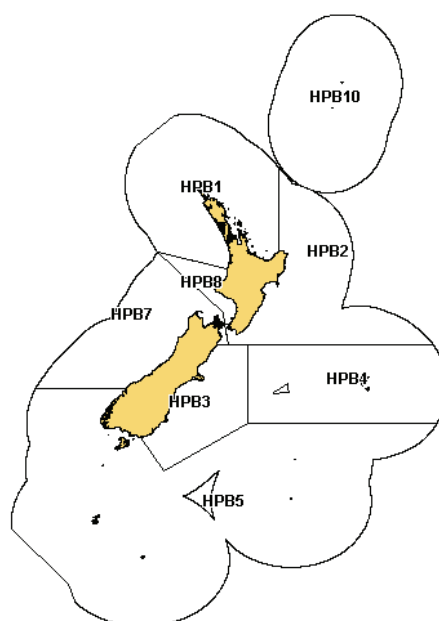


GROPER (HPB)

(*Polyprion oxygeneios*, *Polyprion americanus*)
Hapuku, Moeone

**1. FISHERY SUMMARY****1.1 Commercial fisheries**

Both groper species, *Polyprion oxygeneios* (hapuku) and *P. americanus* (bass), occur in shelf and slope waters of the New Zealand mainland and offshore islands, from the Kermadecs to the Auckland Islands. The groper fishery takes both species, but in different proportions by region, depth, fishing method and season, and these have changed over time. Reported catches generally do not distinguish between species, and published data combine them. In earlier years, bluenose (*Hyperoglyphe antarctica*) landings were sometimes also combined with groper. In this document, groper is used as collective term for hapuku and bass.

Table 1: Reported total New Zealand landings (t) of groper from 1948 to 1983.

Year	Landings	Year	Landings	Year	Landings	Year	Landings
1948	1 665	1957	1 368	1966	1 222	1975	1 422
1949	1 969	1958	1 532	1967	1 314	1976	1 512
1950	1 709	1959	1 310	1968	1 073	1977	1 942
1951	1 396	1960	1 223	1969	1 122	1978	1 488
1952	1 430	1961	1 203	1970	1 499	1979	2 078
1953	1 403	1962	1 173	1971	1 346	1980	2 435
1954	1 364	1963	1 194	1972	1 120	1981	2 379
1955	1 305	1964	1 370	1973	1 312	1982	2 218
1956	1 399	1965	1 249	1974	1 393	1983	2 511

Reported foreign catches are included from 1974.
Source: MAF data.

The main fishery comprises a number of domestic fishers working small to medium sized vessels – longliners, setnetters and trawlers, at a variety of depths (according to method) out to 500 m (Paul 2002a). Over 90% of early (to 1950) total groper catches were taken by longline. Trawl catches rose from 5–10% during this period to 20–30% by the late 1970s. A setnet fishery developed in the late 1970s and early 1980s, mainly at Kaikoura, taking 14% in 1983 and then subsequently declining.

From 1950 to the mid 1980s, line-fishing took 70–80% of the catch. After the introduction of the QMS, the proportion of the catch taken by lines appeared to drop.

The Cook Strait region has always supported the main groper fishery, followed by the Canterbury Bight; both show the same slow decline from 1949 to 1986 (equivalent regional data from subsequent years are not available). Northland, Bay of Plenty and Hawke Bay fisheries developed at different rates during the 1960s and 1970s. In most other areas, the groper fishery has been small and/or variable.

The first recorded landings of about 1500 t in 1936 were generally typical of the range of catches (1000–2000 t) from then until 1978. After a decrease during the war years when effort was restricted, landings in the total fishery slowly declined from almost 2000 t in 1949 to about 1300 t in the mid 1970s. They then increased sharply to 2700 t in 1983–84 (Tables 1 and 2). Figure 1 shows the historical landings and TACC values for the main HPB stocks.

Landings and TACCs for all Fishstocks are given in Table 2. Total landings of groper were relatively stable throughout the mid 1990s, remaining below 1500 t until 1998–99. From 1999–2000 and onwards, catches have generally ranged between 1500 t and 1700 t. Although the TACC in HPB 3 has been exceeded in recent years, catches have generally remained within the quotas for individual Fishstocks. Despite recent increases in total landings, they have never exceeded the TAC.

For the 1991–92 fishing year the conversion factor for headed and gutted groper was increased from 1.40 to 1.45, for fish landed in this state (about 75% of the total), this will result in a reduction in removals from the stock of 3.5% for the same nominal quota.

Table 2: Reported landings (t) of groper by Fishstock from 1983–84 to 2007–08 and actual TACs (t) from 1986–87 to 2007–08. QMS data from 1986–present.

Fishstock QMA (s)	HPB 1 1 & 9		HPB 2 2		HPB 3 3		HPB 4 4		HPB 5 5 & 6	
	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC
1983–84*	974	–	493	–	505	–	55	–	395	–
1984–85*	642	–	388	–	418	–	52	–	228	–
1985–86*	569	–	270	–	391	–	53	–	126	–
1986–87	238	360	179	210	260	270	42	300	131	410
1987–88	248	388	202	219	268	286	43	315	91	414
1988–89	231	405	187	248	259	294	49	315	70	425
1989–90	310	465	179	263	283	318	40	322	127	430
1990–91	350	480	225	263	311	326	77	323	120	436
1991–92	277	480	252	263	298	326	58	323	112	446
1992–93	375	480	273	264	299	327	68	323	128	446
1993–94	363	480	287	264	306	330	90	323	147	446
1994–95	334	481	259	264	274	335	149	323	161	451
1995–96	335	481	214	264	321	335	173	323	144	451
1996–97	331	481	234	264	301	335	131	323	149	451
1997–98	375	481	260	266	329	335	88	323	91	451
1998–99	433	481	256	266	348	335	121	323	97	451
1999–00	471	481	229	266	385	335	66	323	169	451
2000–01	450	481	220	266	381	335	45	323	188	451
2001–02	427	481	226	266	343	335	82	323	169	451
2002–03	442	481	273	266	350	335	79	323	212	451
2003–04	433	481	281	266	335	335	87	323	166	451
2004–05	433	481	263	266	371	335	147	323	208	451
2005–06	425	481	280	266	406	335	185	323	167	451
2006–07	483	481	243	266	394	335	222	223	157	451
2007–08	439	481	253	266	341	335	241	223	138	451
	HPB 7 7		HPB 8 8		HPB 10 10		Total			
	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC		
1983–84*	174	–	46	–	0	–	2 698	–		
1984–85*	207	–	33	–	0	–	2 039	–		
1985–86*	199	–	25	–	0	–	1 697	–		
1986–87	149	210	35	60	0	10	1 036	1 830		
1987–88	158	215	66	76	0	10	1 076	1 923		
1988–89	132	226	39	78	1	10	968	2 001		
1989–90	119	229	43	80	0	10	1 098	2 117		
1990–91	128	235	48	80	23#	10	1 282	2 153		
1991–92	175	235	50	80	83#	10	1 319	2 163		
1992–93	186	236	62	80	22#	10	1 405	2 165		
1993–94	193	236	69	80	0	10	1 455	2 167		
1994–95	192	236	68	80	0	10	1 437	2 179		
1995–96	214	236	78	80	0	10	1 479	2 179		

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Table 2 continued:

	HPB 7		HPB 8		HPB 10		Total	
	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC
1996-97	186	236	71	80	15	10	1 418	2 179
1997-98	147	236	60	80	33#	10	1 406	2 181
1998-99	218	236	78	80	3#	10	1 562	2 181
1999-00	165	236	65	80	0#	10	1 561	2 181
2000-01	171	236	64	80	0#	10	1 519	2 181
2001-02	204	236	62	80	<1	10	1 514	2 181
2002-03	233	236	72	80	0	10	1 661	2 181
2003-04	239	236	66	80	0	10	1 607	2 181
2004-05	240	236	80	80	0	10	1 742	2 181
2005-06	207	236	56	80	0	10	1 728	2 181
2006-07	206	236	66	80	0	10	1 725	2 181
2007-08	195	236	44	80	0	10	1 651	2 181

* FSU data.

Values in HPB 10 included catches taken under exploratory permit.

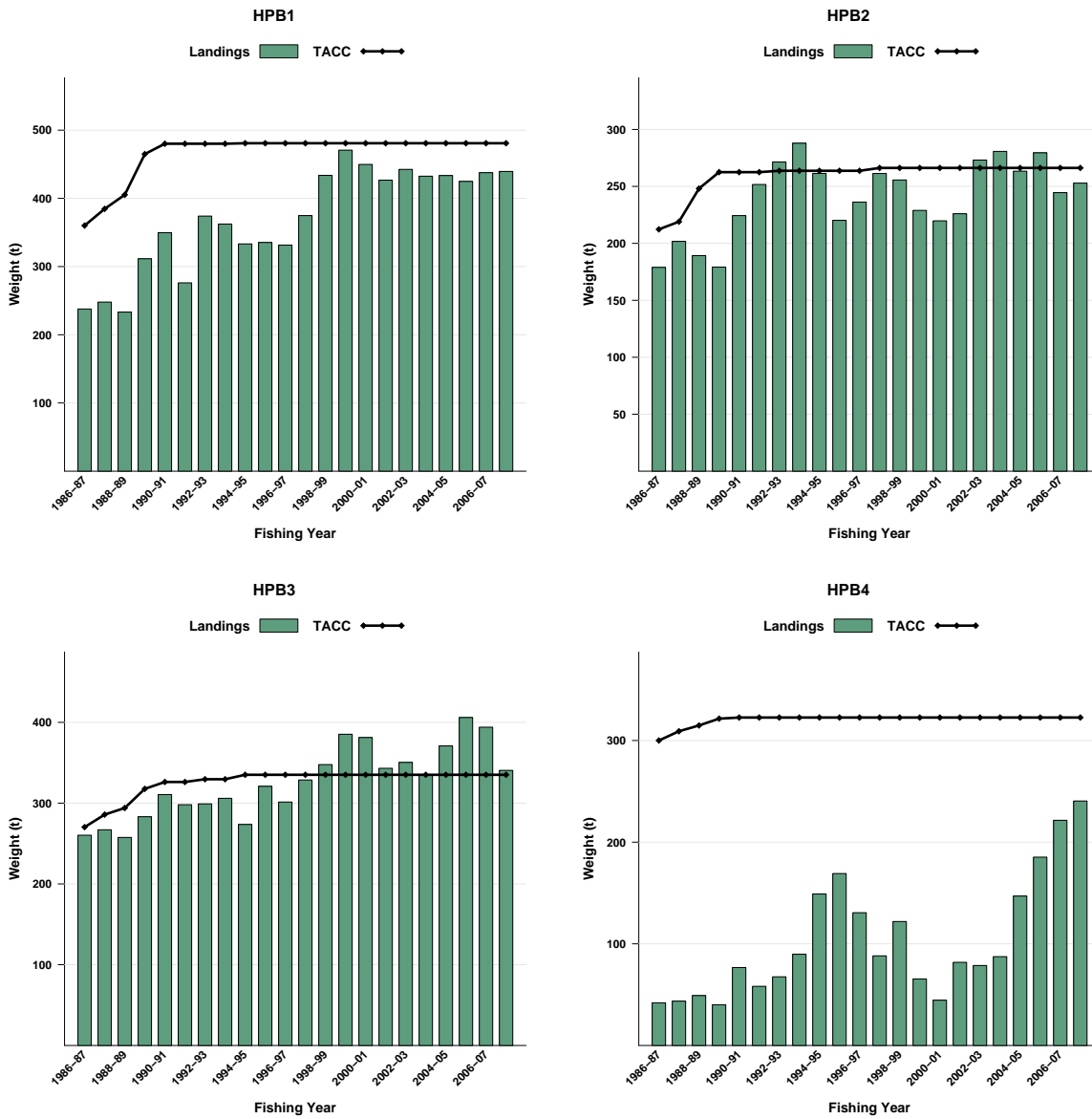


Figure 1: Historical landings and TACC for the seven main HPB stocks. From top left: HPB1 (Auckland), HPB2 (Central East), HPB3 (South East Coast), and HPB4 (Chatham Rise). [Continued on the next page]...

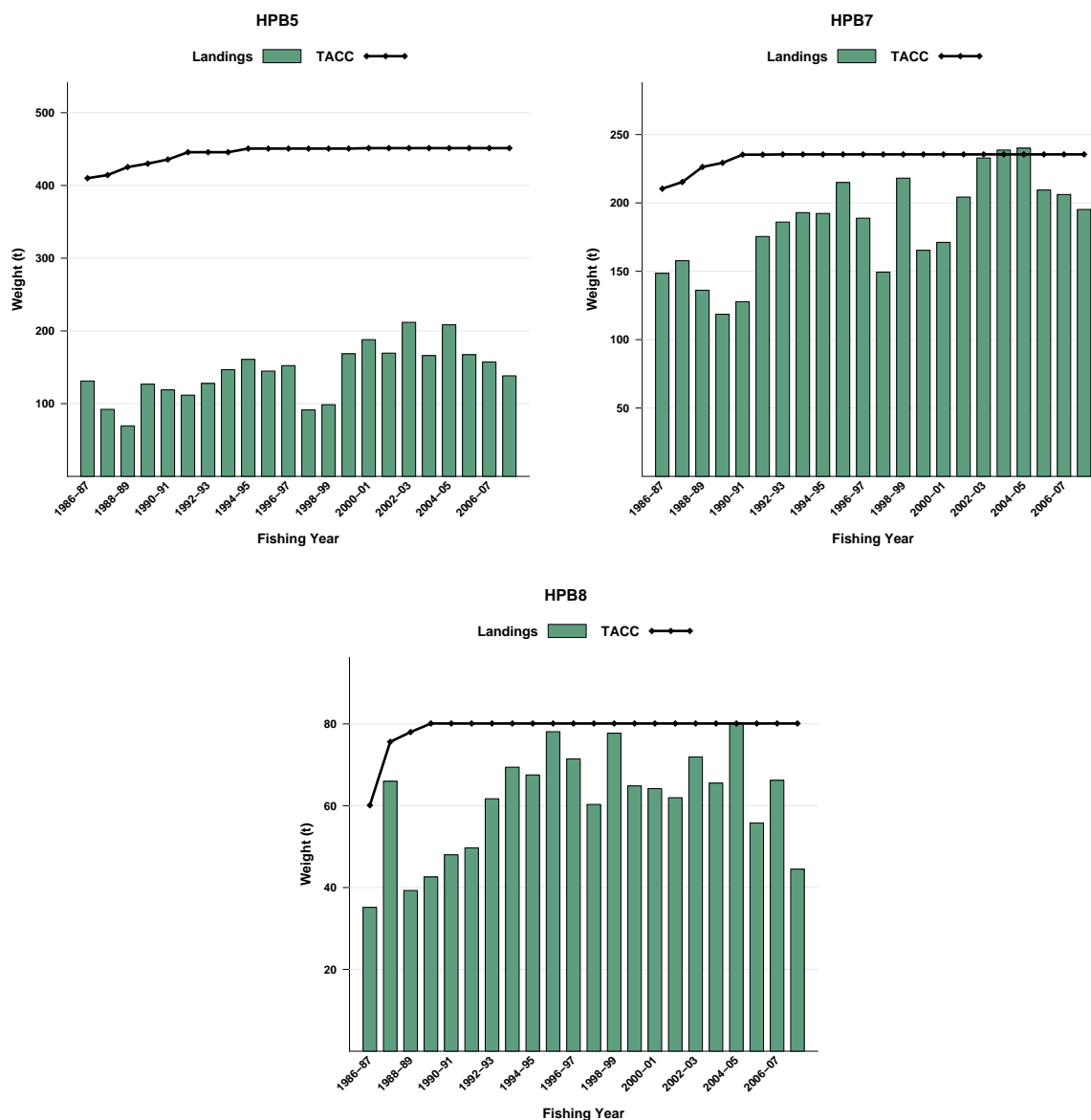


Figure 1 [Continued]: Historical landings and TACC for the seven main HPB stocks. HPB5 (Southland, Sub-Antarctic), HPB7 (Challenger), and HPB8 (Central). Note that these figures do not show data prior to entry into the QMS.

1.2 Recreational fisheries

Groper are taken by handline and setline, and to a lesser extent by setnets. Recreational catch estimates from surveys undertaken in the 1990s are given in Tables 3–5.

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

Fishstock	Survey	Total		Survey harvest (t)
		Number	CV (%)	
HPB 1	North	22 000	17	190–220
HPB 2	North	1 000	–	5–10
HPB 2	Central	10 000	37	45–85
HPB 3	Central	3 000	–	10–30
HPB 3	South	4 000	40	10–30
HPB 5	Central	7 000	36	20–40
HPB 5	South	2 000	–	5–15
HPB 7	Central	12 000	40	45–115
HPB 8	Central	1 000	–	5–10

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Table 4: Results of a national diary survey of recreational fishers in 1996, indicating estimated number of groper harvested by recreational fishers by Fishstock and the corresponding harvest tonnage. 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 estimates (from Bradford 1998).

Fishstock	Number caught	Harvest CV (%)	Point range (t)	estimate (t)
HPB 1	11 000	17	40–60	49
HPB 2	23 000	22	75–125	100
HPB 3	4 000	–	–	–
HPB 5	2 000	–	–	–
HPB 7	9 000	–	–	–
HPB 8	<500	–	–	–

Table 5: Results of the 1999/2000 national diary survey of recreational fishers (Dec 1999–Nov 2000). Estimated number of groper harvested by recreational fishers by Fishstock, and the corresponding harvest tonnage. Estimated harvest is presented as a range to reflect the uncertainty in the estimates (Boyd & Reilly 2002).

Fishstock	Number caught	Harvest CV (%)	Point range (t)	estimate (t)
HPB 1	60 000	39	209–476	342
HPB 2	56 000	33	307–608	457
HPB 3	52 000	50	97–293	195
HPB 5	6 000	70	14–80	47
HPB 7	17 000	37	79–172	125
HPB 8	2 000	67	6–32	19

A key component of the estimating recreational harvest from diary surveys is determining the proportion of the population that fish. 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. The 1999/2000 Harvest estimates for each Fishstock should be evaluated with reference to the coefficient of variation.

Recreational harvest appears to have exceeded the commercial catch in HPB 2. The last nationwide recreational survey was undertaken in 2001, but the results for QMA 2 were considered by the Recreational Technical Working Group to be unbelievably high.

1.3 Customary non-commercial fisheries

Groper (hapuku and bass) were certainly taken by early Maori, and would have been available in greater numbers at shallower depths than is the case at present. Traditional groper grounds are known in several regions. Quantitative information on the current level of customary non-commercial catch is not available.

1.4 Illegal catch

Quantitative information on the level of illegal catch is not available.

1.5 Other sources of mortality

None are apparent.

2. BIOLOGY

Both hapuku and bass are widely distributed around New Zealand, generally over rough ground from the central shelf (about 100 m) to the shelf edge and down the upper slope. Their lower limits are ill-defined, but hapuku extends to at least 300 m and bass to 500 m.

Hapuku mature sexually between 10 and 13 years old and may live in excess of 60 years (Francis *et al.* 1999). Cook Strait hapuku mature over a wide size range, with the size at 50% maturity at 80–85 cm total length (TL) and 85–90 cm TL for males and females respectively (Paul 2002d). Spawning

occurs during winter, anecdotally earlier in the north of New Zealand than in the south, but running ripe fish are seldom caught and spawning grounds are unknown. The smallest juveniles are virtually unknown, but are mottled, pelagic and epi-pelagic, perhaps schooling in association with drifting weed.

The size range of commercially caught hapuku is 50–140 cm TL, with a broad mode between 70 and 100 cm TL. Bass are slightly larger at 60–150 cm TL, with a mode at 80–110 cm TL, but much bulkier and heavier at equivalent lengths.

There appear to be some regional differences in the size structure of populations. Trawl-caught hapuku on the Stewart-Snares Shelf are mainly 50–80 cm, modal length 60 cm, and therefore juveniles. Trawl-caught hapuku on the Chatham Rise are slightly larger, 50–100 cm, modal length 70 cm, with those on the shelf around the islands having their main mode at 60–75 cm; most of these fish are also juveniles. These offshore regions may be important nurseries.

Both groper species are assumed to be long-lived. Natural mortality in the past was assumed to be 0.2, however, a study of a South American (Juan Fernandez) population suggested that it may be lower (0.13–0.16) (Pavez and Oyarzun 1985). Furthermore, preliminary unvalidated aging in New Zealand has indicated that maximum age may be greater than 40 years, and that M may be 0.1 or less (Francis *et al.* 1999). This value of M will be retained until clearer information becomes available from aging.

Migration patterns are also little known, but are probably related to spawning. Tagging of mostly immature fish in Cook Strait has shown a high level of site fidelity, but about 5% of these fish have moved up to 160 km north and south. Other information is largely anecdotal and speculative. It is known that good fishing grounds, particularly pinnacles and reefs or ledges, can be quickly fished out and take some time to recover, suggesting a high level of residency (except, perhaps, for the spawning season). On the other hand, trawlers sometimes catch groper on the flat and clear seafloor, and it is not known whether this represents their normal habitat, whether they are simply dispersing by travelling from one rough ground to another, or whether they are on a purposeful spawning migration.

Hapuku and bass prey on a wide variety of fish and invertebrates, including red cod, tarakihi, blue cod, hoki and squid. In Cook Strait, they are preyed upon by sperm whales, although probably neither heavily nor selectively.

Biological parameters relevant to stock assessment are shown in Table 6.

Table 6: Estimates of biological parameters of groper.

Fishstock	Estimate	Source
1. Natural mortality (M)		
All	$M = 0.1$	Francis (1999)
2. Weight = a (length) ^b (Weight in g, length in cm fork length)		
	Both sexes combined	
BAS 1	$a = 0.2734$ $b = 2.382$	Johnston (1993)
HAP 1	$a = 0.0142$ $b = 3.003$	Johnston (1993)
HAP 2	$a = 0.0242$ $b = 2.867$	Johnston (1993)
HAP 7, 8	$a = 0.01423$ $b = 2.998$	Johnston (1983)

(HAP = hapuku, BAS = bass groper)

3. STOCKS AND AREAS

Tagging studies reveal considerable mixing of hapuku between Otago, South Canterbury and Cook Strait. Fishstock boundaries in Cook Strait separate Cook Strait hapuku into three separate "stocks" (HPB 2, HPB 7, and HPB 8), none of which include Otago-Canterbury fish (HPB 3). Current Fishstock boundaries appear inappropriate for the management of Cook Strait and South Island hapuku. Current stock boundaries are based on QMAs and do not reflect natural stock boundaries. Existing data cannot describe the stock structure of New Zealand groper (Paul 2002b). Electrophoretic studies suggest that separate

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stocks of hapuku could occur. However, the genetic heterogeneity of Cook Strait hapuku, seasonal movements of hapuku through this area, moderately long-distance movements of some tagged hapuku, the presence of both species on open ground and the eventual recovery of heavily exploited reefs, suggest that either each stock is moderately mobile or that there is essentially only one stock (of each species) with some small geographic or temporal genetic differences.

4. STOCK ASSESSMENT

Yield estimates for HPB 4 and HPB 5 have been removed because the previous method used is now considered obsolete. The yield estimates for the other Fishstocks have been revised based on a revision of the estimate of *M*.

4.1 Estimates of fishery parameters and abundance

Estimates of fishery parameters and abundance are not available. Paul (2002c) found that CPUE indices could not be developed for hapuku and bass either separately or in combination.

4.2 Biomass estimates

Estimates of current and reference biomass are not available. Data for hapuku from the East Coast South Island trawl surveys have moderate CVs (average over all years = 28.17; range 19-35) and although the survey does not extend to the entire habitat range, the survey may be monitoring settled juveniles.

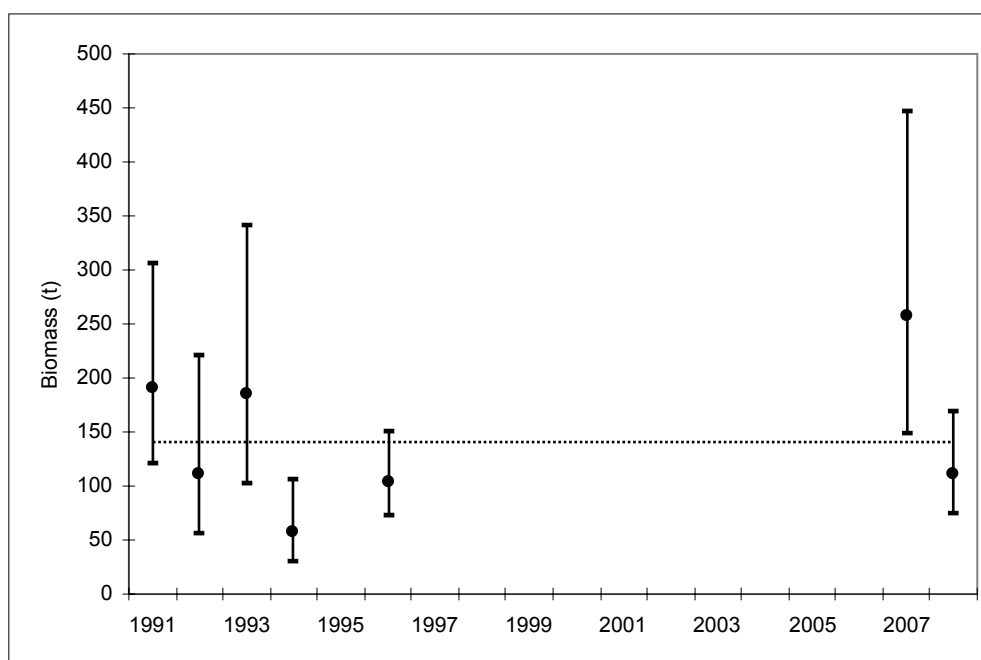


Figure 2: Biomass estimates $\pm 95\%$ CI (estimated from survey CV's assuming a lognormal distribution) and the time series mean (dotted line) from the East Coast South Island trawl survey.

4.3 Estimation of Maximum Constant Yield (MCY)

- (i) North and South Islands (all areas except HPB 4 and HPB 5)

MCY was estimated using the equation $MCY = cY_{AV}$ (Method 4). Y_{AV} was the average of domestic and foreign landings for the period 1936–1986. The domestic catches for 1936–78 were fairly stable, with the decrease during the early 1940s being compensated for by the post-war rise to the 1949 peak. The foreign landings recorded for 1974–86 were less stable and undoubtedly under-reported, but are sufficiently large to require inclusion. No consistent change in effort for the domestic fleet, apart from the war and post-war effect, is known. The foreign fleet effort has varied but the extent of this variation is unknown. The mean of this

catch series is 1474 t. The value of $c = 0.8$ used in previous assessments was changed to 0.9 in view of the lower M value now adopted.

$$MCY = 0.9 * 1474 \text{ t} = 1327 \text{ t (rounded to 1330 t)}$$

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

(ii) Chatham Rise (HPB 4) and Sub-Antarctic (HPB 5)

Because the fisheries have been largely unexploited, MCY cannot be estimated.

4.4 Estimation of Current Annual Yield (CAY)

Current biomass cannot be estimated, so CAY cannot be determined.

Yield estimates are summarised in Table 7.

Table 7: Yield estimates (t).

Parameter	Fishstock	Estimate
MCY	All except HPB 4 and HPB 5	1 330
	HPB 4	Cannot be determined
	HPB 5	Cannot be determined
	Total	Cannot be determined
CAY	All	Cannot be determined

4.5 Other yield estimates and stock assessment results

No information is available.

4.6 Other factors

Although no distinct stocks of either groper species have been identified, results from trawl surveys suggest that there are reasonably large but dispersed populations over the Stewart - Snares Shelf and the Chatham Rise. The relationship between these "offshore" and the more traditionally fished "inshore" populations is not known due to the lack of information on groper movements. Little is known of the species composition and population structure of groper on the rough bottom shelf and ridges extending northwards from New Zealand.

The relative quantity of groper taken as target and non-target catch has not been investigated, but is likely to have varied both spatially and temporally. Groper have been taken by the foreign licensed, chartered and New Zealand-owned trawlers working offshore grounds; although regarded as a small bycatch they were not accurately reported before 1986. The MCY may therefore be under-estimated.

There are three regions where the groper catch has been substantially lower than the TACC.

HPB 1 – Three features of the fishery appear to explain the under-catch of the TACC. (i) A considerable part of the fishing effort which had generated the high catches in the early 1980s left the fishery. (ii) The allocated quota is widely distributed in small units among fishers who appear to use only a modest proportion of it to cover bycatch. (iii) The fishers who hold larger amounts of quota generally also use only a proportion of it to land high-quality fish (in contrast to the earlier bulk landings of lower-quality fish).

HPB 4 and 5 – The original yield estimates made before the introduction of the QMS and the original TAC were based on trawl surveys, not catch histories. The TACCs for these Fishstocks can only be economically targeted around the Chatham Islands in HPB 4, and a few localities in HPB 5. Elsewhere, it is used to cover a small bycatch from trawlers. A moderate quantity of quota is held, unused, by companies which would require it should they resume target fishing for ling and associated species.

5. STATUS OF THE STOCKS

No estimates of current biomass are available. An estimate of B_{AV} is available for HPB 5.

Recent catches are less than the MCY estimates, are considered sustainable, and are probably at levels that will allow the stocks to move towards a size that will support the maximum sustainable yield. Current TACCs are larger than the MCY estimates and it is not known if they are sustainable or at levels that will allow the stocks to move towards a size that will support the maximum sustainable yield.

Yield estimates, TACCs and reported landings are summarised in Table 8.

Table 8: Summary of yield estimates (t), TACCs (t), and reported landings (t) of groper for the most recent fishing year.

Fishstock	QMA	MCY Estimates	2007–08 Actual TACC	2007–08 Reported Landings
HPB 1	Auckland (East, West)	1 & 9	481	439
HPB 2	Central (East)	2	266	253
HPB 3	South-east (Coast)	3	335	341
HPB 4	South-east (Chatham)	4	323	241
HPB 5	Southland, Sub-Antarctic	5 & 6	451	138
HPB 7	Challenger	7	236	195
HPB 8	Central (West)	8	80	44
HPB 10	Kermadec	10	10	0
Total			2 181	1 651

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