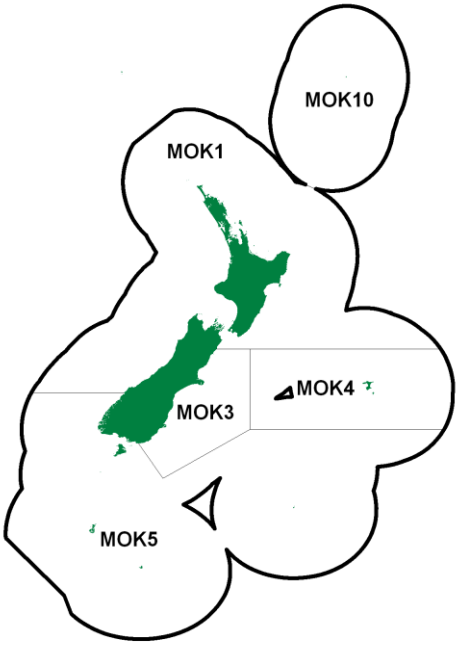
BLUE MOKI (MOK)

(*Latridopsis ciliaris*)
Moki



1. FISHERY SUMMARY

1.1 Commercial fisheries

Most blue moki landings are taken by setnet or trawl on the east coast between the Bay of Plenty (BoP) and Kaikoura, although small quantities are taken in most New Zealand coastal waters. While the proportions of the total commercial landings taken by setnet and trawl have varied over time, setnetting has been the predominant method (60%) since 1979.

Blue moki stocks appeared to have been seriously depleted by fishing prior to 1975 and this resulted in the sum of allocated ITQs being markedly less than the sum of the catch histories. Landings of blue moki peaked in 1970 and 1979 at about 960 t. Since 1993–94, total landings have been around 500 t i.e., approximately 100 t below the aggregated TACC. Reported landings and TACCs are given in Tables 1 and 2, while an historical record of landings and TACC values for the two main MOK stocks are depicted in Figure 1.

Table 1: Total reported landings (*t*) of blue moki from 1979 to 1985–86.

Year	1979*	1980*	1981*	1982*	1983†	1983–84†	1984–85†	1985–86†
Landings	957	919	812	502	602	766	642	636

*MAF data.
†FSU data.

Total annual landings of blue moki were substantially constrained when it was introduced into QMS. In MOK 1, landings increased as the TACC was progressively increased. Since the TACC was set at 400 t (1995–96) landings have fluctuated around the TACC, which was subsequently increased to 403 t in 2001–02.

1.2 Recreational fisheries

Popular with recreational fishers, blue moki are taken by beach anglers, setnetting and spearfishing. Annual estimates of recreational harvest were obtained from diary surveys in 1991–94, 1996 and 1999–2000 (Tables 3 and 4).

Table 2: Reported landings (t) and actual TACCs (t) of blue moki by Fishstock from 1986–87 to 2013–14. Source – QMS data. MOK 10 is not tabulated; no landings have ever been reported from MOK 10.

Fishstock	MOK 1		MOK 3		MOK 4		MOK 5			
FMA (s)	1,2,7,8,9		3		4		5 & 6		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1986–87	109	130	52	60	0	20	3	40	164	260
1987–88	183	142	95	62	0	20	2	40	280	274
1988–89	134	151	121	64	0	20	3	40	258	285
1989–90	202	156	89	65	11	25	1	43	303	299
1990–91	264	157	93	71	1	25	2	43	360	306
1991–92	285	157	66	71	2	25	2	43	355	306
1992–93	289	157	94	122	1	25	4	43	388	358
1993–94	374	200	102	126	4	25	5	43	485	404
1994–95	418	200	90	126	< 1	25	3	43	511	404
1995–96	435	400	91	126	1	25	3	43	530	604
1996–97	408	400	66	126	2	25	3	43	479	604
1997–98	416	400	78	126	3	25	2	43	500	604
1998–99	468	400	78	126	< 1	25	4	43	551	604
1999–00	381	400	56	126	1	25	5	43	443	604
2000–01	420	400	67	126	5	25	6	43	499	604
2001–02	365	403	77	127	8	25	2	44	451	608
2002–03	380	403	87	127	2	25	6	44	475	608
2003–04	372	403	60	127	2	25	6	44	440	608
2004–05	418	403	70	127	3	25	11	44	502	608
2005–06	408	403	69	127	1	25	5	44	483	608
2006–07	402	403	90	127	< 1	25	11	44	504	608
2007–08	401	403	125	127	< 1	25	8	44	533	608
2008–09	413	403	103	127	1	25	8	44	525	608
2009–10	386	403	129	127	< 1	25	6	44	521	608
2010–11	421	403	144	127	< 1	25	10	44	574	608
2011–12	427	403	137	127	< 1	25	6	44	571	608
2012–13	385	403	159	127	< 1	25	5	44	549	608
2013-14	393	403	134	127	<1	25	7	44	535	608

Table 3: Estimated number and weight of blue moki harvested by recreational fishers by Fishstock and survey. Surveys were carried out in different years in the MAF Fisheries regions: South in 1991–92, Central in 1992–93 and North in 1993–94 (Teirney et al 1997).

Fishstock	Survey	Number	CV(%)	Survey harvest (t)
MOK 1	North	6 000	-	5–15
MOK 1	Central	38 000	28	40–80
MOK 1	South	2 000	-	0–5
MOK 3	South	31 000	33	40–70
MOK 5	South	7000	33	5–15

Table 4: Estimates of annual number and weight of blue moki harvested by recreational fishers from national diary surveys in 1996 (Bradford 1998) and Dec1999–Nov 2000 (Boyd & Reilly 2005). The mean weights used to convert numbers to catch weight are considered the best available estimates. Estimated harvest is also presented as a range to reflect the uncertainty in the point estimates.

Fishstock	Number caught	CV	Estimated harvest range (*t*)	Point estimate (*t*)
				1996
MOK 1	63 000	14	80–110	93
MOK 3	16 000	18	20–30	24
MOK 5	9000	-	-	-
				1999–2000
MOK 1	81 000	37	82–180	131
MOK 3	36 000	32	36–70	53
MOK 5	38 000	89	7–115	61

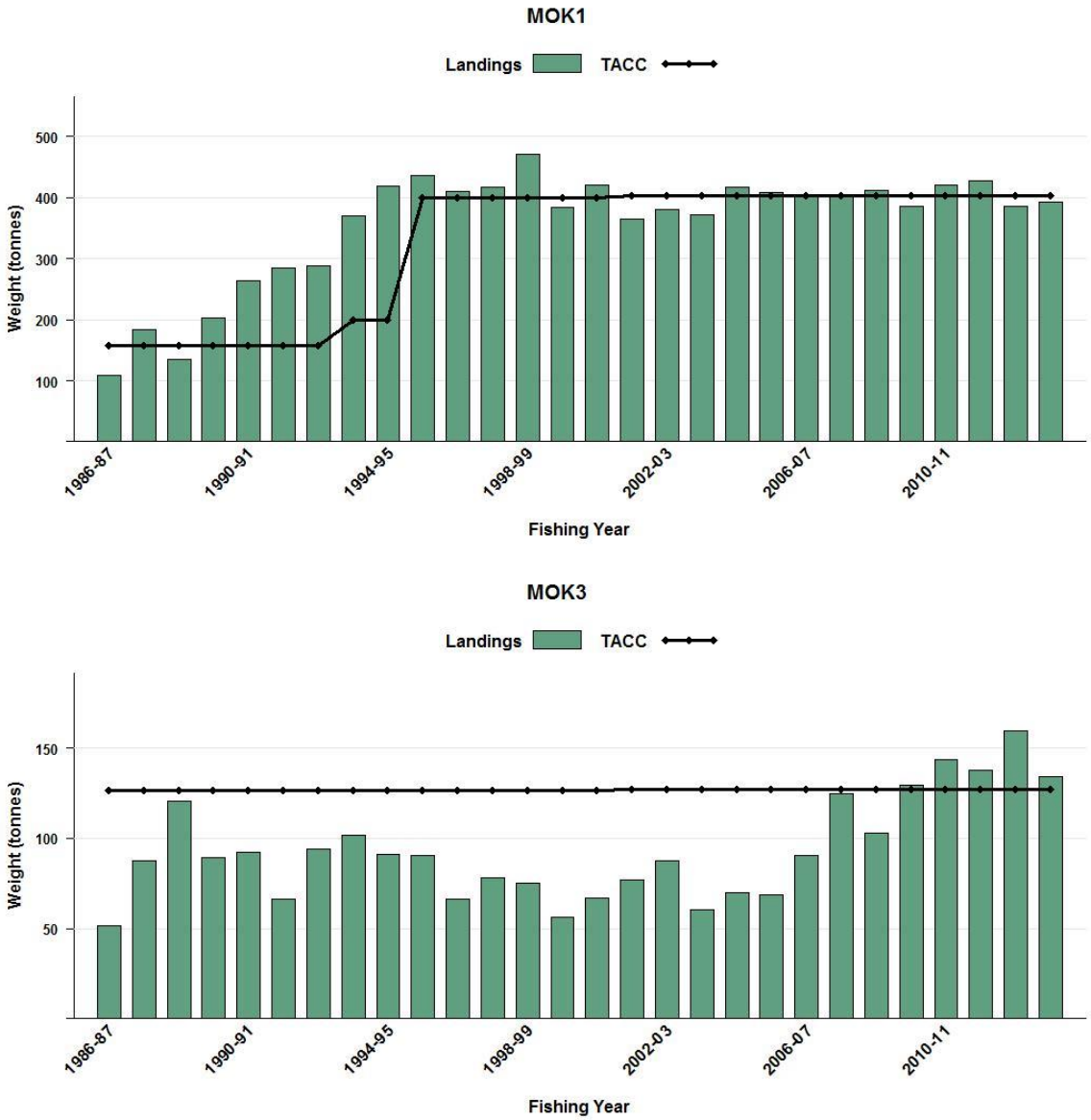


Figure 1: Reported commercial landings and TACC for the two main MOK stocks. Left to right: MOK 1 (Auckland, Central, and Challenger) and MOK 3 (South East Coast). Note: these figures do not show data prior to entry into the QMS.

The MOK 1 recreational harvest estimated during the 1999–2000 survey was around a third (34%) of the commercial catch during that period. However, the Recreational Technical Working Group concluded 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.

1.3 Customary non-commercial fisheries

A traditional Maori fishery exists in some areas, particularly the eastern BoP and East Cape regions. No quantitative information is available on the level of customary non-commercial catch.

Iwi in the Cape Runaway area have a strong view that blue moki are of special significance in the history and life of the community. They believe that blue moki come to spawn in the waters around Cape Runaway and there are traditional fishing grounds, where in earlier years fishing took place in accordance with customary practices. In addition, these local Iwi consider the taking of blue moki by nets in this area to be culturally offensive.

Since September 1996, fishing by the methods of trawling, Danish seining and setnetting has been prohibited at all times within a two nautical-mile wide coastal band beginning at the high water mark and extending from Cape Runaway to a stream tributary at Oruiti Beach. Note this is not a legal description, for full details please refer to the Fisheries Act (Auckland and Kermadec Areas Commercial Fishing Regulations 1986, Amendment No. 13).

1.4 Illegal catch

No quantitative estimates are available.

1.5 Other sources of mortality

Some blue moki caught for use as rock lobster bait have not been reported. While little information is available, this practice appears to have been most common in Stewart Island and the Chatham Islands, and may have accounted for about 45 t and 60 t in Stewart and Chatham respectively in the past. The use of blue moki as bait has not been considered in the determination of *MCY*.

2. BIOLOGY

Blue moki grow rapidly at first, attaining sexual maturity at 40 cm fork length (FL) at 5–6 years of age. Growth then slows, and fish of 60 cm FL are 10–20 years old. Fish over 80 cm FL and 43 years old have been recorded (Manning et al 2009).

Many adults take part in an annual migration between Kaikoura and East Cape. The migration begins off Kaikoura in late April/May as fish move northwards. Spawning takes place in August/September in the Mahia Peninsula to East Cape region (the only known spawning ground), with the fish then returning south towards Kaikoura. The larval phase for blue moki lasts about 6 months.

Juvenile blue moki are found inshore, usually around rocky reefs, while most adults school offshore over mainly open bottom. Some adults do not join the adult schools but remain around reefs.

Biological parameters relevant to the stock assessment are shown in Table 5.

Table 5: Estimates of biological parameters for blue moki.

Fishstock	Estimate	Source
1. Natural mortality (*M*)		
All areas	0.14	Francis (1981b)
For maximum observed age of 33 yr.		
MOK 1	0.10	Manning et al (2009)
For maximum observed age of 44 yr.		

2. Weight = a(length)^b (Weight in g, length in cm fork length).

	Both sexes	
	a	b
All areas	0.055	2.713

Source: Francis (1979)

3. von Bertalanffy growth parameters

	Both sexes		
	L_∞	k	t_0
All areas	66.95	0.208	-0.029

Source: Francis (*pers. comm.*)

The estimate of natural mortality, given a maximum age of 43 years and using the equation $M = \log_e 100$/maximum age, is 0.1. Note maximum age for this calculation is meant to be the maximum age that 1% of the unfished population will reach, however, as this is not known, the maximum observed age was used here.

3. STOCKS AND AREAS

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

Blue moki forms one stock around the North Island and the South Island north of Banks Peninsula. No information is available to indicate stock affiliations of blue moki in other areas (southern South Island and Chatham Rise) so these fish are currently divided into three Fishstocks.

4. STOCK ASSESSMENT

There are no new data which would alter the yield estimates given in the 1996 Plenary Report. The yield estimates are based on commercial landings data only and have not changed since the 1992 Plenary Report.

4.1 Estimates of fishery parameters and abundance

Standardised CPUE analyses (using both loglinear indices of non-zero catches and negative binomial indices or the proportion of zero catches) were undertaken for blue moki caught in four separate fisheries operating between Banks Peninsula and East Cape: blue moki setnet fishery, blue warehou setnet fishery, tarakihi setnet fishery and tarakihi bottom trawl fishery (Langley & Walker 2004).

Setnet CPUE trends, particularly those for the target component, proved to be the most promising candidates for future monitoring of the fishery. However, because of the poor quality of the data collected up to 2002 the current trends were not thought to track abundance. The recently implemented setnet data-form requires higher spatial resolution of catch and effort data, thus promising to provide data of sufficient quality to monitor the fishery in the future.

Estimates of total mortality (Z) for MOK 1 were obtained from catch curve analysis of catch sampling data collected during 2004–05 and 2005–06. Samples were taken from both the target setnet fishery and from bycatch from the TAR 2 trawl fishery. When data were pooled across the two years, sexes and fishing methods, Z estimates ranged from 0.11 to 0.14, depending on assumed age-at-full recruitment (ages 4–12 years were tested). Assuming a value of natural mortality of 0.10 (based on a maximum age of 44 years), this suggests that recent fishing mortality is likely to be in the range of about 0.01 to 0.04. The Working Group considered that the most plausible age-at-full recruitment was 8 years. The estimate of Z and the bootstrapped 95% confidence intervals were 0.14 (0.12–0.16), giving rise to a F estimate of 0.04 (0.02–0.06). These estimates are well below the current assumed value of natural mortality (Manning et al 2009).

4.2 Biomass estimates

Estimates of current and reference biomass are not available.

4.3 Yield estimates and projections

MCY for all Fishstocks combined was estimated using the equation, $MCY = cY_{AV}$ (Method 4). The national catch, and probably effort, over the period 1961–86 varied considerably (annual landings ranged from 450 to 957 t with an average value of 705 t). However, no clear trend in landings over that period is apparent. The value of c was set equal to 0.9 based on the estimate of $M = 0.14$.

$$MCY = 0.9 * 705 \text{ t} = 635 \text{ t}$$

The level of risk to the stock by harvesting the population at the estimated *MCY* value cannot be determined.

Yield estimates for blue moki have been made using reported commercial landings data only and therefore apply specifically to the commercial fishery. Blue moki have been caught and used as bait and not reported. Therefore, the *MCY* estimates are likely to be conservative.
No estimate of *CAY* is available for blue moki stocks.

4.4 Other factors

CPUE data from the 1970s for the main northern blue moki stock indicated that the stock had declined to a level low enough to make recruitment failure a real concern. The 1986–87 TAC was set at a level considered low enough to enable some stock rebuilding. An analysis of MOK 1 CPUE data indicates that annual catch rates remained relatively constant between 1989–90 and 1993–94, despite an increase in the total commercial catch during the same period.

Blue moki forms one stock around the North Island and the east coast of the South Island north of Banks Peninsula. As other stock boundaries are unknown, any interdependence is uncertain. If only one stock exists, then blue moki from the southern waters may be moving north and rebuilding the heavily exploited northern population.

5. STATUS OF THE STOCKS

Stock Structure Assumptions

Blue moki forms one stock around the North Island and the South Island north of Banks Peninsula. The bulk of the commercial catch is taken off the east coast between Banks Peninsula and East Cape, suggesting that this is where most of the blue moki stock resides.

MOK 1&3

Stock Status	
Year of Most Recent Assessment	2008
Assessment Runs Presented	
Reference Points	Target: Not established but $F = M$ assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0
Status in relation to Target	F is Very Likely (> 90%) to be below M
Status in relation to Limits	Soft Limit: Unlikely Hard Limit: Unlikely (< 40%) to be below
Historical Stock Status Trajectory and Current Status	-

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	-
Recent Trend in Fishing Mortality or Proxy	Low estimates of fishing mortality in 2005–06 and stable catches over the previous 14 years suggest that fishing mortality has been low for more than two decades.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Catch curve analysis from recent catch sampling (2004–05 and 2005–06) indicates that total mortality is low, with fishing mortality well below natural mortality. The fishery is comprised of fish across a broad range of ages across both sexes. Given that the MOK 1 catch has been fairly stable since 1993–94, and that catches have been near the TACC since 1995–96, stock size is Likely (> 60%) to remain above the limit reference points under current catches and TACCs, in the short to medium term.

Probability of Current Catch or TACC causing decline below Limits	Soft Limit: Unknown Hard Limit: Unlikely (< 40%)

Assessment Methodology		
Assessment Type	Level 2 - Partial Quantitative stock assessment	
Assessment Method	Estimates of total mortality using Chapman-Robson estimator	
Main data inputs	-Age structure of setnet and trawl catches of blue moki made between Kaikoura and East Cape in 2004–05 and 2005–06 -Instantaneous rate of natural mortality (*M*) of 0.10 based on a maximum age of 44 years	
Period of Assessment	Latest assessment: 2008	Next assessment: 2017
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	Uncertainty in the estimate of *M*	

Qualifying Comments
-
Fishery Interactions
-

Yields and reported landings are summarised in Table 6.

Table 6: Summary of yields (t), TACCs (t), and reported landings (t) for blue moki for the most recent fishing year.

Fishstock	QMA	*MCY*	2013–14 Actual TACC	2013–14 Reported landings
MOK 1	Auckland (East) (West), Central (East) (West), Challenger 1, 2, 7, 8 & 9	-	403	385
MOK 3	South East (Coast) 3	-	127	159
MOK 4	South East (Chatham) 4	-	25	< 1
MOK 5	Southland, Sub-Antarctic 5 & 6	-	44	5
MOK 10	Kermadec 10	-	10	0
Total		635	608	549

6. FOR FURTHER INFORMATION

Boyd, R O; Reilly, J L (2005) 1999/2000 National marine recreational fishing survey: harvest estimates. Final Research Report for Ministry of Fisheries Research Project REC9803. (Unpublished report held by Ministry for Primary Industries, 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 document held by NIWA library, Wellington.)

Colman, J A; McKoy, J L; Baird, G G (Comp. & Ed.) (1985) Background papers for the 1985 Total Allowable Catch recommendations. Fisheries Research Division, New Zealand Ministry of Agriculture and Fisheries. 259 p. (Unpublished report, held by NIWA library, Wellington).

Francis, M P (1979) A biological basis for the management of New Zealand moki (*Latridopsis ciliaris*) and smoothhound (*Mustelus lenticulatus*) fisheries. (Unpublished MSc thesis, University of Canterbury, Christchurch, New Zealand).

Francis, M P (1981a) Spawning migration of moki (*Latridopsis ciliaris*) off eastern New Zealand. *New Zealand Journal of Marine and Freshwater Research* 15: 267–273.

Francis, M P (1981b) Age and growth of moki, *Latridopsis ciliaris* (Teleostei: Latridae). *New Zealand Journal of Marine and Freshwater Research* 15: 47–49.

Horn, P (1988) Blue moki. New Zealand Fisheries Assessment Research Document 1988/10. 11 p. (Unpublished document held by NIWA library, Wellington.)

Langley, A D; Walker, N (2004) Characterisation of the blue moki (*Latridopsis* ciliaris) fishery and recommendations for future monitoring of the MOK 1 Fishstock. *New Zealand Fisheries Assessment Report* 2004/33. 77 p.

Manning, M J; Stevenson, M L; Dick, C M (2009) The length and age composition of the commercial catch of blue moki (*Latridopsis ciliaris*) in MOK 1 during the 2004/05 and 2005/06 fishing years including total and fishing mortality estimates. *New Zealand Fisheries Assessment Report* 2010/34. 65 p.

Teirney, L D; Kilner, A R; Millar, R E; Bradford, E; Bell, J D (1997) Estimation of recreational catch from 1991/92 to 1993/94 New Zealand Fisheries Assessment Research Document 1997/15. 43 p. (Unpublished document held by NIWA library, Wellington