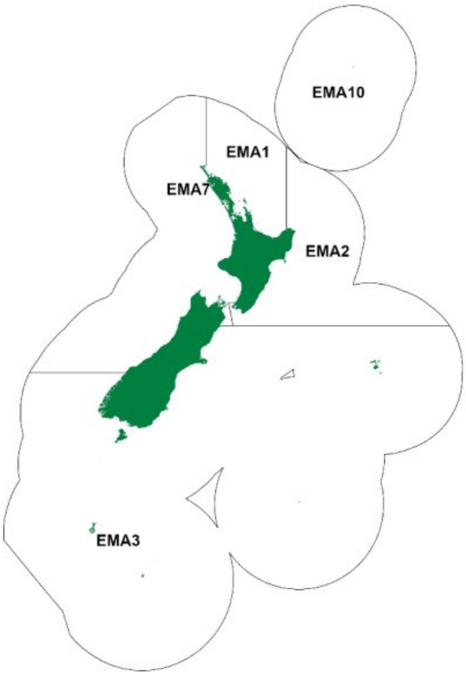
BLUE MACKEREL (EMA)

(*Scomber australasicus*)
Tawatawa



1. FISHERY SUMMARY

Blue mackerel were introduced into the QMS on 1 October 2002. Since then allowances, TACCs, and TACs (Table 1) have not changed.

Table 1: Recreational and Customary non-commercial allowances, other mortality, TACCs, and TACs (t) for blue mackerel by Fishstock.

Fishstock	Recreational allowance	Customary non-commercial allowance	Other sources of mortality	TACC	TAC
EMA 1	40	20	0	7 630	7 690
EMA 2	5	2	0	180	187
EMA 3	1	1	0	390	392
EMA 7	1	1	0	3 350	3 352
EMA 10	–	–	–	0	0

1.1 Commercial fisheries

Blue mackerel are taken by a variety of methods but for most of these methods the catches are very low. The largest and most consistent catches have been from the target purse seine fishery in EMA 1, 2, and 7, and as both target and non-target catch in the midwater trawl fishery in EMA 7, which primarily targets jack mackerel. Most catch is taken north of latitude 43° S (Kaikōura). Historical estimated and recent reported blue mackerel landings and TACCs are shown in Tables 2 and 3, and Figure 1 shows the historical landings and TACC values for these three main stocks. The catch of blue mackerel in New Zealand waters grew substantially after 1983–84 and catches have averaged about 10 000 t annually since 1990–91 (Table 3) with the purse seine fishery in EMA 1 responsible for around two thirds of the total.

Most blue mackerel purse seine catch comes from the Bay of Plenty (BoP) 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 were placed on the purse seine catch of kahawai in the 1990s (Fu 2013). The purse seine fishery has accounted for more than 99% of annual EMA 1 landings since at least 1990, and about 90% of this was targeted (Middleton et al 2025).

Total blue mackerel landings peaked in 1991–92 at more than 15 000 t, of which 60–70% was taken by purse seine. EMA 1 landings have fluctuated around the TACC since 2002–03, except in 2007–08 and 2008–09. EMA 7 landings fluctuated around the TACC from 2001–02 to 2009–10 but were substantially lower from 2010–11 to 2016–17. However, in 2017–18 EMA 7 landings increased to near the TACC and have remained at a similar level with the TACC exceeded in 2021–22 and 2023–24. Landings from EMA 2 and 3 have been below the TACCs since the early to mid-1990s; they are mainly bycatch from purse seine vessels (EMA 2) and trawlers (EMA 3).

Table 2: Reported landings (t) for the main QMAs from 1931 to 1982.

Year	EMA 1	EMA 2	EMA 3	EMA 7	Year	EMA 1	EMA 2	EMA 3	EMA 7
1931–32	0	0	0	0	1957	0	0	0	0
1932–33	0	0	0	0	1958	0	0	0	0
1933–34	0	0	0	0	1959	0	0	0	0
1934–35	0	0	0	0	1960	0	0	0	0
1935–36	0	0	0	0	1961	0	0	0	0
1936–37	0	0	0	0	1962	0	0	0	0
1937–38	0	0	0	0	1963	0	0	0	0
1938–39	0	0	0	0	1964	0	0	0	0
1939–40	0	0	0	0	1965	0	0	0	0
1940–41	0	0	0	0	1966	0	0	0	0
1941–42	0	0	0	0	1967	0	0	0	0
1942–43	0	0	0	0	1968	0	0	0	0
1943–44	0	0	0	0	1969	0	0	0	0
1944	0	0	0	0	1970	0	0	0	0
1945	0	0	0	0	1971	0	0	0	0
1946	0	0	0	0	1972	0	0	0	0
1947	0	0	0	0	1973	0	0	0	0
1948	0	0	0	0	1974	38	8	0	6
1949	0	0	0	0	1975	10	0	0	2
1950	0	0	0	0	1976	50	49	0	0
1951	0	0	0	0	1977	34	135	0	0
1952	0	0	0	0	1978	14	55	0	128
1953	0	0	0	0	1979	185	31	0	317
1954	0	0	0	0	1980	752	32	0	407
1955	0	0	0	0	1981	459	49	0	1 363
1956	0	0	0	0	1982	305	0	0	791

Notes:
1. The 1931–1943 years are April–March, but from 1944 onwards are calendar years.
2. Data up to 1985 are from fishing returns; data from 1986 to 1990 are from Quota Management Reports.
3. Data for the period 1931 to 1982 are based on reported landings by harbour and are likely to be underestimated as a result of under-reporting and discarding practices. Data include both foreign and domestic landings.

Since 1999–2000, the blue mackerel catch from EMA 7 has been principally taken in the jack mackerel midwater trawl fishery, with the proportion of catch taken when blue mackerel was the target species increasing from the early 2000s. However, targeting of blue mackerel did not occur during the 2013–14 to 2016–17 period, when catches were particularly low, and target catch by the MW fleet was minimal from 2021–22 and 2023–24. Purse seine catches in EMA 7 have been relatively minor in comparison to midwater trawl methods since around 2000 but were larger in 2019–20 and exceeded 1000 tonnes from 2021–22 to 2023–24. The temporal and spatial distribution of catches in EMA 7 reflects the operation of the jack mackerel fishery. Prior to the mid-2000s the highest catches were taken during June and July in Statistical Areas 034 and 035 off the west coast South Island (WCSI). Since 2004, catches have become less seasonal and have primarily been taken in Statistical Areas 041 and 801 (North Taranaki Bight).

The purse seine fishery targets multiple species including blue and jack mackerels, skipjack tuna, kahawai and trevally. The seasonal availability and the cumulative catch of each of these species within the fishing year influences the targeting practices and relative preference for each of these species. The seasonal availability of skipjack tuna is one such example that can influence the targeting practices of blue mackerel. When skipjack tuna are available, purse seine vessels may preferentially target this species, forgoing blue mackerel even when prevalent. Conversely, when skipjack tuna are less available (as has been the case in the early 2020s) targeting of blue mackerel may regain priority.

Between 2000 and 2010, fishers reported that the seasonal onset of the blue mackerel fishing season often coincided with the final months of the fishing year (i.e., July to August). In years that the start of this fishing season was delayed due to the late arrival of fish, and after the start of the new fishing year (01 October), the ability of the fleet to catch the available ACE would be curtailed. With only 10% of the total TACC able to be carried over into the new fishing years, this led to instances where commercial operations were unable to achieve full utilisation of the TACC. More recently, fishers have reported a more consistent timing of the fishing season with a wider geographical spread of fish than was observed in the 2000s, enabling full utilisation of the TACC. Factors influencing the targeting of jack mackerel also affect blue mackerel landings.

Table 3: Reported landings (t) of blue mackerel by QMA, and where area was unspecified (Unsp.), from 1983–84 to present. CELR data from 1986–87 to 2000–01. MHR data from 2001–02 to present.

Fishing year	EMA 1	EMA 2	EMA 3	EMA 7	EMA 10†	Unsp.	Total
1983–84*	480	259	44	245	0	1	1 028
1984–85*	565	222	18	865	0	73	1 743
1985–86*	618	30	190	408	0	51	1 296
1986–87	1 431	7	424	489	0	49	2 399
1987–88	2 641	168	864	1 896	0	58	5 625
1988–89	1 580	< 1	1 141	1 021	0	469	4 211
1989–90	2 158	76	518	1 492	0	< 1	4 245
1990–91	5 783	94	478	3 004	0	0	9 358
1991–92	10 926	530	65	3 607	0	0	15 128
1992–93	10 684	309	133	1 880	0	0	13 006
1993–94	4 178	218	223	1 402	5	0	6 025
1994–95	6 734	94	154	1 804	10	149	8 944
1995–96	4 170	119	173	1 218	0	1	5 680
1996–97	6 754	78	340	2 537	0	< 1	9 708
1997–98	4 595	122	78	2 310	0	< 1	7 104
1998–99	4 505	186	62	8 756	0	4	13 519
1999–00	3 602	73	3	3 169	0	0	6 847
2000–01	9 738	113	6	3 278	0	< 1	13 134
2001–02	6 368	177	49	5 101	0	0	11 694
2002–03	7 609	115	88	3 563	0	0	11 375
2003–04	6 523	149	1	2 701	0	0	9 373
2004–05	7 920	9	< 1	4 817	0	0	12 746
2005–06	6 713	13	133	3 784	0	0	10 643
2006–07	7 815	133	42	2 698	0	0	10 688
2007–08	5 926	6	122	2 929	0	0	8 982
2008–09	3 147	2	88	3 503	0	0	6 740
2009–10	8 539	3	14	3 260	0	0	11 816
2010–11	6 630	2	9	1 996	0	0	8 638
2011–12	8 080	2	28	2 707	0	0	10 817
2012–13	7 213	3	100	2 401	0	0	9 716
2013–14	6 860	4	29	1 200	0	0	8 092
2014–15	8 134	16	87	892	0	0	9 129
2015–16	7 226	18	27	761	0	0	8 033
2016–17	7 551	83	126	625	0	0	8 385
2017–18	7 988	112	46	3 254	0	0	11 400
2018–19	7 630	12	32	2 626	0	0	10 300
2019–20	7 169	7	13	2 409	0	0	9 597
2020–21	8 002	129	3	2 832	0	0	10 966
2021–22	7 768	67	10	3 766	0	0	11 612
2022–23	7 306	40	4	3 282	0	0	10 631
2023–24	7 961	5	5	4 537	0	0	12 507

* FSU data.
† Landings
reported from EMA 10 are probably attributable to Statistical Area 010 in the Bay of Plenty (i.e., EMA 1).

1.2 Recreational fisheries

Blue mackerel does not rate highly as a recreational target species although it is popular as bait. There is some uncertainty in all recreational harvest estimates for blue mackerel and there is some confusion between blue and jack mackerels in the recreational data.

The first recreational harvest estimates were provided by offsite telephone-diary surveys conducted between 1991 and 2001 (Bradford 1996, 1998, Boyd et al 2004). These estimates are no longer considered to be reliable by the Marine Amateur Fishing Working Group (MAFWG), because the method was prone to 'soft refusal' bias during recruitment of potential participants and overstated catches during reporting (Wright et al 2004). The recreational harvest estimates provided by the 2000 and 2001 telephone-diary surveys were also thought to be implausibly high for many species by the MAFWG.

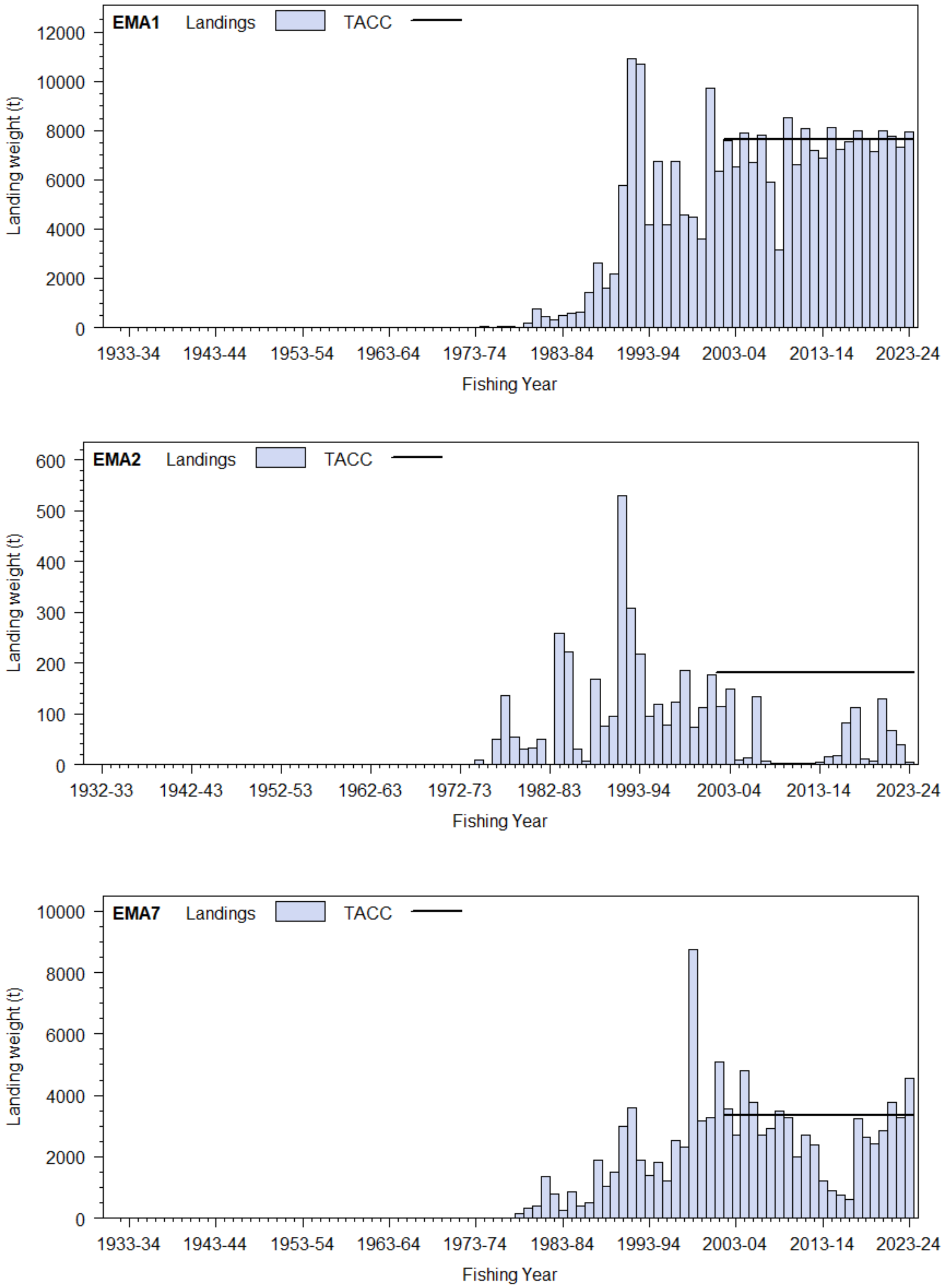


Figure 1: Reported commercial landings and TACC for the three main EMA stocks. From top: EMA 1 (Auckland East), EMA 2 (Central East) and EMA 7 (Challenger to Auckland West).

Concerns about the reliability of these telephone diary surveys and the limited spatial extent at which onsite survey methods can be cost effectively applied led to the development of a rigorously designed National Panel Survey (NPS) for the 2011–12 (1 October–30 September) fishing year (Wynne-Jones et al 2014). This NPS survey used face-to-face interviews of a random sample of 30 390 households to recruit a panel of 7013 fishers and non-fishers for a full year. The panel members were contacted regularly about their fishing activities and catch information was collected in standardised computer-assisted telephone interviews. NPS surveys have subsequently been repeated in 2017–18 and 2022–23 (1 October–30 September) following the same design as used in 2011–12, with face-to-face interview surveys of 34 431 and 36 197 households being used to recruit 6975 and 5625 panellists in each year respectively (Wynne-Jones et al 2019, Heinemann & Gray 2024) (Table 4). Note that national panel survey estimates do not include recreational harvest taken on charter vessel trips or under s111 general approvals (recreational catch from a commercial trip).

Table 4: Recreational harvest estimates for blue mackerel stocks (Wynne-Jones et al 2014, 2019, Heinemann & Gray 2024). Mean weights from boat ramp surveys (Hartill & Davey 2015, Davey et al 2019; 2024).

Stock	Year	Method	Number of fish	Total weight (t)	CV
EMA 1	2011–12	Panel survey	18 438	19.2	0.36
	2017–18	Panel survey	14 686	16.9	0.51
	2022–23	Panel survey	7 940	9.0	0.48
EMA 2	2011–12	Panel survey	3 346	3.5	0.54
	2017–18	Panel survey	1 209	1.3	0.69
	2022–23	Panel survey	6 333	7.1	0.94
EMA 7	2011–12	Panel survey	11 193	11.6	0.43
	2017–18	Panel survey	4 230	4.4	0.46
	2022–23	Panel survey	1 357	1.5	0.63

1.3 Customary non-commercial fisheries

Quantitative information on the current level of customary non-commercial catch is not available.

1.4 Illegal catch

There is no known illegal catch of blue mackerel.

1.5 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, with records from commercial and research catches around the North Island and into Golden Bay and Tasman Bay at the top of the South Island.

By contrast, adults have been recorded around both the North Island and South Island to Stewart Island and across the Chatham Rise almost to the Chatham Islands. Sporadic catches of small numbers of yearling blue mackerel have been made by bottom 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, BoP, South Taranaki Bight, and Kaikōura, but they disappear during winter, when only occasional individuals are found in Northland and the BoP. A possible corollary to this winter disappearance comes from the peak in bycatch of blue mackerel in the winter jack mackerel midwater trawl fishery in EMA 7. This suggests an increased partitioning of the population in deeper water at this time of the year, 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.

Observer data collected in EMA 7 between 1993 and 2019 suggest that blue mackerel spawn from spring into summer (Nov–Feb) (Kienzle 2022). Observer data indicate that sexual maturity is reached at 33 cm fork length and 4.1 years for females (Table 5) and at a smaller size (about 28 cm) and presumably younger age for males (Kienzle 2022).

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 (Crossland 1982), the Hauraki Gulf (Crossland 1981), and the western BoP (Taylor 2002). 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 BoP in EMA 1.

Table 5: Proportion of female blue mackerel mature at age from South Taranaki Bight (EMA 7) (Kienzle 2022).

Sex	Age group (y)	Age (y)	Fraction mature
female	1	0.50	0.01
female	2	1.50	0.03
female	3	2.50	0.10
female	4	3.50	0.29
female	5	4.50	0.61
female	6	5.50	0.86
female	7	6.50	0.96
female	8	7.50	0.99
female	9	8.50	1.00

Blue mackerel otoliths are small, fragile and difficult to age. As a result of between-reader differences in the interpretation of otoliths, Marriot & Manning (2011) documented a protocol for preparing and interpreting blue mackerel otolith sections.

Oxytetracycline marking validated the timing of the first opaque zone in blue mackerel otoliths (Stewart et al 1999). A study attempting to validate the New Zealand age estimation method using lead-radium dating indicated that blue mackerel in New Zealand are a relatively long-lived, small pelagic species, living to at least 17 to 49 years, with the real age most likely nearer the lower value (Marriott et al 2010). Although this range of age estimates is less than desirable for the validation of the growth zone counting method for this species, the findings are consistent with the New Zealand method where otolith ageing studies from commercial catches describe blue mackerel living to at least 24 years. In the purse seine fishery off New South Wales (Australia; Stewart & Ferrell 2001), more than 55% of the fish sampled were aged at 1 year, with a maximum age of 7 years. However, as the NSW fish were aged using whole otoliths, the ages of larger, older blue mackerel may have been underestimated.

Growth parameters estimated from sampling in the Bay of Plenty (Manning et al 2006) are given in Table 6; no evidence was found of statistically significant differences in growth between the sexes. Growth models for blue mackerel have not been updated since the blue mackerel ageing protocol was introduced.

Table 6: von Bertalanffy growth parameters for Bay of Plenty (EMA 1) blue mackerel (Manning et al 2006).

	Males	Females	Both sexes
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

Instantaneous natural mortality (*M*) for blue mackerel was originally estimated using Hoenig's method (Morrison et al 2001). Based on age estimates from otoliths collected during the mid-1980s, when fishing pressure was presumably light, natural mortality estimates of 0.22 yr^{-1} for males and 0.20 yr^{-1} for females were derived. An updated estimate using the median of the prior developed by Hamel &

Cope (2022) suggested natural mortality of 0.225 yr^{-1} for both sexes based on a maximum observed age of 24 years (Middleton et al 2025).

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 BoP; 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, Smith et al (2005) sub-divided blue mackerel into at least three stocks in New Zealand fisheries waters: EMA 1, EMA 2, and EMA 7. No information is currently available on the stock affinity of fish in EMA 3.

4. STOCK ASSESSMENT

4.1 EMA 1

Catch at age sampling of the EMA 1 fishery was carried out in 1997–98 (Morrison et al 2001), and from 2002–03 to 2006–07 (Taylor et al 2014). Despite the introduction of a standardised otolith preparation and reading protocol (Marriott & Manning 2011), there was considerable inter-annual variation in proportions at age and no obvious year class progression. With the conclusion that abundance of blue mackerel could not be monitored using aerial sightings (Taylor 2014), it was considered that an age based assessment of blue mackerel in EMA 1 was not feasible.

Sampling of the purse seine fishery in EMA 1 was carried out in 2022–23 to 2023–24 with the aim of estimating total mortality, *Z*, from age distributions obtained using direct age sampling (Middleton et al 2025). As with previous sampling, there was no clear progression of age classes from 2022–23 to 2023–24 (Figure 2). Chapman-Robson total mortality estimates were similar for the two years of data, whether or not the age samples were corrected for a sampling bias that resulted in undersampling of smaller fish (although bias-correction did affect the estimated age frequencies). The assumed age at full recruitment was, however, influential in the estimates of total mortality .

Noting that the median length of blue mackerel caught in the purse seine fishery tended to be larger in July to December, total mortality estimates were made using samples from that period (without bias correction), with data pooled from sampling in 2023 and 2024. Examination of the ratio of proportion at age in 2024 relative to the proportion in 2023 for age frequencies (across all months) suggested that blue mackerel might be fully recruited to the fishery at about four years of age, although historical age frequencies might indicate an age at full recruitment of up to 7 years of age.

Two-stage bootstrapping, sampling from the available landings then from the fish within a landing, was used to estimate uncertainty in the total mortality estimate. For each of the 1000 bootstrap estimates of *Z*, a value of natural mortality, *M*, was drawn from the natural mortality prior developed by Hamel & Cope (2022). This allowed the probability that the fishing mortality rate, *F*, was less than the F_{MSY} proxy to be estimated (Figure 3).

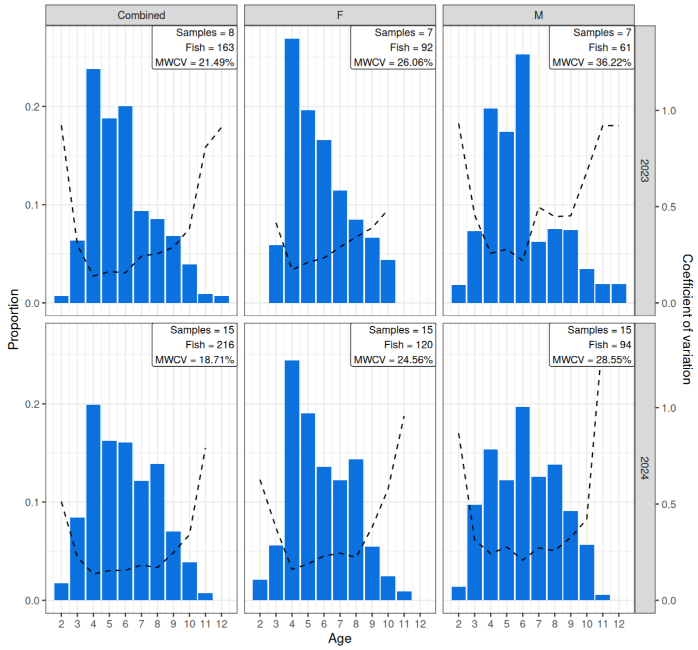


Figure 2: Scaled age frequency distributions by sex and year for male and female blue mackerel sampled from the purse seine fishery in EMA 1 in 2023 and 2024, using the otoliths after subsampling to match the length distribution. The coefficient of variation is calculated analytically, following Gerritsen & McGrath (2007).

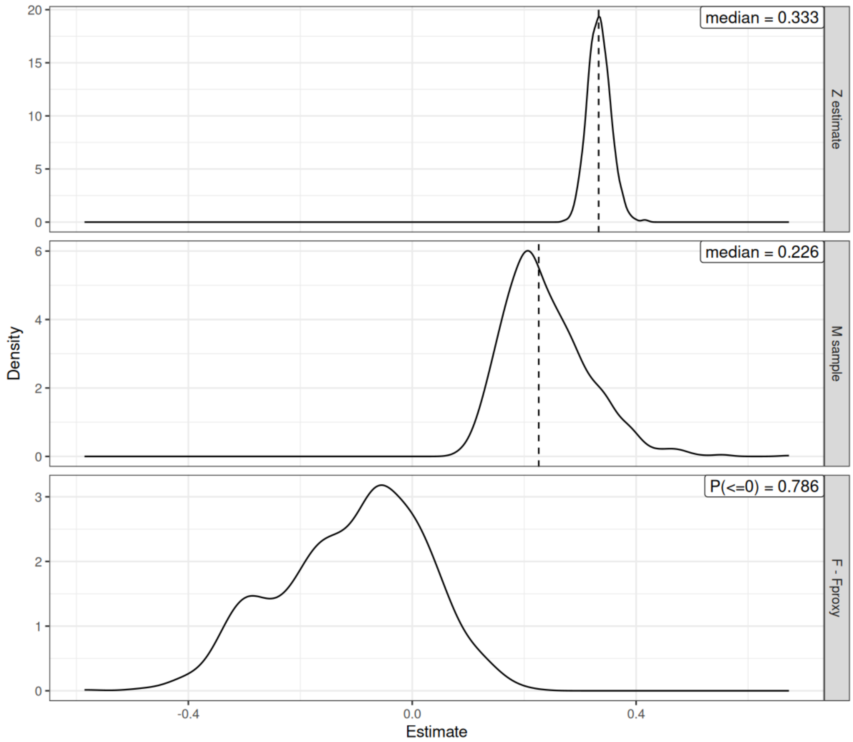


Figure 3: (top panel) the distribution of total mortality estimates estimated using the Chapman Robson estimator for 1000 two-stage bootstrap samples of aged blue mackerel sampled from the EMA 1 purse seine fishery in July to December 2023 and 2024, without length-bias correction; (middle panel) draws from the natural mortality prior for blue mackerel using the prior proposed by Hamel & Cope (2022) and a maximum observed age of 24 years; (bottom panel) the distribution of F - F_{MSY} proxy calculated from the paired Z and M estimates, and with F_{MSY} = 0.87 M (Zhou et al 2012). Medians in the top two panels are indicated by the dashed vertical line.

Establishing B_{MSY}-compatible reference points

Following the approach adopted for *Trachurus novaezealandiae* in JMA 1, the Inshore Fisheries Assessment Working Group adopted $F = 0.87 \times M$ as an F_{MSY} proxy target fishing mortality rate, based on the meta-analysis of Zhou et al (2012). The Harvest Strategy Standard defaults of 20% B_0 and 10% B_0 were adopted for the soft and hard limits respectively.

Because catches had never been higher than current catches, and the current F was less than the F_{MSY} proxy, the Working Group considered that an assessment of status relative to the hard and soft limits, and future status at current catches, was possible.

Future Research Considerations - EMA 1

- Future EMA 1 catch at age sampling for total mortality estimation should target the July – December period.
- The relative benefits of direct random ageing (with weighted bootstrapping of random samples to adjust for length sampling bias) versus use of an age-length key should be considered.
- Re-examine age at full recruitment for Z estimation, and the reliability of the methods that can be used to determine it.
- Historical ageing data for blue mackerel (in both EMA 1 and EMA 7) should be revisited to establish (i) which readings were consistent with the protocol of Marriott & Manning (2011); (ii) a final age estimate for the aged fish. Growth of blue mackerel in EMA 1 and EMA 7 should be re-estimated.
- Having revisited historical age data using the current accepted ageing protocol, calculate Z for historical samples.
- Seasonal and spatial patterns in the size and age of blue mackerel should be investigated to assess likely availability-at-age to the fisheries. This should also draw on a literature review from other relevant fisheries overseas and available domestic aerial sighting data.
- The performance of different estimators of total mortality from catch at age data should be further investigated, with a focus on assessing their performance under catch sampling schemes typically employed in New Zealand, and the resulting effective sample size.
- The performance of management procedures that use total mortality estimates from catch at age should be evaluated.
- Evaluate alternative empirical assessment approaches based on time series of age frequency and/or age-at-length data, for application if there is a substantial risk that availability declines with age.

4.2. EMA 7

Standardised CPUE analyses have provided indices of abundance for blue mackerel in EMA 7 since 2010 (Fu & Taylor 2011), with periodic updates to 2017–18 (Kienzle 2022). A fully quantitative stock assessment, attempted in 2020, was rejected by the Working Group (Kienzle 2022). A revised standardised CPUE analysis (described below) was accepted by the Working Group in 2023; this was updated in 2025 with data to the 2023–24 fishing year.

4.2.1 Estimates of fishery parameters and abundance

Previous CPUE analyses modelled the catch of blue mackerel in jack mackerel target fishing, using estimated catches of EMA and a positive catch standardisation only. A core fleet of vessels with at least three trips in the fishery for a minimum of five years was selected. Data were included from the west coast of the South Island, Taranaki Bight, and west coast of the North Island. Separate analyses were undertaken for 1990 to 1998 and 1997 onwards, presumably due to the significant change in the JMA 7 fleet which saw a transition from vessels using bottom trawls to the current fleet that uses midwater trawls.

In 2023, an updated CPUE analysis was completed using data to the 2021–22 fishing year (Middleton 2025). The series was based on tow by tow (TCEPR and ERS) records of midwater effort targeting either jack or blue mackerels during 1991–92. Estimated catches were scaled to landings on a trip by trip basis. A binomial model was fitted for the occurrence of blue mackerel catch and combined with a model for the magnitude of positive catches to provide the final indices.

A secondary index was calculated based on observer data from the midwater trawl fishery; data selection was similar to the index based on statutory data, but the core fleet selection criteria were reduced to require only one observed trip in a minimum of five years. Nevertheless, because observer coverage of this fishery was lower before the mid-2000s, this index could only be estimated from 2000–01 onwards.

Both series were updated in 2025 using data up to the 2023–24 fishing year (Middleton 2025). The CPUE series using fisher-reported (EMA7 MW MACK event) and observer (EMA7 MW MACK observer) catch and effort data from the midwater trawl fisheries in EMA 7 showed similar trends from the late 2000s; there were larger differences in the early 2000s, a period with lower levels of observer coverage (Figure 4). The main (EMA7 MW MACK event) series suggested higher abundance in the period prior to 2002, dropping substantially between 2001–02 and 2002–03. The observer data series also showed a substantial decrease, but over a longer period and with a slightly later timing (Figure 4).

The Deepwater Working Group accepted the mackerel target, midwater trawl standardised CPUE series using fisher-reported event data (EMA7 MW MACK event) as an index of abundance for blue mackerel in EMA 7 after introduction to the QMS in 2002, but had concerns about the comparability of the index in the pre-QMS period. Reported levels of catch were inconsistent with a ‘fish down’ period resulting in the substantial drop in the index between 2001–02 and 2002–03.

For the period since 2002, the accepted index suggests reduced abundance in the period from 2012 to 2017, which coincides with the period of reduced catches. Abundance increased steadily from 2014 to 2022, with a more substantial increase from 2022 to 2024 that is evident a year earlier in the observer series (Figure 4).

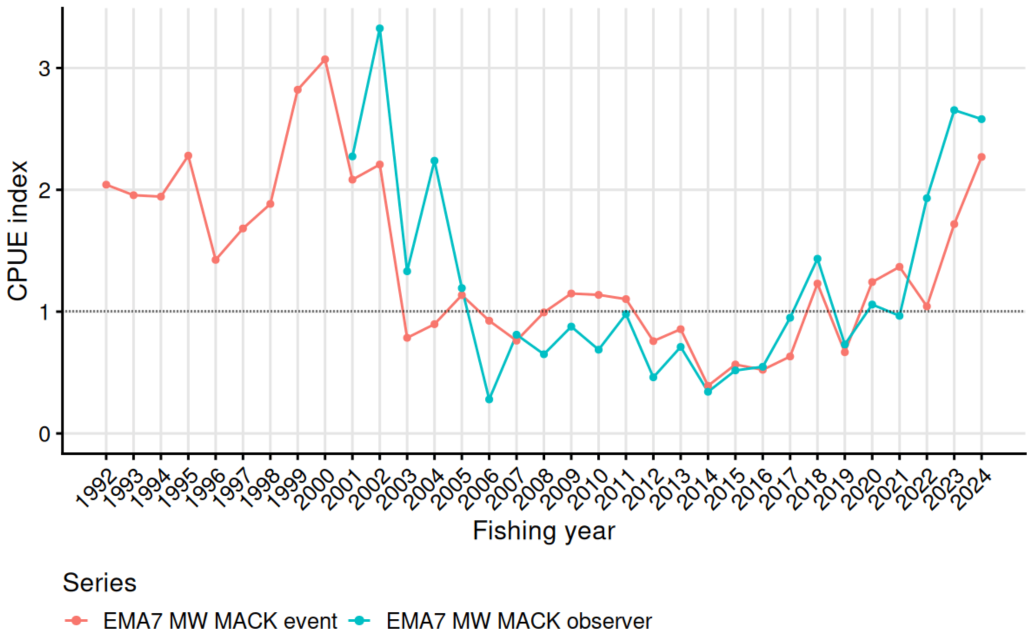


Figure 4: Blue mackerel CPUE during 1992–2024 in EMA 7, using fisher-reported event and observer data (combined binomial/positive indices). Indices have been standardised to have the same geometric mean for the overlapping years. The EMA7 MW MACK event index was accepted as an index of abundance after QMS introduction in 2002 (solid line); the pre-2002 analusis is shown for context (dashed line). Fishing years: 1992 is 1991–92, 1993 is 1992–93, etc.

Establishing B_{MSY}-compatible reference points

In 2023, the Plenary agreed to adopt the period from 2005 to 2010 as a reference period for EMA 7. While discounting the pre-QMS CPUE as comparable with the post-QMS index, the Working Group considered that the potential that abundance was higher in this period provided useful context for the selection of the reference period as a proxy for B_{MSY} (assumed to be 35% B_0 as a medium-productivity species). Catches and abundance were relatively stable over the period 2003 to 2010, but the Working Group proposed, and Plenary agreed, to start the reference period in 2005 to mitigate any impacts associated with the introduction of the TACC from 2002. The soft limit (20% B_0) was set at 4/7 of the mean value for each period and the hard limit (10% B_0) was set at 2/7 of the mean value by period.

Catch-at-age

Biological samples of blue mackerel were most recently collected by observers on board trawlers targeting jack mackerel to estimate an age-length key for 2017–18 (Horn & Ó Maolagáin 2019). This age-length key, and other annual keys estimated in previous years were applied to length frequency distributions to provide estimated age compositions for 2003–04 to 2005–06, 2013–14, and 2017–18 (Horn & Ó Maolagáin 2019). Blue mackerel had ages of between 1 and 25 years. The catch-at-age distributions showed no clear cohort progression and were not consistent from year to year, with 2017–18 being considerably different from earlier years (Figure 5).

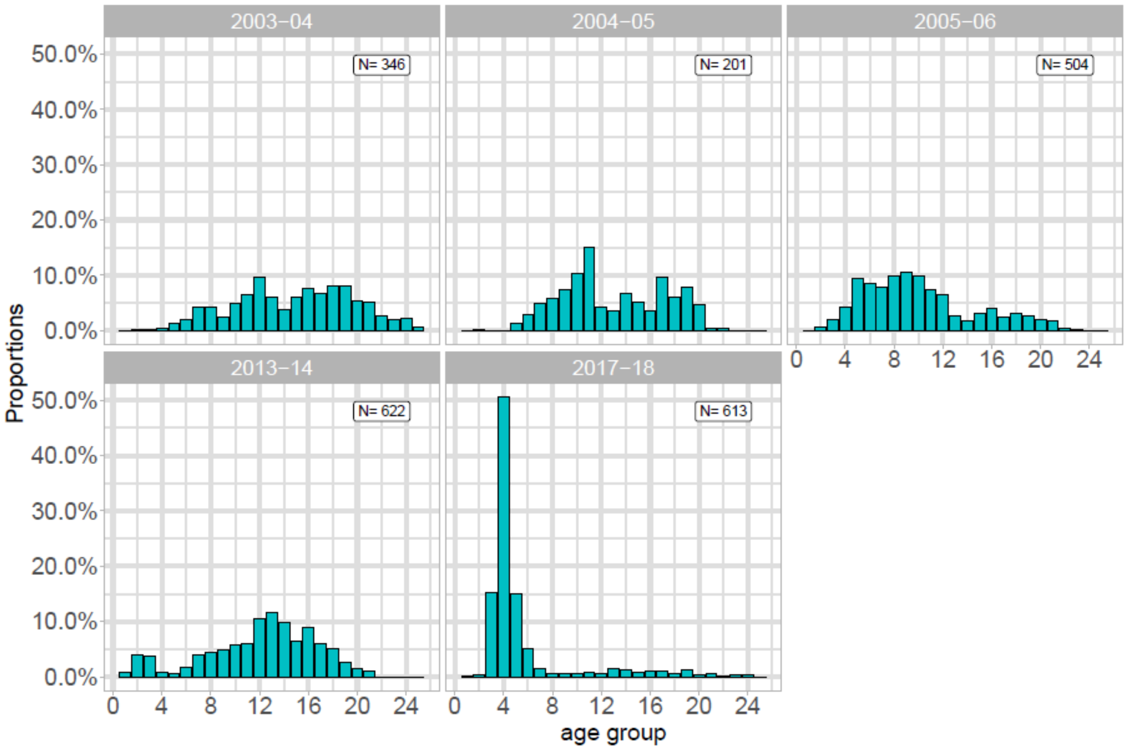


Figure 5: Blue mackerel scaled catch-at-age distributions. The number of age measurements (N) for each year is given in the top right-hand corner of each panel.

Future Research Considerations – EMA 7

- Historical ageing data for blue mackerel (in both EMA 1 and EMA 7) should be revisited to establish (i) which readings were consistent with the protocol of Marriott & Manning (2011); a final age estimate for the aged fish. Growth of blue mackerel in EMA 1 and EMA 7 should be re-estimated.
- Explore CPUE series starting in the 2002–03 fishing year in future analyses, given concerns over the impact of entry into the QMS on data reporting.
- Further explore the CPUE index based on observer data.

- Consider starting the model in 2002–03, if a fully quantitative stock assessment for EMA 7 is attempted in future.
- Undertake comprehensive analysis of the length and age data to determine sampling representativeness and the spatial and temporal patterns in length and age composition. This might include determining the appropriate sample size for annual otolith collection from the fishery.
- Investigate environmental drivers of distribution for EMA, and how these might influence availability to the JMA fishery. Dunn (2022) identified latitudinal shifts potentially related to temperature that should be explored further. There may be merit in conducting an analysis for JMAs and EMA at the same time.

5. STATUS OF THE STOCKS

Based on studies of stock structure within New Zealand waters, blue mackerel may be sub-divided into at least three stocks: EMA 1, EMA 2, and EMA 7. No information is currently available on the stock affinity of fish in EMA 3.

- **EMA 1**

Stock Status		
Most Recent Assessment Plenary Publication Year	2025	
Intrinsic Productivity Level	Medium	
Catch in most recent year of assessment	Year: 2023–24	Catch: 7961 t
Assessment runs presented	Estimates of fishing mortality for 2022–23 and 2023–24 (combined samples from July–December)	
Reference Points	Target(s): F_{MSY} proxy = 0.87×M = 0.196 Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: F_{MSY} proxy = 0.87×M = 0.196	
Status in relation to Target	About As Likely as Not (40–60%) to be at or below the target	
Status in relation to Limits	Unlikely (< 40%) to be below the soft and hard limits	
Status in relation to Overfishing	Overfishing is About As Likely as Not (40–60%) to be occurring	

Historical Stock Status Trajectory and Current Status
-

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	An abundance index for EMA 1 is not available.
Recent Trend in Fishing Mortality or Proxy	-
Trends in other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unlikely (< 40%) for current catch and TACC Hard Limit: Unlikely (< 40%) for current catch and TACC

Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unlikely (<40%) for current catch and TACC

Assessment Methodology and Evaluation		
Assessment Type	Level 2 – Partial Quantitative Stock Assessment	
Assessment Method	Chapman-Robson estimates of total mortality	
Assessment Dates	Latest assessment Plenary publication year: 2025	Next assessment: 2030
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	Age composition from sampling of purse seine landings	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	- No previously accepted assessment	
Major Sources of Uncertainty	- The mortality rate estimates may not represent those experienced by the population of blue mackerel throughout EMA 1 because they were derived using samples that were primarily from purse seine landings taken from the Bay of Plenty (e.g., there may be domed selectivity, which would lead to an overestimate of fishing mortality). - Blue mackerel are difficult to age and ageing error may impact the total mortality estimates.	

Qualifying Comments
The analysis assumed full recruitment at age 4. The Plenary considered there was some evidence full recruitment may be older than this, and that fishing mortality may be underestimated - characterisation of stock status was therefore adjusted to account for this. The analysis was based on the combined 2022–23 and 2023–24 samples from July to December without bias correction in the sampling of age data, but there was some evidence of length bias in the 2023–24 otolith sampling.

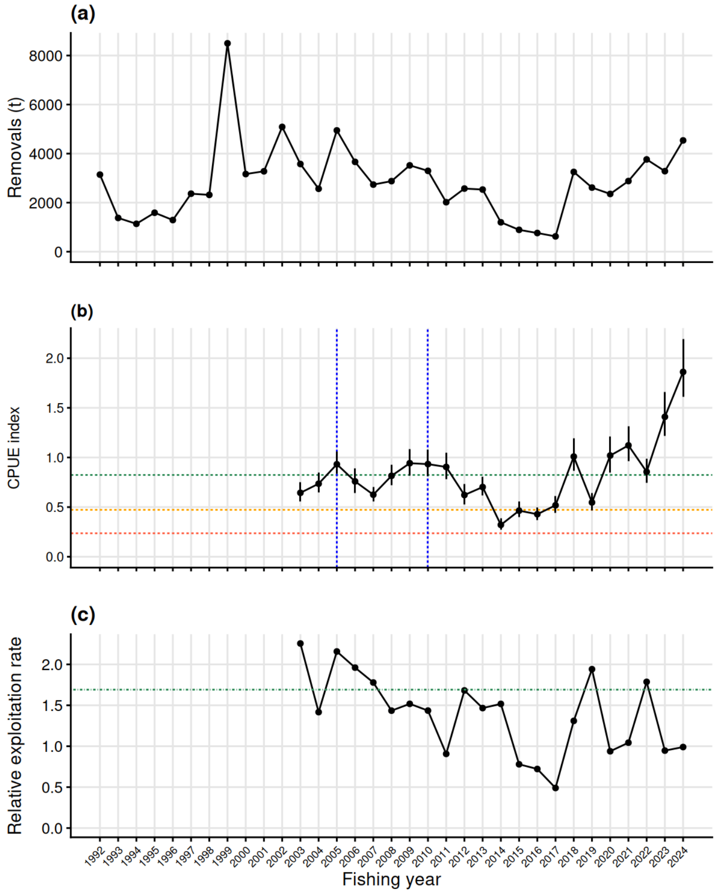
Fishery Interactions
Blue mackerel target purse seining has some bycatch of jack mackerels, kahawai, skipjack and trevally.

- **EMA 7**

Stock Status		
Most Recent Assessment Plenary Publication Year	2025	
Intrinsic Productivity Level	Medium	
Catch in most recent year of assessment	Year: 2023–24	Catch: 4537 t
Assessment Runs Presented	Event resolution CPUE index from mackerel target midwater trawls (EMA7 MW MACK event)	
Reference Points	Management Target: 35% B_0; the geometric mean CPUE for the period 2005–2010 (a conceptual proxy for B_{MSY}) Soft Limit: 20% B_0; scaled from management target Hard Limit: 10% B_0; scaled from management target Overfishing threshold: the mean relative exploitation rate in 2005–2010	

Status in relation to Target	Very Likely (> 90%) to be at or above the target
Status in relation to Limits	Very Unlikely (< 10%) to be be below both the soft and hard limits
Status in relation to Overfishing	Overfishing is Unlikely (< 40%) to be occurring

Historical Stock Status Trajectory and Current Status



(a) Annual removals for EMA 7; (b) the standardised catch per unit effort (CPUE) index with 95% CI, relative to the agreed reference points, for EMA 7 from midwater trawling targeting mackerels; (c) annual relative exploitation rate (catch/CPUE) for blue mackerel in EMA 7. The green, orange, and red dashed lines in (b) represent the interim target, soft limit, and hard limit, respectively. The green dashed line in (c) represents the overfishing threshold.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Biomass has increased more than 5-fold from a low point, near the hard limit, in 2013–14.
Recent Trend in Fishing Intensity or Proxy	Relative exploitation rates have fluctuated, but have generally been below the overfishing threshold since 2007–08.
Other Abundance Indices	A CPUE index calculated using observer data shows similar trends to the main index since the late 2000s.
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Unknown

Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE from the mackerel target midwater trawl fishery	
Assessment Dates	Latest assessment Plenary publication year: 2025	Next assessment: 2026
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Fisher-reported catch, effort and landings data - Observer catch records (used as corroborating index)	1 – High Quality 1 – High Quality
Data not used (rank)	- Proportions at age data from the commercial trawl fishery	2 – Medium or Mixed Quality: lack of year-class tracking
Changes to Model Structure and Assumptions	In 2023: - Combined (binomial/positive catch) model replaced positive catch only model - Use of estimated catches scaled to trip landings rather than raw estimated catches - EMA and JMA target effort included - Series not split in 1998, but new series prior to 2002 not considered comparable to post 2002 series	
Major sources of Uncertainty	- The CPUE index is not considered to be comparable before and after QMS introduction (2002); the reasons for this change in the index are unknown	

Qualifying Comments
Environmental changes may alter the distribution of EMA such that the CPUE index monitors local abundance rather than stock abundance.

Fishery Interactions
There is a small target trawl fishery for blue mackerel off the WCNI but much of the catch is taken as bycatch in the jack mackerel target fishery on the WCSI and WCNI, which has a bycatch of kingfish and snapper. Incidental interactions and associated mortality of common dolphins occur in the jack mackerel fishery but have reduced considerably in recent years (see JMA chapter).

6. FOR FURTHER INFORMATION

Anonymous (2015) Observer manual. New Zealand Ministry for Primary Industries.

Ballara, S (2016) Characterisation analyses for blue mackerel (*Scomber australasicus*) in EMA 1, 2, 3, and 7, 1989–90 to 2013–14. *New Zealand Fisheries Assessment Report 2016/04*. 108 p.

Boyd, R O; Gowing, L; Reilly, J L (2004) 2000–2001 national marine recreational fishing survey: diary results and harvest estimates. (Unpublished draft New Zealand Fisheries Assessment Report for the Ministry of Fisheries project REC2000-03, held by Fisheries New Zealand.) 92 p.

Boyd, R O; Reilly, J L (2004) 1999–2000 National Marine Recreational Fishing Survey: harvest estimates. (Unpublished draft New Zealand Fisheries Assessment Report for the Ministry of Fisheries Project REC9803 held by Fisheries New Zealand.) 28 p.

Bradford, E (1996) A comparison of the 1993-94 diary and boat ramp surveys of recreational fishing in the Ministry of Fisheries North region. New Zealand Fisheries Assessment Research Document 1996/5. 21 p. (Unpublished report held by NIWA library, Wellington.)

Bradford, E (1998) Harvest estimates from the 1996 national marine recreational fishing surveys. New Zealand Fisheries Assessment Research Document 1998/16. 27 p. (Unpublished report held by NIWA library, Wellington.)

Bradford, E; Taylor, P R (1995) Trends in pelagic fish abundance from aerial sightings data. New Zealand Fisheries Assessment Research Document 1995/8. 60 p. (Unpublished report held by NIWA library, Wellington.)

Crossland J. (1981) Fish Eggs and Larvae of the Hauraki Gulf, New Zealand. *Fisheries Research Bulletin No. 23*. 61 p.

Crossland J. (1982) Distribution and Abundance of Fish Eggs and Larvae from the Spring and Summer Plankton of North-east New Zealand, 1976-78. *Fisheries Research Bulletin No. 24*. 59 p.

Davey, N; Hartill, B; Carter, M (2019) Mean weight estimates for recreational fisheries in 2017–18. *New Zealand Fisheries Assessment Report 2019/35*. 32 p.

Davey, N.K.; Johnson, K.S; Maggs, J.Q. (2024). Mean weight estimates for recreational fisheries in 2022–23. *New Zealand Fisheries Assessment Report 2024/28*. 39 p

Dunn, M.R. (2022). Climate change and the distribution of commercially caught marine fish species in New Zealand. Part 1: Spatio-temporal changes since 1989. *New Zealand Aquatic Environment and Biodiversity Report No. 286*. 405 p.

Fu, D (2013) Characterisation analyses for blue mackerel (*Scomber australasicus*) in EMA 1, 2, 3, and 7, 1989–90 to 2009–10. *New Zealand Fisheries Assessment Report 2013/16*. 54 p.

Fu, D; Taylor, P R (2007) Standardised CPUE analysis for blue mackerel (*Scomber australasicus*) in EMA 7, 1989–90 to 2004–05. *New Zealand Fisheries Assessment Report 2007/33*. 33 p.

Fu, D; Taylor, P R (2011) Characterisation and standardised CPUE analyses for blue mackerel (*Scomber australasicus*) in EMA 7, 1989–90 to 2008–09. *New Zealand Fisheries Assessment Report 2011/56*.

Gerritsen, H D; McGrath, D (2007) Precision estimates and suggested sample sizes for length-frequency data. *Fishery Bulletin* 105: 116–121.

Hamel, O S; Cope, J M (2022) Development and considerations for application of a longevity-based prior for the natural mortality rate. *Fisheries Research* 256: 106477.

Hartill, B; Davey, N (2015) Mean weight estimates for recreational fisheries in 2011–12. *New Zealand Fisheries Assessment Report 2015/25*. 37 p.

Heinemann A; Gray, A. (2024) National Panel Survey of Recreational Marine Fishers 2022-23. *New Zealand Fisheries Assessment Report 2024/51*. 116 p.

Horn, P; Ó Maolagáin, C (2019) The length and age composition of the commercial trawl catch of blue mackerel (*Scomber australasicus*) in EMA 7 during the 2017–18 fishing year, with a summary of all available data sets. *New Zealand Fisheries Assessment Report 2019/27*. 15 p.

Kienzle, M (2022) Catch per unit effort standardisation and stock assessment of blue mackerel in EMA 7 to fishing year 2017–18. *New Zealand Fisheries Assessment Report 2022/34. 34 p.*

Langley, A; Anderson, F (1998) Sampling the length and age composition of EMA 1 blue mackerel catches from the 1997–98 target purse seine fishery. (Unpublished research report prepared for Sanford Ltd.)

MacGibbon, D J (2021) Fishery characterisation for blue mackerel, *Scomber australasicus*, in EMA 7, 1989–90 to 2017–18. *New Zealand Fisheries Assessment Report 2021/66.* 71 p.

Manning, M J; Devine, J A; Marriott, P M; Taylor, P R (2007) The length and age composition of the commercial catch of blue mackerel (*Scomber australasicus*) in EMA 1 and EMA 7 during the 2004–05 fishing year. *New Zealand Fisheries Assessment Report 2007/35*. 36 p.

Manning, M J; Marriot, P M; Taylor, P (2006) The length and age composition of the commercial catch of blue mackerel (*Scomber australasicus*) in EMA 1 during the 2002–03 fishing year, including a comparison with data collected during the 1997–98 fishing year, and some remarks on estimating blue mackerel ages from otoliths. *New Zealand Fisheries Assessment Report 2006/42*. 42 p.

Manning, M J; Marriot, P M; Taylor, P R (2007) Length and age composition of the commercial catch of blue mackerel (*Scomber australis*) in EMA 1 and 7 during the 2003–04 fishing year. *New Zealand Fisheries Assessment Report 2007/13.* 41 p.

Marriott, P M; Manning, M J (2011) Reviewing and refining the method for estimating blue mackerel (*Scomber australasicus*) ages*. New Zealand Fisheries Assessment Report 2011/11*.

Marriott, P M; Manning, M J; Andrews, A H (2010) Investigating blue mackerel (*Scomber australasicus*) age-estimation error. (Unpublished Final Research Report for Ministry of Fisheries Research Project EMA2005-02, Objectives 2–3 held by Fisheries New Zealand, Wellington.) 42 p.

Middleton, D A J (2024) Characterisation and CPUE analyses for blue mackerel in EMA 7 to 2022. *New Zealand Fisheries Assessment Report 2024/42*. 153 p.

Middleton, D A J (2025). A rapid update of CPUE for the blue mackerel fishery in EMA 7 to 2024. *New Zealand Fisheries Assessment Report 2025/xx*. xx p.

Middleton, D A J; Cook, D G; Robertson, S (2025) Characterisation of the blue mackerel fishery in EMA 1 and age structure in 2023 and 2024. *New Zealand Fisheries Assessment Report 2025/xx*. xx p.

Millar, R B (2015) A better estimator of mortality rate from age-frequency data. *Canadian Journal of Fisheries and Aquatic Sciences* 72: 364–375.

Morrison, M; Taylor, P; Marriott, P; Sutton, C (2001) An assessment of information on blue mackerel (*Scomber australasicus*) stocks. *New Zealand Fisheries Assessment Report 2001/44*. 26 p.

Parrish, R H; MacCall, A D (1978) Climatic variation and exploitation in the Pacific mackerel fishery. *California Department of Fish and Game Bulletin 167*. 110 p.

Robertson, D A (1978) Blue mackerel, pilchard, anchovy, sprat, saury, and lantern fish. *New Zealand Fisheries Research Division Occasional Publication 15*: 85–89.

Rohde, K (1987) Different populations of *Scomber australasicus* in New Zealand and south-eastern Australia, demonstrated by a simple method using monogenean sclerites. *Journal of Fish Biology 30(6)*: 651–657.

Sette, O E (1950) Biology of the Atlantic mackerel (*Scomber scombrus*) of North America. Part II. Migrations and habits. *Fishery Bulletin of the United States Fish and Wildlife Service 51(49)*: 251–358.

Shaun-ror, W (1970) Age and growth of Taiwan spotted mackerel, *S. australasicus*. (MSc Thesis, Department of Zoology, National Taiwan University.) 38 p. [In Chinese].

Smith, P J; Diggles, B; Kim, S (2005) Stock structure of blue mackerel, *Scomber australasicus*. *New Zealand Fisheries Assessment Report 2005/43*. 38 p.

Stevens, J D; Hausfeld, H F; Davenport, S R (1984) Observations on the biology, distribution and abundance of *Trachurus declivis*, *Sardinops neopilchardus* and *Scomber australasicus* in the Great Australian Bight. *Report (CSIRO Marine Laboratories) No. 164*. 29 p.

Stewart, J; Ferrell, D J (2001) Age, growth, and commercial landings of yellowtail *(Trachurus novaezelandiae)* and blue mackerel *(Scomber australasicus)* off the coast of New South Wales, Australia. *New Zealand Journal of Marine and Freshwater Research 35*: 541–551.

Stewart, J; Ferrell, D J; Andrew, N L (1998) Ageing yellowtail (*Trachurus novaezelandiae*) and blue mackerel (*Scomber australasicus*) in New South Wales. *New South Wales Fisheries Final Report Series No. 3.* 59 p.

Stewart, J; Ferrell, D J; Andrew, N L (1999) Validation of the formation and appearance of annual marks in the otoliths of yellowtail *(Trachurus novaezelandiae)* and blue mackerel *(Scomber australasicus)* in New South Wales. *Australian Journal of Marine and Freshwater Research 50*: 389–395.

Taylor, P R (2002) A summary of information on blue mackerel (*Scomber australasicus*), characterisation of its fishery in QMAs 7, 8, and 9, and recommendations on appropriate methods to monitor the status of its stock. *New Zealand Fisheries Assessment Report 2002/50*. 68 p.

Taylor, P R (2008) Factors affecting fish size and landed volumes in the purse-seine and TCEPR charter-boat fisheries in 2004–05 and 2005–06. *New Zealand Fisheries Assessment Report 2008/32*. 17 p.

Taylor, P R (2014) Developing indices of relative abundance from observational aerial sightings of inshore pelagic finfish; Part 1, exploring the data. *New Zealand Fisheries Assessment Report 2014/34*. 66 p.

Taylor, P R; Smith, M H; Marriott, P; Sutton, C (2014) The length and age composition of the commercial catch of blue mackerel (Scomber australasicus) in EMA 1 during the 2006–07 fishing year. *New Zealand Fisheries Assessment Report 2014/36*. 29 p.

Wright, P; Gowing, L; McClary, D; Boyd, R O (2004) 2000–2001 National Marine recreational fishing survey: direct questioning of fishers compared with reported diary data. Final Research report of Ministry of Fisheries Research Project REC2000-01: Objective 2. 28 p. (Unpublished report held by Fisheries New Zealand, Wellington.)

Wynne-Jones, J; Gray, A; Heinemann, A; Hill, L; Walton, L (2019) National Panel Survey of Marine Recreational Fishers 2017–2018. *New Zealand Fisheries Assessment Report 2019/24*. 104 p.

Wynne-Jones, J; Gray, A; Hill, L; Heinemann, A (2014) National Panel Survey of Marine Recreational Fishers 2011–12: Harvest Estimates. *New Zealand Fisheries Assessment Report 2014/67*. 139 p.

Zhou, S; Yin, S; Thorson, J T; Smith, A D; Fuller, M (2012) Linking fishing mortality reference points to life history traits: an empirical study. *Canadian Journal of Fisheries and Aquatic Sciences* 69: 1292–1301.