be 45% of virgin biomass (Table 6). When either the market sampling data or James Cook research data is dropped the estimated current biomass drops. With natural mortality set at 0.05 the current biomass is estimated to be 30% of the virgin biomass. With a natural mortality of 0.15 the biomass trajectory is implausibly flat, and current biomass is estimated to be 113% of the virgin biomass.

Table 6: Biomass estimates (medians, with 95% confidence intervals in parentheses) for the base model run. $B_{CURRENT}$ is the mid-year biomass in 2005. Estimates are derived from MCMC analysis.

Run	B_0 (t)	$B_{CURRENT}$ (t)	% B_0
Base	62 900 (56 700–74 600)	28 300 (19 500–45 900)	45 (34–61)

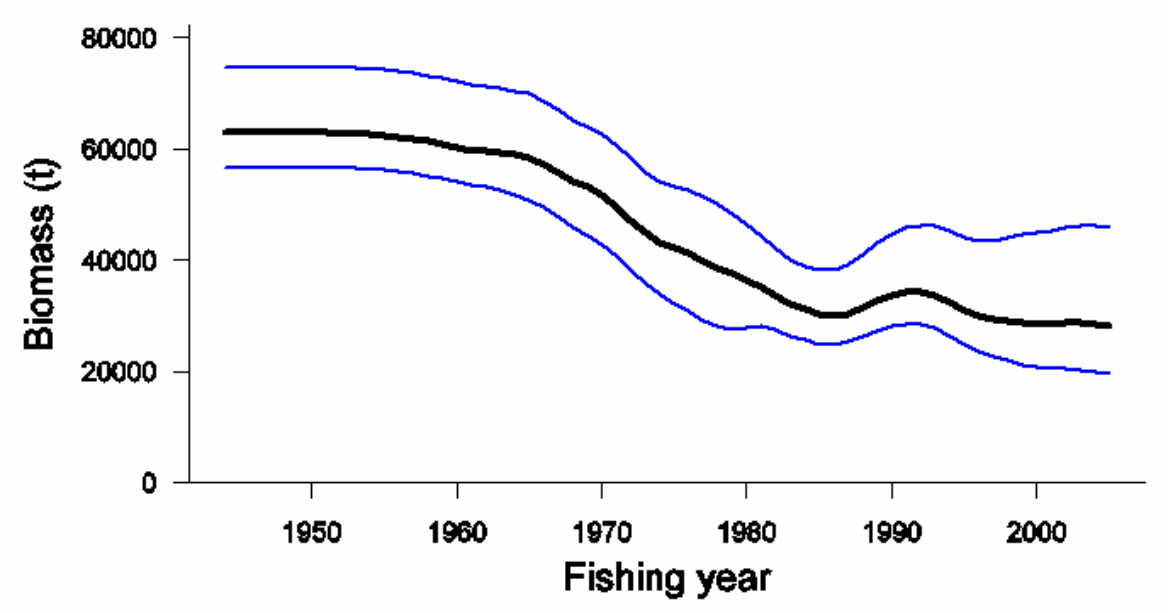


Figure 1: Total biomass trajectories from the MCMC analysis for the base case. The thin lines represent the 5th and 95th percentiles.

4.2 Yield Estimates for all stocks

4.2.1 Estimation of Maximum Constant Yield (MCY)

The estimates of MCY are summarised in Table 8 and detailed in the following sections for each stock. The level of risk to the stock by harvesting the population at the estimated MCY value has not been determined.

(i) TRE 1

An estimate of current surplus production (CSP) is available from a stock reduction analysis of the Bay of Plenty fishery using data from 1973 to 1983. The stock was estimated to have fallen to between 0.3 and 0.7 of its initial size in the period. Using a modified estimate of absolute stock size from a tagging experiment in 1977 and conservative net stock productivity values (0.02–0.06 y^{-1}) the estimate for CSP in 1984 was 600 t. No new information has become available to permit updating the stock reduction analysis estimate of CSP made in 1984. Although not an estimate of equilibrium surplus production, this value for CSP was used to estimate MCY using the equation MCY = 2/3 CSP (Method 3). This is believed to be a conservative estimate of MCY.

$$MCY = 2/3 * 600 \text{ t} = 400 \text{ t}.$$

MCY was estimated using the equation $MCY = cY_{AV}$ (Method 4) for the Hauraki Gulf and North east coast sub-areas. Y_{AV} was set equal to the mean annual commercial landings for the decade 1977–86 and equalled 924 t. Based on an estimate of $M = 0.1$, c was set equal to 0.9.

$$MCY = 0.9 * 924 \text{ t} = 830 \text{ t}.$$

These MCY values were combined to provide the overall MCY estimate for TRE 1 of 1230 t. This estimate of MCY has not changed since the 1992 Plenary Report.

(ii) TRE 2 and TRE 3

MCY estimates using the equation MCY = cY_{AV} (Method 4) with mean annual commercial landings for the decade 1977–86 and the natural variability factor c, set equal to 0.9 for these areas, has not changed since the 1989 Plenary Report.

4.2.2 Other yield estimates and stock assessment results

(i) TRE 7

For the base case assessment, and the more plausible sensitivity analyses, current biomass is estimated to be above the B_{MSY} level. The base case estimates biomass in 2005 as 45% of B0. The MSY is calculated under deterministic recruitment with a Beverton-Holt stock recruitment relationship. For the base case MSY = 2 300 t (29% B_0). For the Bayesian analysis $P(B_{2005} < B_{MSY})$ = 0.00 and the median value of B_{2005}/B_{MSY} = 1.54.

Forward projections were carried out for the base case model over a 5-year period using two constant-catch options. For each constant-catch option, three measures of fishery performance were calculated for each year in the projection period: (1) the median biomass (expressed as a percentage of B_0), (2) the probability that the biomass is less than that in 2005, and (3) the probability that the biomass is less than 29% B_0 (the maximum sustainable yield biomass).

In the first constant-catch option the future commercial catch was maintained at the TAC, in the second the future commercial catch was set at the average level of reported commercial catch from 2001–2004. In both cases an estimated unreported commercial catch of 10% of the reported commercial catch was added, and an additional 82 t for the estimated recreational and customary catch. For all projections, future deviations from the spawner-recruit curve were assumed to be log-normally distributed, with a variance equal to that from the historical estimates. Estimates back to 2004 were replaced with random recruitment because these had not been estimated in the model.

For both scenarios, the biomass slowly decreased over the 5-year projection period, but was very unlikely to move below the biomass at maximum sustainable yield (Table 7).

Table 7: Forward projections to 2010. The labels are: B_{MED} = median biomass (as $\%B_0$), P_{2005} = P(biomass < B_{2005}), P_{MSY} = P(biomass < $29\%B_0$). Annual future catches are 2 450 t (TAC scenario) or 2 260 t ($Mean_{2001–2004}$ scenario). For both scenarios B_{MED} is 44.8% for 2005.

	TAC			$Mean_{2001–2004}$		
	B_{MED}	P_{2005}	P_{MSY}	B_{MED}	P_{2005}	P_{MSY}
2006	44.2	0.90	0.00	44.6	0.86	0.00
2007	43.8	0.86	0.00	44.3	0.79	0.00
2008	43.2	0.83	0.01	44.0	0.75	0.00
2009	42.6	0.82	0.01	43.9	0.73	0.01
2010	42.2	0.80	0.02	43.6	0.70	0.02

4.2.3 Other Factors

Trevally are caught by trawling, together with other species such as snapper, red gurnard and John dory. Mismatches between the proportions of quota held for these species in any year for individual quota holders may affect landings in any one year. As a result of the interaction between snapper and trevally in the TRE 7 trawl fishery, the trevally catch is sometimes constrained by the availability of snapper quota.

Catch sampling of the TRE 1 purse seine catch was carried out annually from 1997–98 to 2002–03. All TRE 1 and TRE 7 catch-at-age compositions comprise a broad range of age classes and a consistently high proportion (5–10%) of fish 20 years and older suggesting that recent and current exploitation rates are not high. In the TRE 1 fishery it is difficult to determine any consistent trend in the progression of year classes in the age compositions from one year to the next. Year class strength progression in TRE 7 is more apparent for some year classes, especially for groups of year classes with relatively similar strengths. A recent catch sampling review (Walsh & McKenzie, in press)

suggests spatial variation in population age structure and otolith reading ambiguities are the likely main causes of the lack of consistency in trevally age data. The report recommends that in future the collection and analyses of trevally age data is made with explicit regard to sub-area. The presence of significant sub-area differences in age composition may have implications in future TRE 1 and TRE 7 stock assessments

5. STATUS OF THE STOCKS

TRE 1

The assessment for TRE 1 undertaken in 2006 was not accepted by the Inshore WG due to the lack of a reliable abundance index, therefore there is no current information to change previous views on the status of the stock. Recent catches reported for TRE 1 are less than the estimated MCY levels and below the TACC. The TACC is probably sustainable, probably allowing the stock to attain a size at or above B_{MSY}. This hypothesis is supported in TRE 1 by the results of catch sampling from the TRE 1 purse seine fishery.

TRE 2

Over the past five years reported catches for TRE 2 have been in excess of the TACC and have also exceeded the estimated MCY level (310 t) in the past three years. It is not known if these recent catches are sustainable or will allow the stock to attain a size at or above $B_{MSY.}$

TRE 7

Based on the assessment undertaken in 2005 the current stock size at that time was estimated to be above B_{MSY}. Catches at the level of the TACC and current catches were projected to be sustainable in the short-term, with a high probability of allowing the stock to be maintained at or above B_{MSY}. However, it is uncertain as to whether catches at the level of the TACC are sustainable in the longer term.

Yield estimates, TACCs and reported landings by Fishstock are summarized in Table 8.

Table 8: Summary of yields (t), TACs (t) and reported landings (t) of trevally for the most recent fishing year.

Fishstock	QMA		MCY	2006–07 Actual TAC	2006–07 Commercial landings
TRE 1	Auckland (East)	1	1 230	1 507	789
TRE 2	Central (East)	2	310	241	368
TRE 3	South–East, Chatham, Southland and Sub–Antarctic	3, 4, 5, 6	5	22	0
TRE 7	Auckland (West), Central (West), Challenger	7, 8, 9	*see assessment	2 153	1 739
TRE 10	Kermadec	10	0	10	0
Total				3 933	2 987

6. FOR FURTHER INFORMATION

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