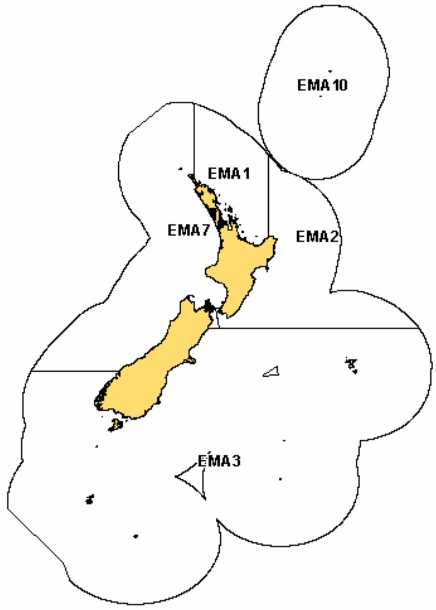
BLUE MACKEREL (EMA)

(*Scomber australasicus*)



1. FISHERY SUMMARY

Blue mackerel were introduced into the QMS on 1 October 2002, with allowances, TACCs and TACs in Table 1.

Table 1: Recreational and Maori allowances, TACCs and TACs for blue mackerel by Fishstock.

Fishstock	Recreational Allowance	Maori customary Allowance	TACC	TAC
EMA 1	40	20	7630	7690
EMA 2	5	2	180	187
EMA 3	1	1	390	392
EMA 7	1	1	3350	3352
EMA 10	0	0	0	0
Total	47	24	11 550	11 621

(a) Commercial fisheries

Blue mackerel are taken by a variety of methods, including bottom longline, bottom pair trawl, beach-seine, bottom trawl, drift net, dip net, Danish seine, handline, lampara, mid-water trawl, purse seine, lobster pot, ring net, surface longline, setnet, and troll. However, for many of these methods the catch is very low. Most catch is taken north of latitude 43° S (Kaikoura). The largest and most consistent catches have been from the target purse seine fishery in EMA 1, 2 and 7, and as non-target catch in the jack mackerel mid-water trawl fishery in EMA 7. Since 1983–84 the catch of blue mackerel in New Zealand waters has grown substantially (Table 2), primarily in the purse seine fishery in EMA 1.

Most blue mackerel purse seine catch comes from the Bay of Plenty and East Northland, where it is primarily taken between July and December. Purse seine fishing effort on blue mackerel has been strongly influenced by the availability and market value of other pelagic species, particularly skipjack tuna and kahawai, with effort increasing as limits have been placed on the purse seine catch of kahawai. Total catches peaked in 1991–92 at more than 15 000 t, of which 60–70% was taken by purse seine. More recently, commercial landings of over 12 500 t were taken in 1998–99 (13 500 t), 2000–01 (13 100 t) and 2004–05 (12 750 t), with the highest landings recorded in EMA 1 and EMA 7. In 2004–05 the pattern of landings changed, with the EMA 1 landings exceeding the TACC for the first time since EMA was introduced to the QMS, although this was not sustained in 2005–06. The purse seine fishery accounted for 92% of the total EMA 1 landings in 2004–05.

Table 2: Reported landings (t) of blue mackerel by QMA, and where area was unspecified (Unsp.), from 1983–84 to 2004–05.

QMA	1	2	3	7	10#	Unsp	Total
1983–84*	480	259	44	245	0	1	1028
1984–85*	565	222	18	865	0	73	1743
1985–86*	618	30	190	408	0	51	1296
1986–87†	1431	7	424	489	0	49	2399
1987–88†	2641	168	864	1896	0	58	5625
1988–89†	1580	<1	1141	1021	0	469	4211
1989–90†	2158	76	518	1492	0	<1	4245
1990–91†	5783	94	478	3004	0	0	9358
1991–92†	10 926	530	65	3607	0	0	15 128
1992–93†	10 684	309	133	1880	0	0	13 006
1993–94†	4178	218	223	1402	5	0	6025
1994–95†	6734	94	154	1804	10	149	8944
1995–96†	4170	119	173	1218	0	1	5680
1996–97†	6754	78	340	2537	0	<1	9708
1997–98†	4595	122	78	2310	0	<1	7104
1998–99†	4505	186	62	8756	0	4	13 519
1999–00†	3602	73	3	3169	0	0	6847
2000–01†	9738	113	6	3278	0	<1	13 134
2001–02‡	6368	177	49	5101	0	0	11 694
2002-03‡	7609	115	88	3563	0	0	11 375
2003-04‡	6523	149	1	2701	0	0	9373
2004-05‡	7920	9	<1	4817	0	0	12 746
2005–06‡	6713	13	133	3784	0	0	10 643

* FSU data.
† CELR data.
\# Landings reported from QMA 10 are probably attributable to Statistical Area 010 in the Bay of Plenty (i.e., QMA 1).
‡ MHR data.

The 2004–05 and 2005–06 EMA 7 landings also exceeded the TACC. By contrast, landings in these years from EMA 2 and EMA 3 were well below the TACC and at levels near the lowest recorded since 1983-84, although there was an increase to 130 t in EMA 3 in 2005–06, the highest catch there since 1996–97. The blue mackerel catch from EMA 7 is principally non-target catch from the jack mackerel mid-water trawl fishery and, in 2004–05, represented about 85% of total landings in that Fishstock with most of the balance taken by purse seine (12%).

Using market and catch sampling data collected during 2004–05, estimated numbers-at-length and numbers-at-age were calculated based on all available groomed length and length-at-age data. These were done separately by sex and scaled to estimates of the total catch from each of the three main blue mackerel fisheries. Results showed that the EMA 1 and 7 purse seine fisheries were composed of fish between 2–21 and 2–24 years of age respectively, although most were between 5–15 years in both cases. Catch-at-age in the EMA 7 mid-water trawl TCEPR bycatch (jack mackerel target) fishery appeared somewhat broader, with fish between 2–24 years represented, and small peaks evident between 10–11 years in both sexes. These results were generally consistent with those from previous years, although relatively low numbers of small fish in the sampled fisheries were noted.

A number of factors have been identified that can influence landing volumes in the blue mackerel fisheries. In the purse seine fishery, blue mackerel has become the second most preferred species because of decreased TACCs on kahawai. Skipjack tuna is the preferred species and blue mackerel will not be targeted once the skipjack season has begun in late-spring, early summer. Thus, early arrival of skipjack can result in reduced volumes of blue mackerel being landed.

Management of company quota is complicated by the relative timing of the fishing season and the fishing year and this, along with the timing of the main market, may influence whether the blue mackerel TACC can all be taken in a particular year. The fishing season usually begins in about July-August, runs through the end-beginning of subsequent fishing years, and finishes in about November. The main market for purse seined blue mackerel takes up to 80% of the catch and requires premium fish to be available from early spring. To meet the demands of this market and to minimise the costs of storing fish from the previous season, fishing companies must carry over some proportion of their quota for a given year until fish become available the following season. If availability is delayed until after October 1, only 10% of the total quota can then be carried over into the new fishing year.

Because blue mackerel is taken principally as bycatch in the jack mackerel TCEPR target fishery in JMA 7, factors influencing the targeting of jack mackerel also affect blue mackerel landings. Other bycatch species taken in this fishery include barracouta, gurnard, John dory, kingfish, and snapper, and, although non-availability of ACE is unlikely to be constraining in the first three of these, the same is not true of kingfish and snapper. Fishing company spokespersons have stated that known hotspots of snapper are avoided. Other factors in this fishery include strategies to avoid the catch of marine mammals, and a code of practice operates where gear is not deployed between 2 a.m. and 4 a.m. It is unknown whether this affects total landing volumes.

(b) Recreational fisheries

Blue mackerel does not rate highly as a recreational target species although it is popular as bait.

There is some uncertainty with all recreational harvest estimates for blue mackerel and there is some confusion between blue and jack mackerels in the recreational data. 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.

Recreational catch in the northern region (EMA 1) was estimated at 114 000 fish by a diary survey in 1993–94 (Bradford, 1996), 47 000 fish in a national recreational survey in 1996 (Bradford, 1998), 84 000 fish (CV 42%) in the 2000 survey (Boyd & Reilly, 2002) and 58 000 fish (CV 27%) in the 2001 survey (Boyd et al., 2004). The surveys suggest a harvest of 35-90 t per year for EMA 1, insignificant in the context of the commercial catch. Estimates from other areas are very low (between 500 and 3000 fish) and are likely to be insignificant in the context of the commercial catch.

(c) Maori customary fisheries

Quantitative information on the current level of customary take is not available.

(d) Illegal catch

There is no known illegal catch of blue mackerel.

(e) Other sources of mortality

There is no information on other sources of mortality.

2. BIOLOGY

The geographical distribution and habitat of blue mackerel vary with life history stage. Juvenile and immature blue mackerel are northerly in their distribution, having been recorded from commercial and research catches around the North Island and into Golden and Tasman Bay at the top of the South Island.

By contrast, adults have been recorded around both the North and South Islands to Stewart Island and across the Chatham Rise to almost the Chatham Islands. Sporadic catches of small numbers of yearling blue mackerel have been made by otter trawl in shallow waters.

The distribution of blue mackerel at the surface is seasonal and differs from its known geographical range. During summer, surface schools are found in Northland, Bay of Plenty, South Taranaki Bight, and Kaikoura, but they disappear during winter, when only occasional individuals are found in Northland and the Bay of Plenty. A possible corollary to this winter disappearance comes from the peak in bycatch of blue mackerel in the winter jack mackerel mid-water trawl fishery in EMA 7. This suggests an increased partitioning of the population in deeper water at this time of the year, thus reflecting an observed behavioural characteristic of the related Atlantic species, *Scomber scombrus*.

Summaries from aerial sightings data show that blue mackerel can be found in mixed schools with jack mackerel (*Trachurus* spp.), kahawai (*Arripis trutta*), skipjack tuna (*Katsuwonus pelamis*) and trevally (*Pseudocaranx dentex*), and that its appearance in mixed schools varies seasonally.

Blue mackerel are serial spawners, releasing eggs in batches over several months. Based on gonad condition, sexual maturity for both sexes of blue mackerel taken in the Great Australian Bight between January 1979 and December 1980 was estimated to be about 28 cm FL, which translates to an age of about 2 years. Eggs are pelagic and development rate is dependent on temperature. In plankton surveys, blue mackerel eggs have been found from North Cape to East Cape, with highest concentrations from Northland, the Hauraki Gulf, and the Western Bay of Plenty. Eggs have been described throughout the Hauraki Gulf from November to the end of January, at surface temperatures in the range 15–23° C. Individuals in spent or spawning condition have been taken in a few tows off Tasman Bay and Taranaki, in EMA 7 and in the Bay of Plenty in EMA 1.

Age and growth studies suggest a difference in the age structures of catches taken in the Bay of Plenty (New Zealand; EMA 1) and New South Wales (Australia). For fish from the New South Wales study, a peak was found at 1 year that accounts for more than 55% of the fish sampled, with a maximum age of 7 yr. The Bay of Plenty results show a much broader distribution, with a maximum age of 24 yr, and a mode in the data around 8 to 10 yr. Growth parameters estimated in the Bay of Plenty study are given in Table 3. Following a quantitative test of competing growth models in the Bay of Plenty study, no evidence was found of statistically significant differences in growth between the sexes in Bay of Plenty blue mackerel.

Table 3: Von Bertalanffy growth parameters for Bay of Plenty (EMA 1) blue mackerel (Manning et al., 2006).

	Males	Females	All fish
L_∞	52.49	53.10	52.79
K	0.15	0.15	0.15
t_0	-3.29	-3.18	-3.19
Age range	1.8-21.9	1.8-21.9	1.8-21.9
N	240	269	509

Catch sampling of the blue mackerel purse seine fishery in EMA 1 shows that in that area, blue mackerel recruit to the fishery at around 3 years of age, and that the catch is dominated by fish in the 4–12 yr age class. Few fish older than 15 years were sampled.

Australian studies may underestimate the ages of larger, older blue mackerel in their catch. The Australian method for estimating blue mackerel ages is based on reading otoliths whole in (lavender) oil, whereas the New Zealand method is based on otolith thin-sections. Results from the New South Wales study referred to above, suggest that blue mackerel 25–40 cm in fork length may be 3–7 years old. Using the New Zealand method, fish in this length range could be as old as 16 years. Australian scientists, reading whole otoliths, may be missing opaque zones near the margin, which are visible in sectioned otoliths.

Although Australian scientists have validated the timing of the first opaque zone in blue mackerel otoliths, their results do not cover the complete life history defined using either the Australian or New Zealand method. A standard and validated age estimation method for blue mackerel is an important topic of future research in New Zealand.

In New Zealand, the diet of blue mackerel has been described as zooplankton, which consists mainly of copepods, but also includes larval crustaceans and molluscs, fish eggs and fish larvae. Feeding involves both filtering of the water and active pursuit of prey, with blue mackerel able to take much smaller animals than, for example, kahawai can.

3. STOCKS AND AREAS

Sampling of eggs, larvae, and spawning blue mackerel indicate at least three spawning centres for this species: Northland-Hauraki Gulf; Western Bay of Plenty; and South Taranaki Bight. Nothing is known of migratory patterns or the fidelity of fish to a particular spawning area. Examination of mitochondrial DNA shows no geographical structuring between New Zealand and Australian fish. Meristic characters show significant regional differentiation within New Zealand fisheries waters and, combined with parasite marker information, blue mackerel are sub divided into at least three stocks in New Zealand fisheries waters: EMA 1, EMA 2, and EMA 7.

4. STOCK ASSESSMENT

(a) Estimates of fishery parameters and abundance

Analysis of aerial sightings data for east Northland from 1985–86 to 2002–03 found no apparent trends in abundance, apart from a peak off east Northland in 1991–92 for both the number of schools and the estimated tonnage, and a further strong signal for the number of schools and the estimated tonnage from 2000–01 through 2002–03.

A standardised CPUE analysis was carried out in 2006–07 using TCEPR tow by tow data from the mid-water trawl jack mackerel target fishery in which blue mackerel form a significant and important bycatch. Tows that targeted jack mackerel but did not report any blue mackerel catch were considered to be a zero tow.

Estimates of relative year effects were obtained using a forward stepwise multiple regression method, where the data were fitted using binomial-lognormal model structure. The data used for the CPUE analyses consisted of catch and effort by core vessels that targeted jack mackerel; core vessels were those vessels that had more than five non-zero tows of blue mackerel catches for at least three years.

Separate standardisations were carried out to two subgroups of core vessels corresponding to an early and late period of the data series respectively. CPUE indices were developed for the early time series from 1989–90 to 1997–98 using catch and effort by 12 core vessels and the late time series from 1996–97 to 2004–05 using catch and effort by 7 core-vessels.

For the early time series (Table 4), the residual deviance explained were 19% for the binomial models and 33% for the lognormal model. For the late time series, the residual deviance explained were 18% for the binomial models and 30% for the lognormal model. For both data series, the main terms selected by the models are statistical area, vessel, and month.

The combined indices produced for the early time series dropped to the lowest in 1992–03, recovered in 1994–05, and then fluctuated to 1997–98. The indices produced for the late time series fluctuated to 1999–2000, declined through the years to a level in 2004–05 about 15% that of 1996–97.

Table 4: Standardised CPUE indices from the binomial-lognormal model fitted to the early time series (1989–90 to 1997–98, vessels 1–12) and the late time series (1996–97 to 2004–05, vessels 13–19); Year 99 donates fishing year 1998–99.

Year	Vessels 1-12 1990 to 1998			Vessels 13-19 1997 to 2005		
	Binomial	Lognormal	Combined	Binomial	Lognormal	Combined
1990	1.00	1.00	1.00			
1991	1.17	1.43	1.51			
1992	0.65	1.65	1.39			
1993	0.30	1.04	0.57			
1994	0.27	1.20	0.61			
1995	0.65	1.63	1.37			
1996	1.01	1.31	1.31			
1997	0.65	1.75	1.47	1.00	1.00	1.00
1998	0.74	1.46	1.30	1.06	0.80	0.83
1999				1.29	0.98	1.14
2000				1.46	0.81	1.01
2001				1.14	0.62	0.67
2002				1.20	0.62	0.68
2003				0.52	0.34	0.22
2004				0.65	0.16	0.12
2005				0.94	0.14	0.14
2004				0.65	0.16	0.12
2005				0.94	0.14	0.14

Due to the significant area / year interactions estimated in the analysis, and the large interannual variation in catches and CPUE in some areas, the PELWG agreed that it was is premature to make conclusions about trends in abundance based on these indices at this time.

(b) Biomass estimates

No biomass estimates are available.

(c) Estimation of Maximum Constant Yield (MCY)

It is not feasible to estimate MCY. There are no estimates of biomass or reference fishing mortalities and recent fishing effort has been interdependent on several small pelagic species. A large proportion of catch is by purse seine, and catch restrictions for kahawai (which traditionally received greater effort) first set in the early 1990s, shifted fishing effort towards blue mackerel. A significant component of the catch is also taken as non-target catch when targeting other small pelagic species.

(d) Estimation of Current Annual Yield (CAY)

Estimates of current biomass are not available and CAY cannot be determined.

(e) Other factors

Recent catch sampling indicates that catch-at-length and catch-at-age is relatively stable between years in EMA 1. Although total mortality in EMA 1 is poorly understood, the relatively stable age-length composition between years and the number of year-classes that compose the catch-at-age within fishing years, suggest that blue mackerel may be capable of sustaining current commercial fishing mortality in EMA 1.

5. STATUS OF THE STOCKS

Little is known about the status of blue mackerel stocks and no estimates of current and reference biomass, or yield, are available for any blue mackerel area. For EMA 1, the stability of the age composition data and the large number of age classes that comprise the catches suggests that blue mackerel may be capable of sustaining current commercial fishing mortality, but generally it is not known if recent catch levels are sustainable or at levels that will allow the stocks to move towards a size that will support the MSY.

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