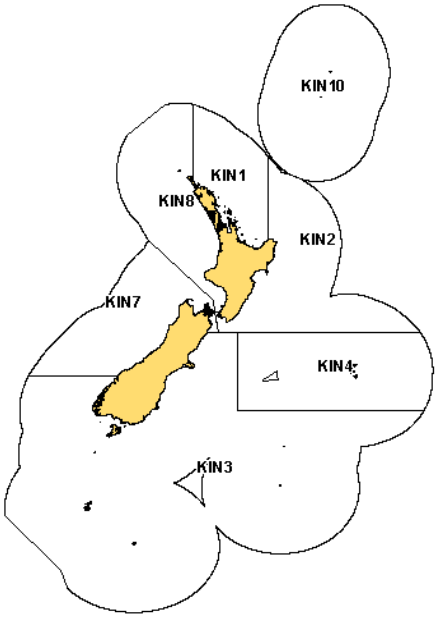
KINGFISH (KIN)

(*Seriola lalandi*)



1. FISHERY SUMMARY

Kingfish were introduced into the QMS on 1 October 2003, with allowances, TACCs and TACs in Table 1.

Table 1: Recreational and Maori allowances, TACCs and TACs by Fishstok.

Fishstock	Recreational Allowance	Maori customary Allowance	Other sources of fishing related mortality	TACC	TAC
KIN 1	459	76	47	91	673
KIN 2	65	18	24	63	170
KIN 3	1	1	0	1	3
KIN 4	1	1	0	1	3
KIN 7	10	2	2	7	21
KIN 8	31	9	7	36	83
KIN 10	1	0	0	1	2

An increased minimum legal size (MLS) of 75 cm (from 65 cm) for recreationally caught kingfish was introduced on 15 January 2004. Kingfish were added to the 6th Schedule in October 2005 for all fishing methods except setnet and in all areas. A requirement for a special reporting code for 6th Schedule releases was also introduced to allow monitoring of releases.

(a) Commercial fisheries

Kingfish commercial landings are reported largely as non-target catch of inshore setnet, trawl and longline fisheries. From 1991 to late 2003, targeting of kingfish (as a non-QMS species) was prohibited unless the species was identified on a fishers permit. A few permit holders were authorized to target kingfish and most of their catch was taken using setnets.

Commercially, kingfish is a moderately high value species and is usually sold as fillets or whole chilled. In recent years about one quarter of the commercial catch has been exported, the main markets being the United States and Australia.

The main fishing areas for kingfish are the east (KIN 1 and KIN 2) and west coast (KIN 8) of the North Island of New Zealand (Table 2). The largest commercial catches generally come from KIN 1. Landings were relatively large in 1983–84, especially in KIN 1, and were probably due to the greater number of vessels in the fishery prior to the introduction of the QMS in 1986. In addition there was

increased effort and better reporting as fishers sought to establish a catch history for the main species in anticipation of the introduction of the QMS. By 1988–89, catches of kingfish had reduced to their lowest levels across most areas. This was most likely due to the under-reporting of less common species in the catch (which includes kingfish) and the introduction of non-QMS restrictions. An increase in kingfish landings in FMA 1 between 1988–89 and 1992–93 and in FMA 2 between 1988–89 and 1991–92 may be due to a number of factors. These include: better reporting of catches; changes in fishing patterns with increased catch by setnet; increased numbers of vessels reporting kingfish catch; and, increased targeting of kingfish.

The total reported catch across all FMAs peaked in 1992–93 at 532 t, with 73% of the catch from KIN 1. By 1993–94, the reported catch of kingfish over all QMAs decreased considerably, mainly because of the reduced catch from KIN 1. Possible reasons for this decrease include: the effect of the October 1993 introduction of a MLS of 65 cm on all methods other than trawl; changes in fishing patterns in the snapper and trevally target setnet, trawl, and bottom longline fisheries (that were responsible for most of the non-target catch of kingfish); decreased target fishing for kingfish; and, setnet area closures in FMA 1 from October 1993. The trawl exemption with respect to MLS was removed in December 2000.

The annual catch of kingfish from KIN 1 has fluctuated between 100 and 250 t from 1993–94 through 2000–01 and declined to less than 50 t in 2003-04. The kingfish catch from KIN 2 over the last seven years has steadily decreased from the 1995–1996 120 t high to 50 t in 2003–04, but have increased to 73 t in 2005-06 (exceeding the TACC). Landings from KIN 8 have averaged approximately 35 t for the last 19 years, with catches ranging from 19–70 t. In 2002–03 landings nearly triple the 2001–02 level were reported in KIN 8, the highest ever landing in this area. Landings returned to near average in 2003-04 and 2004-05, but still above the TACC. In addition about 5 t of kingfish has been taken by New Zealand flagged vessels fishing outside NZ fishing waters.

Assuming kingfish targeting effectively ceased during the mid 1990s, early 2000's catches possibly reflect 'true' bycatch levels. This might account for 2004-05 over-catches in KIN 7 and KIN 8 as the TACCs in these QMAs are significantly below the recent pre QMS average.

Table 2: Reported landings (t) of kingfish by area (QMA) from 1983–84 to 2004-05. From 1986–87 to 2000–01, total landings are from LFRRs, and landings by QMA are from CLRs prorated to the LFRR total. Totals include landings not attributed to the listed QMAs.

QMA	KIN 1	KIN 2	KIN 3	KIN 4	KIN 7	KIN 8	KIN 10	Total
1983–84*	326	58	11	0	3	50	0	448
1984–85*	239	52	8	0	<1	46	0	345
1985–86*	262	43	4	0	1	70	0	380
1986–87	192	52	9	0	1	49	0	356
1987–88	202	56	9	0	1	49	0	373
1988–89	92	17	4	0	<1	16	0	460
1989–90	221	62	2	0	3	26§	<1	428
1990–91	295	85	6	<1	2	37§	<1	448
1991–92	362	93	4	<1	2	32§	9	512
1992–93	378	81	4	0	1	56§	<1	532
1993–94	184	67	2	<1	4	29	<1	288
1994–95	196	73	2	0	6	25	<1	302
1995–96	214	120	2	<1	7	45	<1	380
1996–97	240	114	7	<1	11	48	6	427
1997–98	155	106	2	<1	7	42	1	326
1998–99	159	94	3	<1	16	49	<1	323
1999–00	111	93	4	<1	10	51	0	270
2000–01	138	83	4	<1	11	69	<1	304
2001–02#	95	60	2	<1	22	52	0	231
2002-03#	73	55	1	0	20	143	0	292
2003-04#	49	50	1	<1	3	57	0	160
2004-05#	58	63	1	0	19	53	0	194
2005-06#	47	73	< 1	0	7	40	< 1	169

* FSU data (Area unknown data prorated in proportion to recorded catch).
§ Some data included in FMA 1.
# MHR data.

(b) Recreational fisheries

Kingfish is highly regarded by recreational fishers in New Zealand for its sporting attributes and large size. Kingfish are most often caught by recreational fishers from private boats and from charter boats, but are also a prized catch for spearfishers and land based game fishers. Kingfish are recognized internationally as a sport fish and kingfish caught in New Zealand waters hold 20 of the 22 International Gamefish Association World Records.

Recreational fishers have voiced concerns over a perceived marked decline in the size of kingfish available to them in recent years. Many clubs, competitions and charter boats have implemented a voluntary one kingfish per person per day limit in response. A number of gamefish clubs have also adopted a minimum size limit of 100 cm for kingfish.

Recreational harvest estimates by fish stock have been obtained from national telephone diary surveys undertaken in 1996 and 2000, with a follow up survey in 2001. Regional telephone diary surveys were undertaken in 1991/92 in the South Region, 1992/93 in the Central Region and in 1993/4 in the North Region. There is some uncertainty with all recreational harvest estimates for kingfish as presented in Table 3.

Table 3: Estimated number of kingfish harvested by recreational fishers by Fishstock. (Source: Tierney et al., 1997; Bradford, 1997; Bradford, 1998; Boyd & Reilly, 2002; Boyd et al., 2004).

	KIN 1				KIN 2			
Survey Year	Number	CV (%)	Range	Estimated Harvest (t)	Number	CV (%)	Range	Estimated Harvest (t)
1992	186 000	-	240-280	260	68 000	-	65-120	92.5
1994	180 000	9	-	228#	62 000	18	-	78.5
1996	194 000	7	215-255	234	67 000	11	60-80	70
2000	701 000	13	590.9-764	677.4	69 000	27	58.8-102.6	80.7
2001	449 000	19	-	434.2	107 000	21	-	124.3

	KIN 7				KIN 8			
Survey Year	Number	CV (%)	Range	Estimated Harvest (t)	Number	CV (%)	Range	Estimated Harvest (t)
1992	10 000	-	15-25	20	6000	-	-	7.6#
1994	-	-	-	-	-	-	-	-
1996	9 000	19	10-15	13	2000	-	-	2.5#
2000	153000	60	63.2-256.6	159.9	10 000	45	5.6-14.8	10.2
2001	32 000	23	-	33.9	2000	46	-	1.7

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

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

Comparisons between boat ramp and diary estimates of snapper catch per fisher-trip indicate that there are inconsistencies between the observational and diary information. These inconsistencies, suggest to the RTWG that the diary methodology used in these surveys produces unreliable estimates of total catch. Relative comparisons may be possible between stocks within these surveys.

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

The RTWG recommends that the harvest estimates from the diary surveys should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a

methodological error; and, c) the 2000 and 2001 estimates are implausibly high for many important fisheries.

All indications are that the recreational catch is in the range of 500–700 t in KIN 1. Recreational surveys also indicate 85% of the recreational kingfish catch is taken in the northern QMAs (1 & 8).

It was assumed that the introduction of the higher MLS of 75 cm on 15 January 2004 for kingfish would reduce recreational catches.

In 2004-05 a recreational harvest estimate for KIN 1 was requested as part of the combined aerial / boat ramp survey targeted primarily at snapper and kahawai. The PELWG indicated that this estimate should be considered with considerable caution due to the limited overlap between this methods sampling technique and the fisheries for kingfish, e.g., the target fisheries for kingfish are usually in offshore areas from launches which were not sampled by the boat ramp survey. For this reason the results from this survey have not been accepted or included in the working group report at this time.

(c) Maori customary fisheries

Kingfish is an important traditional food fish for Maori, but no quantitative information on the level of Maori customary take is available. The extent of the traditional fisheries for kingfish in the past is described by the Muriwhenua Fishing Report (Waitangi Tribunal, 1988). Because of the coastal distribution of the species and its inclination to strike lures, it is likely that historically Maori caught considerable numbers of kingfish.

(d) Illegal catch

There is no known illegal catch of kingfish.

(e) Other sources of mortality

The extent of any other sources of mortality is unknown; however handling mortality for sub-MLS size fish is likely to occur in both the recreational (sub 75 cm) and commercial (sub 65 cm) fisheries.

2. BIOLOGY

In New Zealand, kingfish are predominantly found in the northern half of the North Island but also occur from 29° to 46° S, Kermadec Islands to Foveaux Strait (Francis, 1988) and to depths of 200 m. Kingfish are large predatory fish with adults exceeding one and a half metres in length. They usually occur in schools ranging from a few fish to well over a hundred fish. Kingfish tend to occupy a semi-pelagic existence and occur mainly in open coastal waters, preferring areas of high current and or tidal flow adjacent to rocky outcrops, reefs and pinnacles. However, kingfish are not restricted to these habitats and are sometimes caught or observed in open sandy bottom areas and within shallow enclosed bays.

Estimates of age have recently been derived from opaque-zone counts in sagittal otolith thin sections. Estimates of kingfish von Bertalanffy growth parameters were derived from recreational tagging data and otoliths collected from the eastern Bay of Plenty. Estimates of K and L_{inf} were similar being 0.128 and 130 cm from the otolith age data and 0.130 and 142 cm from the tagging increment data respectively (Table 4). The hard-structure ageing techniques have yet to be validated for New Zealand kingfish and the position of the first annual growth ring is still uncertain.

A Bayesian analysis of length and maturity data suggests that the length of 50% maturity is 97 cm in females and 83 cm in males.

The recent research has provided estimates of M ranging from 0.20-0.25, however, these estimates are thought to represent an upper bound as the samples were taken from an exploited population.

Available biological parameters relevant to stock assessment are shown in Table 4.

Table 4: Estimates of biological parameters.

Fishstock	Estimate	Source
1. Weight = a (length)^b (weight in g, length in cm fork length)		
Both sexes		
KIN 1	a = 0.03651 b = 2.762	Walsh et al. (2003)

2. Bertalanffy growth parameters from otolith age data

	Males	Females	Combined	
L_∞	123.81	135.79	130.14	
K	0.137	0.119	0.128	McKenzie et al. (2005)
t_0	-0.911	-0.976	-0.919	

3. STOCKS AND AREAS

A recent study based on meristic characters and between area differences in parasites suggests two stocks of kingfish off the west and east coasts. These stocks are contained within the Tasman current on the west coast and the East Auckland current and East Cape current on the east coat, with little mixing between them. The east coast stock may be further subdivided into northeast and Hawkes Bay stocks based on limited exchange from tagging studies and parasite marker prevalence.

Tagging results suggest that most adult kingfish do not move outside local areas, with many tag returns close to the release site. However some tagged kingfish have been found to move very long distances; there are validated reports of New Zealand tagged kingfish being caught in Australian waters and Australian tagged kingfish being recaptured in New Zealand waters.

4. STOCK ASSESSMENT

(a) Estimates of fishery parameters and abundance

None are available at present.

(b) Biomass estimates

Few kingfish are encountered in trawl surveys, suggesting that trawling is not a suitable method for monitoring changes in kingfish abundance. Kingfish are amenable to mark-recapture studies. However, up to now, tagging studies have been conducted solely to describe kingfish movement patterns and to estimate growth. Data from these programmes is inadequate to estimate stock biomass.

(c) Estimation of Maximum Constant Yield (MCY)

MCY estimates were derived using the cY_{av} method (Method 4, Annala, 1993) (Table 5). The natural variability factor, c, is taken to be 0.6, which is based on the estimated natural mortality rate for New South Wales *S. lalandi* (M = 0.38). The working group considers that the Australian estimate of M is likely to be higher than M for kingfish in New Zealand. The resulting increase to the natural variability factor (c) means that the estimates of MCY using this method are likely to be underestimates. Average annual catch (Y_{av}) was calculated using the fishing years 1983–84 to 1992–93 under the assumption that these years were relatively stable and may best balance out the many factors affecting this non-target fishery (the data can be interpreted in different ways, leading to different estimates of Y_{av}).

It may be more appropriate to select a new set of more recent years for estimating MCY, however, changes to the management of the fishery in recent years create problems with the length of the time series of catch data. Accordingly, the working group has not revised the MCY estimate at this time.

Table 5: Summary of the yields (t) from the commercial fishery.

Fishstock	FMA		MCY
KIN 1	Auckland (East)	1	195
KIN 2	Central (East)	2	40
KIN 3	South East, Chatham, Southland, Sub-Antarctic and Challenger	3, 4, 5, 6, & 7	5
KIN 8	Central (West)	8	20
KIN 9	Auckland (West)	9	not estimated
KIN 10	Kermadec	10	not estimated

The catch totals do not include the non-commercial catch. In KIN 1, this is assumed to account for over 80% of the current catch. Accordingly, the estimates of MCY are reflective of commercial fisheries only, and are not thought to be a reliable indicator of potential long-term yields from kingfish stocks.

(d) Estimation of Current Annual Yield (CAY)

CAY cannot be estimated because of the lack of current biomass estimates.

(e) Other yield estimates and stock assessment results

No information is available.

5. STATUS OF THE STOCKS

Estimates of current and reference biomass are not available.

Kingfish in New Zealand can be regarded as a high value species from customary, commercial and recreational perspectives. Although fluctuating, catches of kingfish have shown very little trend over the last 20 years and there is no direct evidence to suggest that the current catch levels are not sustainable. However, recreational fishers are concerned about a perceived decline in the quality of the fishery.

It is not known if recent combined commercial and recreational catch levels are sustainable or at levels that will allow the stocks to move towards a size that will support the MSY.

Yields, TACCs and reported landings for the 2005/06 fishing year are summarised in Table 6.

Table 6: Summary of yields (t) from the commercial fishery, and reported commercial landings (t) for the most recent fishing year.

Fishstock		QMA	MCY	2005-06 Actual TACC	2005–06 Reported landings
KIN 1	Auckland (East)	1	195	91	47
KIN 2	Central	2	40	63	73
KIN 3	South-east (Coast), Southland, Sub-Antarctic	3, 5 & 6	–	1	< 1
KIN 4	South-east (Chatham)	4	–	1	0
KIN 7	Challenger	7	–	7	7
KIN 8	Central (West) and Auckland (West)	8 & 9	20	36	40
KIN 10	Kermadec	10	–	1	0
Total			260*	200	169

*5 tonne MCY estimate for FMAs 3,4,5,6 & 7 combined included in total.

6. FOR FURTHER INFORMATION

Bradford, E. (1997). Estimated recreational catches from Ministry of Fisheries North region marine recreational fishing surveys, 1993-94. *New Zealand Fisheries Assessment Research Document* 97/7. 16p.

Bradford, E. (1998). Harvest estimates from the 1996 national recreational fishing surveys. *N.Z. Fisheries Assessment Research Document. 98/16.* 27 p.

Boyd, R. O., Reilly, J. L. (2002). 1999/2000 National marine recreational fishing survey: harvest estimates. *Draft New Zealand Fisheries Assessment Report* 2002/xx.

Boyd, R. O., Gowing, L., Reilly, J. L. (2004). 2000-2001 National marine recreational fishing survey:: diary results and harvest estimates. *Draft New Zealand Fisheries Assessment Report* 2004/xx.

Hartill, B.; Davies, N.M. (1999). New Zealand billfish and gamefish tagging, 1997–98. NIWA Technical Report No. 57. 39 p.

Francis, R.I.C.C. (1988). Maximum likelihood estimation of growth and growth variability from tagging data. *N.Z. Journal of Marine and Freshwater Research 22*: 42–51.

McKenzie, J.; Smith, M.; Watson, T.; Francis, M.; O Maolagain, C.; Poortenaar, C.; and Holdsworth, J. (2005). Age, growth, maturity and natural mortality of New Zealand kingfish (*Seriola lalandi lalandi*). *Draft New Zealand Fisheries Assessment Report* 2005/xx. 36p.

McKenzie, J (in press) Review of kingfish (*Seriola lalandi lalandi*) productivity parameters and stock assessment options. *Draft New Zealand Fisheries Assessment Report* 2006/xx 17p.

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. *N.Z. Fisheries Assessment Research Document 97/15*. 43 p.

Walsh, C., McKenzie, J., McGregor, G., Poortenaar, C., Hartill, B., and Smith, M. (2003). Information available for the management of New Zealand kingfish (*Seriola lalandi lalandi*) stocks. *New Zealand Fisheries Assessment Report* 2003/25. 57p.